Attachment 8.2

North Railway Factual Geotechnical Report

(676 Pages)

Baffinland Iron Mines Corporation
Mary River Expansion Project

2016-2017-2018 Rail Geotechnical Investigation Factual Data Report

2018-10-05	2	Approved for Use	M Yang	W Hoyle	D Stanger	F Pittman
2018-09-11	1	Approved for Use	M Yang	W Hoyle	D Stanger	R Stefan
2018-05-22	0	Approved for Use	H Ghiabi	W Hoyle	D Stanger	R Stefan
Date	**Rev.**	**Status**	**Prepared By**	**Checked By**	**Approved By**	**Approved By**
HATCH						**Client**

Document Number Explanation

This report was issued for client review as Rev. B on March 13th, 2018 under the following document number: H352034-1000-229-230-0005. Subsequently, there are 2 additional boreholes drilled at each of the three proposed bridges at KM 16, KM 71, and KM 102 in addition to the 3 boreholes drilled for the proposed bridge at KM 86 presented in revision 1. As a result of this additional information, the document number was revised to H353004-10000-229-230-0005. Although the current project number (H353004) was used to report the new data (borehole reports, test reports, etc.), the former project number (H352034) is still shown on the borehole reports/data sheets from previous investigations.

DISCLAIMER

This Report has been prepared by Hatch Ltd. ("Hatch") for the sole and exclusive benefit of Baffinland Iron Mines Corporation (the "Client") for the sole purpose of assisting the Client to identify potential options to increase production from the Mary River mine, and may not be provided to, used or relied upon by any other party without the prior written consent of Hatch.

Any use of this report by the Client is subject to the terms and conditions provided in the ArcelorMittal General Service Agreement, dated November 14, 2014, including the limitations on liability set out therein. Without limiting the foregoing, Hatch explicitly disclaims all responsibility for losses, claims, expenses or damages, if any, suffered by a third party as a result of any reliance on this Report, including for any decisions made or actions made by such a third party and based on this Report ("Claims"), and such third party's use or review of the Report shall constitute its agreement to waive all such Claims and release Hatch in respect thereof.

This report is meant to be read, and sections should not be read or relied upon out of context. While it is believed that the information contained herein is reliable under the conditions and subject to the limitations set forth herein, this Report is based in part on information not within the control of Hatch and Hatch therefore cannot and does not guarantee the accuracy of such information based in whole or in part on information not within the control of Hatch. The comments in it reflect Hatch's professional judgment in light of the information available to it at the time of preparation.

This report contains the expression of the professional opinion of Hatch exercising reasonable care, skill and judgment and based upon information available at the time of preparation. Hatch has conducted this investigation in accordance with the methodology outlined herein. It is important to note that the methods of evaluation employed, while aimed at minimizing the risk of unidentified problems, cannot guarantee their absence. The quality of the information, conclusions and estimates contained herein is consistent with the intended level of accuracy as set out in this report, as well as the circumstances and constraints under which this report was prepared.

Client's Signature:

Name:

Title:

Date:

Table of Contents

List of Tables

List of Figures

List of Appendices

1. Introduction

Baffinland Iron Mines Corporation (BIM) currently operates the Mary River iron ore mine in Nunavut, Canada. BIM plans to increase the production to 12 Mtpa, shipping the output through Milne Port. This will be achieved by upgrading the mine fleet, constructing an approximately 110 km long rail line from the mine site to the port, building a new crushing and screening facility at the port, construction of larger ore stockpiles and building a second ore dock for ship loading.

Hatch Ltd. (Hatch) was retained by BIM to conduct geotechnical drilling investigations for the design of a railway alignment spanning from Milne Port to the Mine Site. The drilling program included three phases; the first phase was executed from September 28 to December 14, 2016, the second phase was executed between April 9, 2017 and May 2, 2017, and the third phase was executed between March 2, 2018 and April 19, 2018.

This report presents (i) sonic borehole data including the visual observations and laboratory test results for particle size distribution and soil behaviour type and (ii) geophysics data including ground-penetrating radar and refractive seismic lines. In addition, sample photographs are appended providing visual records of soil cores.

1.1 Previous Investigations

Geotechnical investigation programs have previously been conducted at the Mary River mine site, Steensby Inlet port structure, the Milne Inlet port site, the Tote Road from the mine site to Milne Port site, along a proposed southern railway alignment from Mary River and Steensby Inlet, as well as offshore investigations at Milne Port.

These previous programs were conducted in 2006, 2007, and 2008 by Knight Piésold Consulting Ltd. (Knight Piésold), in 2010 by AMEC Earth and Environmental (AMEC), and in 2011 and 2013 by Hatch. Select information from those investigations has been incorporated in this report.

1.2 Local Topology and Geology

The approximately 110 km proposed rail line starts at Milne Port (Km 0) and passes through approximately 20 km of Precambrian bedrock terrain, glaciofluvial sand and gravel terraces. Further south, the rail alignment spans across a relatively flat lying ground comprising fine grained glacial till veneer overlying Paleozoic rocks mainly dolomitic limestone units for approximately 60 km. The final stretch of the rail alignment traverses glaciolacustrine and glaciofluvial plains, terraces, eskers and bedrock outcrops ranging from granitic gneiss to sedimentary rocks. For detailed maps showing the geology along the rail alignment please refer to the Site Assessment of North Railway Alignment Report (H352034-1000-220-068-0001).

2. Geotechnical Investigation

2.1 General

The drilling supervision, field core logging and sampling associated with the railway drilling program was carried out by Hatch. Boart Longyear Ltd. (Boart Longyear) was selected as the drilling contractor. The field program was divided into three phases, the first phase (2016 investigation) was executed from September 28 to December 14, 2016, the second phase (2017 investigation) was executed between April 9 to May 2, 2017, and the third phase (2018 investigation) was executed between March 2, 2018 and April 19, 2018.

A total of 98 boreholes were drilled during the 2016 geotechnical investigation program, ranging from a depth of 1.5 m to 30 m. There were 81 boreholes drilled along the proposed rail alignment, 12 boreholes drilled at the proposed bridge abutments, and 5 boreholes drilled at the proposed quarry locations. These boreholes excluded the ones associated with Milne Port infrastructure.

A total of 14 boreholes were drilled during the early 2017 geotechnical investigation program ranging from a depth of 4.6 m to 25.9 m. Out of these 14 boreholes, 12 boreholes were drilled along the proposed rail alignment, and 2 boreholes were drilled at the proposed bridge abutments.

A total of 3 additional boreholes (BH17-BR86-1, -2, -3) were drilled at the Bridge at Km 86 location during the late 2017 geotechnical investigation program. The boreholes were drilled to a final depth of 39.6 m each.

A total of 6 boreholes were drilled during the 2018 geotechnical investigation program at three proposed bridge abutment locations, excluding boreholes associated with Milne Port Infrastructure. The depths of the boreholes ranged from 11.5 m to 32.5 m.

These boreholes provide data regarding overburden depth, soil type, ground ice and type of bedrock. Approximately 600 samples were collected on site and shipped to the Hatch geotechnical laboratory in Niagara Falls. Representative samples were selected for further laboratory testing.

As part of the 2017 and 2018 drilling program, geophysics work was undertaken along the rail alignment which included refractive seismic surveys and ground-penetrating radar. The geophysics work was undertaken by GPR Geophysics Inc. (GPR Inc.) while field supervision was provided by Hatch.

The focus of this report is the rail alignment portion of the investigation, which includes the boreholes that were drilled along the rail alignment, the bridge abutments and proposed quarry sites, and results from the geophysics surveys that were performed along the rail alignment.

2.2 Borehole Locations

A summary of the as-drilled borehole locations for the rail alignment, bridge abutments and potential quarries is presented in Table 2-1 through Table 2-3. All coordinates are located within Zone 17 of the Universal Transverse Mercator (UTM) Grid. The coordinates were recorded using a hand-held GPS unit. The horizontal datum for this project is the North American Datum 1983 (NAD 83).

The prefix BH represents Borehole, while 16, 17 and 18 refers to 2016, 2017, and 2018, the year of the investigation. The first letter following the dash symbol (-) categorizes the borehole location as Rail in Fill Sections (R), Rail in Cut sections (C), Bridge Abutment (B) or Quarry (Q).

The borehole locations are provided on the Borehole Location Plan, provided in Appendix A.

Table 2-1: Rail Alignment Borehole Locations

Borehole Number	Easting (m)	Northing (m)	Depth (m)
BH16-R003	504,513	7,975,552	5.5
BH16-R004	507,259	7,970,638	4.5
BH16-R005	509,249	7,968,499	4.5
BH16-R006	508,438	7,969,804	2.9
BH16-R007	510,940	7,967,349	4.5
BH16-R008	512,763	7,966,604	4.5
BH16-R009	514,366	7,965,535	4.5
BH16-R010	515,332	7,963,810	4.5
BH16-R011	516,719	7,962,461	4.0
BH16-R012	516,716	7,962,464	4.0
BH16-R013	518,856	7,959,178	4.0
BH16-R014	519,701	7,957,349	4.5
BH16-R015	520,756	7,955,701	4.5
BH16-R016	521,588	7,953,865	4.5
BH16-R017	521,737	7,952,929	4.5
BH16-R018	521,854	7,951,940	4.5
BH16-R019	521,994	7,950,962	4.5
BH16-R020	521,842	7,949,969	4.5
BH16-R021	521,784	7,948,976	4.5
BH16-R022	522,305	7,948,153	4.5
BH16-R023	522,505	7,947,177	4.0
BH16-R024	522,558	7,946,129	4.5
BH16-R025	522,989	7,945,094	4.5
BH16-R026	523,165	7,944,366	4.5
BH16-R027	523,442	7,942,265	4.5
BH16-R028	524,061	7,940,538	3.6
BH16-R029	525,062	7,938,851	3.0
BH16-R030	525,291	7,937,897	3.6
BH16-R032	525,991	7,936,109	2.7
BH16-R033	526,653	7,935,439	4.2
BH16-R034	527,056	7,933,500	4.5
BH16-R035	527,423	7,932,310	4.5
BH16-R036	527,210	7,931,660	4.5
BH16-R037	527,873	7,929,786	4.5

Borehole Number	Easting (m)	Northing (m)	Depth (m)
BH16-R038	528,501	7,928,421	4.5
BH16-R039	528,666	7,927,955	4.5
BH16-R040	528,686	7,927,755	4.5
BH16-R041	528,605	7,927,754	1.5
BH16-R042	528,517	7,927,713	4.5
BH16-R043	528,428	7,927,675	9.0
BH16-R044	528,736	7,926,992	4.5
BH16-R045	528,961	7,926,756	4.5
BH16-R046	529,065	7,926,599	4.6
BH16-R053	528,238	7,928,027	6.1
BH16-R067	535,406	7,918,572	4.6
BH16-R068	537,046	7,919,096	4.6
BH16-R069	539,489	7,920,583	4.6
BH16-R070	540,273	7,921,201	4.6
BH16-C006	508,897	7,968,767	3
BH16-C007	517,221	7,962,080	7.6
BH16-C008	520,080	7,956,909	13.7
BH16-C009	522,032	7,948,728	9.1
BH16-C010	522,513	7,946,595	5.5
BH16-C011	525,427	7,937,567	10.6
BH16-C012	526,569	7,935,536	4.6
BH16-C015	536,142	7,918,691	7.6
BH16-C016	536,362	7,918,814	7.6
BH16-C017	538,597	7,919,724	6.1
BH16-C018	546,111	7,920,740	6.1
BH16-C019	546,163	7,920,494	4.5
BH16-C019B	546,214	7,920,455	6
BH16-C020	546,402	7,920,072	10
BH16-C021	546,593	7,919,917	9
BH16-C022	547,077	7,919,746	9.1
BH16-C023	547,304	7,919,643	10.7
BH16-C024	547,530	7,919,537	10.7
BH16-C025	548,370	7,919,181	7.6
BH16-C026	550,262	7,918,123	10.7
BH16-C027	550,416	7,917,928	12.2
BH16-C028	551,403	7,916,768	11.6
BH16-C029	552,569	7,915,813	7.6
BH16-C030	555,337	7,915,646	12.2
BH16-C031	556,864	7,915,216	1.5
BH16-C032	557,282	7,915,265	9.1
BH16-C201	553,750	7,915,276	2.4
BH16-C202	554,531	7,915,452	7.6
BH16-C203	555,007	7,915,451	9.1
BH16-C204	555,659	7,915,432	2.7
BH16-C205	555,883	7,915,449	8.5
BH16-C206	556,059	7,915,442	9.1
BH16-C207	556,679	7,915,415	7.3
BH17-C001	509,861	7,967,883	9.1
BH17-C002	519,513	7,957,644	10.7
BH17-C003	520,091	7,957,302	9.1
BH17-C004	520,484	7,956,357	10.7
BH17-C005	525,227	7,938,527	9.1

Borehole Number	Easting (m)	Northing (m)	Depth (m)
BH17-C006	527,370	7,932,609	10.7
BH17-C006B	528,253	7,929,081	6.1
BH17-C007	528,564	7,917,138	4.6
BH17-C010	529,961	7,916,702	5.5
BH17-C011	532,072	7,917,478	10.6
BH17-C012	533,228	7,918,553	4.6
BH17-C013	534,196	7,918,569	7.6

Table 2-2: Bridge Abutment Borehole Locations

Borehole Number	Easting (m)	Northing (m)	Depth (m)
BH16-B001	514,191	7,965,675	11.5
BH16-B002	514,290	7,965,604	13.7
BH16-B003	514,357	7,965,533	16.8
BH16-B004	514,367	7,965,540	16.8
BH16-B009	542,204	7,922,291	27.4
BH16-B010	542,208	7,922,304	14.0
BH16-B011	542,365	7,922,121	10.7
BH16-B012	542,376	7,922,131	9.1
BH16-B013	555,619	7,914,671	10.7
BH16-B014	555,599	7,914,683	9.1
BH16-B015	555,824	7,914,884	13.6
BH16-B016	555,830	7,914,892	7.6
BH17-B001	529,031	7,916,747	16.5
BH17-B002	529,323	7,916,577	25.6
BH17-BR86-1	542,257	7,922,182	39.6
BH17-BR86-2	542,269	7,922,172	39.6
BH17-BR86-3	542,304	7,922,142	39.6
BH18-BR15-1	555,758	7,915,441	17.4
BH18-BR15-2	514,211	7,965,645	16.8
BH18-BR70-1	529,143	7,916,680	32.5
BH18-BR70-2	529,107	7,916,700	28.5
BH18-BR102-1	555,758	7,915,441	11.5
BH18-BR102-2	555,697	7,915,443	16.9

Table 2-3: Quarry Borehole Locations

Borehole Number	Easting (m)	Northing (m)	Depth (m)
BH16-Q001	505,308	7,972,797	4.5
BH16-Q7001	529,144	7,927,494	5.0
BH16-Q7002	530,561	7,928,150	6.9
BH16-Q7003	531,053	7,929,065	9.1
BH16-Q7004	529,264	7,927,466	10.6

2.3 Drilling and Sampling Methodology

The geotechnical boreholes were drilled using a BL100 Mini Sonic Drilling rig shown below in Figure 1; manufactured and operated by Boart Longyear. The boreholes were advanced by vibration of the drill string at a high frequency in addition to rotary motion, and pressure by the drilling head. Sonic drilling does not require water at shallow depths in the overburden, and casing was not used for drilling through overburden. Figure 2 shows the equipment used for off road transport of personnel and survival shack during the 2017 and 2018 investigations. Other major equipment included generator sets, welding unit, frost fighters and pickup trucks.

Figure 1: Drilling Rig Setup on a Borehole

Figure 2: Survival Shack and Off-Road Transport

When using sonic drilling in overburden, a 3 m drilling rod was advanced 1.5 m into the ground for each run. The bottom 1.5 m was collected into a 4 inch split PVC pipe as shown in Figure 2. Soil collected above the bottom 1.5 m, if encountered, was disposed to ensure the collected sample was not contaminated by surface soil “fall in” accumulated at the bottom of the drilled hole. Soil sample were photographed in the PVC split. Once the material in the split was photographed and sampled, the splits were secured using caps and aluminum tape, and stored in a shipping container at the Milne Port site.

Bedrock was cored using a HQ-3 triple tube wireline core barrel, which required the use of water and casing. In addition, rock coring required the installation of a high-speed rotary head on the drilling rig every time there was a switch from sonic drilling in soil to rock coring.

The Hatch field supervisor documented the materials encountered, and determined in situ testing and sampling requirements. When ice was encountered in the borehole, it was documented and classified according to ASTM D4083. The description of soils as detailed in the geotechnical borehole reports are based on field visual classification and confirmatory laboratory testing in accordance with the explanatory notes included with these reports.

The detailed geotechnical borehole drilling reports are contained in the attached Appendix B and should be referenced for a complete description of soil materials and the in situ testing and sampling performed. Appendix B also contains a set of explanatory notes detailing terminology used in the borehole reports. Additional observations such as testing and sampling procedures, percent recovery, water loss/gain, and mechanical heating of samples were recorded, along with time of observation. Photographs of samples collected during the drilling investigation are contained in Appendix C. An example of a retrieved sample is shown in Figure 3.

Figure 3: Sample Collected in a PVC Split Using a Mini Sonic Drilling Rig

2.4 Safety Management Plan

Safety management was a key consideration during the planning process for the geotechnical investigations. A safety management plan was prepared by Hatch and reviewed by BIM and Boart Longyear. A copy of this Plan is provided in Appendix I. A Job Hazard Analysis (JHA) was developed by Hatch and BIM and reviewed by Boart Longyear. This JHA was reviewed periodically and updated according to the work activities. A notification procedure was prepared by BIM specifically for the drilling activities in remote areas. A copy of both the final JHA and the notification procedure is presented in Appendix I.

2.5 Laboratory Testing

2.5.1 Soil Testing

All samples were shipped to the Hatch geotechnical laboratory in Niagara Falls, a Canadian Council of Independent Laboratories (CCIL) certified laboratory (see Appendix G for the certification document). Representative samples were selected for testing including moisture content, particle size distribution, and pore water salinity in accordance with the standard listed in Table 2-4. Full laboratory test results are presented in Appendix D and laboratory results are summarized in Appendix F. Select laboratory results are also shown on the boreholes in Appendix B.

Table 2-4: Standards Used for the 2016, 2017, and 2018 Geotechnical Investigation

2

Name	Standard
Standard Test methods for Laboratory Determination of Water Content of Soil and Rock by Mass	ASTM D2216
Standard Test Methods for Particle-Size Distribution of Soils using Sieve Analysis	ASTM D6913
Standard Test method for Particle Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis	ASTM D7928
Standard Test Methods for Pore Water Extraction and Determination of the Soluble Salt Content of Soils by Refractometer	ASTM D4542

2.5.2 Rock Testing

The physical testing of bedrock core and rock samples was completed by Amec Foster Wheeler PLC laboratory in Hamilton, Ontario (CCIL certification is shown in Appendix G). Rock testing was completed following the procedures in the Standards listed in Table 2-5.

Table 2-5: Standards for Testing of Coarse Aggregate

Name	Standard
Standard Test Method for Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus	ASTM D6928
Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates	ASTM C136/C136M
Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate	ASTM D7172
Resistance of Unconfined Coarse Aggregate to Freezing and Thawing	ASTM D4992

Samples were collected on site for the granitic gneiss, dolomitic limestone and diabase rock types. Four of the samples were collected for physical testing at the laboratory. The rock type, sample collection method and location of the four tested samples are presented in Table 2-6.

Table 2-6: Rock Type and Location of The Tested Samples

Borehole No.	Laboratory Sample No.	Depth Range (m)	UTM Coordinates		Rock Type	Sample Type
			Easting	Northing		
BH16-Q7004	*NF17-01*	4.6-7.6	529,264	7,927,466	Upper Limestone	Core
BH16-Q7004	*NF17-02*	7.6-10.6	529,264	7,927,466	Lower Limestone	Core
BH16-M007(1)	*NF17-03*	6.1-9.1	503,822	7,974,945	Granitic Gneiss	Core
Lump Sample	*NF17-04*	From Surface	547,599	7,921,210	Diabase	Grabbed Sample

(1) The report for this borehole is presented in Appendix B.

2.6 Geophysics

GPR Inc. was contracted to undertake a Ground Penetrating Radar (GPR) survey to assess the extent of ground ice in areas that were identified (i) as ice rich or (ii) to have large ice bodies in the 2016, 2017, and 2018 drilling investigation. The survey required towing of a GPR unit (Figure 4) in a line over the area to be surveyed. Readings were recorded using a handheld output device, which can be seen in Figure 5. A detailed description of the GPR survey technique can be found in Appendix J.

Figure 4: Ground Penetrating Radar Survey Unit

Figure 5: GPR Survey in Progress

Seismic refraction testing was carried out to estimate bedrock depth in areas not accessible by a track mounted drilling rig. A wave was generated by vertically striking a striker plate with a sledgehammer. A line of geophones connected to a data acquisition system was used to record seismic data, shown in Figure 6. A detailed description of the seismic refraction testing can be found in Appendix J.

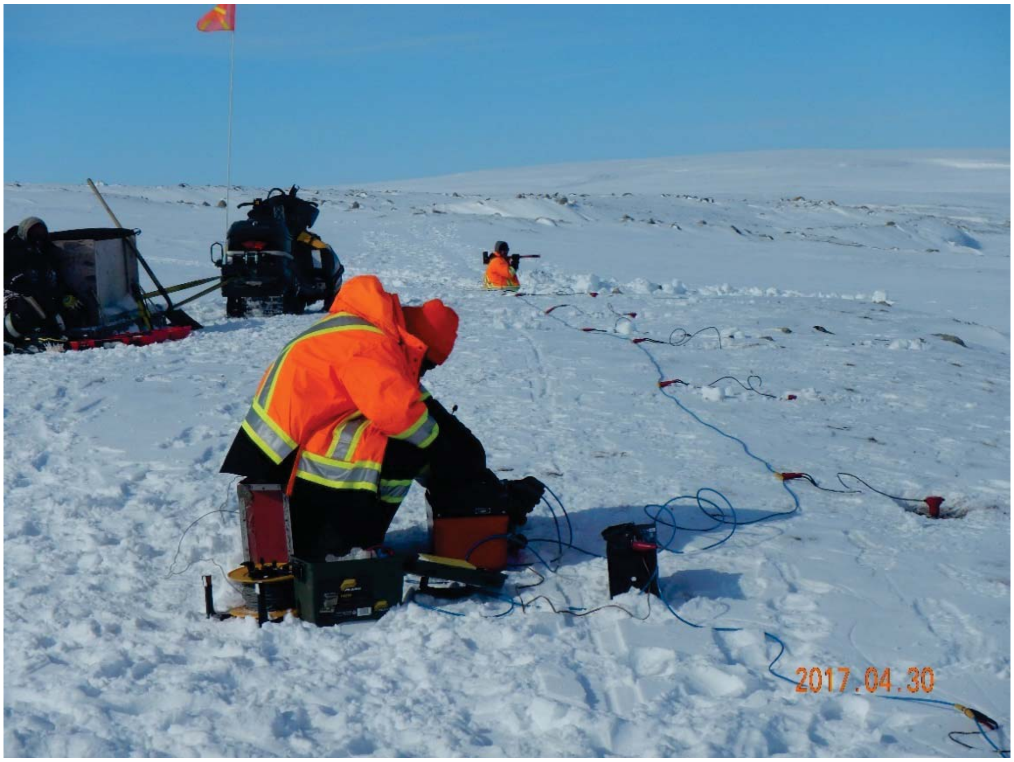


Figure 6: Setup for Seismic Refraction

3. Investigation Results

The sections below include a brief summary of the investigation results. The results of the borehole investigations are presented along the alignment from the Milne Port to the mine site. The boreholes at the bridges and quarry sites are discussed separately.

3.1 Rail Alignment

The following sections contain a summary of the investigation results along the rail alignment grouped by chainage. These observations are a generalization of the borehole findings and the full borehole logs should be consulted to appreciate the full variability of the overburden and bedrock conditions along the alignment. Due to the length of the alignment the investigations are only representative of the conditions in their location and variability may occur between the investigations which have not been considered.

3.1.1 Chainage 0+000 m to 54+000 m

Overburden in this sections of the rail alignment typically consists of sand with silt and/or gravel as secondary components. Layers of gravel or cobbles were encountered in several boreholes in this section. Coarse grain material was often subrounded to rounded, indicating a possible glaciofluvial origin. Layers of coarse grained subangular to angular soil was also encountered and were the most common soil encountered where the rail alignment deviated from the Phillips Creek. Large ice lenses were encountered in BH16-C008, BH16-C011 and BH17-C002. These are discussed in more detail in Section 3.6.

Granitic gneiss bedrock outcrops were noted in the investigation area along the first 24 km of the alignment. A typical example of a granitic gneiss outcropping is presented in Figure 7.

Figure 7: Typical Granitic Gneiss Bedrock Outcrop

3.1.2 Chainage 54+000 m to 58+000 m

Boreholes between approximately Chainage 54+000 m and 58+000 m intersected sand or sand with silt from the surface to termination depths, and bedrock was not reached in any of these investigations. An example of the material encountered in this section of the alignment is presented in Figure 8.

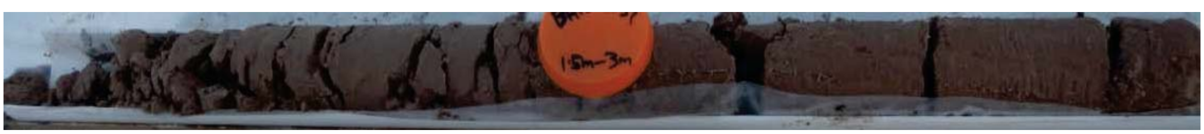


Figure 8: Typical Sand Encountered in Boreholes Located between Chainage km 54 and km 58 (BH16-R037)

Dolomitic limestone bedrock outcrops were also noted until km 58. A typical dolomitic limestone outcrop is shown in Figure 9.

Figure 9: Typical Dolomitic Limestone Outcrop

3.1.3 Chainage 58+000 m to 70+000 m

No boreholes were drilled in this section of the alignment as part of the 2016-17 investigations due to a lack of access to the borehole locations and weather related constraints. Please see Geophysics surveys SL17-D1 through SL17-D7, in Appendix J, for seismic refraction results from this section of the proposed rail alignment.

3.1.4 Chainage 70+000 m to 100+000 m

Typical overburden along this section of the alignment was found to vary from sand to silt and sand, an example is shown in Figure 10. Much of this section of the alignment is mapped as glaciolacustrine or glaciofluvial in origin, which matches the observed materials. Ice lenses were encountered in several boreholes including a 4.6 m thick ice body encountered in BH16-C023 near km 93 of the rail alignment.

Figure 10: Typical Soil Encountered between Chainage 78+000 m and 90+000 m (BH16-C016)

3.1.5 Chainage 100+000 m to Terminus

Boreholes in the remaining section of the alignment, intersected materials ranging from silty sand to sand and gravel. These materials often were intersected within the same borehole. This section generally consists of either a thin veneer of sand and gravel (glacial fluvial) overlying granitic bedrock or exposed granitic rock. Inferred bedrock was encountered in all of the investigations in this section. The bedrock in this area is mapped as sedimentary rocks including dolomitic sandstone and undifferentiated gneiss.

3.2 Proposed Bridge Locations

Drilling was completed at four bridge locations along the rail alignment. The bridge abutment boreholes for bridges 1, 3 and 4 were completed during the 2016, and 2018 investigation; and the bridge 2 boreholes were completed as part of the early 2017 investigation. Three additional holes were drilled for Bridge 3 (KM 86) as part of the geotechnical program completed in late 2017. The approximate chainage for the bridges are as follows: 2

- Bridge 1: 16+000 m
- Bridge 2: 71+000 m
- Bridge 3: 86+000 m
- Bridge 4: 103+000 m.

3.2.1 Bridge 1

Investigations for the Bridge 1 abutments (BH16-B001 to B004, and BH18-BR15-1 and BH18-BR-15-2) encountered primarily sand and silt. Boulders or cobbles were intersected in all investigations, up to 1.5 m thick in BH16-B001. Bedrock, consisting of granitic gneiss, was reached at depths of 10.7 m and 10.2 m for boreholes BH18-BR15-1 and BH18-BR15-2 respectively. Ice lenses were intersected in three of the four boreholes completed in 2016, up to 3 m thick in BH16-B001.

3.2.2 Bridge 2

The investigations at both abutments of Bridge 2 generally encountered silty, silty sand or sand. A layer of silt with high organic content was encountered between 3.0 and 6.1 m depth in BH17-B002 at the proposed east abutment. An ice layer was encountered from 9.1 m to 10.6 m in BH18-BR70-1. Drilling refusal occurred at a depth of 16.5 m at BH17-B001 and at 25.6 m in BH17-B002. Siltstone to dolomitic limestone bedrock was encountered at depths of 22.9 m and 17.1 m for boreholes BH18-BR70-1 and BH18-BR70-2 respectively.

3.2.3 Bridge 3

Overburden materials encountered at the Bridge 3 abutments generally consisted of well bonded frozen sand. Sand and gravel and silty sand layers were observed in some of the boreholes. BH17-BR86-1, BH17-BR86-2 and BH17-BR86-3 were advanced to a target depth of 39.6 m. A 1m thick layer of ice was encountered from 5 m to 6 m deep at BH17-BR86-1. None of the boreholes drilled at the Bridge at km 86 abutments reach bedrock.

3.2.4 Bridge 4

The investigations at both abutments of Bridge 4 generally encountered gravel or sand and gravel. The bedrock was outcropped at the surface at the both edges of the river and dips below the surface moving away from the bridge abutments. Granitic gneiss bedrock was encountered at depths of 1.3 m and 9.7 m for boreholes BH18-102-1 and BH18-BR102-2 respectively.

3.3 Proposed Quarry Boreholes

Most quarry location boreholes were not drilled in the 2016 investigation due to weather constraints and challenges associated with access to their locations; however, following several attempts representative samples of the limestone were recovered approximately 3 km east of the rail alignment at Chainage 58+000 m. A sample of the granitic gneiss was collected from the rail unloading area boreholes at Milne Port. Diabase samples were collected from the surface near Chainage 103+000 m during a site visit in September 2016 and tested during this program.

3.3.1 Overburden

Overburden material of thickness ranging from no cover to approximately 5 m was encountered at the quarry locations.

3.3.2 Bedrock

- Extensive granitic gneiss ridge extends from Chainage 0+000 m to 11+000 m, likely continues to approximately Chainage 24+000 m. Possible quarry locations are available along this ridge.
- Extensive dolomitic limestone ridge extends from Chainage 46+000 m to 58+000 m just east of the rail alignment. Possible quarry locations are available along this ridge.
- Other possible quarry locations were observed east of the rail alignment at approximately Chainage 100+000 m (diabase).

3.4 Laboratory Test Results

The results of the classification and moisture content testing have been presented on the borehole logs in Appendix B, at the corresponding sample depths. The full laboratory reports are included in Appendix D with a summary of the classification test results included as Appendix F. During the investigation, samples of typical rock types were collected, at or near potential quarry locations when possible. Laboratory testing was undertaken to determine the suitability of the rock for use as aggregate, including relative density, absorption, abrasion resistance and unconfined freeze thaw loss. A summary of the laboratory test results for the crushed aggregate samples are presented in Table 3-1. Full laboratory test results are presented in Appendix H.

Table 3-1: Physical Test Results of The Crushed Aggregate Samples

Test Type	Borehole ID: Depth (Lab ID)			
	BH16 – Q7004: 4.6 – 10.6 m	BH16 – Q7004: 4.6 – 10.6 m	BH16 – M007: 6.1 – 9.1 m	Surface Outcrop Sample
	(NF17-01)	(NF17-02)	(NF17-03)	(NF17-04)
Specific Gravity	2.662	2.655	2.618	2.995
Absorption (%)	0.82	0.9	0.37	0.45
Micro-Deval Abrasion (% loss)	10.5	11	4.5	7.9
Unconfined Freeze-Thaw (% loss)	6.7	11.1	1.6	0.8

3.5 Geophysics Results

The GPR investigations were undertaken at fourteen sites along the rail alignment, with seven sites in the deviation area, in order to define ice rich zones. A seismic and georadar survey was undertaken near Chainage 4+500 m of the alignment to determine the depth to bedrock. Seismic surveys were also undertaken at the railway unloading area. The results of the geophysical investigation, including bedrock profiles and ice layer mapping, are presented in Appendix J. Results of the GPR surveys in the ice rich areas are discussed further in Section 3.6.

3.6 Ice Rich Areas

It was found that some of the boreholes drilled during the 2016/2017 rail investigations contained large amounts of ice, and could therefore potentially indicate the presence of large ice bodies. In the area where high ice content were discovered during the borehole investigations, a GPR survey was subsequently used to delineate the subsurface conditions, as presented in Appendix J. Figure 11 is an example of a section of ice core recovered during the borehole investigations.

Figure 11: Ground Ice at Km 47, 1.5 m to 3 m Deep (BH16-C011)

The location of potential ice bodies along the rail alignment may be important for design considerations. Boreholes that contained a significant amount of ice, defined as ice lenses greater than 3 m thick, are shown in Table 3-2.

Table 3-2: Boreholes With Significant Ice Content

Borehole	Ice Depth from Ground Surface (m)	Investigation Depth (m)	Inferred GPR Ice Thickness* (m)
BH16-C008	3	13.7	>10.7
BH16-C011	1.5	10.7	>9.2
BH16-C023	6.1	10.7	>4.6
BH17-C002	2.7	10.7	>8

* Note: the base of the ice lense/body was not reached in any of these investigations.

The inferred ice thicknesses from the GPR surveys are presented in Appendix J. The GPR surveys of the ice rich areas confirmed the results of the borehole investigation and provide inferred thicknesses and extent of these ice rich areas.

3.7 Georadar Surveys Along the Rail Deviation Area

GPR surveys were conducted at seven sites along the rail deviation area subsequent, and as a separate component, to the 2018 Geotechnical Investigation to determine ice depth, thickness, and extent. The chainage of the survey areas spanned from approximately 59 KM to 69 KM, and 77 KM to 78 KM. Ice chunks and Ice lenses were delineated at depths 4 m to 9 m from the surface. Detailed results and ice thickness maps can be found in Appendix J. It should be noted that no boreholes were drilled in the Georadar survey areas along the rail deviation to verify subsurface ice conditions.

4. Summary of Findings

A variety of soil materials were found along the rail alignment including sand, gravel and lesser amounts of silt during the sonic drilling program. The soils along the alignment were primarily alluvium of glaciofluvial or glaciolacustrine origin, or glacial till or moraine deposits. The boreholes along the alignment have been separated based on the primary soil type encountered as summarized in Table 4-1.

Table 4-1: Primary Materials along Rail Alignment

Approximate Alignment Chainage	Borehole/Geophysics ID	Likely Origin of Primary Soils in Borehole
0+000 m to 17+000 m	BH16-R003	Glaciofluvial Origin
	BH16-R004	
	BH16-R006	
	BH16-C006	
	BH16-R005	
	BH17-C001	
	BH16-R007	
	BH16-R008	
	BH16-B001	
	BH16-B002	
	BH16-B004	
	BH16-R009	
	BH16-B003	

Approximate Alignment Chainage	Borehole/Geophysics ID	Likely Origin of Primary Soils in Borehole
	BH18-BR15-1	
	BH18-BR15-2	
17+000 m to 25+000 m	BH16-R010	Mix of glaciofluvial and till/moraine
	BH16-R012	
	BH16-R011	
	BH16-C007	
	BH16-R013	
25+000 m to 37+500 m	BH17-C002	Glaciofluvial
	BH17-C003	
	BH16-R014	
	BH16-C008	
	BH17-C004	
	BH16-R015	
	BH16-R016	
	BH16-R017	
	BH16-R018	
	BH16-R019	
	BH16-R020	
	BH16-R021	
	BH16-C009	
	BH16-R022	
	BH16-R023	
37+500 m to 40+000 m	BH16-C010	Mix of glaciofluvial and till/moraine
	BH16-R024	
	BH16-R025	
40+000 m to 54+000 m	BH16-R026	Glaciofluvial
	BH16-R027	
	BH16-R028	
	BH16-R029	
	BH17-C005	
	BH16-R030	
	BH16-C011	
	BH16-R032	
	BH16-C012	
	BH16-R033	
	BH16-R034	
	BH17-C006	
	BH16-R035	
	BH16-R036	
54+000 m to 58+000	BH16-R037	Glaciolacustrine
	BH17-C006B	
	BH16-R038	
	BH16-R053	
	BH16-R039	
	BH16-R040	
	BH16-R041	
	BH16-R042	
	BH16-R043	
	BH16-R044	
	BH16-R045	
	BH16-R046	
58+000 m to 70+000 m	SL17-D6	Till/moraine

Approximate Alignment Chainage	Borehole/Geophysics ID	Likely Origin of Primary Soils in Borehole
	SL17-D7	
	SL17-D5	
	SL17-D4	
	SL17-D3	
	SL17-D2	
	SL17-D1	
	BH18-BR70-1	
	BH18-BR70-2	
70+000 m to 75+000 m	BH17-C007	Glaciolacustrine
	BH17-B001	
	BH17-B002	
	BH17-C010	
	BH17-C011	
75+000 m to 77+000 m	BH17-C012	Mix of glaciolacustrine and till/moraine deposits
	BH17-C013	
77+000 to 100+000 m	BH16-R067	Glaciolacustrine
	BH16-C015	
	BH16-C016	
	BH16-R068	
	BH16-C017	
	BH16-R069	
	BH16-R070	
	BH16-B009	
	BH16-B010	
	BH16-B011	
	BH16-B012	
	BH16-C018	
	BH16-C019	
	BH16-C019B	
	BH16-C020	
	BH16-C021	
	BH16-C022	
	BH16-C023	
	BH16-C024	
	BH16-C025	
	BH16-C026	
	BH16-C027	
	BH16-C028	
	BH16-C029	
	BH17-BR86-1	
	BH17-BR86-2	
	BH17-BR86-3	
100+000 m to Terminus	BH16-C201	Mix of glaciofluvial and till/moraine deposits
	BH16-C202	
	BH16-C203	
	BH16-C030	
	BH16-B014	
	BH16-B013	
	BH16-C204	
	BH16-B015	
	BH16-B016	
	BH16-C205	

Approximate Alignment Chainage	Borehole/Geophysics ID	Likely Origin of Primary Soils in Borehole
	BH16-C206	
	BH16-C207	
	BH16-C031	
	BH16-C032	
	BH18-BR102-1	
	BH18-BR102-2	

Bedrock was identified in some boreholes and by refractive seismic methods along the rail alignment. Outcroppings of granitic gneiss, dolomitic limestone and diabase were found along the alignment and may provide borrow materials for the rail construction. Ground ice was noted in a number of the boreholes along the alignment. The following locations were identified as having ground ice significant enough to warrant design consideration and alignment modification, other incidents of ground ice were noted in the borehole reports and may also be encountered between the following investigation locations:

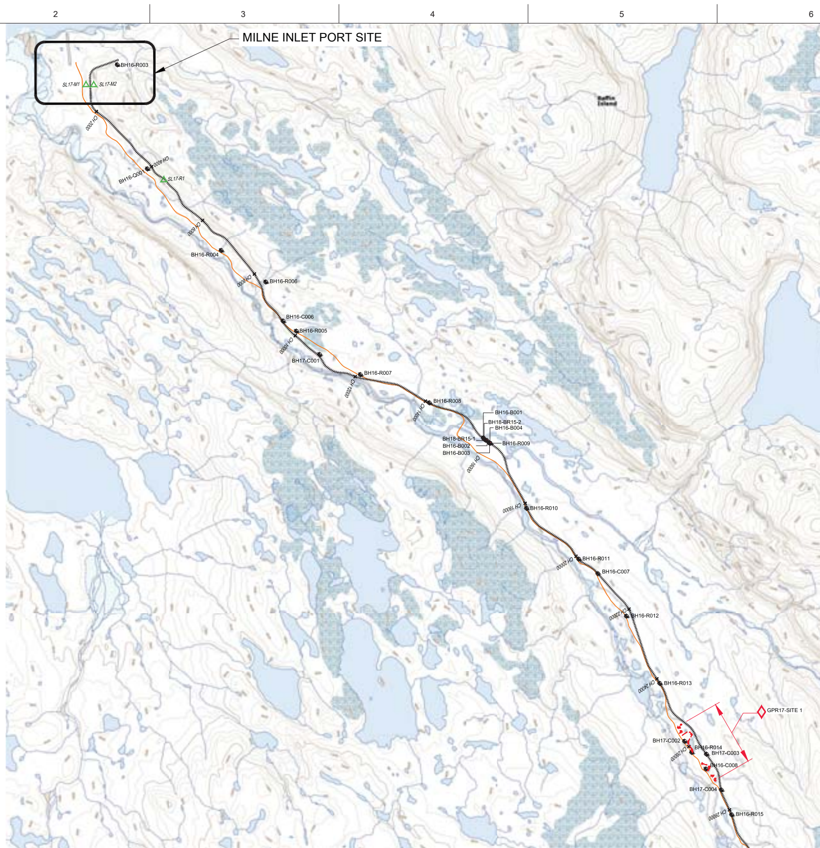
- Some ground ice and individual ice inclusions at the proposed Bridge 1 location at an approximate Chainage at 16+000 m along the proposed rail alignment;
- A large ice body was encountered at the cut location at Chainage 26+700 m on the proposed rail alignment 3 m below the existing ground surface elevation;
- A large ice body was encountered at the cut location at Chainage 47+300 m on the proposed rail alignment at 3 m below the existing ground surface elevation; and
- A large ice body or lenses were encountered at the cut location at Chainage 77+000 m on the proposed rail alignment at approximately 1.5 m to 2.5 m below the existing ground surface elevation;
- Frequent ice inclusions and irregularly oriented excess ice were found at the boreholes drilled between Chainage 92+000 m and 96+000 m of the proposed rail alignment.

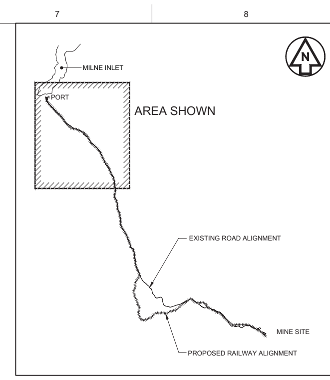
A ground-penetrating radar unit was used to confirm and delineate the ice rich areas identified above, with the exception of the previous proposed bridge location at approximately Chainage 92+000 m to 96+000 m.

5. References

1. ASTM – Standard Practice for Description of Frozen Soils (Visual-Manual Procedure) Designation D4083-89 *Approved June 1 2016.*
2. Scott, D.J., de Kemp, E.A. 1998: Bedrock Geology Compilation, Northern Baffin Island and Northern Melville Peninsula, Northwest Territories, Geological Survey of Canada, Open File 3633, scale 1:500 000.
3. Little, EC., Holme, P.J., and Kerr, D.E. 2013: Surficial Geology, Icebound Lakes (southwest), Baffin Island, Nunavut, Geological Survey of Canada, Canadian Geoscience Map 74 (preliminary), scale 1:100 000 doi:19.1985/292183.
4. Dyke, A.S. 2000: Surficial Geology, Phillips Creek, Baffin Island, Nunavut; Geological Survey of Canada, Map 1961A, scale 1:250 000.
5. AMEC Earth & Environmental, 2010: Geotechnical, Geochemical and Quarry Sourcing Investigation (Draft). Project No. TC101510. Dec. 2010.
6. Knight Piesold Consulting Ltd. (KP) report “Mine Site Infrastructure, Pit Overburden and Waste Dumps – 2006 Site Investigation Summary Report”, (Ref. No. NB102-00181/3-2), February 28, 2007.
7. Knight Piesold Consulting Ltd. (KP) report “Mine Site Infrastructure, Pit Overburden and Waste Dumps – 2007 Site Investigations and Foundations Recommendations Summary Report”, (Ref. No. NB102-00181/8-2), December 14, 2007.
8. Knight Piesold Consulting Ltd. (KP) boreholes (PMT-001, PMBC-002, PMPL-002, PMTF-001,PMSD-001 and BS-001) advanced at Milne Inlet in May 2007.
9. EBA Engineering Consultants Ltd. (EBA) memo “Foundation Recommendations, Mary River Mine Site Infrastructure”, (File: E14101009.003), September 9, 2010.
10. Hatch Ltd. H337697-0000-15-124-0004.Geotechnical Data Report –Infrastructure. April 5, 2012.
11. Hatch Ltd. H349000-1000-15-122-0001. Geotechnical Design Criteria. Aug 08, 2013.
12. Hatch Ltd. H352034-1000-220-068-0001, Site Assessment of North Railway Alignment Report, Oct. 3, 2017.
13. Jackson, G.D., Morgan, W.C. and Davidson, A., 1975: Geology Icebound Lake District of Franklin, Geological Survey of Canada Map 1451A, scale 1:250,000.
14. Blackadar, R.G. and Davison, W.L., 1968: Geology Phillips Creek District of Franklin, Baffin Island, Geological Survey of Canada Map 1239A, scale 1:253,440.

Appendix A
Borehole Location Plan





KEY PLAN

0 10 20 30 40 50 kilometres

SCALE 1:500 000

LEGEND

- AS-BUILT BOREHOLE LOCATION
- CHAINAGE POINT ALONG RAIL ALIGNMENT
- SEISMIC LINE LOCATION
- GROUND PENETRATING RADAR SURVEY (GPR) AREA
- PROPOSED RAILWAY
- EXISTING TOTE ROAD

REFERENCES:

FOR SEISMIC AND GROUND PENETRATING RADAR DETAILS SEE GEOPHYSICS GPR INTERNATIONAL INC REPORT

0 1 2 3 4 5 KILOMETRES

SCALE 1:50 000 (B1 SHEET)

DRAWING No.	DRAWING TITLE
REFERENCE DRAWINGS	

REG. PROFESSIONAL

HATCH

Baffinland

No.	DESCRIPTION	BY	CHK'D	DATE
A	ISSUED WITH GEOTECHNICAL REPORT			20/08/2018

REVISIONS

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	R PELAEZ	NR	10/08/2018
DESIGNER	M YANG	NR	20/08/2018
CHECKER	W HOYLE		20/08/2018
DESIGN COORD.	M YANG		20/08/2018
RESP. ENG.	H GHIABI		20/08/2018
LEAD DISC. ENG.	W HOYLE		20/08/2018
ENG. MANAGER	F VAN BILJON		20/08/2018
PROJ. MANAGER	S PERRY		20/08/2018

DRAWING APPROVAL STATUS: Record Document

BAFFINLAND IRON ORE MINES LP
MARY RIVER EXPANSION PROJECT

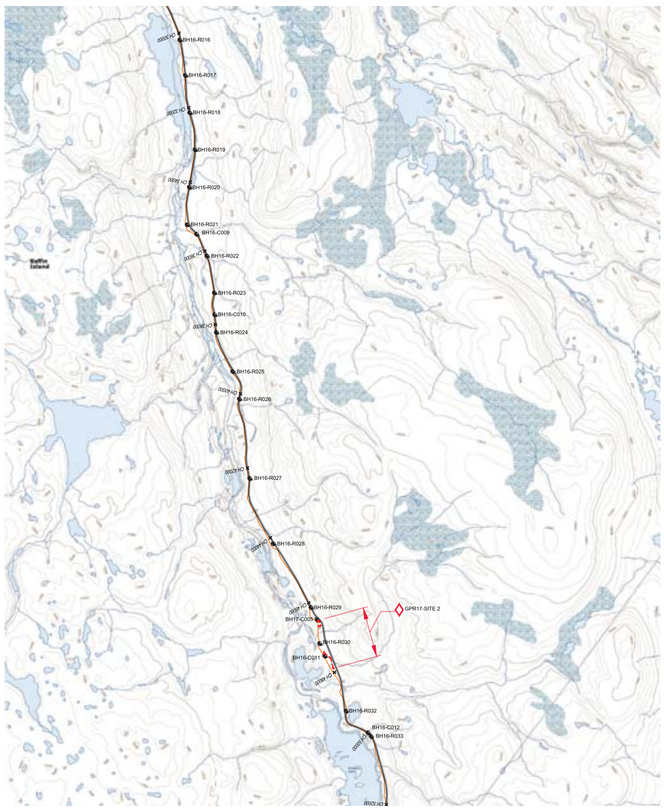
GEOTECHNICAL INVESTIGATIONS
LOCATION PLAN
SHEET 1 OF 4

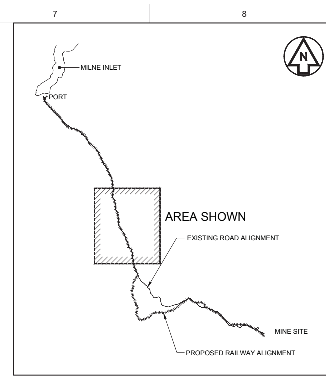
SCALE	DWG. No.	REV
1:50,000 OR AS NOTED	H353004-10000-229-230-0005	A

SHEET SIZE: D

$USERNAME$ $DATE$ $FILE$ $TIME$

DWG. No.
H353004-10000-229-230-0005





KEY PLAN

0 10 20 30 40 50 kilometres

SCALE 1:500 000

LEGEND

- AS-BUILT BOREHOLE LOCATION
- CHAINAGE POINT ALONG RAIL ALIGNMENT
- SEISMIC LINE LOCATION
- GROUND PENETRATING RADAR SURVEY (GPR) AREA
- PROPOSED RAILWAY
- EXISTING TOTE ROAD

REFERENCES:

FOR SEISMIC AND GROUND PENETRATING RADAR DETAILS SEE GEOPHYSICS GPR INTERNATIONAL INC REPORT

0 1 2 3 4 5 KILOMETRES

SCALE 1:50 000 (B1 SHEET)

HATCH

Baffinland

DRAWING No.	DRAWING TITLE
REFERENCE DRAWINGS	

REG. PROFESSIONAL

No.	DESCRIPTION	BY	CHK'D	DATE
A	ISSUED WITH GEOTECHNICAL REPORT			20/08/2018

REVISIONS

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	R PELAEZ	NR	10/08/2018
DESIGNER	M YANG	NR	20/08/2018
CHECKER	W HOYLE		20/08/2018
DESIGN COORD.	M YANG		20/08/2018
RESP. ENG.	H GHIABI		20/08/2018
LEAD DISC. ENG.	W HOYLE		20/08/2018
ENG. MANAGER	F VAN BILJON		20/08/2018
PROJ. MANAGER	S PERRY		20/08/2018

DRAWING APPROVAL STATUS: Record Document

BAFFINLAND IRON ORE MINES LP
MARY RIVER EXPANSION PROJECT

GEOTECHNICAL INVESTIGATIONS
LOCATION PLAN
SHEET 2 OF 4

SCALE 1:50,000 OR AS NOTED

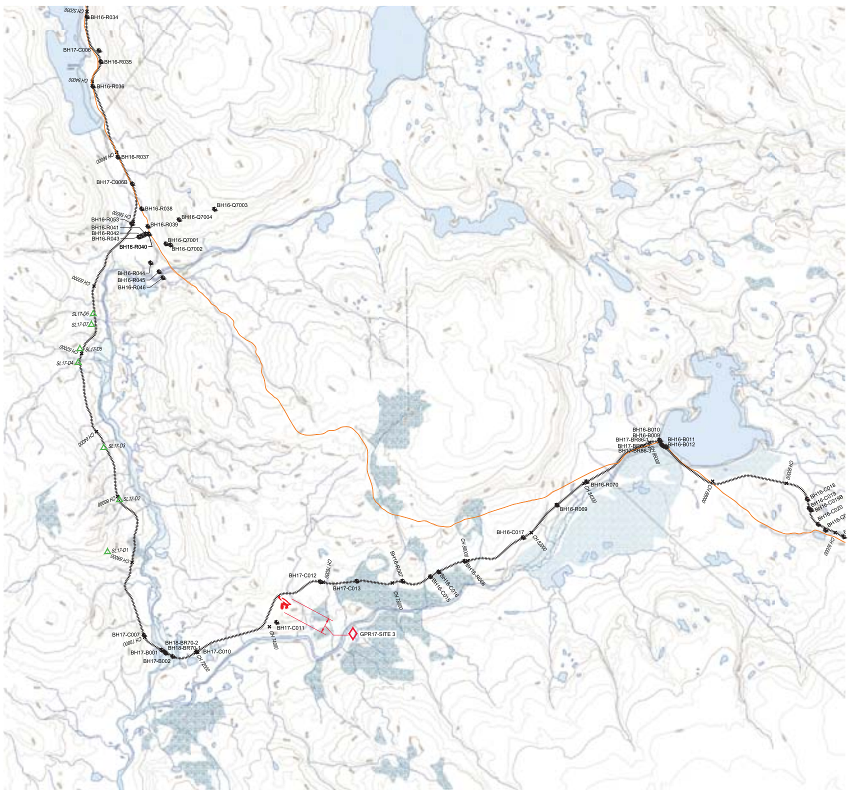
DWG. No. H353004-10000-229-230-0005

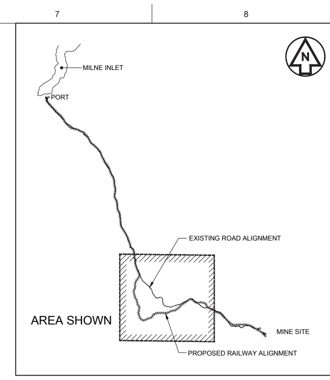
REV A

SHEET SIZE: D

$USERNAME$ $DATE$ $FILE$ $TIME$

H353004-10000-229-230-0005
DWG. No.





KEY PLAN

0 10 20 30 40 50 kilometres

SCALE 1:500 000

LEGEND

- AS-BUILT BOREHOLE LOCATION
- CHAINAGE POINT ALONG RAIL ALIGNMENT
- SEISMIC LINE LOCATION
- GROUND PENETRATING RADAR SURVEY (GPR) AREA
- PROPOSED RAILWAY
- EXISTING TOTE ROAD

REFERENCES:

FOR SEISMIC AND GROUND PENETRATING RADAR DETAILS SEE GEOPHYSICS GPR INTERNATIONAL INC REPORT

0 1 2 3 4 5 KILOMETRES

SCALE 1:50 000 (B1 SHEET)

HATCH

Baffinland

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	R PELAEZ	NR	10/08/2018
DESIGNER	M YANG	NR	20/08/2018
CHECKER	W HOYLE		20/08/2018
DESIGN COORD.	M YANG		20/08/2018
RESP. ENG.	H GHIABI		20/08/2018
LEAD DISC. ENG.	W HOYLE		20/08/2018
ENG. MANAGER	F VAN BILJON		20/08/2018
PROJ. MANAGER	S PERRY		20/08/2018

DRAWING APPROVAL STATUS: Record Document

BAFFINLAND IRON ORE MINES LP
MARY RIVER EXPANSION PROJECT

GEOTECHNICAL INVESTIGATIONS
LOCATION PLAN
SHEET 3 OF 4

No.	DESCRIPTION	BY	CHK'D	DATE
A	ISSUED WITH GEOTECHNICAL REPORT			20/08/2018

REVISIONS

DRAWING No.	DRAWING TITLE

REFERENCE DRAWINGS

REG. PROFESSIONAL

SCALE 1:50,000 OR AS NOTED

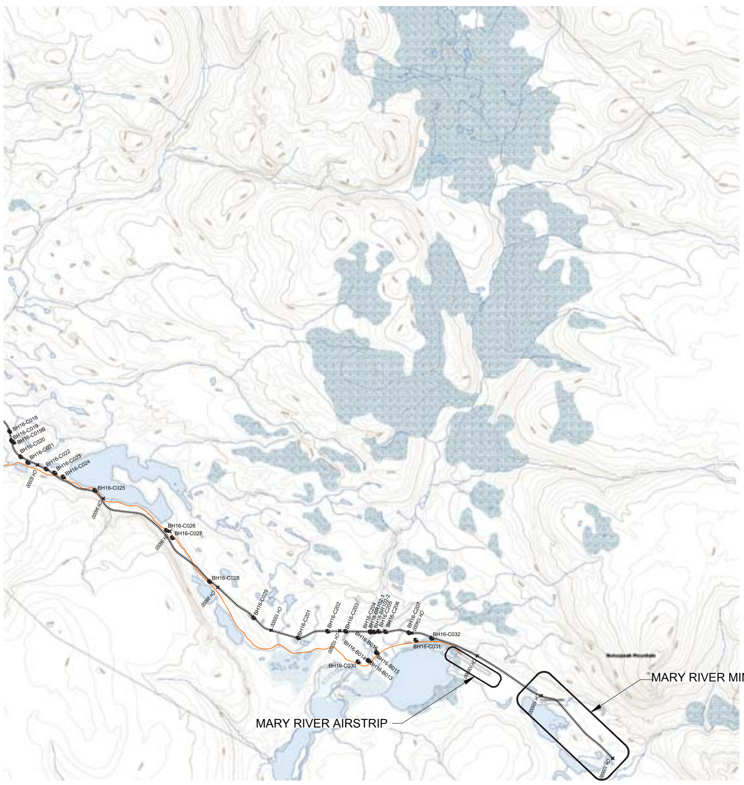
DWG. No. H353004-10000-229-230-0005

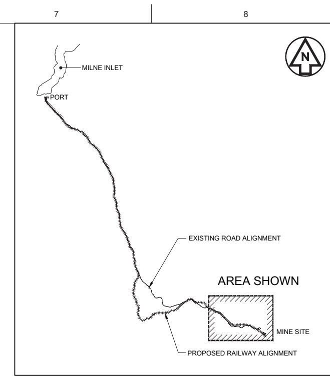
REV A

SHEET SIZE: D

$USERNAME$ $DATE$ $FILE$ $TIME$

DWG. No.
H353004-10000-229-230-0005





KEY PLAN

0 10 20 30 40 50 kilometres
SCALE 1:500 000

LEGEND

- AS-BUILT BOREHOLE LOCATION
- CHAINAGE POINT ALONG RAIL ALIGNMENT
- SEISMIC LINE LOCATION
- GROUND PENETRATING RADAR SURVEY (GPR) AREA
- PROPOSED RAILWAY (ALIGNMENT ADDED IN MARCH 2018)
- EXISTING TOTE ROAD

REFERENCES:

FOR SEISMIC AND GROUND PENETRATING RADAR DETAILS SEE GEOPHYSICS GPR INTERNATIONAL INC REPORT

0 1 2 3 4 5 KILOMETRES
SCALE 1:50 000 (B1 SHEET)

DRAWING No.	DRAWING TITLE
REFERENCE DRAWINGS	

REG. PROFESSIONAL

HATCH

Baffinland

No.	DESCRIPTION	BY	CHK'D	DATE
A	ISSUED WITH GEOTECHNICAL REPORT			20/08/2018

REVISIONS

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	R PELAEZ	NR	10/08/2018
DESIGNER	M YANG	NR	20/08/2018
CHECKER	W HOYLE		20/08/2018
DESIGN COORD.	M YANG		20/08/2018
RESP. ENG.	H GHIABI		20/08/2018
LEAD DISC. ENG.	W HOYLE		20/08/2018
ENG. MANAGER	F VAN BILJON		20/08/2018
PROJ. MANAGER	S PERRY		20/08/2018

DRAWING APPROVAL STATUS: Record Document

BAFFINLAND IRON ORE MINES LP
MARY RIVER EXPANSION PROJECT

GEOTECHNICAL INVESTIGATIONS
LOCATION PLAN
SHEET 4 OF 4

SCALE 1:50,000 OR AS NOTED
DWG. No. H353004-10000-229-230-0005
REV A

SHEET SIZE: D

$USERNAME$ $DATE$ $TIME$ $FILE$

Appendix B
Borehole Reports

List of Abbreviations and Terms Used in the Borehole Reports

(Sheet 1)

General

Elevations
Elevations are referenced to datum indicated.

Depth
All depths are given in meters (feet) measured from the ground surface unless otherwise noted.

Sample Recovery
Indicates the length retained in millimeters (inches) in a split spoon sampler or percentage recovery of sample retained in the core barrel sampler.

Sample Number
Samples are numbered consecutively in the order in which they were obtained or attempted in the borehole.

Sample Type
The first letter describes the sampling method and the second, the shipping container.

Sampling Method

A – Split Tube	E – Auger
B – Thin Wall Tube	F – Wash
C – Piston Sampler	G – Shovel Grab Sample
D – Core Barrel	K – Slotted Sampler

Shipping Container

O – Tube	U – Not Recovered
P – Water Content Tin	X – Plastic & PVC Sleeve (Sonic)
Q – Jar	Y – Core Box
S – Plastic Bag	Z – Discarded

Abbreviations
N/A – Not applicable
N/E – Not encountered
N/O – Not observed

Soil

Soil Description, Label and Symbol
Soil description under the "Description" column conforms generally, but not rigorously, to the Unified Soils Classification System. For a given soil unit, defined by depth boundaries, the descriptive text constitutes the definitive soil unit description and takes precedence over both the brief label and the symbol used to graphically represent the soil unit.

Grain Size

Clay		<0.002 mm
Silt	0.002 –	0.075 mm
Sand	0.075 –	4.75 mm
Fine	0.075 –	0.42 mm
Medium	0.42 –	2.00 mm
Course	2.00 –	4.75 mm
Gravel	4.75 –	75 mm
Fine	4.75 –	19.00 mm
Coarse	19.00 –	75.00mm
Cobbles	75 –	300 mm
Boulder		>300 mm

Relative Quantities

Term	*Example*	*(%)*
Trace	Trace sand	1 – 10
Some	Some sand	10 – 20
With (adjective)	With Sand (Sandy)	20 – 35
And	And sand	>35
Noun	Sand	>50

Standard Penetration Test (SPT)
The test is carried out in accordance with ASTM D-1586 and the 'N' value corresponds to the sum of the number of blows required by a 63.5-kg (140-lb) hammer, dropped 760 mm (30 in.), to drive a 50-mm (2-in.) diameter split tube sampler the second and third 150 mm (6 in.) of penetration.

Density (Granular Soils)

	N(SPT)
Very loose	0 – 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very dense	>50

Consistency (Cohesive Soils)

	N(SPT)
Very soft	<2
Soft	2 – 4
Firm	4 – 8
Stiff	8 – 15
Very stiff	15 – 30
Hard	>30

Plasticity/Compressibility

		Liquid Limit (%)
Low plasticity clays	Low compressibility silts	<30
Medium plasticity clays	Medium compressibility silts	30 – 50
High plasticity clays	High compressibility silts	>50

Dilatancy
None - No visible change, during shaking or squeezing
Slow - Water appears slowly on surface of specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid - Water appears quickly on the surface of specimen during shaking and disappears quickly upon squeezing.

Sensitivity

Insensitive	<2
Low	2 – 4
Medium	4 – 8
High	8 – 16
Quick	>16

HATCH

List of Abbreviations and Terms Used in the Borehole Reports

(Sheet 2)

Rock

Core Recovery
Sum of lengths of rock core recovered from a core run, divided by the length of the core run and expressed as a percentage.

RQD (Rock Quality Designation)
Sum of lengths of hard, sound pieces of rock core equal to or greater than 100 mm from a core run, divided by the length of the core run and expressed as a percentage. Measured along centerline of core. Core fractured by drilling is considered intact. RQD normally quoted for N-size core.

RQD (%) Rock Quality

RQD (%)	Rock Quality
90 - 100	Excellent
75 - 90	Good
50 - 75	Fair
25 - 50	Poor
0 - 25	Very Poor

Grain Size

Term	*Grain Size*
Very coarse-grained	>60 mm
Coarse-grained	2 mm - 60 mm
Medium-grained	60 µm - 2 mm
Fine-grained	2 µm - 60 µm
Very fine-grained	< 2 µm

Bedding

Term	*Bed Thickness*	
Very thickly bedded	>2 m	>6.50 ft
Thickly bedded	600 mm - 2 m	2.00 - 6.50 ft
Medium bedded	200 mm - 600 mm	0.65 - 2.00 ft
Thinly bedded	60 mm - 200 mm	0.20 - 0.65 ft
Very thinly bedded	20 mm - 60 mm	0.06 - 0.20 ft
Laminated	6 mm - 20 mm	0.02 - 0.06 ft
Thinly laminated	<6 mm	<0.02 ft

Discontinuity Frequency
Expressed as the number of discontinuities per meter or discontinuities per foot. Excludes drill-induced fractures and fragmented zones.

Discontinuity Spacing

Term	*Average Spacing*	
Extremely widely spaced	>6 m	>20.00 ft
Very widely spaced	2 m - 6 m	6.50 - 20.00 ft
Widely spaced	600 mm - 2 m	2.00 - 6.50 ft
Moderately spaced	200 mm - 600 mm	0.65 - 2.00 ft
Closely spaced	60 mm - 200 mm	0.20 - 0.65 ft
Very closely spaced	20 mm - 60 mm	0.06 - 0.20 ft
Extremely closely spaced	<20 mm	<0.06 ft

Note: Excludes drill-induced fractures and fragmented rock.

Broken Zone
Zone of full diameter core of very low RQD which may include some drill-induced fractures.

Fragmented Zone
Zone where core is less than full diameter and RQD = 0.

Strength

Term	*Description*	*Unconfined Compressive Strength (MPa)*	*(psi)*
Extremely weak rock	Indented by thumbnail	0.25 – 1.0	36 – 145
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	1.0 – 5.0	145 – 725
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	5.0 – 25	725 – 3625
Medium strong rock	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer to facture it	25 – 50	3625 –7250
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	50 – 100	7250 – 14500
Very strong rock	Specimen requires many blows of geological hammer to fracture it	100 – 250	14500 – 36250
Extremely strong rock	Specimen can only be chipped with geological hammer	>250	>36250

Weathering

Term	*Description*
Fresh	No Visible sign of rock material weathering
Faintly weathered	Discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

BASIS FOR SOIL DESCRIPTION

(Based on AS1726-1993 - Geotechnical Site Investigations, with modifications)

GRAPHIC SYMBOLS FOR SOILS

GRAVEL
- poorly graded -
- well graded -

SAND
- poorly graded -
- well graded -

SILT
- of low plasticity -
- of high plasticity -

CLAY
- of low plasticity -
- of high plasticity -

ICE -

COBBLES AND BOULDERS -

ORGANIC/ PEATY SOIL -

FILL/ MADE GROUND -

Composite soil types are presented using combined symbols, eg. **Gravelly Sandy CLAY**

GROUNDWATER OBSERVATIONS

Permanent Water Level

Temporary Water Level

Inflow into Pit or Borehole

Outflow/ Water Loss in Borehole

Slow Inflow/ Seepage into Pit or Borehole

SAMPLE TYPES

Disturbed bag sample

Bulk Disturbed (>20kg)

Hollow Stem Auger Core

Auger Flight Cuttings

Standard Penetration Test (SPT), with Disturbed Split-Spoon Sample

SPT (no recovery)

Thin walled "undisturbed" push tube sample eg. U60, U100 etc

Sample attempted with no recovery

BASIS FOR ROCK DESCRIPTION

(Based on AS1726-1993 - Geotechnical Site Investigations, with modifications)

GRAPHIC SYMBOLS FOR SOILS

GRAVEL
- poorly graded -
- well graded -

SAND
- poorly graded -
- well graded -

SILT
- of low plasticity -
- of high plasticity -

CLAY
- of low plasticity -
- of high plasticity -

FINE GRAINED TAILINGS -

COBBLES AND BOULDERS -

ORGANIC/ PEATY SOIL -

FILL/ MADE GROUND -

Composite soil types are presented using combined symbols, eg. **Gravelly Sandy CLAY**

GRAPHIC SYMBOLS FOR ROCKS

SEDIMENTARY

SHALE

CLAYSTONE

SILTSTONE

SANDSTONE

CONGLOMERATE

BRECCIA

CORE LOSS

CARBONATE

LIMESTONE

Calcareous CLAYSTONE

Calcareous SILTSTONE

CALCARENITE

CALCIRUDITE

CALCRETE

EVAPORITES

GYPSUM

IGNEOUS

COARSE GRAINED

MEDIUM GRAINED

FINE GRAINED

DOLERITE

METAMORPHIC

COARSE GRAINED

MEDIUM GRAINED

FINE GRAINED

Additional rock graphics may be added for specific projects.

GROUNDWATER OBSERVATIONS

Permanent Water Level

Temporary Water Level

Inflow into Pit or Borehole

Outflow/ Water Loss in Borehole

Slow Inflow/ Seepage into Pit or Borehole

SAMPLE TYPES

Disturbed bag sample

Bulk Disturbed (>20kg)

Hollow Stem Auger Core

Auger Flight Cuttings

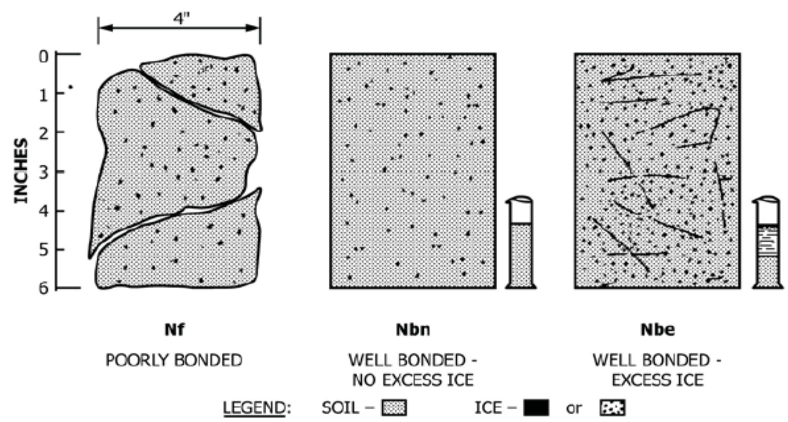
Standard Penetration Test (SPT), with Disturbed Split-Spoon Sample

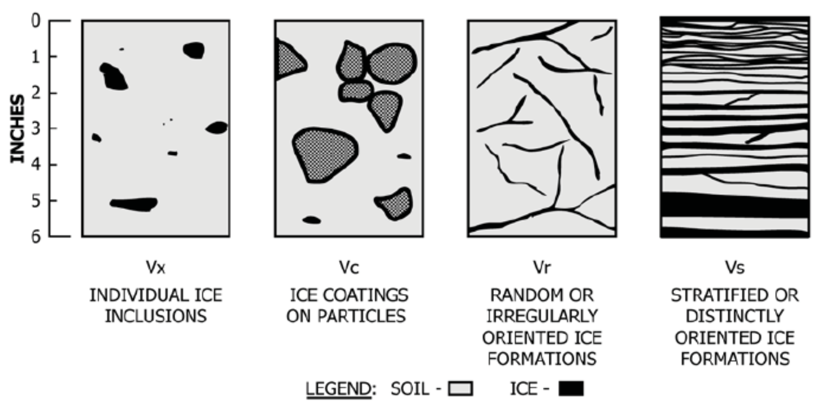
SPT (no recovery)

Thin walled "undisturbed" push tube sample eg. U60, U100 etc

Sample attempted with no recovery

Symbol	Description
Nf	Poorly bonded with no visible excess ice
Nbn	Well bonded with no visible excess ice
Nbe	Well bonded with excess cie
Vx	Individual ice inclusions
Vc	Ice coatings on particles
Vr	Random or Irregularly oriented ice formations
Vs	Stratified or distrinctly oriented ice formations





HATCH

BOREHOLE REPORT

BH16-B001

Sheet 1 of 2

Client: Baffinland Iron Mines

Project: Mary River Expansion Study Stage 2

Location: Proposed Rail Alignment

Project No.: H352034

Datum: NAD83

Platform: Ground

Easting: 514,191.0 m

Northing: 7,965,675.0 m

Surface Elevation: 78.00 m

Bottom Elevation: 66.50 m

Total Depth: 11.5 m

Logged By: MR

Reviewed By: SH/WH

Contractor: Boart Longyear

Rig Type/ Mounting: MiniSonic Rig

Date Logged: 12/3/2016

Driller: Michael Scott

Hole Diameter (mm): 96

Date Reviewed: 2/10/2017

Water: Unobserved due to permafrost

Method: Vibracore

Casing: H-Casing

Depth (m)	Elevation (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description
0.0	78.0	SILT: Organic, fine grained	Vx
		ICE LENSE, silt inclusions: Grey to dark grey, soft, cloudy texture	ICE
		SILTY SAND, trace GRAVEL, trace COBBLES: Grey to light brown, fine to coarse grained sand, subangular to rounded cobbles	Vc
			Nbe
			Nbn
		BOULDERS: Grey, granitic gneiss and mafic gneiss with pulvurized powder	Nf
		Sandy SILT, trace COBBLES, trace BOULDERS: Reddish brown, rounded to subrounded cobbles	Nf

Moisture Content Profile (0 – 50 – 100)

Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
9						
19	6	66	29			

Depth scale (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Elevation scale (m): 77.0, 76.0, 75.0, 74.0, 73.0, 72.0, 71.0, 70.0, 69.0, 68.0

Notes:

BOREHOLE REPORT

BH16-B001

Sheet 2 of 2

Client: Baffinland Iron Mines	**Project No.:** H352034	**Easting:**	514,191.0 m
Project: Mary River Expansion Study Stage 2	**Datum:** NAD83	**Northing:**	7,965,675.0 m
Location: Proposed Rail Alignment	**Platform:** Ground	**Surface Elevation:**	78.00 m
		Bottom Elevation:	66.50 m
		Total Depth:	11.5 m
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:** 12/3/2016	**Logged By:** MR
Driller: Michael Scott	**Hole Diameter (mm):** 96	**Date Reviewed:** 2/10/2017	**Reviewed By:** SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 / 50 / 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	67.0	11.0		[11.5]		BOULDERS: Pulverized rock, angular, possible bedrock											
	66.0	12.0				Drilling Refusal. **Drillhole BH16-B001 terminated at 11.5m.**											
	65.0	13.0															
	64.0	14.0															
	63.0	15.0															
	62.0	16.0															
	61.0	17.0															
	60.0	18.0															
	59.0	19.0															
	58.0	20.0															

Notes:

HATCH BOREHOLE REPORT

BH16-B002

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Driller:	E.Beachamp	**Hole Diameter (mm):**	96
Date Logged:	12/2/2016	**Date Reviewed:**	2/10/2017

Easting:	514,290.0 m
Northing:	7,965,604.0 m
Surface Elevation:	78.00 m
Bottom Elevation:	64.90 m
Total Depth:	13.1 m
Logged By:	UK
Reviewed By:	SH/WH

Water: Unobserved due to permafrost

Method: Vibracore

Casing: H-Casing

Elevation (m): 77.0, 76.0, 75.0, 74.0, 73.0, 72.0, 71.0, 70.0, 69.0, 68.0

Depth (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Moisture Content Profile: 0, 50, 100

Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
SAND: Dark brown to grey, some organics	Nf							
SANDY GRAVEL, some COBBLES: Grey to brown, coarse grained sand, angular gravel	Nf	11						
SAND, some COBBLES, some BOULDERS: Grey, fine grained sand, rounded to subrounded cobbles and boulders	Nf							
SILTY SAND, some COBBLES, trace GRAVEL: Grey, fine grained sand	Nbn	14	5	77	19			
SAND, some SILT, trace GRAVEL: Grey	Nf							
BOULDERS: Granitic, fragmented								
SANDY SILT: Grey, fine grained								
BOULDERS: Granitic gneiss, rock fragments and boulders								
SILTY SAND, some COBBLES, some BOULDERS: Dark grey, fine to coarse grained sand, rounded to subrounded cobbles	Nf							

Notes:

HATCH **BOREHOLE REPORT**

BH16-B002

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 12/2/2016

Driller: E.Beachamp **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Easting:	514,290.0 m
Northing:	7,965,604.0 m
Surface Elevation:	78.00 m
Bottom Elevation:	64.90 m
Total Depth:	13.1 m
Logged By:	UK
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	67.0 66.0	11.0 12.0				SILTY SAND, some COBBLES, some BOULDERS: Dark grey, fine to coarse grained sand, rounded to subrounded cobbles *(Continued)*	Nf *(Continued)*										
	65.0	13.0		[13.1]		SILT, some SAND, trace GRAVEL: Light brown to grey, granular to cohesive, fine to medium grained sand, subangular to angular gravel	Nf										
	64.0 63.0 62.0 61.0 60.0 59.0 58.0	14.0 15.0 16.0 17.0 18.0 19.0 20.0				Drilling Refusal. **Drillhole BH16-B002 terminated at 13.1m.**											

Notes:

HATCH

BOREHOLE REPORT

BH16-B003

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment

Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 514,357.0 m
Northing: 7,965,533.0 m
Surface Elevation: 79.00 m
Bottom Elevation: 63.80 m
Total Depth: 15.2 m

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 12/2/2016
Logged By: MR

Driller: Michael Scott
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017
Reviewed By: SH/WH

Water: Unobserved due to permafrost
Method: Vibracore
Casing: H-Casing

Elevation (m): 78.0, 77.0, 76.0, 75.0, 74.0, 73.0, 72.0, 71.0, 70.0, 69.0
Depth (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Moisture Content Profile: 0, 50, 100

Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
SILTY SAND, with GRAVEL, trace COBBLES: Dark brown to dark grey, Organics, fine to coarse grained sand, subangular gravel	Vc							
GRAVEL, with SAND, some COBBLES, trace SILT: Grey to light brown, fine to coarse grained sand, rounded to subrounded cobbles	Vc	9	24	47	28			
SILTY SAND and GRAVEL: Grey, fine to coarse grained	Nbn							
SAND: Grey, fine to coarse grained sand	Vr							
ICE, silt inclusions: Brown to grey, milky texture		100 (>>)	2	72	26			
	Vr	23						
SAND, some SILT, trace COBBLES: Reddish brown, rounded to subrounded cobbles	Nf							
SILTY SAND: Grey to brown, fine to coarse grained sand, rounded cobbles								

Notes:

BOREHOLE REPORT

BH16-B003

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	514,357.0 m
Northing:	7,965,533.0 m
Surface Elevation:	79.00 m
Bottom Elevation:	63.80 m
Total Depth:	15.2 m
Logged By:	MR
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 12/2/2016

Driller: Michael Scott **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
						BOULDERS: Granitic gneiss											
	68.0	11.0				SILTY SAND, some GRAVEL, some COBBLES: Reddish brown, fine grained sand, angular to subangular gravel	Nf										
	67.0	12.0															
	66.0	13.0															
	65.0	14.0															
	64.0	15.0		[15.2]													
						Drilling Refusal. **Drillhole BH16-B003 terminated at 15.2m.**											
	63.0	16.0															
	62.0	17.0															
	61.0	18.0															
	60.0	19.0															
	59.0	20.0															

Notes:

BOREHOLE REPORT

HATCH

BH16-B004

Sheet 1 of 2

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	514,367.0 m
Northing:	7,965,540.0 m
Surface Elevation:	79.00 m
Bottom Elevation:	62.80 m
Total Depth:	16.2 m
Logged By:	UK
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 12/1/2016

Driller: E.Beachamp **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water: Unobserved due to permafrost

Method: Vibracore

Casing: H-Casing

Elevation (m) / Depth (m): 78.0 / 1.0; 77.0 / 2.0; 76.0 / 3.0; 75.0 / 4.0; 74.0 / 5.0; 73.0 / 6.0; 72.0 / 7.0; 71.0 / 8.0; 70.0 / 9.0; 69.0 / 10.0

Moisture Content Profile: 0 50 100

Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
SAND: Grey, coarse grained sand	Nf							
0.60 m to 1.50 m: SILT, dark grey to dark brown	Nbn							
SILTY SAND, some GRAVEL: Grey, angular to subangular gravel,	Nf	9						
ICE, SILT inclusions: Moderate hardness, greyish color, cloudy texture	ICE	100 (>>)	7	54	39			
Sand and SILT, trace GRAVEL: Grey, fine to coarse grained sand	Vr							
BOULDERS: Granitic gneiss								
SAND: Grey, fine to coarse grained	Nbn	19	35	44	21			
SAND: Grey, fine to coarse grained	Nbn Nf							
SILTY SAND: Grey to brown, fine to coarse grained	Nf							

Notes:

BOREHOLE REPORT

HATCH

BH16-B004

Sheet 2 of 2

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground
Easting: 514,367.0 m
Northing: 7,965,540.0 m
Surface Elevation: 79.00 m
Bottom Elevation: 62.80 m
Total Depth: 16.2 m
Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 12/1/2016
Logged By: UK
Driller: E.Beachamp
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017
Reviewed By: SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
						ROCK: Granitic gneiss, intact, moderate to high strength											
	68.0	11.0				SILTY SAND, some GRAVEL, trace COBBLES: Brown to reddish brown, fine to coarse grained sand, rounded to subrounded cobbles	Nf										
	67.0	12.0					Vx										
	66.0	13.0															
	65.0	14.0				SAND and SILT, trace COBBLES: Grey to dark grey, fine to medium grained sand, rounded to subrounded cobbles	Vc										
	64.0	15.0				SAND, some GRAVEL, some COBBLES, trace BOULDERS :Dark grey, fine to coarse grained sand, rounded to subrounded cobbles and boulders	Nf										
	63.0	16.0		[16.2]													
						Drilling Refusal. **Drillhole BH16-B004 terminated at 16.2m.**											
	62.0	17.0															
	61.0	18.0															
	60.0	19.0															
	59.0	20.0															

Notes:

BOREHOLE REPORT

BH16-B009

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Date Logged:	11/7/2016	**Driller:**	E.Beachamp
Hole Diameter (mm):	96	**Date Reviewed:**	2/10/2017

Easting:	542,204.0 m
Northing:	7,922,291.0 m
Surface Elevation:	143.00 m
Bottom Elevation:	115.60 m
Total Depth:	27.4 m
Logged By:	RS/CS
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost			Vibracore	H-Casing		SAND: Poorly graded, brown, fine to medium grained	Nf										
	142.0	1.0															
						1.50 m to 4.00 m: Trace SILT	Nbn										
	141.0	2.0															
	140.0	3.0															
	139.0	4.0															
	138.0	5.0															
	137.0	6.0															
	136.0	7.0															
	135.0	8.0															
	134.0	9.0															
	133.0	10.0									22	0	98	2			

Notes:

HATCH BOREHOLE REPORT

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	542,204.0 m
Northing:	7,922,291.0 m
Surface Elevation:	143.00 m
Bottom Elevation:	115.60 m
Total Depth:	27.4 m
Logged By:	RS/CS
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/7/2016

Driller: E.Beachamp **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	132.0	11.0				SAND: Poorly graded, brown, fine to medium grained *(Continued)*	Nf *(Continued)*										
	131.0	12.0															
	130.0	13.0															
	129.0	14.0															
	128.0	15.0															
	127.0	16.0															
	126.0	17.0				SAND and GRAVEL: Rounded to subrounded gravel, fine grained sand	Nbn										
	125.0	18.0		[18.8]													
	124.0	19.0															
	123.0	20.0															

Notes:

HATCH BOREHOLE REPORT

BH16-B009

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	542,204.0 m
Northing:	7,922,291.0 m
Surface Elevation:	143.00 m
Bottom Elevation:	115.60 m
Total Depth:	27.4 m
Logged By:	RS/CS
Reviewed By:	SH/WH

Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig	**Date Logged:**	11/7/2016
Driller:	E.Beachamp	**Hole Diameter (mm):**	96	**Date Reviewed:**	2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	122.0	21.0				SAND and GRAVEL: Rounded to subrounded gravel, fine grained sand *(Continued)*	Nbn *(Continued)*										
	121.0	22.0				SAND: Grey with Brown seams, fine to medium grained sand	Nbn										
	120.0	23.0															
	119.0	24.0															
	118.0	25.0															
	117.0	26.0															
	116.0	27.0															
	115.0	28.0				To Target Depth. **Drillhole BH16-B009 terminated at 27.4m.**											
	114.0	29.0															
	113.0	30.0															

Notes:

HATCH

BOREHOLE REPORT

BH16-B010

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	542,208.0 m
Northing:	7,922,304.0 m
Surface Elevation:	143.00 m
Bottom Elevation:	133.00 m
Total Depth:	10.0 m
Logged By:	CS
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/8/2016

Driller: E.Beachamp **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water: Unobserved due to permafrost

Method: Vibracore

Casing: H-Casing [10.0]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
143.0	0.0	SAND, trace SILT, trace GRAVEL: Reddish brown, medium to fine grained sand	Nf							
	1.5		Nbn							
140.0	3.0			11	5	87	8			
	4.20	4.20 m: Slight increase in silt content	Nbn							
	5.2			21	0	98	2			
	6.2		Nf							
136.0	7.0	SILTY SAND: Reddish brown to grey, fine to course grained sand	Nbn							
	8.7		Nbn							
	9.6			20	0	61	39			
133.0	10.0	To Target Depth. **Drillhole BH16-B010 terminated at 10.0m.**								

Moisture Content Profile (0 – 50 – 100)

Notes:

BOREHOLE REPORT

BH16-B011

Sheet 1 of 2

Client: Baffinland Iron Mines

Project: Mary River Expansion Study Stage 2

Location: Proposed Rail Alignment

Project No.: H352034

Datum: NAD83

Platform: Ground

Easting: 542,365.0 m

Northing: 7,922,121.0 m

Surface Elevation: 144.00 m

Bottom Elevation: 133.30 m

Total Depth: 10.7 m

Logged By: RS

Reviewed By: SH/WH

Contractor: Boart Longyear

Driller: Samuel Flynn

Rig Type/ Mounting: MiniSonic Rig

Hole Diameter (mm): 96

Date Logged: 11/8/2016

Date Reviewed: 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0–50–100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	144.0	0.0	Vibracore	H-Casing	SAND, trace SILT, trace GRAVEL: Light brown, fine to coarse grained sand	Nf										
	142.5	1.5				Nbn										
	140.0	4.0				Nbe										
	~139.7	~4.3						Sample			0	98	2			
	~139.4	~4.6				Nbn										
	~134.9	~9.1						Sample	● (19)	19						
	134.0	10.0														

Notes:

HATCH

BOREHOLE REPORT

BH16-B011

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	542,365.0 m
Northing:	7,922,121.0 m
Surface Elevation:	144.00 m
Bottom Elevation:	133.30 m
Total Depth:	10.7 m
Logged By:	RS
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/8/2016

Driller: Samuel Flynn **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
				[10.7]		SAND, trace SILT, trace GRAVEL: Light brown, fine to coarse grained sand *(Continued)*	Nf *(Continued)*										
						To Target Depth. **Drillhole BH16-B011 terminated at 10.7m.**											
	133.0	11.0															
	132.0	12.0															
	131.0	13.0															
	130.0	14.0															
	129.0	15.0															
	128.0	16.0															
	127.0	17.0															
	126.0	18.0															
	125.0	19.0															
	124.0	20.0															

Notes:

HATCH

BOREHOLE REPORT

BH16-B012

Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 542,376.0 m
Northing: 7,922,131.0 m
Surface Elevation: 146.00 m
Bottom Elevation: 136.90 m
Total Depth: 9.1 m
Logged By: RS
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 11/8/2016
Driller: Samuel Flynn
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
			Vibracore	H-Casing		SAND and GRAVEL: Fine to coarse grained sand, angular to subangular gravel	Nf										
	145.0	1.0				SAND, trace SILT: Brown, fine to medium grained sand	Nbn										
Standing Water	144.0	2.0															
						SAND and GRAVEL: Brown, rounded to subrounded gravel, up to 30mm	Nf										
	143.0	3.0				SITLY SAND, trace GRAVEL: Grey and brown layers	Nbn		☒	●	12	4	87	9			
	142.0	4.0															
	141.0	5.0															
	140.0	6.0															
	139.0	7.0															
	138.0	8.0							☒								
	137.0	9.0		[9.1]													
						To Target Depth. **Drillhole BH16-B012 terminated at 9.1m.**											
	136.0	10.0															

Notes:

HATCH

BOREHOLE REPORT

BH16-B013

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig	**Date Logged:**	11/13/2016
Driller:	E.Beachamp	**Hole Diameter (mm):**	96	**Date Reviewed:**	2/10/2017

Easting:	555,619.0 m
Northing:	7,914,671.0 m
Surface Elevation:	154.80 m
Bottom Elevation:	144.20 m
Total Depth:	10.6 m
Logged By:	RS/CS
Reviewed By:	SH/WH

Water: Unobserved due to permafrost

Method: Vibracore

Casing: H-Casing

Elevation (m)	Depth (m)
153.8	1.0
152.8	2.0
151.8	3.0
150.8	4.0
149.8	5.0
148.8	6.0
147.8	7.0
146.8	8.0
145.8	9.0
144.8	10.0

Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
SAND and GRAVEL, some COBBLES: Brown, fine to coarse grained sand, angular gravel	Nf							
1.20 m to 3.00 m: Trace to some silt and cobbles	Nf							
SILTY SAND, some GRAVEL: Grey, angular gravel	Nf							
SAND and SILT: Inferred COBBLES or BOULDERS: Brown, white powder		12	0	53	47			
INFERRED SANDSTONE: Angular pieces of rock, low to moderate strength								
INFERRED SANDSTONE BEDROCK								

Moisture Content Profile: 0 50 100

Recovery | Sample Type

Notes:

HATCH BOREHOLE REPORT

BH16-B013

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	555,619.0 m
Northing:	7,914,671.0 m
Surface Elevation:	154.80 m
Bottom Elevation:	144.20 m
Total Depth:	10.6 m
Logged By:	RS/CS
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/13/2016

Driller: E.Beachamp **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	**Soil Description** TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile 0 50 100	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
				[10.6]		INFERRED SANDSTONE: Angular pieces of rock, low to moderate strength *(Continued)*			X								
						To Target Depth. **Drillhole BH16-B013 terminated at 10.6m.**											
	143.8	11.0															
	142.8	12.0															
	141.8	13.0															
	140.8	14.0															
	139.8	15.0															
	138.8	16.0															
	137.8	17.0															
	136.8	18.0															
	135.8	19.0															
	134.8	20.0															

Notes:

HATCH BOREHOLE REPORT

BH16-B014

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 555,599.0 m
Northing: 7,914,683.0 m
Surface Elevation: 156.00 m
Bottom Elevation: 146.90 m
Total Depth: 9.1 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 10/28/2016
Driller: Samuel Flynn
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water: Unobserved due to Permafrost
Method: Vibracore
Casing: H-Casing [9.1]

Depth (m)	Elevation (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
0.0–3.0	156.0–153.0	SAND and GRAVEL, some COBBLES: Dark grey to brown, medium to coarse grained sand, rounded cobbles 1.50 m to 3.00 m: Trace to some silt	Nf							
3.0–7.0	153.0–149.0	SAND, with GRAVEL, trace COBBLES: Grey, fine to coarse grained sand, angular to subrounded gravel 4.60 m to 7.0 m: Trace to some silt	Nf	12	0	65	35			
7.0–9.1	149.0–146.9	SAND with GRAVEL, trace COBBLES: Light grey, white powder, trace cobbles, fine to coarse grained sand, angular gravel 7.90 m: Inferred sandstone bedrock, weak to moderate strength		1	0	63	37			
9.1	146.9	To Target Depth. **Drillhole BH16-B014 terminated at 9.1m.**								

Moisture Content Profile: 0 50 100

Notes:

BOREHOLE REPORT

HATCH

BH16-B015

Sheet 1 of 2

Client: Baffinland Iron Mines

Project: Mary River Expansion Study Stage 2

Location: Proposed Rail Alignment

Project No.: H352034

Datum: NAD83

Platform: Ground

Easting: 555,824.0 m

Northing: 7,914,884.0 m

Surface Elevation: 156.00 m

Bottom Elevation: 142.40 m

Total Depth: 13.6 m

Contractor: Boart Longyear | **Rig Type/ Mounting:** MiniSonic Rig | **Date Logged:** 11/14/2016 | **Logged By:** US

Driller: Michael Scott | **Hole Diameter (mm):** 96 | **Date Reviewed:** 2/10/2017 | **Reviewed By:** SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	156.0	0.0	Vibracore	H-Casing	SILTY SAND, with GRAVEL, with COBBLES: Brown, fine to coarse grained sand, angular to rounded gravel and cobbles, well graded	Nf										
	155.0	1.0						☒								
	154.0	2.0														
								☒	>>	100	17	41	41			
	153.0	3.0														
	152.0	4.0						☒								
	151.0	5.0						☒	●	11	0	63	37			
	150.0	6.0			6.10 m to 7.60 m: Ice rich soil	Vx										
	149.0	7.0						☒								
	148.0	8.0						☒								
	147.0	9.0														
	146.0	10.0			9.70 m to 10.6 m: Ice rich soil	Vr			>>							

Notes:

HATCH BOREHOLE REPORT

BH16-B015

Sheet 2 of 2

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 555,824.0 m
Northing: 7,914,884.0 m
Surface Elevation: 156.00 m
Bottom Elevation: 142.40 m
Total Depth: 13.6 m
Logged By: US
Reviewed By: SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/14/2016
Driller: Michael Scott **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
							Nf *(Continued)*		X		100	15	66	20			
	145.0	11.0				SANDSTONE: Pulverized sandstone bedrock with some intact sandstone core, grey to white			X								
	144.0	12.0				INFERRED SANDSTONE BEDROCK: bedrock, moderate strength, good quality											
	143.0	13.0		[13.6]					X								
	142.0	14.0				To Target Depth. **Drillhole BH16-B015 terminated at 13.6m.**											
	141.0	15.0															
	140.0	16.0															
	139.0	17.0															
	138.0	18.0															
	137.0	19.0															
	136.0	20.0															

Notes:

BOREHOLE REPORT

BH16-B016
Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 555,830.0 m
Northing: 7,914,892.0 m
Surface Elevation: 153.00 m
Bottom Elevation: 145.40 m
Total Depth: 7.6 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear | **Rig Type/ Mounting:** MiniSonic Rig | **Date Logged:** 11/16/2016
Driller: Samuel Flynn | **Hole Diameter (mm):** 96 | **Date Reviewed:** 2/10/2017

Water: Unobserved due to permafrost
Method: Vibracore
Casing: H-Casing [7.6]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Moisture Content (%)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
153.0–150.3	0.0–2.7	GRAVEL and SAND, some SILT, trace COBBLES: Light brown to brown, fine to coarse grained sand, rounded to subangular gravel	Nf								
150.3–147.2	2.7–5.8	SAND: Grey to light brown, fine to coarse grained sand 2.80 m to 2.90 m: Ice lense	Nf ICE Vx								
	~3.6			●	15	0	88	12			
	~4.7		Nf								
	~5.4					0	67	33			
147.2–146.9	5.8–6.1	5.80 m to 6.10 m: Ice lense	ICE								
146.9–145.4	6.1–7.6	SAND, some GRAVEL, some COBBLES: Light brown to grey	Vx								
	~7.2			●	7	0	66	34			
145.4	7.6	To Target Depth. **Drillhole BH16-B016 terminated at 7.6m.**									

Notes:

BOREHOLE REPORT

BH16-C006

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Driller:	E.Beachamp	**Hole Diameter (mm):**	96
Date Logged:	12/3/2016	**Date Reviewed:**	2/10/2017

Easting:	508,897.0 m
Northing:	7,968,767.0 m
Surface Elevation:	71.75 m
Bottom Elevation:	69.65 m
Total Depth:	2.1 m
Logged By:	UK
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost			Vibracore	H-Casing	SAND, some SILT: Dark brown, organic, medium to coarse grained sand	Nf										
	70.8	1.0			SILTY SAND, with COBBLES, : Grey to white, pulverized rock and angular rock pieces	Nf		▽								
					INFERRED BEDROCK: Granitic gneiss											
	69.8	2.0		[2.1]	Drilling Refusal. **Drillhole BH16-C006 terminated at 2.1m.**											
	68.8	3.0														
	67.8	4.0														
	66.8	5.0														
	65.8	6.0														
	64.8	7.0														
	63.8	8.0														
	62.8	9.0														
	61.8	10.0														

Notes:

HATCH BOREHOLE REPORT

BH16-C007

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	517,221.0 m
Northing:	7,962,080.0 m
Surface Elevation:	105.00 m
Bottom Elevation:	97.40 m
Total Depth:	7.6 m
Logged By:	MR
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 12/1/2016

Driller: Michael Scott **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water: Unobserved due to permafrost

Method: Vibracore

Casing: H-Casing [7.6]

Depth (m)	Elevation (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description
0.0	105.0	SILTY SAND, trace GRAVEL, trace COBBLES: Light brown, fine to medium grained sand, rounded to subangular gravel	Nf
			Vc
			Vx
			Nbn
4.60		4.60 m to 4.80 m: Ice lense	ICE
6.10		6.10 m to 7.60 m: Ice rich silty sand	Vx
7.6	97.4	To Target Depth. **Drillhole BH16-C007 terminated at 7.6m.**	

Moisture Content Profile (0 – 50 – 100)

Sample depth (approx., m)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
1.25	17						
2.55							
3.55	12	1	73	26			
5.05							
7.35	39						

Notes:

HATCH BOREHOLE REPORT

BH16-C008

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment

Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 520,080.0 m
Northing: 7,956,909.0 m
Surface Elevation: 119.30 m
Bottom Elevation: 105.60 m
Total Depth: 13.7 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 11/30/2016
Driller: Michael Scott
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost			Vibracore	H-Casing		GRAVELLY SAND, some COBBLES and SILT: Light brown to grey, fine to coarse grained sand, rounded to subangular gravel	Nf										
	118.3	1.0							⧖	●	13						
							Vx										
	117.3	2.0															
									⧖	●	20						
	116.3	3.0				ICE: Grey to white color, weak to moderate strength, cloudy texture, minor silt inclusions	ICE										
	115.3	4.0															
	114.3	5.0															
	113.3	6.0															
	112.3	7.0															
	111.3	8.0															
	110.3	9.0															
	109.3	10.0															

Notes:

BOREHOLE REPORT

HATCH

BH16-C008

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:** 11/30/2016	
Driller: Michael Scott	**Hole Diameter (mm):** 96	**Date Reviewed:** 2/10/2017	

Easting:	520,080.0 m
Northing:	7,956,909.0 m
Surface Elevation:	119.30 m
Bottom Elevation:	105.60 m
Total Depth:	13.7 m
Logged By:	MR
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	**Soil Description** TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile 0 50 100	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	**Other Tests**
	108.3	11.0				ICE: Grey to white color, weak to moderate strength, cloudy texture, minor silt inclusions *(Continued)*	ICE *(Continued)*										
	107.3	12.0															
	106.3	13.0		[13.7]													
	105.3	14.0				To Target Depth. **Drillhole BH16-C008 terminated at 13.7m.**											
	104.3	15.0															
	103.3	16.0															
	102.3	17.0															
	101.3	18.0															
	100.3	19.0															
	99.3	20.0															

Notes:

BOREHOLE REPORT

BH16-C009

Sheet 1 of 1

Client:	Baffinland Iron Mines
Project:	Mary River Expansion Study Stage 2
Location:	Proposed Rail Alignment
Project No.:	H352034
Datum:	NAD83
Platform:	Ground
Contractor:	Boart Longyear
Driller:	Michael Scott
Rig Type/ Mounting:	MiniSonic Rig
Hole Diameter (mm):	96
Date Logged:	11/28/2016
Date Reviewed:	2/10/2017
Easting:	522,032.0 m
Northing:	7,948,728.0 m
Surface Elevation:	136.50 m
Bottom Elevation:	127.40 m
Total Depth:	9.1 m
Logged By:	MR
Reviewed By:	SH/WH

Water: Unobserved due to permafrost

Method: Vibracore

Casing: H-Casing [9.1]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description
136.5	0.0	SILTY SAND, trace GRAVEL: Light brown, fine to medium grained sand, angular to subangular gravel	Nf
131.9	4.6	SILTY SAND, some GRAVEL: Grey, fine to coarse grained sand, angular to subangular gravel	Nbn; Nf
130.4	6.1	SILTY SAND, with COBBLES, with BOULDERS: Grey, coarse grained sand, angular to subangular gravel	Nf
128.9	7.6	SILTY SAND, with COBBLES, with BOULDERS: Grey, coarse grained sand, rounded to subrounded cobblesm possible weathered bedrock	
127.4	9.1	To Target Depth. **Drillhole BH16-C009 terminated at 9.1m.**	

Elevation scale (m): 135.5, 134.5, 133.5, 132.5, 131.5, 130.5, 129.5, 128.5, 127.5, 126.5

Depth scale (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Moisture Content Profile: 0, 50, 100

Depth (m)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
~2.7	13	9	61	30			

Notes:

BAFFINLAND GINT LIBRARY.GLB Log ICE BOREHOLE RAIL ALIGNMENT ALL_WITH ICE LOG_REV 3.GPJ <<DrawingFile>> 13/09/2017 11:24

BOREHOLE REPORT

BH16-C010

Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 522,513.0 m
Northing: 7,946,595.0 m
Surface Elevation: 168.20 m
Bottom Elevation: 162.70 m
Total Depth: 5.5 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 11/27/2016
Driller: Michael Scott
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water: Unobserved due to permafrost. Method: Vibracore. Casing: H-Casing [5.5]

Moisture Content Profile scale: 0, 50, 100

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
168.2 – 166.7	0.0 – 1.5	SANDY SILT, with GRAVEL, some COBBLES, trace BOULDERS: Brown, fine to coarse grained sand, angular to subangular gravel, rounded to subrounded cobbles and boulders		12						
		ICE LENSE: Clear, no texture								
		SANDY SILT, some COBBLES, trace GRAVEL: Subangular to subrounded cobbles			9	33	58			
		Pulvirized ROCK: Possible boulders or bedrock								
165.2 – 164.2	3.0 – 4.0	3.00 m to 4.00 m: Pulverized rock mixed with water								
164.2 – 162.7	4.0 – 5.5	WEATHERED ROCK: Dolomitic limestone								

Elevation scale: 167.2 (1.0), 166.2 (2.0), 165.2 (3.0), 164.2 (4.0), 163.2 (5.0), 162.2 (6.0), 161.2 (7.0), 160.2 (8.0), 159.2 (9.0), 158.2 (10.0)

Drilling Refusal.
Drillhole BH16-C010 terminated at 5.5m.

Notes:

BAFFINLAND GINT LIBRARY.GLB Log ICE BOREHOLE RAIL ALIGNMENT ALL_WITH ICE LOG_REV 3.GPJ <<DrawingFile>> 13/09/2017 11:24

HATCH BOREHOLE REPORT

BH16-C011

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Date Logged:	11/27/2016	**Driller:**	E.Beachamp
Hole Diameter (mm):	96	**Date Reviewed:**	2/10/2017

Easting:	525,427.0 m
Northing:	7,937,567.0 m
Surface Elevation:	179.00 m
Bottom Elevation:	168.30 m
Total Depth:	10.7 m
Logged By:	UK
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost			Vibracore	H-Casing	SANDY GRAVEL, with SILT, trace COBBLES: Grey, coarse grained sand, angular to subangular gravel											
	178.0	1.0			Dolomitic Boulder: White, pulverized											
					ICE: No soil inclusions, moderate strength, clear to milky white	ICE										
	177.0	2.0							>>	100						
	176.0	3.0			3.00 m to 6.10m: White to milky white, cloudy, weak strength											
	175.0	4.0							>>	100						
	174.0	5.0							>>	100						
	173.0	6.0			6.10m to 7.60 m: White to clear, candled texture in some parts											
	172.0	7.0			7.60m to 10.60 m: Soft, colourless to milky white, clear to cloudy, sand inclusions				>>	100						
	171.0	8.0							>>	100						
	170.0	9.0														
	169.0	10.0							>>							

Notes:

BOREHOLE REPORT

BH16-C011

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:**	11/27/2016
Driller: E.Beachamp	**Hole Diameter (mm):** 96	**Date Reviewed:**	2/10/2017

Easting:	525,427.0 m
Northing:	7,937,567.0 m
Surface Elevation:	179.00 m
Bottom Elevation:	168.30 m
Total Depth:	10.7 m
Logged By:	UK
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
				[10.7]		ICE: No soil inclusions, moderate strength, clear to milky white *(Continued)*	ICE *(Continued)*				100						
	168.0	11.0				To Target Depth. **Drillhole BH16-C011 terminated at 10.7m.**											
	167.0	12.0															
	166.0	13.0															
	165.0	14.0															
	164.0	15.0															
	163.0	16.0															
	162.0	17.0															
	161.0	18.0															
	160.0	19.0															
	159.0	20.0															

Notes:

HATCH BOREHOLE REPORT

BH16-C012

Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion
Location: Tote Road km 53

Project No.: H352034
Datum: NAD83
Platform:

Easting: 526,569.0 m
Northing: 7,935,536.0 m
Surface Elevation: 163.00 m
Bottom Elevation: 158.40 m
Total Depth: 4.6 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/26/2016
Driller: Michael Scott **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost			Vibracore	H-Casing	SAND and GRAVEL: Brown to light brown, organics, fine to coarse grained sand, subangular gravel	Nf										
	162.0	1.0			SAND: With GRAVEL, light brown, trace silt, granular, fine to medium grained, subangular to rounded, poorly bonded, no excess ice, (Nf)											
	161.0	2.0			SANDY SILT and GRAVEL: Grey to light grey, fine to coarse grained sand, subangular to rounded gravel	Vx										
	160.0	3.0			BOULDERS: Pulverized, grey to white, and cobbles of limestone, no bedding, angular 2.70 m to 3.00 m: Weathered rock pieces, dolomitic limestone											
	159.0	4.0		[4.6]	SANDY SILT, some GRAVEL: Grey to white to dark grey, pulvirized dolomite, boulders or bedrock, fine to medium grained, strong rock, faintly weathered, weakly jointed											
	158.0	5.0			Drilling Refusal. **Drillhole BH16-C012 terminated at 4.6m.**											
	157.0	6.0														
	156.0	7.0														
	155.0	8.0														
	154.0	9.0														
	153.0	10.0														

Notes:

HATCH BOREHOLE REPORT

BH16-C015

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting: 536,142.0 m
Northing: 7,918,691.0 m
Surface Elevation: 189.75 m
Bottom Elevation: 182.15 m
Total Depth: 7.6 m
Logged By: UK,MR
Reviewed By: SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/24/2016

Driller: E.Beachamp **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description — TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	188.8	1.0	Vibracore	H-Casing		SILTY SAND, some GRAVEL, trace COBBLES: Brown to grey, organics, coarse grained sand, angular to sunangular gravel, loose,	Nf			●	9						
	187.8	2.0				SILTY SAND, with GRAVEL: Grey, fine to coarse grained sand, angular to subangular gravel	Nf										
	186.8	3.0				SILTY SAND, some GRAVEL: Light brown to grey, with gravel and cobbles, medium to coarse grained sand, rounded to subangular gravel	Vx										
	185.8	4.0															
	184.8	5.0															
	183.8	6.0															
	182.8	7.0		[7.6]													
	181.8	8.0				To Target Depth. **Drillhole BH16-C015 terminated at 7.6m.**											
	180.8	9.0															
	179.8	10.0															

Notes:

HATCH

BOREHOLE REPORT

BH16-C016

Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 536,362.0 m
Northing: 7,918,814.0 m
Surface Elevation: 190.10 m
Bottom Elevation: 182.50 m
Total Depth: 7.6 m
Logged By: UK
Reviewed By: SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/24/2016
Driller: E.Beachamp **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water: Unobserved due to permafrost
Method: Vibracore
Casing: H-Casing [7.6]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
190.1–188.6	0.0–1.5	SAND, some SILT: Reddish brown, coarse grained sand, angular gravel	Nbn	9 (at 1.0)						
188.6–187.1	1.5–3.0	SANDY SILT, with GRAVEL, trace COBBLES: Light grey, fine grained sand, angular to subangular gravel	Vx	9 (at 2.7)	25	53	22			
187.1–185.5	3.0–4.6	SILTY SAND, some GRAVEL: Light brown to grey, fine to coarse grained sand, angular to subangular gravel	Vc	8 (at 4.0)						
185.5–182.5	4.6–7.6	SANDY GRAVEL, with SILT: Light brown to grey, coarse grained sand, angular to subangular gravel	Nbn							
182.5	7.6	To Target Depth. **Drillhole BH16-C016 terminated at 7.6m.**								

Elevation scale: 189.1, 188.1, 187.1, 186.1, 185.1, 184.1, 183.1, 182.1, 181.1, 180.1
Depth scale: 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Moisture Content Profile: 0, 50, 100

Notes:

HATCH BOREHOLE REPORT

BH16-C017

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 538,597.0 m
Northing: 7,919,742.0 m
Surface Elevation: 159.90 m
Bottom Elevation: 153.80 m
Total Depth: 6.1 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 11/23/2016
Driller: Michael Scott
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water: Unobserved due to permafrost
Method: Vibracore
Casing: H-Casing [6.1]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines
159.9	0.0	SAND, some SILT, trace GRAVEL: Brown to light brown, fine to medium grained sand, rounded to subangular gravel	Vx				
	~0.55	(sample)		24	3	74	22
158.9	1.0						
	1.5	1.50 m to 3.00 m: Trace cobbles					
157.9	2.0						
	~2.45	(sample)		11			
156.9	3.0	SAND and GRAVEL, some SILT: Yellowish brown to reddish brown, fine to coarse grained sand, rounded to subangular gravel	Vx				
155.9	4.0	(sample)					
154.9	5.0						
	~5.5	(sample)		10			
153.9	6.0						
	6.1	To Target Depth. **Drillhole BH16-C017 terminated at 6.1m.**					
152.9	7.0						
151.9	8.0						
150.9	9.0						
149.9	10.0						

Moisture Content Profile: 0 50 100

Other columns: Recovery, Sample Type, Liquid Limit, Plastic Index, Other Tests

Notes:

HATCH BOREHOLE REPORT

BH16-C018
Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 546,111.0 m
Northing: 7,920,740.0 m
Surface Elevation: 160.40 m
Bottom Elevation: 154.30 m
Total Depth: 6.1 m
Logged By: UK
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 11/10/2016
Driller: E.Beachamp
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	160.4–157.4	0.0–3.0	Vibracore	H-Casing	SAND, some GRAVEL: Grey, 0.075 mm to 25 mm, angular gravel		9	1	82	17			
	157.4–154.3	3.0–6.1	Vibracore	H-Casing [6.1]	INFERRED BEDROCK: Possible Sandstone, greyish white, thinly bedded, 0.075mm, pulverized rock and intact rock, very low strength, weakly cemented		3						
		6.1			Drilling Refusal. **Drillhole BH16-C018 terminated at 6.1m.**								

Elevation scale: 159.4 (1.0), 158.4 (2.0), 157.4 (3.0), 156.4 (4.0), 155.4 (5.0), 154.4 (6.0), 153.4 (7.0), 152.4 (8.0), 151.4 (9.0), 150.4 (10.0)

Moisture Content Profile: 0 50 100

Notes:

BOREHOLE REPORT

BH16-C019

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:** 11/10/2016	**Logged By:** UK
Driller: E.Beachamp	**Hole Diameter (mm):** 96	**Date Reviewed:** 2/10/2017	**Reviewed By:** SH/WH

Easting:	546,163.0 m
Northing:	7,920,494.0 m
Surface Elevation:	169.50 m
Bottom Elevation:	165.00 m
Total Depth:	4.5 m

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost		0.0 – 4.5	Vibracore	H-Casing [4.5]		SAND, trace GRAVEL: Brown to reddish brown, medium to coarse grained sand, medium gravel, angular to subangular	Nf										
	165.0	4.5				Drilling Refusal. **Drillhole BH16-C019 terminated at 4.5m.**					8						

Elevation scale: 168.5 (1.0), 167.5 (2.0), 166.5 (3.0), 165.5 (4.0), 164.5 (5.0), 163.5 (6.0), 162.5 (7.0), 161.5 (8.0), 160.5 (9.0), 159.5 (10.0)

Notes:

HATCH BOREHOLE REPORT

BH16-C019B

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Date Logged:	11/10/2016	**Driller:**	Samuel Flynn
Hole Diameter (mm):	96	**Date Reviewed:**	2/10/2017

Easting:	546,214.0 m
Northing:	7,920,455.0 m
Surface Elevation:	170.40 m
Bottom Elevation:	164.30 m
Total Depth:	6.1 m
Logged By:	MR
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0–50–100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	170.4 – 168.9	0.0 – 1.5	Vibracore	H-Casing	SAND, some GRAVEL: Light brown, medium to coarse grained sand, subangular to rounded gravel	Nf										
	168.9 – 164.3	1.5 – 6.1		[6.0]	SAND: White, fine to medium grained, weakly cemented 4.60 m to 6.10 m: Pulverized with angular pieces of quartz and sandstone observed at 4.6m				● (~0)	0	0	98	1			
		6.1			Drilling Refusal. **Drillhole BH16-C019B terminated at 6.1m.**											

Elevation scale (m): 169.4, 168.4, 167.4, 166.4, 165.4, 164.4, 163.4, 162.4, 161.4, 160.4
Depth scale (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Notes:

HATCH BOREHOLE REPORT

BH16-C020
Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 546,402.0 m
Northing: 7,920,072.0 m
Surface Elevation: 166.00 m
Bottom Elevation: 157.00 m
Total Depth: 9.0 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 11/10/2016
Driller: Samuel Flynn
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	166.0	0.0	Vibracore	H-Casing	SAND: Light brown to grey, medium to coarse grained sand, weakly cemented	Nf										
	165.0	1.0						Sample								
	163.5	2.5						Sample	●	8						
	163.0	3.0				Vr										
	161.5	4.5				Nf		Sample								
	160.5	5.5						Sample	●	8						
	159.5	6.5						Sample								
	157.5	8.5			8.50 m: Weakly cemented sandstone			Sample	●	11						
	157.0	9.0		[9.0]	To Target Depth. **Drillhole BH16-C020 terminated at 9.0m.**											

Notes:

HATCH BOREHOLE REPORT

BH16-C021

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	546,593.0 m
Northing:	7,919,917.0 m
Surface Elevation:	167.10 m
Bottom Elevation:	158.10 m
Total Depth:	9.0 m
Logged By:	MR
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/9/2016

Driller: Samuel Flynn **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water: Unobserved due to permafrost
Method: Vibracore
Casing: H-Casing [9.0]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
167.1	0.0	SAND: Light brown, medium to coarse grained sand	Nf							
166.1	1.0									
			Nbe							
165.1	2.0	ICE LENSE: Colorless to grey, medium strength, clear to cloudy texture, sand inclusions								
				14						
164.1	3.0	SAND, some GRAVEL, trace SILT: Grey to light brown, fine to coarse grained sand, subangular to rounded gravel	Nf							
				12						
163.1	4.0									
		SAND WITH SOME GRAVEL: grey to light brown, trace silt, subangular, fine to coarse grained, subangular to rounded, poorly bonded, no excess ice, (Nf)	Nbn							
162.1	5.0									
161.1	6.0									
160.1	7.0	7.00 m: Broken pieces of weak sandstone								
		7.50 m to 8.70 m: Trace Silt								
159.1	8.0									
		8.70 m: Light grey powder at 8.7m with angular pieces of quartz sandstone, possible bedrock		5	0	67	33			
158.1	9.0	Drilling Refusal. **Drillhole BH16-C021 terminated at 9.0m.**								
157.1	10.0									

Moisture Content Profile (0, 50, 100)

Notes:

HATCH

BOREHOLE REPORT

BH16-C022

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	547,077.0 m
Northing:	7,919,746.0 m
Surface Elevation:	163.20 m
Bottom Elevation:	154.10 m
Total Depth:	9.1 m
Logged By:	UK
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/11/2016

Driller: E.Beachamp **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water: Unobserved due to permafrost

Method: Vibracore

Casing: H-Casing [9.1]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description
163.2	0.0	PEAT, with SAND: Grey, black, fragmented	Nf
		SAND, trace SILT: Grey, medium to coarse grained	Nbn
162.2	1.0		
		1.50 m: Loose, fine to coarse grained, poorly bonded,	
161.2	2.0		
		2.60 m: Moderately banded	
160.2	3.0		Nf
159.2	4.0		Vx
158.2	5.0		
157.2	6.0		
		6.40 m: Grey to Brown	
156.2	7.0	7.00 m: Trace cobbles	
		ICE LENSE: Grey to blue, Cloudy texture, minor sand and silt inclusions	
155.2	8.0		
154.2	9.0		
		To Target Depth. **Drillhole BH16-C022 terminated at 9.1m.**	
153.2	10.0		

Moisture Content Profile: 0 50 100

Depth (m)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
~4.4	19	0	98	2			
~7.4	24						

Notes:

BOREHOLE REPORT

BH16-C023

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 547,304.0 m
Northing: 7,919,643.0 m
Surface Elevation: 165.90 m
Bottom Elevation: 155.20 m
Total Depth: 10.7 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 11/11/2016
Driller: Samuel Flynn
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water: Unobserved due to permafrost
Method: Vibracore
Casing: H-Casing

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	0.0	PEAT, with SAND: Brown to dark grey, medium to coarse grained sand	Nf							
		SAND, trace SILT: Dark grey to brown, medium to coarse grained sand	Nbn							
164.9	1.0									
163.9	2.0									
162.9	3.0	SAND, trace GRAVEL: Grey to light brown, fine to coarse grained sand, subangular to rounded gravel	Nf							
				16	0	93	7			
161.9	4.0									
		4.60 m to 6.20 m: Light brown, sand and silt, some gravel								
160.9	5.0			17	12	44	45			
159.9	6.0									
		ICE: Colorless to white, soft to moderate strength, clear to cloudy texture, minor silt and sand inclusions		15	12	44	45			
158.9	7.0									
157.9	8.0									
156.9	9.0									
155.9	10.0									

Moisture Content Profile: 0, 50, 100

Notes:

HATCH BOREHOLE REPORT

BH16-C023

Sheet 2 of 2

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 547,304.0 m
Northing: 7,919,643.0 m
Surface Elevation: 165.90 m
Bottom Elevation: 155.20 m
Total Depth: 10.7 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 11/11/2016
Driller: Samuel Flynn
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
				[10.7]		ICE: Colorless to white, soft to moderate strength, clear to cloudy texture, minor silt and sand inclusions *(Continued)*											
						To Target Depth. **Drillhole BH16-C023 terminated at 10.7m.**											
	154.9	11.0															
	153.9	12.0															
	152.9	13.0															
	151.9	14.0															
	150.9	15.0															
	149.9	16.0															
	148.9	17.0															
	147.9	18.0															
	146.9	19.0															
	145.9	20.0															

Notes:

HATCH

BOREHOLE REPORT

BH16-C024

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Date Logged:	11/12/2016	**Driller:**	Samuel Flynn
Hole Diameter (mm):	96	**Date Reviewed:**	2/10/2017

Easting:	547,530.0 m
Northing:	7,919,537.0 m
Surface Elevation:	165.00 m
Bottom Elevation:	154.30 m
Total Depth:	10.7 m
Logged By:	MR
Reviewed By:	SH/WH

Water: Unobserved due to permafrost

Method: Vibracore

Casing: H-Casing

Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.

Moisture Content Profile: 0, 50, 100

Elevation (m)	Depth (m)	Soil Description	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
165.0	0.0	SAND, trace SILT, trace GRAVEL: Light brown, medium to coarse grained sand, rounded to subangular gravel	Nf							
164.0	1.0									
163.0	2.0									
162.0	3.0	3.00 m to 6.00 m: No gravel observed								
161.0	4.0									
160.0	5.0			18	0	90	10			
159.0	6.0	6.10 m to 10.70 m: Light reddish brown sand	Vx							
158.0	7.0			18						
157.0	8.0									
156.0	9.0		Vr							
155.0	10.0									

Notes:

HATCH BOREHOLE REPORT

BH16-C024

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	547,530.0 m
Northing:	7,919,537.0 m
Surface Elevation:	165.00 m
Bottom Elevation:	154.30 m
Total Depth:	10.7 m
Logged By:	MR
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/12/2016

Driller: Samuel Flynn **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
				[10.7]		SAND, trace SILT, trace GRAVEL: Light brown, medium to coarse grained sand, rounded to subangular gravel *(Continued)*	Nf *(Continued)*				14						
	154.0	11.0				To Target Depth. **Drillhole BH16-C024 terminated at 10.7m.**											
	153.0	12.0															
	152.0	13.0															
	151.0	14.0															
	150.0	15.0															
	149.0	16.0															
	148.0	17.0															
	147.0	18.0															
	146.0	19.0															
	145.0	20.0															

Notes:

BOREHOLE REPORT

BH16-C025

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	548,370.0 m
Northing:	7,919,181.0 m
Surface Elevation:	163.00 m
Bottom Elevation:	155.40 m
Total Depth:	7.6 m
Logged By:	UK
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/12/2016

Driller: E.Beachamp **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	163.0–157.5	0.0–5.5	Vibracore	H-Casing		GRAVELLY SILTY SAND: Brown, fine to coarse grained	Nbn (at ~3.7 m); Nf (at ~4.4 m)			● (at 4.0 m)	15	1	89	10			
	157.5–156.0	5.5–7.0				ICE: Grey to blue, moderate hardness milky to cloudy texture, sand inclusions 6.10 m to 7.00 m: White to pink, cloudy texture, sand and silt inclusions											
	156.0–155.4	7.0–7.6		[7.6]		SAND and SILT: LIght brown, fine grained sand	Vx										
		7.6				To Target Depth. **Drillhole BH16-C025 terminated at 7.6m.**											

Elevation scale (m): 162.0, 161.0, 160.0, 159.0, 158.0, 157.0, 156.0, 155.0, 154.0, 153.0
Depth scale (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Notes:

HATCH

BOREHOLE REPORT

BH16-C026

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment

Project No.: H352034
Datum: NAD83
Platform: Ground

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 11/12/2016
Driller: E.Beachamp
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Easting:	550,262.0 m
Northing:	7,918,123.0 m
Surface Elevation:	170.20 m
Bottom Elevation:	159.50 m
Total Depth:	10.7 m
Logged By:	UK
Reviewed By:	SH/WH

Columns: Water | Elevation (m) | Depth (m) | Method | Casing | Graphic Log | Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.) | Frozen Soil Description | Recovery | Sample Type | Moisture Content Profile (0, 50, 100) | Field Water Content | Percent Gravel | Percent Sand | Percent Fines | Liquid Limit | Plastic Index | Other Tests

Water: Unobserved due to permafrost
Method: Vibracore
Casing: H-Casing

Elevation / Depth scale: 169.2 / 1.0; 168.2 / 2.0; 167.2 / 3.0; 166.2 / 4.0; 165.2 / 5.0; 164.2 / 6.0; 163.2 / 7.0; 162.2 / 8.0; 161.2 / 9.0; 160.2 / 10.0

Soil Description	Frozen Soil Description
SNOW and ROOTLETS	
SILTY SAND, trace GRAVEL: Dark brown, coarse grained sand	Nf
	Nbn
SILTY SAND, trace GRAVEL: Brown, fine to medium grained	Nbn
3.90 m to 4.30 m: Some cobbles and gravel	Nbn
ICE: Minor silt inclusions	ICE
SAND and SILT, trace GRAVEL: Brown, fine grained to medium grained sand	
INFERRED BOULDERS	
SILTY SAND, trace GRAVEL: Grey, fine to coarse grained sand	Nf

Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
14	6	69	24			
	2	77	21			
19						
13						

Notes:

BOREHOLE REPORT

BH16-C026

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	550,262.0 m
Northing:	7,918,123.0 m
Surface Elevation:	170.20 m
Bottom Elevation:	159.50 m
Total Depth:	10.7 m
Logged By:	UK
Reviewed By:	SH/WH

Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig	**Date Logged:**	11/12/2016
Driller:	E.Beachamp	**Hole Diameter (mm):**	96	**Date Reviewed:**	2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
				[10.7]		SILTY SAND, trace GRAVEL: Grey, fine to coarse grained sand *(Continued)*	Nf *(Continued)*										
	159.2	11.0				To Target Depth. **Drillhole BH16-C026 terminated at 10.7m.**											
	158.2	12.0															
	157.2	13.0															
	156.2	14.0															
	155.2	15.0															
	154.2	16.0															
	153.2	17.0															
	152.2	18.0															
	151.2	19.0															
	150.2	20.0															

Notes:

BOREHOLE REPORT

BH16-C027

Sheet 1 of 2

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	550,416.0 m
Northing:	7,917,928.0 m
Surface Elevation:	171.00 m
Bottom Elevation:	158.80 m
Total Depth:	12.2 m
Logged By:	MR
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/12/2016

Driller: Samuel Flynn **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water: Unoserved due to permafrost

Method: Vibracore

Casing: H-Casing

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Sample Type	Field Water Content	Percent Gravel	Percent Sand	Percent Fines
		SAND and GRAVEL: Peat, dark grey	Nf					
170.0	1.0	SAND and GRAVEL: Dark grey, medium to coarse grained sand, rounded to subrounded gravel	Nf					
		SILTY SAND, trace GRAVEL: Light brown, medium to coarse grained sand, rounded to subangular gravel	Nf					
169.0	2.0							
168.0	3.0		Nbn					
167.0	4.0			▽	10	9	72	20
166.0	5.0			▽				
		ICE: Grey, low to medium strength, cloudy texture	ICE					
165.0	6.0	SILTY SAND, trace GRAVEL: Light brown to grey, fine to coarse grained sand, rounded to subangular gravel	Nf					
164.0	7.0			▽	16			
		ICE: Grey, low strength, cloudy texture, soil inclusions 7.90 to 12.20 m: Colourless to white, moderate strength, clear to cloudy texture	ICE					
163.0	8.0							
162.0	9.0							
161.0	10.0							

Moisture Content Profile: 0 50 100

Columns: Recovery, Liquid Limit, Plastic Index, Other Tests

Notes:

HATCH

BOREHOLE REPORT

BH16-C027
Sheet 2 of 2

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	550,416.0 m
Northing:	7,917,928.0 m
Surface Elevation:	171.00 m
Bottom Elevation:	158.80 m
Total Depth:	12.2 m
Logged By:	MR
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/12/2016
Driller: Samuel Flynn **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	160.0 159.0	11.0 12.0		[12.2]		ICE: Grey, low strength, cloudy texture, soil inclusions *(Continued)*	ICE *(Continued)*										
	158.0 157.0 156.0 155.0 154.0 153.0 152.0 151.0	13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0				To Target Depth. **Drillhole BH16-C027 terminated at 12.2m.**											

Notes:

HATCH

BOREHOLE REPORT

BH16-C028

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 551,403.0 m
Northing: 7,916,768.0 m
Surface Elevation: 189.00 m
Bottom Elevation: 177.40 m
Total Depth: 11.6 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/12/2016
Driller: Samuel Flynn **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water: Unobserved due to permafrost
Method: Vibracore
Casing: H-Casing

Depth (m)	Elevation (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0–50–100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
0.0	189.0	SAND and GRAVEL, trace COBBLES: Light brown, medium to coarse grained sand, rounded to subangular gravel	Nf										
1.5	187.5	SAND, with GRAVEL: Grey, fine to coarse grained sand, rounded to subangular gravel	Nf										
6.1	182.9	SAND, trace SILT: Light grey, fine to course grained sand	Nf										
~6.4					Sample								
~8.9					Sample	●	7	0	6	94			
9.40		9.40 m to 10.70 m: Some gravel and cobbles											
~9.7					Sample	●	18						

Depth scale: 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0
Elevation scale: 188.0, 187.0, 186.0, 185.0, 184.0, 183.0, 182.0, 181.0, 180.0, 179.0

Notes:

BOREHOLE REPORT

BH16-C028

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 551,403.0 m
Northing: 7,916,768.0 m
Surface Elevation: 189.00 m
Bottom Elevation: 177.40 m
Total Depth: 11.6 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 11/12/2016
Driller: Samuel Flynn
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
						SAND, trace SILT: Light grey, fine to course grained sand *(Continued)*	Nf *(Continued)*										
	178.0	11.0				SAND, some GRAVEL, trace COBBLES: Reddish brown, fine to coarse grained sand, angular to subrounded gravel 10.80 m: Possible weathered bedrock, pulverized quartz sandstone	Nf										
	177.0	12.0		[12.2]		Drilling Refusal. **Drillhole BH16-C028 terminated at 11.6m.**											
	176.0	13.0															
	175.0	14.0															
	174.0	15.0															
	173.0	16.0															
	172.0	17.0															
	171.0	18.0															
	170.0	19.0															
	169.0	20.0															

Notes:

HATCH BOREHOLE REPORT

BH16-C029
Sheet 1 of 1

Client: Baffinland Iron Mines	**Project No.:** H352034	**Easting:** 552,569.0 m	**Northing:** 7,915,813.0 m
Project: Mary River Expansion Study Stage 2	**Datum:** NAD83	**Surface Elevation:** 185.25 m	**Bottom Elevation:** 177.65 m
Location: Proposed Rail Alignment	**Platform:** Ground	**Total Depth:** 7.6 m	
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:** 11/13/2016	**Logged By:** UK
Driller: E.Beachamp	**Hole Diameter (mm):** 96	**Date Reviewed:** 2/10/2017	**Reviewed By:** SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	185.25	0.0	Vibracore	H-Casing	SILTY SAND: Brown to reddish brown, fine grained sand	Nbn							
	183.3–182.3	2.0–3.0					21	1	75	25			
		~3.0				Nf							
	181.5	3.70			3.70 m to 6.10 m: Low-strength pieces of rock								
	179.15	6.10			Reddish brown rocks, narrow bedding, very weak								
	177.65	7.6		[7.6]	To Target Depth. **Drillhole BH16-C029 terminated at 7.6m.**								

Elevation scale: 184.3 (1.0), 183.3 (2.0), 182.3 (3.0), 181.3 (4.0), 180.3 (5.0), 179.3 (6.0), 178.3 (7.0), 177.3 (8.0), 176.3 (9.0), 175.3 (10.0)

Moisture Content Profile: 0 50 100

Notes:

HATCH BOREHOLE REPORT

BH16-C030

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 555,337.0 m
Northing: 7,914,646.0 m
Surface Elevation: 160.75 m
Bottom Elevation: 148.55 m
Total Depth: 12.2 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 11/15/2016
Driller: Michael Scott
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water: Unobserved due to permafrost
Method: Vibracore
Casing: H-Casing

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Moisture Content Profile (0–100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
160.75	0.0	SAND, trace GRAVEL: Light brown, medium to coarse grained sand, rounded to subrounded gravel	Nf								
159.8	1.0										
		SAND, trace SILT, trace GRAVEL: Light brown, fine to coarse grained sand	Vc								
158.8	2.0			●	14						
157.8	3.0										
156.8	4.0										
155.8	5.0			●	19	3	94	3			
154.8	6.0										
		ICE and SOIL: White, low strength, cloudy texture, mixed with SILTY SAND									
153.8	7.0										
152.8	8.0										
151.8	9.0										
150.8	10.0										

Notes:

HATCH BOREHOLE REPORT

BH16-C030

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:** 11/15/2016	
Driller: Michael Scott	**Hole Diameter (mm):** 96	**Date Reviewed:** 2/10/2017	

Easting:	555,337.0 m
Northing:	7,914,646.0 m
Surface Elevation:	160.75 m
Bottom Elevation:	148.55 m
Total Depth:	12.2 m
Logged By:	MR
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	**Soil Description** TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile 0 50 100	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	**Other Tests**
	149.8 148.8	11.0 12.0		[12.2]		ICE and SOIL: White, low strength, cloudy texture, mixed with SILTY SAND *(Continued)*											
	147.8 146.8 145.8 144.8 143.8 142.8 141.8 140.8	13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0				To Target Depth. **Drillhole BH16-C030 terminated at 12.2m.**											

Notes:

HATCH BOREHOLE REPORT

BH16-C031

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	556,864.0 m
Northing:	7,915,216.0 m
Surface Elevation:	170.00 m
Bottom Elevation:	168.50 m
Total Depth:	1.5 m
Logged By:	UK
Reviewed By:	SH/WH

Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig	**Date Logged:**	11/15/2016
Driller:	Michael Scott	**Hole Diameter (mm):**	96	**Date Reviewed:**	2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 / 50 / 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	169.0	1.0	Vibracore	H-Casing [1.5]		SAND, trace GRAVEL: Brown, fine to coarse grained sand, angular to subangular gravel	Nf										
	168.0	2.0				To Target Depth. **Drillhole BH16-C031 terminated at 1.5m.**											
	167.0	3.0															
	166.0	4.0															
	165.0	5.0															
	164.0	6.0															
	163.0	7.0															
	162.0	8.0															
	161.0	9.0															
	160.0	10.0															

Notes:

HATCH BOREHOLE REPORT

BH16-C032
Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	557,282.0 m
Northing:	7,915,265.0 m
Surface Elevation:	171.00 m
Bottom Elevation:	161.90 m
Total Depth:	9.1 m
Logged By:	MR
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/15/2016

Driller: Michael Scott **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water: Unobserved due to permafrost
Method: Vibracore
Casing: H-Casing [9.1]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
171.0–169.5	0.0–1.5	PEAT, with SAND and GRAVEL: Brown, medium to coarse grained sand, rounded to subangular gravel	Nf							
169.5–168.0	1.5–3.0	SILTY SAND, some GRAVEL: Light brown, medium to coarse grained sand, rounded to subangular gravel	Nf	11	10	71	19			
168.0–164.0	3.0–7.0	SILTY SAND and GRAVEL, trace COBBLES: Light brown, medium to coarse grained sand, rounded to subrounded cobbles	Nf / Vc							
164.0–162.3	7.0–8.7	ICE and SOIL: Dark grey to light brown, cloudy texture, ice mixed with silty sand	ICE							
162.3–161.9	8.7–9.1	SILTY SAND and GRAVEL, trace COBBLES: Light brown, medium to coarse grained sand, rounded to subrounded cobbles	Vc							

To Target Depth.
Drillhole BH16-C032 terminated at 9.1m.

Moisture Content Profile: 0, 50, 100

Notes:

HATCH BOREHOLE REPORT

BH16-C201

Sheet 1 of 1

Client: Baffinland Iron Mines	**Project No.:** H352034	**Easting:**	553,750.0 m
Project: Mary River Expansion Study Stage 2	**Datum:** NAD83	**Northing:**	7,915,276.0 m
Location: Proposed Rail Alignment	**Platform:** Ground	**Surface Elevation:**	178.00 m
		Bottom Elevation:	175.60 m
		Total Depth:	2.4 m
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:** 11/18/2016	**Logged By:** UK
Driller: E.Beachamp	**Hole Diameter (mm):** 96	**Date Reviewed:** 2/10/2017	**Reviewed By:** SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	177.0 176.0	1.0 2.0	Vibracore	H-Casing [2.4]		SAND, some GRAVEL, trace COBBLES: Reddish brown, fine to coarse grained sand, angular to subangular gravel, some silt											
						ROCK: Weak to medium strong, sedimentary, grey and white crystals											
	175.0 174.0 173.0 172.0 171.0 170.0 169.0 168.0	3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0				To Target Depth. **Drillhole BH16-C201 terminated at 2.4m.**											

Notes:

BOREHOLE REPORT

BH16-C202

Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 554,531.0 m
Northing: 7,915,452.0 m
Surface Elevation: 174.50 m
Bottom Elevation: 166.90 m
Total Depth: 7.6 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 11/16/2016
Driller: Samuel Flynn
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost		0.0	Vibracore	H-Casing	TOPSOIL, SILTY SAND, with GRAVEL	Nf										
	173.5	1.0			SILTY SAND, with GRAVEL: Light brown, medium to coarse grained sand	Nf										
	172.5	2.0														
	171.5	3.0			Crushed COBBLES and BOULDERS: Grey to pink, fine to coarse grained sand											
	170.5	4.0														
	169.5	5.0			BOULDERS: Grey to light green, granitic gneiss and chloritic schist, medium to coarse grained, very thinly bedded, medium strength, slightly weathered											
	168.5	6.0			INFERRED BEDROCK: Laminated to very thinly bedded, faintly weathered,											
	167.5	7.0		[7.6]												
	166.5	8.0			To Target Depth. **Drillhole BH16-C202 terminated at 7.6m.**											
	165.5	9.0														
	164.5	10.0														

Notes:

HATCH BOREHOLE REPORT

BH16-C203
Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 555,007.0 m
Northing: 7,915,451.0 m
Surface Elevation: 177.00 m
Bottom Elevation: 167.90 m
Total Depth: 9.1 m
Logged By: UK
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 11/17/2016
Driller: E.Beachamp
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water: Unobserved due to permafrost
Method: Vibracore
Casing: H-Casing [9.1]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description
177.0–175.5	0.0–1.5	SILTY SAND, some COBBLES, trace BOULDERS: Grey, fine to coarse grained sand, angular to subangular cobbles	Nf
175.5–174.0	1.5–3.0	SILTY SAND, some GRAVEL: Brown, fine to coarse grained sand	Nf
174.0–171.2	3.0–5.8	SILTY SAND: Brown, fine to medium grained	Nbn
171.2–170.9	5.8–6.1	BOULDER: Sandstone, medium grained, medium bedded, weak	
170.9–169.4	6.1–7.6	WEATHERED ROCK: Mafic gneiss with crystalline fines observed, shiny face when fracutured, grey and white streaks	
169.4–167.9	7.6–9.1	BEDROCK: Gneiss, grey and white bedding layers, approximately 40 mm, thinly bedded,weak to medium quality	
		To Target Depth. **Drillhole BH16-C203 terminated at 9.1m.**	

Elevation scale: 176.0, 175.0, 174.0, 173.0, 172.0, 171.0, 170.0, 169.0, 168.0, 167.0
Depth scale: 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Columns: Water | Elevation (m) | Depth (m) | Method | Casing | Graphic Log | Soil Description | Frozen Soil Description | Recovery | Sample Type | Moisture Content Profile (0, 50, 100) | Field Water Content | Percent Gravel | Percent Sand | Percent Fines | Liquid Limit | Plastic Index | Other Tests

Notes:

BOREHOLE REPORT

BH16-C204

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	555,659.0 m
Northing:	7,915,432.0 m
Surface Elevation:	173.00 m
Bottom Elevation:	170.30 m
Total Depth:	2.7 m
Logged By:	MR
Reviewed By:	SH/WH

Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig	**Date Logged:**	11/16/2016
Driller:	Samuel Flynn	**Hole Diameter (mm):**	96	**Date Reviewed:**	2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	173.0 – 172.8	0.0 – 0.2	Vibracore	H-Casing	PEAT, with SAND and GRAVEL: Brown, fine to coarse grained sand	Nf										
	172.8 – 171.5	0.2 – 1.5	Vibracore	H-Casing	SAND and GRAVEL, trace COBBLES, trace BOULDERS: Light brown to grey	Nf										
	171.5 – 168.4	1.5 – 4.6	Vibracore	H-Casing [2.7]	SILTY SAND, some GRAVEL, trace COBBLES: Grey, fine to coarse grained sand, rounded to subrounded cobbles	Nf										
	168.4 – 163.9	4.6 – 9.1			INFERRED BEDROCK: Grey, pulverized boulders of gneiss or Franklin diabase observed, subcohesive, no bedding											
					Drilling Refusal. **Drillhole BH16-C204 terminated at 2.7m.**											

Elevation scale: 172.0, 171.0, 170.0, 169.0, 168.0, 167.0, 166.0, 165.0, 164.0, 163.0

Depth scale: 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Notes:

HATCH

BOREHOLE REPORT

BH16-C205

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	555,883.0 m
Northing:	7,915,449.0 m
Surface Elevation:	173.00 m
Bottom Elevation:	164.50 m
Total Depth:	8.5 m
Logged By:	UK
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/21/2016

Driller: E.Beachamp **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description — TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	173.0	0.0	Vibracore	H-Casing	SAND, with GRAVEL, some COBBLES, trace BOULDERS: Brown, coarse grained sand, rounded to subangular cobbles and gravel											
	172.0	1.0						⧖								
	171.0	2.0			GRAVELLY SILTY SAND: Brown to grey, coarse grained sand, rounded to subangular gravel			⧖								
	170.0	3.0														
	169.0	4.0						⧖	●	6	20	47	33			
	168.0	5.0			INFERRED BEDROCK: Granitic, white, crushed and pulverized rock pieces			⧖								
	167.0	6.0														
	166.0	7.0						⧖								
	165.0	8.0		[8.5]												
	164.0	9.0			Drilling Refusal. **Drillhole BH16-C205 terminated at 8.5m.**											
	163.0	10.0														

Notes:

HATCH BOREHOLE REPORT

BH16-C206

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment

Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 556,059.0 m
Northing: 7,915,442.0 m
Surface Elevation: 173.00 m
Bottom Elevation: 163.90 m
Total Depth: 9.1 m
Logged By: UK
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 11/22/2016
Driller: E.Beachamp
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Columns: Water | Elevation (m) | Depth (m) | Method | Casing | Graphic Log | Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.) | Frozen Soil Description | Recovery | Sample Type | Moisture Content Profile (0, 50, 100) | Field Water Content | Percent Gravel | Percent Sand | Percent Fines | Liquid Limit | Plastic Index | Other Tests

Water: Unobserved due to permafrost
Method: Vibracore
Casing: H-Casing [9.1]

Elevation (m): 172.0, 171.0, 170.0, 169.0, 168.0, 167.0, 166.0, 165.0, 164.0, 163.0
Depth (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Soil Description	Frozen Soil Description	Field Water Content
SAND: White to grey, pulverized rock, weak to moderate strength, fine grained	Nf	
SILTY SAND, some GRAVEL: Dark brown, fine to medium grained sand, angular to subangular gravel	Nf	
ICE, with Sandy SILT inclusions: Grey, cohesive, fine grained, hard, cloudy	ICE	53 (>>)
SAND and GRAVEL: Reddish brown	Vc Vr	22
SANDY SILT, trace GRAVEL: Dark grey, find grained sand	Nbn	
BOULDERS: Grey, white to grey, pulverized rock, medium strong		
SANDY SILT, trace GRAVEL: Dark brown to grey, find grained sand		
INFERRED BEDROCK: Light grey, pulverized rock with intact pieces, medium strong		
To Target Depth. **Drillhole BH16-C206 terminated at 9.1m.**		

Notes:

BOREHOLE REPORT

BH16-C207

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	556,679.0 m
Northing:	7,915,415.0 m
Surface Elevation:	175.00 m
Bottom Elevation:	167.70 m
Total Depth:	7.3 m
Logged By:	MR
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/21/2016

Driller: Samuel Flynn **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	175.0–173.5	0.0–1.5	Vibracore	H-Casing	SAND and GRAVEL, some COBBLES: Brown, medium to coarse grained sand, subangular to rounded gravel and cobbles	Nf										
	173.5–168.9	1.5–6.1			SAND, some GRAVEL, trace COBBLES: Grey to light yellow, medium to coarse grained sand, rounded to subangular gravel	Vx				12 (at ~2.0 m); 2 (at ~5.6 m)						
	168.9–167.7	6.1–7.3		[7.3]	INFERRED BEDROCK: Light grey, pulverized rock, with intact pieces of sandstone, medium strong											

Drilling Refusal.

Drillhole BH16-C207 terminated at 7.3m.

Elevation scale: 174.0, 173.0, 172.0, 171.0, 170.0, 169.0, 168.0, 167.0, 166.0, 165.0

Depth scale: 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Notes:

HATCH BOREHOLE REPORT

BH16-Q001

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Potential Quarry Location	**Platform:**	Ground

Easting:	505,308.0 m
Northing:	7,972,797.0 m
Surface Elevation:	68.25 m
Bottom Elevation:	63.65 m
Total Depth:	4.6 m
Logged By:	MR
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/5/2016

Driller: Samuel Flynn **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost		0.0	Vibracore	H-Casing		ORGANICS: Frozen organic soil	Nf										
	67.3	1.0				SAND, some GRAVEL, trace COBBLES: Medium to coarse grained sand, fine to coarse gravel, light brown, subangular to rounded			⊠								
	66.3	2.0				SAND and GRAVEL trace COBBLES: Coarse sand, fine to coarse gravel, light brown to grey, subangular to rounded	Nf		⊠								
	65.3	3.0				3.00 m to 4.60 m: Trace COBBLES											
	64.3	4.0		[4.6]													
	63.3	5.0				To Target Depth. **Drillhole BH16-Q001 terminated at 4.6m.**											
	62.3	6.0															
	61.3	7.0															
	60.3	8.0															
	59.3	9.0															
	58.3	10.0															

Notes:

HATCH BOREHOLE REPORT

BH16-Q7001

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Potential Quarry Location	**Platform:**	Ground

Easting:	529,144.0 m
Northing:	7,927,494.0 m
Surface Elevation:	187.80 m
Bottom Elevation:	184.20 m
Total Depth:	3.6 m
Logged By:	CS
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/24/2016

Driller: E.Beachamp **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Water	186.8	1.0	Vibracore	H-Casing	Silty GRAVEL: Light brown, pulverized rock flour (limestone), light grey, subangular to angular limestone, up to 80mm											
	185.8	2.0			SILT, some GRAVEL, trace SAND: Light brown, angular, fine to coarse					11						
	184.8	3.0		[3.6]	LIMESTONE: Pulverized, subrounded to round, grey											
	183.8	4.0			To Target Depth. **Drillhole BH16-Q7001 terminated at 3.6m.**											
	182.8	5.0														
	181.8	6.0														
	180.8	7.0														
	179.8	8.0														
	178.8	9.0														
	177.8	10.0														

Notes:

BOREHOLE REPORT

HATCH

BH16-Q7002

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Potential Quarry Location	**Platform:**	Ground

Easting: 530,561.0 m
Northing: 7,928,150.0 m
Surface Elevation: 284.00 m
Bottom Elevation: 277.14 m
Total Depth: 6.9 m

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** **Logged By:** RS/CS

Driller: E.Beachamp **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017 **Reviewed By:** SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost	284.0–282.5	0.0–1.5	HQ-3 Coring	Wash Bore C/B & Casing	No recovery											
	282.5–281.0	1.5–3.0			Silty GRAVEL, some COBBLES: Brown, fine to coarse gravel, subangular to angular											
	281.0–279.5	3.0–4.5			No recovery											
	279.5–278.8	4.5–5.2			LIMESTONE: Grey, fragmented, angular to subangular, limestone bedrock											
	278.8–277.1	5.2–6.9		[6.9]	Silty GRAVEL, with COBBLES: Light brown, cobbles and gravel are angular to subangular, grey											
					To Target Depth. **Drillhole BH16-Q7002 terminated at 6.9m.**											

Elevation scale: 283.0, 282.0, 281.0, 280.0, 279.0, 278.0, 277.0, 276.0, 275.0, 274.0
Depth scale: 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Notes:

BOREHOLE REPORT

BH16-Q7003

Client: Baffinland Iron Mines
Project No.: H352034
Project: Mary River Expansion Study Stage 2
Datum: NAD83
Location: Potential Quarry Location
Platform: Ground

Contractor: Boart Longyear | **Rig Type/ Mounting:** MiniSonic Rig | **Date Logged:** 10/24/2016
Driller: E.Beachamp | **Hole Diameter (mm):** 96 | **Date Reviewed:** 2/10/2017

Easting:	531,053.0 m
Northing:	7,929,065.0 m
Surface Elevation:	201.00 m
Bottom Elevation:	191.90 m
Total Depth:	9.1 m
Logged By:	RS
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Other Tests
Unobserved due to Permafrost	201.0–199.5	0.0–1.5	Vibracore	H-Casing		SILT and GRAVEL, trace SAND: Fine grained, angular, beige/grey					
	199.5–196.0	1.5–5.0				1.50 m to 5.00 m: Visible ice layers, up to 5 mm thick	Vs		⊠		
	196.0–194.9	5.0–6.1				SAND: Fine to medium, brown	Nbn		⊠		
	194.9–193.7	6.1–7.3				Gravelly SILT: Well graded, grey			⊠		
	193.7	7.3				***Start of Coring at 7.3m.*** ***Continued on Rock Core Log sheet.***					

Elevation scale: 200.0, 199.0, 198.0, 197.0, 196.0, 195.0, 194.0, 193.0, 192.0, 191.0, 190.0
Depth scale: 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0

Notes:

HATCH

BOREHOLE LOG

ROCK CORE FORMAT

BH16-Q7003

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Potential Quarry Location	**Platform:**	Ground

Easting:	531,053.0 m
Northing:	7,929,065.0 m
Surface Elevation:	201.00 m
Bottom Elevation:	191.90 m
Total Depth:	9.1 m
Logged By:	RS
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Bearing:** N/A **Date Logged:** 10/24/2016

Driller: E.Beachamp **Hole Diameter (mm):** 96 **Plunge:** Vertical **Date Checked:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Geological Unit	Rock Description ROCK TYPE; Grain size, texture and fabric, colour, general defect conditions, minor constituents.	Weathering/ Cementation	Estimated Strength EH VH H M L VL EL	Is(50) [UCS] MPa	Defect Spacing mm 2000 600 200 [100] 60 20	RQD %
	200.0	1.0										
	199.0	2.0										
	198.0	3.0										
	197.0	4.0										
	196.0	5.0										
	195.0	6.0										
	194.0	7.0					***Resuming in Rock Core Format 7.3m.***					
	193.0	8.0					LIMESTONE: Bedrock, fragmented / pulverized rock sample					
	192.0	9.0		[9.1]								
	191.0	10.0					To Target Depth. **Drillhole BH16-Q7003 terminated at 9.1m.**					
	190.0	11.0										

Notes:

HATCH

BOREHOLE REPORT

BH16-Q7004

Sheet 1 of 3

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Potential Quarry Location	**Platform:**	Ground
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:** 10/25/2016	
Driller: E.Beachamp	**Hole Diameter (mm):** 96	**Date Reviewed:** 2/10/2017	

Easting:	529,264.0 m
Northing:	7,927,466.0 m
Surface Elevation:	282.80 m
Bottom Elevation:	272.20 m
Total Depth:	10.6 m
Logged By:	RS/CS
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Other Tests
Unobserved due to Permafrost			Vibracore	H-Casing		SILT and GRAVEL: Grey, pulverized limestone					
	281.8	1.0									
						No recovery					
	280.8	2.0									
	279.8	3.0									
	278.8	4.0		[4.6]							
						Start of Coring at 4.6m. Continued on Rock Core Log sheet.					
	277.8	5.0									
	276.8	6.0									
	275.8	7.0									
	274.8	8.0									
	273.8	9.0									
	272.8	10.0									

Notes:

BOREHOLE LOG

ROCK CORE FORMAT

HATCH

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Potential Quarry Location	**Platform:**	Ground

Easting:	529,264.0 m
Northing:	7,927,466.0 m
Surface Elevation:	282.80 m
Bottom Elevation:	272.20 m
Total Depth:	10.6 m
Logged By:	RS/CS
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Bearing:** N/A **Date Logged:** 10/25/2016

Driller: E.Beachamp **Hole Diameter (mm):** 96 **Plunge:** Vertical **Date Checked:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Geological Unit	Rock Description ROCK TYPE; Grain size, texture and fabric, colour, general defect conditions, minor constituents.	Weathering/ Cementation	Estimated Strength (EH VH H M L VL EL)	Is(50) [UCS] MPa	Defect Spacing mm (2000 600 200 [100] 60 20)	RQD %
	281.8	1.0										
	280.8	2.0										
	279.8	3.0										
	278.8	4.0					***Resuming in Rock Core Format 4.6m.***					
	277.8	5.0	HQ-3 Coring	HQ			LIMESTONE: Light grey to brown, thickly bedded, weak to medium strong joints, faintly weathered					77
	276.8	6.0					6.00 m to 7.70 m: Medium texture, very thickly bedded, fresh limestone, medium strong					66
	275.8	7.0										
	274.8	8.0					7.70 m to 10.60 m: Weak to medium strong, subhorizontal joints					52
	273.8	9.0										68
	272.8	10.0										

Notes:

HATCH

BOREHOLE LOG

ROCK CORE FORMAT

BH16-Q7004

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Potential Quarry Location	**Platform:**	Ground

Easting:	529,264.0 m
Northing:	7,927,466.0 m
Surface Elevation:	282.80 m
Bottom Elevation:	272.20 m
Total Depth:	10.6 m
Logged By:	RS/CS
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Bearing:** N/A **Date Logged:** 10/25/2016

Driller: E.Beachamp **Hole Diameter (mm):** 96 **Plunge:** Vertical **Date Checked:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Geological Unit	Rock Description ROCK TYPE; Grain size, texture and fabric, colour, general defect conditions, minor constituents.	Weathering/ Cementation	Estimated Strength EH VH H M L VL EL	Is(50) [UCS] MPa	Defect Spacing mm 2000 600 200 [100] 60 20	RQD %
				[10.6]								68
	271.8	11.0					To Target Depth. **Drillhole BH16-Q7004 terminated at 10.6m.**					
	270.8	12.0										
	269.8	13.0										
	268.8	14.0										
	267.8	15.0										
	266.8	16.0										
	265.8	17.0										
	264.8	18.0										
	263.8	19.0										
	262.8	20.0										

Notes:

HATCH BOREHOLE REPORT

BH16-R003

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Driller:	Vance Madden	**Hole Diameter (mm):**	96
Date Logged:	10/5/2016	**Date Reviewed:**	2/10/2017

Easting:	504,513.0 m
Northing:	7,975,552.0 m
Surface Elevation:	61.00 m
Bottom Elevation:	55.40 m
Total Depth:	5.6 m
Logged By:	UK
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	61.0 – 59.5	0.0 – 1.5	Vibracore	H-Casing	SAND: Coarse to fine grained, moist	Nf										
	59.5 – 58.0	1.5 – 3.0			SAND and GRAVEL: Fine to coarse grained sand	Nf										
	58.0 – 56.0	3.0 – 5.0			3.00 m to 4.6 m: Trace Cobbles	Nf										

Notes:

BOREHOLE REPORT

BH16-R003

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	504,513.0 m
Northing:	7,975,552.0 m
Surface Elevation:	61.00 m
Bottom Elevation:	55.40 m
Total Depth:	5.6 m
Logged By:	UK
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/5/2016

Driller: Vance Madden **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	55.5	5.5		[5.6]		SAND and GRAVEL: Fine to coarse grained sand *(Continued)*	Nf *(Continued)*										
	55.0	6.0				To Target Depth. **Drillhole BH16-R003 terminated at 5.6m.**											
	54.5	6.5															
	54.0	7.0															
	53.5	7.5															
	53.0	8.0															
	52.5	8.5															
	52.0	9.0															
	51.5	9.5															
	51.0	10.0															

Notes:

BOREHOLE REPORT

BH16-R004

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting: 507,259.0 m
Northing: 7,970,638.0 m
Surface Elevation: 43.00 m
Bottom Elevation: 38.43 m
Total Depth: 4.6 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/6/2016

Driller: Samuel Flynn **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	43.0–42.2	0.0–0.8	Vibracore	H-Casing		SAND: Organic, fine to coarse grained											
	42.2–41.5	0.8–1.5				SAND with GRAVEL: Dark brown, medium to coarse grained sand, Rounded to sub rounded gravel	Nf		⊠	●	30						
	41.5–40.0	1.5–3.0				SAND, some SILT, trace GRAVEL: Fine to coarse grained sand, rounded to subrounded gravel	Nf		⊠	●	10	8	74	18			
	40.0–38.4	3.0–4.6		[4.6]		SAND and COBBLES, with GRAVEL, some SILT: Light brown to grey, fine to course grained sand, rounded cobbles	Nf		⊠								
		4.6				To Target Depth. **Drillhole BH16-R004 terminated at 4.6m.**											

Elevation scale: 42.5, 42.0, 41.5, 41.0, 40.5, 40.0, 39.5, 39.0, 38.5, 38.0
Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

HATCH BOREHOLE REPORT

BH16-R005

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	509,249.0 m
Northing:	7,968,499.0 m
Surface Elevation:	84.00 m
Bottom Elevation:	79.43 m
Total Depth:	4.6 m
Logged By:	UK
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/6/2016

Driller: Vance Madden **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	84.0 – 82.5	0.0 – 1.5	Vibracore	H-Casing		SAND and GRAVEL, some SILT: Fine to coarse grained sand, subangular gravel	Nf										
	83.0	1.0								●	11						
	82.5 – 79.43	1.5 – 4.6				SAND, some SILT, trace GRAVEL: Fine to coarse grained sand, angular to subangular gravel	Nbn										
	81.5	2.5										4	78	18			
	81.0	3.0					Nf										
	80.5	3.5								●	10						
	79.5	4.5		[4.6]													
	79.0	5.0				To Target Depth. **Drillhole BH16-R005 terminated at 4.6m.**											

Notes:

BOREHOLE REPORT

BH16-R006

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Driller:	Vance Madden	**Hole Diameter (mm):**	96
Date Logged:	10/6/2016	**Date Reviewed:**	2/10/2017

Easting:	508,438.0 m
Northing:	7,969,804.0 m
Surface Elevation:	78.75 m
Bottom Elevation:	75.85 m
Total Depth:	2.9 m
Logged By:	UK
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	78.3	0.5	Vibracore	H-Casing		SAND: Organic, dark brown	Nf										
	77.8	1.0				SAND and GRAVEL, trace SILT: Coarse grained sand, angular gravel	Nf										
	77.3	1.5					Nbn										
	76.8	2.0					Nf										
	76.3	2.5		[2.9]													
	75.8	3.0				To Target Depth. **Drillhole BH16-R006 terminated at 2.9m.**											
	75.3	3.5															
	74.8	4.0															
	74.3	4.5															
	73.8	5.0															

Notes:

HATCH — BOREHOLE REPORT

BH16-R007

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Driller:	Vance Madden	**Hole Diameter (mm):**	96
Date Logged:	10/6/2016	**Date Reviewed:**	2/10/2017

Easting:	510,940.0 m
Northing:	7,967,349.0 m
Surface Elevation:	83.00 m
Bottom Elevation:	78.43 m
Total Depth:	4.6 m
Logged By:	UK
Reviewed By:	SH/WH

Water: Unobserved due to permafrost
Method: Vibracore
Casing: H-Casing [4.6]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description
83.0	0.0	SAND, some GRAVEL, some SILT: Reddish brown, fine to coarse grained sand, angular to subangular gravel	Nf
	1.5	SAND, some SILT, trace Gravel: Grey, fine grained to coarse grained sand, angular to subangular gravel	Nbn
	3.05	SAND, with GRAVEL: Grey, fine to coarse grained sand, angular to subanbgular gravel	Nf
	3.65	GRAVEL: Coarse, angular to subangular	Nf
	4.6	To Target Depth. **Drillhole BH16-R007 terminated at 4.6m.**	

Depth (m)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
2.5	13	1	87	13			
4.0	10						

Moisture Content Profile: 0 50 100

Notes:

HATCH BOREHOLE REPORT

BH16-R008

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Date Logged:	10/7/2016	**Driller:**	Samuel Flynn
Hole Diameter (mm):	96	**Date Reviewed:**	2/10/2017

Easting:	512,763.0 m
Northing:	7,966,604.0 m
Surface Elevation:	83.50 m
Bottom Elevation:	78.93 m
Total Depth:	4.6 m
Logged By:	MR
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost	83.5–82.0	0.0–1.5				SAND with GRAVEL: Medium to coarse grained sand, fine to coarse gravel, light brown, subangular to angular	Nf		X								
	82.0–80.5	1.5–3.0				SAND with GRAVEL, trace COBBLES: Light brown to grey, coarse grained sand, fine to coarse gravel, rounded to subangular gravel	Nf		X								
	80.5–78.9	3.0–4.6				SAND and GRAVEL, some COBBLES: Light brown, fine to coarse grained sand, fine to coarse gravel, rounded to subrounded	Nf		X								
						To Target Depth. **Drillhole BH16-R008 terminated at 4.6m.**											

Elevation scale (m): 83.0, 82.5, 82.0, 81.5, 81.0, 80.5, 80.0, 79.5, 79.0, 78.5
Depth scale (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

HATCH — BOREHOLE REPORT

BH16-R009

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	514,367.0 m
Northing:	7,965,535.0 m
Surface Elevation:	79.00 m
Bottom Elevation:	74.43 m
Total Depth:	4.6 m
Logged By:	MR
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/8/2016

Driller: Samuel Flynn **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water: Unobserved due to Permafrost

Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content
SAND: Organics, dark brown		
SAND, some GRAVEL: Light brown, fine to coarse grained sand, rounded to subrounded gravel	Nf	23
SILTY SANDY GRAVEL, with COBBLES: Medium to coarse grained sand, rounded to subrounded cobbles	Nbn	
SILTY SANDY GRAVEL, some COBBLES: Light brown, fine to coarse grained sand, fine to coarse gravel, rounded to subrounded cobbles	Nf	
To Target Depth. **Drillhole BH16-R009 terminated at 4.6m.**		

Elevation (m): 78.5, 78.0, 77.5, 77.0, 76.5, 76.0, 75.5, 75.0, 74.5, 74.0

Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Columns: Water, Elevation (m), Depth (m), Method, Casing, Graphic Log, Soil Description, Frozen Soil Description, Recovery, Sample Type, Moisture Content Profile (0, 50, 100), Field Water Content, Percent Gravel, Percent Sand, Percent Fines, Liquid Limit, Plastic Index, Other Tests

Notes:

HATCH BOREHOLE REPORT

BH16-R010

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Driller:	Vance Madden	**Hole Diameter (mm):**	96
Date Logged:	10/8/2016	**Date Reviewed:**	2/10/2017

Easting:	515,332.0 m
Northing:	7,963,810.0 m
Surface Elevation:	80.00 m
Bottom Elevation:	75.43 m
Total Depth:	4.6 m
Logged By:	UK
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost						SAND and GRAVEL: Brown, angular to subangular gravel	Nf										
	79.5	0.5															
	79.0	1.0															
	78.5	1.5				1.50 m to 2.50 m: Some silt											
	78.0	2.0															
	77.5	2.5				2.50 m to 4.00 m: Sand with some gravel											
	77.0	3.0															
	76.5	3.5															
	76.0	4.0															
	75.5	4.5															
						To Target Depth. **Drillhole BH16-R010 terminated at 4.6m.**											
	75.0	5.0															

Notes:

HATCH

BOREHOLE REPORT

BH16-R011

Sheet 1 of 1

Client: Baffinland Iron Mines	**Project No.:** H352034	**Easting:** 516,719.0 m	**Northing:** 7,962,461.0 m
Project: Mary River Expansion Study Stage 2	**Datum:** NAD83	**Surface Elevation:** 94.70 m	**Bottom Elevation:** 90.13 m
Location: Proposed Rail Alignment	**Platform:** Ground	**Total Depth:** 4.6 m	
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:** 10/8/2016	**Logged By:** UK
Driller: Vance Madden	**Hole Diameter (mm):** 96	**Date Reviewed:** 2/10/2017	**Reviewed By:** SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost		0.0				SAND and PEAT: Dark brown	Nf										
	94.2	0.5				SAND, some SILT: Brown, fine to coarse grained sand	Nf										
	93.7	1.0							X								
	93.2	1.5															
	92.7	2.0															
	92.2	2.5							X	●	19	0	86	14			
	91.7	3.0															
	91.2	3.5				GRANITE: Pinkish brown, 75 mm, pieces of granite in frozen sand											
	90.7	4.0							X	●	15						
	90.2	4.5				Drilling Refusal. **Drillhole BH16-R011 terminated at 4.6m.**											
	89.7	5.0															

Notes:

HATCH BOREHOLE REPORT

BH16-R012

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:** 10/8/2016	
Driller: Vance Madden	**Hole Diameter (mm):** 96	**Date Reviewed:** 2/10/2017	

Easting:	516,716.0 m
Northing:	7,962,464.0 m
Surface Elevation:	106.75 m
Bottom Elevation:	102.75 m
Total Depth:	4.0 m
Logged By:	UK
Reviewed By:	SH/WH

Water: Unobserved due to Permafrost

Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
0.0–0.75	SAND, some GRAVEL, some COBBLES: Brown, well graded, subangular to angular gravel								
0.75–3.0	SAND, some SILT, trace GRAVEL: Brown, loose, angular to subangular gravel	Nf							
1.5	1.50 m to 3.00 m: Greyish brown, fragmented rock pieces	Nf							
2.5			10	1	81	18			
3.0–4.0	SAND and GRAVEL: Brown, angular to subangular gravel	Nbn							
4.0	Drilling Refusal. **Drillhole BH16-R012 terminated at 4.0m.**								

Elevation (m) / Depth (m) scale: 106.3 / 0.5; 105.8 / 1.0; 105.3 / 1.5; 104.8 / 2.0; 104.3 / 2.5; 103.8 / 3.0; 103.3 / 3.5; 102.8 / 4.0; 102.3 / 4.5; 101.8 / 5.0

Moisture Content Profile: 0 50 100

Notes:

BOREHOLE REPORT

HATCH

BH16-R013

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Date Logged:	10/8/2016	**Driller:**	Vance Madden
Hole Diameter (mm):	96	**Date Reviewed:**	2/10/2017

Easting:	518,856.0 m
Northing:	7,959,178.0 m
Surface Elevation:	107.00 m
Bottom Elevation:	102.43 m
Total Depth:	4.6 m
Logged By:	UK
Reviewed By:	SH/WH

Water	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Moisture Content Profile (0–100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	0.0–1.5	SAND, trace GRAVEL: Brown, well graded, angular to subangular gravel									
	1.5–2.5	SAND, with GRAVEL: Brown, rounded to subangular gravel	Nbn								
	2.5–3.45	SAND, some SILT: Brown to grey, fine grained sand	Nbn	●	16	0	85	15			
	3.45–4.6	Possible GRANITE: Dark grey streaks, dense		●	16						
	4.6	Drilling Refusal. **Drillhole BH16-R013 terminated at 4.6m.**									

Elevation (m): 106.5, 106.0, 105.5, 105.0, 104.5, 104.0, 103.5, 103.0, 102.5, 102.0

Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

BOREHOLE REPORT

BH16-R014

Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 519,701.0 m
Northing: 7,957,349.0 m
Surface Elevation: 111.00 m
Bottom Elevation: 106.50 m
Total Depth: 4.5 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/8/2016
Driller: Samuel Flynn **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost	111.0–110.55	0.0–0.45	SILTY SAND: Fine grained	Nf							
	110.55–109.5	0.45–1.5	Silty SAND, with GRAVEL, trace COBBLES: Fine gravel, fine to coarse grained sand	Nf							
	109.5–107.0	1.5–4.0	Silty SAND, trace GRAVEL: Subangular to angular gravel, medium to coarse grained sand	Nf	11	11	69	20			
	107.0–106.5	4.0–4.5	Sandy GRAVEL, trace COBBLES: Pinkish grey to light brown, coarse grained sand, rounded to subrounded gravel	Nf							
	106.5	4.5	To Target Depth. **Drillhole BH16-R014 terminated at 4.5m.**								

Elevation scale: 110.5, 110.0, 109.5, 109.0, 108.5, 108.0, 107.5, 107.0, 106.5, 106.0
Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Moisture Content Profile: 0, 50, 100

Notes:

BOREHOLE REPORT

BH16-R015

Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 520,756.0 m
Northing: 7,955,701.0 m
Surface Elevation: 115.00 m
Bottom Elevation: 110.50 m
Total Depth: 4.5 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/8/2016
Driller: Samuel Flynn **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Moisture Content Profile (0–50–100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost	115.0–113.5	0.0–1.5	GRAVEL with SAND, trace SILT, trace COBBLES: Light brown, fine to coarse gravel, rounded, fine to coarse grained sand	Nf								
	113.5–112.0	1.5–3.0	GRAVEL and SAND: Fine to coarse gravel, rounded, fine to medium grained sand, poorly bonded	Nf			2	73	24			
	112.0–110.5	3.0–4.5	SAND with SILT, trace GRAVEL: Light brown, fine to medium grained sand, fine gravel	Nbn		13						
	110.5	4.5	To Target Depth. **Drillhole BH16-R015 terminated at 4.5m.**									

Elevation scale: 114.5, 114.0, 113.5, 113.0, 112.5, 112.0, 111.5, 111.0, 110.5, 110.0
Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

BOREHOLE REPORT

BH16-R016

Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 521,588.0 m
Northing: 7,953,865.0 m
Surface Elevation: 112.00 m
Bottom Elevation: 107.50 m
Total Depth: 4.5 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 10/8/2016
Driller: Samuel Flynn
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water	Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Sample Type	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost			SAND: Organic, dark grey									
			SILTY SAND, trace GRAVEL, trace COBBLES: Light brown, medium to coarse grained sand, fine to coarse gravel, rounded to subrounded	Nf								
	111.0	1.0			☒	32						
	110.5	1.5		Nbe								
	110.0	2.0			☒	15	8	55	28			
			SAND, with GRAVEL, trace SILT: Fine to coarse grained sand, fine to coarse gravel, rounded	Nbe								
	108.0	4.0			☒							
	107.5	4.5	To Target Depth. **Drillhole BH16-R016 terminated at 4.5m.**									

Elevation scale (m): 111.5, 111.0, 110.5, 110.0, 109.5, 109.0, 108.5, 108.0, 107.5, 107.0
Depth scale (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Moisture Content Profile: 0, 50, 100

Notes:

HATCH BOREHOLE REPORT

BH16-R017
Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground
Contractor: Boart Longyear
Driller: Vance Madden
Rig Type/ Mounting: MiniSonic Rig
Hole Diameter (mm): 96
Date Logged: 10/9/2016
Date Reviewed: 2/10/2017

Easting: 521,737.0 m
Northing: 7,952,929.0 m
Surface Elevation: 115.00 m
Bottom Elevation: 110.40 m
Total Depth: 4.6 m
Logged By: UK
Reviewed By: SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost.	115.0 – 110.4	0.0 – 4.6	Vibracore	H-Casing [4.6]		SILTY SAND and GRAVEL: Brown, fine to coarse grained sand	Nf (0.0); Nbn (0.5)				29						
		4.6				To Target Depth. **Drillhole BH16-R017 terminated at 4.6m.**											

Elevation scale: 114.5, 114.0, 113.5, 113.0, 112.5, 112.0, 111.5, 111.0, 110.5, 110.0
Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

BOREHOLE REPORT

HATCH

BH16-R018

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Contractor: Boart Longyear | **Rig Type/ Mounting:** MiniSonic Rig | **Date Logged:** 10/9/2016

Driller: Vance Madden | **Hole Diameter (mm):** 96 | **Date Reviewed:** 2/10/2017

Easting:	521,854.0 m
Northing:	7,951,940.0 m
Surface Elevation:	113.00 m
Bottom Elevation:	108.40 m
Total Depth:	4.6 m
Logged By:	UK
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost.	113.0 – 111.5	0.0 – 1.5	Vibracore	H-Casing		SILTY SAND, some Gravel: Brown, fine gravel, rounded to subangular gravel											
	111.5 – 109.1	1.5 – 3.9				SILTY SAND with GRAVEL: Grey, fine sand, fine to coarse gravel, rounded to subrounded	Nf										
						2.40 m to 3.00 m: Gravel is fine to coarse, well bonded (Nbn)	Nbn										
						3.00 m to 3.90 m: Brown to grey, Subangular gravel, fine to coarse	Nf										
	109.1 – 108.4	3.9 – 4.6		[4.6]		SILTY SAND and BOULDERS: Crushed, grey with white stratification											
		4.6				To Target Depth. **Drillhole BH16-R018 terminated at 4.6m.**											

Elevation scale: 112.5, 112.0, 111.5, 111.0, 110.5, 110.0, 109.5, 109.0, 108.5, 108.0. Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0.

