

**Appendix A**  
Geotechnical Investigation

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2017.01

**GEOTECHNICAL  
INVESTIGATION, GUNNING  
COVE WHARF, SHELBURNE,  
NOVA SCOTIA**



2017.01

**GEOTECHNICAL  
INVESTIGATION, GUNNING  
COVE WHARF, SHELBURNE,  
NOVA SCOTIA**

Project No. 121620196



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May 12, 2017

# GEOTECHNICAL INVESTIGATION, GUNNING COVE WHARF, SHELBURNE, NOVA SCOTIA

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## **1.0 INTRODUCTION**

Stantec Consulting Ltd. (Stantec), acting at the request of Public Services and Procurement Canada (PSPC), has carried out a supplementary geotechnical investigation at the Gunning Cove wharf in Shelburne County, Nova Scotia. The purpose of the investigation was to assess the soil and bedrock conditions in the area of the current proposed breakwater and wharf structures. The reports prepared from the two previous investigations completed at this site are included in Appendix B of this report.

The current investigation was completed in two phases and the scope of work included drilling nine boreholes, six dynamic cone penetration tests, selective laboratory testing and the preparation of this report.

This report presents all our findings from the field and laboratory work undertaken for this investigation.

## **2.0 SITE DESCRIPTION AND GEOLOGY**

The geotechnical investigation was completed to the north of the existing Gunning Cove Wharf in Gunning Cove, Shelburne County, Nova Scotia. The wharf is accessed from Shore Road, approximately 9 kilometres south of Highway 103.

From previous experience in the area and geological mapping, the principal overburden typically consists of marine sediments over silty sand and gravel glacial till overlying gneiss bedrock of the Goldenville Formation.

## **3.0 FIELD PROCEDURES**

### **3.1 GENERAL**

The current geotechnical investigation consisted of drilling sixteen boreholes, six of which were completed using dynamic cone penetration tests, between January 17 to January 21, 2017 and April 12 to April 13, 2017. It should be noted that BH107 was re-drilled at location 107A the following day as bedrock had not been reached in BH107 before drilling had to stop for the day. Drilling and testing was completed using a barge mounted drill-rig provided by Logan Drilling Group for the first phase of the investigation and Lantech Drilling Services for the second phase. Boreholes were advanced with HW size casing within the overburden soil, and bedrock was cored with an HQ size core barrel. Soil samples were obtained using a 50 mm OD split-spoon sampler while performing Standard Penetration Testing, and 75 mm OD Shelby Tubes.





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Detailed logs of the soil conditions encountered, and the sampling carried out are given on the Borehole Records in Appendix A. The results of the laboratory testing performed are provided on the borehole records or are appended separately.

Borehole locations and elevations were surveyed by Stantec field personnel; elevations are referenced to LNT Datum and locations are shown on Drawing No. 1, Appendix A.

### 3.2 LABORATORY TESTING

Samples obtained from split-spoon sampling, Shelby tube sampling and rock coring were transported to our Dartmouth laboratory for index testing upon completion of the field program. Tests performed on soil included moisture content determinations, grain size analyses, miniature field vane testing, and point load testing on rock samples.

### 4.0 SUBSURFACE CONDITIONS

The subsurface conditions encountered are described in detail on the appended and Borehole Records and summarized in the tables and paragraphs below.

**Table 4.1: Summary of Subsurface Conditions from Boreholes**

Borehole No.	Seafloor Elevation* (m)	ORGANIC SILT Thickness (m)	PEAT Thickness (m)	SAND AND GRAVEL Thickness (m)	Glacial TILL Thickness (m)	Bedrock Elevation* (m)
BH101	-2.4	3.0	-	>1.1	-	-
BH102	-2.5	2.2	-	>1.2	-	-
BH103	-2.7	1.5	-	-	>0.9	-
BH104	-2.7	2.0	0.1	-	>1.1	-
BH105	-2.9	1.5	-	-	>0.6	-
BH106	-2.8	1.6	-	-	5.5	-9.9
BH107/107A**	-2.4	2.0	0.2	-	>3.1	-8.6
BH202	-3.2	2.3	-	-	>1.4	-
BH204	-3.6	2.3	-	>1.6	-	-

\*Elevations are referenced to LNT Datum

\*\*Borehole BH107A advanced directly to bedrock

**Table 4.2: Summary of Subsurface Conditions from Dynamic Cone Penetration Tests**

DCPT No.	Seafloor Elevation* (m)	Inferred ORGANIC SILT/PEAT Thickness (m)	SAND AND GRAVEL or Glacial TILL Thickness (m)
BH108	-2.6	2.9	>0.7
BH109	-2.6	2.6	>1.1



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DCPT No.	Seafloor Elevation* (m)	Inferred ORGANIC SILT/PEAT Thickness (m)	SAND AND GRAVEL or Glacial TILL Thickness (m)
BH110	-2.3	2.3	>0.6
BH201	-2.9	2.4	>0.1
BH201A	-2.9	2.7	>1.2
BH203	-3.4	2.7	>0.8
BH205	-3.4	2.1	>0.9

\*Elevations are referenced to LNT Datum

### 4.1 ORGANIC SILT AND PEAT

A layer of grey to dark gray organic silt with sand was encountered in all boreholes. The thickness of this layer ranged from 1.5 m to 3.4 m. A thin layer of peat was encountered beneath the organic silt in two boreholes. The thickness was 0.1 m in BH104 and 0.2 m in BH107.

The results of the grain size analyses testing that was performed on samples of the organic silt with sand yielded 0% gravel, 14 to 17% sand, and 82 to 86% silt and clay sized particles. The moisture content of this material ranged between 70 and 480%. The results of the miniature field vane testing are provided in table 4.3 below.

**Table 4.3: Summary of Miniature Field Vane Test Results**

Borehole No.	Sample No.	Depth (m)	Shear Stress (kPa)
BH101	ST2	1.09	5.54
BH101	ST2	1.52	3.98
BH101	ST4	2.75	20.09*
BH101	ST4	2.26	9.18
BH101	ST4	2.70	11.60
BH102	ST2	0.71	4.50
BH102	ST2	1.14	4.33
BH104	ST2	0.73	2.60
BH104	ST2	1.17	4.85

\*Note BH101 ST4 2.75 m contained organics(sticks/roots)

### 4.2 SAND AND GRAVEL

A layer of grey to brown silty sand to sand and gravel was encountered in boreholes BH101, BH102, and BH 204. The relative compactness of this layer was described as loose to compact based on the N-values obtained.



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### **4.3 GLACIAL TILL**

A layer of grey to brown glacial till was encountered in boreholes BH103-BH107 and BH202. The glacial till was comprised of silty sand with gravel. The relative compactness of the glacial till layer was described as compact to very dense. Occasional cobbles and boulders were encountered in the glacial till layer.

The results of the grain size analyses testing that was performed on samples of the silty sand with gravel glacial till yielded 21 to 39% gravel, 42 to 45% sand, and 19 to 34% silt and clay sized particles. The moisture contents of the two samples of this material tested was 8 and 14%.

### **4.4 BEDROCK**

Very severely fractured grey gneiss bedrock was encountered in BH106 and BH107A at an elevation of -9.86 m and -8.58 m, respectively. The Rock Quality Designation (RQD) for all recovered samples was 0%. RQD is the ratio of the sum of the core recovered greater than 100 mm in length divided by the total core drilled, expressed as a percentage. Point load testing was completed on samples of the bedrock obtained to assess the rock strength. The results of the testing are summarized below:

**Table 4.4: Summary of Point Load Testing Results**

<b>Borehole No.</b>	<b>Sample Depth (m)</b>	<b>Point Load (MPa)</b>	<b>Inferred Unconfined Compressive Strength (MPa)</b>
BH106	8.2	5.6	148
BH106	8.5	1.8	42
BH107	6.9	3.0	84
BH107	7.5	2.3	62
BH107	8.1	4.1	108
BH107	8.4	2.1	50

## **5.0 RECOMMENDATIONS**

It is understood that the proposed development will consist of the construction of a breakwater and wharf structure. The following sections provide recommendations for use in the development of the design of these elements.

### **5.1 SLOPE STABILITY**

Stantec has prepared design drawings and a tender package for the breakwater construction component of this project. Working in collaboration with our marine/structural engineers, a slope





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stability analysis was performed to develop a breakwater geometry considering the relatively thick layer of organic silt that was encountered at the test locations. Our geotechnical recommendations have been incorporated into the design drawings and tender documents for this aspect of the project.

## 5.2 PILE RECOMMENDATIONS

It is understood that the proposed wharf structure will be supported using bedrock-socketed steel pipe piles. It is recommended that the pile sockets be designed using a factored geotechnical bond resistance at Ultimate Limit States of 650 kPa for axial resistance and 500 kPa for uplift resistance. These values include resistance factors of 0.4 for axial resistance and 0.3 for uplift resistance.

The uplift resistance of the socketed piles should consider both bond stress and the weight of rock mobilized. The lesser of the bond stress and weight of cone should be used for uplift loads. The weight of the cone should be taken as a 60° cone from the base of the socket. The effect of overlapping cones may also have to be assessed. The unit weights provided in the following table should be used in the weight calculation for the cone analysis.

Material Type	Total Unit Weight (kN/m <sup>3</sup> )	Submerged Unit Weight (kN/m <sup>3</sup> )
Glacial TILL	20	10.2
Bedrock	24	14.2

If piles are installed through new fill and/or new fill is placed on top of the organic silt, the axial capacities will need to be designed to resist downdrag loads on the piles. The downdrag loads are a function of the pile length in the fill and/or organic silt and the applied design loads should be adjusted according to the condition at the location of individual piles.

Lateral load capacities will be low for vertical piles due to the anticipated large unsupported length and limited embedment of piles.

The pipe piles should be advanced a minimum of 750 millimetres into the bedrock to provide an adequate seal prior to drilling the socket.

The group capacities for piles can be taken as the sum of the individual pile capacities provided that the centre spacing between the piles is at least 3 pile diameters.

It is recommended that full time inspection be provided during pile installation. Comparison of pile tip elevations of each of the piles with bedrock elevations provided in the borehole records should be carried out on an ongoing basis to ensure that the piles are based on or in bedrock.

Pile load capacities should be confirmed by static load testing or by Pile Driving Analyzer (PDA) testing. Testing should be performed on a representative number of piles.



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## **6.0 CLOSURE**

Use of this report is subject to the Statement of General Conditions provided in the Appendix. It is the responsibility of PSPC/SPAC, 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
- Planning, design or construction

This report was prepared by Greg Healy, EIT and James Mitchell, P.Eng., PMP, and was reviewed by Brian Grace, P.Eng. We trust that the information contained in this report is adequate for your present purposes. If you have any questions about the contents of the report or if we can be of any other assistance please contact us at your convenience.

Yours very truly,

**STANTEC CONSULTING LTD.**

  
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## **APPENDIX A**

**Statement of General Conditions**

**Symbols and Terms Used on Borehole and Test Pit Records**

**Borehole Records BH101 to BH107A, BH202 and BH204**

**Cone Penetration Tests BH108 to BH110, BH201, BH201A,  
BH203 and BH205**

**Grain Size Analyses**

**Drawing No. 1, Borehole Location Plan**

## **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 subsurface 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:

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

#### Terminology describing soil structure:

<i>Desiccated</i>	- having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
<i>Fissured</i>	- having cracks, and hence a blocky structure
<i>Varved</i>	- composed of regular alternating layers of silt and clay
<i>Stratified</i>	- composed of alternating successions of different soil types, e.g. silt and sand
<i>Layer</i>	- > 75 mm in thickness
<i>Seam</i>	- 2 mm to 75 mm in thickness
<i>Parting</i>	- < 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, 4<sup>th</sup> 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:

<i>Trace, or occasional</i>	Less than 10%
<i>Some</i>	10-20%
<i>Frequent</i>	> 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
<i>Very Loose</i>	<4
<i>Loose</i>	4-10
<i>Compact</i>	10-30
<i>Dense</i>	30-50
<i>Very Dense</i>	>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	
<i>Very Soft</i>	<0.25	<12.5	<2
<i>Soft</i>	0.25 - 0.5	12.5 - 25	2-4
<i>Firm</i>	0.5 - 1.0	25 - 50	4-8
<i>Stiff</i>	1.0 - 2.0	50 - 100	8-15
<i>Very Stiff</i>	2.0 - 4.0	100 - 200	15-30
<i>Hard</i>	>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:

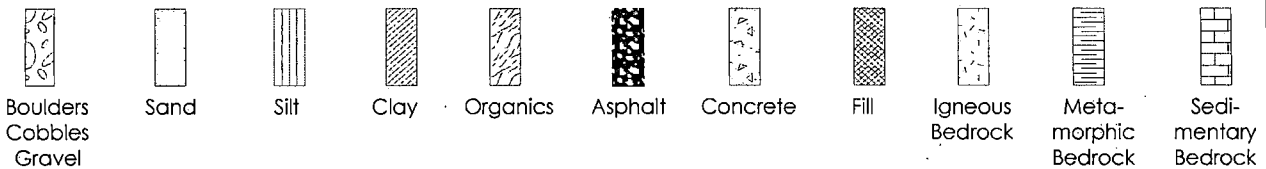
Strength Classification	Grade	Unconfined Compressive Strength (MPa)
Extremely Weak	R0	<1
Very Weak	R1	1 – 5
Weak	R2	5 – 25
Medium Strong	R3	25 – 50
Strong	R4	50 – 100
Very Strong	R5	100 – 250
Extremely Strong	R6	>250

### 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

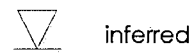
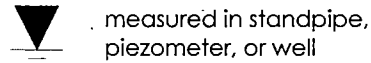
Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



## 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



## 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
y	Unit weight
G <sub>s</sub>	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 <sub>u</sub>	Unconfined compression
I <sub>p</sub>	Point Load Index (I <sub>p</sub> on Borehole Record equals I <sub>p</sub> (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

**BH101**

 CLIENT PUBLIC SERVICES AND PROCUREMENT CANADA

 PROJECT No. 121620196

 LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIA

 BH SIZE HW

 DATES: BORING 2017/01/20

 WATER LEVEL -

 DATUM LNT

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa			
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40	60	80
0	-2.38	Very soft dark grey ORGANIC SILT with sand			SS	1	130	mm	C S	WATER CONTENT & ATTERBERG LIMITS DYNAMIC PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m			
1													
2													
3													
3	-5.35	Compact grey-brown to grey silty SAND			SS	5	230	11					
4													
4	-6.47	End of Borehole			SS	6	0	26					
5													
6													
7													
8													
9													
10													

■ PENETROMETER  
 ▲ FIELD VANE TEST  
 ◆ MINATURE VANE TEST  
 ✕ UU TRIAXIAL TEST

 App'd JSM May 12 2017 15:23:19



# BOREHOLE RECORD

**BH102**

 CLIENT PUBLIC SERVICES AND PROCUREMENT CANADA

 PROJECT No. 121620196

 LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIA

 BH SIZE HW

 DATES: BORING 2017/01/20

 WATER LEVEL -

 DATUM LNT

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa			
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40	60	80
0	-2.51	Very soft dark grey ORGANIC SILT with sand											
	SS				1	100	Wt. of Rods						
1					ST	2	300	PUSH					
	SS				3	50	Wt. of Rods						
2	-4.72	Loose to compact silty SAND -trace gravel			ST	4	460	PUSH					
	SS				5	50	9						
3					SS	6	80	21					
	-5.94	End of Borehole											
4													
5													
6													
7													
8													
9													
10													

■ PENETROMETER  
 ▲ FIELD VANE TEST  
 ◆ MINATURE VANE TEST  
 ✕ UU TRIAXIAL TEST

 App'd JSM May 12 2017 15:23:21



# BOREHOLE RECORD

BH103

CLIENT PUBLIC SERVICES AND PROCUREMENT CANADAPROJECT No. 121620196LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABH SIZE HWDATES: BORING 2017/01/20WATER LEVEL -DATUM LNT

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa			
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40	60	80
0	-2.67	Very soft dark grey to brown ORGANIC SILT with sand					mm			WATER CONTENT & ATTERBERG LIMITS DYNAMIC PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m			
1					SS 1	80	Wt. of Rods						
					SS 2	80	Wt. of Rods						
	-4.19	Compact dark grey to brown silty SAND with gravel: TILL			SS 3	130	19						
2					SS 4	100	19						
	-5.11	End of Borehole											
3													
4													
5													
6													
7													
8													
9													
10													

App'd JSM May 12 2017 15:23:21



# BOREHOLE RECORD

**BH104**

 CLIENT PUBLIC SERVICES AND PROCUREMENT CANADA

 PROJECT No. 121620196

 LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIA

 BH SIZE HW

 DATES: BORING 2017/01/20

 WATER LEVEL -

 DATUM LNT

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa			
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40	60	80
0	-2.74	Very soft dark grey to brown ORGANIC SILT with sand								WATER CONTENT & ATTERBERG LIMITS DYNAMIC PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m			
1					SS	1	80	Wt. of Rods					
					ST	2	360	PUSH					
					SS	3	130	Wt. of Rods					
2	-4.75	Very soft brown PEAT Compact grey to light grey silty sand with gravel: TILL											
	-4.80				SS	4	200	26					
					SS	5	330	16					
3	-5.86	End of Borehole											
4													
5													
6													
7													
8													
9													
10													

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■ PENETROMETER  
 ▲ FIELD VANE TEST  
 ◆ MINATURE VANE TEST  
 × UU TRIAXIAL TEST



# BOREHOLE RECORD

**BH105**

 CLIENT PUBLIC SERVICES AND PROCUREMENT CANADA

 PROJECT No. 121620196

 LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIA

 BH SIZE HW

 DATES: BORING 2017/01/20 WATER LEVEL -

 DATUM LNT

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa	
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40
0	-2.87	Very soft dark grey ORGANIC SILT with sand			SS	1	80	Wt. of Rods		WATER CONTENT & ATTERBERG LIMITS	
1	ST				2	280	PUSH	DYNAMIC PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m			
2	-4.34	Dense grey to brown silty sand with gravel: TILL			SS	3	250	41		10 20 30 40 50 60 70 80 90 W <sub>p</sub> W W <sub>L</sub>	
2	-4.90	End of Borehole									
3											
4											
5											
6											
7											
8											
9											
10											

 App'd JSM May 12 2017 15:23:23



# BOREHOLE RECORD

**BH106**

 CLIENT PUBLIC SERVICES AND PROCUREMENT CANADA

 PROJECT No. 121620196

 LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIA

 BH SIZE HW

 DATES: BORING 2017/01/19

 WATER LEVEL -

 DATUM LNT

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa			
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40	60	80
0	-2.77	Very soft dark grey to brown ORGANIC SILT with sand					mm			WATER CONTENT & ATTERBERG LIMITS DYNAMIC PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m			
1					SS	1	50	Wt. of Rods					
	-4.37	Compact to very dense grey to brown silty sand with gravel: TILL -occasional cobbles and boulders			ST	2	360	PUSH					
2					SS	3	300	23					
3													
4					SS	4	280	66	S				
5													
6					SS	5	30	26					
7	-9.86	Very severely fractured, slightly weathered grey GNEISS BEDROCK											
8					HQ	6	69%	RQD 0%					
9					HQ	7	100%	0%					
9	-11.89	End of Borehole											
10													

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# BOREHOLE RECORD

**BH107**

 CLIENT PUBLIC SERVICES AND PROCUREMENT CANADA

 PROJECT No. 121620196

 LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIA

 BH SIZE HW

 DATES: BORING 2017/01/17 WATER LEVEL -

 DATUM LNT

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa									
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40	60	80	WATER CONTENT & ATTERBERG LIMITS					
										DYNAMIC PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m									
										10 20 30 40 50 60 70 80 90									
0	-2.37	Very soft grey to brown ORGANIC SILT with sand					mm												
					SS	1	580	Wt. of Rods											
1					SS	2	200	Wt. of Rods											
					ST	3	360	PUSH											
2	-4.35				SS	4	300	Wt. of Hammer											
	-4.55	Very soft brown PEAT			SS	5	50	60/80mm											
		Compact grey silty sand with gravel: TILL -occasional cobbles and boulders			SS	6	280	14	S										
5	-7.63				SS	7	130	99/200mm											
6		End of Borehole -Redrilled at location BH107A																	
7																			
8																			
9																			
10																			

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# BOREHOLE RECORD

**BH107A**

 CLIENT PUBLIC SERVICES AND PROCUREMENT CANADA

 PROJECT No. 121620196

 LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIA

 BH SIZE HW

 DATES: BORING 2017/01/18 WATER LEVEL -

 DATUM LNT

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa	
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40
0	-2.31	-Advanced casing to 6.3 m.					mm			WATER CONTENT & ATTERBERG LIMITS DYNAMIC PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m	
1										10 20 30 40 50 60 70 80 90	
2											
3											
4											
5											
6											
7	-8.58	Very severely fractured dark grey GNEISS BEDROCK			HQ	1	74%	RQD 0%			
8					HQ	2	81%	0%			
9	-10.77	End of Borehole									
10											

 App'd JSM May 12 2017 15:23:25



# BOREHOLE RECORD

**BH202**

 CLIENT PUBLIC SERVICES AND PROCUREMENT CANADA

 PROJECT No. 121620196

 LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIA

 BH SIZE HQ

 DATES: BORING 2017/04/12 WATER LEVEL -

 DATUM LNT

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa			
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40	60	80
0	-3.19	Very soft to soft grey to brown ORGANIC SILT with sand					mm			WATER CONTENT & ATTERBERG LIMITS DYNAMIC PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m			
1					SS 1	200	Wt. of Rods						
2					SS 2	325	Wt. of Hammer						
3	-5.48	Compact to dense grey to brown silty sand with gravel: TILL			SS 3	400	2						
4					SS 4	125	17						
5	-6.85				SS 5	175	34						
6		End of Borehole											
7													
8													
9													
10													

 App'd JSM May 12 2017 15:23:25



# BOREHOLE RECORD

**BH204**

 CLIENT PUBLIC SERVICES AND PROCUREMENT CANADA

 PROJECT No. 121620196

 LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIA

 BH SIZE HQ

 DATES: BORING 2017/04/12

 WATER LEVEL -

 DATUM LNT

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa	
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40
0	-3.57	Very soft to soft grey ORGANIC SILT with sand					mm				
1					SS	1	125	Wt. of Rods			
2		-wood debris at 1.68 m			SS	2	300	Wt. of Rods			
	-5.83				SS	3	350	10			
	-6.01	Loose grey silty SAND -some gravel			SS	4	125	8			
3		Loose to dense grey SAND with gravel -some silt			SS	5	150	22			
	-7.38				SS	6	400	48			
4		End of Borehole									
5											
6											
7											
8											
9											
10											

