

**FOUNDATION INVESTIGATION REPORT  
SCHEEL DRIVE TWIN OVERPASS STRUCTURES  
HIGHWAY 17 – 417 FOUR LANING  
NEAR ARNPRIOR, ONTARIO  
G.W.P. 4067-03-00**

**GEOCRES Number: 31F-167**

**Report to**

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**PART 1: FACTUAL INFORMATION**

**1 INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted at the locations of the proposed Scheel Drive Twin Overpass structures. These structures will carry the proposed Highway 17/417 WBL and EBL (existing Highway 17) over the realigned Scheel Drive near the Town of Arnprior, Ontario. Foundation information obtained from previous investigations in the vicinity of these structures is included in References 1 and 2 noted below.

The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide borehole location plans and soil strata drawings, stratigraphic profiles and selected cross-sections, records of boreholes, laboratory test results and a generalized description of the subsurface conditions.

Thurber Engineering Ltd. (Thurber) carried out the investigation as a sub-consultant to McCormick Rankin Corporation (MRC), under the Ministry of Transportation Ontario (MTO) Agreement Number 4006-E-0003.

Reference is made to the following documents during the preparation of this report.

- Thurber Engineering Ltd. report titled "Foundation Investigation and Design Report, Scheel Drive Underpass, Highway 17 Twinning, Arnprior to Renfrew, Ontario", G.W.P. 647-92-00, Site No. 29-414, GEOCRES No.31F-126, File No.19-3745-0, August 27, 2004 (Reference 1).
- Thurber Engineering Ltd. report titled "Foundation Investigation and Design Report, High Embankments, Scheel Drive Underpass Approaches, WBL Mainline Section and Campbell Drive Interchange, Highway 17-417 Four Laning, Near Arnprior, Ontario", G.W.P. 4067-03-00, GEOCRES No. 31F-163, File No. 19-1351-125, February 19, 2008 (Reference 2).

**2 SITE DESCRIPTION**

The site is located in the vicinity of the existing intersection between Highway 17 and Scheel Drive in the Township of McNab, County of Renfrew, Ontario. The general site location is shown on the Borehole Locations and Soil Strata drawing in Appendix C.



The site is situated in an area of relatively flat terrain characterized by shallow bedrock underlying glacio-lacustrine clays and sandy silt to sand. All four quadrants of the intersection are moderately vegetated with trees and shrubs of various sizes. Local drainage in the area is likely governed by the nearby Dochart Creek, which flows in a southwest-northeast orientation and crosses under the existing Highway 17 at a location some 600 m west of the intersection.

In general, the project area is located within a physiographic region known as the Ottawa Valley Clay Plains. This area is located between the Laurentian upland to the north and west, and the Ottawa lowland to the south and east. Native soil deposits typically consist of glacio-lacustrine clayey silts to silty clays that were deposited when the Champlain Sea inundated the Ottawa – St. Lawrence lowland. In Renfrew County, there are prominent east-west trending scarps (fault zones), including a major depression geologically known as the “Ottawa-Bonnechere” graben. Bedrock in the site area consists of crystalline limestone of the Ordovician Period that had been subjected to faulting, weathering and erosion.

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

The site investigation and field testing program was carried out during the period of August 25 to 27, 2008, and consisted of advancing 24 boreholes (08-SCH-01 to 08-SCH-24) at the proposed twin structure locations. The depths of the boreholes ranged from approximately 0.4 m (bedrock just beneath ground surface) to 7.2 m depth below existing ground surface. All boreholes were advanced to refusal on probable bedrock or boulders, and selected boreholes were further advanced by coring into bedrock. The approximate locations of the boreholes are shown on the Borehole Locations and Soil Strata Drawing in Appendix F.

Prior to the start of drilling, the borehole locations were staked in the field and utility clearances were obtained by Thurber. Relocation of some boreholes from the proposed structure locations was necessary due to the presence of rock outcrop, ditches and sloping ground.

A track mounted drill rig was used to drill and sample all but Boreholes 08-SCH-05 and -10 where a shovel was used to manually excavate the shallow pits. The sampled boreholes were advanced by a combination of hollow stem augers through the soil and NQ size coring equipment into bedrock at selected locations. Soil samples were obtained at selected intervals using a 50 mm outside diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT).

Groundwater conditions were observed and noted throughout the drilling operations and upon completion of the boreholes. Standpipe piezometers consisting of 19 mm diameter Schedule 40 PVC pipe with a slotted screen were installed in selected boreholes to allow longer term monitoring of the groundwater level. The completion details of all boreholes, including the piezometer installations, are presented in Table 3.1 below.



**Table 3.1 – Borehole Completion Details**

<b>Borehole Location</b>	<b>Borehole Depth</b>	<b>Piezometer Tip Depth / Elevation (m)</b>	<b>Completion Details</b>
08-SCH-01	5.9	None Installed	Sealed with bentonite and gravel to surface
08-SCH-02	2.1	2.1 / 121.3	Sand from 2.1 to 1.2 m, bentonite to surface
08-SCH-03	1.0	None Installed	Drill cuttings for full depth
08-SCH-04	4.7	None Installed	Sealed with bentonite and gravel to surface
08-SCH-05	0.5	None Installed	Drill cuttings for full depth
08-SCH-06	0.5	None Installed	Drill cuttings for full depth
08-SCH-07	5.7	None Installed	Sealed with bentonite and gravel to surface
08-SCH-08	0.4	None Installed	Drill cuttings for full depth
08-SCH-09	4.3	4.3 / 120.2	Sand from 4.3 to 2.4 m, bentonite to surface
08-SCH-10	0.4	None Installed	Drill cuttings for full depth
08-SCH-11	0.7	None Installed	Drill cuttings for full depth
08-SCH-12	0.6	None Installed	Drill cuttings for full depth
08-SCH-13	5.1	5.1 / 120.1	Sand from 5.1 to 1.5 m, bentonite to surface
08-SCH-14	1.5	None Installed	Gravel to surface
08-SCH-15	2.8	None Installed	Gravel to surface
08-SCH-16	7.2	None Installed	Sealed with bentonite and gravel to surface
08-SCH-17	0.9	None Installed	Gravel to surface
08-SCH-18	1.8	None Installed	Gravel to surface
08-SCH-19	7.1	None Installed	Sealed with bentonite and gravel to surface
08-SCH-20	1.9	None Installed	Gravel to surface
08-SCH-21	2.8	2.8 / 123.6	Sand from 2.8 to 1.0 m, bentonite to surface
08-SCH-22	7.0	None Installed	Sealed with bentonite and gravel to surface
08-SCH-23	0.6	None Installed	Drill cuttings for full depth
08-SCH-24	2.8	None Installed	Sealed with bentonite and gravel to surface

A member of Thurber's technical staff supervised the drilling and sampling operations on a full time basis. The supervisor logged the boreholes, secured the soil samples in labelled and sealed containers, placed the rock cores in wooden core boxes which were then transported to Thurber's laboratory for further examination and testing. All rock cores were logged, the Total Core Recovery (TCR), the Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

#### **4 LABORATORY TESTING**

The recovered soil samples were subjected to visual identification and to natural moisture content determination. At least 25% of soil samples were subjected to grain size distribution analysis and Atterberg limits tests where appropriate. The results of this testing are shown on the Record of Borehole sheets and the figures in Appendix B. Point load testing was carried out on selected rock cores. The results of this testing program are reported in Table 1 immediately following the text and on the Records of Boreholes in Appendix A.



## 5 DESCRIPTION OF SUBSURFACE CONDITIONS

### 5.1 General

Details of the encountered stratigraphy are presented on the Records of Boreholes in Appendix A and on the "Borehole Locations and Soil Strata" drawing in Appendix C. A summary description of the stratigraphy is given in the following paragraphs. The factual information at the borehole locations governs any interpretation of site conditions.

In general, the subsurface conditions encountered in the borehole locations consist of asphalt, topsoil or fill overlying silty clay and/or silty sand to sand. The relatively thin overburden soils is underlain by crystalline limestone bedrock.

### 5.2 Asphalt, Topsoil and Fill

Asphalt of about 50 to 150 mm in thickness was encountered on the existing highway shoulder in Boreholes 08-SCH-21 and 08-SCH-22.

Topsoil of about 100 mm in thickness was encountered in Boreholes 08-SCH-01 and SCH-08-02, and about 500 mm in Borehole 08-SCH-06. Topsoil thickness may vary between and beyond borehole locations, and this limited data should not be used for topsoil quantity estimates.

Silty sand, gravelly sand to sand and gravel fill containing cobbles, rock pieces/slabs was encountered at ground surface or beneath the asphalt in 14 boreholes located adjacent to the roadway. The approximate depths and underside elevations of fill are as shown in the following Table 5.1.

Table 5.1 Fill Thickness and Underside Elevations

Borehole	Fill Thickness (m)	Fill Underside Elevation (m)
08-SCH-11	0.7	122.6
08-SCH-12	0.6	123.0
08-SCH-13	0.9	124.3
08-SCH-14	0.9	124.3
08-SCH-15	0.8	125.4
08-SCH-16	0.9	125.3
08-SCH-17	0.9	124.7
08-SCH-18	0.7	125.4
08-SCH-19	1.4	123.8
08-SCH-20	0.5	124.7
08-SCH-21	0.6	125.8
08-SCH-22	0.9	125.6
08-SCH-23	0.6	125.0
08-SCH-24	0.7	125.0



Measured SPT 'N' values ranged from 3 blows to 51 blows per 0.3 m penetration indicating loose to very dense conditions. The measured moisture contents of samples of the fill were typically in the order of 2 to 8%, although a value up to 20% was recorded.

Figures B1 and B2 in Appendix B present grain size distribution curves for samples of the gravelly sand to sand and gravel fill. Results of these tests are presented on the Record of Borehole sheets in Appendix A and as follows:

Soil Particles	%
Gravel	21 to 37
Sand	52 to 63
Silt and Clay	10 to 24

### 5.3 Silty Sand and Sand

Layers of brown native silty sand to sand containing pieces or slabs of rock were encountered at ground surface or immediately below the existing fill in Boreholes 08-SCH-03, -04, -05, -07, -08, -16, -18, -21, -22 and -24. The thickness of these brown deposits ranged between 0.4 and 2.0 m and the underside of these soils varied from Elevation 121.0 to 126.2 m.

Measured SPT 'N' values typically ranged from 6 to 28 blows per 0.3 m penetration indicating loose to compact conditions, except in Boreholes 08-SCH-03, -15, -16, -21 and -22 where very dense conditions represented by 'N' values of 86 blows per 0.3 m penetration and >50 blows for less than 0.3 m penetration were recorded, respectively, likely due to the presence of rock pieces, rock slabs, cobbles, boulders and particularly above the bedrock contact. The measured moisture contents of samples of these cohesionless soils were in the order of 2 to 20%.

Figure B3 in Appendix B shows the grain size distribution curves for two samples of the silty sand. These test results are summarized as follows:

Soil Particles	%
Gravel	1 to 4
Sand	59 to 61
Silt	28 to 32
Clay	6 to 9

### 5.4 Silty Clay and Clay

Deposits of brown to grey brown silty clay and clay containing trace gravel and pieces of rock were encountered at ground surface or underlying the topsoil, fill and silty sand in Boreholes 08-SCH-01, -02, -09, -10, -13, -14, -19, -20, -21 and -24. The silty clay typically



contains varying proportion of sand. These deposits ranged from 0.4 to 2.8 m in thicknesses with the underside level lying between Elevations 119.5 and 124.3.

