

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 4077-15

DIST. 1 REGION

W.P. No. 259-66-04

CONT. No. 80-43

W. O. No.

STR. SITE No. 6-52

HWY. No. E.C. Row. Expwy

LOCATION Little River, Windsor

No of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

1

INDEX

<u>Page No.</u>	<u>Description</u>
1	Index
2	Abbreviations & Symbols
3-29	Foundation Investigation Reports For
	W.P. 259-66-04 Little River Bridge
	W.P. 259-66-06 Lauzon Parkway Underpass
	W.P. 259-66-08 C.N.R. Overhead on Lauzon Parkway Extension

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

EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS N_c .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON "A" SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

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

S_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

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

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCK QUALITY: 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 DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" 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	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAxIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG. $\bar{C}U$ = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

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

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ ANGLE OF WALL FRICTION
 k_o COEFFICIENT OF EARTH PRESSURE AT REST
 k_A COEFFICIENT OF ACTIVE EARTH PRESSURE
 k_P COEFFICIENT OF PASSIVE EARTH PRESSURE
 i ANGLE OF INCLINATION OF SURCHARGE
 w SLOPE ANGLE-BACKFACE OF WALL
 β ANGLE OF SLOPE
 N_c, N_q, N_γ BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_o INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e IN DENSEST STATE
 D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_P PLASTIC LIMIT
 w_s SHRINKAGE LIMIT
 I_P PLASTICITY INDEX = $w_L - w_P$
 I_L LIQUIDITY INDEX = $\frac{w - w_P}{I_P}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w}{I_P}$
 A_c ACTIVITY = $\frac{I_P}{2.45 - I_P}$
 Om ORGANIC MATTER CONTENT
 S_r DEGREE OF SATURATION
 S SENSITIVITY = $\frac{S_u(\text{undisturbed})}{S_u(\text{remoulded})}$

STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_R RESIDUAL SHEAR STRENGTH
 c COHESION INTERCEPT
 $\sigma_1, \sigma_2, \sigma_3$ NORMAL PRINCIPAL STRESSES
 u PORE WATER PRESSURE
 u_e EXCESS u
 r_u PORE PRESSURE RATIO
 q_u UNCONFINED COMPRESSIVE STRENGTH
 s_u UNDRAINED SHEAR STRENGTH
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_s MODULUS OF SUBGRADE REACTION
 m, n STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
 σ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE;
 σ'_1 = EFFECTIVE NORMAL STRESS

HYDRAULIC TERMS

h HYDRAULIC HEAD OR POTENTIAL
 q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 j SEEPAGE FORCE PER UNIT VOLUME
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 α_v COEFFICIENT OF VOLUME CHANGE
 c_v COEFFICIENT OF CONSOLIDATION
 C_c COMPRESSION INDEX
 C_r RECOMPRESSION INDEX
 d DRAINAGE PATH DISTANCE
 T_v TIME FACTOR
 U DEGREE OF CONSOLIDATION
 O_c OVERCONSOLIDATION RATIO (OCR)

FOUNDATION INVESTIGATION REPORT

For

Little River Bridge
3.2 Miles East of Walker Road
W.P. 259-66-04, Site 6-52
E.C. Row Expressway, District 1, Chatham

INTRODUCTION

This report contains the results of a foundation investigation carried out for the above project. Fieldwork consisted of four sampled boreholes, each accompanied by a dynamic cone penetration test. This work was carried out during the period April 18 to 22, 1968 employing four inch diameter solid augers, as well as casing and washboring techniques. Bedrock was proven in one borehole by the recovery of AXT rock core.

SITE DESCRIPTION

The site is located on the eastern outskirts of the City of Windsor approximately 100 feet north of the existing E.C. Row Blvd. structure over the Little River. The surrounding terrain is flat reflecting its physiographic designation as part of the St. Clair Clay Plain. This part of the city has remained largely agricultural with the land engaged in the production of cash crops. The Little River has been straightened and dredged to act as an agricultural drain.

SUBSURFACE CONDITIONS

General

The subsoil which overlies limestone bedrock, consists of a 120 foot thick cohesive deposit. It is primarily clayey silt (clay of low plasticity) with sand and a trace of gravel but also contains isolated layers of silty clay (clay of intermediate plasticity). A plot of liquid limit versus plastic index for samples from the deposit is shown as Figure 1 of the Appendix.

Reference should be made to the Record of Borehole Sheets which are contained in the report Appendix. They show a summary of the

results of all field and laboratory tests performed. Reference should also be made to Drawing No. 6-52-2 which shows the location and elevation of all borings, as well as an inferred subsoil stratigraphy.

Clayey Silt

The overburden which is primarily clayey silt with sand and traces of gravel is about 120 feet in thickness. It has developed a desiccated crust 15 to 20 feet thick which is brown in colour and has an undrained shear strength ranging from 2000 to 5000 psf. Beneath the crust the subsoil is grey and decreases in undrained shear strength to approximately 1500 psf at a depth of 30 feet before gradually increasing again with depth. Moisture content of the clayey silt ranges from 15 percent in the crust to as high as 25 percent in the lower undesiccated zone. The isolated silty clay layers found throughout the deposit have a much higher moisture content ranging from 25 to 35 percent.

Limestone Bedrock

Sound limestone bedrock was encountered at elevations 470 and 476 approximately 120 feet below the ground surface.

Groundwater

Groundwater was encountered at elevation 586 approximately six feet below the ground surface.

K. G. Selby

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

January, 1980.

APPENDIX

RECORD OF BOREHOLE No 104

W P 259-66-04 LOCATION Coords. N 15 366 630; E 885 693 ORIGINATED BY AP
DIST 1 HWY EC Row Expy BOREHOLE TYPE Continuous Flight Auger and Cone Test COMPILED BY AMS
DATUM Geodetic DATE April 18, 1968 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT		UNIT WEIGHT γ PCF	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	100	W _p	W		
590.7	Ground Level												
0.0	Clayey Silt With Sand Traces of Gravel Occasional Silty Clay Layers Hard to Stiff		1	SS	22		590						2 11 52 35
			2	SS	32								
			3	SS	47		580						
			4	SS	37								
			5	SS	21								
			6	SS	19		570						3 25 45 27
			7	SS	20								
			8	SS	19		560						
			9	TW	PM								
			10	TW	PM		550						134 1 29 45 25
			11	TW	PM		540						
			12	TW	PM		530						129 1 21 48 30
			13	TW	PM		520						
			14	TW	PM		510						135 2 30 42 26
							500						
							490						
							480						
476.7													
114.0	Probable Bedrock End of Borehole Note: Water Level Not Established												

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 105

W P 259-66-04 LOCATION Coords. N 15 366 508; E 885 664 ORIGINATED BY AP
DIST 1 HWY EC Row Expy BOREHOLE TYPE Washbore - NX Casing and Cone Test COMPILED BY AMS
DATUM Geodetic DATE April 18, 1968 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ PCF	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
591.1	Ground Level																
0.0	Clayey Silt With Sand, Traces of Gravel Occasional Silty Clay Layers Hard to Stiff		1	SS	10		590										2 12 59 27
			2	SS	28												3 27 40 30
			3	SS	29												
			4	SS	25												
			5	SS	17												
			6	SS	12												
			7	TW	PM											135	2 27 44 27
			8	SS	11												
554.6			9	TW	PM											134	
36.5	End of Borehole																
	Note: Water Level Not Established																

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 106

W P 259-66-04 LOCATION Coords. N 15 366 605; E 885 810 ORIGINATED BY AMS
DIST 1 HWY EC Row Expy BOREHOLE TYPE Penn Drill, Core Drill and Cone Test COMPILED BY AMS
DATUM Geodetic DATE April 18, & 19, 1968 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH PSF ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 500 1000 1500 2000 2500	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ PCF	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES										
591.9	Ground Level														
0.0	Clayey Silt With Sand, Traces of Gravel Occasional Silty Clay Layers Hard to Stiff		1	SS	9		590								
			2	SS	9		580								
			3	SS	28										
			4	SS	15										
			5	SS	12										
			6	TW	PH			570							2 26 40 32
			7	TW	PH									134	
			8	TW	PH			560						135	
			9	TW	PH										
			10	TW	PH			550						135	
			11	TW	PH			540							
			12	TW	PH			530							
			13	TW	PH			520						115	0 0 (100)
			14A	SS	-			510							
			15	SS	6			500							
			16	SS	37			490							
470.2	Limestone					470									
121.7	Bedrock														
465.2															
126.7	End of Borehole														

