

**FOUNDATION INVESTIGATION REPORT  
REPLACEMENT OF CPR OVERHEAD STRUCTURE  
HIGHWAY 401 WESTBOUND COLLECTORS  
JANE STREET TO KIPLING AVENUE  
G.W.P. 2147-01-00**

**Geocres Number: 30M11-231**

**Report to**

**McCormick Rankin Corporation**

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

February 12, 2009  
File: 19-1351-122

## TABLE OF CONTENTS

### PART A: FOUNDATION INVESTIGATION REPORT

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	General .....	3
5.2	Pavement and Clay Fill.....	3
5.3	Silty Clay .....	4
5.4	Silty Clay Till.....	4
5.5	Discontinuous Non-Cohesive Deposits .....	6
5.6	Discontinuous Cohesive Deposit .....	6
5.7	Bedrock.....	6
5.8	Groundwater .....	7
6	MISCELLANEOUS .....	8

### Appendices

Appendix A	Record of Borehole Sheets
Appendix B	Laboratory Test Results
Appendix C	Photographs, Figures and Tables
Appendix D	Borehole Locations and Soil Strata Drawings

**FOUNDATION INVESTIGATION REPORT  
REPLACEMENT OF CPR OVERHEAD STRUCTURE  
HIGHWAY 401 WESTBOUND COLLECTORS  
JANE STREET TO KIPLING AVENUE  
G.W.P. 2147-01-00**

**Geocres Number: 30M11-231**

**PART A: FOUNDATION INVESTIGATION REPORT**

## **1 INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted for the proposed replacement of the Highway 401 Westbound Collector - CPR Overhead structure located between Wendell Avenue and Weston Road. The new structure will accommodate widening of the Highway 401 westbound collector lanes.

The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, borehole logs, stratigraphic profile and a written description of the subsurface conditions. A model of the subsurface conditions was developed to describe the geotechnical conditions influencing design and construction of foundations for the structure replacement.

Thurber carried out the investigation as a sub-consultant to McCormick Rankin Corporation, under the Ministry of Transportation Ontario (MTO) Agreement Number 2005-E-0023.

## **2 SITE DESCRIPTION**

The existing CPR overhead structure carries the westbound collector lanes of Highway 401 over the CP Railway. The structure has a single span varying in length from approximately 20 m at the south end to near 30 m at the north end. Grades are near elevation 144 m on Highway 401 over the structure and elevation 136 m at the CPR level.

Photographs of the north end of the structure are provided in Appendix C.

The surrounding lands are primarily commercial and light industrial.

The general site area is located within the physiographic region referred to as the Peel Plain, a level to undulating region of massive to laminated, glaciolacustrine clay and silt. The clay and silt are underlain by glacial till deposits of silty clay to clayey silt.

Grey shale bedrock of the Georgian Bay Formation underlies the site. Bedrock topography maps indicate the bedrock surface is near elevation 100 m, sloping down towards a northwest to southeast trending bedrock valley immediately northeast of the site.

### 3 SITE INVESTIGATION AND FIELD TESTING

Thurber carried out site investigation and field testing adjacent to the north end of the existing structure on November 22 and 23, 2007 and January 11 and 14, 2008 as permissions to enter the adjoining commercial properties became available. One borehole was drilled near each abutment in conjunction with investigation for associated retaining wall realignment. Borehole RW-05 was located near the west abutment and terminated in bedrock at 36.7 m depth. Borehole RW-06 was drilled near the east abutment and terminated in very dense till at 36.9 m depth.

A supplementary investigation comprising three additional boreholes, including two near the south end of the abutments, was carried out between October 29 and November 4, 2008 to further evaluate foundation requirements. The additional boreholes were designated 08-01 to 08-03 and were advanced to depths of 16.5 to 31.1 m. Borehole 08-03 was drilled adjacent to the previous borehole RW-05 to obtain thin wall tube samples only.

The approximate locations of the boreholes are shown on the attached Borehole Locations and Soil Strata Drawings in Appendix D.

Thurber positioned the boreholes in the field relative to local site features. The coordinates and ground surface elevations at the boreholes were subsequently established by J.D. Barnes Limited. The coordinates and elevations of the boreholes are given on the Borehole Locations and Soil Strata Drawing and on the individual Record of Borehole Sheets in Appendix A.

Solid stem augers were used to advance the boreholes. Samples were obtained using a split spoon sampler in conjunction with Standard Penetration Tests (SPT). Where soft to very stiff cohesive soils were encountered, the undrained shear strength was evaluated using the MTO shear vane. Thin wall tube samples of the cohesive deposits were recovered from the boreholes drilled during the supplementary investigation.

A member of Thurber's engineering staff supervised the drilling and sampling operations on a full time basis. The inspector logged the soil and groundwater conditions encountered in the boreholes, and collected, labelled and arranged for transport of the samples to Thurber's laboratory.

Standpipe piezometers were installed in two boreholes to monitor groundwater levels. The completion details of the piezometers are presented in Table 3.1. The piezometers were subsequently decommissioned in accordance with the abandonment requirements of MOE Reg. 903. The boreholes without piezometers were grouted upon completion in accordance with the Regulation.

**Table 3.1 – Piezometer Details**

Location	Tip Position (m)		Completion Details
	Depth	Elevation	
RW-05	21.3	115.7	Borehole sidewalls caved to 21.3 m, sand filter and screen from 21.3 to 19.5 m, bentonite to surface.
RW-06	10.4	125.2	Bentonite to 10.4 m, sand filter and screen from 10.4 to 8.5 m, bentonite to surface.

#### **4 LABORATORY TESTING**

All recovered soil samples were subjected to visual identification and to natural moisture content determination. The results of this testing are shown on the Record of Borehole sheets in Appendix A.

Selected samples were subjected to gradation analysis (sieve and hydrometer) and Atterberg Limits testing. Thin wall tube samples were also selected for consolidation testing and triaxial compression tests. The results are shown on the Record of Borehole sheets in Appendix A and on the charts in Appendix B.

#### **5 DESCRIPTION OF SUBSURFACE CONDITIONS**

##### **5.1 General**

Reference is made to the Record of Borehole sheets in Appendix A and to the Borehole Locations and Soil Strata Drawings in Appendix D. An overall description of the stratigraphy based on the conditions encountered in the boreholes is given in the following paragraphs. However, the factual data presented in the borehole logs takes precedence over this general description and interpretation of the site conditions.

The soil stratigraphy encountered at this site generally consists of surficial pavement, topsoil and fill layers overlying silty clay, underlain by a thick deposit of silty clay till. Various deposits of sand, silt and till, as well as shale bedrock, were encountered within or below the clay till.

More detailed descriptions of the individual strata are presented below.

##### **5.2 Pavement and Clay Fill**

A 75 mm thick asphalt surface was encountered in borehole RW-06 located near the north end of the east abutment. The asphalt was underlain by a 225 mm thick concrete slab.

A 100 mm thick topsoil layer underlain by silty clay fill was encountered in borehole RW-05 located near the north end of the west abutment. The clay fill extended to 0.8 m depth (elevation 136.3 m). An SPT N-value of 8 blows/0.3 m was obtained in the fill, indicating a firm to stiff consistency. A moisture content of 17 % was measured.

In the boreholes drilled on the south shoulder of the Westbound Collector Lanes (boreholes 08-01 and 08-02), a rigid pavement structure was encountered, comprising 50 and 80 mm of asphalt over 200 and 230 mm of concrete overlying 300 mm of gravel.

The pavement structure on the Collector Lanes was underlain by silty clay approach fill to depths of 9.7 and 9.6 m depth (elevation 134.8 and 134.9 m). SPT N-values of 5 to 24 blows/0.3 m obtained in the clay fill indicate a firm to very stiff consistency. Moisture contents ranged from 17 to 25%. The results of grain size distribution analyses and Atterberg Limits tests carried out on two samples of the fill are presented in Figures B1 and B6 of Appendix B, respectively.

### 5.3 Silty Clay

Silty clay was encountered below the pavement and fill materials. The clay typically contained a trace of sand and was described as brown or grey.

SPT N-values of 10 to 15 blows/0.3 m were obtained in the clay in boreholes 08-02 and RW-05. Values of 25 and 31 blows/0.3 m were encountered in borehole RW-06. In situ vane testing measured undrained shear strengths of 196 to over 200 kPa. Based on these results, the consistency of the clay is stiff to hard.

The natural moisture content of the silty clay ranged from 15 to 29%.

The results of laboratory tests carried out on two samples were as follows:

Gravel %	0 to 1
Sand %	1 to 8
Silt %	32 to 39
Clay %	59 to 60
Liquid Limit	45 to 46
Plastic Limit	20

The results of these tests indicate that the silty clay is a CI soil (medium plasticity).

The grain size distribution curves are shown in Figure B2, Appendix B. The Atterberg Limits are plotted on Figure B7.

The thickness of the clay layer ranged from 2.0 to 2.6 m. The lower boundary was contacted at depths of 3.0 and 2.3 m (elevation 134.0 and 133.3 m) at the north end of the west and east abutments, respectively. Below the Collector Lanes, the lower boundary was encountered at 11.7 and 12.2 m depth (elevation 132.8 and 132.3 m) at the west and east abutment, respectively.

### 5.4 Silty Clay Till

The silty clay was underlain by silty clay till. The clay till was described as grey, contains trace gravel, and has a sand content typically ranging from some sand to sandy.

SPT N-values obtained in the clay till ranged from 15 to 56 blows/0.3 m. Slightly lower N-values of 10 to 22 blows/0.3 m (stiff to very stiff) were obtained in the supplementary boreholes (08-01 and 08-02). In situ vane testing in the clay till measured undrained shear strengths of 196 to over 200 kPa. Based on these results, the consistency of the clay till is stiff to hard.

The natural moisture content of recovered samples ranged from 11 to 20%.

The grain size distribution curves for ten samples tested are shown in Figures B3 and B4, Appendix B. The Atterberg Limits are plotted on Figures B8 and B9. Although rarely encountered in the boreholes, till soils often contain cobbles and boulders, and isolated occurrences should be anticipated during construction.

The results of the laboratory tests were as follows:

Gravel %	0 to 4
Sand %	18 to 51
Silt %	35 to 51
Clay %	11 to 33
Liquid Limit	22 to 37
Plastic Limit	13 to 19

The results of these tests indicate that the silty clay till is a CL to CI soil (low to medium plasticity).

Consolidated undrained (CU) triaxial tests with pore pressure measurements were conducted on two samples of the clay till. The results of the testing are presented in Appendix B and summarized in Table 5.1.

**Table 5.1 – CU Triaxial Test Parameters**

Borehole	Sample Depth (m)	$w_o$ (%)	Cell Pressure (kPa)	Maximum Deviator Stress (kPa)	Axial Strain at Maximum Deviator Stress (%)	Initial Tangent Modulus $E_i$ (MPa)	Secant Modulus at $\frac{1}{2}$ Deviator Stress $E_{50}$ (MPa)
08-01	15.2-15.8	16	505	263	5.9	32	20
08-03	6.1-6.7	15	255	298	12.5	34	13

The results of consolidation testing conducted on four samples of the silty clay till (including one from Wendell Avenue obtained as part of the overall widening project) are included in Appendix B and summarized in Table 5.2.

**Table 5.2 – Consolidation Test Parameters**

Borehole	Sample Depth (m)	$w_o$ (%)	$\gamma$ (kN/m <sup>3</sup> )	$e_o$	$p_o'$ (kPa)	$p_c'$ (kPa)	OCR	$C_c$	$C_r$	$c_v$ (cm <sup>2</sup> /s)
08-01	15.2-15.8	15	21.7	0.442	310	650	2.1	0.15	0.018	0.050
08-03	6.1-6.7	16	21.0	0.499	130	450	3.5	0.17	0.020	0.100
08-03	15.2-15.8	14	22.0	0.381	280	550	2.0	0.20	0.019	0.004
08-04	9.1-9.8	16	21.5	0.438	200	625	3.1	0.19	0.018	0.003

Comparison of the existing and preconsolidation pressures ( $p_o'$  and  $p_c'$ ) derived from the test results indicate that the natural silty clay till is overconsolidated. The coefficient of consolidation,  $c_v$ , reported in the table applies to the typical pressure range anticipated in the field. The compressibility characteristics will vary with depth in accordance with the moisture content and shear strength profiles.

In boreholes RW-05 and RW-06, the lower boundary of the till was encountered at depths of 33.5 and 27.4 m (elevation 103.5 and 108.2) respectively, indicating a unit thickness of 30.5 and 25.1 m. However, a 2.3 to 3.0 m thick layer of silty sand was encountered within

the till in both boreholes, and a thin layer of clayey silt was encountered above the sand layer at the east abutment.

In boreholes 08-01 and 08-02, a silt/sandy silt layer was encountered within the till at depths of 24.4 and 24.5 m (elevation 120.1 and 120.0 m). Borehole 08-01 was terminated in the sandy silt. In borehole 08-02, the silt layer was penetrated at 30.8 m depth (elevation 113.7 m), and drilling was terminated in clay till at 31.1 m (elevation 113.4 m).

### 5.5 Discontinuous Non-Cohesive Deposits

A layer of silty sand to silt was encountered within the clay till at depths of 18.3 to 24.5 m (elevation 115.0 to 120.1 m). Where fully penetrated, the sand/silt layer was 2.3 to 6.3 m thick with a lower boundary at depths of 21.3 to 30.8 m (elevation 112.7 to 115.7 m). SPT N-values ranged from 20 to 42 blows/0.3 m, indicating a compact to dense condition.

Deposits of sandy silt to silty sand till, silt till and silty sand were encountered below the clay till in boreholes RW-05 and RW-06. SPT N-values obtained in these deposits ranged from 30 blows/0.3 m to 76 blows/0.15 m, indicating a dense to very dense condition. The lower boundary of the non-cohesive material in borehole RW-05 was encountered at 36.0 m depth (elevation 101.0 m). Borehole RW-06 was terminated in the very dense cohesionless deposits at 36.9 m depth (elevation 98.7 m).

The natural moisture content of recovered samples ranged from 10 to 16 %.

The results of laboratory tests carried out on five samples were as follows:

Gravel %	0 to 10
Sand %	8 to 73
Silt %	23 to 79
Clay %	4 to 10

The grain size distribution curves for the samples tested are shown in Figure B3, Appendix B. Although not encountered in the boreholes, glacial till may contain cobbles and large boulders.

### 5.6 Discontinuous Cohesive Deposit

A 0.8 m thick layer of clayey silt was encountered within the clay till unit, immediately above the silty sand layer in borehole RW-06 at the east abutment. An SPT N-value of 26 blows/0.3 m (very stiff) and a moisture content of 18 % were measured in this layer.

### 5.7 Bedrock

At the west abutment (borehole RW-05), weathered grey shale was encountered below silty sand till at 36.0 m depth (elevation 101.0 m). The borehole was terminated in the shale at 36.7 m depth.



### 5.8 Groundwater

The initial and final groundwater depths and elevations measured in the boreholes and piezometers are shown in Table 5.3.

**Table 5.3 – Groundwater Depths and Elevations**

Borehole	Piezometer Tip Depth (m)	Date	Water Level (m)		Event
			Depth	Elevation	
RW-05	21.3	23-Dec-07	22.6	114.4	Upon completion
		09-Jan-08	17.7	119.3	In piezometer
		21-Jan-08	17.5	119.5	In piezometer
		03-Mar-08	17.6	119.4	In piezometer
		04-Apr-08	17.1	119.9	In piezometer
		08-May-08	17.0	120.0	In piezometer
RW-06	10.4	14-Jan-08	24.1	111.5	Upon completion
		21-Jan-08	10.4	125.2	In piezometer
		03-Mar-08	7.8	127.8	In piezometer*
		08-May-08	9.0	126.6	In piezometer* *cap missing

The above water levels reflect the unstabilized conditions in the boreholes upon completion of drilling or the piezometric head at the level of the piezometer tips at the time of the readings. The measurements are short-term observations and seasonal fluctuations of the groundwater level are to be expected.

## 6 MISCELLANEOUS

J.D. Barnes Limited determined the co-ordinates and ground elevations at the boreholes following completion of the site investigation.

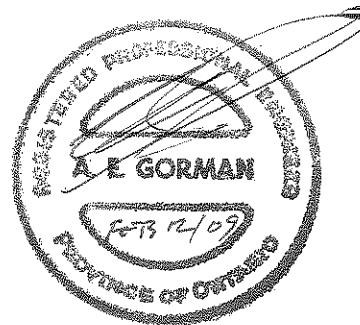
DBW Drilling Limited and Walker Drilling Ltd. supplied and operated the drilling and sampling equipment for the initial and supplementary field programs, respectively. Full time supervision of the field activities, including obtaining utility clearances, was carried out by Mr. George Azzopardi, Mr. David Elwood and Mr. Will Ball of Thurber.

Supervision of the field program, interpretation of the field data, and preparation of the report was performed by Mr. Murray Anderson, P.Eng. The report was reviewed by Mr. Alastair Gorman, P.Eng., and by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.  
Murray R. Anderson, P.Eng., M.Eng.  
Senior Geotechnical Engineer



Alastair E. Gorman, P.Eng., M.Sc.  
Project Manager



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



## **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

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



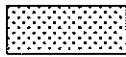


 Water Level  
 C<sub>pen</sub> Shear Strength Determination by Pocket Penetrometer

- (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 RW-05

1 OF 4

METRIC

G.W.P. 2147-01-00 LOCATION Weston Road to Highway 400, N 4 841 699.5 E 302 397.1 ORIGINATED BY GA  
 HWY 401 Westbound Collectors BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007.11.22 - 2007.11.23 CHECKED BY MRA

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
137.0							20	40	60	80	100							
0.0	TOPSOIL: (100mm)		1	SS	8													
0.1	Silty CLAY, trace to some sand, trace gravel, occasional wood fibres																	
136.3	Stiff Brown (FILL)																	
0.8	Silty CLAY, trace sand		2	SS	10													
	Stiff Brown to Mottled Brown-Grey																	
			3	SS	14													
			4	SS	15													
134.0																		
3.0	Silty CLAY, some sand to sandy, trace gravel		5	SS	22													
	Very Stiff Brown (TILL)																	
	Grey		6	SS	25													
			7	SS	25													
			8	SS	23													
			9	SS	15													

Continued Next Page

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

## METRIC

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100					
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
Continued From Previous Page							20 40 60 80 100						

[illegible]

+ 3, × 3: Numbers refer to Sensitivity



# RECORD OF BOREHOLE No RW-05

3 OF 4

METRIC

G.W.P. 2147-01-00 LOCATION Weston Road to Highway 400, N 4 841 699.5 E 302 397.1 ORIGINATED BY GA  
 HWY 401 Westbound Collectors BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007.11.22 - 2007.11.23 CHECKED BY MRA

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 (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
	Continued From Previous Page														
115.7	Silty SAND, fine grained Dense Grey Wet		17	SS	35		117							0 65 29 6	
21.3	Silty CLAY, some sand to sandy, trace gravel Hard to Very Stiff Grey (TILL)		18	SS	45		116								
							115								
							114								
							113								
			19	SS	52		112								
							111								
							110								
	occasional sand seams		20	SS	16		109							3 51 35 11	
							108								

Continued Next Page

+<sup>3</sup>, x<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No RW-05

4 OF 4

METRIC

G.W.P. 2147-01-00 LOCATION Weston Road to Highway 400, N 4 841 699.5 E 302 397.1 ORIGINATED BY GA  
 HWY 401 Westbound Collectors BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007.11.22 - 2007.11.23 CHECKED BY MRA

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 (%)		
	Continued From Previous Page							20 40 60 80 100											
	Silty CLAY, some sand to sandy, trace gravel Hard Grey (TILL)		21	SS	50		107												
							106												
							105												
							104												
103.5							103												
33.5	Silty SAND, some gravel, trace clay, occasional shale fragments Very Dense Grey (TILL)		22	SS	105		102								10 47 34 9				
							101												
101.1			23	SS	125/ 250														
36.0	Highly weathered, grey SHALE																		
100.3			24	SS	100/ 100														
36.7	END OF BOREHOLE AT 36.7m. BOREHOLE OPEN TO 29.6m AND WATER LEVEL AT 22.6m UPON COMPLETION. Piezometer installation consists of 30mm diameter schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.01.09 17.7 119.3 2008.01.21 17.5 119.5 2008.03.03 17.6 119.4 2008.04.04 17.1 119.9 2008.05.08 17.0 120.0				100														

+ 3, × 3: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No RW-06

1 OF 4

METRIC

G.W.P. 2147-01-00 LOCATION Weston Road to Highway 400, N 4 841 713.9 E 302 441.6 ORIGINATED BY GA  
 HWY 401 Westbound Collectors BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2008.01.11 - 2008.01.14 CHECKED BY MRA

