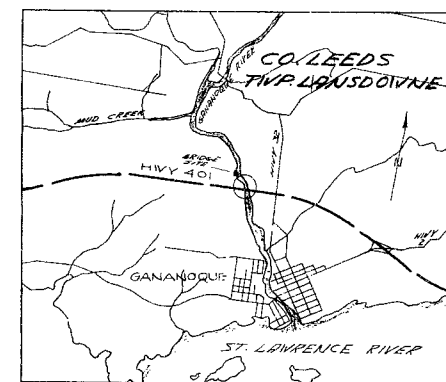
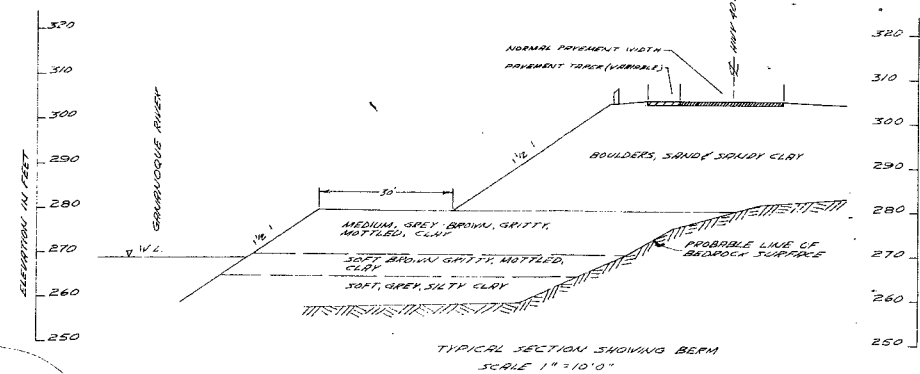
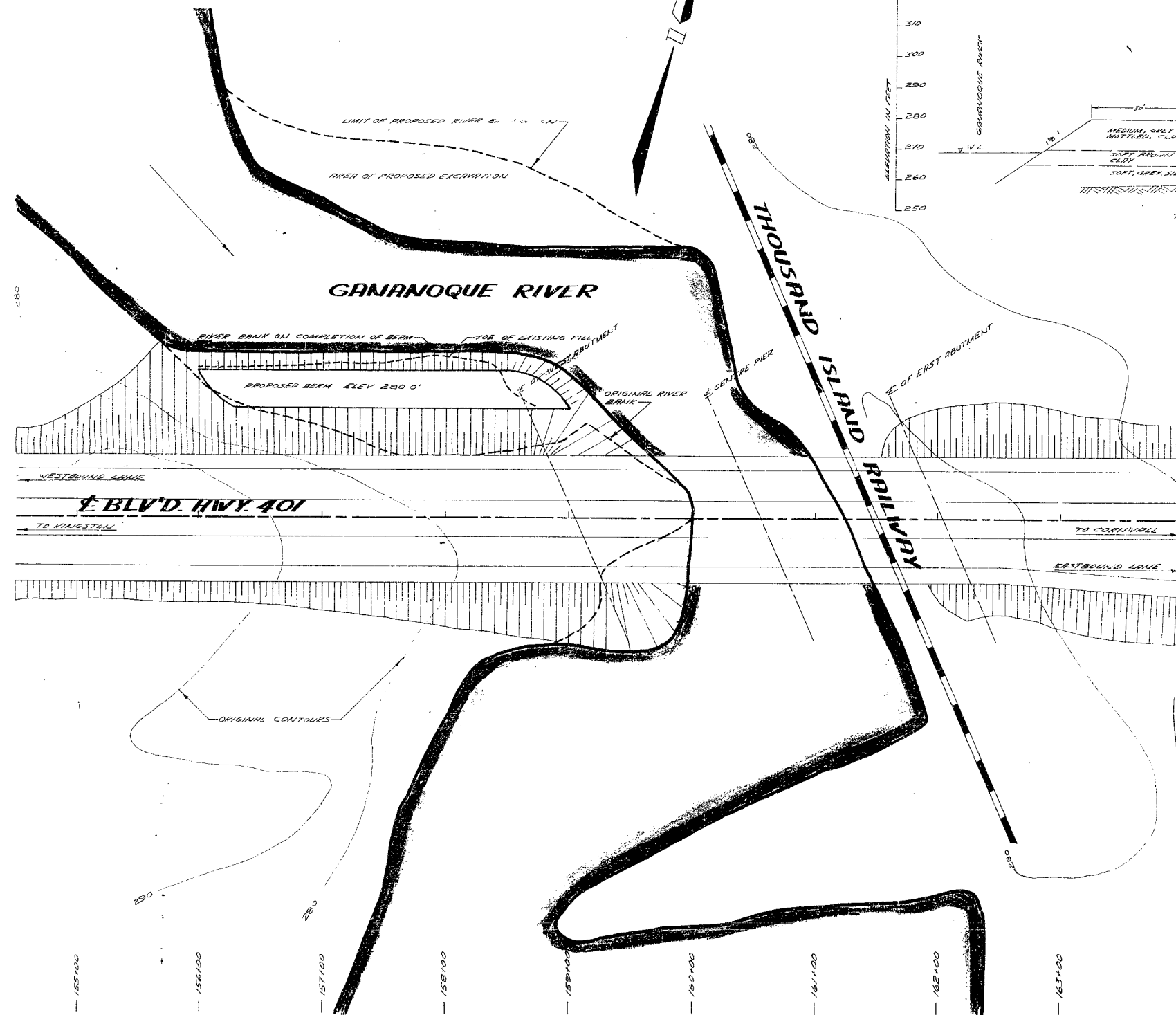


#59-F-80

Hwy. #401

GANANOQUE R.

