w. P. 111-60
23-64-369

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

Attention: Mr. S. McCombie

From: Foundation Section,
Materials and Research Div.,
Room 107, Lab. Bldg.

Date: April 29, 1964

Our File Ref.

In reply to

Subject:

FOUNDATION INVESTIGATION REPORT

For

Proposed County Rd. #20 Overpass at
Q.E.W., Jordan Station Side Road,
District No. 4, Hamilton, Ontario.

W.J. 64-F-13 -- W.P. 111-60

Attached, we are forwarding to you, our detailed foundation investigation report on the subsoil conditions existing at the above structure location.

We believe that you will find the factual data and recommendations contained therein, adequate for your future design work. Should you require additional information, please do not hesitate to contact our Office.

AG Stermac

A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

AGS/MdeF
Attach.
cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
G. K. Hunter (2)
H. Greenland
T. J. Kovich
A. Watt

Foundations Office
Gen. Files

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FOUNDATION INVESTIGATION REPORT

For

Proposed County Rd. #20 Overpass at
Q.E.W., Jordan Station Side Road,
District No. 4, Hamilton, Ontario.

W.J. 64-F-13 -- W.P. 111-60

1. INTRODUCTION:

A request for a foundation investigation at the site of the proposed Lincoln Co. Rd. #20 Overpass at Q.E.W., was received from Mr. F. De Visser, Bridge Location Engineer, in a memo dated February 27, 1964.

A field investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the location of the proposed twin structures. Presented in this report are the results of this investigation and our recommendations pertaining to the design of the proposed foundations.

2. DESCRIPTION OF THE SITE:

The proposed bridge site is located at the intersection of Lincoln County Road #20 (Jordan Station Road) and Q.E.W., approx. 6 miles West of St. Catharines West limit. The surrounding area is generally flat and wood-covered.

Physiographically, the site is located in the region referred to as the Iroquois Plain in the Niagara Fruit Belt.

cont'd. /2 ...

3. FIELD INVESTIGATION PROCEDURE:

A total of ten boreholes and seven dynamic cone penetration tests was carried out during the course of the field work. Boring was achieved by means of conventional diamond drilling equipment adapted for soil sampling purposes. During the field work, disturbed and undisturbed samples were obtained. Disturbed samples were obtained by means of a standard split-spoon sampler and the energy used in driving it, conform to the requirements of the Standard Penetration Test. Dynamic cone penetration tests were carried out adjacent to seven boreholes. Driving energy to advance the cone was 350 ft.-lbs. per blow. Other samples were obtained by means of 2-inch I.D. Shelby tubes which were pushed into the soil by hand or occasionally driven into the soil with a 140-lb. hammer delivering 350 ft.-lbs. per blow. In-situ vane tests were carried out wherever possible, at elevations 12 inches below the various sample depths.

The locations and elevations of all boreholes are shown on Drawing No.64-F-13A which accompanies this report. The elevations were determined from a D.H.O. bench mark (elevation 288.5') located at the Southwest corner of the site.

4. LABORATORY TESTS:

Samples were visually examined and classified at the site as well as in the laboratory. Certain tests were carried out in the laboratory for classification and shear strength determination purposes. These tests consisted of Atterberg limits, moisture content and unconfined shear strength determinations. The test results are shown on the Borehole Record Sheets which form part of this report.

cont'd. /3 ...

5. SOIL TYPES AND SOIL CONDITIONS:

5.1) General:

The subsoil at the site consists of about five different deposits. The boundaries of the different deposits are shown on the accompanying Borelog sheets. The estimated stratigraphical profile shown on Drawing No. 64-F-13A, is based upon this information. From ground level downwards, the various soil types are as follows:

5.2) Sandy Silt - Fill Material:

This fill material was encountered in Boreholes No. 1, 3, 4, 7, 9, 10, and varies in depth from about 5 ft. to 14 ft. The maximum thickness occurs in Borehole No. 9, being about 14 ft. The average depth is 10 ft. In Boreholes No. 1 and 3 only, the material underlies a 5-ft. layer of clayey silt and extends from el. 282 to el. 277. The material consists of brown-coloured sandy silt with traces of clay and organic material. The relative density may be described as loose to dense. The 'N' values ranged from 7 to 37 blows per foot. The average moisture content was found to be 20%.

5.3) Clayey Silt - Fill Material:

This deposit was observed in Boreholes No. 1, 2, 3, 5, 6, 8, and extends from ground level to about el. 277, except in B.H.'s 1 and 3, where it extends to about el. 282.0. The thickness varies from 5 ft. to 11 ft. The chief constituents are silt and clay with traces of sand and organic material. The average moisture content is 15%. Liquid and plastic limits average 34% and 20%, respectively. The consistency varies from soft to hard, with an average 'N' value of 25 blows per foot.

cont'd. /4 ...

5. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

5.4) Silt:

This deposit was observed in all boreholes to underlie the fill material. The thickness varies from 3 ft. to 10 ft. It consists of silt with some fine sand and traces of clay. The material is predominantly non-cohesive and exhibits slight to quick dilatency. The average moisture content was found to vary from 15% to 28%. The relative density of the deposit may be described as compact to very dense, the 'N' values being in the order of 10 - 80 blows per foot.

Similar material was encountered in Boreholes No. 7 and 10, at a much lower depth between elevations 239.0 - 212.5, and 228.0 - 218.0, respectively.

5.5) Clayey Silt - (Glacial Till):

This stratum underlies the silt material in all boreholes. The upper surface of the deposit varies from el. 274 in B.H. No. 7 to el. 266 in B.H. No. 3. The depth varies from 35 ft. to 83 ft. The lower boundaries in Boreholes No. 2, 4, 6, 8 and 10 were not determined since the borings were terminated in this layer. The consistency of the overall stratum ranges from soft to hard. The material in the deposit consists of a heterogeneous mixture of clayey silt, sand and gravel. The average proportions of the different sizes are: Gravel: 10%, sand 20%, silt 55%, clay 15%. The moisture content varies from 8% to 28%. Liquid and plastic limit ranges are 19% - 33% and 12% - 18%, respectively. Bulk density ranges from 125 p.c.f. to 140 p.c.f.

cont'd. /5 ...

5. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

5.5) Clayey Silt - (Glacial Till): (cont'd.) ...

The undrained shear strength of the material as determined from field and laboratory tests, was found to vary considerably from borehole to borehole. In B.H. No's 2, 4, 6, 7 & 10, the shear strength ranges from about 500 p.s.f. at the upper surface (el. 270 ±) to about 800 p.s.f. at el. 261.0. It then increases rapidly to about 2,000 p.s.f. at about el. 260.0, afterwards increasing randomly with depth to about 3,000 p.s.f. at el. 215.0. In B.H. No's 1, 5, & 9, the shear strength increases more or less uniformly from about 1,500 p.s.f. at the surface (el. 270 ±) to about 3,000 p.s.f. at el. 215.0. In B.H. No's 3 & 8, the shear strength decreases from about 2,500 p.s.f. at the surface (el. 266 ±) to about 500 p.s.f. at el. 260.0 and from then on, increases to about 1,500 p.s.f. at el. 240.0, thereafter increasing more rapidly to about 3,000 p.s.f. at el. 215.0. In all boreholes, a sudden increase in shear strength below approximate el. 215.0 was observed to occur. Below this elevation the shear strength is estimated to be in the order of 7,000 - 8,000 p.s.f.

