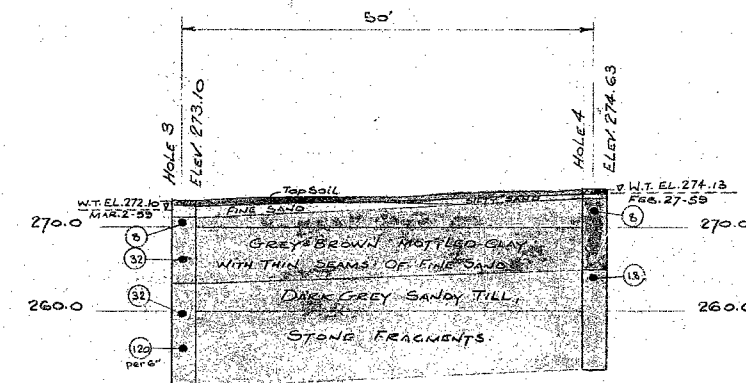
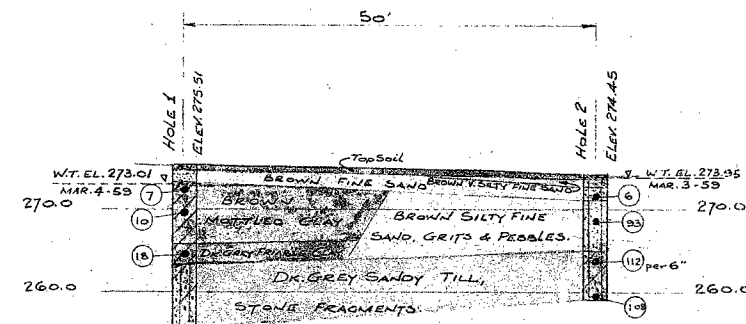
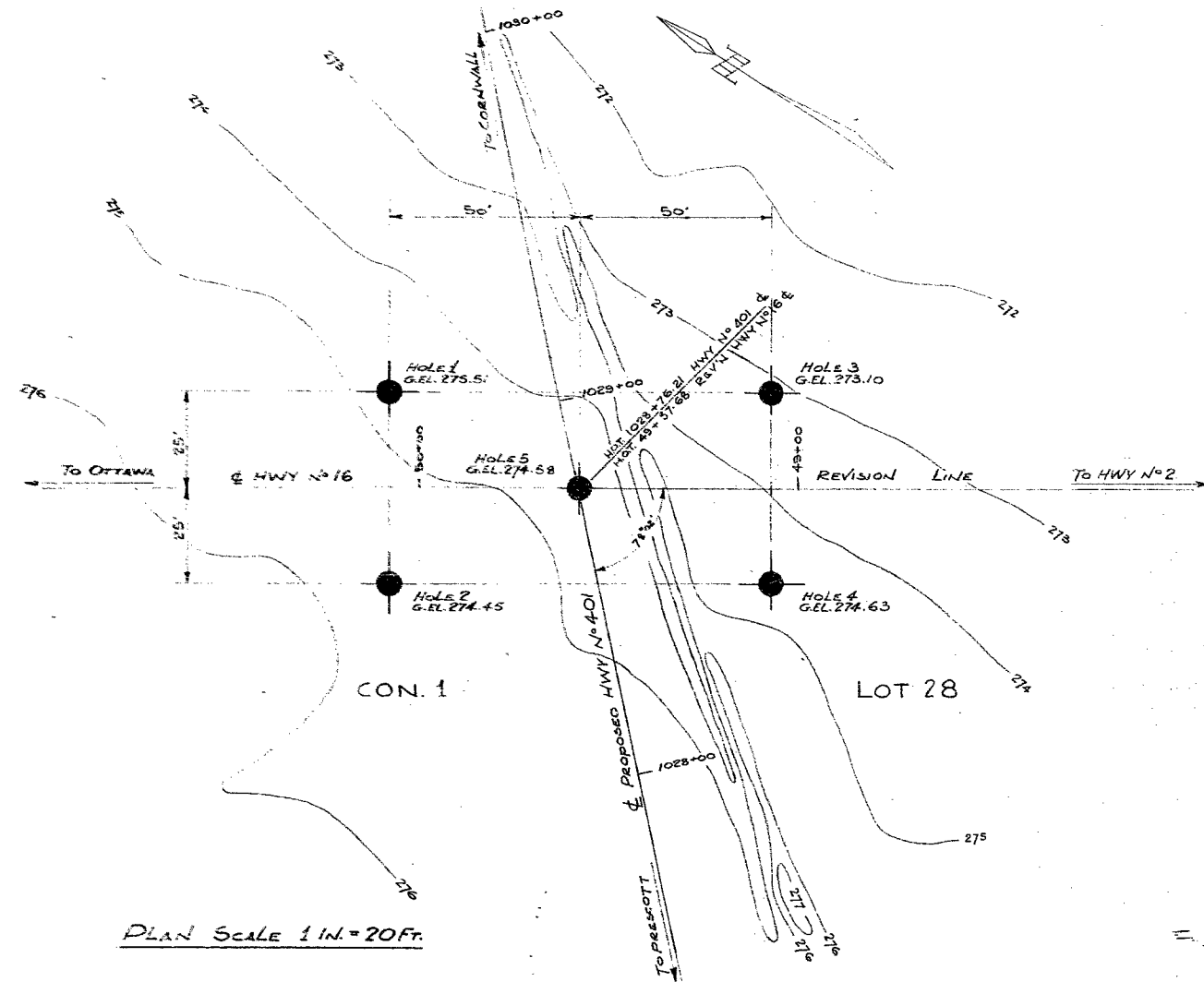
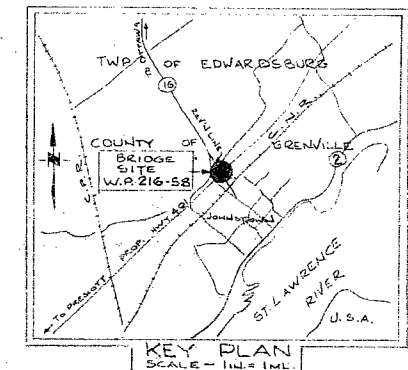


#59-F-204C
W.P. # 216-58
HWY # 401 & #16
REALIGNMENT



NOTE:- PLEASE SEE BOREHOLE LOGS FOR COMPLETE SOIL DETAILS.



PROFILES.
SCALES: HOR 1" = 10'
VERT.

LEGEND.
● TEST HOLE.
⊙ BLOWS/FOOT.
⊙ STD. PENETRATION TEST.
W.T. - GROUND WATER TABLE IN SOIL.

