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GEOCRES No. 30M 12-150

DIST. 6 REGION

W.P. No. 127-66-67
36-74-03

CONT. No. 82-107

W. O. No.

STR. SITE No. 24-81-354A

HWY. No. 403

LOCATION Bridge #64 ; Hwy 403 E.B. Coll.
over Matheson Blvd.

No of PAGES -

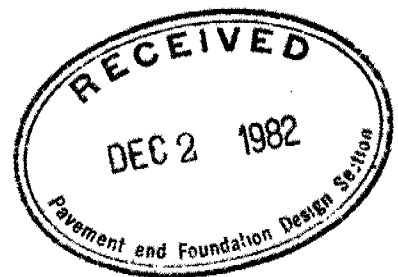
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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FOUNDATION INVESTIGATION REPORT

CONTRACT NO *82 - 107*



Ministry of
Transportation and
Communications

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NOTE: For purposes of the contract this report supercedes all other foundation reports prepared by or for the Ministry in connection with the above mentioned project.

EXPLANATION OF TERMS USED IN REPORT

2

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

SS	SPLIT SPOON	TP	THINWALL PISTON
WS	WASH SAMPLE	OS	OSTERBERG SAMPLE
ST	SLOTTED TUBE SAMPLE	RC	ROCK CORE
BS	BLOCK SAMPLE	PH	TW ADVANCED HYDRAULICALLY
CS	CHUNK SAMPLE	PM	TW ADVANCED MANUALLY
TW	THINWALL OPEN	FS	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	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						

For

Hwy. 403 E.B. Collector Over

Matheson Boulevard

W.P. 127-66-67, Site 24-81-354A

Highway 403, District 6, TorontoINTRODUCTION:

This report summarizes the factual information obtained from a foundation investigation program performed at the above-mentioned structural site.

The fieldwork was carried out and report issued under W.P. 36-74-03 for the original crossing in late 1975 and early 1976. No additional fieldwork has been required since the original investigation was sufficient in scope to encompass the revised structural scheme. The field investigation consisted of advancing 4 sampled boreholes using hollow stem continuous flight augers and obtaining rock cores in two of these borings to ascertain the condition of bedrock. The borings ranged in depth from 1.5 metres to 9.1 metres.

SITE DESCRIPTION AND GEOLOGY

The site is located immediately east of the Hwy. 403 E.B. Core Overpass structure at Matheson Blvd., between the First Line East and Second Line East, some 1.2 kilometers north of Eglinton Avenue West, in the City of Mississauga, Regional Municipality of Peel. The west branch of Etobicoke Creek passes approximately 300 metres south of the site.

Land use in the area is changing from predominately farming to industrial subdivision development. Topography across the site is generally flat to gently undulating with ground surface sloping gradually towards Lake Ontario.

The site is located in the physiographic region known as the "Peel Plain". The characteristic deposit, in the vicinity of the area under investigation, is composed of cohesive glacial till, whose thickness varies from nil to 15 metres. The overburden is underlain by shale bedrock of the Meaford-Dundas Formation, Ordovician Period.

SUBSURFACE CONDITIONS

Borings carried out at the structure site indicates generally uniform subsurface conditions. The overburden consists of a thin layer of topsoil and/or a shallow deposit of cohesive glacial till. Underlying this is shale bedrock. The upper portion of the shale was found to be weathered.

The boundaries between the various soil types, insitu and laboratory test results, as well as stabilized ground water levels, are shown on the attached Record of Borehole Sheets. The locations and elevations of the borings, along with a profile and two estimated stratigraphical sections based on borehole data, are shown on Drawing No. 2, which should be read in conjunction with the borehole sheets and this report.

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

Overburden (Topsoil and/or Glacial Till)

The surficial deposit at the site consists of a thin layer of topsoil and/or a thin deposit of glacial till ranging in thickness from 0.5 metres to 1.8 metres. Generally, the glacial till stratum is a heterogeneous mixture of hard silty clay of low plasticity, sand and gravel, with shale fragments.

Shale Bedrock

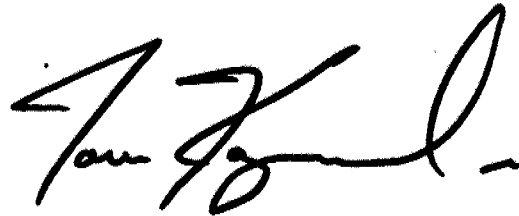
The shale bedrock was encountered immediately underneath the topsoil /glacial till across the site. The upper 0.8 to 2.5 metres of the bedrock is in a weathered condition. The bedrock surface varies between elevations 164.7 to 162.7 corresponding to depths of approximately 0.5 to 1.7 metres below original ground surface prior to cut excavations for Matheson Blvd.

Bedrock surface is sloping gently in a southeasterly direction across the site.

The rock is described as a dark grey, fine textured, soft shale interbedded with thin layers (2 to 25 cm thick) of light grey, fine to medium texture, medium hard limestone.

GROUNDWATER CONDITIONS

Groundwater level observations have been carried out during and after the period of investigation by recording the water levels in the open boreholes. No water levels were encountered in the open boreholes at the time of the investigation.

A handwritten signature in black ink, appearing to read 'Tom Kazmierowski', with a long horizontal stroke extending to the right.

T. J. Kazmierowski, P. Eng.
Foundation Engineer

A handwritten signature in black ink, appearing to read 'M. Devata', with a stylized, cursive script.

M. Devata, P. Eng.
Senior Foundations Engineer

APPENDIX



Ministry of
Transportation and
Communications
Ontario

RECORD OF BOREHOLE No 5 METRIC

7

W P 127-66-67 LOCATION Sta. 7 + 167.0 1.2 Rt. ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Augers/BXL Rock Core COMPILED BY T.J.K.
DATUM Geodetic DATE 75-12-01 CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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		
** 164.7	Original Ground Surface												
0.0	Topsoil												
0.5	Weathered Shale		1	SS	91								
161.7			2	SS	100	3 cm							
3.0	Sound Shale Bedrock With Limestone Bands		3	BXL R.C.	100 Rec.								
			4	BXL R.C.	80 Rec.								
			5	BXL R.C.	80 Rec.								
			6	BXL R.C.	95 Rec.								
155.6	End of Borehole												
9.1	* Note: W.L. not encountered ** Ground elev. as of 75-12-01												

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 6

METRIC

8

W P 127-66-67 LOCATION Sta. 7 + 146.2 1.0 Lt. ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Augers COMPILED BY T.J.K.
DATUM Geodetic DATE 75-12-1 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					
165.2	Original Ground Surface																
164.7	Topsoil					*											
0.5	Weathered Shale																
163.7			1	SS	100	3 cm	164										
1.5	End of Borehole																
	* Note: W.L. not encountered						162										
	** Ground elev. as of 75-12-01																

*³, x⁵: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

ORIGINAL RECORD ON SOIL BOREHOLE

RECORD OF BOREHOLE No 7 METRIC

9

W P 127-66-67 LOCATION Sta. 7 + 172.0 26.2 Lt. ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Augers COMPILED BY T.J.K.
DATUM Geodetic DATE 75-12-01 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
164.5	Original Ground Surface																GR SA SI CL
0.0	(Glacial Till) Het. mix. of Silty Clay Sand & Gravel Hard With Shale Fragments					*	164										
162.7			1	SS	108/23 cm												
1.8	Weathered Shale						162										
161.4			2	SS	100/13 cm												
3.1	End of Borehole						160										
	* Note: W.L. not encountered																
	** Ground elev. as of 75-12-01																

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



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RECORD OF BOREHOLE No 8

METRIC 10

W P 127-66-67 LOCATION Sta. 7 + 149.0 26.0 Lt. ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Augers/BXL Rock Core COMPILED BY T.J.K.
DATUM Geodetic DATE 75-12-01 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					
165.2	Original Ground Surface																
0.0	Topsoil																
0.5	(Glacial Till) Het. Mix of silty clay, sand & Gravel with shale frags																
163.5	Hard		1	SS	67		164										
1.7	weathered		2	SS	100	3 cm											
	Sound		3	R.C.	70%		162										
	Shale																
	Bedrock		4	BXL	65%		160										
	with Limestone			R.C.	Rec												
	Bands		5	BXL	70%												
				R.C.	Rec		158										
			6	BXL	100%												
				R.C.	Rec												
156.7			7	BXL	100%												
				R.C.	Rec												
8.5	End of Borehole						156										
	* Note: W.L. not encountered																
	** Ground elev. as of 75-12-01																

+3, x5: Numbers refer to
Sensitivity

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

For

Hwy. 403 W.B. Collector Over

Matheson Boulevard

W.P. 127-66-68, Site 24-81-354B

Highway 403, District 6, TorontoINTRODUCTION:

This report summarizes the factual information obtained from a foundation investigation program performed at the above-mentioned structural site.

