

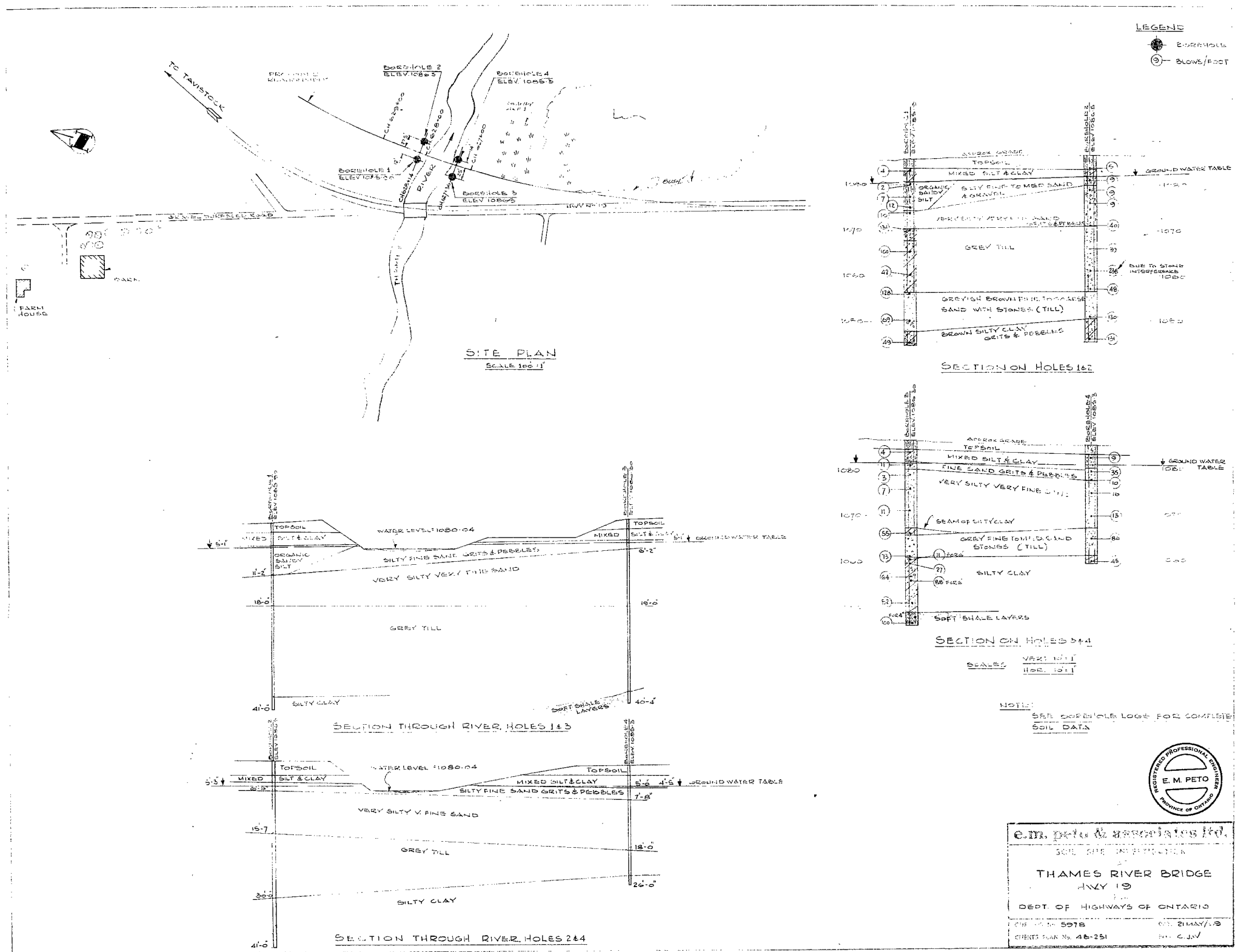
#59-F-207C

W.P. #157-59

Hwy #19 &

THAMES R. AT

TAVISTOCK



e. m. peto associates ltd.

YOUR REFERENCE:-

OUR REFERENCE:- 5978

850 roselawn avenue,
TORONTO 19, ONTARIO.
RUssell 1-4955.

May 22nd, 1959.

59-F-2076

The Department of Highways of Ontario,
Soil and Foundation Engineering Branch,
Materials and Research Section,
Administrative Offices,
Downsview, Ontario.

Attention: Mr. K. Peaker P. Eng.

Re: Soil Site Investigation,
Thames River Bridge - Highway#19
Tavistock, Ontario - District #3
W.P. 157 - 59

Gentlemen:

We are pleased to submit herewith ten copies of our report for the above mentioned project. For your convenience we set out here a summary of our findings and recommendations.

1. The Thames River flows in a defined channel of medium depth, flanked by a low flood plain. We observed some indication of previous flooding in the area.
2. We have considered the site conditions and the soils encountered in the main body of the report.

3. The ground water table on the banks slopes gently to the river water level. At the time of the investigation the water level at the various test holes occurred at a depth of;

5'1" in hole 1
5'3" in hole 2
5'1" in hole 3
4'5" in hole 4

Water must therefore be expected in excavations deeper than the figures given above, and provision should be made for adequate pumping during construction. There was no indication of any Artesian water condition. A series of water level checks during the field work indicated only minor variation in the water table level. Seasonal water level variations must, of course, be expected.

4. Although it would be possible to found the structure on large strip footings at elevation 1074.00 ft., the allowable safe bearing capacity of the soil at this elevation is only

0.5 t.s.f. for 4 ft. wide footing, and
0.4 t.s.f. for 10 ft. wide footing.

5. Settlement under this loading should be within the limit of 1 inch; differential settlement should be some fraction of the maximum settlement and would be within normal construction tolerance.

6. Adequate braced sheeting will be required in any excavation.

7. In view of the existing soil and water conditions we consider it preferable to found the bridge on the till stratum, using either piles or caissons to reach this depth.

The safe allowable bearing value on the stratum of till at elevation 1065.00 for caissons is 3.5 tons per sq. ft. No settlements should be expected.

We trust the report is complete and contains all the information that you require. However, if there are any points on which you would like clarification we will be pleased to be of further service.

Yours very truly,

E. M. PETO ASSOCIATES LTD.,



E. M. Peto, P. Eng.

KP:sb

THE DEPARTMENT OF HIGHWAYS OF ONTARIO

SOILS REPORT

for

THAMES RIVER BRIDGE - HIGHWAY 19 CROSSING

TAVISTOCK, ONTARIO

W.P. 157 - 59

May, 1959

Job No. 5978

Client's Ref. No.

Date May 22nd, 1959

Report on
SOIL SITE INVESTIGATION
THAMES RIVER BRIDGE - HIGHWAY 19 CROSSING
TAVISTOCK, ONTARIO

W. P. 157 - 59

for

DEPARTMENT OF HIGHWAYS OF ONTARIO

INTRODUCTION:

We refer to Mr. K. Peaker's letter of April 28th, 1959, by which we were authorized to carry out a soil investigation at the above mentioned site. We were at the same time, issued with a D. E. O. unnumbered profile, dated September 20th, 1955, and plan No. 4B-251, on which was indicated four suggested test hole locations.

We were required to determine:

- a) the existing soil and ground water conditions.
- b) the foundation types suitable for such conditions.
- c) suitable elevations and bearing capacities for structural foundations, where applicable.
- d) any potential construction problems which might exist.

Two of the test holes, at diagonally opposite corners, were to be put down to bedrock, or terminated after proving 20 ft. of good load bearing stratum. The depth of the remaining two test holes was left to the discretion of the Field Engineer.

At each test hole before commencement an adjacent "Dutch cone" dynamic penetration test was to be carried out. These were to be terminated at the depths as stated above for the test holes.

As required by the Client we provided full engineering supervision at all times during the progress of the field investigation. The field results obtained at the first test hole were forwarded to the Client on completion.