Note: Water Level
Not Established

+3, x5: Numbers refer to
Sensitivity

20
15 - 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 108

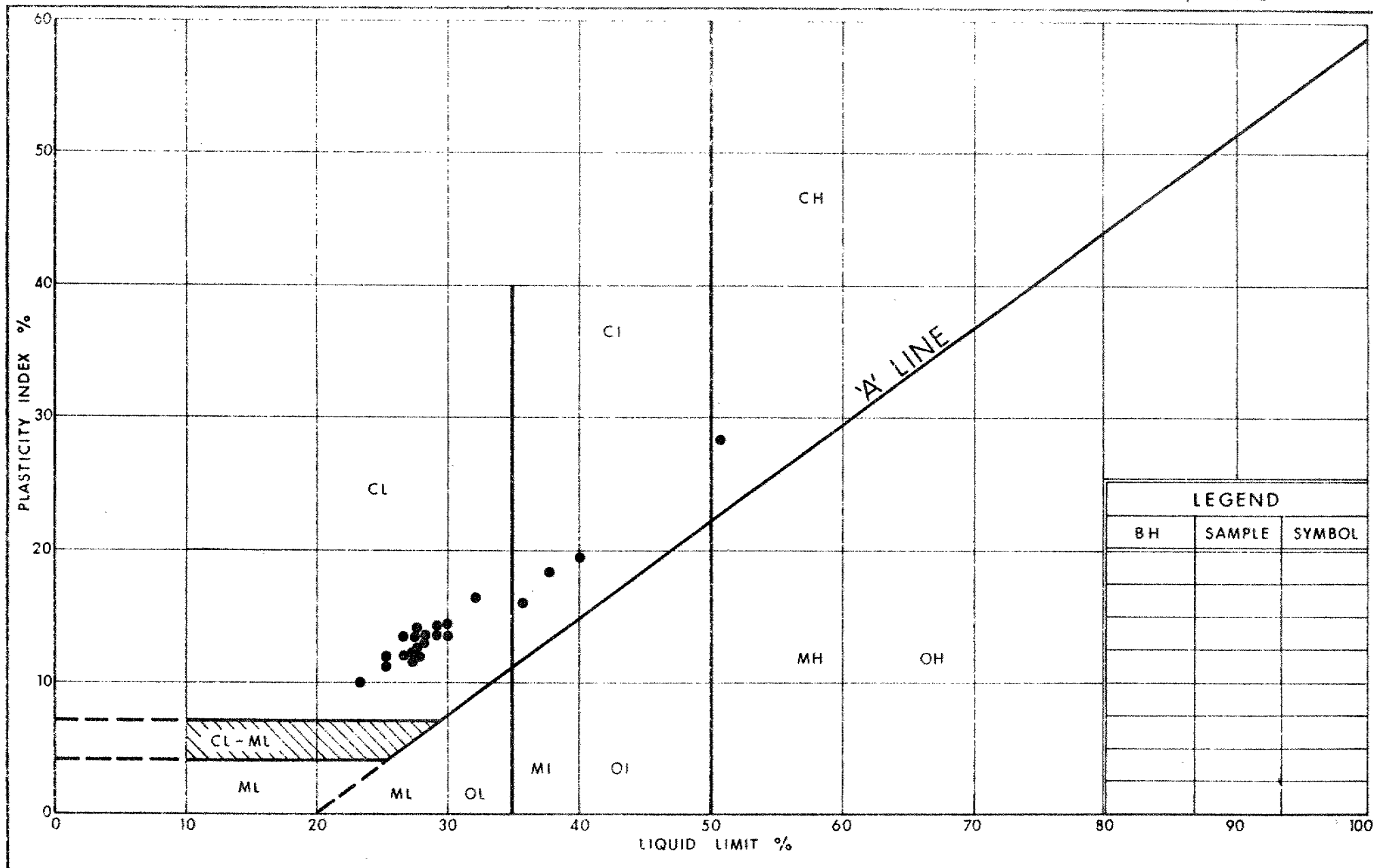
W P 259-66-04 LOCATION Coords. N 15 366 678; E 885 795 ORIGINATED BY AMS
DIST 1 HWY EC Row Expy BOREHOLE TYPE Continuous Flight Auger and Cone Test COMPILED BY AMS
DATUM Geodetic DATE April 19 & 22, 1968 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ PCF	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH PSF							WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 500 1000 1500 2000 2500							10 20 30				
552.0	Ground Level																		
0.0	Clayey Silt With Sand Traces of Gravel Occasional Silty Clay Layers Hard to Stiff		1	SS	9		590							0 7 64 29					
			2	SS	7														
			3	SS	27														
			4	SS	16														
			5	SS	11														
			6	TW	PH										133	9 24 37 30			
			7	TW	PH														
			8	TW	PH										134				
			9	TW	PH														
			10	TW	PH										136	3 30 38 29			
			11	TW	PH														
539.0							540												
53.0	End of Borehole																		

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



Ministry of
Transportation and
Communications

PLASTICITY CHART CLAYEY SILT, WITH SAND TRACES OF GRAVEL OCC SILTY CLAY LAYERS

FIG No 1

W P 259-66-04

made to Drawing No. 6-296-2 which shows the location and elevations of all borings, together with an inferred subsoil stratigraphy.

The cohesive deposit which extends to a depth of about 110 feet consists primarily of clayey silt (clay of low plasticity) with a trace of sand and gravel. It does contain, however, occasional layers of silty clay (clay of intermediate plasticity) including one which forms the upper six feet of the deposit. Results of Atterberg Limit Tests for both these soil types are shown in Figure 1 of the Appendix. In terms of other parameters the deposit must be divided into a desiccated crust some 10 to 15 feet in thickness and the lower undesiccated portion. The crust is brown in colour with an undrained shear strength ranging from 2000 to 5000 pounds per square foot. The soil below the crust is grey with undrained shear strength decreasing to a minimum of about 1500 pounds per square foot at a depth of 35 feet and then gradually increasing with depth. Samples from the crust have moisture contents of 15 to 18 percent for the clayey silt and approximately 25 percent for the silty clay. Below the crust moisture contents increased to 18 to 20 percent for the clayey silt and 35 percent for the silty clay.

Groundwater

Groundwater levels were recorded in the open boreholes during the period of the field investigation. They indicate that the groundwater level was at elevation 588 some five feet below the ground surface.

K. G. Selby

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

January, 1980.

