Appendix E

Geotechnical Report

Geotechnical Investigation, VHF Tower Installation, Cuslett, NL

Geotechnical Report

Stantec

Prepared for:
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Final Report

May 1, 2018

Sign-off Sheet

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Reviewed by 

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1.0 INTRODUCTION

Acting at the request and authorization of Canadian Coast Guard (CCG), Stantec Consulting Ltd. (Stantec) has completed a geotechnical investigation at the existing VHF tower site located in Cuslett, Newfoundland and Labrador at the coordinates of Latitude: N 46° 58' 27.9"; Longitude: W 54° 9' 14.8".

The purpose of this geotechnical investigation was to assess the subsurface soil and rock conditions in order to facilitate the foundation/anchor design for the proposed new VHF guyed tower. It is understood that the Client is planning to replace the existing 39.6 m VHF Tower with a new 45.7 m Tower.

The scope of work completed for this project was in general accordance with Stantec's proposal dated March 19, 2018 and included the following:

- Conduct a field subsurface investigation consisting of four (4) boreholes. One borehole was located at the tower base, and the remaining three (3) was at 120 degrees apart.
- Laboratory testing on representative samples recovered.
- A geotechnical report presenting the findings of the field investigation and laboratory testing, as well as general comments and recommendations for preliminary foundation design and site development.

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 site is located off Route 100, approximately 2 km north of the Town of Cuslett, Newfoundland and Labrador.

At the time of the investigation, the site included two (2) towers and associated equipment, structures/buildings within a fenced area. Thin vegetative and/or exposed weathered bedrock areas were observed across the site.

Based on the surficial geological mapping literature and past experiences in the area, the natural overburden materials in the area consist of a concealed vegetation mat developed on either colluvium surfaces or a thin layer of angular frost-shattered and frost-heaved rock fragments overlying bedrock. The overburden materials are discontinuous. Bedrock geology at the site is mapped as dominantly red mudstone with interbeds of purple and green mudstone of Bonavista Formation.

3.0 METHODOLOGY

The geotechnical investigation was completed from April 6 to April 8, 2018 and consisted of drilling four (4) boreholes using a track mounted CME 55 drill provided by Logan's Drilling Group. Approximate locations

of boreholes drilled are shown on the attached CCG's Drawing: CCG DFO, Cuslett, NL. Boreholes were located in the field by the CCG's surveyor. One (1) borehole (BH 1) was located at the proposed tower base, and three boreholes (BH 2 to BH 4) were located at the proposed three tower anchor locations. Final borehole locations and elevations, shown in Table 3.1, were recorded by All North with survey control referenced to a Survey Monument 619030 (N 5204509.92, E 217043.98) located on site (see attached drawing).

Table 3.1 Final Borehole Coordinates

Borehole	Easting	Northing	Elevation (m)	Comments
BH 1	216993.1	5204521.58	134.19	Tower Center
BH 2	217027.33	5204498.9	133.07	Guy, South East
BH 3	216954.37	5204502.3	130.79	Guy, South West
BH 4	216995.74	5204564.19	131.39	Guy, North

Boreholes were advanced using NW/NQ size core. The depths of the boreholes ranged from 3.1 m to 4.2 m below existing ground surface. Soils were sampled using a 50 mm OD split spoon sampler during the performance of the Standard Penetration Test (SPT). Bedrock was sampled by coring in NQ size. Photos of recovered rock cores from BH 1 to BH 4 locations are attached with this report (see attached bedrock photos). Upon completion, boreholes were backfilled with drilling spoils and surrounding fill materials. It is understood that CCG will assume responsibility for monitoring these test hole locations for any future safety, environmental or other related issues.

The field work was conducted under the supervision of Stantec personnel who maintained detailed logs and obtained representative samples of the various strata encountered. The soils and bedrock were classified in general accordance with the procedures outlined in the attached explanatory key, Symbol and Terms Used on Borehole Records and Test Pit Records. Samples were returned to our St. John's laboratory for visual classification and additional testing. Samples will be stored for a period of three months at which time they will be discarded unless instructions to the contrary are received.

