Geotechnical Investigation Report, MCTS Communication Tower,1200 Highway 69, Pointe au Baril, ON

File: 121622542

Prepared for:

Canadian Coast Guard,
Central and Arctic Region.
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May 30, 2019

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1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec), acting at the request of the Canadian Coast Guard (CCG), has completed a geotechnical investigation at the site of an existing communication tower at 1200 Highway 69, near Point Au Baril, ON. The purpose of the geotechnical investigation was to obtain information on the soil, bedrock, and groundwater conditions to support design of a new tower foundation. All work was conducted according to the Stantec proposal dated December 13, 2018, File No. 703197.

Limitations associated with this report and its contents are provided in the Statement of General Conditions included in Appendix A.

2.0 SITE AND PROJECT INFORMATION

The location of the proposed communication tower at 1200 Highway 69, Pointe Au Baril, ON is within an existing compound operated by the Canadian Coast Guard. The existing tower is located within a fenced compound, which is adjacent to a field office and small equipment building. The ground surface is relatively flat within the compound area but is undulating outside of the compound.

The general location of the site is shown on Drawing No. 1 in Appendix B.

As per the Site Plan provided by the Client (Drawing No. CM451-001-PP), we understand that the existing structure is a 250 m steel guyed tower and the new tower will consist of a similar structure. It is also our understanding that the existing field office is to be demolished and reconstructed as a component of the project. A copy of the Site Plan is provided in Appendix B.

3.0 SCOPE OF WORK

The scope of work for this geotechnical investigation included the following:

- A field investigation comprising three boreholes to characterize the soil, bedrock, and groundwater conditions at the location of the guy anchor locations;
- Advance one borehole within a 5.0 m radius of the existing tower;
- Laboratory testing consisting of unconfined compressive strength tests on selected rock core samples;
- Documentation of the results of the field investigation and laboratory results in a report; and
- Geotechnical input on site preparation and tower foundation design.

4.0 GEOTECHNICAL INVESTIGATION

The field drilling program for the geotechnical investigation was initially carried out on January 28, 2019 at which time only one borehole was completed. Due to extreme cold and access restriction from deep snow the field program was postponed and rescheduled for May 7 and 8, 2019. The approximate borehole locations are shown on Drawing No. 1 in Appendix B.

4.1 INVESTIGATIVE PROCEDURES

As a component of our standard procedures and due diligence, Stantec hired Landshark Drilling to complete the private underground utilities clearances. The location of the boreholes were staked by Stantec Personnel prior to the field work being completed. As noted above, due to limited access during the field investigation only BH1 was drilled during the initial visit on January 28, 2019. The three remaining boreholes were drilled on May 7 and 8, 2019

The boreholes were drilled with a track-mount CME drill-rig equipped with soil sampling and rock coring capabilities supplied and operated by Landshark Drilling Ltd. of Brantford, ON. The subsurface stratigraphy encountered in the boreholes was recorded in the field by experienced Stantec personnel while performing Standard Penetration Tests (SPTs). Split spoon samples were collected at regular depth intervals in the boreholes. Where auger refusal was encountered, boreholes were cored using HQ and NQ size coring equipment.

All recovered samples were stored in moisture-proof bags while bedrock core samples were labelled and placed in core boxes and returned to the Stantec Ottawa laboratory for detailed classification and testing.

4.2 LABORATORY TESTING

Samples returned to the laboratory were subjected to detailed visual examination and additional classification by a geotechnical engineer. Unconfined compressive strength tests were completed on selected bedrock samples. The results of the laboratory tests are discussed in the text of this report and are provided on the rock core logs and borehole logs included in Appendix C.

A soil sample was sent to a third-party laboratory for soil chemistry and resistivity testing. The results are discussed in the text of this report and provided in Appendix D.

4.3 SURVEY

The ground surface elevations at the boreholes were surveyed using a survey level tied into a local benchmark, the top of a concrete base of the left gate post to the gated entrance. The benchmark was given an assumed elevation of 100.0 m. The elevation at the borehole location is shown on the Borehole Records in Appendix C.

5.0 SUBSURFACE PROFILE

Soil classification was based on the procedures described in American Society for Testing and Materials D2488 (Standard Practice for Description and Identification of Soils Visual-Manual Procedure). A detailed log of the soil conditions encountered is provided on the borehole records BH1 to BH4, in Appendix C.

A brief summary of the stratigraphy is provided in Table 5.1.

Table 5.1: Subsurface Profile

Layer Thickness (m)	Soil Description
0.2 to 0.6	Topsoil/peat/organic matter
0.6[1]	Silty gravel with sand FILL
-	Granitic BEDROCK

[1]observed at two borehole locations

5.1 TOPSOIL/PEAT/ORGANIC MATTER

A layer of organic matter consisting of topsoil, peat and decaying vegetation was encountered at the ground surface in the boreholes. The thickness of the layer ranged between 600 mm and 50 mm.

5.2 FILL

A 0.6m to 0.9 m thick layer of brown silty gravel with sand was encountered in BH1 and BH4.

5.3 BEDROCK

Bedrock was encountered at depths between 0.2 m to 1.5 m below ground surface. Bedrock was cored at all borehole locations to obtain samples to characterize the rock. The boreholes were terminated in bedrock at depths ranging from 1.7 m to 4.4 m. The bedrock is described as dark grey to black Granite. The weathering of the bedrock was described as fresh to slightly weathered.

For all core runs (boreholes BH1 to BH4) the Total Core Recovery (TRC) ranged from 97% to 100% and the Solid Core recovery ranged from 92% to 100%. The Rock Quality Determination value for the cores ranged from 78 to 94 indicating that the rock is of good to excellent quality.

Two core samples were selected for unconfined compressive strength testing. The results are summarized in Table 5.2.

Table 5.2: Unconfined Compressive Strength of Bedrock Core

Borehole	Sample Depth (m)	Unconfined Compressive Strength (MPa)	Rock Type
BH2	0.9 – 1.2	151	Granite
BH4	1.7 – 1.9	128	Granite

Based on the results of the unconfined compressive strength tests the limestone bedrock is very strong.

