



WP-194

Memo to Mr. A. M. Tove Date March 28, 1960.
Bridge Engineer. Subject Re: W.P. 194-58 - Campbell
Materials & Research Section. Corners Side Road,
Hwy. 403 - District 4.

Attention: Mr. S. McCombie.

As requested, the foundations for the above proposed structure have been reviewed by the Foundation Section. The review of the foundation report prepared by this Section, indicates that if bearing pressures of 4 T/ft.^2 are used, the clay layer extending from approx. elevation 356' - 346' will be overstressed. It is therefore recommended that the bearing pressure be reduced to 3 T/ft.}^2 for both abutment and pier footings. The footing locations shown on the Preliminary Plan D-4608-A, are satisfactory.

The Preliminary Plan provided to this Section, is enclosed.

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

KP/MdeF
Encl. (1)

(K. Peaker,
FIELD FOUNDATIONS SUPERVISING ENGR

cc: Foundations Office
Gen. Files.



ONTARIO
DEPARTMENT OF HIGHWAYS

BA 941

Memo to Mr. A. M. Toye, Date September 9, 1959.
Bridge Engineer. Subject FOUNDATION REPORT -
From Materials & Research Section. W.P. 194-58 -- W.J. F-59-71.

Attention: Mr. S. McCombie.

Re: Proposed Hwy. #403 & Relocated Gravel Rd.
Between Lots 1 & 2, Approximately 2 Miles
N.E. of Aldershot, Twp. of Flamborough E.,
District #4.

The detailed foundation report for the above site has been prepared by the Foundation Section. Reference to the contents of this report shows a firm to hard layer of clayey till overlying a shale bedrock. The clayey till material is such that spread footings may be used for the support of the proposed underpass structure.

An allowable bearing capacity of 4 tons/sq. ft. may be used in the clay till. Some soft pockets of material were noted on the borehole logs. If excavation reveals that footings would be founded on this soft material, the pockets should be excavated and backfilled with well compacted granular material. It is probable that footings will be founded 5 feet below the grade of Hwy. 403 or elevation 355 ±'.

No problems associated with approach embankments or cuts are to be expected. These should be designed using the standard 2:1 slope.

Ground water entering open excavations should be of limited quantity and easily handled by low capacity pumps.

If further information is required with respect to the contents of this report, please contact our office.

KP/MdeF
Encl.

cc: Messrs. A. M. Toye
H. A. Tregaskes
D. G. Ramsay
J. Ford
R. E. Richardson
P. F. Weber
A. Watt
Foundation Section
Gen. Files.

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

[Signature]
(K. Peaker,
FOUNDATION FIELD SUPERVISING ENGR.)

FOUNDATION REPORT

on

Proposed Hwy. #403 & Relocated Gravel Rd.
Between Lots 1 & 2, Approximately 2 Miles
N.E. of Aldershot, Twp. of Flamborough E.,
District #4.

Site Plan No: 59-71A

Profile No: F 2407-27

Chainage: Sta. 125+39.27

Distribution:

Mr. A. M. Teye, Bridge Engineer.	(2)
Mr. H. A. Tregaskes, Construction Engineer.	(1)
Mr. D. G. Ramsay, Rd. Design Engineer.	(1)
Mr. J. Ford, Project Design Engr.	(1)
Mr. R. E. Richardson, District Engr., Hamilton.	(1)
Mr. P. F. Weber, Regional Soils Engineer.	(1)
Mr. A. Watt, Ontario Water Resources Commission.	(1)
Foundation Section.	(1)
Gen. Files.	(1)

W.J. F-59-71

W.P. 194-58

INTRODUCTION:

Presented in this report are the results of an investigation carried out to determine the competence of the subsoil material at the site of a proposed underpass located approximately 2 miles N.E. of Aldershot. At this location the proposed Hwy. #403, Line 'B' crosses the gravel road between Lots 1 & 2 in Con. I, Twp. of Flamorough East (Sta. 125+39.27, Profile No. - F 2407-27).

The field work commenced on July 8th, 1959 and was completed on July 14th, 1959.