Notes:

HATCH BOREHOLE REPORT

BH16-R019
Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Driller:	Vance Madden	**Hole Diameter (mm):**	96
Date Logged:	10/9/2016	**Date Reviewed:**	2/10/2017

Easting:	521,994.0 m
Northing:	7,950,962.0 m
Surface Elevation:	112.30 m
Bottom Elevation:	107.70 m
Total Depth:	4.6 m
Logged By:	UK
Reviewed By:	SH/WH

Water: Unobserved due to permafrost.
Method: Vibracore
Casing: H-Casing [4.6]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description
	0.0	SILTY SAND, with GRAVEL, trace COBBLES: Brown, rounded to subangular gravel, well graded	Nf
111.8	0.5		
		GRAVEL and SAND: Brown, rounded to subround gravel	Nf
111.3	1.0		
110.8	1.5	SAND,with GRAVEL, with COBBLES: Brown, rounded to subangular gravel	Nf
110.3	2.0		
109.8	2.5	SILTY SAND with GRAVEL: Brown, rounded to subangular gravel, fragmented rock	Nf
109.3	3.0	3.00 m to 4.00 m: Grey	Nbn
108.8	3.5		
108.3	4.0	4.00 m to 4.60 m: Some cobbles	Nf
107.8	4.5	To Target Depth. **Drillhole BH16-R019 terminated at 4.6m.**	
107.3	5.0		

Other columns: Recovery, Sample Type, Moisture Content Profile (0, 50, 100), Field Water Content, Percent Gravel, Percent Sand, Percent Fines, Liquid Limit, Plastic Index, Other Tests.

Notes:

BOREHOLE REPORT

HATCH

BH16-R020

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting: 521,842.0 m
Northing: 7,949,969.0 m
Surface Elevation: 117.50 m
Bottom Elevation: 112.90 m
Total Depth: 4.6 m
Logged By: UK
Reviewed By: SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/9/2016

Driller: Vance Madden **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 / 50 / 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost.	117.5 – 116.0	0.0 – 1.5	Vibracore	H-Casing	SAND and GRAVEL, some SILT, some COBBLES: Brown, angular to subangular gravel	Nf										
	116.0 – 114.5	1.5 – 3.0			SILTY SAND, with GRAVEL, with COBBLES: White to grey, angular to subangular gravel, crushed rock	Nf										
	114.5 – 112.9	3.0 – 4.6		[4.6]	SILT and SAND: Brown to grey, angular to subangular gravel	Nbn		☒ (at ~4.0–4.2)	●	20	0	57	43			
					To Target Depth. **Drillhole BH16-R020 terminated at 4.6m.**											

Elevation scale: 117.0, 116.5, 116.0, 115.5, 115.0, 114.5, 114.0, 113.5, 113.0, 112.5
Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

HATCH BOREHOLE REPORT

BH16-R021
Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:**	10/9/2016
Driller: Samuel Flynn	**Hole Diameter (mm):** 96	**Date Reviewed:**	2/10/2017

Easting:	521,784.0 m
Northing:	7,948,976.0 m
Surface Elevation:	123.25 m
Bottom Elevation:	118.75 m
Total Depth:	4.5 m
Logged By:	MR
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description — TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost.	122.8	0.5	Vibracore	H-Casing		SILTY SAND, some GRAVEL, trace COBBLES: Light brown to grey, fine to medium grained sand, fine to coarse gravel, rounded to subangular	Nf										
	122.3	1.0															
	121.8	1.5															
	121.3	2.0				SILTY SAND, some SILT, some GRAVEL, trace COBBLES: Grey to dark grey, angular to subangular gravel, rounded to subrounded cobbles, fine to coarse grained sand	Nf										
	120.8	2.5															
	120.3	3.0				SILTY SAND, some GRAVEL: Light brown to reddish brown, fine to medium grained sand, fine gravel, rounded	Nf										
	119.8	3.5															
	119.3	4.0															
	118.8	4.5		[4.5]		To Target Depth. **Drillhole BH16-R021 terminated at 4.5m.**											
	118.3	5.0															

Notes:

HATCH BOREHOLE REPORT

BH16-R022

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Driller:	Samuel Flynn	**Hole Diameter (mm):**	96
Date Logged:	10/9/2016	**Date Reviewed:**	2/10/2017

Easting:	522,305.0 m
Northing:	7,948,153.0 m
Surface Elevation:	141.40 m
Bottom Elevation:	136.90 m
Total Depth:	4.5 m
Logged By:	MR
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost.	141.40 – 138.7	0.0 – 2.7	Vibracore	H-Casing		SILTY SAND and GRAVEL, trace COBBLES: Grey to light brown, angular to subangular gravel, fine to coarse,rounded to subrounded, coarse grained sand	Nf										
	138.7 – 136.9	2.7 – 4.5		[4.5]		SILT and SAND, some GRAVEL: TILL, grey, fine to coarse grained sand, fine to coarse gravel, rounded to subangular	Nbn										
	137.4	4.0								●	9	13	44	44			
	136.9	4.5				To Target Depth. **Drillhole BH16-R022 terminated at 4.5m.**											

Elevation scale: 140.9 (0.5), 140.4 (1.0), 139.9 (1.5), 139.4 (2.0), 138.9 (2.5), 138.4 (3.0), 137.9 (3.5), 137.4 (4.0), 136.9 (4.5), 136.4 (5.0)

Notes:

HATCH

BOREHOLE REPORT

BH16-R023

Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment

Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 522,505.0 m
Northing: 7,947,177.0 m
Surface Elevation: 158.00 m
Bottom Elevation: 154.00 m
Total Depth: 4.0 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 10/10/2016
Driller: Samuel Flynn
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost	158.0 – 157.0	0.0 – 1.0	Vibracore	H-Casing		SILTY SAND, some GRAVEL: Light brown, fine to medium grained sand, coarse gravel, rounded to subrounded	Nf										
	157.0 – 154.0	1.0 – 4.0		[4.0]		SAND and SILT: Grey, fine to medium grained	Nbn					0	61	39			
	154.0	4.0				Drilling Refusal. **Drillhole BH16-R023 terminated at 4.0m.**											

Elevation scale (m): 157.5, 157.0, 156.5, 156.0, 155.5, 155.0, 154.5, 154.0, 153.5, 153.0
Depth scale (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

HATCH BOREHOLE REPORT

BH16-R024
Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 522,558.0 m
Northing: 7,946,129.0 m
Surface Elevation: 153.00 m
Bottom Elevation: 148.40 m
Total Depth: 4.6 m
Logged By: UK
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 10/10/2016
Driller: Vance Madden
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost	153.0 – 148.4	0.0 – 4.6	Vibracore	H-Casing [4.6]	SILTY SAND and GRAVEL: Brown, angular to subangular gravel	Nf								
	151.5	1.5					●	9	30	38	32			
	150.0	3.0				Nbn	●	8						
	148.4	4.6			To Target Depth. **Drillhole BH16-R024 terminated at 4.6m.**									

Elevation scale (m): 152.5, 152.0, 151.5, 151.0, 150.5, 150.0, 149.5, 149.0, 148.5, 148.0
Depth scale (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

BOREHOLE REPORT

HATCH

BH16-R025
Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:**	10/10/2016
Driller: Vance Madden	**Hole Diameter (mm):** 96	**Date Reviewed:**	2/10/2017

Easting:	522,989.0 m
Northing:	7,945,894.0 m
Surface Elevation:	153.75 m
Bottom Elevation:	149.15 m
Total Depth:	4.6 m
Logged By:	UK
Reviewed By:	SH/WH

Water: Unobserveddue to Permafrost
Method: Vibracore
Casing: H-Casing [4.6]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	0.0	SANDY SILT, some GRAVEL, trace COBBLES: Grey, angular to subabgular gravel	Nf							
153.3	0.5									
152.8	1.0			18	13	33	54			
152.3	1.5		Nbn							
151.8	2.0									
151.3	2.5			15	16	43	41			
150.8	3.0		Vx							
150.3	3.5									
149.8	4.0			16						
149.3	4.5									
	4.6	To Target Depth. **Drillhole BH16-R025 terminated at 4.6m.**								
148.8	5.0									

Moisture Content Profile: 0 50 100

Notes:

BAFFINLAND GINT LIBRARY.GLB Log ICE BOREHOLE RAIL ALIGNMENT ALL_WITH ICE LOG_REV 3.GPJ <<DrawingFile>> 13/09/2017 11:25

HATCH BOREHOLE REPORT

BH16-R026

Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 523,165.0 m
Northing: 7,944,366.0 m
Surface Elevation: 152.00 m
Bottom Elevation: 147.40 m
Total Depth: 4.6 m
Logged By: UK
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 10/10/2016
Driller: Vance Madden
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0–100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost	152.0	0.0	Vibracore	H-Casing	SAND with GRAVEL, trace SILT: Grey, granular, organics	Nf										
	151.5	0.45			SILTY SAND, wtih GRAVEL: Brown, rounded to subangular GRAVEL	Nf										
		0.90			0.90 m to 3.00 m : Fragmented rock											
	151.0	1.0						Sample	●	27						
	149.0	3.0				Nbn										
	148.0	4.0						Sample	●	8						
	147.4	4.6		[4.6]	To Target Depth. **Drillhole BH16-R026 terminated at 4.6m.**											

Elevation scale: 151.5, 151.0, 150.5, 150.0, 149.5, 149.0, 148.5, 148.0, 147.5, 147.0; Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

BOREHOLE REPORT

BH16-R027

Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/10/2016
Driller: Vance Madden **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Easting:	523,442.0 m
Northing:	7,942,265.0 m
Surface Elevation:	171.10 m
Bottom Elevation:	166.50 m
Total Depth:	4.6 m
Logged By:	UK
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost	171.1–170.1	0.0–1.1	Vibracore	H-Casing	SAND, with SILT, with COBBLES: Brown, rounded to subrounded cobbles 0.45 m to 1.10 m: Crushed limestone cobbles and boulders	Nf	8	22	43	35			
		1.1–3.0			SAND and SILT, with GRAVEL: Brown 1.50 m to 3.00 m: Inferred rock/cobbles, fragmented, cobbles rounded to angular	Nf							
	168.1	3.0–4.6		[4.6]	SILTY SAND, with GRAVEL, with COBBLES: Brown, rounded to subangular gravel	Nbn	9						
	166.5	4.6			To Target Depth. **Drillhole BH16-R027 terminated at 4.6m.**								

Elevation scale: 170.6 (0.5), 170.1 (1.0), 169.6 (1.5), 169.1 (2.0), 168.6 (2.5), 168.1 (3.0), 167.6 (3.5), 167.1 (4.0), 166.6 (4.5), 166.1 (5.0)

Moisture Content Profile: 0, 50, 100

Notes:

BAFFINLAND GINT LIBRARY.GLB Log ICE BOREHOLE RAIL ALIGNMENT ALL_WITH ICE LOG_REV 3.GPJ <<DrawingFile>> 13/09/2017 11:25

BOREHOLE REPORT

BH16-R028

Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment

Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 524,061.0 m
Northing: 7,940,538.0 m
Surface Elevation: 172.30 m
Bottom Elevation: 168.70 m
Total Depth: 3.6 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 10/10/2016
Driller: Samuel Flynn
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Field Water Content	Other Tests
Unobserved due to Permafrost	172.3	0.0	Vibracore	H-Casing	SAND and SILT, some GRAVEL: Light grey,fine to coarse grained sand, angular to subangular gravel	Nf	3	
	171.3	1.0			Gravelly Silty SAND: Grey, dark grey mixed, fine to coarse grained sand, fine to coarse gravel, rounded to subrounded	Nf		
	169.3	3.0			SANDY SILT, with GRAVEL, with COBBLES: Fine to medium grained sand, fine to coarse gravel, rounded to subrounded	Nf		
	168.7	3.6		[3.6]	Drilling Refusal. **Drillhole BH16-R028 terminated at 3.6m.**			

Elevation scale (m): 171.8, 171.3, 170.8, 170.3, 169.8, 169.3, 168.8, 168.3, 167.8, 167.3
Depth scale (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Moisture Content Profile: 0 50 100

Recovery | Sample Type | Percent Gravel | Percent Sand | Percent Fines | Liquid Limit | Plastic Index

Notes:

HATCH BOREHOLE REPORT

BH16-R029
Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	525,062.0 m
Northing:	7,938,851.0 m
Surface Elevation:	186.00 m
Bottom Elevation:	183.00 m
Total Depth:	3.0 m
Logged By:	MR
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/11/2016

Driller: Samuel Flynn **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost	186.0 – 184.4	0.0 – 1.6	Vibracore	H-Casing		SANDY SILT and GRAVEL, trace COBBLES: Light brown, subangular to angular gravel, fine to coarse sand, fine to coarse gravel	Nf										
	184.4 – 183.0	1.6 – 3.0		[3.0]		GRAVEL and COBBLES, some SAND: Grey, subgranular to angular gravel, fine to coarse, fine to coarse grained sand	Nf										
	183.0	3.0				Drilling Refusal. **Drillhole BH16-R029 terminated at 3.0m.**											

Elevation scale: 185.5, 185.0, 184.5, 184.0, 183.5, 183.0, 182.5, 182.0, 181.5, 181.0
Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

BOREHOLE REPORT

BH16-R030

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion	**Datum:**	NAD83
Location:	Mary River	**Platform:**	

Easting:	525,291.0 m
Northing:	7,937,897.0 m
Surface Elevation:	178.75 m
Bottom Elevation:	175.15 m
Total Depth:	3.6 m
Logged By:	UK
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/11/2016

Driller: Vance Madden **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description — TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost	178.75	0.0	Vibracore	H-Casing		SAND with SILT, with GRAVEL: Brown, angular to subangular gravel	Nf										
	178.3	0.5															
		0.6				SANDY SILT, with GRAVEL, with COBBLES: Grey, angular to subangular gravel	Nf										
	177.8	1.0															
	177.3	1.5															
		1.75				Pulverized rock with fragments of rocks, angular, sharp edges	Nf										
	176.8	2.0															
	176.3	2.5									10						
	175.8	3.0															
	175.3	3.5		[3.6]													
		3.6				Drilling Refusal. **Drillhole BH16-R030 terminated at 3.6m.**											
	174.8	4.0															
	174.3	4.5															
	173.8	5.0															

Notes:

BOREHOLE REPORT

BH16-R032

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	525,991.0 m
Northing:	7,936,109.0 m
Surface Elevation:	168.75 m
Bottom Elevation:	166.05 m
Total Depth:	2.7 m
Logged By:	UK
Reviewed By:	SH/WH

Contractor: Boart Longyear | **Rig Type/ Mounting:** MiniSonic Rig | **Date Logged:** 10/11/2016

Driller: Vance Madden | **Hole Diameter (mm):** 96 | **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost	168.3 / 167.8	0.5 / 1.0	Vibracore	H-Casing		SILTY SAND, some GRAVEL, some COBBLES: Brown to grey, fine to coarse grained sand											
	167.3 / 166.8 / 166.3	1.5 / 2.0 / 2.5		[2.7]		LIMESTONE: Pulverized rock, white to grey, angular rock fragments, weak to moderate strength											
	165.8 / 165.3 / 164.8 / 164.3 / 163.8	3.0 / 3.5 / 4.0 / 4.5 / 5.0				Drilling Refusal. **Drillhole BH16-R032 terminated at 2.7m.**											

Notes:

BOREHOLE REPORT

BH16-R033

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting: 526,653.0 m
Northing: 7,935,439.0 m
Surface Elevation: 164.00 m
Bottom Elevation: 159.80 m
Total Depth: 4.2 m
Logged By: UK
Reviewed By: SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/11/2016
Driller: Vance Madden **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0–50–100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost	164.0–162.5	0.0–1.5	Vibracore	H-Casing	GRAVEL, some SILT, some SAND: Light brown, medium to coarse grained sand, subrounded to rounded gravel	Nf		X (~1.0–1.2 m)								
	162.5–161.0	1.5–3.0			SAND and GRAVEL, with SILT, trace COBBLES: Grey, fine to coarse gravel, fine to coarse grained sand, rounded to subrounded gravel	Nf		X (~2.5–2.7 m)	● (~7)	7						
	161.0–159.8	3.0–4.2		[4.2]	COBBLES, with GRAVEL, with SAND, trace SILT: Light brown, grey mixed, coarse gravel, angular to subangular, fine to medium grained sand	Nf		X (~4.0–4.2 m)								
	159.8	4.2			To Target Depth. **Drillhole BH16-R033 terminated at 4.2m.**											

Elevation scale: 163.5 (0.5), 163.0 (1.0), 162.5 (1.5), 162.0 (2.0), 161.5 (2.5), 161.0 (3.0), 160.5 (3.5), 160.0 (4.0), 159.5 (4.5), 159.0 (5.0)

Notes:

BOREHOLE REPORT

BH16-R034
Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Date Logged:	10/12/2016	**Driller:**	Samuel Flynn
Hole Diameter (mm):	96	**Date Reviewed:**	2/10/2017

Easting:	527,056.0 m
Northing:	7,933,500.0 m
Surface Elevation:	175.60 m
Bottom Elevation:	171.10 m
Total Depth:	4.5 m
Logged By:	MR
Reviewed By:	SH/WH

Water: Unobserved due to Permafrost
Method: Vibracore
Casing: H-Casing [4.5]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
175.6	0.0	SAND and GRAVEL, trace silt: Light brown, grey mixed, fine to coarse grained sand, rounded	Nf							
175.1	0.5									
174.6	1.0									
174.1	1.5	GRAVELLY SILTY SAND: Light brown, grey mixed, angular to subangular gravel, fine to coarse grained sand	Vx							
173.6	2.0									
173.1	2.5			8	27	40	32			
172.6	3.0									
172.1	3.5			9						
171.6	4.0									
171.1	4.5	To Target Depth. **Drillhole BH16-R034 terminated at 4.5m.**								
170.6	5.0									

Moisture Content Profile: 0 50 100

Notes:

BOREHOLE REPORT

BH16-R035

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/12/2016

Driller: Vance Madden **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Easting:	527,423.0 m
Northing:	7,932,310.0 m
Surface Elevation:	186.00 m
Bottom Elevation:	181.40 m
Total Depth:	4.6 m
Logged By:	UK
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved	186.0–185.4	0.0–0.6	Vibracore	H-Casing	SAND, with GRAVEL, with SILT: Grey to brown, angular to subangular gravel	Nf										
	185.4–184.85	0.6–1.15			GRAVEL, with SAND, with COBBLES: Brown, rounded to subrounded gravel	Nf		X								
	184.85–184.5	1.15–1.5			SAND and GRAVEL, some SILT: Grey, fine grained sand	Nf										
	184.5–182.4	1.5–3.6			GRAVELLY SILTY SAND: Grey	Nbn		X			24	42	34			
	182.4–181.4	3.6–4.6		[4.6]	LIMESTONE: Framnebted rock, light grey to white, pulverized, angular, sharp edges			X								
	181.4	4.6			To Target Depth. **Drillhole BH16-R035 terminated at 4.6m.**											

Elevation scale: 185.5, 185.0, 184.5, 184.0, 183.5, 183.0, 182.5, 182.0, 181.5, 181.0
Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

HATCH

BOREHOLE REPORT

BH16-R036

Sheet 1 of 1

Client: Baffinland Iron Mines

Project: Mary River Expansion Study Stage 2

Location: Proposed Rail Alignment

Project No.: H352034

Datum: NAD83

Platform: Ground

Easting: 527,210.0 m

Northing: 7,931,660.0 m

Surface Elevation: 172.00 m

Bottom Elevation: 167.40 m

Total Depth: 4.6 m

Logged By: UK

Reviewed By: SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/12/2016

Driller: Vance Madden **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water: Unobserved due to Permafrost

Method: Vibracore

Casing: H-Casing [4.6]

Depth (m)	Elevation (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
0.0–1.5	172.0–170.5	Gravelly SAND, some SILT, trace COBBLES: Organic, grey to brown, angular to subangular gravel	Nf							
1.5–3.0	170.5–169.0	SAND and SILT, with GRAVEL trace COBBLES: Brown to grey, angular to subangular gravel	Nf	10	23	42	35			
3.0–4.6	169.0–167.4	SILT and COBBLES, with SAND: Brown	Nf							
4.6	167.4	To Target Depth. **Drillhole BH16-R036 terminated at 4.6m.**								

Moisture Content Profile: 0 50 100

Depth (m): 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

Elevation (m): 171.5 171.0 170.5 170.0 169.5 169.0 168.5 168.0 167.5 167.0

Notes:

BOREHOLE REPORT

BH16-R037

Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment

Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 527,873.0 m
Northing: 7,929,786.0 m
Surface Elevation: 162.25 m
Bottom Elevation: 157.65 m
Total Depth: 4.6 m
Logged By: UK
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 10/12/2016
Driller: Vance Madden
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Sample depth (m)	Moisture Content Profile (0–100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost	162.25 – 157.65	0.0 – 4.6	Vibracore	H-Casing [4.6]	SAND, trace SILT: Reddish brown, angular	Nf (0.0 m); Nbn (from ~1.5 m)									
							~1.0–1.2								
							~2.5–2.7	● ~20	20	0	91	9			
							~4.0–4.2	● ~20	20						
	157.65	4.6			To Target Depth. **Drillhole BH16-R037 terminated at 4.6m.**										

Elevation / depth scale: 161.8 / 0.5; 161.3 / 1.0; 160.8 / 1.5; 160.3 / 2.0; 159.8 / 2.5; 159.3 / 3.0; 158.8 / 3.5; 158.3 / 4.0; 157.8 / 4.5; 157.3 / 5.0

Notes:

BOREHOLE REPORT

BH16-R038

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Driller:	Samuel Flynn	**Hole Diameter (mm):**	96
Date Logged:	10/12/2016	**Date Reviewed:**	2/10/2017

Easting:	528,501.0 m
Northing:	7,928,421.0 m
Surface Elevation:	164.00 m
Bottom Elevation:	159.50 m
Total Depth:	4.5 m
Logged By:	MR
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost	164.0 – 159.5	0.0 – 4.5	Vibracore	H-Casing [4.5]		SAND, trace SILT, trace GRAVEL: Light brown, reddish brown mixed, medium to coarse grained sand, rounded to subrounded gravel	Nf										
	163.0 – 162.9	1.0 – 1.2							Sample								
	162.5	1.5					Vc										
	162.0 – 161.8	2.0 – 2.2							Sample	●	16	2	89	9			
	160.0 – 159.8	4.0 – 4.2							Sample	●	8						
	159.5	4.5				To Target Depth. **Drillhole BH16-R038 terminated at 4.5m.**											

Elevation scale (m): 163.5, 163.0, 162.5, 162.0, 161.5, 161.0, 160.5, 160.0, 159.5, 159.0
Depth scale (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

BOREHOLE REPORT

BH16-R039

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	528,666.0 m
Northing:	7,927,955.0 m
Surface Elevation:	165.75 m
Bottom Elevation:	161.25 m
Total Depth:	4.5 m
Logged By:	MR
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/12/2016

Driller: Samuel Flynn **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 / 50 / 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost.			Vibracore	H-Casing		SAND, trace SILT, trace GRAVEL: Light brown, reddish brown mixed, medium to coarse grained sand, rounded to subrounded gravel	Nf										
	165.3	0.5															
	164.8	1.0							X	●	20	3	94	3			
	164.3	1.5					Nbn										
	163.8	2.0															
	163.3	2.5							X								
	162.8	3.0															
	162.3	3.5															
	161.8	4.0							X								
	161.3	4.5		[4.5]		To Target Depth. **Drillhole BH16-R039 terminated at 4.5m.**											
	160.8	5.0															

Notes:

HATCH BOREHOLE REPORT

BH16-R040

Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground
Easting: 528,686.0 m
Northing: 7,927,755.0 m
Surface Elevation: 166.00 m
Bottom Elevation: 161.40 m
Total Depth: 4.6 m
Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 10/13/2016
Logged By: UK
Driller: Vance Madden
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017
Reviewed By: SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost.	166.0–161.4 (165.5, 165.0, 164.5, 164.0, 163.5, 163.0, 162.5, 162.0, 161.5)	0.0–4.6 (0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5)	Vibracore	H-Casing [4.6]		SAND and SILT, trace GRAVEL: Reddish brown to grey, angular to subangular gravel	Nf		Samples at ~1.0–1.2, ~2.5–2.7, ~4.0–4.2	● at ~19 (2.5 m)	19						
	161.0	5.0				To Target Depth. **Drillhole BH16-R040 terminated at 4.6m.**											

Notes:

BOREHOLE REPORT

BH16-R041

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	528,605.0 m
Northing:	7,927,754.0 m
Surface Elevation:	166.00 m
Bottom Elevation:	164.50 m
Total Depth:	1.5 m
Logged By:	UK
Reviewed By:	SH/WH

Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig	**Date Logged:**	10/14/2016
Driller:	Vance Madden	**Hole Diameter (mm):**	96	**Date Reviewed:**	2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost.	166.0–164.5	0.0–1.5	Vibracore	H-Casing [1.5]		SAND: Reddish brown, fine to coarse grained sand											
	164.5	1.5				To Target Depth. **Drillhole BH16-R041 terminated at 1.5m.**											

Elevation scale: 165.5, 165.0, 164.5, 164.0, 163.5, 163.0, 162.5, 162.0, 161.5, 161.0

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

BOREHOLE REPORT

BH16-R042

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Date Logged:	10/14/2016	**Logged By:**	MR
Driller:	Samuel Flynn	**Hole Diameter (mm):**	96
Date Reviewed:	2/10/2017	**Reviewed By:**	SH/WH

Easting:	528,517.0 m
Northing:	7,927,713.0 m
Surface Elevation:	167.00 m
Bottom Elevation:	162.50 m
Total Depth:	4.5 m

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost.	167.0	0.0	Vibracore	H-Casing		SAND, trace GRAVEL: Reddish brown, light brown mixed, medium to coarse grained sand, angular to subangular gravel,	Nf										
	166.5	0.5															
	166.0	1.0															
	165.5	1.5															
	165.0	2.0															
	164.5	2.5															
	164.0	3.0															
						3.30 m to 4.60 m: Trace to some gravel	Nbn										
	163.5	3.5															
	163.0	4.0								●	15						
	162.5	4.5		[4.5]		To Target Depth. **Drillhole BH16-R042 terminated at 4.5m.**											
	162.0	5.0															

Notes:

HATCH

BOREHOLE REPORT

BH16-R043

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	528,428.0 m
Northing:	7,927,675.0 m
Surface Elevation:	167.00 m
Bottom Elevation:	158.00 m
Total Depth:	9.0 m
Logged By:	MR
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/13/2016

Driller: Samuel Flynn **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost.	167.0	0.0	Vibracore	H-Casing	Sand	SAND: Grey to light brown, fine to coarse grained	Nf										
	166.5	0.5															
	166.0	1.0							Sample								
	165.5	1.5															
	165.0	2.0															
	164.5	2.5							Sample								
	164.0	3.0					Vc										
	163.5	3.5															
	163.0	4.0							Sample	●	15						
	162.5	4.5				4.50 m to 7.50m: Trace gravel	Nf										
	162.0	5.0															

Notes:

BOREHOLE REPORT

BH16-R043

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting:	528,428.0 m
Northing:	7,927,675.0 m
Surface Elevation:	167.00 m
Bottom Elevation:	158.00 m
Total Depth:	9.0 m
Logged By:	MR
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/13/2016
Driller: Samuel Flynn **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
					SAND	SAND: Grey to light brown, fine to coarse grained *(Continued)*	Nf *(Continued)*										
	161.5	5.5															
	161.0	6.0															
	160.5	6.5							X								
	160.0	7.0															
	159.5	7.5				7.50 m to 9.00 m: Light brown, fine to medium grained sand, no gravel	Nf										
	159.0	8.0															
	158.5	8.5															
				[9.0]					X	●	7						
	158.0	9.0				To Target Depth. **Drillhole BH16-R043 terminated at 9.0m.**											
	157.5	9.5															
	157.0	10.0															

Notes:

HATCH

BOREHOLE REPORT

BH16-R044

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig	**Date Logged:**	10/28/2016
Driller:	Vance Madden	**Hole Diameter (mm):**	96	**Date Reviewed:**	2/10/2017

Easting:	528,736.0 m
Northing:	7,926,992.0 m
Surface Elevation:	167.00 m
Bottom Elevation:	162.50 m
Total Depth:	4.5 m
Logged By:	CS
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost	167.0 – 165.5	0.0 – 1.5	Vibracore	H-Casing	SANDY GRAVEL, trace COBBLES: Light brown, fine to coarse gravel , angular to subangular gravel											
	166.0	1.0						⊠								
	165.5 – 162.5	1.5 – 4.5			SAND, some SILT, some GRAVEL: Light brown, rounded to subrounded gravel, medium to coarse grained sand											
	165.0	2.0						⊠	●	11						
	163.0	4.0						⊠	●	16						
	162.5	4.5		[4.5]	To Target Depth.											

Elevation (m): 166.5, 166.0, 165.5, 165.0, 164.5, 164.0, 163.5, 163.0, 162.5, 162.0

Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Drillhole BH16-R044 terminated at 4.5m.

Notes:

BOREHOLE REPORT

HATCH

BH16-R045

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	528,961.0 m
Northing:	7,926,756.0 m
Surface Elevation:	138.75 m
Bottom Elevation:	134.25 m
Total Depth:	4.5 m
Logged By:	CS
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/28/2016

Driller: Vance Madden **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost	138.75	0.0	Vibracore	H-Casing	SAND, some SILT, some GRAVEL, trace COBBLES: Light brown, medium to coarse grained sand											
	138.3	0.5														
	137.8	1.0						☒	●	8						
	137.3	1.5														
	136.8	2.0														
	136.3	2.5														
	135.8	3.0														
	135.3	3.5						☒	●	21						
	134.8	4.0														
	134.3	4.5		[4.5]	To Target Depth. **Drillhole BH16-R045 terminated at 4.5m.**											
	133.8	5.0														

Notes:

HATCH BOREHOLE REPORT

BH16-R046
Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 529,065.0 m
Northing: 7,926,599.0 m
Surface Elevation: 138.20 m
Bottom Elevation: 133.60 m
Total Depth: 4.6 m
Logged By: RS
Reviewed By: SH/WH

Contractor: Boart Longyear | **Rig Type/ Mounting:** MiniSonic Rig | **Date Logged:** 10/28/2016
Driller: E.Beachamp | **Hole Diameter (mm):** 96 | **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0–50–100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost	138.2–137.2	0.0–1.0	Vibracore	H-Casing		SAND, some GRAVEL, trace SILT: Light brown, subrounded to rounded gravel, medium to coarse grained sand	Nf										
	137.2–136.6	1.0–1.6				SAND and GRAVEL, trace SILT: Fine to medium grained sand	Nf			●	6						
	136.6–135.2	1.6–3.0				SILT: Organics, peat, dark brown, black, organic odour, frozen	Nbn			●	40						
	135.2–133.6	3.0–4.6		[4.6]		SILTY SAND: Grey, fine to medium grained sand, brown layers	Nbn			●	22						
						To Target Depth. **Drillhole BH16-R046 terminated at 4.6m.**											

Elevation scale: 137.7 (0.5), 137.2 (1.0), 136.7 (1.5), 136.2 (2.0), 135.7 (2.5), 135.2 (3.0), 134.7 (3.5), 134.2 (4.0), 133.7 (4.5), 133.2 (5.0)

Notes:

HATCH BOREHOLE REPORT

BH16-R053

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Driller:	E.Beachamp	**Hole Diameter (mm):**	96
Date Logged:	10/28/2016	**Date Reviewed:**	2/10/2017

Easting:	528,238.0 m
Northing:	7,928,027.0 m
Surface Elevation:	163.25 m
Bottom Elevation:	157.20 m
Total Depth:	6.1 m
Logged By:	RS
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to Permafrost		0.0	Vibracore	H-Casing		SAND, trace SILT, trace GRAVEL: Light grey to brown, medium to coarse grained sand	Nf										
	162.8	0.5															
	162.3	1.0															
	161.8	1.5					Nbn		X								
	161.3	2.0															
	160.8	2.5															
	160.3	3.0															
	159.8	3.5															
	159.3	4.0															
	158.8	4.5															
	158.3	5.0															

Notes:

HATCH

BOREHOLE REPORT

BH16-R053

Client: Baffinland Iron Mines
Project No.: H352034
Project: Mary River Expansion Study Stage 2
Datum: NAD83
Location: Proposed Rail Alignment
Platform: Ground

Easting: 528,238.0 m
Northing: 7,928,027.0 m
Surface Elevation: 163.25 m
Bottom Elevation: 157.20 m
Total Depth: 6.1 m
Logged By: RS
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 10/28/2016
Driller: E.Beachamp
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
						SAND, trace SILT, trace GRAVEL: Light grey to brown, medium to coarse grained sand *(Continued)*	Nf *(Continued)*										
	157.8	5.5				5.50 m to 6.10 m: Fine to medium grained sand	Nf				23						
	157.3	6.0		[6.1]													
						To Target Depth. **Drillhole BH16-R053 terminated at 6.1m.**											
	156.8	6.5															
	156.3	7.0															
	155.8	7.5															
	155.3	8.0															
	154.8	8.5															
	154.3	9.0															
	153.8	9.5															
	153.3	10.0															

Notes:

HATCH BOREHOLE REPORT

BH16-R067
Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Contractor: Boart Longyear | **Rig Type/ Mounting:** MiniSonic Rig | **Date Logged:** 11/24/2016

Driller: Michael Scott | **Hole Diameter (mm):** 96 | **Date Reviewed:** 2/10/2017

Easting:	535,406.0 m
Northing:	7,918,572.0 m
Surface Elevation:	189.00 m
Bottom Elevation:	184.40 m
Total Depth:	4.6 m
Logged By:	MR
Reviewed By:	SH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	189.0 – 188.1	0.0 – 0.9	Vibracore	H-Casing	PEAT, with SAND, with GRAVEL, trace COBBLES: Dark brown to black, Organic, medium to coarse grained sand, rounded to subrounded cobbles	Nf										
	188.1 – 184.4	0.9 – 4.6		[4.6]	SAND, trace GRAVEL, trace COBBLES: Dark grey to dark brown, medium to coarse grained sand, rounded to subrounded cobbles	Nf		☒ (1.2)	●	16	3	60	37			
								☒ (2.4)								
								☒ (4.6)								
	184.4	4.6			To Target Depth. **Drillhole BH16-R067 terminated at 4.6m.**											

Elevation scale: 188.5, 188.0, 187.5, 187.0, 186.5, 186.0, 185.5, 185.0, 184.5, 184.0. Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0.

Notes:

BOREHOLE REPORT

HATCH

BH16-R068

Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment

Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 537,046.0 m
Northing: 7,919,096.0 m
Surface Elevation: 183.50 m
Bottom Elevation: 178.90 m
Total Depth: 4.6 m
Logged By: MR
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 11/24/2016
Driller: Michael Scott
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	183.5 – 182.0	0.0 – 1.5	Vibracore	H-Casing	GRAVELLY SAND, trace SILT: Light brown, fine to coarse grained sand, angular to subangular gravel	Vx		⊠	●	42						
	182.0 – 180.5	1.5 – 3.0			SAND: Light brown to yellowish grey, fine to medium grained sand	Vx		⊠	●	15						
	180.5 – 178.9	3.0 – 4.6		[4.6]	SAND, trace SILT, trace GRAVEL: Dark brown, Organic, fine to medium grained sand	Vx		⊠								
					To Target Depth. **Drillhole BH16-R068 terminated at 4.6m.**											

Elevation scale (m): 183.0, 182.5, 182.0, 181.5, 181.0, 180.5, 180.0, 179.5, 179.0, 178.5
Depth scale (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

BOREHOLE REPORT

BH16-R069

Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 539,489.0 m
Northing: 7,920,583.0 m
Surface Elevation: 152.00 m
Bottom Elevation: 147.40 m
Total Depth: 4.6 m
Logged By: UK
Reviewed By: SH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 11/23/2016
Driller: E.Beachamp
Hole Diameter (mm): 96
Date Reviewed: 2/10/2017

Elevation (m)	Depth (m)	Method	Casing	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Sample Type	Field Water Content	Percent Gravel	Percent Sand	Percent Fines
152.0–147.4	0.0–4.6	Vibracore	H-Casing [4.6]	Sandy SILT, with GRAVEL, with COBBLES: White to grey, fine grained sand, angular to subangular gravel					
151.0	1.0				⊠	21	19	41	40
149.5	2.5				⊠				
148.0	4.0				⊠				
147.4	4.6			To Target Depth. **Drillhole BH16-R069 terminated at 4.6m.**					

Moisture Content Profile: 0 50 100

Elevation scale: 151.5, 151.0, 150.5, 150.0, 149.5, 149.0, 148.5, 148.0, 147.5, 147.0
Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Columns: Water, Recovery, Frozen Soil Description, Liquid Limit, Plastic Index, Other Tests

Notes:

BOREHOLE REPORT

BH16-R070
Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	540,273.0 m
Northing:	7,921,201.0 m
Surface Elevation:	146.00 m
Bottom Elevation:	141.40 m
Total Depth:	4.6 m
Logged By:	MR
Reviewed By:	SH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 11/23/2016

Driller: Michael Scott **Hole Diameter (mm):** 96 **Date Reviewed:** 2/10/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0–50–100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
Unobserved due to permafrost	146.0	0.0	Vibracore	H-Casing	PEAT, GRAVELLY SAND: Brown, coarse grained sand	Nf										
					SAND, trace GRAVEL: Brown to light brown, fine to medium grained sand, angular to subangular gravel	Nf										
	145.5	0.5														
	145.0	1.0						X	●	8	0	84	16			
	144.5	1.5			1.50 m to 3.00 m: Light brown, some silt	Vx										
	144.0	2.0														
	143.5	2.5						X								
	143.0	3.0				Nf										
	142.5	3.5														
	142.0	4.0						X								
	141.5	4.5		[4.6]												
	141.0	5.0			To Target Depth. **Drillhole BH16-R070 terminated at 4.6m.**											

Notes:

HATCH

BOREHOLE REPORT

BH17-B001

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	529,031.0 m
Northing:	7,916,747.0 m
Surface Elevation:	125.00 m
Bottom Elevation:	108.50 m
Total Depth:	16.5 m
Logged By:	UK
Reviewed By:	CH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 4/22/2017

Driller: Emile and/or Sam **Hole Diameter (mm):** 100 **Date Reviewed:** 6/8/2017

Method: Sonic Drilling
Casing: NO CASING [5.0]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
125.0–123.5	0.0–1.5	SILTY SAND: Brown, fine grained sand	Nf							
123.5–120.4	1.5–4.6	SAND, trace SILT: Grey, fine grained sand	Nbn	26	0	93	7			
120.4–120.0	4.6–5.0	SILT, trace SAND: Black organics, fine grained sand	Nbn							

Moisture Content Profile: 0 50 100

Notes:

HATCH

BOREHOLE REPORT

BH17-B001

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Date Logged:	4/22/2017	**Driller:**	Emile and/or Sam
Hole Diameter (mm):	100	**Date Reviewed:**	6/8/2017

Easting:	529,031.0 m
Northing:	7,916,747.0 m
Surface Elevation:	125.00 m
Bottom Elevation:	108.50 m
Total Depth:	16.5 m
Logged By:	UK
Reviewed By:	CH/WH

Method: Sonic Drilling

Casing: NO CASING [10.0]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Moisture Content Profile (0–100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
		SILT, trace SAND: Black organics, fine grained sand *(Continued)*	Nbn *(Continued)*								
			Vs								
119.5	5.5			●	37	0	6	94			
119.0	6.0										
118.5	6.5										
118.0	7.0										
117.5	7.5										
		SILTY SAND, trace GRAVEL, trace COBBLES: Dark grey, fine to medium grained, well graded sand; multi-coloured, fine to coarse, rounded cobbles	Vx								
117.0	8.0										
116.5	8.5			●	10	6	65	29			
		8.80 m: Inferred boulders									
116.0	9.0										
		SILT with SAND, trace GRAVEL: Dark grey, fine to coarse grained, well graded sand; multi-coloured, fine to coarse, rounded gravel									
115.5	9.5										
115.0	10.0										

Notes:

HATCH BOREHOLE REPORT

BH17-B001

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	529,031.0 m
Northing:	7,916,747.0 m
Surface Elevation:	125.00 m
Bottom Elevation:	108.50 m
Total Depth:	16.5 m
Logged By:	UK
Reviewed By:	CH/WH

Contractor: Boart Longyear | **Rig Type/ Mounting:** MiniSonic Rig | **Date Logged:** 4/22/2017

Driller: Emile and/or Sam | **Hole Diameter (mm):** 100 | **Date Reviewed:** 6/8/2017

Method: Sonic Drilling; Casing: NO CASING [15.0]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Moisture Content Profile (0–100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
115.0–114.5	10.0–10.5	SILT with SAND, trace GRAVEL: Dark grey, fine to coarse grained, well graded sand; multi-coloured, fine to coarse, rounded gravel *(Continued)*	Vc								
114.0	11.0	11.00 m to 12.00 m: Large sub-angular cobbles (~ 10 cm) or possible boulders	Vx								
113.6	11.4			●	42	7	30	63			
113.0	12.0		Nf								
112.8	12.2	12.20 m: Inferred boulder									
112.2	12.8	12.80 m: Grey, inferred boulder									
111.9	13.1			●	12						
111.3	13.7	13.70 m to 16.50 m: Grey, fine grained sand; multi-coloured, fine, rounded gravel									
110.0	15.0										

Notes:

HATCH

BOREHOLE REPORT

BH17-B001

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground
Easting: 529,031.0 m
Northing: 7,916,747.0 m
Surface Elevation: 125.00 m
Bottom Elevation: 108.50 m
Total Depth: 16.5 m
Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 4/22/2017
Logged By: UK
Driller: Emile and/or Sam
Hole Diameter (mm): 100
Date Reviewed: 6/8/2017
Reviewed By: CH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	109.5 – 108.5	15.5 – 16.5	Sonic Drilling	NO CASING [16.5]		SILT with SAND, trace GRAVEL: Dark grey, fine to coarse grained, well graded sand; multi-coloured, fine to coarse, rounded gravel *(Continued)*				●	12						
	108.5	16.5				Drilling Refusal. **Drillhole BH17-B001 terminated at 16.5m.**											

Elevation scale (m): 109.5, 109.0, 108.5, 108.0, 107.5, 107.0, 106.5, 106.0, 105.5, 105.0
Depth scale (m): 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5, 20.0

Notes:

HATCH

BOREHOLE REPORT

BH17-B002

Sheet 1 of 6

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment

Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 529,323.0 m
Northing: 7,916,577.0 m
Surface Elevation: 125.00 m
Bottom Elevation: 99.40 m
Total Depth: 25.6 m
Logged By: AB
Reviewed By: CH/WH

Contractor: Boart Longyear | **Rig Type/ Mounting:** MiniSonic Rig | **Date Logged:** 4/18/2017
Driller: Emile and/or Sam | **Hole Diameter (mm):** 100 | **Date Reviewed:** 6/8/2017

Method: Sonic Drilling; Casing: NO CASING [5.0]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Moisture Content Profile (0–100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
125.0–122.0	0.0–3.0	SAND, some SILT: Brown, medium to fine grained, well graded sand									
124.5	0.5			●	19	0	88	12			
122.0–120.0	3.0–5.0	ORGANIC SILT, some SAND: Black, fine grained sand with strong organic odour.	Nbn								
121.3	3.7			●	37	0	16	84			
121.0	4.0		Nbe								
120.7	4.3		Nbn								
120.4	4.6		Vx								

Elevation scale: 124.5, 124.0, 123.5, 123.0, 122.5, 122.0, 121.5, 121.0, 120.5, 120.0
Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

HATCH BOREHOLE REPORT

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Date Logged:	4/18/2017	**Driller:**	Emile and/or Sam
Hole Diameter (mm):	100	**Date Reviewed:**	6/8/2017

Easting:	529,323.0 m
Northing:	7,916,577.0 m
Surface Elevation:	125.00 m
Bottom Elevation:	99.40 m
Total Depth:	25.6 m
Logged By:	AB
Reviewed By:	CH/WH

Method: Sonic Drilling
Casing: NO CASING [10.0]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Moisture Content Profile (0–100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
		ORGANIC SILT, some SAND: Black, fine grained sand with strong organic odour. *(Continued)*	Nbn *(Continued)*								
119.5	5.5										
119.0	6.0										
		SILTY and SAND: Brown, fine to coarse grained, well graded sand	Nf								
118.5	6.5										
				●	24	0	48	52			
118.0	7.0										
117.5	7.5										
117.0	8.0		Nbe								
116.5	8.5										
116.0	9.0										
		9.10 m to 12.20 m: Black, medium to fine grained, well graded sand; multicoloured, rounded to subrounded gravel	Nf								
115.5	9.5										
115.0	10.0										

Notes:

BOREHOLE REPORT

HATCH

BH17-B002

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment
Project No.: H352034
Datum: NAD83
Platform: Ground
Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 4/18/2017
Driller: Emile and/or Sam
Hole Diameter (mm): 100
Date Reviewed: 6/8/2017

Easting: 529,323.0 m
Northing: 7,916,577.0 m
Surface Elevation: 125.00 m
Bottom Elevation: 99.40 m
Total Depth: 25.6 m
Logged By: AB
Reviewed By: CH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 / 50 / 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
			Sonic Drilling	NO CASING	SILTY and SAND: Brown, fine to coarse grained, well graded sand *(Continued)*	Nf *(Continued)*										
	114.5	10.5														
	114.0	11.0														
	113.5	11.5							●	9	3	66	32			
	113.0	12.0														
					SAND, some SILT, trace to some GRAVEL: Brown, fine to coarse grained, poorly graded sand											
	112.5	12.5														
	112.0	13.0														
	111.5	13.5														
	111.0	14.0														
	110.5	14.5														
	110.0	15.0		[15.0]												

Notes:

HATCH BOREHOLE REPORT

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:** 4/18/2017	
Driller: Emile and/or Sam	**Hole Diameter (mm):** 100	**Date Reviewed:** 6/8/2017	

Easting:	529,323.0 m
Northing:	7,916,577.0 m
Surface Elevation:	125.00 m
Bottom Elevation:	99.40 m
Total Depth:	25.6 m
Logged By:	AB
Reviewed By:	CH/WH

Method: Sonic Drilling
Casing: NO CASING [20.0]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
		SAND, some SILT, trace to some GRAVEL: Brown, fine to coarse grained, poorly graded sand *(Continued)*								
109.5	15.5									
				11	10	70	20			
109.0	16.0									
108.5	16.5									
108.0	17.0									
107.5	17.5		Nbe							
107.0	18.0									
106.5	18.5									
		18.60 m to 19.80 m: Some GRAVEL: Multi-coloured, well graded; rounded gravel	Nf	8	15	66	20			
106.0	19.0									
105.5	19.5									
		19.80 m to 21.30 m: Dark brown, fine to coarse grained, well graded sand; fine	Nf							
105.0	20.0									

Moisture Content Profile: 0 50 100

Notes:

HATCH

BOREHOLE REPORT

BH17-B002

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Driller:	Emile and/or Sam	**Hole Diameter (mm):**	100
Date Logged:	4/18/2017	**Date Reviewed:**	6/8/2017

Easting:	529,323.0 m
Northing:	7,916,577.0 m
Surface Elevation:	125.00 m
Bottom Elevation:	99.40 m
Total Depth:	25.6 m
Logged By:	AB
Reviewed By:	CH/WH

Method: Sonic Drilling. Casing: NO CASING [25.0]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
104.5	20.5	to coarse gravel SAND, some SILT, trace to some GRAVEL: Brown, fine to coarse grained, poorly graded sand *(Continued)*	Nbn							
104.0	21.0									
103.5	21.5	21.30 m to 24.40 m: SILTY SAND, trace GRAVEL: Brown, fine grained sand	Nf							
103.0	22.0									
102.5	22.5									
102.0	23.0									
101.5	23.5			15	1	72	27			
101.0	24.0									
100.5	24.5	Inferred BEDROCK, grey, rock flour, Granitic								
100.0	25.0									

Moisture Content Profile: 0 50 100

Notes:

HATCH

BOREHOLE REPORT

BH17-B002

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	529,323.0 m
Northing:	7,916,577.0 m
Surface Elevation:	125.00 m
Bottom Elevation:	99.40 m
Total Depth:	25.6 m
Logged By:	AB
Reviewed By:	CH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 4/18/2017

Driller: Emile and/or Sam **Hole Diameter (mm):** 100 **Date Reviewed:** 6/8/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	99.5	25.5	Sonic Drilling	NO CASING [25.6]		Inferred BEDROCK, grey, rock flour, Granitic *(Continued)*											
	99.0 – 95.0	26.0 – 30.0				Drilling Refusal. **Drillhole BH17-B002 terminated at 25.6m.**											

Notes:

BOREHOLE REPORT

BH17-C001

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:**	4/13/2017
Driller: Emile and/or Sam	**Hole Diameter (mm):** 100	**Date Reviewed:**	6/8/2017

Easting:	509,838.0 m
Northing:	7,967,861.0 m
Surface Elevation:	74.00 m
Bottom Elevation:	65.80 m
Total Depth:	8.2 m
Logged By:	AB
Reviewed By:	CH/WH

Method: Sonic Drilling; Casing: NO CASING [5.0]

Elevation (m): 73.5, 73.0, 72.5, 72.0, 71.5, 71.0, 70.5, 70.0, 69.5, 69.0
Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Moisture Content Profile: 0, 50, 100

Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
ORGANICS: Brown, fine grained, black mottling								
GRAVELLY SAND, some COBBLES: Grey, well graded, fine grained sand; Coarse, rounded to subrounded gravel								
SAND: Multi-coloured, coarse grained, poorly graded	Nf							
2.10 m: Black mottling								
SAND and SILT, some GRAVEL: Reddish brown, poorly graded, coarse grained sand; coarse, rounded gravel	Nf	7	14	49	37			
3.40 m to 3.70 m: Inferred cobbles								
3.70 m to 6.10 m: Grey, coarse grained, well graded sand; rounded to sub-angular, coarse gravel	Nf							

Notes:

BOREHOLE REPORT

HATCH

BH17-C001

Client: Baffinland Iron Mines
Project No.: H352034
Project: Mary River Expansion Study Stage 2
Datum: NAD83
Location: Proposed Rail Alignment
Platform: Ground

Easting: 509,838.0 m
Northing: 7,967,861.0 m
Surface Elevation: 74.00 m
Bottom Elevation: 65.80 m
Total Depth: 8.2 m
Logged By: AB
Reviewed By: CH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 4/13/2017
Driller: Emile and/or Sam **Hole Diameter (mm):** 100 **Date Reviewed:** 6/8/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	68.5 – 66.0	5.5 – 8.0	Sonic Drilling	NO CASING [8.2]		SAND and SILT, some GRAVEL: Reddish brown, poorly graded, coarse grained sand; coarse, rounded gravel *(Continued)* 5.20 m to 5.80 m: Inferred cobbles 6.10 m to 7.60 m: No gravel encountered, light brown, fine to coarse grained sand 7.30 m: Inferred cobbles 7.60 m to 8.20 m: Grey, fine grained Sand; well-graded, rounded gravel	Nf *(Continued)* Nf				3	0	48	52			
	65.5 – 64.0	8.5 – 10.0				Drilling Refusal. **Drillhole BH17-C001 terminated at 8.2m.**											

Notes:

HATCH BOREHOLE REPORT

BH17-C002

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Driller:	Emile and/or Sam	**Hole Diameter (mm):**	100
Date Logged:	4/13/2017	**Date Reviewed:**	6/8/2017

Easting:	519,532.0 m
Northing:	7,957,667.0 m
Surface Elevation:	116.00 m
Bottom Elevation:	105.30 m
Total Depth:	10.7 m
Logged By:	UK
Reviewed By:	CH/WH

Depth (m)	Elevation (m)	Method	Casing	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
0.0–0.6	116.0–115.4	Sonic Drilling	NO CASING	SAND, trace GRAVEL: Brown, fine to medium grained sand; coarse, rounded gravel	Nf							
0.6–1.5	115.4–114.5			COBBLES and BOULDERS, some SAND, trace GRAVEL: White, subangular cobbles; Inferred boulders	Nf							
1.5–2.7	114.5–113.3			GRAVELLY SAND, some SILT: Grey, fine to coarse grained sand; coarse gravel	Nf	10	22	59	19			
2.7–5.0	113.3–111.0		[5.0]	ICE: Clear to cloudy texture 3.00 m to 9.10 m: White cloudy texture	ICE							

Column headings: Water; Elevation (m); Depth (m); Method; Casing; Graphic Log; Soil Description; Frozen Soil Description; Recovery; Sample Type; Moisture Content Profile (0, 50, 100); Field Water Content; Percent Gravel; Percent Sand; Percent Fines; Liquid Limit; Plastic Index; Other Tests

Elevation scale: 115.5, 115.0, 114.5, 114.0, 113.5, 113.0, 112.5, 112.0, 111.5, 111.0

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

HATCH BOREHOLE REPORT

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:** 4/13/2017	
Driller: Emile and/or Sam	**Hole Diameter (mm):** 100	**Date Reviewed:** 6/8/2017	

Easting:	519,532.0 m
Northing:	7,957,667.0 m
Surface Elevation:	116.00 m
Bottom Elevation:	105.30 m
Total Depth:	10.7 m
Logged By:	UK
Reviewed By:	CH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	110.5 – 106.0	5.5 – 10.0	Sonic Drilling	NO CASING [10.0]		ICE: Clear to cloudy texture *(Continued)* 8.80 m to 9.10 m: Ice with silt Inclusions	ICE *(Continued)*										

Elevation scale (m): 110.5, 110.0, 109.5, 109.0, 108.5, 108.0, 107.5, 107.0, 106.5, 106.0
Depth scale (m): 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5, 10.0

Notes:

HATCH

BOREHOLE REPORT

BH17-C002

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting: 519,532.0 m
Northing: 7,957,667.0 m
Surface Elevation: 116.00 m
Bottom Elevation: 105.30 m
Total Depth: 10.7 m
Logged By: UK
Reviewed By: CH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 4/13/2017
Driller: Emile and/or Sam **Hole Diameter (mm):** 100 **Date Reviewed:** 6/8/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	105.5	10.5	Sonic Drilling	NO CASING [10.7]		ICE: Clear to cloudy texture *(Continued)*	ICE *(Continued)*										
	105.0	11.0				To Target Depth. **Drillhole BH17-C002 terminated at 10.7m.**											
	104.5	11.5															
	104.0	12.0															
	103.5	12.5															
	103.0	13.0															
	102.5	13.5															
	102.0	14.0															
	101.5	14.5															
	101.0	15.0															

Notes:

HATCH BOREHOLE REPORT

BH17-C003

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment

Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 520,130.0 m
Northing: 7,957,541.0 m
Surface Elevation: 118.25 m
Bottom Elevation: 109.15 m
Total Depth: 9.1 m
Logged By: UK/AB
Reviewed By: CH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 4/14/2017
Driller: Emile and/or Sam
Hole Diameter (mm): 100
Date Reviewed: 6/8/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
		0.0–0.3	Sonic Drilling	NO CASING		SILTY SAND: Brown, fine to medium grained sand											
	117.8 / 117.3 / 116.8 / 116.3 / 115.8	0.5 / 1.0 / 1.5 / 2.0 / 2.5				Inferred BOULDERS, GRAVELLY SAND: Brown, coarse grained sand; Fine to coarse, rounded to sub-angular gravel											
	115.3 / 114.8 / 114.3 / 113.8	3.0 / 3.5 / 4.0 / 4.5				GRAVELLY SILTY SAND: Grey, coarse grained, poorly graded sand; Multi-coloured, coarse, rounded gravel 4.00 m to 4.60 m: Inferred boulders				●	7	33	46	21			
	113.3	5.0		[5.0]		SILTY SAND, trace GRAVEL: Light brown, well graded sand	Nf										

Notes:

HATCH BOREHOLE REPORT

BH17-C003

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Driller:	Emile and/or Sam	**Hole Diameter (mm):**	100
Date Logged:	4/14/2017	**Date Reviewed:**	6/8/2017

Easting:	520,130.0 m
Northing:	7,957,541.0 m
Surface Elevation:	118.25 m
Bottom Elevation:	109.15 m
Total Depth:	9.1 m
Logged By:	UK/AB
Reviewed By:	CH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
			Sonic Drilling	NO CASING		SILTY SAND, trace GRAVEL: Light brown, well graded sand *(Continued)*	Nf *(Continued)*										
	112.8	5.5								●	24	4	73	23			
	112.3	6.0				6.10 m to 9.10 m: Some cobbles, rounded to sub-rounded, multi-coloured, up to 10 cm diamater											
	111.8	6.5															
	111.3	7.0															
	110.8	7.5															
	110.3	8.0				7.90 m: Sand changes from light brown to reddish											
	109.8	8.5								●	9	9	57	34			
	109.3	9.0															
						To Target Depth. **Drillhole BH17-C003 terminated at 9.1m.**											
	108.8	9.5															
	108.3	10.0		[10.0]													

Notes:

HATCH BOREHOLE REPORT

BH17-C004

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:** 4/14/2017	
Driller: Emile and/or Sam	**Hole Diameter (mm):** 100	**Date Reviewed:** 6/8/2017	

Easting:	520,486.0 m
Northing:	7,956,367.0 m
Surface Elevation:	116.30 m
Bottom Elevation:	105.60 m
Total Depth:	10.7 m
Logged By:	AB
Reviewed By:	CH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
		0.0–3.0	Sonic Drilling	NO CASING		SAND, some SILT, trace GRAVEL: Grey, well graded, sand; Fine to coarse, rounded to sub-rounded gravel											
	115.8	0.5															
	115.3	1.0															
	114.8	1.5				1.80 m to 3.0 m: Some cobbles											
	114.3	2.0															
	113.8	2.5															
	113.3	3.0				SILTY SAND: Light brown, fine to coarse grained, poorly graded sand	Nf										
	112.8	3.5				3.40 m: Inferred boulder											
	112.3	4.0															
	111.8	4.5				4.30 m: Inferred boulder	Vx										
	111.3	5.0		[5.0]													

Notes:

HATCH BOREHOLE REPORT

BH17-C004

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	520,486.0 m
Northing:	7,956,367.0 m
Surface Elevation:	116.30 m
Bottom Elevation:	105.60 m
Total Depth:	10.7 m
Logged By:	AB
Reviewed By:	CH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 4/14/2017

Driller: Emile and/or Sam **Hole Diameter (mm):** 100 **Date Reviewed:** 6/8/2017

Columns: Water | Elevation (m) | Depth (m) | Method | Casing | Graphic Log | Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.) | Frozen Soil Description | Recovery | Sample Type | Moisture Content Profile (0, 50, 100) | Field Water Content | Percent Gravel | Percent Sand | Percent Fines | Liquid Limit | Plastic Index | Other Tests

Method: Sonic Drilling. Casing: NO CASING [10.0]

Elevation (m)	Depth (m)	Soil Description	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines
		SILTY SAND: Light brown, fine to coarse grained, poorly graded sand *(Continued)*	Nf *(Continued)*				
110.8	5.5						
110.3	6.0						
109.8	6.5						
109.3	7.0			30	9	75	17
		7.20 m: Inferred Boulder					
108.8	7.5						
		SILTY SAND, trace GRAVEL: Brown, well graded sand, multi-coloured, fine, rounded to subangular gravel					
108.3	8.0						
107.8	8.5						
107.3	9.0						
		9.10 m to 9.80 m: Some inferred fragmented cobbles					
106.8	9.5						
				10	8	60	32
106.3	10.0						

Notes:

HATCH

BOREHOLE REPORT

BH17-C004

Sheet 3 of 3

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	520,486.0 m
Northing:	7,956,367.0 m
Surface Elevation:	116.30 m
Bottom Elevation:	105.60 m
Total Depth:	10.7 m
Logged By:	AB
Reviewed By:	CH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 4/14/2017

Driller: Emile and/or Sam **Hole Diameter (mm):** 100 **Date Reviewed:** 6/8/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	105.8	10.5	Sonic Drilling	NO CASING [10.7]		SILTY SAND, trace GRAVEL: Brown, well graded sand, multi-coloured, fine, rounded to subangular gravel *(Continued)*			X								
	105.3	11.0				To Target Depth. **Drillhole BH17-C004 terminated at 10.7m.**											
	104.8	11.5															
	104.3	12.0															
	103.8	12.5															
	103.3	13.0															
	102.8	13.5															
	102.3	14.0															
	101.8	14.5															
	101.3	15.0															

Notes:

BOREHOLE REPORT

BH17-C005

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:** 4/14/2017	
Driller: Emile and/or Sam	**Hole Diameter (mm):** 100	**Date Reviewed:** 6/8/2017	

Easting:	525,227.0 m
Northing:	7,938,527.0 m
Surface Elevation:	185.00 m
Bottom Elevation:	175.90 m
Total Depth:	9.1 m
Logged By:	UK
Reviewed By:	CH/WH

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 / 50 / 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	185.0–183.5	0.0–1.5	Sonic Drilling	NO CASING		SILTY SAND: Grey, fine grained, poorly graded	Nf										
							Nbn		X								
	183.5–182.0	1.5–3.0				ICE and SILTY SAND: Ice rich, grey, poorly graded sand	Vr		X								
	182.0–180.0	3.0–5.0		[5.0]		SILTY SAND, some GRAVEL: Grey, fine to coarse grained sand; coarse, rounded to subrounded, well graded gravel.	Nf		X								
						4.60 m to 6.10 m: Some cobbles, trace boulders	Nbn										

Elevation scale: 184.5, 184.0, 183.5, 183.0, 182.5, 182.0, 181.5, 181.0, 180.5, 180.0

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

HATCH BOREHOLE REPORT

BH17-C005

Sheet 2 of 2

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	525,227.0 m
Northing:	7,938,527.0 m
Surface Elevation:	185.00 m
Bottom Elevation:	175.90 m
Total Depth:	9.1 m
Logged By:	UK
Reviewed By:	CH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 4/14/2017

Driller: Emile and/or Sam **Hole Diameter (mm):** 100 **Date Reviewed:** 6/8/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
			Sonic Drilling	NO CASING		SILTY SAND, some GRAVEL: Grey, fine to coarse grained sand; coarse, rounded to subrounded, well graded gravel. *(Continued)*	Nf *(Continued)*										
	179.5	5.5							X	●	7	19	57	24			
	179.0	6.0															
	178.5	6.5															
	178.0	7.0							X								
	177.5	7.5															
	177.0	8.0															
	176.5	8.5				8.50 m to 8.80 m: Some sand	Nbn		X								
	176.0	9.0															
						To Target Depth. **Drillhole BH17-C005 terminated at 9.1m.**											
	175.5	9.5															
	175.0	10.0		[10.0]													

Notes:

HATCH BOREHOLE REPORT

BH17-C006
Sheet 1 of 3

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	527,315.0 m
Northing:	7,932,504.0 m
Surface Elevation:	178.60 m
Bottom Elevation:	167.90 m
Total Depth:	10.7 m
Logged By:	AB
Reviewed By:	CH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 4/15/2017
Driller: Emile and/or Sam **Hole Diameter (mm):** 100 **Date Reviewed:** 6/8/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
		0.0	Sonic Drilling	NO CASING		SILTY SAND, inferred BOULDERS: Grey, fine grained, poorly graded sand; grey boulder fragments											
	178.1	0.5															
	177.6	1.0															
	177.1	1.5															
	176.6	2.0															
	176.1	2.5															
	175.6	3.0				SAND and SILT, some GRAVEL, ICE Inclusions: Brown sand; multi-coloured, fine, rounded gravel	Vr										
	175.1	3.5					Vc										
										●	14	19	43	38			
	174.6	4.0															
	174.1	4.5															
	173.6	5.0		[5.0]													

Notes:

BOREHOLE REPORT

BH17-C006

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	527,315.0 m
Northing:	7,932,504.0 m
Surface Elevation:	178.60 m
Bottom Elevation:	167.90 m
Total Depth:	10.7 m
Logged By:	AB
Reviewed By:	CH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 4/15/2017

Driller: Emile and/or Sam **Hole Diameter (mm):** 100 **Date Reviewed:** 6/8/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
			Sonic Drilling	NO CASING		SAND and SILT, some GRAVEL, ICE Inclusions: Brown sand; multi-coloured, fine, rounded gravel *(Continued)*	Vr *(Continued)*										
	173.1	5.5															
	172.6	6.0					Nbe										
	172.1	6.5															
						SILT and SAND, inferred BOULDERS: Light brown silt; fine grained, well graded sand; grey boulder fragments											
	171.6	7.0															
	171.1	7.5															
						GRAVELLY SAND and SILT, ICE Inclusions: Light brown silt; angular gravel; possible boulders	Vx										
	170.6	8.0															
										●	16	22	42	27			
	170.1	8.5															
	169.6	9.0					Vr										
	169.1	9.5															
	168.6	10.0		[10.0]													

Notes:

HATCH BOREHOLE REPORT

BH17-C006

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	527,315.0 m
Northing:	7,932,504.0 m
Surface Elevation:	178.60 m
Bottom Elevation:	167.90 m
Total Depth:	10.7 m
Logged By:	AB
Reviewed By:	CH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 4/15/2017

Driller: Emile and/or Sam **Hole Diameter (mm):** 100 **Date Reviewed:** 6/8/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	168.1	10.5	Sonic Drilling	NO CASING [10.7]		GRAVELLY SAND and SILT, ICE Inclusions: Light brown silt; angular gravel; possible boulders *(Continued)* 10.40 m to 10.70 m: Inferred Boulders	Vx *(Continued)* Vr										
	167.6	11.0				To Target Depth. **Drillhole BH17-C006 terminated at 10.7m.**											
	167.1	11.5															
	166.6	12.0															
	166.1	12.5															
	165.6	13.0															
	165.1	13.5															
	164.6	14.0															
	164.1	14.5															
	163.6	15.0															

Notes:

HATCH

BOREHOLE REPORT

BH17-C006B

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment

Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 528,253.0 m
Northing: 7,929,081.0 m
Surface Elevation: 0.00 m
Bottom Elevation: -6.10 m
Total Depth: 6.1 m
Logged By: UK
Reviewed By: CH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 4/17/2017
Driller: Emile and/or Sam
Hole Diameter (mm): 100
Date Reviewed: 6/8/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	-0.5 / -1.0	0.5 / 1.0	Sonic Drilling	NO CASING		SILTY SAND, some COBBLES: Brown, fine grained sand; rounded to sub-rounded cobbles	Nf										
	-1.0 to -5.0	1.0 to 5.0		[5.0]		SILTY SAND: Reddish brown, fine to medium grained sand	Nf Nbn Nbn										

Elevation (m): -0.5, -1.0, -1.5, -2.0, -2.5, -3.0, -3.5, -4.0, -4.5, -5.0

Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

HATCH BOREHOLE REPORT

BH17-C006B
Sheet 2 of 2

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	528,253.0 m
Northing:	7,929,081.0 m
Surface Elevation:	0.00 m
Bottom Elevation:	-6.10 m
Total Depth:	6.1 m
Logged By:	UK
Reviewed By:	CH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 4/17/2017

Driller: Emile and/or Sam **Hole Diameter (mm):** 100 **Date Reviewed:** 6/8/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 50 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	-5.5 -6.0	5.5 6.0	Sonic Drilling	NO CASING [6.1]		SILTY SAND: Reddish brown, fine to medium grained sand *(Continued)*	Nf *(Continued)*										
	-6.5 -7.0 -7.5 -8.0 -8.5 -9.0 -9.5 -10.0	6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0				To Target Depth. **Drillhole BH17-C006B terminated at 6.1m.**											

Notes:

BOREHOLE REPORT

BH17-C007

Sheet 1 of 1

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	528,564.0 m
Northing:	7,917,138.0 m
Surface Elevation:	132.00 m
Bottom Elevation:	127.40 m
Total Depth:	4.6 m
Logged By:	AB
Reviewed By:	CH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 4/22/2017

Driller: Emile and/or Sam **Hole Diameter (mm):** 100 **Date Reviewed:** 6/8/2017

Method: Sonic Drilling; Casing: NO CASING [4.6]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Moisture Content Profile (0–100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
132.0–130.5	0.0–1.5	ORGANIC SILT, some SAND: Brown sand, dark grey organics, some rootlets									
130.5–127.4	1.5–4.6	SILT and SAND, trace GRAVEL: Light brown, fine to coarse grained, well graded sand	Nbe								
	~2.5		Vc								
	~2.8		Vr								
	3.70	3.70 m to 4.60 m: Grey, fine grained	Vs								
128.0	~4.0			● (~14)	14	10	37	53			
127.4	4.6	To Target Depth. **Drillhole BH17-C007 terminated at 4.6m.**									

Elevation scale: 131.5, 131.0, 130.5, 130.0, 129.5, 129.0, 128.5, 128.0, 127.5, 127.0

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

BOREHOLE REPORT

HATCH

BH17-C010

Sheet 1 of 1

Client: Baffinland Iron Mines
Project No.: H352034
Project: Mary River Expansion Study Stage 2
Datum: NAD83
Location: Proposed Rail Alignment
Platform: Ground

Easting: 529,961.0 m
Northing: 7,916,702.0 m
Surface Elevation: 0.00 m
Bottom Elevation: -4.60 m
Total Depth: 4.6 m
Logged By: AB
Reviewed By: CH/WH

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 4/20/2017
Driller: Emile and/or Sam **Hole Diameter (mm):** 100 **Date Reviewed:** 6/8/2017

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 50 – 100)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	0.0 to -4.6	0.0 to 4.6	Sonic Drilling	NO CASING [4.6]		SAND, trace SILT, trace GRAVEL: Brown, very dense, fine to coarse grained sand, well graded	Nf (0.0 m); Nbe (~1.8 m); Nf (~3.0 m)										
		~2.5									14	1	88	11			
		~3.8									15	0	90	9			
	-4.6	4.6				To Target Depth. **Drillhole BH17-C010 terminated at 4.6m.**											

Notes:

HATCH

BOREHOLE REPORT

BH17-C011

Client:	Baffinland Iron Mines	**Project No.:**	H352034
Project:	Mary River Expansion Study Stage 2	**Datum:**	NAD83
Location:	Proposed Rail Alignment	**Platform:**	Ground

Easting:	532,072.0 m
Northing:	7,917,478.0 m
Surface Elevation:	168.00 m
Bottom Elevation:	163.40 m
Total Depth:	4.6 m
Logged By:	UK
Reviewed By:	CH/WH

Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig	**Date Logged:**	4/19/2017
Driller:	Emile and/or Sam	**Hole Diameter (mm):**	100	**Date Reviewed:**	6/8/2017

Elevation (m)	Depth (m)	Method	Casing	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
168.0	0.0	Sonic Drilling	NO CASING	SILTY SAND: Dark brown, organic	Nf							
167.7	0.3			SILTY SAND, trace COBBLES: Brown, fine grained sand, rounded to subrounded cobbles	Nf							
166.5	1.5			1.50 m to 3.0 m: No cobbles encountered	Vs							
					Vr							
					Nbn							
164.0	4.0					17	0	76	24			
163.4	4.6		[4.6]	To Target Depth. **Drillhole BH17-C011 terminated at 4.6m.**								

Elevation scale (m): 167.5, 167.0, 166.5, 166.0, 165.5, 165.0, 164.5, 164.0, 163.5, 163.0

Depth scale (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Moisture Content Profile: 0, 50, 100

Notes:

HATCH BOREHOLE REPORT

BH17-C012
Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment

Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 533,228.0 m
Northing: 7,918,553.0 m
Surface Elevation: 182.66 m
Bottom Elevation: 178.06 m
Total Depth: 4.6 m
Logged By: UK
Reviewed By: CH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 4/19/2017
Driller: Emile and/or Sam
Hole Diameter (mm): 100
Date Reviewed: 6/8/2017

Method: Sonic Drilling
Casing: NO CASING [4.6]

Depth (m)	Elevation (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
0.0–2.4	182.66–180.26	SILTY SAND: Dark grey, fine grained sand	Nf; Vx							
2.4–3.0	180.26–179.66	ICE: White, cloudy texture	ICE							
3.0–4.6	179.66–178.06	GRAVELLY SILT and SAND: Brown, fine grained sand; coarse, angular to sub-angular gravel	Nf							
4.0 (sample)	178.7			8	25	35	40			
4.6	178.06	To Target Depth. **Drillhole BH17-C012 terminated at 4.6m.**								

Moisture Content Profile: 0, 50, 100

Elevation scale (m): 182.2, 181.7, 181.2, 180.7, 180.2, 179.7, 179.2, 178.7, 178.2, 177.7
Depth scale (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Notes:

BOREHOLE REPORT

BH17-C013

Sheet 1 of 1

Client: Baffinland Iron Mines
Project: Mary River Expansion Study Stage 2
Location: Proposed Rail Alignment

Project No.: H352034
Datum: NAD83
Platform: Ground

Easting: 534,196.0 m
Northing: 7,918,569.0 m
Surface Elevation: 182.20 m
Bottom Elevation: 177.60 m
Total Depth: 4.6 m
Logged By: UK
Reviewed By: CH/WH

Contractor: Boart Longyear
Rig Type/ Mounting: MiniSonic Rig
Date Logged: 4/18/2016
Driller: Emile and/or Sam
Hole Diameter (mm): 100
Date Reviewed: 6/8/2017

Method: Sonic Drilling
Casing: NO CASING [4.6]

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
182.2–180.7	0.0–1.5	SAND and SILT, some GRAVEL: Brown, fine grained sand; coarse, sub-rounded to rounded gravel	Nf	14	12	43	46			
180.7–177.6	1.5–4.6	ICE and SILTY SAND: Grey, fine grained sand, stratified to irregular oriented ice formation	ICE + SOIL							
		To Target Depth. **Drillhole BH17-C013 terminated at 4.6m.**								

Elevation scale: 181.7 (0.5), 181.2 (1.0), 180.7 (1.5), 180.2 (2.0), 179.7 (2.5), 179.2 (3.0), 178.7 (3.5), 178.2 (4.0), 177.7 (4.5), 177.2 (5.0)

Moisture Content Profile: 0, 50, 100

Notes:

HATCH BOREHOLE REPORT

BH17-BR86-1

Client:	Baffinland Iron Mines Corporation	**Project No.:**	H353004
Project:	Mary River Expansion Project	**Datum:**	NAD83
Location:	North West Abutment	**Platform:**	Ground
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:**	10/1/2017
Driller: Brent McAndrew	**Hole Diameter (mm):** 100 mm	**Date Reviewed:**	2/10/2018

Easting:	542,257.3 m
Northing:	7,922,181.7 m
Surface Elevation:	142.93 m
Bottom Elevation:	103.33 m
Total Depth:	39.6 m
Logged By:	R.S
Reviewed By:	H.G

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 25 50)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
						Sandy GRAVEL, trace Silt: Brown.	unfrozen										
	141.9	1.0				SAND, trace Silt: Brown to greyish-brown, medium to fine grained, well graded. Ice poor soil.	Nbn										
	140.9	2.0															
	139.9	3.0															
	138.9	4.0															
	137.9	5.0				ICE	ICE										
	136.9	6.0				SAND, trace Silt: Alternating layers of grey sand and brown silty sand, poorly graded, medium to fine grained. Ice poor soil.	Nbn										
	135.9	7.0															
	134.9	8.0															
	133.9	9.0															
	132.9	10.0															
	131.9	11.0															

Notes: Hole not located directly on abutment.

BOREHOLE REPORT

BH17-BR86-1

Client:	Baffinland Iron Mines Corporation	**Project No.:**	H353004
Project:	Mary River Expansion Project	**Datum:**	NAD83
Location:	North West Abutment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Driller:	Brent McAndrew	**Hole Diameter (mm):**	100 mm
Date Logged:	10/1/2017	**Date Reviewed:**	2/10/2018

Easting:	542,257.3 m
Northing:	7,922,181.7 m
Surface Elevation:	142.93 m
Bottom Elevation:	103.33 m
Total Depth:	39.6 m
Logged By:	R.S
Reviewed By:	H.G

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 25 – 50)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
						SAND, trace Silt: Alternating layers of grey sand and brown silty sand, poorly graded, medium to fine grained. Ice poor soil. *(Continued)*	Nbn *(Continued)*										
	130.9	12.0															
	129.9	13.0															
	128.9	14.0															
	127.9	15.0															
	126.9	16.0															
	125.9	17.0															
	124.9	18.0															
	123.9	19.0															
	122.9	20.0															
	121.9	21.0															
	120.9	22.0															

Notes: Hole not located directly on abutment.

BOREHOLE REPORT

BH17-BR86-1

Client:	Baffinland Iron Mines Corporation	**Project No.:**	H353004
Project:	Mary River Expansion Project	**Datum:**	NAD83
Location:	North West Abutment	**Platform:**	Ground

Easting:	542,257.3 m
Northing:	7,922,181.7 m
Surface Elevation:	142.93 m
Bottom Elevation:	103.33 m
Total Depth:	39.6 m
Logged By:	R.S
Reviewed By:	H.G

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/1/2017

Driller: Brent McAndrew **Hole Diameter (mm):** 100 mm **Date Reviewed:** 2/10/2018

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 25 – 50)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
						SAND, trace Silt: Alternating layers of grey sand and brown silty sand, poorly graded, medium to fine grained. Ice poor soil. *(Continued)*	Nbn *(Continued)*										
	119.9	23.0															
	118.9	24.0															
	117.9	25.0															
	116.9	26.0															
	115.9	27.0															
	114.9	28.0															
	113.9	29.0															
						29.30m to 29.4m: Some fine gravel.											
	112.9	30.0															
	111.9	31.0															
	110.9	32.0															
	109.9	33.0															

Notes: Hole not located directly on abutment.

Client:	Baffinland Iron Mines Corporation	**Project No.:**	H353004
Project:	Mary River Expansion Project	**Datum:**	NAD83
Location:	North West Abutment	**Platform:**	Ground
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	MiniSonic Rig
Driller:	Brent McAndrew	**Hole Diameter (mm):**	100 mm
Date Logged:	10/1/2017	**Date Reviewed:**	2/10/2018

Easting:	542,257.3 m
Northing:	7,922,181.7 m
Surface Elevation:	142.93 m
Bottom Elevation:	103.33 m
Total Depth:	39.6 m
Logged By:	R.S
Reviewed By:	H.G

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description
		SAND, trace Silt: Alternating layers of grey sand and brown silty sand, poorly graded, medium to fine grained. Ice poor soil. *(Continued)*	Nbn *(Continued)*
108.9	34.0		
107.9	35.0	SAND, with SILT: Brown, fine grained. Ice poor soil.	Nbn
106.9	36.0		
105.9	37.0	35.0m to 37.8m: Dark brownish-grey.	
104.9	38.0		
103.9	39.0		
		To Target Depth. **Drillhole BH17-BR86-1 terminated at 39.6m.**	
102.9	40.0		
101.9	41.0		
100.9	42.0		
99.9	43.0		
98.9	44.0		

Columns also present (no entries): Water, Method, Casing, Graphic Log, Recovery, Sample Type, Moisture Content Profile (0, 25, 50), Field Water Content, Percent Gravel, Percent Sand, Percent Fines, Liquid Limit, Plastic Index, Other Tests

Notes: Hole not located directly on abutment.

HATCH

BOREHOLE REPORT

BH17-BR86-2

Client: Baffinland Iron Mines Corporation
Project: Mary River Expansion Project
Location: North West Abutment

Project No.: H353004
Datum: NAD83
Platform: Ground

Easting: 542,268.6 m
Northing: 7,922,171.3 m
Surface Elevation: 142.97 m
Bottom Elevation: 103.37 m
Total Depth: 39.6 m
Logged By: U.K and R.S
Reviewed By: H.G

Contractor: Boart Longyear
Driller: Brent McAndrew
Rig Type/ Mounting: MiniSonic Rig
Hole Diameter (mm): 100 mm
Date Logged: 10/26/2017
Date Reviewed: 2/10/2018

Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.

Moisture Content Profile: 0 25 50

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description	Frozen Soil Description	Recovery	Sample Type	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
						Sandy GRAVEL, trace SILT: Brown.	unfrozen									
	142.0	1.0				SAND, trace SILT: Brown and greyish-brown. Ice poor soil.	Nbn			14	25	72	2			
	141.0	2.0								23	0	93	7			
	140.0	3.0								18	0	91	9			
	139.0	4.0														
	138.0	5.0				4.6m to 6.1m: Uniform brown colour, trace multi-coloured fine gravel.				37	4	91	5			
	137.0	6.0														
	136.0	7.0														
						SAND, trace to some Silt: Alternating layers of grey sand and brown silty-sand, poorly graded. Ice poor soil.	Nbn									
	135.0	8.0														
	134.0	9.0														
	133.0	10.0								22	0	89	11			
	132.0	11.0														

Notes: Hole is directly on North West Abutment.

HATCH BOREHOLE REPORT

Client:	Baffinland Iron Mines Corporation	**Project No.:**	H353004
Project:	Mary River Expansion Project	**Datum:**	NAD83
Location:	North West Abutment	**Platform:**	Ground

Easting:	542,268.6 m
Northing:	7,922,171.3 m
Surface Elevation:	142.97 m
Bottom Elevation:	103.37 m
Total Depth:	39.6 m
Logged By:	U.K and R.S
Reviewed By:	H.G

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/26/2017

Driller: Brent McAndrew **Hole Diameter (mm):** 100 mm **Date Reviewed:** 2/10/2018

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 25 50)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
						SAND, trace to some Silt: Alternating layers of grey sand and brown silty-sand, poorly graded. Ice poor soil. *(Continued)*	Nbn *(Continued)*										
		11.3							■	●	23						
	131.0	12.0															
	130.0	13.0															
	129.0	14.0															
	128.0	15.0															
	127.0	16.0															
	126.0	17.0															
	125.0	18.0															
	124.0	19.0															
	123.0	20.0							■	●	22	0	90	10			
	122.0	21.0															
	121.0	22.0															

Notes: Hole is directly on North West Abutment.

HATCH BOREHOLE REPORT

BH17-BR86-2

Client:	Baffinland Iron Mines Corporation	**Project No.:**	H353004
Project:	Mary River Expansion Project	**Datum:**	NAD83
Location:	North West Abutment	**Platform:**	Ground

Easting:	542,268.6 m
Northing:	7,922,171.3 m
Surface Elevation:	142.97 m
Bottom Elevation:	103.37 m
Total Depth:	39.6 m
Logged By:	U.K and R.S
Reviewed By:	H.G

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/26/2017

Driller: Brent McAndrew **Hole Diameter (mm):** 100 mm **Date Reviewed:** 2/10/2018

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 25 – 50)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
						SAND, trace to some Silt: Alternating layers of grey sand and brown silty-sand, poorly graded. Ice poor soil. *(Continued)*	Nbn *(Continued)*										
	120.0	23.0															
	119.0	24.0							■	●	25						
	118.0	25.0															
	117.0	26.0															
	116.0	27.0															
	115.0	28.0															
	114.0	29.0															
	113.0	30.0							■	●	26						
	112.0	31.0															
	111.0	32.0							■								
	110.0	33.0															

Notes: Hole is directly on North West Abutment.

HATCH BOREHOLE REPORT

BH17-BR86-2

Client:	Baffinland Iron Mines Corporation	**Project No.:**	H353004
Project:	Mary River Expansion Project	**Datum:**	NAD83
Location:	North West Abutment	**Platform:**	Ground

Easting: 542,268.6 m
Northing: 7,922,171.3 m
Surface Elevation: 142.97 m
Bottom Elevation: 103.37 m
Total Depth: 39.6 m
Logged By: U.K and R.S
Reviewed By: H.G

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/26/2017
Driller: Brent McAndrew **Hole Diameter (mm):** 100 mm **Date Reviewed:** 2/10/2018

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Moisture Content Profile (0–50)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
		SAND, trace to some Silt: Alternating layers of grey sand and brown silty-sand, poorly graded. Ice poor soil. *(Continued)*	Nbn *(Continued)*								
109.0	34.0										
108.0	35.0										
107.0	36.0			●	27						
106.0	37.0										
105.0	38.0	37.4m to 39.3m: Trace Organics, dark brownish-grey to black, thin lenses of organics.									
104.0	39.0										
		SAND, and SILT: Brown, fine grained. Ice poor soil.	Nbn	●	25	0	61	39			
103.0	40.0	To Target Depth. **Drillhole BH17-BR86-2 terminated at 39.6m.**									
102.0	41.0										
101.0	42.0										
100.0	43.0										
99.0	44.0										

Notes: Hole is directly on North West Abutment.

BOREHOLE REPORT

BH17-BR86-3

Sheet 1 of 4

Client:	Baffinland Iron Mines Corporation	**Project No.:**	H353004
Project:	Mary River Expansion Project	**Datum:**	NAD83
Location:	South East Abutment	**Platform:**	Ground

Easting:	542,304.8 m
Northing:	7,922,141.4 m
Surface Elevation:	143.38 m
Bottom Elevation:	103.78 m
Total Depth:	39.6 m
Logged By:	U.K
Reviewed By:	H.G

Contractor: Boart Longyear **Rig Type/ Mounting:** MiniSonic Rig **Date Logged:** 10/22/2017

Driller: Brent McAndrew **Hole Diameter (mm):** 100 mm **Date Reviewed:** 2/10/2018

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
143.38	0.0	SAND with Gravel, trace Silt: Brown.	unfrozen							
142.4	1.0			14	21	69	10			
	1.5	SAND, trace to some SILT: Brown and greyish- brown, medium to fine grained. Ice poor soil.	Nbn							
141.4	2.0			23	0	93	7			
140.4	3.0			24	0	94	6			
139.4	4.0									
138.4	5.0			25	0	89	11			
137.4	6.0	6.1m to 9.0m: Colour changes to uniform dark brown.								
136.4	7.0									
135.4	8.0			26	0	78	22			
134.4	9.0	SAND, trace Silt: Alternating layers of grey sand and brown silty sand, poorly graded, medium to fine. Ice poor soil.	Nbn							
133.4	10.0									
132.4	11.0									

Moisture Content Profile: 0 — 25 — 50

Notes: Hole is directly on South East Abutment

HATCH BOREHOLE REPORT

Client:	Baffinland Iron Mines Corporation	**Project No.:**	H353004
Project:	Mary River Expansion Project	**Datum:**	NAD83
Location:	South East Abutment	**Platform:**	Ground
Contractor: Boart Longyear	**Rig Type/ Mounting:** MiniSonic Rig	**Date Logged:** 10/22/2017	**Logged By:** U.K
Driller: Brent McAndrew	**Hole Diameter (mm):** 100 mm	**Date Reviewed:** 2/10/2018	**Reviewed By:** H.G

Easting:	542,304.8 m
Northing:	7,922,141.4 m
Surface Elevation:	143.38 m
Bottom Elevation:	103.78 m
Total Depth:	39.6 m

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 25 50)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
						SAND, trace Silt: Alternating layers of grey sand and brown silty sand, poorly graded, medium to fine. Ice poor soil. *(Continued)*	Nbn *(Continued)*										
	131.4	12.0							■	●	26	0	93	7			
	130.4	13.0															
	129.4	14.0															
	128.4	15.0															
	127.4	16.0				15.2m to 16.8m: Silty sand layers are dark brown.											
	126.4	17.0															
	125.4	18.0															
	124.4	19.0															
	123.4	20.0							■								
	122.4	21.0															
	121.4	22.0															

Notes: Hole is directly on South East Abutment

HATCH

BOREHOLE REPORT

BH17-BR86-3

Client: Baffinland Iron Mines Corporation

Project: Mary River Expansion Project

Location: South East Abutment

Project No.: H353004

Datum: NAD83

Platform: Ground

Easting: 542,304.8 m

Northing: 7,922,141.4 m

Surface Elevation: 143.38 m

Bottom Elevation: 103.78 m

Total Depth: 39.6 m

Contractor: Boart Longyear | **Rig Type/ Mounting:** MiniSonic Rig | **Date Logged:** 10/22/2017 | **Logged By:** U.K

Driller: Brent McAndrew | **Hole Diameter (mm):** 100 mm | **Date Reviewed:** 2/10/2018 | **Reviewed By:** H.G

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description
		SAND, trace Silt: Alternating layers of grey sand and brown silty sand, poorly graded, medium to fine. Ice poor soil. *(Continued)*	Nbn *(Continued)*
120.4	23.0	23.0m to 24.5m: Colour changes to dark brown, layers are now brown and dark brown.	
119.4	24.0		
118.4	25.0		
117.4	26.0		
116.4	27.0	27.4m to 30.5m: Colour changes to grey, layers are now light and dark grey.	
115.4	28.0		
114.4	29.0		
113.4	30.0		
		SAND, trace SILT: Brown to grey. Ice poor soil.	Nbn
112.4	31.0		
111.4	32.0		
110.4	33.0		

Sample at approx. 30.0 m:

Moisture Content Profile (0–25–50)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
● (~25)	25	0	92	8			

Notes: Hole is directly on South East Abutment

BOREHOLE REPORT

BH17-BR86-3

Client:	Baffinland Iron Mines Corporation
Project:	Mary River Expansion Project
Location:	South East Abutment
Project No.:	H353004
Datum:	NAD83
Platform:	Ground
Contractor:	Boart Longyear
Driller:	Brent McAndrew
Rig Type/ Mounting:	MiniSonic Rig
Hole Diameter (mm):	100 mm
Date Logged:	10/22/2017
Date Reviewed:	2/10/2018
Easting:	542,304.8 m
Northing:	7,922,141.4 m
Surface Elevation:	143.38 m
Bottom Elevation:	103.78 m
Total Depth:	39.6 m
Logged By:	U.K
Reviewed By:	H.G

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 25 – 50)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	109.4 – 103.78	33.0 – 39.6				SAND, trace SILT: Brown to grey. Ice poor soil. *(Continued)*	Nbn *(Continued)*										
	103.78	39.6				To Target Depth. **Drillhole BH17-BR86-3 terminated at 39.6m.**											

Elevation scale (m): 109.4, 108.4, 107.4, 106.4, 105.4, 104.4, 103.4, 102.4, 101.4, 100.4, 99.4

Depth scale (m): 34.0, 35.0, 36.0, 37.0, 38.0, 39.0, 40.0, 41.0, 42.0, 43.0, 44.0

Notes: Hole is directly on South East Abutment

HATCH BOREHOLE REPORT

BH18-102-1

Client:	Baffinland Iron Mine	**Project No.:**	H353004
Project:	Mary River Expansion Study	**Datum:**	NAD83
Location:	Proposed Bridge 102 Abutment	**Platform:**	

Easting:	555,763.0 m
Northing:	7,915,435.0 m
Surface Elevation:	168.00 m
Bottom Elevation:	158.35 m
Total Depth:	9.7 m
Logged By:	YF/MY
Reviewed By:	

Contractor:	Boart Longyear	**Rig Type/ Mounting:**	Sonic Drill Rig	**Date Logged:**	4/7/2018
Driller:	Brent McAndrew	**Hole Diameter (mm):**	100	**Date Reviewed:**	

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile 0 25 50	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
						PEAT: Frozen with roots.	Nf										
						GRAVEL: Two boulders.											
	167.0	1.0				GRAVELLY SAND with COBBLES: Brown.											
						Start of Coring at 1.3m.											
						Continued on Rock Core Log sheet.											
	166.0	2.0															
	165.0	3.0															
	164.0	4.0															
	163.0	5.0															
	162.0	6.0															
	161.0	7.0															
	160.0	8.0															
	159.0	9.0															
	158.0	10.0															

Notes:

BOREHOLE LOG

ROCK CORE FORMAT

BH18-102-1

Client:	Baffinland Iron Mine	**Project No.:**	H353004
Project:	Mary River Expansion Study	**Datum:**	NAD83
Location:	Proposed Bridge 102 Abutment	**Platform:**	

Easting:	555,763.0 m
Northing:	7,915,435.0 m
Surface Elevation:	168.00 m
Bottom Elevation:	158.35 m
Total Depth:	9.7 m
Logged By:	YF/MY
Reviewed By:	

Contractor: Boart Longyear **Rig Type/ Mounting:** Sonic Drill Rig **Bearing:** N/A° **Date Logged:** 4/7/2018

Driller: Brent McAndrew **Hole Diameter (mm):** 100 **Plunge:** ° **Date Checked:**

Water	Elevation (m)	Depth (m)	Method	Run #/TCR	Graphic Log	Geological Unit	Rock Description: ROCK TYPE; Grain size, texture and fabric, colour, general defect conditions, minor constituents.	Weathering/ Cementation	Estimated Strength (EH VH H M L VL EL)	$Is_{(50)}$ [UCS] MPa	Defect Spacing mm (2000 600 200 [100] 60 20)	RQD %	Defect Log	Defect Description: Inclination, type, infill, amount, aperture, planarity, roughness, frequency (Specific / General)
	167.0	1.0					***Resuming in Rock Core Format 1.3m.***							
	166.0 165.0 164.0 163.0 162.0 161.0 160.0 159.0 158.0	2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0					BEDROCK: Gneiss, red plagioclase feldspar, coarse to very coarse grained, strong to very strong rock, fresh. 1.73 m: One discontinuity angled approx. 30 deg, black coated, 8 mm black alteration zone. 2.09 m - 2.31 m: Fractured area. 2.31 m - 2.91 m: Becoming coarser grained. 3.00 m: Becoming grey with pink (7 mm) veins, medium grained, strong to very strong. 3.53 m - 3.74 m: Black biotite mica, fractured zone, irregularly oriented 0.5 mm - 5 mm crystals. 3.74 m - 4.54 m: Quartzo feldspathic gneiss, grey to pink, very strong to strong. 4.54 m - 4.85 m: Potassium feldspar rich, pink, fractured zone. 4.85 m - 4.96 m: Possibly chloritized, 2 mm vein, medium grained, medium strong. 4.91 m - 4.93 m: Clay vein, weak. 4.96 m - 5.06 m: Some gneissic banding, red/black fine grained, strong. 5.06 m - 5.26 m: Broken core, clay rich vein, fine to medium grained, red/black, chlorite infilled joints. 5.26 m - 6.01 m: Trace potassium feldspar banding, quartz rich, strong grey, fine. 6.06 m - 6.36 m: Quartzo feldspar with black biotite banding, potassium feldspar rich, red, chlorite infilled joints. 6.36 m - 6.59 m: Quartz and feldspar, grey. 8.12 m - 8.26 m: Gneiss, grey pink, strong. 8.26 m - 8.30 m: Possible clay zone,							

Notes:

Defect Description Legend

Planarity		Type				Roughness		Infill Amount	
Pl	Planar	DI	Drilling Induced	Sm	Seam	Ro	Rough	cn	Clean
Ir	Irregular	Jt	Joint	Cz	Crushed Zone	Sm	Smooth	sn	Stained
Cu	Curved	Pt	Parting on Contact	Fz	Fractured Zone	Po	Polished	vn	Veneer
Un	Undulose	Sh	Shear Seam	Band	Weak Band	Sl	Slickenside	cg	Coating
St	Stepped	Cs	Crushed Seam						

HATCH

BOREHOLE LOG
ROCK CORE FORMAT

BH18-102-1

Client:	Baffinland Iron Mine	**Project No.:**	H353004
Project:	Mary River Expansion Study	**Datum:**	NAD83
Location:	Proposed Bridge 102 Abutment	**Platform:**	

Easting:	555,763.0 m
Northing:	7,915,435.0 m
Surface Elevation:	168.00 m
Bottom Elevation:	158.35 m
Total Depth:	9.7 m
Logged By:	YF/MY
Reviewed By:	

Contractor: Boart Longyear **Rig Type/ Mounting:** Sonic Drill Rig **Bearing:** N/A° **Date Logged:** 4/7/2018

Driller: Brent McAndrew **Hole Diameter (mm):** 100 **Plunge:** ° **Date Checked:**

Water	Elevation (m)	Depth (m)	Method	Run #/TCR	Graphic Log	Geological Unit	Rock Description ROCK TYPE; Grain size, texture and fabric, colour, general defect conditions, minor constituents.	Weathering/ Cementation	Estimated Strength EH VH H M L VL EL	$Is_{(50)}$ [UCS] MPa	Defect Spacing mm 2000 600 200 [100] 60 20	RQD %	Defect Log	Defect Description Inclination, type, infill, amount, aperture, planarity, roughness, frequency Specific / General
							possibly chloritized, weak. 8.30 m - 8.61 m: Fine to medium grained, grey. 8.61 m - 8.87 m: Band of quartz to potassium feldspar, coarse grained, pink. Remainder fine to medium grained, grey, possible possible chlorite veins, trace pyrite, black biotite veins.							
	157.0	11.0												
							To Target Depth. **Drillhole BH18-102-1 terminated at 9.7m.**							
	156.0	12.0												
	155.0	13.0												
	154.0	14.0												
	153.0	15.0												
	152.0	16.0												
	151.0	17.0												
	150.0	18.0												
	149.0	19.0												
	148.0	20.0												

Notes:

Defect Description Legend

Planarity		Type				Roughness		Infill Amount	
Pl	Planar	DI	Drilling Induced	Sm	Seam	Ro	Rough	cn	Clean
Ir	Irregular	Jt	Joint	Cz	Crushed Zone	Sm	Smooth	sn	Stained
Cu	Curved	Pt	Parting on Contact	Fz	Fractured Zone	Po	Polished	vn	Veneer
Un	Undulose	Sh	Shear Seam	Band	Weak Band	Sl	Slickenside	cg	Coating
St	Stepped	Cs	Crushed Seam						

HATCH BOREHOLE REPORT

BH18-102-2

Sheet 1 of 3

Client: Baffinland Iron Mine

Project: Mary River Expansion Study

Location: Proposed Bridge 102 Abutment

Project No.: H353004

Datum: NAD83

Platform:

Easting: 555,674.0 m

Northing: 7,915,409.0 m

Surface Elevation: 166.00 m

Bottom Elevation: 149.10 m

Total Depth: 16.9 m

Logged By: YF/MY

Reviewed By:

Contractor: Boart Longyear

Rig Type/ Mounting: Sonic Drill Rig

Date Logged: 4/8/2018

Driller: Brent McAndrew

Hole Diameter (mm): 100

Date Reviewed:

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 25 – 50)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
						SAND and GRAVEL: Medium grained sand, brown, slightly moist.	Nf inferred										
	165.0	1.0				GRAVELLY SAND, trace BOULDERS: Fine sand, possible boulder dust.	Nf inferred										
	164.0 / 163.0	2.0 / 3.0				GRAVELLY SAND, trace SILT: Medium to coarse grained, brownish grey to brown, subrounded to subangular. 3.40 m and 3.70 m: Cobbles	Nf inferred					31	69	0			
	162.0 / 161.0	4.0 / 5.0				SAND, some GRAVEL, trace SILT: Medium to fine grained, brownish grey. 4.70 m: Inferred boulder. 5.00 m and 5.30 m: Cobble.	Nf inferred										
	160.0 / 159.0 / 158.0	6.0 / 7.0 / 8.0				GRAVEL to COBBLES: Mixed igneous / metamorphic, washed. 5.6m: Organic / sulfur layer.											
	157.0 / 156.0	9.0 / 10.0				***Start of Coring at 8.7m.*** ***Continued on Rock Core Log sheet.***											

Notes:

BOREHOLE LOG

ROCK CORE FORMAT

BH18-102-2

Client:	Baffinland Iron Mine	**Project No.:**	H353004
Project:	Mary River Expansion Study	**Datum:**	NAD83
Location:	Proposed Bridge 102 Abutment	**Platform:**	

Easting:	555,674.0 m
Northing:	7,915,409.0 m
Surface Elevation:	166.00 m
Bottom Elevation:	149.10 m
Total Depth:	16.9 m
Logged By:	YF/MY
Reviewed By:	

Contractor: Boart Longyear **Rig Type/ Mounting:** Sonic Drill Rig **Bearing:** N/A° **Date Logged:** 4/8/2018

Driller: Brent McAndrew **Hole Diameter (mm):** 100 **Plunge:** ° **Date Checked:**

Water	Elevation (m)	Depth (m)	Method	Run #/TCR	Graphic Log	Geological Unit	Rock Description ROCK TYPE; Grain size, texture and fabric, colour, general defect conditions, minor constituents.	Weathering/ Cementation	Estimated Strength (EH VH H M L VL EL)	$Is_{(50)}$ [UCS] MPa	Defect Spacing mm (2000 600 200 [100] 60 20)	RQD %	Defect Log	Defect Description Inclination, type, infill, amount, aperture, planarity, roughness, frequency (Specific / General)
	165.0	1.0												
	164.0	2.0												
	163.0	3.0												
	162.0	4.0												
	161.0	5.0												
	160.0	6.0												
	159.0	7.0												
	158.0	8.0												
							Resuming in Rock Core Format 8.7m.							Fz
	157.0	9.0		9 / 135			BEDROCK: Gneiss, visible medium to coarse grains, red, black, and grey, strong to very strong.					77		DI DI 10° Jt Pl Sm 20° Jt Pl Sm Red stains sn Fz
	156.0	10.0										22		

Notes:

Defect Description Legend

Planarity		Type				Roughness		Infill Amount	
Pl	Planar	DI	Drilling Induced	Sm	Seam	Ro	Rough	cn	Clean
Ir	Irregular	Jt	Joint	Cz	Crushed Zone	Sm	Smooth	sn	Stained
Cu	Curved	Pt	Parting on Contact	Fz	Fractured Zone	Po	Polished	vn	Veneer
Un	Undulose	Sh	Shear Seam	Band	Weak Band	Sl	Slickenside	cg	Coating
St	Stepped	Cs	Crushed Seam						

HATCH

BOREHOLE LOG
ROCK CORE FORMAT

BH18-102-2
Sheet 3 of 3

Client: Baffinland Iron Mine
Project: Mary River Expansion Study
Location: Proposed Bridge 102 Abutment
Project No.: H353004
Datum: NAD83
Platform:

Easting: 555,674.0 m
Northing: 7,915,409.0 m
Surface Elevation: 166.00 m
Bottom Elevation: 149.10 m
Total Depth: 16.9 m
Logged By: YF/MY
Reviewed By:

Contractor: Boart Longyear **Rig Type/ Mounting:** Sonic Drill Rig **Bearing:** N/A° **Date Logged:** 4/8/2018
Driller: Brent McAndrew **Hole Diameter (mm):** 100 **Plunge:** ° **Date Checked:**

Elevation (m)	Depth (m)	Run #/TCR	Rock Description (ROCK TYPE; Grain size, texture and fabric, colour, general defect conditions, minor constituents.)	RQD %	Defect Description (Inclination, type, infill, amount, aperture, planarity, roughness, frequency)
		10 / 98	BEDROCK: Gneiss, visible medium to coarse grains, red, black, and grey, strong to very strong. *(Continued)*	22	
155.0	11.0	11 / 76	10.90 m: Possible porphyriticm, no gneissic banding.	43	Cz 90° Jt Pl Sm 40° Jt Cu Sm 70° Jt Pl Sm Orange stains sn DI 75° Jt Pl Sm Fz
154.0	12.0	12 / 115		87	45° Jt Pl Sm Rust staining sn Fz
153.0	13.0	13 / 115	12.50 m: Two weathered / soft zones / seams at 13.00 m and 13.30 m, 4 mm, one visible joint, non stained.	66	DI 30° Jt Pl Sm sn 80° Jt Pl Ro cg 50° Jt Pl Sm cg Fz 20° Jt Pl Sm 75° Jt Cu Ro Rust stain, silt infill sn
152.0	14.0	14 / 91	13.70 m: Minor gneissic banding, becoming iron stained, black, weak.	49	DI 70° Jt Cu Sm Rusty infill sn Fz 80° Jt Pl Sm Rust infill sn DI 5° Jt Pl Ro Black silty infill cg 75° Jt
151.0	15.0	15 / 117		40	80° Jt Pl Sm infill cg 90° Jt Cu Sm 20° Jt Cu Sm Black silt sn Fz
150.0	16.0	16 / 106	15.70 m: Potassium felspar and quartz rich core, medium grained, red. 16.40 m: Quartz vein, very stained.	24	45° Jt Cu Sm Rusty sn Cz 45° Jt Cu Sm sn 45° Jt Pl Sm infill cg 80° Jt Pl Sm Rusty sn DI 50° Jt Cu Sm
149.0	17.0		To Target Depth. **Drillhole BH18-102-2 terminated at 16.9m.**		
148.0	18.0				
147.0	19.0				
146.0	20.0				

Other columns: Water; Method; Graphic Log; Geological Unit; Weathering/ Cementation; Estimated Strength (EH VH H M L VL EL); $Is_{(50)}$ [UCS] MPa; Defect Spacing mm (2000 600 200 [100] 60 20); Defect Log. Defect Description: Specific / General.

Notes:

Defect Description Legend

Planarity		Type				Roughness		Infill Amount	
Pl	Planar	DI	Drilling Induced	Sm	Seam	Ro	Rough	cn	Clean
Ir	Irregular	Jt	Joint	Cz	Crushed Zone	Sm	Smooth	sn	Stained
Cu	Curved	Pt	Parting on Contact	Fz	Fractured Zone	Po	Polished	vn	Veneer
Un	Undulose	Sh	Shear Seam	Band	Weak Band	Sl	Slickenside	cg	Coating
St	Stepped	Cs	Crushed Seam						

HATCH BOREHOLE REPORT

BH18-BR15-1

Client: Baffinland Iron Mine

Project: Mary River Expansion Study

Location: Bridge 15 (Kilometer 18)

Project No.: H353004

Datum: NAD83

Platform:

Easting: 555,758.0 m

Northing: 7,915,441.0 m

Surface Elevation: 78.00 m

Bottom Elevation: 60.63 m

Total Depth: 17.4 m

Contractor: Boart Longyear

Rig Type/ Mounting: Sonic Drill Rig

Date Logged: 3/11/2018

Logged By: MY/PS

Driller: Brent McAndrew

Hole Diameter (mm): 100

Date Reviewed:

Reviewed By:

Column headings: Water | Elevation (m) | Depth (m) | Method | Casing | Graphic Log | Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.) | Frozen Soil Description | Recovery | Sample Type | Moisture Content Profile (0, 25, 50) | Field Water Content | Percent Gravel | Percent Sand | Percent Fines | Liquid Limit | Plastic Index | Other Tests

Method: Mini Sonic Drilling Rig BL100

Elevation (m): 77.0, 76.0, 75.0, 74.0, 73.0, 72.0, 71.0, 70.0, 69.0, 68.0

Depth (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

Soil Description	Frozen Soil Description
SNOW	ICE
ICE	ICE
SILTY SAND, some GRAVEL: fine to medium grained sand, brownish grey.	Nf inferred
4.20 m - 4.30 m: Boulder inferred with silty sand layer.	Possible ice feature, all melted.
COBBLES and BOULDERS: Cobble at 7.75 m and 8.90 m.	
MUD SLURRY with GRAVEL to COBBLES: Coarse gravel (26 mm).	Nf inferred

Field Water Content	Percent Gravel	Percent Sand	Percent Fines
6	34	44	22
11	6	57	37
7			

Notes:

HATCH BOREHOLE REPORT

BH18-BR15-1

Client:	Baffinland Iron Mine	**Project No.:**	H353004
Project:	Mary River Expansion Study	**Datum:**	NAD83
Location:	Bridge 15 (Kilometer 18)	**Platform:**	

Easting:	555,758.0 m
Northing:	7,915,441.0 m
Surface Elevation:	78.00 m
Bottom Elevation:	60.63 m
Total Depth:	17.4 m
Logged By:	MY/PS
Reviewed By:	

Contractor: Boart Longyear **Rig Type/ Mounting:** Sonic Drill Rig **Date Logged:** 3/11/2018

Driller: Brent McAndrew **Hole Diameter (mm):** 100 **Date Reviewed:**

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 / 25 / 50)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
						ROCK: 60% mafic, 10-15% red mineral, 10% black elongate, reflective. Refusal on hard rock.											
	67.0	11.0				***Start of Coring at 10.7m.*** ***Continued on Rock Core Log sheet.***											
	66.0	12.0															
	65.0	13.0															
	64.0	14.0															
	63.0	15.0															
	62.0	16.0															
	61.0	17.0															
	60.0	18.0															
	59.0	19.0															
	58.0	20.0															

Notes:

BOREHOLE LOG

ROCK CORE FORMAT

BH18-BR15-1

Client:	Baffinland Iron Mine	**Project No.:**	H353004
Project:	Mary River Expansion Study	**Datum:**	NAD83
Location:	Bridge 15 (Kilometer 18)	**Platform:**	

Easting:	555,758.0 m
Northing:	7,915,441.0 m
Surface Elevation:	78.00 m
Bottom Elevation:	60.63 m
Total Depth:	17.4 m
Logged By:	MY/PS
Reviewed By:	

Contractor: Boart Longyear **Rig Type/ Mounting:** Sonic Drill Rig **Bearing:** N/A° **Date Logged:** 3/11/2018

Driller: Brent McAndrew **Hole Diameter (mm):** 100 **Plunge:** ° **Date Checked:**

Elevation (m)	Depth (m)	Run #/TCR	Rock Description (ROCK TYPE; Grain size, texture and fabric, colour, general defect conditions, minor constituents.)	RQD %	Defect Description (Inclination, type, infill, amount, aperture, planarity, roughness, frequency)
	10.7		***Resuming in Rock Core Format 10.7m.***		
67.0	11.0	1 / 130	BEDROCK: Granitic gneiss alternating with mafic bands.	52	Fz; 3° Jt Pl Sm; 5° Jt Pl Sm
66.0	12.0	2 / 105		76	Dl; 40° Jt Pl Sm; 10° Jt Pl Sm cg; 90° Jt Pl Sm; 85° Jt Pl Sm; 90° Jt Pl Ro; 90° Jt Pl Sm; 75° Jt Pl Sm
65.0	13.0	3 / 96	12.58 m: Mafic matrix with white minerals peppered throughout, medium grain size.	43	Fz; 0° Jt Pl Sm Soil cg; Cz; 30° Jt Pl Ro Rust staining sn; 80° Jt Pl Ro Rust staining sn; 90° Jt Pl Sm; 45° Jt Pl Ro Rust sn
64.0	14.0	4 / 154		92	30° Jt Pl; 30° Jt Pl Sm Darker staining
63.0	15.0	5 / 101	14.80 m - 15.85 m: Dark mafic to ultramafic matrix, black visable minerals.	86	0° Jt Pl Ro; 45° Jt Pl Sm; 45° Jt Pl Sm; 70° Jt Pl Ro; Dl; Fz
62.0	16.0	6 / 99	15.85 m - 15.95 m: Granitic gneiss. 15.95 m - 17.22 m: Mafic matrix.	95	Dl; 45° Jt Pl Sm
61.0	17.0		17.22 m: Mafic matrix with red banding, granitic gneiss.		45° Jt Pl Sm Some staining, infill cg; Dl; 40° Jt Pl Sm Staining sn
	17.4		To Target Depth. **Drillhole BH18-BR15-1 terminated at 17.4m.**		
60.0	18.0				
59.0	19.0				
58.0	20.0				

Notes:

Defect Description Legend

Planarity		Type				Roughness		Infill Amount	
Pl	Planar	Dl	Drilling Induced	Sm	Seam	Ro	Rough	cn	Clean
Ir	Irregular	Jt	Joint	Cz	Crushed Zone	Sm	Smooth	sn	Stained
Cu	Curved	Pt	Parting on Contact	Fz	Fractured Zone	Po	Polished	vn	Veneer
Un	Undulose	Sh	Shear Seam	Band	Weak Band	Sl	Slickenside	cg	Coating
St	Stepped	Cs	Crushed Seam						

BOREHOLE REPORT

BH18-BR15-2

Sheet 1 of 3

Client: Baffinland Iron Mine
Project: Mary River Expansion Study
Location: Bridge 15 (Kilometer 18)
Project No.: H353004
Datum: NAD83
Platform:

Easting: 514,211.0 m
Northing: 7,965,645.0 m
Surface Elevation: 78.00 m
Bottom Elevation: 61.20 m
Total Depth: 16.8 m
Logged By: MY/PS
Reviewed By:

Contractor: Boart Longyear | **Rig Type/ Mounting:** Sonic Drill Rig | **Date Logged:** 3/12/2018
Driller: Brent McAndrew | **Hole Diameter (mm):** 100 | **Date Reviewed:**

Method: Mini Sonic Drilling Rig BL100

Elevation (m)	Depth (m)	Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components)	Frozen Soil Description	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
78.0	0.0	ICE	ICE							
77.0	1.0	BOULDERS to COBBLES: Grey with red viens.	Nf							
		SAND, trace SILT: Fine to medium grained, light brown, red, and black.	Nbn - Vx	14	1	85	14			
76.0	2.0	SANDY SILT: Grey.	Nbn	>>63	1	45	54			
		SILTY SAND, trace to some GRAVEL: Fine to medium grained, brownish grey.		9	29	39	32			
75.0	3.0		Nf							
74.0	4.0	3.90 m: Trace boulders, sub-rounded to rounded gravel and boulders.		11	14	60	26			
73.0	5.0		Nf inferred							
		5.20 m: Some gravel, trace boulders.								
72.0	6.0			5	22	48	30			
71.0	7.0									
70.0	8.0	7.80 m: Trace cobbles.								
		8.50 m - 8.70 m: Trace boulders, coarsening downwards, sub-angular to sub-rounded.								
69.0	9.0	9.45 m - 9.80 m: Boulders, dark matrix with granitic crystals.	Nf							
68.0	10.0									

Moisture Content Profile: 0, 25, 50

Notes:

HATCH BOREHOLE REPORT

BH18-BR15-2

Client:	Baffinland Iron Mine	**Project No.:**	H353004
Project:	Mary River Expansion Study	**Datum:**	NAD83
Location:	Bridge 15 (Kilometer 18)	**Platform:**	

Easting:	514,211.0 m
Northing:	7,965,645.0 m
Surface Elevation:	78.00 m
Bottom Elevation:	61.20 m
Total Depth:	16.8 m
Logged By:	MY/PS
Reviewed By:	

Contractor:	Boart Longyear	**Rig Type/ Mounting:**	Sonic Drill Rig	**Date Logged:**	3/12/2018
Driller:	Brent McAndrew	**Hole Diameter (mm):**	100	**Date Reviewed:**	

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 25 50)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
						10.00 m - 10.15 m: Boulders, dark matrix with granitic crystals.											
						Start of Coring at 10.2m.											
						Continued on Rock Core Log sheet.											
	67.0	11.0															
	66.0	12.0															
	65.0	13.0															
	64.0	14.0															
	63.0	15.0															
	62.0	16.0															
	61.0	17.0															
	60.0	18.0															
	59.0	19.0															
	58.0	20.0															

Notes:

BOREHOLE LOG
ROCK CORE FORMAT

BH18-BR15-2

Client: Baffinland Iron Mine
Project No.: H353004
Project: Mary River Expansion Study
Datum: NAD83
Location: Bridge 15 (Kilometer 18)
Platform:

Easting: 514,211.0 m
Northing: 7,965,645.0 m
Surface Elevation: 78.00 m
Bottom Elevation: 61.20 m
Total Depth: 16.8 m
Logged By: MY/PS
Reviewed By:

Contractor: Boart Longyear **Rig Type/ Mounting:** Sonic Drill Rig **Bearing:** N/A° **Date Logged:** 3/12/2018
Driller: Brent McAndrew **Hole Diameter (mm):** 100 **Plunge:** ° **Date Checked:**

Water	Elevation (m)	Depth (m)	Method	Run #/TCR	Graphic Log	Geological Unit	Rock Description ROCK TYPE; Grain size, texture and fabric, colour, general defect conditions, minor constituents	Weathering/ Cementation	Estimated Strength (EH VH H M L VL EL)	$Is_{(50)}$ [UCS] MPa	Defect Spacing mm (2000 600 200 [100] 60 20)	RQD %	Defect Log	Defect Description (Inclination, type, infill, amount, aperture, planarity, roughness, frequency) Specific / General
							Resuming in Rock Core Format 10.2m.							
	67.0	11.0					BEDROCK: Granitic gneiss, grey matrix with red veins. 10.70 m - 11.10 m: mafic matrix with plagioclase and granitic banding (gneissic banding). Crushed rock, up to 30 cm.							
	66.0	12.0												
	65.0	13.0												
	64.0	14.0					13.70 m - 13.85 m: Pulverized rock.							
	63.0	15.0												
	62.0	16.0					15.50 m: Thicker plagioclase beds, thicker clasts (granite)							
	61.0	17.0					To Target Depth. **Drillhole BH18-BR15-2 terminated at 16.8m.**							
	60.0	18.0												
	59.0	19.0												
	58.0	20.0												

Notes:

Defect Description Legend

Planarity		Type				Roughness		Infill Amount	
Pl	Planar	DI	Drilling Induced	Sm	Seam	Ro	Rough	cn	Clean
Ir	Irregular	Jt	Joint	Cz	Crushed Zone	Sm	Smooth	sn	Stained
Cu	Curved	Pt	Parting on Contact	Fz	Fractured Zone	Po	Polished	vn	Veneer
Un	Undulose	Sh	Shear Seam	Band	Weak Band	Sl	Slickenside	cg	Coating
St	Stepped	Cs	Crushed Seam						

HATCH BOREHOLE REPORT

BH18-BR70-1

Client:	Baffinland Iron Mine	**Project No.:**	H353004
Project:	Mary River Expansion Study	**Datum:**	NAD83
Location:	Proposed Bridge 70 Abutment	**Platform:**	

Easting:	529,138.0 m
Northing:	7,916,667.0 m
Surface Elevation:	124.00 m
Bottom Elevation:	91.50 m
Total Depth:	32.5 m
Logged By:	YF/MY
Reviewed By:	

Contractor:	Boart Longyear	**Rig Type/ Mounting:**	Sonic Drill Rig	**Date Logged:**	4/13/2018
Driller:	Brent McAndrew	**Hole Diameter (mm):**	100	**Date Reviewed:**	

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 25 50)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	124.0	0.0				SILTY SAND: Greyish brown, fine to medium grained.	Nbn										
	123.0	1.0															
	122.0	2.0															
											22	0	97	3			
	121.0	3.0				3.00 m: Saline smelling dark organic layer.	Nbn to Vx										
						3.30 m: Banding of silt.											
						3.70 m: Organic layer.											
	120.0	4.0				4.20 m: Micaceous minerals, organics.	Vs										
	119.0	5.0															
	118.0	6.0					Nbn										
	117.0	7.0									28	0	80	20			
						7.60 m: Interbedded silt and organic layers, pungent organics.	Vr to Vx										
	116.0	8.0															
	115.0	9.0															
						ICE and SOIL: Silt, trace sand, grey.	I+S				36	0	3	97			
	114.0	10.0															

Notes:

HATCH

BOREHOLE REPORT

BH18-BR70-1

Client: Baffinland Iron Mine
Project: Mary River Expansion Study
Location: Proposed Bridge 70 Abutment
Project No.: H353004
Datum: NAD83
Platform:

Easting: 529,138.0 m
Northing: 7,916,667.0 m
Surface Elevation: 124.00 m
Bottom Elevation: 91.50 m
Total Depth: 32.5 m
Logged By: YF/MY
Reviewed By:

Contractor: Boart Longyear
Rig Type/ Mounting: Sonic Drill Rig
Date Logged: 4/13/2018
Driller: Brent McAndrew
Hole Diameter (mm): 100
Date Reviewed:

Soil Description (TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.)	Frozen Soil Description
ICE and SOIL: Silt, trace sand, grey. *(Continued)*	I+S *(Continued)*
SILTY SAND: Brownish grey, stratified, possible laminated organics. 11.30 m - 11.45 m: Clay layers. 11.80 m - 12.00 m: Inferred boulder. 12.25 m - 12.30 m: Trace gravel, grey. 12.70 m - 13.05 m: Inferred boulder. 13.30 m: Cobbles.	Nbn
SANDY SILT, trace GRAVEL: Grey. 15.20 m, 16.40 m: Cobbles, greyish brown. 17.40 m - 18.00 m: Boulders	Nbn Nbn inferred
SANDY SILT, trace CLAY: Dark grey.	Nbn inferred
SILT, trace GRAVEL, trace SAND: Grey, coarse grained sand. 19.80 m - 21.70 m: Trace to some	Nbn inferred

Depth scale (m): 11.0, 12.0, 13.0, 14.0, 15.0, 16.0, 17.0, 18.0, 19.0, 20.0
Elevation scale (m): 113.0, 112.0, 111.0, 110.0, 109.0, 108.0, 107.0, 106.0, 105.0, 104.0

Moisture Content Profile: 0, 25, 50

Approx. Depth (m)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
11.4	19	0	39	61			
14.7	15	9	51	40			
16.6	14	19	26	55			

Notes:

HATCH BOREHOLE REPORT

BH18-BR70-1

Client:	Baffinland Iron Mine	**Project No.:**	H353004
Project:	Mary River Expansion Study	**Datum:**	NAD83
Location:	Proposed Bridge 70 Abutment	**Platform:**	

Easting:	529,138.0 m
Northing:	7,916,667.0 m
Surface Elevation:	124.00 m
Bottom Elevation:	91.50 m
Total Depth:	32.5 m
Logged By:	YF/MY
Reviewed By:	

Contractor:	Boart Longyear	**Rig Type/ Mounting:**	Sonic Drill Rig	**Date Logged:**	4/13/2018
Driller:	Brent McAndrew	**Hole Diameter (mm):**	100	**Date Reviewed:**	

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 25 – 50)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
						angular fine to medium gravel, trace cobbles. SILT, trace GRAVEL, trace SAND: Grey, coarse grained sand. *(Continued)*	Nbn inferred *(Continued)*										
	103.0	21.0															
	102.0	22.0				21.70 m: Angular gravel in a silt matrix. Inferred as rock flour, cobbles, gravel, boulders, white to grey dust.											
	101.0	23.0				BEDROCK (Inferred): Rock dust.											
	100.0	24.0															
	99.0	25.0															
	98.0	26.0				***Start of Coring at 25.9m.*** ***Continued on Rock Core Log sheet.***											
	97.0	27.0															
	96.0	28.0															
	95.0	29.0															
	94.0	30.0															

Notes:

HATCH

BOREHOLE LOG

ROCK CORE FORMAT

BH18-BR70-1

Client:	Baffinland Iron Mine	**Project No.:**	H353004
Project:	Mary River Expansion Study	**Datum:**	NAD83
Location:	Proposed Bridge 70 Abutment	**Platform:**	

Easting:	529,138.0 m
Northing:	7,916,667.0 m
Surface Elevation:	124.00 m
Bottom Elevation:	91.50 m
Total Depth:	32.5 m
Logged By:	YF/MY
Reviewed By:	

Contractor: Boart Longyear **Rig Type/ Mounting:** Sonic Drill Rig **Bearing:** N/A° **Date Logged:** 4/13/2018

Driller: Brent McAndrew **Hole Diameter (mm):** 100 **Plunge:** ° **Date Checked:**

Water	Elevation (m)	Depth (m)	Method	Run #/TCR	Graphic Log	Geological Unit	Rock Description: ROCK TYPE; Grain size, texture and fabric, colour, general defect conditions, minor constituents.	Weathering/ Cementation	Estimated Strength (EH VH H M L VL EL)	$Is_{(50)}$ [UCS] MPa	Defect Spacing mm (2000 600 200 [100] 60 20)	RQD %	Defect Log	Defect Description: Inclination, type, infill, amount, aperture, planarity, roughness, frequency (Specific / General)
	103.0	21.0												
	102.0	22.0												
	101.0	23.0												
	100.0	24.0												
	99.0	25.0												
							Resuming in Rock Core Format 25.9m.							
	98.0	26.0		18 / 101			BEDROCK: Siltstone to dolomitic limestone, grey with dark grey / black streaks, fine to very fine grained, medium strong rock. 25.98 m - 27.02 m: Silt seams.					64		90° Jt Pl Sm 90° Jt Pl Sm Silt, light brown cg DI 90° Jt Pl Sm 90° Jt Pl Sm Yellowish brown coating cg 90° Jt Pl Sm Silt cg 90° Jt Pl Sm Some silt cg 90° Jt Pl Sm Silt cg 90° Jt Pl Sm Sm
	97.0	27.0		19 / 72			27.32 m - 27.36 m: Silt seams. 27.40 m - 28.60 m: Irregular black bands, bioturbated with mud seams, strong rock (excepting weak seams). 27.82 m - 27.83 m: Silt seams.					42		90° Jt Pl Sm 90° Jt Pl Sm 90° Jt Pl Sm Sm 90° Jt Pl Sm 90° Jt Pl Sm 90° Jt Pl Sm 90° Jt Pl Sm 90° Jt Pl Sm Sm
	96.0	28.0												
	95.0	29.0		20 / 86			28.60 m - 29.50 m: No visible mud, but some core loss.					83		90° Jt Pl Sm 90° Jt Pl Sm Silt cg 90° Jt Pl Sm Silt cg 90° Jt Pl Sm 90° Jt Pl Sm 90° Jt Pl Sm 90° Jt Pl Sm
							29.50 m - 31.00 m: Bioturbated, 5 cm mud seam, strong rock.					58		80° Jt Pl Sm 90° Jt Pl Sm Fz 90° Jt Ir Ro
	94.0	30.0												

Notes:

Defect Description Legend

Planarity		Type				Roughness		Infill Amount	
Pl	Planar	DI	Drilling Induced	Sm	Seam	Ro	Rough	cn	Clean
Ir	Irregular	Jt	Joint	Cz	Crushed Zone	Sm	Smooth	sn	Stained
Cu	Curved	Pt	Parting on Contact	Fz	Fractured Zone	Po	Polished	vn	Veneer
Un	Undulose	Sh	Shear Seam	Band	Weak Band	Sl	Slickenside	cg	Coating
St	Stepped	Cs	Crushed Seam						

BOREHOLE LOG

ROCK CORE FORMAT

BH18-BR70-1

Client: Baffinland Iron Mine

Project: Mary River Expansion Study

Location: Proposed Bridge 70 Abutment

Project No.: H353004

Datum: NAD83

Platform:

Easting:	529,138.0 m
Northing:	7,916,667.0 m
Surface Elevation:	124.00 m
Bottom Elevation:	91.50 m
Total Depth:	32.5 m
Logged By:	YF/MY
Reviewed By:	

Contractor: Boart Longyear **Rig Type/ Mounting:** Sonic Drill Rig **Bearing:** N/A° **Date Logged:** 4/13/2018

Driller: Brent McAndrew **Hole Diameter (mm):** 100 **Plunge:** ° **Date Checked:**

Water	Elevation (m)	Depth (m)	Method	Run #/TCR	Graphic Log	Geological Unit	Rock Description ROCK TYPE; Grain size, texture and fabric, colour, general defect conditions, minor constituents.	Weathering/ Cementation	Estimated Strength EH VH H M L VL EL	$Is_{(50)}$ [UCS] MPa	Defect Spacing mm 2000 600 200 [100] 60 20	RQD %	Defect Log	Defect Description Inclination, type, infill, amount, aperture, planarity, roughness, frequency Specific / General
		30.0–31.0		21 / 103			BEDROCK: Siltstone to dolomitic limestone, grey with dark grey / black streaks, fine to very fine grained, medium strong rock. *(Continued)*					58		90° Jt Pl Sm Silt cg 90° Jt Pl Sm Sm 90° Jt Ir Ro 90° Jt Pl Sm 90° Jt Pl Sm 90° Jt Pl Sm Silt cg Fz 90° Jt Pl Ro Dl
	93.0	31.0												
		31.0–32.5		22 / 103								95		
	92.0	32.0												
		32.5					To Target Depth. **Drillhole BH18-BR70-1 terminated at 32.5m.**							
	91.0	33.0												
	90.0	34.0												
	89.0	35.0												
	88.0	36.0												
	87.0	37.0												
	86.0	38.0												
	85.0	39.0												
	84.0	40.0												

Notes:

Defect Description Legend

Planarity		Type				Roughness		Infill Amount	
Pl	Planar	Dl	Drilling Induced	Sm	Seam	Ro	Rough	cn	Clean
Ir	Irregular	Jt	Joint	Cz	Crushed Zone	Sm	Smooth	sn	Stained
Cu	Curved	Pt	Parting on Contact	Fz	Fractured Zone	Po	Polished	vn	Veneer
Un	Undulose	Sh	Shear Seam	Band	Weak Band	Sl	Slickenside	cg	Coating
St	Stepped	Cs	Crushed Seam						

HATCH BOREHOLE REPORT

BH18-BR70-2

Client:	Baffinland Iron Mine	**Project No.:**	H353004
Project:	Mary River Expansion Study	**Datum:**	NAD83
Location:	Proposed Bridge 70 Abutment	**Platform:**	
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	Sonic Drill Rig
Driller:	Brent McAndrew	**Hole Diameter (mm):**	100
Date Logged:	4/17/2018	**Date Reviewed:**	

Easting:	529,107.0 m
Northing:	7,916,700.0 m
Surface Elevation:	124.00 m
Bottom Elevation:	95.50 m
Total Depth:	28.5 m
Logged By:	YF/MY
Reviewed By:	

Column headings: Water | Elevation (m) | Depth (m) | Method | Casing | Graphic Log | Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components. | Frozen Soil Description | Recovery | Sample Type | Moisture Content Profile (0, 25, 50) | Field Water Content | Percent Gravel | Percent Sand | Percent Fines | Liquid Limit | Plastic Index | Other Tests

Elevation / Depth scale: 123.0 / 1.0; 122.0 / 2.0; 121.0 / 3.0; 120.0 / 4.0; 119.0 / 5.0; 118.0 / 6.0; 117.0 / 7.0; 116.0 / 8.0; 115.0 / 9.0; 114.0 / 10.0

Soil Description	Frozen Soil Description
SAND, trace to some SILT: Light brown, fine to medium grained.	Nbn
	Nbe
6.10 m: With fine black organic layers.	
7.00 m - 7.10 m: Silt, some sand.	
SAND interbedded with SILT.	Nbe
8.30 m: Becoming finer with depth.	Vr
ICE: 40% soil	ICE
SILT, some CLAY: Dark brown.	Vr - Vs
9.70 m - 10.10 m: Ice lenses, snow like.	