NOTE:-
THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. A LINEAR VARIATION IN SOIL STRATIGRAPHY HAS BEEN ASSUMED BETWEEN BOREHOLES, AND THIS MAY ACTUALLY DIFFER FROM THAT SHOWN.



e.m. peto & associates ltd.
SOIL SITE INVESTIGATION
AT
CROSSING HWY 401-HWY 16
EDWARDSBURG TOWNSHIP BRIDGE NO. 4
FOR
DEPARTMENT OF HIGHWAYS OF ONTARIO
OUR JOB No. 5819 DATE: MAR. 13-59
CLIENTS PLAN No. E 3556-1 PER. G. T.

e. m. peto associates ltd.

EN 878

YOUR REFERENCE:-

OUR REFERENCE:- 5919

850 roselawn avenue.

TORONTO 19, ONTARIO.

RUssell 1 - 4955.

Sept. 8th. 1959

The Department of Highways of Ontario,
Bridge Office,
280 Davenport Road,
Toronto, Ontario.

Attention: Mr. J. Smits

Re: Soil Site Investigation
Highway #401 - Highway #16 Realignment
Edwardsburg Twp. W.P. 216-58.

Dear Sirs:

We refer to your telephone call this morning regarding the use of a higher bearing value at a slightly lower elevation than that noted in our report reference 5919 dated March 24th. 1959. The elevation you have in mind for placing your foundations was 261.0.

At this elevation and to the termination of the holes the stratum is a dense till, with the standard penetration test blows increasing with depth.

On this basis we confirm that it would be in order to use a maximum bearing value of 4.0 T.S. F. for footings not less than 5 feet minimum dimension irrespective of shape. This statement assumes there are no soft strata at depth below the depth penetrated by the test holes, and in this connection our information is that such an eventuality is extremely unlikely.

Yours very truly,

E. M. PETO ASSOCIATES LTD.

C. F. Freeman

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

CFF/sam



ONTARIO
DEPARTMENT OF HIGHWAYS

Memo to Mr. A. M. Toye, **Date** April 10, 1959.
Bridge Engineer.
From Materials & Research Section. **Subject** Re: Subsoil Conditions -
Highway 401 and Highway 16,
Edwardsburgh Twp. -(W.P. 216-58)

Attention: Mr. S. McCombie.

Enclosed, please find two copies of a letter recently received from E. M. Peto & Associates, in connection with the embankment stability at the above noted structure site.

As we have already advised, in our memorandum to you dated April 8th, 2:1 slopes are adequate for this embankment, but Peto suggest that there is a variation in subsoil conditions for this site (W.P. 216-58), and the adjacent structure location - (W.P. 217-58), which was reported by them in their Report #5919. They have indicated that at the structure location, W.P. 217-58, 3:1 slopes are required. As we do not have a copy of their soils report for this structure, we would request that you send one to us -- if this is not possible, we can request a copy from Peto, to review the stability at this site, as well.

If there is a variation in subsoil conditions between the two structure locations, then additional soils borings will be required to define where this change takes place so that embankment slopes can be designed, accordingly.

L. G. Soderman

LGS /MdeF
Encls.(2)

L. G. Soderman,
PRINCIPAL SOILS & FOUNDATION ENGINEER

cc: Messrs. H. A. Tregaskes

H. D. McMillan

File

e. m. peto associates ltd.

YOUR REFERENCE:-

OUR REFERENCE:- 5918

850 roselawn avenue,

TORONTO 19, ONTARIO.

RUssell 1 - 4955.

April 7th, 1959

The Department of Highways of Ontario,
Materials and Research Section,
Downsview Avenue,
Keele St. - Highway 401,
Toronto, Ontario.

Attention: Mr. L. G. Soderman, P. Eng.

Re: Foundation Investigation
Highway 401 and Highway 16
Edwardsburg Twp. - W.P. 216-58

Gentlemen:

We refer to your letter dated April 1st, 1959, in connection with the Soils Report for this site.

We have carefully rechecked the soil conditions and our calculations for the slope stability analysis at this site, and we confirm our agreement to your contention outlined in your letter under reference that side slopes of 2 on 1 are sufficient for the embankment at this site.

We regret that this conclusion, which was very much influenced by the poorer conditions at the nearby site (Your W.P. 217-58 and our report reference 5920 refers) was not established in our report reference 5919.

The situation now regarding these two sites which are approximately 500 yards apart is, that at some point between them at present not known, the conditions change sufficiently to warrant an increase in the side slopes of the proposed embankment (assumed to be 30 ft. high throughout) from 3 on 1 to 2 on 1.

Perhaps you would like to consider this aspect of the proposed embankment and advise us as to whether you wish any further investigation work carried between these two sites in order to establish this point of change in the soil conditions.

Lastly we have noted that in future you wish to have nine copies of the soils reports submitted instead of four copies as hitherto.

Yours very truly,

E. M. PETO ASSOCIATES LTD. ,

A handwritten signature in cursive script, appearing to read 'E. M. Peto'.

E. M. Peto, P. Eng.

CFF:sb

April 1, 1959.

E. M. Peto & Associates,
850 Roselawn Avenue,
Toronto, Ontario.

Dear Sirs:-

Re: Foundation Investigation,
Highway 401 and Highway 16,
Edwardsburgh Twp. - W.P. 216-58.
Your Reference No. 5918.

We have recently received a copy of your Foundation Report for the above structure, from Mr. McAllister of the Bridge Section, requesting that we review the recommendations contained therein. In this regard, we request clarification of the results of stability analyses carried out by yourselves on the proposed 30 foot embankment at this location. We have carried out stability computations using a 30 ft. fill height and your reported value of shear strength = 1216 p.s.f. for the underlying brown mottled clay stratum.

Our preliminary work indicates that 2:1 slopes are sufficient for this embankment. In view of the discrepancy between this result and your conclusion that 3:1 slopes are required, we would be pleased if you would submit a summary of your calculations and assumptions upon which the recommendation of a 3:1 slope is based.

Perhaps the discrepancy stated above would be easier to resolve by a meeting with your Project Engineer and ourselves rather than by correspondence. If this is the case, would you please contact us by phone and we could schedule a meeting to discuss this matter.

LGS/MdeF

Yours very truly,

A. Rutka,
ACTING MAT'LS. & RESEARCH ENGR.
per:

L. G. Soderman
(L. G. Soderman,
PRINCIPAL SOILS & FOUNDATION ENGR.)

BA878



ONTARIO
DEPARTMENT OF HIGHWAYS

Memo to Mr. A. M. Toye, **Date** April 8, 1959.
Bridge Engineer.
From Materials & Research Section. **Subject** Re: Subsoil Conditions -
Highway 401 and Highway 16,
Edwardsburgh Twp. W.P. 216-58.

Attention: Mr. S. McCombie.

Attached please find copy of a letter we had written to E. M. Peto & Associates, requesting additional information to support their recommendations that 3:1 slopes are necessary at this structure location.

We have been advised by telephone that they have checked their analysis and concur with our preliminary results indicating that a 2:1 slope is satisfactory for this embankment. They will be submitting a copy of their review of this analysis to our office in three or four days. Immediately we receive this, we will forward it to you.

