cc: Gen. Files

W.P. 445-65

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

Attention: Mr. S. McCombie

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

Date: December 4, 1967

Our Fil. Ref.

In reply to

DEC - 8 1967

Subject:

FOUNDATION INVESTIGATION REPORT
For
Proposed Underpass at the Crossing of
Baker Road and Q.E.W.
District No. 4 (Hamilton)
W.J. 67-F-96 --- W.P. 445-65

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

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

A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

AGS/MdeF
Attach.
cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
G. K. Hunter (2)
H. Greenland
W. S. Melinyshyn
T. J. Kovich
R. A. Singh
Foundations Files
Gen. Files

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For
Proposed Underpass at the Crossing of
Baker Road and Q.E.W.
District No. 4 (Hamilton)
W.J. 67-F-96 -- W.P. 445-65

1. INTRODUCTION:

The Foundation Section was requested to carry out an investigation for the proposed underpass at the crossing of the Queen Elizabeth Way and Baker Road in the Twp. of Willoughby, County of Welland, Ontario. The request was contained in a memo from the Bridge Location Section (Mr. W. S. Melinyshyn, Regional Bridge Location Engineer), dated September 8, 1967. An investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the site.

This report contains the results of the investigation, together with recommendations pertaining to the foundations of the new structure and the stability of the approach embankments.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located about seven miles northwest of Fort Erie. At this location, the Queen Elizabeth Highway grade is about 4 to 5 ft. above the surrounding ground surface elevation with a small gradient towards Fort Erie. The highway consists of four paved lanes with a median strip and associated gravel shoulders. Along each side of the highway there is a wide drainage ditch, 2 ft. to 3 ft. below the surrounding ground surface elevation. The grade of the existing Baker Rd. is at about the same elevation as the surrounding ground level. The immediate area is generally flat farmland with some farm buildings towards the east.

cont'd. /2 ...

2. <u>DESCRIPTION OF THE SITE AND GEOLOGY</u>: (cont'd.) ...

Physiographically, the site is located in the "Haldimand Clay Plain." Based on available geological information, it is known that the overburden of this region consists of lacustrine clay deposited in glacial Lake Warren, formed during the retreat of the last continental glacier.

3. <u>FIELD AND LABORATORY WORK</u>:

Four boreholes and four dynamic cone penetration tests were carried out during the course of the recent field work. In addition, two boreholes and two dynamic cone penetration tests were carried out by H. Q. Golder and Associates Ltd., during Aug. 1966, for preliminary investigation purposes. Boring was achieved by means of a conventional diamond drill adapted for soil sampling purposes. Samples were recovered at required depths in 2-inch O.D. split-spoon samplers which were hammered into the soil, or in 2-inch I.D. Shelby tubes which were manually pushed into the soil. The method of driving the split-spoon samplers conformed to the requirements of the Standard Penetration Test. The same method was used to advance the cone in the dynamic cone penetration test. Where possible, field vane tests were carried out at various depth intervals in order to determine the undrained shear strength of the cohesive strata. Bedrock was proven in four boreholes by obtaining BXT size rock core samples. During sampling and drilling operations, detailed logs of the borings were made which described drilling and sampling techniques, soil types encountered, and groundwater conditions.

The locations and elevations of all borings were surveyed in the field by personnel from the Central Region Engineering Surveys, and are shown on Dwg. #67-F-96A, together with the estimated stratigraphical profile.

All samples were subjected to a careful visual inspection in the laboratory prior to any tests being carried out.

cont'd. /3 ...

3. FIELD AND LABORATORY WORK: (cont'd.) ...

Following this inspection, tests were carried out on certain samples to determine the following physical properties of the various soil types:

Atterberg Limits
Natural Moisture Contents
Bulk Densities
Grain-Size Distributions
Consolidation Characteristics
Undrained Shear Strengths

The results of these tests are summarized and plotted on the Record of Borelog sheets contained in the Appendix of the report.

On completion of laboratory testing, the various soil samples were classified as to type and consistency, or relative density, in general, according to the Unified Soil Classification System (Oct. 1963).

4. SOIL TYPES AND CONDITIONS:

4.1) General:

Subsoil at the site consists of 38 ft. to 45 ft. of hard to soft silty clay followed by 3 ft. to 7 ft. of a very stiff to hard or very dense glacial till deposit underlain by shale bedrock at a depth of 44 ft. to 49 ft.

The boundaries between the various soil strata are shown on the Record of Borelog sheets contained in the Appendix of the report. The estimated stratigraphical profile shown on Dwg. #67-F-96A is based upon this information. From ground level downwards, the different soil types are described in detail as follows:

cont'd. /4 ...

4. <u>SOIL TYPES AND CONDITIONS</u>: (cont'd.) ...

4.2) <u>Silty Clay</u>:

This deposit was encountered in all boreholes immediately below the ground surface, except in boreholes #2 and #3 where a thin cover of 3 ft. to 4 ft. of fill material (mixture of sand and gravel) overlies the silty clay deposit.

The thickness of the silty clay layer varied from 38 ft. in borehole #4 to 44 ft. in borehole #3. The material is essentially cohesive in nature, generally consisting of silty clay with a trace of sand and occasional gravel. The sand and gravel content appears to be increasing with depth. This deposit contains occasional layers of clayey silt and clay.

Physical properties of the material as determined from laboratory tests, are summarized in tabular form as follows:

		Upper Zone Desiccated Crust Range	Lower Zone Range
Bulk Density (p.c.f.)	(γ)	118 - 124	125
Liquid Limit (%)	(W_L)	37 - 50	33 - 58
Plastic Limit (%)	(W_P)	20 - 23	16 - 29.5
Moisture Content (%)	(W)	20 - 28	25 - 44
Undrained Shear Strength (p.s.f.)	(C_u)	2500 - 3400	400 - 1600
Sensitivity	(S_t)	-	2 - 5
'N' Values (blows/ft.)		11 - 43	6 - 11

The Atterberg Limit tests listed above are summarized on the Plasticity Chart appended to this report. These indicate that the silty clay is inorganic and generally of intermediate plasticity.

cont'd. /5 ...

