

# 66-F-53

W.P. #634-64

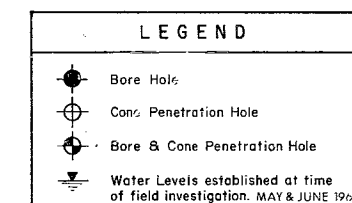
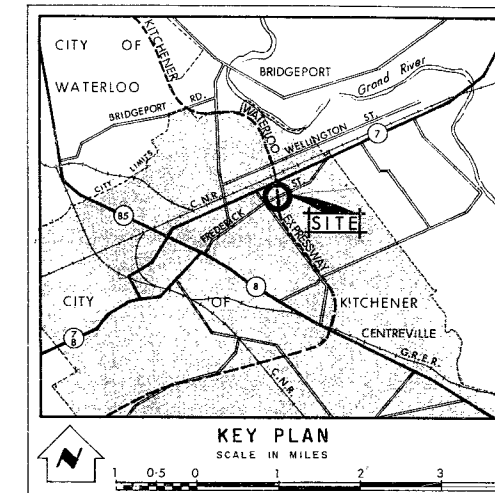
KITCHENER -

WATERLOO

EXPRESSWAY

FREDERICK ST.

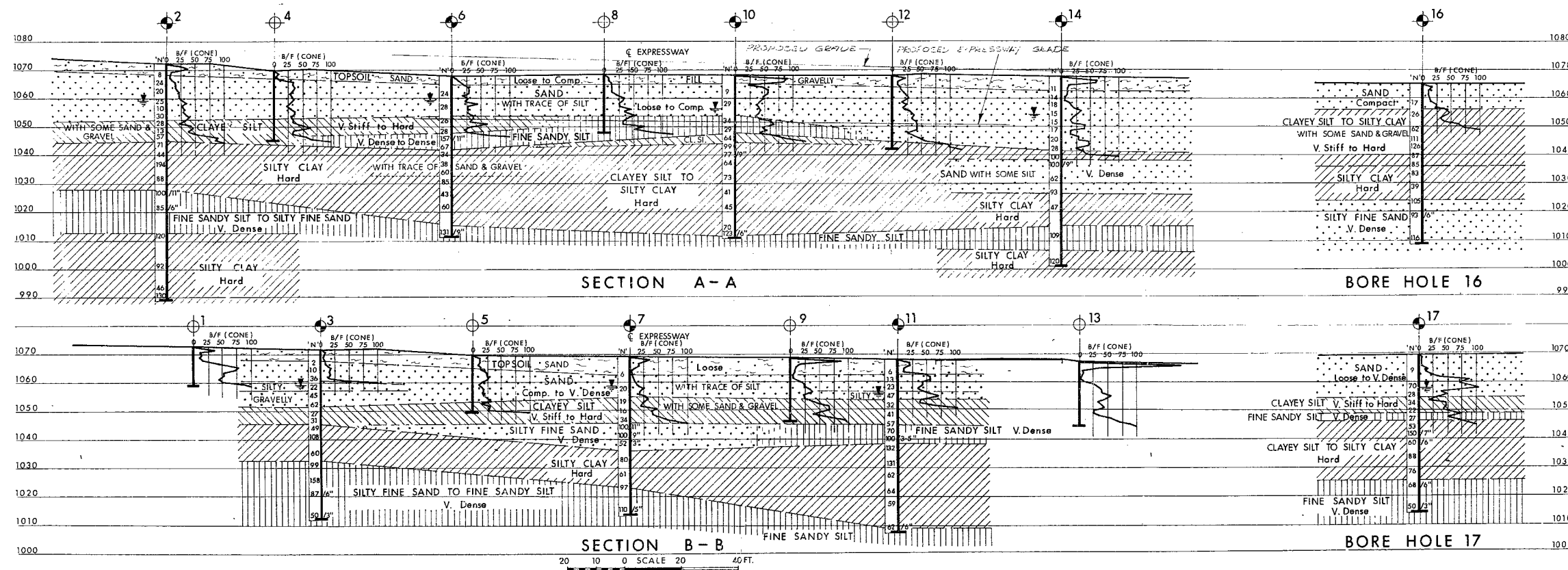
UNDERPASS



NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	1072.7	200,786	210,719
2	1072.4	200,887	210,709
3	1071.9	200,803	210,761
4	1069.3	200,890	210,747
5	1069.8	200,821	210,811
6	1067.7	200,919	210,802
7	1069.1	200,844	210,861
8	1068.1	200,939	210,847
9	1069.0	200,873	210,912
10	1067.9	200,955	210,895
11	1068.2	200,883	210,947
12	1067.6	200,967	210,949
13	1067.0	200,914	211,000
14	1067.2	200,997	210,999
16	1065.0	201,116	210,741
17	1049.6	200,754	210,935

- 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.

[illegible][illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION - FOUNDATION SECTION

FREDERICK STREET

KING'S HIGHWAY NO. KITCHENER-WATERLOO EXPRY. DIST. NO. 4  
CO. WATERLOO CITY OF KITCHENER  
TWP. LOT CON.