PROGRAMME OF WORK:

- May 1st, 1959: Reconnaissance of site by Field Engineer, permission to enter property obtained from farmer, test holes staked out, elevations based on temporary bench mark determined. Field crew and equipment moved onto site.
- May 2nd, 1959: Dutch cone penetration test performed near borehole 3.
- May 4th, 1959: Test hole 3 commenced, and sampled to 37'6".
- May 5th, 1959: Test hole 3 completed, probe hole 4 performed, test hole 4 commenced and sampled to 31 ft. water levels checked.
- May 6th, 1959: Test hole 4 completed, probe hole 2 performed, test hole 2 started and put down to 26 ft. Water levels checked.
- May 7th, 1959: Test hole 2 completed.
- May 8th, 1959: Probe hole 1 performed, test hole 1 started and sampled to 26 ft. Water levels checked.
- May 9th, 1959: Sampling continued at test hole 1 to 36 ft. Water levels checked.
- May 11th, 1959: Test hole 1 completed. Field crew and equipment moved off site and returned to Toronto. Field Engineer met Client's Engineer, Mr. John Sabrizio on site to determine the chainages of and offsets to the four test holes.

GENERAL INFORMATION:

1. Our standard soil sampling procedures were followed throughout the course of the investigation. These are described in Appendix II. Starting at approximately 10 ft. below surface each test hole was driven with the use of wash water in order to clean casing and expedite the work. The field crew was instructed to sample dry, as far as possible, and in any case for not less than 10 ft. in order to obtain the most reliable ground water information.

2. We found a number of hard layers, and large rock fragments imbedded in the soil at various depths, however, diamond drilled cores could not be obtained.

GENERAL INFORMATION: (Cont'd)

3. A site plan showing the test hole locations, together with two sectional views of the soil stratigraphy have been drawn and form part of the report.

4. All samples obtained were carefully examined in our laboratory, and visually classified, after which individual borehole logs were drawn up and are included with this report.

5. Laboratory tests were performed as considered necessary, the results of these tests being included in Appendix I, "Laboratory Test Results".

a) A number of moisture content samples were taken in order to obtain general information of the existing soil conditions. The natural moisture contents have been plotted against elevation, and this graphical representation of moisture conditions is included under Appendix I.

b) An Atterberg Limit test was carried out to assist in the classification of the cohesive stratum. The result of this test is appended in graphical form.

c) Some mechanical analyses were done in order to obtain more detailed information on the granular materials (see under Appendix I).

6. All elevations mentioned in this report are to Geodetic datum, and were obtained from an old D. H. O. bench mark, approximately 350 ft. south of the crossing site. This was the top of a square iron bar 50 ft. left of station 620 + 06.66. The elevation of this bench mark was taken to be 1091.83 ft. The elevation of a temporary bench mark established by our Field Engineer was determined to be 1037.57 ft. This was the top of a 5 inch long bolt driven in the Eastern root of the 6 ft. elm tree growing near the crossing and shown on your plan.

SITE AND GEOLOGY:

The site is located approximately 100 ft. East of the existing Highway 19 structure over the Thames River at Tavistock.

The general topography in the area is gently rolling. The Thames River meanders and flows in a very wide East-West valley flanked by flat plateaux on both sides. The proposed bridge site area is uncultivated, and covered by grass. Some 150 ft. to the South, this grass covered land is swampy, with a few inches of standing water, and light underbrush and bushes cover the area. Both to the North and South, where the plateaux end, the slightly rising hill-sides are at present cultivated. The South approach below the cultivated fields is covered by quite heavy brush; a few trees exist elsewhere on the site. The existing river channel is the only cut in the flood plain and there is no indication of any form meandering of the river. The bank on the South side is in a somewhat defaced condition, and it is apparent that the area to the South is covered by seasonal floods at times. However, the water level at the time of the investigation was only 1030.04.

SITE AND GEOLOGY: (Cont'd)

The site lies in the physiographic region known as the Oxford till plain, in Oxford County. This is an upland surface ranging from 1000 to 1200 ft., and is crossed by three well-marked valleys cut by glacial melt-water streams. The till is a pale brown, calcareous boulder loam in which Norfolk limestone is the dominant material. The valleys that cut across this till plain are at present occupied by the headwaters of the Thames River. Gentle slopes, good drainage, loamy texture, neutral reaction, and lack of extreme stoniness are the main characteristics of the surface soil. Stoniness varies, probably due to the variation in the depth of silt found on the surface.

SOIL CONDITIONS:

The configurations assumed by the various soil strata are demonstrated on the attached soil profiles.

The soils encountered are described and occur as follows:

1. Topsoil

The entire site is covered by a mantle of dark brown topsoil. The topsoil is generally 2 ft. thick, and consists of organic sandy and silt loam with a considerable amount of grass-roots. The soil is moist to wet and generally very loose.

2. Mixed Silt and Clay

Beneath the topsoil down to 4'7" to 5 ft. below the existing surface, there is a layer of grey and brown mixed silt and clay containing roots, rotted vegetable and some organic matter, grits, pebbles and occasionally some gravel. The soil is very sandy in hole 4 only. The natural moisture content, ranging from 18.0 to 26.0%, is generally above the plastic limit, and the soil is saturated where classified as sandy. The soil densities generally are soft or loose.

3. Silty Fine to Medium Sand with Grits and Pebbles

Terminating at a depth of 6'2" to 7'8" below surface, a stratum of grey to brown silty fine to medium sand with grits and pebbles occurred. Some gravel, occasional stones and pockets of silt were also noted. The natural moisture contents varied from 18.7 to 21%; the soil was oversaturated. This unusually high value of natural moisture content for a sandy soil can be explained by the existing ground water table in this stratum. The soil is loose, loose to compact and dense in holes 2, 3 and 4 respectively.

7

SOIL CONDITIONS:

3. Silty Fine to Medium Sand with Grits and Pebbles (Cont'd)

This soil was not encountered in hole 1 where, from 5 ft. to 11'2", a deposit of dark grey organic sandy silt was found. The upper boundary of this layer is very loose, however, the consistency becomes loose to compact with depth. All of the samples obtained from this stratum were much wetter than the plastic limit with a variable natural moisture content of 37 to 47%. These rather high values for a sandy silt are undoubtedly due to the organic content.

4. Very Silty very Fine Sand

Underlying the upper layers and terminating at the 15'7" to 19 ft. depth, there is a uniform deposit of grey very silty very fine sand. Occasional grits and pebbles were noted in hole 2 only. The soil is saturated and only loose to compact in general.

5. Silty Clay

An imbedded seam of grey silty clay with a thickness of 1'6" was noted, in hole 3 only. The soil was very soft and the natural moisture content was near the liquid limit.

6. Grey Clayey Fine to Medium Sand with Stones

Commencing at a depth of 15'7" to 20'6" below surface the soil changed to a grey clayey fine to medium sand with grits, pebbles and a considerable amount of stone fragments. Some of the samples contained sufficient clay binder to suggest a classification as a sandy till. This sandy till material had a high natural moisture content and the samples were generally saturated. This stratum was dense or very dense, and generally the field penetration test results were somewhat in excess of 40 blows per foot.

7. Fine to Coarse Sand with Stones

Beneath the stratum described above, down to 38 ft. and 36 ft. below surface in holes 1 and 2 respectively, the soil is a grey fine to coarse sand with stone fragments. It would appear that this layer is the till stratum without clay binder. The soil is very dense with standard penetration blows of 69 to 130.

SOIL CONDITIONS: (Cont'd)

8. Brown Silty Clay with Grits and Pebbles

Underlying the entire site commencing at 24 ft. to 33 ft. below surface and down to the depth investigated, a thick deposit of silty clay was encountered. This layer is somewhat heterogeneous in character containing grits and pebbles, occasional stone fragments with considerable sand content at places. The soil was quite sandy at the 35 ft. depth in hole 3 only. The clay is generally brown in colour, and is very stiff near its upper boundary in hole 3, but becomes hard everywhere else with a standard penetration test value exceeding 50 blows per foot. The natural moisture content is considerably less than the plastic limit and ranges between 9.2 and 16%.

