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G.I.-30 SEPT. 1976

GEOCRES No. 40P1-52

DIST. 4 REGION

W.P. No. 156-60-00

CONT. No.

W. O. No.

STR. SITE No. 1-140

HWY. No. 403

LOCATION CNR O'HEAD

(0.4 MILES West of BRANTFORD W. Limits)

No OF PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

MEMORANDUM

TO: Mr. G. C. E. Burkhardt, (2) FROM: Foundations Office,
Regional Bridge Planning Engineer, Design Services Branch,
Central Region, Central Bldg., Downsview.
90 Floral Pkwy., Downsview.

ATTENTION: DATE: February 17, 1972.

OUR FILE REF. IN REPLY TO MAR 1 1972

SUBJECT:

40 P1 - 52
GEOCREC No.

FOUNDATION INVESTIGATION REPORT

For

The C.N.R. Overhead of Hwy. #403, Line 'K'
0.4 Mi. West of Brantford W. Limits
District #4 (Hamilton)
W.O. 71-11107 - W.P. 156-60-00

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/ao
Attach.

cc: Messrs. D. W. Farren
B. R. Davis
A. Rutka
G. K. Hunter
C. R. Robertson
B. J. Giroux
T. J. Kovich
G. A. Wrong
B. A. Singh

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER.

Foundations Files ✓
Documents

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FOUNDATION INVESTIGATION REPORT

For

The C.N.R. Overhead of Hwy. #403, Line 'K'
0.4 Mi. West of Brantford W. Limits
District #4 (Hamilton)
W.O. 71-11107 - W.P. 156-60-00

1. INTRODUCTION:

A foundation investigation was requested at the site of the proposed C.N.R. overhead of Hwy. #403, Line 'K', 0.4 Mi. West of Brantford W. limits, by Mr. A. P. Watt, Regional Bridge Planning Engineer, Southwestern Region. The memo containing the request was dated September 29, 1971.

A foundation investigation had already been carried out in 1965 for Hwy. #403, Line 'A', approximately 100 ft. south of the present proposal. The results of this previous investigation were compiled in a report numbered 65-F-33. Some additional boreholes were found to be necessary at the locations of the proposed footings along Line 'K', and these were carried out under the supervision of this Office. The borings were staked out and surveyed by personnel of the Engineering Surveys Office of the Southwestern Region.

Following are the results of the investigations, together with recommendations concerning foundations and approach fill stability.

2. DESCRIPTION OF THE SITE, FIELD AND LABORATORY INVESTIGATIONS:

The vicinity of the proposed crossing is gently undulating terrain, occupied by farmlands and some woods. At the present time the C.N.R. line consists of two tracks with provision to build two additional tracks in the future. Geologically the area belongs to the Horseshoe moraines physiographic region. This eastern arm of the horseshoe is more hilly and stony than

the rest, and the drift contains much less clay and more gravel and sand. The terraces are important sources of gravel, large sand and gravel pits are located at this area.

A total of five boreholes and eight cone penetration tests, numbered 9-16 inclusive was carried out during the recent field work. Some additional eight boreholes, numbered 1-8 inclusive, drilled in 1965 were also incorporated in this report. The locations and elevations of the borings are shown on Drawing #71-11107A in the Appendix, together with the estimated stratigraphical sections at the proposed footing locations. Borings were implemented by means of a hollow stem auger (C.M.E.) taking samples at frequent intervals. Split-spoon samplers were advanced by performing Standard Penetration Tests. Penetration resistances (N = blows per ft.) as well as the results of the laboratory tests are marked on the attached borelog sheets.

All the soil samples were visually examined upon recovery and again in the laboratory. Specimens were further tested in the laboratory in order to determine natural moisture contents and grain-size distributions of the subsoil.

3. SOIL CONDITIONS:

The soil stratigraphy was found to be fairly uniform, consisting of granular deposits of silty fine sands to fine sandy silts, with traces of clay and pockets of gravel. The relative density of the uppermost 6-10 ft. is generally loose with penetration "N" values of 5-10 blows per ft. At the locations of the west abutments, however, the depth of loose sand was noted to extend to some 19-20 ft. below ground level, to elevation 772 ft. Below the loose surficial sands the density increases rapidly, with penetration resistances ranging from 60 blows per ft. to well above 100 blows per ft.

Numerous grain-size analyses were performed in the laboratory resulting in rather steep particle size curves, indicating uniform grain-size distributions. The constituent

particle sizes of the tested samples, expressed in percent, are marked on the borelogs.

