

Mr. F. E. Cavell,
Superintendent of
Special Services Section.

February 17, 1960.

D.H.O. FOUNDATION INVESTIGATION

Materials & Research Section.

W.J. F-59-122.

Attention: Mr. J. Hamilton.

Re: Proposed D.H.O. Garage & Patrol Yard
at Cumberland -- District No. 9.

A detailed foundation investigation at the above site has been completed by the Foundation Section. For your convenience, the results of this investigation are summarized as follows:-

1. The proposed site is underlain by a 50-ft. layer of stiff silty marine clay overlying a limestone bedrock.
2. Spread footings may be used to support the proposed structures. The spread footings should be designed for a bearing pressure of 2 7/ft.². A 5-foot footing depth will be required for frost protection.
3. At the request of the Building Section, a water well was drilled at the proposed site. The well was founded at a depth of 56 feet where a pumping capacity of in excess of 10 g.p.m. was established.
4. Granular base, and pavement for service roads and parking areas should be constructed as recommended in the Foundations report.

If we can be of further assistance in connection with this investigation, please contact the Foundation Section.

KP/MaeF
Attach.

cc: Messrs. F. E. Cavell (2)

H. A. Tregaskes

H. D. McMillan

C. Tackaberry

L. E. Walker

J. E. Gruspier

Foundation Section ✓

Gen. Files.

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

R. Peaker
(R. Peaker,
FOUNDATIONS FIELD SUPERVISING ENGR.

D.H.O. GARAGE & PATROL YARD
AT CUMBERLAND
W.J. F-59-122 -- DISTRICT #9.

Presented in this report are the results of a foundation investigation carried out at the above site. The site was the proposed D.H.O. Garage & Patrol Yard on the N. side of Hwy. #17, approx. 1.5 miles E. of Cumberland.

DESCRIPTION OF SITE:

The site is located in a physiographic area known as the Ottawa Clay Plain. The clay in this area is a very sensitive marine clay known as "Leda" clay. The proposed location is situated in an area of gently rolling farmland. The site is bordered on the E. and W. by wooded ravines which run from the highway down toward the Ottawa River (immediately N. of the property).

Each of these ravines contains a small creek which drains into the Ottawa River.

DESCRIPTION OF FIELD WORK:

The field work which consisted of 5 boreholes, supplemented by dynamic cone penetration tests was carried out during the period from December 10 to December 22, 1959.

The sampling was carried out by a skid-mounted core drill machine adapted for soil sampling.

Conventional wash boring procedures were employed and samples were recovered at depths required. Samples were obtained using 2" ϕ thin walled Shelby tubes.

Sampling in B.H. #1, 2, 3, & 5, was carried out to depths of approx. 20 ft. with B.H. #4 sampled to 50 ft.

In each borehole, cones were driven from the depth at which sampling was discontinued to refusal depth (100 blows/12").

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

Field shear strength values were obtained where possible, from in-situ vane tests.

At the time of the investigation, no drawing showing the proposed location of the buildings was available. Consequently, the site was divided into a grid and borings located using the grid as a guide (see Dwg.).

All elevations are based on an assumed elevation of 200.0' for a temporary Bench Mark located on the property. This Bench Mark was established by the Department to facilitate a survey of the site.

The Bench Mark is a nail in a root of an 18" tree located approx. 175' N.W. of the well.

SUBSOIL CONDITIONS:

The predominant material at the site is a silty, sensitive marine clay known as "Leda" clay. This strata extends to a depth of approx. 55' where a thin layer of gravel overlies bedrock.

The stiff upper crust is a brown oxidized silty clay extending to an approx. depth of 15'.

The clay then changes to a firm, dark grey sensitive silty clay extending from the lower limits of the upper crust to the thin layer of gravel which overlies bedrock.

(1) From Ground Level to approx. 15.0' -

Average properties for this material are as follows:-

Moisture Content.....	= 43.5%
Plastic Limit	= 29.1%
Liquid Limit	= 66.3%
Unit Weight	= 110.7 p.c.f.
P.I.	= 37.2%
Average Shear Strength ...	= Approx. 1200 p.s.f.

cont'd. /3 ...

