

**FOUNDATION INVESTIGATION REPORT  
DOANE ROAD UNDERPASS  
HIGHWAY 404 EXTENSION  
FROM GREEN LANE TO WOODBINE AVENUE/RAVENSHOE ROAD  
ONTARIO  
G.W.P. 2109-05-00**

**Geocres Number: 31D-483**

**Report to**

**Philips Engineering / Hatch Mott MacDonald Joint Venture**

Thurber Engineering Ltd.  
2010 Winston Park Drive, Suite 103  
Oakville, Ontario  
L6H 5R7  
Phone: (905) 829 8666  
Fax: (905) 829 1166

September 9, 2009  
File: 19-1605-96

\\Torserver1\Projects\19\1605\96 Hwy404  
Foundations\Reports & Memos\Doane Rd\19160596 Doane  
Rd FIR- Final.doc



## TABLE OF CONTENTS

### PART 1      FACTUAL INFORMATION

1	INTRODUCTION .....	1
2	SITE DESCRIPTION .....	1
3	SITE INVESTIGATION AND FIELD TESTING.....	2
4	LABORATORY TESTING .....	3
5	DESCRIPTION OF SUBSURFACE CONDITIONS .....	3
5.1	Pavement Structure .....	4
5.2	Fill .....	4
5.3	Sand and Silt Till.....	5
5.4	Gravelly Sand.....	6
5.5	Clayey Silt Till .....	7
5.6	Silt Till .....	7
5.7	Water Levels .....	8
6	MISCELLANEOUS .....	10

### Appendices

Appendix A	Record of Borehole Sheets
Appendix B	Laboratory Test Results
Appendix C	Site Photographs
Appendix D	Drawing titled “Borehole Locations and Soil Strata”



**FOUNDATION INVESTIGATION REPORT**  
**DOANE ROAD UNDERPASS**  
**HIGHWAY 404 EXTENSION**  
**FROM GREEN LANE TO WOODBINE AVENUE/RAVENSHOE ROAD**  
**ONTARIO**  
**G.W.P. 2109-05-00**

**Geocres Number: 31D-483**

**PART 1: FACTUAL INFORMATION**

**1 INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted at the location of a proposed underpass carrying Doane Road over the proposed Highway 404 extension in the Regional Municipality of York, Ontario.

The purpose of this investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, records of boreholes, stratigraphic profile and cross-sections, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained in the course of the present investigation.

Thurber carried out the investigation as a sub-consultant to Philips Engineering/Hatch Mott MacDonald Joint Venture under the Ministry of Transportation Ontario (MTO) Agreement Number 2007-E-0027.

**2 SITE DESCRIPTION**

The proposed Doane Road underpass structure will be located on the existing Doane Road alignment, approximately 2.0 km north of Mount Albert Road and approximately 900.0 m west of the intersection of Doane Road and Woodbine Avenue (York Regional Road 8), in the Town of East Gwillimbury, Regional Municipality of York.

Currently, the topography along Doane Road slopes downward to the southeast. The ground surface within the proposed structure varies from west to east from Elevations 265.6 to 261.7.



The lands around the site are generally undeveloped and/or agricultural. Vegetation consists mainly of tall grass, shrubs and a few mature trees. There are farmsteads to the north and south of Doane Road.

The site lies within the physiographic region known as The Peterborough Drumlin Field, characterized by drumlinized till. The till is typically sandy with shallow coverings of silt and fine sand.

Photographs in Appendix C show:

1. View of the site looking at Boreholes 08-50 and 08-52 drilled on the south side of Doane Road.
2. View of the site looking at Borehole 08-53, WBL of Doane Road.
3. View of the site looking at Borehole 08-54 drilled on the south side of Doane Road.
4. View of the site looking at Borehole 08-55 drilled on Doane Road.

### **3 SITE INVESTIGATION AND FIELD TESTING**

The site investigation and field testing for this project were carried out from October 20 to 24, 2008 and consisted of drilling and sampling a total of eight boreholes (numbered 08-48 to 08-55). Six boreholes (Boreholes 08-49 to 08-54) were drilled at the proposed foundation elements (embankments and pier) to depths ranging from 9.3 m to 12.3 m (Elevations 248.7 to 256.8). One borehole was drilled at each approach embankment. Termination depths for the approach boreholes (Boreholes 08-48 and 08-55) were 7.9 m and 9.3 m (Elevations 257.8 and 252.4 m), respectively.

Permission to access and drill on adjacent lands located on the north side of Doane Road had not been granted by the land owner at the time of investigation. In light of this situation and after discussions with MTO's Foundation office, Boreholes 08-49, 08-51 and 08-53 were moved from their original locations approximately 5.0 to 10.0 m to the south and drilled on the existing Doane Road.

The approximate borehole locations are shown on the Borehole Locations and Soil Strata 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.

The borehole locations were marked in the field and utility clearances were obtained prior to drilling.

Drilling was carried out using a track mounted CME 55 drill rig. A combination of solid and hollow stem auger drilling techniques were used to advance the boreholes. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in the overburden soils.



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 samples for transport to Thurber's laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Standpipe piezometers consisting of 19 mm diameter PVC pipe with slotted screens were installed and enclosed in filter sand in three boreholes to permit longer term groundwater level monitoring. The locations and completion details of the piezometers are shown in Table 3.1.

**Table 3.1 – Borehole Completion Details**

Foundation Unit	Borehole	Piezometer Tip Depth/ Elevation (m)	Completion Details
West Approach	08-48	None installed	Borehole backfilled with holeplug to 0.07 m, then asphalt to surface.
West Abutment	08-49	None installed	Borehole backfilled with holeplug to 0.05 m, then asphalt to surface.
	08-50	9.1/255.2	Sand from 9.1 m to 7.3 m, holeplug from 7.3 m to surface.
Pier	08-51	8.1/255.5	Sand from 8.1 m to 5.8 m, holeplug from 5.8 m to 0.15 m, then concrete to surface.
	08-52	None installed	Borehole backfilled with holeplug to 3.0 m, then auger cuttings to surface.
East Abutment	08-53	None installed	Borehole backfilled with holeplug to 0.07 m, then asphalt to surface.
	08-54	9.8/251.2	Sand from 9.8 m to 7.6 m, holeplug from 7.6 m to surface.
East Approach	08-55	None installed	Borehole backfilled with holeplug to 0.2 m, auger cuttings from 0.2 m to 0.05 m then asphalt to surface.

#### 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) and Atterberg Limits testing where appropriate. 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.

#### 5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendix A. Details of the encountered soil stratigraphy are presented in these sheets and on the "Borehole Locations and Soil Strata Drawing" and "Stratigraphic Sections" in Appendix D. An overall description of the stratigraphy is given in



the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general, the soil stratigraphy encountered across the site consists of fill of variable composition (sand, sand and gravel, silty sand and clayey silt) overlying native deposits of sand and silt till, gravelly sand, clayey silt and silt till. Asphalt was encountered at the surface in boreholes drilled on Doane Road. More detailed descriptions of the individual strata are presented below.

### 5.1 Pavement Structure

Pavement structure consisting of approximately 25 mm to 50 mm of asphalt overlying granular (sand and gravel fill) road base was encountered in Boreholes 08-48, 08-49, 08-51, 08-53 and 08-55 drilled on existing Doane Road lanes and shoulders.

### 5.2 Fill

Fill was contacted below the pavement structure in most of the boreholes, except in Boreholes 08-50, 08-52 and 08-54. The fill generally consists of brown to dark brown sand and silty sand containing trace to some gravel and some silt. In Borehole 08-53, drilled at the proposed east abutment, a cohesive layer of silty clay fill containing trace sand and occasional silt seams was contacted below the cohesionless fill at 0.8 m depth (Elevation 261.4).

The thickness of the fill ranged from 0.55 m to 2.25 m. The depth to the base of the fill varied from 0.6 to 2.3 (Elevations 260.4 to 265.5).

SPT 'N' values recorded in the cohesionless fill ranged from 13 to 37 blows per 0.3 m penetration indicating a loose to dense relative density. In Borehole 08-55, an SPT 'N' value of 73 blows per 0.3 m of penetration indicating a very dense relative density was measured below the asphalt layer.

In the silty fill layer, the SPT 'N' values were 7 and 12 blows per 0.3 m of penetration, indicating a firm to stiff consistency.

The moisture content of the fill ranged from 5% to 23%.

Grain size distribution curve for a sample of silty clay fill tested is presented on the Record of Borehole sheet and on Figure B1. Atterberg Limit test results are presented on Figure B9 of Appendix B. The results of the laboratory test are summarized as follows:

Soil Particles	(%)
Gravel	0
Sand	4
Silt	68
Clay	28



<b>Index Property</b>	<b>(%)</b>
Liquid Limit	27
Plastic Limit	16

The above results show that the silty clay fill is typically of low plasticity with a group symbol of CL.

### 5.3 Sand and Silt Till

Layers of native brown to grey sand and silt till containing trace to some clay, trace to some gravel and occasional cobbles were observed across the site in Boreholes 08-48 to 08-54 at depths and elevations as indicated in Table 5.1.

**Table 5.1 – Locations of Native Sand and Silt Till**

<b>Foundation Unit</b>	<b>Borehole</b>	<b>Depth below existing ground surface (m)</b>	<b>Elevation (m)</b>	<b>Thickness (m)</b>
West Approach	08-48	0.8 to 2.4	264.9 to 263.2	1.6
West Abutment	08-49	0.6 to 3.0	265.5 to 263.0	2.4
	08-50	0.05 to 2.1	264.3 to 262.2	2.1
Pier	08-51	2.3 to 12.3 (borehole termination depth)	261.4 to 251.3	At least 10.0
	08-52	0.05 to 9.5 (borehole termination depth)	262.3 to 252.8	At least 9.5
East Abutment	08-53	1.8 to 10.8 (borehole termination depth)	260.4 to 251.4	At least 9.0
	08-54	0.05 to 2.3 5.6 to 12.3 (borehole termination depth)	260.9 to 258.7 255.4 to 248.7	2.2 At least 6.7

Standard Penetration tests in this sand and silt till deposit gave SPT 'N' values ranging from 5 to 58 blows per 0.3 m of penetration, indicating a loose to very dense relative density. Higher SPT 'N' values ranging from 83 blows per 0.3 m of penetration to 100 blows per 0.075 m of penetration were measured below 2.3 m depth (Elevation 261.4) in Borehole 08-51, below 3.4 m and 4.6 m depth (Elevations 259.0 and 257.5) in Boreholes 08-52 and 08-53 and below 7.6 m depth (Elevation 253.4) in Borehole 08-54.

The moisture content of samples from the sand and silt till deposit varies between 8% and 22%.

Grain size distribution curves for sand and silt till samples tested are presented on the Record of Borehole sheet and on Figures B2 and B3. A sample of sand and silt containing



some clay was tested for Atterberg Limits and the test results are presented on Figure B10 of Appendix B.

The results of the laboratory tests are summarized as follows:

<b>Soil Particles</b>	<b>(%)</b>
Gravel	0 to 8
Sand	32 to 48
Silt	45 to 57
Clay	4 to 13

<b>Index Property</b>	<b>(%)</b>
Liquid Limit	17
Plastic Limit	12

The above results show that the clayey zones in the sand and silt till are typically of low plasticity with group symbols of CL-ML.

Glacial tills inherently contain cobbles and boulders which may account for some high blow counts and resistance to augering.

#### **5.4 Gravelly Sand**

A layer of native brown gravelly sand containing some silt and clay was encountered in Borehole 08-48 at 2.4 m depth (Elevation 263.2). Cobbles were encountered within the gravelly sand layer at 3.5 m depth (Elevation 262.1). Thickness of the gravelly sand layer was 1.7 m. The depth to the base of the gravelly sand was 4.1 m (Elevation 261.5).

SPT 'N' values measured in the gravelly sand were 35 and 50 blows per 0.3 m of penetration, indicating a dense relative density. Moisture contents were 2% and 10%.

Grain size distribution curve for a gravelly sand sample tested is presented on the Record of Borehole sheets and on Figure B4. The results of the laboratory test are summarized as follows:

<b>Soil Particles</b>	<b>Gravelly Sand (%)</b>
Gravel	23
Sand	64
Silt & Clay	13



## 5.5 Clayey Silt Till

Native brown to grey clayey silt till containing trace of sand was contacted at 2.3 m depth (Elevation 258.7) in Borehole 08-054, drilled at the proposed east abutment. Thickness of the clayey silt was 3.3 m. The depth to the base of the clayey silt was 5.6 m (Elevation 255.4).