5.4 GROUNDWATER CONDITIONS

Groundwater was not observed in the open borehole within the depth of investigation immediately following the drilling.

Groundwater levels will fluctuate seasonally and in response to specific rainfall events, snow melts, and extended dry periods. As such, groundwater conditions encountered during construction may differ from those observed during the geotechnical investigation.

5.5 CHEMICAL AND RESISTIVITY ANALYSIS

A soil sample obtained from a depth of approximately 0.9 m was submitted to an external laboratory for chemical and electrical resistivity analyses. The summary of the results of analyses for the soil sample is presented in Table 5.3. The laboratory certificate of analysis is included in Appendix D.

Table 5.3: Results of Chemical and Resistivity Analysis

Borehole	Sample No.	Depth (m)	pH	Chloride (µg/g)	Sulphate (µg/g)	Resistivity (Ω·m)
BH4	SS2	0.9	6.8	4	12	132

6.0 DISCUSSION AND RECOMMENDATIONS

Based on the information provided by the Client, it is understood that the existing 76 m high guyed-communications tower is to be removed and replaced with a tower of similar size and dimension. Details of the proposed tower loads or footing sizes are not known at this time. The following recommendations are based on several assumptions outlined throughout this report and the site conditions encountered at the time of the investigation.

6.1 SEISMIC SITE CLASSIFICATION

The site classification was determined based on confirmation of bedrock at shallow depth (<3 m) at the proposed anchor locations.

Based on the conditions observed, a Site Class B should be used for seismic loads and effects in accordance with Table 4.1.8.4.A of the National Building Code of Canada (2015), for foundations bearing on rock. If foundations are not bearing on rock, a Site Class C should be used for design.

6.2 TOWER FOUNDATIONS

It is strongly recommended that the subgrade and bedrock conditions at the foundation locations be observed by qualified geotechnical personnel prior to the construction of the foundation to verify that the subgrade and bedrock conditions are consistent with our observations at the boreholes and are capable of supporting the foundation loads.

6.2.1 Frost Penetration Depth

The design frost penetration depth for Pointe Au Baril, ON is 1.8 m for unheated structures. Therefore, footings bearing on soil should be embedded with 1.8 m of soil cover (to underside of footing) or be provided with equivalent insulation where appropriate earth cover cannot be provided.

Footings bearing directly on bedrock do not require earth cover provided the bedrock surface is not fractured and the footing subgrade is well drained.

6.2.2 Soil and Rock Design Parameters

Table 6.1 contains the soil parameters which may be used in the design for the tower foundations and equipment shelter. It is recommended that for design purposes to assume that the groundwater table is at surface.

Table 6.1: Soil Design Parameters

Parameter	Symbol	Units	Imported OPSS Granular A or B, Type II Fill
Unit Weight (Above Water Table)	γ_m	kN/m^3	20.0
Submerged Unit Weight (Below Water Table)	γ'	kN/m^3	10.2
Angle of Internal Friction	φ	degree	33
Undrained Shear Strength	S_u	kN/m^2	0
Effective Angle of Internal Friction	φ'	degree	33
Coefficient of Earth Pressure at Rest (Rankine)	K_0	n/a[1]	0.46
Coefficient of Active Earth Pressure (Rankine)	K_a	n/a[1]	0.29
Coefficient of Passive Earth Pressure (Rankine)	K_p	n/a[1]	3.39

[1]n/a = not applicable

Table 6.2 contains the rock parameters which may be used in the design for the tower foundations and equipment shelter.

Table 6.2: Rock Design Parameters

Parameter	Symbol	Units	Granite Bedrock
Unit Weight (Above Water Table)	γ_m	kN/m^3	26.0
Unit Weight (Below Water Table)	γ'	kN/m^3	16.2
Unconfined Compressive Strength	q_u	MPa	127 to 151

Table 6.3 provides the geotechnical resistance factors to be used for design, in accordance with CSA Group S37-13 for Antennas, towers, and antenna-supporting towers.

Table 6.3: Geotechnical Resistance Factors – Anchored Foundation

Condition	Geotechnical Resistance Factor
Bearing resistance for guyed mast, positive engagement on rock	0.60
Pull-out / uplift for anchors in rock, assumes one rock bolt, dowel or anchoring device	0.50
Lateral Resistance for anchors in rock	0.75

6.2.3 Geotechnical Resistance

Foundations bearing on rock may be designed using a factored geotechnical resistance of 1000 kPa (1 MPa), SLS bearing resistance will not govern the design. The factored geotechnical resistance at ULS incorporates a resistance factor of 0.6. If a dead-man anchor, or massive block, is used that depends on passive soil resistance against lateral loading, the soil within the frost penetration depth 1.8 m should not be relied upon. Based on the depth to bedrock observed in the boreholes (depth to bedrock less than 0.9 m), imported fill would be required to provide passive soil resistance.

6.2.4 Uplift Resistance

The uplift capacity of the foundations will be principally calculated based on the unit weight of the foundation using the calculation method presented in Appendix E titled “Calculation of Uplift Resistance of Spread Footings”.

The soil parameters to be used in the calculation are provided in Table 4; it is assumed that the material placed above the foundations would be compacted to at least 95% of its standard proctor maximum dry density.

6.2.5 Coefficient of Sliding Friction

Table 6.4 summarizes the coefficients of friction between concrete and bedrock, estimated in accordance with the Canadian Foundation Engineering Manual (2006).

Table 6.4: Unfactored Friction Coefficient for Sliding Resistance

Condition	Unfactored Friction Coefficient
Between concrete and bedrock	0.7

6.2.6 Rock Anchor Design

Due to the shallow depth of rock, anchored foundation is recommended to provide adequate resistance for uplift and overturning. For the design of rock anchors, the following design parameters may be considered for the rock mass:

- An unfactored (ultimate) rock to grout bond stress of 1000 kPa may be used for holes grouted with non-shrink grout having a minimum compressive strength of 30 MPa.
- The minimum fixed anchor length (i.e., the length over which the rock to grout bond stress is developed) should be no less than 3 m.
- The unbonded length of anchor should be equal to the height of the rock cone minus half of the bonded length.
- Load testing of the anchors should be carried out to confirm the capacity of the anchors has been achieved.
- A 90° (apex angle) failure cone with the apex located at the midpoint of the bonded length as shown on the sheet titled “Rock Anchor Resistance to Rock Mass Failure” in Appendix E should be used for design.

