Geotechnical Investigation, CSB - Wabush Airport, Wabush, NL

Final Report

July 28, 2021

Prepared for:

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1.0 INTRODUCTION

Acting on the request and authorization of Jewer Bailey Consultants Ltd. (the Client), Stantec Consulting Ltd. (Stantec) has completed a geotechnical investigation in support of the proposed new CSB Building located at the Wabush Airport, southwest of the existing Combined Services Building.

The purpose of this geotechnical investigation was to determine the subsurface conditions at the site to facilitate planning and design of the proposed noted development. The scope of work for this project was completed in general accordance with Stantec's proposal dated April 29, 2021 and included the following:

- A geotechnical field subsurface investigation consisting of four (4) boreholes at the building location;
- Geotechnical laboratory testing on three (3) representative soil samples; and
- A geotechnical report presenting the findings of the field investigation, including Borehole Records, laboratory results, as well as provide comments and recommendations for site development, foundation design and earthworks.

This report has been prepared specifically and solely for the proposed development described herein and contains all of the findings of this investigation.

2.0 SITE AND GEOLOGY

The proposed site is a located within the Wabush Airport area, southwest of the existing Combined Services Building, which a chain link fence and security gate., as shown on the attached Drawing No. 121623797-GE-01: Approximate Borehole Locations. The majority of the ground surface of the site is level with a gravel surface and all vegetation having been removed.

Based on previous experience in the area and available geology literature, the natural subsurface conditions in the area are understood to consist of glacial till over bedrock. The bedrock geology at the site is mapped as cherty ironstone and underlying quartzite and is part of the Knob Lake Geologic Group, within the Grenville Province.

3.0 FIELD PROCEDURES

The geotechnical investigation was completed on May 28, 2021 and consisted of drilling four (4) geotechnical boreholes at the locations shown on attached Drawing No. 121623797-GE-01. The borehole locations were selected by the Client and established in the field by Stantec based on the existing infrastructure. Final borehole locations were marked in the field for subsequent survey by the project's surveyor. All measurements reported herein are referenced relative to the ground surface at the time of the investigation. Drilling services were provided by Logan Drilling Group using a Model CME 75 drill rig.

The depths of the boreholes ranged from 5.18 m to 5.61 m below the existing ground surface. The work was supervised by a senior geotechnical technician from Stantec who kept detailed records of the subsurface conditions encountered in general accordance with ASTM D5434. Boreholes were advanced through overburden soils by solid stem augers (75 mm) and diamond wet rotary drilling method in HQ-size (96 mm). Soils were sampled using a 50 mm outside diameter split spoon sampler during the performance of the Standard Penetration Test (SPT) and N-values were recorded in general accordance with ASTM D1586. The retained soil samples were classified in general accordance with the Unified Soil Classification System (USCS - per ASTM D2487 and D2488) and with the procedures outlined in the attached explanatory key: Symbol and Terms Used on Borehole and Test Pit Records. Details of the subsurface conditions encountered at the borehole locations are presented on the attached Borehole Records.

Soil samples were stored in moisture proof bags and returned to our St. John's, NL laboratory for testing. The samples will be stored for a period of three (3) months at which time they will be discarded unless instructions to the contrary are received.

Upon completion, all boreholes had a temporary 25 mm standpipe installed to determine water levels. All boreholes were backfilled with drill cuttings and silica sand. It is the responsibility of the Client and/or site owner to address any potential hazards due to settlement of backfilled materials should it occur at the test locations.

4.0 LABORATORY TESTING

Laboratory testing consisting of soil gradations and moisture content determinations were performed on representative samples of the glacial till obtained from BH1, BH2 and BH3. The laboratory test results are presented in the attached Figure 1 – Gradation Curves. Note that the samples tested for soil gradation excluded over-size materials larger than 50 mm (2 inches).

5.0 SUBSURFACE CONDITIONS

Subsurface conditions observed in the boreholes are summarized in the subsections below and described in detail on the attached Borehole Records along with an accompanying explanatory key: Symbols and Terms used on Borehole and Test Pit Records.

5.1 ORGANIC SOIL (TOPSOIL)

A layer of topsoil was encountered at the surface of BH2 and terminated at a depth of 0.15 m below the ground surface.

5.2 FILL

A surficial layer of fill was encountered at all borehole locations with the exception of BH2. This fill layer extended to depths ranging from 0.15 m (BH4) to 0.3 m (BH1 and BH3) below the existing ground surface.

Based on our field observations, the fill generally consisted of a brown, poorly graded sand with silt and gravel (SP-SM) with occasional debris (i.e., wood) and occasional cobbles.

In terms of consistency, based on Standard Penetration Test N-Values and drilling performances, the fill can be classified as compact.

5.3 GLACIAL TILL

Native glacial till was encountered at all borehole locations underlying the organic soil and fill and extended to the termination depth of the boreholes. The till layer varied in thickness from 4.88 m (BH3) to 5.36 m (BH2).