4. <u>SOIL TYPES AND CONDITIONS</u>: (cont'd.) ...

4.2) <u>Silty Clay</u>: (cont'd.) ...

The undrained shear strength results indicate that the consistency of the stratum varies from very stiff immediately below the desiccated crust, changing to soft to firm with depth. The consistency of the crust varies from hard to very stiff. The Standard Penetration tests carried out, corroborate the consistency pattern given above.

4.3) <u>Heterogeneous Mixture of Clayey Silt, Sand and Gravel - or Silty Sand with Gravel (Glacial Till)</u>:

Underlying the silty clay stratum between elev. 536 and elev. 542 is a deposit of glacial till varying in thickness from 3 ft. in B.H. #3 to 10 ft. in B.H. #1. The matrix of the till is quite variable across the site. In general, the deposit is composed of a granular mixture of silt, sand and gravel with traces of clay. Occasional boulders up to 6" Ø were encountered below elev. 538 in B.H. #4.

Standard penetration resistance or 'N' values of 20 blows/ft. to 126 blows/7", generally increasing with depth, were observed in this material. From these values it is estimated that the consistency of the cohesive portion of the till stratum varies from very stiff to hard, whereas the relative density of the granular portion is very dense. Typical grain-size distribution curves obtained from the samples of this deposit are included in the Appendix of this report.

4.4) <u>Shale Bedrock</u>:

Shale bedrock directly underlies the glacial till deposit. The bedrock was proven by drilling 3 to 6 ft. of BXT core in B.H.'s #1, 2, 3 and 4. Boreholes #5 and 6 were terminated only after refusal to augering was met; it is inferred that this occurred on the surface of the sound bedrock. The bedrock surface

cont'd. /6 ...

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

4.4) Shale Bedrock: (cont'd.) ...

across the site varies from elev. 531 to elev. 533 - i.e., some 44 to 49 ft. below the existing ground surface. The rock core obtained, shows the rock to be shale with gypsum inclusions. The upper 0.5 to 1.5 ft. of the bedrock was found to be weathered and below this, it appears to be generally sound with recovery ranging from 60 to 90%.

5. GROUNDWATER CONDITIONS:

Water level observations carried out during the period of the field investigation, indicate that the water level in the borings ranged from about elev. 565 to elev. 570, which is some 7 to 14 ft. below the existing ground surface.

The exact water levels observed during the time of the field investigation, are shown on the enclosed drawings as well as on the borehole logs (Appendix I).

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct an underpass structure to carry Baker Rd. over the Queen Elizabeth Way. Present proposals call for a four-span (65'-103'-103'-65') structure with approach fills having a maximum height about 21 ft. above the existing Q.E.W. grade.

Subsoil at the site consists of a deposit of hard to soft silty clay, some 38 to 44 ft. thick, followed by 3 to 9 ft. of glacial till deposit. The till is, in turn, underlain by shale bedrock approximately 44 to 49 ft. below ground surface.

cont'd. /7 ...

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

6.2) Structure Foundations:

Since the upper 15 to 20 ft. of subsoil consists of a hard to very stiff silty clay, conditions are favourable for spread footing support and, in the case of the proposed piers, it is recommended that the footings be placed some 4 ft. below the existing ground surface, with an allowable bearing pressure of 2.5 t.s.f.

The proposed abutments may be constructed within the approach fills; two alternative methods are given for the foundation support of the abutments:

i) Abutments can be founded on spread footings founded on a compacted granular (G.B.C. Class 'A') material using a safe bearing pressure of 2.0 t.s.f. The granular fill should extend for a horizontal distance of at least 10 ft. from the footing edges in the plane of the footing tops. This portion of the fill should be built with side slopes of 2:1. The remainder of the fill should be completed to about profile grade for a distance of about 50 ft. behind the abutments before re-excavating for the abutment footings.

ii) Abutments can be supported on 12-3/4" O.D. closed-end pipe piles driven about 10 ft. into the upper desiccated zone of the silty clay stratum - i.e., to about elevation 568. For piles driven to this depth, a design load of 20 tons per pile can be used.

Care should be taken to ensure that no bouldery fill is placed at the locations through which piles have to be driven.

It is estimated that the settlements of the abutments for the above alternatives will be of the same magnitude as those of the approach fills - i.e., about 5 inches - as described elsewhere in this report.

cont'd. /8 ...

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

6.2) Structure Foundations: (cont'd.) ...

No major dewatering problems are anticipated during the construction of the pier footings, in view of the low permeable nature of the subsoil; however, care should be taken to prevent softening of the subsoil of the foundation levels by the surface run-off. In this regard, it is recommended that the foundation base be protected by pouring a mat of lean concrete as soon as subgrade level is reached.

An analysis, based on Skempton and Bjerrum's* method, has been made to estimate the consolidation settlement of the foundation subsoil due to the pier footing and embankment loading. It is assumed in the computations, that $\mu = 0.5$ for the upper crust and $\mu = 0.6$ for the lower portion.

Results of the analysis are summarized as follows:

*Skempton, A. W. and Bjerrum, L. -
"A Contribution to the Settlement Analysis of Foundations of Clay" -
Geotechnique - 1958, p. 168.

cont'd. /9 ...

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

6.2) Structure Foundations: (cont'd.) ...

1)	Ultimate settlements at the end pier locations	$\approx$	2"
	Induced by embankment loading (footing size 7' x 40')	$\approx$	1"
	Total		3"
2)	Ultimate settlement at the centre pier location (footing size 7' x 40')	$\approx$	2"
3)	Ultimate settlements at the abutment locations (Induced by embankment - 21-ft. height - 35-ft. width at the top with 2:1 slopes)	$\approx$	5"

These figures represent the total long-term consolidation settlement, of which eighty percent should occur within about 10 years. Fifty percent of the settlement should take place within a 2 - 3 year period, and approximately thirty percent within one year.