APPENDIX



RECORD OF BOREHOLE No 1

W P 259-66-06 LOCATION Coords. N 15 366 346; E 884 746 ORIGINATED BY PJS
DIST 1 HWY E.C. Row BOREHOLE TYPE Hollow Stem Auger COMPILED BY PJS
DATUM Geodetic DATE December 15, 1978 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
591.2	Ground Level															
0.0	Silty Clay						590									
585.2	Very Stiff		1	SS	8											Om = .5%
6.0			2	SS	26											
			3	SS	15		580									
	Brown		4	TW	PH											P _c = 4.2t/ft ²
	Grey		4A	SS	9											C _c = 0.115
			5	TW	PH		570									E _o = 0.437
	Clayey Silt		5A	SS	9											
	Trace of Sand															
	and Gravel															
	Very Stiff to Stiff		6	TW	PH		560									
			7	SS	8		550									
			8	SS	8		540									
							530									
			9	TW	PH		520									
	Silty Clay															
	Layer															
			10	SS	8		510									
							500									
			11	SS	45		490									
							480									
475.2	Refusal to Augering															
116.0	End of Borehole															
	Probable Bedrock															

Note: Water Level
Not Established

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2

W P 259-66-06 LOCATION Coords. N 15 366 233; E 884 744 ORIGINATED BY PJS
 DIST 1 HWY E.C. Row BOREHOLE TYPE Hollow Stem Auger COMPILED BY PJS
 DATUM Geodetic DATE December 19, 1978 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH PSF							WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE						
593.4	Ground Level							20 40 60 80 100							
0.0	Silty Clay						590								
587.4	Very Stiff		1	SS	10										
6.0	Brown Grey Clayey Silt Trace of Sand and Gravel Very Stiff to Stiff		2	SS	31										
			3	SS	25										
			4	SS	22										
			5	TW	PH										144
			6	SS	12										
			7	TW	PH										137
564.9			8	TW	PH										
28.5	End of Borehole Note: Water Level Not Established														

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

W P 259-66-06 LOCATION Coords. N 15 366 260; E 884 853 ORIGINATED BY PJS
 DIST 1 HWY E.C. Row BOREHOLE TYPE Hollow Stem Auger COMPILED BY PJS
 DATUM Geodetic DATE December 19, 1978 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	100	200	300					
593.4	Ground Level															
0.0	Silty Clay															
587.4	Very Stiff		1	SS	11		590									
6.0			2	SS	26											
			3	SS	28											
			4	SS	16		580									
			5	SS	11											
			6	SS	14											
			7	SS	14											
			8	SS	9		570									
565.4																
28.0	End of Borehole															
	Note: Water Level Not Established															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4

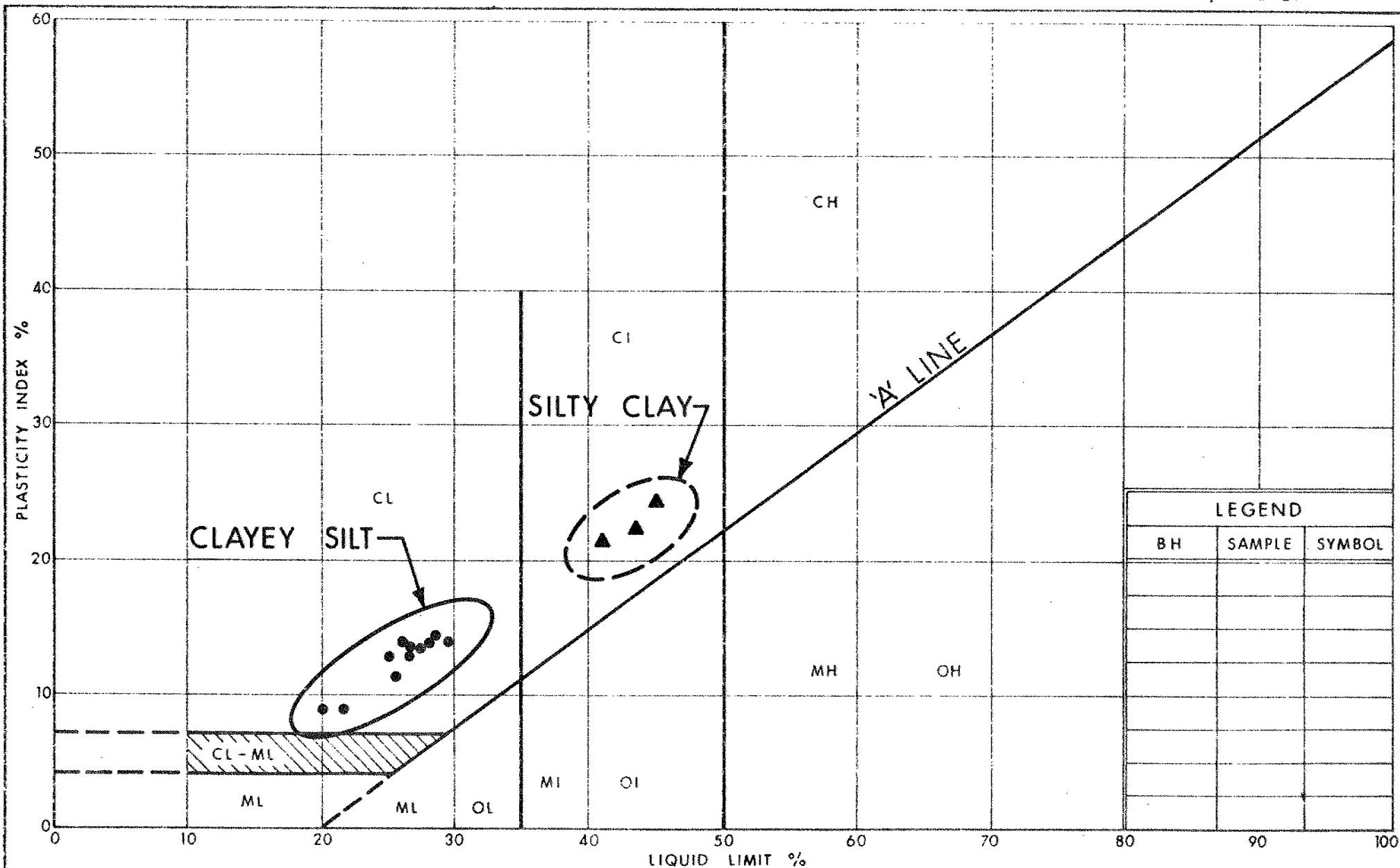
W P 259-66-06 LOCATION Coords. N 15 366 176; E 884 881 ORIGINATED BY PJS
DIST 1 HWY E.C. Row BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY PJS
DATUM Geodetic DATE December 13 & 14, 1978 CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	PSF					
592.6	Ground Level													
0.0	Silty Clay													
586.6	Very Stiff		1	SS	11		590							
6.0			2	SS	30									
			3	SS	22									
			4	SS	15									
			5	SS	11									
			6	SS	13									
			7	SS	9									
			8	SS	9									
			9	SS	9									
			10	SS	10									
			11	SS	15									
			12	SS	13									
			13	SS	11									
			14	SS	14									
			15	SS	26									
			16	SS	100/5"									
476.1	Sandy Silt Some Gravel (Fill) Very Dense		17	BXL	95% Rec									
116.5	Limestone													
471.6	Bedrock													
121.0	End of Borehole													

