

FOUNDATION INVESTIGATION AND DESIGN REPORT
OVERHEAD SIGNS
HIGHWAY 11, BURK'S FALLS TO SOUTH RIVER
ONTARIO
W.P. 742-93-00

Geocres Number: 31E-283

Report to
MMM Group Limited

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September 22, 2009
File: 19-5161-36

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a geotechnical investigation conducted at the location of two proposed overhead sign supports (OHS) to be constructed in connection with the widening of Highway 11, north of Burk's Falls, Ontario.

The purpose of the investigation was to explore the subsurface conditions at the OHS locations and, based on the data obtained, provide a borehole location plan, borehole logs, laboratory test results and a written description of the subsurface conditions.

Thurber carried out the investigation as a sub-consultant to MMM Group Limited under the Ministry of Transportation Ontario (MTO) Agreement Number 5005-A000188.

2 SITE DESCRIPTION

The two sites are located to the north of Burk's Falls, in the Parry Sound District, Township of Strong, Ontario. The approximate locations of the proposed signs are as follows:

Structure	Location
OHS 1	Station 23+770, Township of Strong; approximately 80 m south of the South Horn Lake Road and Highway 11 intersection.
OHS 2	Station 25+050, Township of Strong; approximately 1.2 km north of the South Horn Lake Road and Highway 11 intersection.

The natural ground surface at the sites has a relatively flat topography. Vegetation consists mainly of tall grass, shrubs and mature trees. There is no development within the immediate vicinity of the sites.

The sites lie within the Canadian Shield, characterized by low, rounded hills of Pre-Cambrian bedrock mantled by varying thicknesses of overburden. At this site, the overburden primarily consists of cohesionless sand and silty sand till deposits. The sand deposits probably originated from glacial outwash and are typical of the soils encountered in this stretch of the Highway 11 corridor.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing at the locations of the proposed OHS were carried out on September 5 and 6, 2008. Two sampled boreholes were drilled near each proposed OHS location. A summary of the borehole designations and sampling termination depths/elevations is provided in Table 3.1.

Table 3.1 – Borehole Designations and Depths

Sign	Borehole	Sampled Borehole Termination		Rock Core Depth (m)
		Depth (m)	Elevation	
OHS 1	OH1-A	8.0	312.8	-
	OH1-B	8.1	312.1	-
OHS 2	OH2-A	8.8	311.7	5.1 – 8.8
	OH2-B	5.5	314.6	2.5* – 5.5

* Prior to coring, the borehole was relocated from the original position (and designated Borehole OH2-B(RC))

The approximate locations of the boreholes are shown on the Borehole Locations drawing in Appendix D. The coordinates and elevations of the boreholes are given on the drawing and on the individual Record of Borehole Sheets in Appendix A.

Prior to commencement of drilling, utility clearances were obtained for all borehole locations.

Hollow stem augers were used to advance the boreholes in the overburden. Samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT). Boreholes OH2-A and OH2-B were advanced 3.7 and 3.0 m into bedrock by NQ size diamond coring.

The drilling and sampling operations were supervised on a full time basis by a member of Thurber's technical staff. The supervisor logged the boreholes and processed the recovered soil and rock samples for transport to Thurber's laboratory for further examination and testing.

All rock cores were logged, and the Total Core Recovery (TCR), Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

Groundwater conditions in the open boreholes were observed throughout the drilling operations.

Boreholes OH1-A, OH1-B and OH2-A were backfilled with bentonite grout to 0.6 m, then auger cuttings to the ground surface. Borehole OH2-B was backfilled with bentonite grout to the surface. Completion of the boreholes was carried out in accordance with the requirements of O. Reg. 903 (as amended by O.Reg. 372/07).

4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size distribution analyses (sieve and hydrometer). The results of this testing program are shown on the Record of Borehole sheets in Appendix A and on the figures contained in Appendix B.

Point load tests were carried out on selected samples of intact bedrock upon arrival at the laboratory to assist in evaluation of the compressive strength of the bedrock. The assessed compressive strength values are shown on the Record of Borehole sheets in Appendix A.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendix A for details of the encountered soil stratigraphy. Overall descriptions of the stratigraphy are given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions. It must be recognized that soil conditions may vary between and beyond borehole locations.

The soil stratigraphy encountered in the boreholes near OHS-1 typically consists of topsoil underlain by native deposits of sandy silt, sand and silty sand till. In the boreholes near OHS-2, sand was encountered below the topsoil, and was underlain by bedrock.

More detailed descriptions of the individual strata at each of the proposed structures are presented below.

5.1.1 Topsoil

A surficial topsoil layer was identified in all boreholes. The topsoil thickness ranged from 50 mm to 300 mm.

The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

5.1.2 Sandy Silt

Native brown sandy silt containing trace clay and occasional roots and rootlets was contacted below the topsoil in Boreholes OH1-A and OH1-B. The thickness of the sandy silt layer was

2.9 m. The depth to the base of the sandy silt was 3.0 m (Elevation 317.8 and 317.1) in both boreholes.

SPT 'N' values in the sandy silt layer ranged from 5 to 21 blows for 0.3 m of penetration, indicating a loose to compact relative density. Moisture contents ranged from 23 to 25%, with a value of 45% near the ground surface in Borehole OH1-A.