In addition to the aforementioned consolidation settlements, there will be elastic or immediate settlements. It can be assumed that elastic settlements will take place during and immediately after construction.

If the footings and approach embankments are constructed at the same time, the maximum differential settlements between the centre and end piers will be in the order of 1". The maximum differential settlement between the end piers and the abutments will be in the order of 2".

cont'd. /10 ...

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

6.2) Structure Foundations: (cont'd.) ...

The differential settlements could be reduced by constructing the approach embankments well in advance of the construction of the structure foundations. For example, if the approach fills are constructed 12 months prior to the construction of the foundations, about 30% of the consolidation settlements will take place during this period. Consequently, the differential settlements between the centre pier and end piers will be in the order of 0.5 to 1.0 in. The differential settlements between the end piers and the abutments founded in the approach fills will be in the order of 1.0 in.

The total and differential settlements between the pier and abutment foundations could be eliminated by supporting the foundations of the entire structure on end-bearing piles driven to bedrock. Such piles would be of the order of 44 to 49 ft. long at the pier locations. The load carrying capacity of the piles will be dependent on the pile section used; for example, a 14 BP 74 steel H-pile could be designed for 90 tons/pile.

6.3) Approach Embankments:

The proposed approach embankments will be of the order of 21 ft. above existing ground surface. No stability problems are anticipated for embankments constructed of properly compacted fill, and with standard 2:1 slopes.

7. SUMMARY:

A foundation investigation for the proposed structure at the crossing of Baker Rd. and the Q.E.W. is reported.

Subsoil at the site consists of a deposit of hard to soft silty clay followed by a glacial till underlain by shale bedrock at 44 to 49 ft. below the ground surface.

cont'd. /11 ...

7. SUMMARY: (cont'd.) ...

Pier foundations for the structure should be supported on spread footings some 4 ft. below ground surface where a safe bearing pressure of 2.5 t.s.f. can be applied.

The abutments can be founded: i) within a zone composed of properly compacted granular fill using an allowable bearing pressure of 2.0 t.s.f., or ii) on 12-3/4" O.D. closed-end pipe piles driven about 10 ft. into the hard silty clay; the allowable load per pile will be about 20 tons. The anticipated settlement of the structure foundations and approach fills are discussed in the section, "Discussion and Recommendations".

As an alternative, the entire structure can be supported on steel H-piles driven to bedrock, as discussed in the report.

No major dewatering problems are anticipated for the pier footing excavations.

No stability problems are anticipated for the approach fills with standard 2:1 slopes.

8. MISCELLANEOUS:

The field work, performed during the period October 4 to 18, 1967, was undertaken by Mr. P. B. Schnabel, Project Foundation Engineer, who also prepared this report.

The equipment was owned and operated by Dominion Soil Investigation Ltd.

The work was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who also reviewed this report.

December, 1967

APPENDIX I

FORM DB-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

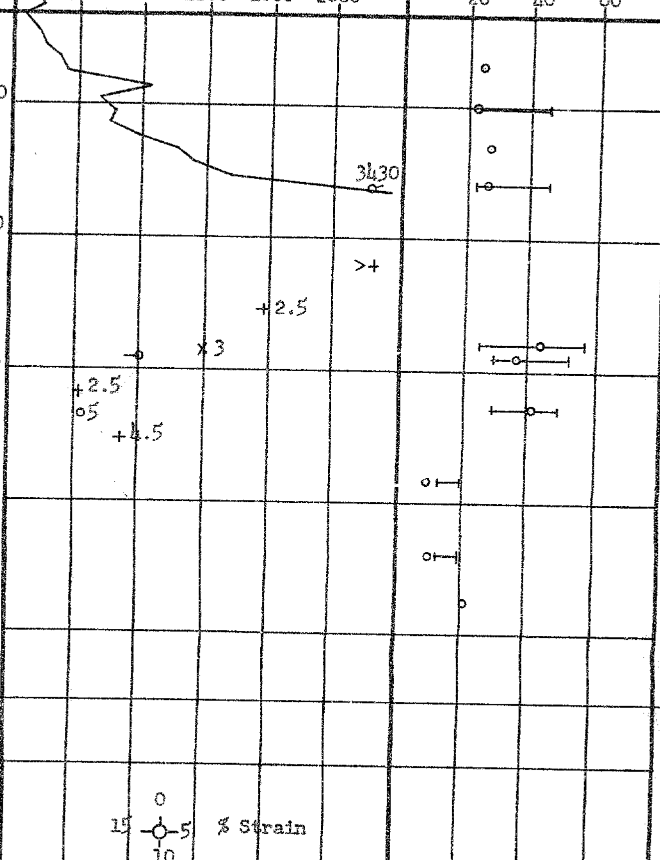
RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 67-F-96
W.P. 445-65
DATUM Geodetic
LOCATION Q.E.W. - Baker Rd. 41 + 60 19' Lt.
BORING DATE Oct. 4 - 6, 1967
BOREHOLE TYPE Washboring
ORIGINATED BY PBS
COMPILED BY PBS
CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BULK DENSITY γ P.C.F.	REMARKS
576.9	Ground Level							
0.0	Silty clay, trace of sand and occasional gravel.		1	SS	35			
			2	SS	43	570		
			3	SS	21			566.0
			4	TW	PM		125	
	Hard to soft.		5	TW	PM	560		
			6	TW	PM			
			7	TW	PM	550		
			8	TW	PM			
542.4			9	TW	PM			
34.5	Het. mixture of clayey silt, sand & gravel. (Glacial Till)		10	SS	55	540		Gr.30, Sa.23 Si.35, Cl.12
			11	SS	75			
532.4	Hard		12	SS	37/2"			
530.9	Weathered Bedrock							
46.0	Sound becrock Shale with gypsum inclusions		13	BXT RC	85% Rec	530		
525.0								
51.9	End of Borehole					520		

