

59-F-48

W.P.# 161-59

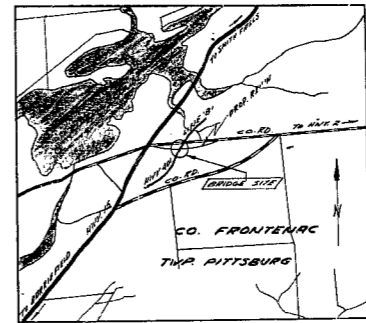
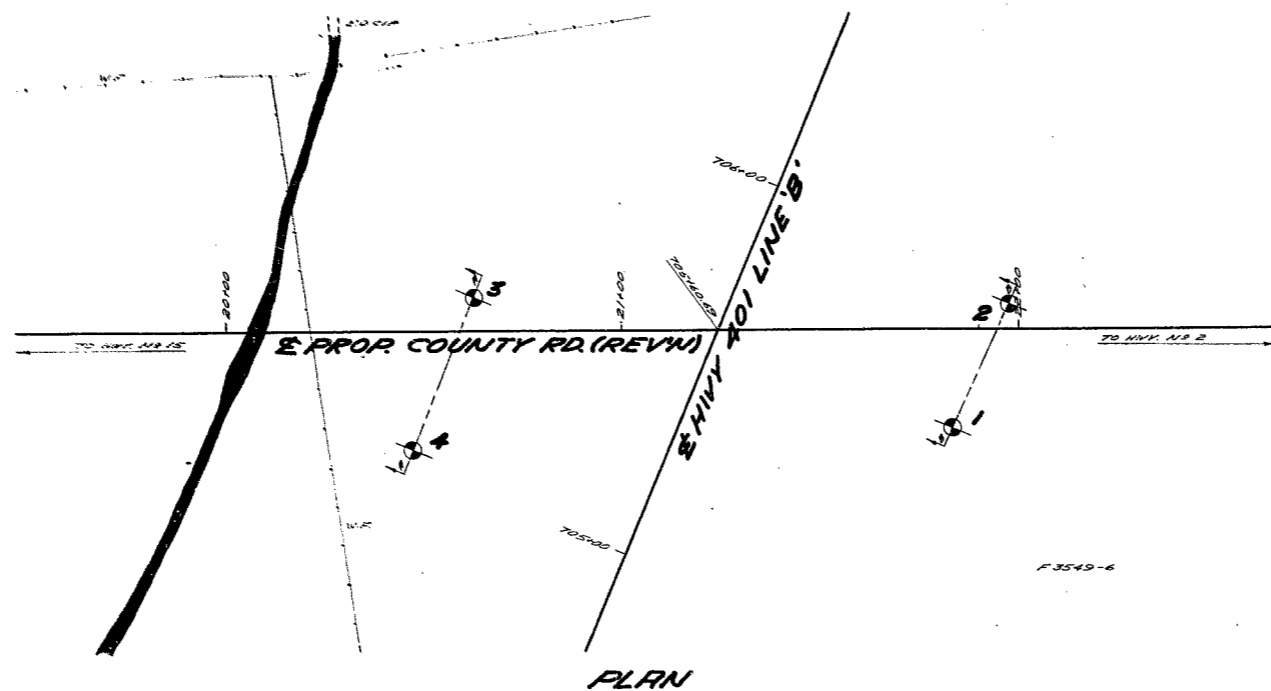
Hwy. # 401

CROSSING

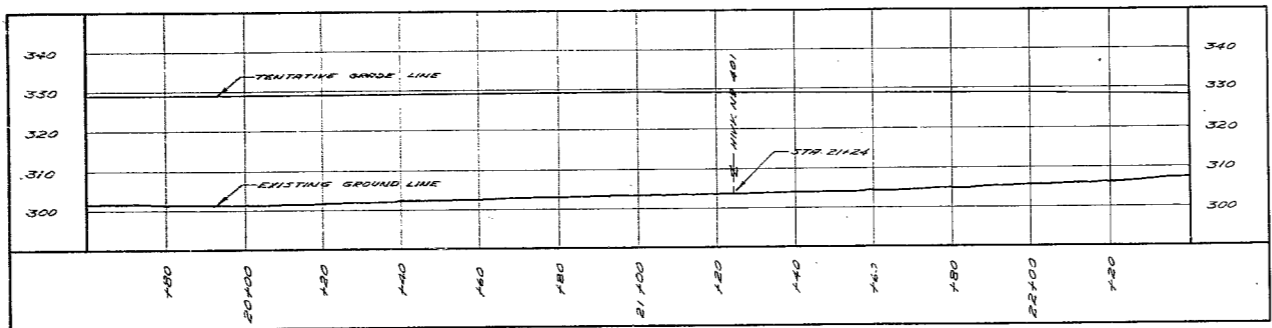
REV. CTY. RD.

CON. # 2

5 MILES N.E. OF
KINGSTON



KEY PLAN
SCALE
1 in. = 1 mi.