Grain size distribution curves for two sandy silt samples are presented on the Record of Borehole sheets and on Figure B1 of Appendix B. The results of the laboratory tests are summarized as follows:

Soil Particles	(%)
Gravel	0
Sand	26 to 29
Silt	65 to 69
Clay	5 to 6

5.1.3 Sand

Native dark brown to grey sand containing trace to some silt, trace gravel, trace clay and occasional cobbles and boulders was contacted below the topsoil in Boreholes OH2-A and OH2-B. A layer of grey sand was also contacted in Borehole OH1-A within the silty sand till deposit at 4.5 m (Elevation 316.2) and in Borehole OH1-B below the sandy silt at 3.0 m depth (Elevation 317.1).

The thickness of the sand layer varied from 0.8 to 4.9 m. The depth to the base of the sand layer ranged from 3.1 to 5.5 m (Elevation 315.2 to 317.0).

SPT 'N' values in the sand layer typically ranged from 0 to 22 blows for 0.3 m of penetration, indicating a very loose to compact relative density. In Borehole OH1-B, an SPT value of 54 blows per 0.3 m of penetration was obtained, indicating a very dense relative density. Moisture contents generally ranged from 8% to 23%. Higher moisture contents of 38 to 60% were measured in sand samples obtained near the ground surface in Boreholes OH2-A and OH2-B.

Grain size distribution curves for three sand samples are presented on the Record of Borehole sheets and on Figure B2 of Appendix B. The results of the laboratory tests are summarized as follows:

Soil Particles	(%)
Gravel	0 to 7
Sand	74 to 89
Silt & Clay	11 to 22

In Borehole OH2-A, a 300 mm thick silt layer and an 800 mm thick gravelly zone were encountered within the sand. A grain size distribution curve from the silt layer is presented on Figure B3 of Appendix B.

5.1.4 Silty Sand Till

Grey silty sand till containing trace clay and gravel was encountered in Boreholes OH-1A and OH1-B at 3.0 and 3.8 m (Elevation 317.8 and 316.4). The boreholes were terminated within the silty sand till at 8.0 and 8.1 m depth (Elevations 312.8 and 312.1), indicating a layer thickness of at least 5.0 and 4.3 m.

Generally the SPT 'N' values measured in the silty sand till ranged from 13 to 34 blows per 0.3 m of penetration, indicating a compact to dense relative density. SPT 'N' values of 100 blows for less than 0.3 m of penetration were measured in the silty sand till near the borehole termination depths of 8.0 and 8.1 m.

The moisture content of samples from this deposit ranged from 10% to 17%.

Grain size distribution curves for two silty sand till samples are presented on the Record of Borehole sheets and on Figure B4 of Appendix B. The results of the laboratory tests are summarized as follows:

Soil Particles	(%)
Gravel	1 to 2
Sand	54 to 63
Silt	32 to 36
Clay	4 to 8

Although not encountered in the boreholes, this glacial till layer may contain cobbles and boulders, which may account for the high SPT 'N' values near the borehole termination depths.

5.1.5 Bedrock

In Boreholes OH2-A and OH2-B, the overburden soils described above are underlain by Pre-Cambrian migmatitic gneiss bedrock. The bedrock is described as black with occasional pink bands, and slightly weathered to fresh with horizontal and subvertical joints.

The depths and elevations at which bedrock or auger refusal was encountered are shown in Table 5.1. Upon auger refusal, Borehole OH2-B was relocated 1.2 m west of the initial location, to a location designated Borehole OH2-B(RC), and refusal was met 0.6 m higher than at the original location. The bedrock was proved by coring in Boreholes OH2-A and OH2-B(RC).

Table 5.1 – Bedrock/Refusal Elevations

Borehole	Top of Bedrock/Refusal		Basis
	Depth (m)	Elevation (m)	
OH2-A	5.1	315.4	Cored
OH2-B	3.1	317.0	Auger refusal
OH2-B(RC)	2.5	317.6	Cored

Core recovery in the bedrock was 100% in all runs. The RQD values ranged from 60 to 90%, indicating fair to good rock quality. The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 0 to 5.

The unconfined compressive strength of the rock cores is estimated to range between 44 and 178 MPa indicating medium to very strong rock. These estimated rock strength values are based on point load tests that were conducted on rock cores recovered from the boreholes.

5.2 Water Levels

The water levels observed in the boreholes upon completion of drilling are summarized in Table 5.2.

Table 5.2 – Measured Groundwater Levels

Borehole	Date	Water Level (m)	
		Depth	Elevation
OH1-A	Sept-06-2008	3.3	317.4
OH1-B	Sept-06-2008	4.3	315.8
OH2-A	Sept-06-2008	2.4	318.1
OH2-B	Sept-06-2008	1.9	318.2

The above values are very short-term, unstabilized readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

6 MISCELLANEOUS

The borehole locations were selected by Thurber. The coordinates for the boreholes and the ground surface elevations were obtained by Tulloch Consulting Group.

Thurber obtained utility clearances for the borehole locations prior to drilling.

Eastern Ontario Diamond Drilling Ltd. supplied a track mounted CME 75 drill rig and conducted the drilling, coring, sampling and in-situ testing operations.

The field program was supervised on a full time basis by Mr. Stephane Loranger, C.E.T. of Thurber Engineering Ltd.

Routine laboratory testing was carried out by Thurber Engineering Ltd.

Overall supervision of the field program was conducted by Mr. Alastair E. Gorman, P.Eng. and Ms. R. Palomeque Reyna, P.Eng. Interpretation of the data and preparation of the report were carried out by Mr. Murray R. Anderson, P.Eng. and Ms. R. Palomeque Reyna, P.Eng.