5.6) Gravelly Sand:

This deposit underlies the glacial till deposit and was observed in Boreholes No's 1, 3, and 9, at el. 197, el. 192, and el. 201, respectively. The borings were terminated in this layer which extends below el. 191. The material consists mainly of gravelly sand with silt and clay in the following average proportions: Gravel 25%, sand 45%, silt and clay 30%. The moisture content was found to range from 9% to 21%. The relative density may be described as very dense; the average 'N' value is in excess of 100 blows per foot.

cont'd. /6 ...

6. GROUND WATER CONDITIONS:

The following ground water levels were observed in the various boreholes:

B.H. No. 1	El. 281.2	34	days	after	drilling
2	283.6	26	"	"	"
3	283.7	31	"	"	"
4	285.9	24	'	"	"
5	284.2	18	"	"	"
6	283.9	12	"	"	"
7	286.0	7	"	"	"
8	282.9	3	"	"	"
9	283.7	5	"	"	"
10	284.2	5	"	"	"

No artesian water pressures were observed during the field investigation.

7. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct an overpass at the junction of Q.E.W. and Lincoln County Road #20. At the present time, this is a level crossing. The traffic on Q.E.W. will be carried over the intersection by means of twin structures, constructed along the centre lines of the East and Westbound lanes. It was observed from the preliminary general plan that the present grade line of the County Road will be excavated to an approx. depth of 20 ft. The proposed footing elevations are 264.0 for the piers and 277.0 for the abutments.

cont'd. /7 ...

7. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

The investigation has revealed that considerable variation in shear strength exists over the entire site and that, in general, the shear strength of the upper layers is inadequate to provide suitable support for spread footing type foundations. To achieve a safe bearing capacity of about 2.0 T.S.F., excavations would have to be carried down to a considerable depth below the elevations which have been proposed. In our view, this would be most uneconomical.

In view of the foregoing, it is recommended that the abutments and piers be founded on large displacement piles, driven into the hard layers of the glacial till stratum which occur around elevation 215'. For $12\frac{3}{4}$" O.D. x $\frac{1}{4}$" wall steel tube piles, a design load of 75 tons per pile should be achieved at or about el. 210.0 - el. 205.0. It would be advantageous if a pile loading test could be carried out at the site in order to confirm the proposed design load and to obtain information on driving conditions. In this way, a much more accurate prediction of pile lengths could be made.

No stability problems are anticipated for the proposed side slopes of the 20-ft. cut on Co. Rd. #20, provided standard 2:1 slopes are constructed. It may be necessary, however, to provide a sand filter over the silt layers in the cut slopes if the ground water level is not lowered sufficiently to prevent piping.

8. SUMMARY:

A foundation investigation at the proposed overpass at Lincoln County Rd. #20 and Q.E.W. is reported.

Subsoil at the site was found to consist of fill material

cont'd. /8 ...

8. SUMMARY: (Cont'd.) ...

followed by compact to dense silt, followed by soft to hard clayey silt with sand and gravel, followed by very dense gravelly sand. Depth to the hard glacial till is about 80 ft.

The proposed abutments and piers are recommended to be founded on steel tube piles driven to approximate elevations 210.0 - 205.0. A design load of 75 tons per pile is recommended.

No stability problems are anticipated for the proposed side slopes of the 20-ft. cut.

Details are given in the foregoing section "Discussion and Recommendations".

9. MISCELLANEOUS:

The field work was carried out during the period of March 6, 1964 to April 10, 1964. Equipment used was owned and operated by Dominion Soil Investigation Limited. The supervision of the field work, together with the preparation of this report was carried out by Mr. P. Payer, Project Foundation Engineer, under the supervision of Mr. K. G. Selby, Senior Foundation Engineer.

April 1964

APPENDIX I.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 1

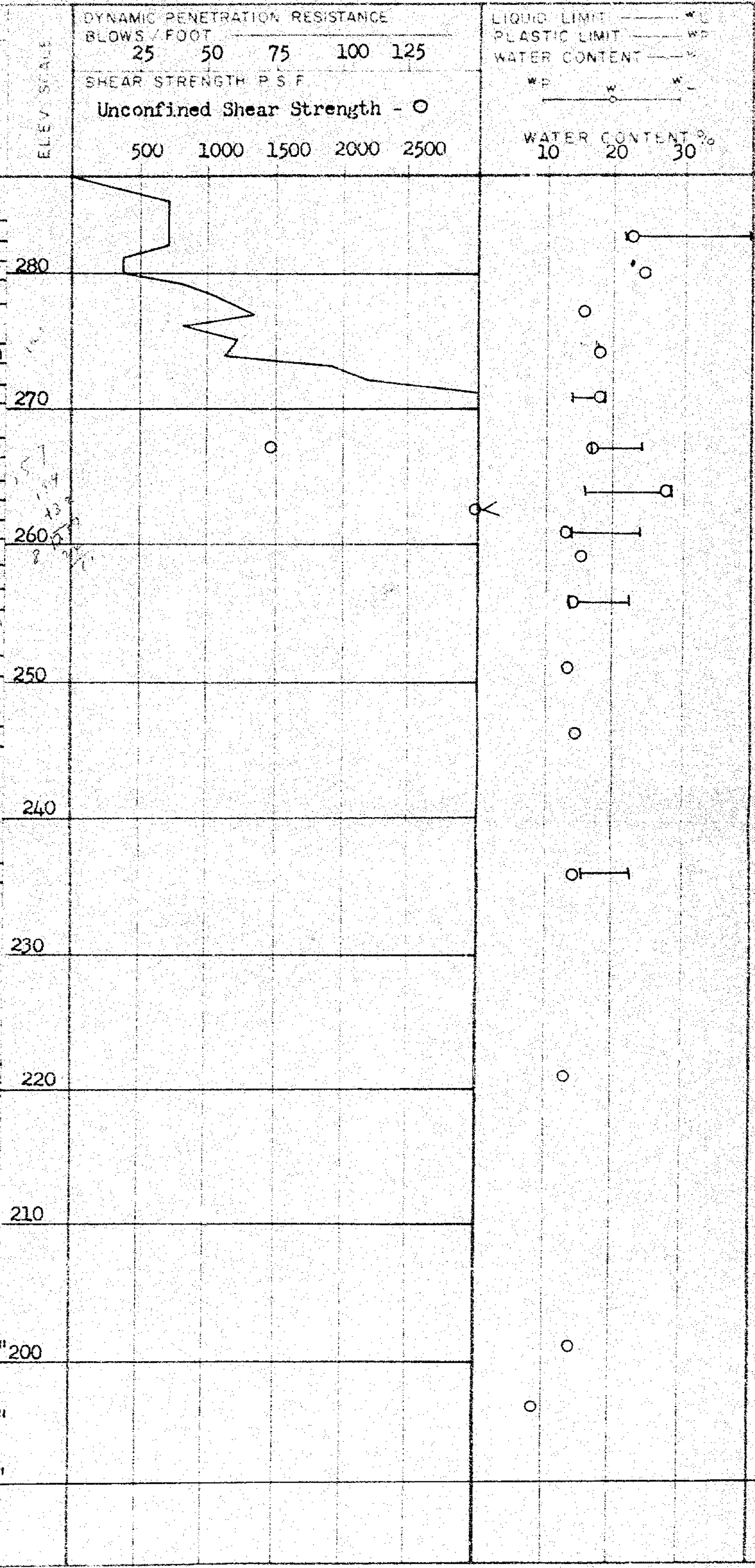
FOUNDATION SECTION

JOB 64-F-13 LOCATION Sta. 16+65; 54' Rt. ORIGINATED BY P.P.

