

G.I-30 SEPT 1976

GEOCRES No. 30M12-58DIST. 6 REGION CentralW.P. No. 213-65-01CONT. No. 78-111

W. O. No. _____

STR. SITE No. _____

HWY. No. 427

LOCATION Twin Overhead Structures at
the Crossings of N.B. + S.B. lanes
of Hwy. 427 with CNR

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 4

REMARKS: documents to be unfolded
before microfilming

FOUNDATION INVESTIGATION REPORT
For
Twin Overhead Structures at the Crossings
of the N.B. and S.B. Lanes of Hwy. #427
With the C.N.R.
Borough of Etobicoke, County of York
District No. 6 (Toronto)
W.O. 72-11022 - W.P. 213-65

1. INTRODUCTION:

The Foundations Office was requested to carry out a subsurface investigation for the twin three span structures to be constructed at the crossings of the proposed N.B. and S.B. lanes of Hwy. 427 with the C.N.R., in the Borough of Etobicoke, County of York. The request was contained in a memo from the Bridge Office (Mr. G.C.E. Burkhardt, Regional Structural Planning Engineer, Central Region) dated January 31, 1972. Subsequently, an investigation was carried out by this Office to determine the subsoil, bedrock and groundwater conditions at the site.

The factual data obtained from this investigation, together with our recommendations for the design of the structure foundations as well as the stability considerations associated with the approach fills, are presented in this report.

2. DESCRIPTION OF SITE AND GEOLOGY:

The site is located immediately to the east of Indian Line Road, approximately 1-1/4 miles south of Rexdale Blvd., in the Borough of Etobicoke. The area has been developed for commercial purposes; numerous industrial buildings are present. The terrain is flat to gently undulating in relief between elevations 540 and 550. A single line C.N.R. track traverses across the

site; the track is located in a cut section which extends some 5 to 6 feet below the surrounding ground level.

The site is located in the physiographic region known as the "Peel Plain." The characteristic deposit in this region is a ground moraine laid down during the Wisconsin Glacial Age. In the vicinity of the area under investigation the moraine is primarily composed of a cohesive glacial till whose thickness generally ranged from 70 to 85 feet. Interglacial deposits of granular material are frequently found interbedded within the glacial till. The overburden is underlain by grey shale bedrock of the Meaford-Dundas formation, Ordovician Period.

3. FIELD AND LABORATORY WORK:

Ten boreholes, all of which were accompanied by a dynamic cone penetration test were put down during the field investigation phase. The boreholes and the cone penetration tests were advanced by means of a continuous flight auger machine (C.M.E.) adopted for soil sampling purposes.

At required depths samples were obtained by means of a 2" O.D. split-spoon sampler. The method of driving the split-spoon conformed to the specifications for the Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests. Bedrock was proven at four of the boring locations by obtaining BX size rock core samples. The groundwater level conditions across the site, during the period of the investigation, were determined by recording the water levels in the open boreholes.

During sampling and drilling operations, detailed logs of the borings were made. These logs contain a record of the drilling and sampling techniques used, together with the soil types and bedrock encountered. The location and elevation of all the boreholes are shown on Drawing No. W.O. 72-11022A, together with a number of estimated stratigraphical sections across the site. Surveying at the site was carried out by personnel from the Central Region Engineering Survey Section. The elevations given in this

report are referenced to a Geodetic datum.

All the samples were subjected to a careful visual examination in the field and subsequently in the laboratory. Following this examination, laboratory testing was carried out on selected representative samples to determine the following physical properties of the overburden:

Natural Moisture Content

Atterberg Limits

Grain-Size Distribution

The results of these tests are plotted on the Record of Borehole sheets as well as Figures 1, 2 and 3, all of which are located in Appendix I of this report.

4. SUBSOIL AND BEDROCK CONDITIONS:

4.1) General:

The predominant stratum across the site is a stiff to hard cohesive glacial till, the base of which extends anywhere from 48 to 84 feet below existing ground surface. Over the major portion of the site a compact to very dense silty sand to sandy silt deposit is interbedded within the glacial till. The thickness of the granular deposit varies from 4 to 34 feet. The overburden is underlain by sound shale bedrock.

The boundaries of the various deposits, as determined in the boreholes, are shown on the accompanying Record of Borehole sheets. The stratigraphical sections, shown on Drawing No. 72-11022A, have been inferred from this data. From ground surface downward, the soil types and bedrock encountered are as follows:

4.2) Glacial Till (Heterogeneous Mixture of Clayey Silt, Sand and Gravel):

The thin (1 to 1.5 feet thick) topsoil cover is underlain by a glacial till stratum which is composed of a heterogeneous mixture of clayey silt with sand and gravel. The base of this stratum extends anywhere from 48 feet (B.H. #6) to 84 feet (B.H. #9)

existing ground surface. The upper 11 to 14 feet of the till is brown in colour which indicates that this zone has been subjected to desiccation, below this zone of stratum is grey. Fragments of shale were encountered in the lower 6 to 16 feet of the glacial till at many of the boring locations.

Grain-size distribution curves for samples of the cohesive stratum, obtained with a 2-inch O.D. split-spoon sampler, are shown on Figure No. 1 in Appendix I. Atterberg limit tests were performed on samples of the glacial till, the results were plotted on the Record of Borelog sheets, as well as on a Plasticity Chart (Figure #2), are summarized in tabular form below.

	<u>Range</u>	<u>Average</u>
Liquid Limit (W_L) (%)	17 - 37	27
Plastic Limit (W_p) (%)	12 - 20	16
Natural Moisture Content (W) (%)	10 - 20	15

Based on these values it is estimated that the cohesive deposit has a matrix which is inorganic and of low to intermediate plasticity.

The Standard Penetration Tests, carried out with this glacial till stratum, are plotted on the Record of Borehole sheets. This testing gave "N" values ranging from 13 blows/ft. to in excess of 100 blows per foot. Based on this testing it is estimated that the consistency of this cohesive deposit varies from stiff to hard.

4.3) Silty Sand to Sandy Silt:

In some areas a granular deposit is interbedded within the glacial till deposit, while at other locations this granular material extends from the base of the till to bedrock. The granular deposit is composed of a compact to very dense ('N' values 23 to 162 blows/ft.) silty sand to sandy silt with a trace of clay and gravel. Its thickness varies from 4 feet (B.H. #10) to 34.5 feet (B.H. 7). Grain-size distribution curves for samples of this granular material are shown on Figure No. 3.

4.4) Shale Bedrock:

The overburden is underlain by bedrock, which was proven in four of the boreholes by obtaining between 4 and 5 feet of BX size rock core samples. The bedrock surface was found to vary between elevations 458 and 472, corresponding to depths of from 76.5 to 84 feet below existing ground surface.

The bedrock is composed of a grey shale, which is in a sound state as evidenced by the high percentage of core recovered.

5. GROUNDWATER CONDITIONS:

The groundwater level conditions, across the site, were observed by taking readings in the open boreholes during the period of the field investigation (March 1972). The results of the readings are shown on the borelog sheets as well as on Drawing No. 72-11022A.

The observations indicate that the groundwater level, during this time, was located between elevations 541 and 542.5, which corresponds to levels ranging from existing ground surface to 6.5 feet below ground surface.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to extend the present Airport Expressway northerly toward Finch Avenue, following closely the existing Indian Line road. This expressway will be designated as Hwy. 427. A number of interchanges and structure crossings will be required. This report will deal with one of these structure crossings, namely, where the south and northbound lanes of Hwy. #427 will cross the C.N.R. track in the Borough of Etobicoke, County of York.

It is understood that each of the twin overhead structures at this site will be approximately 65 feet wide and have three spans (40' - 70' - 40'). At the present time the C.N.R. is a single track line, the present proposal, however, calls for a

four track operation.