The report was reviewed by Dr. P.K. Chatterji, P.Eng. a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

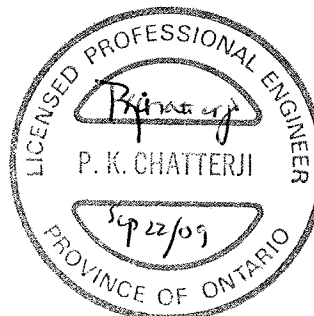
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PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7 INTRODUCTION

This report presents interpretation of the geotechnical data in the factual report and presents foundation design recommendations for two proposed overhead signs (OHS) located along Highway 11, north of Burk's Falls, Ontario.

The discussion and recommendations presented in this report are based on our understanding of the project and on the factual data obtained during the course of the investigation. The plans and profiles used for preparation of this report were provided by MMM Group Limited.

8 SIGN SUPPORT DESIGN RECOMMENDATIONS

8.1 Foundation Design Parameters

Two boreholes were drilled near each of the proposed OHS locations, with a borehole located in close proximity to each sign support foundation. Table 1 immediately following the text provides a listing of boreholes relevant to the design of each OHS and the recommended foundation design parameters for the OHS foundations.

The design of the OHS should be carried out in accordance with the following document:

- Ministry of Transportation, Ontario (2007) "Sign Support Manual", Engineering Standards Branch, Bridge Office.

As per the Sign Support Manual, each proposed OHS will be supported on two caissons. The conditions at these sites meet or exceed the geotechnical parameters assumed in the manual and therefore the standard foundation design is considered appropriate. It is recommended that independent checks be made using the parameters in Table 1 to confirm that the standard design satisfies the lateral load capacity requirements.

In view of the bedrock depth, it may be possible to reduce the caisson depth at OHS-2 as outlined in the Sign Manual. Alternatively the diameter of the rock socket could be reduced to lessen the effort required to advance the caisson into rock, provided the structural design of the foundation is specifically prepared for the site conditions indicated in Table 1.

Where downward sloping ground exists in front of a caisson, reduction of lateral passive resistance should be taken into account during design. For foundation design at the caissons, it can be assumed that full lateral resistance can only be mobilized where the width of the soil in front of the caisson is equal to or greater than approximately 4 times the diameter of the caissons. For sloping ground in front of a caisson, the magnitude of the mobilized passive resistance can be estimated using the following reduction factors:

Table 8.1 Slope Reduction Factors

Slope Inclination	Passive Resistance Reduction Factor
2H : 1V	0.60
2.5H : 1V	0.65
3H : 1V	0.70
4H : 1V	0.75

When designing for portions of the caissons below the groundwater level in cohesionless soils (sands and silts), the submerged soil unit weight, γ' , should be used. The required embedment depth of the caisson will be governed by lateral loads, including wind loads, acting on the sign support.

The depth of frost penetration at the site is 1.9 m. Accordingly all adhesion/skin friction or ultimate passive resistance within the upper 1.9 m should be neglected in foundation design.

8.2 Caisson Installation

Caisson installation should generally be carried out in accordance with SP 903S01.

The contract documents should contain an NSSP alerting the contract bidders of the specific aspects relating to caisson construction for OHS foundation supports at this site. Suggested wordings for this NSSP are provided in Appendix C.

Caisson installation equipment must be able to dislodge, handle and remove cobbles and boulders, and core into medium to very strong bedrock. Cobbles and boulders may also be present in the glacial till.

The bedrock elevation at OHS-2 may vary within short distances, as shown by a difference of 0.6 m between Boreholes OH2-B and OH2-B(RC) located 1.2 m apart. The depth to rock at

the precise location of the sign support may therefore be greater or less than that indicated by the borehole findings. The potential for encountering a sloping bedrock surface should also be anticipated.

Unstabilized groundwater levels were observed at depths of 1.9 to 4.3 m the below ground surface in the boreholes upon completion of drilling. Soil sloughing and water seepage will occur in sands and silts below the groundwater level if the caisson holes are unsupported. Temporary liners must be provided to support the caisson sidewalls and provide seepage cut-off.

The caisson should be dewatered prior to concrete placement or the concrete should be placed by tremie if dewatering is not practical. A head of at least 600 mm of concrete must be maintained in the liner at all times during liner withdrawal to minimize necking of the concrete by the saturated sands.

8.3 Construction Concerns

Concerns during caisson construction mainly involve the handling and removal of cobbles or boulders, soil sloughing and water seepage from caisson sidewalls, coring of medium to very strong rock, and a variable bedrock surface elevation.

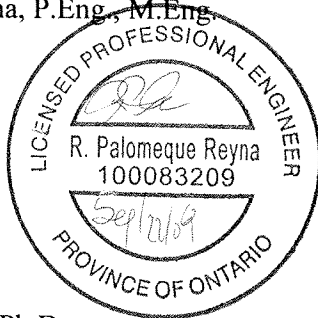
9 CLOSURE

Engineering analysis and preparation of the report were carried out by Mr. Murray R. Anderson, P.Eng and Ms. R. Palomeque Reyna, P.Eng.