LGS/MdeF
Attach.

L. G. Soderman
for -
L. G. Soderman,
PRINCIPAL SOILS & FOUNDATION ENGR.

e. m. peto associates ltd.

YOUR REFERENCE:-

OUR REFERENCE:- 5919

850 roselawn avenue,

TORONTO 19, ONTARIO.

RUssell 1 - 4955.

March 24th, 1959.

59-F-209C

Department of Highways of Ontario,
Bridge Office,
280 Davenport Road,
Toronto, Ontario.

Attention: Mr. J. C. McAllister

Re: Soil Site Investigation,
Highway #401 - Highway #16 Realignment
Edwardsburg Twp. W.P. 216 - 58

Dear Sir:

We refer to your letter dated January 28th, 1959, and have pleasure in forwarding herewith four copies of our report for the above project.

We have considered the soil conditions in detail in the soil report. Here, for your convenience is a summary of our findings and recommendations.

1. The soils encountered were:
 - a) Dark brown to black organic topsoil with a thickness of 6 inches to one foot. The soil contains roots, pebbles, and organic matter; it is loose and saturated.
 - b) Brown fine sand with occasional pockets of silt, pebbles and stone fragments, and is silty at places. The thickness varies from 3 inches to 1 ft. 4 inches. The soil is loose and saturated. Some roots and organic matter were noted in hole 4 only.
 - c) Brown silty sand with pebbles and a considerable amount of stone fragments terminating at a depth of 9 ft. below surface. This soil was encountered in hole 2 only. The upper boundary is loose (N=6) but the soil becomes dense with depth. It is generally saturated.

- d) Brown and grey mottled clay arises within 1 to 2 ft. below surface terminating at about 10 ft. The natural moisture content is extremely high (30.4 - 41.0%), the soil is fully saturated. Occasional seams of sand were noted. In hole 3 the stratum contains a large amount of stone fragments. Standard penetration test blows gave an average value of 8, however, an erratic result of 32 blows was noted at 7 ft. depth below surface in hole 3 only.
- e) Dark grey friable clay with grits and pebbles was noted in holes 1 and 5 only. The thickness of this stratum ranged from 1'10" to 2'6". The natural moisture content is above the plastic limit and the standard penetration tests indicated a very stiff condition (N=18).
- f) Underlying the entire site there is a grey to dark grey sandy till containing stone fragments and boulders. The natural moisture content is between 6.0 and 8.8%. Standard penetration tests showed great variations probably due to existing stone fragments and boulders.

2. Ground water near the surface was noted in all of the holes during the time of our field investigation. However, seasonal variations in ground water levels should be expected.

3. We have considered founding the bridge on large footings placed on the mottled clay stratum, at about 5 ft. below surface, however, this solution must be avoided, since soil failure is likely to occur in consequence of the superimposed embankment.

4. Founding the bridge on the grey till stratum at elevation 263.00 the allowable safe bearing values are:

for footings 5 ft. wide : 3.0 tons per sq. ft.
for footings 10 ft. wide : 2.6 tons per sq. ft.
for footings 15 ft. wide : 2.2 tons per sq. ft.

Settlements should be within the tolerable construction limit of 1 inch and differential settlements exceeding 1/2 an inch need not be anticipated.

5. Excavations will encounter water. Provision therefore must be made for adequate pumping.

6. Excavation at a vertical wall will be stable except in the vicinity of hole 2 where soil conditions call for relatively flat side slopes or suitable bracing should be provided.

7. Another, and preferable alternative, is the use of pile foundation. Piles would be driven down to the till stratum where the allowable bearing value is 2.5 tons per sq. ft.

An alternative to pile foundation is the placing of caissons.

8. Approach embankments of 30 ft. high will be stable subject to suitable toe berms detailed in the report.

We trust we have covered all the points on which you may need information. However, should you require any additional information in connection with this report, we shall be pleased to be of further service.

Yours very truly,

E. M. PETO ASSOCIATES LTD.,



E. M. Peto, F. Eng.

KP:sb

THE DEPARTMENT OF HIGHWAYS OF ONTARIO

SOILS REPORT

for

HIGHWAY #401 - HIGHWAY 16 REALIGNMENT

W. P. 216 - 58 EDWARDSBURG TOWNSHIP

March, 1959

e. m. peto associates ltd.

Job No. 5919

Client's Ref. No.

Date March 24th, 1959.

Report on

SOIL SITE INVESTIGATION

at

HIGHWAY #401 - HIGHWAY 16 REALIGNMENT

W.P. 216 - 58 EDWARDSBURG TOWNSHIP

for

THE DEPARTMENT OF HIGHWAYS OF ONTARIO

INTRODUCTION:

We were requested by letter from Mr. J. C. McAllister dated January 28th, 1959, to carry out a complete investigation for the above project.

The object of the investigation was:

1. to determine existing soil and ground water conditions.
2. to locate bedrock if it exists within reasonable limits.
3. to determine any other factors affecting the design and construction.

PROGRAMME OF WORK:

February 19th, 1959: Test holes located and ground levels determined by Field Engineer.

February 26th, 1959: Crew and equipment moved onto site from the other site (Job No. 5920) in this area.

February 27th, 1959: Field work commenced at hole 4.

March 5th, 1959: Field work completed at hole 5.

March 6th, 1959: General work; repairing fences, loading, etc.

March 7th, 1959: Crew and equipment moved off site and returned to Toronto.

Note: Field work was protracted by unexpected soil conditions, such as large amount of boulders. It was also necessary to haul water used in driving the test holes.

GENERAL INFORMATION:

1. Our standard soil sampling procedures were followed during the course of the field work. These are detailed in Appendix II.

2. Five soil test holes were driven. Originally it was proposed that holes 2, 3 and 4 be driven using BX casing whilst holes 1 and 5 be put down with 4 inch casing. Hole 2 was to be driven to 75 ft. or rock. When the results of the first test hole were available our Field Engineer amended the original work order and instructed that only one hole, namely hole 3 was to be driven using 4 inch pipe casing. In addition it was decided to terminate the holes at a depth of about 20 ft. below surface.

The details of the test holes are:

<u>Hole#</u>	<u>Ground elevation</u>	<u>Depth of Hole</u>
1	275.51	19'1/2"
2	274.45	15'3"
3	273.10	22'8"
4	274.63	21'9"
5	274.58	17'4"

3. The bench mark given and described on your drawing, i. e. "the nail in root of 3 ft. oak 97 ft. left of Station 1030 + 63 (Hwy. 401 Profile)" has been used. All elevations mentioned in the report are referred to this Geodetic datum. The elevation of this bench mark was taken to be 274.34.

4. All of the soil samples obtained on site were carefully examined and visually classified following which operation detailed individual borehole logs were drawn up. These are included with and form part of the report.

5. A number of moisture content samples were taken in order to determine soil conditions in general.

Atterberg limit tests were carried out to assist in classification of the soils. The results of these tests are appended at the rear of this report.