The fieldwork was carried out and report issued under W.P. 36-74-02 for the original crossing in late 1975 and early 1976. No additional fieldwork has been required since the original investigation was sufficient in scope to encompass the revised structural scheme. The field investigation consisted of advancing 4 sampled boreholes using hollow stem continuous flight augers and obtaining rock cores in two of these borings to ascertain the condition of bedrock. The borings ranged in depth from 2.5 metres to 8.8 metres.

SITE DESCRIPTION AND GEOLOGY

The site is located immediately west of the Hwy. 403 W.B. Core Overpass structure at Matheson Blvd., between the First Line East and Second Line East, some 1.2 kilometers north of Eglinton Avenue West, in the City of Mississauga, Regional Municipality of Peel. The west branch of Etobicoke Creek passes approximately 300 metres south of the site.

Land use in the area is changing from predominately farming to industrial subdivision development. Topography across the site is generally flat to gently undulating with ground surface sloping gradually towards Lake Ontario.

The site is located in the physiographic region known as the "Peel Plain". The characteristic deposit, in the vicinity of the area under investigation, is composed of cohesive glacial till, whose thickness varies from nil to 15 metres. The overburden is underlain by shale bedrock of the Meaford-Dundas Formation, Ordovician Period.

SUBSURFACE CONDITIONS

Borings carried out at the structure site indicates generally uniform subsurface conditions. The overburden consists of a thin layer of topsoil and/or a shallow deposit of cohesive glacial till. Underlying this is shale bedrock. The upper portion of the shale was found to be weathered.

The boundaries between the various soil types, insitu and laboratory test results, as well as stabilized ground water levels, are shown on the attached Record of Borehole Sheets. The locations and elevations of the borings, along with a profile and two estimated stratigraphical sections based on borehole data, are shown on Drawing No. 2, which should be read in conjunction with the borehole sheets and this report.

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

Overburden (Topsoil and/or Glacial Till)

The surficial deposit at the site consists of a thin layer of topsoil and/or a thin deposit of glacial till ranging in thickness from 0.5 metres to 1.8 metres. Generally, the glacial till stratum is a heterogeneous mixture of hard silty clay of low plasticity, sand and gravel, with shale fragments.

Shale Bedrock

The shale bedrock was encountered immediately underneath the topsoil /glacial till across the site. The upper 1.2 to 3.1 metres of the bedrock is in a weathered condition. The bedrock surface varies between elevations 166.6 to 165.4 corresponding to depths of approximately 0.5 metres below original ground surface prior to cut excavations for Matheson Blvd.

Bedrock surface is sloping gently in a southeasterly direction across the site.

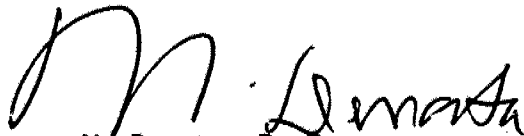
The rock is described as a dark grey, fine textured, soft shale interbedded with thin layers (2 to 25 cm thick) of light grey, fine to medium texture, medium hard limestone.

GROUNDWATER CONDITIONS

Groundwater level observations have been carried out during and after the period of investigation by recording the water levels in the open boreholes. No water levels were encountered in the open boreholes at the time of the investigation.



T. J. Kazmierowski, P. Eng.
Foundation Engineer



M. Devata, P. Eng.
Senior Foundations Engineer

A P P E N D I X



Ministry of
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Communications

RECORD OF BOREHOLE No 1 METRIC

15

W P 127-66-68 LOCATION Sta. 7 + 576.6 14.8 Rt. ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Augers/BXL Rock Core COMPILED BY T.J.K.
DATUM Geodetic DATE 75-11-27 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					
165.9	Original Ground Surface																
0.0	Topsoil																
	Weathered Shale Bedrock		1	SS	100%	3											
162.3			2	SS	100%	8											
3.6	Sound Shale Bedrock with Limestone Bands		3	BXL	80% R.C. Rec.												
			4	BXL	40% R.C. Rec.												
			5	BXL	100% R.C. Rec.												
			6	BXL	100% R.C. Rec.												
157.4																	
8.5	End of borehole																
	* Note: W.L. not encountered																
	** Ground elev. as of 75-11-28																

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



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Ontario

RECORD OF BOREHOLE No 2 METRIC

16

W P 127-66-68 LOCATION Sta. 7 + 552.8 16.0 Rt. ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Augers COMPILED BY T.J.K.
DATUM Geodetic DATE 75-11-28 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					
** 167.1	Original Ground Surface												
0.0	Topsoil												
0.46	Weathered Shale		1	SS	100/	3 cm							
164.3			2	SS	100/	3 cm							
2.8	End of borehole												
	* Note: W.L. not encountered												
	** Ground elev. as of 75-11-28												

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 4 METRIC

18

W P 127-66-68 LOCATION Sta. 7 + 557.0 15.0 Lt. ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Augers/BXL Rock Core COMPILED BY T.J.K.
DATUM Geodetic DATE 75-11-28 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					
** 166.5	Original Ground Surface																
0.0	Topsoil																
0.5	Weathered Shale						166										
163.8							164										
2.7	Sound Shale Bedrock with Limestone Bands		2	BXL R.C.	100% Rec.		162										
			3	BXL R.C.	100% Rec.		160										
			4	BXL R.C.	100% Rec.												
			5	BXL R.C.	100% Rec.		158										
157.7	End of Borehole																
8.8	* Note: W.L. not encountered ** Ground elev. as of 75-11-28																

+³, x⁵: Numbers refer to
Sensitivity

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

For

Bridge #35

Hwy. 403 E.B. Expressway Over

Hwy. 410 N.B. Expressway and

Ramp S-W

W.P. 127-66-69, Site 24-81-463

Hwy. 403, District 6, Toronto.INTRODUCTION:

This report summarizes the factual information obtained from a foundation investigation program performed at the above-mentioned structural site.

The fieldwork was carried out between 82 03 19 and 82 03 22, and consisted of advancing 4 sampled boreholes using solid stem continuous flight augers with bedrock being cored in two of the borings. The depth of borings ranged from 2.7 metres to 10.7 metres terminating within the shale bedrock.

Site Description and Geology

The structure site is located southeast of the existing Hwy. 403 W.B. Collector structure (Bridge #43) over Hwy. 410 which was constructed under Contract 75-16 as part of the Hwy. 401/403 Interchange complex.

Land use in the area is changing from predominately farming to industrial subdivision development. Topography across the site is generally flat to gently undulating with ground surface sloping gradually towards Lake Ontario.

The site is located in the physiographic region known as the "Peel Plain". The characteristic deposit, in the vicinity of the area under investigation, is composed of cohesive glacial till, whose thickness varies from nil to 15 metres. The overburden is underlain by shale bedrock of the Meaford-Dundas Formation, Ordovician Period.

Subsurface Conditions

Borings carried out at the structure site indicates generally uniform subsurface conditions. The overburden consists of a shallow deposit of cohesive glacial till underlain by shale bedrock. The upper portion of the shale was found to be weathered.

The boundaries between the various soil types, insitu and laboratory test results, as well as stabilized ground water levels, are shown on the attached Record of Borehole Sheets. The locations and elevations of the borings, along with a profile showing an estimated soil stratigraphy based on borehole data, are shown on Drawing No. 2, which should be read in conjunction with the borehole sheets and this report.

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

Silty Clay, Gravel and Sand (Glacial Till)

The surficial deposit overlying the site consists of a shallow deposit of glacial till composed of a silty clay of low to intermediate plasticity with varying amounts of gravel and some sand. Typical grain size distribution curves for representative samples from this deposit are shown in envelope form on Figure 1. An increasing frequency of fragments, and detached slabs of weathered shale and limestone were encountered within the lower portion of this till.

