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DIST. 6 REGION

W.P. No. 54-82-09

CONT. No. 88-48

W. O. No.

STR. SITE No.

HWY. No. 401/410

LOCATION Hwy 401/410 Interchange
 H.M.L.

No. of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 88 - 48



Ministry of
Transportation and
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	- Bridge #32, Ramp N-E W.P. 54-82-11, Site 24-81-325 Hwy. 401/410 Interchange District 6, Toronto

Note: For the purposes of this contract, these reports supersede all other Foundation Investigation Reports prepared by or for the Ministry in connection with the above-noted projects.

EXPLANATION OF TERMS USED IN REPORT

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N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O D SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N}

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O D 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_i	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kn/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kn/m ³	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kn/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ² /s	RATE OF DISCHARGE
γ_d	kn/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kn/m ³	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kn/m ³	SEEPAGE FORCE
γ'	kn/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

FOUNDATION INVESTIGATION REPORT

For

W.P. 54-82-09; Site N/A

High Mast Lighting (Hwy. 401/Hwy. 410 Interchange)

Hwy. 401, District 6, TorontoINTRODUCTION

This report summarizes the foundation investigation required for the above-noted high mast lighting.

The fieldwork was conducted between 86 06 02 and 86 06 19 utilizing a continuous flight auger machine equipped with solid-stem augers, N casing and B core barrels.

This work consisted of advancing sampled boreholes at or near all proposed high mast light locations (C11 to C32).

SITE DESCRIPTION

These high mast lights are located along Hwy. 401 and Hwy. 410 at the Hwy. 401/Hwy. 410 interchange.

According to Chapman and Putnam (1984), the site lies within the 'Peel Plain' physiographic area. It is characterized by a relatively level area of shallow overburden overlying shale bedrock.

SUBSURFACE CONDITIONSGeneral

The Record of Borehole Sheets (Appendix) illustrate the conditions at the borehole locations (refer to BH #C11 to BH #C32). The locations of high mast lights C11 to C32 are illustrated on Drawing No. 548209-A* while specific locations are indicated in Table 1.

STRATIGRAPHYOverburden

The overburden is generally silty clay of low plasticity, containing variable amounts of sand and gravel and occasional shaly zones. In most cases the material is glacial till. However, in some locations it is fill.

*NOTE: Refer to Sheet No. 124-1 of the Contract Drawings.

Based on 'N' values ranging from 7 to over 100, the consistency of the material varies from firm to hard but is generally very stiff to hard.

The thickness of the overburden is variable, ranging from 0 to 4.6 m.

Bedrock

Detailed descriptions of the bedrock core samples are provided in Tables 2A, 2B and 2C.

Bedrock is alternating shale and limestone of the Georgian Bay Formation.

Groundwater Conditions

At the time of the field investigations, the depth to groundwater at Boreholes C18, C21 and C22 ranged from 0.95 m to 1.30 m below the surface. All other boreholes were dry.

MISCELLANEOUS

The fieldwork for this project was carried out under the supervision of Mr. J. Duffield, Student Engineer, using equipment owned and operated by Master Soil Investigation Ltd.

Bedrock descriptions, based on the rock core samples, were provided by Mr. E. Magni, Geologist.

The report was written by Mr. D. Dundas, Senior Foundations Engineer and reviewed by Mr. M. Devata, Chief Foundations Engineer (East).



D. H. Dundas,
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Sr. Foundations Engineer

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APPENDIX

W.P. 54-82-09

TABLE 1

HIGHWAY 401/410 INTERCHANGE HIGH-MAST POLE



ELEVATIONS

Coordinates

<u>Pole No.</u>	<u>Easting</u>	<u>Northing</u>	<u>Existing Elevation</u>	<u>Ultimate *</u> <u>Elevation</u>
C11	291868.4	4832843.2	182.8	182.8
C12	291951.1	4832957.5	174.0	173.7
C13	292102.0	4833015.8	181.2	181.2
C14	291961.0	4833075.0	181.1	178.5
C15	292123.0	4833161.5	180.2	175.3
C16	292182.4	4833345.0	175.0	175.0
C17	292029.0	4833251.0	177.2	177.2
C18	291870.4	4833301.5	177.7	177.7
C19	291830.6	4833170.3	176.4	176.4
C20	291685.4	4833135.6	182.5	175.1
C21	291530.0	4833117.5	184.2	184.2
C22	291428.2	4833199.0	181.8	181.8
C23	291555.5	4833270.9	180.6	180.6
C24	291704.0	4833337.0	177.9	177.9
C25	291397.8	4833375.3	179.1	179.1
C26	291538.4	4833442.6	177.7	177.5
C27	291435.4	4833570.0	178.2	178.2
C28	291312.0	4833669.8	180.0	180.0
C29	291184.5	4833784.0	179.6	179.6
C30	291265.0	4833468.0	179.5	179.5
C31	291179.0	4833618.0	179.6	179.6
C32	291073.0	4833728.9	181.0	181.0

* Ultimate elevations are based on Preliminary Design Cross-Sections and are therefore subject to change during detailed design stage.

W.P. 54-82-09

File # 18-85035

TABLE 2A

DESCRIPTION OF ROCK CORE - W.P. 54-82-09

BOREHOLE NUMBER				CORE DESCRIPTION	
	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
C11	0.97 - 2.14	46	15	0.97 - 2.14	SHALE (85%), grey, highly weathered, with LIMESTONE (15%), grey, in layers up to 27.5 cm
	2.14 - 2.69	100	27		
	2.69 - 4.21	48	18	2.14 - 5.49	LIMESTONE (80%), grey, unweathered, with SHALE (20%), grey, in 1.2 to 5.0 cm layers
	4.21 - 5.49	90	52		
C13	0.76 - 1.93	28	22	0.76 - 3.66	SHALE, grey, slightly to highly weathered, high core loss zone, with LIMESTONE layers from 2.5 to 27.5 cm
	1.93 - 2.47	24	0		
	2.47 - 2.54	100	0	3.66 - 4.80	SHALE (50%), grey, unweathered, closely to moderately spaced joints, with LIMESTONE (50%), grey, unweathered in layers from 2.5 to 10.0 cm
	2.54 - 3.25	43	0		
	3.25 - 3.66	55	0		
	3.66 - 4.80	100	38		
C14	2.0 - 3.15	76	24	2.0 - 2.52	SOIL, limestone slab, and till
	3.15 - 4.80	100	0	2.52 - 3.15	LIMESTONE (100%), grey, unweathered, medium spaced joints
				3.15 - 4.80	SHALE (75%), grey, slightly weathered to unweathered, closely to medium spaced joints, with LIMESTONE (25%), grey, unweathered
C16	1.47 - 3.18	91	31	1.47 - 1.78	SHALE (80%), grey, highly weathered, very closely spaced joints, with LIMESTONE (20%), grey, in 5.0 cm layer
	3.18 - 3.71	100	95	1.78 - 3.71	SHALE (90%), grey, slightly weathered becoming unweathered with depth, with LIMESTONE (10%), grey, in 2.5 to 15.0 cm layers
C18	3.20 - 3.43	78	0	3.20 - 4.33	SHALE (80%), grey, slightly weathered, very closely spaced bedding joints, with LIMESTONE (20%), grey, in 1.2 to 5.0 cm layers
	3.43 - 3.71	82	0		
	3.71 - 4.98	94	20	4.33 - 5.89	SHALE (80%), grey, unweathered, closely to medium spaced bedding joints, with LIMESTONE (20%), grey in 1.2 to 7.5 cm layers
	4.98 - 5.89	100	22		

* CR = CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION

TABLE 2B

DESCRIPTION OF ROCK CORE - W.P. 54-82-09

BOREHOLE NUMBER				CORE DESCRIPTION	
	DEPTH (m)	% CR *	% RQD *	DEPTH (m)	DESCRIPTION
C20	3.54 - 4.91	46	7	3.54 - 4.09	LIMESTONE, slightly weathered, closely spaced joints (oxidized)
	4.91 - 6.02	25	0	4.09 - 11.03	SHALE, highly weathered, high core loss, with LIMESTONE in layers 2.5 to 25.0 cm
	6.02 - 7.72	8	0		
	7.72 - 8.99	74	28	11.03 - 12.35	SHALE (50%), unweathered, closely spaced joints, with LIMESTONE (50%), in layers 2.5 to 25.0 cm
	8.99 - 10.45	13	0		
	10.98 - 12.35	85	44		
C21	2.03 - 3.51	59	7	2.03 - 3.76	SHALE (60%), grey, highly weathered, high core loss zone, with LIMESTONE (40%), grey, in 2.5 to 27.5 m layers
	3.51 - 5.03	100	8	3.76 - 5.03	SHALE (60%), grey, unweathered, close to medium spaced joints, with LIMESTONE (40%), grey, in 2.5 to 22.5 cm layers
C26	1.93 - 3.46	100	12	1.93 - 2.14	LIMESTONE (12.5 cm slab) and BROWN TILL
				2.14 - 2.59	SHALE (50%), grey, moderately weathered, very closely spaced joints, with LIMESTONE (50%), grey, in 2.5 to 15.0 cm layers
				2.59 - 3.46	SHALE (85%), grey, unweathered, closely to medium spaced joints, with LIMESTONE (15%), in 2.5 to 5.0 cm layers
C30	2.78 - 3.39	46	0	2.78 - 4.96	LIMESTONE (50%), grey, slightly weathered to unweathered, medium spaced joints, with SHALE (50%), grey, high core loss
	3.39 - 4.96	65	18	4.96 - 6.23	SHALE, grey, slightly to moderately weathered, closely spaced bedding joints, high core loss (5.36 - 6.18 cm, probable highly weathered shale)
	4.96 - 6.23	44	16		
	6.23 - 7.35	93	29	6.23 - 9.38	SHALE, grey, unweathered, medium spaced joints, with LIMESTONE, grey, unweathered
	7.35 - 8.48	78	11		
	8.48 - 9.38	94	54		

* CR = CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION

DESCRIPTION OF ROCK CORE - W.P. 54-82-09

6

* CR= CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION

RECORD OF BOREHOLE No C11

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 832 844.8; E 291 870.6 ORIGINATED BY JD
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
 DATUM Geodetic DATE 86 06 06 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
180.6	Ground Surface										
0.0	Silty Clay (CL) Some Sand Trace Gravel Occ. Shaly Zones Stiff to Hard (Till)					DRY					
179.7	Bedrock Shale and Limestone Georgian Bay Formation		1	SS	60/	10cm					
0.9	weathered unweathered		2	RC	32% rec						
			3	RC	100% rec						
			4	RC	48% rec						
			5	RC	84% rec						
175.1	End of Borehole										
5.5											



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RECORD OF BOREHOLE No C12

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 832 957.5; E 291 951.1 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 11 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH C UNCONFINED + FIELD VANE • QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES							
174.0	Ground Surface											
0.0	Bedrock Shale and Limestone Georgian Bay Formation Weathered		1	SS	60/	DRY 13 cm						
173.2												
0.8	End of Borehole											

+³, x⁵: Numbers refer to
Sensitivity

20
15 \diamond 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No C13

METRIC

W P 54-82-09 LOCATION Co-ords. N 4 833 015.8; E 292 102.0 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 19 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
181.2	Ground Surface												
0.0	Silty Clay (cl) *(Till)					Dry	181						
180.7													
0.5	Bedrock Shale and Limestone Georgian Bay Formation		1	SS	90								
			1A	SS	50/0cm								
			2	RC	28% rec		180						
			3	RC	24% rec								
			4	RC	100% rec		179						
			5	RC	43% rec								
			6	RC	66% rec		178						
			7	RC	100% rec		177						
176.4													
4.8	End Of Borehole												
	*Some Sand Trace Gravel occ. Shaly Zones Hard												



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RECORD OF BOREHOLE No C14

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 075.0; E 291 961.0 ORIGINATED BY JD
DIST 6 HWY 401/410 1C BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 12 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH					
181.1	Ground Surface					DRY	181							
0.0	Silty Clay (CL) With Sand Some Gravel (Fill) Stiff to Very Stiff		1	SS	22		180							
179.7														
1.4	Silty Clay (CL) Some Sand Trace Gravel Occ. Shaly and Limestone Zones Hard (Fill)		2	SS	86/28 cm		179							
178.6			3	RC	71% rec		178							
2.5	Weathered Unweathered		4	RC	98% rec		177							
	Bedrock Shale and Limestone Georgian Bay Formation													
176.3														
4.8	End of Borehole													

4³, x⁵: Numbers refer to
Sensitivity

20
15 ± 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No C15

METRIC

W P 54-82-09 LOCATION Co-ords N 4 833 161.5; E 292 123.0 ORIGINATED BY JD
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
 DATUM Geodetic DATE 86 06 12 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
180.2	Ground Surface										
0.0	Silty Clay (cl) Some Sand Trace Gravel occ. shaly zones (Till) hard		1	SS	52	DRY	180				
178.7							179				
1.5	1.7 End Of Borehole										
	*Bedrock Shale and Limestone Georgian Bay Formation Weathered										

RECORD OF BOREHOLE No C16

METRIC

W P 54-82-09 LOCATION Co-ords. N 4 833 345.0E 292 182.4 (Approx.) ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 13 CHECKED BY DD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE						
173.8	Ground Surface									
0.0	Bedrock									
	Shale and Limestone		1	SS	60/	10 cm				
	Georgian Bay Forma- tion		2	SS	60/	3 cm				
	Weathered		3	RC	90% rec					
	Unweathered									
170.1	End of Borehole		4	RC	100% rec					