The information available, at the time of writing this report, would indicate that the profile grade of the N.B. and S.B. lanes of Hwy. #427, in the vicinity of the structures, will be at approximately elevation 570. With this grade line the approaches will have a maximum height of the order of 26 feet.

The predominant stratum across the site is a stiff to hard cohesive glacial till, the base of which extends anywhere from 48 to 84 feet below existing ground surface. A 4 to 34 feet thick compact to very dense silty sand to sandy silt deposit is interbedded within the glacial till. The overburden is underlain by sound shale bedrock.

6.2) Structure Foundations:

6.2.1) Piers (Refer to B.H.'s #3, 4, 7 and 8):

Due to the competent nature of the cohesive glacial till, spread footing type of foundations can be used at the pier locations. A minimum of 4 feet of earth cover should be provided above the underside of the foundations for frost protection purposes. Footings founded as recommended could be designed using an allowable bearing value of 3.0 t.s.f.

The footing excavations may extend some 1 to 2 feet below the groundwater level recorded during the period of the investigation. The excavations, however, will be located within the relatively impervious cohesive glacial till. No major dewatering problems are, therefore, anticipated. Any minor groundwater seepage, emanating from sources such as water bearing granular seams, could be controlled using conventional techniques such as pumping from sumps.

Settlement will be induced in the cohesive glacial till by the imposed footing pressure. The cohesive till is highly preconsolidated; therefore, the settlement will be of a recompression nature - i.e., take place during or immediately following the construction period. Computations carried out indicate that this settlement should not exceed 3/4 inch, provided the foundation subsoil is not softened by uncontrolled surface runoff or groundwater seepage. In this regard consideration could be given to

the placing of a lean concrete working slab over the subsoil as soon as the excavations reach footing foundation level.

6.2.2) Abutments (B.H.'s #2, 5, 6 and 9):

The proposed abutments will be 'perched' within the approach fills. The abutments may be supported on spread footings placed within the fills. The fill material, below the tops of the footings, should consist of well compacted granular 'A' material, and should extend to a horizontal distance of at least 10 feet from the footing edges in the plane of the footing tops. This portion of the fill should be constructed with side slopes no steeper than 2:1. The remainder of the fill should be completed to about profile grade for a distance of 50 feet behind the abutments before re-excavation for the abutment footings. An allowable bearing pressure of 2.5 t.s.f. may be used in design.

If the abutments are supported on spread footings, there will be differential settlement between the abutments and adjacent pier. Providing the fill, in the immediate vicinity of the abutment footings, is well compacted this settlement should not exceed 1 inch. Since the major portion of the settlement will occur within the fill itself it would be advantageous, if scheduling permits, to build the fills to as high a height as feasible and leave them in place for a period of time prior to constructing the abutments. This would reduce the differential settlement to a value less than that quoted above. It is recommended that a period of six months would be ideal for this purpose.

As an alternative the abutments may be supported on end-bearing piles driven to practical refusal within the lower competent portion of the overburden. The piles could be designed for the ultimate capacity of the pile section chosen - e.g., 12BP74 steel H piles could be designed for 95 tons/pile. For estimating purposes the pile tips can be assumed to be located at the following elevations.

<u>Location</u>	<u>Estimated Pile Tip Elevation</u>	<u>Reference</u>
<u>N.B.L.</u>		
South Abutment	484 to 487	B.H. #2
North Abutment	479 to 481	B.H. #5
<u>S.B.L.</u>		
South Abutment	482 to 486	B.H. #6
North Abutment	490 to 492	B.H. #9

It should be noted that the required penetration to realize the design load should be controlled in the field and employing the Hiley Dynamic Pile Driving formula (M.T.C. Standard BD 82-7).

No rock or bouldery fill should be placed in areas where piles are to be driven.

6.3) Approach Fill Embankments:

The approach fills will have a maximum height of 26 feet. No stability problems are anticipated, provided i) the fill is properly compacted and ii) standard 2:1 slopes are employed.

The cohesive glacial till will settle due to the loading of the approach fills. As discussed previously the till is highly preconsolidated and thus the settlement will be of a recompression nature - i.e., take place during or immediately following fill placement. The computations carried out indicate that the settlement should be of the order of 1 to 1-1/2 inches.

7. MISCELLANEOUS:

The field work for this project was carried out during the period of March 3 to March 13, 1972, under the supervision of Mr. V. Korlu, Project Foundations Engineer, who also prepared this report.

The report was reviewed by Mr. M. Devata, Supervising Foundations Engineer.

The equipment used was owned and operated by Master
Soil Investigation Ltd. of Toronto.

V. Korlu
V. Korlu, P. Eng.



VK/ao
Oct. 6, 1972.

M. Devata
M. Devata, P. Eng.

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 1

JOB 72-11022

LOCATION Co-ord's 880,424 N. 970,262 E.

ORIGINATED BY V.K.

W.P. 213-65

BORING DATE March 13, 1972

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Auger and Sample with C.M.E.

CHECKED BY *so*

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w w_p — w — w_L WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F. GR. S. CL	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE					
545.7	Ground level.								
0.0	Ret. mixture of clayey silt, sand & gravel. Glacial Till.		1	SS	20	540			4 6 75 15
			2	SS	24				
			3	SS	33				
532.7	Brown		4	SS	27				
13.0	Grey		5	SS	20	530			
	Very stiff to hard.		6	SS	20				
			7	SS	19				
			8	SS	20	520			
			9	SS	24				
			10	SS	23	510			
			11	SS	55				
			12	SS	11	500			
			13	SS	53	490			5 17 64 14
474.7			14	SS	100 3"	480			
71.0	End of borehole.					470			

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 2

JOB 72-11022

LOCATION Co-ord's 880,461 N. 970,342 E.

ORIGINATED BY V.K.

W.P. 213-65

BORING DATE March 6, 1972

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Auger and Sample with C.M.E. Machine.

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L			BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	BLOWS / FOOT					PLASTIC LIMIT — w_p				
							20	40	60	80	100	WATER CONTENT — w				
							SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					w_p — w — w_L 10 20 30			γ	P.C.F.
546.9	Ground level.															
0.0	Het. mixture of clayey silt, sand & gravel. Glacial Till.		1	SS	14	540										
			2	SS	36											
532.9	Brown		3	SS	57											
14.0	Grey.		4	SS	37	530										
	Stiff to hard.		5	SS	13											
			6	SS	19	520										
			7	SS	22											
			8	SS	15	510										
			9	SS	24											
			10	SS	44	500										
			11	SS	100/5"	490										
			12	SS	120/5"	480										
469.9	Fragments of shale		13	BXL	Rec. 40%	470										
77.0	Shale Bedrock.		14	BXL	Rec. 90%											
465.9	Grey. Sound															
81.0	End of borehole.					460										

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 3

JOB 72-11022

LOCATION Co-ord's 880,496 N. 970,326 E.

ORIGINATED BY V.K.

W.P. 213-65

BORING DATE March 13, 1972

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Auger and Sample with C.M.E. Machine

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p w w_L	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLAT	NUMBER	TYPE	BLOWS/FOOT					
547.9	Ground level.									
0.0	Het. mixture of clayey silt, sand & gravel.		1	SS	29					
	Glacial Till.		2	SS	27	540				
			3	SS	76					
535.4	Brown.		4	SS	26					
12.5	Grey.		5	SS	19					
	Very stiff to hard.		6	SS	18	530				
			7	SS	23					
			8	SS	19					
			9	SS	25	520				
512.9			10	SS	31					
35.0	Silty sand, traces of clay & gravel.					510				
	Dense.		11	SS	40					
503.9										
44.0	Het. mix. of clayey silt, sand & gravel.		12	SS	97	500				
	Glacial Till.									
	Hard.		13	SS	55	490				
						480				
477.4			14	SS	100/5					
70.5	End of borehole.					470				

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 4

JOB 72-11022

LOCATION Co-ord's 880,563 N. 970,293 E.