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
135.6													
0.0	ASPHALT: (75mm)												
0.1													
135.3	CONCRETE: (225mm)												
0.3													
	Silty CLAY, trace sand, oxide staining Very Stiff to Hard Brown		1	SS	25								
			2	SS	31								
133.3													
2.3	Silty CLAY, some sand to sandy, trace gravel Very Stiff to Hard Brown (TILL)		3	SS	39								0 22 46 32
			4	SS	30								
			5	SS	20								
			6	SS	15								
			7	SS	15								0 22 47 31
			8	SS	21								
			9	SS	25								

Continued Next Page

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

# RECORD OF BOREHOLE No RW-06

2 OF 4

METRIC

G.W.P. 2147-01-00 LOCATION Weston Road to Highway 400, N 4 841 713.9 E 302 441.6 ORIGINATED BY GA  
 HWY 401 Westbound Collectors BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2008.01.11 - 2008.01.14 CHECKED BY MRA

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 (%)					
	Continued From Previous Page													
	Silty CLAY, some sand to sandy, trace gravel Very Stiff to Hard Grey (TILL)		10	SS	35		125							
							124							
			11	SS	24		123							
							122							
			12	SS	25		121							
							120							
			13	SS	35		119							
							118							
			14	SS	21		117							
							116							
			15	SS	52									
115.8														
19.8	Clayey SILT													

Continued Next Page


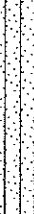


+ 3 x 3 : Numbers refer to  
Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No RW-06

3 OF 4

METRIC

G.W.P. 2147-01-00 LOCATION Weston Road to Highway 400, N 4 841 713.9 E 302 441.6 ORIGINATED BY GA  
 HWY 401 Westbound Collectors BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2008.01.11 - 2008.01.14 CHECKED BY MRA

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							WATER CONTENT (%)		
								20   40   60   80   100							w <sub>p</sub> w      w <sub>L</sub>		
Continued From Previous Page							○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      x LAB VANE										
115.0	Very Stiff Grey		16	SS	26		115										
20.6	Silly SAND, fine grained Compact Grey Wet		17	SS	22		114								0   73   23   4		
112.7							113										
22.9	Silty CLAY, some sand to sandy, trace gravel Hard Grey (TILL)		18	SS	56		111										
							110										
							109										
108.2							108										
27.4	SILT, some sand, trace gravel Dense Grey Damp (TILL)		19	SS	47		107										
							106										

Continued Next Page

+ 3, x 3. Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

## METRIC

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 (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100	20 40 60 80 100	W <sub>P</sub>	W		
105.3 30.3	<p>Continued From Previous Page</p> <p>SILT, some sand, trace gravel Dense Grey Damp (TILL)</p> <p>Silty SAND, trace gravel Dense Grey Wet</p>		20	SS	30								
102.1 33.5	<p>Sandy SILT, trace gravel Very Dense Grey Wet (TILL)</p> <p>occasional shale fragments</p>		21	SS	64/ .150								
98.7 36.9	<p>END OF BOREHOLE AT 36.9m. BOREHOLE OPEN TO 36.6m AND WATER LEVEL AT 24.1m UPON COMPLETION. Piezometer installation consists of 19mm diameter schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.01.21 10.4 125.2 2008.03.03 7.8 127.8* 2008.05.08 9.0 126.6* * Cap missing</p>		22	SS	73/ .150								
			23	SS	76/ .150								

ONTMT4S 1122.GPJ 8/19/08

+ 3, x 3; Numbers refer to Sensitivity

# RECORD OF BOREHOLE No 08-01

1 OF 3

METRIC

G.W.P. 2147-01-00 LOCATION CPR Overpass, N 4 841 668.1 E 302 389.0 ORIGINATED BY DEE  
 HWY 401 Westbound Collectors BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.11.03 - 2008.11.03 CHECKED BY MRA

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	W <sub>p</sub> W W <sub>L</sub>	WATER CONTENT (%)				
144.5														
0.0	PAVEMENT: 80mm asphalt over 230mm concrete over 300mm gravel													
143.9														
0.6	Silty CLAY, trace to some sand Firm to Very Stiff Brown (FILL)													
			1	SS	5									
			2	SS	9									
			3	SS	9									
			4	SS	15									
			5	SS	17									
			6	SS	15									
134.8														
9.7	Silty CLAY, trace sand Stiff													

Continued Next Page

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

RECORD OF BOREHOLE No 08-01

2 OF 3

METRIC

G.W.P. 2147-01-00 LOCATION CPR Overpass, N 4 841 668,1 E 302 389.0 ORIGINATED BY DEE  
HWY 401 Westbound Collectors BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2008.11.03 - 2008.11.03 CHECKED BY MRA

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			20 40 60 80 100	120 140 160 180 200	PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>		
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
132.8	Silty CLAY, trace sand Stiff Grey		7	TW	PH		134							
11.7	Silty CLAY, some sand to sandy, trace gravel Stiff to Very Stiff Grey (TILL)		8	SS	11		133							
			9	SS	10		132							
			10	TW	PH		131							
			11	SS	11		130							
			12	SS	16		129							
							128							
							127							
							126							
							125							

Continued Next Page

+<sup>3</sup>, x<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 08-01

3 OF 3

METRIC

G.W.P. 2147-01-00 LOCATION CPR Overpass, N 4 841 668.1 E 302 389.0 ORIGINATED BY DEE  
HWY 401 Westbound Collectors BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2008.11.03 - 2008.11.03 CHECKED BY MRA

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE		
	Continued From Previous Page												
	Silty CLAY, some sand to sandy, trace gravel Stiff to Very Stiff Grey (TILL)		13	TW	PH								
			14	SS	15								
			15	SS	20								
120.1													
24.4	Sandy SILT, some clay to clayey Compact Grey Wet		16	SS	20								
119.5													
25.0	END OF BOREHOLE AT 25.0m. BOREHOLE BACKFILLED WITH BENTONITE TO 0.3m, THEN ASPHALT TO SURFACE.												

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity 20  
15 10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-02

1 OF 4

METRIC

G.W.P. 2147-01-00 LOCATION CPR Overpass, N 4 841 681.9 E 302 432.8 ORIGINATED BY WB  
 HWY 401 Westbound Collectors BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.29 - 2008.10.30 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	100 80 60 40 20	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
144.5														
0.0	PAVEMENT: 50mm asphalt over 200mm concrete over 300mm gravel													
143.9														
0.6	Silty CLAY, trace to some sand Stiff to Very Stiff Brown (FILL)		1	SS	12		144							
			2	SS	12		143							
			3	SS	9		142							
			4	SS	7		141							
			5	SS	23		140							
			6	SS	24		139							
			7	SS	16		138							
134.9							137							
9.6	Silty CLAY, trace sand Stiff Brown						136							
							135							

Continued Next Page

+<sup>3</sup> . X<sup>3</sup> : Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

## METRIC

ORIGINATED BY WB

COMPILED BY      AN

CHECKED BY MRA

Continued Next Page

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-02

3 OF 4

METRIC

G.W.P. 2147-01-00 LOCATION CPR Overpass, N 4 841 681.9 E 302 432.8 ORIGINATED BY WB  
HWY 401 Westbound Collectors BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2008.10.29 - 2008.10.30 CHECKED BY MRA

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 <sub>p</sub> w w <sub>L</sub>				
	Continued From Previous Page		18	SS	22												
	Silty CLAY, some sand to sandy Stiff to Very Stiff Grey (TILL)						124										
			19	SS	17		123									2 33 43 22	
							122										
							121										
120.0							120										
24.5	SILT, trace sand, trace clay Compact Brown Moist		20	SS	30												
							119										
							118										
			21	SS	29		117									3 8 79 10	
							116										
							115										

Continued Next Page

+<sup>3</sup>, x<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-02

4 OF 4

METRIC

G.W.P. 2147-01-00 LOCATION CPR Overpass, N 4 841 681.9 E 302 432.8 ORIGINATED BY WB  
 HWY 401 Westbound Collectors BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.29 - 2008.10.30 CHECKED BY MRA

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page							20	40	60	80	100					
	SILT, trace sand, trace clay Compact Brown Moist						114										
113.7																	
30.8	Silty CLAY, some sand, trace gravel		22	SS	55												
113.4	Hard																
31.1	Grey (TILL)																
	END OF BOREHOLE AT 31.1m. WATER LEVEL AT 24.3m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE TO 0.3m, THEN ASPHALT TO SURFACE.																

+ 3 . x 3 : Numbers refer to  
Sensitivity 20 15 10 5 0  
(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 08-03

2 OF 2

METRIC

G.W.P. 2147-01-00 LOCATION CPR Overpass, N 4 841 699.5 E 302 398.1 ORIGINATED BY DEE  
 HWY 401 Westbound Collectors BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.11.04 - 2008.11.04 CHECKED BY MRA

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 80 100	40 80 120 160 200					
	Continued From Previous Page													
	Silty CLAY (TILL)		3	TW	PH		127							
							126							
							125							
							124							
							123							
							122							
			4	TW	PH		121							
120.5														
16.5	END OF BOREHOLE AT 16.5m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.													

+<sup>3</sup> . X<sup>3</sup> : Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

## **Appendix B**

### **Laboratory Test Results**

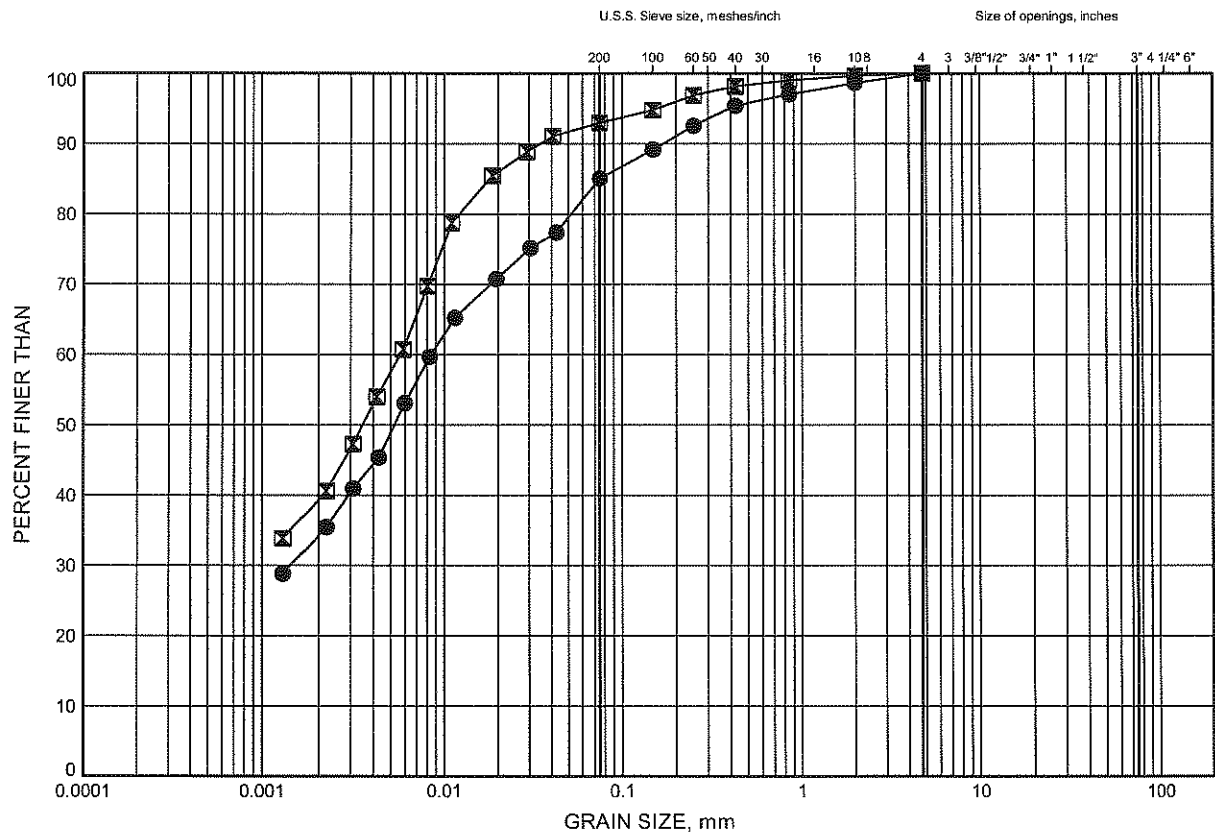


# Hwy 401 Westbound Collectors, Jane to Kipling

## 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)
●	08-01	6.40	138.10
×	08-02	4.88	139.62



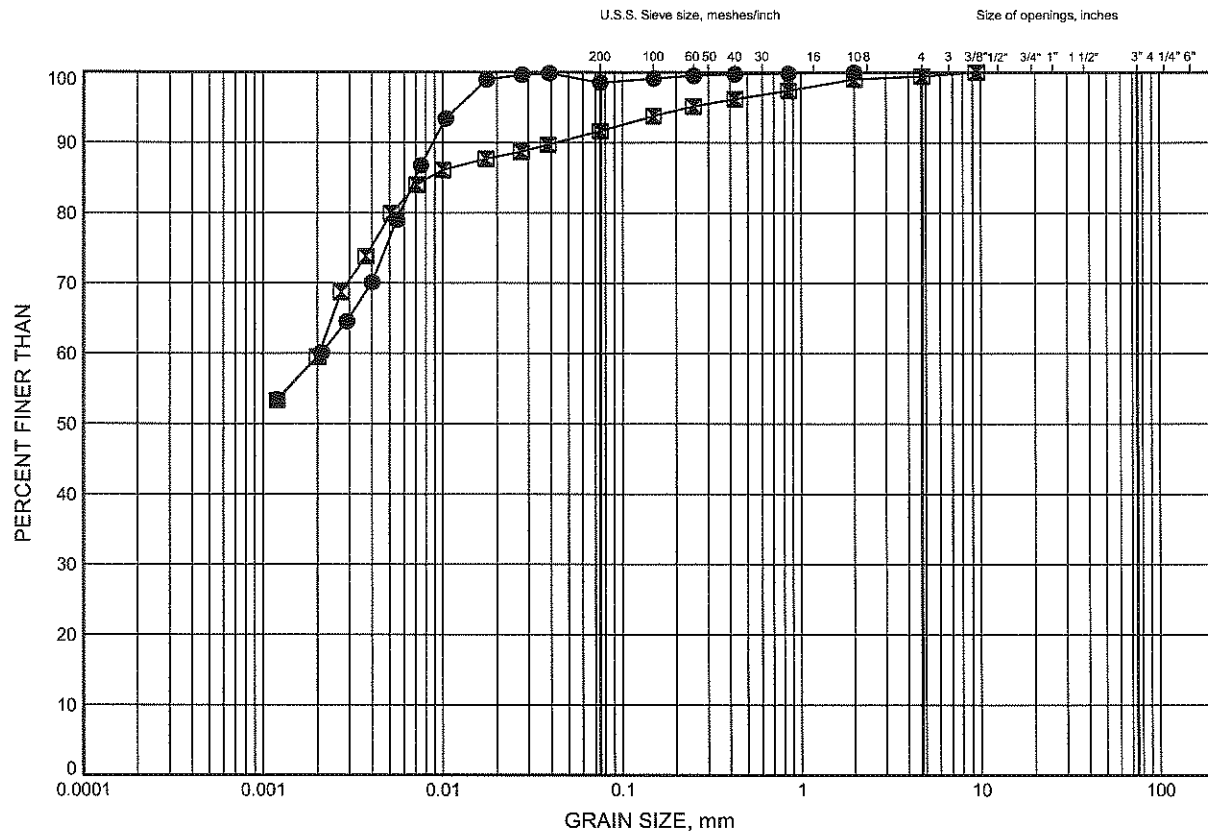
W.P.# .2147-01-00.....  
 Prepared By .AN.....  
 Checked By .MEF.....

# Hwy 401 Westbound Collectors, Jane to Kipling

## GRAIN SIZE DISTRIBUTION

FIGURE B2

### SILTY CLAY



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-02	9.75	134.75
⊠	RW-05	2.59	134.43



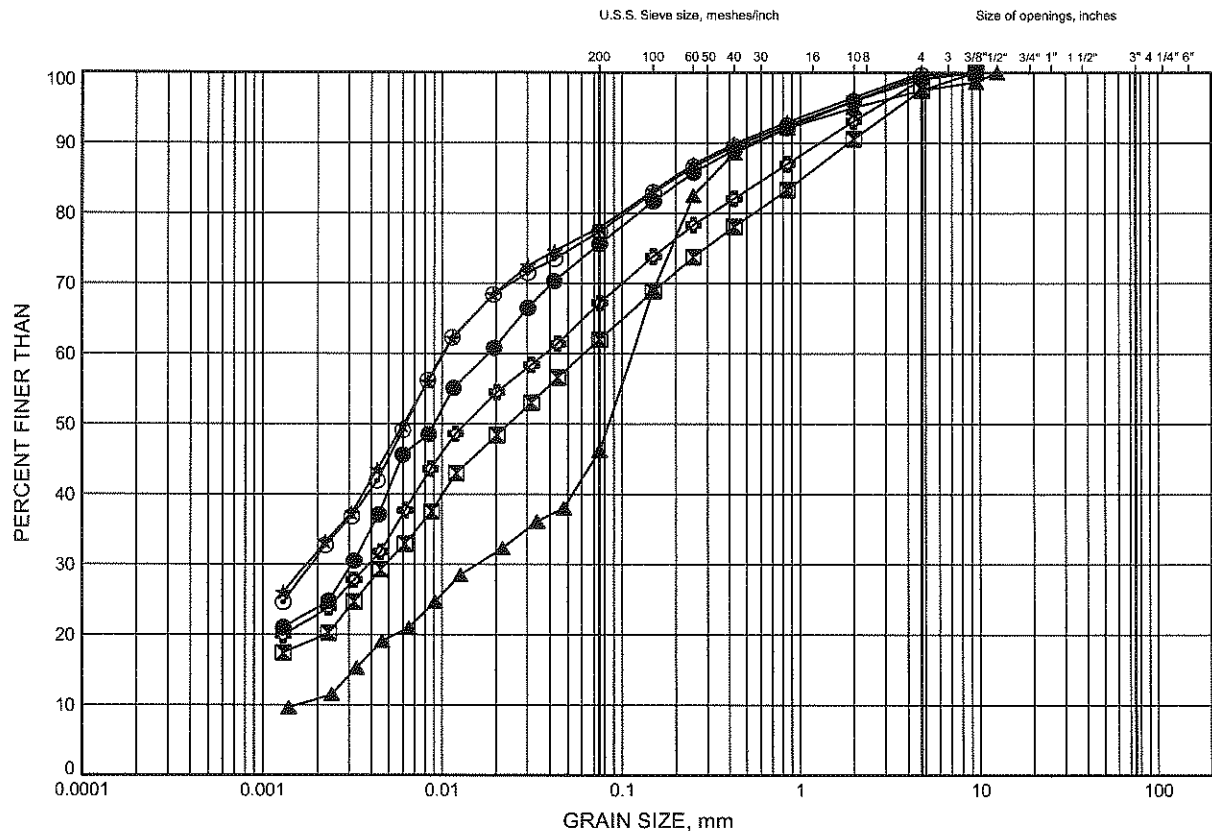
W.P.# .2147-01-00.....  
 Prepared By .AN.....  
 Checked By .MEF.....