W.P. 111-60 BORING DATE March 6, 9, 1964. COMPILED BY P.P.

DATUM Geodetic BOREHOLE TYPE Washbore - NX Casing. CHECKED BY K.S.

ELEV / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FOOT	BULK DENSITY γ P.C.F.	REMARKS
287.2	Groundlevel					
0.0 / 282.0	Clayey-silt with some sand& org. material. Brown-Fill. Stiff	1	SS	10		
5.2 / 278.1	Sandy-silt. Brown-Fill. Compact.	2	SS	18		W.L. El. 281.2'
9.1	Silt with some sand & clay. Grey coloured. Dense to very dense.	3	SS	38		
		4	SS	40		Gr 0% Sa 20%
269.2		5	SS	81		Si) Cl) 80%
18.0	Clayey-silt with some sand and gravel.	6	TW	19	136	
		7	TW	PM		
		8	TW	PM	140	
		9	SS	38		
		10	SS	37		
	Grey coloured.	11	SS	34		
		12	SS	25		Gr 3% Sa 20% Si 53% Cl 24%
	Stiff to hard.	13	SS	27		
	Glacial Till.	14	SS	34		
		15	SS	27		
197.2		16	SS	69/6"		
90.0	Gravelly sand with some silt & clay.	17	SS	91/5"		Gr 23% Sa 44% Si) Cl) 33%
190.7	V. dense	18	SS	75/6"		
96.5	End of borehole.					



MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 64-F-13 — LOCATION Sta. 16+72; 27' Rt. — ORIGINATED BY P.P.

W.P. 111-60 — BORING DATE March 17, 18, 1964. — COMPILED BY P.P.

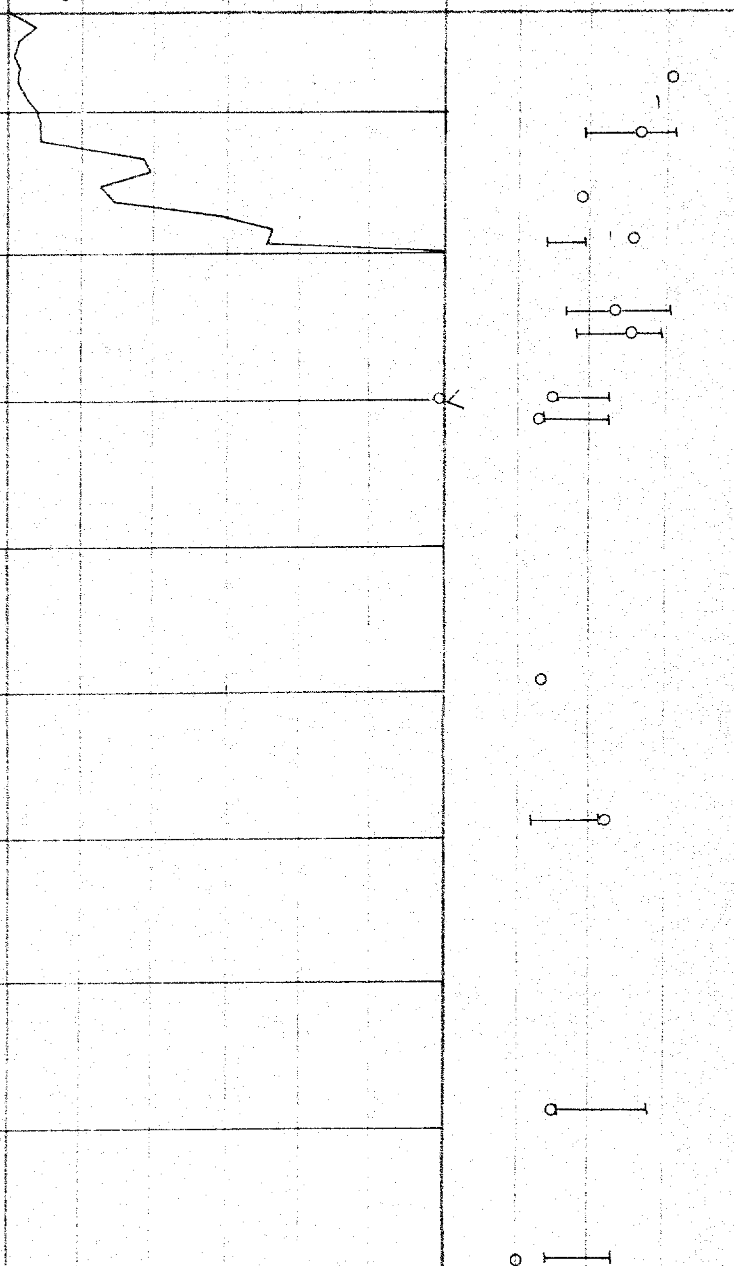
DATUM Geodetic — BOREHOLE TYPE Washbore - NX Casing. — CHECKED BY K.S.

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT: 25, 50, 75, 100, 125

SHEAR STRENGTH P.S.F.: Field Vane Test - + ; Unconfined - o ; 500, 1000, 1500, 2000, 2500

LIQUID LIMIT — W_L; PLASTIC LIMIT — W_P; WATER CONTENT — W; WATER CONTENT %: 10, 20, 30

BULK DENSITY P.C.F.



Soil Profile

ELEV. / DEPTH	DESCRIPTION
286.8	Groundlevel
0.0	Clayey-silt with some sand and org. material Brown-Fill
277.8	Firm.
9.0	Clayey-silt.
274.6	Grey.
12.2	Silt with some sand. Grey coloured.
268.0	Compact to v. dense.
18.8	Clayey-silt with some sand and gravel. Grey coloured. Soft to hard. Glacial Till
202.0	
86.5	End of borehole.

Samples

NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BULK DENSITY P.C.F.	REMARKS
					W.L. El. 283.6
1	SS	6	280		
2	SS	10			
3	SS	22			
4	SS	60	270		
5	SS	6		123	Gr 0% Sa 0% Si 64% Cl 36%
6	TW	PM			
7	TW	23	260	139	Gr 0% Sa 13% Si 65% Cl 22%
8	SS	45			
9	SS	24	250		
10	SS	32	240		Gr 19% Sa 47% Si) Cl) 34%
11	SS	24	230		Gr 0% Sa 22% Si 53% Cl 25%
12	SS	23	220		
13	SS	40	210		
14	SS	82	200		Gr 5% Sa 32% Si 42% Cl 21%

DEPARTMENT OF HIGHWAYS ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 64-F-13	LOCATION Sta. 17+01; 43' Lt.	ORIGINATED BY	P.P.
W.P. 111-60	BORING DATE March 12, 13, 1964.	COMPILED BY	P.P.
DATUM Geodetic	BOREHOLE TYPE Washbore - NX Casing.	CHECKED BY	K.S.