ORIGINATED BY V.K.

W.P. 213-65

BORING DATE March 7, 1972

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Auger and Sample with C.M.E. Machine.

CHECKED BY LS

SOIL PROFILE		STRAT. PLT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	w_p	w	w_L		
548.4	Ground level.															
0.0	Het. mix. of clayey silt, sand & gravel. Glacial Till.		1	SS	26											
			2	SS	35											
536.9	Brown		3	SS	63											
11.3	Grey		4	SS	59											
	Very stiff to hard.		5	SS	23											
			6	SS	27											
			7	SS	39											
			8	SS	31											
			9	SS	37											
512.4			10	SS	90											
36.0	Silty sand, traces of clay and gravel. Dense.		11	SS	44											
502.4																
46.0	Het. mix. of clayey silt, sand & gravel. Glacial Till.		12	SS	56											
	Hard.															
			13	SS	72											
			14	SS	100											
	Fragments of shale		15	BXL	Rec. 5%											
471.9	Shale bedrock.		16	BXL	Rec. 90%											
76.5	Grey. Sound															
467.4																
81.0	End of borehole.															

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 5

JOB 72-11022

LOCATION Co-ord's 380,629 N. 970,261 N.

ORIGINATED BY V.K.

W.P. 213-65

BORING DATE March 6, 1972

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Auger and Sample with C.M.E. Machine

CHECKED BY *SO*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_p — W — W_L WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT					
546.5	Ground level.									
0.0	Het. mix. of clayey silt, sand & gravel. Glacial Till.		1	SS	37	540				W.L. ∇ 541.0
			2	SS	26					4 32 49 15
535.5	Brown		3	SS	55					
11.0	Grey.		4	SS	23	530				
	Stiff to hard.		5	SS	13					
			6	SS	17					
			7	SS	29					
			8	SS	36	520				
			9	SS	28					
508.5			10	SS	79	510				3 21 60 16
38.0	Silty sand, traces of clay & few gravel. Dense.		11	SS	30					
500.5						500				
46.0	Het. mix. of clayey silt, sand & gravel. Glacial Till. Hard.		12	SS	36					
						490				
			13	SS	71					
						480				
476.4	Fragments of shale		14	SS	100 7 1/2					
70.1	End of borehole.					470				

RECORD OF BOREHOLE N^o6

JOB 72-11022

LOCATION Co-ord's 880,455 N. 970,137 E.

ORIGINATED BY V.K.

W.P. 213-65

BORING DATE March 10, 1972

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Auger and Sample with C.M.E. Machine.

CHECKED BY *LD*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20'	40	60	80	100	W_p	W	W_L	
546.6	Ground level.														
0.0	Het. mix. of clayey silt, sand & gravel.		1	SS	20										
	Glacial Till.		2	SS	32	540									
			3	SS	50										
533.1	Brown		4	SS	52										
13.5	Grey		5	SS	18	530									
	Very stiff to hard.		6	SS	30										
			7	SS	41										
			8	SS	46	520									
			9	SS	31										
			10	SS	70	510									
			11	SS	124										
			12	SS	181	500									
498.6															
48.0	Silty sand, traces of clay and some gravel.		13	SS	48	490									
	Dense to very dense.														
			14	SS	152	480									
476.5															
			15	SS	10072"										
70.1	End of borehole.					470									

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 7

JOB 72-11022

LOCATION Co-ord's 880,490 N. 970,122 E.

ORIGINATED BY V.K.

W.P. 213-65

BORING DATE March 7, 1972

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Auger and Sample with C.M.E. Machine.

CHECKED BY *LB*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w w_p — w — w_L	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
548.8	Ground level.									
0.0	Het. mix. of clayey silt, sand & gravel. Glacial Till.		1	SS	14					
			2	SS	29					
534.8	Brown.		3	SS	29					
14.0	Grey.		4	SS	14					
	Stiff to hard.		5	SS	15					
			6	SS	28					
			7	SS	20					
			8	SS	21					
			9	SS	20					
502.8										
46.0	Sandy silt to silty sand with traces of clay and gravel. Very dense.		10	SS	100					
			11	SS	57					
			12	SS	74					
468.3			13	SS	100 7 4"					
80.5	Shale Bedrock.		14	BXL	Rec. 90%					
463.3	Grey Sand									
85.5	End of borehole.									

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 8

JOB 72-11022

LOCATION Co-ord's 880,553 N. 970,094 E.

ORIGINATED BY V.K.

W.P. 213-65

BORING DATE March 8, 1972

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Auger and Sample with C.M.E. Machine.

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. PLT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	W_P	W	W_L		
545.6	Ground level.															
0.0	Het. mix. of clayey silt, sand & gravel. Glacial Till.		1	SS	34	540										W.L. 541.6
			2	SS	40											2 20 63 15
534.6	Brown.		3	SS	55											
11.0	Grey.		4	SS	21											
	Very stiff to hard.		5	SS	22	530										
			6	SS	38											
			7	SS	43											
			8	SS	50	520										
			9	SS	89											0 4 88 8
			10	SS	96	510										
504.6			11	SS	109											
41.0	Silty sand with traces of clay and gravel. Very dense.					500										
494.6			12	SS	108											3 20 68 9
51.0	Het. mix. of clayey silt, sand & gravel. Glacial Till. Hard.					490										
			13	SS	97	480										
475.5			14	SS	100	470										
70.1	End of borehole.															

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE No 9

FOUNDATIONS OFFICE

JOB 72-11022

LOCATION Co-ord's 880,624 N. 970,064 E.

ORIGINATED BY V.K.

W.P. 213-65

BORING DATE March 6, 1972

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Auger and Sample with C.M.E. Machine

CHECKED BY

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			PLASTIC LIMIT — w_p						
							20	40	60	80	100	WATER CONTENT — w				
												w_p			w	w_L
						SHEAR STRENGTH P.S.F.			WATER CONTENT %							
						○ UNCONFINED + FIELD VANE										
						● QUICK TRIAXIAL × LAB VANE										
									10 20 30							
542.1	Ground level.					540										
0.0	Het. Mix. of clayey silt, sand and gra. Glacial Till.		1	SS	27											
			2	SS	41											
531.1	Brown		3	SS	57											
11.0	Grey		4	SS	39	530										
			5	SS	39											
	Very stiff to hard.		6	SS	51											
			7	SS	61	520										
			8	SS	41											
			9	SS	22	510										
			10	SS	133											
			11	SS	150	500										
494.1			12	SS	73											
48.0	Silty sand, gravel with traces of clay.		13	SS	162	490										
488.1	Very dense.															
54.0	Het. mix. of clayey silt, sand & gravel. Glacial Till		14	SS	16	480										
	Hard															
	Fragments of shale		15	SS	100%	470										
458.1			16	BXL	100%	460										
84.0	Shale bedrock.		17	BXL	Rec. 100%	450										
453.1	Grey. Sound															
89.0	End of borehole.															

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 10

JOB 72-11022

LOCATION Co-ord's 880,661 N. 970,150 E.

ORIGINATED BY V.K.

W.P. 213-65

BORING DATE March 3, 1972

COMPILED BY V.K.