DESCRIPTION OF THE SITE & GEOLOGY:

The site is on the Niagara escarpment which extends from the Niagara River to the tip of Bruce Peninsula. In this section the escarpment is cut by numerous small creeks. On the North side of the site a rather broad belt of shale is exposed and the long lower slopes of the escarpment are highly eroded. According to the available geological information, it is the valley of the pre-glacial river which joined the basins of Lake Erie and Lake Ontario.

The site is located on a steep grade sloping from North to South. Approximately 12 ft. difference in elevation is noted from one side of the site to the other. The area in the vicinity of the site is mainly pasture with a few scattered fruit trees. A small creek running from North-West to South-West is dry.

cont'd. /2 ...

DESCRIPTION OF FIELD & LABORATORY WORK:

The investigation consisted of 4 boreholes carried out by a skid-mounted core-drill machine adapted for soil sampling. Conventional wash boring procedures were followed and samples were recovered at depths required. Samples were obtained by means of 2" I.D. thin-walled Shelby tube sampler and 2" O.D. split barrelled spoon sampler. The dimensions of this spoon sampler and the energy used in driving it, conform to the requirements of the Standard Penetration Test. Bedrock was proven by drilling 5 ft. using an AXT core bit and the core was retained in a 5-ft. double tube core barrel.

In addition to the sampled boreholes, dynamic cone penetration tests were carried out adjacent to each hole.

Upon receipt in the laboratory, samples were visually examined and identified. Routine index tests were carried out on selected representative samples. Rock core samples were carefully examined to determine the quality and soundness of the rock.

Laboratory and field test results have been summarized in Table No. I and are included in this report under Appendix I.

Drawing No. F 59-71A shows the borehole locations and the estimated subsoil stratigraphy.

SUBSOIL CONDITIONS:

The site is underlain by Queenston shale bedrock covered by a thick layer of hard silty clay.

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

In each of the sampled boreholes, the topsoil was found to be underlain by silty clay to clay. This stratum extends approximately 35 ft. below the existing surface. Underlying this stratum and immediately overlying the shale bedrock, a thin layer of red clay with gravel and fragments of shale was encountered.

Bedrock was drilled and cored in order to determine its quality and soundness.

In the order of stratigraphic succession, the following soil types are defined:-

1. Hard Stiff Clayey Glacial Till:

The layer of silty clay was found to be continuous over the site. The upper zone has been subjected to oxidation resulting in its present brownish colour. Below the oxidized zone, the colour is predominantly grey. The hard silty clay contains 32% silt, 22% sand, and 11% gravel. The average unit weight and moisture content were found to be 145 p.c.f. and 17%. Standard Penetration tests carried out during sampling, gave 'N' values varying from 41 to 138 blows.

Underneath the layer of hard silty clay a stratum of stiff clay was encountered. The colour is predominantly reddish grey with an average unit weight of 135 p.c.f. Its consistency is defined by a moisture content of 16%, liquid and plastic limits of 25% and 15%, respectively. The average 'N' value was found to be 60 blows. The bedrock was encountered immediately below the clay stratum.

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

2. Bedrock:

The bedrock consists of Queenston shale of upper Ordovician age. The formation consists of interbedded red and grey shale. The top 6" of the bedrock is medium soft. The shale is in a sound condition with no signs of weathering or fracture. Bedrock is at Elev. 333.7' in Boring 1; Elev. 339.2' in Boring 2; Elev. 339.3' in Boring 3, and at Elev. 334.4' in Boring 4. From the elevations of bedrock, surface is sloping in a South-Westerly direction.

WATER CONDITIONS:

Due to low permeability of the clayey subsoil existing at the site, precise ground water table elevations were not established during the boring and sampling operations. No artesian conditions or water-bearing sand seams were encountered. The material is saturated throughout and the ground water table elevation is considered to be slightly below existing ground surface.

FOUNDATION CONSIDERATIONS:

Reference to the borehole logs appended to the report, shows that the subsoil conditions at the site consist of shale bedrock overlain by very hard clay till varying from 30 to 35 feet in thickness. The stiff to hard nature of the upper layers of till will enable spread footings to be used for the foundations of the proposed structure. A bearing pressure of 4 tons/sq. ft.

cont'd. /5 ...

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

may be used for footings founded in the silty clay till. Since the grade of Hwy. 403 is indicated at elevation 360.2', it is probable that the footings for the proposed underpass structure will be 5 feet below this point or approx. elevation 355'.

