

**FOUNDATION INVESTIGATION REPORT**  
**VETERANS MEMORIAL PARKWAY INTERCHANGE IMPROVEMENTS**  
**Highway 401**  
**G.W.P. 3033-11-00**

**GEOCRES Number: 40I14-153**

**Report to**  
  
**Ministry of Transportation of Ontario**  
**West Region**

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March 31, 2014  
File: 15-64-27

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**PART 1: FACTUAL INFORMATION**

**1. INTRODUCTION**

This report presents the factual data obtained from a foundation investigation conducted at an interchange between the Veterans Memorial Parkway and Highway 401 near London, Ontario. The Ministry of Transportation of Ontario (MTO) has proposed that this interchange undergo improvements.

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, records of boreholes, a stratigraphic profile, 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 investigation.

Thurber carried out the investigation under Work Item Number 3 of the MTO Agreement Numbers 3012-E-007 and 3012-E-008. Previous investigations have been carried out by Infrastructure Engineering Group Inc. (2012) and by the Ministry's Soil Mechanics Section (1974). The results of these investigations have been reviewed and taken into account during the preparation of this report.

The factual information presented in this report is intended to support the Planning and Preliminary Design Functions for the project. It is not intended to support Detail Design and may not be of sufficient extent or detail to support the Detail Design function. At the Detail Design stage, those responsible for the design must make their own assessment of the adequacy of the factual

information to support the Detail Design and, where necessary, must take steps to obtain such additional information as they deem necessary to properly complete the design.

## **2. SITE DESCRIPTION**

The interchange is located approximately 15 Km southeast of London, Ontario, where the Veterans Memorial Parkway (VMP) meets Highway 401.

The VMP is a four lane expressway providing a corridor from Highway 401 to Oxford Street in London, Ontario. The interchange bridge is two lanes wide with a concrete boulevard. At the interchange, Highway 401 consists of a six lane facility with full right and left shoulders and a concrete median wall.

The interchange is located in a rural area where surrounding land use is primarily agricultural in nature. Land east and southeast of the interchange is currently undeveloped and consists of wood lots. Properties north- and southwest of the interchange have mixed industrial and agricultural land use, with some land appearing to currently be under development.

The site lies within a physiographic region known as the Mount Elgin Ridge (Chapman and Putnam, 1984). Published geological data indicates that the subsurface material in the region is predominately classified as clay to silt till derived from glaciolacustrine deposits. Bedrock in the region consists of limestone, dolostone, and shale of the Dundee Formation. Land in the general vicinity of the interchange is of low relief, with elevations in the range of 275 to 276 metres above sea level.

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

The site investigation and field testing for this project was carried out between December 2 and December 16, 2013. A total of ten boreholes numbered 13-01 through 13-11 (Borehole 13-10 was not drilled) were advanced to depths ranging from 15.8 m to 40.2 m (Elevations ranging from 266.2 m to 241.9 m) below the existing highway and embankment grades.

Borehole 13-01 was drilled in the north approach, Borehole 13-02 was drilled near the north abutment, Borehole 13-03 was drilled in the Highway 401 median, Borehole 13-04 was drilled near the south abutment, Borehole 13-08 was drilled in the south approach, Borehole 13-09 was drilled in the high fill area, Borehole 13-11 was drilled at the proposed location of the Crinklaw Drain, and boreholes 13-05, 13-06, and 13-07 were drilled along the proposed alignment of the retaining wall (east of the south approach).

Prior to the start of drilling, the borehole locations were staked in the field and utility clearances were obtained. The co-ordinates and elevations of the as-drilled boreholes were subsequently surveyed by Callon Dietz. The approximate borehole locations are shown on a Borehole Locations and Soil Strata drawing included in Appendix C.

The drilling was carried out using a D-120 track-mounted drill rig with hollow stem augers. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in the overburden soils.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Standpipe piezometers consisting of a 25 mm PVC pipe with a slotted screen were installed in boreholes 13-02, 13-04, 13-05, 13-06, 13-07, and 13-09. The locations and completion details of the piezometers are shown in Table 3.1. The boreholes in which no piezometers were installed were grouted with bentonite in general accordance with the requirements of MOE Reg. 903 (as amended by Reg. 372/07). The borehole completion details are shown in Table 3.1.

**Table 3.1 –Borehole Completion Details**

Borehole	Details	
	Screen Depth (m)	Completion Details
13-02	32.6 – 34.1 (silty clay till)	Bentonite seal from 40.2 m to 34.1 m, Piezometer with 1.5 m slotted screen installed with sand filter to 32.0 m, bentonite seal to 30.5 m, bentonite grout to 24.0 m, bentonite seal to 0.3 m, sand to 0.2 m, concrete to surface.
13-04	33.5 – 35.0 (sand)	Bentonite seal from 40.2 m to 35.0 m, piezometer with 1.5 m slotted screen installed with sand filter to 33.1 m, bentonite seal to 32.3 m, bentonite grout to 18.3 m, bentonite seal to 0.3 m, sand to 0.2 m, concrete to surface.
13-05	13.7 – 15.2 (sand)	Piezometer with 1.5 m slotted screen installed with sand filter to 13.3 m, bentonite seal to surface.
13-06	12.4 – 13.9 (sand)	Piezometer with 1.5 m slotted screen installed with sand filter to 12.1 m, bentonite seal to surface.
13-07	12.0 - 13.5 (silty clay till/sand)	Piezometer with 1.5 m slotted screen installed with sand filter to 11.4 m, bentonite seal to surface.
13-09	12.3 – 13.8 (silty clay till)	Piezometer with 1.5 m slotted screen installed with sand filter to 11.9 m, bentonite seal to surface.

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.

#### 4. LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. The results of this testing are shown on the Record of Borehole sheets in Appendix A. Approximately 33 % of the samples were also subjected to gradation analysis (sieve

and hydrometer) and plasticity testing (Atterberg Limits) and 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**

### **5.1 General**

Reference is made to the Record of Borehole sheets in Appendix A for details of the soil stratigraphy encountered in the boreholes. A stratigraphic profile and selected cross-sections for this interchange site are presented on the Borehole Locations and Soil Strata Drawings in Appendix C for illustrative purposes; however, the factual data presented in the record of boreholes governs any interpretation of the site conditions.

In general, the stratigraphy encountered in the boreholes drilled at the overpass abutments and approaches consisted of a thin layer of asphalt over granular and silty clay fill, which was underlain by layers of clay till, silt till, and sand. The stratigraphy encountered in the boreholes drilled at the proposed locations of the retaining wall, Crinklaw drain, and high fill encountered topsoil overlying layers of clay till, silt till, and sand. Bedrock was not encountered in any of the boreholes drilled at this site.

### **5.2 Asphalt and Topsoil**

A layer of asphalt between 25 and 125 mm in thickness was encountered at ground surface in boreholes 13-01, 13-02, 13-03, and 13-04, which were drilled through the roadway and paved shoulder of the highway. The asphalt thickness may vary in other areas of the site.

In boreholes 13-05, 13-06, 13-07, 13-08, 13-09, and 13-11, a layer of topsoil 100 to 225 mm in thickness was encountered. The topsoil thickness may vary between and beyond the borehole locations, and the limited data is not suitable for estimating topsoil quantities.

### **5.3 Fill**

#### **5.3.1 Granular Fill**

Boreholes 13-01, 13-02, 13-04, and 13-08 were drilled through the existing embankment. In these boreholes, 0.8 m to 1.1 m of granular fill was encountered beneath the asphalt. Borehole 13-03, drilled through the Highway 401 median for the bridge pier, encountered 1.7 m of granular fill.

The granular fill had SPT N-values ranging from 11 to 40 blows per 0.3 m penetration, indicating compact to dense conditions. The granular fill was described as sand, sand and gravel, and sandy gravel, brown, and was described as having some silt/clay and some gravel. The granular fill was moist, with moisture contents ranging from 2% to 17%.

The base of the granular fill was found at a depth of 0.9 m to 1.2 m (Elevations 280.8 m to 281.1 m) near the north abutment, a depth of 1.1 m to 1.2 m (Elevations 280.1 m and 280.8

m) near the south abutment, and at a depth of 1.8 m (Elevation 273.6 m) at the Highway 401 median.

The gradation of the granular fill is shown in Figure B1 in Appendix B. The results of laboratory tests carried out on selected samples of the granular fill are summarized below:

<b>Soil Particles – Granular Fill</b>	<b>%</b>
<b><u>Sand Fill</u></b>	
Gravel	17
Sand	68
Silt and Clay	15
<b><u>Sand and Gravel to Sandy Gravel Fill</u></b>	
Gravel	41 to 62
Sand	26 to 44
Silt and Clay	12 to 15

### 5.3.2 Silty Clay Fill

Boreholes 13-01, 13-02, 13-04, and 13-08 encountered 6.1 m to 6.5 m of silty clay fill beneath the granular fill. The silty clay fill had SPT N-values ranging from 4 to 29 blows per 0.3 m penetration, indicating firm to very stiff conditions. The fill was described as silty clay, and silt with clay and sand, and was moist, brown in colour, and had measured moisture contents ranging from 9% to 18%.

The base of the silty clay fill was found at a depth of 7.4 m to 7.6 m (Elevations 274.4 m to 274.7 m) near the north abutment and 7.2 m to 7.3 m (Elevations 274.7 m and 274.0 m) near the south abutment.

The gradations of the silty clay fill are shown in Appendix B in Figures B12 and B13. The results of laboratory tests carried out on selected samples of the fill are summarized below:

<b>Soil Particles – Silty Clay Fill</b>	<b>%</b>
Gravel	0 to 8
Sand	8 to 25
Silt	40 to 59
Clay	22 to 38
<b><u>Soil Property</u></b>	
Liquid Limit	25 to 36
Plasticity Index	11 to 18

The results of the Atterberg Limits tests indicate that the silty clay fill is typically of low plasticity (CL) with occasional intermediate plasticity (CI) zones.

## **5.4 Silty Clay Till**

Silty clay till was the predominant soil material encountered at the site and was present within all of the boreholes. Three separate layers of the silty clay till were encountered during the geotechnical investigation.

### **5.4.1 Upper Silty Clay Till**

An upper layer of silty clay till was fully penetrated in all ten boreholes with the exception of boreholes 13-01 and 13-08, which were terminated within the upper layer at a depth of 15.8 m (Elevations 266.2 m and 265.5 m, respectively). Where fully penetrated, the thickness of the upper layer ranged from 9.9 m to 13.2 m with base elevations ranging from 260.6 m to 265.2 m. The upper silty clay till contained trace gravel and trace to some sand, was brown to grey in colour, moist to wet, and had measured moisture contents of 6% to 30%. SPT N-values recorded in the upper part of the silty clay till ranged from 4 to 11 blows for 0.03 m penetration, indicating soft to stiff conditions; values in the remainder of the silty clay till layer ranged from 13 to 66 blows per 0.03 m penetration, indicating stiff to hard conditions.

### **5.4.2 Intermediate Silty Clay Till**

An intermediate layer of silty clay till was encountered and fully penetrated in boreholes 13-02 and 13-04. The thickness of the layer ranged from 8.2 to 9.1 m with base elevations ranging from 247.9 m to 248.4 m. The intermediate silty clay till contained trace gravel and trace to some sand, was grey in colour, moist to wet, and had measured moisture contents between 10% and 14%. SPT N-values recorded in the intermediate silty clay till layer ranged from 21 to 43 blows for 0.03 m penetration, indicating very stiff to hard conditions.

### **5.4.3 Lower Silty Clay Till**

A lower layer of silty clay till was encountered and fully penetrated in boreholes 13-02 and 13-04. The thickness of the lower layer ranged from 1.7 to 2.4 m with base elevations ranging from 242.7 m to 242.9 m. The lower silty clay till layer contained some sand, was grey in colour, wet, and had measured moisture contents of 15% and 18%. SPT N-values recorded in the lower silty clay till deposit ranged from 20 to 29 blows for 0.03 m penetration, indicating very stiff conditions.

Grain size analyses conducted on samples of the three layers of silty clay till are presented in Figures B4 to B7 in Appendix B, and Atterberg Limits test results are presented in Figures B14 to B17. The results are summarized in the following table:



Soil Particles	%
<u>Silty Clay Till</u>	
Gravel	0 – 4
Sand	0 – 21
Silt	42 – 67
Clay	13 – 57
<b>Soil Property</b>	
Liquid Limit	24 – 39
Plasticity Index	10 - 21

The results of the Atterberg Limits tests indicate that the silty clay till is typically of low plasticity (CL) with occasional intermediate plasticity (CI) zones.

### 5.5 Silt Till

A layer of silt till was encountered within the upper silty clay till in boreholes 13-05, 13-06, 13-07, 13-08, 13-09, and 13-11. The silt till was fully penetrated in all boreholes it was encountered in with the exception of Borehole 13-08, which was terminated within this layer at depth of 15.8 m (Elevation 265.5 m). Where fully penetrated, the silt till layer was found to have thicknesses ranging from 1.2 m to 4.2 m with its base at elevations of 262.1 m to 266.4 m. The clayey silt till was brown to grey in colour, and typically contained trace to no gravel, trace to some sand, and was described as being clayey to having trace clay. The silt till was described as moist to wet and had measured moisture contents between 13% and 23%. SPT N-values recorded in the silt till deposit ranged from 17 to 76 blows for 0.03 m penetration, indicating very stiff to hard conditions.

The gradations of the silt till deposit are shown in Appendix B in Figure B8. The results are summarized in the following table:

Soil Particles	%
<u>Silt Till</u>	
Gravel	0 – 3
Sand	0 – 16
Silt	52 - 92
Clay	8 - 29

### 5.6 Sand

#### 5.6.1 Upper Sand

A layer of sand was encountered beneath the upper layer of silty clay till. The upper sand layer was encountered in boreholes 13-02, 13-03, 13-04, 13-05, 13-06, 13-07, 13-09, and 13-11 at depths of 10.1 m to 19.5 m (Elevations 260.6 m to 265.1 m). The upper sand layer was only fully penetrated in boreholes 13-02 and 13-04. The thickness of the layer was

found to be 5.5 m to 7.3 m with its base at 25.0 m and 25.3 m below grade (Elevations 256.6 m and 257.1 m). The remaining boreholes were terminated within this layer at elevations of 258.0 m to 260.2 m. The sand was grey in colour, wet, and typically contained trace to no gravel and trace silt, with the exception of a sample of gravelly sand collected from the base of Borehole 13-06. The sand had measured moisture contents between 2% and 24%. Lower moisture contents were noted in zones of the sand located just above the measured water levels in the boreholes. SPT N-values recorded in the upper sand deposit ranged from 13 to 86 blows for 0.03 m penetration, indicating compact to very dense conditions.

