APPENDIX E.5.6

QMR2 Quarry Management Plan

Baffinland Iron Mines Corporation

QMR2 Quarry Management Plan

BAF-PH1-830-P16-0040

Rev 3

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TRACK CHANGES TABLE

A review and update of the QMR2 Quarry Management Plan has been undertaken, the following revisions have been completed.

Index of Major Changes/Modifications in Revision 2, January 2021:

Item No.	Description of Change	Relevant Section
1	Updated to reflect current Early Revenue Phase operations and proposed quarry design.	Document wide.
2	Updated to reflect changes after July 28, 2017	Document wide.
3	Updated to reflect inclusion of MHSR 1.03, 1.05 and 1.135 - 1.141 Updated to reflect quarry design changes due to geomechanical design recommendations. Reference to "NB21-00718 - Mary River Mine - Geomec Design Rec for QMR2 Quarry" report by consulting firm Knight Piesold Ltd. Added reference to Ground Control Management Plan (BAF-PH1-340-P16-002) Added reference to Operations Blasting Procedure (BAF-PH1-340-PRO-0003) Added reference to Mine Traffic Patterns Procedure (BAF-PH1-340-PRO-0002)	Section 4.1 Section 4.2 Section 4.3 Section 4.4.1 Section 4.4.2

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1 INTRODUCTION

1.1 PURPOSE AND SCOPE

The Mary River Project requires aggregate to sustain current production levels (4.2Mt per annum). This document outlines the site description, operations and reclamation for the Mary River Mine Site Quarry QMR2 (QMR2 Quarry). This plan will be periodically revised to ensure the plan reflects current operations and the aggregate volumes to be extracted from the QMR2 Quarry.

1.2 REGULATORY CONTEXT

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

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

QMR2 Quarry at the Mary River Mine Site exceeds the volume threshold of 1,000 m^3, and therefore this plan is required. This plan should be used in conjunction with the Borrow Pit and Quarry Management Plan (BAF-PH1-830-P16-0004), and other plans referred to in the document. In the case of the QMR2 Quarry, because the quarry is situated on Inuit Owned Lands, the Qikiqtani Inuit Association (QIA) is the regulatory body that approves the quarry operation. As such, revisions of this plan will be submitted to QIA for approval under the Quarry Concession Agreement that forms part of the Commercial Lease No. Q13C301 (Commercial Lease) agreed upon between QIA and Baffinland Iron Mines Corporation (Baffinland).

1.3 SITE DESCRIPTION

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

TABLE 1-1: QMR2 QUARRY SPECIFICATIONS

Requirement	Description
NTS Map Sheet (1:50,000)	37 G/2 Edition 1 ASE Series A 713
Corresponding Plan of Property Drawing	Refer to Appendix A for quarry location.
Canada Lands Survey	Conducted in February 2014 by Montieth and Sutherland and provided to QIA.
Topographic Survey Data	Conducted by Baffinland Operations. Provided upon request.
Quarry Vertices Coordinates (UTM)	559997E 7914429N (centre point) 559412E 7914288N (W extent) 560511.48E 7914389N (E extent) 560043E 7914049N (S extent) 560141E 7914598N (N extent)
Total Area of Quarry	258,580 m^2 (25.9 ha)
Current Volume Removed	Approx. 831,000 banked cubic metres (BCM)
Total Volume to be Removed with Contingency	1,500,000 banked cubic meters (BCMs) (~831,000 BCM currently removed plus an additional 700,000 BCM)
Area of Proposed Quarrying	Appendix A shows the quarry permit limits, current development and proposed quarry design footprint. The total area of the proposed quarrying (existing and additional) and associated ground disturbance is 10.7 hectares (107,000 m^2).
Topsoil / Overburden Storage Area	None is required as site is primarily exposed rock
Access Roads/Trails	The main roadway at the Mine Site runs south of the quarry. The quarry access road runs perpendicular to the main Mine Site main roadway, intersecting near the current Ore Haul Truck Laydown.
Camp Locations	No camp will be built specifically for the quarry operation. Personnel will be housed at the existing Mary River Mine Site camps.

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

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

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

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

1.3.1 Environmental Setting

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

At least 10 different surface water bodies exist within 200 m of the quarry permit limits. All of these are relatively small (<2 ha) with several being less than 0.1 ha in size and are shown in the quarry drainage plan in Appendix A. None of these lakes were found to contain fish species, due to the shallow nature of the basins. Camp Lake located 2 km to the west, and the north basin of Sheardown Lake, 500 m to the south east are known to contain arctic char. The Camp Lake tributary is indicated to support char as far east as the East end of the airstrip and may support stickleback upstream of this. Three monitoring points have been established in the drainages downstream of the quarry and upstream of fish bearing waters (refer to Quarry Drainage Plan in Appendix A). The flow path from where the drainage from current operations flows into the fish bearing water of CLT1 is approximately 150 metres.

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

Several species of songbirds and shorebirds migrate to this area annually to breed, and were predominately found in the various types of lowland habitats (river deltas, coastal plains, tundra, and near wetlands) that offer an abundant source of insects and vegetation for foraging and nesting habitat. This

type of habitat is present near Camp and Sheardown lakes, within 2 km of the proposed quarry site. Bird densities though, are considered to be relatively low.

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

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

2 BAFFINLAND POLICIES

2.1 HEALTH SAFETY AND ENVIRONMENT (HSE) POLICY

This Baffinland Iron Mines Corporation Policy on Health, Safety and Environment is a statement of our commitment to achieving a safe, healthy and environmentally responsible workplace. We will not compromise this policy for the achievement of any other organizational goals.

We implement this Policy through the following commitments:

- Continual improvement of safety, occupational health and environmental performance
- Meeting or exceeding the requirements of regulations and company policies
- Integrating sustainable development principles into our decision-making processes
- Maintaining an effective Health, Safety and Environmental Management System
- Sharing and adopting improved technologies and best practices to prevent injuries, occupational illnesses and environmental impacts
- Engaging stakeholders through open and transparent communication.
- Efficiently using resources, and practicing responsible minimization, reuse, recycling and disposal of waste.
- Reclamation of lands to a condition acceptable to stakeholders.

Our commitment to provide the leadership and action necessary to accomplish this policy is exemplified by the following principles:

- As evidenced by our motto “Safety First, Always” and our actions Health and safety of personnel and protection of the environment are values not priorities.
- All injuries, occupational illnesses and environmental impacts can be prevented.
- Employee involvement and active contribution through courageous leadership is essential for preventing injuries, occupational illnesses and environmental impacts.
- Working in a manner that is healthy, safe and environmentally sound is a condition of employment.
- All operating exposures can be safeguarded.
- Training employees to work in a manner that is healthy, safe and environmentally sound is essential.
- Prevention of personal injuries, occupational illnesses and environmental impacts is good business.
- Respect for the communities in which we operate is the basis for productive relationships.

We have a responsibility to provide a safe workplace and utilize systems of work to meet this goal. All employees must be clear in understanding the personal responsibilities and accountabilities in relation to the tasks we undertake.

The health and safety of all people working at our operation and responsible management of the environment are core values to Baffinland. In ensuring our overall profitability and business success every Baffinland and business partner employee working at our work sites is required to adhere to this Policy.

Brian Penney
Chief Executive Officer
May 2019

2.2 BAFFINLAND SUSTAINABLE DEVELOPMENT POLICY

At Baffinland Iron Mines Corporation (Baffinland), we are committed to conducting all aspects of our business in accordance with the principles of sustainable development & corporate responsibility and always with the needs of future generations in mind. Baffinland conducts its business in accordance with the Universal Declaration of Human Rights and ArcelorMittal's Human Rights Policy which applies to all employees and affiliates globally.

Everything we do is underpinned by our responsibility to protect the environment, to operate safely and fiscally responsibly and with utmost respect for the cultural values and legal rights of Inuit. We expect each and every employee, contractor, and visitor to demonstrate courageous leadership in personally committing to this policy through their actions. The Sustainable Development and Human Rights Policy is communicated to the public, all employees and contractors and it will be reviewed and revised as necessary on a regular basis. These four pillars form the foundation of our corporate responsibility strategy:

1. Health and Safety
2. Environment
3. Upholding Human Rights of Stakeholders
4. Transparent Governance

1.0 HEALTH AND SAFETY

- We strive to achieve the safest workplace for our employees and contractors; free from occupational injury and illness, where everyone goes home safe everyday of their working life. Why? Because our people are our greatest asset. Nothing is as important as their health and safety. Our motto is "Safety First, Always".
- We report, manage and learn from injuries, illnesses and high potential incidents to foster a workplace culture focused on safety and the prevention of incidents.
- We foster and maintain a positive culture of shared responsibility based on participation, behaviour, awareness and promoting active courageous leadership. We allow our employees and contractors the right to stop any work if and when they see something that is not safe.

2.0 ENVIRONMENT

- Baffinland employs a balance of the best scientific and traditional Inuit knowledge to safeguard the environment.
- Baffinland applies the principles of pollution prevention, waste reduction and continuous improvement to minimize ecosystem impacts, and facilitate biodiversity conservation.
- We continuously seek to use energy, raw materials and natural resources more efficiently and effectively. We strive to develop more sustainable practices.
- Baffinland ensures that an effective closure strategy is in place at all stages of project development to ensure reclamation objectives are met.

3.0 UPHOLDING HUMAN RIGHTS OF STAKEHOLDERS

- We respect human rights, the dignity of others and the diversity in our workforce. Baffinland honours and respects the unique cultural values and traditions of Inuit.
- Baffinland does not tolerate discrimination against individuals on the basis of race, colour, gender, religion, political opinion, nationality or social origin, or harassment of individuals freely employed.
- Baffinland contributes to the social, cultural and economic development of sustainable communities in the North Baffin Region.
- We honour our commitments by being sensitive to local needs and priorities through engagement with local communities, governments, employees and the public. We work in active partnership to create a shared understanding of relevant social, economic and environmental issues, and take their views into consideration when making decisions.
- We expect our employees and contractors, as well as community members, to bring human rights concerns to our attention through our external grievance mechanism and internal human resources channels. Baffinland is committed to engaging with our communities of interest on our human rights impacts and to reporting on our performance.

4.0 TRANSPARENT GOVERNANCE

- Baffinland will take steps to understand, evaluate and manage risks on a continuing basis, including those that may impact the environment, employees, contractors, local communities, customers and shareholders.
- Baffinland endeavours to ensure that adequate resources are available and that systems are in place to implement risk-based management systems, including defined standards and objectives for continuous improvement.
- We measure and review performance with respect to our safety, health, environmental, socio-economic commitments and set annual targets and objectives.
- Baffinland conducts all activities in compliance with the highest applicable legal & regulatory requirements and internal standards.
- We strive to employ our shareholder's capital effectively and efficiently and demonstrate honesty and integrity by applying the highest standards of ethical conduct.

5.0 FURTHER INFORMATION

Please refer to the following policies and documents for more information on Baffinland's commitment to operating in an environmentally and socially responsible manner:

Health, Safety and Environment Policy
Workplace Conduct Policy
Inuktitut in the Workplace Policy
Site Access Policy
Hunting and Fishing (Harvesting) Policy
Annual Report to Nunavut Impact Review Board
ArcelorMittal Canada Sustainability and Corporate Responsibility Report

If you have questions about Baffinland's commitment to upholding human rights, please direct them to contact@baffinland.com.

Brian Penney
Chief Executive Officer
March 2016

3 SITE SECURITY AND SAFETY

Copies of all safety and management documents will be made available to on site personnel. On site personnel involved with operations at the QMR2 Quarry are required to take mandatory operational and safety training. The active supervisor, with support from the onsite Environment and Health & Safety departments, will ensure that quarry 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.

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. Personnel working in the area will provide warnings if approach by any animals is noted. All employees working on the quarry operation will receive wildlife awareness training. Baffinland's OPERATIONS BLAST GUARDING, FIRING AND CLEARING PROCEDURE (BAF-PH1-340-PRO-0056) further describes blasting protocols followed onsite.

4 QUARRY OPERATIONS

4.1 DEVELOPMENT AND OPERATION

The quarry is accessed by a road that branches off from the main Mary River Mine Site roadway. Current operations transports the following equipment to and from the quarry, as required:

- Drilling equipment
- Rock hauling trucks
- Loading equipment
- Explosives

No mining activities have taken place in the QMR2 quarry since 2019. Prior to mining activities resuming, mine technical services and mine operations must ensure a thorough inspection of the quarry is undertaken with specific attention to Mine Health Safety Regulations 1.03, 1.05 and 1.135 through 1.141. Based on the drone survey photos of June 2020, extensive clean up of the quarry is required before production resumes.

4.2 CURRENT QUARRY DEVELOPMENT AND PROPOSED DESIGN

Development of the QMR2 Quarry began in 2013 at the Mary River Mine Site to support the construction of the Mary River Project's Early Revenue Phase. Following the completion of construction in 2014, the quarry continues to be used to support current operations at the Mine Site.

To ensure Mine Site operations continues to have access to the required amount of aggregate to support production, an updated quarry design that allows for an additional 700,000 BCMs (1,500,000 BCMs total since quarry development in 2013) to be removed, as shown in Figure 4-1, is proposed in this plan. The current quarry development and the limits of the proposed quarry design are within the QMR2 Quarry permit limits and are presented in Appendix A.

The bench heights have been redesigned to be a uniform 10m in height with bench face design angles of 65 degrees. Catch benches are designed 10m in width in order to ensure final width is not less than 8m. The West and Northwest walls have catch bench widths of 14m and 12m respectively in order to accommodate the expected planar and wedge failures in these sectors. These changes are based on the July 27, 2021 "NB21-00718 - Mary River Mine - Geomec Design Rec for QMR2 Quarry" report by the consulting firm Knight Piesold Ltd.

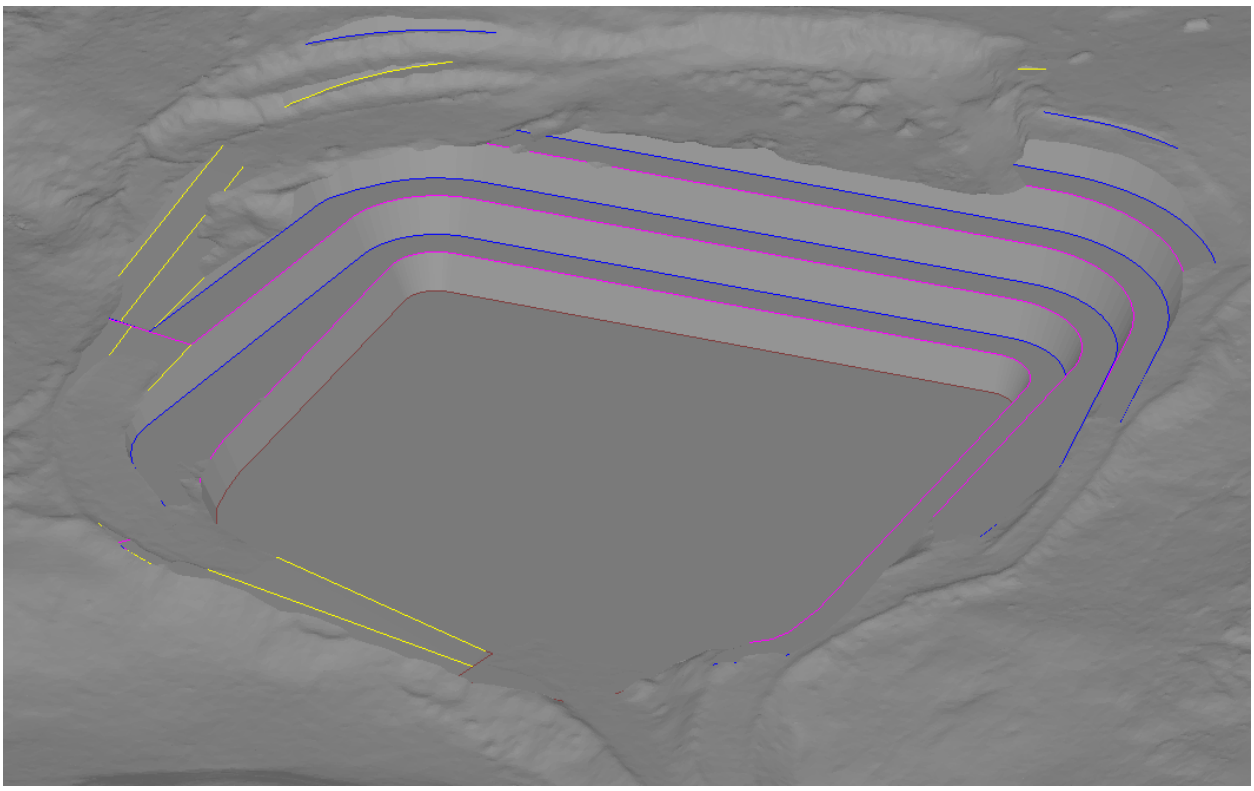


FIGURE 4-1– PROPOSED QMR2 QUARRY DESIGN

4.3 QUARRY DEVELOPMENT

The following steps provide a general description of how QMR2 Quarry was developed and provides details of the different activities associated with quarry development. Since there may be several faces where quarry mining is progressed at QMR2, the following steps apply to each quarry face.

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

   Note: The Mine Site Crusher Pad, used for production, has been and will continue to be used to process blasted quarry rock from the QMR2 Quarry.

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

3. Subsequent Bench Development: Additional benches are created at higher elevations, starting at the open face of the site. Each bench proceeds toward the main body of rock at that elevation. Lower benches follow behind upper benches and drilled and blasted to move toward the main body of rock. Ramps may be constructed to the upper benches for truck loading near the blasted rock. Material is excavated from benches and loaded onto trucks for delivery to the crusher. As the quarry is developed, the GROUND CONTROL MANAGEMENT PLAN (BHP-PH1-340-P16-0002) will be followed.
4. Drilling Quarry Rock: Drilling of the quarry rock is normally completed with the use of one drill rig. The boreholes are laid out by a surveyor to the engineered spacing and burden for each particular rock type, geology, and desired product size. The drill is removed from the area for loading explosives and blasting. The drill can proceed along the bench to continue drilling or proceed to a new bench.
5. Blasting Operations: Blasting rock is completed by installing high explosive detonating boosters with initiation wires, followed by dropping pre-packaged sticks of explosives, or pouring from pre-packaged bags, or by pumping bulk explosives (i.e. emulsion) from an explosives truck into the boreholes. Detonation and initiation is carried out with the use of delays to time the detonators in a very fast millisecond sequence of smaller blasts for efficient rock breakage. Blasting lags behind the drill as more drilling is completed. As each new drill round is completed, the drill moves on and the drilled round is loaded with explosives and blasted.
6. Hauling Quarry Rock: The blasted rock is loaded onto trucks for delivery to the crusher.
7. Crushing Operations: Quarry rock is fed to the crusher and screening equipment to size and produce the desired rock product, stored in stockpiles and loaded into trucks for delivery to construction sites.

4.4 Quarry Activities

4.4.1 Explosives Management and Blasting

Baffinland's OPERATIONS BLASTING PROCEDURE (BAF-PH1-340-PRO-0003) describes blasting protocols followed onsite.

