

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M13-55

DIST. 6 REGION

W.P. No. 164-79-05

CONT. No. 87-60

W. O. No.

STR. SITE No. 37-125

HWY. No. 400

LOCATION Hwy 7 Underpass

No. of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

**METRIC**

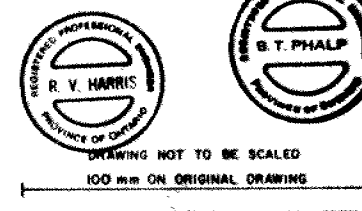
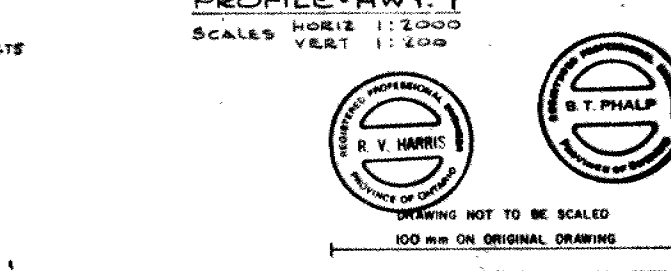
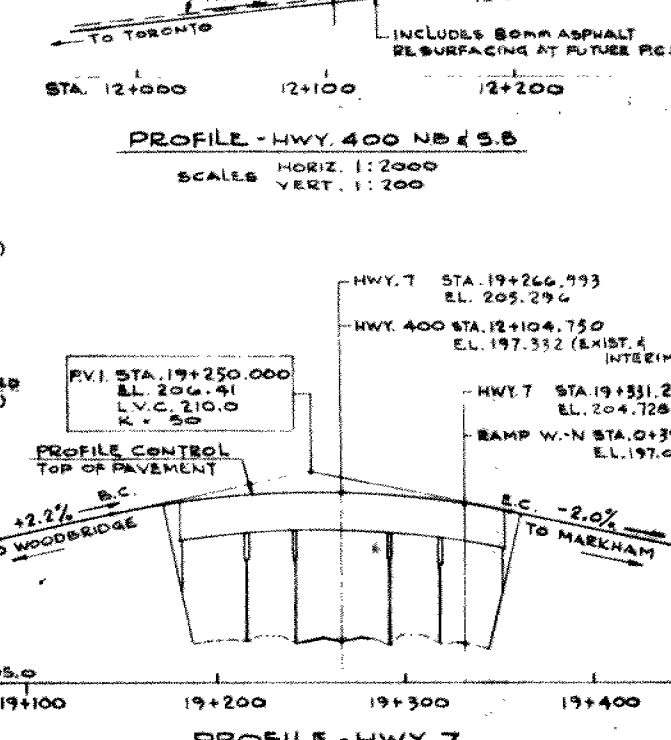
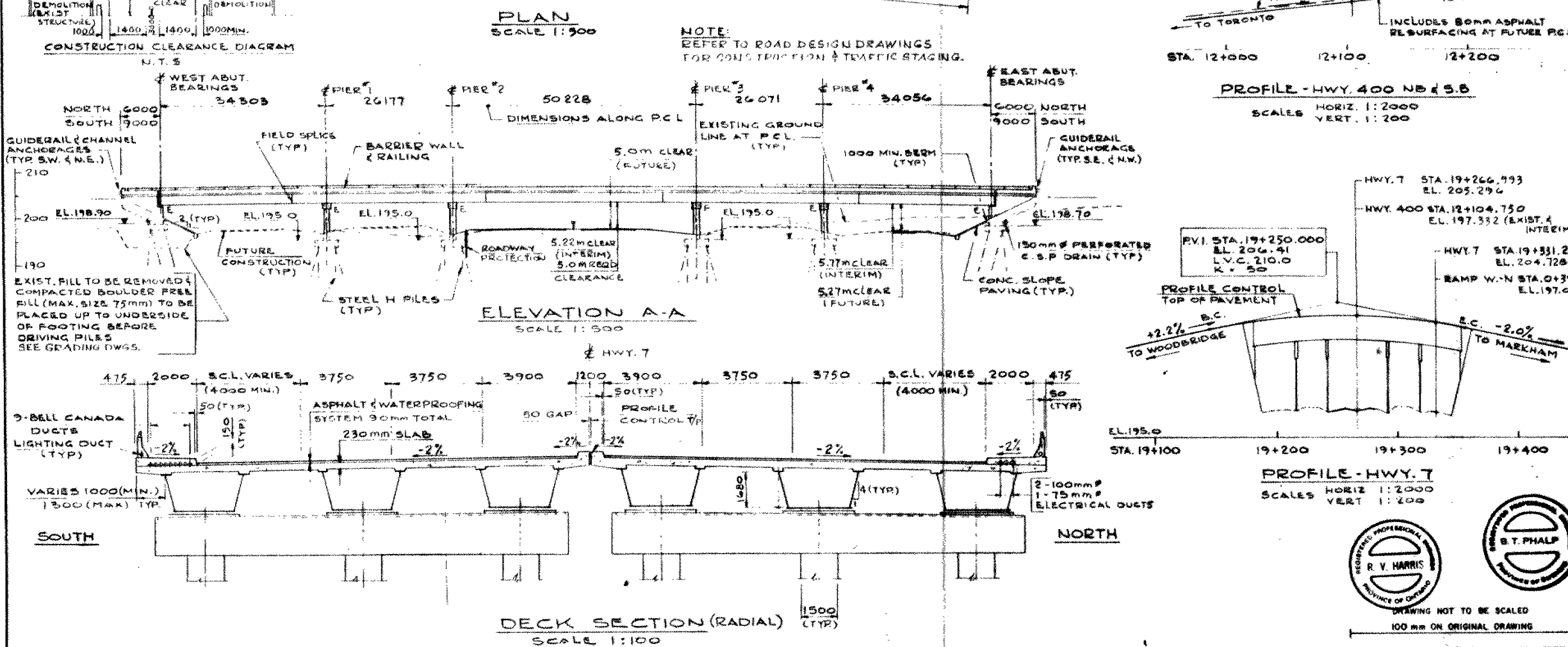
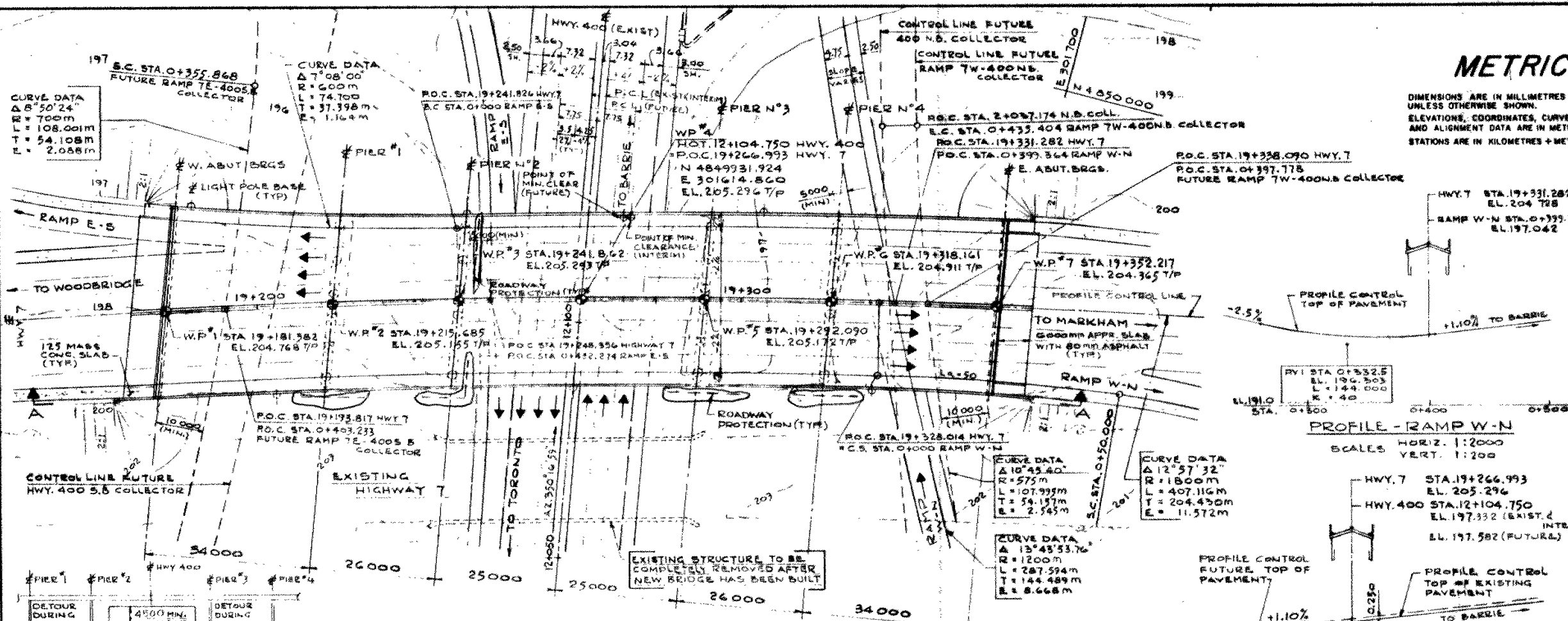
DIMENSIONS ARE IN MILLIMETRES  
UNLESS OTHERWISE SHOWN.  
ELEVATIONS, COORDINATES, CURVE  
AND ALIGNMENT DATA ARE IN METRES.  
STATIONS ARE IN KILOMETRES + METRES.

- GENERAL NOTES**
- CLASS OF CONCRETE**  
DECK, PIERS, ABUTMENTS AND  
BARRIER WALLS 30MPa  
REMAINDER 20MPa
- REINFORCING STEEL - GRADE 400**  
BAR MARKS WITH SUFFIX 'C' SHALL BE  
COATED BARS.
- CLEAR COVER TO REINFORCING STEEL:**  
FOOTINGS - 100 : 25  
PIERS - 70 : 20  
ABUTMENTS - FRONT FACE 80 : 20  
BACK FACE 70 : 20  
DECK SLAB - TOP TO 120 BOT. 40 : 10  
REMAINDER - 70 : 20 (OR AS NOTED ON  
THE DRAWINGS)

- CONSTRUCTION NOTES**  
THE CONTRACTOR IS RESPONSIBLE FOR  
FINISHING THE BEARING SEATS DEAD LEVEL  
TO THE SPECIFIED ELEVATIONS WITH A  
TOLERANCE OF 3 mm.
- ROADWAY PROTECTION**  
FOR DETAILS OF ROADWAY PROTECTION  
SEE DWG. 21

- LIST OF DRAWINGS**  
ST-75-125 GENERAL ARRANGEMENT,  
PIERHOLE LOCATIONS & SOIL STRATA.
- FOUNDATION LAYOUT
  - WEST ABUTMENT - PLANS
  - WEST ABUTMENT - ELEVATIONS
  - EAST ABUTMENT - PLANS
  - EAST ABUTMENT - ELEVATIONS
  - PIERS
  - STRUCTURAL STEEL I
  - STRUCTURAL STEEL II
  - STRUCTURAL STEEL III
  - BEARINGS
  - EXPANSION JOINT - WEST ABUTMENT
  - DECK SLAB - REINFORCEMENT
  - DECK SLAB - SCAFFOLD ELEVATIONS
  - BARRIER WALL ON SIDEWALK
  - RAILING FOR BARRIER WALL
  - 6000MM APPROACH SLAB
  - DETAILS OF CONC. SLOPE PAVING
  - DRIVING - STEAM AND  
DIESEL HAMMERS
  - STANDARD DETAILS
  - BRIDGE DATA & SITE NUMBER DATA
  - AS CONSTRUCTED ELEVATIONS  
AND DIMENSIONS.
  - ELECTRICAL EMBEDDED WORK I
  - ELECTRICAL EMBEDDED WORK II

- CONCRETE QUANTITIES**  
CONCRETE QUANTITIES ARE LISTED BELOW  
FOR THE APPROPRIATE CONCRETE LUMP  
SUM TENDER ITEMS
- 1. CONCRETE IN PIERS, ABUTMENTS AND  
WINGWALLS 1174 m<sup>3</sup>
  - 2. CONCRETE IN DECK 1856 m<sup>3</sup>
  - 3. CONCRETE IN BARRIER WALLS 85 m<sup>3</sup>
  - 4. CONCRETE IN SLOPE PAVING 94 m<sup>3</sup>
  - 5. CONCRETE IN APPROACH SLABS 113 m<sup>3</sup>
- STRUCTURAL STEEL 980 t**



REVISIONS	DATE	BY	DESCRIPTION

DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

# METRIC

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

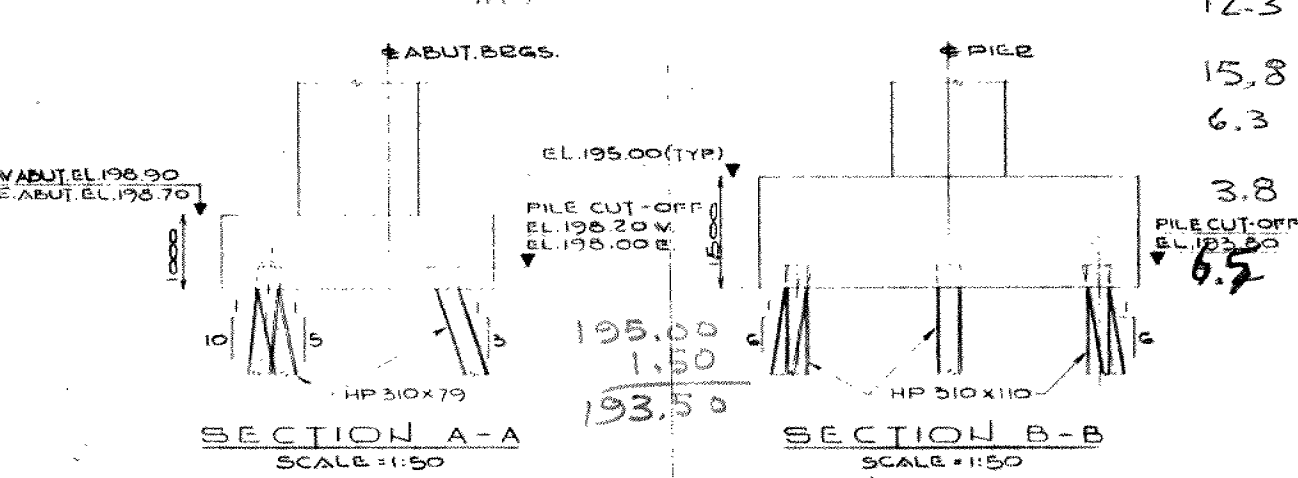
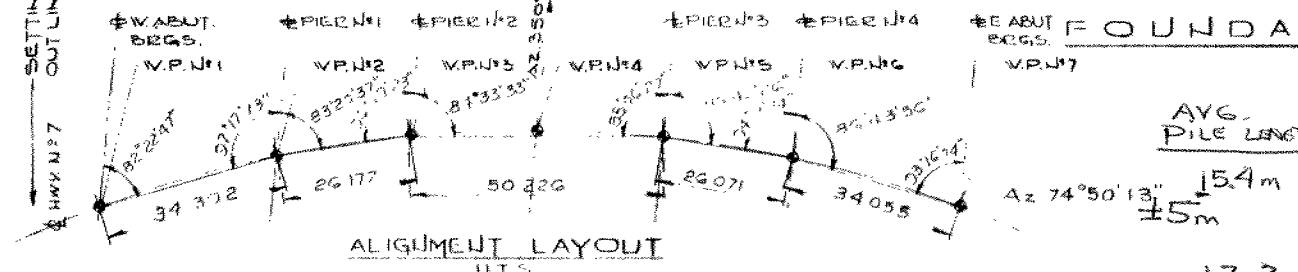
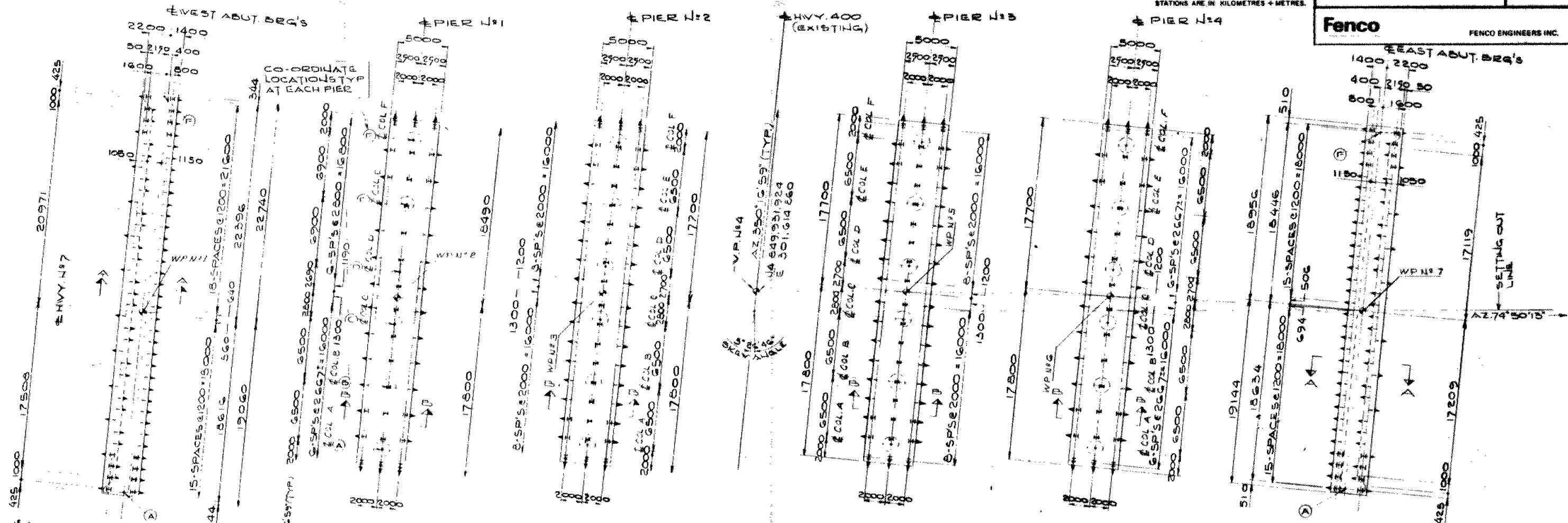
DIST. 6  
CONT No  
WP No 164-79-05



HIGHWAY 400/7 INTERCHANGE  
HIGHWAY 7 UNDERPASS  
FOUNDATION LAYOUT

SHEET

**Fenco** FENCO ENGINEERS INC.



FOUNDATION LAYOUT  
SCALE = 1:200

LOCATION	FRONT ROW	N°	LENGTH	BATTER
WEST ABUT.	FRONT ROW	35	15800	5:1
PIER N#1	FRONT ROW	25	15500	5:1
PIER N#2	FRONT ROW	12	14800	10:1
PIER N#3	FRONT ROW	2	12500	6:1
PIER N#4	FRONT ROW	2	12500	6:1
EAST ABUT.	FRONT ROW	35	15800	5:1
PIER N#1	REAR ROW	25	15500	5:1
PIER N#2	REAR ROW	12	14800	10:1
PIER N#3	REAR ROW	2	12500	6:1
PIER N#4	REAR ROW	2	12500	6:1
EAST ABUT.	REAR ROW	35	15800	5:1

LOCATION	W.P.N#	A	B	C	D	E	F
WEST ABUT.	W.P.N#1	W.P.N#2	W.P.N#3	W.P.N#4	W.P.N#5	W.P.N#6	W.P.N#7
PIER N#1	W.P.N#1	W.P.N#2	W.P.N#3	W.P.N#4	W.P.N#5	W.P.N#6	W.P.N#7
PIER N#2	W.P.N#1	W.P.N#2	W.P.N#3	W.P.N#4	W.P.N#5	W.P.N#6	W.P.N#7
PIER N#3	W.P.N#1	W.P.N#2	W.P.N#3	W.P.N#4	W.P.N#5	W.P.N#6	W.P.N#7
PIER N#4	W.P.N#1	W.P.N#2	W.P.N#3	W.P.N#4	W.P.N#5	W.P.N#6	W.P.N#7
EAST ABUT.	W.P.N#1	W.P.N#2	W.P.N#3	W.P.N#4	W.P.N#5	W.P.N#6	W.P.N#7

- PILE SPACING IS MEASURED AT UNDERSIDE OF FOOTING
- PILING AT ABUTMENTS SHALL BE HP 310X79 STEEL 'H' PILES.
- PILING AT PIERS SHALL BE HP 310X110 STEEL 'H' PILES.
- PILES TO BE DRIVEN IN ACCORDANCE WITH STANDARD SS103-11 USING AN ULTIMATE CAPACITY OF 2400 KN PER PILE AT ABUTMENTS AND 2940 KN PER PILE AT PIERS.
- PILE LENGTHS SHOWN ABOVE ARE THEORETICAL LENGTHS BELOW PILE CUT-OFF.
- PILE DESIGN DATA  
CAPACITY AT SLS TYPE II BOOKS FOR HP 310X79  
1750KN FOR HP 310X110  
1250KN FOR HP 310X79  
1600KN FOR HP 310X110



DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
1			
2			
3			

# FOUNDATION INVESTIGATION REPORT

CONTRACT NO 87-60



Ontario

Ministry of  
Transportation and  
Communications

INDEX

<u>Page</u>	<u>Description</u>
1	Index
2	Abbreviations and Symbols
3 - 52	Foundation Investigation Report for - Hwy. 7 Underpass Replacement Structure W.P. 164-79-05, Site 37-125 Hwy. 400, District 6, Toronto - Hwy. 400 and Hwy. 7 High Mast Lighting W.P. 164-79-04/05; Site 37 Hwy. 400/7, District 6, Toronto

Note: For the purpose of this contract, these reports supercede all other foundation reports prepared by or for the Ministry in connection with the above-noted projects.

**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

$m_v$	$kPa^{-1}$	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	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
$\sigma'_{vo}$	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

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

## FOUNDATION INVESTIGATION REPORT

For

Hwy. 7 Underpass Replacement Structure

W.P. 164-79-05, Site 37-125

Hwy. 400, District 6, Toronto.INTRODUCTION:

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

The fieldwork was carried out between 82 08 16 and 82 08 25 and consisted of 12 sampled boreholes, 7 accompanied by dynamic cone penetration tests, advanced by means of hollow and solid stem continuous flight augers. Borings were continued for depths ranging from 8.1 metres to 29.5 metres.

Site Description and Geology

The relocated underpass site is located immediately north of the present crossing of Hwy. 400/7 within the Regional Municipality of York. The existing underpass is a 33 x 18 metre single span rigid frame structure with full height abutments and shows no signs of obvious structural distress.

Physiographically, the site is located within the "Peel Plain" region which is characterized by bevelled till plains composed of level to undulating tracts of clay soils. Much of the plain has been modified by a veneer of clay which, when deep enough, takes on a varved appearance. In various locals, ancient stream valleys are bordered by trains of sandy alluvium.

Bedrock consisting of the Georgian Bay Foundation, Upper Ordovician Period is located at depths in excess of 60 metres at this site.

### Subsurface Conditions

In general, reasonably uniform subsurface conditions with varying insitu consistency/denseness were encountered across the site. The area is covered by a man-made fill ranging from reworked parent till material to construction debris for a maximum thickness of 4.0 metres. Underlying the fill and encountered for a maximum thickness of 10.5 metres is a cohesive glacial till deposit composed of silty clay with varying amounts of sand. A non cohesive silty sand to sandy silt deposit was encountered immediately below the till deposit. This fine granular deposit was underlain by a varved deposit of silty clay.

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 a simplified stratigraphical summary are shown on Drawing No. 1647905-A.\* Six sections showing detailed stratigraphy based on borehole data are shown on Drawing No. 1647905-B.\* These drawings should be read in conjunction with the borehole sheets and this report.

The various soil types encountered are described in detail as follows:

### Fill Material

Embankment and interchange fill material was found overlying the site for thickness ranging from 0.6 to 4.0 metres. This fill material is composed of a reworked silty clay and sand to a sandy clay some gravel which appears to be derived from the parent glacial till of the area. In addition, a boring at the proposed east abutment location encountered construction debris consisting of slabs of asphalt and gravel. Apparently, this debris was graded into the slopes inside the loops of the existing interchange, predominately in the North-East locale. Two typical grain size distribution curves for this surficial deposit are plotted on Figure 1 of the appendix.

\* Refer to Sheets No. 238 and 238-1 of the Contract Drawings.



Based on interpretation of Standard Penetration Test 'N' values and augering operations, the fill material is assessed as having undergone a moderate degree of compactive effort.