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

RQD = 82%

OFFICE REPORT ON SOIL EXPLORATION

Ministry of
Transportation and
Communications

- ▲ SILTY CLAY
- CLAYEY SILT, TRACE OF SAND & GRAVEL

FIG No 1

W P 259-66-06

VOID RATIO - PRESSURE CURVES

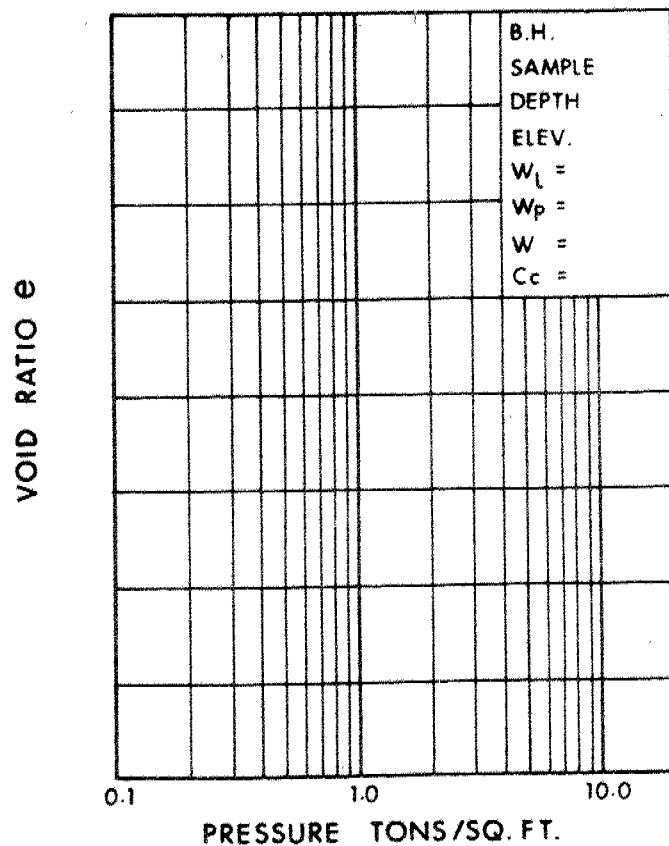
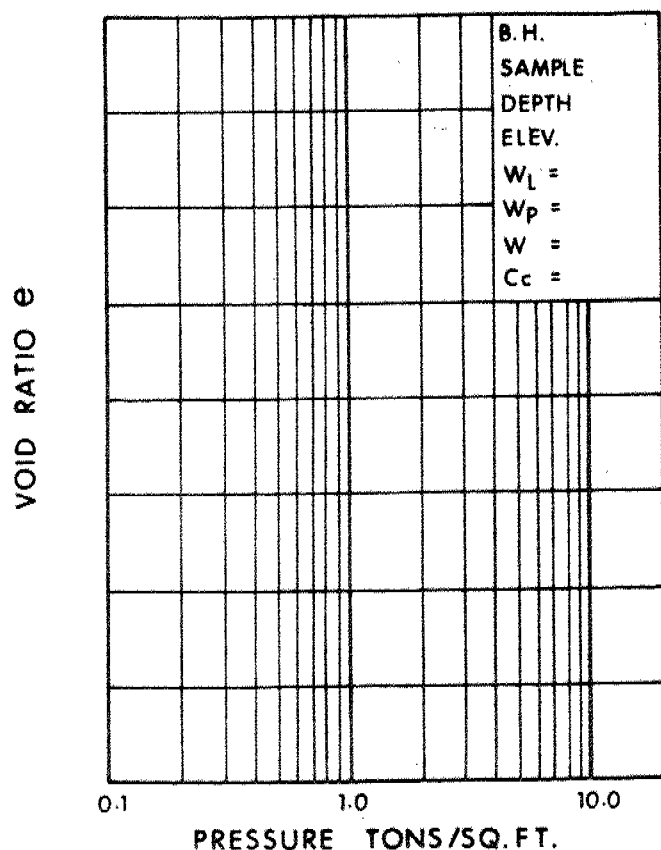
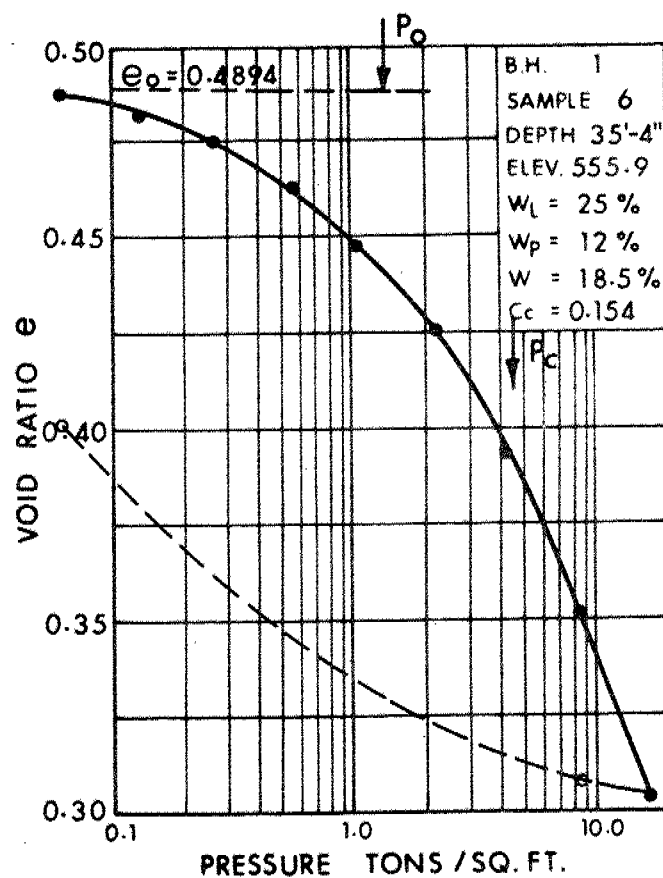
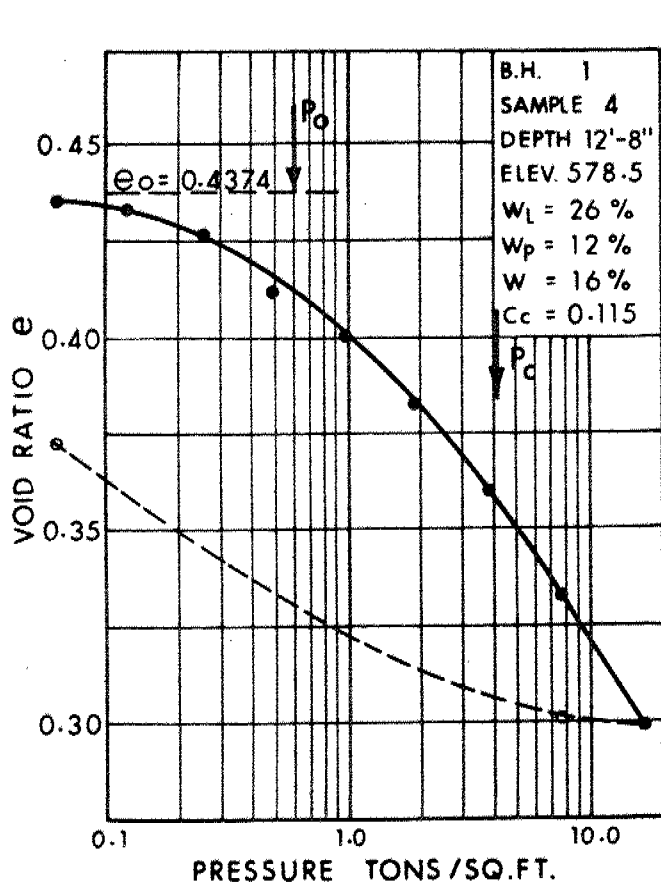


FIG. 2

W P 259-66-06

FOUNDATION INVESTIGATION REPORT

For

C.P.R. Overhead
on Lauzon Parkway Extension
W.P. 259-66-08, Site 6-298
E.C. Row Expressway, District 1, Chatham

INTRODUCTION

This report contains the results of a foundation investigation carried out for the above project. Fieldwork consisted of five sampled boreholes, two of which were accompanied by dynamic cone penetration tests. The boreholes were advanced during the period December 18 to 20, 1978 employing a CME 750 auger mounted on a rubber tired all-terrain vehicle. Hollow stem augers were used in all boreholes.

SITE DESCRIPTION

The site is located on the southeast boundary of the City of Windsor approximately 1/3 of a mile west of the present intersection of Lauzon Road and the C.P.R. rail line. The surrounding area is flat reflecting its physiographic description as part of the St. Clair Clay Plain. This area has remained agricultural and is engaged in the production of cash crops. The twin tracks of the Canadian Pacific Railway run on a low embankment approximately five feet in height. This embankment is flanked by shallow ditches and by a utility corridor on the south side. This corridor contains a high pressure gas main and a number of high voltage power lines running to the transformer station west of Lauzon Road.

SUBSURFACE CONDITIONS

Limestone bedrock is overlain by a cohesive deposit some 115 feet in thickness. It consists primarily of clayey silt (clay of low plasticity) containing traces of sand and gravel, as well as occasional layers of silty clay (clay of intermediate plasticity). A plot of liquid limit versus plasticity index for this deposit is shown as Figure 1 of the Appendix. A desiccated crust has developed

which extends to a depth of between 10 and 15 ft. It is brown in colour and has an undrained shear strength ranging from 2000 to 5000 p.s.f. In the undesiccated zone the shear strength decreases to about 1500 p.s.f. and then increases to in excess of 5000 p.s.f. in the 20 feet above the bedrock. Moisture content for the clayey silt ranges from 14 to 18 percent in the desiccated zone and from 16 to 20 percent in the undesiccated portion. The silty clay has a much higher moisture content ranging from 25 to 35 percent.