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RECORD OF BOREHOLE No C17

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 251.0; E 292 029.0 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 12 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
177.2	Ground Surface												
0.0	Silty Clay (CL) With Sand Some Gravel (Fill) Stiff to Very Stiff		1	SS	14	DRY	177						
	Asphalt Zone		2	SS	20		176						
174.9			3	SS	60	13 cm	175						
2.3													
2.4	End of Borehole												
	* Bedrock Shale and Limestone Georgian Bay Formation Weathered												

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No C18

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 306.3; E 291 874.5 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 02 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
178.6	Ground Surface												
0.0	Silty Clay (CL) Some Sand Trace Gravel Occ. Shaly Zones (Till) Stiff to Hard		1	SS	19		178						
			2	SS	47		177						
175.9			3	SS	13		176						
2.7	Bedrock Shale and Limestone Georgian Bay Formation		3a	SS	100% rec	0 cm							
			4	RC	78% rec		175						
			5	RC	81% rec		174						
	Weathered Unweathered		6	RC	90% rec		173						
172.7			7	RC	100% rec								
5.9	End of Borehole												

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No C19

METRIC

W P 54-82-09 LOCATION Co-ords: N 4 833 171.5; E 291 819.2 ORIGINATED BY JD
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
 DATUM Geodetic DATE 86 06 12 CHECKED BY DD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
174.4	Ground Surface											
	Silty Clay (cl) Some Sand Some Gravel Occ. Shaly Zones (Till) Stiff to hard		1	SS	24							
172.8			1A	SS	60	0 cm						
1.6	End of Borehole											
	Probable Bedrock Shale and Limestone Georgian Bay Forma- tion Weathered											

RECORD OF BOREHOLE No C20a

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 129.8; E 291 684.3 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test, B Core COMPILED BY JD
DATUM Geodetic DATE 86 06 04 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
183.6	Ground Surface												
0.0	Silty Clay (cl) Some Sand Trace Gravel Occ. Shaly Zones (Till) Stiff to Hard		1	SS	17		183						
			2	SS	33		182						
			3	SS	36		181						
180.4			4	SS	60/	13 cm	180						
3.2			5	RC	46% rec		179						
			6	RC	25% rec		178						
	Bedrock Shale and Limestone Georgian Bay Formation Weathered		7	RC	0% rec		177						
			8	RC	fragments rec		176						
175.8			9	SS	60/	5 cm							
7.8	End of Borehole												

+3, x5: Numbers refer to
Sensitivity

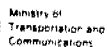
20
15 ÷ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No C20b

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 129.8; E 291 684.3 ORIGINATED BY JD
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core COMPILED BY JD
 DATUM Geodetic DATE 86 06 05 CHECKED BY DD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100					
183.6	Ground Surface												
0.0					DRY								
						183							
						182							
						181							
						180							
						179							
						178							
						177							
175.8	Refer to BH #20a					176							
7.8	Bedrock Shale and Limestone Georgian Bay Formation Weathered		10	RC	72% rec	175							
			11	RC	18% rec	174							
			12	WS		173							
172.5													
11.1	End of Borehole												



METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 129.8; E 291 684.3 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core COMPILED BY JD
DATUM Geodetic DATE 86 06 09 CHECKED BY DD

[illegible]

+3, x5: Numbers refer to Sensitivity

20
15 \diamond 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No C21

METRIC

W P 54-82-09 LOCATION Co-ords N 4 833 116.1; E 291 525.6 ORIGINATED BY JD
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
 DATUM Geodetic DATE 86 06 04 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
184.2	Ground Surface												
0.0	Silty Clay (cl) Some Sand Trace Gravel occ. shaly zones (Till) Stiff to Very Stiff		1	SS	16		184						
			2	SS	33		183						
182.2	Bedrock Shale and Limestone Georgian Bay Formation		3	RC	59% rec		182						
2.0	Weathered Unweathered		4	RC	100% rec		181						
							180						
179.2	End of Borehole												
5.0													

RECORD OF BOREHOLE No C22

METRIC

W P 54-82-09 LOCATION Co-ords: N 4 833 199.0; E 291 428.2 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 10 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
181.8	Ground Surface												
0.0	Silty Clay (cl) Trace Sand Trace Gravel (Till) Stiff to hard		1	SS	18								
	Occ. Shaly Zones		2	SS	86/	30 cm							
179.7	Bedrock		3	SS	60/	0 cm							
2.1	Shale and Limestone Georgian Bay Formation, Weathered		3A	SS	60/	0 cm							
178.8	End of Borehole												
3.0													

RECORD OF BOREHOLE No C23

METRIC

W P 54-82-09 LOCATION Co-ords: N 4 833 270.9; E 291 555.5 ORIGINATED BY JD
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
 DATUM Geodetic DATE 86 06 03 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES						
180.6	Ground Surface										
0.0	Silty Clay (cl) Some Sand Trace Gravel (Till) Very Stiff		1	SS	38	DRY	180				
178.5	occ. Shaly Zones		2	SS	38		179				
2.1	Bedrock Shale and Limestone Georgian Bay Formation Weathered		3	SS	118/23cm		178				
177.3			4	SS	60/3cm						
3.3	End of Borehole										

RECORD OF BOREHOLE No C24

METRIC

W P 54-82-09 LOCATION Co-ords: N 4 833 337.0; E 291 704.0 ORIGINATED BY JD
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
 DATUM Geodetic DATE 86 06 03 CHECKED BY DD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
177.9	Ground Surface											
0.0	Silty Clay Some Sand (Till)											
	Trace Gravel with Gravel		1	SS	27							
	occ. Shaly Zones		2	SS	178/	23 cm						
175.9	Very stiff to hard											
2.0	Bedrock											
175.5	*		3	SS	1007	0 cm						
2.4	End of Borehole											
	* Shale and Limestone Georgian Bay Formation Weathered											

RECORD OF BOREHOLE No C25

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 376.2; E 291 398.0 ORIGINATED BY JD
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
 DATUM Geodetic DATE 86 06 10 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
178.8	Ground Surface												
0.0	Silty Clay (CL) Some Sand Trace Gravel (Till) Firm to Hard		1	SS	8	DRY							
177.0	Occ. Shaly Zones		2	SS	60/	13 cm							
1.8	Bedrock												
176.4	Shale and Limestone Georgian Bay Formation		3	SS	60/	10 cm							
2.4	Weathered												
	End of Borehole												

RECORD OF BOREHOLE No C26

METRIC

W P 54-82-09 LOCATION Co-ords N 4 833 441.1; E 291 535.9 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 03 CHECKED BY DD

SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER TYPE 'N' VALUES						
177.4	Ground Surface								
0.0	Silty Clay (cl) Some Sand (Till) Stiff to hard Trace Gravel Some Gravel		1 SS 16		177				
175.3			2 SS 60/5	5 CB	176				
2.1			3 SS 100/0	0 CB	175				
173.9	Weathered Unweathered Bedrock Shale and Limestone Georgian Bay Formation		4 RC 100% rec		174				
3.5	End of Borehole								
	*occ. shaly and lime- stone zones								



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RECORD OF BOREHOLE No C27

METRIC

W P 54-82-09 LOCATION Co-ords: N 4 833 570.0; E 291 435.4 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 11 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
178.2	Ground Surface											
0.0	Silty Clay Some Sand Trace Gravel occ. shaly zones stiff to hard (Till)		1	SS	18	DRY	178					
			2	SS	73/25cm		177					
	Some Gravel		3	SS	114/23cm		176					
175.5	End of Borehole											
2.7	Probable Bedrock Shale and Limestone Georgian Bay Formation Weathered											

+3, x5 : Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No C28

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 669.8; E 291 312.0 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 17 - 18 CHECKED BY DD

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE						
180.0	Ground Surface									
0.0	Silty Clay (CL)									
	Some Sand									
	Trace Gravel									
	Occ. Shaly Zones		1	SS	17					
	Stiff to Hard (Till)		2	SS	18					
			3	SS	33					
			3a	SS	60/70	cm				
	Frequent Boulders		4	RC	42% rec					
			5	RC	22% rec					
			6	RC	22% rec					
			7	RC	67% rec					
171.5			8	RC	100% rec					
8.5	Bedrock Shale and Limestone Georgian Bay Formation Unweathered									
170.6										
9.4	End of Borehole									

+3, x5: Numbers refer to
Sensitivity

20
15 ÷ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No C29

METRIC

W P 54-82-09 LOCATION Co-ords: N 4 833 783.0; E 291 184.9 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 11 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
179.3	Ground Surface										
0.0	Silty Clay (cl) Some Sand occ. shaly zones stiff to hard (Till)		1	SS	22	DRY	179				
			2	SS	40		178				
			3	SS	34		177				
175.9	End of Borehole		4	SS	60/5cm		176				
3.4	Probable Bedrock Shale and Limestone Georgian Bay Formation weathered										

RECORD OF BOREHOLE No C30

METRIC

W P 54-82-09 LOCATION Co-ords: N 4 833 468.0; E 291 265.0 ORIGINATED BY JD
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
 DATUM Geodetic DATE 86 06 16-17 CHECKED BY DD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE						
179.5	Ground Surface									
0.0	Silty Clay (cl) Some Sand Trace Gravel Firm to hard (Till)		1	SS	7					
			2	SS	29					
176.8	occ. Shaly Zones		3	SS	80/28 cm					
2.7	Bedrock Shale and Limestone Georgian Bay Formation		4	RC	46% rec					
			5	RC	65% rec					
			6	RC	44% rec					
	Weathered Unweathered		7	RC	86% rec					
			8	RC	78% rec					
			9	RC	94% rec					
170.1	End of Borehole									
9.4										



RECORD OF BOREHOLE No C31

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 618.0; E 291 179.0 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 11 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
179.6	Ground Surface												
0.0	Silty Clay (CL) Some Sand Trace Gravel (Till) Firm to Hard		1	SS	10		179						
			2	SS	27		178						
			3	SS	61		177						
176.6	Occ. Shaly Zones		4	SS	60								
3.0	End of Borehole Probable Bedrock Shale and Limestone Georgian Bay Formation Weathered												

RECORD OF BOREHOLE No C32

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 728.9; E 291 073.0 ORIGINATED BY JD
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
 DATUM Geodetic DATE 86 06 13 - 16 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
181.0	Ground Surface										
0.0	Silty Clay (CL) Some Sand Trace Gravel (Till) Stiff to Hard		1	SS	24						
			2	SS	63						
			3	SS	60						
	Occ. Shaly Zones		4	SS	60/13 cm						
			5	SS	60/13 cm						
176.4			6	SS	60/13 cm						
4.6	Bedrock Shale and Limestone Georgian Bay Formation		7	RC	15% rec						
	Weathered Unweathered		8	RC	89% rec						
173.0			9	RC	81% rec						
8.0	End of Borehole										

For
Bridge #67, Ramp W-N
Hwy. 401/Hwy. 410 Interchange
W.P. 54-82-10; Site 24-81-492
District 6, Toronto

INTRODUCTION:

This report summarizes the results of a foundation investigation required for the proposed ramp and its associated retaining walls.

The fieldwork was conducted from 84 09 24 to 84 10 10 utilizing continuous flight auger machines equipped with solid stem augers and B and N core barrels. Additional field work was conducted on 85 03 13.

This work consisted of,

- 3 sampled boreholes, and
- 17 sampled boreholes/rock cores

SITE DESCRIPTION

The site is located at the existing partial interchange of Hwy. 401 and Hwy. 410 in the City of Mississauga, Regional Municipality of Peel.

Topographically, the ground surface is generally level, sloping gently towards the east. Near the eastern limit of the site, existing Hwy. 410 is in a 10± m cut.

Physiographically, the site lies in the Peel Plain (Chapman and Putnam, 1969), an area characterized by level to undulating till plains underlain by shale or limestone bedrock.

Land use in the area is predominantly light industrial.

SUBSURFACE CONDITIONS

General

The Record of Borehole Sheets, (Appendix) illustrate the conditions at the borehole locations. The locations and elevations of the boreholes and stratigraphical profiles based on the borehole data, are shown on Drawing No. 548210-A. **

At the borehole locations, less than 3.4 m of predominantly silty clay overburden, overlies the shale bedrock.

** NOTE: Refer to Sheet No. 87 of the Contract Drawings.

Overburden

SILTY SAND; occasional gravel zones

This loose material was encountered at the surface at BH #1 where it extended for a thickness of 0.9 m.

SILTY CLAY; with/some sand, some/trace gravel, occasional shaly zones

This firm to hard (typically hard) material was encountered at the surface at all boreholes except BH #1. At BH #1 it underlies the surface SILTY SAND.

The material is a heterogeneous, cohesive mixture, with low plasticity and in some areas occasional organics.

The material overlies the bedrock and ranges in thickness from 0.3 to 3.4 m at the borehole locations.

Physical properties of the material as determined by field tests and laboratory tests are summarized below:

	<u>Range</u>	<u>Average</u>	<u>Median</u>
Natural Moisture Content (w)	4.5 - 17.5%	9.3%	9.8%
Liquid Limit (w_L)	17.0 - 35.0%	29.3%	30.8%
Plastic Limit (w_p)	17.0 - 20.0%	18.1%	18.8%

Figure 1 illustrates a typical grain size distribution for this material.

Bedrock

The bedrock is Georgian Bay Formation shale containing occasional limestone layers. The upper 1± m is weathered.

Refer to the Record of Borehole Sheets for bedrock elevations and boundaries between weathered and unweathered bedrock.

Refer to the appended Descriptions of Rock Core for detailed descriptions of the bedrock.

Groundwater

The groundwater elevation is variable but generally near the surface. Refer to the Record of Borehole Sheets for groundwater elevations at the borehole locations.