#### Silty Clay, Sand, and Gravel (Glacial Till)

The natural surficial deposit encountered across the site is a cohesive glacial till composed of silty clay of low plasticity with varying amounts of sand and a trace of gravel. Typical gradation curves from representative samples of this deposit are plotted in envelope form on figure 2. A distinct layer of sandy silt to silty sand was encountered in most borings between elevations 190 and 192, in addition to the occasional fine granular layers throughout this deposit.

As a result of previous construction activity, the upper surface of this till is often reworked and difficult to distinguish from the overlying derived embankment fill material.

Results of water content and Atterberg Limit testing on representative samples from this till deposit are plotted on the Plasticity Chart (Figure 3) and summarized as follows:

		<u>Range</u>	<u>Average</u>
Water Content	(w) %	7-21	13
Liquid Limit	(W <sub>L</sub> ) %	16-39	24
Plastic Limit	(W <sub>p</sub> ) %	11-20	13
Plasticity Index (I <sub>p</sub> ) %		5-20	10

These results generally indicate the matrix of the cohesive till deposit to be an inorganic silty clay of low plasticity (CL).

Based on interpretation of Standard Penetration Test 'N' values ranging from 12 to in excess of 100 blows per 0.3 metres and augering operations through this deposit, the consistency for this glacial till ranges from stiff to hard.

### Silty Sand to Sandy Silt

The cohesive till deposit is underlain by a fine grained glaciolacustrine deposit consisting of silty sand to sandy silt with a trace of gravel. This deposit was encountered for thicknesses ranging from 3.1 metres to 7.2 metres. Two typical grain size distribution curves for this deposit are shown on Figure No. 4. Occasional seams and zones of silty clay were encountered within this deposit.

Interpretation of Standard Penetration Test 'N' values which ranged from 12 to in excess of 100 blows per 0.3 metres but generally greater than 30 blows/0.3 metres, indicates the denseness for this deposit to range from compact to very dense, but generally dense to very dense throughout.

### Varved Silty Clay

Underlying the fine grained glaciolacustrine deposit and explored for a maximum thickness of 14.1 metres is a varved silty clay deposit consisting alternating bands of low and intermediate plasticity silty clays, with a trace of sand. The upper transition portion of this deposit exhibited a higher sand content where it grades from the overlying fine granular stratum. Two grain size distribution curves, one indicating the higher transitional sand content, are shown on Figure 5.

The results of Atterberg Limit and water content testing are plotted on the plasticity chart, Figure 6. Although not truly representative of the relative plasticity of the individual varves due to the mixing of the material during testing, visual examination indicates the alternating bands to consist of low plasticity (CL-ML) and intermediate plasticity (CL-CI) silty clays.

Interpretation of Standard Penetration Test 'N' values and augering operations suggests a hard consistency for this deposit.

### Groundwater Condition

Based on water level readings taken in open boreholes over a period of time during the field investigation, a perched water table exists within the relatively impermeable silty clay till deposit which varies between elevations 194 and 197, dipping at a shallow gradient to the south. These levels are expected to fluctuate accordingly, depending on the time of year and relative rainfall conditions.

In addition, subartesian conditions can be assumed within the silty sand to sandy silt deposit based on this fine granular material 'boiling up' within the augers during borehole advancement operations.

### MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Mr. D Wismath, Student Engineer, utilizing equipment owned and operated by Master Soil Drilling.

This report was written by Mr. T. J. Kazmierowski, Foundations Engineer and reviewed by Mr. M. Devata, Senior Foundations Engineer.



*D. H. Dundas*

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

*M. Devata*

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

**A P P E N D I X**

# RECORD OF BOREHOLE No 1

METRIC

W P 164-79-05 LOCATION Co-ords. N 4 849 892.8; E 301 535.5 ORIGINATED BY D.W.  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY T.J.K.  
DATUM Geodetic DATE 82 08 16 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
198.4	Ground Surface													GR SA SI CL
0.0	(Fill)						198							
	Silty Clay and Sand		1	SS	11									
	varying amounts of		2	SS	4									
	Gravel		3	SS	9									26 46 22 6
194.4			4	SS	12									
4.0	organic		5/6	SS	8									
	(Glacial Till)		7	SS	12									
	Silty Clay													
	with Silty Sand		8	SS	37									1 19 55 25
	varying													
	amounts of Sand		9	SS	100/	13 cm								1 37 49 13
	Trace of Gravel		10	SS	100/	28 cm								
187.3	Stiff to Hard		11	SS	100		188							
11.1	End of Borehole													
	Note: Borehole caved at 8.0 m													

OFFICE REPORT ON SOIL EXPLORATION



# RECORD OF BOREHOLE No 2

METRIC

W P 164-79-05 LOCATION Co-ords. N 4 849 935.0; E 301 563.0 ORIGINATED BY D.W.  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY D.W.  
DATUM Geodetic DATE 82 08 16 and 17 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	W' VALUES			20	40	60	80	100		
196.2	Ground Surface													
0.0	(Fill) Silty Clay, some Sand, Trace of Gravel & Organics		1	SS	14		196							
194.8			2	SS	21		194							4 29 48 19
1.4	(Glacial Till)		3	SS	22									
	Brown		4	SS	20									
	Grey Silty Sand		5	SS	39		192							18 40 36 6
	Silty Clay Varying amounts of Sand Trace of Gravel Very Stiff to Hard		6	SS	20									
			7	SS	31		190							
188.0			8	SS	49									
8.2	Grey		9	SS	37		188							
	Silty Sand to Sandy Silt		10	SS	25		186							
	Trace of Gravel		11	SS	12		184							
	Occ. zones and layers of Silty Clay													
	Compact to Dense						182							
180.8			12	SS	58		180							
15.4	Grey		13	SS	100/	26 cm								
	Varved													
	Silty Clay		14	SS	43		178							
	with alternating bands of low and intermediate plasticity		15	SS	100/	28 cm								
	brittle texture						174							
	Hard		17	SS	64		172							
			18	SS	100/	29 cm	170							
							168							
166.7			19	SS	85									
29.5	End of Borehole Note: Borehole caved at 6.8 m													

$\gamma^3, \gamma^5$ : Numbers refer to  
Sensitivity

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

RECORD OF BOREHOLE No 3										METRIC				
W P 164-79-05		LOCATION Co-ords. N 4 849 911.3; E 301 593.0				ORIGINATED BY D.W.								
DIST 6 HWY 400		BOREHOLE TYPE Hollow Stem Auger & Cone Test				COMPILED BY T.J.K.								
DATUM Geodetic		DATE 82 08 18				CHECKED BY <i>CP</i>								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	'N' VALUES			20	40					
196.7	Ground Surface													
0.0	(Fill) Silty Clay with organics, some Sand, Trace of Gravel		1	SS	17		196							
195.3			2	SS	34									
1.4	(Glacial Till)		3	SS	30		194							6 28 41 25
	Brown Silty Sand		4	SS	38									
	Grey		5	SS	100/	20 cm								
	Silty Clay with varying amounts of Sand Trace of Gravel		6	SS	100/	28 cm	192							
			7	SS	78		190							
189.4	Hard													
7.3	Grey		8	SS	85									
	Silty Sand to Sandy Silt Trace of Gravel Occ. zones and layers of Silty Clay		9	SS	32		188							4 34 54 8
			10	SS	100/	26 cm	186							
184.8	Dense to Very Dense													
11.9	with Sand		11	SS	82		184							2 23 55 20
	Grey Varved Silty Clay with bands of low to intermediate plasticity Trace of Sand		12	SS	100/	26 cm	182							
							180							
178.0	Hard		13	SS	100/	23 cm								
18.7	End of Borehole													
	Note: Borehole caved at 8.7 m													

RECORD OF BOREHOLE No 4										METRIC		
W P 164-79-05		LOCATION Co-ords. N 4 849 928.5; E 301 529.3		ORIGINATED BY D.W.								
DIST 6 HWY 400		BOREHOLE TYPE Solid Stem Auger & Cone Test		COMPILED BY T.J.K.								
DATUM Geodetic		DATE 82 08 19		CHECKED BY <i>[Signature]</i>								
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					
197.0	Ground Surface											
0.0	(Fill) Silty Clay and Sand, Some Gravel											
194.9	2.1 (Glacial Till)		1	SS	25							
	Brown Grey Silty Sand		2	SS	21							4 31 45 20
	Silty Clay with Varying amounts of Sand		3	SS	94							
	Trace of Gravel		4	SS	20							
	Very Stiff to Hard		5	SS	39							
187.2	9.8 Grey		6	SS	85							
	Silty Sand to Sandy Silt		7	SS	61							
	Trace of Gravel		8	SS	28							0 60 39 1
	Occ. zones of Silty Clay											
	Compact to Very Dense											
181.7	15.3 Grey		9	SS	100/ 21 cm							
	Varved Silty Clay with bands of low to intermediate plasticity		10	SS	100/ 23 cm							
	Hard											
175.2	21.8 End of Borehole		11	SS	100							
	Note: Borehole caved at 8.0 m											

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

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


OFFICE REPORT ON BORE INFORMATION



RECORD OF BOREHOLE No 5										METRIC			
W P 164-79-05		LOCATION Co-ords. N 4 849 901.8; E 301 568.3				ORIGINATED BY D.W.							
DIST 6 HWY 400		BOREHOLE TYPE Solid Stem Auger & Cone Test				COMPILED BY T.J.K.							
DATUM Geodetic		DATE 82 06 19 and 20				CHECKED BY <i>CP</i>							
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					
198.2 0.0	Ground Surface												
	Fill												
	Silty Clay and Sand		1	SS	8								
	Some Gravel												
194.9 3.3	(Glacial Till)		2/3	SS	12								
	Silty Clay with Varying amounts of Sand		4	SS	30								
	Trace of Gravel		5	SS	100/18 cm								5 36 51 8
	Sandy Silt												
	Brown		6	SS	80								1 9 53 37
	Grey												
			7	SS	100/20 cm								
188.2 10.0	Very Stiff to Hard												
	Grey												
	Silty Sand to Sandy Silt		8	SS	100/26 cm								
	Trace of Gravel												
	Very Dense		9	SS	100/10 cm								
185.1 13.1	Silty Clay												
184.1 14.1	Trace of Sand Hard		10	SS	100/20 cm								
	End of Borehole												
	Note: Borehole caved at 5.8 m												

# RECORD OF BOREHOLE No 6

METRIC

W P 164-79-05 LOCATION Co-ords. N 4 849 932.7; E 301 587.2 ORIGINATED BY D.W.  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY T.J.K.  
DATUM Geodetic DATE 82 08 20 and 23 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					
196.9	Ground Surface																
0.0	Fill						196										
195.0	Silty Sand																
	Some Gravel		1	SS	8												
1.9	organics																
	(Glacial Till)		2	SS	32		194										
	Brown																
	Grey		3	SS	17		192										4 35 41 20
	Silty Clay with varying amounts of Sand		4	SS	14		190										
	Silty Sand		5	SS	100/	10 cm											6 44 44 6
	Trace of Gravel																
186.8	Stiff to Hard		6	SS	48		188										
10.1	Grey																
	Silty Sand to Sandy Silt		7	SS	64		186										
	Trace of Gravel																
	Occ. zones and layers of Silty Clay		8	SS	21		184										
	Compact to Very Dense																
181.3			9	SS	66		182										
15.6	Grey Varved Silty Clay with bands of low to intermediate plasticity						180										
	Trace of Sand		10	SS	100/	18 cm	178										0 6 55 39
	Hard																
			11	SS	94		176										
							174										
172.1			12	SS	100/	28 cm											
24.8	End of Borehole																
	Note: Borehole caved at 4.7 m																

+3, x5: Numbers refer to  
Sensitivity


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

RECORD OF BOREHOLE No 7										METRIC			
W P 164-79-05		LOCATION		Co-ords. N 4 849 954.2; E 301 637.2		ORIGINATED BY D.W.							
DIST 6 HWY 400		BOREHOLE TYPE		Solid Stem Auger & Cone Test		COMPILED BY D.W.							
DATUM Geodetic		DATE		82 08 23 and 24		CHECKED BY							
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	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>		
196.8	Ground Surface												
0.0	Fill												
196.2	(Glacial Till)		1	SS	19								
0.6			2	SS	32								
			3	SS	33								
	Brown		4	SS	70								
	Grey		5	SS	42								
	Silty Clay with Varying Amounts of Sand		6	SS	90								
	Trace of Sandy Silt		7	SS	100								
	Gravel		8	SS	100/	26 cm							
	Very Stiff to Hard		9	SS	100/	28 cm							
185.7			10	SS	100/	26 cm							
11.1	End of Borehole												
	Note: Borehole caved at 5.9 m												

# RECORD OF BOREHOLE No 8

METRIC

W P 164-79-05 LOCATION Co-ords. N 4 849 928.3; E 301 667.2 ORIGINATED BY D.W.  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY T.J.K.  
DATUM Geodetic DATE 82 08 24 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					
198.5	Ground Surface													GR SA SI CL
0.0	Fill						198							
	Silty Clay and Sand		1	SS	4									
	Trace of Gravel		2	SS	10									6 32 42 20
1.8	(Glacial Till)		3	SS	12			196						3 33 45 19
	Silty Clay with		4	SS	21									
	Varying Amounts		5	SS	31									
	of Sand		6	SS	100/	16 cm	194							5 39 46 10
	Sandy Silt		7	SS	100/	20 cm	192							
	Brown - Gray		8	SS	100/	29 cm	190							
190.0	Trace of Gravel													
	Stiff to Hard													
8.5	Silty Fine Sand													
189.0	Very Dense		9	SS	100/	20 cm								
9.5	End of Borehole													

\*2, \*5: Numbers refer to 20  
Sensitivity 15-5 (%) STRAIN AT FAILURE  
10

RECORD OF BOREHOLE No 9										METRIC				
W P 164-79-05		LOCATION Co-ords. N 4 849 967.0; E 301 696.5		ORIGINATED BY D.W.										
DIST 6 HWY 400		BOREHOLE TYPE Solid Stem Auger & Cone Test		COMPILED BY T.J.K.										
DATUM Geodetic		DATE 82 08 24		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	20 40 60 80 100					
200.0	Ground Surface													
0.0	Fill Silty Clay and Sand Trace of Gravel		1	SS	21		198							
197.9	(Glacial Till) Silty Clay with Varying amounts of Sand Trace of Gravel Very Stiff to Hard		2	SS	16		196							2 26 48 24
2.1			3	SS	48		194							
			4	SS	100/	28 cm	192							
			5	SS	100/	29 cm	190							
			6	SS	100/	13 cm								
189.0			7	SS	100/	19 cm								
11.0	End of Borehole  Note: Borehole caved at 4.9 m													

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXAMINATION

RECORD OF BOREHOLE No 10										METRIC				
W P 164-79-05		LOCATION Co-ords. N 4 849 926.6; E 301 642.0		ORIGINATED BY D.W.										
DIST 6 HWY 400		BOREHOLE TYPE Solid Stem Auger		COMPILED BY T.J.K.										
DATUM Geodetic		DATE 82 08 25		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					
196.7	Ground Surface													
0.0	Fill					*	196							
195.8														
0.9	(Glacial Till) Silty Clay with Varying amounts of Sand, Trace of Gravel		1	SS	20		194							10 33 38 19
			2	SS	100	23 cm								5 37 51 7
			3	SS	100	10 cm	192							1 18 67 14
			4	SS	35		190							
	alternating layers of Silty Fine Sand		5	SS	100									
			6	SS	100	28 cm	188							
	Hard		7	SS	100	23 cm	186							
185.6	End of Borehole Note: Borehole caved at 0.5 m.  * Water Level not Established													

RECORD OF BOREHOLE No 11										METRIC		
W P 164-79-05		LOCATION Co-ords. N 4 849 959.5; E 301 662.0		ORIGINATED BY D.W.								
DIST 6 HWY 400		BOREHOLE TYPE Solid Stem Auger		COMPILED BY T.J.K.								
DATUM Geodetic		DATE 82 08 25		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					
198.7	Ground Surface											
0.0	Fill		1	SS	8		198					8 29 41 22
196.9	Silty Clay and Sand Trace of Gravel		2	SS	11		196					
1.8	(Glacial Till)		3	SS	14		194					
	Silty Clay with Varying Amounts of Sand		4	SS	41		192					
	Brown		5/6	SS	75		190					
	Grey		7	SS	69							
	Trace of Gravel		8	SS	100/							
	Stiff to Hard		9	SS	100/							
189.2	End of Borehole											
9.5	Note: Borehole caved at 6.9 m											

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

20  
15 5 (%) STRAIN AT FAILURE  
10

RECORD OF BOREHOLE No 12										METRIC					
W P 164-79-05		LOCATION Co-ords. N 4 849 937.7; E 301 700.5		ORIGINATED BY D.W.											
DIST 6 HWY 400		BOREHOLE TYPE Solid Stem Auger		COMPILED BY T.J.K.											
DATUM Geodetic		DATE 82 08 25		CHECKED BY											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	Wp	W	WL	Y	GR SA SI CL		
200.5	Ground Surface														
0.0	Fill Silty Clay and Sand With Slabs of Asphalt and Gravel		1	SS	15		200								
197.8	(Glacial Till) Brown		2	SS	12		198								
2.7	Grey		3	SS	16		196								
	Silty Clay with Varying Amounts of Sand, Trace of Gravel		4	SS	100/		194								
192.4	Stiff to Hard		5	SS	100/										
8.1	End of Borehole														
	Note: Borehole caved at 5.4 m														

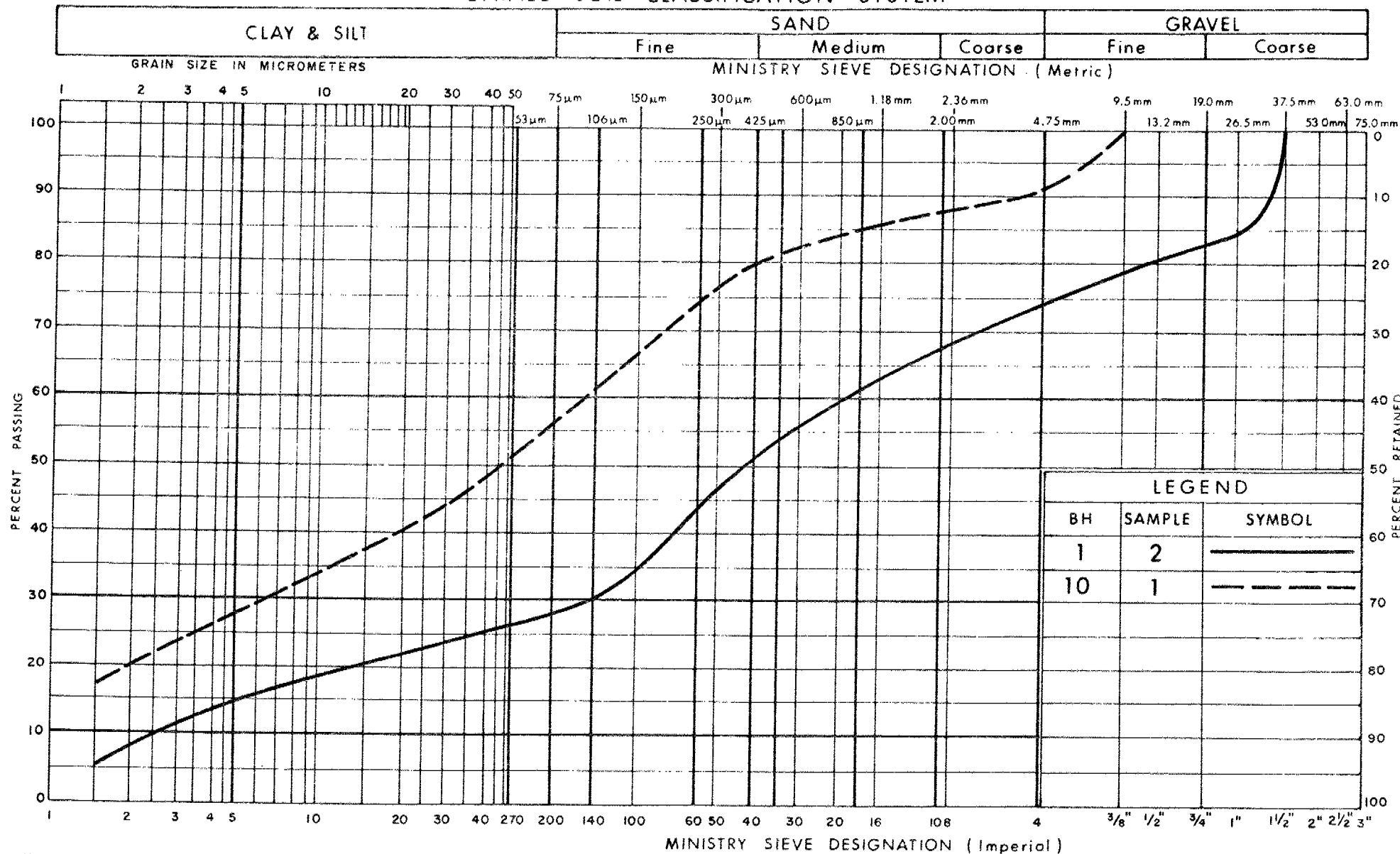
OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to  
Sensitivity

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



## UNIFIED SOIL CLASSIFICATION SYSTEM



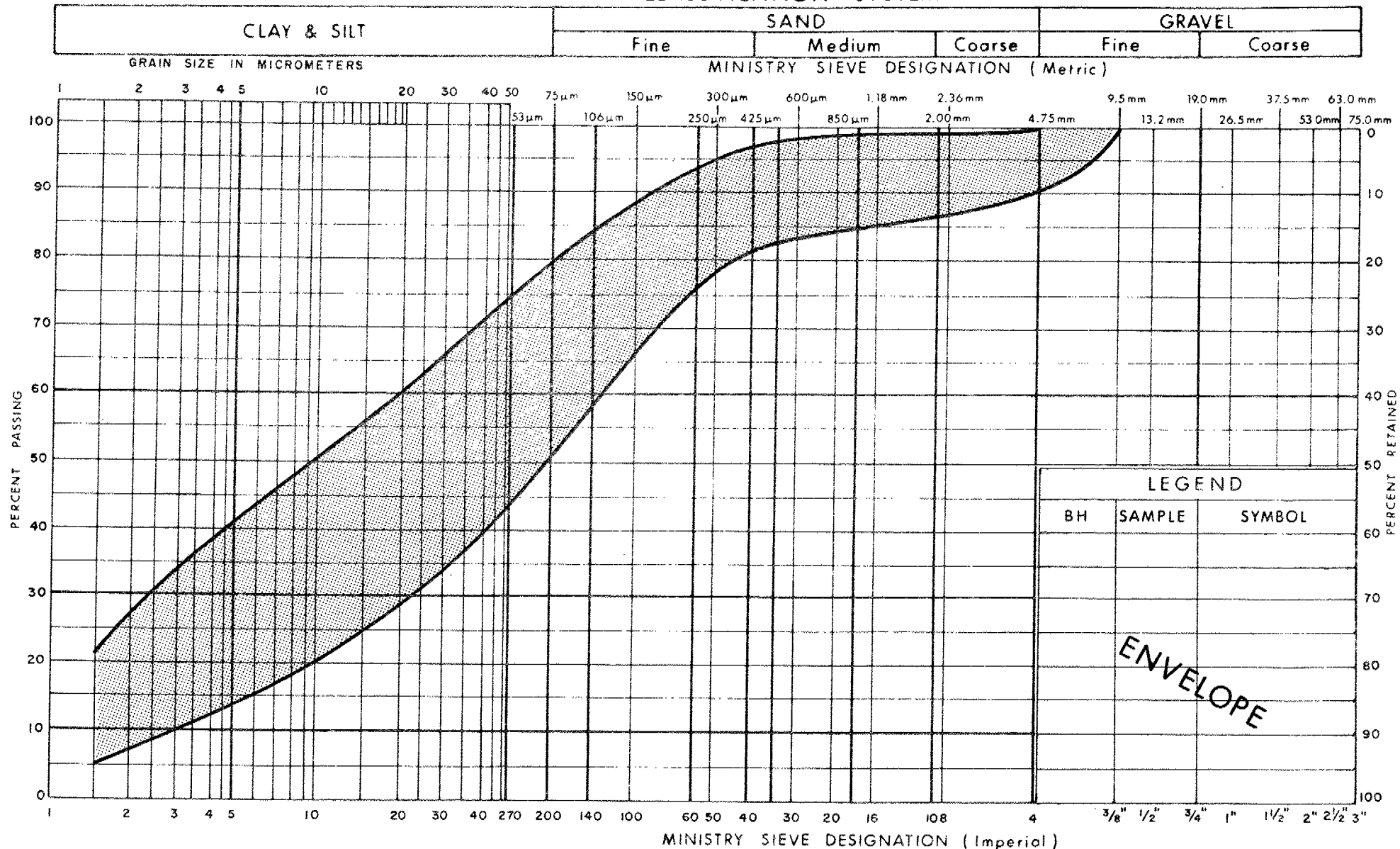
Ministry of  
Transportation and  
Communications