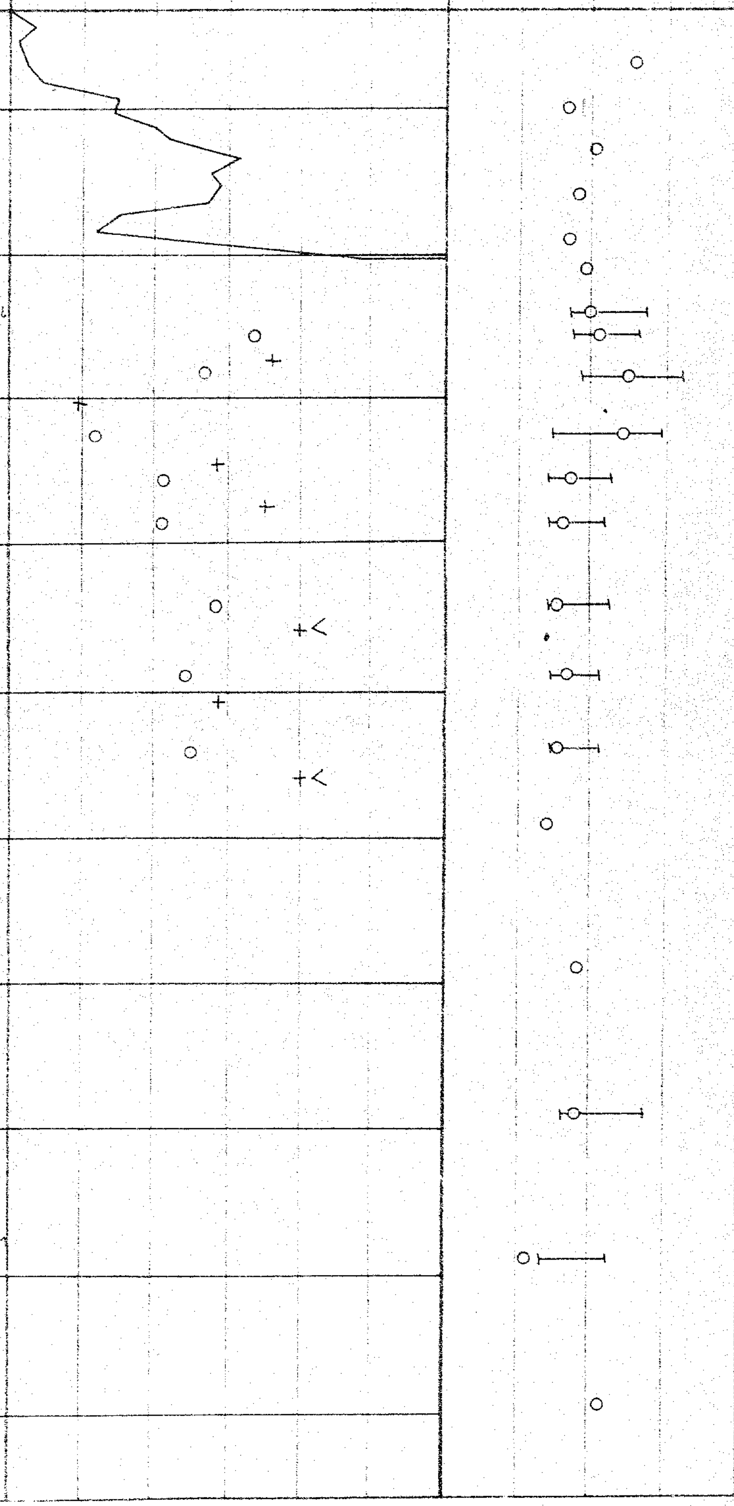
Soil Profile

Elev. / Depth	Description
86.7	Groundlevel
0.0	Clayey-silt with some sand & org. material.
1.7	Brown-Fill. Stiff.
5.0	Sandy-silt Brown-Fill
76.6	Dense
10.1	Silt with sand. Grey coloured.
65.8	Compact to dense.
20.9	Clayey-silt with some sand and gravel. Grey coloured. Soft to hard. Glacial Till.
0.2	Gravelly sand.
6.5	End of borehole.

Samples

Number	Type	Blows/Foot	Elev. Scale	Bulk Density P.C.F.	Remarks
					W.L. El. 283.7'
1	SS	13			
2	SS	36	280		Gr 0% Sa 4% Si 74% Cl 22%
3	SS	33			
4	SS	12			
5	TW	PM			
6	SS	38	270		
7	SS	45			
8	SS	21			
9	TW	PM		131	
10	TW	PM	260	127	
11	TW	PM		126	
12	TW	PM		135	
13	TW	PM	250	137	
14	TW	PM		137	
15	TW	PM	240	137	
16	TW	PM		137	
17	SS	25	230		Gr 7% Sa 20% Si 48% Cl 25%
18	SS	27	220		
19	SS	51	210		
20	SS	123	200		Gr 0% Sa 20% Si 53% Cl 27%
21	SS	70/5"			

DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 25 50 75 100 125
SHEAR STRENGTH P.S.F. Field Vane Test - + Unconfined Shear Strength - o 500 1000 1500 2000 2500
LIQUID LIMIT, PLASTIC LIMIT, WATER CONTENT — WATER CONTENT % 10 20 30



DEPARTMENT OF HIGHWAYS ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

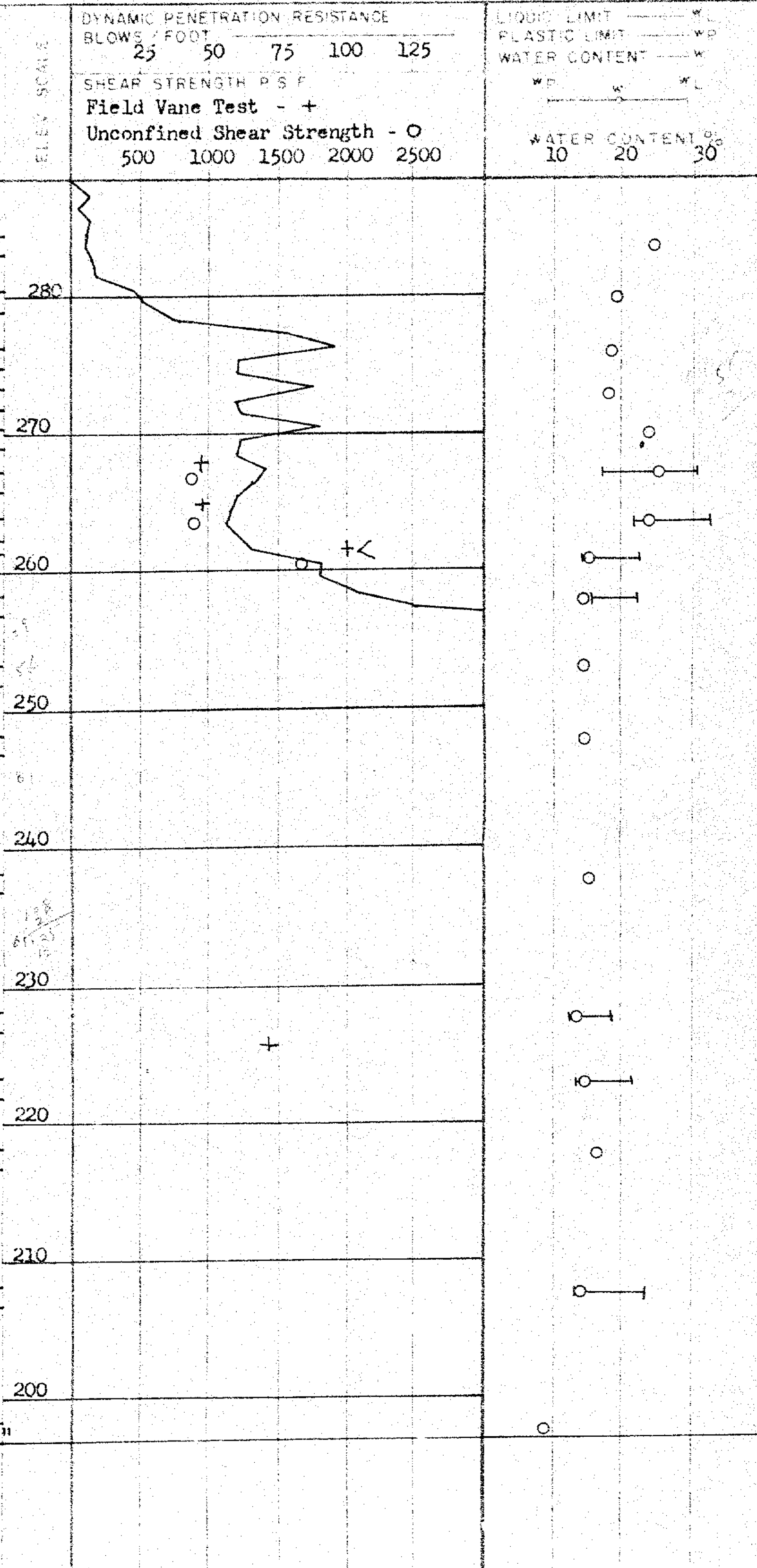
JOB 64-F-13 | LOCATION 15+49; 38' Lt. | ORIGINATED BY P.P.
W.P. 111-60 | BORING DATE March 19, 20, 1964. | COMPILED BY P.P.
DATUM Geodetic | BOREHOLE TYPE Washbore - NX Casing. | CHECKED BY K.S.