BORE HOLE LOCATIONS &amp; SOIL STRATA

SUBM'D D.W.	CHECKED <i>1</i>	W.P. NO.	634-6A	M.B.T. DRAWING NO. <b>66-F-53A</b>
DRAWN S.O.	CHECKED <i>HK</i>	JOB NO.	66-F-53	
DATE 16 AUG. 1966		SITE NO.		BRIDGE DRAWING NO.
APPROVED <i>A. J. Thomas</i>		CONT. NO.		

cc: GEN. FILES 23-68-62

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. B. R. Davis,  
Bridge Engineer,  
Bridge Division.

Attention: Mr. S. McCombie

FROM: Foundation Section,  
Materials & Testing Div.,  
Room 107, Lab. Bldg.

DATE: July 21, 1966

OUR FILE REF.

IN REPLY TO

AUG 23 1966

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Frederick Street Underpass  
Kitchener-Waterloo Expressway  
District #4 (Hamilton)  
W.J. 66-F-53 -- W.P. 634-64

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

We believe that the factual data and recommendations contained therein, will be adequate for your design requirements. Should additional information be required, please feel free to contact our Office.

*A. G. Stermac*

AGS/MdeF  
Attach.

A. G. Stermac,  
PRINCIPAL FOUNDATION ENGINEER

cc: Messrs. B. R. Davis (2)  
H. A. Tregaskes  
D. W. Farren  
A. Gater  
H. Greenland  
J. Roy  
W. S. Melinyshyn  
W. L. Bradley  
A. D. Margison Ltd.  
University of Waterloo  
Foundations Office  
Gen. Files

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FOUNDATION INVESTIGATION REPORT  
For  
Frederick Street Underpass  
Kitchener-Waterloo Expressway  
District #4 (Hamilton)  
W.J. 66-F-53    --    W.P. 634-64

1. INTRODUCTION:

A request dated April 15, 1966, for a foundation investigation at the site of the proposed crossing of Frederick Street and the Kitchener-Waterloo Expressway, was received by this office from Mr. W. S. Melnyshyn, Regional Bridge Location Engineer.

A field investigation was subsequently carried out by this Section. Presented in this report are the results of this investigation, together with recommendations pertaining to the foundation design for this structure.

2. DESCRIPTION OF SITE:

The site is located 3/4 mile west of the east boundary of Kitchener City Limits on Frederick Street. The surrounding immediate area is partially built up and the topography is generally flat. The centre-line of the proposed expressway at this point passes through a proposed cut of about 17 feet deep at a grade of elevation 1052.0.

Physiographically, the site is located in the region referred to as the "Waterloo Hills." Soils in this region are mainly well drained glacio-fluvial deposits.

3. FIELD WORK AND LABORATORY TESTING:

A total of nine sampled boreholes and sixteen dynamic cone penetration tests was carried out during the course of the

cont'd. /2 ...

3. FIELD WORK AND LABORATORY TESTING: (Cont'd.) ...

field investigation using a conventional diamond drill adapted for soil sampling purposes.

Samples were obtained using a 2" O.D. split-spoon soil sampler advanced by blows of a 140-lb. hammer falling freely a distance of 30" thus imparting an impulse of 350 ft.-lbs./blow.

The locations and elevations of all boreholes were surveyed in the field by personnel from A. D. Margison and Associates, and are shown on Drawing #66-F-53A, which accompanies this report.

Samples were visually examined in the field prior to transportation to the laboratory where they were carefully visually classified. Subsequently, combinations of the following tests were carried out on selected samples:

Atterberg Limits  
Moisture Contents  
Grain-Size Distributions

The laboratory test results are summarized on the borelog sheets attached to the Appendix of this report.

4. SUBSOIL CONDITIONS:

4.1) General:

Subsoil at the site consists of stratified glacio-fluvial deposits, mostly of fine-grained composition. Detailed descriptions of the soil in each borehole are recorded in borehole logs appended to this report, together with the inferred stratigraphical profile of the area in question, shown on Drawing #66-F-53A.

From ground level downwards, the soil types encountered were as follows:

4.2) Topsoil:

Topsoil of loose sand with traces of organics, from three to six feet in depth, was found to overlies the site area adjacent to the existing road.

cont'd. /3 ...

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

4.3) Sand with traces of Silt:

The depth of this deposit ranges from about 8 to 22 feet. The material consists mostly of sand (90%) with traces of silt (10%). 'N' values obtained from Standard Penetration tests, ranged from 9 to 47 blows/ft., indicating a loose to dense relative density.

4.4) Clayey Silt:

This deposit of grey clayey silt of low plasticity was found in B.H. No's 3, 6 and 7. 'N' values obtained by Standard Penetration tests, ranged from 16 to 34 blows/ft., indicating a very stiff to hard consistency. Tests for moisture content and Atterberg limits gave the following average values: moisture content = 16%, plastic limit = 15%, liquid limit = 20%. Based on the foregoing, the shear strength of this deposit is estimated to range from 2,000 to 4,500 p.s.f.

4.5) Fine Sandy Silt to Silty Fine Sand:

This deposit has an average moisture content of 17%. Standard Penetration tests gave 'N' values ranging from 29 to 157 blows/ft., indicating a relative density of dense to very dense.

4.6) Clayey Silt with some Sand and Gravel:

This brownish-grey deposit was found in most of the boreholes with a varying thickness from 3 feet in B.H. #10 to 10 feet in B.H. #6. Mechanical analyses indicate the following average grain-size distribution: gravel 10%, sand 27% silt 45%, clay 17%. Standard Penetration tests gave 'N' values ranging from 13 to 70 blows/ft., indicating a stiff to hard consistency. The results of Atterberg limit tests showed this soil to fall mainly in the classification of CL (clayey silt). The results of these tests are summarized as follows:

cont'd. /4 ...

