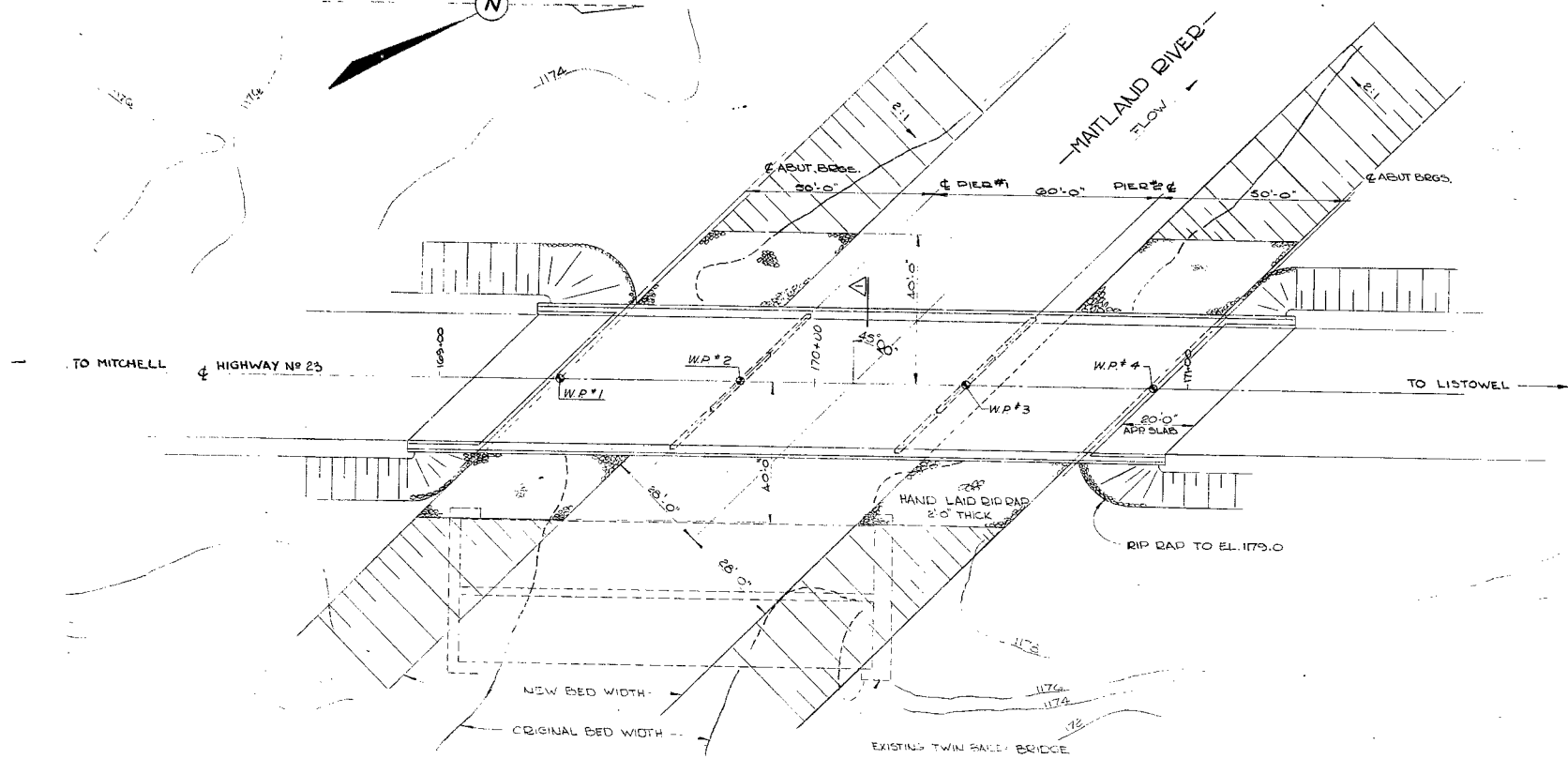
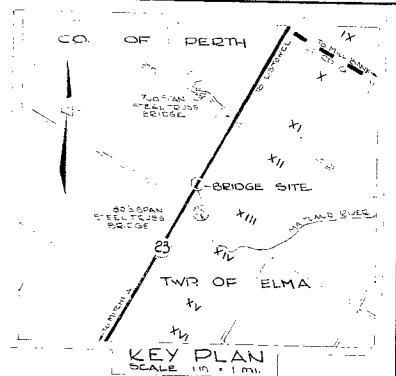
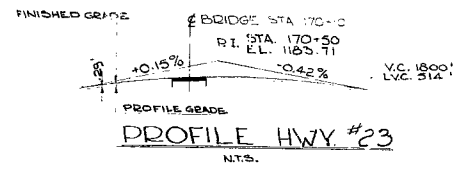


#66-F-231C
W.P. #108-66
HWY #23
MAITLAND
RIVER
(BOYLE DRAIN)



NOTE:
EXISTING STRUCTURE TO BE REMOVED
BELOW FOOTINGS
DETOUR TO BE VIA BAILEY BRIDGE
ALREADY ERECTED.

PLAN
SCALE 1" = 20'-0"



GENERAL NOTES

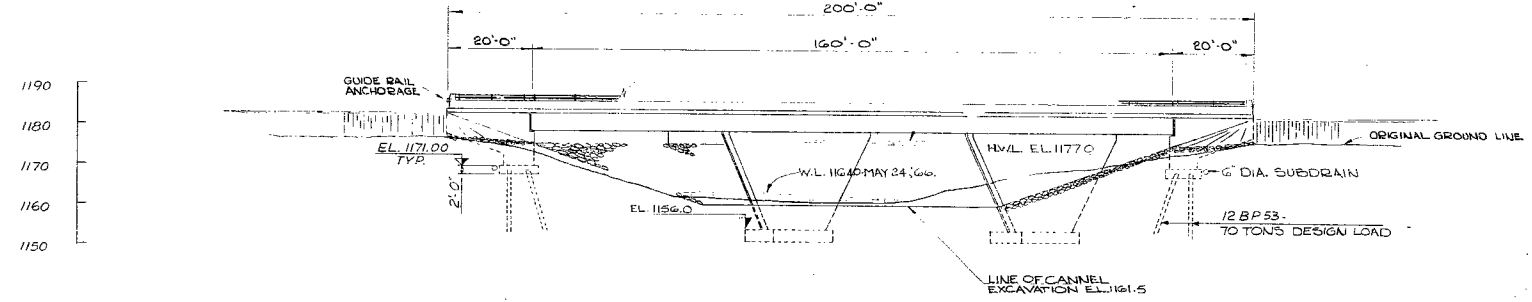
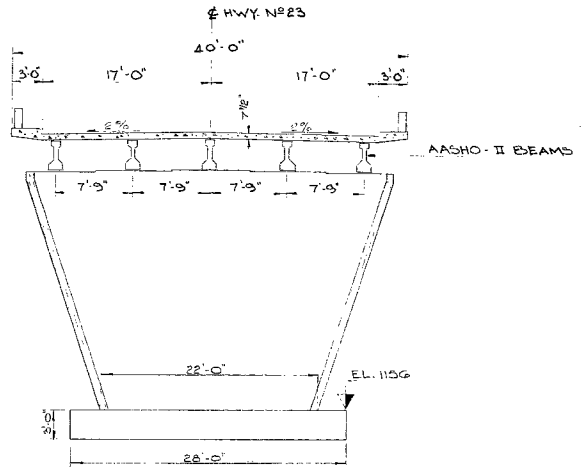
CLASS OF CONCRETE:
DECK & PARAPET WALL 5000 P.S.I.
REMAINDER 3000 P.S.I.
CLEAR COVER ON REINFORCING STEEL:
FOOTINGS, ABUTMENTS & PIERS 3", CURBS 2",
DECK: TOP 2", BTM. 1 1/2"

SKREW ANGLE 45° 00' 00"

SIN 7071068
COS 7071068
TAN 1.0000000
SEC. 1.4142135

B.M. EL 1179.23

GEODETIC DATUM:
CUT "X" ON E. SIDE ON STN. FDN., 0.1 FROM
N.E. CORNER & 0.2 BELOW BRICKWORK 97'S
LT. OF STA. 168+43.



ELEVATION
SCALE 1" = 20'-0"

PRINT RECORD		
No.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION			
MAITLAND RIVER BRIDGE			
8.7 MILES SOUTH OF SOUTH JCT. HWY. #86			
KING'S HIGHWAY No. 23		DIST. No. 3	
CO.		CON. 13	
TWP. OF ELMA		LOT 15 & 16	
PRELIMINARY			
APPROVED		SITE No. 25-72 W.P. No. 108-66	
DESIGN	J. L.	CHECK	
DRAWING	B. S. A.	CHECK	
DATE	OCT/66	LOADING	H520-46
CONTRACT No.		DRAWING No. D-6062-P	

E. M. PETO ASSOCIATES LTD.

SOILS INVESTIGATION REPORT
PROPOSED BRIDGE-HIGHWAY 23 & BOYLE DRAIN

W. P. 108-66

66F231C FOR

DEPARTMENT OF HIGHWAYS, ONTARIO

DISTRIBUTION:

12 c.c. Department of Highways, Ontario
1 c.c. File

e. m. peto associates ltd.

YOUR REFERENCE: .

OUR REFERENCE: . 66224

1287 caledonia road,

TORONTO 19, ONTARIO

Telephone: 789-1126

September 9th, 1966

Department of Highways, Ontario,
Materials and Testing Division,
Downsview, Ontario.

Attention: Mr. A. Rutka, P.Eng.

Dear Sirs:

Re: Soils Investigation Report
Proposed Bridge - Highway 23 & Boyle Drain
W.P. 108-66

We have pleasure in submitting herewith our report on the soil and ground water conditions found to exist at the above site and our recommendations for the foundation design of the proposed bridge.