# Hwy 401 Westbound Collectors, Jane to Kipling

## GRAIN SIZE DISTRIBUTION

FIGURE B3

### SILTY CLAY TILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	RW-05	7.92	129.10
⊠	RW-05	15.54	121.48
▲	RW-05	27.74	109.28
★	RW-06	2.59	133.00
⊙	RW-06	6.40	129.19
⊕	RW-06	15.54	120.05



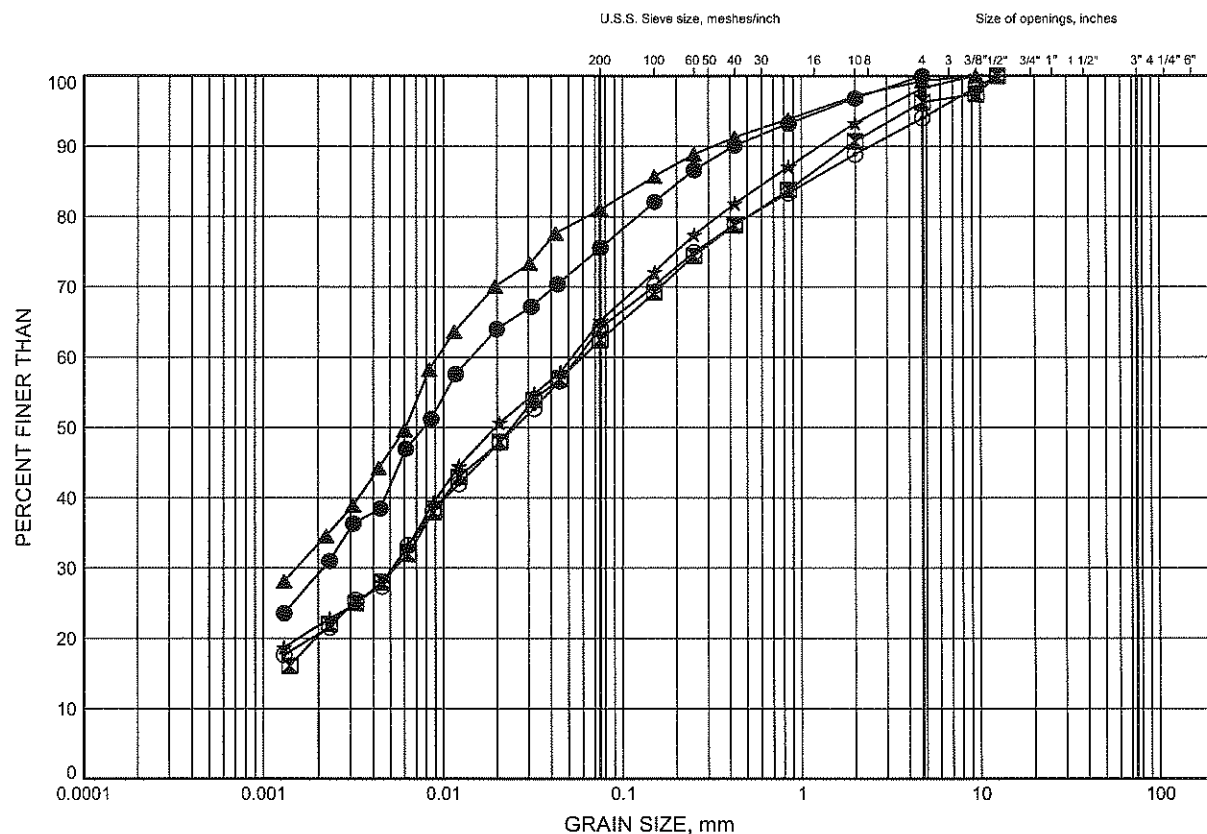
W.P.# .2147-01-00.....  
 Prepared By .AN.....  
 Checked By .MEF.....

# Hwy 401 Westbound Collectors, Jane to Kipling

## GRAIN SIZE DISTRIBUTION

FIGURE B4

### SILTY CLAY TILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-01	12.50	132.00
⊠	08-01	18.59	125.91
▲	08-02	14.78	129.72
★	08-02	21.64	122.86
⊙	08-03	15.54	121.46

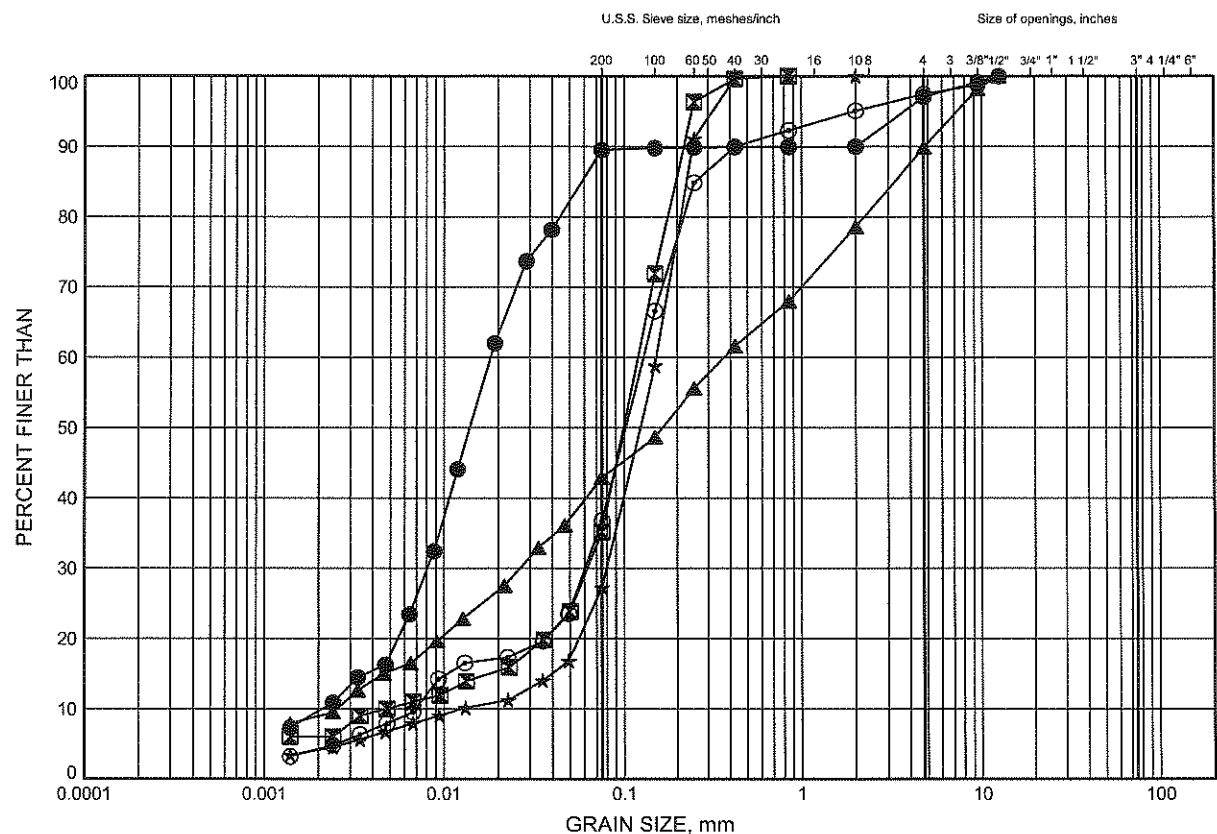


W.P.# .2147-01-00.....  
 Prepared By .MFA.....  
 Checked By .MRA.....

Hwy 401 Westbound Collectors, Jane to Kipling  
**GRAIN SIZE DISTRIBUTION**

FIGURE B5

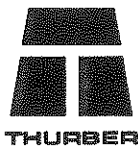
**SILT, SILTY SAND AND SILTY SAND TILL**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-02	27.74	116.76
⊠	RW-05	20.12	116.90
▲	RW-05	33.83	103.19
★	RW-06	21.64	113.95
⊙	RW-06	30.78	104.81

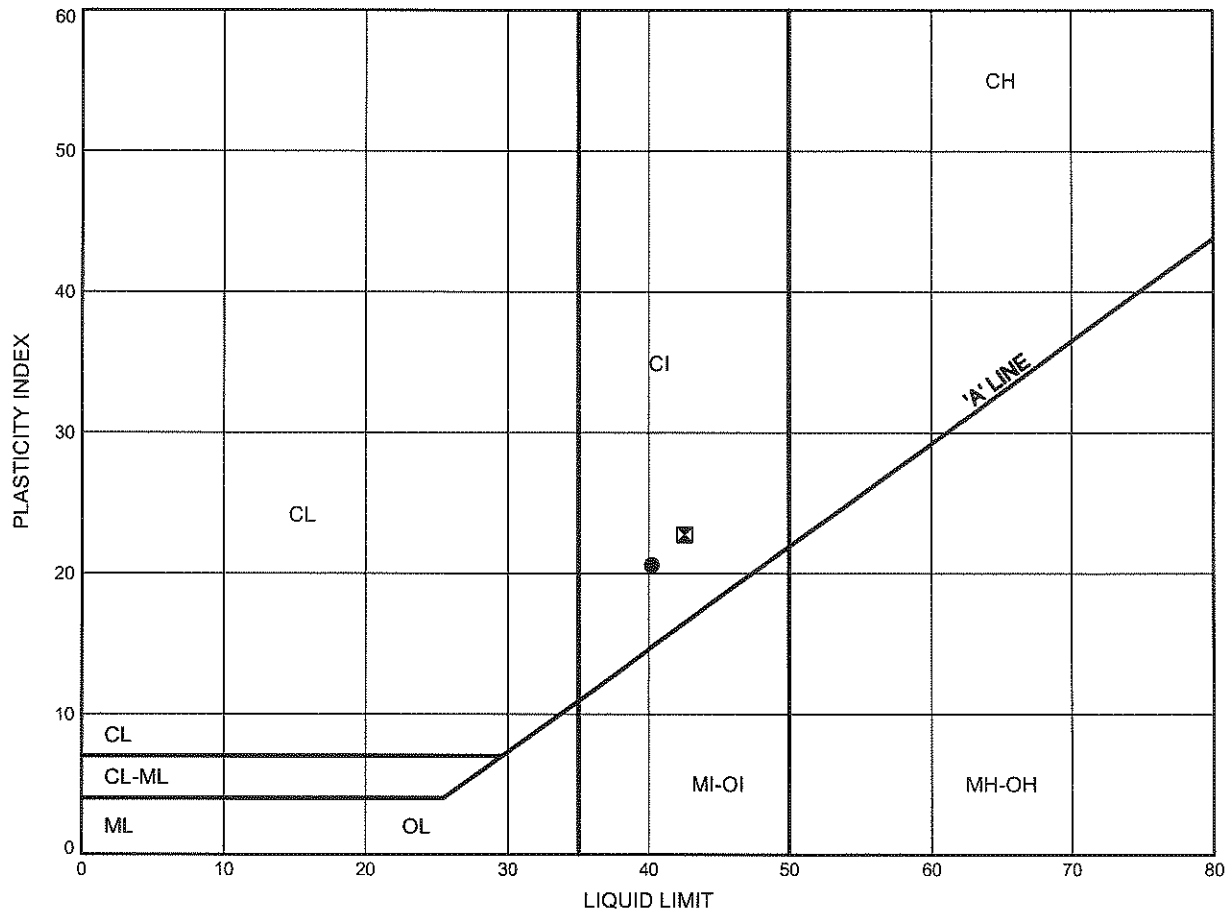


W.P.# .2147-01-00.....  
 Prepared By .MFA.....  
 Checked By .MRA.....

Hwy 401 Westbound Collectors, Jane to Kipling  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B6

**SILTY CLAY FILL**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-01	6.40	138.10
⊠	08-02	4.88	139.62

Date December 2008  
 Project 2147-01-00

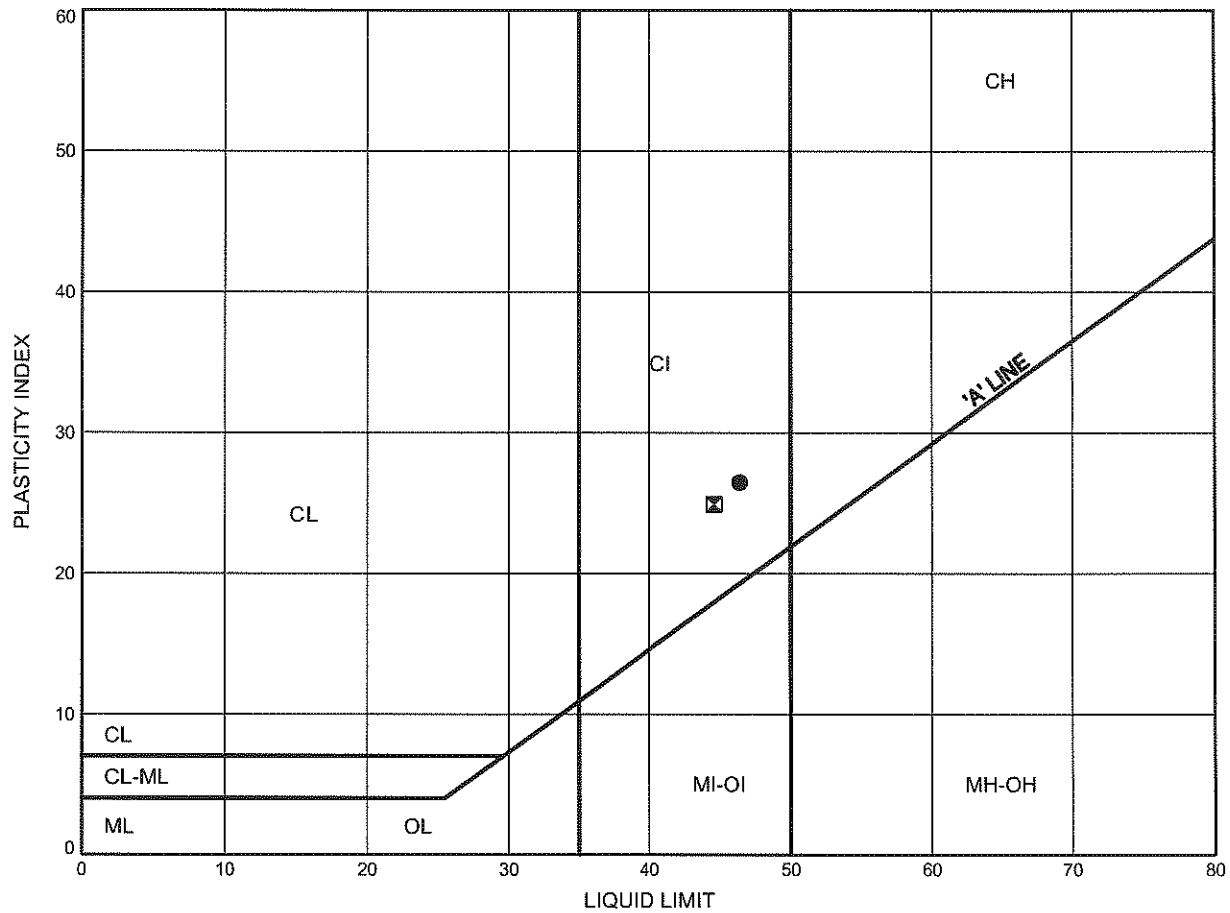


Prep'd AN  
 Chkd. MEF

Hwy 401 Westbound Collectors, Jane to Kipling  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B7

**SILTY CLAY**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-02	9.75	134.75
⊠	RW-05	2.59	134.43

Date December 2008  
 Project 2147-01-00

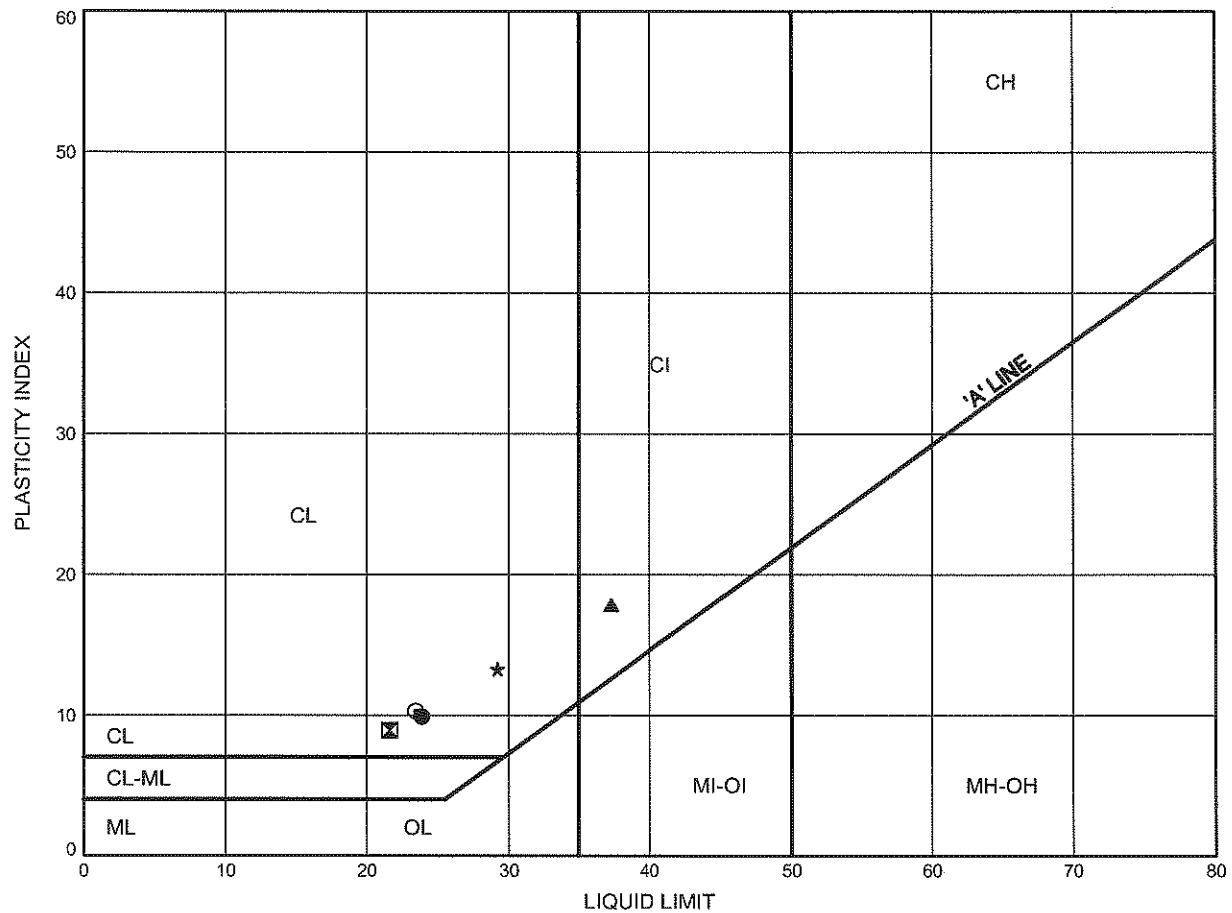


Prep'd AN  
 Chkd. MEF

Hwy 401 Westbound Collectors, Jane to Kipling  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B8

**SILTY CLAY TILL**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	RW-05	7.92	129.10
⊠	RW-05	15.54	121.48
▲	RW-06	2.59	133.00
★	RW-06	6.40	129.19
⊙	RW-06	15.54	120.05

Date December 2008  
 Project 2147-01-00



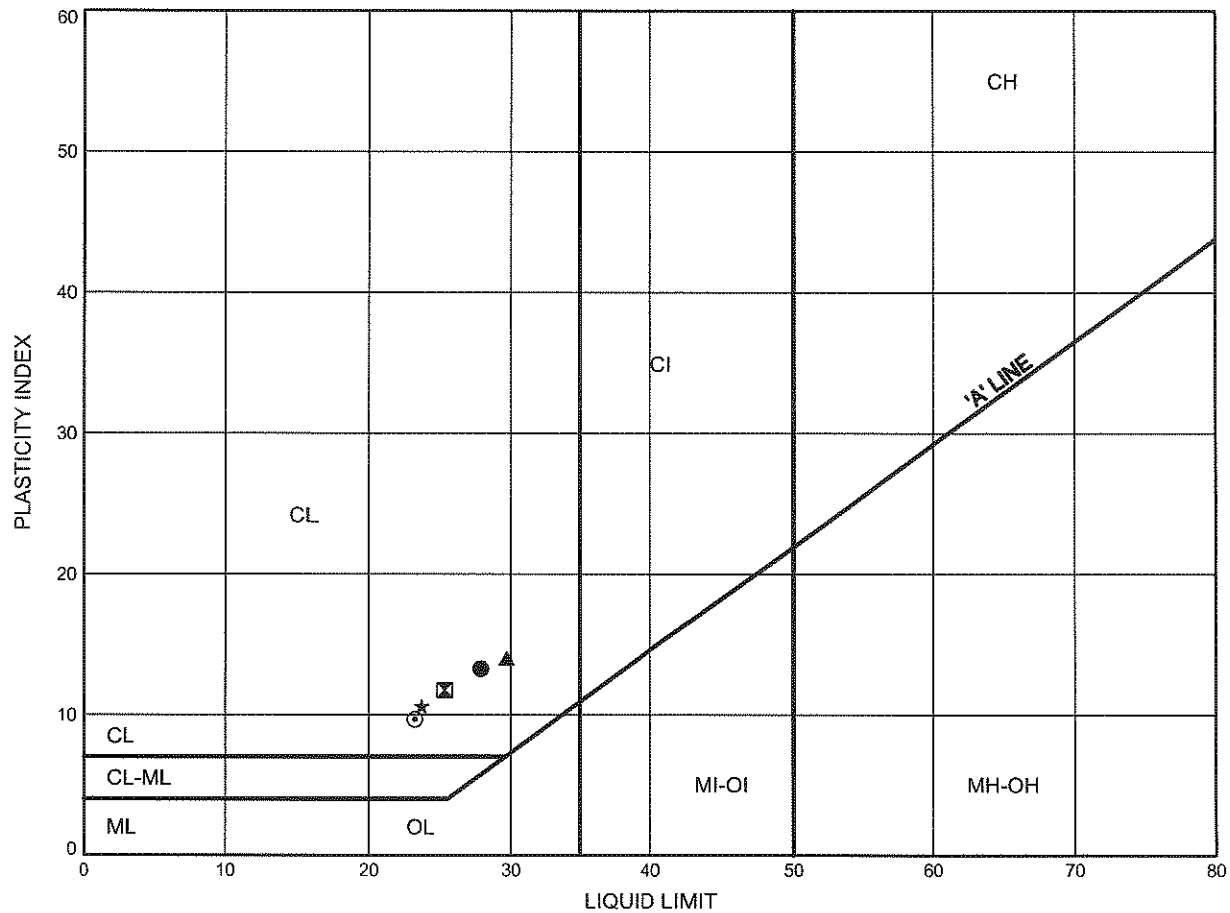
Prep'd AN  
 Chkd. MEF



Hwy 401 Westbound Collectors, Jane to Kipling  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B9