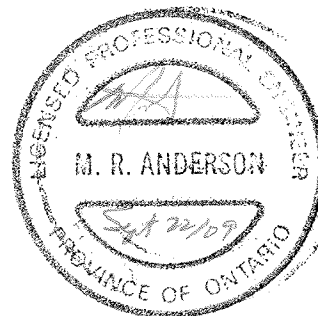
The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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TABLE 1
GEOTECHNICAL DESIGN PARAMETERS
OVERHEAD SIGN SUPPORTS
HIGHWAY 11, BURK'S FALLS TO SOUTH RIVER

Site Number and Approximate Location	Reference Borehole Number	Simplified Subsurface Stratigraphy for Design	Depth Below Existing Grade (m)	Geotechnical Design Parameters					
				ϕ' (deg.)	γ (kN/m ³)	γ' (kN/m ³)	K_p	f_{horiz} (kPa)	Groundwater Depth (m)
Highway 11, Station 23+770 Township of Strong	OH1-A	Sandy Silt (Loose to compact)	1.9 to 3.0	30	20	10	3.0	-	1.0 (below existing grade)
	OH1-B	Silty sand till with sand layers (Compact to dense)	3.0 – 8.0	32	-	10	3.3	-	-
Highway 11, Station 25+050 Township of Strong	OH2-A	Sand (Compact)	1.9 – 5.1	32	20	10	3.3	-	1.0 (below existing grade)
		Bedrock	Below 5.1	-	-	-	-	4000	-
Highway 11, Station 25+050 Township of Strong	OH2-B	Sand (Compact)	1.9 – 3.1	30	20	10	3.0	-	1.0 (below existing grade)
		Bedrock	Below 3.1	-	-	-	-	4000	-

Notes: This table must be read in conjunction with the report.

The ultimate lateral passive resistance within 1.9 m of the ground surface should be neglected in consideration of frost action and surficial disturbance.

Legend:

ϕ'	=	angle of internal friction
γ	=	bulk unit weight
γ'	=	submerged unit weight (use below design water level)
K_p	=	coefficient of passive earth pressure
f_{horiz}	=	horizontal bearing resistance at ULS

Appendix A
Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

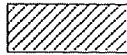




 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ($W_L < 30\%$).
		CI	Inorganic clays of medium plasticity, silty clays. ($30\% < W_L < 50\%$).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION		SYMBOLS	
Fresh (FR)	No visible signs of weathering.		
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

DISCONTINUITY SPACING		STRENGTH CLASSIFICATION			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
		Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
		Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS	
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.

RECORD OF BOREHOLE No OH1-A

1 OF 1

METRIC

G.W.P. 19-5161-36 LOCATION N 5 057 274.8 E 311 562.6 ORIGINATED BY SLL
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SLL
 DATUM Geodetic DATE 2008.09.06 - 2008.09.06 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
								20 40 60 80 100						
320.7														
0.0 0.1	TOPSOIL: (100mm) Black		1	SS	9									
	Sandy SILT, trace clay, occasional roots and rootlets Loose to Compact Brown Wet		2	SS	13									
			3	SS	8									
			4	SS	6									
317.8														
3.0	Silty SAND, trace gravel Compact Grey Moist (TILL)		5	SS	25									
			6	SS	30									
316.2														
4.5	SAND, trace gravel, some silt, trace clay Loose Grey Wet		7	SS	6									
315.2														
5.5	Silty SAND, trace gravel, trace clay Dense Grey Wet (TILL)		8	SS	31									
312.8	Very Dense		9	SS	100/ 200									
8.0	BOREHOLE TERMINATED AT 8.0m. BOREHOLE CAVED TO 4.1m. WATER LEVEL AT 3.3m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE GROUT TO 0.6m THEN AUGER CUTTINGS TO SURFACE.													

ONTMT4S 6136 GPJ 11/4/08

RECORD OF BOREHOLE No OH1-B

1 OF 1

METRIC

G.W.P. 19-5161-36 LOCATION N 5 057 274.3 E 311 544.0 ORIGINATED BY SLL
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SLL
 DATUM Geodetic DATE 2088.09.06 - 2008.09.06 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							WATER CONTENT (%) w _p w w _L					
320.1								20	40	60	80	100								
0.0	TOPSOIL: (50mm) Black		1	SS	16		320													
	Sandy SILT, trace clay, occasional roots and rootlets																			
	Loose to Compact		2	SS	21		319													
	Brown																			
	Moist to Wet		3	SS	10		318												0 26 69 5	
			4	SS	5															
317.1																				
3.0	SAND, trace to some silt, trace clay, occasional cobbles		5	SS	54		317												0 89 11 (SI+CL)	
	Very Dense																			
	Grey																			
	Moist to Wet																			
316.4																				
3.8	Silty SAND, trace gravel		6	SS	34		316													
	Dense to Compact																			
	Grey																			
	Moist		7	SS	13		315													
	(TILL)																			
			8	SS	16		314												1 63 32 4	
	Layer of sand: (400mm)						313													