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

(2) From 15.0' to approx. 55.0' -

The average properties are as follows:-

Moisture Content	= 60.6%
Plastic Limit	= 27.0%
Liquid Limit	= 62.5%
Unit Weight	= 102.5 p.c.f.
P.I.	= 35.5%
Average Shear Strength	= Approx. 1500 p.s.f.

A consolidation test was carried out on the material which will be influenced by the footing loads.

The results of this test indicate that this material has been preconsolidated to a load of 3 t.s.f.

Since the footing loads will not exceed the preconsolidation load, settlements will be small.

WATER CONDITIONS:

Measurements carried out during the exploration programmes indicate ground water level is encountered at depths from 1 - 5' below ground level.

At the request of the Building Section, a well was drilled on the property to determine if water was present and the quantity of water available.

The well was sunk through clay to approximately 56', where a water-bearing stratum of coarse sand and gravel overlying bedrock, was encountered.

The recommended pumping rate for this well is 10 g.p.m. with a pumping level of 30'.

cont'd. /4 ...

FOUNDATION CONSIDERATIONS & RECOMMENDATIONS:

- (1) Spread footings are recommended placed at a minimum depth of 5' and will support 2 t.s.f.
- (2) Settlements will be in the order of 1 - 2" with 50% settlement in 1 year and 90% settlement occurring in approx. 4 years.
- (3) Since the excavation will go to approx. 3' below ground water level, some seepage may be encountered. This seepage will be of a very minor nature and can be easily handled by low-capacity pumps.
- (4) If the ground at the bottom of the footings is wet, it is recommended that a thin concrete pad be placed immediately after excavation to prevent softening of the underlying material and to ensure a dry surface on which to pour the footings.

SERVICE ROADS:

In the area of service roads, parking lots, etc., the topsoil should be stripped and replaced with an 18" layer of G.B.C. "B" or sand cushion, and topped with 6" of G.B.C. class "A".

A 3 1/2" thickness of H.L.-4 is recommended, for all paved areas. This should be comprised of a 2" base course and a 1 1/2" wearing surface.

cont'd. /5 ...

CONCLUSIONS & RECOMMENDATIONS:

- (1) Spread footings placed at a minimum depth of 5' will be capable of supporting 2 tons/ft.².
- (2) Settlements will be of the order of 1 - 2".
- (3) Water seepage into the excavation should be of a minor nature and can be handled by a low-capacity pumping system. If the ground at the bottom of the footings is wet, it is recommended that a thin concrete pad be placed immediately after excavation to prevent softening of the underlying material and ensure a dry surface on which to pour the footings.
- (4) A suitable well with a capacity of 10 g.p.m. is on the site.
- (5) For service roads and parking lots, topsoil should be stripped and replaced with 18" of G.B.C. class "B" or sand cushion, topped with 6" of G.B.C. class "A". For all paved areas, a 3 1/2" thickness of H.L.-4 is recommended. This should be comprised of a 2" base course and a 1 1/2" wearing surface.

G. G. Cherrington
G. G. Cherrington,
FOUNDATION PROJECT ENGR.

APPENDIX I.

SUMMARY OF FIELD & LABORATORY TESTS

JOB F 59-122

W.P. Garage

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	T1	3'-4.5'	Stiff brown silty clay (marine clay)	14	34.3	29.7	58.8	-	117.0	
	T2	6'-7.5'	Stiff grey brown silty clay (marine clay)	11-7"	42.8	-	-	2085	112.1	
	T3	9'-10.5'	Firm to stiff grey brown silty clay (marine clay)	P	58.8	27.8	67.5	-	104.9	
	VANE	12'	Firm to stiff grey brown silty clay (marine clay)	-	-	-	-	1680	-	Sens: 14.0
	T4	15'-16.5'	Firm to stiff dk. grey silty clay (marine clay)	P	59.0	-	-	-	103.2	
		18'	Firm to stiff dk. grey silty clay (marine clay)	-	-	-	-	1920	-	Sens; 4.8
	T5	20'-21.5'	Firm to stiff dk. grey silty clay with shells and organic material (marine clay)	P	53.0	25.9	60.0	-	104.3	
	VANE	23'	Firm to stiff dk. grey silty clay (marine clay)	-	-	-	-	2000	-	Sens: -
2	T1	4'-5.5'	Stiff brown silty clay with seams of very fine sand. silty (marine clay)	75-9"	34.9	-	-	-	-	
	T2	8'-9.5'	Stiff grey-brown clay with black specks (marine clay)	P	46.2	-	-	2115	108.5	
	VANE	11'	Stiff grey brown silty clay (marine clay)	-	-	-	-	>2000	-	
	T3	15'-16.5'	Firm dk. grey silty clay (marine clay)	P	66.5	29.7	69.8	1010	100.2	