### 5.6.2 Lower Sand

A lower layer of sand was encountered beneath the intermediate layer of silty clay till. The lower sand layer was 3.1 m to 3.5 m in thickness and was encountered in boreholes 13-02 and 13-04 with its base at depths of 37.6 m 36.6 m (Elevations 244.4 m and 245.3 m). The lower sand contained trace silt, was grey in colour, and wet, with measured moisture contents of 19%. SPT N-values recorded in the lower sand deposit ranged from 22 to 27 blows for 0.03 m penetration, indicating compact conditions.

Grain size analyses conducted on samples of the sand are presented on Figures B9 and B10 in Appendix B. The results are summarized in the following table:

Soil Particles	%
<u>Sand</u>	
Gravel	0 – 24
Sand	72 – 96
Silt and Clay	3 – 11

### 5.7 Sandy Silt Till

A layer of sandy silt till was found near the base of boreholes 13-02 and 13-04 at depths of 39.0 m to 39.3 m (Elevations 242.7 m and 242.9 m). Both boreholes were terminated within this layer at depths of 40.2 m (Elevations 241.7 m and 241.8 m). The sandy silt till was grey in colour, wet, contained trace clay, and had measured moisture contents between 21% and 22%. An SPT N-value recorded in the sandy silt till was 40 blows for 0.03 m penetration, indicating dense conditions.

The gradation of the silt till deposit is shown in Appendix B in Figures B10 and B11 and is summarized in the following table:

Soil Particles –Silt Till	%
<u>Sandy Silt Till</u>	
Gravel	0
Sand	19
Silt	69
Clay	12

## 5.8 Water Levels

Standpipe piezometers were installed in boreholes 13-02, 13-04, 13-05, 13-06, 13-07, and 13-09. Water levels were measured for the duration of the site work. The water level readings from the piezometers and open boreholes are presented in Table 5.2.

Based on these observations, local groundwater levels existed at Elevations 261.7 to 268.9 at the time of the investigation. All groundwater observations at this site are short term and the levels are expected to fluctuate seasonally and after severe weather events.

**Table 5.2: Water Level Measurements**

Borehole	Date of Reading	Water Level Depth (m)	Water Level Elevation (m)
13-01	12/13/2013	13.1 (in open borehole)	268.9
13-02	12/13/2013	18.3	263.8
	01/17/2014	18.4	263.6
13-03	12/16/2013	13.7 (in open borehole)	261.7
13-04	12/12/2013	19.2	262.7
	01/17/2014	18.7	263.2
13-05	12/12/2013	13.1	262.9
	01/17/2014	13.7	262.3
13-06	12/12/2013	13.1	262.1
	01/17/2014	13.5	261.7
13-07	12/12/2013	11.9	262.3
	01/17/2014	11.9	262.3
13-08	12/06/2013	12.8 (in open borehole)	268.5
13-09	12/20/2013	11.6	262.5
	01/17/2014	11.5	262.5
13-11	12/02/2013	7.9	265.9

## 6. MISCELLANEOUS

Altech Drilling Limited of Elmira, Ontario, supplied the drill rig and conducted the drilling, sampling and in-situ testing operations. A D-120 track-mounted drill rig was used for the duration of the investigation.

The drilling and sampling operations in the field were supervised on a full time basis by Mr. George Azzopardi of Thurber. Geotechnical laboratory testing was carried out by Thurber in its MTO-approved laboratory.

Overall project management and direction of the field and laboratory program was provided by Mr. Alastair E. Gorman, P.Eng. Interpretation of the field data and preparation of this report was carried out by Ms. Katrina Young, E.I.T. The report was reviewed by Mr. Alastair Gorman, P.Eng., a Designated Principal Contact for MTO Foundations projects.

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## **Appendix A**

### **Record of Borehole Sheets**

## SYMBOLS AND TERMS USED ON TEST HOLE LOGS

### 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 naked eye

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

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

### TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROX. SPT <sup>(1)</sup> "N" VALUE
Very Soft	< 10	< 2
Soft	10 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	> 200	> 30

(1) Standard Penetration Test – the number of blows from a 63.5kg hammer falling through 0.76m to advance a 60 degree truncated cone 0.3m

### TERMS DESCRIBING DENSITY (COHESIONLESS SOILS)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	< 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50


### HIERARCHY OF SOIL STRENGTH PREDICTION

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

### LEGEND FOR TEST HOLE LOGS

 Shelby Tube   
  A – Casing   
  SPT   
  Grab/Auger sample   
  Core   
  No Recovery

• MC – Moisture Content (% by Weight) as determined by sample

 Water Level  
 C<sub>vane</sub> Shear Strength Determination by Field Insitu Vane  
 C<sub>pen</sub> Shear Strength Determination by Pocket Penetrometer  
 C<sub>lab</sub> Shear Strength Determination using a Laboratory Vane Apparatus  
 C<sub>u</sub> Undrained Shear Strength determined by Unconfined Compression Test  
 AS/GS/BS Auger Sample/Grab Sample/ Block Sample  
 SS Split-spoon  
 SC Soil core  
 AED Oedometer test  
 TXL Triaxial test

### 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 <sub>L</sub> < 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 <sub>L</sub> < 30%).
		CI	Inorganic clays of medium plasticity, silty clays. (30% < W <sub>L</sub> < 50%).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS W <sub>L</sub> > 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





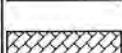
### ROCK WEATHERING CLASSIFICATION

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

### DISCONTINUITY SPACING

<b>Bedding</b>	<b>Bedding Plane Spacing</b>
Very thickly bedded	Greater than 2m
Thickly bedded	0.6 to 2m
Medium bedded	0.2 to 0.6m
Thinly bedded	60mm to 0.2m
Very thinly bedded	20 to 60mm
Laminated	6 to 20mm
Thinly Laminated	Less than 6mm

### SYMBOLS

	CLAYSTONE
	SILTSTONE
	SANDSTONE
	COAL
	BEDROCK

### STRENGTH CLASSIFICATION

<b>Rock Strength</b>	<b>Approximate Uniaxial Compressive Strength</b>		<b>Field Estimation of Hardness*</b>
	<b>(MPa)</b>	<b>(psi)</b>	
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
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 % 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.



## METRIC

[illegible]

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

# RECORD OF BOREHOLE No 13-01

2 OF 2

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 903.4 E 416 948.9 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2013.12.13 - 2013.12.13 CHECKED BY KY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE      LIQUID CONTENT      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			SHEAR STRENGTH kPa				WATER CONTENT (%)							
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE				W <sub>p</sub> W      W <sub>L</sub>							
								20   40   60   80   100 20   40   60   80   100				20   40   60							
	Continued From Previous Page					▽	272												
	Silty <b>CLAY</b> , some sand, trace gravel Stiff to Very Stiff Brown Moist (TILL)		10	SS	26		271									0	17	51	32
							270												
			11	SS	22		269							○					
							268							○					
			12	SS	13		267												
			13	SS	16										0	14	50	36	
266.2																			
15.8	END OF BOREHOLE AT 15.8 m. BOREHOLE OPEN TO 15.8 m AND WATER LEVEL AT 13.1 m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.3 m, CONCRETE TO 0.1 m, THEN ASPHALT PATCH TO SURFACE.																		

ONTMT4S 6427.GPJ 2012TEMPLATE(MTO).GDT 3/14/14

# RECORD OF BOREHOLE No 13-02

1 OF 5

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 895.3 E 416 964.9 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2013.12.10 - 2013.12.12 CHECKED BY KY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  <b>γ</b>  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					
282.0													
0.0													
0.1	ASPHALT: (100 mm)						282						
	SAND and GRAVEL, some silt Dense Brown Moist (FILL)		1	SS	40								47 38 15 (SI+CL)
281.1													
0.9	Silty CLAY, trace to some sand Stiff to Very Stiff Brown Moist (FILL)		2	SS	14		281						
			3	SS	10								0 17 45 38
							280						
			4	SS	19								
			5	SS	21		279						
							278						
			6	SS	26								
							277						
			7	SS	16		276						0 8 59 33
							275						
274.7													
7.4	Silty CLAY, trace to some sand, trace gravel Firm Brown Moist (TILL)		8	SS	6		274						
273.4													
8.7	Very Stiff						273						
			9	SS	21								

Continued Next Page

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

20  
15 10 5  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 13-02

2 OF 5

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 895.3 E 416 964.9 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2013.12.10 - 2013.12.12 CHECKED BY KY

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			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL
								20	40	60	80	100	20	40					
	Continued From Previous Page																		
	Silty <b>CLAY</b> , trace to some sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		10	SS	31		272												
							271												
			11	SS	16		270												
			12	SS	20		269												
							268										0 6 54 40		
			13	SS	24		267												
			14	SS	40		266												
							265												
							264												
			15	SS	20		263												
262.5																			
19.5	<b>SAND</b> , trace silt, trace gravel Compact to Very Dense Grey																		

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 13-02

3 OF 5

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 895.3 E 416 964.9 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2013.12.10 - 2013.12.12 CHECKED BY KY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  <b>γ</b>  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										
Continued From Previous Page							<div><div>○ UNCONFINED</div><div>● QUICK TRIAXIAL</div></div> <div><div>+ FIELD VANE</div><div>× LAB VANE</div></div>				<div><div>PLASTIC LIMIT</div><div>NATURAL MOISTURE CONTENT</div><div>LIQUID LIMIT</div></div> <div><div>W<sub>P</sub></div><div>W</div><div>W<sub>L</sub></div></div> <div>WATER CONTENT (%)</div> <div>20 40 60</div>				GR SA SI CL			
	<b>SAND</b> , trace silt, trace gravel Compact to Very Dense Grey Wet		16	SS	40		262							0	95	5 (SI+CL)		
							261											
							260											
			17	SS	55		259											
							258											
257.1							257											
25.0	Silty <b>CLAY</b> , trace to some sand, trace gravel Hard Grey Wet (TILL)		18	SS	32		256											
							255											
							254											
			19	SS	30		253							0	0	45 55		

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

## METRIC

[illegible]

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

ONTMT4S 6427.GPJ 2012TEMPLATE(MTO).GDT 3/14/14

# RECORD OF BOREHOLE No 13-02

5 OF 5

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 895.3 E 416 964.9 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2013.12.10 - 2013.12.12 CHECKED BY KY



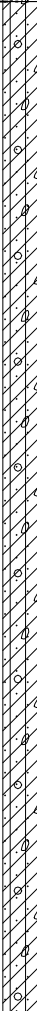
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W <sub>p</sub> W W <sub>L</sub> 20 40 60					
241.8	(TILL)						242										
40.2	END OF BOREHOLE AT 40.2 m. Piezometer installation consists of 25 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Dec. 12/13 18.2 263.8 Jan. 17/14 18.4 263.6																

# RECORD OF BOREHOLE No 13-03

1 OF 2

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 843.5 E 416 957.5 ORIGINATED BY GA  
HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2013.12.16 - 2013.12.16 CHECKED BY KY

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				w <sub>p</sub>	w	w <sub>L</sub>								
SHEAR STRENGTH kPa								WATER CONTENT (%)														
○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE																						
275.4																						
0.0	ASPHALT: (125 mm)																					
0.1	SAND and GRAVEL, some silt Dense Brown Moist (FILL)			1	SS	39													41   44   15 (SI+CL)			
				2	SS	38																
273.6				3	SS	24																
1.8	Silty CLAY, trace to some sand, trace gravel Stiff Brown Moist (TILL)																					
				4	SS	11																
272.4																						
3.0	Very Stiff			5	SS	16																
					6	SS	17															
				7	SS	19												2   17   46   35				
				8	SS	16																
				9	SS	19																

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 13-03

2 OF 2

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 843.5 E 416 957.5 ORIGINATED BY GA  
HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2013.12.16 - 2013.12.16 CHECKED BY KY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT  <b>γ</b>  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	× LAB VANE	w <sub>P</sub>	w	w <sub>L</sub>						
	Continued From Previous Page							20	40	60	80	100								
	Silty <b>CLAY</b> , trace to some sand, trace gravel Very Stiff Brown Moist (TILL)		10	SS	20															
263.7																				
11.7	Hard																			
262.6			11	SS	33															
12.8	<b>SAND</b> , trace silt Compact Grey Wet																			
															</					

ONTMT4S 6427.GPJ 2012TEMPLATE(MTO).GDT 3/14/14

# RECORD OF BOREHOLE No 13-04

1 OF 5

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 799.5 E 416 975.3 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2013.12.06 - 2013.12.10 CHECKED BY KY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL
								○ UNCONFINED	+	FIELD VANE	● QUICK TRIAXIAL	×	LAB VANE						
281.9							20	40	60	80	100								
0.0	ASPHALT: (25 mm)																		
	SAND and GRAVEL, some silt Dense Brown Moist (FILL)		1	SS	35												44	44 12 (SI+CL)	
280.8			2	SS	10														
1.1	Silty CLAY, some sand, trace gravel Firm to Stiff Brown Moist (FILL)																		
			3	SS	4												8	25 40 27	
			4	SS	12														
			5	SS	11														
			6	SS	18														
276.3																			
5.6	Very Stiff																		
			7	SS	28												6	22 50 22	
274.7																			
7.2	Silty CLAY, some sand, trace gravel Firm Brown Moist (TILL)																		
			8	SS	6														
273.2																			
8.7	Very Stiff																		
			9	SS	23														

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 13-04

2 OF 5

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 799.5 E 416 975.3 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2013.12.06 - 2013.12.10 CHECKED BY KY

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								
	Continued From Previous Page															
	Silty <b>CLAY</b> , some sand, trace gravel Stiff Grey Damp (TILL)		10	SS	15		271									0 20 52 28
270.2																
11.7	Very Stiff						270									
			11	SS	18											
							269									
			12	SS	26		268									
267.1																
14.8	Hard						267									
			13	SS	32											4 13 50 33
							266									
			14	SS	66		265									
263.9							264									
18.0	<b>SAND</b> , trace silt, trace gravel Dense to Very Dense Grey Moist		15	SS	49											
							263									

Continued Next Page

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

# RECORD OF BOREHOLE No 13-04

3 OF 5

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 799.5 E 416 975.3 ORIGINATED BY GA  
HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2013.12.06 - 2013.12.10 CHECKED BY KY

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	20 40 60 80 100	W <sub>p</sub> W W <sub>L</sub>	20 40 60			
	Continued From Previous Page		16	SS	49									
260.3							261							
21.6	Compact						260							
			17	SS	24		259							
							258							
							257							
256.6							256							
25.3	Silty CLAY, trace to some sand, trace gravel Very Stiff to Hard Grey Moist (TILL)		18	SS	43		255							
							254							
			19	SS	28		253							
							252							

Continued Next Page

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

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 13-04

4 OF 5

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 799.5 E 416 975.3 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2013.12.06 - 2013.12.10 CHECKED BY KY

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					
	Continued From Previous Page							20 40 60 80 100					
								○ UNCONFINED + FIELD VANE					
								● QUICK TRIAXIAL × LAB VANE					
								WATER CONTENT (%)					
								20 40 60					

Continued Next Page

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

# RECORD OF BOREHOLE No 13-04

5 OF 5

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 799.5 E 416 975.3 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2013.12.06 - 2013.12.10 CHECKED BY KY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			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																
241.7																	
40.2	END OF BOREHOLE AT 40.2 m. BOREHOLE OPEN TO 35.1 m AND WATER LEVEL AT 24.7 m. Piezometer installation consists of 25 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Dec. 12/13 19.2 262.7 Jan. 17/14 18.7 263.2																

# RECORD OF BOREHOLE No 13-05

1 OF 2

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 782.4 E 417 002.7 ORIGINATED BY GA  
HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2013.12.03 - 2013.12.03 CHECKED BY KY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL	
								20	40	60	80	100	20	40	60						
276.0																					
0.0	TOPSOIL: (200 mm)																				
0.2	Silty <b>CLAY</b> , some sand, trace gravel Firm to Stiff Dark Brown Moist (TILL)		1	SS	6																
			2	SS	10																
			3	SS	8																
273.8																					
2.2	Very Stiff to Hard		4	SS	21													0	17	48	35
			5	SS	38																
			6	SS	22													4	16	46	34
			7	SS	22																
			8	SS	37																
267.1																					
8.9	Clayey <b>SILT</b> , trace sand Hard Grey Wet (TILL)		9	SS	59													0	2	77	21

Continued Next Page

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

20  
15 10 5  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 13-05

2 OF 2

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 782.4 E 417 002.7 ORIGINATED BY GA  
HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2013.12.03 - 2013.12.03 CHECKED BY KY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  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					
	Continued From Previous Page												
265.9 10.1	Silty <b>CLAY</b> Very Stiff Grey Wet (TILL)		10	SS	24								0 0 57 43
263.8 12.2	<b>SAND</b> , trace to some silt Compact to Very Dense Grey Wet		11	SS	57								0 91 9 (SI+CL)
			12	SS	25								
			13	SS	84								
260.2 15.8	END OF BOREHOLE AT 15.8 m. BOREHOLE OPEN TO 15.8 m AND WATER LEVEL AT 15.2 m. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Dec. 12/13 13.1 262.9 Jan. 17/14 13.7 262.3												

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# RECORD OF BOREHOLE No 13-06

1 OF 2

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 740.6 E 417 010.6 ORIGINATED BY GA  
HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2013.12.04 - 2013.12.04 CHECKED BY KY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W P      W      W L				GR	SA	SI	CL	
								20   40   60   80   100													
275.2								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE					WATER CONTENT (%)								
0.0	TOPSOIL: (200 mm)							20	40	60	80	100	20	40	60						
0.2	Silty <b>CLAY</b> , some sand, trace gravel Soft to Firm Brown Moist (TILL)		1	SS	4		275							○							
			2	SS	5									○							
273.8							274														
1.4	Stiff to Hard		3	SS	12									●	—		1	19	54	26	
			4	SS	30		273							○							
			5	SS	32		272							○							
							271														
270.6			6	SS	26		270							○			0	0	71	29	
4.6	Clayey <b>SILT</b> , trace sand, occasional iron oxide staining Very Stiff Brown Moist (TILL)		7	SS	21		269							○			0	5	73	22	
268.0			8	SS	38		268							○							
7.2	Hard						267														
266.4			9	SS	22		266							○							
8.8	Silty <b>CLAY</b> Very Stiff Grey Moist (TILL)																				

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 13-06

2 OF 2

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 740.6 E 417 010.6 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2013.12.04 - 2013.12.04 CHECKED BY KY

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		× LAB VANE
								20	40	60	80	100	20	40	60				
265.2	Continued From Previous Page																		
10.1	SAND, gravelly, trace silt Dense Grey Moist		10	SS	37								○						
262.0	Compact		12	SS	24								○						
260.4	Dense																		
			13	SS	45								○			24 72 4 (SI+CL)			
259.4	END OF BOREHOLE AT 15.8 m. BOREHOLE OPEN TO 15.8 m AND WATER LEVEL AT 14.3 m. Piezometer installation consists of 25 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.																		
15.8	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Dec. 12/13 13.1 262.1 Jan. 17/14 13.5 261.7																		

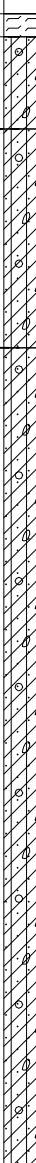

ONTMT4S 6427.GPJ 2012TEMPLATE(MTO).GDT 3/14/14

# RECORD OF BOREHOLE No 13-07

1 OF 2

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 698.6 E 417 005.2 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2013.12.04 - 2013.12.04 CHECKED BY KY

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  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)				GR	SA	SI	CL
								20	40	60	80					100	20	40	60				
274.2																							
0.0	TOPSOIL: (150 mm)																						
0.2	Silty <b>CLAY</b> , some sand, trace gravel		1	SS	6	274											3	17	54	26			
273.5	Firm																						
0.8	Brown																						
	Moist																						
	(TILL)																						
	Stiff		2	SS	11	273																	
			3	SS	12																		
272.0						272																	
2.2	Very Stiff		4	SS	21													4	15	49	32		
			5	SS	18	271																	
			6	SS	23	270																	
			7	SS	29	268												4	16	42	38		
266.6																							
7.6	Clayey <b>SILT</b> , trace sand		8	SS	35	266																	
	Compact to Dense																						
	Grey																						
	Wet																						
	(TILL)																						
			9	SS	21	265																	

Continued Next Page

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

20  
15 10 5 0  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 13-07

2 OF 2

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 698.6 E 417 005.2 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2013.12.04 - 2013.12.04 CHECKED BY KY

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						WATER CONTENT (%) w P                      w                      w L				
	Continued From Previous Page							20	40	60	80	100						
263.6							264											
10.7	Silty <b>CLAY</b> , some sand, trace gravel Hard Brown Moist (TILL)		10	SS	41		263							○				
262.0							262											
12.2	<b>SAND</b> , trace silt Compact to Dense Grey Moist		11	SS	34		261											
							260											
			12	SS	22		259											
258.4														○				
15.8	END OF BOREHOLE AT 15.8 m. BOREHOLE OPEN TO 15.8 m AND WATER LEVEL AT 14.3 m. Piezometer installation consists of 25 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) Dec. 12/13      11.9      262.3 Jan. 17/14      11.9      262.3																	

ONTMT4S 6427.GPJ 2012TEMPLATE(MTO).GDT 3/14/14

# RECORD OF BOREHOLE No 13-08

1 OF 2

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 782.1 E 416 977.6 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2013.12.06 - 2013.12.06 CHECKED BY KY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W P      W      W L				GR   SA   SI   CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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281.3						● QUICK TRIAXIAL      × LAB VANE <td>20</td> <td>40</td> <td>60</td> <td>80</td> <td>100</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> 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<td>&lt;/</td>	20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													</

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

20  
15  
10  
(%) STRAIN AT FAILURE

## METRIC

[illegible]

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

# RECORD OF BOREHOLE No 13-09

1 OF 2

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 675.2 E 416 995.1 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2013.12.02 - 2013.12.02 CHECKED BY KY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  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	×	LAB VANE										
274.0								20	40	60	80	100							
0.0	TOPSOIL: (150 mm)						274												
0.2	Silty <b>CLAY</b> , some sand, trace gravel Firm Brown Moist (TILL)			1	SS	6													
				2	SS	4	273											0   21   49   30	
272.5																			
1.5	Very Stiff to Hard			3	SS	21	272												
						4	SS	37											
						5	SS	37	271										1   15   49   35
									270										
				6	SS	35	269												
							268												
				7	SS	37	267												
							266												
				8	SS	43													
265.3																			
8.7	Clayey <b>SILT</b> , trace sand Very Stiff to Hard Brown Moist (TILL)						265												
				9	SS	36											0   7   68   25		

Continued Next Page

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

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 13-09

2 OF 2

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 675.2 E 416 995.1 ORIGINATED BY GA  
HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
DATUM Geodetic DATE 2013.12.02 - 2013.12.02 CHECKED BY KY

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    × LAB VANE								
	Continued From Previous Page							20 40 60 80 100								
262.1	Clayey <b>SILT</b> , trace sand Very stiff to Hard Grey Moist (TILL)		10	SS	17											
11.9	Silty <b>CLAY</b> Very Stiff Brown Wet (TILL)		11	SS	24											0 0 43 57
260.6																
13.4	<b>SAND</b> , some silt, trace gravel Very Dense Brown Wet		12	SS	60											2 87 11 (SI+CL)
258.1			13	SS	86											
15.8	END OF BOREHOLE AT 16.8 m. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) Dec. 20/ 13      11.5      262.5 Jan. 17/ 14      11.5      262.5															

ONTMT4S 6427.GPJ 2012TEMPLATE(MTO).GDT 3/14/14



# RECORD OF BOREHOLE No 13-11

1 OF 2

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 657.9 E 416 993.9 ORIGINATED BY GA  
HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
DATUM Geodetic DATE 2013.12.02 - 2013.12.02 CHECKED BY KY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL		
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE	20	40	60	80	100	W <sub>P</sub>		W	W <sub>L</sub>				
273.8																					
0.0	TOPSOIL: (225 mm)																				
0.2	Silty <b>CLAY</b> , some sand, trace gravel, occasional wood fibres Soft to Firm Brown Moist (TILL)		1	SS	6								○								
			2	SS	4								○								
			3	SS	6								○					0	12	65	23
271.6																					
2.2	Very Stiff																				
			4	SS	22								○								
			5	SS	33								●	—	—			2	16	53	29
			6	SS	27								○								
			7	SS	27								○								
			8	SS	27								●	—	—			1	11	52	36
265.0																					
8.8	Clayey <b>SILT</b> Very Dense Brown Wet (TILL)																				
			9	SS	76								○					0	0	92	8
		</																			

Continued Next Page

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

20  
15 10 5 0  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 13-11

2 OF 2

METRIC

W.P. 3033-11-00 LOCATION VMP Interchange at Hwy 401 N 4 756 657.9 E 416 993.9 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2013.12.02 - 2013.12.02 CHECKED BY KY

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    × LAB VANE									
	Continued From Previous Page							20	40	60	80	100					
263.3																	
10.5	Silty <b>CLAY</b> , trace sand Very Stiff Brown Wet (TILL)		10	SS	25		263							○			
							262										
			11	SS	26		261							○			
260.6																	
13.3	<b>SAND</b> , trace gravel, trace silt Compact to Very Dense Brown Wet		12	SS	29		260							○			
							259										
			13	SS	53									○			2 95 3 (SI+CL)
258.0																	
15.8	END OF BOREHOLE AT 15.8 m. BOREHOLE OPEN TO 15.8 m AND WATER LEVEL AT 7.9 m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.																

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

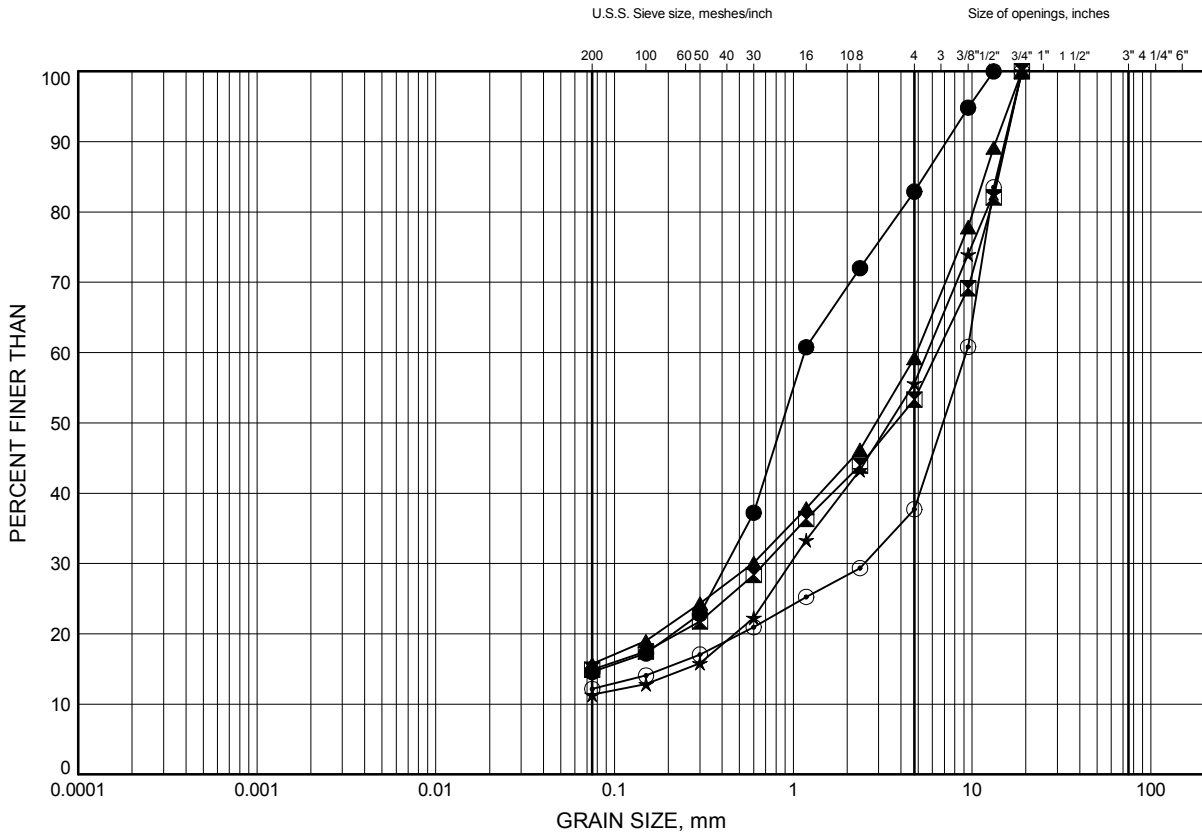
## **Appendix B**

### **Laboratory Test Results**

VMP Interchange at Hwy 401  
**GRAIN SIZE DISTRIBUTION**

FIGURE B1

**GRANULAR FILL**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-01	1.07	280.96
⊠	13-02	0.38	281.67
▲	13-03	0.38	275.06
★	13-04	0.38	281.52
⊙	13-08	1.07	280.27

Date February 2014  
W.P. 3033-11-00



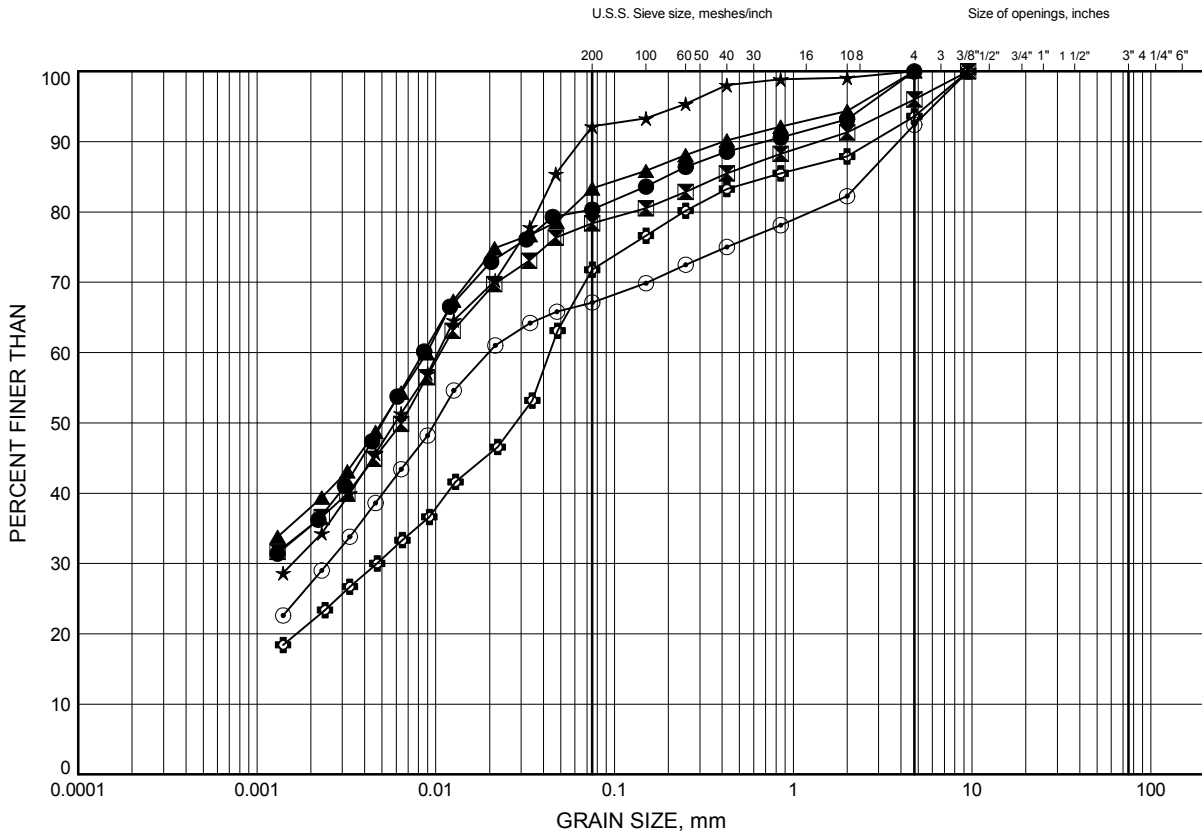
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Chkd. AG

# VMP Interchange at Hwy 401

## GRAIN SIZE DISTRIBUTION

FIGURE B2

### SILTY CLAY FILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-01	1.83	280.20
⊠	13-01	4.88	277.15
▲	13-02	1.83	280.22
★	13-02	6.40	275.65
⊙	13-04	1.83	280.07
⊗	13-04	6.40	275.50

Date February 2014  
W.P. 3033-11-00

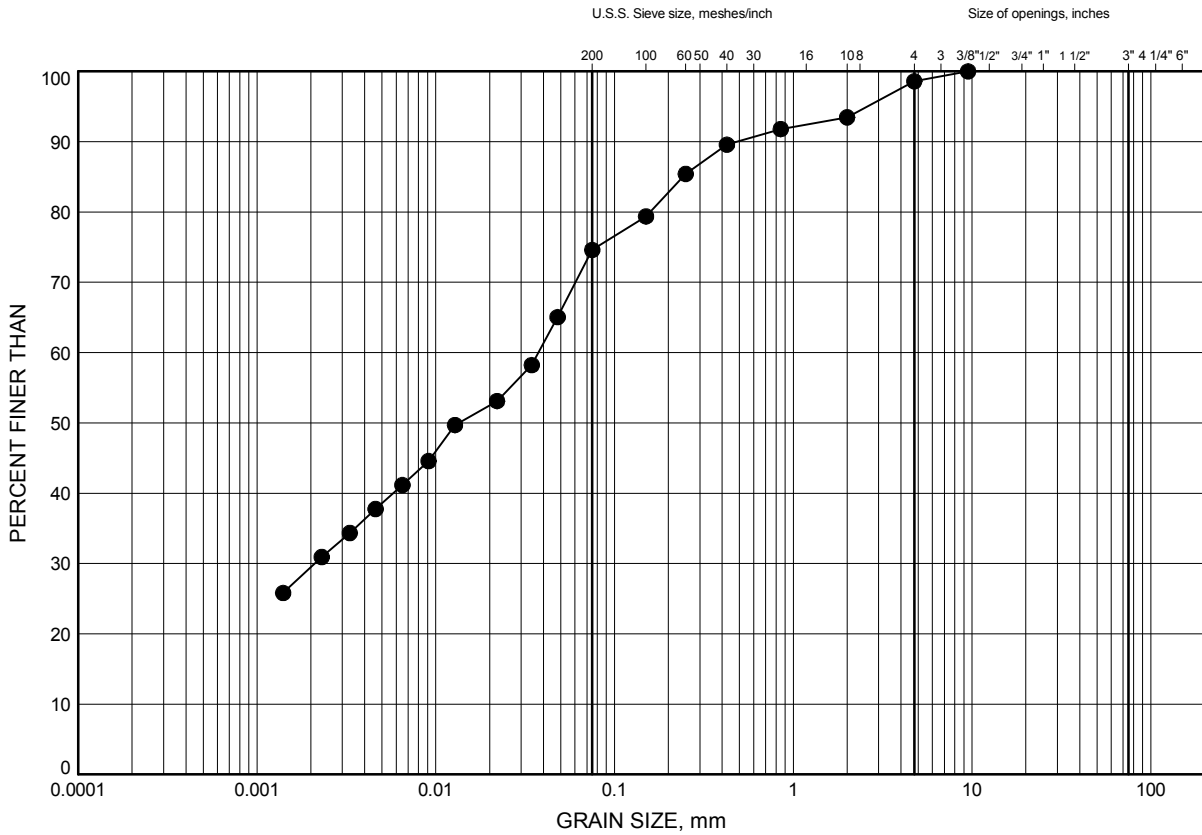


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VMP Interchange at Hwy 401  
**GRAIN SIZE DISTRIBUTION**

FIGURE B3

**SILTY CLAY FILL**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-08	2.59	278.74

Date February 2014  
W.P. 3033-11-00

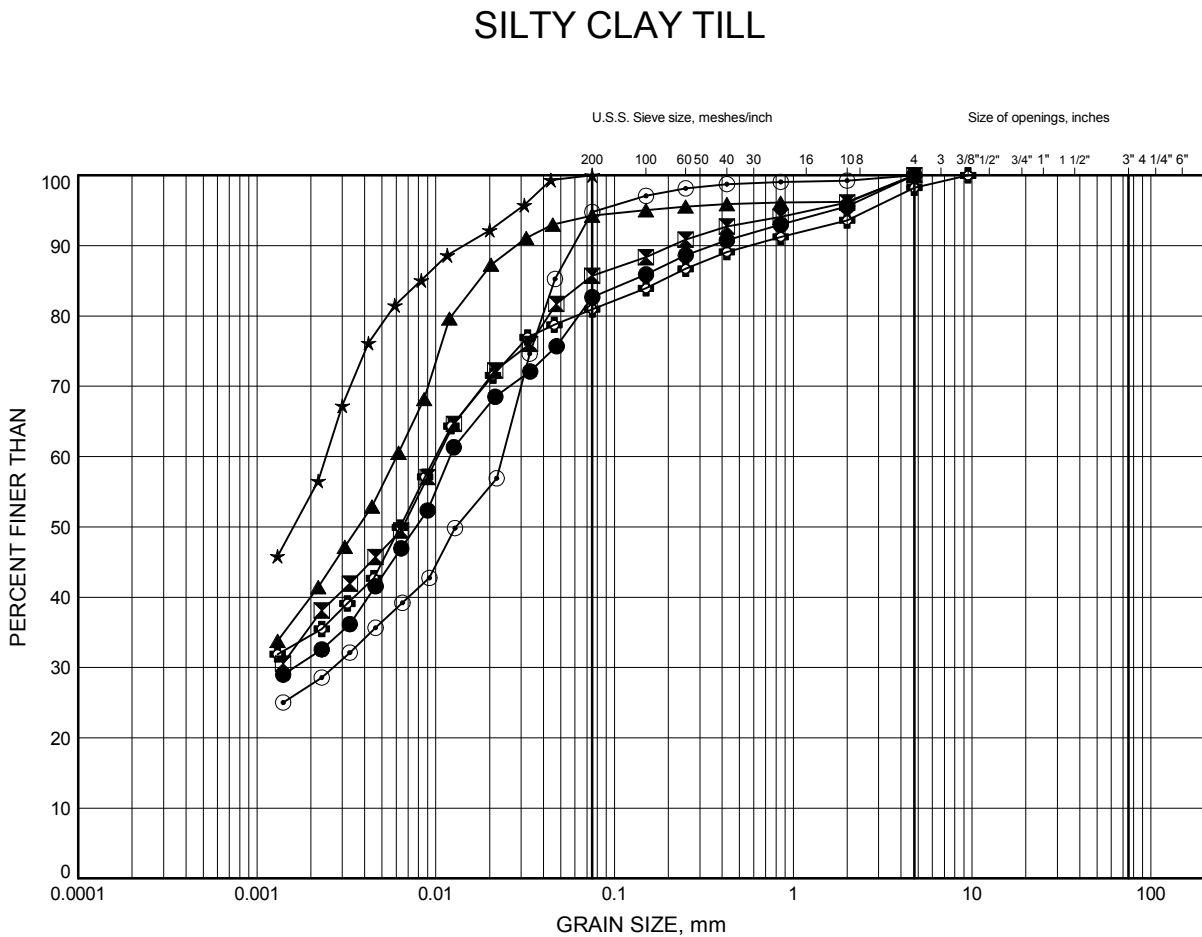


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# VMP Interchange at Hwy 401

## GRAIN SIZE DISTRIBUTION

FIGURE B4



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-01	10.97	271.05
⊠	13-01	15.54	266.48
▲	13-02	14.02	268.03
★	13-02	29.26	252.79
⊙	13-03	2.59	272.85
⊕	13-03	6.40	269.04

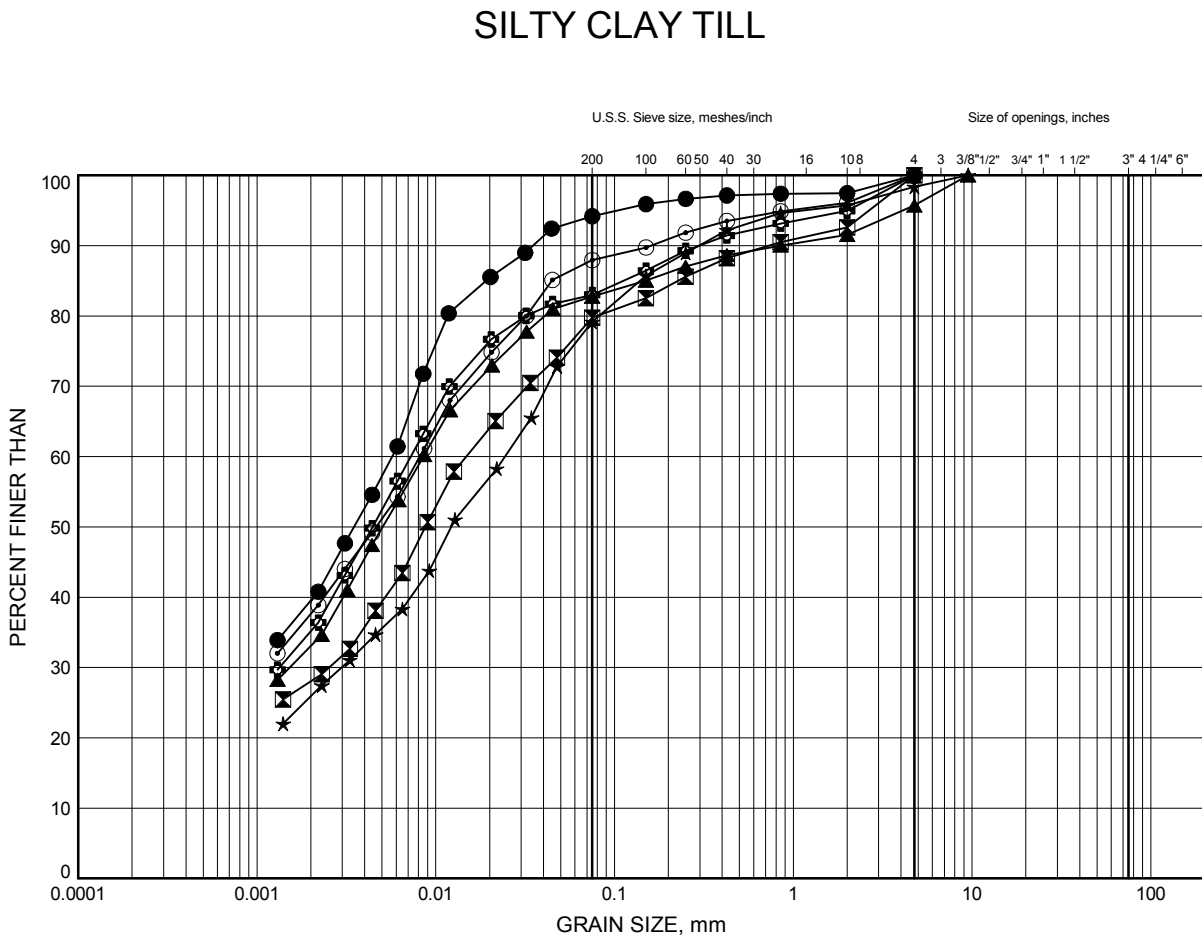
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VMP Interchange at Hwy 401  
GRAIN SIZE DISTRIBUTION

FIGURE B5



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-03	10.97	264.47
⊠	13-04	10.97	270.93
▲	13-04	15.54	266.36
★	13-04	32.31	249.59
⊙	13-04	38.40	243.50
⊕	13-05	2.59	273.42

Date February 2014  
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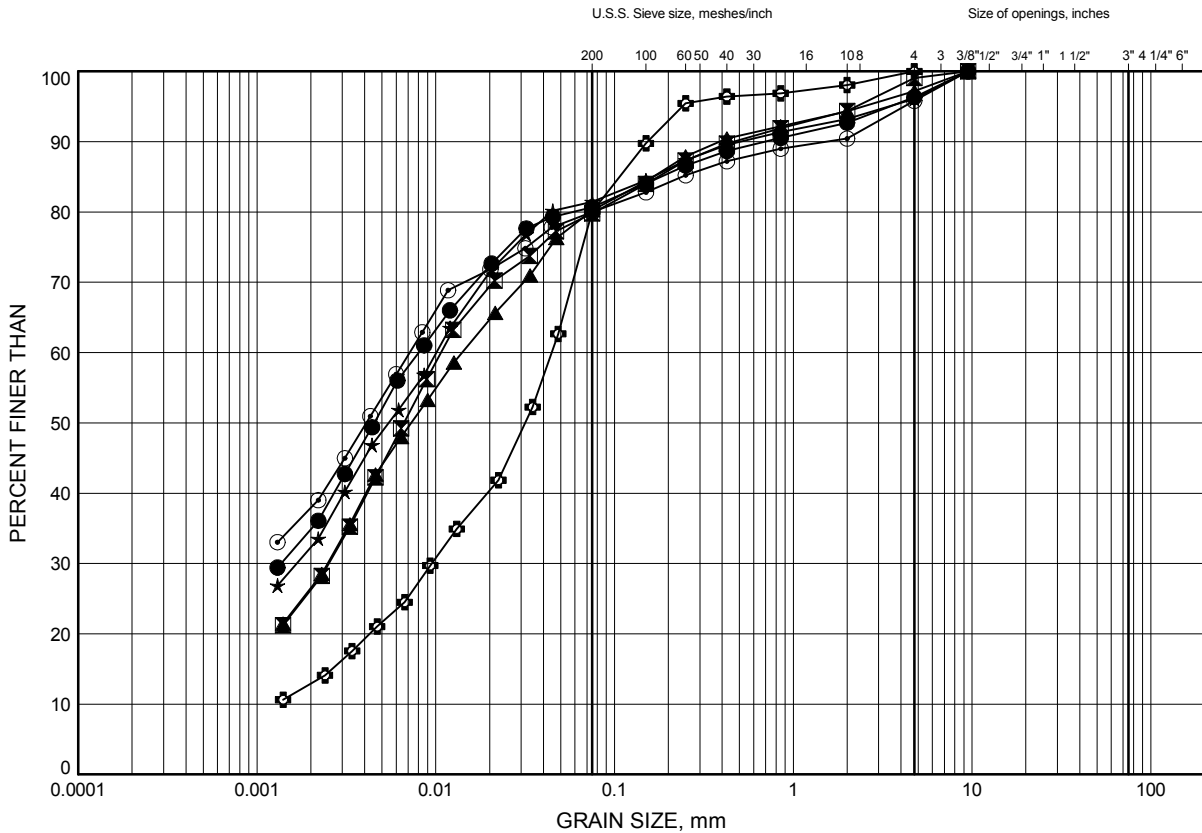


# VMP Interchange at Hwy 401

## GRAIN SIZE DISTRIBUTION

FIGURE B6

### SILTY CLAY TILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-05	4.88	271.13
⊠	13-06	1.83	273.38
▲	13-07	0.30	273.92
★	13-07	2.59	271.63
⊙	13-07	6.40	267.82
⊕	13-08	7.92	273.41

Date February 2014  
W.P. 3033-11-00

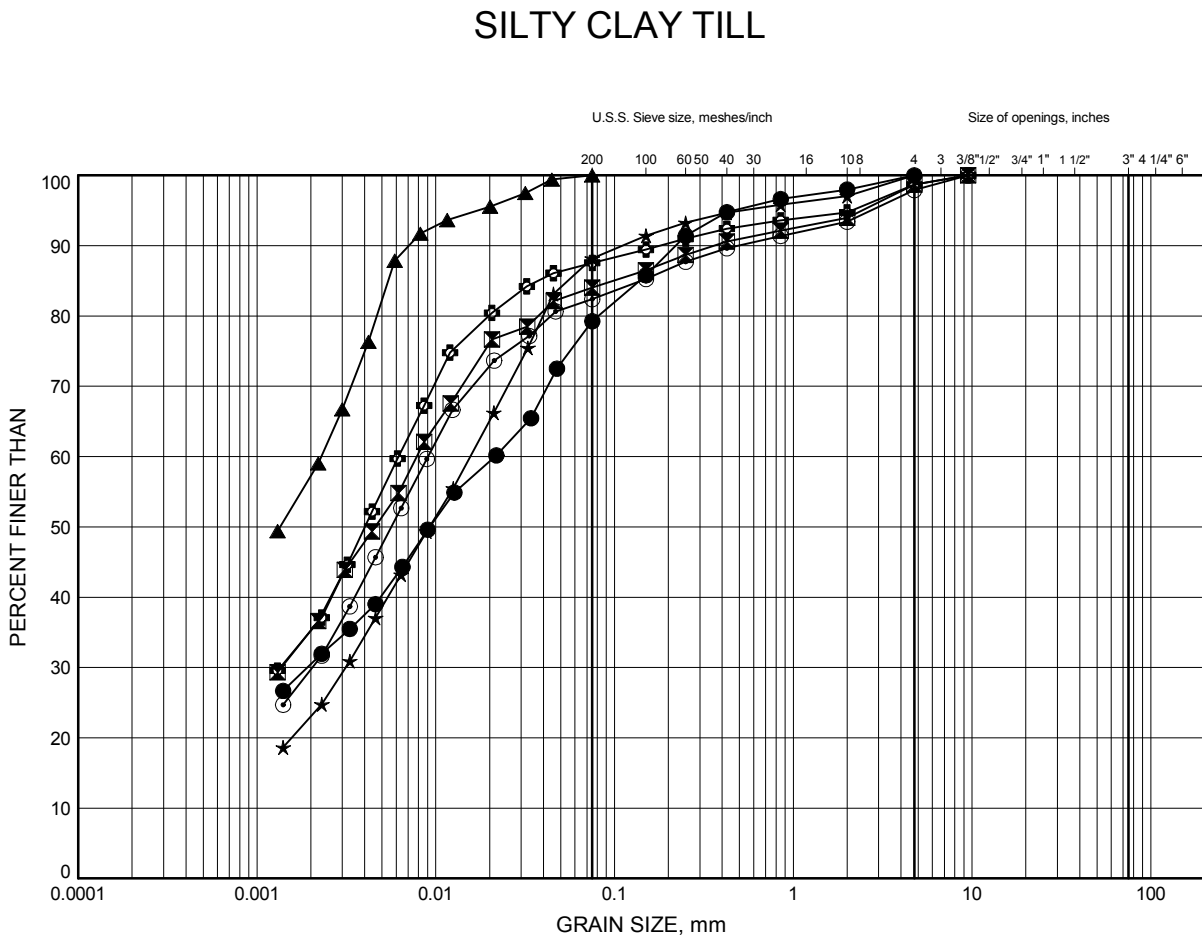


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# VMP Interchange at Hwy 401

## 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)
●	13-09	1.07	272.92
⊠	13-09	3.35	270.63
▲	13-09	12.50	261.49
★	13-11	1.83	271.99
⊙	13-11	3.35	270.47
⊕	13-11	7.92	265.90

Date February 2014  
W.P. 3033-11-00

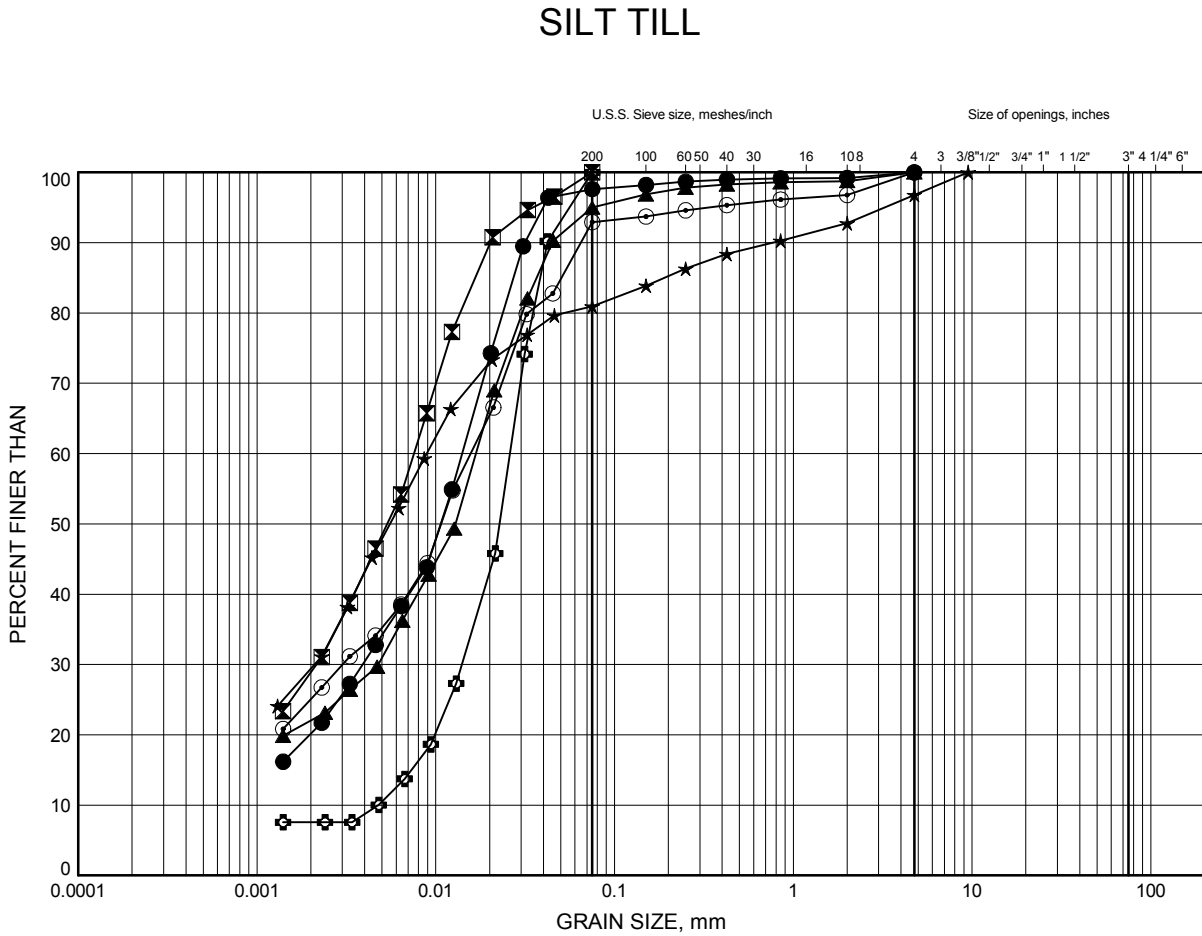


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# VMP Interchange at Hwy 401

## 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)
●	13-05	9.45	266.56
⊠	13-06	4.88	270.34
▲	13-06	6.40	268.81
★	13-08	14.02	267.31
⊙	13-09	9.45	264.54
⊕	13-11	9.45	264.37

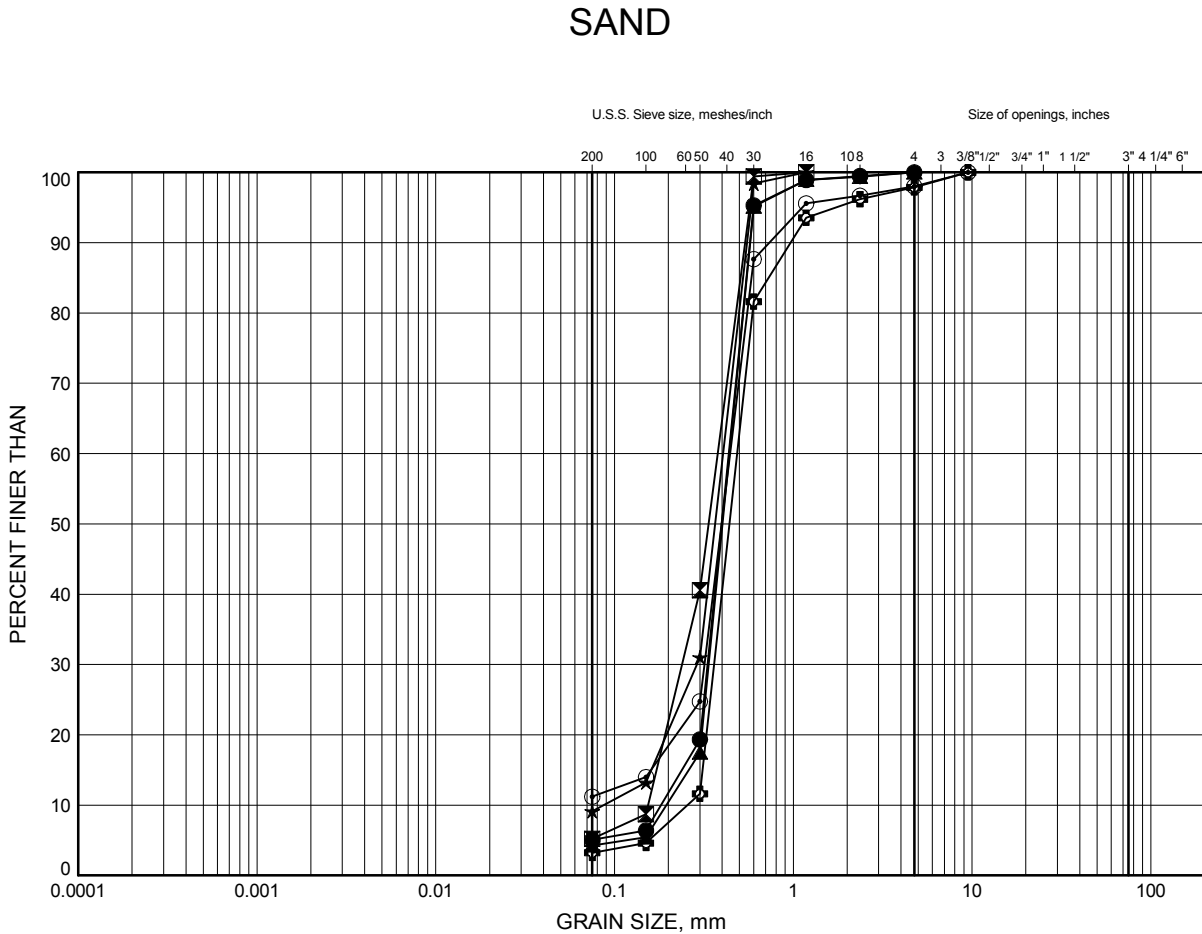
Date March 2014  
W.P. 3033-11-00



Prep'd KY  
Chkd. AG

VMP Interchange at Hwy 401  
GRAIN SIZE DISTRIBUTION

FIGURE B9



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-02	20.12	261.93
⊠	13-03	14.02	261.42
▲	13-04	23.16	258.74
★	13-05	12.50	263.51
⊙	13-09	14.02	259.96
⊕	13-11	15.54	258.28

Date February 2014  
W.P. 3033-11-00

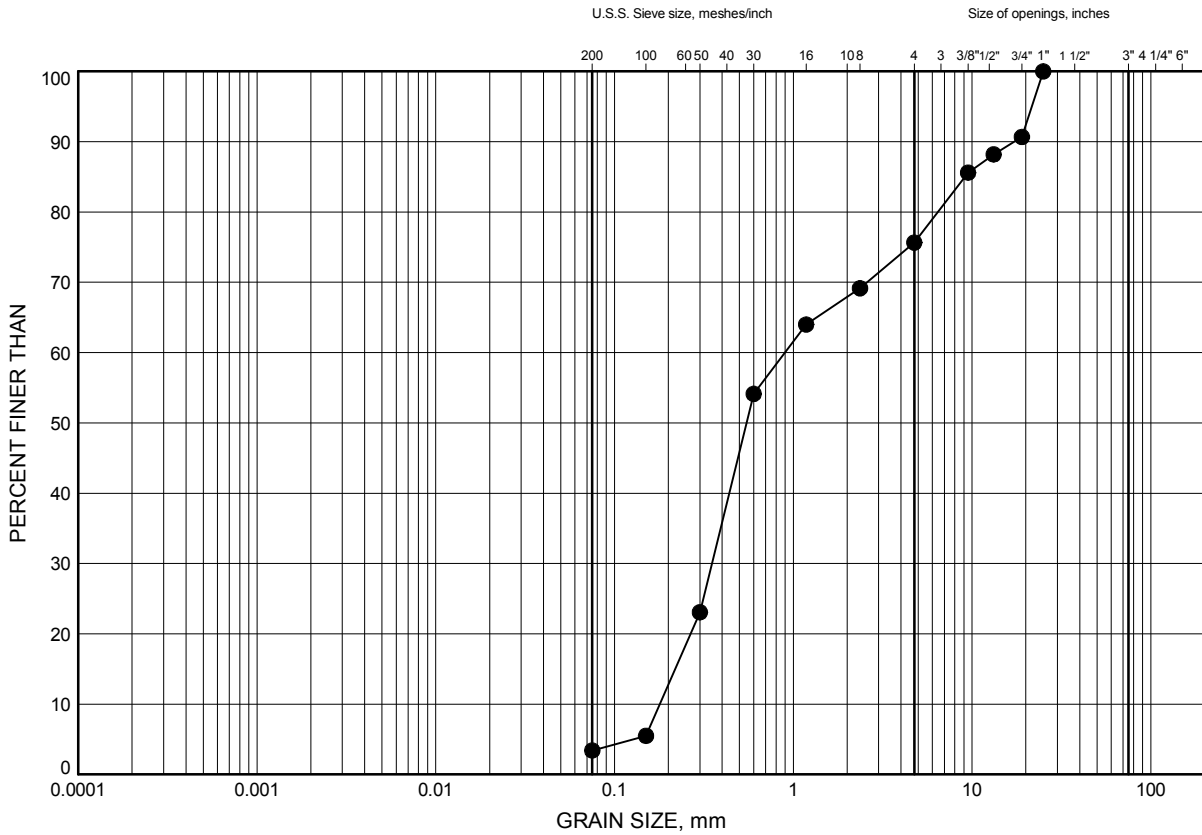


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VMP Interchange at Hwy 401  
GRAIN SIZE DISTRIBUTION

FIGURE B10

GRAVELLY SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-06	15.54	259.67

Date February 2014  
W.P. 3033-11-00

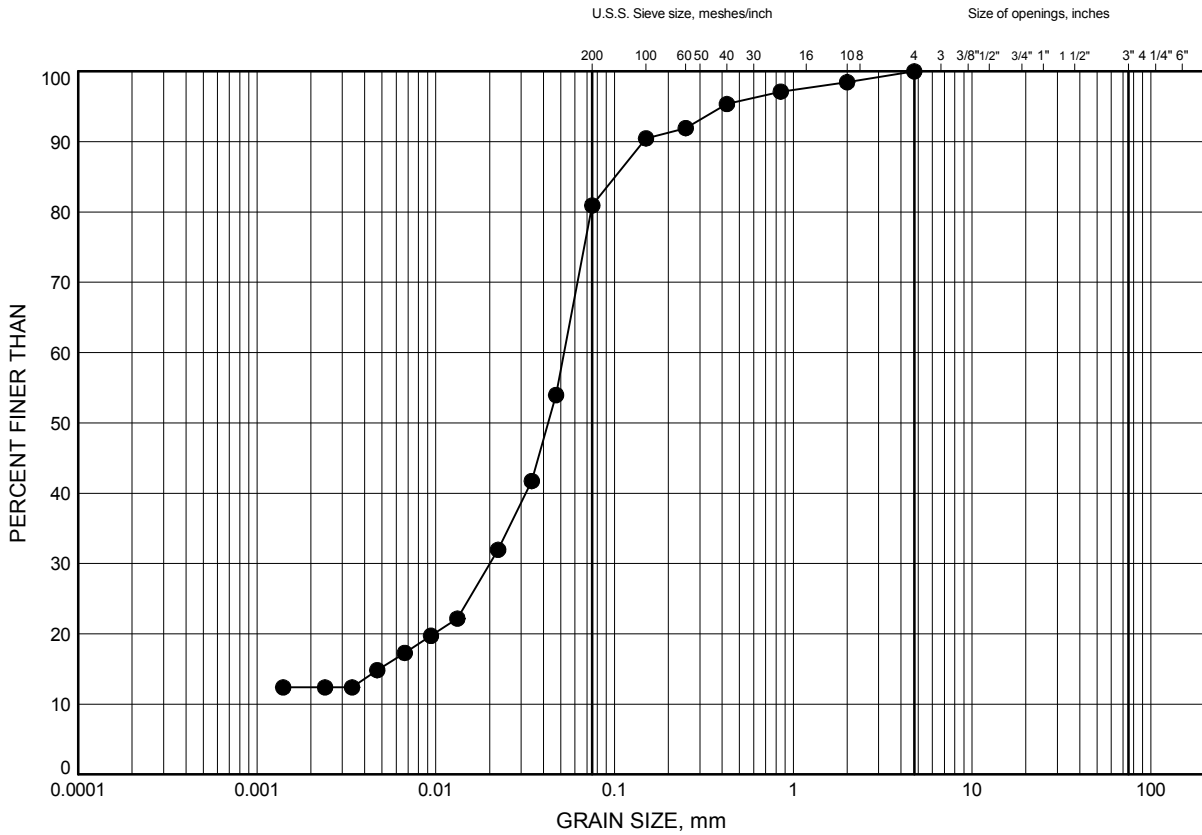


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VMP Interchange at Hwy 401  
**GRAIN SIZE DISTRIBUTION**

FIGURE B11

**SANDY SILT TILL**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-02	39.93	242.12

Date February 2014  
W.P. 3033-11-00

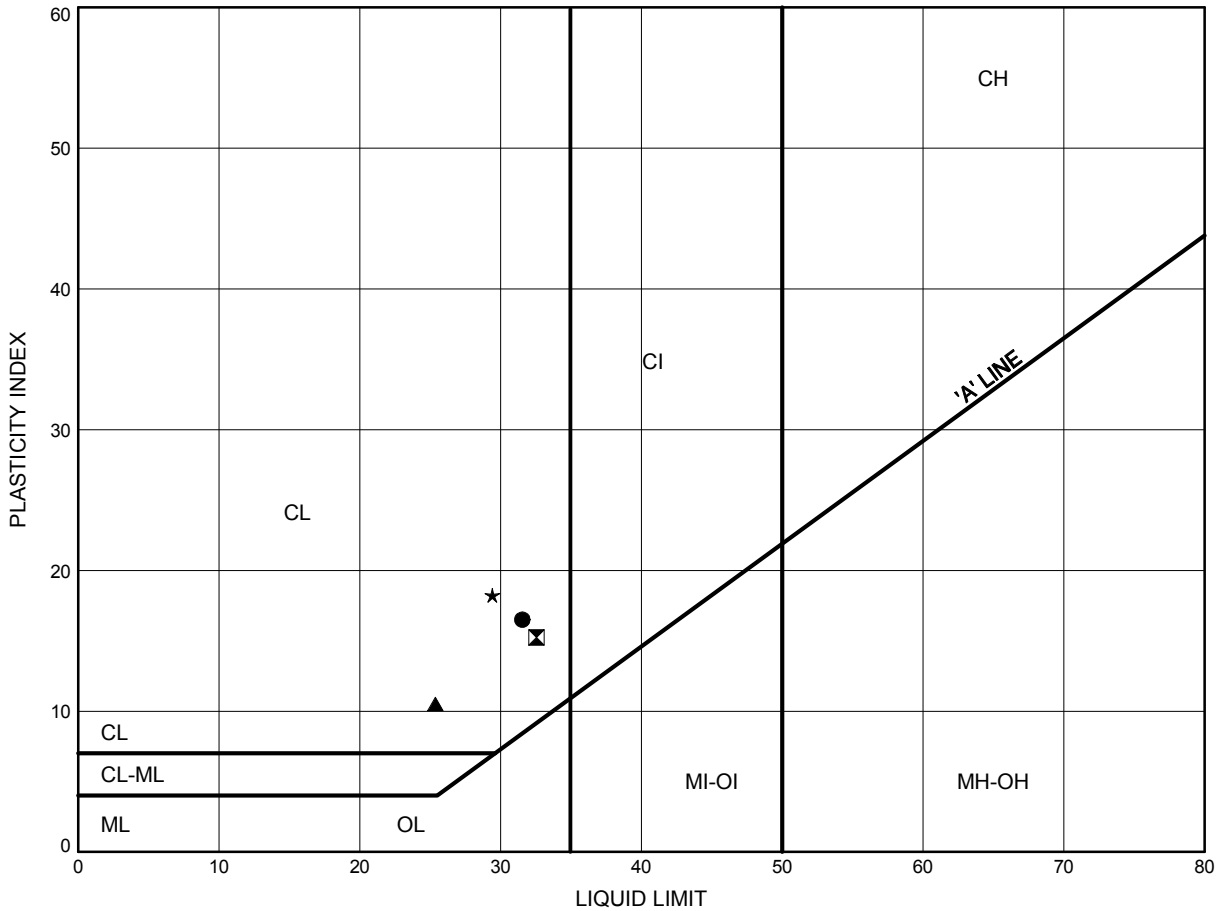


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VMP Interchange at Hwy 401  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B12

**LOW PLASTICITY SILTY CLAY FILL**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-01	4.88	277.15
⊠	13-02	6.40	275.65
▲	13-04	6.40	275.50
★	13-08	2.59	278.74

Date March 2014  
W.P. 3033-11-00

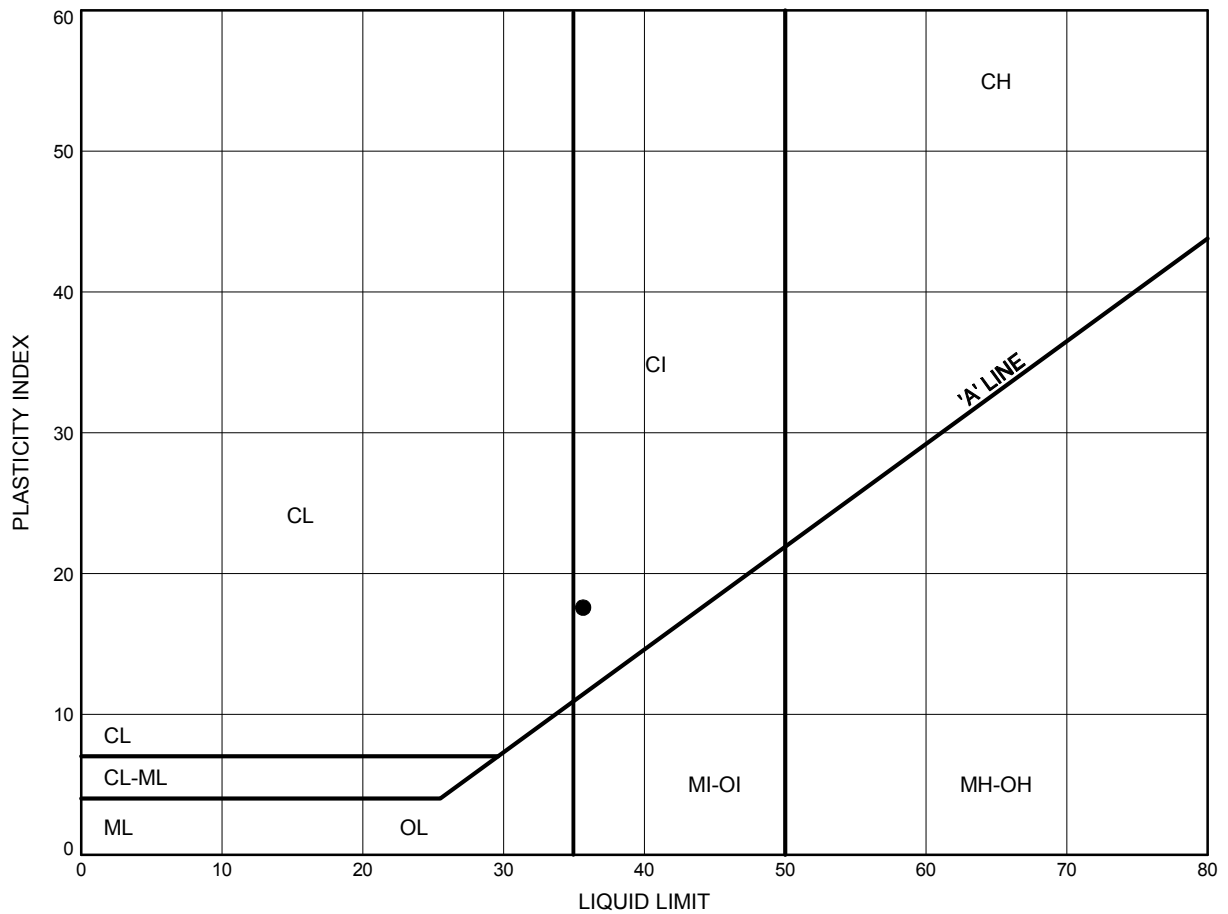


Prep'd KY  
Chkd. AG

VMP Interchange at Hwy 401  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B13

**INTERMEDIATE PLASTICITY SILTY CLAY FILL**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-02	1.83	280.22

Date March 2014  
W.P. 3033-11-00



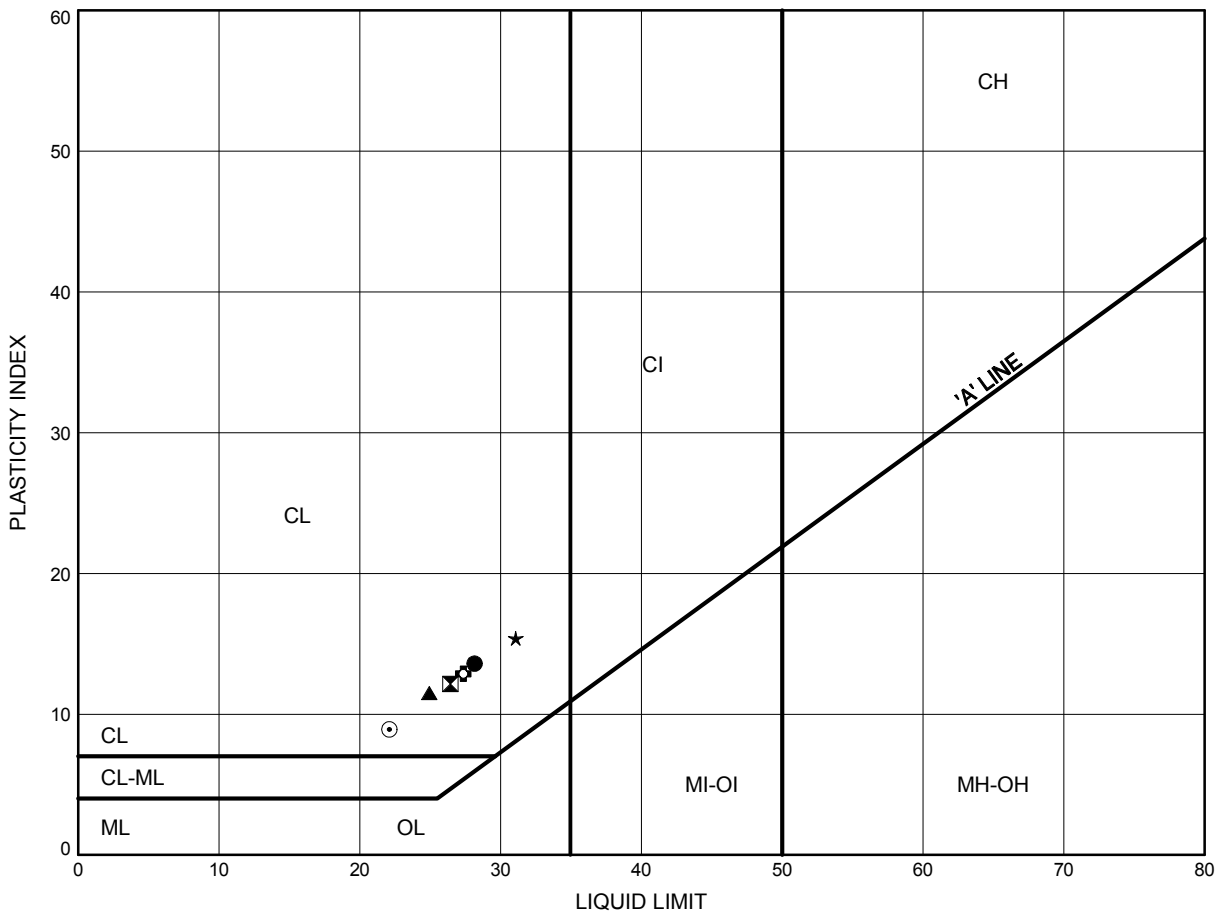
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Chkd. AG



VMP Interchange at Hwy 401  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B14

**LOW PLASTICITY SILTY CLAY TILL**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-01	10.97	271.05
⊠	13-01	15.54	266.48
▲	13-03	6.40	269.04
★	13-03	10.97	264.47
⊙	13-04	10.97	270.93
⊕	13-05	4.88	271.13

Date March 2014  
W.P. 3033-11-00

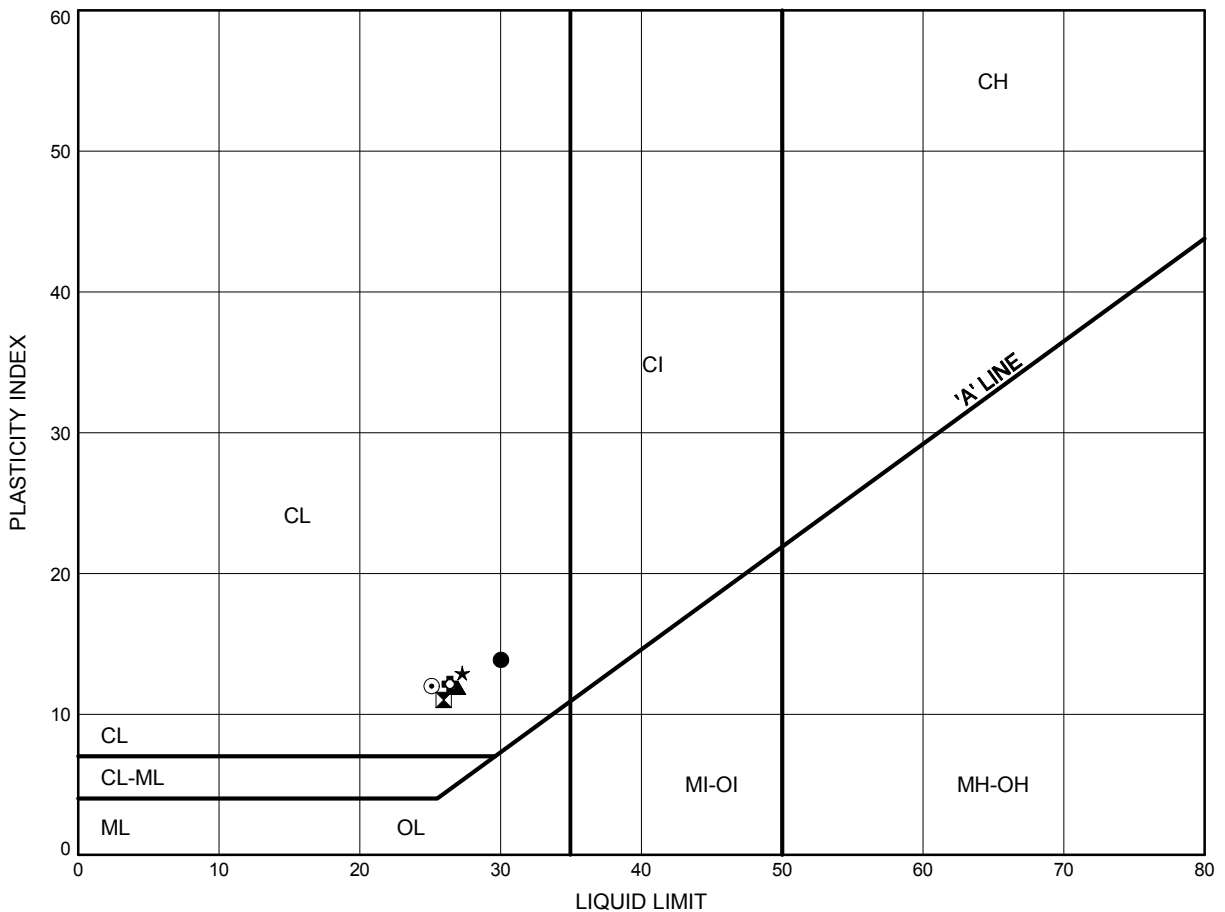


Prep'd KY  
Chkd. AG

VMP Interchange at Hwy 401  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B15

**LOW PLASTICITY SILTY CLAY TILL**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-05	10.97	265.03
⊠	13-06	1.83	273.38
▲	13-07	2.59	271.63
★	13-07	6.40	267.82
⊙	13-08	14.02	267.31
⊕	13-09	3.35	270.63

Date March 2014  
W.P. 3033-11-00

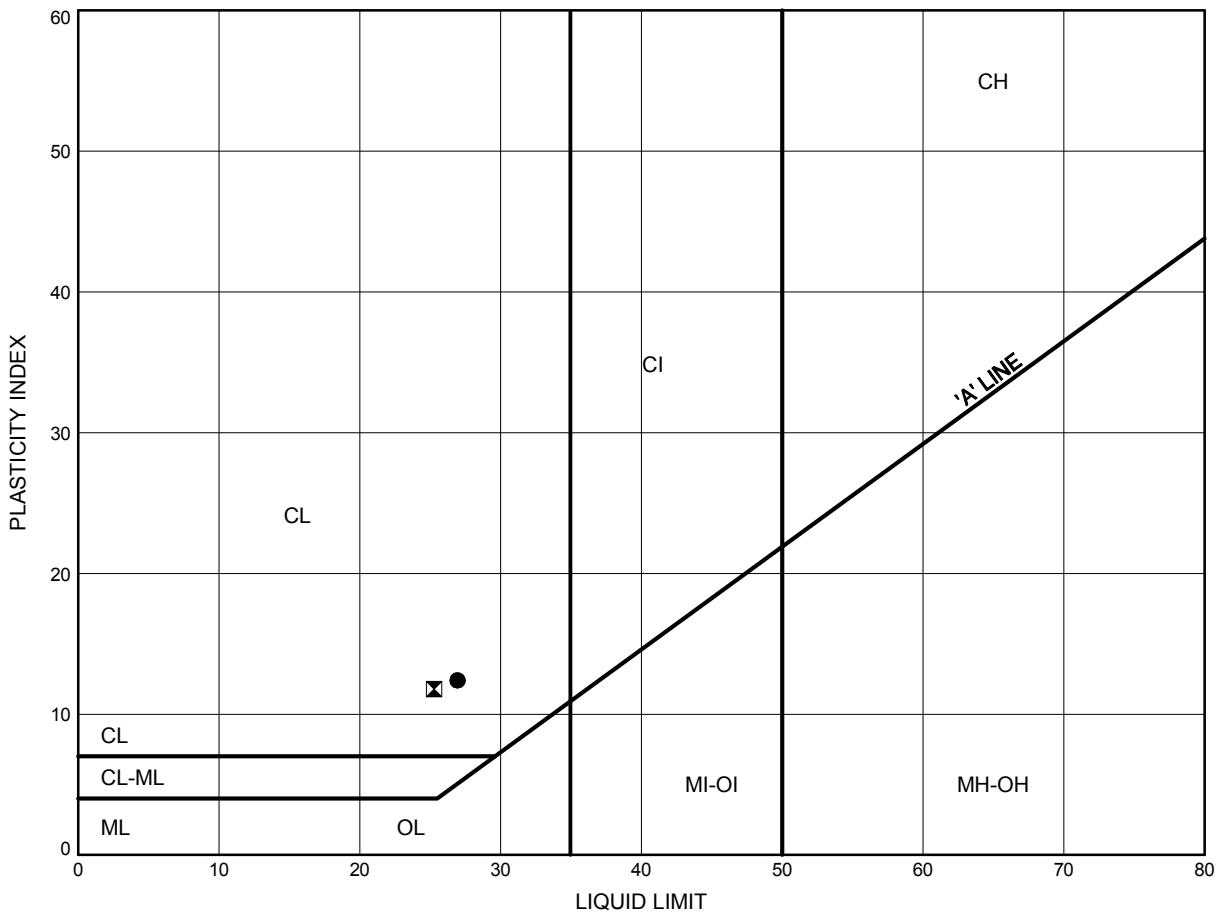


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Chkd. AG

VMP Interchange at Hwy 401  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B16

**LOW PLASTICITY SILTY CLAY TILL**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-11	3.35	270.47
⊠	13-11	7.92	265.90

Date March 2014  
W.P. 3033-11-00

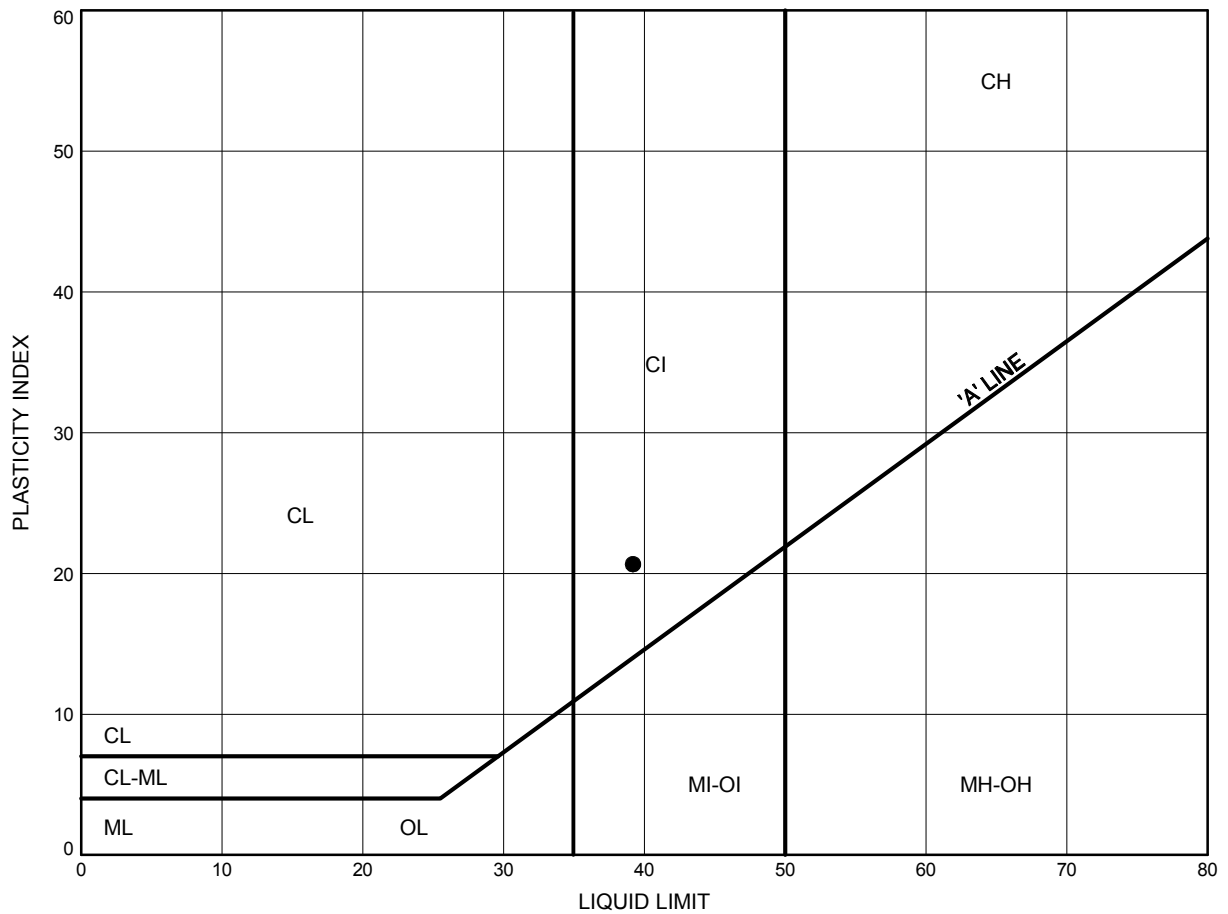


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Chkd. AG

VMP Interchange at Hwy 401  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B17