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

4.6) Clayey Silt with some Sand and Gravel: (cont'd.) ...

	<u>Minimum</u>	<u>Maximum</u>	<u>Average</u>
Plastic Limit	10.6%	19.8%	14.5%
Liquid Limit	17.7%	49.1%	28.8%
Moisture Content	8.6%	22.4%	14.9%

The shear strength of this deposit is estimated to range from 2,000 to more than 4,000 p.s.f.

4.7) Silty Clay:

This silty clay of medium plasticity, was found in every borehole. The material consists of silty clay, brownish-grey in colour. It is similar to the clayey silt deposit described in Section 4.4, except with a higher plasticity and does not have the sand and gravel content. Average grain-size distribution indicated by mechanical analyses are: sand 1%, silt 48%, clay 51%. 'N' values obtained from Standard Penetration tests, ranged from 41 to 130 blows/ft., indicating a hard consistency. The results of Atterberg limit tests, showed that this deposit is classified as silty clay (CI) on the Plasticity Chart; the summary of the tests are as follows:

	<u>Minimum</u>	<u>Maximum</u>	<u>Average</u>
Plastic Limit	15.4%	22.2%	19.5%
Liquid Limit	32.5%	55.5%	43.7%
Moisture Content	14.5%	26.0%	20.7%

The shear strength of this deposit is estimated to be more than 4,000 p.s.f.

4.8) Silty Fine Sand to Fine Sandy Silt:

This deposit was found to underlie the silty clay deposit in every borehole, having an 'N' value of more than 99 blows/ft.,

cont'd. /5 ...



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

4.8) Silty Fine Sand to Fine Sandy Silt: (cont'd.) ...

and an average moisture content of 13.7%. These results indicate that this material has a very dense relative density.

4.9) Silty Clay:

This brownish-grey silty clay of medium plasticity, is found below the silty fine sand to fine sandy silt described in Section 4.6, in B.H. #2 and B.H. #4 only. The index properties are: plastic limit = 17.4%, liquid limit = 36.6%, moisture content = 17.5%. The consistency of this material is hard, as indicated by 'N' values ranging from 46 to 130 blows/ft., given by Standard Penetration tests. Based on the foregoing, the shear strength of this deposit is estimated to be more than 4,000 p.s.f.

5. GROUNDWATER:

Groundwater levels at the time of field investigation were found to range from El. 1054.2 in B.H. #14 to El. 1059.4 in B.H. #2.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct an underpass structure at this site. The bridge presently proposed is a six-span bridge structure, some 300 feet long, crossing a cut section about 17 ft. deep.

Subsoil conditions at this site are such that adequate support for spread footing type foundations can be obtained at relatively shallow depths. The proposed grade of the expressway is at approximate elevation 1052.0. It is recommended that the structure be founded on spread footings placed at or below elevation 1046.0, in which case, a safe net bearing pressure of 2.5 t.s.f. may be assumed for design purposes. This also applies to the two proposed retaining walls.

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

If perched abutments are contemplated, they may be supported on large displacement piles driven through the fill. 12-3/4" O.D. steel tube or 12" Ø precast concrete piles driven to approximate elevation 1030.0 for both abutments, should achieve a safe capacity of 50 tons/pile. As an alternative, the piers may also be supported on large displacement piles driven to approximate elevation 1025, in which event, a safe capacity of 50 tons per pile should be achieved. If the above recommendations are followed, differential settlements are expected to be of a negligible order.

Dewatering may be required in the excavation of footings when non-cohesive silt is encountered in order to prevent 'boiling'. This may be achieved by using steel sheeting driven into the impermeable cohesive clayey silt deposit which occurs at a relatively shallow depth below the proposed grade of the expressway.

No stability problems are anticipated for the proposed cuts provided standard 2:1 slopes are constructed.

7. SUMMARY:

A foundation investigation at the site of the proposed crossing of Frederick Street and the Kitchener-Waterloo Expressway is reported.

Subsoil at the site consists of stratified glacio-fluvial deposits, mostly of fine-grained composition.

It is recommended that the proposed structure and the retaining walls be supported on spread footings founded at or below elevation 1046.0. Alternative recommendations for piled foundations are also given. Differential settlements are expected to be of a negligible order.

Dewatering of footing excavations is discussed.

No stability problems are anticipated for the proposed cut with 2:1 slopes.

cont'd. /7 ...

8. MISCELLANEOUS:

The field work for this project was carried out during the period May 26 to June 6, 1966, under the supervision of Mr. D. T. Wan, Project Foundation Engineer, who also prepared this report. Mr. K. G. Selby, Supervising Foundation Engineer, generally supervised the entire project and reviewed this report. The equipment used was owned and operated by Dominion Soil Investigation Limited.