SPT 'N' values measured in the clayey silt till were 14 and 26 blows per 0.3 m of penetration, indicating a stiff to very stiff consistency. Moisture content ranged from 19% to 20%.

A grain size distribution curve for a clayey silt till sample tested is presented on the Record of Borehole sheet and on Figure B5. Atterberg Limit test results are presented on Figure B11 of Appendix B. The results of the laboratory test are summarized as follows:

Soil Particles	(%)
Gravel	0
Sand	1
Silt	76
Clay	22

Index Property	(%)
Liquid Limit	26
Plastic Limit	19

The above results show that the clayey silt till is typically of low to medium plasticity with group symbols of ML-CL.

## 5.6 Silt Till

Layers of native brown to grey silt till containing some sand to sandy, trace to some clay, trace to some gravel and occasional cobbles were observed in Boreholes 08-48 to 08-50 and 08-55 at depths and elevations as indicated in Table 5.1.

**Table 5.1 – Locations of Native Silt Till**

Foundation Unit	Borehole	Depth below existing ground surface (m)	Elevation (m)	Thickness (m)
West Approach	08-48	4.1 to 7.9 (borehole termination depth)	261.5 to 257.8	At least 3.8
West Abutment	08-49	3.0 to 9.3 (borehole termination depth)	263.0 to 256.8	At least 6.3
	08-50	2.1 to 9.4 (borehole termination depth)	262.2 to 255.0	At least 7.3
East Approach	08-55	1.1 to 9.3 (borehole termination depth)	260.5 to 252.4	At least 8.2



Layers of sand and silty sand were contacted within the silt till at 4.1 m depth (Elevations 262.0 and 260.3) in Boreholes 08-49 and 08-50.

Standard Penetration tests in this deposit gave SPT 'N' values ranging from 24 to 92 blows per 0.3 m of penetration, indicating a compact to very dense relative density. Locally in Borehole 08-55, loose conditions were measured at 1.5 m depth (Elevation 260.2). SPT 'N' values higher than 100 blows per 0.3 m of penetration were measured generally below 4.0 m depth (approximate Elevation 261.0) in Boreholes 08-48 to 08-50 drilled at the west abutment and west approach and at 7.5 m depth (Elevation 254.2.) in Borehole 08-55 drilled at the east approach.

The moisture content of samples from the sand and silt till deposit varies between 3% and 22%.

Grain size distribution curves for the silt till samples tested are presented on the Record of Borehole sheet and on Figures B6 and B7. Grain size distribution curve for the layer of silty sand tested is presented on the Record of Borehole sheet and on Figure B8. A sample of silt till containing some clay was tested for Atterberg Limits and the test results are presented on Figure B12 of Appendix B.

The results of the laboratory tests are summarized as follows:

<b>Soil Particles</b>	<b>Silt Till (%)</b>	<b>Silty Sand (%)</b>
Gravel	0 to 6	1
Sand	2 to 28	68
Silt	54 to 81	26
Clay	7 to 17	5

<b>Index Property</b>	<b>(%)</b>
Liquid Limit	18
Plastic Limit	12

The above results show that the clayey zones in the silt till are typically of low plasticity with group symbols of CL-ML.

Glacial tills inherently contain cobbles and boulders which may account for some high blow counts.

## 5.7 Water Levels

Water levels were observed in the boreholes during and upon completion of drilling. Standpipe piezometers were installed in three boreholes to monitor water levels after completion of drilling. The water levels measured in the piezometers are summarized in Table 5.3, along with the measurements in the boreholes upon completion of drilling.



**Table 5.3 – Water Level Measurements**

Foundation Unit	Borehole	Date	Water Level (m)		Comment
			Depth	Elevation	
West Approach	08-48	October 22, 2008	6.5	259.1	Open borehole
West Abutment	08-49	October 22, 2008	7.1	259.0	Open borehole
	08-50	October 20, 2008	5.0	259.4	Open borehole
		October 24, 2008	4.4	260.0	In piezometer
		November 28, 2008	4.9	259.5	In piezometer
		February 6, 2009	0.1	264.3	In piezometer
		February 20, 2009	0.2*	264.6	In piezometer
		March 20, 2009	1.0	263.4	In piezometer
		April 22, 2009	1.1	263.3	In piezometer
		September 2, 2009	2.6	261.8	In piezometer
Pier	08-51	November 28, 2008	4.1	259.5	In piezometer
	08-52	October 21, 2008	4.6	257.8	Open borehole
East Abutment	08-53	October 23, 2008	3.0	259.1	Open borehole
	08-54	October 24, 2008	2.1	258.9	Open borehole
		November 28, 2008	3.7	257.3	In piezometer
		February 6, 2009	Ground surface	261.0	In piezometer
		February 20, 2009	0.4*	261.4	In piezometer
		March 20, 2009	0.7*	261.7	In piezometer
		April 22, 2009	0.6*	261.6	In piezometer
		September 2, 2009	0.6	260.4	In piezometer
East Approach	08-55	October 22, 2008	4.2	257.5	Open borehole

\* Water level above ground surface (artesian condition)

The piezometric readings of the current investigation indicate that the groundwater level at the site is high and the water level decreases from west to east from Elevations 264.6 to 261.7.

Water levels were observed approximately 0.2 m to 0.7 m above the existing ground surface (artesian conditions) during the later Winter/early Spring season in Boreholes 08-50 and 08-054, near Elevations 264.6 and 261.7, respectively.

The above values are short-term 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

Borehole locations were selected by Thurber Engineering Ltd. Surveyors from J. D. Barnes obtained the co-ordinates and the ground surface elevations at each borehole.

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

DBW Drilling of Ajax Ontario supplied track mounted CME 55 drill rig and conducted the drilling, sampling and in-situ testing operations.

The field program was supervised on a full time basis by Ms. Eckie Siu of Thurber.

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. Alastair E. Gorman, P.Eng and Ms. R. Palomeque Reyna, P.Eng.

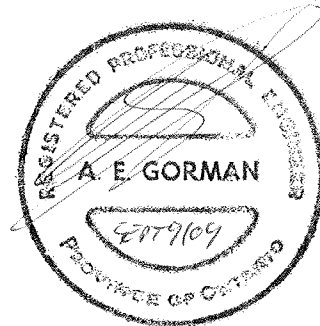
The report was reviewed by Dr. P.K. Chatterji, P.Eng. a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd

Rocio Palomeque Reyna, P.Eng.  
Geotechnical Engineer



Alastair E. Gorman, P.Eng.  
Senior Foundations Engineer



P. K. Chatterji, P.Eng.  
Review Principal





Doane Road Underpass  
Highway 404 Extension from Green Lane to Woodbine Avenue/Ravenshoe Rd.

---

## **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 <sup>(1)</sup> '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.



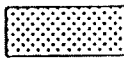




# UNIFIED SOILS CLASSIFICATION

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
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 08-48

1 OF 1

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 093.56 E 310 301.81 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.22 - 2008.10.22 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)	
								20 40 60 80 100		PLASTIC LIMIT w <sub>p</sub>		NATURAL MOISTURE CONTENT w				LIQUID LIMIT w <sub>L</sub>
							● UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    x LAB VANE									
265.6	ASPHALT (50mm)															
0.0	SAND, some silt to silty, some gravel Compact Brown to Dark Brown Moist (FILL)		1	SS	13											
264.9																
0.8	SAND and SILT, some clay, trace gravel, occasional oxide staining Loose to Compact Brown Moist (TILL)		2	SS	8											
			3	SS	13											
263.2																
2.4	Gravelly SAND, some silt, some clay Dense Brown Moist		4	SS	35											
			5	SS	50											
	Cobbles at 3.5m															
261.5																
4.1	SILT, some sand to sandy Very Dense Grey Wet (TILL)		6	SS	140											
			7	SS	180/ .275											
		</														



# RECORD OF BOREHOLE No 08-49

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 108.93 E 310 311.68 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.22 - 2008.10.22 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								WATER CONTENT (%)						
266.1							20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT				
8.8	ASPHALT (25mm)							○ UNCONFINED	+ FIELD VANE					
265.5	SAND, some gravel Compact Brown Moist (FILL)		1	SS	23			● QUICK TRIAXIAL	× LAB VANE					
0.6	SAND and SILT, some clay, trace gravel, occasional oxidize staining Compact to Dense Brown Moist (TILL)		2	SS	25								1 35 52 12	
			3	SS	28									
			4	SS	33									
263.0														
3.0	SILT, some sand, trace clay, occasional cobbles, occasional oxide staining Compact to Very Dense Brown Moist (TILL)		5	SS	24								0 2 81 17	
	Layer of sand (800mm) Wet													
	Brown to Grey		6	SS	135								0 39 56 5	
	Some sand		7	SS	188/ .275								0 19 73 8	
			8	SS	100/ .150									
256.8			9	SS	100/ .125									
9.3	END OF BOREHOLE AT 9.3m. BOREHOLE OPEN TO 8.2m AND WATER LEVEL AT 7.1m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH													

Continued Next Page

+ 3 x 3 Numbers refer to  
Sensitivity

20  
15 10 5  
(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 08-49

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 108.93 E 310 311.68 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.22 - 2008.10.22 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	40 80 120 160 200					
	Continued From Previous Page													
	HOLEPLUG TO 0.05m THEN ASPHALT TO SURFACE.													



# RECORD OF BOREHOLE No 08-50

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 090.43 E 310 327.05 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.20 - 2008.10.20 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100		PLASTIC LIMIT w <sub>p</sub>			NATURAL MOISTURE CONTENT w	
							WATER CONTENT (%)							
264.4														
0.8	TOPSOIL (50mm)													
	SAND and SILT, trace clay, trace roots Compact Dark Brown to Brown Moist (TILL) Possible cobbles at 0.4m Layer of sand (200mm)		1	SS	10		264							
			2	SS	26		263							
	Occasional cobbles and boulders Very Dense		3	SS	58									
262.2														
2.1	SILT, some sand, trace to some clay Very Dense Brown Moist (TILL)		4	SS	77		262						0 15 73 12	
			5	SS	92		261							
	Layer of silty sand (400mm)						260							
	Grey Wet		6	SS	100/ 200								1 68 26 5	
							259							
			7	SS	100/ 225		258						1 14 78 7	
							257							
			8	SS	100/ 200									
							256							
255.0			9	SS	180/ 225									
9.4	END OF BOREHOLE AT 9.4m. BOREHOLE OPEN AND WATER LEVEL AT 5.0m UPON COMPLETION OF DRILLING.													

Continued Next Page

+<sup>3</sup> ×<sup>3</sup> Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 08-50

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 090.43 E 310 327.05 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.20 - 2008.10.20 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL																							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40						60	80	100																				
	Continued From Previous Page																																				
	<p>Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.</p> <p>WATER LEVEL READINGS:</p> <table border="1"> <thead> <tr> <th>DATE</th> <th>DEPTH (m)</th> <th>ELEV. (m)</th> </tr> </thead> <tbody> <tr> <td>2008.10.24</td> <td>4.4</td> <td>260.0</td> </tr> <tr> <td>2008.11.28</td> <td>4.9</td> <td>259.5</td> </tr> <tr> <td>2009.02.06</td> <td>0.1</td> <td>264.3</td> </tr> <tr> <td>2009.02.20</td> <td>0.2*</td> <td>264.6</td> </tr> <tr> <td>2009.03.20</td> <td>1.0</td> <td>263.4</td> </tr> <tr> <td>2009.04.22</td> <td>1.1</td> <td>263.3</td> </tr> <tr> <td>2009.09.02</td> <td>2.6</td> <td>261.8</td> </tr> </tbody> </table> <p>* (above ground surface)</p>	DATE	DEPTH (m)	ELEV. (m)	2008.10.24	4.4	260.0	2008.11.28	4.9	259.5	2009.02.06	0.1	264.3	2009.02.20	0.2*	264.6	2009.03.20	1.0	263.4	2009.04.22	1.1	263.3	2009.09.02	2.6	261.8												
DATE	DEPTH (m)	ELEV. (m)																																			
2008.10.24	4.4	260.0																																			
2008.11.28	4.9	259.5																																			
2009.02.06	0.1	264.3																																			
2009.02.20	0.2*	264.6																																			
2009.03.20	1.0	263.4																																			
2009.04.22	1.1	263.3																																			
2009.09.02	2.6	261.8																																			