Soil Profile

ELEV. / DEPTH	DESCRIPTION
288.5	Groundlevel
0.0	Sandy-silt with some clay & organic material. Brown-Fill Loose to dense.
278.5 / 10.0	Silt with sand & traces of clay. Grey coloured. Dense.
270.5 / 18.0	Clayey-silt with sand and gravel. Grey coloured. Firm to hard.
219.0 / 69.5	Silt Grey coloured. V. dense
215.0 / 73.5	Glacial Till
197.0 / 91.5	End of borehole.

Samples

NUMBER	TYPE	BLOWS/FOOT	BULK DENSITY P.C.F.	REMARKS
				W.L. El. 285.9
1	SS	7		
2	SS	30		Gr 0% Sa 16% Si 64% Cl 20%
3	SS	26		
4	SS	30		
5	SS	5		
6	TW	PM	125	
7	TW	PM	125	
8	TW	PM	138	
9	SS	24		Gr 0% Sa 14% Si 57% Cl 29%
10	SS	27		
11	SS	25		
12	SS	27		
13	SS	17		Gr 2% Sa 16% Si 66% Cl 17%
14	TW	PM		
15	SS	123		
16	SS	79		
17	SS	75/3"		Gr 4% Sa 41% Si&Cl 55%



RECORD OF BOREHOLE NO 5

JOB 64-F-13	LOCATION Sta. 15+23; 33' Rt.	ORIGINATED BY	P.P.
W.P. 111-60	BORING DATE March 23, 24, 26, 1964.	COMPILED BY	P.P.
DATUM Geodetic	BORING METHOD Washbore	CHECKED BY	K.S.

DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT: 25, 50, 75, 100, 125
SHEAR STRENGTH P.S.F.: Field Vane Test - +; Unconfined Shear Strength - O: 500, 1000, 1500, 2000, 2500
LIQUID LIMIT, PLASTIC LIMIT, WATER CONTENT: WATER CONTENT %: 10, 20, 30

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/FOOT	ELEVATION SCALE	UNIT WEIGHT P.C.F.	REMARKS
286.2	Groundlevel						
0.0	Clayey-silt with traces of sand and org. material. Brown-Fill V. stiff to hard.	1	SS	21	280		W.L. El. 284.2
277.2 / 9.0	Silt with traces of clay. Grey coloured. Compact to dense.	2	SS	36			
		3	SS	25			Gr 0% Sa 8% Si 72% Cl 20%
271.2 / 15.0	Clayey-silt with sand and gravel. Grey coloured. Soft to hard. Glacial Till	4	SS	13	270		
		5	TW	PM		134.3	Gr 5% Sa 13% Si 60% Cl 22%
		6	SS	35	260		
		7	SS	27			
		8	SS	29	250		
		9	SS	42	240		
		10	SS	19	230		Gr 2% Sa 15% Si 58% Cl 25%
		11	TW	PM	220	133.2	
		12	SS	46			
					210		
		13	SS	76			Gr 3% Sa 20% Si 59% Cl 18%
					200		
		14	SS	79			
199.2 / 87.0	Gravelly sand with some silt and clay. Very dense.				190		
		15	SS	103			Gr 4% Sa 44% Si 30% Cl 22%
					180		
					170		
168.2 / 118.0	End of borehole.	16	RC	-			6" Boulder
					160		

286.2
87.0
199.2

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

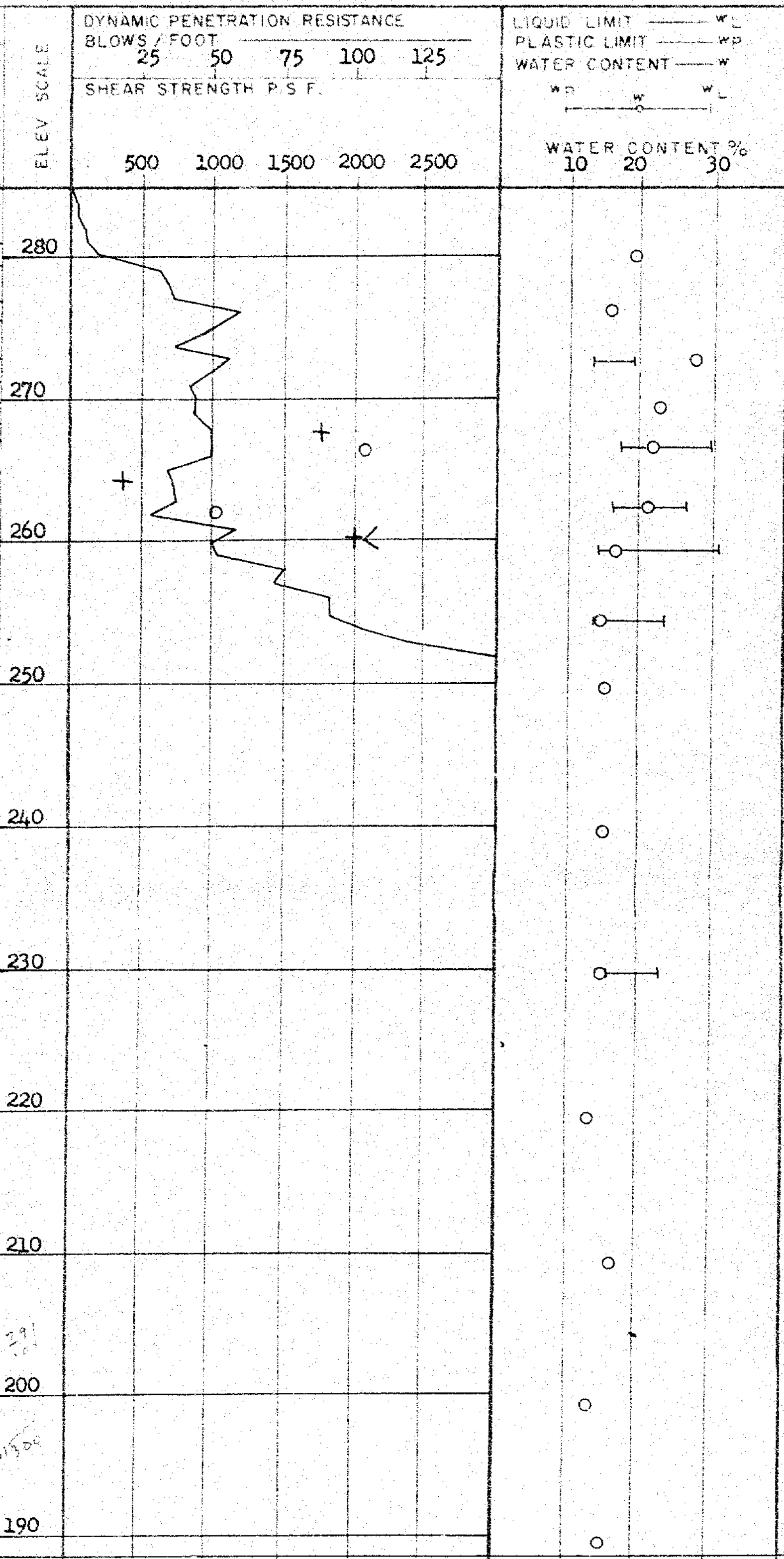
JOB 64-F-13 LOCATION Sta. 15+14; 62' Rt. ORIGINATED BY P.P.