**SILTY CLAY TILL**

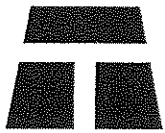


SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-01	12.50	132.00
⊠	08-01	18.59	125.91
▲	08-02	14.78	129.72
★	08-02	21.64	122.86
⊙	08-03	15.54	121.46

Date December 2008  
 Project 2147-01-00



Prep'd AN  
 Chkd. MEF



## Consolidation Test Report

CLIENT: **McCormick Rankin Corporation**

FILE NUMBER: 19-1351-122

PROJECT: **HWY 401 Westbound Collectors, Jane to Kipling**

REPORT DATE: 10-Dec-08

TEST DATES: November 12, 2008 - November 29, 2008

SAMPLE: BH08-3-TW4 (50'-52')

Clay, Silty, Sandy, trace Gravel, grey, (CL), 21% Clay, 43% Silt, 30% Sand & 6% Gravel

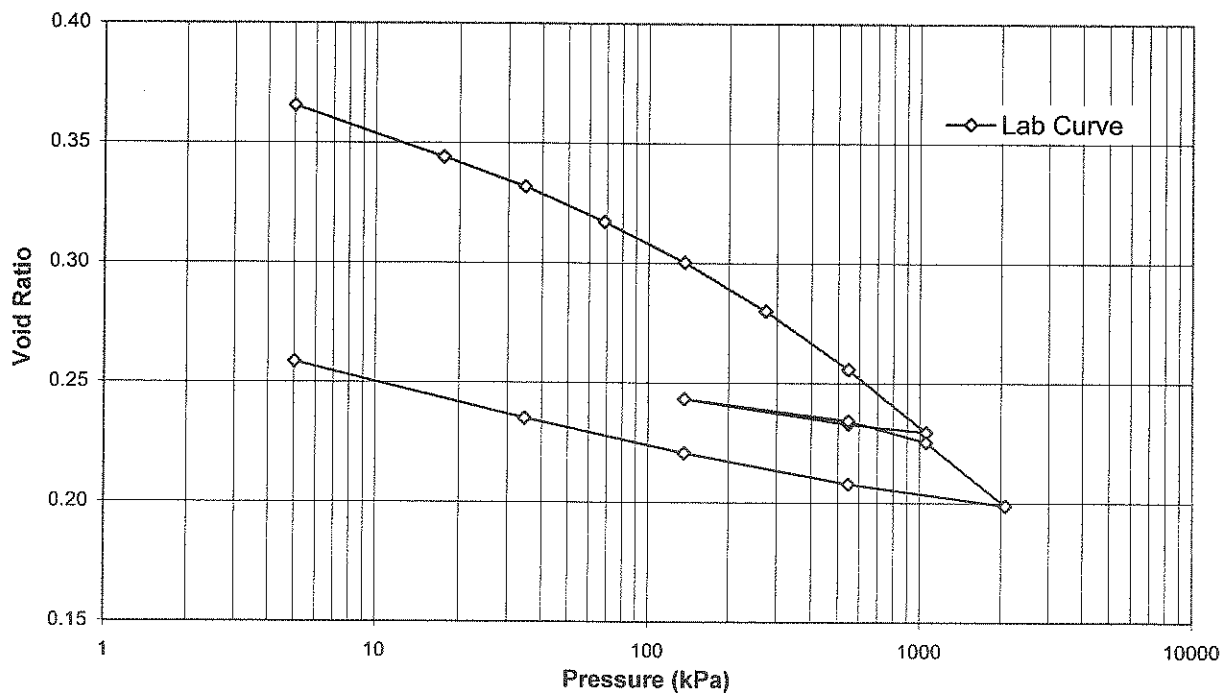
PROCEDURE: Test carried out in accordance with Standard Test Method for One-Dimensional Consolidation Properties of Soils, ASTM D 2435-04, method B

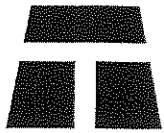
	<u>Start of Test</u>	<u>End of Test</u>
Wet Dens. (kg/m <sup>3</sup> )	2246.3	2416.1
Dry Dens. (kg/m <sup>3</sup> )	1953.0	2142.7
Moisture Cont. (%)	14.1	12.8
Void Ratio	0.381	0.259
Saturation (%)	100.0	

Note: A Specific Gravity of 2.70 was measured for the void ratio and saturation calculations.

Project #: 19-1351-122  
Client: McCormick Rankin Corporation  
Project Name: HWY 401 Westbound Collectors, Jane to Kipling  
Sample: BH08-3-TW4 (50'-52')  
Oedometer Consolidation Test

**Void Ratio vs Pressure**





## Consolidation Test Report

HWY 401 Westbound Collectors, Jane to Kipling  
19-1351-122

BH08-3-TW4 (50'-52')

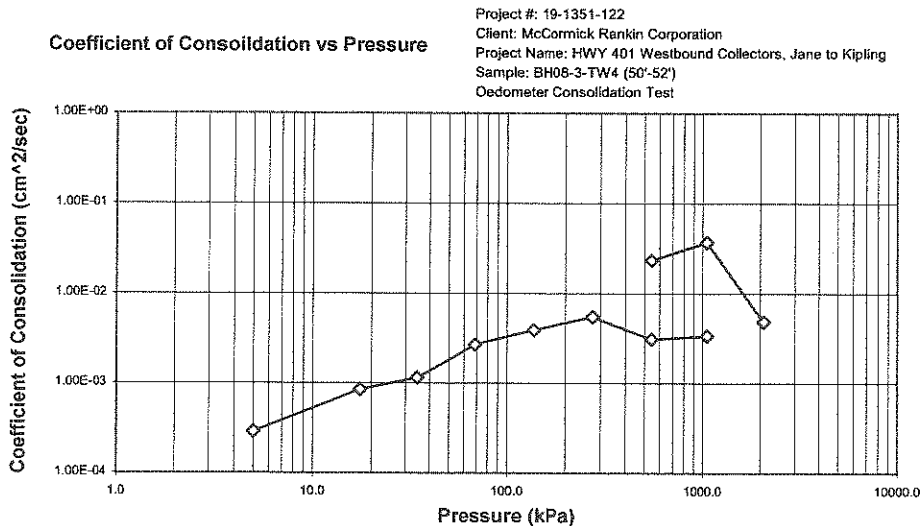
**TRIMMING:** The Specimen was manually trimmed to the size of consolidation ring, then mounted in a fixed ring consolidometer.

**LOADING:** A seating load of 5 kPa was applied and the consolidometer was flooded with distilled water. Sample was monitored to ensure no swelling effect occurred before the start of the test. Subsequent loads were applied and the duration of each load step was 24 hours.

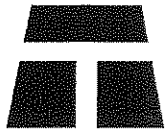
**CALCULATIONS:** Coefficients of Consolidation were calculated by the square root time method.

Pressure (kPa)	Corr. Hgt (mm)	Avg. Hgt. (mm)	D90 (mm)	T90 (min)	Cv (cm <sup>2</sup> /s)	Void Ratio	mv (m <sup>2</sup> /kN)	k (cm/s)
0.00	20.000					0.381		
5.02	19.778	19.889	0.196	48.34	2.89E-04	0.366	2.21E-03	6.27E-08
17.56	19.467	19.623	0.250	16.00	8.50E-04	0.344	1.25E-03	1.05E-07
34.53	19.288	19.378	0.134	11.56	1.15E-03	0.332	5.42E-04	6.10E-08
68.48	19.077	19.183	0.146	4.84	2.69E-03	0.317	3.22E-04	8.49E-08
136.85	18.833	18.955	0.160	3.24	3.92E-03	0.300	1.87E-04	7.19E-08
273.20	18.539	18.686	0.180	2.25	5.48E-03	0.280	1.14E-04	6.16E-08
545.45	18.187	18.363	0.236	3.84	3.10E-03	0.256	6.97E-05	2.12E-08
1057.67	17.807	17.997	0.245	3.39	3.38E-03	0.230	4.08E-05	1.35E-08
545.50	17.855	17.831				0.233		
136.90	18.007	17.931				0.243		
545.50	17.877	17.942	0.101	0.49	2.32E-02	0.234	1.77E-05	4.02E-08
1057.70	17.748	17.813	0.068	0.30	3.71E-02	0.225	1.41E-05	5.12E-08
2080.10	17.364	17.556	0.230	2.25	4.84E-03	0.199	2.12E-05	1.00E-08
545.45	17.494	17.429				0.208		
136.85	17.680	17.587				0.221		
34.53	17.889	17.785				0.235		
5.02	18.229	18.059				0.259		

Coefficient of Consolidation vs Pressure



Notes: Cv and k calculated using  $t_{90}$  values



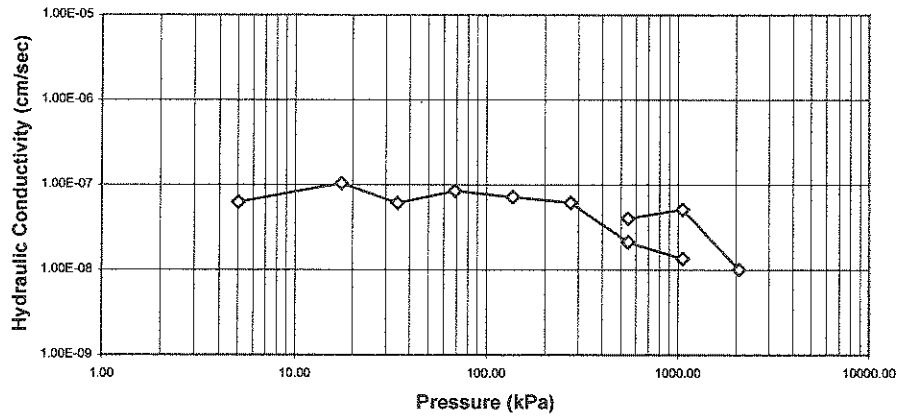
## Consolidation Test Report

HWY 401 Westbound Collectors, Jane to Kipling  
19-1351-122

BH08-3-TW4 (50'-52')

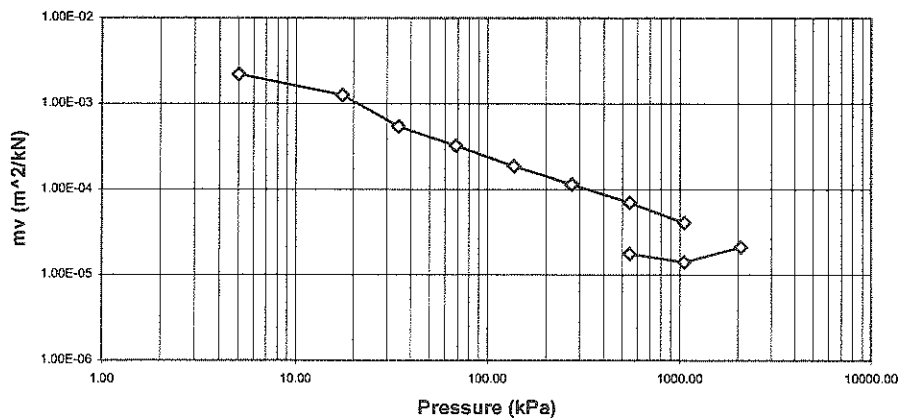
### Hydraulic Conductivity vs Pressure

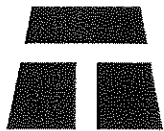
Project #: 19-1351-122  
Client: McCormick Rankin Corporation  
Project Name: HWY 401 Westbound Collectors, Jane to Kipling  
Sample: BH08-3-TW4 (50'-52')  
Oedometer Consolidation Test



### mv vs Pressure

Project #: 19-1351-122  
Client: McCormick Rankin Corporation  
Project Name: HWY 401 Westbound Collectors, Jane to Kipling  
Sample: BH08-3-TW4 (50'-52')  
Oedometer Consolidation Test





## Consolidation Test Report

CLIENT: McCormick Rankin Corporation

FILE NUMBER: 19-1351-122

PROJECT: HWY 401 Westbound Collectors, Jane to Kipling

REPORT DATE: 10-Dec-08

TEST DATES: November 12, 2008 - November 29, 2008

SAMPLE: BH08-4-TW11 (30'-32')

Clay, Silty, Sandy, trace Gravel, grey, (CL), 32% Clay, 43% Silt, 23% Sand & 2% Gravel

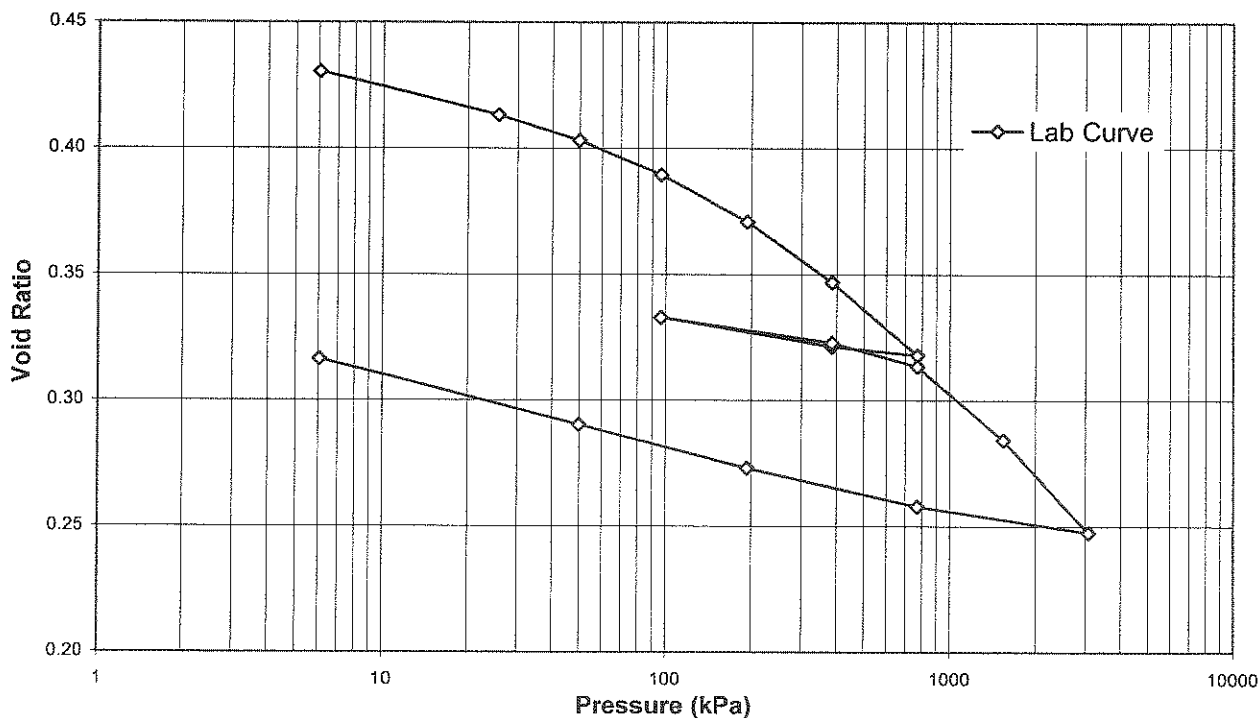
PROCEDURE: Test carried out in accordance with Standard Test Method for One-Dimensional Consolidation Properties of Soils, ASTM D 2435-04, method B

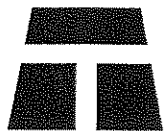
	<u>Start of Test</u>	<u>End of Test</u>
Wet Dens. (kg/m <sup>3</sup> )	2195.1	2347.4
Dry Dens. (kg/m <sup>3</sup> )	1883.9	2058.5
Moisture Cont. (%)	16.2	14.0
Void Ratio	0.438	0.316
Saturation (%)	100.0	

Note: A Specific Gravity of 2.71 was measured for the void ratio and saturation calculations.

Project #: 19-1351-122  
Client: McCormick Rankin Corporation  
Project Name: HWY 401 Westbound Collectors, Jane to Kipling  
Sample: BH08-4-TW11 (30'-32')  
Oedometer Consolidation Test

**Void Ratio vs Pressure**





## Consolidation Test Report

HWY 401 Westbound Collectors, Jane to Kipling  
19-1351-122

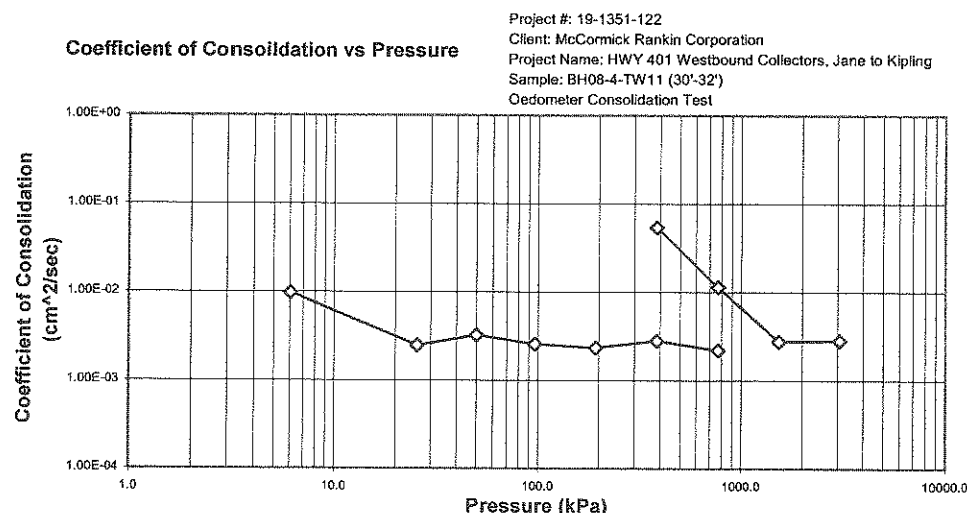
BH08-4-TW11 (30'-32')

**TRIMMING:** The Specimen was manually trimmed to the size of consolidation ring, then mounted in a fixed ring consolidometer.

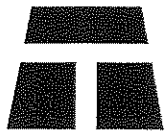
**LOADING:** A seating load of 6 kPa was applied and the consolidometer was flooded with distilled water. Sample was monitored to ensure no swelling effect occurred before the start of the test. Subsequent loads were applied and the duration of each load step was 24 hours.