At the bottom of testhole 3 only, the last 2 ft. of this stratum contained layers of shale.

FIELD TESTS:

Both the "Dutch Cone" Dynamic Penetration Test and the Standard Field Penetration Test were carried out at each of the holes. The adjacent Dutch Cone test at each hole was performed 6 inches apart from the soil test hole location.

The Dutch Cone tests were terminated at various depths when the resistance against penetration became extremely high and the rod could not be driven ahead.

It should be noted that in some cases, penetration into the soil could not be achieved by driving a split spoon sampler, and it was necessary to drill through these deposits with special tungsten carbide bits.

The results of these tests have been plotted against elevation and are given under Appendix I. These sounding profiles gave indications of the consistency of cohesive soils and the compactness of granular materials in situ. From these it is apparent that:

- a) The density varies considerably with depth: ignoring the upper few feet of surface layer, the density initially increased rapidly, varied irregularly over a depth of about 15 ft. and thereafter tended to increase again with depth.
- b) The great variations in densities are more than likely due to the character and the stone content of the layers penetrated.
- c) A very good bearing stratum exists below approximately elevation 1065.

WATER CONDITIONS:

It appears that the free ground water table slopes gently from both sides to river water level, and this is clearly indicated on the attached soil profiles. The approximate depth to free ground water was determined before the use of wash water in each hole. During the process of sampling ahead and cleaning the holes by means of auger, the water level observations were as follows:

Hole 1: water at 5'3" in casing after sampling to 8'8"
Hole 2: water at 6'3" in casing after sampling to 7'
Hole 3: water at 5'1" in casing after sampling to 6'
Hole 4: water at 4'5" in casing after sampling to 6'

The entrance of water into the holes was clearly observed.

On completion of holes and after withdrawal of casing all of the holes caved in and the following observations were made:

Hole 1: caved in at 10', W. T. 5'1" May 11th, 1959, 11:05 a. m.
Hole 2: caved in at 7'2", W. T. 5'3" May 11th, 1959, 7:30 a. m.
Hole 3: caved in at 6'3", W. T. 5'10" May 6th, 1959, 8:00 a. m.
 caved in at 4'4", hole dry, May 11th, 1959, 9:00a. m.
Hole 4: caved in at 4'9", W. T. 4'7", May 9th, 1959, 8:00 a. m.
 caved in at 4'9", W. T. 4'8", May 11th, 1959, 9:00 a. m.

Accordingly, based on these observations we assumed the ground water table as follows:

<u>Hole #</u>	<u>Depth to W. T.</u>	<u>Elevation</u>
1	5'1"	1080.83
2	5'3"	1081.25
3	5'1"	1081.23
4	4'5"	1080.88

The water level of the Thames River at the time of our investigation was 1080.04 ft.

No Artesian water conditions were noted. Seasonal variations in water table level undoubtedly occur.

CONCLUSIONS AND RECOMMENDATIONS:

1. Taking into consideration the weak and probably highly compressible upper mixed silt and clay stratum, the presence of the very soft organic silt in hole 1 and the non-uniformity of the silty fine sand in the other holes, it is essential that the bridge loadings be transmitted to the deeper underlying materials.
2. It is theoretically possible to found the structure on large strip footings placed on the very silty fine sand. However, the allowable bearing value of this stratum is so low that this alternative may be precluded due to the design load requirements.

Although this bearing stratum is generally in a loose to compact condition, it should be pointed out that the standard penetration test blows remained throughout below the conservative value of 15 blows per foot for a submerged sandy soil.

If a spread footing design is adopted, we suggest founding the bridge at elevation 1074.00 ft., that is, about 12 ft. below existing grade. We recommend this depth in order to avoid the great variations in densities of the upper boundary of this stratum.

The safe allowable bearing capacity at the recommended depth is 0.4 tons per sq. ft. to 0.5 tons per sq. ft. for footings ranging from a minimum of 4 ft. to a maximum of 10 ft. in width.

These values are based on limiting the total settlements to a maximum of 1 inch and include a factor of safety against shear failure of at least 3, taking into account the position of the water table. Differential settlements should be some fraction of the theoretical total settlements, and should be within normal construction limits.

The settlements should be immediate, taking place largely during the construction period.

Water will be somewhat of a problem in any excavation extending below the 5 ft. depth. Throughout the investigation, the soils were virtually saturated throughout the test holes; in addition, the ground water table appears connected with the river level. While the ground water condition may be alleviated in the dry months of the year, we feel that considerable pumping will be required in the excavations. In addition, "quicking" is likely to develop in open excavation to elevation 1074 due to the fine nature of the soil and the head of water to be expected.

CONCLUSIONS AND RECOMMENDATIONS:

2. (Cont'd)

It appears that close sheeting driven into the top surface of the dense sand and till will be required. This should cut off the water, and it should then be possible to keep the excavation in a workable condition by pumping without quicking of the bottom of the excavation.

3. Consideration of these conditions therefore leads us to recommend some form of piled foundation supported on the till stratum. While any type of displacement pile should be suitable, we do not recommend timber piles because of the possibility of damage from small boulders, or inadequate final penetration. Steel H piles may drive to a somewhat greater and more variable depth. Accordingly, we recommend pipe or monotube piles for this site.

The piles should be driven to virtual refusal, but in any event they should penetrate, if possible, to elevation 1065. Piles should be driven in one continuous operation if practicable. Some difficulty may be encountered in achieving the elevation suggested due to stone or small boulder interference.

4. We feel in this instance that some consideration to the use of caissons may be given, and that the final choice between comparatively short end-bearing piles or the use of caissons will largely be a matter of economic choice. The allowable bearing value of the till stratum below elevation 1065.0 is at least 3.5 tons per sq. ft.; settlement should be negligible.

Excavation inside the caissons should be carried out under water; after completion the caissons can be filled with either concrete or compacted well-graded gravel.