Unconfined compression test results gave a reasonable value of shear strength of the mottled clay for design purposed.

6. Location of test holes are shown on a site plan traced from your drawing (Plan E-3556-1). Profiles showing the stratigraphy based on the test hole results are also included on our site plan, attached at the rear of the report.

SITE DESCRIPTION:

The site is located in the region of Edwardsburg Township approximately 1 mile North of Johnstown and about 400 ft. East of the existing Highway #16.

The topography on this site is rolling, gently undulating, however, it is quite flat at places. The site is cultivated farm land.

It is located in the County of Grenville in Eastern Ontario. Large deposits of clay are known to exist in close proximity to the rivers. Occasionally they contain some grits and boulders.

The underlying limestone bedrock is below the boundaries of the holes investigated at this site.

SOIL CONDITIONS:

Soil conditions are somewhat erratic comparing to those of the other site investigated nearby in this area. (Our job number 5920). The soils encountered have been broken down into main classes; they occur and are described as follows:

1. Organic topsoil

The site is covered by a 6 inch to 1 foot thickness of dark brown to black organic topsoil containing roots, pebbles, and can be regarded as a silty sand loam. The soil is generally very loose and saturated.

2. Brown Fine Sand

Varying in thickness from 3 inches to 1 ft. 4 inches there is a layer of brown fine sand becoming silty at places. Occasional silt pockets, pebbles and stone fragments were noted. It contains roots and organic matter at hole 4 only. The soil is loose and saturated.

3. Brown silty sand

Terminating at a depth of 9 ft. below surface a stratum of brown silty sand with pebbles and considerable amount of stone fragments was encountered at hole 2 only. Below a depth of 3 ft. from surface the soil is fine sand with an increasing silt content. The upper boundary is loose with standard penetration test blows of 6. At a depth of 5 to 6 ft. 93 blows were noted, however, we do not feel this value realistic for this soil. This unusual high value is likely to be due to some interference with the sampler such as stone fragments. The natural moisture content ranged from 8.7 to 10.6%, and generally the soil is saturated.

SOIL CONDITIONS: (Cont'd)

4. Brown and Grey Mottled Clay

Arising within 1 to 2 ft. below surface and terminating at a depth of 9 ft. 5 inches to 10 ft. there is a brown and grey mottled friable clay stratum of high plasticity. A large amount of grits, pebbles, and stone fragments were noted in hole 3 only. Thin seams of sand were also noted in holes 3 and 4. It has been subject to some oxidation. The natural moisture content of this stratum is extremely high, generally much higher than the plastic limit; the soil is fully saturated.

Standard penetration tests showed no great variation ranging from 7 to 10, with an average value of 8. The number of blows increased up to 32 at a depth of 7 ft. in hole 3 only. This value, however, has been disregarded being evidently due to the presence of stone fragments at this depth.

The representative values for this soil based on laboratory tests are:

	<u>Range</u>	<u>Average</u>
Moisture Content	30.4 - 41.0%	35.7%
Liquid Limit		56.8%
Plastic Limit		27.8%
Wet Density	114.2 - 122.9 p.c.f.	118.5 p.c.f.
Dry Density	81.0 - 94.2 p.c.f.	87.6 p.c.f.
Void ratio	.675 - .922	.798
Degree of Saturation	All samples	100%
Shear Strength	1122 - 1311 p.s.f.	1216 p.s.f.
Strain at failure	3.3 - 5.0%	4.1%

5. Dark Grey Friable Clay

Dark grey friable clay with grits and pebbles occurred thereafter at a depth of 9 ft. 6 inches and 9 ft. 5 inches in holes 1 and 5 only, with a thickness of 2 ft. 6 inches and 1 ft. 10 inches, respectively. The natural moisture content varies between 18.1 and 20.0%, and generally is above the plastic limit. Standard penetration tests with 18 blows per foot indicated a very stiff condition.

SOIL CONDITIONS: (Cont'd)

6. Grey Sandy Till

Underlying the whole site there is a grey to dark grey sandy till containing pebbles, stone fragments and boulders. The natural moisture content ranged from 6.0 to 8.8%. Standard penetration test results are quite erratic; in hole 4 at a depth of 10 ft. the soil is compact, whilst in hole 3 at a depth of 14 ft. below surface it is dense. Other test results gave blows in excess of 100 and in holes 1 and 3 the AX rod was driven only 1/2 inch ahead by 50 and 100 blows respectively. No attempt was made to penetrate this stratum down to bedrock.

WATER CONDITIONS:

In all of the holes wash water was used during the sampling procedure. Details of the water level readings in the holes during our field investigation are as follows:

Hole 1 Elevation 275.51

Slight water seepage was noted from topsoil.

Hole bailed to 12 ft. March 3rd, 1959, 5:00 p. m.

Depth, 12', casing to 10', W.T. 4' March 4th, 1959, 7:30 a. m.

Hole bailed to 12' March 4th, 1959 4:30 p. m.

Depth 12', casing to 5' W. T. 2'6" March 4th, 1959, 5:15 p. m.

Hole 2 Elevation 274.45

Depth 11', casing to 10' hole bailed out March 2nd, 1959: 5:00 p. m.

With circumstances as above water rose to 6" overnight

Depth 15'3" casing to 10' bailed to 10'6" March 3rd, 1959, 10:30 a. m.

With the casing withdrawn the hole caved in at 10'6" and W. T. was 6" March 3rd, 1959, 10:45 a. m.

After removal of the casing the hole collapsed and W. T. was at surface (11:00 a. m. the same day.)

Hole 3 Elevation 273.10

Depth 17'9" casing to bottom hole bailed out February 28th, 1959: 5:00 p. m.
Water rose to 1' overnight.

Depth 19', casing to 17'9" hole bailed to 17'9" March 2nd, 1959 10:00 a. m.
With circumstances as above W. T. 1', in 45 minutes.

After pulling casing the hole caved in at 7' and W. T. was at surface March 2nd, 1959, 11:15 a. m.

WATER CONDITIONS: (Cont'd)

Hole 4 Elevation 274.63

In the topsoil water seepage was noted.

Depth 11'9" casing to bottom of hole, bailed out February 27th, 1959
4:30 p. m.

W. T. rose to 6" overnight.

Depth 11'9", casing to 5' bailed out March 28th, 1959 8:00 a. m.

W. T. at 6" in 30 minutes.

Hole 5 Elevation 274.58

Depth 17'4", casing to 10' hole bailed to 12' March 5th, 1959, 4:30 p. m.
With circumstances as above W. T. 1', March 6th, 1959, 8:00 a. m.

In summing up the above observations:

- a) Some water seepage was observed in the topsoil at holes 1 and 4.
- b) the water table, from numerous reliable observations, was near the ground surface during the course of our field work. However, seasonal water level variations could occur.
- c) After bailing out, ground water filled up the holes rapidly.