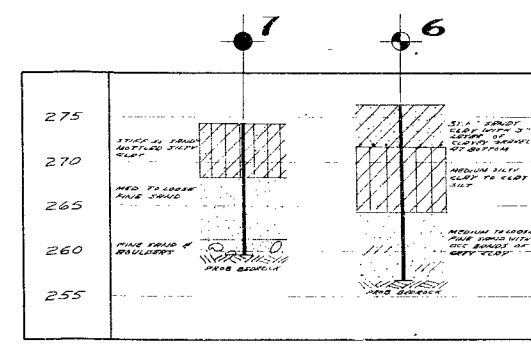
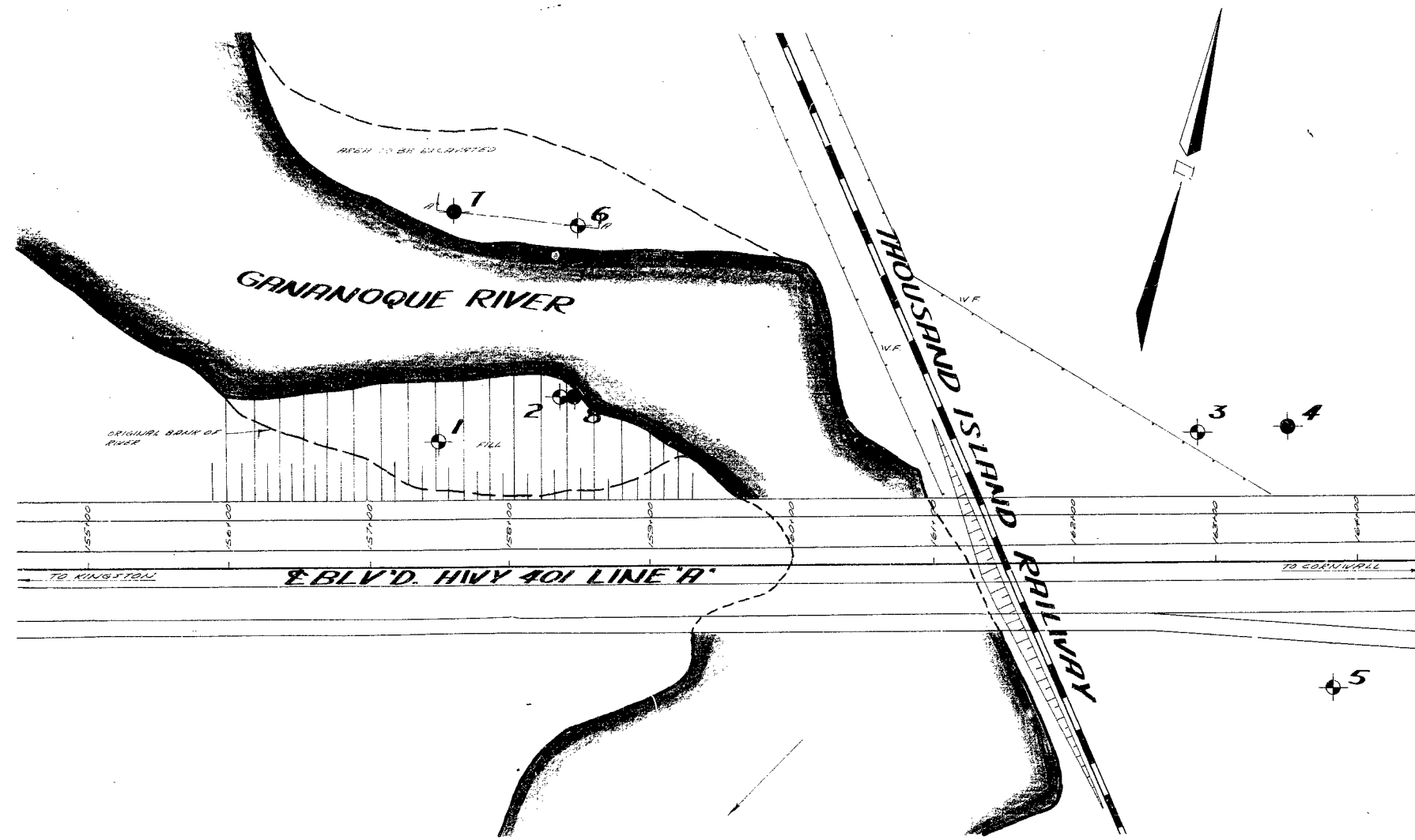


KEY PLAN
SCALE 1" = 1 MI.

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			
GANANOQUE RIVER			
HWY. 401 EMBANKMENTS			
SHOWING POSITIONS & ELEVATIONS OF HOLES			
HWY. 401	DISTRICT 8	COUNTY LEEDS	
TOWNSHIP LAUSDONNE	LOT 18E	CON 1	
LOCATION APP. 1 MI. N. OF GANANOQUE			
DRAWN BY T. MELLORS	CHECKED BY W.K.	W.P.	
DATE JULY 1959	APPROVED BY		DRAWING NO.
SCALE AS SHOWN			F59-80A

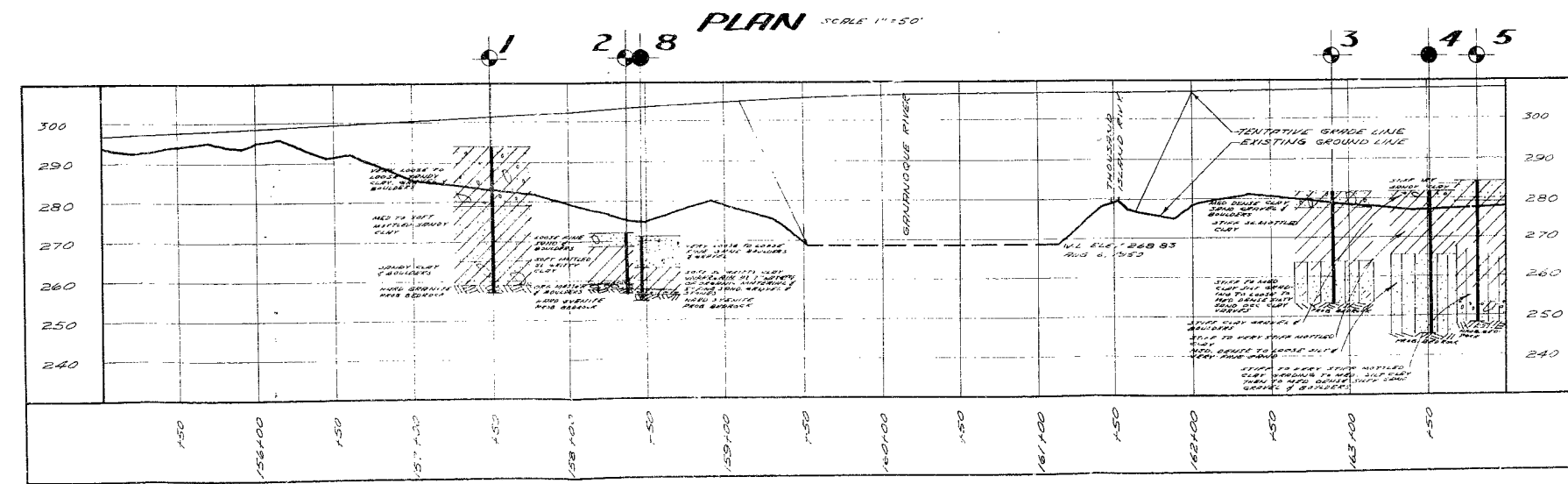
PLAN
SCALE 1" = 50'0"



RA
VERTICAL SCALE 1" = 10'

LEGEND			
BORE HOLE			
PENETRATION HOLE			
BORE & PENETRATION HOLE			
HOLE NO.	ELEVATION	STATION	DISTANCE FROM
1	294.0	157148	75' LT.
2	272.4	158136	119' LT.
3	281.9	162180	92' LT.
4	282.0	163150	96' LT.
5	284.6	163180	90' RT.
6	276.5	158148	240' LT.
7	274.2	157160	250' LT.
8	271.5	158146	119' 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.



PROFILE
SCALE: HORIZONTAL 1" = 50'
VERTICAL 1" = 20'

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION

**GANANOQUE RIVER
HWY. 401 EMBANKMENTS**

SHOWING POSITIONS & ELEVATIONS OF HOLES

HWY 401 DISTRICT 8 COUNTY LEEDS
TOWNSHIP LANSDOWNIE LOT 18 2 CON 1
LOCATION APP 1411 N OF GANANOQUE

DRAWN BY J. M. GLORES CHECKED BY W.P.
DATE 14 DEC 59 APPROVED BY
SCALE AS SHOWN DRAWING NO. F55-80B

Mr. H. A. Tregaskes,
Construction Engineer.
Materials & Research Section.

August 7, 1959.

Re: Highway No. 401 Crossing
at Gananoque River -
District #8 - W.J. P-59-80.

A complete, detailed foundation report dealing with conditions at the above site will be forwarded in the near future. For your convenience, some of the conclusions and recommendations are presented herein. It is hoped that these conclusions will enable work to continue with a minimum of delay.

1. Unless remedial measures are taken, further embankment failures are probable at the West approach on the North side of the river between Stations 156+00 and 159+00. These probable failures, as in previous failures, are due to a layer of soft clay found near the bottom of the embankment. This soft clay is believed to be fill material; however, some may be river deposits.
2. To prevent further failures, the embankment between Stations - 156+00 to 158+50 should be trimmed and a berm constructed as shown on Drawing P 59-80A (enclosed). This berm has been designed so that it extends a minimum distance into the existing river. Material trimmed from the top of the slope should be used in the construction of the berm.
3. Blasting operations to widen the river channel should not be undertaken until the berm has been constructed. A safety factor of 1.3 has been used for the design of the berm. With this low factor of safety, vibrations set up by blasting, should be kept to a minimum.
4. Bore holes placed at the east approach, indicate that cracking along the edge of the embankment is due to settlement of fill. No stability problem is anticipated in this particular area.