MISCELLANEOUS

The fieldwork for this project was carried out under the supervision of Mr. H. Sturm, Project Foundations Engineer, and Mr. D. Thanasse, Student Engineer.

Descriptions of the rock core samples were carried out under the supervision of Mr. E. Magni, Geologist.

The report was written by Mr. D. H. Dundas, Foundations Engineer and reviewed by Mr. M. Devata, Chief Foundations Engineer.

The equipment used was owned and operated by Longyear Canada Ltd., and Master Soil Investigation Ltd.

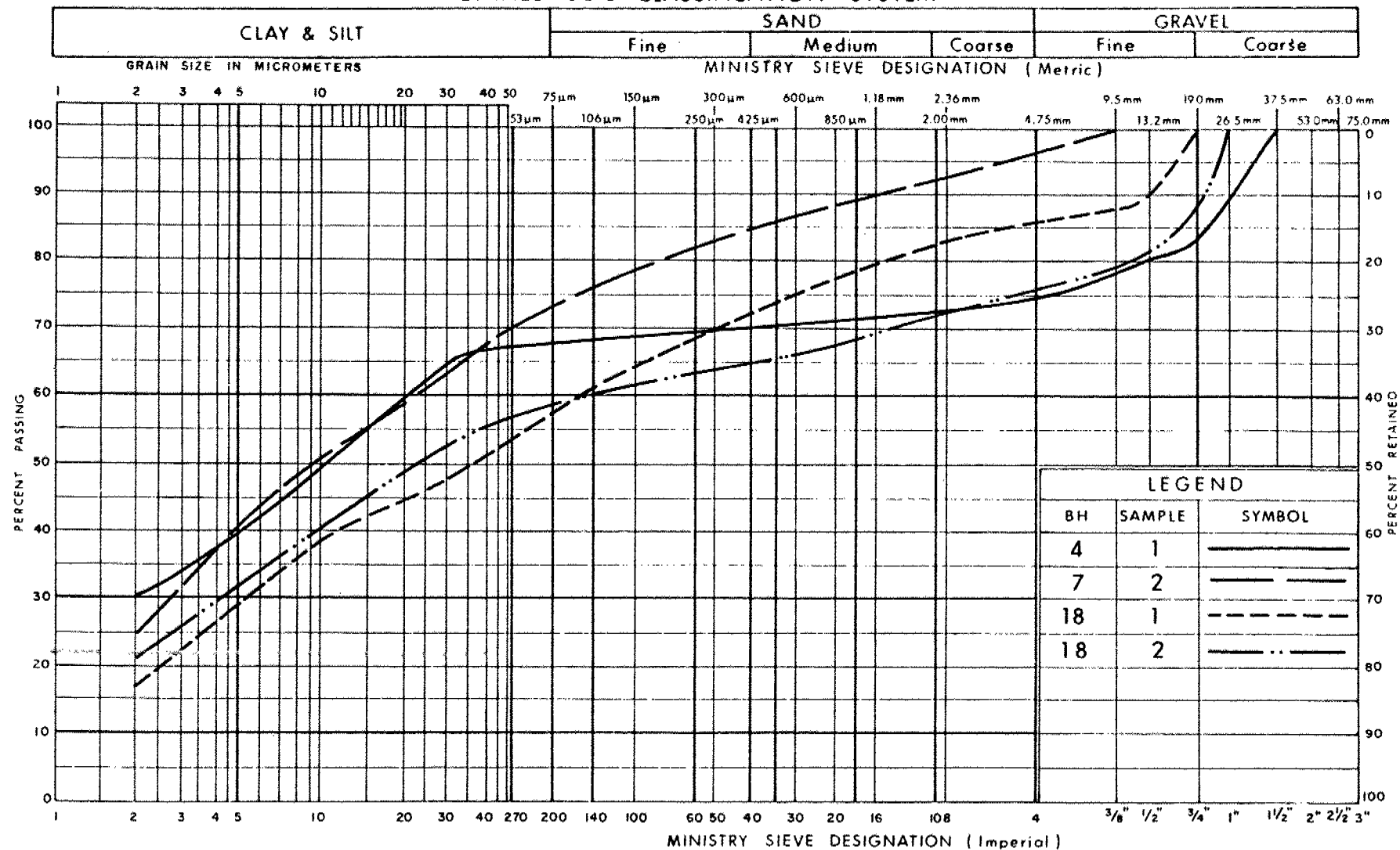


D. H. Dundas
D. H. Dundas, P. Eng.
Foundations Engineer

M. Devata
M. Devata, P. Eng.
Chief Foundations Engineer (East)

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM



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GRAIN SIZE DISTRIBUTION
SILTY CLAY, WITH/SOME SAND SOME/TRACE OF GRAVEL
OCCASIONAL SHALY ZONES

FIG No 1

W P 54-82-10

DESCRIPTION OF ROCK CORE - W.P. 54-82-10

BOREHOLE NUMBER	CORE RECOVERIES			CORE DESCRIPTION	
	DEPTH (M)	% CR*	% RQD*	DEPTH (M)	DESCRIPTION
2NW	1.93 - 3.46 - 3.91 - 4.98	38 75 93	10 20 14	1.93 - 3.91 - 4.98	Shale, highly weathered, with limestone layers (high core loss zone) Shales (95%), grey, unweathered, closely spaced joints, with limestone (5%), unweathered, 1 to 10 cm thick layers
3NW	2.85 - 4.35 - 5.72	48 100	12 0	2.85 - 4.35 - 5.72	Shale, highly weathered, very closely spaced joints (high core loss zone) with limestone, 2 to 15 cm thick layers Limestone (60%), grey, unweathered, closely spaced joints, with shale (40%), grey, slightly weathered, with moderately weathered zones, closely spaced joints
4NW	3.46 - 4.47 - 5.85	65 85	0 67	3.46 - 4.47 - 5.85	Shale (50%), moderately weathered, very closely spaced joints, with limestone (50%), 1 to 7 cm thick layers Shale (60%), grey, unweathered, moderately spaced joints, with limestone (40%), grey, 1 to 20 cm thick layers
6NW	3.46 - 5.11	100	39	3.46 - 5.11	Shale (75%), grey, unweathered, closely spaced joints, with limestone (25%), unweathered, closely spaced joints, 2 to 20 cm thick layers
7NW	3.23 - 5.44	100	18	3.23 - 3.39 - 5.44	Soil Shale (50%), grey, slightly weathered to unweathered, closely spaced joints, with limestone (50%), light grey, unweathered, closely spaced joints, 2 to 25 cm thick layers

* CR = CORE RECOVERY; RQD = ROCK QUALITY DESIGNATION

DESCRIPTION OF ROCK CORE - W.P. 54-82-10

BOREHOLE NUMBER	CORE RECOVERIES			CORE DESCRIPTION	
	DEPTH (M)	% CR*	% RQD*	DEPTH (M)	DESCRIPTION
8NW	2.39 - 3.76	80	13	2.39 - 3.76	Limestone (90%), light grey, unweathered, closely spaced joints, with shale (10%), grey, slightly to moderately weathered, very closely spaced joints
9NW	0.89 - 1.45 - 2.32 - 3.41	64 35 84	0 0 30	0.89 - 1.45 - 2.32 - 3.00 - 3.41	Limestone (100%), light grey, slightly weathered, closely spaced joints Shale, highly weathered, with some limestone layers, high core loss zone Shale (95%), grey, moderately weathered, very closely spaced joints, with limestone (5%), 2 to 3 cm thick layers Limestone (100%), light grey, unweathered, moderately spaced joints
10NW	1.98 - 3.13 - 3.74	89 100	42 83	1.98 - 2.72 - 3.74	Limestone (100%), light grey, unweathered, closely spaced joints Shale (80%), grey, slightly weathered to unweathered, closely spaced joints, with limestone (20%), unweathered, 1 to 8 cm thick layers
11NW	0.71 - 0.98 - 2.49 - 3.18	100 100 100	0 42 22	0.71 - 1.30 - 3.18	Shale (50%), grey, moderately weathered, very closely spaced joints, with limestone (50%), light grey, slightly weathered Shale (60%), grey, slightly weathered to unweathered, closely spaced joints, with limestone (40%), light grey, 5 to 15 cm thick layers

* CR = CORE RECOVERY; RQD = ROCK QUALITY DESIGNATION

DESCRIPTION OF ROCK CORE - W.P. 54-82-10

BOREHOLE NUMBER	CORE RECOVERIES			CORE DESCRIPTION	
	DEPTH (M)	% CR*	% RQD*	DEPTH (M)	DESCRIPTION
12NW	0.84 - 1.27 - 2.54	76 100	0 54	0.84 - 1.88 - 2.54	Shale (90%), grey, slightly weathered, very closely spaced joints, with limestone (10%), 20 cm thick layer Shale (100%), grey, unweathered, closely spaced joints
13NW	0.46 - 1.45 - 1.96 - 2.59 - 4.50	33 50 40 91	0 0 16 53	0.46 - 2.59 - 4.50	Shale, moderately to highly weathered, with some limestone, high core loss zone Shale (50%), grey, unweathered, closely spaced joints, with limestone (50%), light grey, unweathered, closely spaced joints
13(A)NW	0.20 - 1.25 - 1.40 - 1.86 - 2.46	29 17 100 100	10 0 0 33	0.20 - 1.40 - 2.46	Soil and boulders Shale (70%), grey, unweathered, closely spaced joints, with limestone (30%), unweathered, 1 to 20 cm thick layers
14NW	0.31 - 1.58 - 1.83	90 100	60 100	0.31 - 1.83	Limestone (70%), grey, unweathered, with shale (30%), unweathered
15NW	2.44 - 3.44 - 5.74	41 74	0 22	2.44 - 3.44 - 5.74	Shale, highly weathered, with some limestone, high core loss zone Limestone (75%), grey, unweathered, closely spaced joints with shale (25%), grey, slightly weathered

* CR = CORE RECOVERY; RQD = ROCK QUALITY DESIGNATION

DESCRIPTION OF ROCK CORE - W.P. 54-82-10

BOREHOLE NUMBER	CORE RECOVERIES			CORE DESCRIPTION	
	DEPTH (M)	% CR*	% RQD*	DEPTH (M)	DESCRIPTION
15(A)NW	1.93 - 3.41	22	0	1.93 - 3.41	Soil
	- 4.45	78	24	- 3.74	Limestone (100%), light grey, unweathered, closely spaced joints
				- 4.45	Shale (80%), grey, moderately weathered, very closely spaced joints, with limestone layers 1 to 12 cm thick
17NW	1.83 - 2.27	53	0	1.83 - 4.04	Shale and limestone, highly weathered, high core loss zone
	- 3.36	28	0		
	- 3.66	58	0		
	- 4.04	60	0		
18NW	2.39 - 3.29	20	0	2.39 - 3.29	Shale and limestone, highly weathered, high core loss zone
	- 3.86	67	26	- 6.00	Limestone (50%), light grey, slightly weathered, with shale (50%), moderately weathered, high core loss
	- 6.00	63	18		

* CR = CORE RECOVERY; RQD = ROCK QUALITY DESIGNATION

DESCRIPTION OF ROCK CORE - W.P. 54-82-10

BOREHOLE NUMBER				CORE DESCRIPTION	
	DEPTH (m)	% CR *	% RQD *	DEPTH (m)	DESCRIPTION
5	2.21 - 3.71	86	25	2.21 - 2.87	Limestone (50%), light grey, moderately weathered, very closely spaced joints with shale (50%), dark grey, highly weathered with occasional sheared clay zones
				2.87 - 3.71	Limestone (50%), light grey, unweathered, closely spaced joints with shale (50%), dark grey, slightly weathered with 0.05 m clay layer at 3.23 m
20	1.42 - 1.57	50	0	1.42 - 2.29	Shale (80%), dark grey, moderately weathered, very closely spaced joints with limestone (20%), light grey, slightly weathered, closely spaced joints
	1.57 - 1.93	64	0		
	1.93 - 2.97	93	10	2.29 - 2.97	Limestone (75%), light grey, unweathered, very closely spaced joints with shale (25%), dark grey, slightly weathered with some moderately weathered zones

* CR = CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION



RECORD OF BOREHOLE No 1

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 832 872, E 291 648 ORIGINATED BY HS
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B Core COMPILED BY DD
DATUM Geodetic DATE 84 10 10 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
184.6	Ground Surface																
0.0	Asphalt					**											
183.7	Silty Sand occ. gravel zones Loose		1	SS	36		184										
0.9	Silty Clay (CL) with/some sand some/trace gravel																
182.8	*		2	SS	114	23 cm	183										
1.8	End of Borehole																
	Probable Bedrock Shale with limestone layers weathered																
	* occ. organics occ. shaly zones hard																
	** groundwater elevation not determined																

RECORD OF BOREHOLE No 2

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 832 889; E 291 633 ORIGINATED BY DT
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B. Core COMPILED BY DD
 DATUM Geodetic DATE 84 10 09-10 CHECKED BY GP

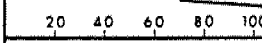
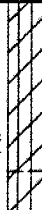

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
184.6	Ground Surface													
0.0	Silty Clay (CL) with/some sand some/trace gravel occ. shaly zones Hard		1	SS	39									
182.8			2	SS	127/	23 cm								
1.8	Bedrock Shale with limestone layers		3	RC	REC. 38%									
	— weathered — unweathered		4	RC	REC. 75%									
			5	RC	REC 93%									
179.6														
5.0	End of Borehole													
	* groundwater elevation not determined													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

METRIC


W P 54-82-10 LOCATION Co-ords. N 4 832 880; E 291 597 ORIGINATED BY HS
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Augers, B. Core COMPILED BY DD
 DATUM Geodetic DATE 84 10 10 CHECKED BY CP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
184.5	Ground Surface												
0.0	Silty Clay (CL) with/some sand some/trace gravel		1	SS	8	*	184						
	occ. organics firm to stiff occ. shaly zones Hard		2	SS	146/20 cm		183						
182.2	Bedrock						182						
2.3	Shale with limestone layers		3	RC	REC 48%		181						
	Weathered Unweathered		4	RC	REC 100%	180							
178.8						179							
5.7	End of Borehole * groundwater elevation not determined												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 832 903; E 291 657 ORIGINATED BY DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B. Core COMPILED BY DD
DATUM Geodetic DATE 84 10 09 CHECKED BY 

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
								SHEAR STRENGTH						

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 832 861; E 291 622 ORIGINATED BY IW
 DIST 6 HWY 401/410 BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core COMPILED BY HS
 DATUM Geodetic DATE 85 03 13 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
184.8	Ground Surface																GR SA SI CL
0.0	Asphalt																
	Sandy Gravel (Fill) Compact		1	SS	23	*	184										
183.7																	
1.1	Silty Clay with/some Sand some/trace Gravel Hard		2	SS	56		183										
182.6																	
2.2	Bedrock Shale with weathered limestone unweathered layers		3	RC BXL	REC 86%		182										RQD 25%
181.1																	
3.7	End of Borehole																
	* Groundwater elevation not determined.																