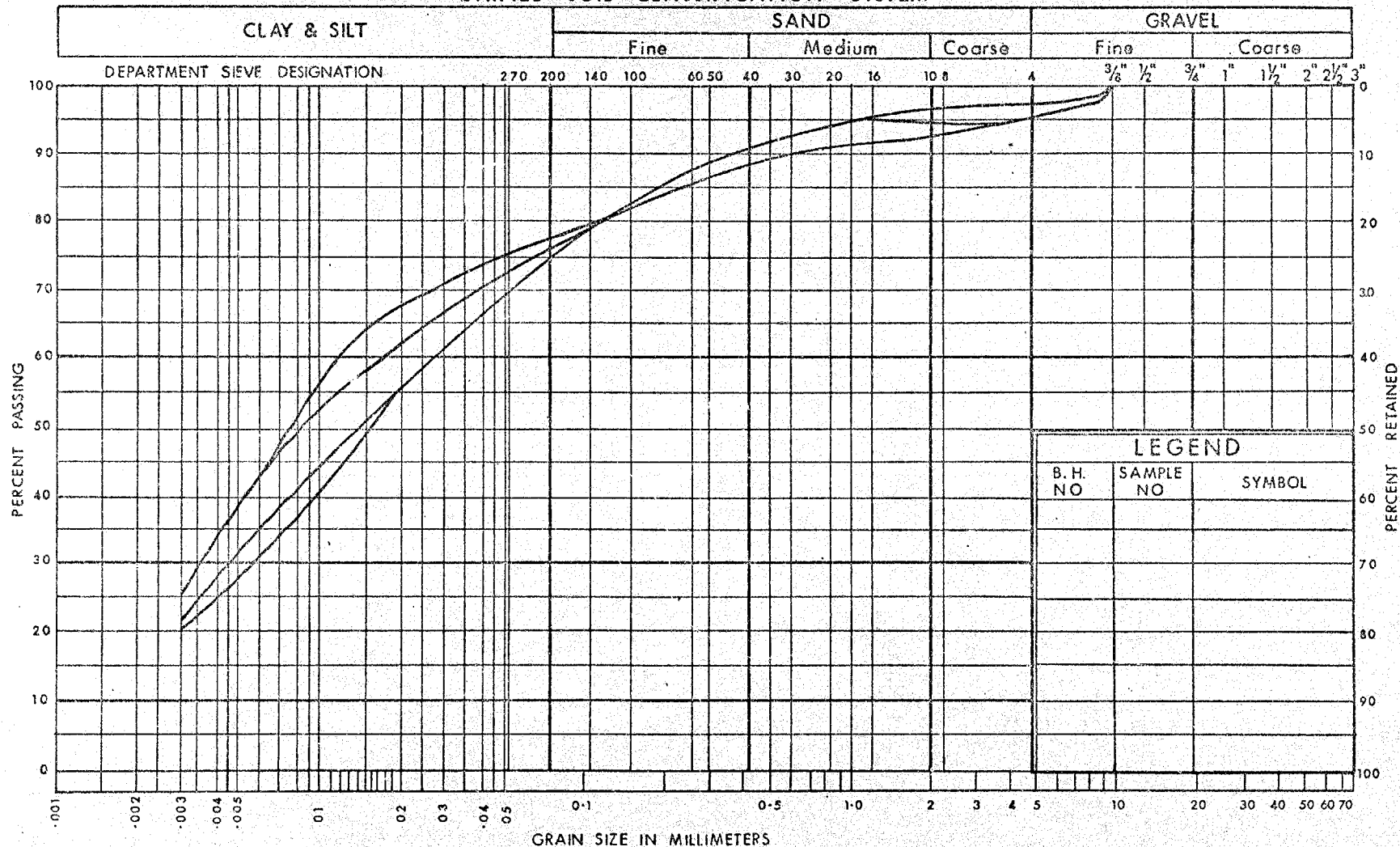
DATUM Geodetic

BOREHOLE TYPE Auger and Sample with C.M.E. Machine.

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		
544.3	Ground level.															
0.0	Het. mix. of clayey silt, sand and grav. Glacial Till.		1	SS	33	540										W.L. 540.8
			2	SS	18											28 54 17
533.3	Brown		3	SS	50											
11.0	Grey		4	SS	13	530										
	Stiff to hard.		5	SS	12											
			6	SS	21											
			7	SS	15											
			8	SS	7	520										
			9	SS	18											
510.3						510										
34.0	Silty sand, trace of cl. & gra. Compact.		10	SS	23											
506.3																
38.0			11	SS	160/5"											
	Het. mix. of clayey silt, sand & gravel.					500										
	hard.		12	SS	22											
						490										
			13	SS	160/5"											
	Fragments of shale					480										
474.2																
			14	SS	100/5"											
70.1	End of borehole.					470										

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT
OF
TRANSPORTATION AND COMMUNICATIONS



DESIGN SERVICES
BRANCH

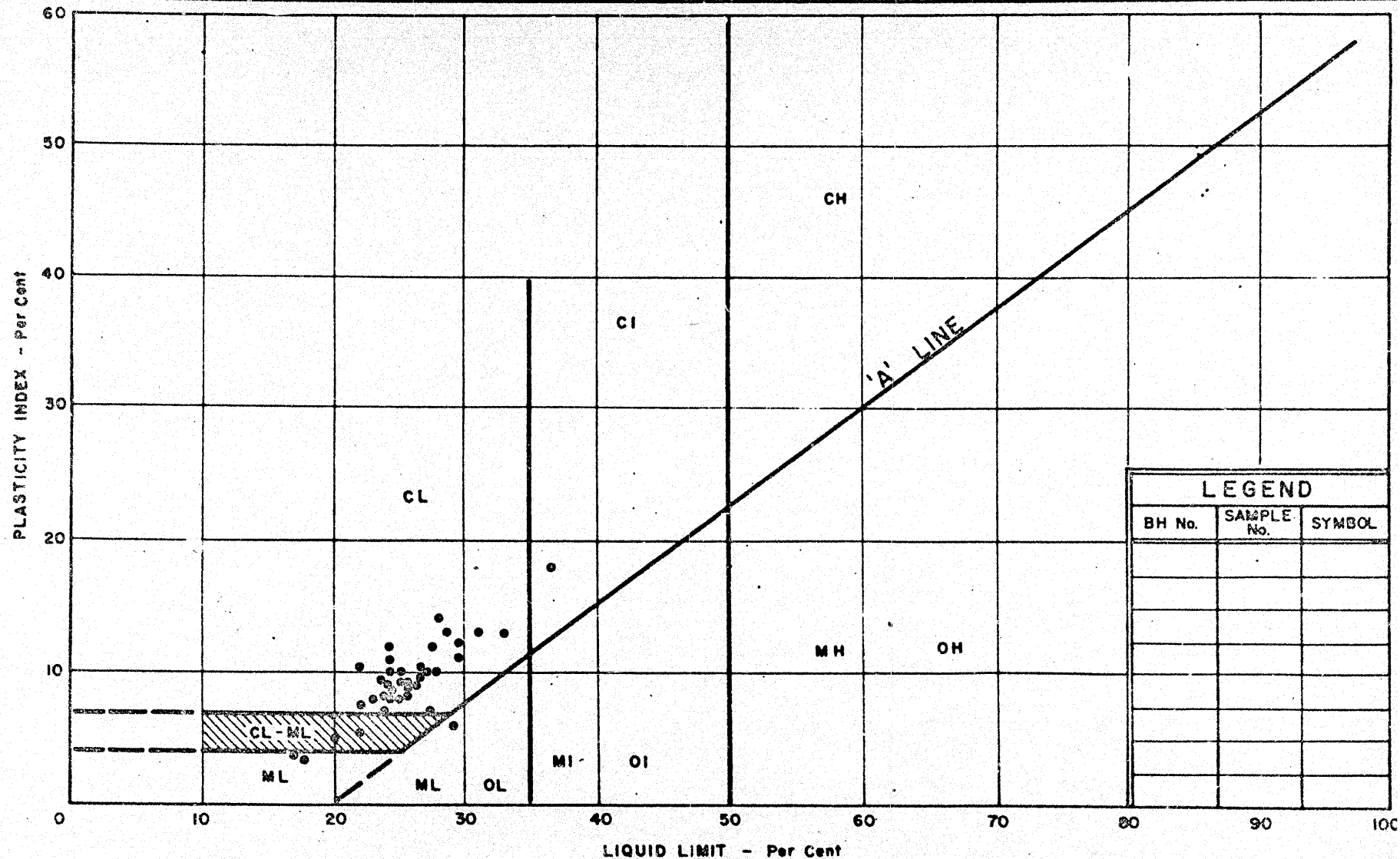
GRAIN SIZE DISTRIBUTION

HET. MIX. OF CLAYEY SILT, SAND AND GRAVEL.
(GLACIAL TILL)