E. M. PETO ASSOCIATES LTD.,



E. M. Peto, P. Eng.

KP:sb

APPENDIX I

LABORATORY TEST RESULTS

e. m. peto associates ltd.
SOIL TESTING LABORATORY

LIQUID LIMIT TEST

FLOW LINE CHARTS

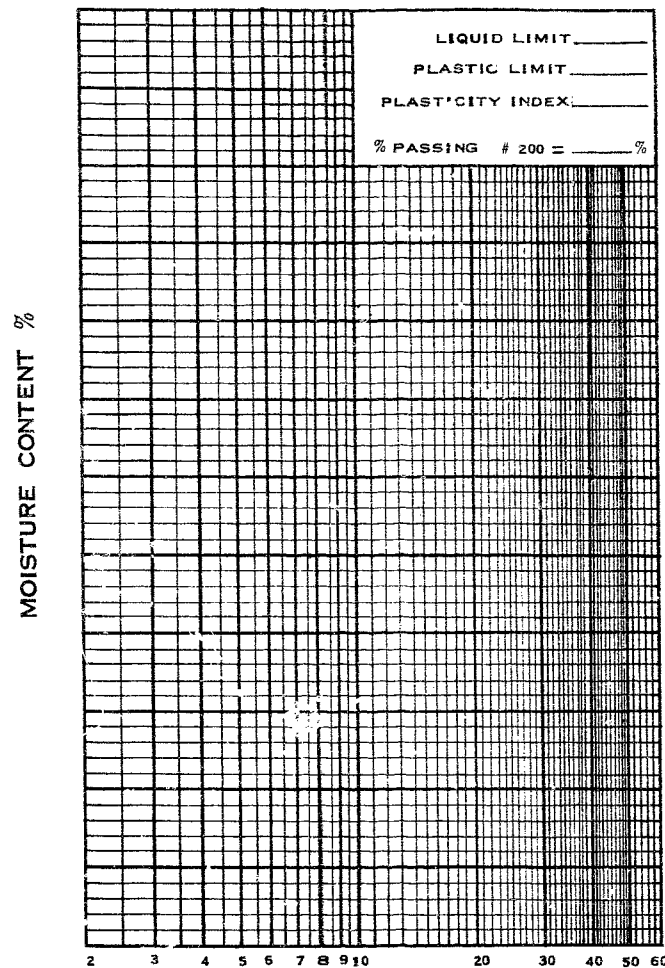
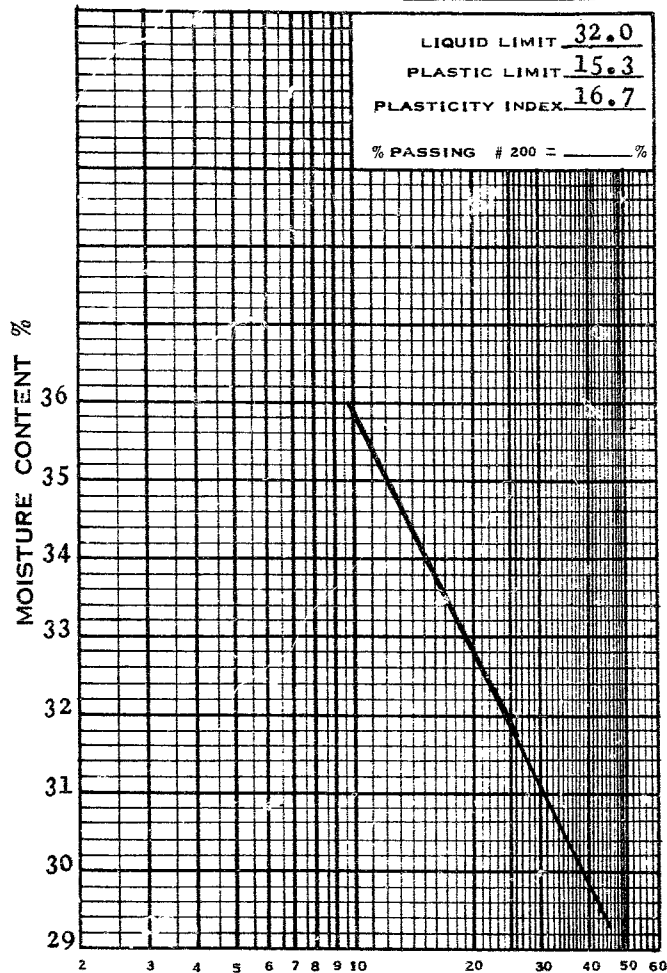
JOB No. 5978 PROJECT Thames River Bridge - Hwy. 19.

SAMPLE FROM B.H. # 3.

SAMPLE FROM _____

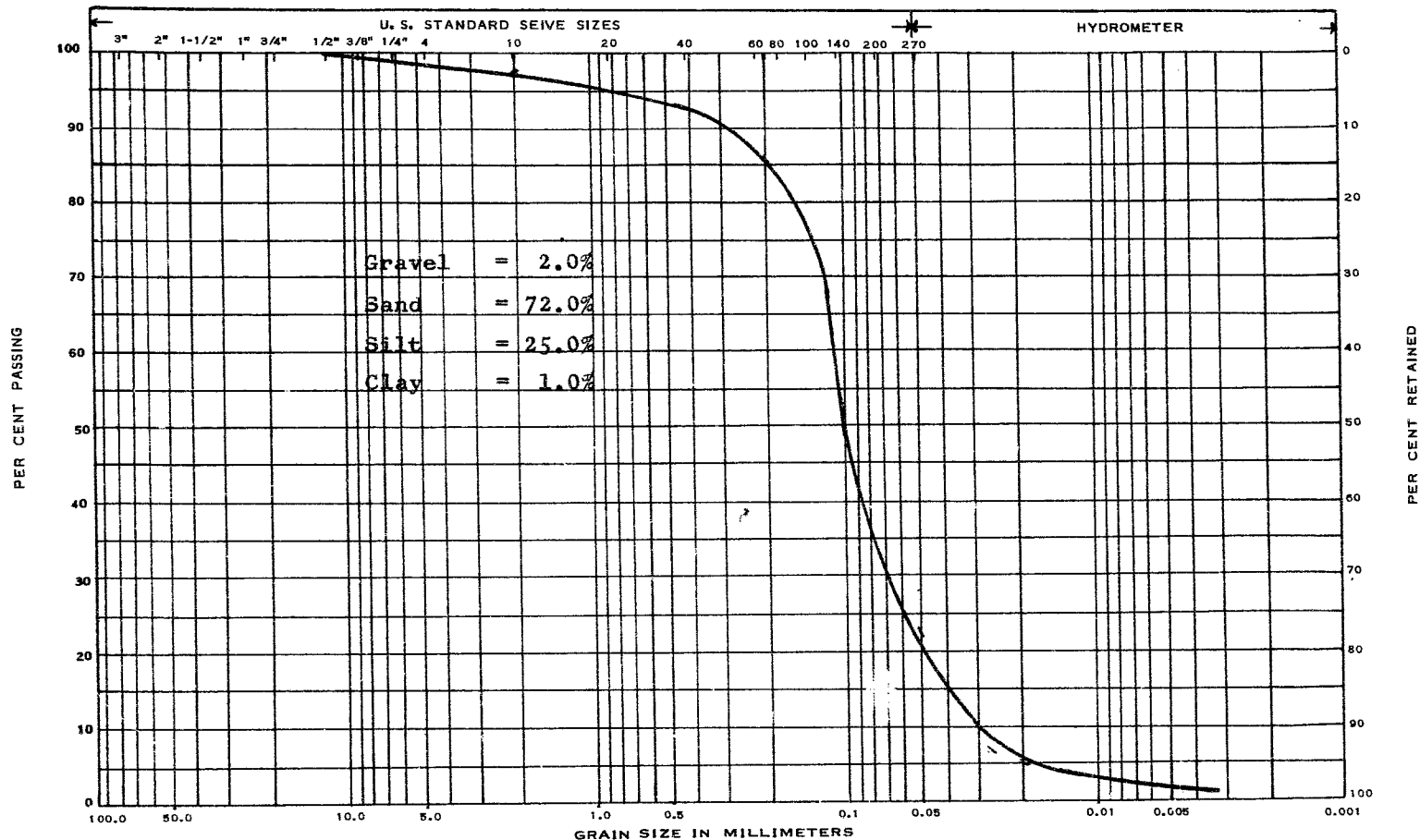
DEPTH 30' - 31'6"

DEPTH _____



e. m. peto associates ltd.

Toronto 19, Ontario



STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
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MASS. INST. OF TECH. CLASSIFICATION