* 3, * 5 : Numbers refer to
Sensitivity

20
15
10
5
0
[%] STRAIN AT FAILURE

RECORD OF BOREHOLE No 6

METRIC


W P 54-82-10 LOCATION Co-ords. N 4 832 920; E 291 672 ORIGINATED BY DT
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B. Core COMPILED BY DD
 DATUM Geodetic DATE 84 10 09 CHECKED BY EP



SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
183.3	Ground Surface																GR SA SI CL
0.0	Probable Silty Clay(CL) with/some sand						183										
182.5	* some/trace gravel																
0.8			1	SS	180		182										
	Bedrock Shale with limestone layers		2	SS	70	12 cm	181										
							180										
	Weathered Unweathered						179										
178.2			3	RC	REC 100%												
5.1	End of Borehole * occ. shaly zones																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 7

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 832 969; E 291 700 ORIGINATED BY JC/DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, N. Core COMPILED BY DD
DATUM Geodetic DATE 84 10 05-09 CHECKED BY 

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
184.6	Ground Surface												
0.0													
	Silty Clay (CL) with/some sand some/trace gravel occ. organics occ. shaly zones Stiff to Hard		1	SS	14		184						
			2	SS	29		183						
							182						
181.0			3	SS	20		181						
3.4							180						
	Bedrock Shale with limestone layers Unweathered		4	RC	REC 100%								
179.0													
5.4	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 8

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 020; E 291 721 ORIGINATED BY DT
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, N Core COMPILED BY DD
 DATUM Geodetic DATE 84 10 09 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	PLASTIC LIMIT W _p	W	LIQUID LIMIT W _L		
182.8	Ground Surface															GR SA SI CL
0.0	Silty Clay (CL) with/some sand some/trace gravel occ. organics occ. shaly zones Hard		1	SS	72											
181.1			2	SS	110/	23 cm										
1.7	Bedrock Shale with limestone layers - Weathered - Unweathered		3	RC	REC 80%											
179.1	End of Borehole															
3.7																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 9

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 058; E 291 730 ORIGINATED BY DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B Core COMPILED BY DD
DATUM Geodetic DATE 84 10 02 CHECKED BY *JP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80					
182.2	Ground Surface															
0.0	Probable Silty Clay (CL) *															
181.6																
0.6																
	Bedrock Shale with limestone layers		1	RC	REC 64%											
			2	RC	REC 35%											
	Weathered Unweathered		3	RC	REC 84%											
178.8																
3.4	End of Borehole * with/some sand some/trace gravel occ. shaly zones															

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 10

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 099; E 291 740 ORIGINATED BY DT
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger COMPILED BY DD
 DATUM Geodetic DATE 84 10 02 CHECKED BY *EP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
179.2	Ground Surface																GR SA SI CL
0.0	Silty Clay (CL) with/some sand some/trace gravel occ. shaly zones Hard		1	SS	69	*	179										
							178										
177.2			2	SS	39												
2.0	Bedrock Shale with limestone layers Unweathered		3	RC	REC 89%		177										
			4	RC	REC 100%		176										
175.5	End of Borehole																
3.7	* groundwater elevation not determined																

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 11

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 148; E 291 738 ORIGINATED BY DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B Core COMPILED BY DD
DATUM Geodetic DATE 84 10 04 CHECKED BY EP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
173.8	Ground Surface																
0.0	Silty Clay (CL) * with/some sand Weathered Unweathered Bedrock Shale with limestone layers		1	SS	14	**	173										
173.0			2	RC	REC 100%												
0.6			3	RC	REC 100%		172										
			4	RC	REC 100%		171										
170.4	End of Borehole																
3.2	* some/trace gravel stiff to hard **groundwater elevation not determined																

+³, x⁵: Numbers refer to
Sensitivity

20
15 \pm 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 12

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 208; E 291 732 ORIGINATED BY DT
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B. Core COMPILED BY DD
 DATUM Geodetic DATE 84 09 27 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
176.9	Ground Surface																
0.0 176.6	Probable Silty Clay (CL)																
0.3	Weathered Unweathered		1	RC	REC 76%		176										
	Bedrock Shale with limestone layers		2	RC	REC 100%		175										
174.4 2.5	End of Borehole * with/some sand some/trace gravel occ. shaly zones																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 13

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 258; E 291 719 ORIGINATED BY DT
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B Core COMPILED BY DD
 DATUM Geodetic DATE 84 10 01 CHECKED BY CR

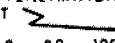
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
177.6	Ground Surface																
0.0	Silty Clay (CL) with/some sand some/trace gravel occ. boulders occ. shaly zones		1	RC	REC 29%		177										
176.2	Hard		2	RC	*17%												
1.4	Bedrock Shale		3	RC	REC 100%		176										
175.2	with limestone layers Unweathered		4	RC	REC 100%												
2.4	End of Borehole																
	* REC																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 14

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 883 300; E 291 700 ORIGINATED BY DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B Core COMPILED BY DD
DATUM Geodetic DATE 84 09 27 CHECKED BY *CP*

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					
175.1	Ground Surface															
0.0	Probable Silty Clay*					175										
174.8	Weathered															
0.3	Unweathered															
	Bedrock		1	RC	REC 90%	174										
	Shale															
	with limestone layers															
173.3			2	RC	**100%											
1.8	End of Borehole															
	* with/some sand some/trace gravel occ. shaly zones															
	** REC															

RECORD OF BOREHOLE No 15 & 15A

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 343; E 291 670 ORIGINATED BY DT
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B Core COMPILED BY DD
 DATUM Geodetic DATE 84 10 04 CHECKED BY CP

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
177.0	Ground Surface																
0.0	Silty Clay (CL) with/some sand some/trace gravel occ. boulders occ. shaly zones Very Stiff to Hard		1	SS	29	*											
			2	SS	48												
174.6	Bedrock Shale with limestone layers — Weathered Unweathered		3	RC	REC 22%												
2.4			4	RC	REC 78%												
172.6	End of Borehole																
4.4	* groundwater elevation not determined																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 16

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 349; E 291 680 ORIGINATED BY DT
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B Core COMPILED BY DD
 DATUM Geodetic DATE 84 09 24 CHECKED BY SP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
178.0	Ground Surface																
0.0	Silty Clay (CL) with/some sand some/trace gravel occ. shaly zones Very Stiff to Hard		1	SS	23	*	177										
176.0			2	SS	36												
2.0	End of Borehole Probable Bedrock Shale with limestone layers Weathered * groundwater elevation not determined																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 17

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 367; E 291 652 ORIGINATED BY DT
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B. Core COMPILED BY DD
 DATUM Geodetic DATE 84 09 25 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
177.8	Ground Surface																
0.0	Probable Silty Clay (CL) with some sand some/trace gravel occ. boulders occ. shaly zones																
176.3																	
1.5	Bedrock Shale with limestone layers Weathered		1	RC	REC 53%												
			2	RC	REC 28%												
			3	RC	REC 58%												
173.8			4	RC	REC 60%												
4.0	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 18

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 391; E 291 632 ORIGINATED BY DT
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B Core COMPILED BY DD
 DATUM Geodetic DATE 84 09 25 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
177.6	Ground Surface															
0.0	Silty Clay (CL) with/some sand trace/some gravel occ. boulders occ. shaly zones Very Stiff to Hard		1	SS	23	↓	177									14 28 41 17
			2	SS	22		176									24 18 38 20
175.5	Bedrock Shale with limestone layers Weathered		3	RC	REC 20%		175									
2.1			4	RC	REC 67%		174									
			5	RC	REC 63%		173									
171.6	End of Borehole						172									
6.0																

+3, x5: Numbers refer to
Sensitivity

20
15
10

5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 19

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 396; E 291 664 ORIGINATED BY DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger COMPILED BY DD
DATUM Geodetic DATE 84 09 24 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
177.9	Ground Surface																GR SA SI CL
0.0	Silty Clay (CL) with/some sand some/trace gravel occ. shaly zones Hard					*	177										
			1	SS	38												
176.2			2	SS	37												
1.7	End of Borehole																
	Probable Bedrock Shale with limestone layers Weathered																
	* groundwater elevation not determined																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 20

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 074; E 291 734 ORIGINATED BY IW
DIST 6 HWY 401/410 BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core COMPILED BY HS
DATUM Geodetic DATE 85 03 13 CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100				
182.1	Ground Elevation														
0.0	Probable Silty Clay														
181.5															
0.6	Bedrock Shale with limestone layers		1	SS	16										
			2	SS	51										
			3	RC	50										
			4	RC	REC										
			4	BXL	0.4										
	weathered unweathered		5	RC	REC										
			5	BXL	93										
179.1															
3.0	End of Borehole														
	* with/some sand some/trace gravel														
	** Water Level immediately after drilling														

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

For

Bridge #32, Ramp N-E 401/410 Interchange

W.P. 54-82-11; Site 24-81-325

District 6, TorontoINTRODUCTION:

This report summarizes the factual information obtained from a foundation investigation carried out between 84-09-28 and 84-10-10 at the structure site mentioned above. The fieldwork consisted of 9 sampled boreholes advanced by means of solid stem augers or washing boring BX casing. The boreholes ranged in depth from 2.0 to 5.7 m with bedrock being proven in 8 of the boreholes. Bedrock was sampled by coring up to 4.3 m of rock using either a BQ or NXL core barrel.

SITE DESCRIPTION AND GEOLOGY

The site is located at the existing partial interchange of Highway 401 and Highway 410 in the City of Mississauga, Regional Municipality of Peel.

Land use in the area is predominantly industrial subdivisions. The ground surface in the investigated area is generally level and tends to slope down gently to the east. At the eastern limit of the site is a 10 m cut in which the existing Highway 410 southbound lane is located.

The site is located in the physiographic region known as the "Peel Plain". This region is characterized by a level to undulating "till or boulder clay" plain underlain by shale or limestone bedrock. In the vicinity of this site the overburden is very shallow with shale bedrock very close to the surface.

SUBSURFACE CONDITIONSGeneral

The subsurface conditions across the site are quite uniform with a surficial deposit of a heterogeneous mixture of silty clay some sand. This cohesive deposit varies in thickness from 0.4 to 2.0 m and is underlain by shale bedrock which is generally very weathered in the upper 1 to 2 m. At one borehole location on the south side of westbound Highway 401 a 1.4 m stratum of silt of slight plasticity was encountered overlying the deposit of silty clay.

The boundaries between the various soil types, in-situ and laboratory test results are shown on the attached Record of Borehole Sheets. The elevations and locations of the boreholes along with an estimated stratigraphical profile based on borehole data, are shown on Drawing No. 548211-A. ***

The various soil types encountered are described in the following paragraphs.

Silt, some Sand, Trace of Clay

This 1.4 m thick surficial deposit was encountered in only one borehole located on the south side of the Highway 401 westbound lanes (BH 4). The silt was found to be of slight plasticity with the deposit being assessed as cohesive.

Grain size distribution testing carried out on a sample from this stratum indicates that the deposit is predominantly silt. Results of the testing are plotted on Fig. 1.

Based on interpretation of an 'N' value of 101 the consistency of this generally cohesive deposit is assessed to be hard.

Heterogeneous Mixture of Silty Clay some Sand

This cohesive deposit was encountered across the site and varies in thickness from 0.4 to 2.0 m.

Atterberg Limits testing carried out on two samples from this stratum indicate the deposit to vary from a silty clay of low plasticity (CL-ML zone) to a silty clay of intermediate plasticity (CI zone). The results of these tests are plotted on Fig. 2.

The consistency of this layer varies from stiff to hard based on 'N' values ranging from 11 to 60 blows per 0.3 m.

*** NOTE: Refer to Sheet No. 45 of the Contract Drawings.

Shale Bedrock

Bedrock was encountered in all boreholes with the top of rock elevation varying from 172.2 at the bottom of the existing Highway 410 cut to 183.0 on the generally level plain.