WATER CONTENT & ATTERBERG LIMITS  
 DYNAMIC PENETRATION TEST, BLOWS/0.3m  
 STANDARD PENETRATION TEST, BLOWS/0.3m

UNDRAINED SHEAR STRENGTH - kPa  
 20 40 60 80  
 W<sub>p</sub> W W<sub>L</sub>

10 20 30 40 50 60 70 80 90



# CONE PENETRATION TEST

BH108

CLIENT PUBLIC SERVICES AND PROCUREMENT CANADA

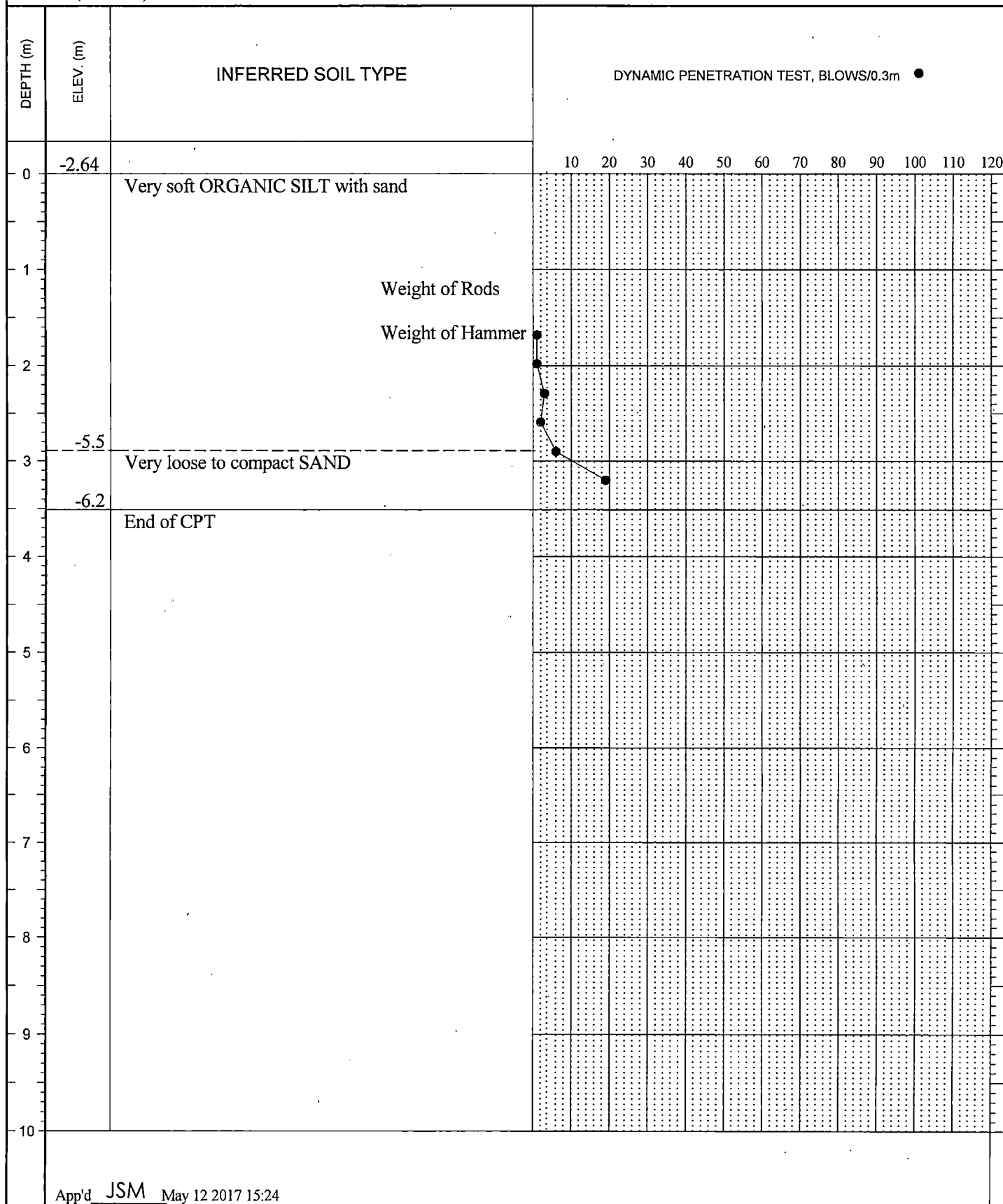
PROJECT No. 121620196

LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIA

C P T No. BH108

DATE (TESTING): 2017/01/21

DATUM LNT





# CONE PENETRATION TEST

BH109

CLIENT PUBLIC SERVICES AND PROCUREMENT CANADA

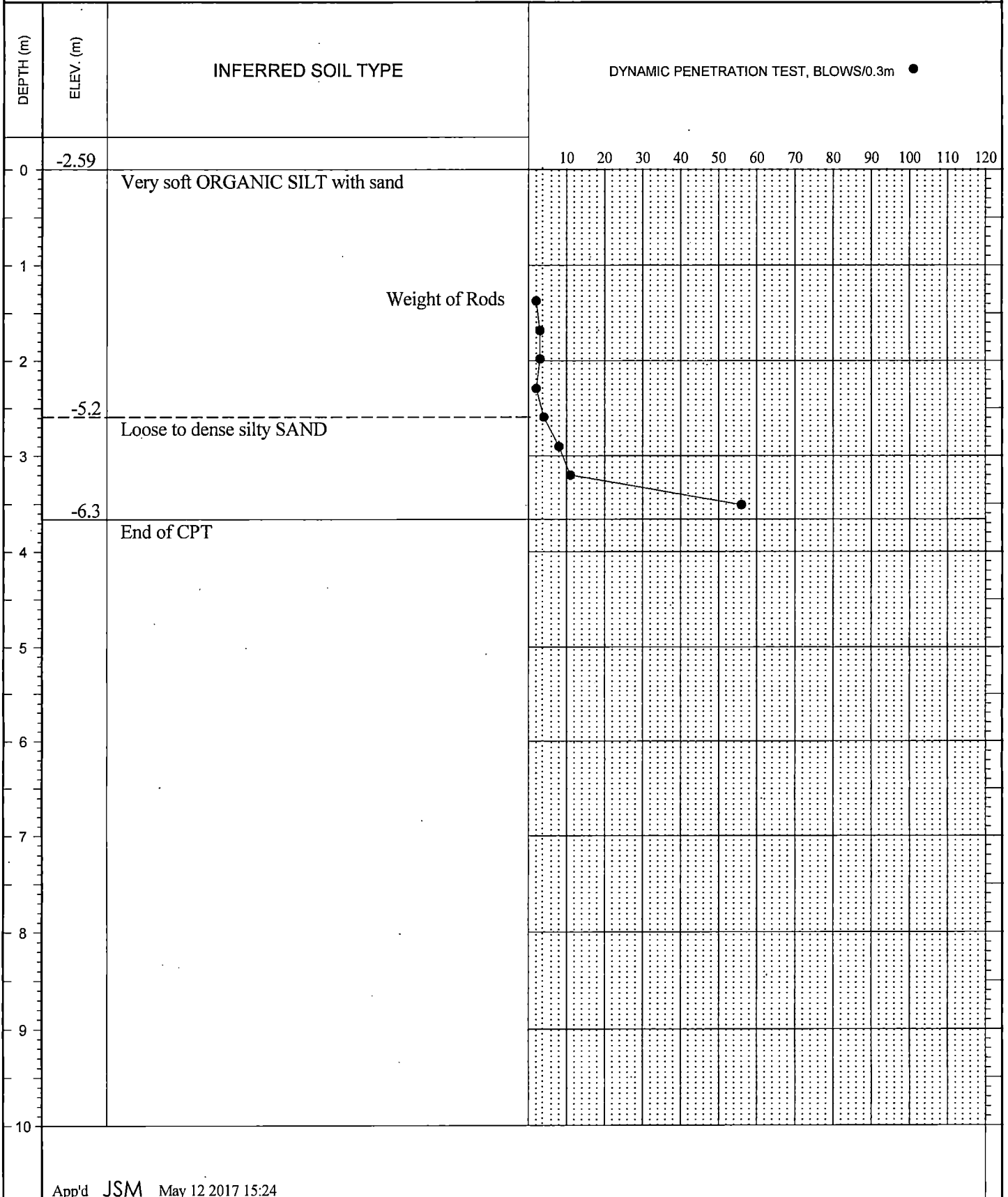
PROJECT No. 121620196

LOCATION GUNNING COVE, SHELburnE COUNTY, NOVA SCOTIA

C P T No. BH109

DATE (TESTING): 2017/01/21

DATUM LNT





# CONE PENETRATION TEST

BH110

CLIENT PUBLIC SERVICES AND PROCUREMENT CANADA

PROJECT No. 121620196

LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIA

C P T No. BH110

DATE (TESTING): 2017/01/21

DATUM LNT

DEPTH (m)	ELEV. (m)	INFERRED SOIL TYPE	DYNAMIC PENETRATION TEST, BLOWS/0.3m ●											
			10	20	30	40	50	60	70	80	90	100	110	120
0	-2.31	Very soft ORGANIC SILT with sand												
1		Weight of Rods												
2	-4.6	Weight of Hammer												
		Loose to compact silty SAND												
3	-5.2	End of CPT												
4														
5														
6														
7														
8														
9														
10														

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# CONE PENETRATION TEST

BH201

CLIENT PUBLIC SERVICES AND PROCUREMENT CANADA

PROJECT No. 121620196

LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIA

C P T No. BH201

DATE (TESTING): 2017/04/13

DATUM LNT

DEPTH (m)	ELEV. (m)	INFERRED SOIL TYPE	DYNAMIC PENETRATION TEST, BLOWS/0.3m ●											
			10	20	30	40	50	60	70	80	90	100	110	120
0	-2.94	Very soft ORGANIC SILT with sand												
1														
2														
		Weight of Rods												
		Weight of Hammer												
	-5.4													
	-5.5	Very dense silty sand with gravel: TILL 56/125mm												
3		End of CPT -Cone refusal. Retry at BH201A												
4														
5														
6														
7														
8														
9														
10														

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# CONE PENETRATION TEST

BH201A

CLIENT PUBLIC SERVICES AND PROCUREMENT CANADA

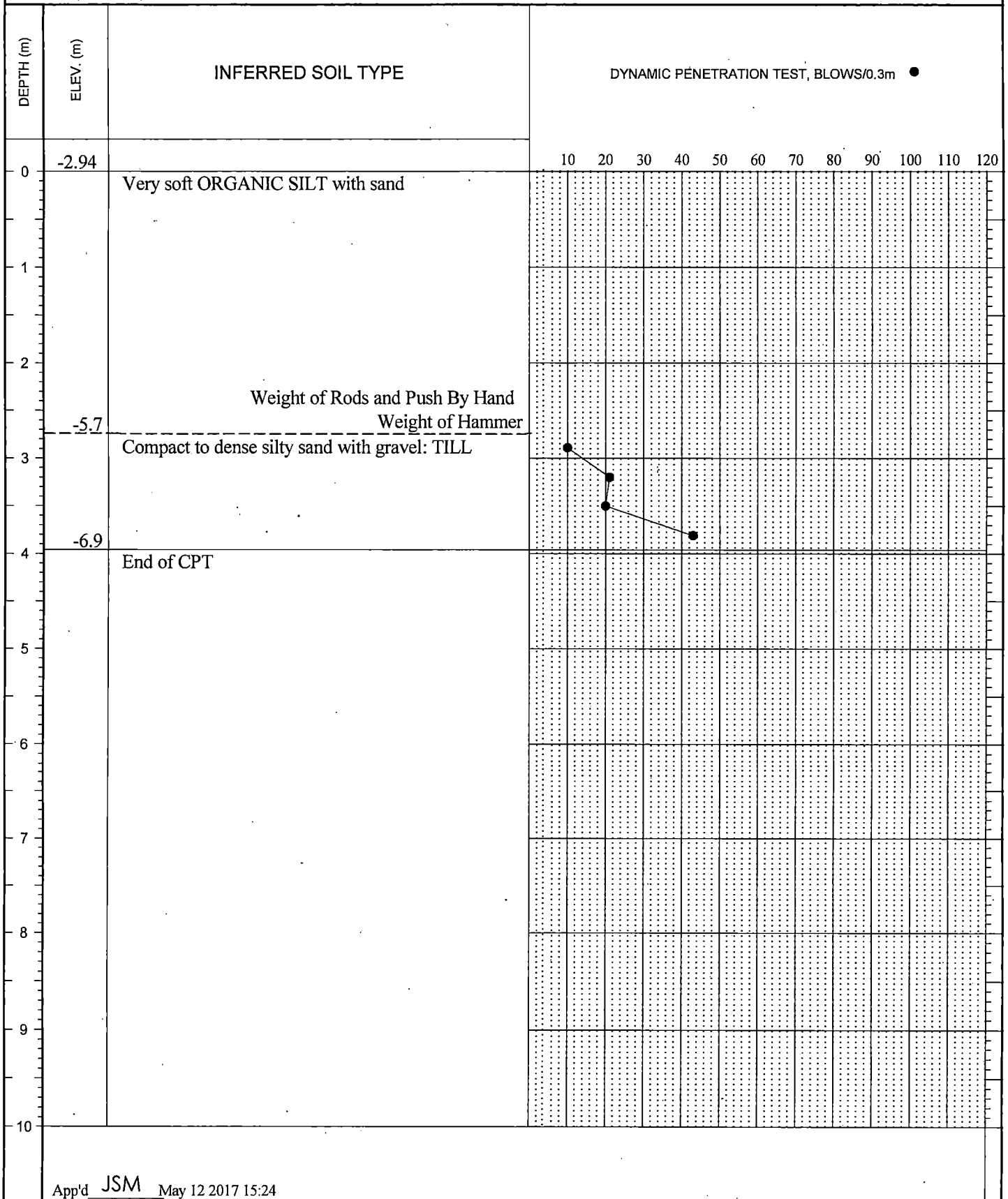
PROJECT No. 121620196

LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIA

C P T No. BH201A

DATE (TESTING): 2017/04/13

DATUM LNT





# CONE PENETRATION TEST

BH203

CLIENT PUBLIC SERVICES AND PROCUREMENT CANADA

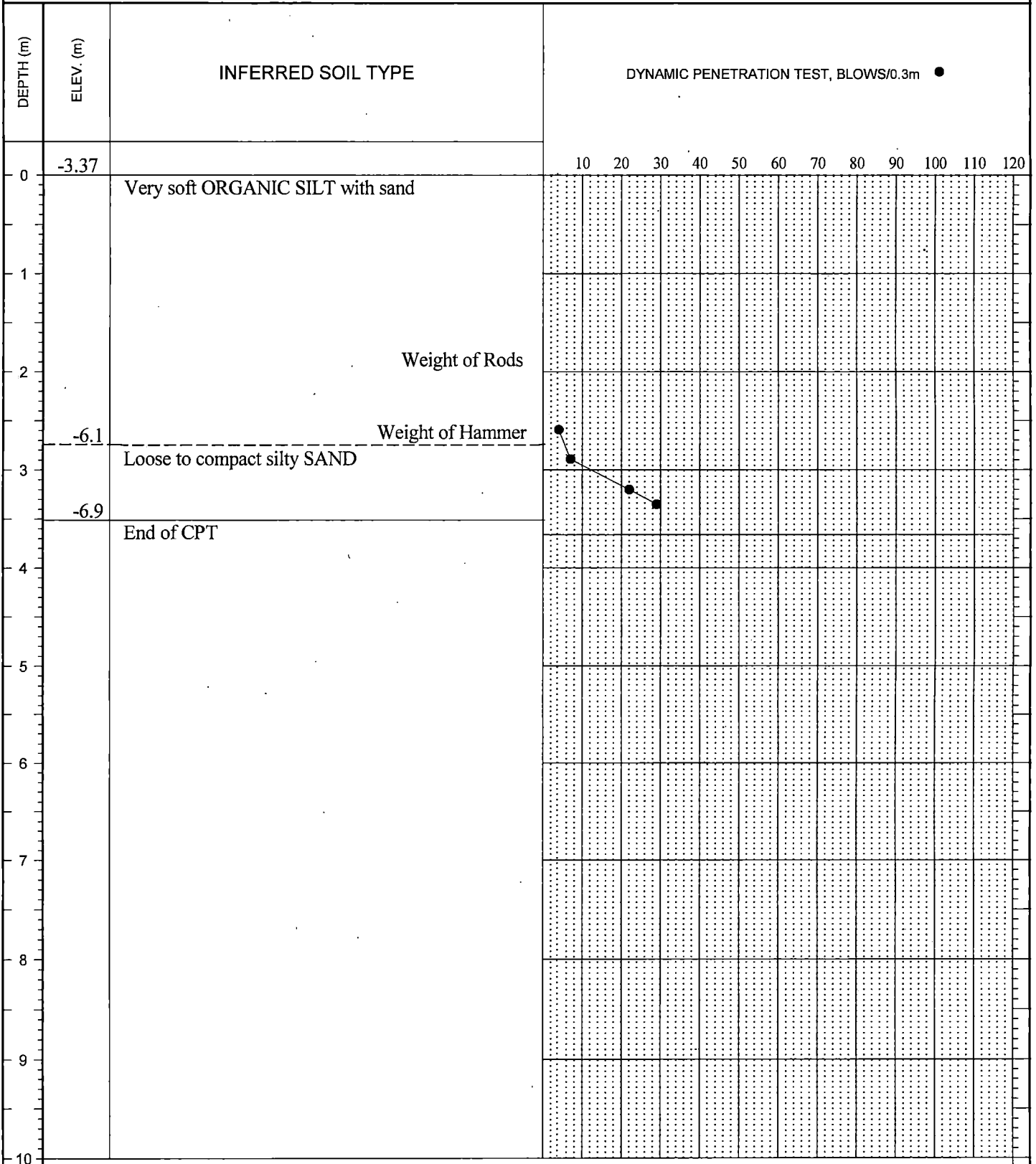
PROJECT No. 121620196

LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIA

C P T No. BH203

DATE (TESTING): 2017/04/12

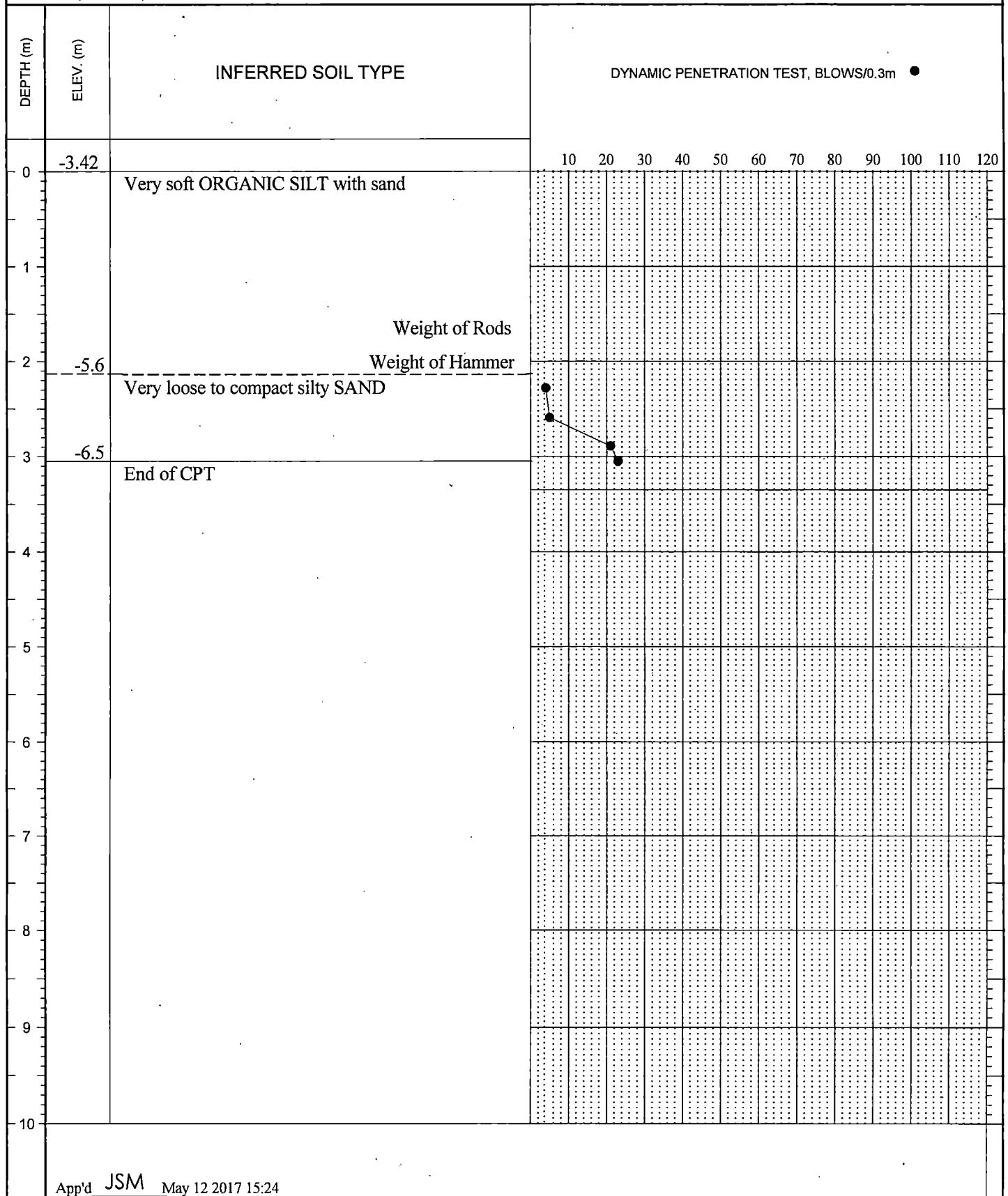
DATUM LNT

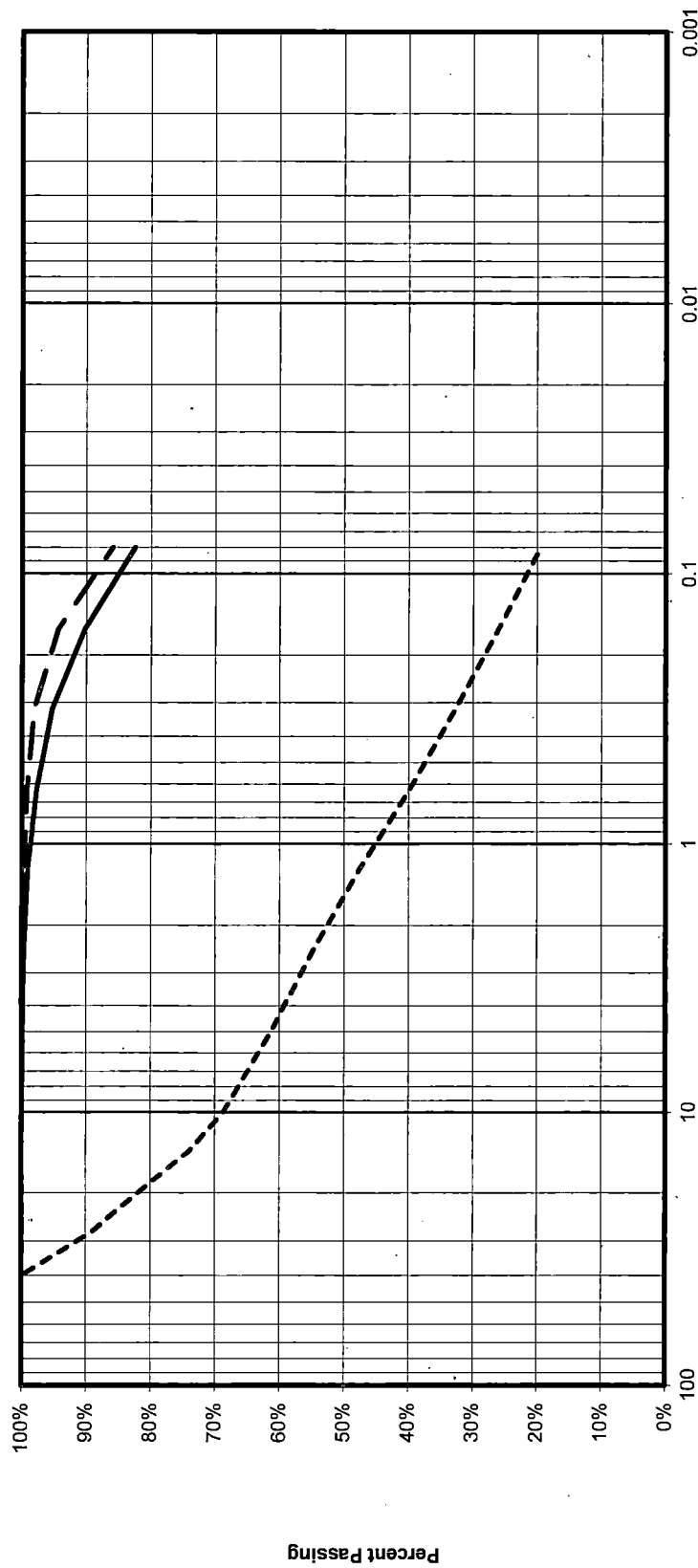


App'd JSM May 12 2017 15:24



# CONE PENETRATION TEST

**BH205**CLIENT PUBLIC SERVICES AND PROCUREMENT CANADAPROJECT No. 121620196LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIAC P T No. BH205DATE (TESTING): 2017/04/12DATUM LNT



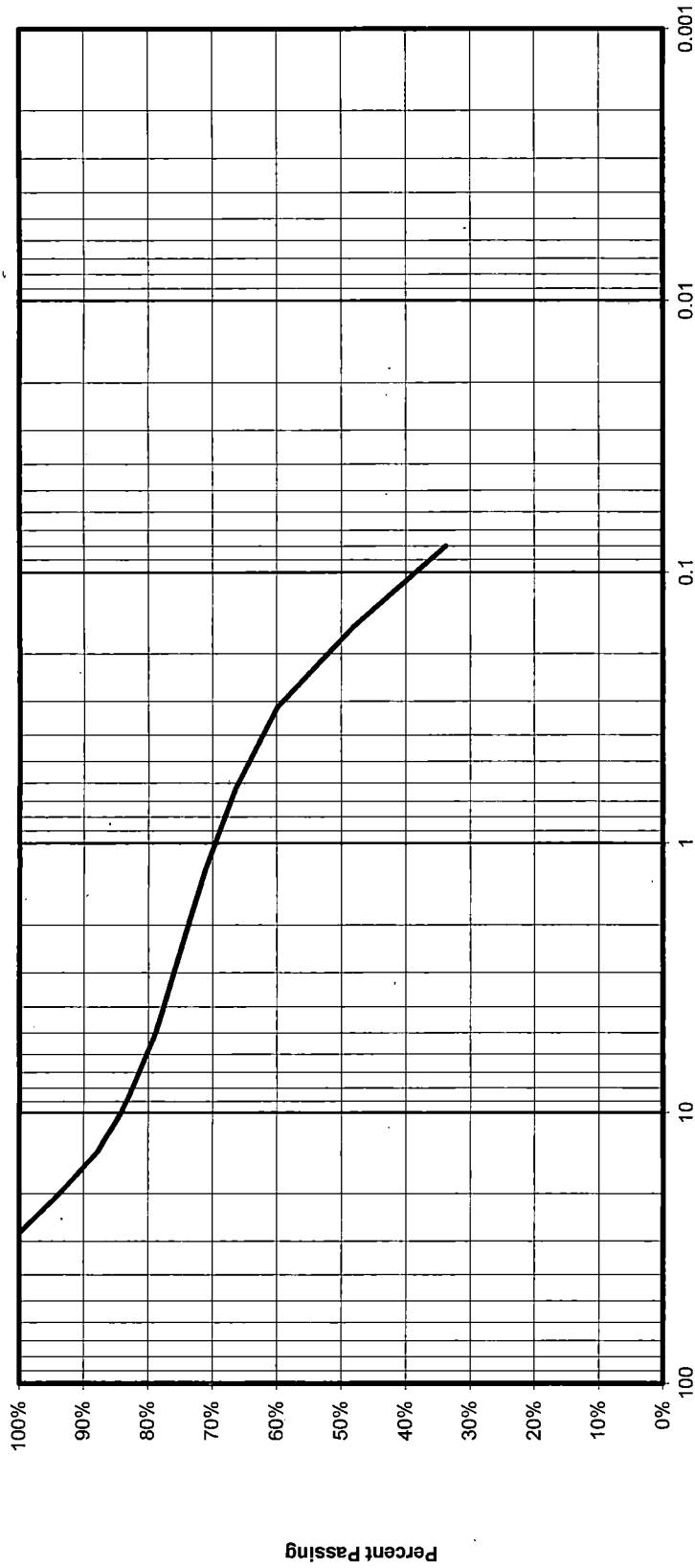
Grain Size in Millimetres

Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Unified Soil Classification System ASTM D 2487/2488

Curve	BOREHOLE/TEST PIT	SAMPLE	DEPTH (m)	Soil Fractions			Soil Description
---	BH101	ST2	1.0 - 1.6	Gravel	Sand	Silt/Clay	ORGANIC SILT with sand
---	BH102	ST2	0.6 - 1.3	0%	17%	82%	ORGANIC SILT with sand
---	BH106	SS4	3.6 - 4.2	39%	42%	19%	Silty sand with gravel: TILL