Approx. Depth (m)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines
0.8	1	38	47	15
1.2	20	0	86	14
3.3	15	0	91	9
9.6	23	0	2	98

Notes:

BOREHOLE REPORT

BH18-BR70-2

Client:	Baffinland Iron Mine	**Project No.:**	H353004
Project:	Mary River Expansion Study	**Datum:**	NAD83
Location:	Proposed Bridge 70 Abutment	**Platform:**	
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	Sonic Drill Rig
Driller:	Brent McAndrew	**Hole Diameter (mm):**	100
Date Logged:	4/17/2018	**Date Reviewed:**	

Easting:	529,107.0 m
Northing:	7,916,700.0 m
Surface Elevation:	124.00 m
Bottom Elevation:	95.50 m
Total Depth:	28.5 m
Logged By:	YF/MY
Reviewed By:	

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 25 50)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	113.0	11.0				SILT, some CLAY: Dark brown. *(Continued)* 10.50 m - 10.70 m: Fine to medium sand, trace silt. 10.70 m - 10.75 m: Ice, snow like. 10.75 m: Fine sand, interbedded with darker brown silt.	Vr - Vs *(Continued)* Nbn Vr										
	112.0, 111.0	12.0, 13.0				SILTY SAND, trace GRAVEL: Dark brown with layers of yellow, angular gravel. 12.70 m - 12.90 m: White to grey limestone cobbles. 12.90 m: Fine to medium gravel, angular to sub-rounded. 13.60 m - 13.70 m: Becoming darker brown.											
	110.0, 109.0, 108.0, 107.0, 106.0, 105.0, 104.0	14.0, 15.0, 16.0, 17.0, 18.0, 19.0, 20.0				COBBLES: Limestone in possible rock floor. 14.90 m - 15.20 m: Highly disturbed, dark grey wilt wirh angular gravel, inferred rock. 15.20 m - 16.80 m: Potential bedrock surface, grey angular gravel size pieces in majority crushed grey silt sized matrix. 17.10 m: Fractured rock, weathered top layer, 5 mm pockets of silt with 10 cm silt pocket below, very fine grained, laminated to fractured to full of holes. 18.30 m - 18.75 m: Loss of fines. 18.75 m - 19.30 m: Laminated, very fine grained. 19.35 m - 19.60 m: Silt, grey, pieces of rock, likely bedrock, thin horizontal laminations, smooth, horizontal	Nf inferred					0	2	98			

Notes:

BOREHOLE REPORT

Client:	Baffinland Iron Mine	**Project No.:**	H353004
Project:	Mary River Expansion Study	**Datum:**	NAD83
Location:	Proposed Bridge 70 Abutment	**Platform:**	
Contractor:	Boart Longyear	**Rig Type/ Mounting:**	Sonic Drill Rig
Date Logged:	4/17/2018	**Driller:**	Brent McAndrew
Hole Diameter (mm):	100	**Date Reviewed:**	

Easting:	529,107.0 m
Northing:	7,916,700.0 m
Surface Elevation:	124.00 m
Bottom Elevation:	95.50 m
Total Depth:	28.5 m
Logged By:	YF/MY
Reviewed By:	

Water	Elevation (m)	Depth (m)	Method	Casing	Graphic Log	Soil Description: TYPE; plasticity or particle characteristics (size, grading, shape, roundness), colour, structure, accessory components.	Frozen Soil Description	Recovery	Sample Type	Moisture Content Profile (0 – 25 – 50)	Field Water Content	Percent Gravel	Percent Sand	Percent Fines	Liquid Limit	Plastic Index	Other Tests
	103.0	21.0				fractures, silt seams present. COBBLES: Limestone in possible rock floor. *(Continued)*											
	102.0	22.0				21.20 m - 22.10 m: Fractured zone, fresh, strong. ***Start of Coring at 21.3m.***											
						Continued on Rock Core Log sheet.											
	101.0	23.0															
	100.0	24.0															
	99.0	25.0															
	98.0	26.0															
	97.0	27.0															
	96.0	28.0															
	95.0	29.0															
	94.0	30.0															

Notes:

HATCH

BOREHOLE LOG
ROCK CORE FORMAT

BH18-BR70-2

Client: Baffinland Iron Mine
Project No.: H353004
Project: Mary River Expansion Study
Datum: NAD83
Location: Proposed Bridge 70 Abutment
Platform:

Easting: 529,107.0 m
Northing: 7,916,700.0 m
Surface Elevation: 124.00 m
Bottom Elevation: 95.50 m
Total Depth: 28.5 m
Logged By: YF/MY
Reviewed By:

Contractor: Boart Longyear **Rig Type/ Mounting:** Sonic Drill Rig **Bearing:** N/A° **Date Logged:** 4/17/2018
Driller: Brent McAndrew **Hole Diameter (mm):** 100 **Plunge:** ° **Date Checked:**

Water	Elevation (m)	Depth (m)	Method	Run #/TCR	Graphic Log	Geological Unit	Rock Description ROCK TYPE; Grain size, texture and fabric, colour, general defect conditions, minor constituents.	Weathering/ Cementation	Estimated Strength EH VH H M L VL EL	$Is_{(50)}$ [UCS] MPa	Defect Spacing mm 2000 600 200 [100] 60 20	RQD %	Defect Log	Defect Description Inclination, type, infill, amount, aperture, planarity, roughness, frequency Specific / General
	103.0	21.0					***Resuming in Rock Core Format 21.3m.***							
	102.0 101.0 100.0 99.0 98.0 97.0 96.0	22.0 23.0 24.0 25.0 26.0 27.0 28.0					BEDROCK: Siltstone to dolomitic limestone. 22.10 m - 24.00 m: Fractured, crystal filled (white, medium grade) voids from 23.30 m, fresh, strong. 24.00 m - 25.50 m: Void to 24.40 m, becoming beige 24.50 m - 24.70 m, mottled. 25.50 m - 27.00 m: Beige mottled from 25.60 m - 26.00 m, decreasing in beige concentrate after, fresh. 27.00 m - 28.50 m: Beige mottled grey mudstone, becoming more banded, strong, fresh, one vein at 28.00 m.							
	95.0 94.0	29.0 30.0					To Target Depth. **Drillhole BH18-BR70-2 terminated at 28.5m.**							

Notes:

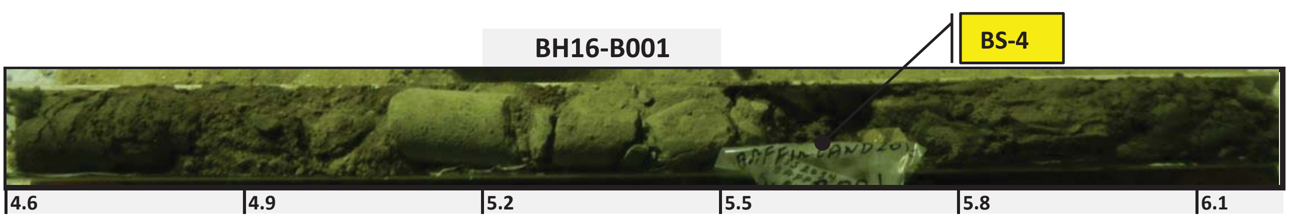
Defect Description Legend

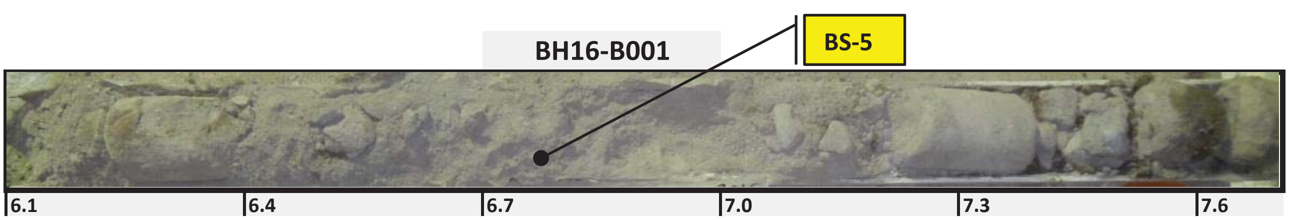
Planarity		Type				Roughness		Infill Amount	
Pl	Planar	DI	Drilling Induced	Sm	Seam	Ro	Rough	cn	Clean
Ir	Irregular	Jt	Joint	Cz	Crushed Zone	Sm	Smooth	sn	Stained
Cu	Curved	Pt	Parting on Contact	Fz	Fractured Zone	Po	Polished	vn	Veneer
Un	Undulose	Sh	Shear Seam	Band	Weak Band	Sl	Slickenside	cg	Coating
St	Stepped	Cs	Crushed Seam						

Appendix C
Sample Photographs

Sample Photographs

Borehole Name:	BH16-B001	Mary River 12 MTPA Mine Expansion
Location:	17 W 514191 7965675	Pre-feasibility Study
Completion Date:	3/12/2016	Baffinland Iron Mines

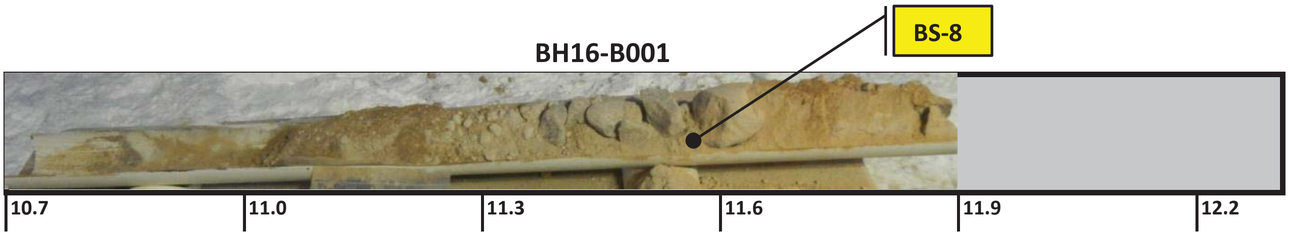




HATCH

BH16-B001

BH16-B001



HATCH

Sample Photographs

Borehole Name:	BH16-B002	Mary River 12 MTPA Mine Expansion
Location:	17 W 514290 7965604	Pre-feasibility Study
Completion Date:	2/12/2016	Baffinland Iron Mines

BH16-B002

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-B002

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-B002

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH16-B002

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-B002

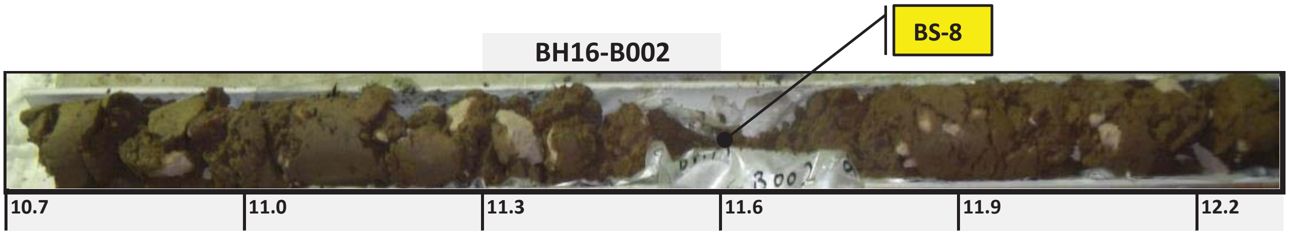
6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

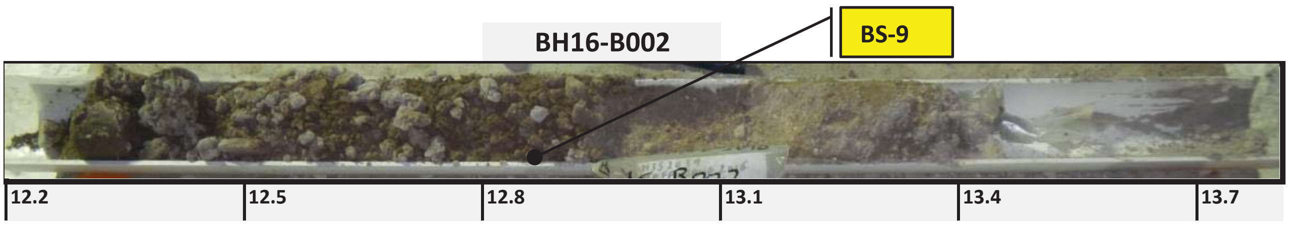
BH16-B002

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

HATCH


BH16-B002
BS-7
9.1
9.4
9.8
10.1
10.4
10.7

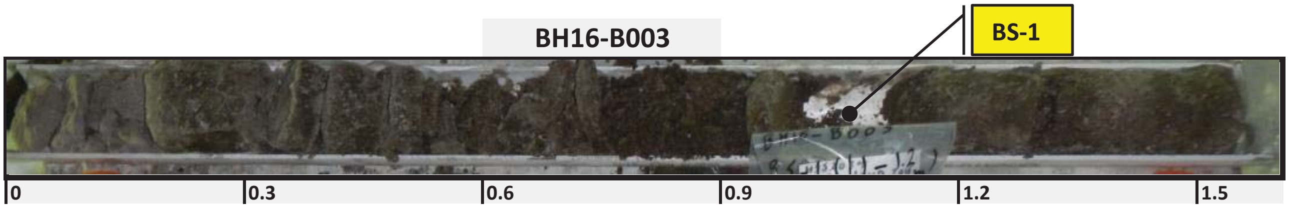

BH16-B002
BS-8
10.7
11.0
11.3
11.6
11.9
12.2


BH16-B002
BS-9
12.2
12.5
12.8
13.1
13.4
13.7

Sample Photographs

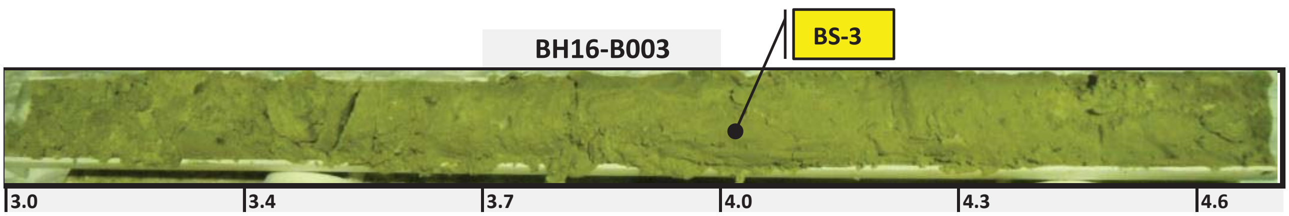
Borehole Name:	BH16-B003	Mary River 12 MTPA Mine Expansion
Location:	17 W 514357 7965533	Pre-feasibility Study
Completion Date:	2/12/2016	Baffinland Iron Mines

BH16-B003



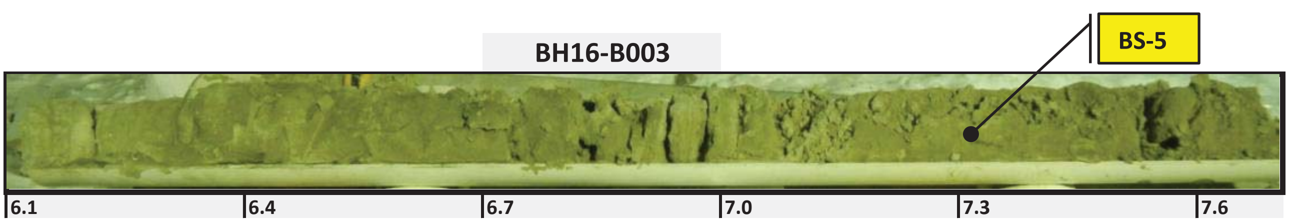
BH16-B003

BH16-B003



BH16-B003

BH16-B003



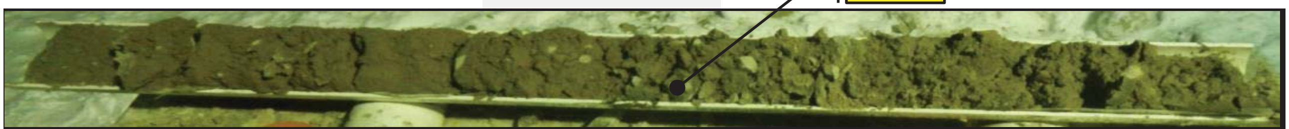
BH16-B003

HATCH

BH16-B003

9.1	9.4	9.8	10.1	10.4	10.7

BH16-B003



10.7	11.0	11.3	11.6	11.9	12.2

BH16-B003

12.2	12.5	12.8	13.1	13.4	13.7

BH16-B003

13.7	14.0	14.3	14.6	14.9	15.2

Sample Photographs

Borehole Name:	BH16-B004	Mary River 12 MTPA Mine Expansion
Location:	17 W 514367 7965540	Pre-feasibility Study
Completion Date:	1/12/2016	Baffinland Iron Mines

BH16-B004

BS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

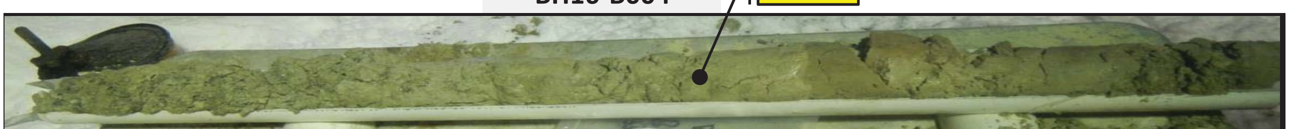
BH16-B004

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-B004

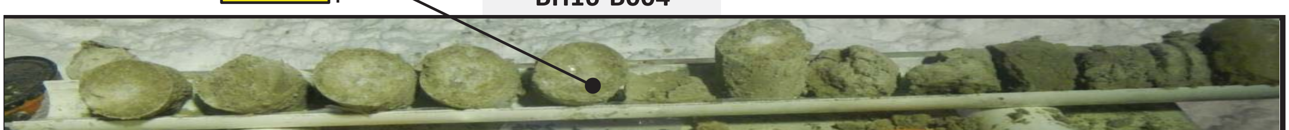
BS-3



3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BS-4

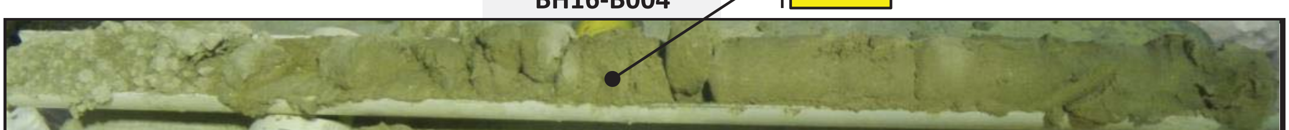
BH16-B004



4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-B004

BS-5



6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

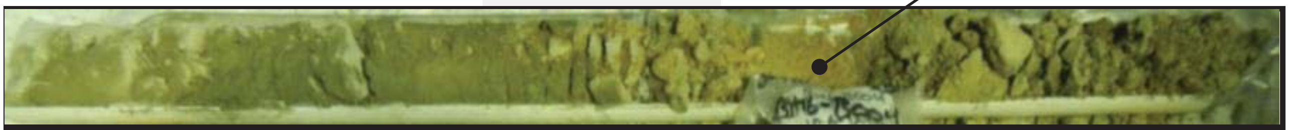
BS-6

BH16-B004

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

BS-7

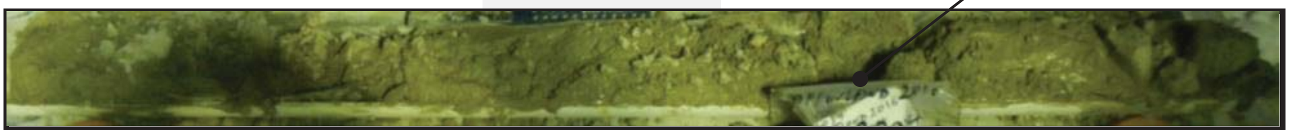
BH16-B004



10.6	10.9	11.2	11.5	11.8	12.1

BS-8

BH16-B004



12.1	12.4	12.7	13.0	13.3	13.6

BS-9

BH16-B004

13.6	14.0	14.3	14.6	14.9	15.2

BS-10

BH16-B004

15.2	15.5	15.8	16.1	16.4	16.7

Sample Photographs

Borehole Name:	BH16-B010	Mary River 12 MTPA Mine Expansion
Location:	17 W 542208 7922304	Pre-feasibility Study
Completion Date:	08/10/2016	Baffinland Iron Mines

BS-1

BH16-B010

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BS-2

BH16-B010

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BS-3

BH16-B010

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BS-4

BH16-B010

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BS-5

BH16-B010

6.1 | 6.6 | 7.1 | 7.6 | 8.1 | 8.6

BS-6

BH16-B010

8.6 | 8.9 | 9.2 | 9.5 | 9.8 | 10.1

HATCH

Sample Photographs

Borehole Name:	BH16-B013	Mary River 12 MTPA Mine Expansion
Location:	17 W 555619 7914671	Pre-feasibility Study
Completion Date:	13/11/2016	Baffinland Iron Mines

BH16-B013

Sample photo not taken

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-B013

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-B013

BS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH16-B013

BS-4

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-B013

BS-5

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BH16-B013

BS-6

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

BH16-B013

9.1 | 9.4 | 9.8 | 10.1 | 10.4 | 10.7

HATCH

Sample Photographs

Borehole Name:	BH16-B014	Mary River 12 MTPA Mine Expansion
Location:	17 W 555599 7914683	Pre-feasibility Study
Completion Date:	14/11/2016	Baffinland Iron Mines

BH16-B014

BH16-B014

BH16-B014

BH16-B014

BH16-B014

BH16-B014

HATCH

Sample Photographs

Borehole Name:	BH16-B015	Mary River 12 MTPA Mine Expansion
Location:	17 W 555824 7914884	Pre-feasibility Study
Completion Date:	14/11/2016	Baffinland Iron Mines

BH16-B015

BH16-B015

BH16-B015

BH16-B015

BH16-B015

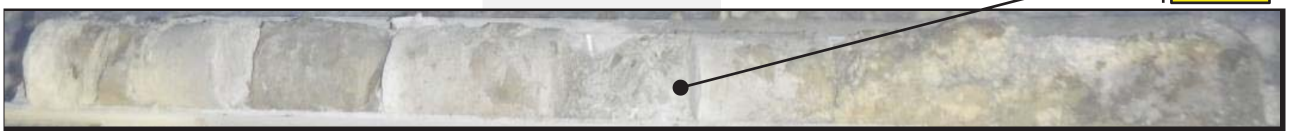
BH16-B015

HATCH

BH16-B015

9.1	9.4	9.8	10.1	10.4	10.7

BH16-B015



10.7	11.0	11.3	11.6	11.9	12.2

BH16-B015

12.2	12.5	12.8	13.1	13.4	13.7

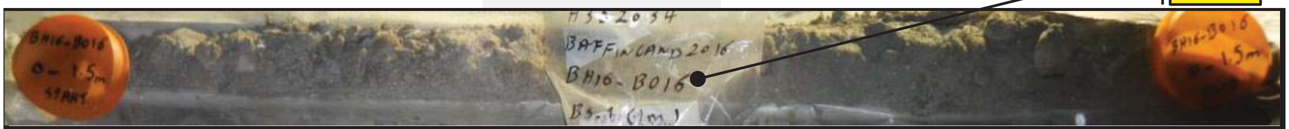
HATCH

Sample Photographs

Borehole Name:	BH16-B016	Mary River 12 MTPA Mine Expansion
Location:	17 W 555830 7914892	Pre-feasibility Study
Completion Date:	14/11/2016	Baffinland Iron Mines

BH16-B016

BS-1



0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-B016

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

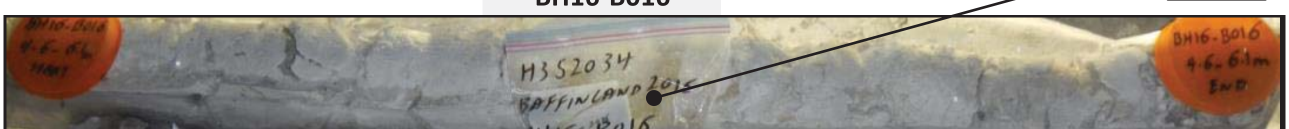
BH16-B016

BS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH16-B016

BS-4



4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-B016

BS-5

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

HATCH

Sample Photographs

Borehole Name:	BH16-C006	Mary River 12 MTPA Mine Expansion
Location:	17 W 508897 7968767	Pre-feasibility Study
Completion Date:	3/12/2016	Baffinland Iron Mines

BH16-C006

BS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-C006

End of borehole at 2.1m

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

HATCH

Sample Photographs

Borehole Name:	BH16-C007	Mary River 12 MTPA Mine Expansion
Location:	17 W 517221 7962080	Pre-feasibility Study
Completion Date:	1/12/2016	Baffinland Iron Mines

BH16-C007

BH16-C007

BH16-C007

BH16-C007

BH16-C007

Sample Photographs

Borehole Name:	BH16-C008	Mary River 12 MTPA Mine Expansion
Location:	17 W 520080 7965909	Pre-feasibility Study
Completion Date:	11/30/2016	Baffinland Iron Mines

BH16-C008

BS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-C008

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-C008

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH16-C008

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-C008

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BH16-C008

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

BH16-C008

9.1 | 9.4 | 9.8 | 10.1 | 10.4 | 10.7

BH16-C008

10.7 | 11.0 | 11.3 | 11.6 | 11.9 | 12.2

BH16-C008

12.2 | 12.5 | 12.8 | 13.1 | 13.4 | 13.7

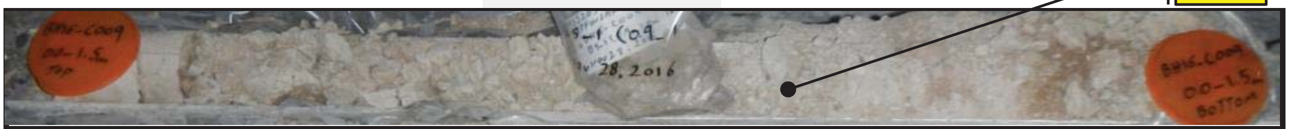
HATCH

Sample Photographs

Borehole Name:	BH16-C009	Mary River 12 MTPA Mine Expansion
Location:	17 W 522032 7948728	Pre-feasibility Study
Completion Date:	28/11/2016	Baffinland Iron Mines

BH16-C009

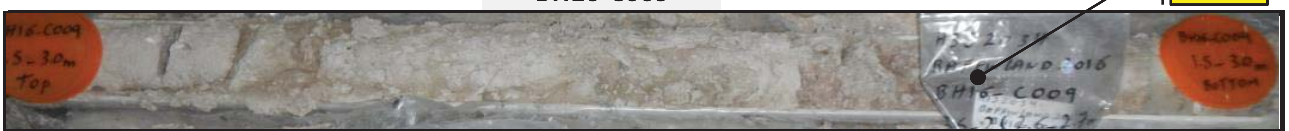
BS-1



0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-C009

BS-2



1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BS-3

BH16-C009

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH16-C009

BS-4

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-C009

BS-5

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BH16-C009

BS-6

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

HATCH

Sample Photographs

Borehole Name:	BH16-C010	Mary River 12 MTPA Mine Expansion
Location:	17 W 522513 7946595	Pre-feasibility Study
Completion Date:	27/11/2016	Baffinland Iron Mines

BH16-C010

BS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-C010

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-C010

BS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH16-C010

BS-4

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

HATCH

Sample Photographs

Borehole Name:	BH16-C011	Mary River 12 MTPA Mine Expansion
Location:	17 W 525427 7937567	Pre-feasibility Study
Completion Date:	27/11/2016	Baffinland Iron Mines

BH16-C011

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-C011

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-C011

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH16-C011

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-C011

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

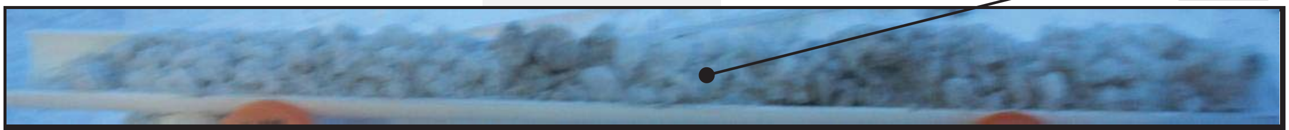
BH16-C011

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

HATCH

BH16-C011

BS-7



9.1	9.4	9.8	10.1	10.4	10.7

Sample Photographs

Borehole Name:	BH16-C015	Mary River 12 MTPA Mine Expansion
Location:	17 W 536142 7918691	Pre-feasibility Study
Completion Date:	24/11/2016	Baffinland Iron Mines

BH16-C015

BS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-C015

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BS-3

BH16-C015

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BS-4

BH16-C015

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-C015

BS-5

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

HATCH

Sample Photographs

Borehole Name:	BH16-C016	Mary River 12 MTPA Mine Expansion
Location:	17 W 536362 7918814	Pre-feasibility Study
Completion Date:	24/11/2016	Baffinland Iron Mines

BH16-C016

BS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

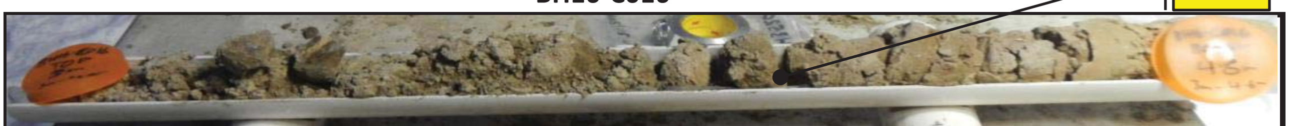
BH16-C016

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-C016

BS-3



3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH16-C016

BS-4

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-C016

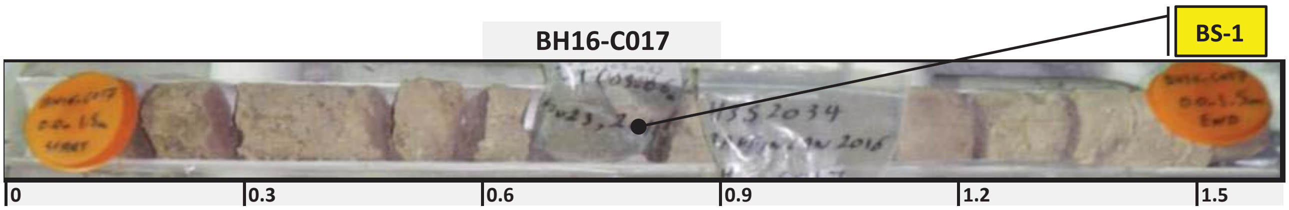
BS-5

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

Sample Photographs

Borehole Name:	BH16-C017	Mary River 12 MTPA Mine Expansion
Location:	17 W 538597 7919724	Pre-feasibility Study
Completion Date:	23/11/2016	Baffinland Iron Mines

BH16-C017



BH16-C017

BH16-C017

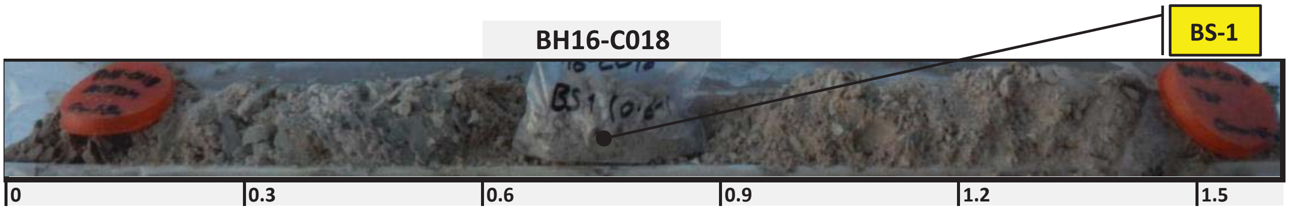
BH16-C017

HATCH

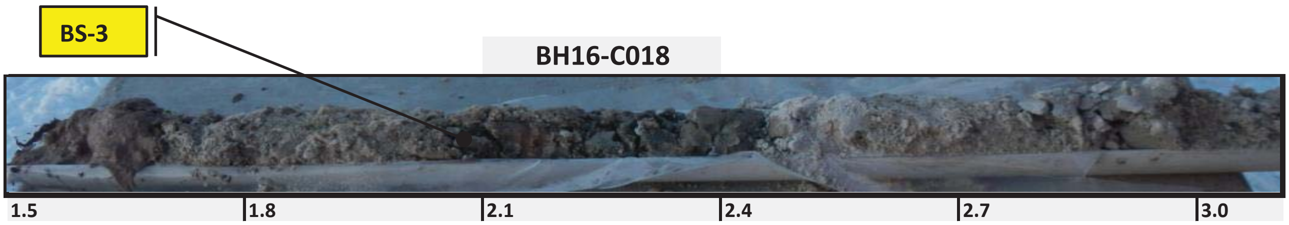
Sample Photographs

Borehole Name:	BH16-C018	Mary River 12 MTPA Mine Expansion
Location:	17 W 546111 7920740	Pre-feasibility Study
Completion Date:	10/11/2016	Baffinland Iron Mines

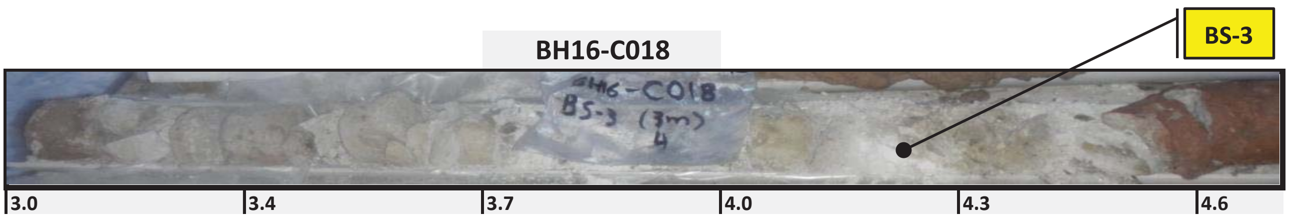
BH16-C018



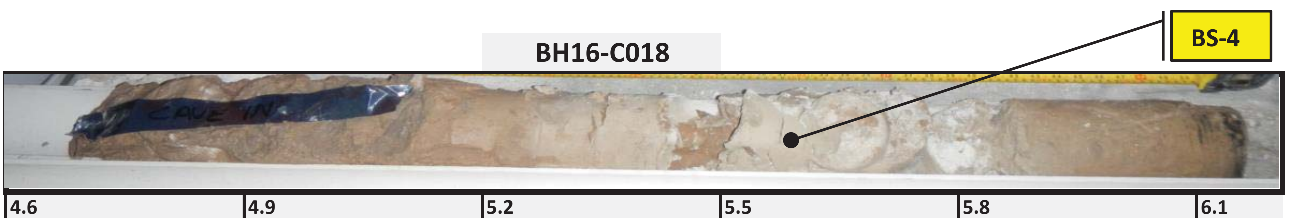
BH16-C018



BH16-C018



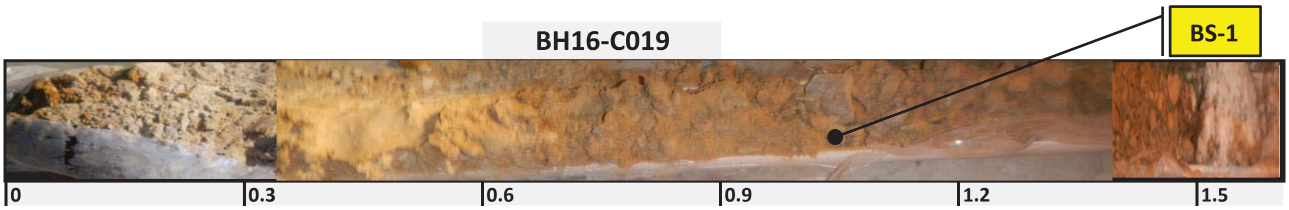
BH16-C018



Sample Photographs

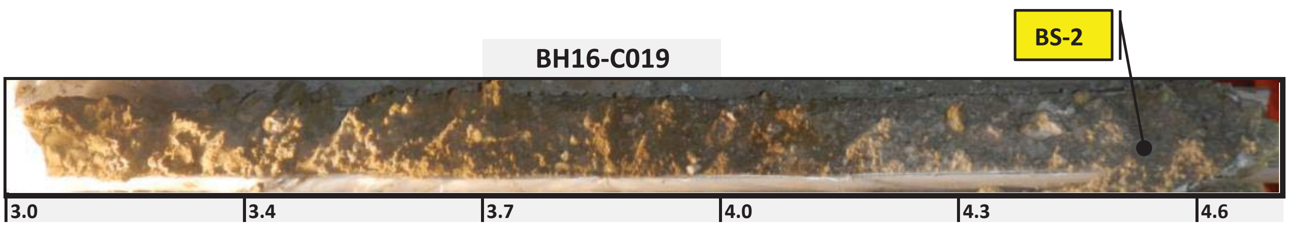
Borehole Name:	BH16-C019	Mary River 12 MTPA Mine Expansion
Location:	17 W 546163 7920494	Pre-feasibility Study
Completion Date:	10/11/2016	Baffinland Iron Mines

BH16-C019



BH16-C019

BH16-C019



HATCH

Sample Photographs

Borehole Name:	BH16-C019B	Mary River 12 MTPA Mine Expansion
Location:	17 W 546214 7920455	Pre-feasibility Study
Completion Date:	11/11/2016	Baffinland Iron Mines

BH16-C019B

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-C019B

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-C019B

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BS-1

BH16-C019B

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

Sample Photographs

Borehole Name:	BH16-C020	Mary River 12 MTPA Mine Expansion
Location:	17 W 546402 7920072	Pre-feasibility Study
Completion Date:	10/11/2016	Baffinland Iron Mines

BH16-C020

BS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-C020

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-C020

BS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH16-C020

BS-4

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-C020

BS-5

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BH16-C020

BS-6

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

HATCH

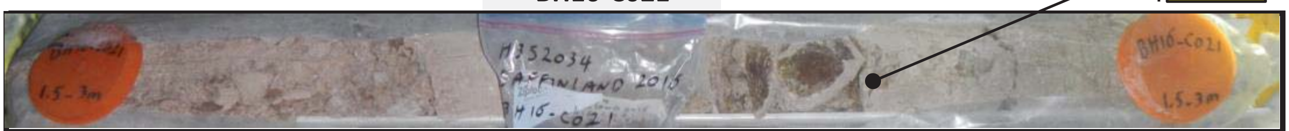
Sample Photographs

Borehole Name:	BH16-C021	Mary River 12 MTPA Mine Expansion
Location:	17 W 546593 7919917	Pre-feasibility Study
Completion Date:	09/11/2016	Baffinland Iron Mines

BH16-C021

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-C021



1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-C021

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH16-C021

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-C021

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BH16-C021

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

Sample Photographs

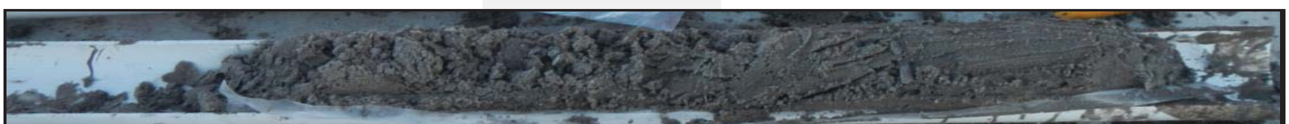
Borehole Name:	BH16-C022	Mary River 12 MTPA Mine Expansion
Location:	17 W 547077 7919746	Pre-feasibility Study
Completion Date:	11/11/2016	Baffinland Iron Mines

BH16-C022

BH16-C022

BH16-C022

BH16-C022



BH16-C022

BH16-C022

Sample Photographs

Borehole Name:	BH16-C023	Mary River 12 MTPA Mine Expansion
Location:	17 W 547304 7919643	Pre-feasibility Study
Completion Date:	11/11/2016	Baffinland Iron Mines

BH16-C023

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-C023

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

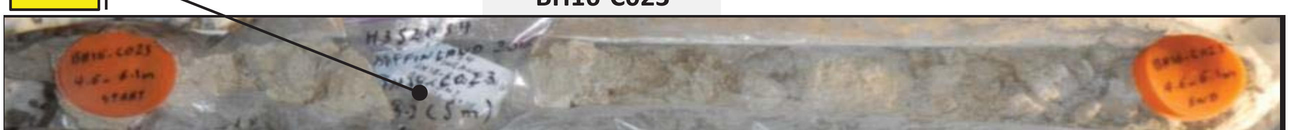
BS-1

BH16-C023

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BS-2

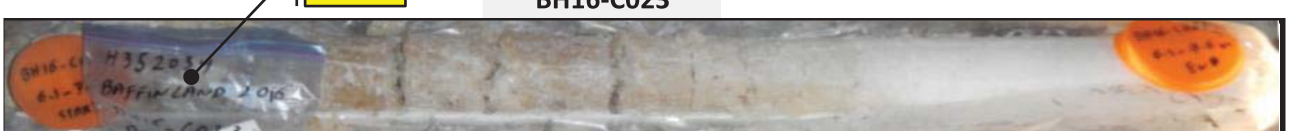
BH16-C023



4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BS-3

BH16-C023



6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BH16-C023

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

BH16-C023

9.1	9.4	9.8	10.1	10.4	10.7

HATCH

Sample Photographs

Borehole Name:	BH16-C024	Mary River 12 MTPA Mine Expansion
Location:	17 W 547530 7919537	Pre-feasibility Study
Completion Date:	14/11/2016	Baffinland Iron Mines

BH16-C024

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-C024

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BS-1

BH16-C024

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BS-2

BH16-C024

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

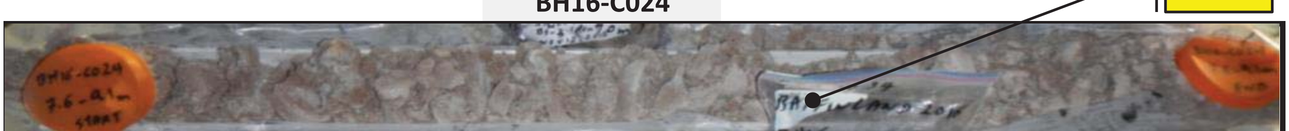
BS-3

BH16-C024

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BS-4

BH16-C024



7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

HATCH

BH16-C024

BS-5

9.1	9.4	9.8	10.1	10.4	10.7

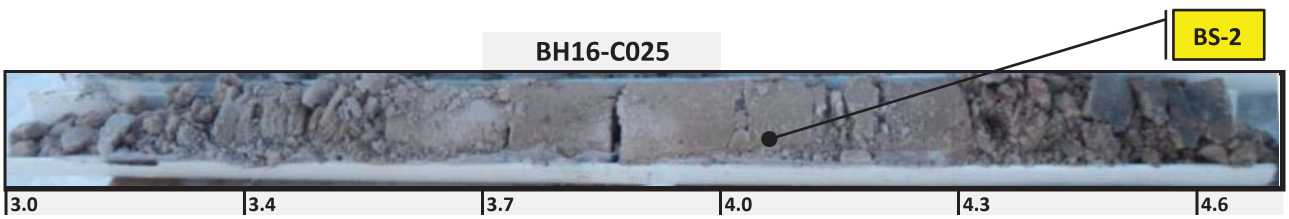
Sample Photographs

Borehole Name:	BH16-C025	Mary River 12 MTPA Mine Expansion
Location:	17 W 548370 7919181	Pre-feasibility Study
Completion Date:	12/11/2016	Baffinland Iron Mines

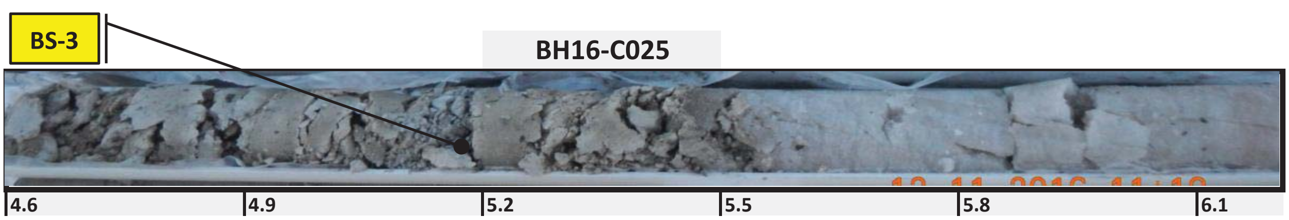
BH16-C025

BH16-C025

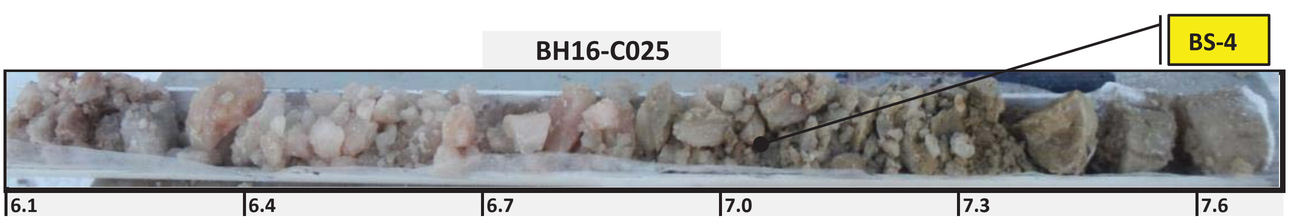
BH16-C025



BH16-C025



BH16-C025



HATCH

Sample Photographs

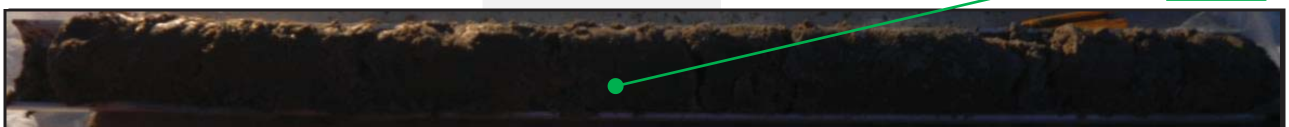
Borehole Name:	BH16-C026	Mary River 12 MTPA Mine Expansion
Location:	17 W 550262 7918123	Pre-feasibility Study
Completion Date:	12/11/2016	Baffinland Iron Mines

BH16-C026

0 0.3 0.6 0.9 1.2 1.5

BS-1

BH16-C026



1.5 1.8 2.1 2.4 2.7 3.0

BS-2

BH16-C026

3.0 3.4 3.7 4.0 4.3 4.6

BH16-C026

Sample photo not taken

4.6 4.9 5.2 5.5 5.8 6.1

BS-4

BH16-C026

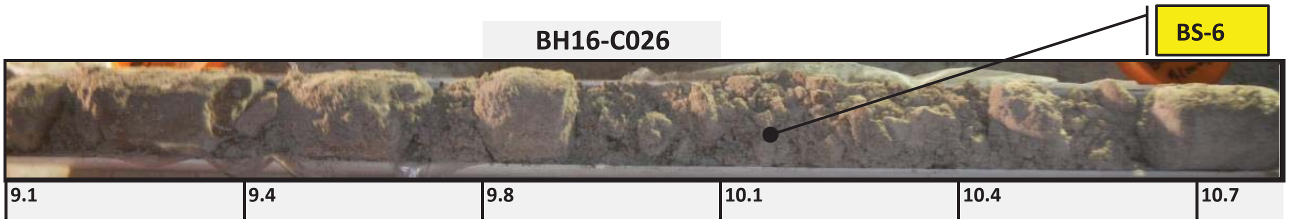
6.1 6.4 6.7 7.0 7.3 7.6

BS-5

BH16-C026

7.6 7.9 8.2 8.5 8.8 9.1

BH16-C026



Sample Photographs

Borehole Name:	BH16-C027	Mary River 12 MTPA Mine Expansion
Location:	17 W 550416 7917928	Pre-feasibility Study
Completion Date:	12/11/2016	Baffinland Iron Mines

BH16-C027

BH16-C027

BH16-C027

BH16-C027

BH16-C027

BH16-C027

BH16-C027

9.1	9.4	9.8	10.1	10.4	10.7

BH16-C027

10.7	11.0	11.3	11.6	11.9	12.2

BH16-C027

Sample photo not taken

12.2	12.5	12.8	13.1	13.4	13.7

BH16-C027

Sample photo not taken

13.7	14.0	14.3	14.6	14.9	15.2

HATCH

Sample Photographs

Borehole Name:	BH16-C028	Mary River 12 MTPA Mine Expansion
Location:	17 W 551403 7916768	Pre-feasibility Study
Completion Date:	13/11/2016	Baffinland Iron Mines

BH16-C028

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-C028

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-C028

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH16-C028

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BS-1

BH16-C028

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BS-2

BH16-C028

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

HATCH

BS-3

BH16-C028

9.1 | 9.4 | 9.8 | 10.1 | 10.4 | 10.7

BH16-C028

BS-4

10.7 | 11.0 | 11.3 | 11.6 | 11.9 | 12.2

HATCH

Sample Photographs

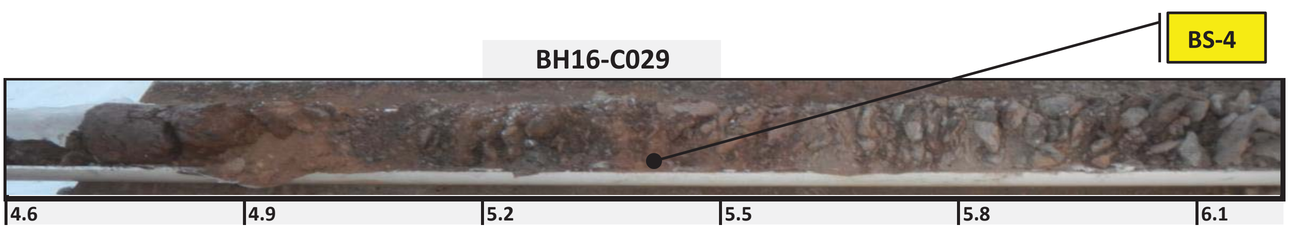
Borehole Name:	BH16-C029	Mary River 12 MTPA Mine Expansion
Location:	17 W 552569 7915813	Pre-feasibility Study
Completion Date:	13/11/2016	Baffinland Iron Mines

BH16-C029

BH16-C029

BH16-C029

BH16-C029



BH16-C029

HATCH

Sample Photographs

Borehole Name:	BH16-C030	Mary River 12 MTPA Mine Expansion
Location:	17 W 555337 7915646	Pre-feasibility Study
Completion Date:	16/11/2016	Baffinland Iron Mines

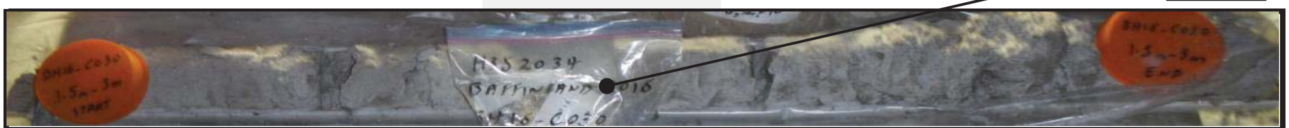
BH16-C030

BS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-C030

BS-2



1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-C030

BS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BS-4

BH16-C030

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-C030

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BH16-C030

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

BH16-C030

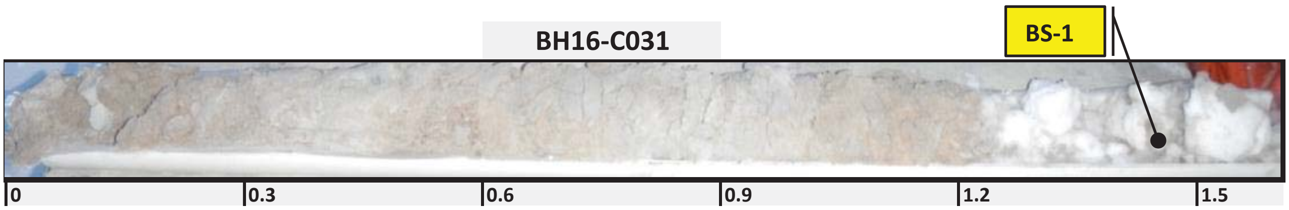
9.1	9.4	9.8	10.1	10.4	10.7

BH16-C030

10.7	11.0	11.3	11.6	11.9	12.2

Sample Photographs

Borehole Name:	BH16-C031	Mary River 12 MTPA Mine Expansion
Location:	17 W 556864 7915216	Pre-feasibility Study
Completion Date:	15/11/2016	Baffinland Iron Mines

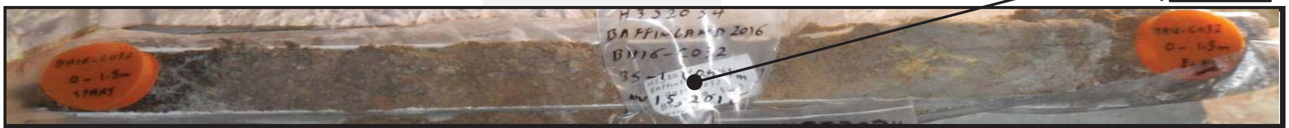


Sample Photographs

Borehole Name:	BH16-C032	Mary River 12 MTPA Mine Expansion
Location:	17 W 557282 7915265	Pre-feasibility Study
Completion Date:	15/11/2016	Baffinland Iron Mines

BH16-C032

BS-1



0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-C032

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-C032

BS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH16-C032

BS-4

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-C032

BS-5

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BH16-C032

BS-6

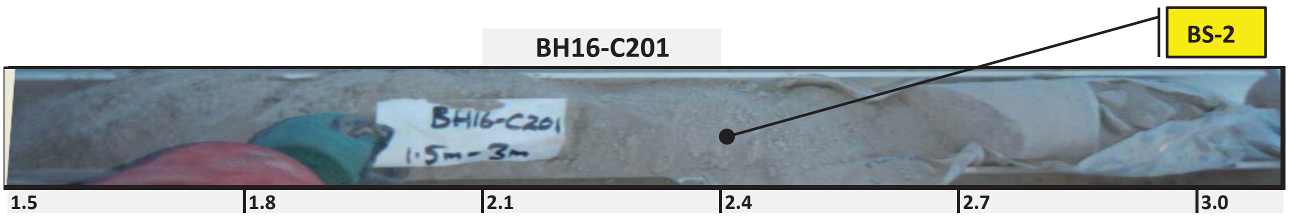
7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

Sample Photographs

Borehole Name:	BH16-C201	Mary River 12 MTPA Mine Expansion
Location:	17 W 553750 7915276	Pre-feasibility Study
Completion Date:	18/11/2016	Baffinland Iron Mines

BH16-C201

BH16-C201



Sample Photographs

Borehole Name:	BH16-C202	Mary River 12 MTPA Mine Expansion
Location:	17 W 554531 7915452	Pre-feasibility Study
Completion Date:	17/11/2016	Baffinland Iron Mines

BH16-C202

BS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-C202

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-C202

BS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BS-4

BH16-C202

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BS-5

BH16-C202

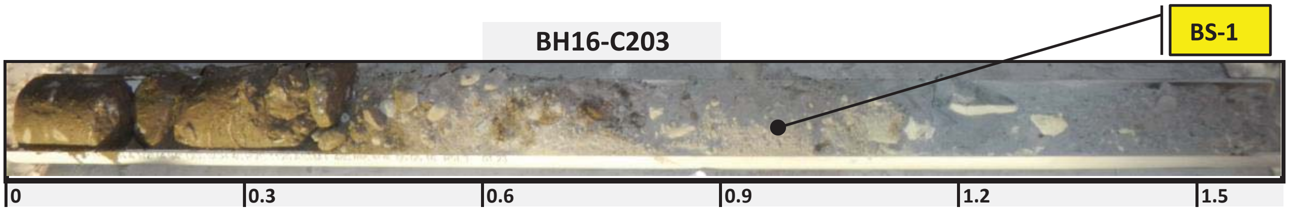
6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

HATCH

Sample Photographs

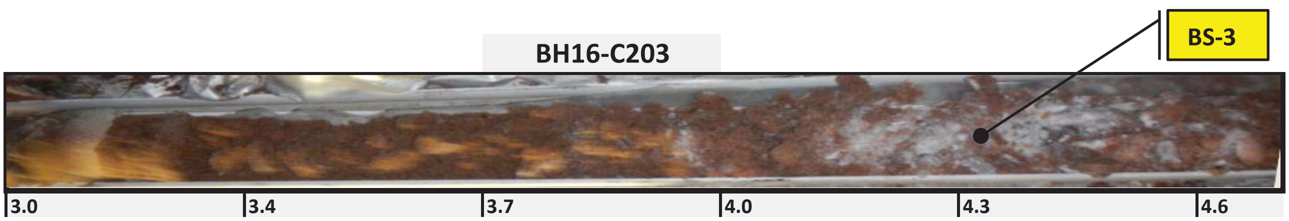
Borehole Name:	BH16-C203	Mary River 12 MTPA Mine Expansion
Location:	17 W 555007 7915451	Pre-feasibility Study
Completion Date:	17/11/2016	Baffinland Iron Mines

BH16-C203



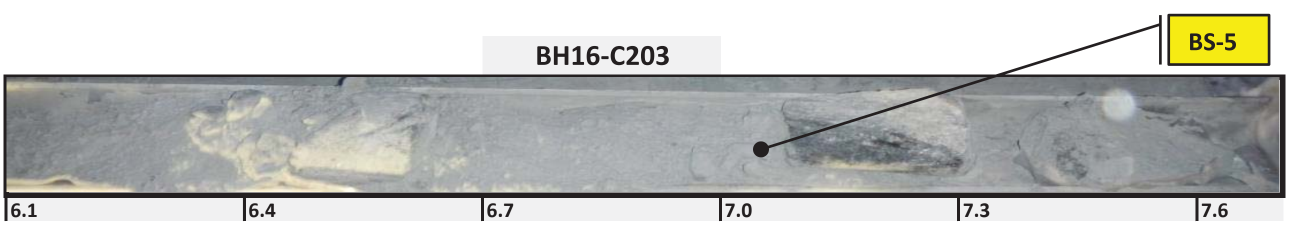
BH16-C203

BH16-C203

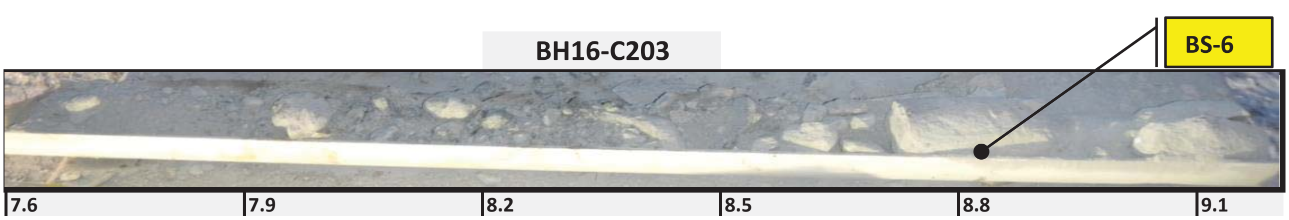


BH16-C203

BH16-C203



BH16-C203

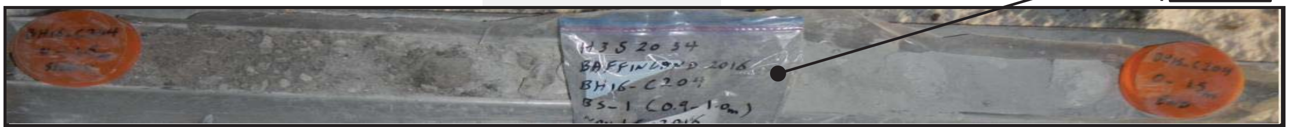


Sample Photographs

Borehole Name:	BH16-C204	Mary River 12 MTPA Mine Expansion
Location:	17 W 555659 7915432	Pre-feasibility Study
Completion Date:	16/11/2016	Baffinland Iron Mines

BS-1

BH16-C204



0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BS-2

BH16-C204

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

HATCH

Sample Photographs

Borehole Name:	BH16-C205	Mary River 12 MTPA Mine Expansion
Location:	17 W 555883 7915449	Pre-feasibility Study
Completion Date:	21/11/2016	Baffinland Iron Mines

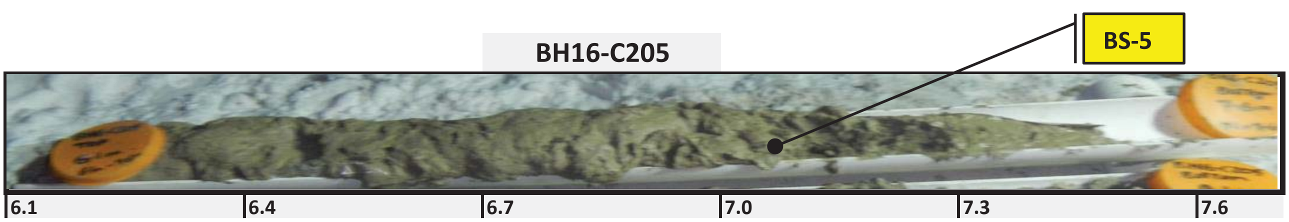
BH16-C205

BH16-C205

BH16-C205

BH16-C205

BH16-C205



BH16-C205

Sample Photographs

Borehole Name:	BH16-C206	Mary River 12 MTPA Mine Expansion
Location:	17 W 556059 7915442	Pre-feasibility Study
Completion Date:	22/11/2016	Baffinland Iron Mines

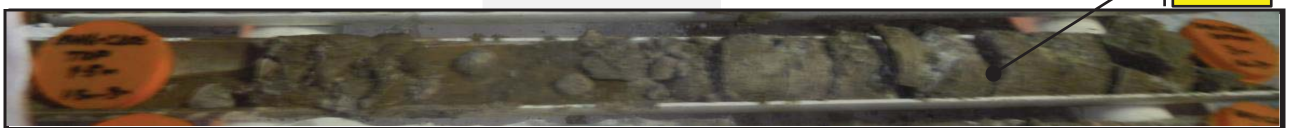
BH16-C206

BS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-C206

BS-2



1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-C206

BS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH16-C206

BS-4

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-C206

BS-5

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BH16-C206

BS-6

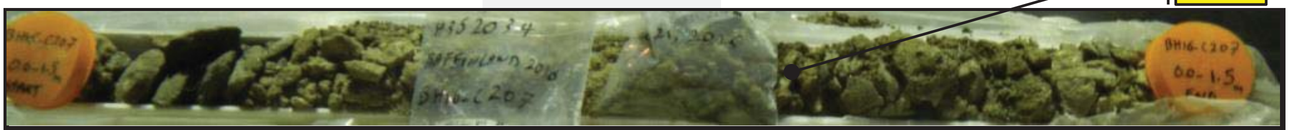
7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

Sample Photographs

Borehole Name:	BH16-C207	Mary River 12 MTPA Mine Expansion
Location:	17 W 556679 7915415	Pre-feasibility Study
Completion Date:	22/11/2016	Baffinland Iron Mines

BH16-C207

BS-1



0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BS-2

BH16-C207

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-C207

BS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH16-C207

BS-4

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-C207

BS-5

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

Sample Photographs

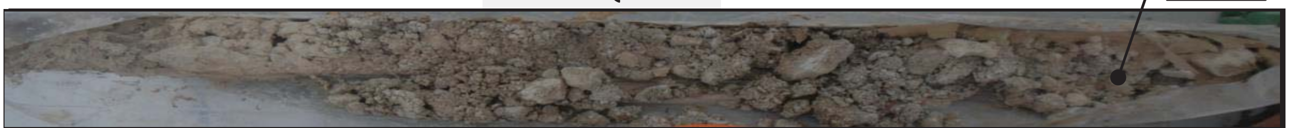
Borehole Name:	BH16-Q7002	Mary River 12 MTPA Mine Expansion
Location:	17 W 530561 7928150	Pre-feasibility Study
Completion Date:	28/10/2016	Baffinland Iron Mines

BH16-Q7002

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-Q7002

BS-2



1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-Q7002

Sample photo not taken

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BS-4

BH16-Q7002

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-Q7002

BS-5

5.2 | 5.5 | 5.8 | 6.1 | 6.4 | 6.7

Sample Photographs

Borehole Name:	BH16-Q7004	Mary River 12 MTPA Mine Expansion
Location:	17 W 529264 7927466	Pre-feasibility Study
Completion Date:	25/10/2016	Baffinland Iron Mines

BH16-Q7004

Core sample

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-Q7004

Core sample

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-Q7004

Core sample

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH16-Q7004

Core sample

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-Q7004

Core sample

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BH16-Q7004

Core sample

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

BH16-Q7004

Core sample

9.1 | 9.4 | 9.8 | 10.1 | 10.4 | 10.7

BH16-Q7004

BS-8

Sample photo not taken

10.7 | 11.0 | 11.3 | 11.6 | 11.9 | 12.2

BH16-Q7004

BS-9

Sample photo not taken

12.2 | 12.5 | 12.8 | 13.1 | 13.4 | 13.7

BH16-Q7004

BS-10

Sample photo not taken

13.7 | 14.0 | 14.3 | 14.6 | 14.9 | 15.2

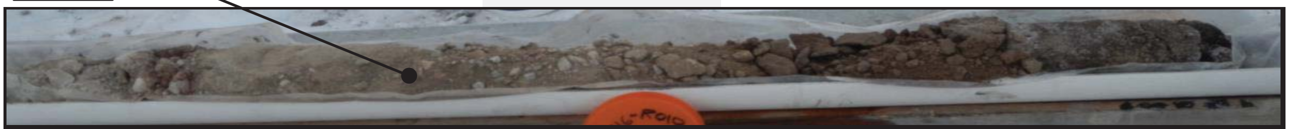
HATCH

Sample Photographs

Borehole Name:	BH16-R010	Mary River 12 MTPA Mine Expansion
Location:	17 W 515332 7963810	Pre-feasibility Study
Completion Date:	08/10/2016	Baffinland Iron Mines

BS-1

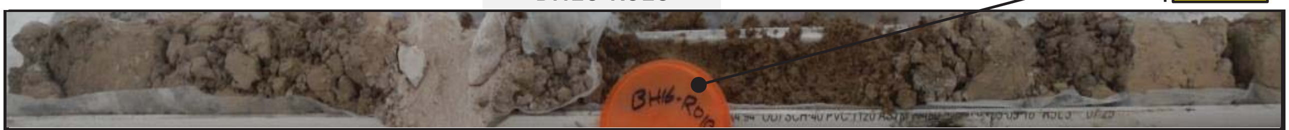
BH16-R010



0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BS-2

BH16-R010



1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BS-2

BH16-R010

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

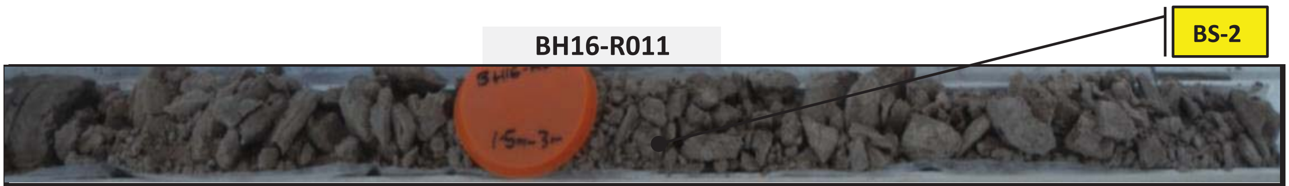
HATCH

		Sample Photographs
Borehole Name:	BH16-R011	Mary River 12 MTPA Mine Expansion
Location:	17 W 516719 7962461	Pre-feasibility Study
Completion Date:	08/10/2016	Baffinland Iron Mines

BH16-R011

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R011



1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

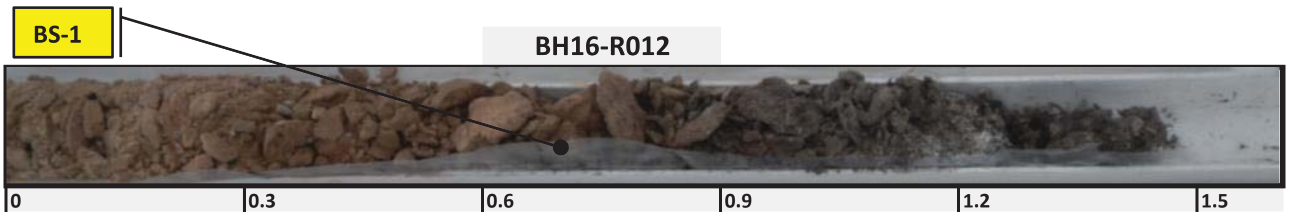
BH16-R011

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

HATCH

Sample Photographs

Borehole Name:	BH16-R012	Mary River 12 MTPA Mine Expansion
Location:	17 W 516716 7962464	Pre-feasibility Study
Completion Date:	08/10/2016	Baffinland Iron Mines



Sample Photographs

Borehole Name:	BH16-R013	Mary River 12 MTPA Mine Expansion
Location:	17 W 518856 7959178	Pre-feasibility Study
Completion Date:	08/10/2016	Baffinland Iron Mines

BS-1

BH16-R013

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R013

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BS-3

BH16-R013

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

HATCH

Sample Photographs

Borehole Name:	BH16-R014	Mary River 12 MTPA Mine Expansion
Location:	17 W 518856 7959178	Pre-feasibility Study
Completion Date:	08/10/2016	Baffinland Iron Mines

BS-1

BH16-R014

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BS-2

BH16-R014

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BS-3

BH16-R014

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

HATCH

Sample Photographs

Borehole Name:	BH16-R015	Mary River 12 MTPA Mine Expansion
Location:	17 W 520756 7955701	Pre-feasibility Study
Completion Date:	09/10/2016	Baffinland Iron Mines

BS-1

BH16-R015

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

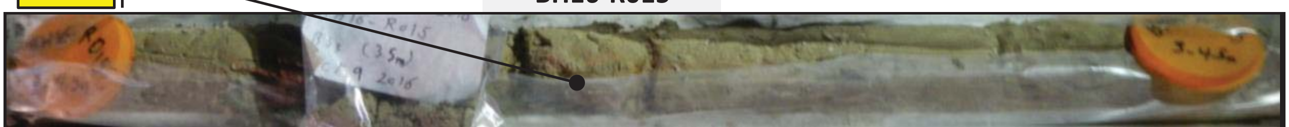
BS-2

BH16-R015

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BS-3

BH16-R015



3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

HATCH

Sample Photographs

Borehole Name:	BH16-R016	Mary River 12 MTPA Mine Expansion
Location:	17 W 521588 7953865	Pre-feasibility Study
Completion Date:	09/10/2016	Baffinland Iron Mines

BS-1

BH16-R016

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BS-2

BH16-R016

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

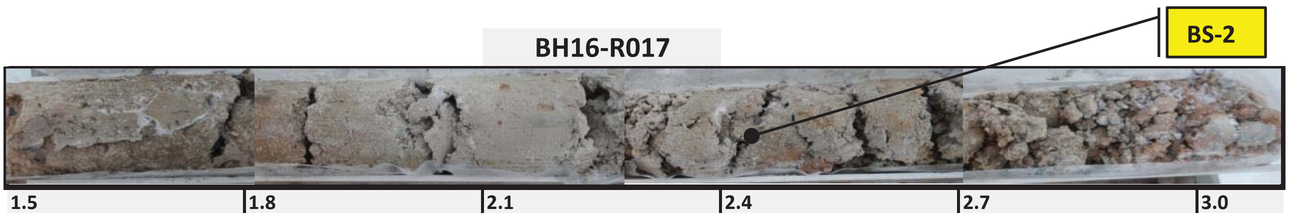
BS-3

BH16-R016

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

Sample Photographs

Borehole Name:	BH16-R017	Mary River 12 MTPA Mine Expansion
Location:	17 W 521737 7952929	Pre-feasibility Study
Completion Date:	09/10/2016	Baffinland Iron Mines



HATCH

Sample Photographs

Borehole Name:	BH16-R018	Mary River 12 MTPA Mine Expansion
Location:	17 W 521854 7951940	Pre-feasibility Study
Completion Date:	09/10/2016	Baffinland Iron Mines

Sample Photographs

Borehole Name:	BH16-R019	Mary River 12 MTPA Mine Expansion
Location:	17 W 521994 7950962	Pre-feasibility Study
Completion Date:	09/10/2016	Baffinland Iron Mines

BH16-R019

BS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R019

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R019

BS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

HATCH

Sample Photographs

Borehole Name:	BH16-R020	Mary River 12 MTPA Mine Expansion
Location:	17 W 521842 7949969	Pre-feasibility Study
Completion Date:	09/10/2016	Baffinland Iron Mines

BH16-R020

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R020

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BS-3

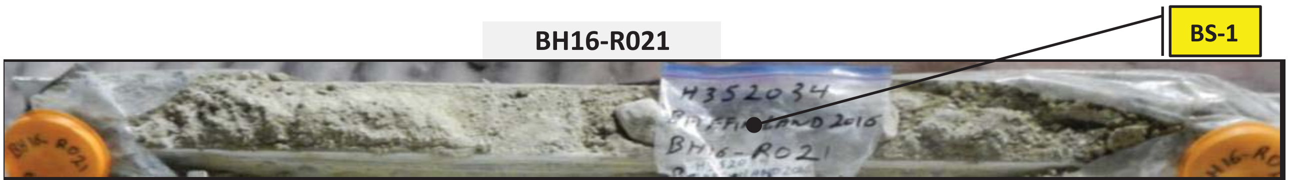
BH16-R020

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

Sample Photographs

Borehole Name:	BH16-R021	Mary River 12 MTPA Mine Expansion
Location:	17 W 522305 7948153	Pre-feasibility Study
Completion Date:	09/10/2016	Baffinland Iron Mines

BH16-R021

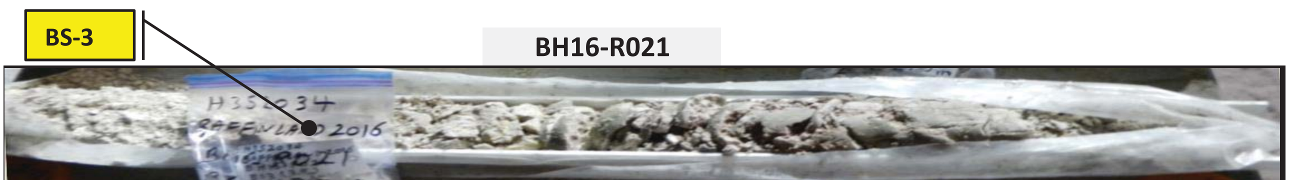


0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R021

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R021



3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

Sample Photographs

Borehole Name:	BH16-R022	Mary River 12 MTPA Mine Expansion
Location:	17 W 522305 7948153	Pre-feasibility Study
Completion Date:	10/10/2016	Baffinland Iron Mines

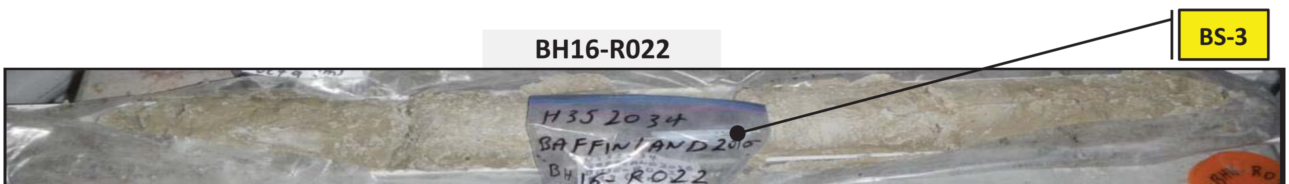
BH16-R022

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R022

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R022



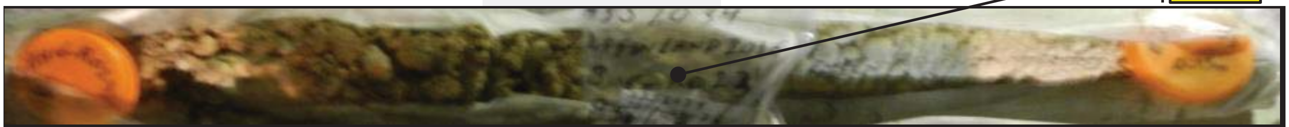
3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

Sample Photographs

Borehole Name:	BH16-R023	Mary River 12 MTPA Mine Expansion
Location:	17 W 522505 7947177	Pre-feasibility Study
Completion Date:	10/10/2016	Baffinland Iron Mines

BH16-R023

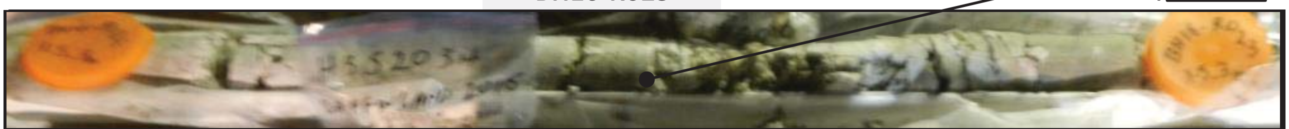
BS-1



0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R023

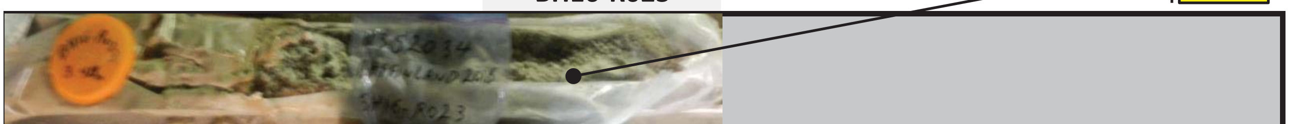
BS-2



1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R023

BS-3



3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

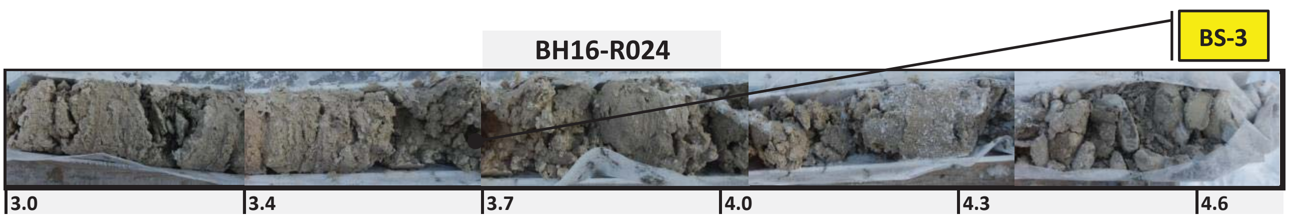
Sample Photographs

Borehole Name:	BH16-R024	Mary River 12 MTPA Mine Expansion
Location:	17 W 522558 7946129	Pre-feasibility Study
Completion Date:	10/10/2016	Baffinland Iron Mines

BH16-R024

BH16-R024

BH16-R024

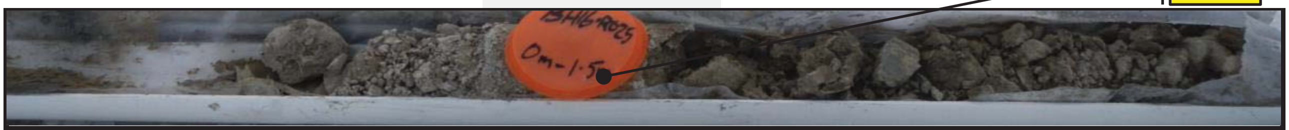


Sample Photographs

Borehole Name:	BH16-R025	Mary River 12 MTPA Mine Expansion
Location:	17 W 522989 7945094	Pre-feasibility Study
Completion Date:	10/10/2016	Baffinland Iron Mines

BH16-R025

BS-1



0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R025

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R025

BS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

Sample Photographs

Borehole Name:	BH16-R026	Mary River 12 MTPA Mine Expansion
Location:	17 W 523165 7944366	Pre-feasibility Study
Completion Date:	10/10/2016	Baffinland Iron Mines

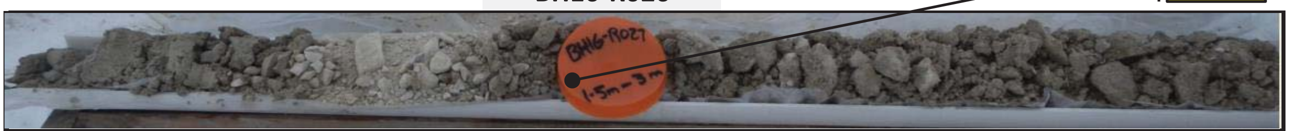
BH16-R026

BS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R026

BS-2



1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R026

BS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

HATCH

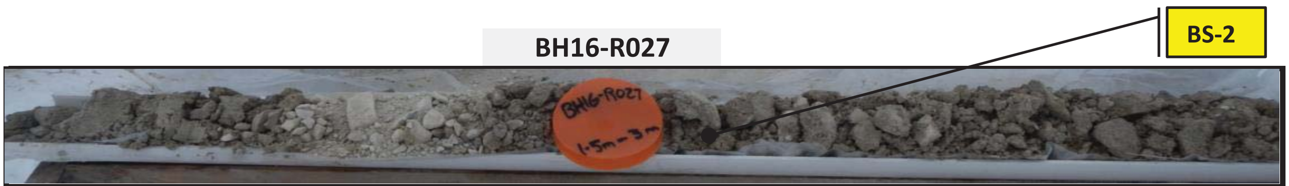
Sample Photographs

Borehole Name:	BH16-R027	Mary River 12 MTPA Mine Expansion
Location:	17 W 523442 7942265	Pre-feasibility Study
Completion Date:	10/10/2016	Baffinland Iron Mines

BH16-R027

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R027



1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R027

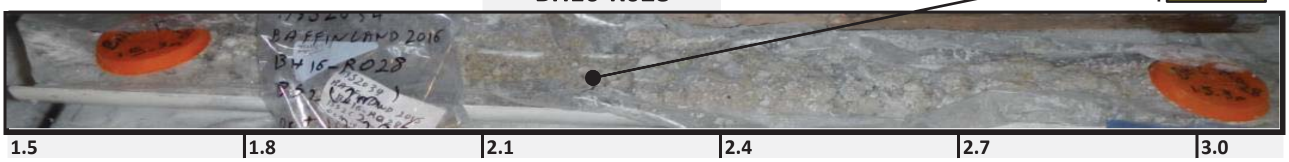
3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

Sample Photographs

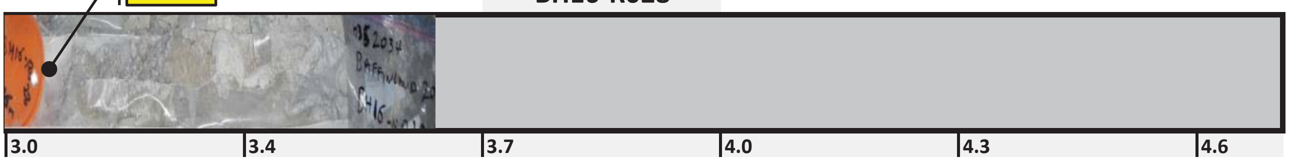
Borehole Name:	BH16-R028	Mary River 12 MTPA Mine Expansion
Location:	17 W 524061 7940538	Pre-feasibility Study
Completion Date:	10/10/2016	Baffinland Iron Mines

BH16-R028

BH16-R028



BH16-R028



HATCH

Sample Photographs

Borehole Name:	BH16-R029	Mary River 12 MTPA Mine Expansion
Location:	17 W 525062 7938851	Pre-feasibility Study
Completion Date:	11/10/2016	Baffinland Iron Mines

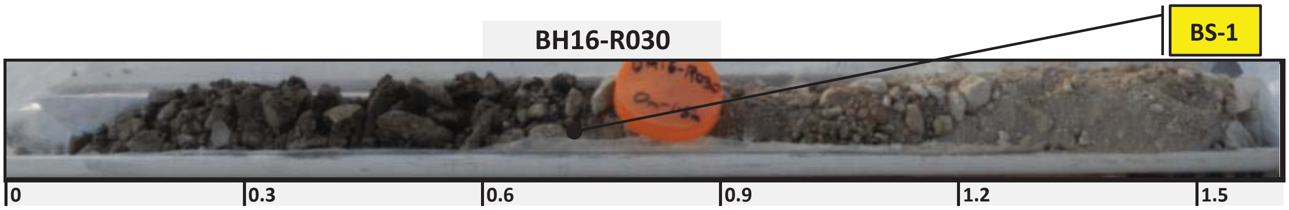
BH16-R029

BH16-R029

Sample Photographs

Borehole Name:	BH16-R030	Mary River 12 MTPA Mine Expansion
Location:	17 W 525291 7937897	Pre-feasibility Study
Completion Date:	11/10/2016	Baffinland Iron Mines

BH16-R030



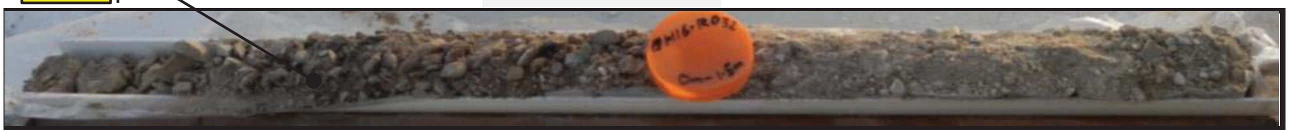
HATCH

Sample Photographs

Borehole Name:	BH16-R032	Mary River 12 MTPA Mine Expansion
Location:	17 W 525991 7936109	Pre-feasibility Study
Completion Date:	11/10/2016	Baffinland Iron Mines

BS-1

BH16-R032



0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BS-2

BH16-R032

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

Sample Photographs

Borehole Name:	BH16-R033	Mary River 12 MTPA Mine Expansion
Location:	17 W 526653 7935439	Pre-feasibility Study
Completion Date:	11/10/2016	Baffinland Iron Mines

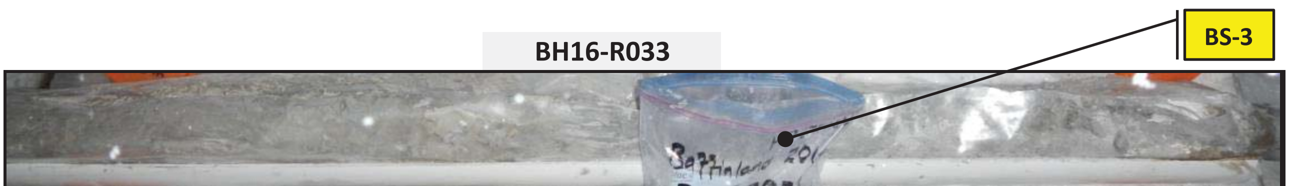
BH16-R033

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R033

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R033

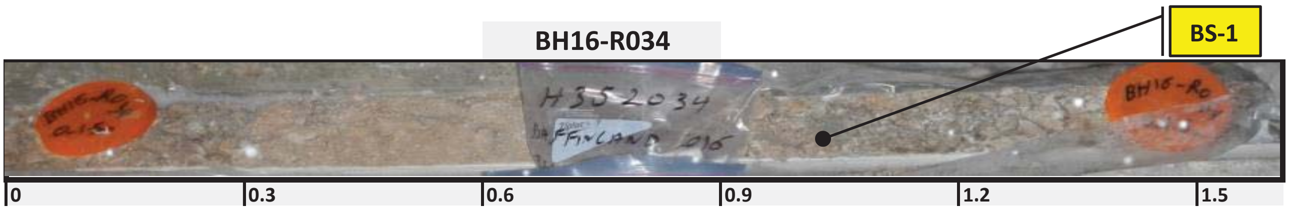


3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

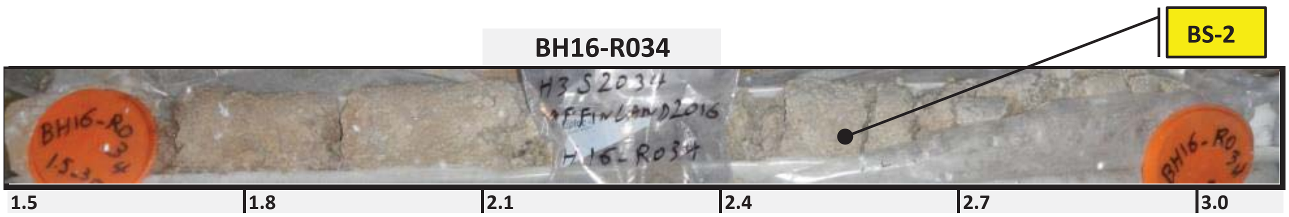
Sample Photographs

Borehole Name:	BH16-R034	Mary River 12 MTPA Mine Expansion
Location:	17 W 527056 7933500	Pre-feasibility Study
Completion Date:	12/10/2016	Baffinland Iron Mines

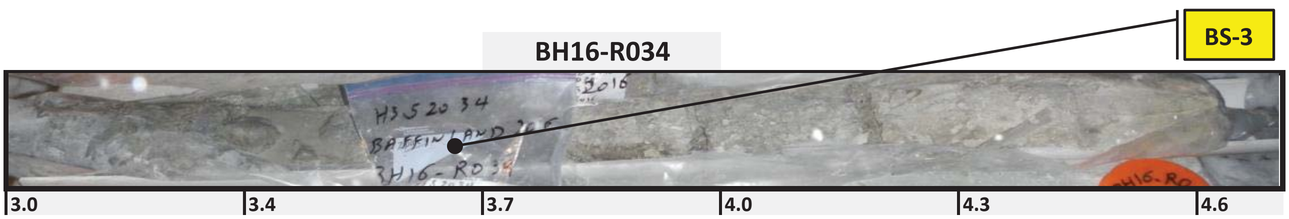
BH16-R034



BH16-R034



BH16-R034



Sample Photographs

Borehole Name:	BH16-R035	Mary River 12 MTPA Mine Expansion
Location:	17 W 527423 7932310	Pre-feasibility Study
Completion Date:	12/10/2016	Baffinland Iron Mines

HATCH

	Sample Photographs
Borehole Name: BH16-R036	Mary River 12 MTPA Mine Expansion
Location: 17 W 527210 7931660	Pre-feasibility Study
Completion Date: 12/10/2016	Baffinland Iron Mines

BH16-R036

BS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R036

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R036

BS-2

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

Sample Photographs

Borehole Name:	BH16-R037	Mary River 12 MTPA Mine Expansion
Location:	17 W 527873 7929786	Pre-feasibility Study
Completion Date:	12/10/2016	Baffinland Iron Mines

BH16-R037

BS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R037

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R037

BS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

HATCH

Sample Photographs

Borehole Name:	BH16-R038	Mary River 12 MTPA Mine Expansion
Location:	17 W 528501 7928421	Pre-feasibility Study
Completion Date:	12/10/2016	Baffinland Iron Mines

BH16-R038

BS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R038

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R038

BS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

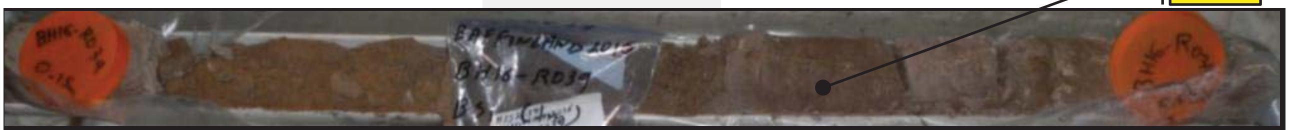
HATCH

Sample Photographs

Borehole Name:	BH16-R039	Mary River 12 MTPA Mine Expansion
Location:	17 W 528666 7927955	Pre-feasibility Study
Completion Date:	12/10/2016	Baffinland Iron Mines

BH16-R039

BS-1



0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

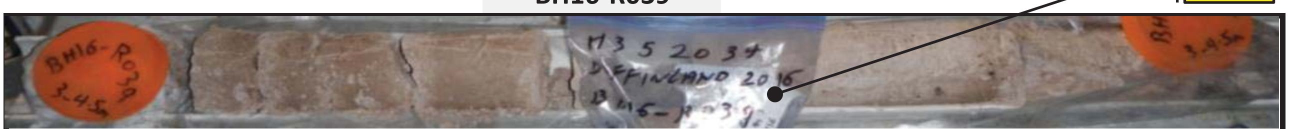
BH16-R039

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R039

BS-3



3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

Sample Photographs

Borehole Name:	BH16-R040	Mary River 12 MTPA Mine Expansion
Location:	17 W 528686 7927755	Pre-feasibility Study
Completion Date:	13/10/2016	Baffinland Iron Mines

BH16-R040

BH16-R040

BH16-R040

HATCH

Sample Photographs

Borehole Name:	BH16-R041	Mary River 12 MTPA Mine Expansion
Location:	17 W 528605 7927754	Pre-feasibility Study
Completion Date:	14/10/2016	Baffinland Iron Mines

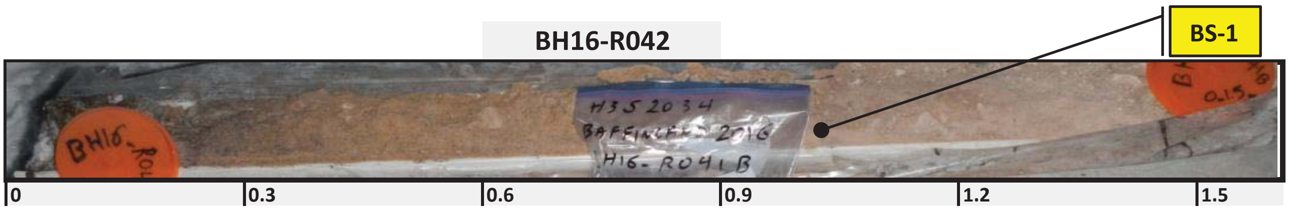
BH16-R041

0	0.3	0.6	0.9	1.2	1.5

Sample Photographs

Borehole Name:	BH16-R042	Mary River 12 MTPA Mine Expansion
Location:	17 W 528517 7927713	Pre-feasibility Study
Completion Date:	14/10/2016	Baffinland Iron Mines

BH16-R042



BH16-R042

BH16-R042

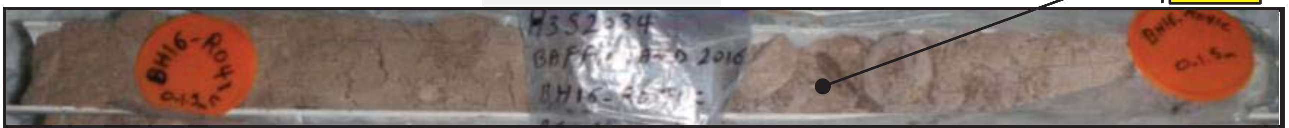
HATCH

Sample Photographs

Borehole Name:	BH16-R043	Mary River 12 MTPA Mine Expansion
Location:	17 W 528428 7927675	Pre-feasibility Study
Completion Date:	13/10/2016	Baffinland Iron Mines

BH16-R043

BS-1



0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

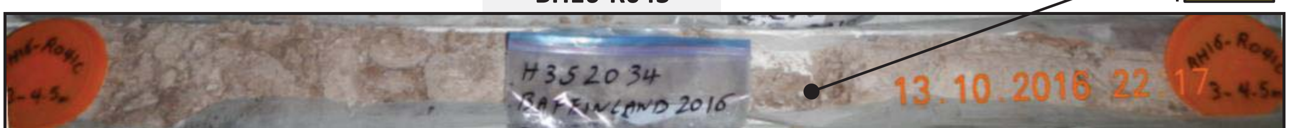
BH16-R043

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R043

BS-3



3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH16-R043

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH16-R043

BS-4

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BH16-R043

BS-5

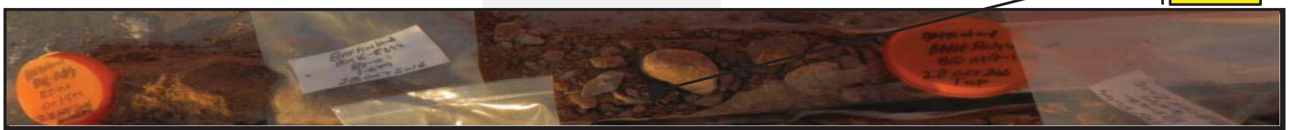
7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

Sample Photographs

Borehole Name:	BH16-R044	Mary River 12 MTPA Mine Expansion
Location:	17 W 528736 7926992	Pre-feasibility Study
Completion Date:	28/10/2016	Baffinland Iron Mines

BH16-R044

BS-1



0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R044

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R044

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

HATCH

Sample Photographs

Borehole Name:	BH16-R045	Mary River 12 MTPA Mine Expansion
Location:	17 W 528961 7926756	Pre-feasibility Study
Completion Date:	28/10/2016	Baffinland Iron Mines

BS-1

BH16-R045

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R045

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R045

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

		Sample Photographs
Borehole Name:	BH16-R053	Mary River 12 MTPA Mine Expansion
Location:	17 W 528238 7928027	Pre-feasibility Study
Completion Date:	28/10/2016	Baffinland Iron Mines

BH16-R053

BS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R053

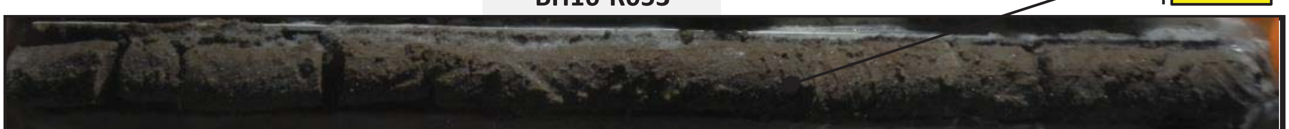
1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R053

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH16-R053

BS-2



4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

HATCH

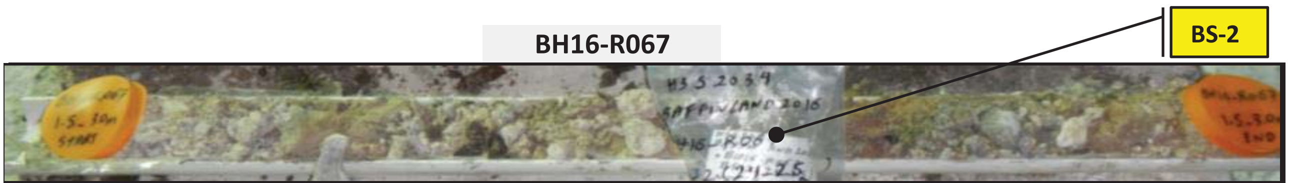
Sample Photographs

Borehole Name:	BH16-R067	Mary River 12 MTPA Mine Expansion
Location:	17 W 535406 7918572	Pre-feasibility Study
Completion Date:	24/11/2016	Baffinland Iron Mines

BH16-R067

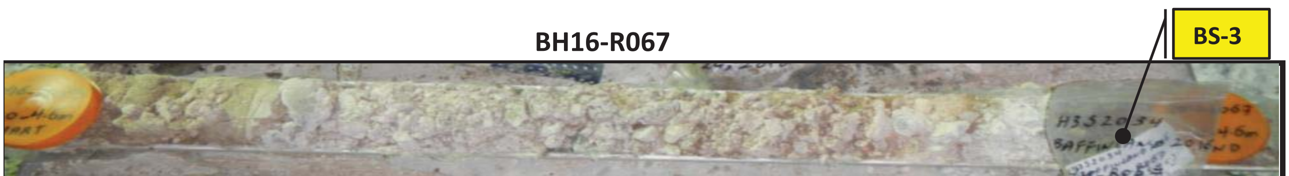
0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R067



1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R067



3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

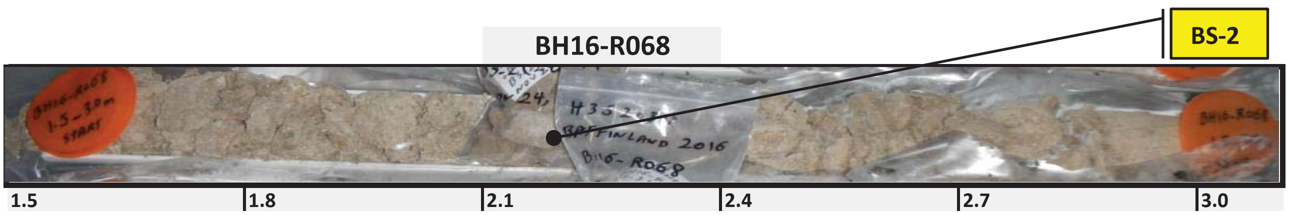
HATCH

Sample Photographs

Borehole Name:	BH16-R068	Mary River 12 MTPA Mine Expansion
Location:	17 W 537046 7919096	Pre-feasibility Study
Completion Date:	24/11/2016	Baffinland Iron Mines

BH16-R068

BH16-R068



BH16-R068

Sample Photographs

Borehole Name:	BH16-R069	Mary River 12 MTPA Mine Expansion
Location:	17 W 539489 7920583	Pre-feasibility Study
Completion Date:	23/11/2016	Baffinland Iron Mines

BH16-R069

BS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R069

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R069

BS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

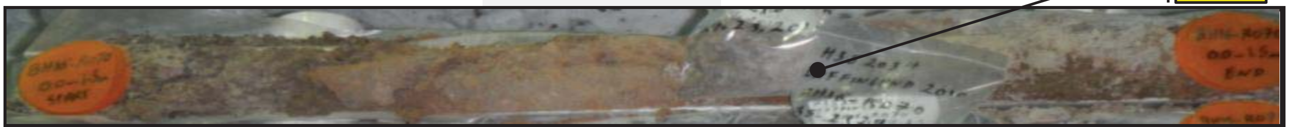
HATCH

Sample Photographs

Borehole Name:	BH16-R070	Mary River 12 MTPA Mine Expansion
Location:	17 W 540273 7921201	Pre-feasibility Study
Completion Date:	23/11/2016	Baffinland Iron Mines

BH16-R070

BS-1



0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH16-R070

BS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH16-R070

BS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

HATCH

Sample Photographs

Borehole Name:	BH17-B001	Mary River Expansion Study Stage 2
Location:	17 W 529031 7916747	2017 Geotechnical Investigation
Completion Date:	April 22, 2017	Baffinland Iron Mines

BH17-B001

DS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH17-B001

DS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH17-B001

DS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

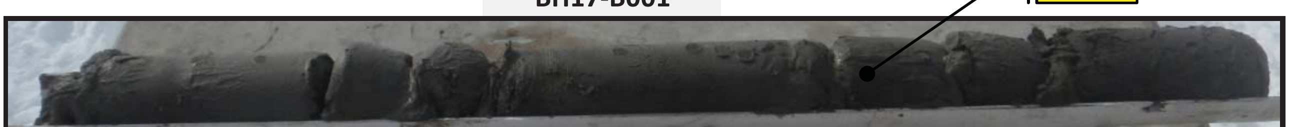
BH17-B001

DS-4

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH17-B001

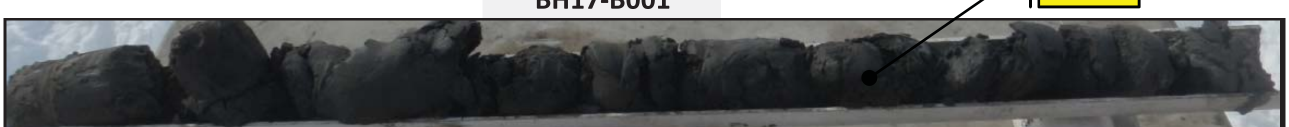
DS-5



6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BH17-B001

DS-6



7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

HATCH

Sample Photographs

Borehole Name:	BH17-B001	Mary River Expansion Study Stage 2
Location:	17 W 529031 7916747	
Completion Date:	April 22, 2017	Baffinland Iron Mines

DS-7

BH17-B001

9.1 | 9.4 | 9.8 | 10.1 | 10.4 | 10.7

BH17-B001

DS-8

10.7 | 11.0 | 11.3 | 11.6 | 11.9 | 12.2

BH17-B001

DS-9

12.2 | 12.5 | 12.8 | 13.1 | 13.4 | 13.7

DS-10

BH17-B001

13.7 | 14.0 | 14.3 | 14.6 | 14.9 | 15.2

DS-11

BH17-B001

15.2 | 15.5 | 15.8 | 16.2 | 16.5 | 16.8

Sample Photographs

Borehole Name:	BH17-B002	Mary River Expansion Study Stage 2
Location:	17 W 529323 7916577	2017 Geotechnical Investigation
Completion Date:	April 21, 2017	Baffinland Iron Mines

DS-1

BH17-B002

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

DS-2

BH17-B002

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

DS-3

BH17-B002

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

DS-4

BH17-B002

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

DS-5

BH17-B002

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

DS-6

BH17-B002

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

Sample Photographs

Borehole Name:	BH17-B002		Mary River Expansion Study Stage 2
Location:	17 W 529323 7916577		
Completion Date:	April 21, 2017		Baffinland Iron Mines

DS-7

BH17-B002

9.1	9.4	9.8	10.1	10.4	10.7

DS-8

BH17-B002

10.7	11.0	11.3	11.6	11.9	12.2

DS-9

BH17-B002

12.2	12.5	12.8	13.1	13.4	13.7

DS-10

BH17-B002

13.7	14.0	14.3	14.6	14.9	15.2

DS-11

BH17-B002

15.2	15.5	15.8	16.2	16.5	16.8

Sample Photographs

Borehole Name:	BH17-B002	Mary River Expansion Study Stage 2
Location:	17 W 529323 7916577	
Completion Date:	April 21, 2017	Baffinland Iron Mines

DS-12

BH17-B002

16.8 | 17.1 | 17.4 | 17.7 | 18.0 | 18.3

DS-13

BH17-B002

18.3 | 18.6 | 18.9 | 19.2 | 19.5 | 19.8

DS-14

BH17-B002

19.8 | 20.1 | 20.4 | 20.7 | 21.0 | 21.3

BH17-B002

DS-15

21.3 | 21.6 | 21.9 | 22.3 | 22.6 | 22.9

DS-16

BH17-B002

22.9 | 23.2 | 23.5 | 23.8 | 24.1 | 24.4

HATCH

Sample Photographs

Borehole Name:	BH17-B002	Mary River Expansion Study Stage 2
Location:	17 W 529323 7916577	
Completion Date:	April 21, 2017	Baffinland Iron Mines

BH17-B002

DRILL BIT LOST; NO SAMPLE COLLECTED. END OF HOLE AT 25.6 M

24.4	24.7	25.0	25.3	25.6	25.9

HATCH

Sample Photographs

Borehole Name:	BH17-C001	Mary River Expansion Study Stage 2
Location:	17 W 509861 7967883	2017 Geotechnical Investigation
Completion Date:	April 13, 2017	Baffinland Iron Mines

BH17-C001

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH17-C001

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH17-C001

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH17-C001

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH17-C001

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BH17-C001

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

Sample Photographs

Borehole Name:	BH17-C002	Mary River Expansion Study Stage 2
Location:	17 W 519513 7957644	2017 Geotechnical Investigation
Completion Date:	April 14, 2017	Baffinland Iron Mines

DS-1

BH17-C002

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

DS-2

BH17-C002

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

DS-3

BH17-C002

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

DS-4

BH17-C002

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

DS-5

BH17-C002

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

DS-6

BH17-C002

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

Sample Photographs

Borehole Name:	BH17-C002	Mary River Expansion Study Stage 2
Location:	17 W 519513 7957644	
Completion Date:	April 14, 2017	Baffinland Iron Mines

BH17-C002

Sample Photographs

Borehole Name:	BH17-C003	Mary River Expansion Study Stage 2
Location:	17 W 520091 7957302	2017 Geotechnical Investigation
Completion Date:	April 14, 2017	Baffinland Iron Mines

HATCH

Sample Photographs

Borehole Name:	BH17-C004	Mary River Expansion Study Stage 2
Location:	17 W 520484 7956357	2017 Geotechnical Investigation
Completion Date:	April 14, 2017	Baffinland Iron Mines

DS-1

BH17-C004

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH17-C004

DS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

DS-3

BH17-C004

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

DS-4

BH17-C004

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH17-C004

DS-5

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

DS-6

BH17-C004

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

Sample Photographs

Borehole Name:	BH17-C004	Mary River Expansion Study Stage 2
Location:	17 W 520484 7956357	
Completion Date:	April 14, 2017	Baffinland Iron Mines

DS-7

BH17-C004

9.1 | 9.4 | 9.8 | 10.1 | 10.4 | 10.7

Sample Photographs

Borehole Name:	BH17-C005	Mary River Expansion Study Stage 2
Location:	17 W 525227 7938527	2017 Geotechnical Investigation
Completion Date:	April 14, 2017	Baffinland Iron Mines

DS-1

BH17-C005

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

DS-2

BH17-C005

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

DS-3

BH17-C005

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

DS-4

BH17-C005

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

DS-5

BH17-C005

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

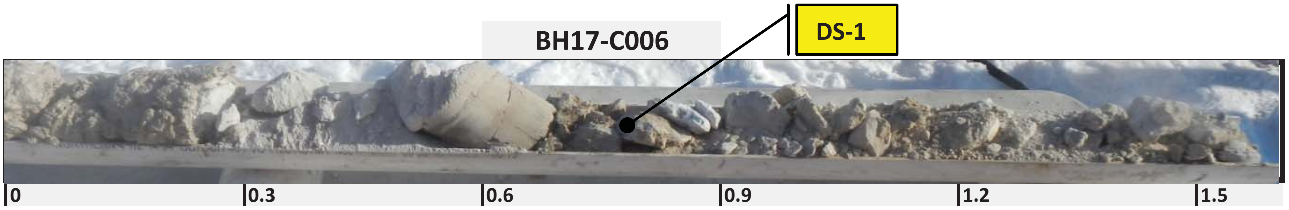
DS-6

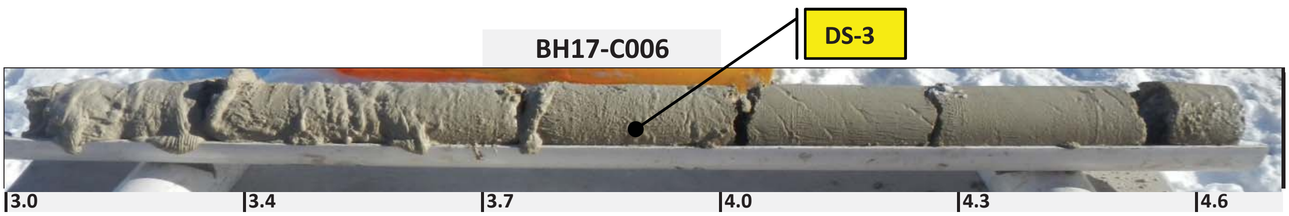
BH17-C005

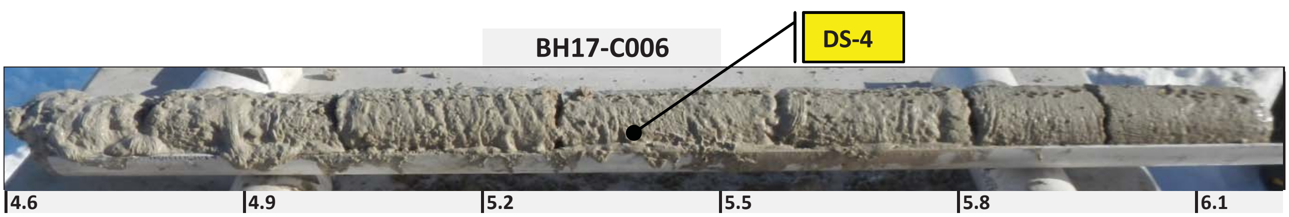
7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

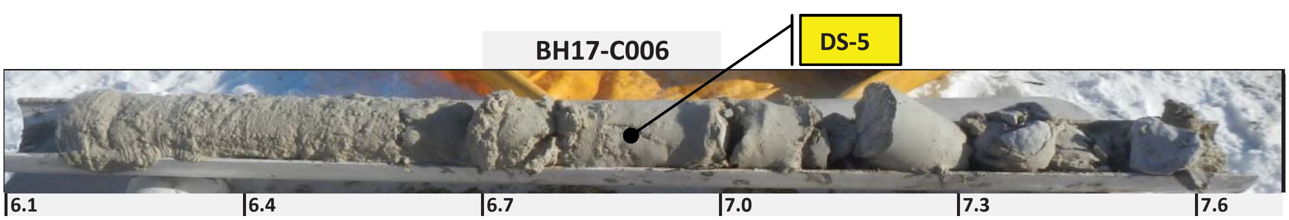
Sample Photographs

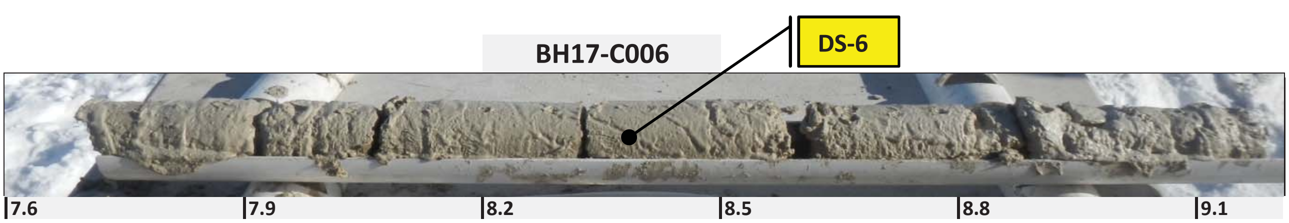
Borehole Name:	BH17-C006	Mary River Expansion Study Stage 2
Location:	17 W 527370 7932609	2017 Geotechnical Investigation
Completion Date:	April 15, 2017	Baffinland Iron Mines











HATCH

Sample Photographs

Borehole Name:	BH17-C006	Mary River Expansion Study Stage 2
Location:	17 W 527370 7932609	
Completion Date:	April 15, 2017	Baffinland Iron Mines

BH17-C006

9.1	9.4	9.8	10.1	10.4	10.7

HATCH

Sample Photographs

Borehole Name:	BH17-C006B	Mary River Expansion Study Stage 2
Location:	17 W 528253 7929081	2017 Geotechnical Investigation
Completion Date:	April 16, 2017	Baffinland Iron Mines

BH17-C006B

DS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH17-C006B

DS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH17-C006B

DS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH17-C006B

DS-4

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

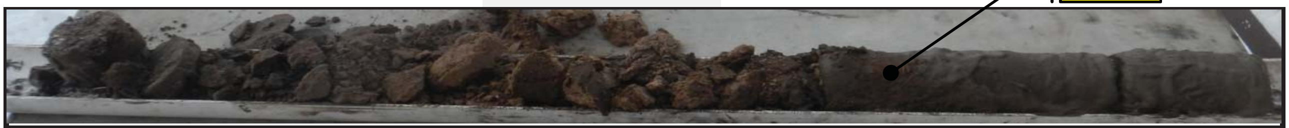
HATCH

Sample Photographs

Borehole Name:	BH17-C007	Mary River Expansion Study Stage 2
Location:	17 W 528564 7917138	2017 Geotechnical Investigation
Completion Date:	April 22, 2017	Baffinland Iron Mines

DS-1

BH17-C007



0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

DS-2

BH17-C007

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

DS-3

BH17-C007

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

HATCH

Sample Photographs

Borehole Name:	BH17-C010	Mary River Expansion Study Stage 2
Location:	17 W 529961 7916702	2017 Geotechnical Investigation
Completion Date:	April 19, 2017	Baffinland Iron Mines

BH17-C010

DS-1

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH17-C010

DS-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH17-C010

DS-3

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

HATCH

Sample Photographs

Borehole Name:	BH17-C011	Mary River Expansion Study Stage 2
Location:	17 W 532072 7917478	2017 Geotechnical Investigation
Completion Date:	April 19, 2017	Baffinland Iron Mines

DS-1

BH17-C011

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

DS-2

BH17-C011

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

DS-3

BH17-C011

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

HATCH

Sample Photographs

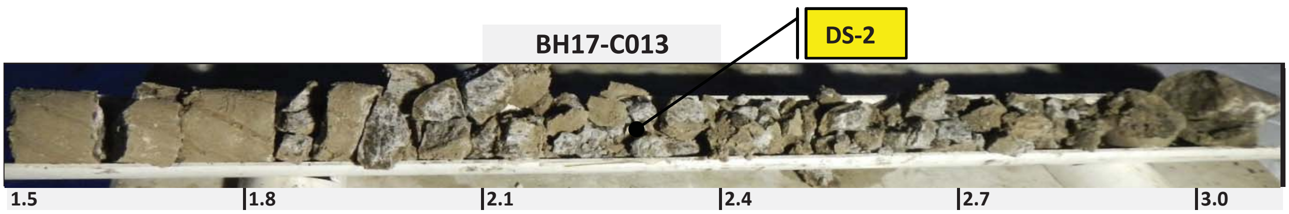
Borehole Name:	BH17-C012	Mary River Expansion Study Stage 2
Location:	17 W 533228 7918553	2017 Geotechnical Investigation
Completion Date:	April 19, 2017	Baffinland Iron Mines

Sample Photographs

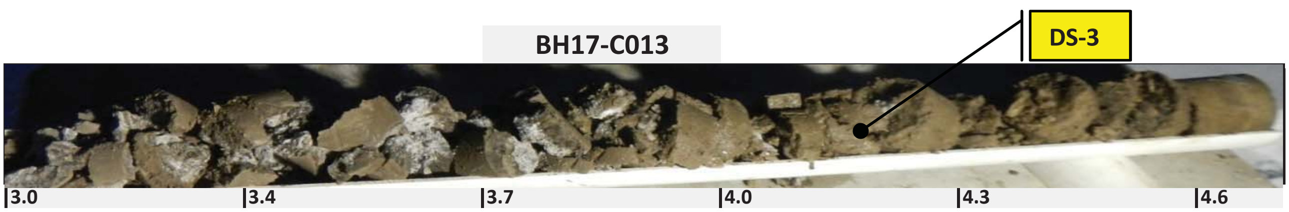
Borehole Name:	BH17-C013	Mary River Expansion Study Stage 2
Location:	17 W 534196 7918569	2017 Geotechnical Investigation
Completion Date:	April 18, 2017	Baffinland Iron Mines

BH17-C013

BH17-C013



BH17-C013



Sample Photographs

Borehole Name:	BH17-BR86-1	Mary River Expansion Study Stage 2
Location:	17 W 542257 7922182	2017 Geotechnical Investigation
Completion Date:	October 3, 2017	Baffinland Iron Mines

Sample Photographs

Borehole Name:	BH17-BR86-1	Mary River Expansion Study Stage 2
Location:	17 W 542257 7922182	
Completion Date:	October 3, 2017	Baffinland Iron Mines

BH17-BR86-1

9.1 | 9.4 | 9.8 | 10.1 | 10.4 | 10.7

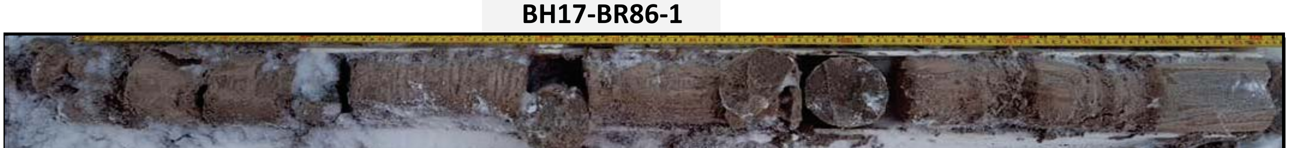
BH17-BR86-1

10.7 | 11.0 | 11.3 | 11.6 | 11.9 | 12.2

BH17-BR86-1

12.2 | 12.5 | 12.8 | 13.1 | 13.4 | 13.7

BH17-BR86-1



13.7 | 14.0 | 14.3 | 14.6 | 14.9 | 15.2

BH17-BR86-1

15.2 | 15.5 | 15.8 | 16.2 | 16.5 | 16.8

BH17-BR86-1

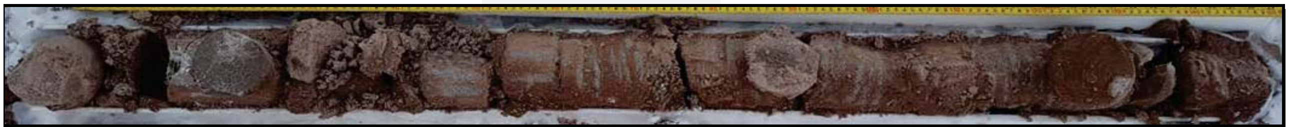
16.8 | 17.1 | 17.4 | 17.7 | 18.0 | 18.3

HATCH

Sample Photographs

Borehole Name:	BH17-BR86-1	Mary River Expansion Study Stage 2
Location:	17 W 542257 7922182	
Completion Date:	October 3, 2017	Baffinland Iron Mines

BH17-BR86-1



18.3 18.6 18.9 19.2 19.5 19.8

DQ-8

BH17-BR86-1

19.8 20.1 20.4 20.7 21.0 21.3

BH17-BR86-1

21.3 21.6 21.9 22.3 22.6 22.9

BH17-BR86-1

22.9 23.2 23.5 23.8 24.1 24.4

DQ-9

BH17-BR86-1

24.4 24.7 25.0 25.3 25.6 25.9

BH17-BR86-1

25.9 26.2 26.5 26.8 27.1 27.4

Sample Photographs

Borehole Name:	BH17-BR86-1	Mary River Expansion Study Stage 2
Location:	17 W 542257 7922182	
Completion Date:	October 3, 2017	Baffinland Iron Mines

BH17-BR86-1

27.4 27.7 28.0 28.3 28.7 29.0

DQ-10

BH17-BR86-1

29.0 29.3 29.6 29.9 30.2 30.5

DQ-11

BH17-BR86-1

30.5 30.8 31.1 31.4 31.7 32.0

BH17-BR86-1

32.0 32.3 32.6 32.9 33.2 33.5

BH17-BR86-1

33.5 33.8 34.1 34.4 34.7 35.1

DQ-12

BH17-BR86-1

35.1 35.4 35.7 36.0 36.3 36.6

Sample Photographs

Borehole Name:	BH17-BR86-1	Mary River Expansion Study Stage 2
Location:	17 W 542257 7922182	
Completion Date:	October 3, 2017	Baffinland Iron Mines

BH17-BR86-1

36.6 36.9 37.2 37.5 37.8 38.1

BH17-BR86-1

DQ-13

38.1 38.4 38.7 39.0 39.3 39.6

Sample Photographs

Borehole Name:	BH17-BR86-2	Mary River Expansion Study Stage 2
Location:	17 W 542269 7922171	2017 Geotechnical Investigation
Completion Date:	October 26, 2017	Baffinland Iron Mines

BH17-BR86-2

BH17-BR86-2

BH17-BR86-2

BH17-BR86-2

BH17-BR86-2

BH17-BR86-2

Sample Photographs

Borehole Name:	BH17-BR86-2	Mary River Expansion Study Stage 2
Location:	17 W 542269 7922171	
Completion Date:	October 26, 2017	Baffinland Iron Mines

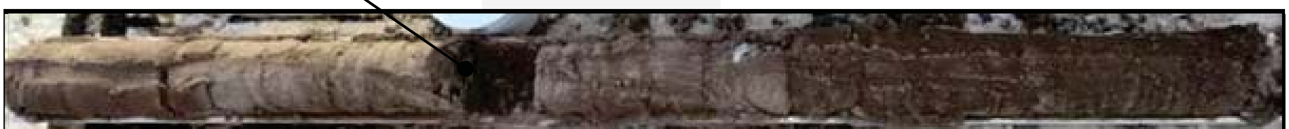
DQ-5

BH17-BR86-2

9.1 | 9.4 | 9.8 | 10.1 | 10.4 | 10.7

DQ-6

BH17-BR86-2



10.7 | 11.0 | 11.3 | 11.6 | 11.9 | 12.2

BH17-BR86-2

12.2 | 12.5 | 12.8 | 13.1 | 13.4 | 13.7

BH17-BR86-2

13.7 | 14.0 | 14.3 | 14.6 | 14.9 | 15.2

BH17-BR86-2

15.2 | 15.5 | 15.8 | 16.2 | 16.5 | 16.8

BH17-BR86-2

16.8 | 17.1 | 17.4 | 17.7 | 18.0 | 18.3

HATCH

Sample Photographs

Borehole Name:	BH17-BR86-2	Mary River Expansion Study Stage 2
Location:	17 W 542269 7922171	
Completion Date:	October 26, 2017	Baffinland Iron Mines

BH17-BR86-2

18.3 18.6 18.9 19.2 19.5 19.8

DQ-7

BH17-BR86-2

19.8 20.1 20.4 20.7 21.0 21.3

BH17-BR86-2

21.3 21.6 21.9 22.3 22.6 22.9

DQ-8

BH17-BR86-2

22.9 23.2 23.5 23.8 24.1 24.4

BH17-BR86-2

24.4 24.7 25.0 25.3 25.6 25.9

BH17-BR86-2

25.9 26.2 26.5 26.8 27.1 27.4

HATCH

Sample Photographs

Borehole Name:	BH17-BR86-2	Mary River Expansion Study Stage 2
Location:	17 W 542269 7922171	
Completion Date:	October 26, 2017	Baffinland Iron Mines

BH17-BR86-2

27.4 | 27.7 | 28.0 | 28.3 | 28.7 | 29.0

DQ-9

BH17-BR86-2

29.0 | 29.3 | 29.6 | 29.9 | 30.2 | 30.5

BH17-BR86-2

30.5 | 30.8 | 31.1 | 31.4 | 31.7 | 32.0

DQ-10

BH17-BR86-2

32.0 | 32.3 | 32.6 | 32.9 | 33.2 | 33.5

BH17-BR86-2

33.5 | 33.8 | 34.1 | 34.4 | 34.7 | 35.1

DQ-11

BH17-BR86-2

35.1 | 35.4 | 35.7 | 36.0 | 36.3 | 36.6

HATCH

Sample Photographs

Borehole Name:	BH17-BR86-2	Mary River Expansion Study Stage 2
Location:	17 W 542269 7922171	
Completion Date:	October 26, 2017	Baffinland Iron Mines

BH17-BR86-2

DQ-12

36.6 | 36.9 | 37.2 | 37.5 | 37.8 | 38.1

BH17-BR86-2

DQ-13

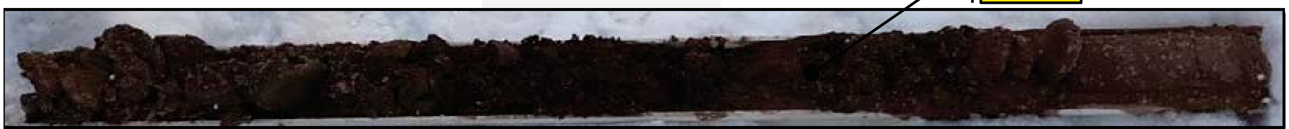
38.1 | 38.4 | 38.7 | 39.0 | 39.3 | 39.6

HATCH

Sample Photographs

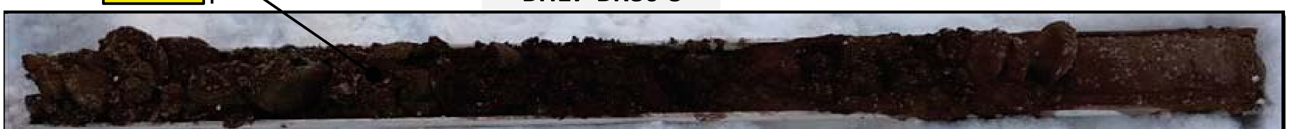
Borehole Name:	BH17-BR86-3	Mary River Expansion Study Stage 2
Location:	17 W 542305 7922141	2017 Geotechnical Investigation
Completion Date:		Baffinland Iron Mines

BH17-BR86-3



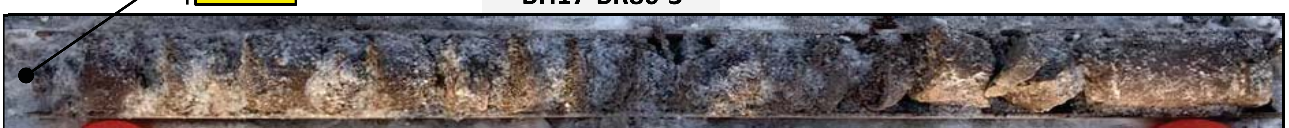
0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH17-BR86-3



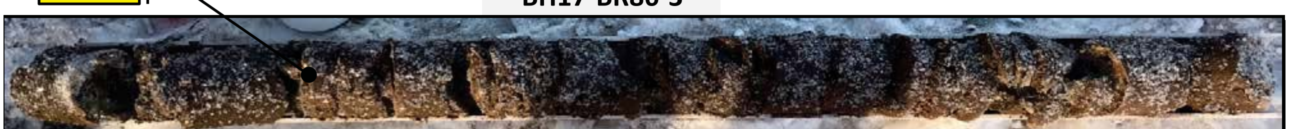
1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH17-BR86-3



3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH17-BR86-3



4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH17-BR86-3

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BH17-BR86-3

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

HATCH

Sample Photographs

Borehole Name:	BH17-BR86-3	Mary River Expansion Study Stage 2
Location:	17 W 542305 7922141	
Completion Date:		Baffinland Iron Mines

BH17-BR86-3

9.1 | 9.4 | 9.8 | 10.1 | 10.4 | 10.7

BH17-BR86-3

10.7 | 11.0 | 11.3 | 11.6 | 11.9 | 12.2

BH17-BR86-3

12.2 | 12.5 | 12.8 | 13.1 | 13.4 | 13.7

BH17-BR86-3

13.7 | 14.0 | 14.3 | 14.6 | 14.9 | 15.2

BH17-BR86-3

15.2 | 15.5 | 15.8 | 16.2 | 16.5 | 16.8

BH17-BR86-3

16.8 | 17.1 | 17.4 | 17.7 | 18.0 | 18.3

HATCH

Sample Photographs

Borehole Name:	BH17-BR86-3	Mary River Expansion Study Stage 2
Location:	17 W 542305 7922141	
Completion Date:		Baffinland Iron Mines

BH17-BR86-3

18.3 18.6 18.9 19.2 19.5 19.8

BH17-BR86-3

DQ-7

19.8 20.1 20.4 20.7 21.0 21.3

BH17-BR86-3

21.3 21.6 21.9 22.3 22.6 22.9

BH17-BR86-3

22.9 23.2 23.5 23.8 24.1 24.4

BH17-BR86-3

24.4 24.7 25.0 25.3 25.6 25.9

BH17-BR86-3

25.9 26.2 26.5 26.8 27.1 27.4

HATCH

Sample Photographs

Borehole Name:	BH17-BR86-3	Mary River Expansion Study Stage 2
Location:	17 W 542305 7922141	
Completion Date:		Baffinland Iron Mines

BH17-BR86-3

27.4 | 27.7 | 28.0 | 28.3 | 28.7 | 29.0

BH17-BR86-3

29.0 | 29.3 | 29.6 | 29.9 | 30.2 | 30.5

BH17-BR86-3

30.5 | 30.8 | 31.1 | 31.4 | 31.7 | 32.0

BH17-BR86-3

32.0 | 32.3 | 32.6 | 32.9 | 33.2 | 33.5

BH17-BR86-3

33.5 | 33.8 | 34.1 | 34.4 | 34.7 | 35.1

BH17-BR86-3

35.1 | 35.4 | 35.7 | 36.0 | 36.3 | 36.6

Sample Photographs

Borehole Name:	BH17-BR86-3	Mary River Expansion Study Stage 2
Location:	17 W 542305 7922141	
Completion Date:		Baffinland Iron Mines

BH17-BR86-3

36.6	36.9	37.2	37.5	37.8	38.1

BH17-BR86-3

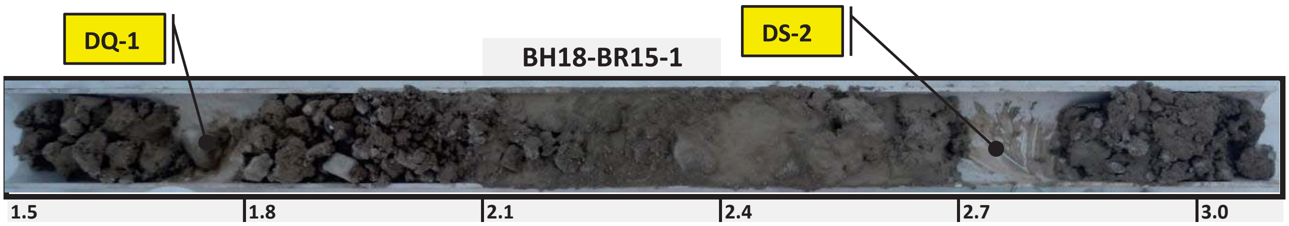
38.1	38.4	38.7	39.0	39.3	39.6

Sample Photographs

Borehole Name:	BH18-BR15-1	Mary River Expansion Study Stage 2
Location:	17 W 514260 7965610	2018 Geotechnical Investigation
Completion Date:	March 14, 2018	Baffinland Iron Mines

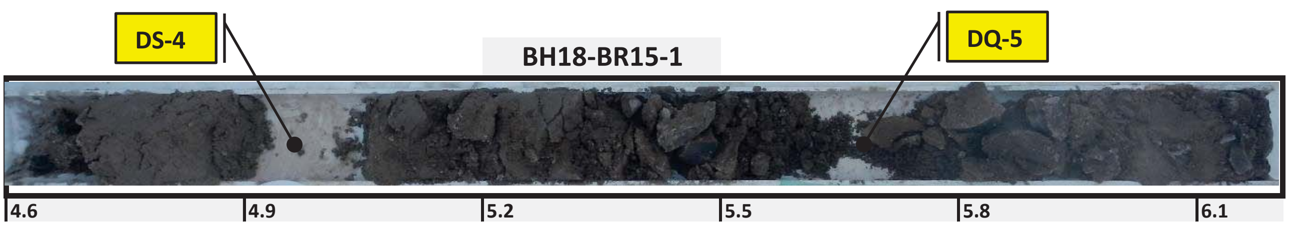
BH18-BR15-1

BH18-BR15-1



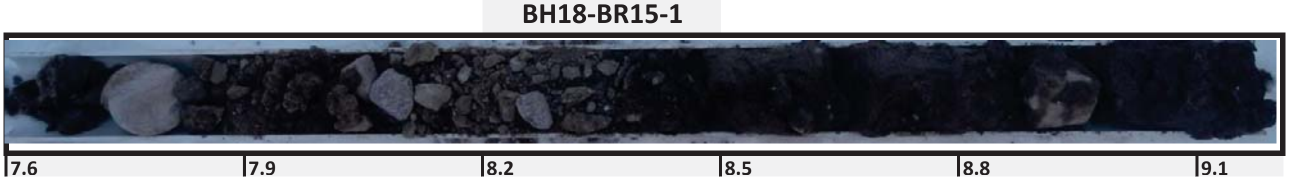
BH18-BR15-1

BH18-BR15-1



BH18-BR15-1

BH18-BR15-1



HATCH

Sample Photographs

Borehole Name:	BH18-BR15-1	Mary River Expansion Study Stage 2
Location:	17 W 514260 7965610	
Completion Date:	March 14, 2018	Baffinland Iron Mines

BH18-BR15-1

9.1 | 9.4 | 9.8 | 10.1 | 10.4 | 10.7

BH18-BR15-1

10.7 | 10.8 | 10.9 | 10.9 | 11.0 | 11.1

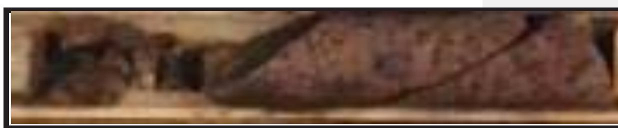
BH18-BR15-1

11.1 | 11.4 | 11.7 | 12.0 | 12.3 | 12.6

BH18-BR15-1

12.6 | 13.0 | 13.3 | 13.6 | 13.9 | 14.2

BH18-BR15-1



14.2 | 14.2 | 14.3

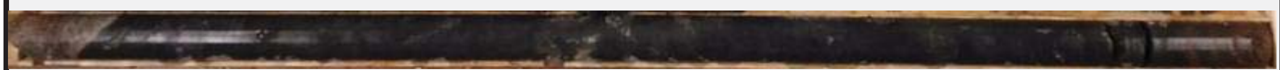
BH18-BR15-1

14.3 | 14.6 | 14.9 | 15.2 | 15.5 | 15.8

Sample Photographs

Borehole Name:	BH18-BR15-1	Mary River Expansion Study Stage 2
Location:	17 W 514260 7965610	
Completion Date:	March 14, 2018	Baffinland Iron Mines

BH18-BR15-1



15.8	16.1	16.4	16.7	17.0	17.3

HATCH

Sample Photographs

Borehole Name:	BH18-BR15-2	Mary River Expansion Study Stage 2
Location:	17 W 514211 7965645	2018 Geotechnical Investigation
Completion Date:	March 12, 2018	Baffinland Iron Mines

BH18-BR15-2

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH18-BR15-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH18-BR15-2

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH18-BR15-2

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH18-BR15-2

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BH18-BR15-2

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

HATCH

Sample Photographs

Borehole Name:	BH18-BR15-2	Mary River Expansion Study Stage 2
Location:	17 W 514211 7965645	
Completion Date:	March 12, 2018	Baffinland Iron Mines

DS-10

BH18-BR15-2

9.1 | 9.4 | 9.8 | 10.1 | 10.4 | 10.7

BH18-BR15-2

10.7 | 11.0 | 11.3 | 11.6 | 11.9 | 12.2

BH18-BR15-2

12.2 | 12.5 | 12.8 | 13.1 | 13.4 | 13.7

BH18-BR15-2

13.7 | 14.0 | 14.3 | 14.6 | 14.9 | 15.2

BH18-BR15-2

15.2 | 15.5 | 15.8 | 16.2 | 16.5 | 16.8

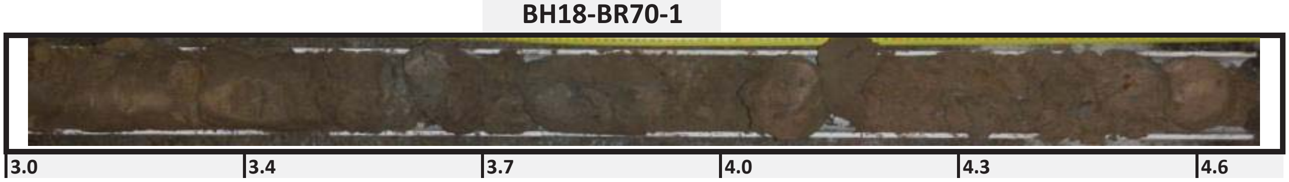
Sample Photographs

Borehole Name:	BH18-BR70-1	Mary River Expansion Study Stage 2
Location:	17 W 529138 7916667	2018 Geotechnical Investigation
Completion Date:	April 16, 2018	Baffinland Iron Mines

BH18-BR70-1

BH18-BR70-1

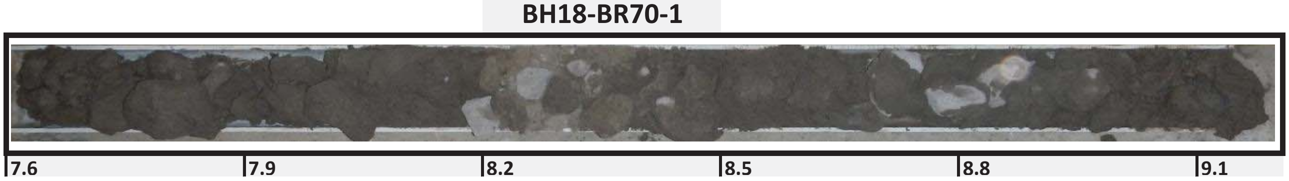
BH18-BR70-1



BH18-BR70-1

BH18-BR70-1

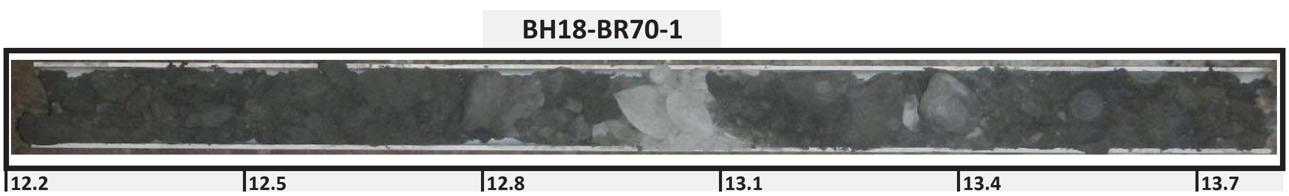
BH18-BR70-1

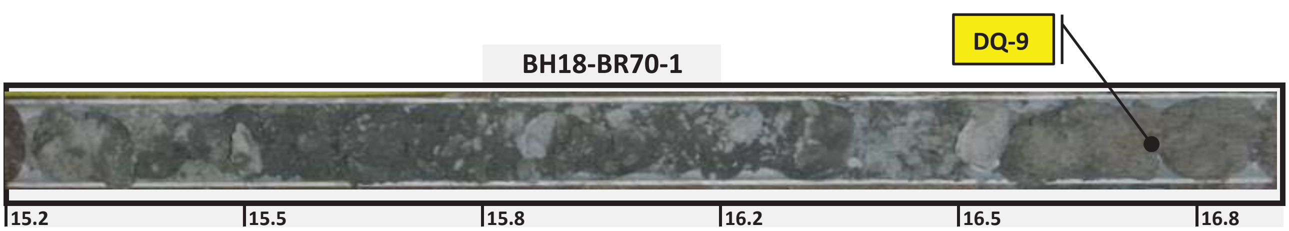


HATCH

Sample Photographs

Borehole Name:	BH18-BR70-1	Mary River Expansion Study Stage 2
Location:	17 W 529138 7916667	
Completion Date:	April 16, 2018	Baffinland Iron Mines





HATCH

Sample Photographs

Borehole Name:	BH18-BR70-1	Mary River Expansion Study Stage 2
Location:	17 W 529138 7916667	
Completion Date:	April 16, 2018	Baffinland Iron Mines

BH18-BR70-1

18.3 | 18.6 | 18.9 | 19.2 | 19.5 | 19.8

BH18-BR70-1

19.8 | 20.1 | 20.4 | 20.7 | 21.0 | 21.3

BH18-BR70-1

21.3 | 21.6 | 21.9 | 22.3 | 22.6 | 22.9

BH18-BR70-1

22.9 | 23.2 | 23.5 | 23.8 | 24.1 | 24.4

BH18-BR70-1

24.4 | 24.7 | 25.0 | 25.3 | 25.6 | 25.9

BH18-BR70-1

25.9 | 26.2 | 26.5 | 26.8 | 27.1 | 27.4

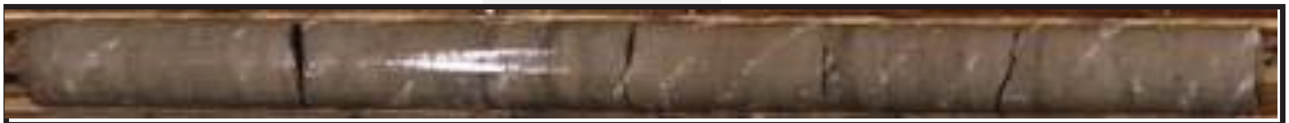
Sample Photographs

Borehole Name:	BH18-BR70-1	Mary River Expansion Study Stage 2
Location:	17 W 529138 7916667	
Completion Date:	April 16, 2018	Baffinland Iron Mines

BH18-BR70-1

27.4 27.7 27.9 28.1 28.3 28.6

BH18-BR70-1



28.6 28.8 28.9 29.1 29.3 29.5

BH18-BR70-1

29.5 29.8 30.1 30.4 30.7 31.0

BH18-BR70-1

31.0 31.3 31.6 31.9 32.2 32.5

Sample Photographs

Borehole Name:	BH18-BR70-2	Mary River Expansion Study Stage 2
Location:	17 W 529107 7916700	2018 Geotechnical Investigation
Completion Date:	April 18, 2018	Baffinland Iron Mines

DS-1 DQ-1

BH18-BR70-2

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

BH18-BR70-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

DS-2

BH18-BR70-2

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH18-BR70-2

4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH18-BR70-2

6.1 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6

BH18-BR70-2

7.6 | 7.9 | 8.2 | 8.5 | 8.8 | 9.1

Sample Photographs

Borehole Name:	BH18-BR70-2	Mary River Expansion Study Stage 2
Location:	17 W 529107 7916700	
Completion Date:	April 18, 2018	Baffinland Iron Mines

DQ-3

BH18-BR70-2

9.1 9.4 9.8 10.1 10.4 10.7

BH18-BR70-2

10.7 11.0 11.3 11.6 11.9 12.2

BH18-BR70-2

12.2 12.5 12.8 13.1 13.4 13.7

BH18-BR70-2

13.7 14.0 14.3 14.6 14.9 15.2

BH18-BR70-2

15.2 15.5 15.8 16.2 16.5 16.8

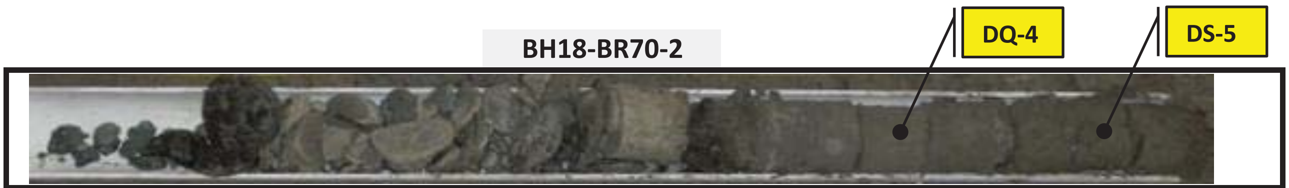
BH18-BR70-2

16.8 17.1 17.4 17.7 18.0 18.3

Sample Photographs

Borehole Name:	BH18-BR70-2	Mary River Expansion Study Stage 2
Location:	17 W 529107 7916700	
Completion Date:	April 18, 2018	Baffinland Iron Mines

BH18-BR70-2



18.3 | 18.6 | 18.9 | 19.2 | 19.5 | 19.8

BH18-BR70-2

19.8 | 20.1 | 20.4 | 20.7 | 21.0 | 21.3

BH18-BR70-2

21.3 | 21.5 | 21.6 | 21.8 | 21.9 | 22.1

BH18-BR70-2

22.1 | 22.5 | 22.9 | 23.3 | 23.7 | 24.0

BH18-BR70-2

24.0 | 24.4 | 24.7 | 25.0 | 25.3 | 25.6

BH18-BR70-2

25.6 | 25.9 | 26.2 | 26.5 | 26.8 | 27.1

Sample Photographs

Borehole Name:	BH18-BR70-2	Mary River Expansion Study Stage 2
Location:	17 W 529107 7916700	
Completion Date:	April 18, 2018	Baffinland Iron Mines

BH18-BR70-2

27.1	27.4	27.7	28.0	28.3	28.6

Sample Photographs

Borehole Name:	BH18-BR102-1		Mary River Expansion Study Stage 2
Location:	17 W 555763 7915435		2018 Geotechnical Investigation
Completion Date:	April 7, 2018		Baffinland Iron Mines

BH18-BR102-1

0	0.3	0.6	0.9	1.2	1.5

BH18-BR102-1

1.5	1.7	1.8	2.0		

BH18-BR102-1

2.0	2.3	2.6	2.9	3.2	3.5

BH18-BR102-1

3.5	3.8	4.1	4.4	4.7	5.0

BH18-BR102-1

5.0	5.3	5.6	5.9	6.2	6.6

BH18-BR102-1

6.6	6.9	7.2	7.5	7.8	8.1

Sample Photographs

Borehole Name:	BH18-BR102-1	Mary River Expansion Study Stage 2
Location:	17 W 555763 7915435	
Completion Date:	April 7, 2018	Baffinland Iron Mines

BH18-BR102-1

8.1 8.4 8.7 9.0 9.3 9.6

Sample Photographs

Borehole Name:	BH18-BR102-2	Mary River Expansion Study Stage 2
Location:	17 W 555674 7915443	2018 Geotechnical Investigation
Completion Date:	April 10, 2018	Baffinland Iron Mines

BH18-BR102-2

0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5

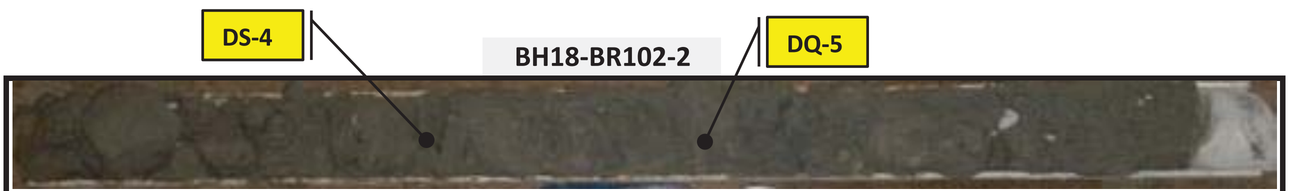
BH18-BR102-2

1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0

BH18-BR102-2

3.0 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6

BH18-BR102-2



4.6 | 4.9 | 5.2 | 5.5 | 5.8 | 6.1

BH18-BR102-2

6.1 | 6.5 | 6.9 | 7.3 | 7.7 | 8.1

BH18-BR102-2

8.1 | 8.4 | 8.7 | 9.0 | 9.3 | 9.6

Sample Photographs

Borehole Name:	BH18-BR102-2	Mary River Expansion Study Stage 2
Location:	17 W 555674 7915443	
Completion Date:	April 10, 2018	Baffinland Iron Mines

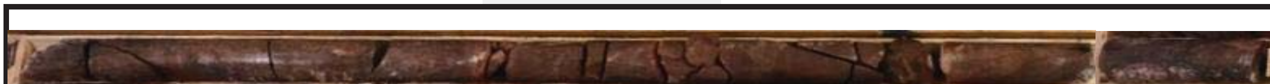
BH18-BR102-2

9.6 | 9.9 | 10.2 | 10.5 | 10.8 | 11.1

BH18-BR102-2

11.1 | 11.4 | 11.7 | 12.0 | 12.3 | 12.6

BH18-BR102-2



12.6 | 13.0 | 13.3 | 13.6 | 13.9 | 14.2

BH18-BR102-2

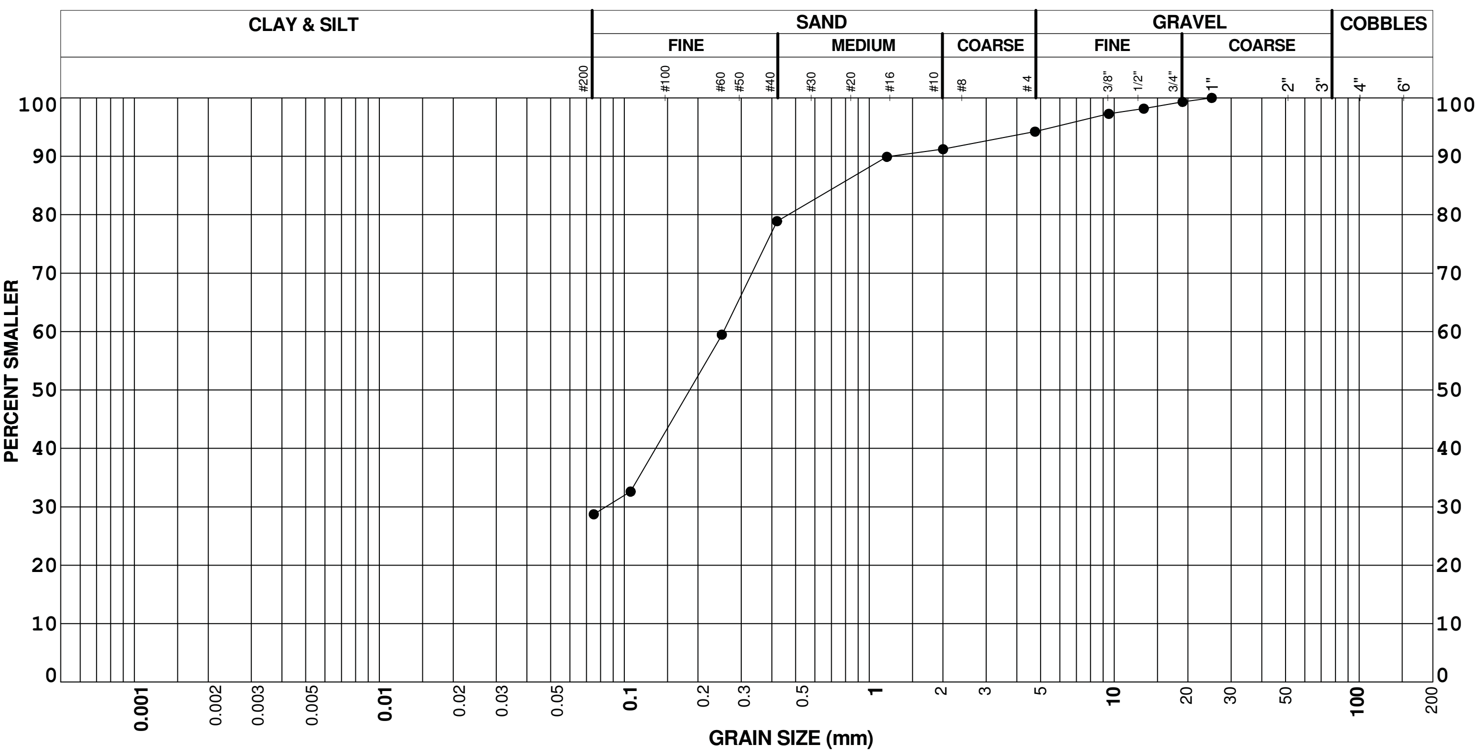
14.2 | 14.5 | 14.8 | 15.1 | 15.4 | 15.7

BH18-BR102-2

15.7 | 16.0 | 16.3 | 16.6 | 16.9 | 17.2

Appendix D
Laboratory Reports

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

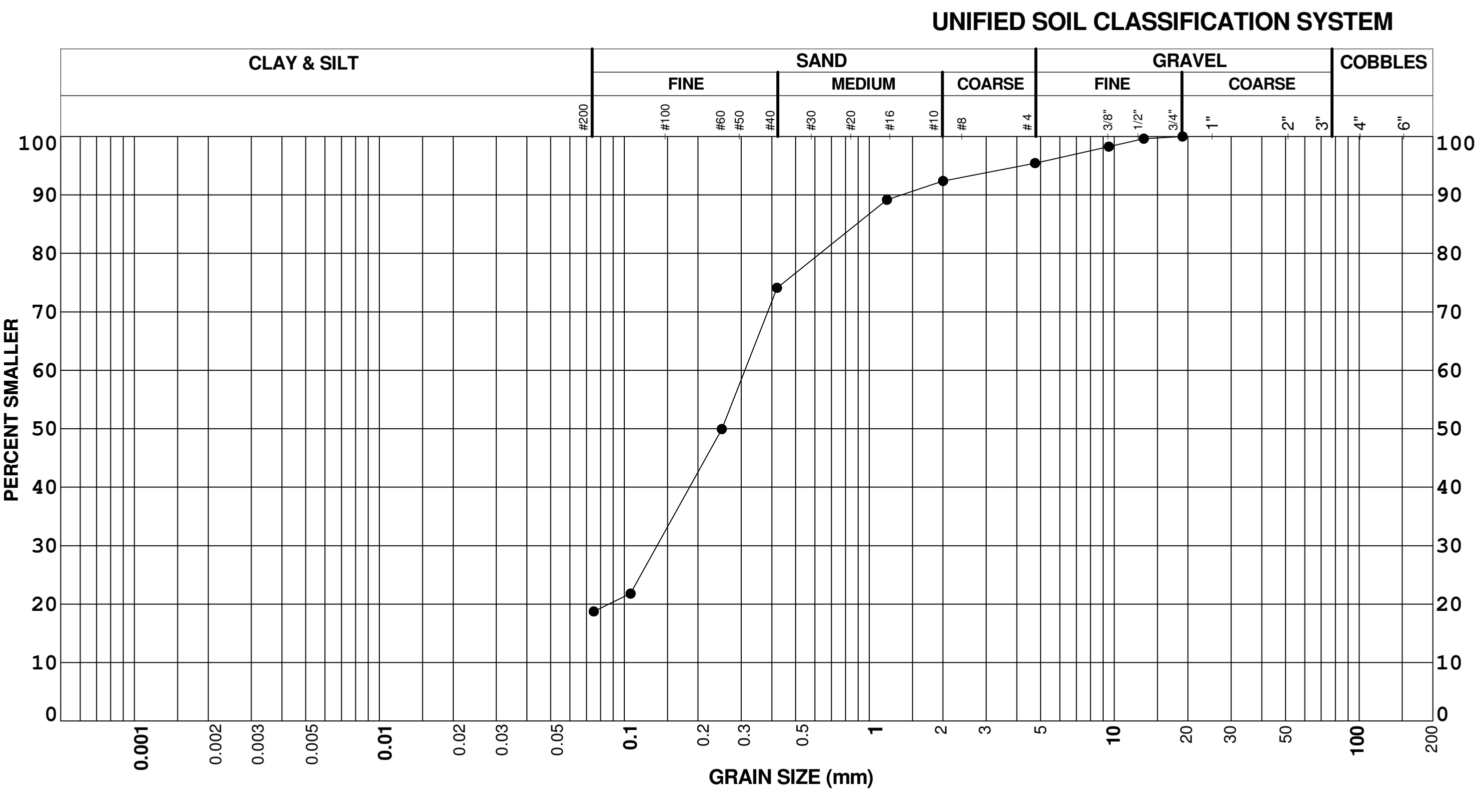
	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH16-B001	BS3	3.50	6	66	29		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-B002	BS4	5.90	5	77	19		

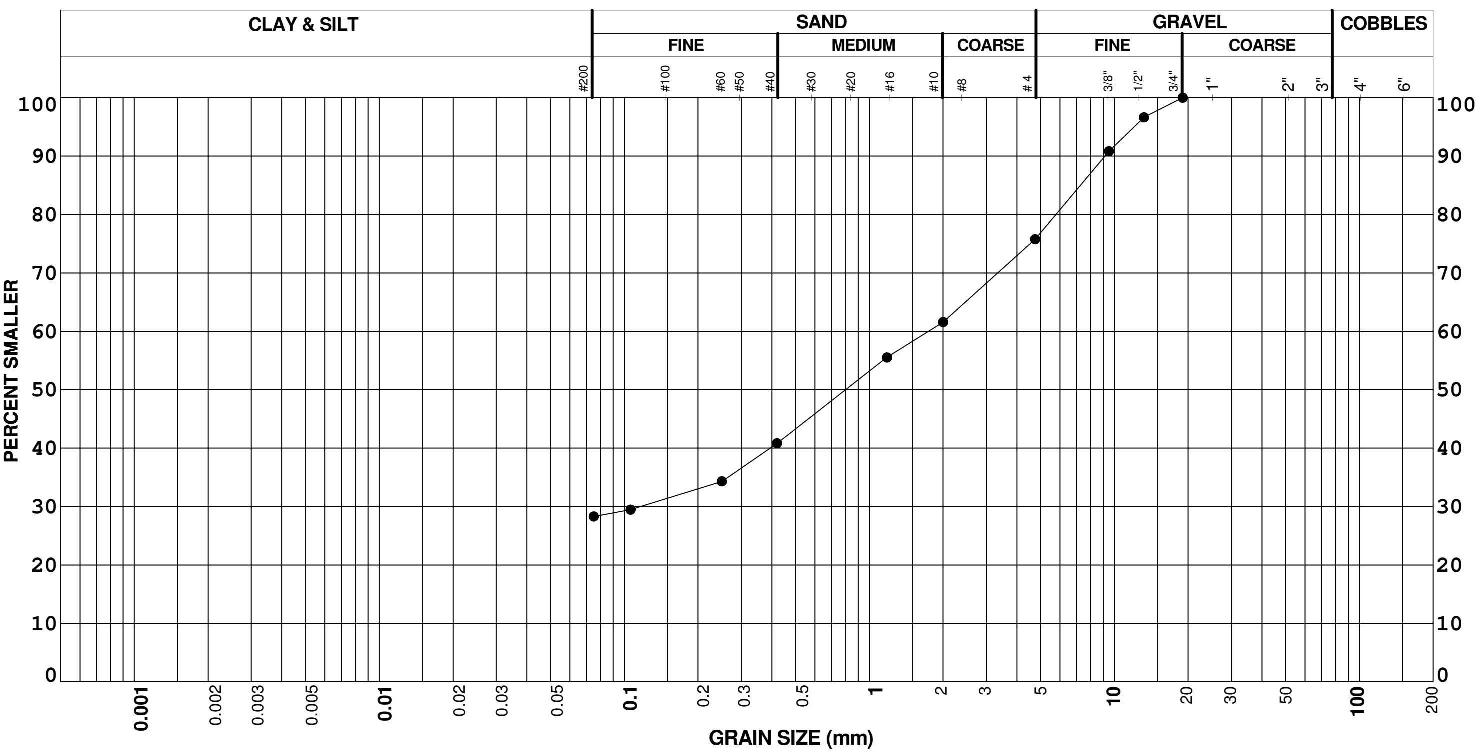
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

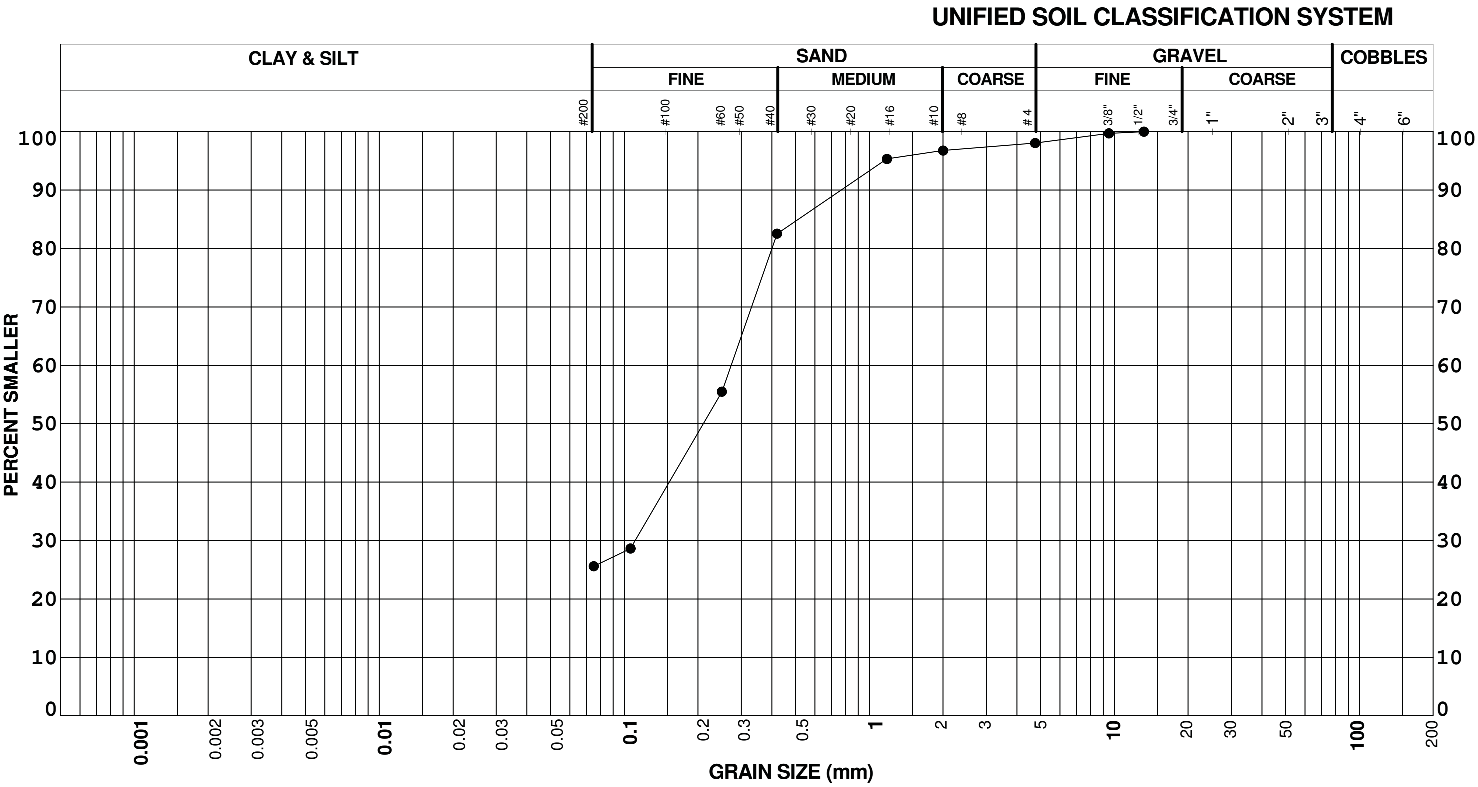
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-B003	BS2	1.90	24	47	28		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-B003	BS4	5.80	2	72	26		

REMARKS:

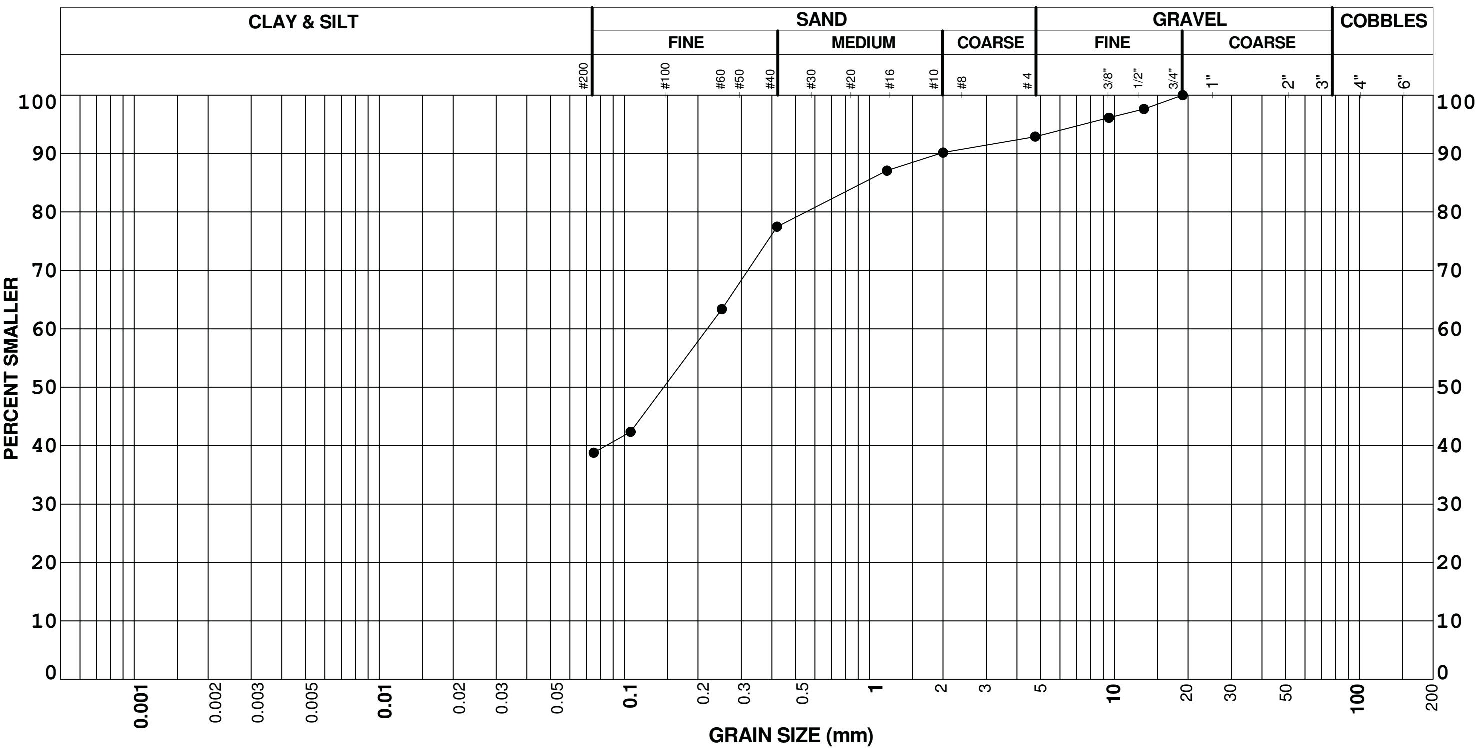
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH16-B004	BS4	5.80	7	54	39		

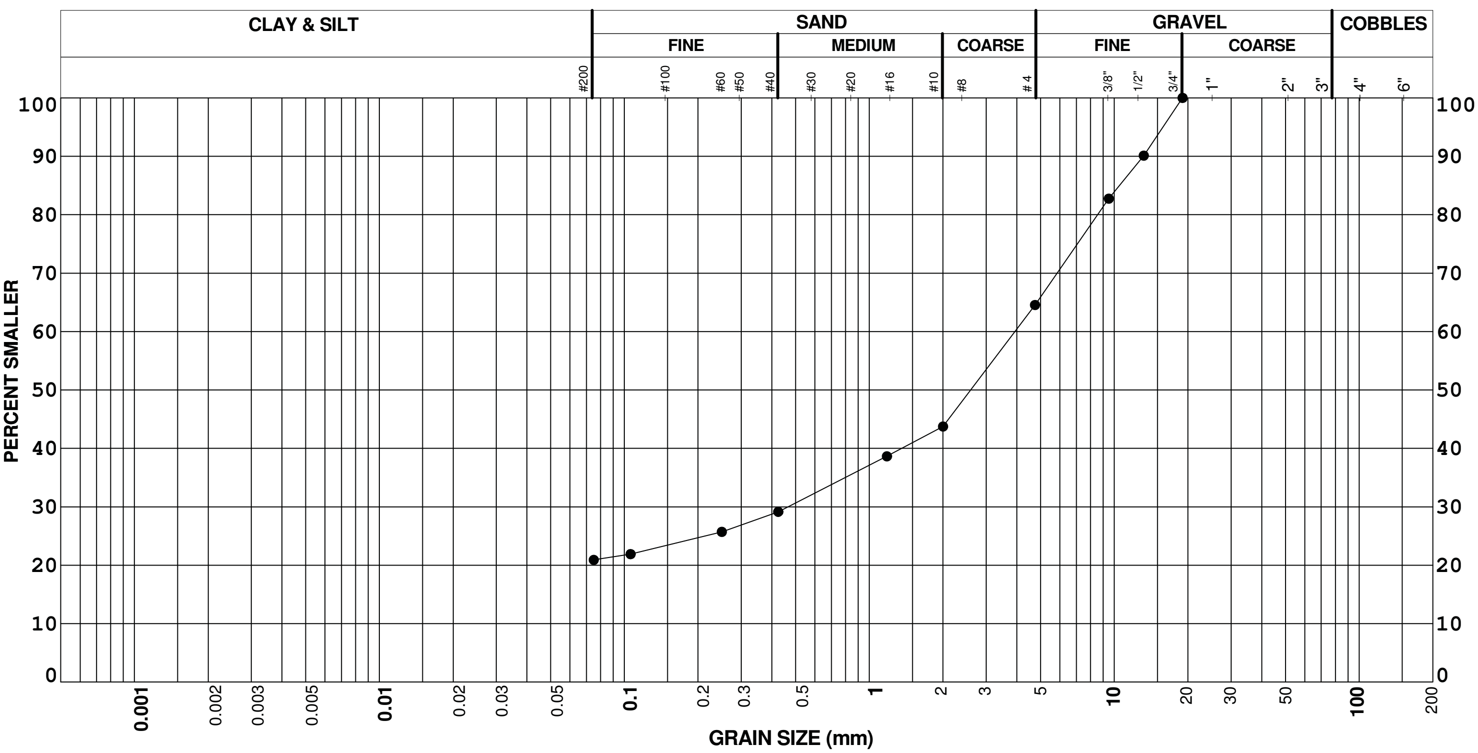
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-B004	BS5	7.30	35	44	21		