RP/ndaf

Encl.

cc: Messrs. A. M. Toye
S. McCombie
D. G. Ramsay
A. Markiewicz
L. E. Walker
J. E. Gruspier

Foundation Office ✓

Gen. Files.

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

R. J. B. Maden
(K. Szekar,
FOUNDATION FIELD SUPERVISING ENGR.)

Mr. A. M. Teye,

August 19, 1959.

Bridge Engineer.

Re: Highway No. 401 Crossing
At Gananoque River -
District #8 - W.J. F-59-80.

Materials & Research Section.

Attention: Mr. S. McCombie.

Please find, accompanying our memo, a detailed foundation report for the above noted site. The conclusions and recommendations were forwarded to you in a memo to Mr. H. A. Tregaskes, dated August 7th.

For your convenience, these are repeated, as follows:-

- (1) Unless remedial measures are taken, further embankment failures are probable at the West approach on the North side of the river between Stations 156+00 and 159+00. These probable failures, as in previous failures, are due to a layer of soft clay found near the bottom of the embankment. This soft clay is believed to be fill material; however, some may be river deposits.
- (2) To prevent further failures, the embankment between Stations - 156+00 to 158+50 should be trimmed and a berm constructed as shown on Drawing F 59-80A. This berm has been designed so that it extends a minimum distance into the existing river. Material trimmed from the top of the slope should be used in the construction of the berm.
- (3) Blasting operations to widen the river channel should not be undertaken until the berm has been constructed. A safety factor of 1.3 has been used for the design of the berm. With this low factor of safety, vibrations set up by blasting, should be kept to a minimum.
- (4) Bore holes placed at the East approach, indicate that cracking along the edge of the embankment is due to settlement of fill. No stability problem is anticipated in this particular area.

EP/McC
Encl.

cc: Messrs. A. M. Teye
H. A. Tregaskes
D. G. Ramsay
S. Markiewicz
T. A. Sharpe
J. E. Gruspier
A. Watt

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

K. Peaker
(K. Peaker,
Foundation Field Supervising Engr.
Foundation Section -- Gen. Files.

REPORT ON
EMBANKMENT STABILITY INVESTIGATION
HIGHWAY 401 at GANANOQUE RIVER
DISTRICT NO. 8, KINGSTON.

Plan No: F-3584.

Profile No: F-3584-1.

Distribution:

Mr. A. M. Toye, Bridge Engineer.	(2)
Mr. H. A. Tregaskes, Construction Engineer.	(1)
Mr. D. G. Ramsay, Ed. Design Engineer.	(1)
Mr. S. Markiewicz, Project Design Engr.	(1)
Mr. T. A. Sharpe, District Engineer, Kingston.	(1)
Mr. J. E. Gruspier, Regional Soils Engineer.	(1)
Mr. A. Watt, Ont. Water Resources Commission.	(1)
Foundation Section.	(1)
Gen. Files.	(1)

Contract No's: 55-198 and
58-121

W.J. F-59-80.

INTRODUCTION:

Presented in this report are the results of a subsoil investigation carried out at the crossing of Hwy. 401 and the Gananoque River. This site is located approximately one mile north of the town of Gananoque. The purpose of the foundation investigation was to determine the stability of the embankment at the west bridge approach. In addition to the stability of the west approach, the east approach embankment stability was also checked.

Prior to the investigation, numerous movements and cracking had occurred at this site. A brief history of these movements and cracks follows:-

1. West Bank:

Before the commencement of construction operations, the West bank of the river formed a point of exposed bedrock (with a little overburden) jutting into the river. The proposed grade required an embankment up to 30 feet in height. This embankment had been partially constructed with clay fill when a portion of the fill on the North side of the highway slid into the river in July, 1956.

Rock fill was then placed along the bottom of the North side of the fill and the embankment built up to grade with clay fill. Again, a slip occurred and the embankment was brought up to grade with clay fill. In July, 1957, a third slip occurred. More recently, a rock berm was constructed near the toe of the North slope but this was later loaded with excess material. As

1. West Bank: (cont'd.) ...

a result of the added load, cracks appeared in the top of the fill and in the road shoulder. At this point, it was decided to conduct an investigation to determine whether a further serious slip was likely.

2. East Bank:

The embankment to the East of the bridge is mainly rock fill with the exception of the granular backfill to the structure and some earth fill which was end-dumped over the North side of the rock fill. Recently, cracks about 1" wide appeared in the pavement taper about 100 feet from the West end of the bridge on the North side of the highway. Smaller, similar cracks also appeared on the South side of the fill. It was therefore decided to conduct a subsoil investigation to determine whether the cracks were being caused by failure of the underlying material, or by consolidation of the fill.

DESCRIPTION OF FIELD WORK:

The field work was commenced on July 21st, 1959 and completed on July 29th, 1959. This work was carried out using a coredrill machine and continuous flight auger.

On the North side of the West approach, one borehole, with adjacent dynamic cone penetration test, was made from the top of the embankment. At the foot of this embankment, two additional boreholes and one dynamic cone penetration test were made. In each

cont'd. /3 ...

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

case, it was necessary to drill BX casing through rock fill near the surface before being able to obtain samples of the medium to soft clay fill underneath. As far as possible, 2" Ø thin-walled Shelby tube samplers were used to obtain relatively undisturbed samples. Field shear strength values were determined by in-situ vane tests.

Below the clay, 1 1/4" Ø and 1 7/8" Ø rock cores were taken in order to prove bedrock.

On the East bank of the river, a continuous flight auger was used in making three boreholes at the foot of the embankment, two on the North side and one on the South side. In addition, two dynamic cone penetration tests were made.

Boreholes were also located directly across the river from the North side of the West approach. These were made in order to determine whether there was possibly a continuous layer of soft clay extending under the river from the West bank to the East bank.

In all cases, both a 2" O.D. split-barrelled spoon sampler and 2" Ø thin-walled Shelby tube samplers were used together with in-situ vane tests. Holes were advanced until no further penetration was possible.

The results of the field and laboratory tests are presented in the borehole logs and are also detailed in tabular form under Appendix I.

Drawing No. F-59-80 B shows the borehole locations and the subsoil profile.

cont'd. /4 ...

SUBSOIL CONDITIONS:

1. West Embankment:

Samples obtained from the boreholes in the "failure zone" of the West embankment indicate that the embankment consists basically of a varying depth of rock fill and sand and sandy clay overlying a layer of soft clay or sandy clay up to nearly 20 feet in depth. The shear strength of the clay layer ranges from 700 p.s.f. at the bottom, to about 1400 p.s.f. at the top. This material is believed to be mostly the initial earth fill as it is underlain in Boreholes No. 2 and 8 by a thin layer of slightly decomposed organic material which is possibly the original river bottom. Beneath this decomposed organic material, is a thin layer of fine sand and boulders underlain by very hard pink granite and grey syenite bedrock. It must be realized, however, that the numerous failures which have occurred make it practically impossible to define accurately the limits of the various strata.

2. East Embankment:

The subsoil beneath the embankment on the East side of the river consists of a surface layer of 2 to 5 feet of stiff sandy clay, gravel and boulders underlain by 13 to 15 feet of stiff to very stiff grey-brown mottled clay. The average shear strength of this material is near 3000 p.s.f., while the average moisture content and unit weight are 29% and 123 lbs./cu.ft., respectively.

This layer of clay is in turn, underlain by medium grey clay silt grading to fine or silty sand with probable bedrock at depths ranging from 28.5 feet to 36.8 feet below ground level.

cont'd. /5 ...