4.0 LABORATORY TESTING

Rock core samples were taken to St. John's laboratory to perform unconfined compressive strength (UCS) tests. UCS testing was performed on three samples obtained from BH 2, BH 3 and BH 4. The results of the laboratory testing are described below and are also shown on the attached Borehole Records.

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

A surficial rootmat layer was encountered at BH 4 and had thickness of 0.1 m.

5.2 Fill

At BH 1, a layer of fill was encountered at the ground surface and extended to a depth of approximately 0.6 m below the ground surface. Based on our visual observations in the field, the fill is classified as a red, silty gravel with sand (GM) with trace organics and occasional cobbles. Based on the Standard Penetration Test N-values and drilling performance, the relative density of the fill material can be classified as loose.

5.3 Bedrock

5.3.1 Residual Soil

A layer of highly weathered, decomposed bedrock (residual soil) was encountered at BH 3 and BH 4 at the ground surface or below the organic soil. The thickness of the residual soil layer ranged approximately from 0.6 m to 1.2 m.

5.3.2 Weathered Bedrock

Weathered bedrock was encountered at all borehole locations at depths ranging from the ground surface to a depth of 1.2 m. The weathered bedrock layer was approximately 0.6 m to 1.7 m thick.

Recovered bedrock core consisted of highly weathered, red, mudstone. The Rock Quality Designation (RQD) values ranged from 0% to 31%, indicating a “very poor quality” to “poor quality” rock mass. Photographs of the recovered bedrock core are attached. Based on observation, weathered bedrock can be classified as extremely weak (R0) to very weak (R1).

5.3.3 Bedrock

Bedrock was encountered at all borehole locations below the weathered layer at depths ranging from 1.4 m to 2.3 m below the ground surface.

Recovered bedrock core consisted of slightly weathered to fresh, medium to very thin bedded, moderate to very close discontinuities (fractures), red, mudstone. The Rock Quality Designation (RQD) values ranged

from 52% to 100%, indicating a “fair quality” to “excellent quality” rock mass. Photographs of the recovered bedrock core are attached.

Unconfined compressive strength (UCS) testing performed on three samples obtained from BH 2, BH 3 and BH 4, at corresponding depths of 2.9 m, 2.6 m and 4.1 m, indicated strength of 48.6 MPa, 39.5 MPa and 80.7 MPa, respectively. Based on the laboratory testing, bedrock can be classified as medium strong to strong (R3 to R4).

6.0 DISCUSSION AND RECOMMENDATIONS

Based on the information provided by CCG, it is understood that the existing 39.6 m high VHF tower will be replaced by a new 45.7 m high tower. This geotechnical investigation was carried out to determine the subsurface conditions and provide foundation design recommendations (in accordance with Section 4.0: Geotechnical Investigation outlined in the RFP) for the proposed tower foundation and anchors, as shown on the attached CCG’s Drawing.

The existing guy tower base is currently founded on bedrock. The approximate upper 1.5 m fractured rock was replaced with reinforced concrete and doweled using four (4) 25 mm diameter rebar approximately 0.6 m into the good quality bedrock. The existing tower anchors were installed as deadman anchor (reinforced concrete anchorage) having approximately 1.8 m of granular soil cover and a roughly 0.9 m of granular pad built on grade. The anchors are currently inclined at an angle of approximately 40.5° with horizontal.