GRAIN SIZE DISTRIBUTION  
FILL  
SILTY CLAY AND SAND SOME GRAVEL

FIG No 1

W P 164-79-05

## UNIFIED SOIL CLASSIFICATION SYSTEM

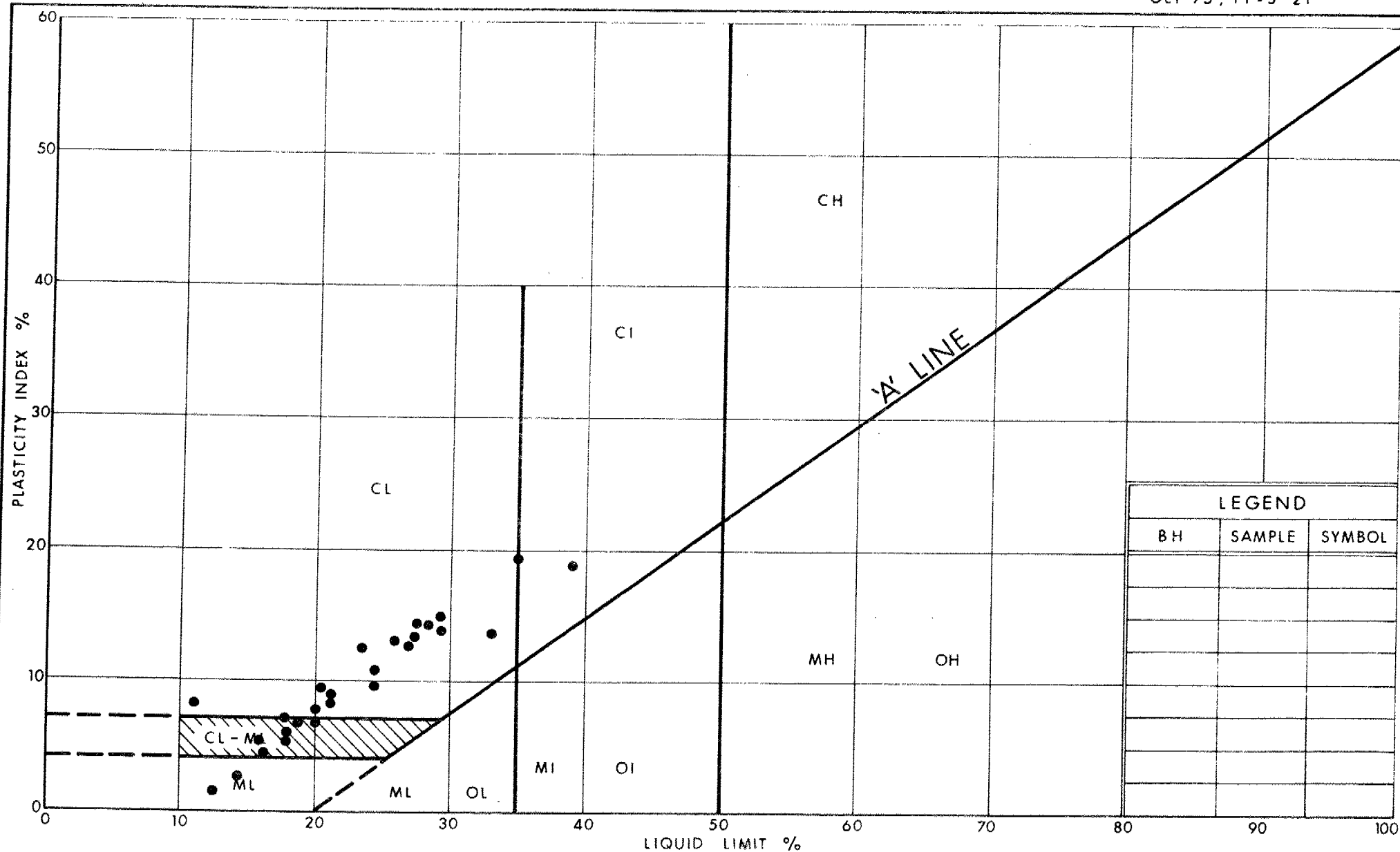


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Transportation and  
Communications

**GRAIN SIZE DISTRIBUTION**  
**SILTY CLAY (Glacial Till)**  
 WITH VARYING AMOUNTS OF SAND, TRACE OF GRAVEL

FIG No 2

W P 164-79-05



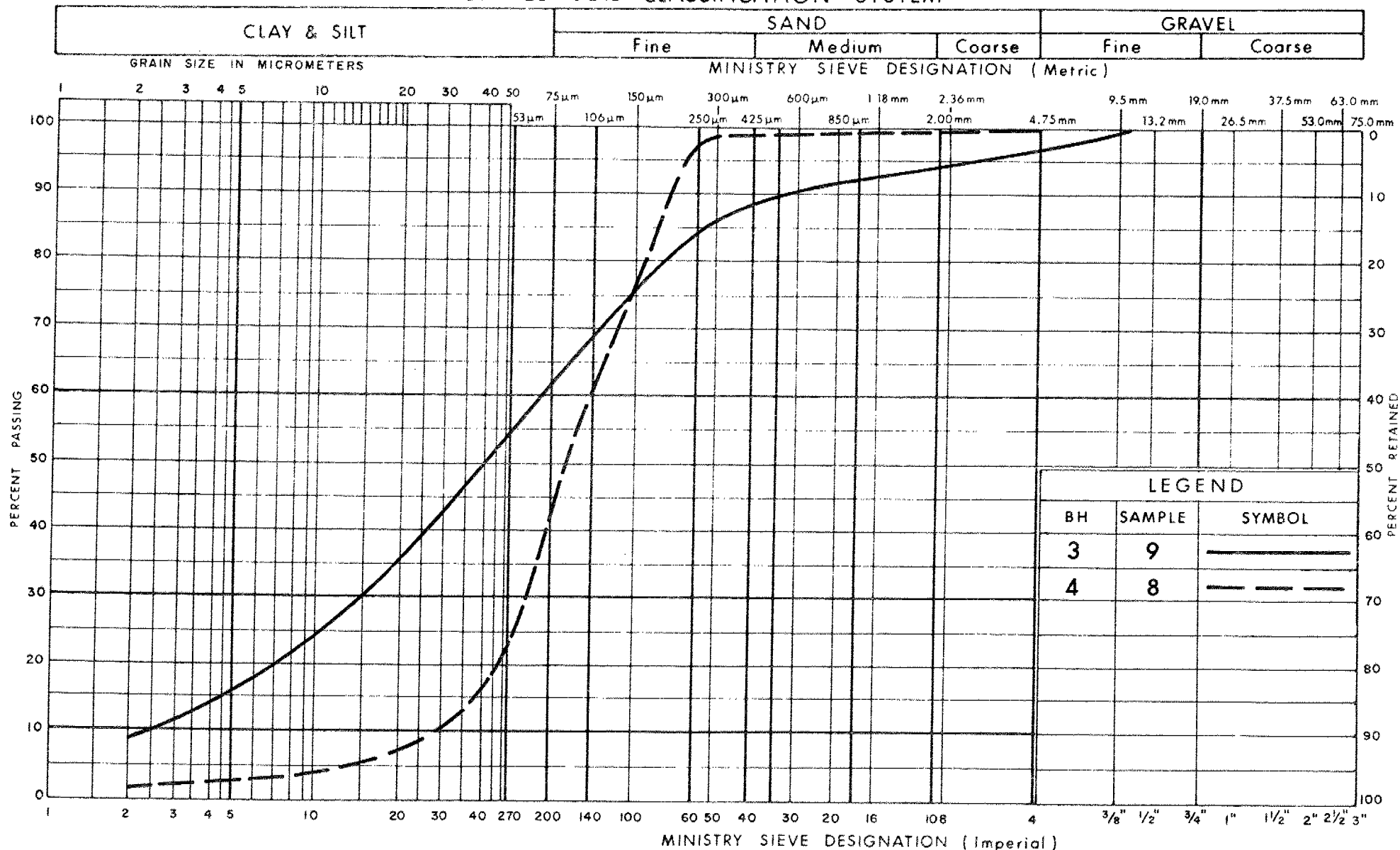
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Transportation and  
Communications

# PLASTICITY CHART SILTY CLAY Matrix (Glacial Till)

FIG No 3

W P 164 - 79 - 05

## UNIFIED SOIL CLASSIFICATION SYSTEM



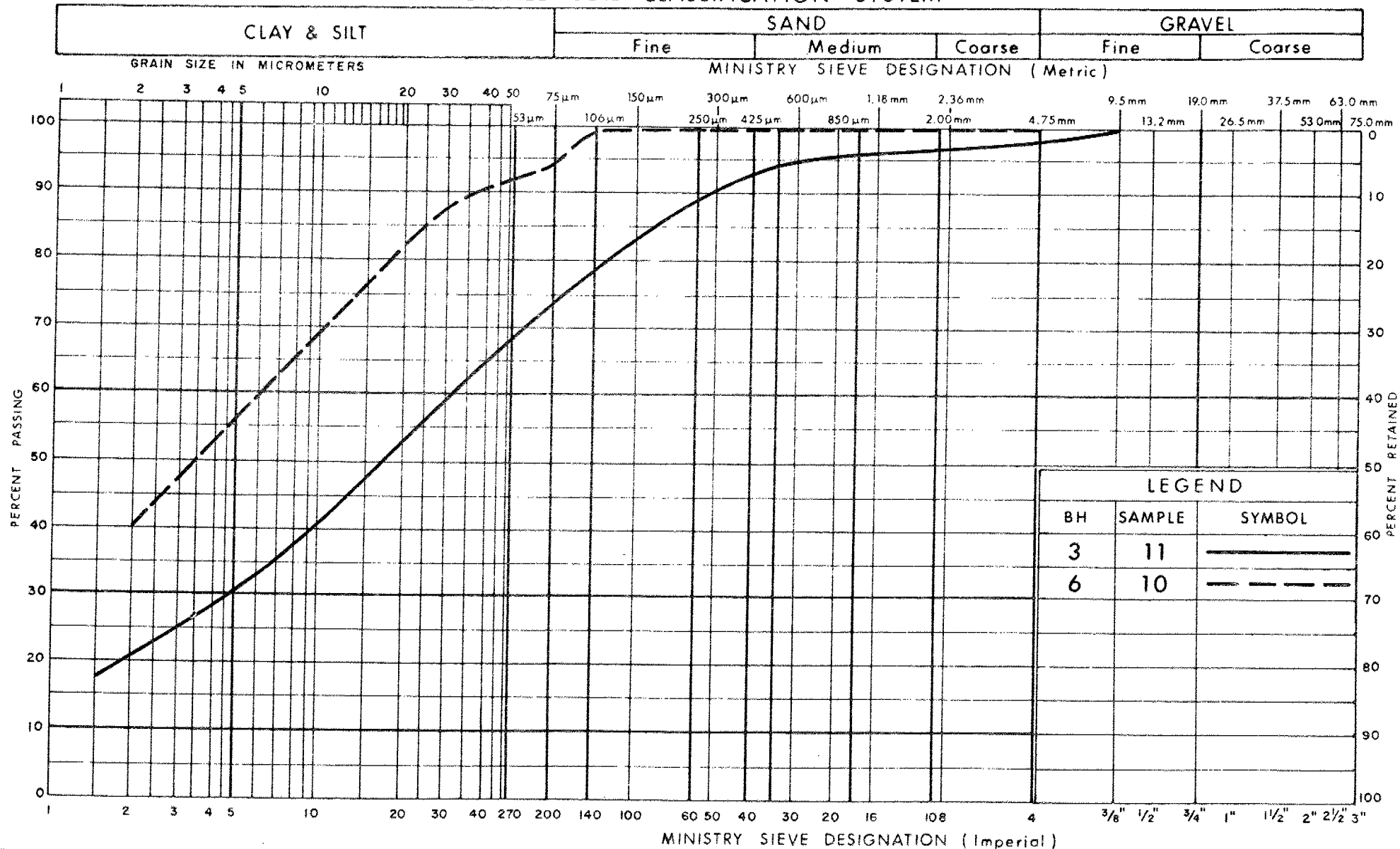
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Transportation and  
Communications

GRAIN SIZE DISTRIBUTION  
SILTY SAND TO SANDY SILT, TRACE OF GRAVEL

FIG No 4

W P 164-79-05

## UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION  
VARVED SILTY CLAY

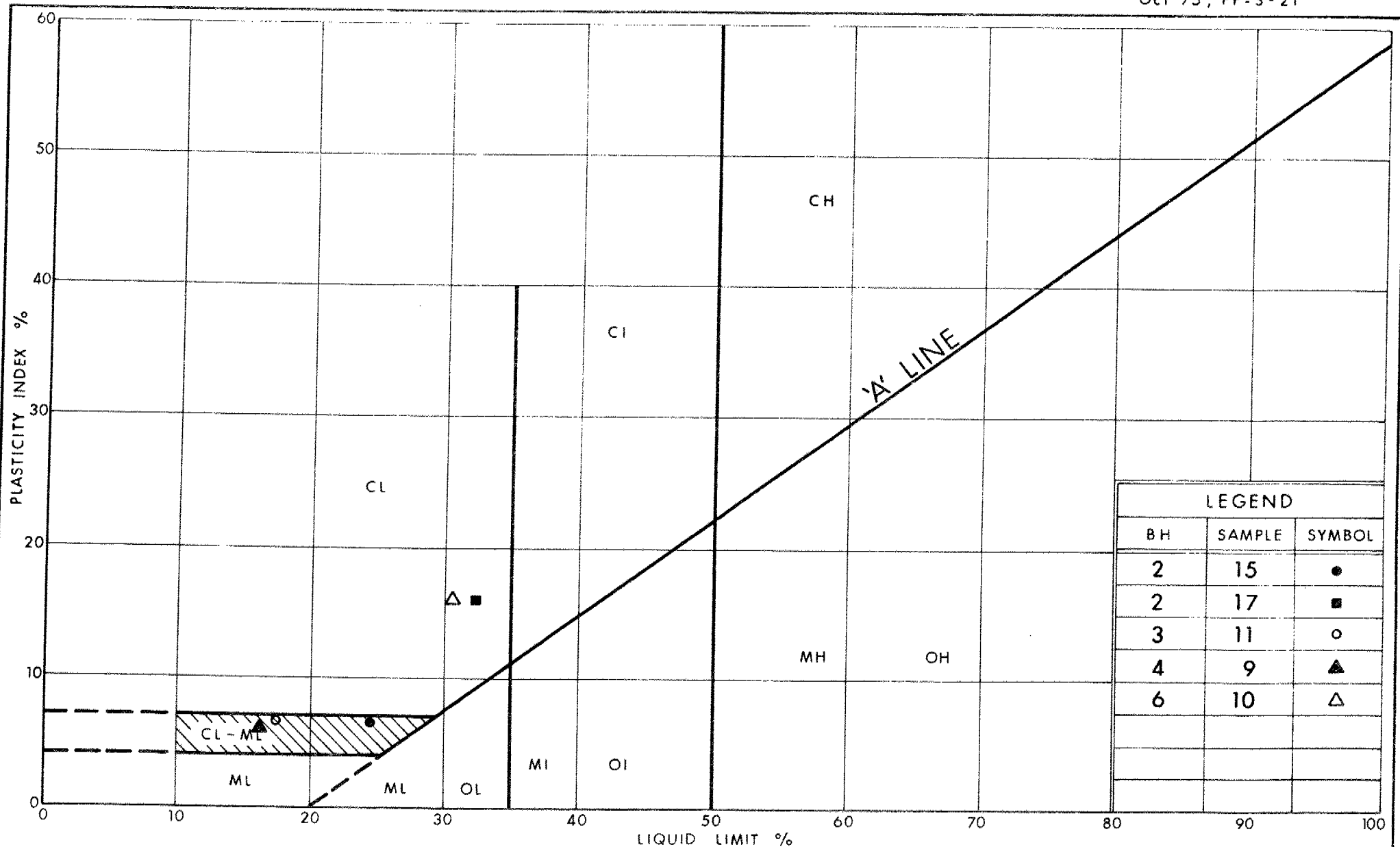
FIG No 5

W P 164-79-05



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## LEGEND

BH	SAMPLE	SYMBOL
2	15	•
2	17	■
3	11	○
4	9	▲
6	10	△



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Ontario

# PLASTICITY CHART VARVED SILTY CLAY

FIG No 6

W P 164-79-05

## FOUNDATION INVESTIGATION REPORT

For

Hwy 400 and Hwy 7, High Mast Lighting

W.P. 164-79-04/05, Site 37

District 6, Central RegionINTRODUCTION

This report summarizes the factual information obtained from a foundation investigation performed at the above-mentioned site between 1985-06-10 and 1985-06-14. The fieldwork consisted of advancing one borehole at each high mast lighting location. The boreholes included sampling the overburden at 0.75 m intervals down to 3.5 m and at 1.5 m intervals from 3.5 m down to the end of the borehole. Boreholes ranged from 6.2 m to 12.6 m in depth and all 18 boreholes were accompanied by cone penetration tests.

SITE DESCRIPTION

The site is in the area of the existing Hwy. 400 and Hwy 7 intersection in the Regional Municipality of York. The ground surface tends to slope to the South.

The site is located in the physiographic region known as the Peel Plain; which is described as "a level - to - undulating tract of clay soils".<sup>1</sup>

SUBSURFACE CONDITIONSGeneral

In general, reasonably uniform subsurface conditions with varying insitu consistency/denseness were encountered across the site. The surficial deposit of silty clay, trace to with sand, trace gravel with silty sand to sandy silt seams was encountered across the site. At the south end of the site this cohesive deposit was proven to be at least 12.6 m thick. At the north end of the site the silty clay was underlain by a non-cohesive deposit of sand some silt, trace clay, trace gravel in a very dense state. The boundaries between the soil types, insitu and laboratory tests results, and groundwater levels, are shown on the attached Record of Borehole Sheets. The locations of the borings are shown on Drawing 164790405-A. \*

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

<sup>1</sup>The Physiography of Southern Ontario 3rd Ed.

\* Refer to Sheet No. 265-1 of the Contract Drawings.

Silty Clay, trace to with Sand, trace Gravel

This cohesive material was encountered in all boreholes as the surficial deposit. At the South end of the site the deposit was shown to be up to 12.6 m thick. At the North end of the site the deposit was approximately 9 m thick and was underlain by a non-cohesive sand deposit.

The results of Atterberg Limits testing carried out on 12 samples of this material are plotted on Figure 1 in the appendix and can be summarized as follows:

	<u>Range</u>	<u>Average</u>	<u>Median</u>
w	8 to 20%	13%	12.5%
w <sub>L</sub>	17 to 43.5%	25%	23%
w <sub>p</sub>	10.5 to 19.5%	14 %	14%
I <sub>p</sub>	6.5 to 25%	11%	10%

This information indicates that this material is primarily a silty clay of low plasticity, (CL Group).

The results of grain size distribution testing are shown in envelope form on Figure 2. These results can be summarized as follows:

	<u>Range</u>	<u>Average</u>	<u>Median</u>
Gravel	0- 8%	3%	3%
Sand	1-34%	18%	18%
Silt	41-73%	52%	52%
Clay	15-56%	27%	25%

Based on this information this material is described as a silty clay, trace to with sand, trace gravel.

Interpretation of Standard Penetration test 'N' values indicates that this material has a firm to hard consistency. The material tends to become stiffer with depth and in general, the material becomes hard at 2 to 4 m below the ground surface.

Thin seams of silty sand to sandy silt were encountered within the silty clay, trace to with sand, trace gravel. The upper seam was encountered across the site in all holes with the exception of C-5, C-6, C-11, C-15, and C-17. In general this non-cohesive seam slopes to the south and thus it is approximately



parallel to the ground surface. At the north end of the site this seam is encountered at approximately Elev. 192 m and at the south end it is at approximately Elev. 187 m.

The result of one grain size distribution test done on a sample of this material is shown on Figure 3 and can be summarized as follows:

Gravel	0
Sand	1
Silt	97
Clay	2

Based on this information along with visual identification of other samples of this material this seam is made up of silty sand to sandy silt.

Interpretation of Standard Penetration Test 'N' values indicate this material is in a loose to very dense state.

#### Sand some Silt, trace Clay, Gravel

This material was encountered below the silty clay described above in 2 holes, C-7 and C-8, towards the northern end of the site.

No tests were carried out on this non-cohesive material.

Interpretation of Standard Penetration Test 'N' values ranging from 185 to 242 for 25 cm indicates this material to be in a very dense state.

#### Groundwater Conditions

Groundwater levels were determined by measuring in open boreholes. The groundwater elevation ranges from 189.7 m in borehole C-3 to 199.6 m in borehole C-11. In seven holes the stabilized water level was not established. In these cases the groundwater level may be assumed to be at ground surface.

Miscellaneous

The field work for this project was carried out under the supervision of Mr. F. Saccon, Project Foundations Engineer. The drilling equipment used was owned and operated by Atcost Soil Drilling Inc.

The report was written by Mr. I. Richardson, Student Engineer, under the supervision of Mr. D. Dundas, Foundations Engineer and reviewed by Mr. M. Devata, Chief Foundations Engineer (East).