ONTMT4S 0596.GPJ 9/8/09



# RECORD OF BOREHOLE No 08-51

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 113.65 E 310 353.28 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.23 - 2008.10.23 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						
263.6							20 40 60 80 100	40 80 120 160 200	20 40 60							
0.8	ASPHALT (25mm)															
	Silty SAND, trace to some gravel Compact Brown Moist (FILL) Occasional cobbles at 0.9m		1	SS	27											
			2	SS	15											
			3	SS	37											
261.4																
2.3	SAND and SILT, trace to some clay, trace gravel, occasional oxide staining Very Dense Brown Moist (TILL)		4	SS	116									3 34 51 12		
			5	SS	115											
			6	SS	133									0 56 38 6		
	Layer of fine sand (1.2m) Brown to Grey															
			7	SS	100/ 150									0 32 56 11		
			8	SS	83											
	Layer of fine sand (0.9m)															
			9	SS	100/ 75									4 43 46 7		
	Hard augering, auger grinding															

Continued Next Page

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



# RECORD OF BOREHOLE No 08-51

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 113.65 E 310 353.28 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.23 - 2008.10.23 CHECKED BY RPR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
	Continued From Previous Page															
	SAND and SILT, trace gravel. occasional sand pockets Very Dense Grey (TILL)		10	SS	100/	.75										
251.3																
12.3	END OF BOREHOLE AT 12.3m. BOREHOLE OPEN TO 8.1m UPON COMPLETION OF DRILLING. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.11.28 4.1 259.5		11	SS	100/	.100										



## METRIC

ORIGINATED BY ES

COMPILED BY AN

CHECKED BY RPR

ONTMT4S 0596.GPJ 8/26/09
$$+^3 \cdot \times^3$$

Numbers refer to  
Sensitivity

(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 08-52

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 100.05 E 310 368.44 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.20 - 2008.10.21 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
	Continued From Previous Page																
	BOREHOLE BACKFILLED WITH HOLEPLUG TO 3.0m THEN AUGER CUTTINGS TO SURFACE.																



# RECORD OF BOREHOLE No 08-53

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 127.36 E 310 398.80 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.23 - 2008.10.23 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
262.1	ASPHALT (50mm)		1	SS	25									
261.4	SAND, some gravel, some silt to silty Compact Brown to Dark Brown Moist (FILL)		2	SS	12									
260.4	Silty CLAY, trace sand, occasional silt seams, occasional oxide staining Firm to Stiff Brown (FILL)		3	SS	7									0 4 68 28
			4	SS	10									
			5	SS	14									6 36 45 13
	Very Dense		6	SS	97									
	Occasional sand pockets		7	SS	100/ .175									4 33 53 9
	Layer of fine sand (500mm) Occasional cobbles		8	SS	178/ .225									
	Grey		9	SS	100/ .100									4 40 48 8

Continued Next Page

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



# RECORD OF BOREHOLE No 08-53

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 127.36 E 310 398.80 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.23 - 2008.10.23 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	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 X LAB VANE					WATER CONTENT (%) W P W W L				
	Continued From Previous Page							20 40 60 80 100									
251.4	SAND and SILT, some clay, trace gravel Very Dense Grey Moist (TILL)		10	SS	100		252										
10.8	END OF BOREHOLE AT 10.8m. BOREHOLE OPEN TO 4.8m AND WATER LEVEL AT 3.0m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.07m THEN ASPHALT TO SURFACE.				100												



# RECORD OF BOREHOLE No 08-54

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 112.68 E 310 413.77 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.21 - 2008.10.24 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
261.0								20 40 60 80 100	PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>		
0.0	TOPSOIL (50mm)		1	SS	8		261						
	SAND and SILT, trace clay, occasional oxide staining Loose Dark Brown to Brown Moist (TILL)		2	SS	9		260						
			3	SS	7		259						
258.7			4	SS	14		258						0 1 77 22
2.3	Clayey SILT, trace sand Stiff to Very Stiff Brown to Grey (TILL)		5	SS	26		257						
			6	SS	14		256						
255.4			7	SS	34		255						
5.6	SAND and SILT, trace gravel, trace clay Dense to Very Dense Grey Moist (TILL)		8	SS	158/ .125		254						8 41 44 7
	Possible boulder at 7.3m. Layer of fine sand (400mm).		9	SS	100/ .150		253						
							252						

Continued Next Page

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



# RECORD OF BOREHOLE No 08-54

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 112.68 E 310 413.77 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.21 - 2008.10.24 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	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    x LAB VANE									
Continued From Previous Page							20	40	60	80	100	WATER CONTENT (%) 40    80    120    160    200					
	SILT, some sand, some clay, trace gravel Very Dense Grey Moist (TILL)		10	SS	100/		251									3 17 65 15	
						.100		250									
248.7			11	SS	100/			249									
12.3	END OF BOREHOLE AT 12.3m. BOREHOLE OPEN TO 9.7m AND WATER LEVEL AT 2.1m UPON COMPLETION OF DRILLING. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE        DEPTH (m)    ELEV. (m) 2008.11.28    3.7        257.3 2009.02.06    0.0        261.0 2009.02.20    0.4*       261.4 2009.03.20    0.7*       261.7 2009.04.22    0.6*       261.6 2009.09.02    0.6        260.4  * (above ground surface)				.100												



# RECORD OF BOREHOLE No 08-55

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 131.71 E 310 424.00 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.22 - 2008.10.22 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100		PLASTIC LIMIT W <sub>P</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub>				
							WATER CONTENT (%)							
							20 40 60							
							40 80 120 160 200							
							o UNCONFINED + FIELD VANE							
							● QUICK TRIAXIAL x LAB VANE							
261.7	0.0	ASPHALT (50mm)												
		SAND, some gravel, some silt to silty, occasional oxide staining Compact to Very Dense Brown Moist (FILL)	1	SS	73		261							
260.5			2	SS	19									
1.1		SILT, some clay, some sand, occasional oxide staining Loose to Compact Brown Moist (TILL)	3	SS	8		260						0 13 74 13	
		Occasional coarse sand pockets	4	SS	15		259						1 42 45 12	
			5	SS	18		258							
			6	SS	18		257							
			7	SS	19		256							
		Sandy Grey	8	SS	118		255						6 25 55 15	
		Occasional cobbles Very Dense	9	SS	100/		254							
252.4							253							
9.3		END OF BOREHOLE AT 9.3m. BOREHOLE OPEN AND WATER LEVEL AT 4.2m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH			.150									

Continued Next Page

+ 3 x 3 Numbers refer to  
Sensitivity 20  
15 10 (%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 08-55

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 131.71 E 310 424.00 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.22 - 2008.10.22 CHECKED BY RPR

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  Y kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	40 80 120 160 200					
	Continued From Previous Page													
	HOLEPLUG TO 0.2m, AUGER CUTTINGS TO 0.05m THEN ASPHALT TO SURFACE.													



Doane Road Underpass  
Highway 404 Extension from Green Lane to Woodbine Avenue/Ravenshoe Rd.

---

## **Appendix B**

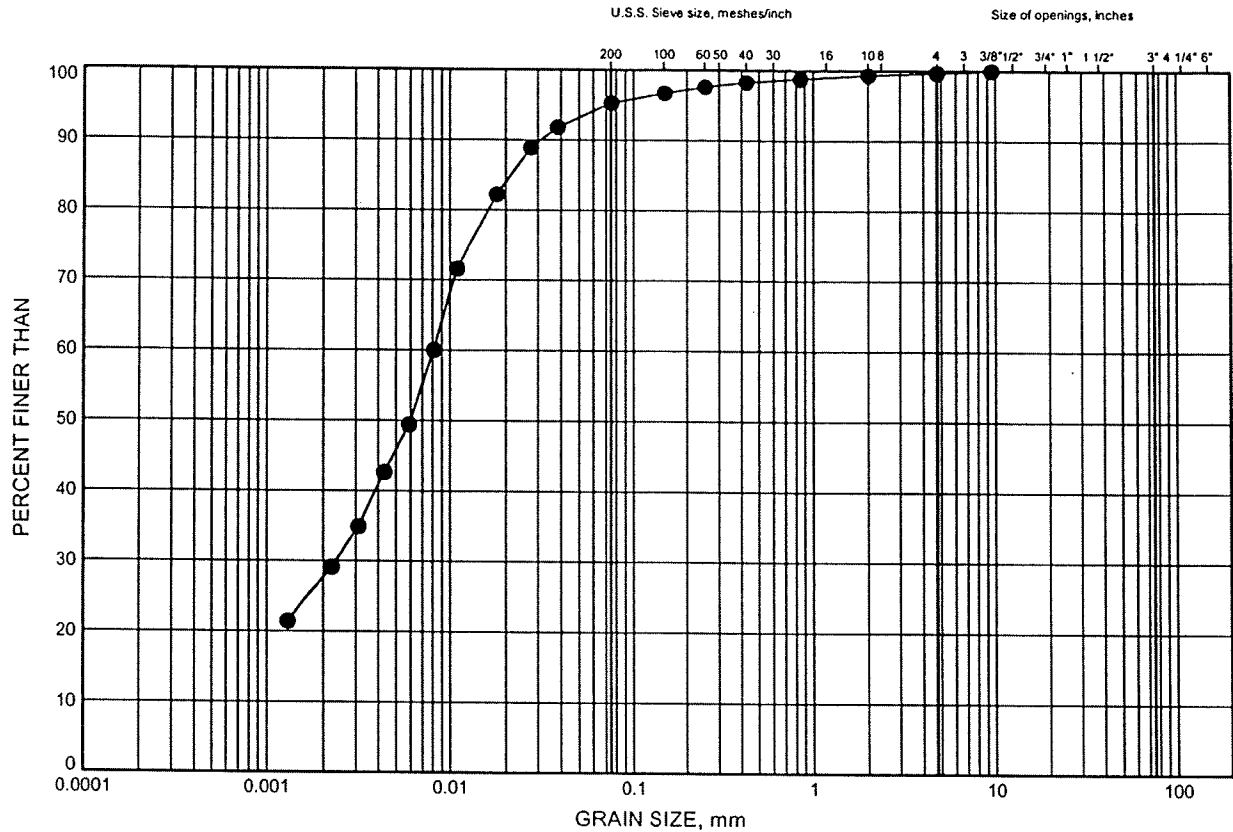
### **Laboratory Test Results**



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE B1

## Silty Clay (FILL)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-53	1.83	260.31



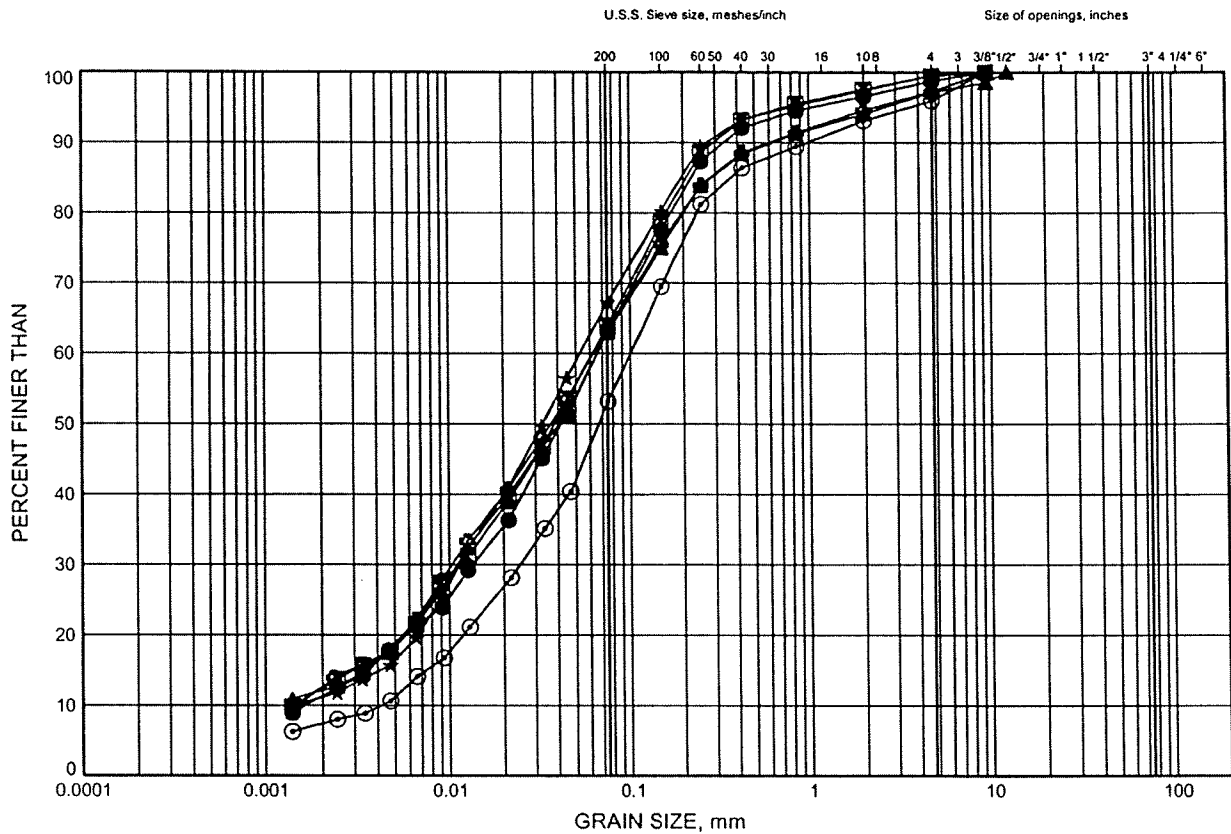
W.P.# 19-1605-96.....  
Prepared By AN.....  
Checked By RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE B2