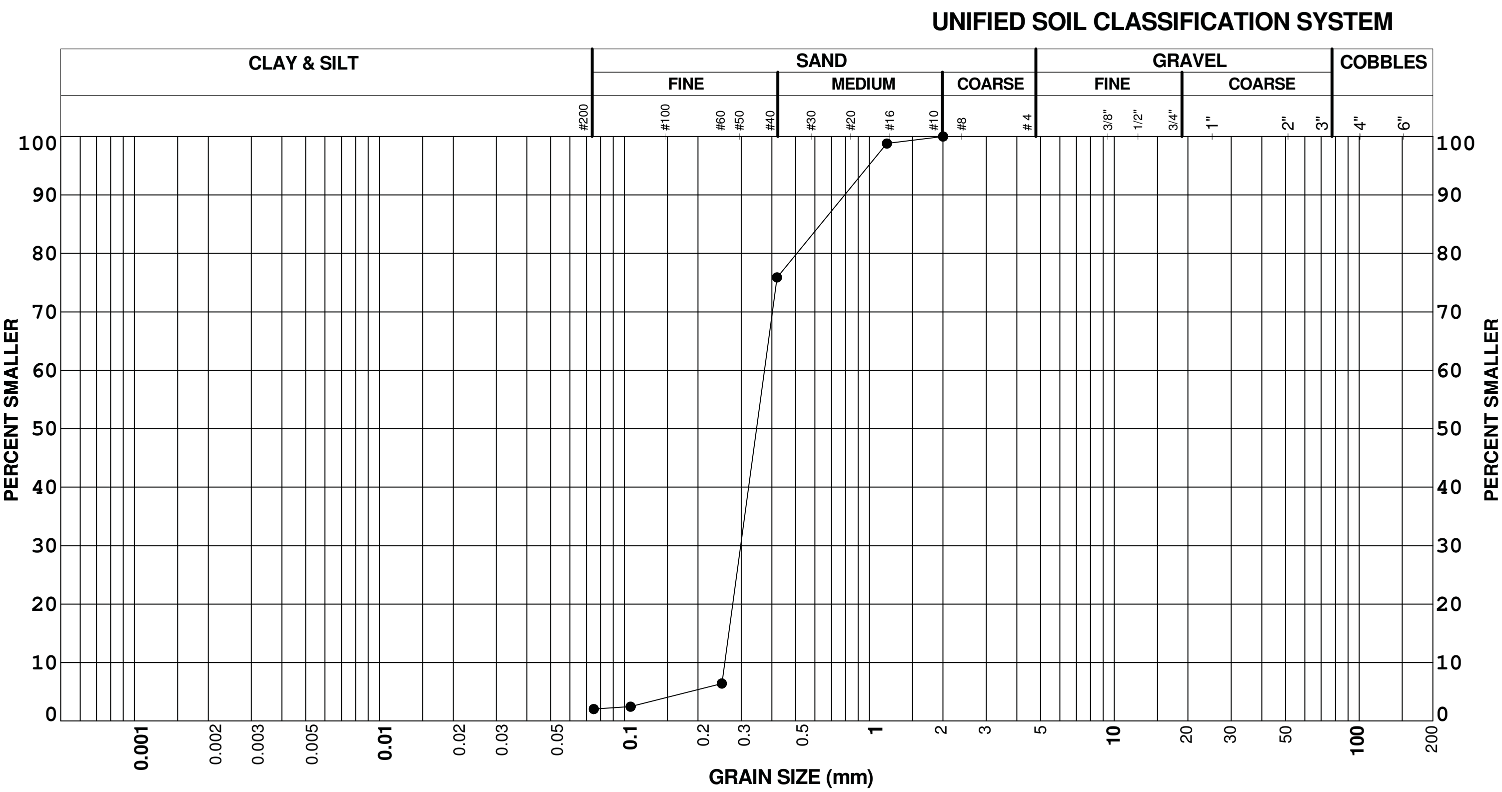
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-B009	BS3	9.80	0	98	2		

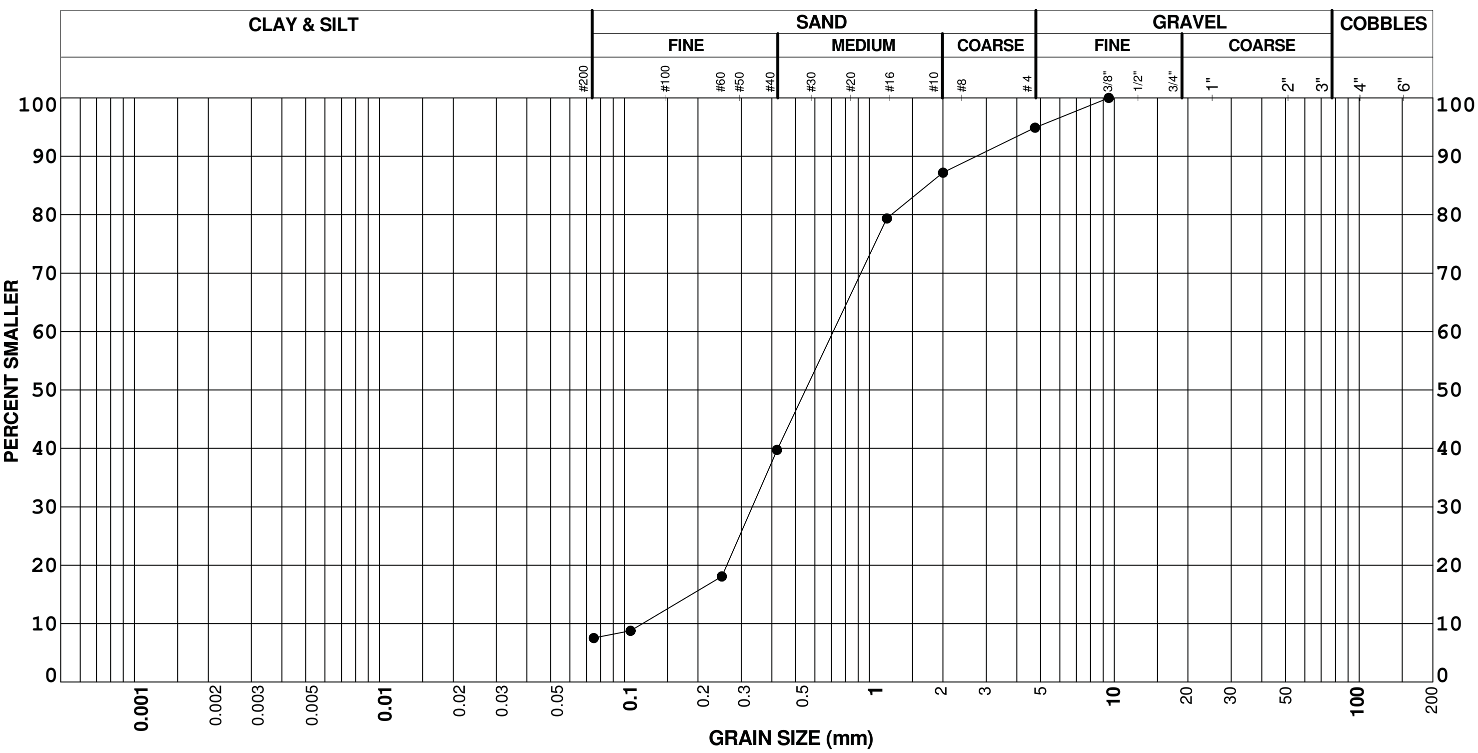
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-B010	BS2	2.90	5	87	8		

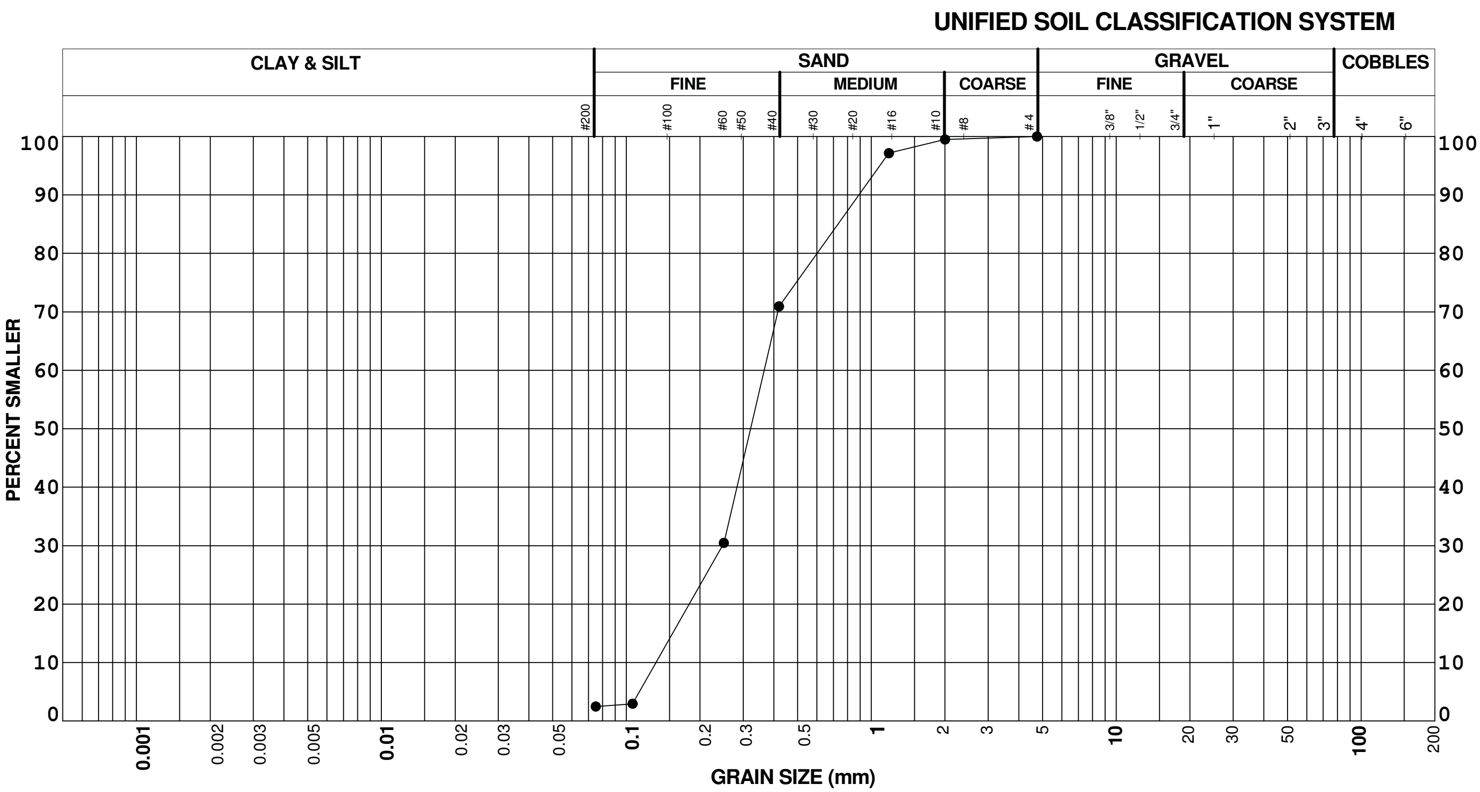
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-B010	BS4	5.10	0	98	2		

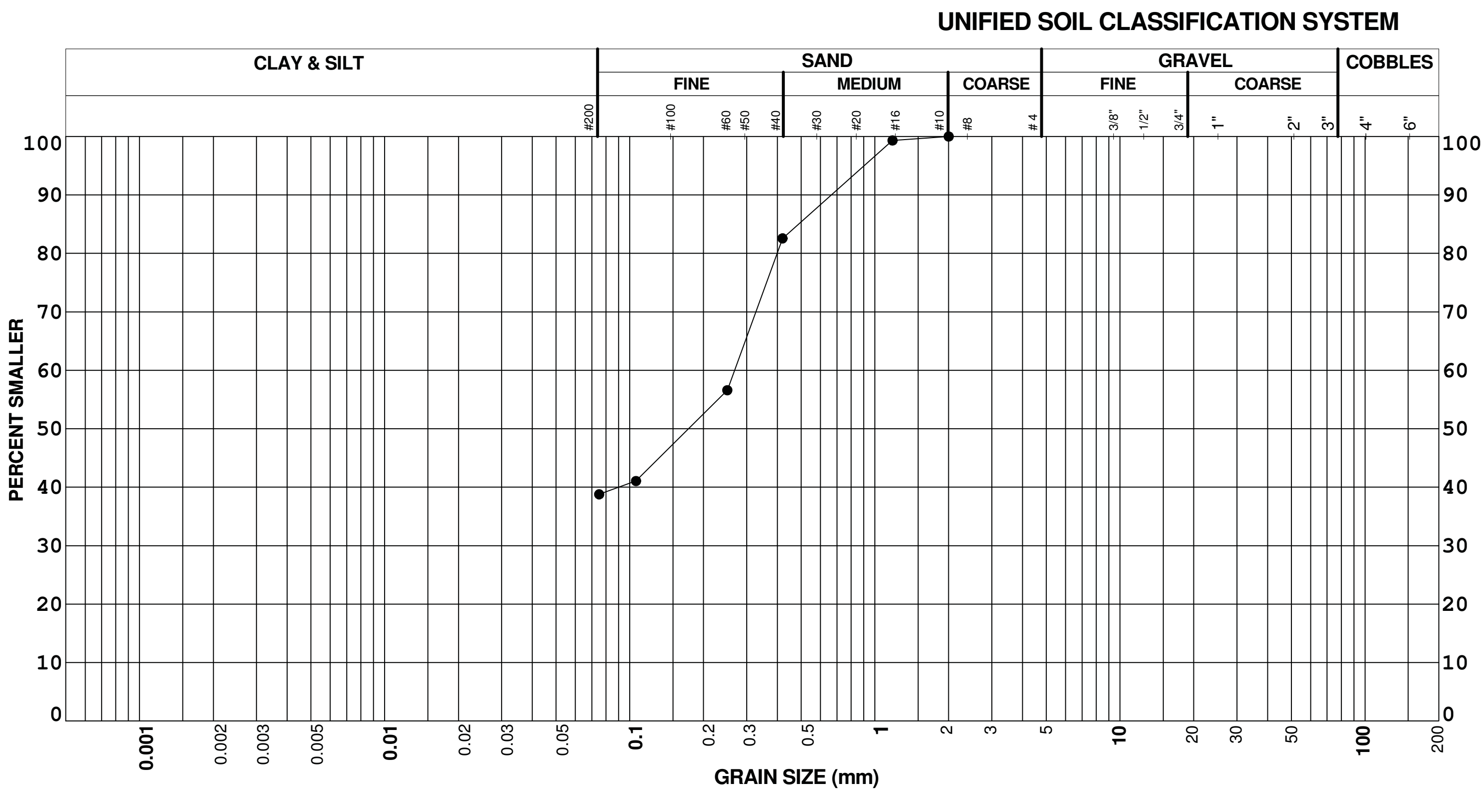
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-B010	BS6	9.50	0	61	39		

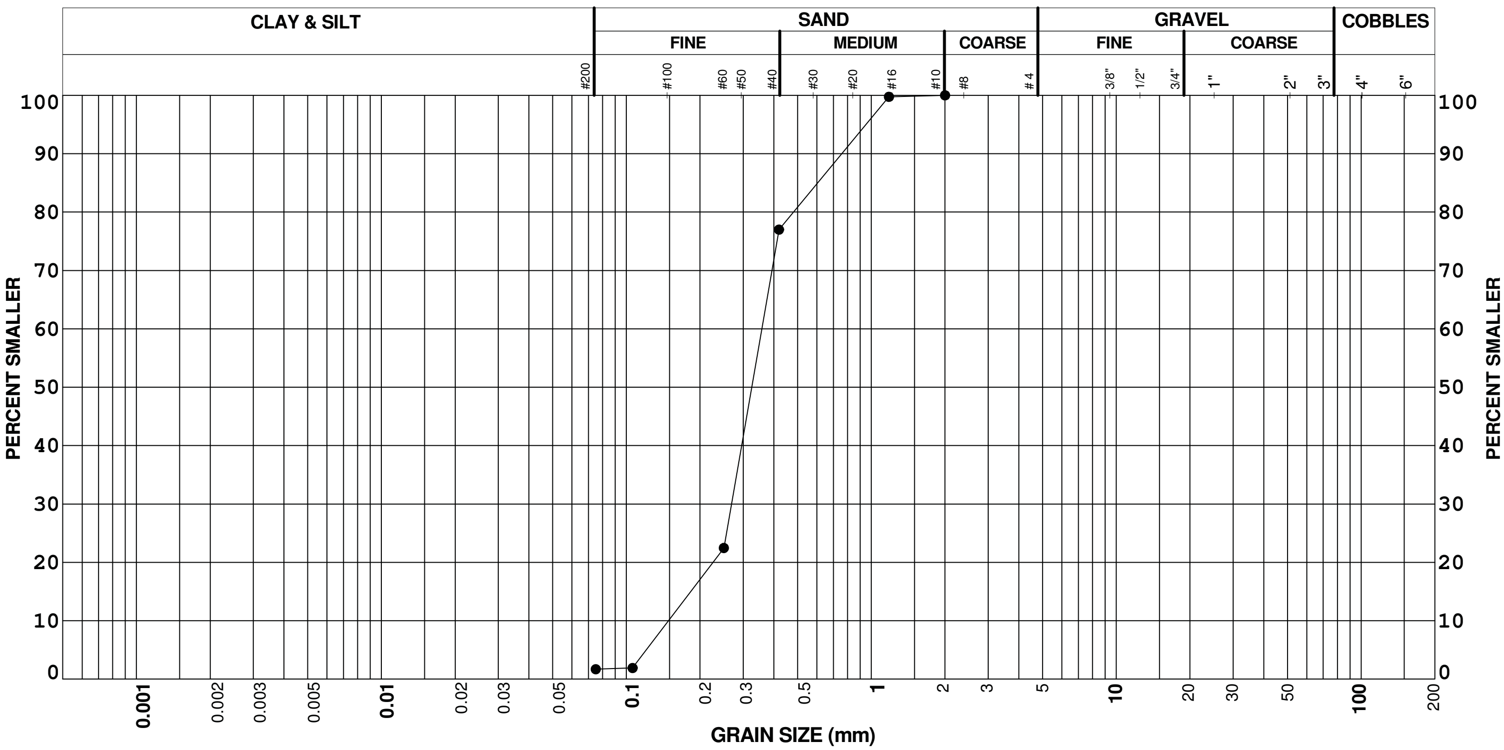
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

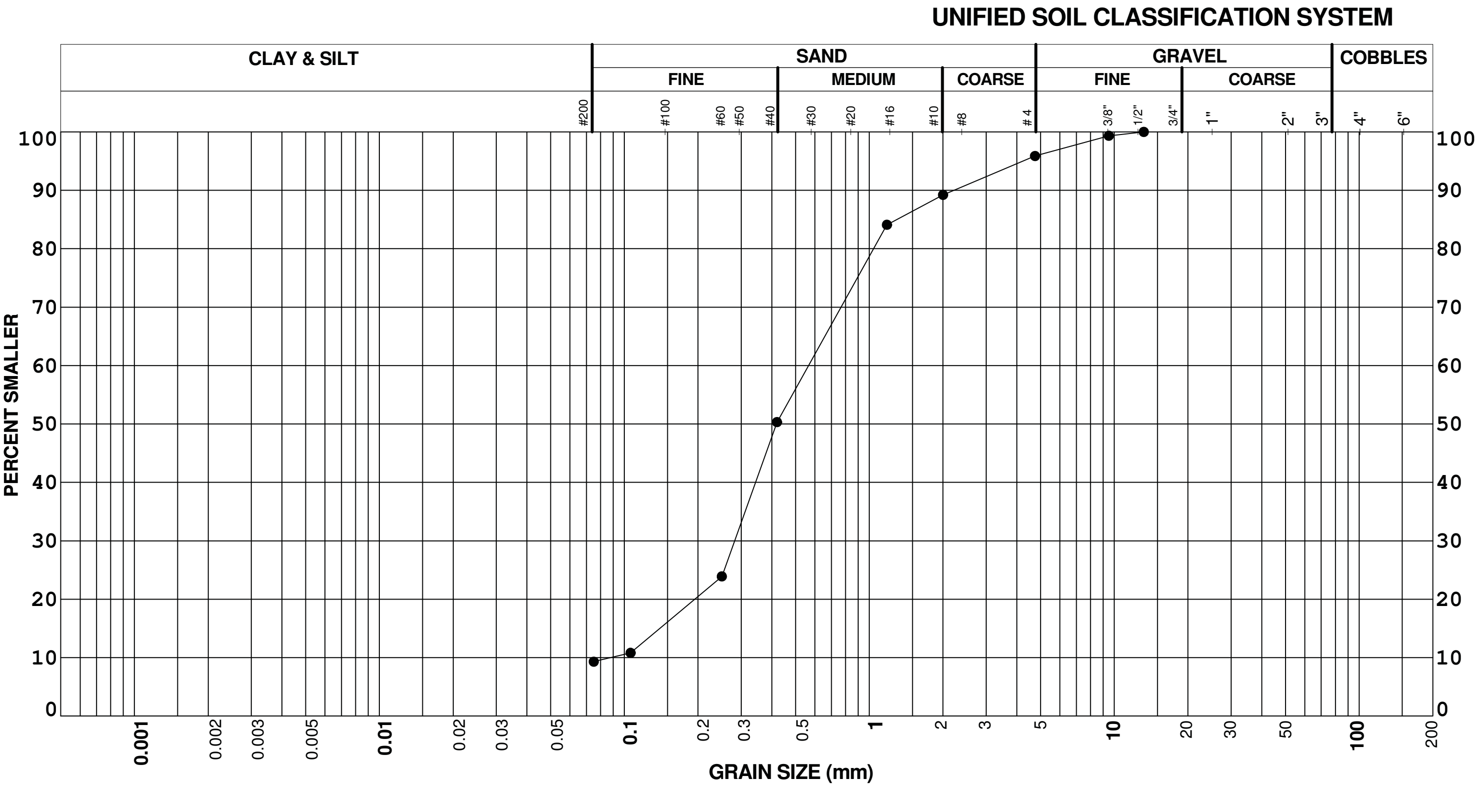
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-B011	BS2	9.00	0	98	2		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-B012	BS1	3.00	4	87	9		

REMARKS:

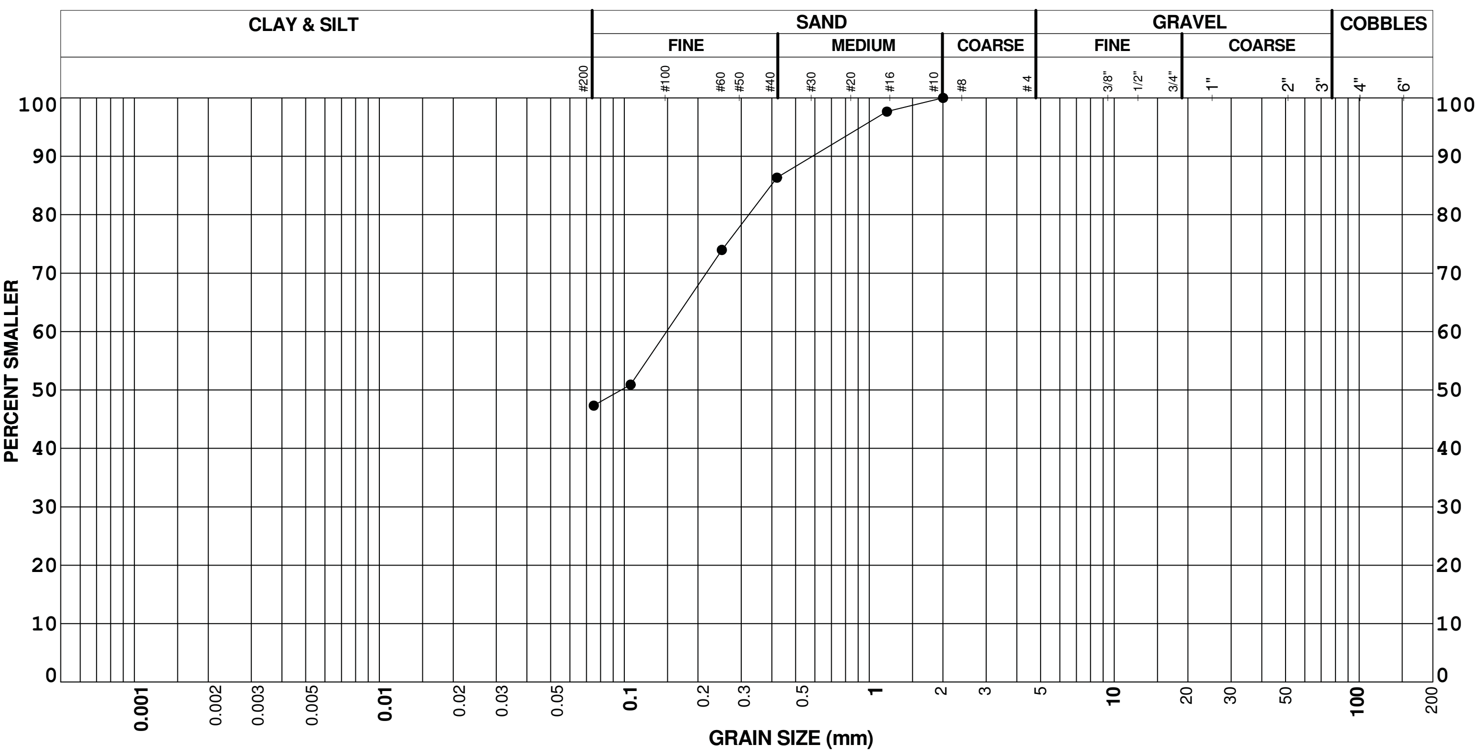
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

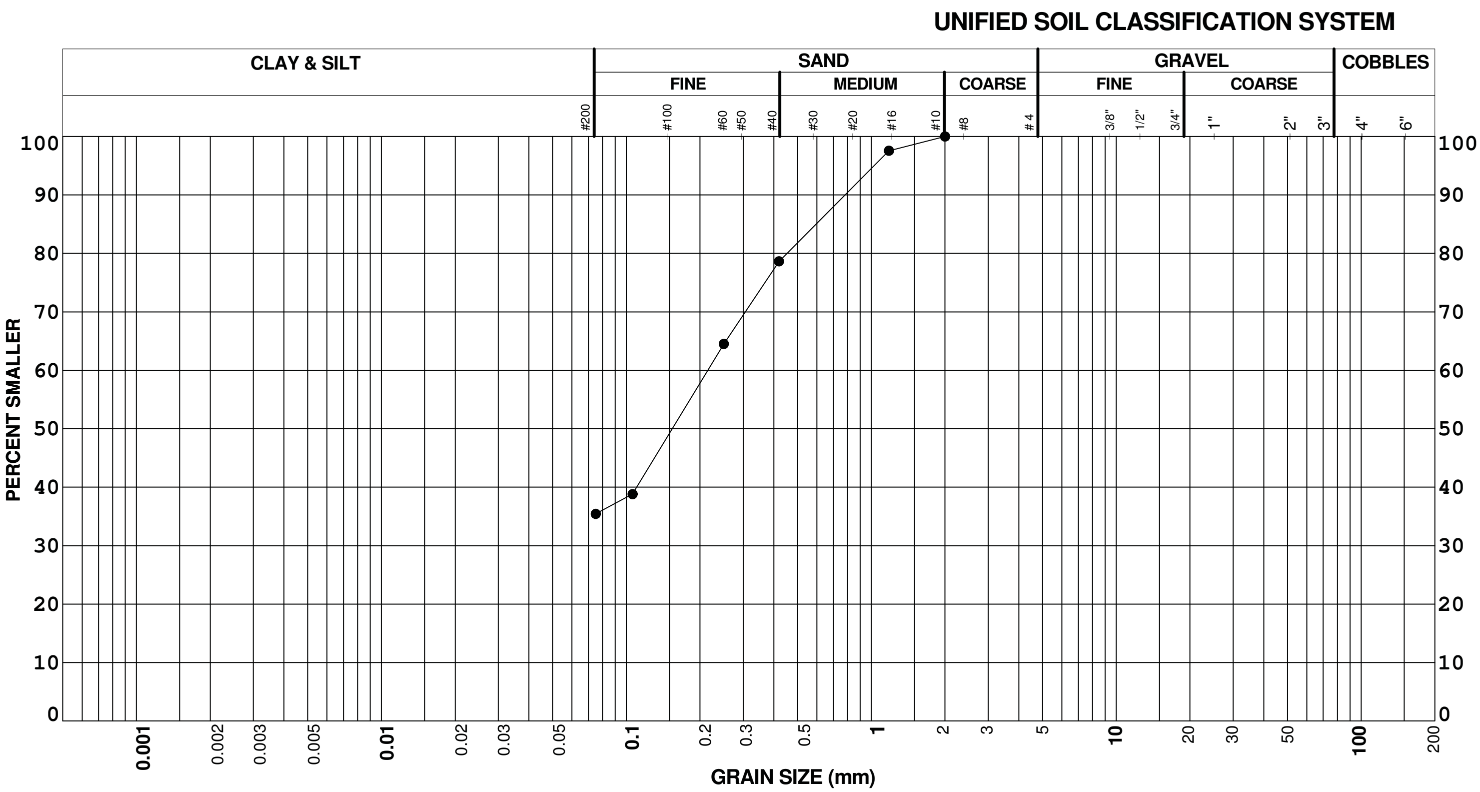
	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH16-B013	BS3	4.00	0	53	47		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

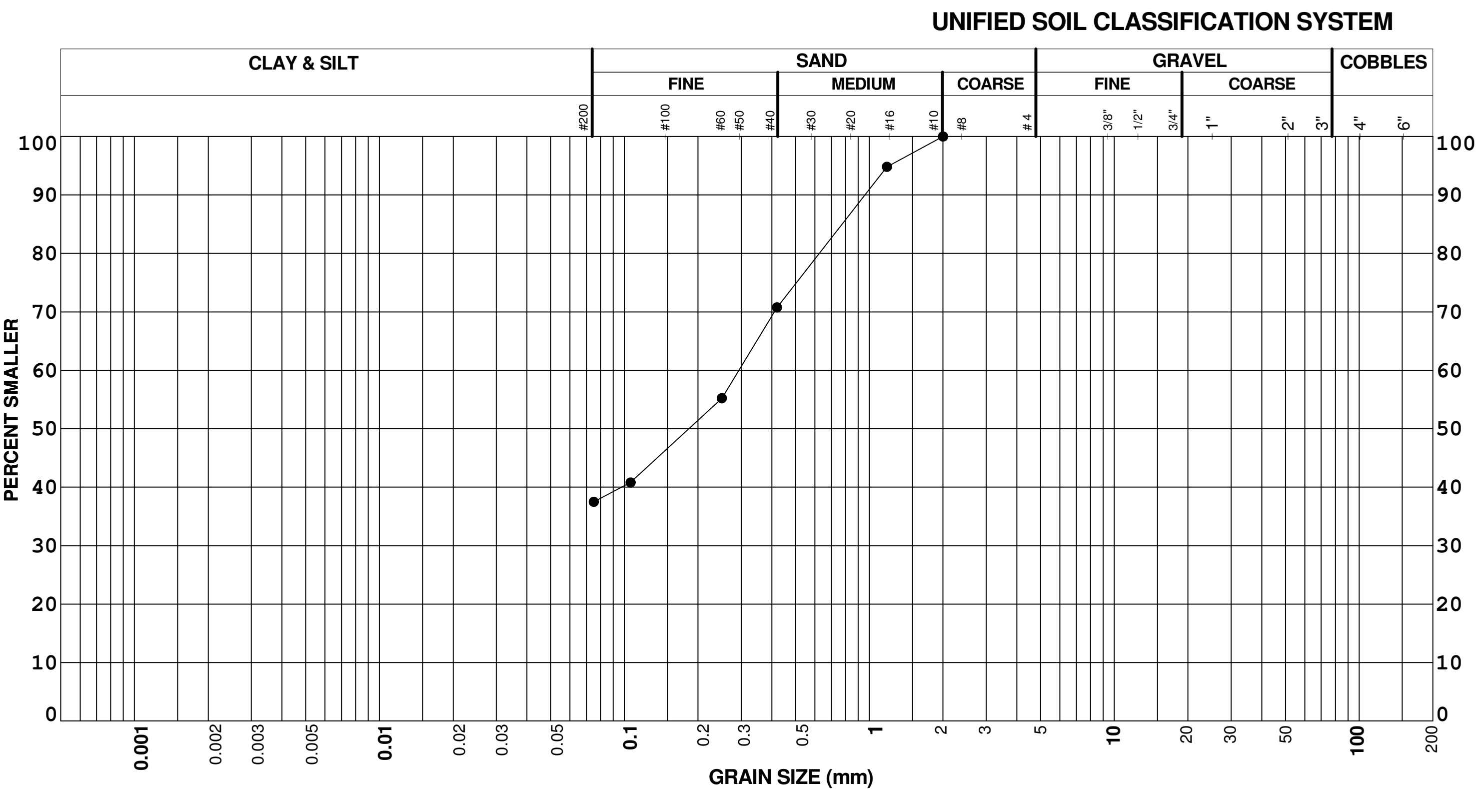
	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH16-B014	BS3	3.50	0	65	35		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH16-B014	BS5	7.00	0	63	37		

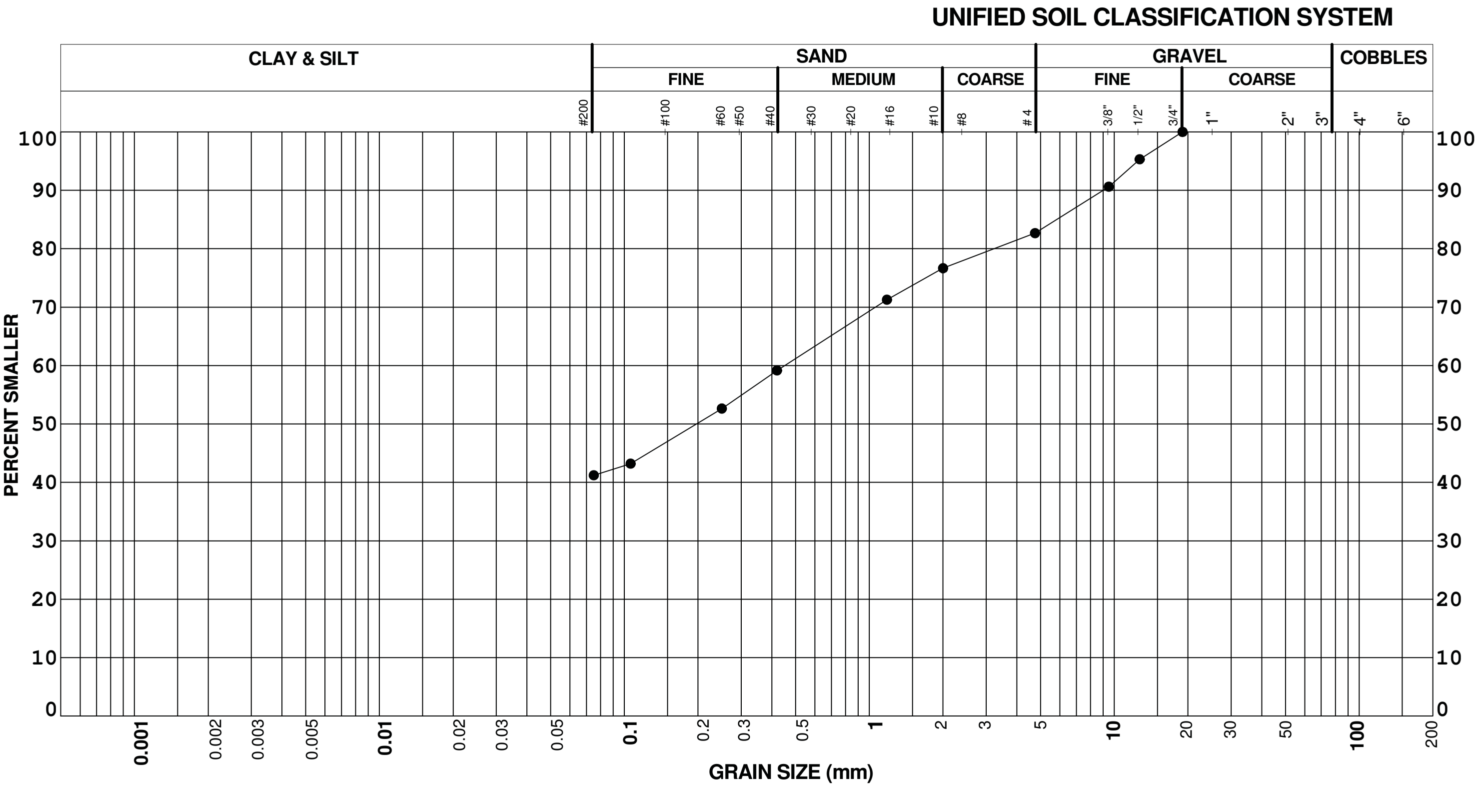
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

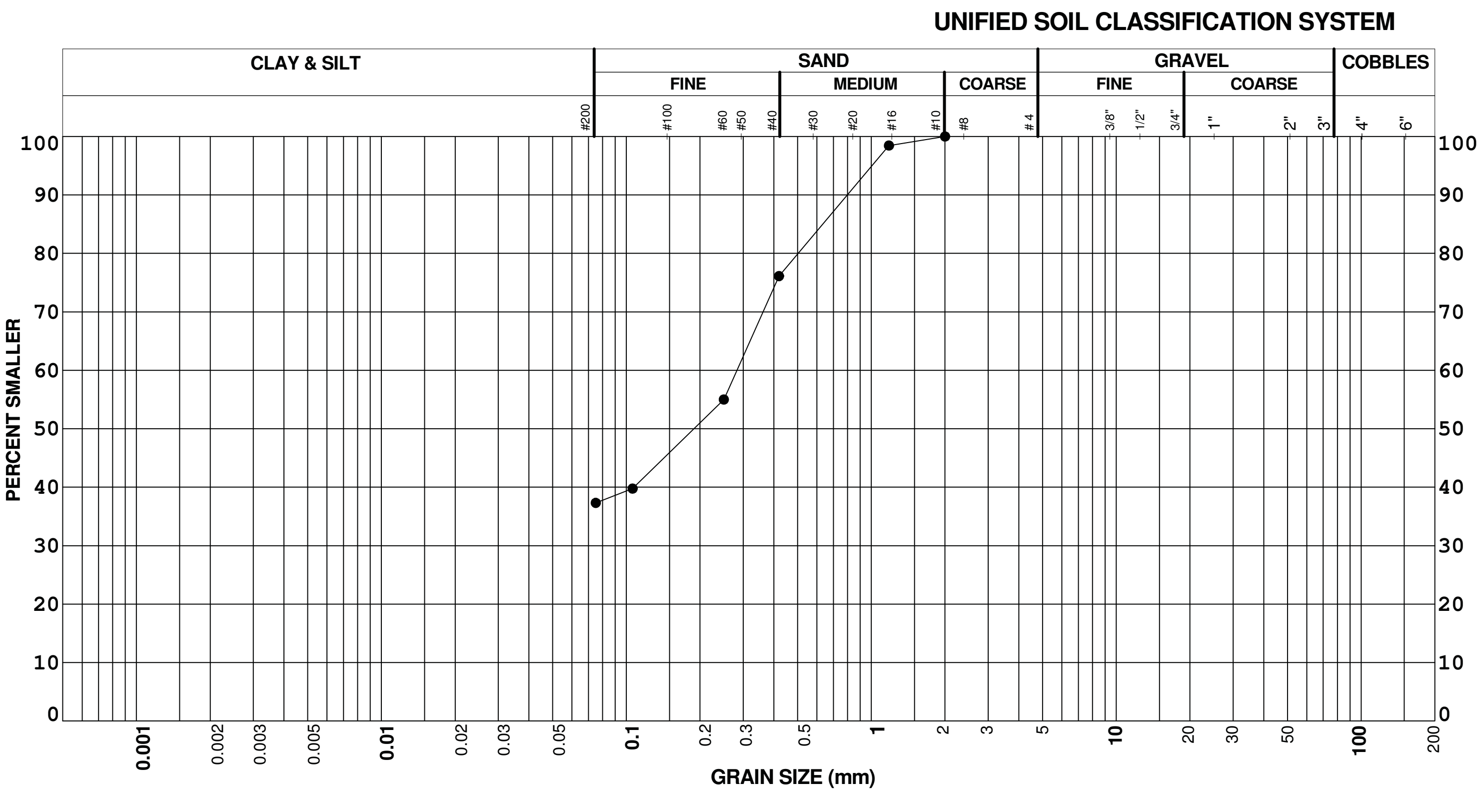
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-B015	BS2	2.50	17	41	41		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-B015	BS4	5.00	0	63	37		

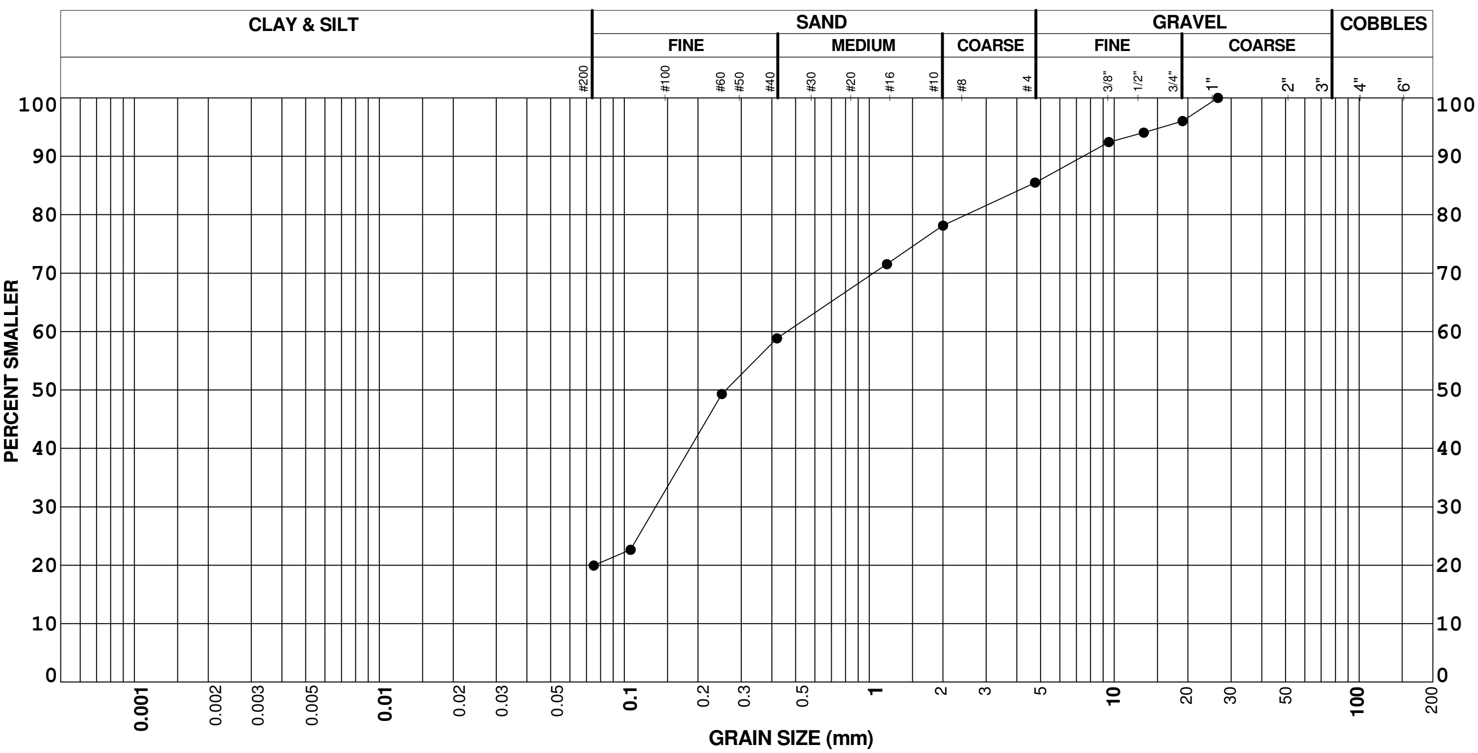
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH16-B015	BS7	10.00	15	66	20		

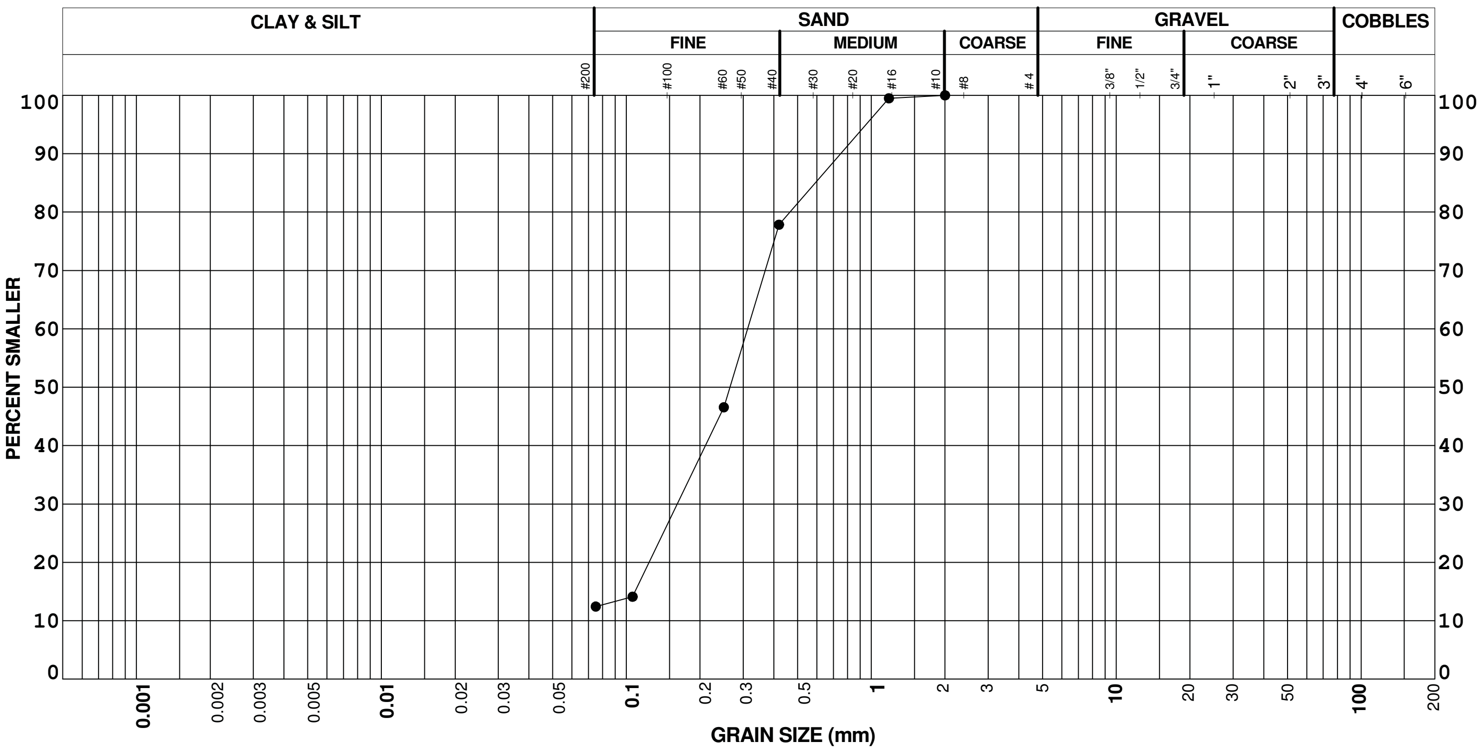
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

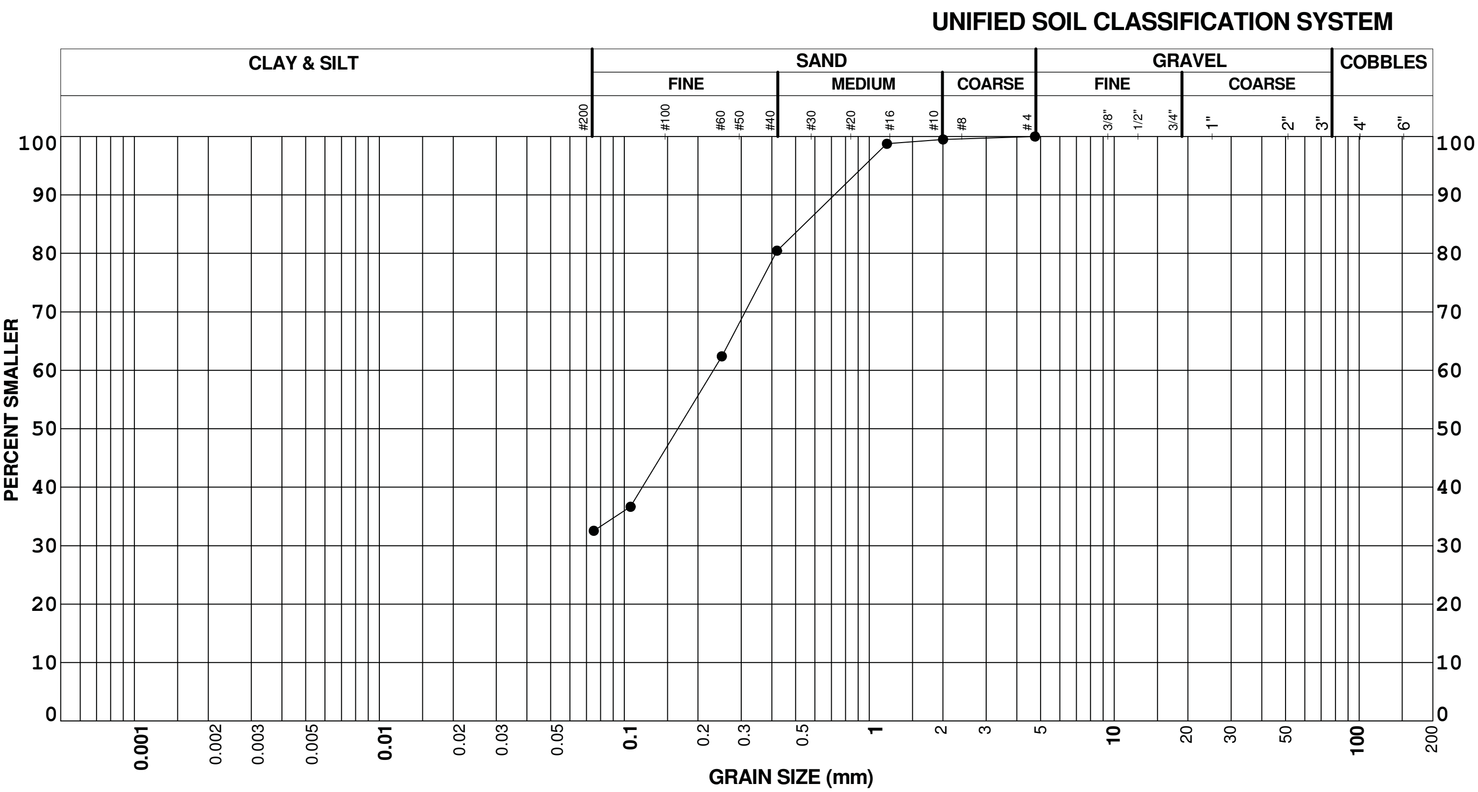
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-B016	BS3	3.60	0	88	12		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

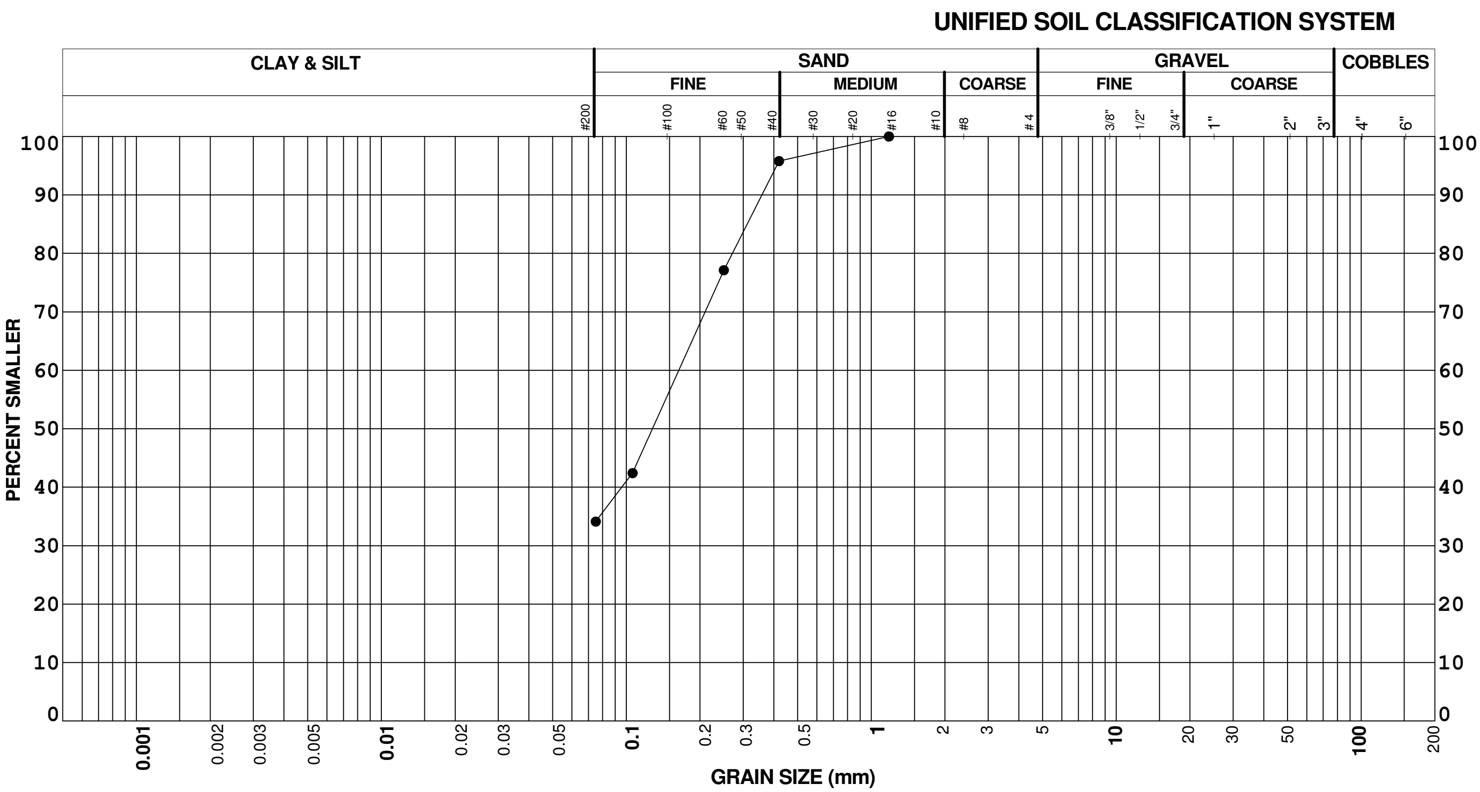
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-B016	BS4	5.30	0	67	33		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

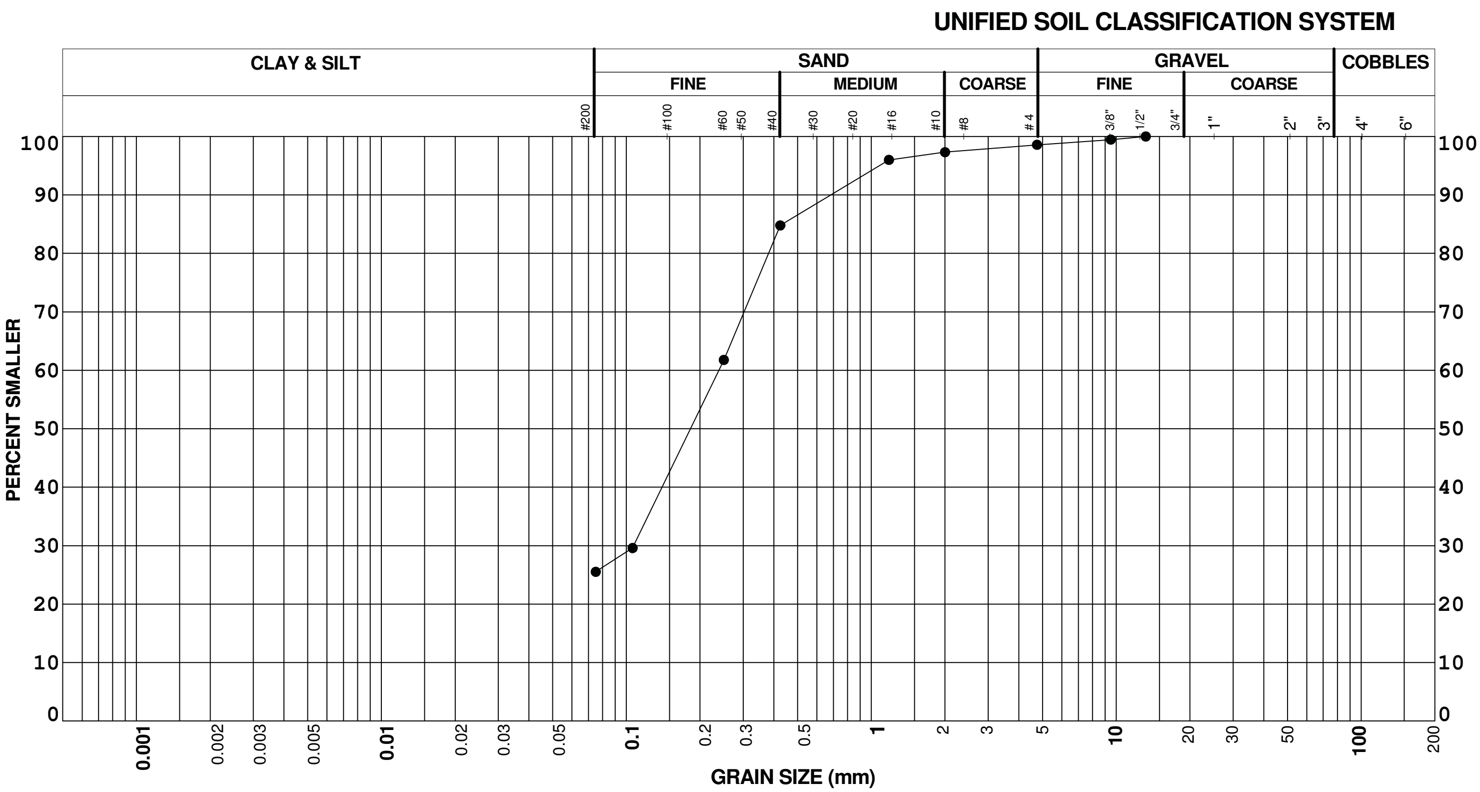
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-B016	BS5	7.20	0	66	34		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



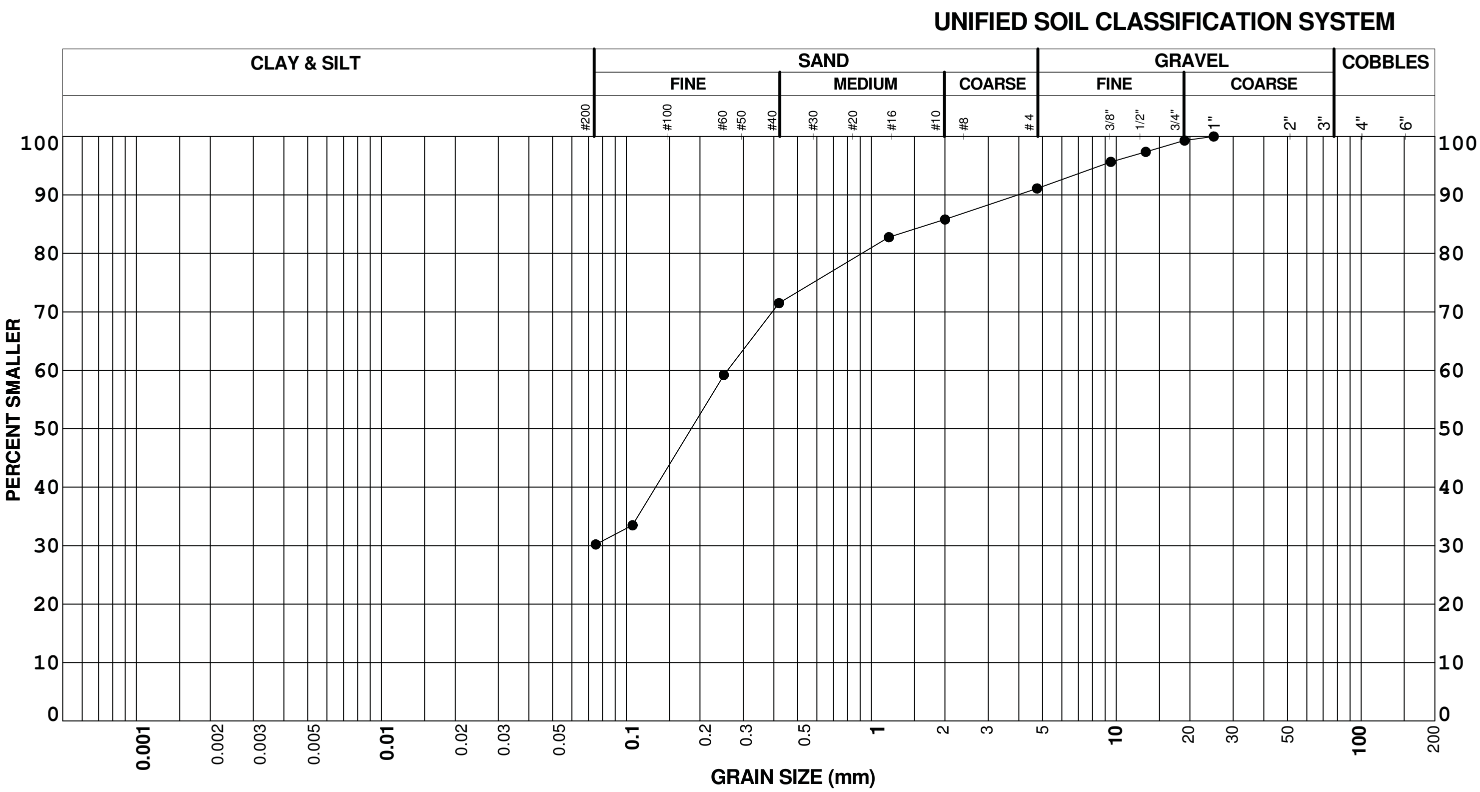
REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C007	BS3	3.50	1	73	26		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

Project



REMARKS:

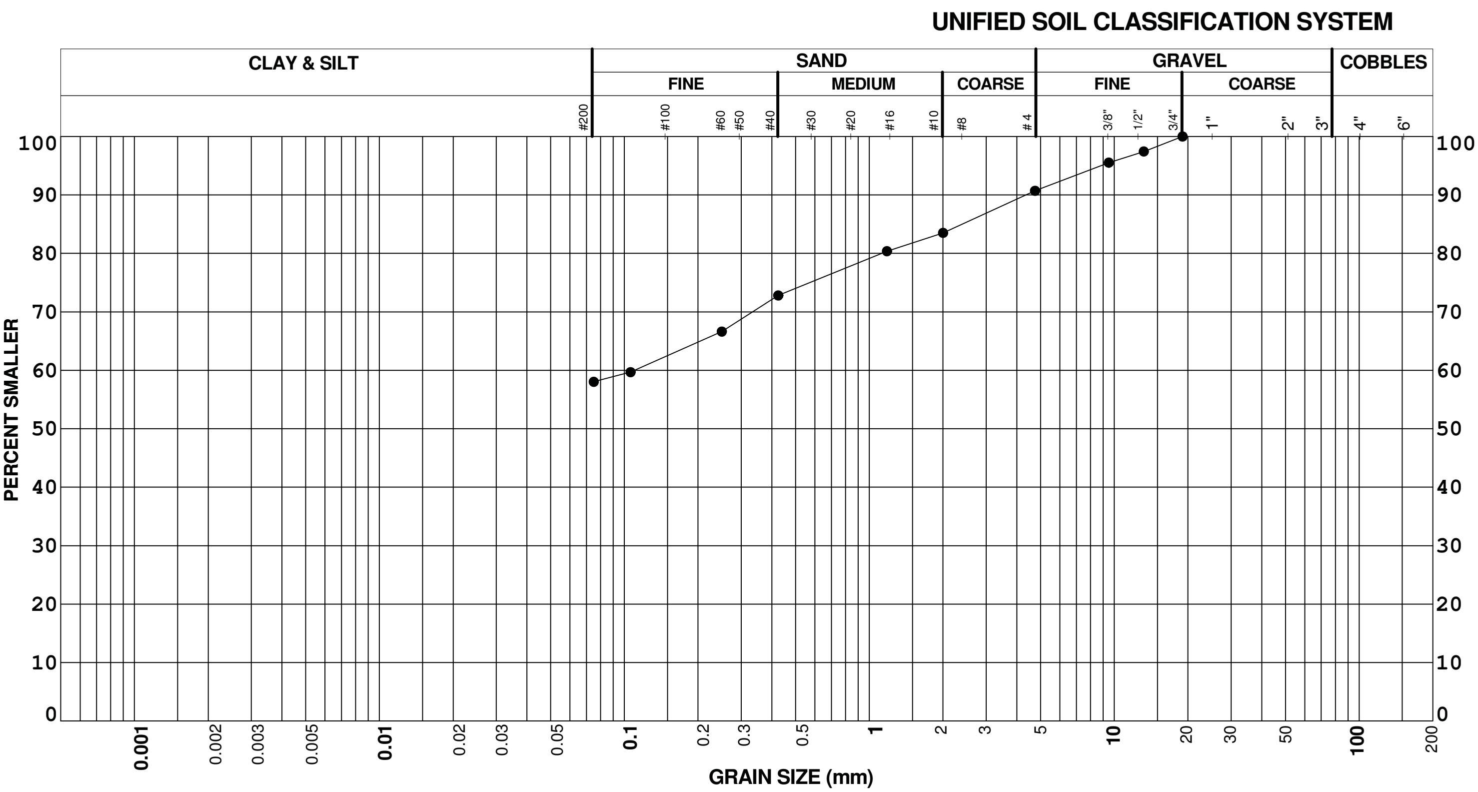
	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH16-C009	BS2	2.60	9	61	30		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C010	BS2	2.50	9	33	58		

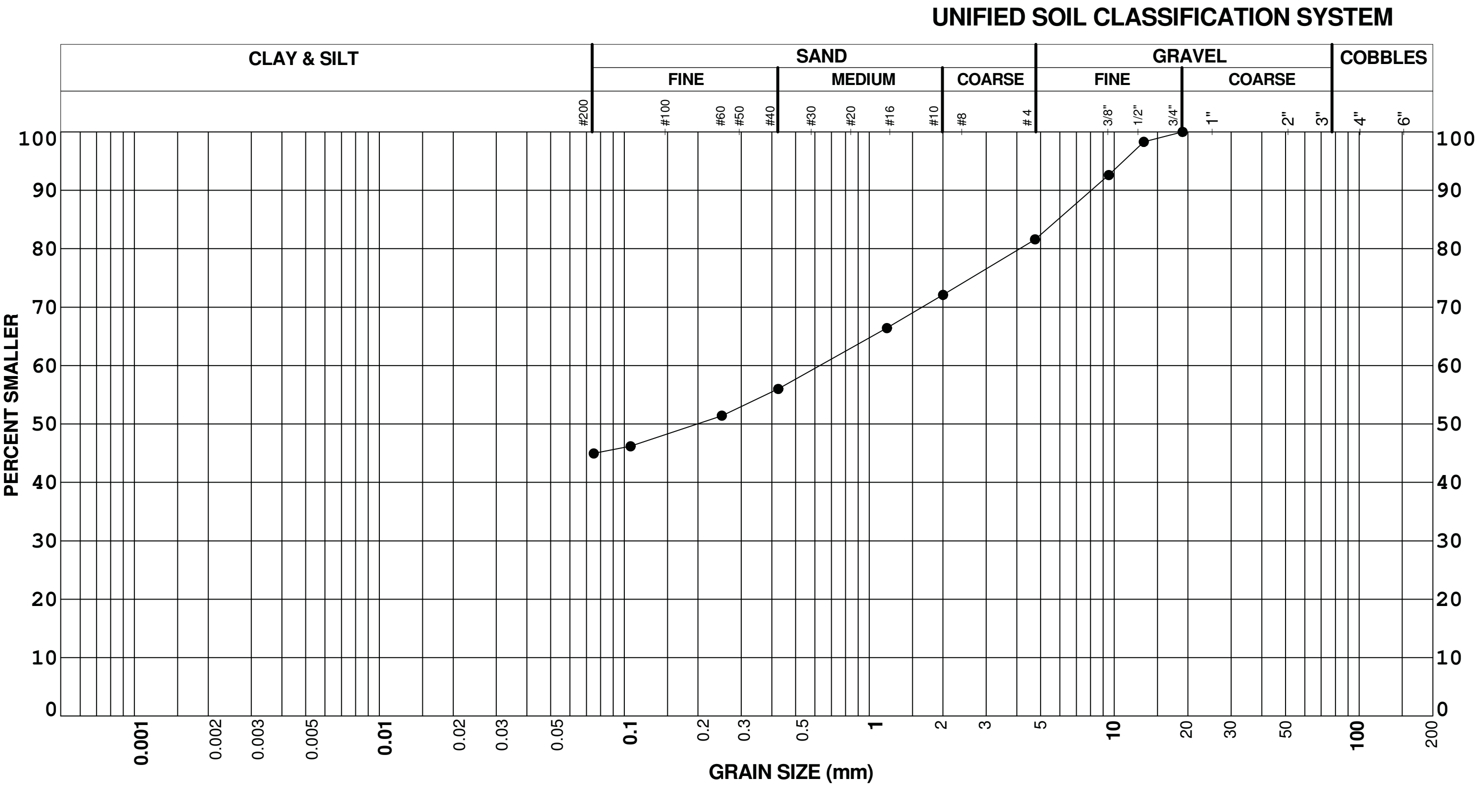
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C012	BS3	4.00	18	37	45		

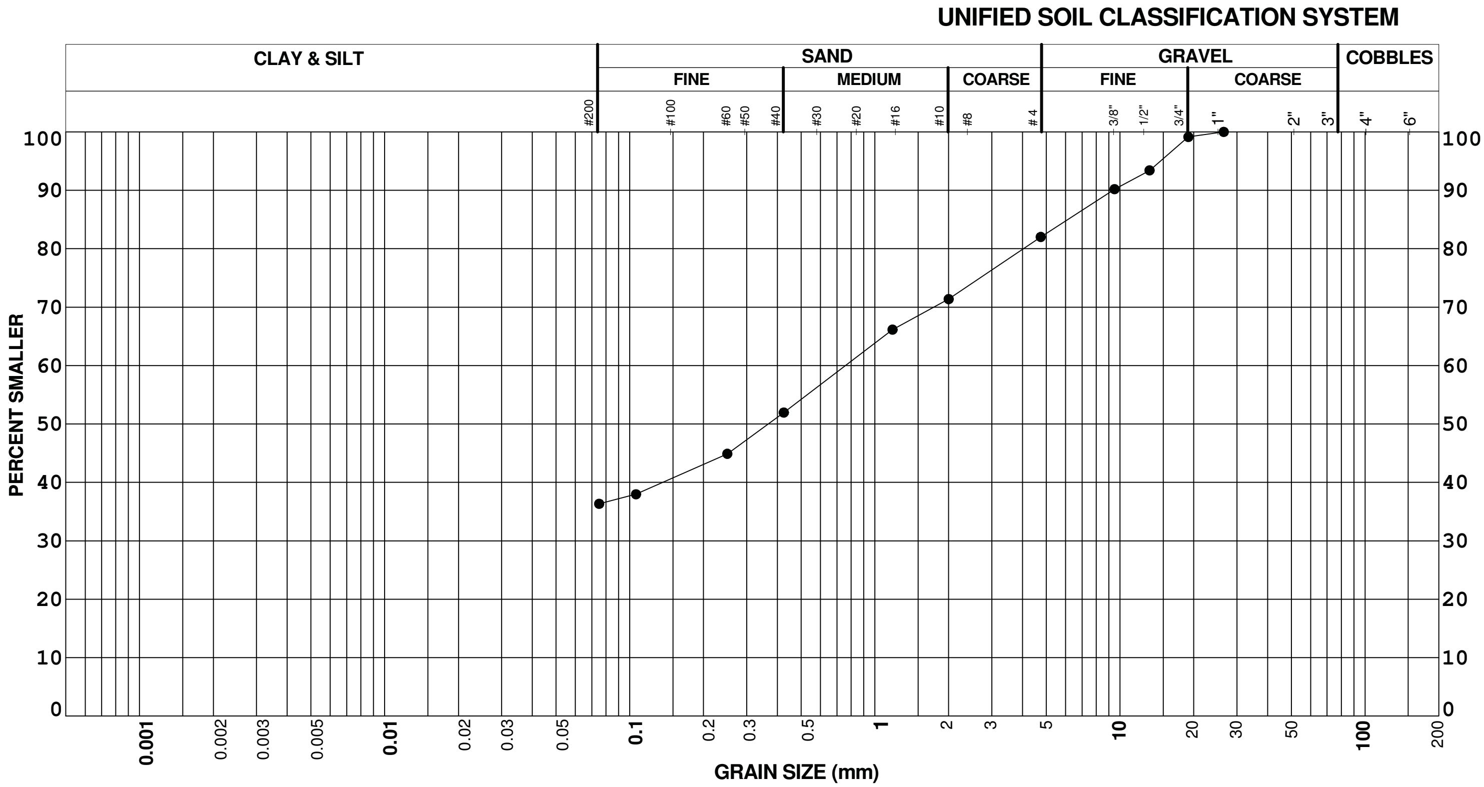
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH16-C015	BS2	2.50	18	46	36		

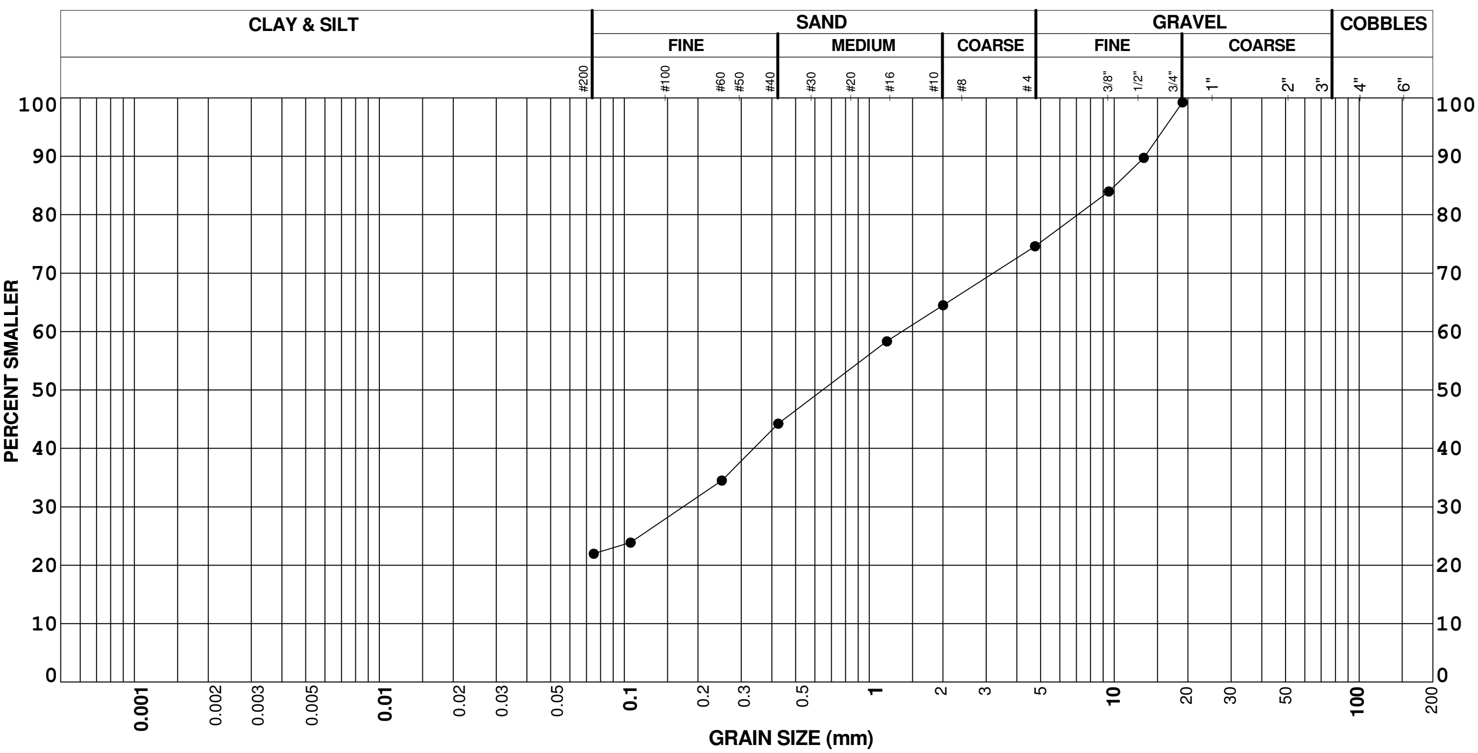
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C016	BS2	2.70	25	53	22		

REMARKS:

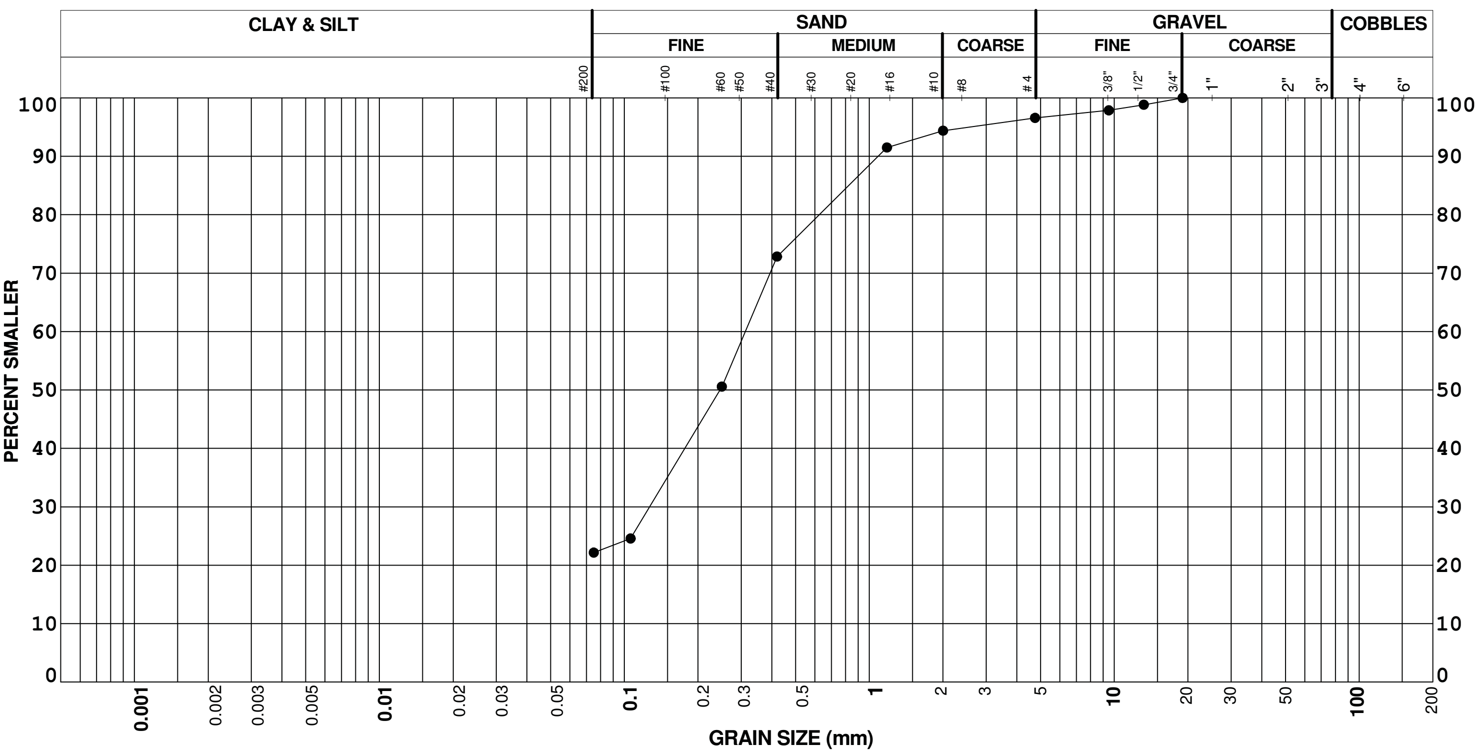
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C017	BS1	0.50	3	74	22		

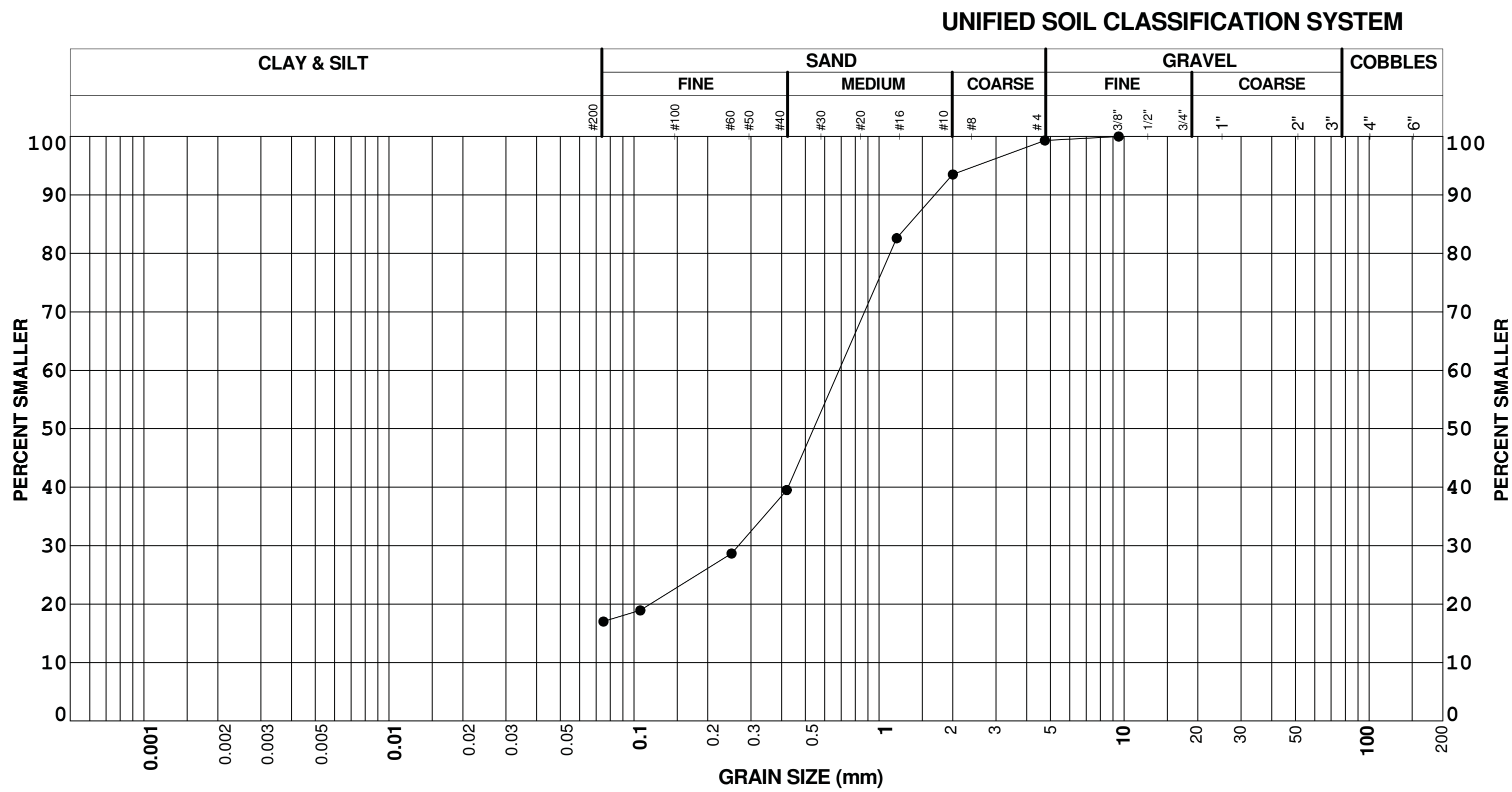
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C018	BS2	2.20	1	82	17		

REMARKS:

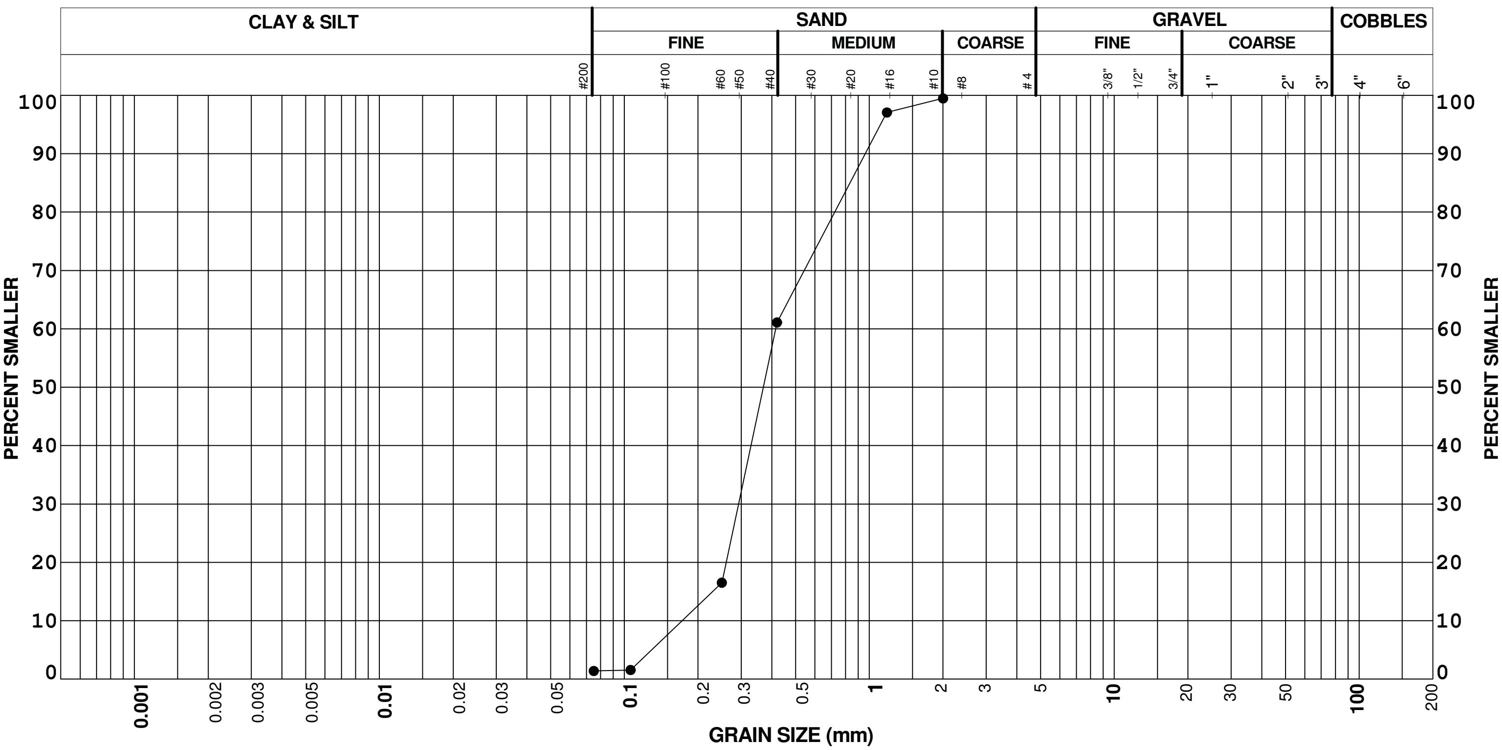
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

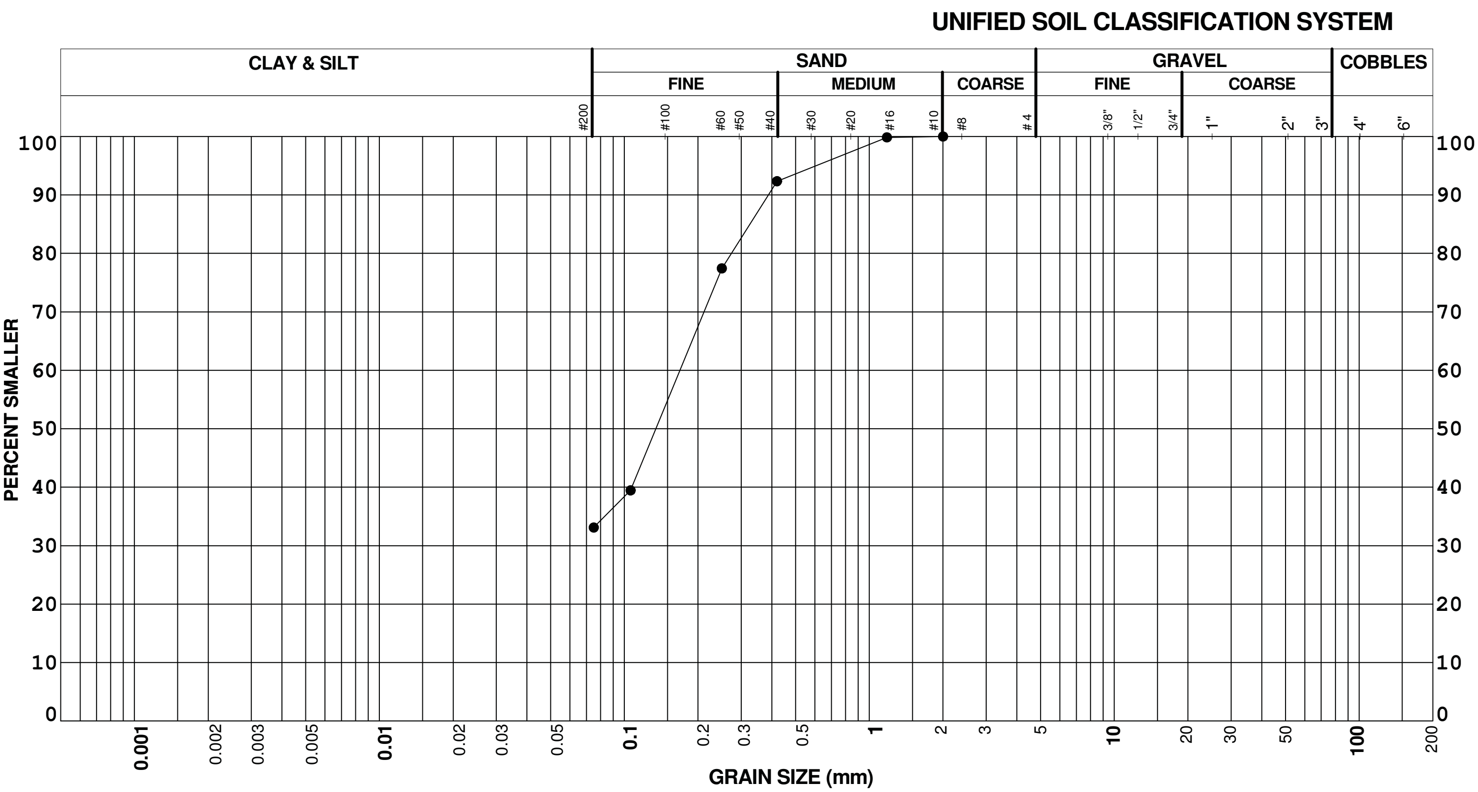
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C019B	BS1	5.80	0	98	1		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

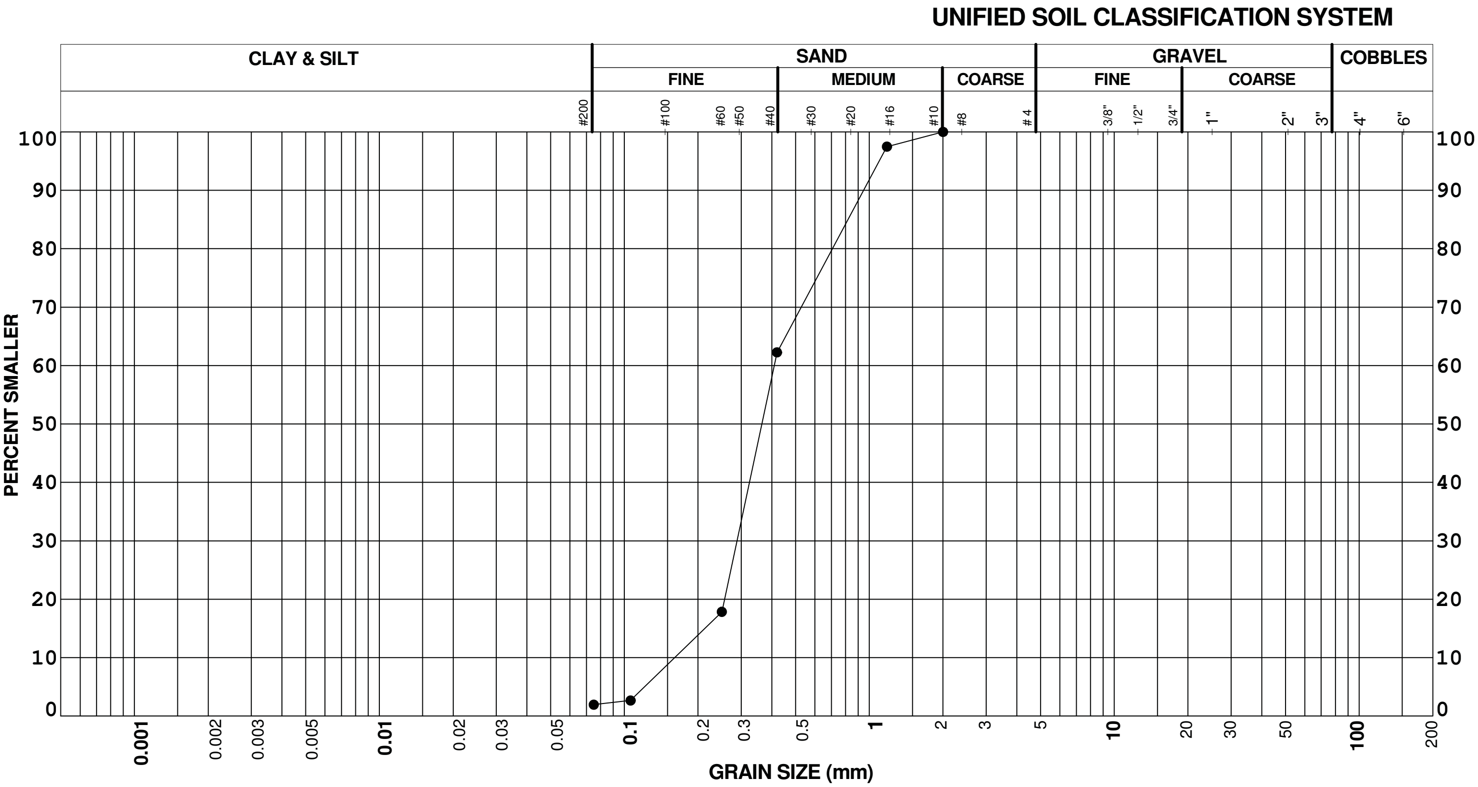
	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH16-C021	BS5	8.70	0	67	33		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH16-C022	BS2	4.40	0	98	2		

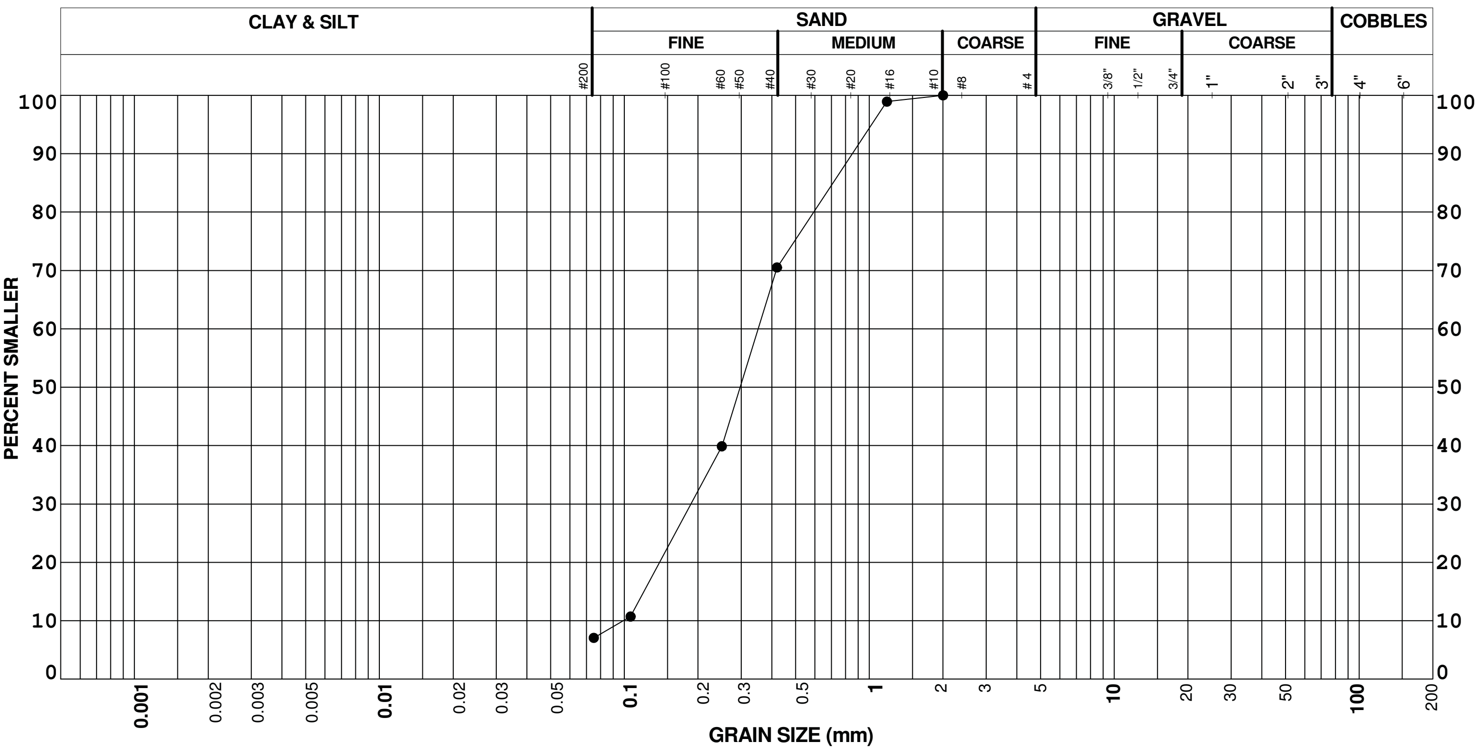
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH16-C023	BS1	3.70	0	93	7		

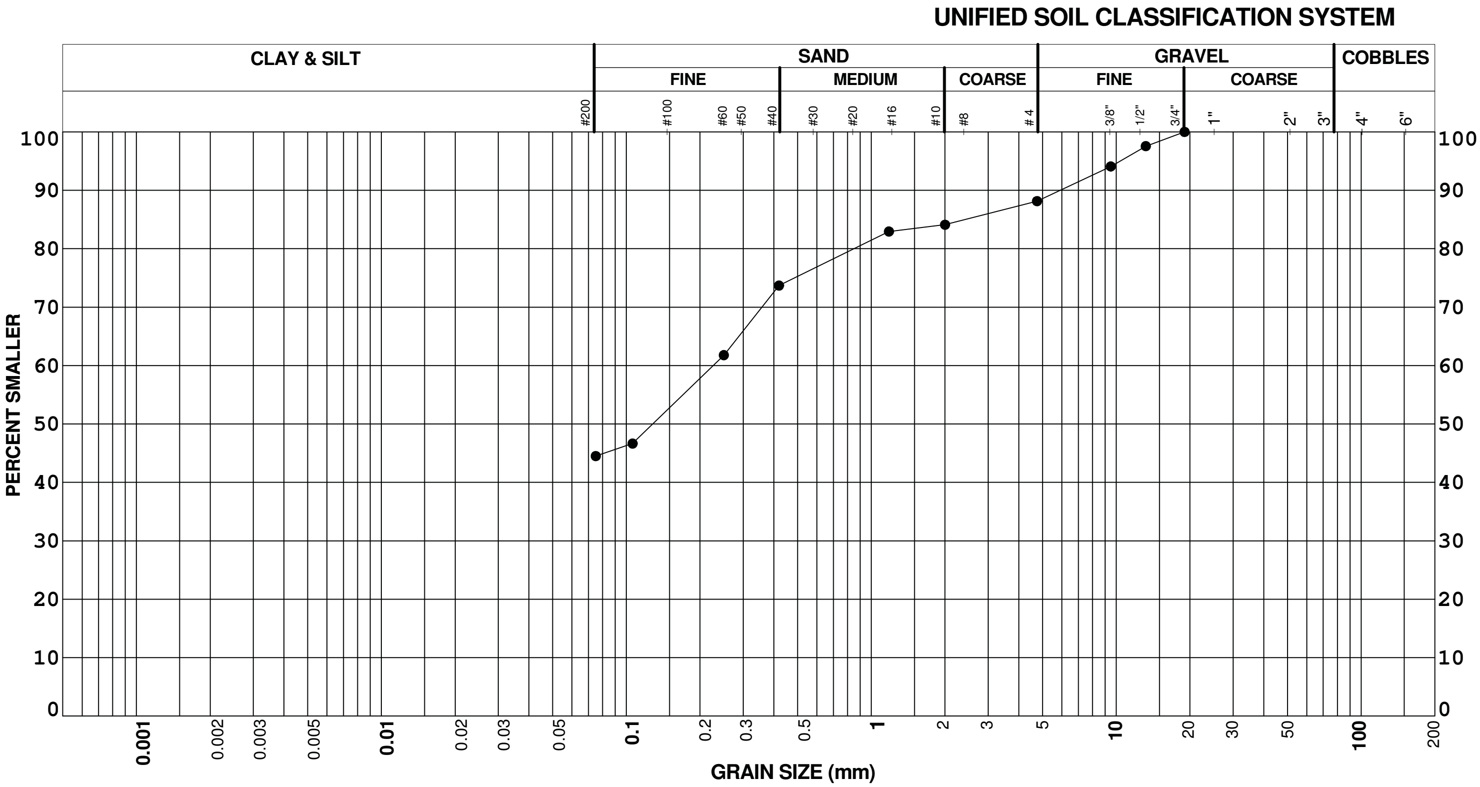
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C023	BS2	5.00	12	44	45		

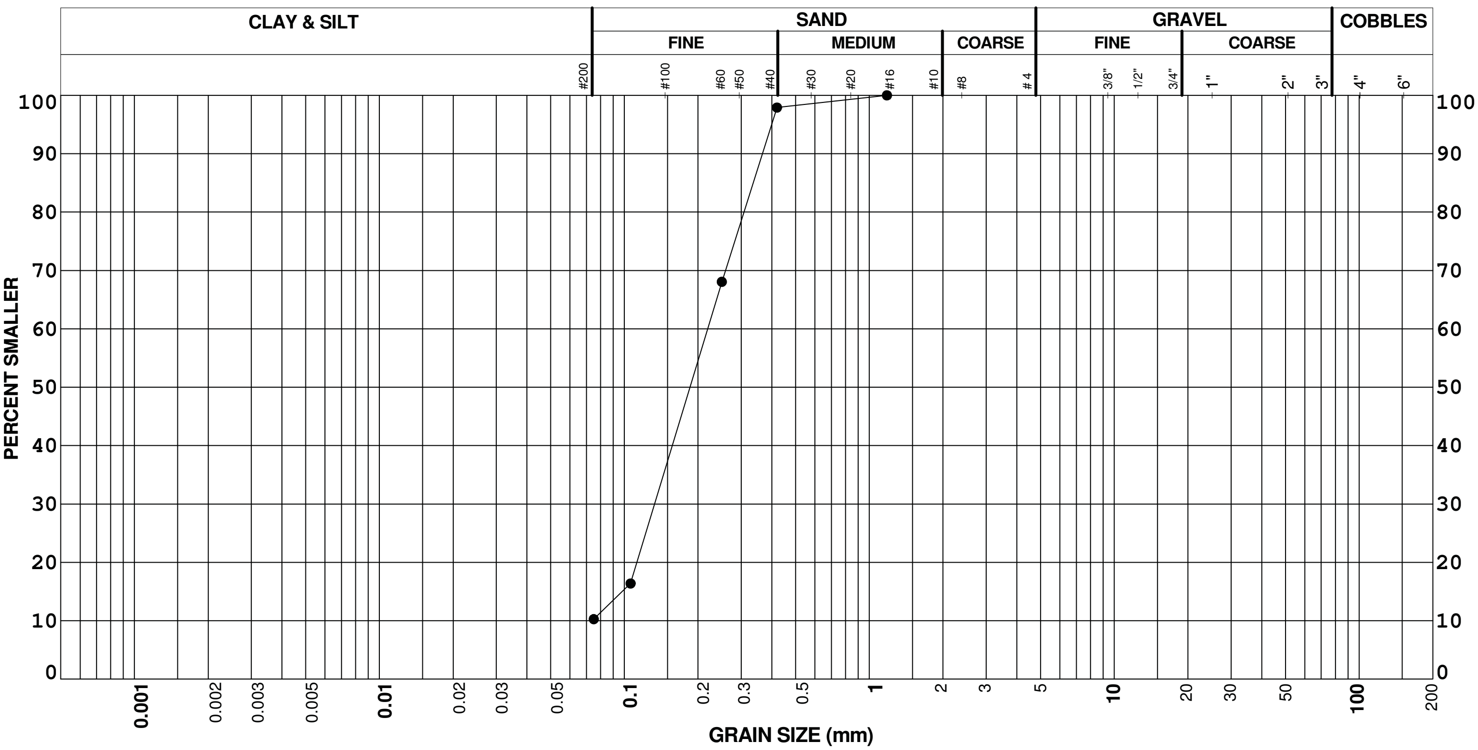
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

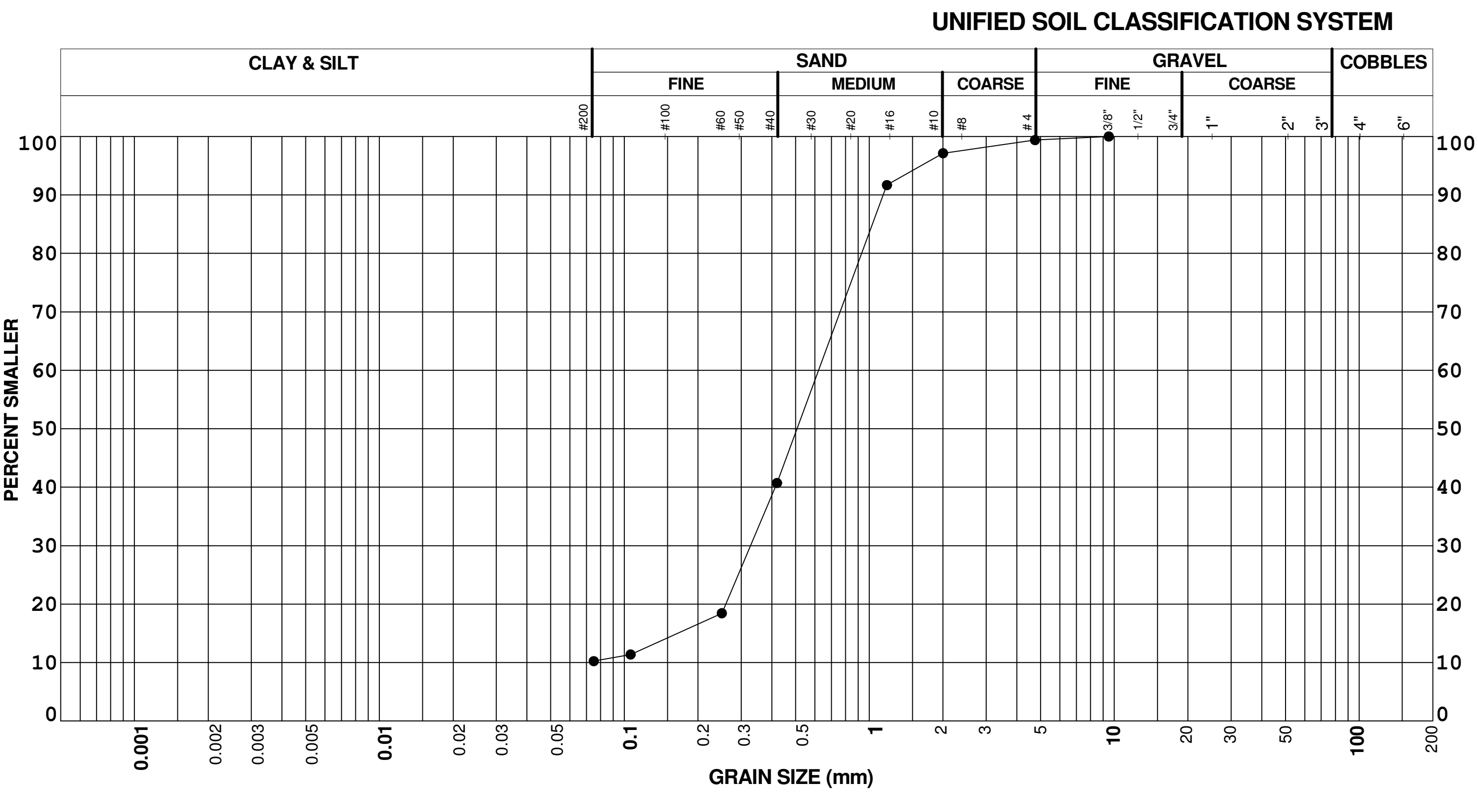
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C024	BS2	5.00	0	90	10		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

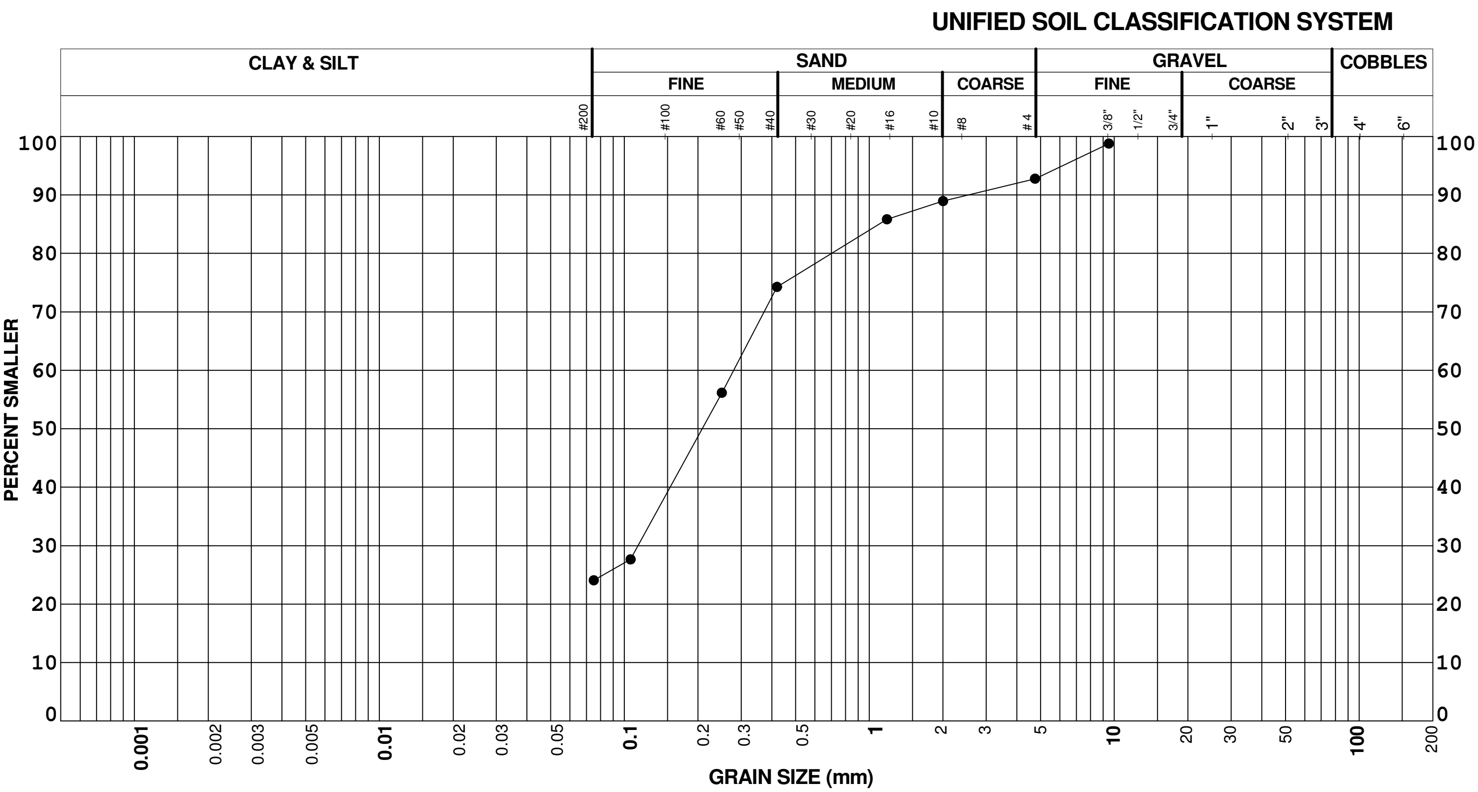
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C025	BS2	4.00	1	89	10		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C026	BS1	2.40	6	69	24		

REMARKS:

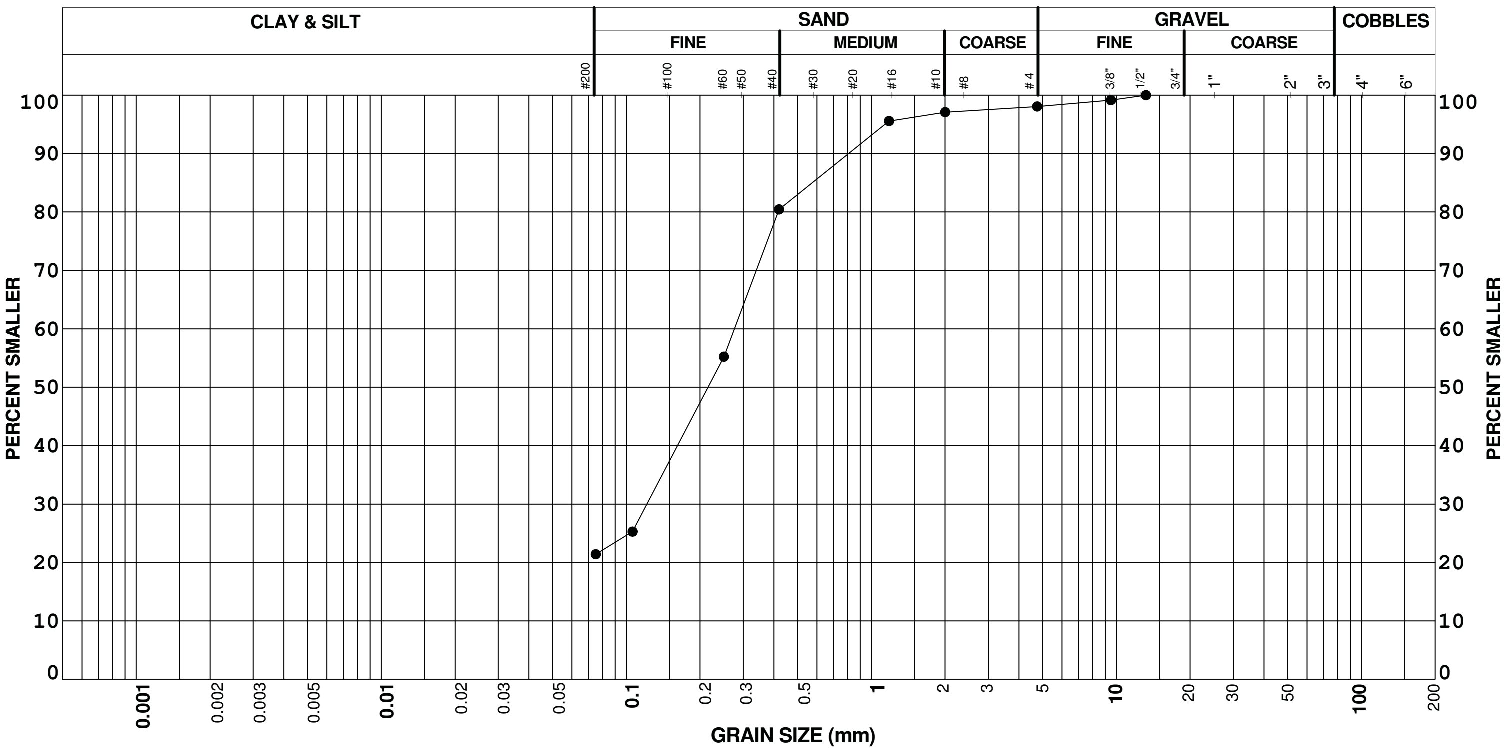
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

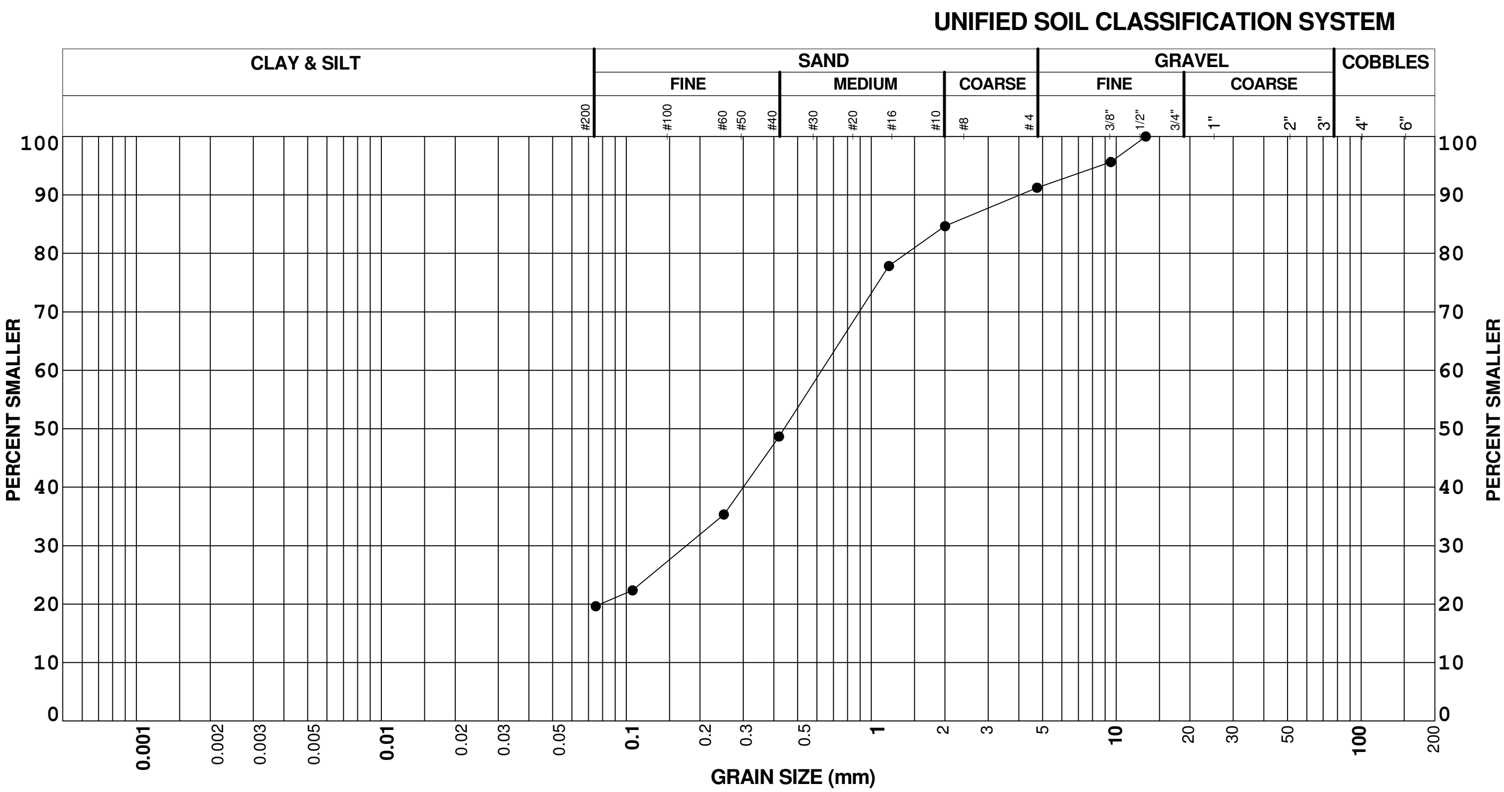
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C026	BS2	4.00	2	77	21		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C027	BS1	4.00	9	72	20		

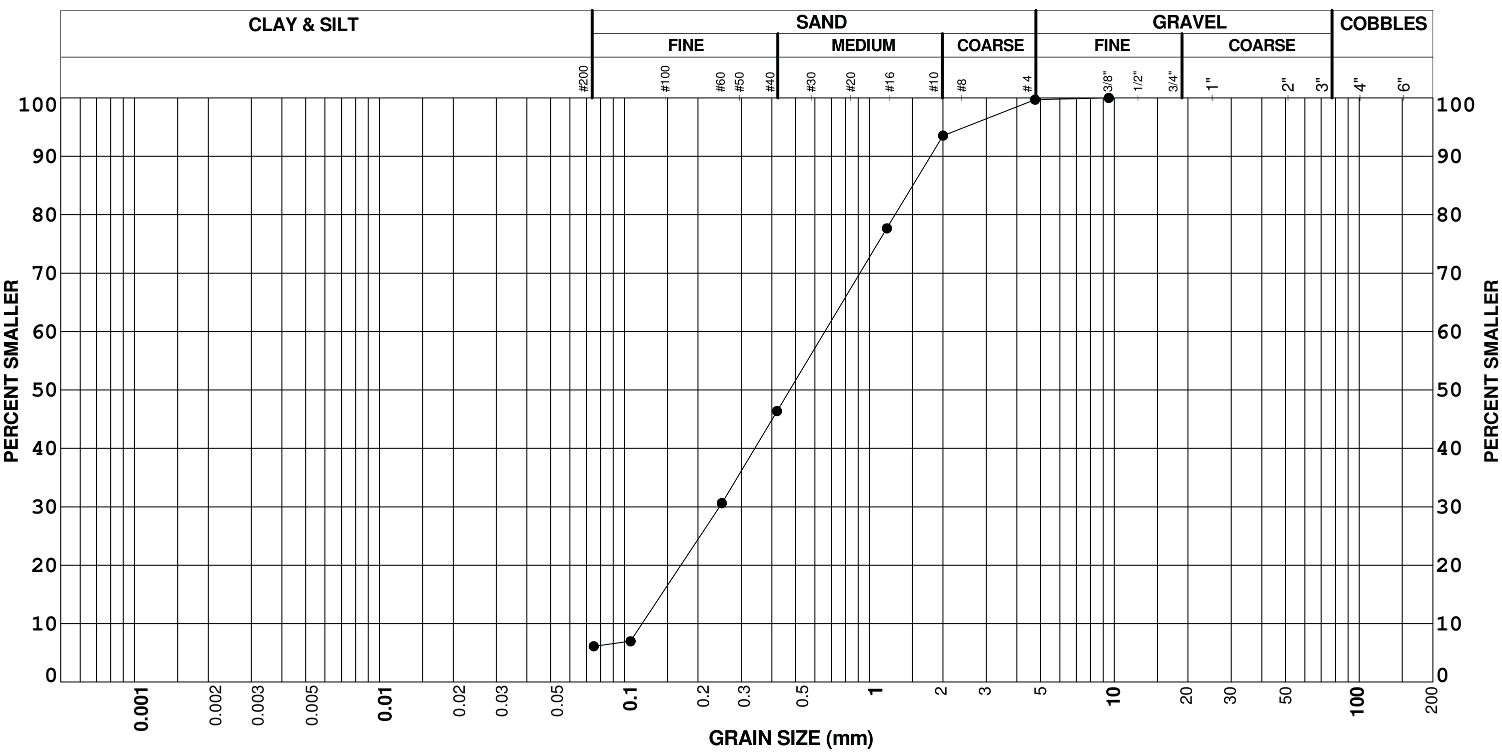
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C028	BS2	8.80	0	94	6		

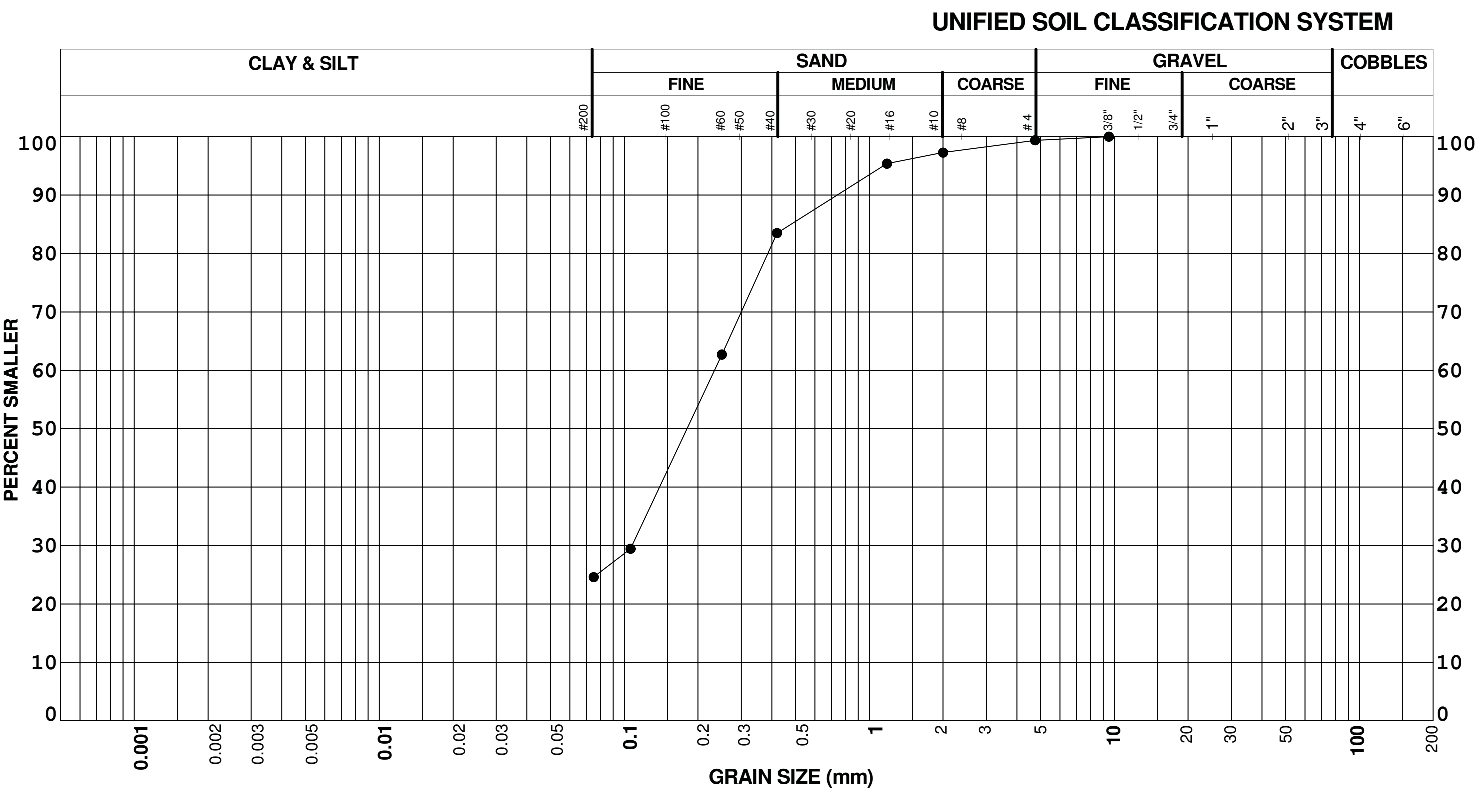
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C029	BS2	2.40	1	75	25		

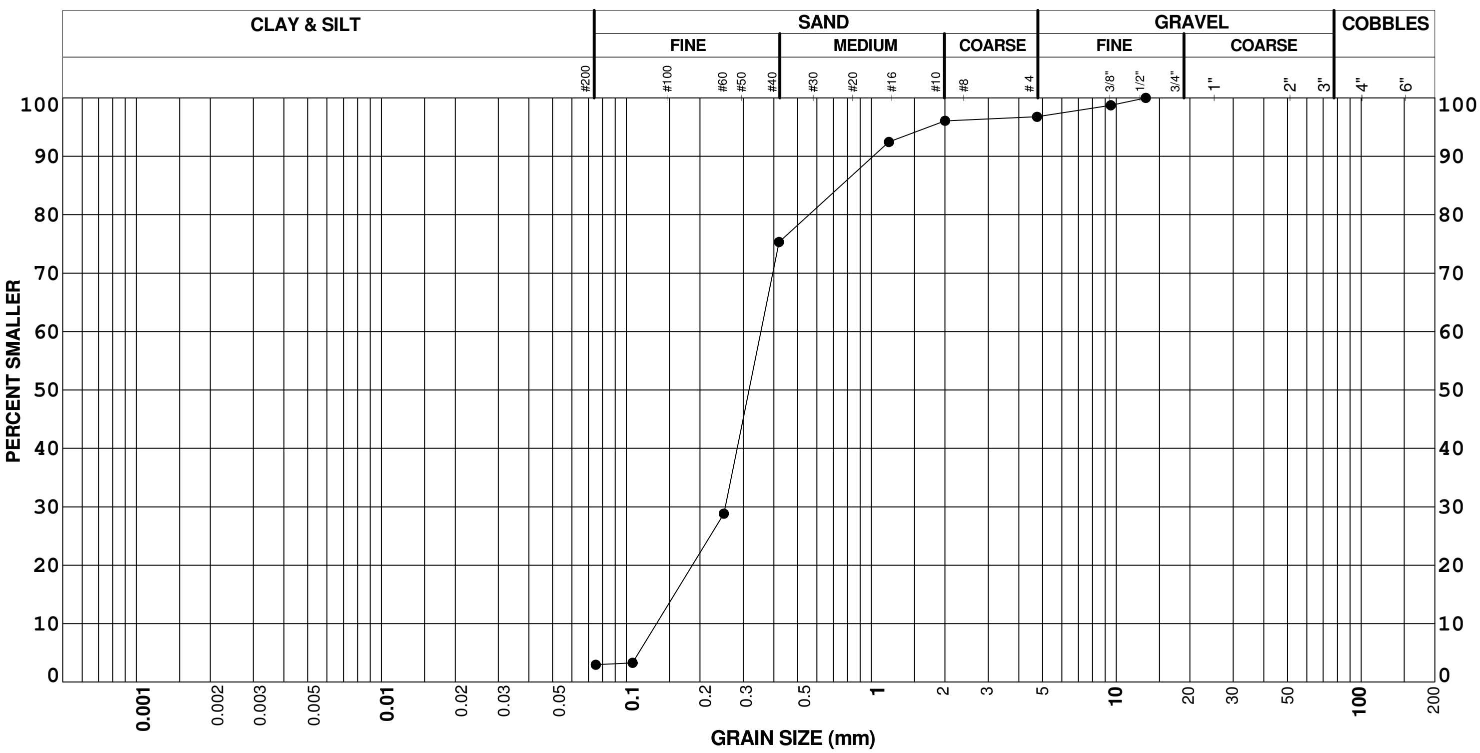
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

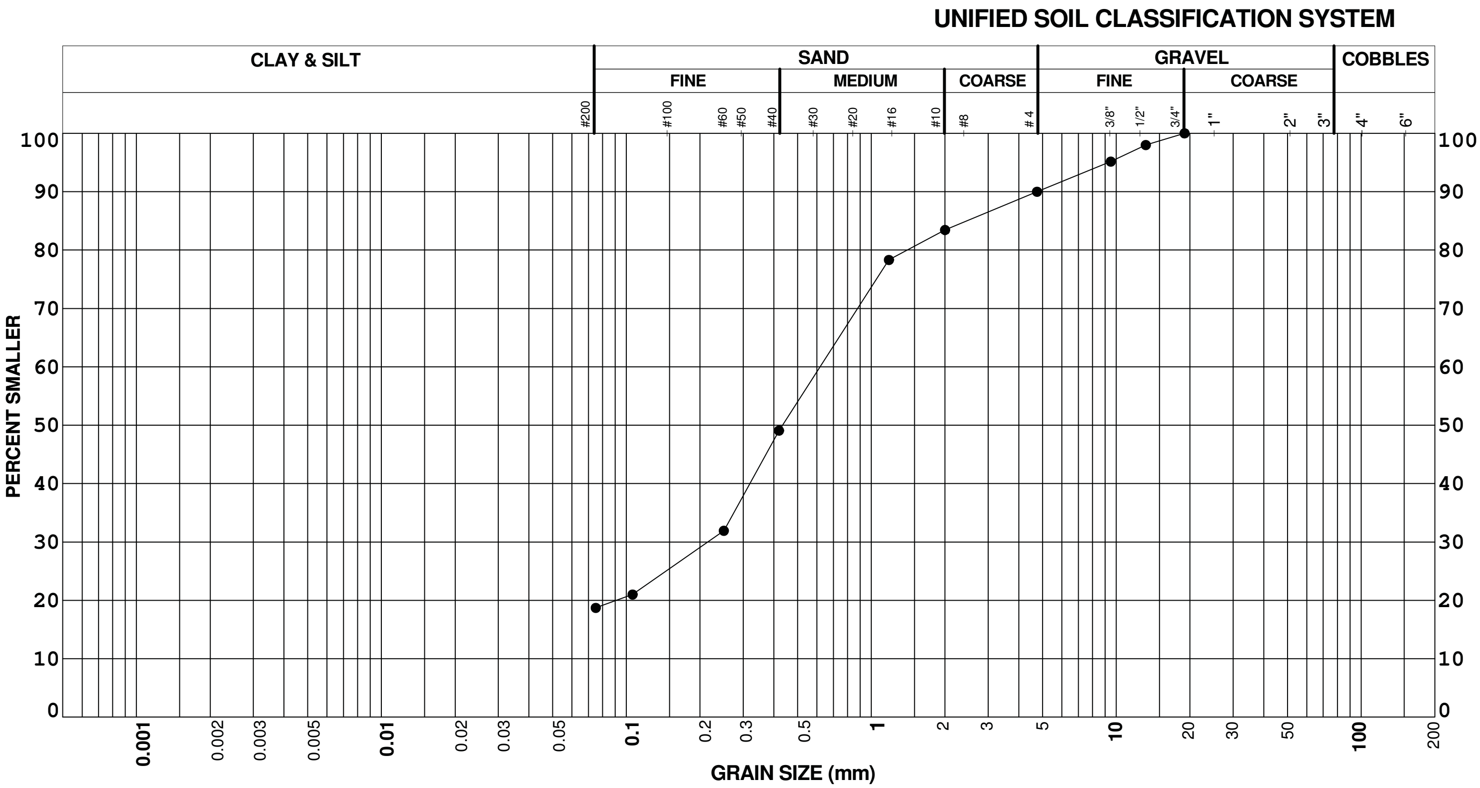
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C030	BS4	5.00	3	94	3		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C032	BS2	2.40	10	71	19		

REMARKS:

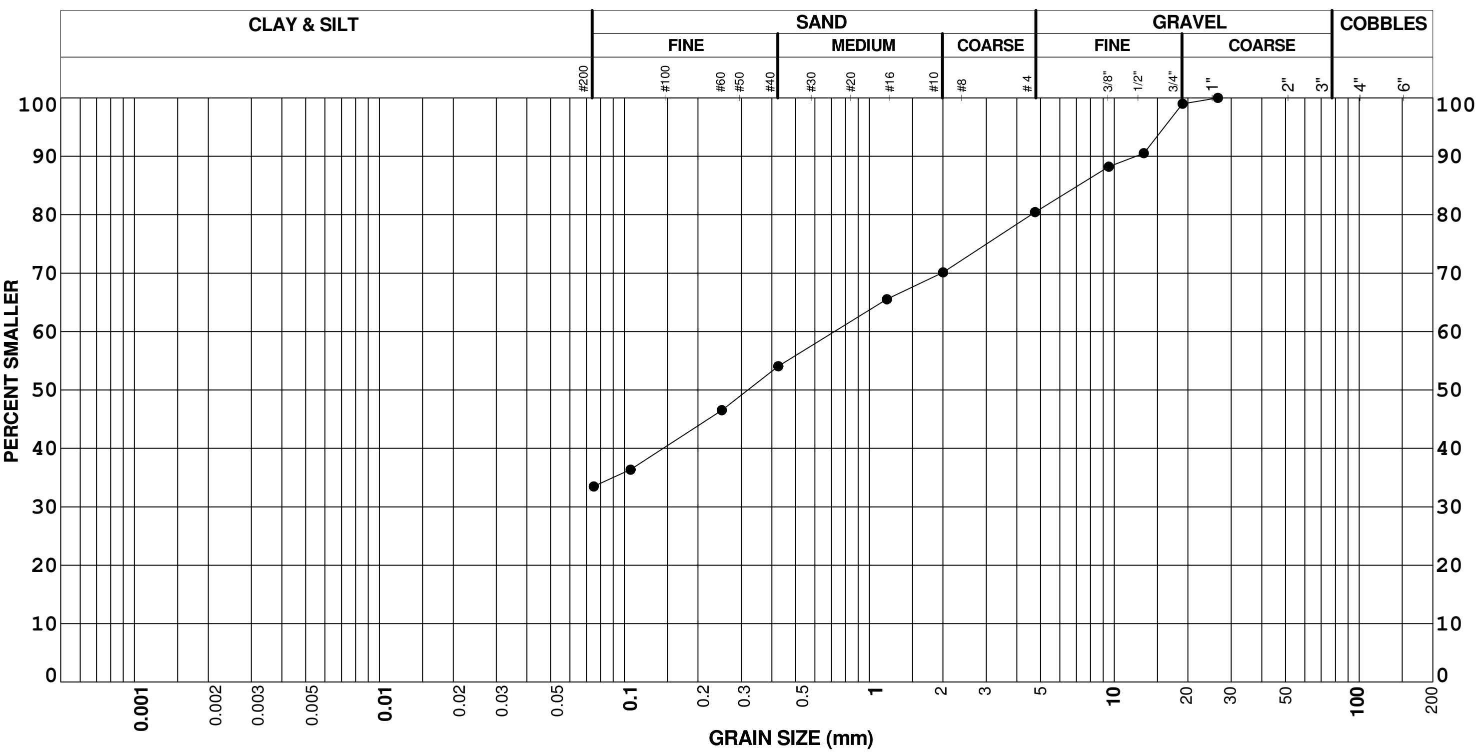
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-C205	BS3	4.00	20	47	33		

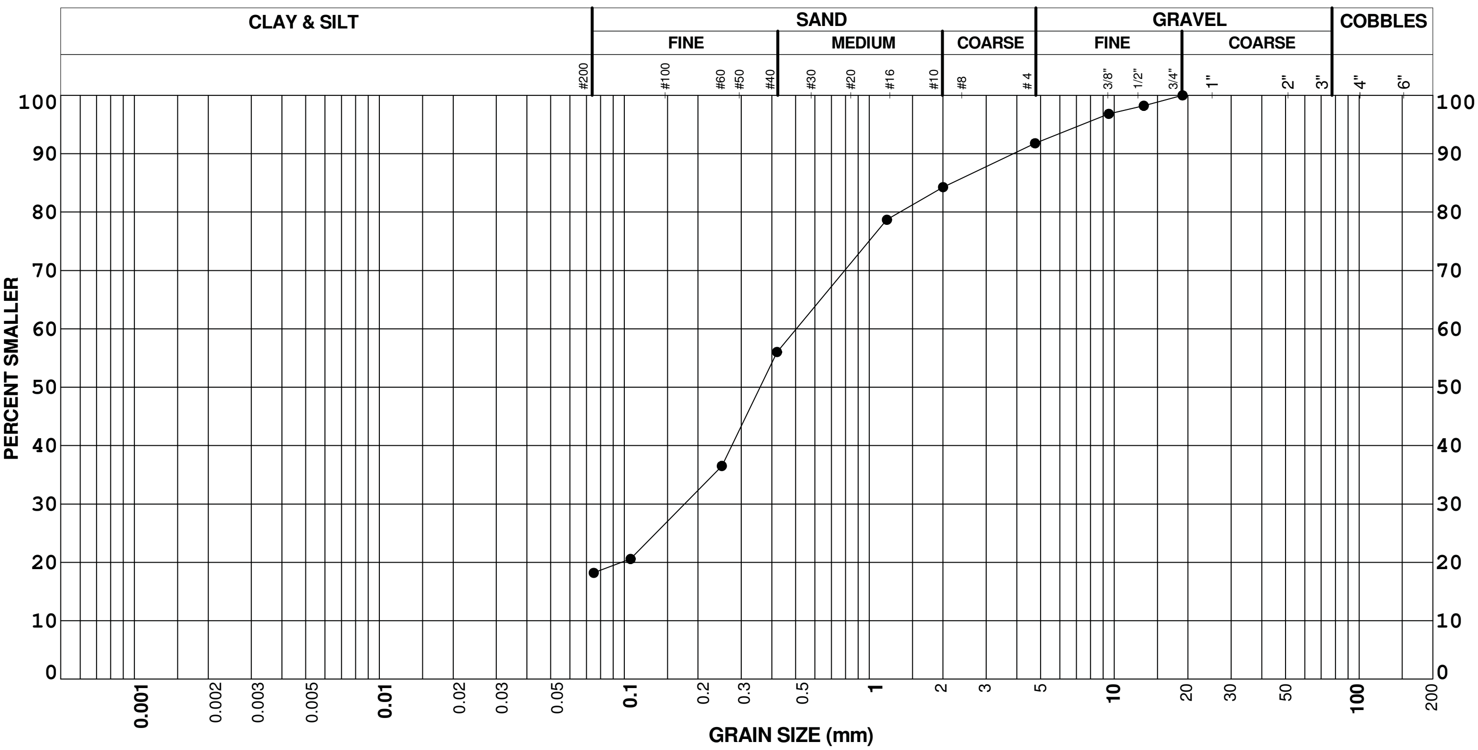
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

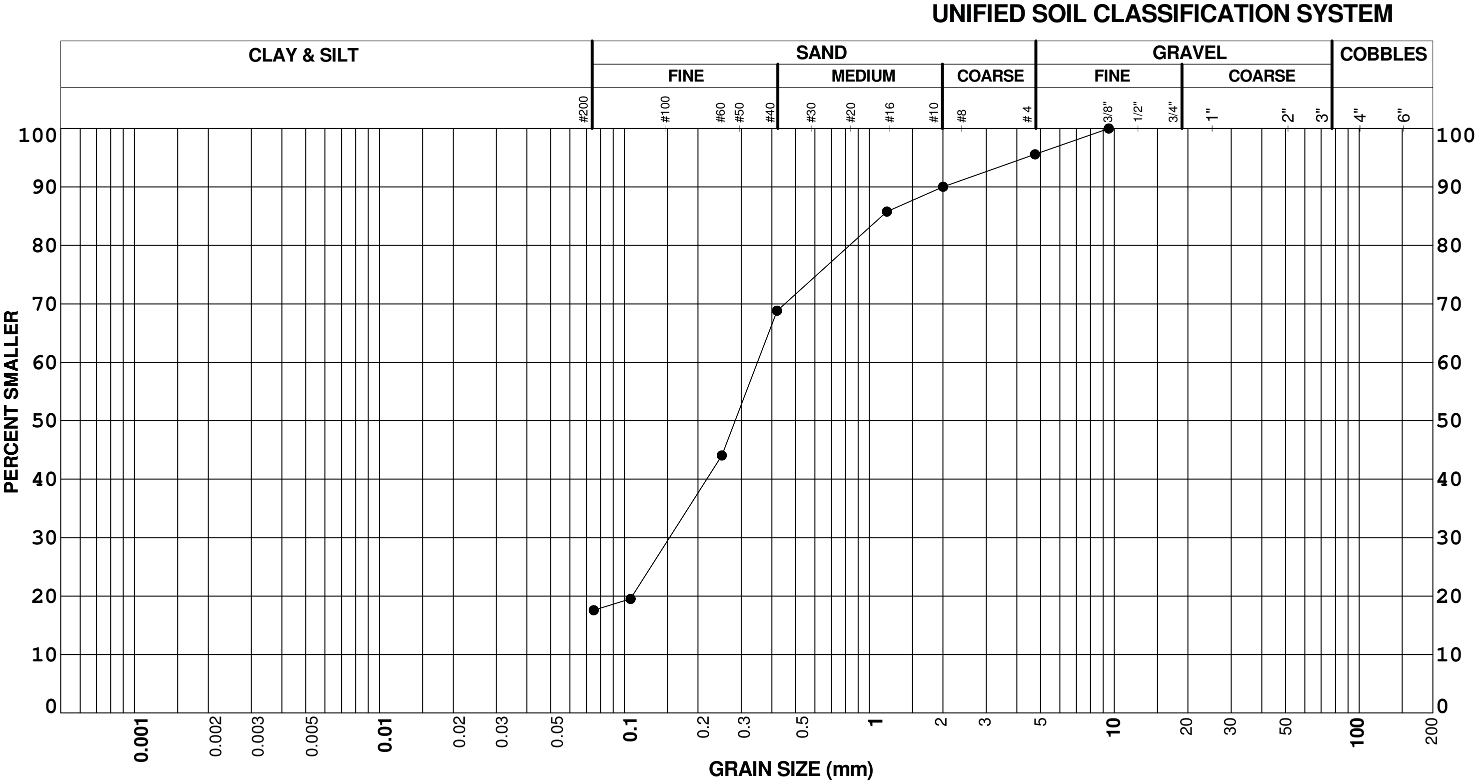
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R004	BS2	2.51	8	74	18		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

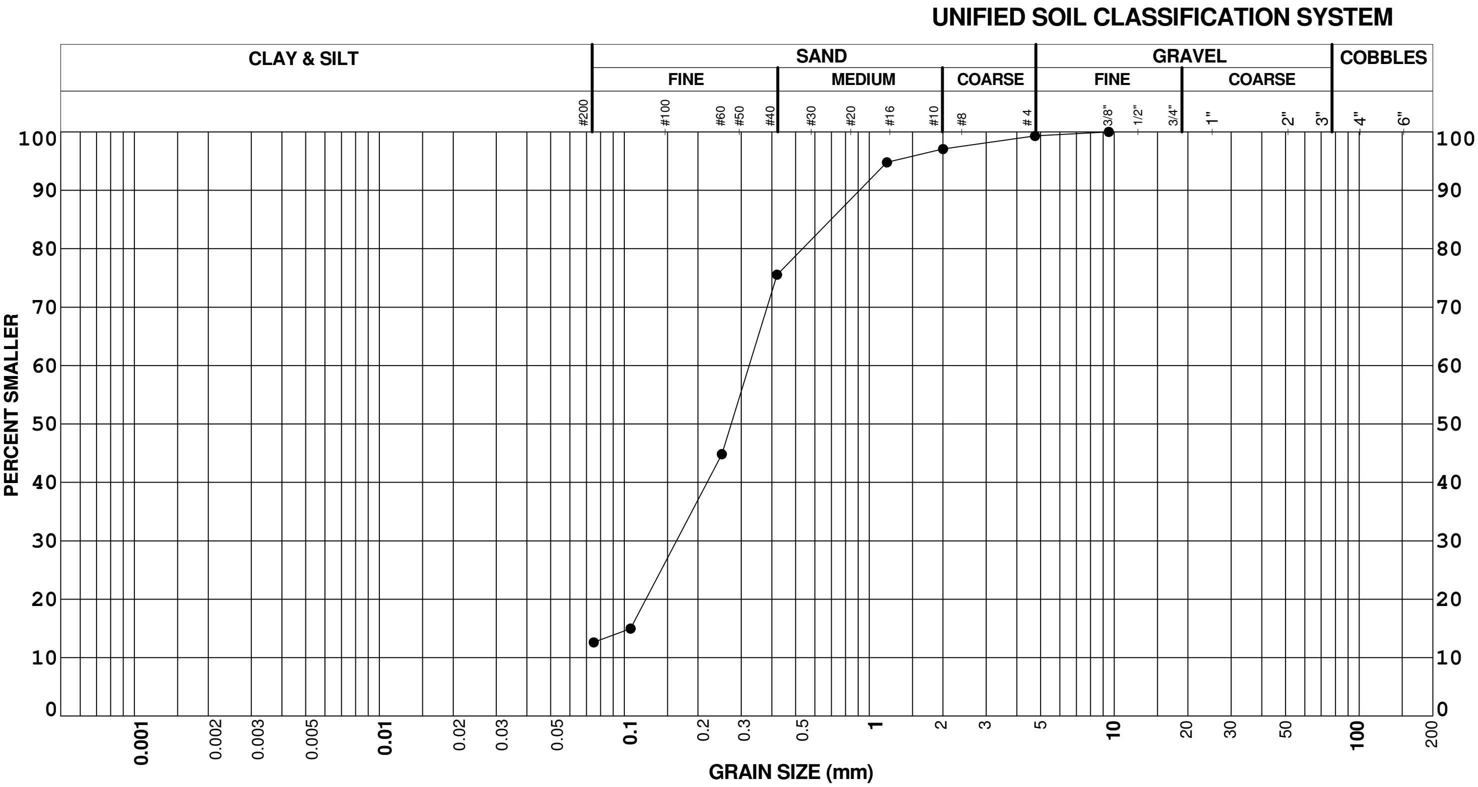
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R005	BS2	2.50	4	78	18		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

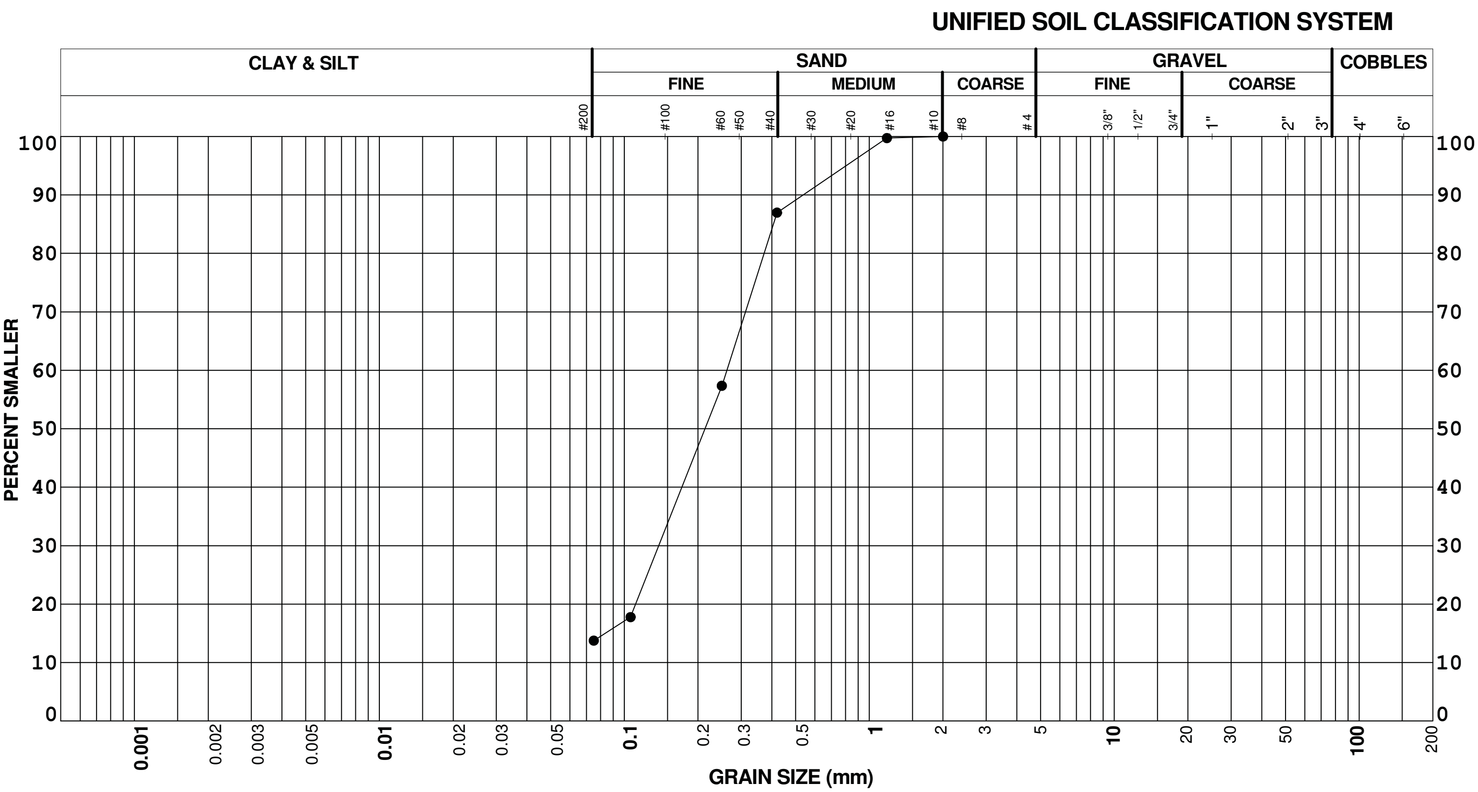
	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH16-R007	BS2	2.50	1	87	13		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R011	BS2	2.50	0	86	14		

REMARKS:

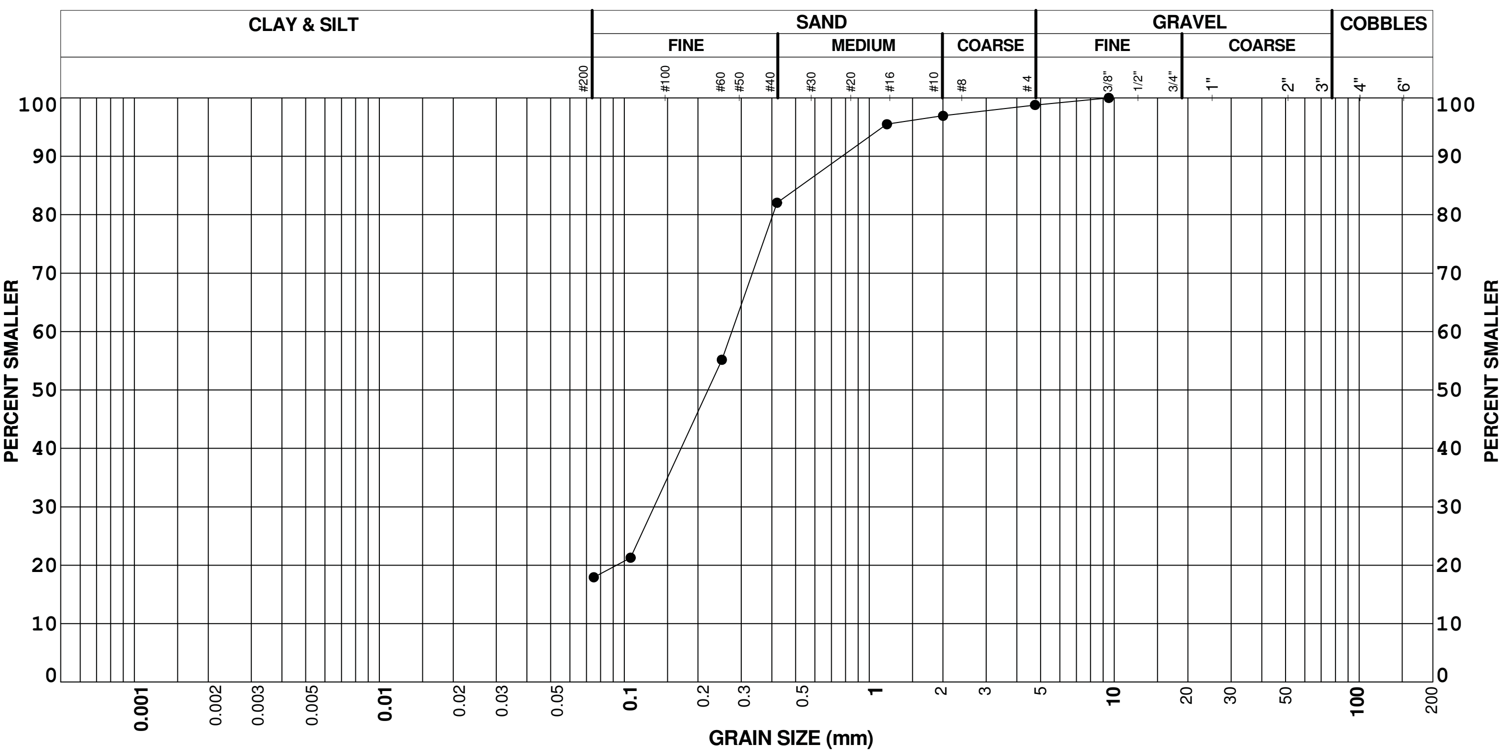
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

