FUNDY Engineering

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Andre Leger
Public Works and Government Services Canada
Real Property Services
1045 Main Street, Unit 100
Moncton, New Brunswick
E1C 1H1

Job File: 9258
May 14, 2012

RE: Westmorland Institution – Multipurpose Building
Geotechnical Recommendations

Dear Mr. Leger:

Fundy Engineering & Consulting Ltd. (Fundy Engineering) was contracted by Public Works and Government Services Canada to provide geotechnical recommendations for a proposed multi-purpose building at the Westmorland Institution in Dorchester, New Brunswick. The recommendations made in the following letter report are based on the geotechnical investigation completed in January 2012 by Fundy Engineering under the project number 8915.

The geotechnical investigation completed in January 2012 consisted of eight (8) boreholes that were extended through the overburden material until bearing soil (N value of 20) was encountered in all holes. Bedrock was not encountered during the geotechnical investigation.

Soils encountered in this geotechnical investigation can generally be described as a Loose to Dense Brown Silty Sand with Trace Gravel that overlays a Very Stiff to Hard Reddish Brown Clay and Sand Till with Some Gravel. A thin layer of vegetation with roots at the ground surface overlays the materials noted above.

The following recommendations may be used for the earthwork in the construction of a new structure:

- Minimum dimension of spread footings should be no less than 600mm (2 feet).
- Minimum depth of frost cover for exterior foundations should be no less than 1.5 metres (5 feet).
- Active soil pressure coefficient (K_a)
  - Till - $K_a = 0.32$.
  - Class A (Table 1) - $K_a = 0.25$.
  - Class B (Table 2) - $K_a = 0.29$.
- Passive (at rest) soil pressure coefficient (K_p)
  - Till - $K_p = 3.12$.
  - Class A (Table 1) - $K_p = 4.02$.
  - Class B (Table 2) - $K_p = 3.40$.

Sieve Size (mm)	% Passing
31.5	100
25.0	95 - 100
19.0	-
12.5	50 - 83
4.75	30 - 60
1.18	15 - 40
0.60	10 - 32
0.30	5 - 22
0.075	3 - 9

Table 1 – Class A

Sieve Size (mm)	% Passing
90.0	100
75.0	95 – 100
63.0	85 – 100
50.0	73 – 95
37.5	58 – 87
19.0	35 – 69
9.50	25 – 54
4.75	17 – 43
2.36	12 – 35
1.18	8 – 24
0.300	4 – 16
0.075	0 – 9

Table 2 – Class B

- Sliding coefficient of friction (ɗ) = 26° and tan(26°) = 0.48
- Groundwater was not encountered during the geotechnical investigation. Therefore the elevation of the water table could not be determined.
- Sub-grade modulus;
  - For 300mm (1 foot) of Class A (Table 1) gravel of Till sub-grade modulus = 112 000 kN/m^3 (400 lb/in^3)
  - Till sub-grade modulus = 56 000 kN/m^3 (200 lb/in^3)
- The site should be classified as Class D for seismic response (Table 4.1.8.4, *A Site Classification for Seismic Response* (NBCC 2005)).

- Undercutting of excavations to create a stable base should be completed to a minimum of 300 mm below the bottom elevation of footings, slabs, spread footings etc. elevation. Fills placed below building areas should consist of Class A (Table 1) gravel compacted to 100% of maximum standard proctor density.

Fill materials placed under footings should be placed such that the soil improvements form a 1:1 slope to the insitu (Till) material.

Should you have any questions or require additional information please contact the undersigned at your convenience via telephone at 506.674.9421 or by email at al.mouland@fundyeng.com .

Sincerely;

Alex Mouland, *P.Eng. PMP*
Fundy Engineering & Consulting Ltd.

GEOTECHNICAL INVESTIGATION REPORT:

GEOTECHNICAL INVESTIGATION
WESTMORLAND INSTITUTION
DORCHESTER,
NEW BRUNSWICK

Prepared for:

Public Works and
Government Services Canada
Real Property Services
1045 Main Street
Unit 100
Moncton, NB
E1C 1H1

January 2012

Prepared by:

FUNDY Engineering

Fundy Engineering
27 Wellington Row
Saint John, NB
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www.fundyeng.com

Project No: 8915

EXECUTIVE SUMMARY

Fundy Engineering & Consulting Ltd. (Fundy Engineering) was contracted by Public Works and Government Services Canada to complete a geotechnical investigation at Westmorland Institution in Dorchester, New Brunswick. The purpose of this geotechnical investigation was to identify the soils and bedrock within the area of the proposed structure, determine the properties of the soils and bedrock, and to provide earthwork recommendations for the construction of a proposed structure. The geotechnical investigation consisted of eight (8) boreholes in the cleared area that was previously occupied by Building F-62. A track mount drill supplied and operated by Lantech Drilling was used to put down the boreholes. The boreholes were extended through the overburden material until bearing soil (N value of 20) was encountered in all holes. Bedrock was not encountered during the geotechnical investigation.

Soils encountered in this geotechnical investigation can generally be described as a Loose to Dense Brown Silty Sand with Trace Gravel that overlays a Very Stiff to Hard Reddish Brown Clay and Sand Till with Some Gravel. A thin layer of vegetation with roots at the ground surface overlays the materials noted above.

The following recommendations may be used for the earthwork in the construction of a new structure:

- Footings founded on Very Stiff to Hard Reddish Brown Clay and Sand Till or structural Fill may be designed with an allowable bearing capacity of 150 kPa and should be a minimum 600 mm wide. Total and differential settlements under the proposed loading will be less than 25 mm and 15 mm, respectively.
- The building pad (*i.e.*, Engineered Fills used to bring site up to grade), if required, must be constructed with a minimum slope of 1:1 from the edge of the pad to the insitu bearing soils and must extend beyond the edge of the footing a minimum distance of 0.5 m to the top of the pad slope.
- All engineered Fills placed should be inspected on-site by a Geotechnical Engineer.

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APPENDICES

1.0 INTRODUCTION

Fundy Engineering & Consulting Ltd. (Fundy Engineering) was contracted by Public Works and Government Services Canada (PWGSC) to complete a geotechnical investigation at Westmorland Institution in Dorchester, New Brunswick. The purpose of this geotechnical investigation was to identify the soils and bedrock within the area of the proposed expansion, determine the properties of the soils and bedrock, and to provide recommendations for the earthwork in the construction of a new structure. The geotechnical investigation consisted of eight (8) boreholes in the cleared area that was previously occupied by Building F-62. A track mount drill supplied and operated by Lantech Drilling was used to put down the boreholes. The boreholes were extended through the overburden material until bearing soil (N value of 20) was encountered in all holes. Bedrock was not encountered during the geotechnical investigation.

1.1 Scope of Work Completed

This following scope of work was performed by Fundy Engineering as part of our geotechnical investigation:

- Eight (8) geotechnical boreholes;
- Identification of soils and bedrock encountered within boreholes and respective parameters for each material determined from laboratory testing; and
- Geotechnical report with findings and recommendations pertaining to the earthwork in the construction of a new structure.

1.2 Limitations

The observations made and facts presented in this report are based on the site visit carried out in December 2011. While every effort has been made to comprehensively catalogue geotechnical concerns pertaining to the site at the Westmorland Institution in Dorchester, NB, discovery or development of other geotechnical problems cannot be precluded. Further investigation may reveal additional information that may have some bearing on the recommendations included herein. Should such information be revealed, Fundy Engineering should be notified in a timely fashion so that any required amendments to our recommendations can be made.

These results are reported confidentially to the client, who is advised to take appropriate action to rectify any areas of concern. No professional responsibility is assumed for the use or interpretation of these findings by others.

2.0 SITE DESCRIPTION

2.1 Area of Interest

The existing area is a cleared area previously occupied by Building F-62, which is located to the south western section of the facilities that make up Westmorland Institution.

2.2 Location and Property Ownership

The subject property is the location of Westmorland Institution at 4209 Main Street in Dorchester, NB. This facility contains numerous structures, in addition to the cleared vegetated area noted above. The property is identified by Service New Brunswick as PID#00795633. The registered owner of the 143.5 ha property is the Government of Canada-Public Works. The property is accessible via Route 106.

2.3 Geotechnical Setting

Surficial geology in the area consists of Marine Sediments of the Holocene epoch, namely intertidal plains and salt marshes: clay, silt, some fine sand, minor peat and organic sediment; generally more than 2 m thick (New Brunswick Department of Natural Resources, Surficial Geology-New Brunswick, Geological Survey of Canada, Map 1594A, 1984).

3.0 SITE WORK COMPLETED

3.1 Borehole Investigation

The purpose of the borehole investigation was to assess the underlying soils and bedrock in the cleared field to the east of the existing facilities in order to provide recommendations for the earthwork required in the construction of a new structure. On December 20th to 22nd, 2011, six (6) geotechnical boreholes were put down to obtain such information via a track mounted drill provided by Lantech Drilling Services under the direction of Rob Haineault, EIT, of Fundy Engineering. Continuous samples of the overburden soils were obtained using a split spoon sampler and rock samples were not taken as bedrock was not encountered. Borehole elevations are in reference to the manhole located to the north of the work area. The manhole is located at NB Grid coordinates 5085054.019 North 382773.625 East and at an elevation of 44.59 metres.

3.2 Soils Encountered

Soils encountered in this geotechnical investigation can generally be described as a Loose to Dense Brown Silty Sand with Trace Gravel that overlays a Very Stiff to Hard Reddish Brown Clay and Sand Till with Some Gravel (see Appendix IV). A thin layer of vegetation with roots at the ground surface overlays the materials noted above. Throughout the Till stratum, various sand seams were encountered. Further details of the soils encountered in the geotechnical investigation can be found in the borehole logs that are appended to this report (see Appendix III).

3.3 Bedrock

Bedrock was not encountered during the geotechnical investigation. Boreholes were extended to a minimum depth of five (5) metres and a maximum depth of eleven (11) metres.

3.4 Groundwater Encountered

Groundwater was not encountered during the geotechnical investigation. Due to the nature of the soils and the response time for groundwater to stabilize, it was not possible to determine groundwater levels during this investigation.

3.5 Radon Testing

One (1) borehole was sampled for radon gas. The representative borehole was selected on site and was within the footprint of the proposed structure.

Radon samples were collected using Electret Ion Chambers (EIC). The EIC's were obtained from and analyzed by RPC Laboratory in Fredericton, NB. The EIC's were placed, collected, and shipped following the recommendations of RPC Laboratory. The sample collection procedure was as follows:

Placement of EIC Sampling Kit

The placement of the EIC was conducted by our geotechnical technologist supervising the drilling operation.

1. The EIC was placed in a perforated housing and lowered into the borehole to a depth of approximately one metre below existing grade. The EIC was suspended from the top of the borehole casing.
2. The top of the borehole was then sealed airtight with a plug.
3. The EIC remained in the borehole for a total of 28 hours.

Collection of EIC Sampling Kit

The collection of the EIC was conducted by our senior air quality technologist.

1. Following the 28 hour sampling period, the EIC was removed from the borehole and properly prepared for shipment to the laboratory.
2. The analysis was completed by a third party laboratory (RPC Laboratory).
3. A letter report was prepared which explains the sample analysis, as well as what impacts the identified radon levels may have on the proposed structure.

Results of Radon Testing

Sample Identification	Radon Detected (Bq/m^3)
Borehole #1	13 408

Health Canada recommends remedial action is taken if a radon concentration in an occupied indoor space exceeds 200 Bq/m^3 (Becquerels per cubic metre). However, when testing in a subsoil condition as in a borehole, the concentration of radon is expected to be approximately

100 times higher than a building located at the same location. Therefore, a radon concentration collected from a borehole, with a concentration ≤20,000 Bq/m^3 would be considered acceptable according to the Health Canada guideline. The radon concentration identified during this testing procedure was measured at a concentration below the recommended threshold limit value.

3.6 Atterburg Limits

Fine grained Silt and Clay from Till samples recovered during the field program were tested to determine the Plastic Limit, Liquid Limit and Plasticity Index of the soil. The Plasticity Index of a fine grained soil indicates the magnitude of water content range over which the soil remains plastic.

The Silty Clay portion of the Till can be classified as a Low Plasticity Clay. Five (5) samples from Boreholes 1,5,6,7 and 8 were tested at varying depths and the Plasticity Index of each was determined. Plasticity Index of these samples ranged from 9 to 12. Detailed laboratory results of the Atterberg Limits testing are attached in Appendix IV.

4.0 RECOMMENDATIONS

Based on our observations made in the field the preferred foundation design for the new facility is a standard concrete wall on footings. At the time of this report the design of the foundations was not known to us. Some assumptions have been made based on the underground conditions. Footings may be founded on the Very Stiff to Hard Reddish Brown Clay and Sand Till.