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P.S.F. o Unconfined x Lab. Vane + Field Vane 400 800 1200 1600 2000
LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w
WATER CONTENT % 20 40 60



FORM 08-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS – ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

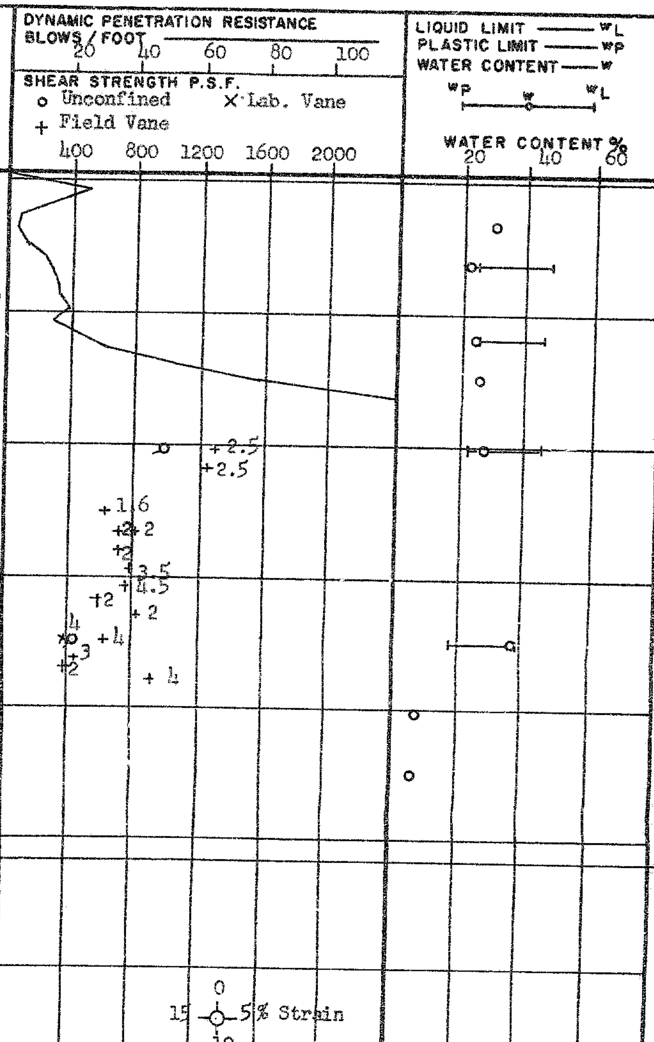
FOUNDATION SECTION

JOB 67-F-96 LOCATION Q.E.W. - Baker Rd. 41 + 14 14' Rt. ORIGINATED BY PBS

W.P. 445-65 BORING DATE Oct. 13-17, 1967 COMPILED BY PBS

DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	BULK DENSITY γ P.C.F.	REMARKS
580.4	Ground Level						
0.0	Sand and gravel (Loose). Fill material						
577.1 / 3.3	Silty clay, trace of sand and occasional gravel. Hard to soft	1	SS	11			
		2	SS	41			Gr.1, Sa.4 Si.& Cl.95
		3	SS	32	570		
		4	SS	29			▼565.9
		5	SS	32			
		6	TW	PM	560	121.5	
		7	TW	PM			
		8	TW	PM	550		
		9	TW	PM		121	Sa.1 Si.& Cl.99
540.5 / 39.9	Het. mixture of clayey silt, sand & gravel. Hard. (Glacial Till)	10	SS	41	540		
		11	SS	110/6"			
531.3 / 49.1	Bedrock. Shale with gypsum inclusions	12	BXT RC	73%	530		
528.4 / 52.0	End of Borehole						
					520		



FORM DB-MT-125
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS – ONTARIO

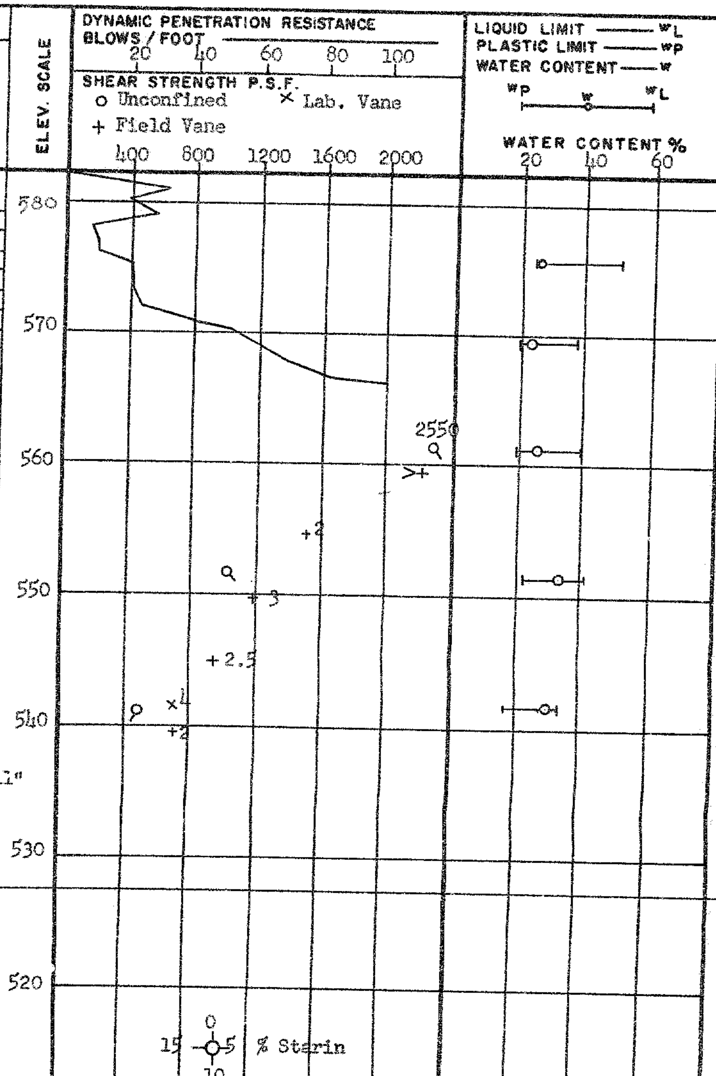
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 67-F-96
LOCATION Q.E.W. - Baker Rd. 39 + 80 20' Lt.
ORIGINATED BY PBS
W.P. 445-65
BORING DATE Oct. 11-12, 1967
COMPILED BY PBS
DATUM Geodetic
BOREHOLE TYPE Washboring
CHECKED BY