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

2. East Embankment: (cont'd.) ...

On the North side of the highway the water table was at Elev. 275.5' (i.e., 6.5 ft. below ground level and about 6.5 ft. above the river water level). On the South side of the highway the water table was somewhat lower.

Farther North on the East bank, opposite the failure zone of the West embankment, the subsoil consists essentially of 6 to 12 feet of stiff to medium grey-brown sandy to silty clay, underlain by about 8 feet of medium to loose brown fine sand with probable bedrock at depths of 14.5 ft. and 20.0 ft. The water table was approximately at the level of the water in the river.

EMBANKMENT STABILITY:

1. West Bank:

Failure to find any evidence of a layer of soft clay at any location other than in the West embankment indicates that past and present failures at the West embankment are due to failure of the fill material.

At the time of the investigation, cross-sections of the North side of the existing embankment were taken between Sta. 156+00 and Sta. 159+00. In addition, prints of the original cross-sections were obtained. Using these cross-sections and the field and laboratory results, sections at Stations 157+50 and 158+50 were analyzed for stability using the conventional slip circle analysis. Factors of safety of 1.16 and 1.02, respectively, were obtained with a

cont'd. /6 ...

EMBANKMENT STABILITY: (cont'd.) ...

1. West Bank: (cont'd.) ...

limited number of circles, indicating that there is imminent danger of further failures occurring unless immediate remedial measures are taken.

Various trial sections were analyzed in order to obtain one with an adequate factor of safety. The analysis was made assuming four strata as follows:

- (i) Elev. 259.0 to 265.0: Soft clay:
C = 725 p.s.f.; $\phi = 0$; γ submerged = 58 p.c.f.
- (ii) Elev. 265.0 to 270.0: Soft clay:
C = 900 p.s.f.; $\phi = 0$; γ submerged = 58 p.c.f.
- (iii) Elev. 270.0 to 280.0: Medium sandy clay:
C = 1400 p.s.f.; $\phi = 0$; $\gamma = 120$ p.c.f.
- (iv) Elev. 280.0 to 305.0: Boulders, sand and sandy clay:
C = 0; $\phi = 30^\circ$; $\gamma = 120$ p.c.f.

Tension cracks assumed to extend down to Elev. 290.0.

2. East Bank:

Samples recovered from boreholes at the toe of the embankment on the East side of the river, indicate that there is no soft material, there which is likely to cause an embankment failure. It is therefore believed that the cracks which appeared at the top of the embankment and at the edge of the pavement, were caused by consolidation of the end-dumped fill and were not due to any subsoil failure.

cont'd. /7 ...

RECOMMENDATIONS:

1. West Bank:

It was found that in order to obtain a factor of safety of 1.3, it will be necessary to construct a berm at elevation 280, 30 feet wide. The slopes from the edge of the shoulder to the berm and from the edge of the berm to the river should be constructed at 1 1/2:1. Drawing F-59-80 A shows the proposed typical section. This operation would involve moving material from the upper part of the embankment to the toe. Superposition of the proposed section on the cross-sections of the existing embankment indicates that there is probably sufficient material presently in the embankment to construct the berm without having to dispose of excess material. Furthermore, the proposed section does not at any point, encroach more than an additional 10 feet into the river except at Sta. 158+50 where the present slope is dangerously steep.

It is recommended that the berm should extend from Sta. 156+00 to Sta. 158+50 and then taper in to the present slope at about Sta. 159+00.

Furthermore, it is considered vital that the berm should be constructed prior to any blasting operations necessary for widening the river. If this is not carried out, vibrations are likely to set off serious slides in the highway embankment. Even after the berm has been constructed, blasting operations should be closely controlled to keep vibrations to a minimum. This is recommended because of the relatively low factor of safety of 1.3 used in the design of the berm.

RECOMMENDATIONS: (cont'd.) ...

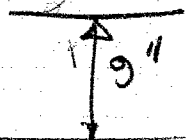
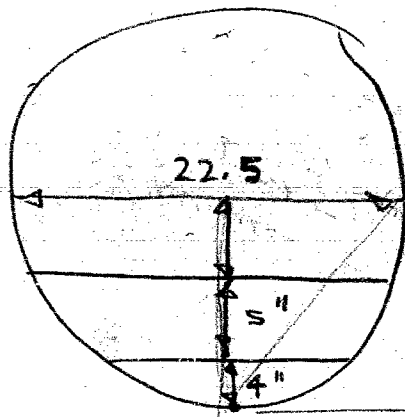
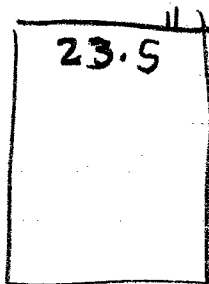
2. East Bank:

The cracks in the East embankment have been repaired and no precautionary measures to prevent future cracking are considered feasible.

CONCLUSIONS:

- (1) Further embankment failures are likely to occur on the North side of Highway 401 between Sta. 156+00 and Sta. 159+00 unless remedial measures are taken.
- (2) It is recommended that a 30 ft. wide berm be constructed at elevation 280.0 approx. with 1 1/2:1 slopes above and below the berm.
- (3) The above berm can probably be constructed without moving any additional material into the site and without encroaching more than about 10 ft. into the river from the existing toe of the embankment.
- (4) It is considered vital that the berm should be constructed prior to any blasting operations necessary for widening the river. Furthermore, due to the relatively low factor of safety of 1.3 used in the design of the berm, blasting operations carried out subsequent to the construction of the berm should be closely controlled to keep vibrations to a minimum.

OVER



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CONCLUSIONS: (cont'd.) ...

- (5) On the East side of Gananoque River, cracks in the top of the embankment and the edge of the pavement are believed to be due to consolidation of the fill material itself, and not to any failure of the subsoil. The cracks have been repaired and no precautionary measures to prevent future cracking are considered feasible.

B. J. Mackenzie.

B. J. Mackenzie,
Project Foundation Engineer.

APPENDIX I.

SUMMARY OF FIELD & LABORATORY TESTS

JOB F 59 - 80

W.P. --

HOLE NO.	SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
1	S1	4.5' - 6'	Soft brown sandy clay	1	--	--	--	--	--	
	S2	8' - 9.5'	Loose dark-brown clay sand & gravel	20	--	--	--	--	--	
	S3	12'-13.5'	Medium dense sand, gravel, pieces of boulders and a little asphalt	16	--	--	--	--	--	
	T4	16'-17.5'	Medium brown sandy clay	12	27.5	--	--	1420	119.0	
	VANE	19.5'		--	--	--	--	1882	--	Sens: 9.1
	T5	20'-21.5'	Medium grey-brown mottled sandy clay	p	27.7	--	--	1440	119.0	
	VANE	23.5'		--	--	--	--	1530	--	Sens: 5.2
	T6	25'-26.5'	Soft brown mottled sandy clay	p	26.5	19.7	37.4	892	128.3	
	VANE	28.5'		--	--	--	--	1100	--	Sens: ---
2	S1	4' - 6'	Soft blue-grey clay	3	35.1	23.9	66.4	--	--	
	T2	6' - 8'	Soft grey-brown sandy clay	p	--	--	--	--	--	
	VANE	9.5'		--	--	--	--	1137	--	Sens: 2.7
	T3	10'-11.5'	Soft grey-brown mottled clay	p	30.0	24.1	46.8	705	117.2	
	T4	12'-13.3'	Soft grey clay	p	40.9	--	--	710	115.6	
3	S1	3' - 4.5'	Medium dense medium to coarse clay sand and gravel	13	--	--	--	--	--	
	S2	6' - 7.5'	Stiff grey-brown mottled clay	29	27.7	--	--	2640	120.7	
	T3	9'-10.5'	" " " " "	27	31.4	--	--	2680	128.3	
	T4	12'-13.5'	" " " " "	23	30.1	--	--	3040	122.0	
	T5	15'-16.5'	Stiff grey clay	15	26.2	16.8	36.1	2690	124.0	
	T6	18'-19.5'	Medium grey clay silt	8	18.0	16.4	27.4	1610	132.3	
	VANE	21'		--	--	--	--	>2100	--	
	T7	21'-22.5'	Medium grey clay with seams of very fine sand	9	22.3	--	--	--	128.8	
	VANE	23.5'		--	--	--	--	1092	--	Sens: 6.5
	T8	23.5'-25'	Loose grey fine silty sand	9	--	--	--	--	--	
	T9	26.5'-28'	Medium grey fine silty sand	17	--	--	--	--	--	