4.1 Site Preparation

With any development in the area of the investigation, it is recommended that the layer of topsoil be removed. In addition, the Loose to Compact Silty Sand should be removed. At a minimum the excavation to prepare the site for foundation footings should extend to the Very Stiff to Hard Reddish Brown Clay and Sand Till.

4.2 Footings Founded on Till

The Very Stiff to Hard Till bearing stratum should be proof rolled with a large highway type vibratory roller and approved by a Geotechnical Engineer. Soft areas identified should be removed and replaced with compacted structural fill. Any surface water should be directed away from the excavated areas to prevent any disturbance of the Till which is susceptible to water softening. Traffic should also be minimized in the building footprint as building grade is approached to prevent the mobilization of the Till material at the surface.

After the removal of all unsuitable materials the footings are to be placed on the Till material. If additional material is required to bring the building footings or slabs up to grade, it should be done so using a structural fill. Structural fill should consist of an approved material which is free from organics and deleterious materials, such as a pit run or other approved inorganic soil.

All structural fill placed within the building area should be placed and compacted in lifts to 100 percent of its Standard Proctor density. The lift thickness must be compatible with the compaction equipment used. A maximum lift thickness of 0.30 m is recommended for structural fill material placed under the building.

It is recommended that removal of all unsuitable materials and the placement of structural fills be monitored by a Geotechnical Engineer. This will ensure that all unwanted materials that are susceptible to excessive settlements are removed and replaced with suitable load bearing materials, and that the required degree of compaction is attained during the placement of the structural fills.

Footings founded on Very Stiff to Hard Reddish Brown Clay and Sand Till or structural Fill may be designed with an allowable bearing capacity of 150 kPa and should be a minimum 600 mm wide. Total and differential settlements under the proposed loading will be less than 25 mm and 15 mm, respectively. The building pad (*i.e.*, engineered fills used to bring the site up to grade), if required, must be constructed with a minimum slope of 1:1 from the edge of the pad to the insitu bearing soils and must extend beyond the edge of the footing a minimum distance of 0.5 m to the top of the pad slope. Footings may be placed directly on competent insitu Till or on compacted structural fill.

All footings should have a minimum of 1.5 m of soil cover or equivalent in insulation for frost protection. All footings should also have a minimum of 600 mm coverage above any ground water.

4.3 Material Reuse

Any overburden material removed from the site has limited reuse application. Due to the high fine material content, these materials shall not be used as a bedding sand, roadway sub-base or roadway base.

5.0 CONCLUSIONS AND CLOSING REMARKS

Fundy Engineering & Consulting Ltd. (Fundy Engineering) was contracted by Public Works and Government Services Canada to complete a geotechnical investigation at Westmorland Institution in Dorchester, New Brunswick. The purpose of this geotechnical investigation was to identify the soils and bedrock within the area of the proposed structure, determine the properties of the soils and bedrock, and to provide earthwork recommendations for the construction of a proposed structure. The geotechnical investigation consisted of eight (8) boreholes in the cleared area that was previously occupied by Building F-62. A track mount drill supplied and operated by Lantech Drilling was used. The boreholes were extended through the overburden material until bearing soil (N value of 20) was encountered in all holes. Bedrock was not encountered during the geotechnical investigation.

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- All engineered Fills placed should be inspected on-site by a Geotechnical Engineer.

We trust this is sufficient for your present needs, please feel free to contact the undersigned for any additional information or clarification that may be required.

Sincerely,
Fundy Engineering & Consulting Ltd.

Mr. Alex Mouland, P.Eng., PMP

APPENDIX I

DRAWINGS

SITE
LOCATION

GENERAL NOTES

1. Site Plan (underlay) provided by others and depicted for reference use only and not for construction.

No.	REVISION/ISSUE	DATE

FUNDY Engineering

27 Wellington Row
P.O. Box 6626
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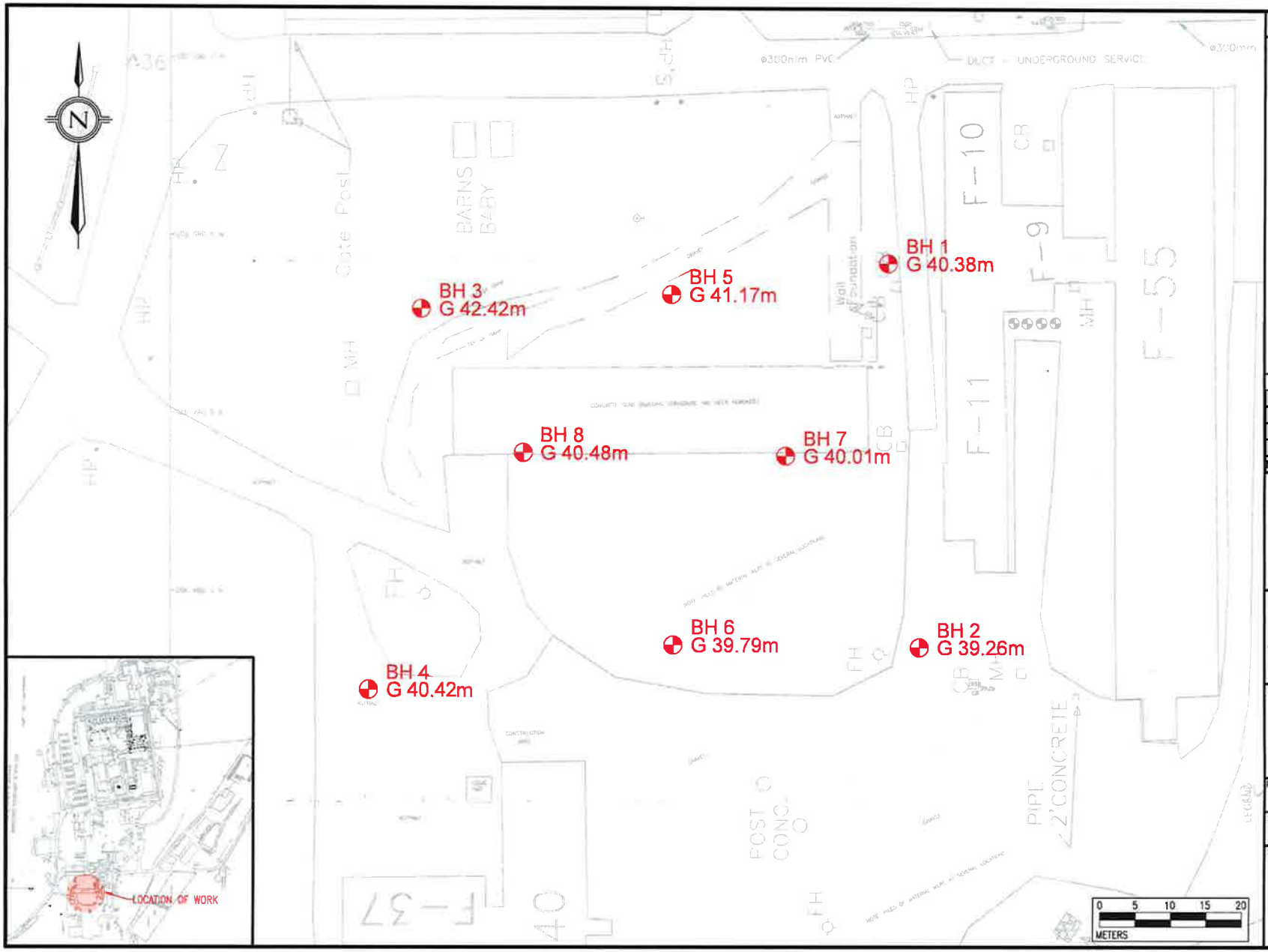
Project:
GEOTECHNICAL INVESTIGATION
WESTMORELAND INSTITUTION
DORCHESTER, NB

Drawing:
SITE LOCATION PLAN

Project No.	Designed	Date (y/m/d)
8915	AGM	12/01/16
Scale	Drawn	Rev.
0.000192	RTH	

Sheet
S1



GENERAL NOTES

1. Site Plan (underlay) provided by others and depicted for reference use only and not for construction.

BH Bore Hole
G Grade

No.	REVISION/ISSUE	DATE

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Project:
GEOTECHNICAL INVESTIGATION
WESTMORELAND INSTITUTION
DORCHESTER, NB

Drawing:
BOREHOLE LOCATION PLAN

Project No.	Designed	Date (m/mm/dd)
8915	AGM	12/01/16
Scale	Drawn	Rev.
1:10,000	RTH	

Sheet
S2

APPENDIX II

SYMBOLS AND TERMS

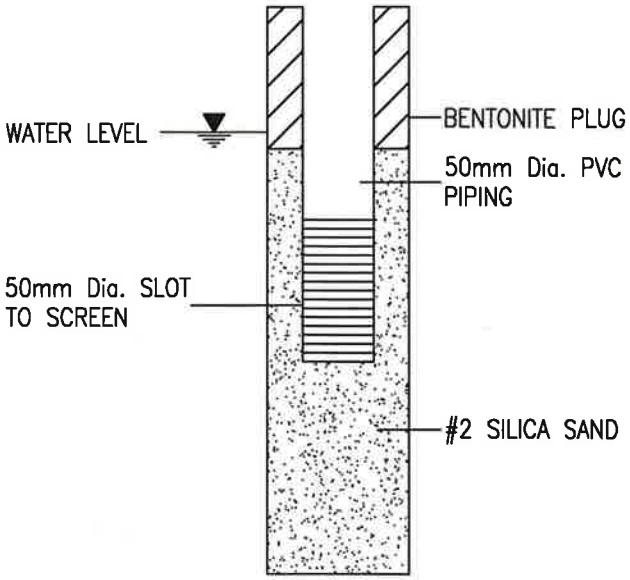
SYMBOLS AND TERMS

SAMPLES

SS...	Silty Spoon
ST...	Shelby Tube
PS...	Piston Sample
BS...	Bulk Sample
WS...	Wash Sample
RC...	Rock Core
RF...	Split Spoon Refusal (50 Blows/25 mm)

OTHER TESTS

G...	Specific Gravity
H...	Hydrometer Analysis
S...	Sieve Analysis
Y...	Unit Weight
C...	Consolidation
CD...	Consolidation Drained Triaxial
CU...	Consolidation Undrained Triaxial
UU...	Unconsolidated Undrained Triaxial
DS...	Direct Shear
P...	Field Permeability



Monitoring Well

ROCK DESCRIPTION

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

The classification is based on a modified core recovery percentage in which all pieces of sound core over 100mm long are expressed as a percentage of the total recovery. The small 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 measured on NXL core.

RQD	ROCK QUALITY
90–100	Excellent, intact, very sound
75–90	Good, massive, moderately jointed or sound
50–75	Fair, block and seamy, fractured
25–50	Poor, shattered and very seamy or blocky, severely fractured
0–25	Very poor, crushed, very severely fractured

SYMBOLS AND TERMS CONTINUED

SYMBOLS AND TERMS USED ON THE TEST PIT AND BOREHOLE 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 or sand)	35–50%

The standard terminology to describe cohesion less 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 (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 consistancy, which is based on undrained shear strength as measured by insitu vane tests, penetrometer test, 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

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APPENDIX III

BOREHOLE LOGS

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BOREHOLE LOG
No. BH01

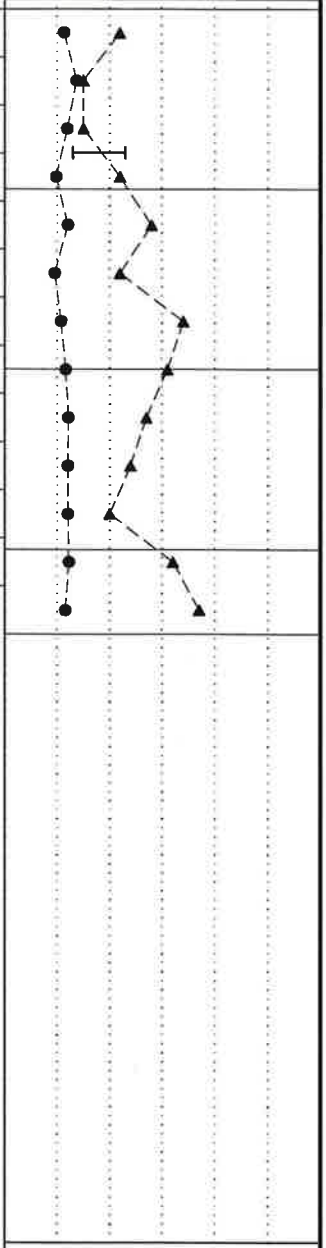
PROJECT: Geotechnical Investigation
CLIENT: Public Works and Government Services **DATUM:** Geodetic
PROJECT LOCATION: Westmorland Institution **ELEVATION (m):** 40.38
DRILLING CONTRACTOR: Lantech Drilling **PROJECT #** 8915
LOGGED BY: Travis Henrikson **CHECKED BY:** Al Mouland
DRILLING METHOD: Truck Mount **DATE:** Dec21/11
DEPTH TO WATER (m): INITIAL: **24 hrs.**