6.3 CORROSIVITY AND SULPHATE ATTACK POTENTIAL

One soil sample was submitted to AGAT Laboratories in Mississauga, ON for analysis of pH, water soluble sulphate and chloride concentrations, and resistivity. The analysis results are summarized in Table 3 and the results are provided in Appendix D.

The pH, resistivity, and chloride concentration provide an indication of the degree of corrosiveness of the subsurface environment. The measured pH (6.8) falls within the normal range of soils which is between 4.0 and 8.5. The chloride concentration threshold value of 500 µg/g is typically used to designate soil or water as being corrosive. The chloride concentration for the sample is 4 µg/g, indicating low corrosivity.

The scale of soil corrosiveness based on resistivity is as follows (pas per British Standard BS-1377):

- Resistivity > 100 Ω·m slightly corrosive
- 50 < resistivity < 100 Ω·m moderately corrosive
- 10 < resistivity < 50 Ω·m corrosive
- resistivity < 10 Ω·m severely corrosive

The degree of corrosiveness based on the resistivity, 132 Ω·m, the soil should be considered slightly corrosive.

The pH, chloride and resistivity values presented in Table 3 may be used by structural designers in assessing the potential for chemical attack on buried streel and as an aid in selecting coating and corrosion protection systems for buried steel objects.

The concentration of soluble sulphates provides an indication of the degree of sulphate attack that is expected for concrete in contact with soil and groundwater. Soluble sulphate concentrations less than 1000 μg/g usually indicate that a low degree of sulphate attack is expected for concrete in contact with soil and groundwater.

The results of the test for soluble sulphates referenced in Table 3 yielded a concentration of 12 μg/g. Based on the test result there is a low degree of potential sulphate attack for concrete in contact with the soil. Type GU Portland Cement can therefore be considered suitable for use in buried concrete.

6.4 ADVERSE WEATHER CONDITIONS

Additional precautions, effort, and measures may be required, when and where construction is undertaken during late fall, winter, and/or early spring (i.e., when temperatures and climatic conditions can have an adverse influence on the standard construction practices) or during periods of inclement weather. With respect to all earthworks activities undertaken during the late fall through late spring, when less-than-ideal construction conditions may prevail, the following comments are provided:

1. All of the Structural Fill should consist of OPSS Granular A or B (type II) materials. The use of non-granular fill materials may be considered but obtaining suitable compaction of these materials would be problematic.
2. Fill placement should be inspected by qualified geotechnical personnel on a full-time basis, with the authority to stop the placement of fill at any time when conditions are considered to be less than favourable.
3. Imported materials that contain ice, snow, or any frozen material should not be accepted for use.
4. Overnight frost penetration may occur, even in granular fill materials, where precipitation and ground surface runoff pools and accumulated, and freezing temperatures exist. Any frozen materials should be removed prior to placing subsequent lifts of Structural Fill. Breaking the frost in-situ is not considered acceptable.
5. It may be necessary to stop the placement of Structural Fill during periods of cold, where ambient temperatures are -5°C or less, exist.
6. Concrete should not be placed over frozen subgrade. Once concrete is placed the subgrade must be protected from freezing.

The placement of Structural Fill materials, grout, and concrete, during cold weather conditions requires extra effort beyond that typical when better climatic conditions prevail. At any time where conditions are deemed unfavourable, the placement operation may need to be suspended.

Additional considerations for heating of concrete, heating of forms and reinforcing steel, protection of concrete from freezing, and similar measures may also be required subject to climatic conditions at the time of construction.

7.0 CLOSING COMMENTS

The recommendations made in this report are in accordance with our present understanding of the project and assumptions as outlined throughout this report. Continued geotechnical engineering involvement during the project should be maintained to ensure the recommendations as outlined in this report are adhered to.

Use of this report is subject to the Statement of General Conditions provided in Appendix A. It is the responsibility of Canadian Coast Guard, who is identified as “the Client” within the Statement of General Conditions, and its agents, to review the conditions and to notify Stantec Consulting Ltd. 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.

This report has been prepared by Peter Healy, C.E.T. and reviewed by Chris McGrath, P.Eng.

We appreciate the opportunity to complete this work, if we can be of further assistance please contact the undersigned at your convenience.

Yours very truly,

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Appendix A

A.1 STATEMENT OF GENERAL CONDITIONS

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.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