During the foundation investigation a pocket of soft material was encountered near elevation 351' in borehole No. 2. All such pockets should be removed and backfilled with compacted gravel before placing the footings.

At elevation 355' protection from frost for the footings will be adequate. Settlements arising from bearing pressures of 4 tons/sq. ft. on footings placed near elevation 355' will be negligible.

No problems associated with embankment stability will be encountered at this site. Side slopes for cuts in this material should be 2 horizontal to 1 vertical. The cut slope of 2:1 is recommended since softening of the exposed till may result in local movements of the slopes if much steeper sides are used.

No problem with water in the excavations is anticipated due to the impermeable nature of the clayey till. Small sump pumps should handle all water entering the excavations.

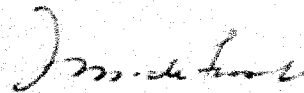
CONCLUSIONS & RECOMMENDATIONS:

- (1) The site is underlain by red Queenston shale covered by a thick crust of hard stiff clayey glacial till.

cont'd. /6 ...

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

- (2) It is recommended that footings be founded in the cohesive layer approximately 5 ft. below the profile grade of the proposed Hwy. 403, and that a bearing pressure of 4 tons/sq.ft. be used.
- (3) No ground water problems with respect to footing excavation, are anticipated. Total and differential settlements should be negligible.
- (4) The proposed grade line does not present any approach fill stability problems.



^{for} M. Devata,
Project Foundation Engineer.

APPENDIX I.

SUMMARY OF FIELD & LABORATORY TESTS

JOB F 59 - 72

W P 124 - 58

HOLE NO	SAMP NO	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENETN RESIST BLOW/FT	MOIST CONT %	PLASTIC LIMIT %	LIQUID LIMIT %	SATUR STRENGTH (PSF)	UNIT WEIGHT (PCF)	REMARKS
1	S1	3'-4.5'	Dense brown silty clay with sand and gravel	54	13.0	--	--	--	129.7	
	S2	6'-7.5'	Dense dark brown silty clay with gravel	75	11.9	16.7	28.6	--	--	
	S3	9'-10.5'	Dense greyish brown silty clay with gravel	76	16.4	--	--	--	--	
	S4	13.5'-15'	Dense grey silty clay with gravel	70	16.5	17.0	26.8	--	148.8	
	S5	20'-21.5'	Dense grey clay with gravel	111	12.2	--	--	--	--	
	S6	28'-29'	Dense red clay with gravel	112	8.1	--	--	--	--	
	R7	30'-35'	Soft to hard shale	--	--	--	--	--	--	
2	S1	3'-4.5'	Dense brown sandy silty clay	116	11.7	--	--	--	156.2	
	S2	6'-7.5'	Dense brown silty clay with gravel	138	12.1	16.8	30.6	--	--	
	S3	10'-11.5'	Greyish brown silty clay with gravel	64	20.7	--	--	--	143.2	
	S4	15'-16.5'	Dense brown clay with gravel	60	13.7	--	--	--	--	
	S5	20'-21.5'	Stiff greyish brown clay with gravel	32	14.0	14.2	19.2	--	131.9	
	T6	23'-24.5'	Stiff greyish brown clay with gravel	P	17.6	--	--	2235	133.5	
	T7	27'-28.5'	Dense grey clay with gravel	9"-P	15.5	--	--	1815	138.8	
				9"-27						
	S8	30'-31.5'	Dense red clay with gravel	118	--	--	--	--	--	
	R9	37'-42'	Red and grey shale	--	--	--	--	--	--	
3	S1	5'-6.5'	Dense brown silty clay with sand	72	17.3	--	--	--	--	
	S2	10'-11.5'	Dense brown sandy silty clay	67	18.4	16.4	31.4	--	151.0	
	S3	15'-16.5'	Dense brown clay with gravel	59	15.4	--	--	--	--	
	T4	20'-21.5'	Dense grey silty clay with gravel	44	15.7	14.7	24.1	4870	138.4	
	T5	25'-26.5'	Dense greyish brown silty clay	32	15.0	--	--	2290	135.1	
	T6	30'-31.0'	Dense grey silty clay with gravel	77	12.9	--	--	8500	142.6	
	R7	37.5'-42.7'	Red and grey shale	--	--	--	--	--	--	

