City of Iqaluit

Geotechnical Investigation
Northwest Granular Deposit, Iqaluit, Nunavut

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Project Name:
Geotechnical Investigation – Northwest Granular Deposit

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OTT-00219428-A0

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Date Submitted
January 29, 2016

City of Iqaluit

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Executive Summary

Exp Services Inc. (**exp**) has carried out a geotechnical investigation of the Northwest Granular Deposit (Northwest Deposit), located approximately 6 km northwest from the nearest existing road within the City of Iqaluit, NU. The purpose of the geotechnical investigation was to quantify and classify the quality of granular material present is support of general decisions on the viability of the deposit for development.

In 2005, Indian and Northern Affairs Canada (now Aboriginal and Northern Development of Canada (AANDC)) had a granular aggregate assessment carried out to identify potential borrow sources within a 10 km radius of the City of Iqaluit. The assessment consisted of air photo interpretation and preliminary site reconnaissance. Two distinct areas were identified northwest of the city: the Trail Area Deposit and the Northwest Deposit. The current area of interest within the Northwest Deposit begins at the south end of the overall deposit, extends approximately 3 km north and is approximately 0.5 km to 1 km wide. It is understood that the granular deposit is expected to extend a considerable distance further north/northwest based on the initial air photo interpretation carried out in 2005. To date however, only the current area of interest has been evaluated beyond that initial air photo interpretation to date.

Between May 7, 2015 and May 23, 2015 a total of twenty-five (25) boreholes were drilled throughout the south end of the Northwest Deposit using an air-track drill rig. A senior geotechnician from **exp** was on site to observe the drilling activities and log the subsurface conditions encountered. Disturbed samples of the soils encountered were obtained at 1 m intervals from the drill cuttings circulated to the surface during drilling. The boreholes were spaced approximately 100 m apart and drilled to depths ranging from 3.0 m to 7.0 m depth below current grade. Bulk samples were also gathered from the surface of the deposits during the investigation. The quality of the granular material encountered in the boreholes has been classified in accordance with Table 2 herein, which is intended to roughly categorize the materials encountered into suggested uses based on gradation and material strength.

It is noted that the drill method used is highly disruptive and larger gravels, cobbles and boulders have been broken down during drilling and show as smaller gravels, sand and possibly fines within the gradations presented and discussed herein. However, it is expected that this represents a level of conservatism with the results, as one of the primary intentions of the program is to confirm the presence of deposits rich with coarse aggregates and containing little to no fines (Class 1 and Class 2). Such deposits would be considered suitable for use in production of materials such as concrete aggregates, asphalt aggregates, surface coarse granulars, base coarse granulars, sub-base coarse granulars, winter sand, etc. It is expected that the actual gradations encountered in the field will be coarser and possibly contain less fines than presented herein, which should only be better for feeding production of such materials. The same would be true for the material identified as being appropriate for use as general subgrade and backfill material (Class 3); however, it is expected that these materials have been altered much less by the drilling method than the cobble and boulder rich granular layers above.

Observations made of the area without snow cover during previous site visits revealed that t is generally barren with little to no overburden. Based on our observations during drilling and our laboratory test results, the upper 1.0 m to 6.0 m of material throughout the areas investigated can be classified as

Class 1 – Excellent Quality Granular (less than 5 percent fines) and/or Class 2 – Good Quality Granular (less than 10 percent fines). It is estimated that this upper layer of excellent to good quality granular contains 20 percent to 40 percent cobbles and boulders (crushable rock) to potentially help fill gaps in gradation during crushing/processing. The layer of Class 1 and Class 2 granular was observed to be underlain by either Class 3 – Fair Quality Granular (less than 25 percent fines) or bedrock. The in-situ moisture content of the Class 3 material encountered was quite variable, with some ice-rich zones apparently present throughout the deposit. These zones of ice-rich Class 3 material may require excessive dry times to become usable. Additionally, massive ice lenses/wedges (pure ice) were encountered at depth within the Class 3 material in four of the twenty-five boreholes (16%). Therefore, care will be required during Pit Development as outlined below. At the time of the investigation the active layer was completely frozen. It is anticipated that the maximum active layer thickness throughout the area (late September to early October) would be in the range of 1.5 m to 2.5 m, depending on sun exposure, in-situ moisture of upper materials, etc.

Based on the above, the Northwest Deposit is recommended for development as a borrow source capable of meeting the City of Iqaluit requirements for the next 10 years and beyond. Class 1 and/or Class 2 material was encountered directly at the surface in twenty-four of the twenty-five boreholes. Similar material is visible throughout the majority of the remaining deposit as indicated by Aboriginal and Northern Development of Canada (AANDC) in 2005. The boreholes have verified the thickness of these surficial deposits is significant with an average thickness of 3.8 m throughout the area explored. Furthermore, additional material usable as general subgrade fill (Class 3 material) and/or blending with Class 1 and Class 2 to create desired gradations is present in mass quantities directly beneath the Class 1 and Class 2 layers.

The total estimated volume of usable borrow material within the area investigated by boreholes is between 834,854 m^3 to 1,063,000 m^3. It is noted that the estimated volumes presented above:

- Do not include the above-noted zones of ice-rich Class 3 material encountered, which represent another 125,660 m^3 to 160,000 m^3 of potentially usable material depending on the actual in-situ moisture contents encountered.
- Do not include the full thickness of Class 2 or Class 3 material encountered at many of the borehole locations, as drilling was ceased due to time constraints.
- Represents the area investigated by boreholes, which is approximately 25% of the total area investigated by EBA Engineering Ltd. (EBA) in 2006 and estimated to contain 7,941,000 m^3 of usable granular based on their GPR results.

Therefore, it is anticipated that the Northwest Deposit will easily provide access to over 1,000,000 m^3 of usable granular material and it is likely to provide access to over 1,000,000 m^3 of Class 1 Excellent Quality Granular and/or Class 2 Good Quality Granular material as defined herein.

With regards to Pit Development, care will be required during planning and excavation to assure that sufficient room is available within each individual section to allow for alternate site access if/when ice-rich Class 3 materials and/or zones of pure ice lenses/wedges are encountered at depth and exposed.

Exposing such materials will limit or eliminate site access through that area as the materials thaw and destabilize. This is understood to have been a major issue during development of the Trail Area Deposit. How to deal with such areas will depend on the topography of the individual deposits being excavated and surrounding area, as well as the thickness of the problem soils encountered. Therefore, it will require real time assessment and decision by qualified people with knowledge on quarrying permafrost soils successfully. In general, we would anticipate many possible scenarios with various potential solutions. We have outlined two possible scenarios and our envisioned solutions herein.

Although two distinct zones of buried ice lenses/wedges are discussed herein, it is anticipated that other such zones exist throughout the Northwest Deposit due to the nature of deposition and presence of permafrost. Therefore, monitoring and maintenance of site access roads will be required throughout the duration of Pit Development and must account for potential thawing of underlying ice-rich soils/pure ice and possible weakening/failure of road embankment side slopes. Problem areas must be addressed quickly once warning signs present themselves (i.e. development of soft ground, rutting, longitudinal tension cracks along embankment crests/slopes, sloughing of embankment slopes, etc.) to limit the effects of the issue as much as possible. Thawing of ice-rich soils and/or buried ice is expected to result in development of excess surface water, which will need to be dealt with constantly and quickly removed. Surface water should not be allowed to flow or pond over or adjacent to areas where access is required, as the presence of this warm water will exhilarate permafrost degradation and exacerbate the situation.

Further discussion on how best to deal with this potential issue during Pit Development will be required at the planning stage and considering the interests of all parties (owner, engineering team, contractor, etc.). However, this is considered more of a contractual and planning issue, and should not affect the ability of the City of Iqaluit to extract well over 10 years supply of excellent to fair quality granular material from the Northwest Deposit.

The above and other related recommendations have been discussed in greater detail in the report.

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1 Introduction

Exp Services Inc. (**exp**) has carried out a geotechnical investigation of the Northwest Granular Deposit (Northwest Deposit), located approximately 6 km northwest from the nearest existing road within the City of Iqaluit, NU. The purpose of the geotechnical investigation is to quantify and classify the quality of granular material present to support general decisions on the viability of the deposit for development.

The current area of interest within the Northwest Deposit begins at the south end of the overall deposit, extends approximately 3 km north and is approximately 0.5 km to 1 km wide. It is understood that the granular deposit is expected to extend a considerable distance further north/northwest based on the initial air photo interpretation carried out in 2005. However, only the current area of interest has been evaluated beyond that initial air photo interpretation, as outlined below.

The terms of reference for the geotechnical investigation outlined herein were as follows:

i. Review of available information.

ii. Confirm the presence of 10 year supply of suitable borrow material within the deposit, estimated at 10,000 m^3 of borrow material per year, or 100,000 m^3 of borrow material total.

iii. Carry out laboratory testing program to classify the quality of the material for various potential uses and estimate the volume of materials present within the deposit.

iv. Provide a geotechnical investigation report summarizing the laboratory test results, approximate material quality classifications, approximate volumes available throughout the area investigated and preliminary comments and recommendations regarding potential development of the deposit.

2 Project Background

2.1 Previous Investigation of the Northwest and Trail Area Deposits

In 2005, Indian and Northern Affairs Canada (now Aboriginal and Northern Development of Canada (AANDC)) had a granular aggregate assessment carried out to identify potential borrow sources within a 10 km radius of the City of Iqaluit. The assessment consisted of air photo interpretation and preliminary site reconnaissance. Two distinct areas were identified northwest of the city: the Trail Area Deposit and the Northwest Deposit. In 2006, further evaluation of the two deposits was carried out by AANDC and EBA Engineering Ltd. (EBA). Representatives from AANDC visited the deposits to carry out surficial mapping and excavate a series of shallow hand dug test pits (less than 0.6 m deep) using a shovel. The test pits were excavated at an approximate spacing of 100 m along each deposit and samples recovered for laboratory testing. Representatives from EBA then visited the areas to carry out ground penetrating radar (GPR) throughout the same deposits. Based on the GPR findings, EBA provided preliminary volume estimates for a well sorted fluvial gravel and sand layer, and underlying glacial till layer. The GPR survey carried out by EBA covered an overall area of about 128,000 m^2 within the Trail Area Deposit and 1,000,000 m^2 within the Northwest Deposit. Based on their assessment EBA estimated the Trail Area Deposit contained 599,000 m^3 of well-sorted gravel and sand, underlain by 3,248,000 m^3 of unsorted till material. EBA's estimates for the Northwest Deposit included 4,631,000 m^3 of well-sorted gravel and sand, underlain by 3,310,000 m^3 of unsorted till material.

Additionally, a borehole drill program was carried out and reported by Naviq Consulting Inc. (Naviq) in 2011 to assess an apparent massive ice body (or bodies) at the Trail Area deposit, as discussed below.

2.2 Buried Ice in the Trail Area Deposit

Development of the Trail Area Deposit began in 2010. During development, it was discovered that ice lenses/wedges were present at depth throughout portions of the deposit. The buried ice created access issues and combined with the setbacks between leased areas, resulted in the usable volume being much less than anticipated based on the above-noted preliminary investigation. Therefore, a geotechnical borehole program was undertaken by Naviq in 2011 to further assess the extent of buried ice within the deposit. Given the history with the Trail Area Deposit, it was considered necessary to carry out a similar geotechnical investigation and confirm the viability of the Northwest Deposit as a long-term source before the road is extended to this location.

3 Procedure

3.1 Drill Program

Between May 7, 2015 and May 23, 2015 a total of twenty-five (25) boreholes were drilled throughout the south end of the Northwest Deposit using an air-track drill rig. The boreholes were spaced approximately 100 m apart and drilled to depths ranging from 3.0 m to 7.0 m depth below current grade.

A senior geotechnician from **exp** was on site to observe the drilling activities and log the subsurface conditions encountered. Disturbed samples of the soils encountered were obtained at 1 m intervals from the drill cuttings circulated to the surface during drilling. The collected soil samples were evaluated by our senior geotechnician and logged in accordance with ASTM D2488 (*Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*) and ASTM D4083 (*Standard Practice for Description of Frozen Soils (Visual Manual Procedure)*).

Following the initial visual assessment, each soil sample was sealed in plastic bags, weighed to determine the initial wet weight (to facilitate accurate moisture content determination later on) and stored for transport to **exp**'s laboratory in Ottawa. All boreholes were backfilled using soil cuttings upon completion and the approximate borehole locations were determined by handheld GPS. Final survey of the borehole locations and elevations was outside our current scope of work. Elevations were determined based on available topographic survey and are therefore, considered approximate.

During the drill program, our geotechnical representative also collected a total of three large composite samples from the surface of the various deposits using a shovel. The purpose of these composite samples was to provide bulk material for Los Angeles (LA) Abrasion testing and Petrographic analyses to further classify the soils encountered. The composite samples collected in the field consisted predominantly of cobbles and large gravels present across the surface of the various deposits, as well as portions taken from the drill cuttings that remained from the upper most 1.0 m of the boreholes. Therefore, the samples are considered to be representative of the upper most 1.0 m of each deposit, which was typically coarser material more probable for use in production of concrete aggregates, granular surface courses, granular base course, etc. where durability is more of a factor.

3.2 Laboratory Testing

Upon arrival at the **exp** laboratory, each sample was assessed visually by a senior geotechnical engineer (the author) to confirm or alter the field classification in a more controlled environment. Laboratory testing was then assigned, consisting of; moisture content determinations on all recovered samples and grain size analyses on select samples. During the visual assessment, it was determined that all fines were non-plastic; therefore, Atterberg limit determinations were not required.

In the laboratory, we compiled four additional composite samples from the various borehole samples, which were intended to represent the various materials encountered. These composite samples were

submitted for total sulphur and sulphate sulphur content determination, in order to determine if the aggregates have potential to be acid producing based on their sulphide content. The boreholes and defined polygons represented by the four composite samples submitted for acid producing potential testing are summarized as follows:

- **Composite Sample 1:** Represents Polygons 19, 22, 115 and 116 (BH's 1 to 10 inclusive)
- **Composite Sample 2:** Represents Polygons 107, 113 and 114 (BH's 14 to 20 inclusive)
- **Composite Sample 3:** Represents Polygon 21 (BH's 11, 12, 13)
- **Composite Sample 4:** Represents Polygons 16A and 18 (BH's 21 to 25 inclusive)

The above-noted composite samples collected from the surface or near surface drill cuttings of each deposit were submitted for petrographic number analysis and LA abrasion testing. The boreholes and defined polygons represented by these three composite samples are summarized as follows:

- **Composite Sample 5:** Represents Polygons 19, 22, 115 and 116 (BH's 1 to 10 inclusive)
- **Composite Sample 6:** Represents Polygons 107, 113 and 114 (BH's 14 to 20 inclusive)
- **Composite Sample 7:** Represents Polygons 16A, 18 and 21 (BH's 11, 12, 13 and 21 to 25 inclusive)

3.3 Material Quality Classification

It is noted that the drill method used is highly disruptive and larger gravels, cobbles and boulders have been broken down during drilling and show as smaller gravels, sand and possibly fines within the gradations presented and discussed herein. However, it is expected that this represents a level of conservatism with the results, as one of the primary intentions of the program is to confirm the presence of deposits rich with coarse aggregates and containing little to no fines (Class 1 or Class 2 below). Such deposits would be considered suitable for use in production of materials such as concrete aggregates, asphalt aggregates, surface coarse granulars, base coarse granulars, sub-base coarse granulars, winter sand, etc., with fines introduced through blending with more fine grained deposits as required. It is expected that the actual gradations encountered in the field will be coarser and possibly contain less fines than presented herein, which should only be better for feeding production of such materials. The same would be true for the material identified as being appropriate for use as general subgrade and backfill material (Class 3 below); however, it is expected that these materials have been altered much less by the drilling method than the cobble and boulder rich granular layers above.

The gradation test results for samples collected from each borehole are presented graphically in the appended Grain Size Distribution Curve figures that immediately follow each Borehole Log. The gradation test results have been compared against typical specifications for Granular A, Granular B and Select Subgrade Material as summarized in Table 1 below.

Table 1: Assumed Gradation Requirements for Granular A, Granular B and Subgrade

Property	ASTM Test Method	Granular A (Base)	Granular B (Sub-Base)	Select Subgrade
Gradation (sieve/% passing)				
150 mm	C136	-	-	100
75 mm	C136	-	100	-
37.5 mm	C136	-	-	-
25.0 mm	C136	100	50-100	50-100
19.0 mm	C136	75-100	-	-
9.5 mm	C136	50-85	-	-
4.75 mm	C136	35-65	20- 55	20-100
2.0 mm	C136	25-50	-	-
0.425 mm	C136	15-30	5-35	-
0.300 mm	C136	-	-	5-95
0.150 mm	C136	-	-	2-65
0.075 mm	C117	5-8	0-8	0-25
Crushed Content (%) min. (2)	-			
50 to 37.5 mm	-	60	60	-
37.5 to 19.0 mm	-	60	60	-
19.0 to 4.75 mm	-	60	60	-
Plasticity Index (%) max.	D4318	NP	NP	-
Abrasion Loss (%) max.	C131	45	50	-
Flat or Elongated Particles (%) Max. (3)	D4791	15	15	-

Additionally, the quality of the granular material encountered in the boreholes has been classified in accordance with Table 2 below. Similar classification criteria have been used to evaluate potential borrow sources throughout the Northwest Territories since the 1980's (reportedly developed by AANDC (formerly INAC)). The classification system is intended to roughly categorize the materials encountered into suggested uses based on gradation and material strength.

Table 2: Quality Classification of Granular Materials			
Source Quality Description	**General Description of Material**	**Minimum Technical Identification Parameters**	**Suggested Uses of Materials**
1 – Excellent	Well-graded gravels and sands suitable for use as aggregates with a minimum of processing (<5% fines passing the 80µm sieve).	Petrographic Number = 160 (max). LA Abrasion Loss = 35% (max).	Portland Cement Concrete, Asphaltic Concrete, Masonry Sand, Concrete Block, Surface Treatment, and Roofing Aggregate.
2 – Good	Graded sands and gravels with varying quantities of silt (<10% fines passing the 80µm sieve).	Petrographic Number = 200 (max). LA Abrasion Loss = 60% (max). Fines greater than10% passing the 80µm sieve can be removed with a minimum of processing.	Granular base and sub-base. Winter sand backfill for trenches and slabs. Pads for construction.
3 – Fair	Poorly graded sands and gravels with or without substantial silt content (<25% fines passing the 80µm sieve).	Petrographic Number = 250 (max). Can be processed to meet local frost susceptibility criteria.	Granular sub-base, general backfill material, pads for equipment.
4 – Poor	Poorly graded granular soils of high silt content, possibly containing very weak particles and deleterious materials (>25% fines passing the 80µm sieve).	Nil	General non-structural fill.

3.4 Volume Estimates

Material volumes for each material Class presented herein have been estimated based on the following assumptions:

- The upper boundary of our volume estimation is based on each borehole representing a 100 m by 100 m square (10,000 m^2) and assumes that any desirable material present above buried ice lenses/wedges can be removed through proper planning and development. However, the ice-rich Class 3 material encountered has not been included as it is expected that this material will require excessive dry times to become usable in construction.

- The lower boundary of our volume estimation is based on each borehole representing a 100 m diameter circle (7,854 m^2) which represents an overall 22% reduction of material volume to account for zones of unsuitable material and/or loss of material during processing or to site access road maintenance as discussed in Section 6 Additionally we have removed the boreholes/areas where buried ice lenses/wedges were encountered and assumed these areas will not be developed. Therefore, the lower bound value is considered to be a very conservative value at this time.

- The subsurface layers in a given borehole extend in a horizontal manner over the surrounding circular area, at the elevation encountered in the borehole, such that the base of each soil unit was a horizontal circular plane.

It should be recognized that the above-mentioned assumptions were made in order to provide a consistent and measurable approach for determining the viability of the Northwest Deposit. Subsurface conditions will vary both with depth and laterally, and a high degree of variability in the material composition, thicknesses and ice-content should be expected between the borehole locations.

It should also be noted that only six of the twenty-five boreholes (24%) were terminated in bedrock and the remaining boreholes were terminated due to time constraints. Therefore, it is anticipated that an unknown volume of additional usable granular material is available beyond the estimated volumes presented herein. Due to time constraints, we attempted to focus on and prove out the vertical extent of granular rich Class 1 and Class 2 materials present throughout the area investigated. Boreholes were typically terminated once we either encountered; possible Class 3 material, bedrock or massive ice/snow.

4 Subsurface Conditions and Material Classification

A detailed description of the subsurface soil and groundwater/ground ice conditions encountered in the boreholes are given on the appended Borehole Log Figures followed immediately by Gradation Test Result Figures for samples from that borehole. The Borehole Logs and related information depict subsurface conditions only at the specific locations and times indicated. Subsurface conditions, ice content and potential water levels at other locations may differ from conditions at the locations where sampling was conducted. It should be noted that the soil boundaries indicated on the borehole logs are intended to reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The "Note on Sample Descriptions" preceding the borehole logs form an integral part of this report and should be read in conjunction with this report.

Furthermore, as noted above the method of drilling has affected the gradation of the material and returned altered samples to the surface. Therefore, the gradation and classifications outlined below should be interpreted carefully by qualified personnel.