**CALCULATIONS:** Coefficients of Consolidation were calculated by the square root time method.

Pressure (kPa)	Corr. Hgt (mm)	Avg. Hgt. (mm)	D90 (mm)	T90 (min)	Cv (cm <sup>2</sup> /s)	Void Ratio	mv (m <sup>2</sup> /kN)	k (cm/s)
0.00	25.500					0.438		
6.07	25.357	25.429	0.095	2.32	9.84E-03	0.430	9.24E-04	8.92E-07
25.67	25.052	25.205	0.246	9.00	2.49E-03	0.413	6.14E-04	1.50E-07
49.86	24.874	24.963	0.115	6.76	3.26E-03	0.403	2.94E-04	9.38E-08
96.64	24.633	24.754	0.166	8.41	2.57E-03	0.390	2.07E-04	5.23E-08
193.23	24.303	24.468	0.229	9.00	2.35E-03	0.371	1.39E-04	3.20E-08
385.74	23.876	24.090	0.275	7.29	2.81E-03	0.347	9.13E-05	2.52E-08
770.65	23.363	23.620	0.341	9.00	2.19E-03	0.318	5.58E-05	1.20E-08
385.70	23.424	23.394				0.321		
96.60	23.628	23.526				0.333		
385.70	23.451	23.540	0.116	0.36	5.44E-02	0.323	2.59E-05	1.38E-07
770.60	23.285	23.368	0.099	1.69	1.14E-02	0.314	1.84E-05	2.06E-08
1540.66	22.766	23.026	0.333	6.76	2.77E-03	0.284	2.89E-05	7.87E-09
3081.39	22.116	22.441	0.440	6.25	2.85E-03	0.248	1.85E-05	5.17E-09
770.65	22.299	22.208				0.258		
193.23	22.570	22.435				0.273		
49.86	22.875	22.723				0.290		
6.07	23.337	23.106				0.316		



Notes: Cv and k calculated using  $t_{90}$  values



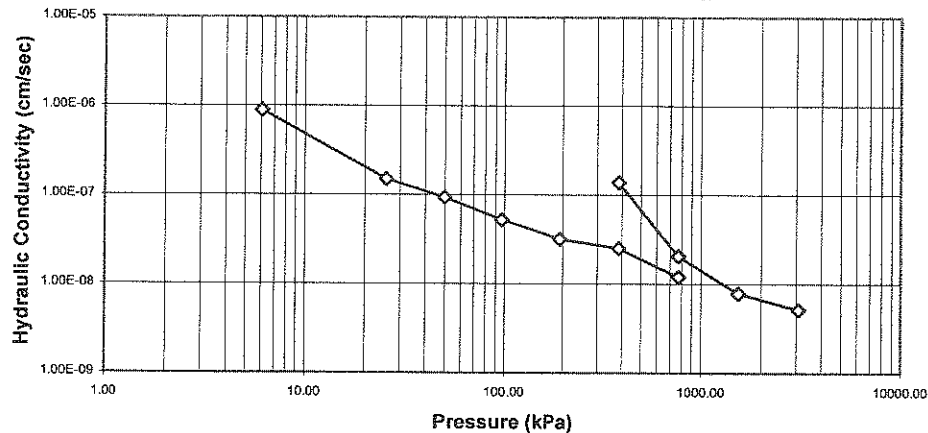
## Consolidation Test Report

HWY 401 Westbound Collectors, Jane to Kipling  
19-1351-122

BH08-4-TW11 (30'-32')

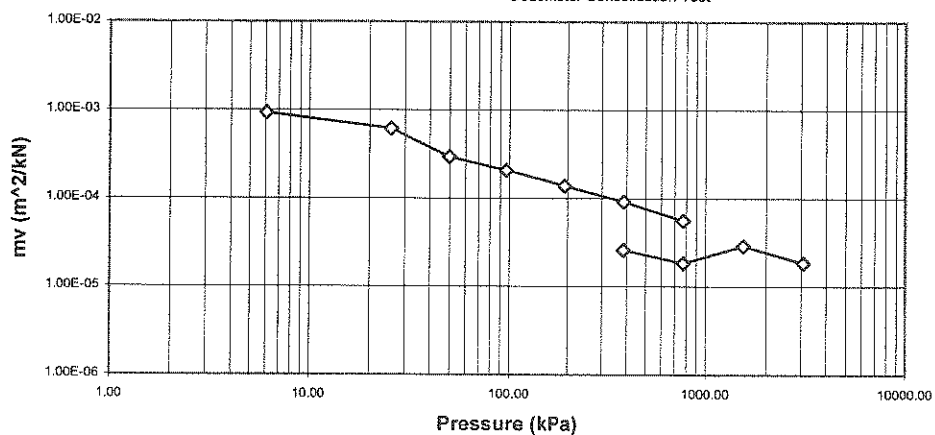
**Hydraulic Conductivity vs Pressure**

Project #: 19-1351-122  
Client: McCormick Rankin Corporation  
Project Name: HWY 401 Westbound Collectors, Jane to Kipling  
Sample: BH08-4-TW11 (30'-32')  
Oedometer Consolidation Test



**mv vs Pressure**

Project #: 19-1351-122  
Client: McCormick Rankin Corporation  
Project Name: HWY 401 Westbound Collectors, Jane to Kipling  
Sample: BH08-4-TW11 (30'-32')  
Oedometer Consolidation Test



# OEDOMETER CONSOLIDATION SUMMARY

## SAMPLE IDENTIFICATION

Project Number	08-1116-0032	Sample Number	TW 10
Borehole Number	08-1	Sample Depth, m	15.2-15.8

## TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	11		
Date Started	11/17/2008		
Date Completed	12/11/2008		

## SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.54	Unit Weight, kN/m <sup>3</sup>	21.67
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m <sup>3</sup>	18.77
Area, cm <sup>2</sup>	31.57	Specific Gravity, measured	2.76
Volume, cm <sup>3</sup>	80.16	Solids Height, cm	1.761
Water Content, %	15.44	Volume of Solids, cm <sup>3</sup>	55.59
Wet Mass, g	177.13	Volume of Voids, cm <sup>3</sup>	24.56
Dry Mass, g	153.44	Degree of Saturation, %	96.5

## TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t <sub>90</sub> sec	cv. cm <sup>2</sup> /s	mv m <sup>2</sup> /kN	k cm/s
0.00	2.539	0.442	2.539				
4.87	2.533	0.438	2.536	6	2.27E-01	4.93E-04	1.10E-05
9.56	2.527	0.435	2.530	46	2.95E-02	5.04E-04	1.46E-06
19.31	2.518	0.430	2.522	34	3.97E-02	3.64E-04	1.41E-06
38.81	2.505	0.422	2.511	52	2.57E-02	2.63E-04	6.62E-07
77.67	2.487	0.412	2.496	46	2.87E-02	1.83E-04	5.16E-07
155.27	2.464	0.399	2.475	13	9.99E-02	1.17E-04	1.15E-06
310.85	2.433	0.381	2.448	38	3.34E-02	7.82E-05	2.56E-07
621.55	2.391	0.358	2.412	7	1.76E-01	5.34E-05	9.21E-07
155.30	2.403	0.364	2.397				
39.01	2.420	0.374	2.411				
9.64	2.436	0.383	2.428				
19.47	2.432	0.381	2.434	11	1.14E-01	1.56E-04	1.75E-06
38.80	2.428	0.379	2.430	12	1.04E-01	8.15E-05	8.33E-07
77.62	2.421	0.375	2.424	12	1.04E-01	7.20E-05	7.33E-07
155.30	2.412	0.370	2.416	41	3.02E-02	4.61E-05	1.36E-07
310.63	2.401	0.363	2.406	86	1.43E-02	2.76E-05	3.87E-08
620.89	2.383	0.353	2.392	22	5.51E-02	2.30E-05	1.24E-07
1240.67	2.341	0.329	2.362	59	2.00E-02	2.66E-05	5.23E-08
2481.32	2.286	0.298	2.313	15	7.56E-02	1.75E-05	1.29E-07
1240.67	2.290	0.300	2.288				
310.85	2.309	0.311	2.299				
77.67	2.331	0.324	2.320				
19.31	2.358	0.339	2.344				
4.87	2.373	0.348	2.366				

Note:

k calculated using cv based on t<sub>90</sub> values.

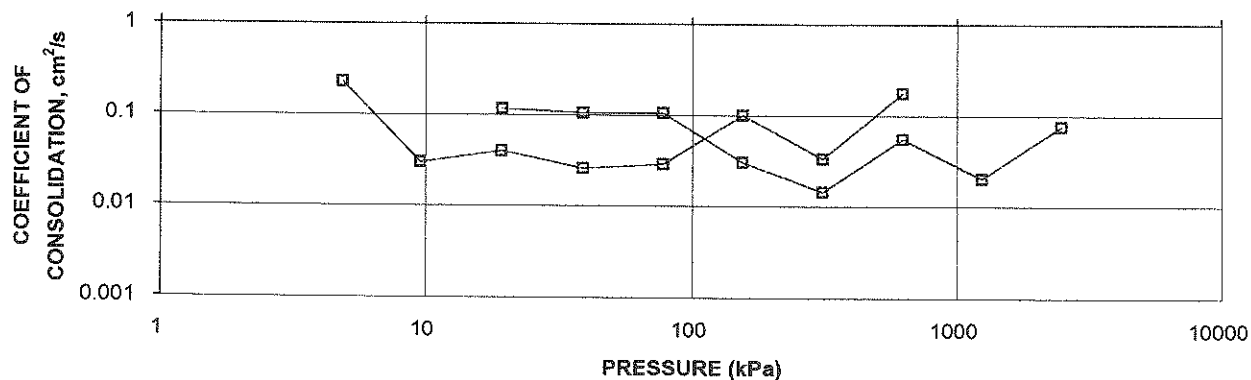
## SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	2.37	Unit Weight, kN/m <sup>3</sup>	22.80
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m <sup>3</sup>	20.09
Area, cm <sup>2</sup>	31.57	Specific Gravity, measured	2.76
Volume, cm <sup>3</sup>	74.91	Solids Height, cm	1.761
Water Content, %	13.50	Volume of Solids, cm <sup>3</sup>	55.59
Wet Mass, g	174.16	Volume of Voids, cm <sup>3</sup>	19.32
Dry Mass, g	153.44		

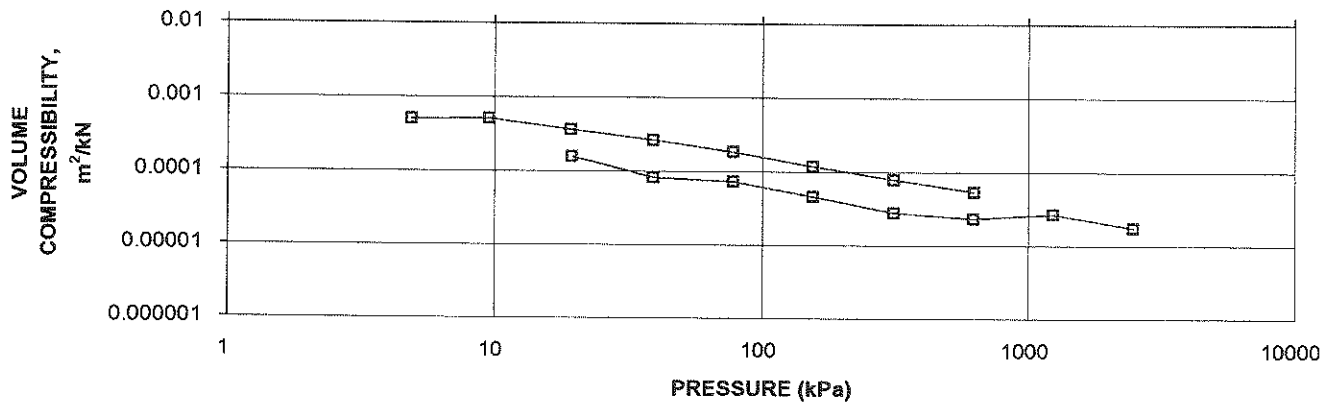


# OEDOMETER CONSOLIDATION SUMMARY

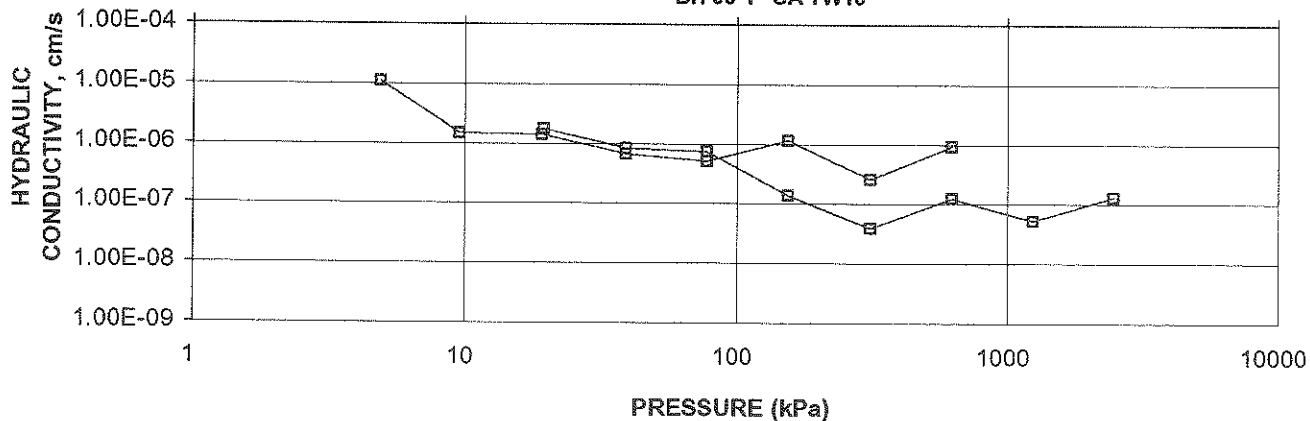
CONSOLIDATION TEST  
CV  $\text{cm}^2/\text{s}$  VS PRESSURE (kPa)  
BH 08-1 SA TW10



CONSOLIDATION TEST  
MV  $\text{m}^2/\text{kN}$  vs PRESSURE (kPa)  
BH 08-1 SA TW10



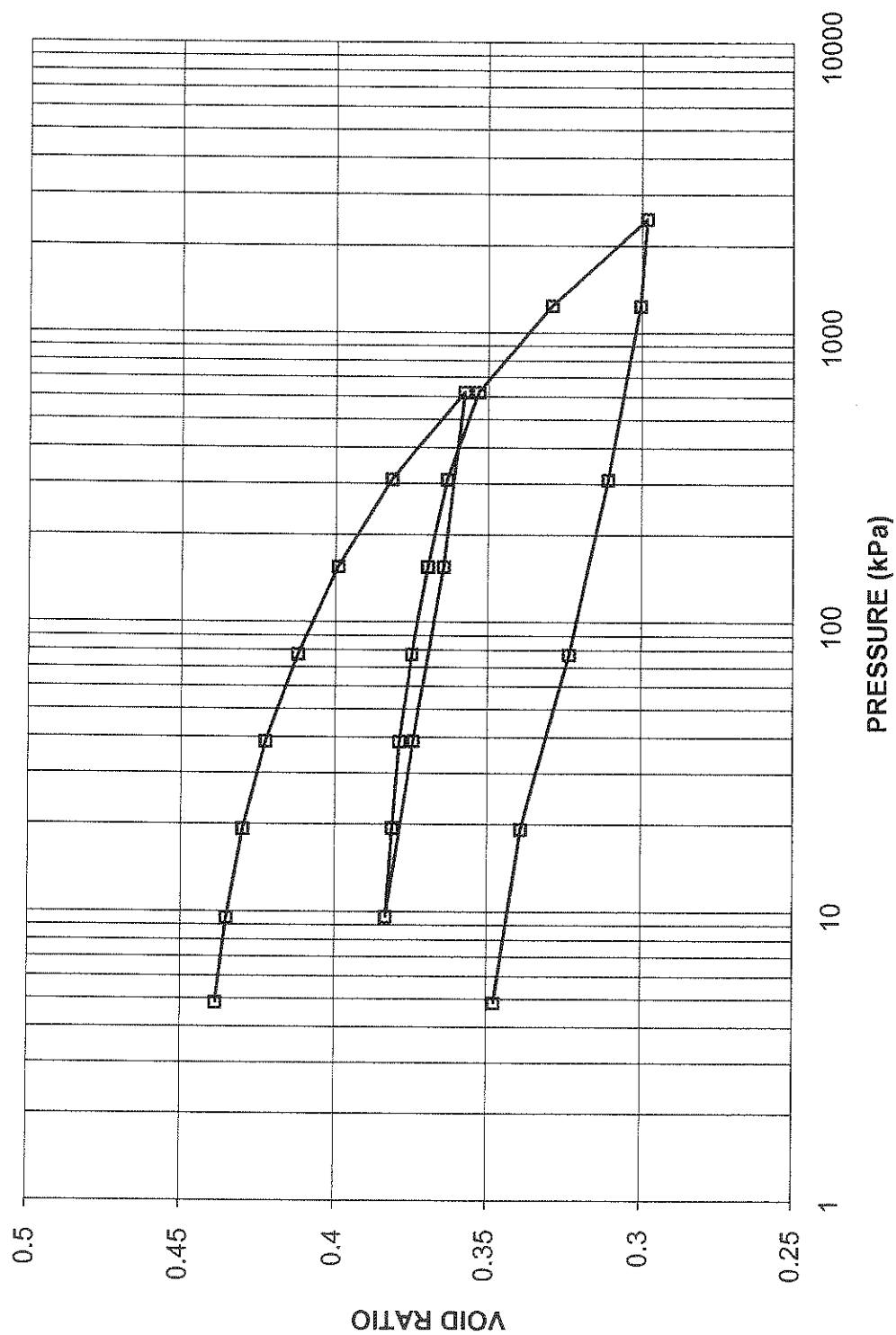
CONSOLIDATION TEST  
HYDRAULIC CONDUCTIVITY vs PRESSURE  
BH 08-1 SA TW10



# CONSOLIDATION TEST VOID RATIO VS. LOG PRESSURE

FIGURE

CONSOLIDATION TEST  
VOID RATIO vs PRESSURE  
BH 08-1 SA TW10



# OEDOMETER CONSOLIDATION SUMMARY

## SAMPLE IDENTIFICATION

Project Number	08-1116-0032	Sample Number	TW2
Borehole Number	08-3	Sample Depth, m	6.1-6.7

## TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	1		
Date Started	11/18/2008		
Date Completed	12/09/2008		

## SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.54	Unit Weight, kN/m <sup>3</sup>	20.97
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m <sup>3</sup>	18.06
Area, cm <sup>2</sup>	31.61	Specific Gravity, measured	2.76
Volume, cm <sup>3</sup>	80.38	Solids Height, cm	1.697
Water Content, %	16.13	Volume of Solids, cm <sup>3</sup>	53.63
Wet Mass, g	171.89	Volume of Voids, cm <sup>3</sup>	26.76
Dry Mass, g	148.01	Degree of Saturation, %	89.3

## TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t <sub>90</sub> sec	cv, cm <sup>2</sup> /s	mv m <sup>2</sup> /kN	k cm/s
0.00	2.543	0.499	2.543				
4.76	2.543	0.499	2.543	8	1.71E-01	8.26E-06	1.39E-07
9.47	2.539	0.496	2.541	2	6.84E-01	3.59E-04	2.41E-05
19.02	2.532	0.492	2.535	15	9.08E-02	2.84E-04	2.53E-06
38.71	2.516	0.483	2.524	118	1.14E-02	3.22E-04	3.61E-07
77.53	2.495	0.471	2.505	47	2.83E-02	2.11E-04	5.85E-07
155.07	2.466	0.454	2.480	10	1.30E-01	1.46E-04	1.87E-06
310.55	2.427	0.430	2.446	12	1.06E-01	9.91E-05	1.03E-06
620.03	2.381	0.403	2.404	14	8.75E-02	5.88E-05	5.04E-07
154.98	2.397	0.413	2.389				
38.57	2.420	0.426	2.408				
9.58	2.442	0.439	2.431				
19.53	2.436	0.436	2.439	12	1.05E-01	2.53E-04	2.60E-06
38.76	2.431	0.433	2.433	96	1.31E-02	1.04E-04	1.34E-07
77.66	2.420	0.426	2.425	34	3.67E-02	1.09E-04	3.92E-07
155.07	2.407	0.419	2.413	5	2.47E-01	6.50E-05	1.57E-06
309.76	2.390	0.409	2.398	20	6.10E-02	4.37E-05	2.61E-07
617.89	2.371	0.397	2.380	23	5.22E-02	2.46E-05	1.26E-07
1237.08	2.322	0.369	2.346	37	3.15E-02	3.08E-05	9.52E-08
2476.39	2.255	0.329	2.288	43	2.58E-02	2.14E-05	5.42E-08
1237.08	2.258	0.331	2.256				
309.76	2.287	0.348	2.273				
77.53	2.314	0.364	2.300				
19.02	2.348	0.384	2.331				
4.76	2.372	0.398	2.360				

Note:

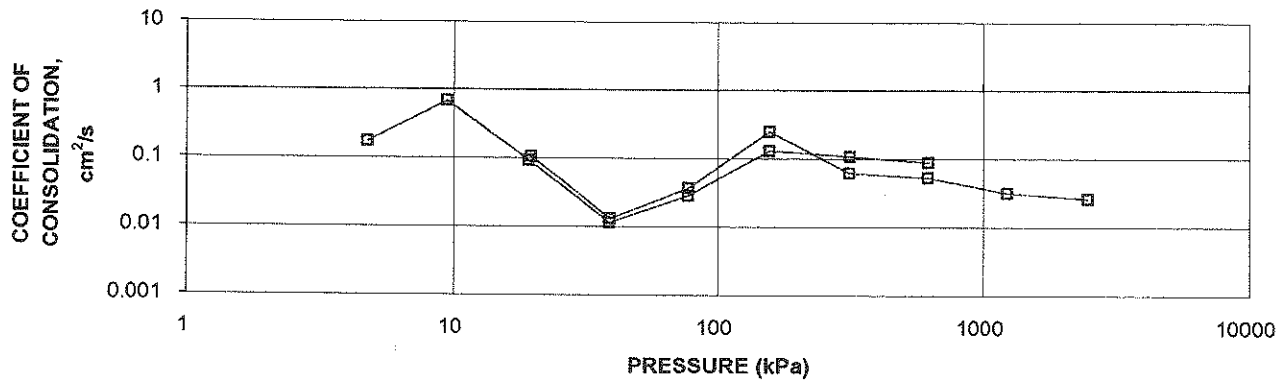
k calculated using cv based on t<sub>90</sub> values.