Approved: JSM

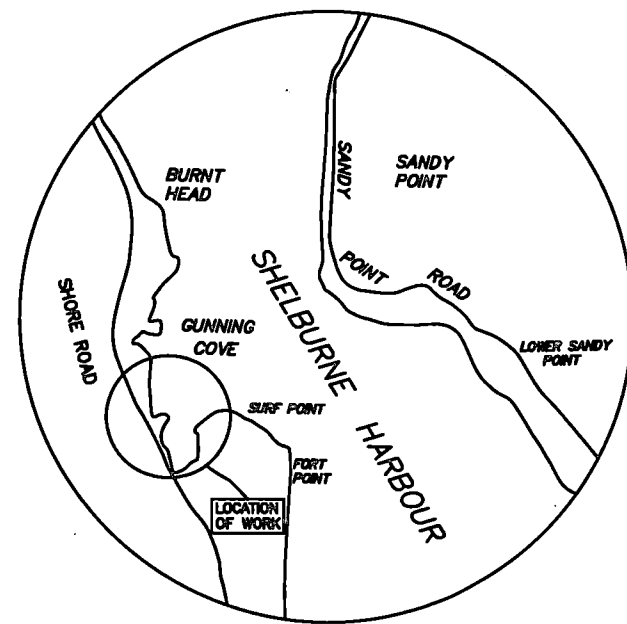


Grain Size in Millimetres

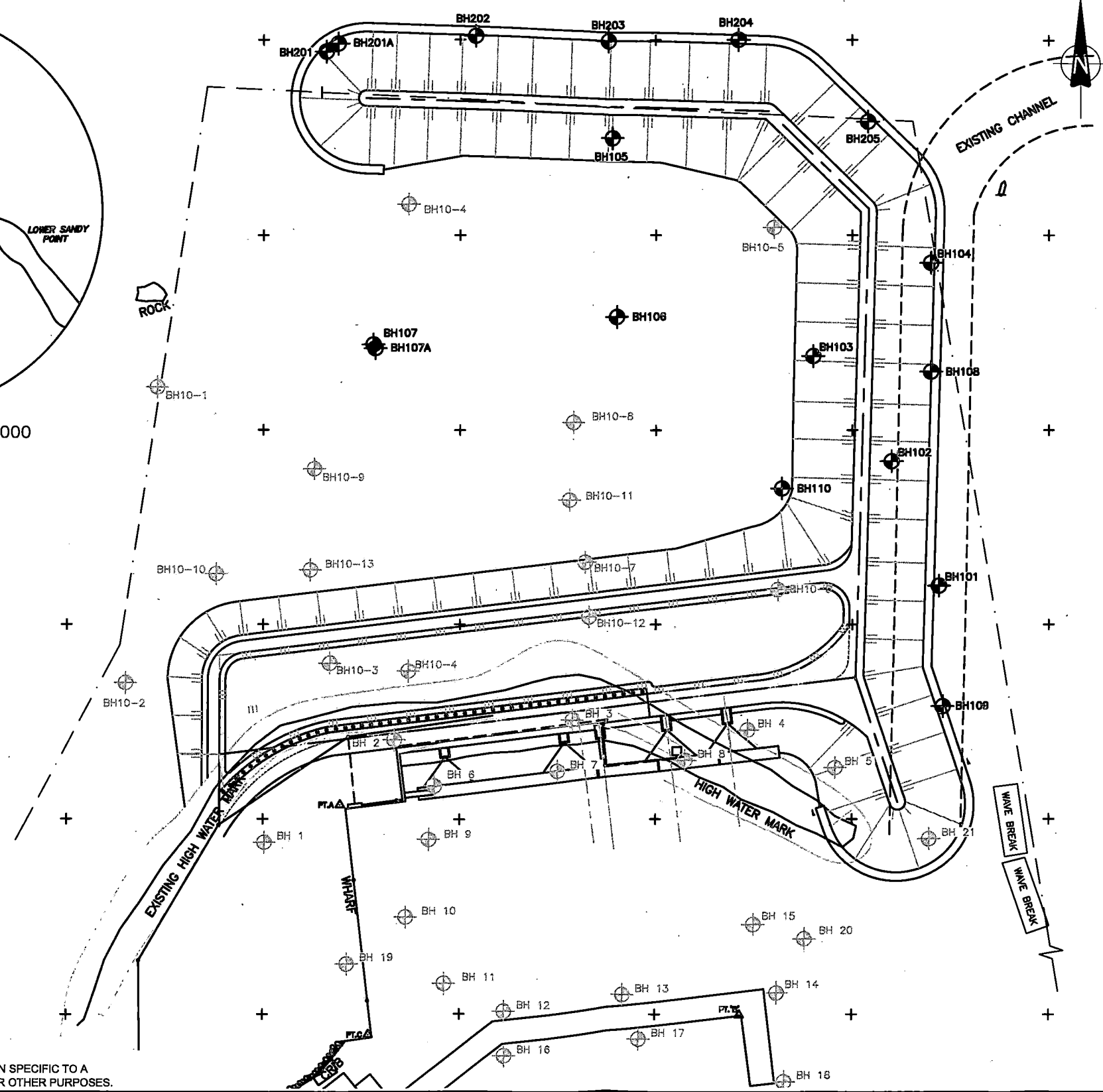
Gravel		Sand		Silt and Clay
Coarse	Fine	Coarse	Fine	

Unified Soil Classification System ASTM D 2487/2488

Curve	BOREHOLE/TEST PIT	SAMPLE	DEPTH (m)	Soil Fractions			Soil Description
				Gravel	Sand	Silt/Clay	
—	BH107	SS6	3.2 - 3.8	21%	45%	34%	Silty sand with gravel: TILL



KEY PLAN 1:50,000



CURRENT BOREHOLE COORDINATE TABLE		
BH101	E 311472	N 4839160
BH102	E 311460	N 4839192
BH103	E 311440	N 4839219
BH104	E 311470	N 4839243
BH105	E 311389	N 4839275
BH106	E 311390	N 4839229
BH107	E 311328	N 4839222
BH107A	E 311329	N 4839221
BH108	E 311470	N 4839215
BH109	E 311473	N 4839129
BH110	E 311432	N 4839185
BH201	E 311316	N 4839297
BH201A	E 311319	N 4839299
BH202	E 311354	N 4839301
BH203	E 311388	N 4839300
BH204	E 311421	N 4839300
BH205	E 311454	N 4839279

UTM NAD83 ZONE 20

**LEGEND**

- BOREHOLE LOCATION (CURRENT 2017 INVESTIGATION)
- TEMPORARY BENCHMARK
- BOREHOLE LOCATION (PREVIOUS INVESTIGATION)

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC LIMITED REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

Reference: REF. DWG. "R.082142.001 C-003" GENERAL ARRANGEMENT POST INFILL" BY STANTEC DATED MAR. 31, 2017.	Job No.: 121620196	Client:  PSPC/SPAC  Site Address GUNNING COVE, SHELburne COUNTY, N.S.	Project:  GUNNING COVE WHARF GEOTECHNICAL INVESTIGATION	Drawing Title:  BOREHOLE LOCATION PLAN	Dwg. No.:  1	
	Scale: 1:1250					
	Date: 2016/04/28					
	Dwn. By: SJT / BSP					
	App'd By: JSM					

T:\1216XXX\121620196 Gunning Cove\121620196-1.dwg PRINTED: May 12, 2017



May 12, 2017

## **APPENDIX B**

**Stantec File No. 6825, Subsurface Investigation, Proposed  
Wharf Extension, Gunning Cove, dated March 7, 1991  
Stantec File No. 121612715, Geotechnical Investigation,  
Gunning Cove, dated January 31, 2011**



---

PUBLIC WORKS CANADA

SUBSURFACE INVESTIGATION  
PROPOSED WHARF EXTENSION  
GUNNING COVE, YARMOUTH CO., NOVA SCOTIA

PROJECT NO. 6825





**Jacques,  
Whitford and  
Associates Limited**

Consulting Engineers  
and Scientists

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B3B 1W8

Tel: 902 468 7777  
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Site Investigations  
Blasting Control  
Materials, Mining  
Hydrogeology  
Earthworks  
Foundations  
Environmental Sciences  
Rock Mechanics

Sydney, N.S.  
Charlottetown, P.E.I.  
Saint John, N.B.  
Fredericton, N.B.  
Bathurst, N.B.  
Moncton, N.B.  
St. John's, Nfld.  
Corner Brook, Nfld.  
Hull, P.Q.  
Ottawa, Ont.

March 7, 1991  
Project No. 6825

Public Works Canada  
PO Box 2247  
16th Floor, 1505 Barrington Street  
Halifax, NS  
B3J 3C9

Attention: Mr. John Stanton

Dear Sir:

RE: GUNNING COVE, YARMOUTH CO., NOVA SCOTIA

Please find enclosed six copies of our subsurface investigation report on this site. We trust the information contained is satisfactory.

If we can be of further assistance, or if you have any queries, we would be pleased to discuss these further with you.

Yours very truly,

JACQUES, WHITFORD & ASSOCIATED LTD

William R. Sutherland, M.Sc., P.Eng.

Enclosure

PROJECT NO. 6825

REPORT TO

PUBLIC WORKS CANADA

ON

SUBSURFACE INVESTIGATION

PROPOSED WHARF EXTENSION

GUNNING COVE, YARMOUTH CO., NOVA SCOTIA

Jacques, Whitford & Associates Limited

March 7, 1991



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## APPENDIX

Symbols and Terms Used on the Borehole Records

Borehole Records

Moisture Content Analysis

Grain Size Analysis

Drawing No. 6825-GC1, Borehole Location Plan



## **1.0 INTRODUCTION**

Jacques, Whitford and Associates Limited, acting at the request of Public Works Canada, has carried out a subsurface investigation for proposed additions and alterations to the public wharf facilities at Gunning Cove, Nova Scotia. The purpose of the investigation was to determine the soil and, where encountered, bedrock conditions at several specified locations.

This report has been prepared specifically and solely for the project which is described above and contains all of our findings.

## **2.0 SITE DESCRIPTION**

Gunning Cove is located approximately 20 km south of the town of Shelburne, in Shelburne County, Nova Scotia. There is an existing wooden wharf at the site, which extends approximately 100 m east from the shore. The general layout is shown on Drawing No. 6825-GC1, obtained from plans submitted to us by Public Works Canada. Planned works include renovating and enlarging the wharf, and placing a breakwater and floating dock to the north. The boreholes were located throughout the site.

## **3.0 INVESTIGATION PROCEDURE**

The field investigation was carried out from January 3rd to 25th, 1991. Twenty-one boreholes were drilled at the locations indicated on Drawing No. 6825-GC1, which is included in the Appendix. Two boreholes were moved from their originally planned locations. Borehole 17 had been located in the middle of the wharf, and was moved 4 m to the south. Borehole 19 had been located near boulders exposed at low tide, and was moved 5 m to the northeast. Some of the boreholes were abandoned short of their full depth due to weather conditions or broken casing. All boreholes were drilled using an Acker II drill positioned on a floating plant, consisting of a wooden barge which was properly equipped with an anchor system.

All drilling was performed with B size casing within the overburden, to depths from 4.9 m to 13.6 m below harbour bottom. Samples were obtained at approximately 1.5 m intervals.



Standard Penetration Tests were carried out where possible, with a 50 mm O.D. split spoon sampler. In softer material, defined by a blow count N of less than 3 blows per 300 mm travel, thin wall samples were taken with a 50 mm I.D. Shelby tube. Bedrock was proven by core drilling in BQ size core barrel. Detailed logs of the soil and bedrock encountered, and the sampling carried out, are given on the Borehole Records in the Appendix. Difficulty was encountered in the advancement of some of the boreholes due to the sea and weather conditions, the presence of boulders and fractured bedrock near the soil/bedrock interface, and twisting of the casing during advancement.

All soil samples recovered were stored in moisture proof, rigid-sidewall containers and returned, with the rock core, to our Halifax laboratory for classification and testing. Samples remaining after testing will be stored until January 1993.

Borehole locations and ground surface elevations were determined by our representative. All elevations given are referred to Chart datum based on the benchmark provided by Public Works Canada located inside the ell of the wharf, as shown on Drawing No. 6825-GC1, and indicated to be elevation 3.17 m (Chart datum).

#### **4.0 SOIL AND BEDROCK PROFILE**

The subsurface conditions encountered at the borehole locations are described in detail on the Borehole Records, and are summarised below. Borehole Records and grain size plots are presented in the Appendix.

##### **4.1 Soil Conditions**

###### **4.1.1 Organic Silt and Sand**

A surficial layer of dark grey organic material ranging from silt with some sand to silty fine sand with trace gravel was encountered in all but Boreholes 1 and 19. The thickness ranged from under 0.2 m in Borehole 16 to 1.0 m in Borehole 2. In Borehole 1, a 0.15 m layer of compact sandy gravel was encountered above the sand and silt layer. A summary of the grain size analyses (minus 35 mm) carried out on this layer follows:



			Percent	Percent	Percent
BH	Sample	Depth (m)	Gravel	Sand	Silt
6	ST-1	0.0 - 0.6	9	68	23
8	ST-1	0.0 - 0.6	3	57	40
13	SS-1	0.0 - 0.6	11	48	40
1	SS-2	0.6 - 1.2	7	42	51
Average:			7	54	39

Hydrometer analysis performed on samples from Boreholes 6 and 8 are incorporated in the grain size plots presented in the Appendix.

The majority of sampling in the silt to silty sand layer was performed with Shelby tubes, with a total of 11 taken. The Shelby tubes were advanced under the weight of the rods, or with a manual or hydraulic push. This indicates a consistency from very soft to firm for the more cohesive silt material. In addition, five Standard Penetration Tests completed wholly within the layer in Boreholes 11 through 15 yielded results of 3, 15, 4, 6, and 8 blows/300 mm, respectively. Generally, the material has a relative density classified from very loose to compact. Two Atterberg Limit analyses were attempted on samples from this layer. These tests indicated the material to be non-plastic.

#### 4.1.2 Sand

Compact to dense sand was encountered directly below the surficial silt layer in Boreholes 13 and 17. The thickness of this layer was in the range of 1.2 m. The sand deposit may be within a former stream bed or could be a fill overlying the peat or grey silt with some peat.



#### 4.1.3 Gravelly Sand

A thick, compact to very dense layer of material was encountered in all boreholes, below the surface organic silt and sand except in Boreholes 13 and 17. In Boreholes 13 and 17, this material underlies the silt and peat at a depth of some 3.0 m and 1.8 m below the surface. This material ranged in composition from silty sand to sandy gravel. The average composition was gravelly sand with some silt. All of the boreholes, with the exception of Borehole 17, were terminated in this layer, at depths from 4.9 m to 8.2 m below harbour bottom. The gradation of the material varied for the samples obtained within each borehole. Generally, the sand fraction remained constant at about 50%. The silt content decreased with depth from about 35% to 5%, while the gravel content increased from about 15% to 45%. Cobbles began to appear at about 2 m to 3 m below harbour bottom, increasing in size and frequency with depth.

Within the layer, there were many stratified pockets of uniform fine sand, uniform coarse sand, well-graded sand, and sand and gravel. Colour varied from light grey to brown to speckled black and white. These sublayers ranged from 2 mm thick to over 300 mm. The Borehole Records do not include each sublayer, but identify approximate transitions from, for examples, a silty sand to a sand, or a sand with some gravel to sand and gravel. A summary of the eight grain size analyses (minus 35 mm) carried out on this layer follows:





			Percent	Percent	Percent
BH	Sample	Depth (m)	Gravel	Sand	Silt
7	SS-2	1.4 - 2.1	15	57	28
3	SS-2	1.5 - 2.1	9	65	26
18	SS-2	1.5 - 2.1	23	44	33
1	SS-4	3.5 - 3.9	37	54	9
18	SS-4	4.6 - 5.2	45	49	6
11	SS-7	4.6 - 5.3	36	58	6
13	SS-8	6.4 - 7.0	43	50	7
Average:			30	54	16

Standard Penetration Test resistances ranged from  $N = 17$  blows/300 mm to values in excess of 100, with refusal of the split spoon encountered at a number of locations. The refusal and high  $N$  values are likely indicative of the presence of gravel, cobble, and boulder size particles. Generally, the material has a relative density classified as dense.

#### 4.1.4 Peat/Silt with Peat

Saturated, odorous, very soft to soft brown silt with peat was encountered in Borehole 13 and a brown organic peat was encountered in Borehole 17, both of which are adjacent to the existing wharf. In Borehole 13, the peat was recovered intact in BQ size core barrel, between cored cobble-sized material. The thickness of the peat was approximately 100 mm. In Borehole 17, the peat was recovered in a split spoon which advanced under the weight of the rods, and indicated a thickness of approximately 1.6 m.



#### 4.1.5 Other Material

An extremely hard, unknown material was encountered in the first attempt at Borehole 13, at an elevation of -5.3 m. Both the B size casing and the BQ size core barrel were refused by the material, and had to be withdrawn together. The final 200 mm of both had deformed and fused together. The borehole was completed at another nearby location. This material may have been scrap steel.

#### 4.2 Bedrock

Medium grey schist bedrock was encountered below surface soils in Borehole 17 only. The top of the bedrock was very severely fractured, becoming more sound with depth. Recovery varied from 63% to 100%. The elevation of the bedrock was -12.8 m, with an overlying soil thickness of 10.1 m. A thickness of 3.5 m of bedrock was cored.

An unconfined compressive strength test performed on a sample of the bedrock indicated a compressive strength of 19.9 MPa.

#### 5.0 SUMMARY

Any soils investigation is a random sampling of a site. The subsurface conditions at borehole locations can rarely be determined beyond question, nor can the continuity of conditions inferred between boreholes be guaranteed. We trust that any design and specifications relying on the information presented will recognise this.

This report was prepared by Brian Walsh, B.Eng. and reviewed by William Sutherland, M.Sc., P.Eng.

Respectfully submitted,

JACQUES, WHITFORD & ASSOCIATED LTD

*J. Brian Walsh*  
J. Brian Walsh, B.Eng.

*William R. Sutherland*  
William R. Sutherland, P.Eng., M.Sc.



## APPENDIX



## SYMBOLS AND TERMS USED ON THE BOREHOLE AND TEST PIT RECORDS

### SOIL DESCRIPTION

Behavioural properties (i.e. plasticity, permeability) take precedence over particle gradation in describing soils.

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 layers of different soil types, e.g. silt and sand or silt and clay
Well Graded	-	having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
Uniformly Graded	-	predominantly of one grain size.

Terminology used for describing soil strata based upon the proportion of individual particle sizes present:

Trace, or occasional	less than 10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. silt and sand)	35-50%

The standard terminology to describe cohesionless soils includes the relative density, as determined by laboratory test or by the Standard Penetration Test 'N' - value: the number of blows of 140 pound (64kg) hammer falling 30 inches (760mm), required to drive a 2 inch (50.8mm) O.D. split spoon sampler one foot (305mm) into the soil.

Relative Density	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by insitu vane tests, penetrometer tests, unconfined compression tests, or occasionally by standard penetration tests.

Consistency	Undrained Shear Strength		'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

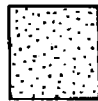


## SYMBOLS AND TERMS CONTINUED

### STRATA PLOT



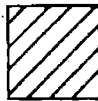
Gravel &  
Boulders



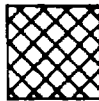
Sand



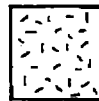
Silt



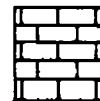
Clay



Fill



Igneous  
Bedrock



Sedimentary  
Bedrock

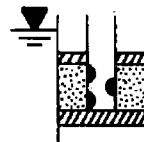


Metamorphic  
Bedrock

### WATER LEVEL MEASUREMENT



Borehole or  
Standpipe



Piezometer

### SAMPLES

SS.... Split spoon sample  
(obtained by performing the  
standard penetration test)

ST.... Shelby tube or thin  
wall tube

PS.... Piston sample

BS.... Bulk sample

WS.... Wash sample

RC.... Rock core

AXT, BXL, etc....

Rock core samples obtained  
with the use of standard  
diamond drilling bits.

### OTHER TESTS

G.... Specific gravity

H.... Hydrometer analysis

S.... Sieve analysis

$\gamma$ .... Unit weight

C.... Consolidation

CD.... Consolidated drained  
triaxial

CU.... Consolidated undrained  
triaxial with pore  
pressure measurements

UU.... Unconsolidated undrained  
triaxial

DS.... Direct shear

P.... Field permeability

### ROCK DESCRIPTION

The description of bedrock is based on the rock quality designation (RQD).

The classification is based on a modified core recovery percentage in which all pieces of sound core over 100mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. In most cases RQD is run on NXL core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from normal insitu fractures.

#### RQD

90-100

75-90

50-75

25-50

0-25

#### ROCK QUALITY

Excellent, intact, very sound

Good, massive, moderately jointed or sound

Fair, blocky and seamy, fractured

Poor, shattered and very seamy or blocky,  
severely fractured

Very poor, crushed, very severely fractured.



## BOREHOLE RECORD

1

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABOREHOLE No. 1DATES: BORING 91/01/24

WATER LEVEL

DATUM CHART

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPa	
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40
0	-0.94	Compact SANDY GRAVEL Compact brown fine SAND and SILT, with occasional gravel					mm				
	-1.09				SS	1	0	1			
1	-2.20	Dense to very dense grey mottled brown gravelly silty SAND			SS	2	535	21	W/S		
2											
3	-3.90	Very dense grey SAND and GRAVEL with trace of silt -frequent cobbles			SS	3	255	106	W		
4											
5	-6.00	Very dense grey GRAVEL with some sand -frequent cobbles and boulders			SS	5	0	50/100mm			
6					BQ	6	50	50/50mm			
					SS	7	50				
					BQ	8	255				
	-7.52	End of Borehole			BQ	9	280				
7											
8											
9											
10											



## BOREHOLE RECORD

2

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABOREHOLE No. 2DATES: BORING 91/01/16 to 91/01/24

WATER LEVEL

DATUM CHART

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPa																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40	60	80	WATER CONTENT & ATTERBERG LIMITS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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**3**

**CLIENT** **PUBLIC WORKS CANADA**

PROJECT No. 6825

**LOCATION** GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIA

BOREHOLE No. 3

**DATES: BORING** 91/01/15

## WATER LEVEL

DATUM            CHART           

[illegible]



## BOREHOLE RECORD

4

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABOREHOLE No. 4DATES: BORING 91/01/12

WATER LEVEL

DATUM CHART

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPa				
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40	60	80	
0	-2.32						mm			WATER CONTENT & ATTERBERG LIMITS DYNAMIC PENETRATION TEST, BLOWS/0.3m * STANDARD PENETRATION TEST, BLOWS/0.3m ●				
	-3.05	Soft black organic SILT and SAND			ST	1	300	pushed	W/A					
1		Compact to very dense dark grey SAND with some silt and gravel												
2			SS	2	500	38								
3			SS	3	100	100/100mm								
4	-6.30	Very dense SAND and GRAVEL -frequent cobbles			BQ	4	75							
5			BQ	5	205									
	-7.96	End of Borehole												
6														
7														
8														
9														
10														



## BOREHOLE RECORD

5

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABOREHOLE No. 5DATES: BORING 91/01/05

WATER LEVEL \_\_\_\_\_

DATUM CHART

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPa			
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40	60	80
0	-2.72	Soft dark grey organic sandy SILT			ST	1	150	mm	wt. rods				
1	-3.40	Compact to dense grey SAND with some gravel and trace silt											
2	-5.00	Very dense grey SAND and GRAVEL -occasional to frequent cobbles and boulders			SS	2	180	49					
3					SS	3	180	129					
4					BQ	4	180						
5					BQ	5	100						
6					BQ	6	610						
7					BQ	7	280						
8	-10.19	End of Borehole											
9													
10													



## BOREHOLE RECORD

6

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABOREHOLE No. 6DATES: BORING 91/01/15

WATER LEVEL \_\_\_\_\_

DATUM CHART

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPa		WATER CONTENT & ATTERBERG LIMITS					
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40	60	80	W <sub>p</sub>	W <sub>L</sub>		
0	-1.96	Dark grey silty fine SAND with occasional cobbles			ST	1	510	mm	wt. rods	W/S H							
	-2.36																
1		Dense to very dense grey SAND with some gravel and minor silt -occasional cobbles															
2											SS	2	380	65			
3											SS	3	355	42			
4	-5.80	Dense to very dense grey to brownish grey SAND and GRAVEL -occasional cobbles and boulders															
5											SS	4	50	51			
6																	
7											BQ	5	125				
											BQ	6	90				
	-9.43	End of Borehole															
8											SS	7	280	101/290mm			
9																	
10																	



## BOREHOLE RECORD

7

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABOREHOLE No. 7DATES: BORING 91/01/14

WATER LEVEL \_\_\_\_\_

DATUM CHART

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPa									
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40	60	80						
0	-2.33						mm			WATER CONTENT & ATTERBERG LIMITS $W_p$ $W$ $W_L$									
	-2.71	Soft grey and black ORGANIC SILT with some sand			ST	1	400	wt. rods			DYNAMIC PENETRATION TEST, BLOWS/0.3m *								
		Dense to very dense grey and brown SAND with some gravel and silt									STANDARD PENETRATION TEST, BLOWS/0.3m •								
1											10	20	30	40	50	60	70	80	90
2					SS	2	380	44	W/S										
3																			
4					SS	3	400	108											108
5																			
6	-7.80	Very dense brownish grey gravelly SAND with minor silt -occasional cobbles			SS	4	610	106	W										106
7																			
8					SS	5	400	93											93
9																			
10	-10.31	End of Borehole			SS	6	510	142											142





## BOREHOLE RECORD

9

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABOREHOLE No. 9DATES: BORING 91/01/16