The blasting operations will be carried out by Operations and/or an experienced contractor(s). Quarry operations will be using a combination of Ammonium Nitrate Emulsion (ANE), manufactured onsite at the Mary River Mine Site Emulsion Plant, and pre-packaged explosives. Transportation of ANE and pre-packaged explosives to and from the quarry site will occur from the magazine storage area(s) and the Mary River Mine Site Emulsion Plant via Project roadways.

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. The management of explosives for the QMR2 Quarry

will be consistent with the Project's Explosives Management Plan developed by Dyno Nobel (Dyno Nobel, 2013).

4.4.2 Excavation and Crushing

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

Some minor organic surface soils are present in the quarry area. If these overburden soils cannot be avoided, then they will be stripped and stored separately at the storage area for later re-use. Quarrying will work along the exposed rock faces and will be terraced to minimize run off from the site. Efforts will be made during blasting operations to avoid creating depressions which might collect run off or melt waters. Drilling and extraction exercises may occur concurrently, depending on issues of safety and schedule. Blasted rock will be cleared by loader and/or scraper and put into rock trucks for transport to the crusher/screener facility. Haulage will follow the Mine Traffic Patterns Procedure (BAF-PH1-340-PRO-0002). Loaders will feed rock to the crushing and screening operation.

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

4.5 Site Management Measures

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

4.5.1 Pre-Development Assessment for Metal Leaching and Acid Rock Drainage (ML/ARD)

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

Field observations and sampling from quarry operations to date continue to confirm the low potential for ARD/ML at QMR2 Quarry. Operational sampling results for the QMR2 Quarry are provided to QIA annually in the Annual Report, required by the Commercial Lease.

4.5.1.1 Review of Geological Information and Site Reconnaissance

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

4.5.1.2 Sampling

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

4.5.1.3 Analytical Testing Methods

Analytical tests included the following:

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

4.5.1.4 Results

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

- Paste pH is weakly alkaline (9.95)
- Sulphide content was less than 0.01%
- The neutralization potential ratio (NPR) is well in excess of three. This material is considered non-acid generating
- Neutralization potential (NP) value was 4.9
- In a comparison of total metal results of samples to crustal abundances, no notable elevation of metals were noted
- There were no concerns regarding the results of the SFE tests

4.5.1.5 Key Conclusions and Recommendations from Pre-Development ML/ARD Assessment

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

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

4.5.1.6 Future Reporting

Operational testing results will continue to be included in the Annual Report prepared for the QIA as required by the Commercial Lease.

4.5.2 Blasting Operational Management

A Blasting Management Framework has been developed and is presented in Annex 3 of the Borrow Pit and Quarry Management Plan. The framework focuses on the control and mitigation of key potential risks arising from the management and use of ammonium nitrate explosives at Project quarries.

In addition, blasting operations at the QMR2 Quarry will adhere to the protocols outlined in Baffinland's OPERATIONS BLAST GUARDING, FIRING AND CLEARING PROCEDURE (BAF-PH1-340-PRO-0056)

4.5.3 Drainage Management

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

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

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

4.5.4 Ground Ice and Permafrost Management

Current development of the QMR2 Quarry has uncovered no significant amounts of permafrost (frozen unconsolidated material) and/or ground ice. Due to this and the limited amount of data available, the depth of the permafrost's active layer in unconsolidated rock near the QMR2 Quarry is assumed to be consistent with the Project area's typical depth of 1 to 2 metres.

In the event that significant sections of permafrost and/or ground ice are uncovered during quarry development, a specific action plan will be developed and submitted for approval to the relevant agencies prior to executing the mitigation measures outlined in the action plan. In general, mitigation measures to prevent degradation of uncovered permafrost and/or ground ice will consist of removing any ponding water and backfilling the impacted permafrost and/or ground ice with available material to reinstate the original topography.

Until the uncovered permafrost and/or ground ice can be addressed, the condition of the uncovered permafrost and/or ground ice will be periodically monitored by Operations personnel and inspected once a year during the summer months by a Geotechnical Engineer as part of the annual geotechnical inspections required by Baffinland's Type "A" Water Licence (2AM-MRY1325 – Amend. 1). The condition of the permafrost and/or ground ice at the quarry will be included in the annual Geotechnical Inspection Reports and provided to the Nunavut Water Board and QIA as required.

4.5.5 Dust Management

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

Dust management activities will include dustfall monitoring. Dustfall monitoring for the QMR2 Quarry will consist of monitoring the snow near the quarry for deposits of quarry dust by means of visual observations

in concert with the Project's Dustfall Monitoring Program, developed to quantify the extent and magnitude of dust fall generated by Project activities. If significant dust deposits are observed, an action plan will be developed to mitigate potential risks to receiving water bodies. The Project's current Dustfall Monitoring Program is presented in Baffinland's Terrestrial Environment Mitigation and Monitoring Plan (BAF-PH1-830-P16-0027 r1) and includes several monitoring locations at and around the Mine Site.

4.5.6 Noise Management

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

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

4.5.7 Chance Finds (Carving Stone Deposits and Cultural Heritage Sites)

The Mary River Project area has been occupied by humans for over 4,000 years. Archaeological sites are very common throughout the region, mostly consisting of stone structures that usually represent tent rings and shelters, caches, traps, hunting blinds, cairns and inukshuks. Therefore the potential exists to encounter undiscovered cultural heritage or archaeological resources (Chance Finds) during quarry development.

The quarry permitted limits, as shown in Appendix A, for the QMR2 Quarry were fully assessed for cultural heritage and archaeological sites as well as "carving stone" deposits during 2007 and 2008. No sites or deposits were found in the permitted quarry limits during the assessment.

In the event that a cultural heritage or archeological site is discovered, the discovery will be managed as outlined in the Section 2.1 of Baffinland's Environmental Protection Plan (BAF-PH1-830-P16-008 r1).

Similarly, discoveries of "carving stone" deposits, as defined in the Commercial Lease, will be reported to the onsite Environment Department and confirmed by the onsite Project geologist. If confirmed, Baffinland will notify the QIA and relevant agencies of the discovery and manage the deposit in accordance with Article 19 of the IIBA between the QIA and Baffinland.

4.6 MONITORING

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

- Regular inspection of site-preparation measures
- Regular inspection of drainage from the quarry site
- Volume and quality estimates of the granular resource material produced
- Monitoring for permafrost and 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
- Any additional reporting requirements as outlined in any permits

Water quality monitoring locations (MQ-C-A, B and D), as shown on the drainage plan in Appendix A, will be sampled and compared to the relevant discharge criteria in accordance with Baffinland's Type A Water Licence 2AM-MRY1325. In addition, the Project's Aquatic Effects Monitoring Program (AEMP), which monitors several waterbodies near the Mine Site, monitors the Camp Lake tributaries and fish habitat downstream of the QMR2 Quarry.

In the event that water quality at monitoring locations exceed the relevant discharge criteria, additional investigative water sampling will be conducted to identify the source of elevated water quality parameters and prescribe the appropriate corrective actions to ensure water quality meets the relevant discharge criteria outlined in the Type A Water Licence.

5 SUPPORTING MANAGEMENT PLANS

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

- Emergency Response Plan (BAF-PH1-840-P16-0002 r4)
- Spill Contingency Plan (BAF-PH1-830-P16-0036 r3)
- Surface Water and Aquatic Ecosystems Management Plan (BAF-PH1-830-P16-0026 r6)
- Terrestrial Environment Mitigation and Monitoring Plan (BAF-PH1-830-P16-0027 r1)
- Explosives Management Plan (Dyno Nobel, 2013)
- Waste Management Plan (BAF-PH1-830-P16-0028 r7)
- 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, BAF-PH1-830-P16-0004 r0 Annex B)
- Operations Blast Guarding, Firing and Clearing Procedure (BAF-PH1-340-PRO-0056)
- Operations Blasting Procedure (BAF-PH1-340-PRO-0003)
- Mine Traffic Patterns Procedure (BAF-PH1-340-PRO-0002)
- Ground Control Management Plan (BAF-PH1-340-P16-002)

6 CLOSURE AND RECLAMATION ACTIVITIES

The closure and reclamation of the QMR2 Quarry and access roads has been integrated into the Projects Interim Closure and Reclamation Plan (BAF-PH1-830-P16-0012 r5). Specific activities required for closure and reclamation of QMR2 Quarry are described in the subsections below. Closure of the active quarry face will involve removing all materials, equipment and infrastructure and reclaiming the site to a self-sustaining productive ecosystem.

6.1 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.

6.2 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 with Baffinland's Waste Management Plan (BAF-PH1-830-P16-0028).

6.3 Stockpile Removal

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

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

6.4 Road Reclamation

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

6.5 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 Milne Port Landfarm Facility for bio treatment. Other contamination, such as heavy metals or toxins, will require containerization for shipment off site to an appropriate facility (refer to Interim Closure and Reclamation Plan)

6.6 Permafrost and Ground Ice

Reclamation of uncovered permafrost and ground/ice will involve removing any ponding water and backfilling the impacted permafrost and/or ground ice with available material as described in Section 6.3 of this plan.

7 ENVIRONMENTAL RESPONSIBILITIES

7.1 ROLES AND RESPONSIBILITIES

The Baffinland environmental team is organised into two parts, on site as well as off site. The organisational structure for the Mary River Project in relation to the environment discipline is shown in the Table 7-1 below. Communication channels are described as liaisons in the tables outlining the responsibilities and accountabilities in the following sections.

7.1.1 ENVIRONMENTAL PROJECT TEAM

7.1.1.1 THE BAFFINLAND ENVIRONMENTAL TEAM

The Baffinland Environmental Team will oversee all environmental and community works on and off site. The Baffinland Corporate Environmental Team responsibilities are summarized in Table 7-1.

TABLE 7-1: BAFFINLAND IRON MINES CORPORATION SENIOR MANAGEMENT

Baffinland Senior Management	
Position	**Responsibilities and Accountabilities**
Chief Operating Officer	- Reports to Baffinland's Group Executive VP, Operations & Growth - Overall accountability for the operation of the Project - 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	- Reports to Baffinland's CEO - Establish corporate environmental policies and objectives - Monitors and reports on Baffinland's performance related to environmental policies and objectives - Liaise with regulatory authorities - Obtains necessary permits and authorizations - Monitors compliance with terms and conditions of permits and licences
Chief Procurement Officer	- Reports to Baffinland's Group Executive VP, Operations & Growth - Accountable for procurement and purchasing - Ensure that environmental commitments, policies and objectives are included in all contract documents

Baffinland Senior Management	
Position	**Responsibilities and Accountabilities**
Manager, Government Relations and Public Affairs	- Reports to VP Sustainable Development - Accountable for external communication (Governments, media, NGO, others) related to Baffinland's press release and overall communication of site incidents/events - Community liaisons report to position
Sr. Director of Sustainable Development	- Reports directly to VP Sustainable Development and indirect reporting and coordination with Chief of Operations - Liaises with the senior management, regulators and stakeholders - Ensures effective monitoring and auditing of environmental performance of departments and contractors on site and identifies opportunities for improvement - Monitors compliance with permits, licenses and authorizations - Ensures all regulatory environmental monitoring and reporting requirements (monthly, annual) are met - Leads and coordinates site permitting requirements. - Initiates and oversees environmental studies

The Baffinland Environmental Team will oversee all environmental activities on site. These responsibilities on-site are outlined in 7-2.

TABLE 7-2: BAFFINLAND IRON MINES CORPORATION ON-SITE ENVIRONMENTAL TEAM

Baffinland Project Environmental Department (Onsite)	
Position	**Responsibilities and Accountabilities**
Environmental Superintendent	- Reports to Health, Safety, Security, Training and Environment Manager - Overall accountability for environmental staff and performance at site - Coordinates implementation and monitors the performance of the Environmental Management System at site - Serves as the liaison for regulators during onsite inspections and visits - Provides ongoing environmental education and environmental awareness training to all employees and contract workers - Oversees investigations and reporting of environmental incidents to regulatory bodies, stakeholders and senior management - Reviews updates for management plans
Environmental Coordinator	- Reports to the Environmental Superintendent - Specific accountabilities for environmental monitoring and reporting - Provides day to day direction to Environmental staff onsite - Serves as a liaison for regulators during onsite inspections and visits. - Provides ongoing environmental education and environmental awareness training to all employees and contract workers - Assists with environmental database management

Baffinland Project Environmental Department (Onsite)	
Position	**Responsibilities and Accountabilities**
	- Prepare updates for management plans - Assist with monitoring and sampling activities as per the project's management plans
Environmental Monitor and Technician	- Reports to the Environmental Superintendent or designate - Assists with environmental database management - Assists with monitoring and sampling activities as per the Project's management plans
QIA Monitor	- Works alongside the Baffinland Environment Department to ensure the proper implementation of all environmental management and monitoring plans - Acts as the QIA liaison for onsite environmental matters
Environmental Support Groups (Consultants, etc.)	- Assists with sampling, monitoring and reporting activities as required by permits, licenses and environmental management plans - Provides technical expertise to various environmental studies

8 REFERENCES

Dyno Nobel. 2013. Baffinland Iron Mines: Mary River Project – Explosives Management Plan

APPENDIX A

QMR2 Quarry Mine Site Drainage Drawings and Updated Quarry Design

Baffinland

N

E

Updated Design Footprint

QMR2 Quarry Permit Limits

1 : 3000

Legend

- Toe
- Road
- Crest

PROJECT:	QUARRY QMR2
DATE SURVEYED:	2020/06/30
PREPARED BY:	JDC
DATE PLOTTED:	2021/01/13
REMAINING VOLUME:	700K m3

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

N 7,915,000

E 558 000

E 559 000

PLANT NORTH

CAMP LAKE

FLOW PATH TO CAMP LAKE

TOTE ROAD ALIGNMENT

TOTE ROAD ALIGNMENT DURING CONSTRUCTION

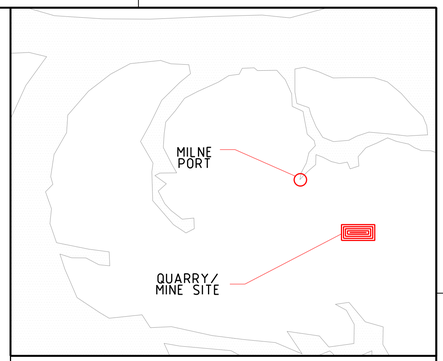
CONSTRUCTION QUARRY CRUSHER PAD #2

NEW AERODROME APRON

N 7,914,000

MATCHLINE SEE H349000-4000-00-015-0009

0 30 60 90 120 150
SCALE IN METRES



KEY PLAN

LEGEND

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

NOTES:

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

APPROVED FOR USE

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

REVISIONS					
NO.	DESCRIPTION	BY	CHK'D	APP'D	DATE

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

HATCH™

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

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

MINE SITE
QUARRY QMR2
DRAINAGE PLAN

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

ORIGINAL SHEET SIZE: ISO A1 (841 x 594)

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lesc59970

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

PLANT NORTH

MQ-C-A

BH-QMR2

QUARRY QMR2

E 560,000

E 561,000

MQ-C-D

FISH BEARING CULVERT

N 7,914,000

EXISTING TOTE ROAD

MQ-C-B

NON-FISH BEARING CULVERT

PROBABLE FISH BEARING CULVERT

ALTERNATE ACCESS TO QMR 2

SERVICE BERM FOR WATER & POWER

NON-FISH BEARING CULVERT

EXISTING FISH BEARING CULVERT

CONSTRUCTION QUARRY CRUSHER PAD #1

EXISTING CRUSHING PAD

SHEARDOWN LAKE NW

MATCHLINE SEE H349000-4000-00-015-0008

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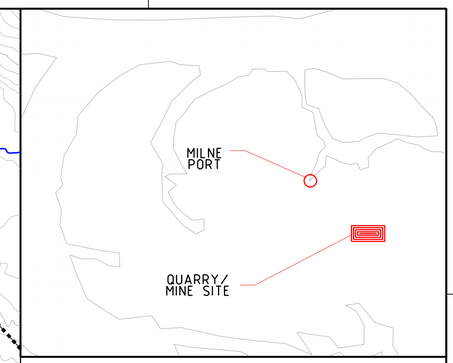
SCALE IN METRES



KEY PLAN

LEGEND

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

NOTES:

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

APPROVED FOR USE

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

NO.	DESCRIPTION	BY	CHK'D	APP'D	DATE
REVISIONS					

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

HATCH™

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

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

MINE SITE
QUARRY QMR2
DRAINAGE PLAN

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

ORIGINAL SHEET SIZE: ISO A1 (841 x 594)

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2013-05-15 2:04:49 PM

APPENDIX B

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

APPENDIX B

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

SGS Canada Inc.
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Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Baffinland Iron Mines Corp
Attn : Jim Millard

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

Phone: 416-364-8820
Fax:pdf

Modified ABA (Price 1997)

Wednesday, November 02, 2011

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

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

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

OnLine LJMS

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*NP (Neutralization Potential)

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

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

Sulphur analysis performed following BC ARD Guidelines (Price 1997)

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

OnLine LIMS

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Tuesday, November 01, 2011

Baffinland Iron Mines Corp
Attn : Jim Millard

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

Phone: 416-364-8820
Fax:pdf

Date Rec. : 25 October 2011
LR Report: CA10404-OCT11
Reference: PO13013

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

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

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NAG Test

LR Report : **CA10404-OCT11**

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

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

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

OnLine LIMS

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Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Baffinland Iron Mines Corp
Attn : Jim Millard

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

Phone: 416-364-8820
Fax:pdf

Tuesday, November 01, 2011

Date Rec. : 25 October 2011
LR Report: CA10405-OCT11
Reference: PO13013

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

Analysis	15: QTR13	16: QS3A	17: Q50+000	18: Q138+000	19: Q25+500	20: QMR2	21: Q53+700	22: Q82+700	23: Q0+500	24: Q14+600	25: Q42+000	26: Q44+000	27: Q56+750
Mercury [µg/g]	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Gold [µg/g]	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.03	< 0.02	< 0.02
Silver [µg/g]	0.06	0.15	0.08	0.10	0.05	0.13	0.08	0.11	0.09	0.03	0.33	0.02	0.03
Aluminum [µg/g]	3400	18000	9100	9300	6700	6000	21000	4900	55000	6800	12000	4100	10000
Arsenic [µg/g]	< 0.5	0.7	0.6	< 0.5	< 0.5	0.8	< 0.5	0.6	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Barium [µg/g]	12	170	75	120	58	8.1	95	19	52	8.2	45	14	35
Beryllium [µg/g]	0.06	0.17	0.14	0.28	0.22	0.35	0.16	0.23	1.6	0.12	0.26	0.27	0.15
Bismuth [µg/g]	< 0.09	0.41	< 0.09	< 0.09	< 0.09	0.13	< 0.09	< 0.09	< 0.09	< 0.09	0.14	< 0.09	< 0.09
Calcium [µg/g]	940	1350	4400	4800	1900	370	1400	310	33000	7800	3200	340	1800
Cadmium [µg/g]	< 0.02	0.03	0.02	< 0.02	< 0.02	0.06	0.03	0.02	0.24	< 0.02	< 0.02	< 0.02	< 0.02
Cobalt [µg/g]	0.63	21	5.6	7.7	2.7	1.7	15	1.9	36	6.1	25	1.4	5.5
Chromium [µg/g]	40	210	69	64	39	60	120	64	100	140	53	28	59
Copper [µg/g]	3.6	73	17	14	5.4	13	39	33	68	4.0	580	4.8	4.6
Iron [µg/g]	8300	42000	15000	26000	11000	7800	52000	8000	84000	10000	48000	10000	20000
Potassium [µg/g]	2400	13000	8000	8300	4900	5200	20000	2400	11000	1600	7400	2100	8200
Lithium [µg/g]	5	24	17	29	26	9	23	9	38	5	19	5	21
Magnesium [µg/g]	340	16000	6500	7100	3900	3600	14000	2200	59000	8400	8100	2200	5800
Manganese [µg/g]	89	130	290	180	200	180	480	65	610	150	320	74	260
Molybdenum [µg/g]	1.1	2.2	0.6	1.0	0.7	1.0	1.2	0.9	0.3	0.4	0.7	0.6	0.7