Depth (meters)	Depth (feet)	Description	Elevation (m)	Groundwater	Graphic	Sample Type	Sample No.	Lab Tests	Sample Rec (cm)	Blow Counts (N Value)	% < #200
0	0	Loose Brown Sand and Gravel	40.38				1		61	34-14-8-9 (22)	
		Stiff to Hard Reddish Brown Clay and Sand Till with some Gravel	40.08				2		45.5	5-8-7-4 (15)	
1.5	5		39.77				3		45.5	8-7-8-7 (15)	52
			39.16				4		61	9-11-11-12 (22)	
3	10		38.55				5		61	14-14-14-16 (28)	
			37.94				6		61	12-9-13-14 (22)	
4.5	15		37.33				7		61	14-17-17-14 (34)	
			36.72				8		61	9-13-18-10 (31)	
6	20		36.11				9		0	13-14-13-14 (27)	56
			35.5				10		61	11-11-13-13 (24)	
7.5	25		34.89				11		61	9-10-10-10 (20)	
			34.28				12		61	14-15-17-15 (32)	
		Sandstone Fragments	33.67				13		61	17-17-20-30 (37)	
		Borehole Terminated at 7.93 m (Elevation = 32.45m)	33.06								
			32.45								

TEST RESULTS

Plastic Limit ⊢ Liquid Limit
Water Content - ●
SPT N-Value - ▲

10 20 30 40 50



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BOREHOLE LOG No. BH02

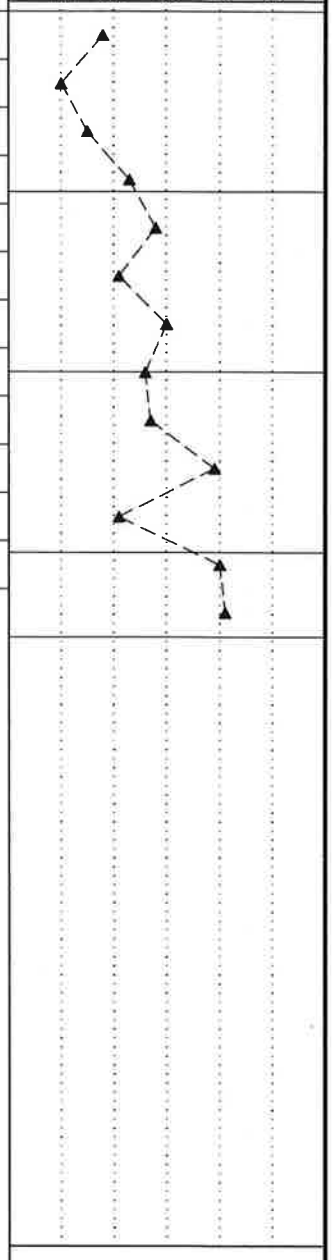
PROJECT: Geotechnical Investigation
CLIENT: Public Works and Government Services **DATUM:** Geodetic
PROJECT LOCATION: Westmorland Institution **ELEVATION (m):** 39.26
DRILLING CONTRACTOR: Lantech Drilling **PROJECT #** 8915
LOGGED BY: Travis Henrikson **CHECKED BY:** Al Mouland
DRILLING METHOD: Truck Mount **DATE:** Dec21/11
DEPTH TO WATER (m): INITIAL: **24 hrs.**

Depth (meters)	Depth (feet)	Description	Elevation (m)	Sample No.	Sample Rec (cm)	Blow Counts (N Value)	% < #200
0	0	Loose Brown Sand and Gravel	39.26	1	61	17-12-6-6 (18)	
			38.65				
		Stiff to Hard Reddish Brown Clay and Sand Till with some Gravel	38.5	2	61	9-6-4-7 (10)	
1.5	5		38.04	3	61	5-7-8-8 (15)	
			37.43	4	61	12-13-10-10 (23)	
			36.82	5	61	10-11-17-15 (28)	49
3	10		36.21	6	61	7-11-10-12 (21)	
		Very Stiff to Hard Reddish Brown Sandy Clay Till with some Gravel (Large Sandstone Fragments)	35.6	7	61	14-14-16-15 (30)	
4.5	15		34.99	8	61	11-13-13-14 (26)	
			34.38	9	61	12-14-13-15 (27)	
			33.77	10	61	15-21-18-19 (39)	
6	20		33.16	11	61	9-10-11-13 (21)	
			32.55	12	61	20-20-20-19 (40)	48
7.5	25		31.94	13	61	24-22-19-21 (41)	
		Borehole Terminated at 7.93 m (Elevation = 31.33m)	31.33				

TEST RESULTS

Plastic Limit ⊢ Liquid Limit
Water Content - ●
SPT N-Value - ▲

10 20 30 40 50



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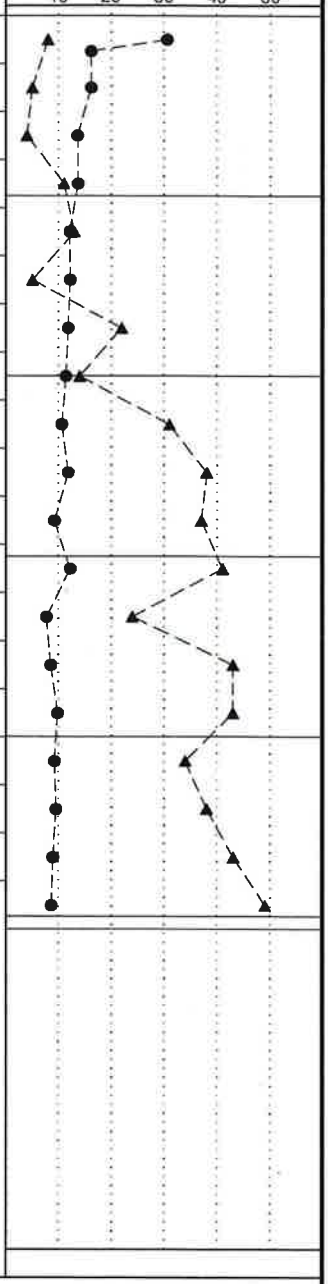
BOREHOLE LOG
No. BH03

PROJECT: Geotechnical Investigation
CLIENT: Public Works and Government Services **DATUM:** Geodetic
PROJECT LOCATION: Westmorland Institution **ELEVATION (m):** 42.42
DRILLING CONTRACTOR: Lantech Drilling **PROJECT #** 8915
LOGGED BY: Travis Henrikson **CHECKED BY:** Al Mouland
DRILLING METHOD: Truck Mount **DATE:** Dec22/11
DEPTH TO WATER (m): INITIAL: **24 hrs.**

Depth (meters)	Depth (feet)	Description	Elevation (m)	Groundwater	Graphic	Sample Type	Sample No.	Lab Tests	Sample Rec (cm)	Blow Counts (N Value)	% < #200
0	0	Topsoil	42.42								
		Soft to Hard Reddish Brown Clay and Sand Till with Some Gravel	42.27				1		35.5		
			41.97				2		15	3-2-3-4 (5)	40
1.5	5		41.81				3		15	1-2-2-1 (4)	
			41.2				4		30	2-3-8-5 (11)	
			40.59				5		61	7-6-7-8 (13)	
3	10		39.98				6		61	3-2-3-4 (5)	
			39.37				7		61	8-10-12-9 (22)	
4.5	15		38.76				8		61	4-7-7-9 (14)	
			38.15				9		0	10-13-18-18 (31)	56
6	20		37.54				10		61	21-20-18-19 (38)	
			36.93				11		61	9-20-17-20 (37)	
7.5	25		36.32				12		5	20-22-19-21 (41)	
			35.71				13		61	8-10-14-14 (24)	
9	30		35.1				14		61	14-20-23-23 (43)	
			34.49				15		61	14-20-23-23 (43)	
10.5	35		33.88				16		61	15-16-18-18 (34)	
			33.27				17		61	17-18-20-19 (38)	
			32.66				18		61	12-21-22-25 (43)	
			32.05				19		61	16-20-29-17 (49)	
			31.44								
		Borehole Terminated at 11.5 m (Elevation = 30.83m)	30.83								

TEST RESULTS

Plastic Limit ⊢ Liquid Limit
Water Content - ●
SPT N-Value - ▲



FUNDY Engineering

BOREHOLE LOG No. BH04

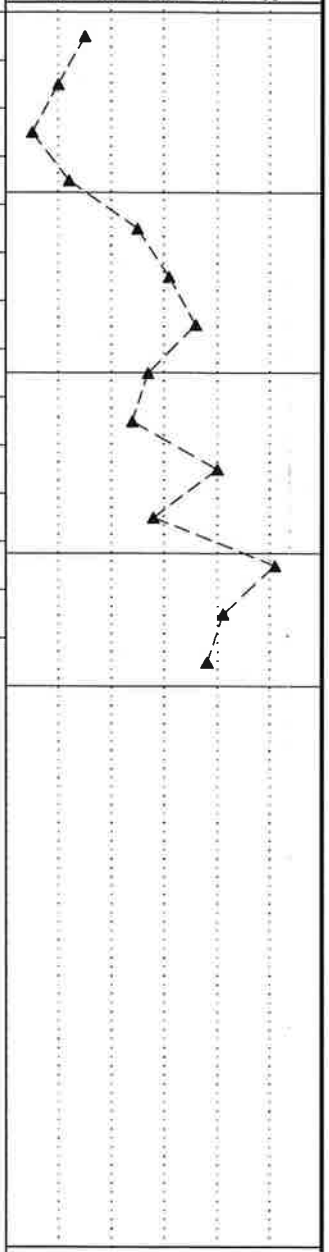
PROJECT: Geotechnical Investigation
CLIENT: Public Works and Government Services **DATUM:** Geodetic
PROJECT LOCATION: Westmorland Institution **ELEVATION (m):** 40.42
DRILLING CONTRACTOR: Lantech Drilling **PROJECT #** 8915
LOGGED BY: Travis Henrikson **CHECKED BY:** Al Mouland
DRILLING METHOD: Truck Mount **DATE:** Dec20/11
DEPTH TO WATER (m): INITIAL: **24 hrs.**

Depth (meters)	Depth (feet)	Description	Elevation (m)	Groundwater	Graphic	Sample Type	Sample No.	Lab Tests	Sample Rec (cm)	Blow Counts (N Value)	% < #200
0	0	Compact Brown Sand and Gravel Fill	40.42				1		25	14-9-6-5 (15)	
		Stiff Reddish Brown Clayey Sand Till with some Gravel	39.81				2		30	5-5-5-5 (10)	
1.5	5		39.7				3		61	1-2-3-4 (5)	
			39.2				4		25	1-3-9-11 (12)	34
		Very Stiff to Hard Reddish Brown Clay and Sand Till with Trace Gravel	38.6				5		15	15-16-9-7 (25)	
3	10		37.9				6		61	4-6-25-31 (31)	
			37.3				7		61	20-17-19-16 (36)	
4.5	15		36.7				8		15	7-13-14-17 (27)	57
			36.1				9		61	8-12-12-17 (24)	
6	20		35.5				10		61	11-21-19-19 (40)	
			34.9				11		30	12-14-14-14 (28)	
7.5	25		34.3				12		61	21-24-27-26 (51)	
			33.7				13		61	18-18-23-19 (41)	
			33.1				14		30	21-18-20-17 (38)	
		Borehole Terminated at 8.54 m (Elevation = 31.88m)	32.4								
			31.88								