4.1 General

The surface of the area investigated was covered with snow at the time of the investigation. However, we have observed the area without snow cover during previous site visits and it is generally barren with little to no overburden. Based on our observations during drilling and our laboratory test results, the upper 1.0 m to 6.0 m of material throughout the areas investigated can be classified as Class 1 – Excellent Quality Granular (less than 5 percent fines) and/or Class 2 – Good Quality Granular (less than 10 percent fines). It is estimated that this upper layer of excellent to good quality granular contains 20 percent to 40 percent cobbles and boulders (crushable rock) to potentially help fill gaps in gradation during crushing/processing.

The layer of Class 1 and Class 2 granular was observed to be underlain by either Class 3 – Fair Quality Granular (less than 25 percent fines) or bedrock. The in-situ moisture content of the Class 3 material encountered was quite variable, with some ice-rich zones apparently present throughout the deposit. These zones of ice-rich Class 3 material may require excessive dry times to become usable. Additionally, massive ice lenses/wedges were encountered at depth within the Class 3 material in four of the twenty-five boreholes (16%). Therefore, care will be required during Pit Development as outlined below. At the time of the investigation the active layer was completely frozen. It is anticipated that the maximum active layer thickness throughout the area (late September to early October) would be in the range of 1.5 m to 2.5 m.

A summary of the borehole stratigraphy classified in accordance with Table 2 above is included in Table 3 below. The subsurface conditions encountered are further outlined within the following subsections.

Table 3: Borehole Summary Table, Material Classification as per Section 3.4								
BH No.	Elev. (m)	Total Depth (m)	Stratigraphy (m)				Ice-Rich Soil and/or Massive Ice (m)	Bedrock (m)
			Class 1	Class 2	Class 3	Class 4		
BH01	159	4.0	-	-	0.0 to 2.5	-	1.0 to 2.5	2.5 to 4.0
BH02	155	6.0	-	0.0 to 3.0	3.0 to 6.0	-	3.0 to 4.5	-
BH03	155	6.0	0.0 to 5.0	-	-	-	-	5.0 to 6.0
BH04	157	7.0	-	0.0 to 2.0	2.0 to 7.0	-	4.0 to 7.0	-
BH05	168	6.0	-	0.0 to 3.0	3.0 to 6.0	-	3.0 to 6.0	-
BH06	166	6.0	0.0 to 2.0	-	2.0 to 6.0	-	2.0 to 6.0	-
BH07	170	6.0	0.0 to 4.0	-	4.0 to 6.0	-	-	-
BH08	170	6.0	0.0 to 4.0	4.0 to 6.0	-	-	-	-
BH09	168	6.0	0.0 to 1.5	1.5 to 4.0	4.0 to 6.0	-	4.0 to 6.0	-
BH10	170	6.0	0.0 to 4.0	-	4.0 to 6.0	-	-	-
BH11	170	4.0	-	0.0 to 4.0	-	-	-	-
BH12	172	6.0	0.0 to 1.5	1.5 to 4.0	-	4.0 to 6.0	-	-
BH13	170	6.0	0.0 to 1.5	-	1.5 to 6.0	-	-	-
BH14	205	4.0	0.0 to 1.0	-	1.0 to 4.0	-	-	4.0
BH15	194	5.0	-	0.0 to 5.0	-	-	-	5.0
BH16	185	3.0	-	0.0 to 3.0	-	-	-	3.0
BH17	180	3.0	-	0.0 to 3.0	-	-	-	3.0
BH18	186	3.0	0.0 to 3.0	-	-	-	-	-
BH19	183	4.0	-	0.0 to 4.0	-	-	-	-
BH20	183	6.0	0.0 to 4.0	4.0 to 6.0	-	-	-	-
BH21	174	4.3	0.0 to 1.5	1.5 to 3.0	3.0 to 4.3	-	-	-
BH22	167	4.5	0.0 to 3.0	3.0 to 4.5	-	-	-	-
BH23	168	4.0	0.0 to 4.0	-	-	-	-	-
BH24	174	5.0	0.0 to 3.0	3.0 to 5.0	-	-	-	-
BH25	174	6.0	0.0 to 3.0	3.0 to 6.0	-	-	5.0 to 6.0	-

4.2 Class 1 Material

Class 1 material was encountered directly at the surface in sixteen of the twenty-five boreholes (64%) distributed throughout the area investigated (not isolated to one specific area). The Class 1 material ranged in thickness from 1.0 m (BH14) to 5.0 m (BH03), with an average thickness of 2.9 m. Based on the USCS, the Class 1 material comprised of light brown sand and gravel with trace silt, to light brown gravel with sand and trace silt, to dark brown sand with gravel and trace silt. The in-situ moisture content of the Class 1 samples ranged between 1.0 percent and 11.0 percent with an average value of 3.8

percent, based on 32 samples. The percentage of gravel, sand and silt for each Class 1 gradation test result are summarized below in Table 4. A review of the table indicates that the average gradation for the 32 samples tested is 35% gravel, 62% sand and 3% silt. Based on drill progress, we estimate the Class 1 material contains 20% to 40% cobbles and boulders (crushable rock).

The petrographic number for the three of the above-noted Bulk Samples 5, 6 and 7 were all determined to be 100, which is well below the maximum value of 160 required for the Class 1 classification. The LA Abrasion test results for Bulk Samples 5, 6 and 7 were 36%, 38% and 40%, respectively, which is slightly higher than the maximum value of 35% required for the Class 1 classification. However, it is noted that the laboratory had to crush down some of the larger particles to get enough of the specified particle sizes required to run the test. It is anticipated that this resulted in mechanical fractures within the particles used to run the test and increased the percent wear. Therefore, any gradation test result meeting the maximum 5% fines criteria has been tentatively assigned the Class 1 classification herein.

It is noted that the laboratory test results presented herein are intended to provide a means of assessing the deposits potential suitability for various applications. The actual material produced from any one or combination of these deposits or material types will have to meet project specific criteria based on laboratory testing carried out at the time of production.

4.3 Class 2 Material

Class 2 material was encountered directly at the surface or directly beneath the above-noted Class 1 material in sixteen of the twenty-five boreholes (64%) distributed throughout the area investigated (also not isolated to one specific area). The Class 2 material ranged in thickness from 1.5 m (BH21 and BH22) to 5.0 m (BH15), with an average thickness of 2.8 m; however, nine boreholes were terminated within the Class 2 material due to time constraints. Therefore, an unknown amount of additional Class 2 material is present at these locations. Based on the USCS, the Class 2 material comprised of dark brown sand with gravel and trace silt, to light brown sand with silt and gravel, to light brown.

The in-situ moisture content of the Class 2 ranged between 1.0% and 20.0% with an average value of 6.6% based on 28 samples. The percentage of gravel, sand and silt for each Class 2 gradation test result are summarized below in Table 5. A review of the table indicates that the average gradation based on the 28 samples is 16% gravel, 76% sand and 7% silt. It is also noted that based on observations of drill progress we estimate the Class 2 material contains 20% to 40% cobbles and boulders (crushable rock).

As noted above, the petrographic number and LA Abrasion test results for the above-noted Bulk Samples 5, 6 and 7 were well below the maximum petrographic number of 200 and maximum LA Abrasion wear of 60%. Therefore, any gradation test result meeting the maximum 10% fines criteria and failing the Class 1 criteria of less than 5% has been assigned the Class 2 classification herein.

4.4 Class 3 Material

Class 3 material was encountered directly at the surface in BH01 and beneath the above-noted Class 1 or Class 2 material in ten of the remaining twenty-four boreholes (44%). The Class 3 material ranged in thickness from 1.3 m (BH21) to 4.5 m (BH13), with an average thickness of 2.8 m; however, nine boreholes were terminated within the Class 3 material due to time constraints and without encountering bedrock. Therefore, an unknown amount of additional Class 3 material is present at these locations. Based on the USCS, the Class 3 material comprised of medium brown silty sand with gravel, to grey silty sand with trace to some gravel, to light brown predominantly fine-grained silty sand.

The in-situ moisture content of the Class 3 ranged between 3.0 and 66.0 with an average value of 21.4 based on 14 samples. The elevated moisture contents reflect the presence of excess ice and/or ice lenses/wedges within the layer. The percentage of gravel, sand and silt for each Class 3 gradation test result are summarized below in Table 6 below. A review of the table indicates that the average gradation based on the 14 samples tested is 11% gravel, 73% sand and 16% silt. It is also noted that based on observations of drill progress we estimate the Class 3 material contains 0% to 20% cobbles and boulders (crushable rock).

The Class 3 material is considered suitable for use as general subgrade fill (fill pads, roadway embankments, etc.) provided the moisture content of the material allows for proper placement and compaction. Generally, this will require that the material be within 2 percent of the optimum moisture content determined by standard Proctor test. As noted above, zones of the Class 3 material encountered were determined to have elevated moisture contents, likely due to the presence of excess ice and/or ice lenses within the soil matrix.

4.5 Class 4 Material

Class 4 material was only encountered in BH12, directly beneath the Class 2 material present at that location. The borehole was terminated within the Class 4 material at a thickness of 2.0 m and without encountering bedrock. Based on the USCS, the Class 4 material comprised of grey silty sand with gravel.

The in-situ moisture content of the Class 4 sample tested was 16.0% and the gradation test indicated it comprised 17% gravel, 54% sand and 29% silt.

4.6 Buried Ice Lenses/Wedges

Buried ice lenses/wedges were encountered beneath about 3 m to 5 m of gravel and sand at four of the twenty-five borehole locations (16% of the area investigated by **exp**). The buried ice lenses/wedges were encountered within two distinct zones investigated. The first zone was encountered in the north half of Poly 116 and south end of Poly 22 (BH4, BH5 and BH6) at depths of 3.0 m and 5.0 m below existing grade. The second zone was encountered in the south half of Poly 18B (BH25) at a depth of 5.0 m below existing grade. These ice lenses/wedges were present well within the Class 3 material layer at each borehole location.

Table 4: Class 1 Laboratory Test Results

BH No.	Sample No.	Depth (m)	Percentage (%)			Moisture (%)	Material Classification
			Gravel	Sand	Fines		
BH3	S1	0 – 1.0	23	72	5	3	Class 1
BH3	S3	2.0 – 3.0	30	65	5	7	Class 1
BH3	S4	3.0 – 4.0	23	72	5	7	Class 1
BH6	S1	0 – 1.0	33	65	2	3	Class 1
BH7	S1	0 – 1.0	24	72	4	3	Class 1
BH7	S3	2.0 – 3.0	46	51	3	4	Class 1
BH7	S4	3.0 – 4.0	25	71	4	9	Class 1
BH8	S1	0 – 1.0	45	53	2	1	Class 1
BH8	S3	2.0 – 3.0	58	40	2	5	Class 1
BH8	S4	3.0 – 4.0	31	65	4	10	Class 1
BH9	S1	0 – 1.0	55	43	2	1	Class 1
BH10	S1	0 – 1.0	52	47	1	1	Class 1
BH10	S3	2.0 – 3.0	24	73	3	5	Class 1
BH10	S4	3.0 – 4.0	40	54	6	11	Class 1
BH12	S1	0 – 1.0	58	41	1	2	Class 1
BH13	S1	0 – 1.0	16	82	2	3	Class 1
BH14	S1	0 – 1.0	33	62	5	3	Class 1
BH18	S1	0 – 1.0	50	48	2	2	Class 1
BH18	S3	2.0 – 3.0	13	84	3	1	Class 1
BH20	S1	0 – 1.0	20	77	3	3	Class 1
BH20	S3	2.0 – 3.0	14	83	3	1	Class 1
BH20	S4	3.0 – 4.0	14	82	4	9	Class 1
BH21	S1	0 – 1.0	51	47	2	3	Class 1
BH22	S1	0 – 1.0	38	58	4	5	Class 1
BH22	S3	2.0 – 3.0	28	70	2	1	Class 1
BH23	S1	0 – 1.0	19	76	5	3	Class 1
BH23	S3	2.0 – 3.0	72	27	1	1	Class 1
BH23	S4	3.0 – 4.0	33	66	1	1	Class 1
BH24	S1	0 – 1.0	27	70	3	3	Class 1
BH24	S3	2.0 – 3.0	33	63	4	6	Class 1
BH25	S1	0 – 1.0	37	59	4	3	Class 1
BH25	S3	2.0 – 3.0	45	52	3	3	Class 1
Overall Average Results (%)			**35**	**62**	**3**	**4**	

Table 5: Class 2 Laboratory Test Results							
BH No.	Sample No.	Depth (m)	Percentage (%)			Moisture (%)	Material Classification
			Gravel	Sand	Fines		
BH2	S3	2.0 – 3.0	19	73	8	13	Class 2
BH4	S1	0 – 1.0	15	78	7	8	Class 2
BH5	S1	0 – 1.0	26	69	5	1	Class 2
BH5	S3	2.0 – 3.0	2	90	8	14	Class 2
BH8	S5	4.0 – 5.0	1	93	6	14	Class 2
BH9	S3	2.0 – 3.0	3	90	7	11	Class 2
BH9	S4	3.0 – 4.0	7	86	7	14	Class 2
BH11	S1	0 – 1.0	36	58	8	3	Class 2
BH11	S3	2.0 – 3.0	15	82	3	1	Class 2
BH11	S4	3.0 – 4.0	11	86	3	1	Class 2
BH12	S3	2.0 – 3.0	6	84	10	20	Class 2
BH12	S4	3.0 – 4.0	49	39	12	7	Class 2
BH15	S1	0 – 1.0	7	85	8	4	Class 2
BH15	S3	2.0 – 3.0	10	87	3	1	Class 2
BH15	S4	3.0 – 4.0	2	91	7	3	Class 2
BH16	S1	0 – 1.0	23	69	8	4	Class 2
BH16	S3	2.0 – 3.0	30	63	7	2	Class 2
BH17	S1	0 – 1.0	12	80	8	3	Class 2
BH17	S3	2.0 – 3.0	3	86	11	1	Class 2
BH19	S1	0 – 1.0	24	69	7	5	Class 2
BH19	S3	2.0 – 3.0	25	71	4	2	Class 2
BH19	S4	3.0 – 4.0	17	76	7	2	Class 2
BH21	S3	2.0 – 3.0	27	66	7	4	Class 2
BH22	S4	3.0 – 4.0	23	71	6	3	Class 2
BH24	S4	3.0 – 4.0	20	74	6	12	Class 2
BH25	S4	3.0 – 4.0	12	81	7	9	Class 2
BH25	S5	4.0 – 5.0	17	74	9	14	Class 2
Overall Average Results (%)			**16**	**76**	**7**	**7**	

Table 6: Class 3 Laboratory Test Results							
BH No.	Sample No.	Depth (m)	Percentage (%)			Moisture (%)	Material Classification
			Gravel	Sand	Fines		
BH1	S1	0 – 1.0	15	66	19	10	Class 3
BH1	S2	2.0 – 2.5	4	78	18	20	Class 3
BH2	S4	3.0 – 4.0	10	72	18	25	Class 3
BH4	S3	2.0 – 3.0	22	66	12	10	Class 3
BH4	S4	3.0 – 4.0	16	65	19	19	Class 3
BH5	S4	3.0 – 4.0	0	81	19	43	Class 3
BH6	S3	2.0 – 3.0	23	65	12	34	Class 3
BH6	S4	3.0 – 4.0	40	50	10	66	Class 3
BH9	S5	4.0 – 5.0	2	87	11	26	Class 3
BH10	S6	5.0 – 6.0	3	76	21	16	Class 3
BH13	S3	2.0 – 3.0	3	80	17	10	Class 3
BH13	S4	3.0 – 4.0	3	76	21	19	Class 3
BH14	S3	2.0 – 3.0	3	83	14	3	Class 3
BH14	S4	3.0 – 4.0	18	68	14	5	Class 3
BH21	S4	3.0 – 4.0	13	75	12	3	Class 3
Overall Average Results (%)			**11**	**73**	**16**	**21**	

5 Estimated Volumes

Material volumes for each Class were estimated based on the borehole logs and laboratory testing results, and the areas of influence for each borehole as per Section 3.4. As noted above, the drill method used is highly disruptive and larger gravels, cobbles and boulders have been broken down during drilling and show as smaller gravels, sand and even fines within the gradations presented and discussed herein. Additionally, the level of processing required to crush/blend the available materials into specified gradations has yet to be determined and cannot be estimated based on the available information. The volume calculations are summarized below in Table 7.

Table 7: Estimated Material Volumes

	Stratigraphy (m)					
	Class 1	**Class 2**	**Class 3**	**Class 4**	**Ice-Rich Soil and/or Massive Ice**	
Total Thickness of Usable Granular Encountered in All Boreholes Combined (m)	46.0	45.0	31.3	N/A	- 16.0	**Total Usable Granular (m^3)**
Upper Boundary – Est. Total Volume Usable Granular Encountered (m^3)	460,000	450,000	313,000	N/A	- 160,000	**1,063,000**
Lower Boundary – Est. Total Volume Usable Granular Encountered (m^3)	361,273	353,419	245,822	N/A	- 125,660	**834,854**

A review of Table 7 indicates the total volume of usable borrow materials (Class 1, Class 2 and Class 3) available throughout the area investigated by boreholes is estimated to be between 834,854 m^3 to 1,063,000 m^3. For the purpose of this assessment we have assumed any Class 3 material having in-situ moisture content greater than 20% is too wet for immediate use, deemed it ice-rich and removed it from the estimated total usable volume above. Class 3 material having in-situ moisture contents less than 20% may also be deemed too wet for immediate use at the time of quarrying, depending on the actual gradation of the material.

Note that subsurface conditions are expected to vary both with depth and laterally, and based on the findings of this investigation a high degree of variability in the materials and thicknesses of the strata should be expected throughout the deposit. Therefore, these estimates may be high or low dependent on the actual stratigraphy encountered between boreholes. Additionally, although we have attempted to remove those materials that appear to require excessive dry times before they would be usable, it is expected that the in-situ moisture content will be highly variable across the deposits and this will affect the projected volumes.

6 Overall Assessment

Based on the above, the Northwest Deposit is recommended for development as a borrow source capable of meeting the City of Iqaluit requirements for the next 10 years and beyond. Class 1 and/or Class 2 material was encountered directly at the surface in twenty-four of the twenty-five boreholes. Similar material is visible throughout the majority of the remaining deposit as indicated by AANDC in 2006. The boreholes have verified the thickness of these surficial deposits is significant, ranging from 1.0 m to 6.0 m with an average thickness of 3.8 m throughout the area explored. Furthermore, Class 3 material suitable for use as general subgrade fill and/or blending with Class 1 and Class 2 to create desired gradations is present in mass quantities directly beneath the Class 1 and Class 2 layers.

The total estimated volume of usable borrow material within the area investigated by boreholes is between 834,854 m^3 to 1,063,000 m^3. It is noted that the estimated volumes presented above:

- Do not include the above-noted identified zones of ice-rich Class 3 material encountered, which represent another 125,660 m^3 to 160,000 m^3 of potentially usable material depending on the actual in-situ moisture contents present at the time of quarrying.
- Do not include the full thickness of Class 2 or Class 3 material encountered at many of the borehole locations, as drilling was ceased due to time constraints.
- Only represent the portion of the deposit investigated by boreholes, which is approximately 25% of the total area investigated by EBA in 2006 and estimated to contain 7,941,000 m^3 of usable granular based on their GPR results.

Therefore, based on all the available information, it is anticipated that the Northwest Deposit will easily provide access to over 1,000,000 m^3 of usable granular material and it is likely to provide access to over 1,000,000 m^3 of Class 1 (Excellent Quality Granular) and/or Class 2 (Good Quality Granular) material as defined herein.

It should be noted that we estimate the usable granular material contains 20% to 40% cobbles and boulders by volume, with some boulders being up to 2 m in size or larger, which will need to be processed or set aside. Additionally, the level of processing required to crush/screen/blend the available materials into specified gradations has not been determined and cannot be determined based on the available information. Furthermore, although the active layer was completely frozen at the time of drilling, we would estimate the maximum active layer thickness (late September or early October) would be approximately 1.5 m to 2.5 m depth depending on sun exposure, in-situ moisture of the upper materials, etc. and the permafrost soils extend for 100's of meters beneath the deposits.

With regards to Pit Development, care will be required during planning and excavation to assure that sufficient room is available within each individual section to allow for alternate site access if/when ice-rich Class 3 materials and/or zones of pure ice lenses/wedges are encountered at depth and exposed. Exposing such materials will limit or eliminate site access through that area as the materials thaw and destabilize. This is understood to have been a major issue during development of the Trail Area Deposit. How to deal with such areas will depend on the topography of the individual deposits being excavated

and surrounding area, as well as the thickness of the problem soils encountered. Therefore, it will require real time assessment and decision by qualified people with knowledge on quarrying permafrost soils successfully. In general, we would anticipate many possible scenarios and potential solutions; however, we have outlined two possible scenarios and our envisioned solutions below for context:

Scenario 1: The ice-rich soils and/or pure ice layers are relatively thin and can be removed down to stable soils or bedrock without affecting positive drainage from the area. In this situation we would expect the problem soils could be fully excavated, stockpiled separately to thaw/drain out (may require many seasons) and site access re-established to continue quarrying. The stockpiled soils may be usable as general site grading material during site reclamation (i.e. infilling low spots to promote proper drainage) or may even become suitable for use as Class 3 depending on how wet the material is and how long it can be left to dry.