The groundwater level was observed to lie between elevation 758 ft. and 764 ft., some 28-35 ft. below existing ground surface.

4. DISCUSSION AND RECOMMENDATIONS:

4.1) General:

The proposal calls for a three span twin overhead structure at the crossing of CAH #403 and the C.N.R. tracks. The future grade of the highway will be roughly at elevation 826-827 ft. with approach fills of 34-35 ft. heights. It is assumed that the abutments will be perched with 2 horizontal to 1 vertical slopes.

Beneath the loose surficial sands the very dense granular deposits are competent materials to support the structure on spread footings. Recommendations pertaining to the various footing locations are as follows.

4.2) East Abutment:

Spread footings may be designed for the skewed as well as for the square structure and the probable adjacent retaining walls. Footings should be placed at a minimum depth of 7 ft. below existing ground level. 3 TSF safe loads may be used for design purposes at the suggested depths. Due to the sloping ground surface, there is a gradient of approximately 15-16 ft. between the north end of the westbound structure footing and the south end of the eastbound footing. Since the eventual length of the individual footings will be around 100-140 ft. it would appear economical to step the footings, maintaining the recommended 7 ft. distance between existing ground level and the underside of the footings. Perched abutments may also be supported on large displacement piles, pile caps being formed within the fill. In using 12-3/4" O.D. steel tubes, driven to approx. elevation 760 ft. safe design loads of 70 ton per pile may be achieved. Pile driving should be controlled in the field by means of the Hiley formula according to DTC Standards #DD-1218 and 1219.

.....4

4.3) East Pier:

Spread footings may be designed for the east pier as well; excavations, however, of some 10-14 ft. will be necessary to reach the competent bearing stratum. Spread footings for the westbound structure should be placed at elevation 785 ft. at the north end stepping down to elevation 779 ft. at the south end. The north end of the eastbound footing may be put at elevation 778 ft., the south end being at elevation 772 ft. with steps in between. Design loads of 3 TSF may be used on above footings.

As an alternative, footings may be placed at 4 ft. below finished ground and supported on piles. It is anticipated that 12-3/4" O.D. steel tubes, having some 20 ft. embedded lengths will support loads of 70 tons per pile. Notwithstanding pile driving should be controlled by the Hiley formula as mentioned earlier.

4.4) West Pier:

Subsoil conditions under the west pier were found to be similar to the ones beneath the east pier. Again spread footings may be built with safe loads of 3 TSF; the base of the footing beneath the westbound lane being placed at elevation 788 ft. at the north end, stepping down to elevation 782 ft. at the south end. The corresponding footing elevations under the eastbound lane structure are 781 ft. below the north end and 778 ft. below the south.

If piled foundation is preferred, it may also be implemented according to the recommendations given for the east pier.

4.5) West Abutment:

In view of the rather extensive depth of the loose material at the location of the west abutments, the construction of spread footings appear to be uneconomical. As a consequence, piled foundations are suggested, piles being driven through the approach fills and pile caps formed within the fill. It is estimated that 12-3/4" O.D. steel tubes, driven to approximate elevation 765 ft. will develop safe bearing pressures of 70 tons per pile. Loads should be checked during pile driving as suggested earlier.

4.6) General Comments:

- a) No bouldery material should be placed in the fill at the locations of the abutments, if piled foundations are adopted.
- b) No dewatering scheme will be necessary for the excavations in view of the deep groundwater levels.
- c) No stability problems are foreseen for the approach fills, provided that they are constructed with 2 horizontal to 1 vertical slopes.

5. MISCELLANEOUS:

The field work was carried out during the period of January 10-12, 1972, under the supervision of Mr. P. Korgemagi, Project Foundation Engineer. Equipment used was owned and operated by PVK Drilling Company, Burford, Ontario.

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

A. K. Barsvary
A. K. Barsvary, P. Eng.

K. G. Selby
K. G. Selby, P. Eng.

AKB/ao
Feb. 15/72



APPENDIX I

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1 (65-F-33) FOUNDATION SECTION

JOB 73-11107 LOCATION Hwy. 403 Line 'K' Sta. 346 + 90 o/s 62' Lt. ORIGINATED BY WVK
W.P. 156-60-00 BORING DATE March 29-30, 1965 COMPILED BY WVK
DATUM Geodetic BOREHOLE TYPE Washboring BX Casing CHECKED BY J.R.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w		BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80		
777.4	Ground Level											
775.4	Black Org. Topsoil											
2.0			1	SS	6							
			2	SS	5 1/2							
			3	SS	73							
			4	SS	43							
			5	SS	52							
			6	SS	100							
			7	SS	115/11"							
			8	SS	147/10"							
			9	SS	152/9"							
730.9												
46.5	End of Borehole											

770
760
750
740
730

for 9"

771.3

Loose to Very Dense

Silty sand to sandy silt with traces of clay and gravel.