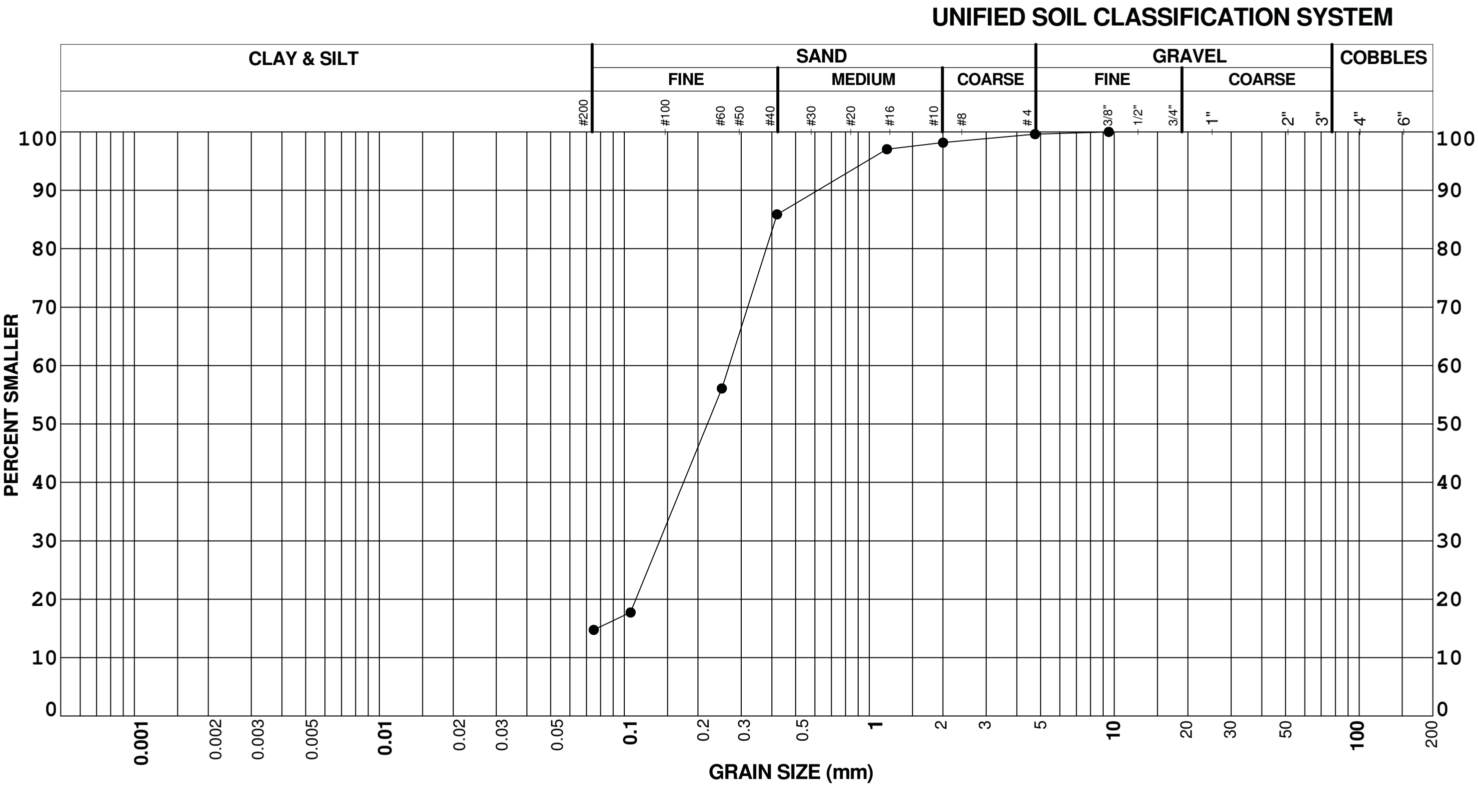
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R012	BS2	2.50	1	81	18		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R013	BS2	2.50	0	85	15		

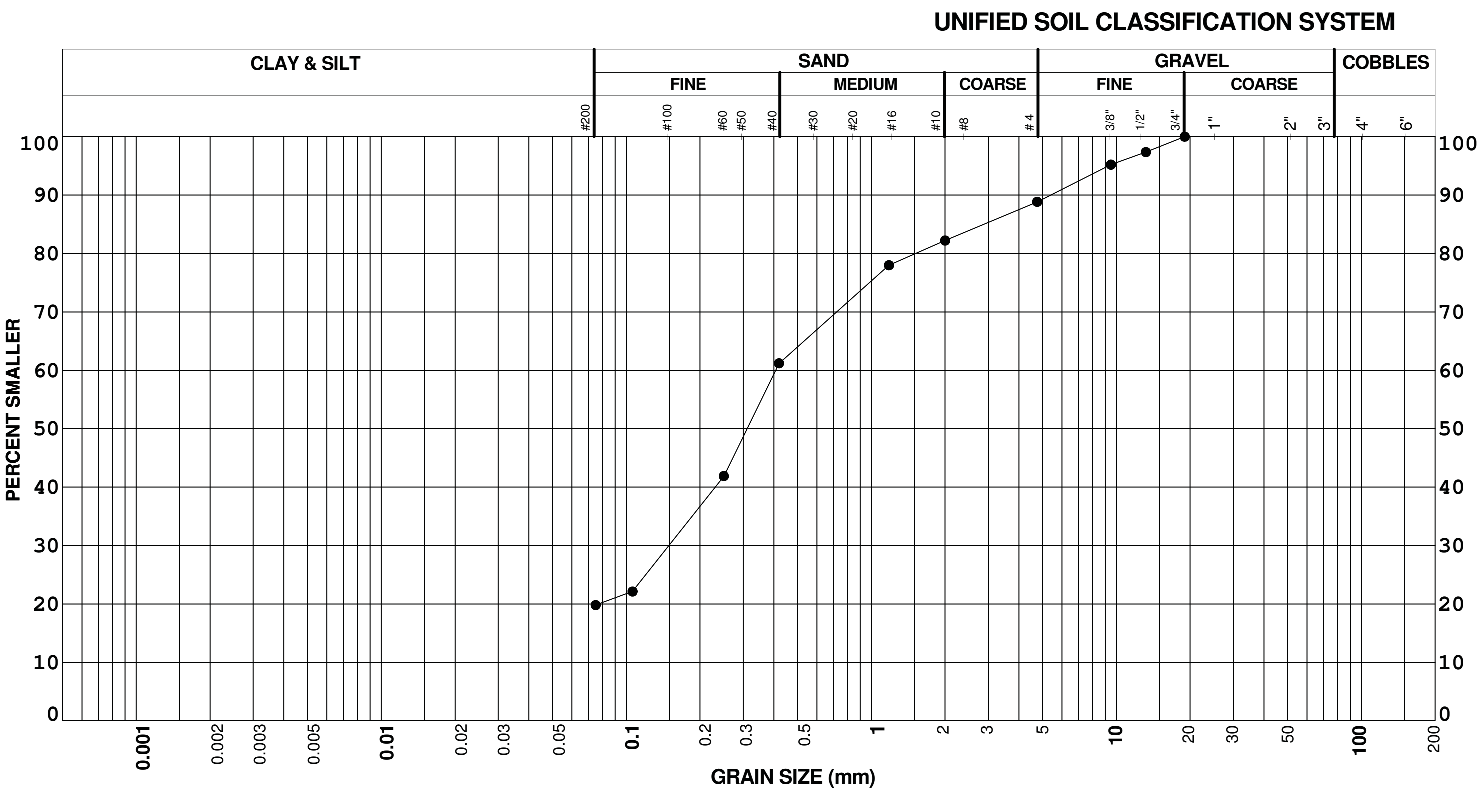
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R014	BS2	2.00	11	69	20		

REMARKS:

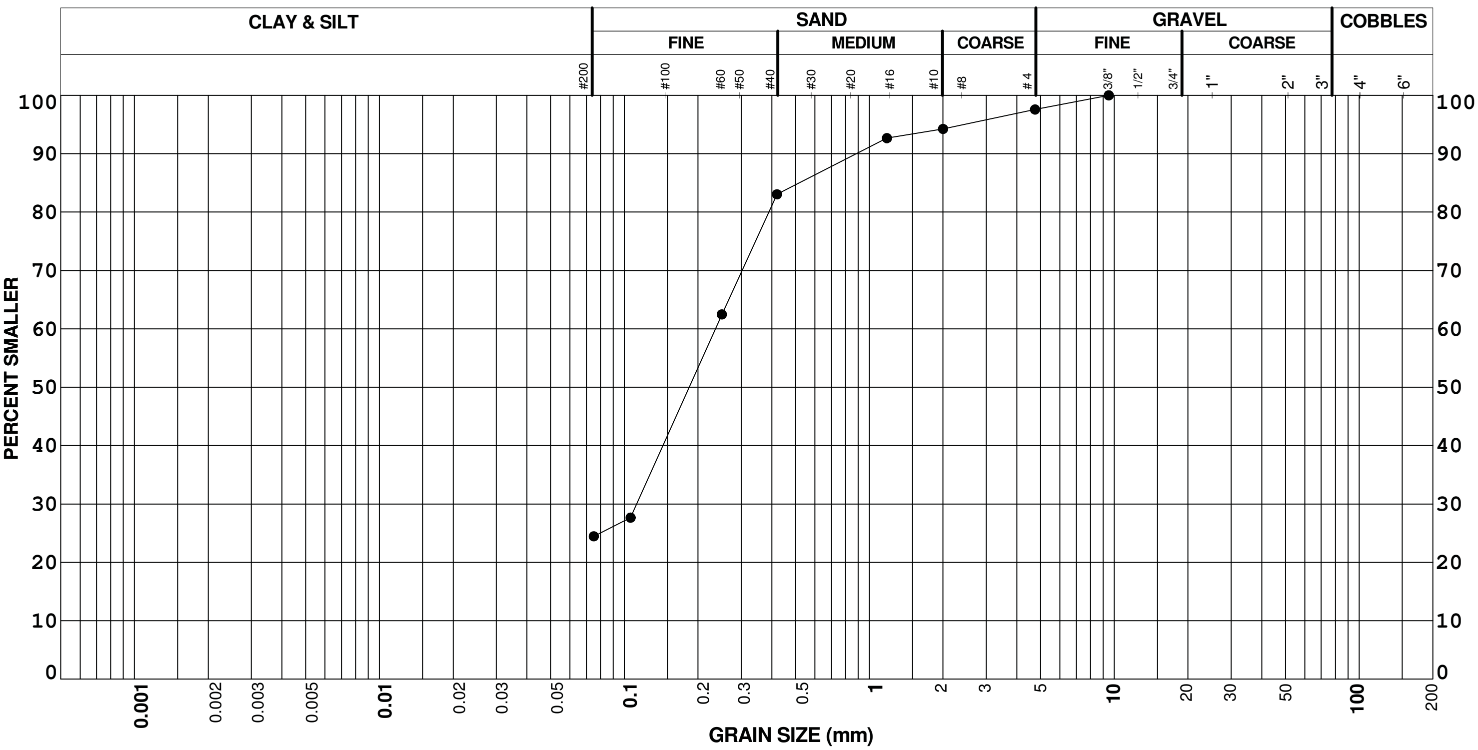
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

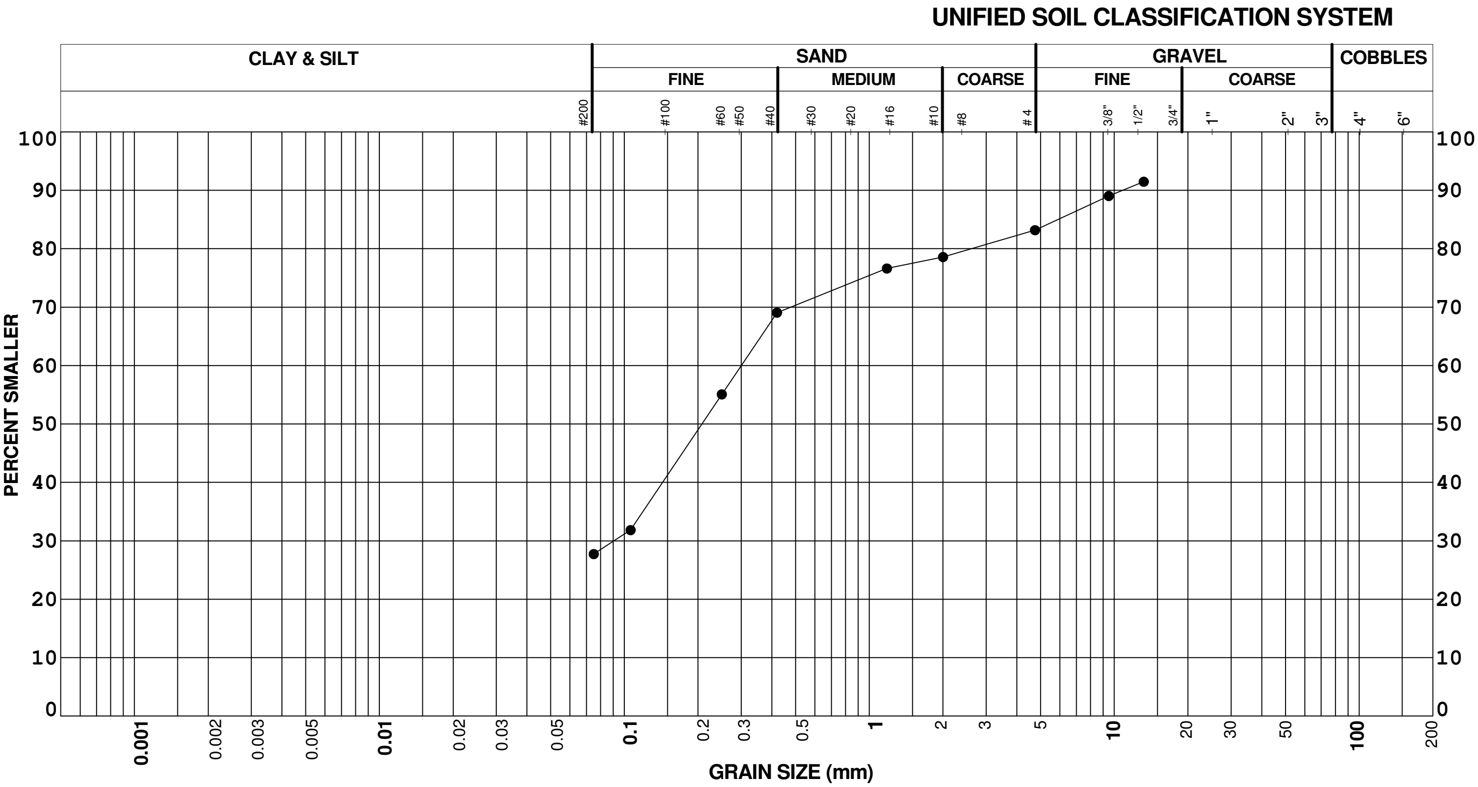
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R015	BS3	4.00	2	73	24		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R016	BS2	2.00	8	55	28		

REMARKS:

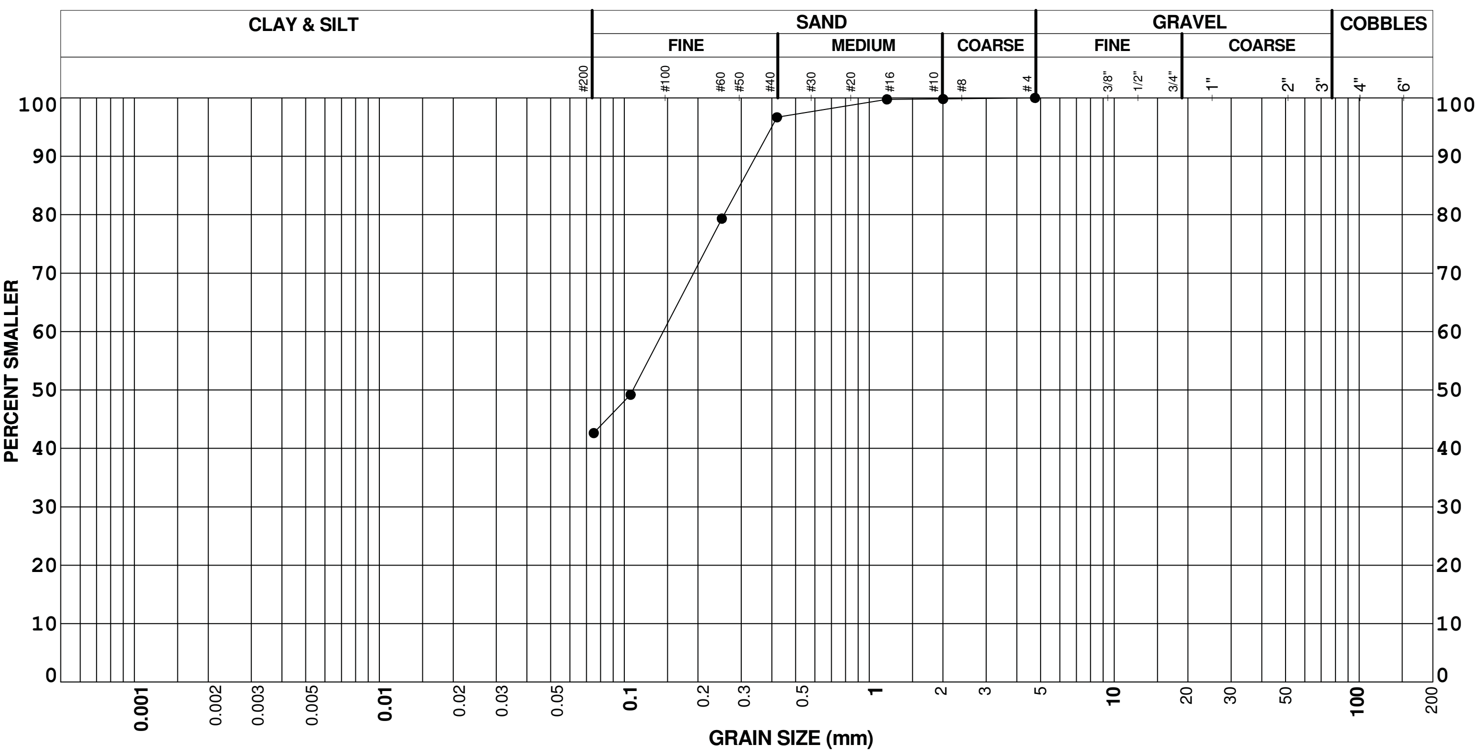
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R020	BS3	4.00	0	57	43		

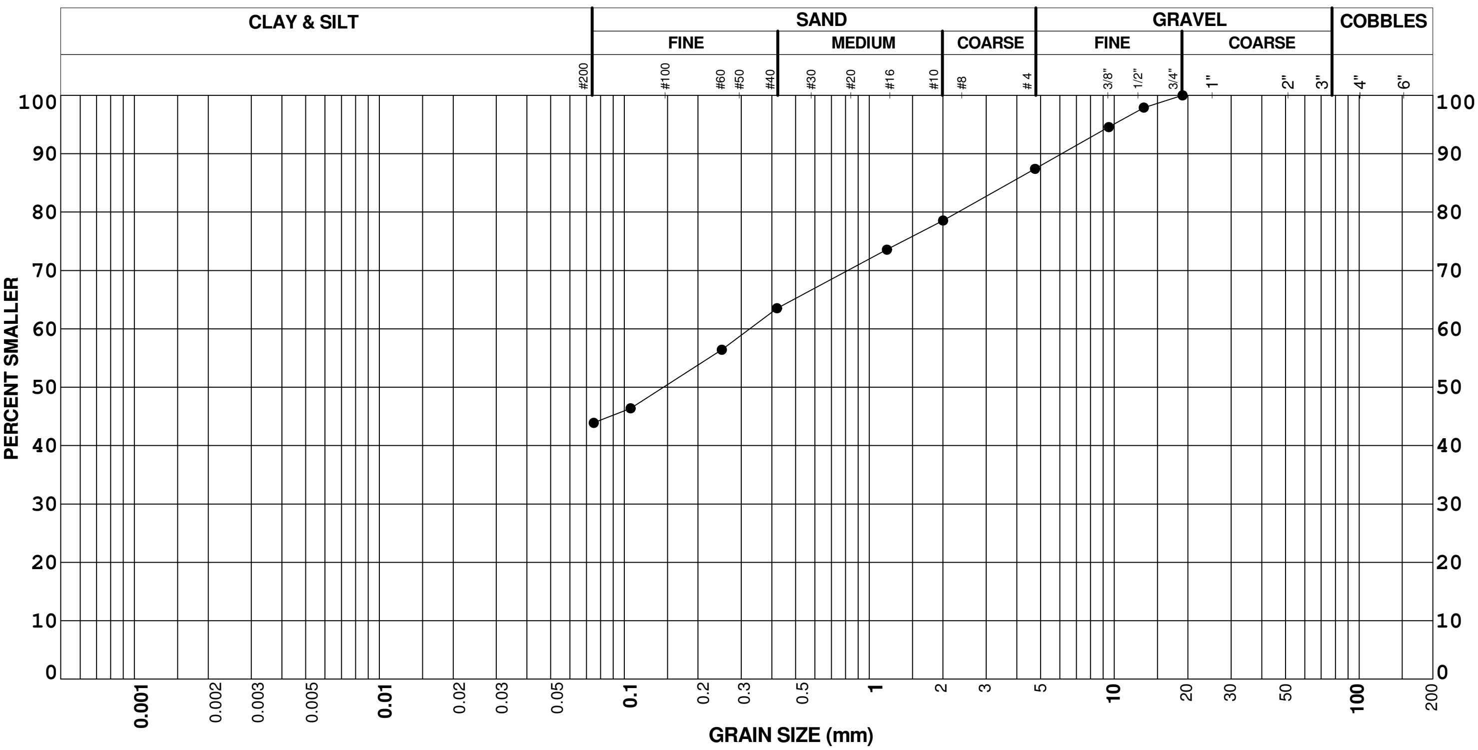
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

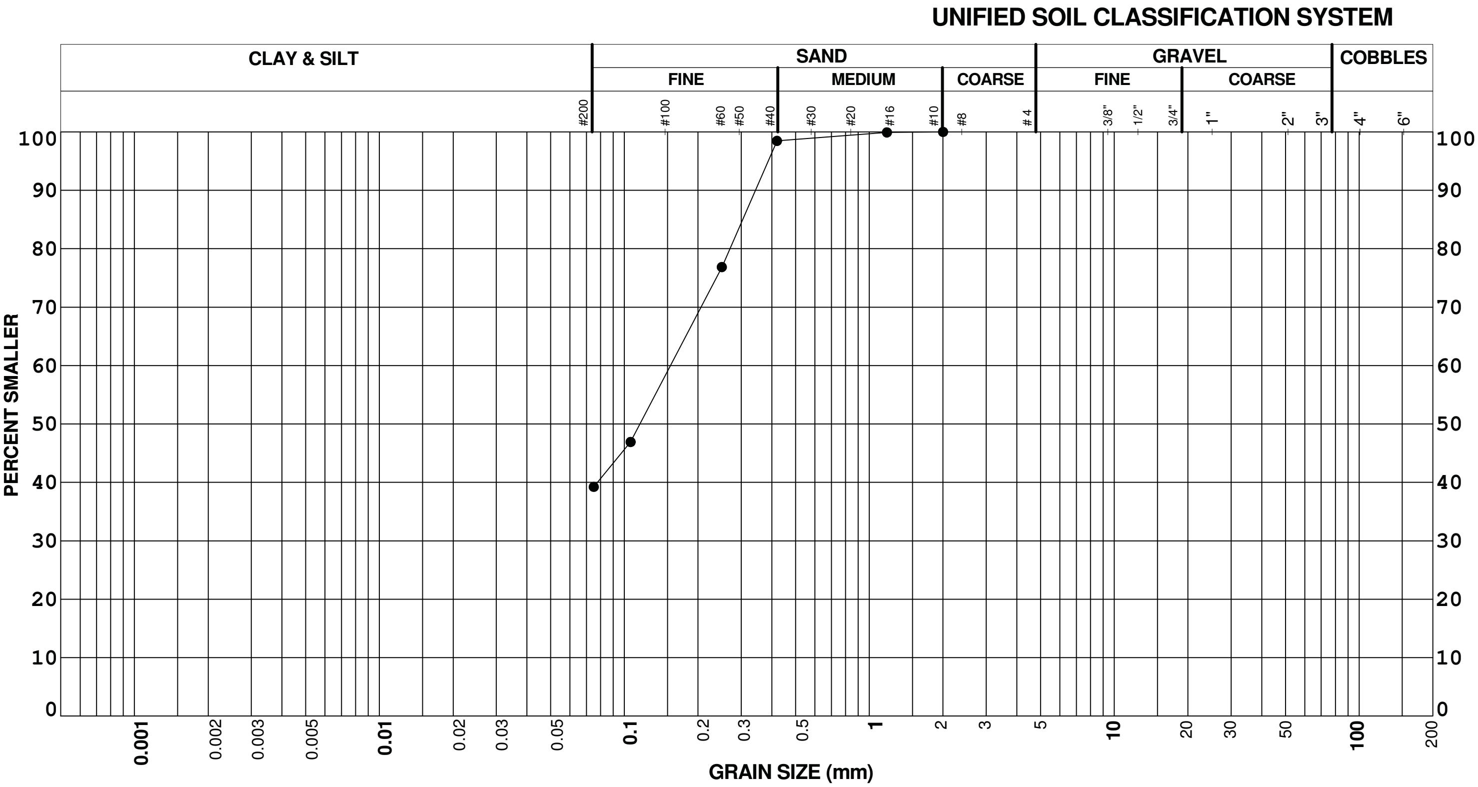
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R022	BS3	4.00	13	44	44		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH16-R023	BS2	2.00	0	61	39		

REMARKS:

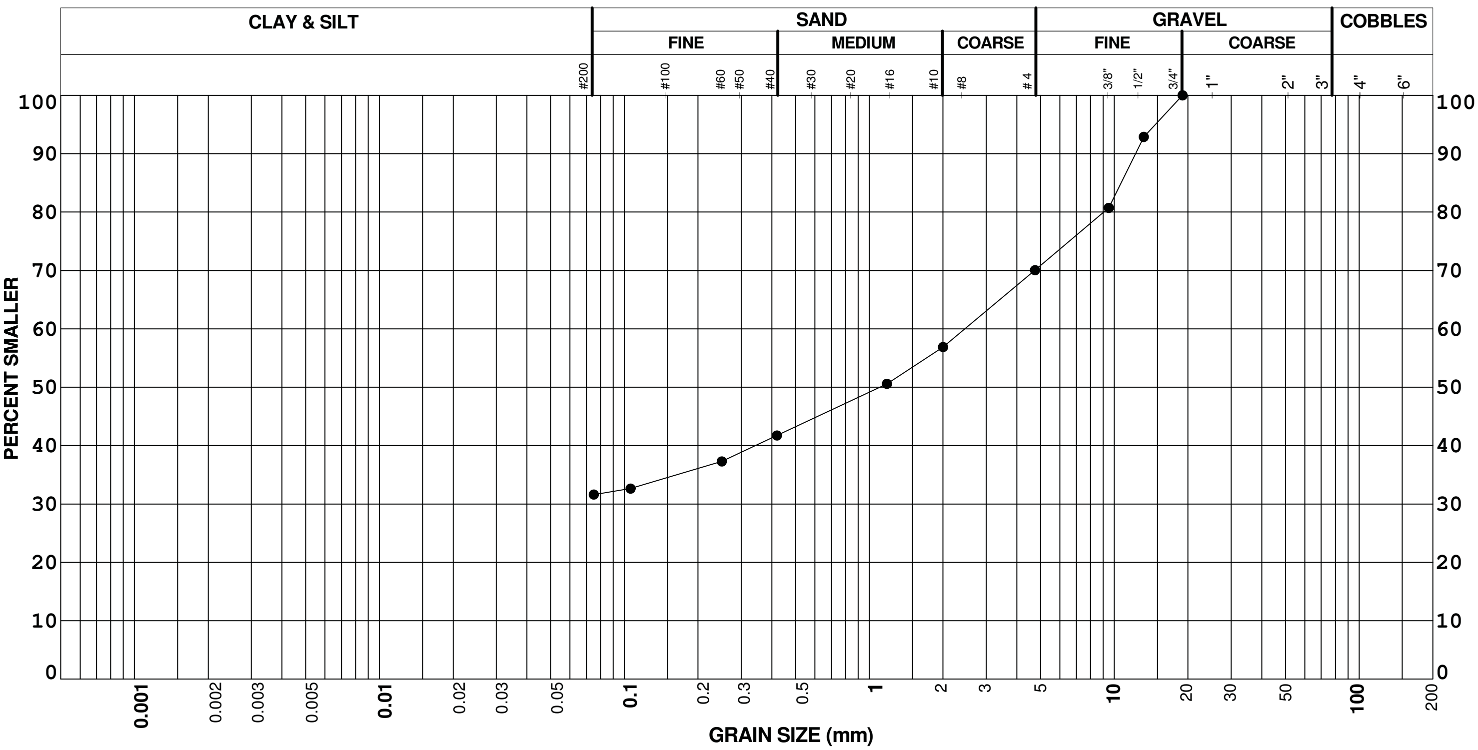
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R024	BS2	1.50	30	38	32		

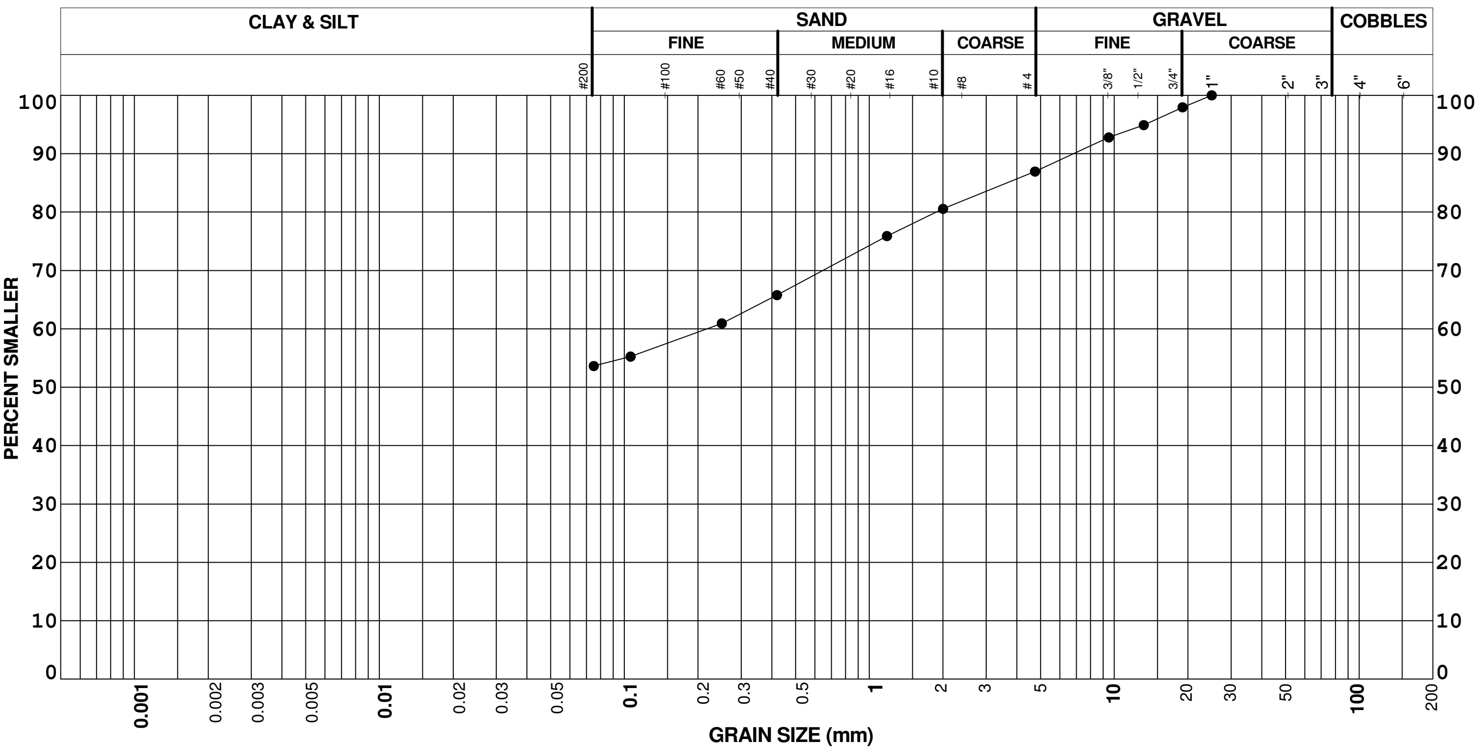
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

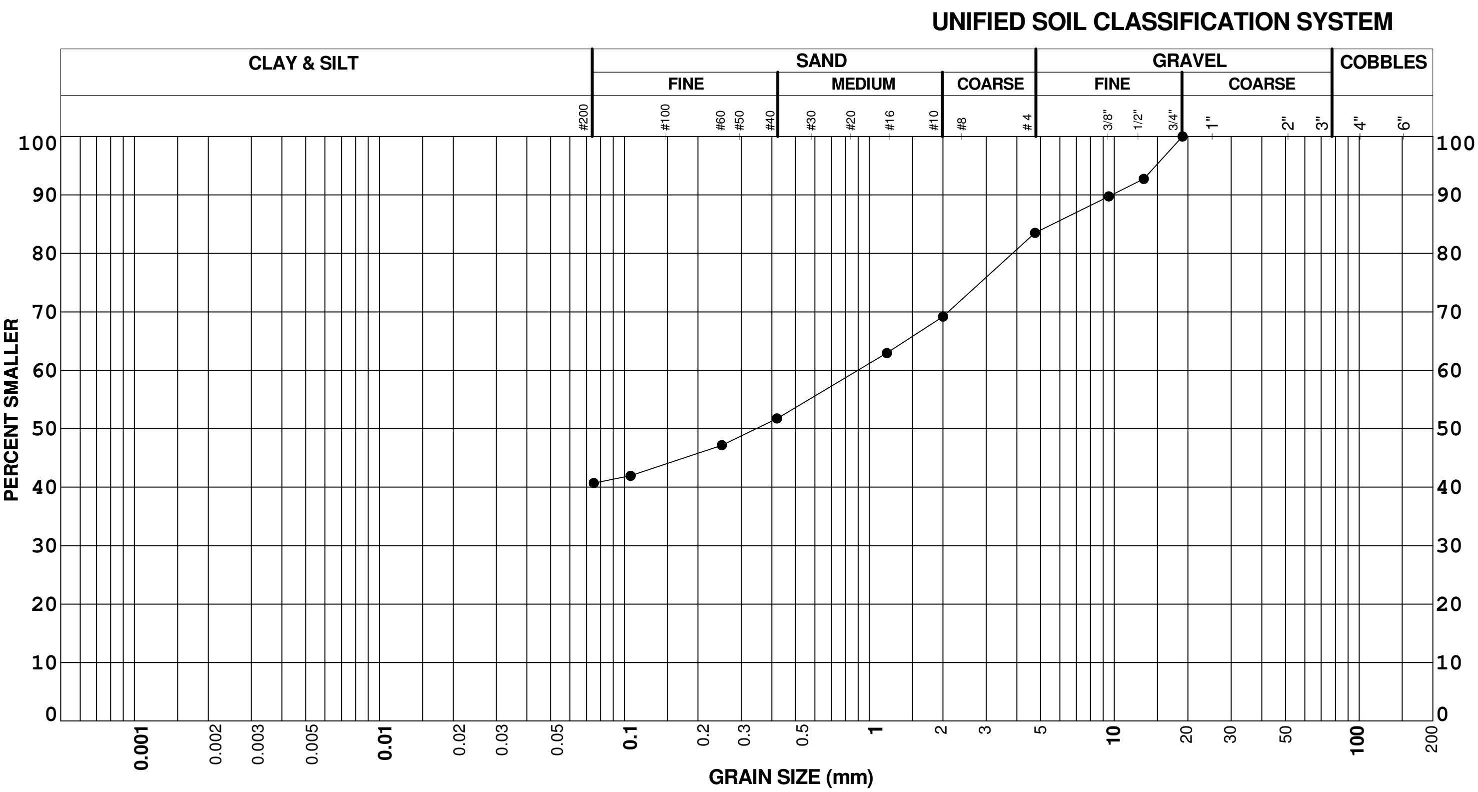
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R025	BS1	1.00	13	33	54		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R025	BS2	2.50	16	43	41		

REMARKS:

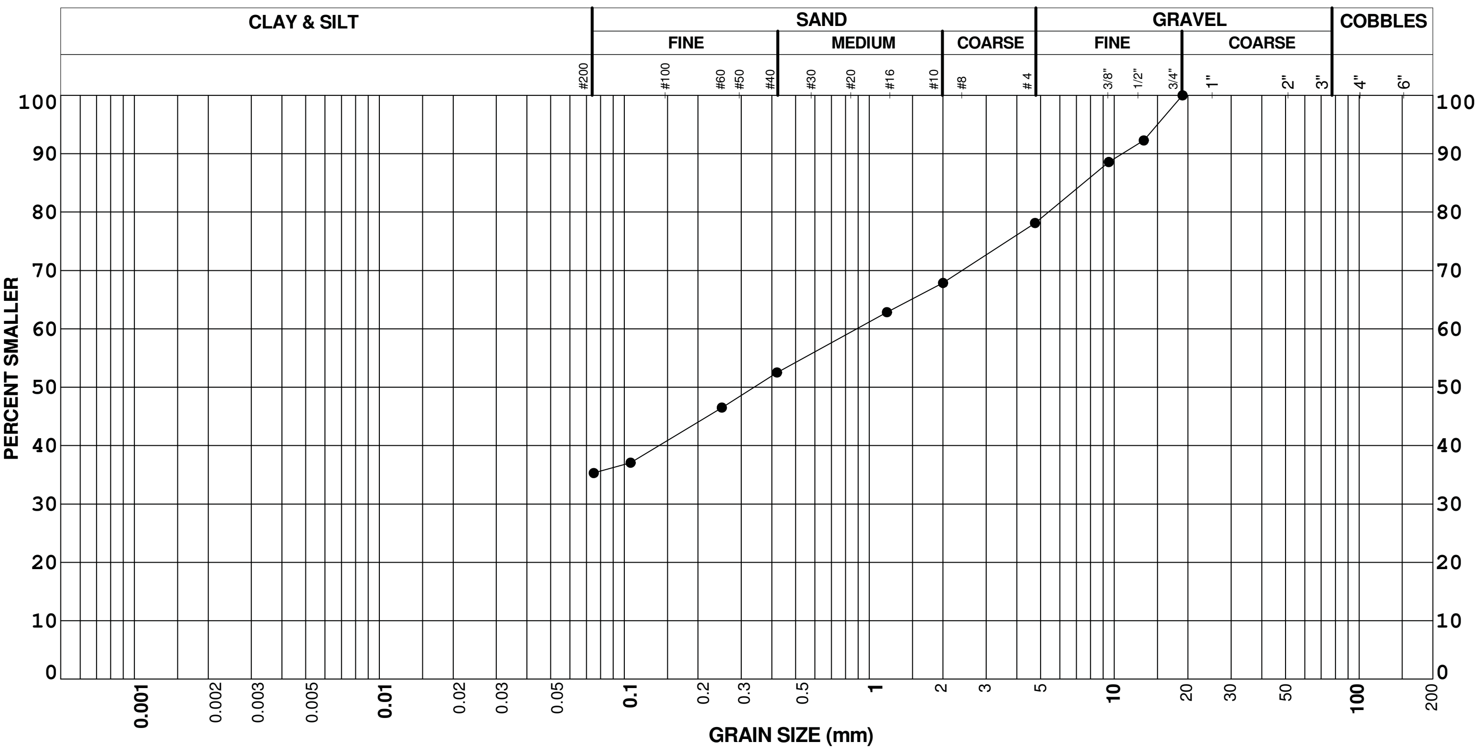
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



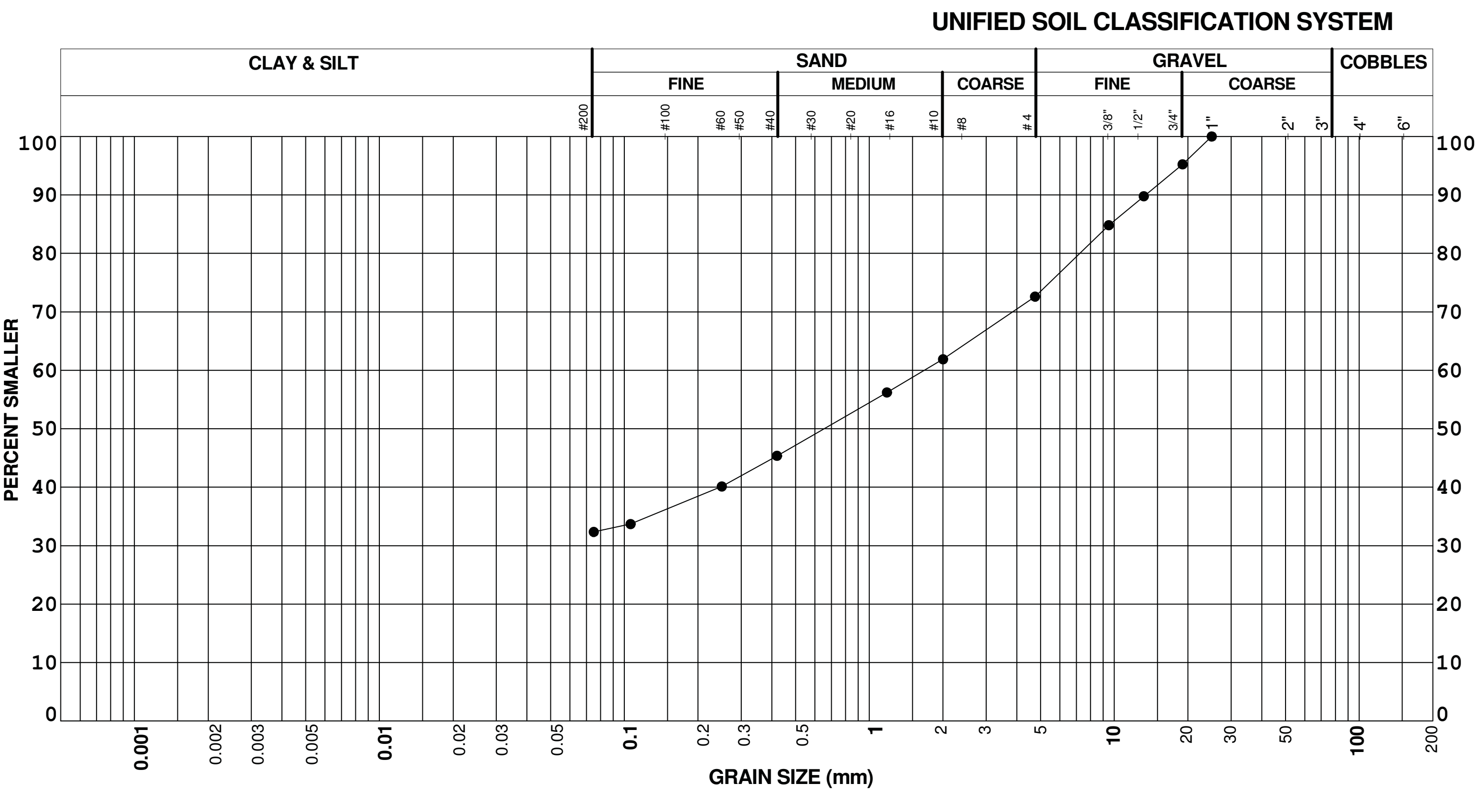
REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R027	BS1	1.00	22	43	35		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R034	BS2	2.50	27	40	32		

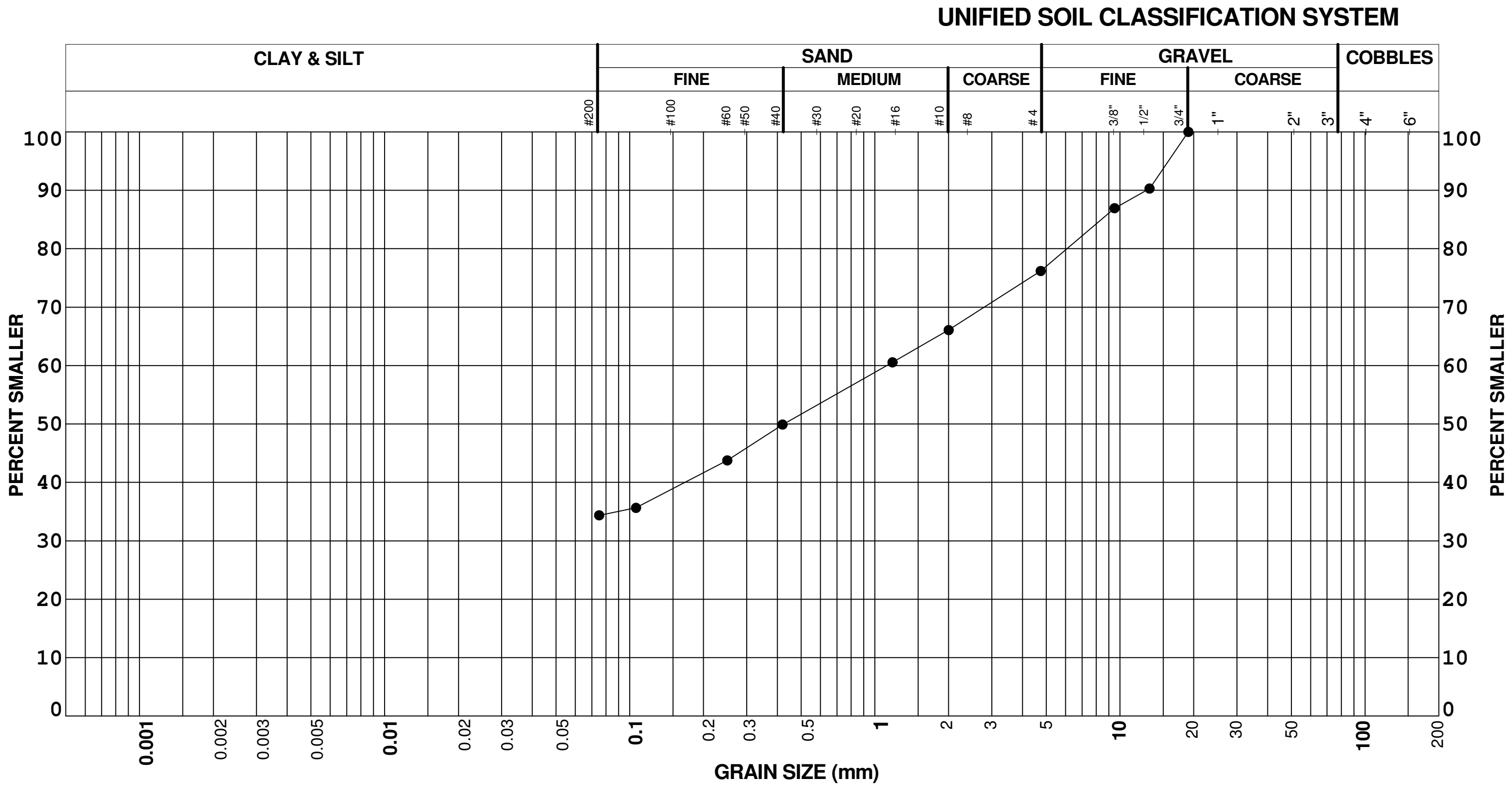
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R035	BS2	2.50	24	42	34		

REMARKS:

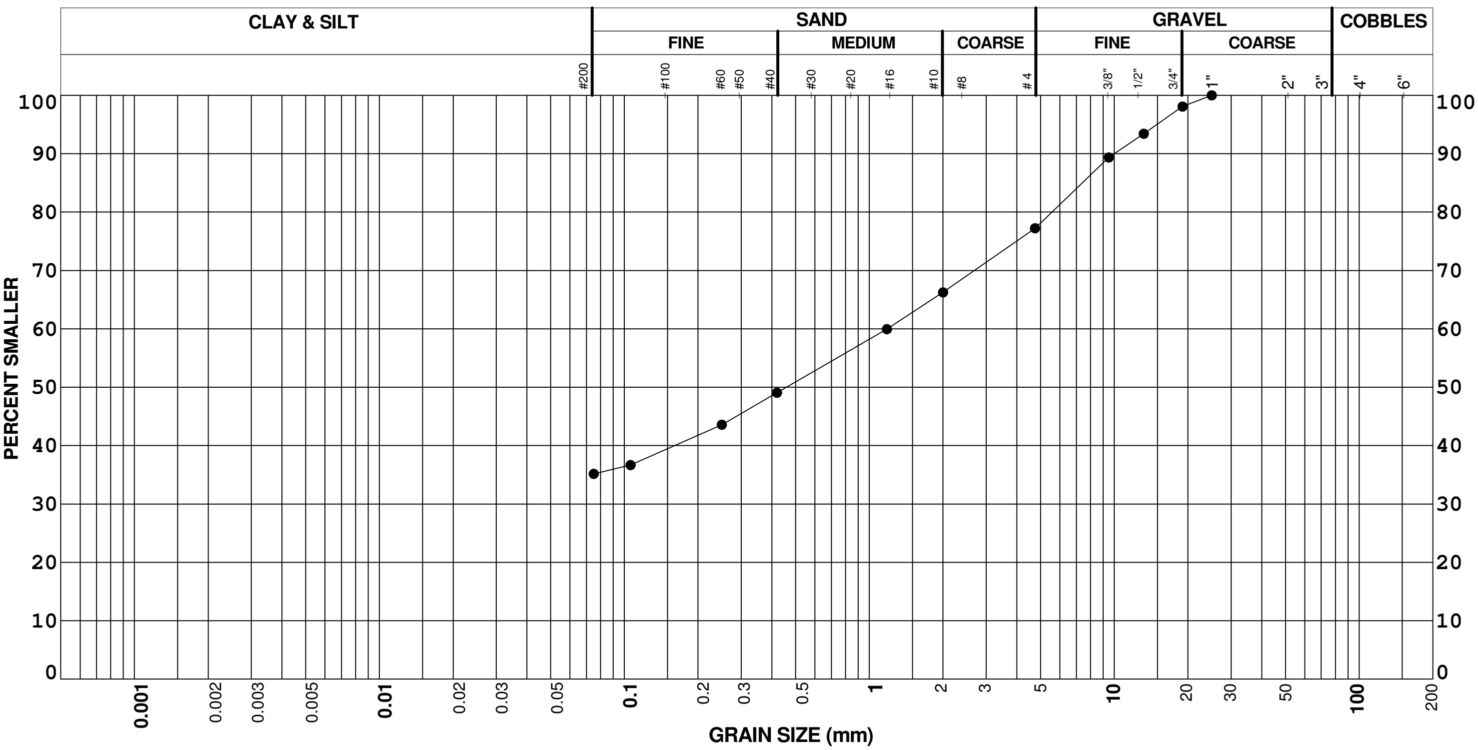
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R036	BS2	2.50	23	42	35		

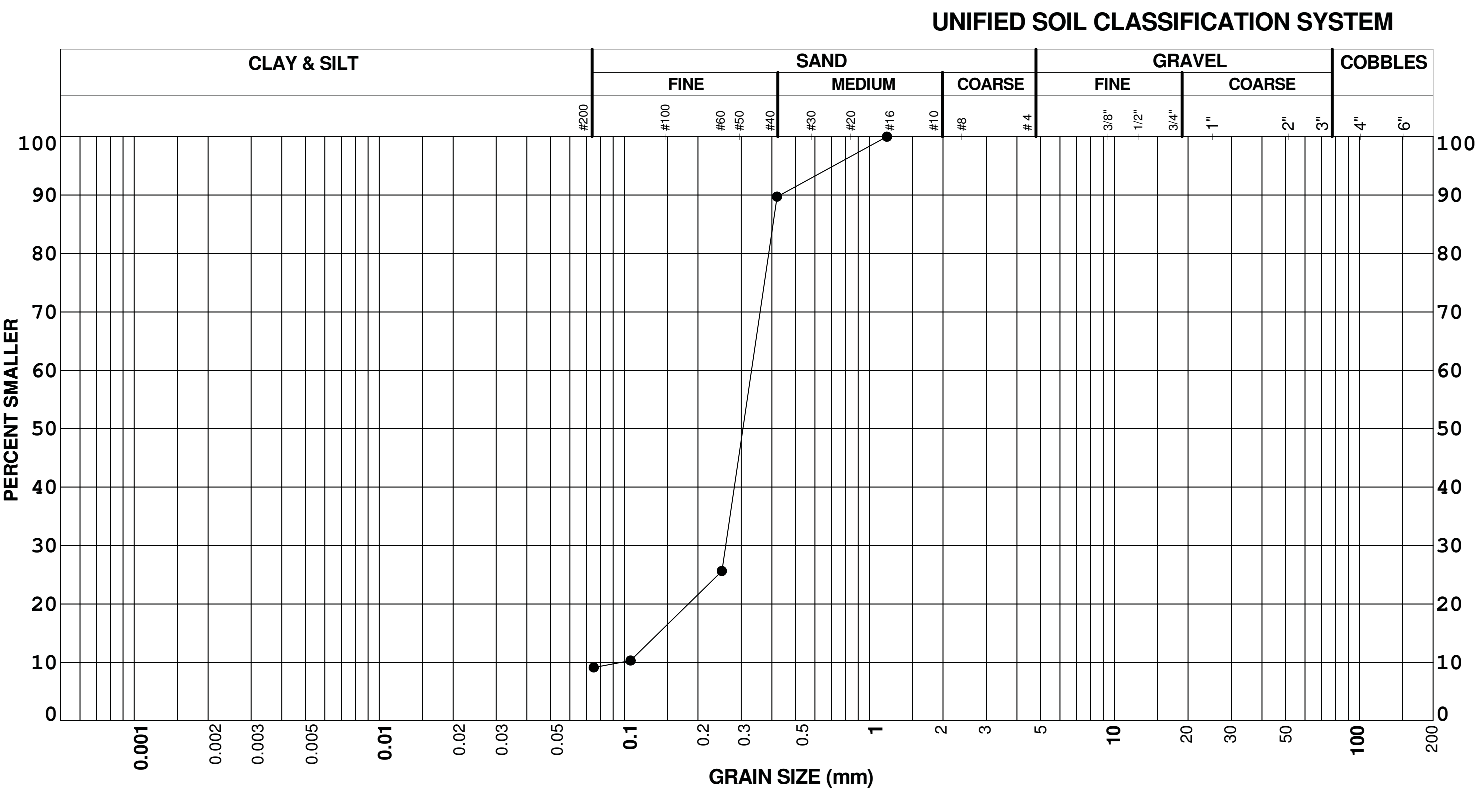
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

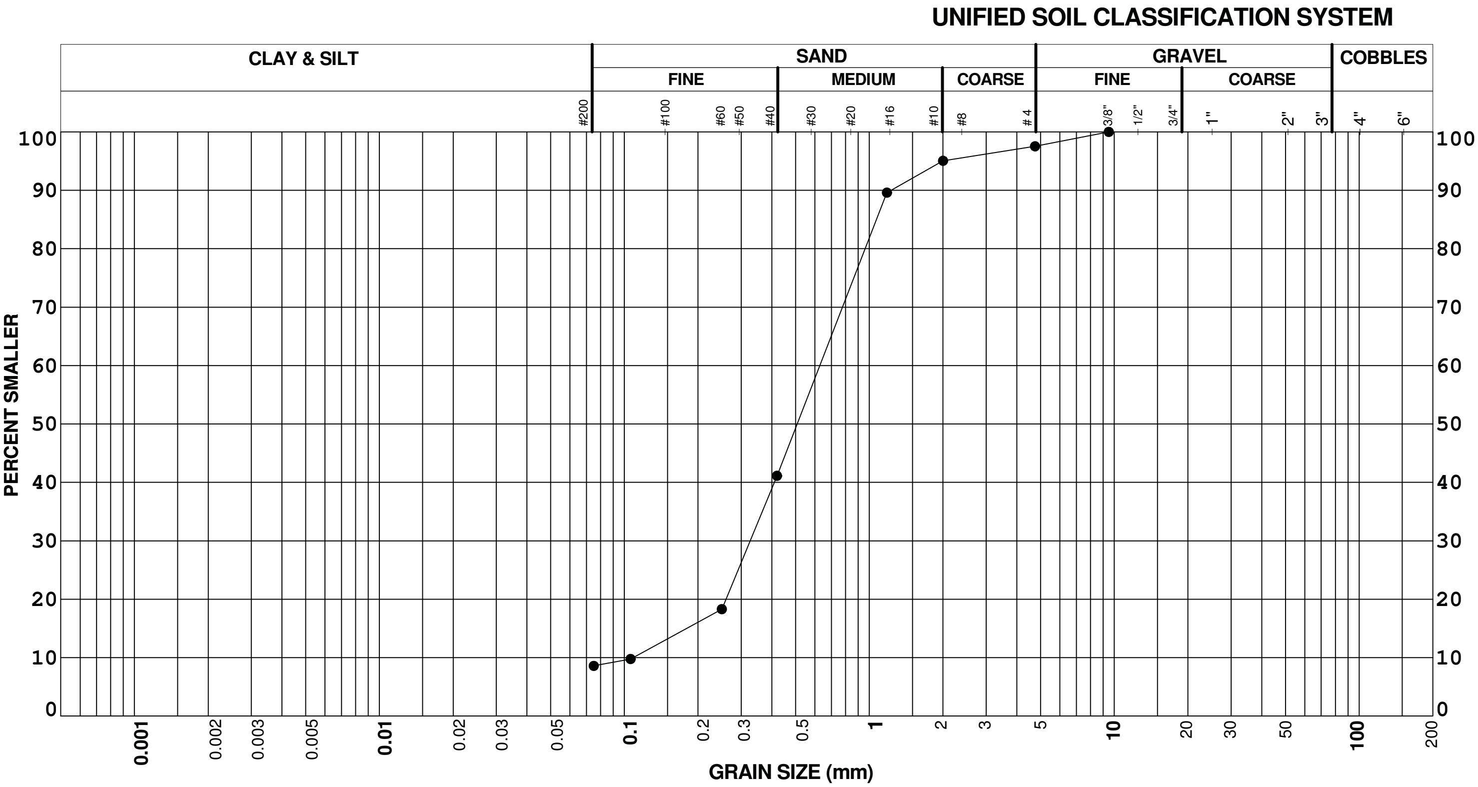
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R037	BS2	2.50	0	91	9		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R038	BS2	2.00	2	89	9		

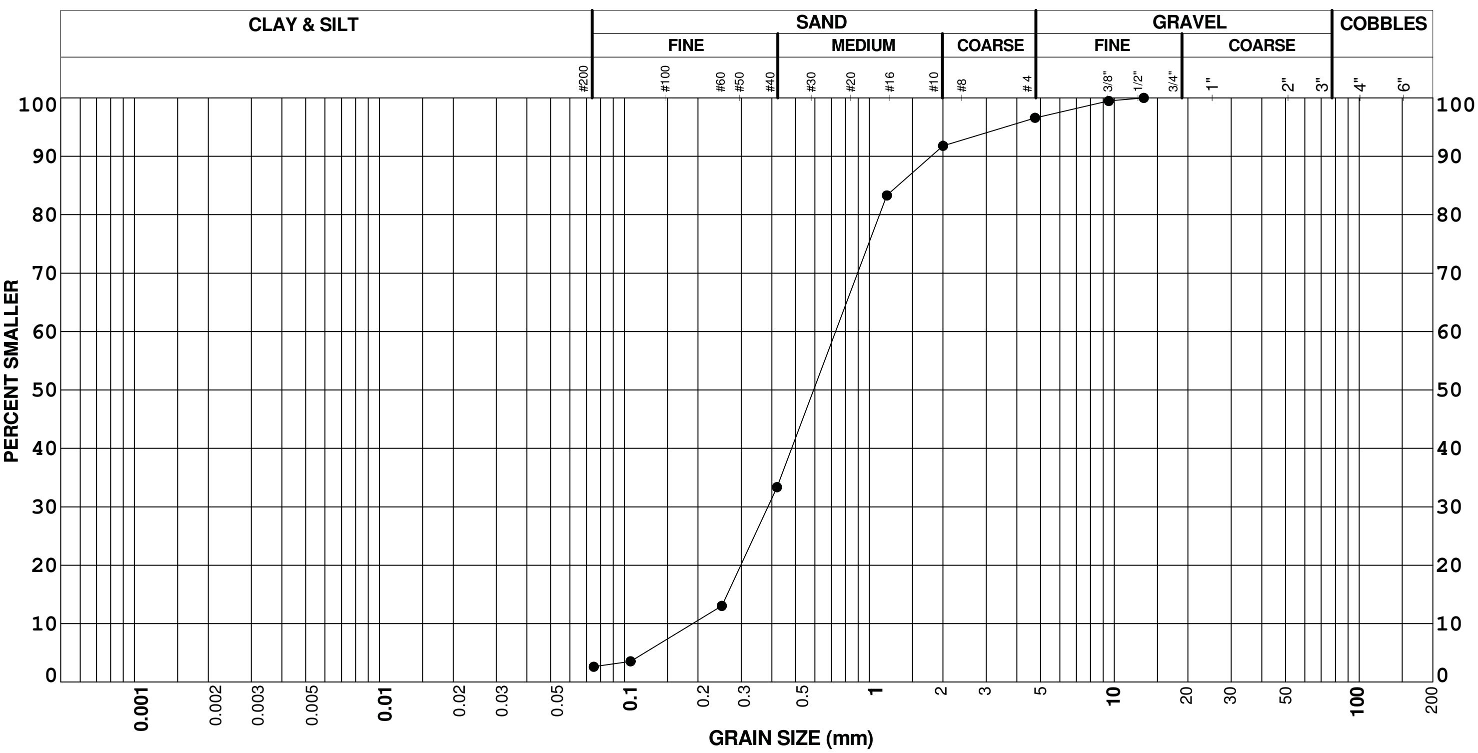
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

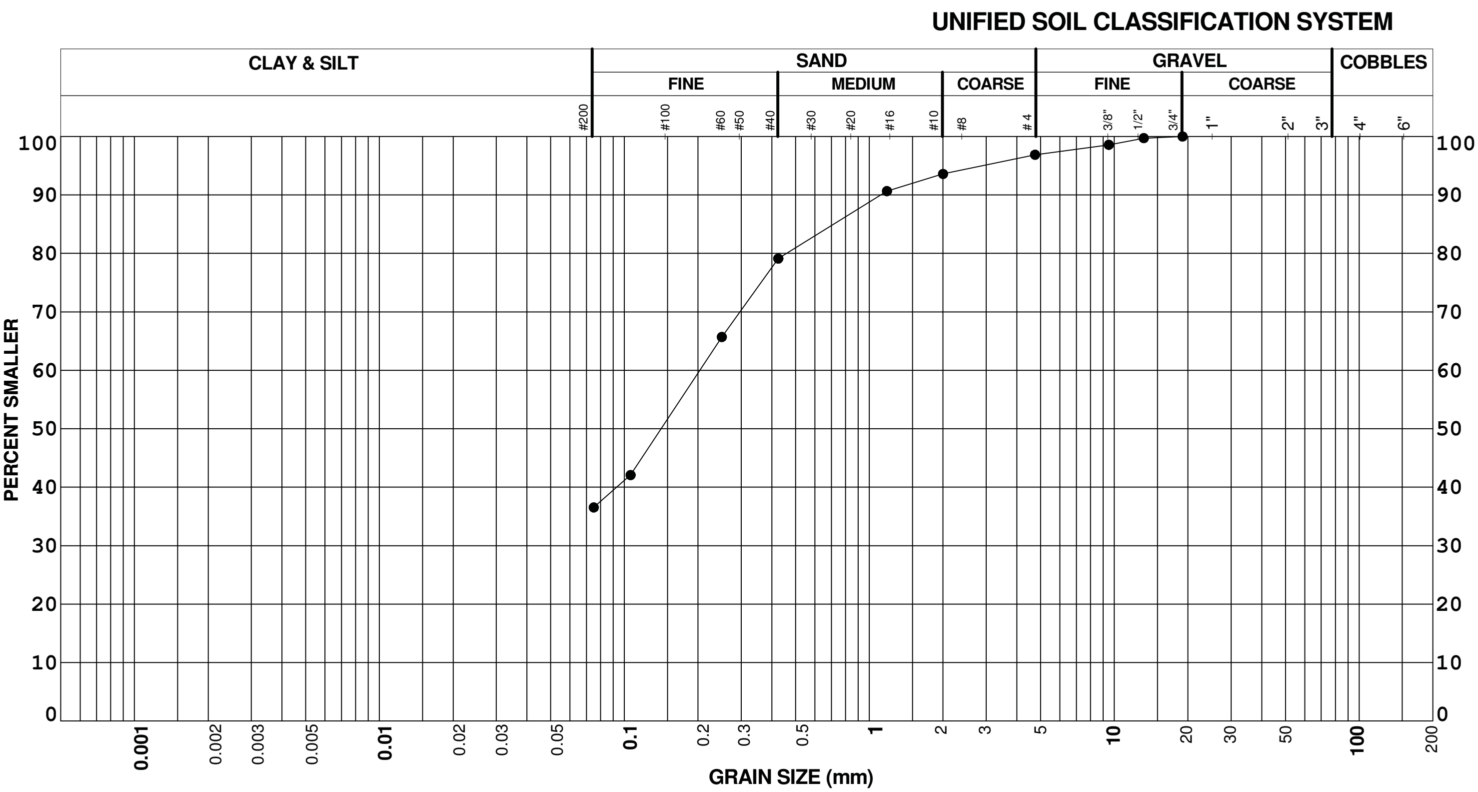
	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH16-R039	BS1	1.00	3	94	3		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R067	BS1	1.20	3	60	37		

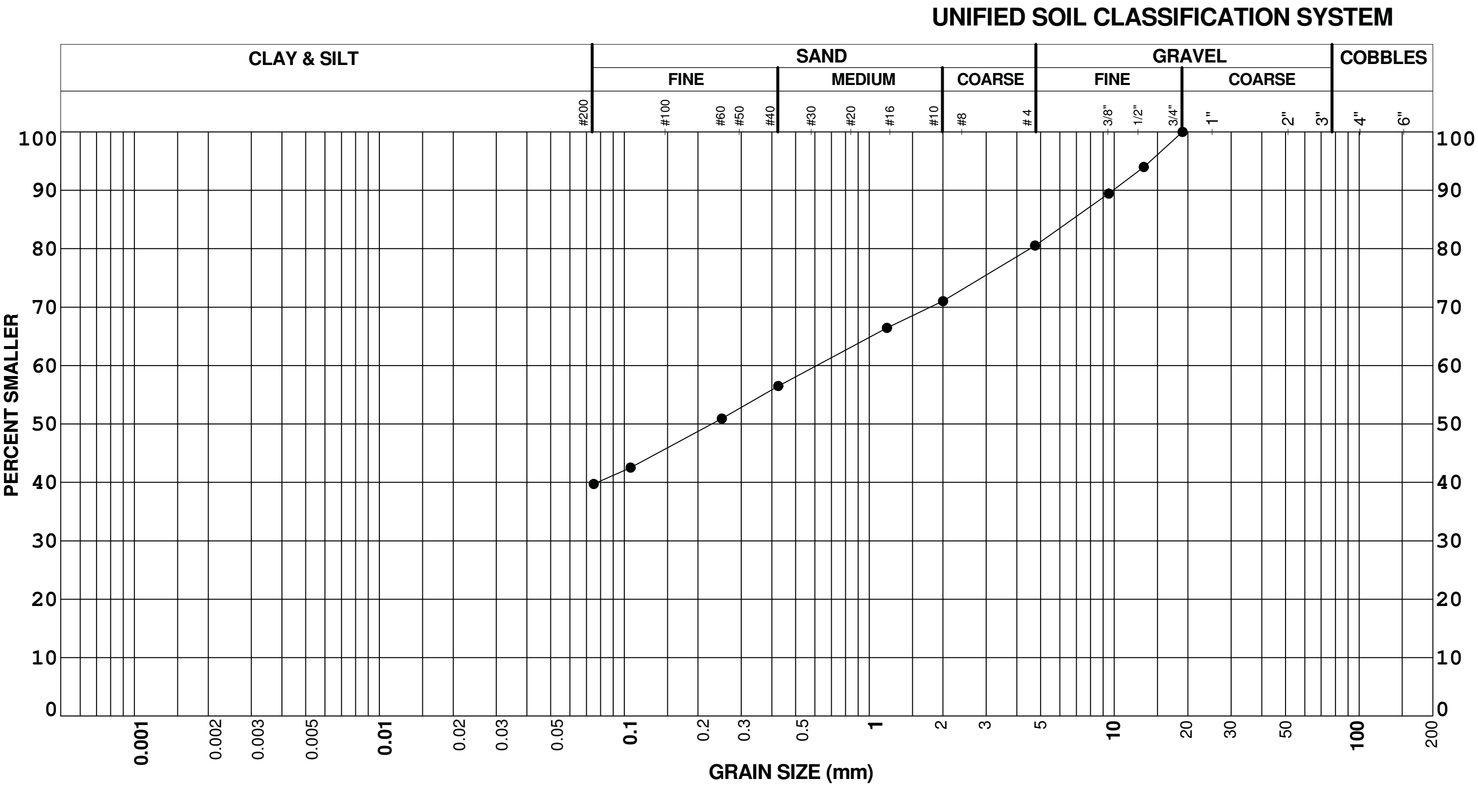
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH16-R069	BS1	1.00	19	41	40		

REMARKS:

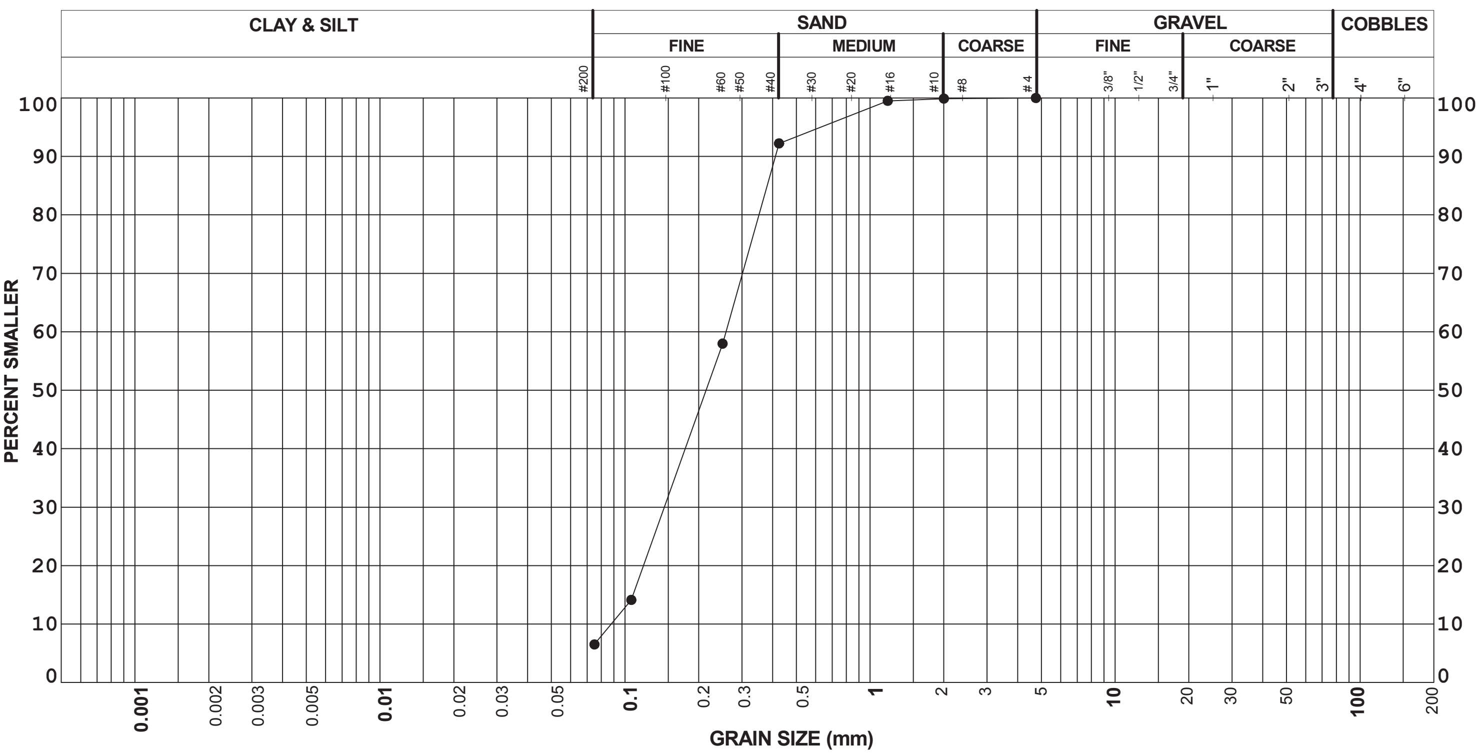
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-B001	DS2	2.40	0	93	7		

REMARKS:

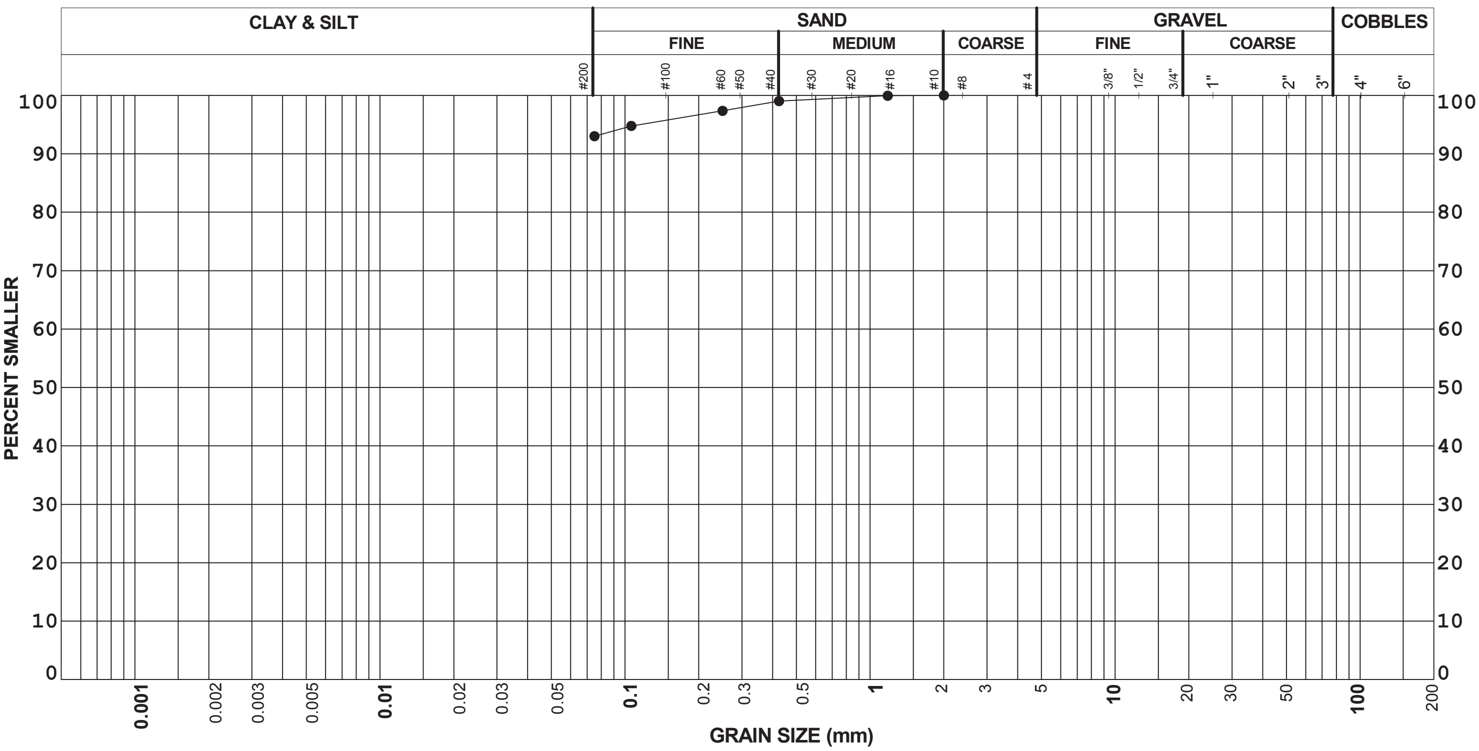
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH17-B001	DS4	5.50	0	7	93		

REMARKS:

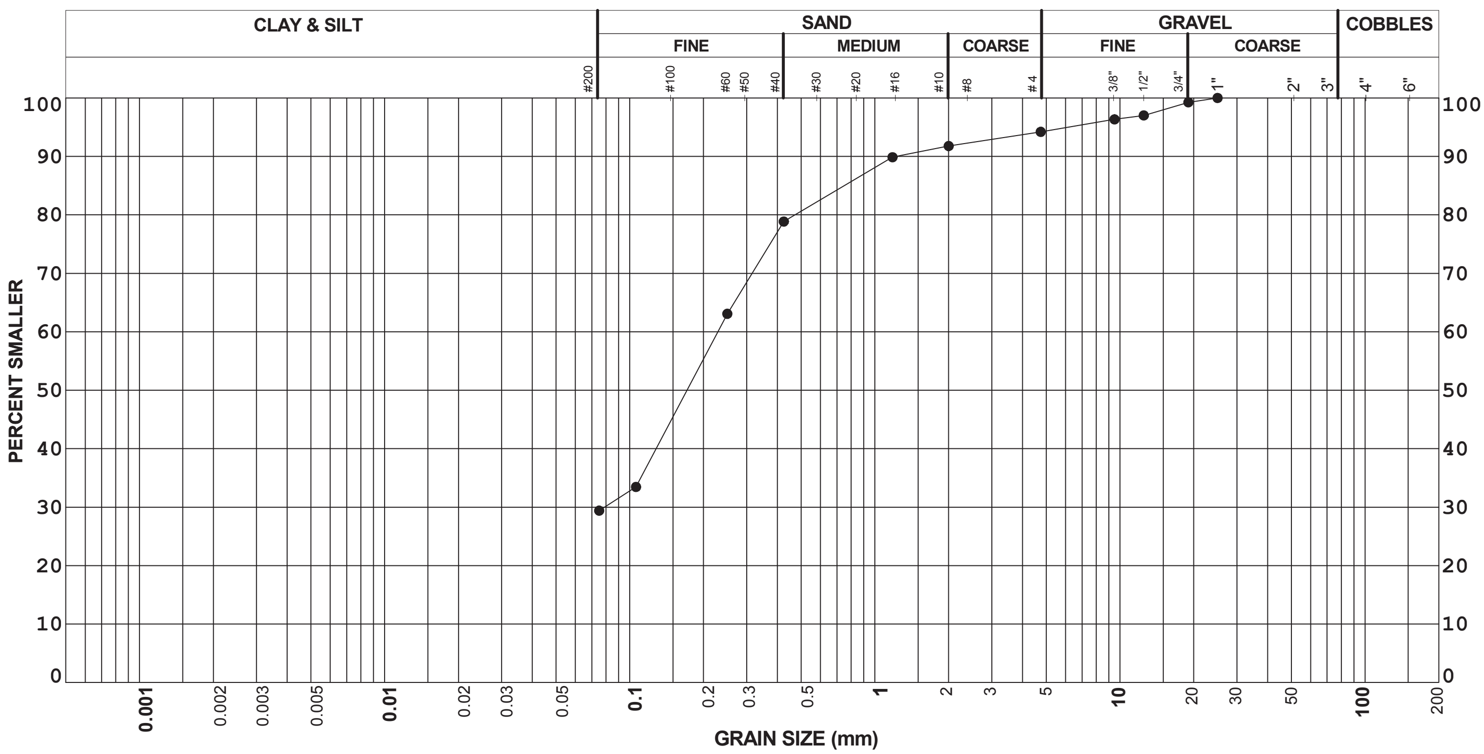
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-B001	DS6	8.50	6	65	29		

REMARKS:

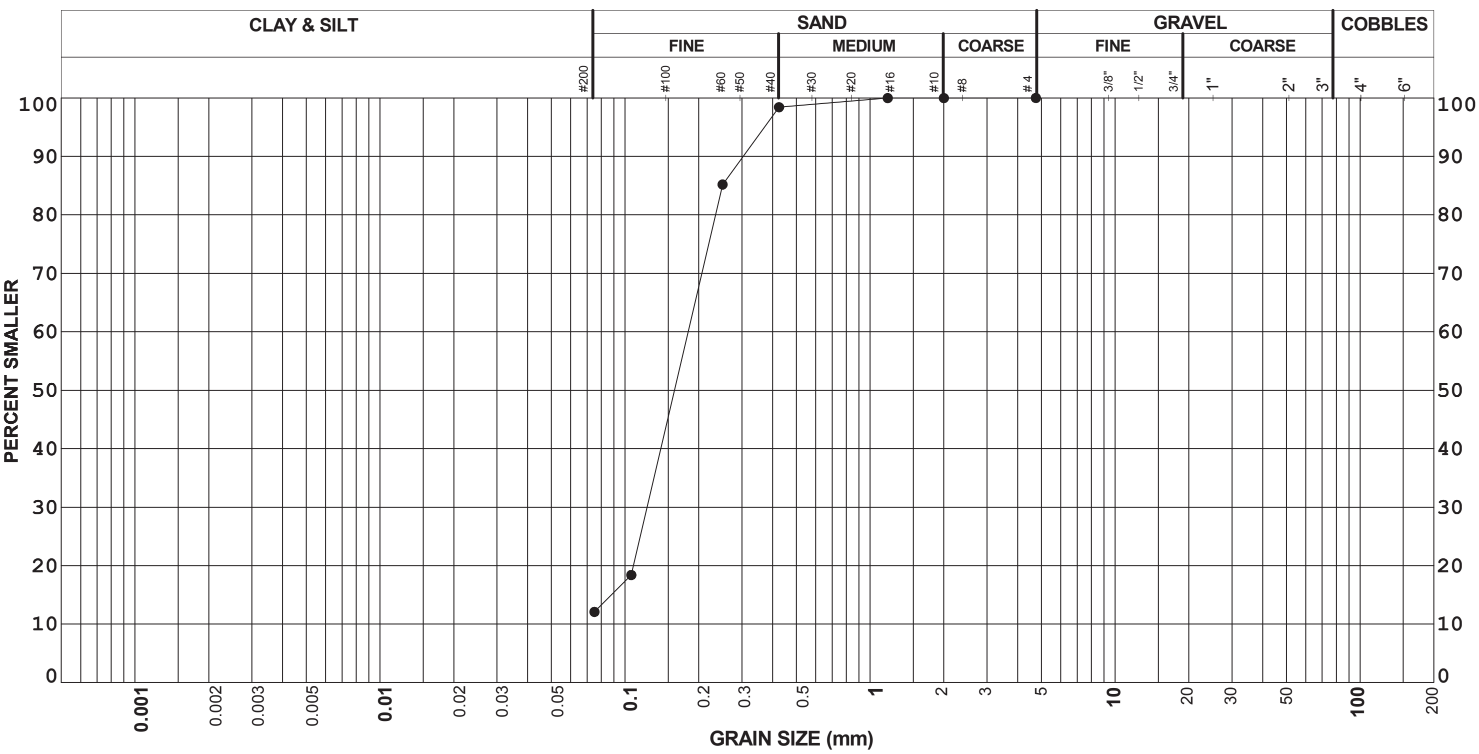
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH17-B002	DS1	0.50	0	88	12		

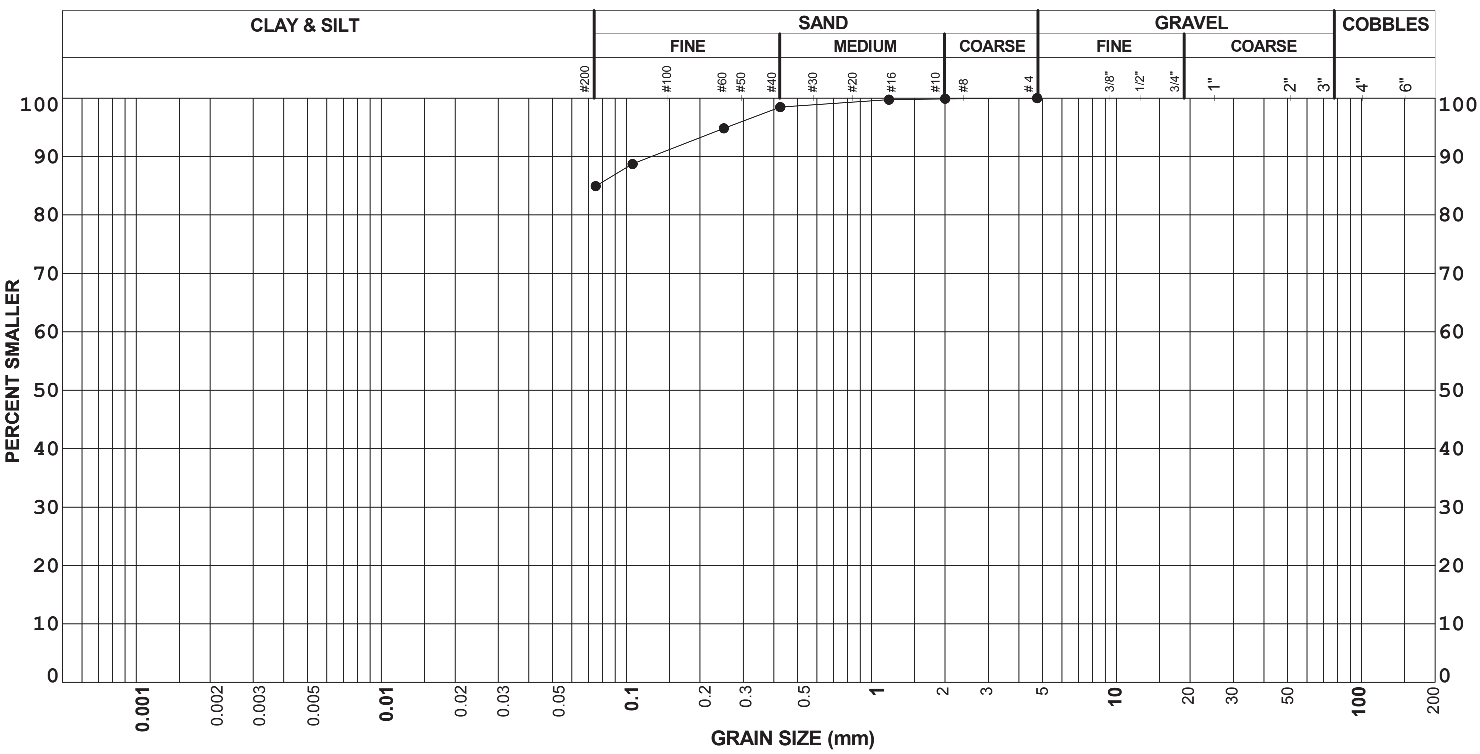
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-B002	DS3	3.70	0	15	85		

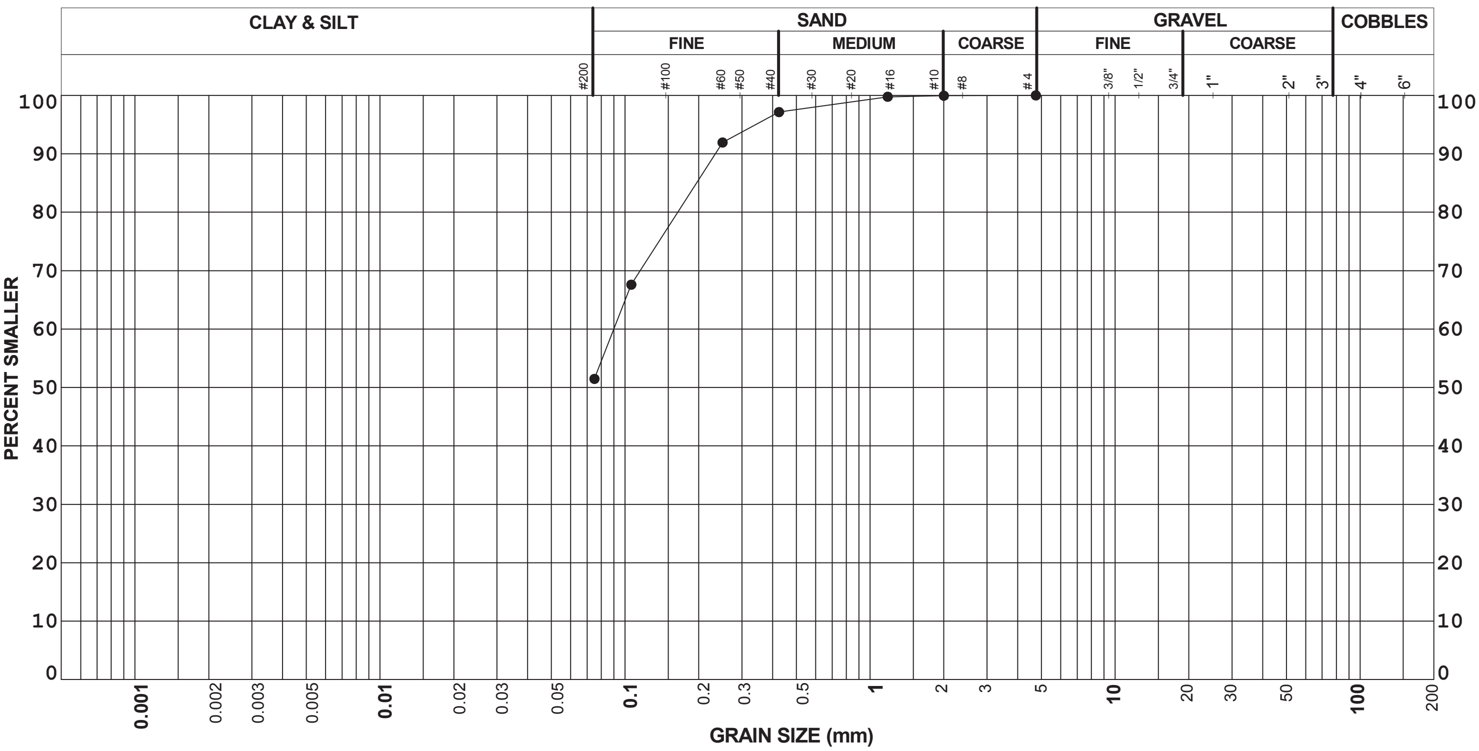
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-B002	DS5	6.70	0	49	51		

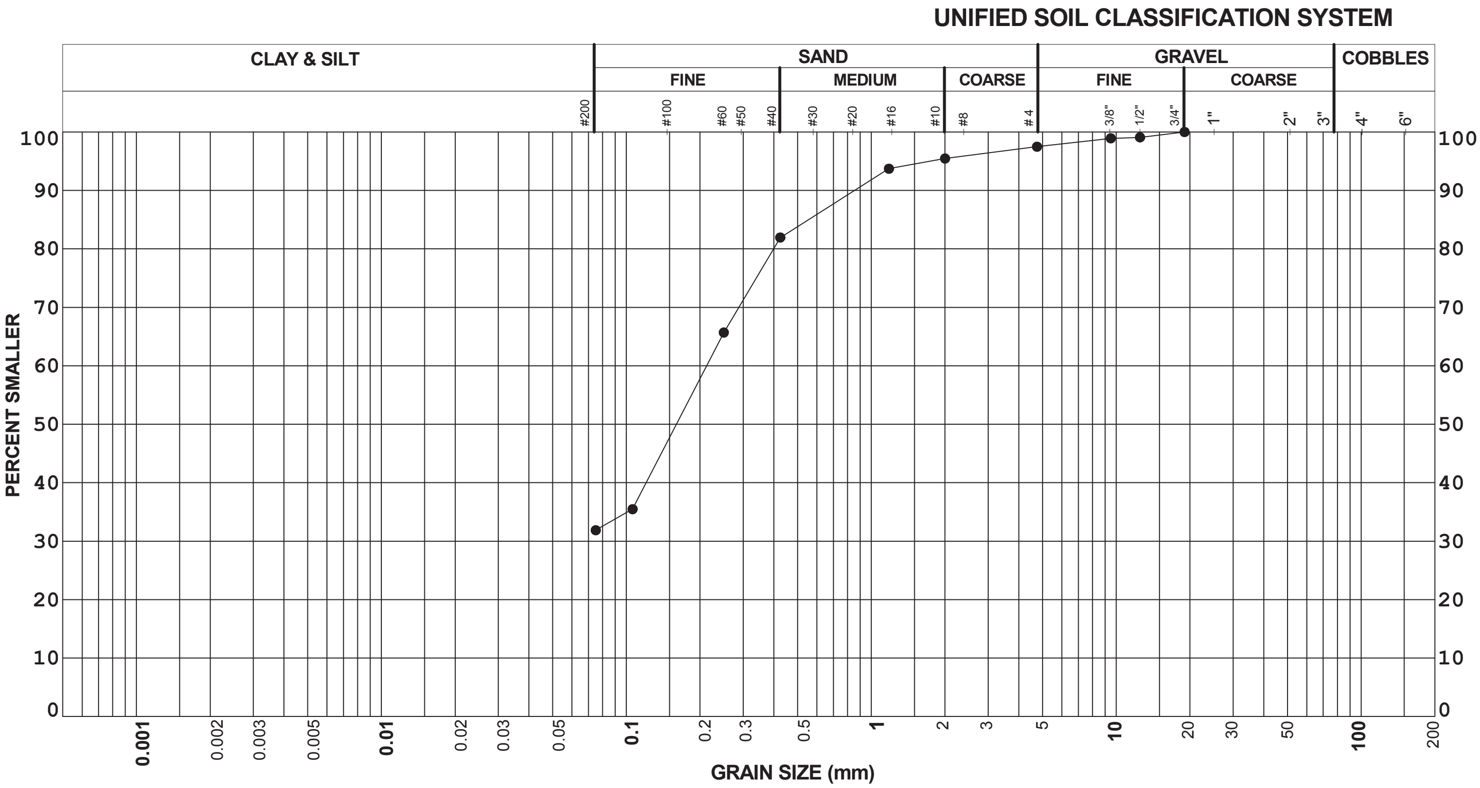
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-B002	DS8	11.50	3	66	32		

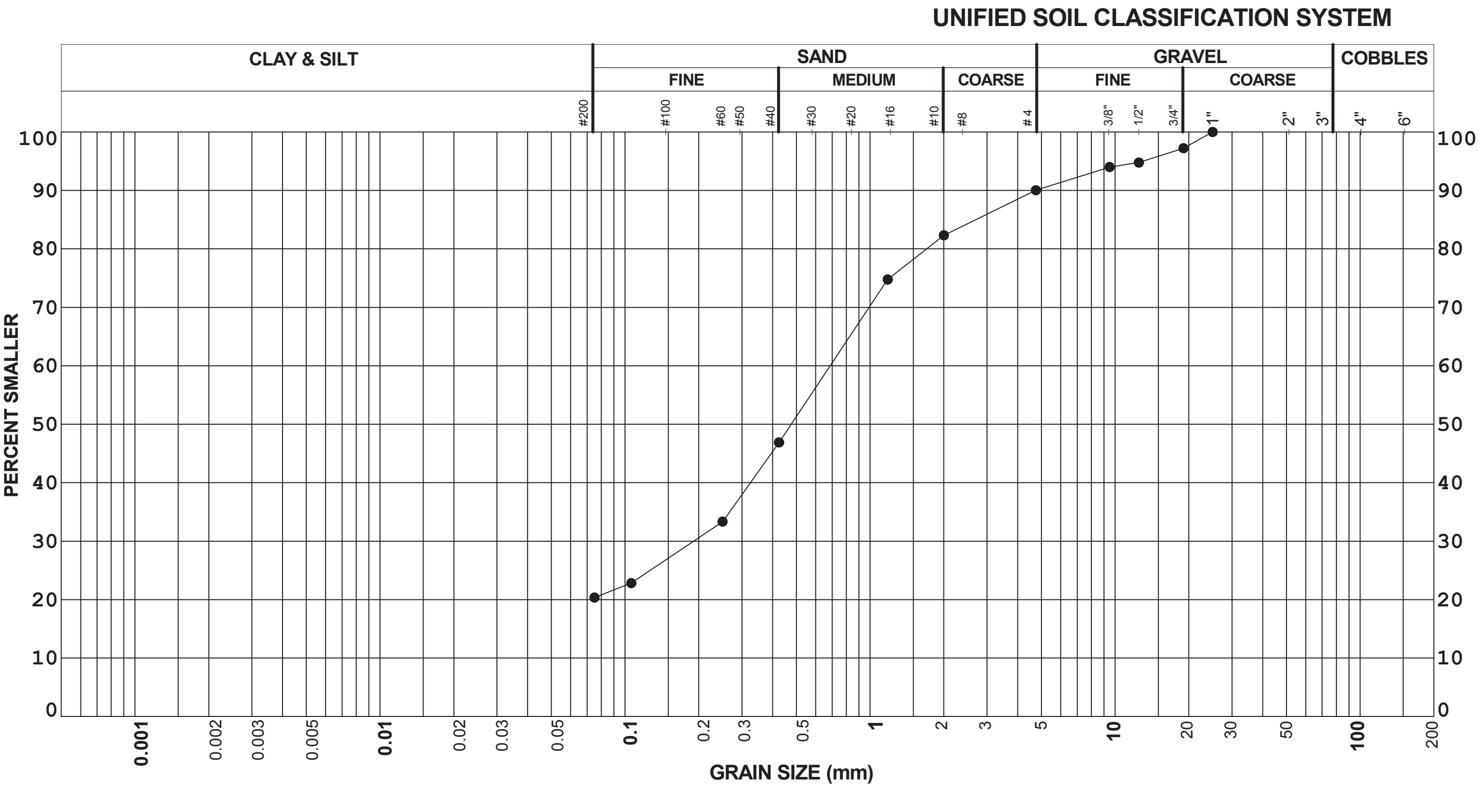
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-B002	DS11	15.80	10	70	20		

REMARKS:

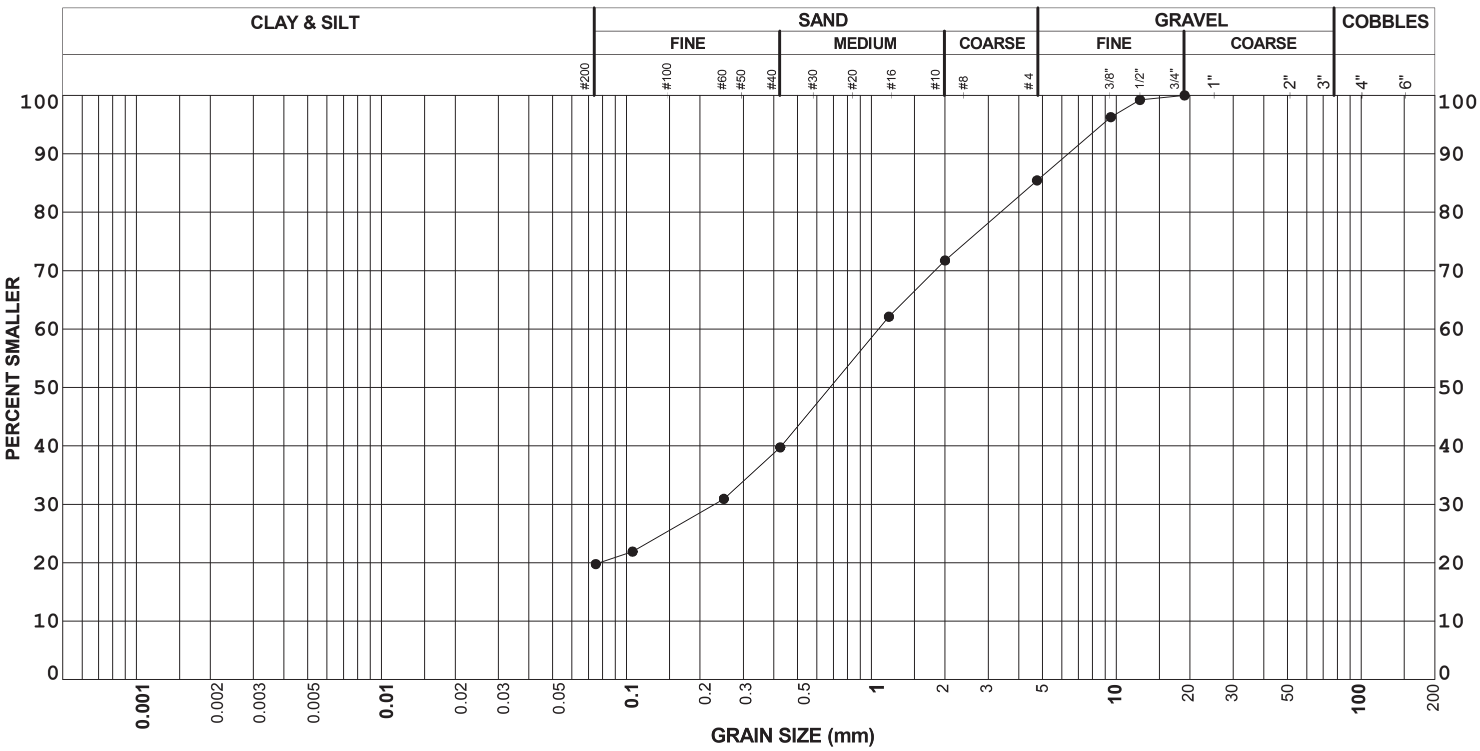
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-B002	DS13	18.60	15	66	20		

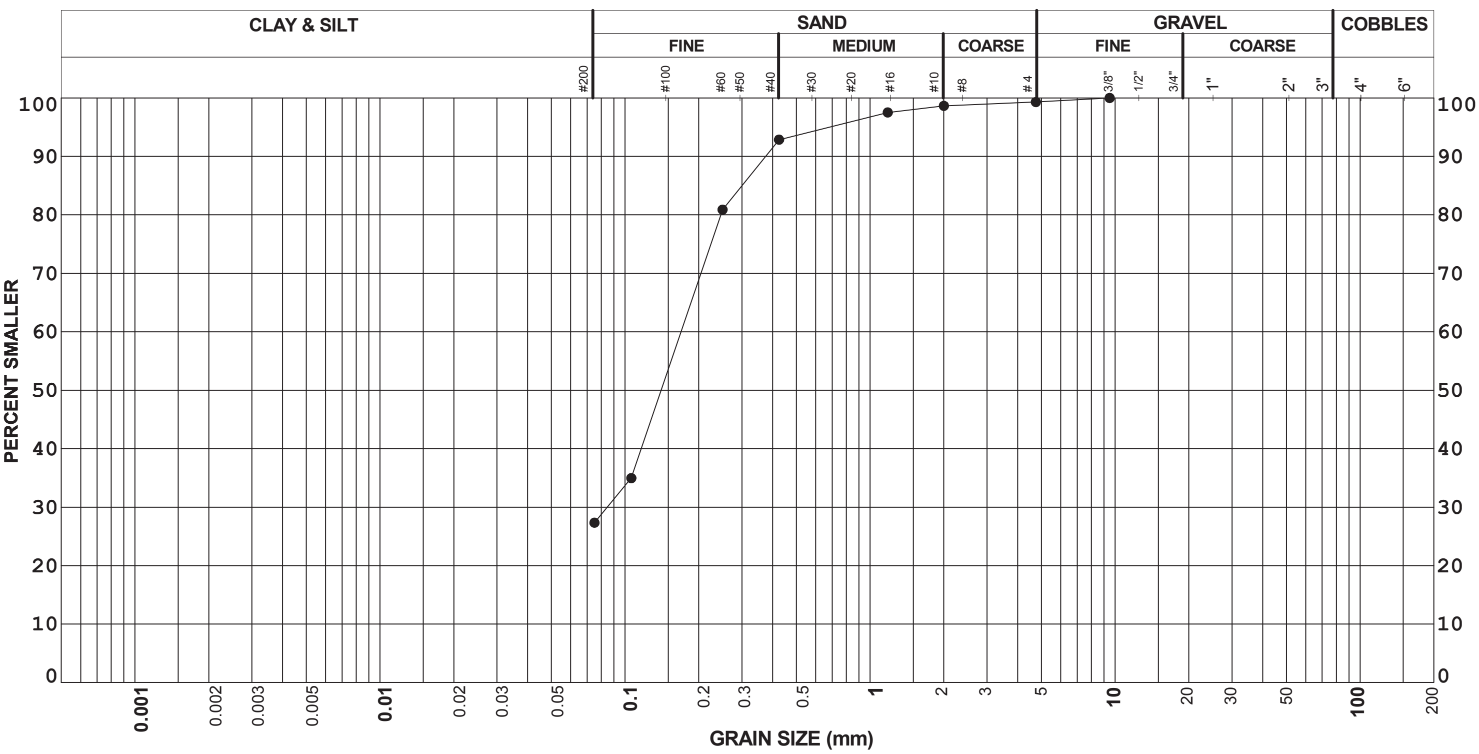
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-B002	DS16	23.50	1	72	27		

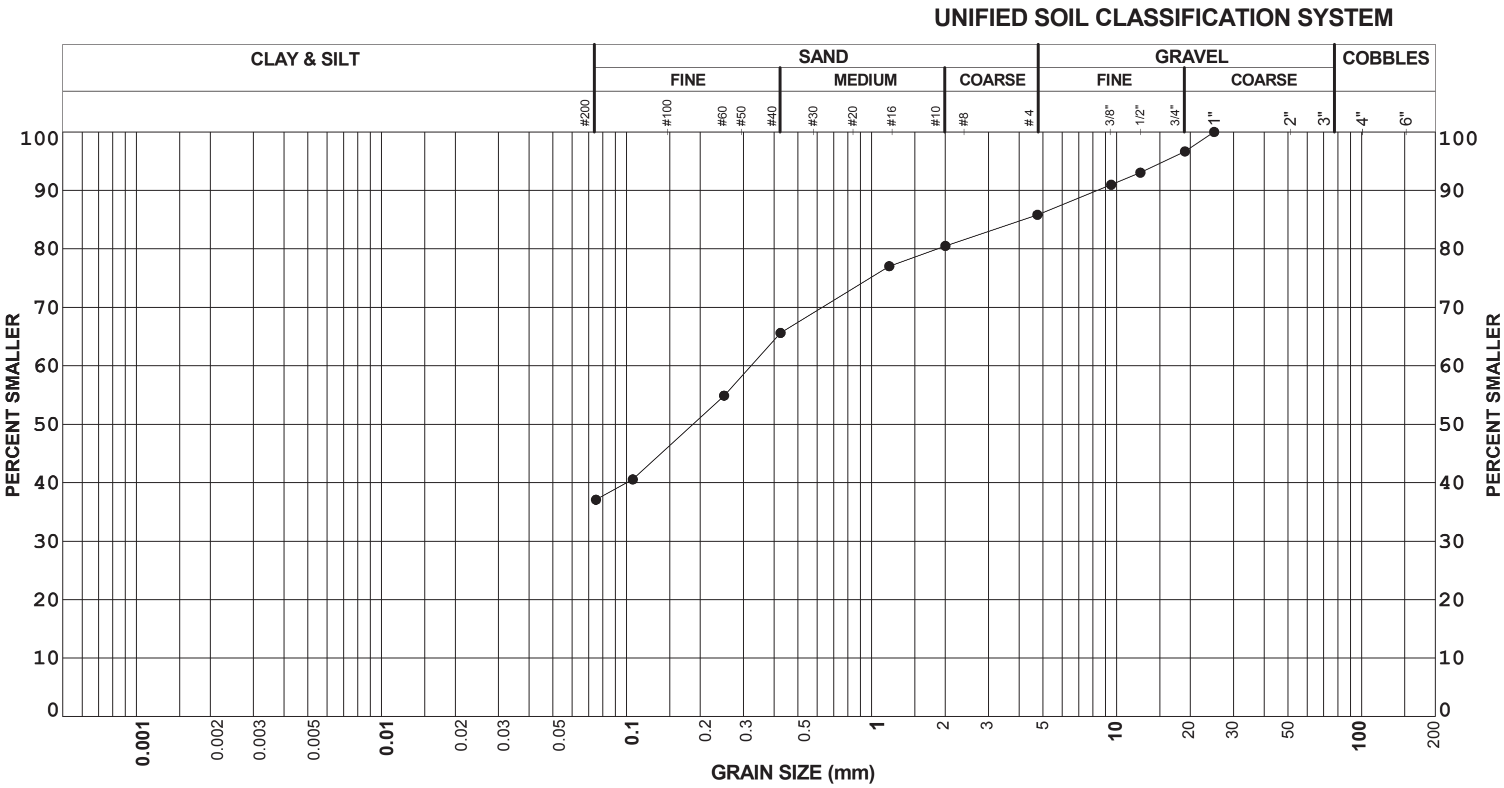
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-C001	DS3	3.10	14	49	37		

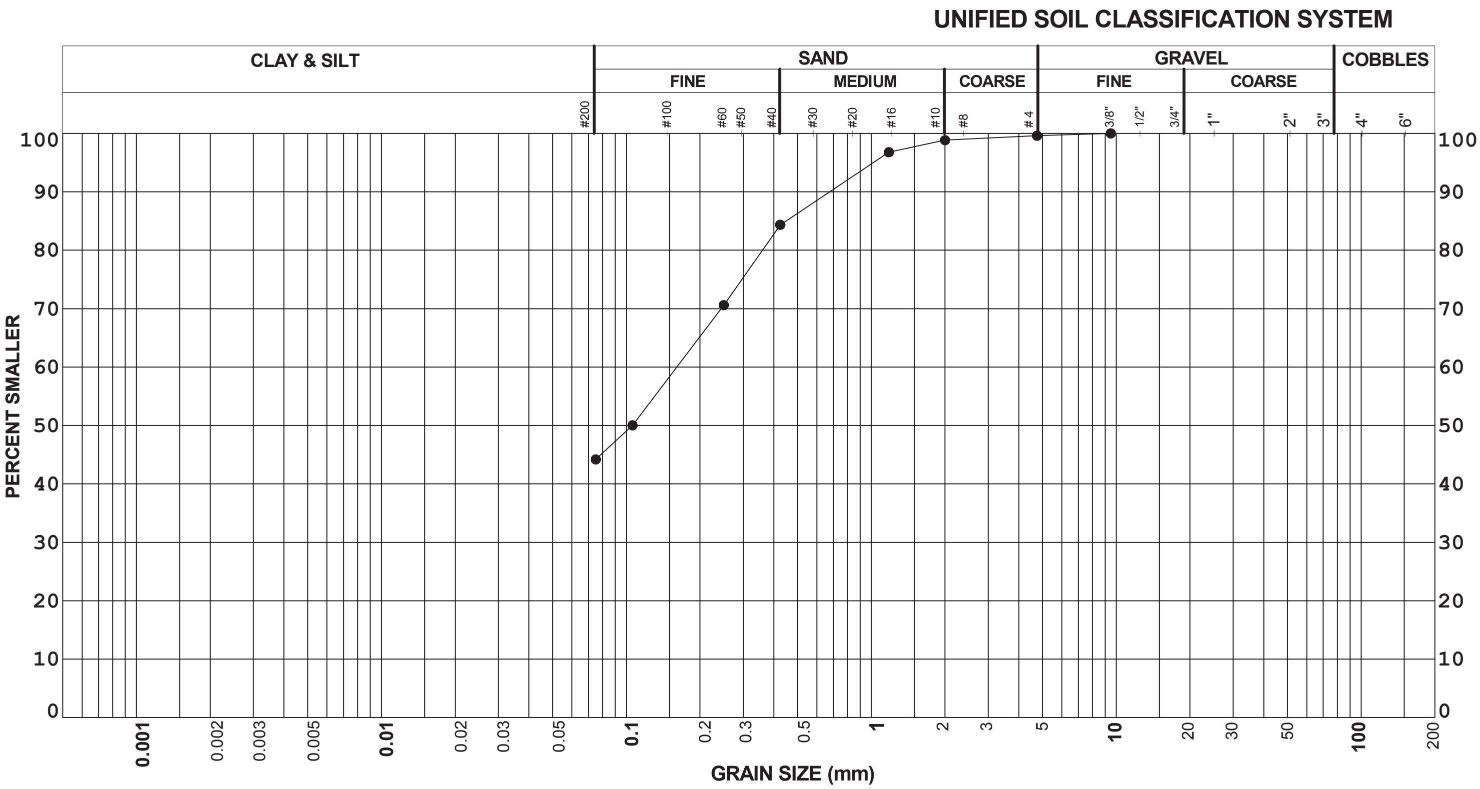
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-C001	DS5	7.00	0	55	44		

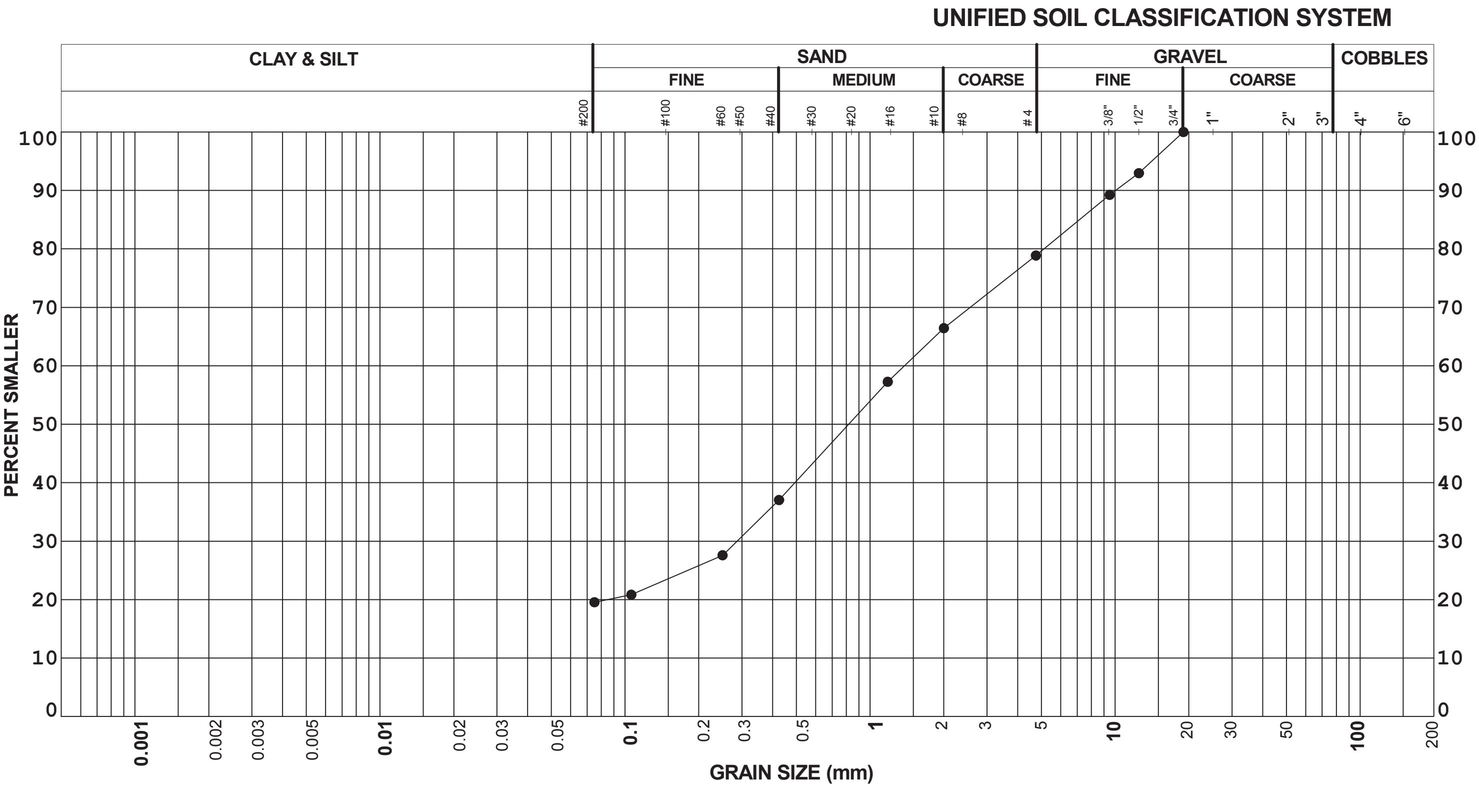
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

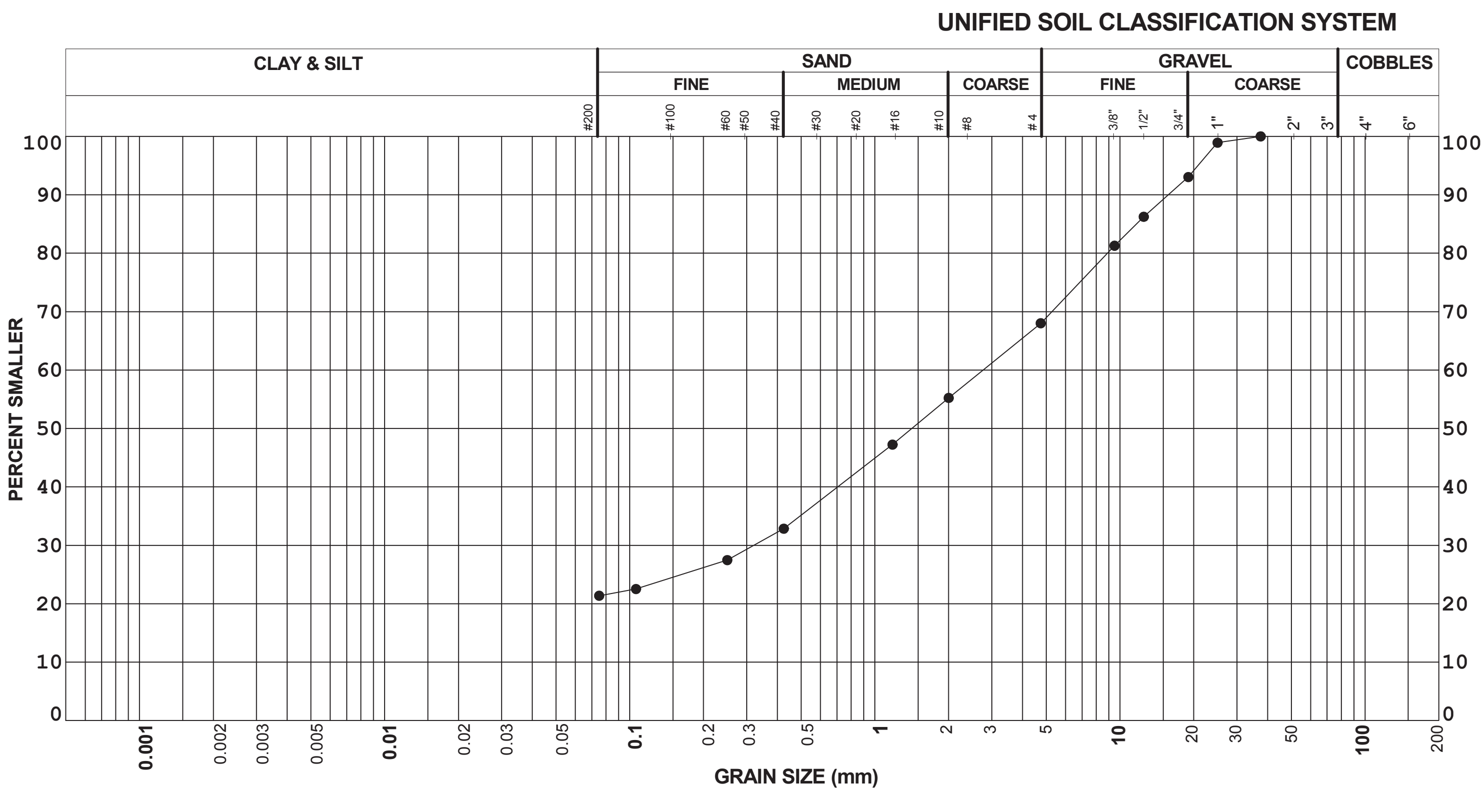
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-C002	DS2	2.40	21	59	20		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-C003	DS3	3.40	32	47	21		

REMARKS:

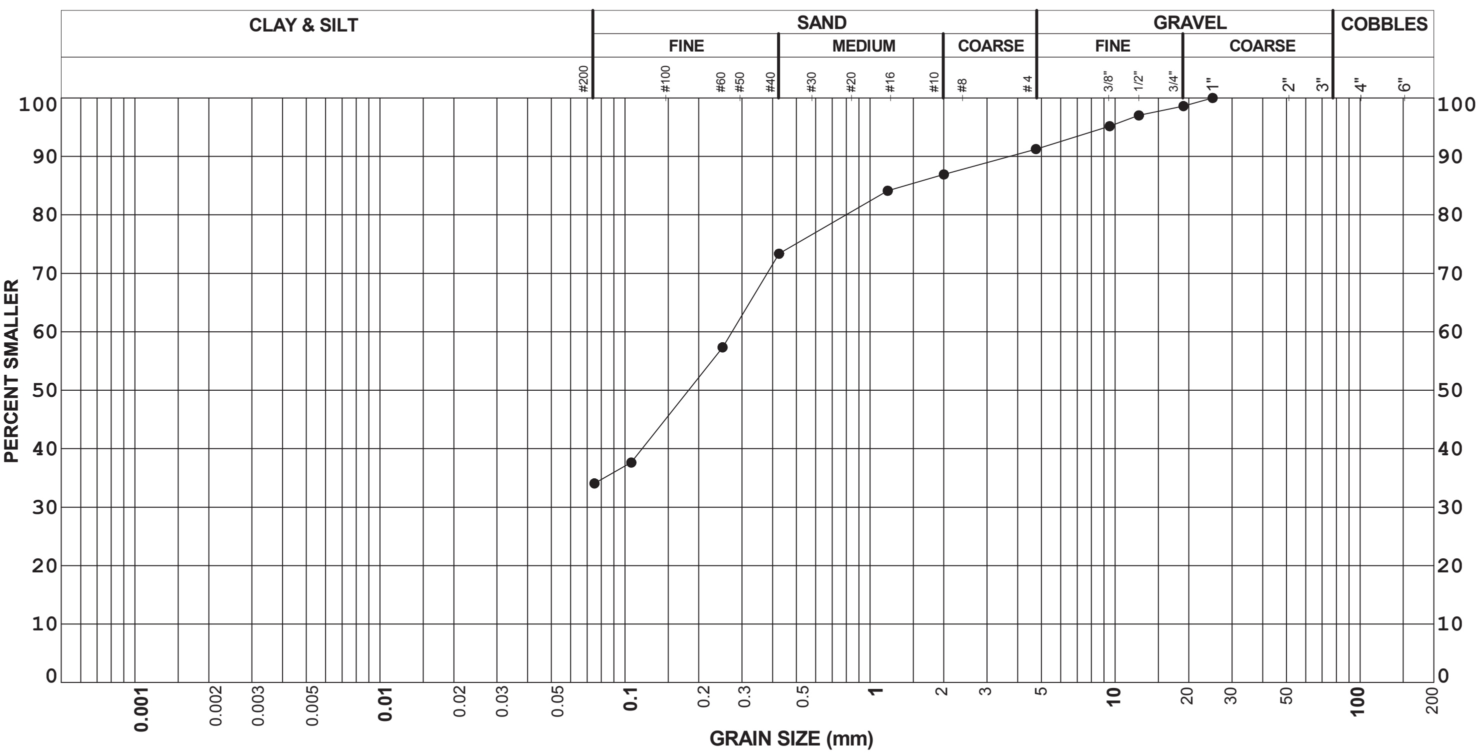
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH17-C003	DS6	8.80	9	57	34		

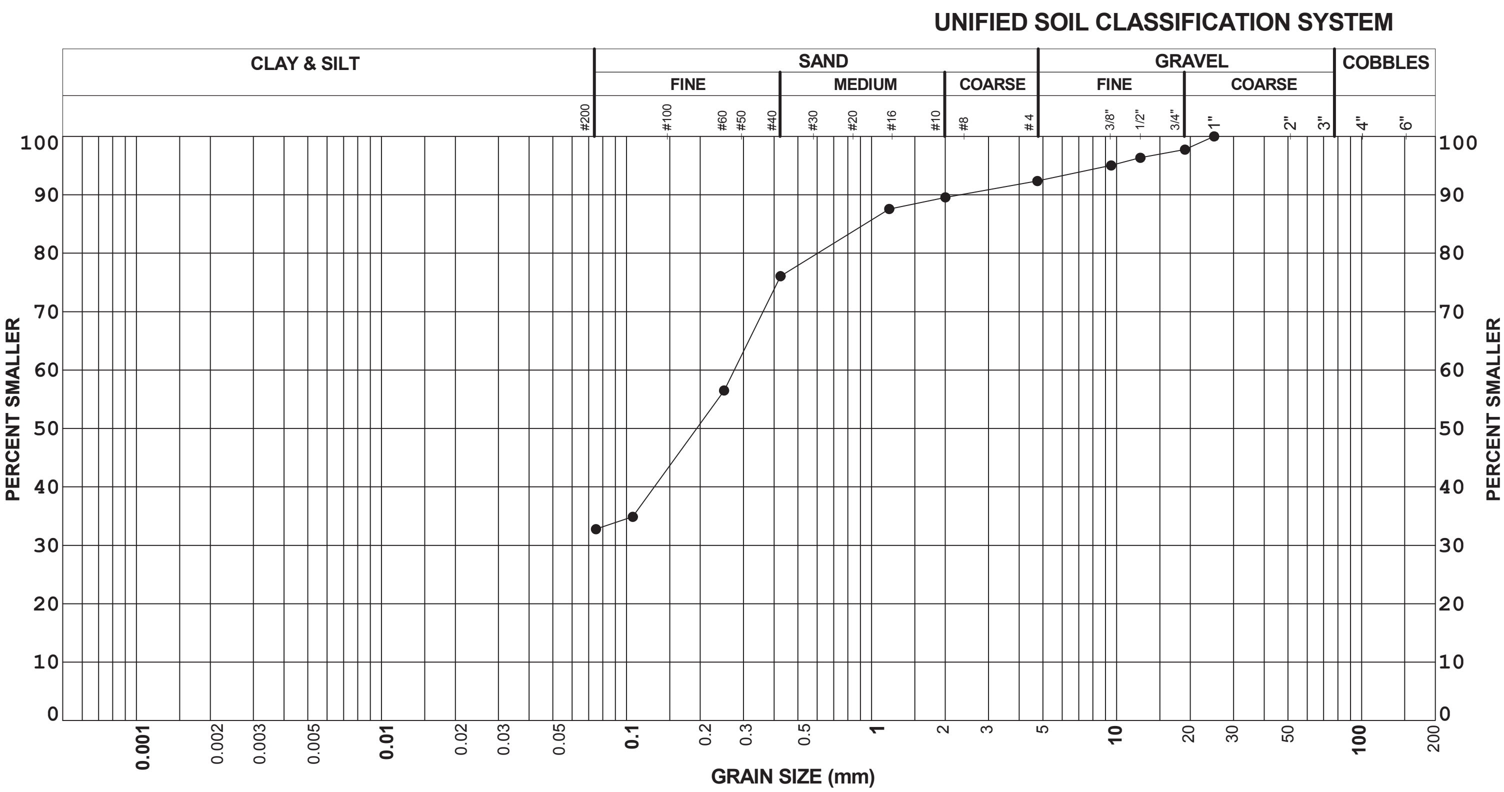
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH17-C004	DS7	9.80	8	60	33		

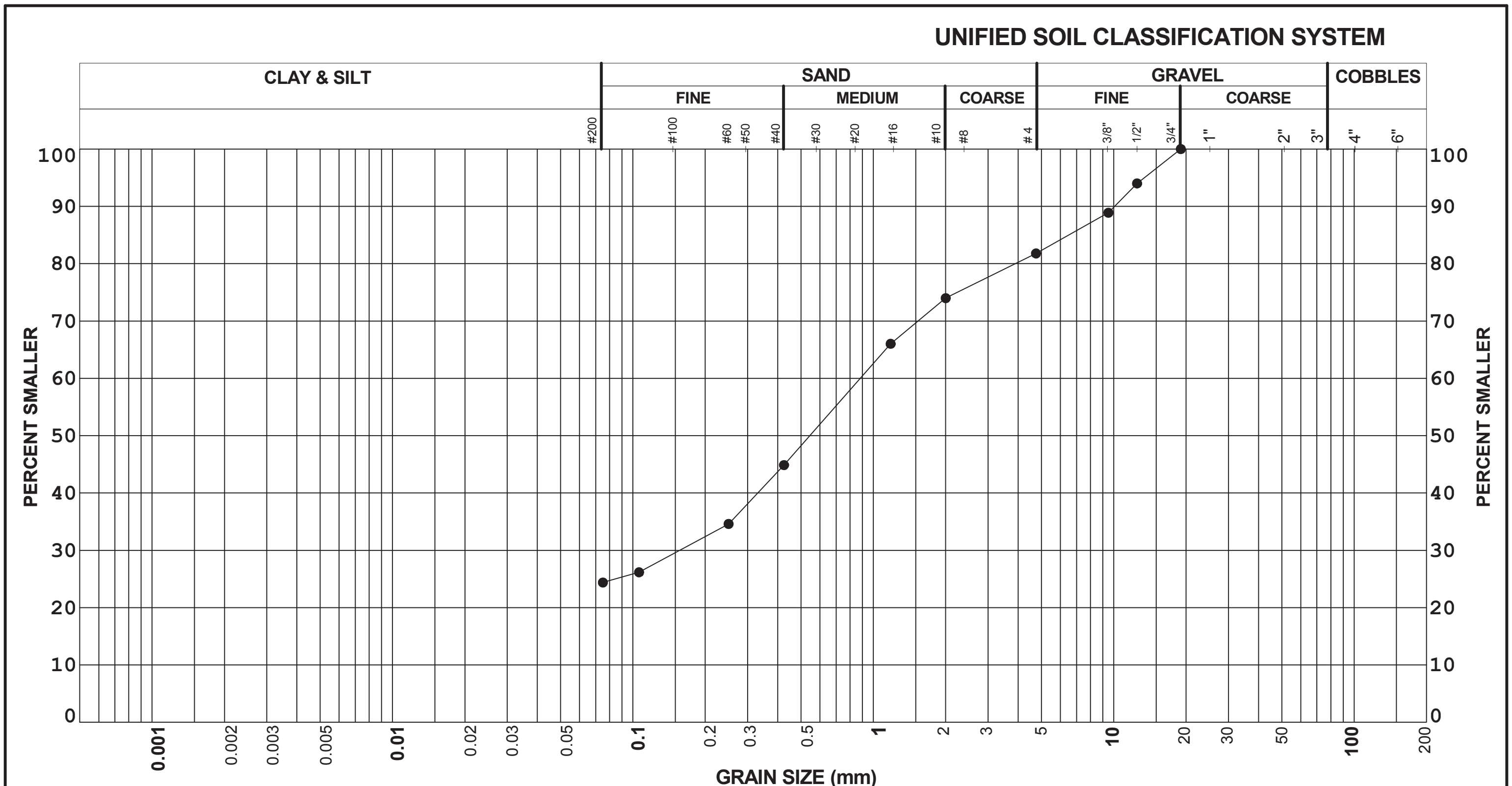
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-C005	DS4	5.50	18	57	24		

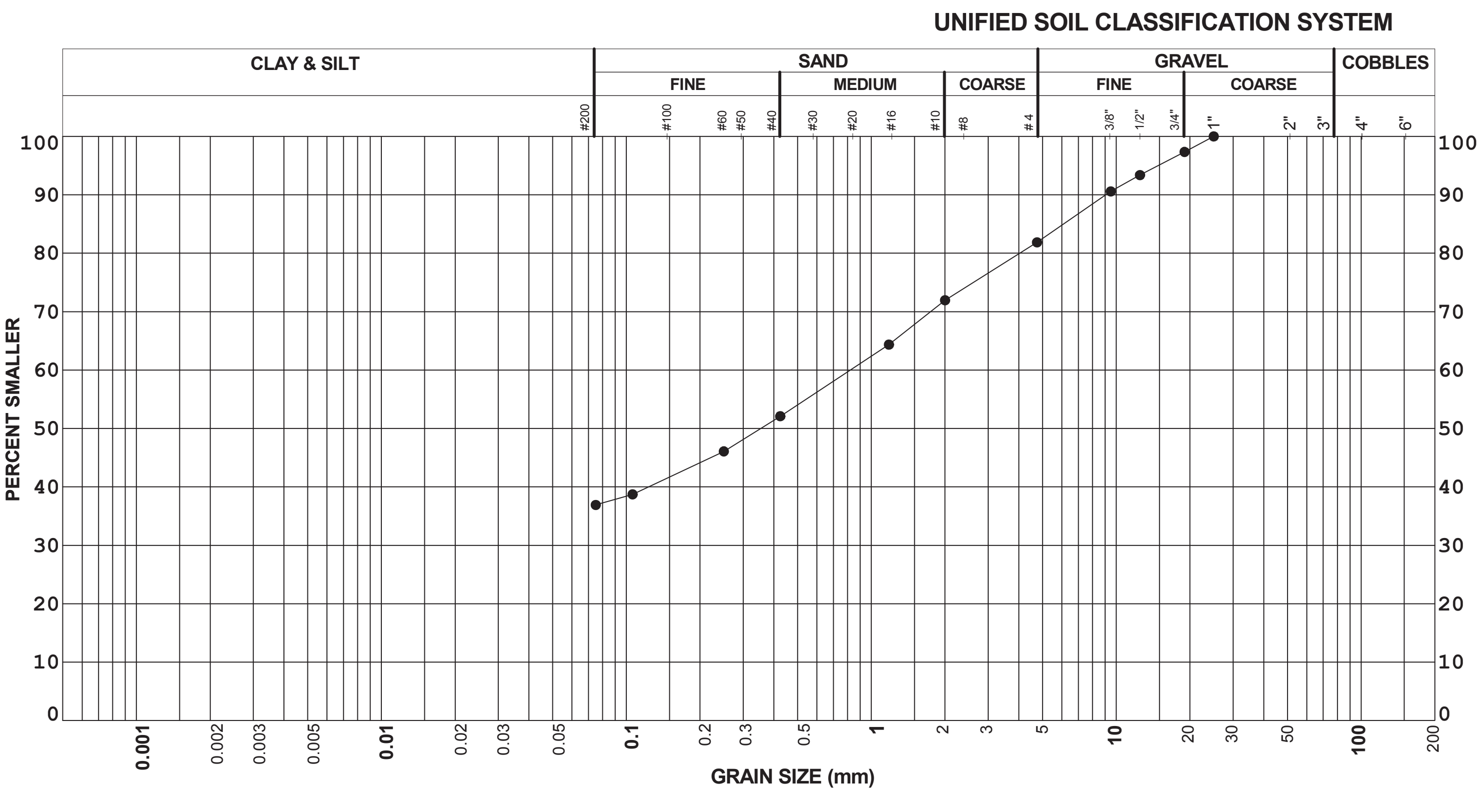
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-C006	DS3	3.70	18	45	37		

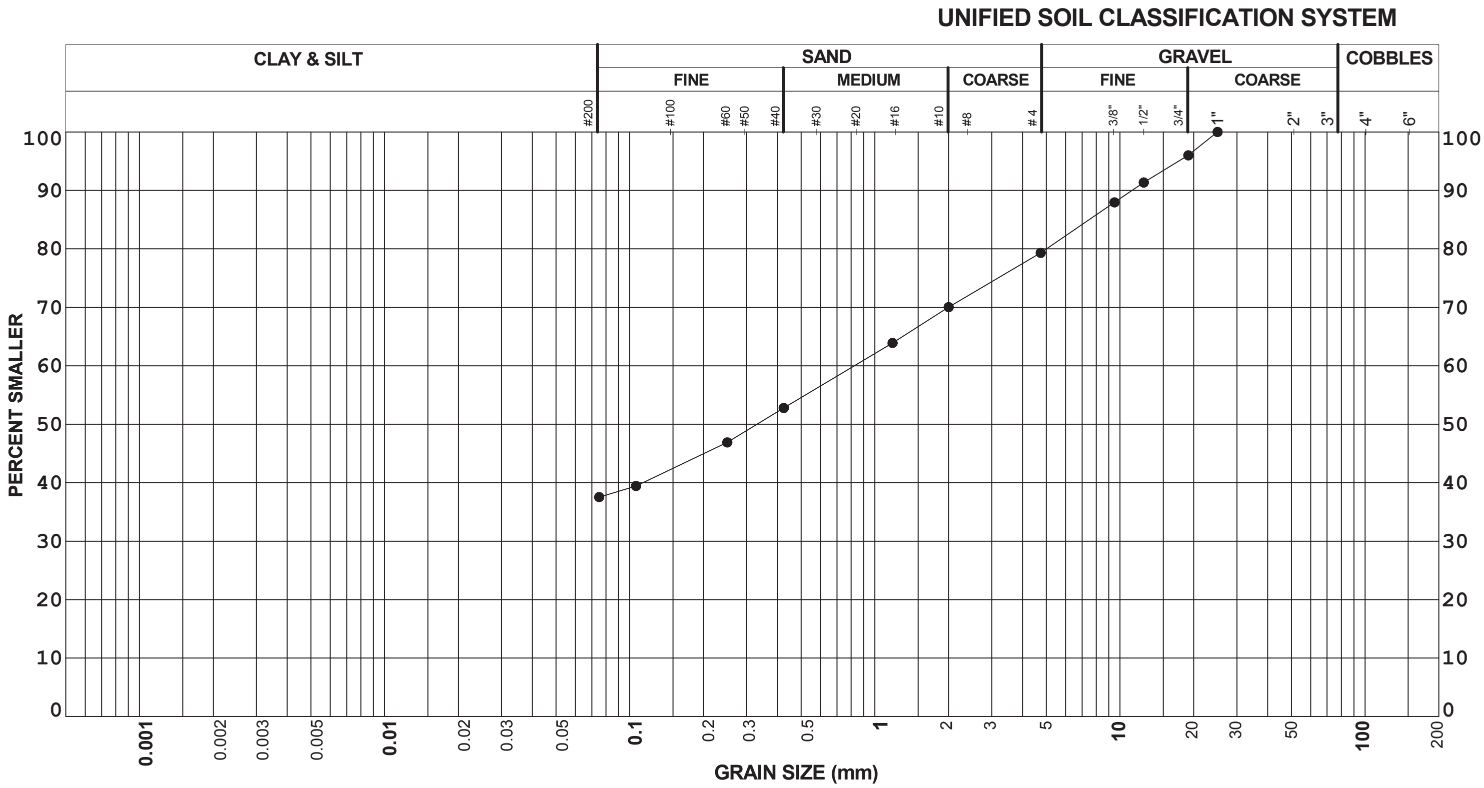
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

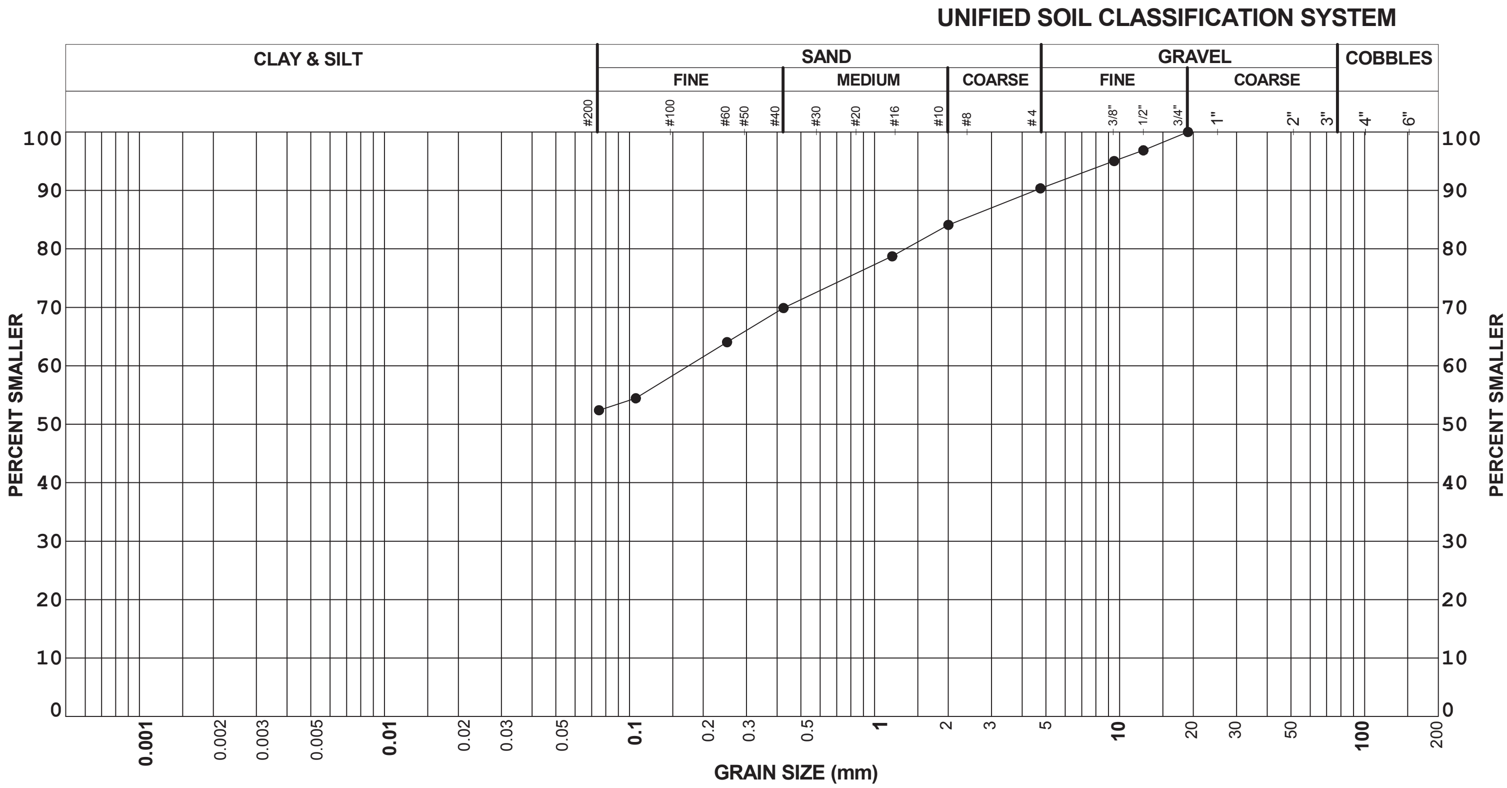
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-C006	DS6	8.20	21	42	38		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-C007	DS3	4.00	10	38	52		

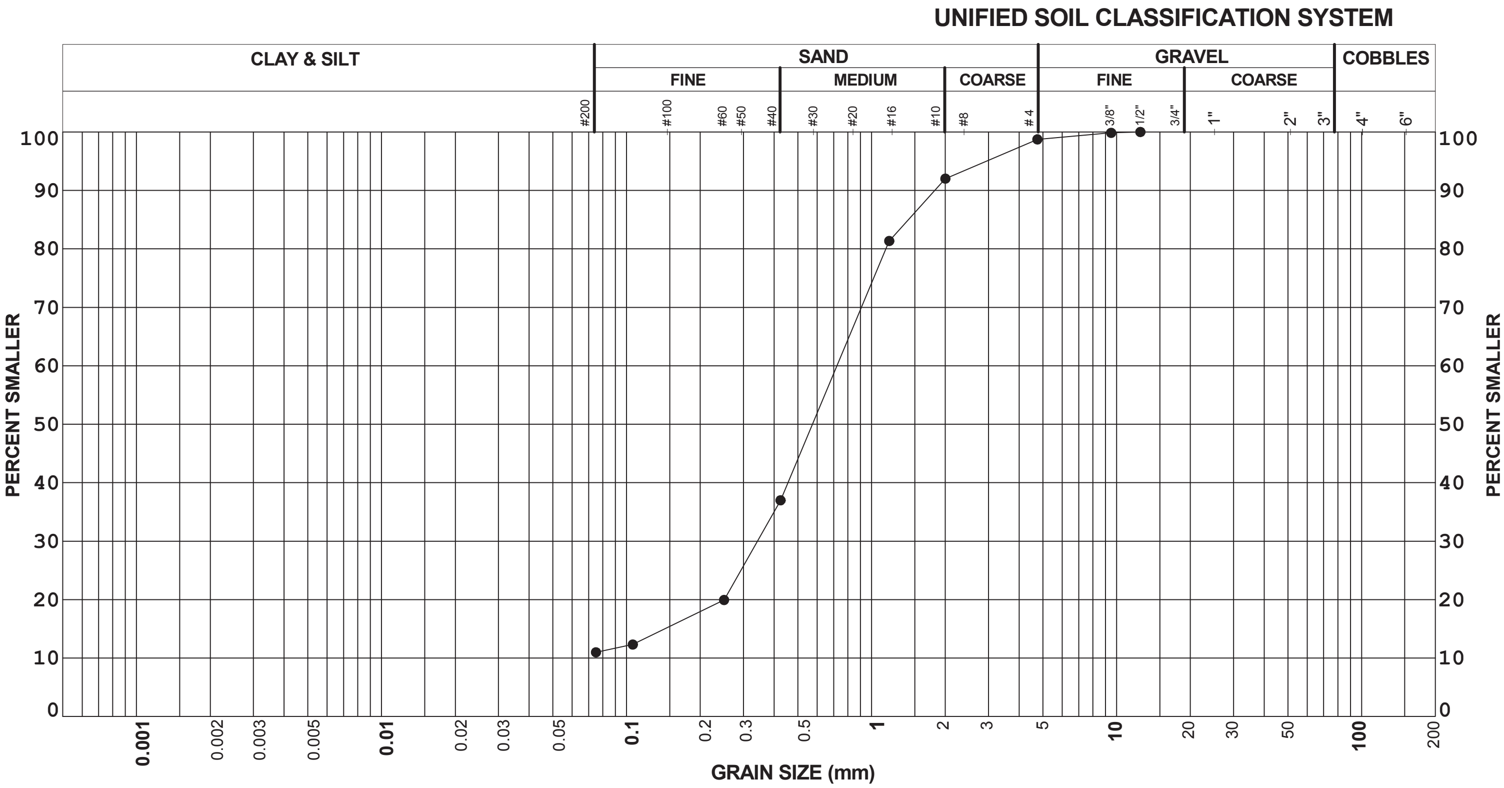
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-C010	DS2	2.40	1	88	11		

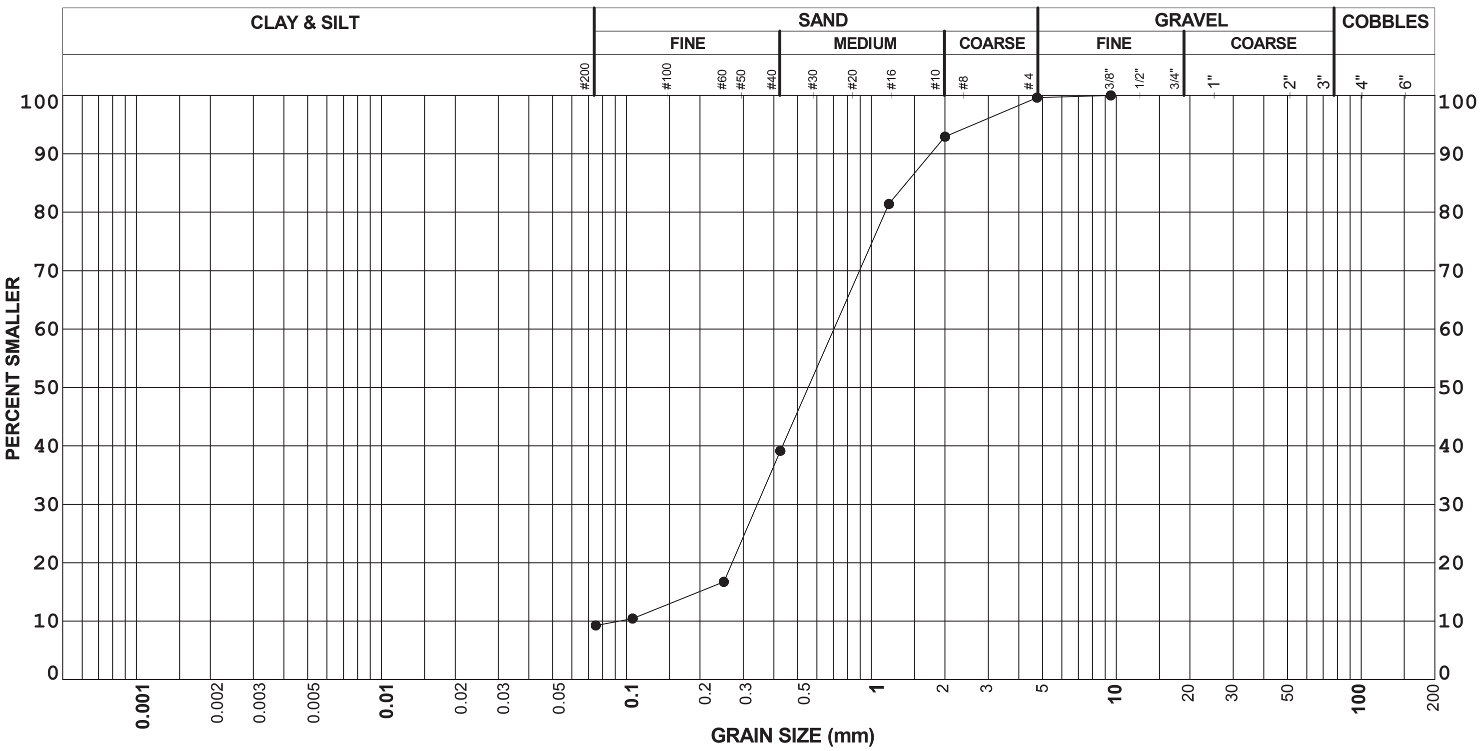
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



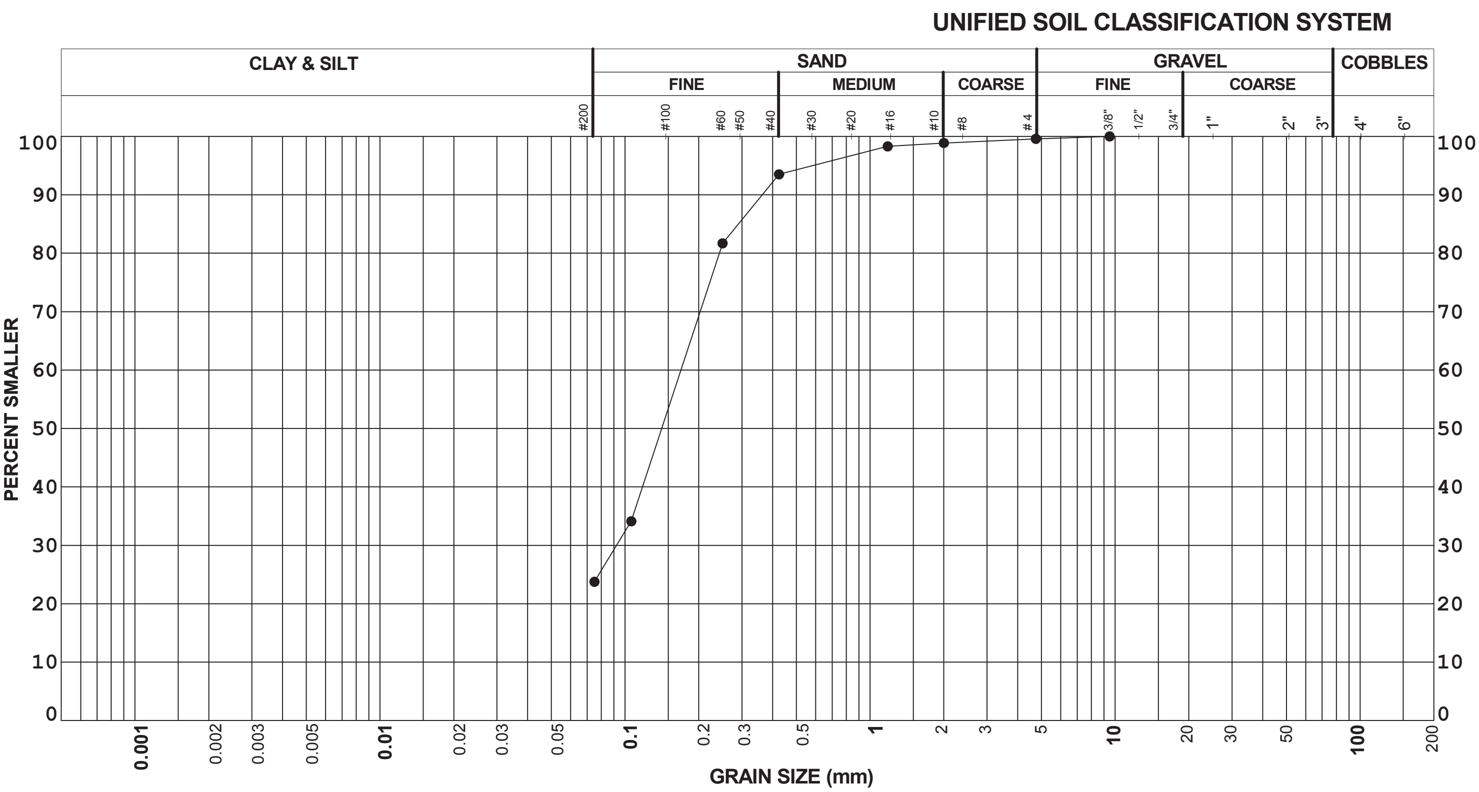
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-C010	DS3	3.70	0	90	9		

REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

Project



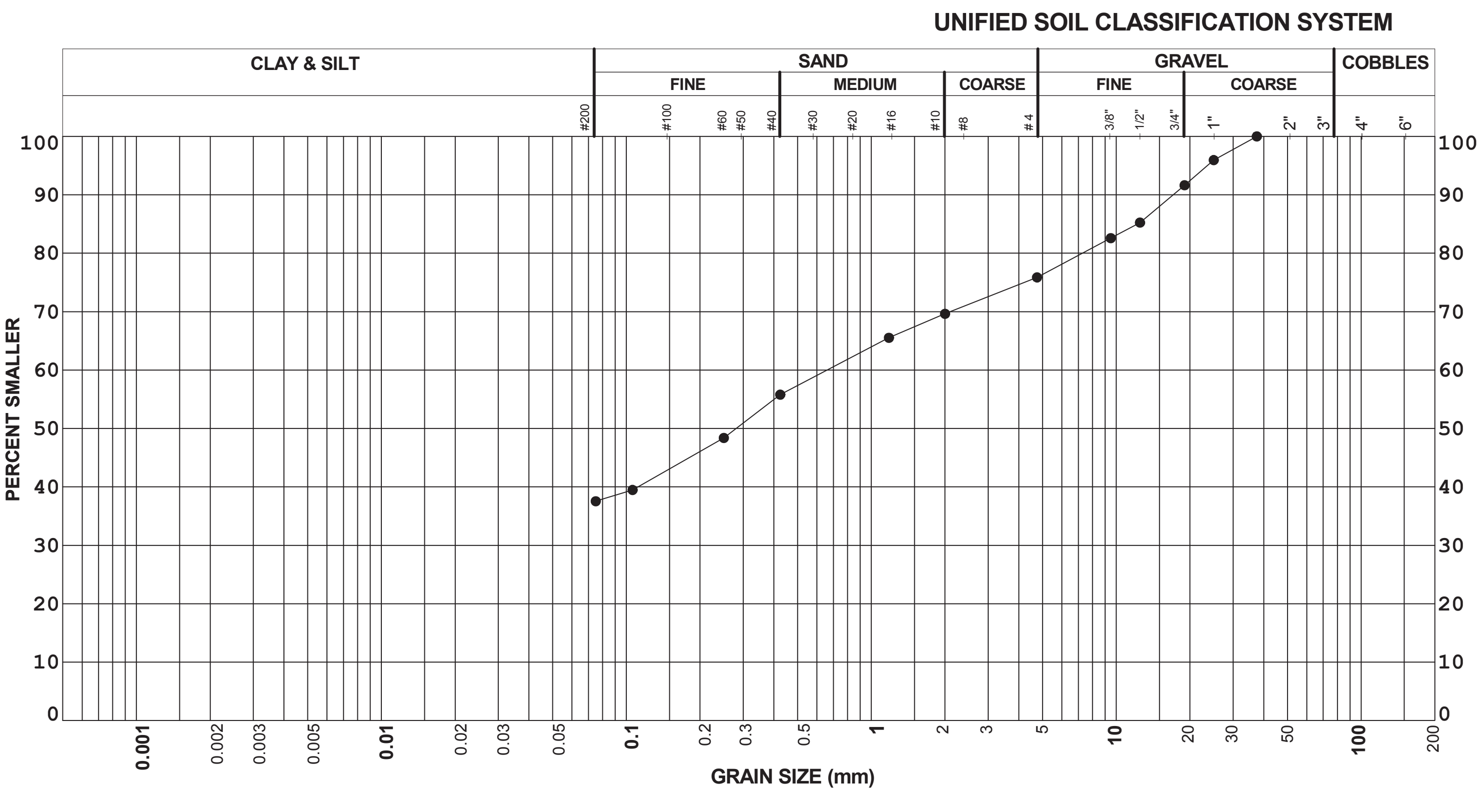
REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-C011	DS3	4.00	0	76	24		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