SUMMARY OF FIELD & LABORATORY TESTS

JOB F 52 - 71

W.P. 194 - 58

HOLE NO.	SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENETW RESIST. BLOWS/FT	MOIST CONT. (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	SHEAR STRENGTH (PSF)	UNIT WEIGHT (PCF)	REMARKS
4	S1	5'-6.5'	Dense brown silty clay with gravel	76	12.8	--	--	--	141.0	
	S2	10'-11.5'	Dense brown silty clay with gravel	104	15.7	--	--	--	--	
	T3	15'-16.5'	Dense grey silty clay with gravel	41	15.7	16.1	27.3	5180	139.0	
	T4	20'-21.5'	Dense grey clay with gravel	58	15.0	--	--	2740	139.0	
	S5	25'-26.5'	Dense red clay with gravel	150	8.9	--	--	--	--	
	R6	32'-37'	Red and grey shale	--	--	--	--	--	--	
			S Denotes Split spoon T Denotes Thin Walled Shelby tube R Denotes Rock core							

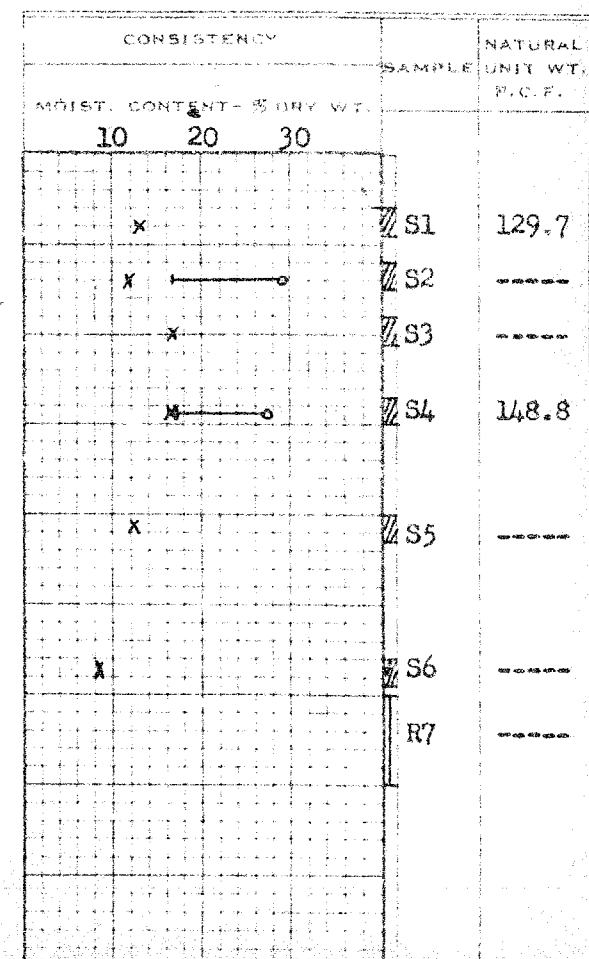
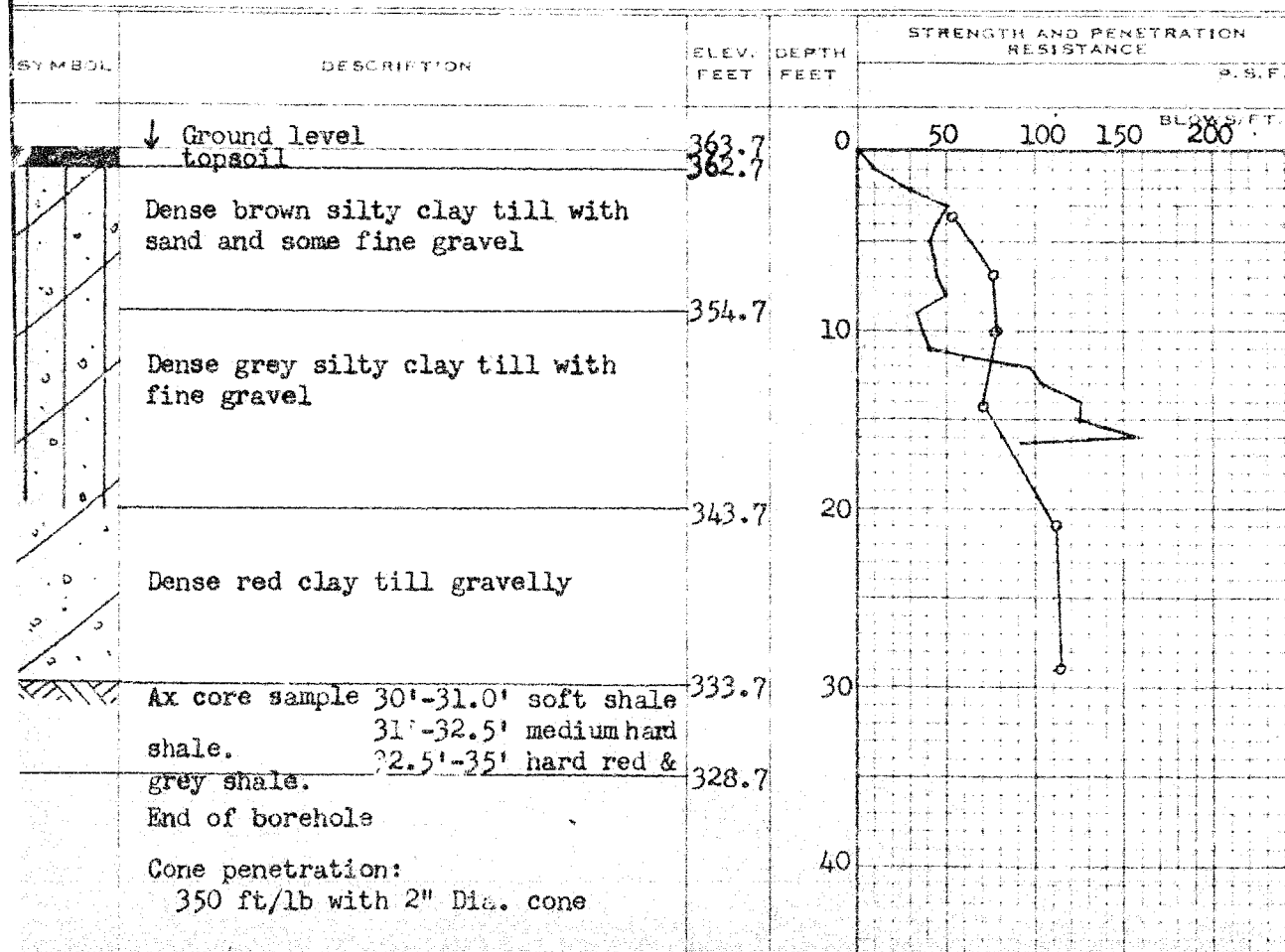
DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. 124 - 58 BORE HOLE NO. 1
 JOB F. 59 - 71 STATION 125 + 29 (60' LT)
 DATUM 363.7' COMPILED BY B.K.
 BORING DATE July 8/59 CHECKED BY M.D.

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



MATERIALS AND RESEARCH SECTION

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

UNCONFINED COMPRESSION (Qu) _____	0
VANE TEST(C) AND SENSITIVITY(S) _____	+5
NATURAL MOISTURE AND	
LIQUIDITY INDEX _____	X
LIQUID LIMIT _____	
PLASTIC LIMIT _____	

CONSISTENCY		NATURAL	
MOIST. CONTENT - % DRY WT.		UNIT WT. P.C.F.	
10	20	30	
x			S1 156.2
x	—○—		S2 -----
	x		S3 143.2
x			S4 -----
x —○—			S5 131.9
	x		S6 133.5
x			S7 138.8
			S8 -----
			R9 -----