+ ³, X ³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OH2-A

1 OF 1

METRIC

G.W.P. 19-5161-36 LOCATION N 5 058 413.2 E 311 050.2 ORIGINATED BY SLL
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/NW Casing/NQ Rods COMPILED BY SA
 DATUM Geodetic DATE 2008.09.05 - 2008.09.06 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
320.5								20	40	60	80	100			
0.0	TOPSOIL: (200mm)														
0.2	Black		1	SS	3										
	SAND, trace silt, occasional rootlets Very Loose to Loose Dark Brown to Brown Moist Layer of silt at 1.0m (300mm)		2	SS	5										0 18 78 4
	Gravelly zone at 1.4m (800mm) Compact		3	SS	22										
	Boulder at 2.2m occasional cobbles and boulders Grey Wet														Auger refusal at 2.2m. Cored through boulder.
			4	SS	20										
315.4			5	SS	10										
5.1	MIGMATITIC GNEISS BEDROCK, fresh to slightly weathered, massive, black, pink quartz bands		1	RC										FI	RUN 1# TCR=100%, SCR=94%, RQD=83%, UCS=178MPa average
	Horizontal joints at 5.9, 6.7, and 6.9m. Sub-vertical joints at 6.1, 6.2, 6.4, and 6.5m.		2	RC										2	RUN 2# TCR=100%, SCR=100%, RQD=72%, UCS=111MPa average
	Pink quartz bands Horizontal joints at 7.4, 7.5, 7.6, 7.7, 8.2, 8.3, and 8.7m.													5	RUN 3# TCR=100%, SCR=100%, RQD=60%, UCS=44MPa average
	Sub-vertical joints at 7.6, 8.7, and 8.8m.		3	RC										1	
														2	
														1	
														2	
311.7															
8.8	END OF BOREHOLE AT 8.8m. WATER LEVEL AT 2.4m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE GROUT TO 0.6m AND DRILL CUTTINGS TO SURFACE.														

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+ ³ , x ³ : Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OH2-B

1 OF 1

METRIC

G.W.P. 19-5161-36 LOCATION N 5 058 406.3 E 311 034.6 ORIGINATED BY SLL
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/NW Casing/NQ Rods COMPILED BY SA
 DATUM Geodetic DATE 2008.09.05 - 2008.09.05 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
320.1														
0.0	TOPSOIL: (300mm)						320							
319.8	Dark Brown		1	SS	3									
0.3	SAND, some silt, trace gravel, trace clay, occasional roots and rootlets Very Loose to Compact Dark Brown to Brown Moist to Wet		2	SS	0		319							
			3	SS	18									
			4	SS	16		318							
317.0			5	SS	50/									
3.1	AUGER REFUSAL AT 3.1m. MOVED DRILL RIG 1.2m WEST. REFER TO LOG OF BOREHOLE OH2-B(RC)				.050									

ONTMT4S 6136.GPJ 11/4/08

RECORD OF BOREHOLE No OH2-B(RC)

1 OF 1

METRIC

G.W.P. 19-5161-36 LOCATION N 5 058 406.3 E 311 034.6 ORIGINATED BY SLL
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/NW Casing/NQ Rods COMPILED BY SA
 DATUM Geodetic DATE 2008.09.05 - 2008.09.05 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			WATER CONTENT (%) w _p w w _L				
320.1							20 40 60 80 100								
0.0	Augered to refusal at 2.5m.														
317.6							320								
							319								
							318								
2.5	MIGMATITIC GNEISS BEDROCK , fresh to slightly weathered, massive, black, pink quartz bands Sub-vertical joints at 2.5, 2.6, 2.7, 2.8, 2.9, 3.0, 3.1, and 3.3m.														
			1	RC			317								
	Horizontal joints at 4.1, 4.2, 4.8, 5.1, 5.3, and 5.4m.						316								
	Sub-vertical joints at 4.6, and 5.1 to 5.3m.		2	RC			315								
314.6															
5.5	END OF BOREHOLE AT 5.5m. WATER LEVEL AT 1.9m UPON COMPLETION OF DRILLING. BOREHOLES BACKFILLED WITH BENTONITE TO SURFACE.														