LEGEND

BORE HOLE

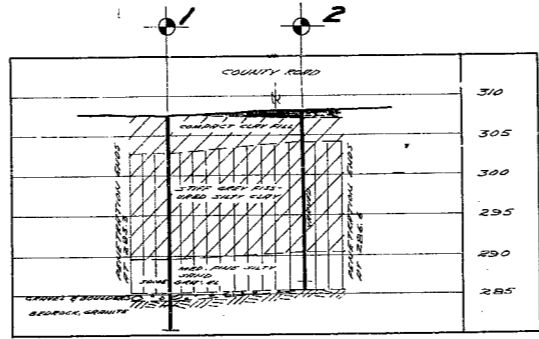
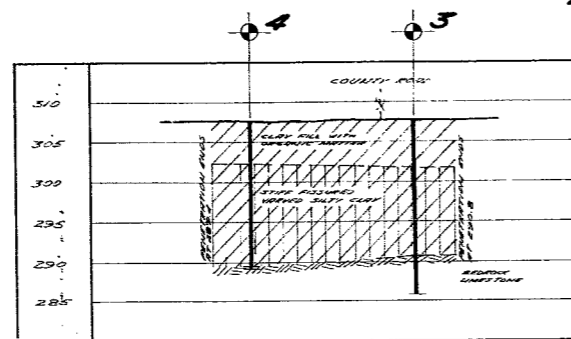
REVEIMENTATION HOLE

BORE & REVEIMENTATION NO. 1

HOLE NO.	ELEVATION	STATION	DISTANCE FROM E.
1	307.6	705161	64' RT.
2	308.2	705196	64' RT.
3	307.9	705145	60' LT.
4	307.6	705104	60' LT.

- NOTE -

THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BORE HOLE LOCATIONS. BETWEEN BORE HOLES THE BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE AND MAY BE SUBJECT TO CONSIDERABLE ERROR.



DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION

**COUNTY ROAD
PROPOSED CROSSING**

SHOWING POSITIONS & ELEVATIONS OF HOLES

HWY. 401	DISTRICT B	COUNTY FRONTENAC
TOWNSHIP PITTSBURGH	LOT 1	CON. II
LOCATION 200 S.W. 1/4 OF KINGSTON		
DRAWN BY: J. M. F. 1973	CHECKED BY: J. M. F. 1973	W. F. M. 1973
DATE 17 JUL 1973	APPROVED BY: J. M. F. 1973	DRAWING NO. F59-48A
SCALE 1 IN. = 20 FT.		

23-65-216

Mr. A. M. Toye,
Bridge Engineer.
Materials & Research Division,
(Foundation Section)
Attention: Mr. J. B. Curtis,
Bridge Location Engr.

May 25, 1962.
W.P. 161-59, Pittsburg Twp.,
Br. #3, Hwy. 401 at Kingston
Mills Rd.. 0.3 miles east of
Hwy. #15, District #8.

This is to confirm the verbal discussion with
Mr. Brian Richardson, and the agreement reached at May
24, 1962, on the above project.

(a) The soil report does not provide adequate
information to justify a prediction that the differential
settlement of the piers and abutment of the proposed bridge
to be within 1/2 in., basing on the present design.

(b) Two alternatives were discussed. The first
is to support the abutments on footings so that the induced
loads on subsoil are approximately equal. The abutments and
piers will, therefore, settle uniformly. The second alternative
is to support the piers and abutments all with piles to bedrock.
It was agreed that the second proposal should be adopted.

KYL/MdeF

cc: Mr. B. Richardson
Foundations Office
Gen. Files.


K. Y. Lo,
SUPERVISING FOUNDATION ENGINEER



ONTARIO

DEPARTMENT OF HIGHWAYS

Bridge Division

Memo to Mr. A. Stermac, Date May 2, 1962.
Principal Foundation Engr.,
Room 107, Lab. Bldg. Subject W.P. 161-59, Pittsburg Twp.
J. B. Curtis Br. #3, Hwy. 401 at Kingston
Mills Rd., 0.8 miles east of
Hwy. 15, District #8.

Enclosed find two copies of the preliminary plan for the subject structure. The designer has followed the recommendations of the foundation report completed by your section in 1959. This foundation investigation was carried out with a single span structure in mind.

We have sent you two preliminary plans since you said you would require additional borings at the time we finished the preliminary plan. One may be taken to the field and the other for your records. Kindly advise us as soon as possible if you foresee any changes in the design due to unanticipated foundation conditions.

JBC/rt

J. B. Curtis,
Bridge Location Engineer.

c.c. D. Smith
R. Fitzgibbon

Memo

Problem discussed with J. B. Curtis and the following suggestions made:

1. Results of previous investigation show the stratigraphy to be quite regular, and extrapolation of results seems therefore warranted
2. Presently no additional investigation is recommended
3. When bridge design drawings are completed, bedrock elevations should be checked at locations where end bearing piles are designed
4. Because it is believed that bedrock is about 20-30 ft below ground level, the field investigation could be carried out by the Regional soil group in Kingston

Friday, March 30th, 1962

Alf Storrman

SUMMARY

Subsoil conditions are generally uniform.

0 - 4.0 layer of clay full
or 6.0
4.0 - 14.0 stiff grey varied silty clay (c = 1500 p.s.f. to 5700 p) ^{overconsolidated}
- 16.0
14.0 - 18.0 (only in B.H. #1 & 2) Silty sand - ~~not~~ Loose
18.0 - Bedrock.

Bearing Capacity - $2\frac{1}{2} + 5.4$ @ Elev 301 or below
i.e. 6 to 8.0 below ground.

Water table Elev 302 - 306.

Settlements max 2.0"

No problems with excavation.

An alternative to build the structure on bedrock.

Recommendations for the four span structure

- 1) The subsoil conditions are generally uniform. Spread footing support in the stiff clay with a safe bearing pressure of $2\frac{1}{2} + 5.4$ can be used for footing design.
- 2) If a bearing capacity greater than $2\frac{1}{2} + 5.4$ is desired, the structure can be supported on short end bearing piles.

- driven to practical ~~at~~ refusal into the bedrock.
- 3) Max Settlements of 2" are predicated in the foundation report
- 4) If greater loads are required for piles, ~~as~~ bored in caissons with lower ^{section} belled out can provide a safe load of 120 tons ~~pile~~ for 36" ϕ caissons.
- 5) No approach fill problems can be anticipated for 25' high embankments.
- 6) No dewatering problems—because of the impermeable nature of clay.