ENGINEERING CONSIDERATIONS:

Supporting the structure on large footings upon the mottled clay stratum has been considered. However, this solution should, if possible, be avoided.

In this case, the depth of foundation should be controlled only by the frost depth in the given locality, i. e. the structure could be founded at a depth of approximately 5 ft. below surface.

The allowable safe bearing capacity of this stratum at the proposed depth is 1.0 t. s. f. and this value is the maximum permitted at the footing toe; however, it should be borne in mind that this stratum will be overloaded by the fill and any additional loading would almost certainly cause failure.

ENGINEERING CONSIDERATIONS:

(Cont'd)

Furthermore, although the clay stratum is considerably preconsolidated, settlements, probably in excess of 1 inch, could occur. Moreover, in consequence of the local variations of the soil (not uniform stratification, different soil conditions, etc.) differential settlements exceeding the conservative limit of $3/4$ of an inch could occur.

Accordingly, we do not consider this approach is a practical solution, and we recommend founding the bridge on the till stratum at elevation 263.00.

In determining the allowable safe bearing capacity of this stratum the effect of submergence has been also considered. Accordingly, the allowable soil pressures on this stratum are:

for 5 ft. wide footings	3.0 tons per square foot.
for 10 ft. wide footings	2.6 tons per square foot.
for 15 ft. wide footings	2.2 tons per square foot.

These values have been selected in such a manner that the total settlements should not exceed 1 inch. Differential settlements, if any, should be within the tolerable construction limit of $1/2$ inch. Settlements will be quick, taking place mostly during construction time.

Excavations will encounter water and for this reason provision for adequate pumping must be made.

Excavation at a vertical wall will be generally stable except at the vicinity of hole 2 where existing soil conditions call for relatively flat side slope or suitable shoring to provide adequate slope stability.

Pile foundation in order to avoid the cost of excavation could be considered. Steel H, monotube, or concrete filled pipe pile, could all be used satisfactorily.

Another alternative of pile foundation would be the use of caissons placed upon the till stratum. Settlements should be minor, having little effect on the design.

ENGINEERING CONSIDERATIONS: (Cont';d)

Thirty foot high approach embankments will be stable providing slopes of 3 horizontal to 1 vertical are used. However, certain precautions should be taken, since a factor of safety of only 1.50 was used.

In connection with the slope stability analyses we refer to our investigation No. 5920 on this area. In this instance the same methods of slope stability analyses have been used.

If the embankment is to be raised rapidly we propose placing the embankment with toe width identical with that of a fill constructed with side slopes of 3:1 to a height of 6 ft. following which the width of embankment should be reduced to be equivalent to E the base of an embankment of height $(H-6)$ feet with side slopes of 2 on 1 vertical, where E is the total height of the embankment and berm in feet. In other words toe berm construction would be provided. The advantage of this method is that the weight of the berm increases the surcharge which will counteract the tendency for a slip to develop.

E. M. PETO ASSOCIATES LTD.,



E. M. Peto, P. Eng.

KP:stb

APPENDIX I

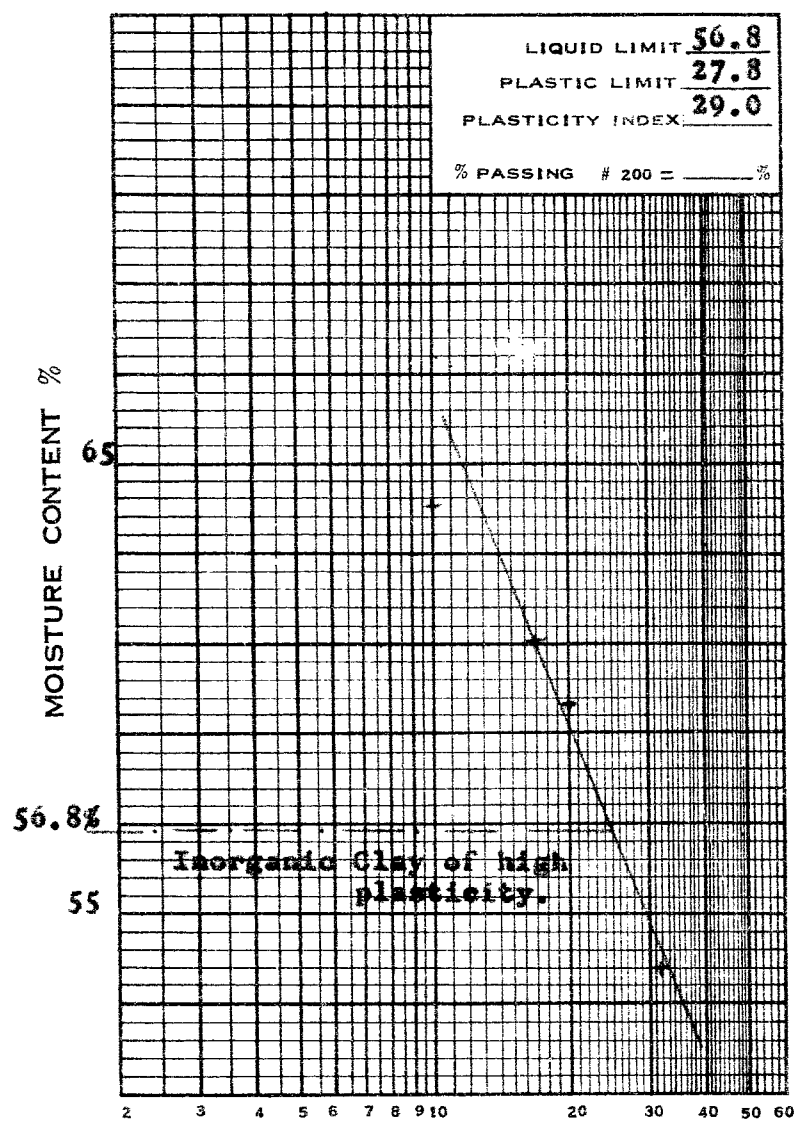
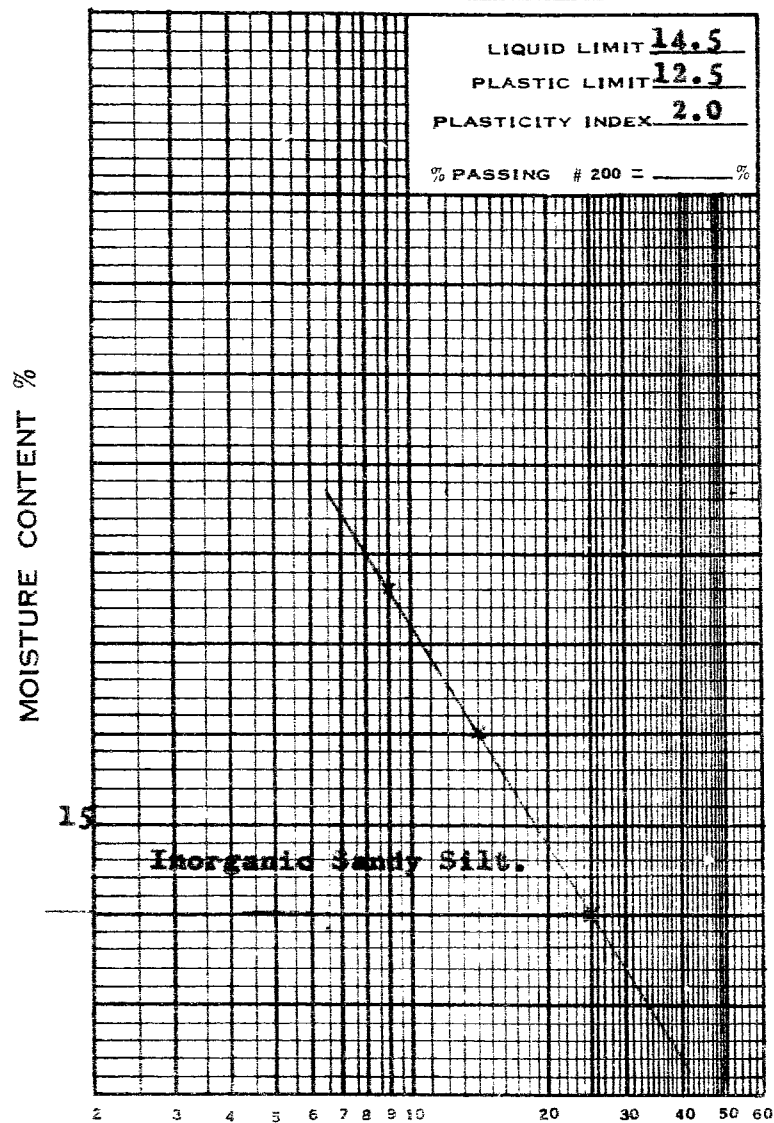
LABORATORY TEST RESULTS