+³ ×³: Numbers refer to
Sensitivity

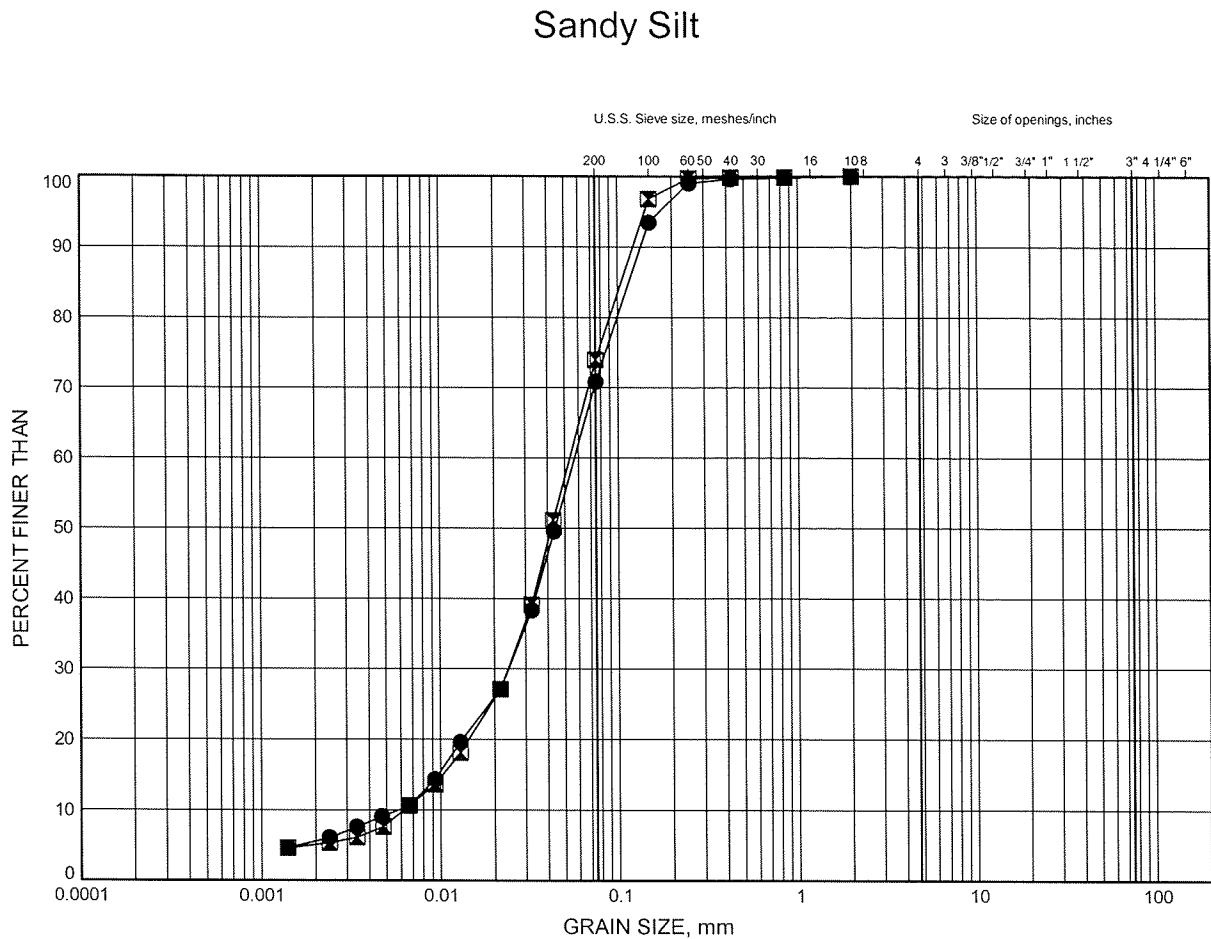
20
15
10

(%) STRAIN AT FAILURE

Appendix B
Laboratory Test Results

HWY 11 OVERHEAD SIGN GRAIN SIZE DISTRIBUTION

FIGURE B1



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND			GRAVEL		SIZE

LEGEND

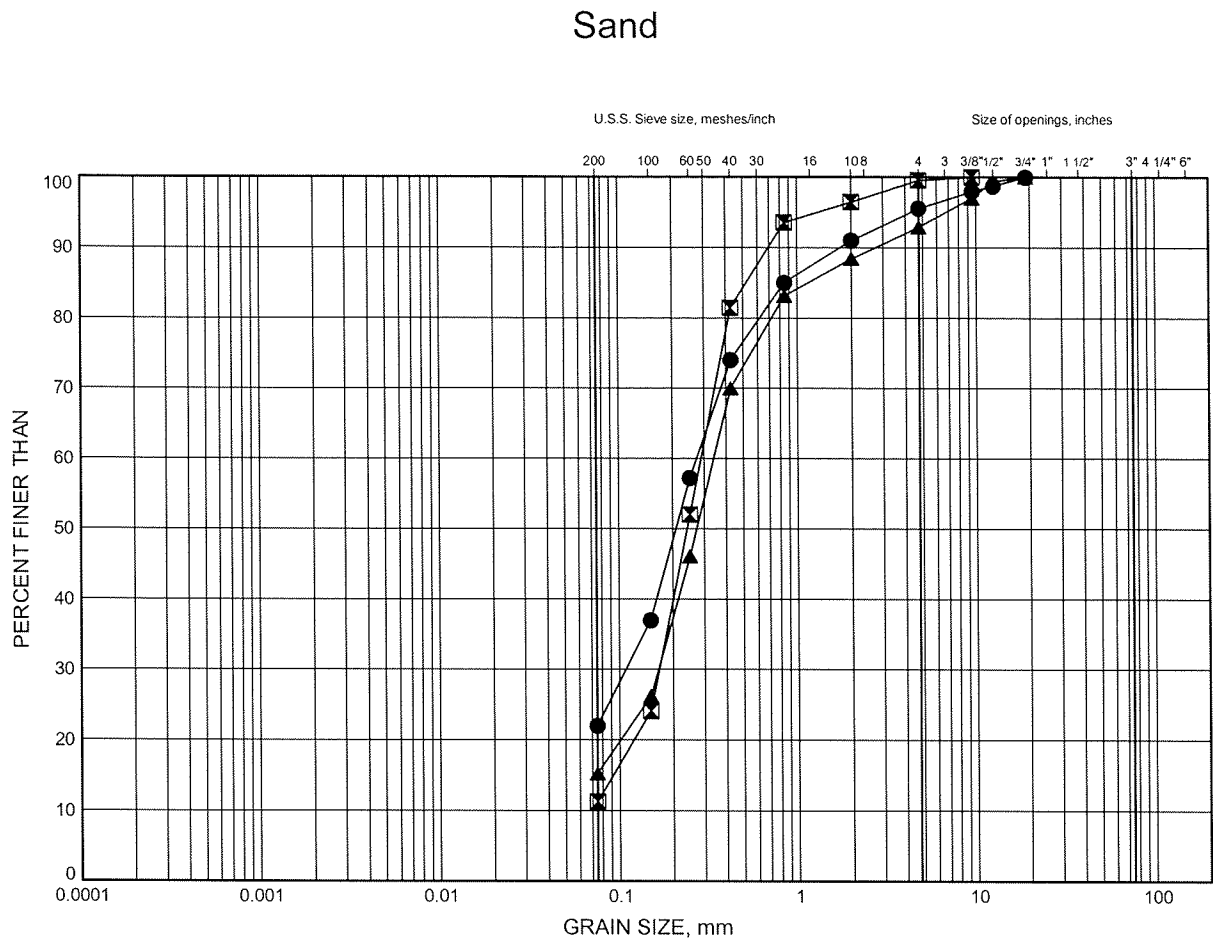
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OH1-A	1.83	318.91
⊠	OH1-B	1.83	318.32