ONTARIO
DEPARTMENT OF HIGHWAYS

Bridge Division.

Memo to Mr. A. G. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Building
From J. B. Curtis
Date March 23, 1962.
Subject Hwy. #401 at Kingston Mills Rd.
0.8 mi. E. of Hwy. #15
Fillsburg Twp. Br. #3
W.P. 161-59 - District #8

The Foundation Section carried out an investigation at the above site in May, 1959. The results of this investigation are presented in report #BA961 (W.J.F. 59-48).

We are now proposing a considerably longer structure with a pier in the median. The outside piers will fall very close to where you took borings for our first proposal. We will probably place abutments on piles. These abutments will be placed on the approach fills a distance of 45 to 50 feet distant from the outside piers.

The foundation report indicates somewhat uniform sub-soil conditions for the boreholes taken. Do you feel we can use this report without further information being obtained from the field. If you do not feel we can depend entirely on the old report for the new structure, do you think boreholes to determine bedrock elevations at the abutment locations after the preliminary design will suffice?

Would you kindly look over your copy of the old report and advise us accordingly.

JBC/ea
cc. D. Smith

J. B. Curtis,
Bridge Location Engineer.

15	15	15	15	15
15	15	15	15	15
15	15	15	15	15
15	15	15	15	15



ONTARIO
DEPARTMENT OF HIGHWAYS

BA 961

Memo to Mr. A. M. Toye, Date November 5, 1959.
Bridge Engineer. Subject FOUNDATION REPORT - D.H.O. -
From Materials & Research Section. W.J. F 59-48 -- W.P. 161-59.

Attention: Mr. S. McCombie.

Re: Hwy. 401 Line 'B' & County Rd. Revision Crossing,
Lot 1, Con. II, Twp. of Pittsburgh - Approximately
5 Miles N.E. of Kingston, Ontario.

Enclosed herewith is our report on the foundation conditions existing at the above noted site. Reference to the contents of the report shows that the subsoil consists of a layer of clay fill, followed by a thin stratum of stiff varved silty clay (12' to 14' thick) underlain by bedrock.

For your convenience, principal comments are as follows:-

1. Simple spread footings, founded in the stiff varved silty clay, are recommended. For footings typically 6' to 10' wide, an allowable footing pressure of 2 1/2 t.s.f. can be used for design. For either a single-span or a two-span structure, total and differential settlements are considered tolerable. Footings are recommended to be placed at Elev. 301' or below.
2. To avoid swelling and softening of the varved clay, if excavations for the footings are to be left open for any period of time, a lean mix of concrete should be placed immediately upon excavations.
3. If a bearing capacity greater than 2 1/2 t.s.f. as recommended above, is desired, the structure can be founded either on spread footings placed directly on the bedrock or on short end-bearing piles driven to refusal into the bedrock. ✓
4. No excessive seepage problems with respect to footing excavations, are anticipated.

cont'd. /2 ...

Comments: (cont'd.) ...

5. No approach fill stability problems are anticipated. ✓

If there are any queries with respect to the contents of this report, please contact our office.

L. G. Soderman,
PRINCIPAL SOILS & FOUNDATIONS ENGR.
per:

AKL

(A. K. Loh,
Project Foundation Engr.)

AKL/MdeF
Encl.

cc: Messrs. A. M. Toye
H. A. Tregaskes
D. G. Ramsay
I. Campbell
T. A. Sharpe
J. E. Gruspier
A. Watt
Foundation Section.
Gen. Files.

FOUNDATION REPORT

on

Hwy. 401 Line 'B' & County Rd. Revision Crossing,
Lot 1, Con. II, Twp. of Pittsburgh - Approximately
5 Miles N.E. of Kingston, Ontario.

Plan No: F-3549-6
Profile No: F-3549-13
Site Plan No: E-3659-1
Chainage: Sta. 705+60.69

Distribution:

Mr. A. M. Towe, Bridge Engineer.	(2)
Mr. H. A. Tregaskes, Construction Engineer.	(1)
Mr. D. C. Ramsay, Rd. Design Engineer.	(1)
Mr. I. Campbell, Sr. Project Design Engz	(1)
Mr. T. A. Sharpe, District Engr., Kingston.	(1)
Mr. J. E. Gruspier, Regional Soils Engineer.	(1)
Mr. A. Watt, Ont. Water Resources Commission.	(1)
Foundation Section.	(1)
Gen. Files.	(1)

W.J. F-59-48
W.P. 161-59

INTRODUCTION:

Presented in this report are the results of a subsoil investigation carried out at a structure location approximately 5 miles N.E. of Kingston where existing Hwy. 401 Line 'B' underpasses the County Rd. Revision in Lot 1, Con. II, Twp. of Pittsburgh (Sta. 705+60.69, Profile No. F-3549-13). This report contains the detailed field and laboratory findings and recommendations for the foundation of the structure.

The field work commenced on May 12, 1959 and was completed on May 14, 1959.

DESCRIPTION OF THE SITE AND GEOLOGY:

The topography of the site is undulating to moderately rolling. Drumlins as well as bedrock outcrops are visible in the vicinity of the site. The area on both sides of existing Hwy. 401 is presently in pasture.

The site under consideration, is located at the edge between the Napanee Limestone Plain and the Precambrian Shield. The overburden above bedrock in the area is generally shallow. At this site, bedrock was found to be overlain by a 12 to 14 ft. thick layer of stiff varved clay.

DESCRIPTION OF FIELD AND LABORATORY WORK:

Field work consisted of four sampled boreholes. The investigation was carried out by a standard diamond drill adapted for soil sampling. Samples were recovered at depths required by means of 2" I.D. thin-walled Shelby tube samplers or a 2" O.D. split barrelled spoon sampler. The dimension of this spoon sampler and

cont'd. /2 ...

