

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 3012-169

DIST. 4 REGION

W.P. No. 197-77-03

CONT. No. 84-78

W. O. No.

STR. SITE No. 10-82-325

HWY. No. 403/407

LOCATION Ramp E-S Underpass (Structure #4)  
403 E-407 S Ramp over 403 & 407

No. of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

DIST No 4  
CONT No  
WP No 197-77-03

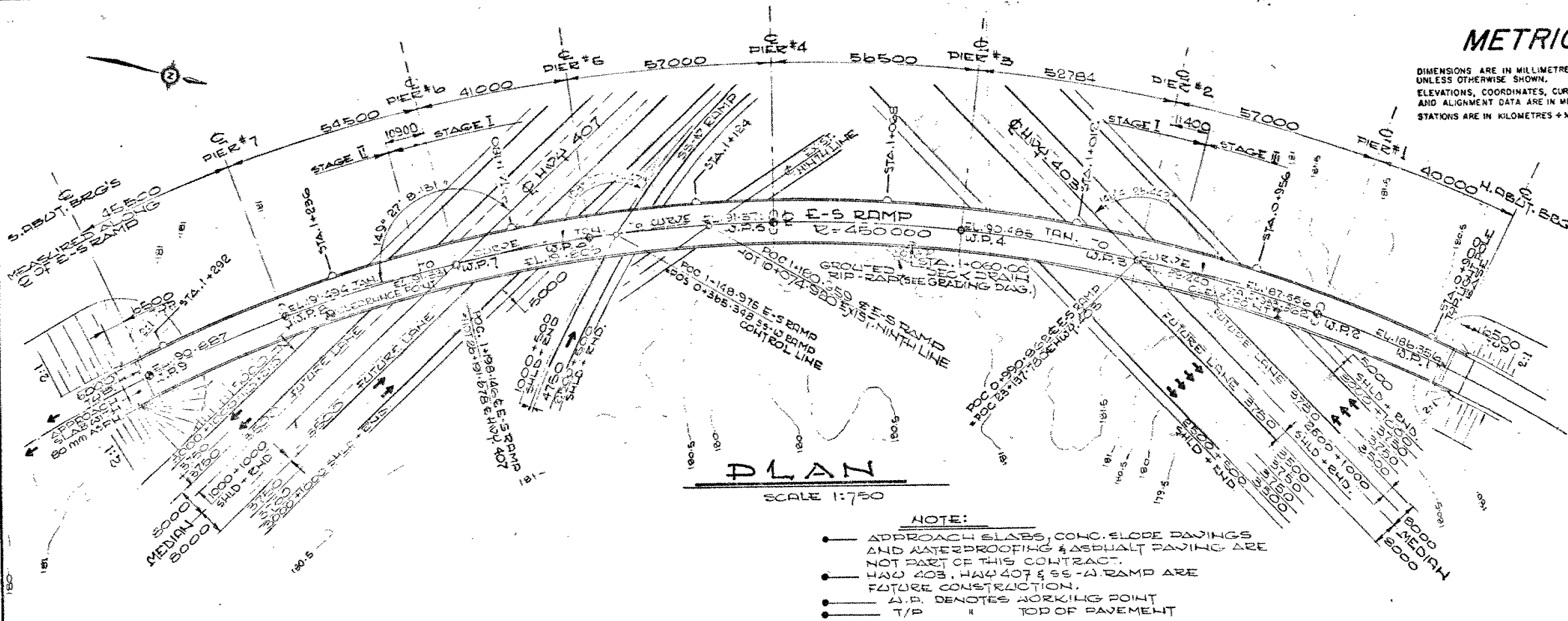


METRIC

DIMENSIONS ARE IN MILLIMETRES  
UNLESS OTHERWISE SHOWN.  
ELEVATIONS, COORDINATES, CURVE  
AND ALIGNMENT DATA ARE IN METRES.  
STATIONS ARE IN KILOMETRES + METRES.

RAMP E-S UNDERPASS  
HIGHWAY 403/407 INTERCHANGE  
GENERAL ARRANGEMENT

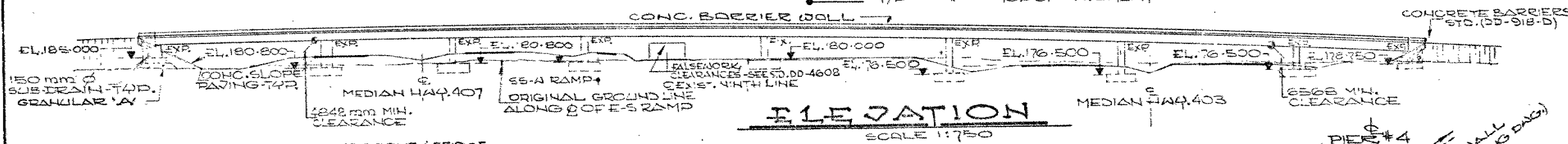
SHEET



GENERAL NOTES

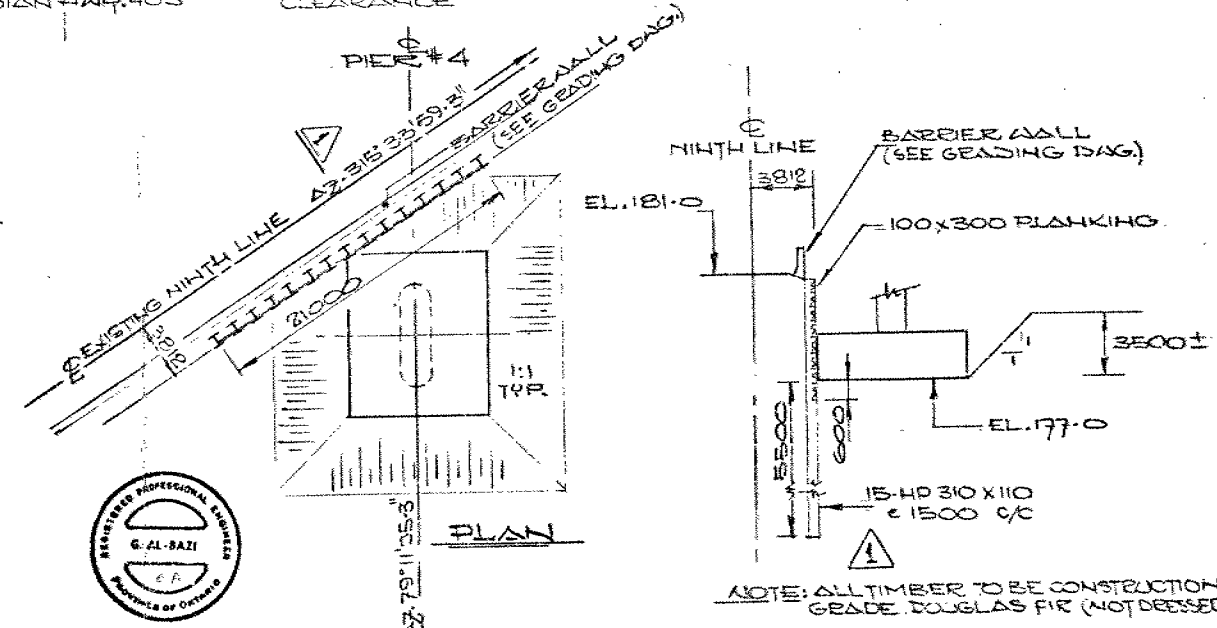
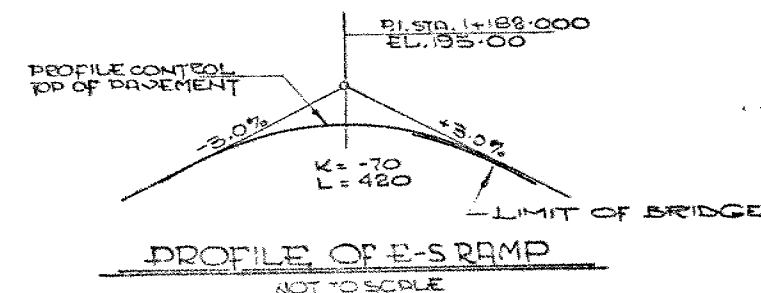
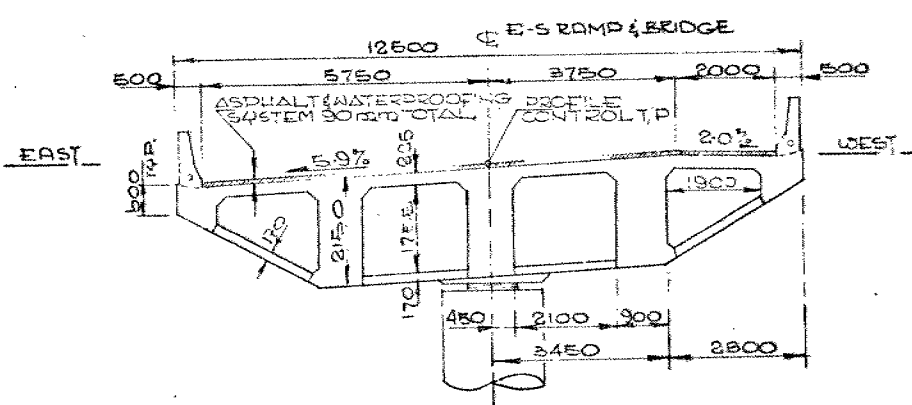
CLASS OF CONCRETE

DECK & PIER COLUMNS	35 MPa
BARRIER WALLS, ABUTMENTS	30 MPa
WINGWALLS	30 MPa
REMAINDER	20 MPa
CLEAR COVER TO REINFC. STEEL	
FOOTINGS	50 ± 25 mm
TOP SLAB - TOP	70 ± 20 mm
TOP SLAB - BOTT.	40 ± 10 mm
BOTTOM SLAB - TOP	40 ± 10 mm
BOTTOM SLAB - BOTT.	40 ± 10 mm
ABUT. SIDES	40 ± 10 mm
PIERS, ABUTMENTS & WINGWALLS	80 ± 20 mm
FRONT FACES	70 ± 20 mm
REMAINDER	40 ± 10 mm
UNLESS OTHERWISE NOTED	
REINFORCING STEEL	
REINFORCING STEEL SHALL BE GRADE 400	
REINFORCING BARS WITH DESIGNATION 'C' AT END OF BAR MARKS SHALL BE EPOXY COATED BARS.	
CONSTRUCTION NOTES	
THE CONTRACTOR SHALL FINISH THE BEARING SEAT/STEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF ± 3 mm	
THE SUPERSTRUCTURE SHALL BE BUILT IN THREE CONSTRUCTION STAGES AS SHOWN.	



LIST OF DRAWINGS

- 1 - GENERAL ARRANGEMENT
- 2 - BOREHOLE LOCATIONS & SOIL STRATA
- 3 - LOCATION OF WORKING POINTS
- 4 - ABUTMENT FOOTINGS
- 5 - PIER FOOTINGS
- 6 - NORTH ABUTMENT
- 7 - SOUTH ABUTMENT
- 8 - PIER DETAILS
- 9 - BEARINGS
- 10 - DECK DETAILS I
- 11 - " " II
- 12 - TRANSVERSE TENDONS
- 13 - LONGITUDINAL CABLE DETAILS I
- 14 - " " II
- 15 - DECK REINFORCING DETAILS I
- 16 - " " II
- 17 - " " III
- 18 - " " IV
- 19 - " " V
- 20 - EXPANSION JOINTS
- 21 - BARRIER WALL
- 22 - 6000 mm APPROACH SLABS
- 23 - DETAILS OF CONC. SLOPE DRAINING
- 24 - AS CONSTRUCTED ELEV. & DIM.
- 25 - BRIDGE DATA & SITE NUMBER DATA
- 26 - STANDARD DETAILS
- 27 - QUANTITIES (P.Q.D.)
- 28 - " " "



DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN		CHECK	LOADING
DRAWING		CHECK	SITE

METRIC

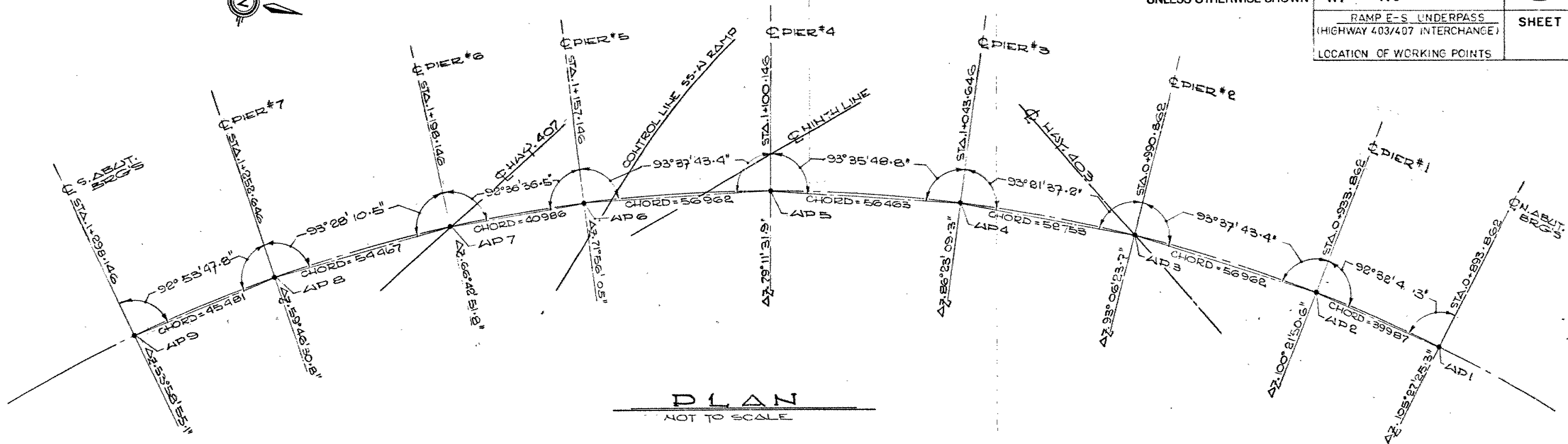
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
WP No 197-77-03

RAMP E-S UNDERPASS  
(HIGHWAY 403/407 INTERCHANGE)

LOCATION OF WORKING POINTS

SHEET



PROVINCIAL CO-ORDINATES OF WORKING POINTS

AP9		AP8		AP7		AP6		AP5		AP4		AP3		AP2		AP1	
N	E	N	E	N	E	N	E	N	E	N	E	N	E	N	E	N	E
4820516.970	286735.275	4820555.061	286710.422	4820603.697	286685.902	4820642.042	286671.431	4820697.206	286657.230	4820753.222	286650.142	4820805.975	286649.939	4820862.544	286656.590	4820901.520	286665.524



DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN		CHECK	LOADING
DRAWING		CHECK	SITE No

# FOUNDATION INVESTIGATION REPORT

CONTRACT NO 84 - 78



Ministry of  
Transportation and  
Communications

INDEX

<u>PAGE NO.</u>	<u>DESCRIPTION</u>
1	Index
2	Abbreviations and Symbols
3 - 42	Foundation Investigation Reports For  Ramp E-S Underpass Hwy. #403 & #407 Interchange W.P. 197-77-03; Site 10-82-325  Ramp W-S Underpass At Ninth Line Hwy. #403 & #407 Interchange W.P. 197-77-04; Site 10-82-328  Ninth Line Underpass Hwy. #403 & #407 Interchange W.P. 197-77-05; Site 10-82-327  Ramp SS-W Ramp, Hwy. #407 Underpass Hwy. #403 & #407 Interchange W.P. 197-77-17; Site 10-82-326

NOTE: For purposes of the contract these reports supercede all other Foundation Investigation Reports prepared by or for the Ministry in connection with the above mentioned projects.