ELEV. / DEPTH	DESCRIPTION (SOIL PROFILE)	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	BULK DENSITY γ P.C.F.	REMARKS
582.1	Ground Level						
0.0 / 578.1	Sand and gravel. Loose. (Fill material)						
4.0	Silty clay, trace of sand and occasional gravel.		1	SS	12		
			2	SS	28		
			3	SS	39		
			4	SS	32		
	Hard to soft.		5	SS	24		
			6	TW	PM	124.5	
			7	TW	PM		
			8	TW	PM	118	
			9	TW	PM		
536.6			10	TW	PM	124	Sa.2 Si. & Cl.98
45.5 / 533.4	Het. mixture of clayey silt, sand and gravel. Hard. (Glacial Till)		11	SS	158/11"		
48.7 / 527.6	Sound bedrock, shale with gypsum inclusions		12	BXT RC	Rec 90%		
54.5	End of Borehole						



FORM 08-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

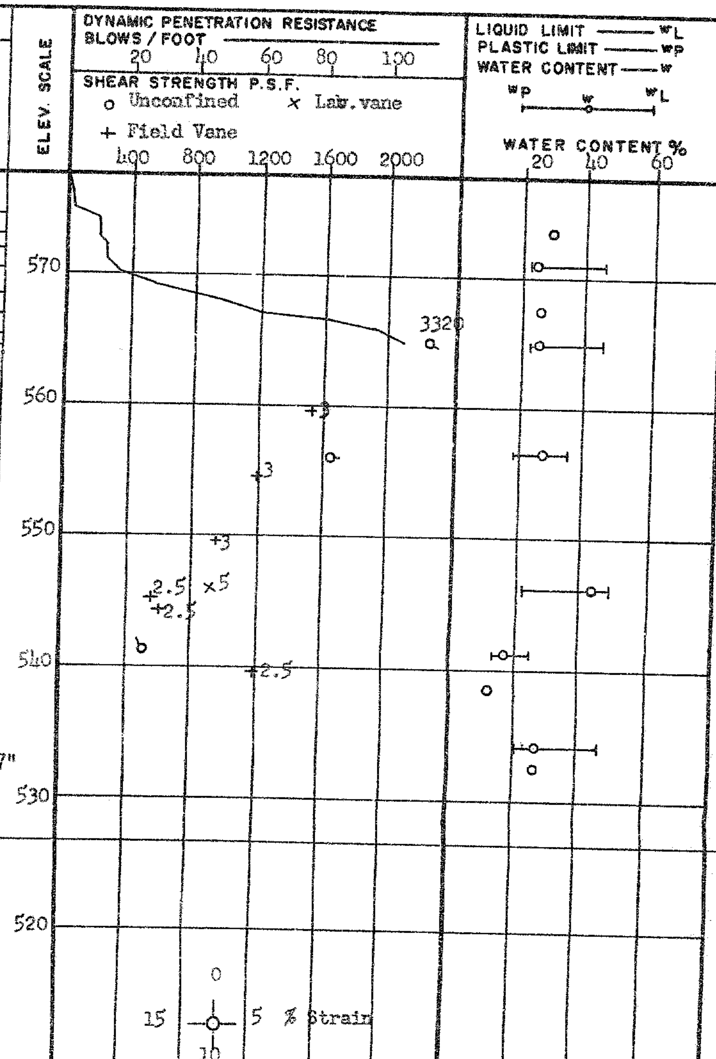
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 67-F-96
LOCATION W.E.W.-Baker Rd. 38 + 12 19' Lt.
ORIGINATED BY PBS
W.P. 445-65
BORING DATE Oct. 6-11, 1967
COMPILED BY PBS
DATUM Geodetic
BOREHOLE TYPE Washboring
CHECKED BY

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FOOT	BULK DENSITY γ P.C.F.	REMARKS
577.2	Ground Level					
0.0	Silty clay, trace of sand and occasional gravel.	1	SS	27		
		2	SS	27		▼ 569.3
	Firm to hard.	3	SS	37		
		4	TW	PM	125	
		5	TW	PM		
		6	TW	PM	124	
		7	TW	PM		
		8	TW	PM		
539.2		9	TW	PM		
38.0	Het.mix. of clayey silt, sand & gravel. Very stiff to hard. (Glacial Till) (with occ.boulder below 538)	10	SS	39	136	
			BXT	Rec		
		10A	RC	15%		
		11	SS	20		
532.2		12	SS	126/7"		Gr.1,Sa.10 Si.37,Cl.52
45.0	Sound bedrock Shale with gypsum inclusions	13	BXT RC	65% Rec		
526.7 / 50.5	End of Borehole					