DESCRIPTION OF FIELD AND LABORATORY WORK: (cont'd.) ...

the energy used in driving it, conform to the requirements of the Standard Penetration Test. Upon recovery, samples were visually examined and identified in the field and wax-sealed or placed in moisture proof containers for transport to our laboratory. Bedrock was proven by drilling into it 5 ft. and rock core samples were examined at the site as well as in the laboratory to determine its quality and soundness.

Upon receipt in the laboratory, samples were visually examined and identified. Triaxial shear and consolidation tests as well as routine index tests, were performed on selected, representative samples. Results of laboratory tests have been presented in the borehole logs and summarized in Table No. 1.

SUBSOIL CONDITIONS:

The site is underlain by a layer of clay fill, followed by a thin stratum of stiff varved silty clay overlying bedrock. Immediately above the bedrock a layer of fine silty sand with occasional boulders, was encountered in Borings 1 & 2.

In each of the sampled boreholes, the ground surface was found to be underlain by a 4' to 6' thick layer of clay fill at approximately Elev. 302' - 304'. Underneath the clay fill the layer of stiff grey varved silty clay was encountered. It extends from Elev. 302' - 304' to Elev. 290'. Underneath the stiff varved silty clay layer bedrock was encountered. In Borings 1 & 2, immediately above the bedrock and below the stiff clay, a layer of fine silty sand with occasional boulders, 4 to 5 ft. in thickness

cont'd. /3 ...

SUBSOIL CONDITIONS: (cont'd.) ...

was intersected.

In general, the soil types encountered, are as follows:-

1. Fill:

This layer of fill was intersected immediately below the ground surface in each of the sampled boreholes. It is composed of approximately 57% clay, 13% sand and 30% silt and is well-compacted. The colour is brown to greyish-brown. The average unit weight and moisture content were found to be 120 p.c.f. and 28%, respectively. Liquid and plastic limits averaged 45% and 22%, respectively. Laboratory tests show that the clay fill has a shear strength of approximately 2000 p.s.f. The thickness of clay fill ranges from 4 ft. in Boring 2, to 6 ft. in Boring 3.

2. Stiff Grey Varved Silty Clay:

Immediately underneath the clay fill the stratum of stiff grey varved silty clay was encountered. It has a typical varved clay structure, composed of approximately 1 1/4" thick light grey silty clay and clay silt layers interbedded with approximately 1/8" thick dark grey clay layers. It is fissured throughout the entire stratum. The average unit weight was found to be 121 p.c.f. Its consistency was defined by moisture contents of 24% to 39%; liquid and plastic limits of 31% to 46% and 17%, respectively. Laboratory triaxial compression tests show that the varved clay has shear strengths ranging from 1500 p.s.f. to 5700 p.s.f.

cont'd. /4 ...

SUBSOIL CONDITIONS: (cont'd.) ...

2. Stiff Grey Varved Silty Clay: (cont'd.) ...

A plot of shear strength vs. depth has been presented and is included in this report under Appendix I. Consolidation tests show that the varved clay is saturated and preconsolidated. Its thickness ranges from 11 ft. in Boring 3, and 14 ft. in Boring 2.

3. Bedrock:

In Borings 3 & 4, bedrock was encountered immediately underneath the varved clay stratum. In Borings 1 & 2, however, a layer of fine silty sand with occasional boulders, approximately 5 ft. in thickness, was encountered immediately below the varved clay stratum and above the bedrock. In Borings 1 & 3, bedrock was drilled and cored 5 ft. to determine its quality and soundness. In Borings 2 & 4, bedrock was not drilled, but wash boring procedures were carried out until the bedrock surface was reached. Rock core samples obtained from Borings 1 & 3, show that at the location of Boring 1, bedrock is composed of igneous rock of granite, whereas at the location of Boring 3, bedrock is composed of sedimentary rock of conglomerate and limestone. The granite conglomerate and limestone are in a very sound condition with no signs of weathering or fracture. Bedrock was reached at Elev. 284.1' in Boring 1; Elev. 290.2' in Boring 2; Elev. 290.9' in Boring 3, and at Elev. 289.6' in Boring 4.

Results of field and laboratory tests have been summarized in Table No. 1 and are included in this report under Appendix I.

cont'd. /5 ...

WATER CONDITIONS:

Due to the impermeable nature of the clay, it was not feasible to accurately establish the ground water table at the site during boring and sampling operations. All the samples obtained below the ground surface were saturated and the water table has been assumed to be at or slightly below the ground surface at approximately Elev. 306' to Elev. 302'. In view of the fact that no artesian water conditions or water-bearing sand seams of any significance were encountered during the exploration programme, seepage inflow during footing excavations will be local and of minor quantities, only. Surface run-off into excavations may be controlled by pumping.

FOUNDATION CONSIDERATIONS:

The stiff varved clay is competent to provide adequate foundation support for the structure. Strength and compressibility characteristics are such that at Elev. 301' or below, spread footing support can be obtained in the stiff varved clay. At this elevation or below, for footings of 6' to 10' in width, a bearing pressure of 2 1/2 t.s.f., incorporating a safety factor of 3, can be used for spread footing design. Settlements of the footings resulting from the application of 2 1/2 t.s.f. bearing pressure and the embankment load, due to approximately 25 ft. of fill, will be of the order of 2 inches. For a single-span or a two-span structure, total and differential settlements are considered tolerable.

To avoid swelling and softening of the varved clay, if excavations for the footings are to be left open for any period

cont'd. /6 ...