July 1966

APPENDIX I

**FOUNDATION SECTION**

CHECKED BY K.G.S. *[Signature]*


SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W		BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F.	WATER CONTENT % WP ——— W ——— WL			
1072.7	Groundlevel										
0.0						1070					
1058.8						1060					
13.9	End of borehole.										
						1050					

**FOUNDATION SECTION**

CHECKED BY K.G.S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W		
							20		40	60		
1072.4	Groundlevel											
0.0	Sand (Topsoil)					1070						
1068.4	Loose		1	SS	8							
4.0	Sand occasional trace of silt. Compact.		2	SS	24							
			3	SS	20							
			4	SS	25	1060						
			5	SS	10							
			6	SS	30							
1052.4				7	SS	28	1050					
20.0	Clayey silt with some sand and gravel Stiff to hard.		8	SS	15							
			9	SS	57							
1045.4			10	SS	71							
27.0	Silty clay Hard Brownish grey.		11	SS	44	1040						
			12	SS	194							
			13	SS	88	1030						
1028.4			14	SS	100/11"							
44.0	Fine sandy silt to silty fine sand. Very dense.		15	SS	85/6"	1020						
			16	SS	120	1010						
1013.4	Silty clay Hard Brownish grey.		17	SS	92	1000						
59.0			18	SS	46							
988.9			19	SS	130	990						
83.5	End of borehole.					980						

### FOUNDATION SECTION

JOB 66-F-53 LOCATION N 200,803.248, E 210,761.731 ORIGINATED BY D.W.  
 W.P. 634-64 BORING DATE May 31, 1966. COMPILED BY D.W.  
 DATUM Geodetic BOREHOLE TYPE Penetration & Washboring. CHECKED BY K.G.S. 

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL PLASTIC LIMIT ——— wp WATER CONTENT ——— w			BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT 20 40 60 80 100	WATER CONTENT % 15 30 45				
1071.9	Groundlevel											
0.0	Sand (Topsoil)					1070						
1067.9	Loose		1	SS	2							
4.0	Sand		2	SS	10							
	Compact to dense.		3	SS	36							
1060.9	Silty fine sand		4	SS	22	1060						
1057.9	Compact		5	SS	45							
14.0	Gravelly sand		6	SS	62							
	Dense to very dense		7	SS	27	1050						
1051.9	Clayey silt		8	SS	31							
20.0	Hard		9	SS	49							
1045.9	Grey		10	SS	108	1040						
26.0	Silty clay		11	SS	60							
	Hard											
	Brownish grey											
1032.9			12	SS	99	1030						
39.0	Silty fine sand to		13	SS	158							
	fine sandy silt.		14	SS	87 7/8"	1020						
	Very dense.											
1012.4			15	SS	50 3/4"							
59.5	End of borehole.					1010						

CHECKED BY K.G.S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT — WL		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20    40    60    80    100	PLASTIC LIMIT — WP	WATER CONTENT — W		
							SHEAR STRENGTH P.S.F.	WP      W      WL	WATER CONTENT %		
1069.3 0.0	Groundlevel										
						1060					
						1050					
1044.5 24.8	End of borehole.					1040					



DEPARTMENT OF HIGHWAYS - ONTARIO

## RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

MATERIALS &amp; TESTING DIVISION

JOB 66-F-53LOCATION N 200.821.407, E210.811.176ORIGINATED BY D.W.W.P. 634-64BORING DATE May 31, 1966.COMPILED BY D.W.DATUM GeodeticBOREHOLE TYPE Dynamic Cone PenetrationCHECKED BY K.G.S. *KL*

## SOIL PROFILE

## SAMPLES

DYNAMIC PENETRATION RESISTANCE  
BLOWS / FOOT

20 40 60 80 100

## SHEAR STRENGTH P.S.F.

LIQUID LIMIT ——— WL

PLASTIC LIMIT ——— WP

WATER CONTENT ——— W

WP ——— W ——— WL

WATER CONTENT %

BULK  
DENSITY  
Y  
P.C.F.

REMARKS

ELEV.  
DEPTH

DESCRIPTION

STRAT. PLOT

NUMBER

TYPE

BLOWS / FOOT

ELEV. SCALE

1060

1050

1040

Groundlevel

0.0

End of borehole.

20.0

DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS &amp; TESTING DIVISION

JOB 66-F-53

LOCATION N 200,919.964, E 210,802.832

ORIGINATED BY D.W.

W.P. 634-64

BORING DATE May 30, 1966.

COMPILED BY D.W.

DATUM Geodetic

BOREHOLE TYPE Penetration & Washboring.

CHECKED BY K.G.S.

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

**MATERIALS & TESTING DIVISION**

JOB 66-F-53

LOCATION N 200.844.706. E 210.861.156

ORIGINATED BY D.W.

W. P. 634-64

BORING DATE May 31, 1966.

COMPILED BY D.W.

DATUM Geodetic

BOREHOLE TYPE Penetration & Washboring.

CHECKED BY K.G.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT — WL	PLASTIC LIMIT — WP	WATER CONTENT — W	BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	20 40 60 80 100	WP	W			WL
							SHEAR STRENGTH P.S.F.	WATER CONTENT %					
								15 30 45					
1069.1	Groundlevel												
0.0	Sand (Topsoil)											Sa 88%	
	Loose											Si 12%	
1062.6			1	SS	6								
6.5	Sand with trace of silt.					1060						GWL El.	
	Compact.		2	SS	20							1058.6	
1055.1													
14.0	Clayey silt with trace of sand and gravel.		3	SS	19								
	Very stiff to hard.		4	SS	16	1050							
1046.1	Grey		5	SS	34							Sa 67%	
23.0			6	SS	100/11"		100/4"					Si 32%	
	Silty fine sand.		7	SS	100/9"	1040							
	Very dense.		8	SS	52/3"								
1036.1													
33.0	Silty clay. Hard. Brownish grey.		9	SS	80								
			10	SS	61	1030							
1023.1			11	SS	97								
46.0	Fine sandy silt. Very dense.					1020						Sa 28%	
1013.2			12	SS	110/5"							Si 72%	
55.9	End of borehole.					1010							

DEPARTMENT OF HIGHWAYS - ONTARIO

## RECORD OF BOREHOLE NO. 8

## FOUNDATION SECTION

**MATERIALS & TESTING DIVISION**

JOB 66-F-53

LOCATION N 200.939.749. E 210.847.402

ORIGINATED BY D.W.