Results of limited water content and Atterberg Limit testing are plotted on the Plasticity Chart (Figure 2) and summarized as follows:

		<u>Range</u>	<u>Average</u>
Water Content	(w) %	9-16	13
Liquid Limit	(W _L) %	28-40	35
Plastic Limit	(W _p) %	14-21	18
Plasticity Index (I _p) %		14-19	17

These results indicate the cohesive matrix of the glacial till consists of an inorganic silty clay of low to intermediate plasticity (CL-CI).

Based on interpretation of Standard Penetration Test 'N' values ranging from 20 to in excess of 100 blows per 0.3 metres, the consistency of this deposit ranges from very stiff to hard.

Bedrock

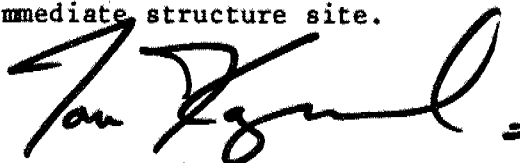
The shale bedrock was encountered immediately beneath the glacial till deposit across the site. The upper 0.4 to 0.9 metres of the bedrock is in a weathered condition. The bedrock surface varies between elevations 176.0 to 176.7 corresponding to depths of 2.3 to 3.2 metres below natural ground surface.

Bedrock surface is sloping gently across the site, and can be expected to exhibit minor fluctuations across the footing locations.

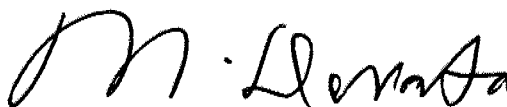
The rock is described as a dark grey, fine textured, soft shale interbedded with thin layers of light grey, fine to medium texture, medium hard limestone. This formation is generally weathered in the upper layers and frequently transitional with the overlying till layer containing fragments and detached slabs of shale and limestone. The badly weathered zone of shale near the top of bedrock grades through a zone of moderate weathering into intact bedrock.

Groundwater Conditions

No natural groundwater level was encountered during augering operations in the borings. Upon completion of rock coring, the induced drill water remained perched within the borings, indicating a low permeability for both the till and shale strata. The existing Hwy. 403 E.B. and W.B. Collector cuts effectively drains the immediate structure site.



T. J. Kazmierowski, P. Eng.
Foundation Engineer



M. Devata, P. Eng.
Senior Foundations Engineer

APPENDIX



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RECORD OF BOREHOLE No 1

METRIC 23

W P 127-66-69 LOCATION N 4 832 783.1; E 292 311.3 ORIGINATED BY V.P.
DIST 6 HWY 403 BOREHOLE TYPE Solid Stem Augers; BXL Rock Core COMPILED BY V.P.
DATUM Geodetic DATE 82 03 19 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	SHEAR STRENGTH								
179.9	Ground Surface																
0.0	Grey (Glacial Till) Brown, Silty Clay, some Sand & Gravel Very Stiff to Hard		1	SS	20	*											
			2	SS	35												
			3	SS	50/	13 cm											
176.7	Shale fragments		4	SS	50/	5 cm											
3.2	Grey weathered		5	SS	50/	2 cm											
	Shale Bedrock with thin layers of Limestone		6	SS	50/	3 cm											
			7	BXL RC	REC 100%												
			8	BXL RC	REC 100%												
			9	BXL RC	REC 100%												
169.2	End of Borehole																
10.7	Note: Refusal to augers at 5.9 m * Water Level not Established																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



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RECORD OF BOREHOLE No 2

METRIC 24

W P 127-66-69 LOCATION N 4 832 744.5; E 292 338.0 ORIGINATED BY V.P.
DIST 6 HWY 403 BOREHOLE TYPE Solid Stem Augers COMPILED BY V.P.
DATUM Geodetic DATE 82 03 22 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100					
178.6	Ground Surface															
0.0	Grey (Glacial Till)															
	Brown															
	Silty Clay, some Sand		1	SS	40											
	and Gravel															
176.5	Hard		2	SS	40/	15 cm										3 14 51 32
2.1																
175.9	Weathered Shale Bedrock		3	SS	50/	8 cm										
2.7	End of Borehole															
	Refusal to Augers															
	Note: Ground Water not Encountered at Time of Investigation															


+3, x⁵ : Numbers refer to
Sensitivity

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

RECORD OF BOREHOLE No 3

METRIC ²⁵

W P 127-66-69 LOCATION N 4 832 700.8; E 292 351.1 ORIGINATED BY V.P.
DIST 6 HWY 403 BOREHOLE TYPE Solid Stem Augers COMPILED BY V.P.
DATUM Geodetic DATE 82 03 22 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								
178.3	Ground Surface												
0.0	Grey (Glacial Till)		1	SS	30	*	178						
	Brown Silty Clay, some Sand & Gravel		2	SS	61								
176.0	Hard		3	SS	50/	15 cm	176						11 9 47 33
2.3	Weathered		4	SS	50//	5 cm							
175.2	Shale Bedrock												
3.1	Refusal to Augers End of Borehole												
<p>* Note: Ground Water not Encountered at time of Investigation</p>													

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



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RECORD OF BOREHOLE No 4

METRIC 26

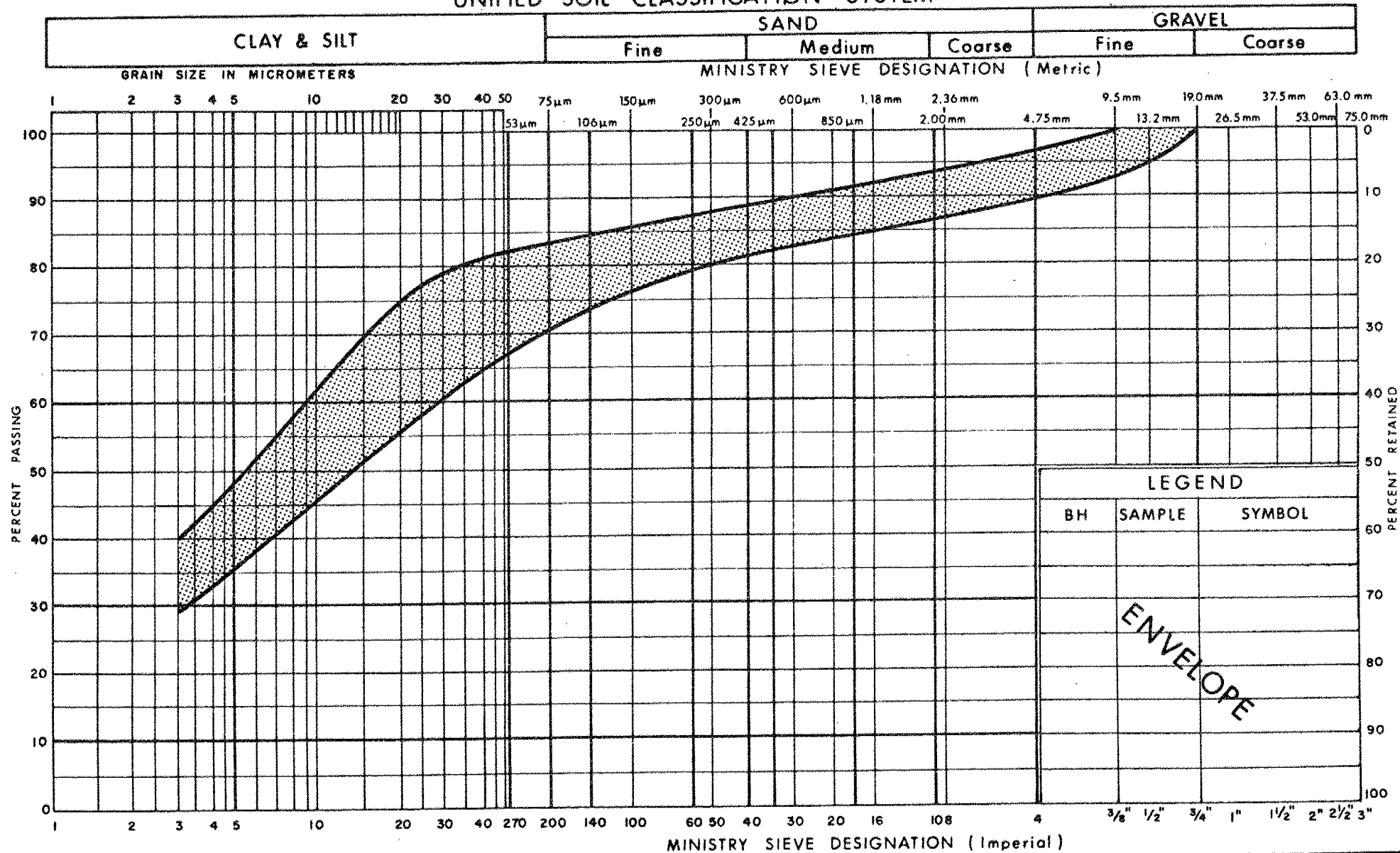
W P 127-66-69 LOCATION N 4 832 682.8; E 292 382.4 ORIGINATED BY V.P.
DIST 6 HWY 403 BOREHOLE TYPE Solid Stem Augers, BXL Rock Core COMPILED BY V.P.
DATUM Geodetic DATE 82 03 22 CHECKED BY