SUMMARY OF FIELD & LABORATORY TESTS

JOB F 59-122

W.P. Garage

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
	VANE	18'	Stiff dk. grey silty clay (marine clay)	-	-	-	-	>2000	-	
	T4	20'-21.5'	Stiff dk. grey silty clay with shells and organic material (marine clay)	P	62.5	-	-	-	104.2	
	VANE	23'	Stiff dk. grey silty clay (marine clay)	P	-	-	-	2160	-	Sens: 6.0
3	T1	3'-4.5'	Stiff brown silty clay (marine clay)	15-10'	35.6	-	-	-	116.2	
	T2	6'-7.5'	Stiff brown silty clay with fine seams of very fine sand and tiny black specks. (marine clay)	6-9"	39.1	-	-	-	113.2	
	13	9'-10.5'	Stiff grey brown silty clay (marine clay)	P	51.3	26.9	65.2	-	105.8	
	VANE	12'	Firm grey silty clay (marine clay)	-	-	-	-	1440	-	Sens: 8.0
	T4	15'-16.5'	Firm dk. grey silty clay (marine clay)	P	64.0	-	-	1340	102.3	
	VANE	18'	Stiff dk. grey silty clay (marine clay)	-	-	-	-	2160	-	Sens: 6.8
	T5	20'-21.5'	Stiff dk. grey silty clay (marine clay)	P	66.0	-	-	-	101.5	
	VANE	23'	Stiff dk. grey silty clay (marine clay)	-	-	-	-	1920	-	Sens: 8.7

SUMMARY OF FIELD & LABORATORY TESTS

JOB F 59-122

W.P. Garage

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	T1	3'-4.5'	Stiff brown slightly silty clay (marine clay)	17-8"	36.7	32.8	61.6	-	114.4	
	T2	6'-7.5'	Firm to stiff grey-brown silty clay with tiny black specks. (marine clay)	3-1.5"	42.0	-	-	1600	111.1	
	T3	10.5'-12'	Firm to stiff grey-brown silty clay (marine clay)	P	50.2	30.4	74.6	-	106.5	
	VANE	13.5'	Soft to firm dk. grey silty clay (marine clay)	-	-	-	-	>2000	-	
	T4	15'-16.5'	Soft to firm dk. grey silty clay (marine clay)	P	58.6	27.3	61.2	898	103.0	
		18'	Firm dk. grey silty clay (marine clay)	-	-	-	-	1200	-	Sens: 6.0
	T5	20'-21.5'	Firm dk. grey silty clay (marine clay)	P	65.1	-	-	1120	101.1	
	VANE	23'	Firm dk. grey silty clay (marine clay)	-	-	-	-	1360	-	Sens: 7.6
4	T6	25'-26.5'	Soft to firm dk. grey silty clay (marine clay)	P	63.2	26.6	42.0	950	101.9	
	VANE	28'	Firm to stiff dk. grey silty clay (marine clay)	-	-	-	-	2000	-	Sens: 5.6
	T7	30'-31.5'	Firm to stiff dk. grey silty clay (marine clay)	P	61.8	-	-	-	103.0	
	VANE	33'	Firm to stiff dk. grey silty clay (marine clay)	-	-	-	-	1680	-	Sens: 7.0