## SAMPLE DIMENSIONS AND PROPERTIES - FINAL

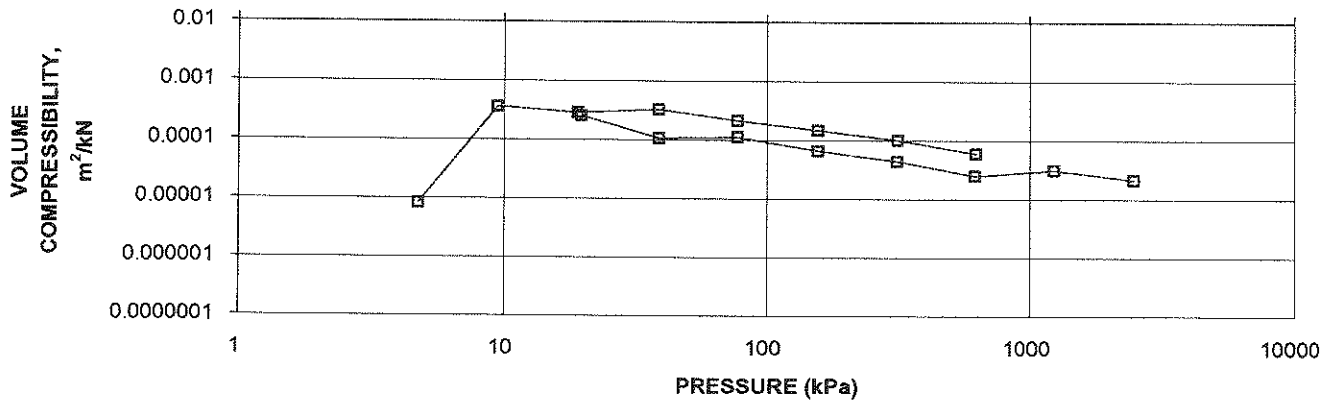
Sample Height, cm	2.37	Unit Weight, kN/m <sup>3</sup>	22.24
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m <sup>3</sup>	19.36
Area, cm <sup>2</sup>	31.61	Specific Gravity, measured	2.76
Volume, cm <sup>3</sup>	74.99	Solids Height, cm	1.697
Water Content, %	14.90	Volume of Solids, cm <sup>3</sup>	53.63
Wet Mass, g	170.06	Volume of Voids, cm <sup>3</sup>	21.36
Dry Mass, g	148.01		

# OEDOMETER CONSOLIDATION SUMMARY

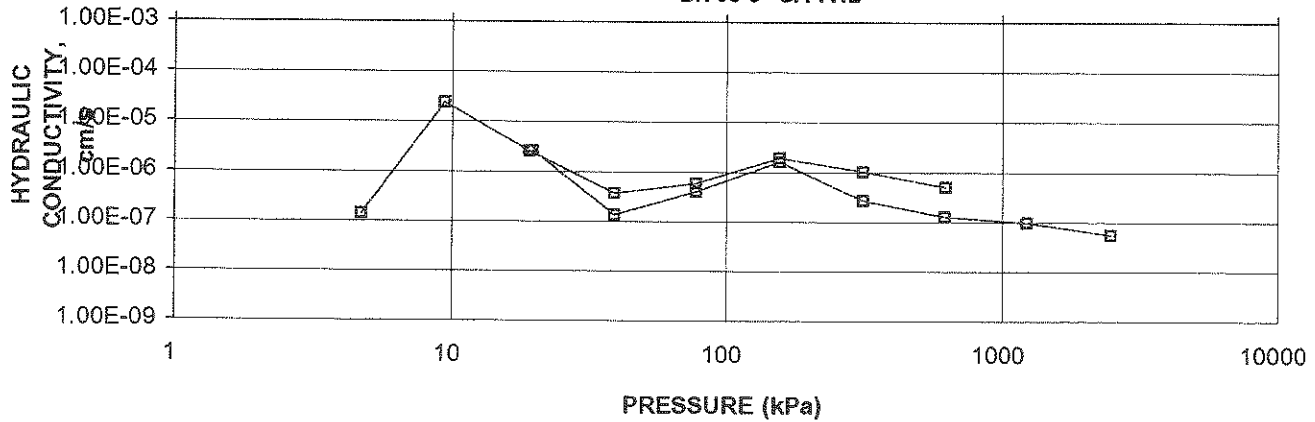
CONSOLIDATION TEST  
CV cm<sup>2</sup>/s VS PRESSURE (kPa)  
BH 08-3 SA TW2



CONSOLIDATION TEST  
MV m<sup>2</sup>/kN vs PRESSURE (kPa)  
BH 08-3 SA TW2



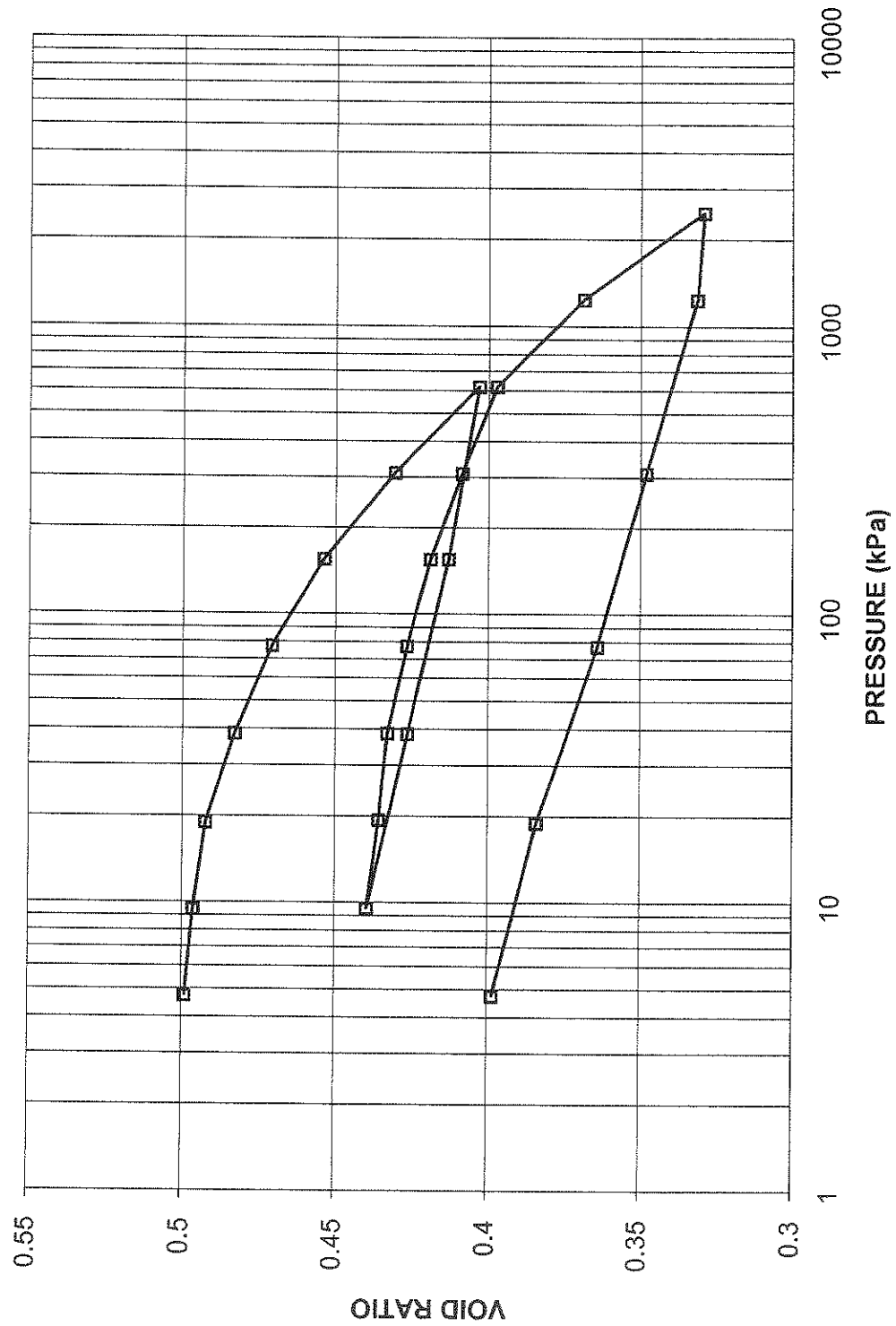
CONSOLIDATION TEST  
HYDRAULIC CONDUCTIVITY vs PRESSURE  
BH 08-3 SA TW2



CONSOLIDATION TEST  
VOID RATIO VS. LOG PRESSURE

FIGURE

CONSOLIDATION TEST  
VOID RATIO vs. PRESSURE  
BH 08-3 SA TW2



*hly*

**CONSOLIDATED UNDRAINED TRIAXIAL  
WITH PORE PRESSURE MEASUREMENTS  
SHEET 1 OF 4**

**FIGURE**

TEST STAGE	A	B	C
BOREHOLE NUMBER	08-1		
SAMPLE	TW-10		
SPECIMEN DIAMETER, cm	5.02		
SPECIMEN HEIGHT, cm	10.15		
WATER CONTENT BEFORE CONSOLIDATION, %	17.0		
CELL PRESSURE, $\sigma_3$ , kPa	505.0		
BACK PRESSURE, kPa	205.0		
PORE PRESSURE PARAMETER "B"	0.96		
CONSOLIDATION PRESSURE, $\sigma_c$ , kPa	300.0		
VOLUMETRIC STRAIN DURING CONSOLIDATION, %	4.9		
WATER CONTENT AFTER CONSOLIDATION, %	14.3		
AVERAGE RATE OF STRAIN, %/hr	0.5		
TIME TO FAILURE, DAYS	1		
WATER CONTENT AFTER TEST, %	15.5		
MAX. DEVIATOR STRESS, $(\sigma_1 - \sigma_3)$ , kPa	262.6		
AXIAL STRAIN AT $(\sigma_1 - \sigma_3)$ MAXIMUM, %	5.9		
MAX EFFECTIVE PRINCIPAL STRESS			
RATIO, $(\sigma_1 / \sigma_3)$ MAXIMUM	3.4		
DEVIATOR STRESS AT $(\sigma_1 / \sigma_3)$ MAXIMUM, kPa	243.0		
AXIAL STRAIN AT $(\sigma_1 / \sigma_3)$ MAXIMUM, %	11.2		
PORE PRESSURE PARAMETER, Af, AT $(\sigma_1 - \sigma_3)$ MAXIMUM	0.71		
PORE PRESSURE PARAMETER, Af, AT $(\sigma_1 / \sigma_3)$ MAXIMUM	0.82		
NATURAL WATER CONTENT, %	16.2		
DRY DENSITY, Mg/m <sup>3</sup>	1.86		
FILTER DRAINS USED, y/n	y		
TEST NOTES:			
CHANGED RATE OF STRAIN, %/hr	-		
AXIAL STRAIN WHERE RATE OF STRAIN WAS CHANGED, %	-		
FAILURE PLANE NUMBER	1.0		
ANGLE OF FAILURE, DEGREES	55.0		

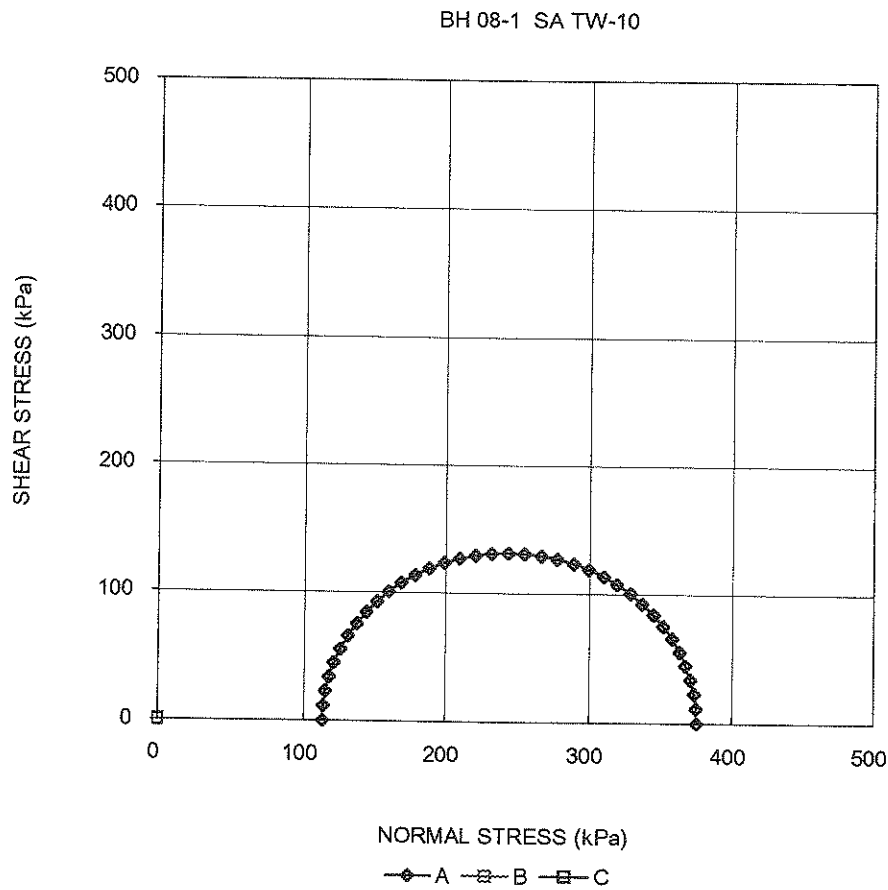
Date: 12/23/2008  
Project No. 08-1116-0032

**Golder Associates**

Prepared By: MM  
Checked By: *ll*

CONSOLIDATED UNDRAINED TRIAXIAL  
WITH PORE PRESSURE MEASUREMENTS  
SHEET 2 OF 4

FIGURE



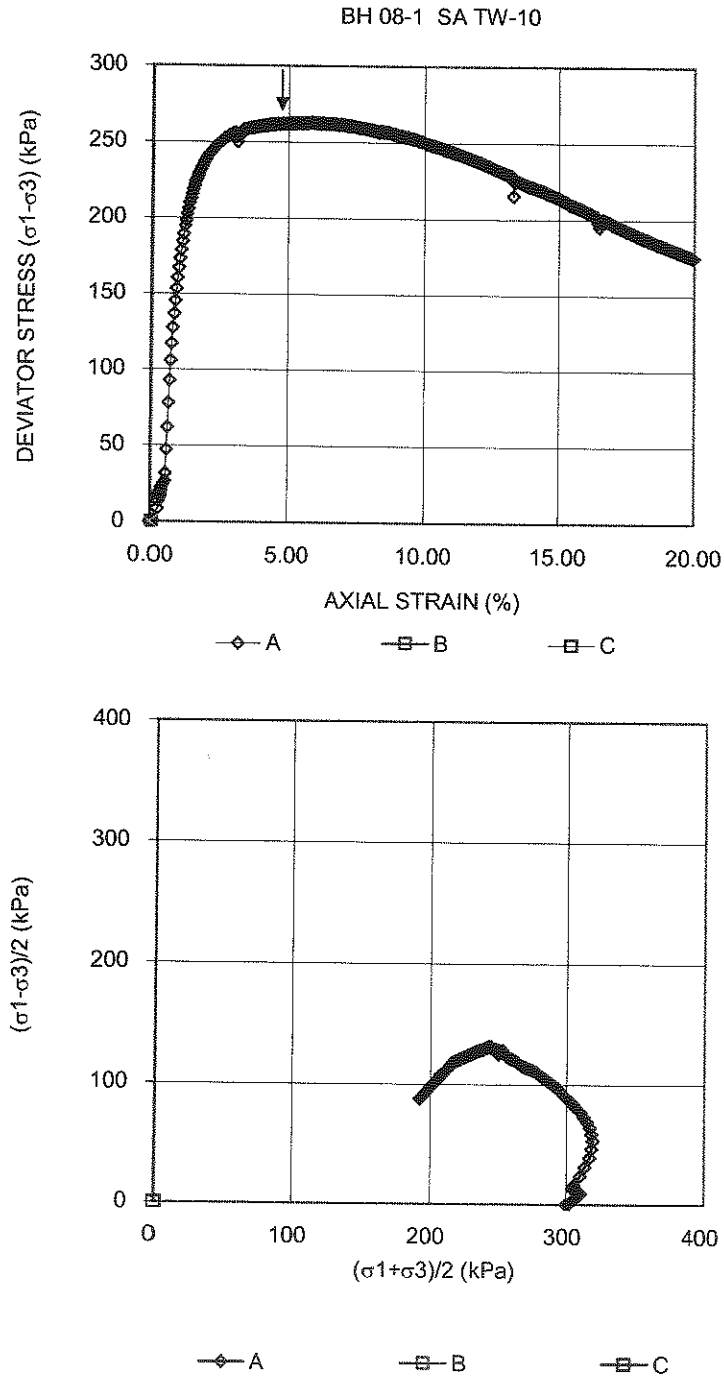
Date: 12/23/2008  
Project No. 08-1116-0032