While we consider the report to be comprehensive, we will be pleased to be of further assistance, should you require any additional information in connection with this report.

Yours very truly,

E. M. PETO ASSOCIATES LTD.,



E. M. Peto, P.Eng.

KSS/hf

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TABLE "I"

Shear Strength & Density Test Results

FIGURE I

Consolidation Test Results

GRADING CURVES

BOREHOLE LOGS

SITE PLAN AND PROFILES

1. INTRODUCTION

1.1 Authority: The authorization for this investigation was given by the Department of Highways, Ontario, Materials and Testing Division, in a letter dated 2nd August 1966.

1.2 Proposal: It is proposed to construct a new bridge, as a replacement for the existing bridge, at station 170+10 on Highway 23, where Boyle Drain crosses the Highway. The new bridge consists of a 71 ft. 0 inch centre span and two 45 ft. 0 inch outer spans. The layout of the proposed footing foundations is shown on the appended site plan, but the foundation pressures are not known at this stage. It is also proposed to raise the grade level of the existing roadway by 3 ft. 6 inches approximately.

1.3 Object of the Investigation: The object of this investigation was to determine the soil and ground water conditions existing at this site and to evaluate their properties for the foundation design of the proposed structure and the road.

2. SITE, GEOLOGY AND GENERAL INFORMATION

2.1 Site Topography: The area surrounding this site consists of fairly flat farmland, except for the banks of the stream and the approach fill embankments of the existing road. The banks of the stream are fairly steep though only about 10 ft. high. Similarly, the sides of the embankments are also steep though not high.

2.2 Stream: The stream is 60 to 70 ft. wide at the top. It flows from south to north and it crosses the road at an angle of about 45 degrees. The road is oriented in a northeast - southwest direction. The elevation of water surface in the stream was 1162.69 on 12 August 1966. There was only about 2 to 3 ft. of water and the rate of flow was slow during the time of this investigation. There is very little evidence of any significant scouring taking place. However, this should be verified from other sources of information.

2. SITE, GEOLOGY AND GENERAL INFORMATION - continued

-2-

2.3 Geology: Geologically, this site overlies alluvial deposits and limestone shale Till of the Brookston Series.

3. FIELDWORK AND DATA

3.1 The fieldwork for this investigation was carried out during the middle part of August, 1966. During this period, seven boreholes were sunk at this site at the locations shown on the appended drawing. Boreholes numbered 1, 2, 5 and 6 were sunk using standard boring rig and the other holes were sunk using self-propelled, track mounted flight auger rig. Wash water was used for boring below 32 ft. 0 inches in borehole 1, below 17 ft. 0 inches in borehole 2 and below 31 ft. 6 inches in borehole 6. No wash water was used in the other holes. The depths of these holes varied from 20 ft. 0 inches to 55 ft. 6 inches as shown on the appended borehole log sheets. The soil profiles are shown on the appended drawing. The boreholes were surveyed and the elevations of the holes were taken by the Surveyors of the Department of Highways, Ontario, South Western Region.

3.2 Standard Penetration tests were carried out at various depths in all the holes and the results are given in the borehole log sheets and on the drawing. It may be noted that there is wide variation in the number of blows "N" in the SILT TILL stratum and this variation is generally attributable to the presence of cobbles in places. Hence, the lower values of "N" should normally be used for estimating bearing capacities.

3.3 Dynamic (cone) penetration tests were also carried out near five of the holes and the results are given in the borehole logs.

3. FIELDWORK AND DATA - continued

-3-

- 3.4 In addition to the split spoon samples of the standard penetration tests, a few thin wall shelby tube samples were also taken at the depths shown on the borehole log sheets. Some of these thin wall shelby tube samples were found to have been disturbed by the gravel in the Till and these samples were not tested in the laboratory.
- 3.5 Attempts were made to obtain undisturbed samples of the Fill material in the existing road embankment by using brass liner tubes inside the split spoon sampler. These attempts were only partially successful, as the soils were fairly loose and some of the samples became disturbed. Wherever possible, these were tested for shear strength and densities.
- 3.6 The ground water conditions observed during the investigation are described later in this report. As ground water under artesian pressure was encountered in boreholes numbered 1, 2, 3, 6 and 7, a plastic pipe, $\frac{1}{4}$ inch internal diameter and open ended, was installed in borehole 1 and another in borehole 6 in order to determine the ground water levels. These pipes have not been removed and water level readings could be taken in the future, if required. Two samples of the ground water and a sample of the water from the stream were obtained for chemical analyses.

4. LABORATORY WORK

- 4.1 Moisture Content Determinations: The moisture contents of the soil samples were determined according to the standard method and the results are given in the borehole log sheets.

4. LABORATORY WORK - continued

-4-

4.2 Mechanical Analyses: Sieve analyses and hydrometer analyses, wherever necessary, were carried out on selected representative samples of the soils, and the results are given as Grain Size Distribution Curves. These were used in the classification of the soils as described under the section "Soil Conditions" in this report.

4.3 Triaxial Shear Strength Tests: These tests were carried out on four undisturbed thin wall tube samples of the soils in order to assess their shear strengths in conjunction with the other laboratory and field test results. In this type of test the samples were first consolidated under a pressure of 10 lbs/sq.in. and then the deviator stress was applied quickly under undrained conditions. The results are given in the appended Table I. The shear strengths represented by these results are generally lower than those given by the standard penetration test results.

4.4 Unconfined Compression and Density Tests: Attempts were made to carry out unconfined compression tests on samples of the existing approach Fill in order to assess the condition of the Fill. But only one sample was stable enough for the unconfined compression test. A density test was carried out on another sample of the Fill. In this latter test the volume of the sample was measured while it was in the sample tube. Then it was extruded and its wet and dry weights were obtained from which the density was determined. The results of these tests are given in the appended Table I. These results are used in conjunction with the standard penetration test results for an assessment of the condition of the Fill given in this report.

4. LABORATORY WORK - continued

-5-

4.5 Consolidation Test: A one dimensional consolidation test was carried out on a sample of the Silty Clay Till in order to assess its compressibility characteristics and the probable settlements under the foundations of the bridge. The void ratio - log pressure curve obtained from this test is shown, together with the coefficient of consolidation C_v and the coefficient of volume change m_v , on the appended Figure I.

4.6 Chemical Analyses: Tests were made on two ground water samples, one from each of the boreholes 3 and 6, and on a stream water sample to determine the concentration of soluble sulphates (expressed as SO_3). This was found to be 57 parts per 100,000 for water from borehole 3, and 65 parts per 100,000 for water from borehole 6 and 27 parts per 100,000 for stream water. The corresponding pH values were 6.4, 6.3 and 6.4 indicating very slight acidity.

5. SOIL CONDITIONS

5.1 The detailed descriptions of the soil strata encountered are given in the appended borehole logs and the soil profiles are shown on the appended drawing. The descriptions and the thicknesses of the soil strata shown, were based on the field observations and on the results of the field and laboratory tests. The profiles represent only a generalized classification. The following major groups of soil strata have been identified:

5.2 The top stratum on the embankments is the Fill. This Fill consists of varying amounts of loose Sand, Silt and Gravel with clay content and with occasional thin layers of Organic Silts and Peat. The maximum thickness of the Fill is 13 ft. 0 inches.

5. SOIL CONDITIONS - continued

-6-

- 5.3 Lying under the fill in the embankments and near the surface in the vicinity of the stream bed are alluvial deposits consisting of layers of soft to firm Silts and Clays and compact to dense Sands and Gravels in varying proportions. These deposits are all above elevation 1158.5 ft.
- 5.4 Below the alluvial deposits is a stiff to hard silty CLAY TILL with seams of Silt, Sand and Pebbles in places. The thickness of this stratum varies from 4 ft. to about 16 ft. and the shear strength also varies somewhat as indicated by the test results.
- 5.5 Underlying the Silty CLAY TILL is a stratum of hard clayey sandy SILT TILL with cobbles. This stratum varies in thickness from 12 to 17 ft. approximately. The sand and clay contents also vary from place to place. The lower surface of this stratum dips down gently from northwest to southeast.
- 5.6 A thin seam of sandy gravel, estimated to be about 0 ft. 6 inches thick, was encountered under the SILT TILL stratum in all the holes taken down to this depth, except in hole No. 4. The significance of this seam is that it contains ground water under artesian pressure, the details of which are given in the section "Ground Water Conditions" later in this report.
- 5.7 Below the SILT TILL lies very dense clayey silty SAND TILL with cobbles.

6. GROUND WATER CONDITIONS

- 6.1 There was no ground water in and above the Clayey SILT TILL, except for the few water bearing seams at about the stream level as shown on the borehole logs. The water in these seams is, most likely, perched water.
- 6.2 The major ground water source encountered was the thin seam of Sandy Gravel below the SILT TILL. The flow of water into the boreholes from this seam was fairly fast and the highest observed standing water level was 1174.0 ft. above geodetic datum. Details of the rate of flow of this water are given in the borehole logs.
- 6.3 The ground water conditions discussed above are those appertaining to the time of the investigation and they may be subject to alterations due to seasonal effects or changes in drainage conditions.

7. CONCLUSIONS AND RECOMMENDATIONS

- 7.1 Allowable Bearing Capacity: Assuming that a minimum depth of foundation of 6 ft. below the stream bed level is required for scour protection, all the foundations would bear in the Silty CLAY TILL stratum. The allowable net bearing capacity of shallow spread foundations bearing in this Silty CLAY TILL stratum is 4.0 kips/sq.ft., including a factor of safety of not less than 3 against general shear failure. This estimate is based on lower values of the field tests and laboratory shear test results and on possible settlement considerations. Although the allowable bearing capacity in this stratum would be greater than 4.0 tons/sq.ft. in some parts of the site, it is considered advisable to use 4.0 kips/sq.ft. for the design of all the foundations. The allowable bearing capacities of deeper foundations would be greater than 4.0 kips/sq.ft., and the exact value would depend on the width and the depth of the foundations. However, it is assumed, although the exact foundation loads are not known, that it would not be necessary or economical to take the foundations deeper.