Based on the information provided by CCG, information available from site visit, and our current understanding of the work, following comments and design recommendations are provided. It is noted that 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 Bearing Pressure

Based on ultimate limit states (bearing capacity) analysis, footings may be designed on suitably prepared competent bedrock surface using bearing pressure as follows:

- Footings founded on fair to good quality bedrock (RQD > 50%) may be designed using a factored geotechnical bearing resistance at ultimate limit states of 1,125 kPa.
- A resistance factor of 0.5 was used in the analysis.
- Site preparation should include removal of all fill and loose/fractured rock to expose competent bedrock (RQD > 50%). Hand cleanup of the bedrock footing bearing areas will be required to provide a level surface for the placement of footings as well as to achieve the recommended bearing pressure.
- Settlement of footings on the suitably prepared bedrock surface as described above will be negligible.
- The minimum soil cover or equivalent for frost protection required for this region is 1.2 m.

6.2 Recommended Anchoring Procedure

- Anchor type: Non-shrink cement or resin set anchors
- Allowable bond strength at the competent rock- grout interface should not exceed 450 kPa.
- Grout Type: Grout used in the installation was assumed as a non-shrink grout or resin with a minimum unconfined compressive strength of 30 MPa.
- The upper 1.5 to 2.0 m of bedrock from the surface should be ignored in determining the anchor bond capacity.
- A maximum apex angle of 60° has been assigned for determining the cone of rock mobilized by the anchor. For calculation purpose, the location of the apex of the cone can be assumed at the mid-point of the bond length.
- We recommend performance testing of anchors on test anchors to verify the design capacities of the materials used before the actual anchors for the towers are installed. All anchors installed for the towers should be tested to include a selection of performance and proof testing in general accordance with ASTM 2235 – Rock Bolt Anchor Pull Test, and guidelines set forth in the Post Tensioning Institute documents (6^{th} edition) to ensure the anchors have meet the project requirements.
- Anchor design should also take into consideration the loading direction where loads may not be normal to the rock surface or parallel to the anchor alignment.

6.3 Seismic Site Classification

For seismic response, the site classification was determined using Table 4.1.8.4.A in National Building Code of Canada (NBCC). According to the code, site classification for seismic response would be Site Class “C”.

6.4 Other Design Parameters

Other design parameters such as unit weight and submerged unit weight for soil/rock, friction angle of the soil and earth pressure resistance are provided below in Table 6.1. The design parameters provided below are based on the information obtained from the geotechnical investigation, laboratory testing on rock samples and information available from the literature.

Table 6.1 Design Parameters

Parameter	Value
Unit Weight of Rock, γ_{rock}	26.5 kN/m^3
Dry Unit Weight of Fill, γ_{dry_fill}	18.5 kN/m^3

Submerged Unit Weight of Rock, γ'_{rock}	16.7 kN/m^3
Submerged Unit Weight of Fill, γ'_{fill}	8.7 kN/m^3
Effective Angle of Internal Friction of Fill, ϕ'	32°
Active Earth Pressure coefficient, k_{a_fill}	0.31
Passive Earth Pressure coefficient, k_{p_fill}	3.25

6.5 Quality Assurance/Quality Control

It is highly recommended that a program of quality assurance, quality control and inspection be carried out by geotechnical personnel during earthworks, and foundation construction. Such a program should include verification of excavation bases and approval before placement of additional fill or footing concrete; founding level inspection and approval; compaction testing during fill placement; and field and laboratory testing during placement of granular fill materials.

7.0 CLOSURE

Use of this report is subject to the Statement of General Conditions, attached. It is the responsibility of the 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 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.

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.

Sincerely,

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NEWFOUNDLAND & LABRADOR

PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL Newfoundland and Labrador
PERMIT HOLDER
This Permit Allows
STANTEC CONSULTING LTD.
To practice Professional Engineering in Newfoundland and Labrador.
Permit No. as issued by PEGNL 10291
which is valid for the year 2018

APPENDIX

Statement of General Conditions

Symbols and Terms Used on Borehole and Test Pit Records

Borehole Records

Bedrock Core Photos

CCG's Drawing: CCG DFO, Cuslett, NL

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.