Based on our field observations and laboratory testing, the till can be generally classified as a greyish brown to brown, silty sand with gravel (SM) to silty sand (SM). Gradation analyses conducted on three (3) representative samples provided approximately 8.5% to 16.2% gravel, 49.4.3% to 71.8% sand, and 17.4%to 34.4% fines (silt/clay). Moisture content of the samples ranged from 5.3% to 9.4%.

In terms of consistency, based on Standard Penetration Test N-Values and drilling performances, the till can be classified as compact to very dense.

5.4 BEDROCK

Bedrock was not encountered at any of the borehole locations during the field investigation.

5.5 GROUNDWATER

Groundwater measurements were obtained from standpipes installed at all the borehole locations. Groundwater was encountered at all borehole locations with the depth of the groundwater ranging from 3.66 m to 4.27 m below the ground surface.

It should be noted that water levels may fluctuate seasonally and in response to precipitation events.

6.0 DISCUSSION AND RECOMMENDATIONS

Based on our understanding of the project, it is understood that a Combined Sweeper Garage and Sand Shed Building with dimensions of 25 m wide by 35 m long with a finished floor elevation of 547.30 m is currently proposed for this site.

At the time of issuance of this report, detailed engineering or design information for the proposed development have not been provided to Stantec. Therefore, the comments and recommendations presented in this report are for general preliminary planning and design purposes only and should be reviewed by Stantec once the design details are known.

6.1 SITE PREPARATION

In preparation for site development, all existing organic soil/fill materials should be excavated to expose the underlying undisturbed compact to very dense native glacial till. Excavated areas should be proof rolled and, if required, built to grade with an approved structural fill as described below. Any softened areas evident upon proof rolling must be removed and replaced with suitably compacted structural fill. Should excavations encounter groundwater seepage and/or surficial water seepage during site preparation, water should be controlled using appropriate measures, such as drainage ditching and/or conventional pump and sump arrangements.

Within the proposed site, the combined thickness of organic soil/fill materials to be removed, as identified in the boreholes, will vary in thickness from about 0.15 m to 0.30 m below ground surface.

The site is underlain by silty soils (i.e., fines content in the order of 34%). Typically, where the fines content of a soil is in excess of 10% - 12%, the soil will tend to soften and become unsuitable and difficult to work with it becomes wetter than its optimum moisture content and is disturbed. In addition, silty soils that have been successfully compacted and approved, may require removal if they subsequently become wet and softened from water infiltration, precipitation, or freezing.

6.2 FROST-SUSCEPTILE SOILS AND FROST HEAVE

By definition, frost heave is an upwards swelling/expansion of soil during freezing conditions caused by an increasing presence of ice as it grows towards the surface, upwards from depth in the soil where freezing temperatures have penetrated into the soil (the freezing front or freezing boundary). There are three basic conditions required for frost heave (or frost action) to occur, which include: a frost-susceptible soil; a supply of water; and soil temperatures sufficiently low to cause some pore water to freeze.

The frost-susceptibility of a soil refers to its ability to grow ice lenses and heave during freezing. Typically soils that have relatively high fines content have a high frost-susceptibility (i.e., silts, clayey silts, silty sands) such as the soils noted on site.

The depth of frost penetration for the Wabush area is estimated to be 3.0 m for unheated structures and 2.5 m for heated structures.

6.3 TEMPORARY AND PERMANENT SLOPES

If structural fill pads are required for this development, proper slope angles are required to ensure that the load influence zone beneath footings or foundations is transferred entirely within the structural fill, undisturbed native glacial till or bedrock. For determining the excavation limits, the zone of influence is equal to the horizontal distance outward at least equal to the depth of fill below the outside edge of the perimeter footing bearing surfaces (i.e., 1-horizontal to 1-vertical splay beyond the perimeter footings).

Temporary slopes comprised of a well-graded gravel (GW) or processed rockfill material should be no steeper than 1 horizontal to 1 vertical (1H:1V). For predominately sandy materials such as a pit run sand and gravel or silty sand with gravel (SM), the slope should be no steeper than 1.5 horizontal to 1 vertical (1.5H:1V). A minimum setback distance of 1.0 m should be maintained between the edges of foundations positioned near the crest of any structural fill pad slopes or excavations. Additional slope flattening or mitigation may be required to maintain the stability of temporary slopes.

All temporary excavations and slopes should be periodically inspected for evidence of instability and movement by experienced geotechnical personnel. The contractor and/or designer should review with Stantec the construction excavation slopes and fill placement geometry plans that would be implemented at the construction phase for the proposed development when they become available.

Final, permanent slopes should be no steeper than 2.5 horizontal to 1 vertical (2.5H:1V) for excavations in native soils. Structural fill slopes constructed using a suitable structural fill material placed and compacted as described below should be no steeper than 2 horizontal to 1 vertical (2H:1V). Erosion control and protection of all slopes is recommended, and, if applicable, drainage ditches should also be constructed at toe and top of slopes.