W. P. 634-64

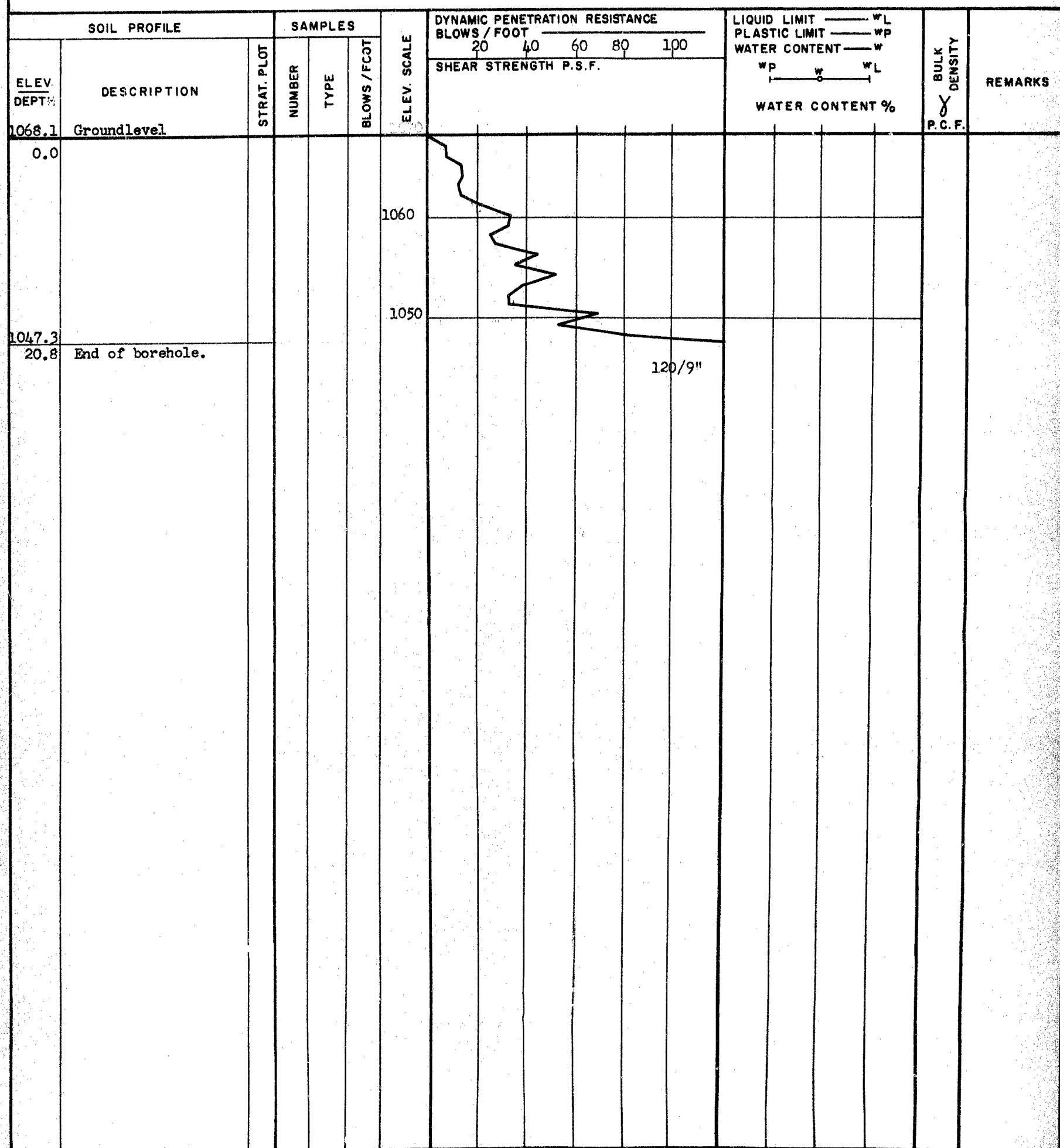
BORING DATE June 6, 1966.

COMPILED BY D.W.

DATUM Geodetic

BOREHOLE TYPE Dynamic Cone Penetration.

CHECKED BY K.G.S.



[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO		<b>RECORD OF BOREHOLE NO. 10</b>		FOUNDATION SECTION	
MATERIALS & TESTING DIVISION					
JOB <u>66-F-53</u>	LOCATION <u>N 200,955.200, E 210,895.815</u>	ORIGINATED BY <u>D.W.</u>			
W.P. <u>634-64</u>	BORING DATE <u>June 3, 1966.</u>	COMPILED BY <u>D.W.</u>			
DATUM <u>Geodetic</u>	BOREHOLE TYPE <u>Penetration &amp; Washboring</u>	CHECKED BY <u>K.G.S.</u>			

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. FLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT			WATER CONTENT %					
							30	40	60	80	100	WP			W
							SHEAR STRENGTH P.S.F.								