WATER LEVEL \_\_\_\_\_

DATUM CHART

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPa	
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40
0	-1.97										
	-2.27	Soft dark grey sandy organic SILT			ST	1	280	pushed			
1		Compact to dense brownish grey SAND with some gravel and minor silt -occasional cobbles									
2					SS	2	430	22			
3	-4.60	Very dense grey gravelly SAND -occasional cobbles and boulders			SS	3	50	60/100mm			
4					BQ	4	510				
5	-7.10	Very dense grey sandy GRAVEL with minor silt -occasional cobbles			SS	5	250	144/275mm			
6					BQ	6	280				
7	-8.83	End of Borehole			SS	7	125	130/275mm			
8											
9											
10											



## BOREHOLE RECORD

10

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABOREHOLE No. 10DATES: BORING 91/01/23

WATER LEVEL

DATUM CHART

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPa								
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40	60	80					
0	-1.78						mm			WATER CONTENT & ATTERBERG LIMITS $w_p$ $w$ $w_L$								
	-2.06	Soft black sandy organic silt			SS	1	205	50/125mm		DYNAMIC PENETRATION TEST, BLOWS/0.3m *								
		Dense to very dense medium grey SAND and GRAVEL with minor silt -frequent cobbles -occasional boulders								STANDARD PENETRATION TEST, BLOWS/0.3m ●								
1										10	20	30	40	50	60	70	80	90
2					BQ	2	175											
					SS	3	230	120/250mm										
					BQ	4	355											
3					SS	5	150	60/125mm										
					BQ	6	205											
					BQ	7	350											
4																		
					BQ	8	600											
5	-6.71	End of Borehole																
6																		
7																		
8																		
9																		
10																		







## BOREHOLE RECORD

12

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABOREHOLE No. 12DATES: BORING 91/01/18

WATER LEVEL

DATUM CHART

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPa		WATER CONTENT & ATTERBERG LIMITS	DYNAMIC PENETRATION TEST, BLOWS/0.3m	STANDARD PENETRATION TEST, BLOWS/0.3m	
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40				60
0	-2.72	Compact grey and black silty SAND			SS	1	150	15							
1	-3.50	Dense grey and brown SAND with some gravel and minor silt -occasional cobbles													
2					SS	2	560	40							
3															
4	-6.10	Compact to very dense grey and brown SAND and GRAVEL -frequent cobbles			SS	3	0	59							
5					BQ	4	510								
6					SS	5	280	28							
7															
8	-10.21	End of Borehole			SS	6	50	60/75mm							
9															
10															



## BOREHOLE RECORD

13

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABOREHOLE No. 13DATES: BORING 91/01/17

WATER LEVEL

DATUM CHART

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPa	
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40
0	-3.17	Soft black and grey organic silt with some sand -occasional shells			SS	1	180	4	W/S		
1	-4.10	Dense grey SAND with some gravel and silt -occasional cobbles			SS	2	280	43			
2	-5.30	Started coring at 2.21m, after slow advance casing and core barrel removed.									
3	-5.85	Last 200mm fused together by contact with very hard material, possibly scrap steel. Continued drilling 1.5m East.			BQ	3	430				
4	-6.22	Soft firm brownish grey silt with some peat			SS	4	230	54	W		
5		Compact to very dense grey SAND with some gravel and minor silt			BO	5	100				
6	-8.70	-frequent cobbles			SS	6	175	27			
7		Dense to very dense brownish grey SAND and GRAVEL with minor silt			BQ	7	255				
8	-11.35	-frequent cobbles			SS	8	305	75	W/S		
9		End of Borehole			SS	9	150	46			
10											



## BOREHOLE RECORD

14

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABORHOLE No. 14DATES: BORING 91/01/09

WATER LEVEL \_\_\_\_\_

DATUM CHART

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPa		WATER CONTENT & ATTERBERG LIMITS		DYNAMIC PENETRATION TEST, BLOWS/0.3m	STANDARD PENETRATION TEST, BLOWS/0.3m	
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40	60	80			W <sub>p</sub>
0	-2.67															
	-3.17	Firm black sandy organic SILT -occasional organic debris			SS	1	180	6								
1		Compact to very dense brownish grey gravelly SAND with minor silt														
2					SS	2	200	89								
3					SS	3	380	135								
4	-6.60	Very dense grey GRAVEL with some sand -frequent cobbles			SS	4	75	125/100mm								
5	-7.80	Very dense brownish grey SAND			BQ	5	430									
	-8.61	-well graded			SS	6	330	62								
6		End of Borehole														
7																
8																
9																
10																



## BOREHOLE RECORD

15

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABOREHOLE No. 15DATES: BORING 91/01/09

WATER LEVEL \_\_\_\_\_

DATUM CHART

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPa		WATER CONTENT & ATTERBERG LIMITS	
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40	60	80
0	-3.14						mm						
	-3.66	Soft brown organic SILT with some sand			SS	1	100	8					
1		Compact to very dense grey gravelly SAND -frequent cobbles											
					SS	2	75	75/75mm					
2													
	-5.60	Dense greyish brown SAND -grading fine to coarse to fine											
3					SS	3	200	37					
	-6.90	Dense to very dense gravelly SAND -frequent cobbles											
4					SS	4	0	100/125mm					
5													
	-8.73	End of Borehole											
6													
7													
8													
9													
10													



## BOREHOLE RECORD

16

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABOREHOLE No. 16DATES: BORING 91/01/03

WATER LEVEL \_\_\_\_\_

DATUM CHART

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPa										
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40	60	80							
0	-2.65						mm													
	-2.80	Soft grey brown organic SILT with some sand			SS	1	480	38												
1		Dense grey silty SAND with some gravel and some silt -occasional cobbles																		
	-4.20																			
2		Dense to very dense gravelly SAND -frequent cobbles			BQ	2	60													
3					SS	3	250	40	W											
4	-6.70																			
		Very dense SAND and GRAVEL -frequent cobbles -occasional boulders			BQ	4	230													
5					BQ	5	430													
6	-8.80																			
		End of Borehole																		
7																				
8																				
9																				
10																				



## BOREHOLE RECORD

17

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABOREHOLE No. 17DATES: BORING 91/01/08

WATER LEVEL \_\_\_\_\_

DATUM CHART

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPa	
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40
0	-2.74	Soft black organic SILT and SAND			ST	1	280	mm	wt. rods		
1	-3.35	Compact SAND with some silt and gravel -occasional cobbles									
2	-4.50	Soft brown organic PEAT			SS	2	200		wt. rods		
3	-6.07	Compact to dense grey SAND with trace gravel			SS	3	500	13			
4											
5					SS	4	100	27			
6											
7	-9.40	Dense to very dense grey SAND and GRAVEL -occasional cobbles			SS	5	250	38			
8					SS	6	205	42			
9											
10	12.84				SS	7	330	155/225mm			



## BOREHOLE RECORD

17

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELburne COUNTY, NOVA SCOTIABOREHOLE No. 17DATES: BORING 91/01/08

WATER LEVEL \_\_\_\_\_

DATUM CHART

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPa	
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40
							mm				
10		Severely fractured to fractured medium grey SCHIST -steeply inclined bedding			BQ	8	78%	30			
11	BQ				9	63%	42				
12	BQ				10	89%	61	U.C.T.			
13	BQ				11	100%	66				
-16.30		End of Borehole									
14											
15											
16											
17											
18											
19											
20											



## BOREHOLE RECORD

18

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABOREHOLE No. 18DATES BORING 91/01/04

WATER LEVEL \_\_\_\_\_

DATUM CHART

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - KPA	
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40
0	-3.02	Soft black ORGANIC SILT with some sand Compact to very dense brownish grey SILT and SAND with some gravel -occasional organic debris			SS	1	180	24			
	-2.84										
1	-3.20										
2					SS	2	410	96	W		
3	-0.34	Very dense greyish brown gravelly SAND with minor silt			SS	3	500	53			
	-1.70										
4											
5	-1.36	Very dense greyish brown SAND and GRAVEL -occasional cobbles			SS	4	230	90	W		
	-1.40										
6											
	-3.23	End of Borehole			SS	5	200	131			
	-9.27										
7											
8											
9											
10											





## BOREHOLE RECORD

19

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABOREHOLE No. 19DATES: BORING 91/01/23

WATER LEVEL \_\_\_\_\_

DATUM CHART

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPa		WATER CONTENT & ATTERBERG LIMITS	DYNAMIC PENETRATION TEST, BLOWS/0.3m	STANDARD PENETRATION TEST, BLOWS/0.3m			
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40				60	80	
0	-1.13	Compact to very dense dark brown SAND with some silt and gravel			SS	1	50	21									
1																	
2	-3.40	Dense to very dense brownish grey SAND and GRAVEL			SS	2	400	85									
3																	
4		Very dense grey SAND and GRAVEL -frequent cobbles -occasional boulders			SS	3	100	44									
5	-6.00																
6					BQ	5	405										
7					BQ	6	180										
8		End of Borehole			BQ	7	480										
9																	
10																	



## BOREHOLE RECORD

20

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABOREHOLE No. 20DATES: BORING 91/01/13

WATER LEVEL \_\_\_\_\_

DATUM CHART

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPA	
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40
0	-3.12										
	-3.40	Soft brown organic SILT with some sand			SS	1	180	9			
1		Loose to dense brownish grey SAND with some gravel and silt									
2					SS	2	280	37	W		
	-5.60										
3		Dense to very dense medium grey SAND with some gravel and trace silt -occasional cobbles			BQ	3	180				
4					SS	4	380	46			
5					SS	5	150	62			
	-8.30										
6		Very dense light brownish grey SAND and GRAVEL -frequent cobbles			BQ	6	280				
7											
	-10.38				SS	7	180	120/250mm			
		End of Borehole									
8											
9											
10											



## BOREHOLE RECORD

21

CLIENT PUBLIC WORKS CANADAPROJECT No. 6825LOCATION GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIABOREHOLE No. 21DATES: BORING 91/01/04

WATER LEVEL

DATUM CHART

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES					UNDRAINED SHEAR STRENGTH - kPa		WATER CONTENT & ATTERBERG LIMITS	
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD	OTHER TESTS	20	40	60	80
0	-2.65	Soft black organic sandy SILT			ST	1	150						
1	-3.60	Compact to very dense medium grey SAND with some gravel and silt			ST	2	250						
2					SS	3	280	36					
3					SS	4	280	59	W				
4	-6.30	Very dense SAND and GRAVEL -frequent cobbles -occasional boulders			BQ	5	230						
5					BQ	6	200						
6					BQ	7	180						
7	-9.25	End of Borehole											
8													
9													
10													

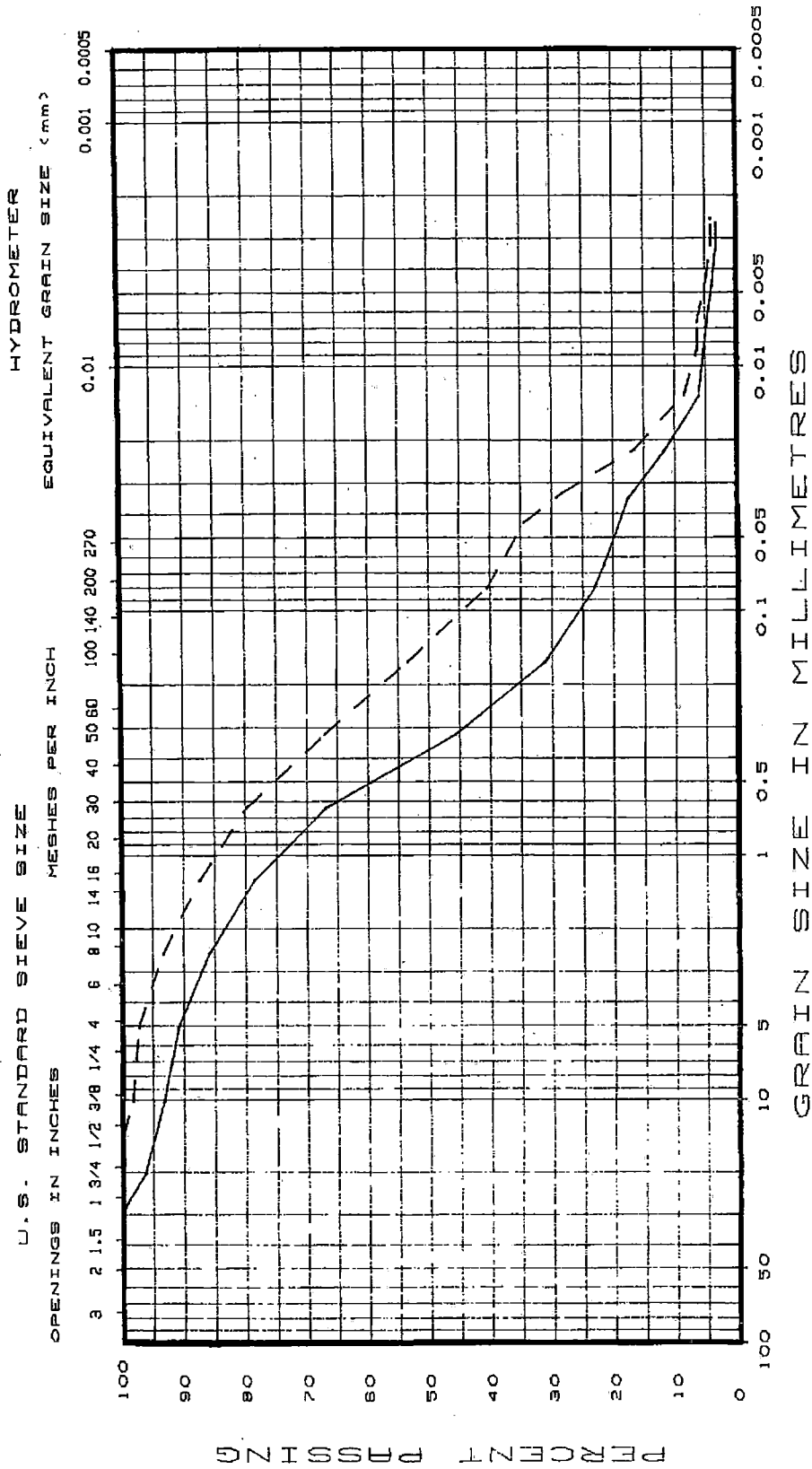


## MOISTURE CONTENT ANALYSIS

The results of moisture content analysis performed on twenty samples are presented below:

		Approximate	Water Content
BH	Sample	Depth (m)	(Percent)
4	ST-1	0.3	84.2
13	SS-1	0.3	75.0
8	ST-1	0.3	60.0
6	ST-1	0.3	35.0
2	ST-1	0.3	32.6
1	SS-2	0.9	23.8
3	SS-2	1.8	17.4
7	SS-2	1.8	16.7
20	SS-2	1.8	11.8
18	SS-2	1.8	10.1
1	SS-3	2.7	9.2
13	SS-4	3.4	11.3
21	SS-4	3.4	10.3
16	SS-3	3.4	8.0
1	SS-4	4.0	10.2
8	SS-5	4.0	8.0
7	SS-4	4.9	13.7
18	SS-4	4.9	9.4
11	SS-7	5.2	10.3
13	SS-8	6.7	10.2



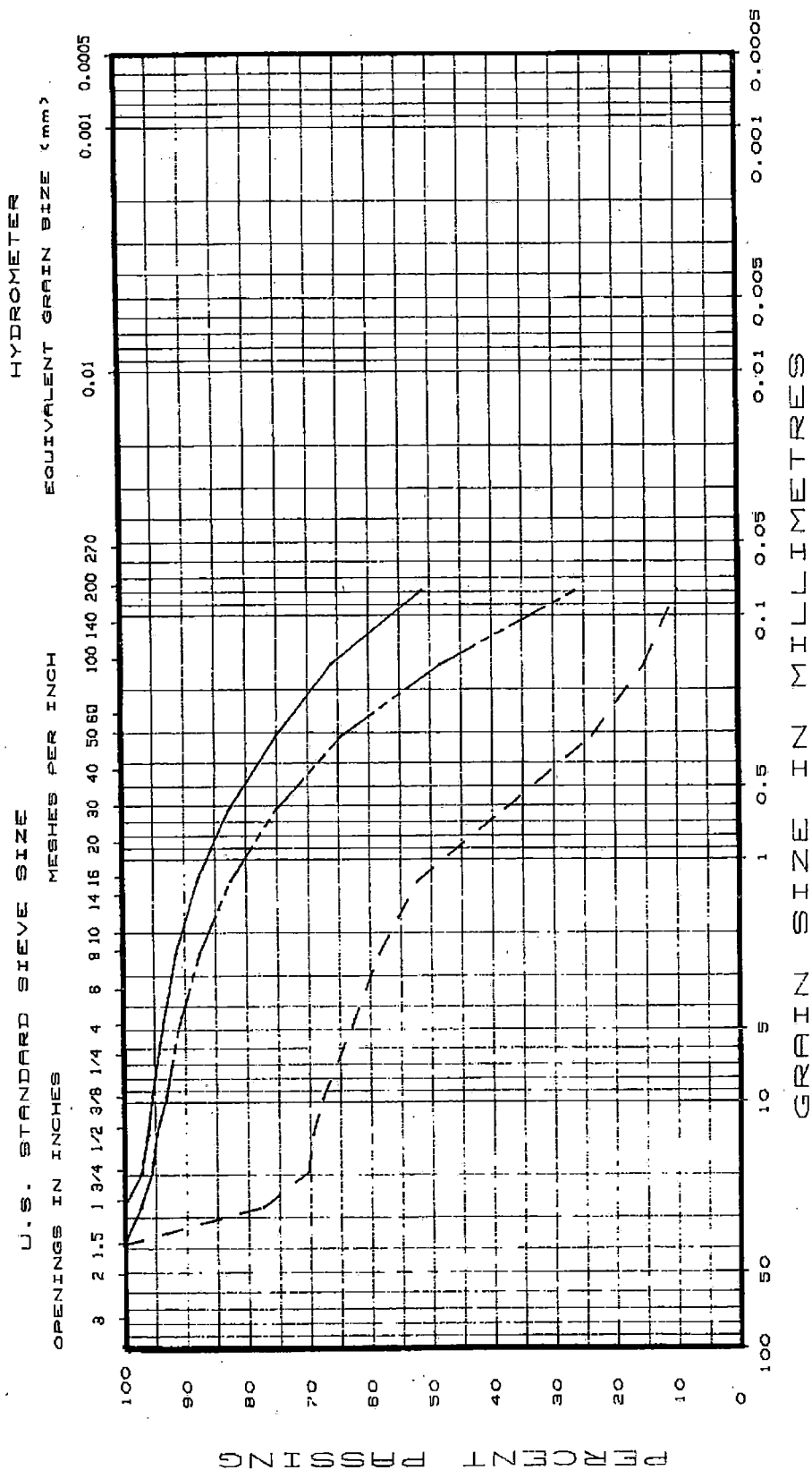


GRAVEL			SAND			SILT & CLAY		
Coarse	Fine		Coarse	Medium	Fine			
Unified Soil Classification								

LOCATION	SAMPLE	DEPTH	DESCRIPTION
BH 6	ST 1	0.0 - 0.6 m	SILTY SAND with trace gravel
BH 8	ST 1	0.0 - 0.6m	SILT AND SAND with trace gravel



FIGURE

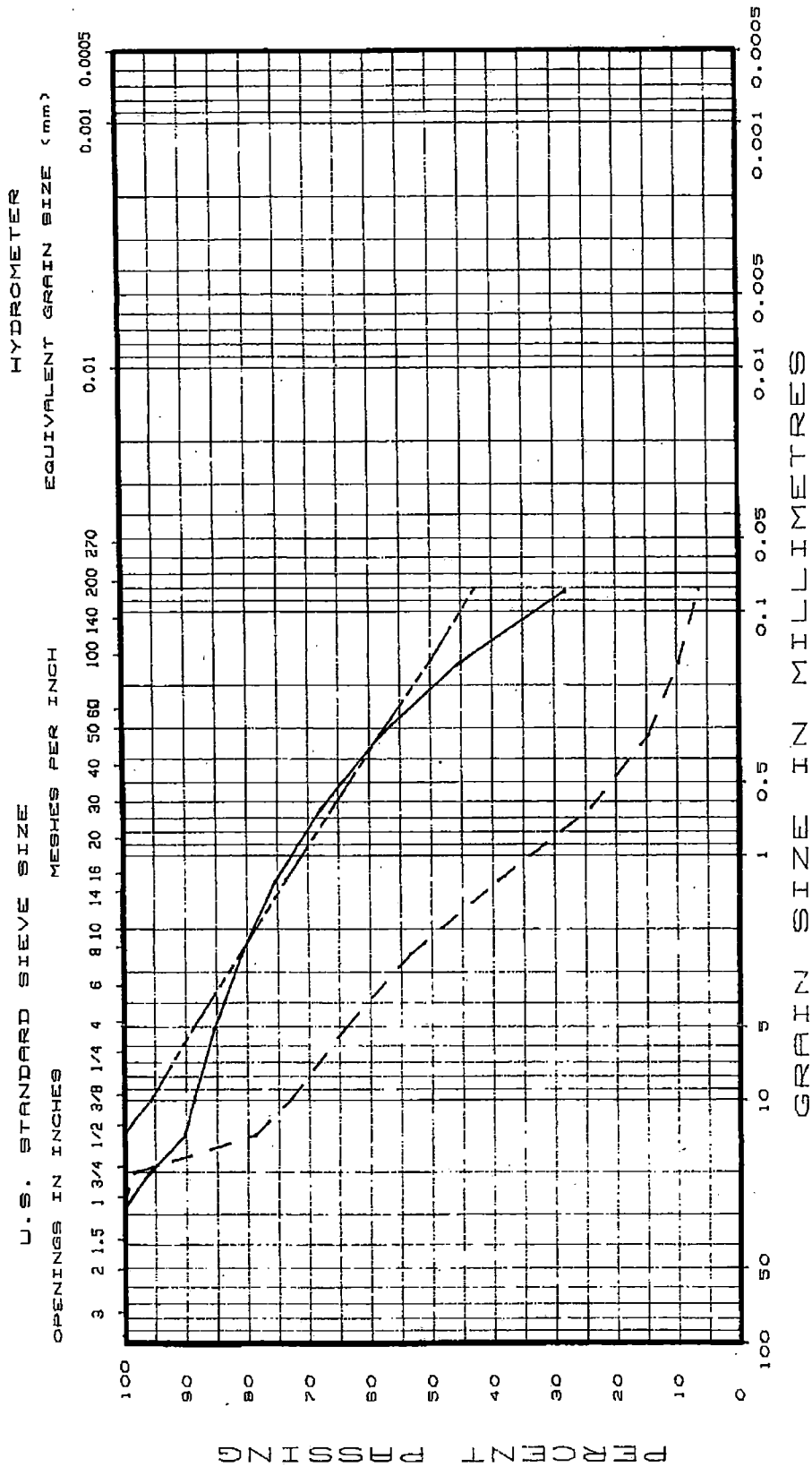


LOCATION	SAMPLE	DEPTH	DESCRIPTION
BH 1	SS-2	0.6 - 1.2M	SAND and SILT with trace gravel
BH 1	SS-4	3.5 - 3.9M	SAND and GRAVEL with trace silt
BH 3	SS-2	1.5 - 2.1M	SILTY SAND with trace gravel

Unified Soil Classification



FIGURE

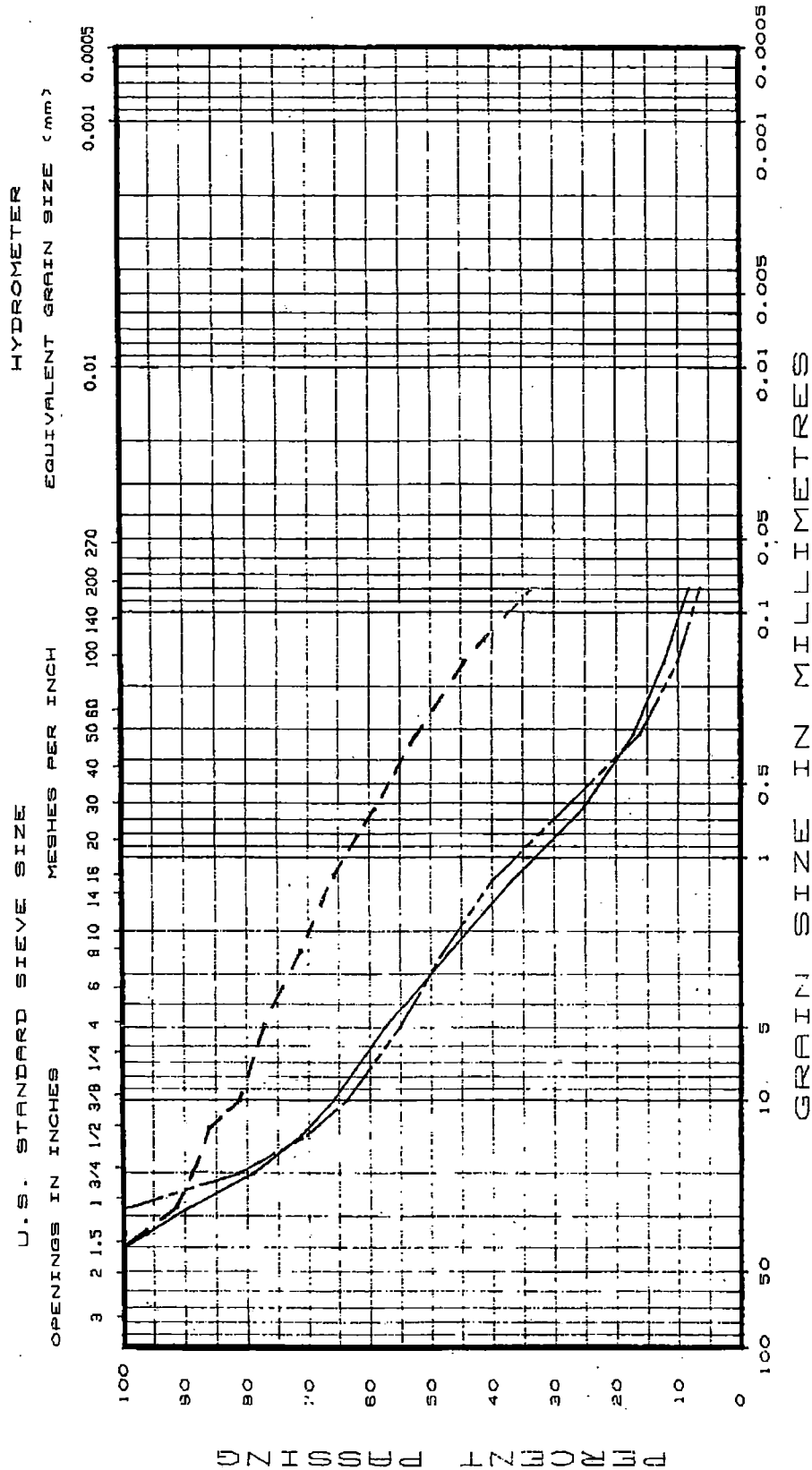


GRAVEL		SAND			SILT & CLAY	
Coarse	Fine	Coarse	Medium	Fine	Unified Soil Classification	