6.4 STRUCTURAL FILL

Structural fill should consist of a well-graded, free-draining granular material such as pit run sand and gravel or processed blasted rock fill. The maximum particle size should not exceed 200 mm. Within 300 mm of the underside of foundations or slab-on-grade, the maximum particle size should not exceed 100 mm. Use of rock fill is recommended in areas such as excavation bases where wet conditions may be encountered. Excavated soil areas should be proof rolled prior to placement of structural fill or setting of foundation formworks.

Site excavated native till soils and existing fill materials may be suitable for re-use as structural fill provided the moisture content is maintained within 1% to 2% of its optimum compaction moisture content value, the fill is free of deleterious materials (i.e., debris, organics, etc), and the maximum particle size gradation criteria is followed. If consideration is given to reusing the in situ native soils and/or existing site fills as structural fill, the above noted concerns regarding handling and placement of these materials under wet/freezing conditions must be considered otherwise the use of imported rockfill materials is recommended.

Structural fill should be placed in horizontal lifts and compacted to the specifications outlined below in Table 6.1. In addition to the compaction requirements presented in the table below, visual approval of all structural fill during placement is recommended. The lift thickness used during structural fill placement should be compatible with the compaction equipment and material type to ensure the required density is achieved throughout the lift thickness. Due to the particle size distribution of coarser grained soils (e.g., rockfill), verification of the field density by geotechnical personnel by visual inspection during proof rolling will be required. As a general guide, structural fill should be placed in 300 mm to 400 mm lifts and compacted with a 10-tonne vibratory roller.

Table 6.1 Recommended Compaction Requirements

Structural Fill Application	Compaction Requirements Percent of Standard Proctor (ASTM D698) maximum dry density
Foundation Areas	100
Floor Slab Areas	98
Parking and Roadway Areas	98
General Backfill	95

6.5 FOUNDATION DESIGN

Shallow foundations will be suitable for this development. Foundations on undisturbed, dense till soils may be designed for a maximum net allowable bearing pressure of 200 kPa. Foundations on properly placed and compacted structural fill may be designed for a maximum net allowable bearing pressure of 150 kPa. The associated total and differential settlements for these pressures are anticipated to be less than 25 mm and 19 mm, respectively, for continuous foundations less than 1.0 m in width and spread (square) foundations no greater than 2.0 m width.

Although not anticipated for this site, shallow foundations may be constructed on suitably prepared, good quality bedrock using an allowable bearing pressure of 500 kPa. The settlement of foundations on bedrock would be negligible.

If footings are to be constructed on two or more founding materials, care must be taken to minimize differential settlements at the material transitions. In general, transition slope should be no steeper than 4 horizontal to 1 vertical (4H:1V). If necessary, additional commentary for this condition can be provided upon request.

As noted earlier, foundations should not be placed on frozen ground, and temporary frost protection during freezing conditions should be provided after construction of footings. Exterior footings and footings in unheated areas should have a minimum soil cover of 3.0 m for frost protection or equivalent insulation.

Backfill material used around foundation walls should be free of deleterious material, be free-draining and classed as non-frost susceptible in order to reduce the potential for adfreezing. Maximum particle size should not exceed 150 mm. The granular backfill should be capped with a less permeable material and graded to help direct run-off away from the structure.

A properly designed weeping tile leading to a positive discharge is recommended along exterior building foundations.

6.6 FLOOR SLABS AND LONG-TERM DRAINAGE REQUIREMENTS

For the preliminary design of floor slabs constructed on compacted granular structural fill subgrades, a modulus of subgrade reaction of 50 MPa/m may be used. This value is based on a 300 mm square steel plate. A 150 mm thick layer of free-draining granular material should be provided immediately beneath the floor slabs, such as a 25 mm minus-sized crushed rock material with permeability greater than 10^{-1} cm/sec. Use of a vapour barrier beneath floor slabs is recommended.

The requirements for long-term or permanent drainage control around and below the structures will depend on the details of the site development and the final finished grades. A perforated drainpipe surrounded with clear stone and leading to a positive discharge is recommended along exterior foundations. An under-slab drainage system leading to a positive discharge or pumping location(s) is recommended if the groundwater level is anticipated to be within 1.0 m of the finished slab on grade elevation.

6.7 PARKING AND ROADWAY AREAS

Site preparation and structural fill placement should be completed in accordance with the previous sections. Preliminary recommendations for parking/road structure are presented below in Table 6.2.

Table 6.2 Preliminary Recommendations for Parking/Road Structure

Materials	Standard Traffic Loading
Class A Gravel	300 mm
Granular Subbase (Class B)	150 mm

Materials types and placement specifications conforming to NL Department of Transportation and Works Engineering Specifications or equivalent will be suitable for this application. Proper surface and subgrade drainage is recommended to ensure that the recommended structure will perform satisfactorily

6.8 QUALITY ASSURANCE/QUALITY CONTROL

It is recommended that a program of quality assurance, quality control, and inspection be carried out by geotechnical personnel during earthworks, and foundation/slab construction. Such a program should include verification of excavation bases and approval before placement of additional structural fill or footing concrete; founding level inspection and approval; compaction testing during structural fill placement; subgrade proof-rolling, and field and laboratory testing during placement of granular fill materials. Stantec would be pleased to provide a cost proposal to undertake such services.

7.0 CLOSURE

Use of this report is subject to the Statement of General Conditions, attached. It is the responsibility of Jewer Bailey Consultants Ltd. who is identified as “the Client” within the Statement of General Conditions, and its agents to review the conditions and to notify Stantec should any of these not be satisfied. The Statement of General Conditions addresses the following: use of the report; basis of the report; standard of care; interpretation of site conditions; varying or unexpected site conditions and planning, design, or construction.

Development or design plans and specifications should be reviewed by Stantec to confirm that this report addresses the project specifics and that the contents of this report have been properly interpreted. Site work relating to the recommendations included in this report should be carried out in the presence of a qualified geotechnical engineer; Stantec cannot be responsible for site work carried out without being present.

We trust this report meets your present requirements. Should any additional information be required, please do not hesitate to contact our office at your convenience.

Regards,

Stantec Consulting Ltd.

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ATTACHMENTS

Statement of General Conditions
Symbols and Terms Used on Borehole and Test Pit Records
Borehole Records
Figure 1 – Gradation Curves
Drawing No. 121623797: Approximate Borehole Locations

STATEMENT OF GENERAL CONDITIONS

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Stantec Consulting Ltd. and the Client. Any use which a third party makes of this report is the responsibility of such third party.

BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Stantec Consulting Ltd.'s present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Stantec Consulting Ltd. is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

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INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec Consulting Ltd. at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec Consulting Ltd. must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec Consulting Ltd. will not be responsible to any party for damages incurred as a result of failing to notify Stantec Consulting Ltd. that differing site or sub-surface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Stantec Consulting Ltd., sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Stantec Consulting Ltd. cannot be responsible for site work carried out without being present.

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

Rootmat	- vegetation, roots and moss with organic matter and topsoil typically forming a mattress at the ground surface
Topsoil	- mixture of soil and humus capable of supporting vegetative growth
Peat	- mixture of visible and invisible fragments of decayed organic matter
Till	- unstratified glacial deposit which may range from clay to boulders
Fill	- material below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

Desiccated	- having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
Fissured	- having cracks, and hence a blocky structure
Varved	- composed of regular alternating layers of silt and clay
Stratified	- composed of alternating successions of different soil types, e.g. silt and sand
Layer	- > 75 mm in thickness
Seam	- 2 mm to 75 mm in thickness
Parting	- < 2 mm in thickness

Terminology describing soil types:
The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488) which excludes particles larger than 75 mm. For particles larger than 75 mm, and for defining percent clay fraction in hydrometer results, definitions proposed by Canadian Foundation Engineering Manual, 4th Edition are used. The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):
Terminology describing materials outside the USCS, (e.g. particles larger than 75 mm, visible organic matter, and construction debris) is based upon the proportion of these materials present:

Trace, or occasional	Less than 10%
Some	10-20%
Frequent	> 20%

Terminology describing compactness of cohesionless soils:
The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test (SPT) N-Value - also known as N-Index. The SPT N-Value is described further on page 3. A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
Very Loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

Terminology describing consistency of cohesive soils:
The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests. Consistency may be crudely estimated from SPT N-Value based on the correlation shown in the following table (Terzaghi and Peck, 1967). The correlation to SPT N-Value is used with caution as it is only very approximate.

Consistency	Undrained Shear Strength		Approximate SPT N-Value
	kips/sq.ft.	kPa	
Very Soft	<0.25	<12.5	<2
Soft	0.25 - 0.5	12.5 - 25	2-4
Firm	0.5 - 1.0	25 - 50	4-8
Stiff	1.0 - 2.0	50 – 100	8-15
Very Stiff	2.0 - 4.0	100 - 200	15-30
Hard	>4.0	>200	>30

ROCK DESCRIPTION

Except where specified below, terminology for describing rock is as defined by the International Society for Rock Mechanics (ISRM) 2007 publication "The Complete ISRM Suggested Methods for Rock Characterization, Testing and Monitoring: 1974-2006"

Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	*Very Poor Quality*
25-50	*Poor Quality*
50-75	*Fair Quality*
75-90	*Good Quality*
90-100	*Excellent Quality*

Alternate (Colloquial) Rock Mass Quality	
Very Severely Fractured	*Crushed*
Severely Fractured	*Shattered or Very Blocky*
Fractured	*Blocky*
Moderately Jointed	*Sound*
Intact	*Very Sound*

RQD (Rock Quality Designation) denotes the percentage of intact and sound rock retrieved from a borehole of any orientation. All pieces of intact and sound rock core equal to or greater than 100 mm (4 in.) long are summed and divided by the total length of the core run. RQD is determined in accordance with ASTM D6032.

SCR (Solid Core Recovery) denotes the percentage of solid core (cylindrical) retrieved from a borehole of any orientation. All pieces of solid (cylindrical) core are summed and divided by the total length of the core run (It excludes all portions of core pieces that are not fully cylindrical as well as crushed or rubble zones).

Fracture Index (FI) is defined as the number of naturally occurring fractures within a given length of core. The Fracture Index is reported as a simple count of natural occurring fractures.

Terminology describing rock with respect to discontinuity and bedding spacing:

Spacing (mm)	Discontinuities	Bedding
>6000	*Extremely Wide*	-
2000-6000	*Very Wide*	*Very Thick*
600-2000	*Wide*	*Thick*
200-600	*Moderate*	*Medium*
60-200	*Close*	*Thin*
20-60	*Very Close*	*Very Thin*
<20	*Extremely Close*	*Laminated*
<6	-	*Thinly Laminated*

Terminology describing rock strength:

Strength Classification	Grade	Unconfined Compressive Strength (MPa)
Extremely Weak	R0	<1
Very Weak	R1	1 – 5
Weak	R2	5 – 25
Medium Strong	R3	25 – 50
Strong	R4	50 – 100
Very Strong	R5	100 – 250
Extremely Strong	R6	>250

Terminology describing rock weathering:

Term	Symbol	Description
Fresh	W1	No visible signs of rock weathering. Slight discoloration along major discontinuities
Slightly	W2	Discoloration indicates weathering of rock on discontinuity surfaces. All the rock material may be discolored.
Moderately	W3	Less than half the rock is decomposed and/or disintegrated into soil.
Highly	W4	More than half the rock is decomposed and/or disintegrated into soil.
Completely	W5	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.
Residual Soil	W6	All the rock converted to soil. Structure and fabric destroyed.

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.

Boulders Cobbles Gravel	Sand	Silt	Clay	Organics	Asphalt	Concrete	Fill	Igneous Bedrock	Meta-morphic Bedrock	Sedi-mentary Bedrock

SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
DP	Direct-Push sample (small diameter tube sampler hydraulically advanced)
PS	Piston sample
BS	Bulk sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

WATER LEVEL MEASUREMENT

▼ measured in standpipe, piezometer, or well

▽ inferred

RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

N-VALUE

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (63.5 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (300 mm) into the soil. In accordance with ASTM D1586, the N-Value equals the sum of the number of blows (N) required to drive the sampler over the interval of 6 to 18 in. (150 to 450 mm). However, when a 24 in. (610 mm) sampler is used, the number of blows (N) required to drive the sampler over the interval of 12 to 24 in. (300 to 610 mm) may be reported if this value is lower. For split spoon samples where insufficient penetration was achieved and N-Values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N-values corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to ‘A’ size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (300 mm) into the soil. The DCPT is used as a probe to assess soil variability.

OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
γ	Unit weight
G_s	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
Q_U	Unconfined compression
I_p	Point Load Index (I_p on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)

	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer

BOREHOLE RECORD

Stantec

BOREHOLE No. BH1
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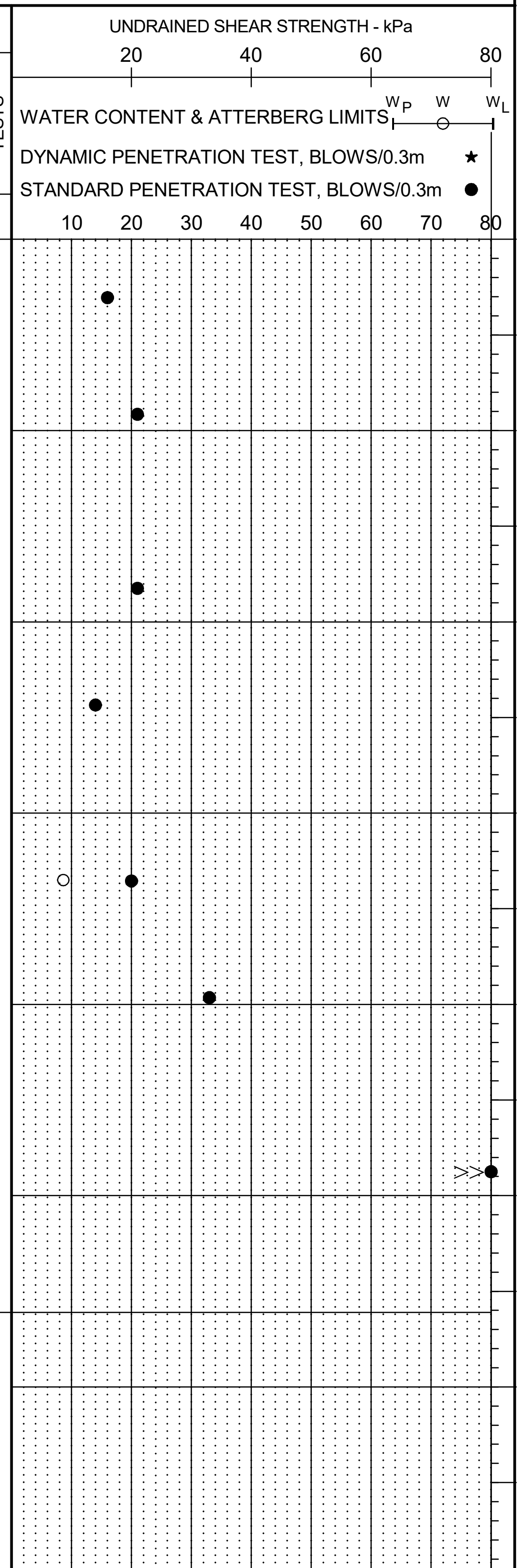
CLIENT: Jewer Bailey Consultants
PROJECT: Geotechnical Investigation - CSB Wabush Airport
LOCATION: Wabush, NL
DATES (mm-dd-yy): BORING 5-28-21 WATER LEVEL 3.84m 5-28-21

PROJECT No. 121623797
DRILLING METHOD Wash Bore
SIZE HW/HQ
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	NUMBER	RECOVERY OR TCR(%) mm	N-VALUE OR RQD (%)	OTHER TESTS
0		Compact, brown, poorly-graded SAND with silt and gravel (SP-SM); dry, occasional debris (i.e. wood): FILL			SS	1	400	16	
		Compact to very dense, greyish brown, silty SAND with gravel (SM); dry to wet, occasional cobbles: TILL			SS	2	525	21	
1									
2					SS	3	550	21	
					SS	4	300	14	
3					SS	5	550	20	S
				▽	SS	6	450	33	
4									
5					SS	7	450	100	
					SS	8	275	173/425	
		End of Borehole							
6		- Standpipe Installed.							
7									



△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test Torvane

Stantec BOREHOLE RECORD

BOREHOLE No. BH2
PAGE 1 of 1

CLIENT Jewer Bailey Consultants
PROJECT Geotechnical Investigation - CSB Wabush Airport
LOCATION Wabush, NL
DATES (mm-dd-yy): BORING 5-28-21 WATER LEVEL 4.27m 5-28-21

PROJECT No. 121623797
DRILLING METHOD Wash Bore
SIZE HW/HQ
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	NUMBER	RECOVERY OR TCR(%) mm	N-VALUE OR RQD (%)	OTHER TESTS
0		TOPSOIL							
		Compact to very dense, greyish brown to brown, silty SAND (SM); dry to wet, occasional cobbles: TILL			SS	1	450	16	
					SS	2	400	25	
					SS	3	500	29	
					SS	4	500	70	S
					SS	5	450	40	
					SS	6	500	38	
				∇ (4.27)					
					SS	7	275	79	
					SS	8	100	173/325	
		End of Borehole - Standpipe Installed.							

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7

UNDRAINED SHEAR STRENGTH - kPa: 20, 40, 60, 80

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◪ Torvane

Stantec

BOREHOLE RECORD

BOREHOLE No. BH3
PAGE 1 of 1
PROJECT No. 121623797
DRILLING METHOD Wash Bore
SIZE HW/HQ
DATUM Geodetic

CLIENT Jewer Bailey Consultants
PROJECT Geotechnical Investigation - CSB Wabush Airport
LOCATION Wabush, NL
DATES (mm-dd-yy): BORING 5-28-21 WATER LEVEL 3.66m 5-28-21

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	NUMBER	RECOVERY OR TCR(%) mm	N-VALUE OR RQD (%)	OTHER TESTS
0		Compact, brown, poorly-graded SAND with silt and gravel (SW-SM); dry, occasional debris (i.e. wood): FILL			SS	1	475	19	
		Dense to very dense, greyish brown to brown, silty SAND (SM); dry to wet, occasional cobbles: TILL			SS	2	550	66	
1									
					SS	3	500	57	
2					SS	4	500	57	
3					SS	5	450	45	
				∇					
4					SS	6	525	80	S
5					SS	7	225	62	
		End of Borehole - Standpipe Installed.							
6									
7									

UNDRAINED SHEAR STRENGTH - kPa
20 40 60 80

WATER CONTENT & ATTERBERG LIMITS W_P W W_L
DYNAMIC PENETRATION TEST, BLOWS/0.3m ★
STANDARD PENETRATION TEST, BLOWS/0.3m ●
10 20 30 40 50 60 70 80

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◪ Torvane

Stantec

BOREHOLE RECORD

CLIENT	Jewer Bailey Consultants
PROJECT	Geotechnical Investigation - CSB Wabush Airport
LOCATION	Wabush, NL
DATES (mm-dd-yy): BORING	5-28-21
WATER LEVEL	4.23m 5-28-21
BOREHOLE No.	BH4
PAGE	1 of 1
PROJECT No.	121623797
DRILLING METHOD	Wash Bore
SIZE	HW/HQ
DATUM	Geodetic

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	NUMBER	RECOVERY OR TCR(%) mm	N-VALUE OR RQD (%)	OTHER TESTS
0		Compact, brown, poorly-graded SAND with silt and gravel (SP-SM); dry, occasional debris (i.e. wood): FILL			SS	1	400	18	
		Dense to very dense, greyish brown, silty SAND with gravel (SM); dry to wet, occasional cobbles: TILL			SS	2	450	42	
1									
2					SS	3	550	58	
					SS	4	300		
3					SS	5	550	20	
4					SS	6	450	33	
				∇ (4.23)					
5					SS	7	450	100	
					SS	8	100	90/100	
		End of Borehole - Standpipe Installed.							
6									
7									

UNDRAINED SHEAR STRENGTH - kPa: 20, 40, 60, 80

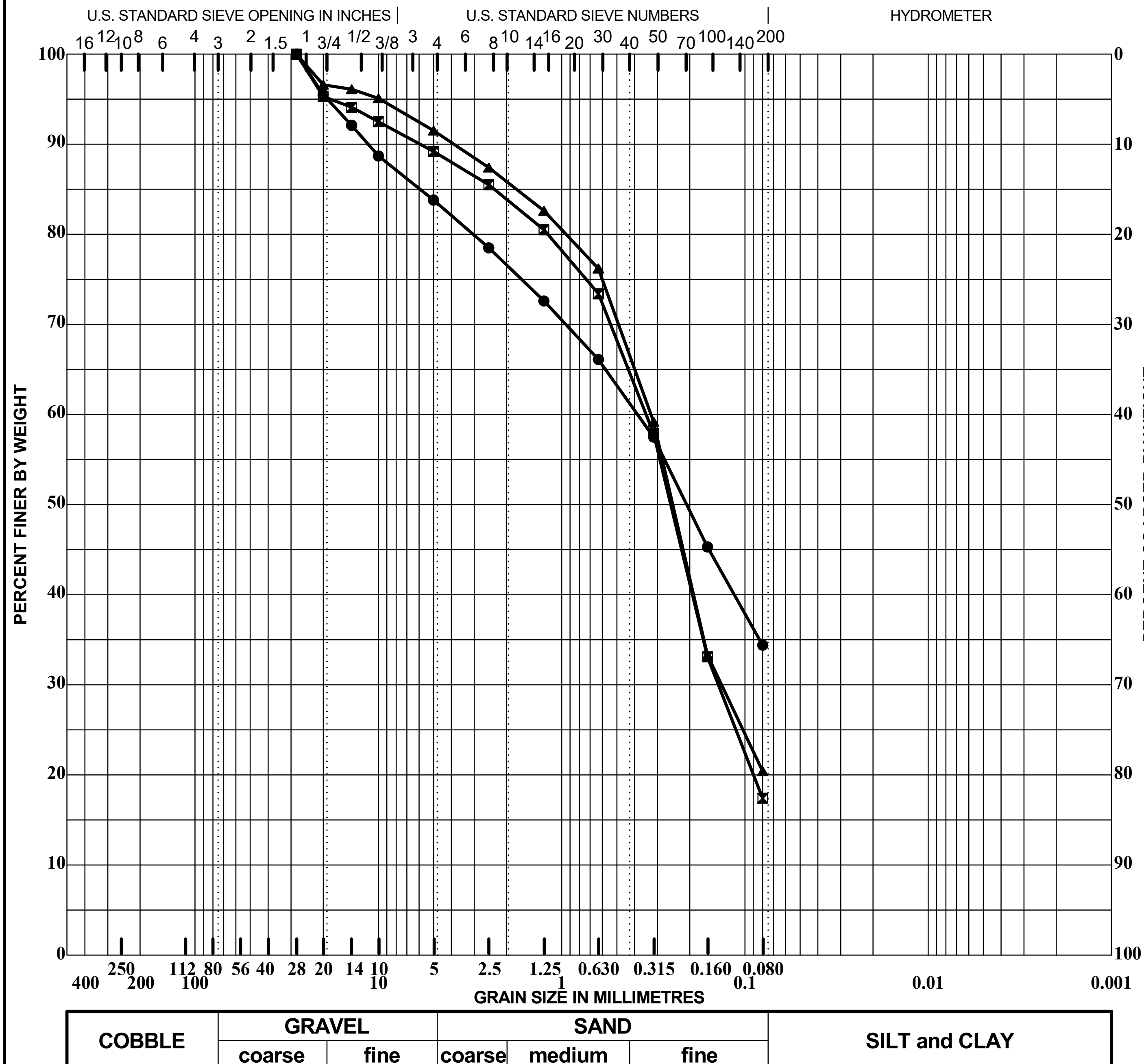
WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded)
◇ Fall Cone Test ◆ (Remolded)
▽ Hand Penetrometer Test ◪ Torvane



	Sample	Depth (m)	Description	W%	W_L	W_P	I_P
●	BH1 SS5	3.35	Silty SAND with gravel (SM)	8.7			
⊠	BH2 SS4	2.43	Silty SAND (SM)	8.0			
▲	BH3 SS6	3.96	Silty SAND (SM)	13.2			

	Sample	Depth (m)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BH1 SS5	3.35	28.00	0.39			16.2	49.4	34.4	
⊠	BH2 SS4	2.43	28.00	0.35	0.140		10.8	71.8	17.4	
▲	BH3 SS6	3.96	28.00	0.33	0.134		8.5	71.1	20.4	

REMARKS:

Stantec

Client: **Jewer Bailey Consultants**

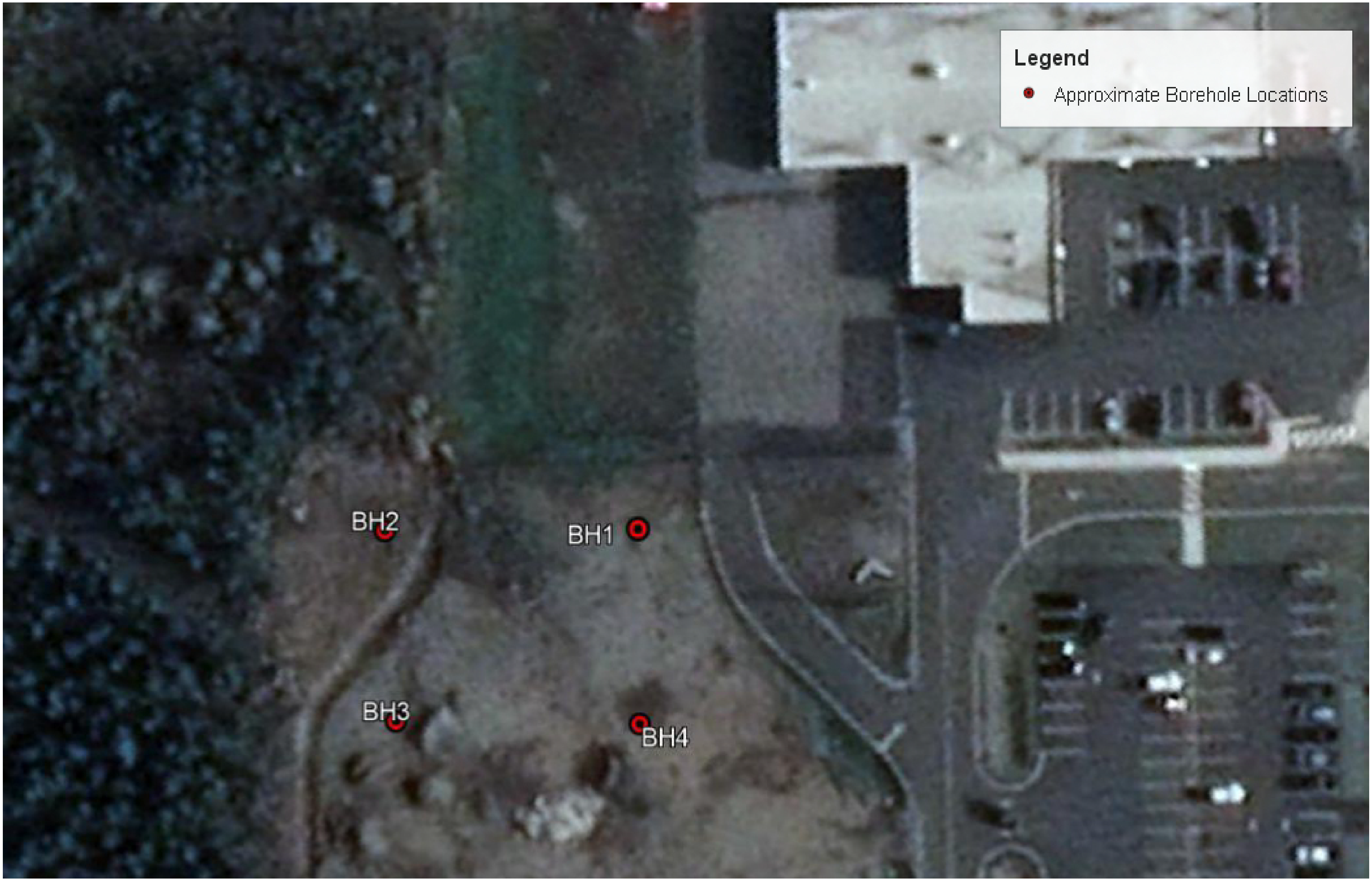
Project: **Geotechnical Investigation - CSB Wabush Airport**

Project No.: **121623797**

Location: **Wabush, NL**

FIGURE 1

GRADATION CURVES



Project: Geotechnical Investigation – CSB – Wabush Airport		**Drawn:**	BW	**Title:** Approximate Borehole Location Plan	Stantec
Client:	Jewer Bailey Consultants Ltd.	**Date:**	06/28/2021		
Project #:	121623797	**Checked:**	LB	**Figure No.:** 121623797-GE-01	