FOUNDATION CONSIDERATIONS: (cont'd.) ...

of time, a lean mix of concrete should be placed on the varved clay immediately upon excavation. If a bearing capacity greater than 2 1/2 t.s.f. as recommended above, is desired, the structure can be founded either on spread footings placed directly on the bedrock or on short end-bearing piles driven to refusal into the bedrock.

In view of the relatively impermeable nature of the clay, no excessive ground water seepage problems during excavations are anticipated. Surface run-off into excavations may be controlled by pumping.

Under the proposed grade line of the revised County road, the maximum height of fill is approximately 27 ft. The subsoil can safely support this embankment loading.

CONCLUSIONS & RECOMMENDATIONS:

- (1) The site is underlain by a layer of clay fill, followed by a thin stratum of stiff varved silty clay overlying bedrock.
- (2) Subsoil conditions are such that spread footing support can be obtained in the stiff varved silty clay at Elev. 301' or below. At this elevation or below, for footings of 6' to 10' in width, an allowable bearing pressure of 2 1/2 t.s.f. can be used for spread footing design. For a single-span or a two-span structure, total and differential settlements are considered tolerable. If excavations for the footings are to be left open for any period of time, a lean mix of concrete should be placed on the clay immediately upon excavation in order to avoid swelling and softening of the clay.

cont'd. /7 ...

CONCLUSIONS & RECOMMENDATIONS: (cont'd.) ...

- (3) If a bearing capacity greater than 2 1/2 t.s.f. is desired, the structure can be founded either on spread footings placed directly on the bedrock or on short end-bearing piles driven to refusal into the bedrock.
- (4) No construction difficulties with respect to ground water seepage during excavation, are anticipated.
- (5) No approach fill stability problems are anticipated.

AKLoh

A. K. Loh,
Project Foundation Engr.

APPENDIX I.

SUMMARY OF FIELD & LABORATORY TESTS

JOB F 59-48.

W.P. 161-59.

[illegible]

SUMMARY OF FIELD & LABORATORY TESTS

JOB F 59-48

W.P. 161-59

Page - Two -

HOLE NO.	SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENETR RESIST. BLOWS FT	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
4	T1	4'-5.5'	Grey-brown clay fill.	21	31.5	-	-	1455	115.0	
	T2	8'-9.5'	Stiff grey fissured varved silty clay.	39	32.5	26.5	46.0	4410	119.0	
	T3	12'-13.5'	" " "	20	29.4	-	-	3020	124.0	
	T4	14'-15.5'	" " "	7	30.6	16.9	31.6	922	122.5	
	Vane	16.5'	" " "	-	-	-	-	1680	-	Sens: 9.3
			T1 - Denotes Shelby Tube Sample. S1 - Denotes Split Spoon Sample. R1 - Denotes Rock Core Sample. <u>CONSOLIDATION TEST RESULTS:</u> Depth: 9' to 10.5' - Coefficient of volume compressibility = 0.0017 Most probable preconsolidation pressure = 6.5 t.s.f. Depth: 13' to 14.5' - Coefficient of volume compressibility = 0.0051 Compression Index = 0.075 Most probable preconsolidation pressure = 1.5 t.s.f.							

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS AND RESEARCH SECTION








W.P. 161-59 BORE HOLE NO. 1.
 JOB F 59-48 STATION 705+61 (64' Rt.)
 DATUM Elev. 302.6' COMPILED BY B.K.
 BORING DATE May 12/59 CHECKED BY A.L.

2" DIA. SPLIT TUBE
 2" SHELBY TUBE
 2" SPLIT TUBE
 2" DIA. CONE
 2" SHELBY
 CASING

LEGEND

1/2 UNCONFINED COMPRESSION (Q_u) O
 VANE TEST (C) AND SENSITIVITY (S) +
 NATURAL MOISTURE AND LIQUIDITY INDEX LI
 LIQUID LIMIT X
 PLASTIC LIMIT

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE			
				2000	4000	6000	8000 P.S.F.
	Ground Level.	307.6	0		50		100
	Compact grey-brown clay fill.	302.6					
	Stiff grey fissured silty clay.		10				
	Medium fine silty sand - some gravel.	289.6	20				
	Gravel & boulders.	285.1					
	Bedrock, granite.	284.1					
	End of Borehole.	281.6	30				

CONSISTENCY		SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.			
15	30	45	
			T1 118.8
			T2 127.0
			T3 123.0
			T4 123.3
			T5 -
			S6 -
			RC -

Borehole No. 1.