LOCATION	SAMPLE	DEPTH	DESCRIPTION
BH 7	SS-2	1.4 - 2.1M	SILTY SAND with some gravel
BH 11	SS-7	4.9 - 5.3M	SAND and GRAVEL with trace silt
BH 13	SS-1	0.0 - 0.6M	SAND and SILT with some gravel



FIGURE



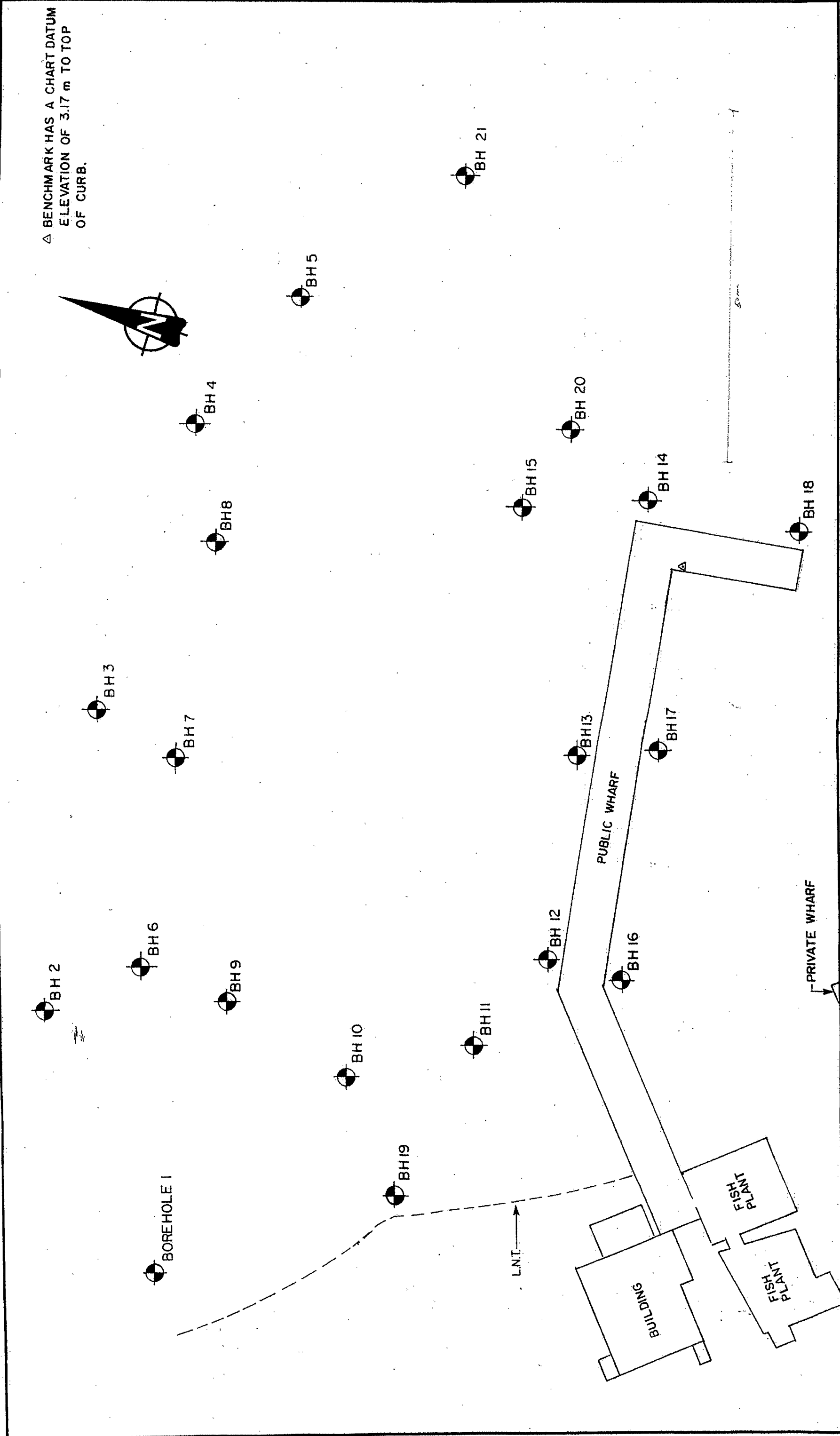
GRAVEL		SAND			SILT & CLAY	
Coarse	Fine	Coarse	Medium	Fine	Unified Soil Classification	


LOCATION	SAMPLE	DEPTH	DESCRIPTION
BH 13	SS-8	6.4 - 7.0M	SAND and GRAVEL with trace silt
BH 18	SS-2	1.5 - 2.1M	GRAVELLY SILTY SAND
BH 18	SS-4	4.6 - 5.2M	SAND and GRAVEL with trace silt



FIGURE





	REFERENCE		PUBLIC WORKS CANADA		BOREHOLE LOCATIONS		DRAWING No.	
			SCALE 1:500		GUNNING COVE		6825-GCI	
		DATE 91 / 02 / 28		SHELburne CO. N.S.				
		DWN. BY G C						
		APP'D BY						



**Stantec**

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## **GEOTECHNICAL INVESTIGATION**

Gunning Cove, Shelburne County,  
Nova Scotia

Report Prepared for:  
PWGSC/TPSGS  
P.O. Box 2247  
1713 Bedford Row  
Halifax NS B3J 3C9

File: Project No. 121612715

January 31, 2011

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## **1.0 Introduction**

---

Stantec Consulting Ltd., acting at the request of Public Works and Government Services Canada (PWGSC), has carried out a geotechnical investigation at the Gunning Cove wharf in Shelburne County, Nova Scotia. The purpose of the investigation was to determine the soil and bedrock conditions at thirteen locations, specified by PWGSC.

The scope of the investigation included drilling thirteen boreholes, selective laboratory testing under the direction of PWGSC, and the preparation of this factual report.

In general accordance with the Terms of Reference provided in the Appendix, this is a factual report presenting all of the findings of the field and laboratory work undertaken for the investigation.

## **2.0 Site Description**

---

Thirteen boreholes were drilled north of an existing breakwater structure located on the north side of the Gunning Cove Wharf in Gunning Cove, Shelburne County, NS. The general layout is presented on Drawing No.1, obtained from plans submitted to Stantec Consulting Ltd. by PWGSC. During low tide, several surficial boulders were observed in the general location of the proposed dredging area.

From previous experience in the area and geological mapping, the principle overburden stratum consists of glacial till comprised of silty sand and gravel overlying gneiss bedrock of the Goldenville Formation.

## **3.0 Investigative Procedure**

---

### **3.1 GENERAL**

The field program was conducted between November 23 and December 4, 2010, and consisted of drilling thirteen boreholes; three breakwater boreholes (BH's 10-4, 10-5, 10-6), three dredging boreholes (BH's 10-1, 10-2, 10-10), and seven pipe pile boreholes (BH's 10-3, 10-7, 10-8, 10-9, 10-11, 10-12, 10-13). It should be noted; BH 10-10 was initially a pipe pile hole and changed to a dredging hole due to the difficulty in drilling a deep borehole at this location because of the presence of large boulders at low tide. An additional pipe pile borehole (BH10-13) was added by PWGSC and is shown on the attached Drawing No.1. All work for the geotechnical investigation

was supervised by experienced Stantec Consulting Ltd. personnel. The locations of the boreholes are presented on Drawing No. 1 in the Appendix.

The boreholes were drilled using a barge mounted drill provided and operated by Boart Longyear Drilling. All boreholes were advanced with NW size casing within the overburden and bedrock was cored with NQ size core. Soil samples were obtained using a 50 mm OD split-spoon sampler and Shelby tubes. Detailed records of the soil and bedrock conditions encountered are presented on the Borehole Records in the Appendix.

### **3.2 LABORATORY TESTING**

Upon completion of the field component of the investigation, the samples obtained from split spoon and Shelby tube sampling were returned to our Dartmouth laboratory in moisture proof, rigid sidewall containers for the selective laboratory testing specified by PWGSC. Laboratory testing performed included grain size analyses, moisture content determinations, Atterberg limits, and unconfined compressive strength tests on samples of the bedrock. The results of the laboratory testing performed are on the Borehole Records and in Appendix A.

### **3.3 SURVEYING**

The borehole locations were determined by PWGSC. The elevation of the boreholes were surveyed by Stantec Consulting Ltd. personnel and are referenced to Chart datum, based on the benchmark supplied by PWGSC located on the top of the existing wharf (BM1). The elevation of the benchmark is 3.93 meters and the location is shown on the attached drawing.

## **4.0 Subsurface Conditions**

---

The subsurface conditions encountered during the geotechnical investigation are described in detail on the appended Borehole Records and are summarized in the following table and sections.

**TABLE 4.1 Summary of Soil and Bedrock Conditions**

Borehole No.	Seafloor Elevation* (m)	SILT with organics Thickness (m)	Cobbles and Boulders Thickness (m)	SAND and GRAVEL Thickness (m)	Glacial TILL Thickness (m)	Bedrock Elevation* (m)
BH10-1 (Dredging)	-1.24	-	1.12	-	>1.98	-
BH10-2 (Dredging)	-0.32	-	1.22	-	>2.41	-
BH10-3 (Pipe Pile)	-1.22	0.23	2.11	1.34	3.03	-7.93
BH10-4 (Breakwater)	-2.85	0.91	-	>3.81	-	-
BH10-5 (Breakwater)	-3.15	1.37	-	4.42	-	-
BH10-6 (Breakwater)	-2.24	2.18	-	3.00	>1.68	-
BH10-7 (Pipe Pile)	-2.04	1.37	-	5.03	-	-8.44
BH10-8 (Pipe Pile)	-2.85	0.89	-	4.60	1.16	-9.50
BH10-9 (Pipe Pile)	-2.04	1.24	-	3.66	1.44	-8.36
BH10-10 (Dredging)	0.20	-	1.71	-	>2.26	-
BH10-11 (Pipe Pile)	-2.26	1.37	-	4.01	-	-7.64
BH10-12 (Pipe Pile)	-1.37	1.63	1.8	4.62	-	-9.42
BH10-13 (Pipe Pile)	-1.36	0.08	-	2.00	5.92	-9.36

\*Elevations are referenced to Chart datum

#### 4.1 SILT

A layer of dark grey to dark brown silt with organics was encountered at the seafloor surface of the majority of the boreholes. The thickness of this layer ranged from 0.08 to 2.18 meters. The average moisture content of the three samples tested was determined to be 98%. Three Atterberg limits were performed on this layer yielding non plastic.

#### 4.2 COBBLES AND BOULDERS

A layer of cobbles and boulders were encountered in five boreholes (BH's 10-1, 10-2, 10-3, 10-10 and 10-12). The thickness of this layer ranged from 1.12 to 1.71 meters.

#### 4.3 SAND AND GRAVEL WITH SILT

An alluvial layer, predominantly consisting of grey sand and gravel with silt, was encountered in the majority of the boreholes, underlying the silt/cobbles and boulders layer. This layer ranged in thickness from 1.34 to 6.42 meters. Occasional to frequent cobbles and boulders were present in this layer. Based on the N-values obtained, the relative compactness of this layer ranged between compact to very dense.

Twelve grain size analyses were performed on samples from this layer which yielded 15 to 68% gravel, 26 to 50% sand and 6 to 36% silt and clay sized particles. The average moisture content from the same samples was found to be 11%.

#### **4.4 GLACIAL TILL**

Glacial till was encountered in eight boreholes, comprised of light brown silty sand with gravel, at depths ranging from 1.2 to 5.5 meters below sea floor. Occasional to frequent cobbles and boulders were present in this layer. The relative compactness of this layer ranged between compact to very dense.

Five grain size analyses were performed on samples from this layer which yielded 26 to 64% gravel, 24 to 44% sand and 12 to 30% silt and clay sized particles. The average moisture content from the same samples was found to be 9%.

#### **4.5 BEDROCK**

Gneiss bedrock was encountered in all seven of the boreholes drilled at the pipe pile locations. Depths of the bedrock ranged between 5.4 to 8.1 meters. The Rock Quality Designation (RQD) of the bedrock ranged from 25% to 100% indicating that the rock is severely fractured to very sound.

Six unconfined strength tests were performed on select rock core samples which are displayed in the following Table 4.2.

**TABLE 4.2 Unconfined Compressive Strength Tests on Bedrock**

<b>Borehole No.</b>	<b>Depth of Sample (m)</b>	<b>Unconfined Compressive Strength (MPa)</b>
BH10-3	5.8	51
BH10-7	6.7	31
BH10-8	7.3	35
BH10-8	8.1	64
BH10-9	7.3	46
BH10-11	6.2	12

## **5.0 Closure**

---

Use of this report is subject to the Statement of General Conditions provided in Appendix A. It is the responsibility of Public Works and Government Services Canada (PWGSC/TPSGS), 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 be not 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
- Planning, design or construction

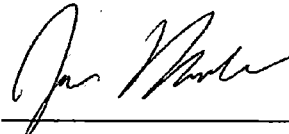
This report was prepared by Lee Fougere, E.I.T. and reviewed by James S. Mitchell, P.Eng. If you have any questions or require any additional information, please do not hesitate to contact the undersigned at your convenience.

Yours very truly,

**STANTEC CONSULTING LTD.**



Lee Fougere, E.I.T.



James S. Mitchell, P.Eng.

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**APPENDIX A**  
**Statement of General Conditions**  
**Symbols and Terms Used on Borehole and Test Pit Records**  
**Borehole Records**  
**Grain Size Analyses**

## 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 subsurface 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.



**Stantec**

## SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

### SOIL DESCRIPTION

#### Terminology describing common soil genesis:

<i>Topsoil</i>	- mixture of soil and humus capable of supporting vegetative growth
<i>Peat</i>	- mixture of visible and invisible fragments of decayed organic matter
<i>Till</i>	- unstratified glacial deposit which may range from clay to boulders
<i>Fill</i>	- material below the surface identified as placed by humans (excluding buried services)

#### Terminology describing soil structure:

<i>Desiccated</i>	- having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
<i>Fissured</i>	- having cracks, and hence a blocky structure
<i>Varved</i>	- composed of regular alternating layers of silt and clay
<i>Stratified</i>	- composed of alternating successions of different soil types, e.g. silt and sand
<i>Layer</i>	- > 75 mm in thickness
<i>Seam</i>	- 2 mm to 75 mm in thickness
<i>Parting</i>	- < 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). The classification excludes particles larger than 76 mm (3 inches). 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 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present:

<i>Trace, or occasional</i>	Less than 10%
<i>Some</i>	10-20%
<i>Frequent</i>	> 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 N-Value (also known as N-Index). A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
<i>Very Loose</i>	<4
<i>Loose</i>	4-10
<i>Compact</i>	10-30
<i>Dense</i>	30-50
<i>Very Dense</i>	>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	Undrained Shear Strength	
	kips/sq.ft.	kPa
<i>Very Soft</i>	<0.25	<12.5
<i>Soft</i>	0.25 - 0.5	12.5 - 25
<i>Firm</i>	0.5 - 1.0	25 - 50
<i>Stiff</i>	1.0 - 2.0	50 - 100
<i>Very Stiff</i>	2.0 - 4.0	100 - 200
<i>Hard</i>	>4.0	>200



## ROCK DESCRIPTION

### Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	<i>Very Poor, Crushed, Very Severely Fractured</i>
25-50	<i>Poor, Shattered and Very Seamy or Blocky, Severely Fractured</i>
50-75	<i>Fair, Blocky and Seamy, Fractured</i>
75-90	<i>Good, Massive, Moderately Jointed or Sound</i>
90-100	<i>Excellent, Intact, Very Sound</i>

Rock quality classification is based on a modified core recovery percentage (RQD) in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. RQD was originally intended to be done on NW core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from *in situ* fractures. The terminology describing rock mass quality based on RQD is subjective and is underlain by the presumption that sound strong rock is of higher engineering value than fractured weak rock.

### Terminology describing rock mass:

Spacing (mm)	Joint Classification	Bedding, Laminations, Bands
> 6000	<i>Extremely Wide</i>	-
2000-6000	<i>Very Wide</i>	<i>Very Thick</i>
600-2000	<i>Wide</i>	<i>Thick</i>
200-600	<i>Moderate</i>	<i>Medium</i>
60-200	<i>Close</i>	<i>Thin</i>
20-60	<i>Very Close</i>	<i>Very Thin</i>
<20	<i>Extremely Close</i>	<i>Laminated</i>
<6	-	<i>Thinly Laminated</i>

### Terminology describing rock strength:

Strength Classification	Unconfined Compressive Strength (MPa)
<i>Extremely Weak</i>	< 1
<i>Very Weak</i>	1 – 5
<i>Weak</i>	5 – 25
<i>Medium Strong</i>	25 – 50
<i>Strong</i>	50 – 100
<i>Very Strong</i>	100 – 250
<i>Extremely Strong</i>	> 250

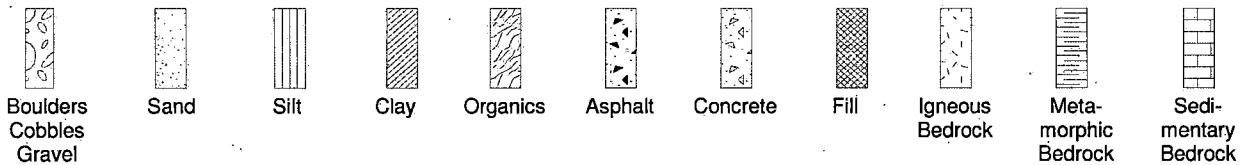
### Terminology describing rock weathering:

Term	Description
<i>Fresh</i>	No visible signs of rock weathering. Slight discolouration along major discontinuities
<i>Slightly Weathered</i>	Discolouration indicates weathering of rock on discontinuity surfaces. All the rock material may be discoloured.
<i>Moderately Weathered</i>	Less than half the rock is decomposed and/or disintegrated into soil.
<i>Highly Weathered</i>	More than half the rock is decomposed and/or disintegrated into soil.
<i>Completely Weathered</i>	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.



## STRATA PLOT

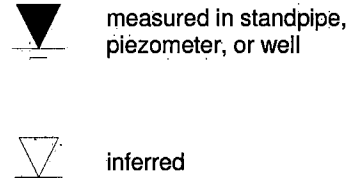
Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



## 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
WS	Wash sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

## WATER LEVEL MEASUREMENT



## 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 (64 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil. 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 value 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 (305 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
y	Unit weight
G <sub>s</sub>	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 <sub>u</sub>	Unconfined compression
I <sub>p</sub>	Point Load Index (I <sub>p</sub> on Borehole Record equals I <sub>p</sub> (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

**BH10-1**

CLIENT PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

PROJECT No. 121612715

LOCATION GUNNING COVE, SHELBURNE COUNTY, NS

BH SIZE      NW

DATE: BORING 2010/11/29

WATER LEVEL

DATUM            CHART           

[illegible]



# BOREHOLE RECORD

**BH10-2**

 CLIENT PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

 PROJECT No. 121612715

 LOCATION GUNNING COVE, SHELBURNE COUNTY, NS

 BH SIZE NW

 DATES: BORING 2010/11/29

WATER LEVEL \_\_\_\_\_

 DATUM CHART

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa	
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40
0	-0.32	COBBLES and BOULDERS			SS	1	50	50/100mm			
1	-1.54	Very dense grey to light brown silty sand with gravel: TILL -frequent cobbles and boulders			SS	2	150	69			
2			SS	3	400	50/50mmS					
3			SS	4	400	40					
4	-3.95		SS	5	500	47					
4		End of Borehole									
5											
6											
7											
8											
9											
10											
11											
12											

WATER CONTENT & ATTERBERG LIMITS:  $W_p$ ,  $W$ ,  $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m: \*

STANDARD PENETRATION TEST, BLOWS/0.3m: •

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

WATER CONTENT & ATTERBERG LIMITS: 10, 20, 30, 40, 50, 60, 70, 80, 90

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# BOREHOLE RECORD

BH10-3

CLIENT PUBLIC WORKS AND GOVERNMENT SERVICES CANADAPROJECT No. 121612715LOCATION GUNNING COVE, SHELBURNE COUNTY, NSBH SIZE NWDATES: BORING 2010/11/23

WATER LEVEL

DATUM CHART

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa									
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20 40 60 80 WATER CONTENT & ATTERBERG LIMITS DYNAMIC PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m 10 20 30 40 50 60 70 80 90									
0	-1.22						mm												
1	-1.45	Soft dark brown SILT with organics			SS	1	150	5	S										
		Dense dark grey GRAVEL with silt and sand -frequent cobbles -trace silt			SS	2	500	44											
2	-2.79	-trace organic decaying odour			SS	3	225	60/125mm											
3		Compact to very dense light brown sand with silt and gravel to gravel with silt and sand: TILL							Qu										
4		-frequent cobbles and boulders			SS	4	100	16											
					SS	5	250	50/25mmS											
5	-5.82	COBBLES and BOULDERS			NQ		625		Qu										
6					NQ		500												
7	-7.93	Severely fractured to very sound grey gneiss: BEDROCK			NQ	6	100%	33%											
8					NQ	7	77%	38%											
9					NQ	8	89%	25%	Qu										
					NQ	9	93%	93%											
10	-10.69	End of Borehole																	
11																			
12																			

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# BOREHOLE RECORD

BH10-4

CLIENT PUBLIC WORKS AND GOVERNMENT SERVICES CANADAPROJECT No. 121612715LOCATION GUNNING COVE, SHELBURNE COUNTY, NSBH SIZE NWDATES: BORING 2010/11/26

WATER LEVEL \_\_\_\_\_

DATUM CHART

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa			
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40	60	80
0	-2.85	Very soft dark grey SILT with organics					mm			WATER CONTENT & ATTERBERG LIMITS DYNAMIC PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m			
1	-3.76				ST	1	0	Push					
1		Dense to very dense dark grey SAND with gravel -frequent cobbles -trace silt -organic decaying odour			SS	2	100	25					
2													
2					SS	3	150	40					
3					SS	4	400	42					
4					SS	5	350	34					
4					SS	6	325	33					
5	-7.57	End of Borehole											
6													
7													
8													
9													
10													
11													
12													

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# BOREHOLE RECORD

**BH10-5**

 CLIENT PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

 PROJECT No. 121612715

 LOCATION GUNNING COVE, SHELBURNE COUNTY, NS

 BH SIZE NW

 DATES: BORING 2010/11/26

WATER LEVEL \_\_\_\_\_

 DATUM CHART

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa		
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40	60
0	-3.15	Very soft dark grey SILT with organics										
1	-4.52			SS	1	50	1					
2		Dense to very dense dark grey SAND with gravel -frequent cobbles -trace silt -organic decaying odour										
3				ST	2	0	Push					
4				SS	3	75	28					
5				SS	4	150	18					
6				SS	5	400	39					
7				SS	6	375	42					
8												
9												
10												
11												
12												
	-8.94	End of Borehole										

WATER CONTENT & ATTERBERG LIMITS:  $W_p$  -  $W$  -  $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m: ★

STANDARD PENETRATION TEST, BLOWS/0.3m: ●

UNDRAINED SHEAR STRENGTH - kPa: 10 20 30 40 50 60 70 80 90

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# BOREHOLE RECORD

BH10-6

CLIENT PUBLIC WORKS AND GOVERNMENT SERVICES CANADAPROJECT No. 121612715LOCATION GUNNING COVE, SHELBURNE COUNTY, NSBH SIZE NWDATES: BORING 2010/11/26

WATER LEVEL

DATUM CHART

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa		
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40	60
0	-2.24	Very soft dark grey SILT with organics					mm					
1					SS	1	50	1				
2					ST	2	350	Push				
2	-4.42	Compact to very dense dark grey SAND with gravel -frequent cobbles -trace silt -organic decaying odour			SS	3	100	3				
3					ST	4	0	Push				
4					SS	5	150	18				
5					SS	6	600	30				
6					SS	7	75	28				
7					SS	8	350	20				
6	-7.42	Compact to dense light brown silty sand with gravel: TILL -frequent cobbles and boulders			SS	9	250	68				
7					SS	10	550	28				
7	-9.10	End of Borehole										
8												
9												
10												
11												
12												

WATER CONTENT & ATTERBERG LIMITS  
DYNAMIC PENETRATION TEST, BLOWS/0.3m  
STANDARD PENETRATION TEST, BLOWS/0.3m

UNDRAINED SHEAR STRENGTH - kPa

10 20 30 40 50 60 70 80 90

W<sub>p</sub> W W<sub>L</sub>



# BOREHOLE RECORD

BH10-7

CLIENT PUBLIC WORKS AND GOVERNMENT SERVICES CANADAPROJECT No. 121612715LOCATION GUNNING COVE, SHELBURNE COUNTY, NSBH SIZE NWDATES: BORING 2010/11/27

WATER LEVEL

DATUM CHART

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa		
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40	60
0	-2.04	Very soft dark brown SILT with organics					mm					
					ST 1	0	Push					
1					SS 2	200	1					
	-3.41	Compact to dense light grey silty SAND with gravel to silty GRAVEL with sand -frequent cobbles -trace silt			ST 3	0	Push					
2					SS 4	250	22					
					SS 5	600	58	S				
3												
					SS 6	250	62					
4					SS 7	225	66					
5					SS 8	200	20	S				
					SS 9	300	19					
6					SS 10	250	81					
	-8.44	Fractured to very sound grey gneiss: BEDROCK			NQ 11	50%	0%					
7					NQ 12	84%	53%	Qu				
					NQ 13	100%	100%					
9	-11.18	End of Borehole										
10												
11												
12												