Bedrock was proven by obtaining up to 4.3 m of BQ or NXL rock core. Bedrock is of the Georgian Bay Formation and is generally a grey shale with occasional limestone layers 10 to 500 mm thick. The limestone layers generally tend to comprise 20% of the bedrock mass with occasional zones where 50% of the rock is limestone. The upper bedrock is weathered to varying degrees and becomes less weathered with depth (see borehole logs). Rock core recovery rates varied from 25 to 100%. Based on rock quality designation (RQD) values ranging from 0 to 81%, the quality of the bedrock is assessed to be very poor to good, but generally being very poor to poor. For a detailed description of the bedrock see Description of Rock Core in the Appendix.

Groundwater

The water table varies considerably across the site. In the existing Highway 410 cut the water table appears to be at an elevation of 172.7 which corresponds to the bottom of the ditch. Outside of the Highway 410 cut the water table varies from an elevation of 180.6 adjacent to Highway 410 (BH 6) to 183.0 in the vicinity of the existing Highway 401 westbound lanes.

MISCELLANEOUS

The field work for this project was carried out under the supervision of Mr. D. Thanasse, Student Engineer, utilizing equipment owned and operated by Longyear Canada Inc.

This report was written by Mr. H. J. Sturm, Project Foundations Engineer and reviewed by Mr. D. Dundas, Foundations Engineer for M. Devata, Chief Foundations Engineer (East).

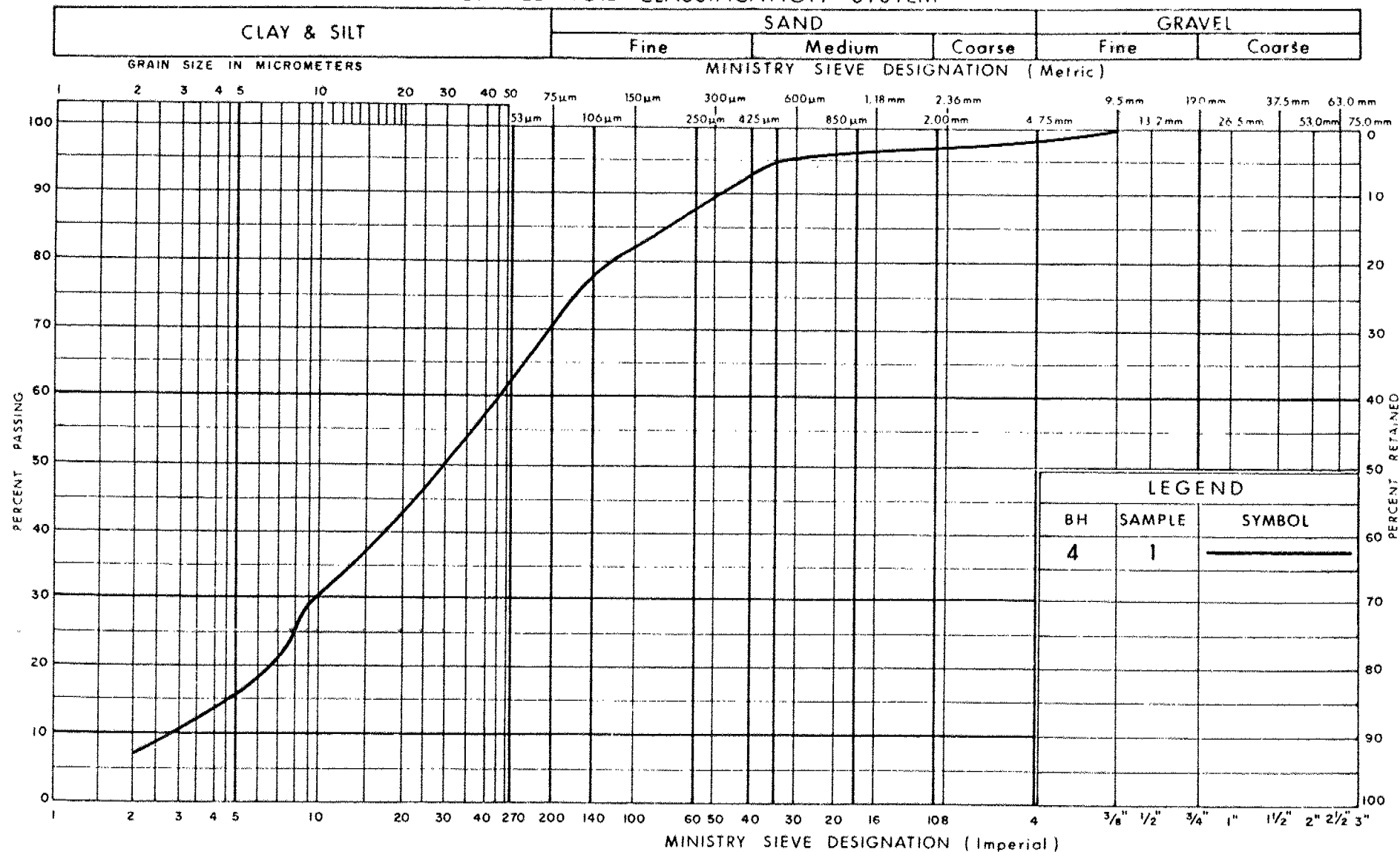


D. H. Dundas
D. H. Dundas, P. Eng.
Sr. Foundations Engineer

M. Devata
M. Devata, P. Eng.
Chief Foundations Engineer
(East)

A P P E N D I X

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

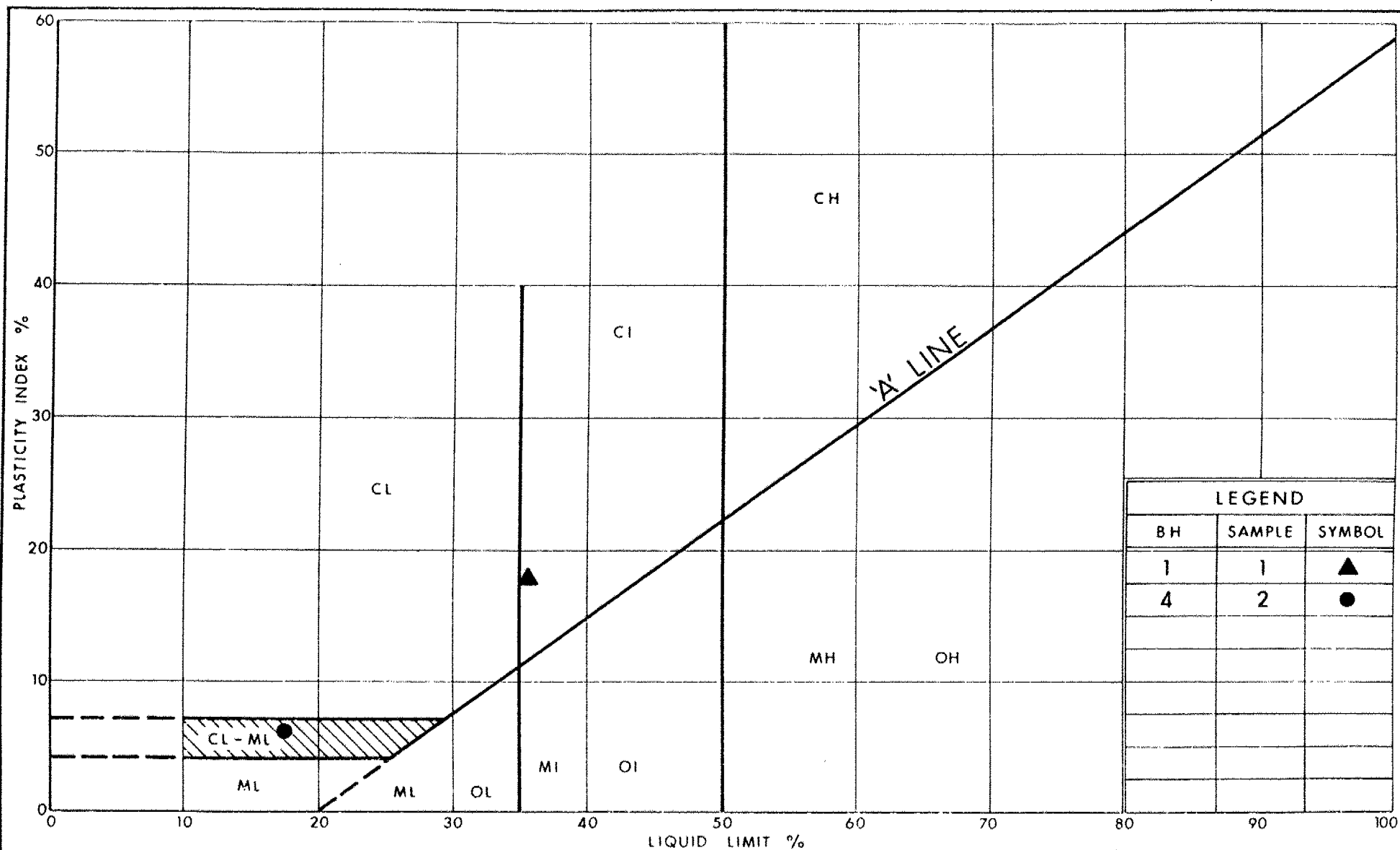
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GRAIN SIZE DISTRIBUTION

SILT, SOME SAND TRACE OF CLAY

FIG No 1

W P 54-82-11



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Ontario

PLASTICITY CHART HET MIXTURE OF SILTY CLAY, SOME SAND

FIG No 2

W P 54-82-11

RECORD OF BOREHOLE No 1										METRIC				
W P 54-82-11		LOCATION Co-ords. N 4 833 074.3; E 291 663.8				ORIGINATED BY DT								
DIST 6 HWY 410/401		BOREHOLE TYPE Solid Stem Auger				COMPILED BY HS								
DATUM Geodetic		DATE 84 10 03				CHECKED BY <i>EP</i>								
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40					
184.5	Ground Surface													
0.0	Heterogeneous Mixture of Silty Clay some sand Occasional pieces of shale		1	SS	11									
	Stiff													
	hard		2	SS	57									
182.5														
2.0	End of Borehole Refusal to Auger Probable Bedrock													
	* Note: Water table not obtained.													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2										METRIC			
W P 54-82-11		LOCATION Co-ords. N 4 833 058.8; E 291 687.5				ORIGINATED BY DT							
DIST 6 HWY 410/401		BOREHOLE TYPE Wash Bore BX Casing, BQ Rock Core				COMPILED BY HS							
DATUM Geodetic		DATE 84 10 03				CHECKED BY <i>[Signature]</i>							
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			VALUES	20					
183.9	Ground Surface												
0.0	Heterogeneous Mixture of Silty Clay some sand												
183.0	Occasional shale slabs												
0.9													
	Grey Shale Bedrock with Limestone Bands		1	RC BQ									
			2	RC BQ									
			3	RC BQ									
			4	RC BQ									
	Grey Limestone Bedrock with Shale Bands												
			5	RC									
			6	RC BQ									
178.7													
5.2	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3										METRIC				
W P 54-82-11		LOCATION Co-ords. N 4 833 048.5; E 291 711.2				ORIGINATED BY DT								
DIST 6 HWY 410/401		BOREHOLE TYPE Wash Bore BX Casing, BQ Rock Core				COMPILED BY HS								
DATUM Geodetic		DATE 84 10 03				CHECKED BY								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
182.0	Ground Surface													
0.0	Heterogeneous Mixture					*								
181.6	of Silty Clay some sand													
0.4	Grey Shale Bedrock with Limestone Bands		1	RC BQ			181	58%	11%					
			2	RC BQ			180	100%	21%					
179.7	Grey Limestone Bedrock													
2.3	End of Borehole													
	* Note: Water table not obtained													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4										METRIC				
W P 54-82-11		LOCATION Co-ords. N 4 833 035.5; E 291 743.6				ORIGINATED BY DT								
DIST 6 HWY 410/401		BOREHOLE TYPE Solid Stem Auger, NXL Rock Core				COMPILED BY HS								
DATUM Geodetic		DATE 84 10 10				CHECKED BY <i>[Signature]</i>								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH					
182.8	Ground Surface													
0.0	Silt some sand trace clay					*								
181.4	Hard		1	SS	101									1 28 64 7
1.4	Heterogeneous Mixture of Silty Clay some sand some shale fragments		2	SS	60									
180.5	Hard		3	SS	20	5 cm								
2.3	Grey Limestone Bedrock Occasional Shale Seams		4	RC NXL										
	Grey Shale Bedrock with Limestone Layers 2 to 50 cm thick		5	RC NXL										
177.1	End of Borehole													
5.7	* Note: Water level not obtained													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5

METRIC

W P 54-82-11 LOCATION Co-ords. N 4 833 021.5; E 291 796.4
 DIST 6 HWY 410/401 BOREHOLE TYPE Solid Stem Auger, BQ Rock Core
 DATUM Geodetic DATE 84 10 05

ORIGINATED BY DT
 COMPILED BY HS
 CHECKED BY CP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100					
183.9	Ground Surface															
0.0	Heterogeneous Mixture of Silty Clay with sand Occasional Rock Slabs Very Stiff		1	SS	14/	8 cm spoon bouding										
182.6																
1.3	Grey Shale Bedrock with Limestone Layers 5 to 20 cm thick		2	RC BQ												
			3	RC BQ												
180.9																
3.0	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 6