*D. H. Dundas*

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

*M. Devata*

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

**APPENDIX**

# RECORD OF BOREHOLE No C1

METRIC

W P 164-79-04/05 LOCATION Co-ords. N 4 849 466; E 301 738 ORIGINATED BY FS  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers, Cone Test COMPILED BY FS  
 DATUM Geodetic DATE 85 06 12 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								
190.7	Ground Surface												
0.0	Silty Clay trace to with Sand trace Gravel Firm		1	SS	4		190						
	Very Stiff		2	SS	19		189						
			3	SS	15		188						
	Silty Sand to Sandy Silt Compact		4	SS	13		187						
	Hard		5	SS	81		186						
			6	SS	80		185						
			7	SS	128		184						
			8	SS	53		183						
181.1							182						
9.6	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

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

# RECORD OF BOREHOLE No C 2

METRIC

W P 164-79-04/05 LOCATION Co-ords. N 4 849 591; E 301 641 ORIGINATED BY FS  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers, Cone Test COMPILED BY FS  
 DATUM Geodetic DATE 85 06 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 <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
191.3	Ground Surface											
0.0	Silty Clay trace to with Sand trace Gravel Stiff to Very Stiff		1	SS	10		191					
			2	SS	22		190					
			3	SS	21		189					
	Silty Sand to Sandy Silt Loose		4	SS	5		188					
	Hard		5	SS	68		187					
			6	SS	128		186					
			7	SS	95		185					
			8	SS	102		184					
181.7	End of Borehole						183					
9.6							182					

OFFICE REPORT ON SOIL EXPLORATION

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

# RECORD OF BOREHOLE No C3

METRIC

W P 164-79-04/05

LOCATION Co-ords. N 4 849 710; E 301 612

ORIGINATED BY FS

DIST 6 HWY 400

BOREHOLE TYPE Solid Stem Augers, Cone Test

COMPILED BY FS

DATUM Geodetic

DATE 85 06 12

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								
192.1	Ground Surface											
0.0	Silty Clay trace to with Sand trace Gravel Stiff to Very Stiff		1	SS	8							
			2	TW	PH							
			3	SS	18							
	Silty Sand to Sandy Silt Compact		4	SS	15							
	Hard		5	SS	55							
			6	SS	143							
			7	SS	91							
			8	SS	65							
			9	SS	70							
179.5			10	SS	68							
12.6	End of Borehole											

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No C4

METRIC

W P 164-79-04/05 LOCATION Co-ords. N 4 849 754; E 301 763 ORIGINATED BY FS  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger, Cone Test COMPILED BY FS  
 DATUM Geodetic DATE 85 06 13 CHECKED BY *JP*

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 Wp	NATURAL MOISTURE CONTENT W	LIQUID LIMIT Wl	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES									
196.1	Ground Surface													
0.0	Silty Clay trace to with sand trace Gravel Very Stiff		1	SS	26		196							
			2	SS	28		195							
			3	SS	27		194							
	Silty Sand to Sandy Silt Dense		4	SS	49		193							
	Hard		5	SS	60		192							
			6	SS	126	/20cm	191							
							190							
							189							
188.4			7	SS	80	/8cm								
7.7	End of Borehole *groundwater level not established													

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No C 5

METRIC

W P 164-79-04/05 LOCATION Co-ords. N 4 849 857; E 301 597 ORIGINATED BY FS  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem, Cone Test COMPILED BY FS  
 DATUM Geodetic DATE 85 06 11 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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
195.7	Ground Surface												
0.0	Silty Clay trace to with Sand trace Gravel Stiff		1	SS	8								
	Very Stiff		2	SS	25								
			3	SS	27								
	Hard		4	SS	99								
			5	SS	160								
			6	SS	38								
187.6			7	SS	198								
8.1	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

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

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



# RECORD OF BOREHOLE No C 6

METRIC

W P 164-79-04/05 LOCATION Co-ords. N 4 849 995; E 301 695  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger, Cone Test  
 DATUM Geodetic DATE 85 06 13  
 ORIGINATED BY FS  
 COMPILED BY FS  
 CHECKED BY *JP*

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
198.9	Ground Surface												
0.0	Silty Clay trace to with Sand trace Gravel		1	SS	6		198						
			2	TW	PH		197						
			3	SS	10		196						
	Firm to Stiff		4	SS	13		195						
	Hard		5	SS	34		194						
			6	SS	65		193						
			7	SS	100	10cm	192						
191.2	End of Borehole												
7.7	*groundwater level not established												

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No C 7

METRIC

W P 164-79-04/05 LOCATION Co-ords. N 4 850 052; E 301 554  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers, Cone Test  
 DATUM Geodetic DATE 85 06 10  
 ORIGINATED BY FS  
 COMPILED BY FS  
 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						
197.3	Ground Surface													
0.0	Silty Clay trace to with Sand trace Gravel Firm to Very Stiff		1	SS	7	*	197							
			2	SS	15		196							
			3	SS	22		195							
			4	SS	26		194							
	Hard		5	SS	35		193							
			6	SS	131		191							
	Silty Sand to Sandy Silt		7	SS	68		190							
	Very Dense						189							
188.3			8	SS	203		188							
9.0	Sand some Silt trace Clay, Gravel Very Dense						187							
186.4			9	SS	242 / 25cm									
10.9	End of Borehole *groundwater level not established													

+3, x5: Numbers refer to  
Sensitivity


20  
15  
10


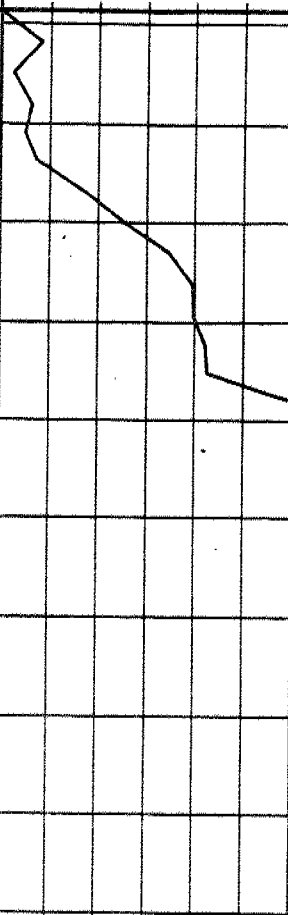
(%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No C 8

METRIC

W P 164-79-04/05 LOCATION Co-ords. N 4 850 173; E 301 521 ORIGINATED BY FS  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers, Cone Test COMPILED BY FS  
DATUM Geodetic DATE 85 06 10 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					
198.1	Ground Surface													
0.0	Silty Clay trace to with Sand trace Gravel Very Stiff						198							
			1	SS	17		197							
			2	SS	25		196							
			3	SS	30		195							
	Hard		4	SS	34		194							
			5	SS	72		193							
							192							
	Silty Sand to Sandy Silt Very Dense	6	SS	189 / 15 cm		191								
						190								
189.1							189							
9.0	Sand some Silt trace Clay, Gravel													
188.5	Very Dense		8	SS	185									
9.6	End of Borehole													
	*groundwater level not established													

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to  
Sensitivity


20  
15  
10

5 (% STRAIN AT FAILURE

RECORD OF BOREHOLE No C 9

METRIC

W P 164-79-04/05 LOCATION Co-ords. N 4 850 146; E 301 637  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger, Cone Test  
DATUM Geodetic DATE 85 06 14

ORIGINATED BY FS  
COMPILED BY FS  
CHECKED BY 

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								
198.4	Ground Surface												
0.0	Silty Clay trace to with Sand trace Gravel Very Stiff		1	SS	19		198						
			2	SS	19		197						
			3	SS	25		196						
	Silty Sand to Sandy Silt Dense		4	SS	30		195						
	Hard		5	SS	40		194						
			6	SS	72		193						
			7	SS	98		192						
			8	SS	112		191						
188.8	End of Borehole						190						
9.6	*groundwater level not established						189						

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No C 10

METRIC

W P 164-79-04/05 LOCATION Co-ords. N 4 850 297; E 301 587 ORIGINATED BY FS  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger, Cone Test COMPILED BY FS  
 DATUM Geodetic DATE 85 06 14 CHECKED BY *gfo*

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					
200.0	Ground Surface													
0.0	Silty Clay trace to with Sand trace Gravel Firm		1	SS	7									
			2	TW	PH									
			3	SS	37									
			4	SS	69									
			5	SS	126									
			6	SS	105									
			7	SS	80	15cm								
192.2	Silty Sand to Sandy Silt Very Dense													
7.8	End of Borehole													
	*groundwater level not established													

OFFICE REPORT ON SOIL EXPLORATION

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

# RECORD OF BOREHOLE No C 11

METRIC

W P 164-79-04/05 LOCATION Co-ords N 4 850 432; E 301 498 ORIGINATED BY FS  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers, Cone Test COMPILED BY FS  
 DATUM Geodetic DATE 85 06 10 CHECKED BY [Signature]

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> WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES						
199.9	Ground Surface										
0.0	Silty Clay trace to with Sand trace Gravel  Very Stiff ----- Hard		1	SS	17		199				
			2	SS	60		198				
			3	SS	90		197				
			4	SS	100		196				
			5	SS	88		195				
			6	SS	100	/15cm	194				
192.4							193				
7.5	Refusal due to probable boulder End of Borehole										

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No C 12

METRIC

W P 164-79-04/05 LOCATION N 4 849 773; E 301 323 ORIGINATED BY FS  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger, Cone Test COMPILED BY FS  
 DATUM Geodetic DATE 85 06 10 CHECKED BY *GP*

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								
193.2	Ground Surface												
0.0	Silty Clay trace to with Sand trace Gravel Very Stiff		1	SS	21		193						
			2	SS	18		192						
			3	TW	PH		191						
	Silty Sand to Sandy Silt Compact		4	SS	21		190						
	Hard		5	SS	99		189						
			6	SS	162		188						
	Silty Sand to Sandy Silt Very Dense		7	SS	224		187						
185.1							186						
8.1	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

RECORD OF BOREHOLE No C 13

METRIC

W P 164-79-04/05 LOCATION Co-ords. N 4 849 678; E 301 516 ORIGINATED BY FS  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers, Cone Test COMPILED BY FS  
DATUM Geodetic DATE 85 06 11 CHECKED BY *JP*

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	SHEAR STRENGTH					
191.9	Ground Surface													
0.0	Silty Clay trace to with Sand trace Gravel Stiff to Very Stiff		1	SS	11		191							
			2	SS	28		190							
			3	TW	PH		189							
	Silty Sand to Sandy Silt Compact		4	SS	13		188							
	Hard		5	SS	54		187							
			6	SS	135		186							
			7	SS	95		185							
183.8							184							
8.1	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No C 14

METRIC

W P 164-79-04/05 LOCATION Co-ords. N 4 849 793; E 301 459 ORIGINATED BY FS  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers, Cone Test COMPILED BY FS  
 DATUM Geodetic DATE 85 06 11 CHECKED BY *FS*

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								
192.2	Ground Surface											
0.0	Silty Clay trace to with Sand trace Gravel Stiff to Very Stiff		1	SS	10							
			2	SS	21							
	Silty Sand to Sandy Silt Very Dense		3	SS	72							
	Hard		4	SS	73							
			5	SS	154							
			6	SS	145							
184.4	Silty Sand to Sandy Silt Very Dense		7	SS	125	15cm						
7.8	End of Borehole											

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No C 15

METRIC

W P 164-79-04/05 LOCATION Co-ords. N 4 849 945; E 301 492 ORIGINATED BY FS  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers, Cone Test COMPILED BY FS  
 DATUM Geodetic DATE 85 06 10 CHECKED BY *JP*

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					
196.2	Ground Surface													
0.0	Silty Clay trace to with Sand trace Gravel						196							
	Firm		1	SS	4		195							
			2	SS	25		194							
			3	TW	PH		193							
			4	SS	13		192							
	Stiff to Very Stiff						191							
	Hard		5	SS	110		190							
			6	SS	100		189							
			7	SS	85		188							
186.9			8	SS	60	15cm	187							
9.3	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

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

# RECORD OF BOREHOLE No C 16

METRIC

W P 164-79-04/05 LOCATION Co-ords. N 4 849 882; E 301 774  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers, Cone Test  
 DATUM Geodetic DATE 85 06 13  
 ORIGINATED BY FS  
 COMPILED BY FS  
 CHECKED BY *SP*

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					
197.0	Ground Surface													
0.0	Silty Clay trace to with Sand trace Gravel Very Stiff		1	SS	22		196							
	Hard		2	SS	40		195							
			3	SS	34		194							
			4	SS	68		193							
	Silty Sand to Sandy Silt Very Dense		5	SS	220	/33cm	192							
190.8			6	SS	100	/15cm	191							
6.2	End of Borehole *groundwater level not established													

OFFICE REPORT ON SOIL EXPLORATION

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

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

# RECORD OF BOREHOLE No C 17

METRIC

W P 164-79-04/05 LOCATION N 4 850 028; E 301 885 ORIGINATED BY FS  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger, Cone Test COMPILED BY FS  
 DATUM Geodetic DATE 85 06 14 CHECKED BY [Signature]

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>	WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER TYPE N' VALUES							
198.2	Ground Surface									
0.0	Silty Clay trace to with Sand trace Gravel Stiff		1 SS 8		198					
			2 SS 8		197					
	Very Stiff		3 SS 20		196					
			4 SS 28		195					
	Hard		5 SS 93		194					
			6 SS 53		193					
			7 SS 73		192					
			8 SS 42		191					
			9 SS 77		190					
			10 SS 82		189					
185.6					188					
12.6	End of Borehole				187					
					186					

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

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No C 18

METRIC

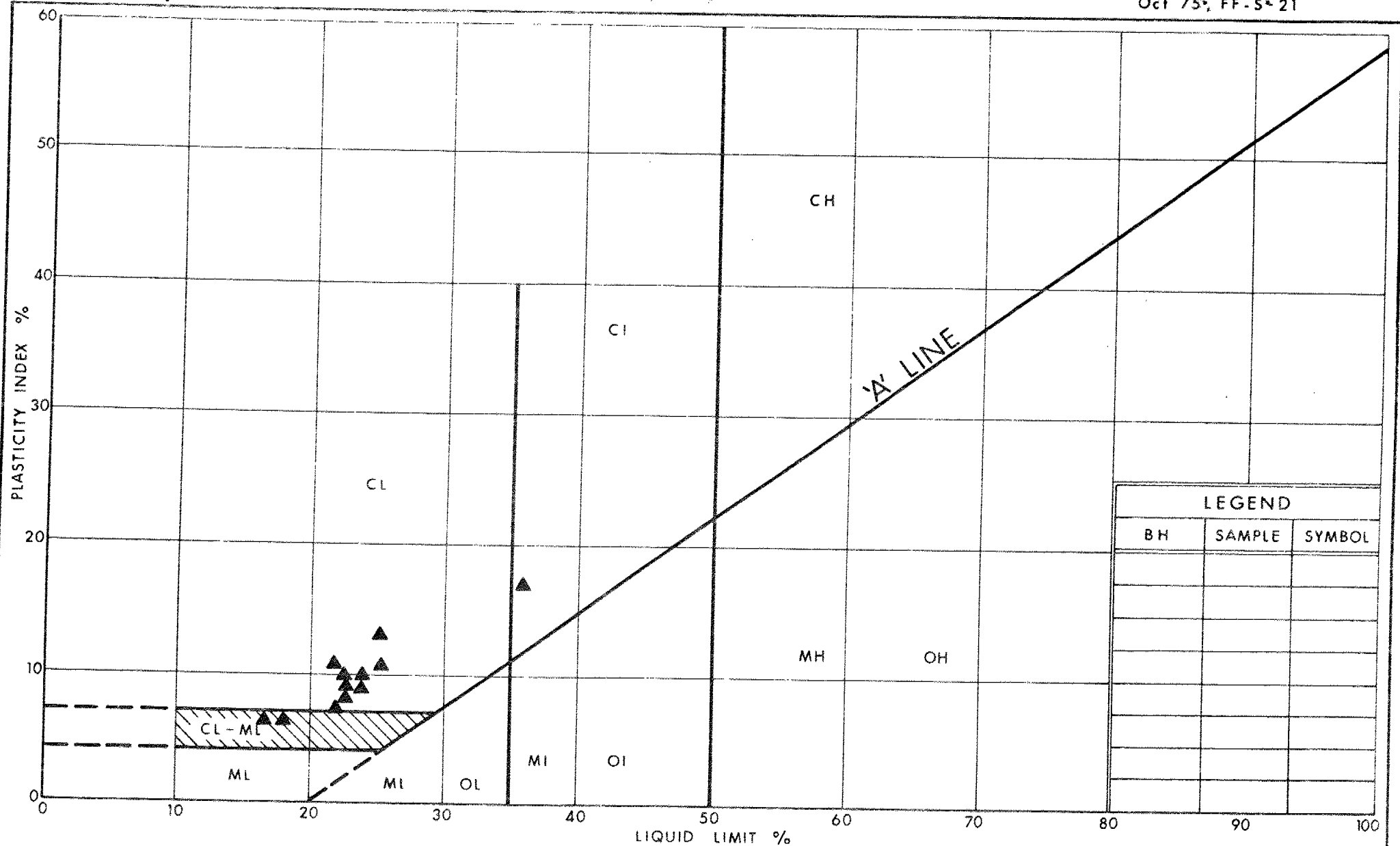
W P 164-79-04/05 LOCATION Co-ords. N 4 850 045; E 301 462 ORIGINATED BY FS  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers, Cone Test COMPILED BY FS  
 DATUM Geodetic DATE 85 06 10 CHECKED BY CP

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> 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						
195.2	Ground Surface										
0.0	Silty Clay trace to with Sand trace Gravel Stiff to Very Stiff		1	SS	12	*	195				
			2	SS	24		194				
	Silty Sand to Sandy Silt Very Dense		3	SS	70		193				2 20 52 26
	Hard		4	SS	108		192				8 16 54 22
			5	SS	46		191				
			6	SS	36		190				
			7	SS	29		189				1 11 65 23
	Silty Sand to Sandy Silt Compact		8	SS	74		188				
			9	SS	55		187				
			10	SS	70		186				4 32 49 15
182.6	End of Borehole						185				
12.6	*groundwater level not established						184				
							183				4 29 51 16

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

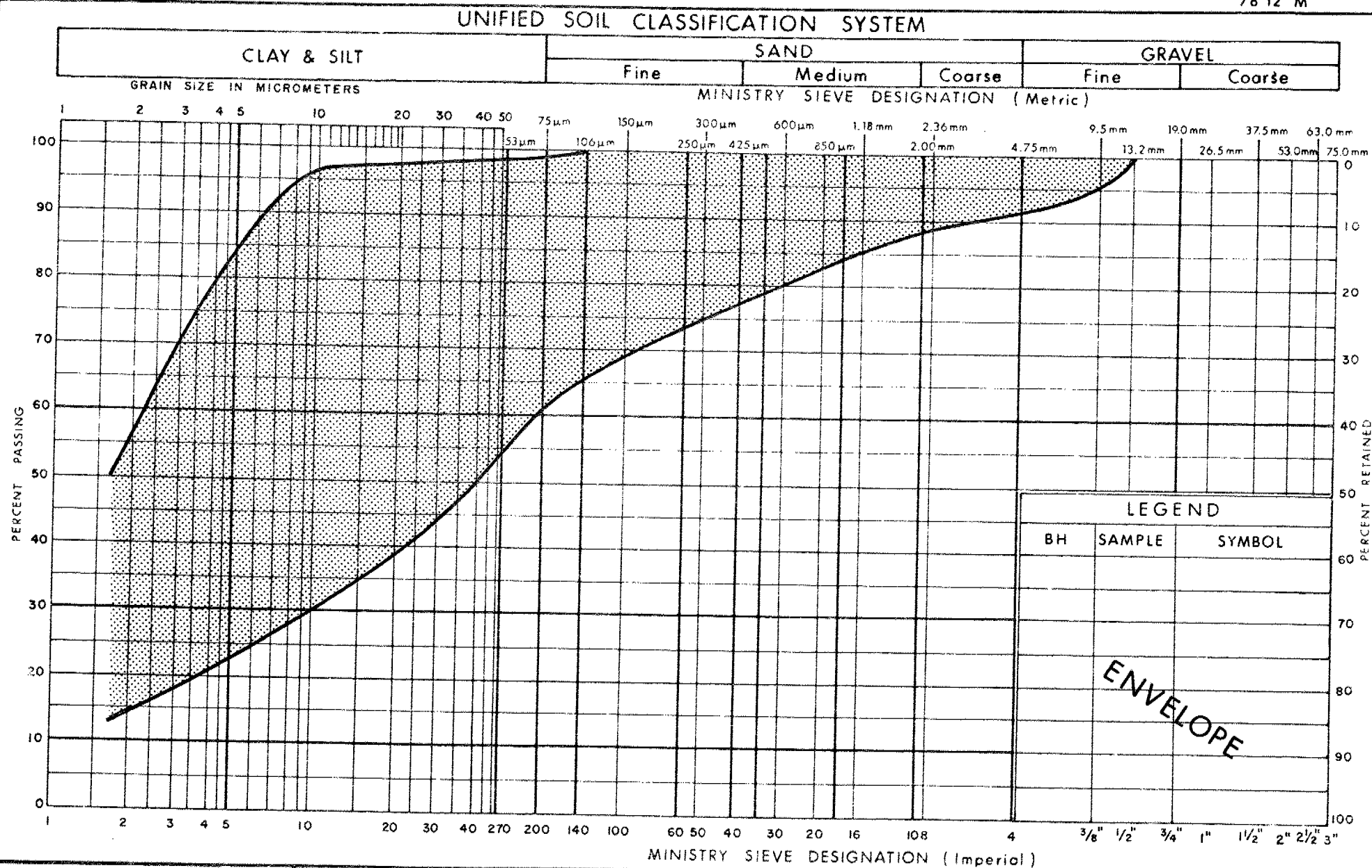


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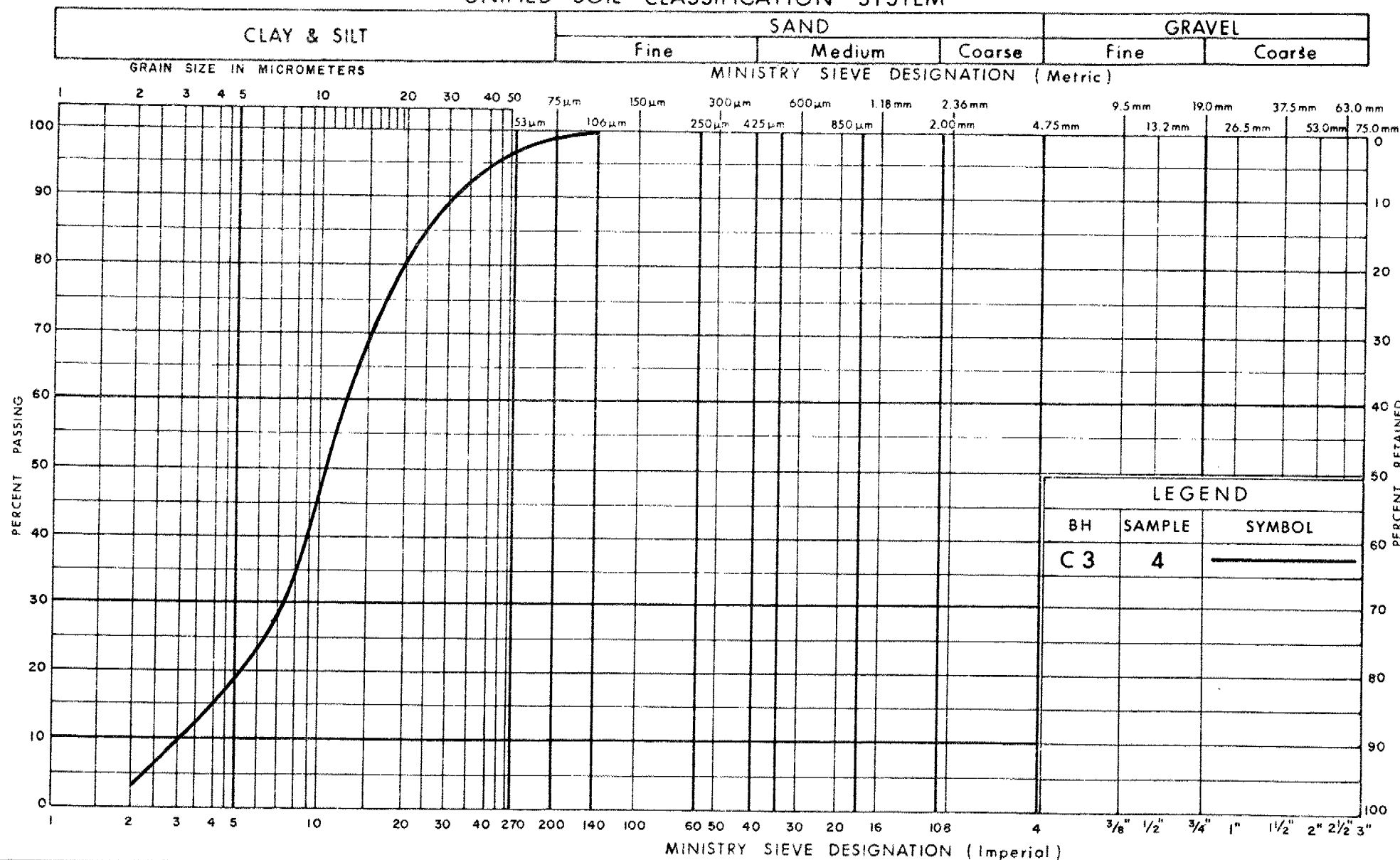
# PLASTICITY CHART SILTY CLAY TRACE TO WITH SAND TRACE OF GRAVEL

FIG No 1

W P 164-79-04/05



## UNIFIED SOIL CLASSIFICATION SYSTEM



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Communications

GRAIN SIZE DISTRIBUTION

SAND, SOME SILT TRACE OF GRAVEL & CLAY

FIG No 3

W P 164-79-04/05



ENGINEERING MATERIALS OFFICE  
PAVEMENT & FOUNDATION DESIGN SECTION

WP 164-79-05 DIST 6  
HWY 400 STR SITE 37-125

Hwy. 7 Underpass Replacement Structure

DISTRIBUTION

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# FOUNDATION INVESTIGATION REPORT

For

Hwy. 7 Underpass Replacement Structure

W.P. 164-79-05, Site 37-125

Hwy. 400, District 6, Toronto.

## INTRODUCTION:

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

The fieldwork was carried out between 82 08 16 and 82 08 25 and consisted of 12 sampled boreholes, 7 accompanied by dynamic cone penetration tests, advanced by means of hollow and solid stem continuous flight augers. Borings were continued for depths ranging from 8.1 metres to 29.5 metres.

## Site Description and Geology

The relocated underpass site is located immediately north of the present crossing of Hwy. 400/7 within the Regional Municipality of York. The existing underpass is a 33 x 18 metre single span rigid frame structure with full height abutments and shows no signs of obvious structural distress.

Physiographically, the site is located within the "Peel Plain" region which is characterized by bevelled till plains composed of level to undulating tracts of clay soils. Much of the plain has been modified by a veneer of clay which, when deep enough, takes on a varved appearance. In various locals, ancient stream valleys are bordered by trains of sandy alluvium.

Bedrock consisting of the Georgian Bay Foundation, Upper Ordovician Period is located at depths in excess of 60 metres at this site.

### Subsurface Conditions

In general, reasonably uniform subsurface conditions with varying insitu consistency/denseness were encountered across the site. The area is covered by a man-made fill ranging from reworked parent till material to construction debris for a maximum thickness of 4.0 metres. Underlying the fill and encountered for a maximum thickness of 10.5 metres is a cohesive glacial till deposit composed of silty clay with varying amounts of sand. A non cohesive silty sand to sandy silt deposit was encountered immediately below the till deposit. This fine granular deposit was underlain by a varved deposit of silty clay.

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 a simplified stratigraphical summary are shown on Drawing No. 1647905-A. Six sections showing detailed stratigraphy based on borehole data are shown on Drawing No. 1647905-B. These drawings should be read in conjunction with the borehole sheets and this report.