SUMMARY OF FIELD & LABORATORY TESTS

JOB F 59 - 80W.P. ---

HOLE NO.	SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS FT	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
4	S1	4' - 5.5'	Medium grey-brown clay	13	32.5	--	--	1630	122.8	
	T2	6' - 7.5'	Stiff grey-brown mottled clay	26	28.6	--	--	3430	122.4	
	T3	9' - 10.5'	Very stiff grey-brown mottled clay	28	27.0	--	--	4150	124.2	
	T4	12' - 13.5'	Stiff grey clay	22	27.9	23.3	40.7	3100	120.4	
	T5	15' - 16.5'	Stiff grey clay	14	28.3	--	--	2260	125.6	
	VANE	18'		--	--	--	--	>2100	--	
	S6	20' - 21.5'	Medium dense grey silt and very fine sand	17	--	--	--	--	--	
	S7	24' - 27'	Very loose grey silty sand	p	--	--	--	--	--	
	S8	29.5' - 31'	Loose grey fine sand	9	--	--	--	--	--	
	S9	34' - 35.5'	Sample not recovered	21	--	--	--	--	--	
5	S1	3' - 4.5'	Stiff dry brown sandy clay	12	--	--	--	--	--	
	S2	6' - 7.5'	Very stiff grey mottled clay	31	--	--	--	--	--	
	T3	9' - 10.5'	Very stiff grey-brown mottled clay	40	30.5	33.9	49.4	4060	119.5	
	S4	14' - 15.5'	Stiff grey-brown mottled clay	25	--	--	--	--	--	
	T5	19' - 20.5'	Medium grey silty clay	13	31.2	20.0	49.6	1530	119.3	
	T6	24' - 25.5'	Stiff grey clay silt	23	--	--	--	--	--	
	S7	29.5' - 31'	Sample not recovered	13	--	--	--	--	--	
	S8	35' - 36.5'	Medium dense grey silty sand with some gravel	27	--	--	--	--	--	
6	S1	4' - 5.5'	Stiff grey-brown mottled sandy clay to silty clay with some gravel	24	22.4	--	--	--	138.1	
	T2	9' - 10.5'	Medium grey clay silt	7	20.2	15.4	29.6	1320	132.4	
	S3	14' - 15.5'	Sample not recovered	14	--	--	--	--	--	
	S4	17' - 18.5'	Sample not recovered	7	--	--	--	--	--	
7	S1	4' - 5.5'	Stiff grey-brown mottled silty clay	18	19.6	--	--	--	--	
	S2	9' - 10.5'	Loose brown to orange-brown fine sand	9	--	--	--	--	--	
	S3	14' - 14.3'	Sample not recovered	--	--	--	--	--	--	

SUMMARY OF FIELD & LABORATORY TESTS

JOB F 59 - 80W.P. --

HOLE NO.	SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS FT	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
8	S1	6.3'-6.8'	Sample not recovered	26	--	--	--	--	--	Sens: 7.0 Sens: 2.8
	T2	8.5'-10'	Soft grey silty clay	p	33.0	--	--	--	--	
	VANE	11'		--	--	--	--	1080	--	
	T3	11.2'-12.8'	Soft grey clay	p	34.5	29.3	46.4	756	118.3	
	VANE	13.3'		--	--	--	--	1333	--	
	S4	13.5'-14.8'	13.5'-13.8': Soft grey clay 13.8'-14.3': Very dark-brown organic material 14.3'-14.8': Grey fine sand & gravel	2	--	--	--	--	--	
			S: Denotes Split Spoon Sa. T: Denotes Thin-Walled Shelby Tube p: Denotes Sampler pushed							

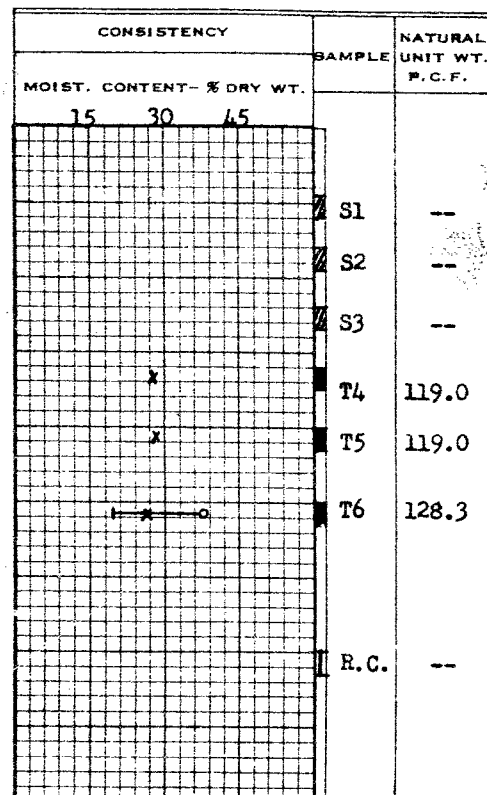
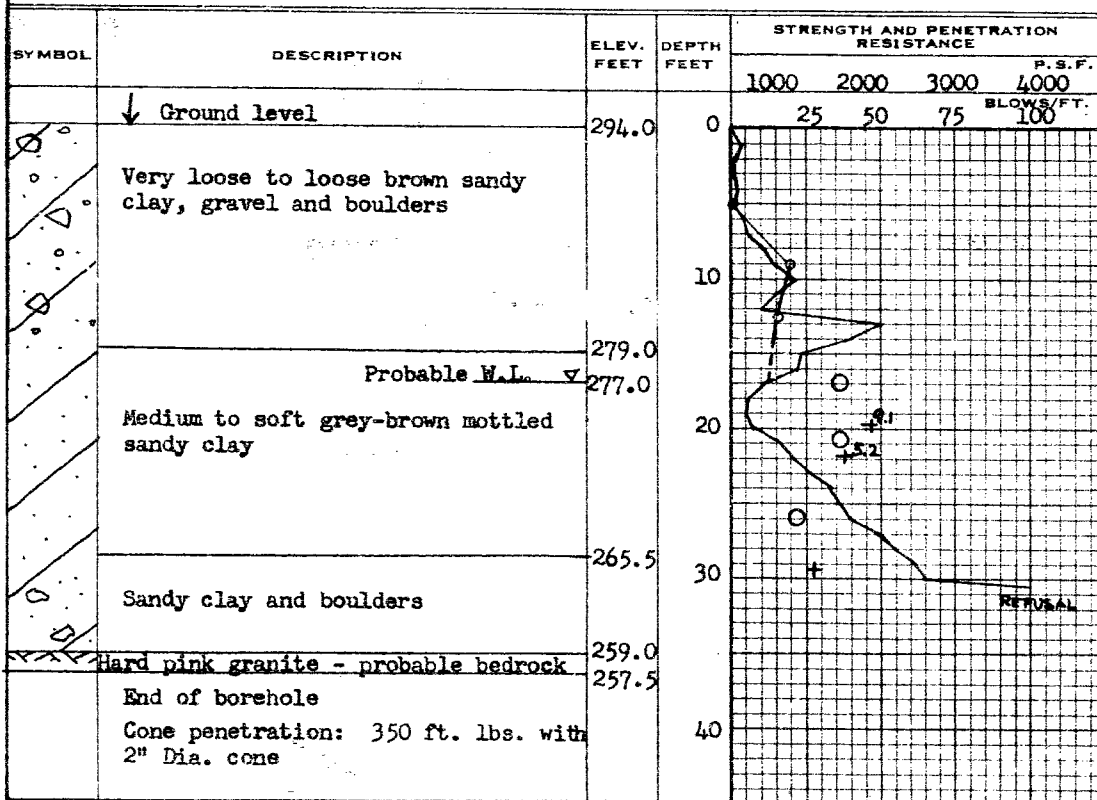
DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS AND RESEARCH SECTIONW.P. --- BORE HOLE NO. 1JOB P 59 - 80 STATION 157+48 (75' IT)DATUM 294.0' COMPILED BY B.K.BORING DATE July 21/59 CHECKED BY B.J.M.