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LR Report : **CA10405-OCT11**

Analysis	15: QTR13	16: QS3A	17: Q50+000	18: Q138+000	19: Q25+500	20: QMR2	21: Q53+700	22: Q82+700	23: Q0+500	24: Q14+600	25: Q42+000	26: Q44+000	27: Q56+750
Sodium [µg/g]	980	1300	1200	1200	1200	690	1000	750	290	1200	1200	700	990
Nickel [µg/g]	3.6	83	25	9.7	6.7	2.5	43	2.6	73	41	86	3.9	6.8
Phosphorus [µg/g]	11	75	890	1000	180	62	66	56	15000	67	160	61	240
Lead [µg/g]	3.7	6.6	8.3	5.3	6.9	14	22	8.2	3.2	0.66	4.1	2.0	6.1
Antimony [µg/g]	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
Selenium [µg/g]	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	1.5	< 0.7	< 0.7
Tin [µg/g]	< 0.5	1.3	0.8	0.9	< 0.5	< 0.5	1.9	< 0.5	2.1	< 0.5	0.8	< 0.5	0.8
Strontium [µg/g]	2.83	3.18	20	14	10.00	1.94	4.20	2.57	15	6.19	4.62	2.73	5.97
Titanium [µg/g]	47	4200	1100	1700	590	410	3400	140	4200	380	1900	56	1600
Thallium [µg/g]	0.02	0.81	0.35	0.34	0.33	0.32	1.00	0.04	0.49	0.06	0.50	0.03	0.46
Uranium [µg/g]	5.6	1.5	0.46	1.1	0.46	8.2	1.3	1.9	11	0.41	0.64	1.5	7.7
Vanadium [µg/g]	< 1	140	18	40	12	< 1	80	2	180	20	41	5	22
Yttrium [µg/g]	1.7	1.3	16	5.8	3.6	6.6	2.9	3.6	15	1.3	3.5	4.9	5.7
Zinc [µg/g]	9.5	75	31	38	30	24	75	11	59	15	42	12	41
Weight [g]	697	704	614	556	603	621	625	567	545	623	539	559	643

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

OnLine LIMS

RECORD OF BOREHOLE QMR-2

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

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

Project No. 19-1605-126
SHEET 1 OF 2
DATUM: CGVD28

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

GROUNDWATER ELEVATIONS

▽ SHALLOW/SINGLE INSTALLATION
WATER LEVEL (date)

▼ DEEP/DUAL INSTALLATION
WATER LEVEL (date)

PRELIMINARY

LOGGED : Boucher/Clarke
CHECKED :

THURBER

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

RECORD OF BOREHOLE QMR-2

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

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

Project No. 19-1605-126
SHEET 2 OF 2
DATUM: CGVD28

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

GROUNDWATER ELEVATIONS

SHALLOW/SINGLE INSTALLATION
WATER LEVEL (date)

PRELIMINARY

DEEP/DUAL INSTALLATION
WATER LEVEL (date)

LOGGED : Boucher/Clarke
CHECKED :

THURBER

THURBER25(5126) 5126.GPJ 9/30/11

APPENDIX C

NB21-00718 - Mary River Mine - Geomec Design Rec for QMR2 Quarry

Knight Piésold CONSULTING

July 27, 2021

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Daniel Janusauskas
Technical Services Superintendent
Baffinland Iron Mines Corporation
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Oakville, Ontario
Canada, L6H 0C3

Dear Daniel,

RE: Mary River Mine - Geomechanical Design Recommendations for QMR2 Quarry

1.0 INTRODUCTION

Baffinland Iron Mines Corporation (Baffinland) owns and operates the Mary River Mine in Nunavut. Knight Piésold Ltd. (KP) has provided environmental, permitting, and geotechnical support for the mine for over a decade, and recently provided updated slope geometry recommendations for the Naluujaak open pit (KP, 2021). Baffinland has started excavation of the QMR2 quarry at the mine site and plans to eventually expand the quarry to a depth of approximately 50 m. Baffinland requested KP's assistance to address an order issued by the Nunavut Worker's Safety and Compensation Commission (WSCC) for a geomechanical design basis for the quarry. This letter summarizes the completed work and presents the geomechanical slope recommendations for the quarry.

2.0 BACKGROUND

The QMR2 quarry is located on a hillside approximately 3 km to the west of the Naluujaak open pit. Excavation of the quarry began in 2013 though it is not currently in use. The quarry measures approximately 305 m by 325 m in plan and the height of the quarry walls ranges from 15 m to 35 m. The final configuration of the quarry is expected to be 50 m deep and is planned to incorporate benches that are 10 m high, 10 m wide and have a Bench Face Angle (BFA) of 65°. The current quarry geometry is shown relative to the planned final configuration on Figure 1.

The quarry is expected to be entirely within the Footwall (FW) Gneiss. The FW Gneiss is a common geological unit at the mine site and is also present in the Naluujaak open pit. A single fault, also referred to as the Sheared Mafic Gouge Unit has been identified in the Northwest Wall of the current quarry. The fault strikes North-Northwest (NNW) and dips to the East-Northeast (ENE) at approximately 45°. The fault is shown on Figure 1.

3.0 ROCK MASS CHARACTERISTICS

3.1 GENERAL

The FW Gneiss was characterized in the vicinity of the Naluujaak open pit as part of the original open pit feasibility study (KP, 2010) and a recent geomechanical review of the open pit (KP, 2021). The existing QMR2 quarry excavation provides an opportunity to confirm the rock mass quality and rock mass structure

in the immediate vicinity of the quarry. Due to the timing of the study, an in-person assessment of the quarry was not practical, and the assessment relied on photos and structural mapping data provided by Baffinland.

3.2 ROCK MASS QUALITY

The rock mass quality of the current quarry excavation was assessed using the Geological Strength Index (GSI) for jointed rocks (Marinos and Hoek, 2000) and pictures of the quarry slopes provided by Baffinland. It is important to note that the quarry was excavated without controlled blasting, that loose rock is present on the bench faces, and that the current slopes have been exposed to repeated freeze-thaw cycles. As a result, the observed rock mass quality is likely to be somewhat less than the true rock mass quality. An effort has been made to discount obvious damage to the rock mass during this assessment. The rock mass quality assessment is included in Appendix A and summarized below:

- The FW Gneiss is blocky to very blocky. The discontinuities were described by Baffinland as rough with very little infilling or alteration.
- A fault zone intersects the North Wall of the quarry. This fault zone is characterized by gouge, a local reduction in rock mass quality and slickensided surfaces, and is typically up to 1 m thick.
- The rock mass is generally of Good quality, with the estimated GSI typically ranging from 55 to 70. This range does not include the fault zone as it is a discrete feature and not representative of the overall rock mass.

The observed rock mass quality is generally consistent with the results of the recent review of the Naluujaak open pit (KP, 2021), which defined GSI values of 65 to 70 for the FW Gneiss in the vicinity of the open pit.

3.3 ROCK MASS STRUCTURE

Baffinland measured the orientation of prominent discontinuities on several benches in the current quarry and identified five discontinuity sets. These measurements formed an initial basis for the assessment of the rock mass structure. Additional photos of the quarry benches were then reviewed by KP to assess whether other joint sets were present and if all of the identified joint sets were consistently observed throughout the quarry. The review is included in Appendix A and the observed discontinuity sets are summarized below:

- Joint Set 1: Sub-vertical joint set striking ENE and dipping at 65° to 85° (average of 80°) to the South-Southeast (SSE).
- Joint Set 2: Joint set striking NNW and dipping at 25° to 75° (average of 45°) to the ENE. This set is associated with the fault.
- Joint Set 3: Sub-horizontal joint set striking South (S) and dipping at 10° to 35° (average of 20°) to the West (W).
- Joint Set 4: Joint set striking S and dipping at 55° to 65° (average of 60°) to the W.
- Joint Set 5: Sub-vertical joint set striking ESE and dipping at 75° to 85° (average of 80°) to the SSW.

Joint Sets 1, 2 and 3 were consistently observed in the quarry and are considered the dominant structural orientations. Joint Sets 4 and 5 were only locally observed and are considered minor joint sets. Note that most of the available photos were for bench faces oriented E-W and the data may be biased against structures oriented E-W as a result.

4.0 STABILITY ANALYSES

4.1 GENERAL

Stability analyses were completed to assess whether the proposed slope geometry was achievable based on the current understanding of the rock mass. The analyses considered the potential for structurally controlled (kinematic) failures, rock mass failures and rockfalls. Given the observed rock mass quality and the limited height of the quarry slopes, kinematic failures are expected to be the most likely failure mechanism.

4.2 KINEMATIC ANALYSES

Kinematic stereographic analyses were completed using DIPS (Rocscience, 2021) to evaluate the potential for planar and wedge failures to limit the achievable slope geometry. Due to the limited structural data available, the analyses consider the average orientation of each joint set rather than the individual discontinuity orientations. The analyses were completed for the four main walls of the quarry (i.e., the Northwest, Northeast, Southeast and Southwest Walls) as well as the West Wall, and focussed on the proposed BFA of 65°. The results of the kinematic analyses are detailed in Appendix A and summarized below:

The results of the analyses suggest that kinematic failures will limit the achievable bench geometry in the following sectors:

- **West Wall -** Planar failures on Joint Set 2 are expected to limit the achievable BFA to 45°. Joint Set 1 could act as a release plane for these failures.
- **Northwest Wall -** Wedge failures on Joint Sets 1 and 2 are expected to limit the achievable BFA to 50°.

Kinematic failures involving minor joint sets are also predicted in several sectors. The likelihood for and potential effects of these failures are sensitive to the prominence of Joint Sets 4 and 5. Based on the current understanding of the rock mass structure, these are expected to result in local bench instabilities rather than limiting the achievable slope geometry of the wall.

- **Southeast Wall -** Planar failures on Joint Set 4 and wedge failures on Joint Sets 4 and 5 could locally limit the achievable BFA to 60°. Wedge failures on Joint Sets 1 and 4 could locally limit the achievable BFA to 65°.
- **West Wall -** Wedge failures on Joint Sets 2 and 5 could locally limit the achievable BFA to 50°.
- **Northwest Wall -** Wedge failures on Joint Sets 2 and 5 could locally limit the achievable BFA to 35°. The potential for these failures is sensitive to the frictional strength of the discontinuities and in practice it is considered unlikely that the BFA will break back to such a shallow angle.

The analyses suggest that the achievable slope geometry of the Northeast and Southwest Walls will not be limited by planar or wedge failures.

4.3 LIMIT-EQUILIBRIUM ANALYSES

Limit-Equilibrium (LE) stability analyses were completed using SLOPE/W© (Seequent, 2021) to evaluate the potential for rock mass quality to limit the achievable slope geometry. The analysis conservatively considered an overall slope angle of 45° based on a bench height of 10 m, bench width of 8 m and a BFA of 75°. The analyses incorporated the intact rock parameters defined for the open pit feasibility

study (KP, 2010) and considered GSI values ranging from 55 to 70. A target Factor of Safety (FoS) of 1.3 was used based on industry practice.

The reported FoS significantly exceeded the target FoS in all cases. The results suggest that rock mass quality is unlikely to limit the achievable slope geometry for the slope heights and angles considered. The results of the analyses are detailed in Appendix A.

4.4 ROCKFALL ANALYSES

Analyses were completed using RocFall (Rocscience, 2020) to assess the capacity of the benches to retain rockfall. The inputs to the analyses were adapted from the recent geomechanical review of the open pit (KP, 2021) which included a back-analysis of a rockfall event in the FW Gneiss. An acceptance criterion of 90% retention on the catch bench directly below the failure was used. The analyses considered benches that are 10 m high, 10 m wide and have a BFA of 65°.

The analyses predict that 100% of the rockfall debris will be retained on the bench immediately below the failure. As a result, the bench performance is considered adequate to mitigate rockfall. The results of the analyses are detailed in Appendix A.

5.0 SLOPE GEOMETRY RECOMMENDATIONS

The slope geometry parameters proposed by Baffinland were reviewed relative to the results of the stability analyses. Alternative bench geometry configurations are recommended for the West and Northwest Walls to accommodate the expected planar and wedge failures in these sectors. Increased bench width has been recommended to accommodate the expected back-break. The current quarry design limits the height of these sectors to approximately two benches, which is expected to limit the effect of any failures. The slope geometry recommendations are summarized in Table 1. Baffinland has acknowledged the slope recommendations and has updated the quarry design to reflect them.

Table 1 QMR2 Quarry Slope Geometry Recommendations

Wall	Bench Face Angle	Bench Width	Bench Height	Inter-Ramp Angle
Northeast	65°	10 m	10 m	34°
Southeast	65°	10 m	10 m	34°
Southwest	65°	10 m	10 m	34°
West	65°	14 m	10 m	28°
Northwest	65°	12 m	10 m	31°

Note that the achievable slope geometry for the Southeast Wall is sensitive to the prominence of Joint Sets 4 and 5. Based on the current understanding of the rock mass characteristics, bench scale planar and wedge failures involving these joint sets could locally limit the BFA to 60°. Local instabilities could also occur along the fault in the Northwest Wall.

Periodic structural mapping and geomechanical inspections are recommended during the development of the quarry. If the encountered rock mass characteristics or observed slope performance deviate from the current understanding, these slope geometry recommendations should be revisited.

6.0 CLOSING

We trust this letter meets your present needs. Please do not hesitate to contact us should you require anything further.

Yours truly,
Knight Piésold Ltd.

PERMIT TO PRACTICE
KNIGHT PIESOLD LTD.
Signature
Date 2021-07-27
PERMIT NUMBER: P 547
The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

REGISTERED PROFESSIONAL ENGINEER
B.D. PEACOCK
LICENSEE
2021-07-27
NT/NU

Prepared:

Jeffrey Ganye, M.A.Sc.
Geotechnical Engineering

Reviewed:

Ben Peacock, P.Eng.
Senior Engineer

Approval that this document adheres to the Knight Piésold Quality System:

Attachments:

Figure 1 Rev 0	Quarry Geometry
Appendix A	Mary River Mine - Geomechanical Review of QMR2 Quarry

References:

Knight Piésold Ltd. (KP), 2010. *Feasibility Design for Deposit No. 1 Open Pit.* April 30. North Bay, Ontario. Ref. No. NB102-181/8-4, Rev 0.

Knight Piésold Ltd. (KP), 2021. *Geomechanical Review for Phase 2 Pushback.* March 19. North Bay, Ontario. Ref. No. NB102-181/63, Rev 0.

Marinos, Paul, and Evert, Hoek, 2000. *GSI: A Geologically Friendly Tool for Rock Mass Strength Estimation.* Paper presented at the ISRM International Symposium. November. Melbourne, Australia.

Rocscience Inc. (Rocscience), 2020. *RocFall*. Version 8.0. Toronto, Ontario.

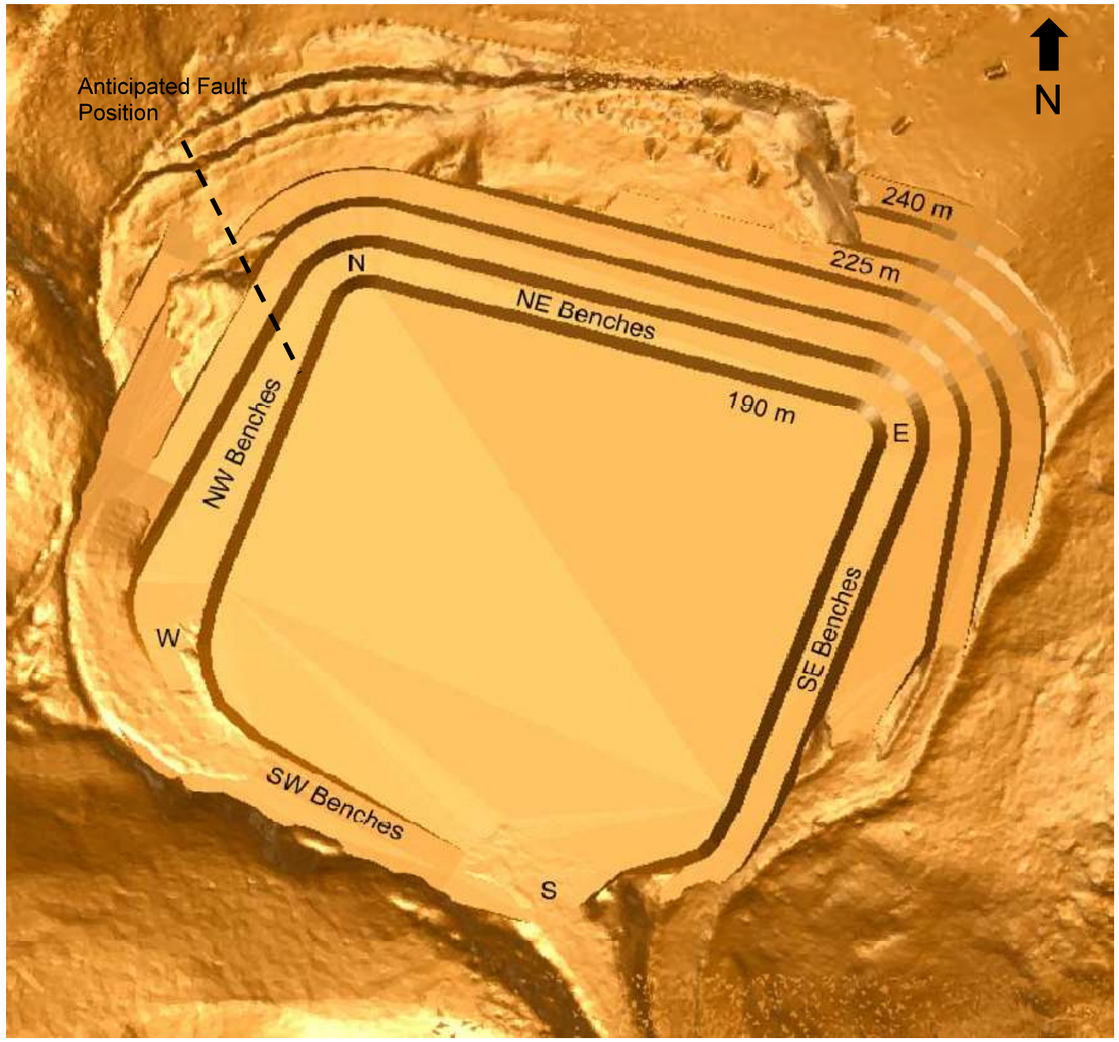
Rocscience Inc. (Rocscience), 2021. *Dips*. Version 8.0. Toronto, Ontario.