e. m. peto associates ltd.
SOIL TESTING LABORATORY

LIQUID LIMIT TEST

FLOW LINE CHARTS

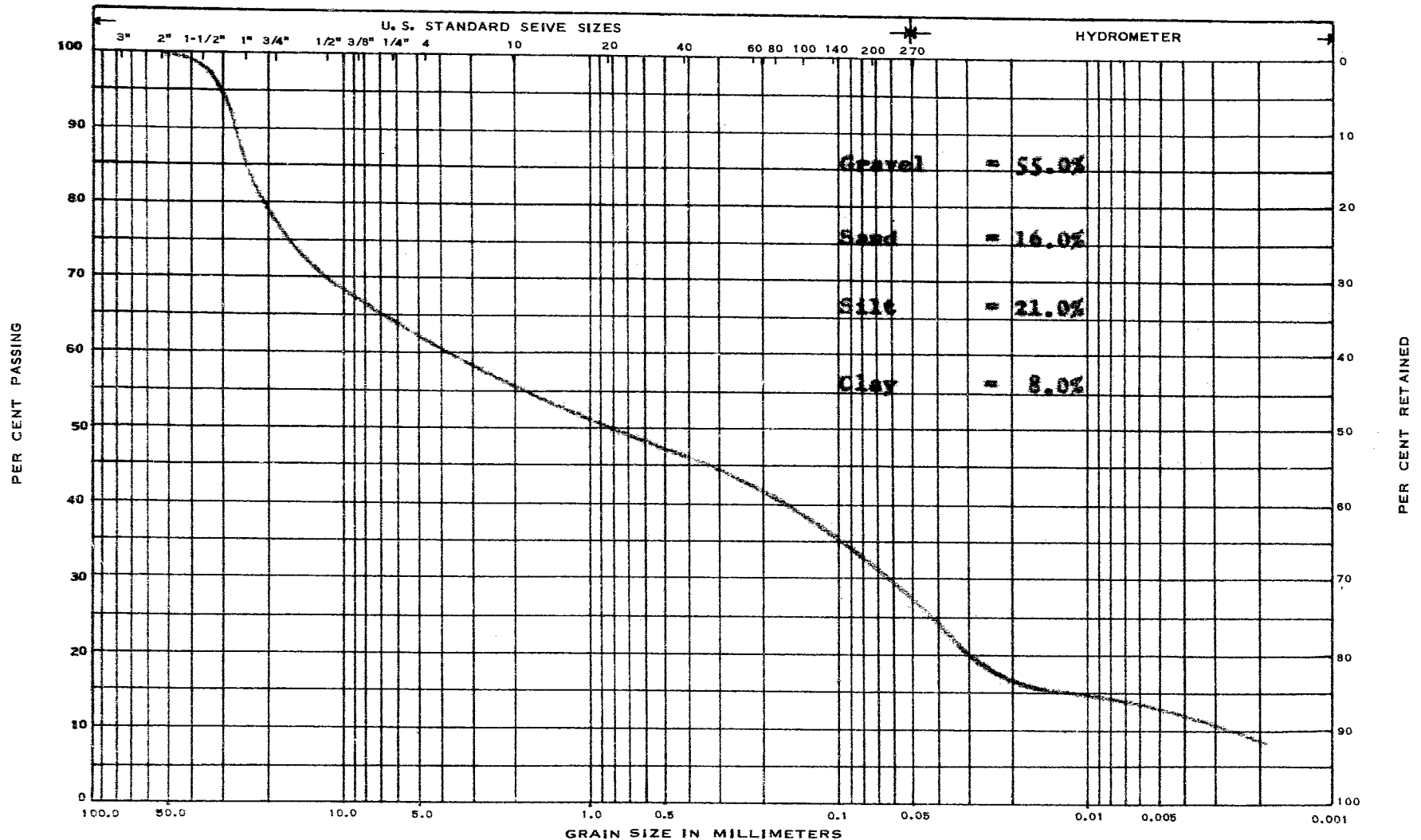
JOB NO. 5919 PROJECT D.H.O. Bridge # 4 Hwy. 401 - Hwy. 16 Re-alignment, Johnstown.
SAMPLE FROM B.H. # 2. Sample # 3. SAMPLE FROM B.H. # 3. Sample # 2.
DEPTH 10' - 11' DEPTH 6' - 6'4"



NO. OF BLOWS (LOG SCALE)

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 D.H.O. Bridge # 4 JOB NO. 5919 HOLE NO. 3 SAMPLE NO. 4