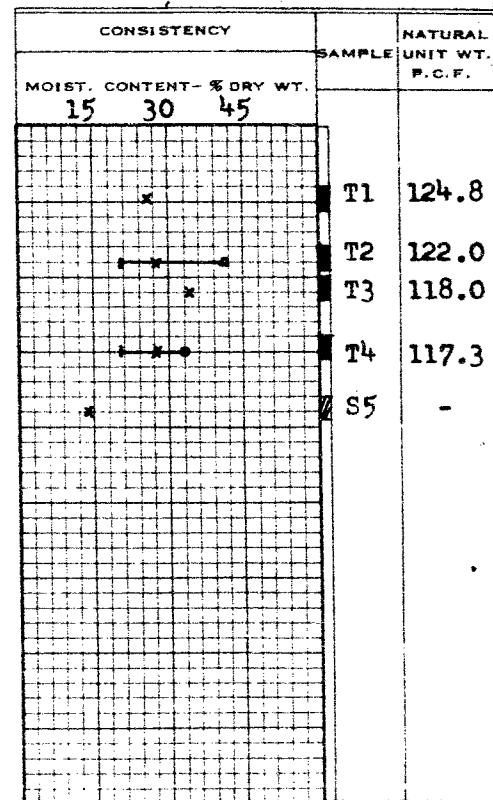
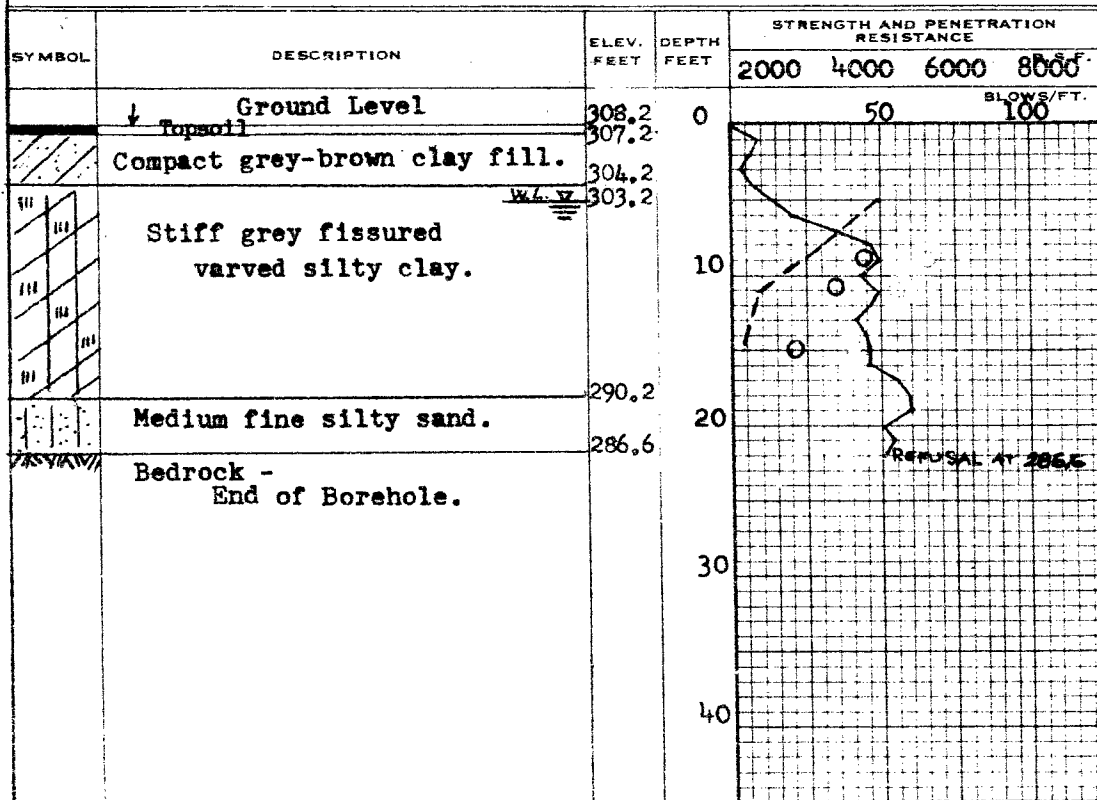
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 161-59 BORE HOLE NO. 2.
 JOB F 59-48 STATION 205+96 (64' Rt.)
 DATUM Elev. 308.2' COMPILED BY B.K.
 BORING DATE May 14/59 CHECKED BY A.L.

2" DIA. SPLIT TUBE -----
 2" SHELBY TUBE -----
 2" SPLIT TUBE -----
 2" DIA. CONE -----
 2" SHELBY -----
 CASING -----

LEGEND

1/2 UNCONFINED COMPRESSION (Q_u) ----- O
 VANE TEST (C) AND SENSITIVITY (S) ----- +
 NATURAL MOISTURE AND LIQUIDITY INDEX ----- LI
 LIQUID LIMIT ----- X
 PLASTIC LIMIT ----- I



Borehole No. 2.

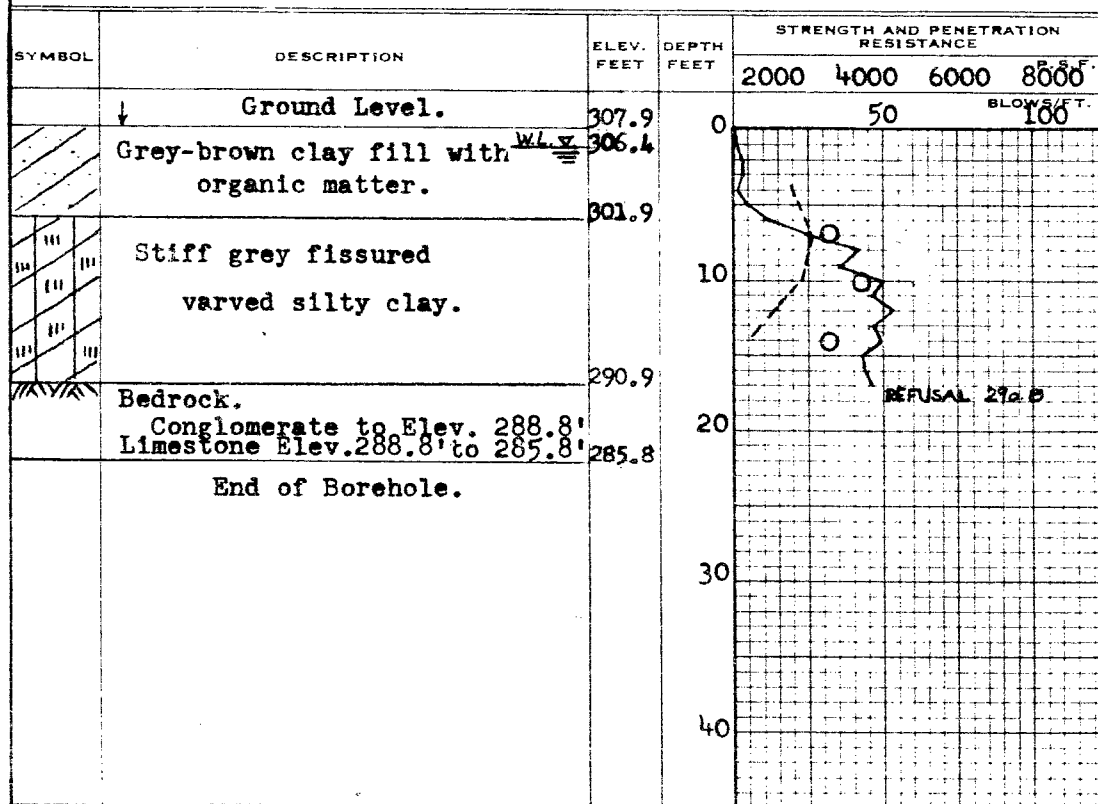
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