Seequent Ltd. (Seequent), 2021. SLOPE/W©. Version 11.1. Toronto, Ontario.

/bdp

Current Quarry Geometry

Proposed Quarry Geometry



NOTES:

1. CURRENT AND PROPOSED QUARRY GEOMETRY WAS PROVIDED BY BAFFINLAND.
2. POSITION OF FAULT IN CURRENT QUARRY PROVIDED BY BAFFINLAND.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	27JUL'21	ISSUED WITH LETTER	JAG	BDP

BAFFINLAND IRON MINES CORPORATION

MARY RIVER MINE

QUARRY GEOMETRY

Knight Piésold CONSULTING

P/A NO. NB102-181/73

REF. NO. NB21-00718

FIGURE 1

REV 0

APPENDIX A

Mary River Mine - Geomechanical Review of QMR2 Quarry

(Pages A-1 to A-38)

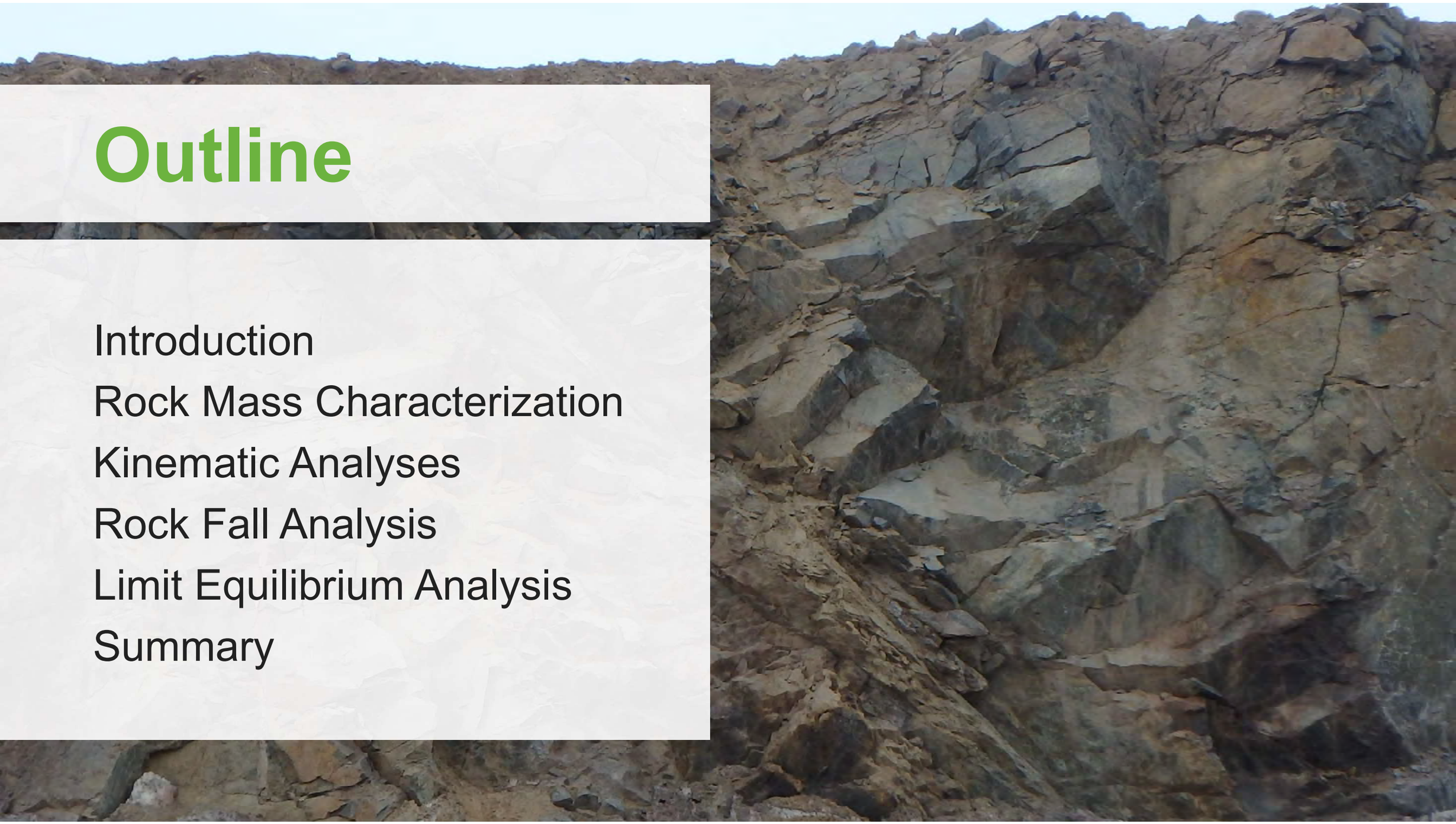
Mary River Mine

Geomechanical Review of QMR2 Quarry

Knight Piésold CONSULTING

Adding value. Delivering results.

Outline



Introduction

Rock Mass Characterization

Kinematic Analyses

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Introduction

Introduction

Project Summary

- Baffinland Mines Corporation (Baffinland) operates the Mary River Mine in Nunavut, Canada.
- As part of the mine site infrastructure, Baffinland has developed the QMR2 quarry and plans to eventually expand the quarry to a depth of approximately 50 m.
- Baffinland requested assistance from Knight Piésold Ltd. (KP) to address an order issued by the Nunavut Worker's Safety and Compensation Commission (WSCC) for a geomechanical design basis for the quarry.
- This presentation presents a summary of the completed work, including:
  - Characterizing the rock masses that comprise the quarry
  - Evaluating the stability of the proposed quarry slopes
  - Confirming the proposed quarry slope design and/or developing alternate recommendations if appropriate

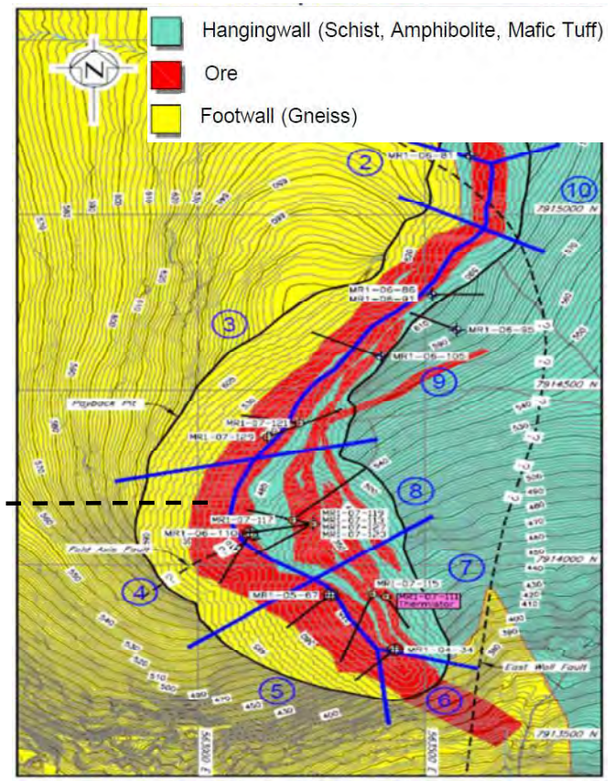
Introduction

Location and Geology

Current Geometry of QMR2 Quarry

Approximate location of QMR2 quarry

3 km



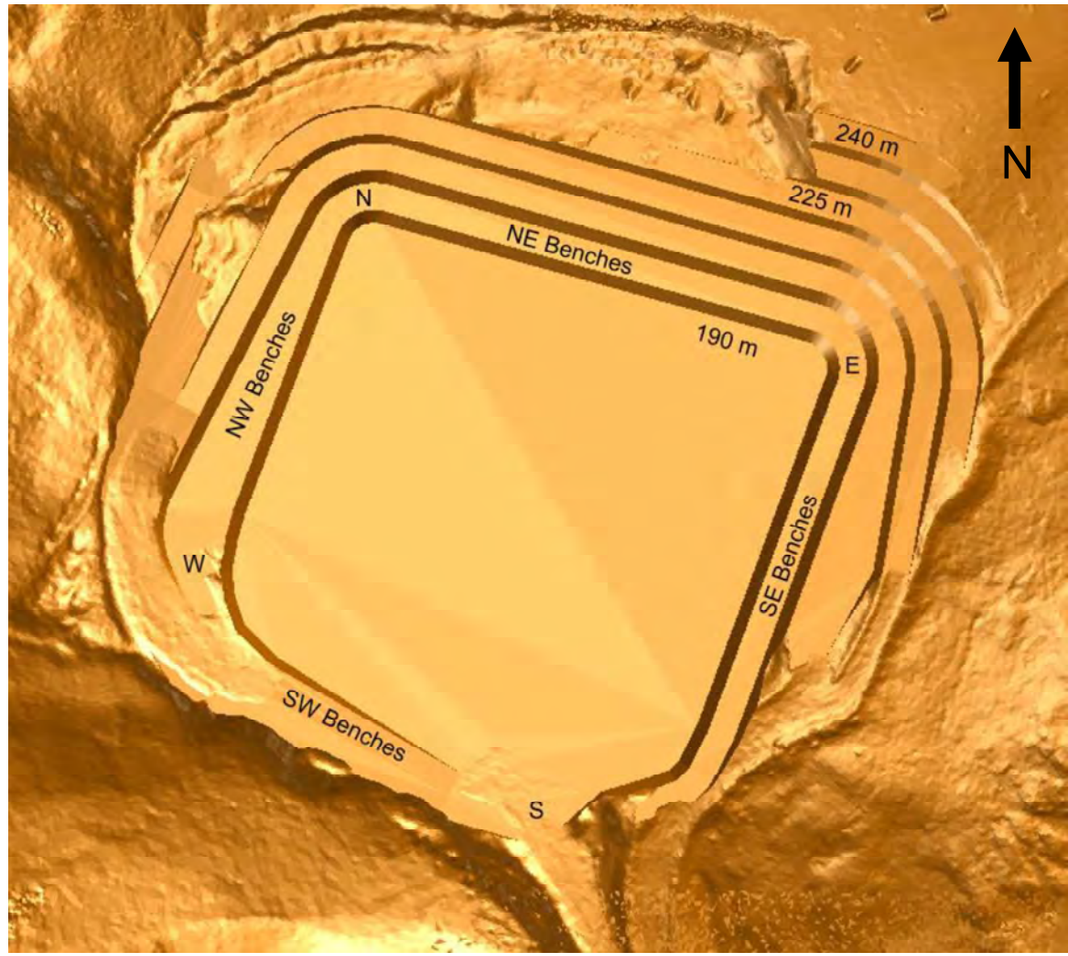
Naluujaak Open Pit

- The quarry is located approximately 3 km to the west of the Naluujaak open pit, as shown above.
- The quarry is currently 15 to 35 m deep and has not been used recently.
- The quarry is expected to be excavated entirely within Footwall Gneiss based on discussions with Baffinland.

Introduction

Proposed Quarry Design

- The proposed quarry design currently under consideration by Baffinland is shown at right.
- The quarry will have a maximum slope height of 50 m (Crest El. 240 m) on the East Wall. It is understood that this may be reduced to 35 m (Crest El. of 225 m). As the quarry is being excavated into a hillside, the South Wall is at grade.
- Baffinland is currently considering the following bench geometry:
  - Bench Face Angle (BFA) of 65°
  - Bench Height of 10 m
  - Bench Width of 10 m
- Note that the design shown at right incorporates bench heights varying between 7.5 and 10 m.



Rock Mass Characterization

Rock Mass Characterization

General

- The rock mass in the immediate vicinity of the QMR quarry has not been formally characterized from a geomechanical perspective to date.
- The Footwall Gneiss in which the quarry will be excavated was characterized as part of the Naluujaak Open Pit Feasibility Study (KP, 2010) as well as during a recent geomechanical review of the open pit (KP, 2021). This characterization was used as a starting point for the current study.
- An in-person assessment of the current quarry was not possible due to travel restrictions associated with the COVID-19 pandemic. As a result, the rock mass quality and rock mass structure were assessed based on photos of the current quarry slopes as well as mapping data provided by Baffinland.
- The rock mass quality was assessed visually from photos using the Geological Strength Index (GSI) for jointed rock masses (Marinos and Hoek, 2000).
- The rock mass structure was initially mapped by Baffinland staff in several locations. KP then used the available photos to assess whether similar dominant discontinuity orientations were generally present in the quarry. All annotations on the following slides are in the format of Strike/Dip.
- The intact properties of the Footwall Gneiss have not been re-evaluated and are based on the KP (2010) open pit feasibility study.

Rock Mass Characterization

2010 Open Pit Feasibility Study

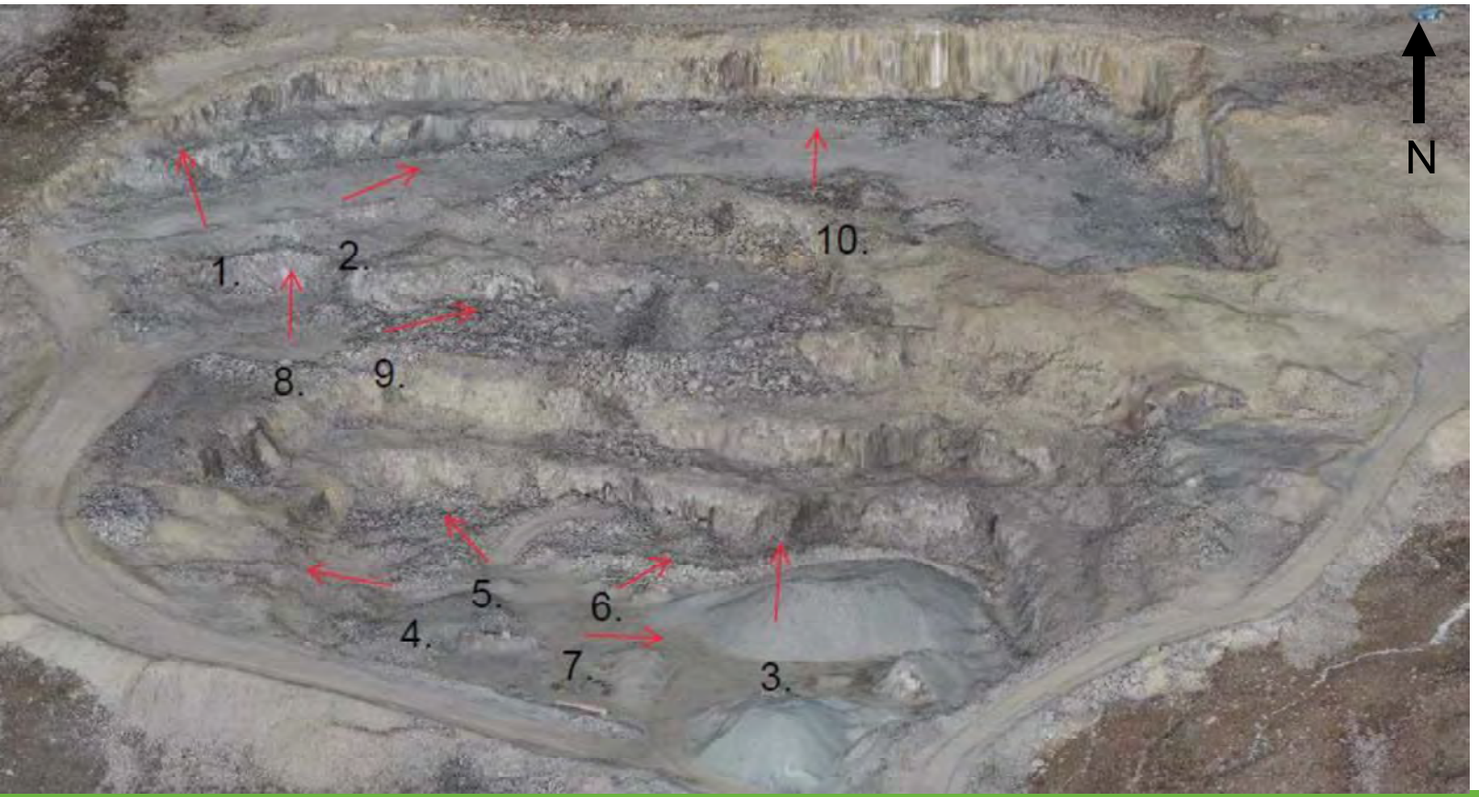
Domain	Design Sectors	Design UCS (MPa)	Density [3]		RMR$_{88}$ [4]			GSI [5]			E [6] (GPa)	Poisson's Ratio [7]	m_i [8]	Design	
			(t/m^3)	(kN/m^3)	Lower	Design	Upper	Lower	Design	Upper				m_b [27]	s [27]
ORE	2	30	4.4	43	45	50	55	40	45	50	43.073	0.16	29	4.07	0.002
	3	85	4.4	43	50	55	60	45	50	55	43.073	0.16	29	4.86	0.004
	4	35	4.4	43	30	40	50	25	35	45	43.073	0.16	12	1.18	0.001
	5	85	4.4	43	45	55	65	40	50	60	43.073	0.16	26	4.36	0.004
	7	85	4.4	43	45	55	65	40	50	60	43.073	0.16	26	4.36	0.004
FW	2,3	50	2.8	28	50	55	60	45	50	55	28.468	0.148	28	3.93	0.002
	4	50	2.8	28	-	40	-	-	35	-	28.468	0.148	28	2.3	0
	5, 6, 7	50	2.8	28	50	55	60	45	50	55	28.468	0.148	28	4.69	0.004
HW	7 (Tuff)	80	2.9	29	45	55	65	40	50	60	25.242	0.169	13	2.18	0.004
	7 (Waste Stringers)	50	2.9	29	35	40	45	30	35	40	25.242	0.169	13	1.28	0.001

- This table summarizes the rock mass properties defined as part of the 2010 open pit feasibility study.
- The rock mass characteristics for FW Design Sector 2 and 3 is thought to be most relevant to the QMR2 quarry. The reduced rock mass quality in FW Design Sector 4 is associated with a prominent fold hinge that is not present in the quarry.