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								
178.1	Ground Surface												
0.0	Grey (Glacial Till) Brown Silty Clay, some Sand & Gravel, Hard		1	SS	34		178						
176.3	Weathered		2	SS	50	8 cm	176						4 25 48 23
1.8	Grey Shale Bedrock with thin layers of Limestone		3	BXL RC	REC 100%		174						
			4	BXL RC	REC 100%								
			5	BXL RC	REC 100%								
			6	BXL RC	REC 100%								
			7	BXL RC	REC 100%		172						
170.7	End of Borehole												
7.4	Note: Refusal to Augers at 2.0 m * Note: Water Level not Established												

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

UNIFIED SOIL CLASSIFICATION SYSTEM

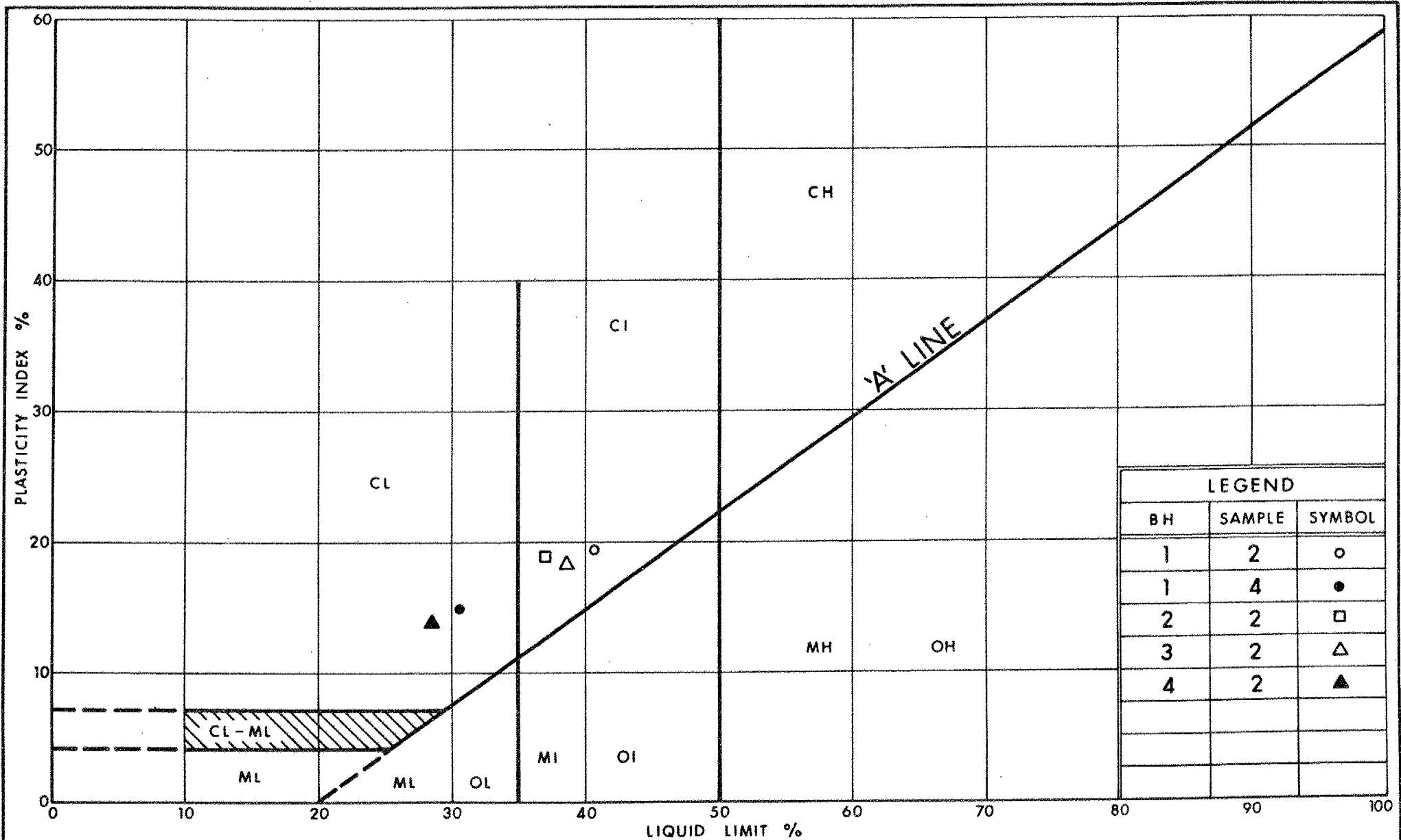


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GRAIN SIZE DISTRIBUTION
SILTY CLAY, SOME SAND & GRAVEL (Glacial Till)

FIG No 1

W P 127-66-69



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PLASTICITY CHART
(Glacial Till Matrix)
SILTY CLAY (OF LOW TO INTERMEDIATE PLASTICITY)

FIG No 2

W P 127-66-69

For

Bridge #34

Hwy. 403 W.B. Expressway Over

Hwy. 410 N.B. Expressway and

Ramp S-W

W.P. 127-66-70, Site 24-81-464

Hwy. 403, District 6, Toronto.INTRODUCTION:

This report summarizes the factual information obtained from a foundation investigation program performed at the above-mentioned structural site.

The fieldwork was carried out between 82 03 11 and 82 03 12, and consisted of advancing 3 sampled boreholes using solid stem continuous flight augers with bedrock being cored in two of the borings. The depth of borings ranged from 3.4 metres to 7.6 metres terminating within the shale bedrock.

Site Description and Geology

The structure site is located immediately southeast of the existing Hwy. 403 W.B. Collector structure (Bridge #43) over Hwy. 410 which was constructed under Contract 75-16 as part of the Hwy. 401/403 Interchange complex.

Land use in the area is changing from predominately farming to industrial subdivision development. Topography across the site is generally flat to gently undulating with ground surface sloping gradually towards Lake Ontario.

The site is located in the physiographic region known as the "Peel Plain". The characteristic deposit, in the vicinity of the area under investigation, is composed of cohesive glacial till, whose thickness varies from nil to 15 metres. The overburden is underlain by shale bedrock of the Meaford-Dundas Formation, Ordovician Period.

Subsurface Conditions

Borings carried out at the structure site indicates generally uniform subsurface conditions. The overburden consists of a shallow deposit of cohesive glacial till underlain by shale bedrock. The upper portion of the shale was found to be weathered.

The boundaries between the various soil types, insitu and laboratory test results, as well as stabilized ground water levels, are shown on the attached Record of Borehole Sheets. The locations and elevations of the borings, along with a profile showing an estimated soil stratigraphy based on borehole data, are shown on Drawing No. 2, which should be read in conjunction with the borehole sheets and this report.

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

Silty Clay, Gravel and Sand (Glacial Till)

The surficial deposit overlying the site consists of a shallow deposit of glacial till composed of a silty clay of low to intermediate plasticity with varying amounts of gravel and some sand. Typical grain size distribution curves for representative samples from this deposit are shown in envelope form on Figure 1. An increasing frequency of fragments, and detached slabs of weathered shale and limestone were encountered within the lower portion of this till.

Results of limited water content and Atterberg Limit testing are plotted on the Plasticity Chart (Figure 2) and summarized as follows:

		<u>Range</u>	<u>Average</u>
Water Content	(w) %	11-18	15
Liquid Limit	(W _L) %	32-37	34
Plastic Limit	(W _p) %	17-20	18
Plasticity Index	(I _p) %	14-18	16

These results indicate the cohesive matrix of the glacial till consists of an inorganic silty clay of low to intermediate plasticity (CL-CI).