Hwy. 401 - Hwy. 16, Re-alignment

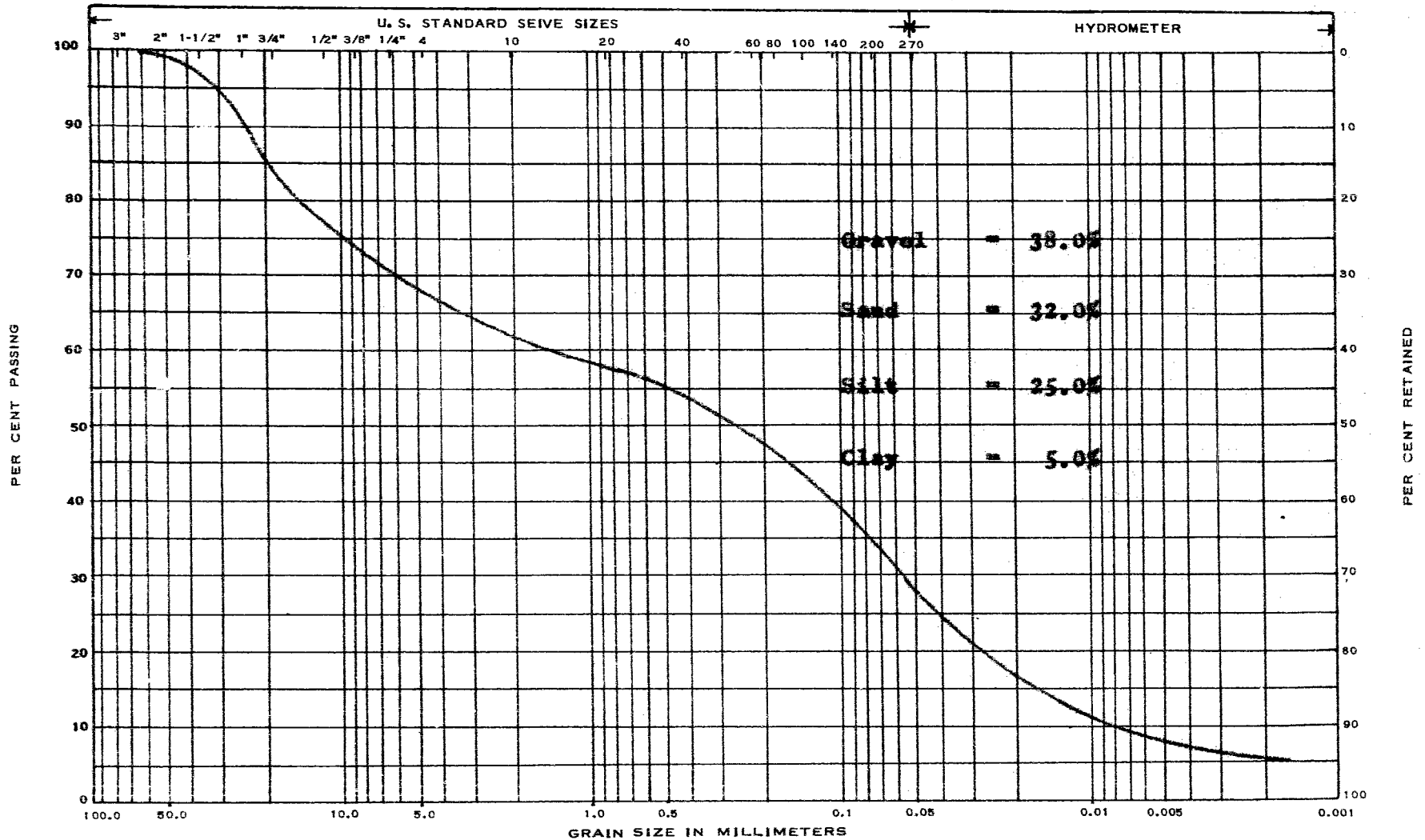
Johnstown.

DEPTH 13'-14' 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 D.H.O. Bridge # 4, Hwy. 401 - Hwy. 16 Re-alignment. JOB NO. 5919 HOLE NO. 5 SAMPLE NO. 5

Johnstown.

DEPTH 15'-16' ELEVATION _____ REMARKS _____

GRAIN SIZE DISTRIBUTION

JOB No.: 5919.

STANDARD PENETRATION TESTS

BLOWS PER FOOT

275

0

20

40

60

80

100

270

ELEVATION IN FEET

265

260

BH 1 ○
BH 2 ●
BH 3 +
BH 4 X
BH 5 V

255

FOR 6"

FOR 4"

FOR 6"

V.
130

BRIDGE # 4

HWY # 401 - HWY 16 RE-ALIGNMENT
JOHNSTOWN

E.M. PETO ASSOCIATES LTD.
MARCH 13, 1959.

BOREHOLE LOG

Checked By E.M.P.

ABBREVIATIONS

W. T. GROUND WATER TABLE IN SOIL

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 LEVELS, SOIL MOISTURE & REMARKS
			0'0"					
ORGANIC TOPSOIL, ROOTS	BLACK		275.5'		1	FROM CASING		SATURATED WATER SEEPAGE AT 0'8"
FINE SAND	BROWN		277.84 2'0"					
MOTTLED FRIABLE CLAY	BROWN & GREY	FIRM	276" 273.5'		2	S.S.	7	W.T. MARCH 4, 1950. WETTER THAN PLASTIC LIMIT
AS ABOVE	AS ABOVE	STIFF			3	S.S.	10	M.C. = 31.1% WETTER THAN PLASTIC LIMIT.
			9'6" 266.0'					
FRIABLE CLAY WITH GRITS & PEBBLES	DK. GREY	VERY STIFF	12'0" 263.5'		4	S.S.	18	M.C. = 20.0% W.T.P.L. AT 12' REFUSAL ON BOULDER
SANDY TILL WITH BOULDERS	GREY					W.S.		
AS ABOVE	AS ABOVE		19' 1/2" 256.47			W.S.		"AX" ROD! 50 BLOWS FOR 1/2 IN.
			HOLE TERMINATED					NOTE: USING WASH WATER FROM G'

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



SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

BOREHOLE LOG

Bridge # 4 Hwy. # 401 - Hwy.
Job Name # 16. Re-alignment, Johnstown Job No. 5919
Client Dep't. of Highways of Ontario Casing BX (2 1/2" Dia.)
Datum Geodetic. Compiled By K.P.

Borehole No. 2
Boring Date March 2nd. & 3rd. 1959.
Checked By E.M.P.