1067.9	Groundlevel														
0.0	Fill gravelly sand.														Sa 90% Si 10%
1064.9															
3.0	Sand with trace of silt. Loose to compact.		1	SS	9	1060									
			2	SS	29										
1053.9															
14.0	Fine sandy silt. Dense		3	SS	34	1050									
1047.9			4	SS	29										
20.0	Clayey silt with some sand & gravel. Hard.		5	SS	54										
1044.9			6	SS	99										
23.0			7	SS	77	9"1040									
			8	SS	64										
	Clayey silt to silty clay. Hard. Brownish grey.		9	SS	73	1030									
			10	SS	41										
			11	SS	45	1020									
1011.4	Fine sandy silt.		12	SS	70										
1010.6	Very dense.		13	SS	123	6"1010									Sa 5% Si 95%
57.5	End of borehole.														

Sa 90%  
Si 10%  
  
GWL El.  
1056.3

Sa 5%  
Si 95%

DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS &amp; TESTING DIVISION

JOA 66-F-53

LOCATION N 200,883.088, E 210,947.710

ORIGINATED BY D.W.

W. P. 634-64

BORING DATE May 31, 1966.

COMPILED BY D.W.

DATUM Geodetic

BOREHOLE TYPE Penetration & Washboring

CHECKED BY K.G.S.

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE						LIQUID LIMIT --- WL PLASTIC LIMIT --- WP WATER CONTENT --- W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT 20 40 60 80 100					WATER CONTENT % 15 30 45				
1068.2	Groundlevel															
0.0	Sand (Topsoil)															
1063.2	Loose		1	SS	6											
5.0	Sand with trace of silt.		2	SS	13	1060									Sa 83% Si 17%	
1057.2	Compact.		3	SS	23										GWL El. ▼ 1055.7	
11.0	Silty fine sand.		4	SS	47											
1054.2	Dense															
14.0	Clayey silt with some sand and gravel.		5	SS	32											
	Hard.		6	SS	41	1050										
1045.2			7	SS	57											
23.0	Fine sandy silt		8	SS	70										Sa 25% Si 75%	
1039.2	Very dense		9	SS	100	1040										
29.0			10	SS	132											
			11	SS	131	1030										
	Silty clay.		12	SS	62											
	Hard.		13	SS	64	1020										
	Brownish grey.		14	SS	59											
1009.2						1010										
1007.2	Fine sandy silt. Very dense.		15	SS	62	1000									Sa 26% Si 74%	
61.0	End of borehole.															

### FOUNDATION SECTION

CHECKED BY K.G.S. *[Signature]*

[illegible]



### FOUNDATION SECTION

CHECKED BY K.G.S.

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 14

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 66-F-53 LOCATION N 200,997.938, E 210,999.324 ORIGINATED BY D.W.  
W.P. 634-64 BORING DATE June 2, 1966 COMPILED BY D.W.  
DATUM Geodetic BOREHOLE TYPE Penetration & Washboring. CHECKED BY K.G.S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT 20 40 60 80 100	SHEAR STRENGTH P.S.F.			WATER CONTENT % 15 30 45			
067.2	Groundlevel													
0.0	Sand (Topsoil)													
1062.2	Compact		1	SS	11									
5.0			2	SS	14	1060								
			3	SS	18									
	Sand with trace of silt.		4	SS	15									
			5	SS	15									
	Compact.		6	SS	17	1050								
			7	SS	20									
			8	SS	28									
041.2	Silty clay with trace of sand. Hard.		9	SS	130	1040								
038.2			10	SS	100	1039"								
29.0	Sand with some silt.													
	Very dense.		11	SS	62	1030								
026.2			12	SS	93									
41.0	Silty clay.													
	Hard.		13	SS	47	1020								
015.2														
52.0	Fine sandy silt.		14	SS	109	1010								
	Very dense.													
006.2														
61.0	Silty clay													
	Hard													
000.7	Brownish grey		15	SS	120	1000								
66.5	End of borehole.													

Sa 89%  
Si 11%  
GWL El.  
1054.2  
Sa 93%  
Si 7%  
Gr 2%  
Sa 97%  
Si 1%

DEPARTMENT OF HIGHWAYS - ONTARIO

## RECORD OF BOREHOLE NO. 16

**FOUNDATION SECTION**

**MATERIALS & TESTING DIVISION**

JOB 66-F-53

LOCATION N 201,116.543, E 210,741.917

ORIGINATED BY D.W.

W. P. 634-64

BORING DATE June 3, 1966

COMPILED BY D.W.