SUMMARY OF FIELD & LABORATORY TESTS

JOB F 59-122

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
	T8	35'-36.5'	Firm to stiff dk. grey silty clay with trace of shells and very fine sand seams (marine clay)	P	58.1	26.1	62.7	1945	102.8	
	VANE	38'	Firm to stiff dk. grey silty clay (marine clay)	-	-	-	-	1920	-	Sens: 8.0
	T9	40'-41.5'	Firm to stiff dk. grey silty clay (marine clay)	P	63.2	-	-	1630	102.1	
	VANE	46'.5	Firm to stiff dk. grey silty clay	-	-	-	-	2000	-	Sens: 10.0
		50'-51.5'	Firm to stiff dk. grey silty clay with trace of organic matter (marine clay)	P	50.0	25.5	38.1	1670	107.9	
	VANE	53'	Firm to stiff dk. grey silty clay (marine clay)	-	-	-	-	1840	-	Sens: 9.2
5	T1	5'-6.5'	Stiff brown silty clay (marine clay)	18	41.1	-	-	-	112.8	
	T2	10'-11.5'	Stiff grey-brown silty clay (marine clay)	P	52.6	27.1	70.0	2150	106.2	
	VANE	13'	Firm grey-brown silty clay (marine clay)	-	-	-	-	1360	-	Sens: 5.7
	T3	15'-16.5'	Soft to firm brown silty clay (marine clay)	P	64.0	27.3	69.4	822	100.2	
	VANE	18'	Firm dk. grey silty clay (marine clay)	-	-	-	-	1280	-	Sens: 6.4

SUMMARY OF FIELD & LABORATORY TESTS

JOB F 59-122

W.P. Garage

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
	T4	20'-21.5'	Firm dk. grey silty clay (marine clay)	P	67.5	-	-	1220	100.3	
	VANE	23'	Firm to stiff dk. grey silty clay (marine clay) T denotes Shelby tube.	-	-	-	-	1600	-	Sens: 10.0

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. Garage BORE HOLE NO. 1
 JOA F 59-122 STATION See Drawing
 DATUM 206.7' COMPILED BY B.K.
 BORING DATE Dec. 19/59 CHECKED BY GGC

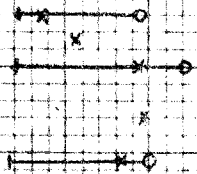
2" DIA. SPLIT TUBE _____
 2" SHELBY TUBE _____
 2" SPLIT TUBE _____
 2" DIA. CONE _____
 2" SHELBY _____
 CASING _____

LEGEND

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

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE			
				500	1000	1500	2000
				P.S.F.			
				BLOWS/FT.			
	↓ groundlevel	206.7	0	25	50	75	100
	Firm to stiff brown silty clay (marine clay)		10	11 for 7"			
	Firm dk. gray silty clay W.L. <u>✓</u> (marine clay)	191.7 188.7 183.7	20				
	End of borehole		30				
			40				
		163.1	50				
	Refusal to cone penetration.		60				
			70				
			80				

Vane test recorded as
 2000 p.s.f. are slightly
 higher.

CONSISTENCY		SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT- % DRY WT.			
20	40	60	
			
		T 1	117.0
		T 2	112.1
		T 3	104.9
		T 4	103.2
		T 5	104.3

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. Garage ----- BORE HOLE NO. 2
 JOB F 59-122 ----- STATION See drawing
 DATUM 206.1' ----- COMPILED BY B.K.
 BORING DATE Dec. 18 ----- CHECKED BY GGC

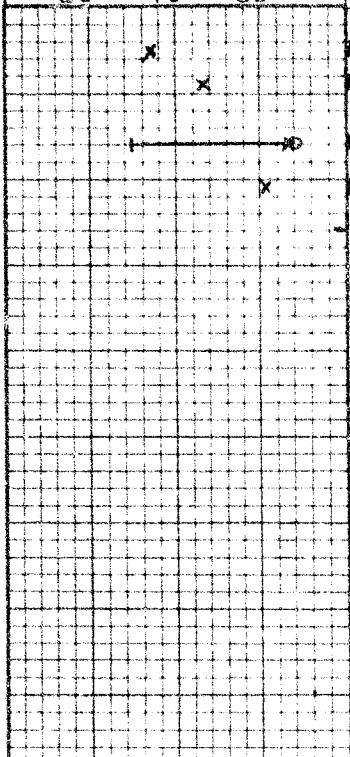
2" DIA. SPLIT TUBE -----
 2" SHELBY TUBE -----
 2" SPLIT TUBE -----
 2" DIA. CONE -----
 2" SHELBY -----
 CASING -----

LEGEND

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

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				
				50	1000	1500	2000	P.S.F.
	↓ groundlevel	206.1	0	25	50	75	100	BLOWS/FT.
	Firm to stiff brown silty clay (marine clay)	204.6	10	15 for 9"			42	O
		193.1	20				83	
	Firm dk. gray silty clay (marine clay)	183.1	30				60	
	End of borehole	152.6	50					
	Refusal to cone penetration.		60					
			70					
			80					

Vane tests recorded as 2000 p.s.f. are slightly higher.