METRIC

W P 54-82-11 LOCATION Co-ords. N 4 833 015.0; E 291 856.2

ORIGINATED BY DT

DIST 6 HWY 410/401 BOREHOLE TYPE Solid Stem Auger, BQ Rock Core

COMPILED BY HS

DATUM Geodetic DATE 84 10 05

CHECKED BY *GR*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
183.4	Ground Surface																
0.0	Heterogeneous Mixture of Silty Clay some sand						183										
182.5	Grey Limestone							REC	RQD	Weathering							
0.9	Grey Shale Bedrock		1	RC BQ			182	64%	0%	Slightly Highly							
	Grey Limestone Bedrock Occasional Shale Seams		2	RC BQ			181	100%	9%	Slightly to Unweathered							
	Grey Shale Bedrock Occasional Limestone Layers 2 cm thick		3	RC BQ			180	93%	21%								
179.3	End of Borehole																
4.1																	

OFFICE REPORT ON SOIL EXPLORATION

*3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 7										METRIC					
W P 54-82-11		LOCATION Co-ords. N 4 833 016.2; E 291 897.0				ORIGINATED BY DT									
DIST 6 HWY 410/401		BOREHOLE TYPE Solid Stem Auger, BQ Rock Core				COMPILED BY HS									
DATUM Geodetic		DATE 84 10 01				CHECKED BY <i>CP</i>									
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60					
172.7	Ground Surface														
0.0	Heterogeneous Mixture														
172.2	of Silty Clay some sand														
0.5															
	Grey Shale Bedrock with Limestone Layers 4 to 20 cm thick		1	RC BQ		172	69%	21%	Weathering Highly						
			2	RC BQ		171	100%	14%	Slightly to Unweathered						
			3	RC BQ		170	100%	25%							
169.4															
3.3	End of Borehole														
	* Note: Water level not obtained														

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 8

METRIC

W P 54-82-11 LOCATION Co-ords. N 4 833 019.2; E 291 923.0 ORIGINATED BY DT
 DIST 6 HWY 410/401 BOREHOLE TYPE Wash BX Casing, BQ Rock Core COMPILED BY HS
 DATUM Geodetic DATE 84 09 28 CHECKED BY OP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100					
172.7	Ground Surface															
0.0	Topsoil															
172.3	Silty Clay some sand															
0.4																
			1	RC BQ		172	54%	0								
			2	RC BQ		171	90%	40%								
	Grey Shale Bedrock with Limestone Layers 1 to 20 cm thick		3	RC BQ		170	88%	39%								
169.2																
3.5	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION



METRIC

W P	54-82-11	LOCATION	Co-ords. N 4 833 028.5; E 291 965.7	ORIGINATED BY	DT
DIST	6	HWY	410/401	BOREHOLE TYPE	Wash SX Casing, BQ Rock Core
DATUM	Geodetic	DATE	84 09 28	COMPILED BY	HS
				CHECKED BY	GP

[illegible]

+3, x5 : Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



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CONT 88-48

FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 54-82-09

DIST #6

HWY 401/410

STR SITE N/A

High Mast Lighting
(Hwy. 401/Hwy. 410 Interchange)

DISTRIBUTION

G.C.E. Burkhardt (3)
T.J. Kazmierowski
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FOUNDATION INVESTIGATION REPORT
For
W.P. 54-82-09; Site N/A
High Mast Lighting (Hwy. 401/Hwy. 410 Interchange)
Hwy. 401, District 6, Toronto

INTRODUCTION

This report summarizes the foundation investigation required for the above-noted high mast lighting.

The fieldwork was conducted between 86 06 02 and 86 06 19 utilizing a continuous flight auger machine equipped with solid-stem augers, N casing and B core barrels.

This work consisted of advancing sampled boreholes at or near all proposed high mast light locations (C11 to C32).

SITE DESCRIPTION

These high mast lights are located along Hwy. 401 and Hwy. 410 at the Hwy. 401/Hwy. 410 interchange.

According to Chapman and Putnam (1984), the site lies within the 'Peel Plain' physiographic area. It is characterized by a relatively level area of shallow overburden overlying shale bedrock.

SUBSURFACE CONDITIONS

General

The Record of Borehole Sheets (Appendix) illustrate the conditions at the borehole locations (refer to BH #C11 to BH #C32). The locations of high mast lights C11 to C32 are illustrated on Drawing No. 548209-A while specific locations are indicated in Table 1.

STRATIGRAPHY

Overburden

The overburden is generally silty clay of low plasticity, containing variable amounts of sand and gravel and occasional shaly zones. In most cases the material is glacial till. However, in some locations it is fill.

Based on 'N' values ranging from 7 to over 100, the consistency of the material varies from firm to hard but is generally very stiff to hard.

The thickness of the overburden is variable, ranging from 0 to 4.6 m.

Bedrock

Detailed descriptions of the bedrock core samples are provided in Tables 2A, 2B and 2C.

Bedrock is alternating shale and limestone of the Georgian Bay Formation.

Groundwater Conditions

At the time of the field investigations, the depth to groundwater at Boreholes C18, C21 and C22 ranged from 0.95 m to 1.30 m below the surface. All other boreholes were dry.

DISCUSSION AND RECOMMENDATIONS

It is proposed to install 22 high mast lights at the Hwy. 401/Hwy. 410 interchange.

Foundation design will be by Broms method as described in two separate papers; Broms B.B. "Lateral Resistance of Piles in Cohesive Soils", Journal of the Soil Mechanics and Foundations Division, ASCE, Vol. 90, No. SM2, Paper 3825, March 1964.; and "Lateral Resistance of Piles in Cohesionless Soils", Journal of the Soil Mechanics and Foundations Division, ASCE, Vol. 90, No. SM3, Paper 3909, May, 1964.

Design

It should be assumed that existing or proposed fill does not provide any lateral resistance unless it is constructed of compacted Granular 'A'.

If an engineering fill is constructed, of compacted Granular 'A' within a 3 m radius of the high mast light footing, the following design parameters may be applied:

$$\begin{aligned}\phi &= 30^\circ \\ \gamma &= 140 \text{ pcf}\end{aligned}$$

Also, it should be assumed that material (fill or native soil) in the zone of frost penetration does not provide any lateral resistance. At this site the depth of frost penetration for earth cover is 1.2 m. For design purposes, the most critical (i.e. lowest) surface elevations should be assumed if there are to be any elevation changes at the high mast light locations.

The following soil parameters are recommended for the design of the high mast lighting caissons:

- ϕ = apparent angle of internal friction for non-cohesive soils
- q_u = unconfined compressive strength in psi
- γ = unit weight in pcf

Light Pole	Elev. (m) From-To	Material Type	ϕ degrees	q_u (psi)	γ (pcf)
C11	182.8-182.5*	Cohesive	0	5	120
	182.5-180.6*	Cohesive	0	10	120
	180.6-179.7	Cohesive	0	20	120
	179.7-176.5	Shale	0	150	135
	176.5-	Shale	0	1000	140
C12	174.0-171.0	Shale	0	150	135
	171.0-	Shale	0	1000	140
C13	181.2-180.7	Cohesive	0	30	120
	180.7-177.5	Shale	0	150	135
	177.5-	Shale	0	1000	140
C14	181.1-179.7	Fill	0	0	0
	179.7-178.6	Cohesive	0	50	130
	178.6-177.0	Shale	0	150	135
	177.0-	Shale	0	1000	140
C15	180.2-179.5	Cohesive	0	20	120
	179.5-178.7	Cohesive	0	50	130
	178.7-175.7	Shale	0	150	135
	175.7-	Shale	0	1000	140
C16	175.0-173.8*	Cohesive	0	5	120
	173.8-171.5	Shale	0	150	135
	171.5-	Shale	0	1000	140
C17	177.2-174.9	Fill	0	0	0
	174.9-171.9	Shale	0	150	135
	171.9-	Shale	0	1000	140
C18	178.6-175.9	Cohesive	0	20	120
	175.9-174.0	Shale	0	150	135
	174.0-	Shale	0	1000	140

*Estimated Soil Conditions

Light Pole	Elev. (m) From-To	Material Type	ϕ degrees	q_u (psi)	γ (pcf)
C19	176.4-174.4*	Cohesive	0	5	120
	174.4-172.8	Cohesive	0	25	120
	172.8-169.8	Shale	0	150	135
	169.8-	Shale	0	1000	140
C20	183.6-182.0	Cohesive	0	15	120
	182.0-180.4	Cohesive	0	40	120
	180.4-172.5	Shale	0	150	135
	172.5-	Shale	0	1000	500
C21	184.2-183.0	Cohesive	0	15	120
	183.0-182.2	Cohesive	0	35	120
	182.2-180.4	Shale	0	150	135
	180.4-	Shale	0	1000	140
C22	181.8-180.4	Cohesive	0	15	120
	180.4-179.7	Cohesive	0	50	130
	179.7-176.7	Shale	0	150	135
	176.7-	Shale	0	1000	140
C23	180.6-180.0	Cohesive	0	10	120
	180.0-178.5	Cohesive	0	30	120
	178.5-175.5	Shale	0	150	135
	175.5-	Shale	0	1000	140
C24	177.9-177.0	Cohesive	0	15	120
	177.0-175.9	Cohesive	0	75	130
	175.9-172.9	Shale	0	150	135
	172.9-	Shale	0	1000	140
C25	179.1-178.8*	Cohesive	0	5	120
	178.8-177.5	Cohesive	0	10	120
	177.5-177.0	Cohesive	0	50	130
	177.0-174.0	Shale	0	150	135
	174.0-	Shale	0	1000	140

*Estimated Soil Conditions

Light Pole	Elev. (m) From-To	Material Type	\emptyset degrees	q_u (psi)	γ (pcf)
C26	177.7-177.4*	Cohesive	0	5	120
	177.4-176.0	Cohesive	0	10	120
	176.0-175.3	Cohesive	0	50	130
	175.3-174.0	Shale	0	150	135
	174.0-	Shale	0	1000	140
C27	178.2-177.5	Cohesive	0	5	120
	177.5-176.3	Cohesive	0	20	120
	176.3-175.5	Cohesive	0	50	130
	175.5-172.5	Shale	0	150	135
	172.5-	Shale	0	1000	140
C28	180.0-178.0	Cohesive	0	15	120
	178.0-177.0	Cohesive	0	30	120
	177.0-171.5	Cohesive	0	75	130
	171.5-170.0	Shale	0	150	135
	170.0-	Shale	0	1000	140
C29	179.6-179.3*	Cohesive	0	5	120
	179.3-178.0	Cohesive	0	15	120
	178.0-175.9	Cohesive	0	40	120
	175.9-172.9	Shale	0	150	135
	172.9-	Shale	0	1000	140
C30	179.5-178.0	Cohesive	0	5	120
	178.0-176.8	Cohesive	0	30	120
	176.8-173.0	Shale	0	150	135
	173.0-	Shale	0	1000	140
C31	179.6-178.0	Cohesive	0	5	120
	178.0-176.6	Cohesive	0	40	120
	176.6-173.6	Shale	0	150	135
	173.6-	Shale	0	1000	140
C32	181.0-180.0	Cohesive	0	5	120
	180.0-179.0	Cohesive	0	25	120
	179.0-176.4	Cohesive	0	60	130
	176.4-174.0	Shale	0	150	135
	174.0-	Shale	0	1000	140

*Estimated Soil Conditions

Rock anchors may be used to provide additional resistance. For design estimation purposes the allowable bond stress between the anchor and the sound bedrock may be assumed to be 70 psi. However, if rock anchors are considered, it is recommended that a test program should be carried out to determine the allowable bond stress. Please contact this office for details regarding suggested testing.

Construction Considerations

The shale bedrock is highly susceptible to weathering. It should be protected by concrete immediately after exposure.

MISCELLANEOUS

The fieldwork for this project was carried out under the supervision of Mr. J. Duffield, Student Engineer, using equipment owned and operated by Master Soil Investigation Ltd.

Bedrock descriptions, based on the rock core samples, were provided by Mr. E. Magni, Geologist.

The report was written by Mr. D. Dundas, Senior Foundations Engineer and reviewed by Mr. M. Devata, Chief Foundations Engineer (East).



D. H. Dundas

D.H. Dundas, P.Eng.
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M. Devata

M. Devata, P.Eng.
Chief Foundations Engineer
(East)

HIGHWAY 401/410 INTERCHANGE HIGH-MAST POLE



ELEVATIONS

Coordinates

<u>Pole No.</u>	<u>Easting</u>	<u>Northing</u>	<u>Existing Elevation</u>	<u>Ultimate *</u> <u>Elevation</u>
C11	291868.4	4832843.2	182.8	182.8
C12	291951.1	4832957.5	174.0	173.7
C13	292102.0	4833015.8	181.2	181.2
C14	291961.0	4833075.0	181.1	178.5
C15	292123.0	4833161.5	180.2	175.3
C16	292182.4	4833345.0	175.0	175.0
C17	292029.0	4833251.0	177.2	177.2
C18	291870.4	4833301.5	177.7	177.7
C19	291830.6	4833170.3	176.4	176.4
C20	291685.4	4833135.6	182.5	175.1
C21	291530.0	4833117.5	184.2	184.2
C22	291428.2	4833199.0	181.8	181.8
C23	291555.5	4833270.9	180.6	180.6
C24	291704.0	4833337.0	177.9	177.9
C25	291397.8	4833375.3	179.1	179.1
C26	291538.4	4833442.6	177.7	177.5
C27	291435.4	4833570.0	178.2	178.2
C28	291312.0	4833669.8	180.0	180.0
C29	291184.5	4833784.0	179.6	179.6
C30	291265.0	4833468.0	179.5	179.5
C31	291179.0	4833618.0	179.6	179.6
C32	291073.0	4833728.9	181.0	181.0

* Ultimate elevations are based on Preliminary Design Cross-Sections and are therefore subject to change during detailed design stage.