FORM 08-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

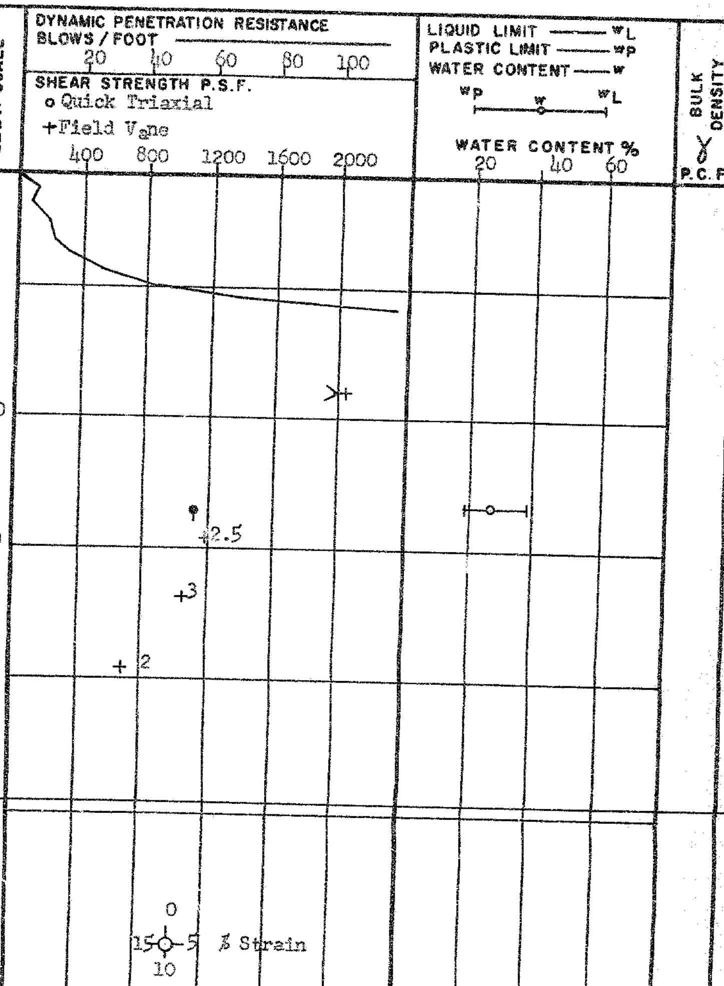
JOB 67-F-96 LOCATION Q.E.W. - Baker Rd. 39 + 39 41' Rt.

W.P. 445-65 BORING DATE August 24-25, 1967 ORIGINATED BY PBS

DATUM Geodetic BOREHOLE TYPE Power Auger COMPILED BY PBS

CHECKED BY

SOIL PROFILE ELEV. DEPTH 578.2	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	REMARKS
0.0	Silty clay, trace of sand and occasional gravel.		1	SS	14		
			2	SS	23	570	
			3	SS	20		565.2
	Very stiff to firm.		4	TW	PH		
			5	SS	11	560	
			6	TW	PM		
			7	SS	7	550	
			8	TW	PM		
536.2			9	SS	3	540	
42.0	Silty sand with some gr.& trace of clay.						
532.2	Very dense.(Glacial Till)		10	SS	>100		
530.7	Weathered Bedrock					530	
47.5	End of Borehole Refusal to augering Probably bedrock						



FORM DB-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

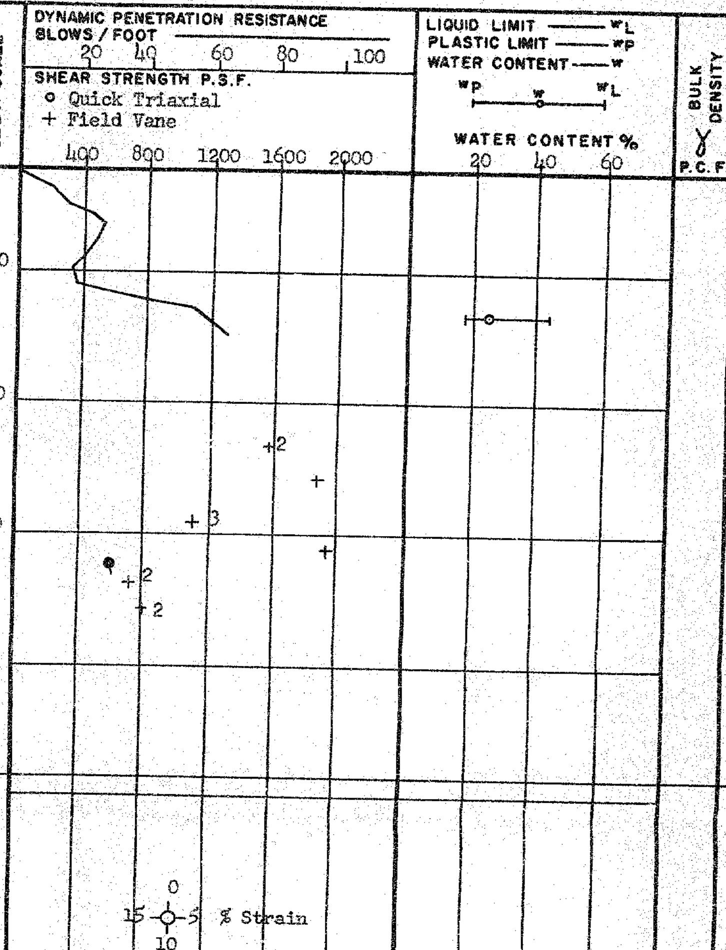
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 6 (Golder BH#18)