CONSISTENCY			SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT- % DRY WT.				
20	40	60		
			1	-
			T 2	108.5
			T 3	100.2
			T 4	104.2

DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. Garage ----- BORE HOLE NO. 3 -----

JOB F 59-122 ----- STATION See drawing -----

DATUM 204.1' ----- COMPILED BY B.K. -----

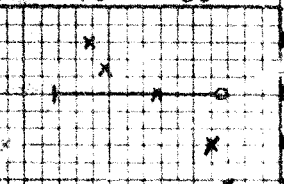
BORING DATE Dec. 16-17/59 CHECKED BY GGC -----

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 ----- X
LIQUID LIMIT -----
PLASTIC LIMIT -----

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE			
				500	1000	1500	2000
	↓ groundlevel	204.1	0	25	50	75	100
	Firm to stiff brown silty clay (marine clay)	202.1	10	15 for 10"			
		189.1	20	6 for 9"			
	Firm dark gray silty clay (marine clay)	181.1	20				
	End of borehole	150.8	30				
			40				
			50				
	Refusal to cone penetration		60				
			70				
			80				

CONSISTENCY			SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.				
20	40	60		
			T 1	116.2
			T 2	113.2
			T 3	105.8
			T 4	102.3
			T 5	101.5

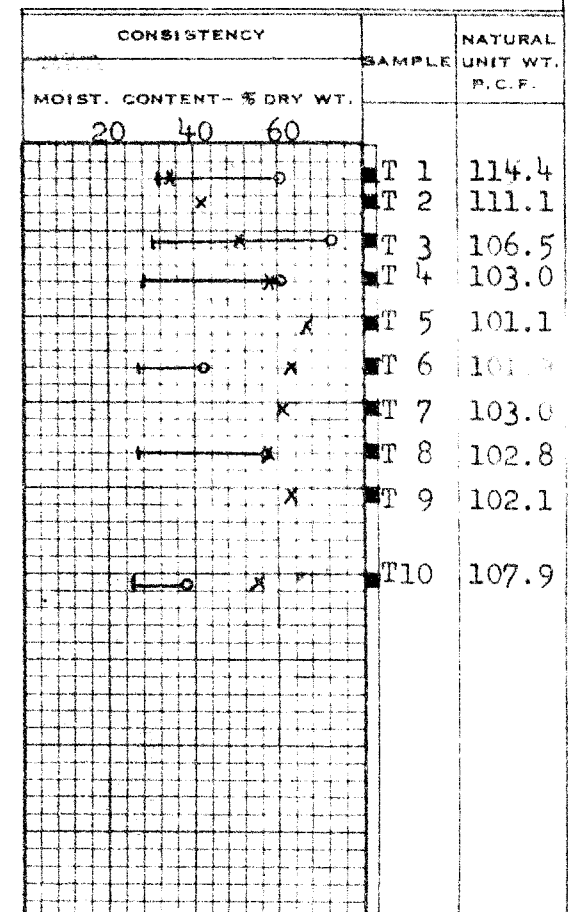
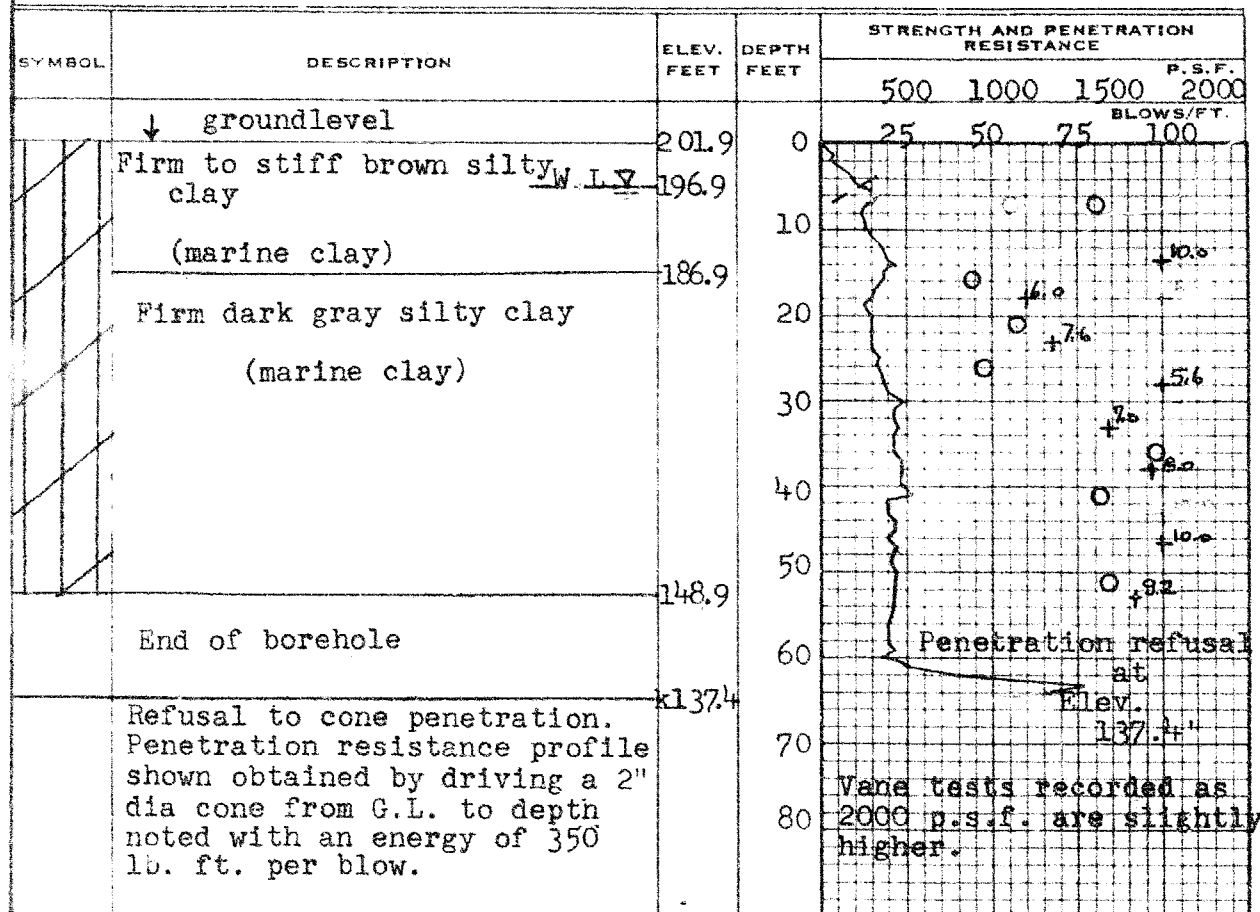
DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. Garage BORE HOLE NO. 4
 JOB F 59-122 STATION See drawing
 DATUM 201.9' COMPILED BY B.K.
 BORING DATE Dec. 10/59 CHECKED BY GCC

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



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS AND RESEARCH SECTION

W.P. Garage _____ BORE HOLE NO. 5
 JOB F 59-122 _____ STATION See drawing
 DATUM 204.4' _____ COMPILED BY B.K.
 BORING DATE Dec. 21/59 CHECKED BY _____

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 _____

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				
				500	1000	1500	2000	P.S.F.
	↓ ground level	204.4	0	25	50	75	100	BLOWS/FT.
	Firm to stiff brown silty clay (marine clay)	188.4	10					
	W.L. <u>187.4</u>	187.4						
	Firm dark gray silty clay (marine clay)	181.4	20					
	End of borehole	149.4	30					
			40					
			50					
	Refusal to cone penetration		60					
			70					
			80					

CONSISTENCY			SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.	20	40		
			T 1	112.8
			T 2	106.2
			T 3	100.2
			T 4	100.3

#59-F-122
Hwy #17
CUMBERLAND
PROPOSED
PATROL YARD