## Sand and Silt (TILL)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-48	1.83	263.80
⊠	08-49	1.07	265.02
▲	08-51	2.59	261.05
★	08-51	6.17	257.47
⊙	08-51	9.18	254.46
⊠	08-52	1.07	261.31

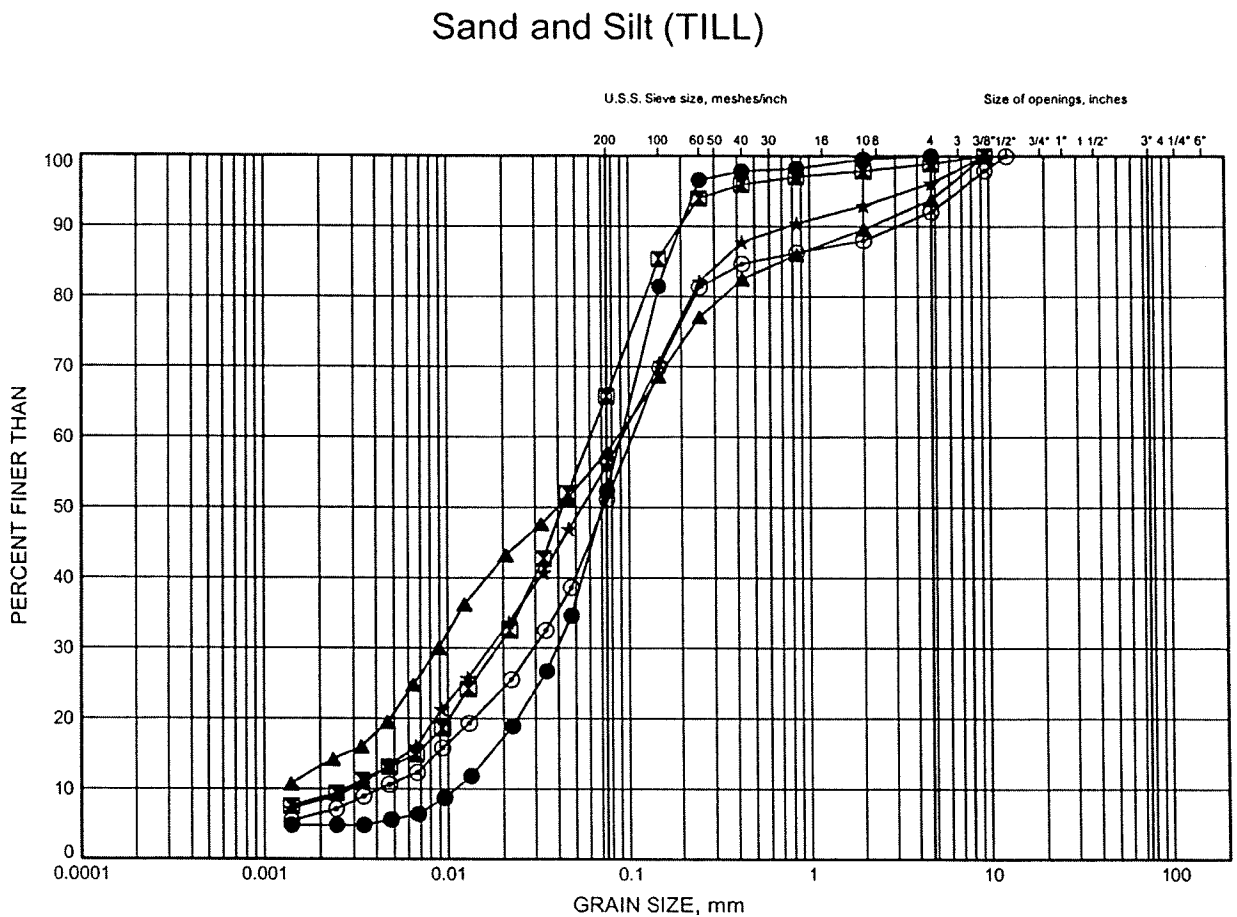


W.P.# 19-1605-96  
Prepared By AN  
Checked By RPR



Hwy 404 Extension  
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)
●	08-52	2.59	259.79
⊠	08-52	9.35	253.03
▲	08-53	3.47	258.67
★	08-53	9.26	252.88
⊙	08-54	7.83	253.17



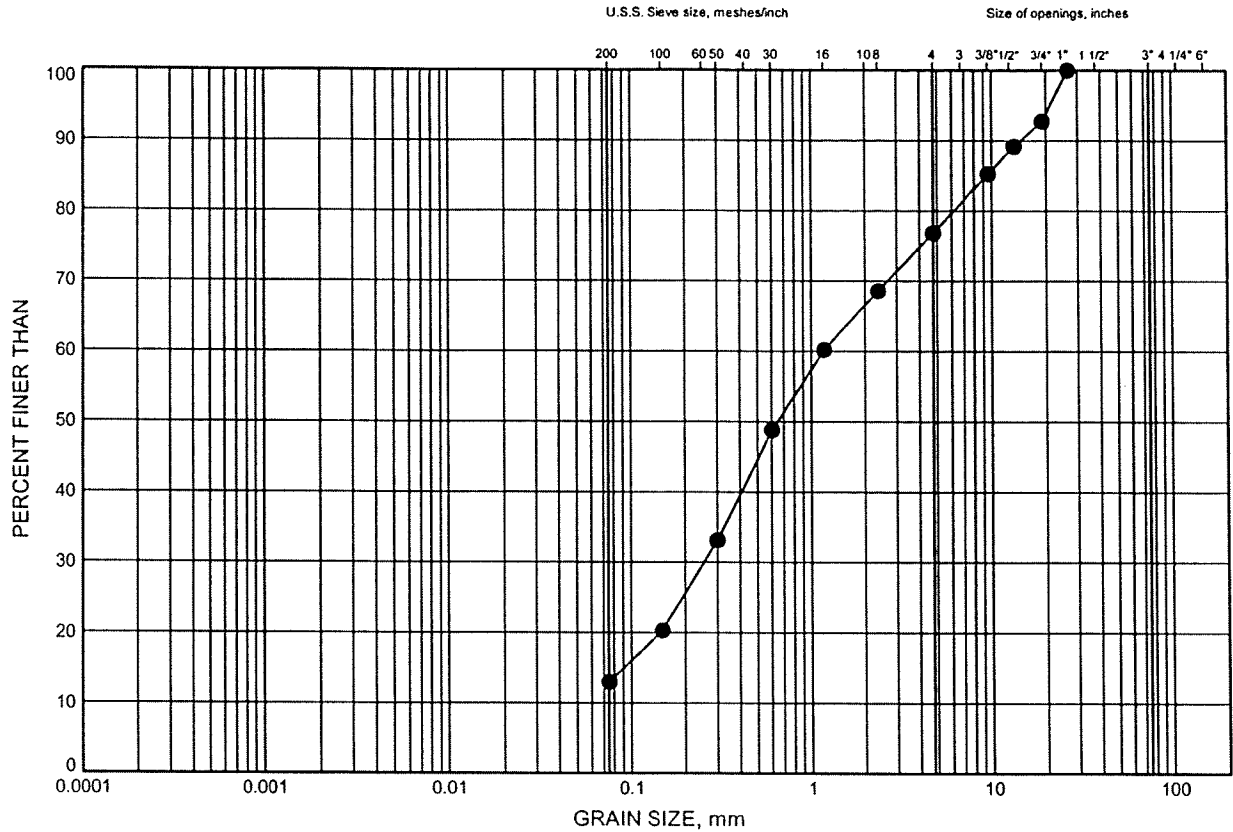
W.P.# 19-1605-96  
Prepared By AN  
Checked By RPR