7. CONCLUSIONS AND RECOMMENDATIONS - continued

-8-

7.2 Settlements: The settlements which are likely to occur would depend on the actual width and depth of the foundation and on the actual pressure. For an assumed width of 10 ft. and a pressure of 4.0 kips/sq.ft. the total settlement should be less than 1.5 inches and within the allowable limits for the proposed structure. The differential settlements should be less than 1.0 inch. If the width is less than 10 ft. the settlements would also be smaller. All the settlements should occur fairly rapidly.

7.3 Excavation: As the excavations for the above recommended foundations would not expose the water bearing seam of Sandy Gravel below the SILT TILL, no serious ground water problems during construction are likely to occur. However, precautions must be taken to deal with the surface water and the perched water from the odd seams, especially if the excavation and the construction are to be carried out under wet weather conditions.

7.4 Chemical Attack: No precautions are necessary to protect the concrete embedded in the ground from chemical attack.

7.5 Stability of Approach Fill: It is considered that the existing Approach Fill is generally stable and should be capable of sustaining the proposed additional fill, which would be placed on top of it. Any compaction and settlement that may occur in the existing Fill due to the weight of the new Fill should be small and rapid.

7. CONCLUSIONS AND RECOMMENDATIONS - continued

-9-

7.6 Scour Protection: It appears, from an inspection of the site during this investigation, that scouring is not a serious problem on this site. However, any further hydrological information, which may be available, should be considered in conjunction with the field and laboratory test results given in this report, in order to decide whether any scour protection of the banks is necessary. It is considered that the foundations of the bridge should be taken down to about 6 ft. below the stream bed.

Yours very truly,

E. M. PETO ASSOCIATES LTD.,



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

KSS/hf

Report Prepared by:

K.S. Senathirajah
K.S. Senathirajah,
Senior Soils Engineer.

TABLE "I"

SHEAR STRENGTH AND DENSITY TEST RESULTS

B.H. No.	Sample No.	Depth	Type of Test	Moisture Content %	Wet Density lbs./cu.ft.	Dry Density lbs./cu.ft.	Degree of Saturation %	Void Ratio e	% Strain at Failure	Shear Strength, lbs/sq.ft.
1	3	10'0"-11'6"	Density	47.6	98.7	66.8	84	1.520	-	-
3	2	5'0"-6'6"	Qu	17.0	128.2	109.6	85	0.540	20	454
4	6	15'0"-16'6"	Qcu	18.9	131.0	110.0	96	0.530	10	4050
6	4	10'0"-11'6"	Qcu	29.7	120.2	92.6	98	0.822	5.5	2730
6	7	17'6"-19'0"	Qcu	10.5	132.2	119.5	70	0.410	20	1820
7	6	20'0"-21'6"	Qcu	26.0	123.0	97.6	96	0.727	7.5	2310

Qu Unconfined Compression

Qcu Consolidated undrained triaxial. In this test the sample was consolidated at 10 lbs./sq.inch and then the deviator stress was applied quickly under undrained conditions.

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS:-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

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

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

A.P.L. ABOUT PLASTIC LIMIT

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL		

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_C	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$
T_v	TIME FACTOR = $\frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
$\bar{\sigma}$	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

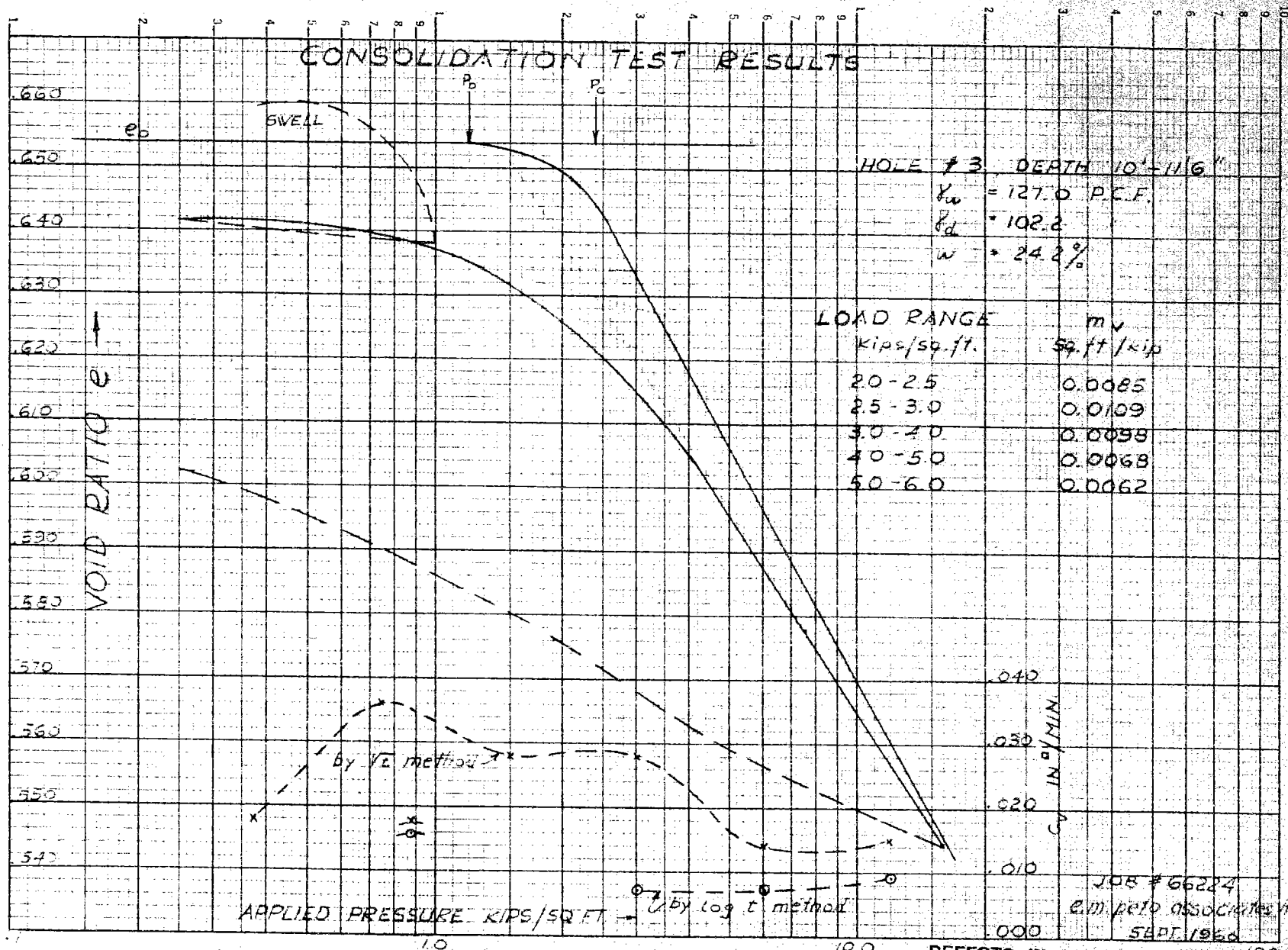
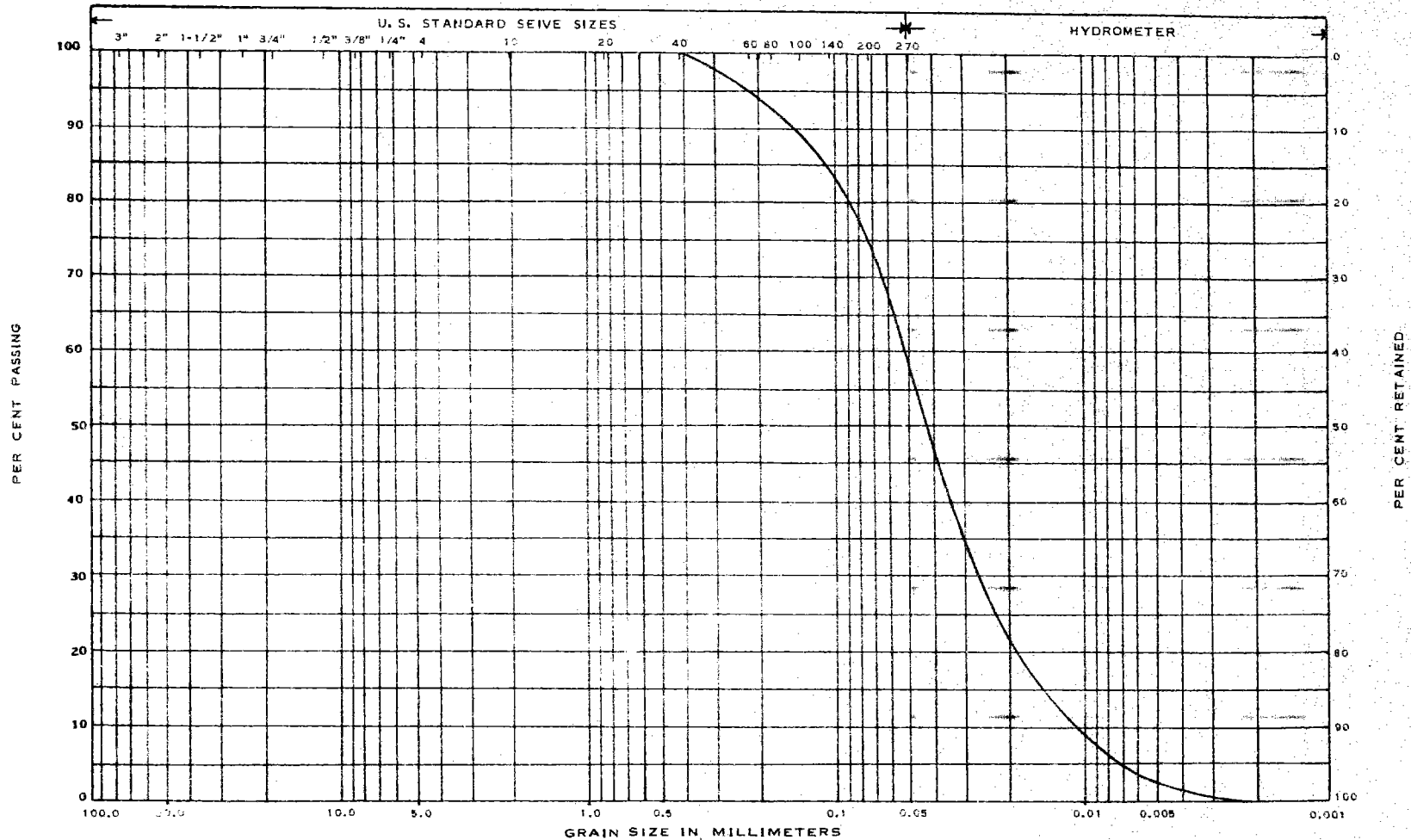