Project



REMARKS:

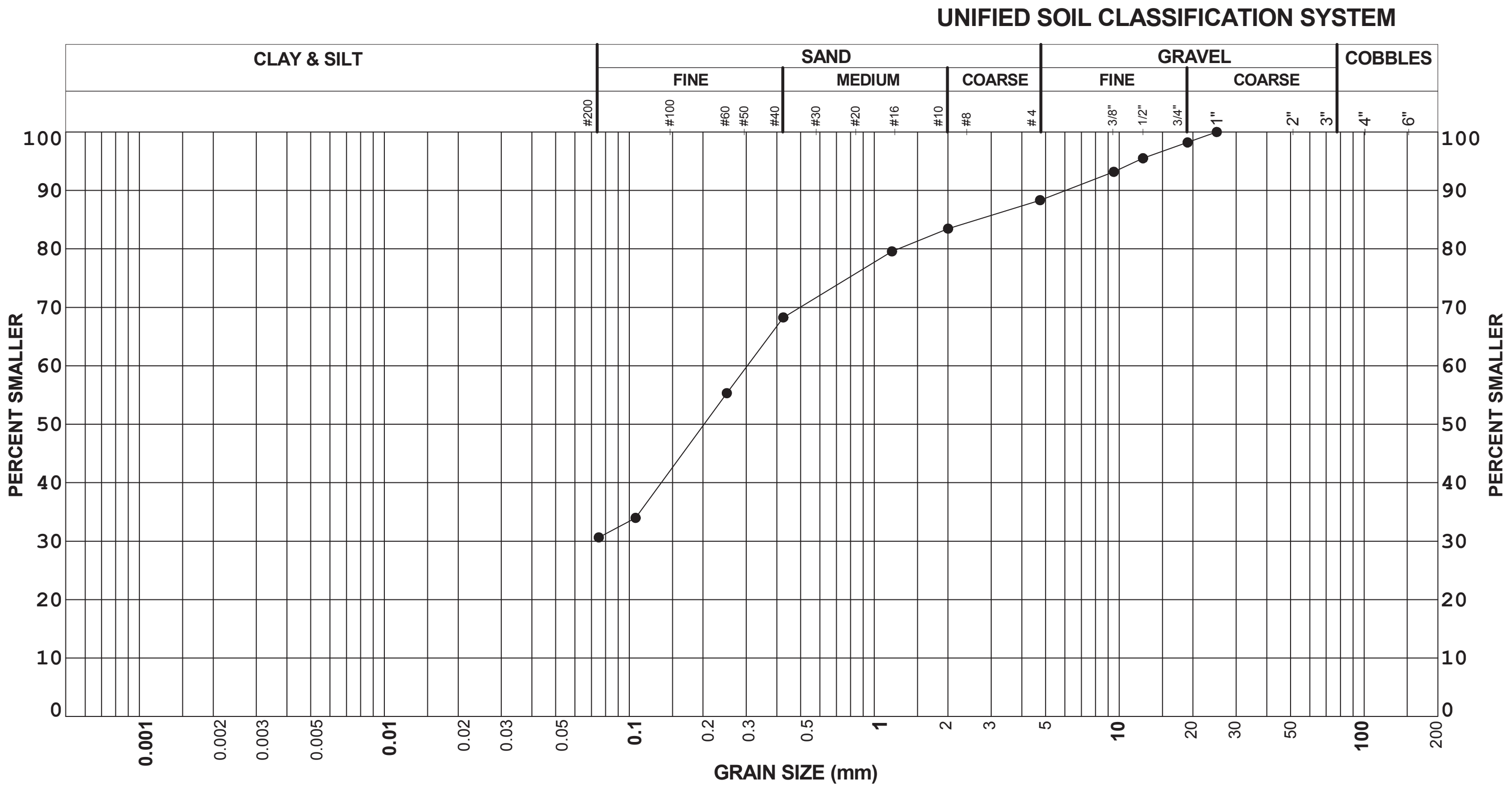
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-C012	DS3	4.00	24	38	38		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



REMARKS:

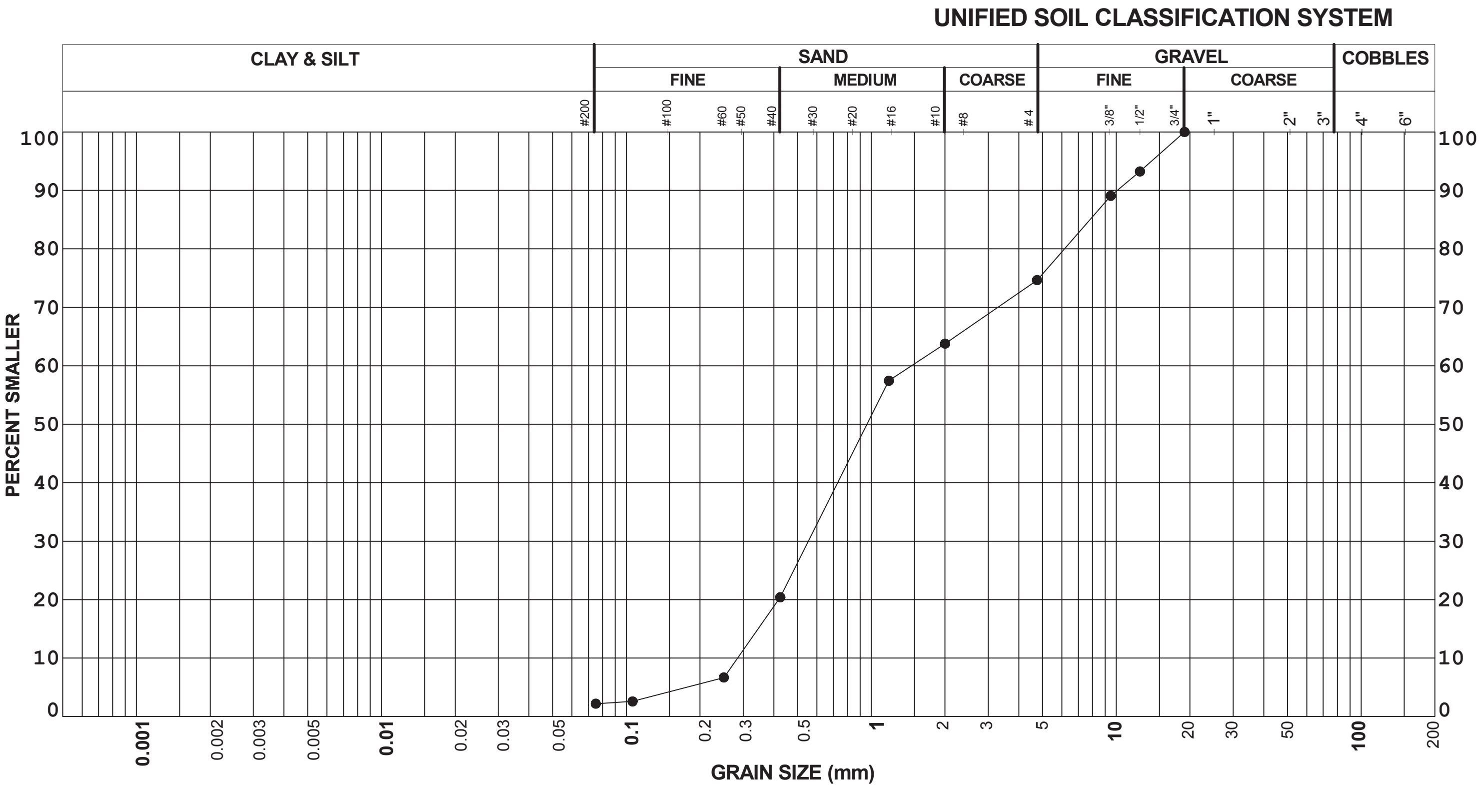
	BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
●	BH17-C013	DS1	0.90	12	58	31		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-BR86-2	DQ1	1.00	25	72	2		

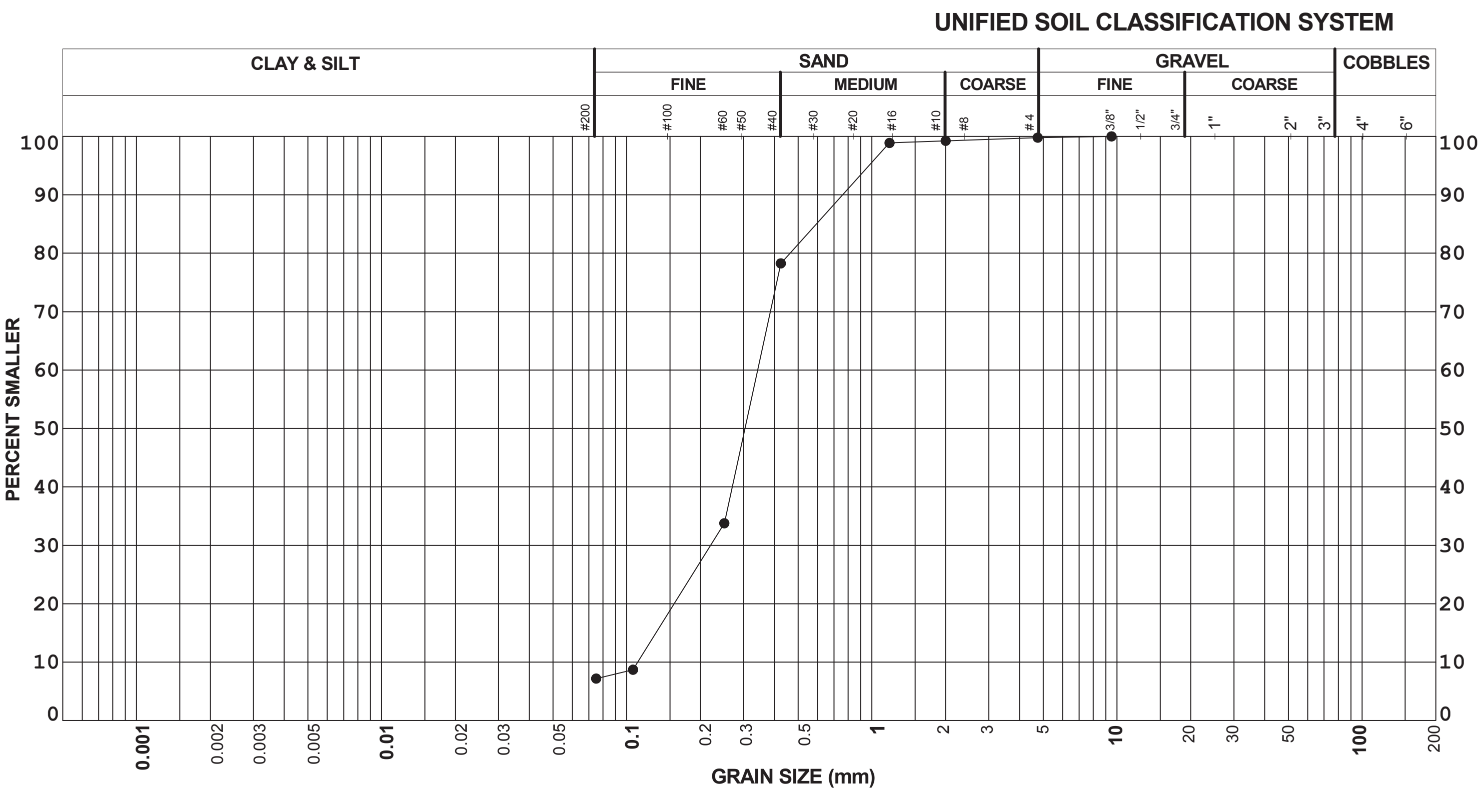
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines Corporation

HATCH

Project



REMARKS:

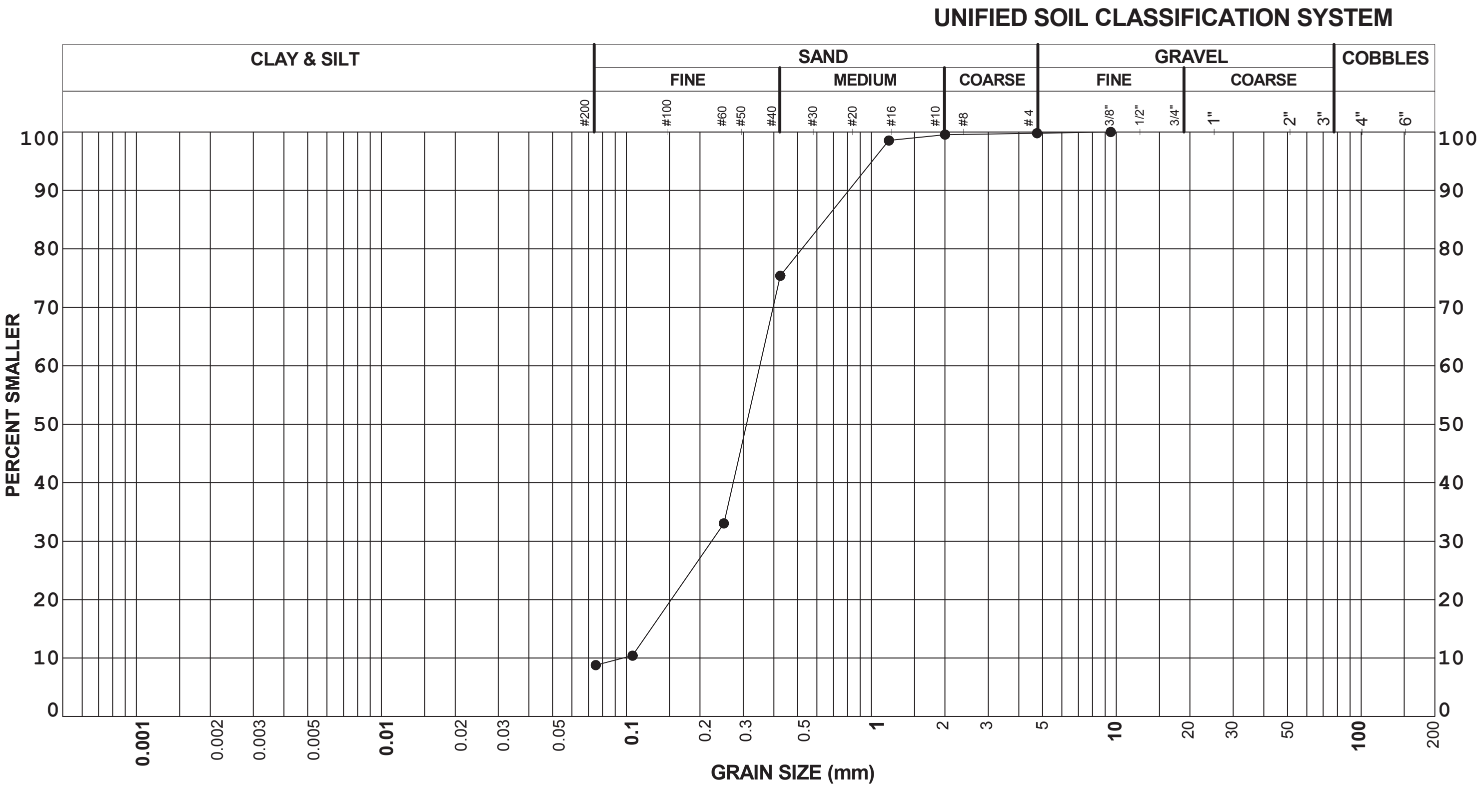
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-BR86-2	DQ2	2.00	0	93	7		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines Corporation

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-BR86-2	DQ3	3.00	0	91	9		

REMARKS:

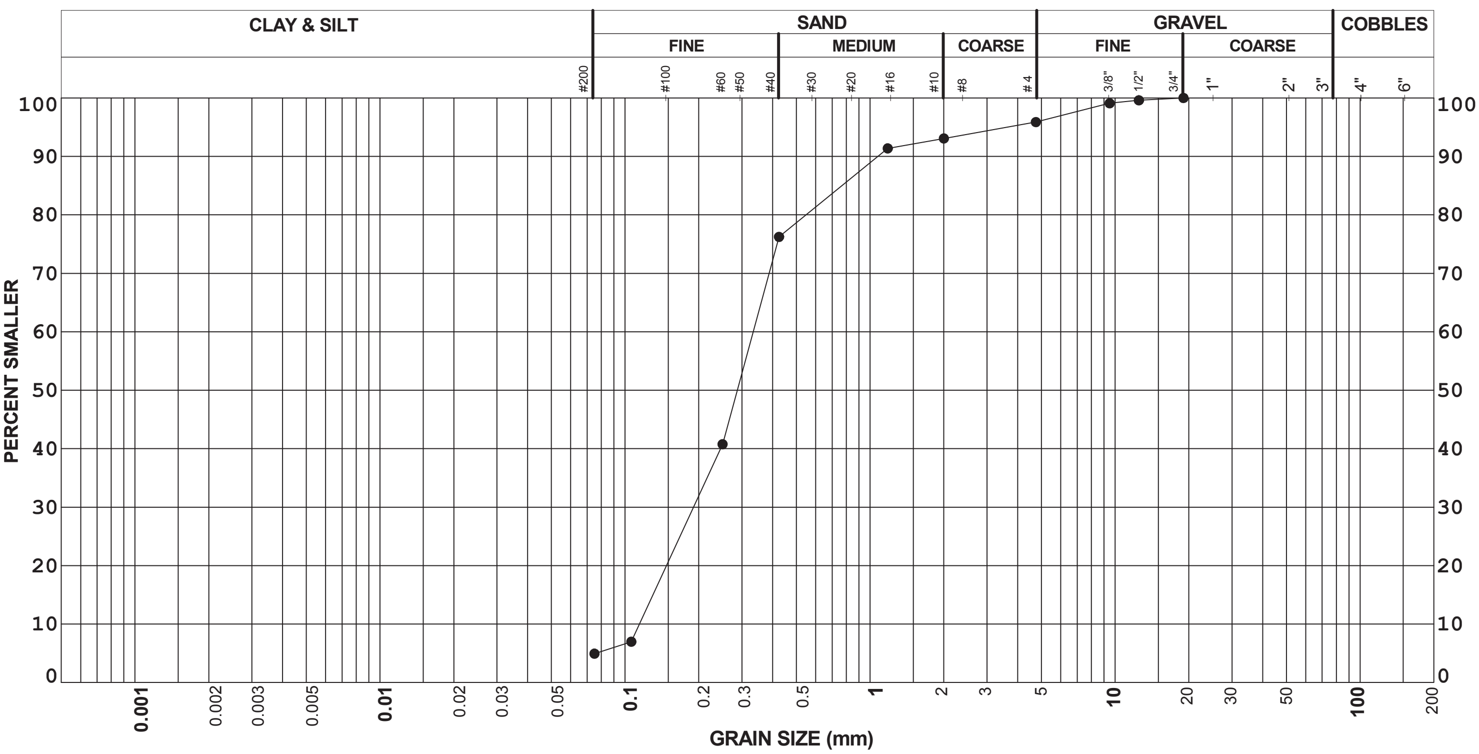
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines Corporation

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

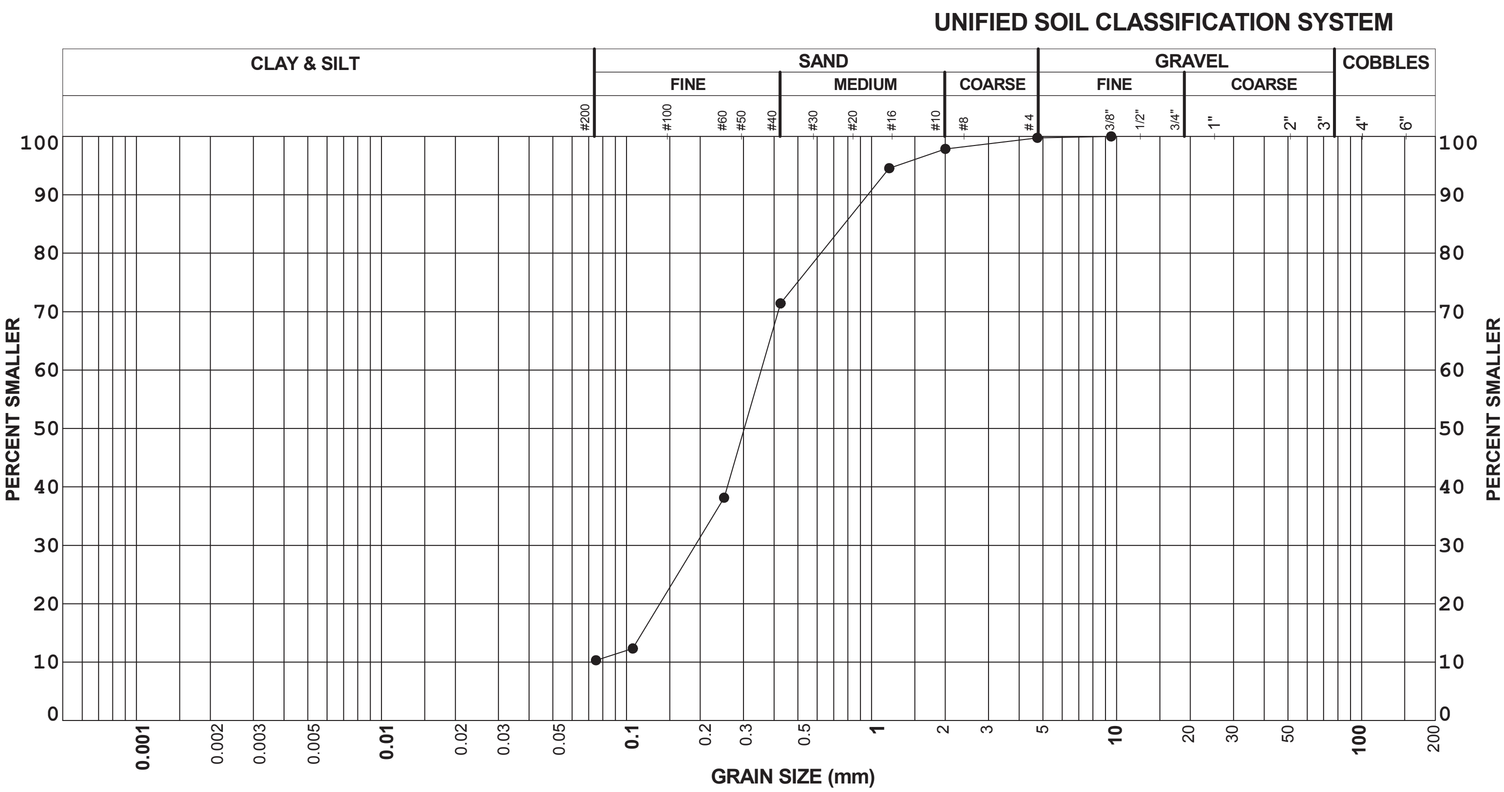
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-BR86-2	DQ4	5.00	4	91	5		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines Corporation

HATCH

Project



REMARKS:

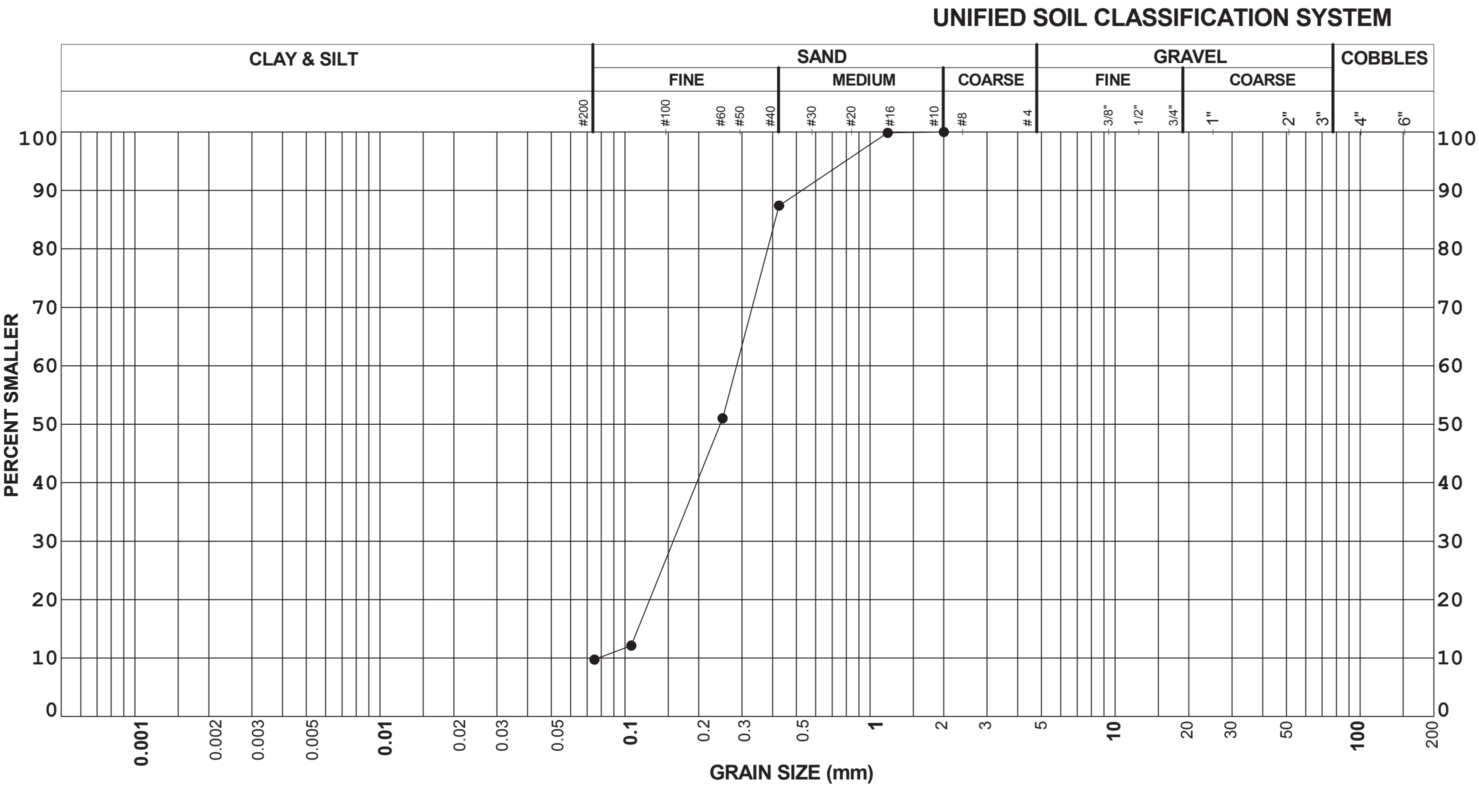
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-BR86-2	DQ5	10.00	0	89	10		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines Corporation

HATCH

Project



REMARKS:

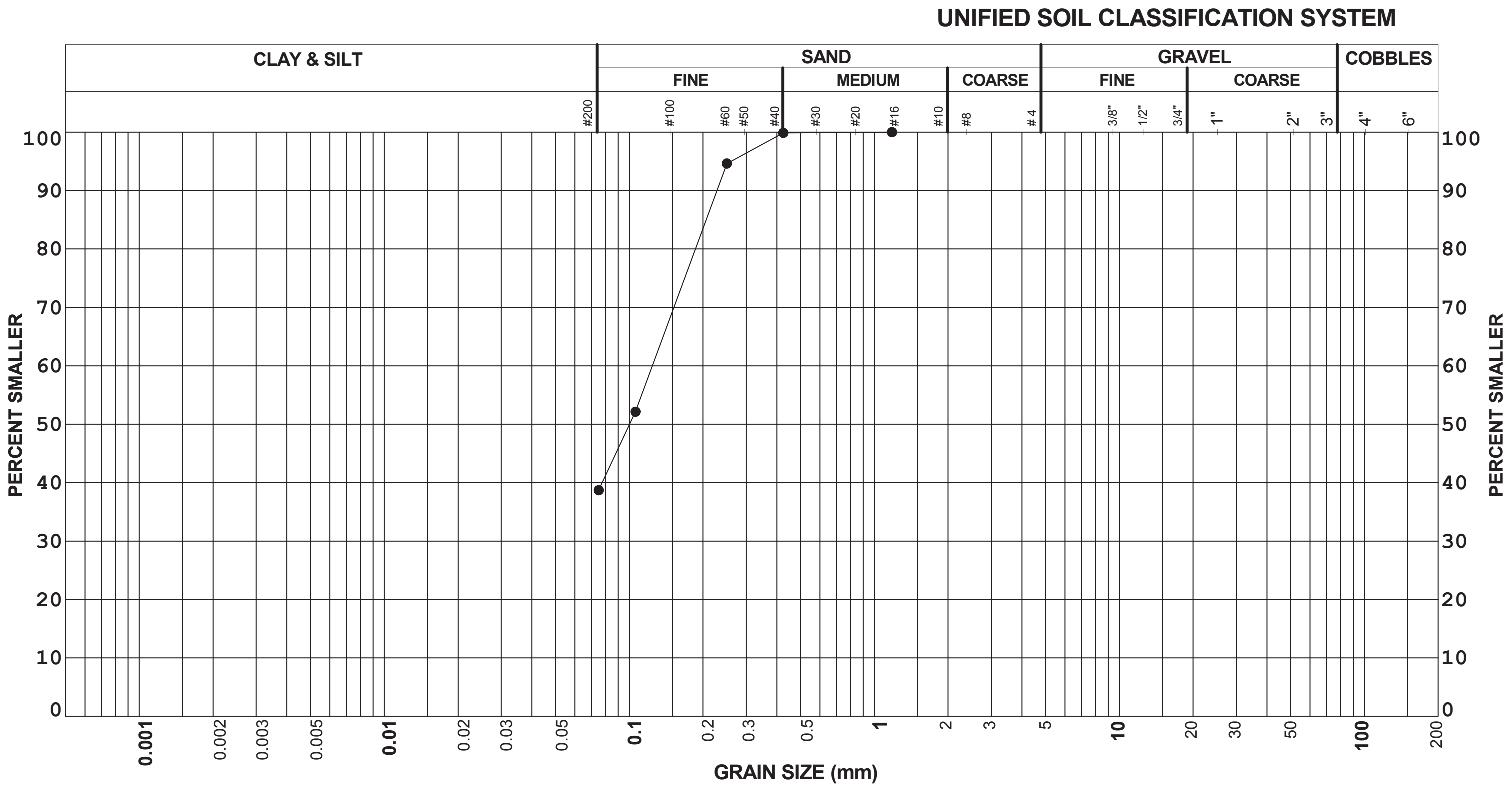
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-BR86-2	DQ7	20.00	0	90	10		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines Corporation

HATCH

Project



REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-BR86-2	DQ13	39.30	0	61	39		

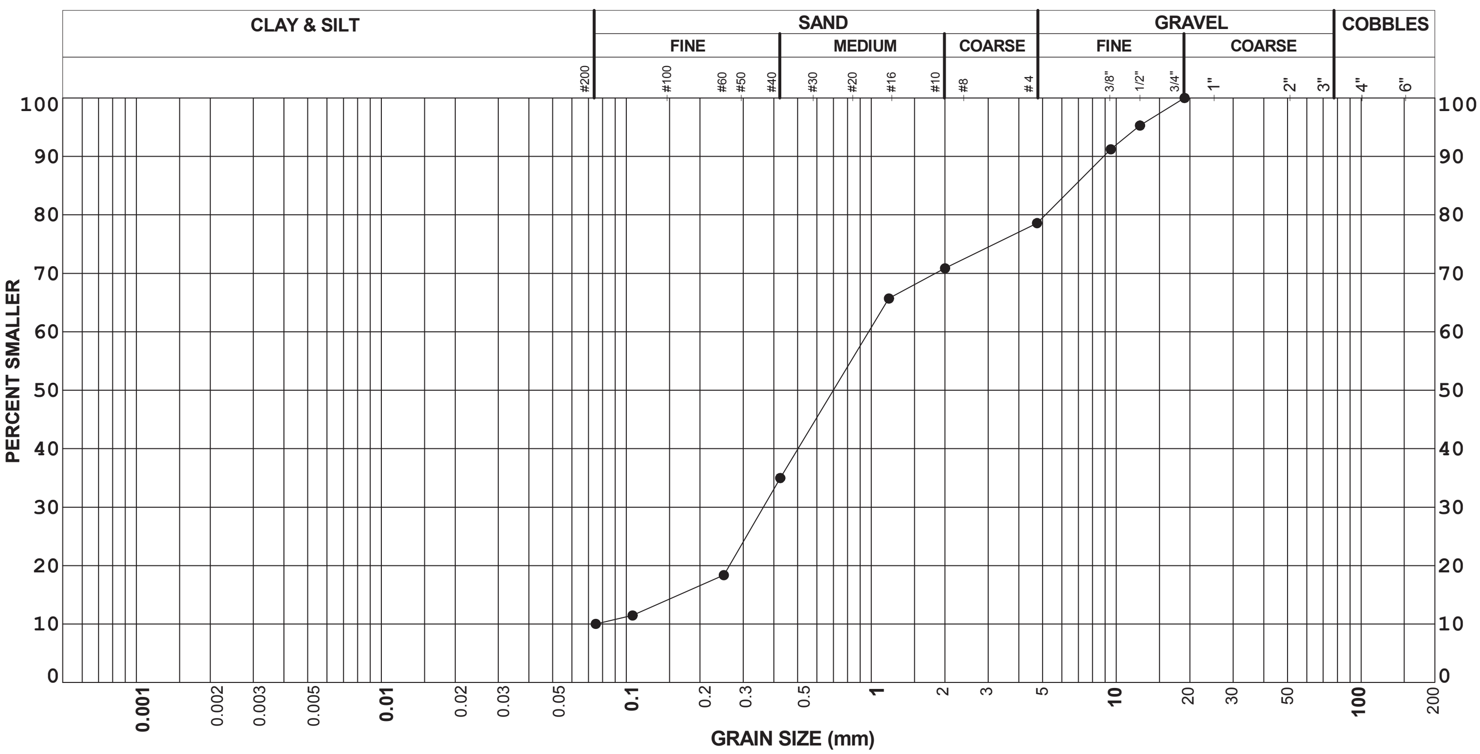
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines Corporation

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-BR86-3	DQ1	1.00	21	69	10		

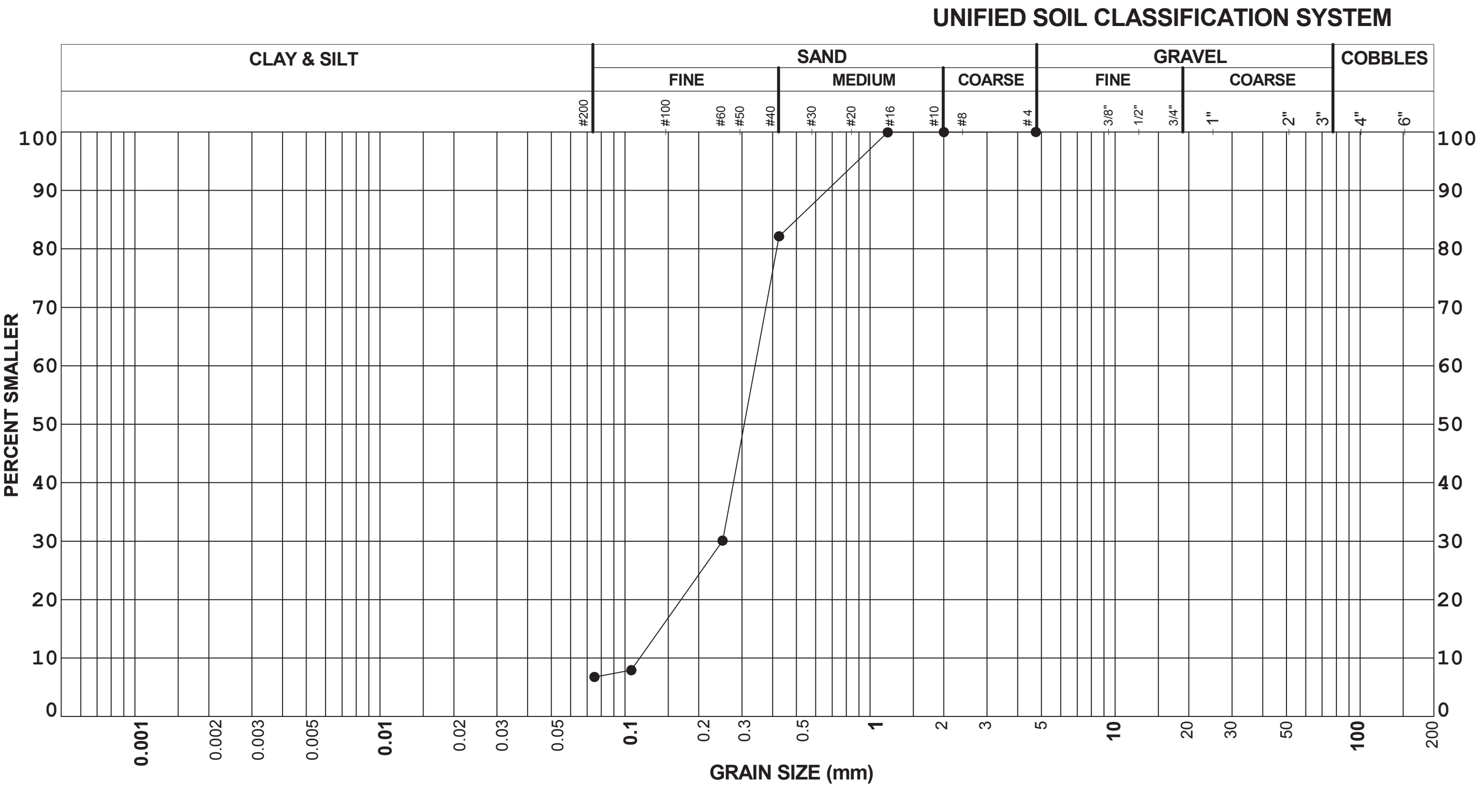
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines Corporation

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-BR86-3	DQ2	2.00	0	93	7		

REMARKS:

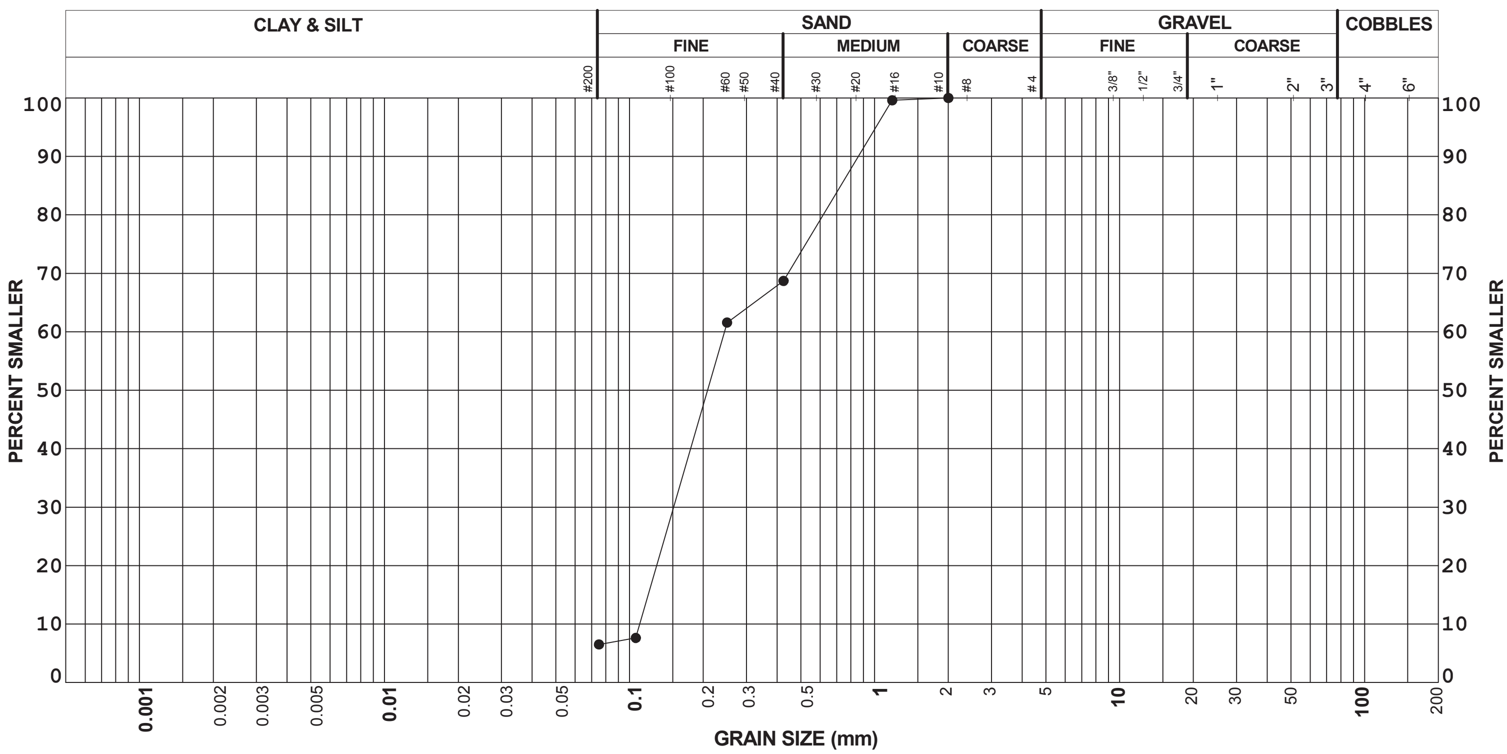
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines Corporation

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-BR86-3	DQ3	3.00	0	94	6		

REMARKS:

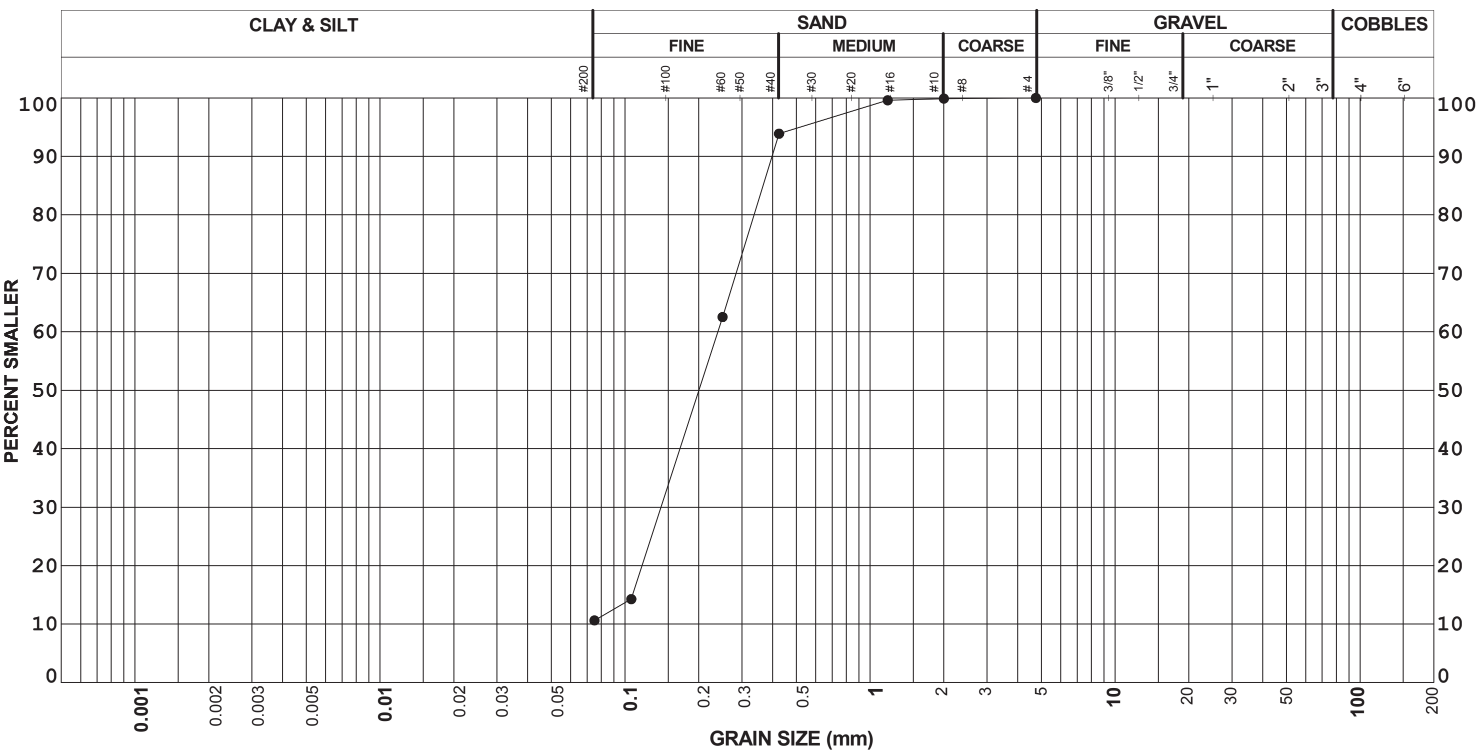
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines Corporation

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-BR86-3	DQ4	5.00	0	89	11		

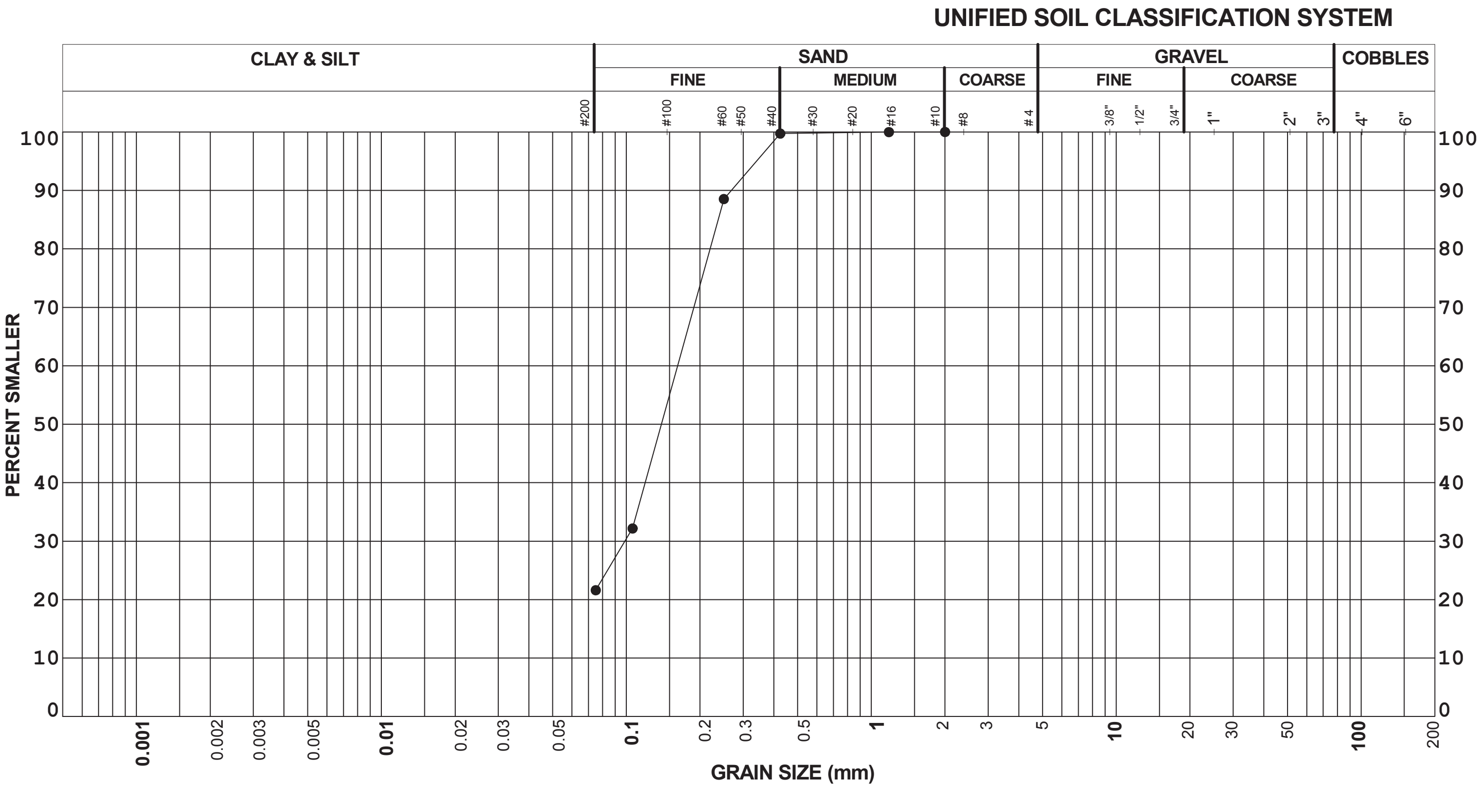
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines Corporation

HATCH

Project



REMARKS:

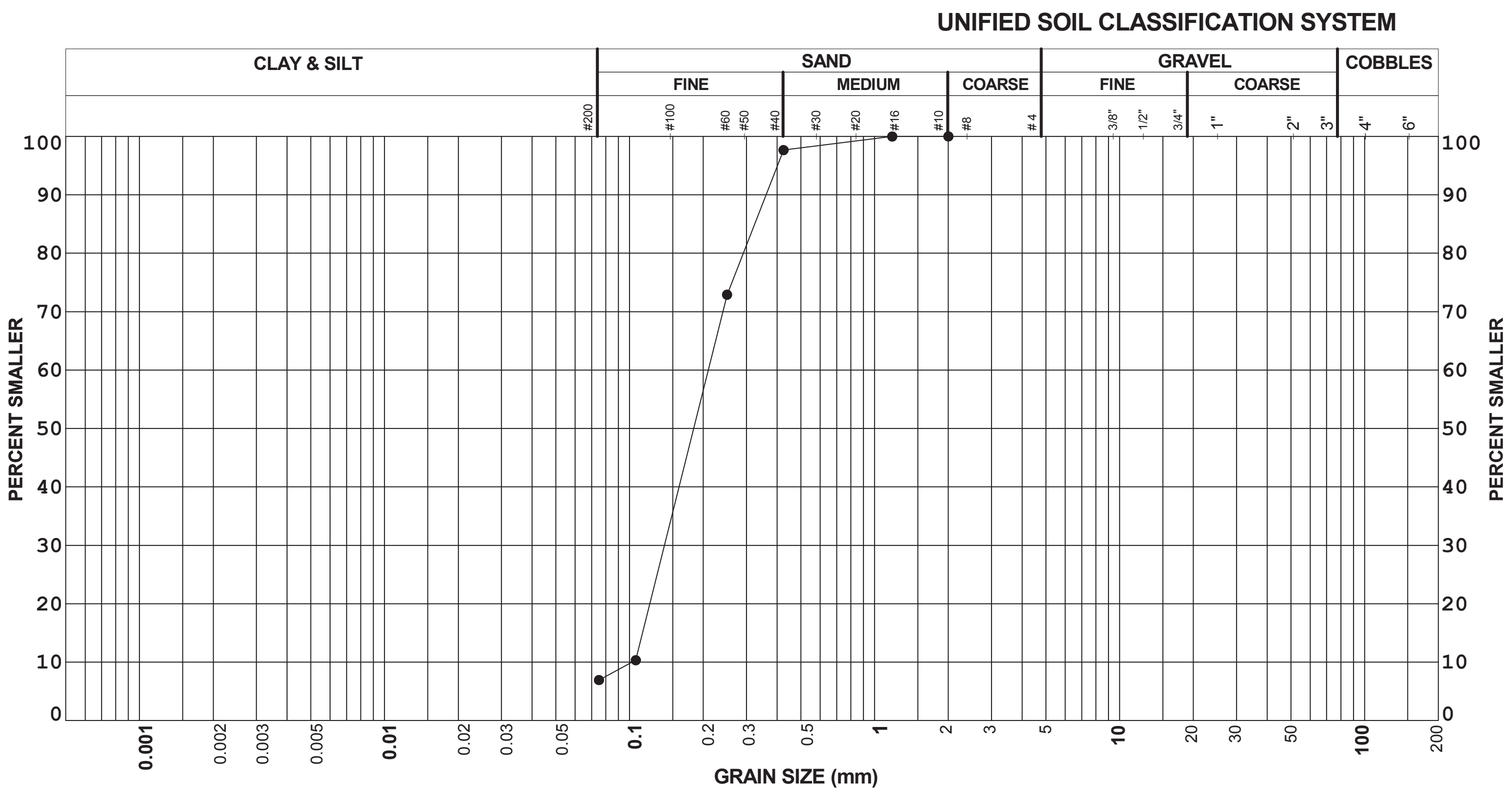
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-BR86-3	DQ5	8.00	0	78	22		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines Corporation

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-BR86-3	DQ6	12.00	0	93	7		

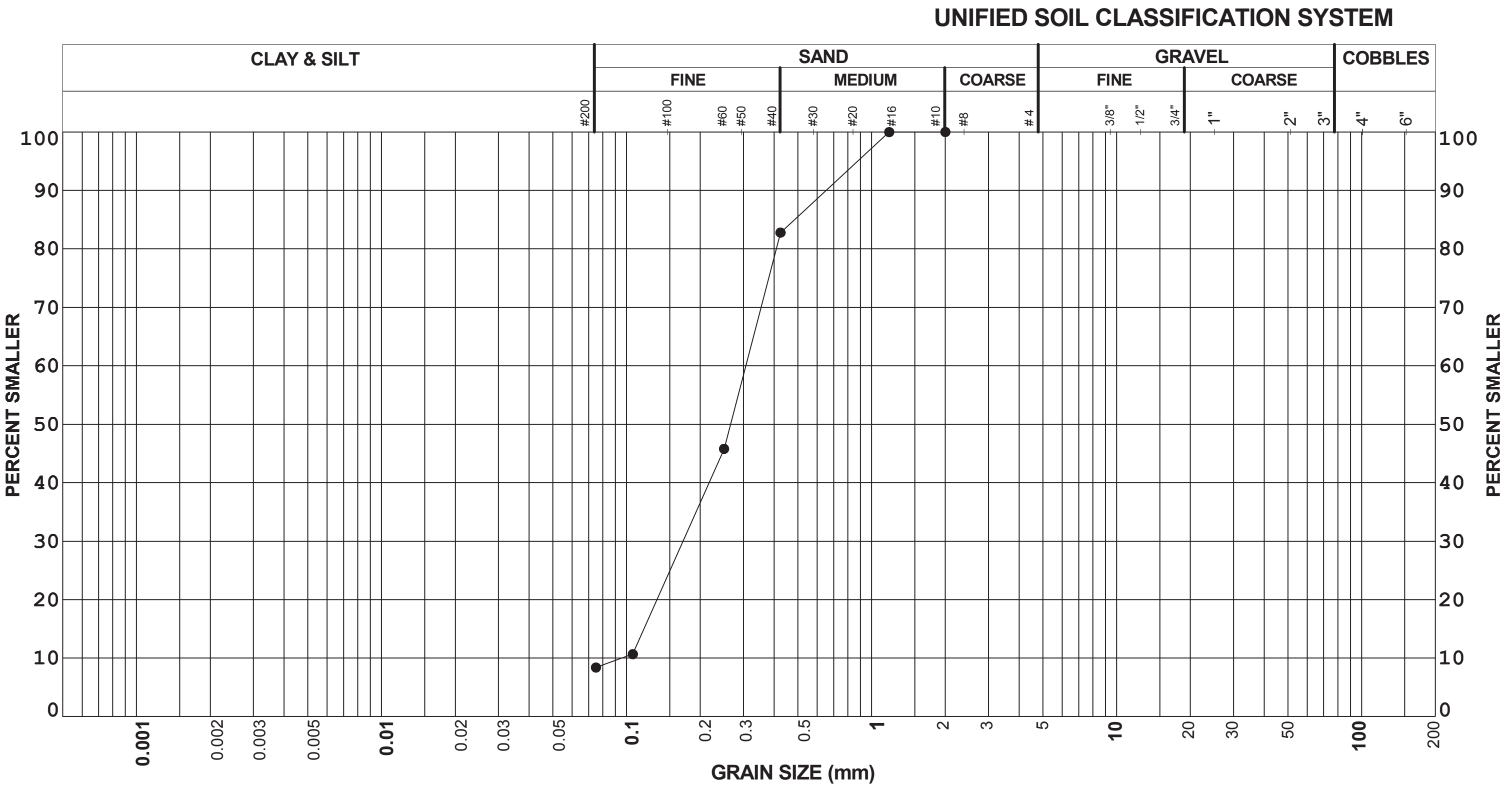
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines Corporation

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH17-BR86-3	DQ8	30.00	0	92	8		

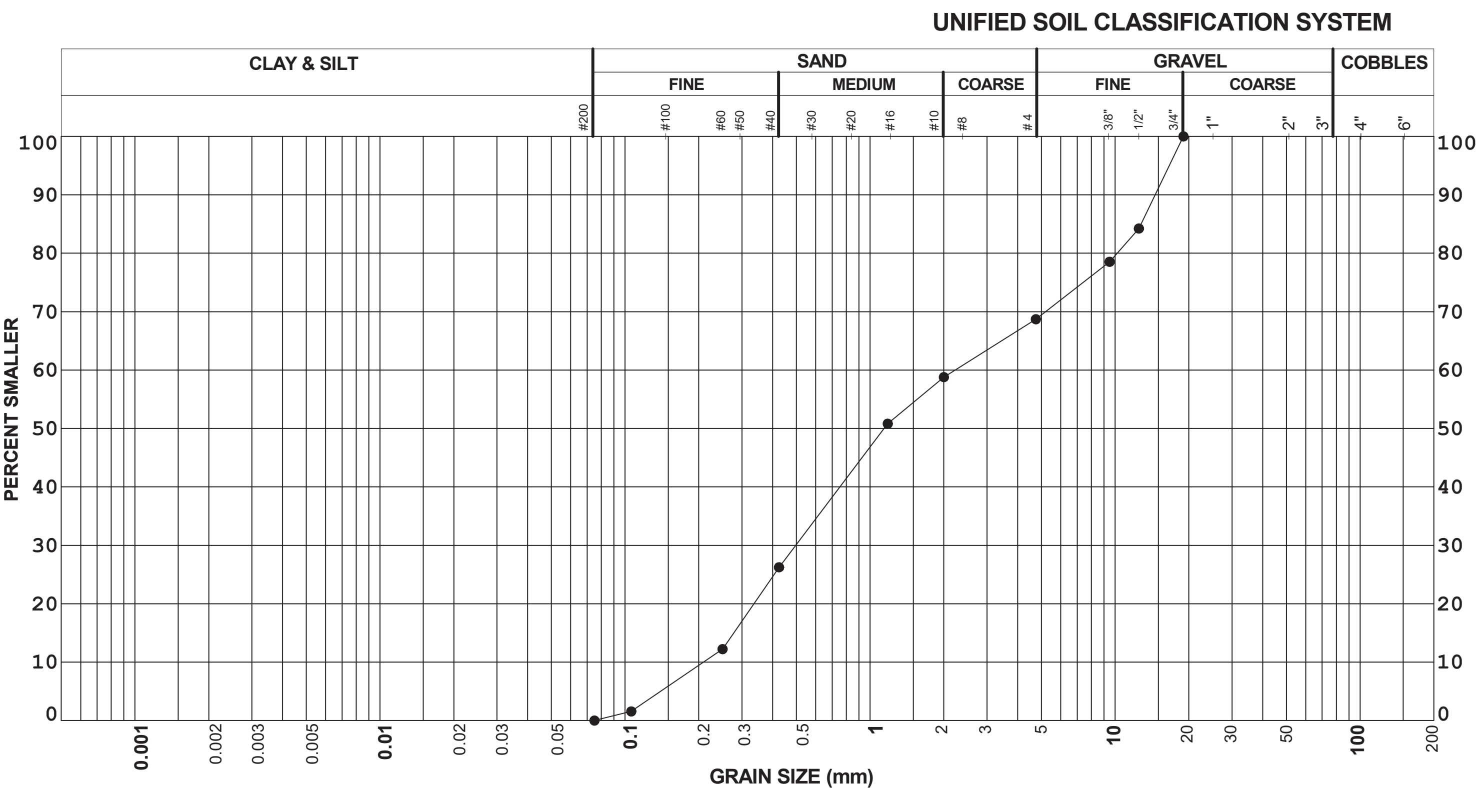
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mines Corporation

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-102-2	DQ-3	3.01	31	69	0		

REMARKS:

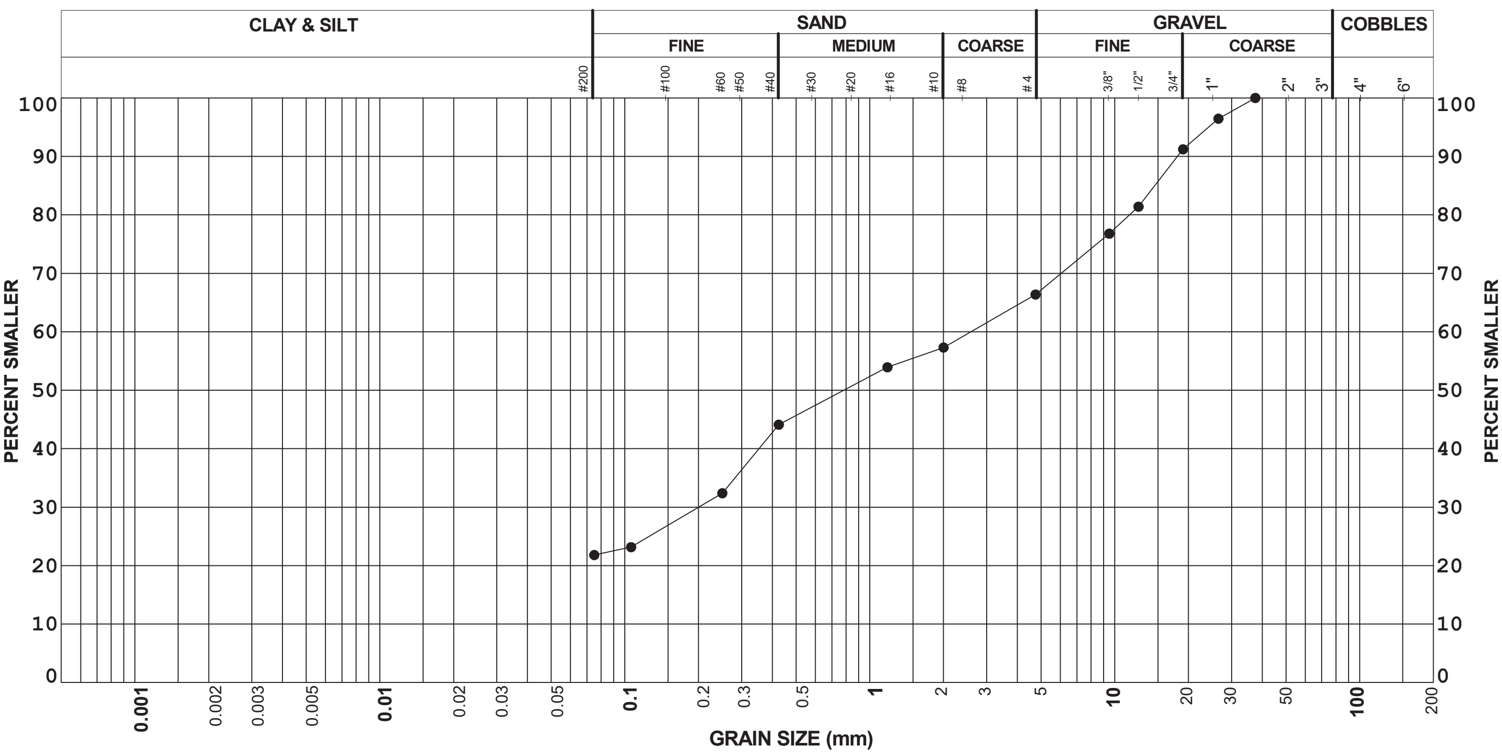
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR15-1	DS-2	2.60	34	44	22		

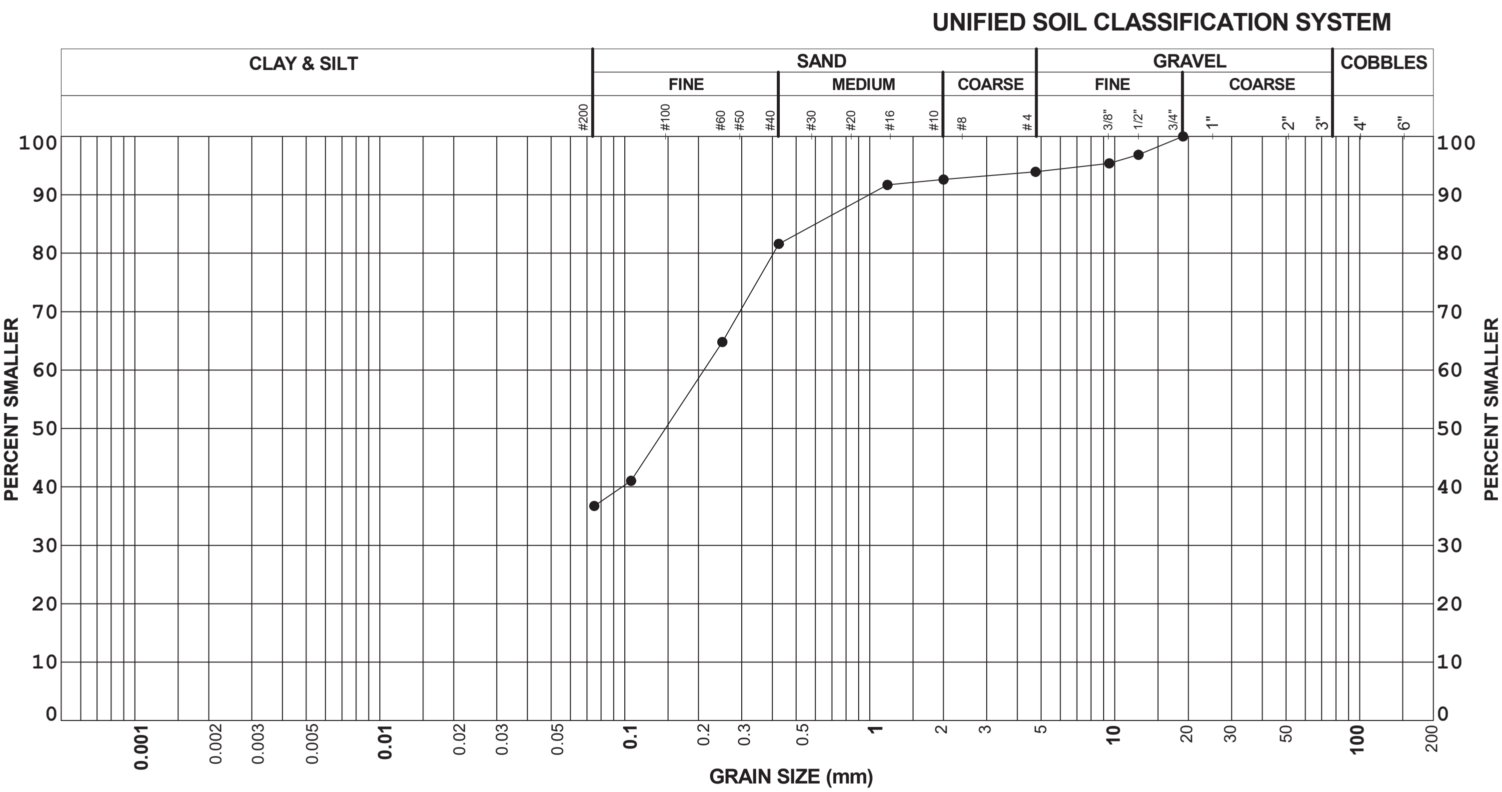
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

HATCH

Project



REMARKS:

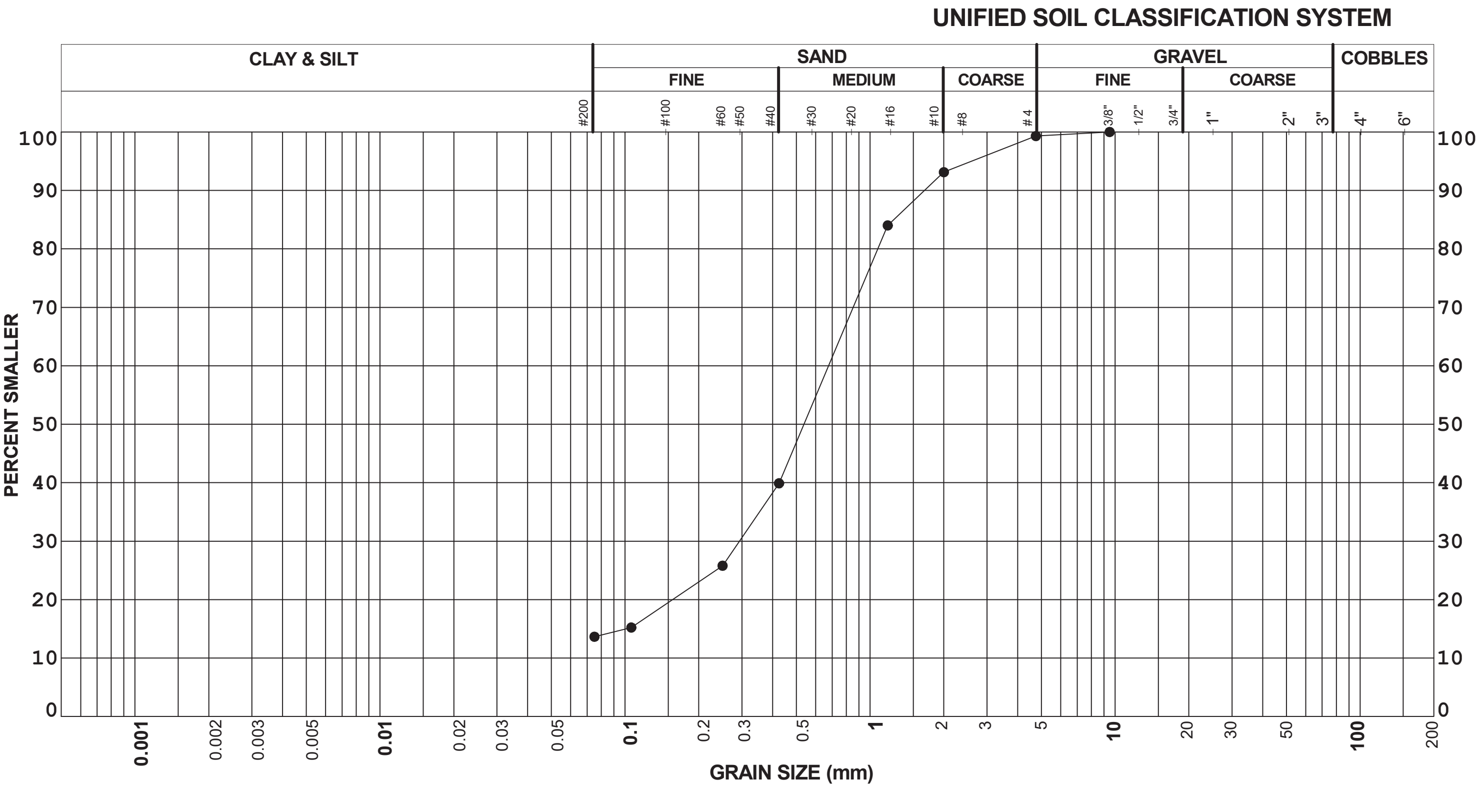
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR15-1	DS-3	3.90	6	57	37		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR15-2	DS-1	1.20	1	85	14		

REMARKS:

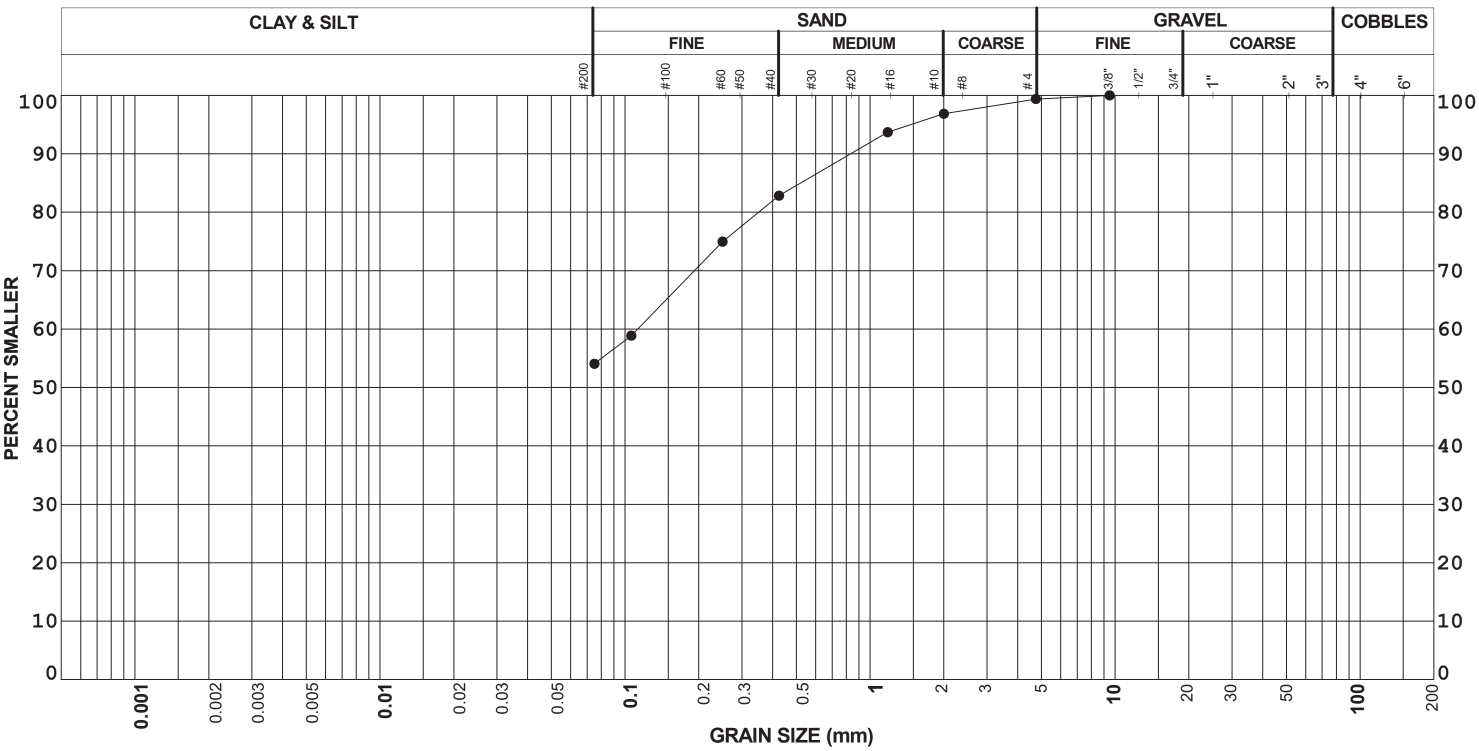
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



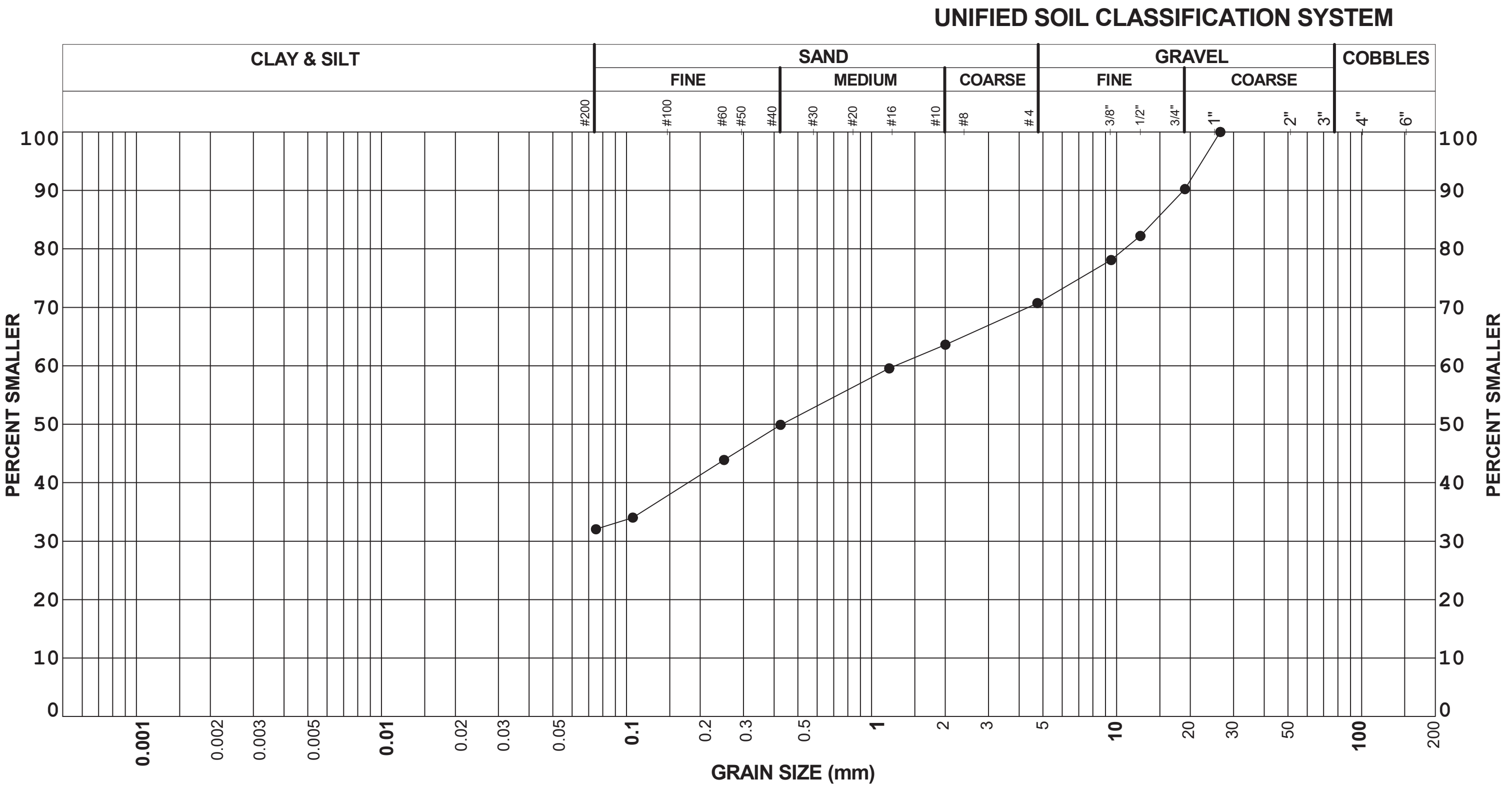
REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR15-2	DS-3	2.00	1	45	54		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR15-2	DS-5	2.55	29	39	32		

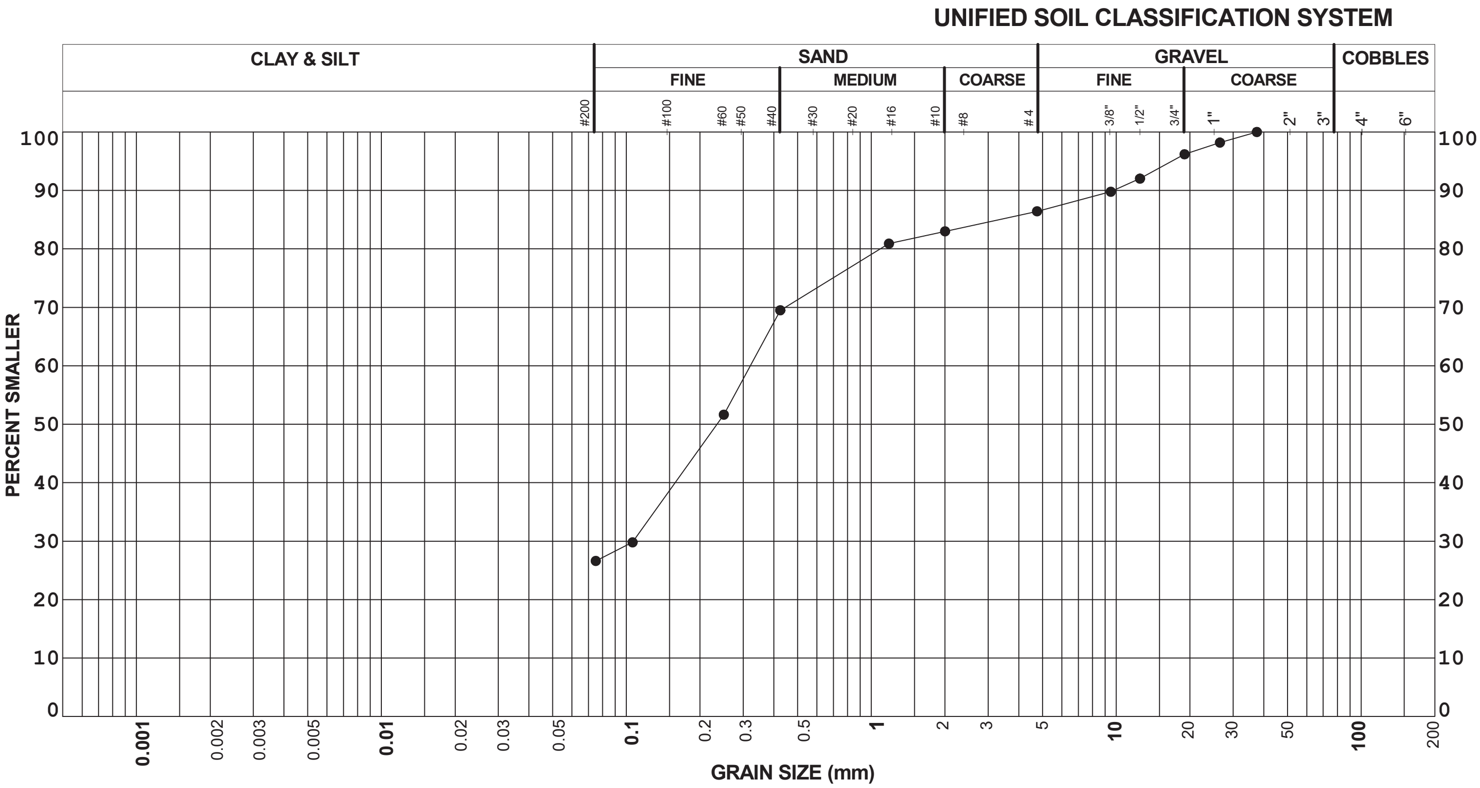
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR15-2	DS-7	4.20	14	60	26		

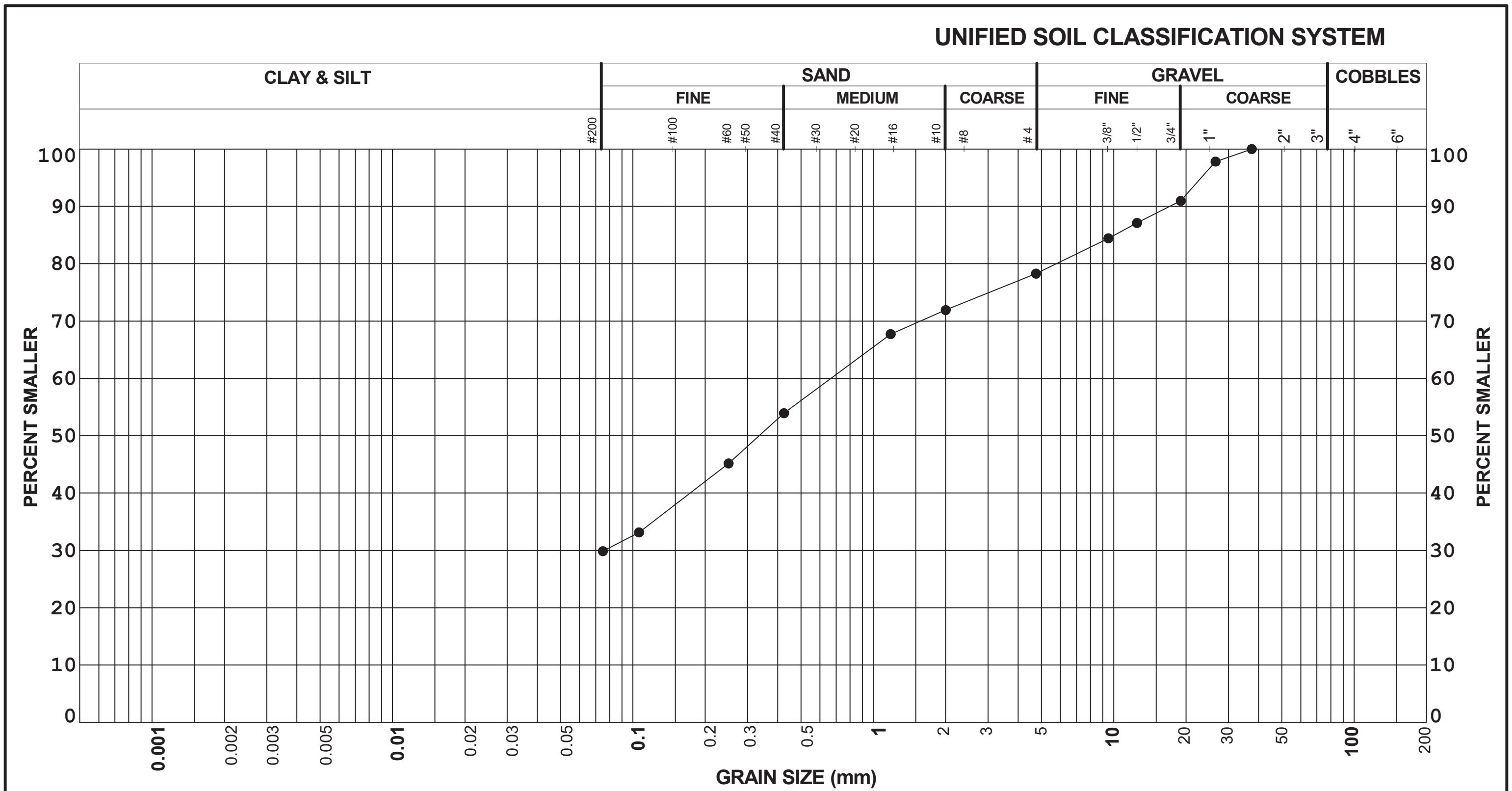
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

HATCH

Project



REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR15-2	DS-8	5.80	22	48	30		

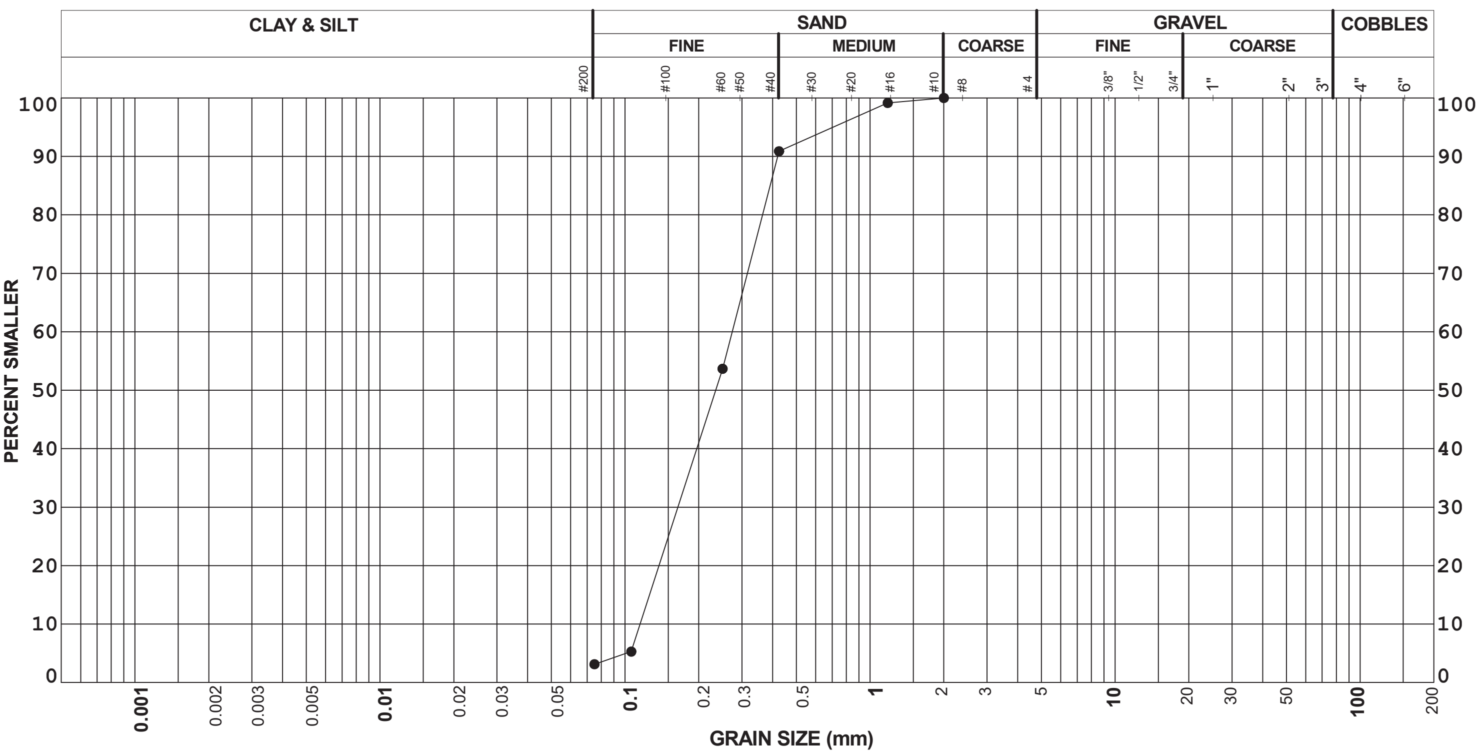
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR70-1	DS-2	2.60	0	97	3		

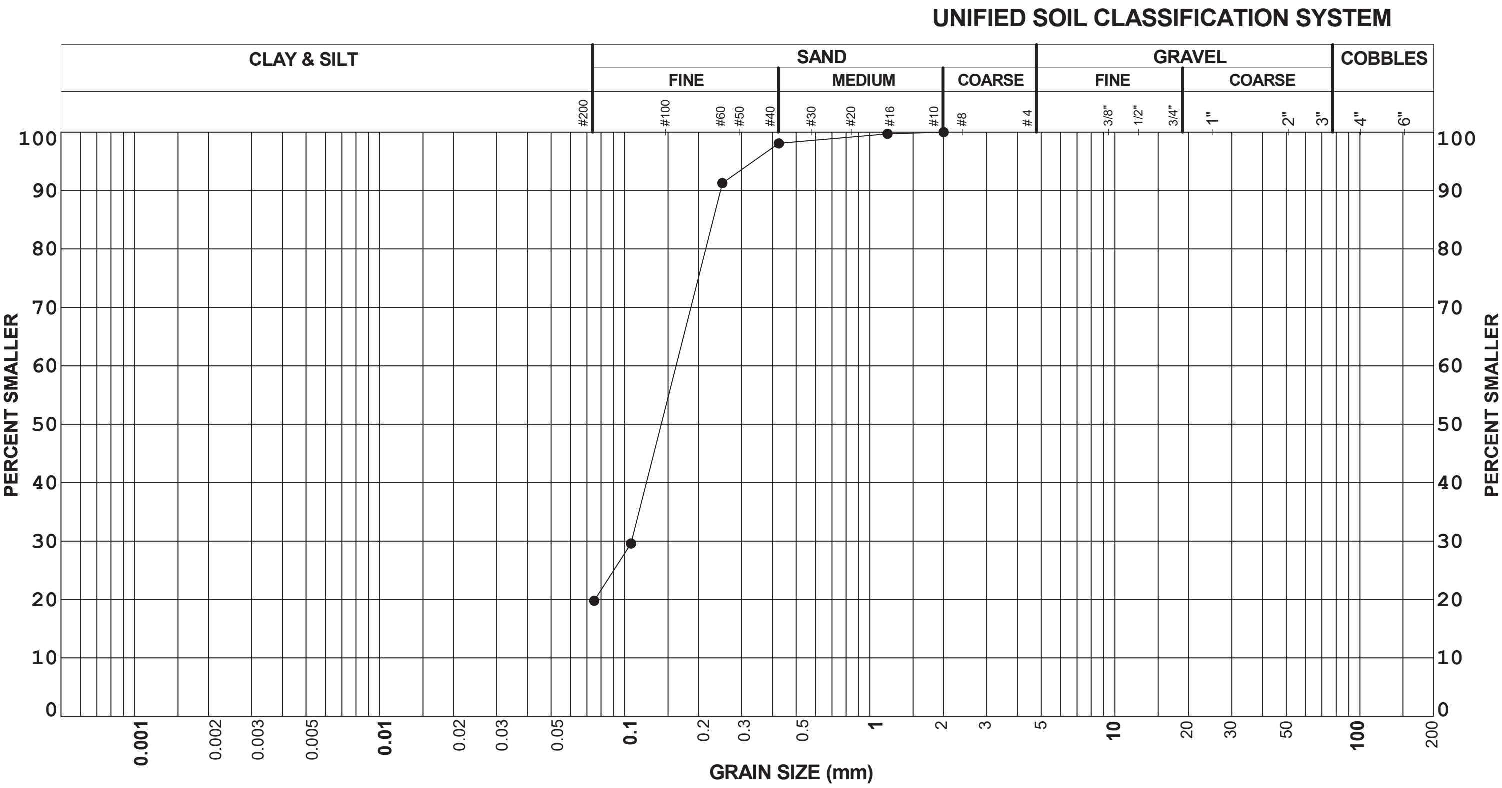
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR70-1	DS-4	6.80	0	80	20		

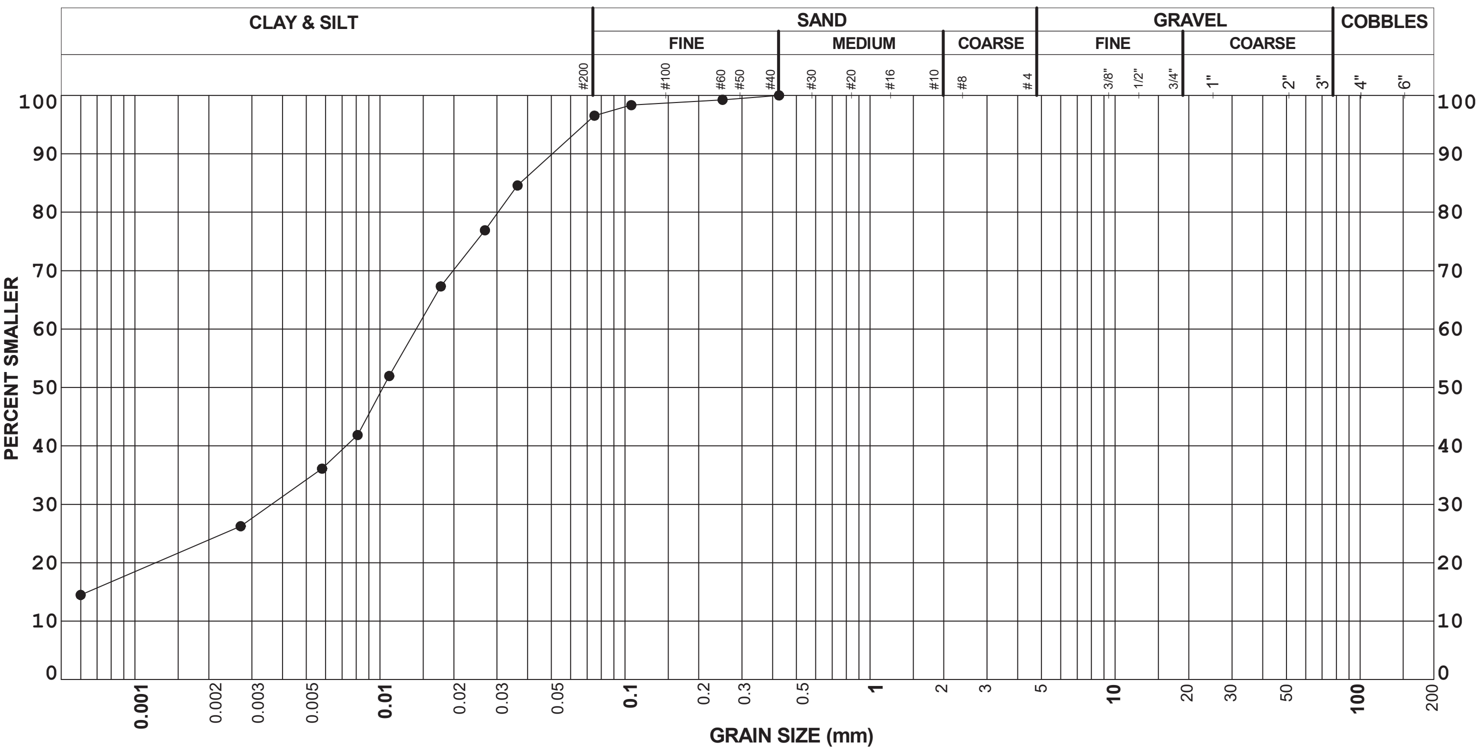
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR70-1	DS-5	9.44	0	3	97		

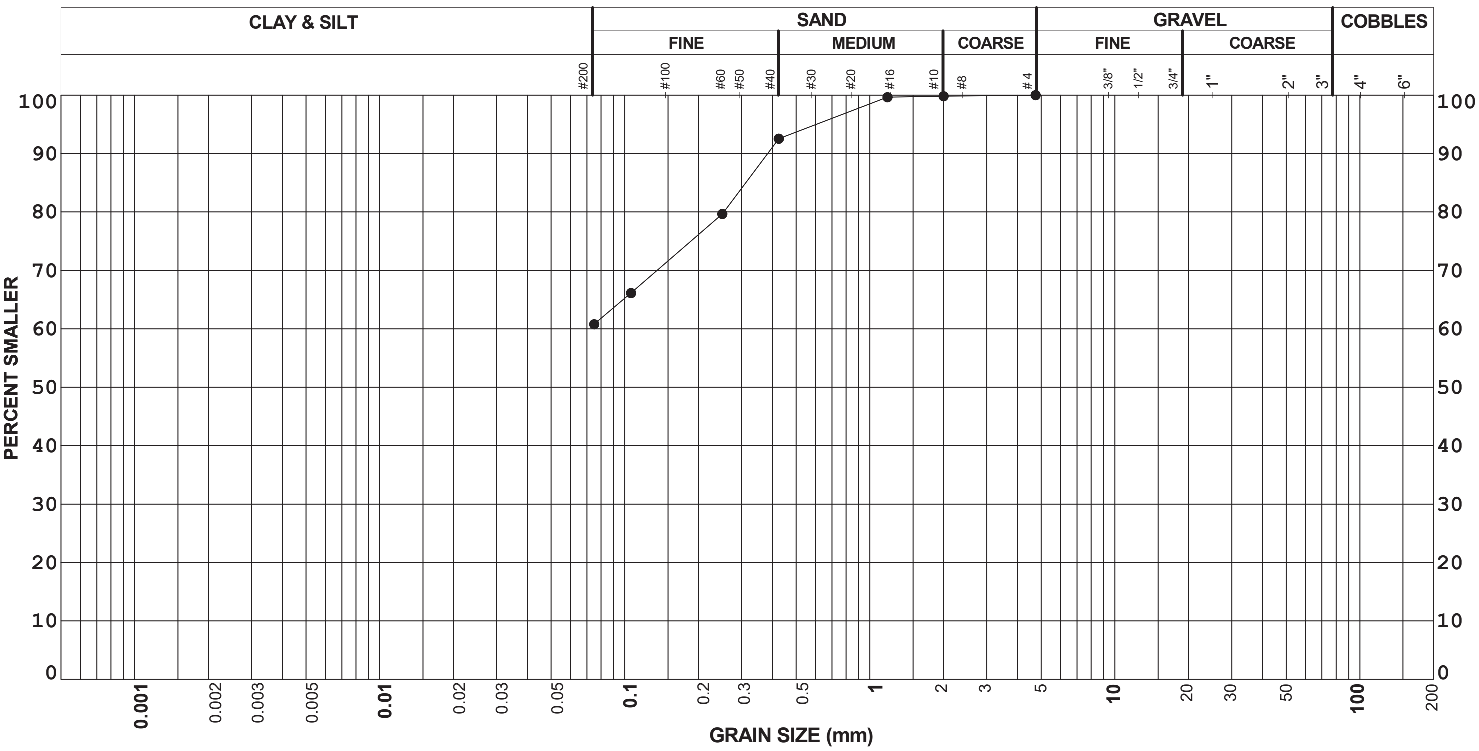
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

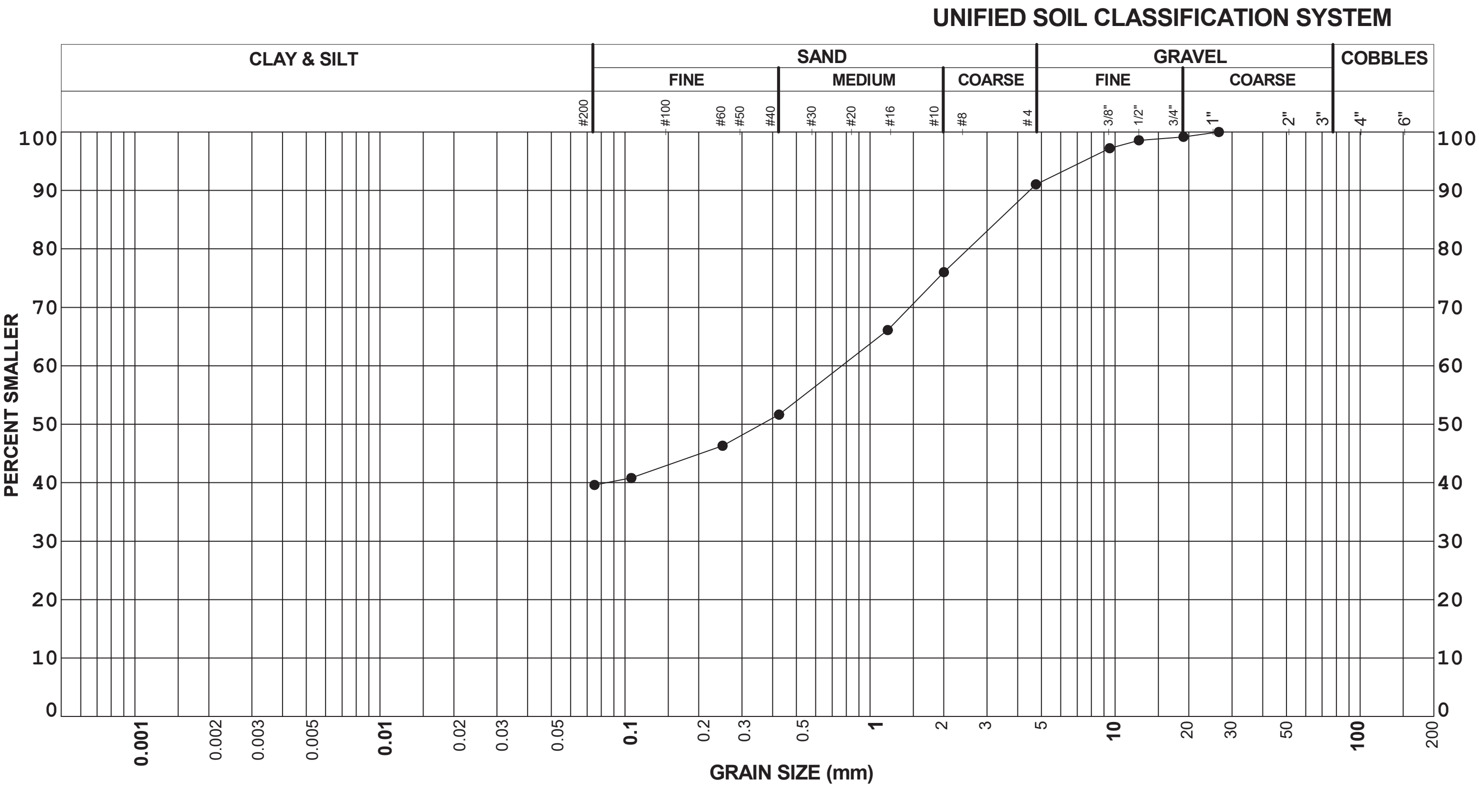
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR70-1	DS-6	11.30	0	39	61		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR70-1	DS-8	14.60	9	51	40		

REMARKS:

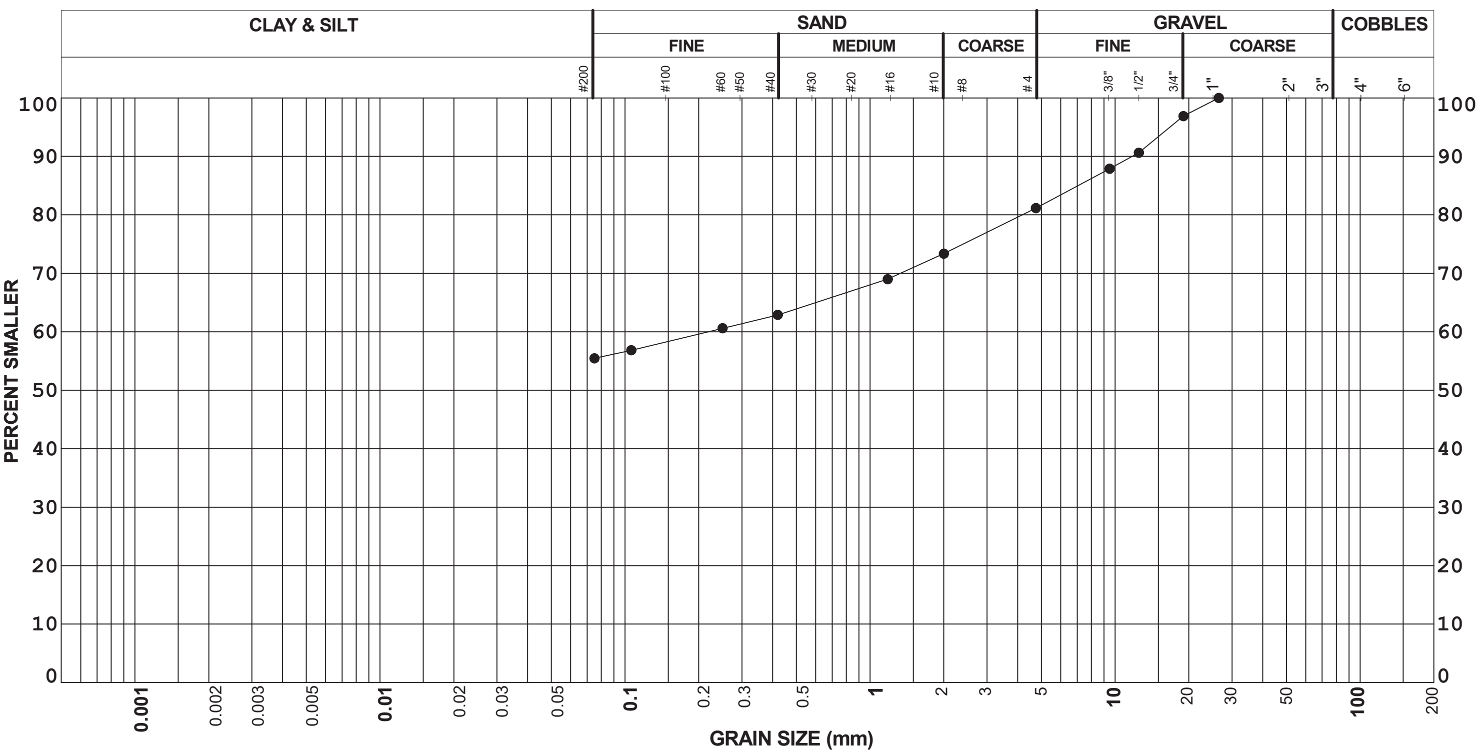
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR70-1	DQ-9	16.50	19	26	55		

REMARKS:

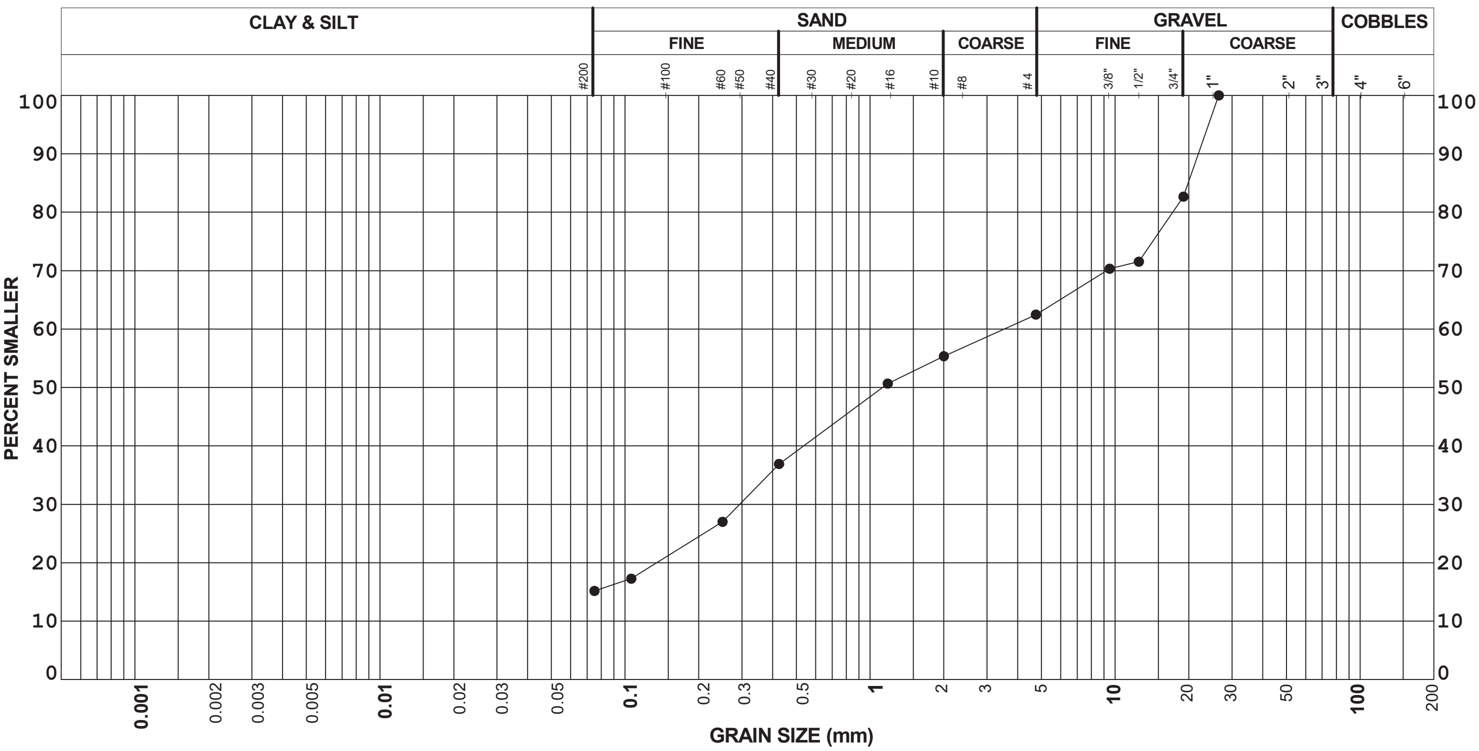
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



REMARKS:

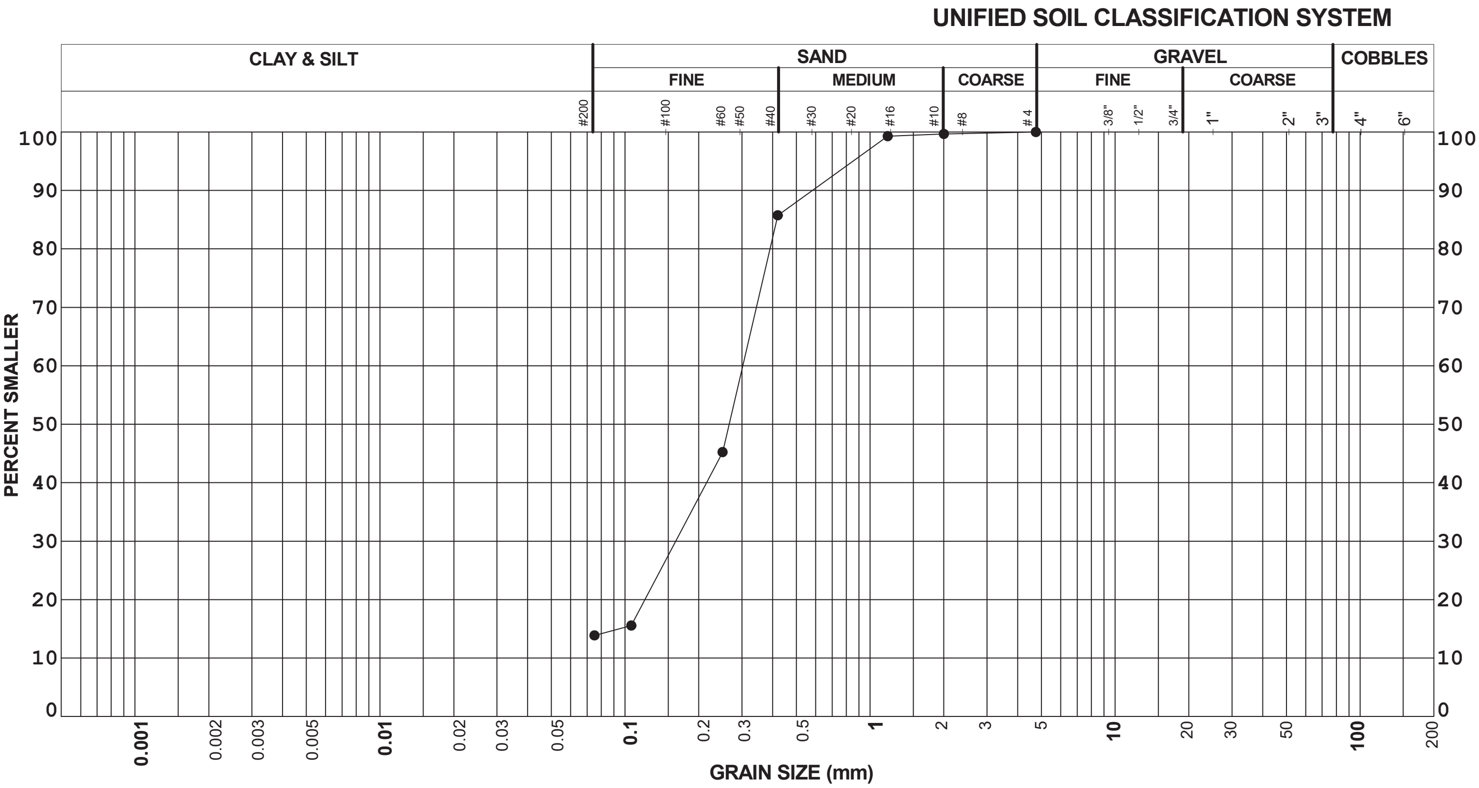
BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR70-2	DS-1	0.80	38	47	15		

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR70-2	DQ-1	1.20	0	86	14		

REMARKS:

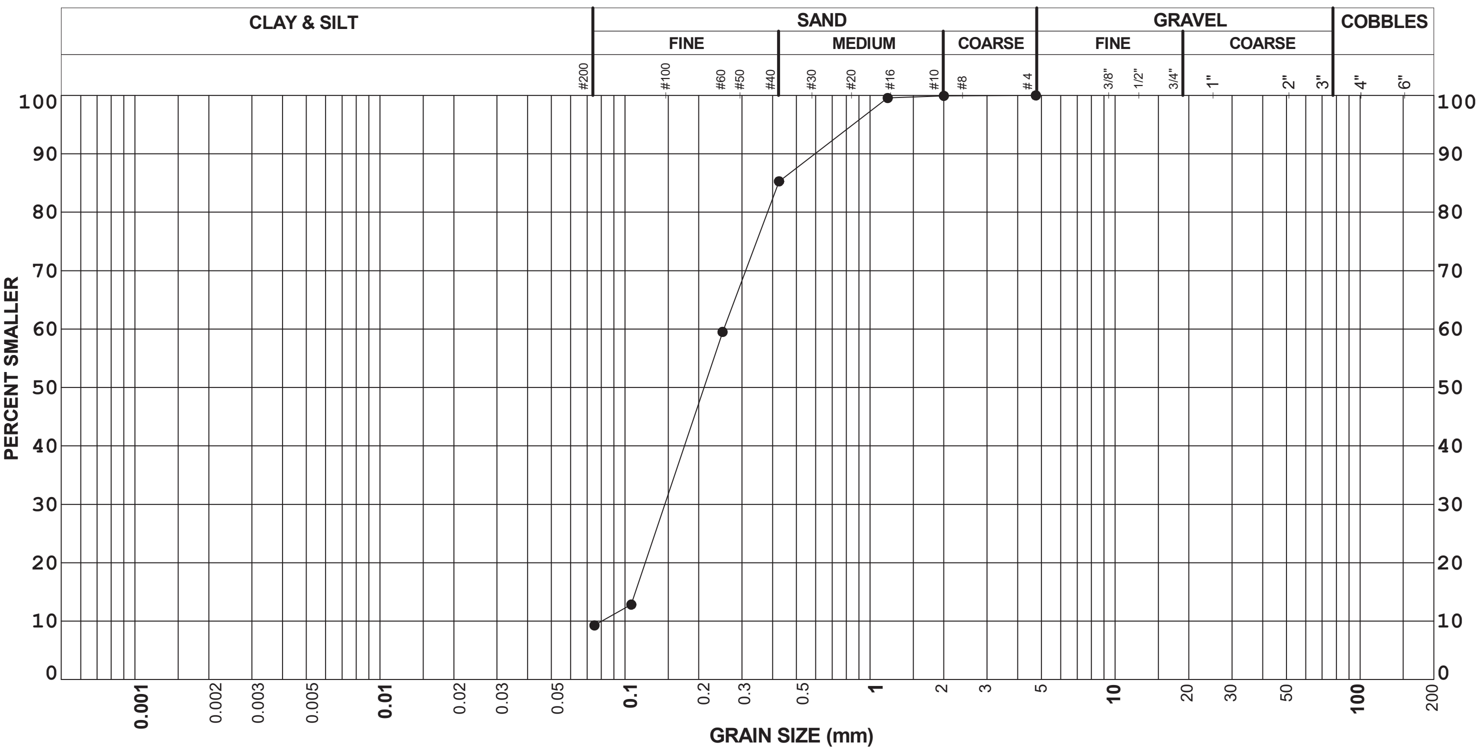
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR70-2	DS-2	3.20	0	91	9		

REMARKS:

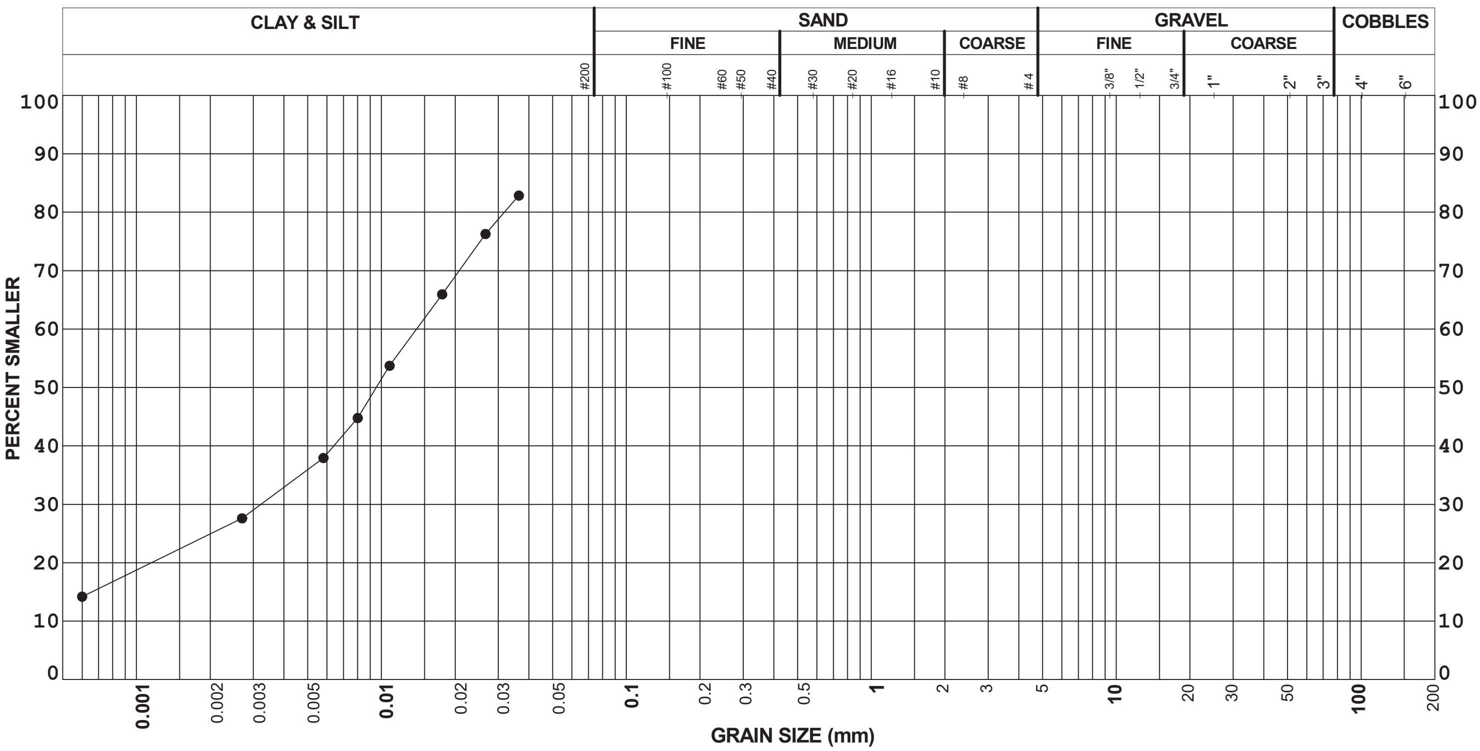
GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

HATCH

Project

UNIFIED SOIL CLASSIFICATION SYSTEM



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR70-2	DQ-3	9.50					

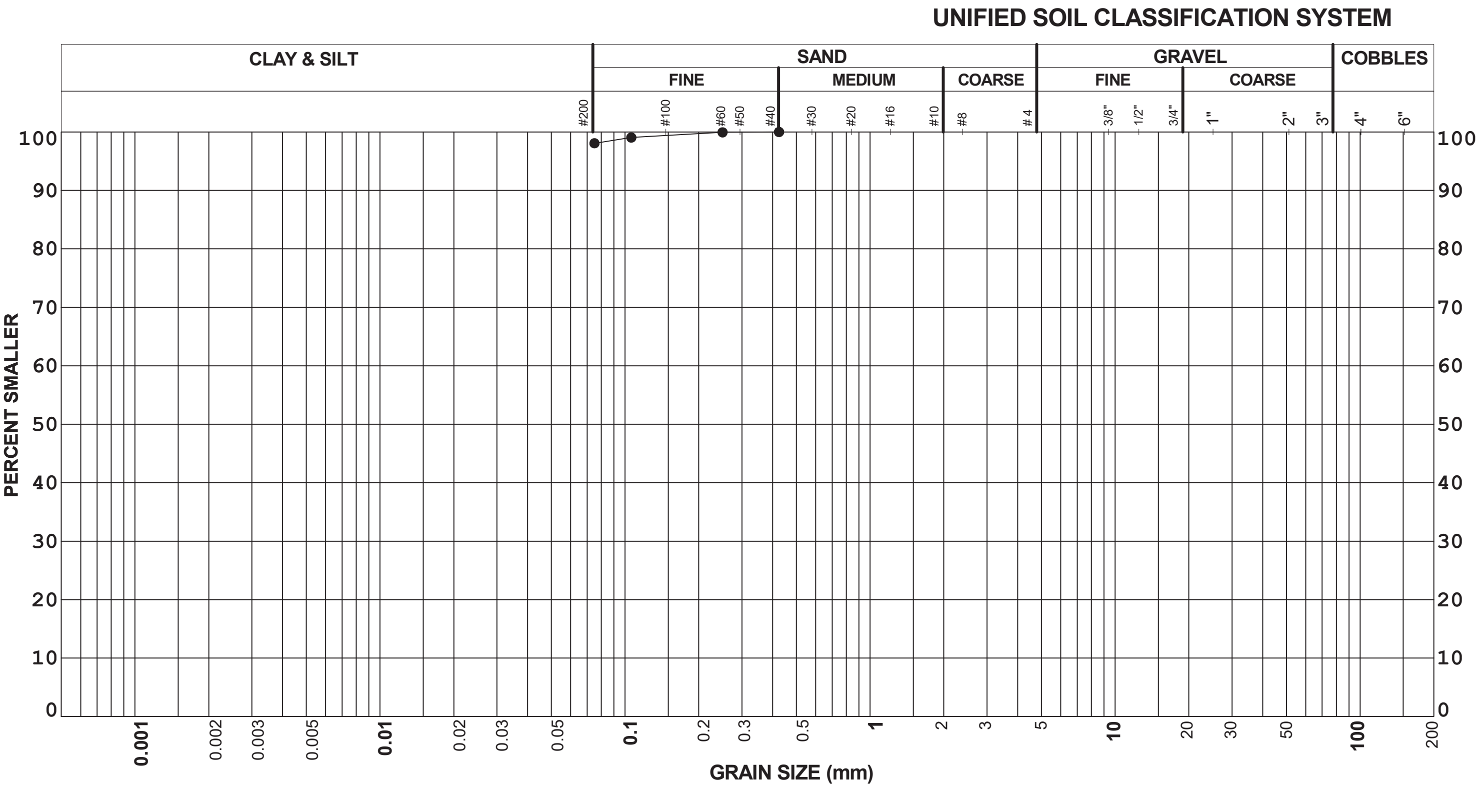
REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

HATCH

Project



BOREHOLE	SAMPLE	DEPTH	GRAVEL (%)	SAND (%)	FINES (%)	LL (%)	PI (%)
● BH18-BR70-2	DS-5	19.60	0	2	98		

REMARKS:

GRAIN SIZE DISTRIBUTION

Baffinland Iron Mine

HATCH

Project

Pore Water Extraction and Determination of Soluble Salt Content of Soils by Refractometer

ASTM D4542-15

HATCH
Geotechnical Laboratory

Date:	December 17, 2017	Baffinland Iron Mines Corporation
Project Number:	H/353004	2275 Upper Middle Rd, Oakville Ontario.
Project:	**Mary River Expansion Project**	**Attention:**

Sample	**As Listed Below**
Source	**BH17-BR86- 2 – Km 86 Rail Bridge N/W Abutment**

Sample I.D	Depth (m)	Salinity Scale (ppt)	Notes
BLANK	NA	0.0	Distilled Water
DQ1	1.00	1.0	
DQ2	2.00	1.0	
DQ4	5.00	1.0	
DQ5	10.00	1.0	
DQ6	11.30	1.0	
BLANK	NA	0.0	Distilled Water
DQ7	20.00	1.0	
DQ8	24.00	1.0	
DQ11	36.40	4.0	
BLANK	NA	0.0	Distilled Water

Comments: Tested with EXTECH Model RF20 Refractometer with automatic temperature compensation.

Reported by: R. Serluca, Lab Tech., Dec. 17, 2017

Name, Title, Date

Reviewed by: W. Hoyle, Feb.16, 2018

Name, Title, Date

Notice: the test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

Pore Water Extraction and Determination of Soluble Salt Content of Soils by Refractometer

ASTM D4542-15

HATCH
Geotechnical Laboratory

Date:	December 17, 2017	Baffinland Iron Mines Corporation
Project Number:	H/353004	2275 Upper Middle Rd, Oakville Ontario.
Project:	**Mary River Expansion Project**	**Attention:**

Sample	**As Listed Below**
Source	**BH17- BR86 - 3 – Km 86 Rail Bridge S/E Abutment**

Sample I.D	Depth (m)	Salinity Scale (ppt)	Notes
BLANK	NA	0.0	Distilled Water
DQ1	1.00	1.0	
DQ2	2.00	1.0	
DQ3	3.00	1.0	
DQ4	5.00	1.0	
BLANK	NA	0.0	Distilled Water
DQ5	8.00	1.0	
DQ6	12.00	1.0	
DQ8	30.00	1.0	
BLANK	NA	0.0	Distilled Water

Comments: Tested with EXTECH Model RF20 Refractometer with automatic temperature compensation.

Reported by: R. Serluca, Lab Tech., Dec. 17, 2017
Name, Title, Date

Reviewed by: W. Hoyle, Feb. 16, 2018
Name, Title, Date

Notice: the test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

Pore Water Extraction and Determination of Soluble Salt Content of Soils by Refractometer
ASTM D4542-15

HATCH
Geotechnical Laboratory

Date:	April 20, 2018	Baffinland Iron Mines
Project Number:	H/353004	2275 Upper Middle Rd, Oakville Ontario.
Project:	**Mary River Expansion Project**	**Attention:** G. Qu

Sample	**As Listed Below**
Source	**BH18-BR15-2 Milne Port**

Sample I.D	Depth (m)	Salinity Scale (ppt)	Notes
BLANK	NA	0.0	Distilled Water
DQ1	1.17	NA	Not enough moisture
DQ2	1.5	3.0	
DQ4	2.00	NA	Not enough moisture
DQ9	11.25	NA	Not enough moisture
BLANK	NA	0.0	Distilled Water

Comments: Tested with EXTECH Model RF20 Refractometer with automatic temperature compensation.

Reported by: P. Snable, G.I.T. April 20, 2018
Name, Title, Date

Reviewed by: G. Qu, July 10, 2018.
Name, Title, Date

Notice: the test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

Pore Water Extraction and Determination of Soluble Salt Content of Soils by Refractometer
ASTM D4542-15

HATCH
Geotechnical Laboratory

Date: June 10, 2018
Project Number: H/353004
Project: **Mary River Expansion Project**

Baffinland Iron Mines
2275 Upper Middle Rd,
Oakville Ontario.
Attention: H. Ghiabi

Sample	**As Listed Below**
Source	**BH18-BR70-1**

Sample I.D	Depth (m)	Salinity Scale (ppt)	Notes
BLANK	NA	0.0	Distilled Water
DQ1	1.50	0.0	
DQ3	6.20	0.0	
BLANK	NA	0.0	Distilled Water

Comments: Tested with EXTECH Model RF20 Refractometer with automatic temperature compensation.

Reported by: R. Serluca, Lab Tech. June 10, 2018
Name, Title, Date

Reviewed by: G. Qu, July 10, 2018.
Name, Title, Date

Notice: the test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

Pore Water Extraction and Determination of Soluble Salt Content of Soils by Refractometer

ASTM D4542-15

HATCH Geotechnical Laboratory

Date:	June 10, 2018	Baffinland Iron Mines
Project Number:	H/353004	2275 Upper Middle Rd, Oakville Ontario.
Project:	**Mary River Expansion Project**	**Attention:** H. Ghiabi

Sample	**As Listed Below**
Source	**BH18-BR70-2**

Sample I.D	Depth (m)	Salinity Scale (ppt)	Notes
BLANK	NA	0.0	Distilled Water
DQ1	1.20	0.0	
DQ3	9.50	12.0	
BLANK	NA	0.0	Distilled Water

Comments: Tested with EXTECH Model RF20 Refractometer with automatic temperature compensation.

Reported by: R. Serluca, Lab Tech. June 10, 2018

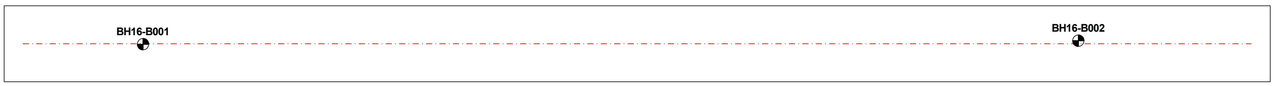
Name, Title, Date

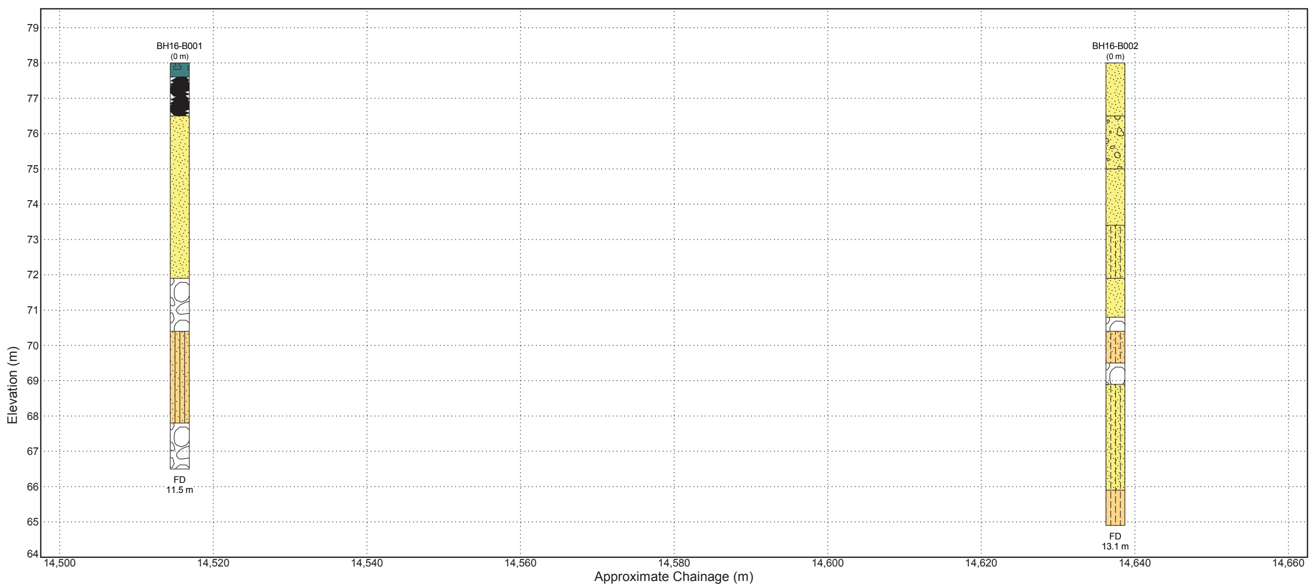
Reviewed by: G. Qu, July 10, 2018.