W.P. No. 213-65

JOB No. 72-11022

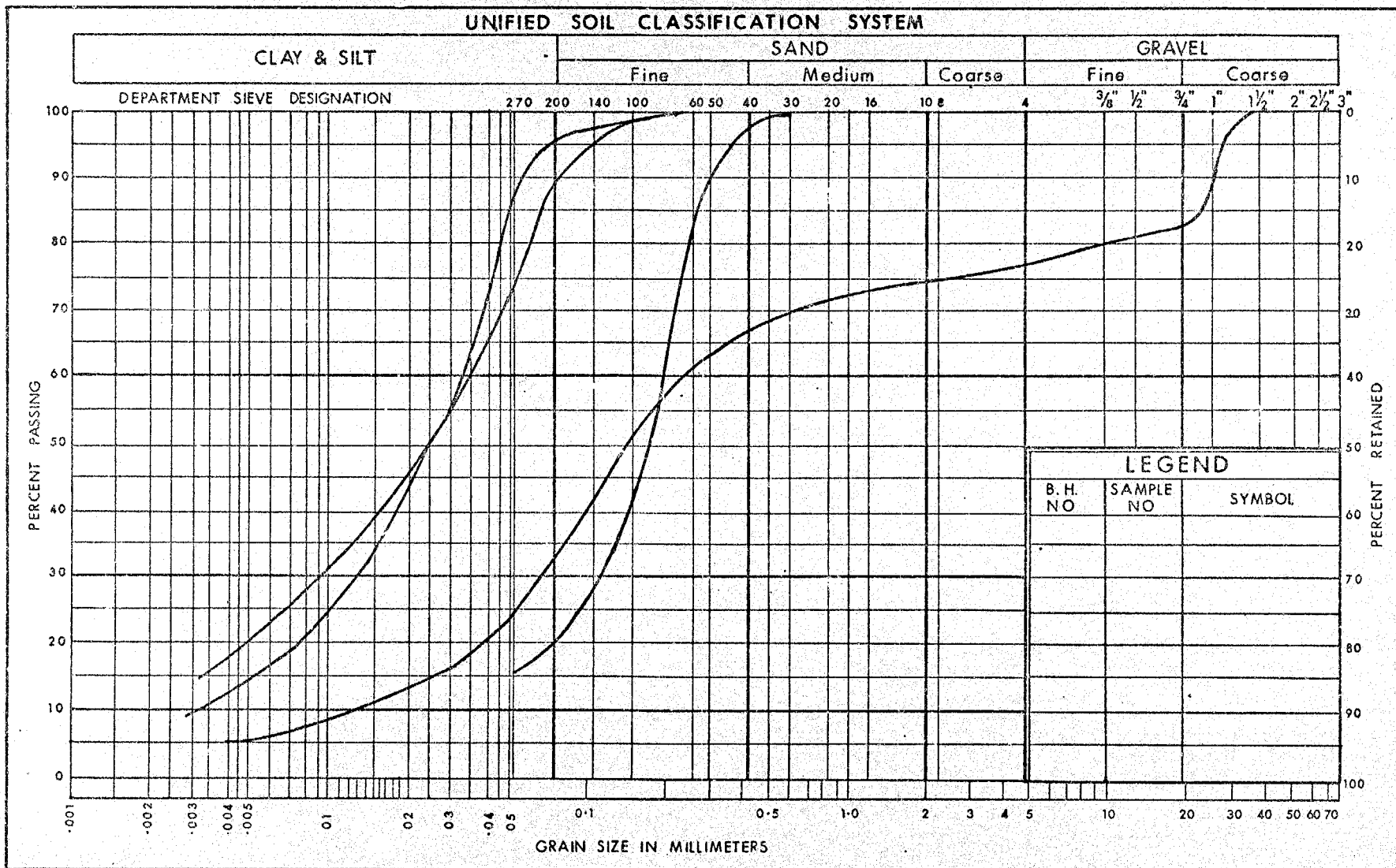
FIG 1



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART GLACIAL TILL

WP. No. 213 - 65
JOB No. 72 - 11022
FIG. 2



ONTARIO

DESIGN SERVICES
BRANCH

GRAIN SIZE DISTRIBUTION

SILTY SAND TO SANDY SILT, TRACE OF CLAY & GRAVEL

W.P. No. 213-65

JOB No. 72 -11022

FIG. 3

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

Q _u	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	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^l	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
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

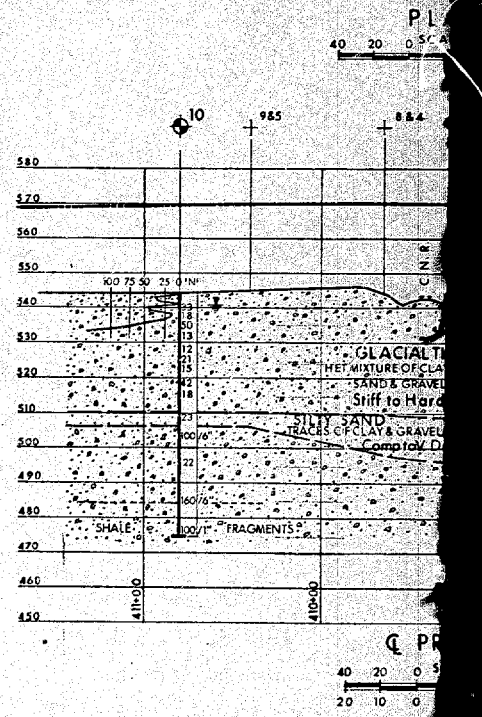
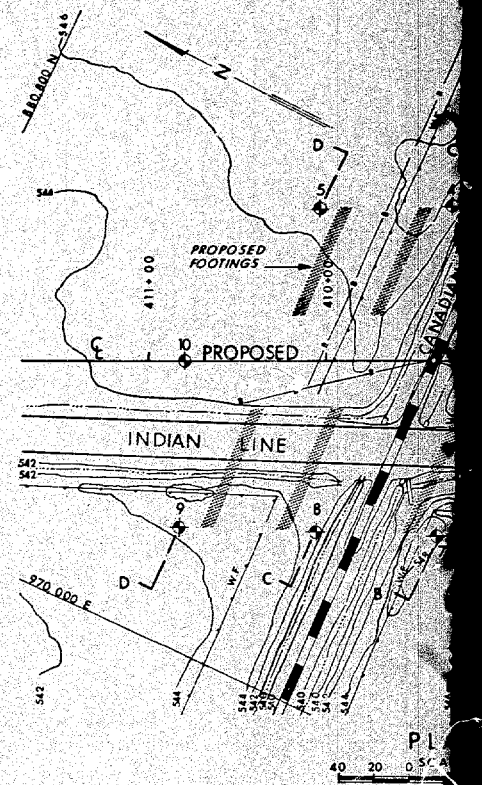
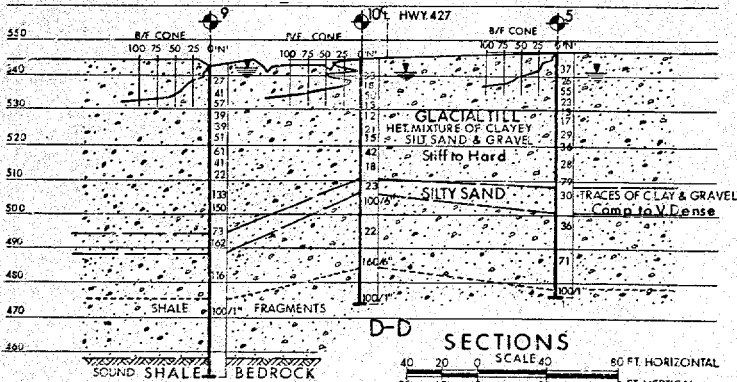
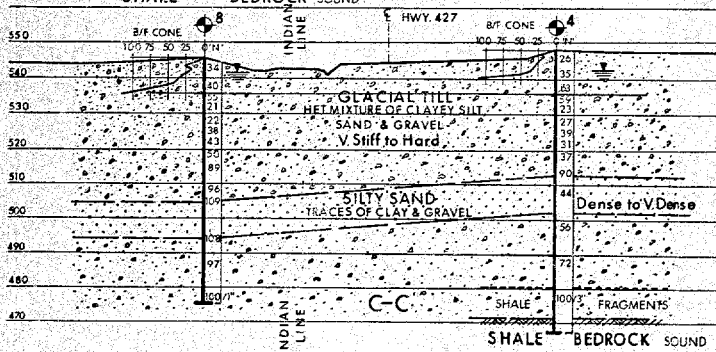
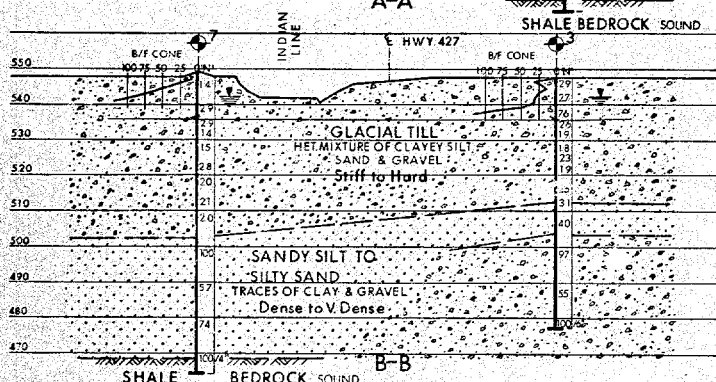
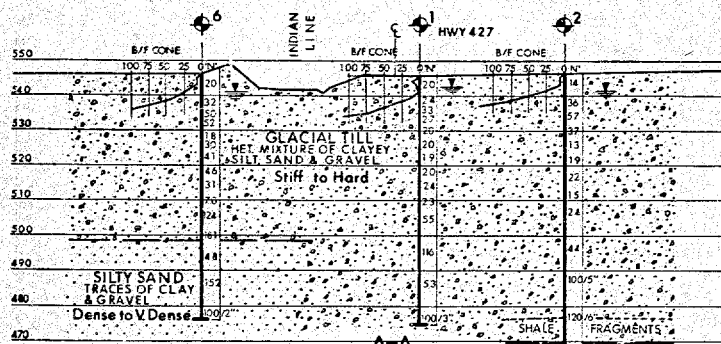
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