W.P. 54-82-09

File # 18-85035

TABLE 2A

DESCRIPTION OF ROCK CORE - W.P. 54-82-09

BOREHOLE NUMBER				CORE DESCRIPTION	
	DEPTH (m)	% CR *	% RQD *	DEPTH (m)	DESCRIPTION
C11	0.97 - 2.14	46	15	0.97 - 2.14	SHALE (85%), grey, highly weathered, with LIMESTONE (15%), grey, in layers up to 27.5 cm
	2.14 - 2.69	100	27		
	2.69 - 4.21	48	18	2.14 - 5.49	LIMESTONE (80%), grey, unweathered, with SHALE (20%), grey, in 1.2 to 5.0 cm layers
	4.21 - 5.49	90	52		
C13	0.76 - 1.93	28	22	0.76 - 3.66	SHALE, grey, slightly to highly weathered, high core loss zone, with LIMESTONE layers from 2.5 to 27.5 cm
	1.93 - 2.47	24	0		
	2.47 - 2.54	100	0	3.66 - 4.80	SHALE (50%), grey, unweathered, closely to moderately spaced joints, with LIMESTONE (50%), grey, unweathered in layers from 2.5 to 10.0 cm
	2.54 - 3.25	43	0		
	3.25 - 3.66	55	0		
	3.66 - 4.80	100	38		
C14	2.0 - 3.15	76	24	2.0 - 2.52	SOIL, limestone slab, and till
	3.15 - 4.80	100	0	2.52 - 3.15	LIMESTONE (100%), grey, unweathered, medium spaced joints
				3.15 - 4.80	SHALE (75%), grey, slightly weathered to unweathered, closely to medium spaced joints, with LIMESTONE (25%), grey, unweathered
C16	1.47 - 3.18	91	31	1.47 - 1.78	SHALE (80%), grey, highly weathered, very closely spaced joints, with LIMESTONE (20%), grey, in 5.0 cm layer
	3.18 - 3.71	100	95	1.78 - 3.71	SHALE (90%), grey, slightly weathered becoming unweathered with depth, with LIMESTONE (10%), grey, in 2.5 to 15.0 cm layers
C18	3.20 - 3.43	78	0	3.20 - 4.33	SHALE (80%), grey, slightly weathered, very closely spaced bedding joints, with LIMESTONE (20%), grey, in 1.2 to 5.0 cm layers
	3.43 - 3.71	82	0		
	3.71 - 4.98	94	20	4.33 - 5.89	SHALE (80%), grey, unweathered, closely to medium spaced bedding joints, with LIMESTONE (20%), grey in 1.2 to 7.5 cm layers
	4.98 - 5.89	100	22		

* CR = CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION

TABLE 2B

DESCRIPTION OF ROCK CORE - W.P. 54-82-09

BOREHOLE NUMBER				CORE DESCRIPTION	
	DEPTH (m)	% CR *	% RQD *	DEPTH (m)	DESCRIPTION
C20	3.54 - 4.91	46	7	3.54 - 4.09	LIMESTONE, slightly weathered, closely spaced joints (oxidized)
	4.91 - 6.02	25	0	4.09 - 11.03	SHALE, highly weathered, high core loss, with LIMESTONE in layers 2.5 to 25.0 cm
	6.02 - 7.72	8	0		
	7.72 - 8.99	74	28	11.03 - 12.35	
	8.99 - 10.45	13	0		SHALE (50%), unweathered, closely spaced joints, with LIMESTONE (50%), in layers 2.5 to 25.0 cm
	10.98 - 12.35	85	44		
C21	2.03 - 3.51	59	7	2.03 - 3.76	SHALE (60%), grey, highly weathered, high core loss zone, with LIMESTONE (40%), grey, in 2.5 to 27.5 m layers
	3.51 - 5.03	100	8	3.76 - 5.03	SHALE (60%), grey, unweathered, close to medium spaced joints, with LIMESTONE (40%), grey, in 2.5 to 22.5 cm layers
C26	1.93 - 3.46	100	12	1.93 - 2.14	LIMESTONE (12.5 cm slab) and BROWN TILL
				2.14 - 2.59	SHALE (50%), grey, moderately weathered, very closely spaced joints, with LIMESTONE (50%), grey, in 2.5 to 15.0 cm layers
				2.59 - 3.46	SHALE (85%), grey, unweathered, closely to medium spaced joints, with LIMESTONE (15%), in 2.5 to 5.0 cm layers
C30	2.78 - 3.39	46	0	2.78 - 4.96	LIMESTONE (50%), grey, slightly weathered to unweathered, medium spaced joints, with SHALE (50%), grey, high core loss
	3.39 - 4.96	65	18	4.96 - 6.23	
	4.96 - 6.23	44	16		SHALE, grey, slightly to moderately weathered, closely spaced bedding joints, high core loss (5.36 - 6.18 cm, probable highly weathered shale)
	6.23 - 7.35	93	29	6.23 - 9.38	
	7.35 - 8.48	78	11		SHALE, grey, unweathered, medium spaced joints, with LIMESTONE, grey, unweathered
	8.48 - 9.38	94	54		

* CR = CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION

TABLE 2C

DESCRIPTION OF ROCK CORE - W.P. 54-82-09

BOREHOLE NUMBER				CORE DESCRIPTION	
	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
C32	4.98 - 6.38	15	0	4.98 - 6.84	SHALE and LIMESTONE, highly weathered, high core loss zone
	6.38 - 7.62	76	27	6.84 - 8.02	SHALE (50%), grey, unweathered, closely spaced joints, with LIMESTONE (50%), in 2.5 to 37.5 cm layers
	7.62 - 8.02	81	50		
C28	3.25 - 4.85	42	0	3.15 - 8.54	BOULDERS and TILL
	4.85 - 6.33	22	0	8.54 - 9.40	SHALE (85%), grey, slightly weathered, closely spaced joints, with LIMESTONE (15%), grey, in layers 2.5 to 5.0 cm
	6.33 - 7.60	22	0		
	7.60 - 8.72	68	0		
	8.72 - 9.40	100	0		

* CR = CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION

APPENDIX

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

R Q D (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

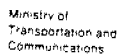
ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{\min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{\max} - e}{e_{\max} - e_{\min}}$
ρ_w	kg/m^3	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m^3	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kN/m^3	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m^3	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m^3/s	RATE OF DISCHARGE
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	i	HYDRAULIC GRADIENT
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	e_{\max}	1, %	VOID RATIO IN LOOSEST STATE	j	kN/m^2	SEEPAGE FORCE
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL						

RECORD OF BOREHOLE No C11

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 832 844.8; E 291 870.6 ORIGINATED BY JD
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
 DATUM Geodetic DATE 86 06 06 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
180.6	Ground Surface													
0.0	Silty Clay (CL) Some Sand Trace Gravel Occ. Shaly Zones Stiff to Hard (Till)													
179.7			1	SS	60/									
0.9	Bedrock Shale and Limestone Georgian Bay Formation		2	RC	32% rec									
	— weathered — unweathered		3	RC	100% rec									
			4	RC	48% rec									
			5	RC	84% rec									
175.1	End of Borehole													



METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 832 957.5; E 291 951.1 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 11 CHECKED BY DD

[illegible]

+3, x5 : Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



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RECORD OF BOREHOLE No C13

METRIC

W P 54-82-09 LOCATION Co-ords. N 4 833 015.8; E 292 102.0 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 19 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
181.2	Ground Surface					Dry	181					
0.0	Silty Clay (cl) *(Till)											
180.7												
0.5	Bedrock Shale and Limestone Georgian Bay Formation		1	SS	90							
			1A	SS	60/0cm							
			2	RC	28% rec							
			3	RC	24% rec							
			4	RC	100% rec							
			5	RC	43% rec							
			6	RC	66% rec							
	Weathered Unweathered		7	RC	100% rec							
176.4												
4.8	End Of Borehole											
	*Some Sand Trace Gravel occ. Shaly Zones Hard											

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No C14

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 075.0; E 291 961.0 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 12 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
181.1	Ground Surface										
0.0	Silty Clay (CL) With Sand Some Gravel (Fill) Stiff to Very Stiff		1	SS	22	DRY	181				
179.7	Silty Clay (CL) Some Sand Trace Gravel Occ. Shaly and Limestone Zones Hard (Fill)		2	SS	86/28 cm		180				
178.6			3	RC	71% rec		179				
2.5	Weathered Unweathered Bedrock Shale and Limestone Georgian Bay Formation		4	RC	98% rec		178				
176.3							177				
4.8	End of Borehole										

*3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No C15

METRIC

W P 54-82-09 LOCATION Co-ords N 4 833 161.5; E 292 123.0 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 12 CHECKED BY DD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20 40 60 80 100	PLASTIC LIMIT Wp	NATURAL MOISTURE CONTENT W	LIQUID LIMIT Wl		
180.2	Ground Surface											
0.0	Silty Clay (cl) Some Sand Trace Gravel occ. shaly zones (Till) hard		1	SS	52	DRY	180					
178.7							179					
1.5	178.5 *		2	SS	60/13 cm							
1.7	End Of Borehole											
	*Bedrock Shale and Limestone Georgian Bay Forma- tion Weathered											

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



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RECORD OF BOREHOLE No C16

METRIC

W P 54-82-09 LOCATION Co-ords. N 4 833 345.0E 292 182.4 (Approx.) ORIGINATED BY JD
DIST 6 HWY 401/410 IC SS Auger, B Core, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 13 CHECKED BY DD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE						
173.8	Ground Surface									
0.0	Bedrock		1	SS	60/	Dry				
	Shale and Limestone					10 cm				
	Georgian Bay Formation		2	SS	60/	3 cm				
	Weathered		3	RC	90% rec					
	Unweathered									
170.1			4	RC	100% rec					
3.7	End of Borehole									

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



Ministry of
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Communications
Ontario

RECORD OF BOREHOLE No C17

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 251.0; E 292 029.0 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 12 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
177.2	Ground Surface										
0.0	Silty Clay (CL) With Sand Some Gravel (Fill) Stiff to Very Stiff		1	SS	14	DRY	177				
			2	SS	20		176				
	Asphalt Zone		3	SS	60		175				
174.9											
2.3											
2.4	End of Borehole										
	* Bedrock Shale and Limestone Georgian Bay Formation Weathered										

+3, x5: Numbers refer to Sensitivity
20
15 5 (%) STRAIN AT FAILURE
10



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RECORD OF BOREHOLE No C18

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 306.3; E 291 874.5 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 02 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
178.6	Ground Surface										
0.0	Silty Clay (CL) Some Sand Trace Gravel Occ. Shaly Zones (Till) Stiff to Hard		1	SS	19		178				
			2	SS	47		177				
175.9			3	SS	13		176				
2.7	Bedrock Shale and Limestone Georgian Bay Formation		3a	SS	100/100	0 cm					
			4	RC	78%		175				
			5	RC	81%		174				
	Weathered Unweathered		6	RC	90%		173				
172.7			7	RC	100%						
5.9	End of Borehole										

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C19

METRIC

W P 54-82-09 LOCATION Co-ords: N 4 833 171.5; E 291 819.2 ORIGINATED BY JD
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
 DATUM Geodetic DATE 86 06 12 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
174.4	Ground Surface										
	Silty Clay (cl) Some Sand Some Gravel Occ. Shaly Zones (Till) Stiff to hard		1	SS	24	Dry	174				
172.8			1A	SS	60	0 cm	173				
1.6	End of Borehole										
	Probable Bedrock Shale and Limestone Georgian Bay Formation Weathered										

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



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RECORD OF BOREHOLE No C20a

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 129.8; E 291 684.3 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test, B Core COMPILED BY JD
DATUM Geodetic DATE 86 06 04 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
183.6 0.0	Ground Surface					DRY						
	Silty Clay (cl) Some Sand Trace Gravel Occ. Shaly Zones (Till) Stiff to Hard		1	SS	17		183					
			2	SS	33		182					
			3	SS	38		181					
180.4 3.2			4	SS	60/	13 cm	180					
			5	RC	46% rec		179					
			6	RC	25% rec		178					
	Bedrock Shale and Limestone Georgian Bay Formation Weathered		7	RC	0% rec		177					
			8	RC	fragments rec		176					
175.8 7.8	End of Borehole		9	SS	60/	5 cm						

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No C20b

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 129.8; E 291 684.3 ORIGINATED BY JD
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core COMPILED BY JD
 DATUM Geodetic DATE 86 06 05 CHECKED BY DD

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80	100	W _p	W		
183.6	Ground Surface															
0.0						DRY										
							183									
							182									
							181									
							180									
							179									
							178									
							177									
175.8	Refer to BH #20a						176									
7.8	Bedrock Shale and Limestone Georgian Bay Formation Weathered		10	RC	72% rec		175									
			11	RC	18% rec		174									
			12	WS			173									
172.5																
11.1	End of Borehole															



RECORD OF BOREHOLE No C 20c

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 129.8; E 291 684.3 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core COMPILED BY JD
DATUM Geodetic DATE 86 06 09 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
183.6	Ground Surface										
0.0						DRY					
							183				
							182				
							181				
							180				
							179				
							178				
			13	SS	60/5	cm	177				
			14	SS	60/5	cm	176				
							175				
							174				
							173				
172.5	Refer to BH #20a and BH #20b						172				
11.1	Weathered Unweathered Bedrock Shale and Limestone Georgian Bay Formation		15	RC	83% rec						
171.3											
12.3	End of Borehole										