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

LEGEND

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



B.H. 1

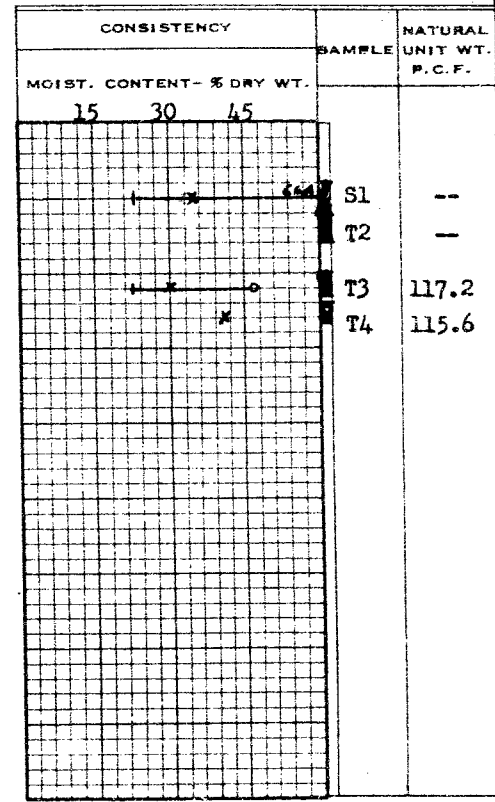
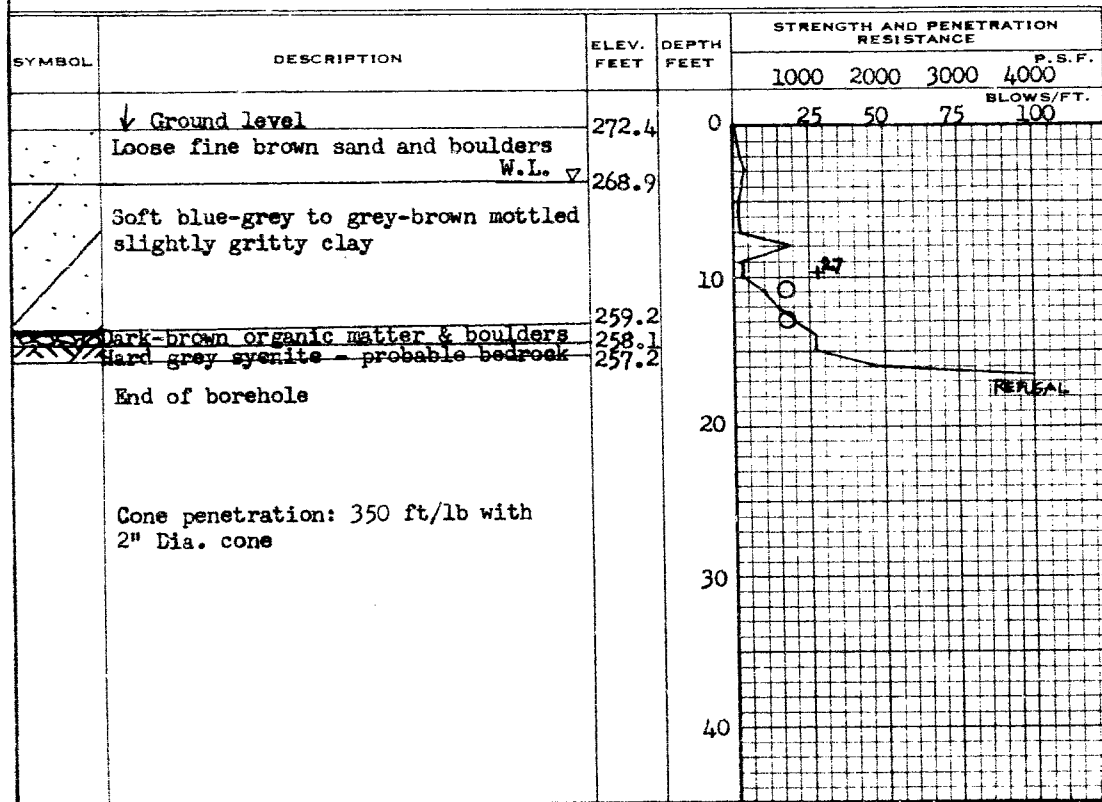
DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. --- BORE HOLE NO. 2
 JOB F 59 - 80 STATION 158/36 (119' LT)
 DATUM 272.4' COMPILED BY B.K.
 BORING DATE July 27/59 CHECKED BY B.J.M.

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

LEGEND

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



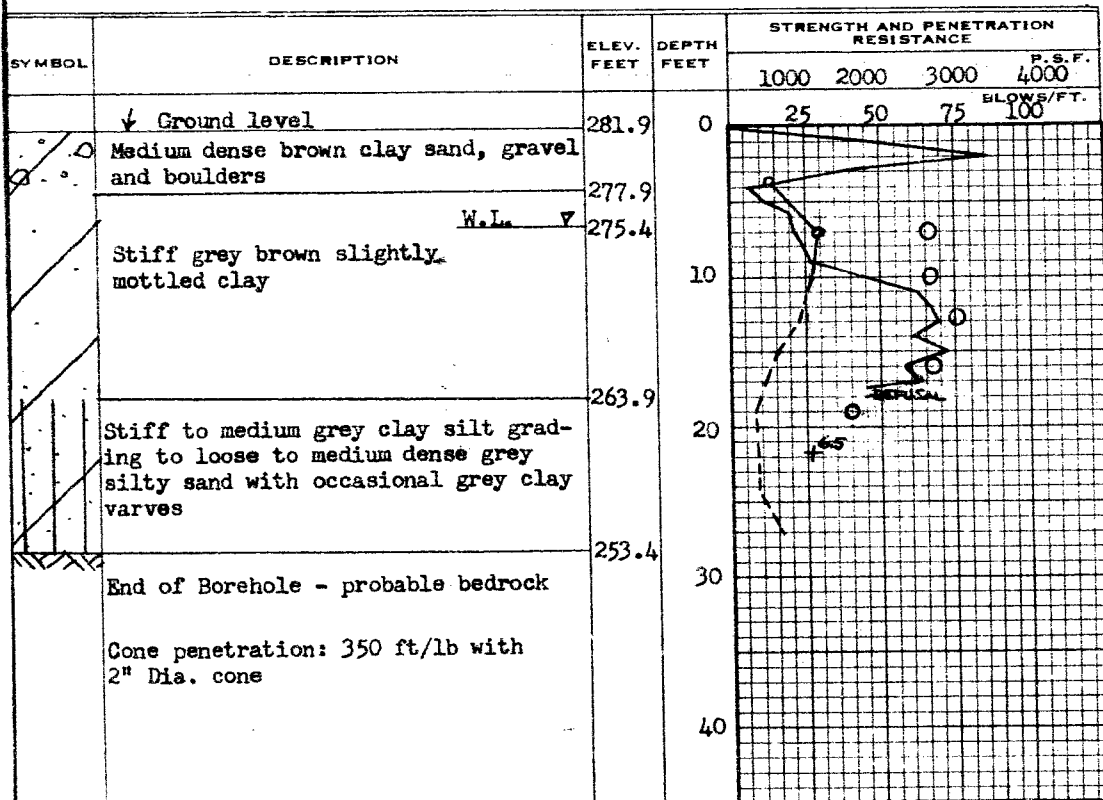
DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. --- BORE HOLE NO. 3
JOB F 52 - 80 STATION 162+88 (92' IT)
DATUM 281.9' COMPILED BY B.K.
BORING DATE July 23/59 CHECKED BY B.J.M.