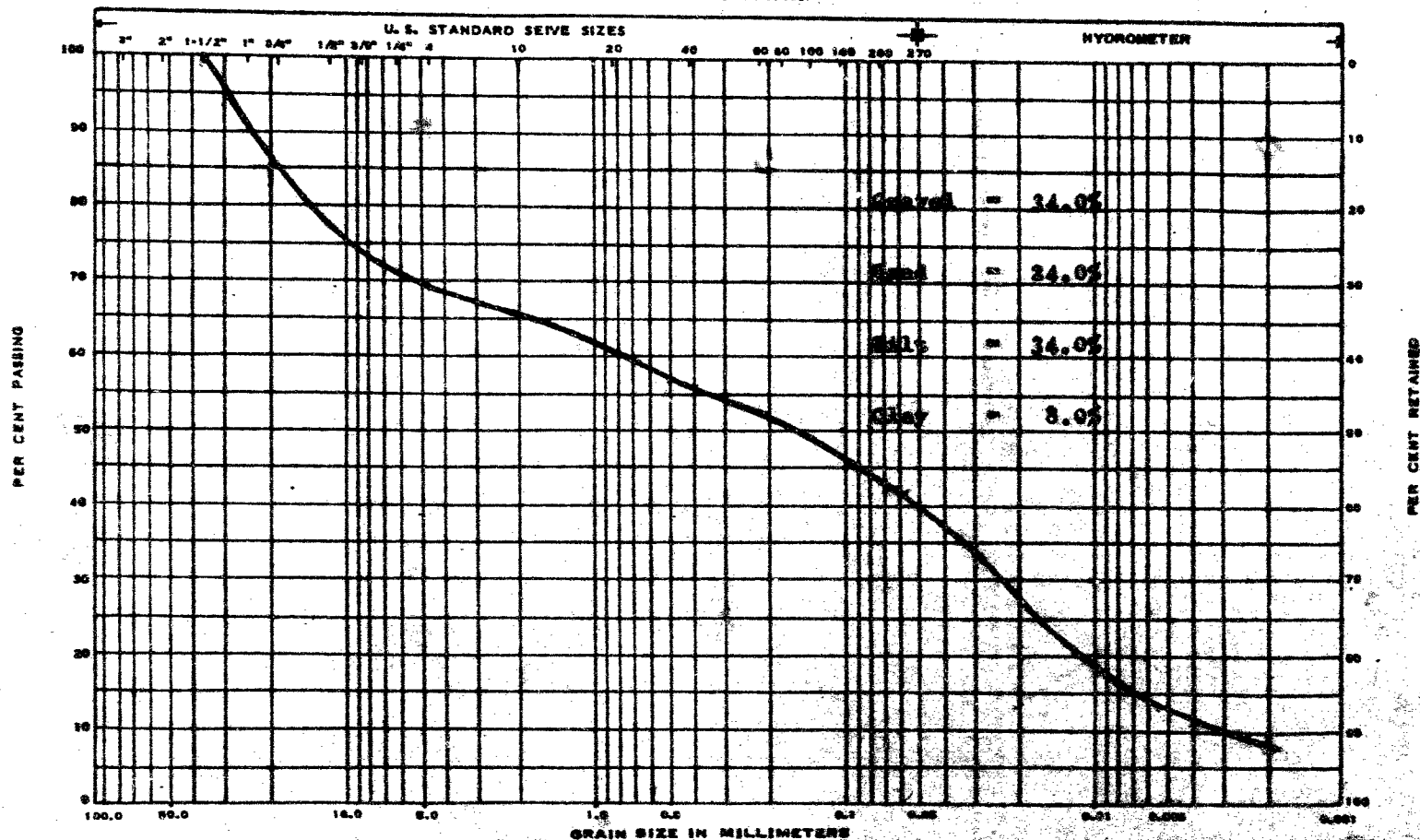
JOB NAME Thames River Bridge - Hwy.19. JOB NO. 5978 HOLE NO. 1 SAMPLE NO. _____

DEPTH 11'-12' ELEVATION _____ REMARKS Silty fine, some medium sand.

GRAIN SIZE DISTRIBUTION

e. m. peto associates ltd.

Toronto 18, Ontario



STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CL.
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MASS. INST. OF TECH. CLASSIFICATION

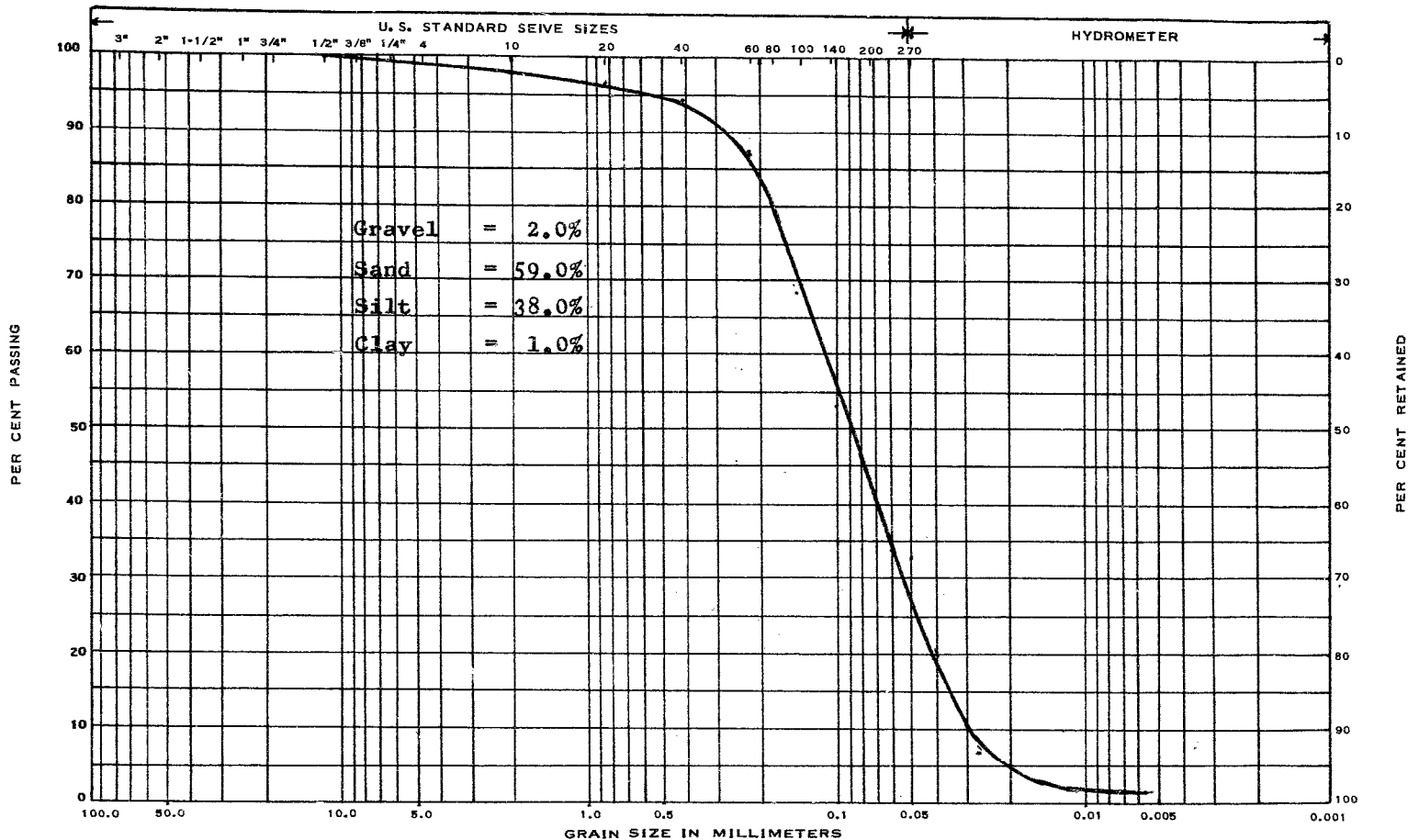
JOB NAME Thomas River Bridge - Hwy 10 NO. 5978 FILE NO. 1 SAMPLE NO. 2

DEPTH 20'-21' ELEVATION _____ REMARKS Sandy Till

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
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MASS. INST. OF TECH. CLASSIFICATION