RECORD OF BOREHOLE No.2 (65-F-33) FOUNDATION SECTION

JOB 71-11107 LOCATION Hwy. 403 Line 'K' Sta. 348 + 05 o/s 54' Lt. ORIGINATED BY WAK
W.P. 156-60-00 BORING DATE April 2, 1965 COMPILED BY WAK
DATUM Geodetic BOREHOLE TYPE Washboring BX Casing CHECKED BY J. S. J.

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION		RESISTANCE		LIQUID LIMIT ——— w_L			BULK DENSITY γ	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT		RESISTANCE		WATER CONTENT ——— w					
							20	40	60	80	100	10			20	30
							SHEAR STRENGTH P.S.F.				WATER CONTENT %			P.C.F.	GR. SA. SI. CL.	
							○ UNCONFINED + FIELD VANE				w_p ——— w ——— w_L					
							● QUICK TRIAXIAL x LAB. VANE									
783.9	Ground Level															
782.2	Black Org. Topsoil															
1.7	Silty sand to sandy silt with traces of clay and gravel. Loose to very dense.															
			1	SS	19	780										
				2	SS	59	770									
				3	SS	51	760									
			4	SS	80/8"	750										
			5	SS	141/8"	740										
727.4			6	SS	164/8"	730										
56.5	End of Penetration															

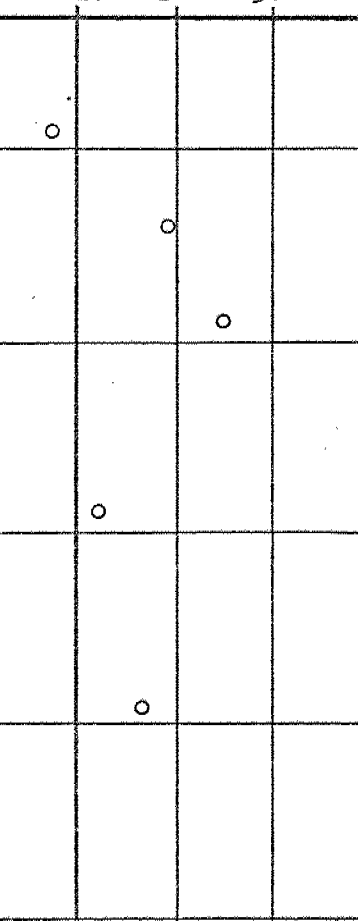
DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3 (65-F-33) FOUNDATION SECTION

JOB 71-11107 LOCATION Hwy. 403 Line 'K' Sta. 349 + 15 o/s 90' Lt. ORIGINATED BY WVK
 W.P. 156-60-00 BORING DATE April 5, 1965 COMPILED BY WVK
 DATUM Geodetic BOREHOLE TYPE Washboring BX Casing CHECKED BY S.C.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p 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.						WATER CONTENT %
							20	40	60	80	100	○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	x LAB. VANE			
786.8	Ground Level																	
785.3	Black Org. Topsoil																	
1.5	Silty sand to sandy silt with traces of clay and gravel. Loose to very dense.		1	SS	19	 780												
2			SS	31														
3			SS	104/10"	770													
4			SS	105/9"	760													
5			SS	80/8"	750													
6			SS	80/8"	740													
740.3																		
16.5	End of Borehole																	





 771.3

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4 (65-F-33) FOUNDATION SECTION

JOB 71-11107 LOCATION Hwy. 403 Line 'K' Sta. 350 + 32 o/s 76' Lt. ORIGINATED BY WWK
W.P. 156-60-00 BORING DATE April 6-7 1965 COMPILED BY WWK
DATUM Geodetic BOREHOLE TYPE Washboring BX Casing CHECKED BY WWK