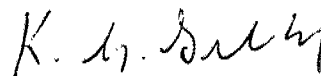
Reference should be made to the Record of Borehole Sheets which are contained in the report Appendix. They show a summary of all field and laboratory tests performed. Reference should also be made to Drawing No. 6-298-2 which shows the location and elevations of all borings, together with an inferred subsoil stratigraphy.

Groundwater

Groundwater levels were recorded in the open boreholes during the period of the field investigation. During this period groundwater levels were within five feet of the ground surface.

Design Considerations

It is proposed that Lauzon Parkway pass over the C.P.R. tracks on a three span structure approximately 185 feet in length. The proposed grade will require that the approach fills be 34 feet in height.



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

January, 1980.

APPENDIX

RECORD OF BOREHOLE No 1

W P 259-66-08 LOCATION Coords. N 15 364 722; E 885 627 ORIGINATED BY PJS
DIST 1 HWY E.C. Row BOREHOLE TYPE Hollow Stem Auger COMPILED BY PJS
DATUM Geodetic DATE December 18, 1978 CHECKED BY [Signature]

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		
594.0	Ground Level						SHEAR STRENGTH PSF						
							○ UNCONFINED + FIELD VANE						
							● QUICK TRIAXIAL x LAB VANE						
							500	1000	1500	2000	2500		
							WATER CONTENT (%)						
							Wp — W — WL						
							10	20	30				
0.0													
			1	SS	10								
			2	SS	34								
			3	SS	21								
			4	SS	15								
			5	SS	13								
			6	SS	11								
			7	SS	9								
			8	SS	9								
			9	SS	11								
			10	SS	9								
			11	SS	10								
			12	SS	14								
			13	SS	9								
			14	SS	40								
			15	SS	40								
478.9	Refusal to Augering												
115.1	End of Borehole												
	Probable Bedrock												

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15 — 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 2

W P 259-66-08 LOCATION Coords. N 15 364 670; E 885 607 ORIGINATED BY PJS
DIST 1 HWY E.C. Row BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY PJS
DATUM Geodetic DATE December 19, 1978 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
592.8	Ground Level																
0.0			1	SS	30		590										
			2	SS	25												
			3	SS	14												
			4	SS	11		580										
			5	SS	8												
			6	SS	10												
			7	SS	11		570										
			8	SS	11												
561.3																	
31.5	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 3

W P 259-66-08 LOCATION Coords. N 15 364 671; E 885 695 ORIGINATED BY PJS
DIST 1 HWY E.C. Row BOREHOLE TYPE Hollow Stem Auger COMPILED BY PJS
DATUM Geodetic DATE December 19, 1978 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
592.8	Ground Level																
0.0			1	SS	7		590										
			2	SS	31												
			3	SS	14												
			4	SS	13		580										
			5	SS	9												
			6	SS	12												
			7	SS	12		570										
			8	SS	12												
561.3																	
31.5	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 4

W P 259-66-08 LOCATION Coords. N 15 364 606; E 885 637 ORIGINATED BY PJS
DIST 1 HWY E.C. Row BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY PJS
DATUM Geodetic DATE December 19, 1978 CHECKED BY EP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH PSF ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 500 1000 1500 2000 2500	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
592.2	Ground Level												
0.0							590						
			1	SS	11								
			2	SS	44								
			3	SS	24								
			4	SS	9								
			5	SS	10								
			6	SS	16								
			7	SS	13								
			8	SS	12								
559.2							560						
33.0	End of Borehole												

Handwritten notes in the form:

- Ground Level: 592.2
- 0.0: Brown Grey
- Clayey Silt
- Traces of Sand and Gravel
- Occasional Layers of Silty Clay
- Hard to Stiff
- 590: 2200
- 570: 2240
- 560: 2240

OFFICE REPORT ON SOIL EXPLORATION



27

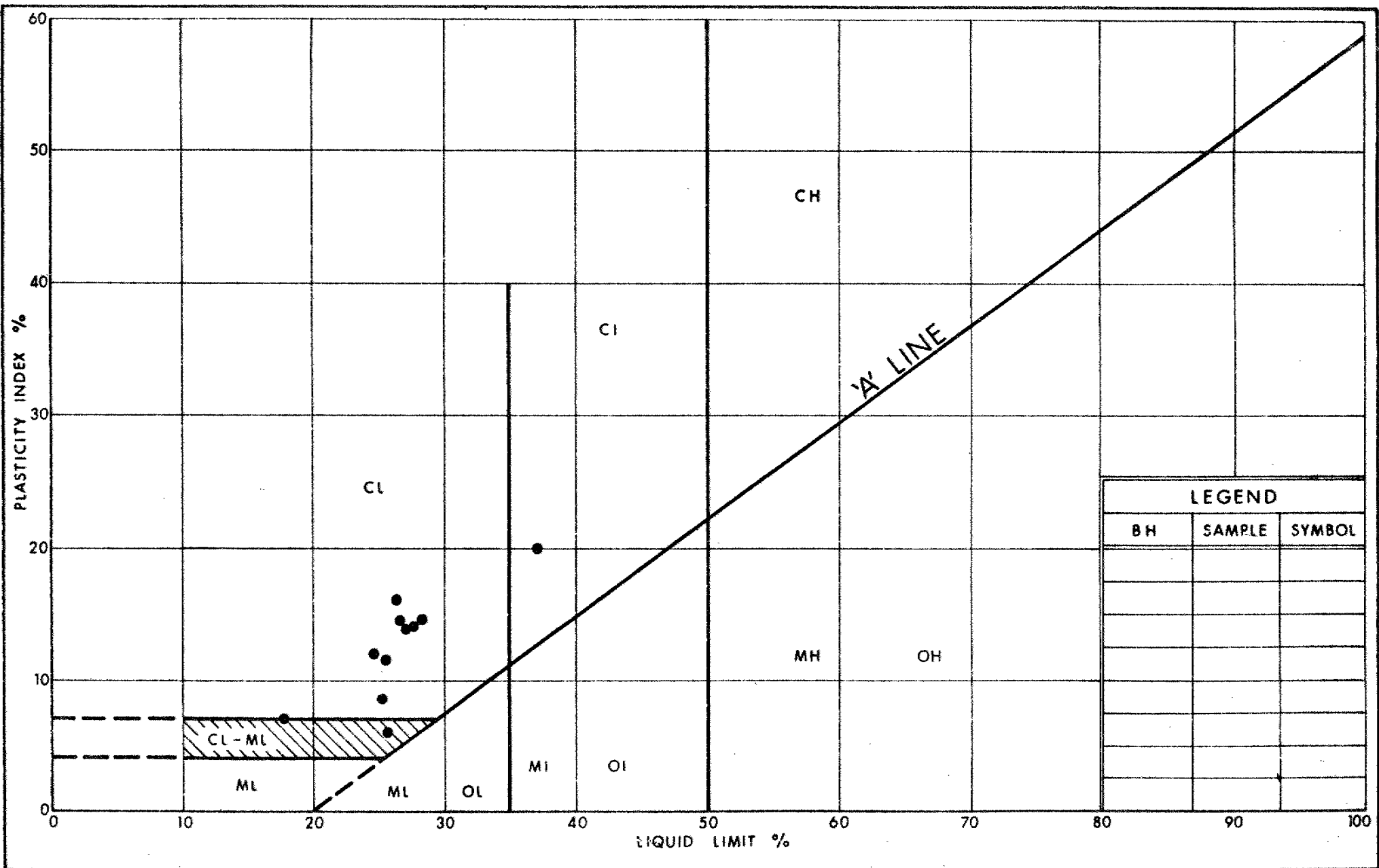
W P 259-66-08 LOCATION Coords. N 15 364 603; E 885 726 ORIGINATED BY PJS
DIST 1 HWY E.C. Row BOREHOLE TYPE Hollow Stem Auger COMPILED BY PJS
DATUM Geodetic DATE December 20, 1978 CHECKED BY [Signature]