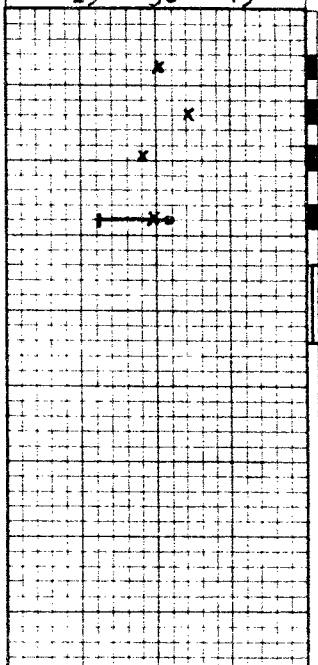
W.P. 161-59. BORE HOLE NO. 3.
 JOB F 59-48 STATION 705+45(60' Lt.)
 DATUM Elev. 307.9' COMPILED BY B.K.
 BORING DATE May 12/59 CHECKED BY A.L.

2" DIA. SPLIT TUBE
 2" SHELBY TUBE
 2" SPLIT TUBE
 2" DIA. CONE
 2" SHELBY
 CASING

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) O
 VANE TEST (C) AND SENSITIVITY (S) +
 NATURAL MOISTURE AND LIQUIDITY INDEX LI
 LIQUID LIMIT X
 PLASTIC LIMIT



CONSISTENCY		SAMPLE	NATURAL UNIT WT P.C.F.
MOIST. CONTENT- % DRY WT.			
15	30	45	
			
		T1	-
		T2	115.5
		T3	121.7
		T4	123.8
		RC	-

Borehole No. 3.

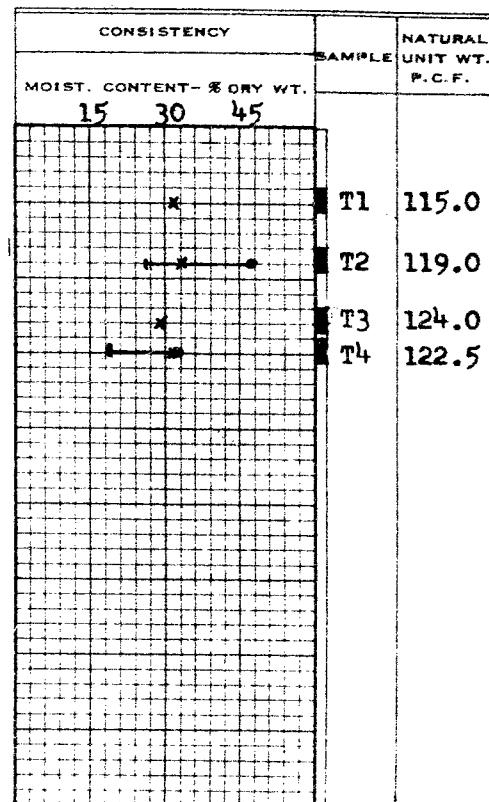
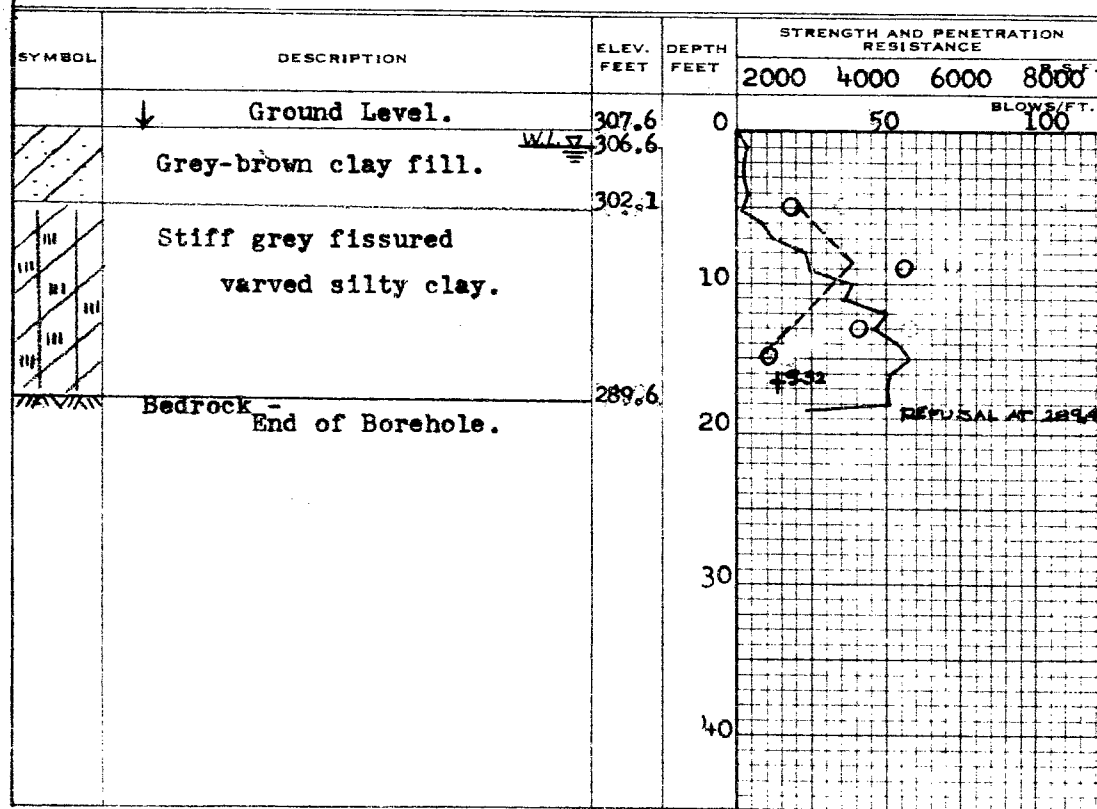
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 161-59 BORE HOLE NO. ⁴.
 JOB F 59-48 STATION 705+04 (60' Lt.)
 DATUM Elev. 307.6' COMPILED BY B.K.
 BORING DATE May 13/59. CHECKED BY A.L.