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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

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BOREHOLE RECORD

BOREHOLE No. **BH 1**
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CLIENT **Canadian Coast Guard**
PROJECT **Geotechnical Investigation - VHF Tower Installation**
LOCATION **Cuslett, NL**
DATES (mm-dd-yy): BORING **4-6-18** WATER LEVEL **N/A**

PROJECT No. **121621755**
DRILLING METHOD **Wash Bore**
SIZE **NW/NQ**
DATUM **Geodetic**

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY OR TCR(%)	SAMPLES N-VALUE OR RQD (%)	SAMPLES OTHER TESTS
	134.19						mm		
0		Loose, red, silty GRAVEL with sand (GM); trace organics and occasional cobbles: FILL			SS	1	178	7	
	133.58	Very poor to poor quality, highly weathered, extremely weak, red, Mudstone: WEATHERED BEDROCK			NQ	2	100%	28%	
1									
					NQ	3	100%	20%	
2	131.90	Excellent quality, medium strong, red, Mudstone: BEDROCK			NQ	4	100%	100%	
3					NQ	5	100%	100%	
	130.53	END OF BOREHOLE							
4									
5									

UNCONFINED COMPRESSIVE STRENGTH (MPa)
50 100 150 200
WATER CONTENT & ATTERBERG LIMITS W_P W W_L
DYNAMIC PENETRATION TEST, BLOWS/0.3m ★
STANDARD PENETRATION TEST, BLOWS/0.3m ●
25 50 75 100 125 150 175 200

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded) ⬠ Field Mini Vane
◇ Fall Cone Test ◆ (Remolded) ⬟ Field Mini Vane (Residual)
▽ Hand Penetrometer Test ◥ Torvane

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BOREHOLE RECORD

BOREHOLE No. **BH 2**
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CLIENT **Canadian Coast Guard**
PROJECT **Geotechnical Investigation - VHF Tower Installation**
LOCATION **Cuslett, NL**
DATES (mm-dd-yy): BORING **4-6-18** WATER LEVEL **N/A**

PROJECT No. **121621755**
DRILLING METHOD **Wash Bore**
SIZE **NW/NQ**
DATUM **Geodetic**

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY OR TCR(%)	SAMPLES N-VALUE OR RQD (%)	SAMPLES OTHER TESTS
	133.07						mm		
0		Very poor quality, highly weathered, extremely weak to weak, red, Mudstone: WEATHERED BEDROCK			NQ	1	29%	0%	
1					NQ	2	57%	31%	
	131.55								
2		Fair to good quality, medium strong to strong, red, Mudstone: BEDROCK			NQ	3	100%	52%	
3	130.02								
		END OF BOREHOLE							
4									
5									

UNCONFINED COMPRESSIVE STRENGTH (MPa)
50 100 150 200
WATER CONTENT & ATTERBERG LIMITS W_P W W_L
DYNAMIC PENETRATION TEST, BLOWS/0.3m ★
STANDARD PENETRATION TEST, BLOWS/0.3m ●
25 50 75 100 125 150 175 200

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded) ⬠ Field Mini Vane
◇ Fall Cone Test ◆ (Remolded) ⬟ Field Mini Vane (Residual)
▽ Hand Penetrometer Test ◥ Torvane

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BOREHOLE RECORD

BOREHOLE No. **BH 3**
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CLIENT **Canadian Coast Guard**
PROJECT **Geotechnical Investigation - VHF Tower Installation**
LOCATION **Cuslett, NL**
DATES (mm-dd-yy): BORING **4-8-18** WATER LEVEL **N/A**

PROJECT No. **121621755**
DRILLING METHOD **Wash Bore**
SIZE **NW/NQ**
DATUM **Geodetic**

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY OR TCR(%)	SAMPLES N-VALUE OR RQD (%)	OTHER TESTS
	130.79						mm		
0		Very poor quality, extremely weak, red, Mudstone: RESIDUAL SOIL (BEDROCK)			SS	1	330	13	
	130.18	Poor quality, highly weathered, weak, red, Mudstone: WEATHERED BEDROCK			NQ	2	100%	29%	
1					NQ	3	100%	64%	
	129.42	Fair quality, medium strong to strong, red, Mudstone: BEDROCK							
2					NQ	4	100%	54%	
3					NQ	5	100%	70%	
	127.13	END OF BOREHOLE							
4									
5									