Scenario 2: The ice-rich soils and/or pure ice layers are thought to be thick and depth to bedrock too deep to fully excavate. In this scenario, one course of action would be to quickly remove any thawed soft soils (stockpile separately as outlined above) and cover the area immediately with 0.75 m to 2.0 m of suitable fill capable of supporting construction traffic to re-establish site access. The intention would be to mitigate the issue by providing an insulating layer of good quality material to stop thaw of the ice-rich soils or pure ice layers below. Therefore, the thickness of fill material required for such a scenario will depend on the amount of warm weather remaining and site access requirements. Ongoing maintenance of affected areas should be anticipated (i.e. regrading, infilling depressions, etc.).

Although two distinct zones of buried ice lenses/wedges are discussed herein, it is anticipated that other such zones exist throughout the Northwest Deposit due to the nature of deposition and presence of permafrost. Therefore, monitoring and maintenance of site access roads will be required throughout the duration of Pit Development and must account for potential thawing of underlying ice-rich soils/pure ice and possible weakening/failure of road embankment side slopes. Problem areas must be addressed quickly once warning signs present themselves (i.e. development of soft ground, rutting, longitudinal tension cracks along embankment crests/slopes, sloughing of embankment slopes, etc.) to limit the effects of the issue as much as possible. Thawing of ice-rich soils and/or buried ice is expected to result in development of excess surface water, which will need to be dealt with constantly and quickly removed. Surface water should not be allowed to flow or pond over or adjacent to areas where access is required, as the presence of this warm water will exhilarate permafrost degradation and exacerbate the situation.

Further discussion on how best to deal with this potential issue during Pit Development will be required at the planning stage and considering the interests of all parties (owner, engineering team, contractor, etc.). However, this is considered more of a contractual and planning issue, and should not affect the ability of the City of Iqaluit to extract well over 10 years supply of excellent to fair quality granular material from the Northwest Deposit.

The above comments are provided for information and are intended to provide a basis for decision on development of the Northwest Deposit as a quarry. A separate Pit Development Plan will be required to address excavation and operations procedures, including any environmental constraints that may be present within or adjacent to the Northwest Deposit.

Figures

CLIENT

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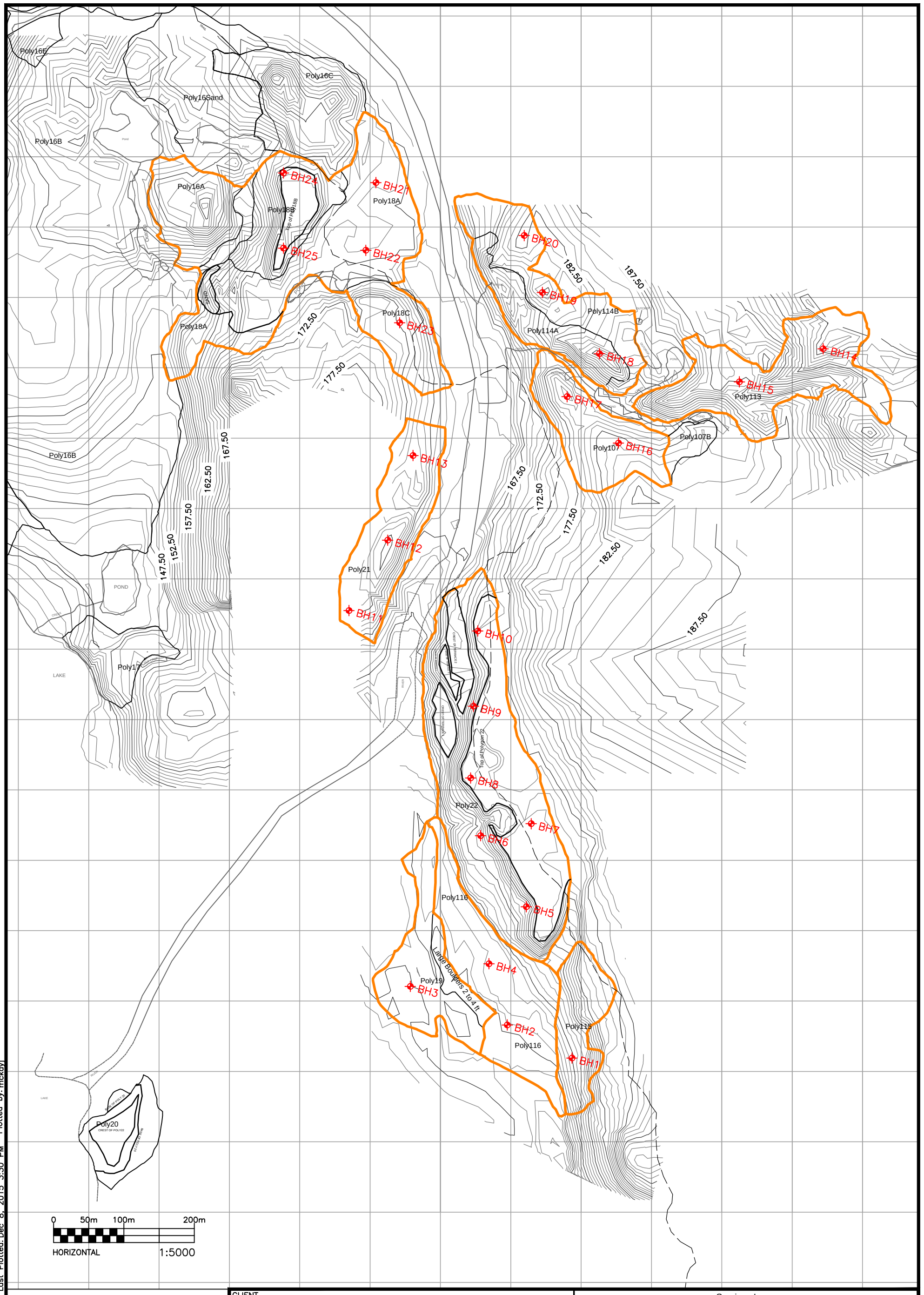
SCALE: NTS	PROJECT: NORTHWEST DEPOSIT IQALUIT NV	PROJECT No.: OTT-00219428-A0
DATE: DECEMBER 2015	TITLE: LOCATION PLAN	DRAWING No.: FIG 1
CAD: JMc		

Filename: P:\Projects\Civil Engineering Services\219000\OTT-00219428-A0 – Road to Northwest Aggregate Deposit – City of Iqaluit\D – DRAWINGS\Sketches and Figures\Location Plan.dwg
Last Saved: Dec 8, 2015 3:35 PM Last Plotted: Dec 8, 2015 3:35 PM Plotted by: mckayj



100mx100m GRID

5m CONTOUR LINE

1m CONTOUR LINE

POLYGON BOUNDARY DEFINED BY AANDC 2005

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SCALE 1:5000	PROJECT NORTHWEST DEPOSIT IQALUIT NV	PROJECT No. OTT–00219428–A0
DATE DECEMBER 2015	TITLE BOREHOLE LOCATION PLAN	DRAWING No. FIG 2
CAD JMc		

Filename: P:\Projects\Civil Engineering Services\219000\OTT-00219428-A0 – Road to Northwest Aggregate Deposit – City of Iqaluit\D – DRAWINGS\Sketches and Figures\Borehole Locations.dwg
Last Saved: Dec 8, 2015 3:30 PM Last Plotted: Dec 8, 2015 3:30 PM Plotted by: mckayj

Notes On Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Societv for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by **exp** Services Inc. also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		

0.002 0.006 0.02 0.06 0.2 0.6 2.0 6.0 20 60 200

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Log of Borehole BH01

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 3

Page. 1 of 1

Date Drilled: 5/7/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test —
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 3 Medium brown, silty sand with gravel - occassional cobbles - no visible ice content - 15% gravel, 66% sand, 19% fines	159	0
		- trace gravel below 1.0 m depth - some visible ice, Vx (10% to 20%) below 1.0 m depth		1
		- 4% gravel, 78% sand, 18% fines		2
		BEDROCK	156.5	3
		End of Borehole at 4.0 m Depth	155.0	4

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

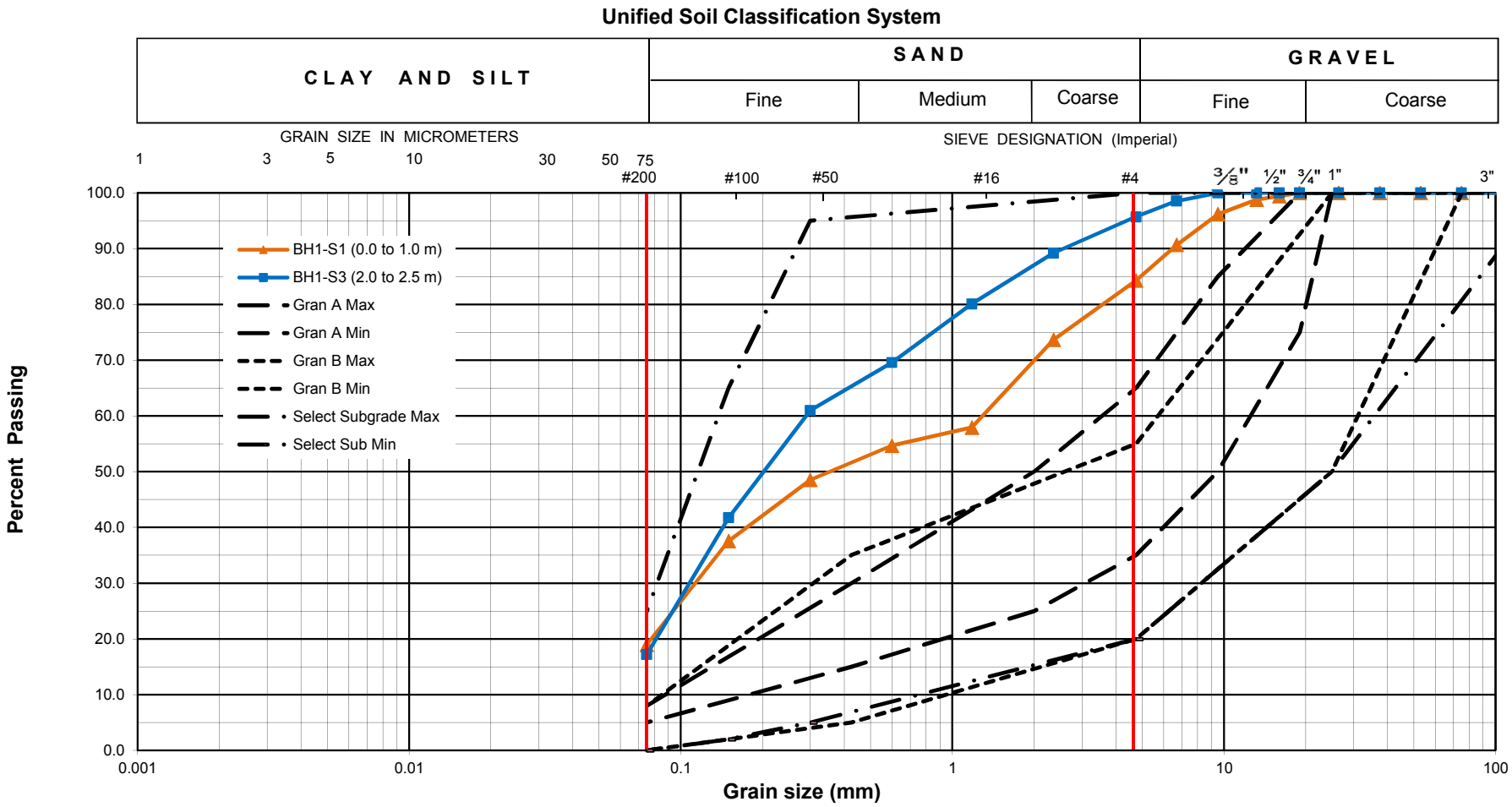
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 7, 2015**	**Borehole:**	**1**	**Sample:**	**S1 & S3**	**Depth (m) :**	**as indicated**
Sample Description :		**silty SAND with gravel to silty SAND**				**Figure :**	**4**

Log of Borehole BH02

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 5

Page. 1 of 1

Date Drilled: 5/7/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 2 Dark brown, sand with gravel - trace silt - occasional cobbles and boulders - no visible ice content	155	0
		- 19% gravel, 73% sand, 8% fines	152.0	3
		CLASS 3 Grey silty sand - trace gravel - some visible ice, Vx (10% to 20%) - 10% gravel, 72% sand, 18% fines		
		End of Borehole at 6.0 m Depth - inferred bedrock	149.0	6

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

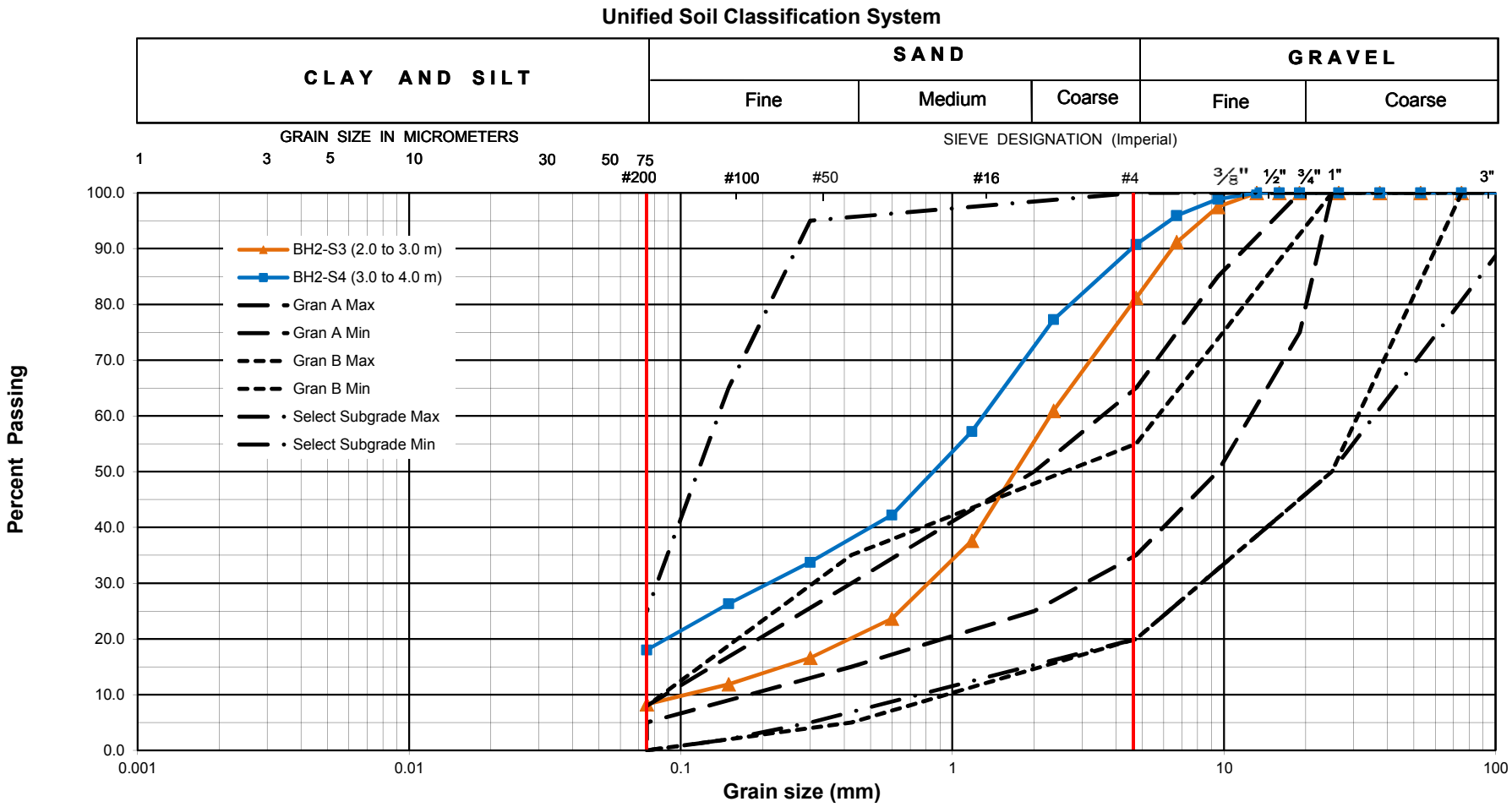
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	OTT-00219428-A0	Project Name :	Geotechnical Investigation - Northwest Deposit				
Client :	City of Iqaluit	Project Location :	Iqaluit, NU				
Date Sampled :	May 7, 2015	Borehole:	2	Sample:	S3 & S4	Depth (m) :	as indicated
Sample Description :	SAND with silt and gravel to silty SAND					Figure :	6

Log of Borehole BH03

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 7

Page. 1 of 1

Date Drilled: 5/7/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		CLASS 1 Light brown, sand with gravel - trace silt - frequent cobbles and boulders - no visible ice content - 23% gravel, 72% sand, 5% fines	155	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
		- 30% gravel, 65% sand, 5% fines		2				
		- 23% gravel, 72% sand, 5% fines		3				
		BEDROCK	150.0	5				
		End of Borehole at 6.0 m Depth	149.0	6				

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

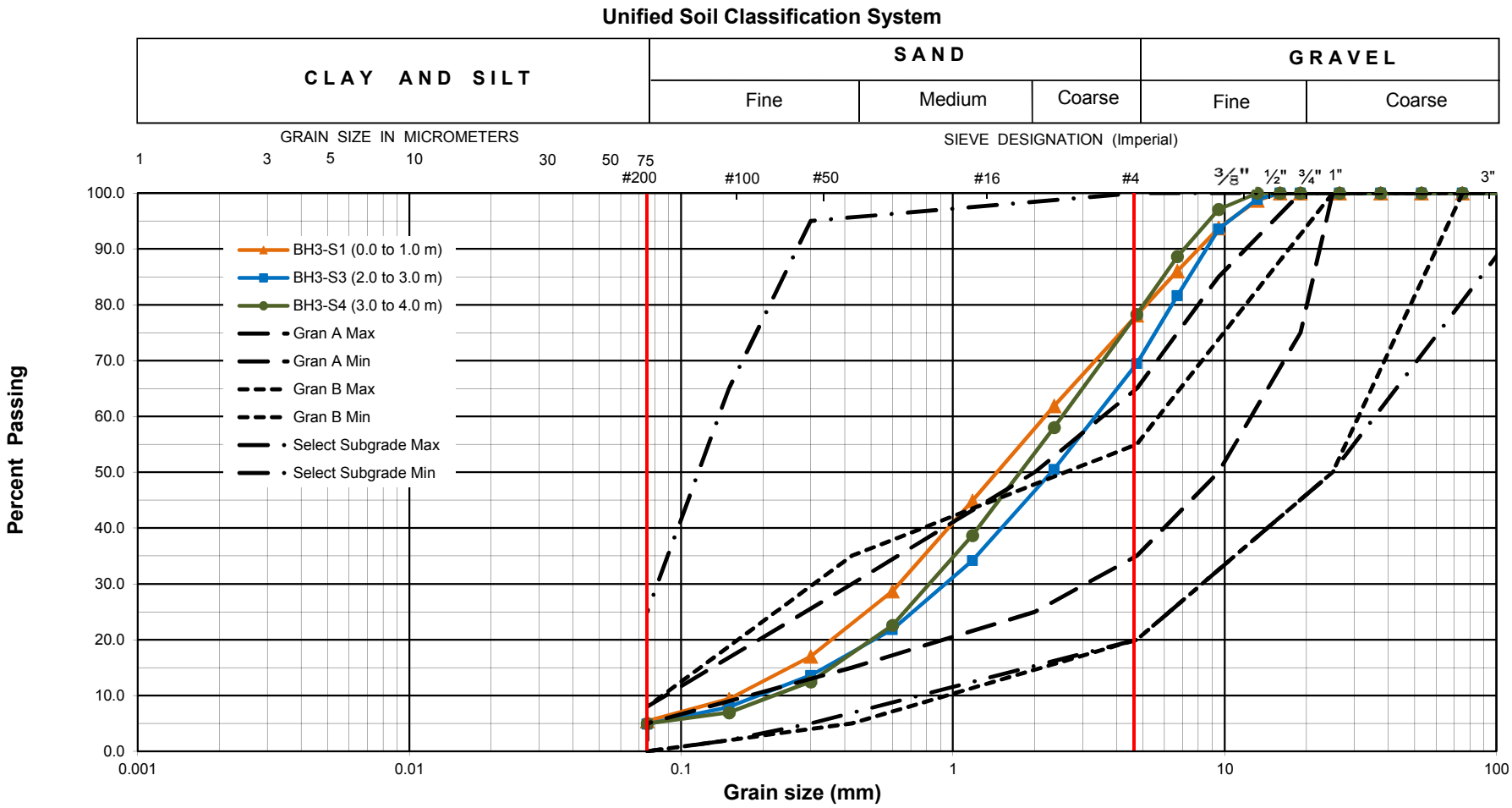
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 7, 2015**	**Borehole:**	**3**	**Sample:**	**S3 & S4**	**Depth (m) :**	**as indicated**
Sample Description :		**SAND with gravel**				**Figure :**	**8**