2" DIA. SPLIT TUBE
 2" SHELBY TUBE
 2" SPLIT TUBE
 2" DIA. CONE
 2" SHELBY
 CASING

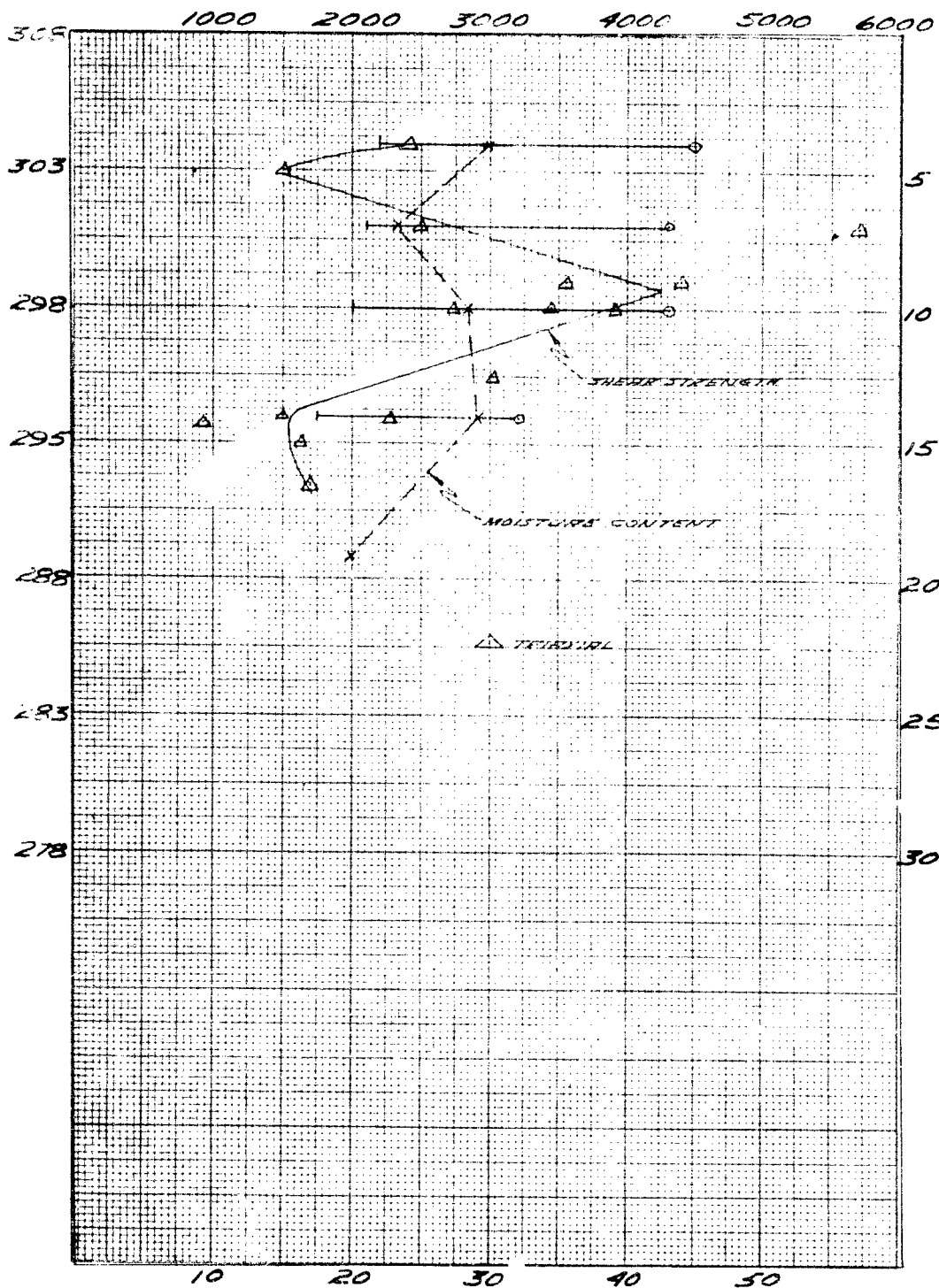
LEGEND

1/2 UNCONFINED COMPRESSION (Q_u) — O
 VANE TEST (C) AND SENSITIVITY (S) — +
 NATURAL MOISTURE AND LIQUIDITY INDEX — X
 LIQUID LIMIT —
 PLASTIC LIMIT —



Borehole No. 4.

SHEAR STRENGTH IN P.S.F.



WATER CONTENT % NAT X ATTEBERG LIMITS