WATER CONTENT & ATTERBERG LIMITS:  $W_p$ ,  $W$ ,  $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m: \*

STANDARD PENETRATION TEST, BLOWS/0.3m: •

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

WATER CONTENT & ATTERBERG LIMITS: 10, 20, 30, 40, 50, 60, 70, 80, 90

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# BOREHOLE RECORD

BH10-8

CLIENT PUBLIC WORKS AND GOVERNMENT SERVICES CANADAPROJECT No. 121612715LOCATION GUNNING COVE, SHELburne COUNTY, NSBH SIZE NWDATES: BORING 2010/11/28

WATER LEVEL \_\_\_\_\_

DATUM CHART

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa	
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40
0	-2.85	Soft dark grey SILT with organics			SS	1	225	1			
1	-3.74	Compact to dense light grey silty GRAVEL with sand to silty SAND with gravel -frequent cobbles -trace silt			SS	2	0	Push			
					SS	3	150	16			
2					SS	4	50	14			
3					SS	5	250	22	S		
4					SS	6	350	21			
5					SS	7	300	60/75mmS			
6	-8.34	Dense to very dense light brown silty sand with gravel: TILL -frequent cobbles and boulders			SS	8	400	54			
					SS	9	250	23			
7	-9.50	Sound to very sound grey gneiss: BEDROCK			NQ	11	68%	0%	Qu		
8					NQ	12	100%	92%			
9					NQ	13	100%	74%	Qu		
					NQ	14	100%	95%			
10	-12.78	End of Borehole			NQ	15	100%	90%			
11											
12											

WATER CONTENT & ATTERBERG LIMITS  
DYNAMIC PENETRATION TEST, BLOWS/0.3m  
STANDARD PENETRATION TEST, BLOWS/0.3m

UNDRAINED SHEAR STRENGTH - kPa  
20 40 60 80  
W<sub>p</sub> W W<sub>L</sub>

10 20 30 40 50 60 70 80 90

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# BOREHOLE RECORD

BH10-9

CLIENT PUBLIC WORKS AND GOVERNMENT SERVICES CANADAPROJECT No. 121612715LOCATION GUNNING COVE, SHELBURNE COUNTY, NSBH SIZE NWDATES: BORING 2010/12/01

WATER LEVEL \_\_\_\_\_

DATUM CHART

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa									
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20 40 60 80 WATER CONTENT & ATTERBERG LIMITS DYNAMIC PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m 10 20 30 40 50 60 70 80 90									
0	-2.04						mm												
1	-3.26	Soft dark brown SILT with organics			ST	1	500	Push											
2		Compact to very dense light brown to grey SAND with silt and gravel -trace silt -frequent cobbles and boulders			SS	2	300	7											
3					SS	3	150	25											
4					SS	4	200	50/75mm											
5					SS	5	325	34	S										
6					SS	6	450	30											
7	-6.92	Very dense light brown silty sand with gravel: TILL -frequent cobbles and boulders			SS	7	75	36											
8					SS	8	175	50/100mm											
9	-8.36	Severely fractured to very sound grey gneiss: BEDROCK			SS	9	300	50/50mm											
10					NQ	10	75%	0%											
11					NQ	11	92%	33%											
12					NQ	12	80%	67%	Qu										
13					NQ	13	100%	100%											
14	-11.95	End of Borehole																	

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# BOREHOLE RECORD

**BH10-10**

 CLIENT PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

 PROJECT No. 121612715

 LOCATION GUNNING COVE, SHELBURNE COUNTY, NS

 BH SIZE NW

 DATES: BORING 2010/12/01

WATER LEVEL \_\_\_\_\_

 DATUM CHART

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa	
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40
0	0.20	Dense brown SAND with gravel -with frequent coarse sand seams COBBLES and BOULDERS			SS	1	500	34		WATER CONTENT & ATTERBERG LIMITS	
-0.61	SS				2	200	50/50mm	DYNAMIC PENETRATION TEST, BLOWS/0.3m			
1					NQ		725	STANDARD PENETRATION TEST, BLOWS/0.3m			
2	-1.91	Compact to dense light brown silty sand with gravel: TILL -with occasional cobbles and boulders			SS	3	300	50/50mmS		WATER CONTENT & ATTERBERG LIMITS	
3								DYNAMIC PENETRATION TEST, BLOWS/0.3m			
4					SS	4	250	29		STANDARD PENETRATION TEST, BLOWS/0.3m	
4	-4.17				SS	5	300	21		STANDARD PENETRATION TEST, BLOWS/0.3m	
5		End of Borehole								WATER CONTENT & ATTERBERG LIMITS	
6										DYNAMIC PENETRATION TEST, BLOWS/0.3m	
7										STANDARD PENETRATION TEST, BLOWS/0.3m	
8										WATER CONTENT & ATTERBERG LIMITS	
9										DYNAMIC PENETRATION TEST, BLOWS/0.3m	
10										STANDARD PENETRATION TEST, BLOWS/0.3m	
11										WATER CONTENT & ATTERBERG LIMITS	
12										DYNAMIC PENETRATION TEST, BLOWS/0.3m	

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# BOREHOLE RECORD

BH10-11

CLIENT PUBLIC WORKS AND GOVERNMENT SERVICES CANADAPROJECT No. 121612715LOCATION GUNNING COVE, SHELBURNE COUNTY, NSBH SIZE NWDATES: BORING 2010/11/30

WATER LEVEL

DATUM CHART

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa									
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20 40 60 80 Wp W WL WATER CONTENT & ATTERBERG LIMITS DYNAMIC PENETRATION TEST, BLOWS/0.3m. ★ STANDARD PENETRATION TEST, BLOWS/0.3m. ●									
0	-2.26						mm			10	20	30	40	50	60	70	80	90	
1	-3.63	Soft dark brown SILT with organics			SS	1	50	1											
2		Compact to dense grey silty SAND with gravel to GRAVEL with silt and sand -frequent cobbles and boulders -trace silt			ST	2	400	Push											
3			SS	3	125	14	S												
4			SS	4	50	28													
5			SS	5	375	16													
6			SS	6	350	20	S												
7			SS	7	300	36													
8	-7.64	Fractured to very sound grey gneiss: BEDROCK			SS	8	75	50/75mm											
9			NQ	9	90%	33%													
10			NQ	10	73%	55%	Qu												
11			NQ	11	70%	91%													
12	-10.62	End of Borehole			NQ	12	86%	71%											
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# BOREHOLE RECORD

BH10-12

CLIENT PUBLIC WORKS AND GOVERNMENT SERVICES CANADAPROJECT No. 121612715LOCATION GUNNING COVE, SHELBURNE COUNTY, NSBH SIZE NWDATES: BORING 2010/11/30

WATER LEVEL \_\_\_\_\_

DATUM CHART

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa	
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20	40
0	-1.37						mm			WATER CONTENT & ATTERBERG LIMITS DYNAMIC PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m	
1		Soft dark brown SILT with organics			SS	1	200	1			
					ST	2	0				
	-3.00				ST	3	0				
2		Compact light grey silty SAND with gravel -organic decaying odour			SS	4	200	16			
					SS	5	375	24	S		
3											
4					SS	6	325	20			
					SS	7	525	24			
5	-6.22	Compact grey GRAVEL with silt and sand -frequent cobbles and boulders			SS	8	200	29			
					SS	9	375	20	S		
6	-7.62	COBBLES and BOULDERS			SS	10	50	50/50mm			
					NQ		525				
7					NQ		550				
8	-9.42	Sound to very sound grey gneiss: BEDROCK			NQ	11	87%	87%			
9											
10					NQ	12	92%	92%			
11	-12.47	End of Borehole									
12											



# BOREHOLE RECORD

BH10-13

CLIENT PUBLIC WORKS AND GOVERNMENT SERVICES CANADAPROJECT No. 121612715LOCATION GUNNING COVE, SHELburne COUNTY, NSBH SIZE NWDATES: BORING 2010/12/04

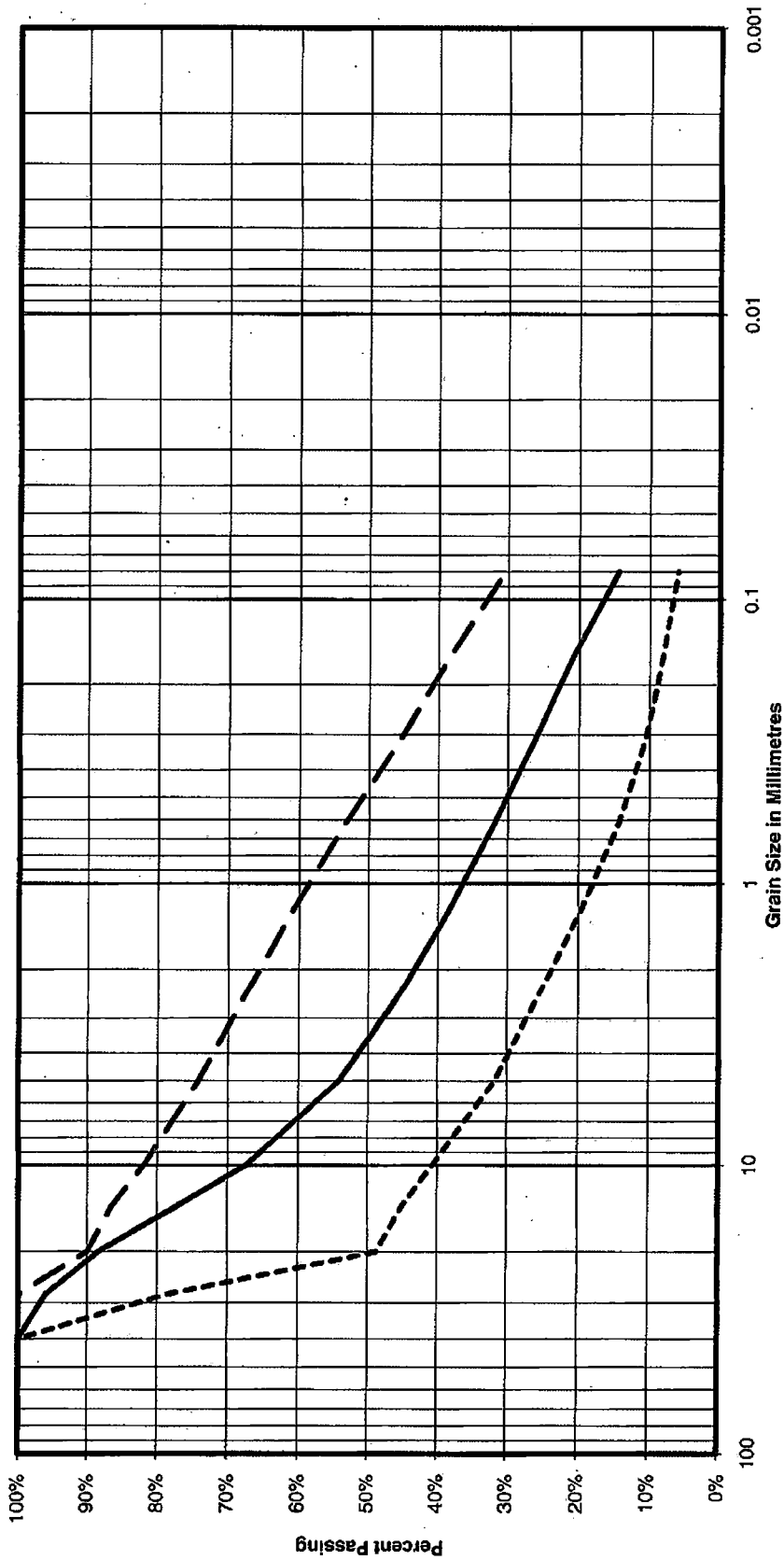
WATER LEVEL \_\_\_\_\_

DATUM CHART

DEPTH(m)	ELEVATION(m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				OTHER TESTS	UNDRAINED SHEAR STRENGTH - kPa									
					TYPE	NUMBER	RECOVERY	N-VALUE OR-RQD %		20 40 60 80 Wp W WL WATER CONTENT & ATTERBERG LIMITS DYNAMIC PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m									
0	-1.36						mm			10	20	30	40	50	60	70	80	90	
0.5	-1.44	Soft dark brown SILT with organics			SS	1	375	7											
1		Compact light brown silty SAND with gravel			SS	2	225	15	S										
2	-3.44				SS	3	600	25											
3		Compact to very dense light brown silty sand with gravel: TILL			SS	4	125	23											
3.5		-frequent cobbles and boulders			SS	5	175	45	S										
4		-with occasional coarse sand seams			NQ		500												
4.5					SS	6	75	50/75mm											
6.5					SS	7	100	50/25mmS											
7					NQ		350												
8	-9.36	Sound to very sound grey gneiss: BEDROCK			NQ	8	100%	65%											
9					NQ	9	100%	73%											
10	-11.56				NQ	10	100%	88%											
10.5		End of Borehole																	
11																			
12																			

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Approved: *LS*



Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

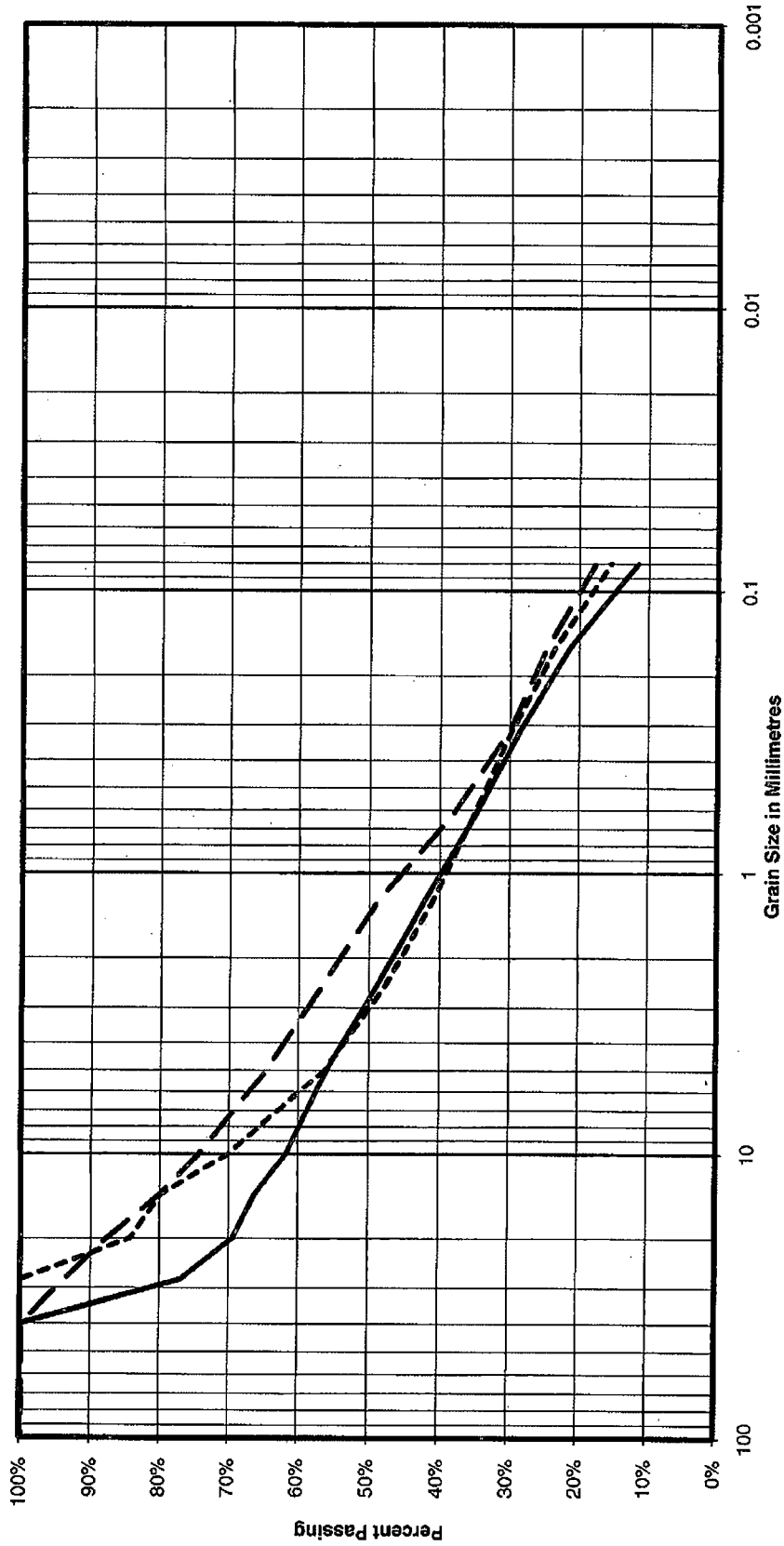
Unified Soil Classification System ASTM D 2487/2488

Curve	BOREHOLE/TESTPIT	SAMPLE	DEPTH (m)	Soil Fractions			Soil Description
				Gravel	Sand	Silt/Clay	
—	BH 1	Sa 2	1.1 to 7.2	46%	40%	14%	silty GRAVEL with sand
- - -	BH 2	Sa 3	1.8 to 2.3	26%	44%	30%	silty SAND with gravel
- - - -	BH 3	Sa 2	0.6 to 1.2	68%	26%	6%	GRAVEL with silt and sand



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Approved: *CA*



Gravel		Sand			Silt and Clay	
Coarse	Fine	Coarse	Medium	Fine		

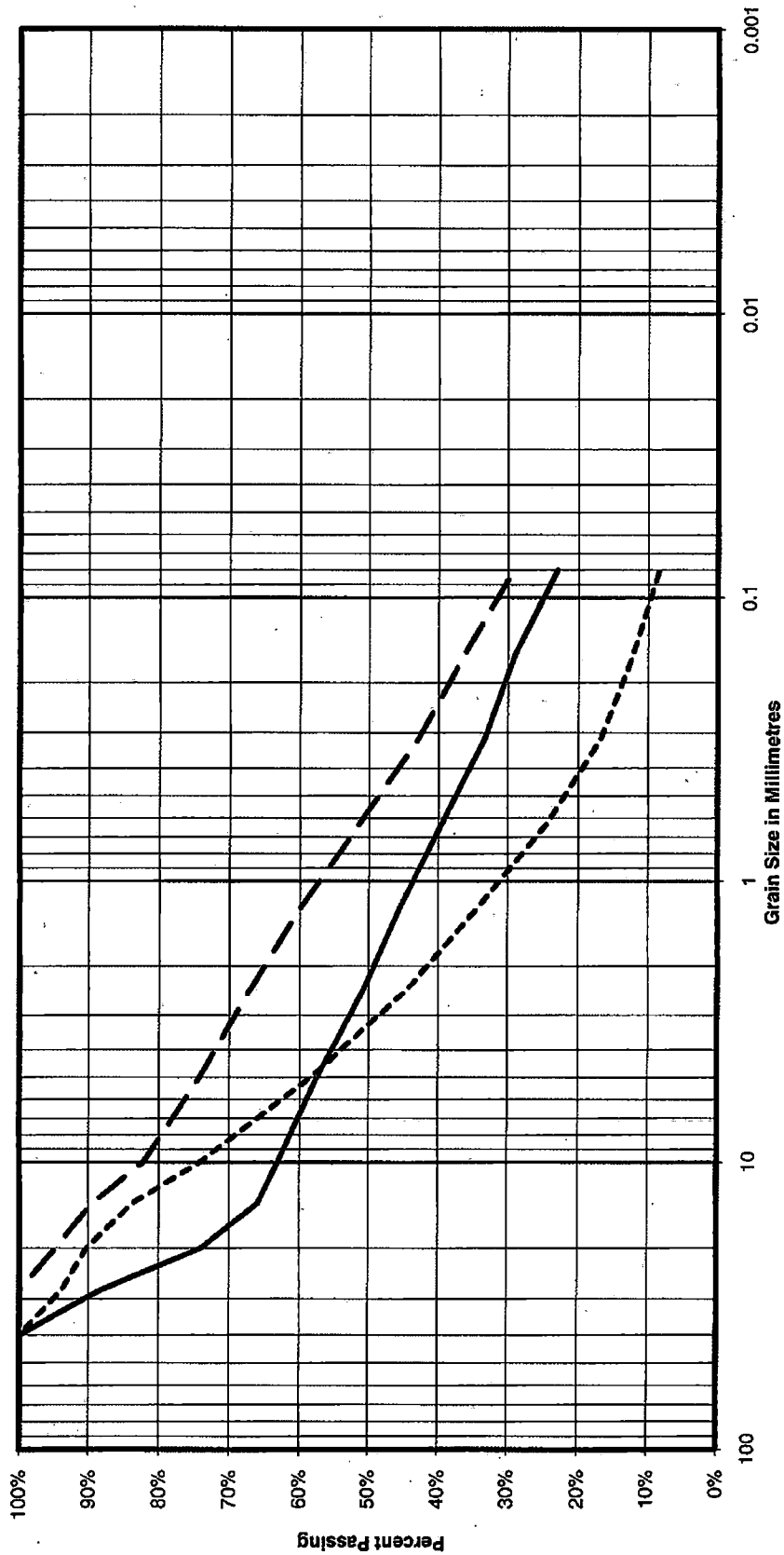
Unified Soil Classification System ASTM D 2487/2488

Curve	BOREHOLE/TEST PIT	SAMPLE	DEPTH (m)	Soil Fractions			Soil Description
				Gravel	Sand	Silt/Clay	
—	BH 3	Sa 5	3.8 to 4.3	44%	44%	12%	SAND with silt and gravel
- - -	BH 7	Sa 5	2.3 to 2.9	35%	47%	18%	silty SAND with gravel
- - - -	BH 7	Sa 8	4.6 to 5.2	44%	41%	15%	silty GRAVEL with sand



Stantec

Approved: *Car*



Gravel		Sand			Silt and Clay	
Coarse	Fine	Coarse	Medium	Fine		

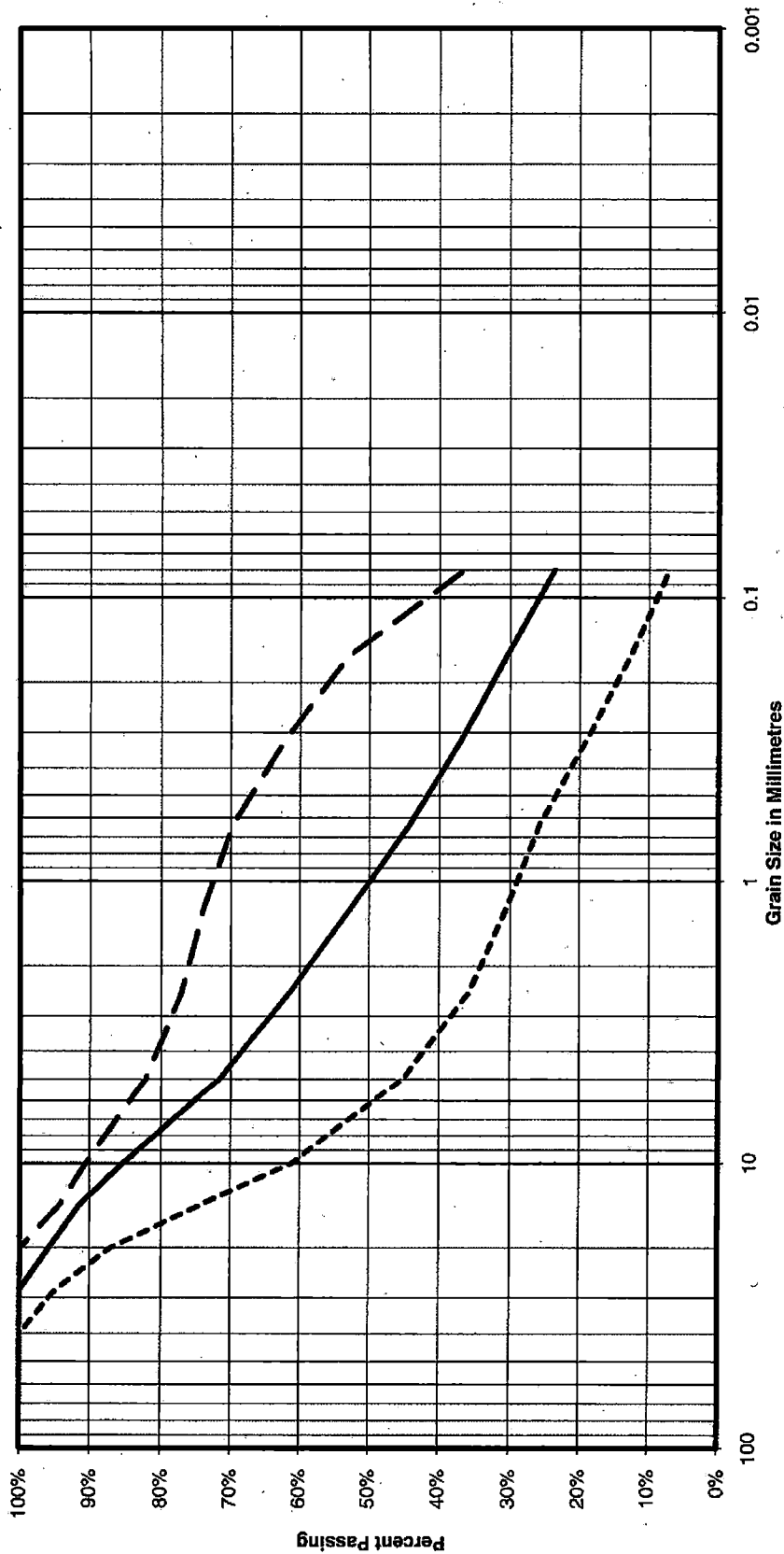
Unified Soil Classification System ASTM D 2487/2488