Note: Water Level
Not Established

+3, x5: Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

Ministry of
Transportation and
Communications

PLASTICITY CHART

CLAYEY SILT, TRACES OF SAND & GRAVEL
OCC LAYERS OF SILTY CLAY

FIG No 1

W P 259-66-08

VOID RATIO-PRESSURE CURVES

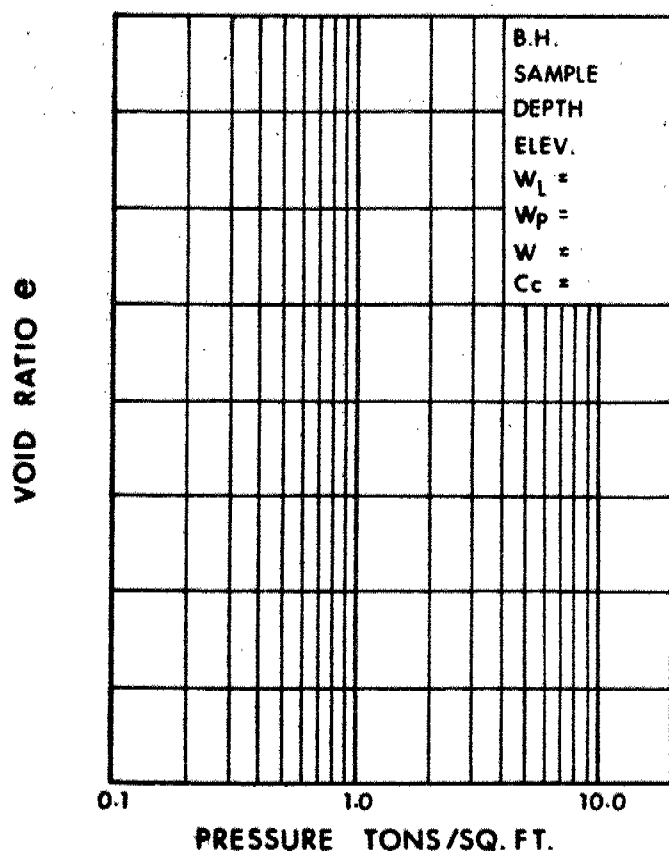
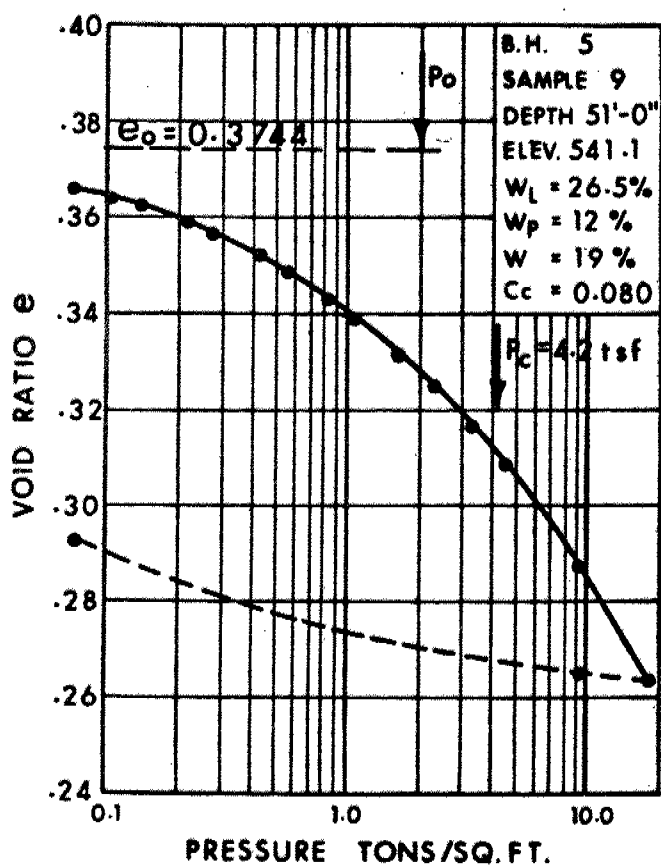
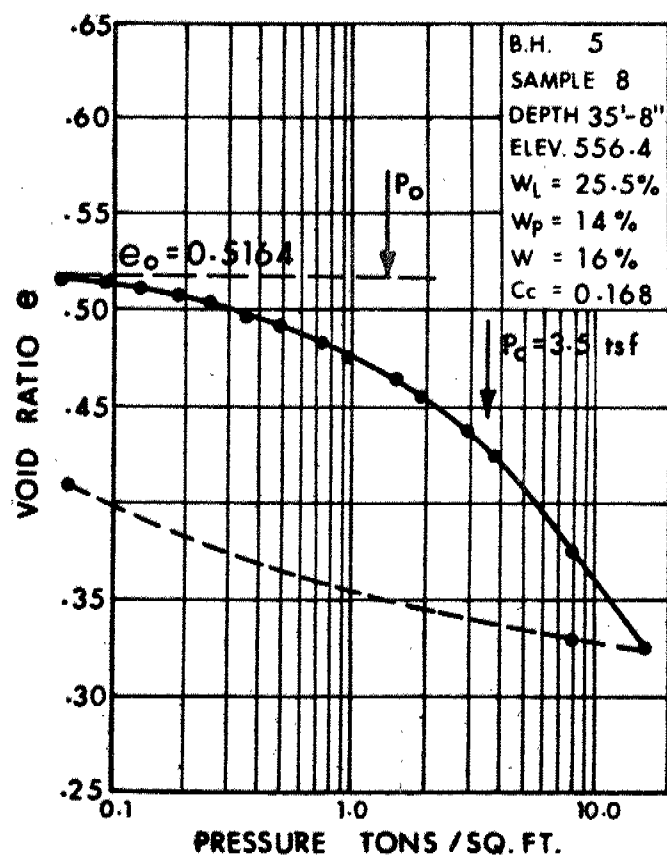
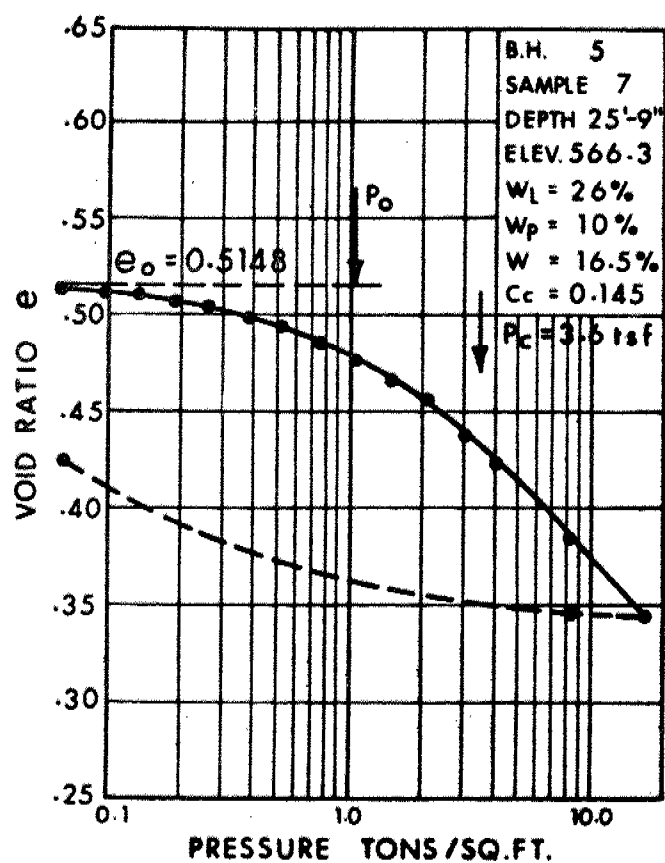