TEST RESULTS

Plastic Limit ⊢ Liquid Limit
Water Content - ●
SPT N-Value - ▲

10 20 30 40 50



FUNDY Engineering

BOREHOLE LOG
No. BH05

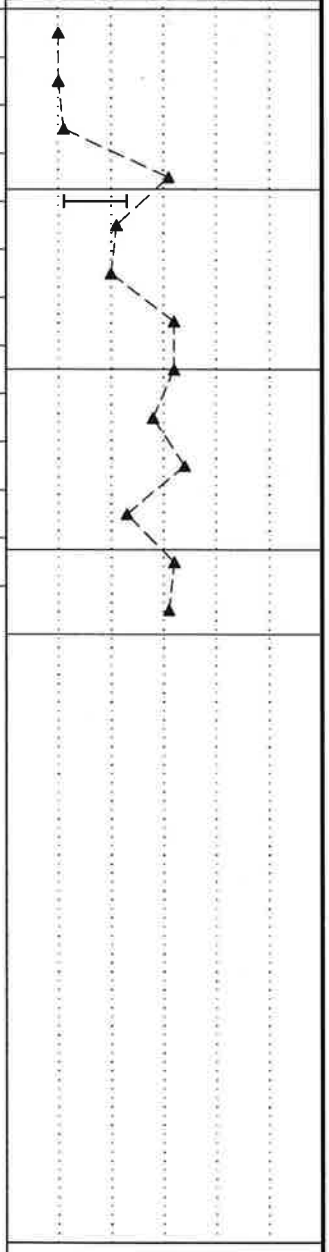
PROJECT: Geotechnical Investigation
CLIENT: Public Works and Government Services **DATUM:** Geodetic
PROJECT LOCATION: Westmorland Institution **ELEVATION (m):** 41.17
DRILLING CONTRACTOR: Lantech Drilling **PROJECT #** 8915
LOGGED BY: Travis Henrikson **CHECKED BY:** Al Mouland
DRILLING METHOD: Truck Mount **DATE:** Dec22/11
DEPTH TO WATER (m): INITIAL: **24 hrs.**

Depth (meters)	Depth (feet)	Description	Elevation (m)	Groundwater	Graphic	Sample Type	Sample No.	Lab Tests	Sample Rec (cm)	Blow Counts (N Value)	% < #200
0	0	Topsoil	41.17				1		20	8-7-3-2 (10)	
		Stiff to Hard Reddish Brown Clay and Sand Till with some Gravel	40.87				2		35	5-7-3-5 (10)	37
1.5	5		40.56				3		45.5	4-4-7-6 (11)	
			39.95				4		61	10-16-15-14 (31)	
3	10		39.34				5		61	10-11-10-11 (21)	
			37.94				6		61	5-8-12-12 (20)	
4.5	15	Very Stiff to Hard Reddish Brown Sandy Clay Till with some Gravel	38.12				7		61	14-17-15-13 (32)	56
			37.51				8		61	17-17-15-16 (32)	
6	20		36.9				9		0	14-13-15-17 (28)	
			36.29				10		61	17-17-17-17 (34)	
7.5	25		35.68				11		61	8-10-13-12 (23)	
			35.07				12		61	14-17-15-17 (32)	
			34.46				13		35	13-16-15-22 (31)	
		Borehole Terminated at 7.93 m (Elevation = 33.24m)	33.85								
			33.24								

TEST RESULTS

Plastic Limit ⊢⊣ Liquid Limit
Water Content - ●
SPT N-Value - ▲

10 20 30 40 50



FUNDY Engineering

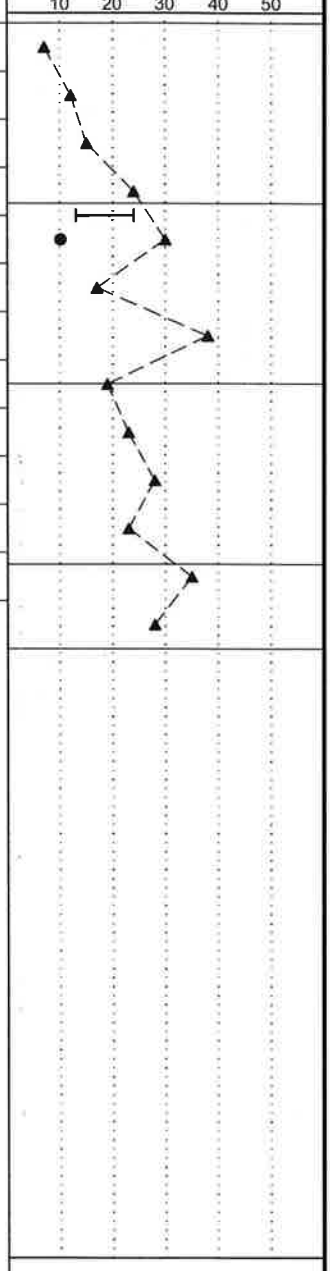
BOREHOLE LOG
No. BH06

PROJECT: Geotechnical Investigation
CLIENT: Public Works and Government Services **DATUM:** Geodetic
PROJECT LOCATION: Westmorland Institution **ELEVATION (m):** 39.79
DRILLING CONTRACTOR: Lantech Drilling **PROJECT #** 8915
LOGGED BY: Travis Henrikson **CHECKED BY:** Al Mouland
DRILLING METHOD: Truck Mount **DATE:** Dec20/11
DEPTH TO WATER (m): INITIAL: **24 hrs.**

Depth (meters)	Depth (feet)	Description	Elevation (m)	Groundwater	Graphic	Sample Type	Sample No.	Lab Tests	Sample Rec (cm)	Blow Counts (N Value)	% < #200
0	0	Loose Brown Silty Sand and Gravel Fill	39.79				1		10	20-4-3-4 (7)	
		Stiff Reddish Brown Clayey Sand Till with some Gravel	39.18				2		60	6-6-8-8 (12)	
1.5	5		38.57				3		45.5	6-7-8-13 (15)	
		Very Stiff to Hard Reddish Brown Clay and Sand Till with Trace Gravel	37.96				4		61	11-11-13-14 (24)	57
			37.35				5		25	10-14-16-18 (30)	
3	10		36.74				6		61	6-7-10-12 (17)	
			36.13				7		40.5	13-18-20-15 (38)	
4.5	15		35.52				8		61	9-9-10-14 (19)	
			34.91				9		61	13-12-11-19 (23)	57
6	20		34.3				10		61	13-14-14-18 (28)	
			33.69				11		30	6-10-13-12 (23)	
			33.08				12		61	15-17-18-17 (35)	
7.5	25		32.47				13		61	12-13-15-20 (28)	
		Borehole Terminated at 7.93 m (Elevation = 31.86m)	31.86								

TEST RESULTS

Plastic Limit ⊢ Liquid Limit
Water Content - ●
SPT N-Value - ▲



FUNDY Engineering

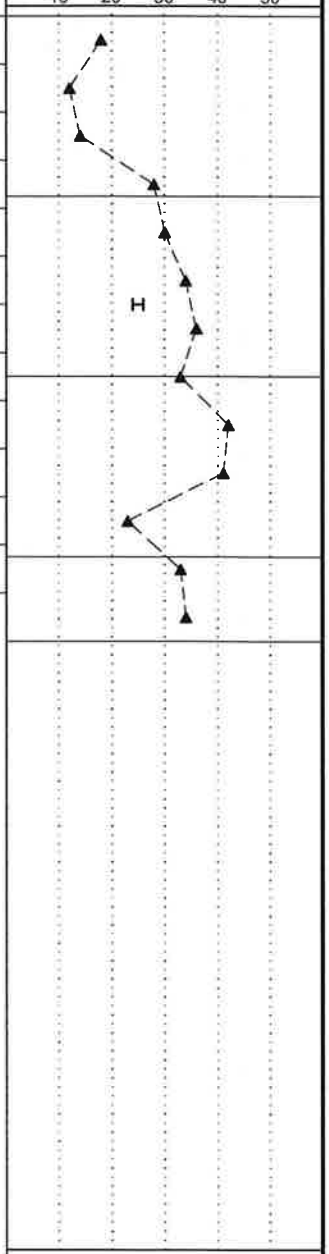
BOREHOLE LOG
No. BH07

PROJECT: Geotechnical Investigation
CLIENT: Public Works and Government Services **DATUM:** Geodetic
PROJECT LOCATION: Westmorland Institution **ELEVATION (m):** 40.01
DRILLING CONTRACTOR: Lantech Drilling **PROJECT #** 8915
LOGGED BY: Travis Henrikson **CHECKED BY:** Al Mouland
DRILLING METHOD: Truck Mount **DATE:** Dec21/11
DEPTH TO WATER (m): INITIAL: **24 hrs.**

Depth (meters)	Depth (feet)	Description	Elevation (m)	Groundwater	Graphic	Sample Type	Sample No.	Lab Tests	Sample Rec (cm)	Blow Counts (N Value)	% < #200
0	0	Loose Brown Silty Sand and Gravel	40.01				1		40.5	21-12-6-6 (18)	
		Firm to Hard Reddish Brown Sandy Clay Till with some Gravel	39.40				2		61	5-6-6-6 (12)	
1.5	5		38.79				3		61	5-7-7-5 (14)	53
			38.18				4		45.5	9-11-17-17 (28)	
			37.57				5		45.5	13-15-15-14 (30)	
3	10		36.96				6		50.5	9-13-21-18 (34)	
			36.35				7		61	18-17-19-19 (36)	
4.5	15		35.74				8		61	10-16-17-16 (33)	55
			35.13				9		61	20-20-22-28 (42)	
		Cobble in tip	34.52				10		2.5	24-20-21-17 (41)	
6	20		33.91				11		61	10-11-12-11 (23)	
			33.3				12		61	16-16-17-18 (33)	
7.5	25		32.69				13		61	15-17-17-18 (34)	
		Borehole Terminated at 7.93 m (Elevation = 32.08m)	32.08								

TEST RESULTS

Plastic Limit ⊢ Liquid Limit
Water Content - ●
SPT N-Value - ▲



FUNDY Engineering

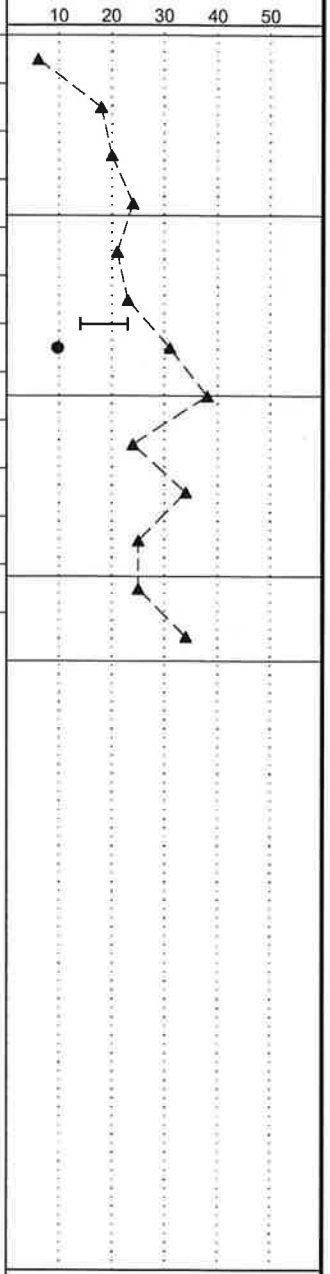
BOREHOLE LOG No. BH08

PROJECT: Geotechnical Investigation
CLIENT: Public Works and Government Services **DATUM:** Geodetic
PROJECT LOCATION: Westmorland Institution **ELEVATION (m):** 40.48
DRILLING CONTRACTOR: Lantech Drilling **PROJECT #** 8915
LOGGED BY: Travis Henrikson **CHECKED BY:** Al Mouland
DRILLING METHOD: Truck Mount **DATE:** Dec21/11
DEPTH TO WATER (m): INITIAL: **24 hrs.**

Depth (meters)	Depth (feet)	Description	Elevation (m)	Groundwater	Graphic	Sample Type	Sample No.	Lab Tests	Sample Rec (cm)	Blow Counts (N Value)	% < #200
0	0	Loose Brown Silty Sand and Gravel	40.48				1		10	14-3-3-3 (6)	
		Concrete Fragments in Spoon	39.87				2		35.5	30-14-4-4 (18)	
1.5	5	Soft to Hard Reddish Brown Sandy Clay Till with some Gravel	39.34				3		61	14-11-9-10 (20)	56
			39.26				4		61	10-10-14-14 (24)	
			38.65				5		61	9-10-11-12 (21)	
3	10		38.04				6		30	7-11-12-16 (23)	
			37.43				7		20	13-16-15-19 (31)	
			36.82				8		61	15-16-22-24 (38)	
4.5	15		36.21				9		61	8-11-13-16 (24)	
			35.6				10		45.5	13-17-17-18 (34)	47
6	20		34.99				11		35.5	12-12-13-16 (25)	
			34.38				12		61	9-11-14-16 (25)	
			33.77				13		45.5	12-16-18-20 (34)	
7.5	25		33.16								
		Borehole Terminated at 7.93 m (Elevation = 32.55m)	32.55								