DATUM Geodetic

BOREHOLE TYPE Penetration & Washboring

CHECKED BY K.G.S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL		BULK DENSITY P.C.F.	REMARKS			
F. EV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT		PLASTIC LIMIT — WP						
							20	40	60	80			100	WATER CONTENT — W	
							SHEAR STRENGTH P.S.F.						WATER CONTENT %		
1065.0	Groundlevel														
0.0	Sand	•••••				1060									
	Compact		1	SS	17										
1056.0		•••••													
9.0		▨▨▨▨▨	2	SS	26										
	Clayey silt to silty clay with some sand and gravel.		3	SS	62	1050									
			4	SS	111										
	Very stiff to hard		5	SS	126										
	Brownish grey.		6	SS	87	1040									
1036.0			7	SS	85										
29.0			8	SS	83										
	Silty clay														
	Hard	▨▨▨▨▨	9	SS	39	1030									
	Brownish grey.														
1024.0		▨▨▨▨▨	10	SS	105										
41.0		•••••													
	Silty fine sand.		11	SS	93 7/8	1020									
	Very dense														
1008.5		•••••	12	SS	116	1010									
56.5	End of borehole.					1000									

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 17

FOUNDATION SECTION

JOB 66-F-53 LOCATION N 200,754.293, E 210,935.966 ORIGINATED BY D.W.  
W.P. 634-64 BORING DATE June 2, 1966 COMPILED BY D.W.  
DATUM Geodetic BOREHOLE TYPE Penetration & Washboring CHECKED BY K.G.S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WP	W	WL		
1069.6	Groundlevel															
0.0	Sand															
	Loose to v. dense		1	SS	9											
			2	SS	70	1060										
1054.6			3	SS	28											
15.0	Clayey silt		4	SS	34											
	Very stiff to hard.		5	SS	22	1050										
1049.1			6	SS	27											
20.5	Fine sandy silt, v. dense		7	SS	53											
1046.6			8	SS	150/7"	1040										
23.0	Clayey silt to silty clay.		9	SS	60/6"											
	Hard.		10	SS	88											
	Brownish grey.		11	SS	75	1030										
1025.3			12	SS	68/6"											
44.2	ne sandy silt.					1020										
	very dense															
1013.8			13	SS	50/3"											
55.8	End of borehole.					1010										

Sa 91%  
Si 9%  
GWL  
El. 1057.8

Sa 1%  
Si 80%  
Cl 19%

Sa 28%  
Si 72%

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

SAND

GRAVEL

Fine

Medium

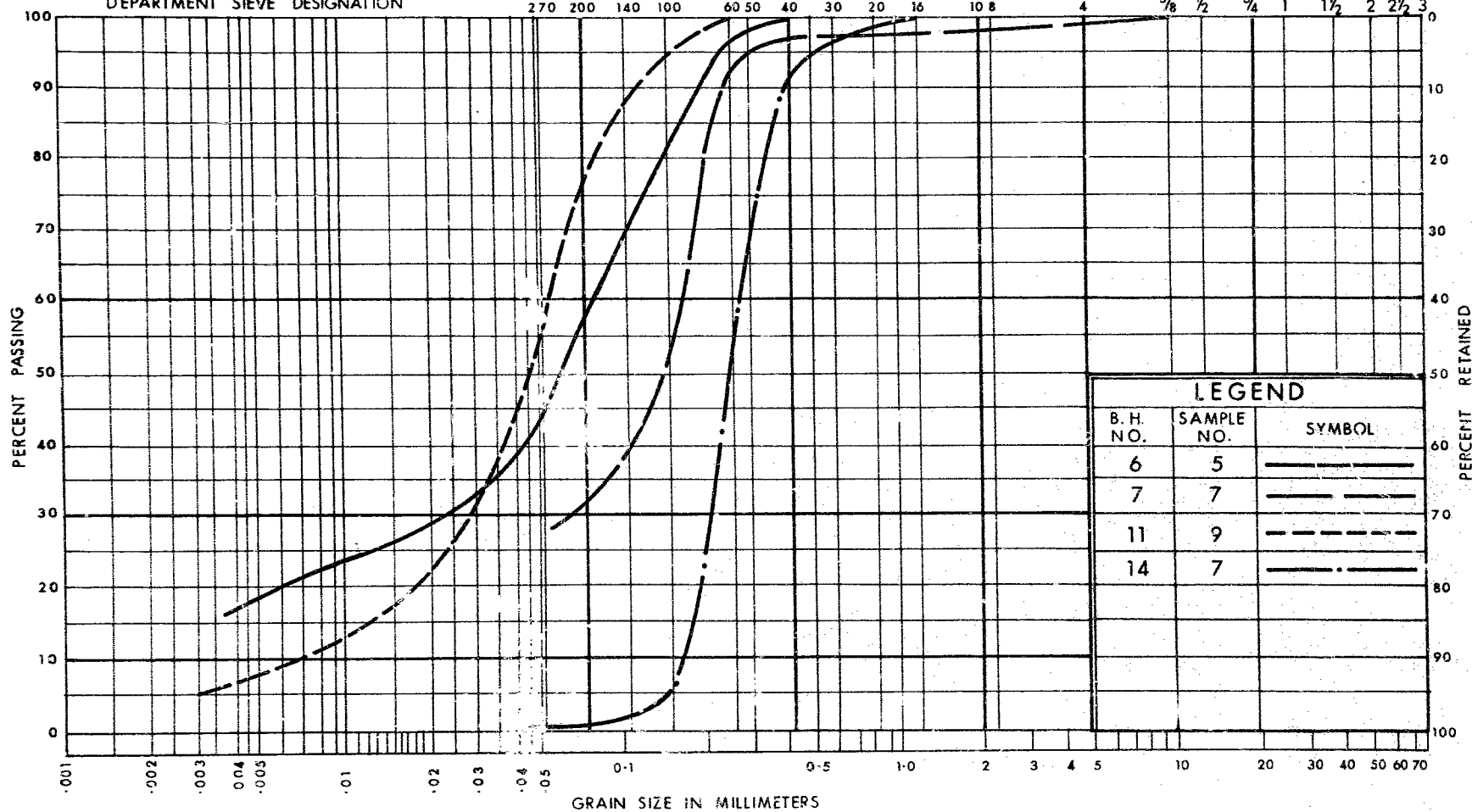
Coarse

Fine

Coarse

DEPARTMENT SIEVE DESIGNATION

270 200 140 100 60 50 40 30 20 16 10 8 4 3/8 1/2 3/4 1 1 1/2 2 2 1/2 3"