FIG. 2

WP 259-66-08

ENGINEERING MATERIALS OFFICE
SOIL MECHANICS SECTION

WP 259-66-04 DIST 1
HWY ECR Expy STR SITE 6-52

Little River Bridge
3.2 Miles East of Walker Road

DISTRIBUTION

A.P. Watt (2)
J.R. Roy
A. Wittenberg
J.H. Blevins (2)

A.E. McKim
G.A. Wrong
B.J. Giroux

R. Hore

A. Crowley)
J. Anderson) cover only
G. Sloan)

Files J

SAMPLE DISPOSITION NOTICE		
TYPE	DISCARD AFTER	RECOMM. BY
JARS	79-05-14	PP
TUBES	79-05-14	PP
ROCK CORES	79-05-14	PP

FOUNDATION INVESTIGATION REPORT

For

Little River Bridge
3.2 Miles East of Walker Road
W.P. 259-66-04, Site 6-52
E.C. Row Expressway, District 1, Chatham

INTRODUCTION

This report contains the results of a foundation investigation carried out for the above project. Fieldwork consisted of four sampled boreholes, each accompanied by a dynamic cone penetration test. This work was carried out during the period April 18 to 22, 1968 employing four inch diameter solid augers, as well as casing and washboring techniques. Bedrock was proven in one borehole by the recovery of AXT rock core.

SITE DESCRIPTION

The site is located on the eastern outskirts of the City of Windsor approximately 100 feet north of the existing E.C. Row Blvd. structure over the Little River. The surrounding terrain is flat reflecting its physiographic designation as part of the St. Clair Clay Plain. This part of the city has remained largely agricultural with the land engaged in the production of cash crops. The Little River has been straightened and dredged to act as an agricultural drain.

SUBSURFACE CONDITIONS

General

The subsoil which overlies limestone bedrock, consists of a 120 foot thick cohesive deposit. It is primarily clayey silt (clay of low plasticity) with sand and a trace of gravel but also contains isolated layers of silty clay (clay of intermediate plasticity). A plot of liquid limit versus plastic index for samples from the deposit is shown as Figure 1 of the Appendix.

Reference should be made to the Record of Borehole Sheets which are contained in the report Appendix. They show a summary of the

results of all field and laboratory tests performed. Reference should also be made to Drawing No. 2596604-A which shows the location and elevation of all borings, as well as an inferred subsoil stratigraphy.

Clayey Silt

The overburden which is primarily clayey silt with sand and traces of gravel is about 120 feet in thickness. It has developed a desiccated crust 15 to 20 feet thick which is brown in colour and has an undrained shear strength ranging from 2000 to 5000 psf. Beneath the crust the subsoil is grey and decreases in undrained shear strength to approximately 1500 psf at a depth of 30 feet before gradually increasing again with depth. Moisture content of the clayey silt ranges from 15 percent in the crust to as high as 25 percent in the lower undesiccated zone. The isolated silty clay layers found throughout the deposit have a much higher moisture content ranging from 25 to 35 percent.

Limestone Bedrock

Sound limestone bedrock was encountered at elevations 470 and 476 approximately 120 feet below the ground surface.

Groundwater

Groundwater was encountered at elevation 586 approximately six feet below the ground surface.

DESIGN CONSIDERATIONS

It is proposed that the E.C. Row Expressway cross the Little River on a rigid frame structure with a span of approximately 40 feet. The road grade will be at approximate elevation 596 requiring approach fills about five feet in height.

RECOMMENDATIONS

Spread Footings

The structure may be supported on spread footings at elevation 578 or higher with a design loading of two tons per square foot. A design adhesion value of 2000 psf should be used to calculate resistance to sliding. It is predicted that the maximum settlement in this case will be three inches.

Piles to Bedrock

As an alternative the structure may be supported on piles driven to bedrock at approximate elevation 470. Either steel tube piles (12 3/4" x 1/4") or HP 12 x 74 piles will carry design loads of up to 120 tons per pile. If tube piles are adopted the driving energy must be reduced to less than 30,000 ft.lb.per blow when the pile tip is below elevation 484. If H piles are employed the tips should be reinforced with standard flange plates to increase the contact area between the pile tip and the bedrock. If piles to bedrock are employed the structure settlement will be less than one inch.

Dewatering

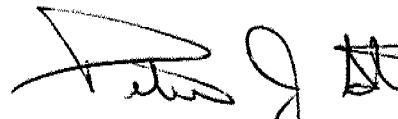
No dewatering problems are anticipated due to the relatively impervious nature of the upper layers of the subsoil.

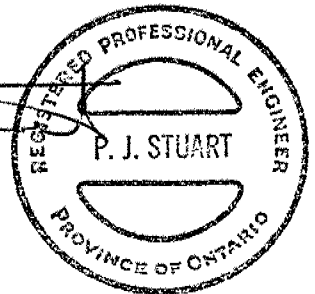
Frost Protection


The base of all footings or pile caps should be protected from frost action by a minimum of four feet of cover.

Approach Embankment

Slopes should be constructed two horizontal to one vertical and rip-rapped above a high water elevation as specified in the Hydrology Report.


P.J. Stuart, P. Eng.
Project Engineer




P. Payer, P. Eng.
Senior Engineer

May, 1979

APPENDIX

RECORD OF BOREHOLE No 104

W P 259-66-04 LOCATION Coords. N 15 366 630; E 885 693 ORIGINATED BY AP
 DIST 1 HWY EC Row Expy BOREHOLE TYPE Continuous Flight Auger and Cone Test COMPILED BY AMS
 DATUM Geodetic DATE April 18, 1968 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ PCF	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH PSF					
590.7	Ground Level								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 500 1000 1500 2000 2500					
0.0	Clayey Silt With Sand Traces of Gravel Occasional Silty Clay Layers Hard to Stiff		1	SS	22		590							2 11 52 35
			2	SS	32		580							
			3	SS	47									
			4	SS	37									
			5	SS	21									
			6	SS	19		570							3 25 45 27
			7	SS	20									
			8	SS	19		560							
			9	TW	PM									
			10	TW	PM		550						134	1 29 45 25
			11	TW	PM		540							
			12	TW	PM		530						129	1 21 48 30
			13	TW	PM		520							
			14	TW	PM		510						135	2 30 42 26
476.7							500							
114.0	Probable Bedrock End of Borehole Note: Water Level Not Established						480							

+³, x⁵: Numbers refer to
Sensitivity

20
15
10

5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 105

W P 259-66-04 LOCATION Coords. N 15 366 508; E 885 664 ORIGINATED BY AP
DIST 1 HWY EC Row Expy BOREHOLE TYPE Washbore - NX Casing and Cone Test COMPILED BY AMS
DATUM Geodetic DATE April 18, 1968 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y PCF	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH PSF							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
591.1	Ground Level							20 40 60 80 100	500 1000 1500 2000 2500	10 20 30					
0.0	Clayey Silt With Sand, Traces of Gravel Occasional Silty Clay Layers Hard to Stiff		1	SS	10		590							2 12 59 27	
			2	SS	28									3 27 40 30	
			3	SS	29										
			4	SS	25		580								
			5	SS	17										
			6	SS	12		570								
			7	TW	PM								135	2 27 44 27	
			8	SS	11		560								
554.6				9	TW	PM									
36.5	End of Borehole Note: Water Level Not Established														



RECORD OF BOREHOLE No 106

W P 259-66-04 LOCATION Coords. N 15 366 605; E 885 810 ORIGINATED BY AMS
DIST 1 HWY EC Row Expy BOREHOLE TYPE Penn Drill, Core Drill and Cone Test COMPILED BY AMS
DATUM Geodetic DATE April 18, & 19, 1968 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH PSF							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
591.9	Ground Level					20 40 60 80 100	500 1000 1500 2000 2500	10 20 30							
0.0	Clayey Silt With Sand, Traces of Gravel Occasional Silty Clay Layers Hard to Stiff		1	SS	9								2 26 40 32		
			2	SS	9										
			3	SS	28										
			4	SS	15										
			5	SS	12										
			6	TW	PH										
			7	TW	PH									134	
			8	TW	PH									135	
			9	TW	PH										
			10	TW	PH									135	
			11	TW	PH										
			12	TW	PH										
			13	TW	PH									115	
			14A	SS	-										
			15	SS	6										
			16	SS	37										
470.2															
121.7	Limestone														
465.2	Bedrock		17	AXT	Rec										
126.7	End of Borehole														