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 ---



CONSISTENCY			SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT- % DRY WT.				
15	30	45		
			S1	--
			S2	120.7
			T3	128.3
			T4	122.0
			T5	124.0
			T6	132.3
			T7	128.8
			T8	--
			T9	--

B.H. 3

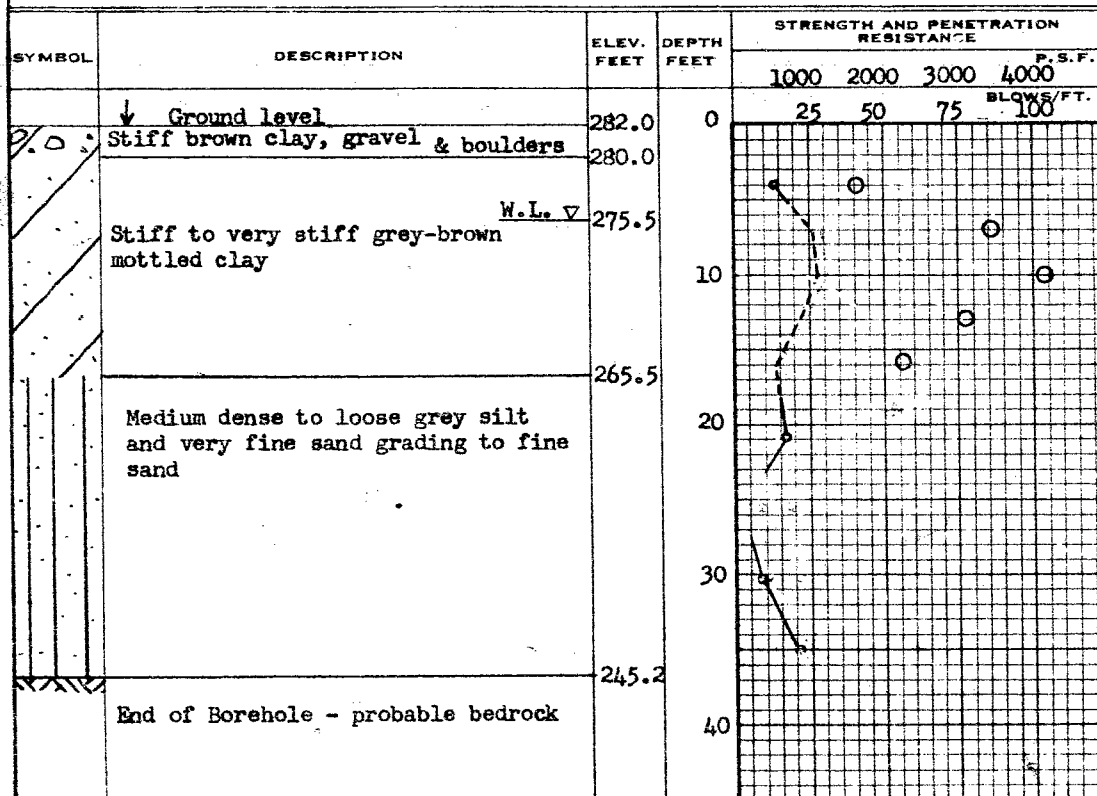
DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. --- BORE HOLE NO. 4
 JOB F 59 - 80 STATION 163+50 (96' IT)
 DATUM 282.0' COMPILED BY B.K.
 BORING DATE July 24/59 CHECKED BY B.J.M.

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 (G) AND SENSITIVITY (S) --- +
 NATURAL MOISTURE AND LIQUIDITY INDEX --- LI
 LIQUID LIMIT --- X
 PLASTIC LIMIT --- I



CONSISTENCY			SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT- % DRY WT.				
15	30	45		
			S1	122.8
			T2	122.4
			T3	124.2
			T4	120.4
			T5	125.6
			S6	--
			S7	--
			S8	--
			S9	--

B.H. 4

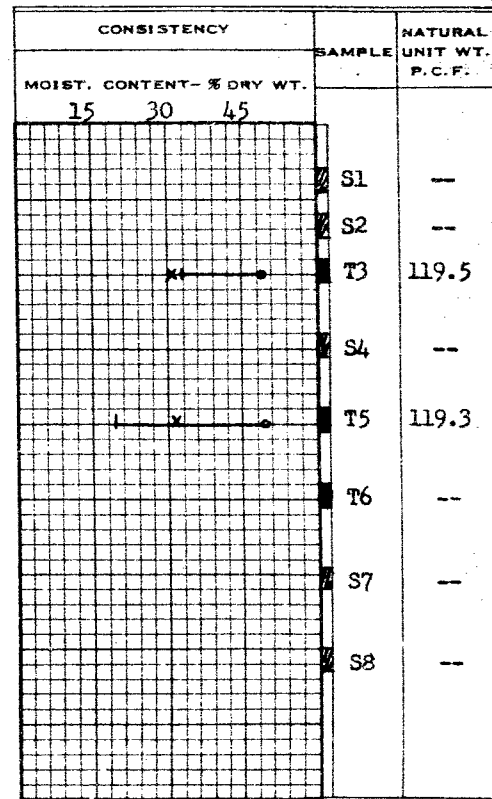
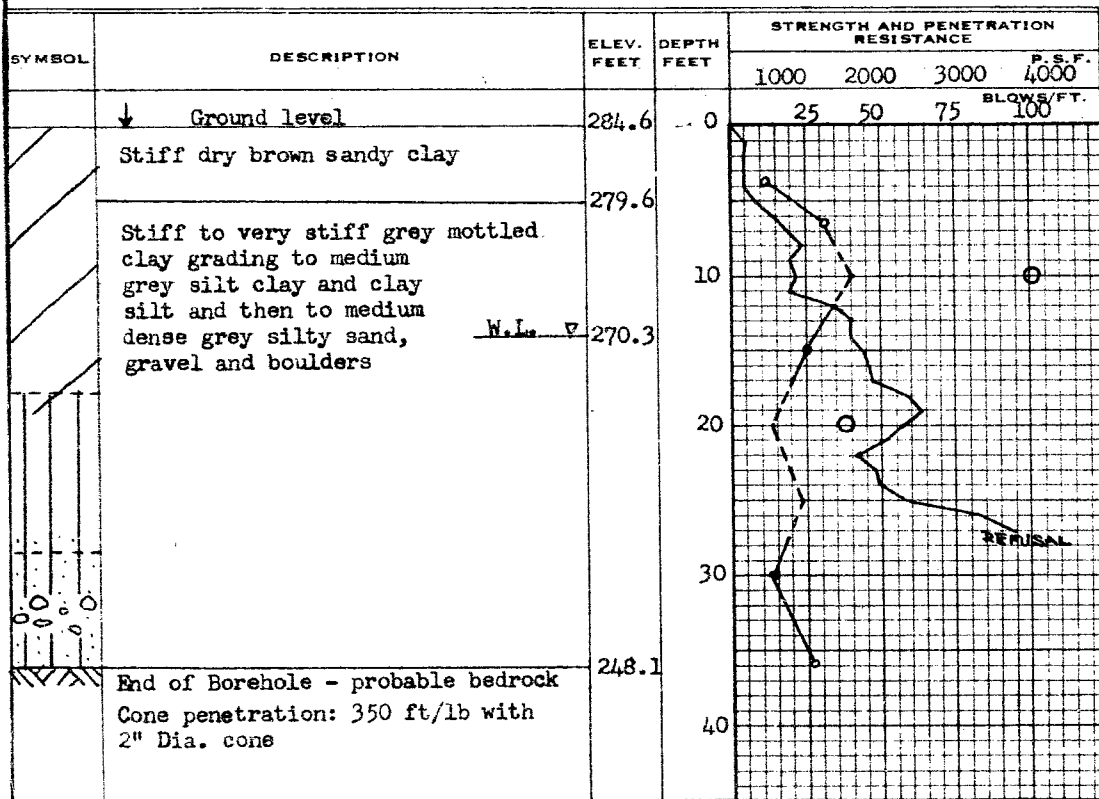
DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. _____ BORE HOLE NO. 5
JOB F 59 - 80 STATION 163+80 (90' RT)
DATUM 284.6' COMPILED BY B. K.
BORING DATE July 27/59 CHECKED BY B. J. M.