TEST RESULTS

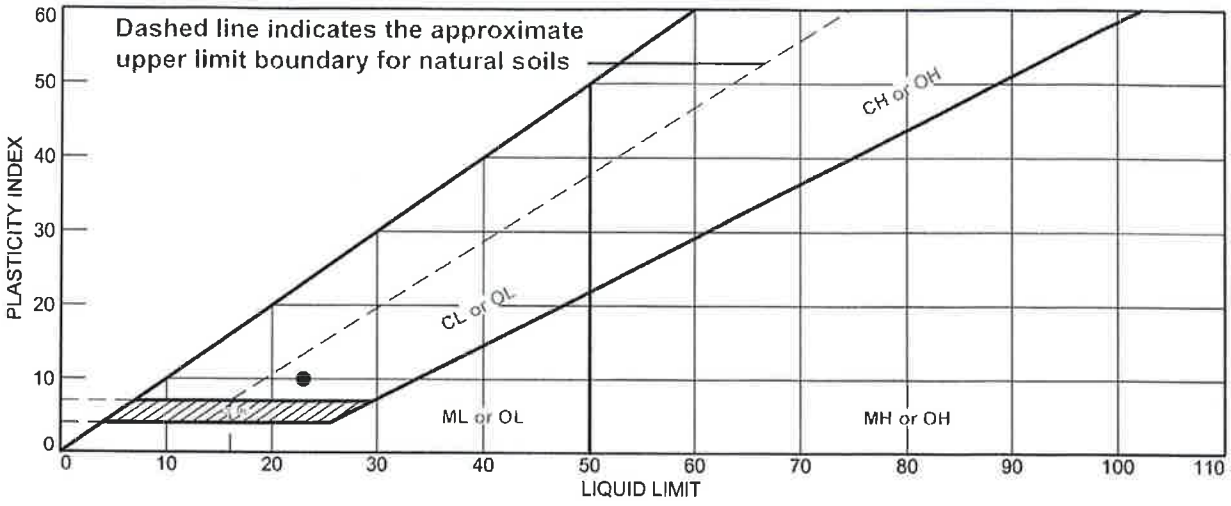
Plastic Limit ⊢ Liquid Limit
Water Content - ●
SPT N-Value - ▲

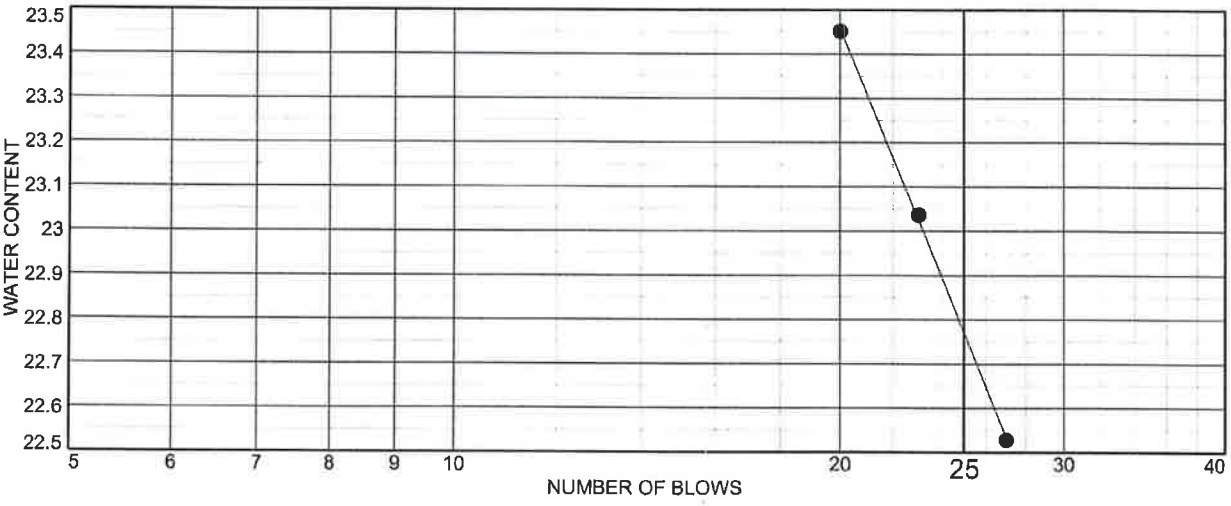


APPENDIX IV

LABORATORY TESTING RESULTS

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		23	13	10			

Project No. 8915 **Client:** Public Works and Government Services

Project: Geotechnical Investigation

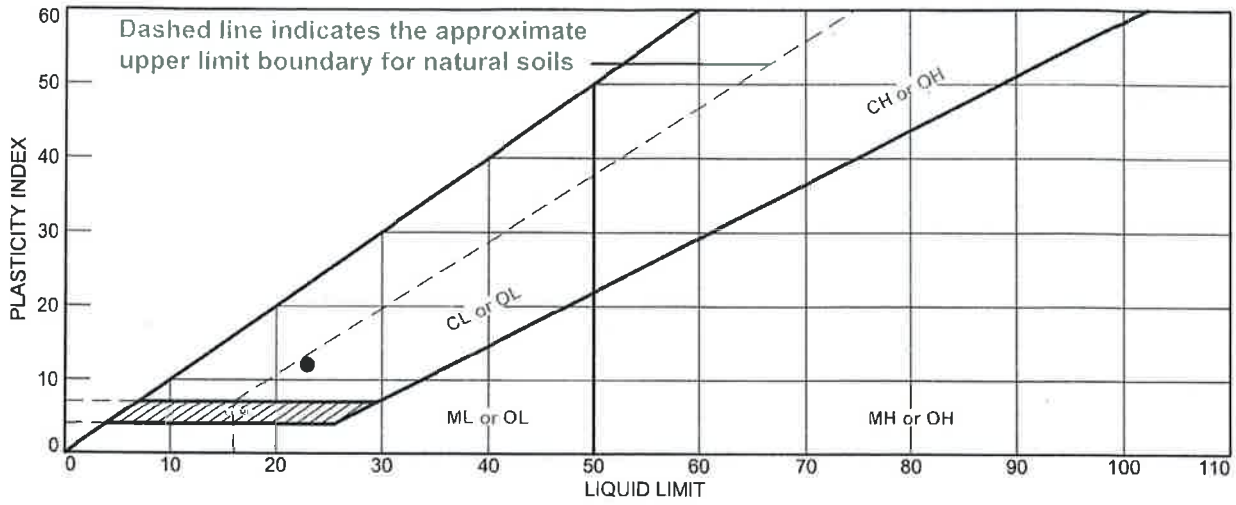
● **Source of Sample:** BH01 **Depth:** 1.83 **Sample Number:** 4

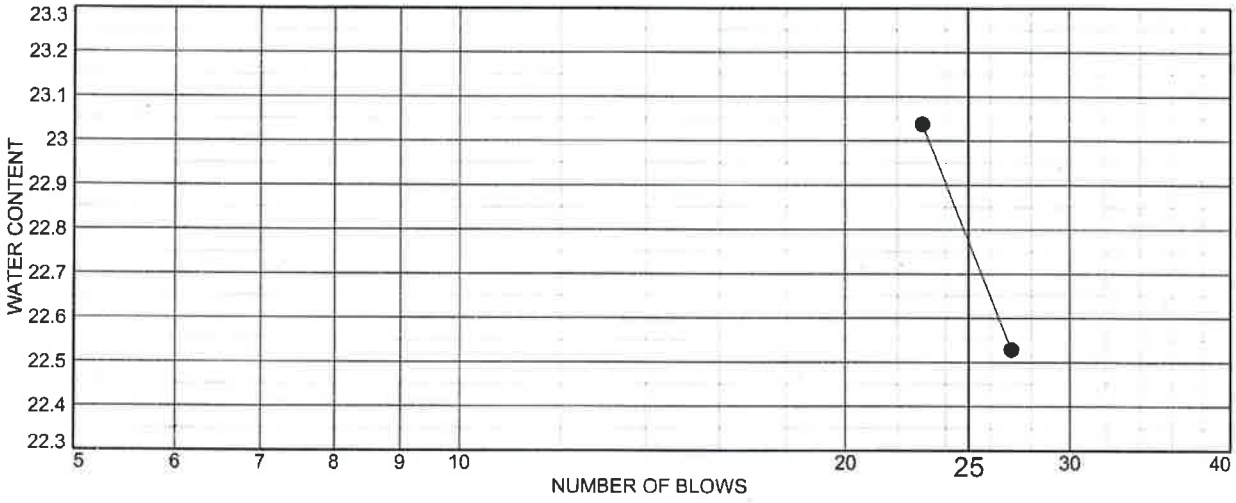
Remarks:

FUNDY Engineering

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		23	11	12			

Project No. 8915 **Client:** Public Works and Government Services

Project: Geotechnical Investigation

● **Source of Sample:** BH05 **Depth:** 2.44 **Sample Number:** 5

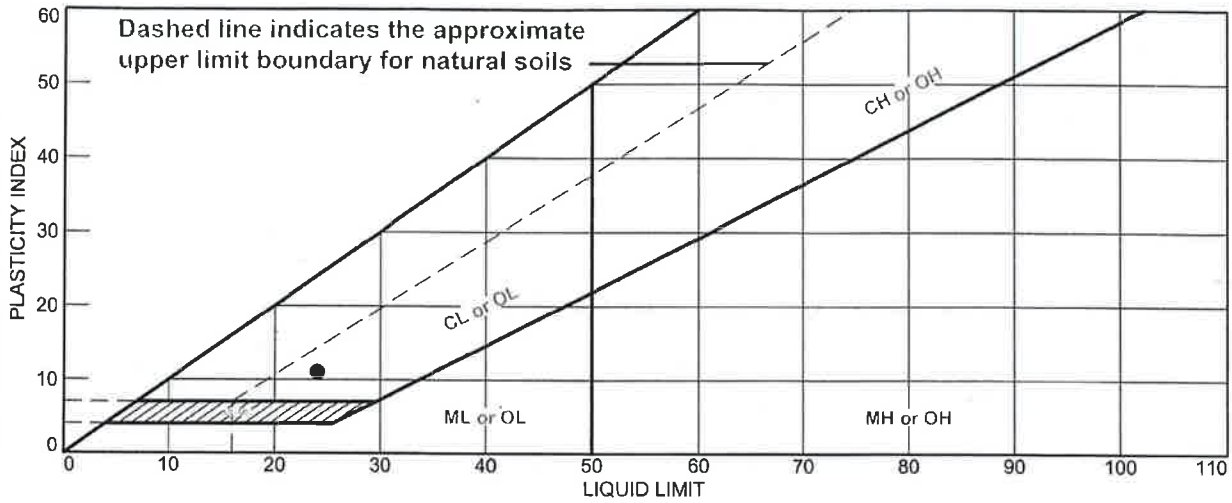
Remarks:

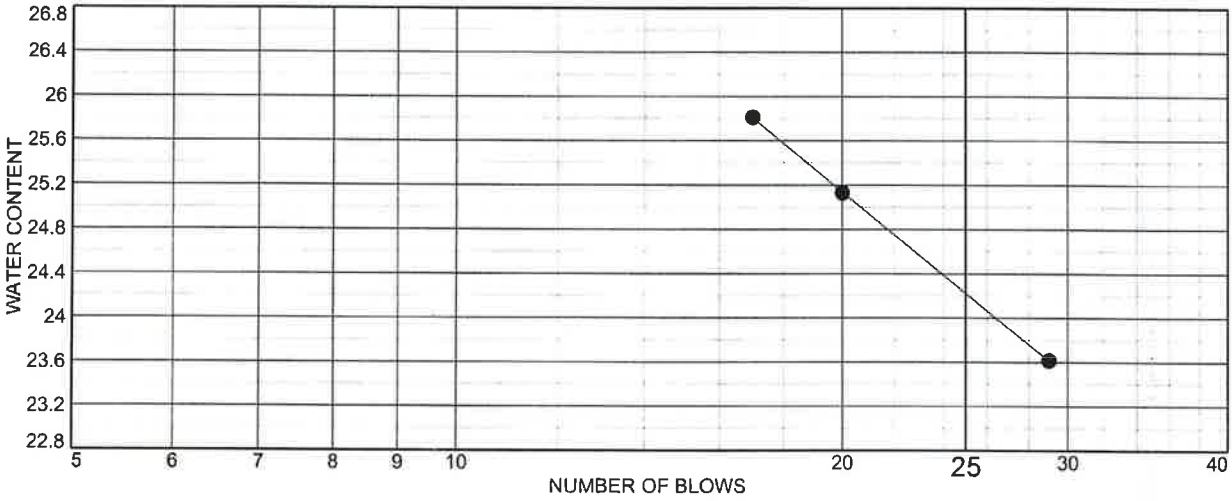
FUNDY Engineering

Figure

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		24	13	11			

Project No. 8915 **Client:** Public Works and Government Services

Project: Geotechnical Investigation

● **Source of Sample:** BH06 **Depth:** 2.44 **Sample Number:** 5

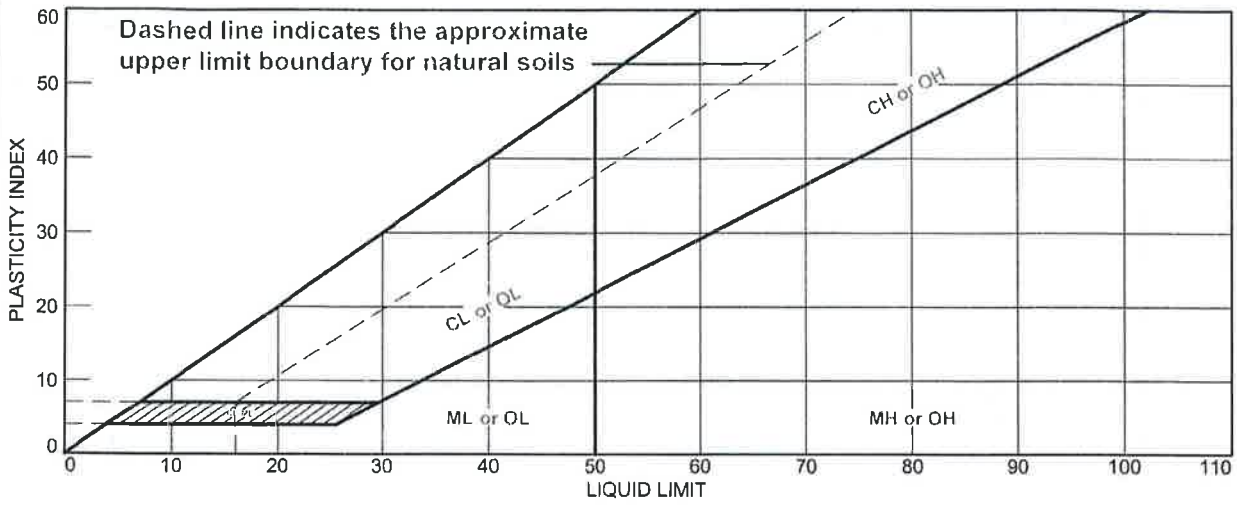
Remarks:

FUNDY Engineering

Figure

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		24	26	NP			

Project No. 8915 **Client:** Public Works and Government Services

Project: Geotechnical Investigation

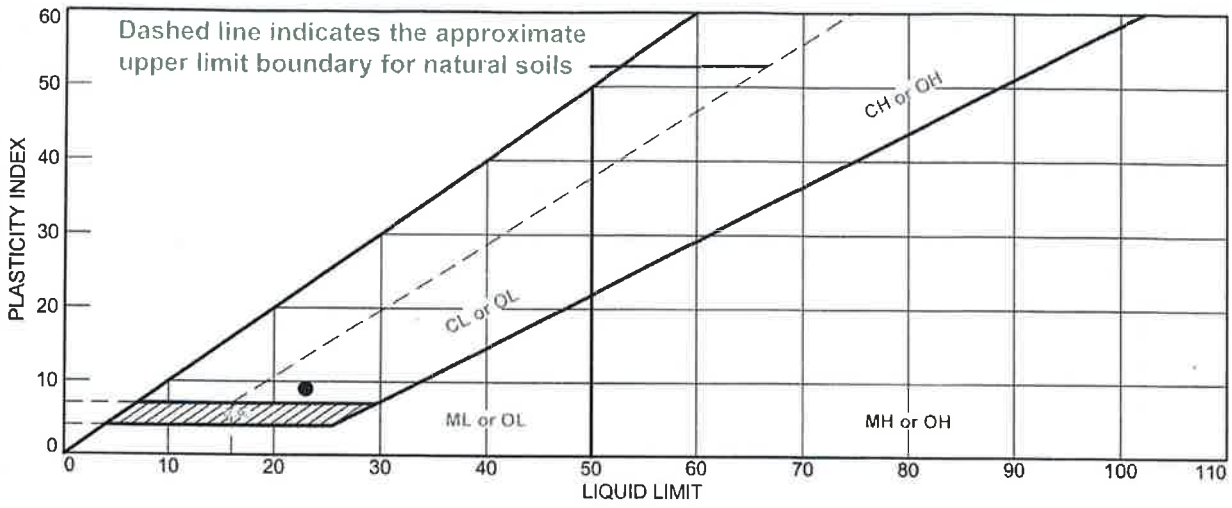
● **Source of Sample:** BH07 **Depth:** 3.66 **Sample Number:** 7

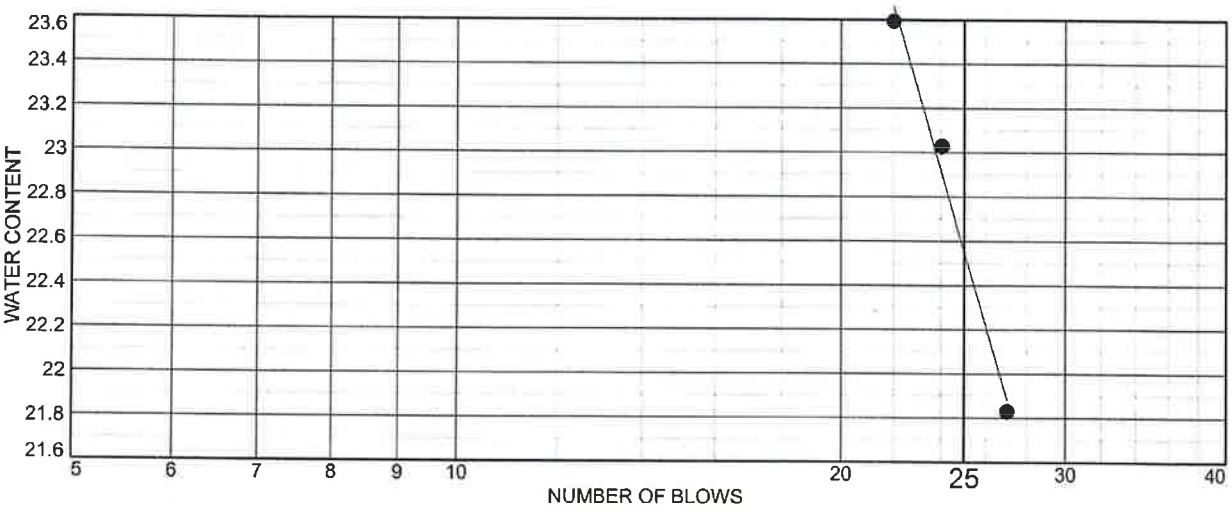
Remarks:

FUNDY Engineering

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		23	14	9			

Project No. 8915 **Client:** Public Works and Government Services

Project: Geotechnical Investigation

● **Source of Sample:** BH08 **Depth:** 3.66 **Sample Number:** 7

Remarks:

FUNDY Engineering

Figure

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report

	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				3	9	26	52	
□				4	7	25	56	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.1158	0.1333						
□			0.6407	0.1080						

	Material Description	USCS	AASHTO
○			
□			

Project No. 8915 **Client:** Public Works and Government Services

Project: Geotechnical Investigation

○ **Source of Sample:** BH01 **Depth:** 1.22 **Sample Number:** 3

□ **Source of Sample:** BH01 **Depth:** 5.49 **Sample Number:** 10

Remarks:

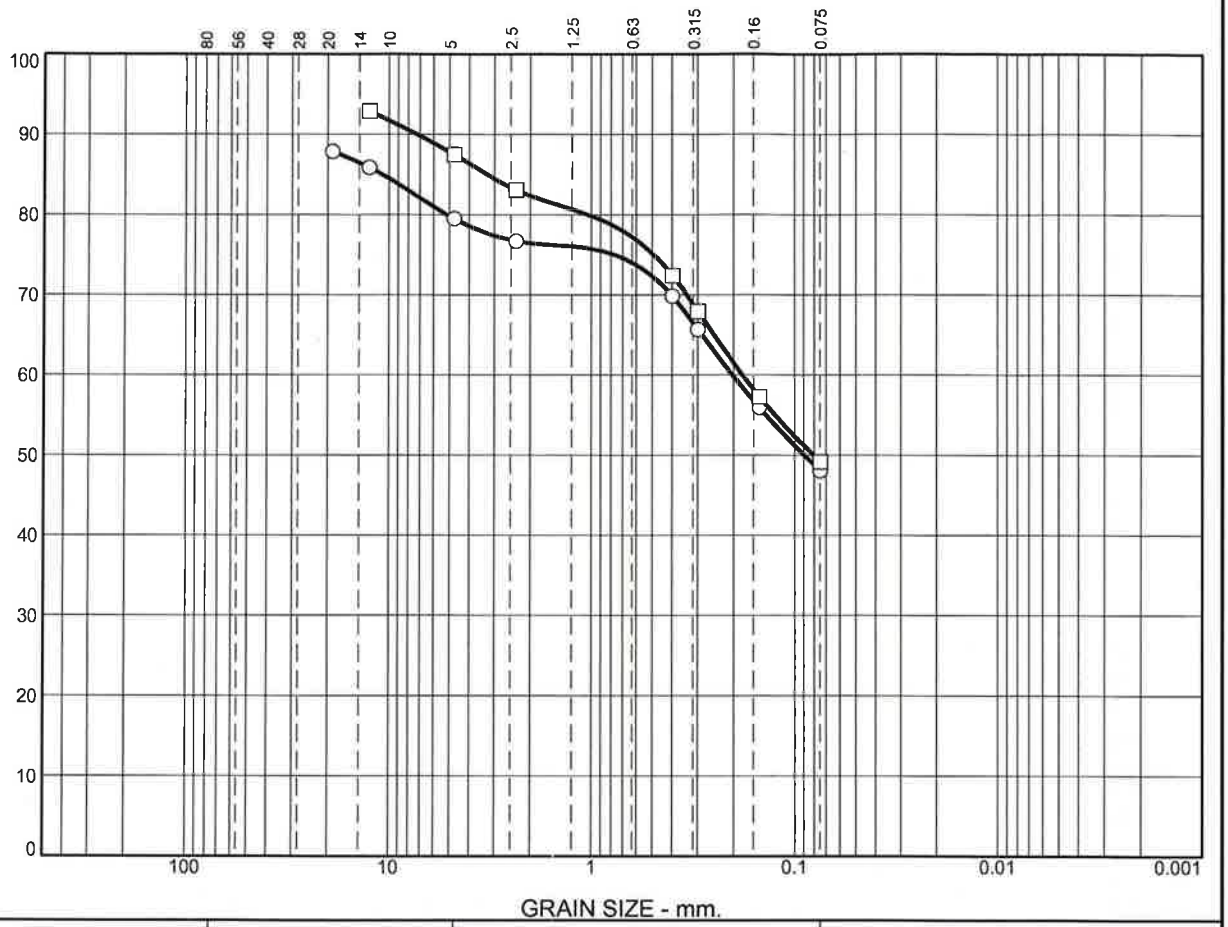
FUNDY Engineering

Figure

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Tested By: Rob Haineault

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				4	5	23	48	
□				5	9	24	49	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			10.7615	0.2035	0.0897					
□			3.2711	0.1815	0.0808					

	Material Description	USCS	AASHTO
○			
□			

Project No. 8915 **Client:** Public Works and Government Services

Project: Geotechnical Investigation

○ **Source of Sample:** BH02 **Depth:** 6.71 **Sample Number:** 12

□ **Source of Sample:** BH02 **Depth:** 2.44 **Sample Number:** 5

Remarks:

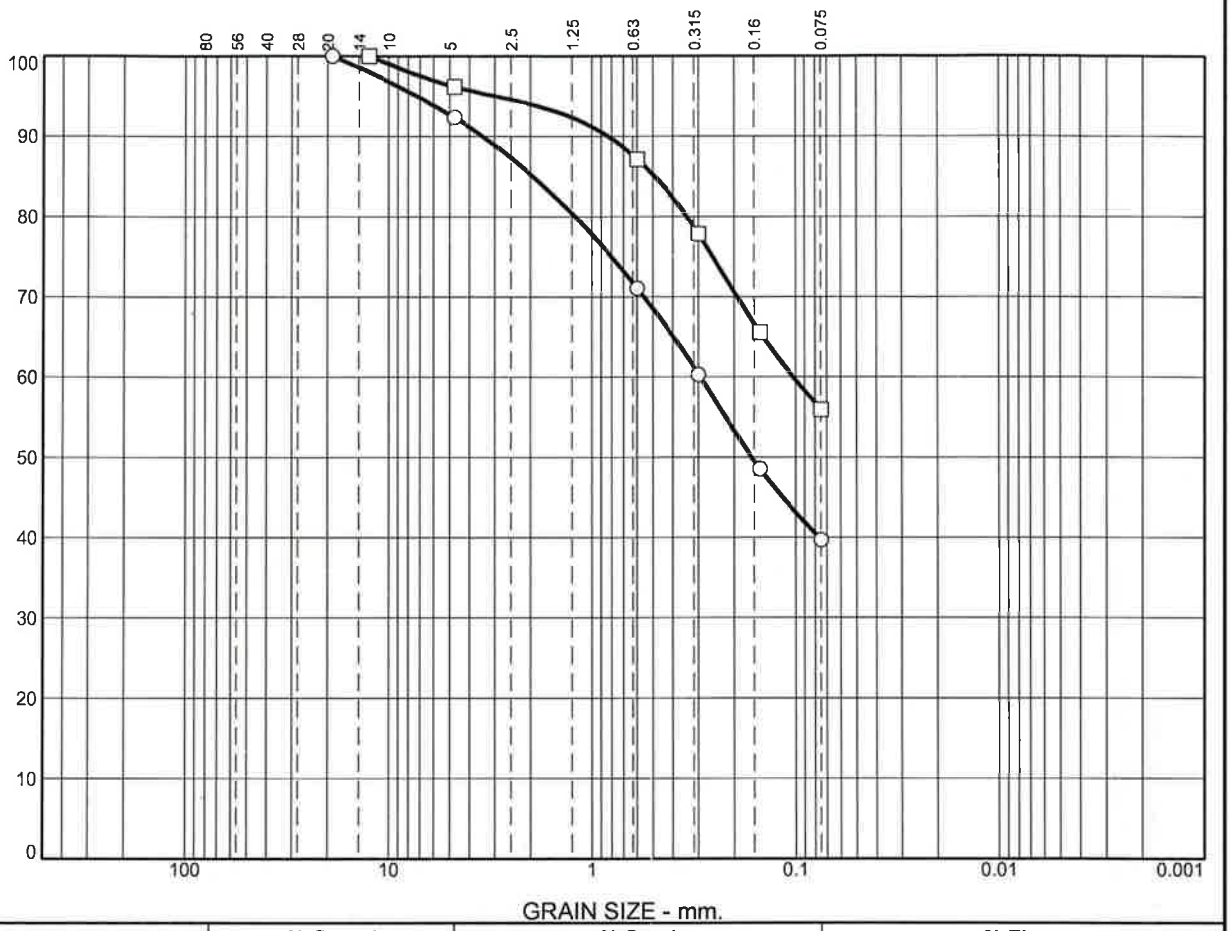
FUNDY Engineering

Figure

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Tested By: Rob Haineault

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0	0	8	7	19	26	40	
□	0	0	4	2	11	27	56	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.9523	0.2944	0.1649					
□			0.4927	0.1030						

	Material Description	USCS	AASHTO
○			
□			

Project No. 8915 **Client:** Public Works and Government Services

Project: Geotechnical Investigation

○ **Source of Sample:** BH03 **Depth:** .61 **Sample Number:** 2

□ **Source of Sample:** BH03 **Depth:** 4.88 **Sample Number:** 9

Remarks:

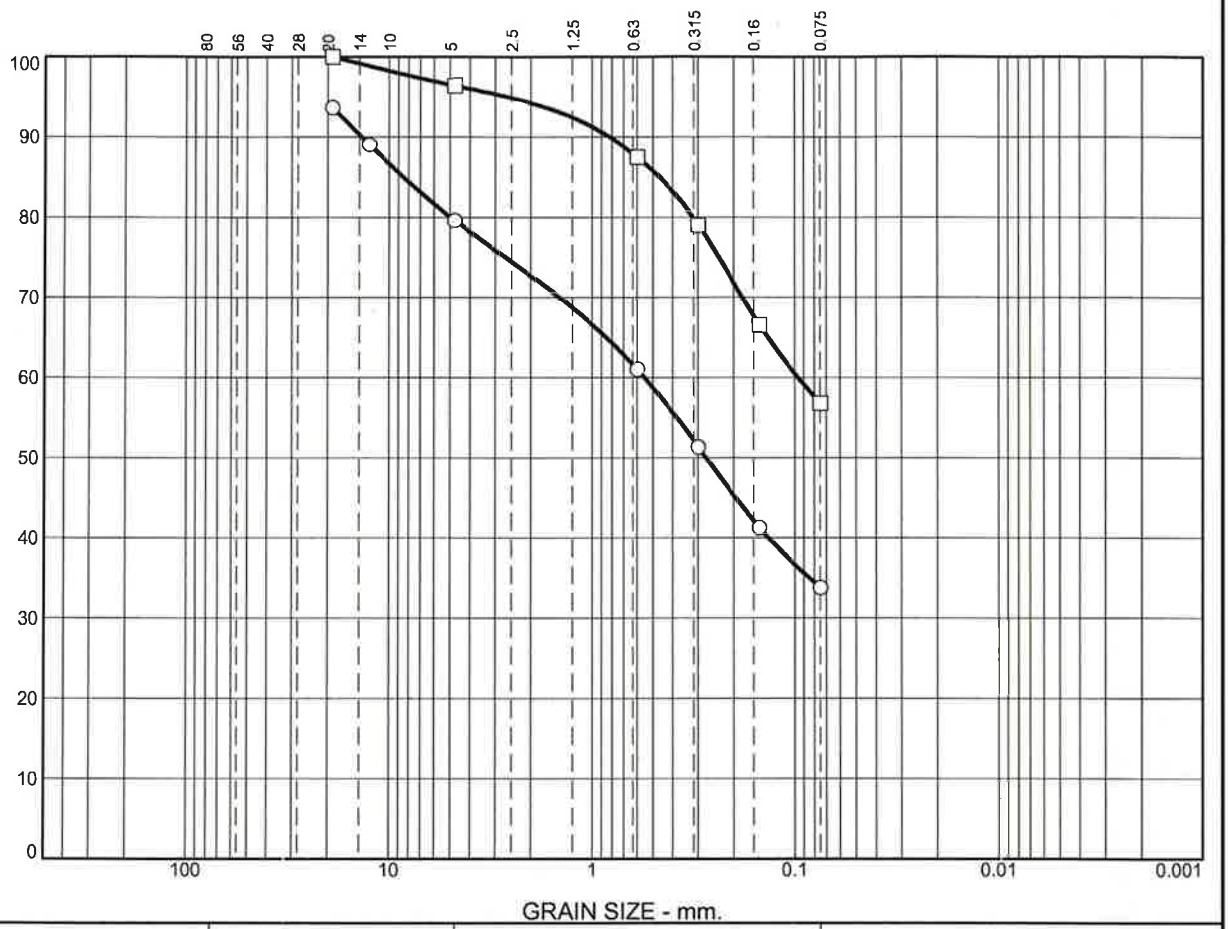
FUNDY Engineering

Figure

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Tested By: Rob Haineault

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				7	17	22	34	
□	0	0	4	2	10	27	57	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			8.4905	0.5534	0.2746					
□			0.4669	0.0963						

	Material Description	USCS	AASHTO
○			
□			

Project No. 8915 **Client:** Public Works and Government Services

Project: Geotechnical Investigation

○ **Source of Sample:** BH04 **Depth:** 1.83 **Sample Number:** 4

□ **Source of Sample:** BH04 **Depth:** 4.27 **Sample Number:** 8

Remarks:

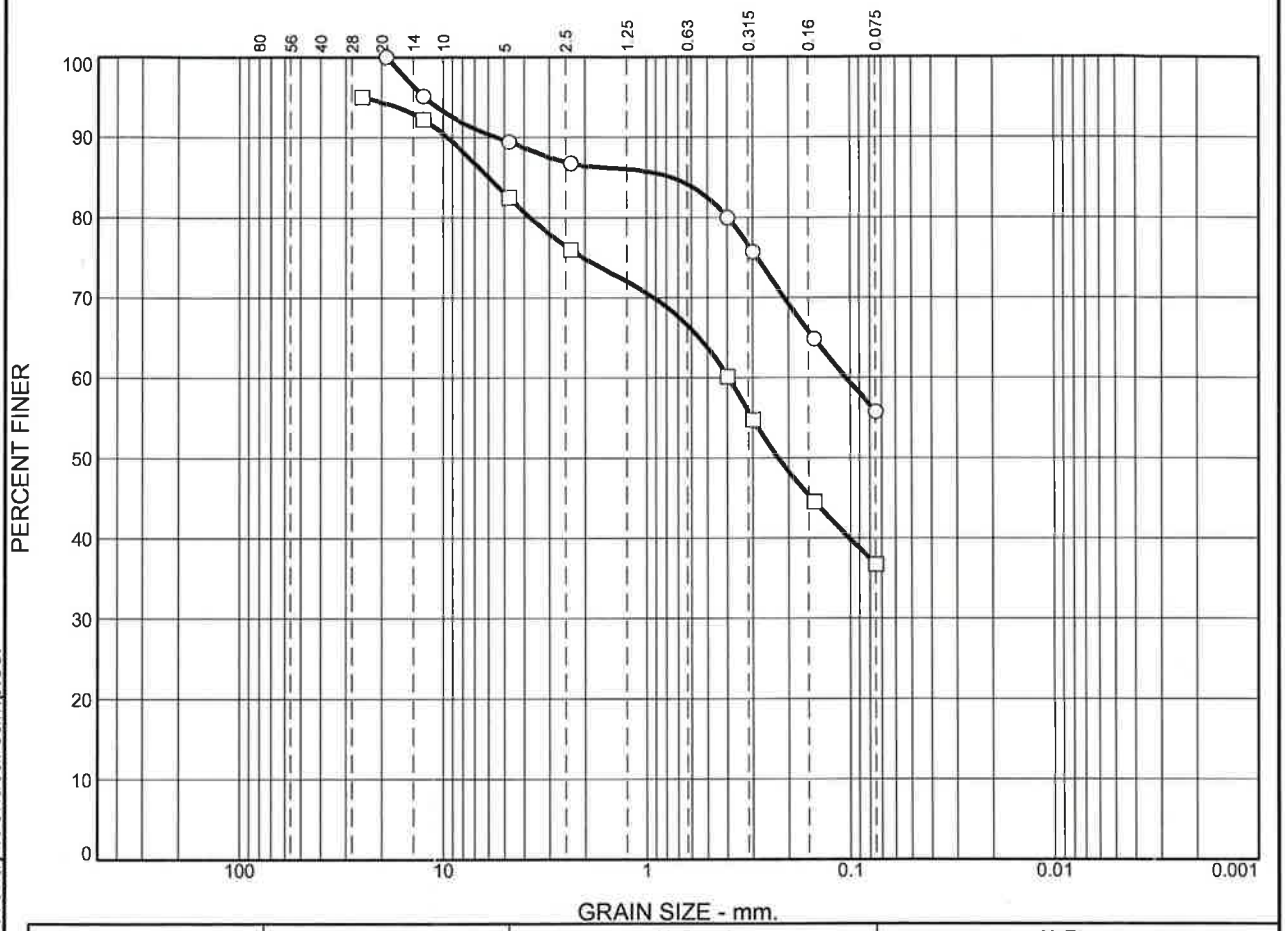
FUNDY Engineering

Figure

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Tested By: Rob Haineault

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0	0	11	3	5	25	56	
□			12	7	14	24	37	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.7554	0.1052						
□			5.9660	0.3964	0.2257					

	Material Description	USCS	AASHTO
○	Very Stiff to Hard Reddish Brown Sandy Clay Till with some Gravel		
□			

Project No. 8915 **Client:** Public Works and Government Services

Project: Geotechnical Investigation

○ **Source of Sample:** BH05 **Depth:** 3.66 **Sample Number:** 7

□ **Source of Sample:** BH05 **Depth:** .61 **Sample Number:** 2

Remarks:

FUNDY Engineering

Figure

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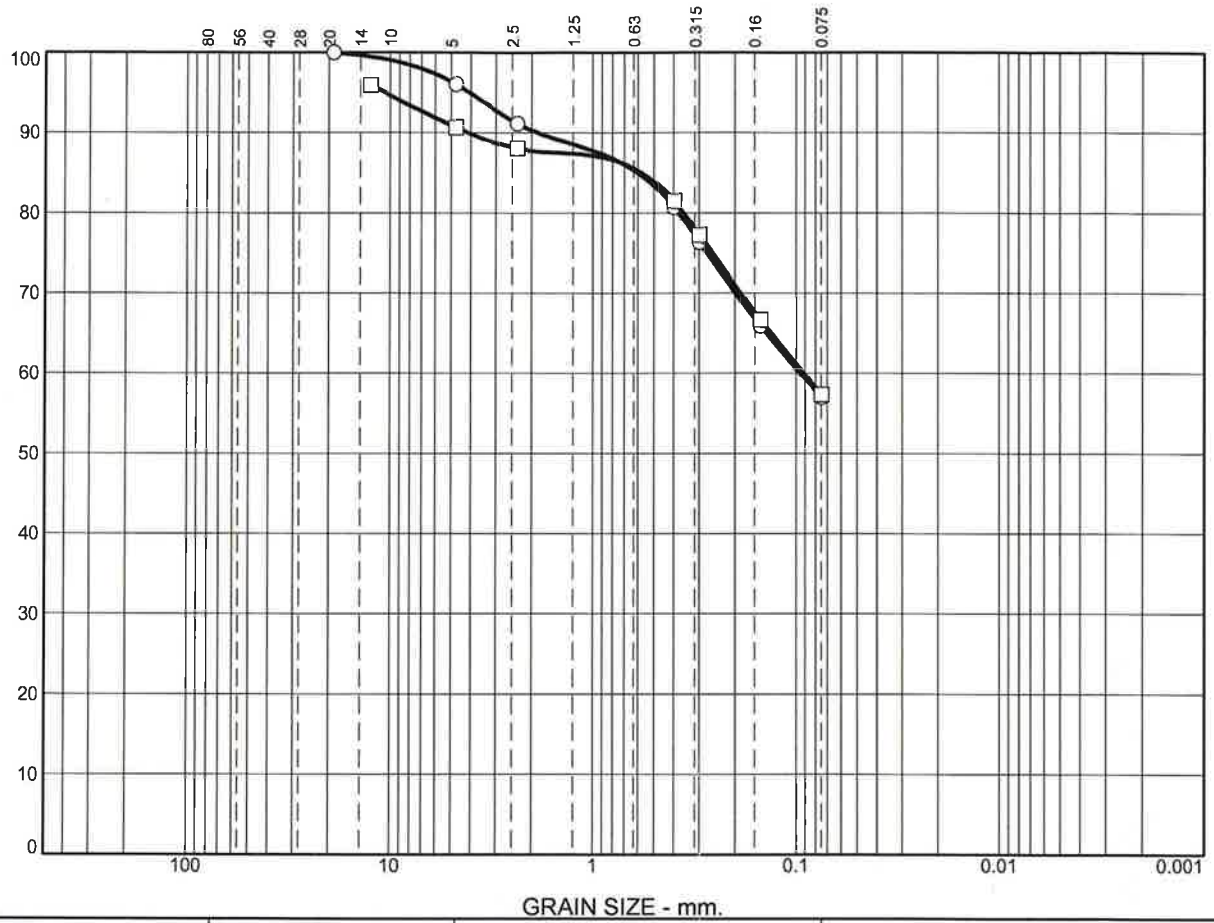
Tested By: Rob Haineault

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0	0	4	6	8	25	57	
□				3	6	25	57	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.6017	0.0956						
□			0.5768	0.0920						

	Material Description	USCS	AASHTO
○	Very Stiff to Hard Clay and Sand Till with Trace Gravel	cl/sc	
□			

Project No. 8915 **Client:** Public Works and Government Services

Project: Geotechnical Investigation

○ **Source of Sample:** BH06 **Depth:** 1.83 **Sample Number:** 4

□ **Source of Sample:** BH06 **Depth:** 4.88 **Sample Number:** 9

Remarks:

FUNDY Engineering

Figure

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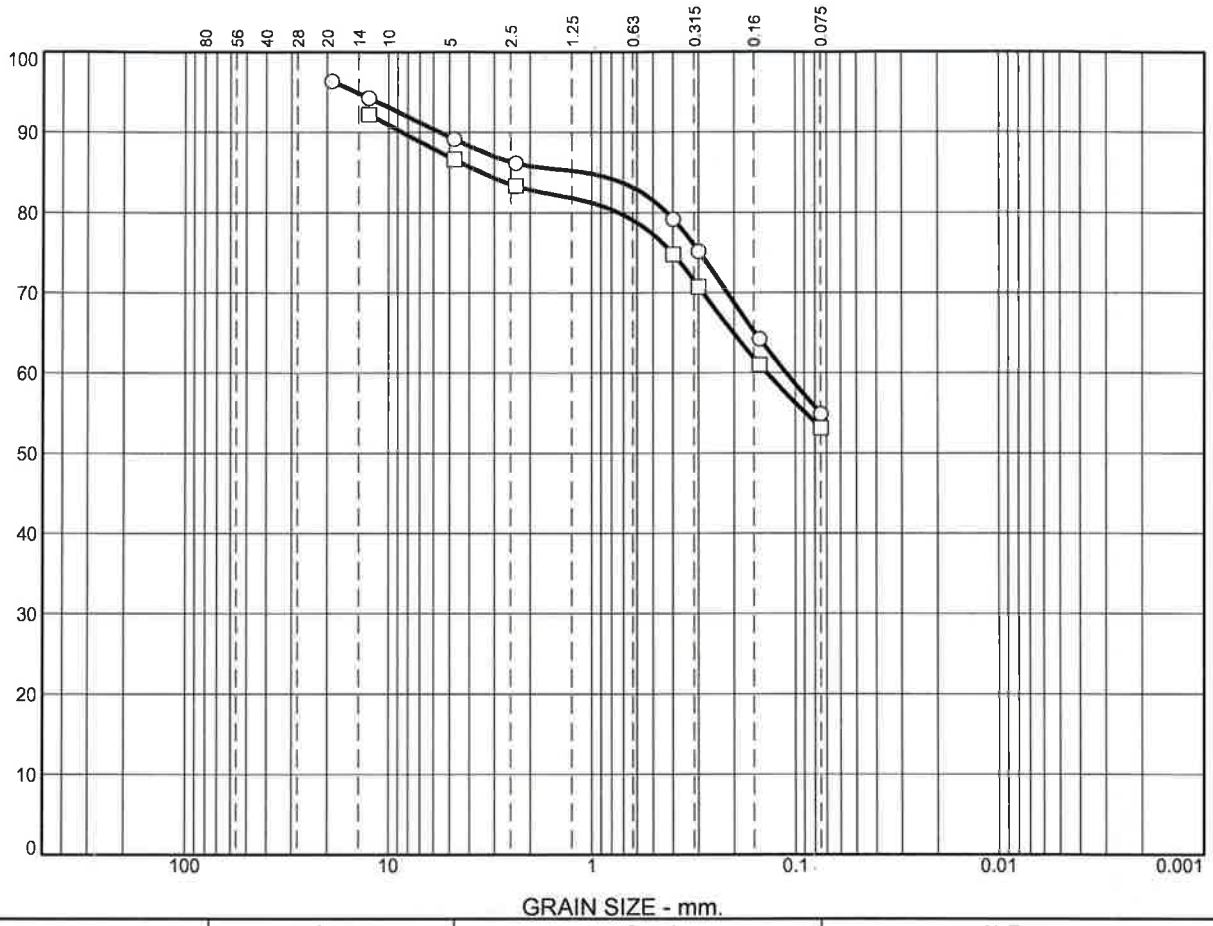
Tested By: Rob Haineault

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				3	6	25	55	
□				4	7	23	53	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
○			1.0946	0.1109						
□			3.4986	0.1382						

	Material Description	USCS	AASHTO
○			
□			

Project No. 8915 **Client:** Public Works and Government Services

Project: Geotechnical Investigation

○ **Source of Sample:** BH07 **Depth:** 4.27 **Sample Number:** 8

□ **Source of Sample:** BH07 **Depth:** 1.22 **Sample Number:** 3

Remarks:

FUNDY Engineering

Figure

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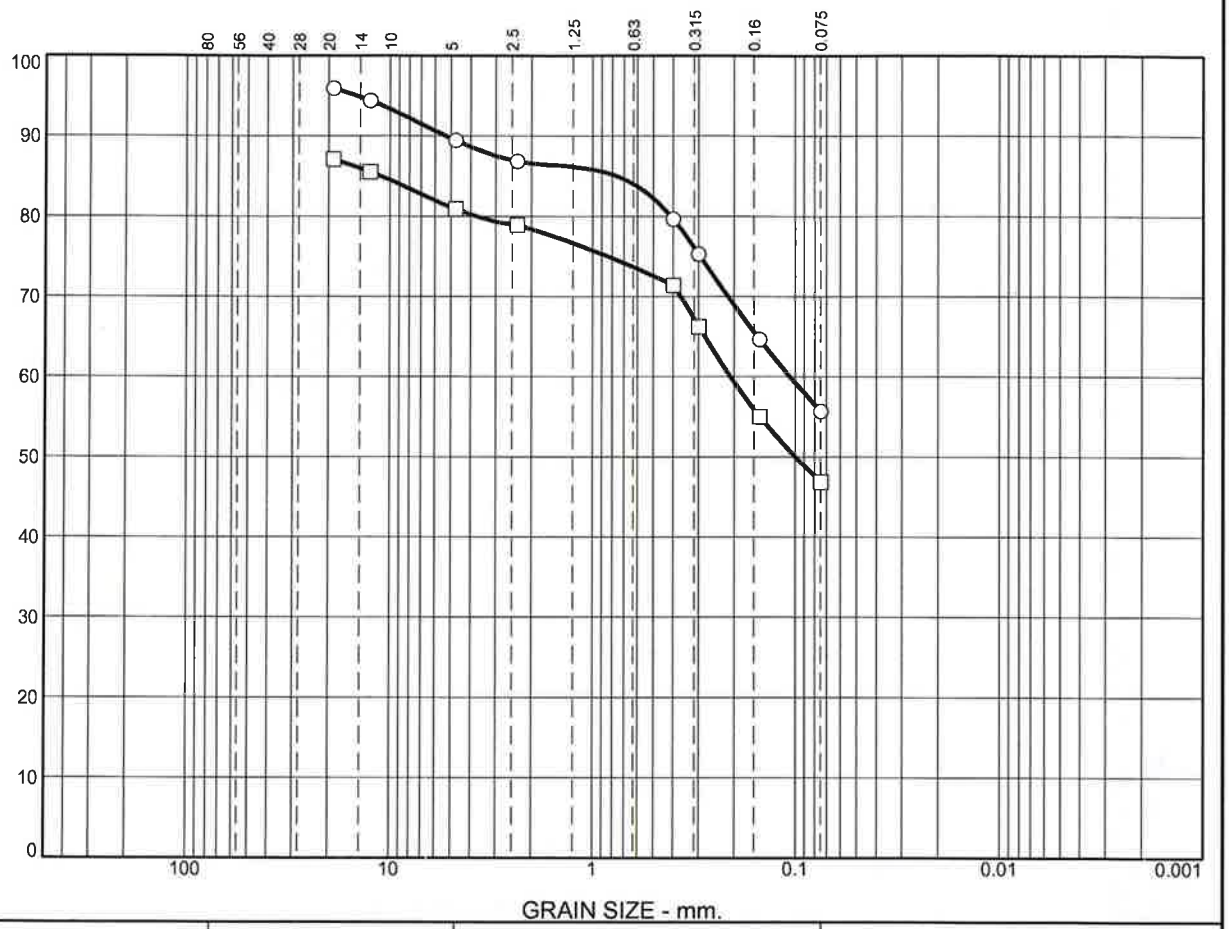
Tested By: Rob Haineault

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				2	7	24	56	
□				3	6	25	47	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.7616	0.1061						
□			11.0942	0.2093	0.0996					

	Material Description	USCS	AASHTO
○			
□			

Project No. 8915 **Client:** Public Works and Government Services

Project: Geotechnical Investigation

○ **Source of Sample:** BH08 **Depth:** 1.22 **Sample Number:** 3

□ **Source of Sample:** BH08 **Depth:** 6.1 **Sample Number:** 11

Remarks:

FUNDY Engineering

Figure

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Tested By: Rob Haineault

rpc

SCIENCE & ENGINEERING • SCIENCE ET INGÉNIERIE

Reference Number: 130656-AQS

Date: January 4, 2012

Client: Travis Henrikson
Fundy Engineering & Consulting
27 Wellington Row
Saint John, NB
E2L 4S1

RADON ANALYSIS

An E-PERM Electret Ion Chamber was used for a short-term radon screening measurement conducted at Westmorland Institution in Dorchester, New Brunswick. The sample was collected over a 28-hour time period. The results can be found in Table 1.

Table 1: Radon Results

Sample Identification	Radon (Bq/m^3)
BH-1	13,408

This report relates only to the sample and information provided to the laboratory

I trust that this information is useful to you and encourage you to call if you have any questions regarding this report.

Darren Tarr
Air Quality Technician

Thelma Green
Manager