Log of Borehole BH04

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 9

Page. 1 of 1

Date Drilled: 5/7/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

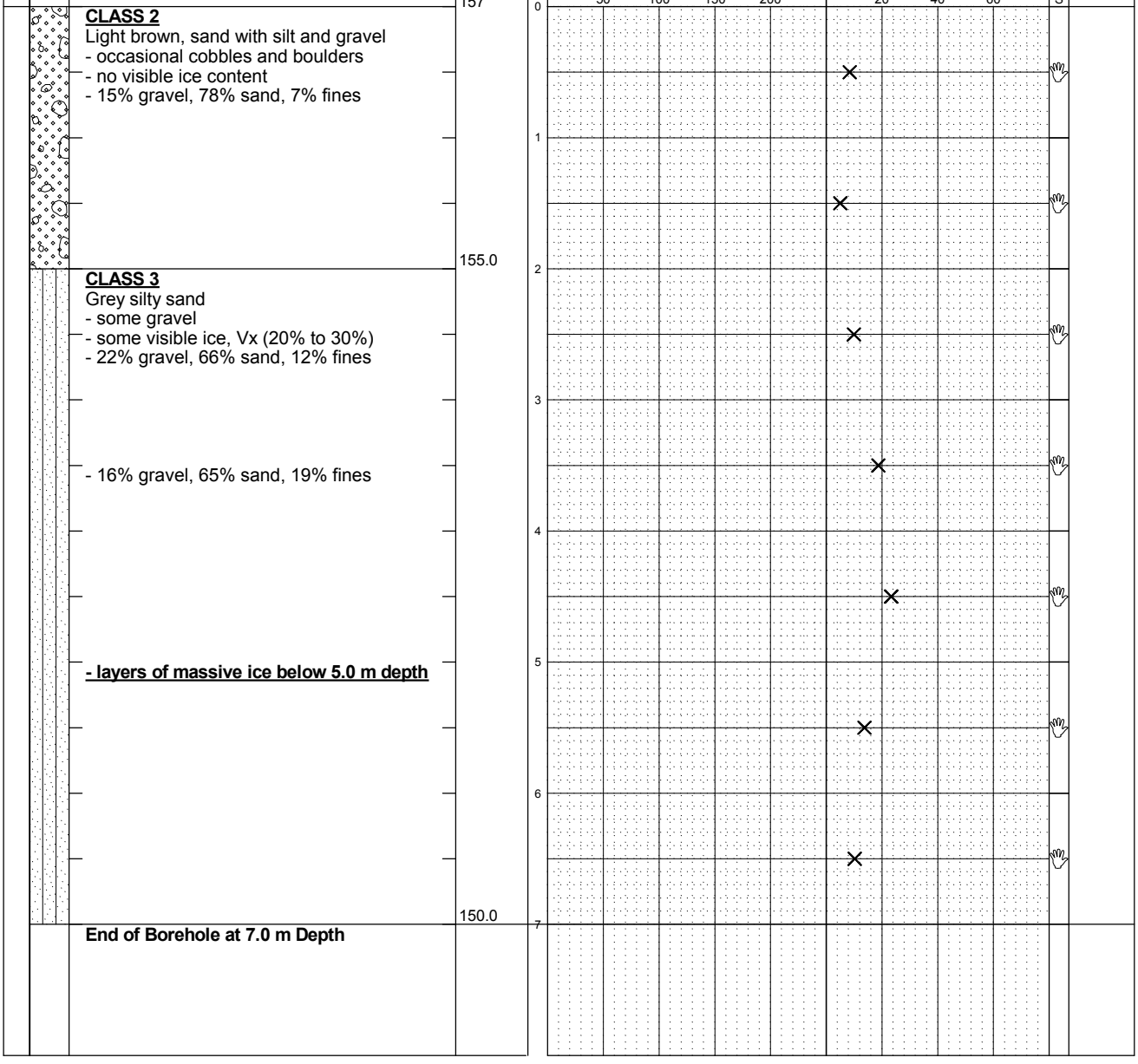
GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 2 Light brown, sand with silt and gravel - occasional cobbles and boulders - no visible ice content - 15% gravel, 78% sand, 7% fines	157	0
				1
			155.0	2
		CLASS 3 Grey silty sand - some gravel - some visible ice, Vx (20% to 30%) - 22% gravel, 66% sand, 12% fines		
				3
		- 16% gravel, 65% sand, 19% fines		
				4
				5
		- layers of massive ice below 5.0 m depth		
				6
			150.0	7
		End of Borehole at 7.0 m Depth		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³



NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

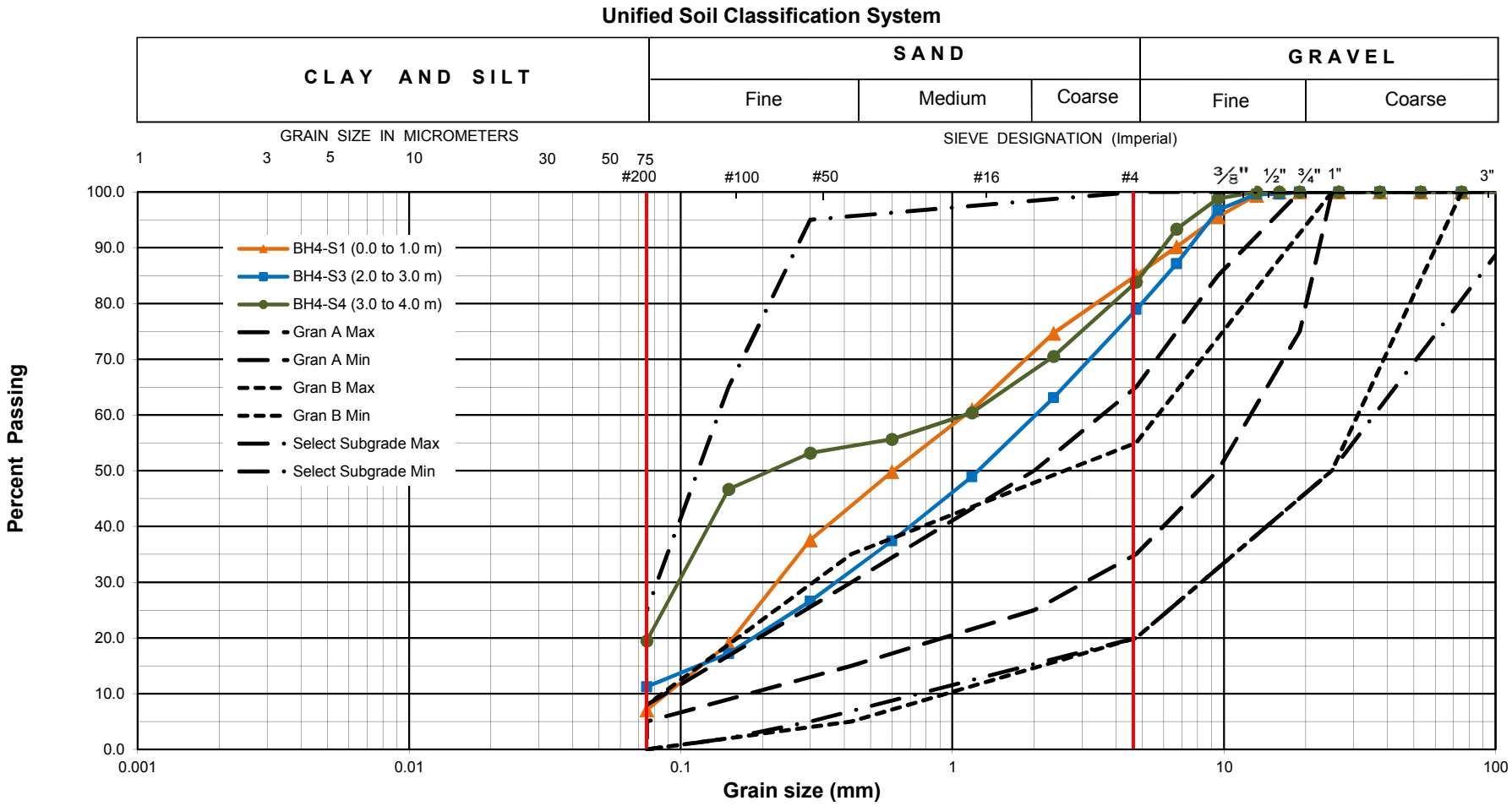
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 7, 2015**	**Borehole:**	**4**	**Sample:**	**S1, S3 & S4**	**Depth (m) :**	**as indicated**
Sample Description :	**SAND with silt and gravel to silty SAND with gravel**					**Figure :**	**10**

Log of Borehole BH05

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 11

Page. 1 of 1

Date Drilled: 5/8/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 2 Medium brown, sand with silt and gravel - no visible ice content - 26% gravel, 69% sand, 5% fines	168	0
		- some visible ice, Vx (10% to 20%) below 2.0 m depth - 2% gravel, 90% sand, 8% fines		1 2
		CLASS 3 Light brown, predominantly fine-grained silty sand - trace to no gravel - trace cobbles and boulders - some visible ice, Vx (10% to 20%) - 0% gravel, 81% sand, 19% fines	165.0	3 4
		- layers of massive ice below 5.0 m depth		5
		End of Borehole at 6.0 m Depth	162.0	6

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

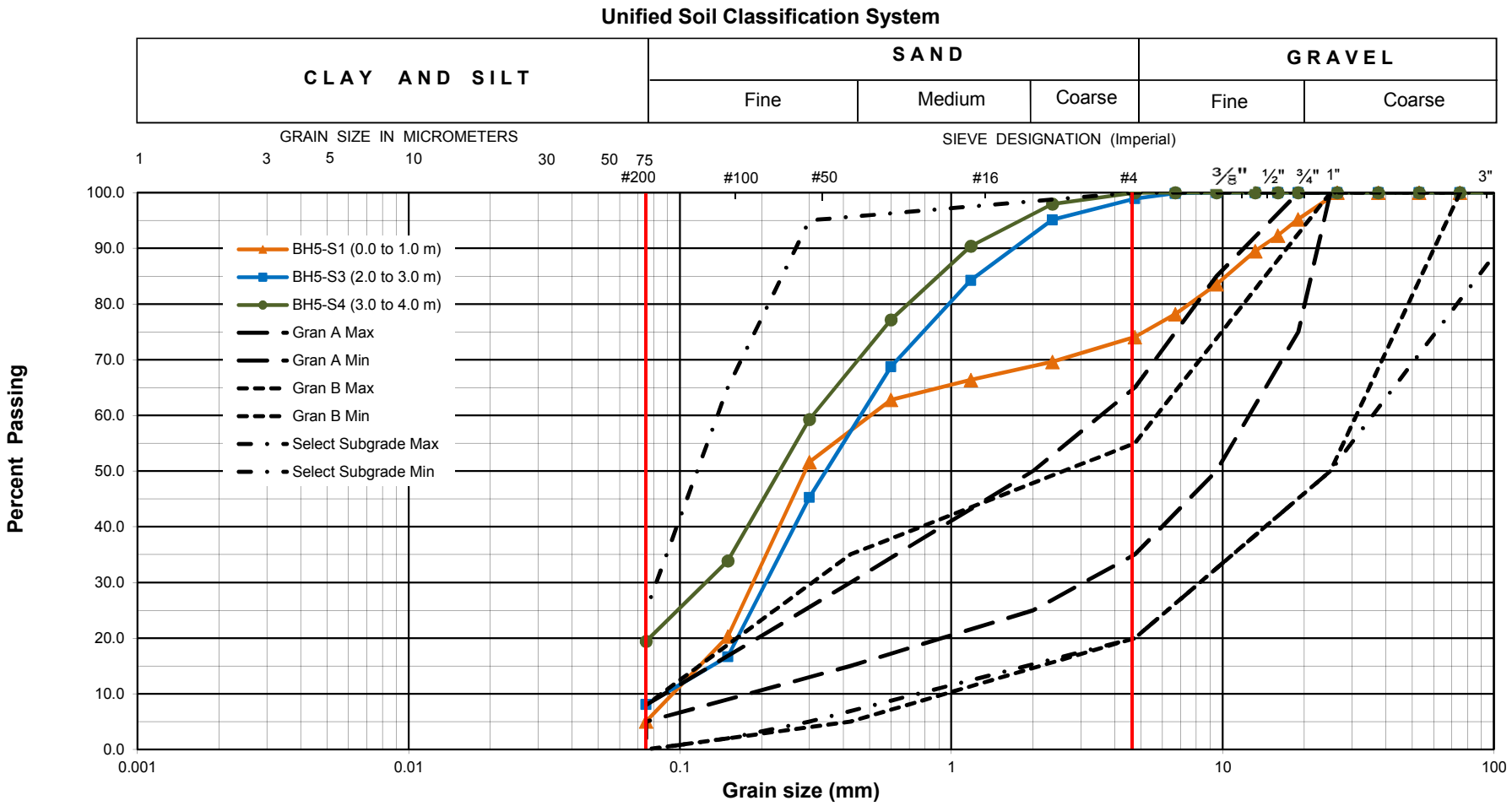
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 8, 2015**	**Borehole:**	**5**	**Sample:**	**S1, S3 & S4**	**Depth (m) :**	**as indicated**
Sample Description :	**SAND with gravel to silty SAND**					**Figure :**	**12**

Log of Borehole BH06

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 13

Page. 1 of 1

Date Drilled: 5/8/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 1 Dark brown, sand with gravel - trace silt - occasional cobbles and boulders - no visible ice content - 33% gravel, 65% sand, 2% fines	166	0
			164.0	2
		CLASS 3 Light brown, silty sand with gravel - frequent cobbles and boulders - some visible ice, Vx (10% to 20%) - 23% gravel, 65% sand, 12% fines **- layers of massive ice below 3.0 m depth** - 40% gravel, 50% sand, 10% fines		3
			160.0	6
		End of Borehole at 6.0 m Depth		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

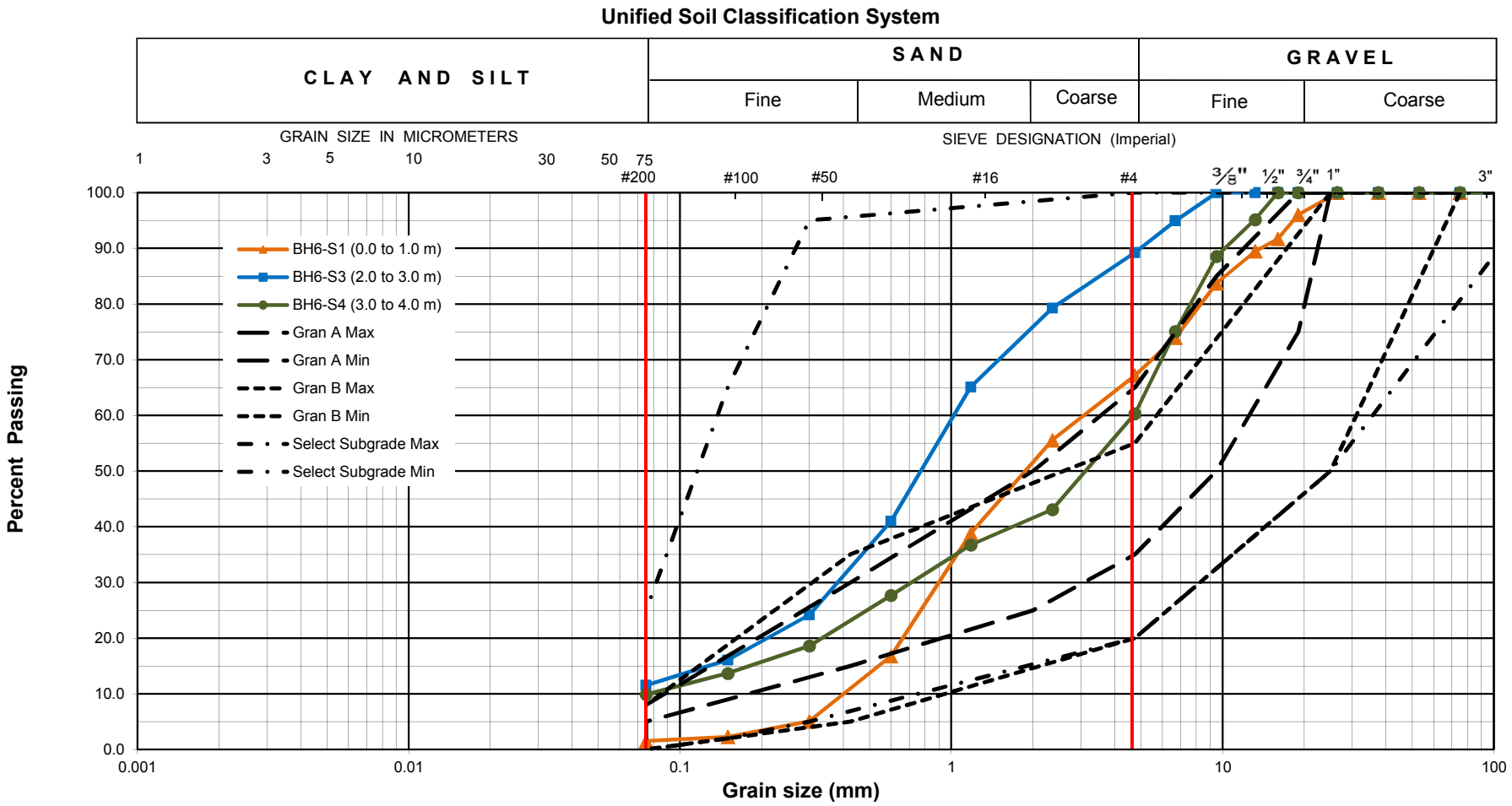
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 8, 2015**	**Borehole:**	**6**	**Sample:**	**S1, S3 & S4**	**Depth (m) :**	**as indicated**
Sample Description :		**SAND with gravel to SAND with silt**				**Figure :**	**14**

Log of Borehole BH07

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 15

Page. 1 of 1

Date Drilled: 5/9/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		CLASS 1 Dark brown, sand with gravel - trace silt - frequent cobbles and boulders - no visible ice content - 24% gravel, 72% sand, 4% fines	170	0	20 40 60 80 / 50 100 150 200 kPa	250 500 750 / 20 40 60		
		- 46% gravel, 51% sand, 3% fines		2				
		- 25% gravel, 71% sand, 4% fines		3				
		CLASS 3 Grey, silty sand - trace gravel - frequent cobbles and boulders - trace visible ice, Vx (<10%)	166.0	4				
		End of Borehole at 6.0 m Depth	164.0	6				

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

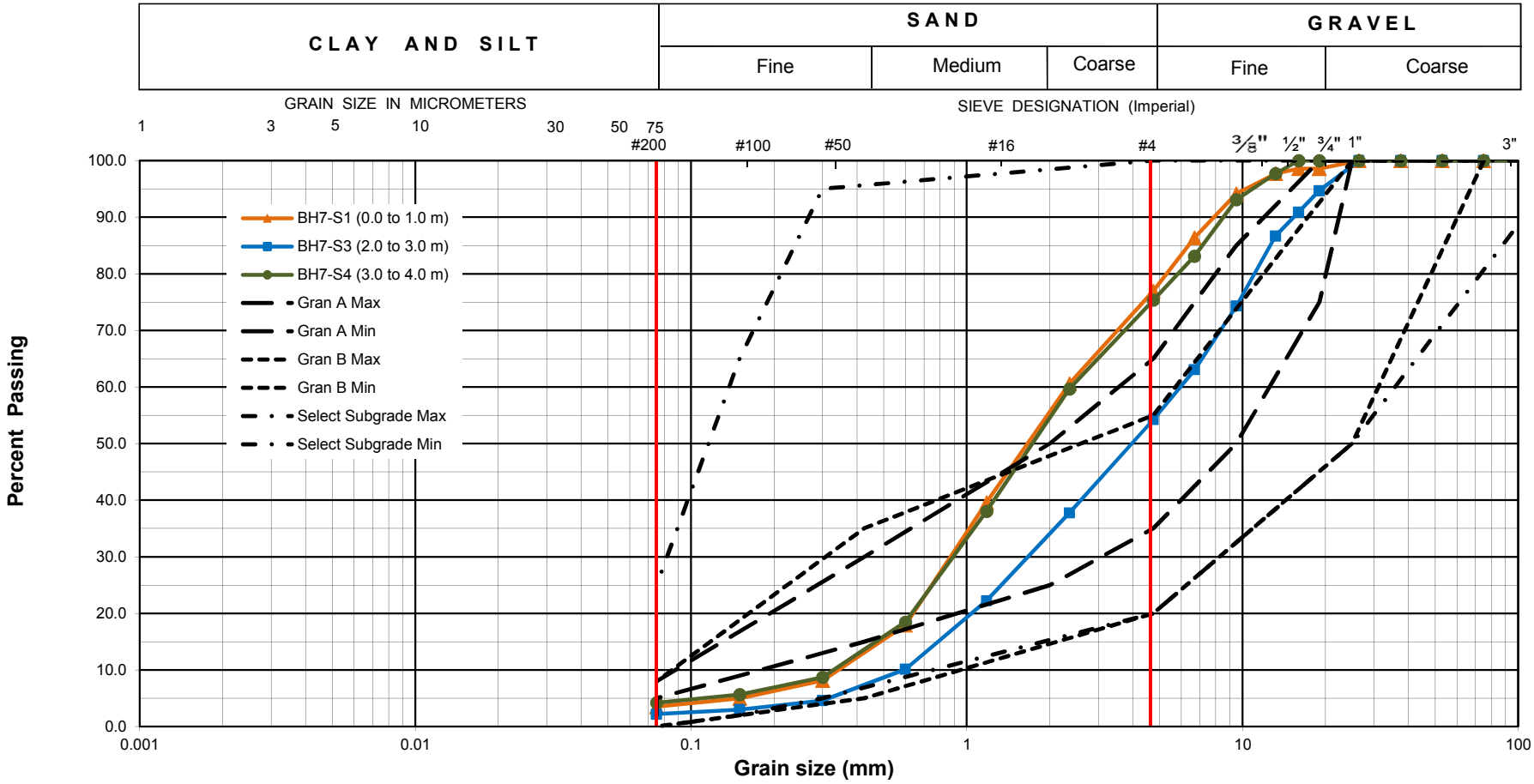
exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136