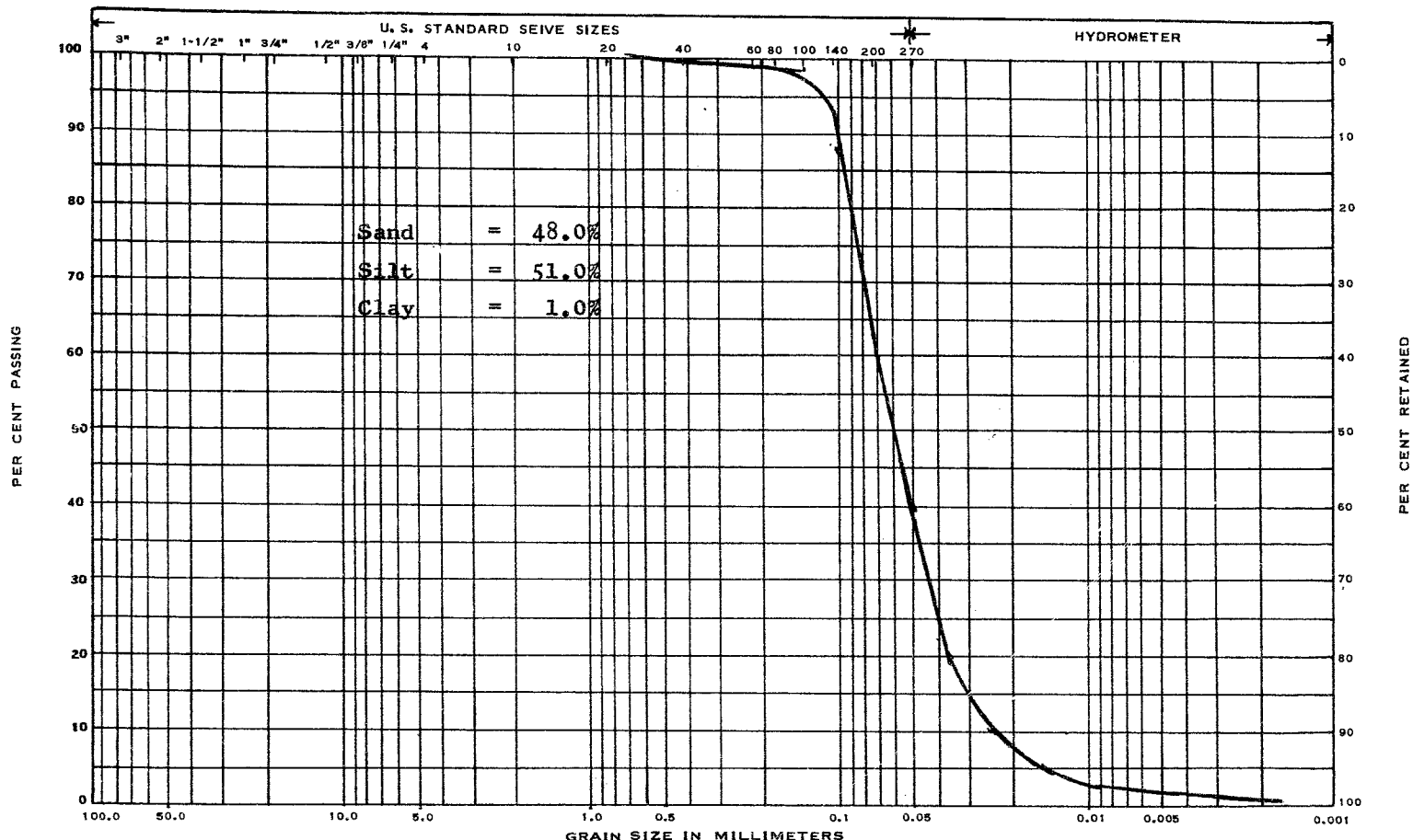
JOB NAME Thames River Bridge - Hwy. 19. JOB NO. 5978 HOLE NO. 2 SAMPLE NO. _____

DEPTH 10'-11' ELEVATION _____ REMARKS Silty fine, some medium sand.

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 Thames River Bridge - Hwy. 19. JOB NO. 5978 HOLE NO. 3 SAMPLE NO. _____

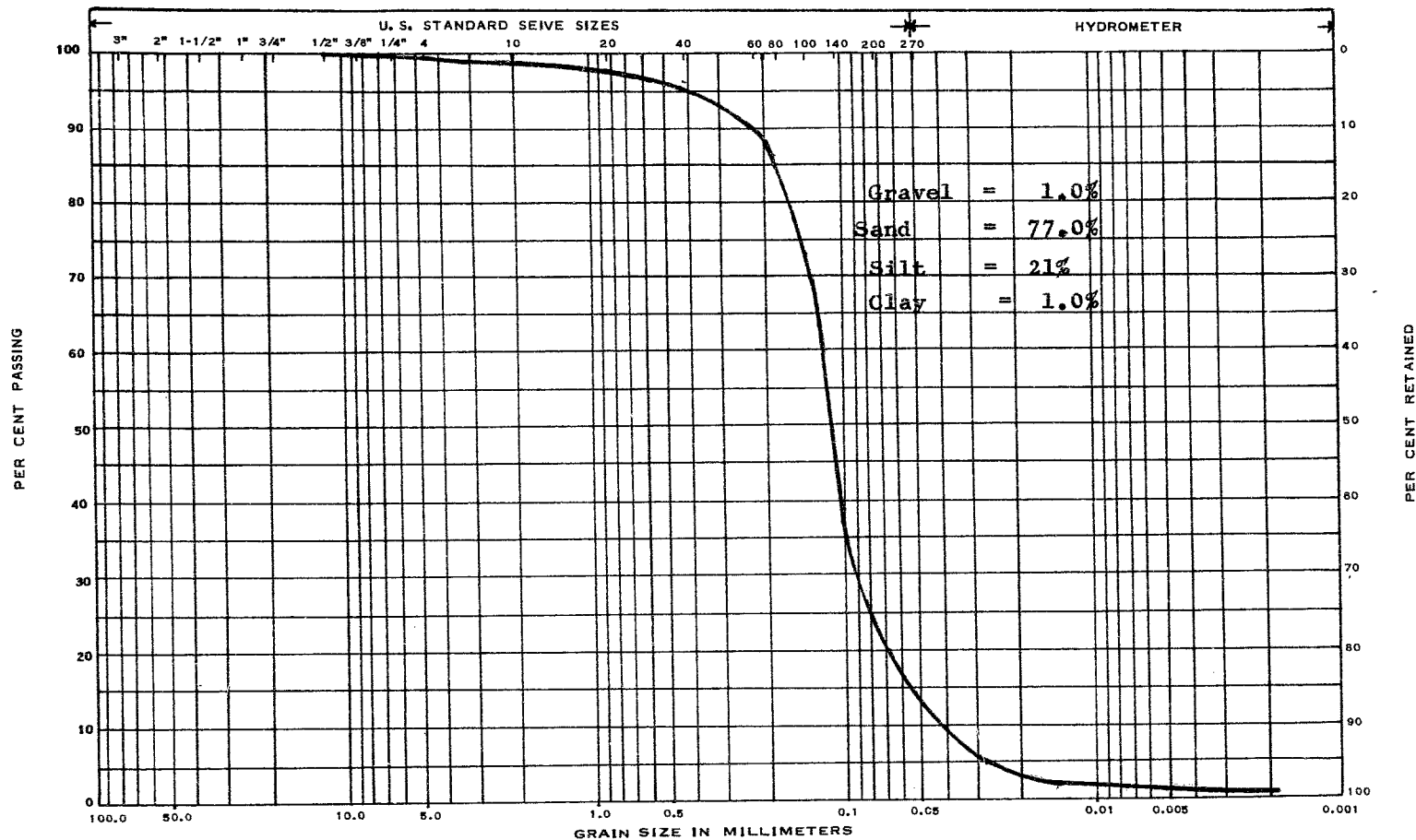
DEPTH 15'0" - ELEVATION _____ REMARKS Silty fine sand.

16'0"

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 Thames River Bridge - Hwy.19. JOB NO. 5978 HOLE NO. 4 SAMPLE NO. _____

DEPTH 10'- ELEVATION _____ REMARKS Silty fine sand.

GRAIN SIZE DISTRIBUTION

JOB NO. 5978.

THAMES RIVER BRIDGE - HWY 19

STANDARD PENETRATION TESTS.