W.P.# 19-5161-36
Prepared By MFA
Checked By RPR

HWY 11 OVERHEAD SIGN GRAIN SIZE DISTRIBUTION

FIGURE B2



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

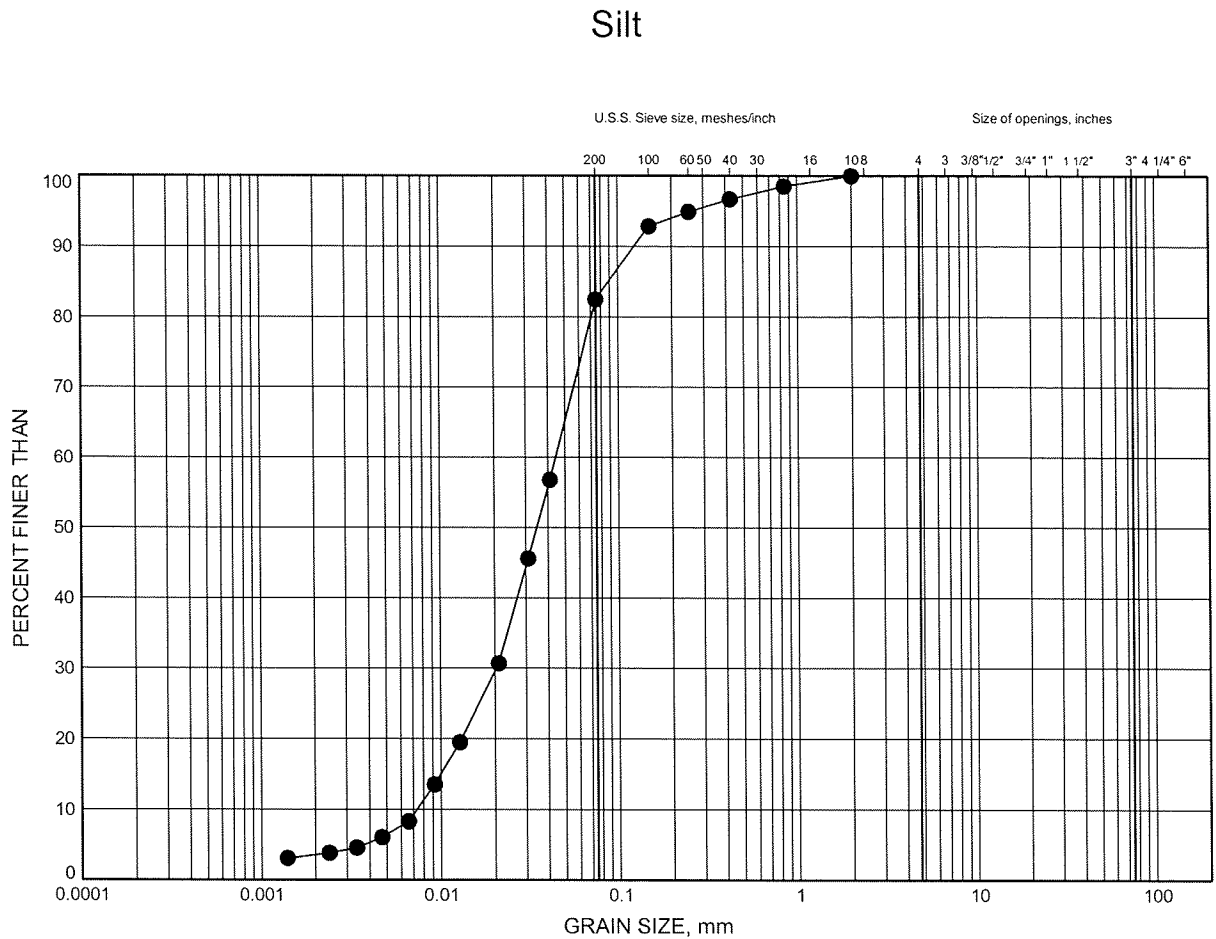
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OH1-A	4.88	315.86
⊠	OH1-B	3.35	316.80
▲	OH2-B	1.83	318.26



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Prepared By MFA
Checked By RPR