Cone penetration: 350 ft/lb with 2" Dia. cone

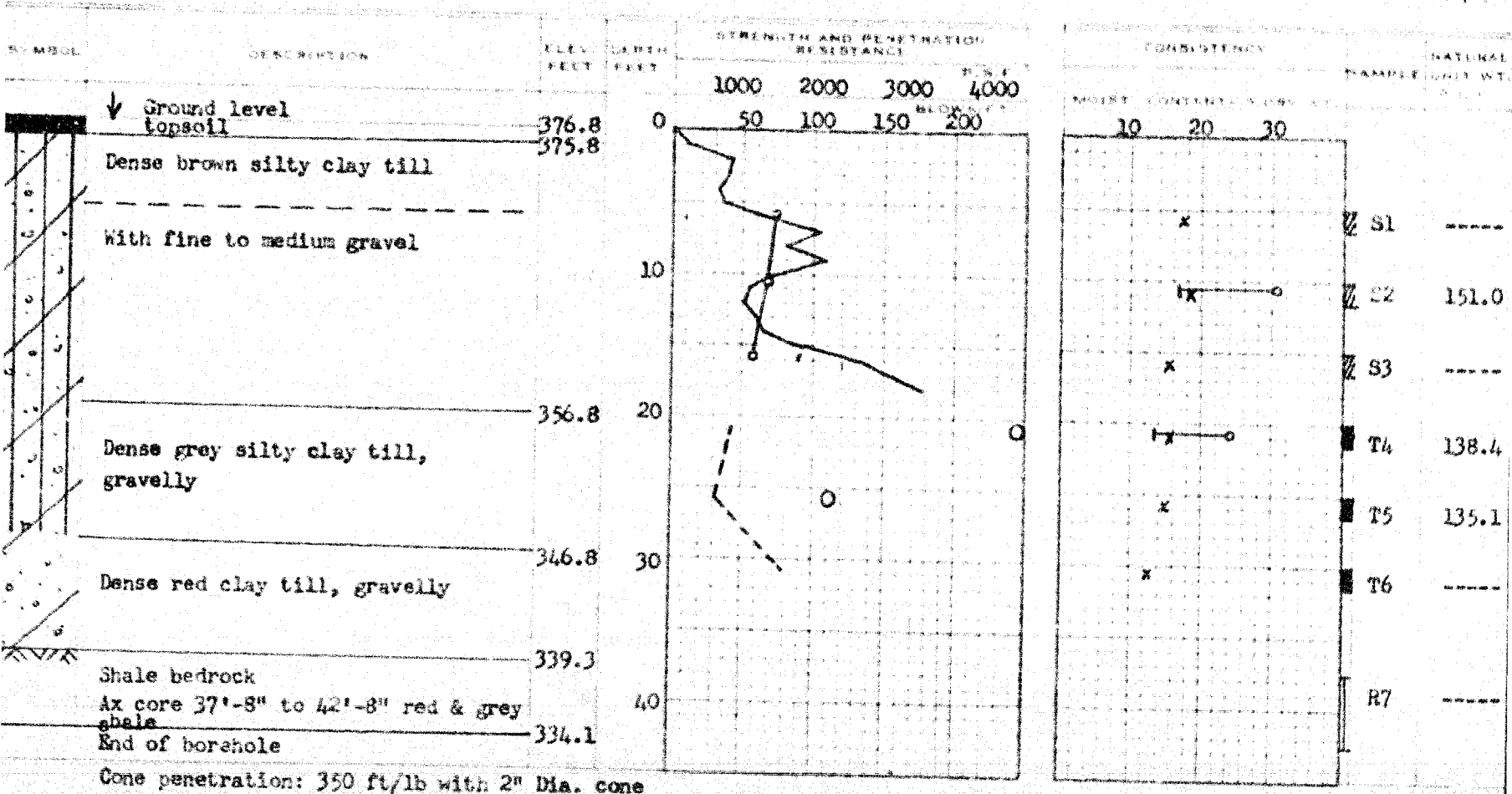
DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. 194 - 58 BORE HOLE NO. 3
JOB E 59 - 71 STATION 125 + 61 (60' RT)
DATUM 376.8' COMPILED BY B.K.
BORING DATE July 13/59 CHECKED BY M.D.

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

LEGEND

UNCONFINED COMPRESSION (QU) (O)
VANE TEST (C) AND SENSITIVITY (S) (V)
NATURAL MOISTURE AND LIQUIDITY INDEX (X)
LIQUID LIMIT (L)
PLASTIC LIMIT (P)



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS AND RESEARCH SECTION

W.P. 194 - 58 BORE HOLE NO. 4

JOB F59 - 71 STATION 125/69 (60' LT.)