BLOWS PER FOOT
120

1090

20

40

60

80

100

120

1080

1070

1060

1050

ELEVATION IN FEET

HOLE 1

HOLE 4

HOLE 2

HOLE 3

88/6"

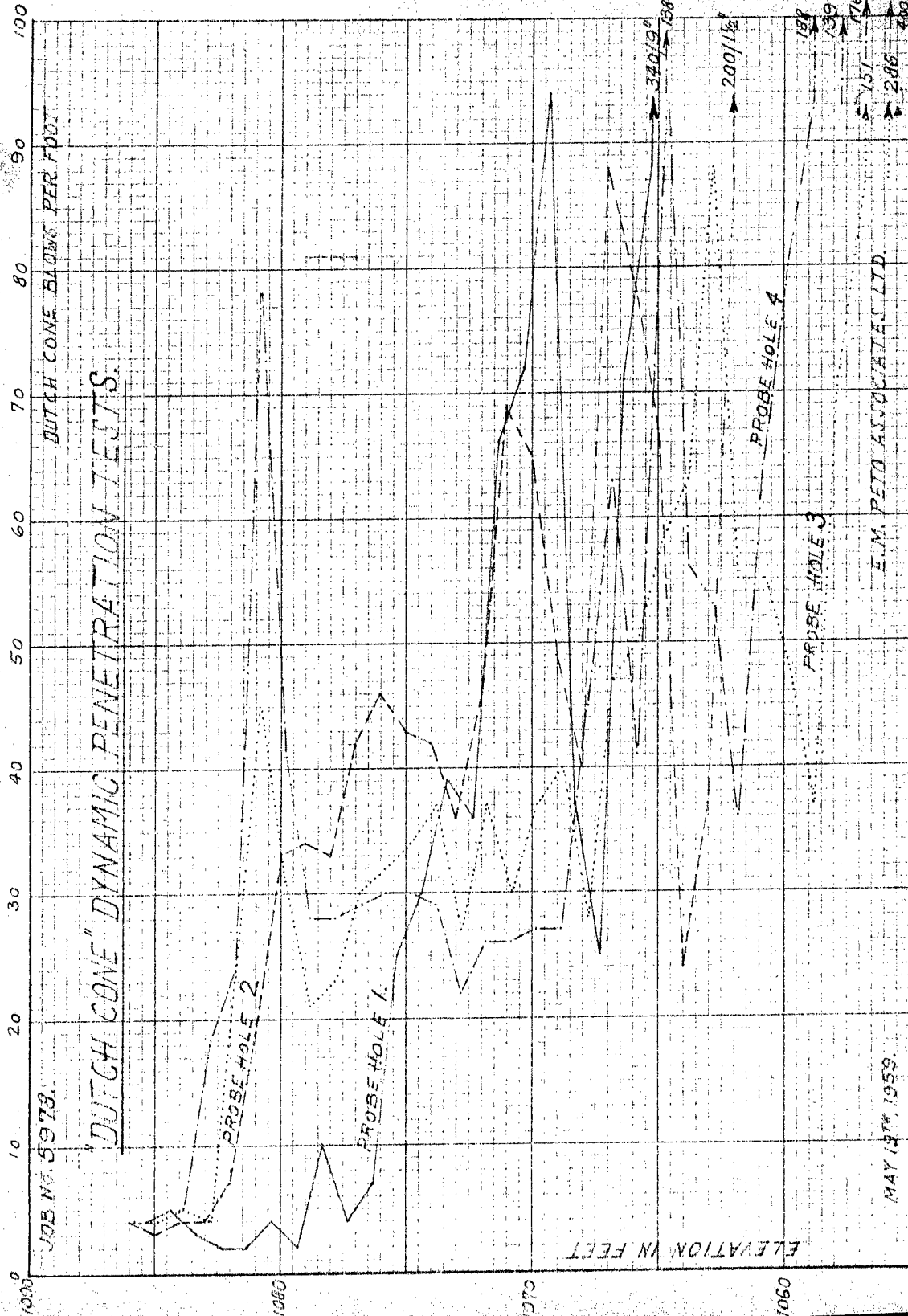
238

MAY 19TH 1959.

E. M. PETO ASSOCIATES LTD.

100/4"

THAMES RIVER BRIDGE - HWY 19.

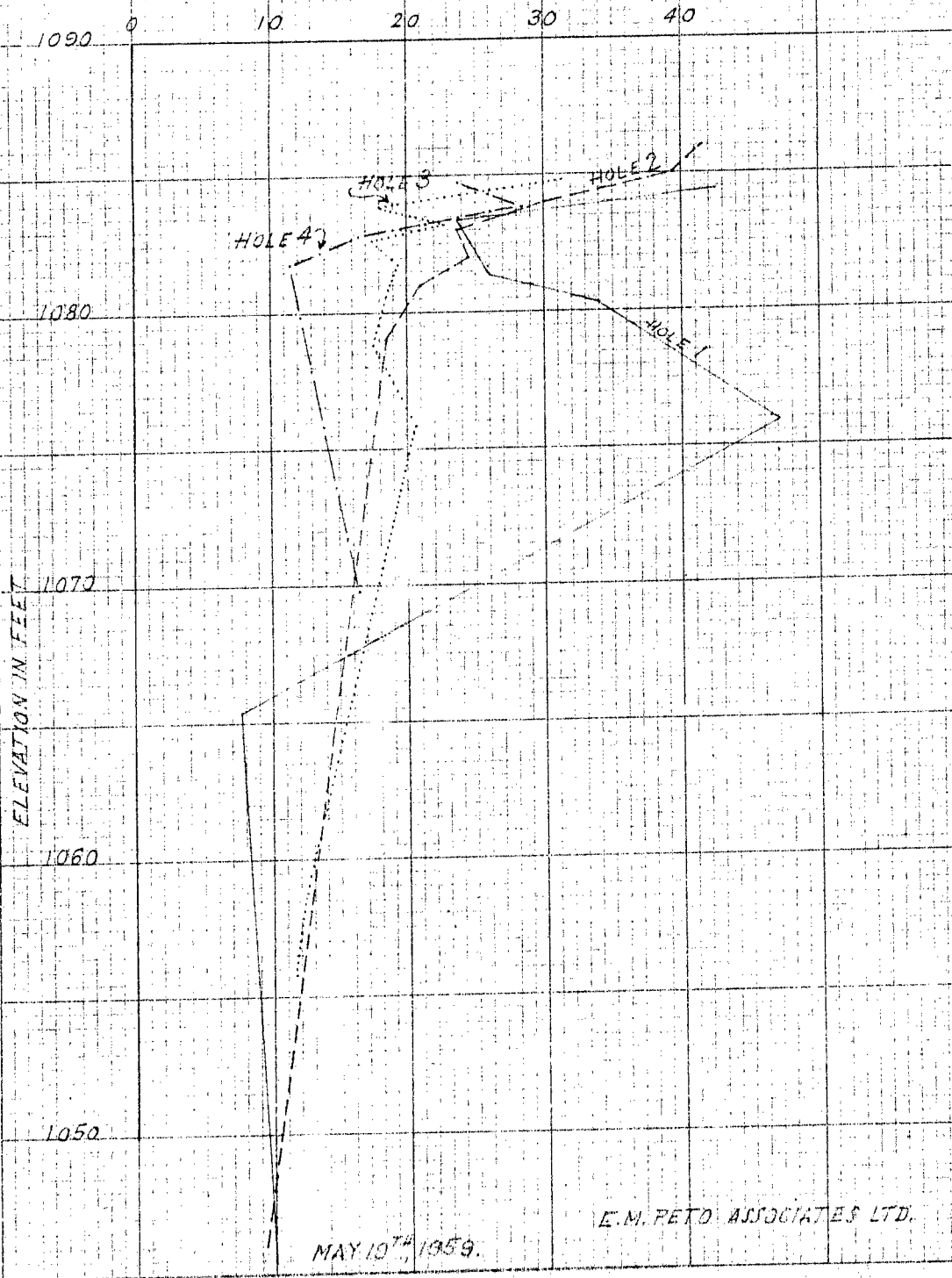


JOB No. 5978.

THAMES RIVER BRIDGE - HWY 19.

MOISTURE CONTENT VERSUS ELEVATION.

NATURAL MOISTURE CONTENT %



MAY 10TH 1959.

E. M. PETO ASSOCIATES LTD.

BOREHOLE LOG

Job Name Thames River Bridge - Hwy. Job No. 5978
19.
Client Dep't. of Highways of Ontario Casing BX (2" Dia.)
Datum Geodetic. Compiled By K.A.P.