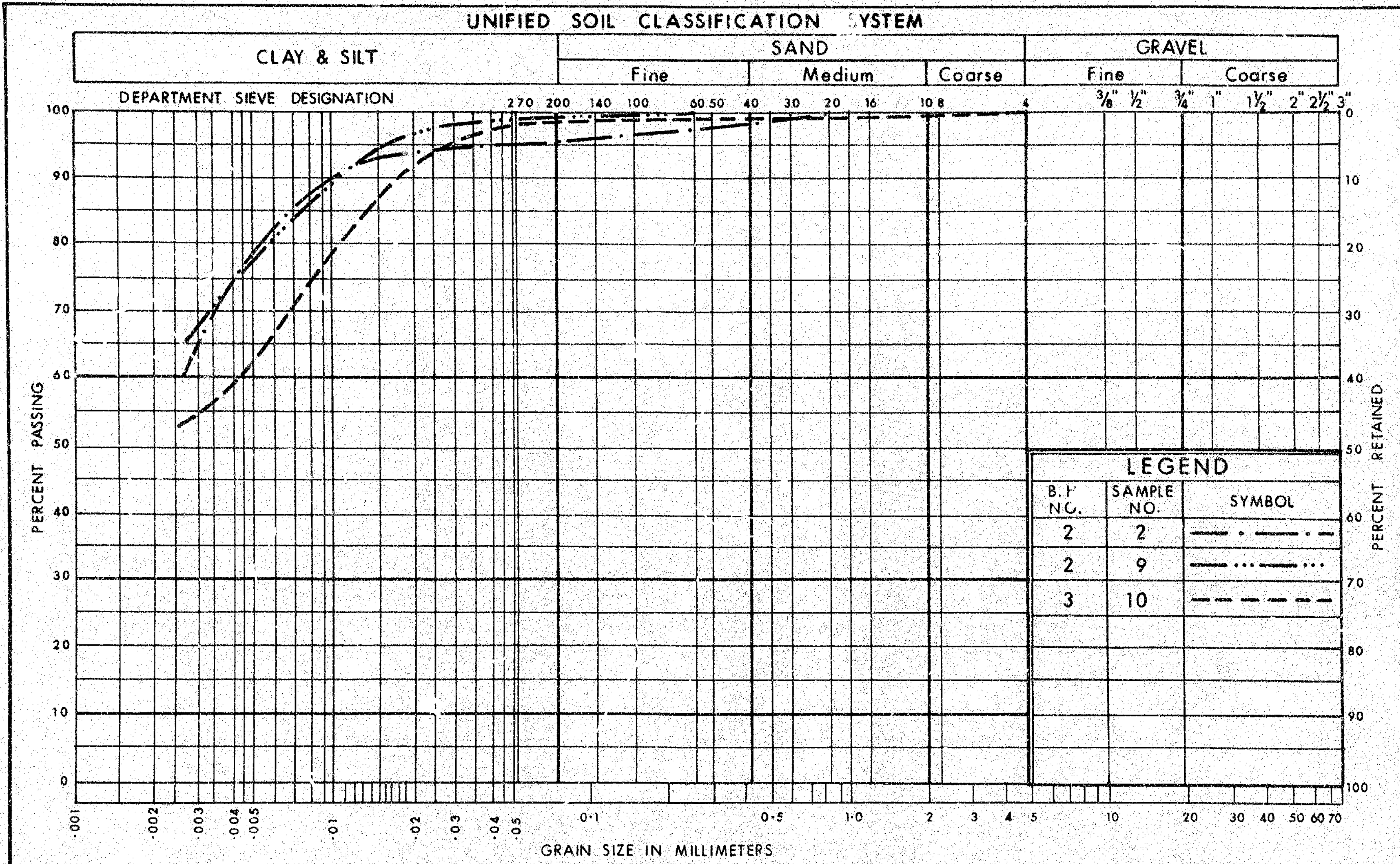
FOUNDATION SECTION

JOB 67-F-96 LOCATION Q.E.W. - Baker Rd. 41 + 55 55' Rt. ORIGINATED BY PBS
W.P. 445-65 BORING DATE August 24-25, 1967 COMPILED BY PBS
DATUM Geodetic BOREHOLE TYPE Power Auger Boring CHECKED BY

ELEV. / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLES – NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	REMARKS
577.4	Ground Level					
0.0	Silty clay, trace of sand and occasional gravel. Hard to firm.	1	SS	13		
		2	SS	39	570	569.7
		3	SS	26		
		4	SS	20	560	
		5	TW	PM		
		6	SS	6	550	
		7	TW	PM		
540.4 / 37.0	Silty sand with gravel and a trace of clay. (Glacial Till) Dense	8	SS	11	540	
		9	SS	48		
533.1 / 532.1	Weathered Bedrock	10	SS	>100		
45.3	End of Borehole Refusal. Probable Bedrock				530	