Golder Associates

Prepared By: MM  
Checked By: RO

**CONSOLIDATED UNDRAINED TRIAXIAL  
WITH PORE PRESSURE MEASUREMENTS  
SHEET 3 OF 4**

**FIGURE**



Date: 12/23/2008  
Project No. 08-1116-0032

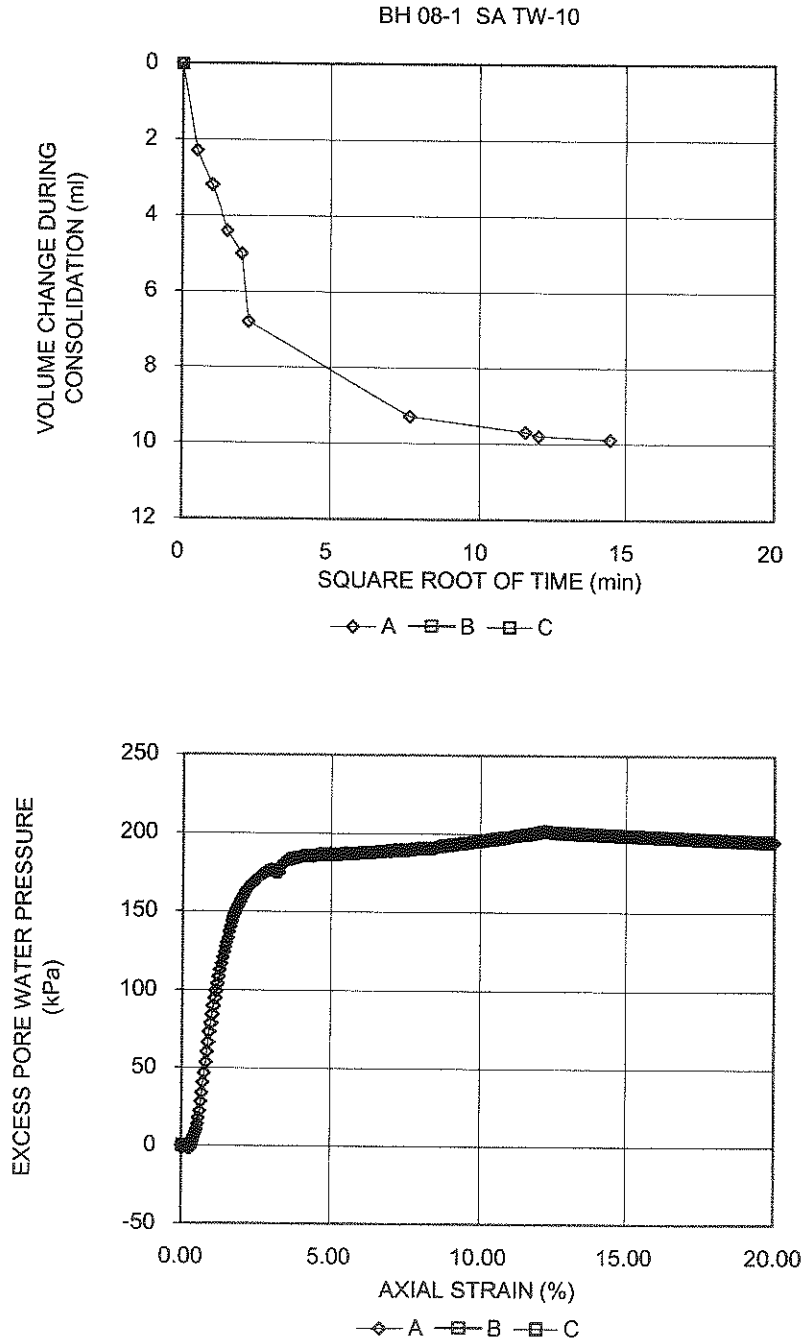
**Golder Associates**

Prepared By: MM  
Checked By: *PO*



**CONSOLIDATED UNDRAINED TRIAXIAL  
WITH PORE PRESSURE MEASUREMENTS  
SHEET 4 OF 4**

**FIGURE**



Date: 12/23/2008  
Project No. 08-1116-0032

**Golder Associates**

Prepared By: MM  
Checked By: Ro

<b>CONSOLIDATED UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENTS</b> <b>SHEET 1 OF 4</b>		<b>FIGURE</b>	
TEST STAGE	A	B	C
BOREHOLE NUMBER	08-3		
SAMPLE	TW-2		
SPECIMEN DIAMETER, cm	5.00		
SPECIMEN HEIGHT, cm	10.19		
WATER CONTENT BEFORE CONSOLIDATION, %	15.3		
CELL PRESSURE, $\sigma_3$ , kPa	255.0		
BACK PRESSURE, kPa	135.0		
PORE PRESSURE PARAMETER "B"	0.97		
CONSOLIDATION PRESSURE, $\sigma_c$ , kPa	120.0		
VOLUMETRIC STRAIN DURING CONSOLIDATION, %	4.7		
WATER CONTENT AFTER CONSOLIDATION, %	12.8		
AVERAGE RATE OF STRAIN, %/hr	0.5		
TIME TO FAILURE, DAYS	1		
WATER CONTENT AFTER TEST, %	13.8		
MAX. DEVIATOR STRESS, $(\sigma_1 - \sigma_3)$ , kPa	297.7		
AXIAL STRAIN AT $(\sigma_1 - \sigma_3)$ MAXIMUM, %	12.5		
MAX EFFECTIVE PRINCIPAL STRESS			
RATIO, $(\sigma_1 / \sigma_3)$ MAXIMUM	3.5		
DEVIATOR STRESS AT $(\sigma_1 / \sigma_3)$ MAXIMUM, kPa	264.9		
AXIAL STRAIN AT $(\sigma_1 / \sigma_3)$ MAXIMUM, %	6.2		
PORE PRESSURE PARAMETER, $A_f$ , AT $(\sigma_1 - \sigma_3)$ MAXIMUM	-0.02		
PORE PRESSURE PARAMETER, $A_f$ , AT $(\sigma_1 / \sigma_3)$ MAXIMUM	0.05		
NATURAL WATER CONTENT, %	14.5		
DRY DENSITY, $Mg/m^3$	1.93		
FILTER DRAINS USED, y/n	y		
TEST NOTES:			
CHANGED RATE OF STRAIN, %/hr	-		
AXIAL STRAIN WHERE RATE OF STRAIN WAS CHANGED, %	-		
FAILURE PLANE NUMBER	1.0		
ANGLE OF FAILURE, DEGREES	60.0		

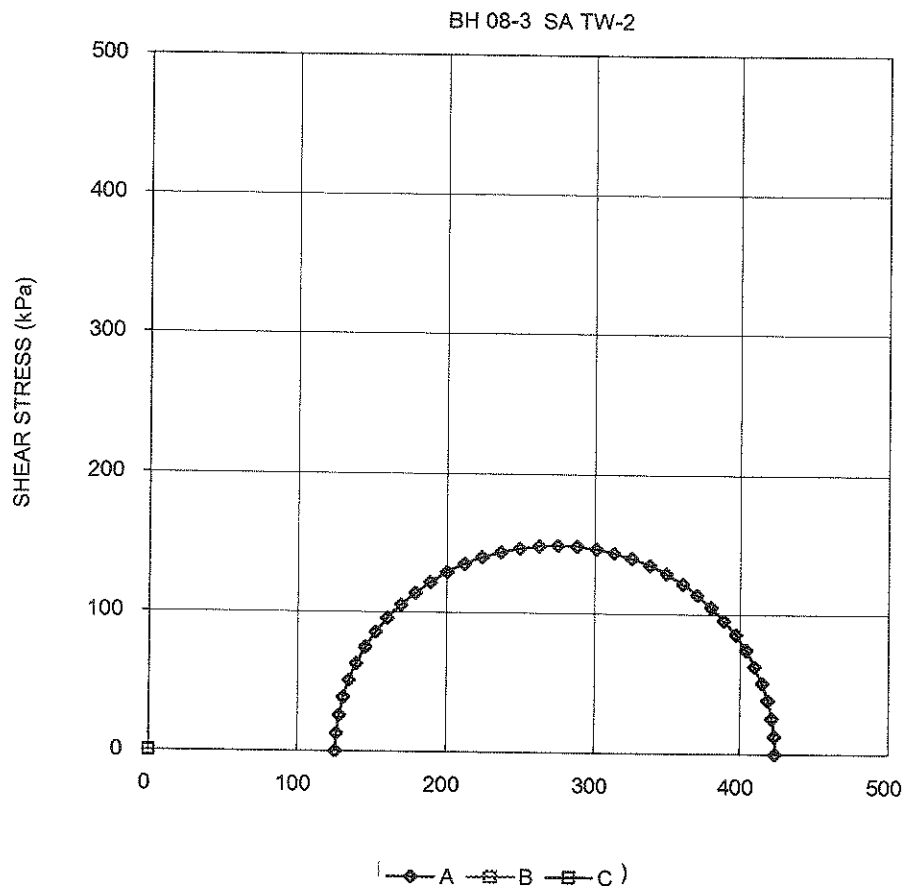
Date: 12/23/2008  
 Project No. 08-1116-0032

**Golder Associates**

Prepared By: MM  
 Checked By: Ro

CONSOLIDATED UNDRAINED TRIAXIAL  
WITH PORE PRESSURE MEASUREMENTS  
SHEET 2 OF 4

FIGURE



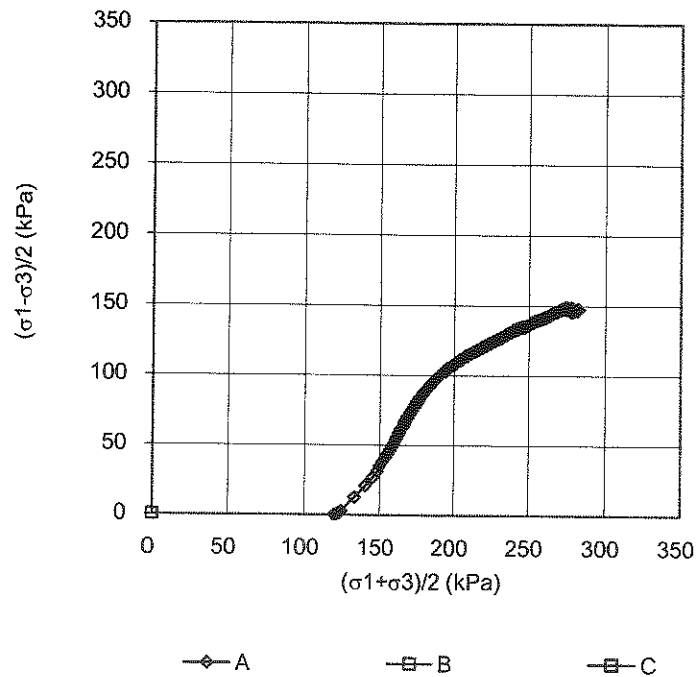
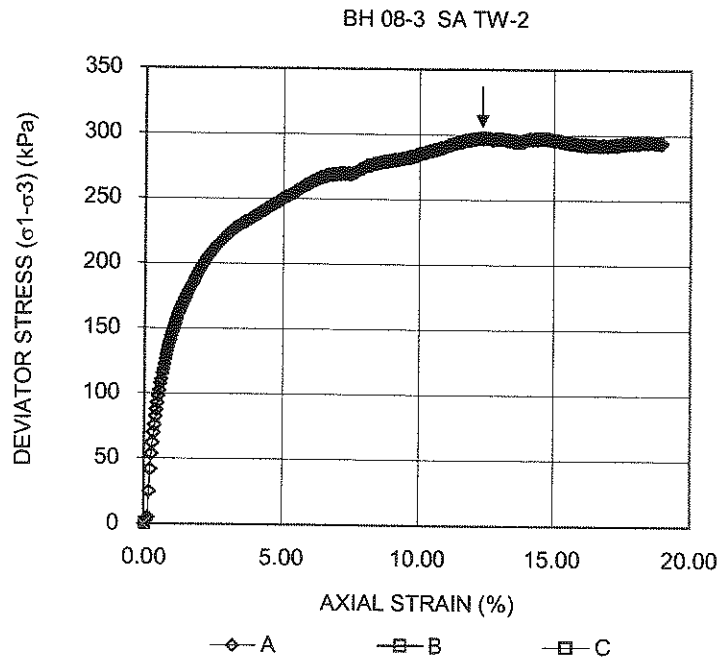
Date: 12/23/2008  
Project No. 08-1116-0032

**Golder Associates**

Prepared By: MM  
Checked By: Ro

CONSOLIDATED UNDRAINED TRIAXIAL  
WITH PORE PRESSURE MEASUREMENTS  
SHEET 3 OF 4

FIGURE



Date: 12/23/2008  
Project No. 08-1116-0032

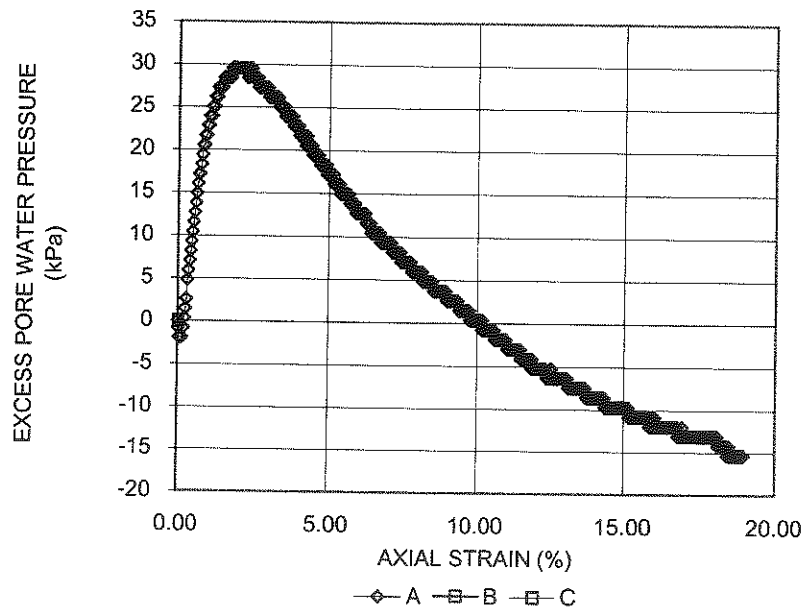
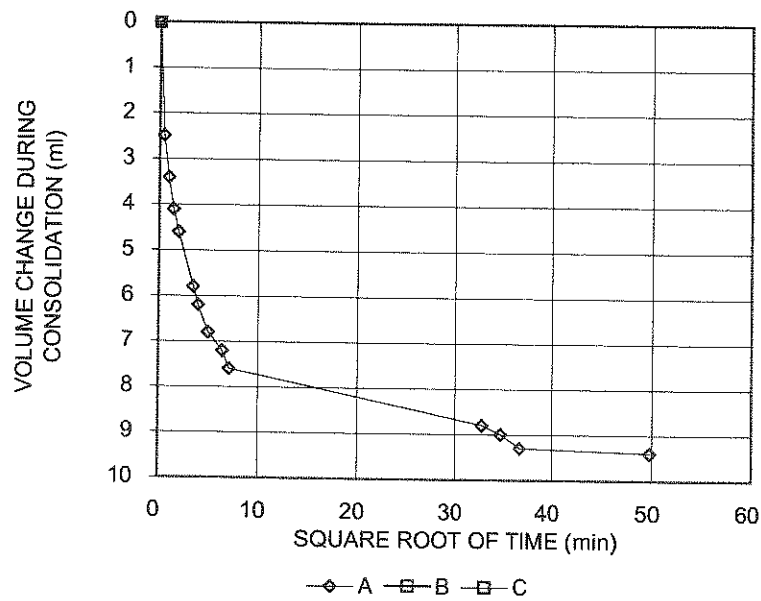
**Golder Associates**

Prepared By: MM  
Checked By: RO

**CONSOLIDATED UNDRAINED TRIAXIAL  
WITH PORE PRESSURE MEASUREMENTS  
SHEET 4 OF 4**

**FIGURE**

BH 08-3 SA TW-2



Date: 12/23/2008  
Project No. 08-1116-0032

**Golder Associates**

Prepared By: MM  
Checked By: *LO*

## SPECIFIC GRAVITY TEST RESULTS

### ASTM D 854-00 TEST METHOD A

PROJECT NUMBER	08-1116-0032	
PROJECT NAME	Thurber / Lab Testing / 19-1351-122	
DATE TESTED	December, 2008	
Borehole	Sample	Specific
No.	No.	Gravity
08-1	TW10	2.76
08-3	TW2	2.76

Note: Test carried out on soil particles <4.75mm using distilled water.

Checked By:



**Golder Associates**

## **Appendix C**

### **Photographs, Figures and Tables**



## Highway 401 Westbound Collectors – CPR Overhead



Photograph 1: View of CPR overhead opening looking east.

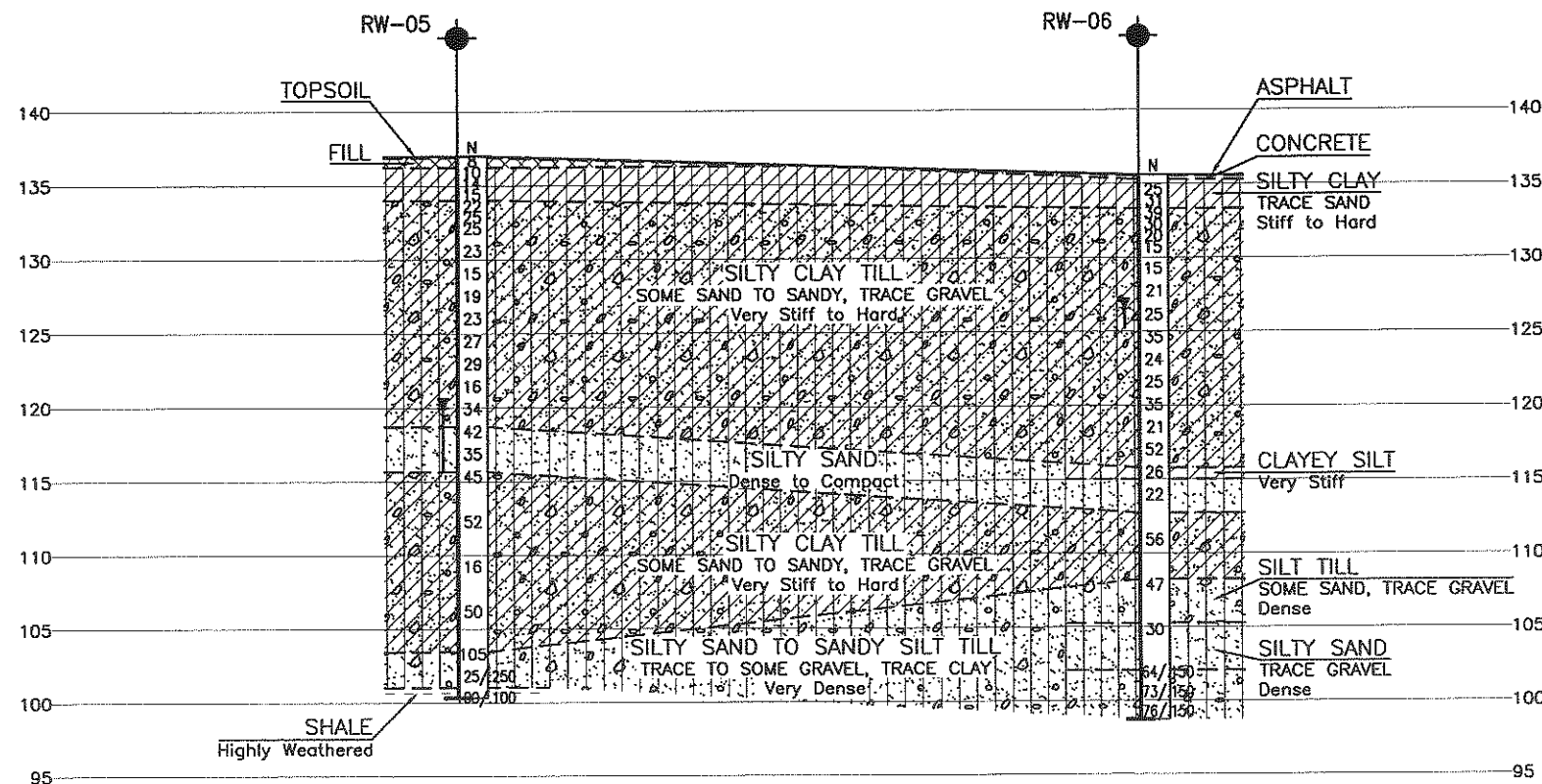
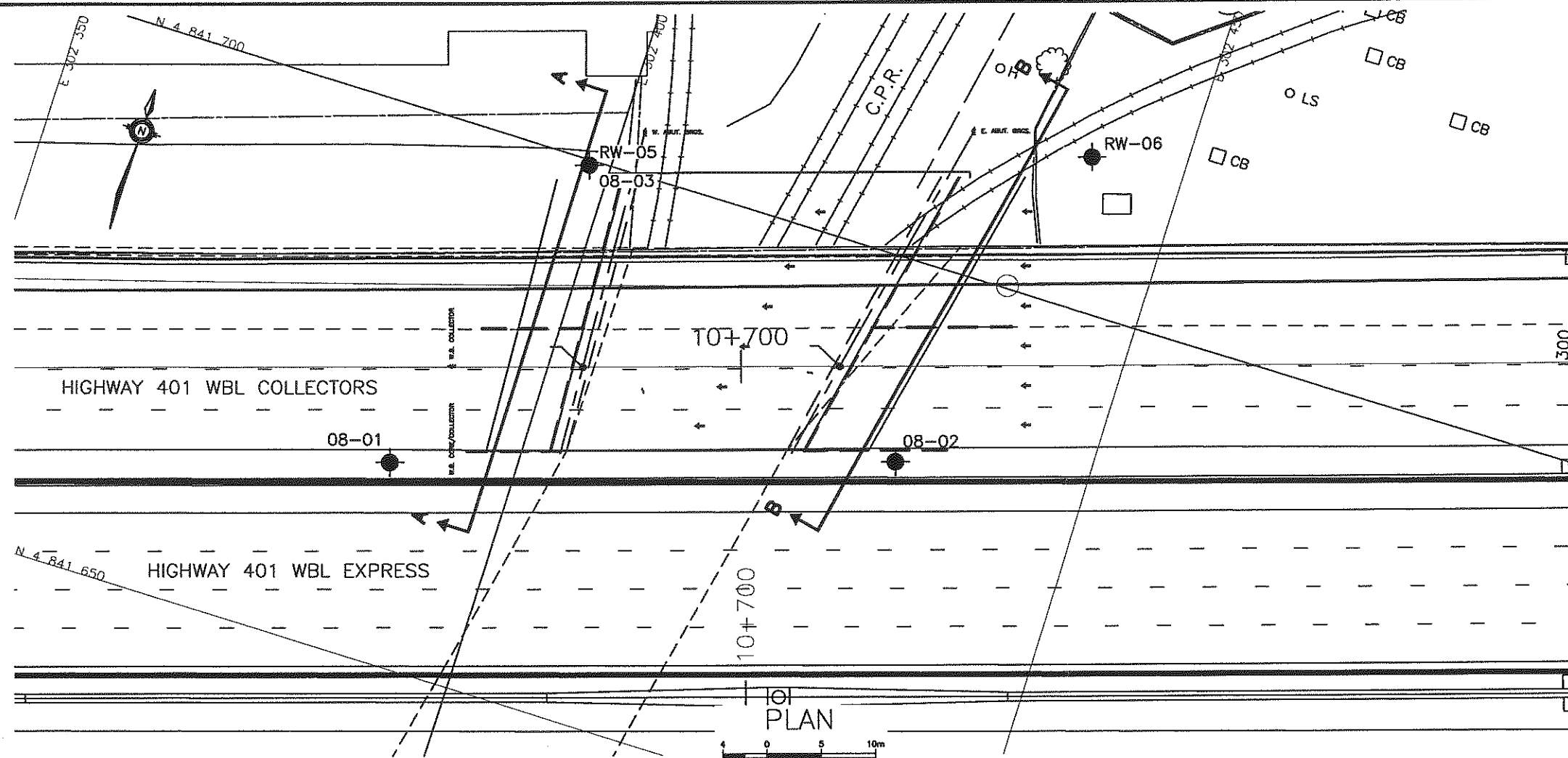