Curve	BOREHOLE/TEST PT	SAMPLE	DEPTH (m)	Soil Fractions			Soil Description
				Gravel	Sand	Silt/Clay	
---	BH 8	Sa 7	4.1 to 4.5	42%	35%	23%	silty GRAVEL with sand
- - -	BH 8	Sa 5	2.6 to 3.2	26%	45%	29%	silty SAND with gravel
- - - -	BH 9	Sa 5	2.9 to 3.5	42%	50%	8%	SAND with silt and gravel



Stantec

Approved: *Cent*



Gravel		Sand			Silt and Clay	
Coarse	Fine	Coarse	Medium	Fine		

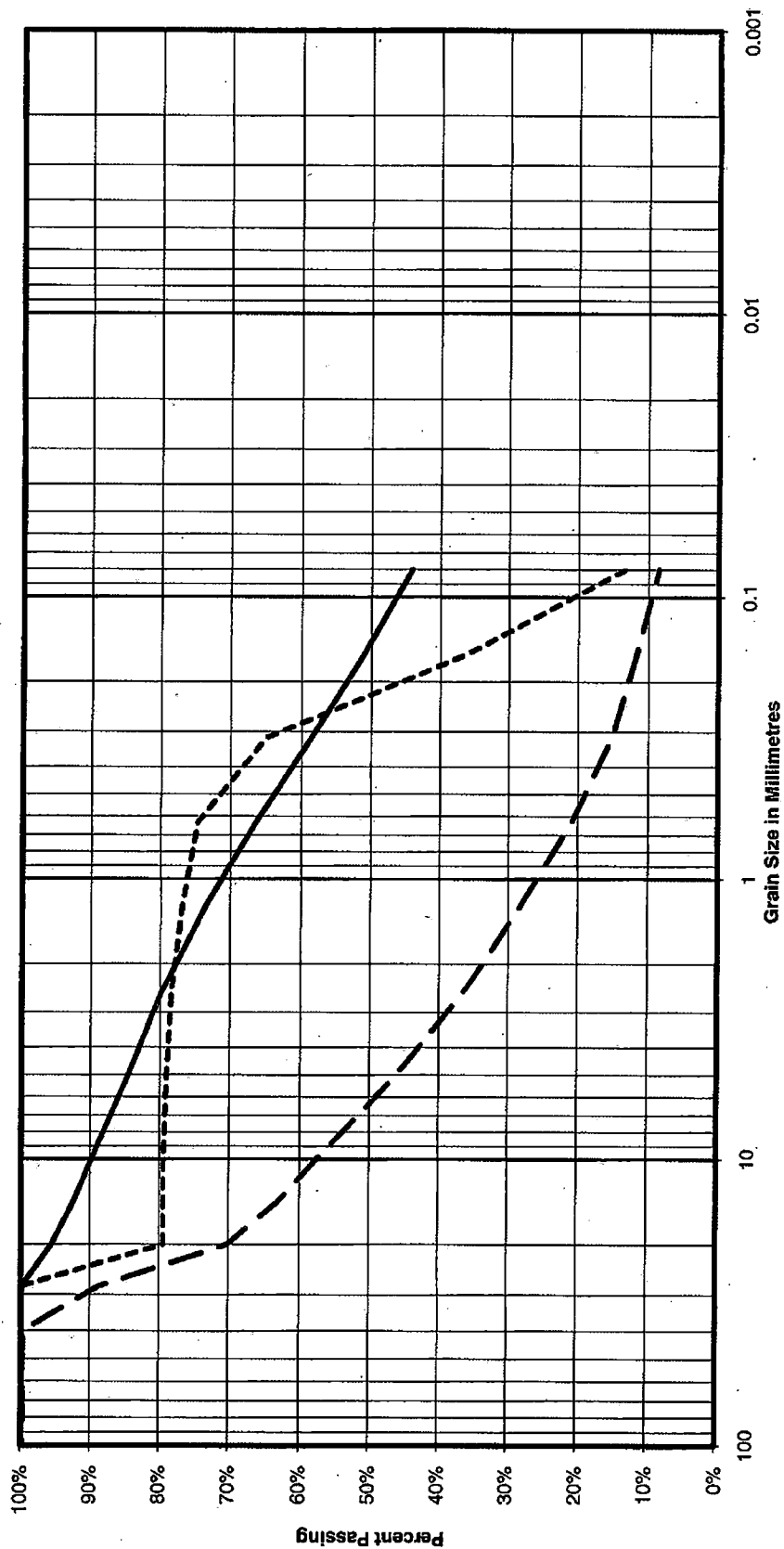
Unified Soil Classification System ASTM D 2487/2488

Curve	BOREHOLE/TEST PIT	SAMPLE	DEPTH (m)	Soil Fractions			Soil Description
				Gravel	Sand	Silt/Clay	
—	BH 10	Sa 3	2.1 to 2.5	28%	48%	24%	silty SAND with gravel
- - -	BH 11	Sa 3	1.8 to 2.4	18%	46%	36%	silty SAND with gravel
- - - -	BH 11	Sa 6	3.9 to 4.5	55%	38%	7%	GRAVEL with silt and sand



Stantec

Approved: *Car*



Gravel		Sand		Silt and Clay	
Coarse	Fine	Coarse	Fine		

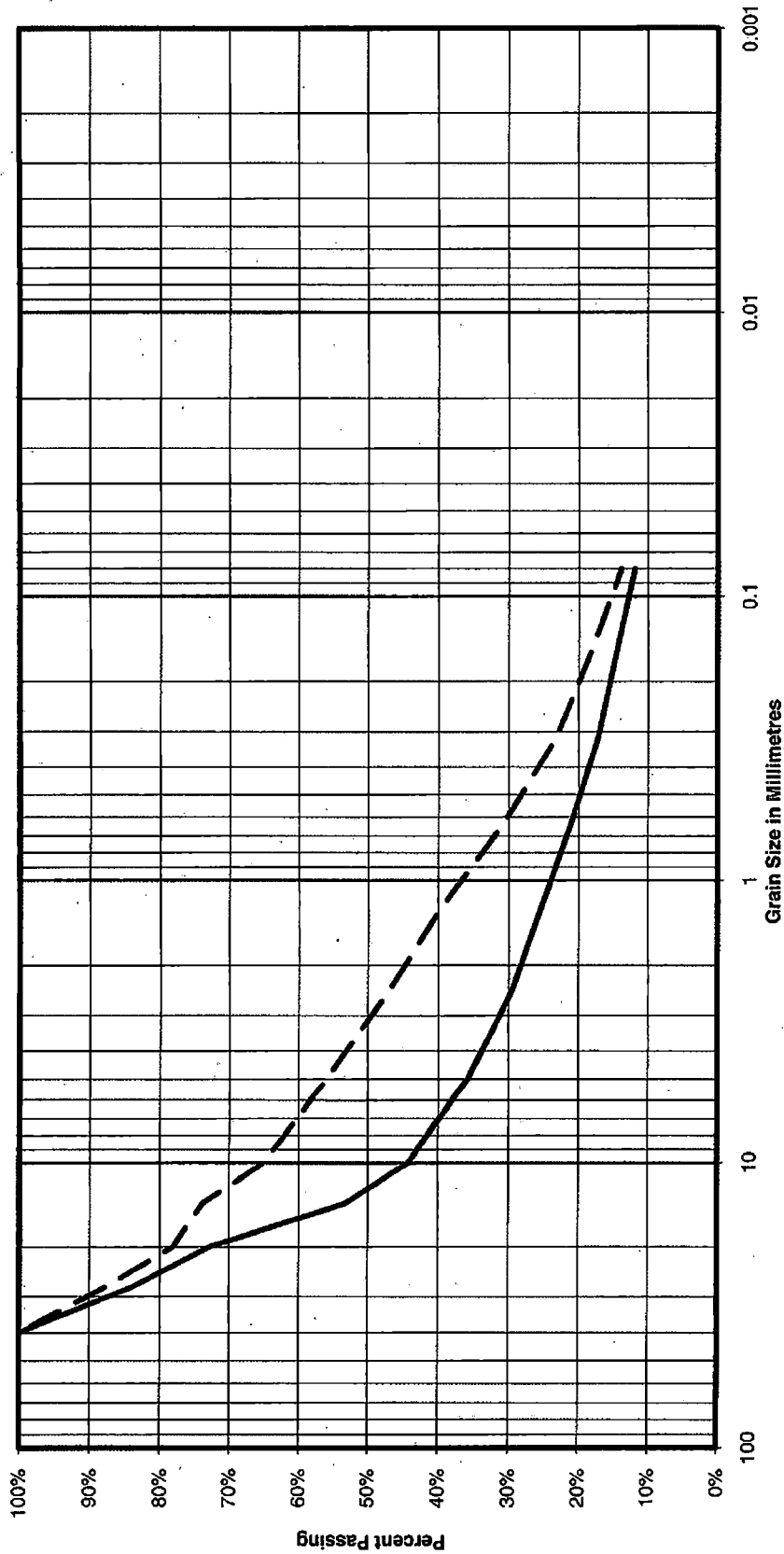
Unified Soil Classification System ASTM D 2487/2488

Curve	BOREHOLE/TESTPIT	SAMPLE	DEPTH (m)	Soil Fractions			Soil Description
---	BH 12	Sa 5	2.2 to 2.8	Gravel	Sand	Silt/Clay	silty SAND with gravel
---	BH 12	Sa 9	5.5 to 6.1	15%	40%	44%	
---	BH 13	Sa 2	0.9 to 1.5	54%	38%	9%	GRAVEL with silt and sand
---				21%	66%	13%	silty SAND with gravel



Stantec

Approved: *Est*



Gravel		Sand			Silt and Clay	
Coarse	Fine	Coarse	Medium	Fine		

Unified Soil Classification System ASTM D 2487/2488

Curve	BOREHOLE/TEST PIT	SAMPLE	DEPTH (m)	Soil Fractions			Soil Description
				Gravel	Sand	Silt/Clay	
—	BH 13	Sa 5	2.8 to 3.4	64%	24%	12%	GRAVEL with silt and sand
- - -	BH 13	Sa 7	6.2 to 6.5	44%	42%	14%	silty GRAVEL with sand



**Stantec**

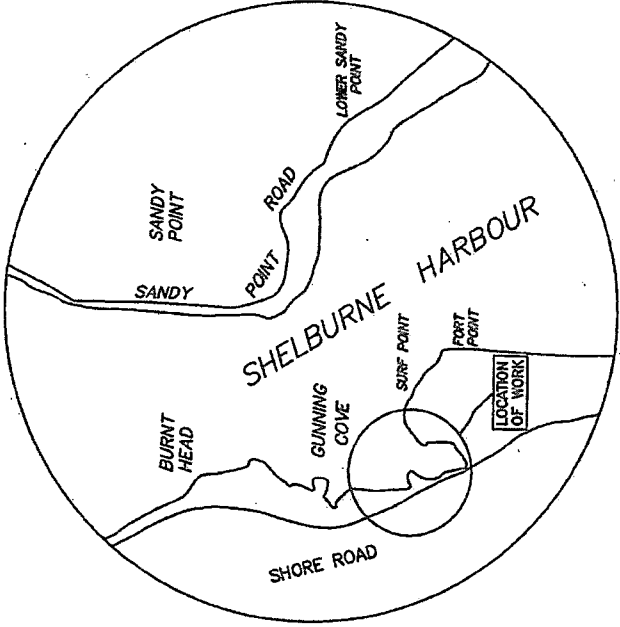


**Stantec**

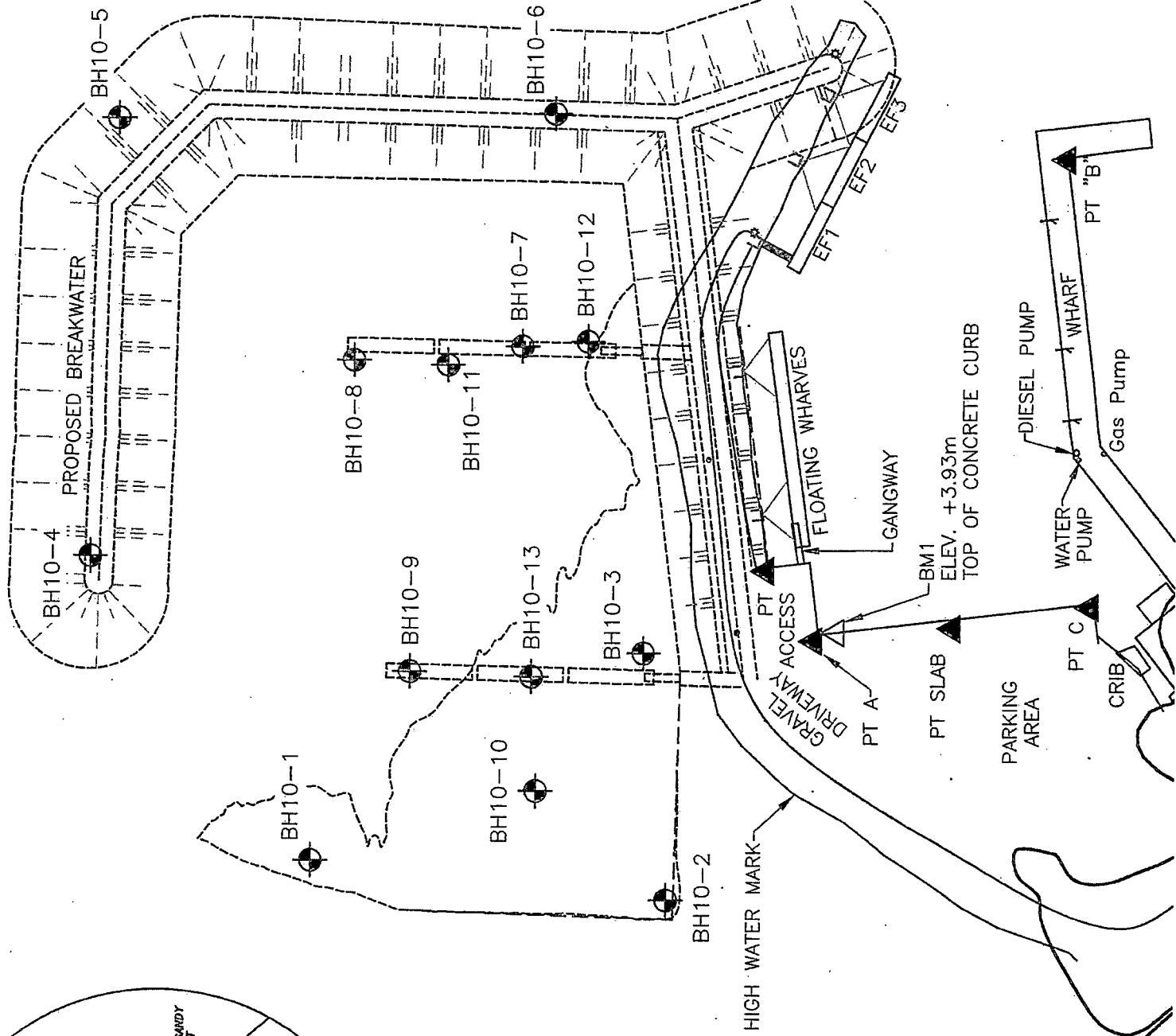
**GEOTECHNICAL INVESTIGATION, GUNNING COVE, SHELBURNE COUNTY, NOVA SCOTIA**

**APPENDIX B**

**Drawing No. 1, Borehole Location Plan  
Pictures of Rock Core Samples  
Terms of Reference**



KEY PLAN  
1:50,000



ACTUAL BOREHOLE COORDINATES			
MARK	EASTING	NORTHING	
B.H.10-1	E 311 273	N 4 839 211	
B.H.10-2	E 311 265	N 4 839 135	
B.H.10-3	E 311 317	N 4 839 140	
B.H.10-4	E 311 337	N 4 839 258	
B.H.10-5	E 311 430	N 4 839 252	
B.H.10-6	E 311 431	N 4 839 159	
B.H.10-7	E 311 382	N 4 839 166	
B.H.10-8	E 311 379	N 4 839 202	
B.H.10-9	E 311 313	N 4 839 190	
B.H.10-10	E 311 288	N 4 839 163	
B.H.10-11	E 311 378	N 4 839 182	
B.H.10-12	E 311 312	N 4 839 164	

LEGEND

ACTUAL BOREHOLE LOCATION

TEMPORARY BENCHMARK

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC LIMITED REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

Reference:  
REF. DWG. "SHT.1  
GEOTECHNICAL INVESTIGATION"  
PROVIDED BY PWGSC ON  
12/14/10.

Job No.:	121612715
Scale:	1:1,250
Date:	2011/01/31
Dwn. By:	SJT
App'd By:	

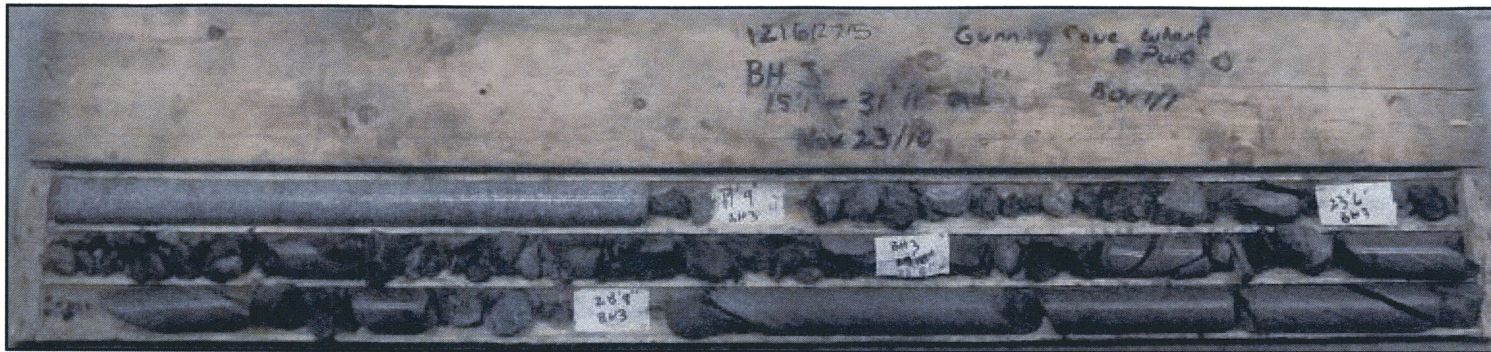
Client:	PWGSC/TPSGC
Site Address:	GUNNING COVE, SHELburne COUNTY, N.S.

Project:  
GEOTECHNICAL  
INVESTIGATION

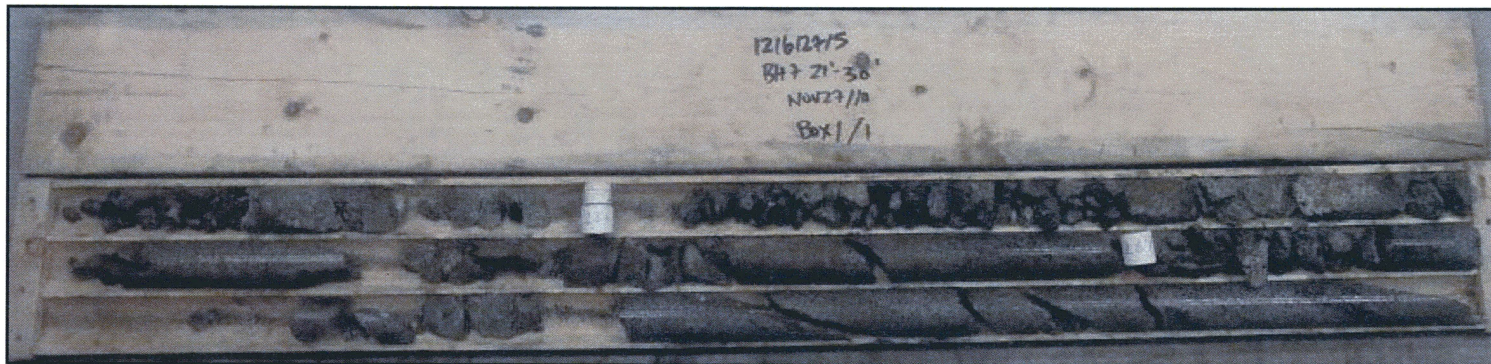
Drawing Title:  
BOREHOLE LOCATION PLAN

Dwg. No.:  
1





**BOREHOLE 10-3**

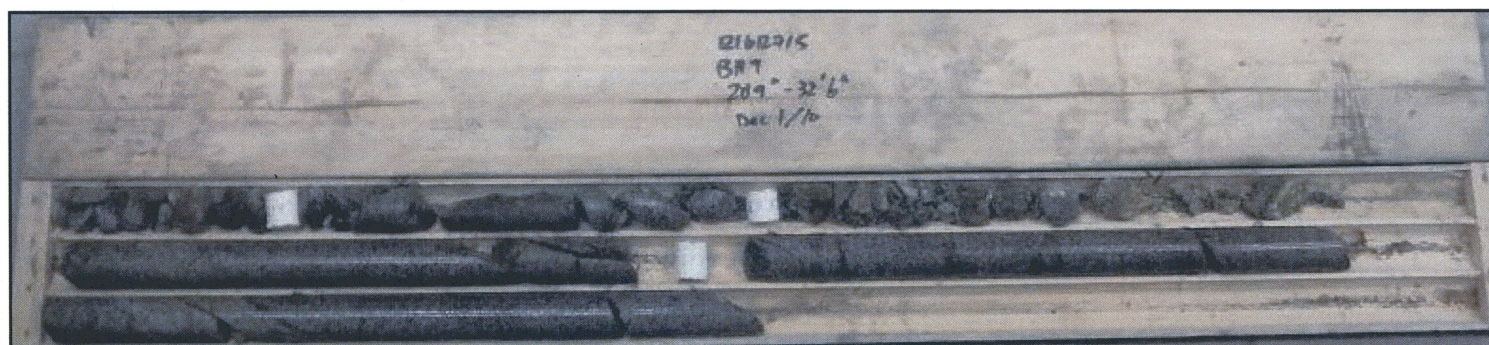


**BOREHOLE 10-7**





**BOREHOLE 10-8**

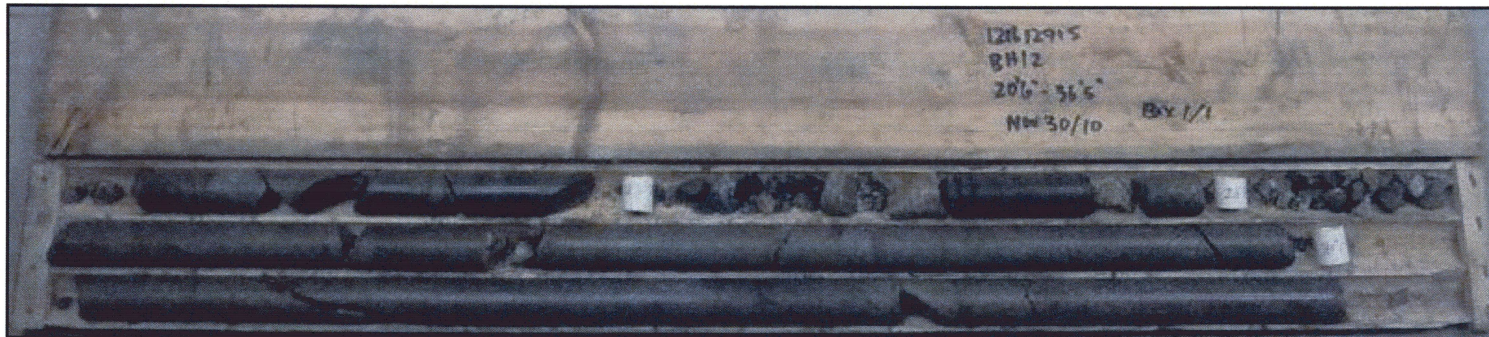


**BOREHOLE 10-9**

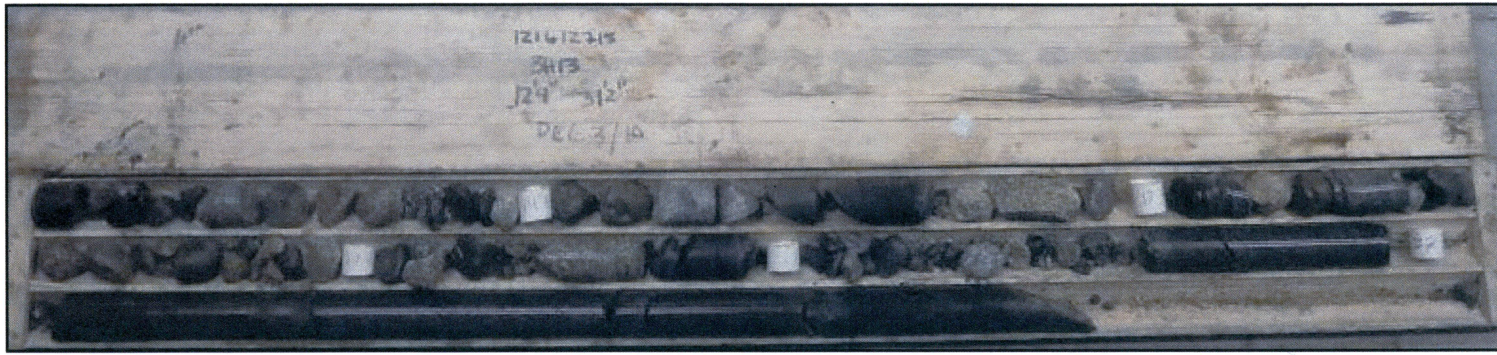




**BOREHOLE 10-11**



**BOREHOLE 10-12**



**BOREHOLE 10-13**



**Purchasing Office - Bureau des achats:**

Real Property Contracting  
1713 Bedford Row  
P.O. Box 2247/C.P.2247  
Halifax, N.S./Halifax, (N.E.)  
B3J 3C9  
Halifax

**CONTRACT - CONTRAT**

**Comments - Commentaires**

**Vendor/Firm Name and Address**

**Raison sociale et adresse du  
fournisseur/de l'entrepreneur**

887251288PG0039  
Stantec Consulting Ltd.  
102-40 Highfield Park Dr  
Dartmouth  
Nova Scotia  
B3A0A3  
Canada

<b>Title - Sujet</b> GEOTECHNICAL INVESTIGATION	
<b>Contract No. - N° du contrat</b> E0225-111874/001/PWA	<b>Date</b> 2010-11-08
<b>Client Reference No. - N° de référence du client</b> E0225-11-1874	
<b>Requisition No. - N° de la demande</b> E0225-111874	
<b>File No. - N° de dossier</b> PWA-0-60104	<b>CCC No./N° CCC - FMS No./N° VME</b>
<b>Financial Code(s)</b> <b>Code(s) financier(s)</b> 1272A561905000906411506000QE8R	
<b>GST/HST TPS/TVH</b> <input type="checkbox"/>	
<b>F.O.B. - F.A.B.</b> Destination	
<b>GST/HST - TPS/TVH</b> See Herein - Voir ci-inclus	<b>Duty - Droits</b>
<b>Destination - of Goods, Services, and Construction:</b> <b>Destination - des biens, services et construction:</b> DEPARTMENT OF PUBLIC WORKS AND GOVERNMENT SERVICES CANADA SEE HEREIN Canada	
<b>Invoices - Original and two copies to be sent to:</b> <b>Factures - Envoyer l'original et deux copies à:</b> DEPARTMENT OF PUBLIC WORKS AND GOVERNMENT SERVICES CANADA 1713 BEDFORD ROW P.O.BOX 2247 HALIFAX Nova Scotia B3J3C9 Canada	
<b>Address Enquiries to: - Adresser toutes questions à:</b> Chinye, Chukwudi	<b>Buyer Id - Id de l'acheteur</b> pwa122
<b>Telephone No. - N° de téléphone</b> (902) 496-5476 ( )	<b>FAX No. - N° de FAX</b> (902) 496-5016
<b>Total Estimated Cost - Coût total estimatif</b> \$74,462.50	<b>Currency Type - Devise</b> CAD
<b>For the Minister - Pour le Ministre</b>	

Contract No. - N° du contrat

E0225-111874/001/PWA

Client Ref. No. - N° de réf. du client

E0225-11-1874

Amd. No. - N° de la modif.