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE B4

## Gravelly Sand



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-48	3.35	262.28

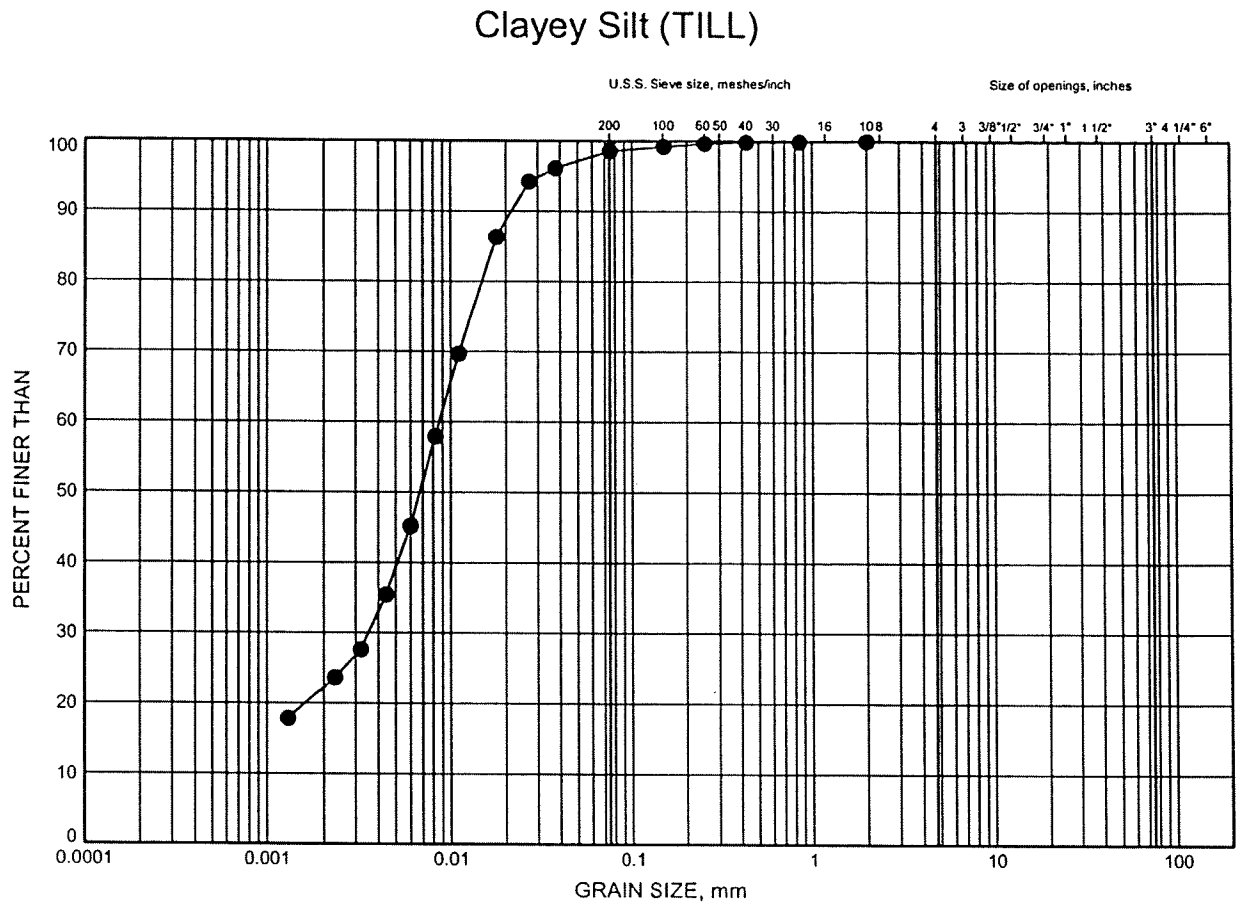


W.P.# 19-1605-96  
Prepared By AN  
Checked By RPR



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE B5



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-54	2.59	258.41

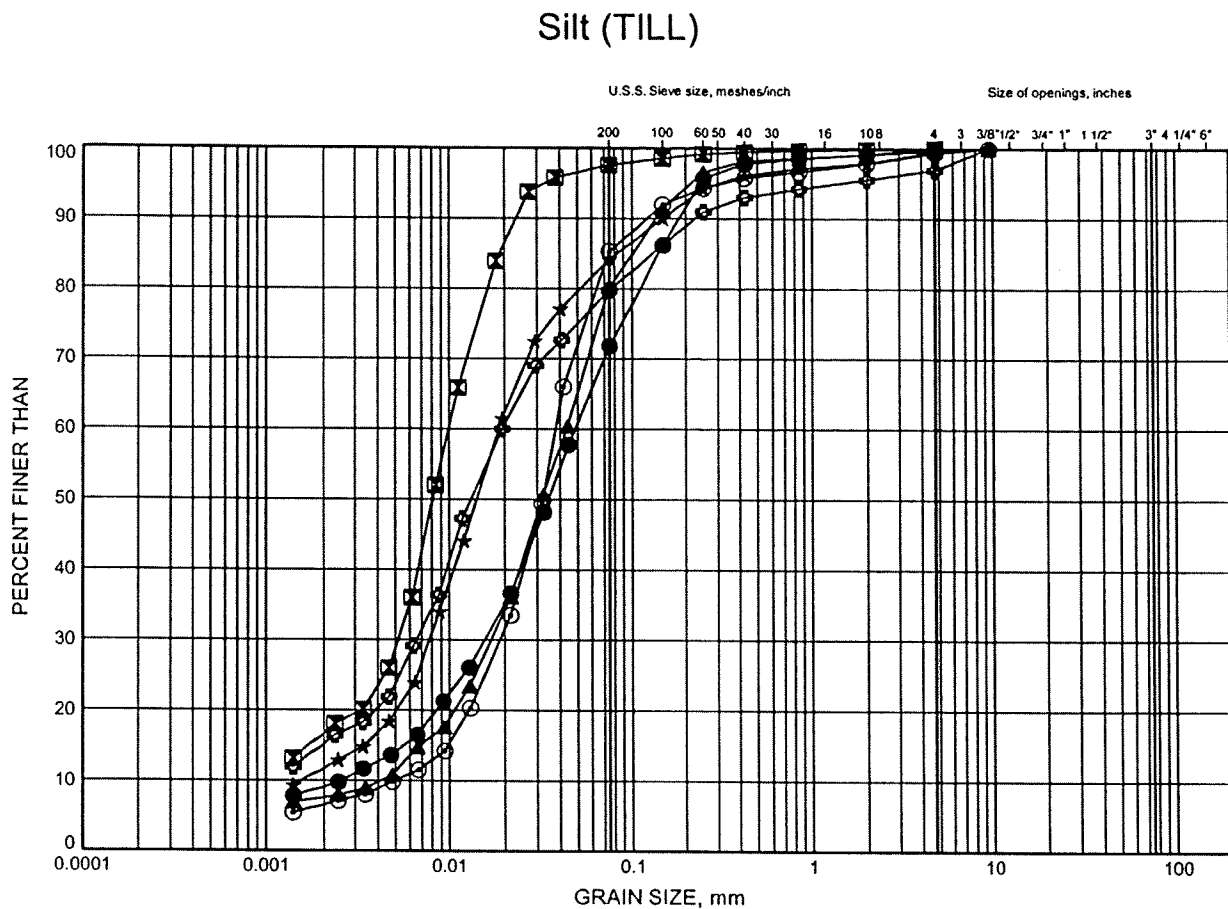


W.P.# 19-1605-96  
Prepared By AN  
Checked By RPR



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE B6



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-48	6.23	259.40
⊠	08-49	3.35	262.74
▲	08-49	6.40	259.69
★	08-50	2.59	261.79
⊙	08-50	6.29	258.09
⊕	08-54	10.72	250.28

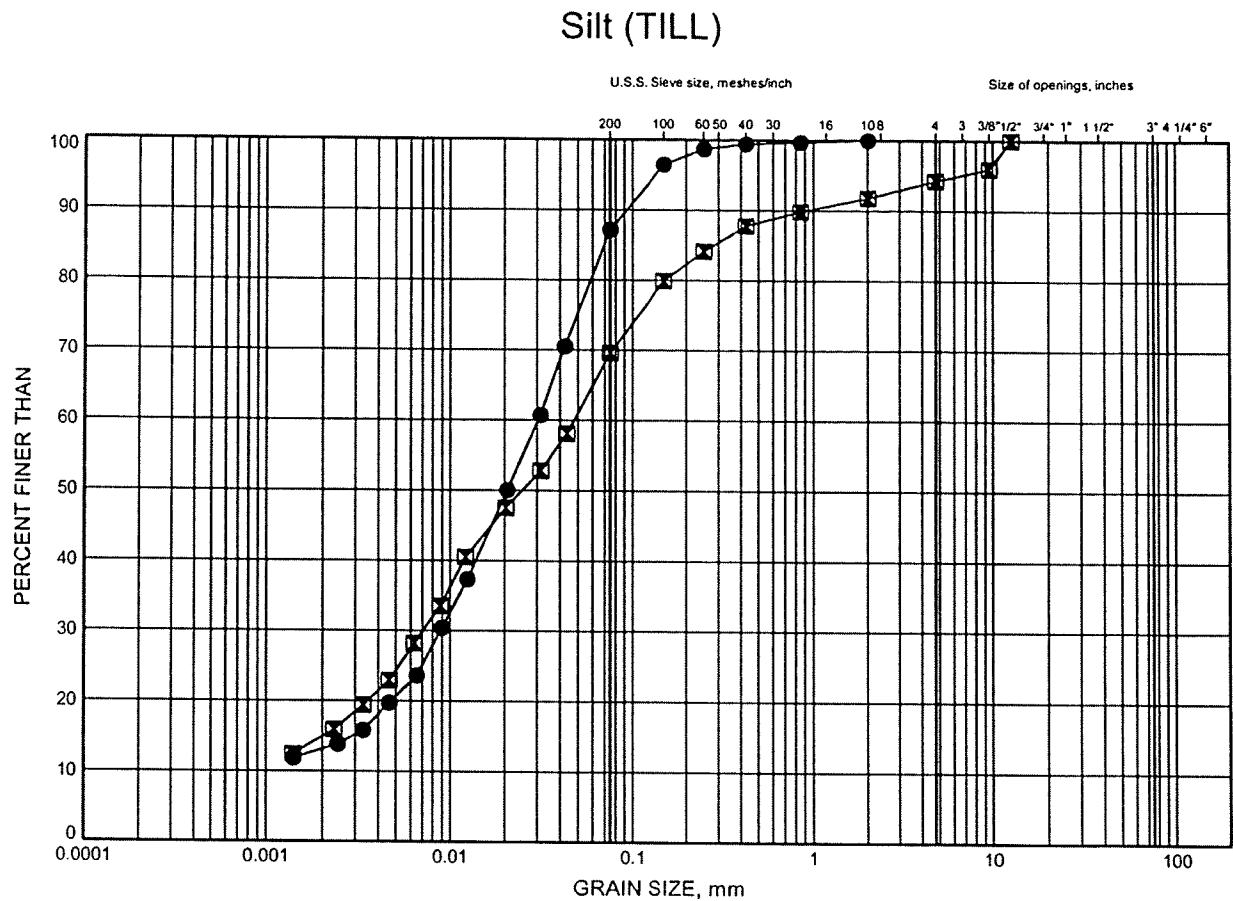


W.P.# 19-1605-96  
Prepared By AN  
Checked By RPR



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE B7



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

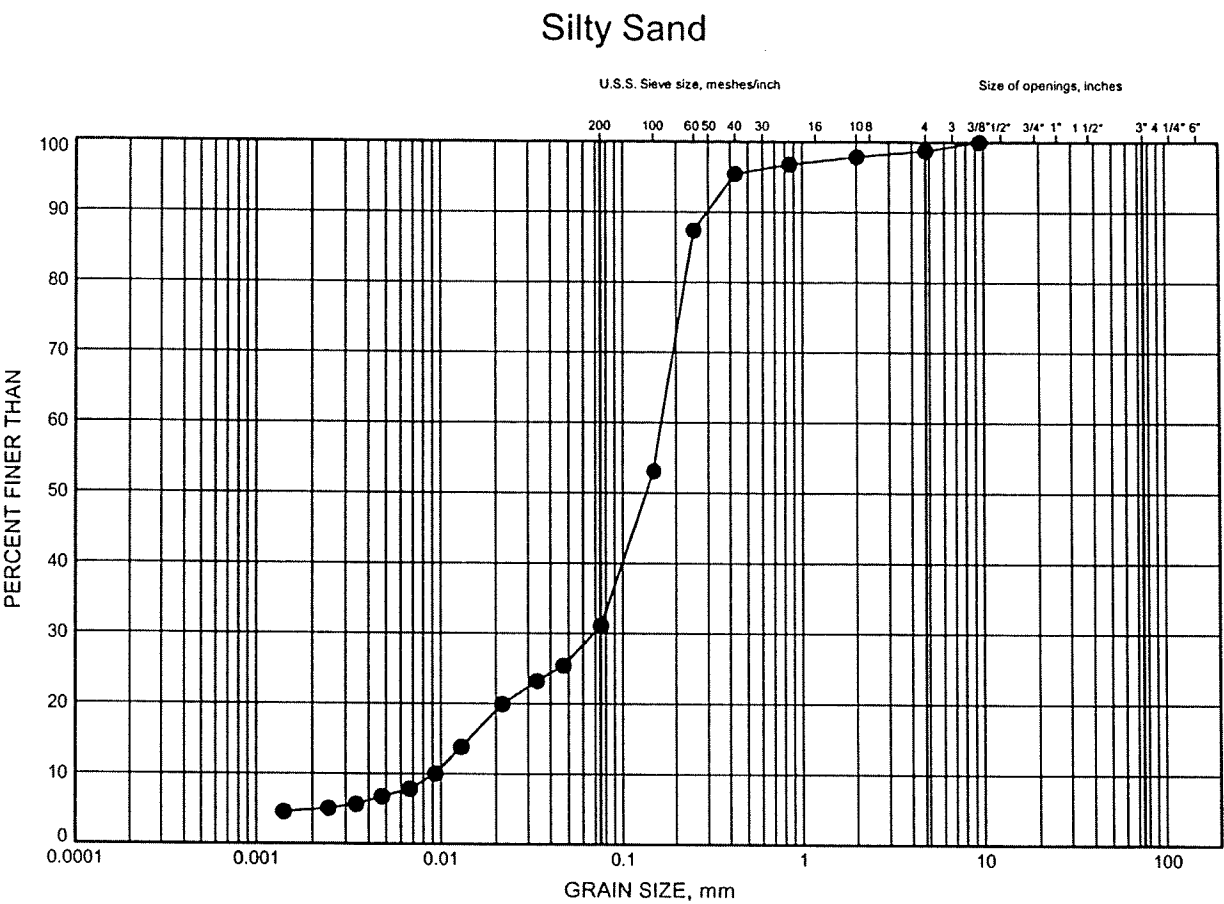
## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-55	1.83	259.84
◻	08-55	6.40	255.27