HWY 11 OVERHEAD SIGN GRAIN SIZE DISTRIBUTION

FIGURE B3



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OH2-A	1.07	319.43

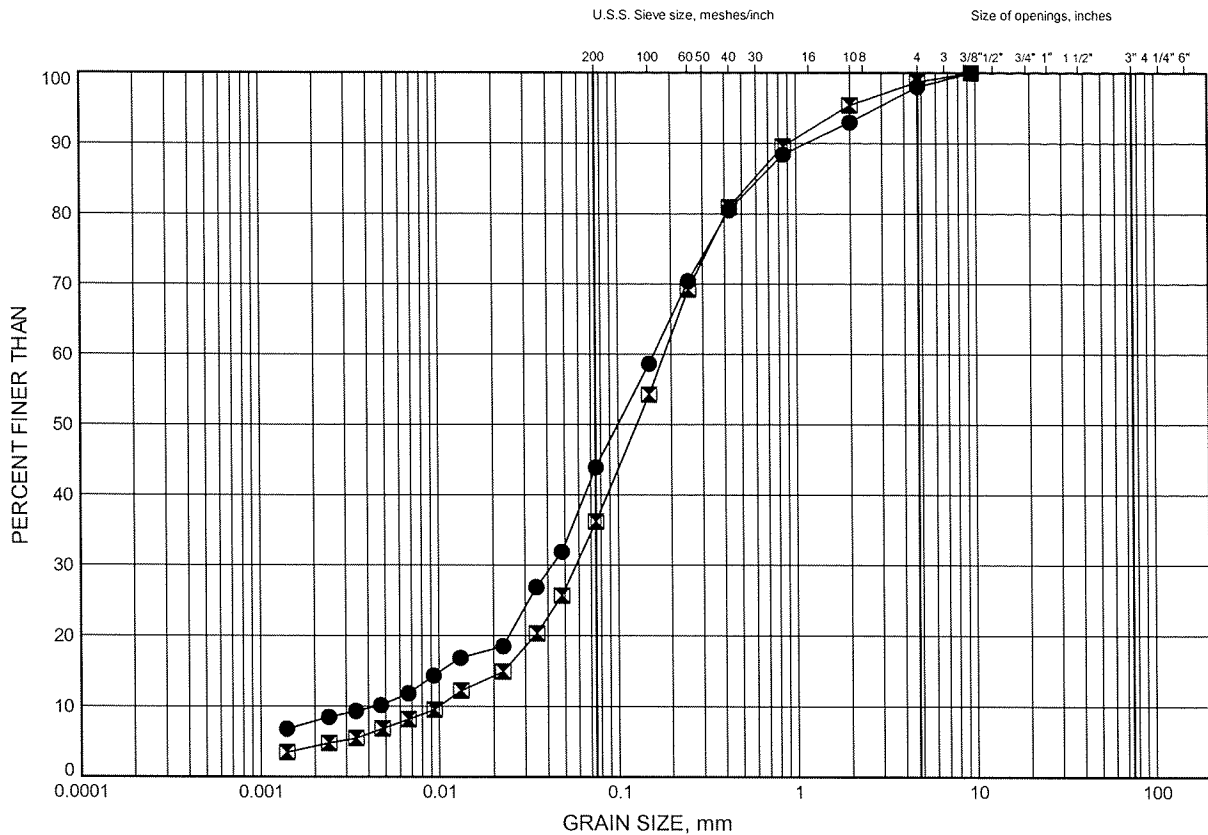


W.P.# 19-5161-36
Prepared By MFA
Checked By RPR

HWY 11 OVERHEAD SIGN GRAIN SIZE DISTRIBUTION

FIGURE B4

Silty Sand Till



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OH1-A	6.40	314.33
◻	OH1-B	6.40	313.75



W.P.# 19-5161-36
Prepared By MFA
Checked By RPR

Appendix C

List of SPs and OPSS, and Suggested Text for Selected NSSP

1. List of Special Provisions and OPSS Documents Referenced in this Report

- SP 903S01

2. Suggested Text for NSSP on:

“Augered Caisson Construction for Overhead Sign Supports (OHS) Foundations”

The Contractor is advised that variable types of subsurface materials may be encountered at the locations of the OHS foundations. For additional information regarding subsurface conditions, the Contractor is referred to the Foundation Investigation Report.

For bidding purposes, the Contractor shall assume the following:

1. The subsurface conditions at an augered caisson location are the same as those encountered in the borehole closest to the subject caisson location.
2. There is a probability that cobbles and boulders may be encountered within the glacial till deposits. Caisson installation equipment must be able to dislodge, handle, remove or otherwise penetrate these obstructions and hard layers.
3. Equipment capable of coring into medium to very strong bedrock (compressive strength of 44 to 178 MPa), and potentially rock shatter or rockfill, must be supplied to install the caissons. The bedrock elevation may slope and/or vary from that determined at the borehole locations, and therefore the depth of rock coring required may be greater or less than that indicated.
4. Water seepage and/or soil sloughing into the caisson hole will occur from existing cohesionless soils. The cohesionless soils would be susceptible to disturbance under conditions of unbalanced hydrostatic head. Temporary liners must be employed to support the caisson sidewalls and provide seepage cut-off.

The caissons must be dewatered prior to concrete placement or the concrete must be placed by tremie if dewatering of the caisson is not practical. A head of at least 600 mm of concrete must be maintained inside the liner at all times to minimize necking during liner withdrawal.

The Contractor is responsible for constructing the OHS foundations without disturbing the material at the sides or bases of the foundations.

Appendix D






Drawing titled "Borehole Locations"

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

BOREHOLE LOCATIONS



LEGEND

- | | |
|---|---------------------------------------|
|  | Borehole |
|  | Borehole and Cone |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
|  | Water Level |
|  | Head Artesian Water |
|  | Piezometer |
| 90% | Rock Quality Designation (RQD) |
| A/R | Auger Refusal |

NO	ELEVATION	NORTHING	EASTING
OH1-A	320.7	5 057 274.8	311 562.6
OH1-B	320.1	5 057 274.3	311 544.0
OH2-A	320.5	5 058 413.2	311 050.2
OH2-B	320.1	5 058 406.3	311 034.6

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 31E-283

[illegible]