Measured SPT 'N' values generally ranged from 3 to 8 blows for 0.3 m penetration indicating a soft to stiff consistency, except just above the bedrock contact where occasional very high 'N' values were noted that were likely due to the presence of rock pieces or slabs. The measured moisture contents of samples of the silty clay typically ranged between 12% and 42%, except in Borehole 08-SCH-01 where a value of 72% was recorded.

Figures B4 to B7 in Appendix B present the laboratory testing results of samples of the clay and silty clay. These test results are summarized as follows:

#### Clay

Soil Particles	%
Gravel	0 to 2
Sand	6
Silt	57 to 67
Clay	25 to 37
Index Property	%
Liquid Limit	55 to 56
Plastic Limit	23 to 26
Plasticity Index	30 to 32

The above results show that the clay is of high plasticity with a group symbol of CH.

#### Silty Clay

Soil Particles	%
Gravel	3
Sand	49 to 57
Silt	30 to 32
Clay	8 to 18
Index Property	%
Liquid Limit	36 to 37
Plastic Limit	18 to 19
Plasticity Index	17 to 19

The above results show that the silty clay is of medium plasticity with a group symbol CI.

### 5.5 Bedrock

The soils described above are underlain by bedrock or boulders that was inferred from refusal to auger penetration or shallow bedrock under a thin veneer of soil in all of the boreholes advanced during this investigation. Bedrock was proven by coring in selected boreholes.





Inferred or proven bedrock surface depths and elevations at the borehole locations are summarized in the following table.

**Table 5.2 – Depth and Elevation of Inferred Bedrock Surface  
Scheel Drive Twin Structures**

<b>Borehole Number</b>	<b>Ground Surface Elevation (m)</b>	<b>Inferred Depth to Bedrock (m)</b>	<b>Inferred Top of Bedrock Elevation (m)</b>
<b>WBL Structure West Abutment</b>			
08-SCH-01	122.4	2.9*	119.5*
08-SCH-02	123.4	2.1	121.3
08-SCH-03	126.4	1.0	125.4
08-SCH-04	127.3	1.1*	126.2*
08-SCH-05	121.5	0.5	121.0
08-SCH-06	124.3	0.5	123.8
SCH-6	121.5	2.6**	118.9**
<b>WBL Structure East Abutment</b>			
08-SCH-07	122.9	1.5*	121.4*
08-SCH-08	122.8	0.4	122.4
08-SCH-09	124.5	0.8*	123.7*
08-SCH-10	124.7	0.4	124.3
08-SCH-11	123.3	0.7	122.6
08-SCH-12	123.6	0.6	123.0
<b>EBL Structure West Abutment</b>			
08-SCH-13	125.2	1.4*	123.8*
08-SCH-14	125.2	1.5	123.7
08-SCH-15	126.2	2.8	123.4
08-SCH-16	126.2	2.6*	123.6*
08-SCH-17	125.6	0.9	124.7
08-SCH-18	126.1	1.8	124.3
<b>EBL Structure East Abutment</b>			
08-SCH-19	125.2	2.5*	122.7*
08-SCH-20	125.2	1.9	123.3
08-SCH-21	126.4	2.8	123.6
08-SCH-22	126.4	2.1*	124.3*
08-SCH-23	125.6	0.6	125.0
08-SCH-24	125.7	2.8	122.9

Notes :           Rock surface inferred by auger refusal except otherwise noted.  
           \*           Rock proven by coring during current investigation.  
           \*\*          Rock proven by coring during previous investigation (Reference 2).

The bedrock surface varies across the site with depths below existing ground surface varying from 0.4 m to 2.9 m, or between approximate Elevations 119.5 m and 126.2 m. Based on the rock cores, the bedrock at this site is a grey crystalline limestone of the Ordovician Period.



The bedrock is typically in a moderately to slightly weathered state, thinly bedded with sub-vertical joints.

The measured Total Core Recovery (TCR) values for the core runs vary between 50% and 100%. The measured Rock Quality Designation (RQD) values range between 0% and 100% indicating very poor to excellent rock quality.

The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, generally range between 0 and 4, except for zones near the rock surface and in Boreholes 08-SCH-11 where higher values of up to 6 were measured. Calcite infilling is frequently present within the joints.

Point load tests were carried out on the intact rock cores at selected intervals. Results of these tests are presented in Table 1 following the text. The inferred Unconfined Compressive Strengths (UCS) of the rock cores (expressed as an average per run) range between 50 and 250 MPa, indicating that the intact limestone is strong to very strong.

## 5.6 Groundwater

Free water was not observed in the boreholes upon completion of drilling. Standpipe piezometers were installed in selected boreholes for longer term monitoring. Measured water levels are presented in the table below.

**Table 5.3 – Depth and Elevation of Water Levels  
Scheel Drive Twin Structures**

Borehole (screen location)	Date of Reading	Water Level Depth (m)	Water Level Elevation (m)
08-SCH-02 (silty clay)	September 12, 2008	1.7	121.7
08-SCH-09 (bedrock)	September 12, 2008	dry	-
08-SCH-13 (bedrock)	September 12, 2008	dry	-
08-SCH-21 (silty sand/clayey silt)	September 12, 2008	dry	-

The piezometer reading measured in Borehole 08-SCH-02 likely reflects the presence of perched water above the bedrock. The remaining three piezometers were dry possibly indicating that there is downward drainage into the bedrock. This observation is consistent with the conditions reported in Reference 2.

It should be noted that the above groundwater conditions are short term observations and the water levels are subject to seasonal fluctuations and severe climatic events. It is also



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anticipated that the local groundwater conditions at this site is influenced by the nearby Dochart Creek.

## **6 MISCELLANEOUS**

The borehole locations were initially staked/marked by Thurber who subsequently surveyed the as-drilled locations to establish the coordinates and geodetic elevations using the in-house GPS system. Thurber obtained utility clearances prior to drilling at all borehole locations.

Eastern Ontario Diamond Drilling Ltd. of Hawkesbury, Ontario supplied the track mounted drill rig and conducted the drilling, sampling and in-situ testing operations.

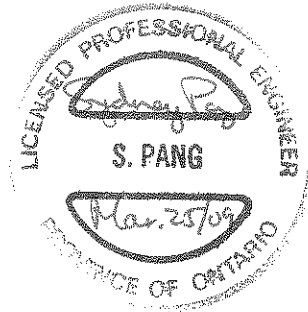
The drilling and sampling operations in the field were supervised on a full time basis by Mr. Luke Gilarski of Thurber.

Laboratory testing was carried out by Thurber in its MTO-approved laboratory.

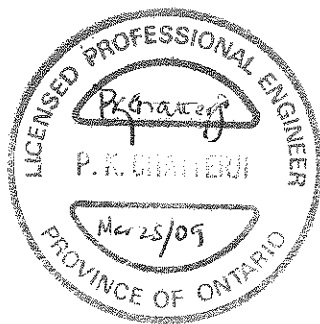
Dr. Sydney Pang, P.Eng. directed the field operations and prepared the report.

Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations projects, reviewed the report.





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**TABLE 1 -Point Load Test Results and Unconfined Compression Strength Correlations  
Highway 17/417 Widening – Scheel Twin Overpass Structures**

SCH08-01	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	Is (MPa)	Is50 (MPa)	BREAK	UCS (Mpa)	Rock Type
	FT.	IN.	(m)								
RUN #1											
	10	6	3.20	12.1	D	47.00	5.478	5.311	OK	127.46	limestone
	10	11	3.33	16.8	D	47.00	7.605	7.374	OK	176.97	limestone
	11	5	3.48	10.3	D	47.00	4.663	4.521	OK	108.50	limestone
	12	4	3.76	20.7	D	47.00	9.371	9.085	OK	218.05	limestone
	12	8	3.86	15.2	D	47.00	6.881	6.671	OK	160.11	limestone
RUN #2	13	4	4.06	15.5	D	47.00	7.017	6.803	OK	163.27	limestone
	13	6	4.11	15.8	D	47.00	7.153	6.935	OK	166.43	limestone
	14	3	4.34	9.9	D	47.00	4.482	4.345	OK	104.28	limestone
	14	10	4.52	17.4	D	47.00	7.877	7.637	OK	183.29	limestone
	15	7	4.75	14.0	D	47.00	6.338	6.145	OK	147.47	limestone
RUN #3	16	5	5.00	15.3	D	47.00	6.926	6.715	OK	161.17	limestone
	18	8	5.69	5.0	D	47.00	2.263	2.195	OK	52.67	limestone

SCH08-04	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	Is (MPa)	Is50 (MPa)	BREAK	UCS (Mpa)	Rock Type
	FT.	IN.	(m)								
RUN #1											
	3	11	1.19	12.9	D	47.00	5.840	5.662	OK	135.88	limestone
	4	11	1.50	15.6	D	47.00	7.062	6.847	OK	164.33	limestone
	7	0	2.13	15.5	D	47.00	7.017	6.803	OK	163.27	limestone
	8	1	2.46	20.0	D	47.00	9.054	8.778	OK	210.67	limestone
RUN #2											
	8	10	2.69	11.2	D	47.00	5.070	4.916	OK	117.98	limestone
	9	10	3.00	5.5	D	47.00	2.490	2.414	OK	57.94	limestone
	11	4	3.45	15.1	D	47.00	6.836	6.627	OK	159.06	limestone
	11	11	3.63	14.8	D	47.00	6.700	6.496	OK	155.90	limestone
RUN #3	12	10	3.91	20.6	D	47.00	9.325	9.041	OK	216.99	limestone
	14	1	4.29	12.0	D	47.00	5.432	5.267	OK	126.40	limestone
	14	8	4.47	15.0	D	47.00	6.790	6.584	OK	158.00	limestone
	15	2	4.62	11.0	D	47.00	4.980	4.828	OK	115.87	limestone

**TABLE 1 -Point Load Test Results and Unconfined Compression Strength Correlations  
Highway 17/417 Widening – Scheel Twin Overpass Structures**

SCH08-07	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	Is (MPa)	Is50 (MPa)	BREAK	UCS (Mpa)	Rock Type
	FT.	IN.	(m)								
RUN #1											
	5	6	1.68	9.2	D	47.00	4.165	4.038	OK	96.91	limestone
	6	11	2.11	11.5	D	47.00	5.206	5.047	OK	121.14	limestone
	7	7	2.31	14.3	D	47.00	6.474	6.276	OK	150.63	limestone
RUN #2	9	8	2.95	17.4	D	47.00	7.877	7.637	OK	183.29	limestone
	10	5	3.18	7.8	D	47.00	3.531	3.423	OK	82.16	limestone
	11	4	3.45	14.6	D	47.00	6.609	6.408	OK	153.79	limestone
	12	0	3.66	16.7	D	47.00	7.560	7.330	OK	175.91	limestone
	12	7	3.84	5.0	D	47.00	2.263	2.195	OK	52.67	limestone
	13	5	4.09	9.4	D	47.00	4.255	4.126	OK	99.02	limestone
RUN #3	14	1	4.29	11.8	D	47.00	5.342	5.179	OK	124.30	limestone
	15	0	4.57	21.8	D	47.00	9.869	9.568	OK	229.63	limestone
	16	1	4.90	12.3	D	47.00	5.568	5.399	OK	129.56	limestone
	17	6	5.33	12.7	D	47.00	5.749	5.574	OK	133.78	limestone