Hwy 404 Extension  
**GRAIN SIZE DISTRIBUTION**

**FIGURE B8**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-50	4.62	259.76



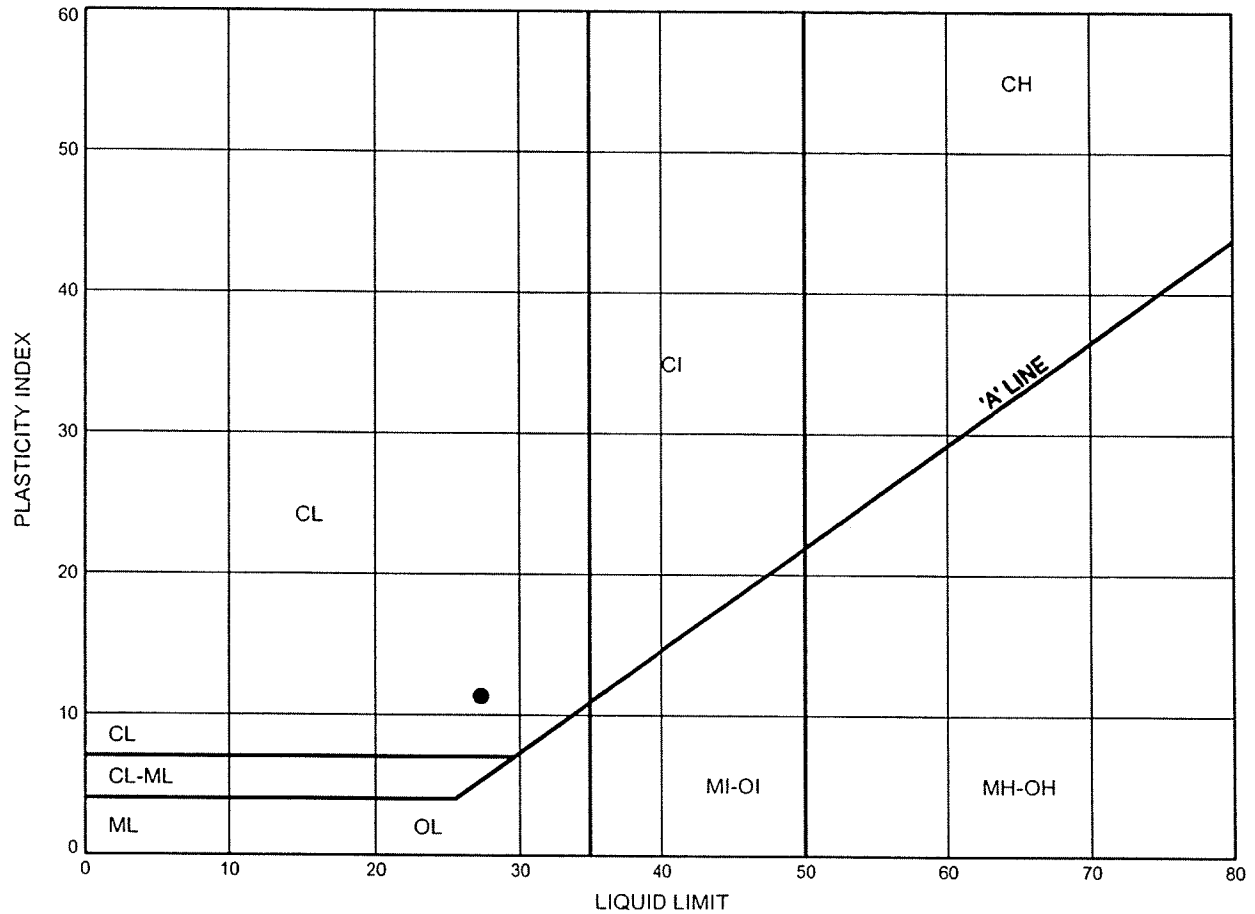
W.P.# 19-1605-96  
 Prepared By AN  
 Checked By RPR



Hwy 404 Extension  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B9

Silty Clay (FILL)



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-53	1.83	260.31

Date January 2009  
 Project 19-1605-96



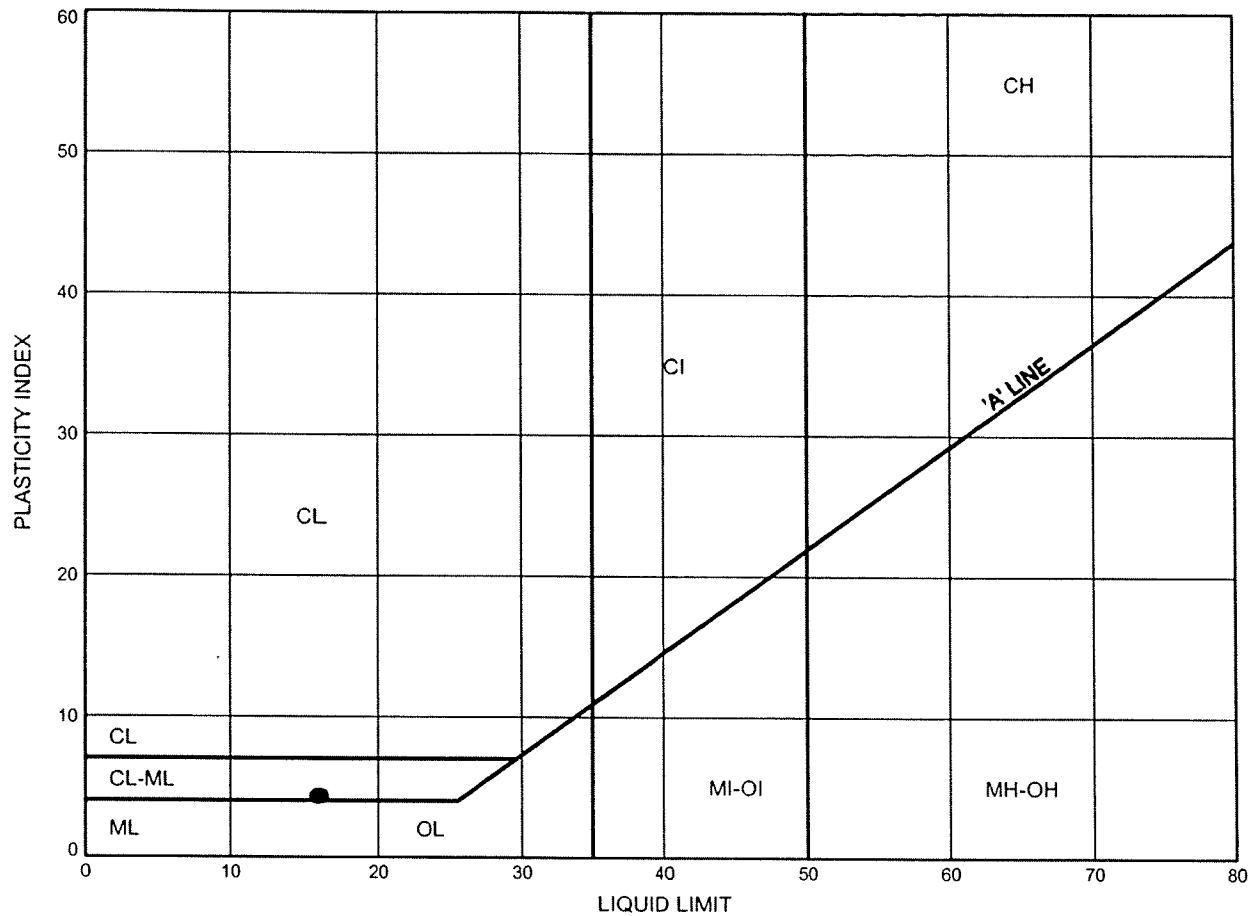
Prep'd AN  
 Chkd. RPR



Hwy 404 Extension  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B10

Sand and Silt (TILL)



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-53	3.54	258.60

Date December 2008  
 Project 19-1605-96



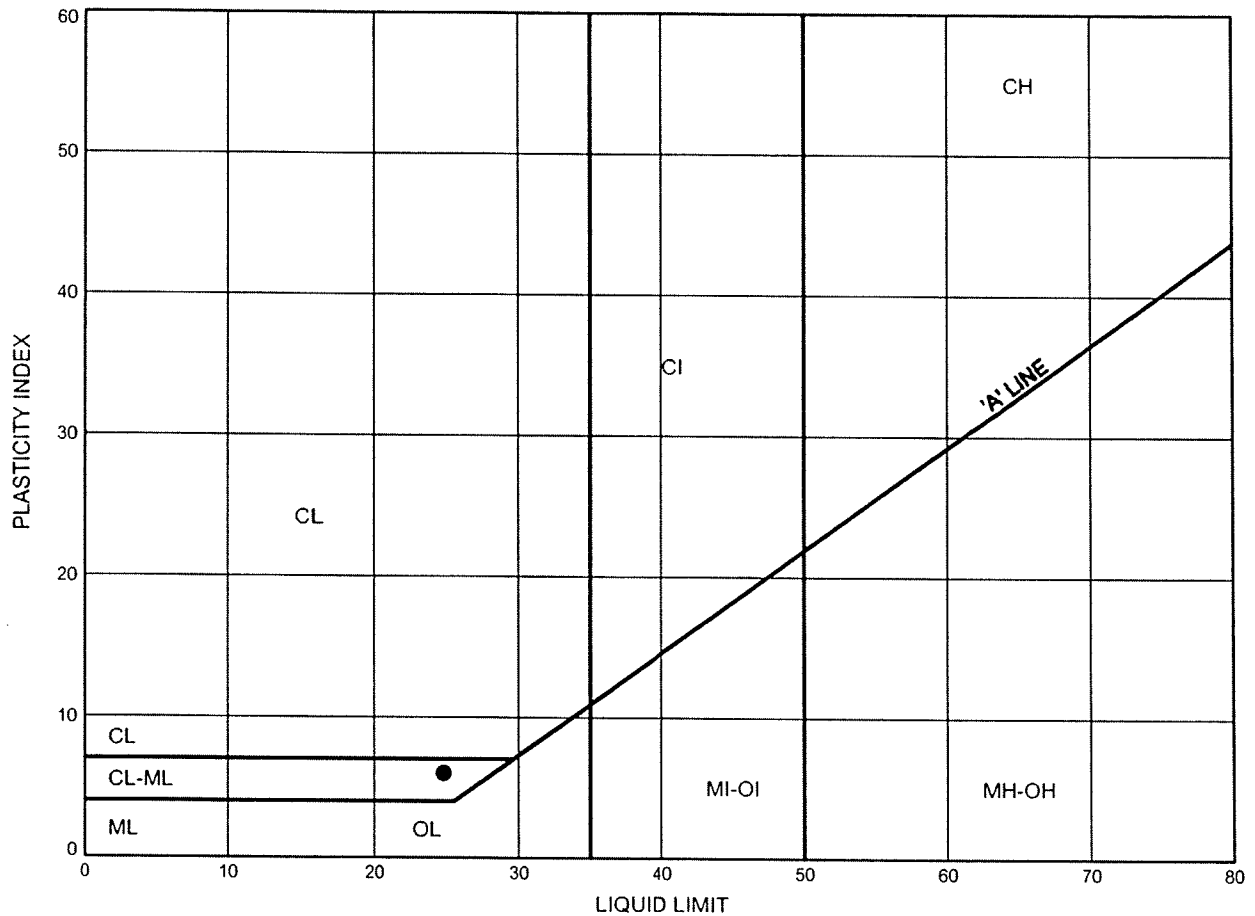
Prep'd AN  
 Chkd. RPR



Hwy 404 Extension  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B11

Clayey Silt (TILL)