ONTARIO

DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

## GRAIN SIZE DISTRIBUTION

W.P. No. 634-64

JOB No. 66-F-53

## 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 :-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
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

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	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
$\tau_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION INTERCEPT
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_t$	SENSITIVITY

## GENERAL

$\pi$	= 3.1416
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
$\sigma$	NORMAL STRESS
$\bar{\sigma}$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

## EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
$K_0$	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
$\beta$	ANGLE OF SLOPE TO HORIZONTAL

66-F-53R

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. G. Stermac,  
Principal Foundation Engineer,  
Room 107, Lab. Bldg.

FROM: Bridge Division,  
Downsview, Ontario.

DATE: October 27, 1966.

OUR FILE REF.

IN REPLY TO:

SUBJECT: The Kitchener-Waterloo Expressway,  
Frederick Street Underpass,  
66-F-53R — W.P. 634-64,  
The Victoria Street Underpass,  
66-F-36R W.P. 635-64,  
The Wellington Street Underpass,  
66-F-43 W.P. 637-64,  
and the Bridgeport Road Overpass,  
66-F-64 W.P. 640-64,  
District No. 4.

Attached please find prints of our preliminary bridge drawings for each of the above structures.

Would you please review our plans to see that they conform with the recommendations of your Foundation Investigations and inform us of your comments and/or approval at your earliest convenience.

WSM/im  
Attach.

  
W. S. Melinyshyn,  
Regional Bridge Location Engineer.



66-F-53

Mr. S. McCombie,  
Bridge Planning Engineer,  
Bridge Division.

Foundation Section,  
Materials & Testing Div.,  
Room 107, Lab. Bldg.

Attention: Mr. W. S. Melinyshyn,  
Regional Bridge  
Location Engr.

November 15, 1966

Review of Preliminary Plans -- Kitchener-Waterloo Expressway ✓  
Frederick Street Underpass ..... W.P. 634-64-66-F-53R  
Victoria Street Underpass ..... W.P. 635-64-66-F-36R  
Wellington Street Underpass ..... W.P. 637-64-66-F-43  
Bridgeport Road Overpass ..... W.P. 640-64-66-F-64  
-- District #4 (Hamilton) --

We have reviewed the preliminary plans for the above mentioned proposed structures. We note that the designers have complied with the recommendations contained in the pertinent foundation report.

For Frederick Street Underpass, no footing elevations are shown: however, Mr. W. S. Melinyshyn advises us that the footing levels are as recommended in the foundation report.

*M. G. Selby*

KGS/MleF

K. G. Selby,  
SUPERVISING FOUNDATION ENGR.  
For:  
A. G. Stermac,  
PRINCIPAL FOUNDATION ENGR.

cc: Foundations Office ✓  
Gen. Files

**A. D. MARGISON AND ASSOCIATES LIMITED**  
**CONSULTING PROFESSIONAL ENGINEERS**

1155 LESLIE STREET, DON MILLS, ONTARIO

TELEPHONE TORONTO 447-9171

66-5-53

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JOHN T. THORPE, B. ENG., P. ENG. MECHANICAL  
ROBERT A. CUNNINGHAM, B.SC., P. ENG. SUPERVISION OF CONSTRUCTION

17th June, 1966

Mr. K. G. Selby, P. Eng.,  
Supervising Foundation Engineer,  
Department of Highways Ontario,  
Downsview, Ontario.

Re: W.P. 634-64, Kitchener-Waterloo Expressway  
Frederick Street Underpass  
Our Project No. 2121

Dear Sir:

Please find enclosed herewith a copy of tables  
listing elevations and coordinates for boreholes on the above pro-  
ject.

Yours very truly,

A. D. MARGISON AND ASSOCIATES LIMITED

Encl.  
GS:rm

  
\_\_\_\_\_  
G. Solty, P. Eng.

A.D. Margison and Associates Limited  
Consulting Professional Engineers

W.P. 634-64, Kitchener-Waterloo Expressway  
Frederick Street Underpass  
Project No. 2121

Bore Hole No.	Elevation	North Coordinates	East Coordinates
1	1072.73	200,786.159	210,719.093
3	1071.88	200,803.248	210,761.731
5	1069.78	200,821.407	210,811.176
7	1069.06	200,844.706	210,861.156
9	1069.03	200,873.400	210,912.942
11	1068.15	200,883.088	210,947.710
13	1066.95	200,914.762	211,000.220
17	1069.586	200,754.293	210,935.966
2	1072.41	200,887.529	210,709.963
4	1069.34	200,890.443	210,747.672
6	1067.69	200,919.964	210,802.832
8	1068.09	200,939.749	210,847.402
10	1067.91	200,955.200	210,895.815
12	1067.55	200,967.693	210,949.158
14	1067.23	200,997.938	210,999.324
16	1064.97	201,116.543	210,741.917