The various soil types encountered are described in detail as follows:

#### Fill Material

Embankment and interchange fill material was found overlying the site for thickness ranging from 0.6 to 4.0 metres. This fill material is composed of a reworked silty clay and sand to a sandy clay some gravel which appears to be derived from the parent glacial till of the area. In addition, a boring at the proposed east abutment location encountered construction debris consisting of slabs of asphalt and gravel. Apparently, this debris was graded into the slopes inside the loops of the existing interchange, predominately in the North-East locale. Two typical grain size distribution curves for this surficial deposit are plotted on Figure 1 of the appendix.

Based on interpretation of Standard Penetration Test 'N' values and augering operations, the fill material is assessed as having undergone a moderate degree of compactive effort.

Silty Clay, Sand, and Gravel (Glacial Till)

The natural surficial deposit encountered across the site is a cohesive glacial till composed of silty clay of low plasticity with varying amounts of sand and a trace of gravel. Typical gradation curves from representative samples of this deposit are plotted in envelope form on figure 2. A distinct layer of sandy silt to silty sand was encountered in most borings between elevations 190 and 192, in addition to the occasional fine granular layers throughout this deposit.

As a result of previous construction activity, the upper surface of this till is often reworked and difficult to distinguish from the overlying derived embankment fill material.

Results of water content and Atterberg Limit testing on representative samples from this till deposit are plotted on the Plasticity Chart (Figure 3) and summarized as follows:

		<u>Range</u>	<u>Average</u>
Water Content	(w) %	7-21	13
Liquid Limit	(W <sub>L</sub> ) %	16-39	24
Plastic Limit	(W <sub>p</sub> ) %	11-20	13
Plasticity Index (I <sub>p</sub> )	%	5-20	10

These results generally indicate the matrix of the cohesive till deposit to be an inorganic silty clay of low plasticity (CL).

Based on interpretation of Standard Penetration Test 'N' values ranging from 12 to in excess of 100 blows per 0.3 metres and augering operations through this deposit, the consistency for this glacial till ranges from stiff to hard.

### Silty Sand to Sandy Silt

The cohesive till deposit is underlain by a fine grained glaciolacustrine deposit consisting of silty sand to sandy silt with a trace of gravel. This deposit was encountered for thicknesses ranging from 3.1 metres to 7.2 metres. Two typical grain size distribution curves for this deposit are shown on Figure No. 4. Occasional seams and zones of silty clay were encountered within this deposit.

Interpretation of Standard Penetration Test 'N' values which ranged from 12 to in excess of 100 blows per 0.3 metres but generally greater than 30 blows/0.3 metres, indicates the denseness for this deposit to range from compact to very dense, but generally dense to very dense throughout.

### Varved Silty Clay

Underlying the fine grained glaciolacustrine deposit and explored for a maximum thickness of 14.1 metres is a varved silty clay deposit consisting alternating bands of low and intermediate plasticity silty clays, with a trace of sand. The upper transition portion of this deposit exhibited a higher sand content where it grades from the overlying fine granular stratum. Two grain size distribution curves, one indicating the higher transitional sand content, are shown on Figure 5.

The results of Atterberg Limit and water content testing are plotted on the plasticity chart, Figure 6. Although not truly representative of the relative plasticity of the individual varves due to the mixing of the material during testing, visual examination indicates the alternating bands to consist of low plasticity (CL-ML) and intermediate plasticity (CL-CI) silty clays.

Interpretation of Standard Penetration Test 'N' values and augering operations suggests a hard consistency for this deposit.

Groundwater Condition

Based on water level readings taken in open boreholes over a period of time during the field investigation, a perched water table exists within the relatively impermeable silty clay till deposit which varies between elevations 194 and 197, dipping at a shallow gradient to the south. These levels are expected to fluctuate accordingly, depending on the time of year and relative rainfall conditions.

In addition, subartesian conditions can be assumed within the silty sand to sandy silt deposit based on this fine granular material 'boiling up' within the augers during borehole advancement operations.

## DISCUSSION AND RECOMMENDATIONS

As part of the reconstruction of Hwy. 7 to accommodate the proposed Hwy. 407 traffic movement and volumes, it is proposed to replace the existing Hwy. 400/7 structure with a 5 span (34-26-50-26-34 metre) by 36 metre wide structure. A slight shift of alignment, 40 metres to the north, will necessitate maximum approach fill heights in the order of 6.5 metres. These geometries will accommodate future Hwy. 400 collector and Hwy. 407/400/7 ramp lanes.

In consideration of the variable strength/deformation characteristics of the underlying glacial deposits, recommendations pertaining to the foundations of the new structure and related earthworks are summarized as follows:

### Structure Foundations

Both perched abutment and pier elements should be founded on deep foundation units driven to endbearing in the highly competent lower glacial deposits. For steel 'H' section piles driven to a minimum set of 15 blows per 25 mm for the final 75 mm of placement using a diesel hammer rated at a minimum driving energy of 48,000 joules/blow, the following O.H.B.D.C. parameters are suggested.

<u>Pile Type</u>	<u>Factored Capacity at U.L.S. (kN)</u>	<u>Capacity at S.L.S. Type II (kN)</u>	<u>Ultimate Capacity (kN)</u>
310 HP 79	1250	800	2400
310 HP 110	1600	980 1160	2940

Pile driving should be controlled in the field through the use of the M.T.C. Modified Hiley Formula (Standard SS 103-11).

For design estimating purposes, theoretical pile embedment lengths can be calculated assuming the following anticipated tip elevations.

<u>Pile Location</u>	<u>Estimated Tip Elevation</u>
West Abutment (north end)	179
(south end)	188
Pier 1 (north end)	175
(south end)	188
Pier 2 (north end)	175
(south end)	181
Pier 3 (north end)	187
(south end)	188
Pier 4 (north end)	189
(south end)	191
East Abutment (north end)	191
(south end)	192

#### Other Considerations

All existing fill, organic, and softened material within the planned limits of the abutment and pier pile caps, and the immediate approaches should be subexcavated for their full depth, backfilled and compacted prior to new fill placement and pile driving operations.

Fill material placed within the zone of pile penetration in the approaches must be restricted to a maximum grain size of 75 mm.

The underside of all abutment and pier caps or footings should be provided with a minimum 1.25 metres of earth cover for frost protection purposes.

Earth pressures against the back of the abutment wall should be computed as per Subsection 6.6.1.2.2 of the O.H.B.D.C. Manual, with provisions made for adequate drainage.



Use of heavy vibratory compaction equipment must be restricted in the area immediately behind the abutment and retaining structures as per current M.T.C. directives.

No major dewatering difficulties are anticipated for pile cap or footing excavations in consideration of the relatively low permeability of the glacial till deposit. Localized seepage into excavations can be controlled by perimeter ditches and pumping from corner sumps.

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

#### MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Mr. D. Wismath, Student Field Technician, utilizing equipment owned and operated by Masters Soil, Toronto. This report was written by Mr. T. J. Kazmierowski, Foundations Engineer and reviewed by Mr. M. Devata, Senior Foundations Engineer.



T. J. Kazmierowski, P. Eng.,  
Project Foundations Engineer

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

## A P P E N D I X

# RECORD OF BOREHOLE No 1

METRIC

W P 164-79-05 LOCATION Co-ords. N 4 849 892.8; E 301 535.5 ORIGINATED BY D.W.  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY T.J.K.  
DATUM Geodetic DATE 82 08 16 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 (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH						WATER CONTENT (%)
198.4	Ground Surface							○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    x LAB VANE	10 20 30					GR SA SI CL	
0.0	(Fill)		1	SS	11										
	Silty Clay and Sand		2	SS	4		196								26 46 22 6
	varying amounts of Gravel		3	SS	9										
194.4			4	SS	12										
4.0	organic		5/6	SS	8										
	(Glacial Till)		7	SS	12										
	Silty Clay with Silty Sand		8	SS	37										1 19 55 25
	varying amounts of Sand		9	SS	100/13 cm										1 37 49 13
	Trace of Gravel		10	SS	100/28 cm										
187.3	Stiff to Hard		11	SS	100										
11.1	End of Borehole														
	Note: Borehole caved at 8.0 m														

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 2

METRIC

W P 164-79-05 LOCATION Co-ords. N 4 849 935.0; E 301 563.0 ORIGINATED BY D.W.  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY D.W.  
DATUM Geodetic DATE 82 08 16 and 17 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>
								SHEAR STRENGTH						
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE							
196.2	Ground Surface											GR SA SI CL		
0.0	(Fill) Silty Clay, some Sand, Trace of Gravel & Organics		1	SS	14		196							
194.8			2	SS	21		194					4 29 48 19		
1.4	(Glacial Till)		3	SS	22									
	Brown		4	SS	20									
	Grey Silty Sand		5	SS	39		192					18 40 36 6		
	Silty Clay Varying amounts of Sand Trace of Gravel Very Stiff to Hard		6	SS	20									
			7	SS	31		190							
188.0			8	SS	49									
8.2	Grey		9	SS	37		188							
	Silty Sand to Sandy Silt		10	SS	25		186							
	Trace of Gravel		11	SS	12		184							
	Occ. zones and layers of Silty Clay													
	Compact to Dense						182							
180.8			12	SS	58		180							
15.4	Grey		13	SS	100/	26 cm	178							
	Varved		14	SS	43		176							
	Silty Clay with alternating bands of low and intermediate plasticity brittle texture		15/16	SS	100/	28 cm	174							
	Hard		17	SS	64		172							
			18	SS	100/	29 cm	170							
							168							
166.7			19	SS	85									
29.5	End of Borehole Note: Borehole													

+3, x5; Numbers refer to Sensitivity 20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 3

METRIC

W P 164-79-05 LOCATION Co-ords. N 4 849 911.3; E 301 593.0 ORIGINATED BY D.W.  
DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auguer & Cone Test COMPILED BY T.J.K.  
DATUM Geodetic DATE 82 08 18 CHECKED BY CP.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
196.7	Ground Surface													
0.0	(Fill) Silty Clay with organics, some Sand, Trace of Gravel		1	SS	17		196							
195.3			2	SS	34									
1.4	(Glacial Till)		3	SS	30									
	Brown Silty Sand		4	SS	38									
	Grey Silty Clay with varying amounts of Sand Trace of Gravel		5	SS	100/	20 cm								
			6	SS	100/	28 cm	192							
			7	SS	78									
189.4	Hard						190							
7.3	Grey		8	SS	85									
	Silty Sand to Sandy Silt Trace of Gravel Occ. zones and layers of Silty Clay		9	SS	32		188							
			10	SS	100/	26 cm	186							
184.8	Dense to Very Dense													
11.9	with Sand		11	SS	82		184							
	Grey Varved Silty Clay with bands of low to intermediate plasticity Trace of Sand		12	SS	100/	26 cm	182							
							180							
178.0	Hard		13	SS	100/	23 cm								
18.7	End of Borehole													
	Note: Borehole caved at 8.7 m													

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

20  
15 5 (%) STRAIN AT FAILURE  
10



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# RECORD OF BOREHOLE No 4

METRIC

W P 164-79-05

LOCATION Co-ords. N 4 849 928.5; E 301 529.3

ORIGINATED BY D.W.

DIST 6 HWY 400

BOREHOLE TYPE Solid Stem Auger & Cone Test

COMPILED BY T.J.K.

DATUM Geodetic

DATE 82 08 19

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				
197.0	Ground Surface														
0.0	(Fill) Silty Clay and Sand, Some Gravel														
194.9			1	SS	25										
2.1	(Glacial Till)														
			2	SS	21										
	Brown Grey Silty Sand		3	SS	94										
	Silty Clay with Varying amounts of Sand		4	SS	20										
	Trace of Gravel		5	SS	39										
	Very Stiff to Hard		6	SS	85										
187.2															
9.8	Grey														
	Silty Sand to Sandy Silt		7	SS	61										
	Trace of Gravel		8	SS	28										
	Occ. zones of Silty Clay														
	Compact to Very Dense														
181.7															
15.3	Grey		9	SS	100/	21 cm									
	Varved Silty Clay with bands of low to intermediate plasticity		10	SS	100/	23 cm									
	Hard														
175.2															
			11	SS	100										
21.8	End of Borehole														
	Note: Borehole caved at 8.0 m														

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



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# RECORD OF BOREHOLE No 5

METRIC

W P 164-79-05 LOCATION Co-ords. N 4 849 901.8; E 301 568.3 ORIGINATED BY D.W.  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY T.J.K.  
DATUM Geodetic DATE 82 08 19 and 20 CHECKED BY *JP*

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	100					
198.2	Ground Surface													GR SA SI CL
0.0	Fill						198							
	Silty Clay and Sand		1	SS	9		196							
	Some Gravel													
194.9	(Glacial Till)		2/3	SS	12		194							
3.3	Silty Clay with Varying amounts of Sand		4	SS	30		192							5 36 51 8
	Trace of Gravel		5	SS	100/18 cm		190							1 9 53 37
	Sandy Silt		6	SS	80		188							
	Brown		7	SS	100/20 cm		186							
	Grey													
188.2	Very Stiff to Hard													
10.0	Grey Silty Sand to Sandy Silt Trace of Gravel		8	SS	100/26 cm									
	Very Dense		9	SS	100/10 cm									
185.1	Silty Clay													
13.1	Trace of Sand Hard		10	SS	100/20 cm									
184.1	End of Borehole													
14.1	Note: Borehole caved at 5.8 m													

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



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# RECORD OF BOREHOLE No 6

METRIC

W P 164-79-05 LOCATION Co-ords. N 4 849 932.7; E 301 587.2 ORIGINATED BY D.W.  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY T.J.K.  
DATUM Geodetic DATE 82 08 20 and 23 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					
196.9	Ground Surface																GR SA SI CL
0.0	Fill						196										
	Silty Sand																
195.0	Some Gravel		1	SS	8												
1.9	Organics																
	(Glacial Till)		2	SS	32		194										
	Brown																
	Grey		3	SS	17		192										4 35 41 20
	Silty Clay with varying amounts of Sand		4	SS	14		190										
	Silty Sand		5	SS	100/	10 cm											6 44 44 6
	Trace of Gravel																
186.8	Stiff to Hard		6	SS	48		188										
10.1	Grey																
	Silty Sand to Sandy Silt		7	SS	64		186										
	Trace of Gravel																
	Occ. zones and layers of Silty Clay		8	SS	21		184										
	Compact to Very Dense																
181.3			9	SS	66		182										
15.6	Grey Varved Silty Clay with bands of low to intermediate plasticity																
	Trace of Sand		10	SS	100/	18 cm	178										0 6 55 39
	Hard																
			11	SS	94		176										
							174										
172.1			12	SS	100/	28 cm											
24.8	End of Borehole																
	Note: Borehole caved at 4.7 m																

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No 7

METRIC

W P 164-79-05 LOCATION Co-ords. N 4 849 954.2; E 301 637.2 ORIGINATED BY D.W.  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY D.W.  
DATUM Geodetic DATE 82 08 23 and 24 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								
196.8	Ground Surface												
0.0	Fill												
196.2	(Glacial Till)		1	SS	19		196						
0.6			2	SS	32								
			3	SS	33								
	Brown		4	SS	70		194						10 24 39 27
	Grey		5	SS	42								
	Silty Clay with Varying Amounts of Sand		6	SS	90		192						
	Trace of Sandy Gravel Silt		7	SS	100		190						3 27 62 8
			8	SS	100/	26 cm							
	Very Stiff to Hard		9	SS	100/	28 cm	188						0 6 54 40
185.7			10	SS	100/	26 cm	186						
11.1	End of Borehole												
	Note: Borehole caved at 5.9 m												

# RECORD OF BOREHOLE No 8

METRIC

W P 164-79-05 LOCATION Co-ords. N 4 849 928.3; E 301 667.2 ORIGINATED BY D.W.  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY T.J.K.  
DATUM Geodetic DATE 82 08 24 CHECKED BY

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								
198.5	Ground Surface											
0.0	Fill											
	Silty Clay and Sand		1	SS	4							
196.7	Trace of Gravel		2	SS	10							
1.8	(Glacial Till)		3	SS	12							6 32 42 20
	Silty Clay with		4	SS	21							3 33 45 19
	Varying Amounts		5	SS	31							
	of Sand		6	SS	100/	16 cm						5 39 46 10
	Sandy Silt		7	SS	100/	20 cm						
	Brown Grey		8	SS	100/	29 cm						
	Trace of Gravel		9	SS	100/	20 cm						
190.0	Stiff to Hard											
8.5	Silty Fine Sand											
189.0	Very Dense											
9.5	End of Borehole											

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

# RECORD OF BOREHOLE No 9

METRIC

W P 164-79-05 LOCATION Co-ords. N 4 849 967.0; E 301 696.5 ORIGINATED BY D.W.  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY T.J.K.  
DATUM Geodetic DATE 82 08 24 CHECKED BY @.

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 Wp	NATURAL MOISTURE CONTENT W	LIQUID LIMIT Wl	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
200.0	Ground Surface												
0.0	Fill Silty Clay and Sand Trace of Gravel		1	SS	21		198						
197.9	(Glacial Till) Silty Clay with Varying amounts of Sand Trace of Gravel Very Stiff to Hard		2	SS	14		196						
			3	SS	48								
			4	SS	100	28 cm	194						
			5	SS	100	29 cm	192						
			6	SS	100	13 cm	190						
189.0			7	SS	100	19 cm							
11.0	End of Borehole Note: Borehole caved at 4.9 m												

+3, x5: Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 10

METRIC

W P 164-79-05 LOCATION Co-ords. N 4 849 926.6; E 301 642.0 ORIGINATED BY D.W.  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY T.J.K.  
DATUM Geodetic DATE 82 08 25 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					
196.7	Ground Surface																
0.0	Fill					*	196										
195.8																	
0.9	(Glacial Till) Silty Clay with Varying amounts of Sand, Trace of Gravel		1	SS	20		194										10 33 38 19
			2	SS	100	23 cm											5 37 51 7
			3	SS	100	10 cm	192										1 18 67 14
			4	SS	55		190										
	alternating layers of Silty Fine Sand		5	SS	100												
			6	SS	100	28 cm	188										
	Hard		7	SS	100	23 cm	186										
185.6																	
11.1	End of Borehole Note: Borehole caved at 0.5 m.  * Water Level not Established																

# RECORD OF BOREHOLE No 11

METRIC

W P 164-79-05 LOCATION Co-ords. N 4 849 959.5; E 301 662.0 ORIGINATED BY D.W.  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY T.J.K.  
DATUM Geodetic DATE 82 08 25 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				NATURAL MOISTURE CONTENT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W <sub>p</sub>	W		
198.7	Ground Surface															
0.0	Fill		1	SS	8											
196.9	Silty Clay and Sand Trace of Gravel		2	SS	11											
1.8	(Glacial Till)		3	SS	14											
	Silty Clay with Varying Amounts of Sand		4	SS	41											
	Brown		5/6	SS	75											
	Grey		7	SS	69											
	Trace of Gravel		8	SS	100/	20 cm										
	Stiff to Hard		9	SS	100/	18 cm										
189.2	End of Borehole															
9.5	Note: Borehole caved at 6.9 m															

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

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



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Communications  
Ontario

# RECORD OF BOREHOLE No 12

METRIC

W P 164-79-05 LOCATION Co-ords. N 4 849 937.7; E 301 700.5 ORIGINATED BY D.W.  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY T.J.K.  
DATUM Geodetic DATE 82 08 25 CHECKED BY

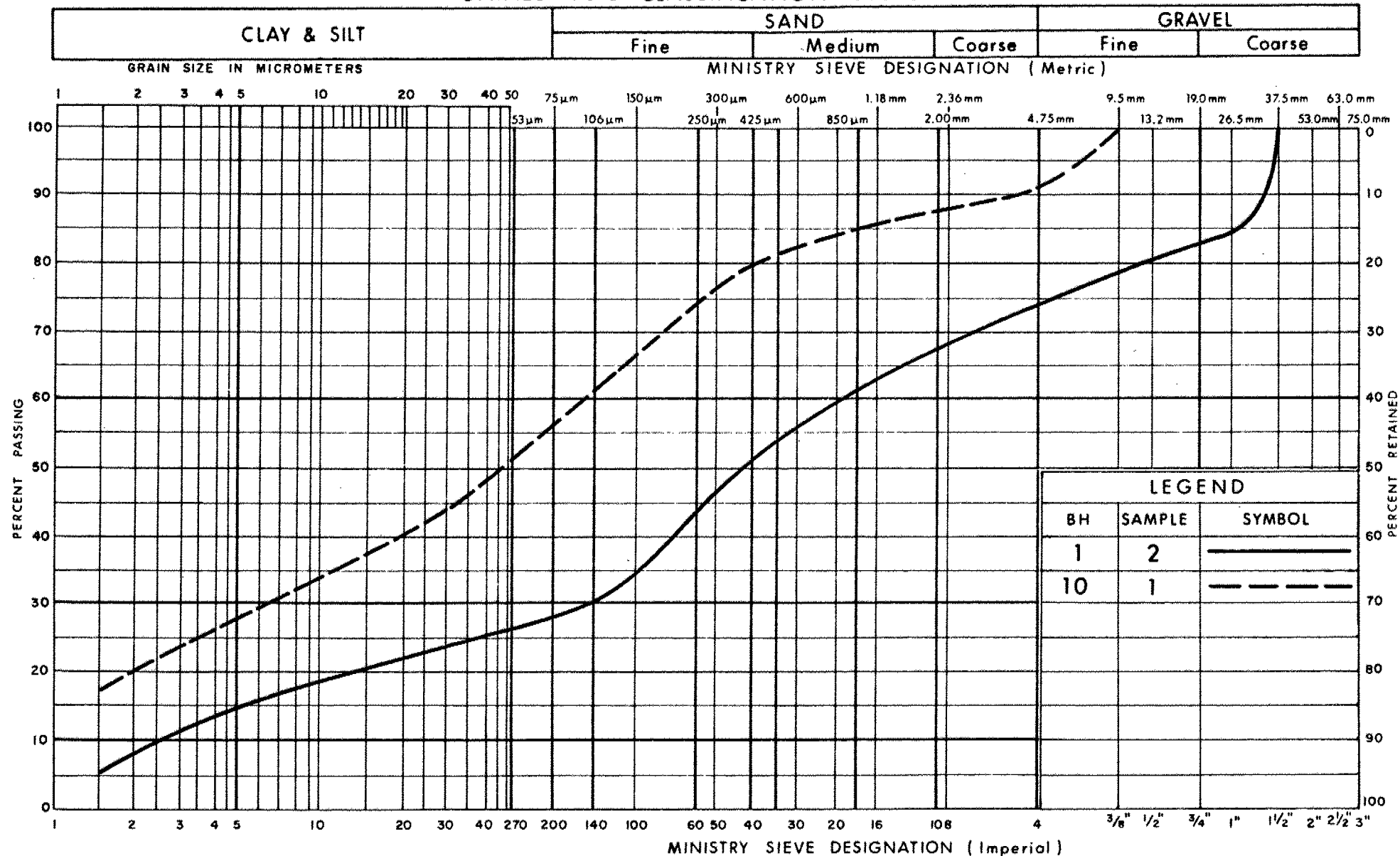
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
200.5	Ground Surface																
0.0	Fill Silty Clay and Sand With Slabs of Asphalt and Gravel		1	SS	15		200										
197.8	(Glacial Till) Brown		2	SS	12		198										
2.7	Grey		3	SS	16		196										
	Silty Clay with Varying Amounts of Sand, Trace of Gravel		4	SS	100/	29 cm	194										
192.4	Stiff to Hard		5	SS	100/	28 cm											
8.1	End of Borehole																
	Note: Borehole caved at 5.4 m																