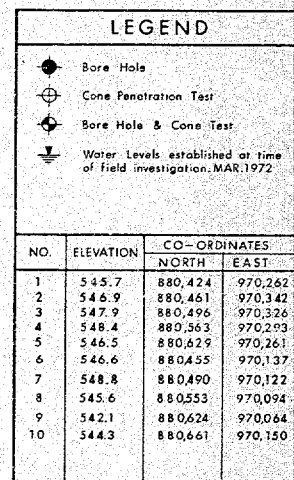
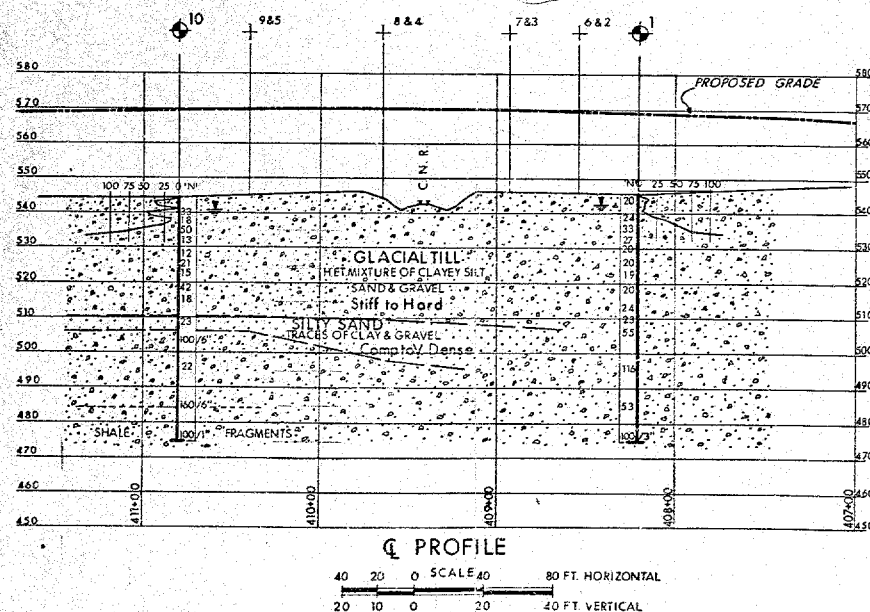
FOUNDATIONS

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





— 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

CANADIAN NATIONAL RAILWAY

HIGHWAY NO. PROP 427 DIST NO. 6
CO. YORK METROPOLITAN TORONTO
TWP. ETOBICOKE LOT _____ CON. _____

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D. V. K.	CHECKED	W.P. NO. 213 - 65	DRAWING NO.
DRAWN F. L.	CHECKED	JOB NO. 72 - 11022	72-11022A
DATE JULY 28, 1972		SITE NO.	BRIDGE DRAWING NO.
APPROVED		CONT. NO.	
PRINCIPAL FOUNDATION ENGINEER			

CONTINUED FROM PREVIOUS PAGE

GEOCRES No. 30 H. D. 58

DIST 6 REGION CENTRAL

W.P. No. 783-65-NI

CONF. No. 78-III

W.C. No.

STR. SITE No.

HWY. No. 427

LOCATION TWIN OAK HEAD STRUCTURES

AT THE CROSSINGS OF N.B. AND S.B.

LANES OF HWY 427 WITH CHR.

OVERLOOK FOR VIEW OF 4

REMARKS:

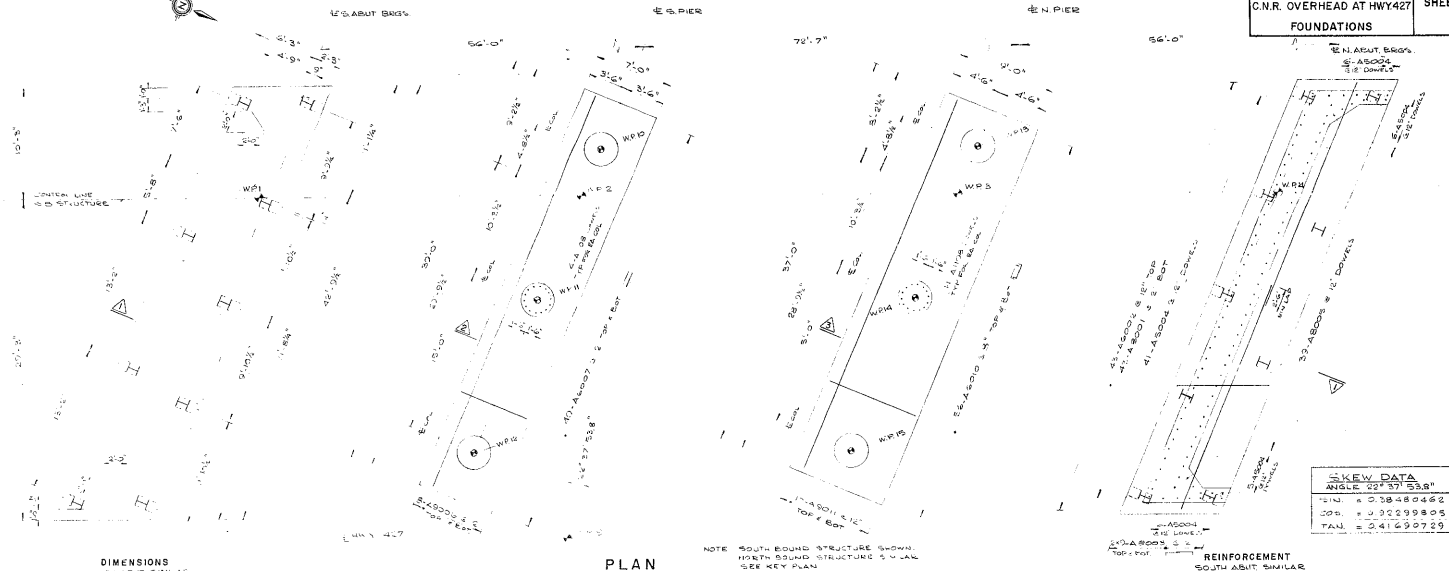
DIST. No. 6 30412-58

CONT No
WP No 213-65

C.N.R. OVERHEAD AT HWY427

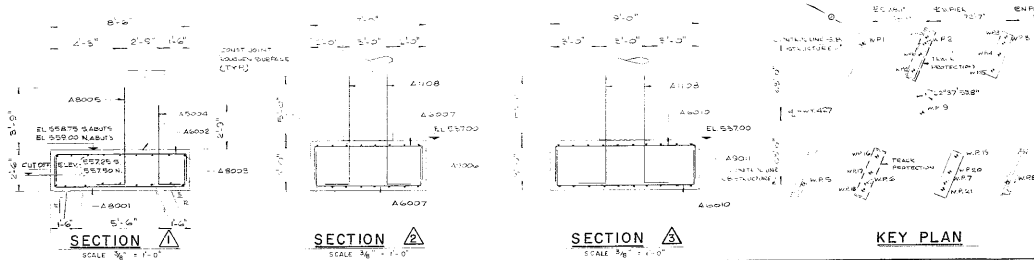
FOUNDATIONS

SHEET

DIMENSIONS
SOUTH ABUTMENT

PLAN

SCALE 1/4" = 1'-0"

NOTE SOUTH ABUTMENT STRUCTURE SHOWN.
NORTH ABUTMENT STRUCTURE IS SIMILAR.
SEE KEY PLAN.REINFORCEMENT
SOUTH ABUTMENT

PILE TABLE		
LOCATION	NO.	LENGTH
SOUTH ABUTMENT	1	72'
	2	72'
	3	72'
NORTH ABUTMENT	4	67'
	5	72'
	6	72'

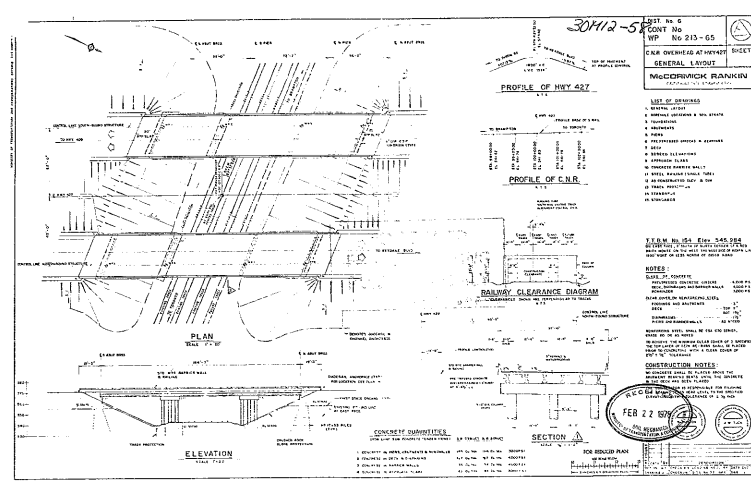
NOTE: ALL PILES TO BE HP12X45.
PILE LENGTHS ARE APPROXIMATE.

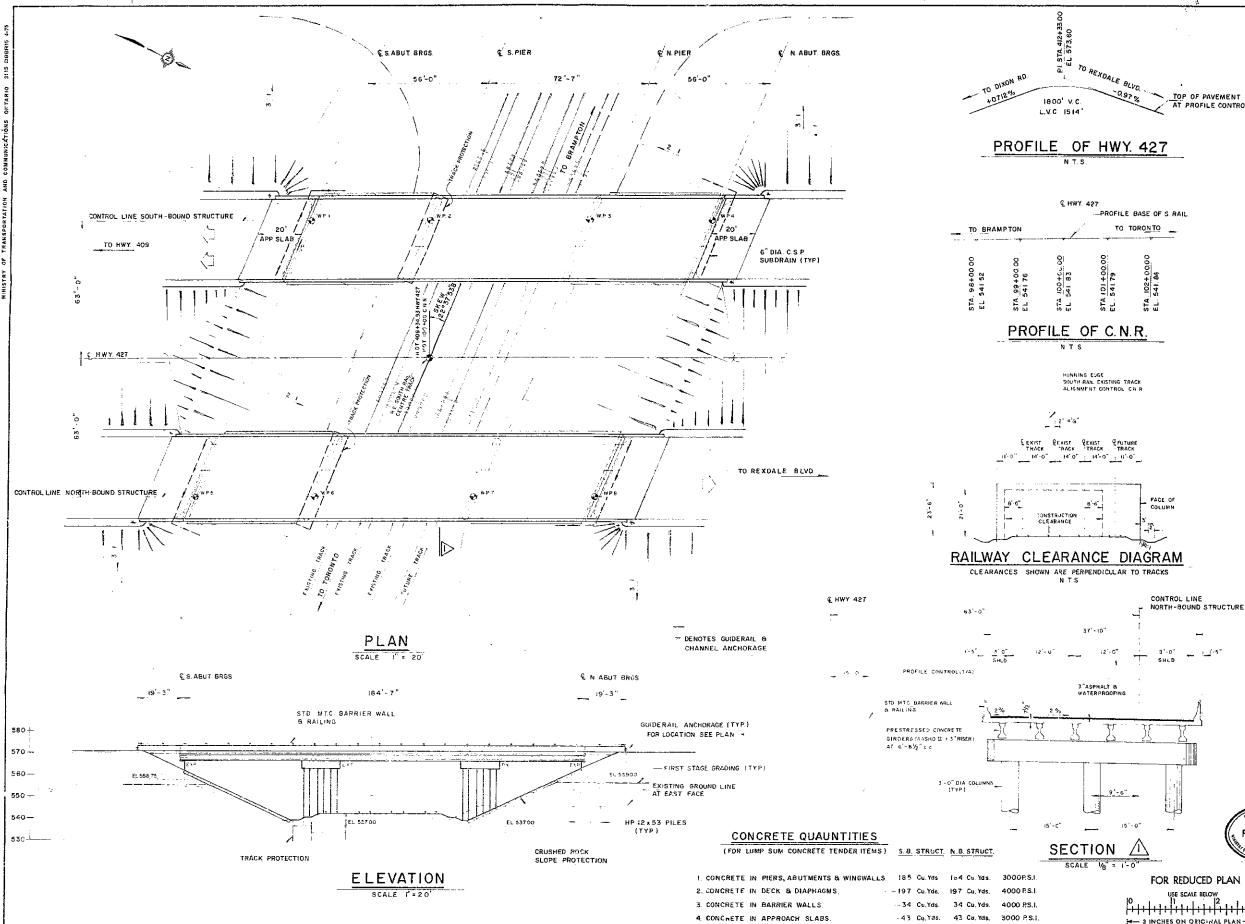
- NOTES:
1. SEE PILE SPECIFICATIONS.
 2. FOR HOE-ROD POINTS DIMENSIONS, SEE C&G - 8.
 3. PILE DETAIL OF TRACK PROTECTION SEE C&G - 15.
 4. PILES TO BE DRIVEN IN ACCORDANCE WITH STANDARD 88-3-11 USING DESIGN LOAD OF 70 TONS/PILE.