Unified Soil Classification System



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 9, 2015**	**Borehole:**	**7**	**Sample:**	**S1, S3 & S4**	**Depth (m) :**	**as indicated**
Sample Description :		**SAND with gravel**				**Figure :**	**16**

Log of Borehole BH08

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 17

Page. 1 of 1

Date Drilled: 5/12/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 1 Light brown, sand with gravel to gravel with sand - trace silt - frequent cobbles and boulders - no visible ice content - 45% gravel, 53% sand, 2% fines	170	0
		- 58% gravel, 40% sand, 2% fines		2
		- 31% gravel, 65% sand, 4% fines		3
		CLASS 2 Grey, sand with silt - trace gravel - occasional cobbles and boulders - trace visible ice, Vx (<10%) - 1% gravel, 93% sand, 6% fines	166.0	4
		End of Borehole at 6.0 m Depth	164.0	6

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

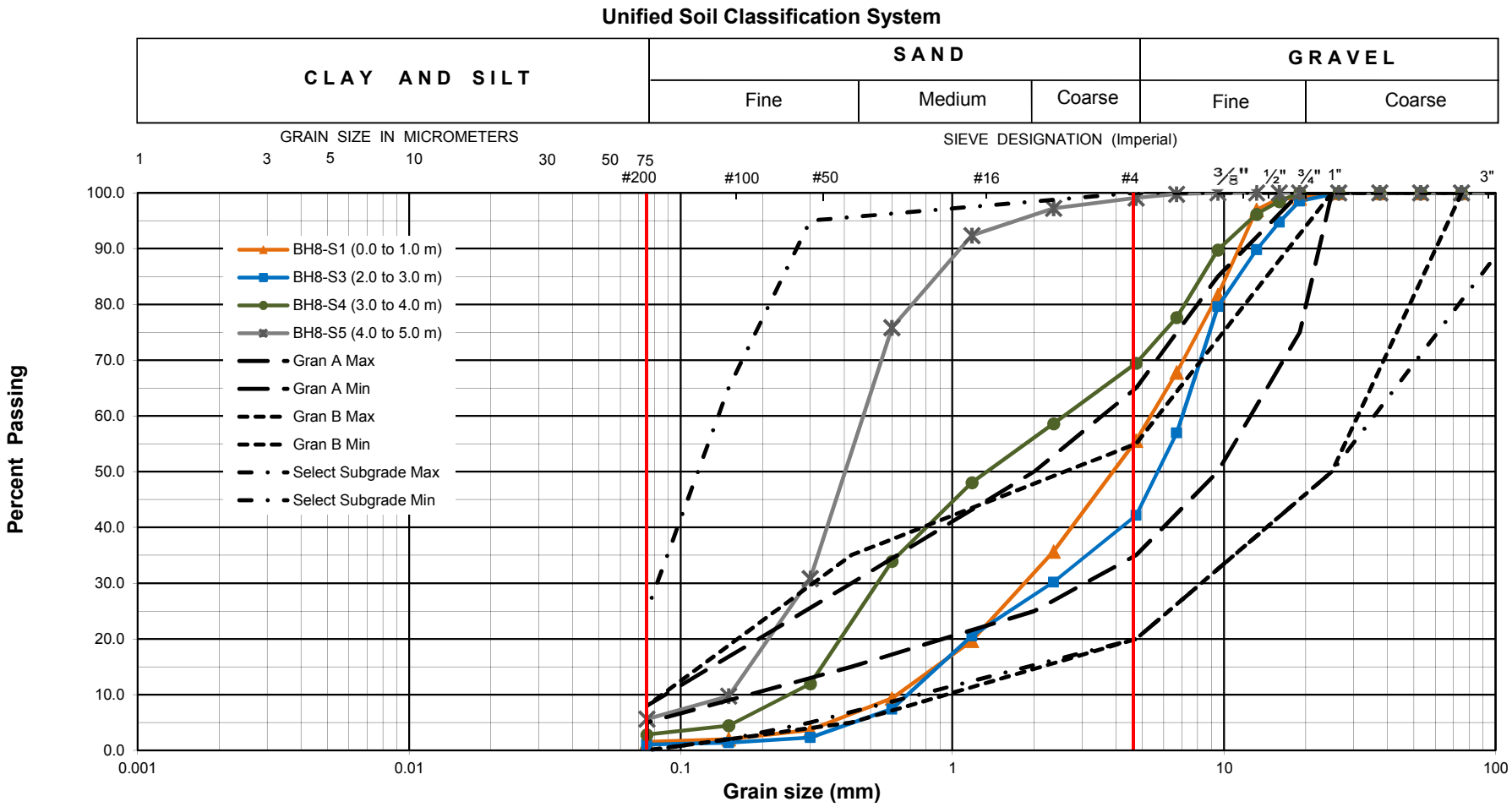
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 12, 2015**	**Borehole:**	**8**	**Sample: S1, S3, S4 & S5**		**Depth (m) :**	**as indicated**
Sample Description :		**GRAVEL with sand to SAND with silt**				**Figure :**	**18**

Log of Borehole BH09

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 19

Page. 1 of 1

Date Drilled: 5/12/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 1 Light brown, gravel with sand - trace silt - frequent cobbles and boulders - no visible ice content - 55% gravel, 43% sand, 2% fines	168	0
		CLASS 2 Light brown, sand with silt - trace gravel - frequent cobbles and boulders - no visible ice content - 3% gravel, 90% sand, 7% fines - 7% gravel, 86% sand, 7% fines	166.5	1
		CLASS 3 Grey, silty sand - trace gravel - occasional cobbles and boulders - trace visible ice, Vx (<10%) - 2% gravel, 87% sand, 11% fines	164.0	2
		End of Borehole at 6.0 m Depth	162.0	3
				4
				5
				6

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

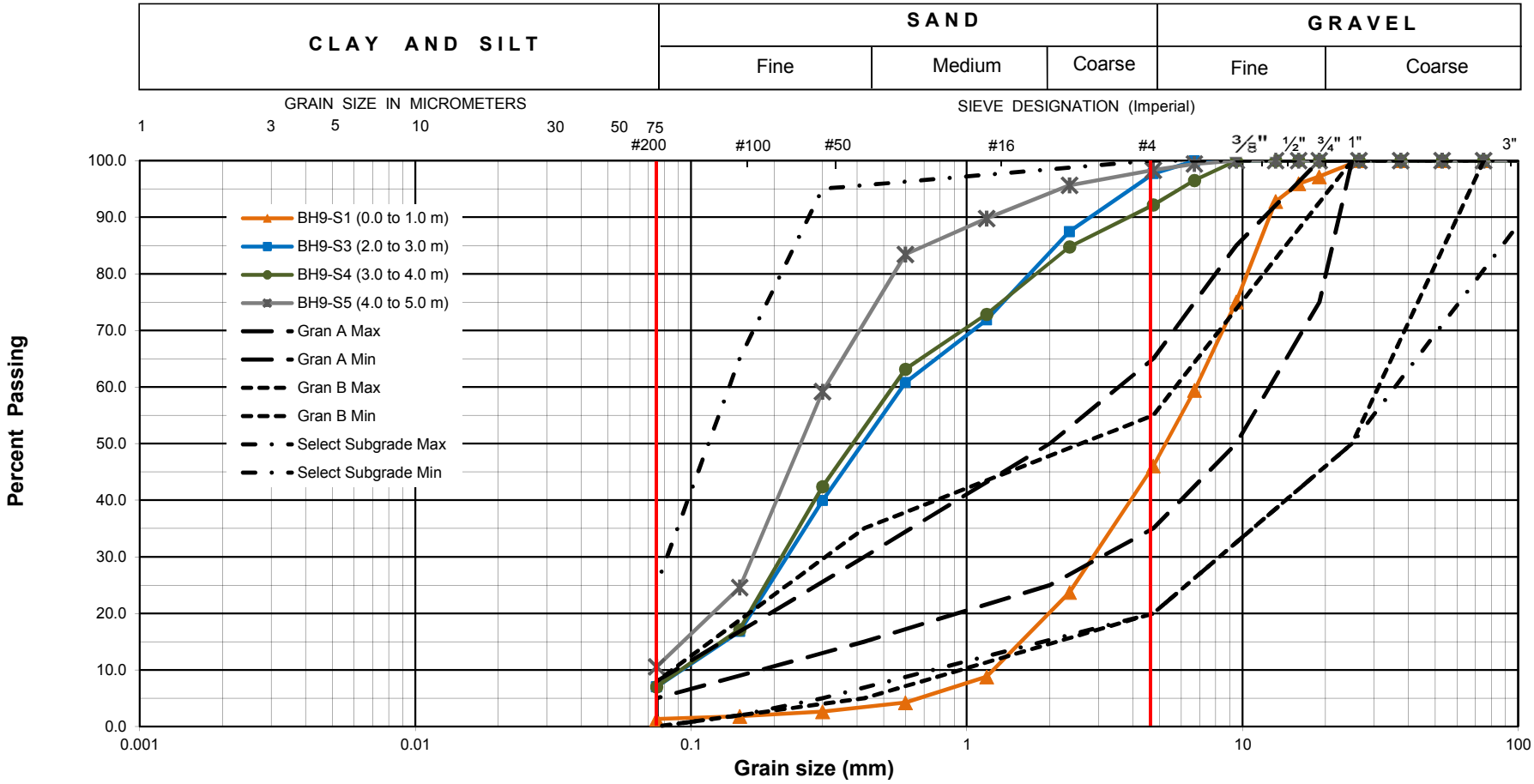
exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136

Unified Soil Classification System



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**		
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**		
Date Sampled :	**May 12, 2015**	**Borehole:**	**9**	**Sample: S1, S3, S4 & S5**	**Depth (m) : as indicated**
Sample Description :		**GRAVEL with sand to SAND with silt**			**Figure : 20**

Log of Borehole BH10

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 21

Page. 1 of 1

Date Drilled: 5/13/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 1 Light brown, gravel with sand to sand with gravel - trace silt - frequent cobbles and boulders - no visible ice content - 52% gravel, 47% sand, 1% fines	170	0
		- 24% gravel, 73% sand, 3% fines		2
		- 40% gravel, 54% sand, 6% fines		3
		CLASS 3 Grey, silty sand - trace gravel - occasional cobbles and boulders - trace visible ice, Vx (<10%) - 3% gravel, 76% sand, 21% fines	166.0	4
		End of Borehole at 6.0 m Depth	164.0	6

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

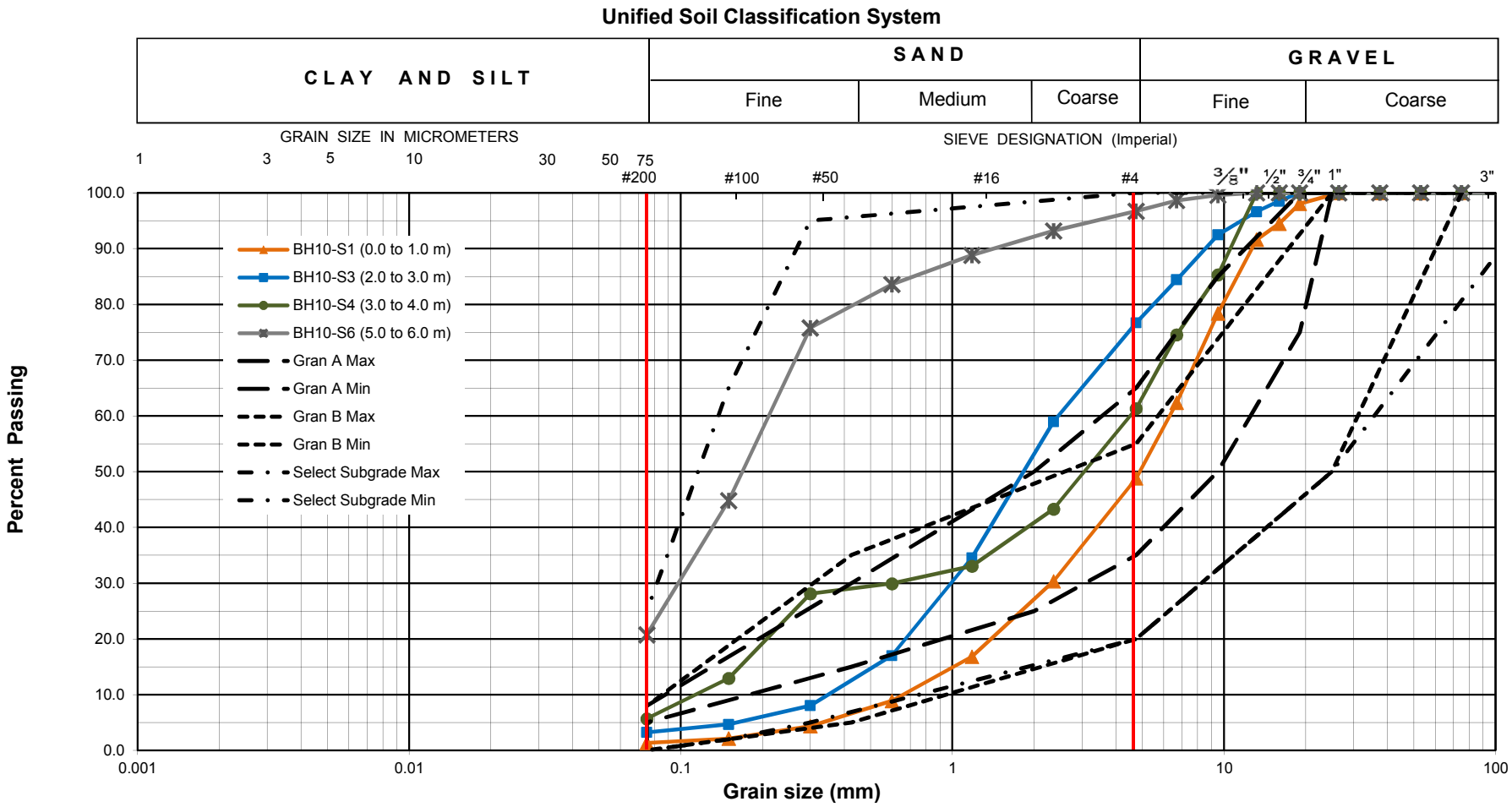
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 13, 2015**	**Borehole:**	**10**	**Sample: S1, S3, S4 & S6**		**Depth (m) :**	**as indicated**
Sample Description :		**GRAVEL with sand to SAND with silt**				**Figure :**	**22**

Log of Borehole BH11

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 23

Page. 1 of 1

Date Drilled: 5/14/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		CLASS 1 to CLASS 2 Medium brown, sand with silt and gravel to sand with gravel - frequent cobbles and boulders - no visible ice content - 36% gravel, 58% sand, 8% fines	170	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
		- 15% gravel, 82% sand, 3% fines		2				
		- 11% gravel, 86% sand, 3% fines		3				
		End of Borehole at 4.0 m Depth	166.0	4				

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

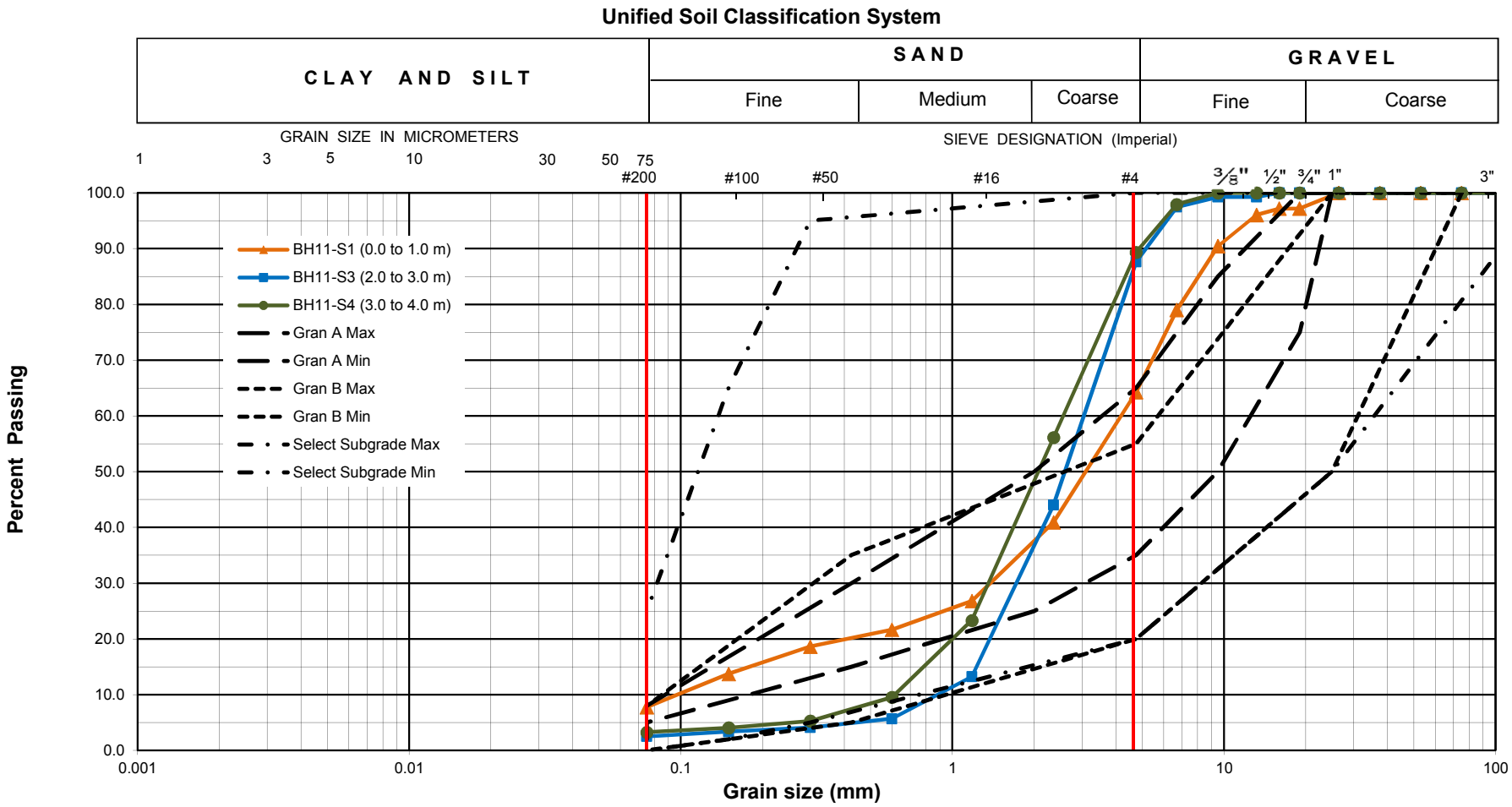
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	OTT-00219428-A0	Project Name :	Geotechnical Investigation - Northwest Deposit		
Client :	City of Iqaluit	Project Location :	Iqaluit, NU		
Date Sampled :	May 14, 2015	Borehole:	11	Sample: S1, S3 & S4	Depth (m) : as indicated
Sample Description :	SAND with gravel				Figure : 24

Log of Borehole BH12

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 25

Page. 1 of 1

Date Drilled: 5/15/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○—|
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 1 Dark brown, gravel with sand - trace silt - frequent cobbles and boulders - no visible ice content - 58% gravel, 41% sand, 1% fines	172	0
		CLASS 2 Dark brown, sand with silt and gravel to silty sand with gravel - frequent cobbles and boulders - trace to some visible ice, Vx (5% to 20%) - 6% gravel, 84% sand, 10% fines - 49% gravel, 39% sand, 12% fines	170.5	1 2 3
		CLASS 4 Grey, silty sand with gravel - occasional cobbles and boulders - some visible ice, Vx (10% to 20%) - 17% gravel, 54% sand, 29% fines	168.0	4 5
		End of Borehole at 6.0 m Depth	166.0	6