SCH08-09	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	Is (MPa)	Is50 (MPa)	BREAK	UCS (Mpa)	Rock Type
	FT.	IN.	(m)								
RUN #1											
	3	0	0.91	12.9	D	47.00	5.840	5.662	OK	135.88	limestone
RUN #2	4	4	1.32	10.6	D	47.00	4.799	4.652	OK	111.66	limestone
	7	1	2.16	9.9	D	47.00	4.482	4.345	OK	104.28	limestone
	7	5	2.26	14.6	D	47.00	6.609	6.408	OK	153.79	limestone
	8	0	2.44	1.6	D	47.00	0.724	0.702	OK	16.85	limestone/jointed
	8	6	2.59	1.5	D	47.00	0.679	0.658	OK	15.80	limestone/jointed
RUN #3	9	8	2.95	16.1	D	47.00	7.288	7.066	OK	169.59	limestone
	10	4	3.15	0.6	D	47.00	0.272	0.263	OK	6.32	limestone/jointed
	10	11	3.33	0.8	D	47.00	0.362	0.351	OK	8.43	limestone/jointed
	12	6	3.81	0.8	D	47.00	0.362	0.351	OK	8.43	limestone/jointed
	12	8	3.86	20.1	D	47.00	9.099	8.822	OK	211.73	limestone
	13	1	3.99	14.8	D	47.00	6.700	6.496	OK	155.90	limestone
	13	9	4.19	17.5	D	47.00	7.922	7.681	OK	184.34	limestone

**TABLE 1 -Point Load Test Results and Unconfined Compression Strength Correlations  
Highway 17/417 Widening – Scheel Twin Overpass Structures**

[illegible]

SCH08-16	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	Is (MPa)	Is50 (MPa)	BREAK	UCS (Mpa)	Rock Type
	FT.	IN.	(m)								
RUN #1											limestone limestone limestone
	9	6	2.90	5.2	D	47.00	2.354	2.282	OK	54.78	
	10	0	3.05	8.9	D	47.00	4.029	3.906	OK	93.75	
	10	11	3.33	13.8	D	47.00	6.247	6.057	OK	145.36	
RUN #2	14	4	4.37	14.0	D	47.00	6.338	6.145	OK	147.47	limestone limestone limestone limestone limestone
	15	2	4.62	15.5	D	47.00	7.017	6.803	OK	163.27	
	15	7	4.75	11.2	D	47.00	5.070	4.916	OK	117.98	
	16	7	5.05	16.9	D	47.00	7.651	7.417	OK	178.02	
	17	6	5.33	13.3	D	47.00	6.021	5.837	OK	140.10	
RUN #3	18	11	5.77	10.3	D	47.00	4.663	4.521	OK	108.50	limestone limestone limestone limestone limestone limestone limestone
	19	4	5.89	13.3	D	47.00	6.021	5.837	OK	140.10	
	19	10	6.05	8.2	D	47.00	3.712	3.599	OK	86.38	
	20	4	6.20	18.5	D	47.00	8.375	8.120	OK	194.87	
	21	3	6.48	9.1	D	47.00	4.120	3.994	OK	95.86	
	22	5	6.83	16.6	D	47.00	7.515	7.286	OK	174.86	
	23	4	7.11	9.8	D	47.00	4.436	4.301	OK	103.23	

**TABLE 1 -Point Load Test Results and Unconfined Compression Strength Correlations  
Highway 17/417 Widening – Scheel Twin Overpass Structures**

SCH08-19	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	Is (MPa)	Is50 (MPa)	BREAK	UCS (Mpa)	Rock Type
	FT.	IN.	(m)								
RUN #1											limestone limestone
	10	4	3.15	14.3	D	47.00	6.474	6.276	OK	150.63	
	11	9	3.58	17.3	D	47.00	7.832	7.593	OK	182.23	
RUN #2	14	6	4.42	12.6	D	47.00	5.704	5.530	OK	132.72	limestone limestone
	14	9	4.50	16.5	D	47.00	7.469	7.242	OK	173.81	
RUN #3	19	0	5.79	14.4	D	47.00	6.519	6.320	OK	151.68	limestone limestone limestone limestone limestone limestone limestone limestone limestone limestone
	19	7	5.97	12.0	D	47.00	5.432	5.267	OK	126.40	
	19	11	6.07	17.5	D	47.00	7.922	7.681	OK	184.34	
	20	4	6.20	12.1	D	47.00	5.478	5.311	OK	127.46	
	20	10	6.35	18.5	D	47.00	8.375	8.120	OK	194.87	
	21	4	6.50	14.3	D	47.00	6.474	6.276	OK	150.63	
	21	10	6.65	14.8	D	47.00	6.700	6.496	OK	155.90	
	22	3	6.78	14.3	D	47.00	6.474	6.276	OK	150.63	
	22	8	6.91	12.5	D	47.00	5.659	5.486	OK	131.67	
	22	11	6.99	18.7	D	47.00	8.465	8.207	OK	196.98	

SCH08-22	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	Is (MPa)	Is50 (MPa)	BREAK	UCS (Mpa)	Rock Type
	FT.	IN.	(m)								
RUN #1											limestone
	7	9	2.36	11.2	D	47.00	5.070	4.916	OK	117.98	
RUN #2	10	2	3.10	13.1	D	47.00	5.930	5.750	OK	137.99	limestone limestone limestone
	10	8	3.25	9.1	D	47.00	4.120	3.994	OK	95.86	
	11	2	3.40	10.0	D	47.00	4.527	4.389	OK	105.34	
RUN #3	13	6	4.11	4.0	D	47.00	1.811	1.756	OK	42.13	limestone limestone
	16	10	5.13	10.6	D	47.00	4.799	4.652	OK	111.66	
RUN #4	18	10	5.74	10.2	D	47.00	4.617	4.477	OK	107.44	limestone limestone limestone limestone
	19	2	5.84	11.6	D	47.00	5.251	5.091	OK	122.19	
	20	8	6.30	17.2	D	47.00	7.786	7.549	OK	181.18	
	21	4	6.50	16.3	D	48.00	7.075	6.932	OK	166.36	



## **Appendix A**

### **Records of Boreholes**



## 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


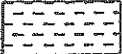



$C_{pen}$  Shear Strength Determination by Pocket Penetrometer

- (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

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>	
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)

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
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

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





# RECORD OF BOREHOLE No 08-SCH-01

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 196.3 E 308 126.4 ORIGINATED BY LG  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Augers / NQ Coring COMPILED BY FK  
 DATUM Geodetic DATE 2008.08.25 - 2008.08.25 CHECKED BY SKP

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 ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
122.4 0.0 0.1	TOPSOIL, roots  CLAY, some silt, trace sand Firm Brown to Grey Brown Moist      Moist to Wet  AUGER REFUSAL AT 2.9m.		1	SS	4										
			2	SS	8										
			3	SS											
			4	SS	7										
119.5 2.9	CRYSTALLINE LIMESTONE (BEDROCK), moderately to slightly weathered, grey, thinly bedded, calcite infilling throughout, very strong Sub-vertical joints at 3.00m, 3.09m, 3.14m, 3.27m, 3.38m, 3.55m, 3.58m, 3.63m, 3.71m, 3.76m, 3.86m  Sub-vertical joints at 4.14m, 4.39m, 4.55m, 4.77m, 5.00m  Highly weathered, iron staining, calcite infilling		1	RUN											
			2	RUN											
			3	RUN											
116.5 5.9	END OF BOREHOLE AT 5.9m. BOREHOLE SEALED WITH BENTONITE AND GRAVEL.														

# RECORD OF BOREHOLE No 08-SCH-02

1 OF 1

METRIC

G.W.P. 4067-03-00

LOCATION Scheel Drive N 5 033 194.4 E 308 128.5

ORIGINATED BY LG

HWY 17/417

BOREHOLE TYPE Hollow Stern Auger

COMPILED BY FK

DATUM Geodetic

DATE 2008.08.25 - 2008.08.25

CHECKED BY SKP

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	40 80 120 160 200					
123.4	TOPSOIL		1	SS	3									0 6 57 37
0.0 0.1	CLAY, some silt, trace sand, trace rootlets Soft to Firm Brown to Light Brown Moist		2	SS	4									
121.3	END OF BOREHOLE AT 2.1m. AUGER REFUSAL AT 2.1m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 0.9m slotted screen. BOREHOLE BACKFILLED WITH CUTTINGS. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.09.12 1.7 121.7													

+ 3 . X 3 : Numbers refer to  
Sensitivity


20  
15 5  
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-SCH-03

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 157.7 E 308 148.7 ORIGINATED BY LG  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY FK  
 DATUM Geodetic DATE 2008.08.26 - 2008.08.26 CHECKED BY SKP

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			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    x LAB VANE										W <sub>P</sub>	W	W <sub>L</sub>
126.4							20	40	60	80	100									
0.0	Silty SAND, trace gravel, trace clay Loose Brown Moist		1	SS	7												1 61 32 6			
125.4			2	SS	50/															
1.0	END OF BOREHOLE AT 1.0m. AUGER REFUSAL AT 1.0m. BOREHOLE BACKFILLED WITH CUTTINGS.				.75															

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

20  
15  
10  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-SCH-04

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 159.0 E 308 151.4 ORIGINATED BY LG  
HWY 17/417 BOREHOLE TYPE Hollow Stem Augers / NQ Coring COMPILED BY FK  
DATUM Geodetic DATE 2008.08.25 - 2008.08.25 CHECKED BY SKP

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						
								20 40 60 80 100						
127.3														
0.0	Silty SAND, trace gravel, rootlets		1	SS	6		127							
126.2	AUGER REFUSAL AT 1.1m.													
1.1	CRYSTALLINE LIMESTONE (BEDROCK) moderately to slightly weathered, grey, thinly bedded, calcium infilling, strong to very strong Sub-vertical joints at 25 to 50mm intervals		1	RUN			126							
	Sub-vertical joints at 50 to 75mm intervals, calcite infilling at 3.3m and 4.1m.		2	RUN			125							
	Sub-vertical joints at 100mm intervals		3	RUN			124							
122.6	END OF BOREHOLE AT 4.8m. BOREHOLE SEALED WITH BENTONITE AND GRAVEL						123							
4.7														



# RECORD OF BOREHOLE No 08-SCH-05

1 OF 1

METRIC

G.W.P. 4067-03-00

LOCATION Scheel Drive N 5 033 177.1 E 308 141.3

ORIGINATED BY LG

HWY 17/417


BOREHOLE TYPE Shovel

COMPILED BY FK

DATUM Geodetic

DATE 2008.08.25 - 2008.08.25

CHECKED BY SKP

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			SHEAR STRENGTH kPa									
121.5								20	40	60	80	100					
0.0	Silty SAND, rootlets		1	AS													
121.0	Brown Moist																
0.5	END OF BOREHOLE AT 0.5m. EXPOSED BOULDER OR BEDROCK. BOREHOLE BACKFILLED WITH CUTTINGS.																