FIG 1

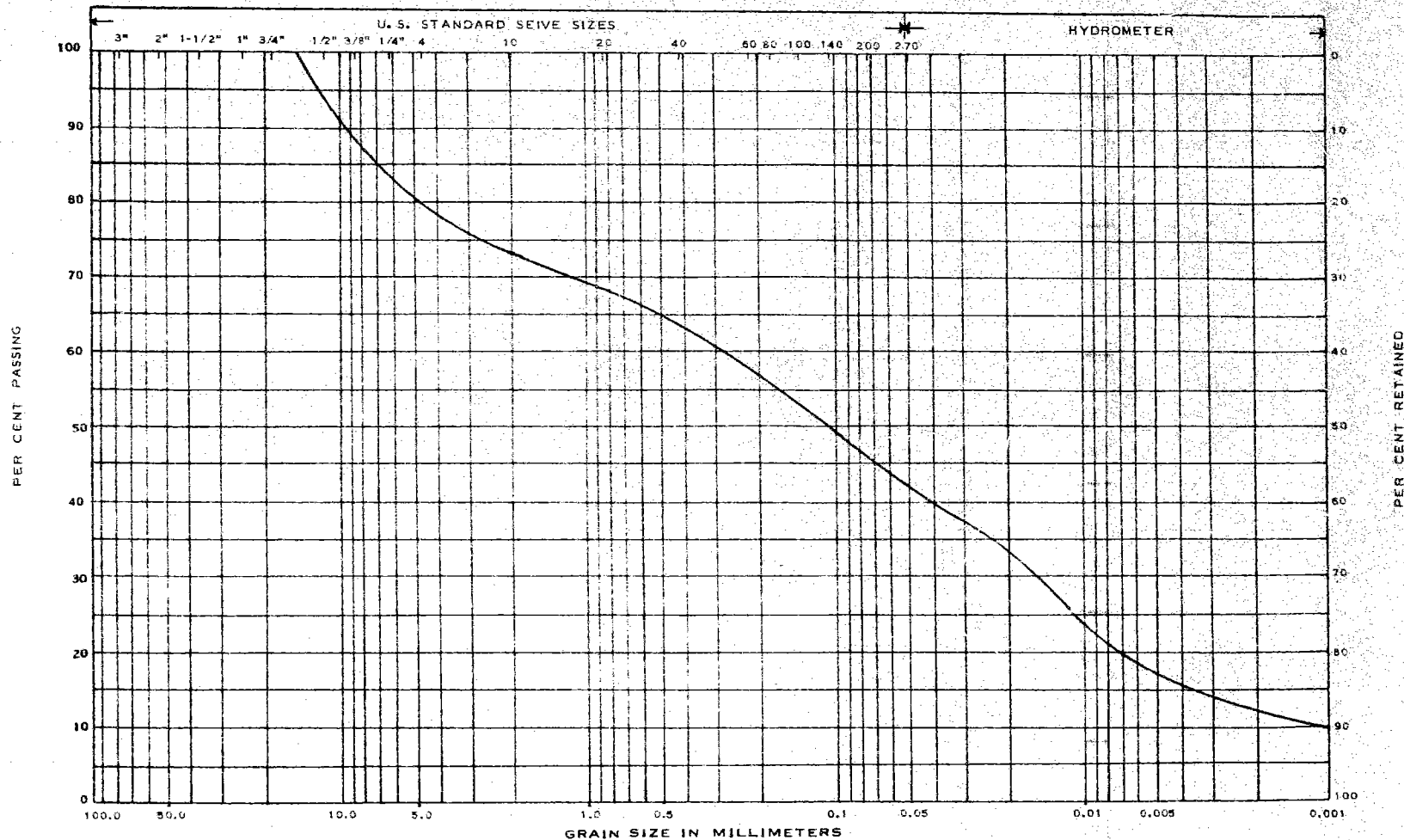
e. m. peto associates ltd.

Toronto 19, Ontario



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

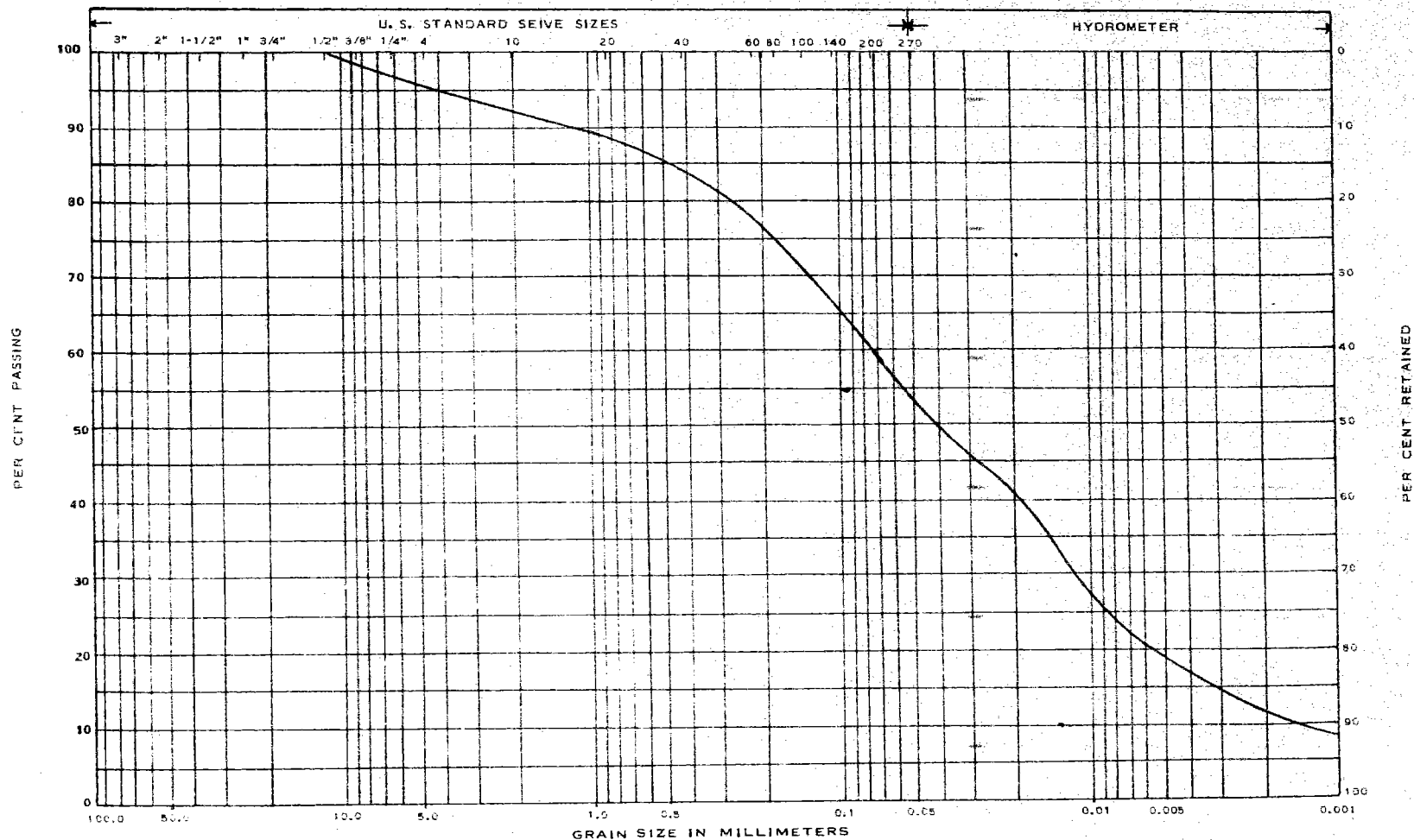
JOB NAME HWY. #23, W.P. 108-66 JOB NO. 66224 HOLE NO. 1 SAMPLE NO. 11