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p 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.					WATER CONTENT % w_p ——— w ——— w_L
							20	40	60	80	100	○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB. VANE				
789.9	Ground Level																
787.9	Black Org. Topsoil																
2.0	Silty sand to sandy silt with traces of clay and gravel Loose to very dense.		1	SS	6												
			2	SS	5	780											
			3	SS	87												
			4	SS	80/5"	770											
			5	SS	117/11"	760											
			6	SS	152/8"	750											
			7	SS	151/8"	740											
738.4	End of Borehole																

772.7

RECORD OF BOREHOLE No. 5 (65-F-33) FOUNDATION SECTION

JOB <u>71-11107</u>	LOCATION <u>Hwy. 403 Line 'K' Sta. 348 + 43 o/s 4' Lt.</u>	ORIGINATED BY <u>WKK</u>
W.P. <u>156-60-00</u>	BORING DATE <u>March 31, 1965</u>	COMPILED BY <u>WKK</u>
DATUM <u>Geodetic</u>	BOREHOLE TYPE <u>Washboring BX Casing</u>	CHECKED BY <u>S.K.</u>

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION BLOWS / FOOT	RESISTANCE	LIQUID LIMIT ——— W _L	PLASTIC LIMIT ——— W _P	WATER CONTENT ——— W	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.						
789.0	Ground Level												
787.0	Black Org. Topsoil												
2.0	Silty sand to sandy silt with traces of clay and gravel. Loose to very dense		1	SS	25	780							
			2	SS	62								
			3	SS	66	770							
			4	SS	63								
			5	SS	121	760							
			6	SS	80 1/4"	750							
737.5			7	SS	150 9"	740							

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6 (65-F-33) FOUNDATION SECTION

JOB 71-11107 LOCATION Hwy. 403 'K' Sta. 349 + 58 o/s 21' Rt. ORIGINATED BY W/K
 W.P. 156-60-00 BORING DATE March 30, 1965 COMPILED BY W/K
 DATUM Geodetic BOREHOLE TYPE Washboring BX Casing CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p 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_p	w	w_L		
791.0	Ground Level															
789.5	Black Org. Topsoil					790										
1.5	Silty sand to sandy silt with traces of clay and gravel. Loose to very dense.		1	SS	17											
			2	SS	25	780										
			3	SS	61											
			4	SS	142 for 10"	770										
			5	SS	148 for 9"											
			6	SS	80 for 2"	760										
744.5			7	SS	80	750										
46.5	End of Borehole				for 2"											

for 9"


▼ 771.3

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 7 (65-F-33) FOUNDATION SECTION

JOB 71-11107 LOCATION Hwy. 403 Line 'K' Sta. 350 + 69 o/s 24' Lt. ORIGINATED BY WKK
 W.P. 156-60-00 BORING DATE April 7, 1965 COMPILED BY WKK
 DATUM Geodetic BOREHOLE TYPE Washboring BX Casing CHECKED BY W.R.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p 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_p	w	w_L		
790.9	Ground Level															
788.9	Black Org. Topsoil					790										
2.0	Silty sand to sandy silt with traces of clay and gravel Loose to Very Dense		1	SS	12											
			2	SS	148	780										
			3	SS	140 for 9"											
			4	SS	80 for 5"											
			5	SS	158 for 10"											
			6	SS	80											
744.4						750										
146.5	End of Borehole															

 771.6

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 8 (65-F-33) FOUNDATION SECTION

JOB 71-11107 LOCATION Hwy. 403 Line 'K' Sta. 351 + 87 o/s 7' Rt. ORIGINATED BY WWK
 W.P. 156-60-00 BORING DATE April 8, 1965 COMPILED BY WWK
 DATUM Geodetic BOREHOLE TYPE Washboring BX Casing CHECKED BY S.R.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — w_L PLASTIC LIMIT — w_p 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.			
791.4	Ground Level										
789.4	Black Org. Topsoil										
2.0	Silty sand to sandy silt with traces of clay and gravel. Loose to Very Dense		1	SS	3						
			2	SS	4						
			3	SS	9						
			4	SS	72						
			5	SS	132						
749.9			6	SS	141						
41.5	End of Borehole				for 9"						

DYNAMIC PENETRATION RESISTANCE: 20 40 60 80 100
 SHEAR STRENGTH P.S.F.:
 ○ UNCONFINED + FIELD VANE
 ● QUICK TRIAXIAL x LAB. VANE

WATER CONTENT %:
 w_p — w — w_L
 10 20 30

for 10"

771.4
 observed in casing

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 9

FOUNDATION SECTION

JOB 71-11107 LOCATION Hwy. 403 Line 'K' Sta. 350 +10 o/s 80' Rt. ORIGINATED BY PK
W.P. 156-60=00 BORING DATE Jan. 10, 1972 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger (CME) CHECKED BY S. J.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
794.8	Ground Level															
0.0	Silty uniform fine sand to fine sandy silt, traces of clay. Loose to Very Dense Brown		1	SS	5										0 48 (52)	
			2	SS	22	790										0 78 (22)
			3	SS	31											0 15 66 19
			4	SS	28											1 11 79 9
			5	SS	66											
			6	SS	59	780										1 86 (13)
			7	SS	80											0 77 (23)
			8	SS	122	770										0 34 60 6
			9	SS	100	760										
756.5			10	SS	100	760										0 52 (48)
38.3	End of Borehole															
						750										

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 10

FOUNDATION SECTION

JOB 71-11107 LOCATION Hwy. 403 Line 'K' Sta. 348 + 95 o/s 20' Lt. ORIGINATED BY PK
W.P. 156-60-00 BORING DATE Jan. 10, 1972 COMPILED BY AKS
DATUM Geodetic BOREHOLE TYPE Cone Test Only CHECKED BY S.V.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE				
791.2	Ground Level															
0.0						790										
						780										
774.4																
16.8	End of Cone Test					770					100/9"					

FOUNDATION SECTION

JOB <u>71-11107</u>	LOCATION <u>Hwy. 403 Line 'K' Sta. 351 + 05 o/s 82' Rt.</u>	ORIGINATED BY <u>AK</u>
W.P. <u>156-60-00</u>	BORING DATE <u>Jan. 11, 1972</u>	COMPILED BY <u>AKB</u>
DATUM <u>Geodetic</u>	BOREHOLE TYPE <u>Hollow Stem Auger (CME)</u>	CHECKED BY <u>S.R.</u>

[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 12

FOUNDATION SECTION

JOB 71-11107

LOCATION Hwy. 403 Line 'K' Sta. 352 + 47 o/s. 82' Rt.

ORIGINATED BY FK

W.P. 156-60-00

BORING DATE Jan. 11, 12, 1972

COMPILED BY AKB

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger (CME)

CHECKED BY *S.R.*

[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 13

FOUNDATION SECTION

JOB 71-11107

LOCATION Hwy. 403 Line 'K' Sta. 353 + 42 o/s 84' Rt.

ORIGINATED BY PK

W.P. 156-60-00

BORING DATE Jan. 11, 1972

COMPILED BY AKB

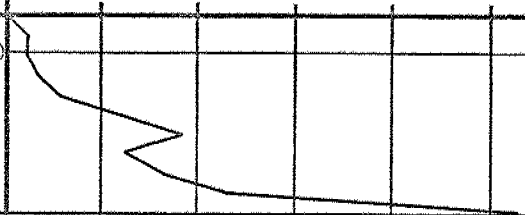
DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger (CME)

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO		RECORD OF BOREHOLE No. 14		FOUNDATION SECTION	
MATERIALS & TESTING OFFICE					
JOB	71-11107	LOCATION	Hwy. 403 Line 'K' Sta. 351 + 49 o/s 24' Lt.		ORIGINATED BY
W.P.	156-60-00	BORING DATE	Jan. 11, 1972		COMPILED BY
DATUM	Geodetic	BOREHOLE TYPE	Dynamic Cone Test		CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION	RESISTANCE	LIQUID LIMIT ——— w_L	BULK DENSITY γ P.C.F.	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					PLASTIC LIMIT ——— w_p	
								SHEAR STRENGTH P.S.F.				WATER CONTENT ——— w	
791.8	Ground Level						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE		w_p ————— w ————— w_L WATER CONTENT %				
0.0						790							
781.8													
10.0	End of Cone Test					780							

FOUNDATION SECTION

ORIGINATED BY PK

COMPILED BY AKB

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION	RESISTANCE	LIQUID LIMIT	PLASTIC LIMIT	WATER CONTENT	BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.					
785.4	Ground Level						20 40 60 80 100						
0.0						780							
770.5													
14.9	End of Cone Test					770							

FOUNDATION SECTION

CHECKED BY *AK*

[illegible]

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

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_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 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
σ	NORMAL STRESS
$\bar{\sigma}$	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 (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

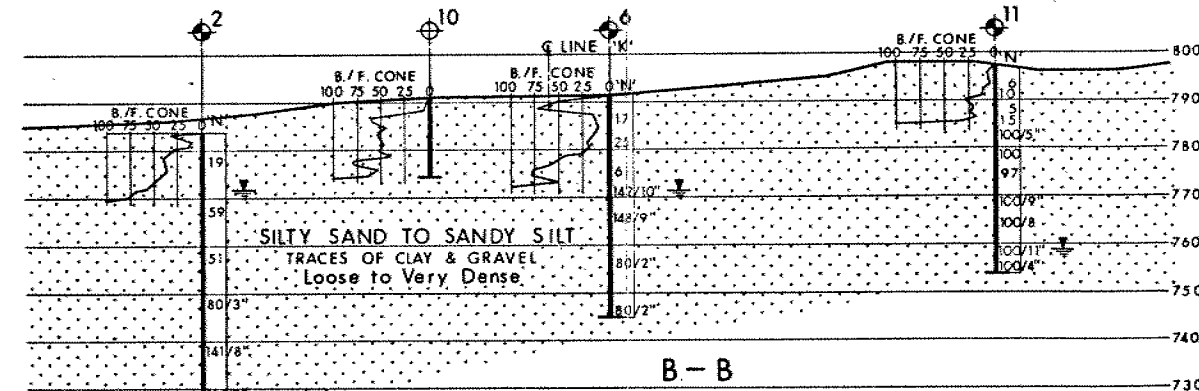
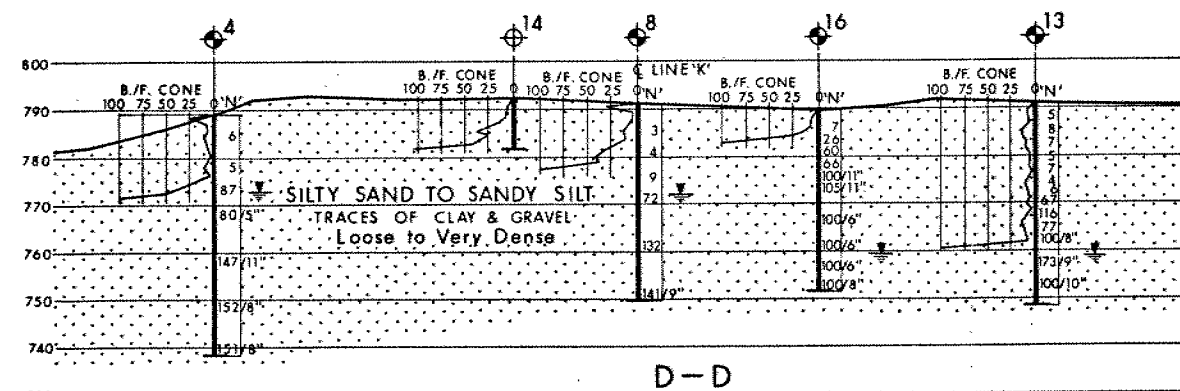
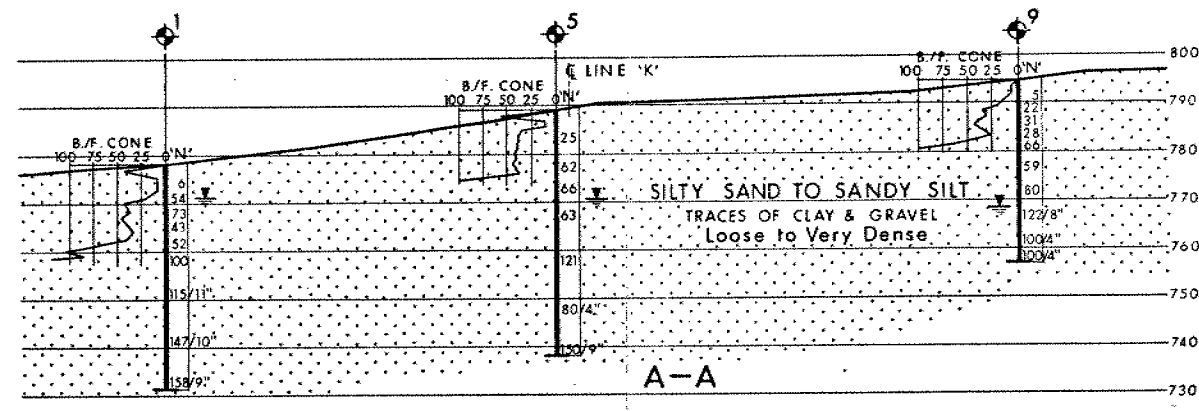
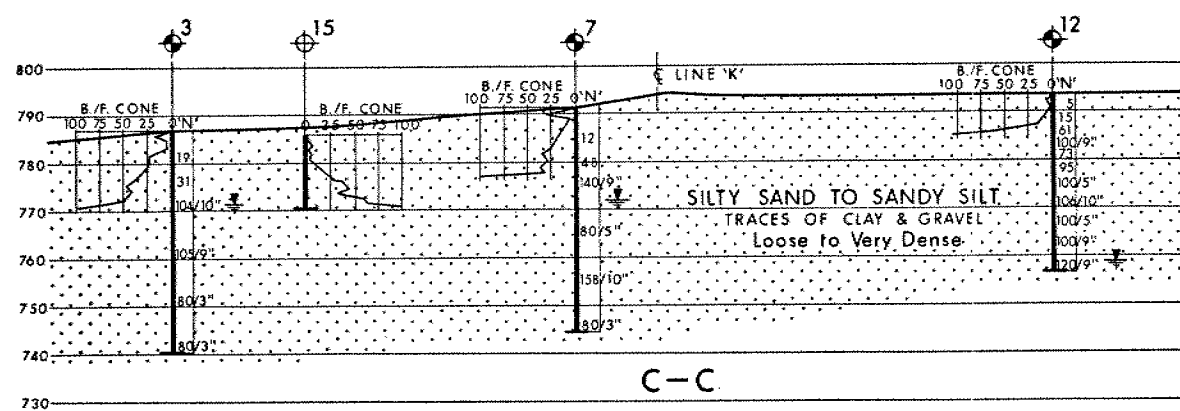
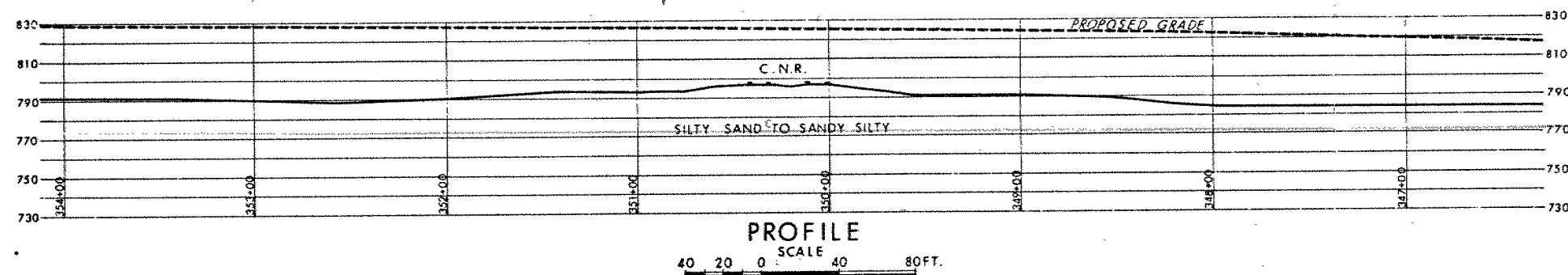
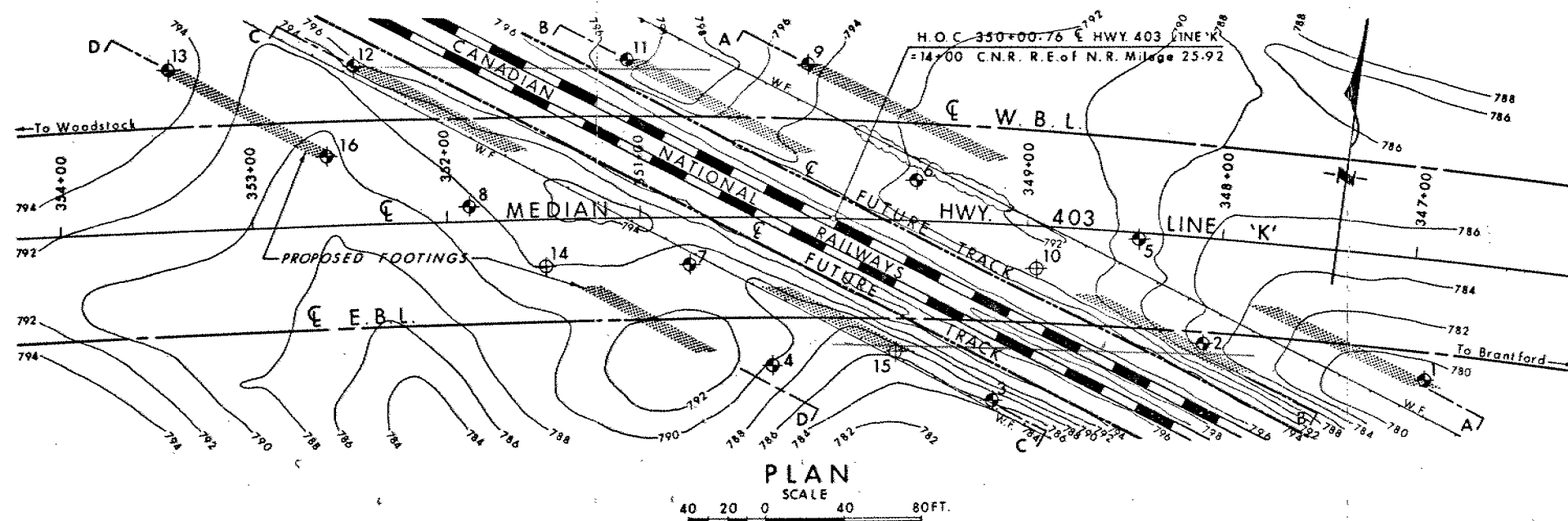
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

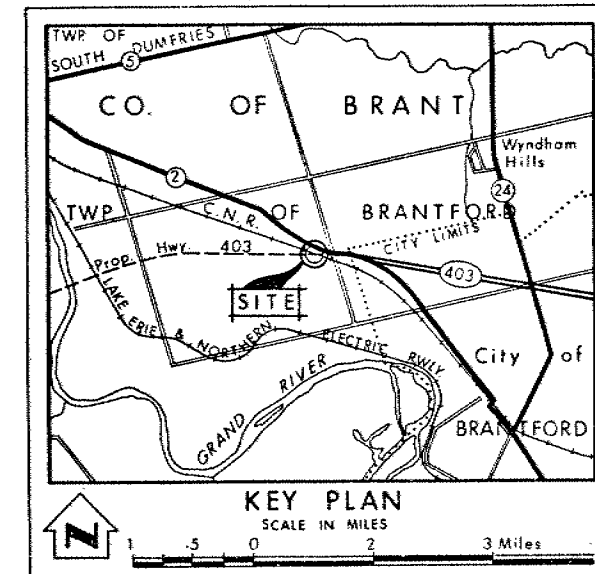
B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

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



SECTIONS
SCALE
HORIZ. 40 20 0 40 80 FT.
VERT. 20 10 0 20 40 FT.



LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation.
Bore Holes 1-8 Mar. & Apr. 1965
Bore Holes 9-16 Jan. 1972

NO.	ELEVATION	STATION	OFFSET
1	777.4	346+90	62' LT.
2	783.9	348+05	54' LT.
3	786.8	349+15	90' LT.
4	789.9	350+32	76' LT.
5	789.0	348+43	4' LT.
6	791.0	349+58	21' RT.
7	790.9	350+69	24' LT.
8	791.4	351+87	7' RT.
9	794.8	350+10	80' RT.
10	791.2	348+95	20' LT.
11	796.6	351+05	82' RT.
12	794.0	352+47	82' RT.
13	791.2	353+42	84' RT.
14	791.8	351+49	24' LT.
15	785.4	349+70	68' LT.
16	789.8	352+62	36' RT.

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.

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF TRANSPORTATION & COMMUNICATIONS
DESIGN SERVICES BRANCH - FOUNDATION OFFICE

CANADIAN NATIONAL RAILWAYS

HIGHWAY NO. 403 LINE 'K' DIST. NO. 4
CO. BRANT
TWP. BRANTFORD LOT 24 CON. II

BORE HOLE LOCATIONS & SOIL STRATA

SUBWD. A. B.	CHECKED <input checked="" type="checkbox"/>	W.P. NO. 156-60-00	DRAWING NO.
DRAWN <input checked="" type="checkbox"/>	CHECKED <input checked="" type="checkbox"/>	JOB NO. 71-11107	71-11107A
DATE Feb. 22, 1972	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <input checked="" type="checkbox"/>	CONT. NO.		

REF. NO. E-4861-1