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




20  
15  
10  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-SCH-06

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 177.7 E 308 127.7 ORIGINATED BY LG  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY FK  
 DATUM Geodetic DATE 2008 08 25 - 2008 08 25 CHECKED BY SKP

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									
124.3								20	40	60	80	100					
0.0	TOPSOIL, organics, clayey silt Firm		1	SS	5		124										
123.8	Black to Brown																
0.5	Moist																
	END OF BOREHOLE AT 0.5m. AUGER REFUSAL AT 0.5m. BOREHOLE BACKFILLED WITH CUTTINGS.																

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





20  
15  
10  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-SCH-07

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 182.2 E 308 159.6 ORIGINATED BY LG  
HWY 17/417 BOREHOLE TYPE Hollow Stem Augers / NQ Coring COMPILED BY FK  
DATUM Geodetic DATE 2008.08.27 - 2008.08.27 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100					
								20 40 60 80 100					
122.9													
0.0	Silty SAND, trace clay, trace gravel Loose Brown Moist		1	SS	7								4 58 28 9
121.4							122						
1.5	AUGER REFUSAL AT 1.5m.												
	CRYSTALLINE LIMESTONE (BEDROCK), moderately to slightly weathered, grey, thinly bedded, occasional calcite infilling, strong to very strong Sub-vertical joints, 25mm calcite infilling at 1.96m.  Sub-vertical joints at 125 to 175mm intervals, occasional calcite infilling		1	RUN			121						RUN 1# TCR=100%, SCR=13%, RQD=13%, UCS=97 to 150MPa
			2	RUN			120						RUN 2# TCR=100%, SCR=75%, RQD=75%, UCS=52 to 183MPa
			3	RUN			119						RUN 3# TCR=75%, SCR=57%, RQD=57%, UCS=124 to 229MPa
117.2							118						
5.7	END OF BOREHOLE AT 5.7m. BOREHOLE SEALED WITH BENTONITE HOLEPLUG AND GRAVEL.												

RECORD OF BOREHOLE No 08-SCH-08

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 180.7 E 308 162.4 ORIGINATED BY LG  
 HWY 17417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY FK  
 DATUM Geodetic DATE 2008.08.27 - 2008.08.27 CHECKED BY SKP



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									
						20	40	60	80	100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%)						
122.8																	
0.0	Silty SAND, trace rock pieces		1	SS													
122.4	Brown																
0.4	Moist																
	END OF BOREHOLE AT 0.4m. AUGER REFUSAL AT 0.4m. BOREHOLE BACKFILLED WITH CUTTINGS.																

# RECORD OF BOREHOLE No 08-SCH-09

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 156.2 E 308 181.3 ORIGINATED BY LG  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Augers / NQ Coring COMPILED BY FK  
 DATUM Geodetic DATE 2008.08.25 - 2008.08.25 CHECKED BY SKP

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						
								20	40	60			80	100
124.5														
0.0	Silty CLAY, some roots. trace gravel Firm Brown Moist		1	SS	6									
123.7	AUGER REFUSAL AT 0.8m.													
0.8	CRYSTALLINE LIMESTONE (BEDROCK), moderately to slightly weathered, grey, thinly bedded, calcite infilling, very strong Sub-vertical joints at 0.93m, 0.99m, 3.42m, 3.58m, and 3.92m; calcite infilling Sub-vertical joints at 1.2m - 1.5m; calcite infilling Vertical fracture from 1.57m to 1.98m, calcite seam from 2.3m to 2.7m  Vertical fracture from 3.45m to 3.68m Sub-vertical joints at 3.12m, 3.316m 3.68m, 3.92m, and 4.01m; calcite infilling		1	RUN										
			2	RUN										
			3	RUN										
120.2	END OF BOREHOLE AT 4.3m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.09.12 dry -													
4.3														

## METRIC

ORIGINATED BY LG

COMPILED BY FK

CHECKED BY SKP

[illegible]

# RECORD OF BOREHOLE No 08-SCH-11

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 168.3 E 308 175.6 ORIGINATED BY LG  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY FK  
 DATUM Geodetic DATE 2008.08.25 - 2008.08.25 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE 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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WP W WL 20 40 60						
123.3																	
0.0	Silty SAND, rootlets, organics, trace gravel Compact Brown Moist (FILL)		1	SS	18												
122.6																	
0.7	END OF BOREHOLE AT 0.7m. AUGER REFUSAL AT 0.7m. BOREHOLE BACKFILLED WITH CUTTINGS.																

# RECORD OF BOREHOLE No 08-SCH-12

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 164.9 E 308 192.3 ORIGINATED BY LG  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY FK  
 DATUM Geodetic DATE 2008.08.25 - 2008.08.25 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE 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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT (%) w <sub>p</sub> w w <sub>L</sub>				
123.6																	
0.0	Gravelly SAND, some rootlets, some silt		1	SS	27											30 55 15 (SI+CL)	
123.0	Compact Brown Moist (FILL)																
0.6	END OF BOREHOLE AT 0.6m. AUGER REFUSAL AT 0.6m. BOREHOLE BACKFILLED WITH CUTTINGS.																



# RECORD OF BOREHOLE No 08-SCH-13

1 OF 1

METRIC

G.W.P. 4067-03-00

LOCATION Scheel Drive N 5 033 130.3 E 308 177.5

ORIGINATED BY LG

HWY 17/417

BOREHOLE TYPE Hollow Stem Augers / NQ Coring

COMPILED BY FK

DATUM Geodetic

DATE 2008.08.26 - 2008.08.26

CHECKED BY SKP

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						
								SHEAR STRENGTH kPa						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
							WATER CONTENT (%)			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT				
							w <sub>p</sub> — w — w <sub>L</sub>							
125.2														
0.0	Silty SAND, trace gravel Compact Brown Moist (FILL)		1	SS	13		125							
124.3														
0.9	CLAY, some sand Soft Brown Moist		2	SS	3		124							
123.8														
1.4	AUGER REFUSAL AT 1.4m.  CRYSTALLINE LIMESTONE (BEDROCK), moderately to slightly weathered, grey, thinly bedded, calcium infilling, strong to very strong Sub-vertical joints at 50 to 75mm intervals Sub-vertical joints at 100 to 125mm intervals  Becoming reddish grey at 4.2m depth.  Sub-vertical joints at 125 to 175mm intervals		1	RUN			123							
			2	RUN			122							
							121							
			3	RUN										
120.1														
5.1	END OF BOREHOLE AT 5.1m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.09.12 dry -													

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-SCH-14

1 OF 1

METRIC

G.W.P. 4067-03-00

LOCATION Scheel Drive N 5 033 129.4 E 308 182.0

ORIGINATED BY LG

HWY 17/417



BOREHOLE TYPE Hollow Stem Auger

COMPILED BY FK

DATUM Geodetic

DATE 2008.08.26 - 2008.08.26

CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
								WATER CONTENT (%)				
125.2							20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>		
0.0	Silty SAND, trace to some gravel Loose Brown to Black Moist (FILL)		1	SS	7		125	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				
124.3												
0.9	CLAY, some sand Firm Brown		2	SS	6		124	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				
123.7												
1.5	END OF BOREHOLE AT 1.5m. AUGER REFUSAL AT 1.5m. BOREHOLE BACKFILLED WITH GRAVEL.											

ONTMT4S 1125.GPJ 3/23/09

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

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-SCH-15

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 106.9 E 308 195.4 ORIGINATED BY LG  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY FK  
 DATUM Geodetic DATE 2008.08.27 - 2008.08.27 CHECKED BY SKP

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							
								20 40 60 80 100							
126.2	Gravelly SAND, trace silt, some pieces of rock Very Dense Brown Moist (FILL)  Silty SAND, trace clay Loose to Compact Brown Moist		1	SS	51									27 63 10 (SI+CL)	
125.4			2	SS	50.7										
0.8			3	SS	7										
			4	SS	10										
123.4	END OF BOREHOLE AT 2.8m. AUGER REFUSAL AT 2.8m. BOREHOLE BACKFILLED WITH GRAVEL.														
2.8															

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

20  
15 10 5  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-SCH-16

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 106.0 E 308 199.3 ORIGINATED BY LG  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Augers / NQ Coring COMPILED BY FK  
 DATUM Geodetic DATE 2008.08.27 - 2008.08.27 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
								20	40	60				80	100	20	40	60																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
126.2 0.0	Silty SAND, some to trace gravel, inferred cobble Dense Brown Moist (FILL)		1	SS	47		126																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-SCH-17

1 OF 1

METRIC

G.W.P. 4067-03-00

LOCATION Scheel Drive N 5 033 125.8 E 308 184.6

ORIGINATED BY LG

HWY 17/417



BOREHOLE TYPE Hollow Stem Auger

COMPILED BY FK

DATUM Geodetic

DATE 2008.08.26 - 2008.08.26

CHECKED BY SKP

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												
125.6								20	40	60	80	100								
0.0	Silty SAND, trace to some gravel Dense Moist (FILL)		1	SS	41															
124.7			2	SS	8/												Sampler bouncing			
0.9	END OF BOREHOLE AT 0.9m. AUGER REFUSAL AT 0.9m. BOREHOLE BACKFILLED WITH GRAVEL				.050															

+<sup>3</sup> ×<sup>3</sup>

Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-SCH-18

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 114.3 E 308 176.7 ORIGINATED BY LG  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY FK  
 DATUM Geodetic DATE 2008.08.27 - 2008.08.27 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA St CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
126.1																	
0.0	Silty SAND, trace to some gravel, some pieces of rock Dense to Compact Brown Moist (FILL)		1	SS	45												
125.4																	
0.7	Silty SAND, trace to some gravel Compact Brown Moist		2	SS	28												
124.3																	
1.8	END OF BOREHOLE AT 1.8m. BOREHOLE BACKFILLED WITH GRAVEL																

# RECORD OF BOREHOLE No 08-SCH-19

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 122.2 E 308 215.4 ORIGINATED BY LG  
HWY 17/417 BOREHOLE TYPE Hollow Stem Augers / NQ Coring COMPILED BY FK  
DATUM Geodetic DATE 2008.08.26 - 2008.08.26 CHECKED BY SKP

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							
125.2								20 40 60 80 100							
0.0	Gravelly SAND, some silt , trace clay Compact Brown Moist (FILL) trace limestone pieces		1	SS	10		125	○ UNCONFINED + FIELD VANE							GR SA SI CL
			2	SS	13		124	● QUICK TRIAXIAL X LAB VANE							
123.8															
1.4	Silty CLAY, with sand, trace gravel Soft to Firm Brown Moist		3	SS	4		123								3 57 32 8
122.7	AUGER REFUSAL AT 2.5m		4	SS	5/										Sampler bouncing
2.5	BEDROCK, moderately to highly weathered, grey, thinly bedded, calcium infilling, very strong Sub-horizontal joints at 50 to 75mm		1	RUN	.150		122						FI		RUN 1# TCR=100%, SCR=20%, RQD=20%, UCS=150 to 182MPa
	Encountered voids; poor recovery within sections of broken core		2	RUN			121						2		RUN 2# TCR=50%, SCR=35%, RQD=18%, UCS=132 to 173MPa
	slightly weathered to fresh		3	RUN			120						2		RUN 3# TCR=100%, SCR=80%, RQD=80%, UCS=126 to 197MPa
118.1							119						1		
7.1	END OF BOREHOLE AT 7.1m. BOREHOLE SEALED WITH BENTONITE HOLEPLUG AND GRAVEL.												2		

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-SCH-20

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 121.0 E 308 219.0 ORIGINATED BY LG  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY FK  
 DATUM Geodetic DATE 2008.08.26 - 2008.08.26 CHECKED BY SKP

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						
								20 40 60 80 100						
								○ UNCONFINED	+ FIELD VANE					
								● QUICK TRIAXIAL	x LAB VANE					
								WATER CONTENT (%)						
								40 80 120 160 200						
										PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
										w <sub>p</sub>	w	w <sub>L</sub>		
125.2														
0.0	Silty SAND, some gravel		1	SS	20		125							
124.7	Compact													
	Moist													
0.5	(FILL)													
	Silty CLAY, some sand, trace rock		2	SS	7									
	pieces													
	Firm													
	Brown to Reddish Brown													
	Moist													
123.3			3	SS	56/ .250		124							
1.9	END OF BOREHOLE AT 1.9m.													
	AUGER REFUSAL AT 1.9m.													
	BOREHOLE BACKFILLED WITH GRAVEL.													