Photograph 2: Rail level inside of CPR overhead



## **Appendix D**

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



PROFILE ALONG HIGHWAY 401



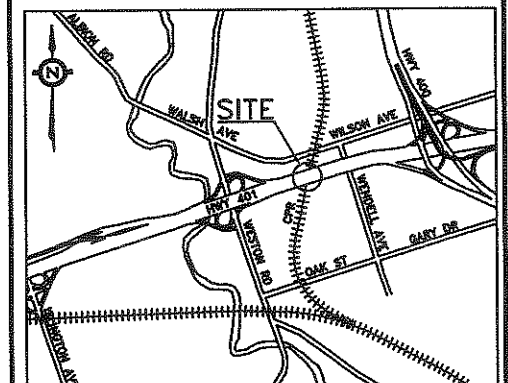
**METRIC**  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
GWP No 2147-01-00  
HIGHWAY 401 W.B. COLLECTORS  
C.P.R. OVERHEAD  
REPLACEMENT  
BOREHOLE LOCATIONS AND SOIL STRATA



**MCCORMICK RANKIN CORPORATION**

**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
W	Water Level
HA	Head Artesian Water
P	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
RW-05	137.0	4 841 699.5	302 398.1
RW-06	135.6	4 841 713.9	302 441.6
08-01	144.5	4 841 668.1	302 389.0
08-02	144.5	4 841 681.9	302 432.8
08-03	137.0	4 841 699.5	302 398.1

-NOTES-

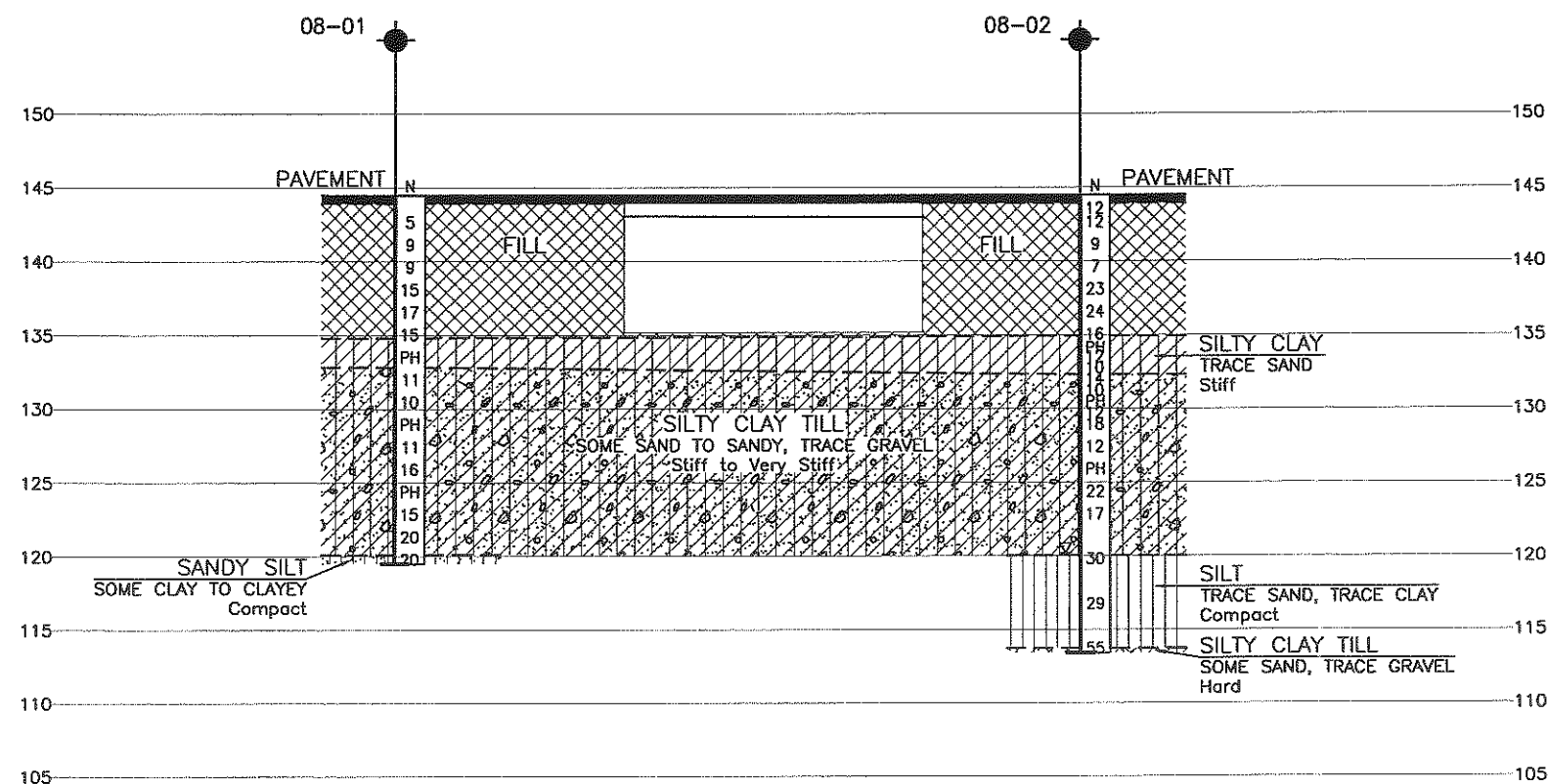
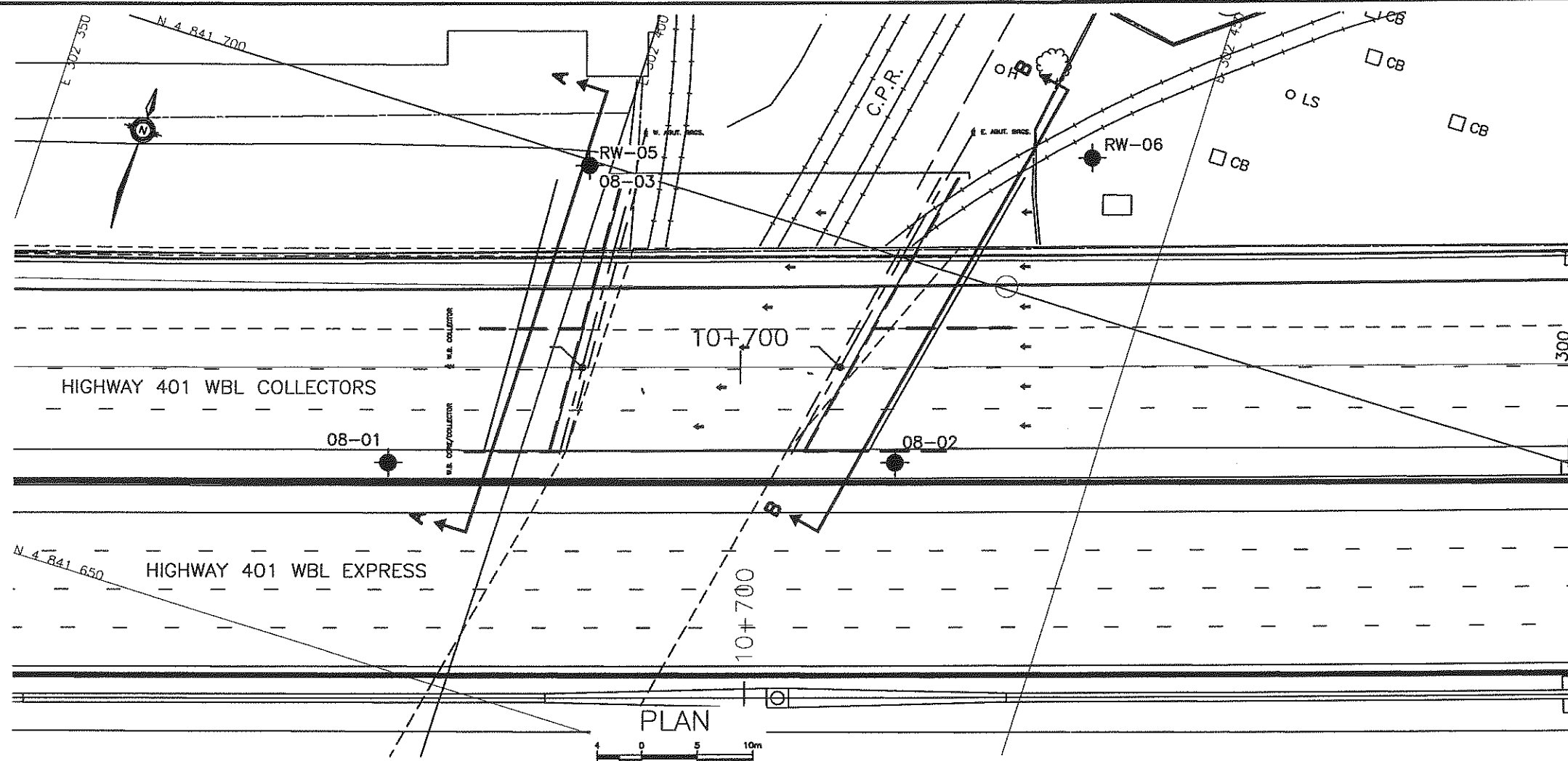
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 30M11-231



DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MRA	CHK PKC	CODE
DRAWN	MFA	CHK MRA	SITE
			LOAD
			STRUCT
			DWG 1
			DATE DEC. 2008



# PROFILE ALONG HIGHWAY 401

METRIC

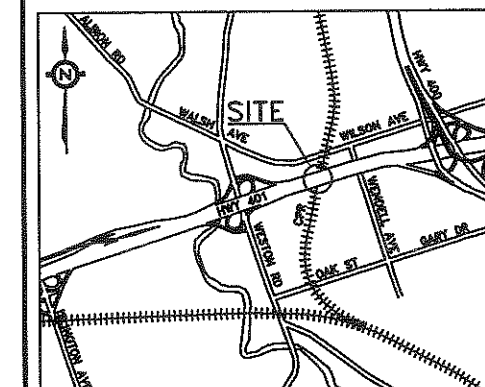
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
GWP No 2147-01-00  
HIGHWAY 401 W.B. COLLECTORS  
C.P.R. OVERHEAD  
REPLACEMENT  
BOREHOLE LOCATIONS AND SOIL STRATA

**McCORMICK RANKIN CORPORATION**







**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
RW-05	137.0	4 841 699.5	302 398.1
RW-06	135.6	4 841 713.9	302 441.6
08-01	144.5	4 841 668.1	302 389.5
08-02	144.5	4 841 681.9	302 432.8
08-03	137.0	4 841 699.5	302 398.1

-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.

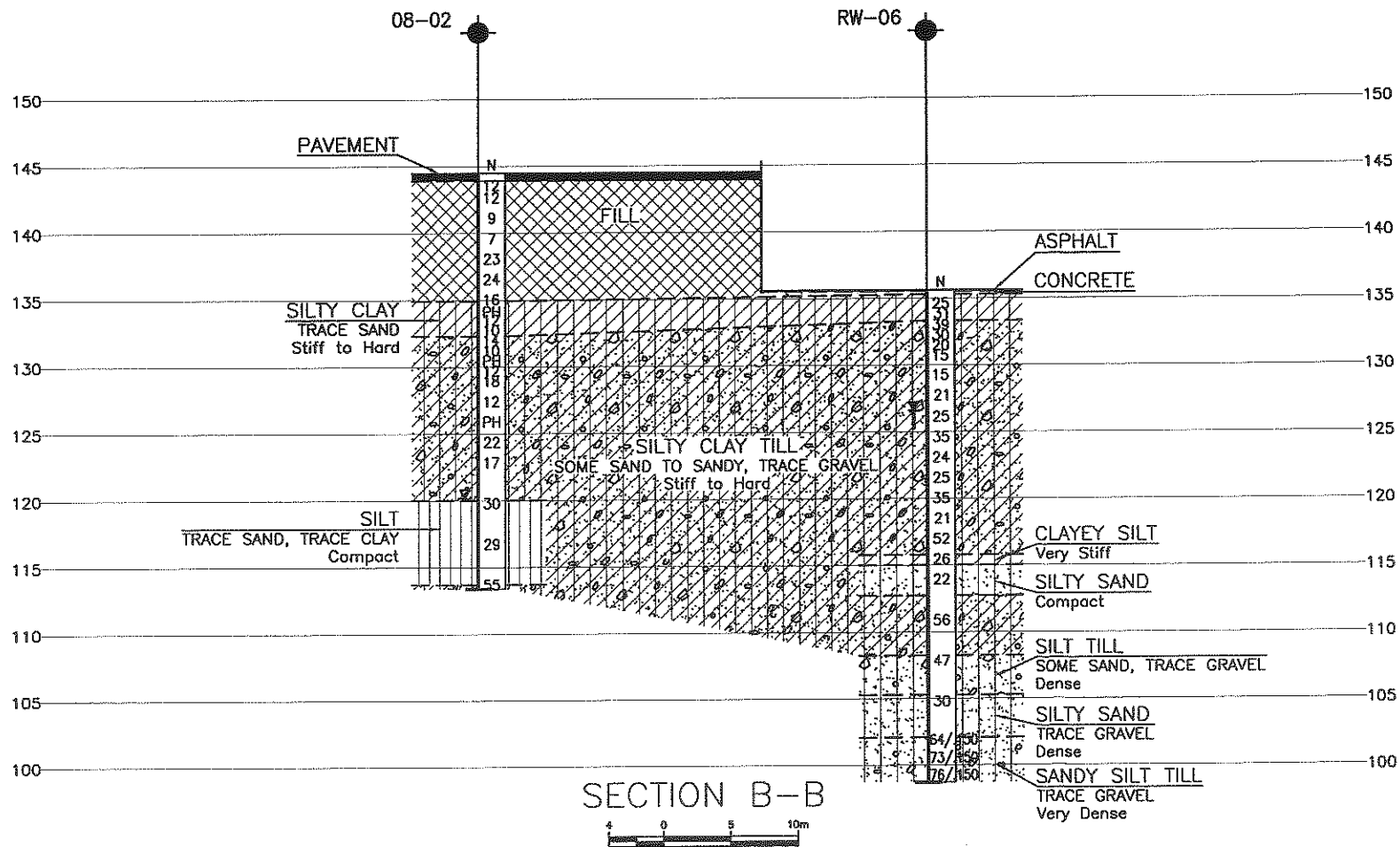
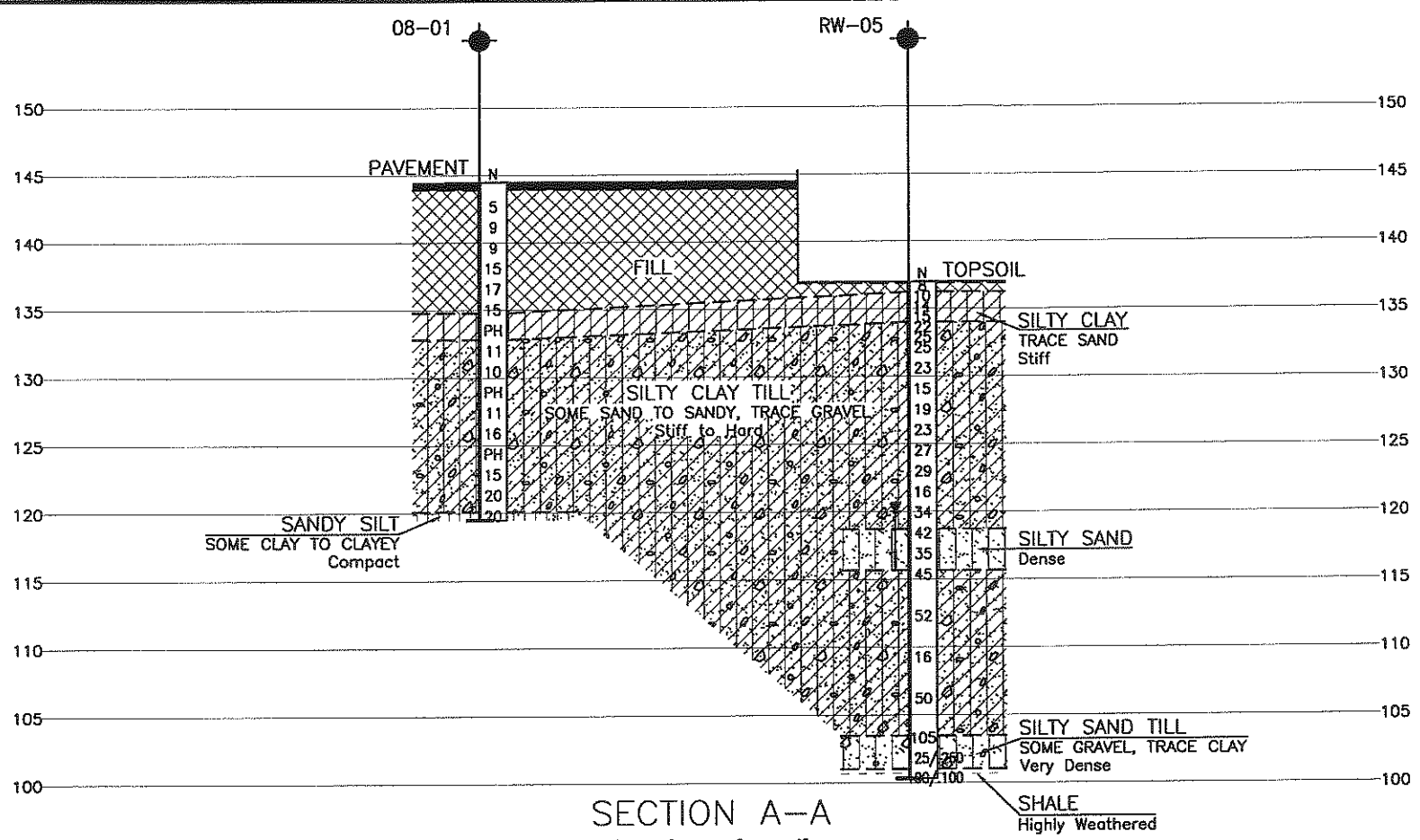
**GEOCRES No. 30M11-231**



DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

[illegible]

3/11/2009 11:22:00 AM  
PLOT SCALE 1:1  
PR-0-707  
UNIVERSITY OF TORONTO, ONTARIO



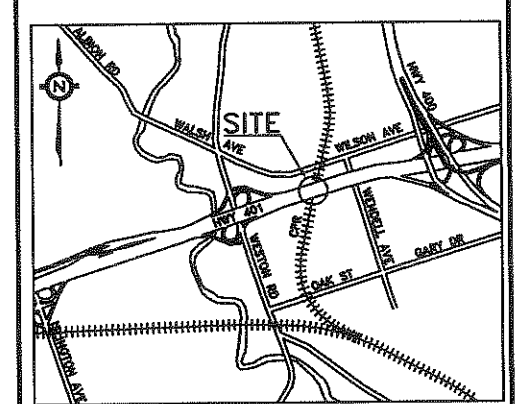
**METRIC**  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
GWP No 2147-01-00

HIGHWAY 401 W.B. COLLECTORS  
C.P.R. OVERHEAD  
REPLACEMENT  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

**McCORMICK RANKIN CORPORATION**



**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
RW-05	137.0	4 841 699.5	302 398.1
RW-06	135.6	4 841 713.9	302 441.6
08-01	144.5	4 841 668.1	302 389.0
08-02	144.5	4 841 681.9	302 432.8
08-03	137.0	4 841 699.5	302 398.1

**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. 30M11-231**



DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MRA	CHK	PKC
DRAWN	MFA	CHK	MRA
SITE			
STRUCT			
DWG			3

FILENAME: H:\Drawing\10\1351\122\1122-CPR0Overhead.dwg  
PLOTDATE Feb 11, 2009 11:22:00 AM