Name, Title, Date

Notice: the test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

Appendix E
Fence Diagrams

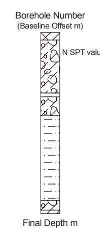




MAP KEY

- BH03 INVESTIGATION ON SECTION
- TP03 INVESTIGATION OFF SECTION
- SECTION LINES

POST LEGEND

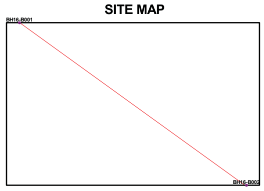


STRATAGRAPHIC BOUNDARIES

MATERIAL GRAPHICS

- PEAT
- Ice
- Poorly-graded SAND
- BOULDERS
- Elastic Sandy SILT
- Poorly-graded Gravelly SAND
- Silty SAND
- Sandy SILT
- SILT

SITE MAP



H 1:492

0 5 10 15 20 25m

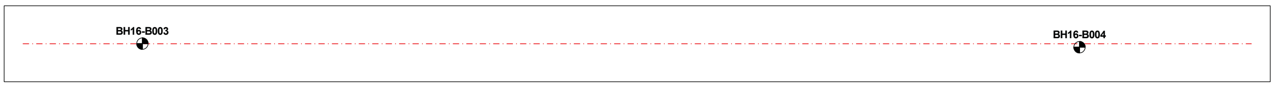
V 1:107

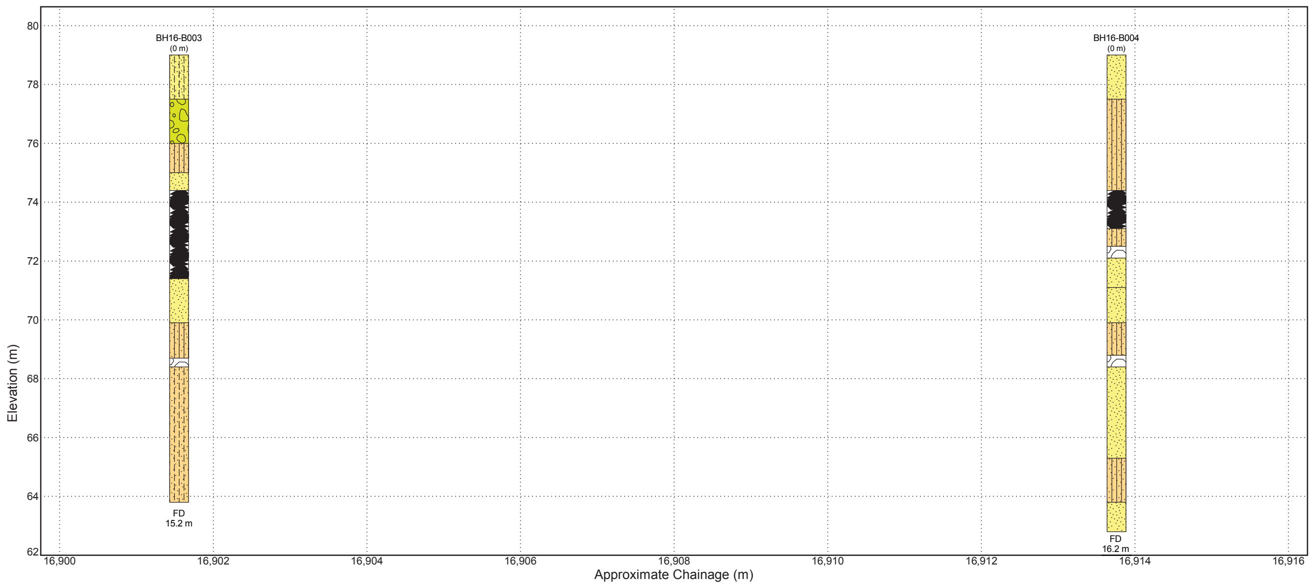
0 1 2 3 4 5m

Coord.System: UTM Zone 17 Height Datum: NAD83

HATCH

CLIENT Baffinland Iron Mines		PROJECT Mary River Expansion Study Stage 2
DRAWN AB/CH	DATE 5/21/2017	TITLE BRIDGE No 1 FENCE DIAGRAM (1 OF 2)
CHECKED WH	DATE 5/22/2017	
SCALE H 1:492 V 1:107 VE=5X	PROJECT No H352034	FIGURE No E1

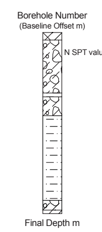




MAP KEY

- BH03 INVESTIGATION ON SECTION
- TP03 INVESTIGATION OFF SECTION
- SECTION LINES

POST LEGEND

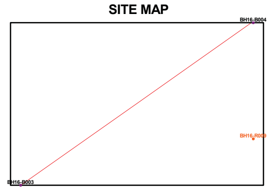


STRATAGRAPHIC BOUNDARIES

MATERIAL GRAPHICS

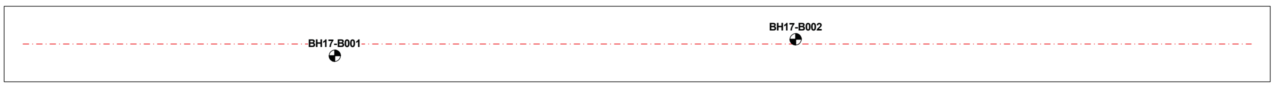
- Silty SAND
- BOULDERS
- Poorly-graded GRAVEL
- Sandy SILT
- Elastic Sandy SILT
- Poorly-graded SAND
- Ice

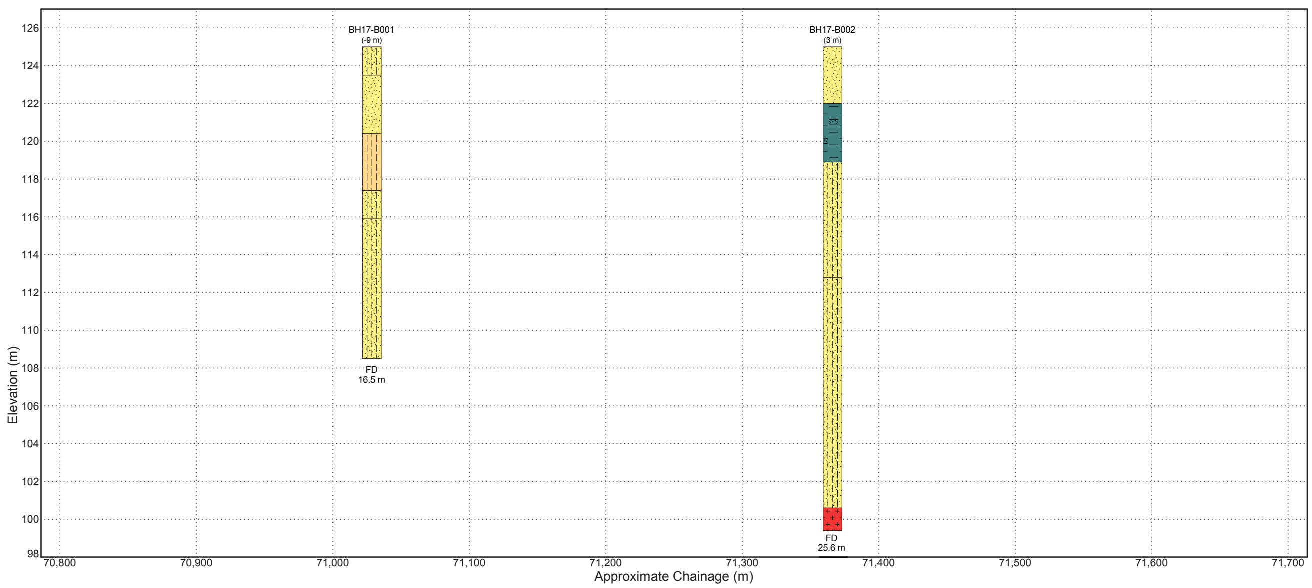
SITE MAP



H 1:49
0 0.5 1 1.5 2 2.5m
V 1:129
0 1 2 3 4 5m
Coord.System: UTM Zone 17 Height Datum: NAD83

HATCH	CLIENT Baffinland Iron Mines		PROJECT Mary River Expansion Study Stage 2
	DRAWN AB/CH	DATE 5/21/2017	TITLE BRIDGE No 1 FENCE DIAGRAM (2 OF 2)
	CHECKED WH	DATE 5/22/2017	
	SCALE H 1:49 V 1:129 VE=0X		PROJECT No H352034 · FIGURE No E2





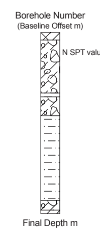
MAP KEY

BH03 INVESTIGATION ON SECTION

TP03 INVESTIGATION OFF SECTION

SECTION LINES

POST LEGEND

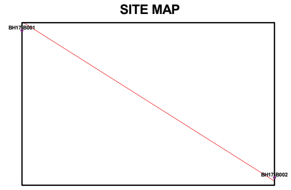


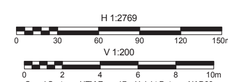
STRATAGRAPHIC BOUNDARIES

MATERIAL GRAPHICS

- Silty SAND
- Poorly-graded SAND
- SILT
- Organic SILT or CLAY
- Inferred Bedrock

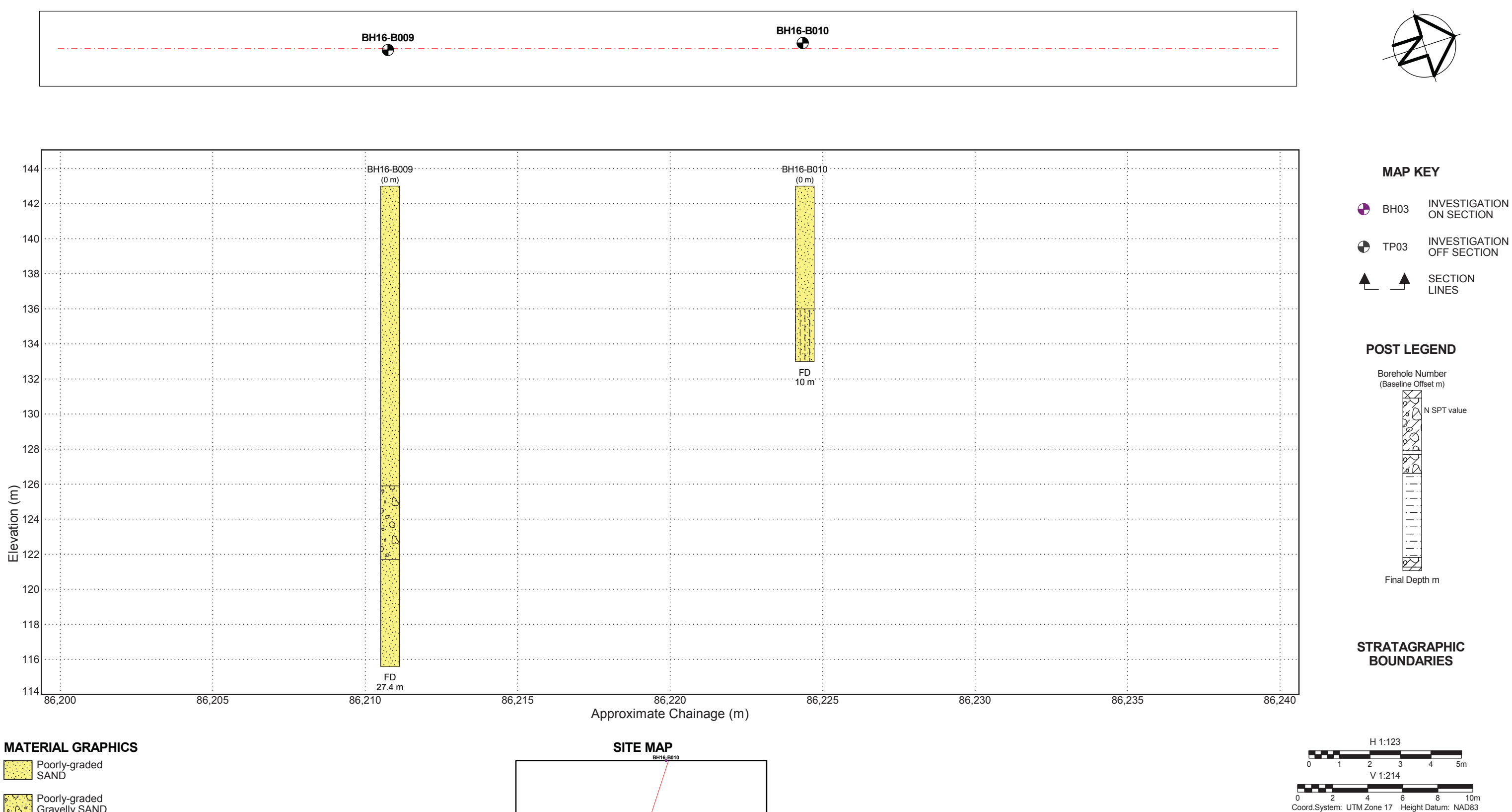
SITE MAP





HATCH

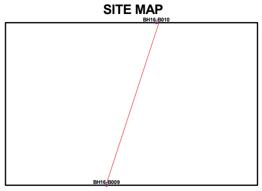
CLIENT Baffinland Iron Mines		PROJECT Mary River Expansion Study Stage 2	
DRAWN AB/CH	DATE 5/21/2017	TITLE BRIDGE No 2 FENCE DIAGRAM	
CHECKED WH	DATE 5/22/2017		
SCALE H 1:2769 V 1:200 VE=14X		PROJECT No H352034	FIGURE No E3



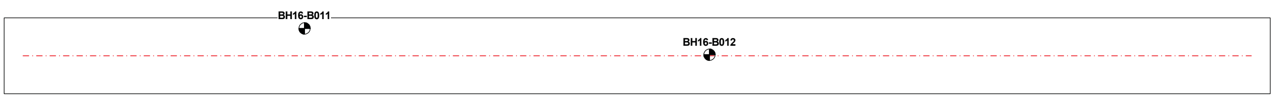
MATERIAL GRAPHICS

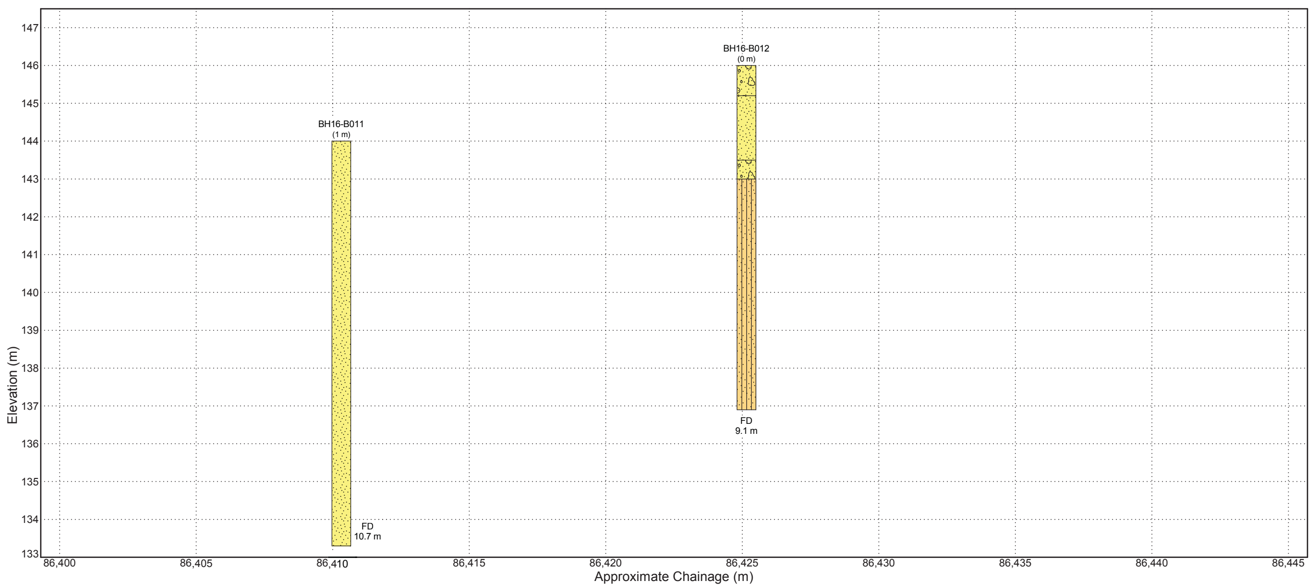
- Poorly-graded SAND
- Poorly-graded Gravelly SAND
- Silty SAND

SITE MAP



HATCH	CLIENT Baffinland Iron Mines		PROJECT Mary River Expansion Study Stage 2
	DRAWN AB/CH	DATE 5/23/2017	TITLE BRIDGE No 3 FENCE DIAGRAM (1 OF 2)
	CHECKED WH	DATE 5/23/2017	
	SCALE H 1:123 V 1:214 VE=1X		PROJECT No H352034 FIGURE No E4





MAP KEY

BH03 INVESTIGATION ON SECTION

TP03 INVESTIGATION OFF SECTION

SECTION LINES

POST LEGEND

Borehole Number
(Baseline Offset m)

N SPT value

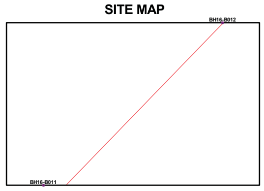
Final Depth m

STRATAGRAPHIC BOUNDARIES

MATERIAL GRAPHICS

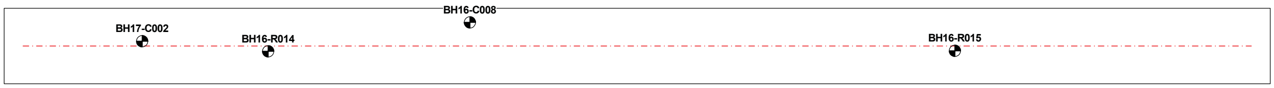
- Poorly-graded SAND
- Poorly-graded Gravelly SAND
- Elastic Sandy SILT

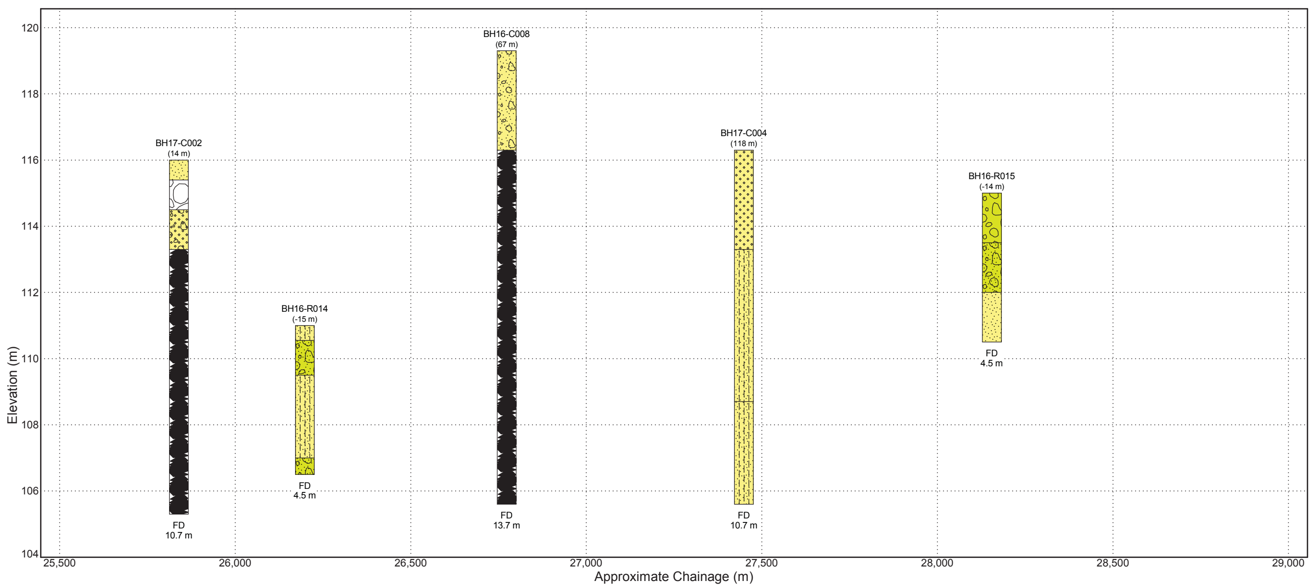
SITE MAP



H 1:138
0 1 2 3 4 5m
V 1:100
0 1 2 3 4 5m
Coord.System: UTM Zone 17 Height Datum: NAD83

HATCH	CLIENT Baffinland Iron Mines		PROJECT Mary River Expansion Study Stage 2	
	DRAWN AB/CH	DATE 5/23/2017	TITLE BRIDGE No 3 FENCE DIAGRAM (2 OF 2)	
	CHECKED WH	DATE 5/23/2017		
	SCALE H 1:138 V 1:100 VE=1X		PROJECT No H352034	FIGURE No E5





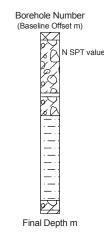
MAP KEY

BH03 INVESTIGATION ON SECTION

TP03 INVESTIGATION OFF SECTION

SECTION LINES

POST LEGEND

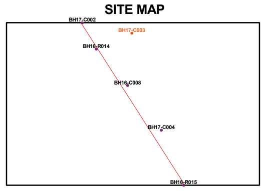


STRATAGRAPHIC BOUNDARIES

MATERIAL GRAPHICS

- Poorly-graded Gravelly SAND
- Poorly-graded SAND
- Ice
- BOULDERS
- Silty SAND
- Well-graded Gravelly SAND
- Poorly-graded Sandy GRAVEL
- Well-graded SAND
- Poorly-graded GRAVEL

SITE MAP



H 1:10769

0 100 200 300 400 500m

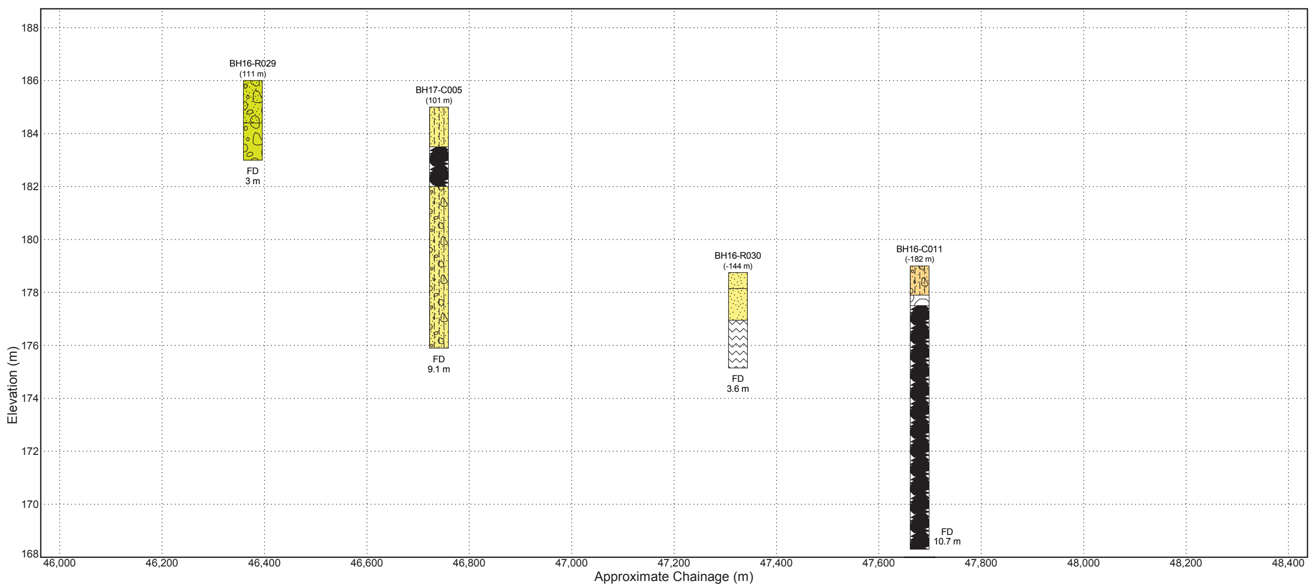
V 1:114

0 1 2 3 4 5m

Coord.System: UTM Zone 17 Height Datum: NAD83

HATCH

CLIENT Baffinland Iron Mines		PROJECT Mary River Expansion Study Stage 2	
DRAWN AB/CH	DATE 6/21/2017	TITLE ICE RICH AREA 1	
CHECKED WH	DATE 6/21/2017		
SCALE H 1:10769 V 1:114 VE=94X		PROJECT No H352034	FIGURE No E6



MAP KEY

- BH03 INVESTIGATION ON SECTION
- TP03 INVESTIGATION OFF SECTION
- SECTION LINES

POST LEGEND

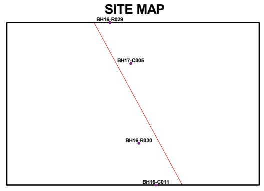
Borehole Number
(Baseline Offset m)
N SPT value
Final Depth m

STRATAGRAPHIC BOUNDARIES

MATERIAL GRAPHICS

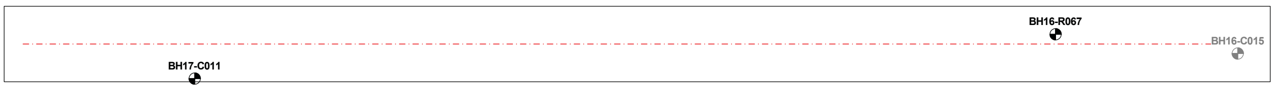
- Gravelly Sandy SILT
- BOULDERS
- Ice
- Poorly-graded Sandy GRAVEL
- Poorly-graded GRAVEL
- Poorly-graded SAND
- Pulverized Rock
- Silty SAND
- Silty SAND with Gravel

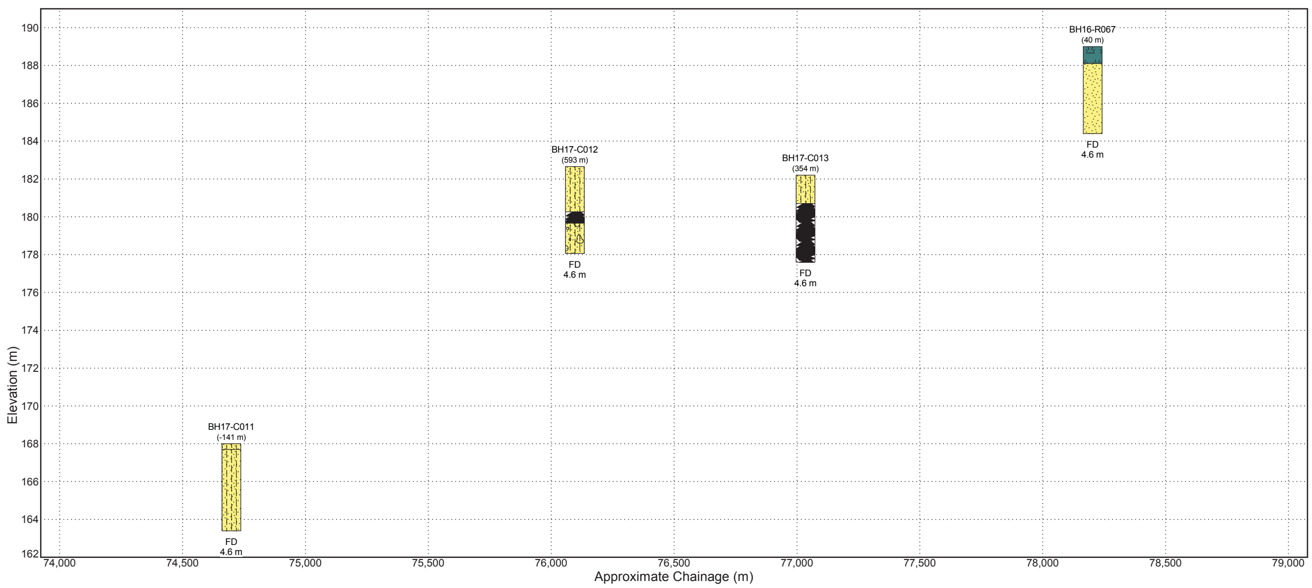
SITE MAP



H 1:7385
0 80 160 240 320 400m
V 1:143
0 1 2 3 4 5m
Coord.System: UTM Zone 17 Height Datum: NAD83

HATCH	CLIENT Baffinland Iron Mines		PROJECT Mary River Expansion Study Stage 2
	DRAWN AB/CH	DATE 6/21/2017	TITLE ICE RICH AREA 2
	CHECKED WH	DATE 6/21/2017	
	SCALE H 1:7385 V 1:143 VE=52X	PROJECT No H352034	FIGURE No E7





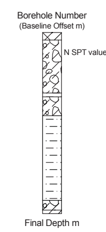
MAP KEY

BH03 INVESTIGATION ON SECTION

TP03 INVESTIGATION OFF SECTION

SECTION LINES

POST LEGEND

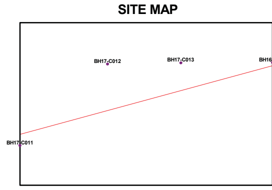


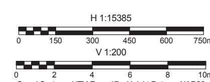
STRATAGRAPHIC BOUNDARIES

MATERIAL GRAPHICS

- PEAT
- Poorly-graded SAND
- Silty SAND
- Ice
- Silty SAND with Gravel

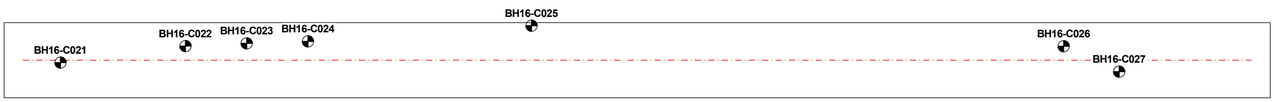
SITE MAP

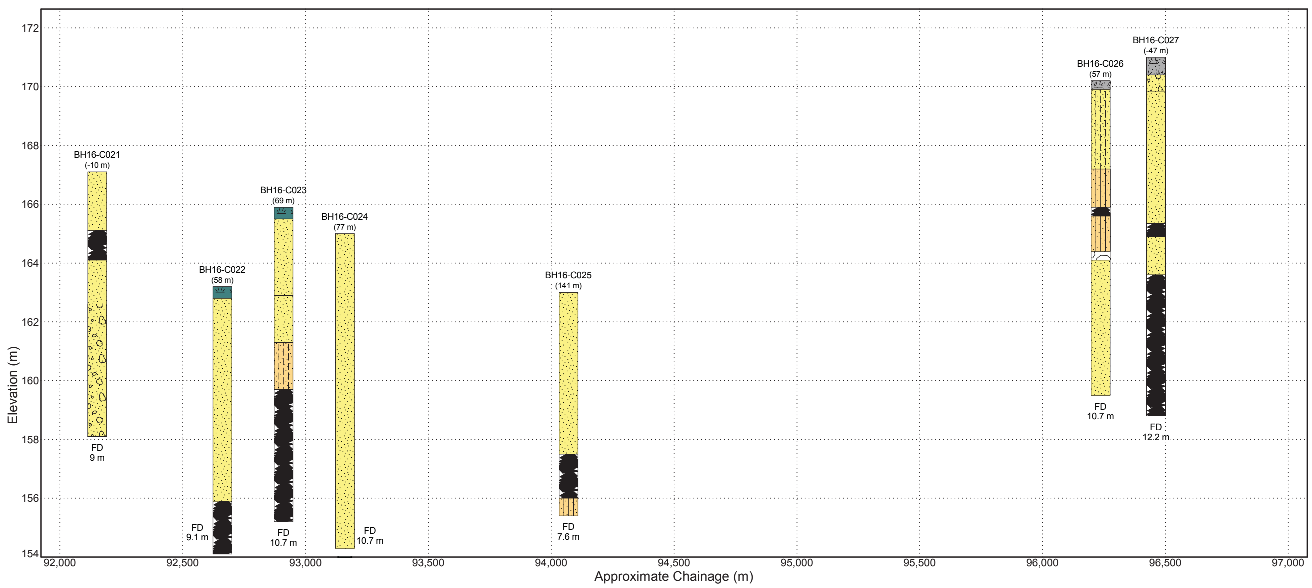




HATCH

CLIENT Baffinland Iron Mines		PROJECT Mary River Expansion Study Stage 2
DRAWN AB/CH	DATE 6/21/2017	TITLE ICE RICH AREA 3
CHECKED WH	DATE 6/21/2017	
SCALE H 1:15385 V 1:200 VE=77X		PROJECT No H352034 / FIGURE No E8





MAP KEY

BH03 INVESTIGATION ON SECTION

TP03 INVESTIGATION OFF SECTION

SECTION LINES

POST LEGEND

Borehole Number
(Baseline Offset m)

N SPT value

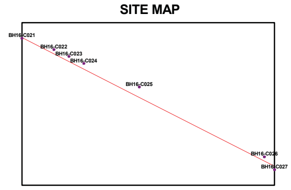
Final Depth m

STRATAGRAPHIC BOUNDARIES

MATERIAL GRAPHICS

- Poorly-graded SAND
- Elastic Sandy SILT
- Ice
- Topsoil
- Poorly-graded Gravelly SAND
- Silty SAND
- PEAT
- BOULDERS
- Sandy SILT

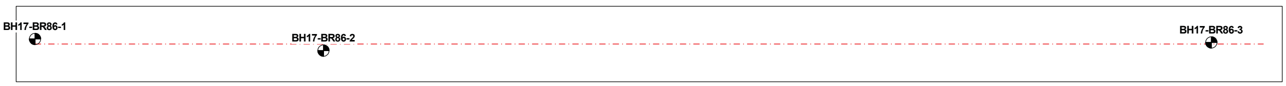
SITE MAP

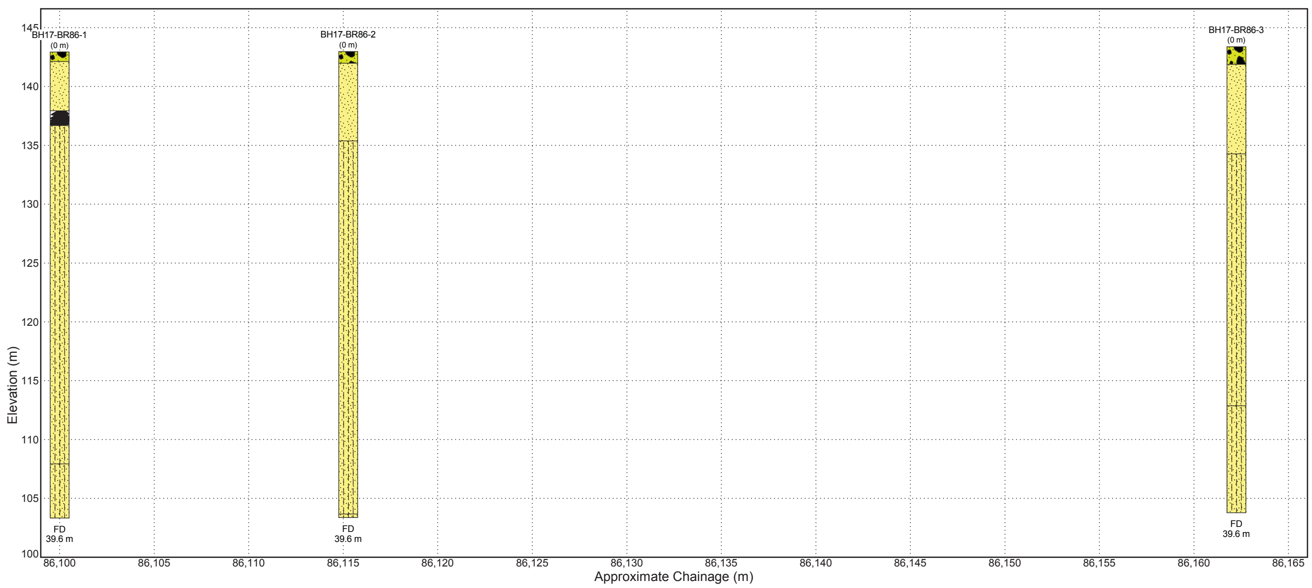


H 1:15385
0 150 300 450 600 750m
V 1:129
0 1 2 3 4 5m
Coord.System: UTM Zone 17 Height Datum: NAD83

HATCH

CLIENT Baffinland Iron Mines		PROJECT Mary River Expansion Study Stage 2	
DRAWN AB/CH	DATE 6/21/2017	TITLE ICE RICH AREA 4	
CHECKED WH	DATE 6/21/2017		
SCALE H 1:15385 V 1:129 VE=120X		PROJECT No H352034	FIGURE No E9





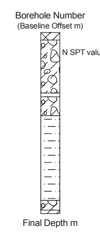
MAP KEY

BH03 INVESTIGATION ON SECTION

TP03 INVESTIGATION OFF SECTION

SECTION LINES

POST LEGEND



STRATAGRAPHIC BOUNDARIES

MATERIAL GRAPHICS

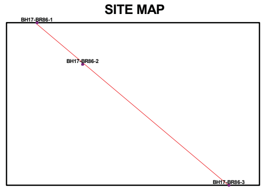
Well-graded Sandy GRAVEL

Poorly-graded SAND

Ice

Silty SAND

SITE MAP



H 1:200

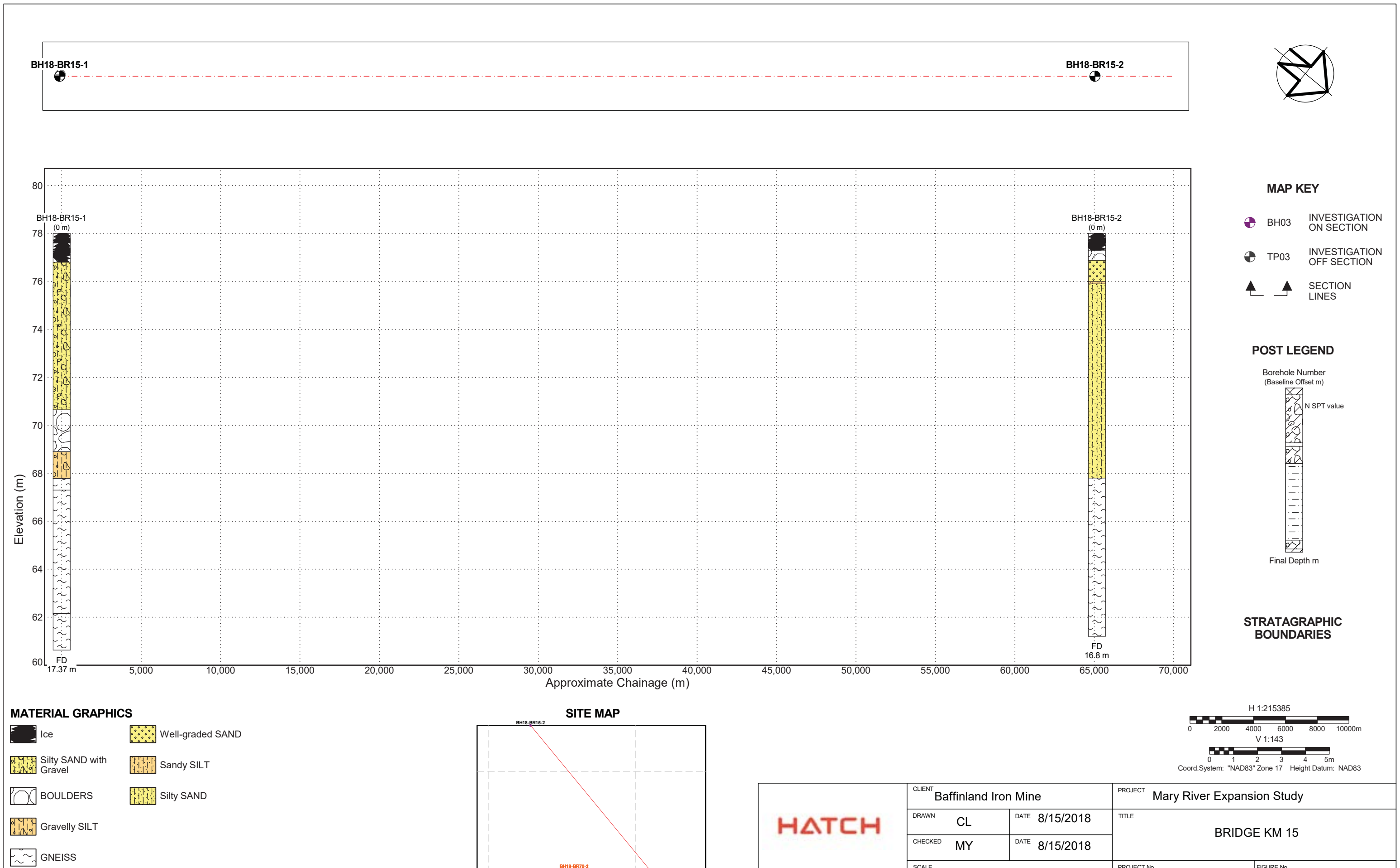
0 2 4 6 8 10m

V 1:321

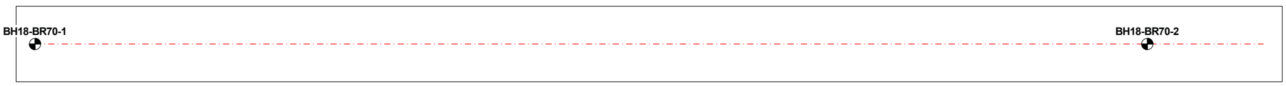
0 2 4 6 8 10m

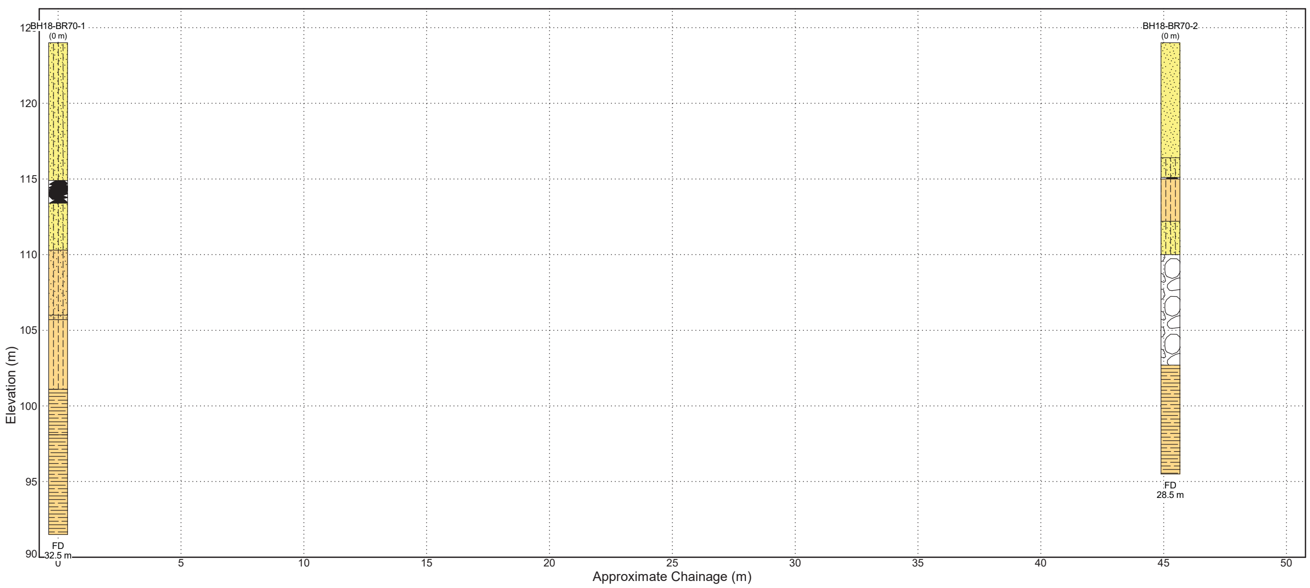
Coord.System: UTM Zone 17 Height Datum: NAD83

HATCH	CLIENT Baffinland Iron Mines Corporation		PROJECT Mary River Expansion Project	
	DRAWN JH	DATE 4/4/2018	TITLE BRIDGE KM 86	
	CHECKED HG	DATE 4/4/2018		
	SCALE H 1:200 V 1:321 VE=1X		PROJECT No H353004	FIGURE No E10



HATCH	CLIENT Baffinland Iron Mine		PROJECT Mary River Expansion Study
	DRAWN CL	DATE 8/15/2018	TITLE BRIDGE KM 15
	CHECKED MY	DATE 8/15/2018	
	SCALE H 1:215385 V 1:143 VE=1508X		PROJECT No H353004 FIGURE No E11





MAP KEY

- BH03 INVESTIGATION ON SECTION
- TP03 INVESTIGATION OFF SECTION
- SECTION LINES

POST LEGEND

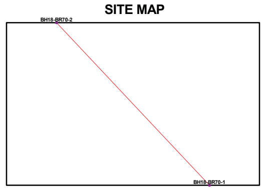
Borehole Number
(Baseline Offset m)
N SPT value
Final Depth m

STRATAGRAPHIC BOUNDARIES

MATERIAL GRAPHICS

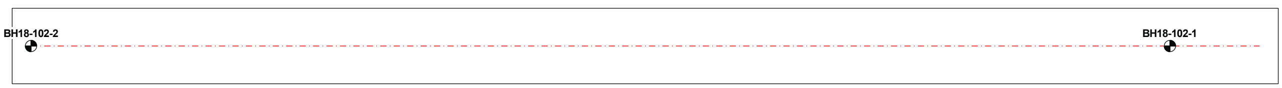
- Silty SAND
- Poorly-graded SAND
- Ice
- BOULDERS
- Sandy SILT
- SILT
- SILTSTONE

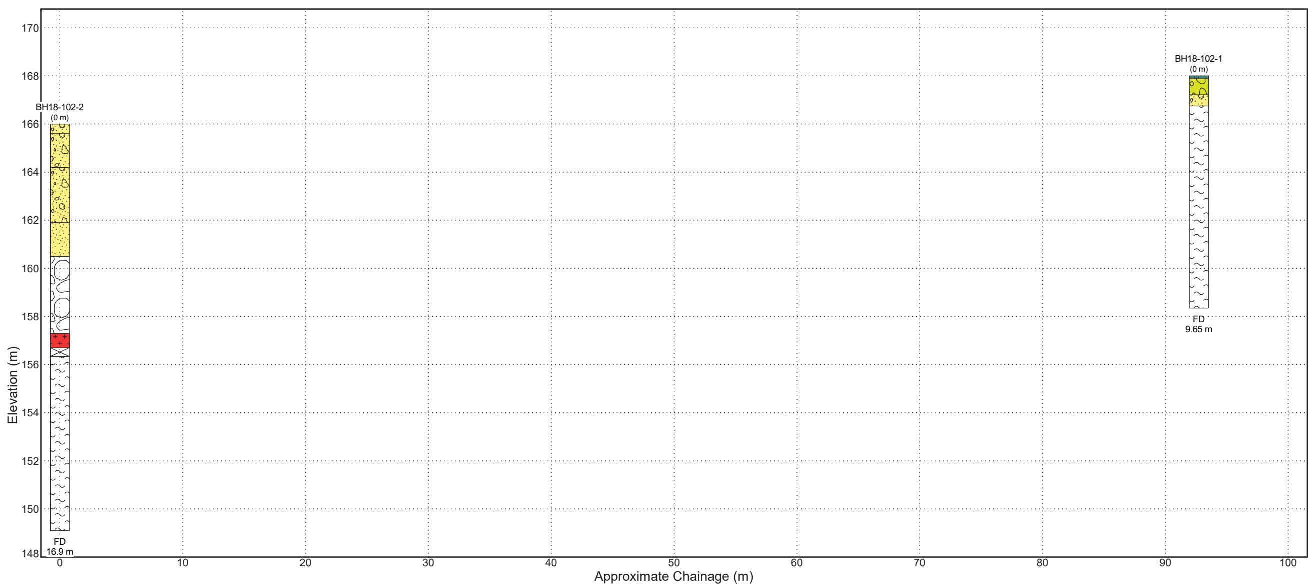
SITE MAP



H 1:154
0 1 2 3 4 5m
V 1:250
0 2 4 6 8 10m
Coord.System: "NAD83" Zone 17 Height Datum: NAD83

HATCH	CLIENT Baffinland Iron Mine		PROJECT Mary River Expansion Study	
	DRAWN CL	DATE 8/15/2018	TITLE BRIDGE KM 70	
	CHECKED MY	DATE 8/15/2018		
	SCALE H 1:154 V 1:250 VE=1X		PROJECT No H353004	FIGURE No E12





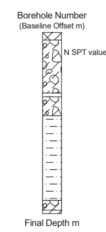
MAP KEY

BH03 INVESTIGATION ON SECTION

TP03 INVESTIGATION OFF SECTION

SECTION LINES

POST LEGEND

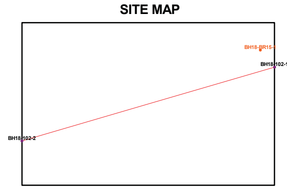


STRATAGRAPHIC BOUNDARIES

MATERIAL GRAPHICS

- PEAT
- Poorly-graded GRAVEL
- Poorly-graded Gravelly SAND
- GNEISS
- Poorly-graded SAND
- BOULDERS
- Granite, Diorite, Gabbro
- Core Loss

SITE MAP



Coord.System: "NAD83" Zone 17 Height Datum: NAD83

HATCH	CLIENT Baffinland Iron Mine	PROJECT Mary River Expansion Study
	DRAWN CL / DATE 8/15/2018	TITLE BRIDGE KM 102
	CHECKED MY / DATE 8/15/2018	
	SCALE H 1:308 V 1:157 VE=2X	PROJECT No H353004 / FIGURE No E13

Appendix F
Summary of Laboratory Results

HATCH

Borehole No.	Sample No.	Depth	Moisture Content (%)	Gravel (%)	Sand (%)	Fines (%)
BH16-R003	BS-1	1.0				
	BS-2					
	BS-3					
BH16-R004	BS-1	0.9	30			
	BS-2	2.5	10	8	74	18
	BS-3	4.3				
BH16-R005	BS-1	1.0	11			
	BS-2	2.5		4	78	18
	BS-3	3.6	10			
BH16-R006	BS-1					
	BS-2					
	BS-3					
BH16-R007	BS-1	1.0	13			
	BS-2	2.5	10	1	87	13
	BS-3	4.0				
BH16-R008	BS-1					
	BS-2					
	BS-3					
BH16-R009	BS-1	0.9	23			
	BS-2	2.1				
	BS-3	4.2				
BH16-R010	BS-1	1.0				
	BS-2	3.0				
	BS-3	4.0				
BH16-R011	BS-1	1.0				
	BS-2	2.5	19	0	86	14
	BS-3	4.0	15			
BH16-R012	BS-1	1.0				
	BS-2	2.5	10	1	81	18
	BS-3	3.8				
BH16-R013	BS-1	1.0				
	BS-2	2.5	16	0	85	15
	BS-3	3.5	16			
BH16-R014	BS-1	0.8				
	BS-2	2.0	11	11	69	20
	BS-3	3.8				
BH16-R015	BS-1	1.0				
	BS-2	2.5		2	73	24
	BS-3	4.0	13			
BH16-R016	BS-1	1.0	32			
	BS-2	2.0	15	8	55	28
	BS-3	4.0				
BH16-R017	BS-1	0.0	29			
	BS-2	2.5				
	BS-3	4.0				
BH16-R018	BS-1	1.0				
	BS-2	2.5				
	BS-3	4.0				

Borehole No.	Sample No.	Depth	Moisture Content (%)	Gravel (%)	Sand (%)	Fines (%)
BH16-R019	BS-1	1.0				
	BS-2	2.5				
	BS-3	4.0				
BH16-R020	BS-1	0.5				
	BS-2	2.0				
	BS-3	3.5	20	0	57	43
BH16-R021	BS-1	1.0				
	BS-2	2.5				
	BS-3	3.4				
BH16-R022	BS-1	0.7				
	BS-2	1.9				
	BS-3	4.0	9	13	44	44
BH16-R023	BS-1	0.8				
	BS-2	2.0		0	61	39
	BS-3	3.7				
BH16-R024	BS-1	0.0				
	BS-2	1.5	9	30	38	32
	BS-3	3.0	8			
BH16-R025	BS-1	1.0	18	16	43	41
	BS-2	2.5	15			
	BS-3	4.0	16			
BH16-R026	BS-1	1.0	27			
	BS-2	2.5				
	BS-3	4.0	8			
BH16-R027	BS-1	1.0	8	22	43	35
	BS-2	2.5				
	BS-3	4.0	9			
BH16-R028	BS-1	0.8	3			
	BS-2	2.0				
	BS-3	3.0				
BH16-R029	BS-1	1.0				
	BS-2	2.5				
	BS-3					
BH16-R030	BS-1	1.0				
	BS-3	1.5	10			
	BS-2	2.5				
BH16-R032	BS-1	0.3				
	BS-2	2.5				
	BS-3					
BH16-R033	BS-1	1.0				
	BS-2	2.5	7			
	BS-3	4.0				
BH16-R034	BS-1	1.0				
	BS-2	2.5	8	27	40	32
	BS-3	3.5	9			
BH16-R035	BS-1	1.0				
	BS-2	2.5		24	42	34
	BS-3	4.0				

HATCH

Borehole No.	Sample No.	Depth	Moisture Content (%)	Gravel (%)	Sand (%)	Fines (%)
BH16-R036	BS-1	1.0				
	BS-2	2.5	10	23	42	35
	BS-3	4.0				
BH16-R037	BS-1	1.0				
	BS-2	2.5	20	0	91	9
	BS-3	4.0	20			
BH16-R038	BS-1	1.0				
	BS-2	2.0	16	2	89	9
	BS-3	4.0	8			
BH16-R039	BS-1	1.0	20	3	94	3
	BS-2	2.5				
	BS-3	4.0				
BH16-R040	BS-1	1.0				
	BS-2	2.5	19			
	BS-3	4.0				
BH16-R041	BS-1					
	BS-2					
	BS-3					
BH16-R042	BS-1	1.0				
	BS-2	2.5				
	BS-3	4.0	15			
BH16-R043	BS-1	1.0				
	BS-2	2.5				
	BS-3	4.0	15			
	BS-4	6.5				
	BS-5	8.8	7			
BH16-R044	BS-1	1.0				
	BS-2	2.0	11			
	BS-3	4.0	16			
BH16-R045	BS-1	1.0	8			
	BS-2					
	BS-3	3.6	21			
BH16-R046	BS-1	0.6				
	BS-2	1.3	6			
	BS-3	2.3	40			
	BS-4	3.9	22			
BH16-R053	BS-1	1.3				
	BS-2	5.5	23			
BH16-R067	BS-1	1.2		3	60	37
	BS-2	2.4				
	BS-3	4.5				
BH16-R068	BS-1	1.0				
	BS-2	2.0				
	BS-3	3.6				
BH16-R069	BS-1	1.0		19	41	40
	BS-2	2.5				
	BS-3	4.0				
BH16-R070	BS-1	1.0		0	84	16
	BS-2	2.4				
	BS-3	3.9				

Borehole No.	Sample No.	Depth	Moisture Content (%)	Gravel (%)	Sand (%)	Fines (%)
BH16-C007	BS-1	1.2	17			
	BS-2	2.5				
	BS-3	3.5		1	73	26
	BS-4	5.0				
	BS-5	7.3	39			
BH16-C008	BS-1	1.0				
	BS-2	2.5				
BH16-C009	BS-1	0.9				
	BS-2	2.6	13	9	61	30
	BS-3	3.5				
	BS-4	5.5				
	BS-5	7.3				
	BS-6	8.8				
BH16-C010	BS-1	1.0				
	BS-2	2.5		9	33	58
	BS-3	4.3				
	BS-4	5.3				
BH16-C011	BS-1	1.0				
	BS-2	2.5	100			
	BS-3	4.0	100			
	BS-4	5.8	100			
	BS-5	7.6	100			
	BS-6	8.8	100			
	BS-7	10.0	100			
BH16-C012	BS-1	1.2				
	BS-2	2.0				
	BS-3	4.0				
BH16-C015	BS-1	1.0				
	BS-2	2.5				
	BS-3	3.4				
	BS-4	5.2				
	BS-5	7.0				
BH16-C016	BS-1	1.0				
	BS-2	2.7		25	53	22
	BS-3	4.0				
	BS-4	5.8				
	BS-5	7.3				
BH16-C017	BS-1	1.0				
	BS-2	2.4		3	74	22
	BS-3	4.0				
	BS-4	5.5				
BH16-C018	BS-1	0.6				
	BS-2	2.2	9	1	82	17
	BS-3	4.0				
	BS-4	5.5				

HATCH

Borehole No.	Sample No.	Depth	Moisture Content (%)	Gravel (%)	Sand (%)	Fines (%)
BH16-C019	BS-1	1.0				
	BS-2					
	BS-3	4.5	8			
BH16-C019B	BS-1	5.8	0	0	98	1
BH16-C020	BS-1	1.0				
	BS-2	2.5	8			
	BS-3	4.3				
	BS-4	5.5	8			
	BS-5	6.7				
	BS-6	8.5	11			
BH16-C021	BS-1	1.0				
	BS-2	2.5	14			
	BS-3	3.5	12			
	BS-4	7.0				
	BS-5	8.7	5	0	67	33
BH16-C022	BS-1	2.4				
	BS-2	4.4	19	0	98	2
	BS-3	6.3				
	BS-4	7.3	24			
	BS-5	8.2				
BH16-C023	BS-1	3.7	16	0	93	7
	BS-2	5.0	17	12	44	45
	BS-3	6.2	15			
BH16-C024	BS-1	3.4				
	BS-2	5.0	18	0	90	10
	BS-3	7.0	18			
	BS-4	8.5				
	BS-5	10.0	14			
BH16-C025	BS-1	2.7				
	BS-2	4.0	15	1	89	10
	BS-3	5.2				
	BS-4	7.0				
BH16-C026	BS-1	2.4		6	69	24
	BS-2	4.0	14	2	77	21
	BS-3	5.5				
	BS-4	7.0	19			
	BS-5	8.5	13			
	BS-6	10.0				
BH16-C027	BS-1	4.0	10	9	72	20
	BS-2	5.0				
	BS-3	7.0	16			
BH16-C028	BS-1	6.3				
	BS-2	8.8	7	0	94	6
	BS-3	9.6	18			
	BS-4	11.4				

Borehole No.	Sample No.	Depth	Moisture Content (%)	Gravel (%)	Sand (%)	Fines (%)
BH16-C029	BS-1	0.9				
	BS-2	2.4	21	1	75	25
	BS-3	4.0				
	BS-4	7.0				
BH16-C030	BS-1	1.0				
	BS-2	2.0	14			
	BS-3	4.0				
	BS-4	5.0	19	3	94	3
BH16-C031	BS-1	1.4				
BH16-C032	BS-1	0.9				
	BS-2	2.4	11	10	71	19
	BS-3	4.4				
	BS-4	5.5				
	BS-5	6.9				
	BS-6	8.9				
BH16-C201	BS-1	1.4				
	BS-2	2.1				
BH16-C202	BS-1	0.9				
	BS-2	2.5				
	BS-3	4.0				
	BS-4	5.0				
	BS-5	6.1				
BH16-C203	BS-1	0.9				
	BS-2	2.4				
	BS-3	4.3				
	BS-4	5.5				
	BS-5	7.0				
	BS-6	8.8				
BH16-C204	BS-1	0.9				
	BS-2	2.6				
BH16-C205	BS-1	1.1				
	BS-2	2.5				
	BS-3	4.0		20	47	35
	BS-4	5.5				
	BS-5	7.0				
BH16-C206	BS-1	1.2				
	BS-2	2.7	53			
	BS-3	4.0	22			
	BS-4	5.5				
	BS-5	7.3				
BH16-C207	BS-1	0.9				
	BS-2	1.9	12			
	BS-3	4.0				
	BS-4	5.5				
	BS-5	7.4				

HATCH

BH17-C001	DS1	0.9				
	DS2	2.1				
	DS3	3.1	7	14	49	37
	DS4	4.9				
	DS5	7	3	0	55	44
BH17-C002	DS1	0.9				
	DS2	2.4	10	21	59	20
	DS3	4				
	DS4	5.5				
	DS5	7				
	DS6	8.2				
	DS7	10.1				
BH17-C003	DS1	0.9				
	DS2	1.8				
	DS3	3.4	7	32	47	21
	DS4	5.5	9	4	73	23
	DS5	7				
	DS6	8.8	10	9	57	34
BH17-C004	DS1	0.6				
	DS2	2.4				
	DS3	3.7				
	DS4	5.2				
	DS5	7		9	75	17
	DS6	7.9				
	DS7	9.8		8	60	33
BH17-C005	DS1	0.9				
	DS2	2.4				
	DS3	4				
	DS4	5.5	7	18	57	24
	DS5	7				
	DS6	8.5				
BH17-C006	DS1	0.6				
	DS2	2.4				
	DS3	3.7	14	18	45	37
	DS4	5.2				
	DS5	6.7				
	DS6	8.2	16	21	42	38
BH17-C006B	DS1	0.9				
	DS2	2.4				
	DS3	4				
	DS4	5.5				
BH17-C007	DS1	1				
	DS2	1.9				
	DS3	4	14	10	38	52
BH17-C010	DS1	0.6				
	DS2	2.4	14	1	88	11
	DS3	3.7	15	0	90	9
BH17-C011	DS1	0.9				
	DS2	2.4				
	DS3	4	17	0	76	24

Borehole No.	Sample No.	Depth	Moisture Content (%)	Gravel (%)	Sand (%)	Fines (%)
BH17-C012	DS1	0.9				
	DS2	2.1				
	DS3	4	8	24	38	38
BH17-C013	DS1	0.9	14	12	58	31
	DS2	2.1				
	DS3	4				
BH16-B001	BS-1	0.3				
	BS-2	2.7				
	BS-3	3.5	19	6	66	29
	BS-4	5.5				
	BS-5	6.7				
	BS-6	8.5				
	BS-7	10.3				
BH16-B002	BS-1	1.2				
	BS-2	2.7	11			
	BS-3	4.3				
	BS-4	5.9	14	5	77	19
	BS-5	7.3				
	BS-6	8.4				
	BS-7	8.8				
	BS-8	11.5				
	BS-9	12.8				
BH16-B003	BS-1	1.1				
	BS-2	1.9	9	24	47	28
	BS-3	4.0				
	BS-4	5.8	100	2	72	26
	BS-5	7.3	23			
	BS-6	8.8				
	BS-7	10.3				
	BS-8	11.5				
	BS-9	13.4				
	BS-10	14.6				
BH16-B004	BS-1	1.0				
	BS-2	2.7				
	BS-3	4.3				
	BS-4	5.8	100	7	54	39
	BS-5	7.3	19	35	44	21
	BS-6	8.8				
	BS-7	10.5				
	BS-8	11.8				
	BS-9	13.2				
	BS-10	14.5				
	BS-11	15.5				

HATCH

BH16-B009	BS-1	0.6				
	BS-2	5.0				
	BS-3	9.8	22	0	98	2
BH16-B010	BS-1	0.9				
	BS-2	2.9	11	5	87	8
	BS-3	4.2				
	BS-4	5.1	21	0	98	2
	BS-5	6.4				
	BS-6	9.5	20	0	61	39
BH16-B011	BS-1	4.2				
	BS-2	9.0	19	0	98	2
BH16-B012	BS-1	3.0	12	4	87	9
	BS-2	8.0				
BH16-B013	BS-1	0.6				
	BS-2	2.7				
	BS-3	4.0				
	BS-4	5.8	12	0	53	47
	BS-5	7.3				
	BS-6	8.5				
	BS-7	10.0				
BH16-B014	BS-1	1.0				
	BS-2	2.5				
	BS-3	3.5	12	0	65	35
	BS-4	5.0				
	BS-5	7.0	1	0	63	37
	BS-6	8.9				
BH16-B015	BS-1	1.0				
	BS-2	2.5	100	17	41	41
	BS-3	4.0				
	BS-4	5.0	11	0	63	37
	BS-5	6.7				
	BS-6	8.0				
	BS-7	10.0	100	15	66	20
	BS-8	11.5				
	BS-9	13.4				
BH16-B016	BS-1	1.0				
	BS-2	2.6				
	BS-3	3.6	15	0	88	12
	BS-4	5.3		0	67	33
	BS-5	7.2	7	0	66	34

Borehole No.	Sample No.	Depth	Moisture Content (%)	Gravel (%)	Sand (%)	Fines (%)
BH17-B001	DS1	0.9				
	DS2	2.4	26	0	93	7
	DS3	4				
	DS4	5.5	37	0	7	93
	DS5	7				
	DS6	8.5	10	6	65	29
	DS7	9.4				
	DS8	11.4		7	30	63
	DS9	13.1	12			
	DS10	14.3				
	DS11	15.5	12			
BH17-B002	DS1	0.5	19	0	88	12
	DS2	2				
	DS3	3.7	37	0	15	85
	DS4	5.1				
	DS5	6.7	24	0	49	51
	DS6	8.2				
	DS7	10.1				
	DS8	11.5	9	3	66	32
	DS9	12.8				
	DS10	14.5				
	DS11	15.8	11	10	70	20
	DS12	17.4				
	DS13	18.6	8	15	66	20
	DS14	20.1				
	DS15	22.3				
	DS16	23.5	15	1	72	27

Borehole No.	Sample No.	Depth	Moisture Content	Gravel (%)	Sand (%)	Fines (%)
BH17-BR86-1	DQ-1	0.5				
	DQ-2	4.4				
	DQ-3	5.6				
	DQ-4	8.9				
	DQ-5	11.9				
	DQ-6	16.0				
	DQ-7	17.0				
	DQ-8	21.0				
	DQ-9	25.5				
	DQ-10	29.5				
	DQ-11	31.9				
	DQ-12	36.0				
	DQ-13	39.0				
BH17-BR86-2	DQ-1	1.0	13.9	25	72	2
	DQ-2	2.0	22.7	0	93	7
	DQ-3	3.0	17.9	0	91	9
	DQ-4	5.0	36.8	4	91	5
	DQ-5	10.0	22.1	0	89	10
	DQ-6	11.3	22.9			
	DQ-7	20.0	21.9	0	90	10
	DQ-8	24.0	24.5			
	DQ-9	30.0	25.9			
	DQ-10	32.5				
	DQ-11	36.4	26.5			
	DQ-12	37.8				
	DQ-13	39.3	25.3	0	61	39
BH17-BR86-3	DQ-1	1.0	13.8	21	69	10
	DQ-2	2.0	22.8	0	93	7
	DQ-3	3.0	24.3	0	94	6
	DQ-4	5.0	25.4	0	89	11
	DQ-5	8.0	26.0	0	78	22
	DQ-6	12.0	26.0	0	93	7
	DQ-7	20.0				
	DQ-8	30.0	24.6	0	92	8

Borehole No.	Sample No.	Depth	Moisture Content	Gravel (%)	Sand (%)	Fines (%)
BH18-BR15-1	DQ-1	1.7				
	DS-2	2.6	6	34	44	22
	DS-3	3.9	11	6	57	37
	DS-4	5.1	7			
	DQ-5	5.8				
BH18-BR15-2	DS-1	1.2	14	1	85	14
	DQ-2	1.5				
	DS-3	2.0	63	1	45	54
	DQ-4	2.5				
	DS-5	2.6	9	29	39	32
	DS-6	3.5				
	DS-7	4.2	11	14	60	26
	DS-8	5.8	5	22	48	30
	DQ-9	6.3				
BH18-BR70-1	DQ-1	1.5				
	DS-2	2.6	22	0	97	3
	DQ-3	6.3				
	DS-4	6.8	28	0	80	20
	DS-5	9.4	36	0	3	97
	DQ-6	9.6				
	DS-6	11.3	19	0	39	61
	DQ-7	14.3				
	DS-8	14.6	15	9	51	40
	DQ-9	16.5	14.0	19	26	55
	DQ-10	18.2				
	DQ-11	20.9				
BH18-BR70-2	DS-1	0.8	1.0	38	47	15
	DQ-1	1.2	20.0	0	86	14
	DS-2	3.2	15.0	0	91	9
	DQ-3	9.5	23.0	0	2	98
	DQ-4	19.5				
	DS-5	19.6		0	2	98
BH18-BR102-2	DS-2	2.1				
	DQ-3	3.0		31	69	0
	DS-4	5.1				
	DQ-5	5.4				

HATCH

Borehole No.	Sample No.	Depth	Salinity Scale (ppt)
BH17-BR86-2	DQ-1	1.0	1.0
	DQ-2	2.0	1.0
	DQ-4	5.0	1.0
	DQ-5	10.0	1.0
	DQ-6	11.3	1.0
	DQ-7	20.0	1.0
	DQ-8	24.0	1.0
	DQ-11	36.4	4.0
BH17-BR86-3	DQ-1	1.0	1.0
	DQ-2	2.0	1.0
	DQ-3	3.0	1.0
	DQ-4	5.0	1.0
	DQ-5	8.0	1.0
	DQ-6	12.0	1.0
	DQ-8	30.0	1.0
BH18-BR15-2	DQ-1	1.2	N/A
	DQ-2	1.5	3.0
	DQ-4	2.0	N/A
	DQ-9	11.3	N/A
BH18-BR70-1	DQ-1	1.5	0.0
	DQ-3	6.2	0.0
BR18-BR70-2	DQ-1	1.2	0.0
	DQ-3	9.5	12.0

Appendix G
Laboratory Certificate of Conformance

Canadian Council of Independent Laboratories

CERTIFICATE OF CONFORMANCE

AGGREGATE LABORATORY CERTIFICATION

This is to certify that

Hatch Geotechnical Laboratory

Located at:

Niagara Falls ON

Has met the Standardization and Interlaboratory Testing Requirements of the CCIL/OSSGA AGGREGATE LABORATORY CERTIFICATION PROGRAM and has qualified under the following categories and test methods:

AGGREGATE QUALITY CONTROL LABORATORY (TYPE C)

LS-600/C-702; LS-601/C-117; LS-602/C-136; LS-607; LS-608; LS-621

AGGREGATE PHYSICAL PROPERTY LABORATORY (TYPE D)

LS-706/D698; LS-702/AASHTO T88; LS-703,704/D4318; LS-705/D854; LS-709/D2434

Gib McIntee

GIB MCINTEE, P. ENG.
CHAIRMAN, CERTIFICATION PROGRAM ADMINISTRATION COMMITTEE

May 1, 2018 - April 30, 2019

Date

Gordon H Leaman

GORDON H. LEAMAN, P. ENG.
PRESIDENT

CCIL

Canadian Council of Independent Laboratories

CERTIFICATE OF CONFORMANCE

AGGREGATE LABORATORY CERTIFICATION

This is to certify that

Hatch

Located at:

Niagara Falls ON

Has met the Standardization and Interlaboratory Testing Requirements of the CCIL/OSSGA AGGREGATE LABORATORY CERTIFICATION PROGRAM and has qualified under the following categories and test methods:

AGGREGATE QUALITY CONTROL LABORATORY (TYPE C)

LS-600/C-702; LS-601/C-117; LS-602/C-136; LS-607; LS-608; LS-621

AGGREGATE PHYSICAL PROPERTY LABORATORY (TYPE D)

LS-706/D698; LS-702/AASHTO T88; LS-703,704/D4318; LS-705/D854; LS-709/D2434

Gib McIntee

GIB MCINTEE, P. ENG.
CHAIRMAN, CERTIFICATION PROGRAM ADMINISTRATION COMMITTEE

May 1, 2017 - April 30, 2018

Date

Gordon H Leaman

GORDON H. LEAMAN, P. ENG.
PRESIDENT

CCIL

Canadian Council of Independent Laboratories

CERTIFICATE OF CONFORMANCE

AGGREGATE LABORATORY CERTIFICATION

This is to certify that

Amec Foster Wheeler Environment & Infrastructure
A Division of Amec Foster Wheeler Americas Limited

Located at:

Hamilton ON

Has met the Standardization and Interlaboratory Testing Requirements of the CCIL/OSSGA AGGREGATE LABORATORY CERTIFICATION PROGRAM and has qualified under the following categories and test methods:

AGGREGATE QUALITY CONTROL LABORATORY (TYPE C)

LS-600/C-702; LS-601/C-117; LS-602/C-136; LS-607; LS-608; LS-621

AGGREGATE PHYSICAL PROPERTY LABORATORY (TYPE D)

LS-412/CSA A23.2-2C,-4C; LS-603/C131&535; LS-604/C127; LS-605/C128; LS-606/C88; LS-609/C294,5 (Petrographic Analysts : John Balinski, Martin Little, Amy McCulloch & Ivan Severenski); LS-610/C40; LS-613/D3042; LS-614/CSA A23.2-24A; LS-615/CSA A23.2-26A; LS-617; LS-618/D6928; LS-619/D7428; LS-620/CSA A23.2-25A; LS-623/D698; LS-709/D2434

Superpave Aggregate Consensus Properties

AASHTO T176/D2419; LS-629/AASHTO T304; ASTM D4791; ASTM D5821

Gib McIntee

GIB MCINTEE, P. ENG.
CHAIRMAN, CERTIFICATION PROGRAM ADMINISTRATION COMMITTEE

May 1, 2016 - April 30, 2017

Date

Gordon H Leaman

GORDON H. LEAMAN, P. ENG.
PRESIDENT

Appendix H
Coarse Aggregate Physical Testing Reports

21 July 2017
File: TB152049

Hatch Ltd.
4342 Queen St. Suite 500
Niagara Falls, Ont.
L2E 7J7

Attention: Mr. Ralph Serluca

Dear Sir,

RE: AGGREGATE TESTING – 10" ROCK GRANITE & DIABASE

We are pleased to present the results of laboratory testing conducted on two samples of 10"rock received in our Amec Foster Wheeler Hamilton laboratory on 27 June 2017. It is understood that a representative of Hatch Ltd. obtained the sample from an unspecified source.

Testing of the 10" rock materials was limited to Mill Abrasion using TMS-004, Track Rock Ballast Specification, rev. 22 Aug. 2013. Oversized samples were crushed to required particle sizes using laboratory Jaw-crusher.

Results of the physical testing can be found in Table 1.

Table 1 – Physical Laboratory Testing Results

Testing Required	NF17-05 (Granitic Gneiss)	NF17-06 (Diabase)
Mill Abrasion	2.7% loss	5.8% loss

If there are any questions concerning this report, please do not hesitate to contact our office.

Yours truly,

Amec Foster Wheeler Environment & Infrastructure
a Division of Amec Foster Wheeler Americas Limited

Reviewed by,

K. Hand

Kristen Hand
Soils & Aggregate Laboratory Supervisor
kh:OL

Ognjenko Lazic
Concrete & Asphalt Laboratory Supervisor

Amec Foster Wheeler Environment and Infrastructure
a Division Amec Foster Wheeler Americas Limited
505 Woodward Avenue, Unit 1
Hamilton, ON L8H 6N6
Canada
Tel (905) 312-0700
Fax (905) 312-0771

15 February 2017
File: TB152049

Hatch Ltd.
4342 Queen St., Suite 500
Niagara Falls, ON
L2E 7J7 Canada

Attention: Mr. Warren R. Hoyle, P.Geo.

RE: PHYSICAL TESTING OF BEDROCK CORE AND ROCK LUMPS

1.0 INTRODUCTION

We are pleased to present the results of our Amec Foster Wheeler Hamilton laboratory testing conducted on rock lump samples provided by HATCH Limited (HATCH). It is understood the rock lump and bedrock core samples were sampled in January 2017 by a representative of Hatch. These samples were received in our laboratory on 26 January 2017.

2.0 METHODLOGY

A total of four pails of rock grab samples (4-8 inch) and bedrock cores were provided for physical durability testing. The aggregate was crushed using a laboratory crusher at Amec Foster Wheeler Hamilton Laboratory. The material was crushed to produce a 20mm coarse aggregate to be tested.

Testing of the 20mm crushed core samples was limited to:

Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus	(CSA A23.2 - 29A)
Sieve Analysisof Coarse and Fine Aggregate	(CSA A23.2 - 2A)
Relative Density and Absorption of Coarse Aggregate	(CSA A23.2 - 12A)
Resistance of Unconfined Coarse Aggregate to Freezing and Thawing	(CSA A23.2 - 24A)

505 Woodward Avenue, Unit 1
Hamilton, Ontario L8H 6N6
Tel +1 905 312 0700
Fax +1 905 312 0771
amecfw.com

The results of testing are summarized in Table 1.

3.0 RESULTS

Table 1. Results of the Physical Testing Crushed Aggregate Sample

Test Required	Test Method	Laboratory Test Results			
		NF17-01	NF17-02	NF17-03	NF17-04
Relative Density (Specific Gravity)	CSA A23.2 - 12A	**2.662**	**2.655**	**2.618**	**2.995**
Absorption (%)	CSA A23.2 - 12A	**0.82**	**0.90**	**0.37**	**0.45**
Micro-Deval Abrasion (% loss)	CSA A23.2 - 29A	**10.5**	**11.0**	**4.5**	**7.9**
Unconfined Freeze-Thaw (% loss)	CSA A23.2 - 24A	**6.7**	**11.1**	**1.6**	**0.8**

Presented in Enclosures 1 through 4 are the gradation results of the coarse portion of each sample.

Please contact us if you have any questions, or if we can be of further service evaluating aggregate sources.

Regards,

Amec Foster Wheeler Environment & Infrastructure
a Division of Amec Foster Wheeler Americas Limited

Reviewed by,

Ognjenko Lazic
Asphalt & Concrete
Laboratory Supervisor

Kristen Hand
Soils & Aggregate
Laboratory Supervisor

LIMITS FOR DELETERIOUS SUBSTANCES AND PHYSICAL PROPERTIES OF AGGREGATE

CSA A23.1 - 14, Table 11 & 12 and A23.2 - 15A & 27A, Rev. August 2014

Clauses 4.2.3.2.2, 4.2.3.4.3, 4.2.3.5.1, 4.2.3.5.3.3, 4.2.3.5.3.4, 4.2.3.7 & 4.2.3.10.1

Job No.:	Client:	Sampled By:	Enclosure:
TB152049	Hatch Ltd.	Client	**2**

Name of Testing Laboratory:	Telephone No.:	Fax No.:
Amec Foster Wheeler Environment & Infrastructure	(905) 312 - 0700	(905) 312 - 0771

Sample Lab No.:	Sample Source:
S018-17	NF17-01

Sample Type:	Date Sampled:	Stockpile Quantity (t)
Crushed Core	January 2017	--

COARSE AGGREGATE

Nominal Max. Size (mm):	Aggregrate Inventory No.:	Gradation Results:	Meets Spec.: (Y/N)
20 mm	n/a	n/a	n/a

Limits for Deleterious Substances and Physical Properties of Aggregates

CSA Laboratory Test and Number	**Acceptance Limits** **Maximum percentage by mass of total sample**		**Reference Material Results**	**Sample Results**	**Meets Spec. Y / N**
Standard Requirements	**Concrete exposed to freezing & thawing**	**Other exposure conditions**			
Clay lumps - A23.2 - 3A †****	0.3 % maximum	0.5 % maximum	-	-	-
Low - density granular materials - A23.2 - 4A‡****	0.5 % maximum	1 % maximum	-	-	-
Material finer than 80 µm - A23.2 - 5A**	1% maximum[1]	1% maximum[1]	-	-	-
Absorption - A23.2 - 12A	-		0.37%	**0.82%**	-
Flat & elongated particles, Procedure A, 4:1 - A23.2-13A	20.0 % maximum	20.0 % maximum	-	-	-
Micro-Deval test - A23.2 - 29A	17 % maximum	21 % maximum	14.0%	**10.5%**	**Y**
Unconfined freeze-thaw test - A23.2 - 24A‡‡	6 % maximum	10 % maximum	9.5%	**6.7%**	**N/Y**
Abrasion loss - A23.2 - 16A and A23.2 - 17A§§	50 % maximum	50 % maximum	-	-	-
Petrographic examination of aggregate - A23.2 -15A	125 maximum	140 maximum	-	-	-
Alkali-Carbonate reactivity - A23.2 - 26A	chem. comp. must plot in non-exp. field		-	-	-
Accelerated mortar bar - A23.2 - 25A	maximum 0.150% at 14 days		-	-	-
Concrete prism - A23.2 - 14A	maximum 0.040% at one year		-	-	-
Alternative Requirements***					
$MgSO_4$ soundness loss - A23.2 - 9A	12 % maximum	18 % maximum	-	-	-

Issued By: Kristen Hand (Print Name) — [signature] (Testing Laboratory Representative Signature) — 14 February 2017 (Date)

LIMITS FOR DELETERIOUS SUBSTANCES AND PHYSICAL PROPERTIES OF AGGREGATE

CSA A23.1 - 14, Table 11 & 12 and A23.2-15A & 27A, Rev. August 2014

Clauses 4.2.3.2.2, 4.2.3.4.3, 4.2.3.5.1, 4.2.3.5.3.3, 4.2.3.5.3.4, 4.2.3.7 & 4.2.3.10.1

Enclosure: **2**

*Limits for deleterious substances not listed in this Table, such as coal, ochre (ironstone), shalestone, siltstone, or argillaceous limestone, shall be specified by the owner to encompass deleterious materials known to be present in a particular region. In the absence of such information, aggregate shall be accepted or rejected in accordance with clause 4.2.3.9

†Clay lumps are defined as fine-grained, consolidated, sedimentary materials of a hydrous aluminosilicate nature.

‡A liquid with a relative density of 2.0 is generally used to separate particles classified as coal or lignite. Liquids with relative densities higher or lower than 2.0 might be required to identify other deleterious low-density materials.

The amount of material of clay size shall be determined by performing a hydrometer analysis as per ASTM D 422 on a sample washed through an 80 μm sieve.

**In the case of crushed aggregate, if material finer than the 80 μm sieve consists of the dust of fracture, essentially free from clay or shale, the maximum shall be 2.0%

‡‡CSA A23.2-24A, a test for coarse aggregate, has good precision and shows fair correlation with the MgSO4 soundness test. For further information, see Rogers, Senior, & Boothe (1989)

§§The abrasion loss shall not be greater than 35% when the aggregate is used in concrete paving or for other concrete surfaces subjected to significant wear. This does not refer to air- cooled iron blast-furnace-slag coarse aggregate. The abrasion loss requirements for coarse aggregate shall be waived provided that the material meets the alternative requirements for Micro-deval detailed in this Table.

***The freeze-thaw requirements for coarse aggregate shall be waived provided that the material meets the laternative requirements for $MgSO_4$ soundness loss detailed in this Table.

****If the Coarse Aggregate when tested according to A23.2-15A does not show the presence of either clay lumps or low-density granular materials, the requirements for testing in accordance with 3A and 4A may be waived.

[1]This limit applies to the amount of material finer than 80μm as determined by washing only.

Amec Foster Wheeler Environment & Infrastructure
a Division of Amec Foster Wheeler Americas Limited
505 Woodward Avenue, Unit 1
Hamilton, Ontario
Canada L8H 6N6

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE

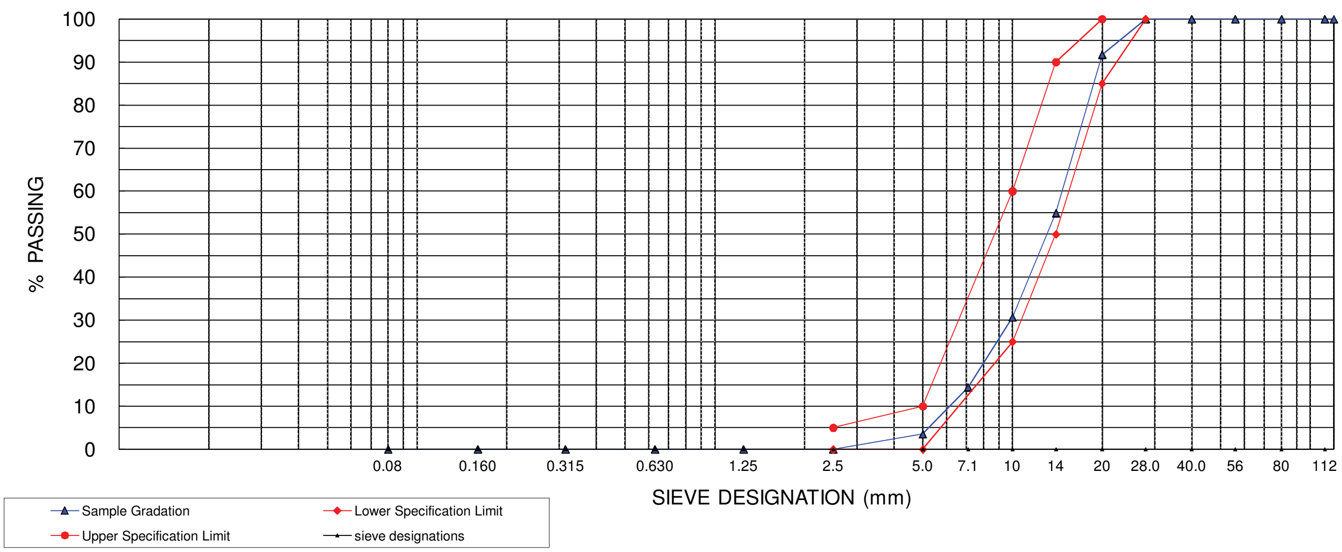
CSA A23.2-2A

Enclosure: 1
Date: 14 February 2017
Project No: TB152049

Client: Hatch
Sample Source: NF17-01
Sampled By: Client
Date Sampled: January 2017
Sample Type: Crushed Core
Specification: CSA A23.1-14, August 2014, Table 11, Group I, 20-5mm Concrete Stone Grading Requirements for Coarse Aggregate

Lab No: S018-17
Date Received: 26 January 2017
Date Tested: 6 February 2017
Lab Technician: KH

SIEVE SIZES (mm)	120	112	80	56	40.0	28.0	20	14	10	7.1	5	2.5	1.25	0.630	0.315	0.160	0.08
SPECIFICATIONS	-	-	-	-	-	100.0	85-100	50-90	25-60	-	0-10	0-5	-	-	-	-	-
% PASSING	100.0	100.0	100.0	100.0	100.0	100.0	91.7	54.9	30.7	14.4	3.5						
% RETAINING	0.0	0.0	0.0	0.0	0.0	0.0	8.3	45.1	69.3	85.6	96.5						



Amec Foster Wheeler Environment & Infrastructure
505 Woodward Avenue, Unit 1
Hamilton, Ontario L8H 6N6
PH: 905 312 0700
FX: 905 312 0771

LIMITS FOR DELETERIOUS SUBSTANCES AND PHYSICAL PROPERTIES OF AGGREGATE

CSA A23.1 - 14, Table 11 & 12 and A23.2 - 15A & 27A, Rev. August 2014

Clauses 4.2.3.2.2, 4.2.3.4.3, 4.2.3.5.1, 4.2.3.5.3.3, 4.2.3.5.3.4, 4.2.3.7 & 4.2.3.10.1

Job No.:	Client:	Sampled By:	Enclosure:
TB152049	Hatch Ltd	Client	**2**

Name of Testing Laboratory:	Telephone No.:	Fax No.:
Amec Foster Wheeler Environment & Infrastructure	(905) 312 - 0700	(905) 312 - 0771

Sample Lab No.:	Sample Source:
S019-17	NF17-02

Sample Type:	Date Sampled:	Stockpile Quantity (t)
Crushed Core	January 2017	--

COARSE AGGREGATE

Nominal Max. Size (mm):	Aggregrate Inventory No.:	Gradation Results:	Meets Spec.: (Y/N)
20 mm	n/a	n/a	n/a

Limits for Deleterious Substances and Physical Properties of Aggregates

CSA Laboratory Test and Number	Acceptance Limits Maximum percentage by mass of total sample		Reference Material Results	Sample Results	Meets Spec. Y / N
Standard Requirements	**Concrete exposed to freezing & thawing**	**Other exposure conditions**			
Clay lumps - A23.2 - 3A †****	0.3 % maximum	0.5 % maximum	-	-	-
Low - density granular materials - A23.2 - 4A‡****	0.5 % maximum	1 % maximum	-	-	-
Material finer than 80 µm - A23.2 - 5A**	1% maximum[1]	1% maximum[1]	-	-	-
Absorption - A23.2 - 12A	-		0.37%	**0.90%**	-
Flat & elongated particles, Procedure A, 4:1 - A23.2-13A	20.0 % maximum	20.0 % maximum	-	-	-
Micro-Deval test - A23.2 - 29A	17 % maximum	21 % maximum	14.0%	**11.0%**	**Y**
Unconfined freeze-thaw test - A23.2 - 24A‡‡	6 % maximum	10 % maximum	9.5%	**11.1%**	**N**
Abrasion loss - A23.2 - 16A and A23.2 - 17A§§	50 % maximum	50 % maximum	-	-	-
Petrographic examination of aggregate - A23.2 -15A	125 maximum	140 maximum	-	-	-
Alkali-Carbonate reactivity - A23.2 - 26A	chem. comp. must plot in non-exp. field		-	-	-
Accelerated mortar bar - A23.2 - 25A	maximum 0.150% at 14 days		-	-	-
Concrete prism - A23.2 - 14A	maximum 0.040% at one year		-	-	-
Alternative Requirements*					
$MgSO_4$ soundness loss - A23.2 - 9A	12 % maximum	18 % maximum			

Issued By: Kristen Hand (Print Name)

Testing Laboratory Representative Signature

14 February 2017 (Date)

LIMITS FOR DELETERIOUS SUBSTANCES AND PHYSICAL PROPERTIES OF AGGREGATE

CSA A23.1 - 14, Table 11 & 12 and A23.2-15A & 27A, Rev. August 2014

Clauses 4.2.3.2.2, 4.2.3.4.3, 4.2.3.5.1, 4.2.3.5.3.3, 4.2.3.5.3.4, 4.2.3.7 & 4.2.3.10.1

Enclosure: **2**

*Limits for deleterious substances not listed in this Table, such as coal, ochre (ironstone), shalestone, siltstone, or argillaceous limestone, shall be specified by the owner to encompass deleterious materials known to be present in a particular region. In the absence of such information, aggregate shall be accepted or rejected in accordance with clause 4.2.3.9

†Clay lumps are defined as fine-grained, consolidated, sedimentary materials of a hydrous aluminosilicate nature.

‡A liquid with a relative density of 2.0 is generally used to separate particles classified as coal or lignite. Liquids with relative densities higher or lower than 2.0 might be required to identify other deleterious low-density materials.

The amount of material of clay size shall be determined by performing a hydrometer analysis as per ASTM D 422 on a sample washed through an 80 µm sieve.

**In the case of crushed aggregate, if material finer than the 80 µm sieve consists of the dust of fracture, essentially free from clay or shale, the maximum shall be 2.0%

‡‡CSA A23.2-24A, a test for coarse aggregate, has good precision and shows fair correlation with the MgSO4 soundness test. For further information, see Rogers, Senior, & Boothe (1989)

§§The abrasion loss shall not be greater than 35% when the aggregate is used in concrete paving or for other concrete surfaces subjected to significant wear. This does not refer to air- cooled iron blast-furnace-slag coarse aggregate. The abrasion loss requirements for coarse aggregate shall be waived provided that the material meets the alternative requirements for Micro-deval detailed in this Table.

***The freeze-thaw requirements for coarse aggregate shall be waived provided that the material meets the laternative requirements for $MgSO_4$ soundness loss detailed in this Table.

****If the Coarse Aggregate when tested according to A23.2-15A does not show the presence of either clay lumps or low-density granular materials, the requirements for testing in accordance with 3A and 4A may be waived.

[1]This limit applies to the amount of material finer than 80µm as determined by washing only.

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE

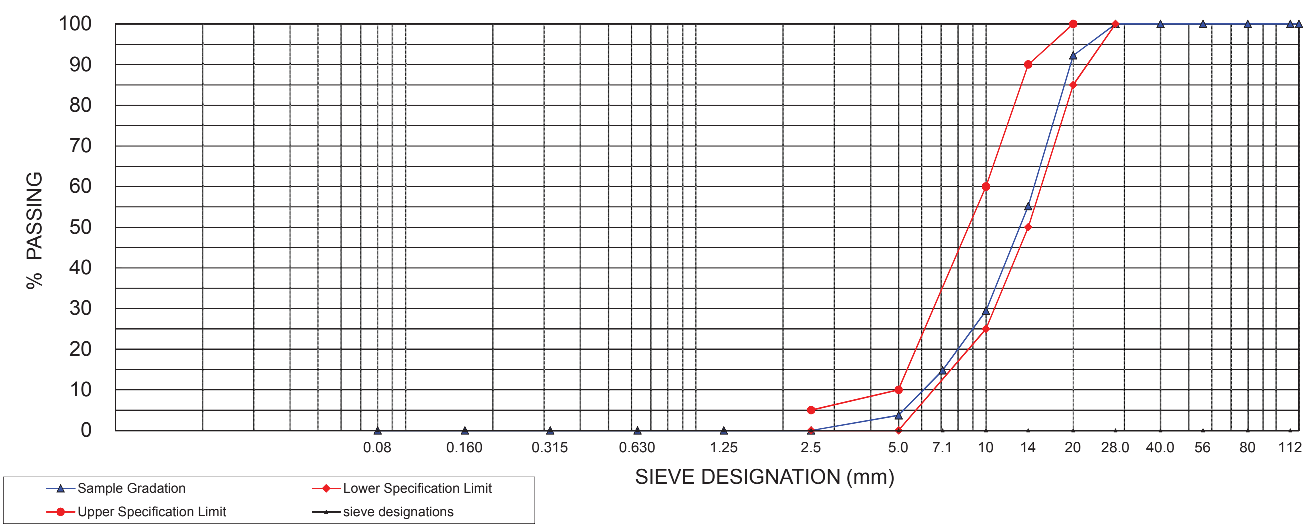
CSA A23.2-2A

Enclosure: 1
Date: 14 February 2017
Project No: TB152049

Client: Hatch Ltd
Sample Source: NF17-02
Sampled By: Client
Date Sampled: January 2017
Sample Type: Crushed Core
Specification: CSA A23.1-14, August 2014, Table 11, Group I, 20-5mm Concrete Stone Grading Requirements for Coarse Aggregate

Lab No: S019-17
Date Received: 26 January 2017
Date Tested: 6 February 2017
Lab Technician: KH

SIEVE SIZES (mm)	120	112	80	56	40.0	28.0	20	14	10	7.1	5	2.5	1.25	0.630	0.315	0.160	0.08
SPECIFICATIONS	-	-	-	-	-	100.0	85-100	50-90	25-60	-	0-10	0-5	-	-	-	-	-
% PASSING	100.0	100.0	100.0	100.0	100.0	100.0	92.3	55.2	29.4	14.8	3.7						
% RETAINING	0.0	0.0	0.0	0.0	0.0	0.0	7.7	44.8	70.6	85.2	96.3						



Amec Foster Wheeler Environment & Infrastructure
505 Woodward Avenue, Unit 1
Hamilton, Ontario L8H 6N6
PH: 905 312 0700
FX: 905 312 0771

LIMITS FOR DELETERIOUS SUBSTANCES AND PHYSICAL PROPERTIES OF AGGREGATE

CSA A23.1 - 14, Table 11 & 12 and A23.2 - 15A & 27A, Rev. August 2014

Clauses 4.2.3.2.2, 4.2.3.4.3, 4.2.3.5.1, 4.2.3.5.3.3, 4.2.3.5.3.4, 4.2.3.7 & 4.2.3.10.1

Job No.:	Client:	Sampled By:	Enclosure:
TB152049	Hatch Ltd.	Client	**2**

Name of Testing Laboratory:	Telephone No.:	Fax No.:
Amec Foster Wheeler Environment & Infrastructure	(905) 312 - 0700	(905) 312 - 0771

Sample Lab No.:	Sample Source:
S020-17	NF17-03

Sample Type:	Date Sampled:	Stockpile Quantity (t)
Crushed Core	Janaury 2017	--

COARSE AGGREGATE

Nominal Max. Size (mm):	Aggregrate Inventory No.:	Gradation Results:	Meets Spec.: (Y/N)
20 mm	n/a	n/a	n/a

Limits for Deleterious Substances and Physical Properties of Aggregates

CSA Laboratory Test and Number	**Acceptance Limits** **Maximum percentage by mass of total sample**		**Reference Material Results**	**Sample Results**	**Meets Spec. Y / N**
Standard Requirements	**Concrete exposed to freezing & thawing**	**Other exposure conditions**			
Clay lumps - A23.2 - 3A †****	0.3 % maximum	0.5 % maximum	-	-	-
Low - density granular materials - A23.2 - 4A‡****	0.5 % maximum	1 % maximum	-	-	-
Material finer than 80 µm - A23.2 - 5A**	1% maximum[1]	1% maximum[1]	-	-	-
Absorption - A23.2 - 12A	-		0.37%	**0.37%**	-
Flat & elongated particles, Procedure A, 4:1 - A23.2-13A	20.0 % maximum	20.0 % maximum	-	-	-
Micro-Deval test - A23.2 - 29A	17 % maximum	21 % maximum	14.0%	**4.5%**	**Y**
Unconfined freeze-thaw test - A23.2 - 24A‡‡	6 % maximum	10 % maximum	9.5%	**1.6%**	**Y**
Abrasion loss - A23.2 - 16A and A23.2 - 17A§§	50 % maximum	50 % maximum	-	-	-
Petrographic examination of aggregate - A23.2 -15A	125 maximum	140 maximum	-	-	-
Alkali-Carbonate reactivity - A23.2 - 26A	chem. comp. must plot in non-exp. field		-	-	-
Accelerated mortar bar - A23.2 - 25A	maximum 0.150% at 14 days		-	-	-
Concrete prism - A23.2 - 14A	maximum 0.040% at one year		-	-	-
Alternative Requirements* **					
$MgSO_4$ soundness loss - A23.2 - 9A	12 % maximum	18 % maximum			

Issued By: Kristen Hand (Print Name) — [signature] (Testing Laboratory Representative Signature) — 14 February 2017 (Date)

LIMITS FOR DELETERIOUS SUBSTANCES AND PHYSICAL PROPERTIES OF AGGREGATE

CSA A23.1 - 14, Table 11 & 12 and A23.2-15A & 27A, Rev. August 2014

Clauses 4.2.3.2.2, 4.2.3.4.3, 4.2.3.5.1, 4.2.3.5.3.3, 4.2.3.5.3.4, 4.2.3.7 & 4.2.3.10.1

Enclosure: **2**

*Limits for deleterious substances not listed in this Table, such as coal, ochre (ironstone), shalestone, siltstone, or argillaceous limestone, shall be specified by the owner to encompass deleterious materials known to be present in a particular region. In the absence of such information, aggregate shall be accepted or rejected in accordance with clause 4.2.3.9

†Clay lumps are defined as fine-grained, consolidated, sedimentary materials of a hydrous aluminosilicate nature.

‡A liquid with a relative density of 2.0 is generally used to separate particles classified as coal or lignite. Liquids with relative densities higher or lower than 2.0 might be required to identify other deleterious low-density materials.

The amount of material of clay size shall be determined by performing a hydrometer analysis as per ASTM D 422 on a sample washed through an 80 µm sieve.

**In the case of crushed aggregate, if material finer than the 80 µm sieve consists of the dust of fracture, essentially free from clay or shale, the maximum shall be 2.0%

‡‡CSA A23.2-24A, a test for coarse aggregate, has good precision and shows fair correlation with the MgSO4 soundness test. For further information, see Rogers, Senior, & Boothe (1989)

§§The abrasion loss shall not be greater than 35% when the aggregate is used in concrete paving or for other concrete surfaces subjected to significant wear. This does not refer to air- cooled iron blast-furnace-slag coarse aggregate. The abrasion loss requirements for coarse aggregate shall be waived provided that the material meets the alternative requirements for Micro-deval detailed in this Table.

***The freeze-thaw requirements for coarse aggregate shall be waived provided that the material meets the laternative requirements for $MgSO_4$ soundness loss detailed in this Table.

****If the Coarse Aggregate when tested according to A23.2-15A does not show the presence of either clay lumps or low-density granular materials, the requirements for testing in accordance with 3A and 4A may be waived.

[1]This limit applies to the amount of material finer than 80µm as determined by washing only.

Amec Foster Wheeler Environment & Infrastructure
a Division of Amec Foster Wheeler Americas Limited
505 Woodward Avenue, Unit 1
Hamilton, Ontario
Canada L8H 6N6

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE

CSA A23.2-2A

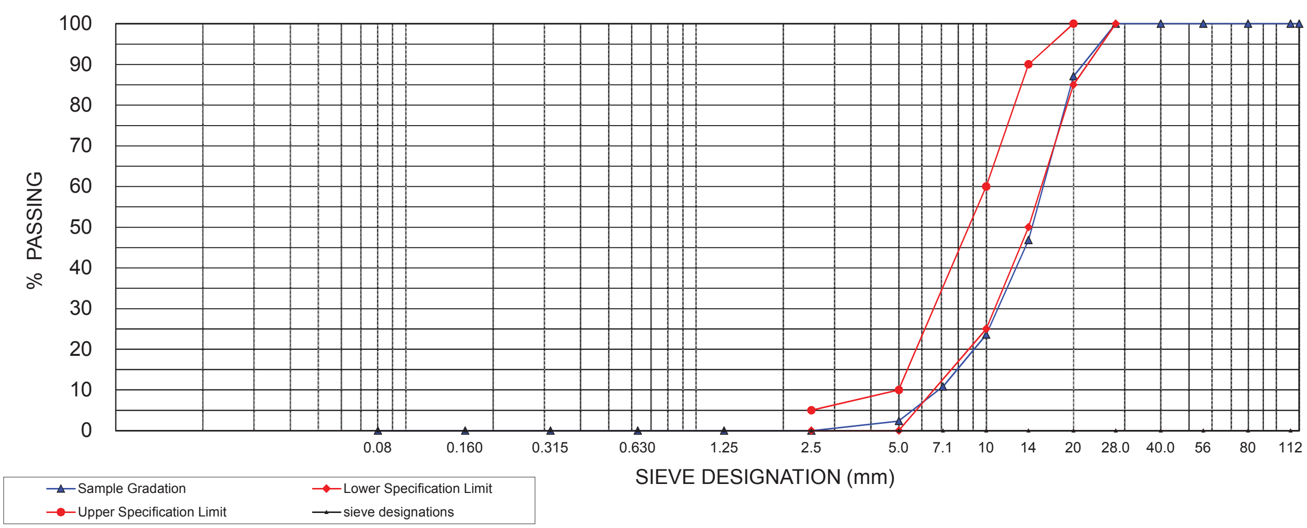
amec foster wheeler

Enclosure: 1
Date: 14 February 2017
Project No: TB152049

Client: Hatch Ltd.
Sample Source: NF17-03
Sampled By: Client
Date Sampled: January 2017
Sample Type: Crushed Core
Specification: CSA A23.1-14, August 2014, Table 11, Group I, 20-5mm Concrete Stone Grading Requirements for Coarse Aggregate

Lab No: S020-17
Date Received: 26 January 2017
Date Tested: 6 February 2017
Lab Technician: KH
Fineness Modulus: #DIV/0!

SIEVE SIZES (mm)	120	112	80	56	40.0	28.0	20	14	10	7.1	5	2.5	1.25	0.630	0.315	0.160	0.08
SPECIFICATIONS	-	-	-	-	-	100.0	85-100	50-90	25-60	-	0-10	0-5	-	-	-	-	-
% PASSING	100.0	100.0	100.0	100.0	100.0	100.0	87.1	46.8	23.6	10.8	2.4						
% RETAINING	0.0	0.0	0.0	0.0	0.0	0.0	12.9	53.2	76.4	89.2	97.6						



Amec Foster Wheeler Environment & Infrastructure
505 Woodward Avenue, Unit 1
Hamilton, Ontario L8H 6N6
PH: 905 312 0700
FX: 905 312 0771

TM-MAT-1005A-05

LIMITS FOR DELETERIOUS SUBSTANCES AND PHYSICAL PROPERTIES OF AGGREGATE

CSA A23.1 - 14, Table 11 & 12 and A23.2 - 15A & 27A, Rev. August 2014

Clauses 4.2.3.2.2, 4.2.3.4.3, 4.2.3.5.1, 4.2.3.5.3.3, 4.2.3.5.3.4, 4.2.3.7 & 4.2.3.10.1

Job No.: TB152049	Client: Hatch Ltd.	Sampled By: Client	Enclosure: 2
Name of Testing Laboratory: Amec Foster Wheeler Environment & Infrastructure		Telephone No.: (905) 312 - 0700	Fax No.: (905) 312 - 0771
Sample Lab No.: S021-17	Sample Source: NF17-04		
Sample Type: Crushed Rock		Date Sampled: January 2017	Stockpile Quantity (t) --

COARSE AGGREGATE

Nominal Max. Size (mm):	Aggregrate Inventory No.:	Gradation Results:	Meets Spec.: (Y/N)
20 mm	n/a	n/a	n/a

Limits for Deleterious Substances and Physical Properties of Aggregates

CSA Laboratory Test and Number	Acceptance Limits Maximum percentage by mass of total sample		Reference Material Results	Sample Results	Meets Spec. Y / N
Standard Requirements	**Concrete exposed to freezing & thawing**	**Other exposure conditions**			
Clay lumps - A23.2 - 3A †****	0.3 % maximum	0.5 % maximum	-	-	-
Low - density granular materials - A23.2 - 4A‡****	0.5 % maximum	1 % maximum	-	-	-
Material finer than 80 μm - A23.2 - 5A**	1% maximum[1]	1% maximum[1]	-	-	-
Absorption - A23.2 - 12A	-		0.37%	**0.45%**	-
Flat & elongated particles, Procedure A, 4:1 - A23.2-13A	20.0 % maximum	20.0 % maximum	-	-	-
Micro-Deval test - A23.2 - 29A	17 % maximum	21 % maximum	14.0%	**7.9%**	**Y**
Unconfined freeze-thaw test - A23.2 - 24A‡‡	6 % maximum	10 % maximum	9.5%	**0.8%**	**Y**
Abrasion loss - A23.2 - 16A and A23.2 - 17A§§	50 % maximum	50 % maximum	-	-	-
Petrographic examination of aggregate - A23.2 -15A	125 maximum	140 maximum	-	-	-
Alkali-Carbonate reactivity - A23.2 - 26A	chem. comp. must plot in non-exp. field		-	-	-
Accelerated mortar bar - A23.2 - 25A	maximum 0.150% at 14 days		-	-	-
Concrete prism - A23.2 - 14A	maximum 0.040% at one year		-	-	-
Alternative Requirements* **					
$MgSO_4$ soundness loss - A23.2 - 9A	12 % maximum	18 % maximum			

Issued By: Kristen Hand (Print Name) — [signature] (Testing Laboratory Representative Signature) — 14 February 2017 (Date)

LIMITS FOR DELETERIOUS SUBSTANCES AND PHYSICAL PROPERTIES OF AGGREGATE

CSA A23.1 - 14, Table 11 & 12 and A23.2-15A & 27A, Rev. August 2014

Clauses 4.2.3.2.2, 4.2.3.4.3, 4.2.3.5.1, 4.2.3.5.3.3, 4.2.3.5.3.4, 4.2.3.7 & 4.2.3.10.1

Enclosure: **2**

*Limits for deleterious substances not listed in this Table, such as coal, ochre (ironstone), shalestone, siltstone, or argillaceous limestone, shall be specified by the owner to encompass deleterious materials known to be present in a particular region. In the absence of such information, aggregate shall be accepted or rejected in accordance with clause 4.2.3.9

†Clay lumps are defined as fine-grained, consolidated, sedimentary materials of a hydrous aluminosilicate nature.

‡A liquid with a relative density of 2.0 is generally used to separate particles classified as coal or lignite. Liquids with relative densities higher or lower than 2.0 might be required to identify other deleterious low-density materials.

The amount of material of clay size shall be determined by performing a hydrometer analysis as per ASTM D 422 on a sample washed through an 80 µm sieve.

**In the case of crushed aggregate, if material finer than the 80 µm sieve consists of the dust of fracture, essentially free from clay or shale, the maximum shall be 2.0%

‡‡CSA A23.2-24A, a test for coarse aggregate, has good precision and shows fair correlation with the MgSO4 soundness test. For further information, see Rogers, Senior, & Boothe (1989)

§§The abrasion loss shall not be greater than 35% when the aggregate is used in concrete paving or for other concrete surfaces subjected to significant wear. This does not refer to air- cooled iron blast-furnace-slag coarse aggregate. The abrasion loss requirements for coarse aggregate shall be waived provided that the material meets the alternative requirements for Micro-deval detailed in this Table.

***The freeze-thaw requirements for coarse aggregate shall be waived provided that the material meets the laternative requirements for $MgSO_4$ soundness loss detailed in this Table.

****If the Coarse Aggregate when tested according to A23.2-15A does not show the presence of either clay lumps or low-density granular materials, the requirements for testing in accordance with 3A and 4A may be waived.

[1]This limit applies to the amount of material finer than 80µm as determined by washing only.

Amec Foster Wheeler Environment & Infrastructure
a Division of Amec Foster Wheeler Americas Limited
505 Woodward Avenue, Unit 1
Hamilton, Ontario
Canada L8H 6N6

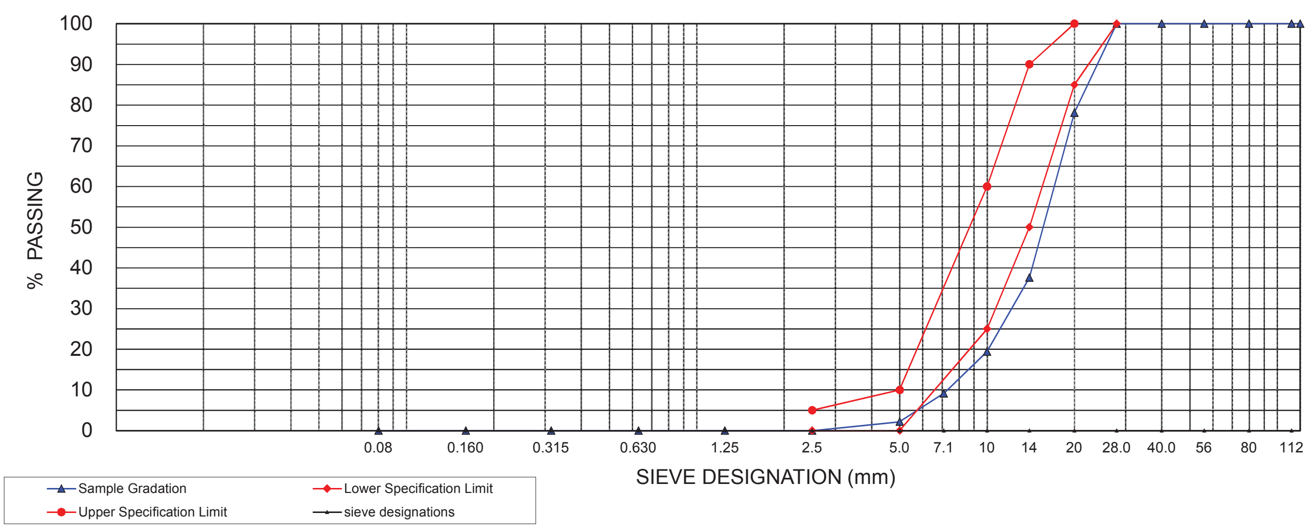
SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE
CSA A23.2-2A

Enclosure: 1
Date: 14 February 2017
Project No: TB152049

Client: Hatch Ltd.
Sample Source: NF17-04
Sampled By: Client
Date Sampled: January 2017
Sample Type: Crushed Rock
Specification: CSA A23.1-14, August 2014, Table 11, Group I, 20-5mm Concrete Stone Grading Requirements for Coarse Aggregate

Lab No: S021-17
Date Received: 26 January 2017
Date Tested: 6 February 2017
Lab Technician: KH

SIEVE SIZES (mm)	120	112	80	56	40.0	28.0	20	14	10	7.1	5	2.5	1.25	0.630	0.315	0.160	0.08
SPECIFICATIONS	-	-	-	-	-	100.0	85-100	50-90	25-60	-	0-10	0-5	-	-	-	-	-
% PASSING	100.0	100.0	100.0	100.0	100.0	100.0	78.1	37.6	19.4	9.2	2.2						
% RETAINING	0.0	0.0	0.0	0.0	0.0	0.0	21.9	62.4	80.6	90.8	97.8						



Amec Foster Wheeler Environment & Infrastructure
505 Woodward Avenue, Unit 1
Hamilton, Ontario L8H 6N6
PH: 905 312 0700
FX: 905 312 0771

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

ABA - Modified Sobek

10-July-2017

Hatch LTD
Attn : Ralph Serluca

4342 Queen St Suite500
Niagara Falls, ON
L2E 6W1,

Phone: 905-374-5200
Fax:905-374-0701

Date Rec. : 27 June 2017
LR Report: **CA13857-JUN17**

Copy: #1

CERTIFICATE OF ANALYSIS

Partial Report

Analysis	**5: NF17-07**	**6: NF17-08**	**7: NF17-09**
Sample Date & Time	Date:N/A	Date:N/A	Date:N/A
Paste pH	9.89	8.89	8.24
Fizz Rate [---]	1	1	3
Sample weight [g]	2.05	1.99	2.00
HCl Added [mL]	20.00	20.00	540.00
HCl [Normality]	0.10	0.10	0.10
NaOH [Normality]	0.10	0.10	0.10
NaOH to [pH=8.3 mL]	17.48	15.50	109
Final pH	1.14	1.73	1.68
NP [t CaCO3/1000 t]	6.1	11	1077
AP [t CaCO3/1000 t]	0.67	0.67	0.67
Net NP [t CaCO3/1000 t]	5.43	10.6	1077
NP/AP [ratio]	9.10	16.9	1608
Sulphur (total) [%]	0.035	0.042	0.029
Acid Leachable SO4-S [%]	0.04	0.04	0.03
Sulphide [%]	< 0.02	< 0.02	< 0.02
Carbon (total) [%]	0.044	0.061	11.1
Carbonate [%]	0.110	< 0.025	54.1

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

OnLine LIMS

0001059049

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365


```
*NP (Neutralization Potential)
 = 50 x (N of HCL x Total HCL added - N NaOH x NaOH added)
   -------------------------------------------------------
                        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 <0.02 will be calculated using a 0.02 value.
```

Appendix I
Geological Investigation Safety Plan

Safety Management Plan - Geotechnical Drilling Program		**Project Number: H352034**
Hatch requires a site-specific Occupational Health and Safety Management Plan for all construction projects. Note that backup documentation is required to demonstrate the veracity of any statements made in this plan. If any are is not applicable to your project please provide an explanation as to why.		
1. Project Definition	Project name	12Mtpa 2016 Field Investigation Program
	Project description	Geotechnical drilling investigation for Baffinland Iron Mines (BIM) including (i) along proposed rail alignment from Mary River to Milne Port, (ii) Milne Port Infrastructure area, (iii) Bridge structures, (iv) quarries and (v) offshore (marine area associated with dock location.
	Project location(s) and project work site location(s)	Locations as noted above.
	What are the safety targets for this project? (Consider LTIs, MTIs, audits etc.)	No incidents.
	How will safety statistics be measured and reported?	Will be recorded along with weekly progress meeting/reports.
2. Project Roles and Responsibilities	Who is the Project Manager?	James Cleland.
	Who is the Principal Contractor for the project?	Boart Longyear (BLY).
	Who is the person on the project team responsible for ensuring compliance with the obligations of the Principal Contractor under the applicable legislation?	BIM, with Hatch as site representative.

Safety Management Plan - Geotechnical Drilling Program				**Project Number: H352034**
	Who is responsible for:	**Responsible:**	**Who is responsible for:**	**Responsible:**
	• identifying, controlling (through elimination or mitigation) and documenting the risks during the design phase of the project	Hatch	• managing compliance of all contractors and persons on site with Safe Work Method Statements and the Site Safety Rules.	BLY Lead supported by Hatch Staff
	• reporting safety aspects of the design to the construction team and plant owner	BLY supported by Hatch.	• making sure that all personnel attend the required safety inductions, have been appropriately trained and keeping records of attendance at inductions and other safety training.	BLY Lead supported by Hatch Staff
	• identifying hazards and assessing the risks associated with all other aspects of the work, and determining and documenting the risk control measures necessary	BLY for all equipment operation	• providing contractors and any person involved in the work with the Site-specific Safety Management Plan and any updates.	BLY SMP supported by Hatch
	• regularly reviewing and updating hazard identification, risk assessment and measures to control risks	BLY supported by Hatch	• managing OHS communication and consultation provisions in accordance with the regulatory and other requirements.	BIM – supported by BLY and Hatch
	• managing compliance on the project with OHS, workplace injury management and workers compensation legislation, regulations, standards and codes	BIM – supported by BLY and Hatch	• preparing, maintaining and making available the register of hazardous substances.	BLY – oversight by Hatch
	• assessing and monitoring the safety management capability of contractors and other service providers	BIM	• ensuring first aid is always available and maintaining first aid stocks.	BLY supported by Hatch FA trained individuals

Safety Management Plan - Geotechnical Drilling Program		Project Number: H352034		
	• Any other project safety responsibility issues?	Weekly progress meeting/reports		
3. Risk Assessment and Management	• Has a risk assessment with representatives from the plant, subcontractors and other stakeholders in the project been held? If not, how will project hazards be identified?	BLY has prepared and will be reviewed with all site staff. Individual daily assessments will be conducted and reviewed at the pre-shift meetings.		
	• Where are the results of the risk assessment documented? Is the level of documentation commensurate with the risks involved?	BLY has provided RA and safe work procedure which has been reviewed and accepted by Hatch.		
	• What is the plan for managing and regularly reviewing the risks and documenting any additionally identified risks?	Pre-shift meeting will be used for risk review of the work activities and drilling locations. JHA's will be updated if major changes occur.		
	• Is any other risk assessment required on this project? (e.g. HAZOP, CHAZOP, HAZAN?)	NA		
	• How will changes in the construction process that might affect the health and safety of any person on the construction site be identified and communicated?	Pre-shift meeting will be used for risk review of the work activities and drilling locations. JHA's will be updated if major changes occur.		
	• How will an emergency on site be handled? How will people be trained in these procedures?	Will use the existing BIM emergency procedures. Need to obtain a copy, assess applicability, make any necessary modifications and review with site Team.		

Safety Management Plan - Geotechnical Drilling Program				Project Number: H352034
	• Any other risk management issues? e.g. do any national or state standards apply to any of the hazards identified?	Travel issues for specific drill locations off of the Tote Road.		
	Consider the other following commonly encountered hazards, indication whether they are an issue on this project and what measures will be taken or put in place to control the hazard:			
	Hazard Will project be exposed to hazard?	**Yes / No**	**Details**	**Control Measure(s) to be implemented**
	Existing services (including electrical, gas or fluid)	No		
	Flammable or toxic gases	Yes	Diesel fuel transport to drills.	Diesel fuel will be transported in closed and safe containers.
	Hazardous materials and dangerous goods (including presence of asbestos)	Yes	BLY	As stated in the BLY RA and procedures.
	Molten metals	No		
	Electrical	Yes	Portable generators.	As stated in the BLY RA and procedures.
	Fire safety	Yes	Portable heating equipment and fuel powered equipment.	As stated in the BLY RA and procedures.
	Internal road safety/ traffic control/ access and egress.	Yes	Tote Road Procedure and BIM Training for individuals driving on the Tote Road.	BIM Procedures and communication requirements, Training by BIM trainer. All other controls to be established in pre-shift meetings and JHA's.

Safety Management Plan - Geotechnical Drilling Program				Project Number: H352034
	Mobile equipment	Yes	BLY equipment and loaned BIM equipment.	BIM Procedures and communication requirements.
	Rail interactions	No		
	Overhead cranes	No		
	Isolations and stored energy.	Yes	BLY equipment	As stated in the BLY RA and procedures.
	Access to or working around .continuous plant	No		
	Manual handling.	Yes	Drill rods and cores and core boxes, handling tools and equipment.	As stated in the BLY RA and procedures.
	Work at heights.	Yes	Possibly required to access drill mast.	As stated in the BLY RA and procedures.
	Falling in (Excavations etc.) or falling on (overhead work/ loads).	No		
	Management of safety by contractors.	Yes	BLY with Hatch oversight.	
	Other interfaces with operations.	Yes	Tote Road use by Operations and Services.	BIM communication requirements.
	Other conditions on the construction site eg: lighting, security, disposal of waste.	Yes	Procedures to meet BIM requirements as stated by Environment. Weather conditions are evaluated on a shift basis – weather conditions reviewed and responsible Hatch site leads to monitor during the shift.	Hatch site leads responsible to shut down work due to weather conditions.

Safety Management Plan - Geotechnical Drilling Program				Project Number: H352034
	Commissioning	NA		

Of the hazards identified above and in the project risk studies, the top ten safety-related risks associated with the project are listed as follows. The list includes the control measures and the person responsible for ensuring that the measures are implemented. The list should consider all phases of the project including design, installation, erection and commissioning and handover to the owners of the plant. **(L = likelihood C=Consequence RR=Risk Rating Resp. = Responsible for control of the risk)**

Risk No.	Description	L	C	Raw RR	Controls	Resp.	L	C	Controlled RR
1	Hazardous materials and dangerous goods.	1	2	3	**MSDS and procedures, BLY with Hatch oversight.**	**BLY**	1	2	3
2	Electrical – portable generators.	2	2	4	**BLY Procedures and Grounding of portable generators.**	**BLY**	1	2	3
3	Fire Safety – portable heating equipment.	2	2	4	**BLY Procedures and MSDS.**	**BLY**	1	2	3
4	Internal road safety/ traffic control/ access and egress.	2	2	4	**Tote Road Procedure and Training for individuals driving on the Tote Road. All travel away from the Tote Road will be assessed and appropriate corrective actions applied.**	**BLY/Hatch**	1	2	3
5	Mobile equipment.	1	2	3	**BLY Procedures. BIM procedures for borrowed mobile equipment.**	**BLY**	1	2	3
6	Isolations and stored energy.	2	2	4	**BLY Procedures.**	**BLY**	1	2	3

Safety Management Plan - Geotechnical Drilling Program					Project Number: H352034				
7	Manual handling	1	2	3	**BLY Procedures.**	**BLY**	1	2	3
8	Work at heights	2	2	4	**BLY Procedures. BLY with Hatch oversight.**	**BLY**	1	2	3
9	Other interfaces with operations.	1	2	3	**BLY Procedures. BLY with Hatch oversight.**	**BLY**	1	2	3
10	Management of safety by contractors.	1	2	3	**BLY Procedures. BLY with Hatch oversight.**	**BLY/Hatch**	1	2	3
11	Other conditions on the construction site e.g.: lighting, security, disposal of waste.	1	2	3	**BLY Procedures. BLY with Hatch oversight.**	**BLY/Hatch**	1	2	3

4. Design	• How will you ensure that the safety hazards and risks (including those associated with the construction phase) will be communicated to the designers and considered through the design process?	**NA**
	• What process will be used to review and verify the design to ensure that the plant/equipment is safe, eliminates, minimizes or controls any OHS risks (including those during construction) and complies with appropriate legislation and standards?	**NA**
	• Does the project include items of plant for which the design or actual item of plant requires registration with government institutions?	**NA**
	• Any other safety related design issues? e.g. process for approving design changes; obtaining appropriate OHS information from suppliers of plant, equipment and materials; designers providing risks identified during design etc.	**Individual drill locations will be assessed for safety accessibility by BLY and supported by Hatch.**

Safety Management Plan - Geotechnical Drilling Program		Project Number: H352034
5. Occupational Health & Safety Training	• What are the minimum induction requirements for access to project site to ensure that work can be undertaken safely? (Tick box if required)	□ Legislative requirement □ Client Specific □ Dept./Hatch Induction (specify)___BIM Site Orientation________ □ Project Specific Induction □ Other (specify): _BLY procedures and BIM procedures/training ________
	• How will records of attendance at inductions be kept?	**It will be reported in the weekly meetings/reports**
	• How will records of the type of induction training (including a description of the content of the training) be kept?	**NA**
	• How will you ensure that all personnel have been appropriately inducted before starting work?	**Review with contractor leadership.**
	• How will you ensure that visitors to the site are kept safe and made aware of any safety hazards?	**Visitors will be escorted**
	• How will you ensure that any additional training (required for safe performance of the work) necessitated by a change in the work site is identified and implemented?	**Pre-shift meetings will be used to detail any additional hazards and controls.**
	• Any other training or induction issues?	**NA**
6. Incident Management	• Who will be available to respond to any injury or illness?	**BLY site leadership supported by Hatch. BIM ERT for serious injuries or incidents.**

Safety Management Plan - Geotechnical Drilling Program		Project Number: H352034
	• What first aid facilities are available for the project site(s)?	**BLY remote FA Kit**
	• How will incidents be reported?	**BLY leadership to BIM safety**
	• Who will be responsible for investigating incidents and ensuring any corrective actions are followed up and completed?	**BLY leadership supported by Hatch**
	• How will any serious incidents be reported to Hatch management (or Legislative instances if required)?	**By Hatch Site staff**
	• How will records of incidents be kept?	**Records will be documented on a daily basis and included in weekly progress reports.**
7. **Communication**	• Where will the signs, containing the name and contact telephone numbers of the principal contractor, be located?	**NA**
	• Where will this safety management plan be kept to ensure that it is available to all people involved in working on the project (including those working on the work site(s))?	**Onsite with BLY leadership and Hatch.**
	• How will the project safety targets be communicated to all personnel involved with the project?	**Site orientation and reviewed in pre-shift meetings.**
	• How will the project safety rules be communicated so that all personnel involved with the project, including personnel on, and visitors to, the work site are made aware of them?	**Site orientation and reviewed in pre-shift meetings.**

Safety Management Plan - Geotechnical Drilling Program		Project Number: H352034
	• How will you ensure that sub-contractors or other service providers are provided with the relevant parts of the safety management plan before commencement of work?	**NA – no subcontractors.**
	• How will you ensure that any change to the safety management plan is communicated to project stakeholders including subcontractors and other service providers?	**Pre-shift meetings.**
	• How will you ensure that any changes to the work site likely to affect health and safety are quickly communicated to all affected personnel? (eg. daily pre-start/toolbox meetings)	**Pre-shift meetings.**
	• Other means to communicate safety matters among the project participants? e.g. safety committees, safety meetings, keeping records of all safety communication etc.	**All BIM safety information will be reviewed at Pre-shift meetings.**
8. Access Control and Work Clearance	• How will you restrict access to the work site(s) to people authorized to do so? (including members of the public)	**NA**
	• How will you ensure that other people in the area of the work site (e.g. adjacent operations facilities), or effected by activities on the site, are kept up to date with activities on the site?	**Drilling locations will be communicated in Baffinland daily toolbox memo.**
	• How will interactions with adjacent or effected sites and stakeholders be managed?	**NA**
	• What Personal Protective Equipment will be required to be worn on the work site(s)?	**BLY and Baffinland requirements and weather dependant.**

Safety Management Plan - Geotechnical Drilling Program		Project Number: H352034
	• Any other access or work clearance issues?	**NA**
9. Audits	• What systems will be used to ensure that project team members, subcontractors, other service providers will comply with this safety management plan and other site safety rules?	**BLY and Hatch site leadership.**
	• What types of audits will be conducted?	**Weekly visible felt leadership inspections.**
	• Who will be involved in audits?	**NA**
	• How often will they be done?	**NA**
	• Any other auditing issues?	**NA**
10. Safe Work Method Statements (for Job Hazard Analysis)	• How will you ensure that subcontractors provide job safety and environmental analysis (JHA), for all work activities assessed as having safety risks, before commencement of work?	**Hatch will oversee work activities based on JHA's.**
	• How will you ensure that the subcontractors comply with the JSEA they have provided?	**NA**
	• What action will be taken if the subcontractor does not comply with the JHA?	**NA**
	• How will you ensure that the JHA is promptly updated to reflect any changes in the way the work is planned to be carried out?	**NA**

Safety Management Plan - Geotechnical Drilling Program		Project Number: H352034
	• Any other issues regarding JHA?	NA
11. Hazardous Materials Register	• How will you keep and maintain a record of the hazardous substances used during the course of the work? This register should include hazardous substances contained in pipes or vessels which are considered a hazard to the project.	**BLY Procedure and requirements.**
	• How will you ensure the register is made accessible to all persons working at the work site?	NA
	• Any other hazardous materials issues?	NA
12. Review and Update of SMP	How will this plan be monitored, maintained and kept up to date during the course of the project? Who will be responsible for this?	**BLY and Hatch site leadership.**
13. Other Issues	Off road travel, Emergency rescue availability – Stand-down work, Deteriorating weather conditions – decisions/communications, wildlife encounter.	

Safety Management Plan Prepared by: Warren R. Hoyle **Warren Hoyle**	**Date Prepared:** **2016-10-12**	**Reviewed by Principal Contractor:** **Date:** Oct 31, 2016 **BLY Leadership** Jarrett Campbell **Principal Contractor Representative: Jarrett Campbell** **Position: Project Manager** **Signature** Jarrett Campbell

Job Hazard Analysis Form

PROJECT/TASK: ZG003 Geotechnical Marine Drilling Milne Inlet					**Department: Projects Boart Longyear**				**JOB No.:ZG003**
SUPERVISOR: Emile Beauchamp					**LOCATION: Future Ore Dock Milne Inlet**				**DATE: March 12 ,2017**
JOB STEP Break the job into steps. Listing work which may be hazardous.	**HAZARDS** List the hazard or type of harm identified with each step.	**Inherent**			**CONTROL MEASURE** List the necessary control measures to be followed to eliminate/reduce the identified hazards.	**Residual**			**ACTION** Person who will ensure this happens
		Consequence	**Likelihood**	**Risk Ranking**		**Consequence**	**Likelihood**	**Risk Ranking**	
1. Pre-job JHA Review.	Missing critical items on the JHA that can lead to an incident	3	2	5	Conduct a pre-job JHA review with Safety and critical team members All workers will have the opportunity to identify changes needed Any changes will be added to this document	1	1	2	Marlon Coakley/Warren Hoyle
2. Workers to complete FLRA card in the field at location prior to starting work.	Additional hazards in the area that may not have been identified on the JHA and daily changes that may pose additional danger to the health and safety of workers, the environment and property	3	3	6	Look at immediate work area for hazards that may exist, not identified on the JHA. Have other workers in the group sign off on the FLHA	1	1	2	All workers
3. Load Weights – The number and types of vehicles and equipment and their maximum gross weights	Not knowing load calculations will run the risk of breaking through the ice.	5	3	8	All equipment and material shall have posted GVW or gross equipment weight or maximum pull back loads available for use with load-ice thickness tables and shall follow the Ice Safety Plan. Refer to Attachment B for minimum ice thickness required for the drilling operations and Attachment C for further guidelines regarding Ice Safety	4	2	6	Warren Hoyle

4. General Site	Ice Conditions – Slip falls Ice Conditions – Adequate load bearing capacity Inadequate lighting Interaction with a Polar Bear Cold Whiteout conditions Emergency Procedures	3	2	5	Construct a working platform for outside of drill shack to store drill steel and allow the use of salt Use of traction aids on work boots will be required for work on ice surfaces. Apply salt to drill shack decks Engineered Assessment of minimum ice thickness as referenced in Attachment B for ice thickness required for the drilling operations and Attachment C for further guidelines regarding Ice Safety Place delineators in the snow marking access from the drilling location to the shoreline Existing Baffinland procedure “Safely Working On Fresh And Salt Water Ice” shall be followed Polar Bear Monitor will be available at all times Employees will have appropriate PPE including clothing available for safely working in -40 C and windy conditions Worksite location is approximately 300 meters from the shoreline. No work will be conducted in whiteout conditions and a safety shelter will be available immediately adjacent to the work area Site emergency procedures will be provided and reviewed at site	2	1	3	All Crew

5. Working around water and sea ice	Water may appear to be completely frozen over, but not enough to support persons Falling in water Equipment breaking through ice Workers unaware of potential dangerous conditions	5 5 4 3	1 1 2 1	6 6 6 4	Ice thickness to be assessed before walking on ice as per BIM Policy. Initial ice profiling will be conducted with an ice auger Floatation suit will be used for the initial ice profiling using an ice auger. Survival Bag (sleeping bag) will be available to reduce the risk of hyperthermia Follow the BIM Working On Ice Procedure (BAF-PH1-320-PRO-005, Rev 0, March 1, 2016) All workers will be required to complete the Alberta Working Safely on Ice Procedure online training	2	1	3	Marlon Coakley/Warren Hoyle
6. Drill testing for ice thickness	Water may appear to be completely frozen over, but not enough to support persons. Large ice cracks or crevices Falling in water Strains/Sprains Slipping on ice Drilling ice with power auger Changes in ice conditions	3	4	7	Traction aids will be used for any ice work Ice thickness to be assessed before walking on ice Floatation suits will be worn by workers while ice auguring, the worker is to be tethered to a primary rescue worker at a distance of 30m Snow must be removed at the hole location so ice can be examined for quality as described in the Ice field guide. Hand shovelling may be necessary If crevices/ cracks greater than 50% of the ice thickness are present, repairs must be made if there is risk of falling through ice into deep water	2	2	4	Warren Hoyle / Marlon Coakley

					Ice thickness for a person to walk on must be a minimum 13 cm. **STOP** all work if this condition is not met and return to shore. Be aware when using power ice auger that auger bit could bind or jam, have secure footing and grip on auger The ice auger hole spacing will be 20 m along the centreline access and the grid established in the designated work area. Secondary test holes will be augured at 10 m spacing within 250 m of the shoreline, if required based on the variable ice thickness Complete daily inspections of ice surfaces and record on ice log inspection sheet				
7. Access from Land to Sea Ice Snow removal equipment, drill rig and access vehicles are to be used for borehole access	Long distances to walk Exposure to cold White Out conditions Risk of falling under sea ice along the shoreline	4	1	5	Proper warm winter wear to be used Sat phones and digital radio use. Rig mats to be used to bridge over the fractured ice transition area if the transition between sea ice and shoreline needs leveling Buddy system is important to verify presence of frost bite or other cold related concerns **Vehicle operators and passengers are not to wear seat belts when working on ice**	1	1	2	All workers

8. Refueling of equipment	Fuel spills Regulatory or social impacts Spills into water bodies	3	2	5	Use of duck ponds with any refueling Have sufficient spill cleanup supplies on hand to respond to potential spills Maximize space between refueling vehicle	3	1	4	All workers
9. Extreme weather exposure when working outdoors or driving to and from the Borehole Location	Stranded work crew in white out conditions Cold emergencies or cold injuries Mechanical equipment failure	4	2	6	BIM has a procedure that is designed for white out conditions – it would be announced on the radio An emergency shelter to be used when in the Marine Drilling areas Emergency Shelter: Heated wooden shack (7’ 8” by 7’ 8”) set on platform with skis Crews to radio from Hatch leads Buddy system to watch out for fellow workers who may not realize they are developing frost bite Workers to dress in arctic gear and layered clothing Proper PPE required Equipment check list Review Tidal charts on a daily basis Workers to take warm up breaks to stay warm and alert At toolbox review weather forecast with crew and prepare accordingly	2	1	3	All workers

10. Chemical handling- No unusual chemicals other than equipment needs are anticipated to be used.	Spills, leaks Chemical splash Chemical exposure	2	2	4	All products to be stored in secondary containment MSDS to supplied to BIM for review MSDS books to be accessible at the work front MSDS training and WHMIS training completed before arriving to site PPE will be followed as per MSDS recommendations as will first aid and environmental responses Spills response training and supplies to be kept with the equipment	1	1	2	Boart Longyear
11. Waste management and Wildlife Encounters	Risk of wildlife encounters due to improper waste controls Regulatory non compliance	3	2	5	Crews will collect waste daily and transport it back to camp Crews will follow BIM waste management guidelines No placing or storing of food in the back of pickup trucks Secure all small tools and PPE as foxes may carry away small articles from the site	2	2	4	All workers
12. Ecological and Cultural sensitive areas	Risk of causing damage to archeological areas Destroying vegetation Sensitive wildlife and marine life areas Regulatory and reputation damage	3	3	6	Crews have been instructed that there will be **NO** entry to the area east of the sealift ramp Crews are not to build or alter any inukshuk's or other rock formations on the tundra Permits will be required for the work	2	2	4	All personnel

13. Assemble Drill on skid platform skid and construct four walls and roofs	General hazards associated with drill assembly Inadequate communication between Boart Longyear and Site Services / mobile equipment operators	2	2	4	FLRA to be complete by Boart Longyear supervisor prior to executing work Boart Longyear Drilling operations SOPs to be followed including Boart Longyear Procedure 4001	1	1	2	Warren Hoyle / Marlon Coakley
14. Auguring holes in ice for sonic drilling and CPT work	Large ice cracks or crevices Falling in water Strains/Sprains Slipping on ice Drilling ice with power auger Changes in ice conditions	3	3	6	Wear traction aids for any ice work PFDs to be worn by workers while ice auguring during the sonic drilling and CPT operations Snow must be removed at the hole location so ice can be examined for quality. Hand shovelling may be necessary Be aware when using power ice auger that auger bit could bind or jam, have secure footing and grip on auger Complete daily inspections of ice surfaces and record on ice log inspection sheet All holes must be marked using an orange spray paint Any hole in ice over 30 cm in diameter must have a physical barrier around the hole	3	2	5	
15. Working around rotating equipment	Entanglement injuries	3	2	5	All equipment guards to be in place and in good working condition No loose clothing or drawstrings that can get pulled into rotating equipment Long hair must be contained to prevent entanglement into rotating equipment	2	1	3	All workers

					If any maintenance is required then energy isolation procedures to be followed				
16. Isolation of energy sources	Potential energy release that causes injury	3	2	5	All crews will follow the BIM Zero Energy State (ZES) procedure Crews to be given the BIM ZES training on site and fully understand the BIM requirements	1	1	2	Boart Longyear Crews BIM H&S
17. Working on equipment	Slip and trip hazards around railings, stairs and uneven ground.	2	2	4	Rails are installed around deck and to be properly maintained in good condition Stairs to be used on equipment A head cage will be used to reduce chance of contact with the rotating head Estops to be in good working order and easily accessible FLRA to be completed daily to review hazards All crews will follow the BIM Zero Energy State (ZES) procedure	1	1	2	Boart Longyear crew
18. Ice monitoring during drilling activities	Excessive deflection in ice	4	3	7	Hatch geotechs crew will monitor ice conditions during drilling including cracks around the work area, monitor freeboard in drilled holes for signs of ice deflection	2	2	4	All crew

19. Spotter activities	Equipment could come in contact with Spotter	4	2	6	Spotter to maintain eye contact with driver Spotter to review FLRA Agreed hand signals to be used with drivers in conjunction with BIM spotter procedure Agreed hand signals will be documented on the FLRA Drivers to immediately stop if the Spotter is out of eye contact	1	1	2	Boart Longyear crew
20. Manual lifting	Pinch point, back injuries, muscle and joint sprains and strains	2	3	5	Work in pairs, FLRA reviews Work with a buddy on heavy or awkward lifts Use proper lifting techniques 100 pound pipes to be handled by two workers	1	1	2	All crew
21. Working with pressure systems	Pressurized water and hydraulic fluids are used on drill and support equipment	3	2	5	Pre operational inspection Follow all safe work procedures. ZES when maintenance is required.	1	1	2	Boart Longyear crew
22. Falling objects	Potential exists for falling of drill rod and casing falling from overhead	3	2	5	Rigging and slinging training required when working with suspended loads and overhead hazards Perform FLRA	1	1	2	Boart Longyear Hatch Geotec EHS techs
23. High noise and vibration areas on the rigs	Hearing damage	2	2	4	Hearing protection is required by use of ear plugs or muffs.	2	1	3	Boart Longyear Hatch Geotec EHS techs

24. Housekeeping	Potential exists for poor housekeeping causing slip/trips and other hazards	3	2	5	Daily site assessments and toolbox meetings by drillers and site supervisors BIM EHS techs to perform daily inspections	2	2	4	All Crew
25. Fatigue	Potential exists for crew fatigue	2	2	4	Fit for duty confirmation required for all employees, daily FLRA reviews Micro breaks to stretch Proper rest during off shift period	1	1	2	All Crew
26. Working at night or 24 hour darkness	Higher risk of injury due to poor visibility	3	3	6	Hi-vis work gear to be used Use of flashlight and headlamp Workers to stay within 10 meters (30 feet) of the worksites at any time Use of wobble lights and light tower Emergency shelter	1	1	2	All Crew
27. Hot work - welding	Fire risk Burn injuries Welders Flash	2	2	4	Hot work training Use of hot work permits and JHA for any Hot Work Fire Watch required Proper PPE Welding training required	1	1	2	Boart Longyear crew

28. Rescue Plan	Rough terrain Further injuries to casualty during transit. Snow storm, white out conditions. Darkness	3	3	6	The track unit will be used to pull the survival shack (survival shack is 7' 8" x 7' 8" square) on platform with skis. When an incident has occurred, the Geotechnical Engineer must call a Code 1. Provide first aid treatment to the injured person until MRT arrives on site MRT will be dispatched to the location. MRT will transport the casualty. Visibility (whiteout conditions) will hinder rescue time, rescuers will have to wait out the storm, or until the whiteout conditions have subsided.	2	2	4	Marlon Coakley/ Warren Hoyle
29. Cleanup and Demob	Unfrozen open holes Complacency	3	3	6	All drill holes must be filled in with water and snow upon completion of drilling operations A Hatch site representative will confirm safe conditions upon demob All debris must be removed from ice surface and disposed off site per waste management plan BIM safety and environment representatives to attend a post project closeout inspection to document the completion of the clean-up	2	2	4	Boart Longyear

Comments:

Baffinland

Baffinland Iron Mines Corporation - Mary River Project - ERP
Job Hazard Analysis Form

Score	CONSEQUENCE People	Plant	Environment
5 – Very High/ Catastrophic	Multiple Fatalities.	Greater than $10 Million Loss	Catastrophe, destruction of sensitive environment, worldwide attention. Likely EPA prosecution. More than 30 days delay.
4 – High/ Major	Fatality or Permanent Disabilities.	$1 Million to $10 Million Loss	Disaster, high levels of media attention, high cost of clean-up. Offsite environmental harm; more than 10 days delay.
3 – Moderate	Major Injuries – Incapacitations or requiring time of work.	$100 Thousand to $1 Million Loss	Major spills, onsite release, substantial environmental nuisance, more than 1day delay. (Leads to additional resources call out i.e. SES).
2 – Low/ Minor	Significant Injuries – Medical Treatments, non-permanent injury.	$10 Thousand to $100 Thousand Loss	Significant spills. (Leads to a call out of Site Emergency Response Group).
1 – Very Low/ Insignificant	Minor Injuries – First Aid Treatments (cuts/bruises).	Less than $10 Thousand Loss	Low environmental impact. Minor Spills less than 80 Litres.

Score	LIKELIHOOD
5 – Almost Certain	The event is expected to occur in most circumstances. Likely to occur frequently - More than 1 per year.
4 – Likely/ Probable	The event will probably occur in most circumstances. Likely to occur several times – 1 per year.
3 – Moderate/ Occasional	The event should occur at some time. Likely to occur at some time – 1 per 5 years.
2 – Remote/ Unlikely	The event could occur at some time. Unlikely but possible. 1 per 10 years.
1 – Rare/ Very Unlikely	The event may occur only in exceptional circumstances. Assumed it may not be experienced. 1 per 100 years.

Job Hazard Analysis Attendees: Darryl Finlay, Marlon Coakley, Warren Hoyle, Usman Khan, Alex Boissonneault

	Name	Signature	Date
Written by:	Marlon Coakley	Marlon Coakley	Mar 20/2017
Reviewed by:	Warren Hoyle (Hatch)	Warren Hoyle	March 20, 2017
	Darryl Finlay (BIM Safety Coordinator)		March 20, 2017

Risk Rating = Consequence + Likelihood

Consequence	Risk Rating				
5	6	7	8	9	10
4	5	6	7	8	9
3	4	5	6	7	8
2	3	4	5	6	7

Risk Rating - Definitions

Risk Rating	Definitions	Action Required
8 - 10	Intolerable	Task not to start till the risk is eliminated or reduced. Bring to the immediate attention of management. Formal assessment required. MUST reduce the risk as a matter of priority.
7	High	Bring to the immediate attention of management. Task not to start till the risk is eliminated or reduced. Further Assessment required. MUST reduce the risk as a matter of priority.
6	Significant Risk	Bring to the attention of supervision. Review risks and ensure that they are reduced to as low as reasonably practicable. To be dealt with as soon as possible, preferably before the task commences. Introduce some form of hardware to control risk.
5	Moderate Risk	Needs to be controlled but not necessarily immediately, an action plan to control the risk should be drawn up. Review effectiveness of controls. Ensure responsibilities for

								control are specified.
1	2	3	4	5	6	2-4	Low Risk	If practical reduce the risk. Ensure personnel are competent to do the task. Manage by routing procedure. Monitor for change
	1	2	3	4	5	**A JHA considers a variety of activities/tasks involved in a job scope and analyses the key hazards (sources of harm) and their consequences (types of harm) eg. Sources of harm – lifting a heavy pipe - manual handling. Types of harm – Back strain.**		
	Likelihood							

Main Points – On how to write a JHA.

1. Define the task – what is to be done.
2. Review previous JHA if any – have we done it before?
3. Identify the steps – what is to be done.
4. Identify the hazards of each step.
5. Identify who or what could be harmed.
6. Give the task a risk rating – Consequence + Frequency
7. Develop solutions to eliminate or control hazards in each step.
8. Review the risk rating after the control system has been implemented.
9. If risk rating unacceptable review the solutions till risk rating acceptable.
10. Agree who will implement the control system.
11. Document the JHA and discuss with the relevant personnel.

Hierarchy of Hazard Management – Control Measures

These steps outline what should be planned for when deciding what control measures are to be put in place. Whenever possible the highest step should be used first and then progress down the list.

1. Eliminate the hazard.
2. Substitution.
3. Reducing the frequency of a hazardous task.
4. Enclosing the hazard.
5. Additional procedures.
6. Additional supervision.
7. Additional training.
8. Instructions / information.
9. Some personal protective equipment.

Worker / Visitor review	Signature
Warren Hoyle	Warren Hoyle March 19/2017
Marlon Coakley	Marlon Coakley March 19/2017
Usman Khan	[signature]
Alex Boissonneault	[signature] March 19, 2017
Emile Beauchamp	Emile Beauchamp March 19/2017
Samuel Flynn	Sam Flynn March 19/2017
Ruben Gross	Ruben Gross MARCH 19/2017
Justin Gross	Justin Gross March 19/2017
Chris Entz	Chris Entz March 19/2017
Doug Roach	
Robbie Jordan	

Enclosed:

Attachment A – BIM Working on Ice Procedure
Attachment B – On Ice Platform for Geotechnical Drilling
Attachment C – Best Practice for Building and Working Safely on Ice Covers in Alberta
Attachment D – Ice Thickness Assessment
Attachment E – Ice Assessment Drawing

Appendix J
Geophysics Assessment

GEOPHYSICS GPR INTERNATIONAL INC.

GEOPHYSICAL INVESTIGATION FOR BAFFINLAND RAILWAY, MARY RIVER PROJECT, NUNAVUT

Prepared for:
Baffinland Iron Mines Corporation

Baffinland

Presented to:
HATCH

4342 Queen Street, Suite 500
Niagara Falls, Ontario
L2E 7J7

Geophysics GPR International Inc.
6741 Columbus Road, Unit 14
Mississauga (Ontario) L5T 2G9
Tel. : +1 905.696.0656
info@geophysicsgpr.com
June 2017 T-17001

Project T17001-Revision#006 **April 2018**

TABLE OF CONTENTS

Index of Figures

Index of Tables

List of Appendices

1 INTRODUCTION

Geophysics GPR International Inc. was requested by Hatch Ltd. to carry out a geophysical survey to aid in projection and planning of a proposed railway for the Mary River Project, Baffin Island, Nunavut.

The purpose of this investigation was to determine the depth to bedrock and to measure the thickness and extent of subsurface ice.

The seismic refraction and the ground penetrating radar (georadar) methods were applied to measure the depth to bedrock and the georadar method was applied to ice thickness measurements.

Data were collected from April 21st to May 2nd, 2017.

The investigation included the following:

1) Georadar mapping of subsurface ice at three sites approximately at Km 26, Km 47, and Km 76 along the proposed rail alignment.

2) Depth to bedrock measurements using the seismic refraction and georadar methods at seven sites in the limited access area ("Deviation area") of the proposed rail alignment (approximately from Km 63 to Km 68).

3) Depth to bedrock measurements using the seismic refraction method at the rail unloading area site at Milne Port.

4) Depth to bedrock measurements using the seismic refraction and georadar methods at the proposed rail alignment Km 4.5 site.

Figure 1 presents an overview map of the investigation area with the locations of the respective sites.

The following report describes the various aspects of the survey including field techniques, survey design, interpretation techniques, and finally an interpretation in the form of bedrock profiles and ice thickness maps.

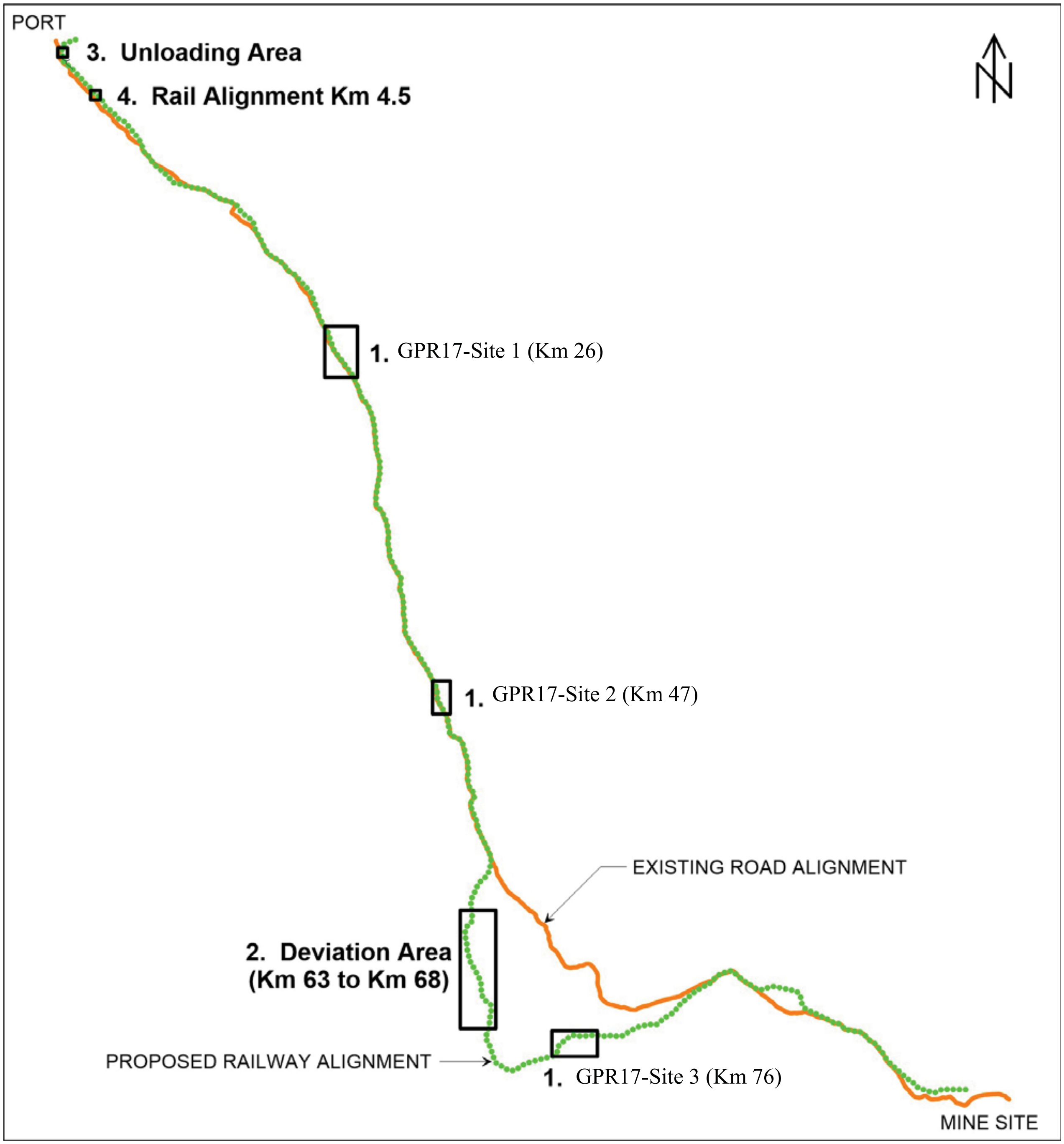


Figure 1: Overview map of the investigation area

2 METHODOLOGY

The Seismic Refraction and Georadar techniques were used for mapping the depth to bedrock. The Georadar method was used to determine ice thicknesses.

2.1 Positioning, Topography and Units of Measurement

The emplacement of the survey areas was determined by the client.

The locations of the georadar survey lines for the purpose of subsurface ice mapping were oriented to align with the design of the proposed railway. Length and number of the lines were chosen based on in-field interpretation of georadar data. Positioning was controlled by the GPS device integrated into the georadar antenna. The UTM coordinates should be accurate to within +/- 2.0 m.

Seismic data were collected along ten (10) profiles. Ground penetrating radar data for the purpose of bedrock mapping were collected along the seismic lines. Positioning was controlled by the georadar antenna built-in GPS and by a handheld GPS device. The beginning and end coordinates of the seismic lines are provided in Table 1.

Table 1: UTM coordinates of seismic lines

Area	Seismic Line	Start (0+00)		End (0+69)		Methodologies
		Easting	Northing	Easting	Northing	
Deviation Area	SL17-D1	527599.0	7919317.4	527599.9	7919386.2	Seismic, Radar
	SL17-D2	527857.7	7920710.1	527895.1	7920768.4	Seismic, Radar
	SL17-D3	527564.2	7922077.5	527527.9	7922137.9	Seismic, Radar
	SL17-D4	526825.1	7924354.0	526889.1	7924325.9	Seismic, Radar
	SL17-D5	526909.9	7924618.2	526929.1	7924684.4	Seismic, Radar
	SL17-D6	527259.7	7925605.9	527242.9	7925673.0	Seismic
	SL17-D7	527184.7	7925311.0	527207.9	7925376.7	Seismic, Radar
Unloading Area	SL17-M1	503783.5	7974922.0	503792.6	7974990.0	Seismic
	SL17-M2	503804.0	7974917.0	503816.1	7974985.0	Seismic
Km 4.5	SL17-R1	505743.6	7972485.5	505690.4	7972529.4	Seismic

The provided coordinates are NAD83/WGS84, UTM zone 17N.

The topography for the Unloading Area site has been estimated using field observations and borehole elevation data.

The depth measurements are noted as depth from surface.

All geophysical measurements were collected in SI units.

2.2 Ground Penetrating Radar (Georadar)

Basic Theory

Georadar utilises radar technology to obtain a near-continuous profile of the subsurface. The basic principle is to emit an electromagnetic impulse into the ground at a predetermined frequency rate (typically 10 to 80 scans/second). This pulse will travel through the sub-surface and reflect off boundaries of differing dielectric constants (contrasts of EM impedances). The reflected pulse returns to the surface and is recorded by a receiver and displayed in real-time as a cross-sectional image. Only by moving the antennas along a profile directly over the targets can the locations and depths be determined. Examples of radar reflecting boundaries include air/water (water table); water/earth (bathymetry); earth/metal, PVC, or concrete (pipe locating); and differing earth materials (stratigraphic profiles, including bedrock profiles).

The depth of investigation is controlled by the frequency and power of the antenna limited by attenuation and diffraction of the radar signal. Lower frequency antennas provide greater depth penetration at the expense of resolution. The radar signal is attenuated by conductive ground materials (e.g. clays, dissolved salts etc.). The radar signal is diffracted by irregular shaped material (e.g. boulders, debris etc.) that prevents the clear return of the reflected pulse.

More information on the georadar operating principle can be found in Appendix B.

Survey Design

The georadar data were collected with a MALA Ground Explorer system and 160 MHz antenna. This antennas is usually the most appropriate for resolution of stratigraphic layers at greater depths.

Positioning for the georadar survey was controlled by built-in GPS receiver.

For the bedrock mapping survey radar lines were collected along seismic profiles. Prior to data collection, test profiles were collected to determine the optimal time window and gain settings for the given subsurface conditions.

Interpretation Method

Processing of the radar images involved basic horizontal normalization, elevation corrections and gain adjustments.

The vertical scale on all radar images is a two-way time scale representing the time taken for a radar pulse to transmit to a reflector and back to the receiver. In order to convert the time scale to a depth scale a signal velocity must be applied. The velocity with which the pulse travels through the given material is determined by the dielectric constant. This dielectric will vary with the type of material.

Calculating a velocity can be done in many ways but the most reliable method is with a test pit or borehole where the real rock contact can be exposed. Based on in-situ measurements or borehole data, the dielectric value can be approximated depending on the expect material type. An underestimate of the dielectric will result in an over estimate of the signal velocity and in turn an over estimate of the depths. For this site a dielectric of 4 (velocity of 15 cm/ns) was assumed based on the expected soil type and tables of relative dielectric values for commonly encountered materials. In this case the materials were mostly frozen granular/boulders with high ice content. This velocity model showed good agreement with the borehole data and the estimated time-to-depth conversion error should not exceed 15% for this particular site.

Interpretation of the data is based primarily on the qualitative analysis of three characteristics of radar reflections: continuity, amplitude and shape. The interpreter then identifies reflectors and textures within the radar records that represent subsurface contacts, objects or zones. The true nature of the interpreted features can only be assumed without corroborating evidence.

Ice bodies have a distinctive appearance on radar images. Granular host material appears as “noise” on the images, whereas uniform ice layer looks transparent with clearly defined top and bottom contacts and can be confidently identified. An example of a uniform ice lens is presented in Figure 3.

Non-uniform ice bodies (stratified or containing layers of soil) are more challenging for interpretation since structure irregularities create multiple reflections within the ice body. Often a borehole is needed to confirm the presence of ice. Other features such as increasing depth of investigation in the presence of thick ice layer may corroborate the interpretation. Example of interpreted radar image illustrating the pattern created by non-uniform ice body is presented in Figure 4.

In summary, ability of georadar is limited by the structure of the ice layer being surveyed and its composition. The identification of an ice layer may be impacted by irregularities inside the ice body, such as layering, fractures and soil inclusions. However, it is possible to create two categories of ice lenses, the obvious and less obvious that may need some ground truthing.

2.3 Seismic Refraction

Basic Theory

The seismic refraction method relies on measuring the transit time of the wave that takes the shortest time to travel from the shot-point to each geophone. The fastest seismic waves are the compressional (P) or acoustic waves, where displaced particles oscillate in the direction of wave propagation. The energy that follows this first arrival (including reflected waves, transverse (S) waves and resonance) is not considered under routine seismic refraction interpretation. Figure 2 illustrates the basic operating principle for refraction surveys.

Survey Design

The seismic spread consisted of 24 vibration-monitoring devices (geophones) connected in line (spread) to a seismograph (ABEM Terraloc Mark 6). Spacing between geophones was 3 m for a total length of 69 m per spread. Seismic pulses (shots) were then generated at various locations with respect to the spread. Typically, six shots were executed per seismic spread: two shots on either side of the spread and two shots at a 'far' distance off either side of the spread (typically 45 m and 90 m). A sledgehammer was used as the primary energy source.

Interpretation Method and Accuracy of Results

Interpretation of the seismic data was primarily done using the Hawkins' method. The Hawkins' method allows the computation of the rock depth to every geophone. This method provides information on the thickness of the various overburden layers, depth to bedrock and rock quality. It is based on the closure times of the inner shots. It can calculate the true velocities of the rock using the apparent velocities, measured with information provided by the outer shots. A full description of the strengths and limitations of the refraction seismic method is presented in Appendix A. A basic description of the Hawkins' method can also be found in the article Seismic Refraction Surveys for Civil Engineering by L. Hawkins (1961).

The seismic refraction method typically allows the determination of the bedrock profile with a precision of 10% or better for depths greater than 10 m and a precision of 1 m for depths less than 10 m. The precision in the determination of rock velocities is plus or minus 3%. The vertical contacts (lateral velocity change), usually associated with faults and deep valleys, are generally accurate to within 5 m in width; although, this is somewhat site specific.

The two most significant problem areas for refraction mapping are the "hidden" layer and effect of velocity inversions. A "hidden" layer or "blind zone" is a stratigraphic layer that is not possible to discern from the arrival time data due to insufficient velocity variation or thickness. The unknown presence of a hidden layer has the effect of making the interpreted bedrock depth too shallow. The presence of a "hidden" layer is typically revealed through borehole or test-pit data and calculations can be made to compensate for the presence of such a layer. Without borehole or secondary bedrock depth information, it is not possible to predict the presence of a hidden layer.

Velocity inversions occur when the velocity does not increase with depth. The velocity inversion can result from the presence of a low or high velocity layer. Refractions from low-velocity layers cannot be determined from the arrival time data. The unknown presence of a low velocity layer has the effect of making the interpreted depths deeper than actual depths.

There is always the potential for "hidden" layers, although the likelihood is decreased for shallow sites. For this particular site the only possibility of velocity inversion is caused an unfrozen layer below permafrost, as the permafrost more easily transmits waves (~3000m/s) while the unfrozen layer transmits waves slower (1500-2000m/s). This results in a lower velocity after a higher velocity, resulting in the inversion.

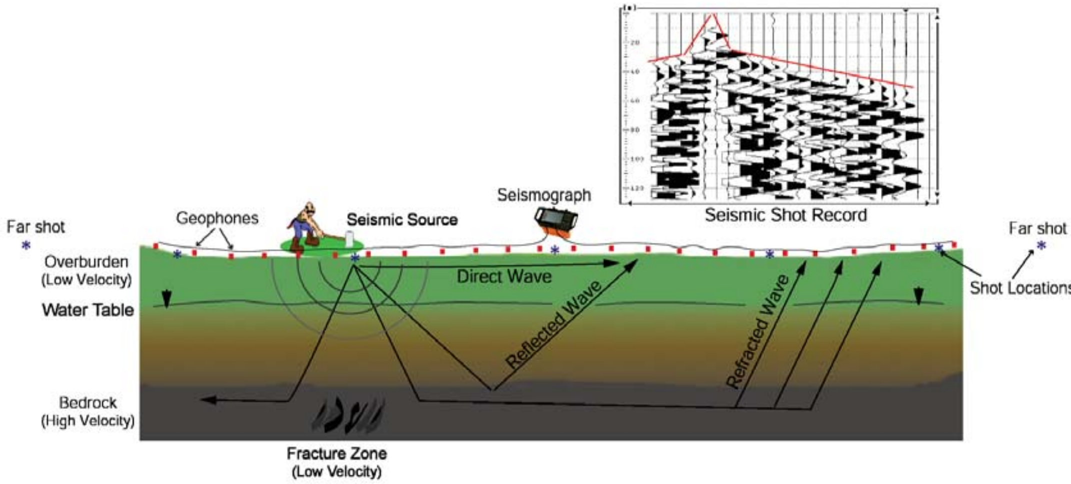


Figure 2: Seismic refraction operating principle

3 RESULTS

3.1 Subsurface Ice Mapping

Georadar data were collected at three sites approximately at Km 26, Km 47, and Km 76 along the proposed rail alignment.

Locations of the survey lines and results of the georadar survey are presented in drawings T17001-A2-1, T17001-A2-2, and T17001-A2-3.

GPR17-Site 1 (Km 26)

A long line 3300 m in length was collected from borehole BH16-R013 to borehole BH17-C004 to delineate potential ice bodies along the proposed rail alignment. The length of the line was chosen based on the borehole information. Eleven cut lines from 130 m to 410 m long were then collected to map ice extents east of the proposed railway. Scanning involved on-site data interpretation and length of the cut lines was controlled by the operator. Locations of the survey lines and results of the survey are presented in Drawing T17001-A2-1.

Distinct subsurface ice bodies were easy interpretable from the georadar images. Uniform ice was identified as a lens-shaped body with little to no signal return (reflection) from within its boundaries. Five separate ice formations were interpreted from the georadar data collected at GPR17-Site 1. Example georadar image showing a typical ice body is presented in Figure 3. The presented line is crossing interpreted ice lens #1 in NW–SE direction.

Drawing T17001-A2-1 provides ice thickness maps for each interpreted ice formation. Top of the ice layers was interpreted to be at a depth range of 1.5 m to 4 m. Ice extends to a maximum depth of 19.5 m below grade.

GPR17-Site 2 (Km 47)

The design of the survey was in general the same as at GPR17-Site 1. First a 1950 m long line was collected along the rail alignment passing the boreholes locations where the ground ice was encountered. Then eight cut lines from 80 m to 420 m long were collected to map ice extents east of the proposed railway. Locations of the survey lines and results of the survey are presented in Drawing T17001-A2-2.

Two ice formations were identified within the georadar data collected at GPR17-Site 2. The ice bodies on the georadar images were less well defined comparing to the data set at GPR17-Site 1. The interpretation was complicated by layered (stratified) ice structure that creates multiple reflections within the ice body. An example georadar image showing a fragment of ice body #2 is presented in Figure 4. The line crosses interpreted ice lens #2 in NW–SE direction. Borehole BH16-C011 is located at chainage 155 m of the presented line.

Drawing T17001-A2-2 provides ice thickness maps for each interpreted ice formation. Top of the ice layers was interpreted to be at a depth range of 1.1 m to 9.4 m. Ice extends to a maximum depth of 20.1 m below grade.

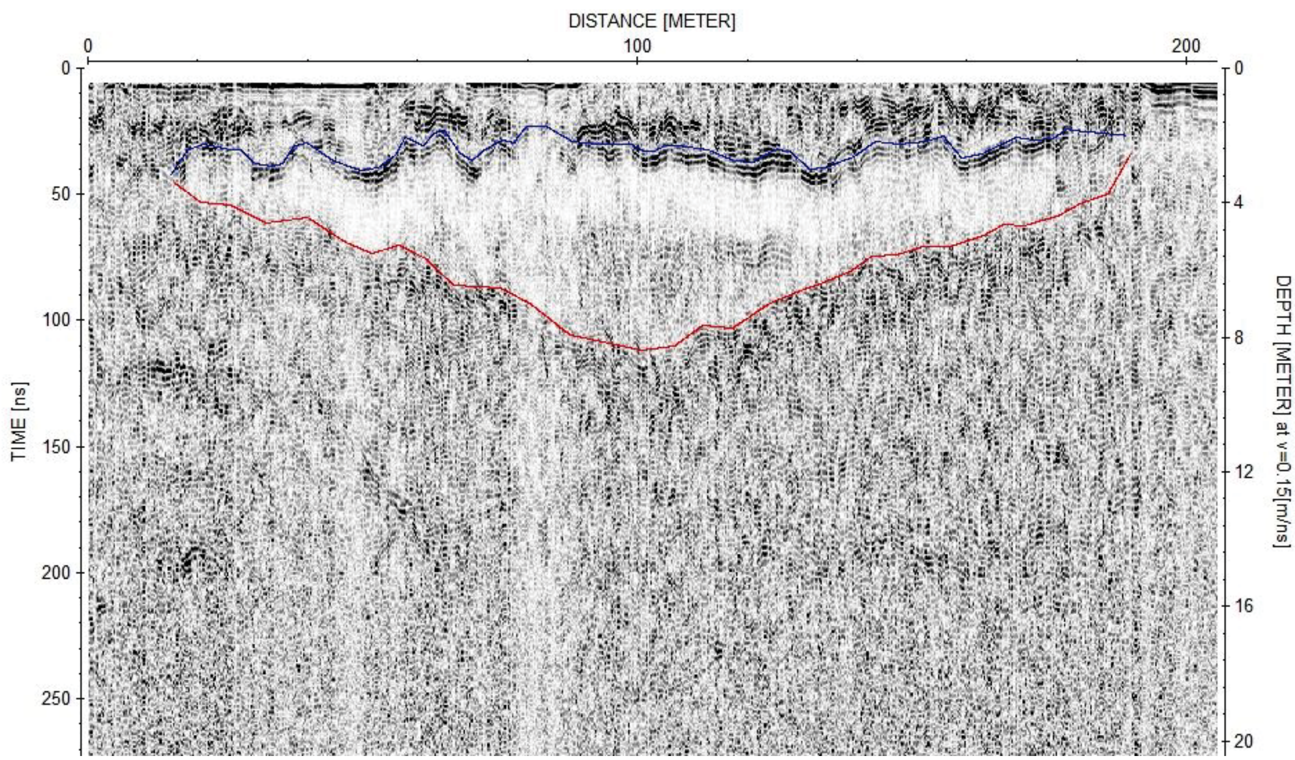


Figure 3: Interpreted georadar image showing a typical ice body at GPR17-Site 1

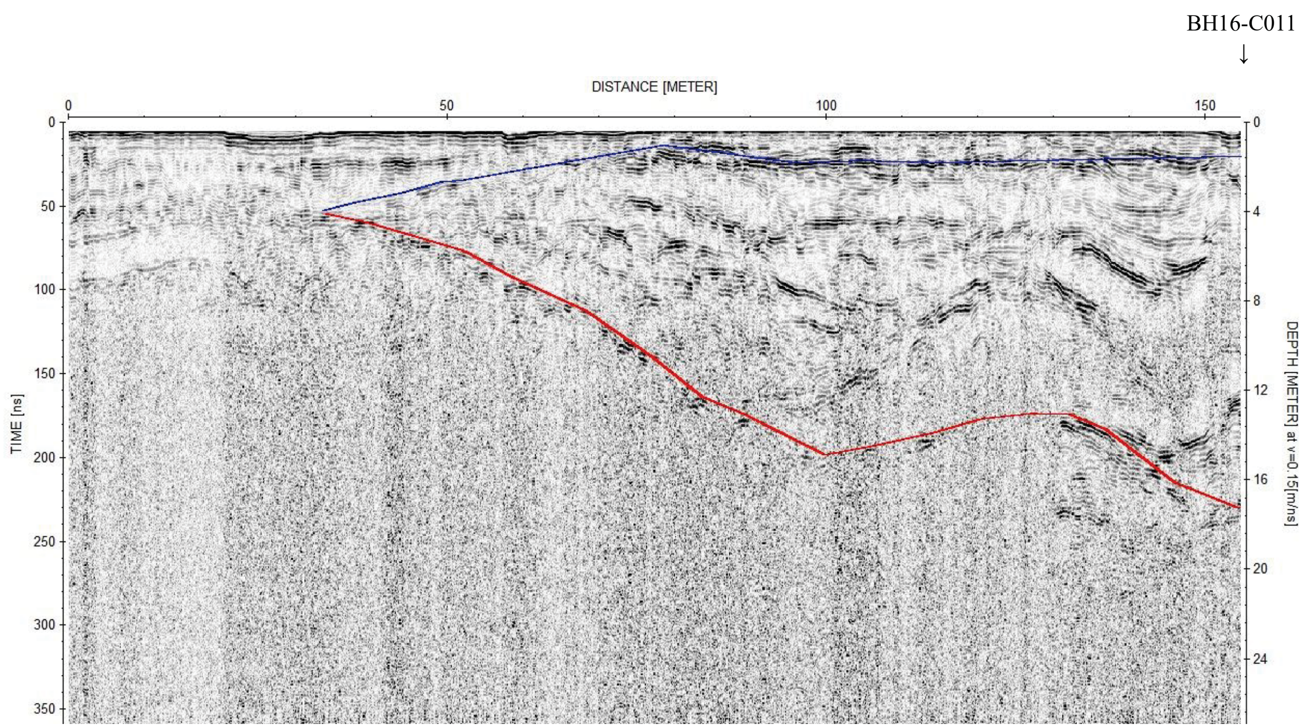


Figure 4: Interpreted georadar image showing a fragment of ice body # 2 at GPR17-Site 2.

GPR17-Site 3 (Km 76)

No large ice bodies were found within the geotechnical boreholes at this site, however, some ground ice and individual ice inclusions were encountered. A 3150 m long line was collected along the rail alignment from borehole BH17-C011 to borehole BH17-C013. Two ice lenses were identified within the data collected between boreholes BH17-C011 and BH17-C012. Two cut lines 460 m and 500 m long were then collected to map ice extents east and west of the proposed railway.

Locations of the survey lines and results of the survey including ice thickness maps for each interpreted ice formation are presented in Drawing T17001-A2-3. Of the two lenses interpreted from the georadar images at GPR17-Site 3 lens #1 was clearly identified as an ice body, whereas lens #2 was interpreted with a lesser level of confidence. The pattern on the radar images of the supposed ice lens #2 was similar to that observed at GPR17-Site 2, however, there is no borehole data to confirm that this formation contains ice.

Top of the ice layers was interpreted to be at a depth range of 1.2 m to 4.9 m. Ice extends to a maximum depth of 9.4 m below grade.

3.2 Deviation Area Bedrock Depth Mapping

A total of 7 sites were investigated at the Deviation Area of the proposed rail alignment. Initially it was presumed that the depth to bedrock should not exceed 10 meters and the survey methodology was chosen to ensure the depth of investigation approximately 20 meters below grade. The interpretation of the data proved that at 4 sites top of bedrock was deeper than the maximum investigation depth of the applied refraction technique.

Analysis of the complete data set collected for this project showed that the general compressional (P) wave velocity model consists of three layers.

The upper layer, with a velocity range of 1200 m/s to 3000 m/s, is interpreted as frozen active layer of overburden (layer with lower ice content). This layer extends from surface to a maximum depth of approximately 3.5 m below grade.

The second layer, with a velocity range of 3700 m/s to 5000 m/s, is interpreted as permafrost overburden. Higher velocity values for this layer imply higher boulder content.

The third layer, with a velocity range of 4700 m/s to 5900 m/s, is interpreted as bedrock. According to geotechnical investigation report provided by the client, from Km 0 approximately to Km 40 of the proposed railway the bedrock is granitic gneiss and from Km 40 to Km 90 the bedrock is limestone. Average measured P-wave velocities were approximately the same for both types of bedrock, with slightly lower values for limestone bedrock.

As it might be seen, there is an overlap in observed velocity ranges for permafrost overburden and bedrock complicating the interpretation of the refraction data and providing additional source of error. To help the interpretation two refraction lines at two different test sites with known bedrock depth were acquired. Test #1 was done above bedrock outcrop with less than 1 m to 1.5 m of overburden and test #2 was done at a borehole location with bedrock 5 to 7 m deep. The second test showed velocity range from 3500 m/s to 4000 m/s for permafrost overburden and both test showed velocity of 5700 m/s for limestone bedrock.

Interpretation of the Deviation area data set was done following these general considerations:

- The three-layer model described above. According to borehole data, the permafrost extends to a considerable depth and probability of a velocity inversion is low.
- The overburden permafrost velocities should not be at a higher end of the observed velocity range (4500 to 5000 m/s) as these values were only observed at sites close to the Milne Port with visibly higher large-size gneiss boulder content on the surface. The average permafrost overburden velocity measured at Deviation area sites was 3900 m/s.
- Velocities higher than 5000 m/s are expected for limestone bedrock.

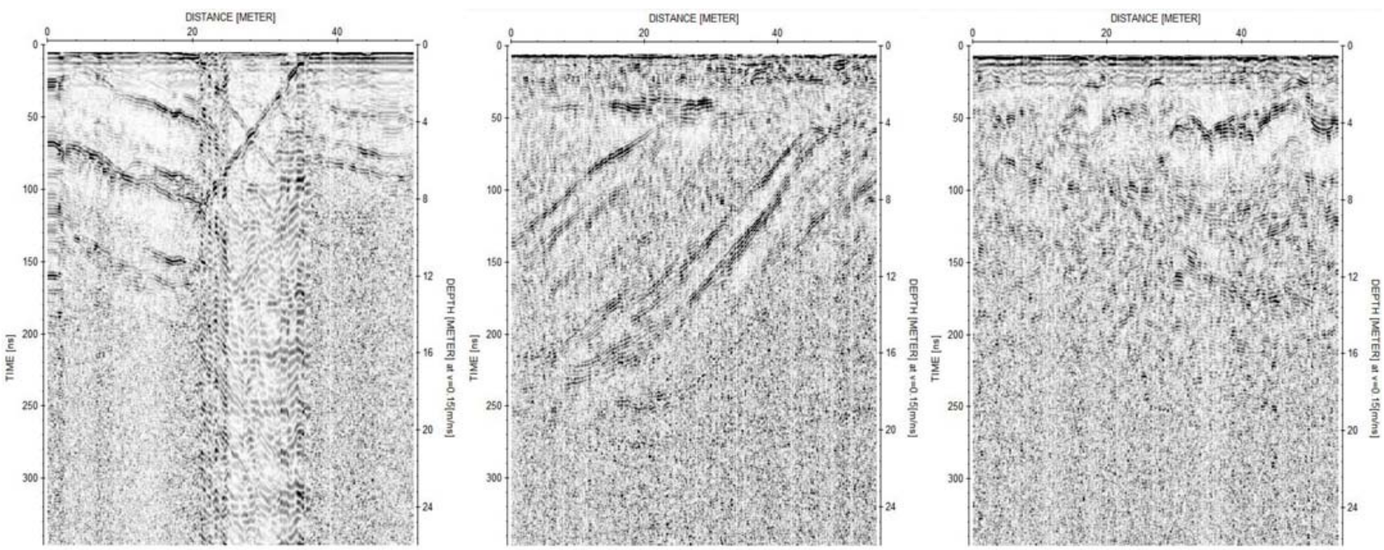
The radar data was also used in the refraction data interpretation. Analysis of the radar data collected at the Deviation area sites as well as at Km 47 showed that the limestone bedrock have a distinct pattern on the georadar images. It could be described as “parallel layering” appearing at the images as a series of parallel reflections. Figure 5 provides examples of georadar images showing limestone bedrock.

Locations of the survey lines and results of the survey are presented in Drawing T17001-A2-4. The drawing presents P-wave velocity models based on refraction data.

Bedrock was identified at 3 sites. At sites 1 and 6 bedrock depth ranged from 21 m to 26 m. At Site 6 (SL17-D6) depth to bedrock was calculated approximately as the interface was too deep to perform full reciprocal time analysis.

At Site 4 (SL17-D4) a shallow interface was interpreted with the layer velocity of 4700 m/s, which is borderline between permafrost overburden and bedrock. This interface was interpreted as bedrock contact as the georadar image taken at line SL17-D4 was the only one of the seven lines in the Deviation area which had the clear “parallel layering” pattern characteristic to limestone (Figure 5).

At sites 2, 3, 5, and 7 there was no indication of bedrock refraction on seismic records. Some calculations using the above described velocity model show that the bedrock at these locations should be more than 20 m deep.



Test Site #1 (outcropping bedrock) SL17-D4 SL17-D3

Figure 5: Example georadar images at Test Site #1 and SL17-D4 showing "parallel layering" pattern typical for limestone bedrock. Image SL17-D3 is typical for sites with deep bedrock contact.

3.3 Rail Unloading Area Bedrock Depth Mapping

Two seismic refraction lines were performed at the Rail Unloading Area to determine depth to bedrock. The seismic spreads were oriented perpendicular to the actual line of interest (which was the line from borehole BH16-M008 to borehole BH16-M007) due to a busy road crossing the line. Thus, depth to bedrock was determined at two points along the line of interest.

Position of the seismic lines and results of the survey in the form of bedrock profiles are presented in Drawing T17001-A3-1.

Three-layer velocity model described above was used for the interpretation. The upper layer, with a velocity range of 1800 m/s to 3000 m/s, extends from surface to a maximum depth of approximately 2.4 m below grade. The second layer interpreted as permafrost overburden has a velocity of 4300 m/s.

True bedrock P-wave velocities ranged from 5800 to 5900 m/s. Based on the refraction interpretation, the bedrock depth ranged approximately from 12 m to 19 m below grade for line SL17-M1, and approximately from 10.5 m to 12 m below grade for line SL17-M2.

The calculated depth to bedrock at intersections of the seismic profiles with the line of interest is 12.0 m for SL17-M1 and 10.9 m for SL17-M2. It should be noted that these values are not vertical distances from points on surface to bedrock interface, but rather shortest distances which will be different from vertical distances in case of dipping bedrock interface.