Rock Mass Characterization

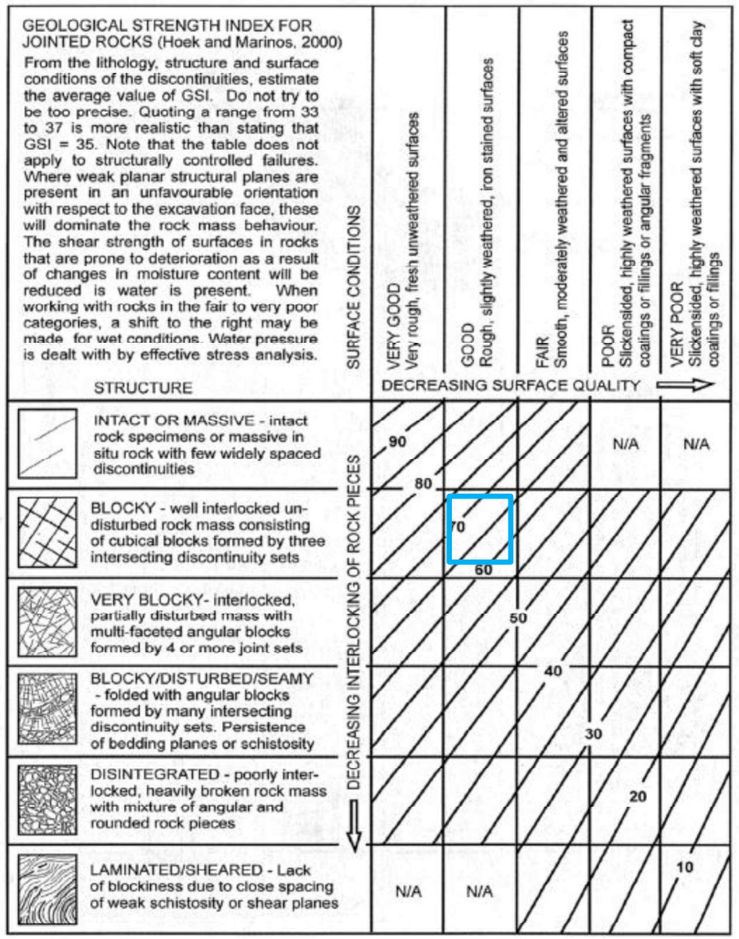
Available Photos

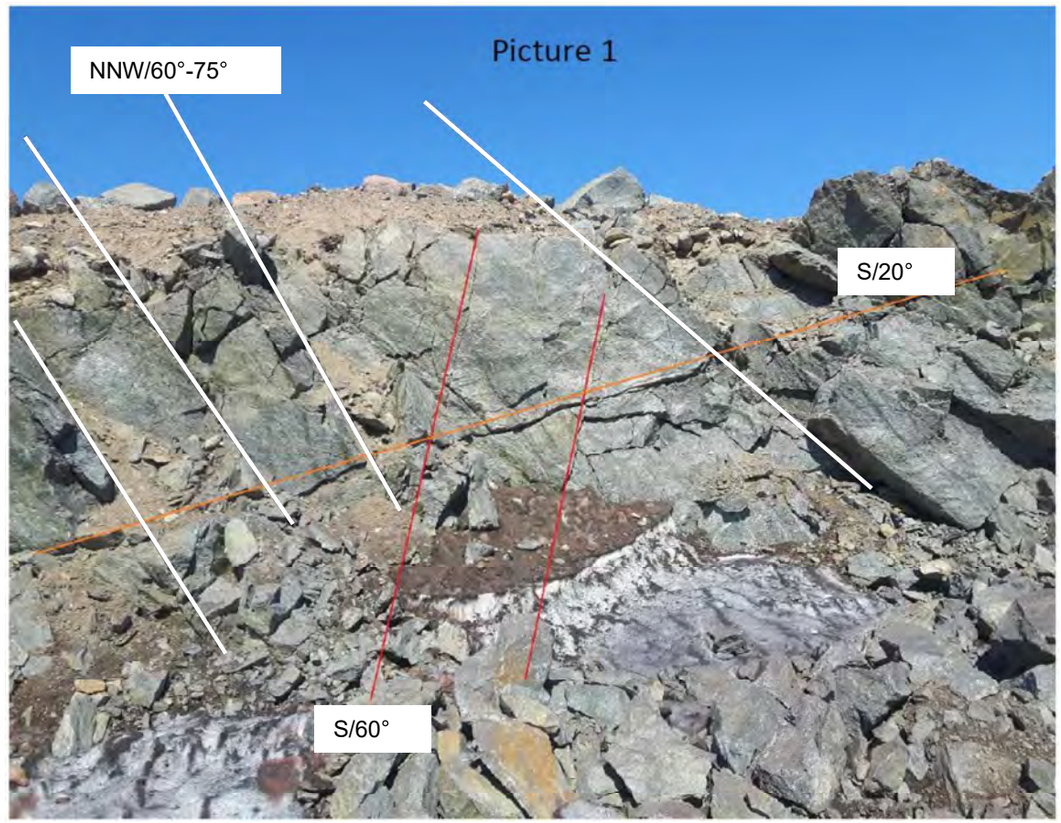
- Set 1 - Twelve photos from ten different positions (shown at left). Several photos have structural mapping annotations.
- Set 2 - Almost 100 photos from numerous positions within the quarry (shown at right).
- Structural annotations have been made to both photo sets by KP during the review.



Rock Mass Characterization

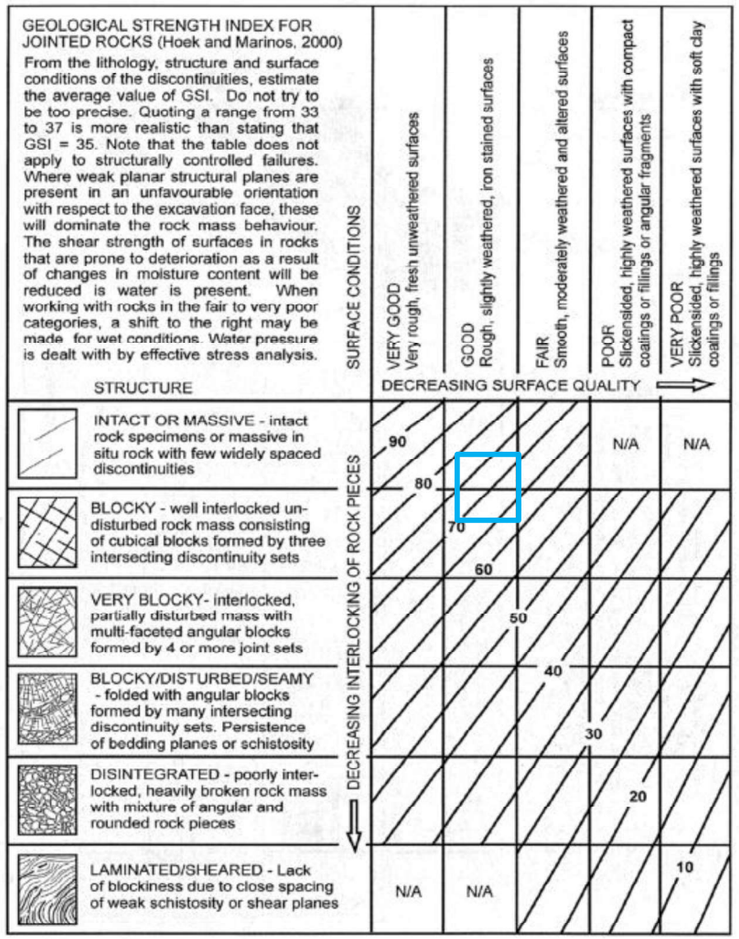
Photo Set 1 - Location 1





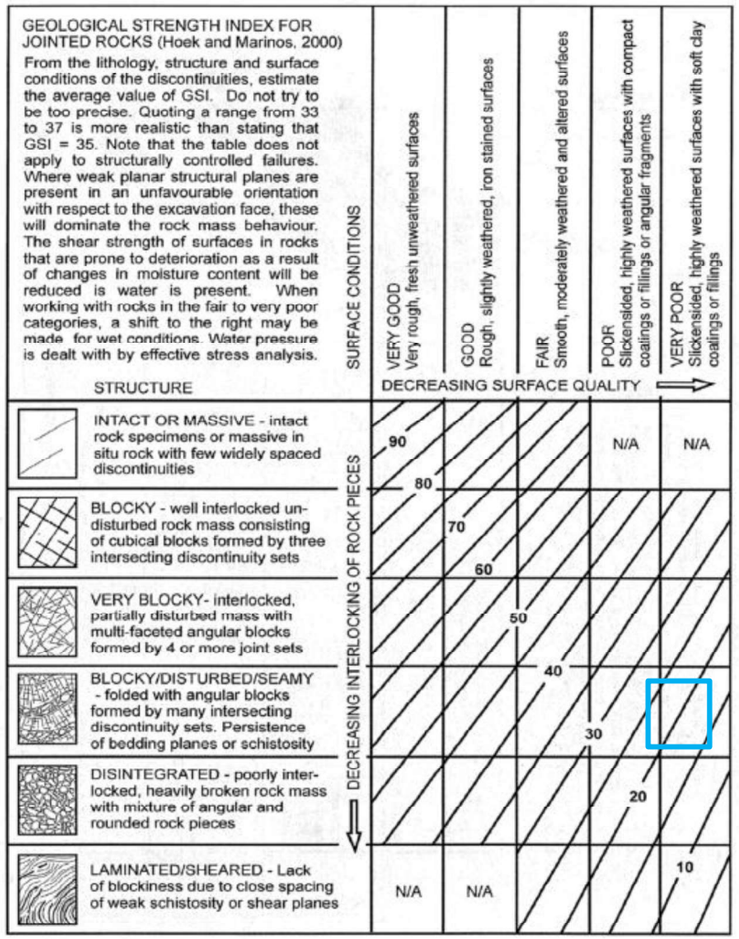
Rock Mass Characterization

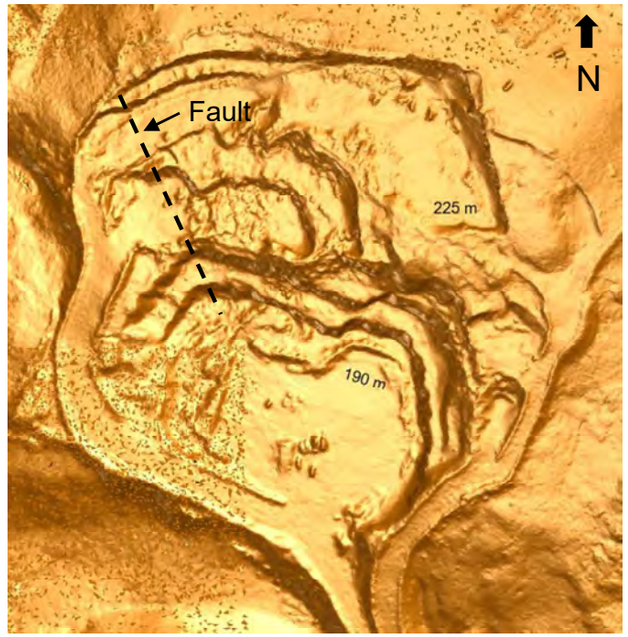
Photo Set 1 - Location 3



Rock Mass Characterization

Photo Set 1 - Fault

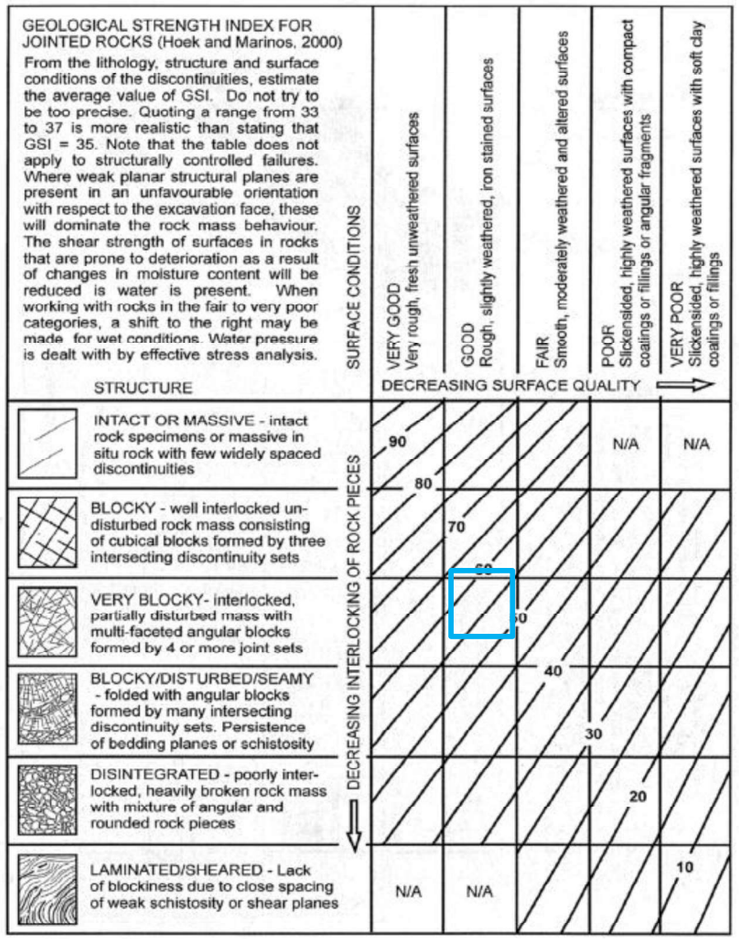


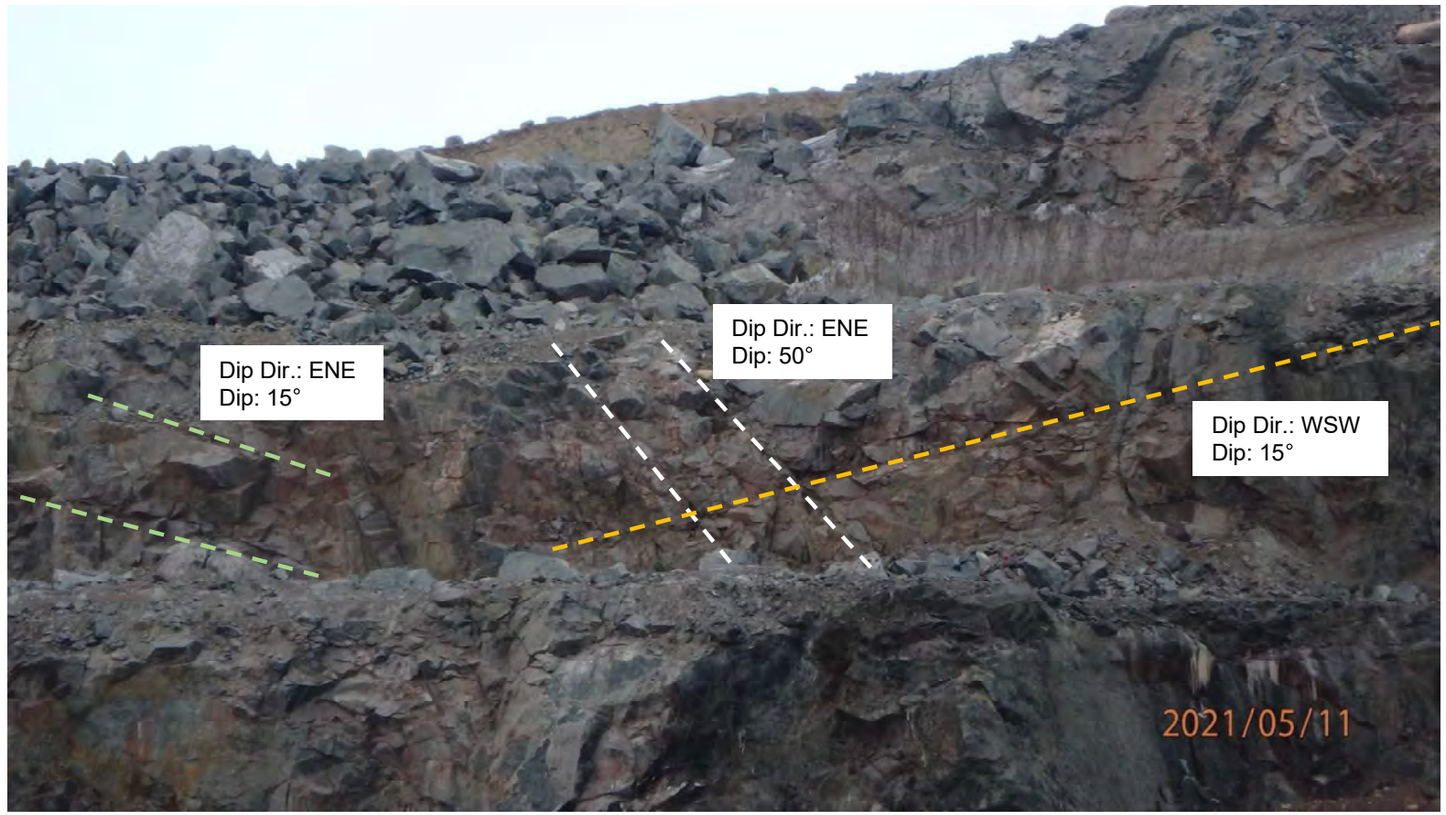


- A single fault/shear zone was observed in the quarry and can be traced between multiple benches. The fault is a discrete feature, typically up to 1 m thick. It is also referred to as the Sheared Mafic Gouge Unit.