UNCONFINED COMPRESSIVE STRENGTH (MPa)
50 100 150 200
WATER CONTENT & ATTERBERG LIMITS W_P W W_L
DYNAMIC PENETRATION TEST, BLOWS/0.3m ★
STANDARD PENETRATION TEST, BLOWS/0.3m ●
25 50 75 100 125 150 175 200

△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded) ⬠ Field Mini Vane
◇ Fall Cone Test ◆ (Remolded) ⬟ Field Mini Vane (Residual)
▽ Hand Penetrometer Test ◥ Torvane

Stantec

BOREHOLE RECORD

BOREHOLE No. **BH 4**
PAGE **1** of **1**

CLIENT **Canadian Coast Guard**
PROJECT **Geotechnical Investigation - VHF Tower Installation**
LOCATION **Cuslett, NL**
DATES (mm-dd-yy): BORING **4-6-18** WATER LEVEL **N/A**

PROJECT No. **121621755**
DRILLING METHOD **Wash Bore**
SIZE **NW/NQ**
DATUM **Geodetic**

DEPTH (m)	ELEVATION (m)	DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY OR TCR(%)	SAMPLES N-VALUE OR RQD (%)	SAMPLES OTHER TESTS
	131.39						mm		
0	131.34	ROOTMAT							
		Very poor quality, extremely weak, red, Mudstone: RESIDUAL SOIL (BEDROCK)			SS	1	305	15	
					SS	2	356	107/430	
1	130.17								
		Very poor quality, highly weathered, extremely weak, red, Mudstone: WEATHERED BEDROCK			NQ	3	100%	0%	
	129.56								
2		Fair to good quality, medium strong to strong, red, Mudstone: BEDROCK - Interbedded layers of quartz encountered			NQ	4	100%	52%	
3					NQ	5	100%	64%	
4					NQ	6	100%	88%	
	127.17								
		END OF BOREHOLE							
5									

UNCONFINED COMPRESSIVE STRENGTH (MPa)
50 100 150 200
WATER CONTENT & ATTERBERG LIMITS W_P W W_L
DYNAMIC PENETRATION TEST, BLOWS/0.3m ★
STANDARD PENETRATION TEST, BLOWS/0.3m ●
25 50 75 100 125 150 175 200

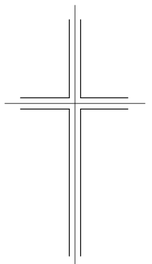
△ Unconfined Compression Test
□ Field Vane Test ■ (Remolded) ⬠ Field Mini Vane
◇ Fall Cone Test ◆ (Remolded) ⬟ Field Mini Vane (Residual)
▽ Hand Penetrometer Test ◥ Torvane

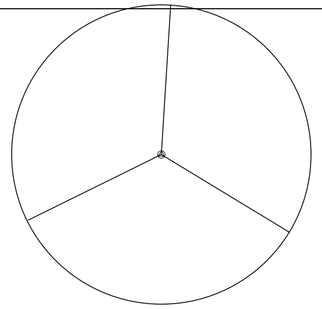
BH 1

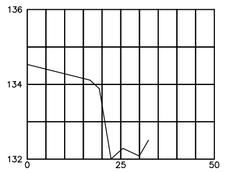
BH 2

BH 3

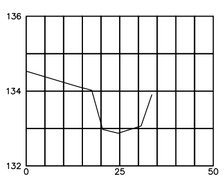
BH 4







Az 1 Profile



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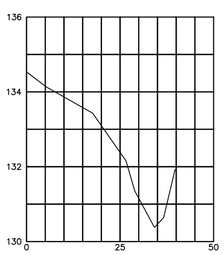