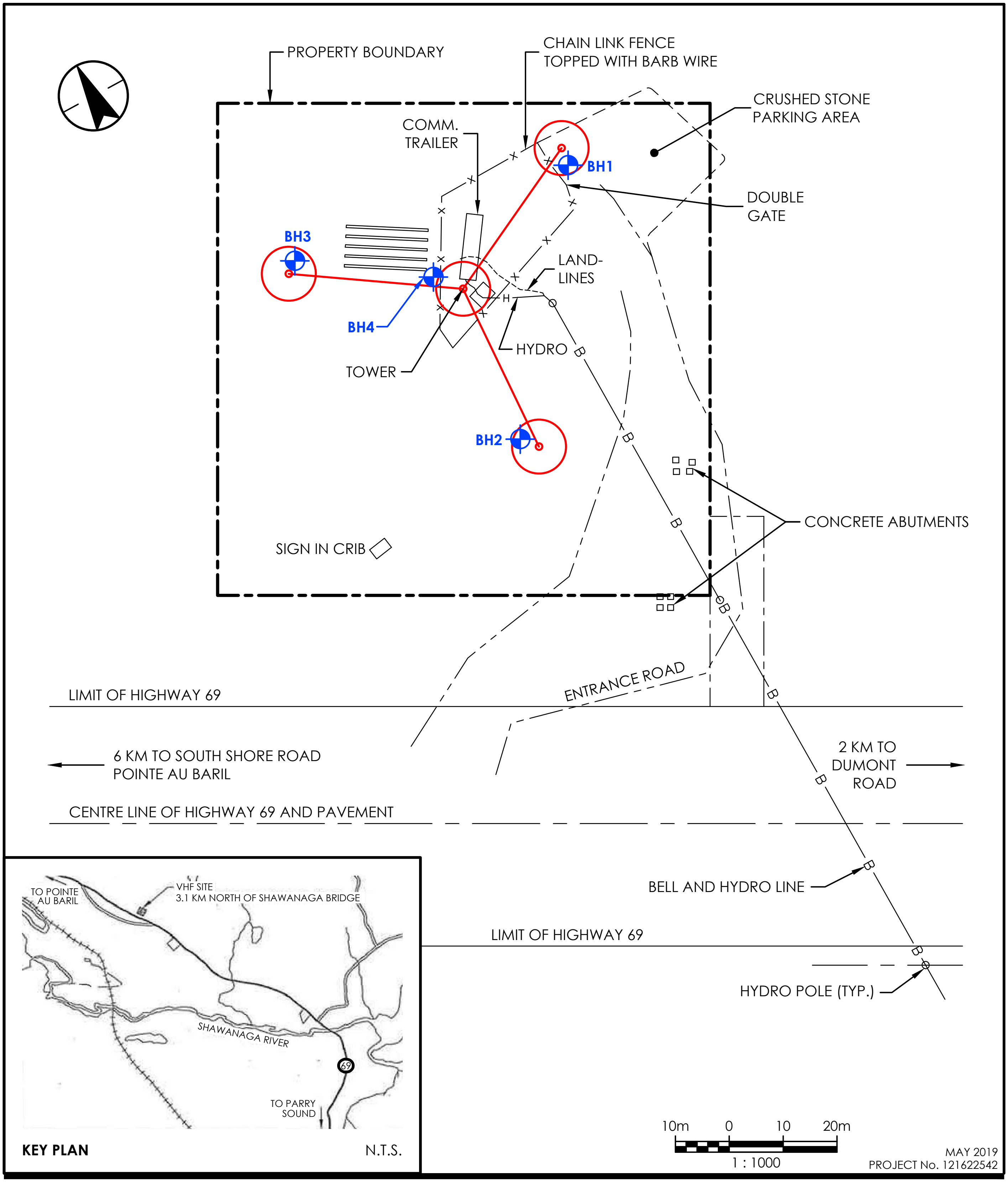
INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec Consulting Ltd at the time of the work and at the specific testing and/or sampling locations. Classifications 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.

Appendix B

B.1 DRAWINGS



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2019/05/15 8:36 AM By: Briones, Gliceria

MAY 2019
PROJECT No. 121622542

LEGEND

APPROXIMATE LOCATION OF PROPOSED BOREHOLE

Stantec

400 - 1331 Clyde Avenue
Ottawa, ON, Canada K2C 3G4
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NOTES

1. BASEPLAN DIGITIZED FROM PDF COPY PROVIDED BY CANADIAN COAST GUARD. DWG. No. CM451-001-PP.

Client/Project

CANADIAN COAST GUARD

MCTS COMMUNICATION TOWER
HIGHWAY 69, POINTE AU BARIL, ON.

Drawing No.

1

Title

BOREHOLE LOCATION PLAN

Appendix C

C.1 SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

C.2 BOREHOLE RECORDS

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

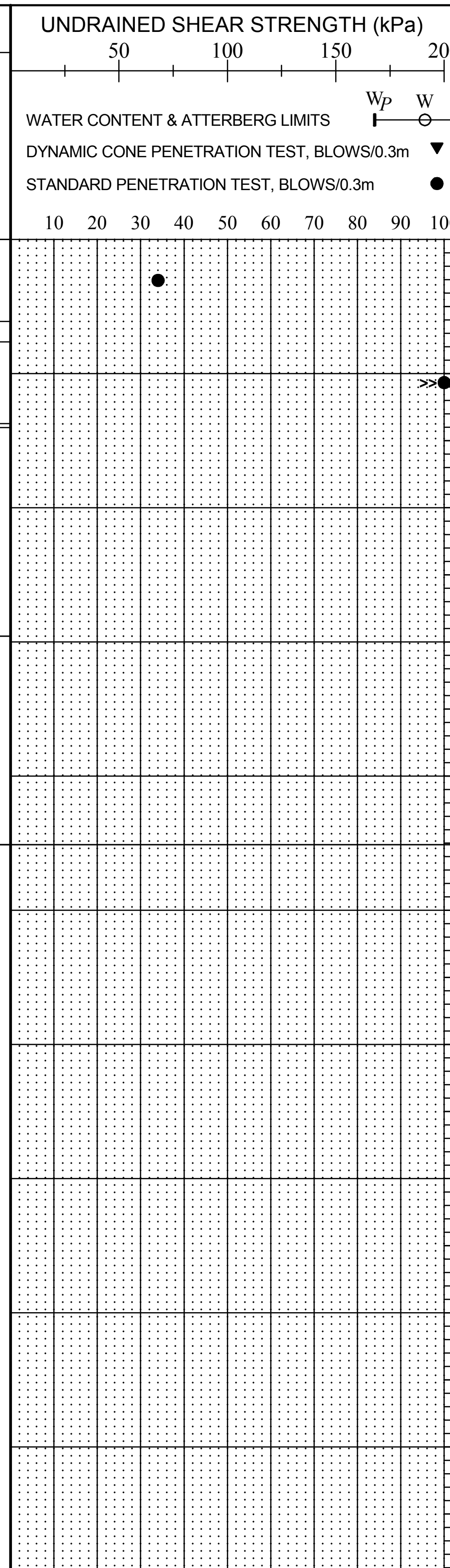
Stantec — BH1

CLIENT: Canadian Coast Guard — PROJECT No.: 121622542

LOCATION: 1200 Hwy 69, North of Perry Sound — DATUM: Local

DATES: BORING: 01/28/2019 — WATER LEVEL: — TPC ELEV.:

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
0	100,1	Topsoil			0				
		Dense, Brown, Damp SAND and Cobbles			1	SS	1	300/610	34
1		- Very Dense			3	SS	2	100/610	50/130
	98,7	Good to Excellent Quality, Slightly Weatehred, Dark Grey to Black GRANITE			7	HQ	1	92%	81%
3		-moderately fractured							
		- Slightly Fractured, Fresh Rock			12	HQ	2	99%	94%
	95,6				15				



REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

□ Field Vane Test, kPa

■ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Stantec

BOREHOLE RECORD

BH2

CLIENT: Canadian Coast Guard — PROJECT No. 121622542

LOCATION: 1200 Hwy 69, North of Perry Sound — DATUM: Local

DATES: BORING 05/07/2019 — WATER LEVEL — TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	98,3									
0	98,0	Very Loose, Dark Brown ORGANICS, slightly weathered over Bedrock			0–1	SS	1	250/300	2	
1		Good Quality, Grey GRANITE - Moderately fractured -Some Staining in Fractures			2–7	NQ	1	100%	78%	
2	96,2									

UNDRAINED SHEAR STRENGTH (kPa): 50, 100, 150, 200

WATER CONTENT & ATTERBERG LIMITS (W_P, W, W_L)

DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m ▼

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90 100

□ Field Vane Test, kPa

■ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

BOREHOLE RECORD

Stantec

BH3

CLIENT: Canadian Coast Guard — PROJECT No.: 121622542

LOCATION: 1200 Hwy 69, North of Perry Sound — DATUM: Local

DATES: BORING 05/07/2019 — WATER LEVEL: — TPC ELEV.:

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	UNDRAINED SHEAR STRENGTH (kPa)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0	97,8				0						
	97,7	Very Loose Moss covered, ORGANICS over bedrock				SS	1	13 / 150	0	● 0	
1		Excellent Quality, Fresh rock, Grey GRANITE -Slightly to moderatley fractured Some Staining in Fractured Joints			1–5	NQ	1	100%	91%		
	96,2										

UNDRAINED SHEAR STRENGTH (kPa): 50, 100, 150, 200

WATER CONTENT & ATTERBERG LIMITS (W_P, W, W_L)

DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m ▼

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90 100

□ Field Vane Test, kPa

■ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

BOREHOLE RECORD

BH4

CLIENT: Canadian Coast Guard — PROJECT No. 121622542

LOCATION: 1200 Hwy 69, North of Perry Sound — DATUM: Local

DATES: BORING 05/07/2019 — WATER LEVEL: — TPC ELEV.:

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
0	99,9		0				
	99,3	Loose, Brown, Moist Sandy TOPSOIL	1	SS	1	200/610	6
1	98,8	Very loose, Brown, Moist SAND and GRAVEL	3	SS	2	300/300	4
		Good Quality, Slightly Weathered, Grey GRANITE - moderately fractured - slight discolouring in fractures	5	NQ	1	93%	83%
			9	NQ	2	97%	82%
4	95,8		12–13	NQ	3	100%	86%

UNDRAINED SHEAR STRENGTH (kPa): 50, 100, 150, 200

WATER CONTENT & ATTERBERG LIMITS (W_P, W, W_L)

DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m ▼

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90 100

REMARKS & GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

□ Field Vane Test, kPa

■ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Appendix D

D.1 ROCK CORE PHOTO'S

Stantec

May 30, 2019
File: 121622542

Reference: Geotechnical Investigation Report, MCTS Communication Tower, 1200 Highway 69, Pointe au Baril, ON

Figure 1: Rock Core – BH 1

Reference: **Geotechnical Investigation Report, MCTS Communication Tower, 1200 Highway 69, Pointe au Baril, ON**

Figure 2: Rock Core – BH 2

Reference: **Geotechnical Investigation Report, MCTS Communication Tower, 1200 Highway 69, Pointe au Baril, ON**

Figure 3: Rock Core – BH 3

Reference: **Geotechnical Investigation Report, MCTS Communication Tower, 1200 Highway 69, Pointe au Baril, ON**