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-54	2.59	258.41

Date December 2008

Project 19-1605-96



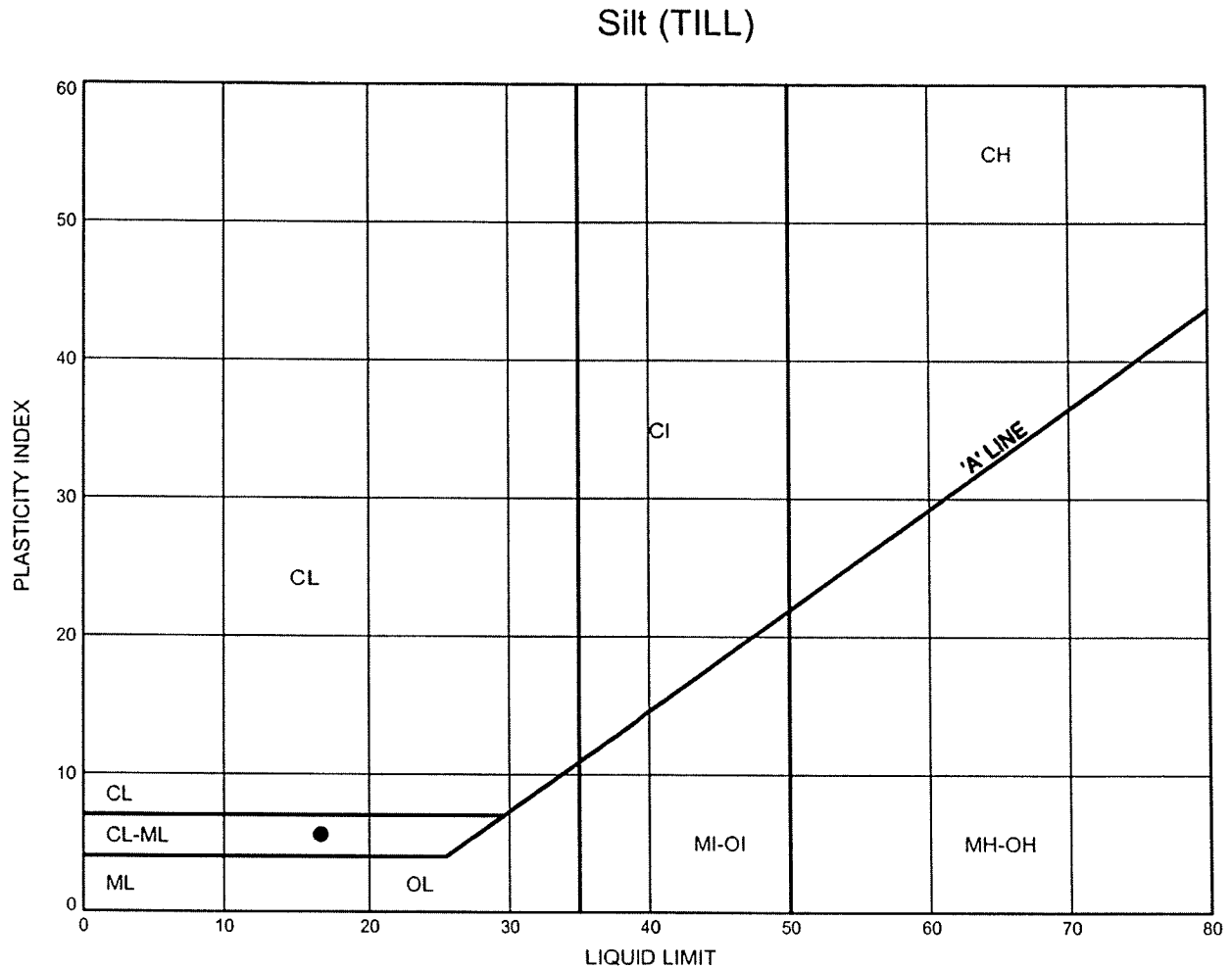
Prep'd AN

Chkd. RPR



Hwy 404 Extension  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B12



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-55	6.40	255.27

Date December 2008  
 Project 19-1605-96



Prep'd AN  
 Chkd. RPR



Doane Road Underpass  
Highway 404 Extension from Green Lane to Woodbine Avenue/Ravenshoe Rd.

---

## **Appendix C**

### **Site Photographs**



Doane Road Underpass  
Highway 404 Extension from Green Lane to Woodbine Avenue/Ravenshoe Rd.

---



**Photograph 1** – View of the site looking at Boreholes 08-50 and 08-52 drilled on the south side of Doane Road



Doane Road Underpass  
Highway 404 Extension from Green Lane to Woodbine Avenue/Ravenshoe Rd.

---



**Photograph 2** – View of the site looking at Borehole 08-53, WBL of Doane Road



Doane Road Underpass  
Highway 404 Extension from Green Lane to Woodbine Avenue/Ravenshoe Rd.

---



**Photograph 3** – View of the site looking at Borehole 08-54 drilled on the south side of Doane Road



Doane Road Underpass  
Highway 404 Extension from Green Lane to Woodbine Avenue/Ravenshoe Rd.

---



**Photograph 4** – View of the site looking at Borehole 08-55 drilled on Doane Road



Doane Road Underpass  
Highway 404 Extension from Green Lane to Woodbine Avenue/Ravenshoe Rd.

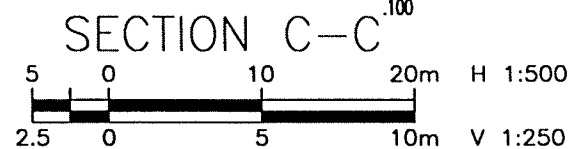
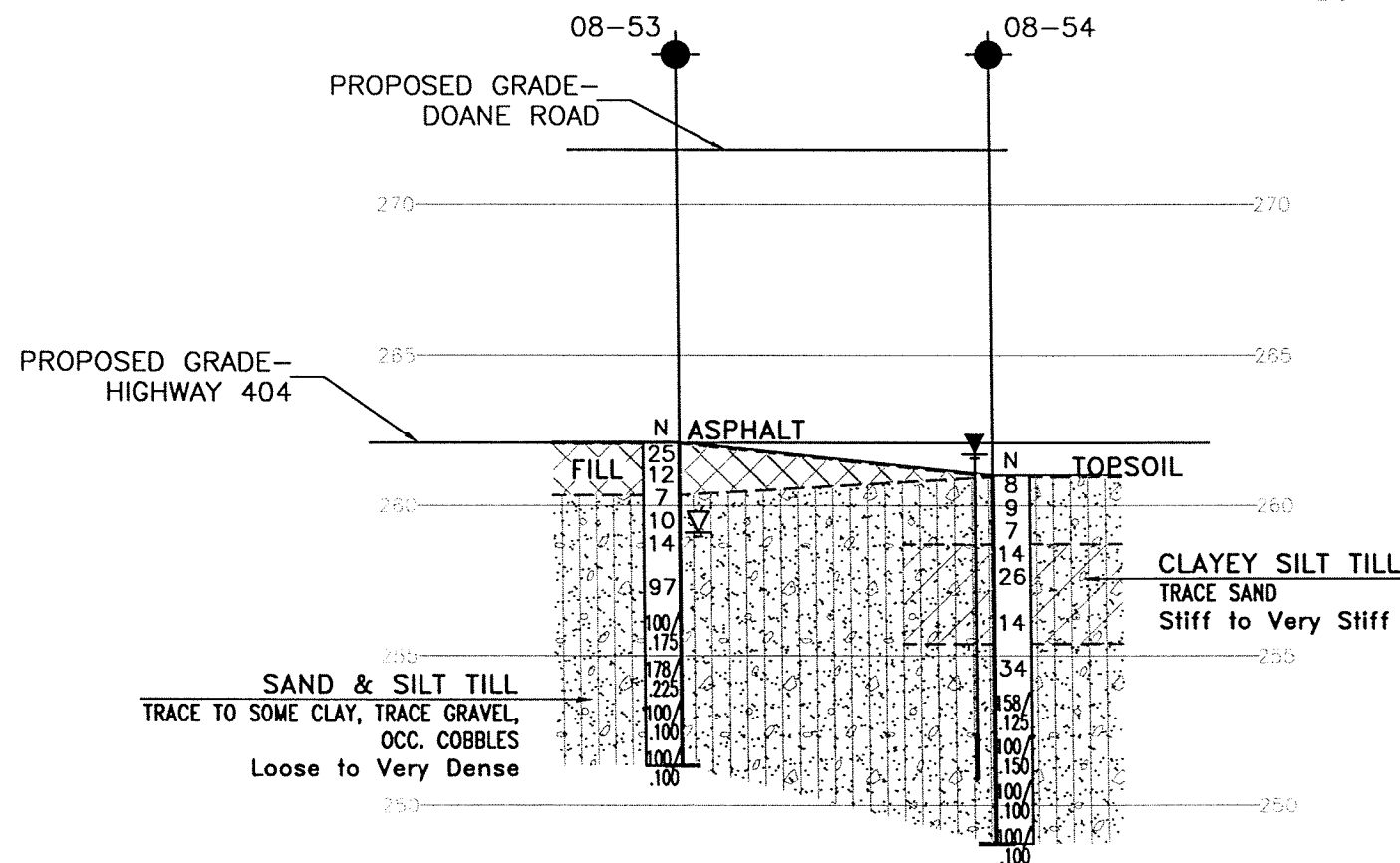
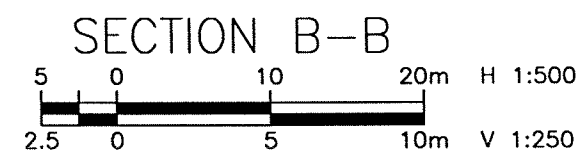
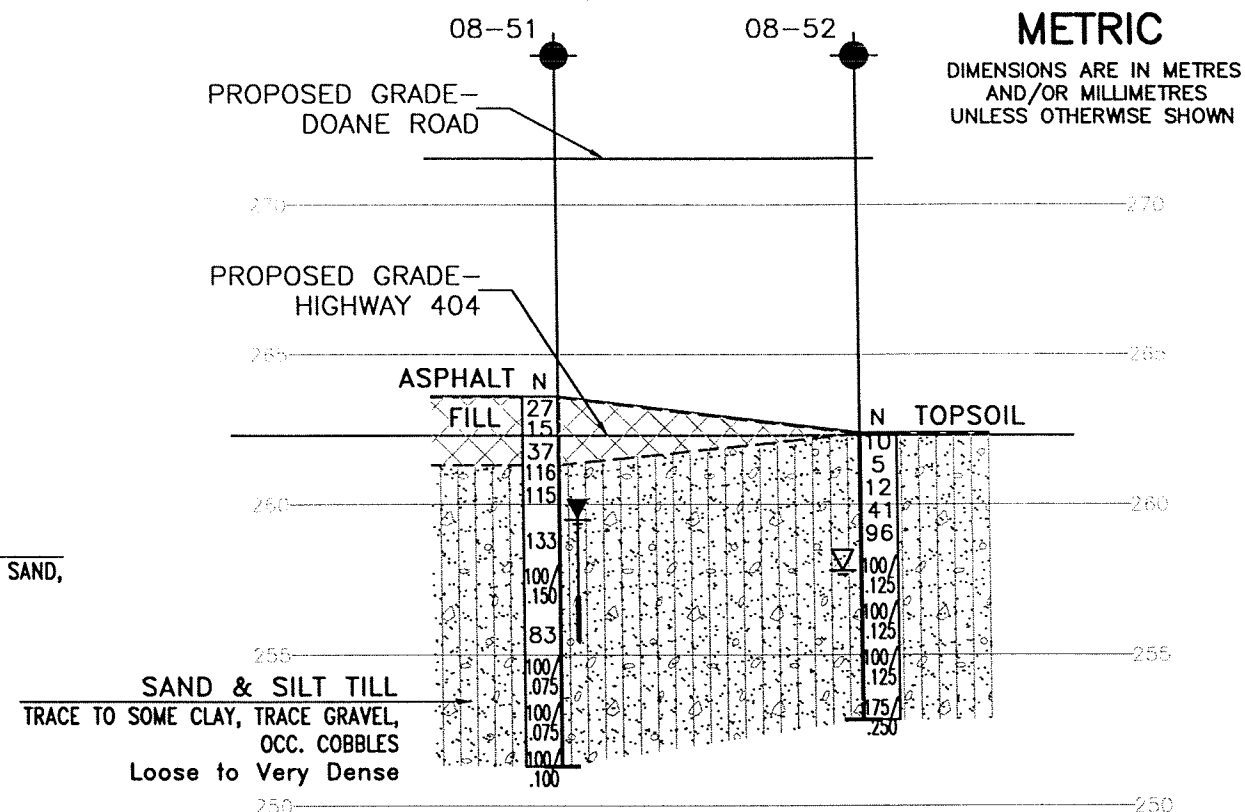
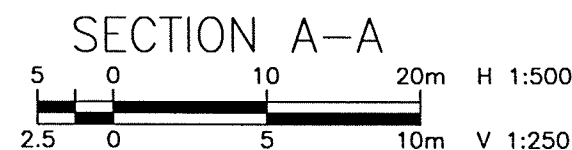
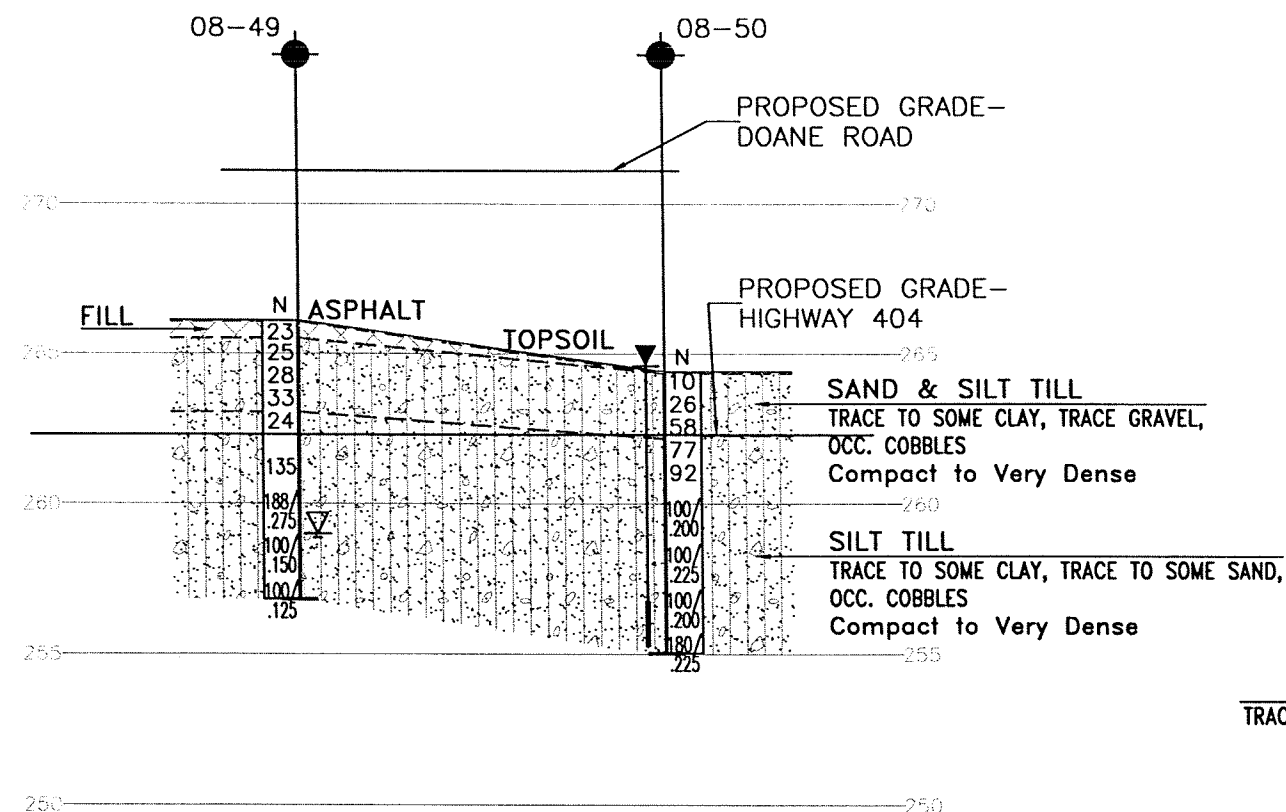
---