Rock Mass Characterization

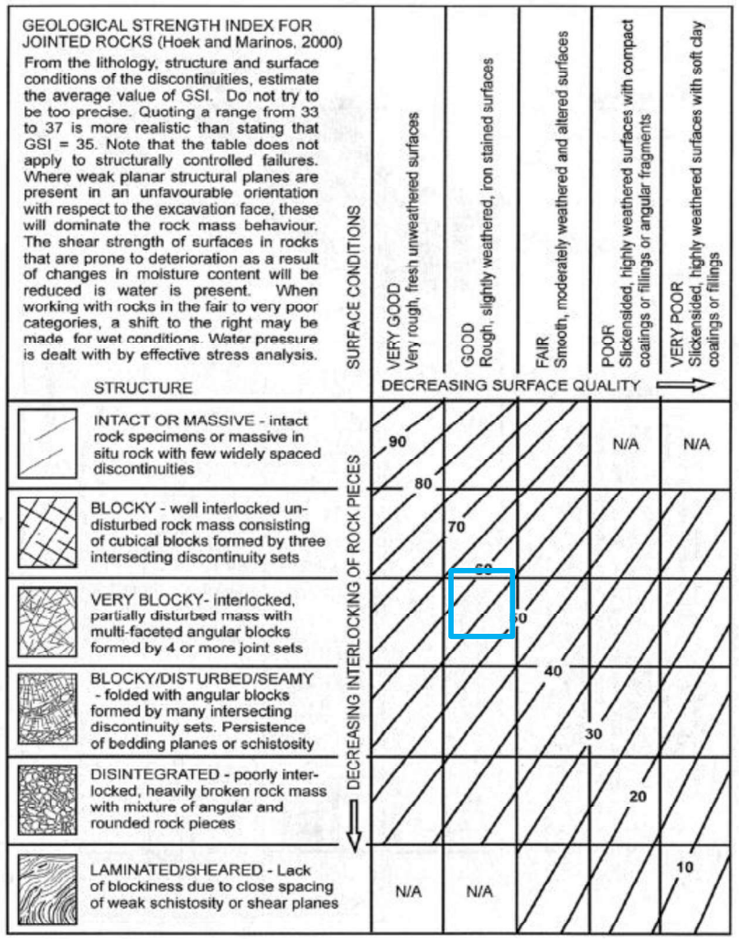
Photo Set 2 - Photo 4





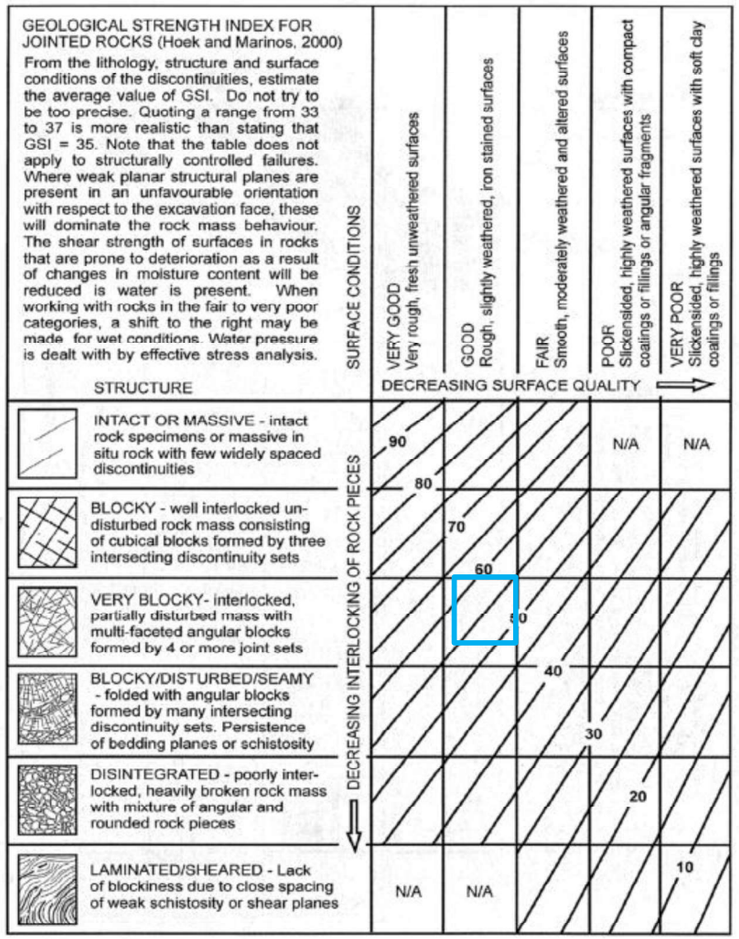
Rock Mass Characterization

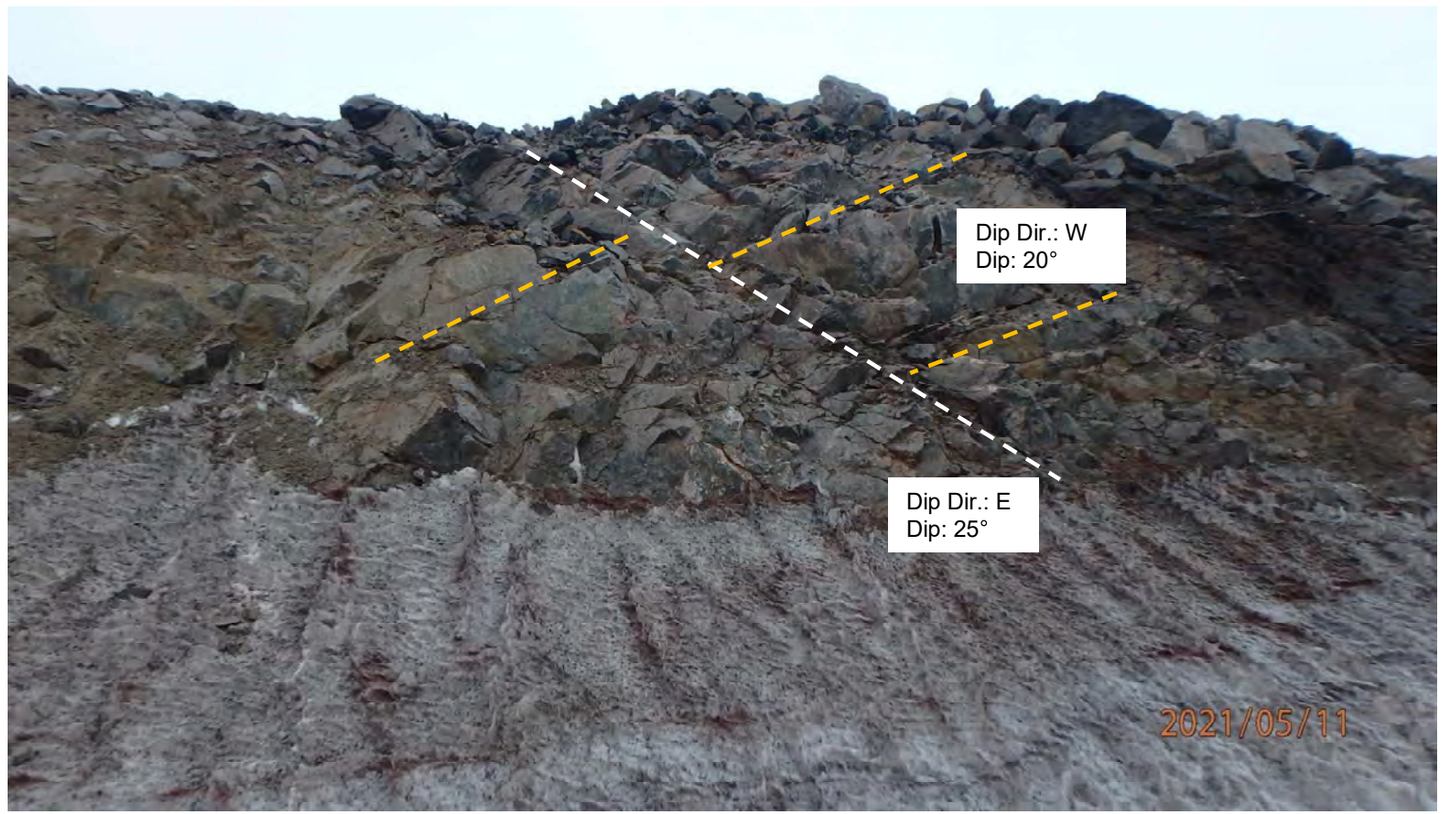
Photo Set 2 - Photo 10



Rock Mass Characterization

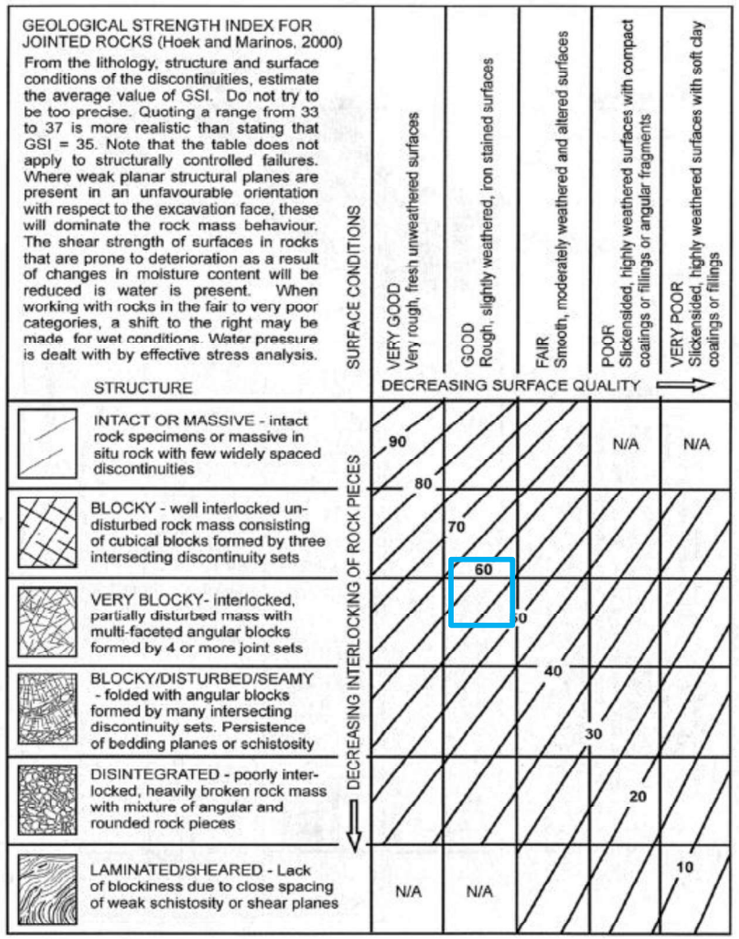
Photo Set 2 - Photo 21

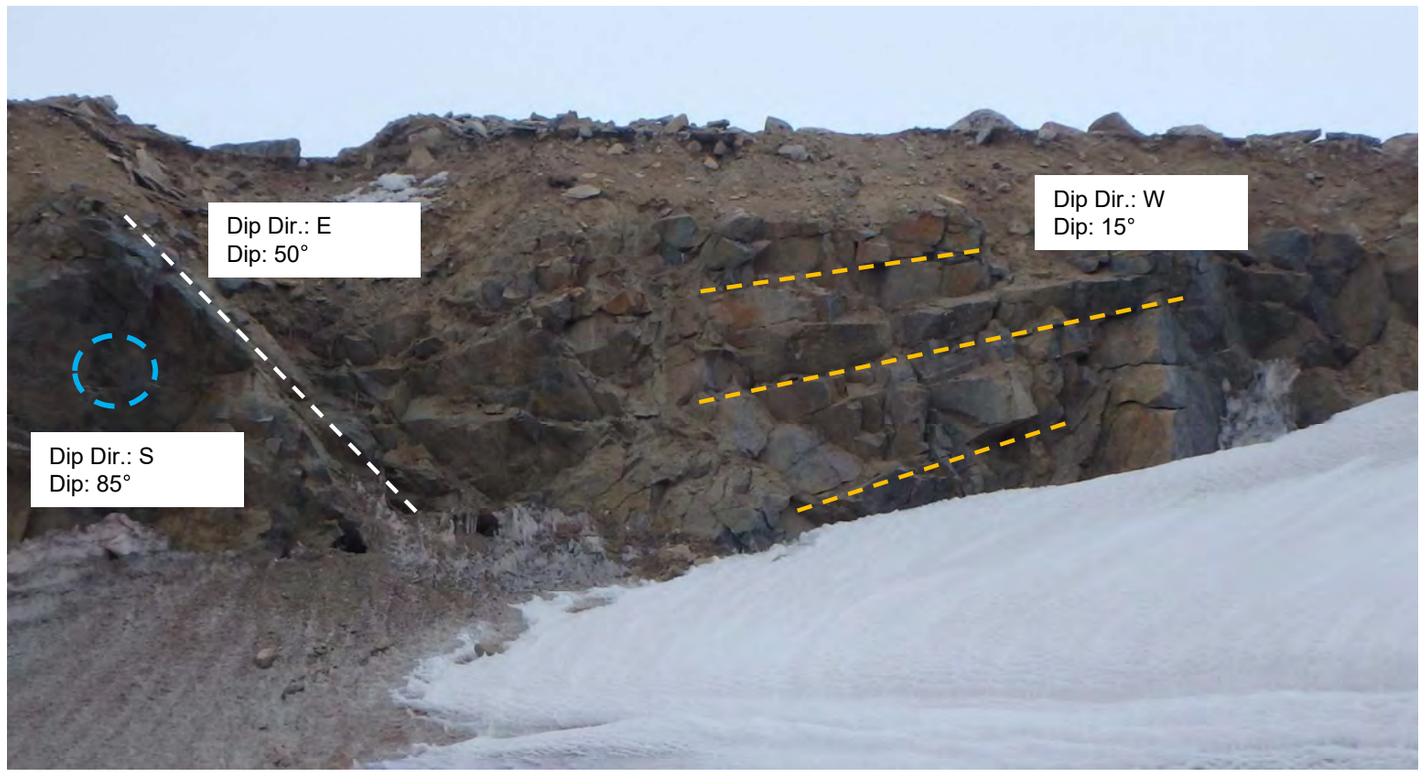




Rock Mass Characterization

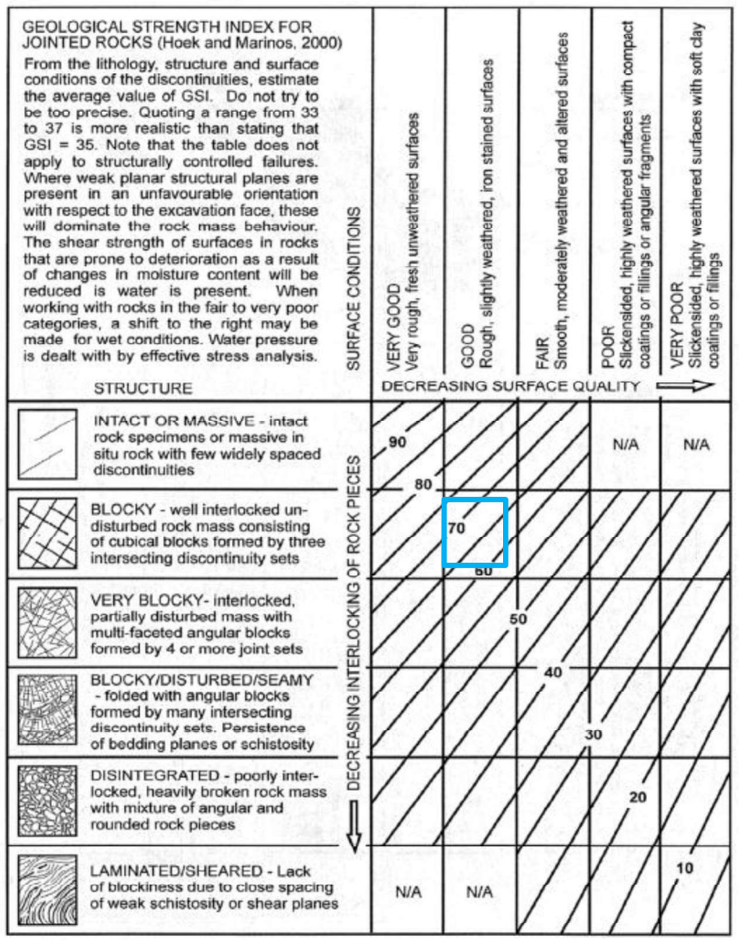
Photo Set 2 - Photo 77

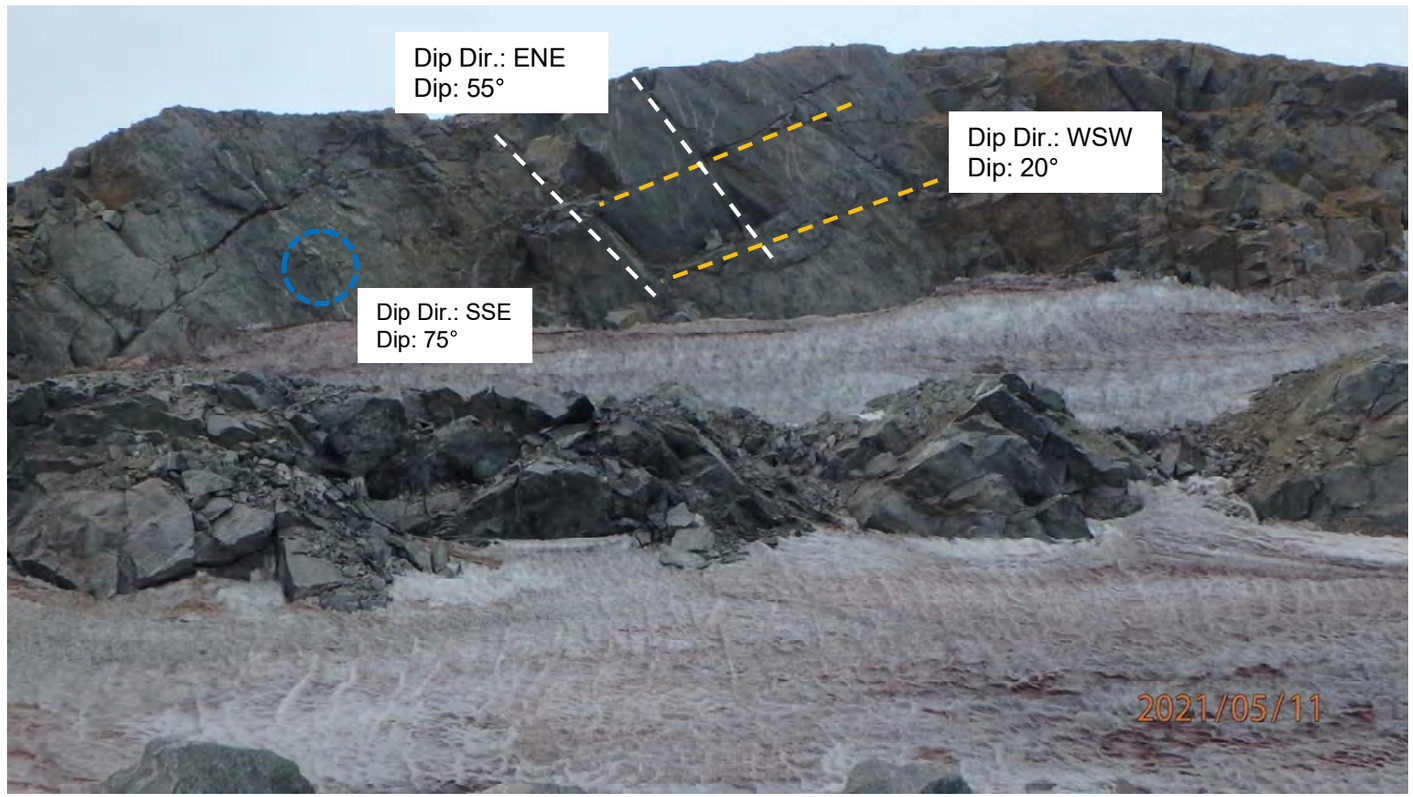




Rock Mass Characterization

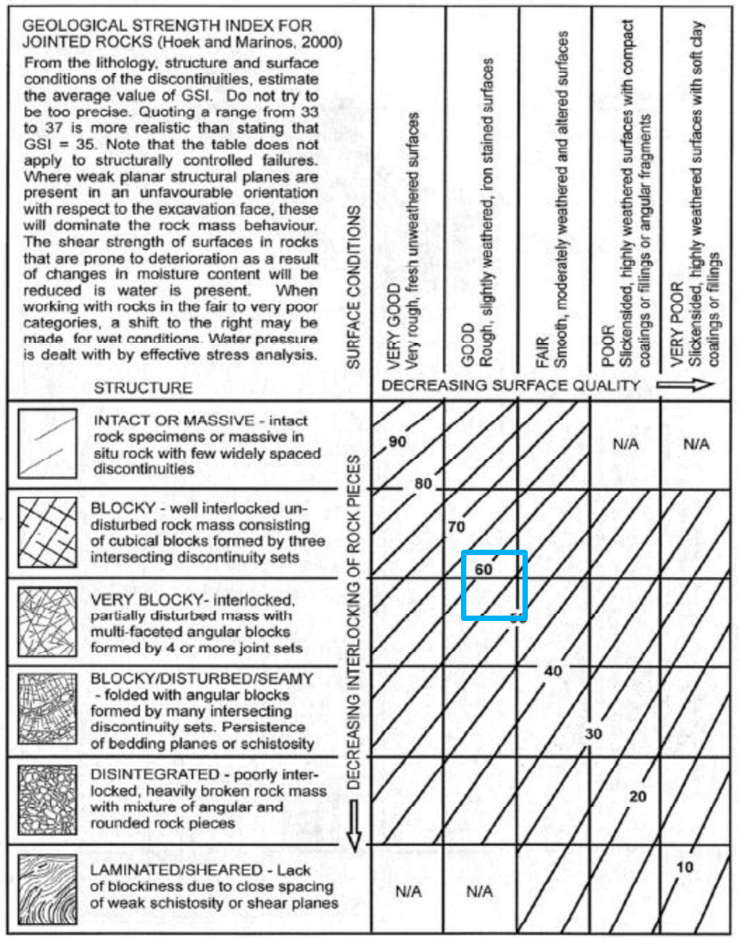
Photo Set 2 - Photo 67





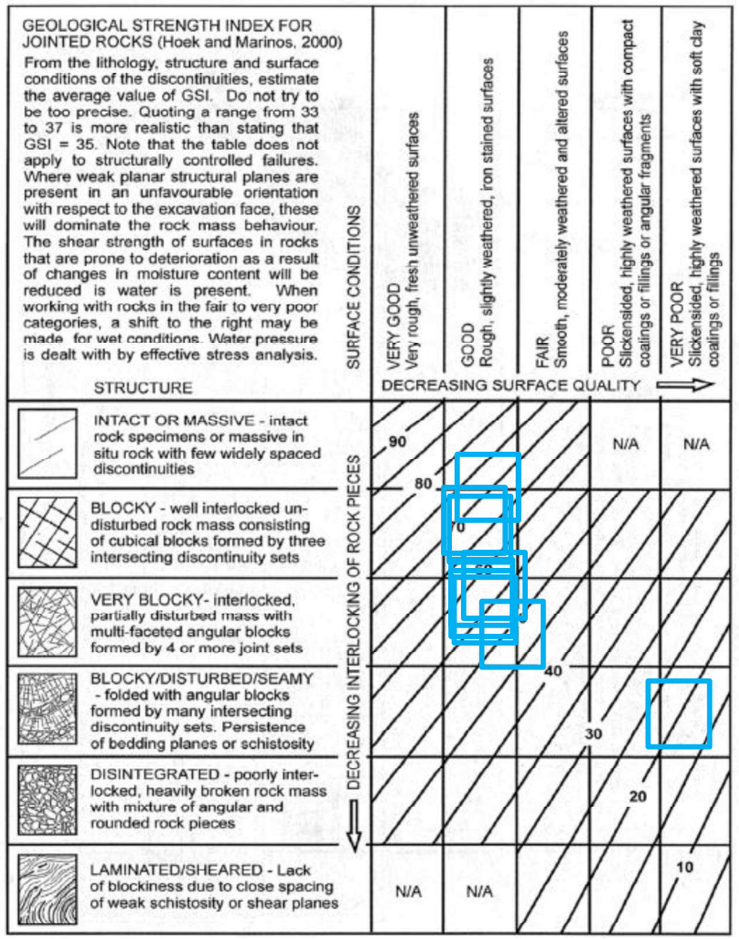
Rock Mass Characterization

Photo Set 2 - Photo 73



Rock Mass Characterization

Rock Mass Quality Summary



- The review suggests that the rock mass quality in the quarry typically varies from GSI 55 to 70 (excluding the fault).
- These estimates are generally consistent with the findings of the recent open pit review which concluded that the FW Gneiss in FW Design Sector 3 of the open pit was of better rock mass quality than originally anticipated in the open pit feasibility study.
- Note that the characterization of the rock mass quality was influenced by the poor state of the current quarry walls, which were not developed with pre-shear blasting. An effort was made to discount these effects during the review, to the extent practical.

STUDY	GSI
2010 Open Pit Feasibility Study (FW Design Sector 3)	45 to 55
2021 Open Pit Review (FW Design Sector 3)	65 to 70
Current Study	55 to 70

Rock Mass Characterization

Rock Mass Structure Summary

- Photo Set 1 included the results of structural mapping completed by Baffinland staff. Five joint sets were identified from four locations in the quarry.
- KP reviewed photos from Photo Set 2 for evidence of these joint sets elsewhere in the quarry.
- Joint Sets 1, 2 and 3 were identified in numerous photos and are thought to be the dominant discontinuity orientations.
- Joint Sets 4 and 5 were not prominent in the other photos reviewed and are considered minor sets.
- Occasional random joints were also observed.

Photo Set 1

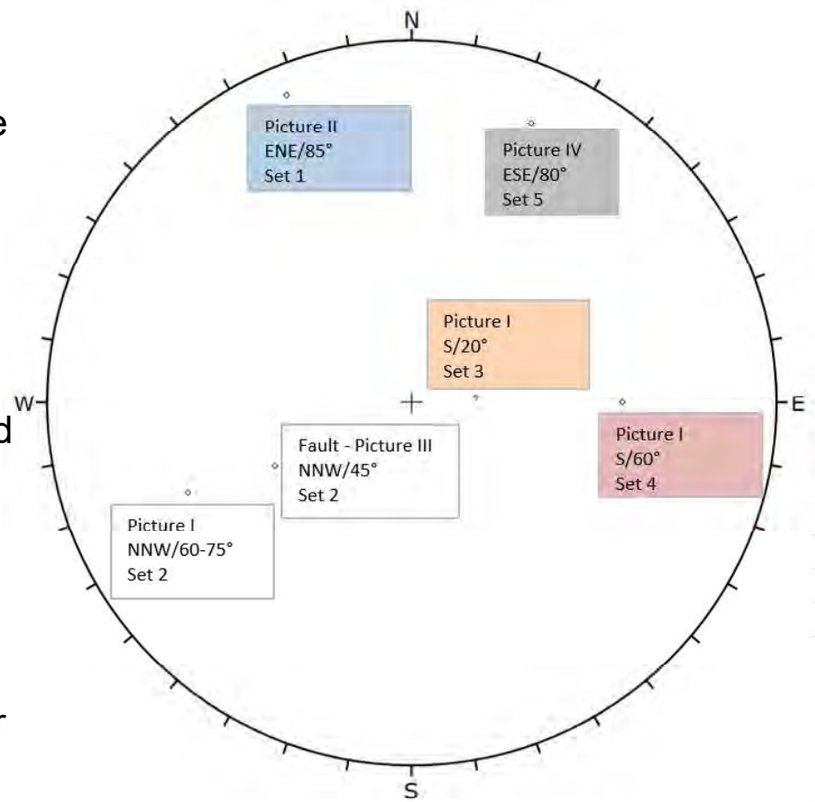
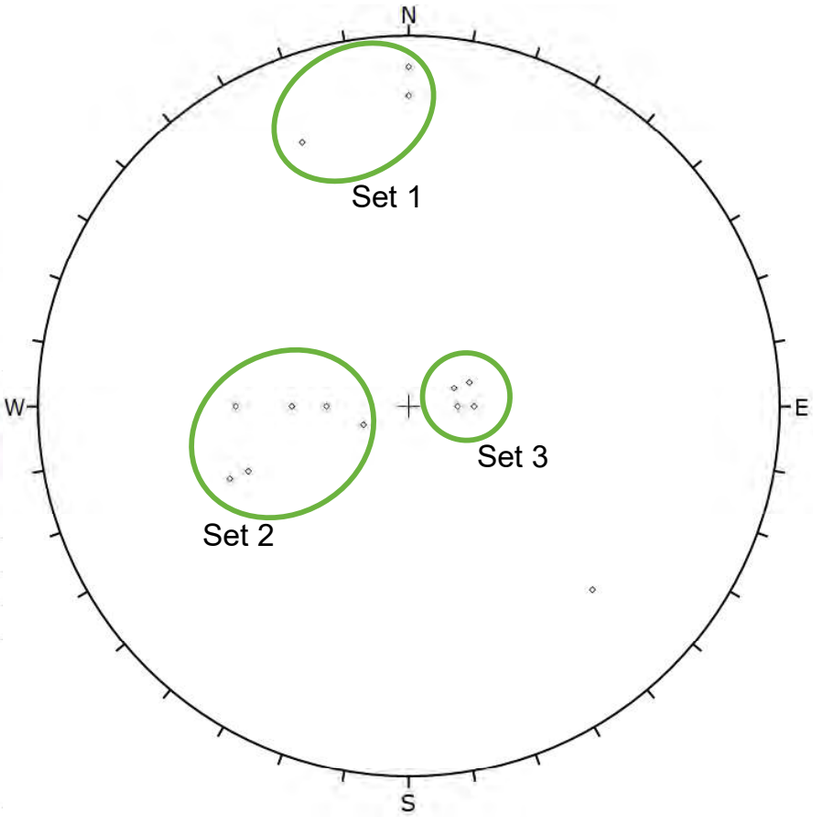


Photo Set 2



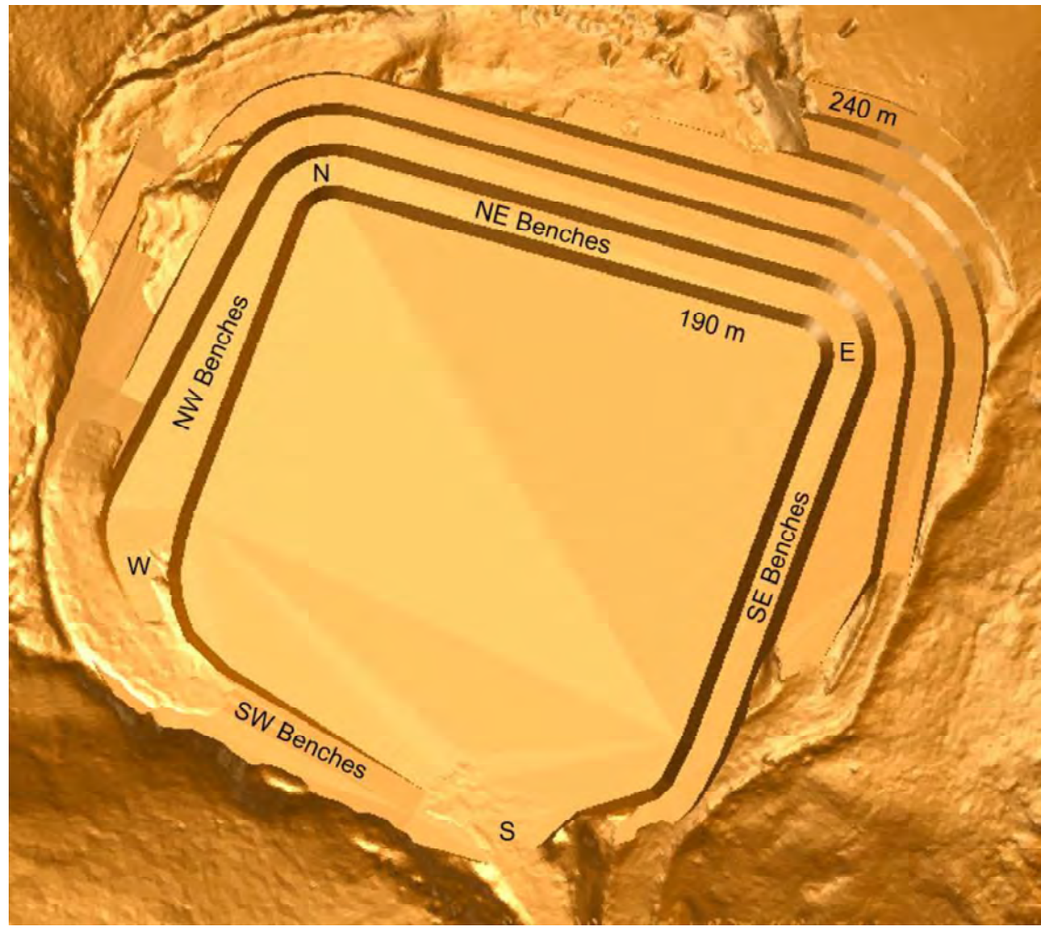
- Note that most of the current quarry walls are oriented East-West. As a result, the data set may be biased against structures oriented East-West .

Kinematic Analyses

Kinematic Analyses

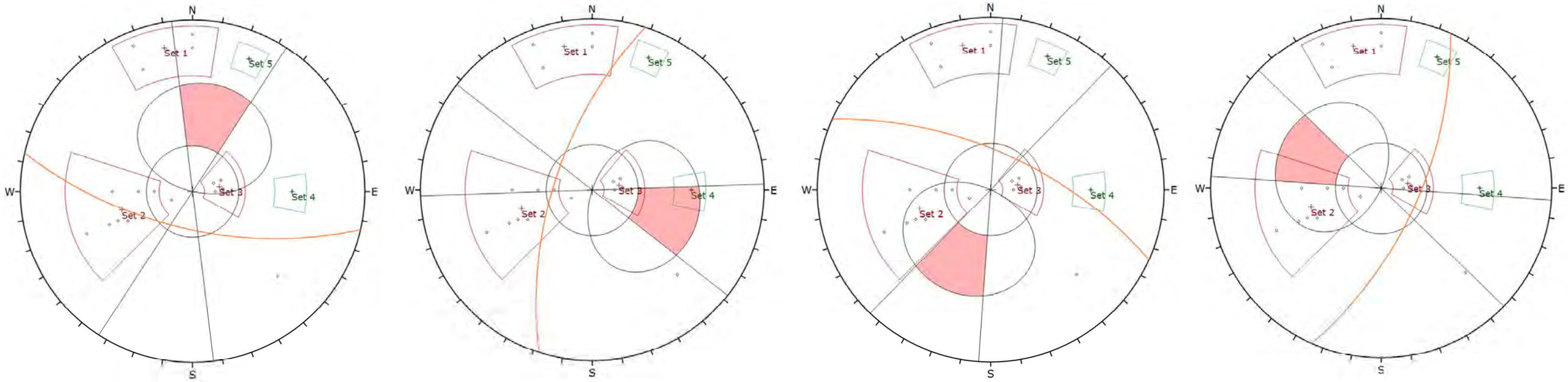
General

- Kinematic failure on rock mass structure (e.g., planar and wedge failures) is expected to be the most likely failure mode based on the observed rock mass characteristics.
- The potential for planar and wedge failures to limit the achievable slope geometry was evaluated using stereographic kinematic analyses.