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

LEGEND

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



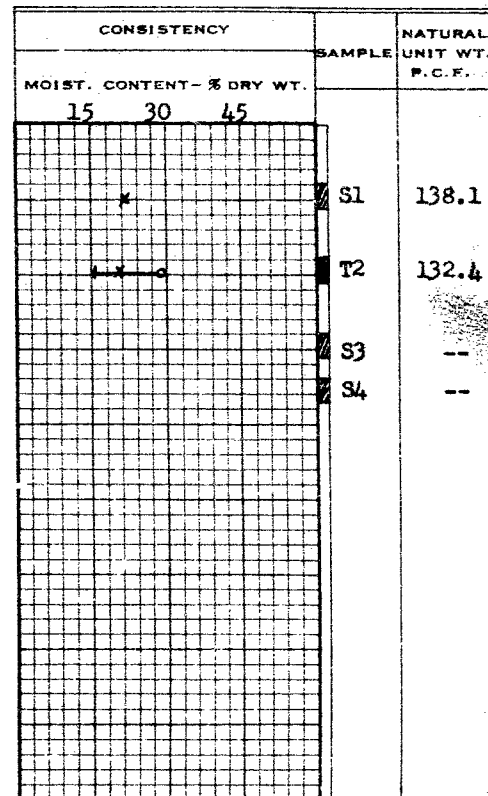
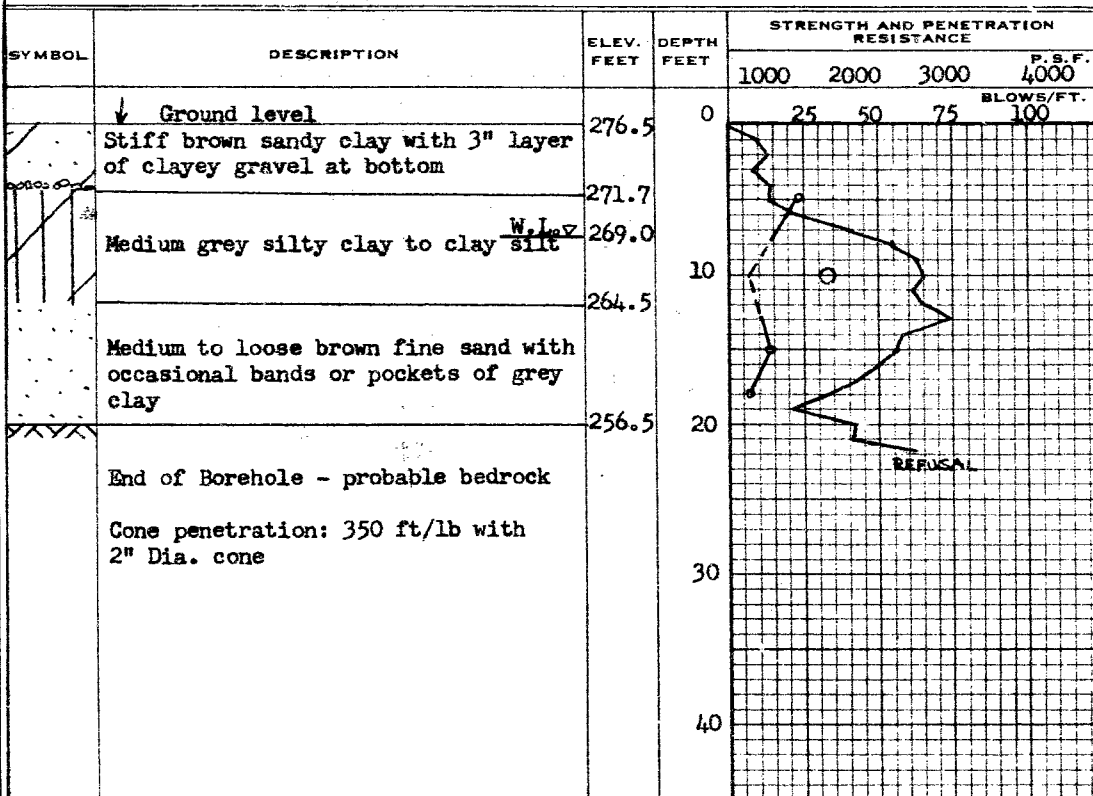
B.H. 5

DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. --- BORE HOLE NO. 6
 JOB P 59 - 80 STATION 158/48 (240' IT)
 DATUM 276.5' COMPILED BY B.K.
 BORING DATE July 28/59 CHECKED BY B.J.M.

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



B.H. 6

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. --- BORE HOLE NO. 7

JOB F 59 - 80 STATION 157+60 (250' LT)

DATUM 274.2' COMPILED BY B.K.

BORING DATE July 28/59 CHECKED BY B.J.M.

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

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE
				P.S.F.
	↓ Ground level	274.2	0	25 50 75 100 B.L.O.W.S./FT.
	Stiff brown to grey-brown slightly sandy mottled silty clay W.L. ↓	269.2 268.2		
	Medium to loose brown to orange-brown fine sand		10	
	fine sand and boulders	261.2 259.7		
	End of Borehole - probable bedrock			

CONSISTENCY	SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.		
15 30 45		
	S1	—
	S2	—
	S3	—

B.H. 7

DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

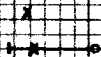
W.P. ----- BORE HOLE NO. 8
 JOB F 59 - 80 STATION 158+46 (119' LT)
 DATUM 271.5' COMPILED BY B.K.
 BORING DATE July 28/59 CHECKED BY B.J.M.

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

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE			
				1000	2000	3000	P.S.F. 4000 BLOWS/FT.
	↓ Ground level	271.5	0				
	Very loose to loose brown fine sand, boulders and gravel <u>W.L.</u>	268.5					
	Soft grey, slightly gritty clay underlain by 7" thick layer of very dark brown organic material and 5" of fine sand, gravel and stones	263.5	10				
	Hard grey syenite - probable bedrock	256.7					
	End of Borehole	255.2	20				
			30				
			40				

CONSISTENCY			SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT- % DRY WT.				
15	30	45		
			S1	—
			T2	—
			T3	118.3
			S4	—

B.H. 8