DEPTH 35'-36'6" 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

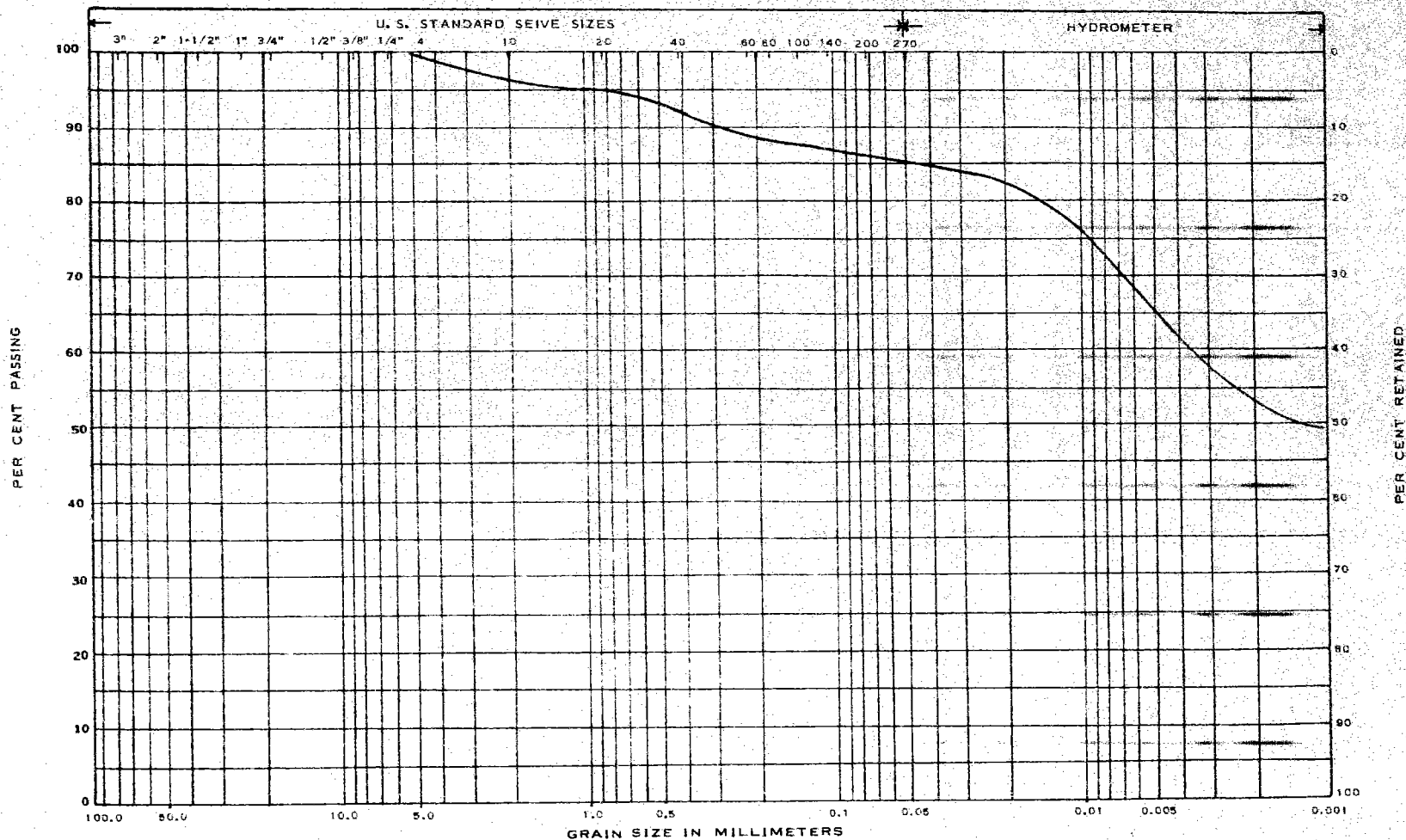
JOB NAME Hwy. 23 - W.P. 108-66 JOB NO. 66224 HOLE NO. 3 SAMPLE NO. 2

DEPTH 516'6" 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
--------	--------	-------------	-----------	-----------	-------------	-----------	-----------	------