- The analyses focused on the four main walls of the quarry (NW, NE, SE, SW).
- The analyses are presented on the following slides and consider the following:
  - Bench Face Angle of 65°
  - Friction angle of 30° based on the open pit feasibility study
  - Planar lateral limits of 20°



Kinematic Analyses

Planar Failure

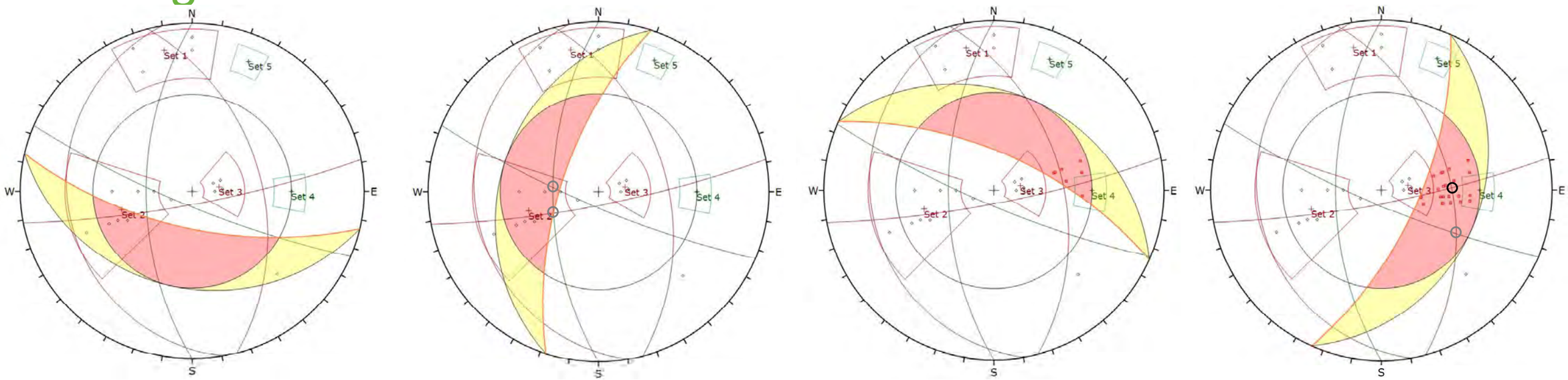


NE Wall | SE Wall | SW Wall | NW Wall

- **NE Wall:** Planar failure is not expected to limit the achievable slope geometry.
- **SE Wall and E:** Planar failure is possible on Joint Set 4 in the SE and E walls, but this is a minor set and is more likely to result in localized failures than to systematically limit the achievable slope geometry. If Joint Set 4 is more prominent than currently expected, the achievable BFA could be limited to 60°. Joint Set 3 has a dip less than the friction angle and failures are not expected on this set.
- **SW and NW Walls:** The potential for planar failure is sensitive to the strike of the wall. Failures are unlikely to occur for the average orientation of these two walls but could occur in the transition between them. This case was considered separately as the W Wall.

Kinematic Analyses

Wedge Failure



NE Wall | SE Wall | SW Wall | NW Wall

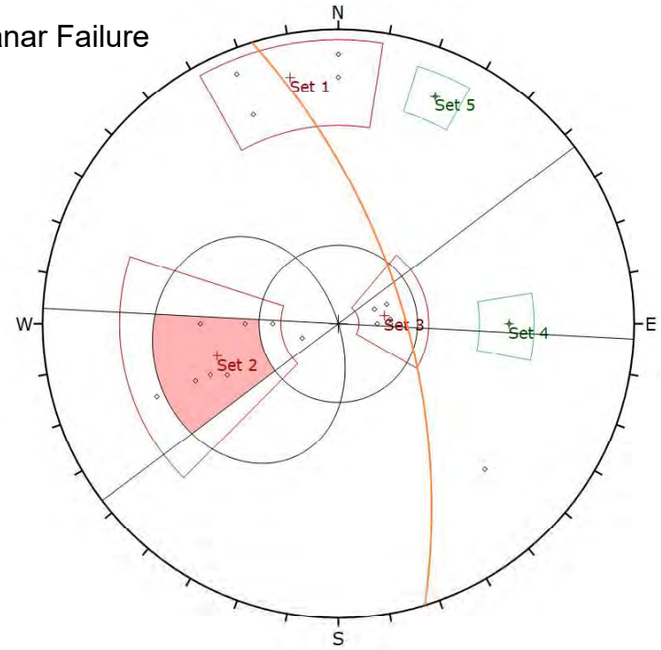
- **NE and SW Walls:** Wedge failures are not expected to limit the achievable slope geometry.
- **SE Wall:** Wedge failures formed by Joint Sets 1 and 4 could limit the achievable BFA to 65° (the planned design value). Wedge failures formed by minor Joint Sets 4 and 5 are possible but are more likely to result in localized failures than to systematically limit the achievable slope geometry. If either set is more prominent than currently expected, the achievable BFA could be limited to 60°.
- **NW Walls:** Wedge failures formed by Joint Sets 1 and 2 are expected to limit the achievable BFA to 50°. Wedge failures formed by Joint Sets 2 and 5 are possible but are more likely to result in localized failures than to systematically limit the achievable slope geometry,

Kinematic Analyses

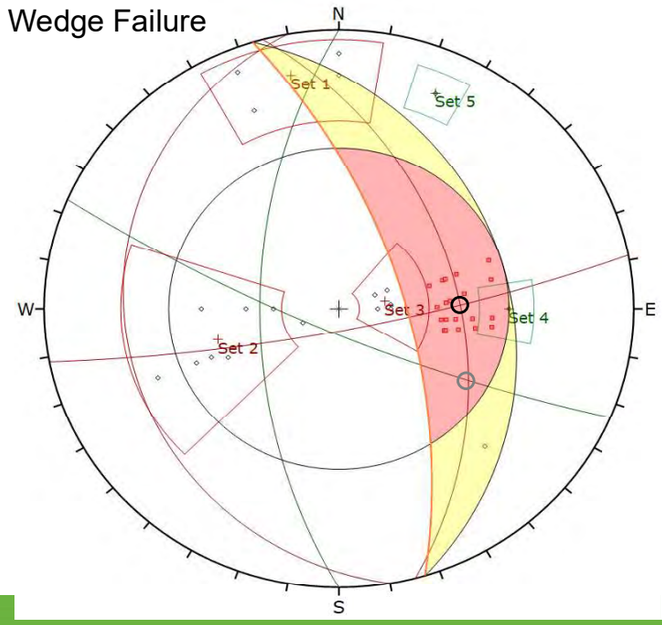
West Wall

- The kinematic analyses suggested that the results for the NW and SW Walls were sensitive to the orientation of the slope. As a result, the W Wall was also evaluated and the results are shown at right.
- Planar failures on Joint Set 2 are expected to limit the achievable BFA to 45°
- Wedge failures are also predicted on Joint Sets 1 and 2. However, this is essentially planar failure on Joint Set 2, with Joint Set 1 acting as a release plane.
- Wedge failures formed by Joint Set 2 and minor Joint Set 5 are possible and could locally limit the achievable BFA to 50°.