Based on interpretation of Standard Penetration Test 'N' values ranging from 19 to in excess of 100 blows per 0.3 metres, the consistency of this deposit ranges from very stiff to hard.

Bedrock

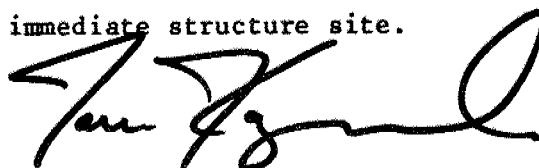
The shale bedrock was encountered immediately beneath the glacial till deposit across the site. The upper 1.1 to 1.4 metres of the bedrock is in a weathered condition. The bedrock surface varies between elevations 177.3 to 177.7 corresponding to depths of approximately 3.2 metres below natural ground surface.

Bedrock surface is sloping gently across the site, and can be expected to exhibit minor fluctuations across the footing locations.

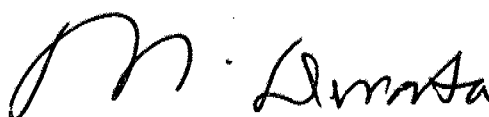
The rock is described as a dark grey, fine textured, soft shale interbedded with thin layers of light grey, fine to medium texture, medium hard limestone. This formation is generally weathered in the upper layers and frequently transitional with the overlying till layer containing fragments and detached slabs of shale and limestone. The badly weathered zone of shale near the top of bedrock grades through a zone of moderate weathering into intact bedrock.

Groundwater Conditions

No natural groundwater level was encountered during augering operations in the borings. Upon completion of rock coring, the induced drill water remained perched within the borings, indicating a low permeability for both the till and shale strata. The existing Hwy. 403 E.B. and W.B. Collector cuts effectively drains the immediate structure site.



T. J. Kazmierowski, P. Eng.
Foundation Engineer



M. Devata, P. Eng.
Senior Foundations Engineer

A P P E N D I X

RECORD OF BOREHOLE No 1

METRIC 33

W P 127-66-70 LOCATION N 4 832 819.5; E 292 260.1 ORIGINATED BY V.P.
DIST 6 HWY 403 BOREHOLE TYPE Solid Stem Augers, BXL Rock Core COMPILED BY V.P.
DATUM Geodetic DATE 82 03 11 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					
180.9	Ground Surface																
0.0	Gray (Glacial Till) Brown Silty Clay some Sand and Gravel		1	SS	19	*	180										2 13 59 26
			2	SS	63												8 21 44 27
177.7	Very Stiff to Hard						178										
3.2	Gray		3	SS	50/13 cm												
	Weathered		4	RC	REC 96%		176										
	Shale Bedrock with thin layers of Limestone		5	RC	REC 100%												
			6	RC	REC 100%		174										
173.5	End of Borehole Note: Refusal to augers at 4.0 m * Water level not established																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2

METRIC 34

W P 127-66-70 LOCATION N 4 832 788.5; E 292 277.3 ORIGINATED BY V.P.
DIST 6 HWY 403 BOREHOLE TYPE Solid Stem Augers COMPILED BY V.P.
DATUM Geodetic DATE 82 03 12 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 γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
180.5	Ground Surface																
0.0	Grey (Glacial Till) Brown Silty Clay some Sand and Gravel Hard		1	SS	39	*	180										
			2	SS	60												
			3	SS	57		178										
177.1	Weathered Shale Bedrock		4	SS	50/3 cm												
3.4	Refusal to Auger End of Borehole * Water Level not encountered. B.H. 'dry' at time of investigation.																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



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RECORD OF BOREHOLE No 3

METRIC ³⁵

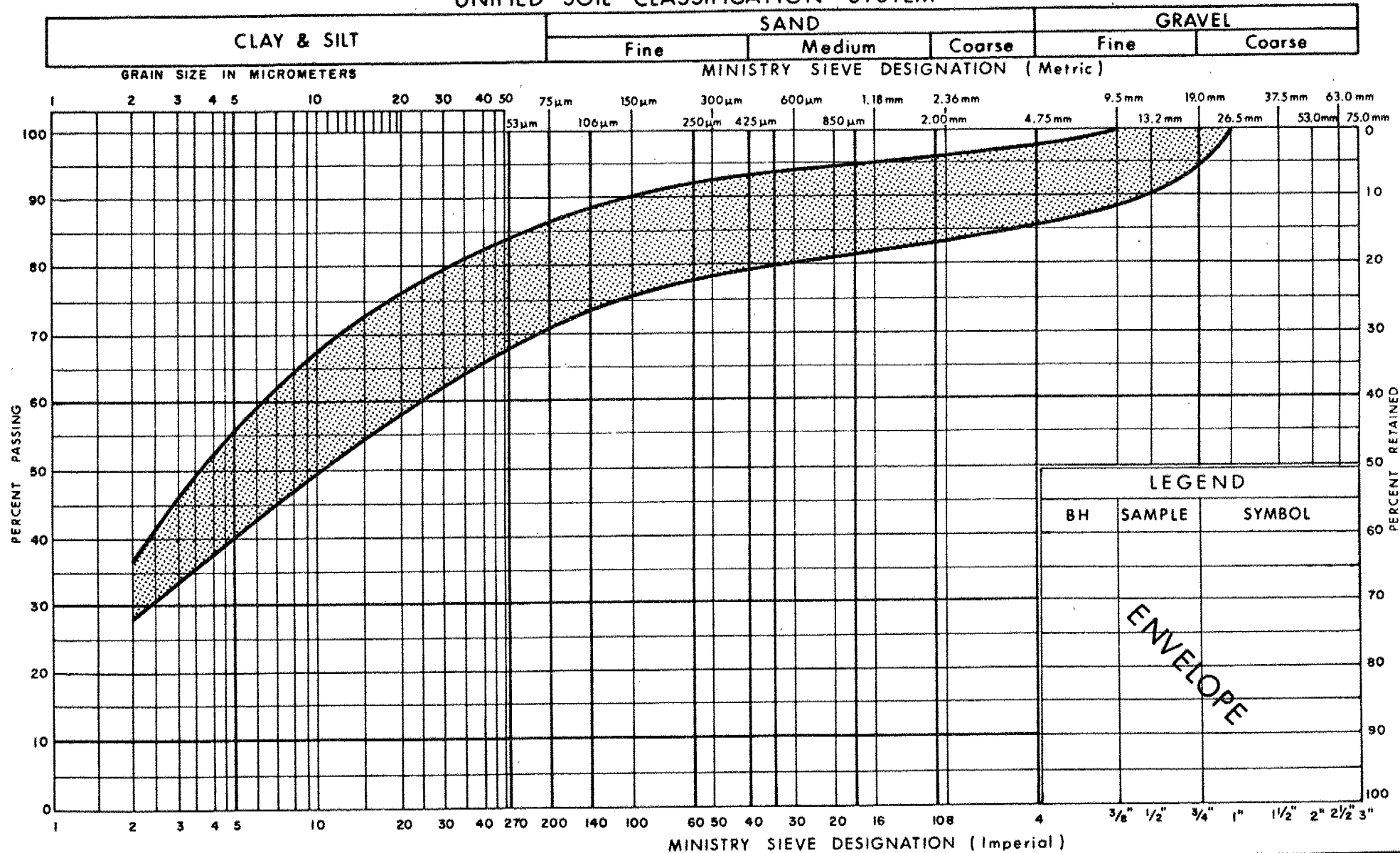
W P 127-66-70 LOCATION N 4 832 735.7; E 292 308.1 ORIGINATED BY V.P.
DIST 6 HWY 403 BOREHOLE TYPE Solid Stem Augers, BXL Rock Core COMPILED BY V.P.
DATUM Geodetic DATE 82 03 12 CHECKED BY CP

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 (%) 10 20 30	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	Grey (Glacial Till) Brown Silty Clay some Sand and Gravel Hard		1	SS	34	*	178				14 12 49 25
177.4			2	SS	46						
2.6	Grey Weathered		3	SS	61/	24 cm					
	Shale Bedrock with thin layers of Limestone		4	BXL RC	REC 100%		176				
			5	RC	REC 100%						
			6	BXL RC	REC 100%		174				
			7	BXL RC	REC 100%						
172.4	End of Borehole Note: Refusal to augers at 3.0 m * Water level not established.										