W.P. 111-60 BORING DATE March 31 & Apr. 1, 1964. COMPILED BY P.P.

DATUM Geodetic BOREHOLE TYPE Washbore - NX Casing. CHECKED BY K.S.

ELEV / DEPTH	SOIL PROFILE DESCRIPTION
285.9	Groundlevel
0.0	Clayey-silt with traces of sand and organic material. Brown-Fill V. stiff.
277.9 / 8.0	Silt with some sand and clay. Grey Compact to dense.
270.3 / 15.6	Clayey-silt with sand and gravel. Grey coloured. Soft to hard. Glacial Till
189.4 / 96.5	End of borehole.

SAMPLE NUMBER	TYPE	BLOWS / FOOT	BULK DENSITY P.C.F.	REMARKS
				W.L. El. 283.9'
1	SS	24		Gr 0% Sa 23% Si 67% Cl 10%
2	SS	16		
3	SS	34		
4	SS	9		
5	TW	PM	132.8	
6	TW	PM	128.1	
7	SS	30		
8	SS	26		Gr 1% Sa 15% Si 61% Cl 23%
9	SS	23		
10	SS	24		Gr 8% Sa 22% Si 48% Cl 22%
11	SS	20		
12	SS	20		Gr 4% Sa 23% Si 44% Cl 29%
13	SS	48		
14	SS	91		Gr 2% Sa 24% Si 54% Cl 20%
15	SS	109		



MATERIALS & RESEARCH DIVISION

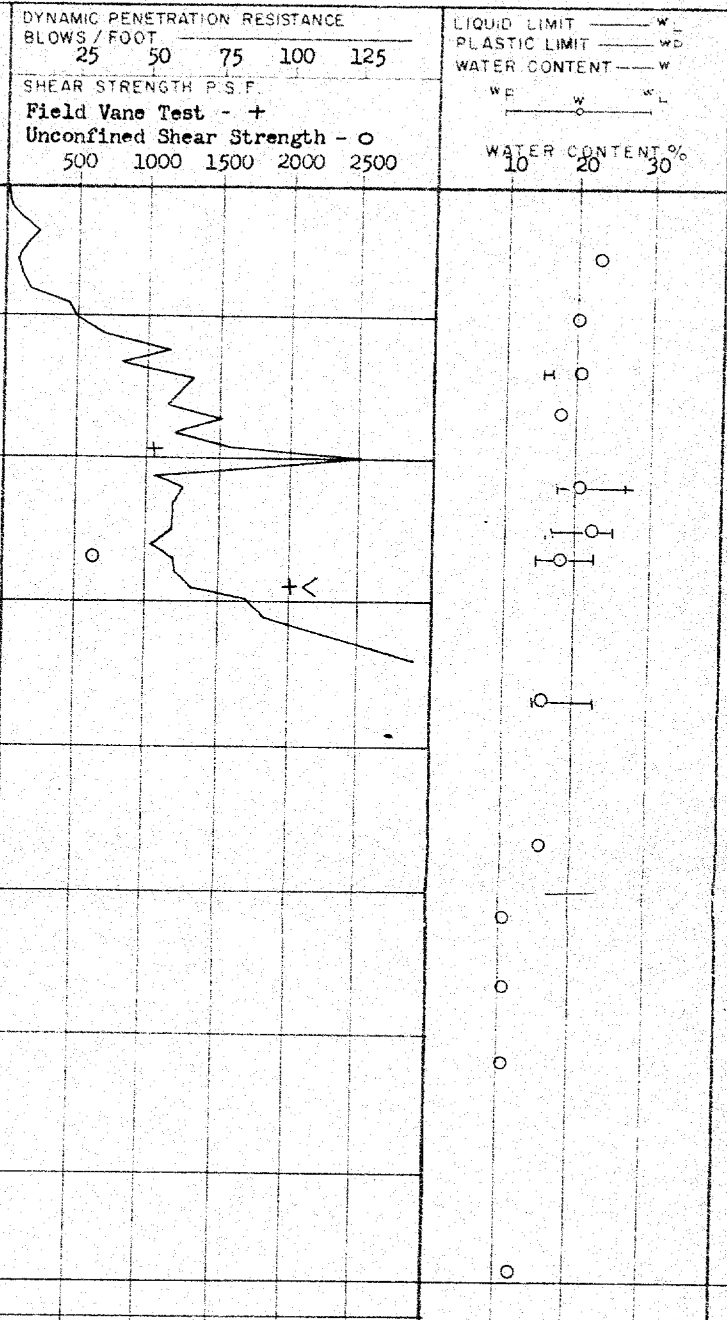
RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

JOB 64-F-13
W.P. 111-60
DATUM Geodetic
LOCATION Sta. 15+66; 51' Lt.
BORING DATE Apr. 2, 6, 1964.
BOREHOLE TYPE Washbore - NX Casing.
ORIGINATED BY P.P.
COMPILED BY P.P.
CHECKED BY K.S.

ELEV / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FOOT	REMARKS
289.0	Groundlevel				
0.0	Sandy-silt with traces of clay and organic material. Brown-Fill. Loose to dense.	1	SS	8	W.L. El. 286.0
		2	SS	37	Gr 0% Sa 12% Si 68% Cl 20%
277.5 / 11.5	Silt with traces of sand. Grey.	3	SS	26	
274.5 / 14.5	Clayey-silt with traces of sand and gravel. Grey coloured. Soft to very stiff. Glacial Till.	4	SS	26	
		5	SS	10	
		6	SS	9	Gr 0% Sa 15% Si 53% Cl 32%
		7	TW	PM	Bulk density 132.2 P.C.F.
		8	TW	PM	
		9	SS	30	Gr 8% Sa 14% Si 52% Cl 26%
		10	SS	22	
239.1 / 49.9	Silt with some sand and gravel, traces of clay. Grey coloured. Very dense.	11	SS	49	
		12	SS	58	
		13	SS	53	Gr 1% Sa 22% Si } Cl } 77%
		14	SS	44/5"	
212.5 / 76.5	End of borehole.				