Figure 4: Rock Core – BH 4

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Appendix E

E.1 LABORATORY TEST RESULTS

Stantec

ROCK CORE COMPRESSIVE STRENGTH

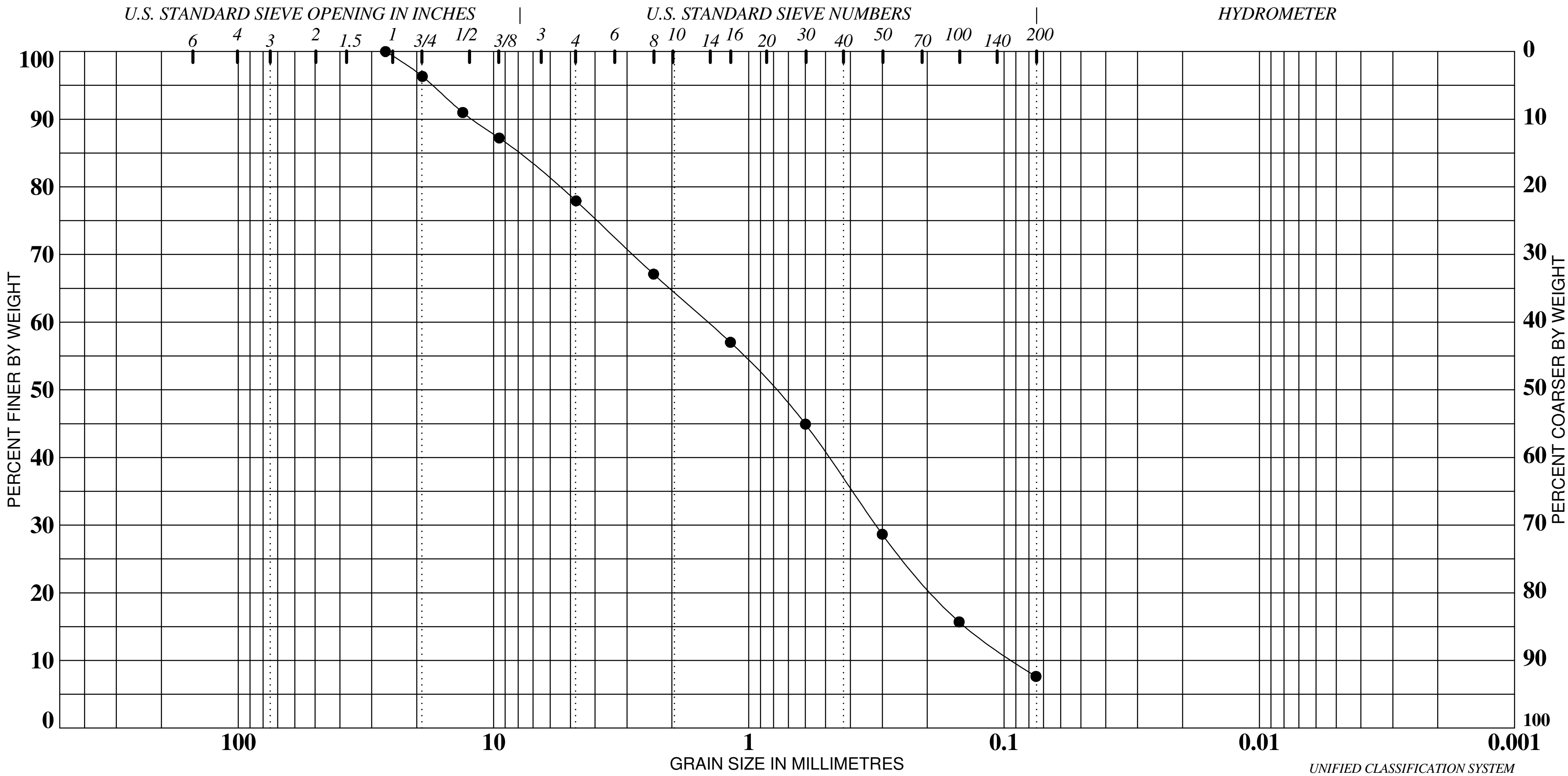
Client:
Project: MCTS Communications Tower
Material Description:
Date Tested: May 17,2019

Project No.: 121622542
Lab No.: 105
Tested By: Bahram Siavash

BH2	**RC**	**3'1"-4'1"**
		Average
LENGTH (mm)	90.97	90.9
	90.91	
	90.93	
DIAMETER (mm)	47.52	47.5
	47.43	
	47.51	
L/D	1.91	
Area m^2	0.0017702	
WEIGHT (kg)	0.417	
Volume (m^3)	0.000161	
Unit Weight (kg/m^3)	2591	
LOAD	(lb)	60013
	N	266949.9
	MPa	**150.8**

BH4	**RC**	**5'10"-6'3"**
LENGTH (mm)	90.66	90.9
	91.08	
	90.98	
DIAMETER (mm)	47.64	47.6
	47.61	
	47.6	
L/D	1.91	
Area m^2	0.0017799	
WEIGHT (kg)	0.429	
Volume (m^3)	0.0001618	
Unit Weight (kg/m^3)	2651	
LOAD	(lb)	51030
	N	226991.7
	MPa	**127.5**

		Average
LENGTH (mm)		#DIV/0!
DIAMETER (mm)		#DIV/0!
L/D	#DIV/0!	
Area m^2	#DIV/0!	
WEIGHT (g)		
Volume (m3)	#DIV/0!	
Unit Weight (kg/m3)	#DIV/0!	
LOAD	(lb)	
	N	0.0
	MPa	**#DIV/0!**



UNIFIED CLASSIFICATION SYSTEM

BLDs	COBBLES	GRAVEL		SAND			SILT & CLAY	
		coarse	fine	coarse	medium	fine	SILT	CLAY

Sample	Depth (m)	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
● BH4	1.1						22	70	8	

Stantec

Project: MCTS Communications Tower

Location: 1200 Highway 69 Pointe au Baril

Project No.: 121622542

GRADATION CURVE (ASTM D422)

Figure: 1

Remarks:

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: **STANTEC CONSULTING LTD.**
300-675 Cochrane Drive
MARKHAM, ON L3R0B8
(905) 444-7777

ATTENTION TO: **Bahram Siavash**

PROJECT: **121622542**

AGAT WORK ORDER: **19T466791**

SOIL ANALYSIS REVIEWED BY: **Amanjot Bhela, Inorganic Supervisor**

DATE REPORTED: **May 22, 2019**

PAGES (INCLUDING COVER): **5**

VERSION*: **1**

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

Certificate of Analysis

AGAT WORK ORDER: 19T466791
PROJECT: 121622542

AGAT Laboratories
5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: STANTEC CONSULTING LTD.
ATTENTION TO: Bahram Siavash
SAMPLING SITE:
SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2019-05-14
DATE REPORTED: 2019-05-22

			SAMPLE DESCRIPTION:	BH #4 SS1
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	2019-05-13
Parameter	**Unit**	**G / S**	**RDL**	**194894**
Sulfide (S2-)	%		0.05	<0.05
Chloride (2:1)	µg/g		2	4
Sulphate (2:1)	µg/g		2	12
pH (2:1)	pH Units		NA	6.81
Electrical Conductivity (2:1)	mS/cm		0.005	0.076
Resistivity (2:1)	ohm.cm		1	13200
Redox Potential 1	mV		NA	254
Redox Potential 2	mV		NA	281
Redox Potential 3	mV		NA	309

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

194894 EC, pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.
*Sulphide analyzed at AGAT 5623 McAdam
Pl note: Redox Potential is not an accredited parameter.
Redox potential measured on as received sample. Due to the potential for rapid change in sample equilibrium chemistry with exposure to oxidative/reduction conditions laboratory results may differ from field measured results.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By: Amanjot Bhela

CHARTERED AMANJOT BHELA CHEMIST — ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: STANTEC CONSULTING LTD.
AGAT WORK ORDER: 19T466791
PROJECT: 121622542
ATTENTION TO: Bahram Siavash
SAMPLING SITE:
SAMPLED BY:

Soil Analysis

RPT Date: May 22, 2019			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Corrosivity Package															
Sulfide (S2-)	194894	194894	< 0.05	< 0.05	NA	< 0.05	101%	80%	120%						
Chloride (2:1)	193802		44	51	14.7%	< 2	101%	80%	120%	91%	80%	120%	101%	70%	130%
Sulphate (2:1)	193802		4	5	NA	< 2	98%	80%	120%	95%	80%	120%	103%	70%	130%
pH (2:1)	193802		8.03	8.08	0.6%	NA	100%	90%	110%	NA			NA		
Electrical Conductivity (2:1)	196463		0.316	0.311	1.6%	< 0.005	100%	90%	110%	NA			NA		
Redox Potential 1	1						99%	90%	110%						

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL

Certified By: Amanjot Bhela

AGAT Laboratories
5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: STANTEC CONSULTING LTD. **AGAT WORK ORDER: 19T466791**
PROJECT: 121622542 **ATTENTION TO: Bahram Siavash**
SAMPLING SITE: **SAMPLED BY:**

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulfide (S2-)	MIN-200-12025	ASTM E1915-09	GRAVIMETRIC
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION
Redox Potential 1	INOR-93-6066	G200-09, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 2	INOR-93-6066	G200-09, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 3	INOR-93-6066	G200-09, SM 2580 B	REDOX POTENTIAL ELECTRODE

1 BOX

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario
L4Z 1Y2
www.agatlabs.com · webearth.agatlabs.com
Ph.: 905.712.5100 · Fax: 905.712.5122 · Toll Free: 800.856.6261

Chain of Custody Record

Laboratory Use Only
Arrival Temperature: 19T466791
AGAT WO #:
Lab Temperature: 14.6
Notes: NO ICE

Client Information:
Company: Stantec Consulting Ltd.
Contact: Bahram Siavash
Address: 300-675 Cochran Drive West Tower
Phone: 905-479-9345 Fax: 905-474-9889
Project: 121622542 PO:
AGAT Quotation #:
Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements:
☐ Regulation 153/09 (incl. 511 Amend.) Table: Indicate one ☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (check one) ☐ Coarse ☐ Fine
☐ Sewer Use Region: Indicate one ☐ Sanitary ☐ Storm
☐ Regulation 558
☐ CCME
☐ Other (specify)
☐ Prov. Water Quality Objectives (PWQO)
☐ None

Turnaround Time Required (TAT) Required*
Regular TAT
☑ 5 to 7 Working Days
Rush TAT (please provide prior notification)
Rush Surcharges Apply
☐ 3 Working Days
☐ 2 Working Days
☐ 1 Working Day
OR
Date Required (Rush surcharges may apply):
*TAT is exclusive of weekends and statutory holidays

Invoice To: Same: Yes [✓] No [ ]
Company:
Contact:
Address:

Is this a drinking water sample? (potable water intended for human consumption) ☐ Yes ☐ No
If "Yes", please use the *Drinking Water Chain of Custody Form*

Is this submission for a **Record of Site Condition**? ☐ Yes ☐ No

Legend Matrix
GW Ground Water O Oil
SW Surface Water P Paint
SD Sediment S Soil

Report Information – reports to be sent to:
1. Name: Bahram Siavash
Email: Bahram.Siavash@stantec.com
2. Name: Peter Healy
Email: peter.healy@stantec.com

Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl- ☐ CN- ☐ EC ☐ FOC ☐ Cr+6- ☐ SAR ☐ NO_3/NO_2 ☐ N-Total ☐ Hg ☐ pH	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3/NO_2	VOC: ☐ VOC ☐ THM ☐ BTEX	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	TCLP:	Sewer Use	Corrosivity Pckg (pH, Redox Potential)	sulphates and sulphides contents,	chlorides contents and resistivity)
BH # 4 SS1	2019-05-13			1	0-2 ft																	X	X	X

Samples Relinquished by (print name & sign): Date/Time
Samples Received by (Print name & sign): MANOJ JOHN Date/Time: MAY 14, 19
Samples Relinquished by (print name & sign): Date/Time
Samples Received by (Print name & sign): Date/Time: 9:30

Pink Copy – Client
Yellow + Golden Copy – AGAT
White Copy – AGAT

Page ____ of ____
NO:

Document ID: DIV-78-1511.006
Date Issued: July 20, 2011

Appendix F

F.1 CALCULATION OF UPLIFT RESISTANCE OF SPREAD FOOTINGS

F.2 ROCK ANCHOR RESISTANCE TO ROCK MASS FAILURE

APPENDIX E

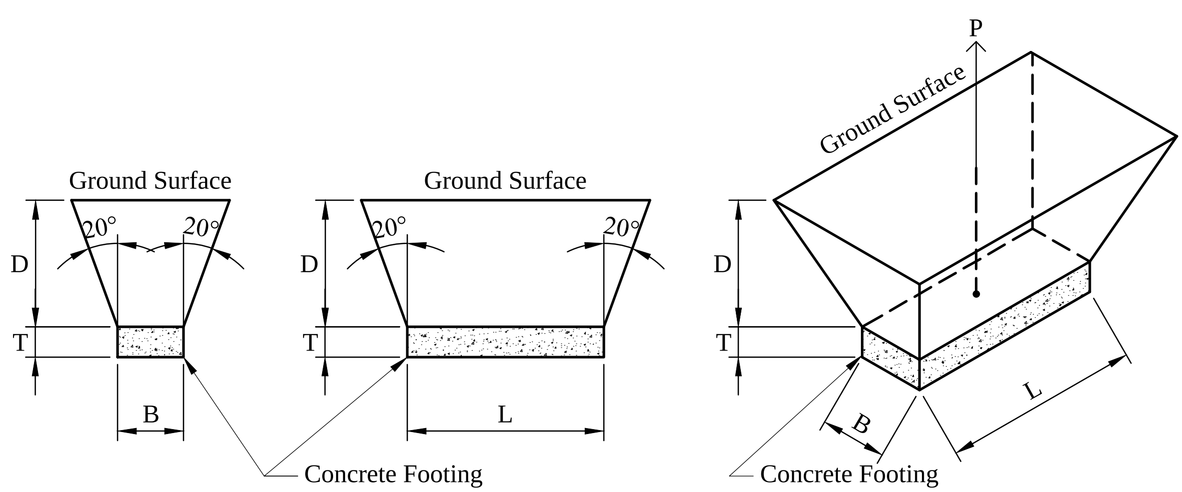
Calculation of Uplift Resistance of Spread Footings
Rock Anchor Resistance to Rock Mass Failure

Calculation of Uplift Resistance of Spread Footings

The allowable uplift resistance of spread footings may be determined from the submerged unit weight of the soil block located above the footing, the dead weight of the footing and an appropriate factor of safety (typically = 2). The soil block used in the calculation of the uplift resistance is defined by imaginary lines drawn at 20° angles upward and away from the top edges of the footing, as per the diagram below:

$$U = (W + W_C) / F \text{ and } U \geq P$$

where:	**U**	=	**Allowable uplift resistance (kN)**
	P	=	**Vertical uplift force (kN)**
	F	=	**Factor of safety equal to 2**
	W	=	**Weight of soil block above the footing (kN)**
			$W = \frac{1}{3} D\gamma' (A_1 + A_2 + \sqrt{(A_1 A_2)})$
	W_C	=	**Weight of concrete footing (kN)**
			$W_C = B \times L \times T \times \gamma'_C$
	γ'	=	**Submerged unit weight of backfill soil (kN/m^3)**
	A_1	=	**Area of footing footprint (m^2)**
			$A_1 = B \times L$
	A_2	=	**Area of topside of the soil block (m^2)**
			$A_2 = 0.5\, D^2 + 0.7\, D(B+L) + B \times L$
	B	=	**Width of concrete footing (m)**
	L	=	**Length of concrete footing (m)**
	T	=	**Thickness of concrete footing (m)**
	γ'_C	=	**Submerged unit weight of concrete (= 13.7 kN/m^3)**



Rock Anchor

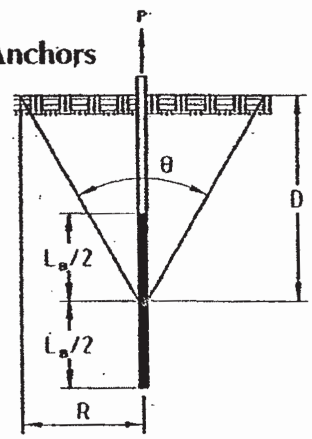
Resistance to Rock Mass Failure

Required Safety Factor for Resistance to Rock Mass Failure: $W_R / P \geq 2.0$

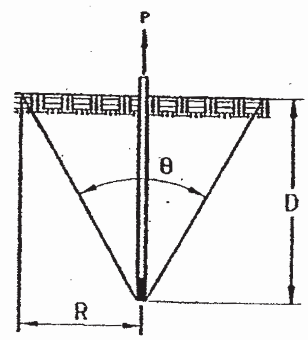
Design Considerations:

1. **Use 60° or 90° apex angle as per recommendations in the geotechnical report**

Vertical Anchors

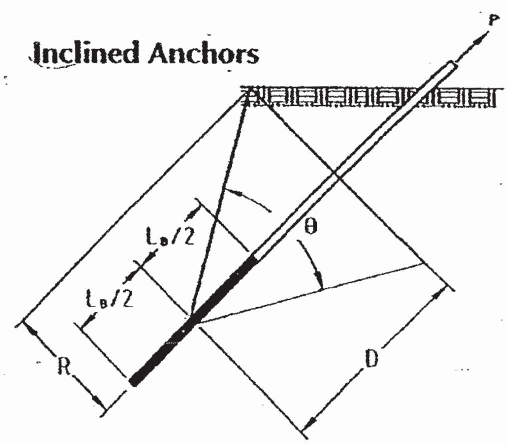


Grouted Rock Anchors

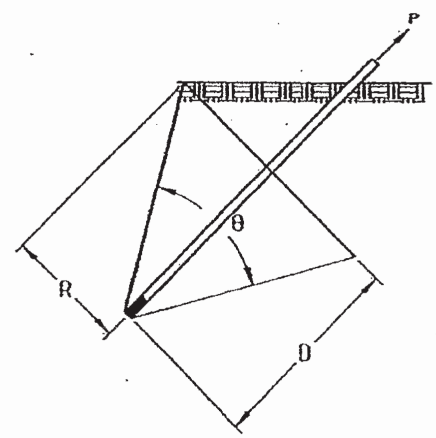


Mechanical Rock Anchors

Inclined Anchors



Grouted Rock Anchors



Mechanical Rock Anchors

P	=	**Resultant of maximum axial anchor forces**
D	=	**Height of rock cone**
R	=	**Radius of rock cone**
θ	=	**Appex angle**
L_B	=	**Bond length**
γ_R	=	**Submerged unit weight of bedrock**
W_R	=	**Weight of rock cone ($W_R = \frac{1}{3}\pi R^2 D \gamma_R$)**

Appendix G

G.1 SEISMIC SITE CLASSIFICATION

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 45.565N 80.317W **User File Reference:** MCTS Communication Tower - Point Au Baril 2019-05-22 13:50 UT

Requested by: Stantec Consulting Ltd.

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.079	0.048	0.031	0.011
Sa (0.1)	0.110	0.070	0.047	0.017
Sa (0.2)	0.109	0.072	0.049	0.018
Sa (0.3)	0.095	0.063	0.043	0.016
Sa (0.5)	0.078	0.052	0.035	0.013
Sa (1.0)	0.048	0.031	0.021	0.006
Sa (2.0)	0.025	0.016	0.010	0.003
Sa (5.0)	0.006	0.004	0.002	0.001
Sa (10.0)	0.003	0.002	0.001	0.000
PGA (g)	0.064	0.040	0.027	0.009
PGV (m/s)	0.065	0.040	0.026	0.008

Notes: Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information