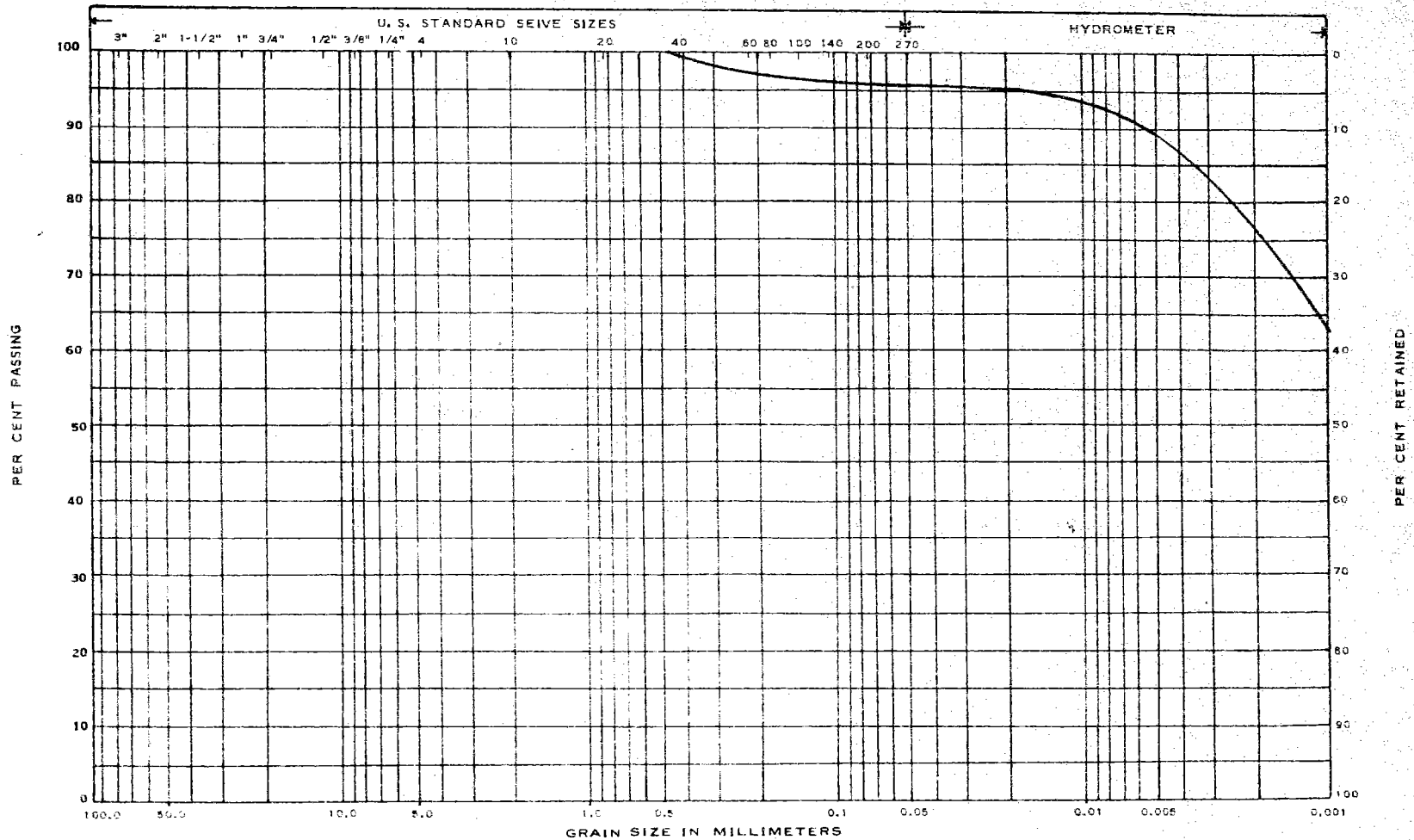
MASS. INST. OF TECH. CLASSIFICATION

JOB NAME Hwy. 23, W.P. 108-66 JOB NO. 66224 HOLE NO. 4 SAMPLE NO. 6

DEPTH 15'-16'6" ELEVATION _____ REMARKS _____

GRAIN SIZE DISTRIBUTION

Toronto 19, Ontario

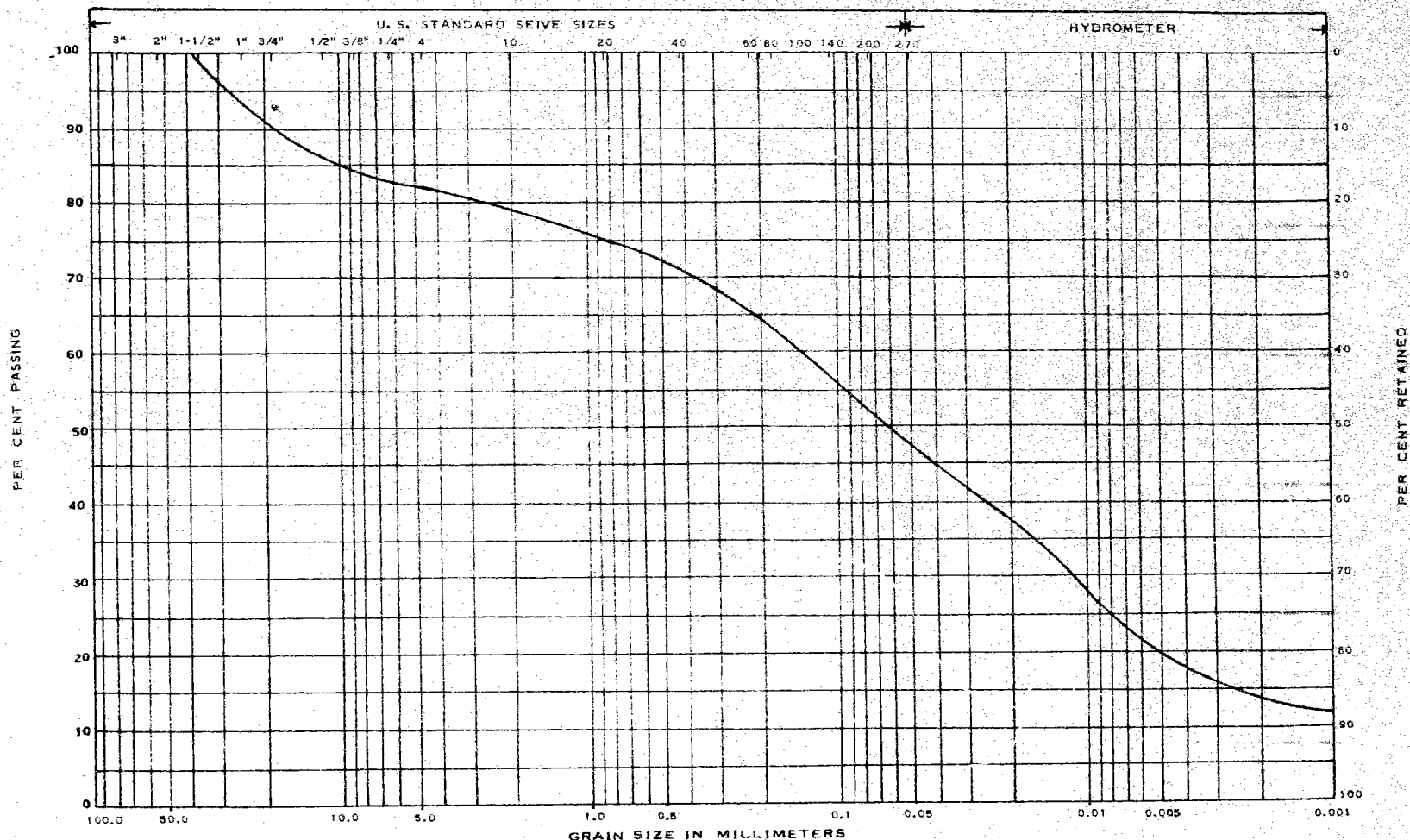


STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
MASS. INST. OF TECH. CLASSIFICATION								
JOB NAME		Hwy.#23, W.P. 108-66		JOB NO. 66224		HOLE NO. 6		SAMPLE NO. 4
DEPTH		10'-11'6"		ELEVATION		REMARKS		

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
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MASS. INST. OF TECH. CLASSIFICATION

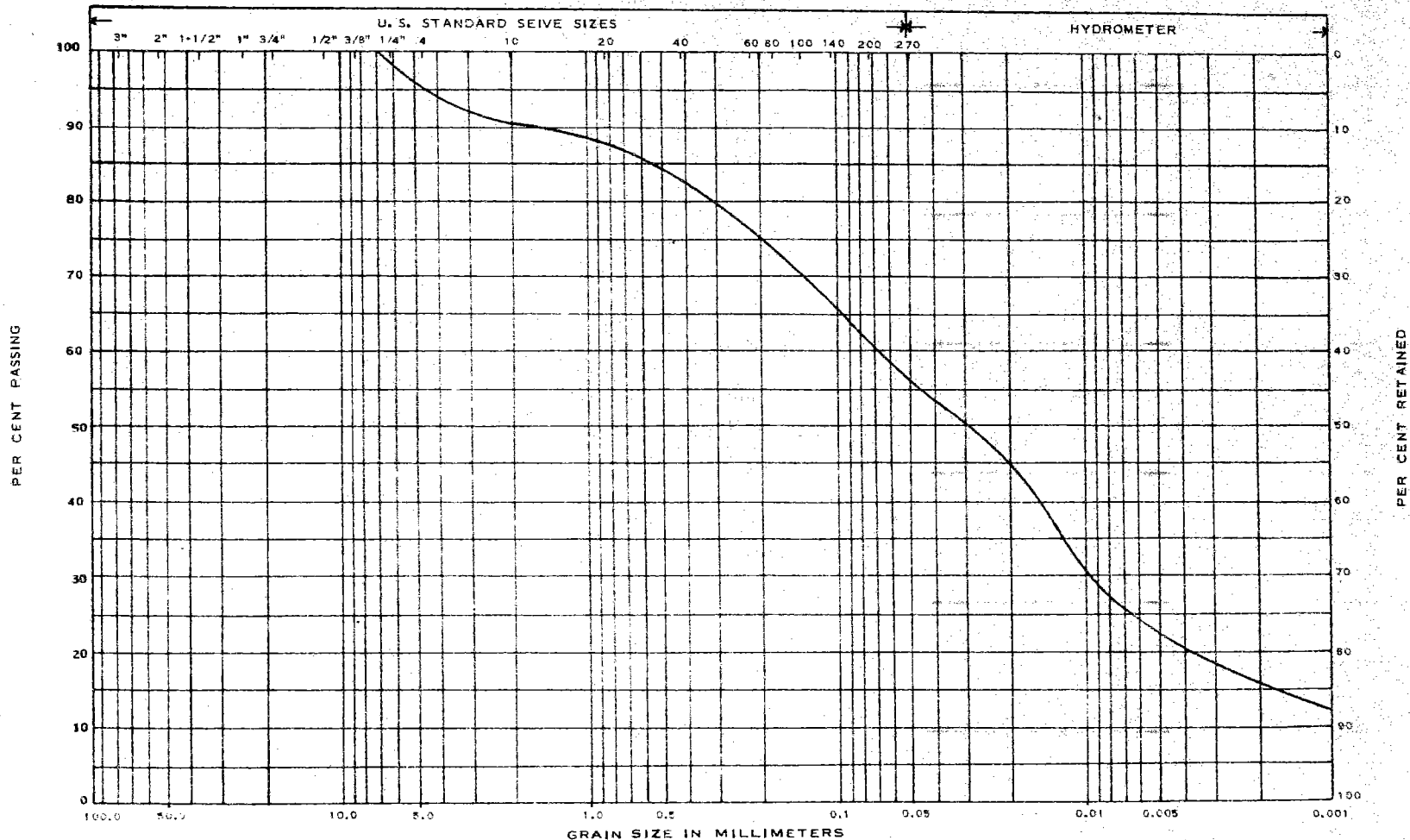
JOB NAME Hwy. #23, W.P. 108-66 JOB NO. 66224 HOLE NO. 7 SAMPLE NO. 8

DEPTH 30'-31'6" ELEVATION _____ REMARKS _____

GRAIN SIZE DISTRIBUTION

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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 Hwy. 23, W.P. 108-66 JOB NO. 66224 HOLE NO. 7 SAMPLE NO. 9

DEPTH 35'-36'6" ELEVATION _____ REMARKS _____

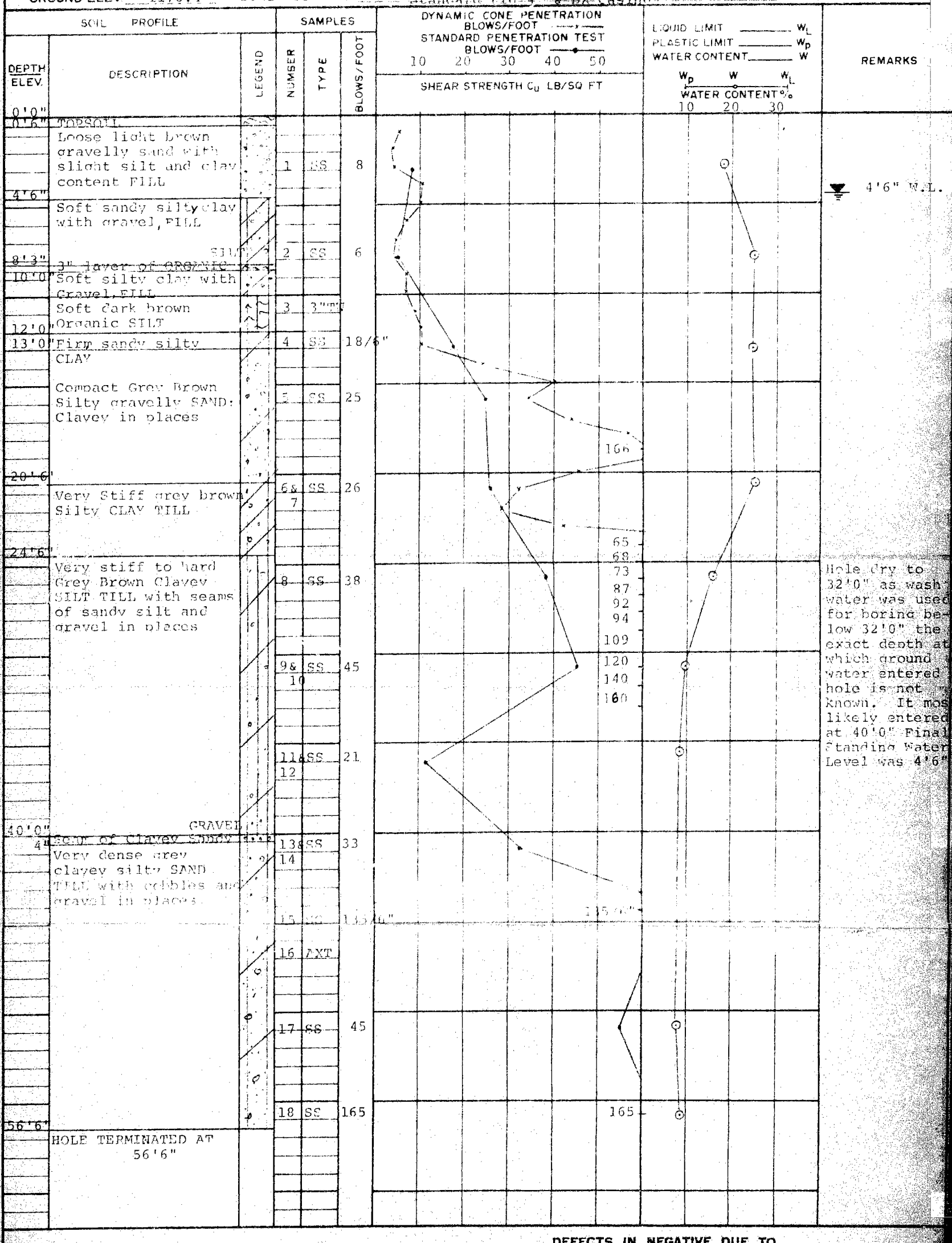
GRAIN SIZE DISTRIBUTION

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Consulting soil engineers

RECORD OF BOREHOLE NO. 1

JOB NO. 66224 JOB NAME Proposed Bridge - Hwy. 23 & Boyle Drain-WP 108-66 TECHNICIAN AJ
BORING DATE Aug. 8/10/66 CLIENT Department of Highways, Ontario ENGINEER KSS
GROUND ELEV. 1178.4 BOREHOLE TYPE Standard Pig 4" & BX-Casing TYPED BY VM