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

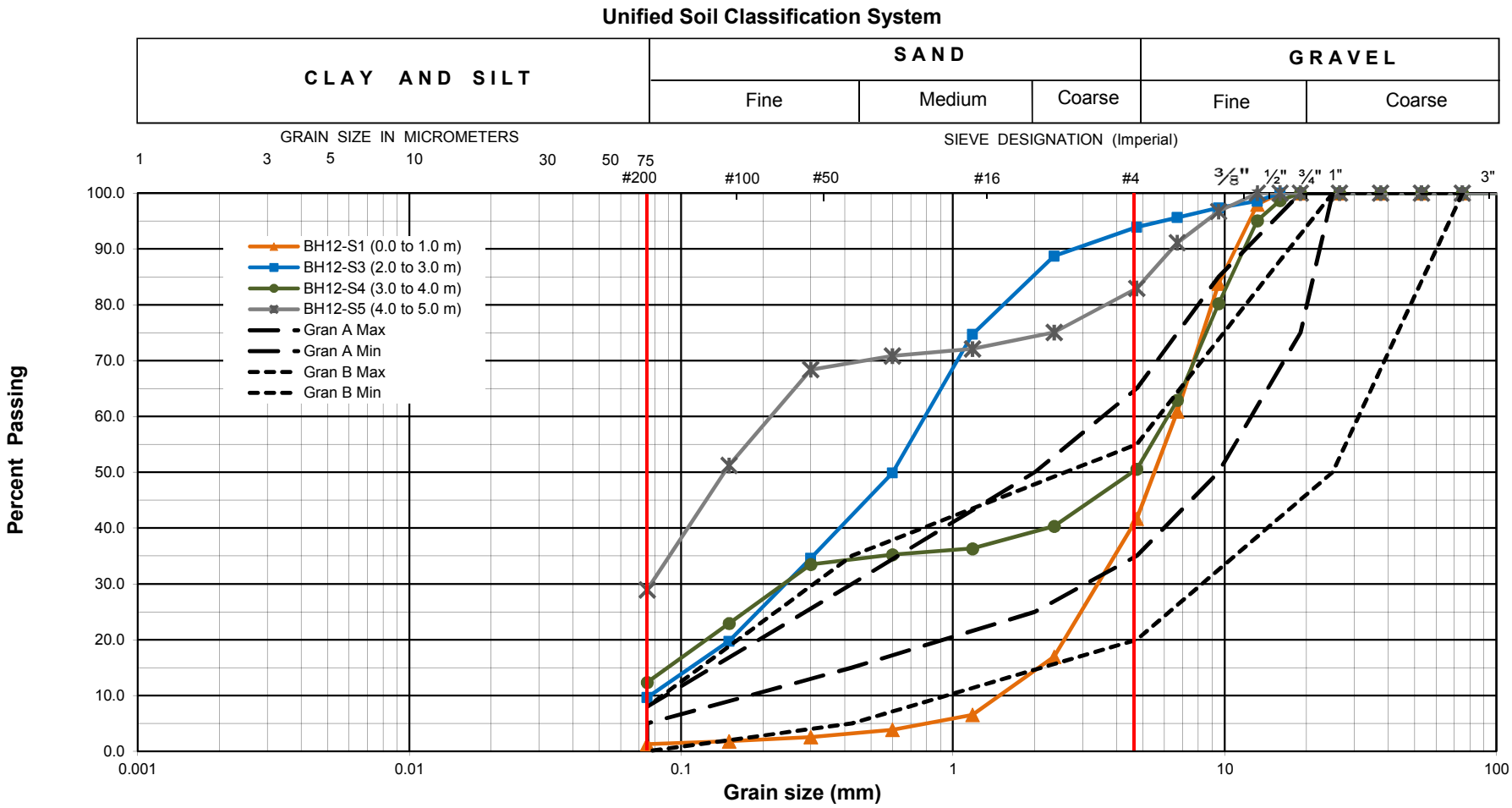
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**		
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**		
Date Sampled :	**May 15, 2015**	**Borehole:**	**12**	**Sample: S1, S3, S4 & S5**	**Depth (m) : as indicated**
Sample Description :	**GRAVEL with sand to silty SAND with gravel**				**Figure : 26**

Log of Borehole BH13

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 27

Page. 1 of 1

Date Drilled: 5/15/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 1 Light brown, sand with gravel - trace silt - no visible ice content - 16% gravel, 82% sand, 2% fines	170	0
			168.5	1
		CLASS 3 Light brown to greyish brown, silty sand - trace gravel - occasional cobbles and boulders - no visible ice content - 3% gravel, 80% sand, 17% fines - some visible ice, Vx (10% to 20%) below 3.0 m depth - 3% gravel, 76% sand, 21% fines		2
				3
				4
				5
			164.0	6
		End of Borehole at 6.0 m depth		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

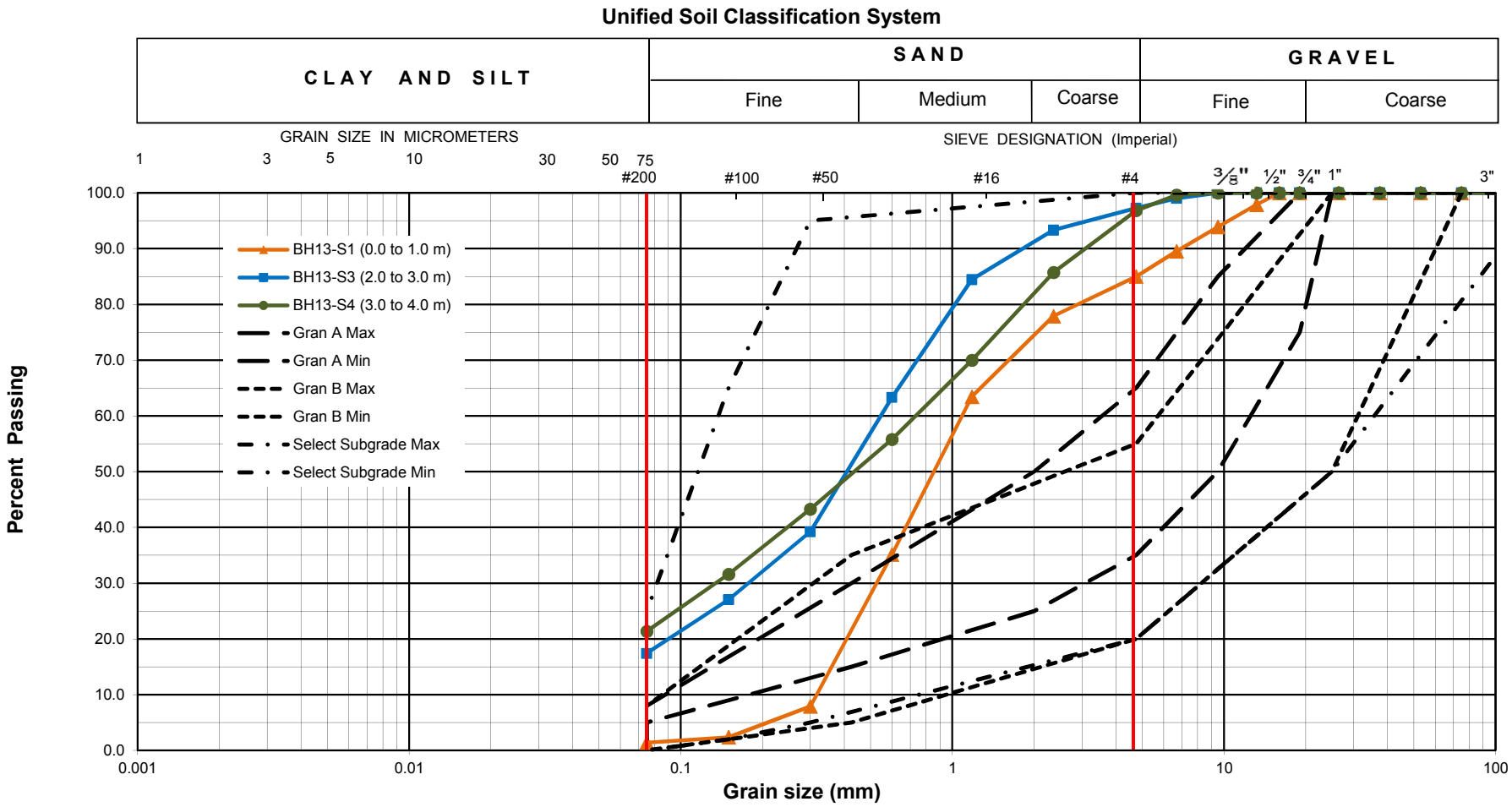
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**		
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**		
Date Sampled :	**May 15, 2015**	**Borehole:**	**13**	**Sample: S1, S3 & S4**	**Depth (m) : as indicated**
Sample Description :	**SAND with gravel to silty SAND**				**Figure : 28**

Log of Borehole BH14

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 29

Page. 1 of 1

Date Drilled: 5/19/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		CLASS 1 Medium brown, sand with gravel - trace silt - occasional cobbles and boulders - no visible ice content - 33% gravel, 62% sand, 5% fines	205 204.0	0	20 40 60 80 50 100 150 200	250 500 750 20 40 60		
		CLASS 3 Light brown, silty sand to silty sand with gravel - frequent cobbles and boulders - no visible ice content		1				
		- 3% gravel, 83% sand, 14% fines		2				
		- 18% gravel, 68% sand, 14% fines		3				
		End of Borehole at 4.0 m Depth - inferred bedrock	201.0	4				

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

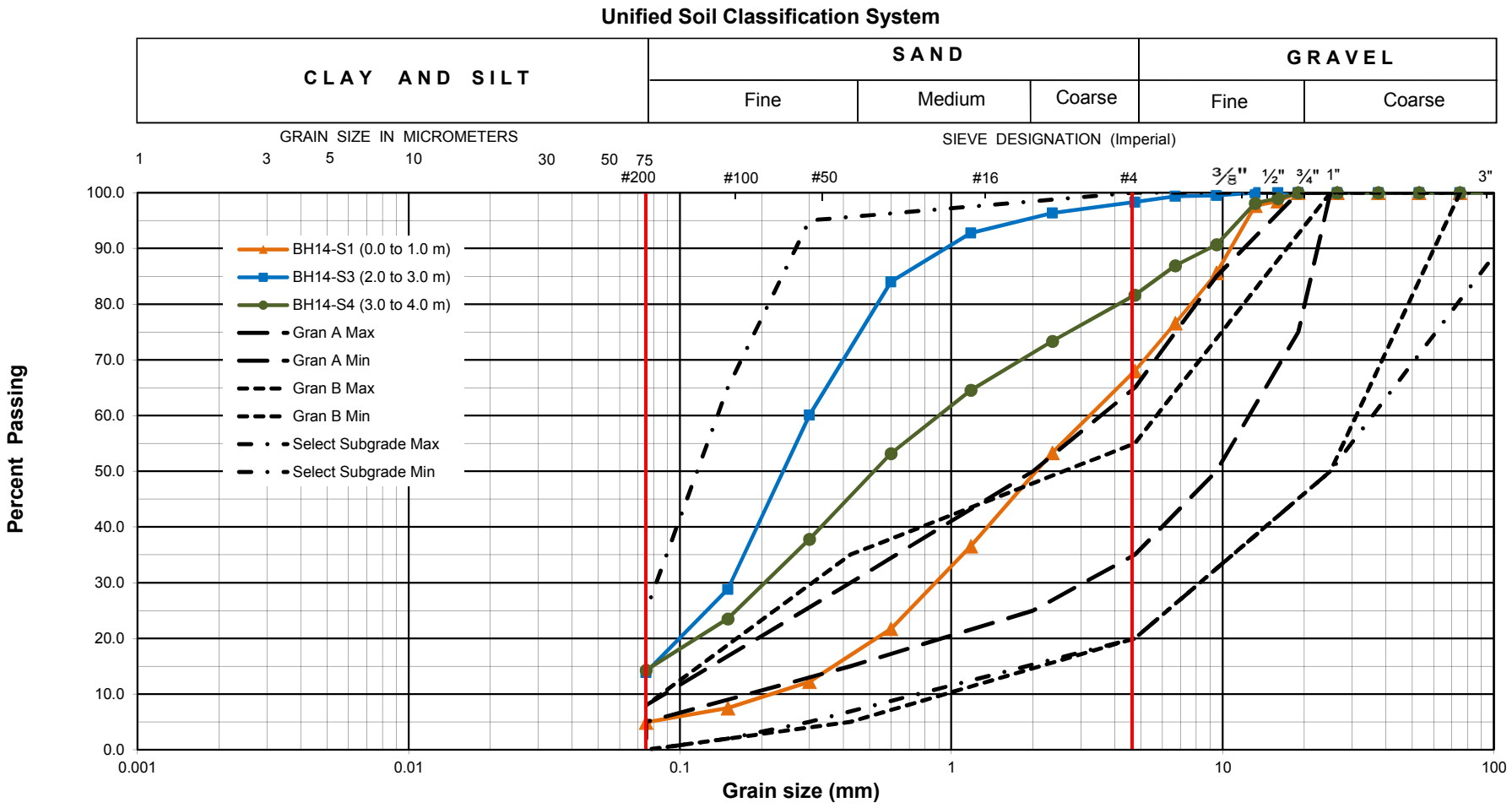
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	OTT-00219428-A0	Project Name :	Geotechnical Investigation - Northwest Deposit		
Client :	City of Iqaluit	Project Location :	Iqaluit, NU		
Date Sampled :	May 19, 2015	Borehole:	14	Sample: S1, S3 & S4	Depth (m) : as indicated
Sample Description :	SAND with gravel to silty SAND				Figure : 30

Log of Borehole BH15

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 31

Page. 1 of 1

Date Drilled: 5/20/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 2 Medium brown to light brown, sand with silt - trace gravel - frequent cobbles and boulders - no visible ice content - 7% gravel, 85% sand, 8% fines	194	0
		- 10% gravel, 87% sand, 3% fines		2
		- 2% gravel, 91% sand, 7% fines		3
			189.0	5
		End of Borehole at 5.0 m Depth - inferred bedrock		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

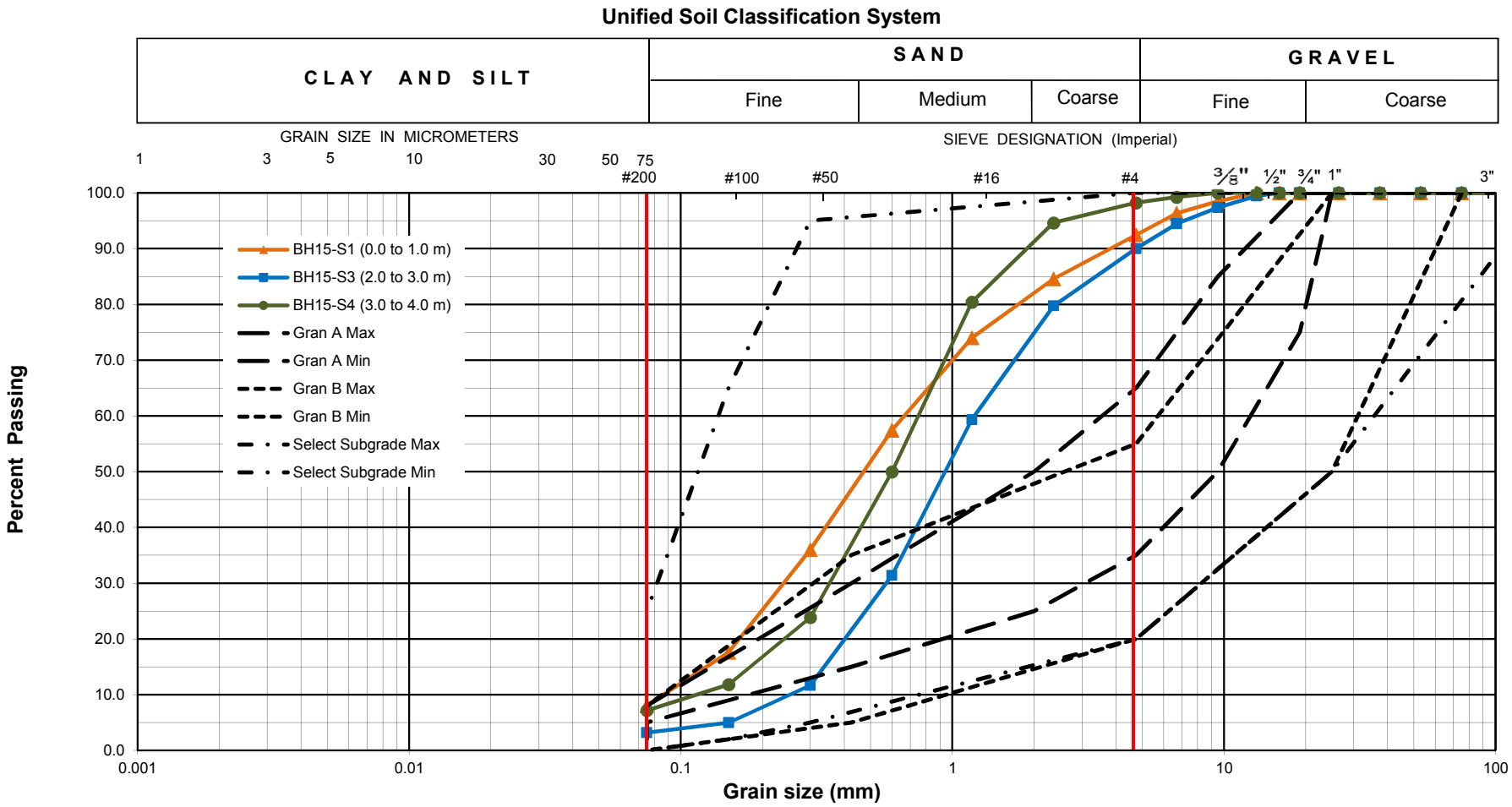
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	OTT-00219428-A0	Project Name :	Geotechnical Investigation - Northwest Deposit		
Client :	City of Iqaluit	Project Location :	Iqaluit, NU		
Date Sampled :	May 21, 2015	Borehole:	15	Sample: S1, S3 & S4	Depth (m) : as indicated
Sample Description :	SAND to SAND with silt and gravel				Figure : 32

Log of Borehole BH16

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 33

Page. 1 of 1

Date Drilled: 5/20/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 2 Medium brown, sand with silt and gravel - frequent cobbles and boulders - no visible ice content - 23% gravel, 69% sand, 8% fines	185	0
		- 30% gravel, 63% sand, 7% fines	182.0	3
		End of Borehole at 3.0 m Depth - inferred bedrock		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

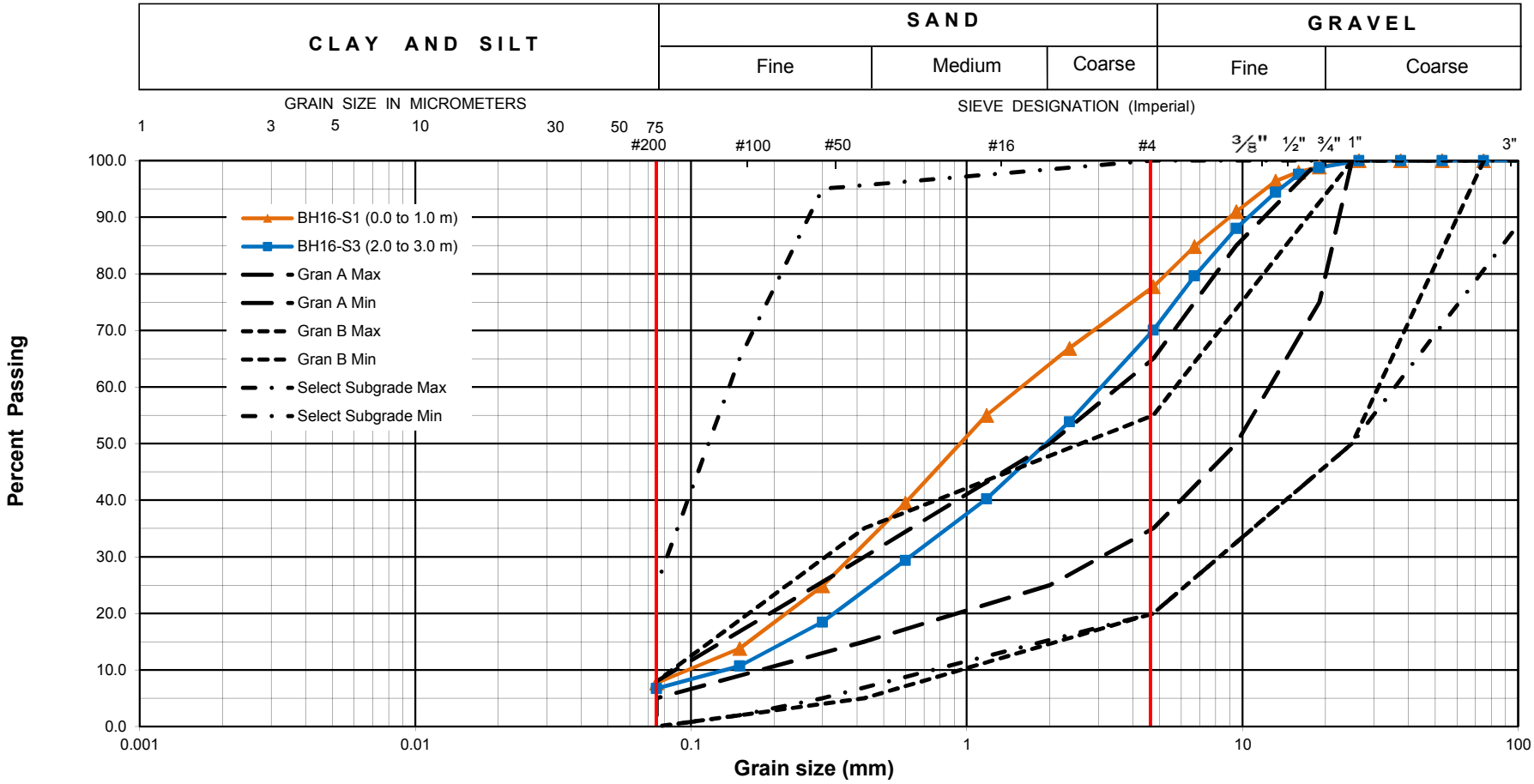
exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136