ELEV SCALE: 280, 270, 260, 250, 240, 230, 220, 210



DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 8

FOUNDATION SECTION

JOB 64-F-13 LOCATION Sta. 17/07; 62' Lt. ORIGINATED BY P.P.
W.P. 111-60 BORING DATE Apr. 9, 10, 1964. COMPILED BY P.P.
DATUM Geodetic BOREHOLE TYPE Washbore - NX Casing. CHECKED BY K.S.

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	REMARKS
287.1	Groundlevel					
0.0	Clayey-silt with some sand and organic material. Brown-Fill. Hard.	1	SS	44	280	W.L. El. 282.9
276.1 / 11.0	Silt with some sand and clay. Grey coloured. Compact.	2	SS	36		
		3	SS	24	270	Gr 0% Sa 7% Si) Cl) 93%
268.1 / 18.0	Clayey-silt with some sand and gravel. Soft to very stiff. Glacial Till. Grey coloured.	4	SS	14		
		5	TW	PM	260	Bulk density 124.3
		6	TW	PM		
		7	TW	PM	250	
		8	SS	21	240	
		9	TW	PM	230	
		10	SS	28	220	Gr 0% Sa 18% Si 55% Cl 27%
214.1 / 73.0	Sandy gravel with some silt and clay.	11	SS	47	210	Gr 60% Sa 26% Si) Cl) 14%
208.1 / 79.0	Clayey-silt with sand and gravel. Grey coloured. Hard. Glacial Till	12	SS	58/4.5"	200	Gr 4% Sa 20% Si 52% Cl 24%
		13	SS	99/8.5"		
190.6 / 96.5		14	SS	103/6"		

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F. Field Vane Test - + Unconfined - o (500, 1000, 1500, 2000, 2500)

LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w — WATER CONTENT % (10, 20, 30)

BULK DENSITY γ P.C.F.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 9

FOUNDATION SECTION

JOB 64-F-13
W.P. 111-60
DATUM Geodetic

LOCATION Sta. 16+09; 45' Rt.
BORING DATE Apr. 7, 8, 1964.
BOREHOLE TYPE Washbore - NX Casing.

ORIGINATED BY P.P.
COMPILED BY P.P.
CHECKED BY K.S.

SOIL PROFILE

ELEV / DEPTH	DESCRIPTION
288.7	Groundlevel
0.0	Sandy-silt with some organic material. Brown - Fill. Loose - Compact.
274.7 / 14.0	Silt with some sand & clay. Grey. Dense.
269.7 / 19.0	Clayey-silt with some sand and gravel. Stiff to hard. Glacial Till. Grey coloured.
200.7 / 88.0	Gravelly Sand. V. dense
197.2 / 91.5	End of borehole.

SAMPLES

NUMBER	TYPE	BLOWS / FOOT	REMARKS
1	SS	10	W.L. El. 283.7'
2	SS	28	
3	SS	50	Sa 25%, Si 58%, Cl 17%
4	SS	18	
5	TW	PM	Bulk density 138.2 P.C.F.
6	SS	28	
7	SS	35	Gr 0%, Sa 17%, Si 44%, Cl 39%
8	SS	23	
9	SS	68	
10	SS	41	Gr 4%, Sa 21%, Si 53%, Cl 22%
11	SS	30	
12	SS	100/10.5"	C 4%, [illegible] 23%, Si 39%, Cl 34%
13	SS	90	

ELEV. SCALE: 280, 270, 260, 250, 240, 230, 220, 210, 200

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
Unconfined - o
Field Vane Test - +
500 1000 1500 2000 2500

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w
w_P w w_L

WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.

REMARKS

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 10

FOUNDATION SECTION

JOB 64-F-13 | LOCATION Sta. 16+42; 38' Lt. | ORIGINATED BY P.P.

W.P. 111-60 | BORING DATE Apr. 7, 8, 1964. | COMPILED BY P.P.

DATUM Geodetic | BOREHOLE TYPE Washbore - NX Casing. | CHECKED BY K.S.

SOIL PROFILE: ELEV. DEPTH, DESCRIPTION, STRAT PLOT | SAMPLES: NUMBER, TYPE, BLOWS / FOOT | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT; SHEAR STRENGTH P.S.F. Field Vane Test - +, Unconfined - o (500, 1000, 1500, 2000, 2500) | LIQUID LIMIT — w_L, PLASTIC LIMIT — w_P, WATER CONTENT — w; WATER CONTENT % (10, 20, 30) | BULK DENSITY γ P.C.F. | REMARKS

ELEV. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BULK DENSITY γ P.C.F.	REMARKS
288.3	Groundlevel						
0.0	Sandy-silt with traces of clay and organic Material. Brown-Fill Compact.	1	SS	10	280		W.L. El. 284.2'
277.7 / 10.6	Silt with some sand & clay. Grey coloured. Compact	2	SS	21			
		3	SS	26	270		
271.8 / 16.5	Clayey-silt with sand & gravel. Grey coloured. Firm to very stiff. Glacial Till	4	TW	PM	260	126.9	
		5	SS	15			Gr 2% Sa 15% Si 45% Cl 38%
		6	SS	24	250		
		7	SS	17	240		
		8	SS	23	230		
228.3 / 60.0	Silt with some sand. Grey coloured. Compact.	9	SS	27	220		Gr 2% Sa 21% Si 61% Cl 16%
218.3 / 70.0	Clayey-silt with sand and gravel. Grey coloured. Hard. Glacial Till.	10	SS	45	210		
		11	SS	115/10"	200		Gr 10% Sa 23% Si 42% Cl 25%
		12	SS	95/10"			
196.8 / 91.5	End of borehole.						

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

CONSISTENCY	'N' BLOWS / FT.	c LB. / SQ. FT.	DENSENESS	'N' BLOWS / FT.
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_P	PLASTIC LIMIT
I_P	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX $= \frac{w - w_P}{I_P}$
I_C	CONSISTENCY INDEX $= \frac{w_L - w}{I_P}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta\sigma'}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma'}$
T_v	TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	(c' and ϕ':) IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	(c_u and ϕ_u:) IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	$= 3{\cdot}1416$
e	BASE OF NATURAL LOGARITHMS 2·7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ε	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNGS MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY. DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

3

1964 MAR 3 PM 1:24

00272

B

HAMN DOWN 4 MAR 3/64 1.12P VR

64-F-13

H GREENLAND DIST ENGR

ATTN W D HAM MTCE ENGR

FOUNDATION SECTION WILL COMMENCE FIELD WORK FOR
PROPOSED STRUCTURE QEW & LINCOLN ROAD NO. 20 WP 111-60
DURING NEXT FEW DAYS PERMISSION IS REQUESTED TO WORK ON
QEW RIGHT OF WAY IF THIS IS NECESSARY. PLS INDICATE WHOM
WE SHOULD CONTACT FOR SIGNS, FLAGMEN, ETC.