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

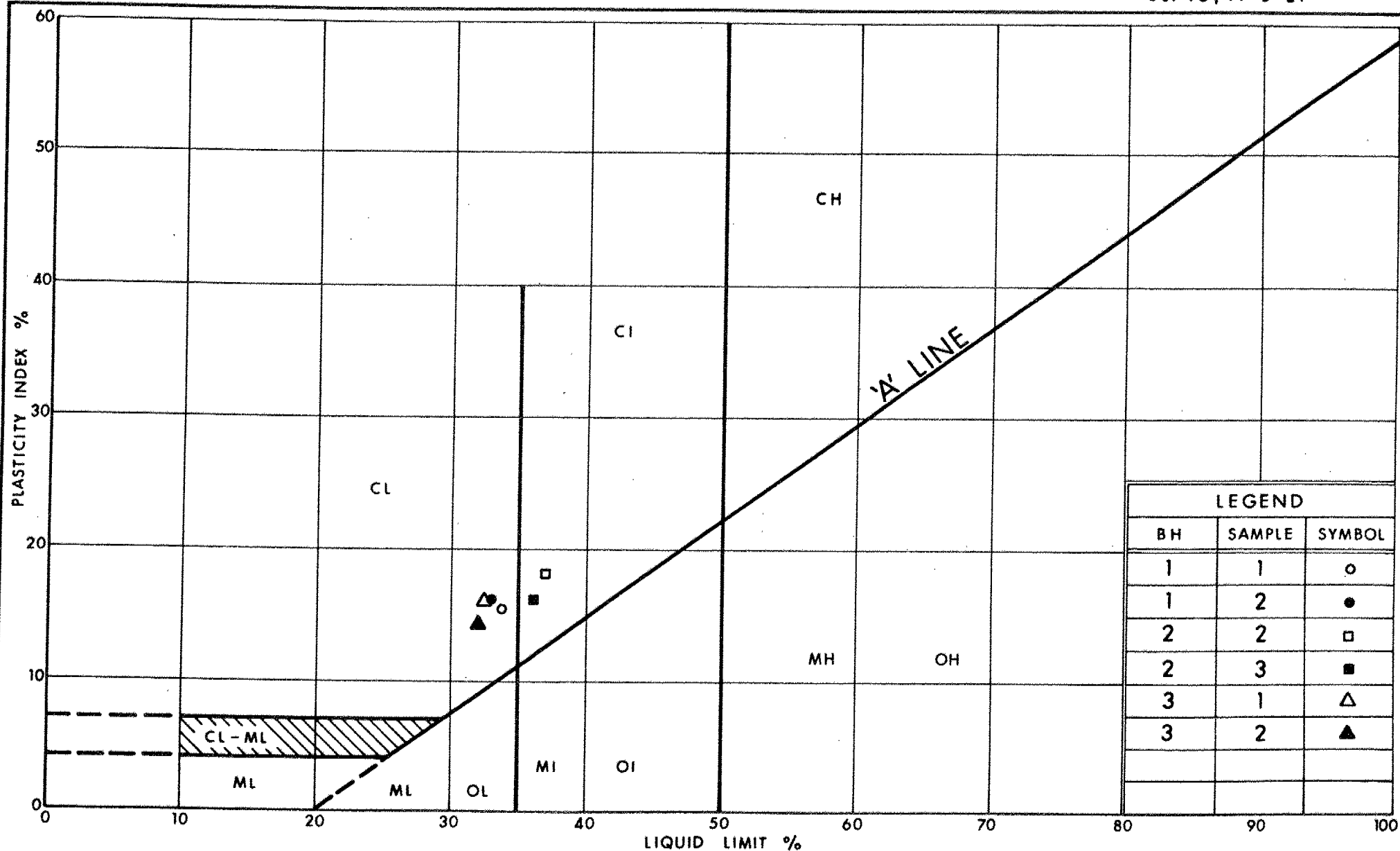
 Ministry of
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Communications

GRAIN SIZE DISTRIBUTION

SILTY CLAY, SOME SAND & GRAVEL (Glacial Till)

FIG No 1

W P 127-66-70



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PLASTICITY CHART
(Glacial Till Matrix)
SILTY CLAY (OF LOW TO INTERMEDIATE PLASTICITY)

FIG No 2

W P 127-66-70

ENGINEERING MATERIALS OFFICE
PAVEMENT & FOUNDATION DESIGN SECTION

WP 127-66-67 DIST 6
HWY 403 STR SITE 24-81-354A

Hwy. 403 E.B. Collector Over Matheson
Boulevard

DISTRIBUTION

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Files

MAR 04 1982

FOUNDATION INVESTIGATION REPORT

For

Hwy. 403 E.B. Collector Over

Matheson Boulevard

W.P. 127-66-67, Site 24-81-354A

Highway 403, District 6, Toronto

INTRODUCTION:

This report summarizes the factual information obtained from a foundation investigation program performed at the above-mentioned structural site and provides detailed recommendations pertaining to the structure foundations and related earthworks.

The fieldwork was carried out and report issued under W.P. 36-74-03 for the original crossing in late 1975 and early 1976. No additional fieldwork has been required since the original investigation was sufficient in scope to encompass the revised structural scheme. The field investigation consisted of advancing 4 sampled boreholes using hollow stem continuous flight augers and obtaining rock cores in two of these borings to ascertain the condition of bedrock. The borings ranged in depth from 1.5 metres to 9.1 metres.

SITE DESCRIPTION AND GEOLOGY

The site is located immediately east of the Hwy. 403 E.B. Core Overpass structure at Matheson Blvd., between the First Line East and Second Line East, some 1.2 kilometers north of Eglinton Avenue West, in the City of Mississauga, Regional Municipality of Peel. The west branch of Etobicoke Creek passes approximately 300 metres south of the site.

Land use in the area is changing from predominately farming to industrial subdivision development. Topography across the site is generally flat to gently undulating with ground surface sloping gradually towards Lake Ontario.

The site is located in the physiographic region known as the "Peel Plain". The characteristic deposit, in the vicinity of the area under investigation, is composed of cohesive glacial till, whose thickness varies from nil to 15 metres. The overburden is underlain by shale bedrock of the Meaford-Dundas Formation, Ordovician Period.

SUBSURFACE CONDITIONS

Borings carried out at the structure site indicates generally uniform subsurface conditions. The overburden consists of a thin layer of topsoil and/or a shallow deposit of cohesive glacial till. Underlying this is shale bedrock. The upper portion of the shale was found to be weathered.

The boundaries between the various soil types, insitu and laboratory test results, as well as stabilized ground water levels, are shown on the attached Record of Borehole Sheets. The locations and elevations of the borings, along with a profile and two estimated stratigraphical sections based on borehole data, are shown on Drawing No. 1276667-A.

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

Overburden (Topsoil and/or Glacial Till)

The surficial deposit at the site consists of a thin layer of topsoil and/or a thin deposit of glacial till ranging in thickness from 0.5 metres to 1.8 metres. Generally, the glacial till stratum is a heterogeneous mixture of hard silty clay of low plasticity, sand and gravel, with shale fragments.

Shale Bedrock

The shale bedrock was encountered immediately underneath the topsoil /glacial till across the site. The upper 0.8 to 2.5 metres of the bedrock is in a weathered condition. The bedrock surface varies between elevations 164.7 to 162.7 corresponding to depths of approximately 0.5 to 1.7 metres below original ground surface prior to cut excavations for Matheson Blvd.

Bedrock surface is sloping gently in a southeasterly direction across the site.

The rock is described as a dark grey, fine textured, soft shale interbedded with thin layers (2 to 25 cm thick) of light grey, fine to medium texture, medium hard limestone.

GROUNDWATER CONDITIONS

Groundwater level observations have been carried out during and after the period of investigation by recording the water levels in the open boreholes. No water levels were encountered in the open boreholes at the time of the investigation.

DISCUSSION AND RECOMMENDATIONS

In order to accommodate the upgrading of Hwy. 403 to a collector/core network in the Hwy. 401 area, East and West Bound Overpass structures are required crossing Matheson Blvd. The proposed E. B. structure will consist of a 20.3 metre single span concrete girder supported deck with a combined cantilever wingwall and 7.0 wide x 5.0 high retaining wall. A proposed Hwy. 403 E. B. Collector profile grade of 166.5, existing Matheson Blvd. grade of 159.0, and an average natural ground elevation of 165 will necessitate maximum approach fill heights in the order of 1.5 metres.

In consideration of the proximity of competent shale bedrock to ground surface across the site, recommendations pertaining to the foundations of the new structure and related earthworks are summarized as follows:

Full height 'closed' abutments can be supported on spread footings founded in sound shale bedrock at or below elevation 157.0. The factored bearing capacity at U.L.S. for abutment footings founded in sound shale is 1500 kPa. The design of shallow foundations founded on an unyielding medium such as shale bedrock will not be governed by settlement since the bearing capacity at S.L.S. Type II is much larger than the factored capacity at U.L.S.

The approach retaining walls can be supported on shallow spread footings located in the weathered shale for a factored bearing capacity at the U.L.S. of 1,000 kPa. Alternatively for retaining wall footings founded at or below elevation 162.0 in the sound shale, a factored bearing capacity at the U.L.S. of 1500 kPa may be used.

A minimum earth cover of 1.25 metres should be provided to the underside of the footings, since the shale is considered susceptible to frost action.

The base of all footing excavations should be covered immediately with a working slab of lean concrete to protect the exposed shale from weathering and softening.

Earth pressures against the abutment and retaining walls should be computed as per Subsection 6.6.1.2.2 of the O. H. B. D. C. Manual with provisions made from adequate drainage behind the abutment and retaining walls.

A constraint on the use of heavy vibratory equipment within a restricted distance to the back of abutment and retaining wall should be included as per current MTC directives.

Resistance to sliding of the abutment footings can be calculated assuming a coefficient of friction of 0.8 between the underside of the concrete footing and the rough shale surface.

No major dewatering difficulties are anticipated for footing excavations in consideration of the relatively low permeability of the shale bedrock. Localized seepage into excavations can be controlled by perimeter ditches and pumping from corner sumps.

No stability problems are anticipated for permanent embankment slopes constructed to a 2:1 geometry

Temporary cut slopes will stand at a 1:1 geometry or steeper, however, these slopes will weather rapidly and show signs of surficial distress if not protected in a reasonable length of time.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Mr. V. Korlu, Project Engineer, utilizing equipment owned and operated by Johnston Drilling Co., Toronto. This report was written by Mr. T. J. Kazmierowski, Foundations Engineer and reviewed by Mr. M. Devata, Senior Foundations Engineer.

for H. Syllie
T. J. Kazmierowski, P.Eng.
Foundations Engineer

M. Devata
M. Devata, P.Eng.
Senior Foundations Engineer



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RECORD OF BOREHOLE No 5 METRIC

W P 127-66-67 LOCATION Sta. 7 + 167.0 1.2 Rt. ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Augers/BXL Rock Core COMPILED BY T.J.K.
DATUM Geodetic DATE 75-12-01 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					
164.7	Original Ground Surface	~															
0.0	Topsoil						164										
0.5	Weathered Shale		1	SS	91												
161.7			2	SS	100/23 cm		162										
3.0	Sound Shale Bedrock With Limestone Bands		3	BXL R.C.	100% Rec.												
			4	BXL R.C.	80% Rec.		160										
			5	BXL R.C.	80% Rec.		158										
			6	BXL R.C.	95% Rec.		156										
155.6	End of Borehole																
	* Note: W.L. not encountered																
	** Ground elev. as of 75-12-01																

*3, *5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



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RECORD OF BOREHOLE No 6 METRIC

W P 127-66-67 LOCATION Sta. 7 + 146.2 1.0 Lt. ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Augers COMPILED BY T.J.K.
DATUM Geodetic DATE 75-12-1 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					
** 165.2	Original Ground Surface															
164.7	Topsoil															
0.5	Weathered Shale															
163.7			1	SS	100-3	cm	164									
1.5	End of Borehole															
	* Note: W.L. not encountered															
	** Ground elev. as of 75-12-01						162									

+3, x5: Numbers refer to
Sensitivity

20
15 + 5 (%) STRAIN AT FAILURE
10



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RECORD OF BOREHOLE No 7 METRIC

W P 127-66-67 LOCATION Sta. 7 + 172.0 26.2 Lt. ORIGINATED BY V.E.
DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Augers COMPILED BY T.J.K.
DATUM Geodetic DATE 75-12-01 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					
164.5	Original Ground Surface																
0.0	(Glacial Till) Het. mix. of Silty Clay Sand & Gravel Hard With Shale Fragments					*											
162.7			1	SS	118	23 cm											
1.8	Weathered Shale																
161.4			2	SS	100	3 cm											
3.1	End of Borehole																
	* Note: W.L. not encountered																
	** Ground elev. as of 75-12-01																

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 8

METRIC

W P 127-66-67 LOCATION Sta. 7 + 149.0 26.0 Lt. ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Augers/BXL Rock Core COMPILED BY T.J.K.
DATUM Geodetic DATE 75-12-01 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT 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		
165.2	Original Ground Surface																
0.0	Topsoil																
0.5	(Clayey Till) Het. Mix of Silty Clay, Sand & Gravel with shale frags																
163.5																	
1.7	weathered Sound		1	SS	67												
			2	SS	100	3 cm											
			3	BXL R.C.	70% Rec												
	Shale Bedrock with Limestone Bands		4	BXL R.C.	65% Rec												
			5	BXL R.C.	70% Rec												
			6	BXL R.C.	100% Rec												
			7	BXL R.C.	100% Rec												
156.7	End of Borehole																
8.5	* Note: W.L. not encountered ** Ground elev. as of 75-12-01																

+3, x5 : Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

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:

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

SS	SPLIT SPOON	TP	THINWALL PISTON
WS	WASH SAMPLE	OS	OSTERBERG SAMPLE
ST	SLOTTED TUBE SAMPLE	RC	ROCK CORE
BS	BLOCK SAMPLE	PH	TW ADVANCED HYDRAULICALLY
CS	CHUNK SAMPLE	PM	TW ADVANCED MANUALLY
TW	THINWALL OPEN	FS	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	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						

METRIC

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

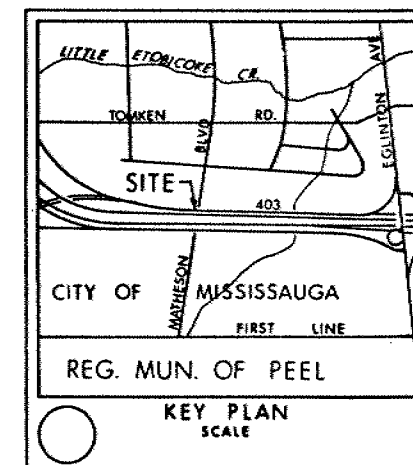
CONT No
WP No 127-66-67

HWY 403 E.B. COLLECTOR
OVERPASS AT MATHESON BLVD.

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
- W.L. NOT Encountered

No	ELEVATION	STATION	OFFSET
5	164.7	7+167.0	1-2 RT
6	165.2	7+146.2	1-0 LT
7	164.5	7+172.0	26-2 LT
8	165.2	7+149.0	26-0 LT