FOR REDUCED PLAN

DATE BY DESCRIPTION DATE REC'D
DESIGNER R. S. CHECKER J. L. B. DATE REC'D
DRAWING CHECKER K. S. DATE REC'D

DATE REC'D
DATE REC'D
DATE REC'D





DIST. No. 6. 30412-68
CONT No
WP No 213-65

C.N.R. OVERHEAD AT HWY 427
GENERAL LAYOUT

MCCORMICK RANKIN
CONSULTING ENGINEERS

SHEET

- LIST OF DRAWINGS**
- GENERAL LAYOUT
 - WORKABLE LOCATIONS & SOIL STRATA
 - FOUNDATIONS
 - ABUTMENTS
 - PIERS
 - PRESTRESSED GIRDERS & BEARINGS
 - DECK
 - SORED ELEVATIONS
 - APPROACH SLABS
 - CONCRETE BARRIER WALLS
 - STEEL RAILING (SINGLE TUBE)
 - AS CONSTRUCTED ELEV. & DIM.
 - TRACK PROTECTION
 - STANDARDS
 - STANDARDS

T.B.M. No. 154 Elev. 545.984
ON EAST FACE, 2' SOUTH OF NORTH CORNER OF A RED BRICK HOUSE ON THE WEST SIDE OF INDIAN LINE, 1800' MORE OR LESS NORTH OF 0500 ROAD.

- NOTES:**
- CLASS OF CONCRETE**
- | | |
|----------------------------------|-------------|
| PRESTRESSED CONCRETE GIRDERS | 4000 P.S.I. |
| DECK, DIAPHRAGMS & BARRIER WALLS | 4000 P.S.I. |
| REMAINDER | 3000 P.S.I. |
- CLEAR COVER ON REINFORCING STEEL**
- | | |
|-------------------------|------------|
| FOOTINGS AND ABUTMENTS | 3" |
| DECK | TOP 2" |
| DIAPHRAGMS | DOT 1 1/2" |
| PIERS AND BARRIER WALLS | AS NOTED |
- REINFORCING STEEL SHALL BE CSA 630 SERIES, GRADE 60 OR AS NOTED.
- TO ACHIEVE THE MINIMUM CLEAR COVER OF 2" SPECIFIED, THE TOP LAYER OF DECK RE-BARS SHALL BE PLACED PRIOR TO CONCRETING WITH A CLEAR COVER OF 2 1/2" ± 1/2" TOLERANCE.

CONSTRUCTION NOTES:

NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SLATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED.

THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SLATS DEAD LEVEL TO THE SPECIFIED ELEVATION WITH A TOLERANCE OF ± 1/8" INCH.

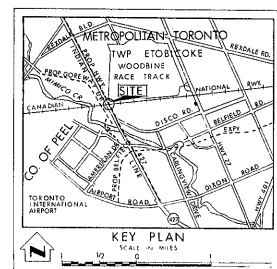
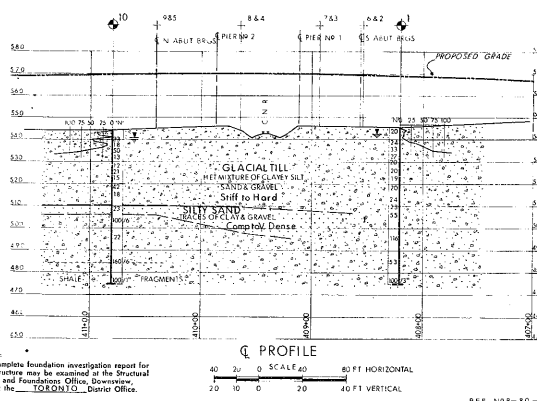
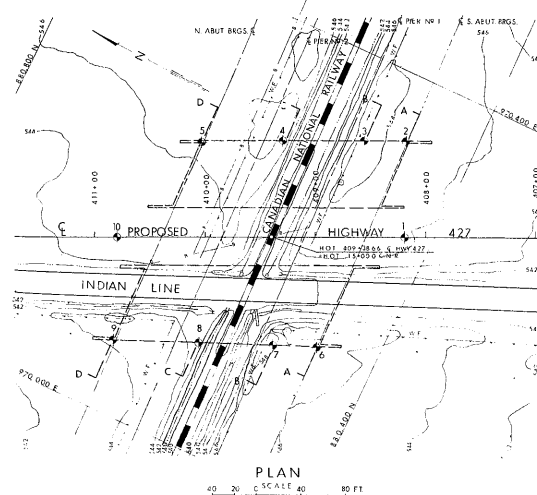
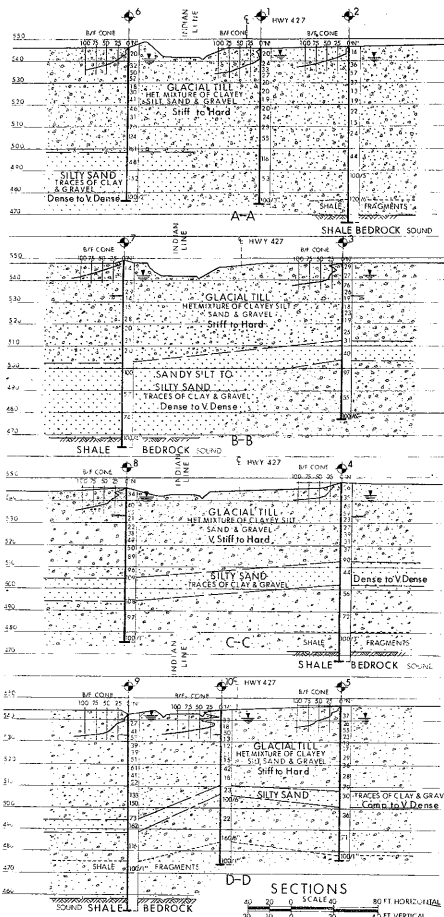
RECEIVED
FEB 07 1978
C.N.R. ENGINEERING

DESIGNED BY
A. W. TUCK

CHECKED BY
A. W. TUCK

DATE
FEB 07 1978

DESCRIPTION
DESIGN & CHECK OF C.N.R. OVERHEAD AT HWY 427
DRAWING NO. 37-984 DWG. 1



LEGEND				
◆	Bore Hole			
⊕	Cone Penetration Test			
⊕	Bore Hole & Cone Test			
⊕	Water Level established at time of field investigation MAR 1972			
		CO-ORDINATES		
NO	ELEVATION	NORTH	EAST	
1	545.7	880.124	970.267	
2	546.9	880.461	970.342	
3	547.5	880.496	970.326	
4	548.4	880.563	970.293	
5	548.5	880.529	970.261	
6	548.6	880.555	970.137	
7	548.8	880.490	970.122	
8	545.6	880.553	970.094	
9	542.1	880.628	970.064	
10	544.3	880.661	970.150	

— NOTE —
The boundaries between soil strata have been established on the basis of Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

30412-58

MINISTRY OF TRANSPORTATION & COMMUNICATIONS
DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

CANADIAN NATIONAL RAILWAY

HIGHWAY NO. 427
CO. YORK
TWP. ETOBICOKE

DIST NO. 6
METROPOLITAN TORONTO
CON.

BORE HOLE LOCATIONS & SOIL STRATA

SHAFT NO. 213-85
DRAWING NO. 72-11022A
DATE JULY 28, 1972
APPROVED: [Signature]
BRIDGE DRAWING NO. 37-984-4

NOTE:
The complete foundation investigation report for this structure may be obtained at the Structural Office and Foundations Office, Downsview, and at the TORONTO District Office.

REF. NPB-80-91