Planar Failure



Wedge Failure



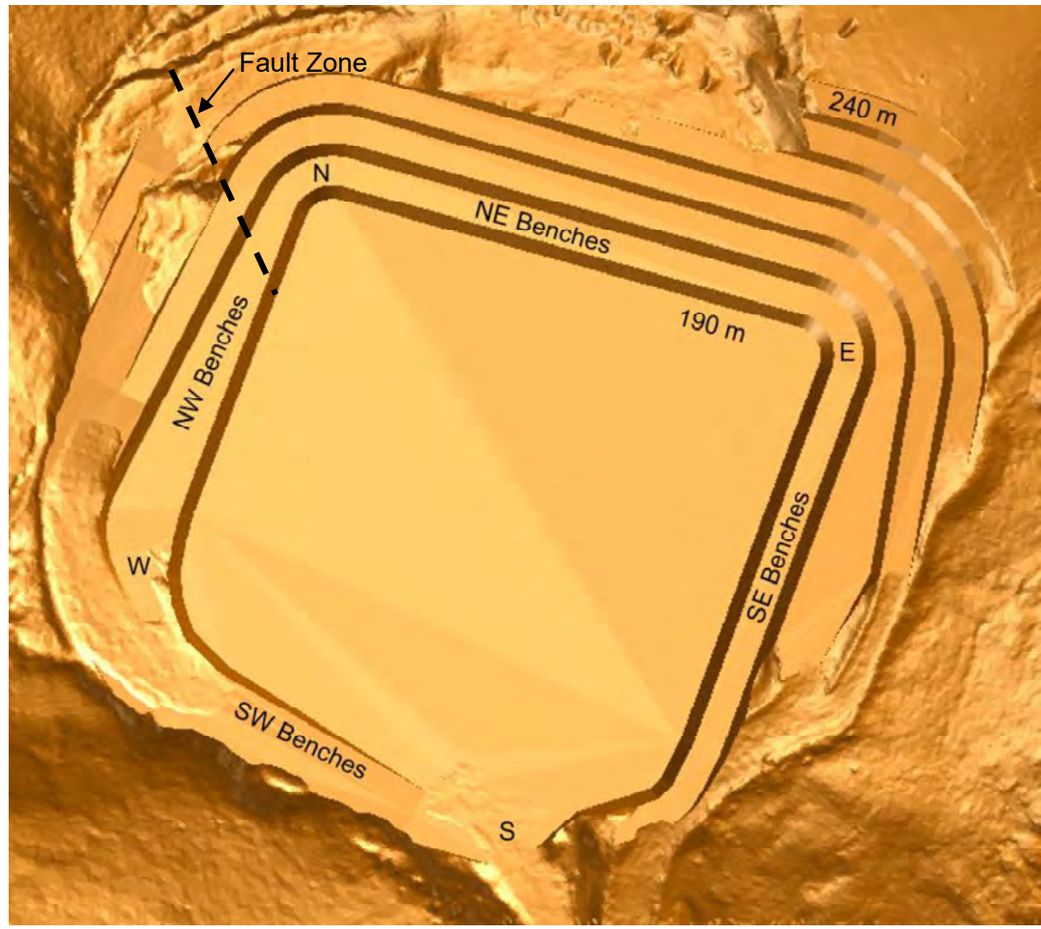
Legend

- Major Set
- Minor Set

Kinematic Analyses

Summary

- Planar failures on Joint Set 2 are expected to limit the achievable BFA to 45° in the W Wall.
- Wedge failures on Joint Sets 1 and 2 are expected to limit the achievable BFA to 50° in the NW Wall.
- The performance of the SE Wall is sensitive to the prominence of minor Joint Sets 4 and 5. Bench scale planar and wedge failures may occur and could locally limit the BFA to 60°.
- The W and NW walls are planned to be approximately two benches high. This will limit the effects of potential kinematic failures. For example, an allowance for increased back break of the crest of the bench could be easily accommodated in these wall.



Rock Fall Analysis

Rock Fall Analysis

General

- Analyses were completed using Rocscience's RocFall software to assess the capacity of the catch benches to retain rockfall.
- The analyses were based on the proposed bench geometry:
  - Bench Face Angle: 65°
  - Bench Width: 10 m
  - Bench Height: 10 m
- The analyses incorporated calibrated material properties developed during the 2021 review of the Naluujaak open pit based on a back-analysis of a rockfall that occurred within the FW Gneiss:
  - Coefficient of Normal Restitution (Rn): 0.35
  - Coefficient of Tangential Restitution (Rt): 0.85
  - Friction Angle: 30°
- An acceptance criteria of 90% retention was selected.

Rock Fall Analysis

Summary

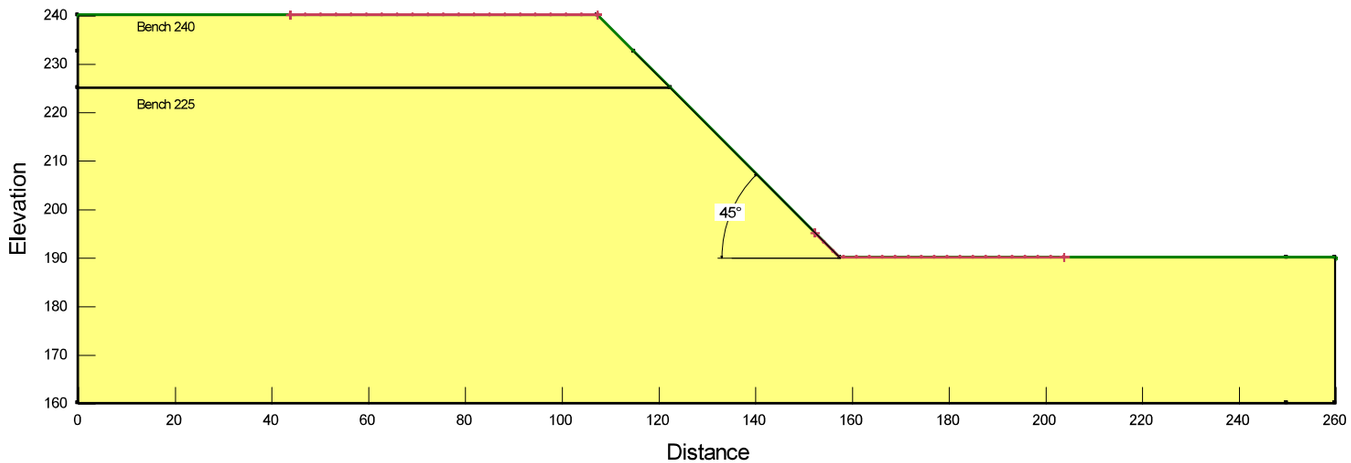
- The analyses predict that 100% of the rockfall debris will be retained on the bench immediately below a failure. This exceeds the acceptance criteria of 90% retention.

Limit Equilibrium Analysis

Limit Equilibrium Analysis

General

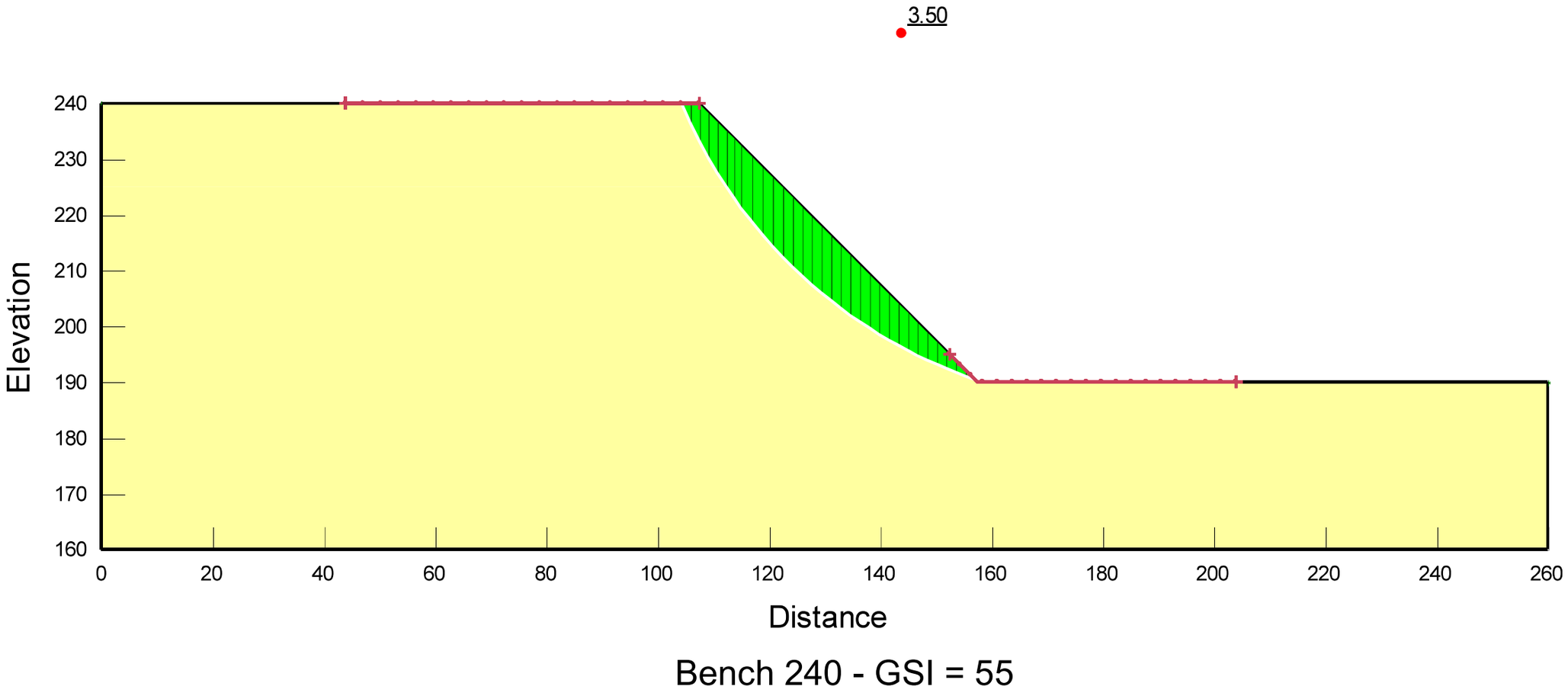
- The potential for rock mass quality to limit the achievable slope geometry was assessed with a limit equilibrium analysis performed using GeoStudio's SLOPE/W© software.
- An overall slope angle of 45° was evaluated. This angle represents a plausible maximum based on the selected bench height of 10 m, a minimum bench width of 8 m and a bench face angle of 75°.



- The current proposed quarry design has a maximum slope height of 50 m with a Crest El. of 240 m. While this may be reduced to 35 m (Crest El. of 225 m), only the full slope height was considered in the analysis.
- The GSI was varied between 55 and 70 based on the rock mass quality review. A UCS of 50 MPa, mi of 28 and unit weight of 28 kN/m^3 were used based on the design values from the open pit feasibility study.

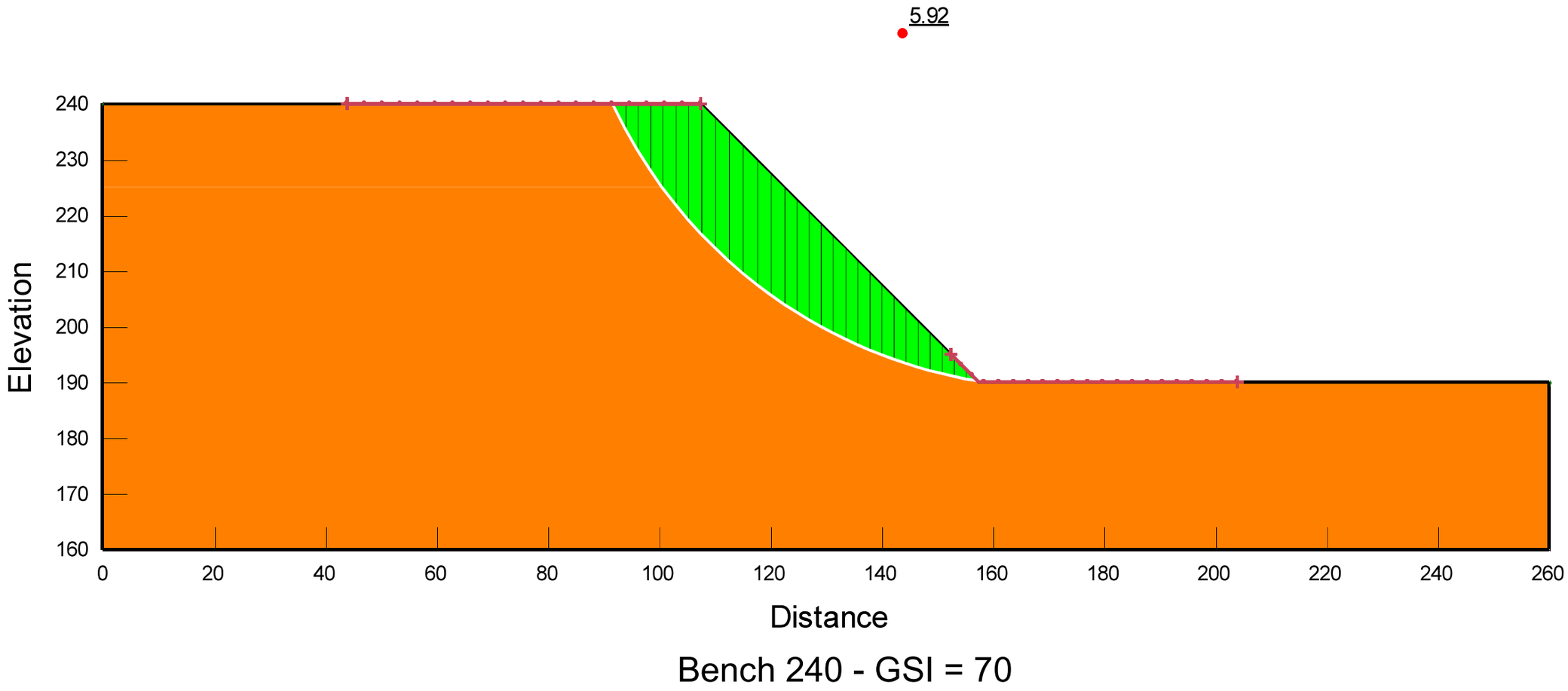
Limit Equilibrium Analysis

Model Results



Limit Equilibrium Analysis

Model Results



Limit Equilibrium Analysis

Summary

- The analyses exceed the target Factor of Safety of 1.3 for overall slope failure. The results suggest that rock mass quality is unlikely to limit the achievable bench geometry.
- The results are consistent with the limited slope height and the observed rock mass characteristics.

Summary

Summary

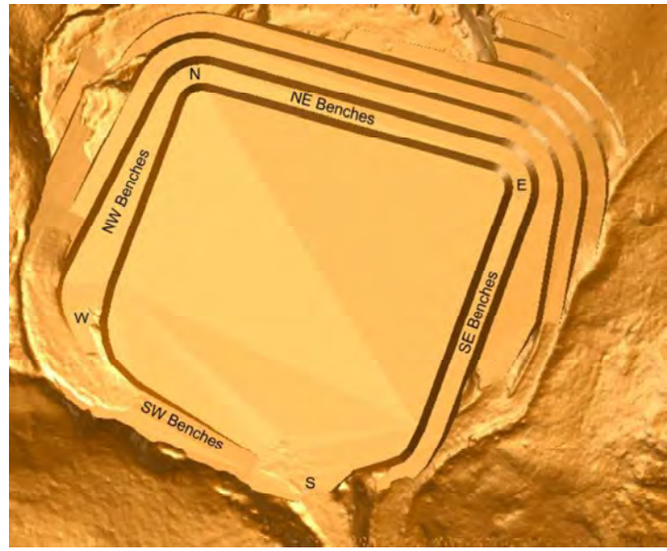
General

- The QMR2 quarry is expected to be excavated within Footwall Gneiss. The characteristics of the rock mass were assessed using a combination of photos, structural mapping completed by Baffinland and previous studies of the nearby Naluujaak Open Pit.
- Planar and Wedge kinematic failures on rock mass structure are expected to be the most likely failure mode based on the observed rock mass characteristics and the limited planned depth of the quarry.
- Kinematic analyses suggest that:
  - Planar failures on major Joint Set 2 will likely limit the achievable BFA to 45° in the W Wall.
  - Wedge failures on major Joint Sets 1 and 2 will likely limit the achievable BFA to 50° in the NW Wall.
  - The performance of the SE Wall is sensitive to the prominence of minor Joint Sets 4 and 5. Bench scale planar and wedge failures may occur and could locally limit the BFA to 60°.
- Limit equilibrium analyses suggest that rock mass quality is unlikely to limit the achievable slope geometry.
- Rockfall analyses suggest that at least 90% of the failed material from a rockfall event will be retained on the first bench below the failure.

Summary

Recommendations

- Slope recommendations for the quarry are summarized below.
- The base case design is expected to be achievable for the NE, SE and SW walls.
- Increased bench width is recommended for the W and NW walls to accommodate bench scale kinematic failures.



Wall	BFA (°)	Expected Back-Break Angle (°)	Bench Width (m)	Bench Height (m)	IRA (°)
NE	65	-	10	10	34
SE	65	65	10	10	34
SW	65	-	10	10	34
W	65	45	14	10	28
NW	65	50	12	10	31