Unified Soil Classification System



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 21, 2015**	**Borehole:**	**16**	**Sample:**	**S1 & S3**	**Depth (m) :**	**as indicated**
Sample Description :		**SAND with silt and gravel**				**Figure :**	**34**

Log of Borehole BH17

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 35

Page. 1 of 1

Date Drilled: 5/20/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 2 Medium brown, sand with silt and gravel to sand with silt - frequent cobbles and boulders - no visible ice content - 12% gravel, 80% sand, 8% fines	180	0
		- 3% gravel, 86% sand, 11% fines	177.0	3
		End of Borehole at 3.0 m Depth - inferred bedrock		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60
SAMPLES
Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
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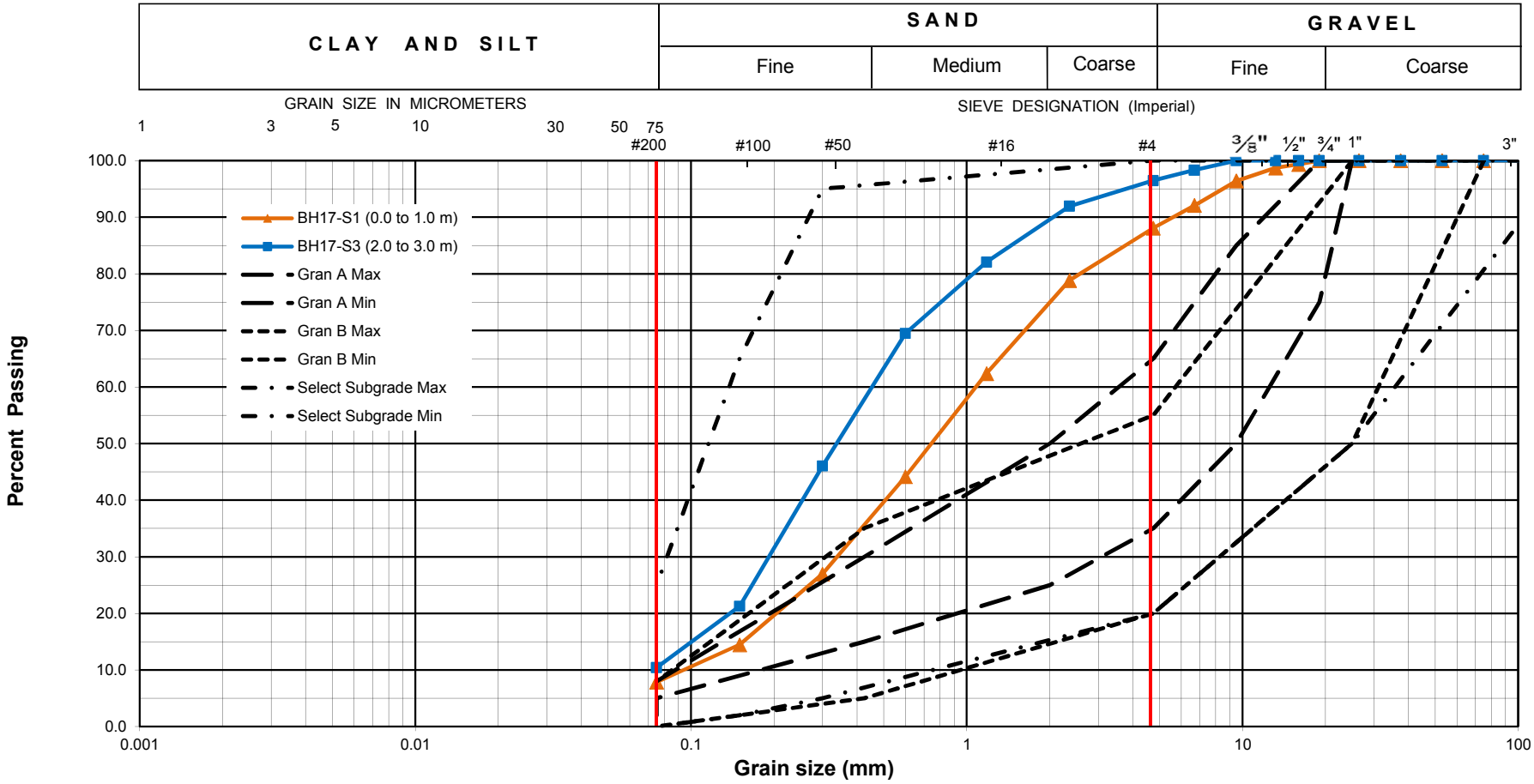
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136

Unified Soil Classification System



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 21, 2015**	**Borehole:**	**17**	**Sample:**	**S1 & S3**	**Depth (m) :**	**as indicated**
Sample Description :	**SAND with silt to SAND with silt and gravel**					**Figure :**	**36**

Log of Borehole BH18

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 37

Page. 1 of 1

Date Drilled: 5/21/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○—|
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 1 Medium brown, gravel with sand to sand with gravel - trace silt - frequent cobbles and boulders - no visible ice content - 50% gravel, 48% sand, 2% fines	186	0
		- 13% gravel, 84% sand, 3% fines		1 2
		End of Borehole at 3.0 m Depth	183.0	3

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

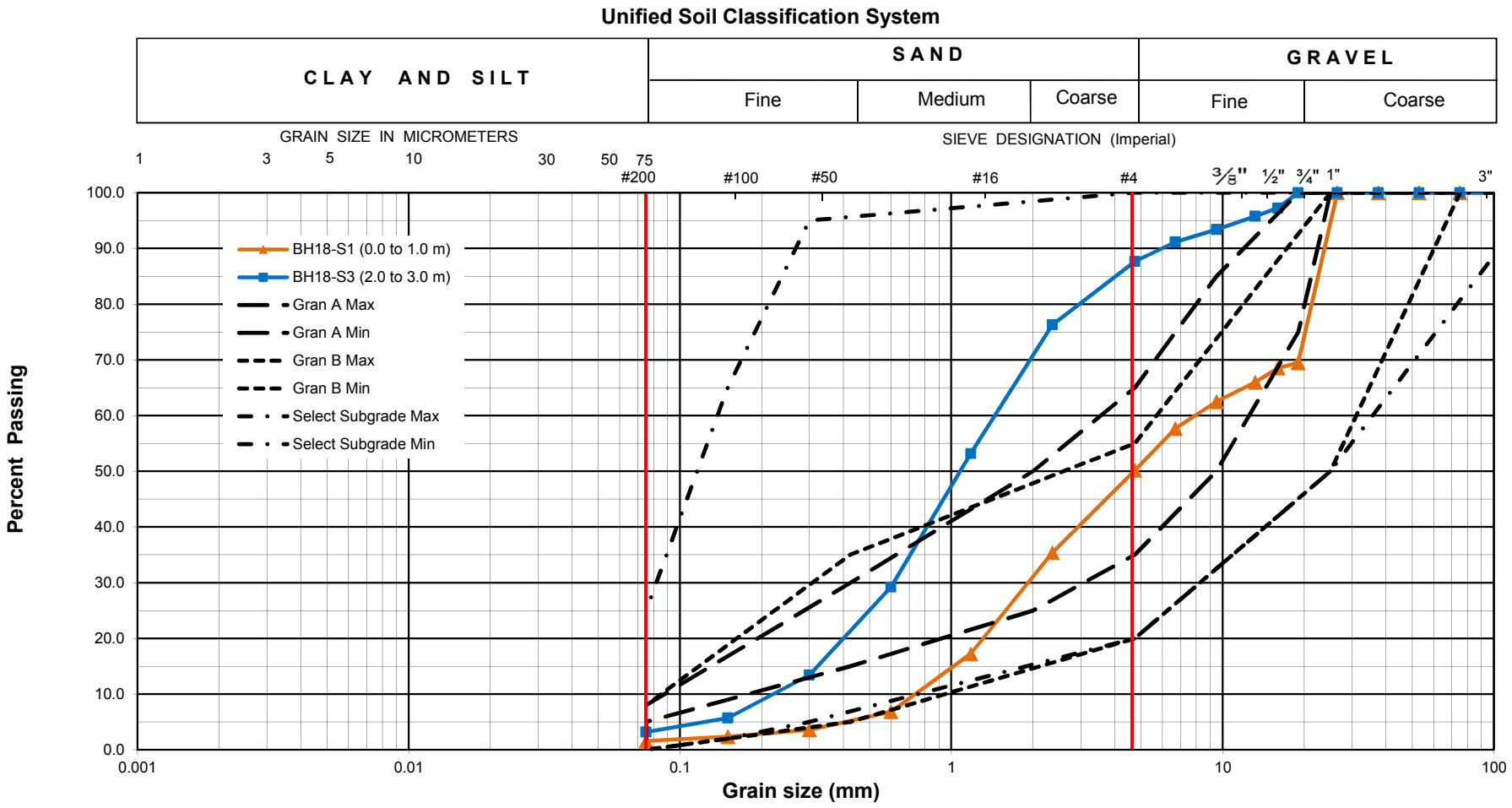
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 21, 2015**	**Borehole:**	**18**	**Sample:**	**S1 & S3**	**Depth (m) :**	**as indicated**
Sample Description :	**SAND with silt to SAND with silt and gravel**					**Figure :**	**38**

Log of Borehole BH19

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 39

Page. 1 of 1

Date Drilled: 5/21/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		CLASS 2 Medium brown, sand with silt and gravel - frequent cobbles and boulders - no visible ice content - 24% gravel, 69% sand,7% fines	183	0	20 40 60 80 / 50 100 150 200 kPa	250 500 750 / 20 40 60		
		- 25% gravel, 71% sand, 4% fines		2				
		- 17% gravel, 76% sand, 7% fines		3				
		End of Borehole at 4.0 m Depth	179.0	4				

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

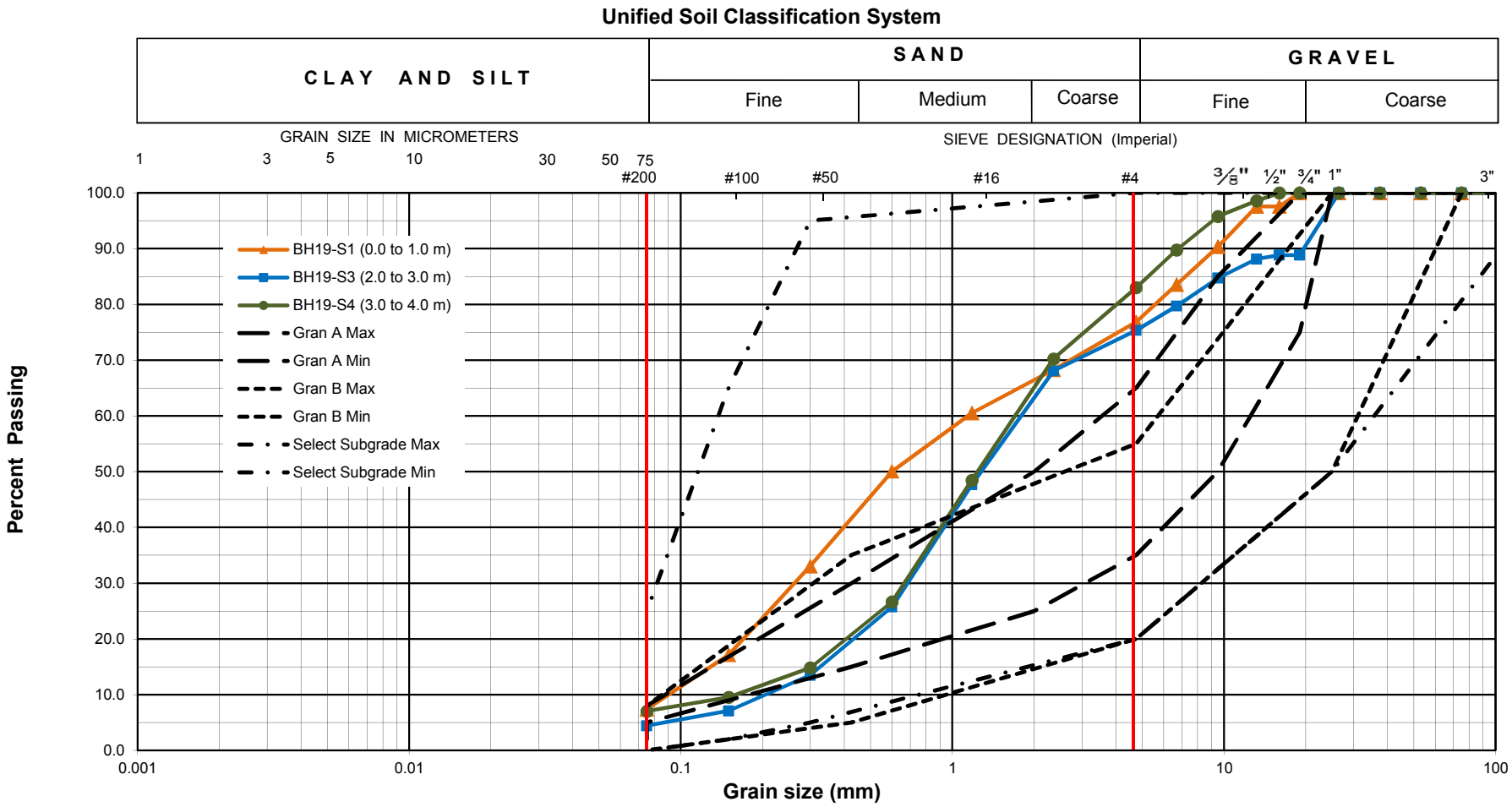
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 21, 2015**	**Borehole:**	**19**	**Sample:**	**S1, S3 & S4**	**Depth (m) :**	**as indicated**
Sample Description :		**SAND with silt and gravel**				**Figure :**	**40**

Log of Borehole BH20

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 41

Page. 1 of 1

Date Drilled: 5/21/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○—|
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 1 Medium brown, sand with gravel - trace silt - frequent cobbles and boulders - no visible ice content - 20% gravel, 77% sand, 3% fines	183	0
		- 14% gravel, 83% sand, 3% fines		2
		- 14% gravel, 82% sand, 4% fines		3
		CLASS 2 Medium brown, sand with gravel - some silt - occasional cobbles and boulders - trace visible ice, Vx (<10%)	179.0	4
		End of Borehole at 6.0 m Depth	177.0	6

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

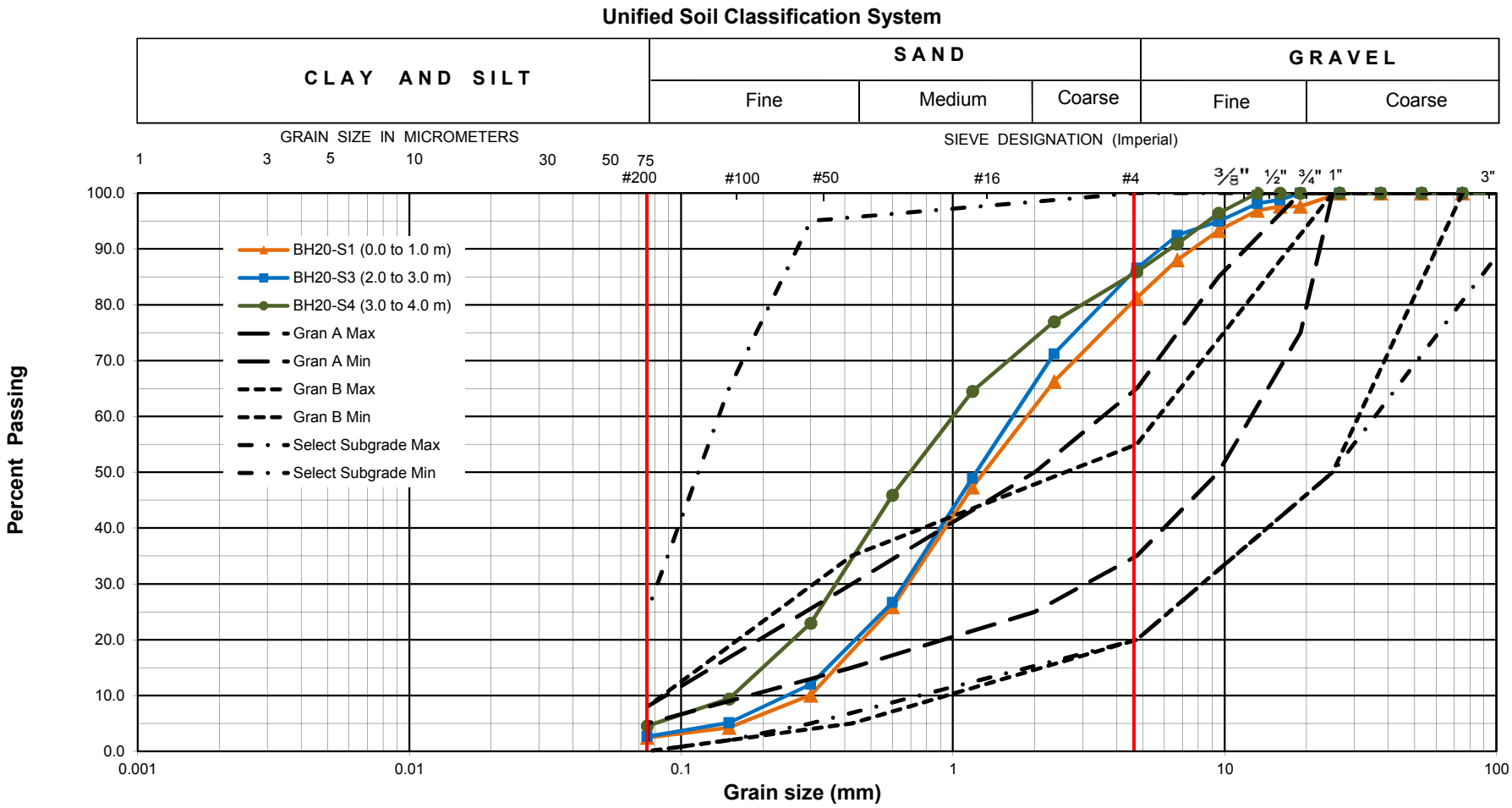
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 21, 2015**	**Borehole:**	**20**	**Sample:**	**S1, S3 & S4**	**Depth (m) :**	**as indicated**
Sample Description :		**SAND with gravel**				**Figure :**	**42**

Log of Borehole BH21

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 43

Page. 1 of 1

Date Drilled: 5/22/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 1 Light brown, gravel with sand - trace silt - frequent cobbles and boulders - no visible ice content - 51% gravel, 47% sand, 2% fines	174	0
		CLASS 2 Light brown, sand with silt and gravel - occasional cobbles and boulders - no visible ice content 27% gravel, 66% sand, 7% fines	172.5	1
		CLASS 3 Grey, silty sand - some gravel - occasional cobbles and boulders - no visible ice content - 13% gravel, 75% sand, 12% fines	171.0	2
		End of Borehole at 4.3 m Depth	169.7	3 4