File No. - N° du dossier

PWA-0-60104

Buyer ID - Id de l'acheteur

pwa122

CCC No./N° CCC - FMS No./N° VME

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## CONTRACT CLAUSES

1. Security Requirement
2. Statement of Work
3. Standard Clauses and Conditions
4. Term of Contract
5. Authorities
6. Payment
7. Invoicing Instructions
8. Certifications
9. Applicable Laws
10. Priority of Documents
11. Commercial General Liability Insurance
12. Environmental Impairment Liability Insurance
13. Errors and Omissions Liability Insurance

### List of Annexes:

- |         |                   |
|---------|-------------------|
| Annex A | Statement of Work |
| Annex B | Basis of Payment  |
| Annex C | Site Plan         |



Contract No. - N° du contrat

E0225-111874/001/PWA

Client Ref. No. - N° de réf. du client

E0225-11-1874

Amd. No. - N° de la modif.

File No. - N° du dossier

PWA-0-60104

Buyer ID - Id de l'acheteur

pwa122

CCC No./N° CCC - FMS No./N° VME

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## CONTRACT CLAUSES

### 1. Security Requirement

There is no security requirement associated with the requirement.

### 2. Statement of Work

The Contractor must perform the Work in accordance with the Statement of Work at Annex "A".

### 3. Standard Clauses and Conditions

All clauses and conditions identified in the Contract by number, date and title are set out in the Standard Acquisition Clauses and Conditions (<http://ccua-sacc.tpsgc-pwgsc.gc.ca/pub/acho-eng.jsp>) Manual issued by Public Works and Government Services Canada.

#### 3.1 General Conditions

2010C; (2010-08-16), General Conditions - Services (Medium Complexity) apply to and form part of the Contract.

### 4. Term of Contract

#### 4.1 Period of the Contract

The period of the Contract is from November 08, 2010 to December 1, 2010 inclusive

### 5. Authorities

#### 5.1 Contracting Authority

The Contracting Authority for the Contract is:

Name: Chukwudi Chinye  
Title: Real Property Contracting Officer  
Public Works and Government Services Canada  
1713 Bedford Row, Halifax, NS B3J 1T3

Telephone: 902-496-5476  
Facsimile: 902-496-5016  
E-mail address: [chukwudi.chinye@pwgsc.gc.ca](mailto:chukwudi.chinye@pwgsc.gc.ca)

The Contracting Authority is responsible for the management of the Contract and any changes to the Contract must be authorized in writing by the Contracting Authority. The Contractor must not perform work in excess of or outside the scope of the Contract based on verbal or written requests or instructions from anybody other than the Contracting Authority.

Contract No. - N° du contrat

E0225-111874/001/PWA

Client Ref. No. - N° de réf. du client

E0225-11-1874

Amd. No. - N° de la modif.

File No. - N° du dossier

PWA-0-60104

Buyer ID - Id de l'acheteur

pwa122

CCC No./N° CCC - FMS No./N° VME

---

## 5.2 Project Authority

The Project Authority for the Contract is:

Name: Kate McCarthy  
Title: Project Authority  
Organization: Public Works and Government Services Canada  
Address: P.O box 2247, 1713 Bedford Row,  
Halifax, Nova Scotia  
B3J 3C9  
Telephone : 902-496-5047  
Facsimile: 902-496-3320  
E-mail address: kate.McCarthy@pwgsc.gc.ca

The Project Authority is the representative of the department or agency for whom the Work is being carried out under the Contract and is responsible for all matters concerning the technical content of the Work under the Contract. Technical matters may be discussed with the Project Authority, however the Project Authority has no authority to authorize changes to the scope of the Work. Changes to the scope of the Work can only be made through a contract amendment issued by the Contracting Authority.

## 5.3 Contractor's Representative

Name: James Mitchell  
Telephone Number: 902-468-0421  
Cellular Number: 902-430-0624  
Facsimile Number: 902-468-9009  
E-Mail: James.mitchell@stantec.com

## 6. Payment

### 6.1 Basis of Payment

In consideration of the Contractor satisfactorily completing all of its obligations under the Contract, the Contractor will be paid firm unit prices, as specified in Annex B for a cost of \$ 64,750.00. Customs duties are excluded and Goods and Services Tax or Harmonized Sales Tax is extra, if applicable.

Canada will not pay the Contractor for any design changes, modifications or interpretations of the Work, unless they have been approved, in writing, by the Contracting Authority before their incorporation into the Work.

### 6.2 Single Payment

SACC Manual clause H1000C (2008-05-12) Single Payment

## 7. Invoicing Instructions

The Contractor must submit invoices in accordance with the section entitled "Invoice Submission" of the general conditions. Invoices cannot be submitted until all work identified in the invoice is completed. Invoices shall be detailed as follows:

- (c) The original and two (2) copies must be forwarded to the following address for certification and payment.

PWGSC/TPSGC  
Regional Director Corp. Services  
1713 Bedford Row,  
PO.BOX 2247  
B3J 3C9  
Halifax, N.S.

## 8. Certifications

- 8.1 Compliance with the certifications provided by the Contractor in its bid is a condition of the Contract and subject to verification by Canada during the term of the Contract. If the Contractor does not comply with any certification or it is determined that any certification made by the Contractor in its bid is untrue, whether made knowingly or unknowingly, Canada has the right, pursuant to the default provision of the Contract, to terminate the Contract for default.

## 8.2 SACC Manual Clauses

D5328C Inspection and Acceptance  
A0285C Workers Compensation

## 9. Applicable Laws

The Contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in Nova Scotia

## 10. Priority of Documents

If there is a discrepancy between the wording of any documents that appear on the list, the wording of the document that first appears on the list has priority over the wording of any document that subsequently appears on the list.

- (a) the Articles of Agreement;
- (b) the general conditions 2010C- Services (Medium Complexity);
- (c) Annex A, Statement of Work;
- (d) Annex B, Basis of Payment;
- (e) Annex C, Site Plan
- (f) the Contractor's bid dated October 28, 2010, as clarified on November 1, 2010.

## 11. Commercial General Liability Insurance

1. The Contractor must obtain Commercial General Liability Insurance, and maintain it in force throughout the duration of the Contract, in an amount usual for a contract of this nature, but for not less than \$2,000,000 per accident or occurrence and in the annual aggregate.

2. The Commercial General Liability policy must include the following:

(a) Additional Insured: Canada is added as an additional insured, but only with respect to liability arising out of the Contractor's performance of the Contract. The interest of Canada should read as follows: Canada, as represented by Public Works and Government Services Canada.

(b) Bodily Injury and Property Damage to third parties arising out of the operations of the Contractor.



(c) **Products and Completed Operations:** Coverage for bodily injury or property damage arising out of goods or products manufactured, sold, handled, or distributed by the Contractor and/or arising out of operations that have been completed by the Contractor.

(d) **Personal Injury:** While not limited to, the coverage must include Violation of Privacy, Libel and Slander, False Arrest, Detention or Imprisonment and Defamation of Character.

(e) **Cross Liability/Separation of Insureds:** Without increasing the limit of liability, the policy must protect all insured parties to the full extent of coverage provided. Further, the policy must apply to each Insured in the same manner and to the same extent as if a separate policy had been issued to each.

(f) **Blanket Contractual Liability:** The policy must, on a blanket basis or by specific reference to the Contract, extend to assumed liabilities with respect to contractual provisions.

(g) **Employees and, if applicable, Volunteers** must be included as Additional Insured.

(h) **Employers' Liability** (or confirmation that all employees are covered by Worker's compensation (WSIB) or similar program)

(i) **Broad Form Property Damage including Completed Operations:** Expands the Property Damage coverage to include certain losses that would otherwise be excluded by the standard care, custody or control exclusion found in a standard policy.

(j) **Notice of Cancellation:** The Insurer will endeavour to provide the Contracting Authority thirty (30) days written notice of policy cancellation.

(k) If the policy is written on a claims-made basis, coverage must be in place for a period of at least 12 months after the completion or termination of the Contract.

(l) **Amendment to the Watercraft Exclusion** to extend to incidental repair operations on board watercraft.

(m) **Owners' or Contractors' Protective Liability:** Covers the damages that the Contractor becomes legally obligated to pay arising out of the operations of a subcontractor.

(n) **Litigation Rights:** Pursuant to subsection 5(d) of the Department of Justice Act, S.C. 1993, c. J-2, s.1, if a suit is instituted for or against Canada which the Insurer would, but for this clause, have the right to pursue or defend on behalf of Canada as an Additional Named Insured under the insurance policy, the Insurer must promptly contact the Attorney General of Canada to agree on the legal strategies by sending a letter, by registered mail or by courier, with an acknowledgement of receipt.

For the province of Quebec, send to:  
Director Business Law Directorate,  
Quebec Regional Office (Ottawa),  
Department of Justice,  
284 Wellington Street, Room SAT-6042,  
Ottawa, Ontario, K1A 0H8

For other provinces and territories, send to:  
Senior General Counsel,  
Civil Litigation Section,

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Department of Justice  
234 Wellington Street, East Tower  
Ottawa, Ontario K1A 0H8

A copy of the letter must be sent to the Contracting Authority. Canada reserves the right to co-defend any action brought against Canada. All expenses incurred by Canada to co-defend such actions will be at Canada's expense. If Canada decides to co-defend any action brought against it, and Canada does not agree to a proposed settlement agreed to by the Contractor's insurer and the plaintiff(s) that would result in the settlement or dismissal of the action against Canada, then Canada will be responsible to the Contractor's insurer for any difference between the proposed settlement amount and the amount finally awarded or paid to the plaintiffs (inclusive of costs and interest) on behalf of Canada.

## **12. Environmental Impairment Liability Insurance**

1. The Contractor must obtain Contractors Pollution Liability insurance, and maintain it in force throughout the duration of the Contract, in an amount usual for a contract of this nature, but for not less than \$1,000,000 per accident or occurrence and in the annual aggregate.

2. If the policy is written on a claims-made basis, coverage must be in place for a period of at least 12 months after the completion or termination of the Contract.

3. The Contractors Pollution Liability policy must include the following:

(a) Additional Insured: Canada is added as an additional insured, but only with respect to liability arising out of the Contractor's performance of the Contract. The interest of Canada as additional insured should read as follows: Canada, represented by Public Works and Government Services Canada.

(b) Notice of Cancellation: The Insurer will endeavour to provide the Contracting Authority thirty (30) days written notice of policy cancellation.

(c) Separation of Insureds: The policy must apply to each Insured in the same manner and to the same extent as if a separate policy had been issued to each.

(d) Contractual Liability: The policy must, on a blanket basis or by specific reference to the Contract, extend to assumed liabilities with respect to contractual provisions.

(e) Incidental Transit Extension: The policy must extend to losses arising from any waste, products or materials transported, shipped, or delivered via any transportation mode to a location beyond the boundaries of a site at which the Contractor or any entity for which the Contractor is legally liable is performing or has performed the operations described in the contract.

(f) Litigation Rights: Pursuant to subsection 5(d) of the Department of Justice Act, S.C. 1993, c. J-2, s.1, if a suit is instituted for or against Canada which the Insurer would, but for this clause, have the right to pursue or defend on behalf of Canada as an Additional Named Insured under the insurance policy, the Insurer must promptly contact the Attorney General of Canada to agree on the legal strategies by sending a letter, by registered mail or by courier, with an acknowledgement of receipt.

For the province of Quebec, send to:  
Director Business Law Directorate,  
Quebec Regional Office (Ottawa),  
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284 Wellington Street, Room SAT-6042,  
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For other provinces and territories, send to:

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A copy of the letter must be sent to the Contracting Authority. Canada reserves the right to co-defend any action brought against Canada. All expenses incurred by Canada to co-defend such actions will be at Canada's expense. If Canada decides to co-defend any action brought against it, and Canada does not agree to a proposed settlement agreed to by the Contractor's insurer and the plaintiff(s) that would result in the settlement or dismissal of the action against Canada, then Canada will be responsible to the Contractor's insurer for any difference between the proposed settlement amount and the amount finally awarded or paid to the plaintiffs (inclusive of costs and interest) on behalf of Canada.

### **13 Errors and Omissions Liability Insurance**

1. The Contractor must obtain Errors and Omissions Liability (a.k.a. Professional Liability) insurance, and maintain it in force throughout the duration of the Contract, in an amount usual for a contract of this nature but for not less than \$1,000,000 per loss and in the annual aggregate, inclusive of defence costs.
2. If the policy is written on a claims-made basis, coverage must be in place for a period of at least 12 months after the completion or termination of the Contract.
3. The following endorsement must be included:

Notice of Cancellation: The Insurer will endeavour to provide the Contracting Authority thirty(30) days written notice of cancellation.



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**ANNEX "A"****STATEMENT OF WORK****Geotechnical Drilling/Sampling/Testing  
Gunning Cove, Shelburne County, N.S.****1.0 PURPOSE**

Geotechnical drilling/sampling/testing is required at Gunning Cove, Shelburne County, N.S. to determine existing subsurface soil strata.

**2.0 SCOPE OF WORK****2.1 Location of Borings**

It is proposed that twelve (12) boreholes be drilled by conventional means at the locations shown on the attached plans. The Contractor will be responsible for surveying all test locations indicated; the actual field location of the drilled boreholes shall be accurately located using UTM (Nad 83) or other method approved by the department ( i.e. using fix structure located on site). Drilled boreholes shall be accurately positioned to within 1.5 m of location identified on the borehole plan. All vertical controls will be referred to Chart Datum using the PWGSC benchmark. Changes in the number or location of boreholes may occur at the request of Public Works and Government Services Canada (PWGSC).

The contractor will have to make arrangements with the local harbour Manager to have access to the site. The contractor will be responsible to coordinate with the harbour manager the removal or moving of boats that might interfere with doing the work.

**2.2 Elevation and Depth of Boreholes**

All borehole elevations shall be referenced to chart datum and shall be measured from a fixed benchmark. Elevations shall be measured accurately to within 0.1 m.

Boreholes:

1.) Breakwater BH 10-4, BH 10-5 and BH 10-6 shall be advanced at least three (3) metres into soil strata with blow counts greater than twenty (20) per 300 mm advancement of the split spoon sampler (S.P.T.).

2.) Dredging Boreholes BH 10-1 and BH 10-2 are to be advanced to a depth of 4.0 metres below chart datum. Where bedrock is encountered in the boreholes it shall be drilled and cored for a depth of not less than three (3) metres.

3.) Pipe Pile Boreholes BH-3, BH 10-7, BH 10-8, BH 10-9, BH10-10, BH 10-11 and BH 10-12 are to be advanced at least six (6) metres into soil strata with blow counts greater than twenty (20) per 300 mm advancement of the split spoon sampler (S.P.T.) and to a minimum depth of 10.5 metres below chart datum. Where bedrock is encountered in the boreholes it shall be drilled and cored for a depth of not less than three (3) metres.

### 2.3 Sampling and Identification of Boreholes

Samples shall be collected from the boreholes and shall be maintained in waterproof, rigid-sidewall, containers for further testing. All samples shall be properly identified, including site, borehole number and depth or elevation of sample, and shall become the property of PWGSC.

Samples and Standard Penetration Tests shall be obtained commencing at harbour bottom/ground surface and then continuous in all boreholes unless otherwise specified. Thin wall tests (Shelby Tubes) shall be attempted where Standard Penetration Test results of less than three (3) blows per 300 mm travel are encountered. Good sample recovery is essential.

The contractor must ensure that samples are recovered at each borehole and from each test as already outlined. Rock cores shall be taken when cobbles, boulders or bedrock is encountered in boreholes. All rock core shall be stored by contractor for period of 12 months and then disposed of unless otherwise indicated.

### 2.4 Field Presentation of Results

The Contractor shall inform PWGSC of the soil types encountered in the boreholes prior to demobilizing equipment from the site, this information to be provided as the work progresses.

### 2.5 Laboratory Testing - Analysis

For the purpose of soil classification for the site, the Contractor shall carry out the testing required to accurately classify the materials encountered on samples from each strata. The Contractor shall perform the listed necessary tests, (see Annex B), required to accurately perform this work. Samples selected for laboratory testing will be directed by PWGSC. Samples for testing will be selected by PWGSC based on the results of contractor submission: section 2.4. Soil properties and soil description shall be referenced to the Canadian Foundation Engineering Manual or Canadian Standard Association.

### 2.6 Factual Report

The Contractor shall provide six (6) bound copies of the Factual Report on completion of the work. The Factual Report shall include no less than the following:

- a) Investigation Procedures Used
- b) Site Description
- c) Subsurface Soil Description From Laboratory Tests
- d) Borehole Logs inclusive of number of rock core fractures per 0.3 m run depth.
- e) Laboratory Report
- f) Borehole Location Plan
- g) Copy of Terms of Reference
- h) Information shall be provided to the Department in both a digital and paper format. All textural data shall be provided in Ms Word, latest release and all drawings shall be provided in Auto-Cad, latest release. All digital information to be provided on 3.5 inch high density diskette.
- i) Colored photos of all rock core



## 2.7 Familiarization With Site and Physical Aspects

The Contractor shall be familiar with access to the site and anticipated subsurface conditions at the site as to the type and quantity of equipment, facilities and supplies needed to execute the work satisfactorily. Failure to do so will not relieve the Contractor of his responsibility for successfully supplying all requirements for the execution of the work and successfully performing the work.

## 2.8 Supervision (Supervisory Field Technician or Equivalent)

The field work is to be supervised in the field, full time, by an experienced Geotechnical technician or equivalent. The field supervisor must have at least three years of relevant geotechnical experience. The Contractor must include with the bid submission, the resume for the proposed field supervisor to demonstrate that the individual has the required experience. The resume submission should also include references for the individual, Public Works and Government Services Canada may contact the references required to verify the experience of the individual proposed as field supervisor.

## 3.0 SCHEDULING

The Contractor shall define and adhere to a timetable for the proposed investigation. The work must be completed with the Factual Report submitted by within four weeks after contract award.

## 4.0 PAYMENT FOR SERVICES

Payment shall be made in accordance with unit prices itemized in Annex B. The basis for successful selection will be the total lowest tendered amount for bid items as shown in Annex B. These items are all inclusive for job monitoring, locating boreholes, geotechnical drilling, sampling, testing, a complete soils report, and any and all inclusions of these Terms of Reference.

## 5.0 PROVISION FOR STANDBY TIME

The Contractor will assess the site conditions; no allowance will be made for standby as a result of wave conditions up to a maximum of 0.50 meters. Standby for wave conditions generated by marine traffic will not be measured for payment. The Department will provide an allowance for standby time incurred as a result of circumstances judged by the Department to be beyond the control of either the Contractor or the Department. The Department shall designate a representative to whom requests for such standby must be made at the time of each difficulty and prior to standing down from work. If permission is not first obtained no standby payment will be made. Only PWGSC shall determine if standby requested is valid for payment. The basis for standby payment will be based on wave conditions and inclement weather conditions only.

The Contractor shall be expected to take advantage of satisfactory sea conditions in prioritizing boreholes such that standby time is minimized. Failure to do so will result in no payment for standby. The Contractor will not be paid standby during set up or during tear down of equipment. The Contractor will not be paid standby during equipment failure with exception to standby time for the supervisory field technician, as per clause 5.2.

## 5.1 Drilling Operation

The Contractor shall submit an hourly rate for the drill crew and equipment, inclusive of all costs and expenses, at which standby will be charged. The maximum daily chargeable standby time will be eight (8) hours and shall be measured such that the total of hours worked plus standby time does not exceed ten (10) hours per day, five (5) days per week (Monday to Friday), or as otherwise agreed to by PWGSC. No payment will be considered for standby prior to drilling the first borehole or upon completion of the last borehole.

## 5.2 Supervisory Field Technician or Equivalent

An hourly rate, inclusive of all expenses, shall be submitted for the supervisory field technician or equivalent for standby time. Standby time shall be paid during drill rig breakdown and non-operational time to a daily maximum of ten (10) hours and shall be measured such that the total of hours worked plus standby time does not exceed ten (10) hours per day, seven days per week (Monday to Sunday), or as otherwise agreed to by PWGSC.

## 6.0 Occupational Health and Safety

### 6.1 Construction Safety Measures

.1 Observe and enforce construction safety measures required by National Building Code, Provincial Government, Workmen's Compensation Board and municipal statutes and authorities. Prepare construction site safety plan as per 5.3.7.

.2 In event of conflict between any provisions of above authorities the most stringent provision will apply.

### 6.2 Fire Safety Requirements

.1 Comply with requirements of standard for Building Construction Operations FCC No.301 Standard for Construction Operations, June 1982, issued by Fire Commissioner for Canada.

.2 This standard may be viewed at Regional *Engineer's* office, P.O. Box 2247, 1713 Bedford Row 2nd Floor, Halifax, N.S. B3J 3C9, and copies may be obtained from:

Fire Commissioner of Canada  
Sir Charles Tupper Building  
Riverside Drive  
Ottawa, Ontario K1A 0M2

.3 Continually maintain on the construction site an approved, workable 2.5 kg or equivalent multi-purpose dry chemical extinguisher for each welding and cutting unit which shall be located so as to be readily accessible to the operator.

.4 At least one 10 kg or equivalent multipurpose dry chemical extinguisher should be located on site and be readily available during the working day.

### 6.3 Overloading

.1 Ensure no part of Work is subjected to a load which will endanger its safety or will cause permanent deformation.



- .2 The Contractor is advised that use of heavy equipment on or close to existing structure(s) is at Contractor's risk and responsibility.

- .3 Repair any damage to existing structure caused by Contractor.

#### 6.4 Falsework

- .1 Design and construct falsework in accordance with CSA S269.1-1975.

#### 6.5 Scaffolding

- .1 Design and construct scaffolding in accordance with CSA S269.2-M1980.

#### 6.6 Hazardous Materials

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets acceptable to Labour Canada and Health and Welfare Canada.
- .2 Deliver copies of WHMIS data sheets to the Departmental Representative on delivery of materials.
- .3 Train staff regarding handling of plant treated wood products and use of field treatment materials.

#### 6.7 Construction Site Safety Plan

Carry out all work of this contract placing maximum emphasis on safety for workers and other authorized persons working or circulating on the construction site.

Notwithstanding other safety requirements specified in this section or in any other section of the Specifications, the Contractor shall prepare a written site specific Construction Safety Plan outlining all procedures and safe work practices which must be followed by all personnel working or circulating on the construction site. This safety plan shall address and conform to the Provincial Safety Act and Regulations, except where noted in the contract documents the requirement to conform with a more stringent Act or Regulation. Develop the Plan in collaboration with the various subcontractors, who will be carrying out work at the site at any time during the construction period, to ensure that all pertinent types of work activity are addressed in the Plan by related safety procedures which must be followed when carrying out such work. It is the Contractor's responsibility to ensure that all workers and authorized persons working or circulating on the construction site become familiar with all safety measures specified in the Plan. These measures and the means of communicating them to all persons must be addressed in the Safety Plan, in a clear and specific manner.

Prior to commencement of work the Safety Plan must be posted on the construction site in common location, visible for all workers and authorized persons working or circulating on the construction site to see. Ensure that all employees are advised of such Safety Plan and of the location where it is posted.

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The Contractor shall use measures to ensure that all workers and any authorized persons entering onto the construction site are notified of and abide by the posted safety rules and procedures. The Departmental Representative reserves the right to demand the removal of any persons not complying with the Safety Plan. Any person removed from the site shall not be permitted re-entry onto the construction site.

The Safety Plan shall be developed immediately upon notification of contract award and be completed prior to the commencement of work. Revise such Plan as required when changes to planned work procedures occur or when directed by any Safety Officer from any authority having jurisdiction. Submit the Safety Plan and any revised version to the Departmental Representative for information and retention purposes only. The submission of the Safety Plan to the Departmental Representative shall not relieve the Contractor of any legal obligations as specified by the Provincial Safety Acts or Regulations.