BH ELEVATIONS
AS OF 75 11 18

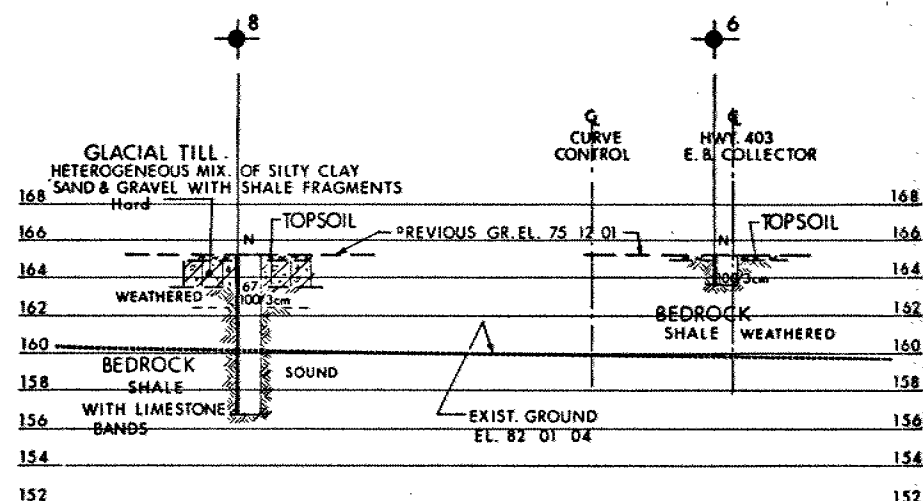
NOTE

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

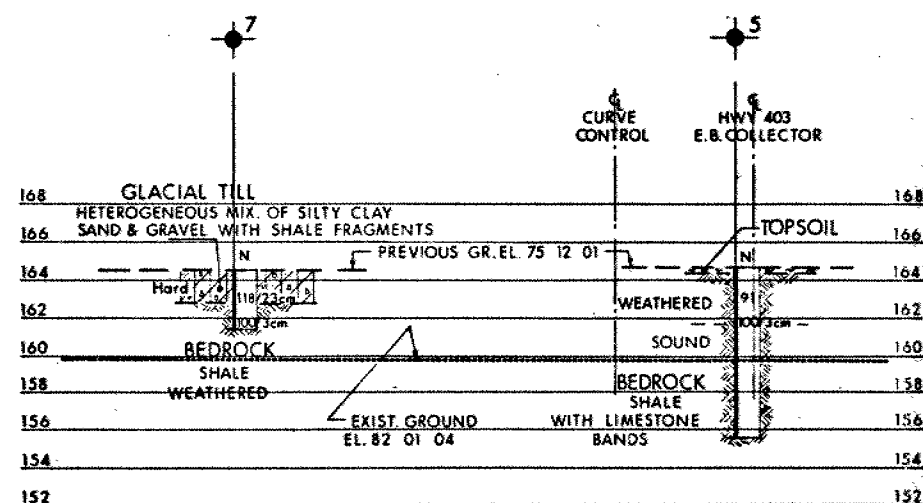
REVISIONS	DATE	BY	DESCRIPTION

Geocres No 30M12-150

HWY No	403	DIST	6
SUBWD T.K. CHECKED	DATE 82 02 22	SITE	24-R1-354A
DRAWN L.J. CHECKED	APPROVED	DWG	127-66-67-A

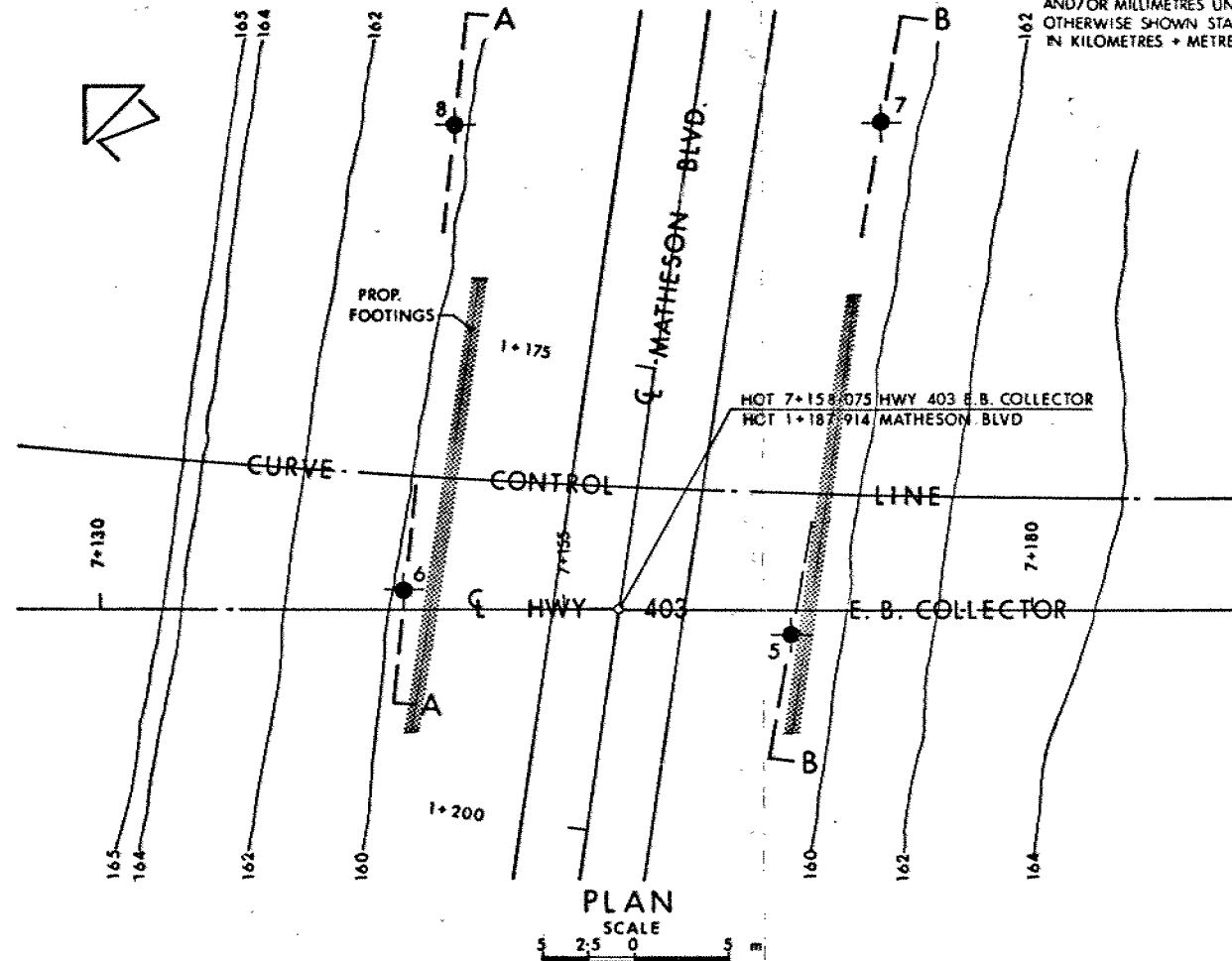


A - A



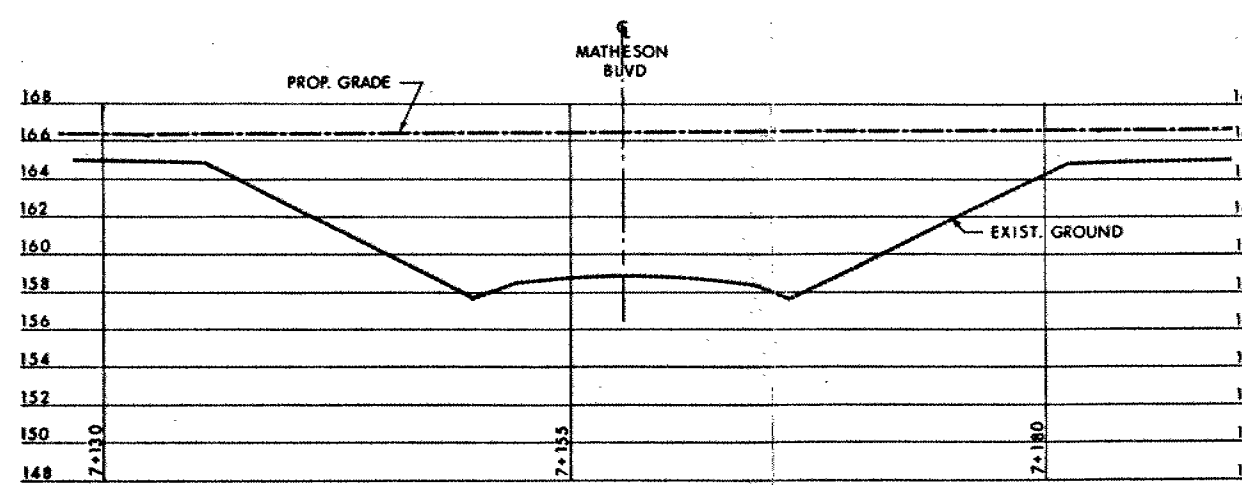
B - B
SECTIONS

SCALE
5 2.5 0 5



PLAN

SCALE
5 2.5 0 5 m



PROFILE HWY. 403 E.B. COLLECTOR

SCALE
5 2.5 0 5