## 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 (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

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
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
$E$	kPa	MODULUS OF LINEAR DEFORMATION
$G$	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

### MECHANICAL PROPERTIES OF SOIL

$m_v$	kPa <sup>-1</sup>	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	m <sup>2</sup> /s	COEFFICIENT OF CONSOLIDATION
$H$	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
$U$	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_t$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	kg/m <sup>3</sup>	DENSITY OF SOLID PARTICLES	$e$	1, %	VOID RATIO	$e_{min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	kn/m <sup>3</sup>	UNIT WEIGHT OF SOLID PARTICLES	$n$	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\rho_w$	kg/m <sup>3</sup>	DENSITY OF WATER	$w$	1, %	WATER CONTENT	$D$	mm	GRAIN DIAMETER
$\gamma_w$	kn/m <sup>3</sup>	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
$\rho$	kg/m <sup>3</sup>	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	kn/m <sup>3</sup>	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	$h$	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	kg/m <sup>3</sup>	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	$q$	m <sup>3</sup> /s	RATE OF DISCHARGE
$\gamma_d$	kn/m <sup>3</sup>	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	$v$	m/s	DISCHARGE VELOCITY
$\rho_{sat}$	kg/m <sup>3</sup>	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	$i$	1	HYDRAULIC GRADIENT
$\gamma_{sat}$	kn/m <sup>3</sup>	UNIT WEIGHT OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	$k$	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	kg/m <sup>3</sup>	DENSITY OF SUBMERGED SOIL	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE	$j$	kn/m <sup>3</sup>	SEEPAGE FORCE
$\gamma'$	kn/m <sup>3</sup>	UNIT WEIGHT OF SUBMERGED SOIL						

FOUNDATION INVESTIGATION REPORT  
FOR  
Ramp E-S Underpass  
(Hwy. #403 & 407 Interchange)  
W.P. 197-77-03; Site 10-82-325  
District #4 (Hamilton)

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### INTRODUCTION

This report contains the results of the foundation investigations carried out at the aforementioned site on 81 12 23 - 82 01 05, 82 10 28 - 82 11 01 and 82 11 22. The fieldwork consisted of seven sampled boreholes and seven dynamic cone penetration tests adjacent to each borings. The borings were advanced by continuous flight auger machines mounted on muskeg vehicles and equipped either with 83 mm (I.D.) hollow stem or solid stem augers.

### SITE DESCRIPTION

The site is located in the vicinity of the existing Ninth Line Road, some 1.0 km north of Burnhamthorpe Rd. in the town of Milton, town of Oakville and the city of Mississauga. The surrounding terrain is relatively flat. Physiographically the site is located in the region referred to as the Peel Plain. The deposits in the vicinity of the area under investigation are composed of cohesive glacial till and granular deposits. The overburden is underlain by shale bedrock.

### SUBSURFACE CONDITIONS

#### General

The subsoil at this location was found to consist of cohesive type glacial till, followed by sandy silt to silty sand deposit, followed by shale bedrock. In some of the borings, a silty clay stratum was encountered over the bedrock. The boundaries of the different strata, together with

the obtained field and laboratory test results are shown on the Record of Borehole sheets contained in the Appendix of this report. A stratigraphical profile is shown on Drawing No. 2 of the contract drawings. A description of the different strata encountered is given below.

Heterogeneous Mixture of Silty Clay, Sand & Gravel (Glacial Till)

Immediately below a thin layer of topsoil a till-like zone was encountered at every boring location. The thickness varies from 7.0 m to 10.5 m. In B.H. 's #14 & 15 this zone was not fully penetrated. The material in the deposit was found to consist of a heterogeneous mixture of silty clay, sand and gravel. The matrix of this till is basically cohesive in nature - i.e., silty clay binding coarser particles. There are random localized zones where the matrix is only slightly cohesive. Standard Penetration Tests carried out within the deposit gave 'N' values to range from 21 to over 100 blows per 30 cm. In the vicinity of Boreholes #14 & 15 the extreme upper portion (1.0 - 1.5 m) of the material is in a soft to very soft condition due to the stagnant surface water.

Physical properties of the material as determined from laboratory tests are summarized as follows:

	<u>Range</u>
Natural Moisture Content (%)	6-16
Liquid Limit (%)	12-29
Plastic Limit (%)	11-18

The results of the grain-size distribution tests are shown in an envelope form on Figure #1 of the Appendix.

The consistency of the overall deposit varies from very stiff to hard. The very stiff zones are mainly confined to the upper portion of the deposit.



### Sandy Silt to Silty Sand, Traces of Gravel & Clay

This stratum was encountered in those borings which were advanced below the above described glacial till. The thickness varied from 5.1 m to 14.4 m at the boring locations. The material in the deposit consists of sands and silts with varying proportions, with traces of gravel and clay. Occasional layers of silty clay were also intercepted in the lower part of the deposit.

Standard Penetration Tests, carried out within the deposit, gave 'N' values over 100 blows per 30 cm. Based on this value, the overall deposit may be classified as being very dense. The natural moisture content ranges from 9 to 14%. The results of the grain-size analyses performed on selected samples are plotted in an envelope form on Figure #2 of the Appendix.

### Silty Clay, Some Sand

An approximate 4.7 to 6.0 m thick silty clay, some (trace) of sand zone was found to underlie the silty sand to sandy silt stratum in B.H.'s #4 and #5.

This deposit has a hard consistency. The natural moisture content is in the order of 15%.

### Shale Bedrock

Shale-type bedrock was encountered below the sandy silt to silty sand and/or below the silty clay deposits in Boreholes #1, 4, 5 and 102. The shale is badly weathered. No core samples were obtained.

GROUNDWATER CONDITIONS

The following groundwater levels were observed during the field investigation:

B.H. #1	El. 179.9
B.H. #2	El. 180.5
B.H. #3	El. 180.0

No groundwater level measurements were carried out in B.H.'s #5 and #102.

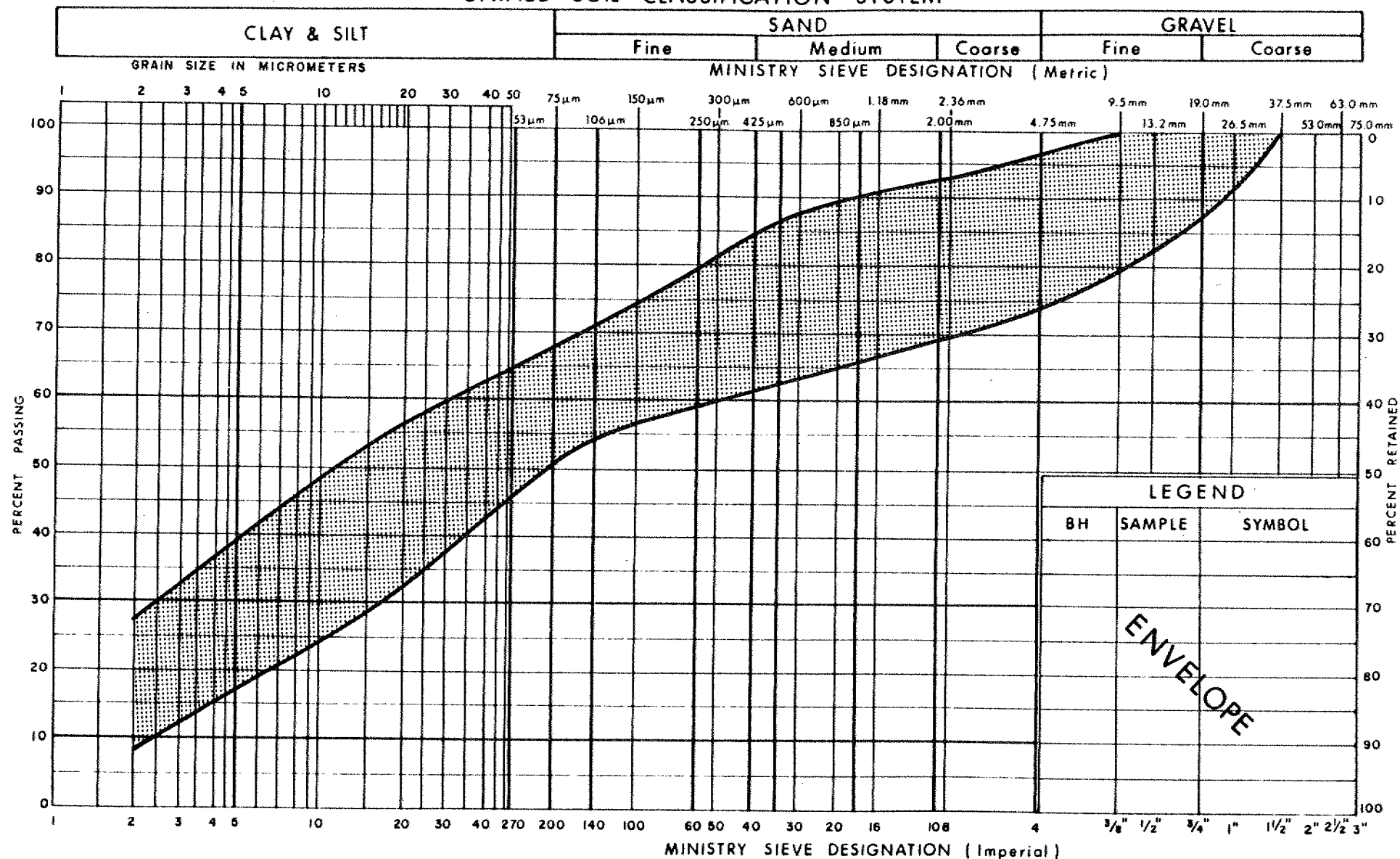


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P. Payer, P. Eng.  
Foundations Engineer

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Chief Foundations Engineer(West)

## A P P E N D I X

## UNIFIED SOIL CLASSIFICATION SYSTEM



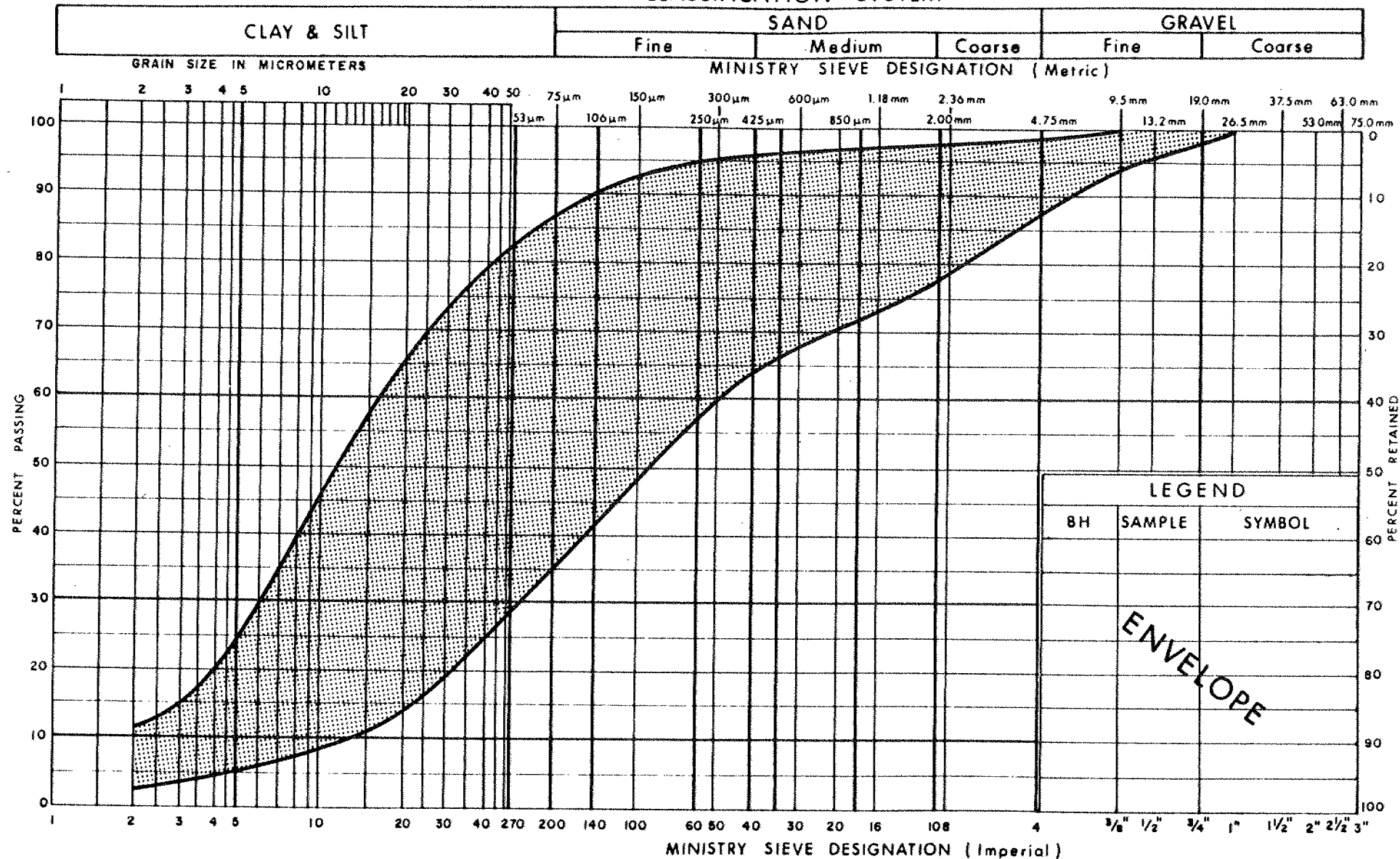
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**GRAIN SIZE DISTRIBUTION**  
**HET MIXTURE OF**  
**SILTY CLAY SAND & GRAVEL (Glacial Till)**

FIG No 1

W P 197-77-03

## UNIFIED SOIL CLASSIFICATION SYSTEM



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**GRAIN SIZE DISTRIBUTION**  
**SILTY SAND TO SANDY SILT**  
**TRACES OF GRAVEL & CLAY**

FIG No 2

W P 197-77-03



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# RECORD OF BOREHOLE No 1

METRIC <sup>10</sup>

W P 197-77-03 LOCATION Co-ords. N 4 820 898.5; E 286 663.8 ORIGINATED BY JH  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone Test COMPILED BY GP  
DATUM Geodetic DATE 82 10 28 CHECKED BY GP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
180.9	Ground Level													
0.0	Heterogeneous Mixture of Silty Clay		1	SS	27		180							
	Sand & Gravel		2	SS	33		178							
	V. Stiff to Hard		3	SS	35									
	Glacial Till		4	SS	21									
			5	SS	39									
			6	SS	69									
173.9							174							
7.0	Compact		7	SS	19		172							8 40 42 10
	Silty Sand to Sandy Silt		8	SS	75/ 15 cm		170							
	Trace of Gravel & Clay		9	SS	90/ 8 cm		168							
	Very Dense		10	SS	90/ 8 cm		166							
			11	SS	70/ 8 cm		164							10 37 51 2
			12	SS	64/ 23 cm		162							
162.5														
18.4	Reddish Brown Weathered Shale													
161.0			13	SS	100/ 5 cm									15 39 34 12
19.9	End of Borehole													

+3, x5: Numbers refer to  
Sensitivity

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

# RECORD OF BOREHOLE No 2

METRIC <sup>11</sup>

W P 197-77-03 LOCATION Co-ords. N 4 820 805.5; E 286 649.5 ORIGINATED BY JH  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone Test COMPILED BY PP  
DATUM Geodetic DATE 82 10 29 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						WATER CONTENT (%) 10 20 30
								SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
181.3	Ground Level													
0.0	Heterogeneous Mixture of Silty Clay (CL)						180							
	Sand & Gravel		1	SS	38/23	cm	178							7 28 50 15
	Hard		2	SS	76/23	cm	176							10 35 44 11
	Glacial Till		3	SS	32									13 32 40 15
			4	SS	60/15	cm								
			5	SS	60/15	cm								
174.3			6	SS	60/15	cm	174							
7.0	Sandy Silt to Silty Sand		7	SS	60/15	cm	172						13 49 32 7	
	Some Gravel		8	SS	80/7	cm	170							
	Traces of Clay		9	SS	75/7	cm	168							
			10	SS	75/7	cm	166						10 43 38 9	
	Very Dense		11	SS	90/7	cm	164							
			12	SS	60/7	cm	162						1 22 75 2	
159.9			13	SS	80/7	cm	160							
21.4	End of Borehole													

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10





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# RECORD OF BOREHOLE No 4

METRIC <sup>12</sup>

W P 197-77-03 LOCATION Co-ords. N 4 820 604.7; E 286 684.4 ORIGINATED BY JH  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone Test COMPILED BY PP  
DATUM Geodetic DATE 82 10 29 and 82 11 01 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH						WATER CONTENT (%)
180.8	Ground Level							○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE	10 20 30					
0.0	Heterogeneous Mixture of Silty Clay		1	SS	30		180						11 23 44 22		
	Sand & Gravel		2	SS	42		178								
	Hard		3	SS	61		176								
	Glacial Till		4	SS	92		174								
			5	SS	40/8	172									
			6	SS	43	170									
			7	SS	60/15	168									
			8	SS	30/8	166									
170.7			9	SS	30/8	164									
10.1	Silty Sand to Sandy Silt		10	SS	90/3	162									
	Traces of Gravel & Clay														
	V. Dense														
165.6															
15.2	Silty Clay		11	SS	30/8								0 12 61 27		
	Some Sand														
	Hard														
160.9			12	SS	60/8										
19.9	End of Borehole														
	Reddish Brown Weathered Shale														

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10





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Ontario

# RECORD OF BOREHOLE No 5

METRIC 13

W P 197-77-03 LOCATION Co-ords. N 4 820 516.5; E 286 734.0 ORIGINATED BY JH  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone Test COMPILED BY GP  
DATUM Geodetic DATE 82 11 01 and 02 CHECKED BY *GP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
180.5	Ground Level													
0.0	Heterogeneous Mixture of Silty Clay		1	SS	35		180							
			2	SS	76									
	Sand & Gravel		3	SS	65		178							
	Hard		4	SS	38		176							
	Glacial Till		5	SS	42		174							
			6	SS	66/23	cm	172							
			7	SS	101									
170.0														
10.5	Silty Sand to Sandy Silt		8	SS	86/23	cm	170							
	Traces of Gravel & Clay		9	SS	80/15	cm	168							
	V. Dense		10	SS	70/15	cm	166							
							164							
163.6														
16.9	Silty Clay		11	SS	65/15	cm	162							
	Traces of Sand						160							
	Hard		12	SS	100/15	cm	158							
157.6														
22.9	Reddish Brown													
156.1	Weathered Shale													
24.4	End of Borehole													
	Note:  No Groundwater Level Measurements Were Carried Out.													

\*3, \*5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No 14

METRIC 14

W P 197-77-03 LOCATION Co-ords. N 4 820 467.5; E 286 767.0 ORIGINATED BY JH  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone Test COMPILED BY PP  
DATUM Geodetic DATE 82 11 22 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
179.8	Ground Level		1	SS	47	45							
0.0	V. Soft to Soft		2	SS	13								
	Heterogeneous Mixture of Silty Clay		3	SS	38								
	Sand & Gravel		4	SS	84								
	Stiff to Hard		5	SS	91								
			6	SS	60								
174.8			7	SS	59								
5.0	End of Borehole												
	Surface Water Level 15 cm above Ground Level (82 11 22)												

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No 15

METRIC 15

W P 197-77-03 LOCATION Co-ords. N 4 820 415.0; E 286 838.5 ORIGINATED BY JH  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone Test COMPILED BY PP  
DATUM Geodetic DATE 82 11 22 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
180.0	Ground Level												
0.0	Soft												
	Heterogeneous Mixture of Silty Clay		1	SS	37								
			2	SS	98	28 cm							
	Sand & Gravel		3	SS	89								
	Hard		4	SS	71								
	Glacial Till		5	SS	34								
173.4			6	SS	40								
6.6	End of Borehole												

# RECORD OF BOREHOLE No 102

METRIC 16

W P 197-77-03 LOCATION Co-ords N 4 820 741.1; E 286 632.4 ORIGINATED BY DBC  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (H.S.) & Cone Test COMPILED BY PP  
DATUM Geodetic DATE 81 12 23 - 82 01 05 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100					
181.0	Ground Level												GR SA SI CL
0.0	Heterogeneous Mixture of Silty Clay		1	SS	22		180						16 23 43 18
	Sand & Gravel		2	SS	29								3 31 42 24
	V. Stiff to Hard		3	SS	27								
	Glacial Till		4	SS	72		178						
			5	SS	38								
			6	SS	33		176						
			7	SS	39								26 23 32 20
			8	SS	111								6 31 55 8
			9	SS	83		174						15 34 38 13
			10	SS	110/18 cm								10 30 45 15
172.5													
8.5	Sandy Silt to Silty Sand		11	SS	125/23 cm		172						
	Traces of Gravel & Clay		12	SS	186/15 cm		170						6 24 61 9
	Occ. Silty Clay Layers		13	SS	100/10 cm		168						
	V. Dense		14	SS	115/13 cm		166						11 43 40 6
			15	SS	49								
			16	SS	100/10 cm		164						4 38 48 10
			17	SS	100/15 cm		162						
			18	SS	67/15 cm								1 12 82 5
160.3													
20.7	Reddish Brown		19	SS	100/15 cm		160						0 26 57 17
159.5	Weathered Shale												
21.5	End of Borehole												
	Note: No Groundwater Level Measurements Were Carried Out.												

## FOUNDATION INVESTIGATION REPORT

For

Ramp W-S Underpass At Ninth Line  
(Hwy. #403 & #407 Interchange)  
W.P. 197-77-04; Site: 10-82-328  
District #4 (Hamilton)

---

INTRODUCTION

This report contains the results of the foundation investigation carried out at the aforementioned site on 82 11 09. The fieldwork consisted of two sampled boreholes and one dynamic cone penetration test adjacent to each boring. The borings were advanced by a continuous flight auger machine mounted on a muskeg vehicle and equipped with solid stem augers.

SITE DESCRIPTION

The site is located west of the existing Ninth Line Road, some 1.0 km north of Burnhamthorpe Rd. in the town of Oakville. The surrounding terrain is relatively flat. Physiographically the site is located in the region referred to as the Peel Plain. The deposits in the vicinity of the area under investigation are composed of cohesive glacial till and granular deposits. The overburden is underlain by shale bedrock.

SUBSURFACE CONDITIONSGeneral

The subsoil at this location was found to consist of cohesive type glacial till, followed by sandy silt to silty sand deposit, followed by shale bedrock. The boundaries of the different strata, together with the obtained field and laboratory test results are shown on the Record of Borehole sheets contained in the Appendix of this report. A stratigraphical profile is shown on Drawing No. 2 of the contract drawings. A description of the different strata encountered is given below.

### Heterogeneous Mixture of Silty Clay, Sand & Gravel (Glacial Till)

Immediately below a thin layer of topsoil a till-like zone was encountered at every boring location. The thickness is about 14.6 m. The material in the deposit was found to consist of a heterogeneous mixture of silty clay, sand and gravel. The matrix of this till is basically cohesive in nature - i.e., silty clay binding coarser particles. Standard Penetration Tests carried out within the deposit gave 'N' values to range from 24 to over 100 blows per 30 cm.

Physical properties of the material as determined from laboratory tests are summarized as follows:

	<u>Range</u>
Natural Moisture Content (%)	7-14
Liquid Limit (%)	18-27
Plastic Limit (%)	11-17

The results of the grain-size distribution tests are shown in an envelope form on Figure #1 of the Appendix.

The consistency of the overall deposit varies from very stiff to hard.

### Sandy Silt to Silty Sand, Some Gravel, Trace of Clay

This stratum was encountered in each boring below the above described glacial till. The thickness was found to be 6.8 m at the boring locations. The material in the deposit consists of sands and silts with varying proportions, with some gravel and trace of clay. Occasional layers of silty clay were also intercepted in the lower part of the deposit.

Standard Penetration Tests, carried out within the deposit, gave 'N' values over 100 blows per 30 cm. Based on this value, the overall deposit may be classified as being very dense. The natural moisture content ranges from 12 to 13%. The results of the grain-size analyses performed on four samples are as follows: Gravel: 2-16%, Sand: 18-44%, Silt: 39-67% and Clay: 5-10%.

#### Bedrock

Shale-type bedrock was encountered below the sandy silt to silty sand deposits at approximate El. 159+. The shale is badly weathered. No core samples were obtained.

#### GROUNDWATER CONDITIONS

The groundwater levels were observed to be at ground surface during the field investigation.



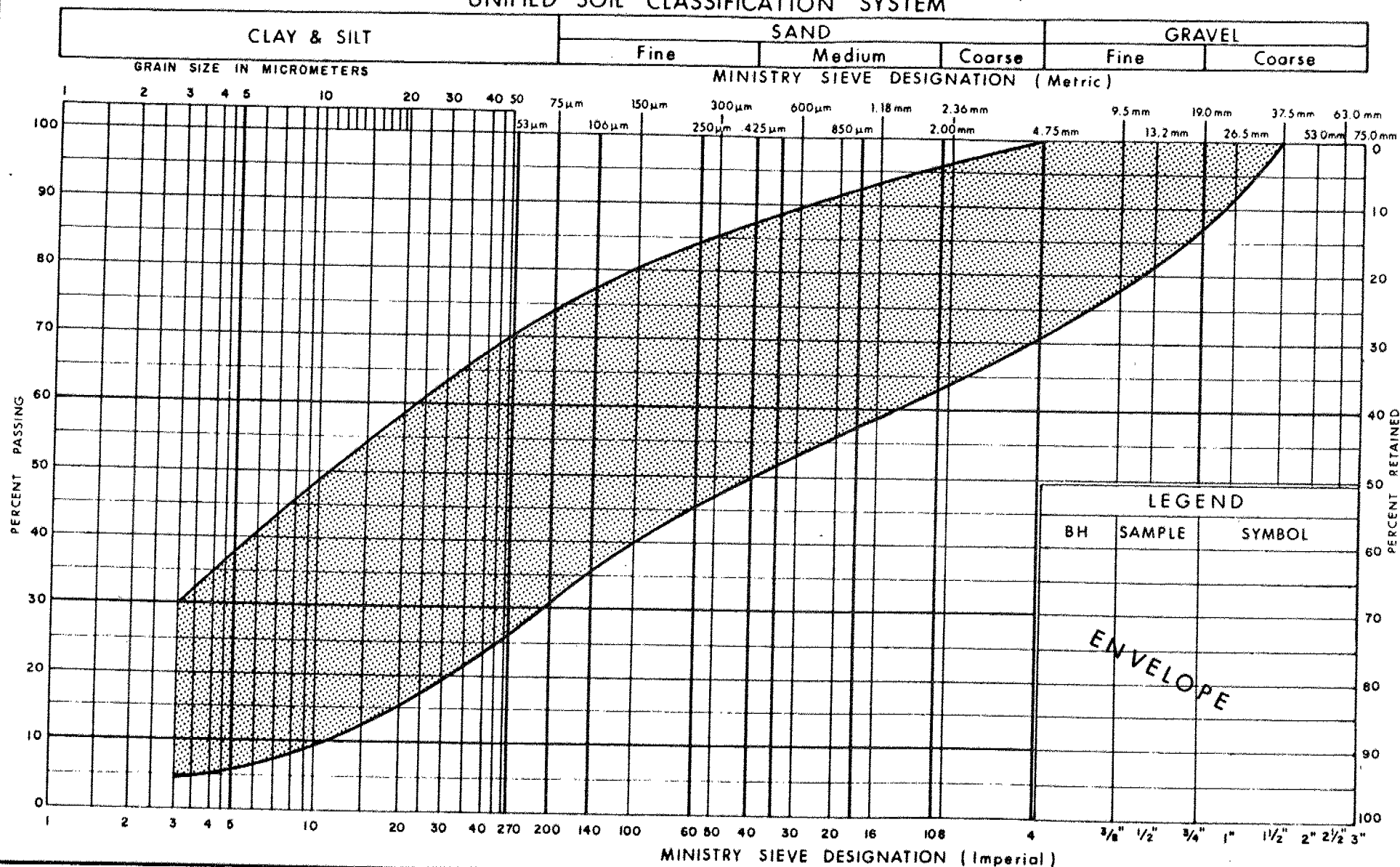
*P. Payer*  
P. Payer, P. Eng.  
Foundations Engineer

*K. G. Selby*  
K. G. Selby, P. Eng.  
Chief Foundations Engineer (West)

## APPENDIX



## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation and  
Communications

**GRAIN SIZE DISTRIBUTION**  
HET MIXTURE OF SILTY CLAY, SAND  
& GRAVEL (Glacial Till)

FIG No 1

W P 197-77-04

# RECORD OF BOREHOLE No 12

METRIC

22

W P 197-77-04 LOCATION Co-ords. 4 820 405.0 N; 286 539.0 E ORIGINATED BY JH  
DIST 4 HWY 403/407 BOREHOLE TYPE Cont'. Flight Auger (S.A.) & Cone Test COMPILED BY JH  
DATUM Geodetic DATE 82 11 09 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
180.3	Ground Surface													
0.0	E.L. 179.5 STSF		1	SS	25		180							4 22 53 21
			2	SS	24		178							
			3	SS	45		176							
			4	SS	91		174							
			5	SS	91		172							
			6	SS	106		170							
			7	SS	79		168							
			8	SS	60/ 15 cm		166							
			9	SS	80/ 15 cm		164							
165.7							162							
14.6			10	SS	112		160							
			11	SS	83/ 15 cm									
158.9														
21.4	End of Borehole		12	SS	80/ 10 cm									
	Weathered Red Shale													

Heterogeneous Mixture  
of Silty Clay (CL)  
Sand & Gravel  
V. Stiff to Hard  
Glacial Till

Sandy Silt to Silty  
Sand, Some Gravel  
Trace of Clay  
V. Dense

65/25 cm  
boulders



# RECORD OF BOREHOLE No 13

METRIC 23

W P 197-77-04 LOCATION Co-ords. 4 820 420.6 N; 286 606.8 E ORIGINATED BY JH  
DIST 4 HWY 403/407 BOREHOLE TYPE Cont', Flight Auger (S.A.) & Cone Test COMPILED BY JH  
DATUM Geodetic DATE 82 11 09 CHECKED BY *Lo*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	10 20 30					
180.1	Ground Surface						180							GR SA SI CL
0.0	Heterogeneous Mixture of Silty Clay (CL) Sand & Gravel Hard Glacial Till		1	SS	40		178							0 27 49 24
			2	SS	52		176							
			3	SS	67		174							
			4	SS	42		172							
			5	SS	49		170							
			6	SS	110		168							5 26 54 15
			7	SS	100/	7.5 cm	166							
			8	SS	100/	12.5 cm	164							29 38 29 5
			9	SS	58/	15 cm	162							
			10	SS	70/	15 cm	160							
165.5			11	SS	100/	12.5 cm								16 29 43 12
14.6	Sandy Silt to Silty Sand, Some Gravel Trace of Clay V. Dense		12	SS	80/	7.5 cm								2 44 47 7
			13	SS	100/	7.5 cm								16 35 39 10
			14	SS	100/	5 cm								
158.7	End of Borehole													
21.4	Weathered Red Shale													

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

FOUNDATION INVESTIGATION REPORT  
For  
Ninth Line Underpass  
(Hwy. #403 & 407 Interchange)  
W.P. 197-77-05; Site 10-82-327  
District 4, Hamilton

---

### INTRODUCTION

This report contains the result of the foundation investigation carried out at the aforementioned site on 82 11 08 and 82 02 16. The fieldwork consisted of two sampled boreholes and one dynamic cone penetration tests adjacent to each boring. The borings were advanced by continuous flight auger machines mounted on muskeg vehicles and equipped with solid stem augers.

### SITE DESCRIPTION

The site is located in the vicinity of the existing Ninth Line Road, some 1.0 km north of Burnhamthorpe Rd. in the town of Milton and town of Oakville. The surrounding terrain is relatively flat. Physiographically the site is located in the region referred to as the Peel Plain. The deposits in the vicinity of the area under investigation are composed of cohesive glacial till and granular deposits. The overburden is underlain by shale bedrock.

### SUBSURFACE CONDITIONS

#### General

The subsoil at this location was found to consists of cohesive type glacial till, followed by sandy silt to silty sand deposit, followed by shale bedrock. The boundaries of the different strata, together with the obtained field and laboratory test results are shown on the Record of Borehole sheets contained in the Appendix of this report. A stratigraphical profile is shown on Drawing No. 2 of the contract drawings. A description of the different strata encountered is given below.

### Heterogenous Mixture of Silty Clay, Sand & Gravel (Glacial Till)

Immediately below a thin layer of topsoil a till-like zone was encountered at every boring location. The thickness varies from 13.7 m to 14.5 m. The material in the deposit was found to consist of a heterogenous mixture of silty clay, sand and gravel. The matrix of this till is basically cohesive in nature - i.e., silty clay binding coarser particles. Standard Penetration Tests carried out within the deposit gave 'N' values to range from 18 to over 100 blows per 30 cm.

Physical properties of the material as determined from laboratory tests are summarized as follows:

	<u>Range</u>
Natural Moisture Content (%)	7-14
Liquid Limit (%)	20-27
Plastic Limit (%)	12-17

The results of the grain-size distribution tests are shown in an envelope form on Figure #1 of the Appendix.

The consistency of the overall deposit varies from very stiff to hard.

### Sandy Silt to Silty Sand, Traces of Gravel & Clay

This stratum was encountered in each boring below the above described glacial till. The thickness varied from 5.3 m to 6.1 m at the boring locations. The material in the deposit consists of sands and silts with varying proportions, with traces of gravel and clay. Occasional layers of silty clay were also intercepted in the lower part of the deposit.

Standard Penetration Tests, carried out within the deposit, gave 'N' values to range from 13 to over 100 blows per 30 cm. Based on this value, the overall deposit may be classified as being compact to very dense. The natural moisture content ranges from 12 to 13%. The results of the grain-size analyses performed on two samples are as follows:  
Gravel: 3-13%, Sand: 41-48%, Silt: 34-48%, and Clay: 5-8%.

### Shale Bedrock

Shale-type bedrock was encountered below the sandy silt to silty sand deposits, at El. 162.9 and at El. 162.4. The shale is badly weathered. No core samples were obtained.

### Groundwater Conditions

The groundwater levels were observed to be at ground surface during the field investigation.

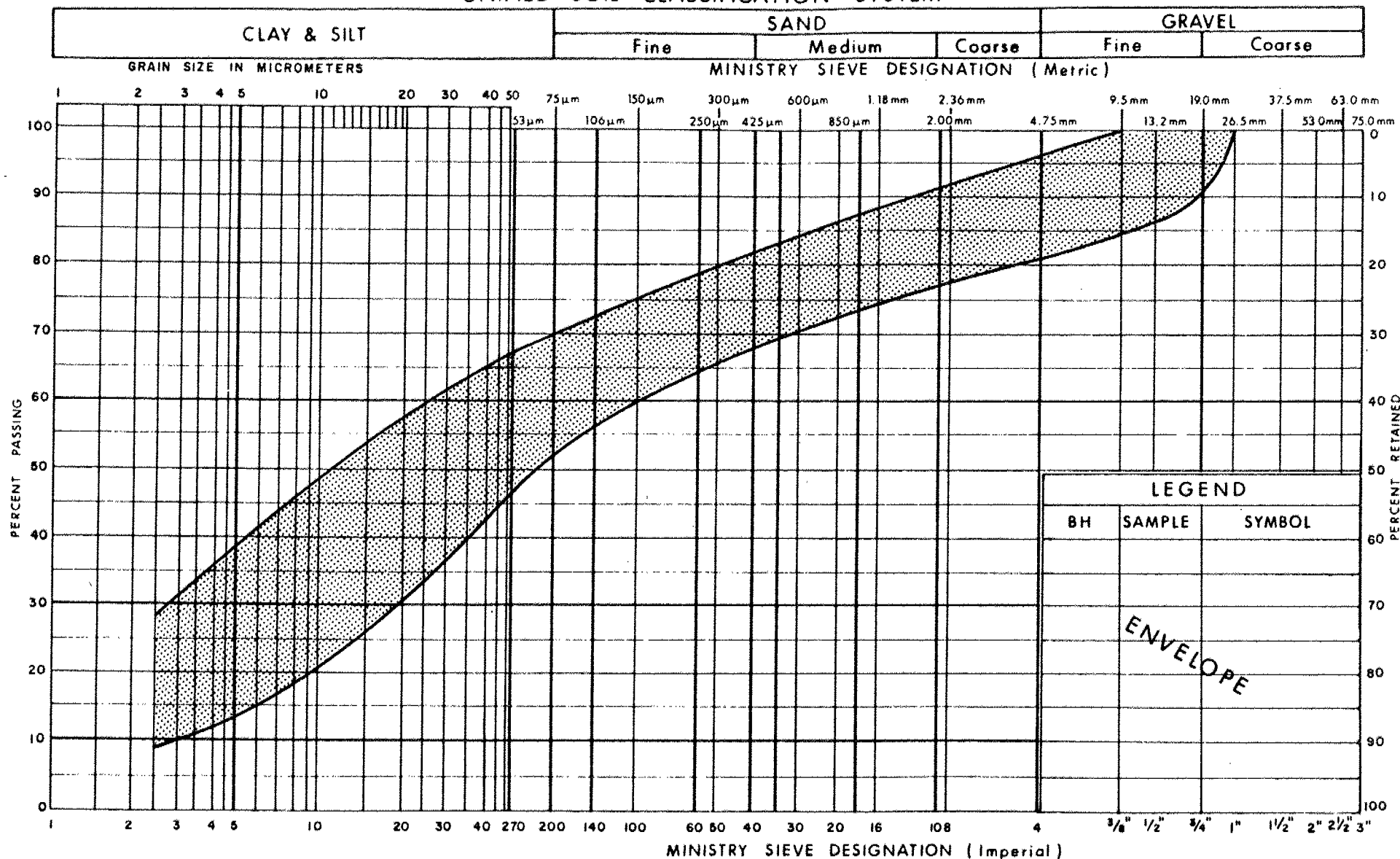


*P. Payer*  
P. Payer, P. Eng.  
Foundations Engineer

*K.G. Selby*  
K.G. Selby, P. Eng.  
Chief Foundations Engineer (West)

## A P P E N D I X

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation and  
Communications

GRAIN SIZE DISTRIBUTION  
HET MIXTURE OF  
SILTY CLAY SAND & GRAVEL  
(GLACIAL TILL)

FIG No 1

W P 197-77-05



# RECORD OF BOREHOLE No 10

METRIC

29

W P 197-77-05

LOCATION Co-ords. N 4 820 518.2; E 286 466.6

ORIGINATED BY JB

DIST 4 HWY 403

BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone

COMPILED BY JB

DATUM Geodetic

DATE 82 11 08

CHECKED BY JB

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100					
182.2	Ground Surface							○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    x LAB VANE	10 20 30				GR SA SI CL
0.0	Heterogeneous Mixture of Silty Clay, Sand & Gravel (Glacial Till) Very Stiff to Hard		1	SS	40								8 22 51 19
			2	SS	78			100/27.5 cm					6 31 44 19
			3	SS	45								7 31 42 20
			4	SS	18								3 31 45 21
			5	SS	42								6 38 43 13
			6	SS	41								
			7	SS	33								
			8	SS	23								
			9	SS	67	23 cm							
			10	SS	60	5 cm							
			11	SS	68								
			12	SS	90	25 cm							6 31 45 18
168.5	Sandy Silt to Silty Sand, Traces of Gravel & Clay Compact to Very Dense												
13.7			13	SS	13								
			14	SS	60	8 cm							3 41 48 8
162.4	Weathered Red Shale												
19.8			15	SS	110	5 cm							
			16	SS	100	10 cm							
157.7	End of Borehole												
24.5													

+3, x5: Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 11

METRIC 30

W P 197-77-05 LOCATION Co-ords. N 4 820 560.3; E 286 415.4 ORIGINATED BY JH  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone COMPILED BY JH  
DATUM Geodetic DATE 82 11 08 CHECKED BY *JD*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						W <sub>p</sub> W W <sub>L</sub>
182.7	Ground Surface												GR SA SI CL	
0.0	Heterogeneous Mixture of Silty Clay, Sand & Gravel (Glacial Till) Very Stiff to Hard		1	SS	37		182							
			2	SS	88		180							
			3	SS	79		178							
			4	SS	47		176							5 29 47 19
			5	SS	29		174							3 28 48 21
			6	SS	24		172							5 25 46 24
			7	SS	28		170							
			8	SS	28		168							
			9	SS	40	23 cm	166							
			10	SS	60	10 cm	164							9 39 43 9
			11	SS	50	8 cm	162							
			12	SS	70	15 cm	160							18 26 39 17
168.2	Sandy Silt to Silty Sand, Some Gravel, Trace Clay Very Dense		13	SS	60		168							
14.5			14	SS	30	3 cm	166							13 48 34 5
162.9	Weathered Red Shale		15	SS	100	8 cm	164							
161.3			16	SS	100	8 cm	162							
21.4	End of Borehole													

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No 12

METRIC 31

W P 197-77-05 LOCATION Co-ords. N 4 820 539.2; E 286 441.2 ORIGINATED BY SO  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger COMPILED BY SO  
DATUM Geodetic DATE 83 02 16 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y	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 Level																
0.0			1	SS	55												
			2	SS	68												
			3	SS	98												
			4	SS	106												
			5	SS	93												
			6	SS	74												
			7	SS	77												
			8	SS	44												
			9	SS	32												
			10	SS	46												
			11	SS	81												
172.9			12	SS	120	10 cm											
9.2	End of Borehole																

+3, x5: Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10

FOUNDATION INVESTIGATION REPORT  
For  
Hwy. 407 Underpass (SS-W Ramp)  
Hwy. 403/407 Interchange  
W.P. 197-77-17; Site 10-82-326  
District #4 Hamilton

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### INTRODUCTION

This report contains the results of the foundation investigations carried out at the aforementioned site on 82 11 02 - 82 11 08 and on 83 02 16. The fieldwork consisted of four sampled boreholes and one dynamic cone penetration test adjacent to each boring. The borings were advanced by continuous flight auger machines mounted on muskeg vehicles and equipped with solid stem augers.

### SITE DESCRIPTION

The site is located in the vicinity of the existing Ninth Line Road, approximately 1.0 km north of Burnhamthorpe Rd. in the towns of Milton and Oakville. The surrounding terrain is relatively flat. Physiographically, the site is located in the region referred to as the Peel Plain. The deposits in the vicinity of the area under investigation are composed of cohesive glacial till and granular deposits. The overburden is underlain by shale bedrock.

### SUBSURFACE CONDITIONS

#### General

The subsoil at this location was found to consist of cohesive type glacial till, followed by a sandy silt to silty sand deposit, followed by shale bedrock. In one of the borings a silty clay stratum was encountered within the sandy silt to silty sand deposit. The boundaries of the different strata, together with the obtained field and laboratory test results are shown on the Record of Borehole Sheets contained in the Appendix of this report. A stratigraphical profile is shown on Drawing No. 2 of the Contract Drawings. A description of the different strata encountered is given below.

### Heterogeneous Mixture of Silty Clay, Sand & Gravel (Glacial Till)

Immediately below the ground surface, a till-like zone was encountered at every boring location. The thickness varies from 6 m to 11 m. This material is basically cohesive in nature - i.e., silty clay binding coarser particles. Standard Penetration Tests carried out within the deposit gave 'N' values to range from 16 to over 95 blows per 30 cm. In all four boreholes the material has a very stiff to hard consistency.

Physical properties of the material as determined from laboratory tests are summarized as follows:

	<u>Range</u>	<u>Avg.</u>
Natural Moisture Content (%)	8.0 - 12.5	10.5
Liquid Limit (%)	18.5 - 23.0	21.7
Plastic Limit (%)	13.0 - 16.0	14.3

The results of the grain-size distribution tests are shown in an envelope form on Figure #1 of the Appendix.

### Sandy Silt to Silty Sand, Some Gravel, Trace of Clay

This stratum was encountered in all four borings below the above described glacial till. The thickness varies from 9 m to 13 m. The material in the deposit consists mainly of sands and silts with traces of clay and varying amounts of gravel. A layer of silty clay was found within the deposit at the location of B.H. #7.

Standard Penetration Tests, carried out within the deposit, gave 'N' values from 27 to over 120 blows per 30 cm. These values indicate that the deposit is in a dense to very dense condition. The natural moisture content ranges from 7.5% to 10%. The results of the grain-size analyses performed on selected samples are plotted in envelope form on Figure #2 of the Appendix.

Silty Clay, With Sand, Trace of Gravel

A layer of silty clay approximately 7 m thick was found within the silty sand to sandy silt layer at B.H. #7.

The deposit has a hard consistency, as indicated by 'N' values of 60 blows per 15 cm. The natural moisture content is in the order of 9%.

Shale Bedrock

Shale-type bedrock was encountered below the sandy silt to silty sand deposits at all four boreholes. The shale is badly weathered and was penetrated by approximately 3m, using augers.

GROUNDWATER CONDITIONS

The following groundwater levels were observed during the field investigation:

B.H. #	6	7	9
El.	181.6	180.9	180.1

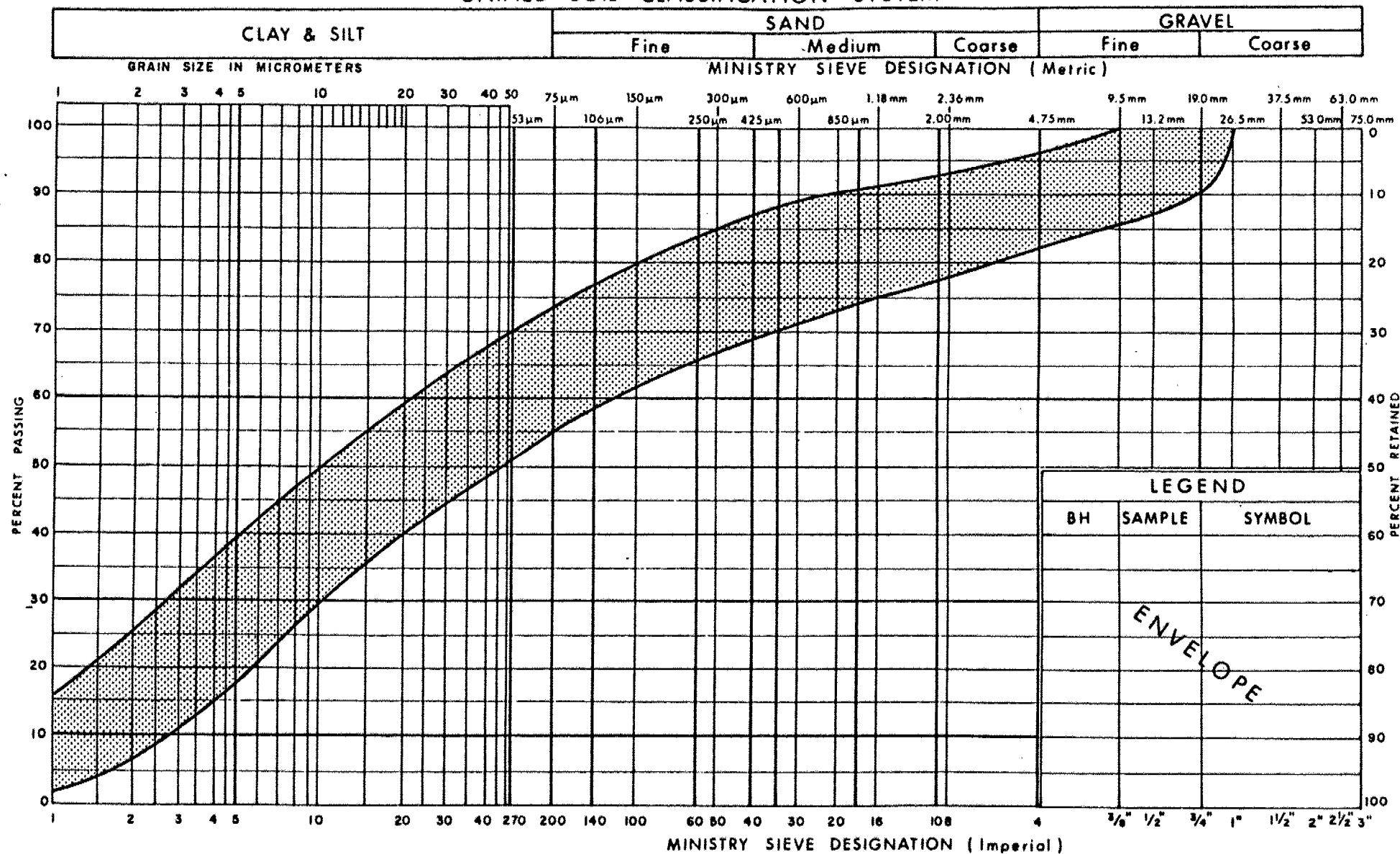


*P. Payer*  
 P. Payer, P. Eng.  
 Foundations Engineer

*K. G. Selby*  
 K. G. Selby, P. Eng.  
 Chief Foundations Engineer(West)

## APPENDIX

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
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Communications

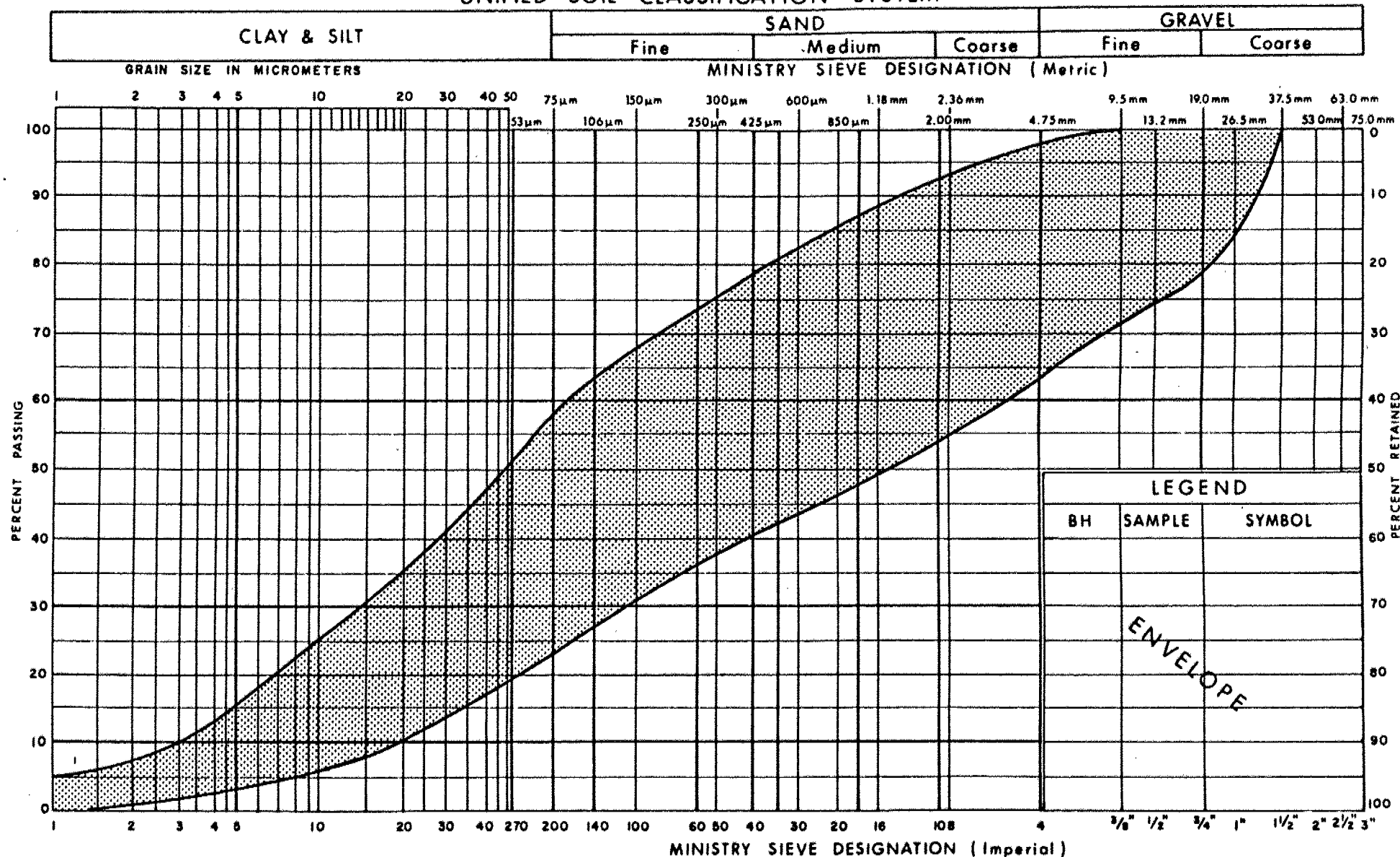
**GRAIN SIZE DISTRIBUTION**  
HET MIXTURE OF  
**SILTY CLAY SAND & GRAVEL**  
(GLACIAL TILL)

FIG No 1

W P 197-77-17



## UNIFIED SOIL CLASSIFICATION SYSTEM



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GRAIN SIZE DISTRIBUTION  
SANDY SILT TO SILTY SAND  
SOME GRAVEL TRACE CLAY

FIG No 2

W P 197 - 77 - 17

# RECORD OF BOREHOLE No 6

METRIC

38

W P 197-77-17 LOCATION Co-ords. N 4 820 651.8; E 286 577.9 ORIGINATED BY JH  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone Test COMPILED BY JH  
DATUM Geodetic DATE 1982 11 02 and 03 CHECKED BY JH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40						60	80	100	WATER CONTENT (%)
								SHEAR STRENGTH										
							○ UNCONFINED + FIELD VANE											
							● QUICK TRIAXIAL × LAB VANE											
181.6	Ground Level													GR SA SI CL				
0.0	Heterogeneous Mixture of Silty Clay, Sand, Gravel (Glacial Till) Very Stiff to Hard		1	SS	22									8 23 49 20				
			2	SS	42													
			3	SS	67													
			4	SS	86										5 21 52 22			
175.3			5	SS	75	23 cm								13 23 44 20				
6.3	Some Gravel  Sandy Silt to Silty Sand Trace Clay Very Dense  with Gravel  Trace Gravel		6	SS	82									10 40 43 7				
			7	SS	40	8 cm												
			8	SS	78										37 37 24 2			
			9	SS	72	15 cm												
			10	SS	100	8 cm								7 43 44 6				
161.8	Weathered Red Shale																	
19.8																		
158.7	End of Borehole																	
22.9																		

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No 7

METRIC 39

W P 197-77-17 LOCATION Co-ords. N 4 820 695.2; E 286 518.5 ORIGINATED BY JH  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone Test COMPILED BY JH  
DATUM Geodetic DATE 1982 11 05 and 08 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH						WATER CONTENT (%)
180.9	Ground Level							○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE					GR SA SI CL	
0.0	Heterogeneous Mixtura of Silty Clay, Sand, Gravel (Glacial Till) Very Stiff to Hard		1	SS	19		180							6 25 50 19	
			2	SS	35										10 26 48 16
			3	SS	51										5 26 44 25
			4	SS	43										9 25 42 24
			5	SS	20										
			6	SS	16										
175.0	Sandy Silt to Silty Sand, Some Gravel, Trace Clay Dense to Very Dense		7	SS	24										
5.9			8	SS	27										
			9	SS	43										25 44 26 5
			10	SS	62										
170.6	Silty Clay with Sand Trace Gravel Hard		11	SS	60/	15 cm									
10.3			12	SS	60/	15 cm									9 30 42 19
			13	SS	80/	10 cm									5 31 42 22
167.2	Sandy Silt to Silty Sand, Trace Gravel, Clay Very Dense						168								
13.7			14	SS	60/	15 cm									6 36 54 4
			15	SS	60/	8 cm									
161.4	Weathered Red Shale						162								
19.5			16	SS	80/	8 cm									
159.5							160								
21.4	End of Borehole														

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15  
10

5 (%) STRAIN AT FAILURE



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Ontario

# RECORD OF BOREHOLE No 8

METRIC 40

W P 197-77-17 LOCATION Co-ords. N 4 820 692.5; E 286 607.3  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone Test  
DATUM Geodetic DATE 1982 11 03  
ORIGINATED BY JH  
COMPILED BY JH  
CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
180.6	Ground Level															
0.0	Heterogeneous Mixture of Silty Clay, Sand, Gravel (Glacial Till) Very Stiff to Hard		1	SS	23		180									
			2	SS	36											3 27 50 20
			3	SS	66		178									
			4	SS	64		176									
			5	SS	42		174									8 25 44 23
173.4	Sandy Silt to Silty Sand, Some Gravel Trace Clay Very Dense		6	SS	70		172									2 74 20 4
7.2			7	SS	94		170									18 48 28 5
			8	SS	60/ 8 cm		168									
			9	SS	70/ 15 cm		166									
			10	SS	90/ 10 cm		164									12 46 37 5
			11	SS	100/ 15 cm		162									
160.8	Weathered Red Shale						160									
19.8																
159.2			12	SS	100/ 8 cm											10 15 52 23
21.4	End of Borehole															
	Note: No Groundwater Level Measurements Were Carried Out.															

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No 9

METRIC

41

W P 197-77-17

LOCATION Co-ords. N 4 820 735.6; E 286 548.0

ORIGINATED BY JH

DIST 4 HWY 403

BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone Test

COMPILED BY JH

DATUM Geodetic

DATE 1982 11 04 and 05

CHECKED BY *JD*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
180.1	Ground Level													GR SA SI CL
0.0	Heterogeneous Mixture of Silty Clay, Sand, Gravel (Glacial Till) Very Stiff to Hard		1	SS	26		180							
			2	SS	70		178							5 27 46 22
			3	SS	36		176							8 30 43 19
			4	SS	41		174							17 22 45 16
			5	SS	46		172							
			6	SS	97		170							17 26 43 14
169.1	Sandy Silt to Silty Sand, Trace Gravel, Clay Very Dense		7	SS	60	15 cm	168							3 27 64 6
11.0			8	SS	71	15 cm	166							
			9	SS	62	15 cm	162							
			10	SS	60	3 cm	160							
160.3	Weathered Red Shale													
19.8														
158.7	End of Borehole													
21.4														

+3, x5: Numbers refer to  
Sensitivity

20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10



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# RECORD OF BOREHOLE No 10

METRIC

42

W P 197-77-17 LOCATION Co-ords. N 4 820 692 E 286 564 ORIGINATED BY SO  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger COMPILED BY SO  
DATUM Geodetic DATE 83 02 16 CHECKED BY SO

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60					
180.8	Ground Level														
0.0															
			1	SS	31										
			2	SS	36										
			3	SS	56										
			4	SS	94										
			5	SS	64										
			6	SS	54										
			7	SS	62										
			8	SS	120/	25 cm									
			9	SS	130/	25 cm									
			10	SS	63										
172.8															
8.0	End of Borehole														

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION



Ministry of  
Transportation and  
Communications

# foundation investigation and design report

ENGINEERING MATERIALS OFFICE  
PAVEMENT & FOUNDATION DESIGN SECTION

WP 197-77-03

DIST 4

HWY 403 & 407

STR SITE 10-82-325

E-S Ramp Underpass Hwy. #403 & 407 Interchange  
Complex

*CONT. 84-78*

DISTRIBUTION

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R. Hore

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Files



## FOUNDATION INVESTIGATION REPORT

For

E-S Ramp Underpass  
Hwy. #403 & 407 Interchange Complex  
W.P. 197-77-03; Site 10-82-325  
District #4 (Hamilton)

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### INTRODUCTION

This report contains the results of the foundation investigations carried out at the aforementioned site on 81 12 23 - 82 01 05, 82 10 28 - 82 11 01 and 82 11 22. The fieldwork consisted of seven sampled boreholes and seven dynamic cone penetration tests adjacent to each borings. The borings were advanced by continuous flight auger machines mounted on muskeg vehicles and equipped either with 83 mm (I.D.) hollow stem or solid stem augers.

### SITE DESCRIPTION

The site is located in the vicinity of the existing Ninth Line Road, some 1.0 km north of Burnhamthorpe Rd. in the town of Milton, town of Oakville and the city of Mississauga. The surrounding terrain is relatively flat. Physiographically the site is located in the region referred to as the Peel Plain. The deposits in the vicinity of the area under investigation are composed of cohesive glacial till and granular deposits. The overburden is underlain by shale bedrock.

### SUBSURFACE CONDITIONS

#### General

The subsoil at this location was found to consist of cohesive type glacial till, followed by sandy silt to silty sand deposit, followed by shale bedrock. In some of the borings, a silty clay stratum was encountered over the bedrock. The boundaries of the different strata, together with

the obtained field and laboratory test results are shown on the Record of Borehole sheets contained in the Appendix of this report. A stratigraphical profile is shown on Drawing No. 1977703-A. A description of the different strata encountered is given below.

Heterogeneous Mixture of Silty Clay, Sand & Gravel (Glacial Till)

Immediately below a thin layer of topsoil a till-like zone was encountered at every boring location. The thickness varies from 7.0 m to 10.5 m. In B.H.'s #14 & 15 this zone was not fully penetrated. The material in the deposit was found to consist of a heterogeneous mixture of silty clay, sand and gravel. The matrix of this till is basically cohesive in nature - i.e., silty clay binding coarser particles. There are random localized zones where the matrix is only slightly cohesive. Standard Penetration Tests carried out within the deposit gave 'N' values to range from 21 to over 100 blows per 30 cm.

In the vicinity of Boreholes #14 & 15 the extreme upper portion (1.0 - 1.5 m) of the material is in a soft to very soft condition due to the stagnant surface water.

Physical properties of the material as determined from laboratory tests are summarized as follows:

	<u>Range</u>
Natural Moisture Content (%)	6-16
Liquid Limit (%)	12-29
Plastic Limit (%)	11-18

The results of the grain-size distribution tests are shown in an envelope form on Figure #1 of the Appendix.

The consistency of the overall deposit varies from very stiff to hard. The very stiff zones are mainly confined to the upper portion of the deposit.

### Sandy Silt to Silty Sand, Traces of Gravel & Clay

This stratum was encountered in those borings which were advanced below the above described glacial till. The thickness varied from 5.1 m to 14.4 m at the boring locations. The material in the deposit consists of sands and silts with varying proportions, with traces of gravel and clay. Occasional layers of silty clay were also intercepted in the lower part of the deposit.

Standard Penetration Tests, carried out within the deposit, gave 'N' values over 100 blows per 30 cm. Based on this value, the overall deposit may be classified as being very dense. The natural moisture content ranges from 9 to 14%. The results of the grain-size analyses performed on selected samples are plotted in an envelope form on Figure #2 of the Appendix.

### Silty Clay, Some Sand

An approximate 4.7 to 6.0 m thick silty clay, some (trace) of sand zone was found to underlie the silty sand to sandy silt stratum in B.H.'s #4 and #5.

This deposit has a hard consistency. The natural moisture content is in the order of 15%.

### Shale Bedrock

Shale-type bedrock was encountered below the sandy silt to silty sand and/or below the silty clay deposits in Boreholes #1, 4, 5 and 102. The shale is badly weathered. No core samples were obtained.

### GROUNDWATER CONDITIONS

The following groundwater levels were observed during the field investigation:

B.H. #1	El. 179.9
B.H. #2	El. 180.5
B.H. #4	El. 180.0

No groundwater level measurements were carried out in B.H.'s #5 and #102.

### DISCUSSION AND RECOMMENDATIONS

#### General

It is proposed to construct two new highways (Hwy. #403 and Hwy. #407) in the vicinity of the existing Ninth Line, about 1.0 km north of Burnhamthorpe Rd. An interchange complex, consisting of several structures will be required to allow traffic transfer from one multi-lane highway to the other. One of these structures, designated as E-S Ramp, is the subject of this report.

This E-S Ramp structure will be built on a horizontal curve, having a radius of 450 m. A total of nine footings will be required. The following span lengths (beginning at the south abutment) are proposed at the time of this report preparation: 44.5 m - 55.5 m - 41.0 m - 55.5 m - 55.5 m - 55.5 m - 53.0 m - 42.5 m. The chainage of the south abutment bearings is at Sta. 1 + 298.142. In this report the piers are numbered from 1 to 7, progressing from the south abutment to the north. The height of the approach embankments are as follows:

South Approach: 10 m

North Approach: 6 m

The vertical clearance is 4.65 m at the crossing of Hwy. #407 N.B.L. and E-S Ramp underpass structure.

## STRUCTURE FOUNDATIONS

The following foundation alternatives are recommended:

### 1) Spread Footings Within Original Ground

The entire structure (abutments and piers) may be supported on spread footing type foundations at or below the following elevations:

<u>Footing Location</u>	<u>Recommended Footing Level (At or Below)</u>
South Abutment	E1. 178.8
Pier #1 7	E1. 178.8 ✓ (178.5)
#2 6	E1. 178.8
#3 5	E1. 178.8
#4 4	E1. 178.2 (179.0)
#5 3	E1. 178.2 ✓ (175.5)
#6 2	E1. 178.2 ✓ (173.5)
#7 1	E1. 177.6 ✓ (175.0)
North Abutment	E1. 177.6

It should be noted, however, that 1.4 m of earth cover should be provided, to the underside of the footings, for frost protection purposes. For footings founded at or below the above quoted elevations, an allowable bearing value of up to 385 kPa can be used in design.

For purposes of the O.H.B.D.C. the following design values are recommended:

Factored Bearing Capacity at U.L.S. = 580 kPa

Bearing Capacity at S.L.S. Type II = 385 kPa

Earth pressures should be computed as per Subsection 6.6.1.2.2 of the code. For the granular backfill a non-yielding foundation condition should be assumed, in which case a value of  $K_o=0.43$  is recommended. The base of the footing excavations should be protected by 15 cm of mass concrete within 8 hours of exposure.

Settlements of the foundation subsoil, due to the surcharge loading of the footings will be negligible (approx. 25 mm) in magnitude.

No dewatering problems are anticipated due to the relatively impervious nature of the subsoil.

## 2) Spread Footings on Compacted Granular Fill

As an alternative, the abutments may be supported on spread footings placed on well compacted, suitable granular material within the approach fills. A safe design load of 355 kPa may be assumed. A detailed construction scheme is outlined on Fig. 3 of the Appendix. In computing the shearing resistance between the base of the footing and the compacted Granular 'A' core, the coefficient of friction may be taken as 0.55. For purposes of the O.H.B.D.C. the following design values are recommended:

Bearing Capacity at S.L.S. Type II = 335 kPa

Factored Bearing Capacity at U.L.S. = 500 kPa

Increase to 900 kPa  
12/8  
84-01-04

## 3) Perched Abutments on Short Piles

As a second alternative, the abutments may be constructed within the approach fills and supported on short piles driven through the fill some 10 m into the original subsoil. In the case of steel 'H' piles (310 HP 110 or 310 HP 79) design loads up to 890 kN may be assumed.

10m

The piles should be driven in accordance with M.T.C. Standards SS103-10 or SS103-11. For the purpose of the O.H.B.D.C. the following design values are recommended:

Factored Capacity at U.L.S. = 1160 kN

Capacity at S.L.S. Type II = 890 kN

The pile caps should have a minimum of 1.4 m earth cover for frost protection requirements.

#### APPROACH EMBANKMENTS

Fills up to 10 m will be required at this location adjacent to the proposed structure. No stability problems are anticipated for the approaches of this height constructed with 2:1 slopes. The fill should consist of well compacted acceptable material. Care should be taken to ensure that no bouldery fill is placed within the approaches through which piles may have to be driven, and it is recommended that this portion of the fill contain no larger grain sizes than 75 mm. It is estimated that the total settlement caused by the embankment loading will be in the order of 50 mm.

In the vicinity of Borehole No. 14 (Sta. 1 + 360+) a very soft, about 1.5 m thick surficial material was encountered. It is recommended that this very soft zone of the glacial till be removed to its full vertical and horizontal extent within the construction area. The exact dimensions (vertical & horizontal) of the soft material at this location and at other locations along the proposed embankment will be determined by the Regional Geotechnical Section.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Mr. D. Collom, Construction Technician (1981) and Mr. J. Hayward, Student Field Technician (1982). The equipment used was owned and operated by Master Soil Investigation Ltd. This report was written by Mr. P. Payer, and reviewed by Mr. K.G. Selby.

*P. Payer*  
P. Payer, P. Eng.  
Foundations Engineer



*K.G. Selby*  
K.G. Selby, P. Eng.  
Senior Foundations Engineer



## APPENDIX



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# RECORD OF BOREHOLE No 1

METRIC

W P 197-77-03 LOCATION Co-ords. N 4 820 898.5; E 286 663.8 ORIGINATED BY JH  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone Test COMPILED BY GP  
DATUM Geodetic DATE 82 10 28 CHECKED BY SP

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	W <sub>p</sub>	W	W <sub>L</sub>	
180.9	Ground Level						SHEAR STRENGTH				WATER CONTENT (%)				GR SA SI CL
0-0	Heterogeneous Mixture of Silty Clay		1	SS	27		○ UNCONFINED + FIELD VANE				○ QUICK TRIAXIAL x LAB VANE				
	Sand & Gravel		2	SS	33										
	V. Stiff to Hard Glacial Till		3	SS	35										
			4	SS	21										
			5	SS	39										
173.9			6	SS	69										
7.0	Compact		7	SS	19										8 40 42 10
	Silty Sand to Sandy Silt		8	SS	75/	15 cm									
	Trace of Gravel & Clay		9	SS	90/	8 cm									
	Very Dense		10	SS	90/	8 cm									
			11	SS	70/	8 cm									10 37 51 2
			12	SS	64/	23 cm									
162.5															
18.4	Reddish Brown Weathered Shale														15 39 34 12
161.0			13	SS	100/	5 cm									
19.9	End of Borehole														

+3, x5: Numbers refer to  
Sensitivity

20  
15 + 5 (%) STRAIN AT FAILURE  
10

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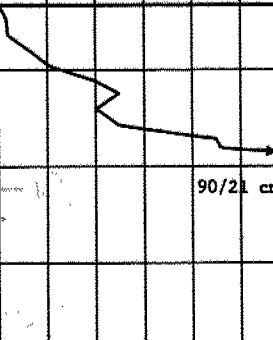


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## RECORD OF BOREHOLE No 2

METRIC

W P 197-77-03 LOCATION Co-ords. N 4 820 805.5 E 286 649.5 ORIGINATED BY JH  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone Test COMPILED BY PP  
DATUM Geodetic DATE 82 10 29 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH							WATER CONTENT (%) 10 20 30
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
181.3	Ground Level														
0.0	Heterogeneous Mixture of Silty Clay (CL)						180								
	Sand & Gravel		1	SS	38	23 cm		178							
	Hard		2	SS	76	23 cm		176							7 28 50 15
	Glacial Till		3	SS	32			174	90/21 cm						10 35 44 11
			4	SS	60	15 cm		172							13 32 40 15
			5	SS	60	15 cm		170							
174.3			6	SS	60	15 cm	168								
7.0	Sandy Silt to Silty Sand		7	SS	60	15 cm	166								
	Some Gravel		8	SS	80	8 cm	164								
	Traces of Clay		9	SS	75	8 cm	162								
			10	SS	75	8 cm	160								
	Very Dense		11	SS	90	8 cm									
			12	SS	60	10 cm									
159.9			13	SS	80	10 cm									
21.4	End of Borehole														

+3, x5 : Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

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# RECORD OF BOREHOLE No 4

METRIC

W P 197-77-03 LOCATION Co-ords. N 4 820 604.7; E 286 684.4 ORIGINATED BY JH  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone Test COMPILED BY PP  
DATUM Geodetic DATE 82 10 29 and 82 11 01 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 <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES									WATER CONTENT (%) 10 20 30

180.8	Ground Level												
0.0	Heterogeneous Mixture of Silty Clay		1	SS	30	8 cm						11 23 44 22	
	Sand & Gravel		2	SS	42								
	Hard		3	SS	61								
	Glacial Till		4	SS	92								
			5	SS	40								
			6	SS	43								
			7	SS	60								
			8	SS	30								
170.7													
10.1	Silty Sand to Sandy Silt		9	SS	30	8 cm							
	Traces of Gravel & Clay												
	V. Dense												
			10	SS	90	3 cm							
165.6													
15.2	Silty Clay												
	Some Sand												
	Hard		11	SS	30	8 cm						0 12 61 27	
160.9			12	SS	60	8 cm							
19.9	End of Borehole												
	Reddish Brown Weathered Shale												

+3, x5: Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

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# RECORD OF BOREHOLE No 5

METRIC

W P 197-77-03 LOCATION Co-ords. N 4 820 516.5; E 286 734.0 ORIGINATED BY JH  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone Test COMPILED BY GP  
DATUM Geodetic DATE 82 11 01 and 02 CHECKED BY EP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    x LAB VANE						
180.5	Ground Level									10	20	30		
0.0	Heterogeneous Mixture of Silty Clay		1	SS	35		180							
			2	SS	76		178							
	Sand & Gravel		3	SS	65		176							
	Hard		4	SS	38		174							
	Glacial Till		5	SS	42		172							
			6	SS	66/	23 cm	170							
			7	SS	101		168							
170.0														
10.5	Silty Sand to Sandy Silt		8	SS	86/	23 cm	170							
	Traces of Gravel & Clay		9	SS	80/	15 cm	168							
	V. Dense		10	SS	70/	15 cm	166							
163.6														
16.9	Silty Clay		11	SS	65/	15 cm	162							
	Traces of Sand						160							
	Hard		12	SS	100/	15 cm	158							
157.6														
22.9	Reddish Brown Weathered Shale													
156.1														
24.4	End of Borehole													
	Note:  No Groundwater Level Measurements Were Carried Out.													

+3, x5 : Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 14

METRIC

W P 197-77-03 LOCATION Co-ords. N 4 820 467.5; E 286 767.0 ORIGINATED BY JH  
 DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone Test COMPILED BY PP  
 DATUM Geodetic DATE 82 11 22 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
179.8	Ground Level		1	SS		4/45								
0.0	V. Soft to Soft		2	SS	13									
	Heterogeneous Mixture of Silty Clay		3	SS	38									
	Sand & Gravel		4	SS	84									
	Stiff to Hard		5	SS	91									
			6	SS	60									
174.8			7	SS	59									
5.0	End of Borehole													
	Surface Water Level 15 cm above Ground Level (82 11 22)													

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 15

METRIC

W P 197-77-03 LOCATION Co-ords. N 4 820 415.0; E 286 838.5 ORIGINATED BY JH  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (S.A.) & Cone Test COMPILED BY PP  
DATUM Geodetic DATE 82 11 22 CHECKED BY [Signature]

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			20 40 60 80 100		W <sub>p</sub>	W	W <sub>L</sub>		
180.0	Ground Level												
0.0	Soft		1	SS	37								
	Heterogeneous		2	SS	98	28 cm							
	Mixture of		3	SS	89								
	Silty Clay		4	SS	71								
	Sand & Gravel												
	Hard		5	SS	34								
	Glacial Till												
173.4			6	SS	40								
6.6	End of Borehole												

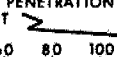

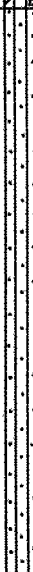

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No 102

METRIC

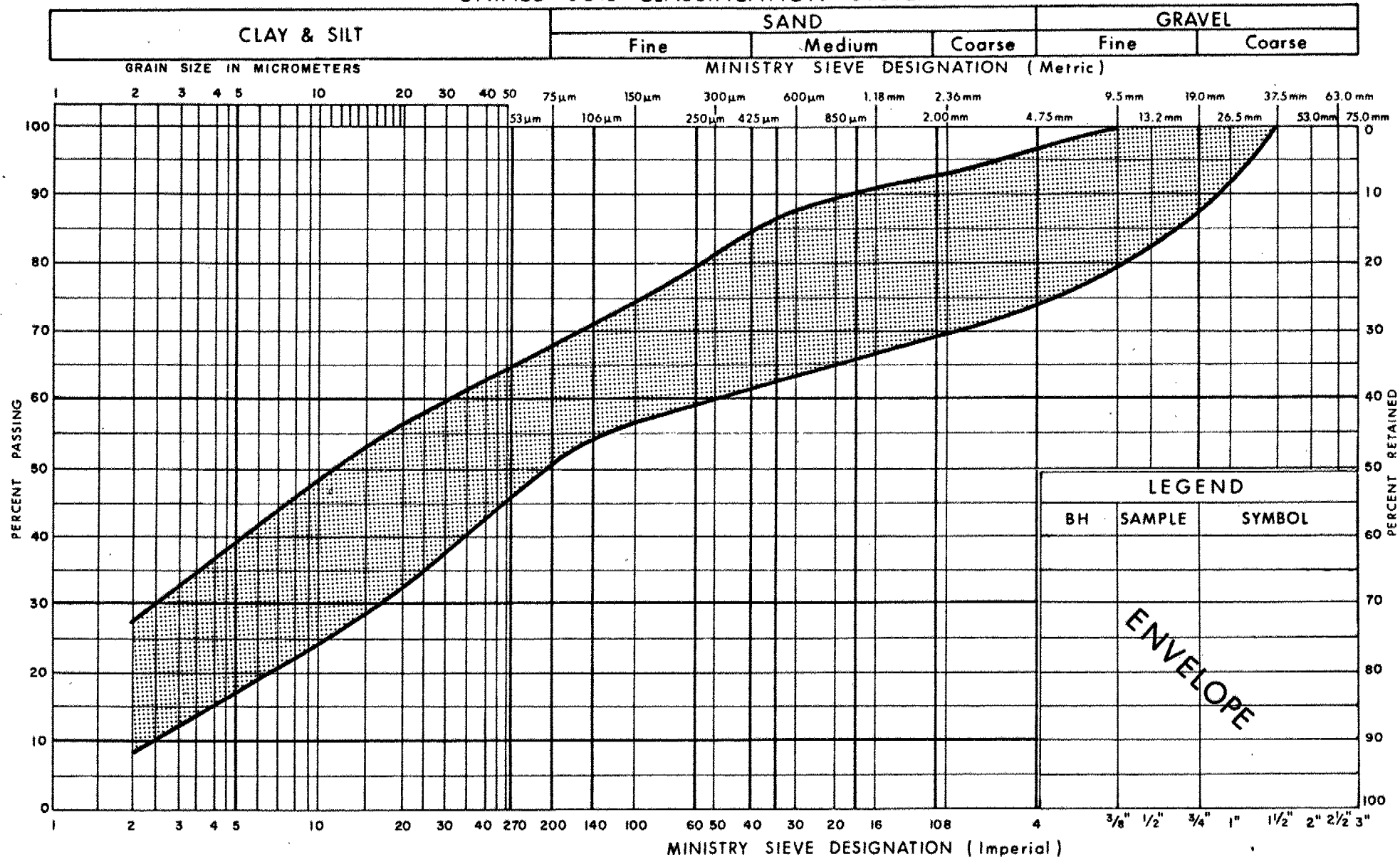
W P 197-77-03 LOCATION Co-ords N 4 820 741.1; E 286 632.4 ORIGINATED BY DBC  
DIST 4 HWY 403 BOREHOLE TYPE Cont. Flight Auger (H.S.) & Cone Test COMPILED BY PP  
DATUM Geodetic DATE 81 12 23 - 82 01 05 CHECKED BY CP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
181.0	Ground Level											GR SA SI CL
0.0	Heterogeneous Mixture of Silty Clay		1	SS	22		180		○	—		16 23 43 18
	Sand & Gravel		2	SS	29							
	V. Stiff to Hard		3	SS	27				○	—		3 31 42 24
	Glacial Till		4	SS	72		178					
			5	SS	38							
			6	SS	33		176					
			7	SS	39				○	—		26 23 32 20
			8	SS	111				○			6 31 55 8
			9	SS	83		174		○			15 34 38 13
172.5				10	SS	110/18 cm			○	—		10 30 45 15
8.5	Sandy Silt to Silty Sand		11	SS	125/23 cm		172					
	Traces of Gravel & Clay		12	SS	186/15 cm		170		○			6 24 61 9
	Occ. Silty Clay Layers		13	SS	100/10 cm							
	V. Dense		14	SS	115/13 cm		168		○			11 43 40 6
			15	SS	49		166					
			16	SS	100/10 cm		164		○	—		4 38 48 10
			17	SS	100/15 cm		162			○		
			18	SS	67/15 cm				○			1 12 82 5
160.3	Reddish Brown Weathered Shale		19	SS	100/15 cm		160		○	W <sub>p</sub> =14% W <sub>L</sub> =52%		0 26 57 17
21.5	End of Borehole											
	Note: No Groundwater Level Measurements Were Carried Out.											

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



## UNIFIED SOIL CLASSIFICATION SYSTEM



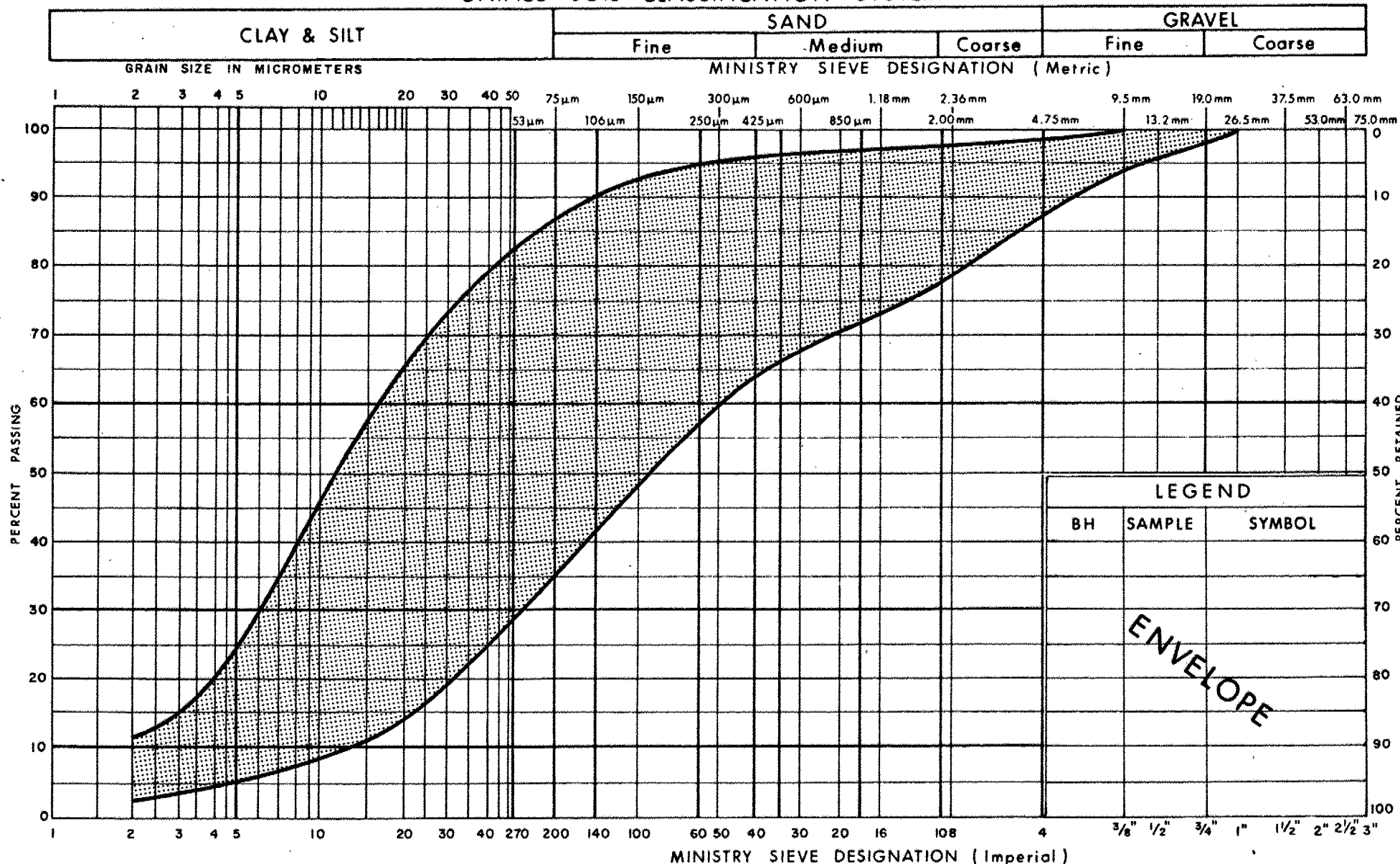
Ministry of  
Transportation and  
Communications

**GRAIN SIZE DISTRIBUTION**  
HET MIXTURE OF  
**SILTY CLAY SAND & GRAVEL (Glacial Till)**

FIG No 1

W P 197-77-03

## UNIFIED SOIL CLASSIFICATION SYSTEM



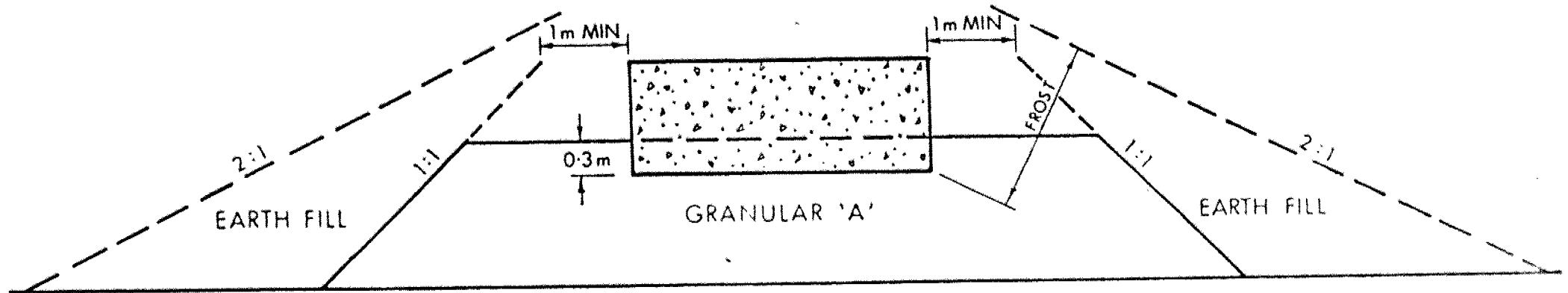
Ministry of  
Transportation and  
Communications

GRAIN SIZE DISTRIBUTION  
SILTY SAND TO SANDY SILT  
TRACES OF GRAVEL & CLAY

FIG No 2

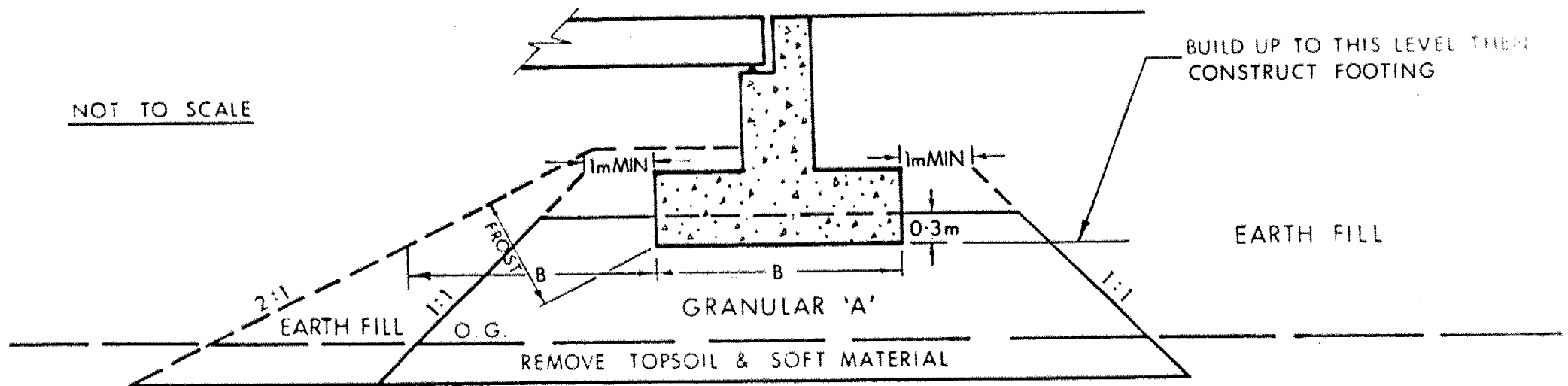
W P 197-77-03

# ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



X SECTION

NOT TO SCALE



LONGITUDINAL SECTION

## NOTES:

- 1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.
- 2 - PLACE GRANULAR 'A' & EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M.T.C. STANDARDS.
- 3 - CONSTRUCT CONCRETE FOOTING
- 4 - PLACE REMAINDER OF GRANULAR 'A' & EARTH FILL AS REQUIRED

## 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 (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

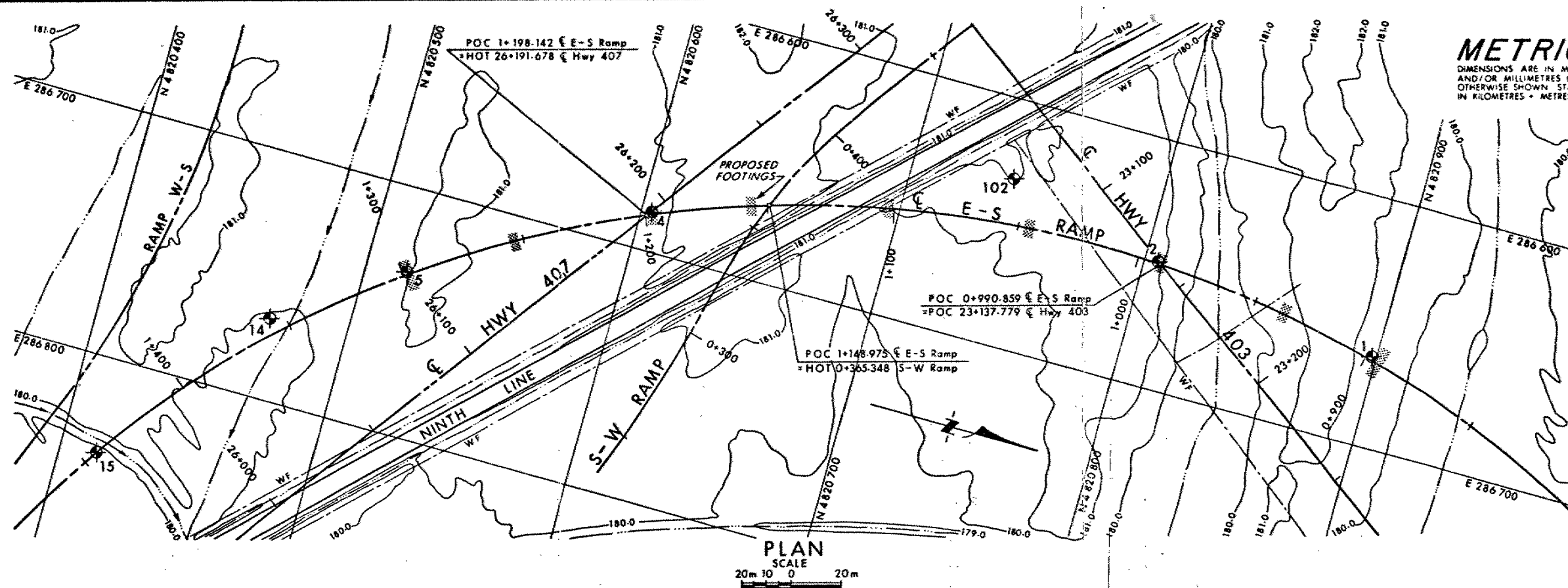
$u_w$	kPa	PORE WATER PRESSURE
$r_u$	1	PORE PRESSURE RATIO
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS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

### MECHANICAL PROPERTIES OF SOIL

$m_v$	kPa <sup>-1</sup>	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	m <sup>2</sup> /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_t$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	kg/m <sup>3</sup>	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	kN/m <sup>3</sup>	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\rho_w$	kg/m <sup>3</sup>	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	kN/m <sup>3</sup>	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
$\rho$	kg/m <sup>3</sup>	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	kN/m <sup>3</sup>	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	kg/m <sup>3</sup>	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	q	m <sup>3</sup> /s	RATE OF DISCHARGE
$\gamma_d$	kN/m <sup>3</sup>	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $\frac{w_L - w_p}{w - w_p}$	v	m/s	DISCHARGE VELOCITY
$\rho_{sat}$	kg/m <sup>3</sup>	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{sat}$	kN/m <sup>3</sup>	UNIT WEIGHT OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	kg/m <sup>3</sup>	DENSITY OF SUBMERGED SOIL	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE	j	kn/m <sup>3</sup>	SEEPAGE FORCE
$\gamma'$	kN/m <sup>3</sup>	UNIT WEIGHT OF SUBMERGED SOIL						

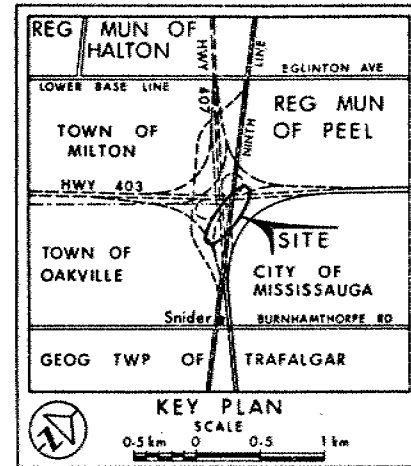


**METRIC**  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES.

CONT No  
WP No 197-77-03  
E-S RAMP UNDERPASS  
(HWY 403 & 407)  
BORE HOLE LOCATIONS & SOIL STRATA

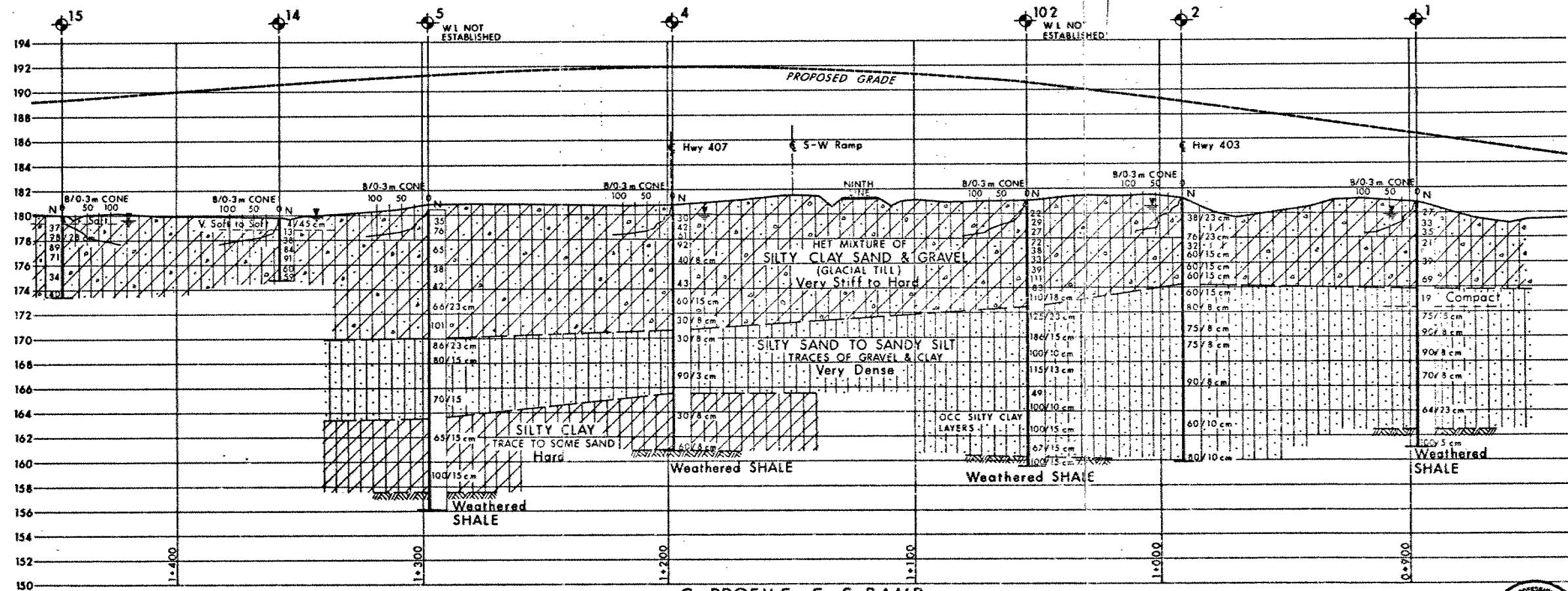


SHEET



**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  
1982 10 and 1982 11
- W.L. Not Established in BH 5 & 102



PROFILE E-S RAMP

SCALE  
HOR 20m 10 0 20m  
VERT 4m 2 0 4m

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	180.9	4820898.5	286663.8
2	181.3	4820805.5	286649.5
4	180.8	4820604.7	286684.4
5	180.5	4820516.5	286734.0
14	179.8	4820467.5	286767.0
15	180.0	4820415.0	286838.5
102	181.0	4820741.1	286632.4

**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
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Geocres No 30M12-169

HWY No 403	SUBMITED PP	CHECKED	DATE 1982 11 30	SITE 10-82-325
DRAWN BY	CHECKED	DATE	DATE 1977 03 04	DWG 1977 03 04



# memorandum



To: Mr. K. Selby,  
Senior Foundation Engineer,  
Pavement and Foundation  
Design Section,  
Central Building, Downsview.

Date: 1983-01-27

Central Region

RE: Foundation Investigation and Design Reports,  
Highway 403/407 Interchange Structures,  
W.P. 197-77-02, -03, -04 and -05,  
District 4, Hamilton

The above four (4) Foundation Investigation Reports, and your memorandum dated 83-01-25, indicate that 1.4 metres of earth cover is required for frost protection purposes. Our practice, however, is to allow for 1.2 metres depth only for the structures located in District 4, Hamilton.

Would you please, therefore, advise us whether the excessive depth for the frost protection to the footings of the structures is necessary.

HKJ:rb

A handwritten signature in dark ink, appearing to read "H. Jagasia".

H.K. Jagasia,  
Senior Structural Engineer,  
for:  
G.C.E. Burkhardt,  
Head, Structural Section.

c.c. K.G. Bassi  
N. Sen  
C.P. Korzeniowski  
(McCormick, Rankin & Assoc.)

EARTH COVER: 1.2m. O.K.  
PHONED BY K.G. SELBY  
83-01-26