Note: Water Level
Not Established

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

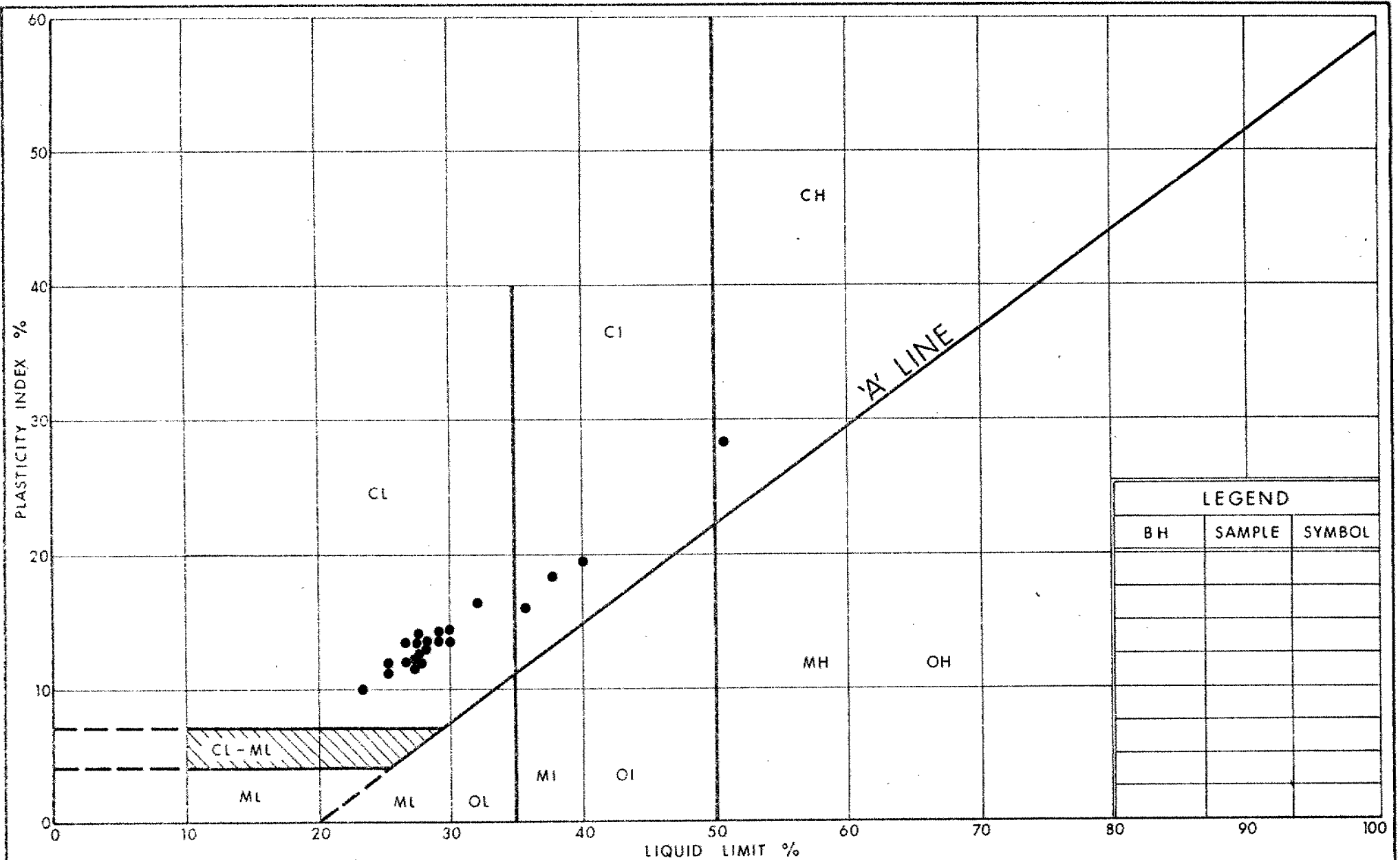


RECORD OF BOREHOLE No 108

W P 259-66-04 LOCATION Coords. N 15 366 678; E 885 795 ORIGINATED BY AMS
DIST 1 HWY EC Row Expy BOREHOLE TYPE Continuous Flight Auger and Cone Test COMPILED BY AMS
DATUM Geodetic DATE April 19 & 22, 1968 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ PCF	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH PSF						WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	500 1000 1500 2000 2500	10 20 30					
592.0	Ground Level														
0.0	Clayey Silt With Sand Traces of Gravel Occasional Silty Clay Layers Hard to Stiff		1	SS	9		590							0 7 64 29	
			2	SS	7										
			3	SS	27										
			4	SS	16										
			5	SS	11										
			6	TW	PH										
			7	TW	PH										
			8	TW	PH										
			9	TW	PH										
			10	TW	PH										
			11	TW	PH										
539.0	End of Borehole						540								
53.0															

OFFICE REPORT ON SOIL EXPLORATION



Ministry of
Transportation and
Communications

PLASTICITY CHART
CLAYEY SILT, WITH SAND TRACES OF GRAVEL
OCC SILTY CLAY LAYERS

FIG No 1

W P 259-66-04

EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS N_c .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

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

S_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

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

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCK QUALITY: 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 DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4"+ 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	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAXIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG. $\bar{C}U$ = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

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

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ ANGLE OF WALL FRICTION
 k_o COEFFICIENT OF EARTH PRESSURE AT REST
 k_A COEFFICIENT OF ACTIVE EARTH PRESSURE
 k_P COEFFICIENT OF PASSIVE EARTH PRESSURE
 i ANGLE OF INCLINATION OF SURCHARGE
 w SLOPE ANGLE-BACKFACE OF WALL
 β ANGLE OF SLOPE
 N_q, N_c BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_o INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e IN DENSEST STATE
 D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_P PLASTIC LIMIT
 w_S SHRINKAGE LIMIT
 I_P PLASTICITY INDEX = $w_L - w_P$
 I_L LIQUIDITY INDEX = $\frac{w - w_P}{w_L - w_P}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w}{w_L - w_P}$
 A_c ACTIVITY = $\frac{I_P \text{ of soil}}{I_P \text{ of } 2\mu m \text{ Soil Fraction}}$
 Om ORGANIC MATTER CONTENT
 S_r DEGREE OF SATURATION
 S SENSITIVITY = $\frac{S_u \text{ (undisturbed)}}{S_u \text{ (remoulded)}}$

STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_R RESIDUAL SHEAR STRENGTH
 c COHESION INTERCEPT
 $\sigma_1, \sigma_2, \sigma_3$ NORMAL PRINCIPAL STRESSES
 u PORE WATER PRESSURE
 u_e EXCESS u
 r_u PORE PRESSURE RATIO
 q_u UNCONFINED COMPRESSIVE STRENGTH
 s_u UNDRAINED SHEAR STRENGTH
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_s MODULUS OF SUBGRADE REACTION
 m, n STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
 ϕ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE;
 σ' = EFFECTIVE NORMAL STRESS

HYDRAULIC TERMS

h HYDRAULIC HEAD OR POTENTIAL
 q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 j SEEPAGE FORCE PER UNIT VOLUME
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 m_v COEFFICIENT OF VOLUME CHANGE
 c_v COEFFICIENT OF CONSOLIDATION
 C_c COMPRESSION INDEX
 C_r RECOMPRESSION INDEX
 d DRAINAGE PATH DISTANCE
 T_v TIME FACTOR
 U DEGREE OF CONSOLIDATION
 O_c OVERCONSOLIDATION RATIO (OCR)