RECORD OF BOREHOLE No C21

METRIC

W P 54-82-09 LOCATION Co-ords N 4 833 116.1; E 291 525.6 ORIGINATED BY JD
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
 DATUM Geodetic DATE 86 06 04 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
184.2 0.0	Ground Surface										
	Silty Clay (cl) Some Sand Trace Gravel occ. shaly zones (Till) Stiff to Very Stiff		1	SS	16						
182.2 2.0			2	SS	33						
	Bedrock Shale and Limestone Georgian Bay Formation		3	RC	59% rec						
	Weathered Unweathered		4	RC	100% rec						
179.2 5.0	End of Borehole										

RECORD OF BOREHOLE No C22

METRIC

W P 54-82-09 LOCATION Co-ords: N 4 833 199.0; E 291 428.2 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 10 CHECKED BY DD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE						
181.8	Ground Surface									
0.0	Silty Clay (cl) Trace Sand Trace Gravel (Till) Stiff to hard Occ. Shaly Zones		1	SS	18					
179.7			2	SS	86/	30 cm				
2.1	Bedrock Shale and Limestone Georgian Bay Forma- tion, Weathered		3	SS	60/	0 cm				
178.8			34	SS	60/	0 cm				
3.0	End of Borehole									

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



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RECORD OF BOREHOLE No C23

METRIC

W P 54-82-09 LOCATION Co-ords: N 4 833 270.9; E 291 555.5 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 03 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES						
180.6	Ground Surface										
0.0	Silty Clay (cl) Some Sand Trace Gravel (Till) Very Stiff		1	SS	38	DRY	180				
178.5	occ. Shaly Zones		2	SS	38		179				
2.1	Bedrock Shale and Limestone Georgian Bay Formation Weathered		3	SS	118/23cm		178				
177.3			4	SS	60/5cm						
3.3	End of Borehole										

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C24

METRIC

W P 54-82-09 LOCATION Co-ords: N 4 833 337.0; E 291 704.0 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 03 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
177.9	Ground Surface										
0.0	Silty Clay Some Sand (Till)					DRY					
	Trace Gravel with Gravel occ. Shaly Zones		1	SS	27						
	Very stiff to hard		2	SS	178/	23 cm					
175.9	Bedrock										
2.0	*										
175.5	*		3	SS	100/	0 cm					
2.4	End of Borehole										
	* Shale and Limestone Georgian Bay Formation Weathered										



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RECORD OF BOREHOLE No C25

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 376.2; E 291 398.0 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 10 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
178.8	Ground Surface										
0.0	Silty Clay (CL) Some Sand Trace Gravel (Till) Firm to Hard		1	SS	8	DRY	178				
177.0	Occ. Shaly Zones		2	SS	60/	13 cm	177				
1.8	Bedrock Shale and Limestone										
176.4	Georgian Bay Formation		3	SS	60/	10 cm					
2.4	Weathered End of Borehole										

+3, x5: Numbers refer to
Sensitivity

20
15
10
5
0
5
10
15
20
(%) STRAIN AT FAILURE



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RECORD OF BOREHOLE No C26

METRIC

W P 54-82-09 LOCATION Co-ords N 4 833 441.1; E 291 535.9 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 03 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
177.4	Ground Surface												
0.0	Silty Clay (cl) Some Sand (Till) Stiff to hard		1	SS	16								
	Trace Gravel Some Gravel		2	SS	60/5	cm							
175.3	*		3	SS	100/20	cm							
2.1	Weathered Unweathered		4	RC	100% rec								
173.9	Bedrock Shale and Limestone Georgian Bay Formation												
3.5	End of Borehole												
	*occ. shaly and lime- stone zones												

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



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RECORD OF BOREHOLE No C27

METRIC

W P 54-82-09 LOCATION Co-ords: N 4 833 570.0; E 291 435.4 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 11 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
178.2	Ground Surface										
0.0	Silty Clay Some Sand Trace Gravel occ. shaly zones stiff to hard (Till)		1	SS	18	DRY	178				
			2	SS	73/25cm		177				
	Some Gravel		3	SS	114/23cm		176				
175.5	End of Borehole										
2.7	Probable Bedrock Shale and Limestone Georgian Bay Formation Weathered										

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



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RECORD OF BOREHOLE No C28

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 669.8; E 291 312.0 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 17 - 18 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
180.0	Ground Surface											
0.0	Silty Clay (CL) Some Sand Trace Gravel Occ. Shaly Zones Stiff to Hard (Till)		1	SS	17		179					
			2	SS	18		178					
			3	SS	33							
			3a	SS	60/70	0 cm	177					
	Frequent Boulders		4	RC	42% rec		176					
			5	RC	22% rec		175					
			6	RC	22% rec		174					
			7	RC	67% rec		172					
171.5	Bedrock Shale and Limestone Georgian Bay Formation Unweathered		8	RC	100% rec		171					
8.5												
170.6												
9.4	End of Borehole											

+3, x5: Numbers refer to Sensitivity
20
15 5 (%) STRAIN AT FAILURE
10



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RECORD OF BOREHOLE No C29

METRIC

W P 54-82-09 LOCATION Co-ords: N 4 833 783.0; E 291 184.9

ORIGINATED BY JD

DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test

COMPILED BY JD

DATUM Geodetic DATE 86 06 11

CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
179.3	Ground Surface											
0.0	Silty Clay (cl) Some Sand occ. shaly zones stiff to hard (Till)		1	SS	22	DRY	179					
			2	SS	40		178					
			3	SS	34		177					
175.9	End of Borehole		4	SS	60/5cm		176					
3.4	Probable Bedrock Shale and Limestone Georgian Bay Formation weathered		4A	SS	60/8cm							

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No C30

METRIC

W P 54-82-09 LOCATION Co-ords: N 4 833 468.0; E 291 265.0 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 16-17 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
179.5	Ground Surface										
0.0	Silty Clay (cl) Some Sand Trace Gravel Firm to hard (Till)		1	SS	7		179				
			2	SS	29		178				
176.8	occ. Shaly Zones		3	SS	80/28 cm		177				
2.7	Bedrock Shale and Limestone Georgian Bay Formation		4	RC	46% rec		176				
			5	RC	65% rec		175				
			6	RC	44% rec		174				
	Weathered Unweathered		7	RC	86% rec		173				
			8	RC	78% rec		172				
			9	RC	94% rec		171				
170.1	End of Borehole										



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RECORD OF BOREHOLE No C31

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 618.0; E 291 179.0 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 11 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
179.6	Ground Surface										
0.0	Silty Clay (CL) Some Sand Trace Gravel (Till) Firm to Hard		1	SS	10		179				
			2	SS	27		178				
			3	SS	61		177				
176.6	Occ. Shaly Zones		4a	SS	607	0 cm					
3.0	End of Borehole Probable Bedrock Shale and Limestone Georgian Bay Formation Weathered										

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



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RECORD OF BOREHOLE No C32

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 728.9; E 291 073.0 ORIGINATED BY JD
DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD
DATUM Geodetic DATE 86 06 13 - 16 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
181.0	Ground Surface										
0.0	Silty Clay (CL) Some Sand Trace Gravel (Till) Stiff to Hard		1	SS	24		180				
			2	SS	63		179				
			3	SS	60		178				
	Occ. Shaly Zones		4	SS	60/13 cm		177				
			5	SS	60/13 cm		176				
176.4			6	SS	60/3 cm		175				
4.6	Bedrock Shale and Limestone Georgian Bay Formation		7	RC	15% rec		174				
	Weathered Unweathered		8	RC	89% rec		173				
173.0			9	RC	81% rec						
8.0	End of Borehole										

+³, x⁵: Numbers refer to Sensitivity
20
15 5 (%) STRAIN AT FAILURE
10

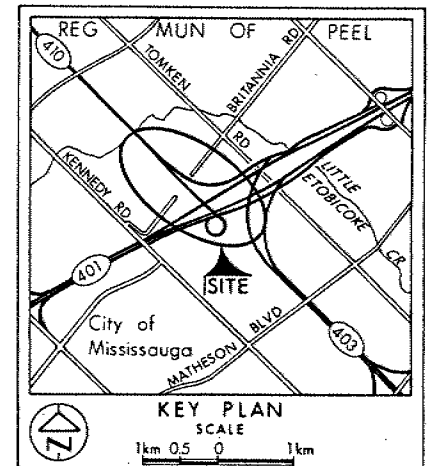
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

CONT No
WP No 54-82-09



HWY 401/410 INTERCHANGE
HIGH MAST LIGHTING
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W.L. at time of investigation 86.06

No	ELEVATION	CO-ORDINATES NORTH	EAST
C11	180.6	4 832 844.8	291 870.6
C12	174.0	4 832 957.5	291 951.1
C13	181.2	4 833 015.8	292 102.0
C14	181.1	4 833 075.0	291 961.0
C15	180.2	4 833 161.5	292 123.0
C16	173.8	4 833 345.0	292 182.4
C17	177.2	4 833 251.0	292 029.0
C18	178.6	4 833 306.3	291 874.5
C19	174.4	4 833 171.5	291 819.2
C20	183.6	4 833 129.8	291 684.3
C21	184.2	4 833 116.1	291 525.6
C22	181.8	4 833 199.0	291 428.2
C23	180.6	4 833 270.9	291 555.5
C24	177.9	4 833 337.0	291 704.0
C25	178.8	4 833 376.2	291 398.0
C26	177.4	4 833 441.1	291 535.9
C27	178.2	4 833 570.0	291 435.4
C28	180.0	4 833 669.8	291 312.0
C29	179.3	4 833 783.0	291 184.9
C30	179.5	4 833 468.0	291 265.0
C31	179.6	4 833 618.0	291 179.0
C32	181.0	4 833 728.9	291 073.0

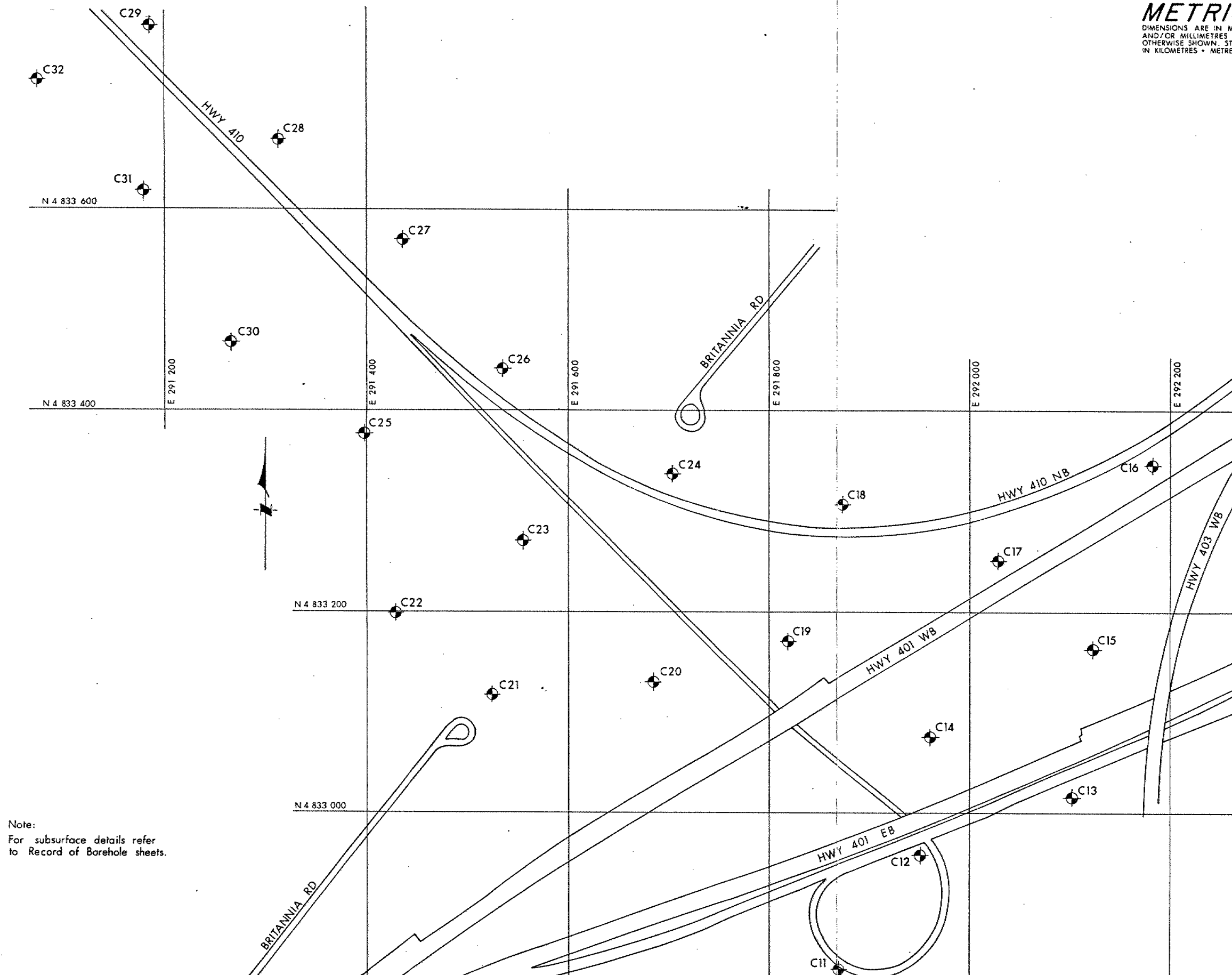
NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REV.	DATE	BY	DESCRIPTION

Geocres No 30M12-196

HWY No 401	SUBM'D JD	CHECKED	DATE 86 07 17	DIST 6
DRAWN DT	CHECKED	APPROVED	SITE	DWG 548209-A



Note:
For subsurface details refer
to Record of Borehole sheets.

PLAN
SCALE
40m 20 0 40m