3.4 Bedrock Depth Mapping at Proposed Rail Alignment Km 4.5

One seismic refraction line and seven georadar lines were performed at the Proposed Rail Alignment Km 4.5 site for the purpose of bedrock depth mapping.

Position of the survey lines and results of the survey in the form of seismic velocity model and bedrock depth map are presented in Drawing T17001-A3-2.

Seismic refraction interpretation utilized the three-layer velocity model described above. The calculated bedrock depth ranged from 5.0 m to 6.5 m below grade.

Seven georadar lines from 50 m to 85 m long were collected with distance between lines ranging from 20 m to 40 m. Although bedrock contact was not always clearly apparent on the georadar images, corroboration of the georadar data by seismic refraction results allowed to identify bedrock reflection with higher level of confidence. Interpreted example georadar image taken at RL-4 can be seen in Drawing T17001-A3-2.

The interpreted bedrock depth from combined seismic and georadar data sets ranged from 3.0 m to 7.5 m below grade.

4 CONCLUSIONS

A geophysical investigation involving seismic and georadar methodologies was carried out at the Mary River Project, Baffin Island, Nunavut.

The seismic refraction and georadar methods were applied to measure the depth to bedrock and the georadar method was applied to ice thickness measurements.

Subsurface ice mapping was carried out at three sites along the proposed rail alignment. Results of the survey are presented in Drawings T17001-A2-1, T17001-A2-2, and T17001-A2-3 as ice layer extent and thickness maps. Overall georadar data quality was excellent. The subsurface ice was easily identifiable on most of the lines. Total of 9 lens-shaped ice bodies have been delineated. It is possible that these bodies have a high ice percentage. If there are formations with lower ice content and the ice presence is masked by the sand and gravel content it is not certain they can be delineated. However, with some ground truthing through boreholes it may be possible to create a second catagory of ice lense.

Bedrock depth mapping at the Deviation area of the rail alignment using seismic refraction and georadar methods proved the bedrock contact to be deeper than 20 m at all of the investigated sites with the exception of Site 4 (SL17-D4). The bedrock depths at Site 4 ranged from 2.5 m to 3.5 m below grade. Results of the survey are presented in Drawing T17001-A2-4 in form of P-wave velocity models.

Two seismic refraction lines were performed at the Rail Unloading Area to determine depth to bedrock between boreholes BH16-M008 and BH16-M007. Results of the survey in the form of bedrock profiles are presented in Drawing T17001-A3-1.

One seismic refraction line and series of parallel georadar lines were performed at the Proposed Rail Alignment Km 4.5 site to map bedrock depth. Results of the survey in the form of seismic velocity model and bedrock depth map are presented in Drawing T17001-A3-2. The interpreted bedrock depth from combined seismic and georadar data sets ranged from 3.0 m to 7.5 m below grade.

Interpretation of the geophysical data has been performed by Ilia Gusakov, GIT. This report has been written by Milan Situm, P.Geo.

Milan Situm

PROFESSIONAL GEOSCIENTIST
MILAN SITUM
PRACTISING MEMBER
0237
ONTARIO

Milan Situm, P.Geo.

Manager

APPENDIX A

Seismic Equipment and Methodology Fact Sheets

TERRALOC MK6 FEATURES

Great features in a small seismograph

The Terraloc mark 6 is a high resolution multi-channel seismograph with an 18-bit A/D converter and 3-bit instantaneous floating point (IFP) amplifier. Overall resolution is thus 21 bits. Its dynamic range, 126 dB, eliminates all gain setting hassles and satisfies the most stringent shallow reflection requirements.

7,8" full colour daylight-visible backlit display with VGA resolution
Armoured glass LCD protection
Sealed, Rugged aluminium case protects against weather and rough handling
sealed 1.44 MB 3.5" floppy drive
Numeric keyboard
Command keyboard

Added Terraloc advantages:

Great for tomography thanks to high sampling rates starting at 25 µs.

Usable with various energy sources (even mini-vabrators) thanks to long record lenghts, auxiliary source signature channel input and built-in correlation software.

provides sophisticated automation. Aversatile digital (TTL) interface (trigger IN/OUT,arming IN/OUT signals) makes it easy to connect several Terralocs and supports handshaking with vibrators and marine seismic energy sources.

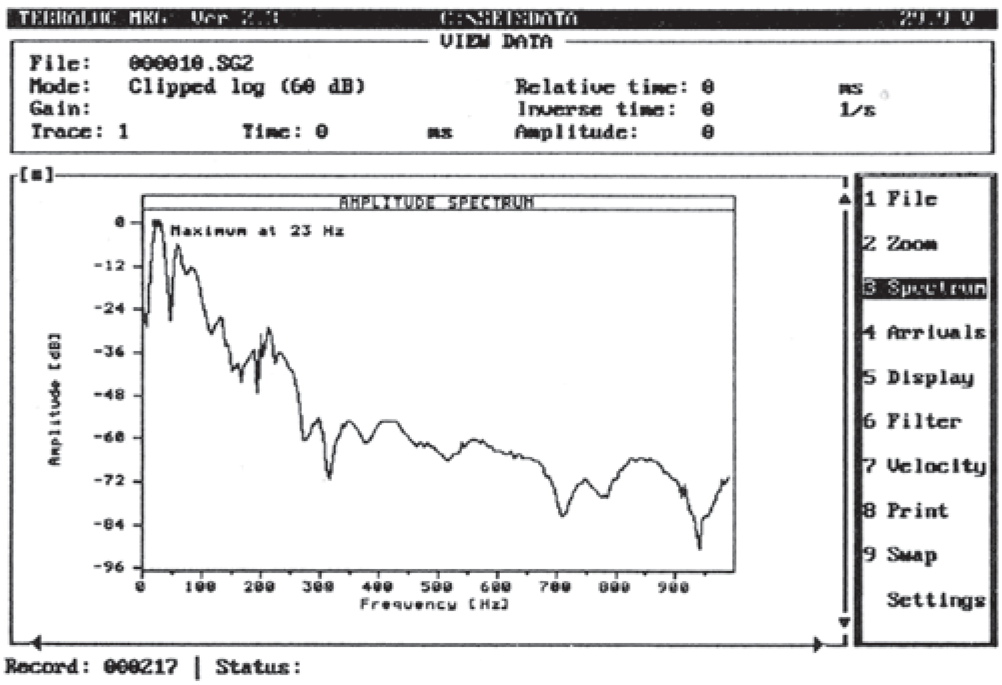
Ideal for refraction as well as shallow reflection seismics thanks to built-in roll-along function and a broad spectrum of analog and digital filters

In-field quality control. On-site geophone testing, cable testing and noise monitoring. Wide choice of multi- or single-trace view modes and frequency spectrum analysis (FFT)

Powerful computer

Fully compatible with your office computer thanks to MS-DOS 6.0 or higher, an internal hard disk, a built-in 1.44mb floppy disk, and compliance with the international SEG-2 format for storing of seismic traces and header information.

Interpretation software can be installed and run right in your Terraloc field unit.



Spectrum analysis helps you select the right filter, and it can also reveal soil properties

Lightweight and easy to use

The compact, lightweight Terraloc mark6 weighs only 16kg (24-channel version) and is less than half the size of its predecessor the popular Terraloc mark 3.

Carefully prepared, logically arranged documentation includes a copies of the operators manual (one for the field, and one to keep in the office), a user's manual for the computer , a complete description of the SEG-2 format and a service manual loaded with detailed technical information and schematics. Also included are a DOS manual and practice records to get you started.

Broad range of viewing provisions.

Scroll through records
Change display settings as desired
Select different time-scales
Select display mode
Select trace mode
Select AGC window length and set time and amplitude scale factors
Analyse single-trace frequency content (FFT)
Calculate refractor velocities
Analyse ground noise
Re-Scale traces individually
Create a geophone test report
Enlarge traces individually (Zoom)

Broad Printer support

The terraloc mark 6 supports a wide range of printers through dynamic link libraries (DLLs) via either the parallel or serial port and new printers can be added easily if required in the future.

Roll-along optimum offset

You can type in numerical values for roll-along start-trace, end-trace and step, you can roll along part of your receiver spread a step at a time . This feature is used in reflection surveys that include CDP stacking.

Expand your system

Two or more Mark 6's can easily be linked together to form a larger system. The print-out below is from a 96channel survey in which four 24-channel Terraloc's were connected

Technical Specifications for the Terraloc

- Number of channels (smaller unit)................. 4-24 in steps of 4
- Number of channels (larger unit).................... 4-48 in steps of 4
- Additional channels....................................... Easily obtained by linking two or more units together
- Up-hole channel.. Yes
- Sampling rate (selectable).............................. 25, 50, 100, 200, 500,1000 & 2000 µs
- Record length (selectable).............................. 128, 256, 512, 1024, 2048,4096, 8192 or 16384 samples per trace equivalent to: 3.2 ms - 32.7 s
- Pre-trig record (selectable)............................. 0-100 % of record length
- Pre stack correlation..................................... Yes, cross correlation with reference or any other channel
- Delay time .... Related to sampling rate May be set (for example) from: 0-0.8 s at 25 ps ,sampling rate 0-131 s at 2 ms sampling rate
- Stacking.. 32 bits, up to 999 impacts
- Unstack.. Remove last shot from stack
- First-arrivals picking.................................... Automatic or manual. Times can be saved with record
- Trigger inputs.. Trigger coil, make/brake, geophone, TTL
- A/D converter resolution.............................. 21 bits (18 bits plus 3-bit IFP)
- Dynamic range (theoretical/measured).......... 126 / 114 dB
- Max input signal... 500 mV p-p
- Frequency range.. 1 - 4000 Hz (at 25 ps sampling rate)
- Total harmonic distortion............................. - 80 dB
- Crosstalk... - 86 dB
- Input impedance.. 3 k
- Noise monitor.. Amplitude or full waveform display available on-line

Analog filters

- Low cut (selectable)... 12 or 24 dB/octave 16 steps from 12 to 240 Hz
- Notch.. 50 or 60 Hz specify when ordering
- Anti-aliasing.. set automatically based on sampling rate

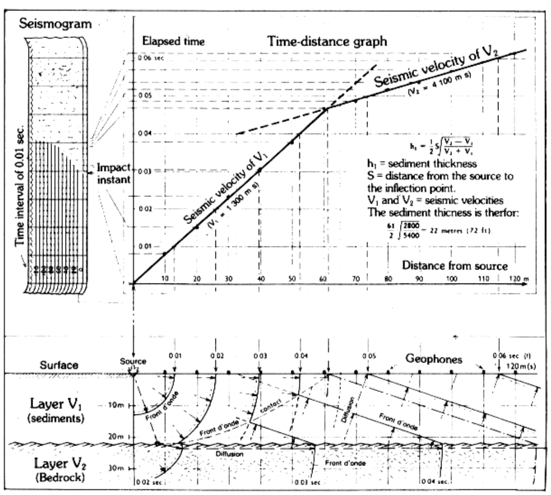
Digital filters

- Bandpass, low-cut, high-cut, bandreject, alpha-beta and remove DC offset Spectrum analysis...... Any single trace

SEISMIC REFRACTION

Seismic refraction consists of recording the length of time taken for an artificially provoked surface vibration to propagate through the earth. By processing the data, the seismic velocities and depths of the underlying rock layers can be determined. These velocities are characteristic of the nature and quality of the bedrock; a fissured, fractured or sheared rock will be characterized by reduced seismic velocities.

The method is generally used to obtain a better geological analysis of the sub-surface and to determine the following characteristics: the quality, profile and depth of bedrock, its nature, degree of alteration and any other physical contrasts. Seismic refraction ensures that maximum information may be gained from geological field work, and that direct investment costs (drilling, excavation), will be reduced.



PRINCIPLE OF SEISMIC REFRACTION

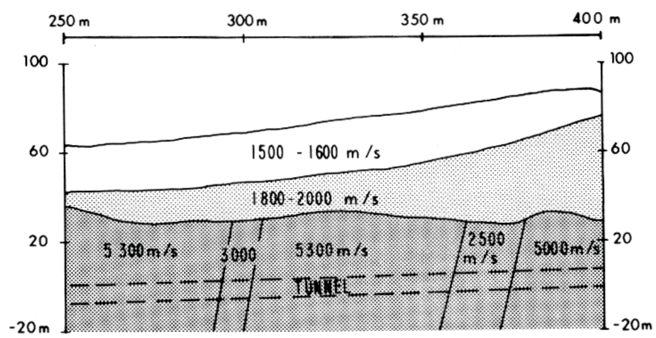
FEATURES

- Precise determination of soil thickness .
- Precise determination of the seismic velocities (rock type and quality).
- Localization and identification of geological units.
- Detailed analysis of soil.
- Year-round use.
- Sea and land surveys (above and below ground).
- Great accessibility possible to rough terrain and remote regions.

AREAS OF APPLICATION

Civil Engineering/Mining Exploration - Exploitation/Petroleum and Gas Sectors/ Geotechnology/Geology/ Hydrology.

- Identification of faults, fractures, shear zones.
- Detection of rock differences (veins, dykes, cavities, etc.).
- Determination of rock topography.
- Evaluation of volume of soil present or to be excavated.
- Excellent complement to geological mapping.
- Recognition of geophysical anomalies such as VLF, gravimetry, etc.
- Drill site selection, better target identification.
- Evaluation of the size, thickness and condition of surface shafts (mining exploitation).
- Mass Rock Quality Determination (MRQD).
- Detection of rock irregularities and breaks.
- Hydrogeology (detection of water tables, veins, reservoirs).
- Excellent complement to any geological analysis.



Interpretation results of a seismic profile

ADDITIONAL REMARKS

Geophysics GPR International Inc. has been recognized for the past fifteen years as a leader in both the application and the development of seismic methods. Seismic refraction is currently used in both civil and mining engineering; the use of lighter high-performance equipment and better tomographical interpretation of the results have contributed to its growing popularity.

GEOPHYSICS G P R INTERNATIONAL INC.

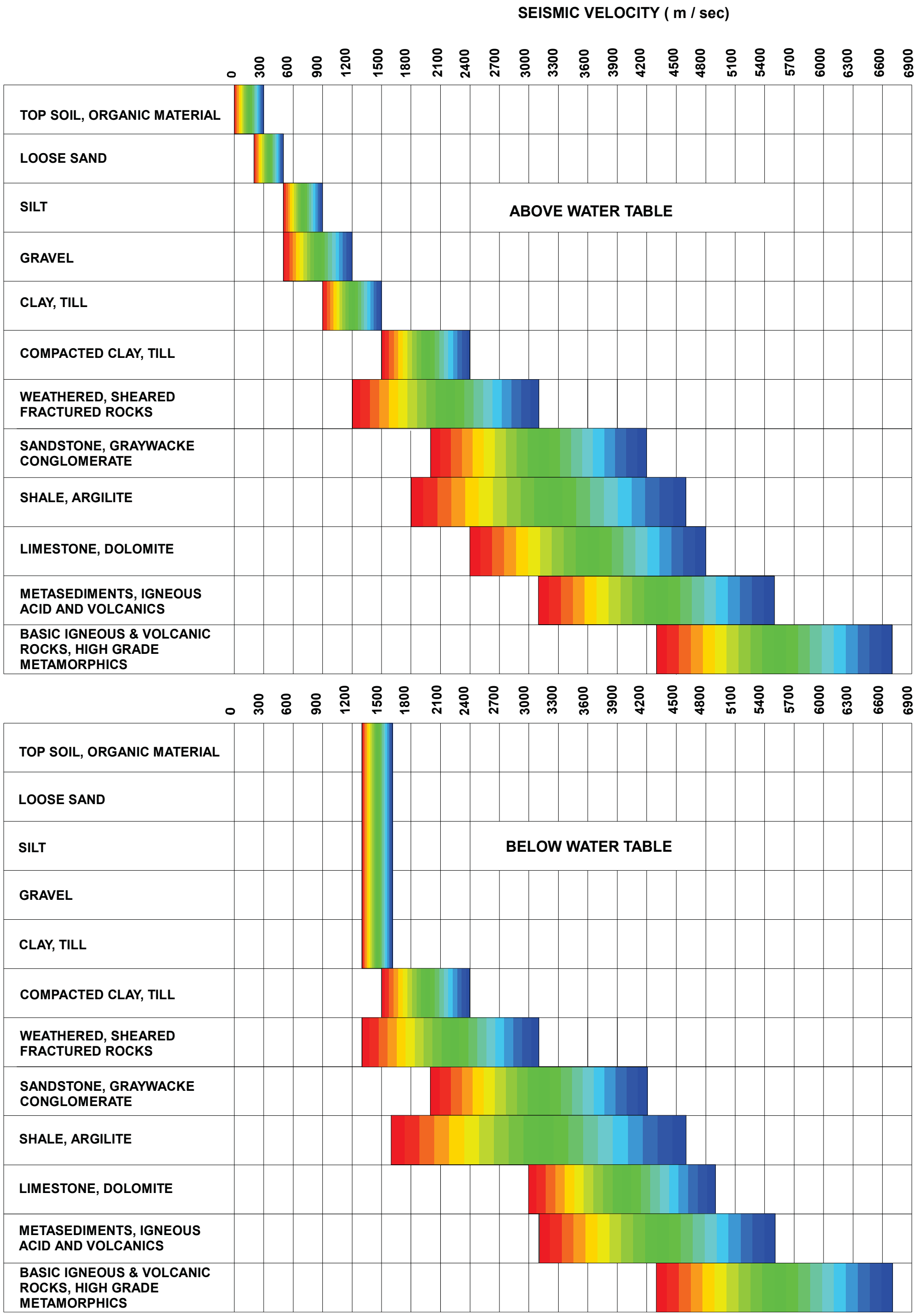


Figure 6: Classification of Geological Materials by Seismic Velocities

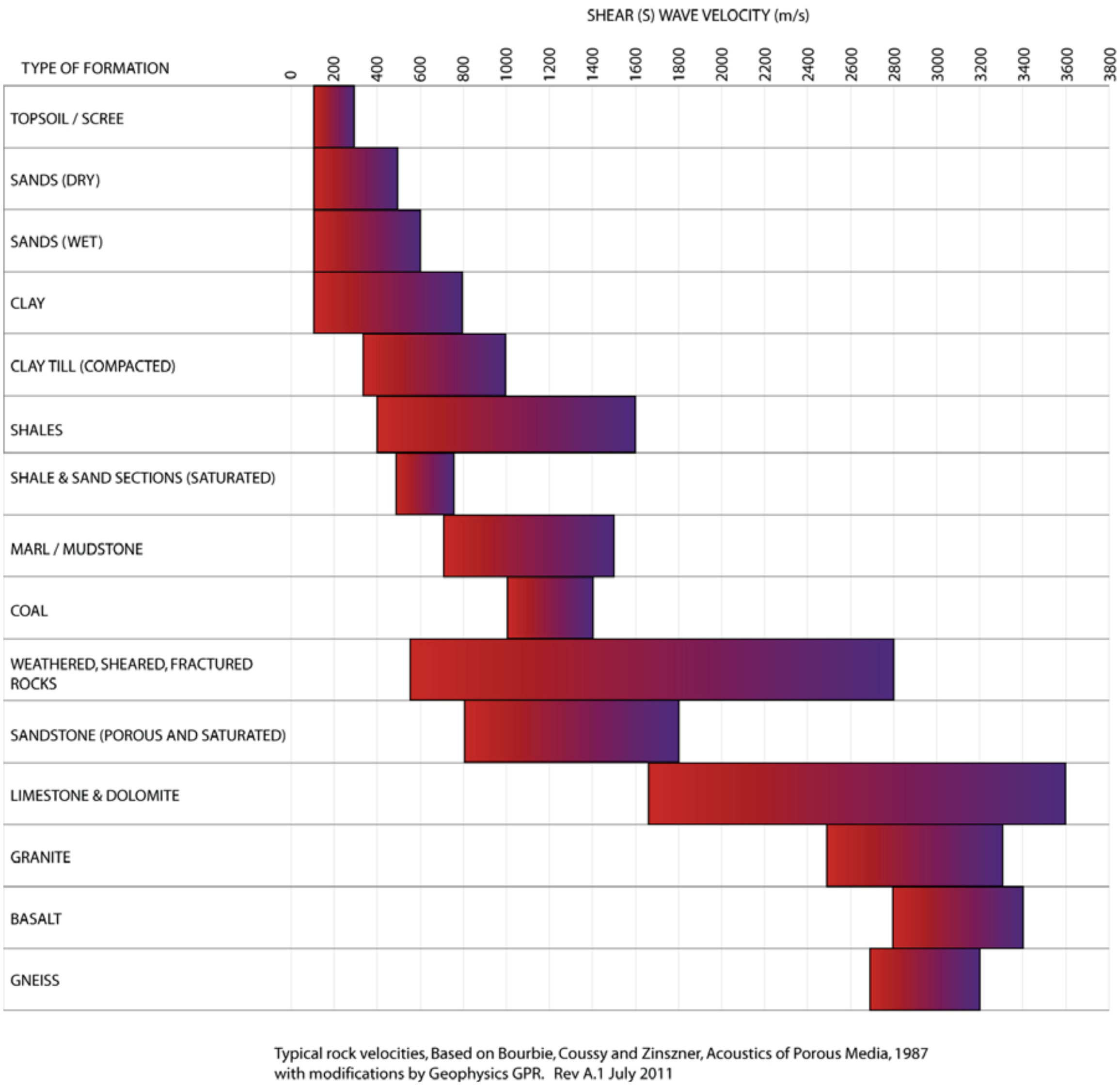
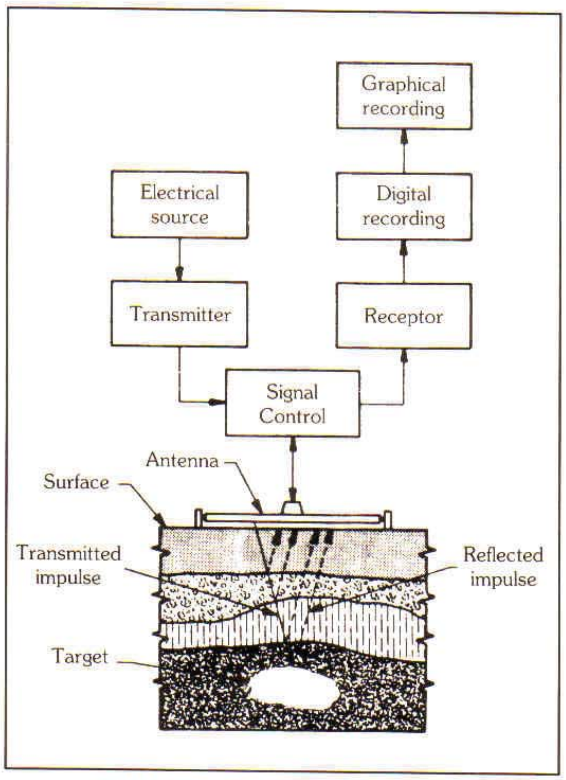


Figure 7: S-wave velocities for given materials

GEORADAR

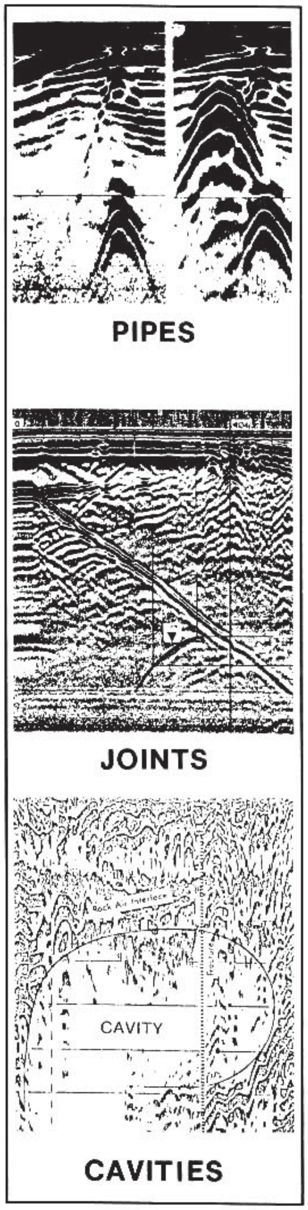
As indicated by its name, georadar combines high resolution radar with geology. The underlying principle is based on the propagation of electromagnetic wave impulses (VHF) that are reflected by anomalies in the terrain (joints, irregularities, interfaces, etc.) at different depths, and then captured by the antenna. The georadar records the time taken by each transmitted signal to complete the cycle in order to calculate the depth of the anomaly. The result is similar to a seismic reflection profile where all the reflections are displayed graphically. This technique is used to solve problems for which there had previously been no practical solution.



PRINCIPLES OF GEORADAR

FEATURES

- Penetration of more than 20 metres in certain materials (penetration being inversely proportional to conductivity).
- Surveying in continuous mode.
- Identification of objects measuring only a few centimeters.
- Light and manoeuvrable equipment.
- Detection of conductivity, open spaces and/or holes (cavities).
- Detection of breaks: faults, fractures, joints, cavities.
- Results similar to seismic reflection: continuous underground profile.
- Results available immediately.
- Can be used in land, sea or airborne surveys.



FIELDS OF APPLICATION

Civil Engineering / Mining Exploration-Exploitation / Research / Archaeology / Environment

- Geotechnology: investigation of soils and surface deposits.
- Optimal selection of anchor bolts in mines and quarries.
- Detection of buried pipes before beginning excavation.
- Detection of liquid or gas leakage in soils.
- Detection of cracks in concrete structures.
- Checking material homogeneity.
- Detection of cavities beneath road pavement.
- Determination of water saturation level.
- Detection of girders in reinforced concrete.
- Detection of pollutant leakage in water bodies.
- Inspection of buried disposal sites and or dangerous deposits.
- Continuous measurement of ice thickness.
- Archaeological research: ancient foundations, artifacts.
- Non-destructive method for measuring road pavement thickness.
- Localization and measurement of soil's thickness (swamps, peat bogs).
- Determination of rock beddings (location and thickness).
- Bathymetric studies (depth sounding).
- Calculation of the thickness of permafrost and ice.
- Geotechnical studies for the installation of aqueducts.

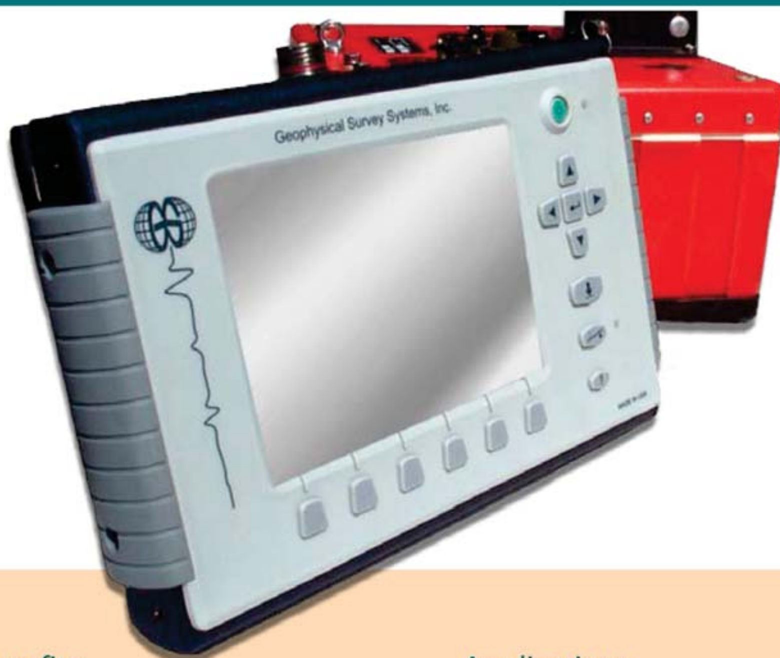
SPECIAL FEATURES

The equipment is practical, easy to manoeuvre, and multi-faceted. The field of application of georadar continues to expand in various sectors, particularly in geotechnology (aqueducts), civil engineering (excavation, structures) and mining (structures).

GEOPHYSICS G P R INTERNATIONAL INC.

SIR-3000 System by GSSI

Rugged, high-performance GPR data acquisition system



Benefits

- Rugged, lightweight, hand-held and portable
- User-friendly
- High-resolution screen—easy to read in daylight
- Large data storage capacity
- Compatible with all GSSI ground-coupled antennas
- Built with pride in the U.S.A.

Applications

Concrete Inspection
Utility Mapping
Bridge Deck Inspection
Geological Investigation
Archaeology
Forensics/Law Enforcement
Snow/Ice Thickness Measurement
Research

APPENDIX B

Georadar Fact Sheet and Equipment

SIR-3000 System Specifications

System

Antennas:
Compatible with all GSSI ground-coupled antennas

Number of Channels: 1 (one)

Data Storage:
Internal memory: 1 GB Flash memory card

Compact Flash port: Accepts industry standard CF memory up to 2 GB (user provided)

Processor: 32-bit Intel StrongArm™ RISC processor @ 206 MHz

Display: Enhanced 8.4" TFT, 800 x 600 resolution, 64K colors

Display Modes: Linescan, O-scope, 3D

Data Acquisition

Data Format: RADAN (dzt)

Scan Rate Examples:
220 scans/sec at 256 samples/scan, 16 bit
120 scans/sec at 512 samples/scan, 16 bit

Sample size: 8-bit or 16-bit, user-selectable

Scan Interval: User-selectable

Number of samples per scan:
256, 512, 1024, 2048, 4096, 8192

Operating Modes:
Free run, survey wheel, point mode

Time Range:
0-8,000 nanoseconds full scale, user-selectable

Gain: Manual or automatic, 1-5 gain points (-20 to +80 dB)

Filters:
Vertical: Low-Pass and High-Pass IIR and FIR
Horizontal: Stacking, Background Removal

Operating

Operating Temperature:
-10°C to 40°C ambient

Charging Power Requirements:
15 V DC, 4 amps

Battery: 10.8 V DC, internal

Transmit Rate: Up to 100 KHz

Input/Output

Available Ports:
Antenna input
DC power input
Serial RS232 (GPS port)
Compact Flash memory
USB master and slave

Mechanical

Dimensions:
31.5 (L) x 22 (W) x 10.5 (H) cm
12.4" x 8.7" x 4.1"

Weight: 4.1 kg, (9 lbs) including battery

Environmental: Water resistant

System Includes:

SIR-3000 data acquisition system
Transit case
2 batteries
Battery charger
AC adapter (also works as charger)
User manual
Sunshade
Carrying harness (optional)

Antennas and antenna control cables sold separately

FCC Compliant

13 Klein Drive, PO Box 97
North Salem, NH 03073-0097
Tel: (603) 893-1109 Fax: (603) 889-3984
Sales@Geophysical.com

GSSI
Geophysical Survey Systems, Inc.
www.geophysical.com

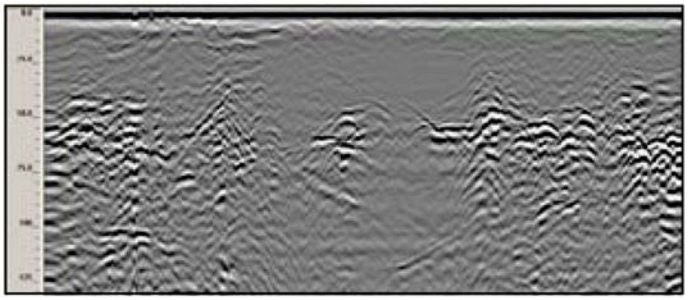
Antennas

Model 5104 - 270MHz

Utility Detection and Mapping
Engineering/Environmental
Geotechnical

The Model 5104 is suited for deeper utility, engineering and geotechnical applications.

Center Frequency:	270 MHz
Depth Range:	0- 6 m (0 - 18 ft)
Dimensions:	45 x 45 x 17 cm (18 x 18 x 6.5 in)
Weight:	8.6 kg (18.5 lbs)



GPR profile showing bedrock interface.

Model 3207 - 100MHz

Bistatic and Monostatic Operation

Geotechnical/Environmental
Mining

Center Frequency:	100 MHz
Depth Range:	2 - 15 m (5 - 50 ft) monostatic 0 - 30 m (0-100 ft) bistatic
Dimensions:	25 x 96 x 56 cm (10 x 38 x 22 in.) monostatic 25 x 96 x 200 cm (10 x 38 x 79 in.) bistatic
Weight:	13 kg (28 lbs) monostatic 28 kg (61 lbs) bistatic

The Model 3207 antenna is used for deep subsurface applications. The 3207AP (monostatic, left) combines the transmit and receive electronics in a single antenna housing. The 3207P (bistatic, right) is a versatile antenna pair that can operate in three different configurations to optimize performance.

Note: This antenna is currently for use outside the U.S.

Geophysical Survey Systems, Inc.
12 Industrial Way, Salem, NH 03079-4843 USA
Tel: 603-893-1109 / Fax: 603-889-3984
www.geophysical.com / sales@geophysical.com

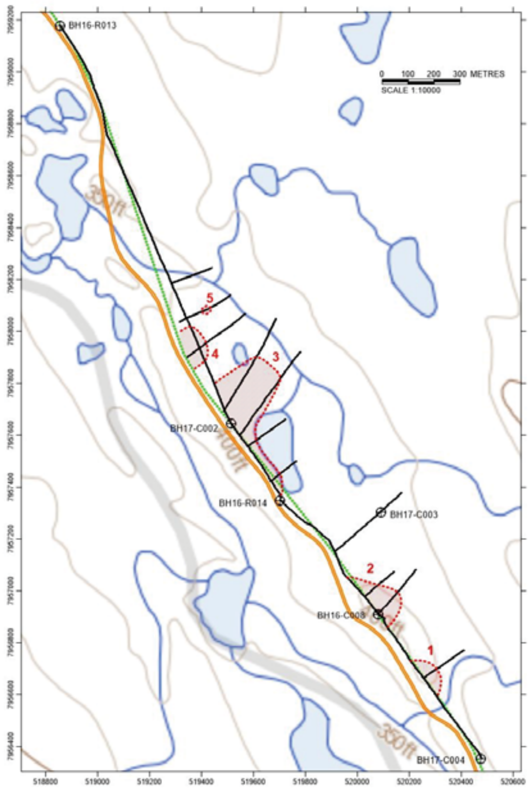
APPENDIX C

Drawings T17001-A2-1, T17001-A2-2,

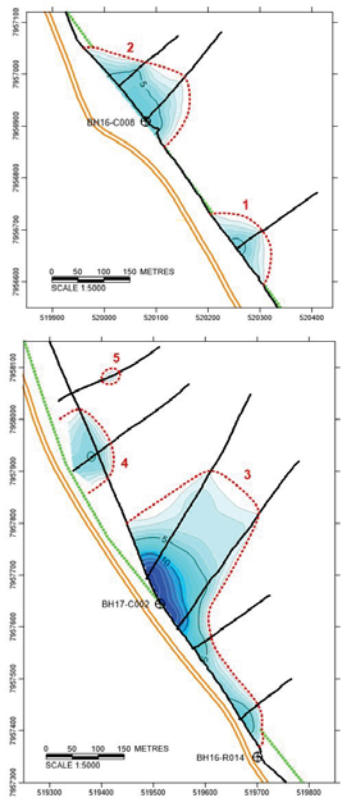
T17001-A2-3, T17001-A2-4, T17001-A3-1,

T17001-A3-2

GPR17-SITE 1

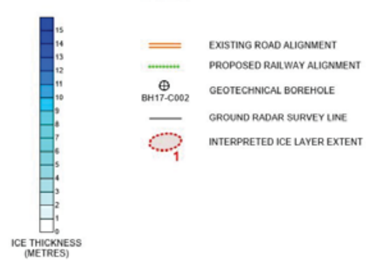


ICE THICKNESS MAP



OVERVIEW MAP

LEGEND



No	NOTES
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. APRIL 2017
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES
5	
6	

No	DATE	MODIFICATIONS	GPR APP

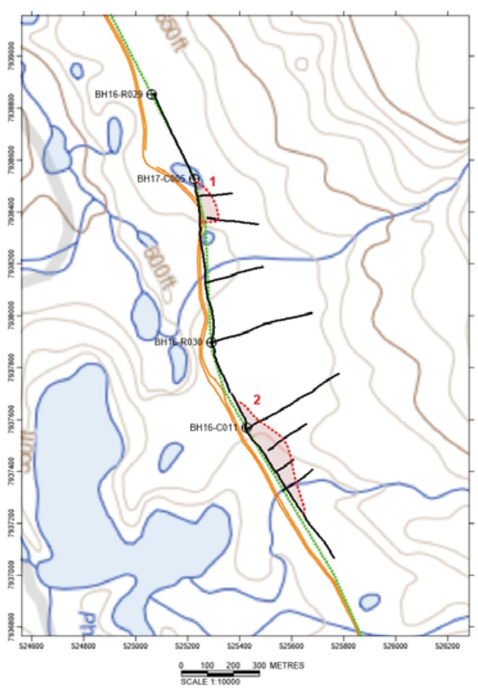
SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

GEOPHYSICS GPR INTERNATIONAL INC.

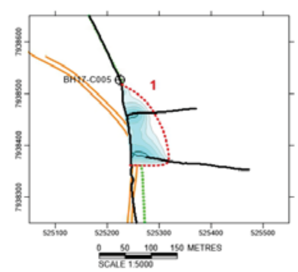
DESSINÉ PAR / DRAWN BY	I.Gusakov, GIT
VERIFIÉ PAR / CHECKED BY	
APPROUVÉ PAR / APPROVED BY	M.Situm, P. Geo
# CONTRAT / CONTRACT #	T17001
ÉCHELLE / SCALE	AS SHOWN
# DESSIN / DRAWING #	T17001-A2-1

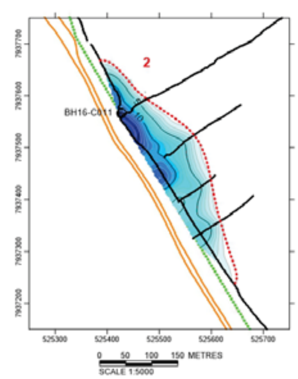
CLIENT / CLIENT	HATCH
PROJET / PROJECT	BAFFINLAND EXPANSION
TITRE / TITLE	GROUND RADAR SURVEY GPR17-SITE 1

GPR17-SITE 2



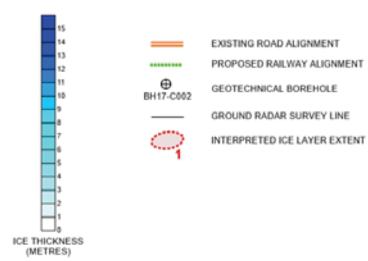
ICE THICKNESS MAP





OVERVIEW MAP

LEGEND



No	NOTES	No	DATE	MODIFICATIONS	GPR APP.
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. APRIL 2017				
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W				
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS				
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES				
5					
6					

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

GEOPHYSICS GPR INTERNATIONAL INC.

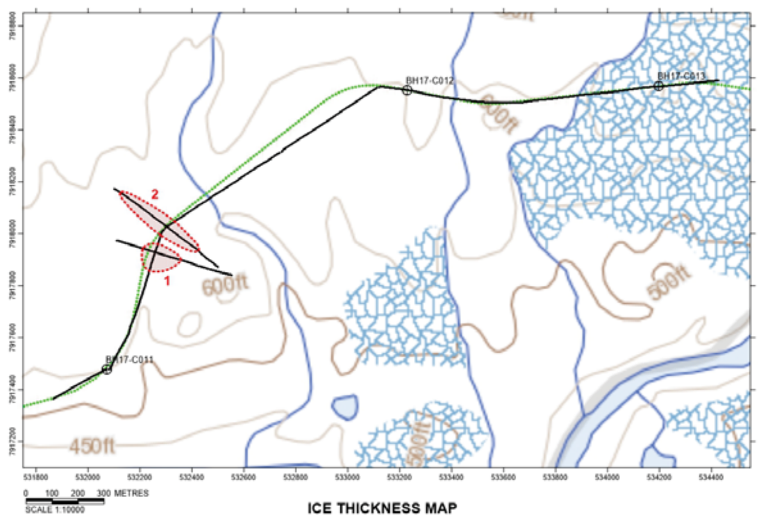
DESSINÉ PAR / DRAWN BY	I.Gusakov, GIT		
VÉRIFIÉ PAR / CHECKED BY			
APPROUVÉ PAR / APPROVED BY	M.Situm, P. Geo		
# CONTRAT / CONTRACT #	T17001		
ÉCHELLE / SCALE	AS SHOWN	# DESSIN / DRAWING #	T17001-A2-2

CLIENT / CLIENT: HATCH

PROJET / PROJECT: BAFFINLAND EXPANSION

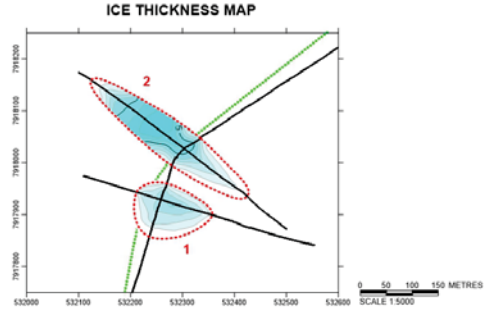
TITRE / TITLE: GROUND RADAR SURVEY GPR17-SITE 2

GPR17-SITE 3

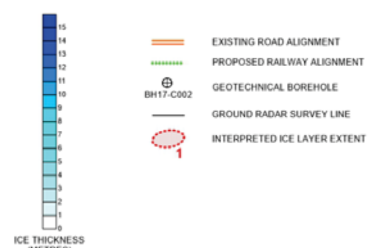


OVERVIEW MAP

ICE THICKNESS MAP



LEGEND



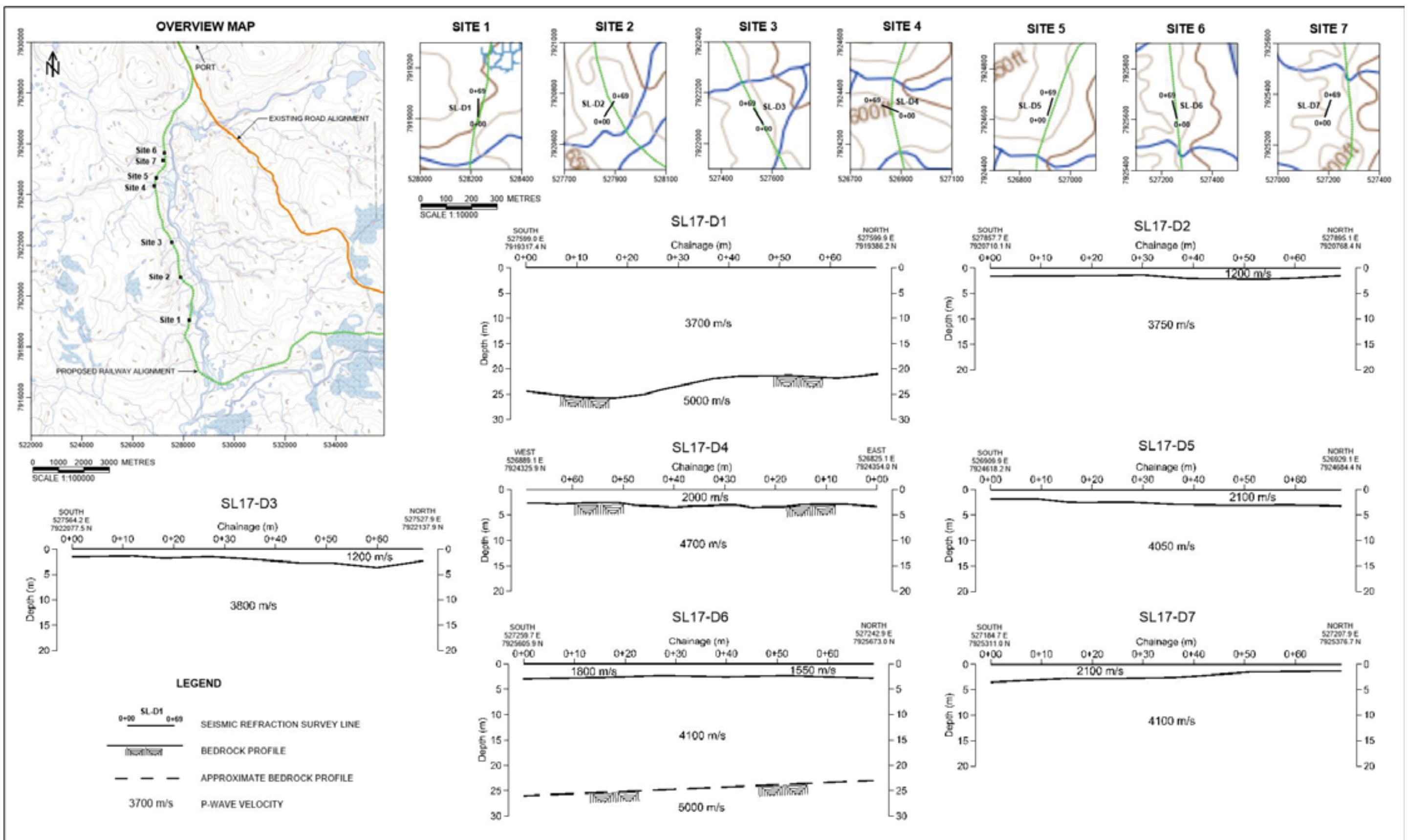
No	NOTES	No	DATE	MODIFICATIONS	GPR APP.
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. APRIL 2017				
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W				
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS				
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES				
5					
6					

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR / DRAWN BY	I.Gusakov, GIT
VERIFIÉ PAR / CHECKED BY	
APPROUVÉ PAR / APPROVED BY	M.Situm, P. Geo
# CONTRAT / CONTRACT #	T17001
ÉCHELLE / SCALE	AS SHOWN
# DESSIN / DRAWING #	T17001-A2-3

CLIENT	HATCH
PROJET / PROJECT	BAFFINLAND EXPANSION
TITRE / TITLE	GROUND RADAR SURVEY GPR17-SITE 3



No	NOTES
1	THE SEISMIC SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. APRIL 2017
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W
3	DEPTHS ARE RELATIVE TO GROUND SURFACE
4	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS
5	
6	

No	DATE	MODIFICATIONS	GPR / APP.

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

GEOPHYSICS GPR INTERNATIONAL INC.

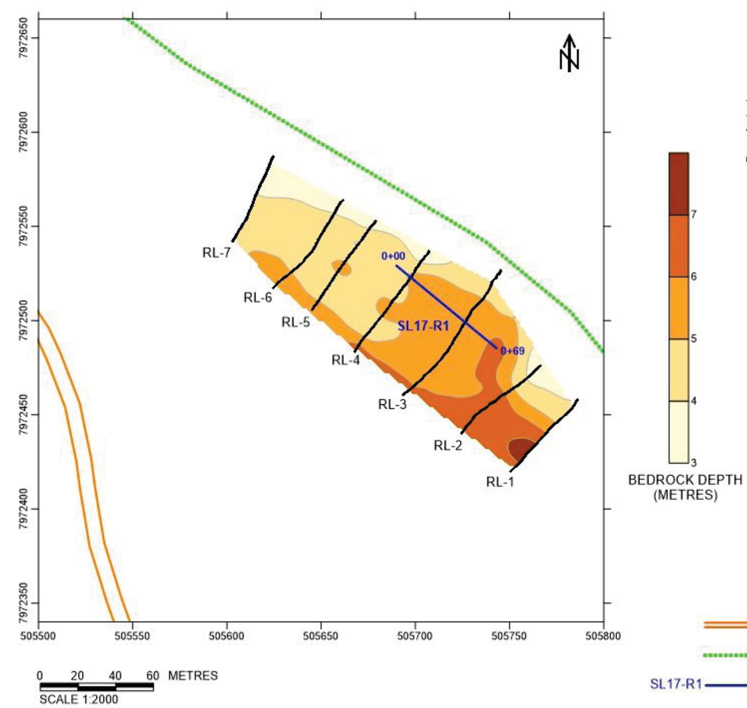
DESSINÉ PAR / DRAWN BY	I.Gusakov, GIT
VÉRIFIÉ PAR / CHECKED BY	
APPROUVÉ PAR / APPROVED BY	M.Situm, P. Geo
# CONTRAT / CONTRACT #	T17001
ÉCHELLE / SCALE	AS SHOWN
# DESSIN / DRAWING #	T17001-A2-4

CLIENT: HATCH

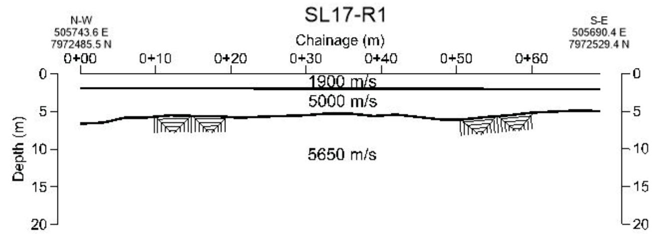
PROJET / PROJECT: BAFFINLAND EXPANSION

TITRE / TITLE: SEISMIC REFRACTION SURVEY DEVIATION AREA

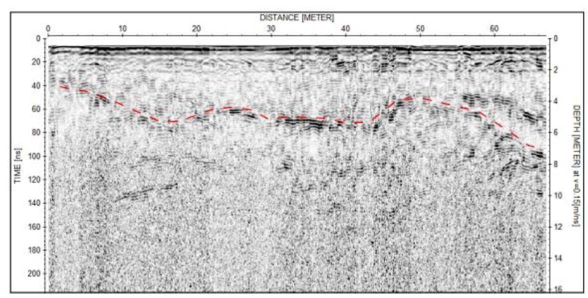
BEDROCK DEPTH MAP



SL17-R1



EXAMPLE RADAR IMAGE (RL-4)



LEGEND

EXISTING ROAD ALIGNMENT	
PROPOSED RAILWAY ALIGNMENT	
SL17-R1	SEISMIC REFRACTION SURVEY LINE
RL-1	GROUND RADAR SURVEY LINE
	BEDROCK PROFILE
5650 m/s	P-WAVE VELOCITY

NOT VALID FOR CONSTRUCTION

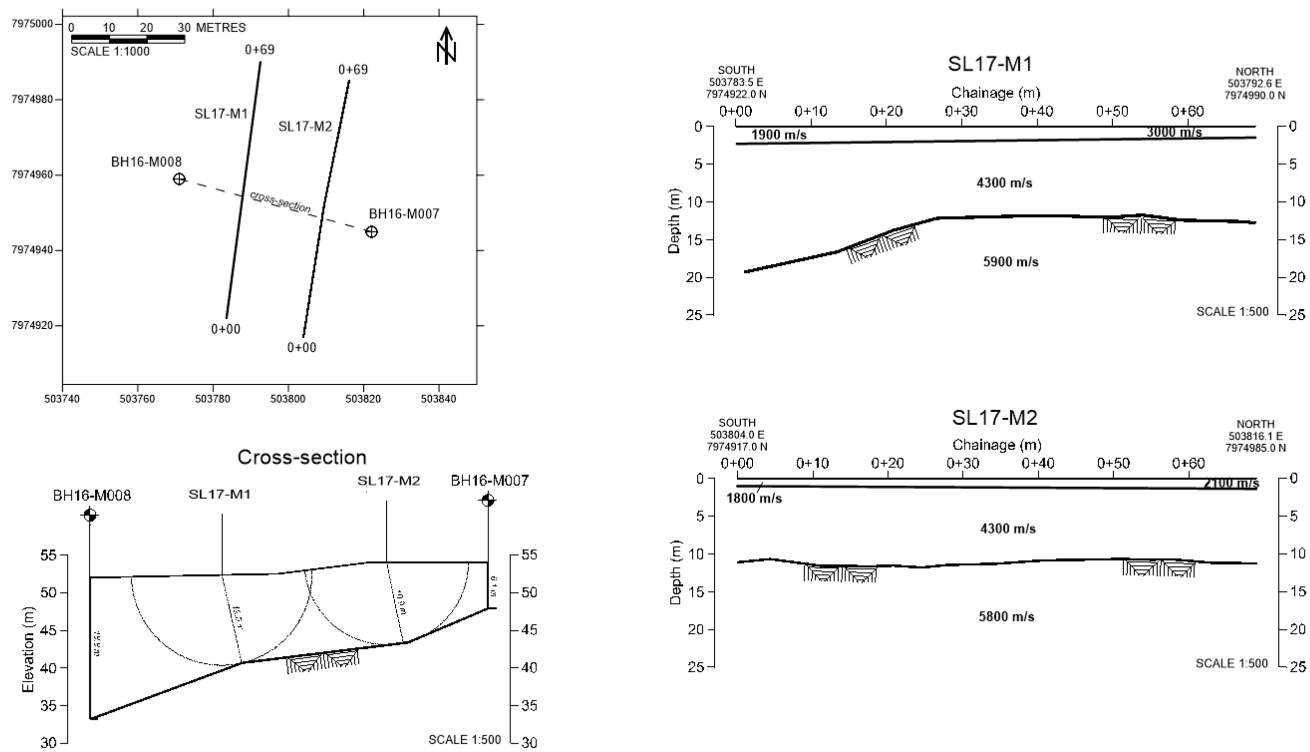
No	NOTES
1	THE SEISMIC SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. APRIL 2017
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W. POSITIONING ACCURACY +/- 2 METRES
3	ELEVATION DATA PROVIDED BY THE CLIENT. DEPTHS ARE RELATIVE TO GROUND SURFACE
4	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS
5	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES
6	

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR / DRAWN BY	I.Gusakov, GIT
VERIFIÉ PAR / CHECKED BY	
APPROUVÉ PAR / APPROVED BY	M.Situm, P. Geo
# CONTRAT / CONTRACT #	T17001
ECHELLE / SCALE	AS SHOWN
# DESSIN / DRAWING #	T17001-A3-2

CLIENT / CLIENT	HATCH
PROJET / PROJECT	BAFFINLAND EXPANSION
TITRE / TITLE	SEISMIC AND GEORADAR SURVEY PROPOSED RAIL ALIGNMENT KM 4.5



No	NOTES
1	THE SEISMIC SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. APRIL 2017
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W. POSITIONING ACCURACY +/- 2 METRES
3	ELEVATION DATA PROVIDED BY THE CLIENT. DEPTHS ARE RELATIVE TO GROUND SURFACE
4	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS
5	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES
6	

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR / DRAWN BY	I.Gusakov, GIT
VERIFIÉ PAR / CHECKED BY	
APPROUVÉ PAR / APPROVED BY	M.Situm, P. Geo
# CONTRAT / CONTRACT #	T17001
ECHELLE / SCALE	AS SHOWN
# DESSIN / DRAWING #	T17001-A3-1

CLIENT / CLIENT: HATCH

PROJET / PROJECT: BAFFINLAND EXPANSION

TITRE / TITLE: SEISMIC SURVEY RAILWAY UNLOADING AREA

GEOPHYSICS GPR INTERNATIONAL INC.

GEOPHYSICAL INVESTIGATION FOR BAFFINLAND RAILWAY, MARY RIVER PROJECT, NUNAVUT

PREPARED FOR:
Baffinland Iron Mines Corporation

Presented to:

4342 Queen Street, Suite 500
Niagara Falls, Ontario
L2E 7J7

Project T17001B-Revision#004 **April 2018**

Geophysics GPR International Inc.
6741 Columbus Road, Unit 14
Mississauga (Ontario) L5T 2G9
Tel. : +1 905.696.0656
info@geophysicsgpr.com

January 2018 T-17001B

TABLE OF CONTENTS

Index of Figures

Index of Tables

List of Appendices

APPENDIX A – Drawings GPR17 – MILNE INLET, GPR17 –KM19, GPR17 –KM20, GPR17 –KM39.6, GPR17 –KM49, GPR17 –KM82.2, GPR17 –KM97, GPR17 –KM100.1, GPR17 –KM109.

APPENDIX B – Georadar Fact Sheet

1 INTRODUCTION

Geophysics GPR International Inc. was requested by Hatch Ltd. to carry out a geophysical survey to aid in projection and planning of a proposed railway for the Mary River Project, Baffin Island, Nunavut.

The purpose of this investigation was to determine the extent of, as well as the thickness of subsurface ice.

The ground penetrating radar (georadar) method was applied to determine the presence of ice and calculate its thickness.

Data was collected from November 3rd to November 15, 2017.

The investigation included the following:

1) Georadar mapping of subsurface ice at nine sites approximately at Km 0, 19.4, 20.5, 39.5, 49.3, 82.2, 97.0, 100.1 and 109 along the proposed rail alignment. Further exploration with gridded georadar lines was conducted in regions both with and without the presence of ice.

Figure 1 presents an overview map of the investigation area with the locations of the respective sites.

The following report describes the various aspects of the survey including field techniques, survey design, interpretation techniques, and finally an interpretation in the form ice thickness maps.

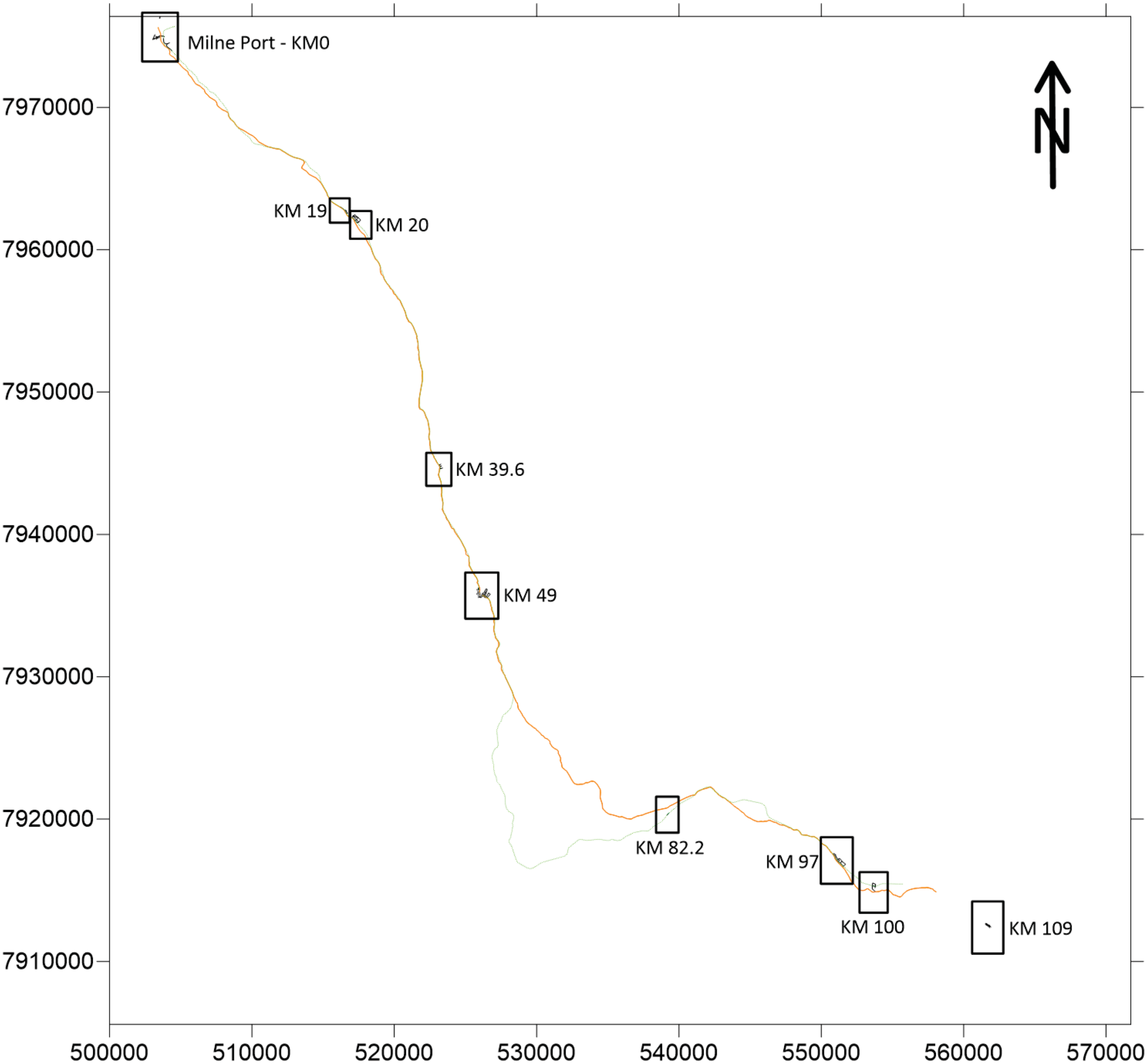


Figure 1: Overview map of the investigation area

2 METHODOLOGY

Georadar was used to determine the presence and thickness of ice.

2.1 Positioning, Topography and Units of Measurement

The emplacement of the survey areas was determined by the client.

The locations of the georadar survey lines for the purpose of subsurface ice mapping were oriented to align with the design of the proposed railway. Length and number of the lines were chosen based on in-field interpretation of georadar data. Positioning was controlled by the GPS device integrated into the georadar antenna. The UTM coordinates should be accurate to within +/- 2.0 m.

Table 1: UTM coordinates of GPR survey lines

Line No.	Start (0+00)		End (0+69)		Chainage (km)		Notes
	Easting	Northing	Easting	Northing	Start	End	
Line 0	502871.8	7976754.0	504000.0	7974502.0	0	2	Milne Port Area
Line 19.4	516252.0	7962974.0	516644.0	7962535.0	19.25	19.85	
Line 20.5	517047.0	7962251.0	517390.0	7961888.0	20.46	20.9	
Line 39.6	523146.0	7944888.0	523216.0	7944604.0	39.6	39.9	
Line 49.3	525992.0	7935880.0	526497.0	7935589.0	49.5	49.9	Rough Terrain
Line 82.2	539154.0	7920274.0	539291.0	7920419.0	82.2	82.4	
Line 97.0	551121.0	7917097.0	551250.0	7916944.0	97.0	97.6	Rough Terrain
Line 100.1	553584.0	7915318.0	553779.0	7915281.0	100.1	100.3	
Line 109.0	561530.0	7912604.0	561844.0	7912356.0	109.0	109.4	

The provided coordinates are NAD83/WGS84, UTM zone 17N.

The depth measurements are noted as depth from surface.

All geophysical measurements were collected in SI units.

In addition to Table 1, further georadar survey lines were created to further explore the given areas. These additional survey lines were generated in a grid-like fashion with the topography dictating the spacing of the lines.

2.2 Ground Penetrating Radar (Georadar)

Basic Theory

Georadar utilises radar technology to obtain a near-continuous profile of the subsurface. The basic principle is to emit an electromagnetic impulse into the ground at a predetermined frequency rate (typically 10 to 80 scans/second). This pulse will travel through the sub-surface and reflect off boundaries of differing dielectric constants (contrasts of EM impedances). The reflected pulse returns to the surface and is recorded by a receiver and displayed in real-time as a cross-sectional image. Only by moving the antennas along a profile directly over the targets can the locations and depths be determined. Examples of radar reflecting boundaries include air/water (water table); water/earth (bathymetry); earth/metal, PVC, or concrete (pipe locating); and differing earth materials (stratigraphic profiles, including bedrock profiles).

The depth of investigation is controlled by the frequency and power of the antenna limited by attenuation and diffraction of the radar signal. Lower frequency antennas provide greater depth penetration at the expense of resolution. The radar signal is attenuated by conductive ground materials (e.g. clays, dissolved salts etc.). The radar signal is diffracted by irregular shaped material (e.g. boulders, debris etc.) that prevents the clear return of the reflected pulse.

More information on the georadar operating principle can be found in Appendix B.

Survey Design

The georadar data were collected with a MALA Ground Explorer system and 160 MHz antenna. This antenna provides a favourable trade off between depth and resolution for ice detection. As well, this antenna has sufficient durability for the terrain and weather conditions for Baffin Island.

Positioning for the georadar survey was controlled by built-in GPS receiver.

Interpretation Method

Processing of the radar images involved basic horizontal normalization, elevation corrections and gain adjustments.

The vertical scale on all radar images is a two-way time scale representing the time taken for a radar pulse to transmit to a reflector and back to the receiver. In order to convert the time scale to a depth scale a signal velocity must be applied. The velocity with which the pulse travels through the given material is determined by the dielectric constant. This dielectric will vary with the type of material.

Calculating a velocity can be done in many ways but the most reliable method is with a test pit or borehole where the real rock contact can be exposed. Based on in-situ measurements or borehole data, the dielectric value can be approximated depending on the expect material type. An underestimate of the dielectric will result in an over estimate of the signal velocity and in turn an over estimate of the depths. For this site a dielectric of 4 (velocity of 15 cm/ns) was assumed based on the expected soil type and tables of relative dielectric values for commonly encountered materials. In this case the materials were mostly frozen granular/boulders with high ice content.

Interpretation of the data is based primarily on the qualitative analysis of three characteristics of radar reflections: continuity, amplitude and shape. The interpreter then identifies reflectors and textures within the radar records that represent subsurface contacts, objects or zones. The true nature of the interpreted features can only be assumed without corroborating evidence.

Ice bodies have a distinctive appearance on radar images. Granular host material appears as "noise" on the images, whereas uniform ice layer looks transparent with clearly defined top and bottom contacts and can be confidently identified. An example of a uniform ice lens is presented in Figure 2.

Non-uniform ice bodies (stratified or containing layers of soil) are more challenging for interpretation since structure irregularities create multiple reflections within the ice body. Often a borehole is needed to confirm the presence of ice. Other features such as increasing depth of investigation in the presence of thick ice layer may corroborate the interpretation.

In summary, ability of georadar is limited by the structure of the ice layer being surveyed and its composition. The identification of an ice layer may be impacted by irregularities inside the ice body, such as layering, fractures and soil inclusions. However, it is possible to create two categories of ice lenses, the obvious and less obvious that may need some ground truthing.

3 RESULTS

3.1 Subsurface Ice Mapping

Georadar data was collected at nine sites approximately at Km 0, 19.4, 20.5, 39.5, 49.3, 82.2, 97.0, 100.1 and 109 along the proposed rail alignment.

Locations of the survey lines and results of the georadar survey are presented in drawings GPR17 – MILNE INLET, GPR17 –KM19, GPR17 –KM20, GPR17 –KM39.6, GPR17 –KM49, GPR17 –KM82.2, GPR17 –KM97, GPR17 –KM100.1, GPR17 –KM109.

KM 0 - GPR17 – MILNE INLET

Multitude of survey lines conducted in the Milne Port area with no evidence of the presence of ice. Georadar penetration of the surface appeared shallow with poor signal attenuation, possibly due to material used for subsurface in port area. Total distance of 1.2km covered.

KM 19 - GPR17 –KM19

Two main survey lines conducted. No apparent ice presence in area. Area was not explored further due to time constraints. Total distance of 1.0km covered.

KM 20 - GPR17 –KM20

No apparent ice presence in area. Grid-like survey conducted to further explore region for ice; two further longitudinal lines, with three additional perpendicular cuts. Total distance of 2.9km covered.

KM 39.6 - GPR17 –KM39.6

No apparent ice presence in area. Latitudinal cuts conducted to further explore region for ice. No longitudinal lines due to topographic obstacle in area. Total distance of 1.5km covered.

KM 49 - GPR17 –KM49

Ice found in region, explored with additional lines where possible. Survey lines constrained due to topography and water in area. Total distance of 4.5km

KM 82.2 - GPR17 –KM82.2

No apparent ice presence in area. Due to distance from tote-road and time constraints no additional surveying was conducted in this area. Total distance of 200m covered.

KM 97 - GPR17 –KM97

No apparent ice presence in area. Area heavily constrained by topographic change. Additional survey lines done around topography to ensure safety maintained. Total distance of 2.2 km covered.

KM 100.1 - GPR17 –KM100.1

No apparent ice presence in area. Area constrained by water. Additional survey lines conducted in area. Total distance of 1.2km covered.

KM 109 - GPR17 –KM109

No apparent ice presence in area. Area constrained by topographic change. Additional survey lines conducted in area. Total distance of 1.2km covered.

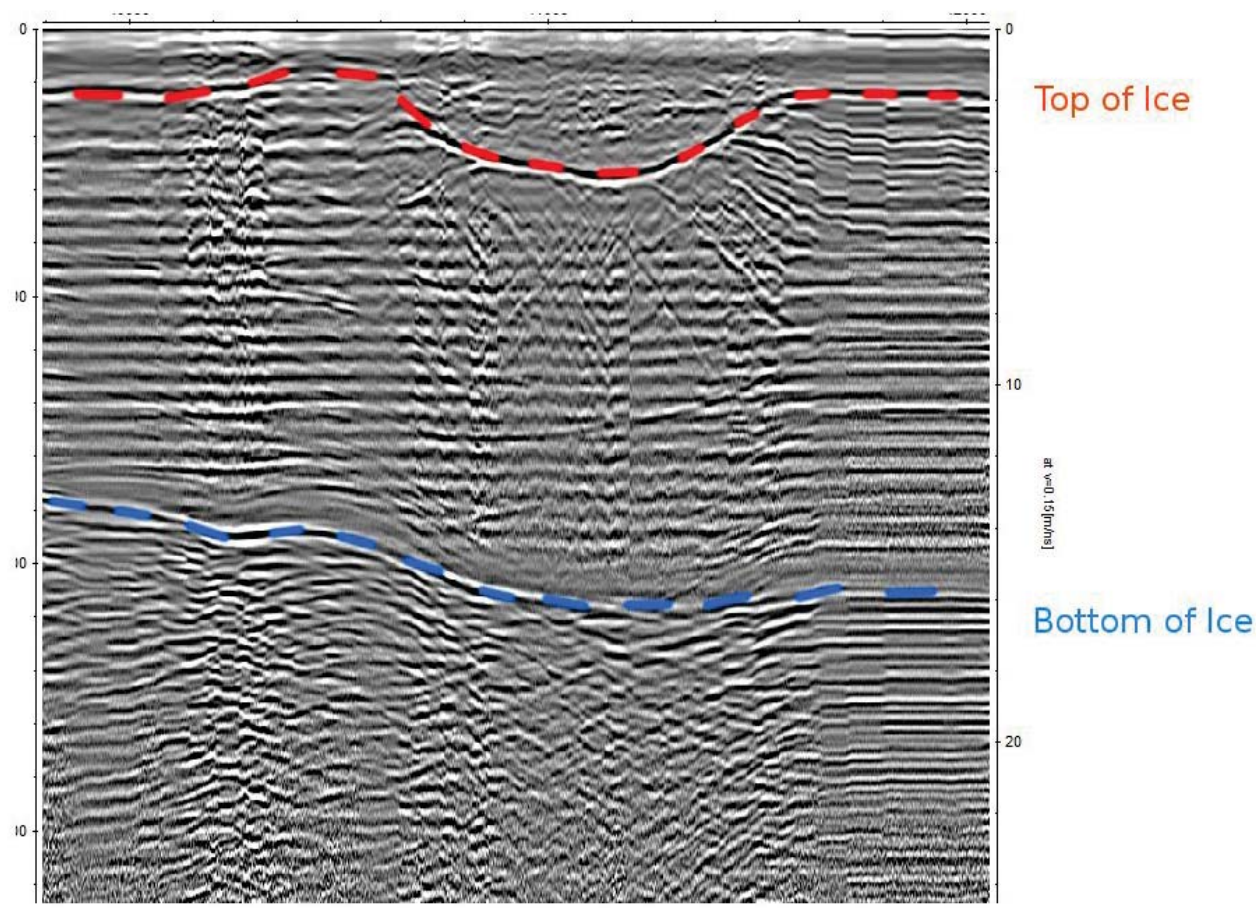


Figure 2: Interpreted georadar image showing a typical ice body

4 CONCLUSIONS

A geophysical investigation involving Georadar was carried out at the Mary River Project, Baffin Island, Nunavut.

Subsurface ice mapping was carried out at nine sites along the proposed rail alignment. Results of the survey are presented in Drawings GPR17 – MILNE INLET, GPR17 –KM19, GPR17 –KM20, GPR17 –KM39.6, GPR17 –KM49, GPR17 –KM82.2, GPR17 –KM97, GPR17 –KM100.1, GPR17 –KM109. Ice was only found in Km 49, seen in drawing GPR17-KM49.

Interpretation of the geophysical data has been performed by Mauritz van Zyl. This report has been written by Milan Situm, P.Geo.

____

Milan Situm, P.Geo.
Manager

PROFESSIONAL GEOSCIENTISTS
MILAN SITUM
PRACTISING MEMBER
0237
ONTARIO

APPENDIX A

Drawings GPR17 – MILNE INLET,

GPR17 –KM19,

GPR17 –KM20,

GPR17 –KM39.6,

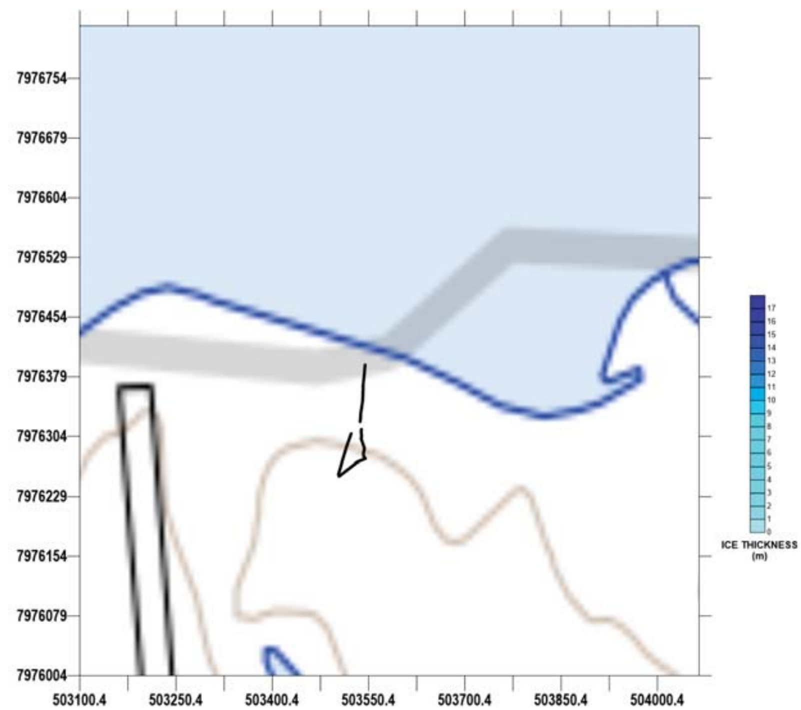
GPR17 –KM49, Ice was only found in Km 49, seen in drawing GPR17-KM49.

GPR17 –KM82.2,

GPR17 –KM97,

GPR17 –KM100.1,

GPR17 –KM109.



LEGEND

- EXISTING ROAD ALIGNMENT
- PROPOSED RAILWAY ALIGNMENT
- BH17-C002 GEOTECHNICAL BOREHOLE
- GROUND RADAR SURVEY LINE

No	NOTES	No	DATE	MODIFICATIONS	GPR
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. NOVEMBER 2017				
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W				
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS				
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES				
5					
6					

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

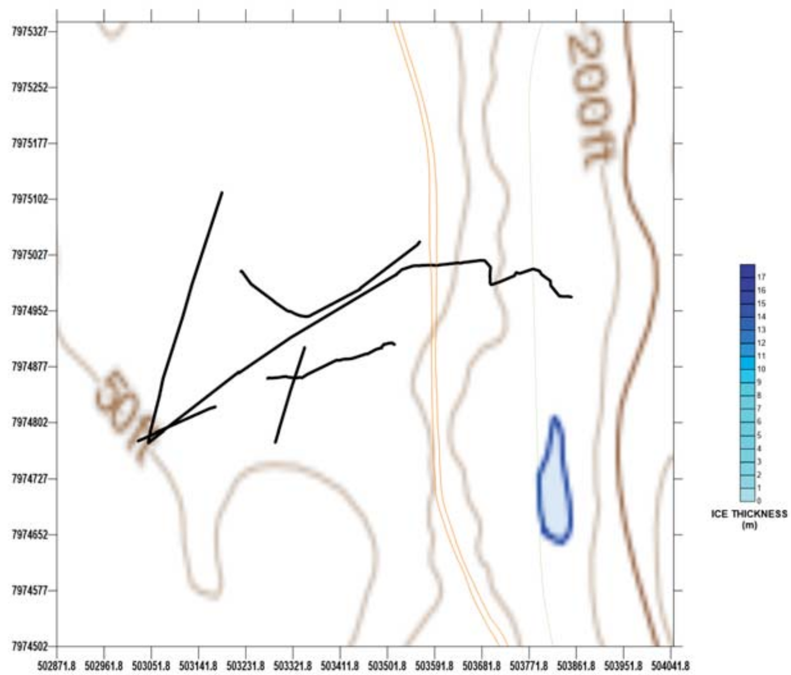
GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR / DRAWN BY	M. Van Zyl
VÉRIFIÉ PAR / CHECKED BY	
APPROUVÉ PAR / APPROVED BY	M.Sikum, P. Geo
# CONTRAT / CONTRACT #	T17001b
ÉCHELLE / SCALE	AS SHOWN
# DESSIN / DRAWING #	T17001b-A2

CLIENT: HATCH

PROJET / PROJECT: BAFFINLAND EXPANSION

TITRE / TITLE: GROUND RADAR SURVEY GPR17-MILNE INLET



LEGEND

- EXISTING ROAD ALIGNMENT
- PROPOSED RAILWAY ALIGNMENT
- BH17-C002 GEOTECHNICAL BOREHOLE
- GROUND RADAR SURVEY LINE

No	NOTES	No	DATE	MODIFICATIONS
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. NOVEMBER 2017			
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17N			
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS			
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES			
5				
6				

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

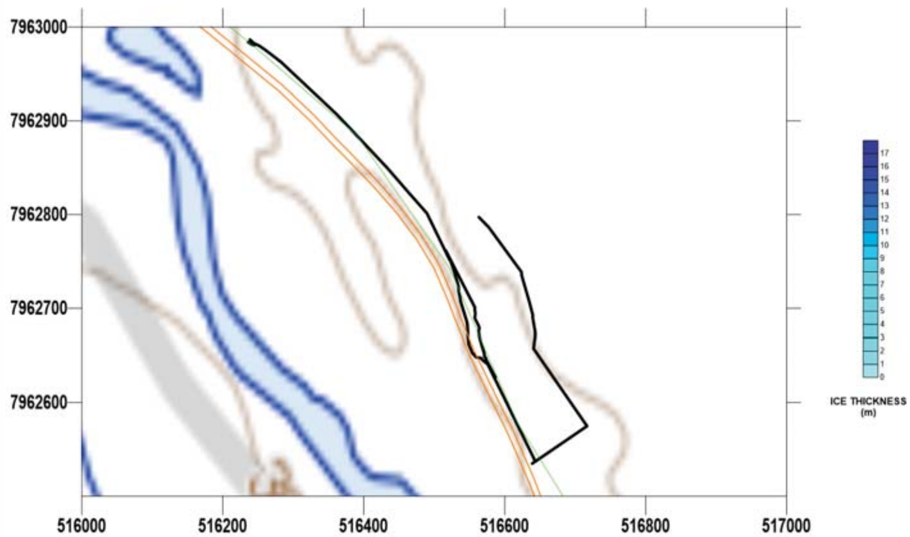
GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR / DRAWN BY	M. Van Zyl
VÉRIFIÉ PAR / CHECKED BY	
APPROUVÉ PAR / APPROVED BY	M.Shum, P. Geo
# CONTRAT / CONTRACT #	T17001b
ÉCHELLE / SCALE	AS SHOWN
# DESSIN / DRAWING #	T17001b-A2

CLIENT: **HATCH**

PROJET / PROJECT: **BAFFINLAND EXPANSION**

TITRE / TITLE: **GROUND RADAR SURVEY GPR17-MILNE INLET**



LEGEND

- EXISTING ROAD ALIGNMENT
- PROPOSED RAILWAY ALIGNMENT
- BH17-C002 GEOTECHNICAL BOREHOLE
- GROUND RADAR SURVEY LINE

No	NOTES	No	DATE	MODIFICATIONS	APP
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. NOVEMBER 2017				
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W				
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS				
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES				
5					
6					

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

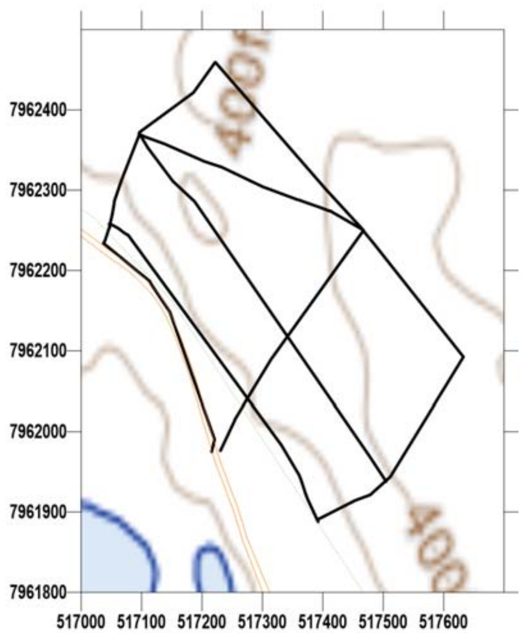
GEOPHYSICS GPR INTERNATIONAL INC.

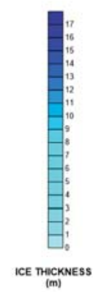
DESSINÉ PAR / DRAWN BY	M. Van Zyl		
VÉRIFIÉ PAR / CHECKED BY			
APPROUVÉ PAR / APPROVED BY	M.Sikum, P. Geo		
# CONTRAT / CONTRACT #	T17001b		
ÉCHELLE / SCALE	AS SHOWN	# DESSIN / DRAWING #	T17001b-A2

CLIENT / CLIENT: **HATCH**

PROJET / PROJECT: **BAFFINLAND EXPANSION**

TITRE / TITLE: **GROUND RADAR SURVEY GPR17-KM19**





LEGEND

- EXISTING ROAD ALIGNMENT
- PROPOSED RAILWAY ALIGNMENT
- BH17-C002 GEOTECHNICAL BOREHOLE
- GROUND RADAR SURVEY LINE

No	NOTES	No	DATE	MODIFICATIONS	GPR
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. NOVEMBER 2017				
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W				
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS				
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES				
5					
6					

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

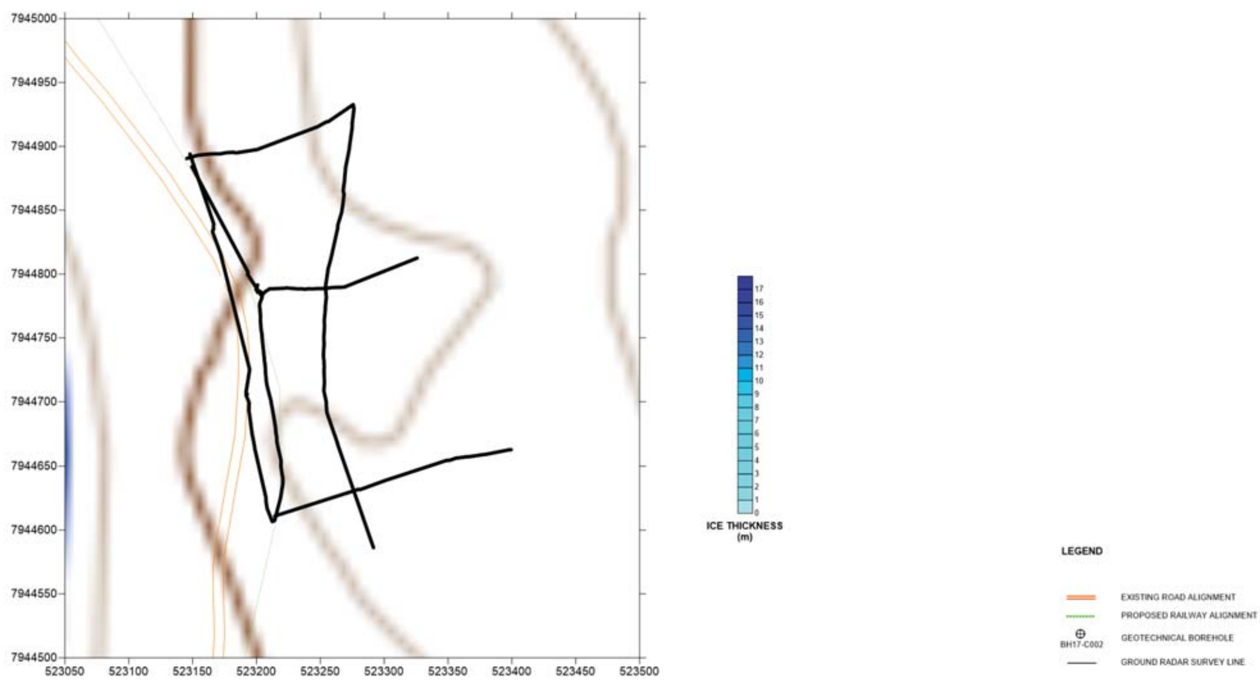
GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR / DRAWN BY	M. Van Zyl
VÉRIFIÉ PAR / CHECKED BY	
APPROUVÉ PAR / APPROVED BY	M.Sikum, P. Geo
# CONTRAT / CONTRACT #	T17001b
ÉCHELLE / SCALE	AS SHOWN
# DESSIN / DRAWING #	T17001b-A2

CLIENT / CLIENT: HATCH

PROJET / PROJECT: BAFFINLAND EXPANSION

TITRE / TITLE: GROUND RADAR SURVEY GPR17-KM20



No	NOTES	No	DATE	MODIFICATIONS
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. NOVEMBER 2017			
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W			
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS			
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES			
5				
6				

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

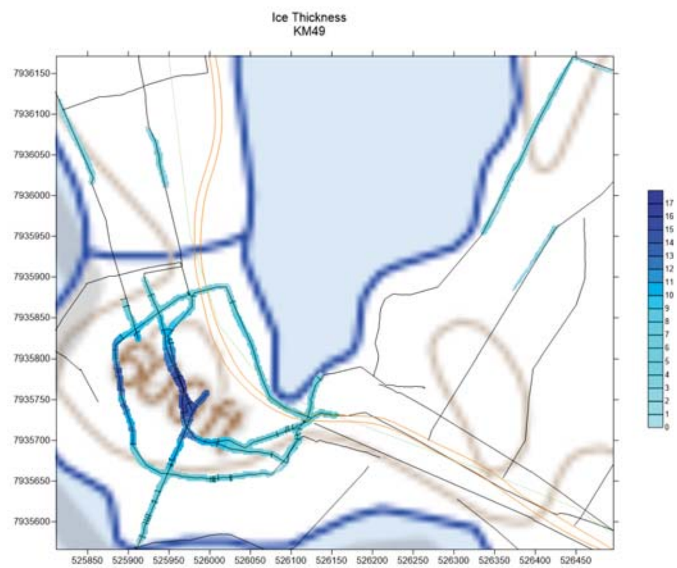
GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR / DRAWN BY	M. Van Zyl
VÉRIFIÉ PAR / CHECKED BY	
APPROUVÉ PAR / APPROVED BY	M.Sfium, P. Geo
# CONTRAT / CONTRACT #	T17001b
ÉCHELLE / SCALE	AS SHOWN
# DESSIN / DRAWING #	T17001b-A2

CLIENT: HATCH

PROJET / PROJECT: BAFFINLAND EXPANSION

TITRE / TITLE: GROUND RADAR SURVEY GPR17-KM39.6



LEGEND

- EXISTING ROAD ALIGNMENT
- PROPOSED RAILWAY ALIGNMENT
- BH17-C002 GEOTECHNICAL BOREHOLE
- GROUND RADAR SURVEY LINE
- 1 INTERPRETED ICE LAYER EXTENT

PRELIMINARY

No	NOTES
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. NOVEMBER 2017
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17N
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES
5	
6	

No	DATE	MODIFICATIONS	GPR

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

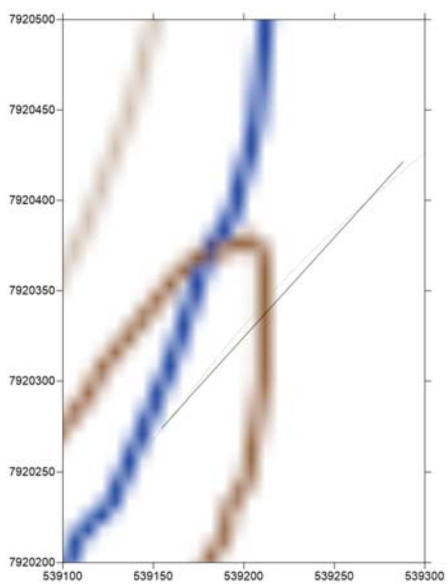
GEOPHYSICS GPR INTERNATIONAL INC.

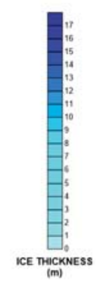
DESSINÉ PAR / DRAWN BY	M. Van Zyl
VÉRIFIÉ PAR / CHECKED BY	
APPROUVÉ PAR / APPROVED BY	M.Sikum, P. Geo
# CONTRAT / CONTRACT #	T17001b
ÉCHELLE / SCALE	AS SHOWN
# DESSIN / DRAWING #	T17001b-A1-1

CLIENT / CLIENT: HATCH

PROJET / PROJECT: BAFFINLAND EXPANSION

TITRE / TITLE: GROUND RADAR SURVEY GPR17-SITE 1





LEGEND

- EXISTING ROAD ALIGNMENT
- PROPOSED RAILWAY ALIGNMENT
- BH17-C002 GEOTECHNICAL BOREHOLE
- GROUND RADAR SURVEY LINE

PRELIMINARY

No	NOTES
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. NOVEMBER 2017
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES
5	
6	

No	DATE	MODIFICATIONS

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

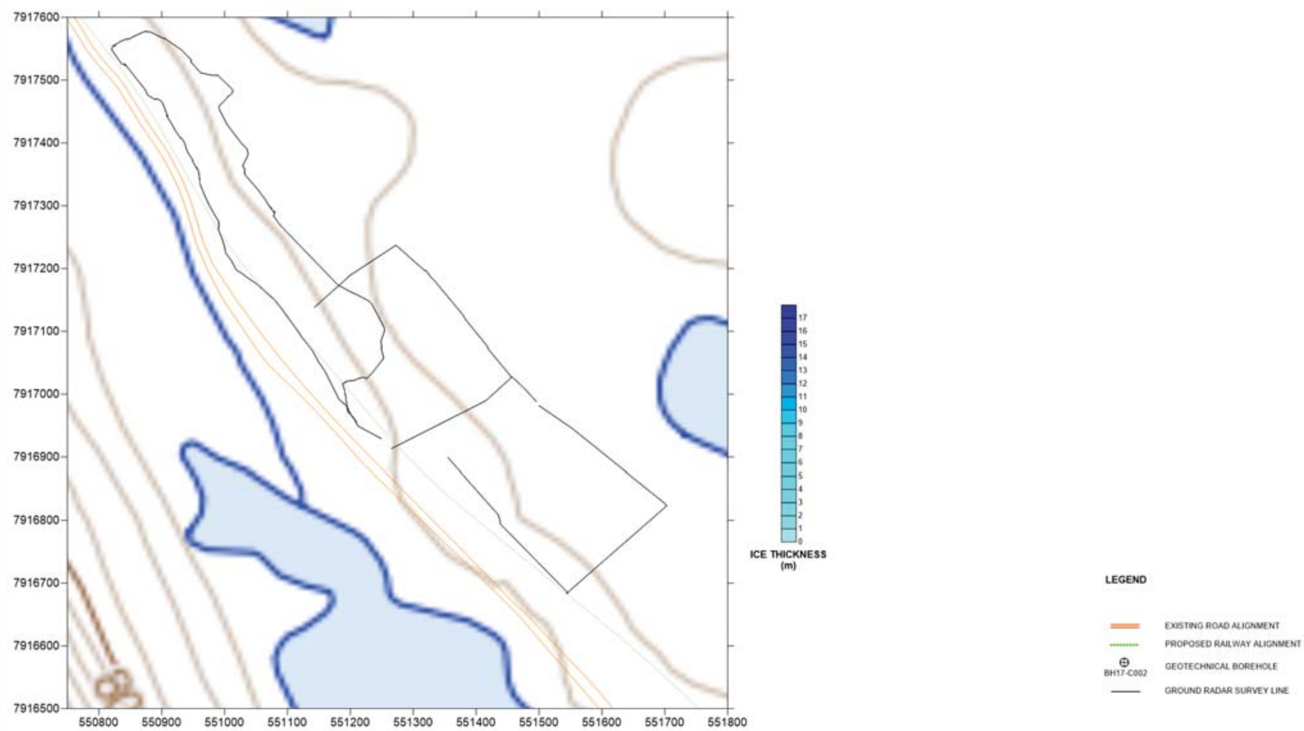
GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR / DRAWN BY	M. Van Zyl
VÉRIFIÉ PAR / CHECKED BY	
APPROUVÉ PAR / APPROVED BY	M.Sikum, P. Geo.
# CONTRAT / CONTRACT #	T17001b
ÉCHELLE / SCALE	AS SHOWN
# DESSIN / DRAWING #	T17001b-A2

CLIENT: **HATCH**

PROJET / PROJECT: **BAFFINLAND EXPANSION**

TITRE / TITLE: **GROUND RADAR SURVEY GPR17-KM82.2**



No	NOTES	No	DATE	MODIFICATIONS
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. NOVEMBER 2017			
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17N			
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS			
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES			
5				
6				

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

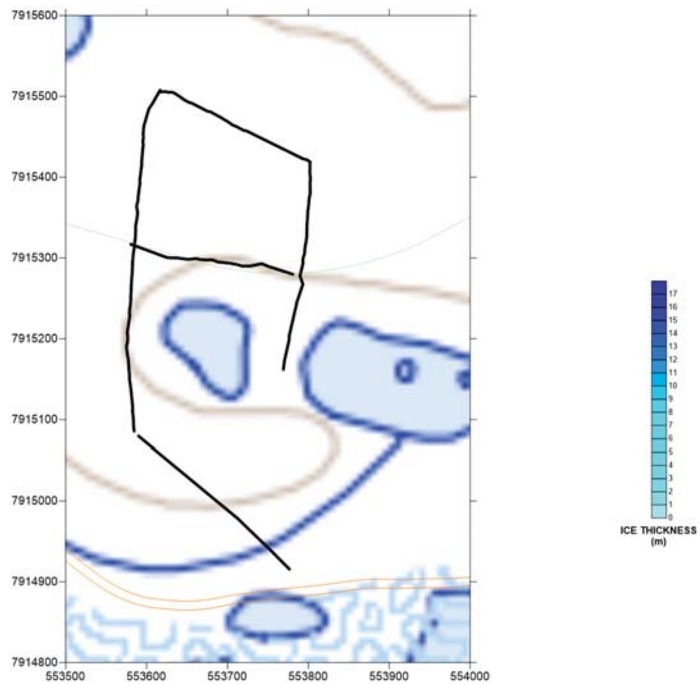
GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR / DRAWN BY	M. Van Zyl
VÉRIFIÉ PAR / CHECKED BY	
APPROUVÉ PAR / APPROVED BY	M.Situm, P. Geo
# CONTRAT / CONTRACT #	T17001b
ÉCHELLE / SCALE	AS SHOWN
# DESSIN / DRAWING #	T17001b-A2

CLIENT: HATCH

PROJET / PROJECT: BAFFINLAND EXPANSION

TITRE / TITLE: GROUND RADAR SURVEY GPR17-KM97



LEGEND

EXISTING ROAD ALIGNMENT

PROPOSED RAILWAY ALIGNMENT

BH17-C002 GEOTECHNICAL BOREHOLE

GROUND RADAR SURVEY LINE

No	NOTES	No	DATE	MODIFICATIONS	GPR
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. NOVEMBER 2017				
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W				
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS				
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES				
5					
6					

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

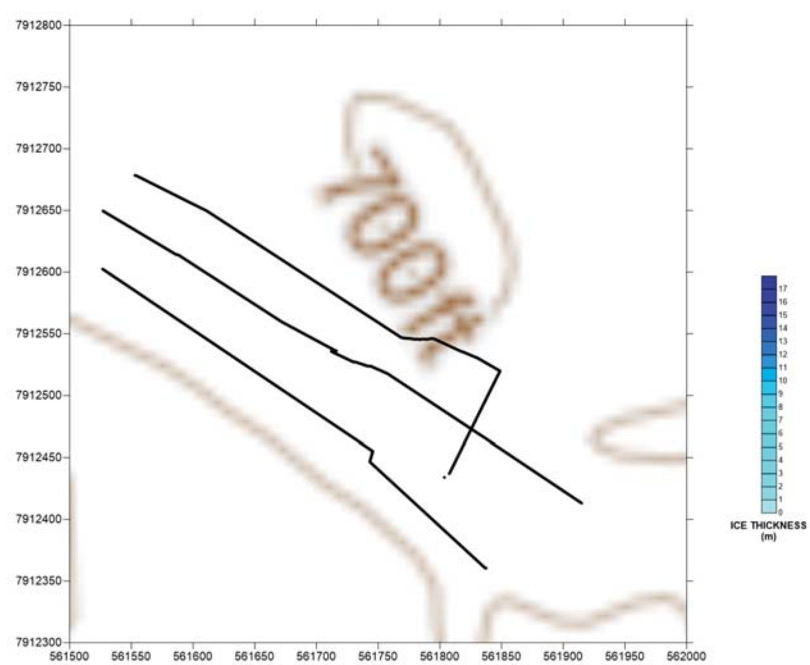
GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR / DRAWN BY	M. Van Zyl
VÉRIFIÉ PAR / CHECKED BY	
APPROUVÉ PAR / APPROVED BY	M.Sikum, P. Geo
# CONTRAT / CONTRACT #	T17001b
ÉCHELLE / SCALE	AS SHOWN
# DESSIN / DRAWING #	T17001b-A2

CLIENT: **HATCH**

PROJET / PROJECT: **BAFFINLAND EXPANSION**

TITRE / TITLE: **GROUND RADAR SURVEY GPR17-KM100.1**



LEGEND

- EXISTING ROAD ALIGNMENT
- PROPOSED RAILWAY ALIGNMENT
- BH17-C002 GEOTECHNICAL BOREHOLE
- GROUND RADAR SURVEY LINE

No	NOTES
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. NOVEMBER 2017
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES
5	
6	

GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR / DRAWN BY	M. Van Zyl
VÉRIFIÉ PAR / CHECKED BY	
APPROUVÉ PAR / APPROVED BY	M.Situm, P. Geo
# CONTRAT / CONTRACT #	T17001b
ÉCHELLE / SCALE	AS SHOWN
# DESSIN / DRAWING #	T17001b-A2

CLIENT: HATCH

PROJET / PROJECT: BAFFINLAND EXPANSION

TITRE / TITLE: GROUND RADAR SURVEY GPR17-KM109

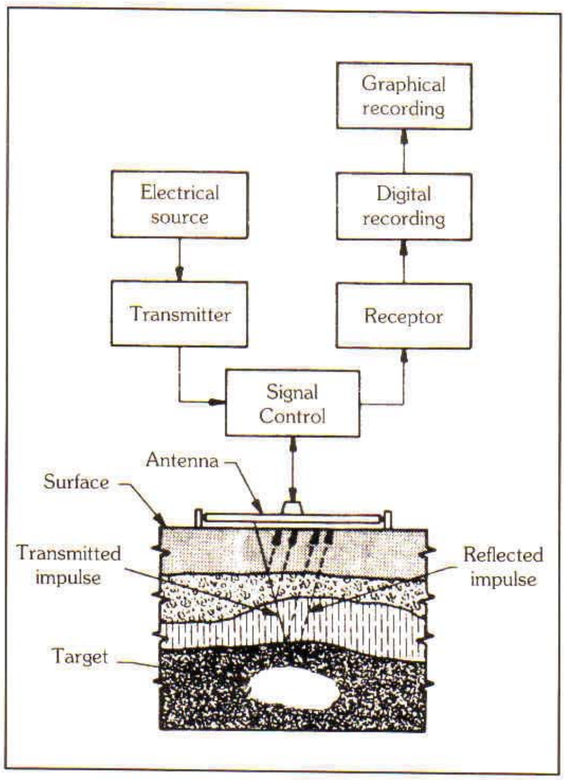
APPENDIX B

Additional Georadar information

GEOPHYSICS G P R INTERNATIONAL INC.

GEORADAR

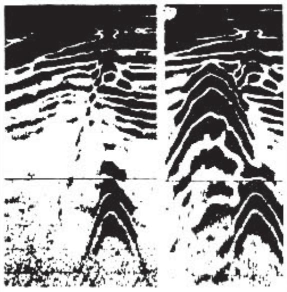
As indicated by its name, georadar combines high resolution radar with geology. The underlying principle is based on the propagation of electromagnetic wave impulses (VHF) that are reflected by anomalies in the terrain (joints, irregularities, interfaces, etc.) at different depths, and then captured by the antenna. The georadar records the time taken by each transmitted signal to complete the cycle in order to calculate the depth of the anomaly. The result is similar to a seismic reflection profile where all the reflections are displayed graphically. This technique is used to solve problems for which there had previously been no practical solution.



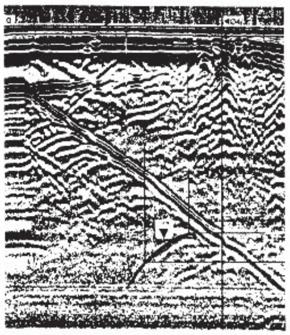
PRINCIPLES OF GEORADAR

FEATURES

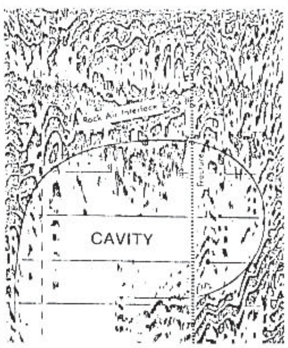
- Penetration of more than 20 metres in certain materials (penetration being inversely proportional to conductivity).
- Surveying in continuous mode.
- Identification of objects measuring only a few centimeters.
- Light and manoeuvrable equipment.
- Detection of conductivity, open spaces and/or holes (cavities).
- Detection of breaks: faults, fractures, joints, cavities.
- Results similar to seismic reflection: continuous underground profile.
- Results available immediately.
- Can be used in land, sea or airborne surveys.



PIPES



JOINTS



CAVITIES

FIELDS OF APPLICATION

Civil Engineering / Mining Exploration-Exploitation / Research / Archaeology / Environment

- Geotechnology: investigation of soils and surface deposits.
- Optimal selection of anchor bolts in mines and quarries.
- Detection of buried pipes before beginning excavation.
- Detection of liquid or gas leakage in soils.
- Detection of cracks in concrete structures.
- Checking material homogeneity.
- Detection of cavities beneath road pavement.
- Determination of water saturation level.
- Detection of girders in reinforced concrete.
- Detection of pollutant leakage in water bodies.
- Inspection of buried disposal sites and or dangerous deposits.
- Continuous measurement of ice thickness.
- Archaeological research: ancient foundations, artifacts.
- Non-destructive method for measuring road pavement thickness.
- Localization and measurement of soil's thickness (swamps, peat bogs).
- Determination of rock beddings (location and thickness).
- Bathymetric studies (depth sounding).
- Calculation of the thickness of permafrost and ice.
- Geotechnical studies for the installation of aqueducts.

SPECIAL FEATURES

The equipment is practical, easy to manoeuvre, and multi-faceted. The field of application of georadar continues to expand in various sectors, particularly in geotechnology (aqueducts), civil engineering (excavation, structures) and mining (structures).

GUIDELINEGEO

MALÅ GroundExplorer

GROUND PENETRATING RADAR

GPR with exceptional range and resolution

MALÅ GroundExplorer (GX) is an integrated GPR solution with four MALÅ GX antenna options: GX80, GX160, GX450 and GX750. Through unique hyperstacking HDR technology, MALÅ GX offers significantly faster data acquisition rates, with outstanding signal-to-noise ratio and depth penetration. An easy-to-use GPR solution on a rugged platform, with excellent detection capabilities for a wide range of applications.

MALÅ GX CONTROLLER

Processor	1.6 GHz Intel Atom
Display	1024 x 768 mm
OS	Linux
Memory	8 GB compact Flash memory
Data output resolution	32 bit
Comms	Ethernet, WiFi (optional), USB 3.0, RS232 (serial)
GPS	Integrated support for built-in GPS, or external GPS via USB/serial port (NMEA 0183 protocol)
Power supply	Internal 12V/20.8 Ah Li-Ion battery, or any external 10-15 V DC source
Charger	Internal. Unit can also be charged from any external 12 - 15 V DC source
Power consumption	1.3 – 2.0 A
Operating time	8 – 10 h
Dimensions	326 x 216 x 92 mm including handles 326 x 216 x 52 mm excluding handles
Weight	3.2 kg
Operating temp	- 20° to + 50° C or 0° to 120° F
Environmental	IP 65

GX WIFI OPTION

Wireless standard:	IEEE802.11 g
Power consumption:	0,3 A

MALÅ

MALÅ GX ANTENNAS

MALÅ GX750 HDR

Technology	MALÅ Semi-Real- Time pat pending
Antenna center freq.	750 MHz
SNR	97 dB
No. of bits	16 bit
Scans/second	> 1290, time window 75 ns
Survey speed	460 [km/h] point distance 10 cm
Bandwidth	120%, fractional, -10 dB
Time window	75 ns
Positioning	Built-in DGPS, external GPS (NMEA 0183 protocol), wheel encoder
Operating time	5 h
Power supply	Interchangeable 12 V Li-Ion batt. or ext. 12 V DC source
Power consumption	1.3 A
Acq. mode	Wheel, time or manual
Dimensions	375 x 235 x 170 mm
Weight	3.6 kg
Operating temp.	- 20° to + 50° C or 0° to 120° F
Environmental	IP 65

MALÅ GX450 HDR

Technology	MALÅ Semi-Real-Time pat pending
Antenna center freq.	450 MHz
SNR	101 dB
No. of bits	> 16 bit
Scans/second	> 770, time window 300 ns
Survey speed	275 [km/h] point distance 10 cm
Bandwidth	>120%, fractional, -10 dB
Time window	300 ns
Positioning	Inbuilt DGPS, external GPS (NMEA 0183 protocol), wheel encoder
Operating time	5 h
Power supply	Interchangeable 12 V Li-Ion batt. or ext. 12 V DC source
Power consumption	1.3 A
Acq. mode	Wheel, time or manual
Dimensions	430 x 360 x 180 mm
Weight	5.5 kg
Operating temp.	- 20° to + 50° C or 0° to 120° F
Environmental	IP 65

MALÅ GX160 HDR

Technology	MALÅ Semi-Real-Time pat pending
Antenna center freq.	160 MHz
SNR	> 107 dB
No. of bits	> 17 bit
Scans/second	> 880, time window 625 ns
Survey speed	320 [km/h] point distance 10 cm
Bandwidth	>120 %, fractional, -10 dB
Time window	625 ns
Positioning	Inbuilt DGPS, external GPS (NMEA 0183 protocol), wheel encoder
Operating time	5 h
Power supply	Interchangeable 12 V Li-Ion batt. or ext. 12 V DC source
Power consumption	1.3 A
Acq. mode	Wheel, time or manual
Dimensions	720 x 480 x 190 mm
Weight	10.7 kg
Operating temp.	- 20° to + 50° C or 0° to 120° F
Environmental	IP 65

MALÅ GX80 HDR

Technology	MALÅ Semi-Real-Time pat pending
Antenna center freq.	80 MHz
SNR	> 114.4 dB
No. of bits	> 19 bit
Scans/second	> 1200, time window 812 ns
Survey speed	430 [km/h] point distance 10 cm
Bandwidth	>120 %, fractional, -10 dB
Time window	812 ns
Positioning	Built-in DGPS, external GPS (NMEA 0183 protocol), wheel encoder
Operating time	5 h
Power supply	Interchangeable 12 V Li-Ion batt. or ext. 12 V DC source
Power consumption	1.3 A
Acq. mode	Wheel, time or manual
Dimensions	1010 x 780 x 220 mm
Weight	24,6 kg
Operating temp.	- 20° to + 50° C or 0° to 120° F
Environmental	IP 65

ABEM | MALÅ

__Guideline Geo__ is a world-leader in geophysics and geo-technology offering sensors, software, services and support necessary to map and visualize the subsurface. Guideline Geo operates in four international market areas: Infrastructure – examination at start-up and maintenance of infrastructure, Environment – survey of environmental risks and geological hazards, Water – mapping and survey of water supplies and Minerals – efficient exploration. Our offices and regional partners serve clients in 121 countries. The Guideline Geo AB share (GGEO) is listed on NGM Equity.

GUIDELINEGEO

GUIDELINE GEO
Löfströms Allé 6A
SE-172 66 Sundbyberg, Sweden
Tel: +46 8 557 613 00
sales@guidelinegeo.com
www.guidelinegeo.com

MALÅ GEOSCIENCE
Skolgatan 11
SE-930 70 Malå, Sweden
Tel: +46 953 345 50
sales@guidelinegeo.com
www.guidelinegeo.com

ABEM INSTRUMENT
Löfströms Allé 6A
SE-172 66 Sundbyberg, Sweden
Tel: +46 8 564 883 00
sales@guidelinegeo.com
www.guidelinegeo.com

MALÅ GEOSCIENCE USA
465 Deanna Lane
Charleston, South Carolina 29492, USA
Tel: +1 843 852 5021
sales@guidelinegeo.com
www.guidelinegeo.com

GEOPHYSICS GPR INTERNATIONAL INC.

GEOPHYSICAL INVESTIGATION FOR BAFFINLAND RAILWAY, MARY RIVER PROJECT, NUNAVUT

PREPARED FOR:

Baffinland Iron Mines Corporation

Presented to:

4342 Queen Street, Suite 500
Niagara Falls, Ontario
L2E 7J7

May 2018

Geophysics GPR International Inc.
6741 Columbus Road, Unit 14
Mississauga (Ontario) L5T 2G9
Tel. : +1 905.696.0656
info@geophysicsgpr.com
May 2018 T-18552

TABLE OF CONTENTS

Index of Figures

Index of Tables

List of Appendices

1 INTRODUCTION

Geophysics GPR International Inc. was requested by Hatch Ltd. to carry out a geophysical survey to aid in projection and planning of a proposed railway for the Mary River Project, Baffin Island, Nunavut.

The purpose of this investigation was to determine the extent of, as well as the thickness of subsurface ice.

The ground penetrating radar (georadar) method was applied to determine the presence of ice and calculate its thickness.

Data was collected from April 16 to May 2, 2018.

The investigation included the following:

1. Georadar mapping of subsurface ice at seven sites across the 'deviation' of the proposed rail alignment.
2. Further exploration with gridded georadar lines were conducted in regions of ice to delineate the extent.

Figure 1 presents an overview map of the investigation area with the locations of the respective sites.

The following report describes the various aspects of the survey including field techniques, survey design, interpretation techniques, and finally an interpretation in the form of ice thickness maps.

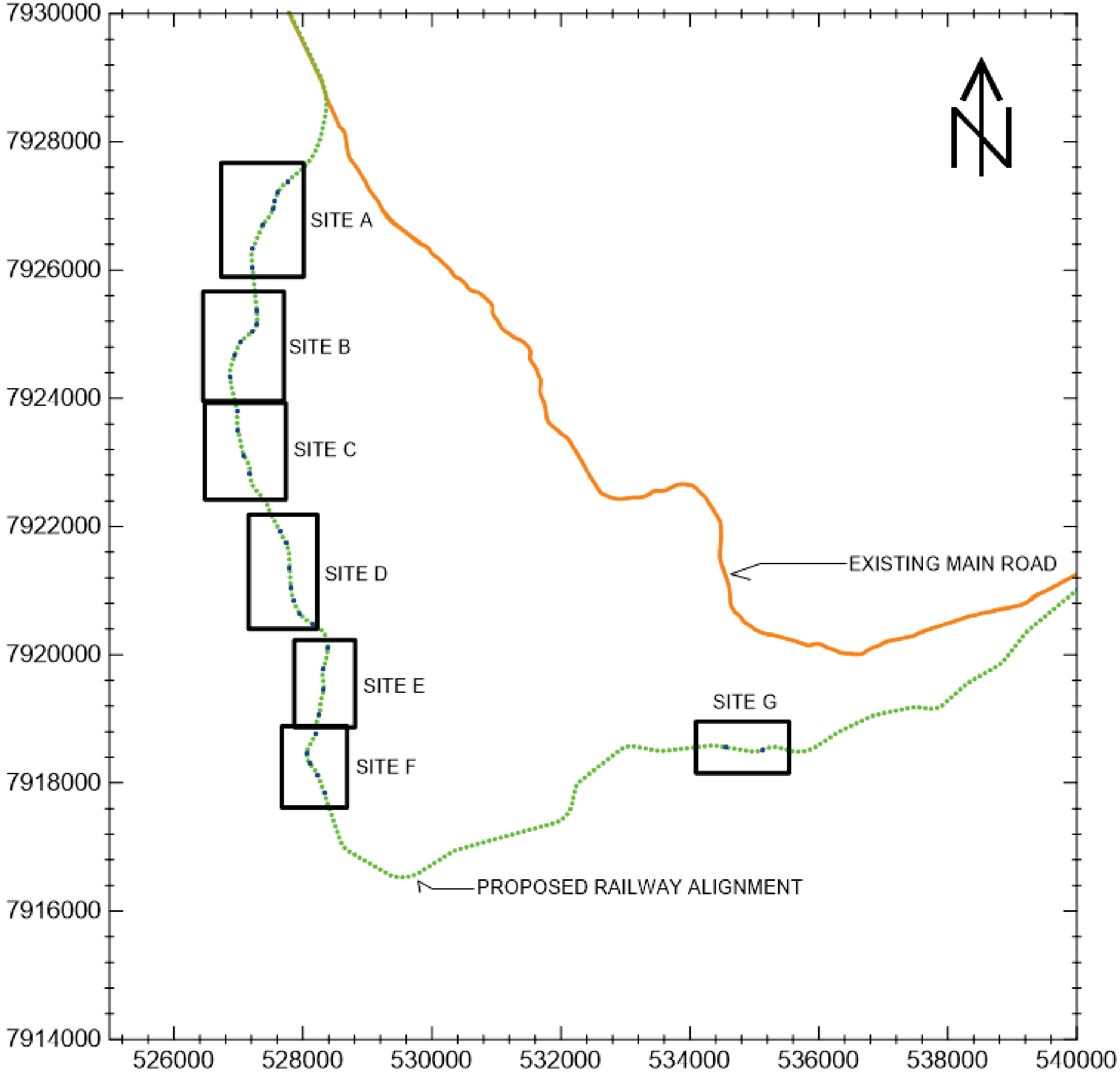


Figure 1: Overview map of the investigation area

2 METHODOLOGY

2.1 Positioning, Topography and Units of Measurement

The emplacement of the survey areas was determined by the client.

The locations of the georadar survey lines for the purpose of subsurface ice mapping were oriented to align with the design of the proposed railway. Length and number of the lines were chosen based on in-field interpretation of georadar data. Positioning was controlled by the GPS device integrated into the georadar antenna. The UTM coordinates should be accurate to within +/- 2.0 m.

Table 1: UTM coordinates of GPR survey lines

Point	Chainage	Northing	Easting
Site A			
a	58.9	7927382.002	527756.0006
b	59.1	7927213.037	527611.0001
c	59.2	7927079.046	527557
d	59.3	7926949.981	527539.0009
e	59.7	7926703.946	527376.0013
f	60.1	7926329.02	527225.0004
Site B			
a	60.4	7926033.002	527218.0006
b	61	7925358.001	527285.0006
c	61.2	7925154.024	527288.0003
d	61.4	7925033.038	527212.0001
e	61.6	7924885.943	527029.0013
f	61.9	7924671.045	526944
g	62.2	7924334.034	526861.0002
h	62.7	7923796.949	526977.0012
i	63	7923502.003	526993.0006
j	63.5	7923106.979	527087.0009

k	63.8	7922823.019	527178.0004
Site C			
a	64.7	7921919.978	527644.0009
b	64.9	7921741.995	527734.0007
Site D			
a	65.3	7921350.032	527795.0002
b	65.6	7921050.977	527812.0009
Site E			
A	65.8	7920854.939	527851.0014
B	66	7920630.979	527956.0009
c	66.3	7920475.027	528152.0003
Site F			
a	66.9	7920106.987	528386.0008
b	67.2	7919773.977	528306.0009
c	67.5	7919452.95	528323.0013
d	68	7919071.027	528247.0003
e	68.3	7918765.022	528193.0003
f	68.6	7918471.991	528056.0007
g	68.7	7918297.02	528103.0002
h	69	7918131.944	528231.0014
i	69.3	7917838.974	528329.001
Site G			
a	77.4	7918561.942	534544.0017
b	78	7918521.023	535132.0004

The provided coordinates are NAD83/WGS84, UTM zone 17N.

The depth measurements are noted as depth from surface.

All geophysical measurements were collected in SI units.

In addition to Table 1, further georadar survey lines were created to further explore the given areas. These additional survey lines were generated in a grid-like fashion with the topography dictating the spacing of the lines.

2.2 Ground Penetrating Radar (Georadar)

Basic Theory

Georadar utilises radar technology to obtain a near-continuous profile of the subsurface. The basic principle is to emit an electromagnetic impulse into the ground at a predetermined frequency rate (typically 10 to 80 scans/second). This pulse will travel through the sub-surface and reflect off boundaries of differing dielectric constants (contrasts of EM impedances). The reflected pulse returns to the surface and is recorded by a receiver and displayed in real-time as a cross-sectional image. Only by moving the antennas along a profile directly over the targets can the locations and depths be determined. Examples of radar reflecting boundaries include air/water (water table); water/earth (bathymetry); earth/metal, PVC, or concrete (pipe locating); and differing earth materials (stratigraphic profiles, including bedrock profiles).

The depth of investigation is controlled by the frequency and power of the antenna limited by attenuation and diffraction of the radar signal. Lower frequency antennas provide greater depth penetration at the expense of resolution. The radar signal is attenuated by conductive ground materials (e.g. clays, dissolved salts etc.). The radar signal is diffracted by irregular shaped material (e.g. boulders, debris etc.) that prevents the clear return of the reflected pulse.

More information on the georadar operating principle can be found in Appendix B.

Survey Design

The georadar data were collected with a MALA Ground Explorer system and 160 MHz antenna. This antenna provides a favourable trade off between depth and resolution for ice detection. As well, this antenna has sufficient durability for the terrain and weather conditions for Baffin Island.

Positioning for the georadar survey was controlled by built-in GPS receiver.

Interpretation Method

Processing of the radar images involved basic horizontal normalization, elevation corrections and gain adjustments.

The vertical scale on all radar images is a two-way time scale representing the time taken for a radar pulse to transmit to a reflector and back to the receiver. In order to convert the time scale to a depth scale a signal velocity must be applied. The velocity with which the pulse travels through the given material is determined by the dielectric constant. This dielectric will vary with the type of material.

Calculating a velocity can be done in many ways but the most reliable method is with a test pit or borehole where the real rock contact can be exposed. Based on in-situ measurements or borehole data, the dielectric value can be approximated depending on the expect material type.

An underestimate of the dielectric will result in an over estimate of the signal velocity and in turn an over estimate of the depths. For this site a dielectric of 4 (velocity of 15 cm/ns) was assumed based on the expected soil type and tables of relative dielectric values for commonly encountered materials. In this case the materials were mostly frozen granular/boulders with high ice content.

Interpretation of the data is based primarily on the qualitative analysis of three characteristics of radar reflections: continuity, amplitude and shape. The interpreter then identifies reflectors and textures within the radar records that represent subsurface contacts, objects or zones. The true nature of the interpreted features can only be assumed without corroborating evidence.

Ice bodies have a distinctive appearance on radar images. Granular host material appears as "noise" on the images, whereas uniform ice layer looks transparent with clearly defined top and bottom contacts and can be confidently identified. An example of a uniform ice lens is presented in Figure 2.

Non-uniform ice bodies (stratified or containing layers of soil) are more challenging for interpretation since structure irregularities create multiple reflections within the ice body. Often a borehole is needed to confirm the presence of ice. Other features such as increasing depth of investigation in the presence of thick ice layer may corroborate the interpretation.

In summary, ability of georadar is limited by the structure of the ice layer being surveyed and its composition. The identification of an ice layer may be impacted by irregularities inside the ice body, such as layering, fractures and soil inclusions. However, it is possible to create two categories of ice lenses, the obvious and less obvious that may need some ground truthing.

3 RESULTS

3.1 Subsurface Ice Mapping

Georadar data was collected at seven sites along the proposed railway deviation. Most sites collected were in the Western region (Sites A – F).

Locations of the survey lines and results of the georadar survey are presented in drawings GPR18_SITE_A, GPR18_SITE_B, GPR18_SITE_C, GPR18_SITE_D, GPR18_SITE_E, and GPR18_SITE_F.

GPR18_SITE_A

Thin ice lenses were possibly detected – neither the shape nor reflection of georadar data appeared well. This could possibly indicate an ice lens with poor homogeneity or structural breakages. Area was explored with subsequent radar profiles; data continued to be generally poor in this area. Estimation of ice depth from surface; 5-8m.

GPR18_SITE_B

The data indicates a considerable amount of ice in this area with varying thickness. The thickest region appeared to have a 12m thick chunk. Estimation of ice depth from surface; 4 to 9m. Topography constrained ability to delineate further.

GPR18_SITE_C

Region appears rich in ice – delineation was able to encapsulate lenses. Estimation of ice depth from surface; 7 to 9m.

GPR18_SITE_D

Region appears to have shallow and small ice lenses. Estimation of ice depth from surface; 4 to 5m.

GPR18_SITE_E

Single possible ice lens found and delineated. Topography limited the amount of delineation possible. Estimation of ice depth from surface; 4 to 5m.

GPR18_SITE_F

Possible ice lenses found in area – region had poor signal attenuation. Topography also limited the amount of delineation possible. Estimation of ice depth from surface; 6m.

No ice found in Eastern end of delineation, chainage 77.4 to 78km.

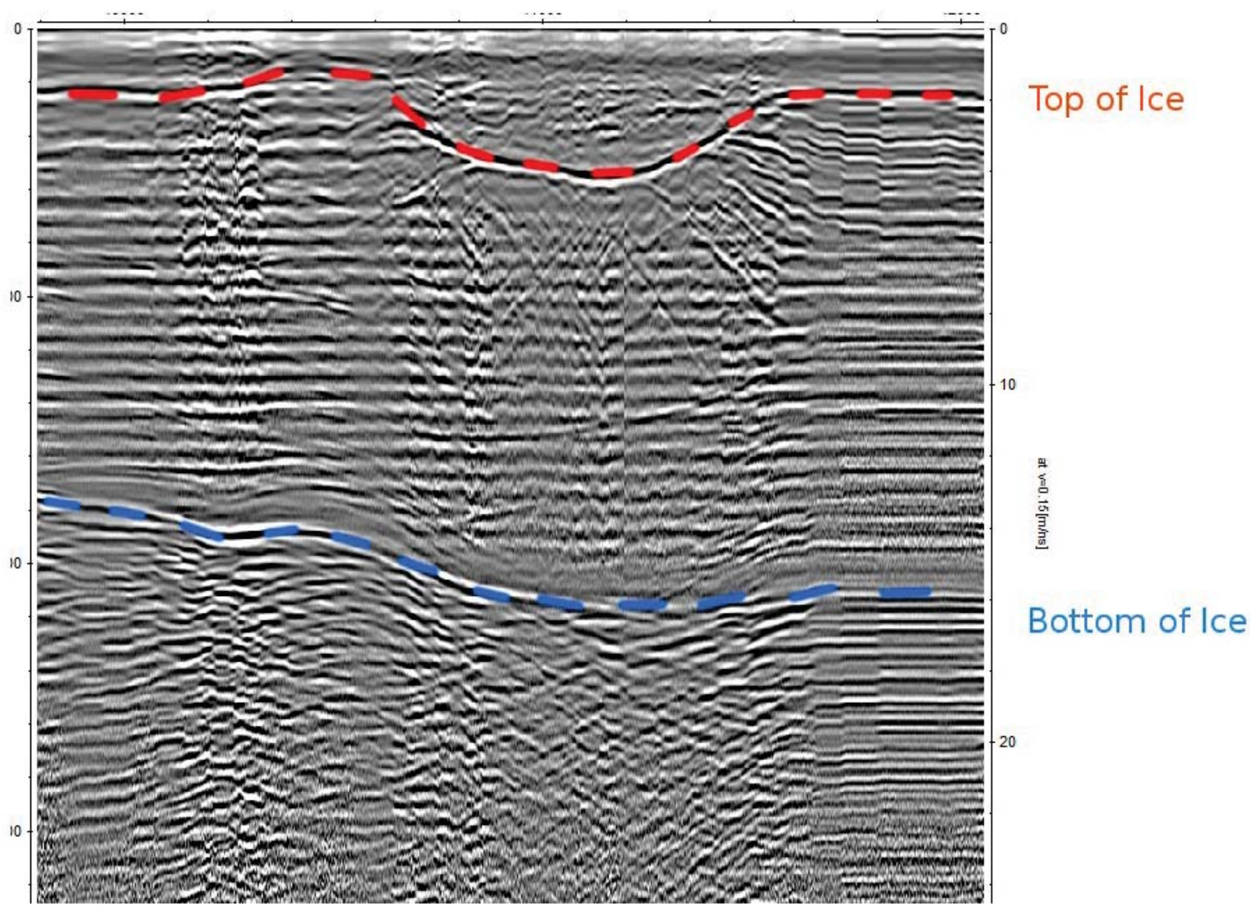


Figure 2: *Interpreted georadar image showing a typical ice body*

4 CONCLUSIONS

A geophysical investigation involving Georadar was carried out at the Mary River Project, Baffin Island, Nunavut.

Subsurface ice mapping was carried out at nine sites along the proposed rail alignment. Results of the survey are presented in Drawings GPR18_SITE_A, GPR18_SITE_B, GPR18_SITE_C, GPR18_SITE_D_GPR18_SITE_E, and GPR18_SITE_F.

Interpretation of the geophysical data has been performed by Mauritz van Zyl. This report has been written by Milan Situm, P.Geo.

Milan Situm, P.Geo.
Manager

APPENDIX A

DRAWINGS

GPR18_SITE_A

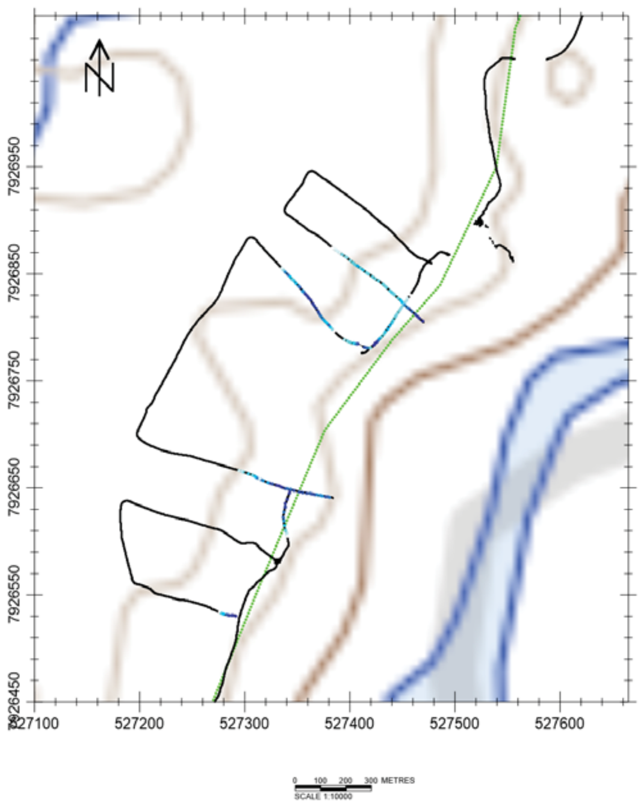
GPR18_SITE_B

GPR18_SITE_C

GPR18_SITE_D

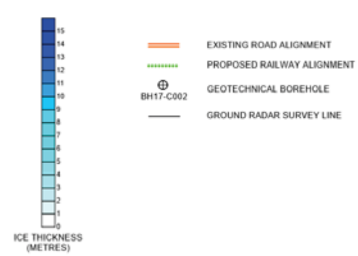
GPR18_SITE_E

GPR18_SITE_F



OVERVIEW MAP

LEGEND



No	NOTES	No	DATE	MODIFICATIONS	GPR APP
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. APRIL 2018				
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W				
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS				
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES				
5					
6					

SCEAU PROFESSIONNEL

PROFESSIONAL SEAL

GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR / DRAWN BY: M. van Zyl

VÉRIFIÉ PAR / CHECKED BY:

APPROUVÉ PAR / APPROVED BY: M.Shum, P. Geo

CONTRAT / CONTRACT #: T17001

ÉCHELLE / SCALE: AS SHOWN

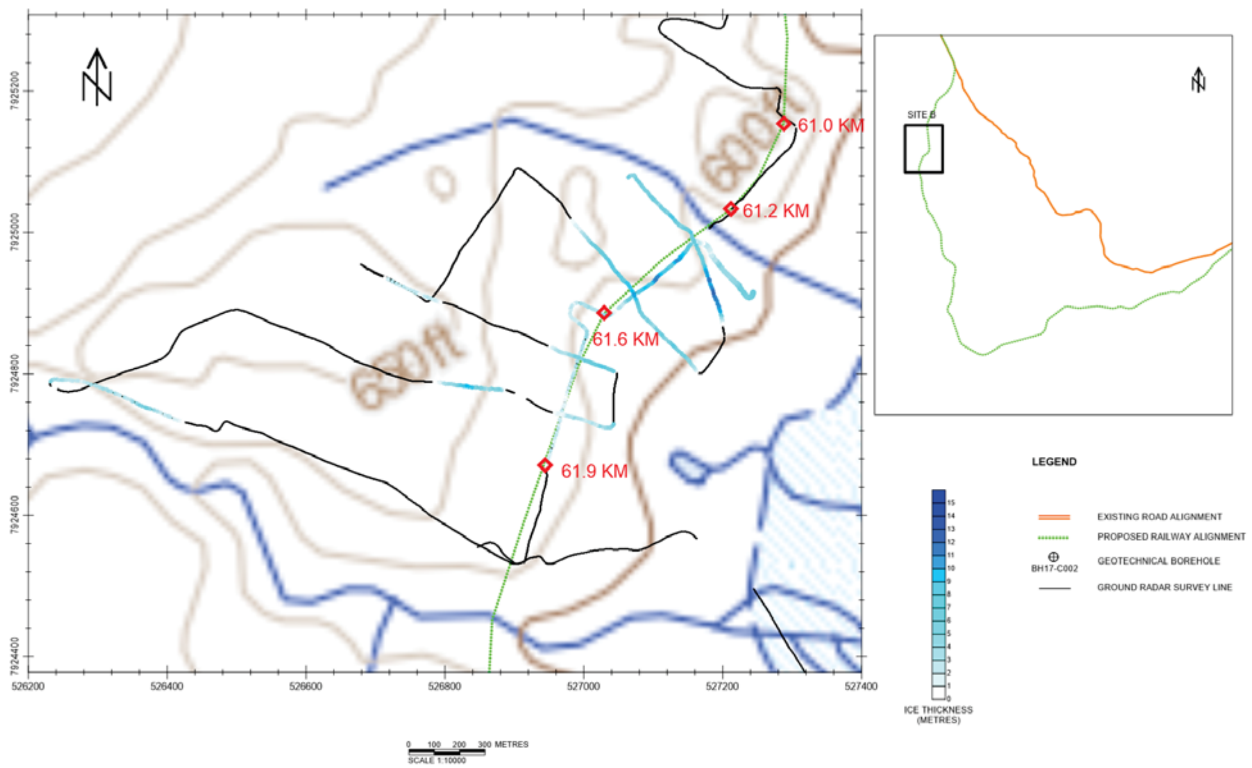
DESSIN / DRAWING #: T17001-A2-3

CLIENT / CLIENT: HATCH

PROJET / PROJECT: BAFFINLAND EXPANSION

TITRE / TITLE: GROUND RADAR SURVEY GPR18 - SITE A

OVERVIEW MAP



No	NOTES	No	DATE	MODIFICATIONS	GPR APP
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. APRIL 2018				
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W				
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS				
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES				
5					
6					

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

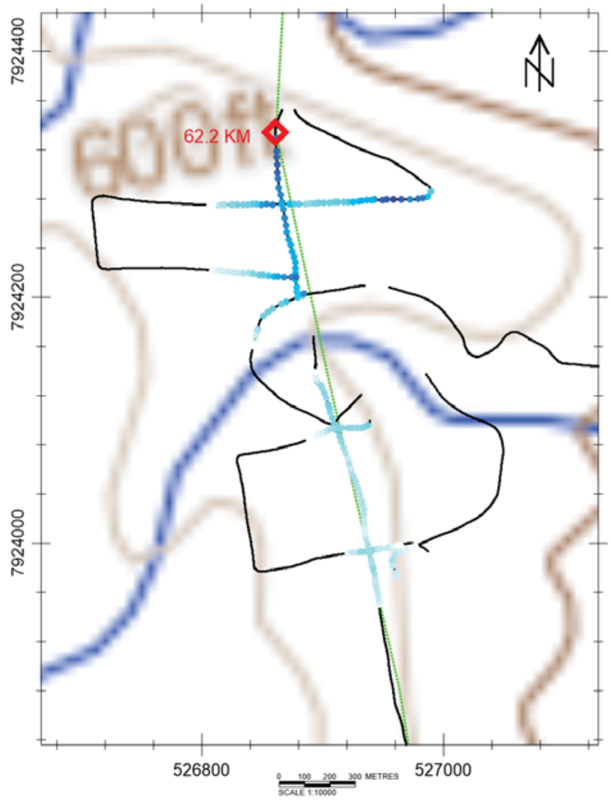
GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR / DRAWN BY	M. van Zyl
VÉRIFIÉ PAR / CHECKED BY	
APPROUVÉ PAR / APPROVED BY	M.Situm, P. Geo
# CONTRAT / CONTRACT #	T17001
ÉCHELLE / SCALE	AS SHOWN
# DESSIN / DRAWING #	T17001-A2-3

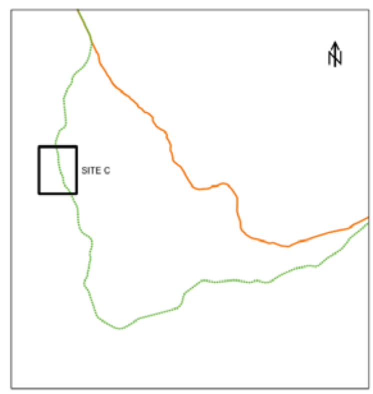
CLIENT: **HATCH**

PROJET / PROJECT: **BAFFINLAND EXPANSION**

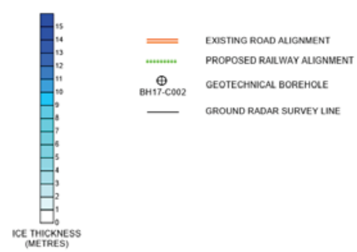
TITRE / TITLE: **GROUND RADAR SURVEY GPR18 - SITE B**



OVERVIEW MAP



LEGEND



No	NOTES	No	DATE	MODIFICATIONS	GPR APP
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. APRIL 2018				
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W				
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS				
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES				
5					
6					

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

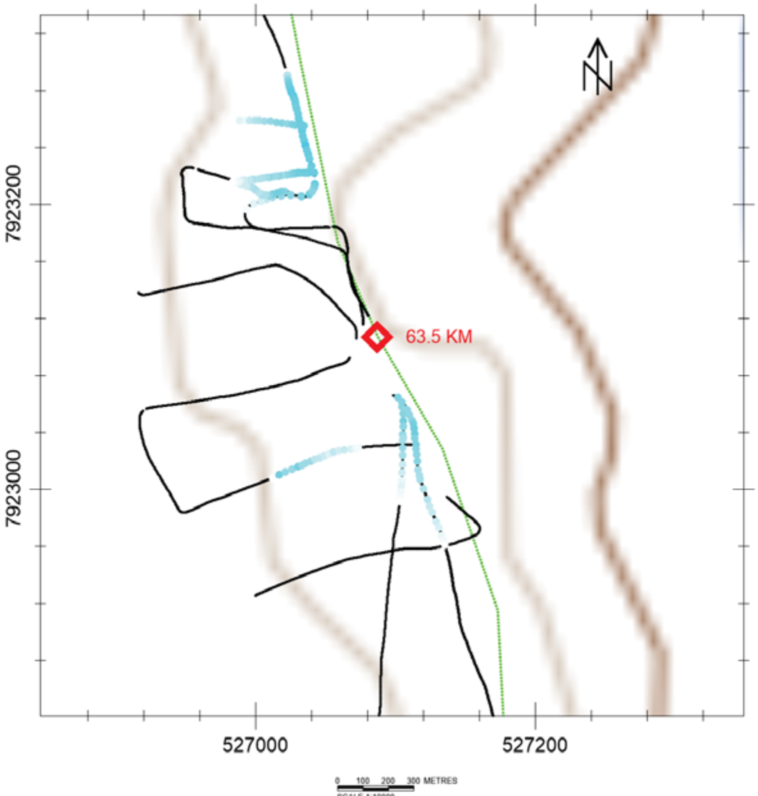
GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR / DRAWN BY	M. van Zyl
VÉRIFIÉ PAR / CHECKED BY	
APPROUVÉ PAR / APPROVED BY	M.Situm, P. Geo
# CONTRAT / CONTRACT #	T17001
ÉCHELLE / SCALE	AS SHOWN
# DESSIN / DRAWING #	T17001-A3-3

CLIENT / CLIENT: HATCH

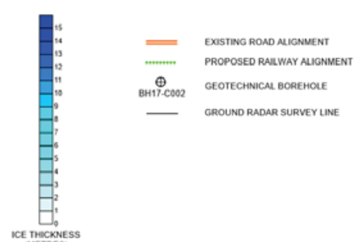
PROJET / PROJECT: BAFFINLAND EXPANSION

TITRE / TITLE: GROUND RADAR SURVEY
GPR18 - SITE C



OVERVIEW MAP

LEGEND



No	NOTES	No	DATE	MODIFICATIONS	GPR APR
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. APRIL 2018				
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W				
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS				
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES				
5					
6					

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR / DRAWN BY: M. van Zyl

VÉRIFIÉ PAR / CHECKED BY:

APPROUVÉ PAR / APPROVED BY: M. Situm, P. Geo

CONTRAT / CONTRACT: #T17001

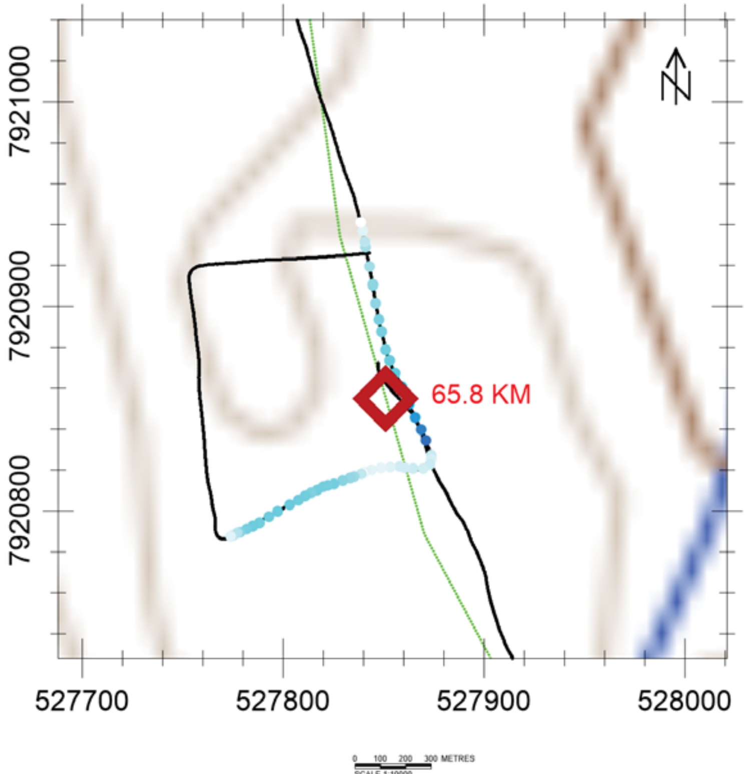
ÉCHELLE / SCALE: AS SHOWN

DESSIN / DRAWING: 1-A2-3

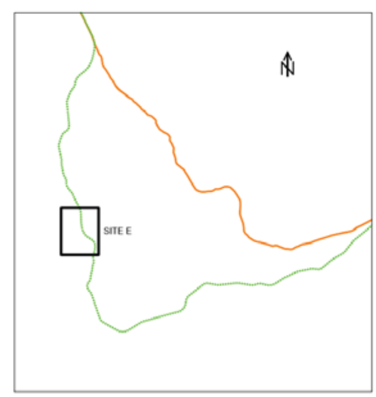
CLIENT: HATCH

PROJET / PROJECT: BAFFINLAND EXPANSION

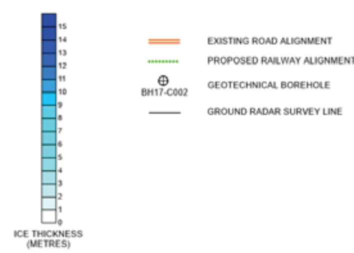
TITRE / TITLE: GROUND RADAR SURVEY GPR18 - SITE D



OVERVIEW MAP



LEGEND



No	NOTES	No	DATE	MODIFICATIONS	GPR APP
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. APRIL 2018				
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W				
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS				
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES				
5					
6					

SCEAU PROFESSIONNEL / PROFESSIONAL SEAL

GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR / DRAWN BY: M. van Zyl

VÉRIFIÉ PAR / CHECKED BY:

APPROUVÉ PAR / APPROVED BY: M. Situm, P. Geo

CONTRAT / CONTRACT #: T17001

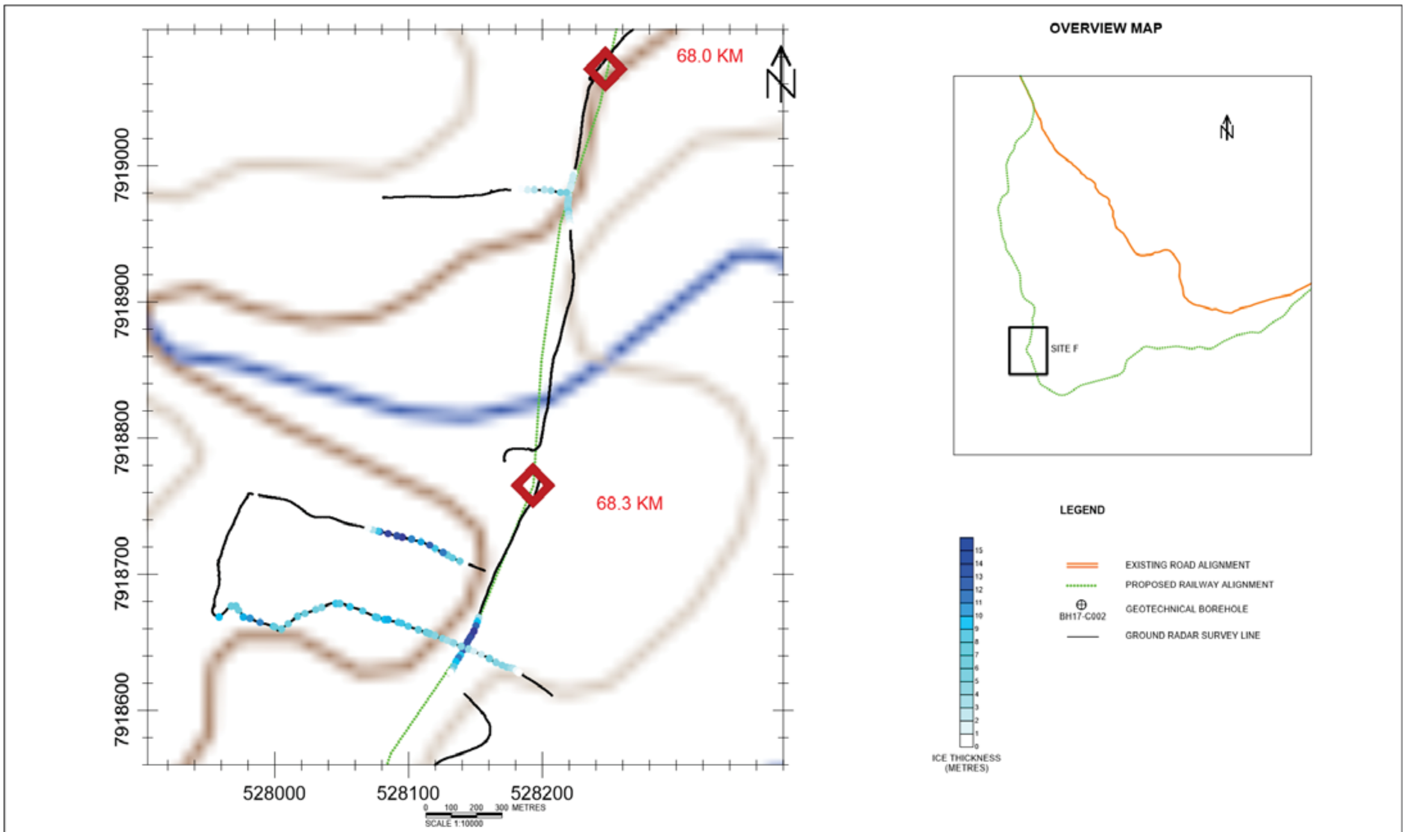
ÉCHELLE / SCALE: AS SHOWN

DESSIN / DRAWING #: 001-A2-3

CLIENT: HATCH

PROJET / PROJECT: BAFFINLAND EXPANSION

TITRE / TITLE: GROUND RADAR SURVEY GPR18 - SITE E



No	NOTES
1	THE RADAR SURVEY WAS EXECUTED BY GEOPHYSICS GPR INTERNATIONAL INC. APRIL 2018
2	COORDINATE SYSTEM: WGS84 UTM ZONE 17W
3	REFER TO FULL REPORT FOR DISCUSSION OF METHODOLOGIES, RESULTS AND LIMITATIONS
4	BOREHOLE DATA PROVIDED BY THE CLIENT FOR REFERENCE PURPOSES
5	
6	

GEOPHYSICS GPR INTERNATIONAL INC.

DESSINÉ PAR / DRAWN BY: M. van Zyl
VERIFIÉ PAR / CHECKED BY:
APPROUVÉ PAR / APPROVED BY: M. Situm, P. Geo
CONTRAT / CONTRACT #: T17001
ÉCHELLE / SCALE: AS SHOWN
DRAWING #: 04-T17001-A2-3

CLIENT: HATCH

PROJET / PROJECT: BAFFINLAND EXPANSION

TITRE / TITLE: GROUND RADAR SURVEY GPR18 - SITE F

APPENDIX B

Additional Georadar information

GUIDELINEGEO

MALÅ GroundExplorer

GROUND PENETRATING RADAR

GPR with exceptional range and resolution

MALÅ GroundExplorer (GX) is an integrated GPR solution with four MALÅ GX antenna options: GX80, GX160, GX450 and GX750. Through unique hyperstacking HDR technology, MALÅ GX offers significantly faster data acquisition rates, with outstanding signal-to-noise ratio and depth penetration. An easy-to-use GPR solution on a rugged platform, with excellent detection capabilities for a wide range of applications.

MALÅ GX CONTROLLER

Processor	1.6 GHz Intel Atom
Display	1024 x 768 mm
OS	Linux
Memory	8 GB compact Flash memory
Data output resolution	32 bit
Comms	Ethernet, WiFi (optional), USB 3.0, RS232 (serial)
GPS	Integrated support for built-in GPS, or external GPS via USB/serial port (NMEA 0183 protocol)
Power supply	Internal 12V/20.8 Ah Li-Ion battery, or any external 10-15 V DC source
Charger	Internal. Unit can also be charged from any external 12 - 15 V DC source
Power consumption	1.3 – 2.0 A
Operating time	8 – 10 h
Dimensions	326 x 216 x 92 mm including handles 326 x 216 x 52 mm excluding handles
Weight	3.2 kg
Operating temp	- 20° to + 50° C or 0° to 120° F
Environmental	IP 65

GX WIFI OPTION

Wireless standard:	IEEE802.11 g
Power consumption:	0,3 A

MALÅ

MALÅ GX ANTENNAS

MALÅ GX750 HDR

Technology	MALÅ Semi-Real- Time pat pending
Antenna center freq.	750 MHz
SNR	97 dB
No. of bits	16 bit
Scans/second	> 1290, time window 75 ns
Survey speed	460 [km/h] point distance 10 cm
Bandwidth	120%, fractional, -10 dB
Time window	75 ns
Positioning	Built-in DGPS, external GPS (NMEA 0183 protocol), wheel encoder
Operating time	5 h
Power supply	Interchangeable 12 V Li-Ion batt. or ext. 12 V DC source
Power consumption	1.3 A
Acq. mode	Wheel, time or manual
Dimensions	375 x 235 x 170 mm
Weight	3.6 kg
Operating temp.	- 20° to + 50° C or 0° to 120° F
Environmental	IP 65

MALÅ GX450 HDR

Technology	MALÅ Semi-Real-Time pat pending
Antenna center freq.	450 MHz
SNR	101 dB
No. of bits	> 16 bit
Scans/second	> 770, time window 300 ns
Survey speed	275 [km/h] point distance 10 cm
Bandwidth	>120%, fractional, -10 dB
Time window	300 ns
Positioning	Inbuilt DGPS, external GPS (NMEA 0183 protocol), wheel encoder
Operating time	5 h
Power supply	Interchangeable 12 V Li-Ion batt. or ext. 12 V DC source
Power consumption	1.3 A
Acq. mode	Wheel, time or manual
Dimensions	430 x 360 x 180 mm
Weight	5.5 kg
Operating temp.	- 20° to + 50° C or 0° to 120° F
Environmental	IP 65

MALÅ GX160 HDR

Technology	MALÅ Semi-Real-Time pat pending
Antenna center freq.	160 MHz
SNR	> 107 dB
No. of bits	> 17 bit
Scans/second	> 880, time window 625 ns
Survey speed	320 [km/h] point distance 10 cm
Bandwidth	>120 %, fractional, -10 dB
Time window	625 ns
Positioning	Inbuilt DGPS, external GPS (NMEA 0183 protocol), wheel encoder
Operating time	5 h
Power supply	Interchangeable 12 V Li-Ion batt. or ext. 12 V DC source
Power consumption	1.3 A
Acq. mode	Wheel, time or manual
Dimensions	720 x 480 x 190 mm
Weight	10.7 kg
Operating temp.	- 20° to + 50° C or 0° to 120° F
Environmental	IP 65

MALÅ GX80 HDR

Technology	MALÅ Semi-Real-Time pat pending
Antenna center freq.	80 MHz
SNR	> 114.4 dB
No. of bits	> 19 bit
Scans/second	> 1200, time window 812 ns
Survey speed	430 [km/h] point distance 10 cm
Bandwidth	>120 %, fractional, -10 dB
Time window	812 ns
Positioning	Built-in DGPS, external GPS (NMEA 0183 protocol), wheel encoder
Operating time	5 h
Power supply	Interchangeable 12 V Li-Ion batt. or ext. 12 V DC source
Power consumption	1.3 A
Acq. mode	Wheel, time or manual
Dimensions	1010 x 780 x 220 mm
Weight	24,6 kg
Operating temp.	- 20° to + 50° C or 0° to 120° F
Environmental	IP 65

ABEM | MALÅ

__Guideline Geo__ is a world-leader in geophysics and geo-technology offering sensors, software, services and support necessary to map and visualize the subsurface. Guideline Geo operates in four international market areas: Infrastructure – examination at start-up and maintenance of infrastructure, Environment – survey of environmental risks and geological hazards, Water – mapping and survey of water supplies and Minerals – efficient exploration. Our offices and regional partners serve clients in 121 countries. The Guideline Geo AB share (GGEO) is listed on NGM Equity.

GUIDELINEGEO

GUIDELINE GEO
Löfströms Allé 6A
SE-172 66 Sundbyberg, Sweden
Tel: +46 8 557 613 00
sales@guidelinegeo.com
www.guidelinegeo.com

MALÅ GEOSCIENCE
Skolgatan 11
SE-930 70 Malå, Sweden
Tel: +46 953 345 50
sales@guidelinegeo.com
www.guidelinegeo.com

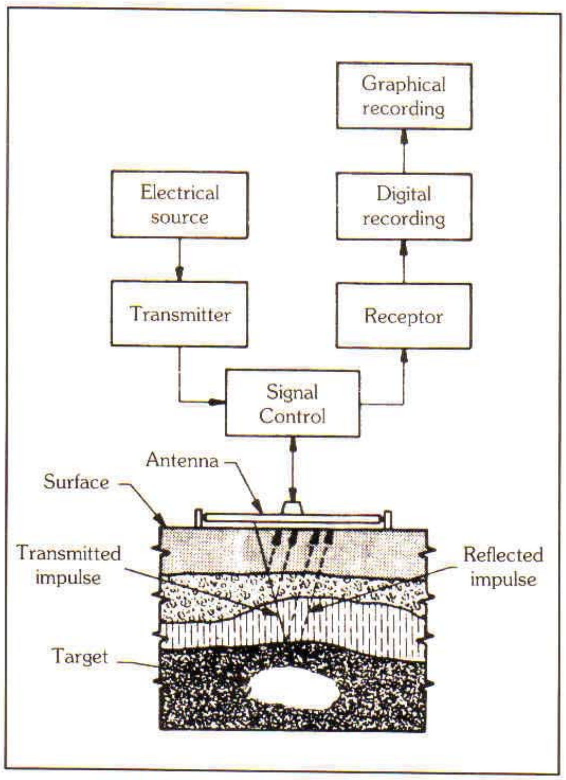
ABEM INSTRUMENT
Löfströms Allé 6A
SE-172 66 Sundbyberg, Sweden
Tel: +46 8 564 883 00
sales@guidelinegeo.com
www.guidelinegeo.com

MALÅ GEOSCIENCE USA
465 Deanna Lane
Charleston, South Carolina 29492, USA
Tel: +1 843 852 5021
sales@guidelinegeo.com
www.guidelinegeo.com

GEOPHYSICS G P R INTERNATIONAL INC.

GEORADAR

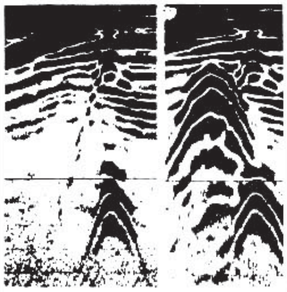
As indicated by its name, georadar combines high resolution radar with geology. The underlying principle is based on the propagation of electromagnetic wave impulses (VHF) that are reflected by anomalies in the terrain (joints, irregularities, interfaces, etc.) at different depths, and then captured by the antenna. The georadar records the time taken by each transmitted signal to complete the cycle in order to calculate the depth of the anomaly. The result is similar to a seismic reflection profile where all the reflections are displayed graphically. This technique is used to solve problems for which there had previously been no practical solution.



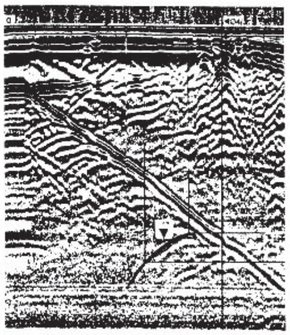
PRINCIPLES OF GEORADAR

FEATURES

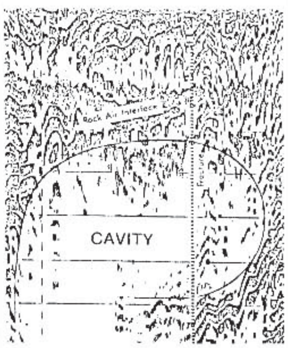
- Penetration of more than 20 metres in certain materials (penetration being inversely proportional to conductivity).
- Surveying in continuous mode.
- Identification of objects measuring only a few centimeters.
- Light and manoeuvrable equipment.
- Detection of conductivity, open spaces and/or holes (cavities).
- Detection of breaks: faults, fractures, joints, cavities.
- Results similar to seismic reflection: continuous underground profile.
- Results available immediately.
- Can be used in land, sea or airborne surveys.



PIPES



JOINTS



CAVITIES

FIELDS OF APPLICATION

Civil Engineering / Mining Exploration-Exploitation / Research / Archaeology / Environment

- Geotechnology: investigation of soils and surface deposits.
- Optimal selection of anchor bolts in mines and quarries.
- Detection of buried pipes before beginning excavation.
- Detection of liquid or gas leakage in soils.
- Detection of cracks in concrete structures.
- Checking material homogeneity.
- Detection of cavities beneath road pavement.
- Determination of water saturation level.
- Detection of girders in reinforced concrete.
- Detection of pollutant leakage in water bodies.
- Inspection of buried disposal sites and or dangerous deposits.
- Continuous measurement of ice thickness.
- Archaeological research: ancient foundations, artifacts.
- Non-destructive method for measuring road pavement thickness.
- Localization and measurement of soil's thickness (swamps, peat bogs).
- Determination of rock beddings (location and thickness).
- Bathymetric studies (depth sounding).
- Calculation of the thickness of permafrost and ice.
- Geotechnical studies for the installation of aqueducts.

SPECIAL FEATURES

The equipment is practical, easy to manoeuvre, and multi-faceted. The field of application of georadar continues to expand in various sectors, particularly in geotechnology (aqueducts), civil engineering (excavation, structures) and mining (structures).

GEOPHYSICS G P R INTERNATIONAL INC.