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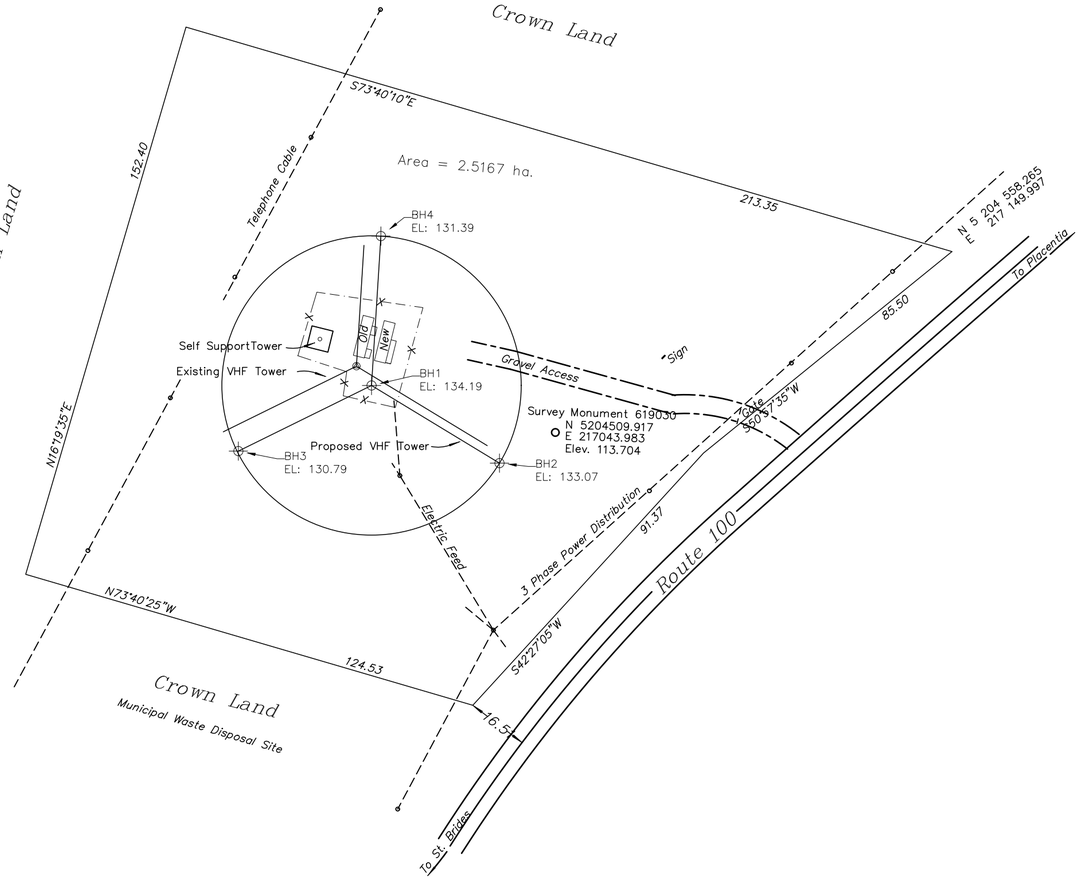

Fisheries and Oceans Coast Guard / Pêches et Océans Garde côtière

Note

Boundary Information as per Plan MT–1256

Reference Monuments

619030	85G4016
N 5 204 509.917	N 5 202 158.282
E 217 043.983	E 216 195.368
Elev. 113.704	Elev. 66.085

no. no	revision revision	date date	by par	approved approuve

Project – projet

Drawing – dessin

CCG DFO

Cuslett

Newfoundland & Labrador

drawn – dessine	designed – déssine par
C. G. Hawco NLS	
date – date	checked – verifie
June 2004	
scale – echelle	approved – approuve
1 : 1000	

project no. – projet no.	drawing no. – no du dessin	sheet – feuille