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RECORD OF BOREHOLE NO. 2

JOB NO. 66224

JOB NAME Proposed Bridge - Highway 23 & Doyle Drain-WP 108/66

TECHNICIAN AJ

BORING DATE Aug. 17/66

CLIENT Department of Highways, Ontario,

ENGINEER KSS

GROUND ELEV. 1162.9

BOREHOLE TYPE Standard Drill Rig

TYPED BY VM

SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION BLOWS/FOOT ———— STANDARD PENETRATION TEST BLOWS/FOOT ————					LIQUID LIMIT ———— W_L PLASTIC LIMIT ———— W_p WATER CONTENT ———— W			REMARKS
DEPTH ELEV.	DESCRIPTION	LEGEND	NUMBER	TYPE	BLOWS/FOOT	SHEAR STRENGTH C_u LB/SQ. FT.					W_p W W_L WATER CONTENT % 10 20 30			
						10	20	30	40	50				
0'0"														
0'6"	Soft clayey silt and pebbles													
1'8"	LT. GREY SILT-wet		1	SS										
	STIFF gravelly sandy		2	SS	18									
3'6"	silty CLAY; silt seams													
	DTPL													
	Very stiff grey brown		3	SS	26									
	silty CLAY TILL with													
	seams of silt, sand and		4	SS	20									
	pebbles in places													
	DTPL													
			5	2"TW										
			6	SS	30									
15'0"														
	Very STIFF TO HARD		7	SS	41									
	grey brown sandy													
	clayey SILT TILL													
			8	SS	56									
			9	SS	62									
27'0"	Seam of Sandy Gravel													
	Very dense grey													
	clayey silty sand till													
	TILL with cobbles													
	and gravel		10	SS	215									
31'6"	HOLE TERMINATED AT 31'6"													

Fast flow of
ground water
from the grave
Seam at 27'0"
Water rose to
top of hole
and continued
to overflow.

Fast flow of
ground water
from the gravel
Seam at 27'0"
Water rose to
top of hole
and continued
to overflow.

e.m. peto associates ltd.

Consulting soil engineers

RECORD OF BOREHOLE NO. 3

JOB NO. 66224

JOB NAME Proposed Bridge - Highway 23 & Boyle Drain-wp 108-66

TECHNICIAN AJ

BORING DATE Aug. 11/66

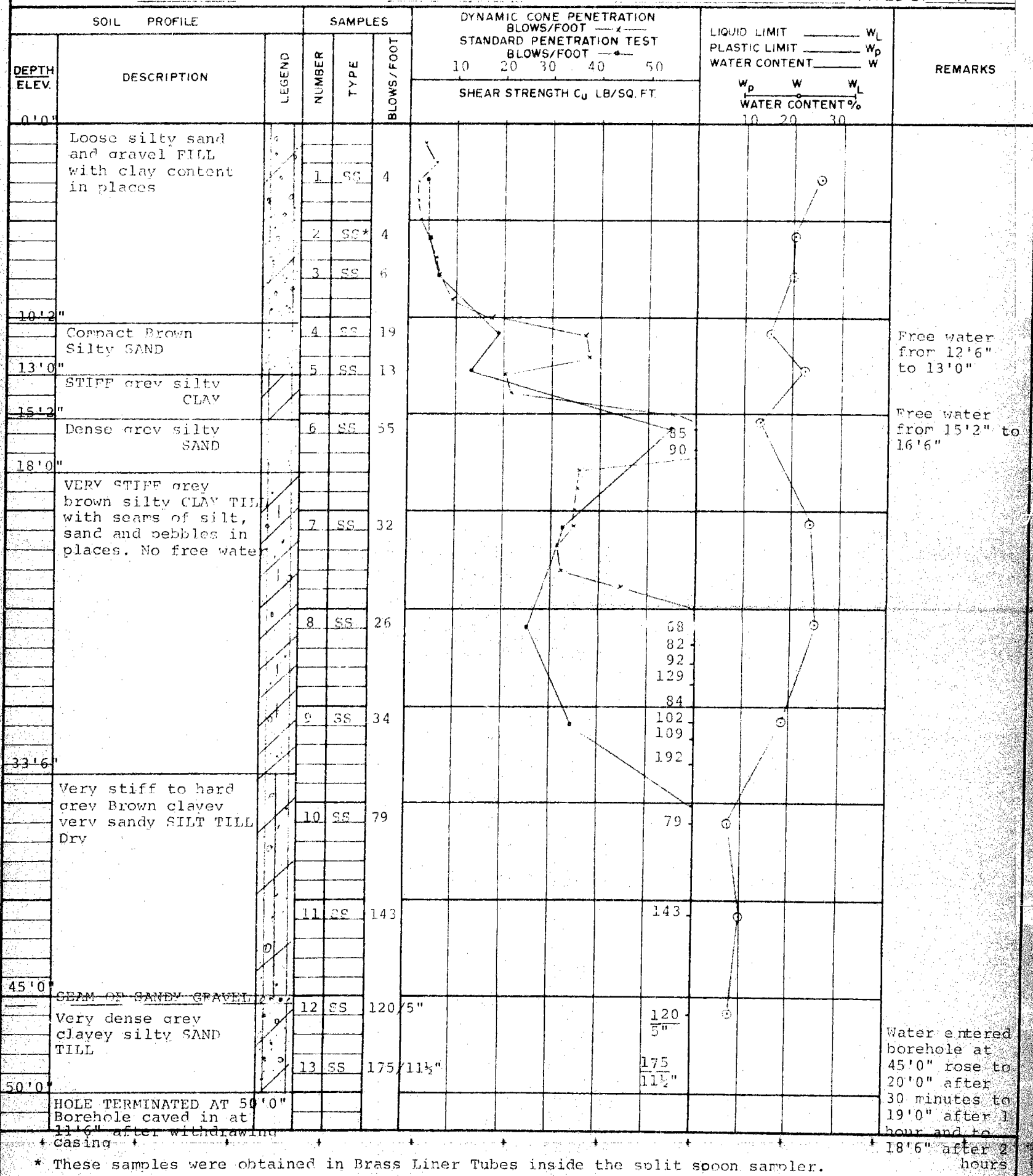
CLIENT Department of Highways, Ontario

ENGINEER KSS

GROUND ELEV. 1179.3

BOREHOLE TYPE 4" Auger

TYPED BY VM



e. m. peto associates ltd.

Consulting soil engineers

RECORD OF BOREHOLE NO. 4

JOB NO. 66224 JOB NAME Proposed Bridge - Highway 23 & Boyle Drain-WP 108-TECHNICIAN AJ
 BORING DATE Aug. 10/66 CLIENT Department of Highways, Ontario ENGINEER KSS
 GROUND ELEV. 1176.6 BOREHOLE TYPE 4" Auger TYPED BY

SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION BLOWS/FOOT STANDARD PENETRATION TEST BLOWS/FOOT					LIQUID LIMIT _____ W _L PLASTIC LIMIT _____ W _p WATER CONTENT _____ W			REMARKS
DEPTH ELEV.	DESCRIPTION	LEGEND	NUMBER	TYPE	BLOWS/FOOT	10	20	30	40	50	W _p W W _L WATER CONTENT %			
						SHEAR STRENGTH C _u LB/SQ. FT.					10	20	30	
0'0"	Loose organic clayey SILT FILL		1	SS	7									Water bearing sand and grave seam from 13'0 to 13'6" only.
			2	SS	7									
7'6"	Soft grey brown silty CLAY with seams of silt		3	SS	10									
10'0"	as above but with pebbles and becoming stiff		4	SS	26									
13'0"	Very Stiff Grey Brown silty CLAY TILL with seams of silt, sand and pebbles in places		5	SS	36									
			6	3" T										Unlike the other holes there was no water bearing sandy gravel seam in the till in this hole.
20'0"	As. above but DTPL		7	SS	34									
			8	SS	22									
28'0"	Hard Grey brown clayey sandy SILT TILL with cobbles DRV		9	SS	44									
			10	SS	132									
			11	SS	138									
45'0"	Very dense clayey gravelly silty SAND TILL with cobbles		12	SS	101/2"									
51'6"	HOLE TERMINATED AT		13	SS	110/2"									

Water bearing
sand and gravel
seam from 13'0
to 13'6" only.

Unlike the other
holes there was
no water bearing
sandy gravel
seam in the till
in this hole.

e.m.peto associates ltd.