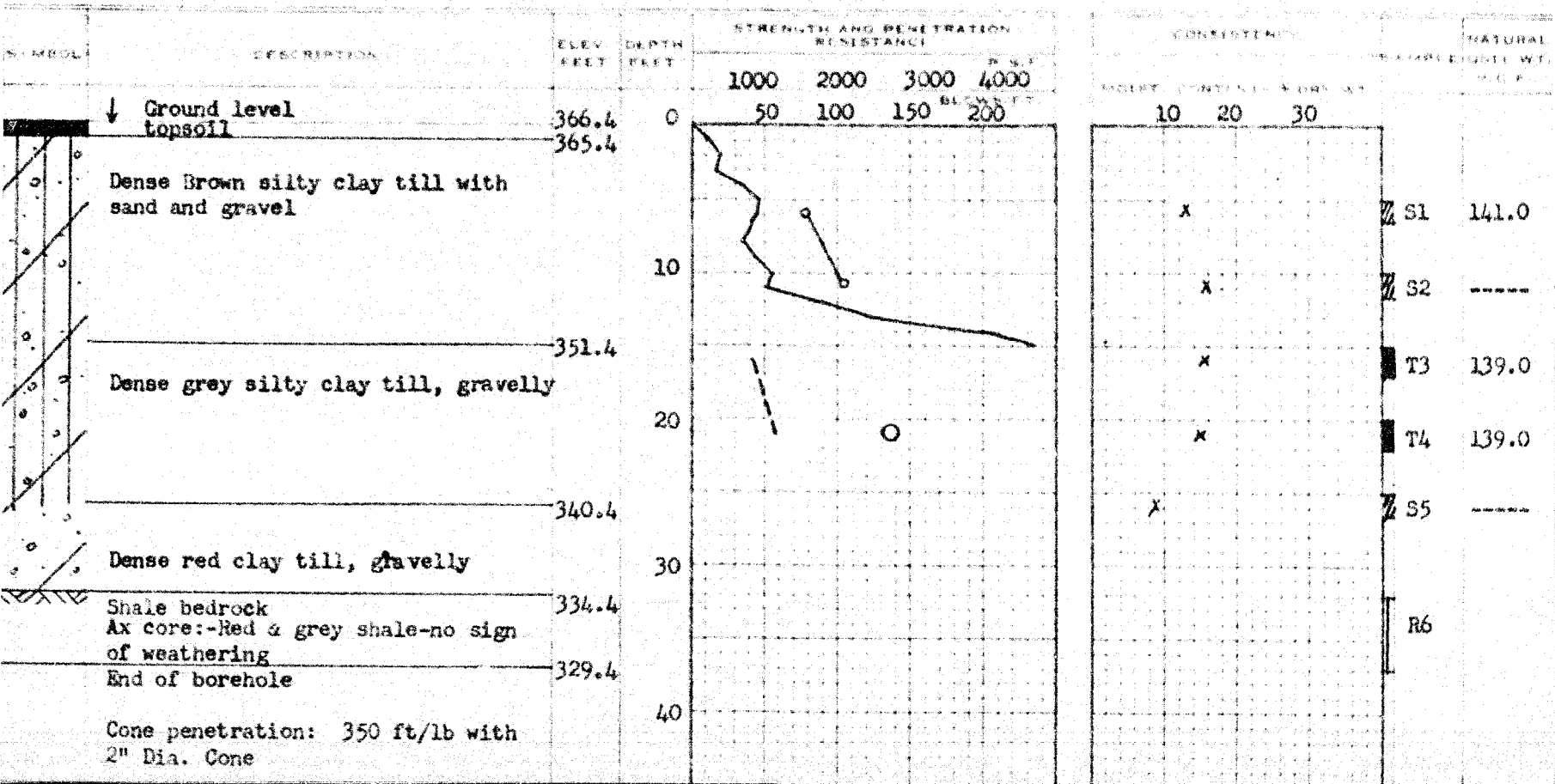
DATUM 366.4' COMPILED BY B.K.