K G SELBY SNR FOUND ENGR FOR A G STERMAC PRINC FOUND ENGR

KS

MAR 3 PM 4:19

DOWN HAMN 11 MAR 3/64 3.35 PM

A G STERMAC

PRINC FOUND ENGR

64-F-13

ATT: K G SELBY

SNR FOUND ENGR

RE: PROPOSED STRUCTURE Q E W AND LINCOLN COUNTY RD NO 20 (VINELAND SIDE RD) W P 111-60

YOUR T T MAR 3/64 PERMISSION GRANTED TO WORK ON Q E W RIGHT OF WAY. MEN AT WORK SIGNS AND FLAGMEN MAY BE OBTAINED FROM WILLIAM WARD, PATROLMAN, LOCATED AT OUR PATROL YARD AT HOMER JUST EAST OF GARDEN CITY SKYWAY ON NEW HWY 8M ANY LARGER SIGNS MAY BE OBTAINED BY US AT WINONA. IF YOU ADVISE DATE YOU WILL BE ON LOCATION I CAN CONTACT PATROLMAN BY RADIO. YOU WILL ISSUE HIM A LOCAL ORDER IS SERVICES ETC ARE NEEDED.

H GREENLAND DIST ENG

PER W D HAM MAINT ENG

GR

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. Stermac,
Principal Foundation Engineer,
Laboratory Building.

From: F. DeVisser.

Date: February 27, 1964.

Our File Ref.

In reply to

Subject: W.P. 111-60, Site 19-177,
Your Job 60-F-58,
County Road #20 Overpass,
Jordan Station Side Road,
Q.E.W. - Dist. #4.

64-F-113

As discussed yesterday morning, additional boreholes are required at the above site, since the original foundation investigation was done approximately 375 feet to the east, which was the bridge site in a 1960 scheme.

Would you please consider this a rush project.

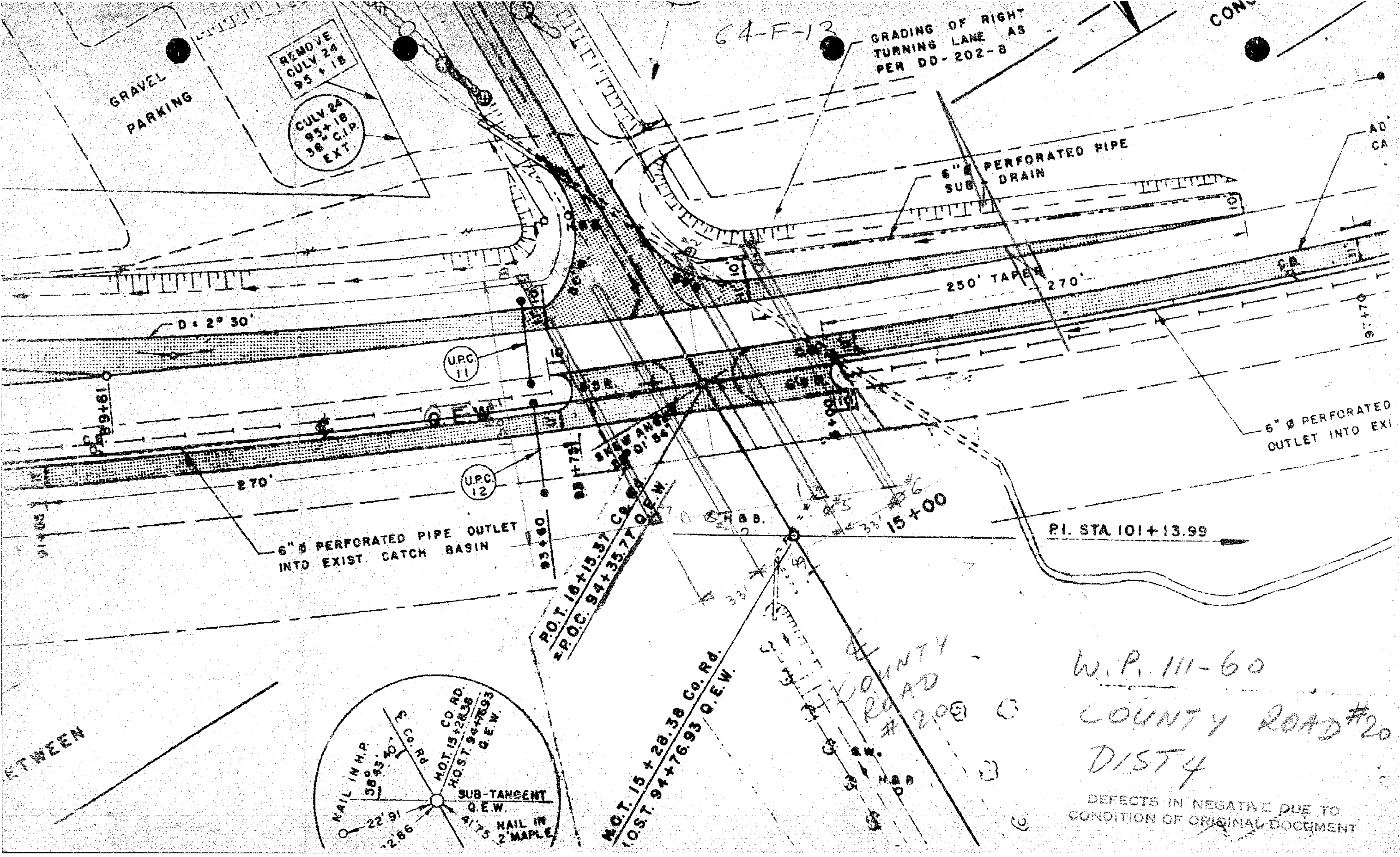
F. DeVisser.

F. DeVisser,
Bridge Location Engineer.

Fd/lg
c.c. B. Richardson,
R. Fitzgibbon.

Informed T. Kovich by phone that we are starting this job in next day or two.
K. G. Selby
March 3rd '64

Note:- At a meeting between B. Richardson A. G. Stermac K. G. Selby the extreme urgency of the above project was emphasized. It was decided to send another machine to complete drilling as soon as possible. K. G. Selby April 6th '64



64-F-13
GRADING OF RIGHT TURNING LANE AS PER DD-202-8
GRAVEL PARKING
REMOVE CULV 24 95+18
CULV 24 95+18 36" C.I.P. EXT.
6" Ø PERFORATED PIPE SUB - DRAIN
250' TAPER
270'
D = 2° 30'
U.P.C. 11
U.P.C. 12
Q.E.W.
6" Ø PERFORATED PIPE OUTLET INTO EXIST. CATCH BASIN
6" Ø PERFORATED OUTLET INTO EXI
SKEW ANGLE
P.O.T. 16+15.37 Co. Rd.
= P.O.C. 94+35.77 Q.E.W.
H.O.T. 15+28.38 Co. Rd.
H.O.ST. 94+76.93 Q.E.W.
15+00
P.I. STA 101+13.99
H.&B.
C.B.
S.W.
COUNTY ROAD #20
W.P. 111-60
COUNTY ROAD #20
DIST 4
NAIL IN H.P.
58°43'40"
℄ Co. Rd
CO. RD. H.O.T. 15+28.38
H.O.ST. 94+76.93 Q.E.W.
SUB-TANGENT Q.E.W.
NAIL IN 2' MAPLE
22.91
41.75
TWEEN
DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT