

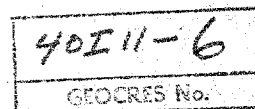
e. m. peto associates ltd.

YOUR REFERENCE:- W. P. 58-59

OUR REFERENCE:- 4081

1287 caledonia road,
TORONTO 19, ONTARIO.
RUssell 9-1126

April 18, 1960.



Department of Highways of Ontario,
Materials and Research Section,
Parliament Buildings,
Toronto 2, Ontario.

Attention: Mr. K. Peaker, P. Eng.

re: Road All'ce. between Lots 13 and 19,
Twp. of Danwich, Hwy. 401 -
W. P. 58-59 --- District No. 2

Dear Sirs:

We refer to Mr. A. Rutka's letter dated March 14, 1960, authorizing this investigation, and we have pleasure in forwarding herewith ten (10) copies of the soils report on this site.

Details of soil conditions, etc., are given in the main report, here for your convenience we give a summary of the findings and recommendations.

1. The soil profile was made up of three strata consisting of:
 - a) an average thickness of 3 feet of topsoil followed by
 - b) a stratum of very loose to compact pale brown fine to medium sand with an average thickness of approximately 2'6". It was saturated.
 - c) a deep stratum of grey silty clay which was normally loaded with a desiccated or precompressed upper portion. Although this stratum was saturated, no free ground water was encountered in it, in fact the ground water table established at approximately 3 feet below existing grade was a perched water table condition arising in the overlying sand stratum and it would be reasonable to assume that this water condition is reasonable.

2. The proposed bridge foundation may be placed at any convenient depth within the upper desiccated crust which is some 20 feet thick. Details of the allowable bearing values are given in the main report.
3. The existing soil conditions present no problems in respect of the approach embankments.
4. No difficulty is foreseen in regard to excavation or ground water conditions on this site apart from a seepage condition which will vary with the season of the year.

We believe we have covered the essential points in respect of this investigation. However, we shall be pleased to be of further service where-ever possible.

Yours very truly,
E. M. PETO ASSOCIATES LTD.



E. M. PETO, P. Eng.

CFF/vs
Encl.

THE DEPARTMENT OF HIGHWAYS OF ONTARIO

SOILS REPORT
for
UNNAMED COUNTY ROAD

April, 1960.

Job No. 0051

Client's Ref. No. W. P. 55-56

Date April 14, 1960.

Report on
SOIL SITE INVESTIGATION
UNNAMED COUNTY ROAD

for
THE DEPARTMENT OF HIGHWAYS OF ONTARIO

INTRODUCTION:

We were asked verbally by Mr. K. Peaker, P. Eng. to conduct a sub-soil investigation at the proposed intersection of Highway 401 and the Unnamed County Road in the township of Dunwich, W. P. 55-56.

The investigation was called for to obtain the details of soil stratification, the shear strength of the soil and any other characteristics likely to affect the proposed foundation of the Highway 401 Underpass.

The site investigation was begun on March 15th and was completed on March 24th. Three test holes and two probe holes were put down at locations as shown on the site plan drawing.

GENERAL INFORMATION:

1. The test holes were put down in accordance with our standard procedure as outlined in Appendix III. The details of the test holes (i. e. the elevation at the existing grade, the diameter of the hole and the terminal depth) were as follows:

<u>Test Hole</u>	<u>Elevation</u>	<u>Diameter of Hole</u>	<u>Terminal Depth</u>
1	728.76	BX	52'0"
2	728.92	4" Pipe and BX	102'6"
3	728.57	BX	51'0"
Probehole 1	729.83) Dutch	17'0"
" 2	727.22) Cone	15'0"

GENERAL INFORMATION: Cont'd.

2. The elevations as given above, in the following report, on the graphs and the site plan drawing are in reference to the B. M., N. & W. in South foot of stump of 3 feet dia. elm, sta 173+15, 115 feet right of the proposed centre line; the elevation of the B. M. was taken to be 725.52.
3. The detailed soil stratification, the results of standard penetration tests, and the natural moisture contents are given on the borehole logs.
4. The location of the test holes and the assumed soil profile are given on the attached site plan drawing.
5. The results of the laboratory tests (Atterberg Limits, Mechanical analysis and the unconfined compressive tests) are given under 'Laboratory test results' in appendix I.
6. Graphical representation of the results of standard penetration tests, the natural moisture contents and the Atterberg Limits, and finally the undrained shear strength versus elevation are given in Appendix III.

SITE AND GEOLOGY:

The site for the proposed underspan is located at the county road between lots 15 and 16 in the township of Dunwich, county of Elgin. The site is surrounded by relatively flat agricultural land with a few clusters of bush. The elevations decrease to the north west. There is a drainage ditch on the East side of the road draining to the North into a creek. At the time of the investigation, the water level in the ditch was at elevation 725.0.

Geologically, the site is located on a clay plain. All boreholes put down at this site, encountered a layer of lacustrine sand overlying the silty clay with grits and pebbles (glacial till).

SOIL CONDITIONS:

During the present investigation, the following main soil strata were encountered:

- (a) Mixed grey to dark grey-brown organic clayey loam (topsoil)
- (b) Pale-brown fine to medium sand
- (c) Grey silty clay

In the following a detailed description of each soil layer is given:

SOIL CONDITIONS: Cont'd.

(a) Topsoil

The uppermost layer at the site investigated was found to be organic clayey loam, and the colour varied from mixed grey to dark grey-brown. The depth of the topsoil was found to be as follows:

Test hole 1 - 2'0" below the existing grade

Test hole 2 - 3'6" " " "

Test hole 3 - 3'6" " " "

The density of the topsoil varied between soft to firm with N values (i. e. number of blows in standard penetration test) of 3 to 5.

The natural moisture contents recorded were between 17.0% and 27.4%.

(b) Pale-brown fine to medium sand

Underlying the topsoil a layer of fine to medium sand, pale-brown in colour, was encountered. The thickness of this stratum was nearly constant throughout the investigated site. At test hole 1, the upper and the lower limits of the sand layer were established at depths of 2'0" and 5'2" below the existing grade, at test holes 2 and 3, between 3'0" and 3'6" below the existing grade. Thus, as may be seen, the lower boundary between the sand and the underlying clay stratum is nearly horizontal.

The fine to medium sand layer was of very loose to compact density.

The natural moisture content of the sand was found to be at about 20% (test hole 1, - 2-3 feet depth - 20.7%, test hole 3, 5-8 feet depth - 20.5%). These results indicated that the sand layer was saturated and this condition was confirmed by examination of the samples.

(c) Grey silty clay

Following the layer of fine to medium sand, there was a stratum of grey silty clay.

The lower limit of this layer could not be established, although test hole 2 was put down to 102'6".

The results of the standard penetration test indicate that the clay stratum is much stiffer at its upper portions where at some depth the density of the clay decreases. This condition suggests that the upper portion of the clay is desiccated or preconsolidated.

SOIL CONDITIONS:

(c) Grey silty clay: Cont'd.

A closer analysis of the results of the natural moisture content shows that although there is some indication that the upper portion of the clay is slightly drier and the moisture content increases with depth to about 87%, it certainly is not the sole cause of the quite stiff character of the upper portion of the clay stratum. Thus, it may be assumed that the clay stratum is preconsolidated.

In test hole 1 the N values are nearly constant to a depth of about 15 feet and vary between 20 and 22. From thereon, an increase in density is evident and the N values increase to 35 (depth 20'6"-21'6") and then to 38 (depth 24'6" to 25'6"). From about 32 feet below the existing grade the clay layer softens and the N values drop down to 14 at 35'6" to 36'6". Considerable variation in the results of the standard penetration test was observed from the 40 feet depth. The inconsistency is considered to be due to the presence of grits or pebbles.

In test hole 2, a gradual decrease in density was observed. At 12 to 13 feet an N value of 31 was recorded and at 35'6" to 36'6" only 9 blows per foot penetration was obtained.

Test hole 3 displayed similar variations in density as test hole 1, i.e. an initial increase in N values was seen to a depth of about 22 feet and from thereon nearly constant decrease in density could be observed.

The natural moisture contents on the other hand were found to increase with depth at test hole 1 and 2 from about 19% at 5 to 6 feet depth to 25% at 40 feet depth.

At test hole 3, nearly constant moisture contents prevailed from 20 to 37 feet depth.

The results of the mechanical analyses was as follows:

Test hole	Depth	Elevation	Per cent		
			Sand	Silt	Clay
3	11'9"-12'9"	716.3	6	42	52
3	21'6"-22'6"	706.6	7	42	51
3	40'0"-41'0"	688.1	5	53	42
2	35'0"-36'0"	643.4	6	39	55

As may be seen the results of the mechanical analyses suggest that the clay stratum is fairly uniform with depth, and apart from the results at elevation 688.1, the material represents a clay soil. The silt content varies only slightly in the upper portion of the clay stratum.

SOIL CONDITIONS:

(c) Grey silty clay: Cont'd.

The uniform character of the clay deposit could also be seen from the results of the Atterberg limits. The results of the tests were as follows:

Test Hole	Depth	Average Elevation	L. L.	Per Cent P. L.	Pl.
1	7'0"-8'0"	721.3	38.5	20.7	17.9
1	10'0"-11'0"	718.2	38.3	19.3	18.7
1	20'0"-21'0"	707.7	39.3	19.7	18.9
1	30'0"-31'0"	697.7	37.9	19.3	18.1
1	40'0"-41'0"	687.7	36.7	19.0	17.7
1	50'0"-52'0"	677.7	36.1	19.3	18.3
2	71'0"-72'0"	657.3	36.7	18.3	17.3
2	91'0"-92'0"	626.2	36.7	20.4	19.3

The results of these tests (i. e. Liquid Limits and Plastic Limits) have been plotted on graph versus elevation together with the results of the natural moisture contents.

First of all, it may be seen that the Atterberg limits are nearly constant with depth. With the maximum Liquid Limit of 39.7% and minimum of 36.7%, the maximum plasticity index of 19.3% and a minimum of 17.7% were calculated.

Comparing the natural moisture contents with the value of the Plastic Limit, it may be seen that the soil at its upper portion is slightly drier than its plastic limit, gradually changing to wetter than plastic limit. At no time was the moisture content at, or wetter than, the liquid limit of the clay. For the grey clay stratum the following average values may be taken:

Wet density $w = 134.0$ lb. per cu. ft.
 Dry density $d = 109.0$ lb. per cu. ft.
 Void ratio $e = 0.540$
 Degree of Saturation $S = 120.0\%$

The results of the unconfined compressive tests are given in tabular form in appendix I. The unconfined shear strength versus elevation are shown graphically in appendix II. As may be seen, the results from all the test holes agree well. The shear strength of the silty clay decreases from a value about 4500 p.s.f. at elevation 711 to 1800 p.s.f. at elevation 675. From there on a nearly linear increase in shear strength is assumed. Such a shear strength distribution with depth indicates a normally loaded clay with a desiccated or precompressed upper portion, which substantiates the conclusion previously reached.

WATER CONDITIONS:

A perched water table was observed to exist in the fine to medium sand layer, overlying the grey silty clay layer.

On completion of the investigation, the water level was at about 2 feet below the existing grade.

OBSERVATIONS AND RECOMMENDATIONS:

1. The soil conditions appear to be very uniform over the whole area investigated.
2. The grey silty clay layer has a stiff crust capable of supporting a proposed bridge structure and the embankment.
3. The allowable bearing values for the bridge structure may be given as follows:

Proposed Foundation Elevation	Width of Footings	Allowable Bearing Value in tons per sq. ft.	
		Cont.	Square
from 720 to 700	5	3.25	3.50
	10	3.25	3.50
	15	2.95	3.50
	20	2.70	3.30

Placing the foundations below elevation 700 is not recommended as the lower shear strength of the clay layer at elevation 670 will reduce considerably the allowable bearing value.

The allowable bearing value as given above has a Factor of Safety of 3 against shear failure.

Due to the character of the soil (moisture contents only slightly higher than the plastic limit, and the low void ratio) no settlement problem is anticipated at the above site.

4. No difficulty is foreseen in placing the proposed embankment at the above site. The analysis showed that for side slopes of 1 vertical to 2 horizontal a maximum height of embankment of about 60 feet could be placed without danger of possible slip failure taking place. (a 42 feet high embankment has F.S. = 1.57)
5. The embankment should be placed on the upper portion of the grey silty clay. The embankment may be placed in one operation.

OBSERVATIONS AND RECOMMENDATIONS: Cont'd.

8. No difficulties are foreseen with regard to water conditions apart from seepage water, and the activity of this will vary with the seasonal changes of weather.

E. M. PETO ASSOCIATES LTD.

C. F. Freeman

C. F. Freeman, P. Eng.
Chief Engineer.

BL/vs

APPENDIX I

LABORATORY TEST RESULTS

UNCONFINED COMPRESSION TEST DATA SHEET

JOB NO. 6051

Borehole #	Depth (Feet)	Elevation (Feet)	M.C. Tin No.		Densities p.c.f.		Degree of Saturation %	Void ratio e	% Strain at Failure	a/c Shear Strength p.c.f.
			Nat	M.C.	Wet	Dry				
1	17'-17'6"	711.5	31.7		134.7	118.8	100.0	.324	20.0	4100
1	24'-24'5"	704.5	31.7		134.0	119.3	100.0	.326	20.0	3210
1	30'-30'6"	698.5	24.3		152.2	105.3	100.0	.582	20.0	2820
1	50'-50'8"	673.5	23.6		132.1	107.0	100.0	.575	20.0	3440

UNCONFINED COMPRESSION TEST DATA SHEET

JOB NO. 6051

Bore hole#	Depth (Feet)	Elevation (Feet)	M.C. Tin No.	Approx. Densities p.c.f.		Approx. Degree of Fabrication %	Approx. void ratio, e	u/c shear strength p.s.f.
			Nat. M.C.	Wet	Dry			
	7' - 8'	721.4	17.8	137.0	116.5	100	.44	> 7800
	12'6" - 13'	719.2	18.5	135.0	114.0	100	.47	> 7300
	17' - 17'6"	711.5	21.0	133.5	113.0	100	.48	4600
	23' - 23'6"	705.5	22.1	132.0	108.0	100	.55	3300
	29'6" - 30'	702.2	23.2	130.3	106.0	100	.50	3440
	41'4" - 42'4"	697.0	24.3	132.3	107.0	100	.59	1870
	53'4" - 54'4"	695.0	24.7	132.0	105.5	100	.58	1870
	71'8" - 72'8"	686.7	23.0	135.0	110.5	100	.52	2020
	85' - 86'	643.4	23.0	140.0	114.0	100	.48	3100
	11'0" - 12'0"	715.3	17.3	132.0	112.5	100	.46	> 7800
	15'15" - 16'	713.3	23.4	131.5	106.5	100	.58	2730
	25' - 26'	708.1	22.0	135.0	111.5	100	.51	2800
	30' - 31'	698.1	20.8	135.0	113.0	100	.46	1970

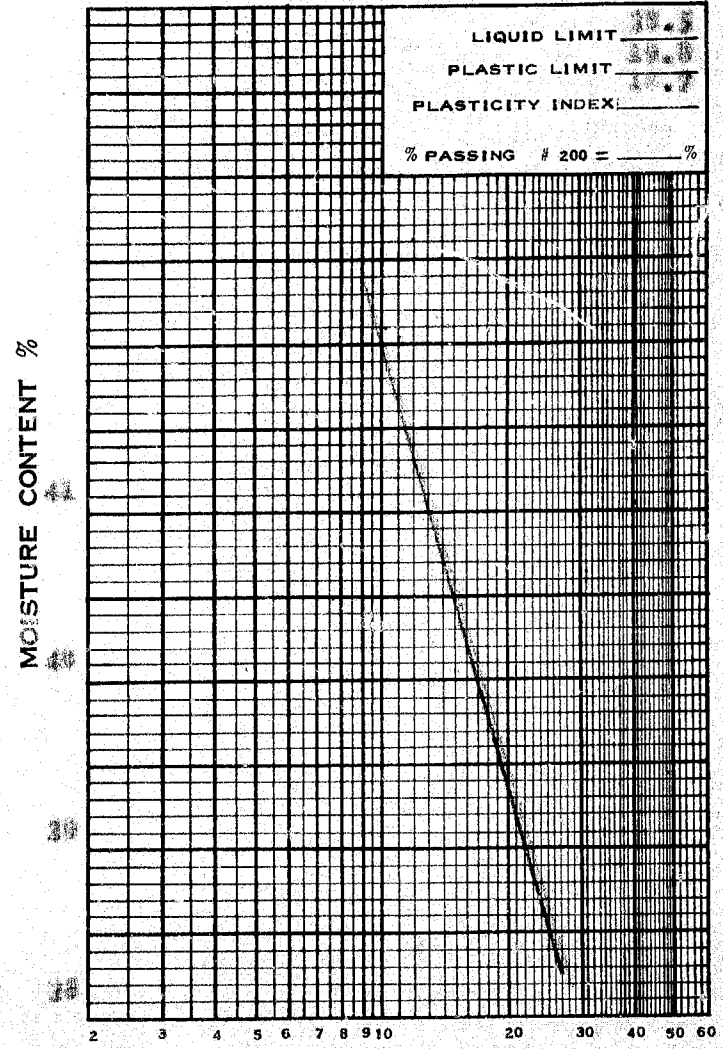
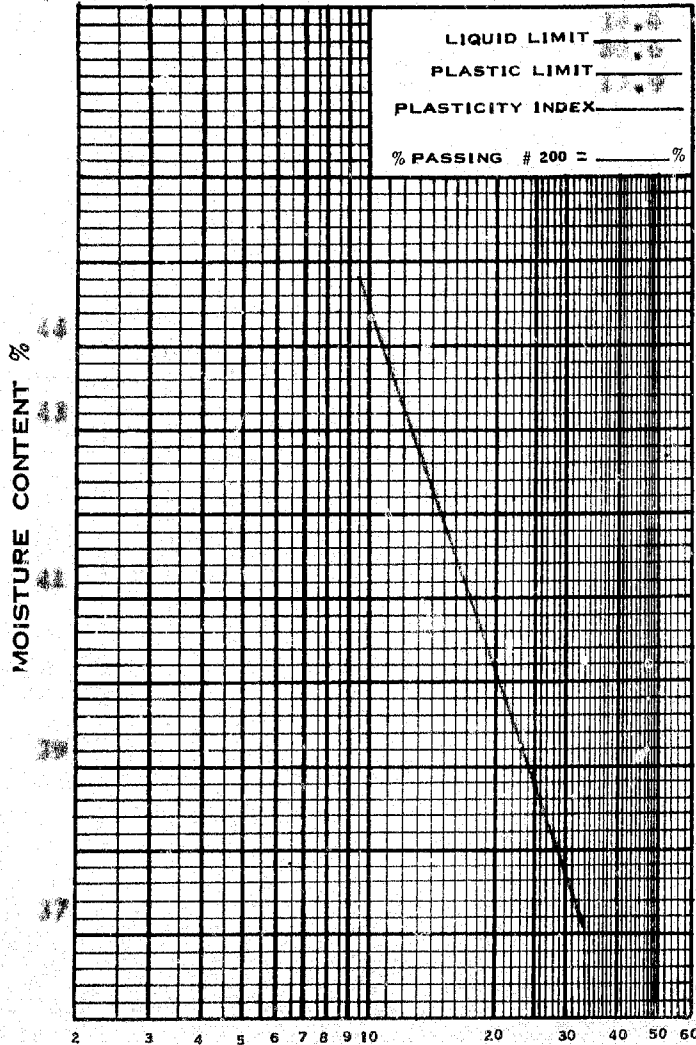
e. m. peto associates ltd.
SOIL TESTING LABORATORY

LIQUID LIMIT TEST

FLOW LINE CHARTS

JOB No. 0001 PROJECT
SAMPLE FROM
DEPTH

SAMPLE FROM
DEPTH



NO. OF BLOWS (LOG SCALE)

SOIL TESTING LABORATORY

LIQUID LIMIT TEST

FLOW LINE CHARTS

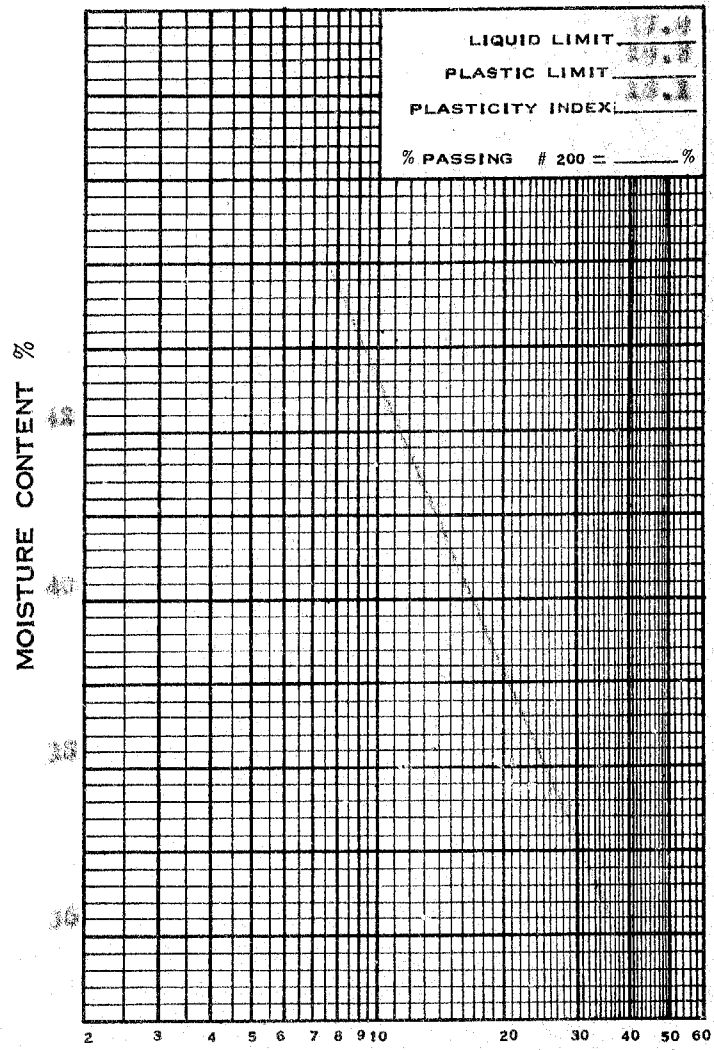
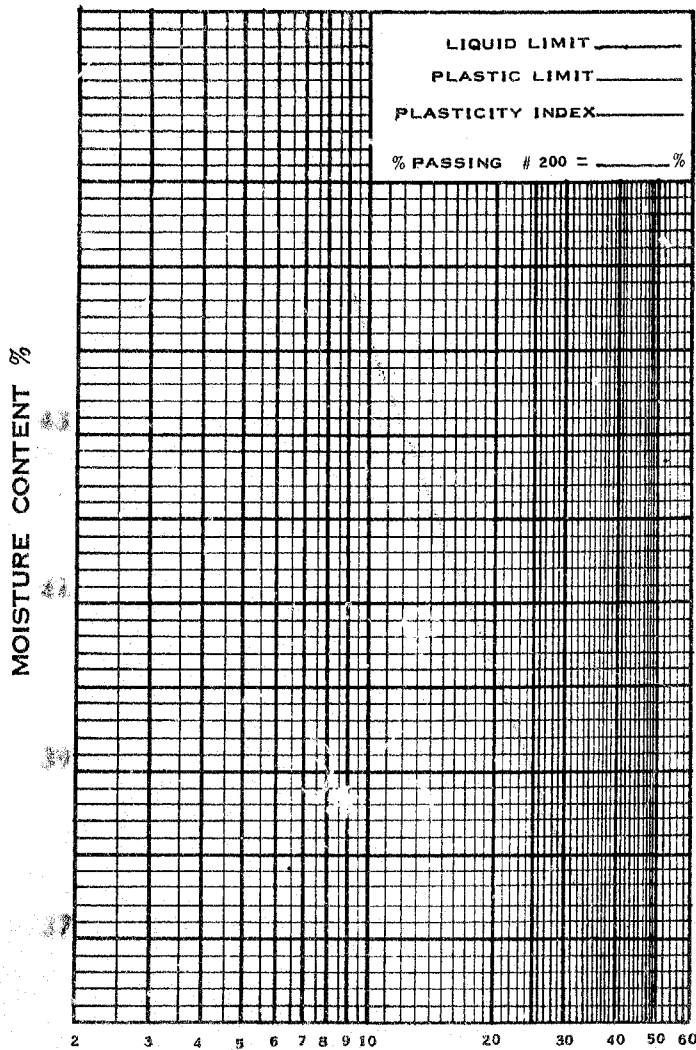
JOB No. _____ **PROJECT** _____

SAMPLE FROM _____

SAMPLE FROM _____

DEPTH _____

DEPTH _____



NO. OF BLOWS (LOG SCALE)

e. m. peto associates ltd.

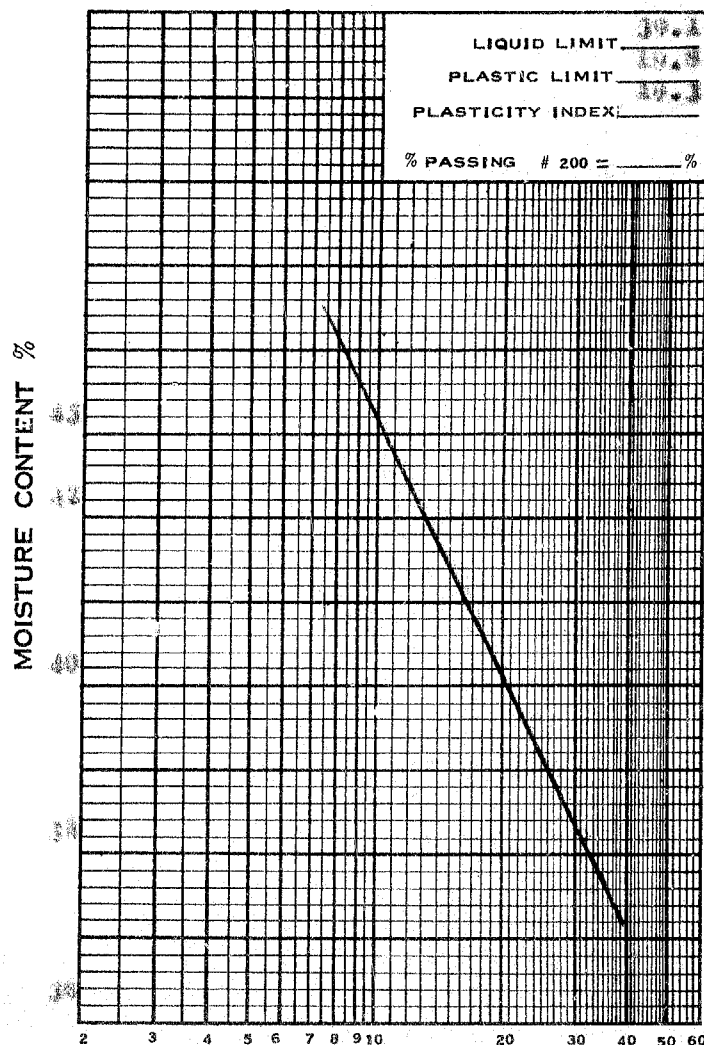
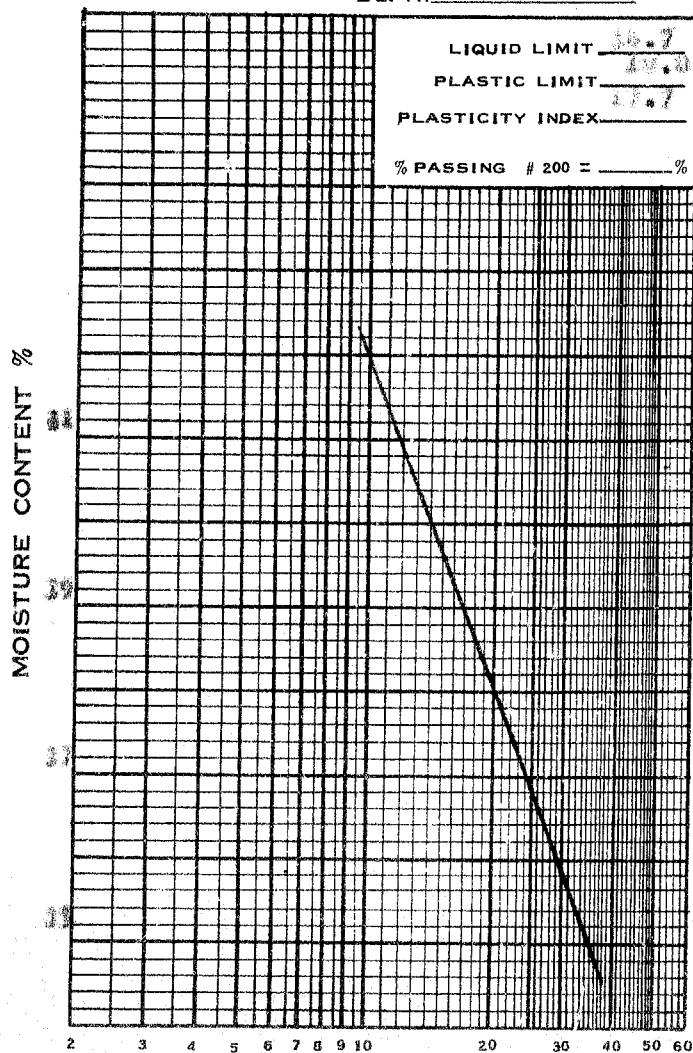
SOIL TESTING LABORATORY

LIQUID LIMIT TEST

FLOW LINE CHARTS

JOB No. 0001 PROJECT PERMANENT CANAL
 SAMPLE FROM 100' DEPTH 100'

SAMPLE FROM 100' DEPTH 100'



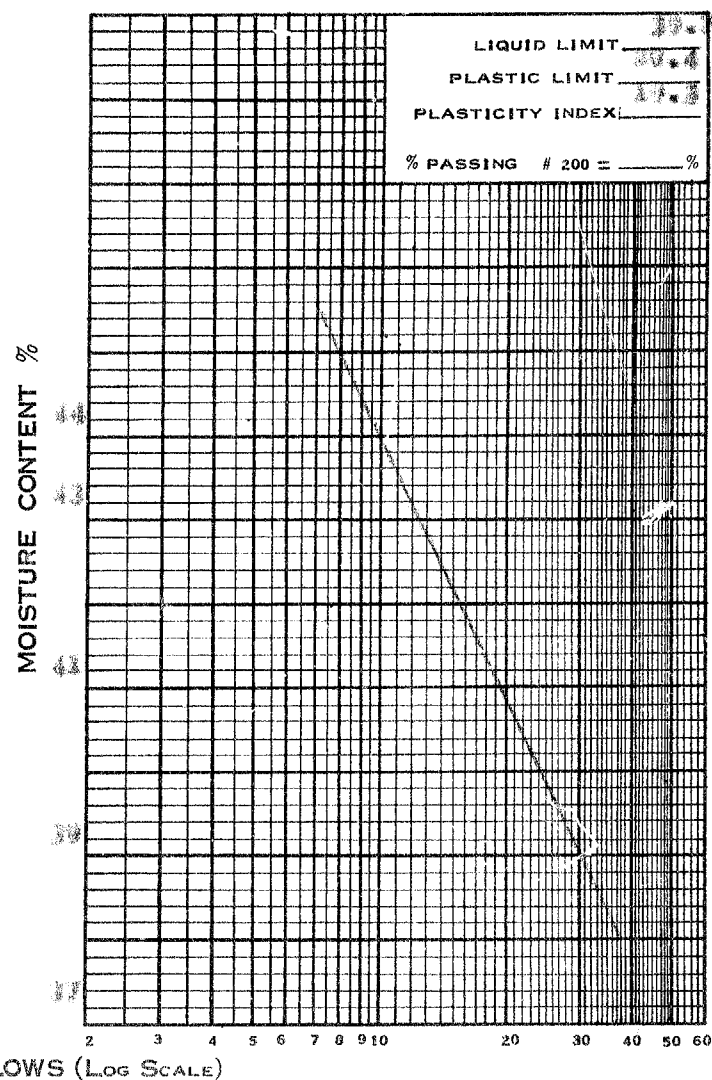
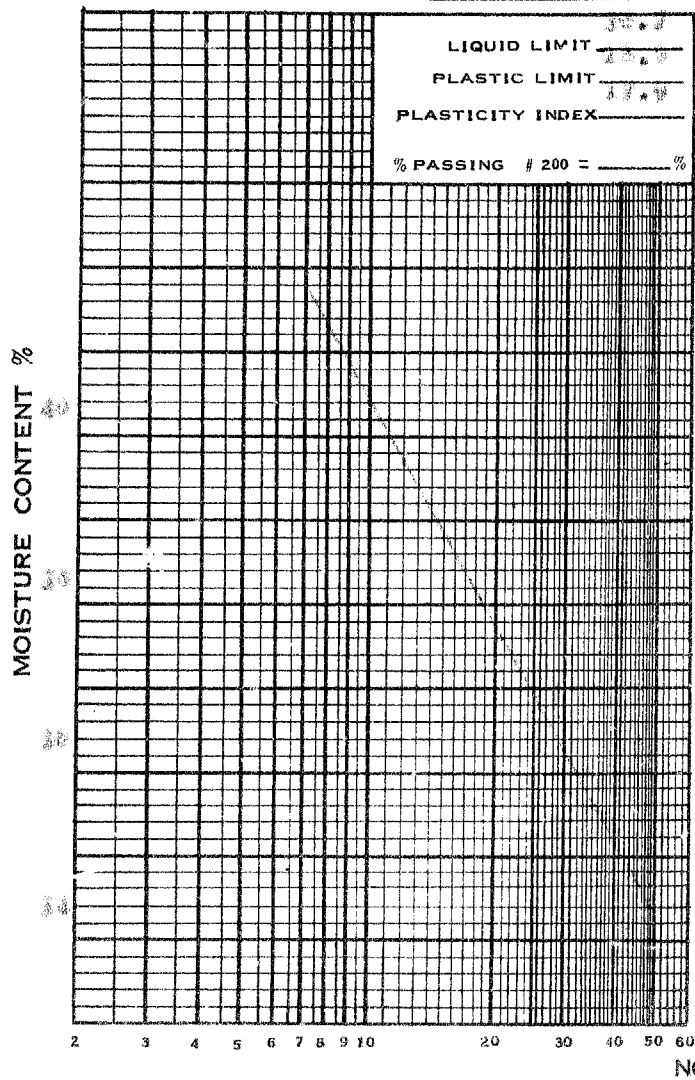
NO. OF BLOWS (LOG SCALE)

e. m. peto associates ltd.
SOIL TESTING LABORATORY

LIQUID LIMIT TEST

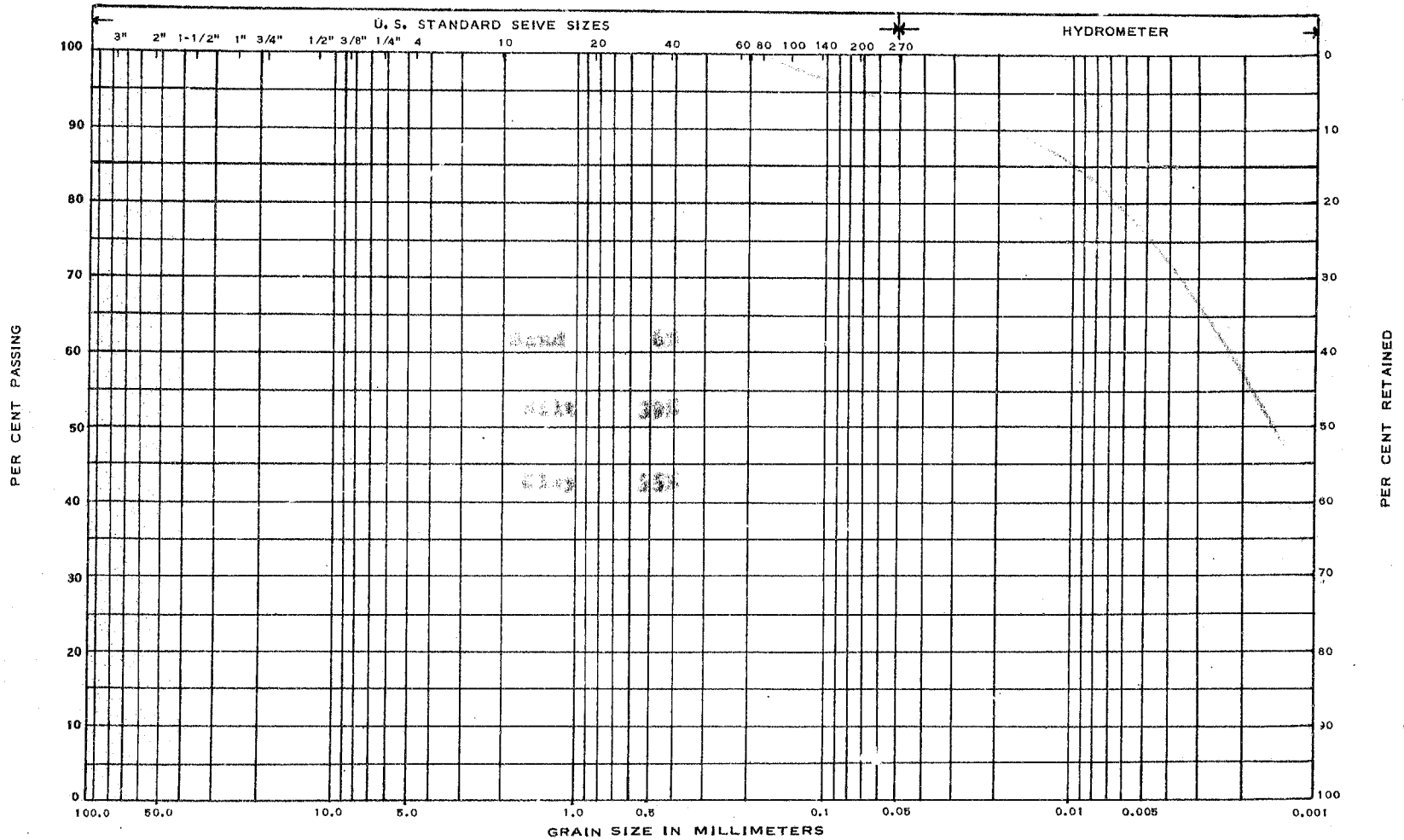
FLOW LINE CHARTS

Job No. 4411 PROJECT Highway 100
SAMPLE FROM 100 DEPTH 10
SAMPLE FROM 100 DEPTH 10



e. m. peto associates ltd.

Toronto 19, Ontario



STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
--------	--------	-------------	-----------	-----------	-------------	-----------	-----------	------

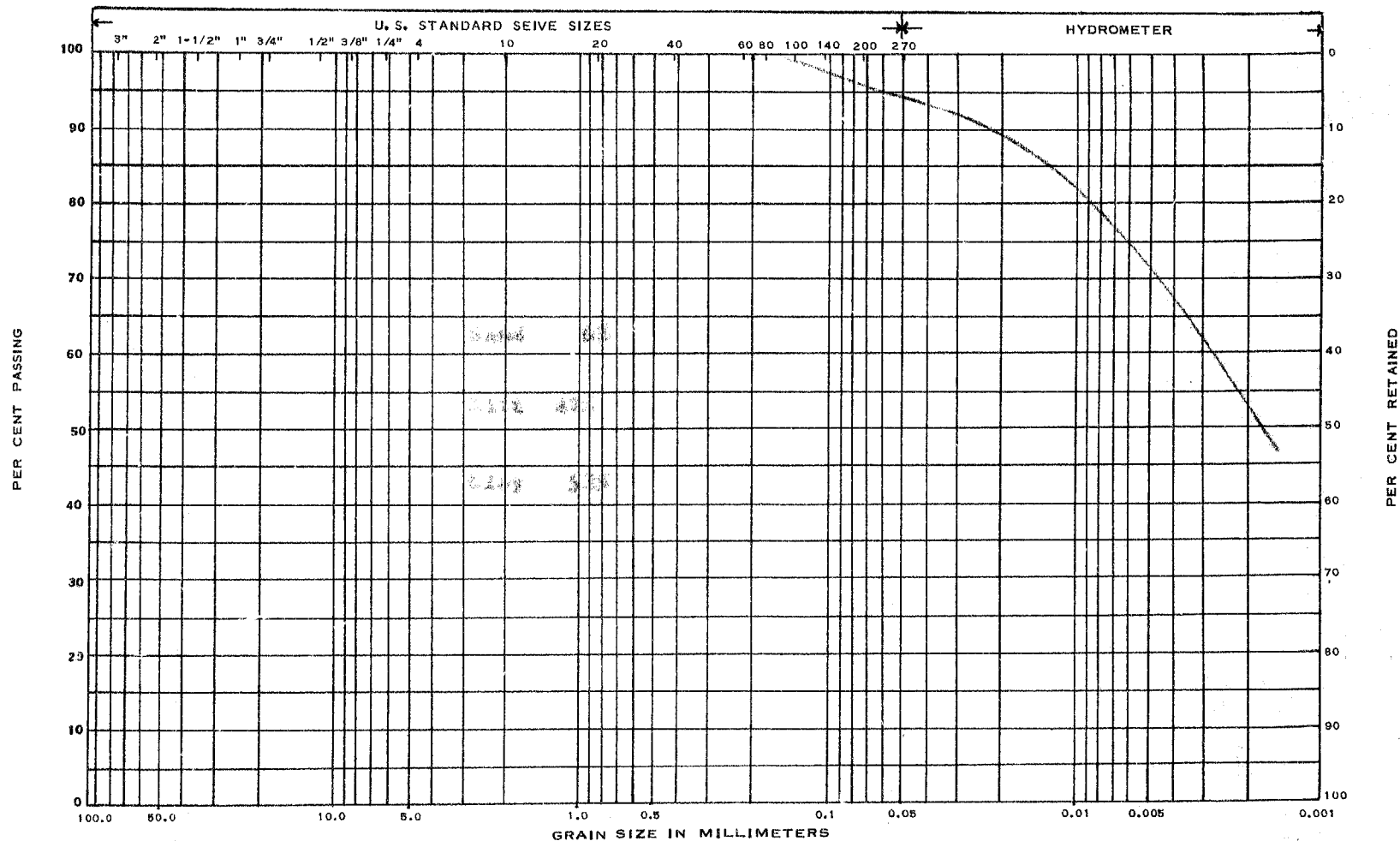
MASS. INST. OF TECH. CLASSIFICATION

JOB NAME JOB NO. HOLE NO. SAMPLE NO.

DEPTH ELEVATION REMARKS

GRAIN SIZE DISTRIBUTION

Toronto 19, Ontario



STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
--------	--------	-------------	-----------	-----------	-------------	-----------	-----------	------

MASS. INST. OF TECH. CLASSIFICATION

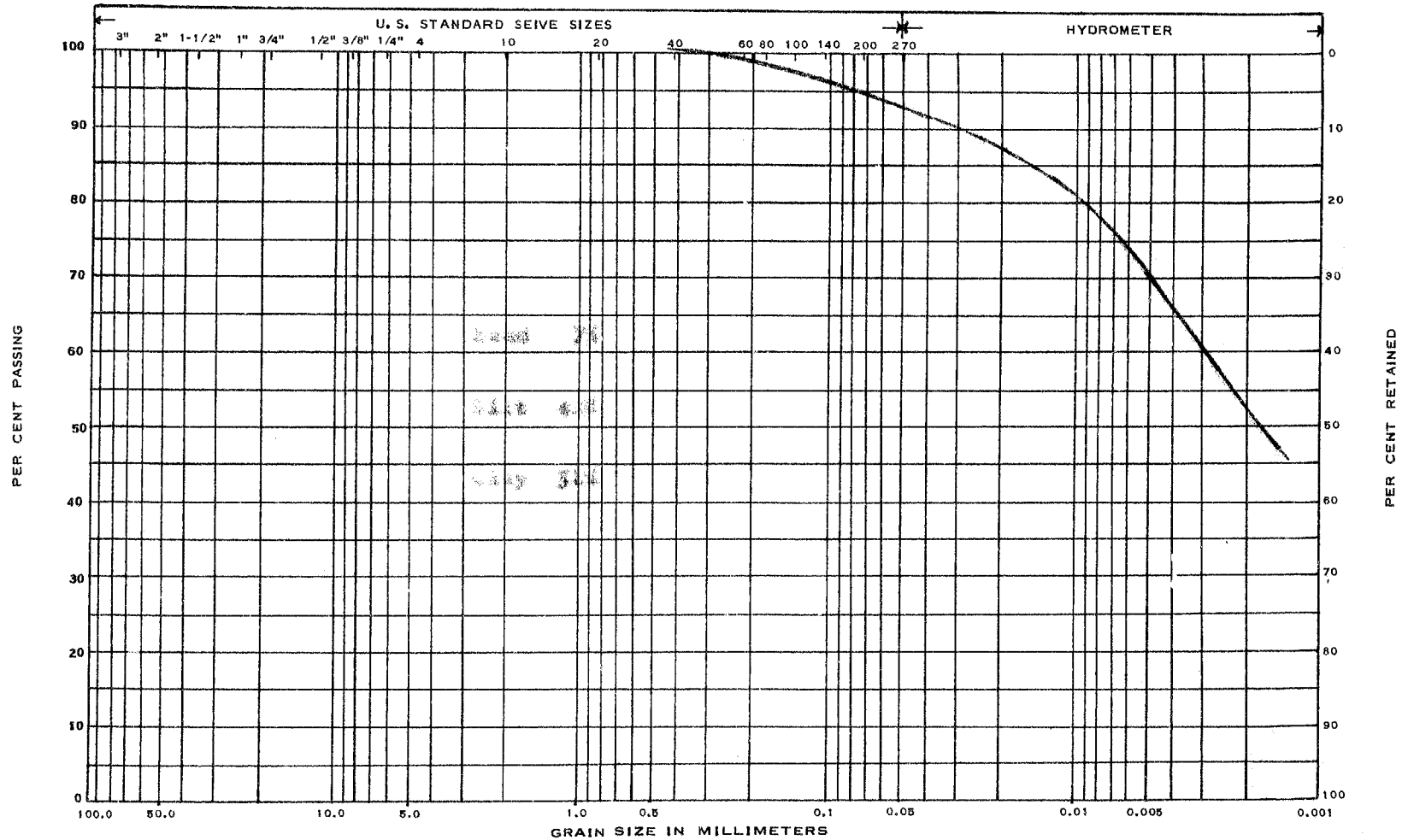
JOB NAME _____ JOB NO. _____ HOLE NO. _____ SAMPLE NO. _____

DEPTH 1.5 ELEVATION 1.5 REMARKS 1.5

GRAIN SIZE DISTRIBUTION

e. m. peto associates ltd.

Toronto 19, Ontario



STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
--------	--------	-------------	-----------	-----------	-------------	-----------	-----------	------

MASS. INST. OF TECH. CLASSIFICATION

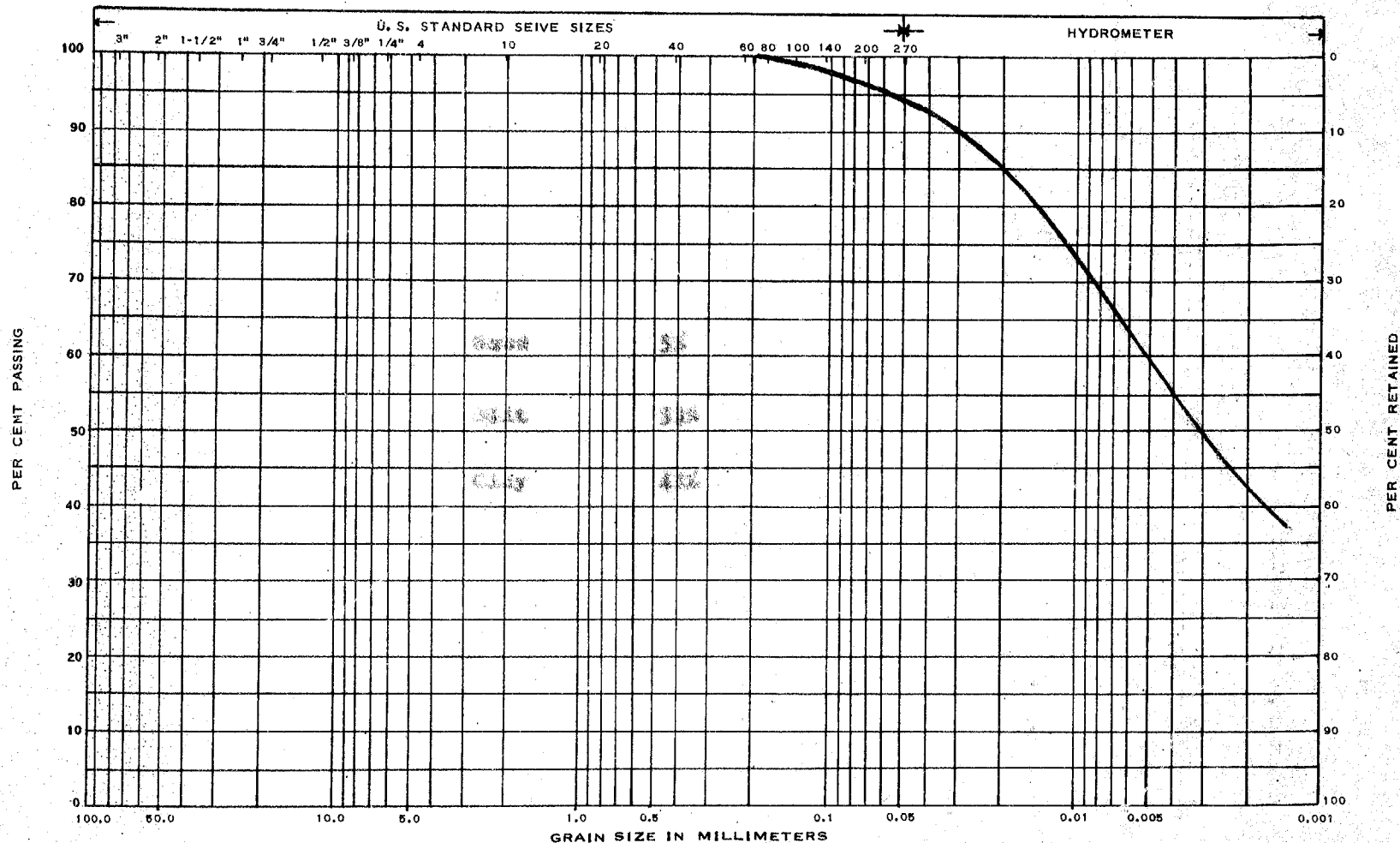
JOB NAME _____ JOB NO. _____ HOLE NO. _____ SAMPLE NO. _____

DEPTH _____ ELEVATION _____ REMARKS _____

GRAIN SIZE DISTRIBUTION

e. m. peto associates ltd.

Toronto 19, Ontario



STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
--------	--------	-------------	-----------	-----------	-------------	-----------	-----------	------

MASS. INST. OF TECH. CLASSIFICATION

JOB NAME BRIDGE JOB NO. 1001 HOLE NO. 1 SAMPLE NO. 1

DEPTH 4.0 ELEVATION 100.0 REMARKS CLAY

GRAIN SIZE DISTRIBUTION

APPENDIX II

GELAPUS

MOISTURE CONTENTS & ATTERBURG LT. VS. ELEVATION

Natural moisture content, in %

5 10 15 20 25 30

ELEVATION

720

710

700

690

680

670

660

650

38.6

38.5

38.6

37.9

36.7

35.1

36.7

36.7

LIQUID LIMITS

Testhole 3

Testhole 2

Testhole 1

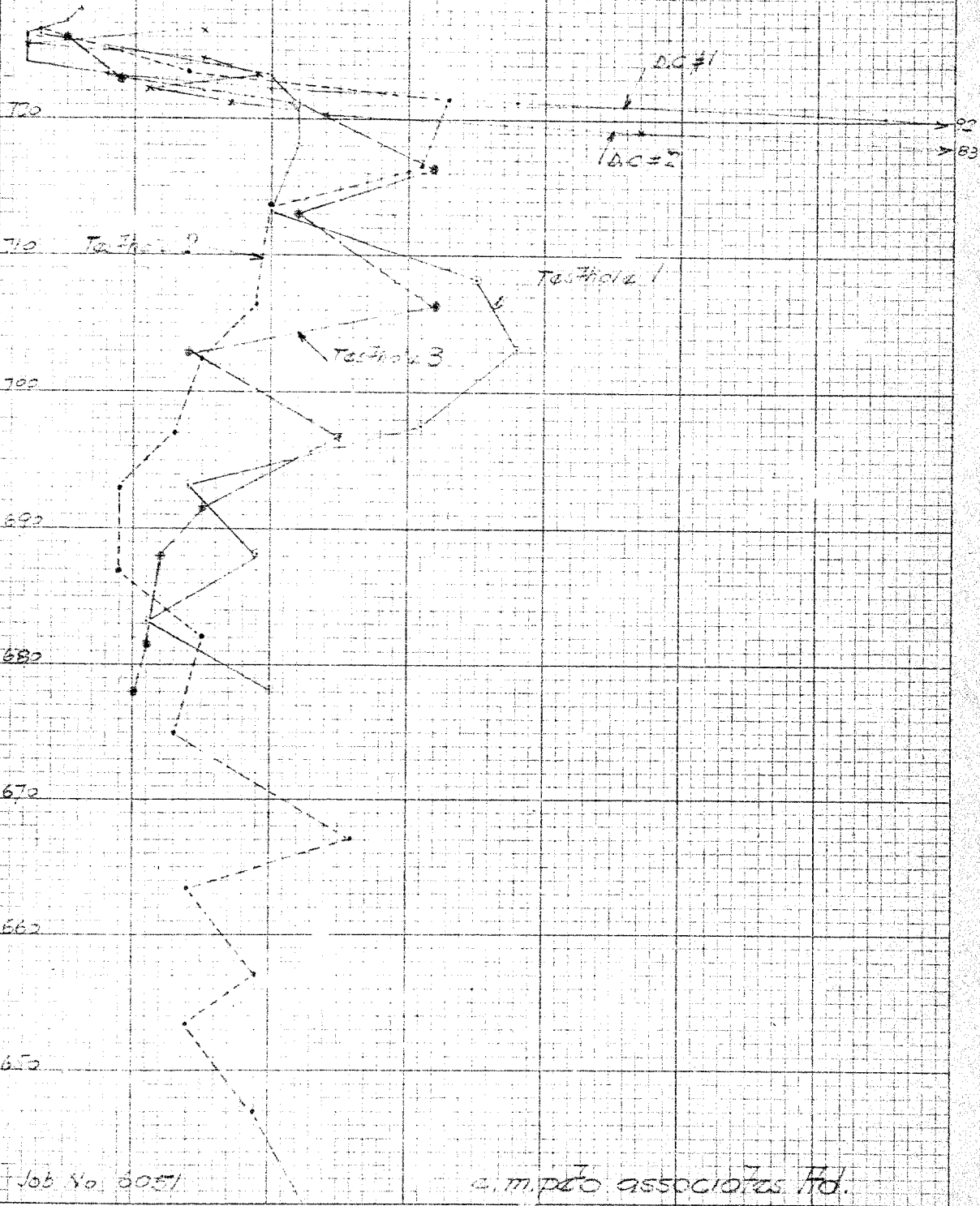
Job No 6051

E. M. D. 10
65505/0703
770

Penetration Test Results vs Elevation

No. of blows, 100' penetration

10 20 30 40 50 60 70



UNCONFINED SHEAR STRENGTH VS. ELEVATION

Unconfined Compressive Shear Strength, p.s.f.

1000 2000 3000 4000 5000 6000

720

710

700

690

680

670

660

650

640

77600

77300

7700

UNCONFINED SHEAR STRENGTH (SU) PROFILE

SYMBOLS:

- TESTHOLE #1
- TESTHOLE #2
- TESTHOLE #3

Job No 6081

a.m. data associates inc.

APPENDIX III
METHOD OF OPERATION

The field investigation work is carried out by means of a skid-mounted diamond drill rig.

Standard sampling procedures are followed. Casing is driven and cleaned, either by tubes or by wash water.

Samples are recovered ahead of the casing at frequent intervals, with either a 2 inch or 3 inch O.D. split barrel sampling tube, Shelby tube, or split barrel sampling tube fitted with brass liners and special sharp cutting nose.

The standard penetration test results are recorded when sampling with the regular 2 inch O.D. split barrel sampler, these being the number of blows of a 140 pound hammer falling 30 inches, required to drive the sampling tube a distance of one foot into undisturbed soil.

The Dutch cone probe test is made by driving the drill rods into the ground with a 2-1/4" - 90° cone tip. The number of 4200 inch pound blows per foot of penetration are recorded, as in the standard penetration test.

Where required, "in situ" shear strength tests are made ahead of the casing, using modified Acker vane test equipment.

Disturbed samples are visually classified in the field, sealed in sample jars, and are re-examined, and tested as necessary, in the soils laboratory. Undisturbed samples are returned to the laboratory for later examination and testing, as required.

The test holes are bailed at the end of the day and on completion. Subsequent water level readings are taken for the duration of the field work. Water pressure readings are recorded when Artesian water conditions are encountered. Moisture content samples are recovered at frequent intervals to assist in the soil classification and the interpretation of water table results.

e. m. peto associates ltd.





SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

BOR: HOLE LOG

Job Name Unnamed County Road
 Client Dept. of Highways of Ontario
 Elevation Client's

Job No. 6051
 Casing BX
 Compiled By U. J. V.

Borehole No. 1
 Boring Date March 15-17, 1960.
 Checked By B. L.

SAMPLE CONDITION		SAMPLE TYPE		ABBREVIATIONS	
	UNDISTURBED	A.S. AUGER SAMPLE	V.T. IN SITU VANE SHEAR TEST		
	FAIR	C.S. CASING SAMPLE	C. SOIL SHEAR STRENGTH LBS/SQ.FT.		
	DISTURBED	S.S. 2" STANDARD SPLIT TUBE SAMPLE	W.L. WATER LEVEL IN CASING		
	LOST	S.L. SPLIT BARREL WITH LINERS	W.T. GROUND WATER TABLE IN SOIL		
		S.T. THIN-WALLED SHELBY TUBE SAMPLE	W.T.P.L. WETTER THAN PLASTIC LIMIT		
		W.S. WASH SAMPLE	D.T.P.L. DRIER THAN PLASTIC LIMIT		
		R.C. ROCK CORE			

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No and Condition	Sample Type	No. of Blows per Ft	Water Level	WATER LEVELS & REMARKS
Ground Surface			0'0"						
Loam topsoil	Mixed Brown		728.74		1	C.S.			Frozen
Fine to medium sand	Pale brown	Very loose to loose	2'0"		2	S.S.	3+	20.7	W.T. on top of the clayey silt at 1'9"
As above changing to silty clay	Grey	Very stiff	5'2"		3	S.S.	20	18.5	Wet and D.T.P.L.
Silty clay	Grey	Very stiff			4	S.S.	22	19.1	Slightly D.T.P.L.
As Above with grits	Grey	Very stiff	10'0"		5	S.S.	22	19.2	About P.L.
					6	S.T.	tapped	20.6	Getting little softer
As above with grits and pebbles	Grey	Very stiff	15'0"		7	S.S.	20	21.0	Slightly W.T.P.L.
					8	S.L.	tapped		
As Above	Grey	Hard	20'0"		9	S.L.	tapped		
					10	S.S.	35	20.8	Slightly W.T.P.L. Starting to use wash water
As Above	Grey	Hard	25'0"		11	S.L.	tapped		
					12	S.S.	38	21.8	W.T.P.L.
As Above grits and pebbles	Grey	Very stiff to hard	30'0"		13	S.L.	tapped		
					14	S.S.	31	21.6	W.T.P.L. Getting softer at 32'
As Above with grits	Grey	Stiff to very stiff	35'0"		15	S.S.	14	22.7	W.T.P.L.
As Above - with odd grit	Grey	Very stiff	40'0"		16	S.L.	pushed		
					17	S.S.	19	25.8	W.T.P.L.
As Above	Grey	Stiff	45'0"		18	S.S.	11/12"	7/6"	W.T.P.L.
As Above	Grey	Very stiff	50'0"		19	S.L.	20/12"		
			52'0"		20	S.S.	11/6"	23.7	W.T.P.L.

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft	Unit Weight	WATER LEVELS & REMARKS
Ground Surface			0'0"						
Loam topsoil	Mixed Brown		728.74 2'0"		1	C.S.			Frozen
Fine to medium sand	Pale brown	Very loose to loose	5'2"		2	S.S.	3+	20.7	W.T. on top of the clayey silt at 1'9"
As above changing to silty clay	Grey	Very stiff			3	S.S.	20	18.5	Wet and D.T.P.L.
Silty clay	Grey	Very stiff			4	S.S.	22	19.1	Slightly D.T.P.L.
As Above with grits	Grey	Very stiff	10'0"		5	S.S.	22	19.2	About P.L.
			15'0"		6	S.L. tapped	20.6		Getting little softer
As above with grits and pebbles	Grey	Very stiff			7	S.S.	20	21.0	Slightly W.T.P.L.
			20'0"		8	S.L. tapped			
As Above	Grey	Hard			9	S.L. tapped			
			25'0"		10	S.S.	35	20.8	Slightly W.T.P.L. Starting to use wash water
As Above	Grey	Hard			11	S.L. tapped			
			30'0"		12	S.S.	38	21.8	W.T.P.L.
As Above grits and pebbles	Grey	Very stiff to hard			13	S.L. tapped			
			35'0"		14	S.S.	31	21.6	W.T.P.L.
									Getting softer at 32'
As Above with grits	Grey	Stiff to very stiff			15	S.S.	14	22.7	W.T.P.L.
As Above - with odd grit	Grey	Very stiff	40'0"		16	F.L. pushed			
			45'0"		17	S.S.	19	25.8	W.T.P.L.
As Above	Grey	Stiff			18	S.S.	11/12"	7/6"	W.T.P.L.
As Above	Grey	Very stiff	50'0"		19	S.L.	20/12"		
			52'0"		20	S.S.	11/6"	23.7	W.T.P.L.
HOLE TERMINATED AT 52'0"									

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE - TORONTO, ONTARIO





BOREHOLE LOG



















Job Name Unnamed County Road Job No. 6051 Borehole No. 2
 Client D.H.O. Casing 4" to 54ft. BX Boring Date March 18th.-22nd. 1960
 Elevation Client's Compiled By P.M.A. Checked By B.L.

SAMPLE CONDITION

SAMPLE TYPE

ABBREVIATIONS

	UNDISTURBED	A.S. AUGER SAMPLE	V.T. IN SITU VANE SHEAR TEST
	FAIR	C.S. CASING SAMPLE	C. SOIL SHEAR STRENGTH LBS/SQ.FT.
	DISTURBED	S.S. 2" STANDARD SPLIT TUBESAMPLE	W.L. WATER LEVEL IN CASING
	LOST	S.L. SPLIT BARREL WITH LINERS	W.T. GROUND WATER TABLE IN SOIL
		S.T. THIN-WALLED SHELBY TUBE SAMPLE	W.T.P.L. WETTER THAN PLASTIC LIMIT
		W.S. WASH SAMPLE	D.T.P.L. DRIER THAN PLASTIC LIMIT
		R.C. ROCK CORE	

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Moisture Content	WATER LEVELS & REMARKS
			0'0"						
Sandy loam organic matter	V. Dk. brown		728.92		1	C.S.			Moist
Clay loam	ditto	soft	3'6"		2	S.S.	3	27.4	W.T. at 2'9" W.T.P.L.
Fine to coarse sand	Pale brown	compact	5'6"		3	S.S.	14	19.7	Saturated W.T.P.L.
Silty clay odd grits & sand pockets	grey	V. stiff			4	S.S.	33	18.5	W.T.P.L.
Silty clay odd grits	ditto	Hard	10'0"		5	3"SL tapped			
Ditto	ditto	v.stiff to hard	15'0"		6	S.S.	31	17.8	Wash water used after 13' 0" depth D.T.P.L.
Silty clay, grits & pebbles	ditto	V. stiff	20'0"		7	S.S.	20	19.7	S.W.T.P.L.
			25'0"		8	3"SL tapped			
ditto	ditto	V. stiff	30'0"		9	S.S.	19	22.0	W.T.P.L.
ditto	ditto	stiff to V. stiff	35'0"		10	S.S.	15	22.8	W.T.P.L.
			40'0"		11	3"SL tapped			
		Stiff	45'0"		12	S.S.	13	10'6"	
ditto	ditto	Firm to stiff	50'0"		13	S.S.	9	25.7	Turning softer at 35'0" W.T.P.L.
			55'0"		14	3"SL tapped			
ditto	ditto	Firm to stiff	60'0"		15	3"SL tapped			
			65'0"		16	S.S.	9	24.7	W.T.P.L.
			70'0"		17	3"SL tapped			
		Stiff to V. stiff	75'0"		18	S.S.	15		
			80'0"						

ditto	ditto	Firm to stiff		13	s.s.	5/0"	25.7	W.T.P.L.
			40'0"	14 ^a c	3" SL	tapped		
ditto	ditto	Firm to stiff		15 ^a c	3" SL	tapped		
				16	s.s.	9	24.7	W.T.P.L.
				17	3" SL	tapped		
		Stiff to V. stiff		18	s.s.	15		
			50'0"					
				19 ^a c	3" SL	tapped		
Ditto	ditto	stiff	55'0"	80	s.s.	13	27.2	W.T.P.L.
			60'0"					
Silty clay grits & pebbles	grey	V. stiff		21 ^a c	3" SL	pushed		
				22	s.s.	26	22.4	W.T.P.L.
			65'0"		s.s.	14		
		stiff to V. stiff						
			70'0"					
				23 ^a c	2" SL			
Ditto	ditto	V. stiff		24	s.s.	19	22.0	W.T.P.L.
			75'0"					
Ditto	ditto	stiff to very stiff		25	s.s.	14	21.4	W.T.P.L.
			80'0"					
				26 ^a c	2" SL	pushed		
Ditto	ditto	V. stiff to hard		27	s.s.	29	22.5	W.T.P.L.
			85'0"					
Ditto	ditto	V. stiff		28	s.s.	19	22.6	W.T.P.L.
			90'0"					
				29 ^a c	2" SL	6" pushed 12" tapped		
Ditto	ditto	V. stiff		30	s.s.	20		M.W.T.P.L.
			95'0"					
Ditto	ditto	stiff to V. stiff		31	s.s.	10	22.6	W.T.P.L.
			100'					
				32 ^a c				
Ditto odd stones	ditto	hard	102'6"	32	s.s.	33		W.T.P.L.
		Borehole terminated at 102'6"						

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE - TORONTO, ONTARIO





BOREHOLE LOG










Job Name Unnamed County Road Job No. 6051 Borehole No. 3
 Client D.H.O. W.P. 59-59 Casing BX Boring Date March 23rd.-24th. 1960
 Elevation Client's Compiled By P.M.A. Checked By B.L.

SAMPLE CONDITION

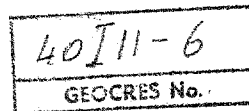
SAMPLE TYPE

ABBREVIATIONS

	UNDISTURBED	A.S. AUGER SAMPLE	V.T. IN SITU VANE SHEAR TEST
	FAIR	C.S. CASING SAMPLE	C. SOIL SHEAR STRENGTH LBS/SQ.FT.
	DISTURBED	S.S. 2" STANDARD SPLIT TUBESAMPLE	W.L. WATER LEVEL IN CASING
	LOST	S.L. SPLIT BARREL WITH LINERS	W.T. GROUND WATER TABLE IN SOIL
		S.T. THIN-WALLED SHELBY TUBE SAMPLE	W.T.P.L. WETTER THAN PLASTIC LIMIT
		W.S. WASH SAMPLE	D.T.P.L. DRIER THAN PLASTIC LIMIT
		R.C. ROCK CORE	

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Natural Moisture Content	WATER LEVELS & REMARKS
<u>Organic loam some sand</u>	<u>Mixed grey</u>		<u>0'0"</u> <u>728.57</u>		1	 c.s.			<u>Wet</u>
<u>Organic clay loam</u>	<u>Dk. grey brown</u>	<u>Firm</u>	<u>3'6"</u>		2	 s.s.	5	17.0	<u>Wet</u>
<u>Fine to medium sand</u>	<u>pale brown</u>	<u>loose to compact</u>	<u>5'6"</u>		3	 s.s.	9	20.3	<u>Sat.</u>
<u>Silty clay, grits & pebbles grey pockets of fine med. sand</u>	<u>grey</u>	<u>V. stiff</u>	<u>10'</u>			 s.s.	22		
<u>Silty clay, grits & pebbles ditto</u>	<u>ditto</u>	<u>hard</u>	<u>15'</u>		4	 s.s.	32	18.3	<u>D.T.P.L.</u>
<u>Ditto</u>	<u>ditto</u>	<u>V. stiff</u>	<u>20'</u>		5	 s.s.	22	22.3	<u>W.T.P.L.</u>
<u>Ditto</u>	<u>ditto</u>	<u>hard</u>	<u>25'</u>		6 ^a 7 ^c	2"SL tapped s.s.	32	21.8	<u>W.T.P.L.</u>
<u>Ditto</u>	<u>ditto</u>	<u>stiff to V. stiff</u>	<u>30'</u>		8	 s.s.	14	21.2	<u>W.T.P.L.</u>
<u>Ditto</u>	<u>ditto</u>	<u>V. stiff</u>	<u>35'</u>		9 ^a 10 ^c	2"SL tapped s.s.	25	21.5	<u>W.T.P.L.</u>
<u>Ditto</u>	<u>ditto</u>	<u>stiff to V. stiff</u>	<u>40'</u>		11 ^a 12 ^c	2"SL pushed s.s.	15	21.4	<u>W.T.P.L.</u>
<u>Ditto</u>	<u>ditto</u>	<u>stiff</u>	<u>45'</u>		13	 s.s.	12	18.0	<u>W.T.P.L.</u>
<u>Ditto</u>	<u>ditto</u>	<u>stiff</u>	<u>51'0"</u>		14 ^a 15 ^c	2"SL s.s.	11	22.6	<u>W.T.P.L.</u>
<u>Ditto</u>	<u>ditto</u>	<u>stiff</u>	<u>51'0"</u>		16	 s.s.	10	23.7	<u>M.W.T.P.L.</u>

[illegible]



Mr. A. M. Toye,
Bridge Engineer.
Materials & Research Section.

July 21, 1960.

Attention: Mr. S. McCombie.

Re: Dunwich Twp. Bridge No. 7,
Highway 401 - District #2,
W.P. 59-59.

As requested, we are forwarding, in writing, the conclusions given verbally in connection with the foundations for the above structure.

- 1) The 12" Ø concrete filled tube piles used as support for the abutments should be driven to elevation $713 \pm 5'$. At this elevation, these piles will be capable of carrying a safe load of 35 tons/pile.
- 2) In the vicinity of the abutments, fill material should be specified to contain no stones. If this is done, it is possible that pre-drilling will not be necessary. If pre-drilling is used, drilling should not be permitted beyond elevation 728.0'.

If further queries arise in connection with foundation problems at this site, please contact this Office.

L. G. Soderman,
PRINCIPAL FOUNDATIONS ENGR.

Per:



(K. Peaker,
FIELD SUPERVISING FOUNDATIONS ENGR.)

KP/MdeF

cc: Mr. N. D. Smith

Foundations Office
Gen. Files.



ONTARIO
DEPARTMENT OF HIGHWAYS

40111 - 6
GEOCRE No.

Memo to Mr. A. M. Toye, **Date** April 25, 1960.
Bridge Engineer. **Subject** FOUNDATION INVESTIGATION -- by
From Materials & Research Section. E. M. Peto Associates, Limited.
Attention: Mr. S. McCombie.

Re: Road All'ce. between Lots 18 & 19,
Twp. of Dunwich, Hwy. 401, Dist. (2),
W.P. 59-59.

We have reviewed the above mentioned Report submitted by E. M. Peto Associates, Ltd. The investigation has shown the ground to be uniformly layered. The grey silty clay layer has a crust of much greater strength than the rest of the layer. Shear strength values of more than 7,500 p.s.f. were determined for the upper portion of the crust. An average value of 4,000 p.s.f. can be taken for the crust down to elevation 700'. Because of the high shear strength value of the upper portion of the crust, it is recommended to place the foundation as high as possible - i.e., at elevation 724' - i.e., just below the layer of loose sand. (The degree of sand compactness varies and therefore it is suggested to place the footing deeper.) A safe nett bearing capacity at the above mentioned elevation can be taken as 4 T/sq.ft. ($c = 7,000$ p.s.f.; $N_c = 6.0$; $\frac{D}{B} = 0.6$; F.S. = 3).

Because of the high shear strength of the material, low water content (at or below plastic limit) and observed stiffness of the soil, no detrimental settlement of the structure (due to load of structure or approach embankment) are expected.

With embankment slopes of 2:1, no stability problems exist, assuming that the top organic clayey loam layer has been previously removed.

cont'd. /2 ...

*Submitted by E. M. Peto on 4th May 1960.
to Mr. S. McCombie.
Per. Hester to Mr. S. McCombie
in case of difficulty in course.*

40J11-6
GEOCREG No.

- 2 -

Because the sand is water bearing, some construction problems can be anticipated.

If there would be any other problems you would like to discuss in connection with this project, please do not hesitate to contact our Office.

L. G. Sodeman,
PRINCIPAL SOILS & FOUNDATIONS ENGR.

Per:

A. Sterman

AS/MdeF
Attach.

(A. Sterman,
FOUNDATION OFFICE ENGINEER)

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
D. G. Ramsay
A. Gater
G. U. Howell
J. Roy
A. Watt

Foundations Office
Gen. Files.

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 40111-6

W.P. No. 59-59

CONT. No. _____

W. O. No. _____

STR. SITE No. _____

HWY. No. 401 Dist. 2

LOCATION Road ALL'CE.
BETWEEN LOTS 18 & 19,
DUNWICH TWP.

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. ONE

REMARKS: _____

SEP 1976