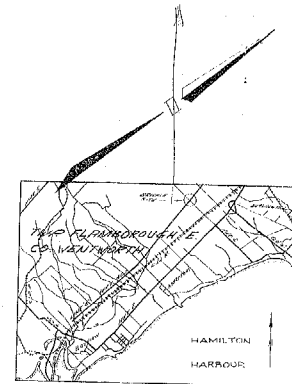
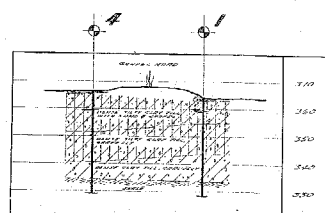
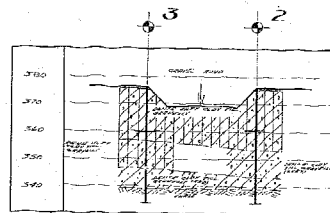
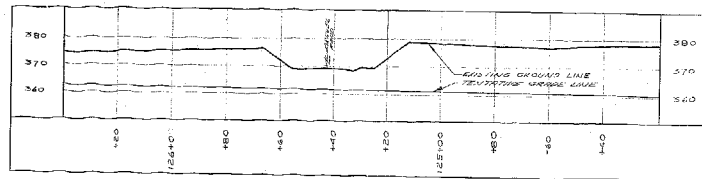
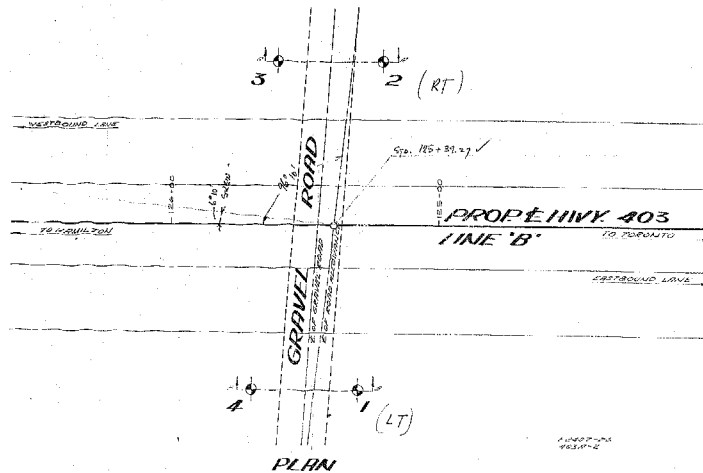
BORING DATE July 13/59 CHECKED BY H.D.

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

LEGEND

UNCONFINED COMPRESSION (QU) O
 VANE TEST (C) AND SENSITIVITY (S) S
 NATURAL MOISTURE AND LIQUIDITY INDEX LI
 LIQUID LIMIT V
 PLASTIC LIMIT P





LEGEND				
GRAVEL ROAD				
PROPOSED HWY 403				
EXISTING GROUND LINE				
STATION	ELEVATION	STATION	ELEVATION	STATION
1	359.7	125+40	359.7	
2	376.0	125+40	359.7	
3	376.0	125+40	359.7	
4	354.7	125+40	359.7	

NOTE
THE BOUNDARY BETWEEN THE GRAVEL ROAD AND THE EXISTING GROUND LINE IS SHOWN ONLY AT THE END LOCATIONS. BETWEEN THE GRAVEL ROAD AND THE EXISTING GROUND LINE, THE BOUNDARY IS ASSUMED TO BE THE GRAVEL ROAD LINE AND MAY BE SUBJECT TO CONSIDERABLE ERROR.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION

**GRAVEL ROAD
PROPOSED CROSSING**

SHOWING POSITIONS & ELEVATIONS OF PILES

PROJECT NO.	DATE	DESIGNED BY	CHECKED BY	APPROVED BY
THIRTY-THREE	1971	THIRTY-THREE	THIRTY-THREE	THIRTY-THREE
LOCATION	DATE	DESIGNED BY	CHECKED BY	APPROVED BY
THIRTY-THREE	1971	THIRTY-THREE	THIRTY-THREE	THIRTY-THREE
DATE	DESIGNED BY	CHECKED BY	APPROVED BY	THIRTY-THREE
DATE	DESIGNED BY	CHECKED BY	APPROVED BY	THIRTY-THREE

F59-71A