Consulting soil engineers

RECORD OF BOREHOLE NO. 5

JOB NO.	66224	JOB NAME	Proposed Bridge - Highway 23 & Boyle Drain-WP 108-66	TECHNICIAN	AJ
BORING DATE	Aug.18/66	CLIENT	Department of Highways, Ontario	ENGINEER	KSS
GROUND ELEV.	1164.5	BOREHOLE TYPE	Standard Drill Rig	TYPED BY	VM

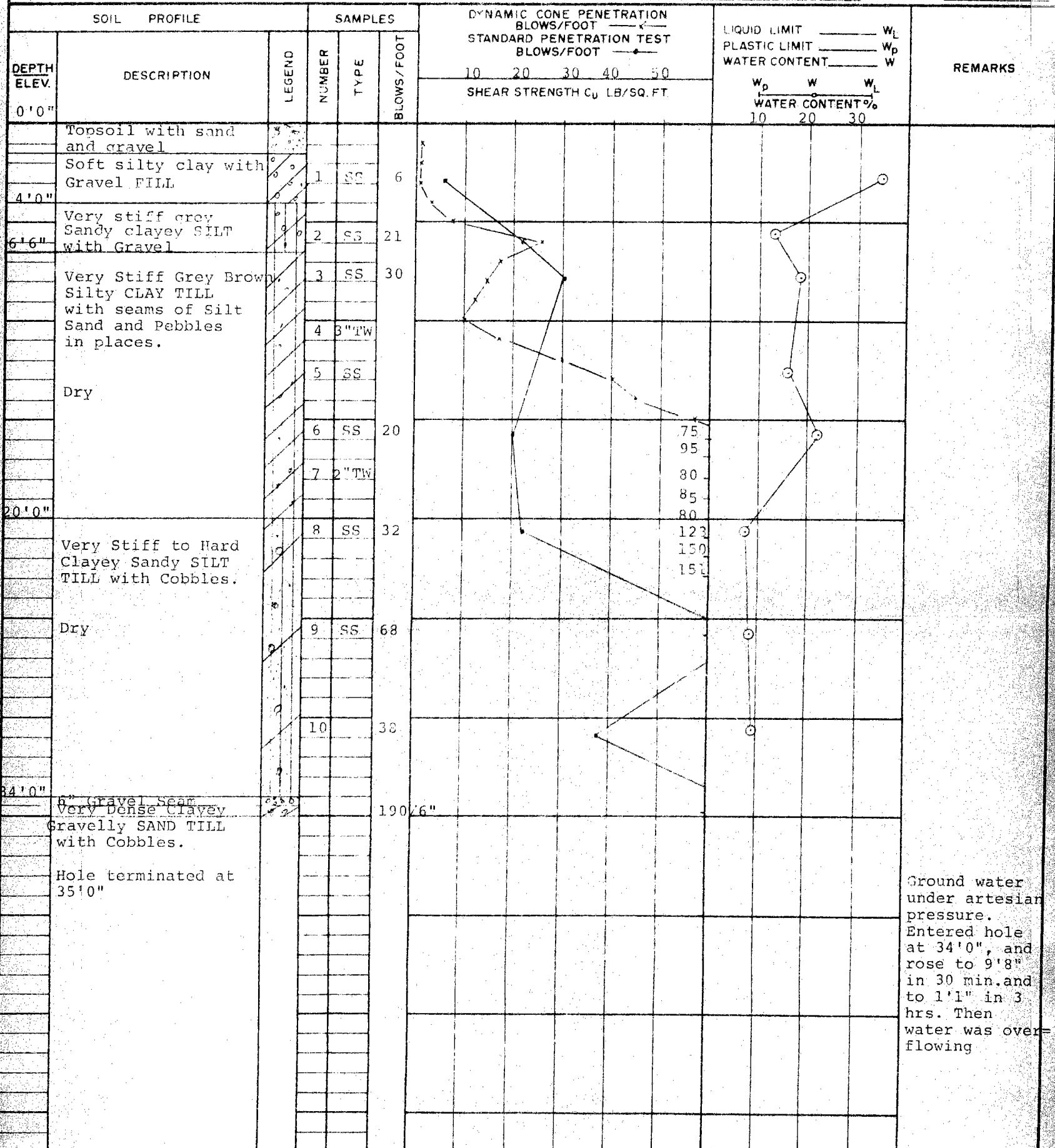
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION BLOWS/FOOT STANDARD PENETRATION TEST BLOWS/FOOT					LIQUID LIMIT _____ W _L PLASTIC LIMIT _____ W _p WATER CONTENT _____ W			REMARKS
DEPTH ELEV.	DESCRIPTION	LEGEND	NUMBER	TYPE	BLOWS/FOOT	SHEAR STRENGTH C _u LB/SQ.FT.					W _p W W _L WATER CONTENT % 10 20 30			
						10	20	30	40	50				
0'0"	Topsoil and soft													No ground water was encountered
1'6"	clayey SILT; NET													
	Very stiff grey brown silty CLAY TILL with seams of silt, sand and pebbles in places		1	SS	25									
			2	SS	27									
			3	SS	23									
			4	TW	LOST									
			5	SS	34									
		6	SS	32										
18'6"	HARD GREY SAND													Penetration test at 20'0" not reliable as the split spoon must have hit a cobble
20'0"	CLAYEY SILT TILL with cobbles HOLE TERMINATED AT 20'0"		7	SS	160/1"									

e. m. peto associates ltd.

Consulting soil engineers

RECORD OF BOREHOLE NO. 6

JOB NO. 66224 JOB NAME Proposed Bridge - Highways 23 & Bayle Drain-WP 108/66 TECHNICIAN AJ
 DRING DATE Aug. 12 & 15/66 CLIENT Department of Highways, Ontario ENGINEER KSS
 GROUND ELEV. 1166.8 BOREHOLE TYPE Standard Drill Rig TYPED BY VM



e.m.peto associates ltd.

Consulting soil engineers

RECORD OF BOREHOLE NO. 7

JOB NO. 66224 JOB NAME Proposed Bridge - Highway 23 & Boyle Drain-WP 108-66 TECHNICIAN AJ
 BORING DATE Aug. 10/66 CLIENT Department of Highways, Ontario ENGINEER KSS
 GROUND ELEV 1178.1 BOREHOLE TYPE 4" Auger TYPED BY VM

DEPTH ELEV.	SOIL PROFILE DESCRIPTION	LEGEND	SAMPLES			DYNAMIC CONE PENETRATION BLOWS/FOOT — x — STANDARD PENETRATION TEST BLOWS/FOOT — • — 10 20 30 40 50 SHEAR STRENGTH C_u LB/SQ. FT.					LIQUID LIMIT — W_L — PLASTIC LIMIT — W_P — WATER CONTENT — W — W_P W W_L WATER CONTENT % 10 20 30			REMARKS
			NUMBER	TYPE	BLOWS/FOOT									
0'0"	New FILL Loose Sand and Gravel													
5'0"	Loose clayey silt FILL		1	SS	5									
7'0"	Loose organic sandy Silt		2	SS	4									
8'6"	Loose gravelly clayey silty SAND		3	SS	10									
12'6"	Compact grey brown silty SAND Saturated Dry		4	SS	30									
16'2"	Very stiff grey brown Silty CLAY TILL with seams of silt, sand and pebbles in places Dry		5	SS	29									
			6	TW										
			7	SS	27									
28'0"	Very stiff to hard clayey sandy SILT TILL With cobbles		8	SS	24									
			9	SS	38									
			10	TW										
				damaged										
43'0"	Seam of water bearing gravel at 43'0"													
	Very dense grey clayey silty gravelly SAND TILL with cobbles		11	SS	189/9"									
49'6"	HOLE TERMINATED AT 49'6"		12	SS	120/6"									

Ground water
under artesian
pressure entered
hole through
gravel seam at
43'0". It rose
to 41'0" after
15 min., to 36'6"
after 1 hour and
to 8'8" after
17 hours.

Foundation File

A. P. Watt
Bridge Division

K. G. Selby
Foundation Section
Materials & Testing Div.

December 19, 1966

W.F. 108-66, Bridge Site 25-72
Maitland River (Boyle Drain) Bridge
8.7 Miles South of South Jct. Hwy. #86
Highway #23
District #3, Stratford

We have reviewed preliminary Plan D-6062-P for the above-noted structure.

The Designer appears to have complied with the recommendations contained in the Foundation Report: Using spread footings with a safe design load of 2.0 T.S.F. for the proposed piers.

We note that the abutments will be supported on 12 BP 53 piles with a design load of 70 tons per pile.

It is believed that this design load could be achieved between El. 1130 and El. 1140.

We have no further comment on this subject.

KGS:mt

K. G. Selby

Nov. 28. 1966

Los Francis - Bridge Division

Q.: To what elevation should piles be driven in order to achieve 70 tons capacity

A.: It is believed that piles should be driven to approx. elev. 1140. Driving should be controlled by the Hiley formula. If better results are obtained at a higher elevation, driving should be discontinued. On the other hand if unsatisfactory driving is occurring up to and beyond elev. 1140 driving should be continued. (All by phone)

Note: Basically there should be no problem whatever happens because the subsoil is very good for spread footings

Alftmann,

cc: Extra Copy (Foundations)

Mr. B. R. Davis,
Bridge Engineer,
Bridge Division.

Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

Attention: Mr. S. McCombie

September 12, 1966

FOUNDATION INVESTIGATION REPORT BY:
E. M. Peto Associates Limited --
Proposed Bridge - Highway 23 and Boyle
Drain - District 3 (Stratford) W.P. 108-66

Attached, please find the report for the above mentioned site, prepared and submitted by the consultant, E. M. Peto Associates Ltd.

We have reviewed the report and believe that it contains all the information necessary for your further design work. Should, however, you desire to discuss any aspect of the report, please feel free to contact this Office.

AGS/Mief
Attach.

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
A. Gater
A. P. Watt
J. G. Tillcock
J. Roy
A. Watt
Foundations Office
Gen. Files