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

20  
15 5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

## UNIFIED SOIL CLASSIFICATION SYSTEM



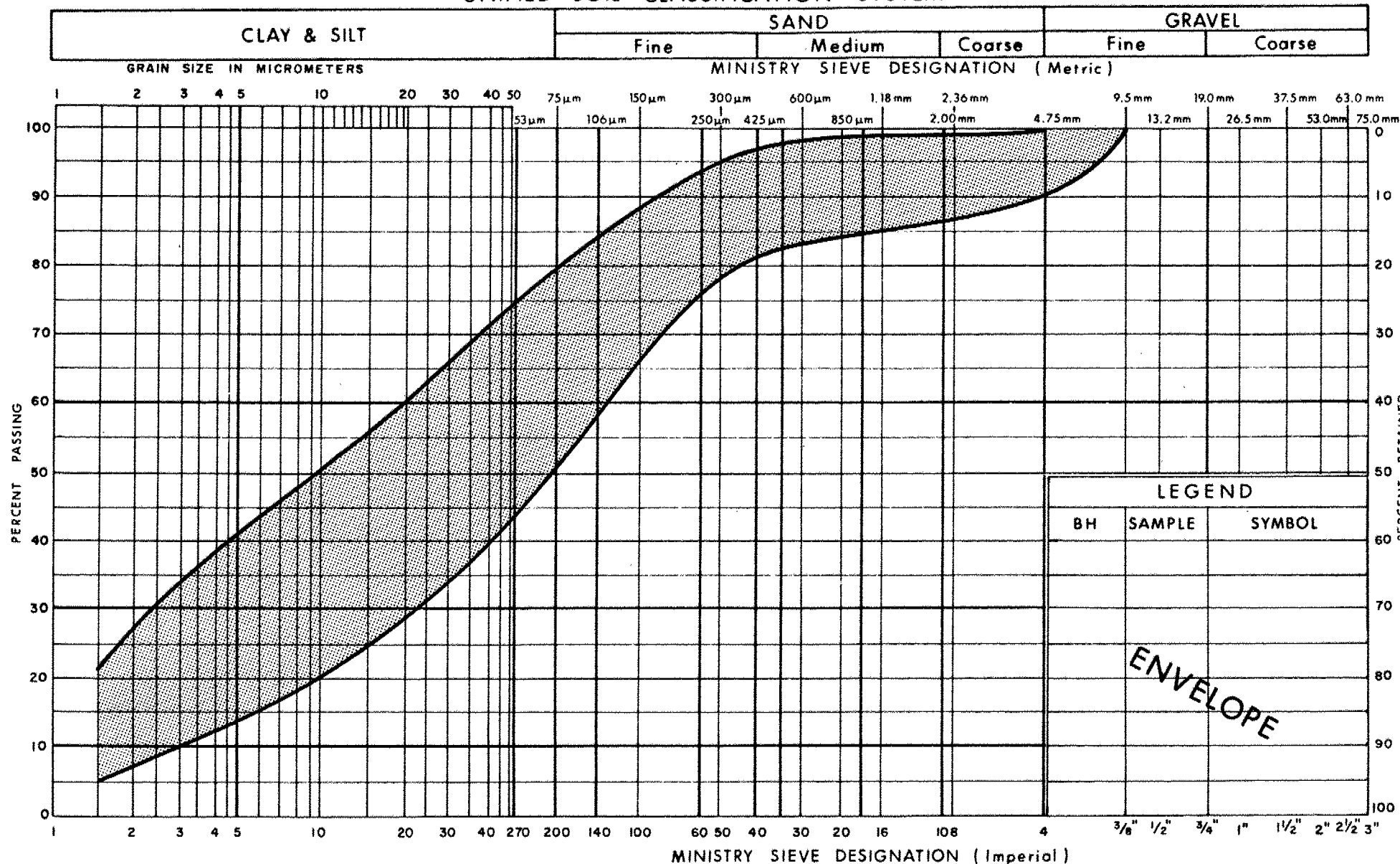
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Communications

GRAIN SIZE DISTRIBUTION  
FILL  
SILTY CLAY AND SAND SOME GRAVEL

FIG No 1

W P 164-79-05

# UNIFIED SOIL CLASSIFICATION SYSTEM



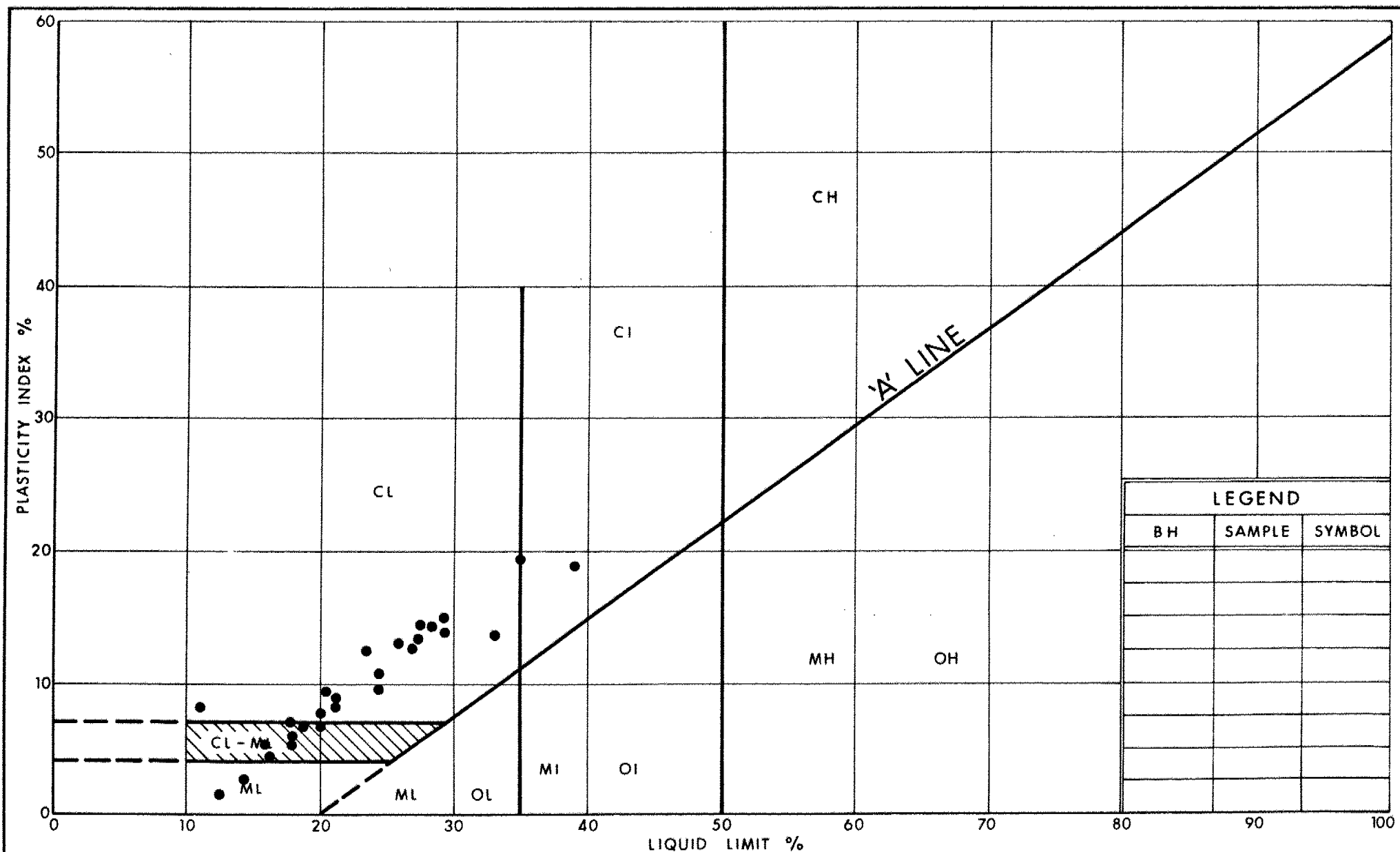
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Transportation and  
Communications

**GRAIN SIZE DISTRIBUTION**  
**SILTY CLAY (Glacial Till)**  
**WITH VARYING AMOUNTS OF SAND, TRACE OF GRAVEL**

FIG No 2

W P 164-79-05





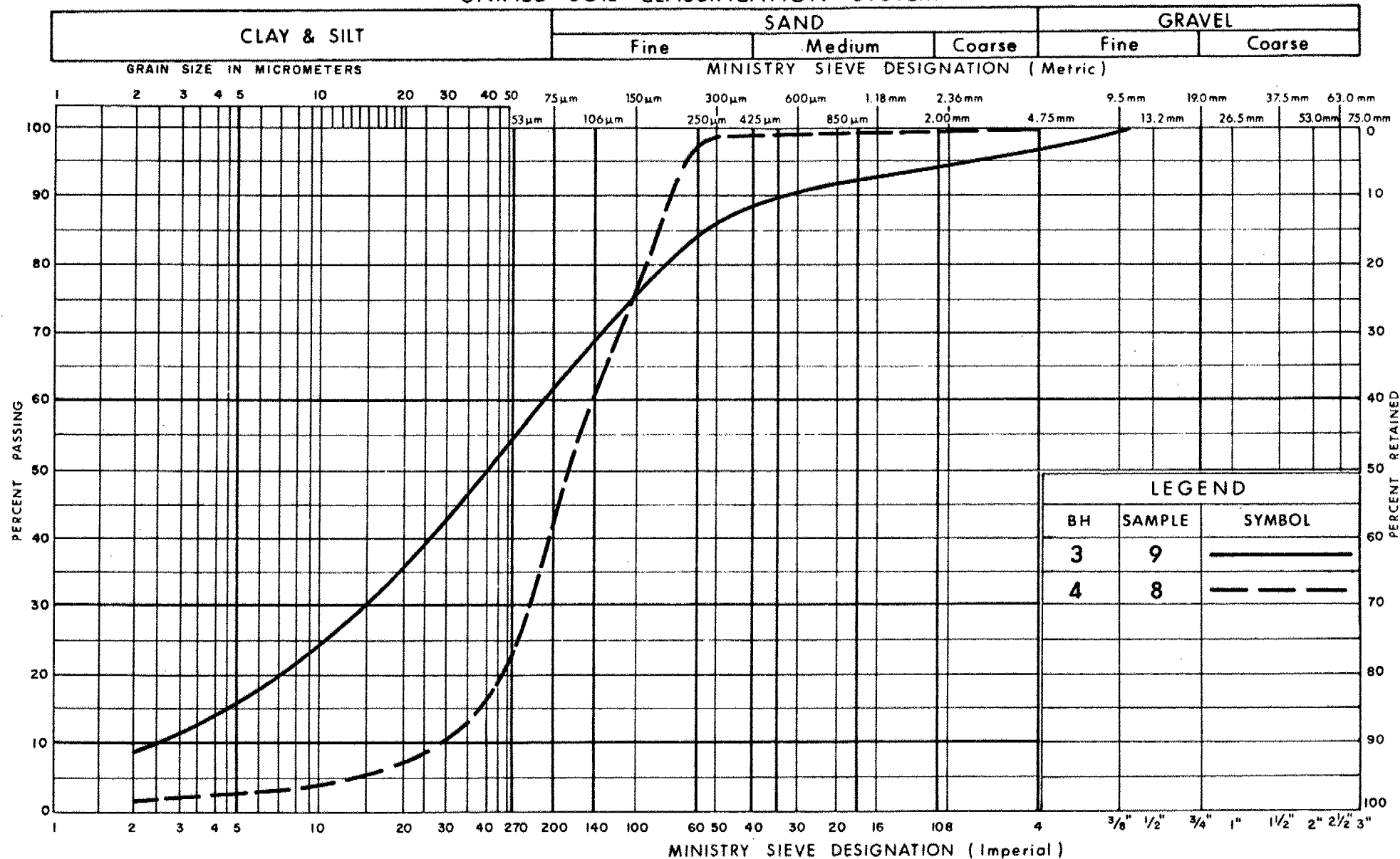
Ministry of  
Transportation and  
Communications

# PLASTICITY CHART SILTY CLAY Matrix (Glacial Till)

FIG No 3

W P 164 - 79 - 05

## UNIFIED SOIL CLASSIFICATION SYSTEM



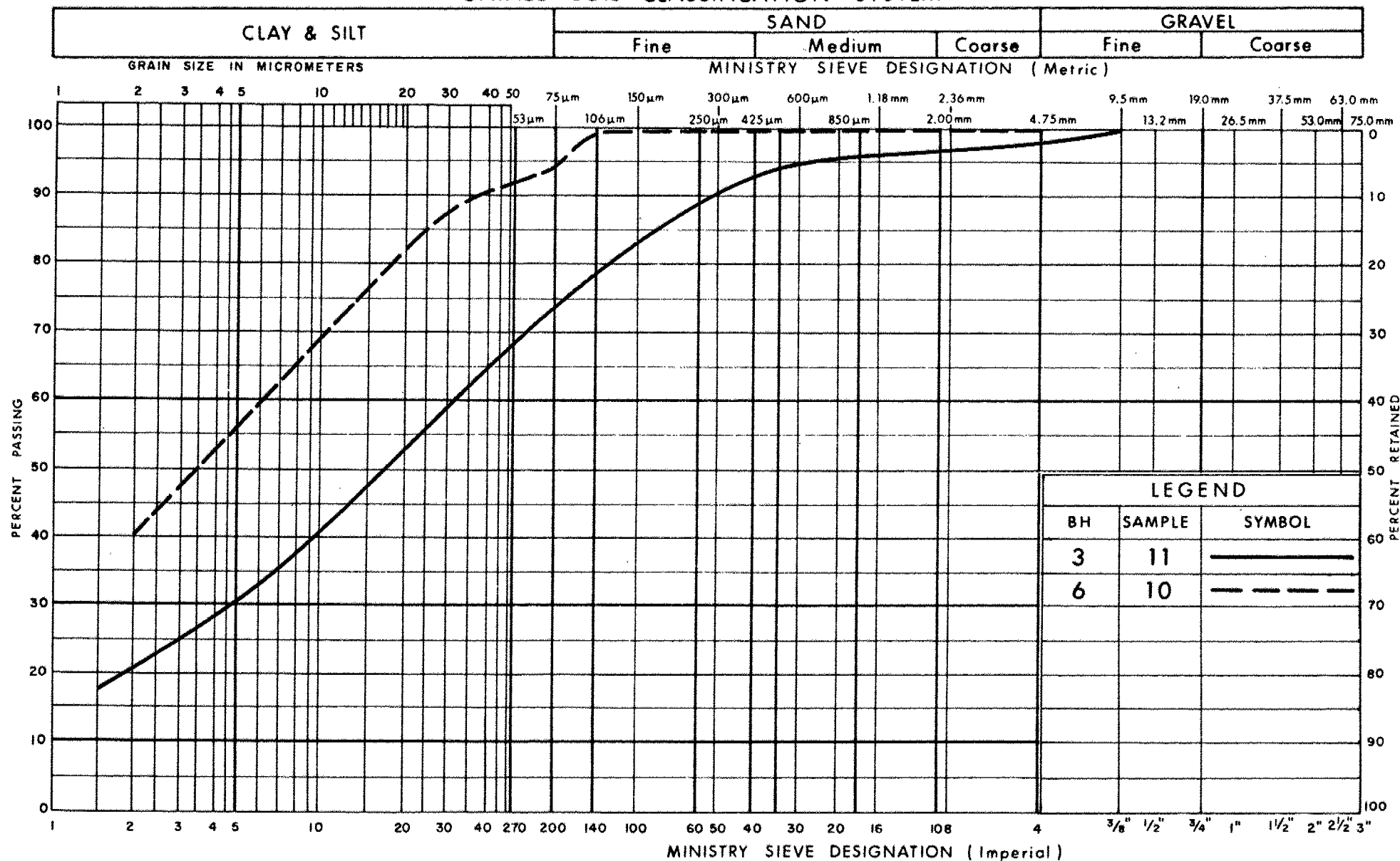
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Communications

**GRAIN SIZE DISTRIBUTION**  
**SILTY SAND TO SANDY SILT, TRACE OF GRAVEL**

FIG No 4

W P 164-79-05

## UNIFIED SOIL CLASSIFICATION SYSTEM

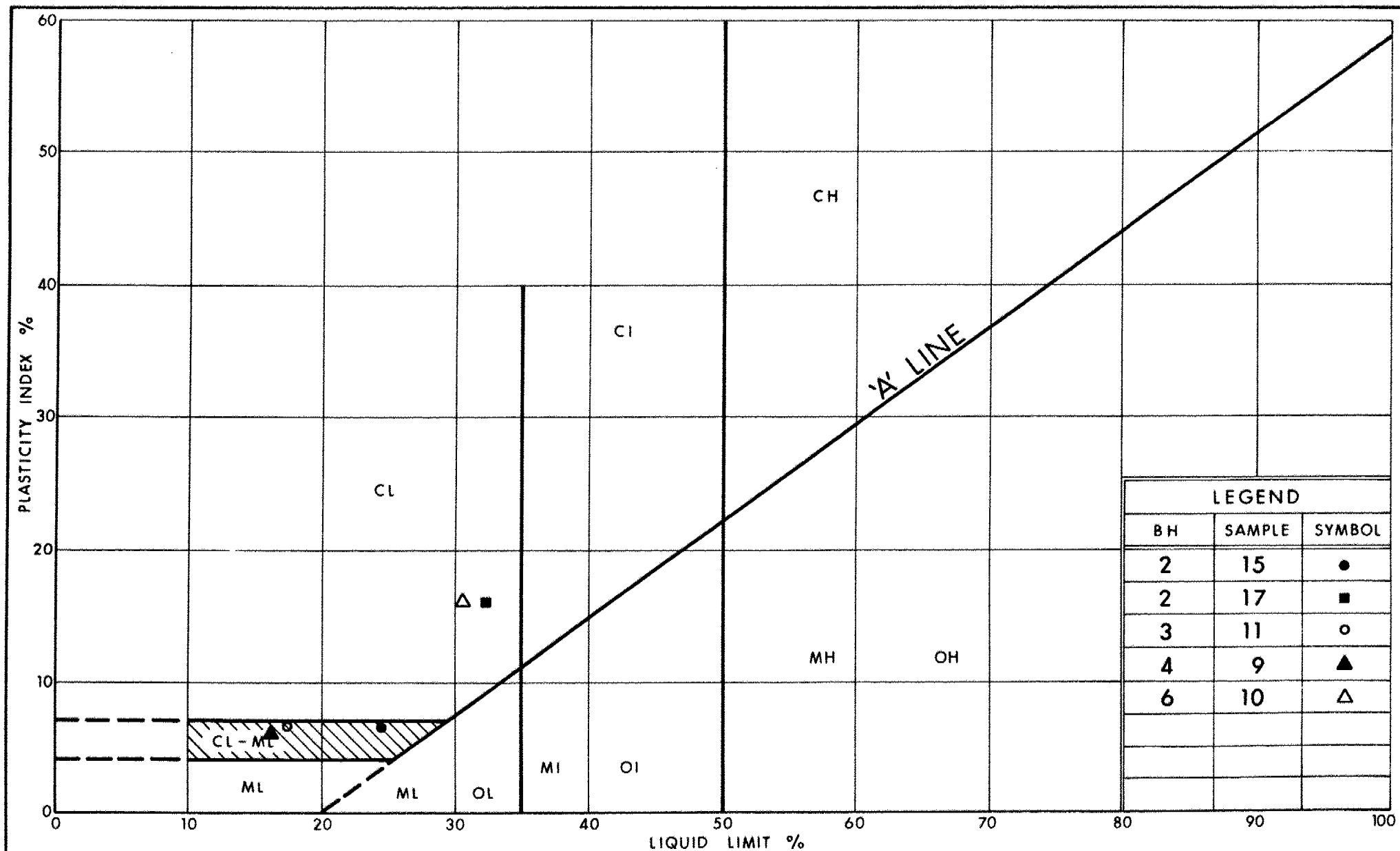


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GRAIN SIZE DISTRIBUTION  
VARVED SILTY CLAY

FIG No 5

W P 164-79-05



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## PLASTICITY CHART VARVED SILTY CLAY

FIG No 6

W P 164-79-05

## 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

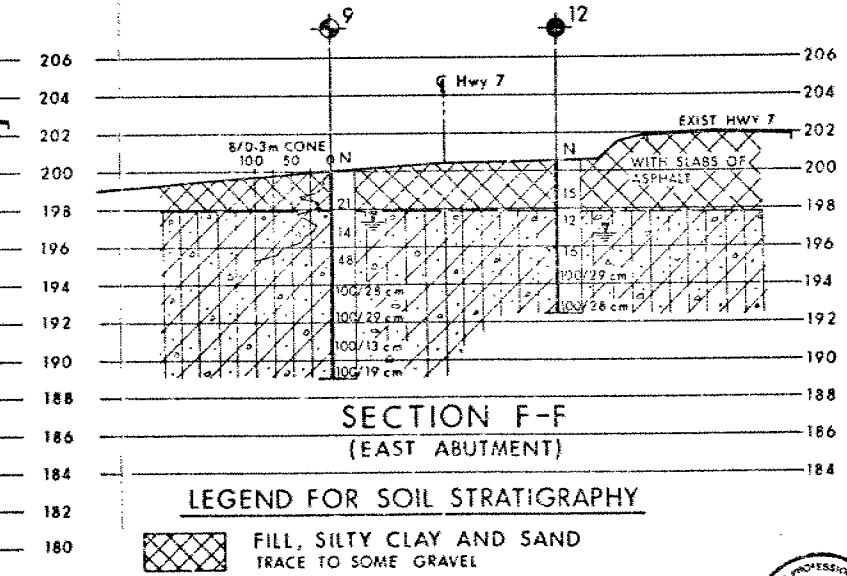
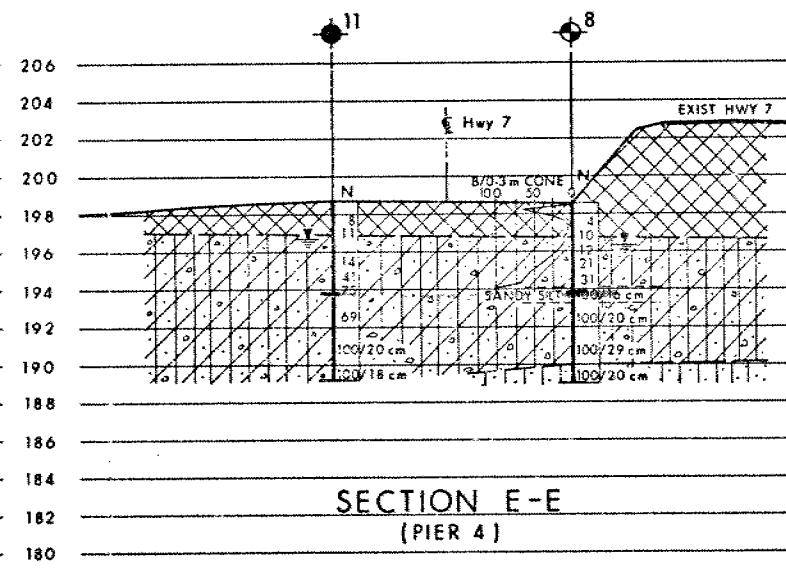
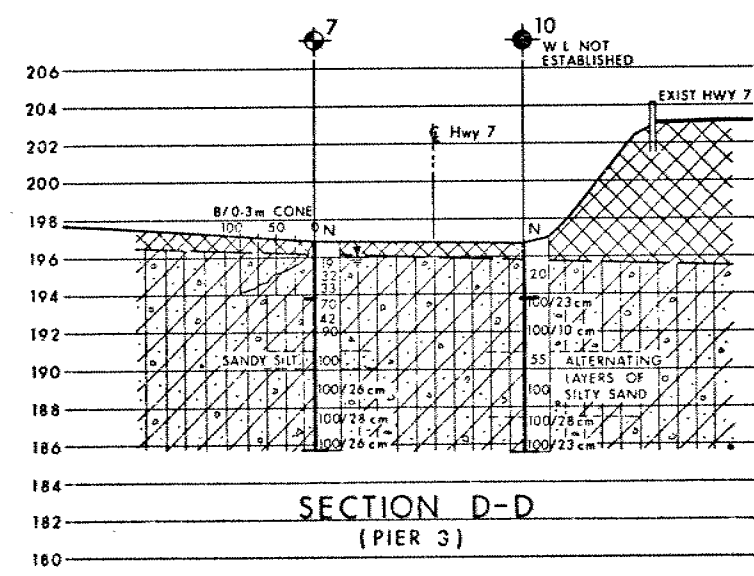
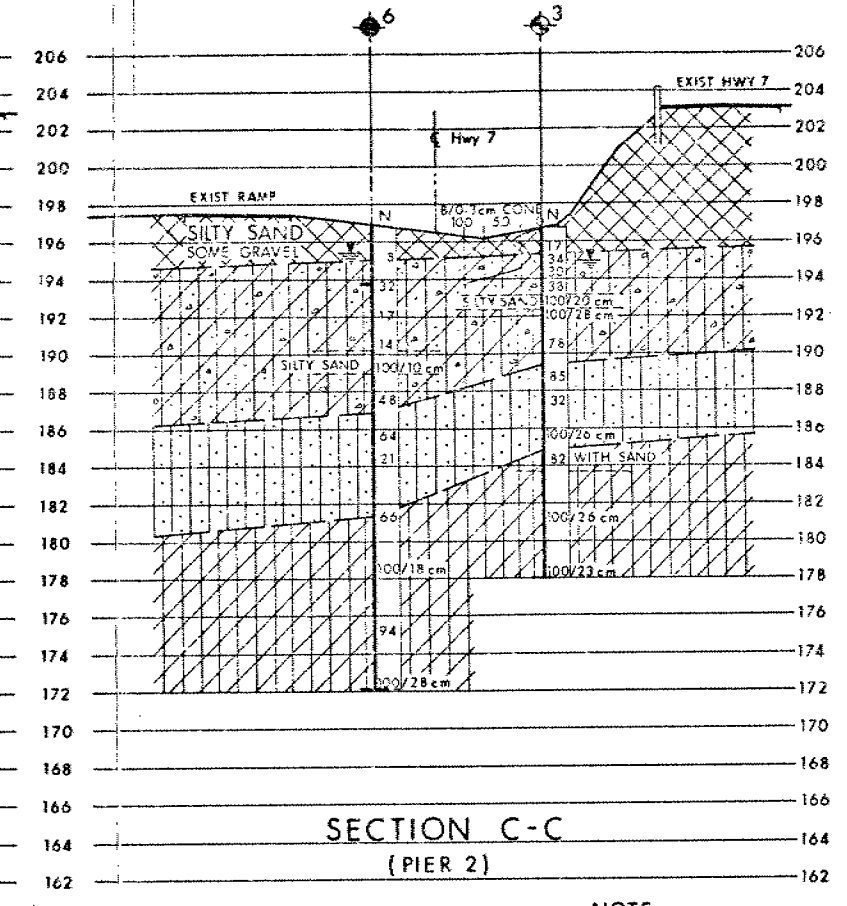
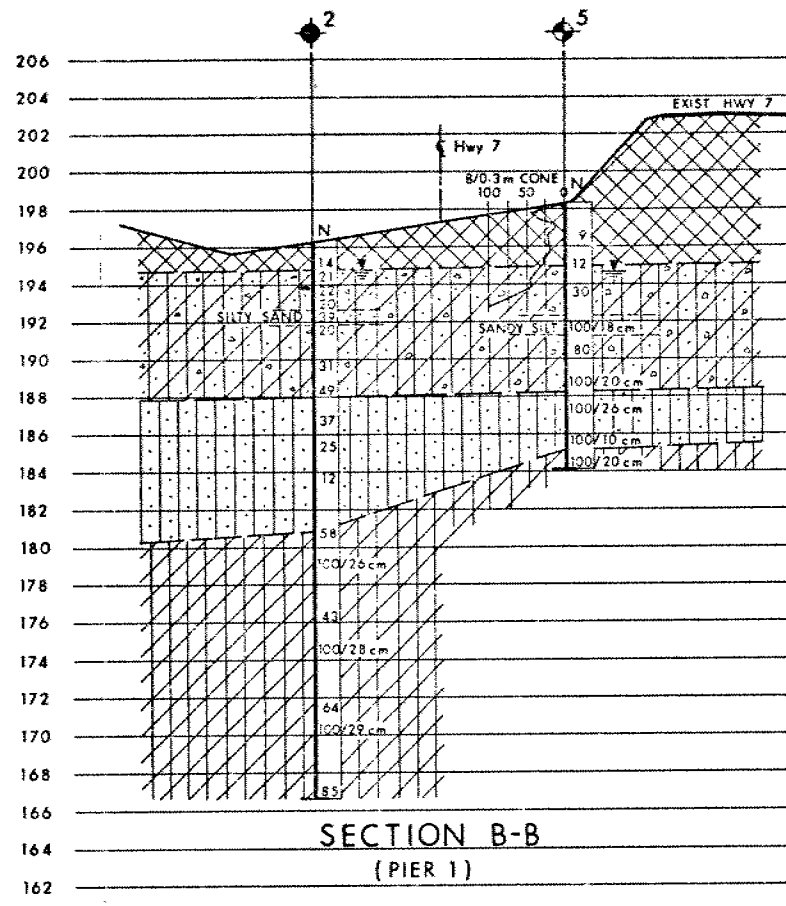
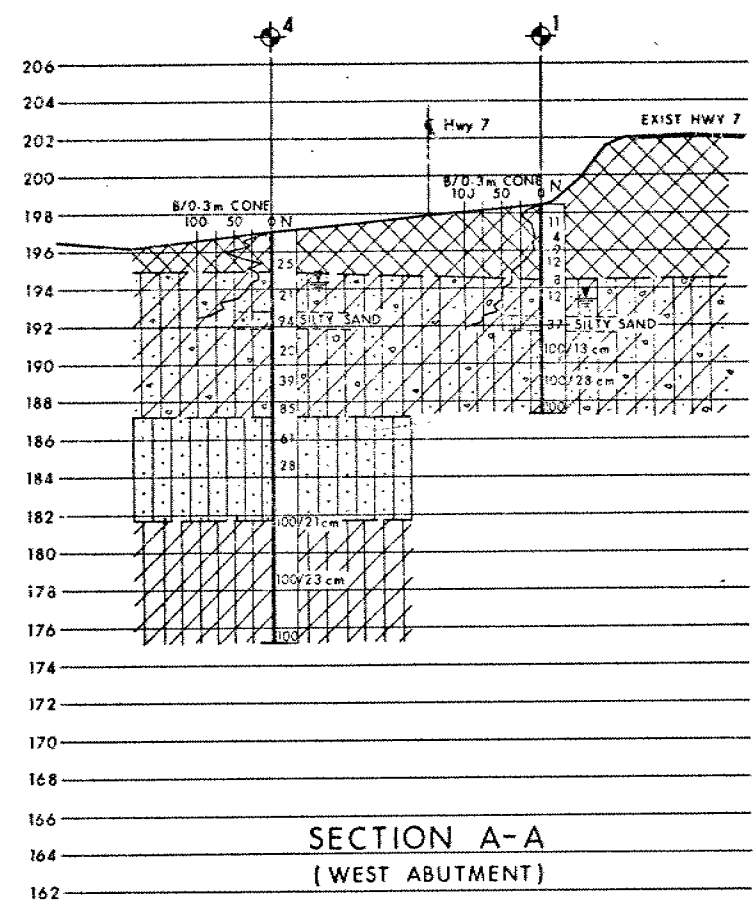
$m_v$	kPa <sup>-1</sup>	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	m <sup>2</sup> /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN 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
$S_f$	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
P	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						

