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DIST. 4 REGION

W.P. No. 72-62-00

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. 403

LOCATION Hwy 403. - 3.1 miles W of Hwy 53  
TwP RD OVERPASS

No of PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

MEMORANDUM

TO: Mr. A. P. Watt, (2)  
Reg. Structural Planning Eng.,  
Southwestern Region,  
London, Ont.

FROM: Foundations Office,  
Design Services Branch,  
West.Bldg., Downsview.

ATTENTION:

DATE: August 10, 1972

OUR FILE REF.

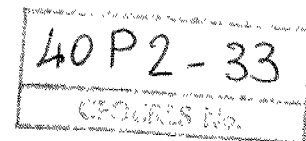
IN REPLY TO SEP 12 1972

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

The Township Rd. Overpass of Proposed  
Hwy. #403, 3.1 Mi. West of Hwy. #53  
District #4 Hamilton  
W.O. 72-11051 W.P. 72-62-00



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

We believe that the factual data and recommendations contained therein will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

AGS/ht  
Attch.

*A. G. Stermac*  
A. G. Stermac,  
PRINCIPAL FOUNDATIONS ENGINEER.

c.c. Messrs. D. W. Farren  
B. R. Davis  
A. Rutka  
A. McConnell  
C. R. Robertson  
B. J. Giroux  
J. R. Roy  
G. A. Wrong  
B. A. Singh

Foundations Files  
Documents

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FOUNDATION INVESTIGATION REPORT  
For  
The Township Rd. Overpass of Proposed  
Hwy. #403, 3.1 Mi. West of Hwy. #53  
District #4 Hamilton  
W.O. 72-11051 W.P. 72-62-00

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1. INTRODUCTION:

The results of a foundation investigation conducted at the site of the East Oxford Township Rd. overpass of proposed Hwy. #403, some 3.1 miles west of Hwy. #53, are reported. The investigation was requested by Mr. S. Jants, Bridge Planning Technician, Southwestern Region, in a memo dated March 24, 1972. This site is one of the several crossings proposed to be constructed along Hwy. #403, between the city of Brantford and Woodstock.

The field investigation was supervised by this Office, while the borehole locations were staked and surveyed by personnel of the Engineering Survey Office, Southwestern Region.

In the following sections a brief outline of the investigation and existing soil conditions are given, together with recommendations concerning structure foundations.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The Township Road at the proposed crossing site is 25 feet wide, with gravel surface. The immediate vicinity has a gently rolling or undulating landscape, the fields being well cultivated, mainly for crops and pastures. Geologically, the area in question lies at the southern extremity of the physiographic region known as the Oxford Till Plain. The surface of this region is drumlinized with good drumlines appearing south of Woodstock, where the glacial apparently overrode an older moraine. The till, forming the drumlines and flutings is a calcareous boulder loam, in which Onondaga limestone is the dominant material.

### 3. FIELD AND LABORATORY INVESTIGATION PROCEDURE:

A total of 8 boreholes and 16 dynamic cone penetration tests was carried out in the field, one hole and two dynamic cone tests being placed at each proposed footing location. The locations and elevations of the holes are marked on the plan of Drawing #72-11051A in the Appendix. Borings were implemented by a CME-45 continuous hollow stem flight auger. Subsoil was sampled by using split spoon and Shelby tube samplers, the latter which were pushed hydraulically 18" into the undisturbed soils. Standard Penetration Tests were performed with each split spoon sample by conventional techniques. Penetration resistances, expressed by the number of hammer blows of a 140 lbs. hammer falling 30" for one foot penetration, were recorded on the fieldlogs.

Upon recovery and again in the laboratory soil samples were visually examined and identified by methods adapted for the unified soil classification system. The laboratory program consisted of tests to determine natural moisture contents, Atterberg limits and grain size distributions. Unconfined compression tests were performed on undisturbed samples and undrained shear strengths and bulk densities of the soils were defined.

Laboratory and field test results are compiled on the attached borehole records.

### 4. SOIL CONDITIONS:

#### 4.1) General:

Boreholes have revealed a fairly uniform soil stratigraphy, consisting of an upper stratum of cohesive clayey silt, followed by sandy silts and gravelly sands with some clay. Portions of the latter materials are fine grained, having 50% or more silt and clay size particles. As a whole, however, the deposit is considered to be non-cohesive. Detailed descriptions of the layers are as follows:

4.2) Clayey Silt with Some Sand and Traces of Gravel:

This is the uppermost material in every borehole, extending to elevation 925 - 939 ft., some 39 - 53 ft. below ground level. Penetration resistances throughout the layer were registered to be between 6 blows per ft. and 40 blows per ft., indicating consistencies ranging from firm to hard. Laboratory unconfined compression tests performed on relatively undisturbed soil samples resulted in shear strengths of 1100 PSF up to and over 5000 PSF. Atterberg limit tests were carried out on representative samples and yielded plastic limits of 14% to 17% and liquid limits of 22% - 34%. Natural moisture contents of 11% to 17% usually lie at or below the plastic limits, suggesting that the soils are overconsolidated. Every sample tested contained some sand size particles and traces of gravel size particles. The range of the constituent gravel particles were measured to be 1 - 7%, sands 12 - 16%, silts 48 - 58% and clays 24 - 30%.

A 1 - 3 ft. thick seam of silty sand with some gravel was recorded in the borings to intercept the clayey silts around 20 ft. below groundlevel.

4.3) Sandy Silts, Silty Sands and Gravelly Sands (Glacial Till):

Underlying the clayey silts, layers of sandy silts, silty sands and gravelly sands were encountered extending to the bottom of boreholes at elevation 614 ft. - 618 ft. The material exhibits very dense relative densities, penetration 'N' values reaching 100 blows/ft. and over around elevation 920 ft. In a few occasions quick conditions occurred in the boreholes on account of the sensitivity of the silts, resulting in unreasonably low 'N' values. These values are not representative of the undisturbed density of the layer, hence, they should be disregarded. The deposit is basically non-cohesive, certain portions, however, showed very slight plasticity, with plastic limits of 11 - 14% and liquid limits of 15 - 19%. The

heterogeneous nature of the samples were manifested by the laboratory grain size analyses, resulting in 0 - 45% gravel, 5 - 61% sand, 11 - 85% silt and 1 - 19% clay size particles.

All the boreholes were terminated in the very dense zone of the deposit, some 60 - 66 ft. below groundlevel.

#### 4.4) Groundwater Conditions:

Groundwater levels were established at every borehole location to be around elevation 975 - 978 ft., corresponding to some 3 - 5 ft. below groundlevel. Since the investigations took place during a rather wet season, the observed water table may be considered to be near the high water level.

### 5. DISCUSSION AND RECOMMENDATIONS:

#### 5.1) General:

Hwy. #403 is proposed to cross East Oxford Township Road between Lots #12 and #13 with a three-span structure. The grade of Hwy. #403 W.B.L. is designed to be at geodetic elevation 1000 ft., the E.B.L. at elevation 998 ft. The grade of the Township Road will be lowered some 2 ft., to be at elevation 979 ft. It is assumed that the overpass structure will be constructed with perched abutments.

Underlying a 39 ft. - 53 ft. deep deposit of clayey silt, layers of sandy silt, silty sand and gravelly sand were observed in the boreholes. The latter materials have generally very dense relative density.

#### 5.2) Foundations:

Beneath a 4 - 5 ft. surficial layer, the clayey silts have stiff to very stiff consistency. It is believed that spread footings might be considered for both structures within this stiff to very stiff zone. Safe loads of 2 t.s.f. may be designed on spread footings, placed at or below elevation 975 ft. under the proposed west-bound structure and at or below elevation 974 ft.

under the east-bound structure. In the event of adopting this type of foundations, a minimum cover of four ft. should be provided at the footing bases.

The clayey silt soils have a tendency to swell and soften under the influence of water. A lean concrete working slab may be poured at the base of the excavations, if they remain open for some time.

If the suggested design load does not lend itself to the economical design of spread footings, the structure ought to be supported on piles. Piles beneath the abutments as well as beneath the piers should be driven in accordance with Standard BD-82-7, using designed loads of 70 Ton/pile. For estimating purposes, elevations where above loads may be reached on 12 3/4 inch diameter tubular piles, are tabulated below:

Structure	Footing	Assumed Pile Tip Elevations (Ft.)
East Bound Structure	East Abutment	910 - 915
	East Pier	917 - 922
	West Pier	917 - 922
	West Abutment	915 - 920
West Bound Structure	East Abutment	912 - 918
	East Pier	912 - 918
	West Pier	912 - 918
	West Abutment	910 - 915

Pile caps at the abutments may be poured within the approach fills, piles being driven through the fills. In this case, care should be taken not to place bouldery material in the fill at the abutment locations. At least four ft. cover should also be maintained for the pile caps for frost protection.

No major dewatering scheme will be necessary for the excavations. Probable seepage could be handled by conventional open pumping.



The shear strength of the subsoil is sufficient to ensure the stability of the proposed approach fills, provided that they are built with 2 horizontal to 1 vertical slopes.

6. MISCELLANEOUS:

The field investigation, carried out during the period May 13 - 31, 1972 was supervised by Mr. P. Martin, Engineering Student.

Equipment used was owned and operated by Johnston Drilling Company Ltd., Toronto.

This report was prepared by Mr. A. K. Barsvary, Senior Foundations Engineer, and reviewed by Mr. K. G. Selby, Supervising Foundations Engineer.



*A. K. Barsvary*

A.K. Barsvary, P. Eng.

*K. G. Selby*

K.G. Selby, P. Eng.

AKB/ht

August 8, 1972

APPENDIX I

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— $w_L$		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT ——— $w_p$	WATER CONTENT ——— $w$		
							○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB. VANE	$w_p$ ——— $w$ ——— $w_L$ WATER CONTENT %				
981.4	Ground Level											
0.0												
970.4												
11.0	End of Cone Test					970						
						960						

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 72-11051

LOCATION 100 + 55 50' Rt. &amp; Twp. Rd.

ORIGINATED BY PM

W.P. 72-62-00

BORING DATE May 25, 1972

COMPILED BY PM

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— $w_L$ PLASTIC LIMIT ——— $w_p$ WATER CONTENT ——— $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS					
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							20 40 60 80 100					1000 2000 3000 4000 5000					$w_p$ ——— $w$ ——— $w_L$				
																	10 20 30				
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB. VANE															
980.5	Ground Level					980															
0.0	Clayey silt with some sand and traces of gravel.  Stiff to Very stiff  Brown becoming Grey		1	TW	PH										136	976.1 4 12 58 26          3 15 57 25					
			2	SS	19																
			3	TW	PM	970									134						
			4	SS	21																
			5	SS	20																
			6	SS	16	960															
			7	TW	PH										139						
			8	SS	21	950															
			9	TW	PH										136						
			10	SS	16	940															
			11	TW	PH										136						
932.5	Sandy silt with some clay & gravel.  Compact to Very Dense  Grey		12	SS	13	930										9 37 40 14					
			13	SS	62																
			14	SS	100/12"	920															
			15	SS	100/14"																
916.5	End of Borehole																				
64.0																					

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 72-11051  
W.P. 72-62-00  
DATUM Geodetic

LOCATION 101 + 22 21' Rt. 0 Twp. Rd.  
BORING DATE May 24, 1972  
BOREHOLE TYPE Hollow Stem Auger

ORIGINATED BY PM  
COMPILED BY PM  
CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— w <sub>L</sub> PLASTIC LIMIT ——— w <sub>p</sub> WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					w <sub>p</sub> ——— w ——— w <sub>L</sub>							
							20 40 60 80 100												
							SHEAR STRENGTH P.S.F.					WATER CONTENT %							
							1000 2000 3000 4000 5000					10 20 30							
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE												
980.2	Ground Level					980													
0.0	Clayey silt with some sand & traces of gravel.  Seam of silty sand with gravel  Stiff to Hard  Brown Becoming Grey  Sandy silt with some clay and gravel.  Compact to very Dense Grey		1	SS	12														139   <



FOUNDATION SECTION

ORIGINATED BY PM

COMPILED BY PM

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION		RESISTANCE		LIQUID LIMIT		BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT				W <sub>L</sub>			
											W <sub>p</sub>			
							SHEAR STRENGTH P.S.F.				WATER CONTENT %			
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE				W <sub>p</sub> — W — W <sub>L</sub>			
980.2	Ground Level					980								GR. SA. SI. CL.
0.0														
970.2														
10.0	End of Cone Test					970								
						960								

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 72-11051

LOCATION 100 + 70 14' Lt. &amp; Twp. Road

ORIGINATED BY PM

W.P. 72-62-00

BORING DATE May 17, 1972

COMPILED BY PM

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — W <sub>L</sub> PLASTIC LIMIT — W <sub>P</sub> WATER CONTENT — W			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	W <sub>P</sub>	W	W <sub>L</sub>			
979.2	Ground Level						SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE 1000 2000 3000 4000 5000					WATER CONTENT % 10 20 30					
0.0	Clayey silt with some sand and traces of gravel.  Firm to Very Stiff  Brown becoming Grey		1	SS	6												
			2	SS	19												
			3	TW	PH	970											
			4	SS	18												
			5	SS	15												
			6	SS	11	960											
			7	SS	18												
			8	TW	PM												
			9	SS	22	950											
			10	SS	29												
			11	SS	19	940											
			12	SS	16												
			13	SS	18	930											
925.7	Gravelly sand, some silt, traces of clay  Very Dense		14	SS	70												
53.5			15	SS	100/6"	920											
916.0	Grey		16	SS	100/2"												
63.2	End of Borehole																



DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 72-11051

LOCATION Sta. 101 + 37 51' Lt. Ø Twp. Rd.

ORIGINATED BY PM


W.P. 72-62-00


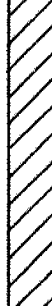



BORING DATE May 23, 1972

COMPILED BY PM

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY 

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					WATER CONTENT %					
							SHEAR STRENGTH P.S.F.					$w_p$ — $w$ — $w_L$					
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE										
981.1	Ground Level						20	40	60	80	100						
0.0	Clayey silt with some sand		1	SS	8	980											
			2	TW	PH											139	
			3	SS	26	970											
			4	SS	15												
			5	TW	PM											136	
963.1	Seam of silty sand with gravel and traces of gravel.																
18.0			6	SS	9	960											18 60 16 6
960.1			7	SS	16												2 16 55 27
21.0			8	TW	PH	950										139	
			9	SS	24												
	Stiff to Hard.		10	SS	10	940											
			11	SS	20												
929.6	Brown becoming Grey		12	SS	31	930											
			13	SS	14												
51.5			14	SS	56	920											
915.1	Compact to Very Dense		15	SS	100/12"											27 50 17 6	
66.0																	
	End of Borehole																

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No.8

FOUNDATION SECTION

JOB 72-110-51

LOCATION Sta. 100 + 78 57' Lt. Ø Twp. Rd.

ORIGINATED BY PM

W.P. 72-62-00

BORING DATE May 23, 1972

COMPILED BY PM

DATUM Geodetic

BOREHOLE TYPE Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_P$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT 20 40 60 80 100					SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE				
980.3	Ground Level					980										
0.0																
969.3						970										
11.0	End of Cone Test															

FOUNDATION SECTION

ORIGINATED BY PM

COMPILED BY PM

CHECKED BY 

[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 10

FOUNDATION SECTION

JOB 72-11051

LOCATION Sta. 99 + 25 50' Rt. 0 Twp. Rd.

ORIGINATED BY PM

W.P. 72-62-00

BORING DATE May 30, 1972

COMPILED BY PM

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY *AK*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w <sub>L</sub> PLASTIC LIMIT — w <sub>p</sub> WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.						
							20 40 60 80 100					1000 2000 3000 4000 5000						
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE					w <sub>p</sub> — w — w <sub>L</sub>						
978.4	Ground Level																	
0.0	Clayey silt with some sand  and  Seam of silty sand with gravel traces of gravel.  Stiff to very Stiff  Brown becoming Grey		1	TW	PM									134	WL not observed			
			2	SS	29											137		
			3	TW	PH													
			4	SS	11													
			5	SS	10												1 14 55 30	
959.4			6	TW	PH												140	
19.0			7A	SS	11													1 73 18 8
956.4			8	TW	PH												138	
22.0			9	SS	25													
			10	TW	PH												135	
938.0	Sandy silt to silty sand, some clay and gravel.  Compact to Very Dense  Grey		11	SS	25											0 15 75 10		
40.4			12	SS	24													
			13	SS	24												0 5 85 10	
			14	SS	44												16 38 33 13	
			15	SS	130/9"													
917.6	End of Borehole																	
60.8																		

DEPARTMENT OF HIGHWAYS- ONTARIO

MATERIALS &amp; TESTING OFFICE

## RECORD OF BOREHOLE No.11

FOUNDATION SECTION

JOB 72-11051

LOCATION Sta. 99 + 85 21' Rt. 0 Twp. Rd.

ORIGINATED BY PM

W.P. 72-62-00

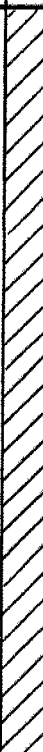


BORING DATE May 29, 1972

COMPILED BY PM

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS					
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							20	40	60	80	100						$w_p$	$w$	$w_L$		
												1000	2000	3000			4000	5000			
978.4	Ground Level																				
0.0	Clayey silt with some sand and traces of gravel.  Stiff to Very Stiff  Brown becoming Grey		1	SS	8	970													WL not observed  136.5  137.5  138  137  0 22 65 13 18 15 48 19  45 36 (19)		
			2	TW	PH																
			3	SS	23																
			4	TW	PH																
			5	SS	17																
			6	SS	13	960															
			7	SS	23																
			8	TW	PH																
			9	SS	15	950															
			10	TW	PH																
938.9	Sandy silt and gravelly sand with some clay.  Compact to Very Dense  Grey		11	SS	13	940															
39.5			11A	SS	13																
			12	SS	17																
			13	SS	17	930															
			14	SS	100/10"																
917.1	End of Borehole		15	SS	100/5"	920															
61.3																					

DEPARTMENT OF HIGHWAYS- ONTARIO MATERIALS & TESTING OFFICE		<h2 style="margin: 0;">RECORD OF BOREHOLE</h2> No. 12		FOUNDATION SECTION
JOB <u>72-11051</u>	LOCATION <u>Sta. 99 + 27 21' Rt. 0 Twp. Rd.</u>	ORIGINATED BY <u>PM</u>		
W.P. <u>72-62-00</u>	BORING DATE <u>May 31, 1972</u>	COMPILED BY <u>PM</u>		
DATUM <u>Geodetic</u>	BOREHOLE TYPE <u>Cone Test</u>	CHECKED BY <u>SR.</u>		

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION		RESISTANCE		LIQUID LIMIT		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	20	40	60	80	100		
978.2	Ground Level						SHEAR STRENGTH P.S.F.				WATER CONTENT %			
0.0							○ UNCONFINED ● QUICK TRIAXIAL		+ FIELD VANE x LAB. VANE		W <sub>P</sub> — W — W <sub>L</sub> WATER CONTENT %			
966.2						970								
12.0	End of Cone Test					960								

15  $\overset{20}{\circ}$  5 % STRAIN AT FAILURE

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 14

FOUNDATION SECTION

JOB 72-11051      LOCATION Sta. 99 + 30 6' Lt. Ø Twp. Road      ORIGINATED BY PM

W.P. 72-62-00      BORING DATE May 16, 1972      COMPILED BY PM

DATUM Geodetic      BOREHOLE TYPE Hollow Stem Auger      CHECKED BY *SR*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — W <sub>L</sub> PLASTIC LIMIT — W <sub>P</sub> WATER CONTENT — W			BULK DENSITY γ P.C.F.	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					WATER CONTENT %						
							20 40 60 80 100					W <sub>P</sub> — W — W <sub>L</sub>						
							SHEAR STRENGTH P.S.F.					10 20 30						
						1000 2000 3000 4000 5000												
978.6	Ground Level																	
0.0	Clayey silt with some sand  and  Sandy silt  traces of gravel.  Stiff to Very Stiff  Brown becoming Grey		1	SS	15	970										137	1 12 57 30	
			2	SS	19													
			3	SS	26													
			4	SS	16													
			5	TW	PM													
			6	SS														
958.1			6A	SS	20													
21.5				7	SS			20										
				8	SS			18										
				9	TW			PH										
937.3		10	SS	9														
41.3	Sandy silt, traces of clay and gravel.  Compact to Very Dense  Grey					930										136	0 26 67 7	
			11	SS	11													
			12	SS	100/7"													
			13	SS	100/3"													
918.3		14	SS	100/1"													3 46 50 1	
60.3	End of Borehole															9 36 47 8		



DEPARTMENT OF HIGHWAYS- ONTARIO		<b>RECORD OF BOREHOLE No.15</b>		FOUNDATION SECTION	
MATERIALS & TESTING OFFICE					
JOB 72-11051	LOCATION	Sta. 99 + 91 50' Lt. Ø Twp. Rd.		ORIGINATED BY PM	
W.P. 72-62-00	BORING DATE	May 19, 1972		COMPILED BY PM	
DATUM Geodetic	BOREHOLE TYPE	Hollow Stem Auger		CHECKED BY <i>[Signature]</i>	

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_P$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %					
							20 40 60 80 100					10 20 30					
978.6	Ground Level																
0.0	Clayey silt with some sand and trace of gravel.  Stiff to Very Stiff  Brown becoming Grey		1	SS	17											WL not observed  137.5  136  137.5 3 15 55 27  137         30 48 18 4	
			2	TW	PH												
			3	SS	21												
			4	TW	PH												
			5	SS	11												
			6	TW	PM												
			7	SS	23												
			8	TW	PH												
			9	SS	21												
			10	SS	18												
			11	SS	12												
928.6	Sandy silt and gravelly sand, traces of clay.  Loose to Very Dense		12	TW	PH												
50.0			13	SS	7												
			14	SS	95												
918.0	End of Borehole		15	SS	100/7"												
60.6																	

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 16

FOUNDATION SECTION

JOB	<u>72-11051</u>	LOCATION	<u>Sta. 99 + 32 57' Lt. Ø Twp. Rd.</u>	ORIGINATED BY	<u>PM</u>
W.P.	<u>72-62-00</u>	BORING DATE	<u>May 31, 1972</u>	COMPILED BY	<u>PM</u>
DATUM	<u>Geodetic</u>	BOREHOLE TYPE	<u>Hollow Stem Auger</u>	CHECKED BY	<u><i>[Signature]</i></u>

SOIL PROFILE			SAMPLES			ELEV. SCALE ELEV. FEET	DYNAMIC PENETRATION BLOWS / FOOT	RESISTANCE	LIQUID LIMIT ———— w <sub>L</sub>	PLASTIC LIMIT ———— w <sub>p</sub>	WATER CONTENT ———— w	BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT % w <sub>p</sub> ———— w ———— w <sub>L</sub>				
							20    40    60    80    100						
								○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    x LAB. VANE					
977.6	Ground Level												
0.0													
967.6						970							
10.0	End of Cone Test					960							

## 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
$\phi'$	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
$\sigma'$	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

## 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:-

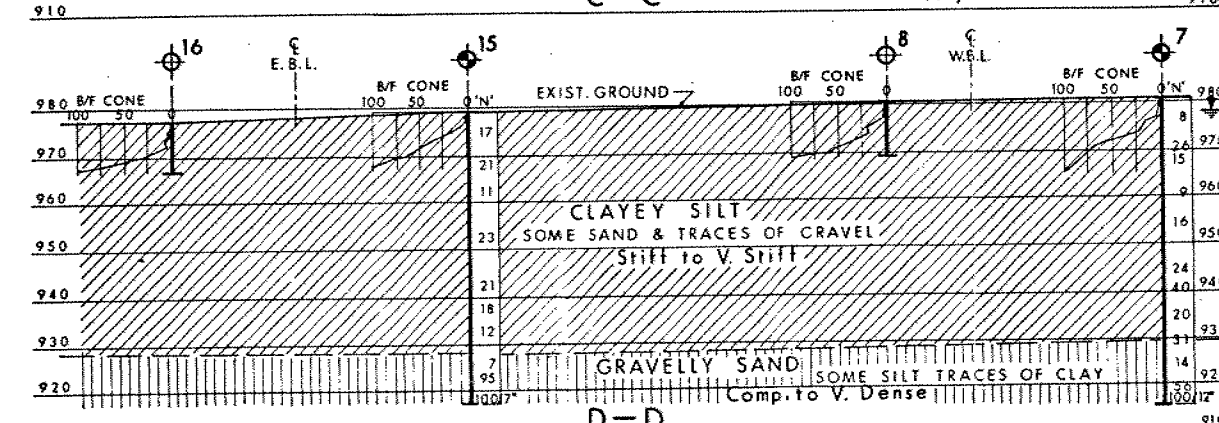
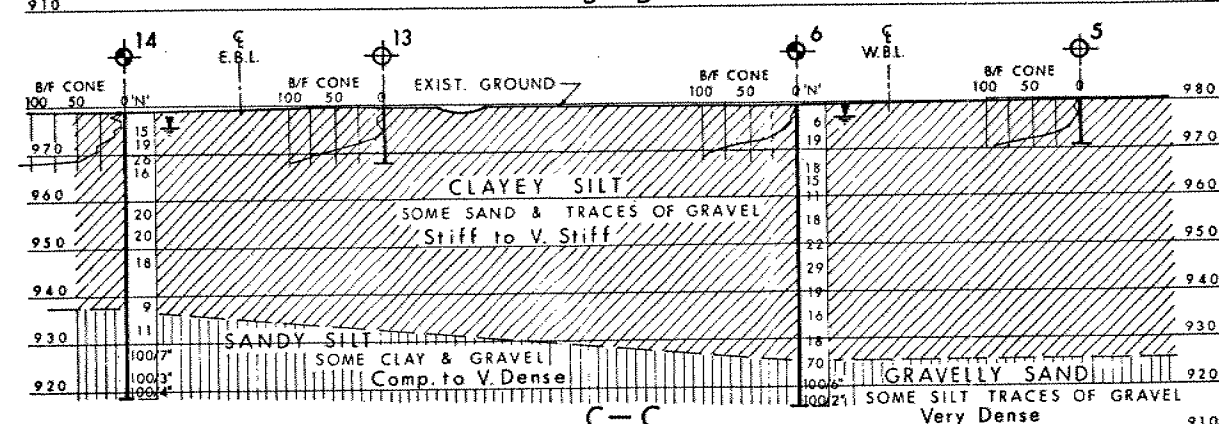
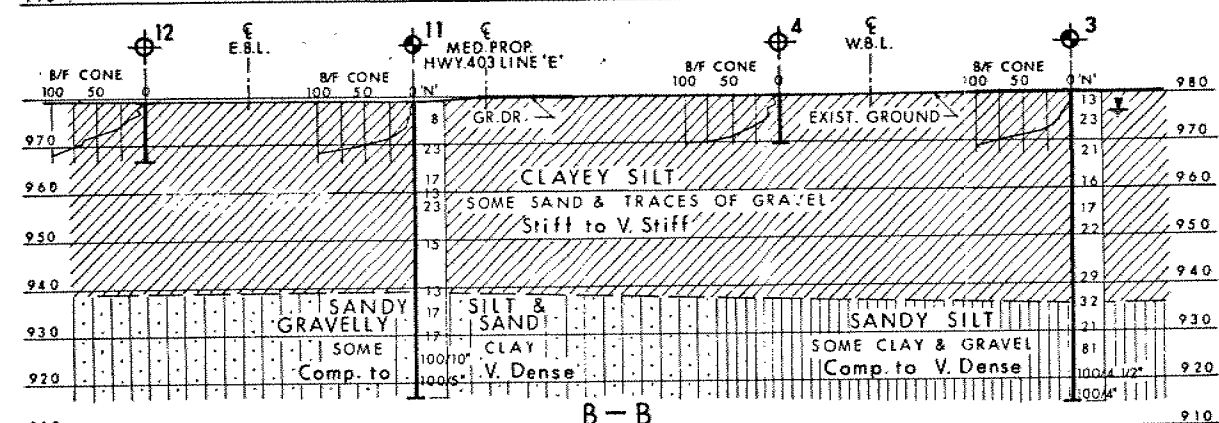
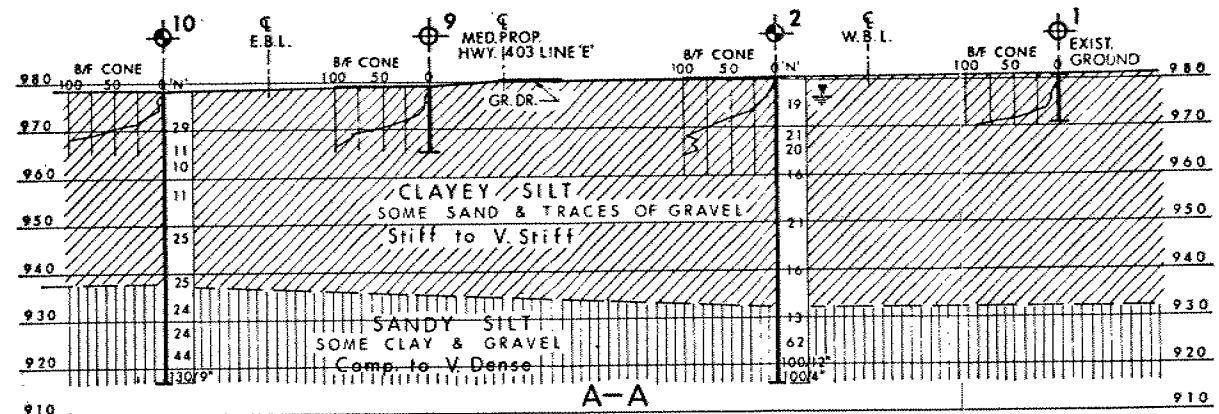
<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	>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

### TYPE OF SAMPLE

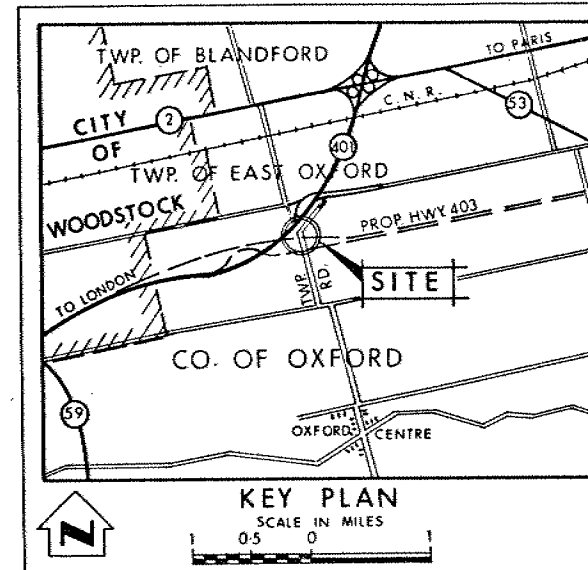
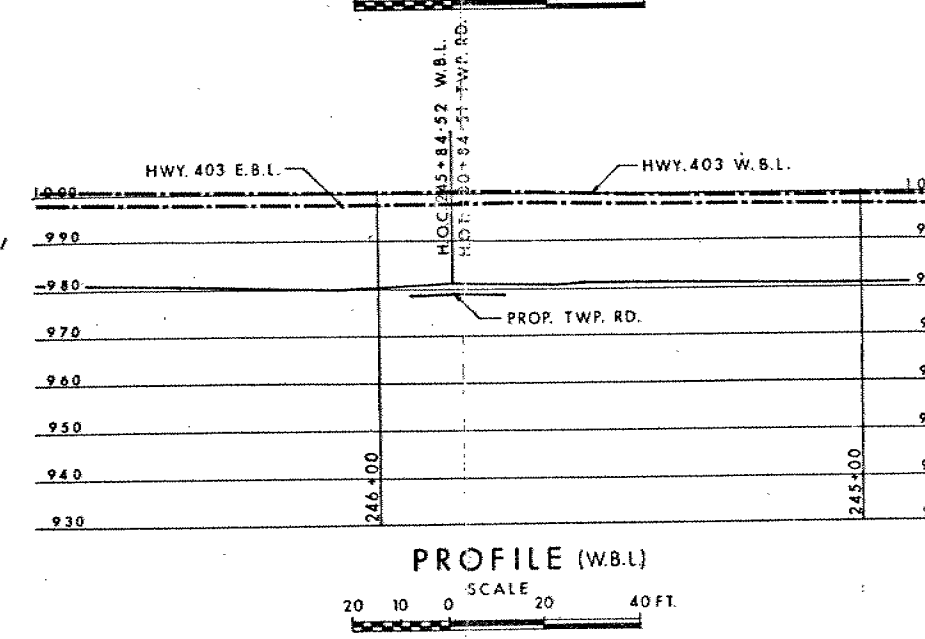
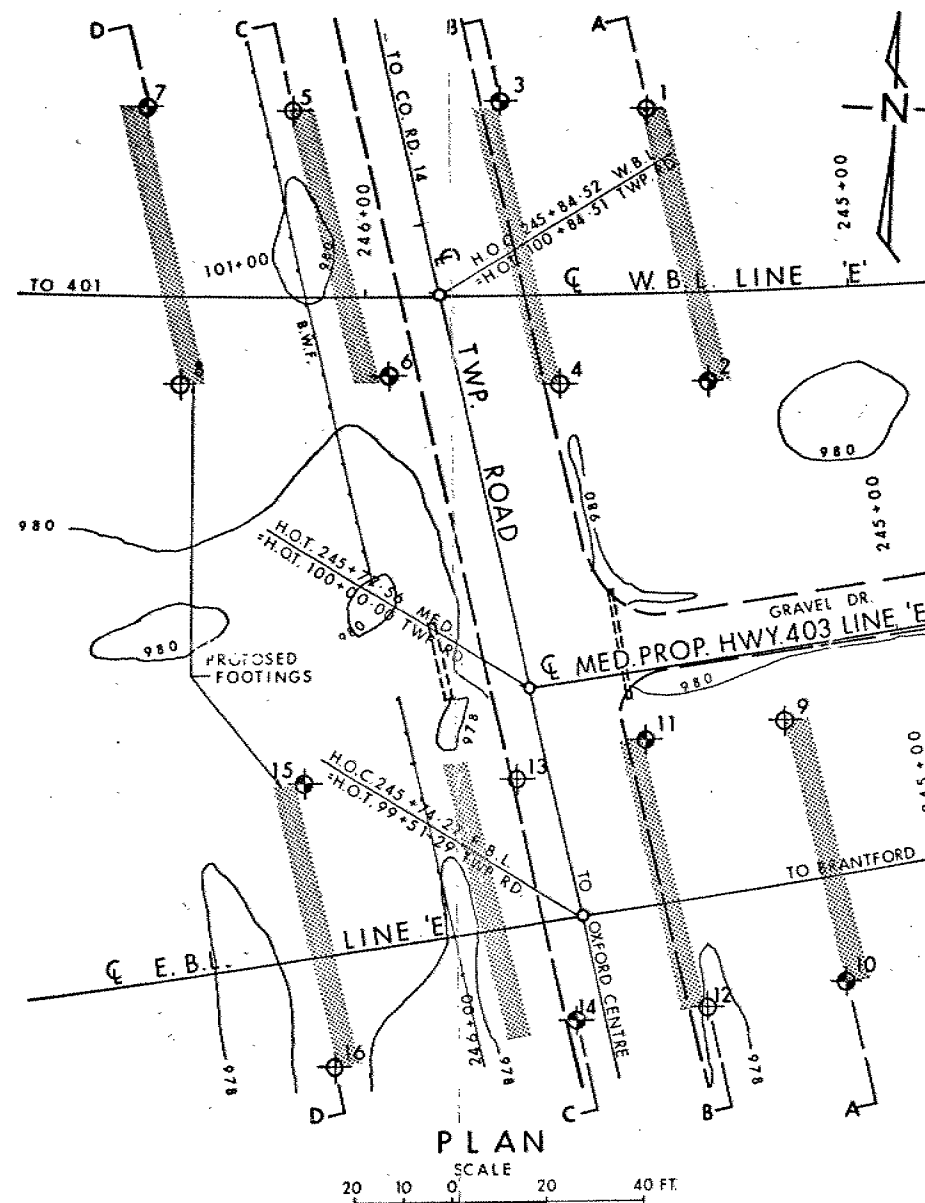
S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

### 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



**SECTIONS**  
SCALE 20 10 0 20 40 FT.



**LEGEND**

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation, May 1972
- Water Levels Not Established In Bore Holes 10, 11, & 15.

NO.	ELEVATION	STATION	OFFSET
1	981.4	101+13	51' RT.
2	980.5	100+55	50' RT.
3	980.2	101+22	21' RT.
4	980.0	100+61	20' RT.
5	980.2	101+29	21' LT.
6	979.2	100+70	14' LT.
7	981.1	101+37	51' LT.
8	980.3	100+78	57' LT.
9	978.7	99+82	50' RT.
10	978.4	99+25	50' RT.
11	978.4	99+85	21' RT.
12	978.2	99+27	21' RT.
13	979.1	99+82	7' LT.
14	978.6	99+30	6' LT.
15	978.6	99+91	50' LT.
16	977.6	99+32	57' LT.

**— NOTE —**  
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

**MINISTRY OF TRANSPORTATION & COMMUNICATIONS**  
DESIGN SERVICES BRANCH FOUNDATIONS OFFICE

**TOWNSHIP ROAD**

HIGHWAY NO. 403 LINE 'E' DIST. NO. 4  
CO. OXFORD  
TWP. EAST OXFORD LOT 12 & 13 CON. 2

**BORE HOLE LOCATIONS & SOIL STRATA**

SUBMD. P. K. CHECKED <input checked="" type="checkbox"/>	W.P. NO. 72-62	DRAWING NO. 72-11051A
DRAWN O.L. CHECKED <input checked="" type="checkbox"/>	JOB NO. 72-11051	BRIDGE DRAWING NO.
DATE 28 AUG. 1972	SITE NO.	CONT. NO.
APPROVED <i>[Signature]</i>	PRINCIPAL FOUNDATION ENGINEER	