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

20  
15 5  
10 (%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 08-SCH-21

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 097.0 E 308 231.3 ORIGINATED BY LG  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY FK  
 DATUM Geodetic DATE 2008.08.27 - 2008.08.27 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
126.4	ASPHALT: (50mm)		1	SS	24		126	20	40	60	80	100		37 52 11 (SI+CL)
125.8	SAND and GRAVEL, trace to some pieces of rock Compact to Very Dense Brown Moist (FILL)		2	SS	86		125	20	40	60	80	100		
124.1	Silty SAND, trace to some rock pieces Very Dense Brown Moist		3	SS	50/ .200		124	20	40	60	80	100		
123.6	Silty CLAY, some sand, trace gravel Firm Brown Moist		4	SS	4			20	40	60	80	100		
2.8	END OF BOREHOLE AT 2.8m. AUGER REFUSAL AT 2.8m. BOREHOLE BACKFILLED WITH BENTONITE. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.09.12 dry -													

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-SCH-22

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 094.4 E 308 235.9 ORIGINATED BY LG  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Augers / NQ Coring COMPILED BY FK  
 DATUM Geodetic DATE 2008.08.27 - 2008.08.27 CHECKED BY SKP

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					
126.4							20	40	60	80	100		
0.0	ASPHALT: (150mm)												
0.1	Silty SAND, trace gravel, trace pieces of rock		1	SS	41								
125.6	Dense Brown Moist (FILL)		2	SS	20								
0.8	SAND, pieces of rock Compact Grey Dry		3	SS	51/ 275								
124.3	AUGER REFUSAL AT 2.1m.												
2.1	CRYSTALLINE LIMESTONE (BEDROCK), moderately weathered, grey, thinly bedded, calcite infilling, strong to very strong Highly weathered zone between 2.44m and 3.50m		1	RUN									
			2	RUN									
	Moderately to highly weathered (Zones of broken core possibly resulting from drilling operations)		3	RUN									
			4	RUN									
119.4													
7.0	END OF BOREHOLE AT 7.0m. BOREHOLE SEALED WITH BENTONITE AND GRAVEL.												

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-SCH-23

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 117.1 E 308 222.4 ORIGINATED BY LG  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY FK  
 DATUM Geodetic DATE 2008.08.26 - 2008.08.26 CHECKED BY SKP

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							
125.6 0.0	Silty SAND, trace gravel, trace pieces of rock Brown Moist (FILL)  END OF BOREHOLE AT 0.6m. AUGER REFUSAL AT 0.6m. BOREHOLE BACKFILLED WITH CUTTINGS.														
125.0 0.6															




ONTMT4S 1125.GPJ 11/17/08

# RECORD OF BOREHOLE No 08-SCH-24

1 OF 1

METRIC

G.W.P. 4067-03-00 LOCATION Scheel Drive N 5 033 119.0 E 308 238.5 ORIGINATED BY LG  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY FK  
 DATUM Geodetic DATE 2008.08.26 - 2008.08.26 CHECKED BY SKP

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						
125.7							20	40	60	80	100						
0.0	Gravelly SAND Compact to Loose Brown (FILL)		1	SS	21											28 62 10 (SI+CL)	
125.0																	
0.7	Silty SAND, trace to some gravel Loose Brown		2	SS	6												
124.5	Moist																
1.2	Silty CLAY, with sand, trace gravel, trace pieces of rock Firm Moist		3	SS	7												
			4	SS	8											3 49 30 18	
122.9																	
2.8	END OF BOREHOLE AT 2.8m. AUGER REFUSAL AT 2.8m. BOREHOLE SEALED WITH GRAVEL AND BENTONITE.																

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

## **Appendix B**

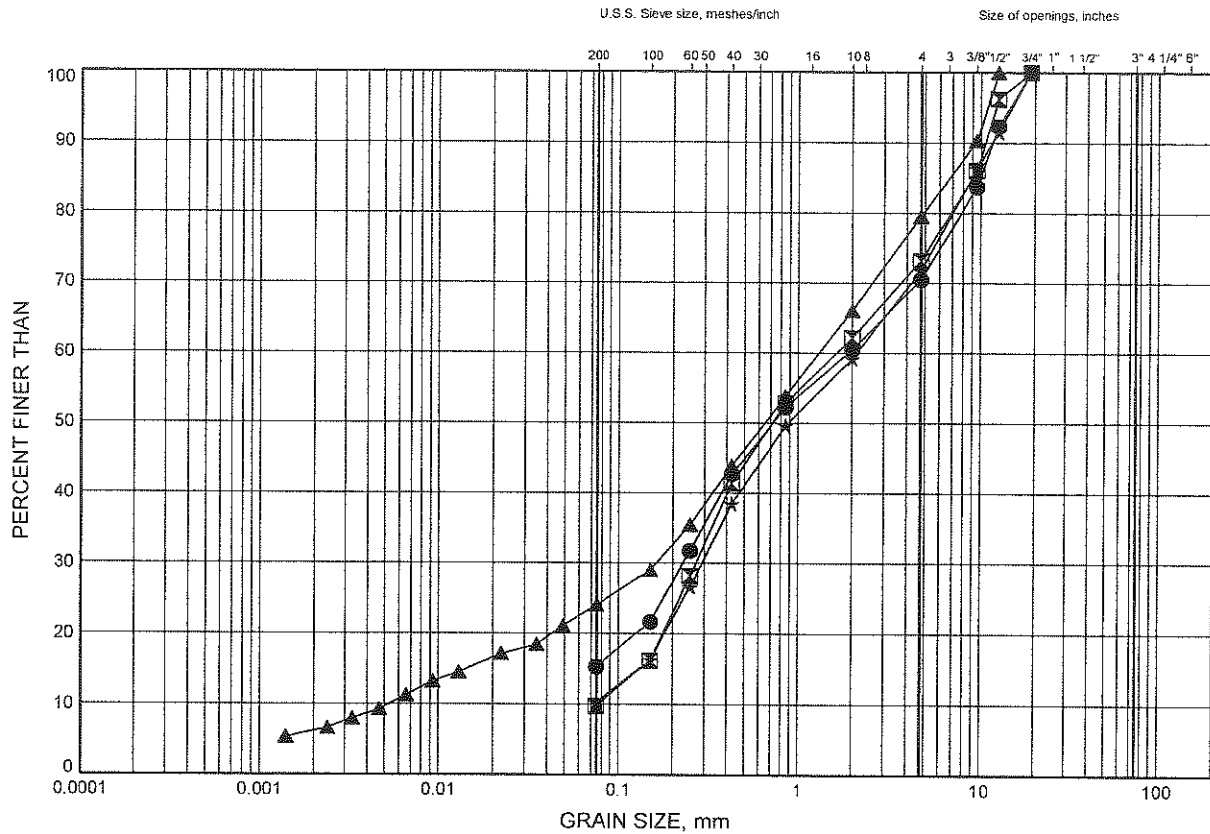
### **Laboratory Test Results**



# GRAIN SIZE DISTRIBUTION

FIGURE B1

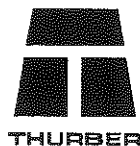
## GRAVELLY SAND FILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-SCH-12	0.28	123.32
■	08-SCH-15	0.30	125.90
▲	08-SCH-19	0.30	124.90
☆	08-SCH-24	0.30	125.40

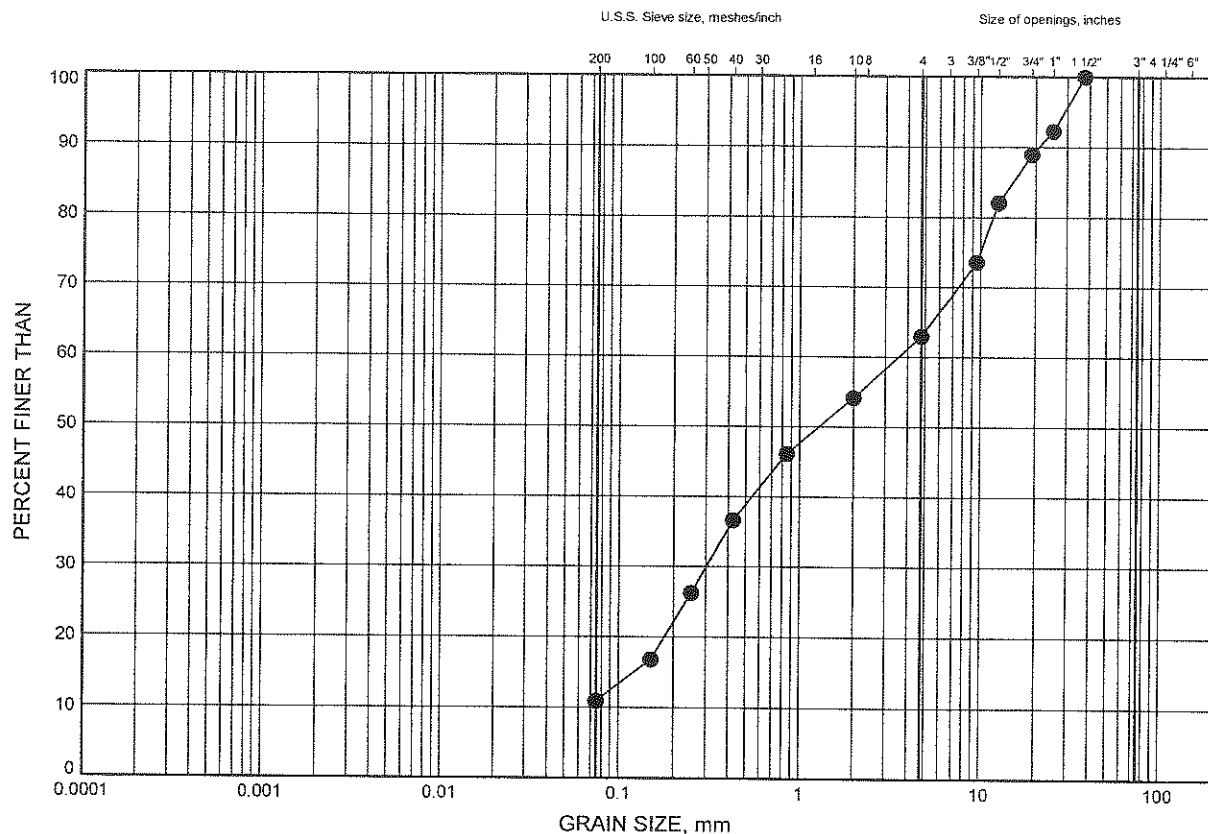


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 Prepared By MFA  
 Checked By SKP

# GRAIN SIZE DISTRIBUTION

FIGURE B2

## SAND AND GRAVEL FILL



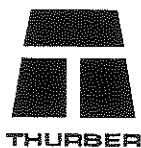
SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-SCH-21	0.30	126.10

GRAIN SIZE DISTRIBUTION - THURBER 1125 GPJ 11/6/08

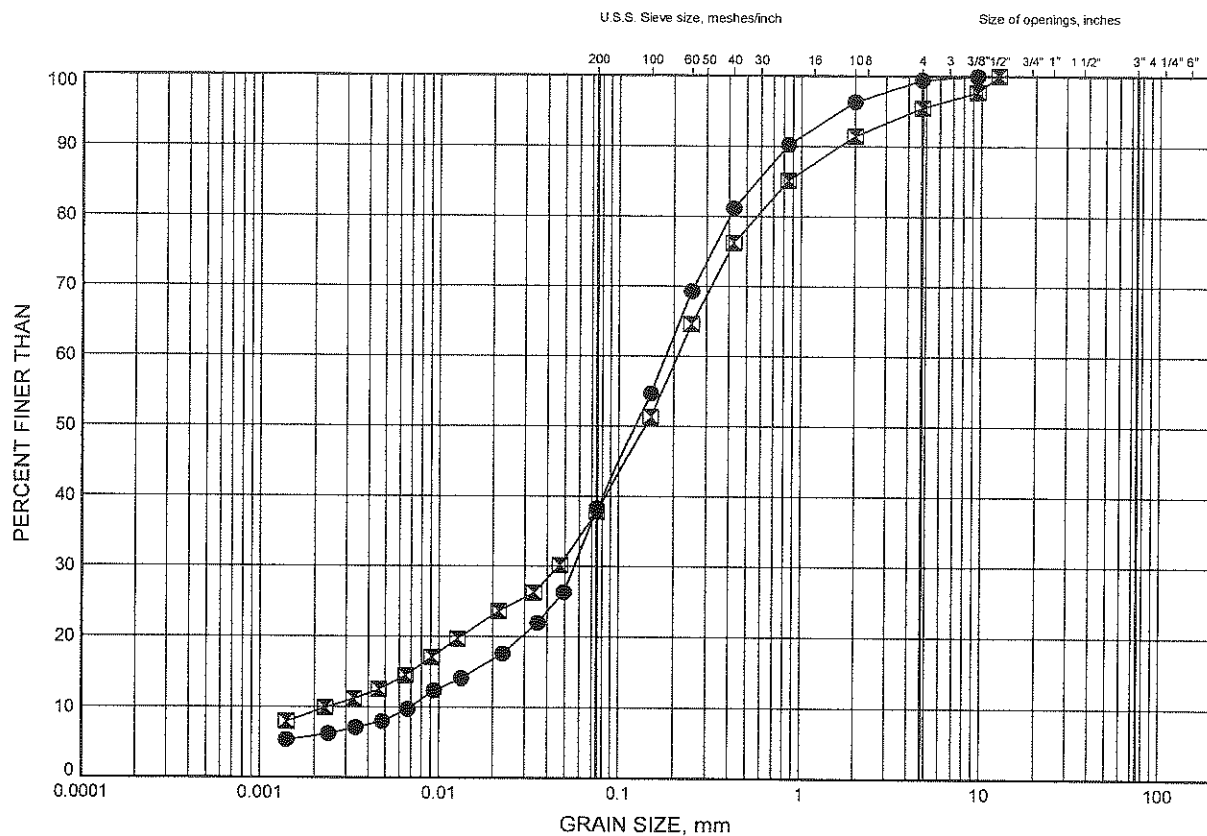
W.P.# 4067-03-00  
 Prepared By MFA  
 Checked By SKP



# GRAIN SIZE DISTRIBUTION

FIGURE B3

## SILTY SAND



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

### LEGEND

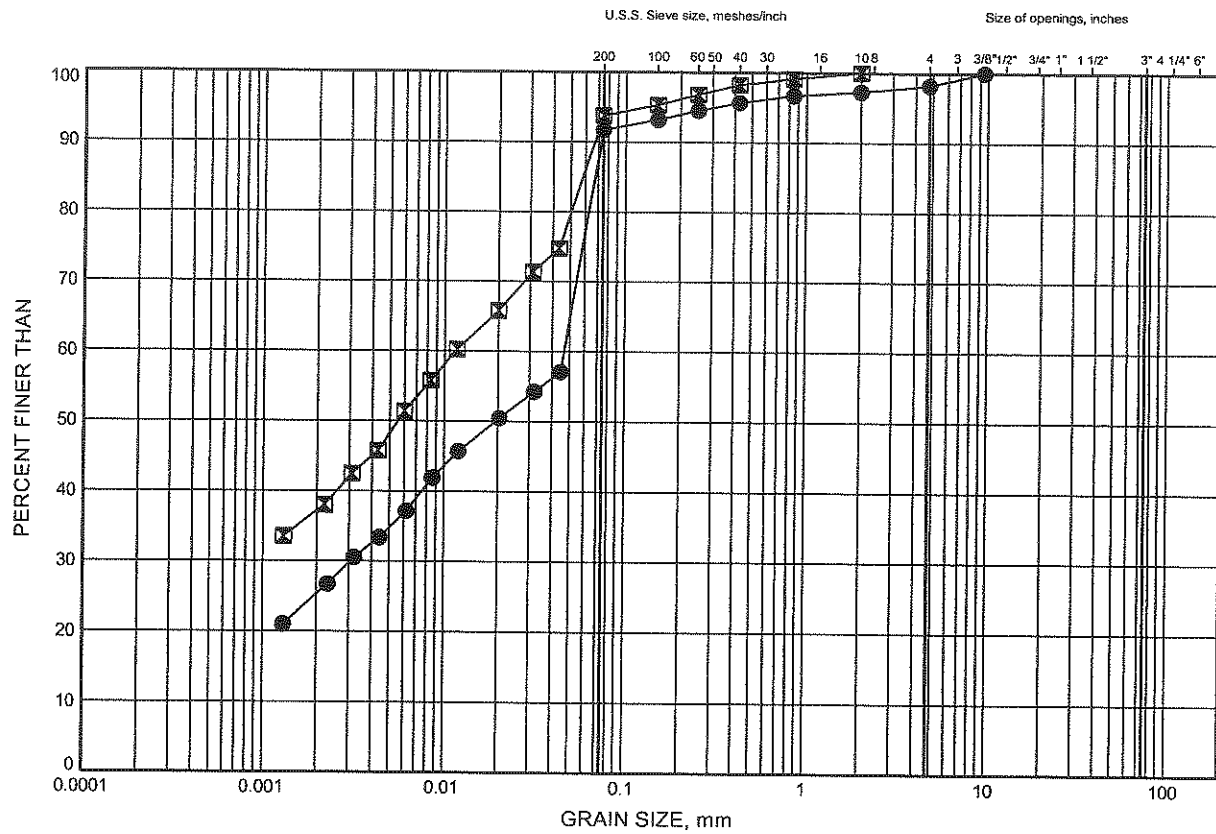
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-SCH-03	0.30	126.10
⊠	08-SCH-07	0.30	122.60



# GRAIN SIZE DISTRIBUTION

FIGURE B4

## CLAY



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

### LEGEND

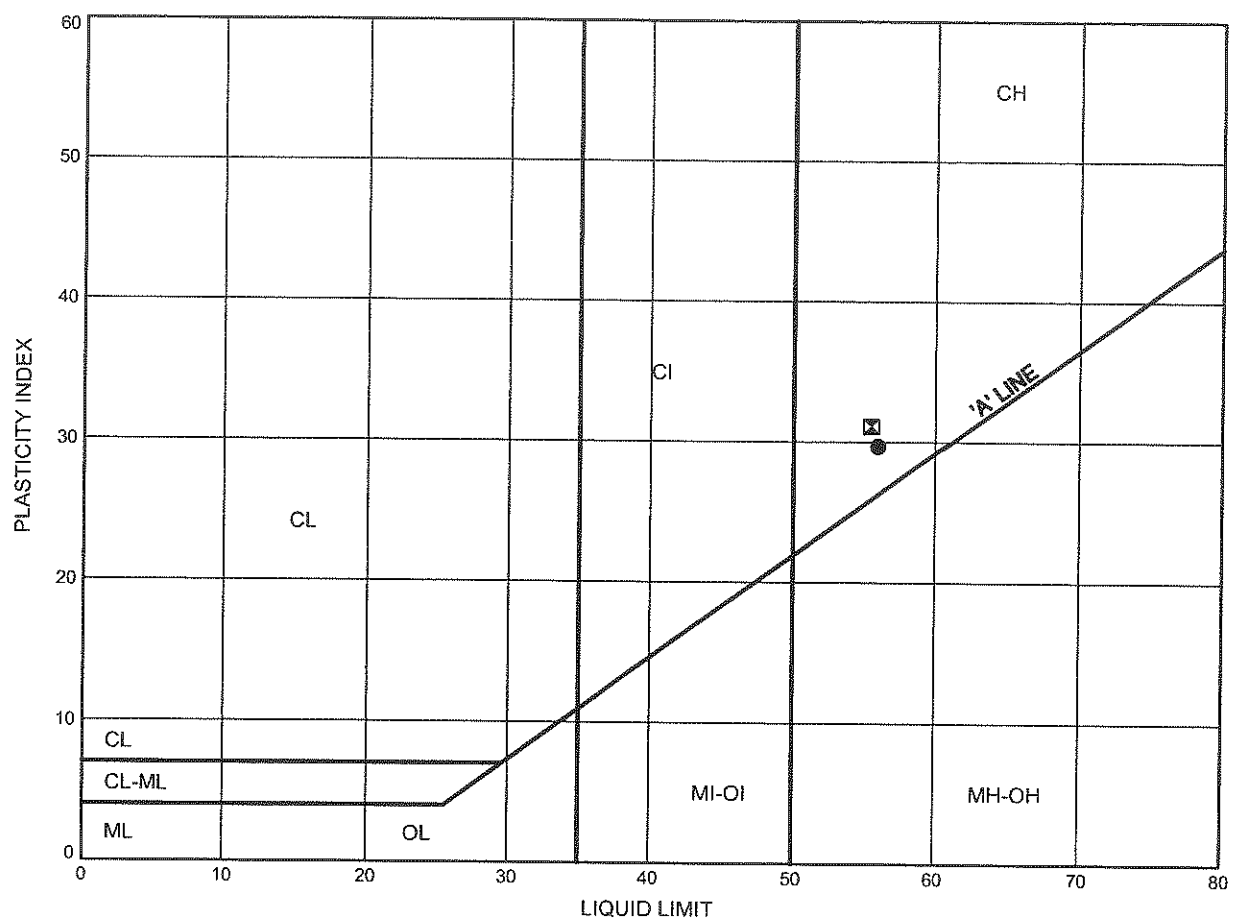
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-SCH-01	1.07	121.33
■	08-SCH-02	1.07	122.33



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 Prepared By .MFA.....  
 Checked By .SKP.....

## FIGURE B5

CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-SCH-01	1.07	121.33
☒	08-SCH-02	1.07	122.33

Project 4067-03-00

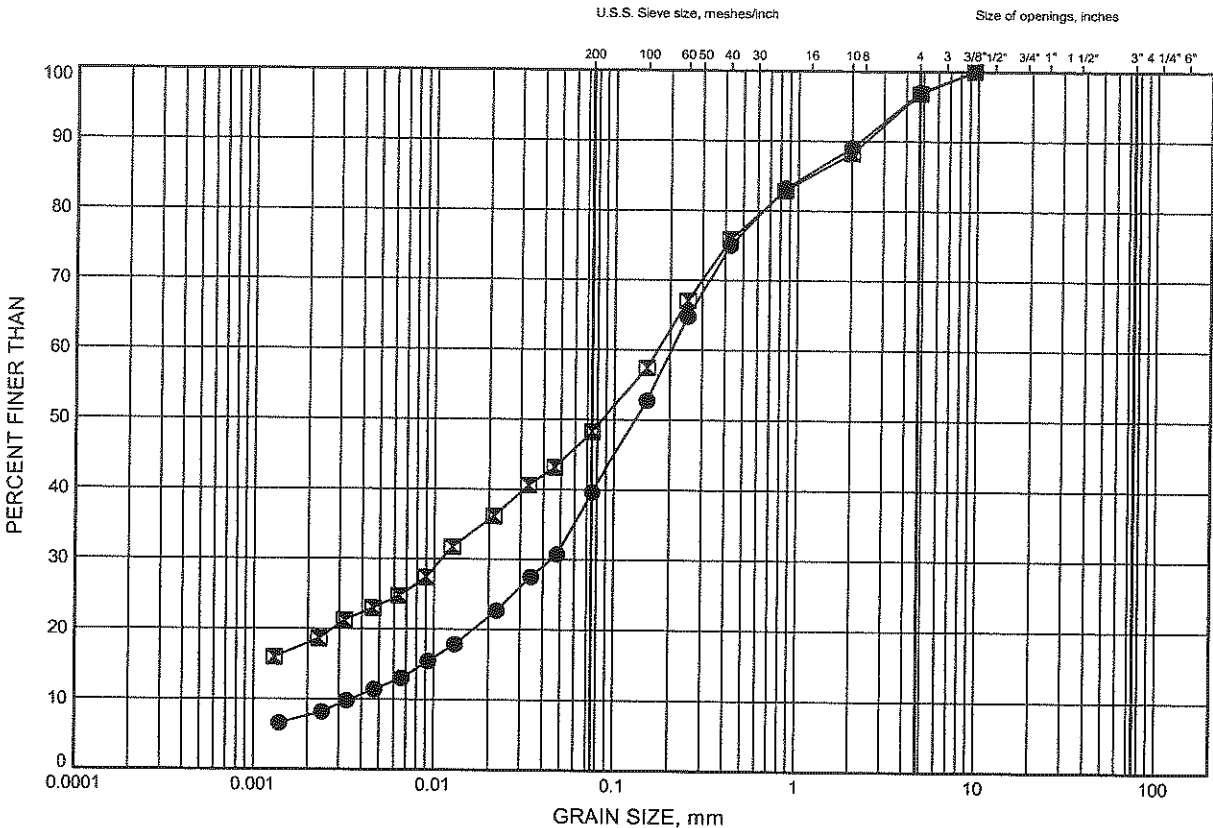


Chkd. .... SKP

# GRAIN SIZE DISTRIBUTION

FIGURE B6

## SILTY CLAY WITH SAND



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-SCH-19	1.83	123.37
■	08-SCH-24	2.55	123.15

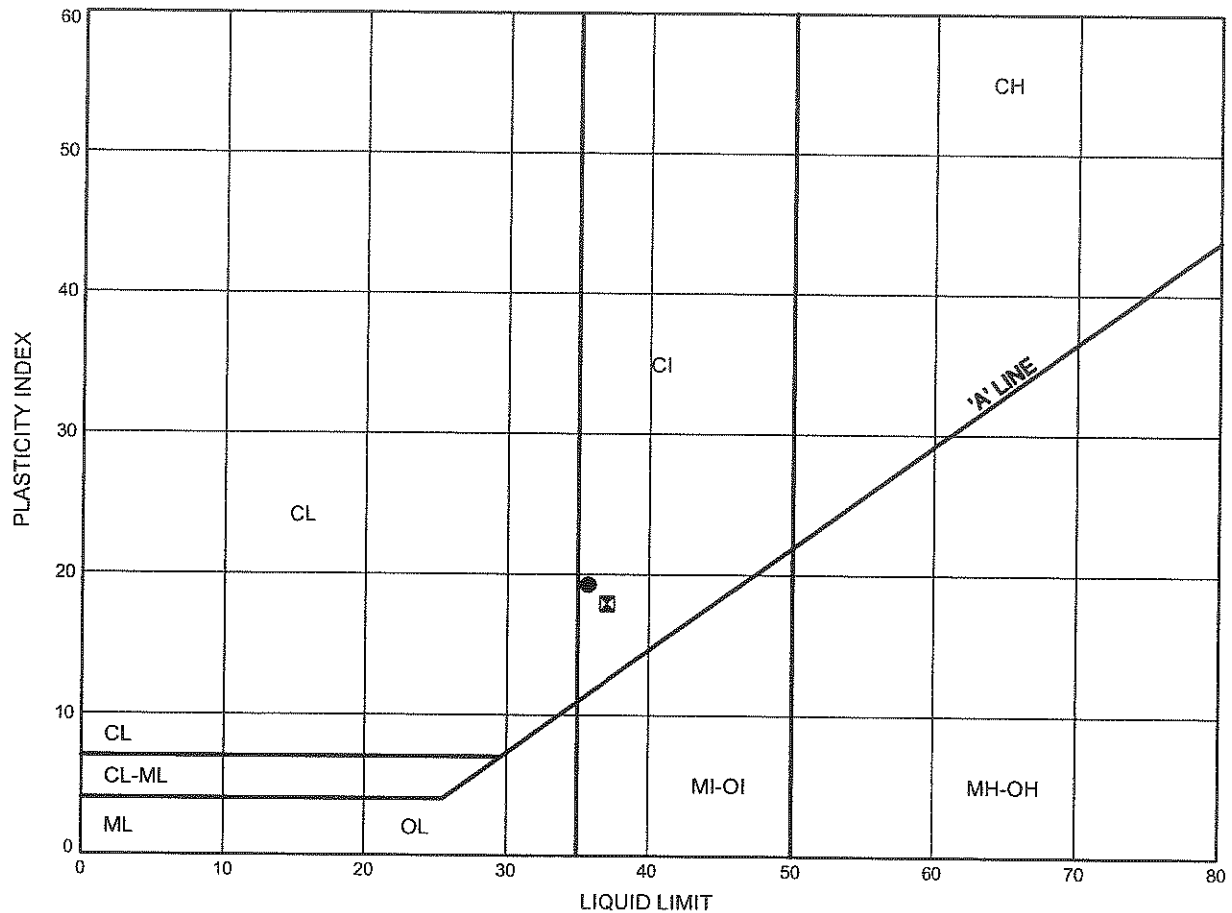


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 Prepared By MFA  
 Checked By SKP

# ATTERBERG LIMITS TEST RESULTS

FIGURE B7

SILTY CLAY WITH SAND



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-SCH-19	1.83	123.37
⊠	08-SCH-24	2.55	123.15

Date March 2009  
Project 4067-03-00



Prep'd MFA  
Chkd. SKP

## **Appendix C**

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

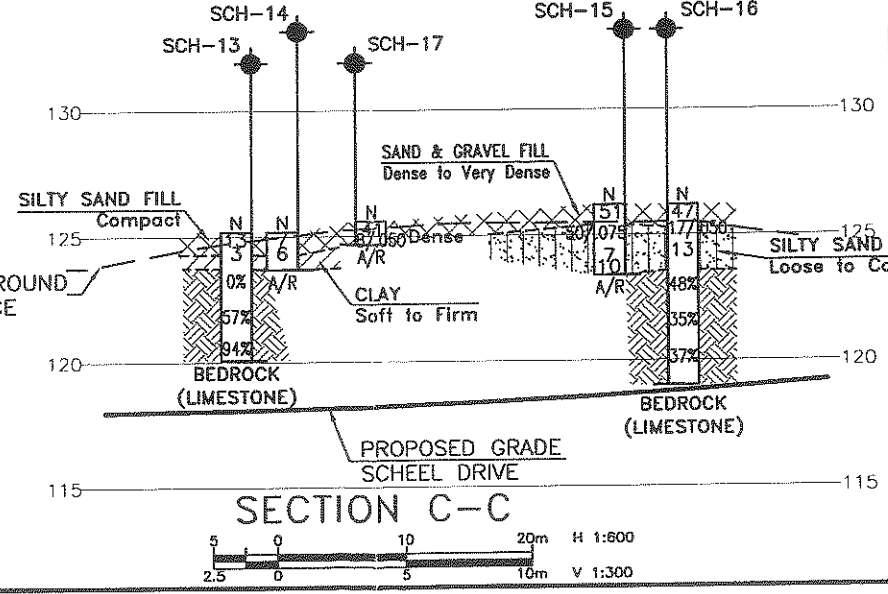
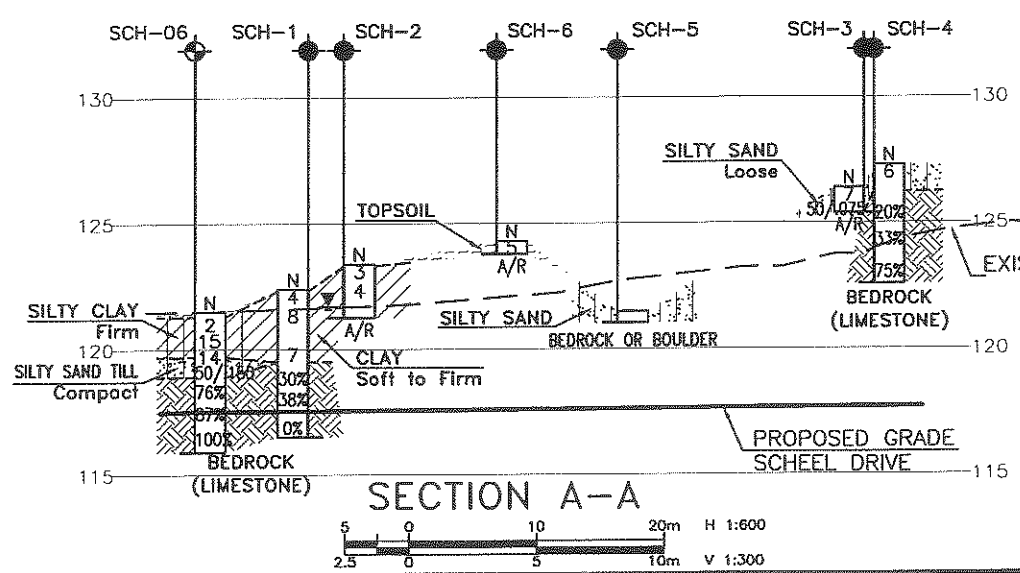
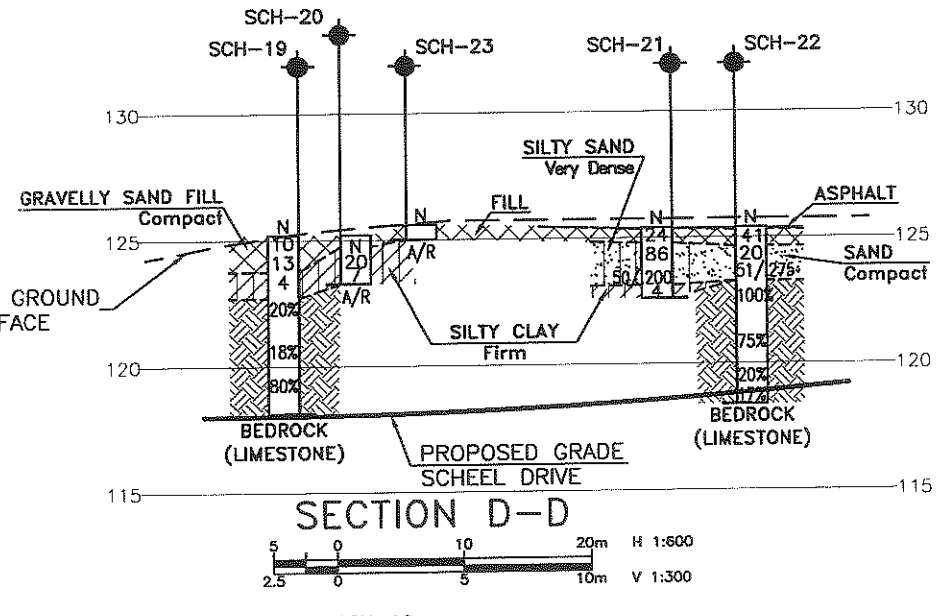
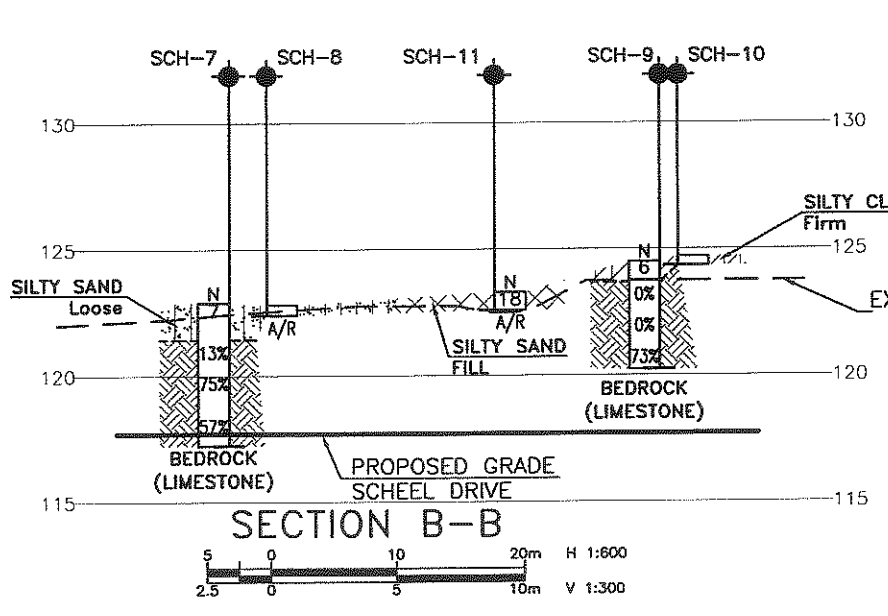
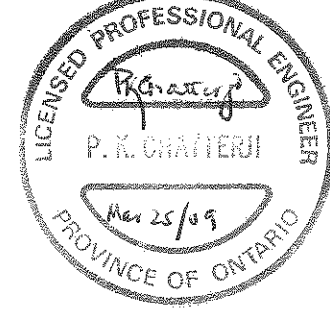
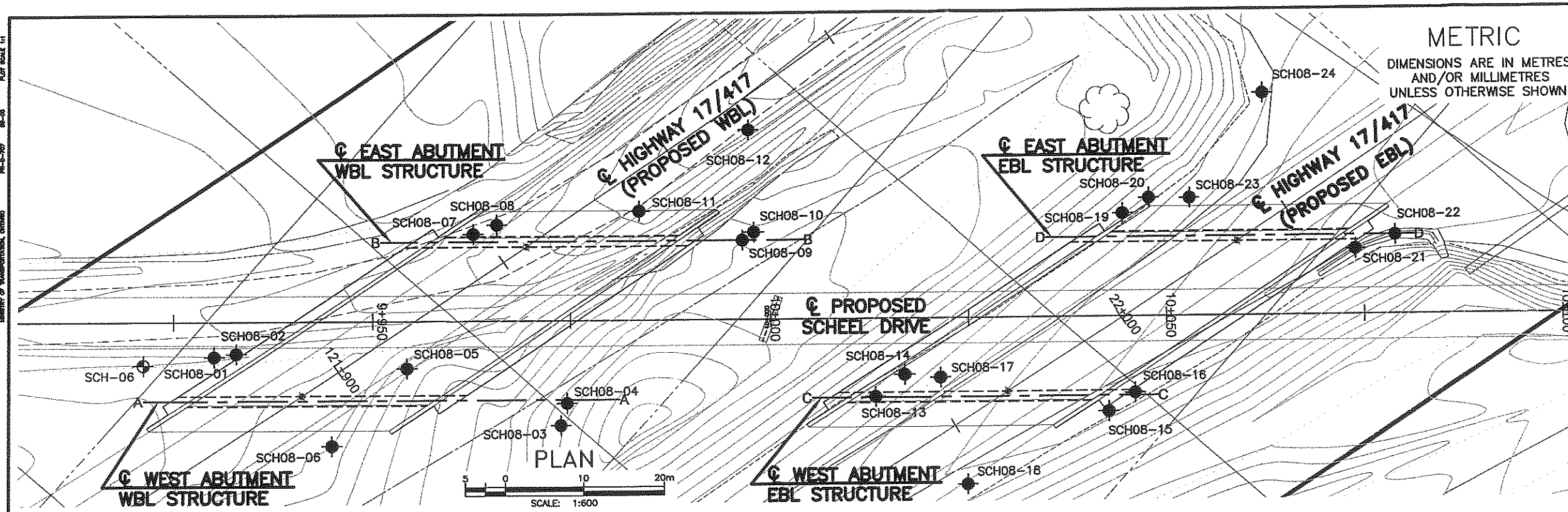


PLAN SCALE 1:600

SECTION SCALE 1:600

MODIFIED:

DRAWING NAME:  
CREATED:



NO	ELEVATION	NORTHING	EASTING
SCH08-01	122.4	5 033 196.3	308 126.4
SCH08-02	123.4	5 033 194.4	308 128.5
SCH08-03	126.4	5 033 157.7	308 148.7
SCH08-04	127.3	5 033 159.0	308 151.4
SCH08-05	121.5	5 033 177.1	308 141.3
SCH08-06	124.3	5 033 177.7	308 127.7
SCH08-07	122.9	5 033 182.2	308 159.6
SCH08-08	122.8	5 033 180.7	308 162.4
SCH08-09	124.5	5 033 156.2	308 181.3
SCH08-10	124.7	5 033 155.8	308 183.0
SCH08-11	123.3	5 033 168.3	308 175.6
SCH08-12	123.6	5 033 164.9	308 192.3
SCH08-13	125.2	5 033 130.3	308 177.5
SCH08-14	125.2	5 033 129.4	308 182.0
SCH08-15	126.2	5 033 106.9	308 195.4
SCH08-16	126.2	5 033 106.0	308 199.3
SCH08-17	125.6	5 033 125.8	308 184.6
SCH08-18	126.1	5 033 114.3	308 176.7
SCH08-19	125.2	5 033 122.2	308 215.4
SCH08-20	125.2	5 033 121.0	308 219.0
SCH08-21	126.4	5 033 097.0	308 231.3
SCH08-22	126.4	5 033 094.4	308 235.9
SCH08-23	125.6	5 033 117.1	308 222.4
SCH08-24	125.7	5 033 119.0	308 238.5
SCH-06	121.5	5 033 202.2	308 119.7

HWY 17/417  
SITE No  
GWP No 4067-03-00

MRC

McCORMICK RANKIN CORPORATION

THURBER ENGINEERING LTD.

GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

KEYPLAN

LEGEND

Borehole (Present Investigation, 2008)

Borehole (Previous Investigation, 2006)

N

Blows /0.3m (Std Pen Test, 475J/blow)

CONE

Blows /0.3m (60° Cone, 475J/blow)

PH

Pressure, Hydraulic

W

Water Level

H

Head Artesian Water

P

Piezometer

90%

Rock Quality Designation (RQD)

A/R

Auger Refusal

NO	ELEVATION	NORTHING	EASTING
SCH08-01	122.4	5 033 196.3	308 126.4
SCH08-02	123.4	5 033 194.4	308 128.5
SCH08-03	126.4	5 033 157.7	308 148.7
SCH08-04	127.3	5 033 159.0	308 151.4
SCH08-05	121.5	5 033 177.1	308 141.3
SCH08-06	124.3	5 033 177.7	308 127.7
SCH08-07	122.9	5 033 182.2	308 159.6
SCH08-08	122.8	5 033 180.7	308 162.4
SCH08-09	124.5	5 033 156.2	308 181.3
SCH08-10	124.7	5 033 155.8	308 183.0
SCH08-11	123.3	5 033 168.3	308 175.6
SCH08-12	123.6	5 033 164.9	308 192.3
SCH08-13	125.2	5 033 130.3	308 177.5
SCH08-14	125.2	5 033 129.4	308 182.0
SCH08-15	126.2	5 033 106.9	308 195.4
SCH08-16	126.2	5 033 106.0	308 199.3
SCH08-17	125.6	5 033 125.8	308 184.6
SCH08-18	126.1	5 033 114.3	308 176.7

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.

GEOCRE No. 31F-167

REVISIONS

DATE	BY	DESCRIPTION
DESIGN	SKP	CHK
DRAWN	MFA	CHK

DATE

BY

DESCRIPTION

LOAD

DATE

MAR. 2009

STRUCT

SCHEME

DWG 1

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PLOTDATE: Mar 23, 2009 2:03pm