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

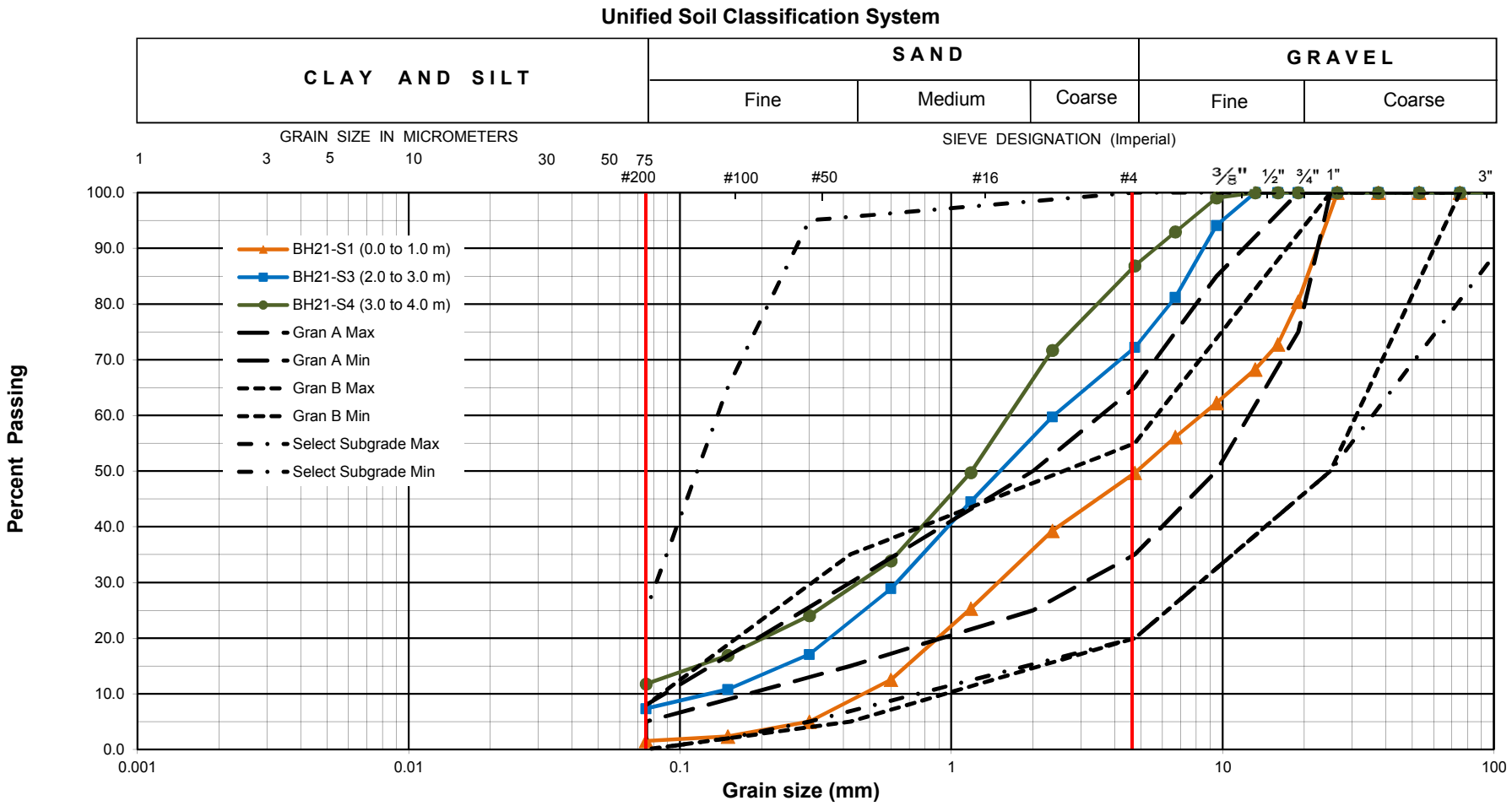
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 21, 2015**	**Borehole:**	**21**	**Sample:**	**S1, S3 & S4**	**Depth (m) :**	**as indicated**
Sample Description :	**GRAVEL with SAND with silt and gravel**					**Figure :**	**44**

Log of Borehole BH22

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 45

Page. 1 of 1

Date Drilled: 5/22/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 1 Medium brown, sand with gravel - trace silt - occasional cobbles and boulders - no visible ice content - 38% gravel, 58% sand, 4% fines	167	0
		- 28% gravel, 70% sand, 2% fines	164.0	3
		CLASS 2 Grey, sand with silt and gravel - no visible ice content - 23% gravel, 71% sand, 6% fines		4
		End of Borehole at 4.5 m Depth	162.5	

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

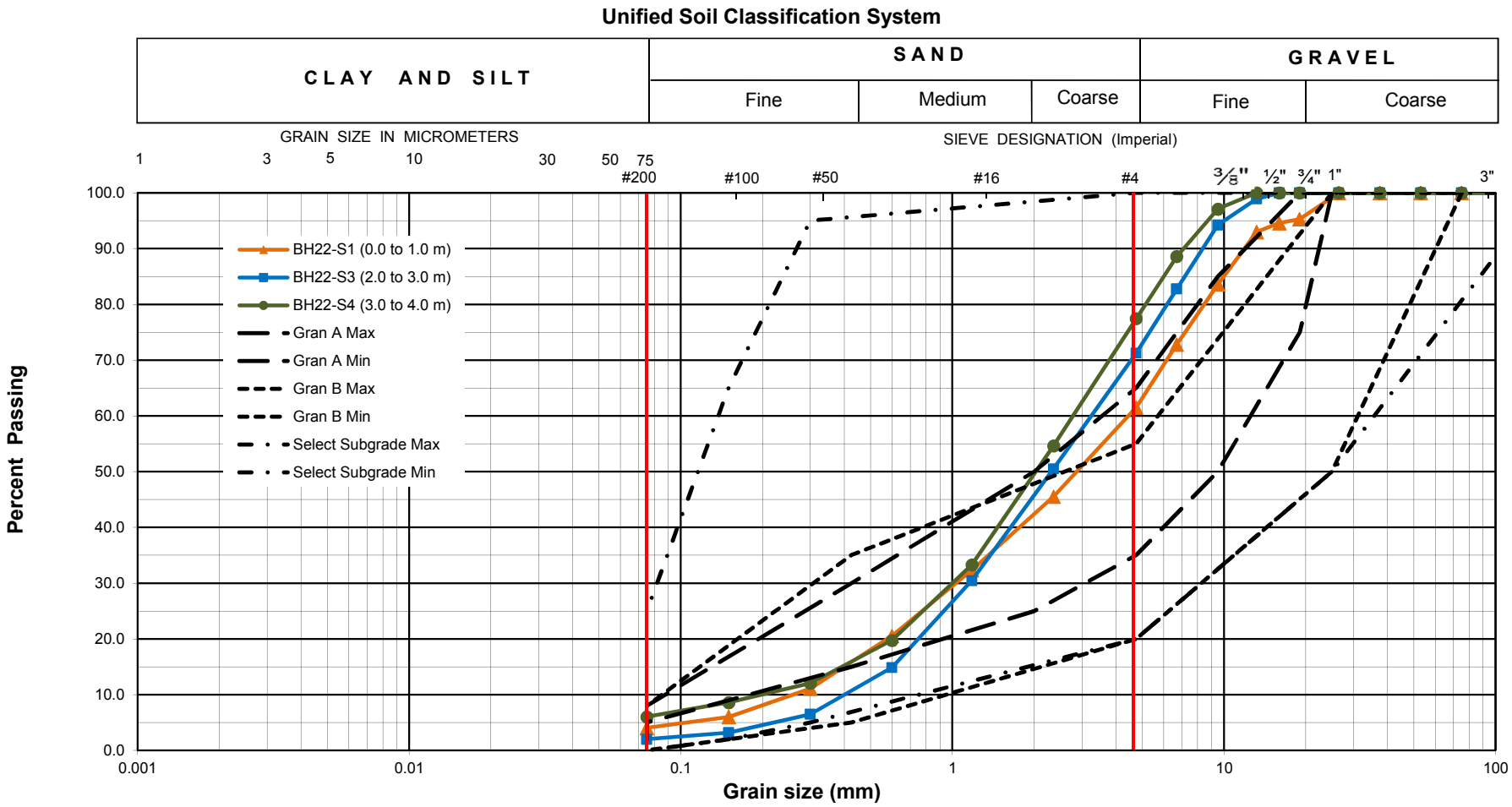
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 21, 2015**	**Borehole:**	**22**	**Sample:**	**S1, S3 & S4**	**Depth (m) :**	**as indicated**
Sample Description :	**SAND with gravel to SAND with silt and gravel**					**Figure :**	**46**

Log of Borehole BH23

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 47

Page. 1 of 1

Date Drilled: 5/22/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test —
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 1	168	0
		Light brown, sand with gravel to gravel with sand		
		- trace silt		
		- frequent cobbles and boulders		
		- no visible ice content		
		- 19% gravel, 76% sand, 5% fines		1
				2
		- 72% gravel, 27% sand, 1% fines		3
		- 33% gravel, 66% sand, 1% fines	164.0	4
		End of Borehole at 4.0 m Depth		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

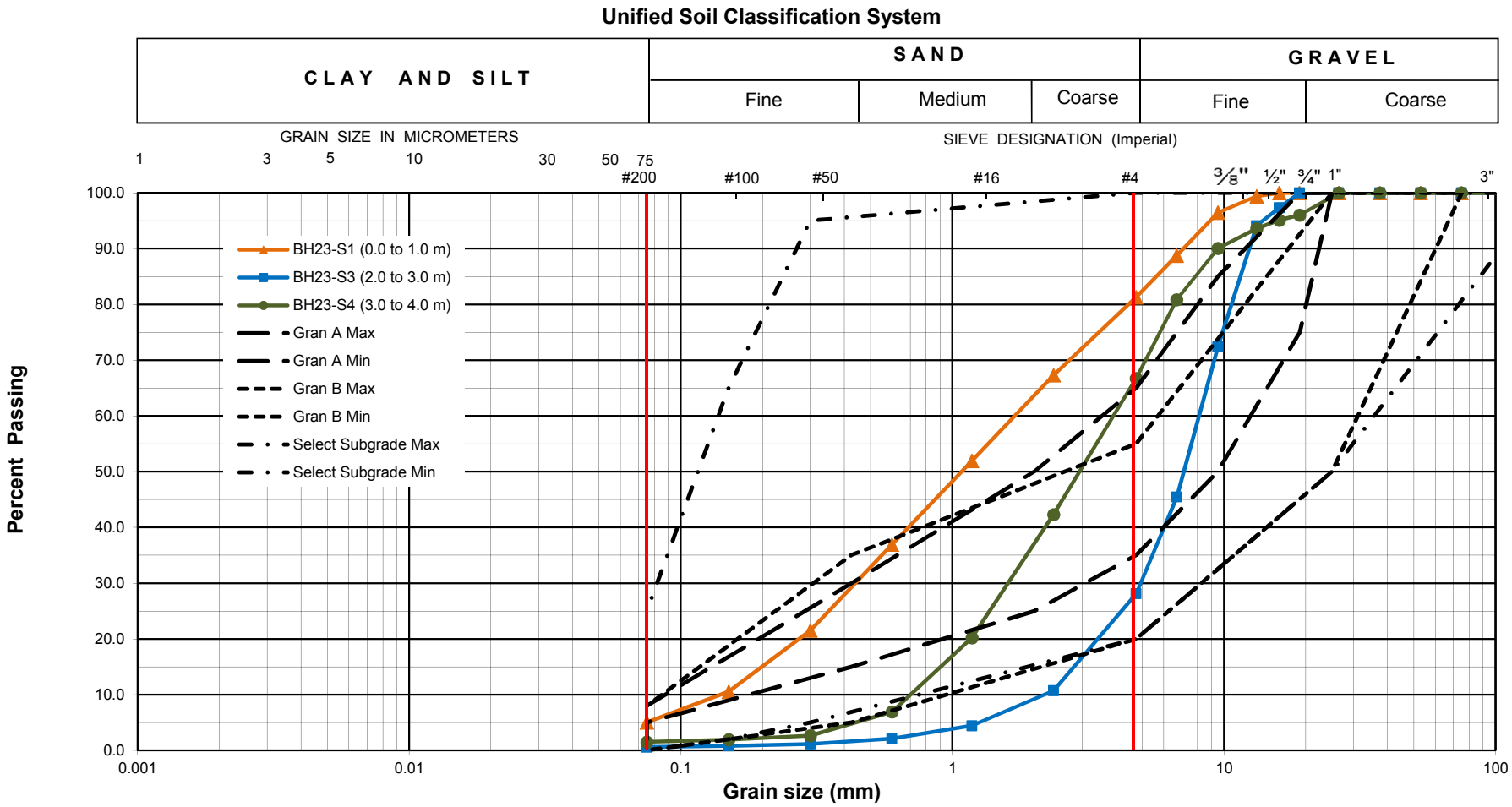
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 21, 2015**	**Borehole:**	**23**	**Sample:**	**S1, S3 & S4**	**Depth (m) :**	**as indicated**
Sample Description :	**GRAVEL with sand to SAND with gravel**					**Figure :**	**48**

Log of Borehole BH24

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 49

Page. 1 of 1

Date Drilled: 5/23/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		CLASS 1 Medium brown, sand with gravel - trace silt - frequent cobbles and boulders - no visible ice content - 27% gravel, 70% sand, 3% fines	174	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
		- 33% gravel, 63% sand, 4% fines		1				
			171.0	2				
		CLASS 2 Medium brown, sand with silt and gravel - frequent cobbles and boulders - trace visible ice, Vx (<10%) - 20% gravel, 74% sand, 6% fines		3				
				4				
			169.0	5				
		End of Borehole at 5.0 m Depth						

LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

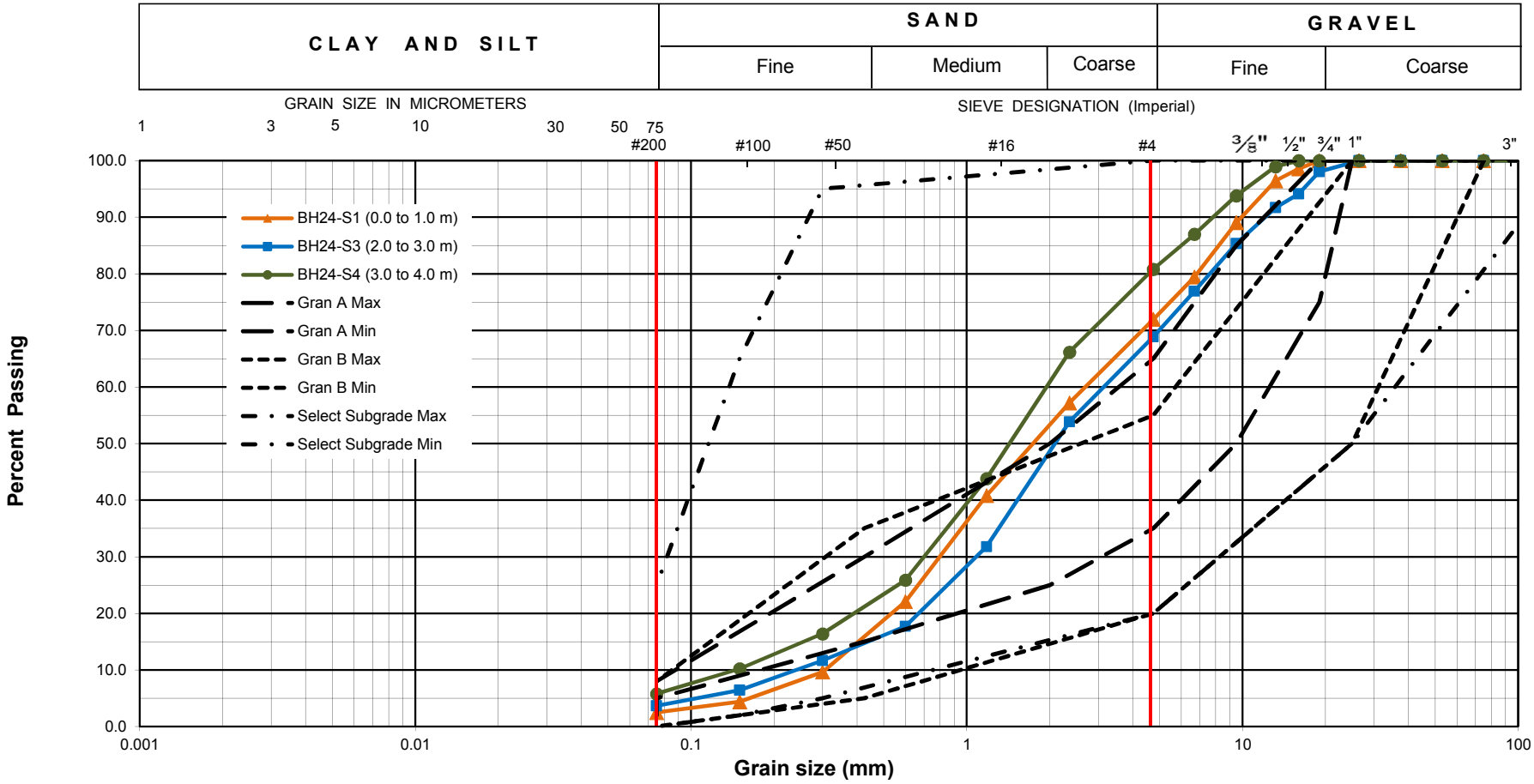
exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136

Unified Soil Classification System



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 21, 2015**	**Borehole:**	**24**	**Sample:**	**S1, S3 & S4**	**Depth (m) :**	**as indicated**
Sample Description :	**SAND with gravel to SAND with silt and gravel**					**Figure :**	**50**

Log of Borehole BH25

Project No: OTT-00219428-A0

Project: GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT

Location: IQALUIT, NU

Figure No. 51

Page. 1 of 1

Date Drilled: 5/23/15

Drill Type: AIR TRACK

Datum: GEODETIC

Logged by: SB Checked by: JAS

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	GEODETIC m	Depth
		CLASS 1 Medium brown, sand with gravel - trace silt - occasional cobbles and boulders - no visible ice content 37% gravel, 59% sand, 4% fines	174	0
		45% gravel, 52% sand, 3% fines		1
				2
			171.0	3
		CLASS 2 Medium brown to grey, sand with silt and gravel - occasional cobbles and boulders - some visible ice, Vx (10% to 20%) 12% gravel, 81% sand, 7% fines		4
		- 17% gravel, 74% sand, 9% fines		5
		- layers of massive ice below 5.0 m depth	168.0	6
		End of Borehole at 6.0 m Depth		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Field work supervised by an exp representative.
3. Borehole backfilled with drill cuttings upon completion.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Frozen	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

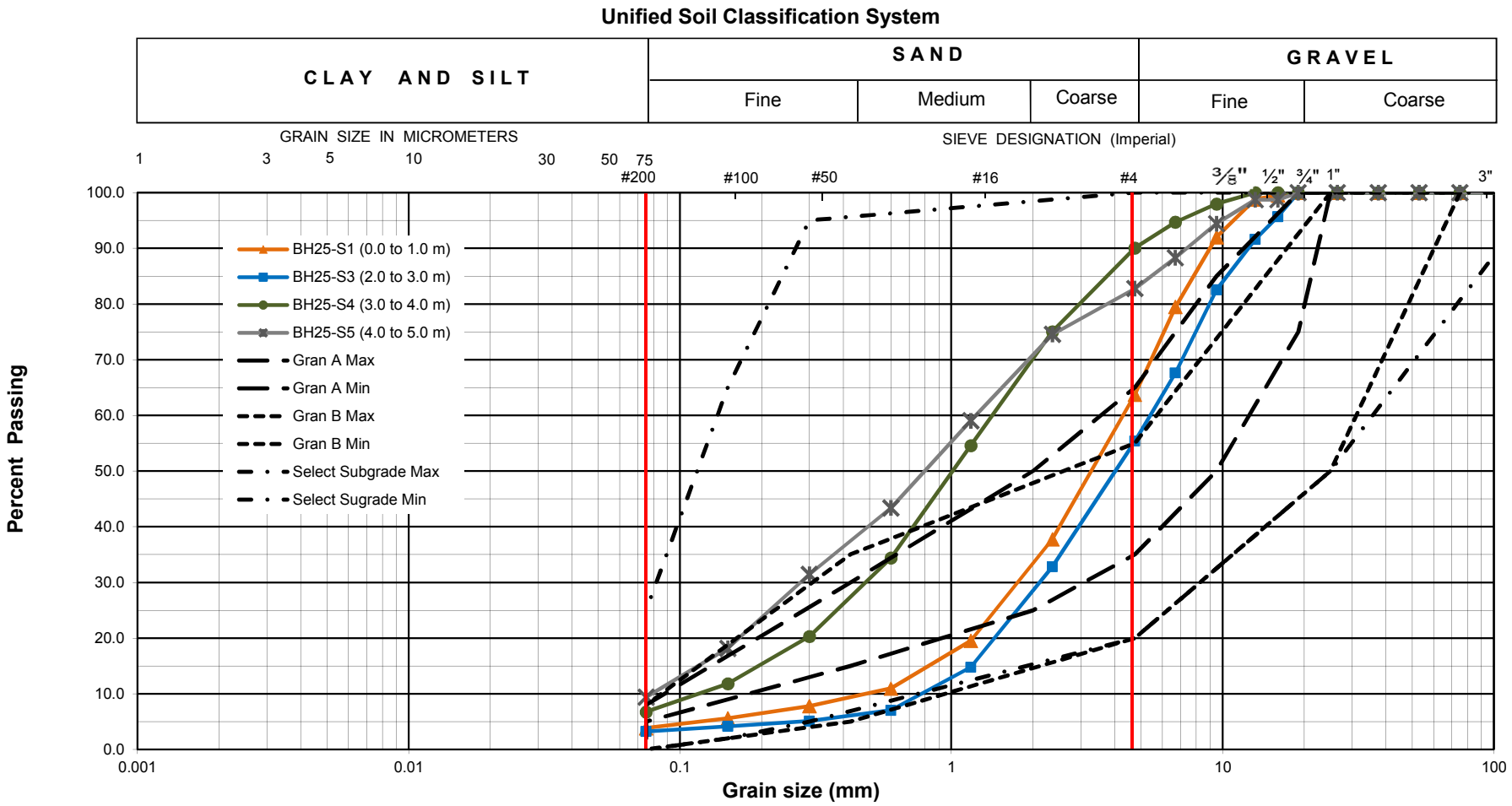
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136



Exp Project No.:	**OTT-00219428-A0**	**Project Name :**	**Geotechnical Investigation - Northwest Deposit**				
Client :	**City of Iqaluit**	**Project Location :**	**Iqaluit, NU**				
Date Sampled :	**May 21, 2015**	**Borehole:**	**25**	**Sample: S1, S3, S4 & S5**		**Depth (m) :**	**as indicated**
Sample Description :	**SAND with gravel to SAND with silt and gravel**					**Figure :**	**52**

List of Distribution

Report Distributed To:

Mr. Paul Clow – P.Clow@city.iqaluit.nu.ca