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

CONT No WP No 164-79-05	
HWY 7 UNDERPASS	
SECTIONS AND SOIL STRATA	SHEET



**SCALE FOR SECTIONS**  
HOR 10m 5 0 10m  
VERT 4m 2 0 4m

- LEGEND FOR SOIL STRATIGRAPHY**
-  FILL, SILTY CLAY AND SAND  
TRACE TO SOME GRAVEL
  -  SILTY CLAY (Glacial Till)  
WITH VARYING AMOUNTS OF SAND, TRACE OF GRAVEL  
Stiff to Hard
  -  SILTY SAND TO SANDY SILT, TRACE OF GRAVEL  
OCC ZONES AND LAYERS OF SILTY CLAY  
Compact to Very Dense
  -  VARVED SILTY CLAY WITH BANDS OF  
LOW TO INTERMEDIATE PLASTICITY  
TRACE OF SAND Hard



**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
1	1982 10 07	...	...

Geocres No 30M13-55

HWY No 400	DIST 6
SUBMITTAL CHECKED	DATE 1982 10 07
DRAWN	DATE 1982 10 07

DWG 1647905-B

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

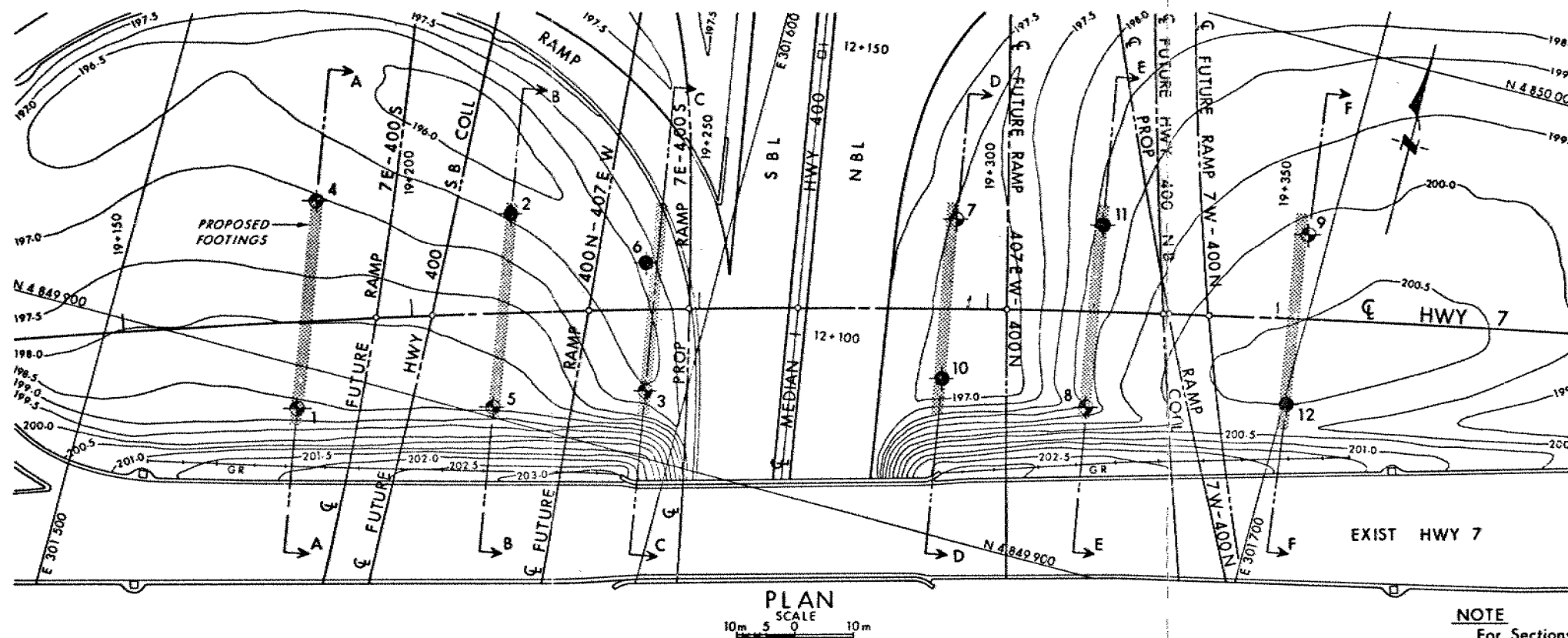
CONT No  
WP No 164-79-05

HWY 7 UNDERPASS

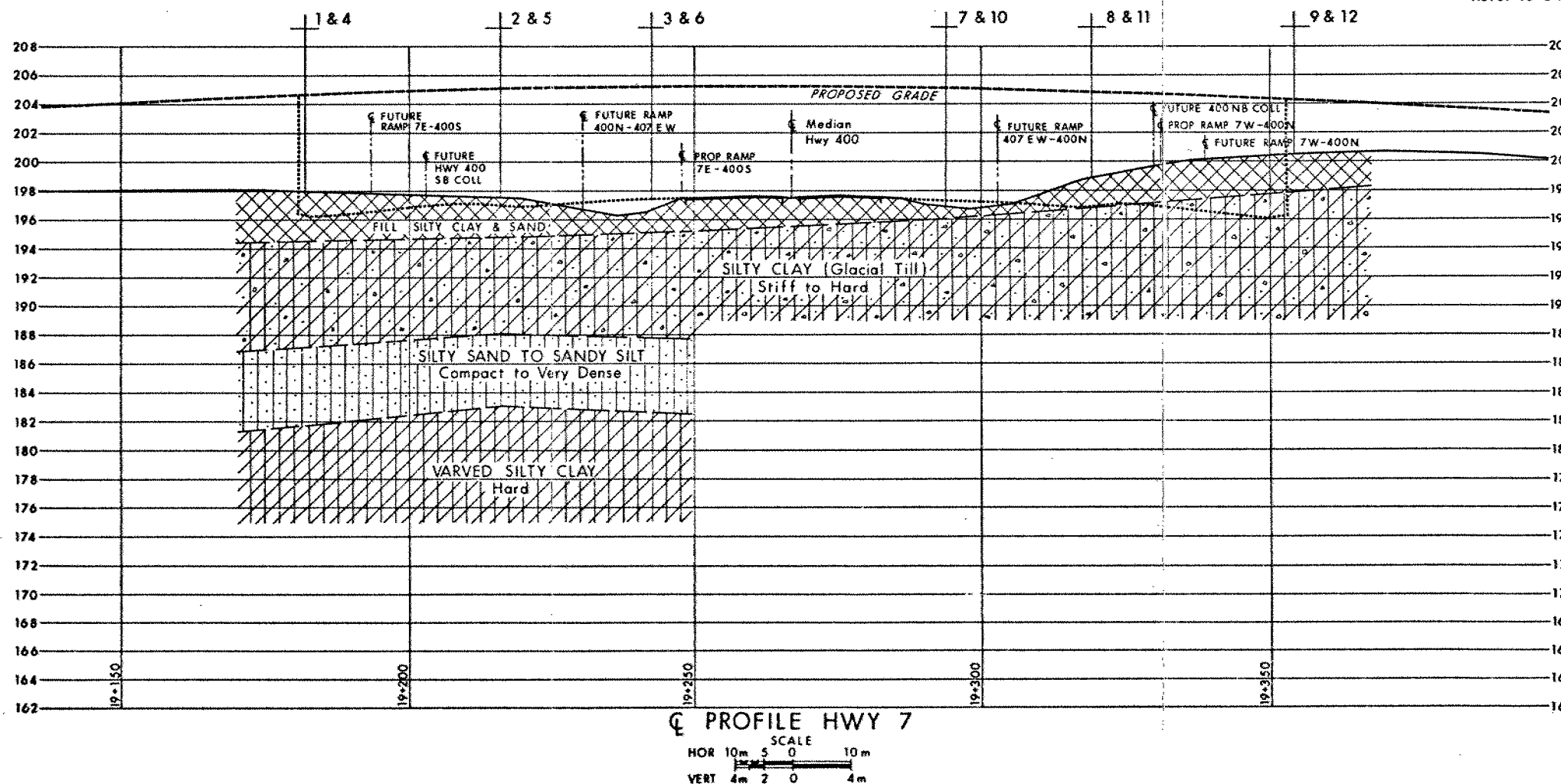
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



**NOTE**  
For Sections and Soil Stratigraphy  
Refer to Dwg No 1647905-A



**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 08

No	ELEVATION	CO ORDINATES NORTH	EAST
1	198.4	4 849 892.8	301 535.5
2	196.2	4 849 935.0	301 563.0
3	196.7	4 849 911.3	301 593.0
4	197.0	4 849 928.5	301 529.3
5	198.2	4 849 901.8	301 568.3
6	196.9	4 849 932.7	301 587.2
7	196.8	4 849 954.2	301 637.2
8	198.5	4 849 928.3	301 667.2
9	200.0	4 849 967.0	301 696.5
10	196.7	4 849 926.6	301 642.0
11	198.7	4 849 959.5	301 662.0
12	200.5	4 849 937.7	301 700.5

**NOTE**

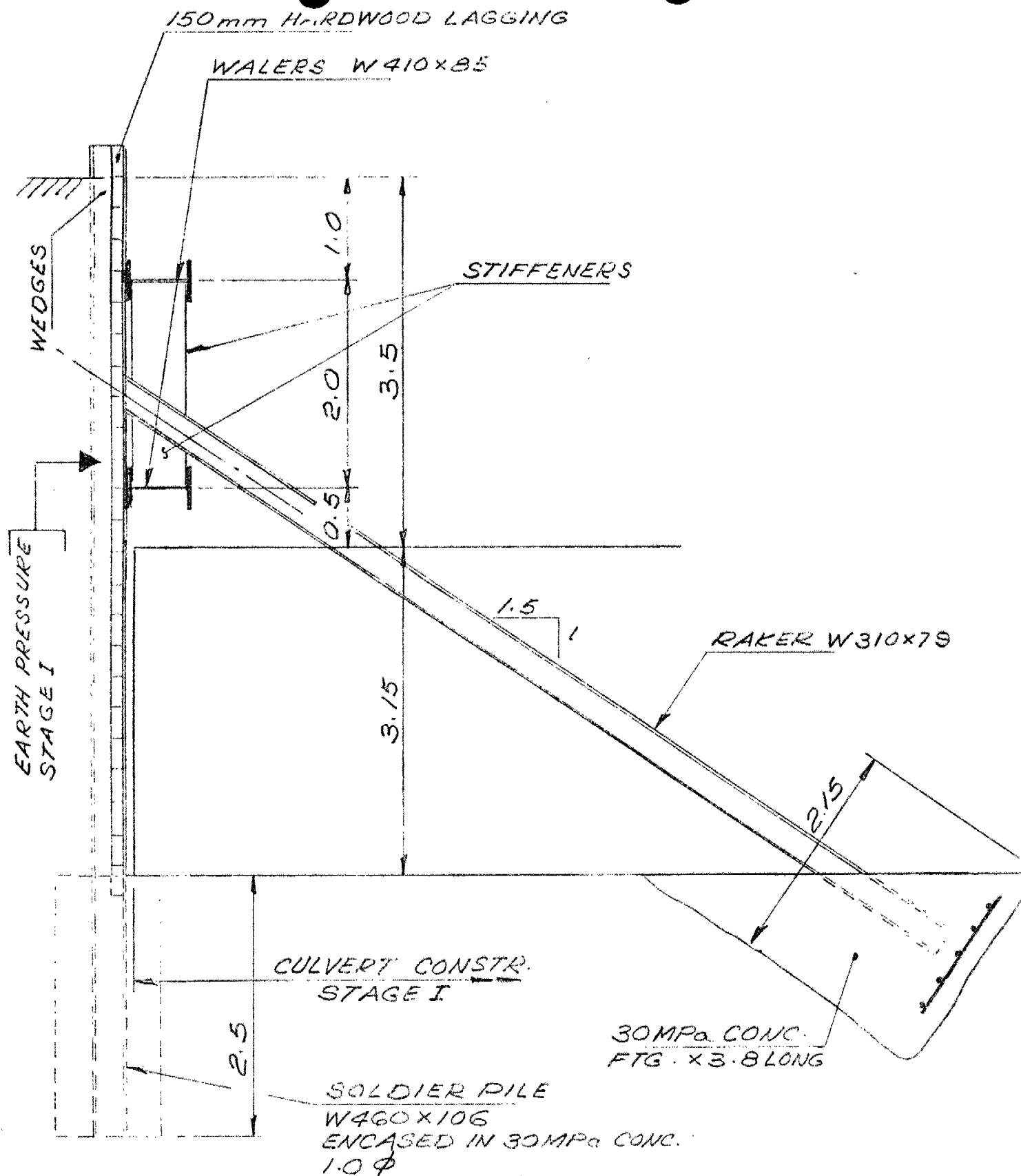
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

Geocres No 30M13-55

HWY No 400	DIST 6
SUBMIT JK CHECKED	DATE 1982 10 08
DRAWN JK CHECKED	SITE 37-125
	DWG 1647905-A

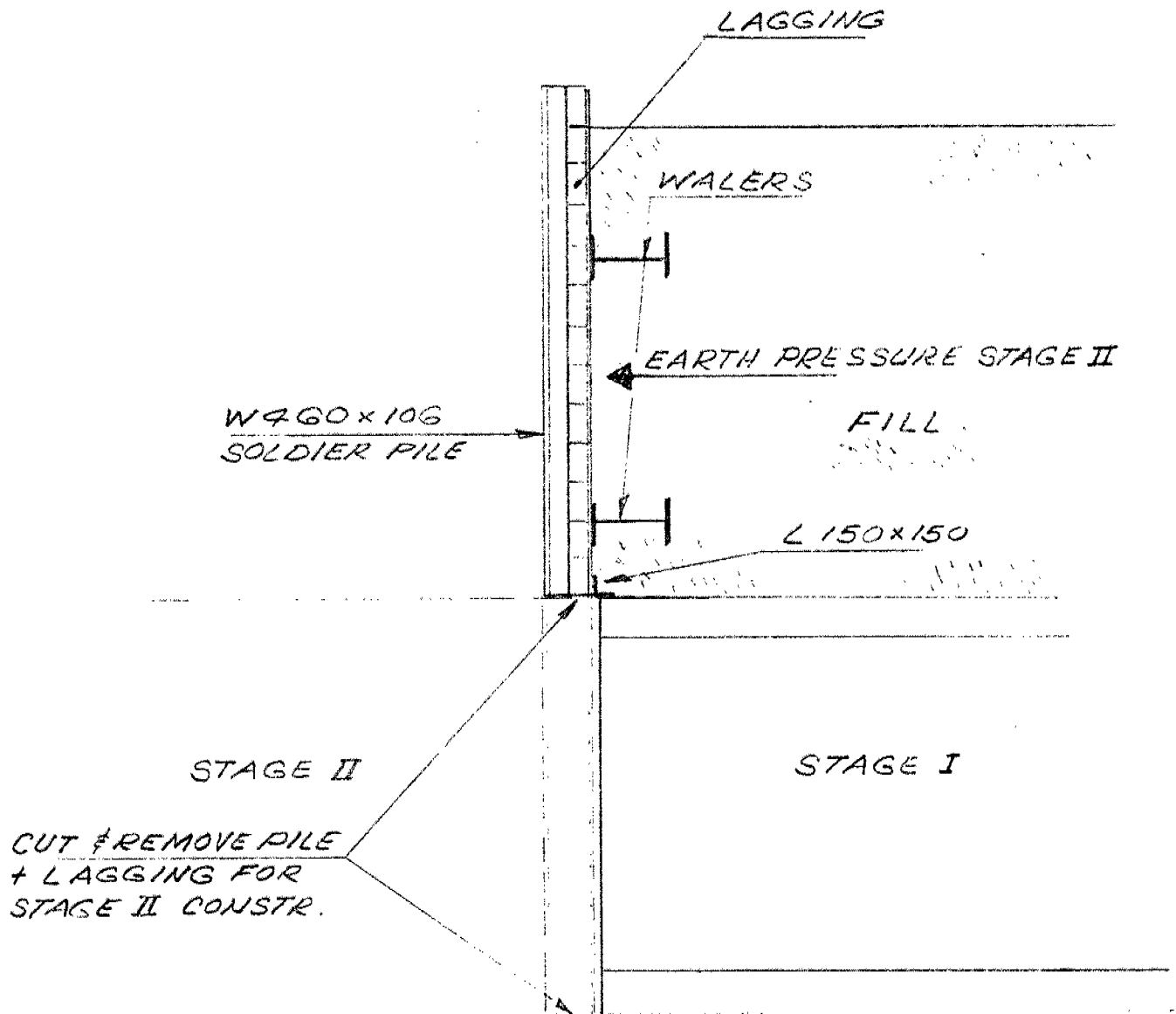


CULVERT #3

1:50

SHEET 144-2





NOTE:  
THE SHORING IS USED IN BOTH STAGES I & II  
TO RESIST LATERAL FORCES.

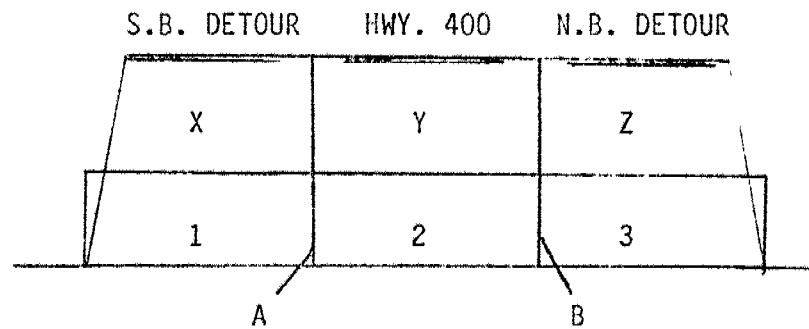


CULVERT #3

1:50

ROADWAY PROTECTION AT CULVERT NO. 3

CONSTRUCTION SEQUENCE

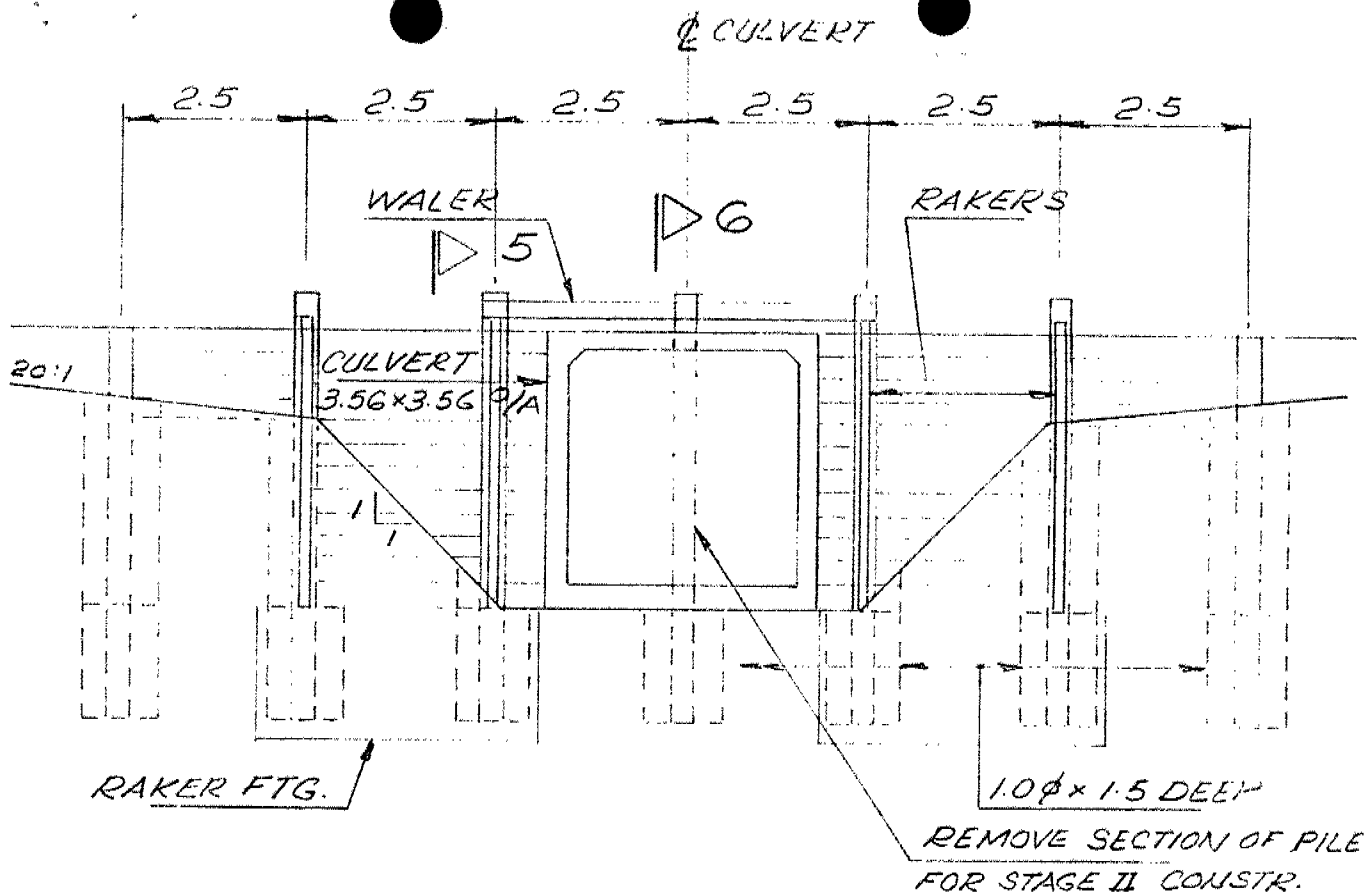


Traffic on Highway 400

1. Excavate X and Z installing shoring at A & B as excavation proceeds.
2. Construct culvert lengths 1 & 3.
3. Backfill X and Z and construct detours.
4. Switch traffic to detours.

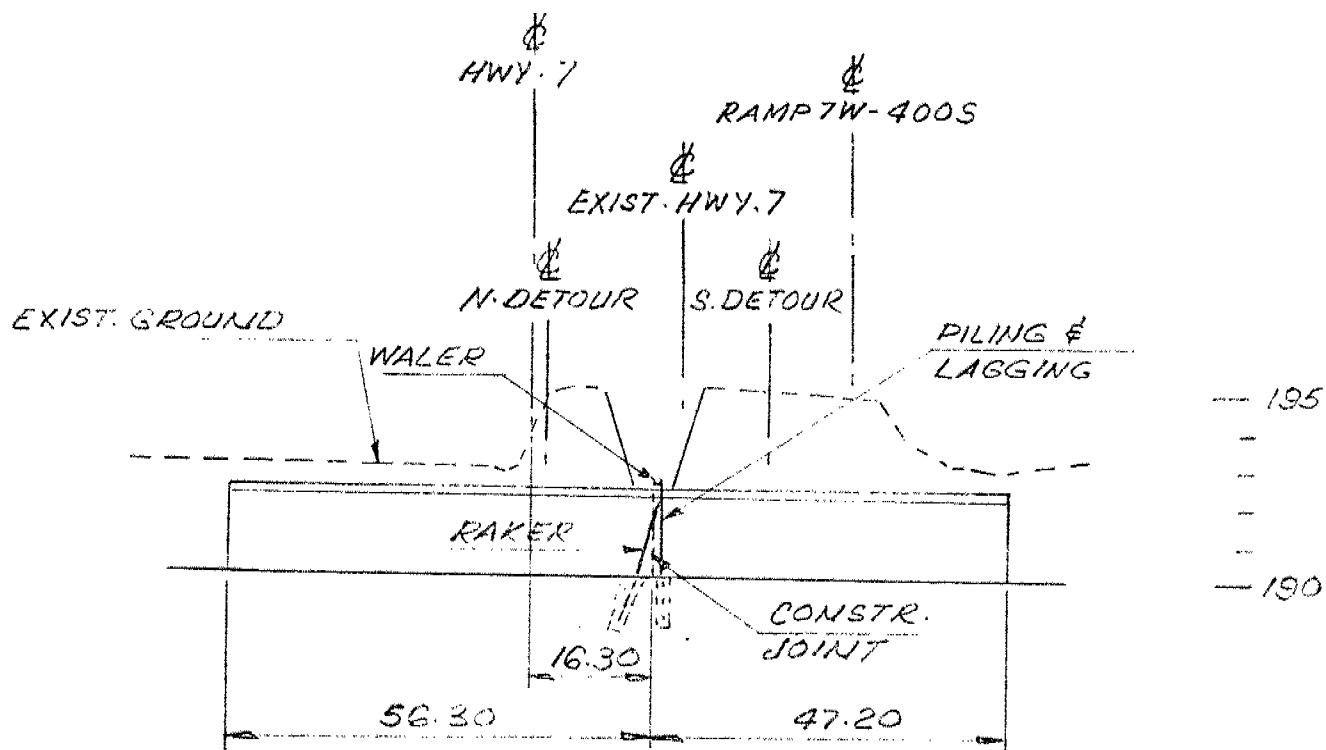
Traffic on Detours

5. Excavate Y (same shoring is used but it now resists forces in opposite direction).
6. Remove lower part of central pile.
7. Construct culvert length 2.
8. Backfill Y and remove shoring as required.



# SECTION

1:100



# ELEVATION (LOOKING EAST)

HORIZ. 1:1000

VERT. 1:200

CULVERT #21

SHEET 14G-1

# CULVERT CONST. STAGE I

125mm HARDWOOD LAGGING

WEDGES

WALER 310 x 74

0.5

STIFFENERS

EARTH PRESSURE  
STAGE I

CULVERT

1.5

3.56

RAKER W310 x 74

30 MPa CONC.  
FTG. x 3.5 LONG

SOLDIER PILE W310 x 74  
ENCASED IN 30 MPa CONC.  
1.0  $\phi$ .

1.75



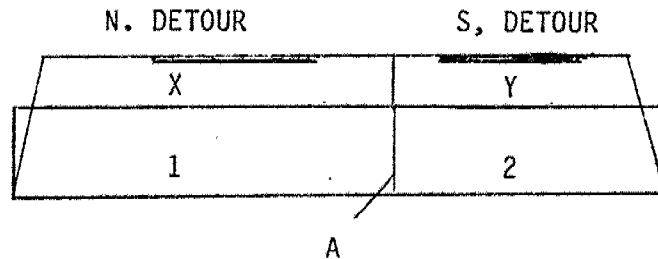
CULVERT #21

1:50



ROADWAY PROTECTION AT CULVERTS NO. 21 & 22.

CONSTRUCTION SEQUENCE

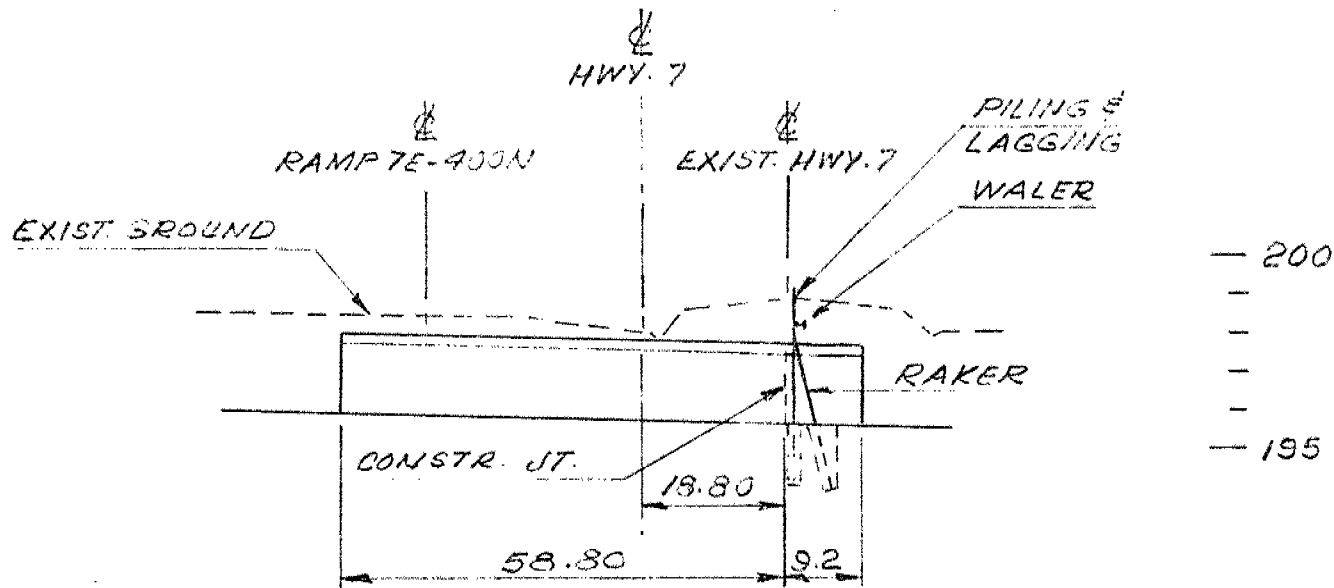
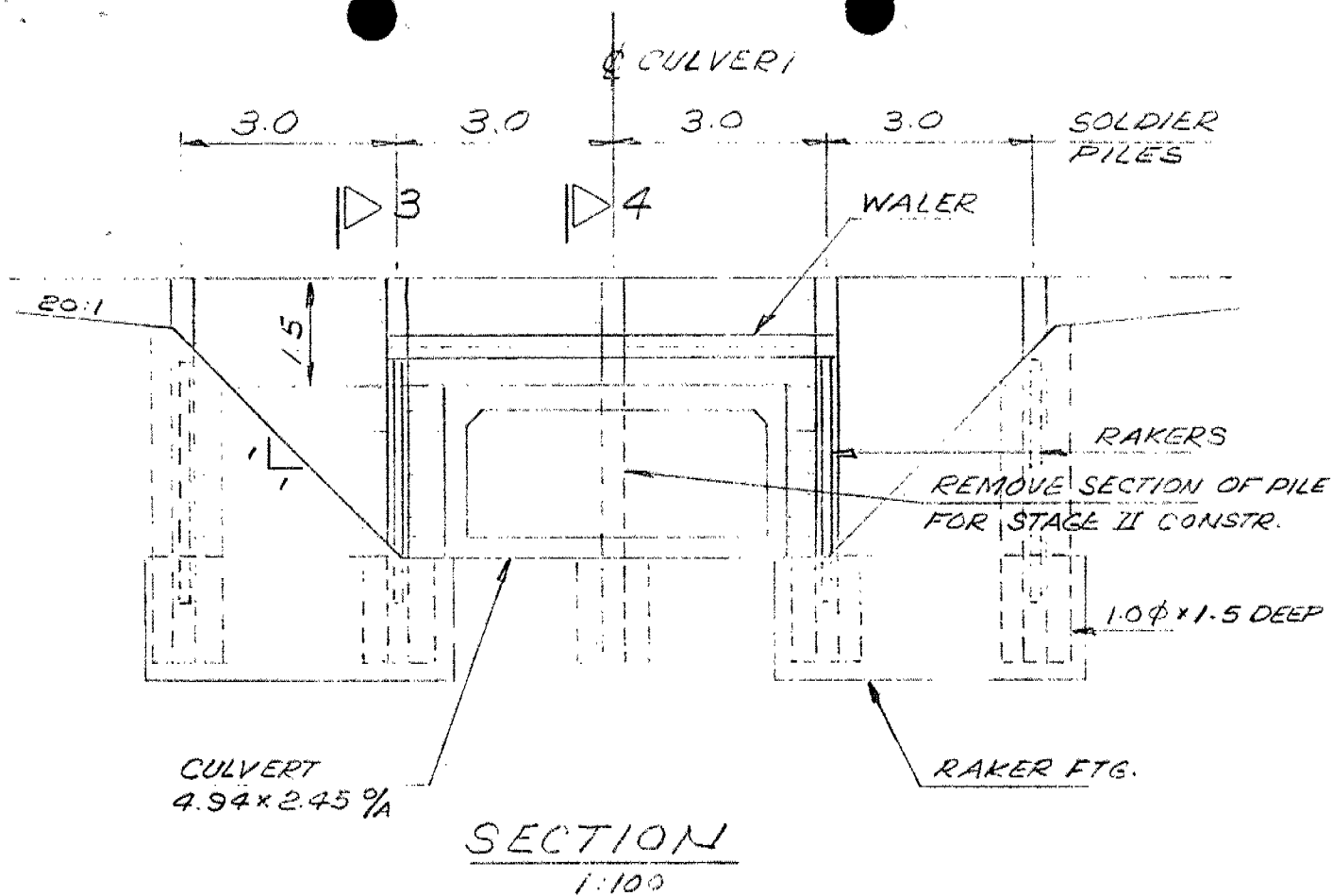


Traffic on South Detour

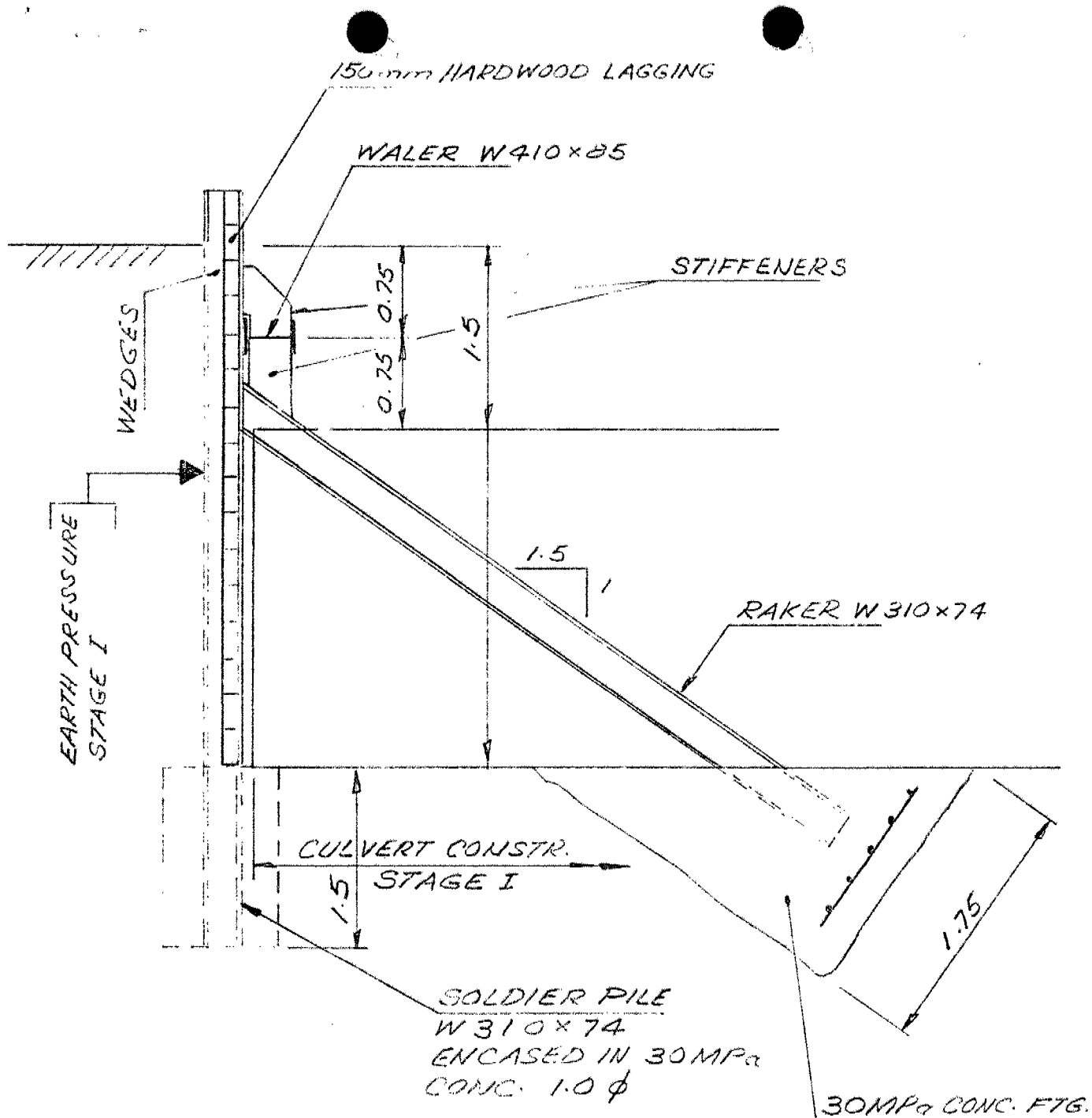
1. Excavate X installing shoring at A as excavation proceeds.
2. Construct culvert length 1
3. Backfill X and Construct North Detour
4. Switch Traffic from South Detour to North Detour.

Traffic on North Detour

5. Excavate Y (same shoring is used, but it now resists forces in opposite direction.)
6. Remove lower part of central pile.
7. Construct culvert length 2.
8. Backfill Y and remove shoring as required.



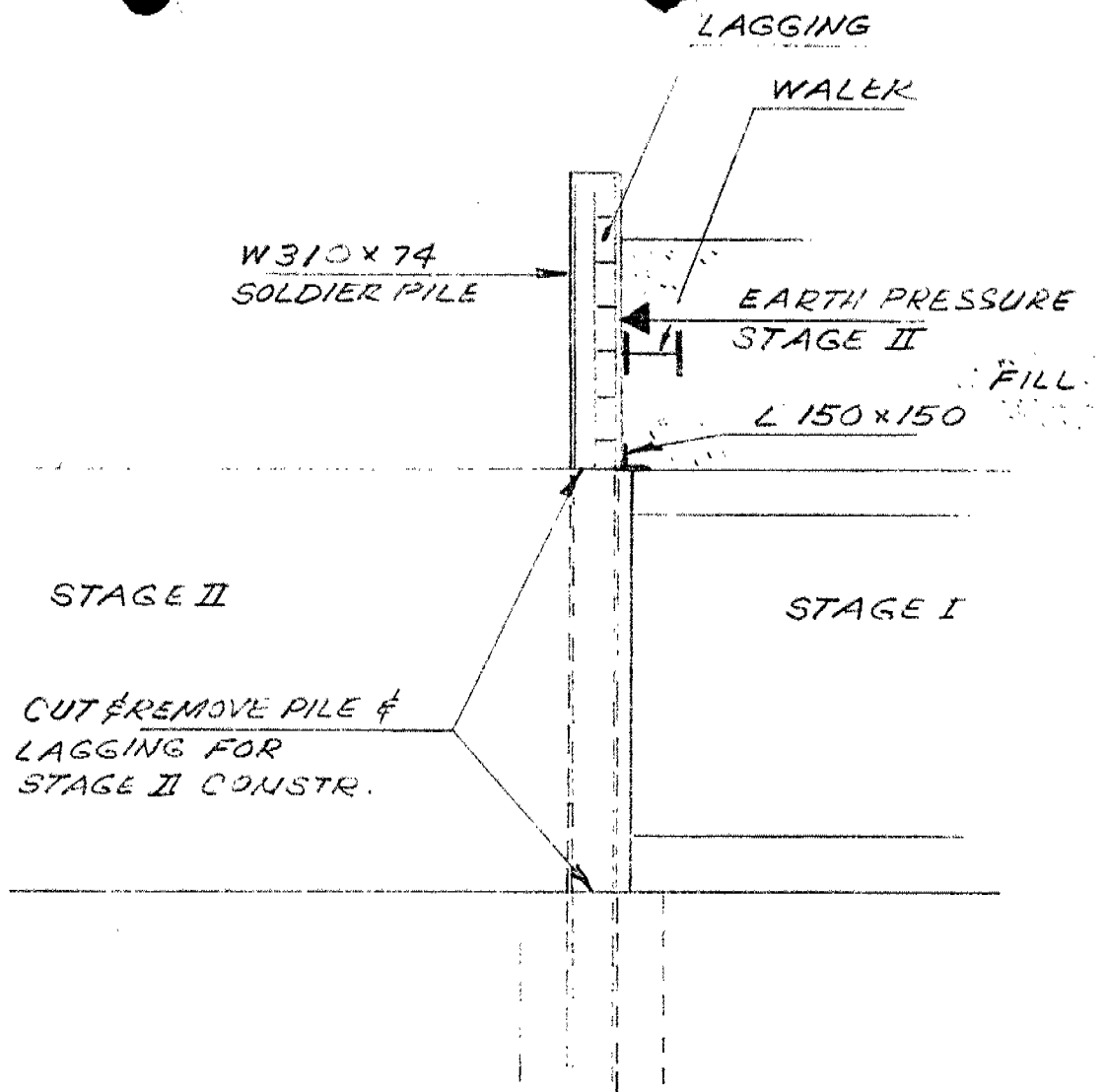
CULVERT #22



CULVERT #22

1:50





NOTE:

THE SHORING IS USED IN BOTH STAGES I & II  
TO RESIST LATERAL FORCES.

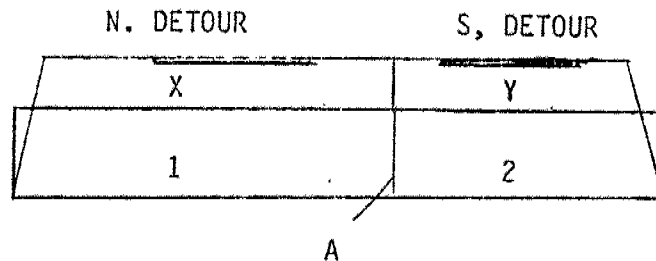


CULVERT #22

1:50

ROADWAY PROTECTION AT CULVERTS NO. 21 & 22.

CONSTRUCTION SEQUENCE



Traffic on South Detour

1. Excavate X installing shoring at A as excavation proceeds.
2. Construct culvert length 1
3. Backfill X and Construct North Detour
4. Switch Traffic from South Detour to North Detour.

Traffic on North Detour

5. Excavate Y (same shoring is used, but it now resists forces in opposite direction.)
6. Remove lower part of central pile.
7. Construct culvert length 2.
8. Backfill Y and remove shoring as required.

# memorandum



To: Mr. W.L. Lin  
Design Engineer (Central)  
Structural Office  
3501 Dufferin St., 4th Floor

Date: 83 02 22

From: Pavement & Foundation Design Section  
Room 315, Central Bldg.  
Downsview

Re: Highway 400/7 Interchange  
Hwy. 7 Underpass  
W.P. 164-79-05, Site 37-125  
District 6, Toronto

We have reviewed the preliminary general arrangement drawing for the above-mentioned site, and provide the following comment:

Steel 310 HP 110 section piles should be designed to a Capacity at S.L.S. Type II of 1150 kN rather than 980 kN as stated in the Foundation Report. The same factored capacity at U.L.S. (1600 kN) remains true.

All other recommendations within the Report are still applicable.

A handwritten signature in dark ink, appearing to read "Tom Kazmierowski".

Tom Kazmierowski, P. Eng.  
Foundations Eng.

TK:syc

cc: G.C.E. Burkhardt

FENCO ENGINEERS INC.  
33 YONGE STREET, TORONTO  
ONTARIO, CANADA M5E 1E7  
TEL.: (416) 365-9955  
TELEX: 06-23765  
CABLE: LAVALIN TOR

January 17, 1983

Mr. T.J. Kazmierowski, P.Eng.  
Project Foundations Engineer  
Ministry of Transportation  
and Communications  
1201 Wilson Ave.  
Downsview, Ontario  
M3M 1J8

Dear Mr. Kazmierowski:

HIGHWAY 7 UNDERPASS  
SITE 37-1179-K25 W.P. 164-79-05  
BACKFILL PRESSURE

This is to confirm our recent telephone conversation.

The abutments for the above structure are supported on steel H piles. For the lateral forces, we will therefore use the equivalent fluid pressures given in the O.H.B.D.C. for the 'at rest' condition viz.

U.L.S. 12 KPa/m  
S.L.S. 10 KPa/m

Yours truly,  
FENCO ENGINEERS INC.



B.T. Phalp, P.Eng.  
SUPERVISING ENGINEER

BTP/jf  
34257

cc: Mr. W. Lin