**INTERMEDIATE PLASTICITY SILTY CLAY TILL**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-09	12.50	261.49

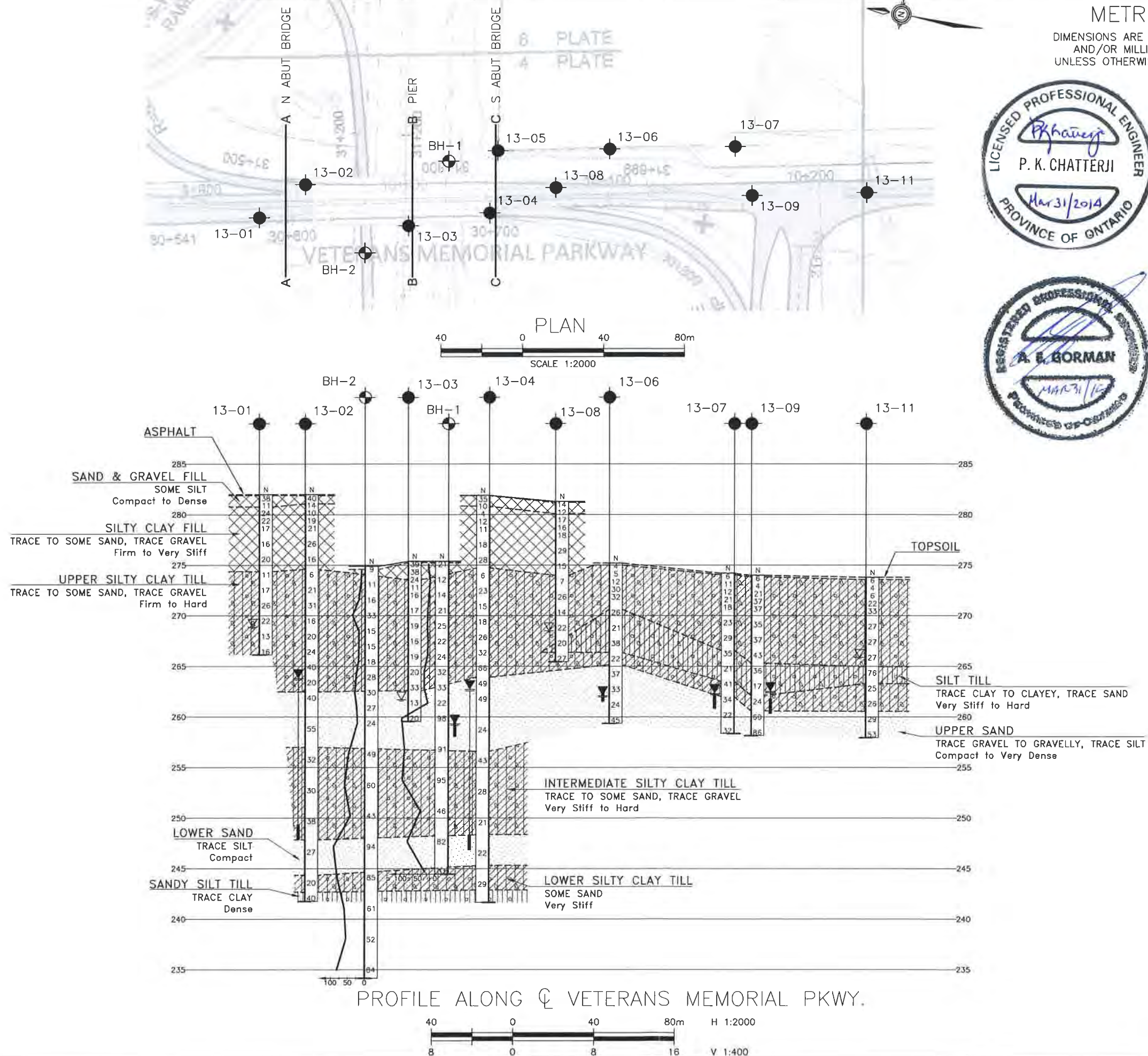
Date March 2014  
W.P. 3033-11-00



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Chkd. AG

## **Appendix C**

### **Drawing “Borehole Locations and Soil Strata”**

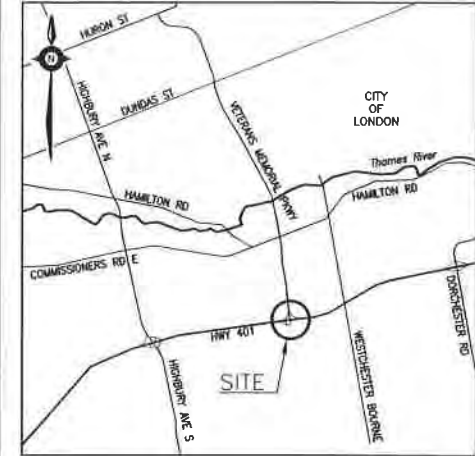


METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN



CONT No  
GWP No 3033-11-00

VETERANS MEMORIAL PARKWAY  
INTERCHANGE IMPROVEMENTS  
BOREHOLE LOCATIONS AND SOIL STRATA



KEYPLAN

LEGEND

- Borehole (Current Investigation)
- Borehole (Previous Investigation)
- 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
- PZ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
13-01	282.0	4 756 903.0	416 949.0
13-02	282.0	4 756 895.0	416 965.0
13-03	275.0	4 756 843.0	416 958.0
13-04	281.9	4 756 799.0	416 975.0
13-05	276.0	4 756 782.0	417 003.0
13-06	275.0	4 756 741.0	417 011.0
13-07	274.2	4 756 699.0	417 005.0
13-08	281.3	4 756 782.0	416 978.0
13-09	274.0	4 756 675.0	416 995.0
13-11	273.8	4 756 658.0	416 994.0
BH-1	275.4	4 756 823.0	416 987.0
BH-2	274.9	4 756 861.0	416 949.0

NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- BH-1 and BH-2 from Infrastructure Engineering Group shown for reference. Current sampling prevails for interpretation.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 40114-153

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	KMY	CHK KMY	CODE
DRAWN	AN	CHK AEG	SITE
			LOAD
			STRUCT
			DWG 1
			DATE MAR 2014



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

CONT No  
GWP No 3033-11-00

VETERANS MEMORIAL PARKWAY  
INTERCHANGE IMPROVEMENTS  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



THURBER ENGINEERING LTD.



# KEYPLAN

## LEGEND

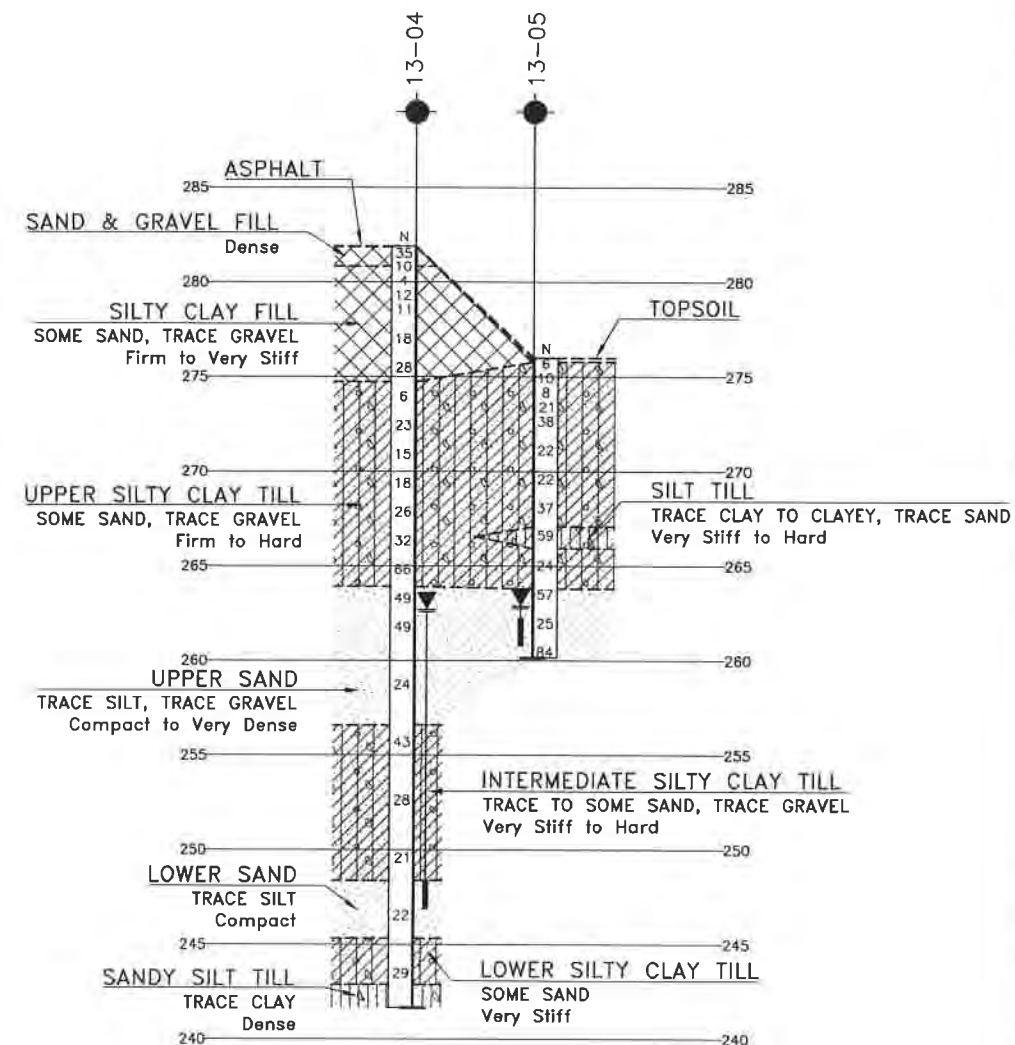
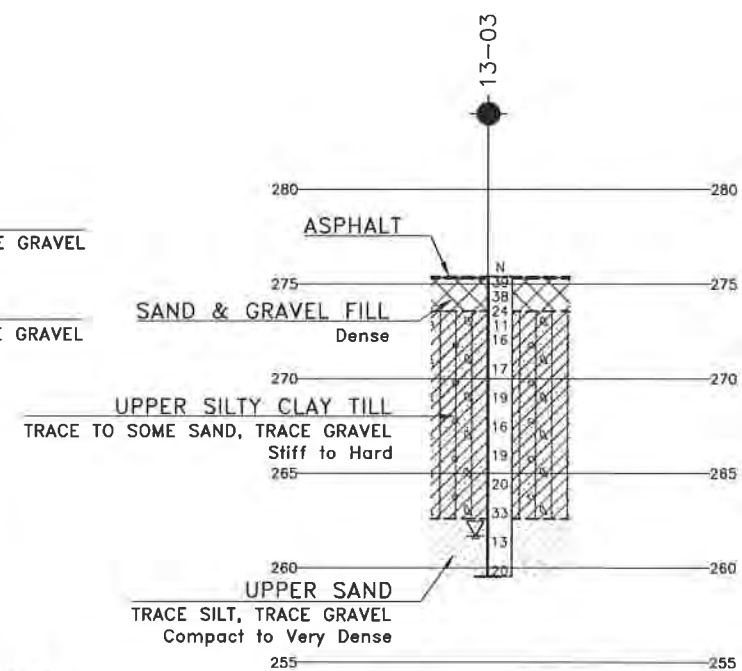
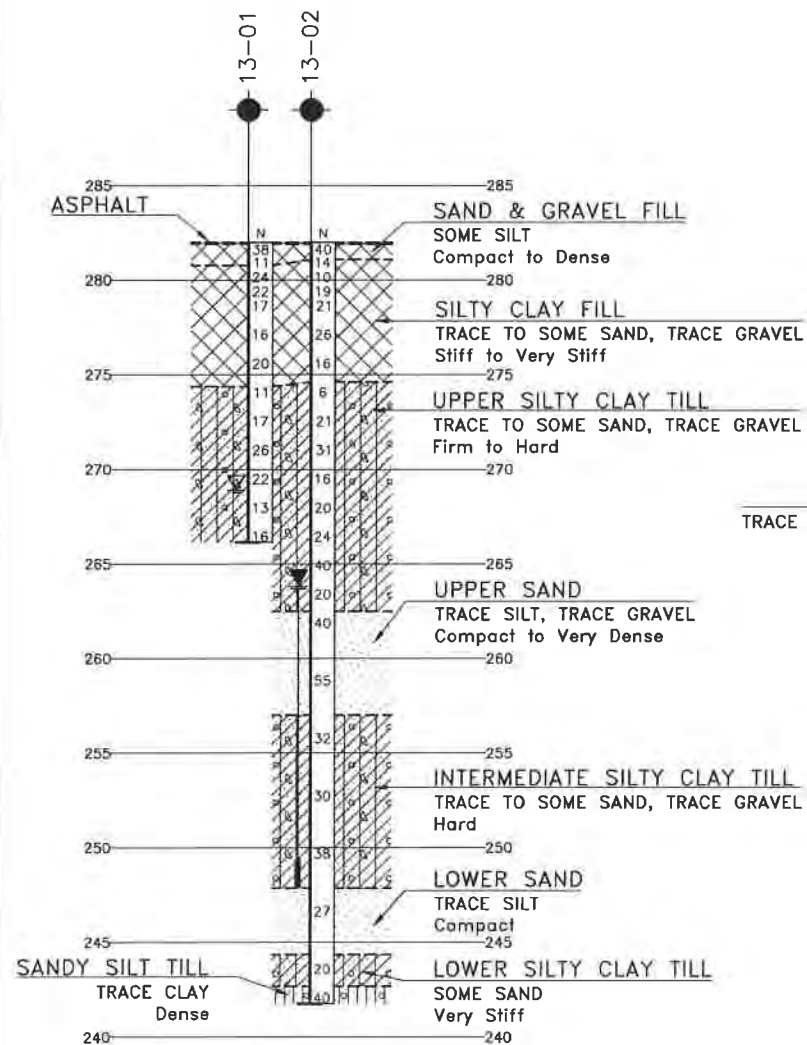
●	Borehole (Current Investigation)
○	Borehole (Previous Investigation)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60' Cone, 475J/blow)
PH	Pressure, Hydraulic
W	Water Level
HA	Head Artesian Water
P	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
13-01	282.0	4 756 903.0	416 949.0
13-02	282.0	4 756 895.0	416 965.0
13-03	275.0	4 756 843.0	416 958.0
13-04	281.9	4 756 799.0	416 975.0
13-05	276.0	4 756 782.0	417 003.0
13-06	275.0	4 756 741.0	417 011.0
13-07	274.2	4 756 699.0	417 005.0
13-08	281.3	4 756 782.0	416 978.0
13-09	274.0	4 756 675.0	416 995.0
13-11	273.8	4 756 658.0	416 994.0
BH-1	275.4	4 756 823.0	416 987.0
BH-2	274.9	4 756 861.0	416 949.0

## NOTES

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

GEOCREs No. 40114-153



H 1:2000

V 1:400



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	KMY	CHK KMY	CODE
DRAWN	AN	CHK AEG	SITE
			LOAD
			DATE
			STRUCT
			UWG 2

## **Appendix D**

### **Site Photographs**





**Photo 1. View looking North from VMP Overpass (Taken from NB shoulder/BH 13-02)**



**Photo 2. View looking South from VMP Overpass (towards BH 13-08).**