SAMPLE CONDITION

-  UNDISTURBED
-  FAIR
-  DISTURBED
-  LOST

SAMPLE TYPE

- 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
- Q/u UNCONFINED COMPRESSIVE STRENGTH
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL





SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft	WATER LEVELS, SOIL MOISTURE & REMARKS
GROUND SURFACE			0' 0"					
SILTY SAND LOAM TOP SOIL VERY SILTY FINE SAND PEBBLES, STONE FRAGMENTS	DK. BROWN BROWN	8' 6" 273'95	274'45 273'20	1' 3"	0' 8"	W.L. MARCH 3, 1959.		SATURATED
SILTY SAND, PEBBLES STONE FRAGMENTS	BROWN	LOOSE	3' 0"	1	S.S.	6	M.C.=10.6%	SATURATED
SILTY FINE SAND WITH STONE FRAGMENTS GRITS, PEBBLES	BROWN	VERY DENSE	5' 0"	2	S.S.	93	M.C.=8.7%	SATURATED
SANDY TILL BOULDERS!	DK. GREY	VERY DENSE	9' 0"	3	S.S.	112/6"	L.L.=14.5%, P.L.=12.5% M.C.=8.8%	SATURATED REFUSAL ON BOULDER AT 10' 6"
AS ABOVE, STONE FRAGMENTS	AS ABOVE		15' 3"		S.S.	108	M.C.=7.0%	
HOLE TERMINATED								NOTE: USING WASH WATER FROM 8'.

e. m. peto associates ltd.
SOIL ENGINEERING SERVICE - TORONTO, ONTARIO
BOREHOLE LOG

Bridge # 4 Hwy. # 401 - Hwy. # 16
Job Name Re-alignment, Johnstown. Job No. 5919
Client Dep't. of Highways of Ontario Casing 4" Pipe
Datum Geodetic. Compiled By K.A.P.

Borehole No. 3
Boring Date Feb. 28th. & March 2nd. 1959
Checked By E.M.A.P.

SAMPLE CONDITION






















-  UNDISTURBED
-  FAIR
-  DISTURBED
-  LOST

SAMPLE TYPE

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

ABBREVIATIONS





- V.T. IN SITU VANE SHEAR TEST
- Q/u UNCONFINED COMPRESSIVE STRENGTH
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft	WATER LEVELS, SOIL MOISTURE & REMARKS
GROUND SURFACE			0' 0"					
SILTY SAND LOAM TOP SOIL ROOTS, ORG. MATTER, PEBBLES	BLACK	110%	0' 8" 273' 10"		1		FROM CASING	W.T. SATURATED MARCH 2, 1959
FINE SAND, FEW ROOTS	BROWN	272' 10" 272' 43"	2' 0"		2		FROM CASING	SATURATED
MOTTLED FRIABLE CLAY WITH THIN SEAMS OF FINE SAND,	BROWN & GREY	FIRM TO STIFF	271' 10"		3		S.S.	8 M.C. = 35.1% WETTER THAN PLASTIC LIMIT
GRITS, PEBBLES & STONE FRAGMENTS			5' 0"		4		S.L. TAPPED	M.C. = 41.0% L.L. = 56.8% P.L. = 27.8%
AS ABOVE, MORE SAND	AS ABOVE	DENSE			5		S.S.	32 $\gamma_w = 114.2 \text{ lb/cuft}$ C = 1122.15 S.F. SATURATED
GRITS, PEBBLES & STONE FRAGMENTS			10' 0" 263' 10"					
					6		W.S.	
SANDY TILL, PEBBLES, STONE FRAGMENTS	DK. GREY	DENSE	15' 0"		7		S.S.	32 M.C. = 6.9%
					8		W.S.	
AS ABOVE	AS ABOVE	VERY DENSE			9		S.S.	120/6" M.C. = 6.0%
			20' 0"					NOTE: "AX" ROD; 100 BLOWS FOR 1/2 IN.
			22' 9"					NOTE: USING WASH WATER FROM 7' 6"
			250' 35"					REFUSAL ON BOULDER

BOREHOLE LOG

Borehole No. 4
Boring Date Feb. 27th. & 28th. 1959.
Checked By E. M. P.

ABBREVIATIONS

 UNDISTURBED
 FAIR
 DISTURBED
 LOST

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

V. T. IN SITU VANE SHEAR TEST
Q/u UNCONFINED COMPRESSIVE STRENGTH
W. L. WATER LEVEL IN CASING
W. T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft	WATER LEVELS, SOIL MOISTURE & REMARKS
GROUND SURFACE			0'0"					FEBRUARY 27, 1959.
TOPSOIL SILTY SAND	BLACK BROWN	1'0" 273'63	0'7 1/2" 274'63 273'98		0'6" 274'13	W.T.		ROOTS, ORG. MATTER -- SAT. WATER SEEPAGE AT 0'6"
MOTTLED FRIABLE CLAY WITH THIN SEAMS OF VERY FINE SAND	GREY & BROWN	FIRM TO STIFF			1		8	M.C.=37.2% WETTER THAN PLASTIC LIMIT
SAME AS ABOVE	AS ABOVE				2	S.L. TAPPED		M.C.=30.4% W.T.P.L. $\gamma_w = 122.9 \text{ lb./cu ft}$ $e = .922$ $C = 1311 \text{ lb.S.F.}$
			9'8"					
SANDY TILL, PEBBLES, STONE FRAGMENTS AS ABOVE	DK. GREY	COMPACT	264'96		3	S.S.	18	L.L.=14.1%, P.L.=12.1% SATURATED
	AS ABOVE					W.S.		
BOULDERS !								
AS ABOVE	AS ABOVE					W.S.		
			21'9"					
			252'88					NOTE: USING WASH WATER FROM 11'9"
						HOLE TERMINATED		

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SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

BOREHOLE LOG





Bridge # 4 Hwy. # 401 - Hwy. # 16
 Job Name Re-alignment Johnstown. Job No. 5919
 Client Dep't. of Highways of Ontario. Casing BX (2 1/2" Dia.)
 Datum Geodetic. Compiled By K.P.

Borehole No. 5.
 Boring Date March 5th. & 6th. 1959.
 Checked By E.M.P.

SAMPLE CONDITION








SAMPLE TYPE

ABBREVIATIONS

 UNDISTURBED
 FAIR
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S.S. 2" STANDARD SPLIT TUBE SAMPLE
 S.L. SPLIT BARREL WITH LINERS
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SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	WATER LEVELS, SOIL MOISTURE & REMARKS
GROUND SURFACE			0'0"					
SILTY SAND ORGANIC TOPSOIL	BLACK		1'0" 274.58					
SILTY SAND	BROWN		273.58 1'7"					
FRIABLE CLAY	BROWN & GREY	FIRM TO STIFF	272.96		1	 S.S.	8	M.C. = 39.3% WETTER THAN PLASTIC LIMIT
AS ABOVE	AS ABOVE	STIFF			2	 S.S.	9	M.C. = 38.5% W.T. P.L.
AS ABOVE	AS ABOVE				3	 S.L.	TAPPED	
			9'5" 265.16					
FRIABLE CLAY	DK. GREY	VERY STIFF	11'3" 263.33		4	 S.S.	18	M.C. = 18.1% ABOUT P.L.
SANDY TILL	DK. GREY				5	 W.S.		
AS ABOVE	AS ABOVE	VERY DENSE	15'0" 257.25		6	 S.S.	130	M.C. = 7.6%
			17'4" 257.25		7	 S.S.	100/4"	NOTE: USING WASH WATER FROM 11'.
	"AX" ROD CANNOT BE DRIVEN.							

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.