## **Appendix D**

### **Drawing**

#### **Borehole Locations and Soil Strata**



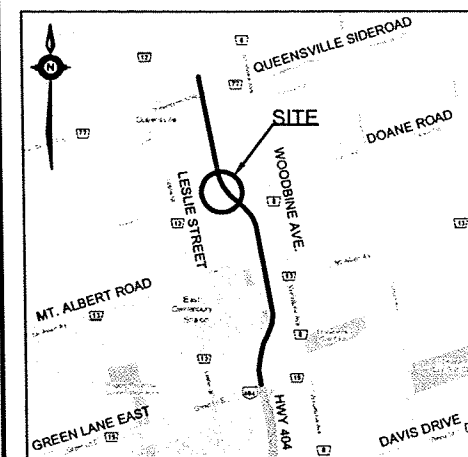


**METRIC**  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
GWP No 2109-05-00






HIGHWAY 404 EXTENSION  
BRIDGE FOUNDATIONS  
DOANE ROAD UNDERPASS  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



## KEYPLAN

## 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
08-48	265.6	4 887 093.6	310 301.8
08-49	266.1	4 887 108.9	310 311.7
08-50	264.4	4 887 090.4	310 327.1
08-51	263.6	4 887 113.7	310 353.3
08-52	262.4	4 887 100.1	310 368.4
08-53	262.1	4 887 127.4	310 398.8
08-54	261.0	4 887 112.7	310 413.8
08-55	261.7	4 887 131.7	310 424.0

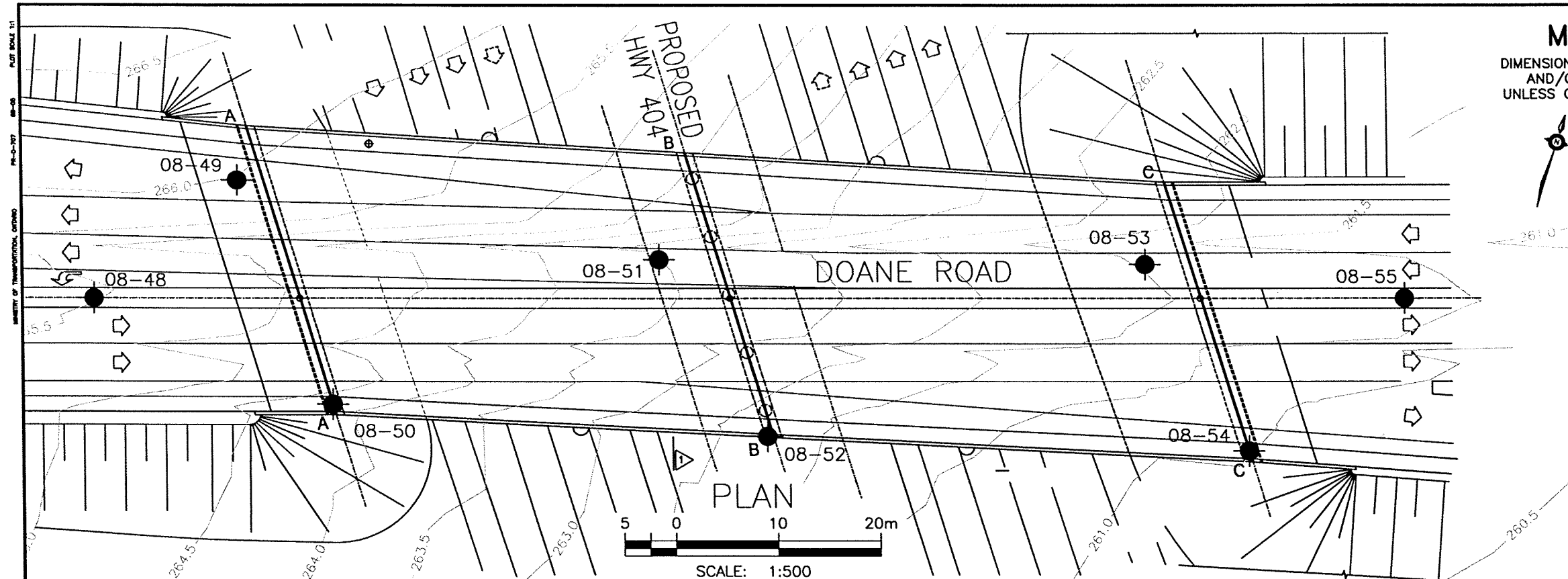
**-NOTES-**

- 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. 31D - 483**

[illegible]





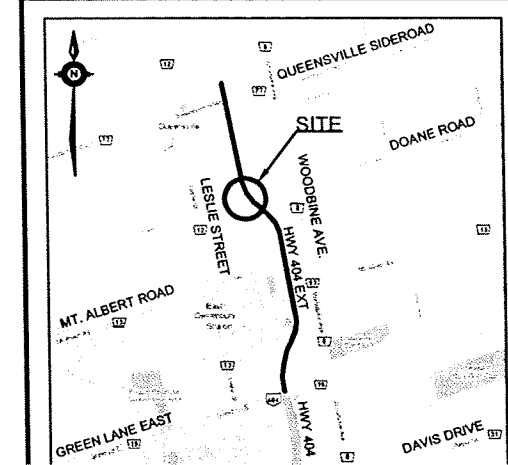
**METRIC**  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
GWP No 2109-05-00

SHHEET

HIGHWAY 404 EXTENSION  
BRIDGE FOUNDATIONS  
DOANE ROAD UNDERPASS  
BOREHOLE LOCATIONS AND SOIL STRATA

THURBER ENGINEERING LTD.  
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

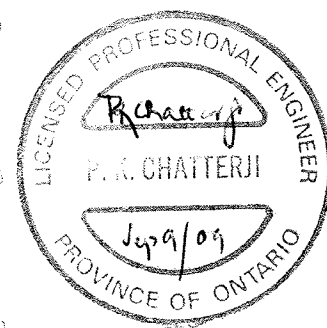
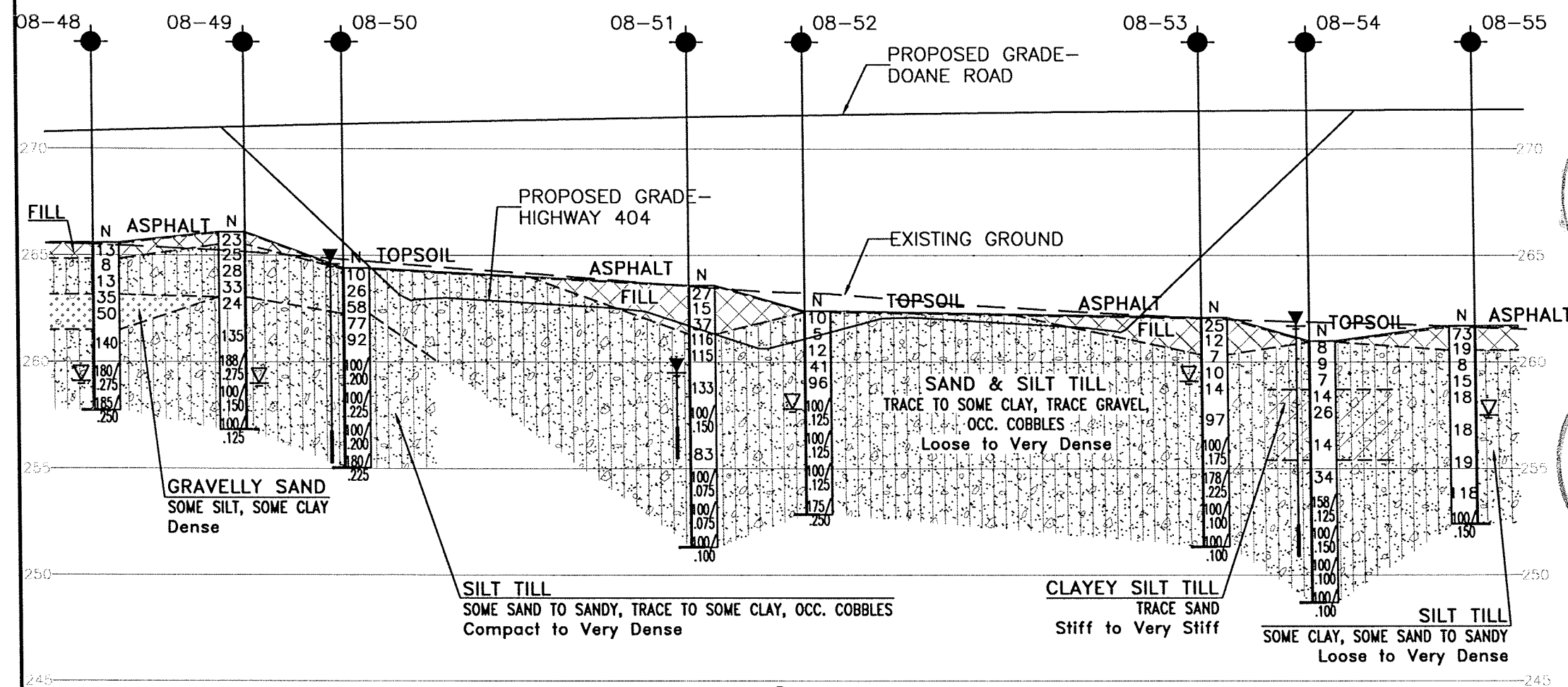
- Borehole
- Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
08-48	265.6	4 887 093.6	310 301.8
08-49	266.1	4 887 108.9	310 311.7
08-50	264.4	4 887 090.4	310 327.1
08-51	263.6	4 887 113.7	310 353.3
08-52	262.4	4 887 100.1	310 368.4
08-53	262.1	4 887 127.4	310 398.8
08-54	261.0	4 887 112.7	310 413.8
08-55	261.7	4 887 131.7	310 424.0

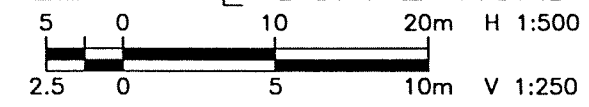
NOTES

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

GEOCRES No. 31D - 483



PROFILE ON Q DOANE ROAD



REVISIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														</
-----------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	----

FILENAME: H:\Drawing\19\1005\483\483-DoaneRoad.dwg  
PLOTDATE: Sep 06, 2009 - 3:50pm