Borehole No. 1
Boring Date May 8th. - 9th. 1959.
Checked By E.M.P.

SAMPLE CONDITION

 **UNDISTURBED** FAIR

 DISTURBED

LOST

SAMPLE TYPE

A.S. AUGER SAMPLE

C.S. CASING SAMPLE

S.S. 2" STANDARD SPLIT TUBE SAMPLE

S.L. SPLIT BARREL WITH LINERS

S.T. THIN-WALLED SHELBY TUBE SAMPLE

W.S. WASH SAMPLE

R.C. ROCK CORE

ABBREVIATIONS

V.T. IN SITU VANE SHEAR TEST

C SOIL SHEAR STRENGTH LBS/SQ.FT.

W.L. WATER LEVEL IN CASING

GROUND WATER TABLE IN SOIL

W.T.P.L. WETTER THAN PLASTIC LIMIT

D.T.P.L. DRIER THAN PLASTIC LIMIT

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
Ground surface.			0' 0"						
Sandy loam, roots, organic matter.	Dark brown		1085.90	1	X	C.S.			Moist.
Silty clay, roots, & organic content.	Brown	Very loose to loose.	2' 0" 1083.90	2	X	S.S.	4	42.3% 23.8%	W.T.P.L.
Silty clay, grits & pebbles, roots, layers of organic matter.	Brown		5' 0" 1080.90	3	X	C.S.		26.0%	W.T.P.L. W.T. 5' 1" May 8th.
Sandy silt, pebbles, some gravel layers of organic matter.	Black & grey.	Soft		4	X	S.S.	2	34.0%	Much W.T.P.L.
Sandy silt with organic matter.	Dark grey.			5	X	A.S.			Water in hole at 5' 3"
As above, grits & pebbles.	As above	Firm		6	X	S.S.	7		after sampling to 8' 8" over 1
As above	Dark grey	Stiff	10' 0" 11' 2"	7	X	S.S.	12	47.0%	Over saturation.
Very silty very fine sand.	Grey	Loose to compact	1074.73	8	X	S.S.	10		Saturated.
As above	As above								Started using wash water at 14' 0" Saturated.
Silty sand, pebbles, stones. (Till)	Dk. Grey	Very dense	15' 7" 1070.25	9	X	S.S.	131		Saturated.
			18' 0" 1067.90						
Clayey silt, grits & pebbles. (Till)	Grey	Hard	20' 0"	10	X	S.S.	100	7.9%	D.T.P.L.
As above, very sandy.	Grey	Hard	25' 0"	11	X	W.S.	42		
6" of fine to medium sand.	Brownish-grey	Very dense	29' 6" 1056.40	12	X	S.S.	128		Sand backing up casing Saturated.
Medium to coarse sand.	Greyish-brown			13	X	W.S.			
Coarse sand with stones & clayey silt. (Till)	Brownish-grey	Very dense	35' 0"	14	X	S.S.	69		Saturated.
Fine to medium sand	Greyish-brown		38' 0"	15	X	W.S.			
Silty clay, grits & Pebbles, stone fragments.	Brown	Hard	40' 0" 41' 0" 1044.90	16	X	S.S.	49	10.0%	D.T.P.L.
									Hole terminated at 41' 0"

BOREHOLE LOG

Job Name Thames River Bridge - Hwy. Job No. 5978
19.
Client Dep't. of Highways of Ontario. Casing BX (2 1/2" Dia.)
Datum Geodetic Compiled By K.P.

Borehole No. 2.
Boring Date May 6th. - 7th, 1959.
Checked By E.M.P.

SAMPLE CONDITION

SAMPLE TYPE

ABBREVIATIONS

	UNDISTURBED
	FAIR
	DISTURBED
	LOST

A.S. AUGER SAMPLE
C.S. CASING SAMPLE
S.S. 2" STANDARD SPLIT TUBESAMPLE
S.L. SPLIT BARREL WITH LINERS
S.T. THIN-WALLED SHELBY TUBE SAMPLE
W.S. WASH SAMPLE
R.C. ROCK CORE

V.T.	IN SITU VANE SHEAR TEST
C.	SOIL SHEAR STRENGTH LBS/SQ.FT.
W.L.	WATER LEVEL IN CASING
W.T.	GROUND WATER TABLE IN SOIL
W.T.P.L.	WETTER THAN PLASTIC LIMIT
D.T.P.L.	DRIER THAN PLASTIC LIMIT





SOIL DESCRIPTION	COLOR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Natural Moisture Content	WATER LEVELS & REMARKS
Ground surface			0' 0"						
Sandy loam, Roots, organic matter.	Dark brown		1086.50	X	1	C.S.		41.5%	Wet,
As above, more silt.	Dark brown	Loose	3' 0"	X	2	S.S.	5	39.4%	
Mixed silty clay, occasional gravel, roots, some organic matter.	Grey & brown		4' 7" 1078.88	X	3	C.S.		23.7%	W.T.P.L.
Silty fine to medium sand, Dk. brown grits & pebbles, some gravel.		Loose	6' 5" 1077.08	X	4	S.S.	9	21.0%	Water in casing at 6' 3"
Very silty very fine sand. Grey		Loose		X	5	S.S.	9	18.4%	after sampling to 7' 0"
			10' 0"						Saturated.
As above, grits & pebbles. As above		Loose		X	6	S.S.	9		Saturated.
Silty fine sand, grits & pebbles, stones. (Till)	Grey	Dense	15' 7" 1067.88	X	7	S.S.	40		Saturated.
			20' 0"						
As above, but less sand.	Grey	Dense		X	8	S.S.	39		Saturated.
			25' 0"						High blows due to stone interference.
As above, stones.	Grey	Very dense		X	9	S.S.	238		Saturated.
Fine to medium sand	Brownish-grey	Dense	30' 0" 1056.50	X		W.S.	48		S.S. Los*
As above	Brownish-grey			X	10	W.S.			
			35' 0"						
As above	Brownish-grey	Very dense	36' 0" 1050.50	X	11	S.S.	130		
			40' 0"						
Silty clay, grits & pebbles.	Brown	Hard	41' 0"	X	12	S.S.	131	9.2%	D.T.P.L.
		Hole terminated at	41' 0"						

BOREHOLE LOG

Job Name Thames River Bridge - Hwy. 10 Job No. 5978
Client Dept. of Highways of Ontario. Casing BX (2 1/2" Dia.)
Datum Geodetic Compiled By K.P.

Borehole No. 3.
Boring Date May 1st. - 5th. 1959.
Checked By E.M.P.

SAMPLE CONDITION

	UNDISTURBED
	FAIR
	DISTURBED
	LOST

SAMPLE TYPE

A.S. AUGER SAMPLE
C.S. CASING SAMPLE
S.S. 2" STANDARD SPLIT TUBE SAMPLE
L.L. SPLIT BARREL WITH LINERS
S.T. THIN-WALLED SHELBY TUBE SAMPLE
W.S. WASH SAMPLE
R.C. ROCK CORE

ABBREVIATIONS

V.T. IN SITU VANE SHEAR TEST
C. SOIL SHEAR STRENGTH LBS/SQ.FT.
W.L. WATER LEVEL IN CASING
W.T. GROUND WATER TABLE IN SOIL
W.T.P.L. WETTER THAN PLASTIC LIMIT
D.T.P.L. DRIER THAN PLASTIC LIMIT

[illegible]

BOREHOLE LOG

Borehole No. 4

Boring Date May 5th. - 6th. 1959.

Checked By E.M.P.

ABBREVIATIONS

V.T. IN SITU VANE SHEAR TEST
C. SOIL SHEAR STRENGTH LBS/SQ.FT.
W.L. WATER LEVEL IN CASING
W.T. GROUND WATER TABLE IN SOIL
W.T.P.L. WETTER THAN PLASTIC LIMIT
D.T.P.L. DRIER THAN PLASTIC LIMIT

LOST

Hole terminated at 26'0"					
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APPENDIX II

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.