FORM OB MT - 17
REV. APR. 1965
65-414



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION
ONTARIO

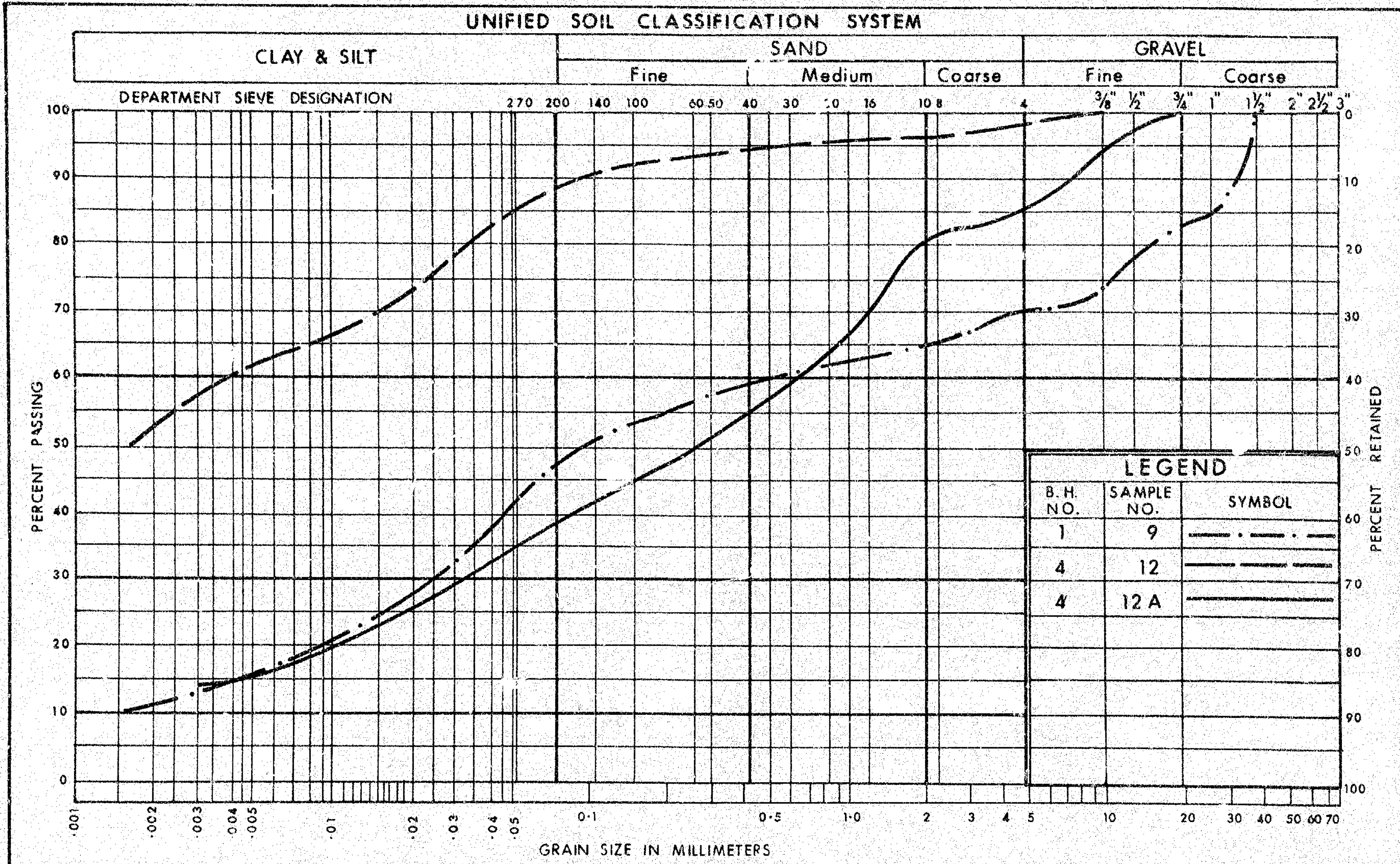
GRAIN SIZE DISTRIBUTION

SILTY CLAY

W.P. No. 445 - 65

JOB No. 67 - F - 96

FORM OB MT-17
REV. APR. 1965
65-414



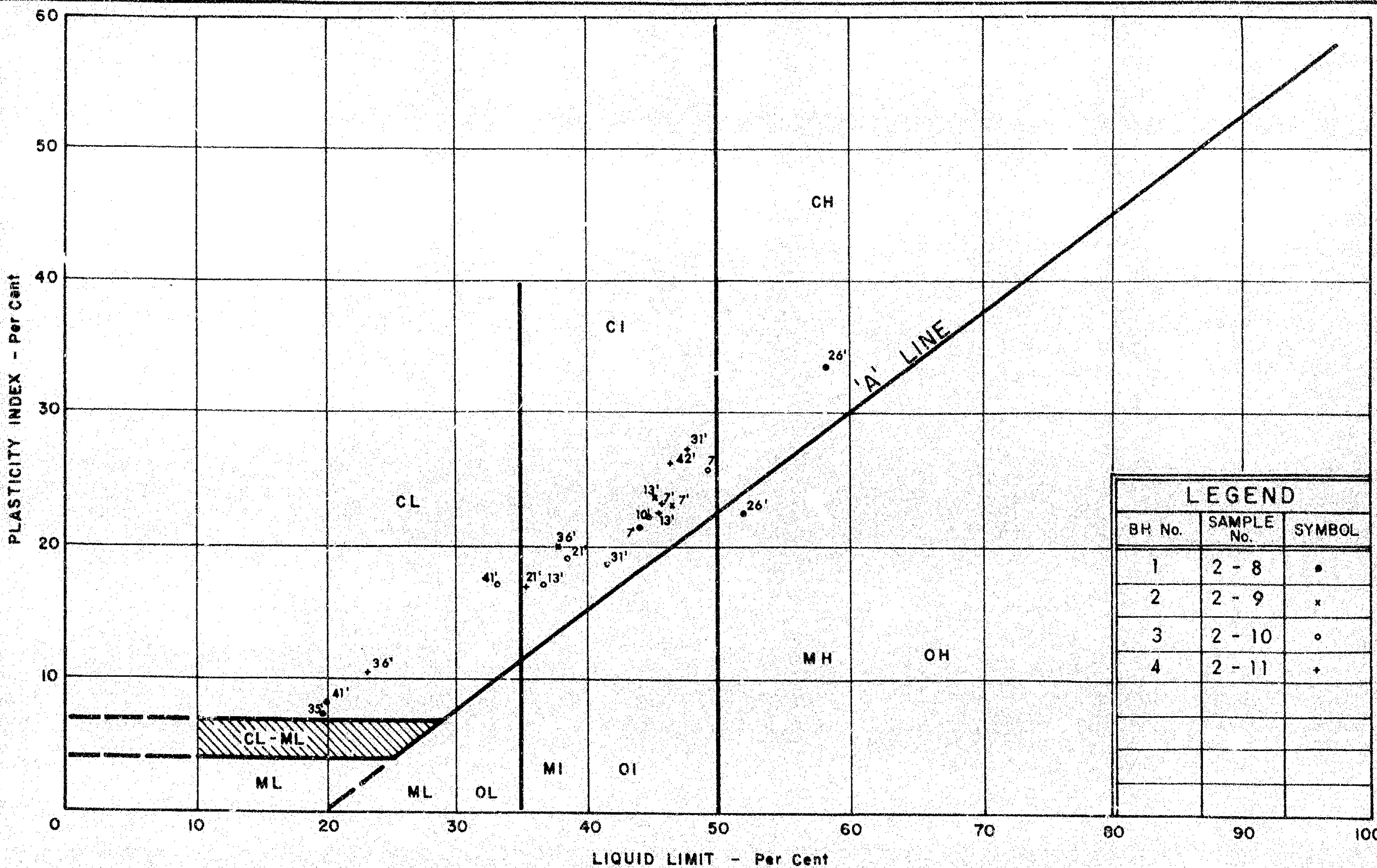
DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION
ONTARIO

GRAIN SIZE DISTRIBUTION
GLACIAL TILL

W.P. No. 445 - 65

JOB No. 67 - F - 96

FORM OB-MT-252
(REV. JUNE 1965)
65-1624



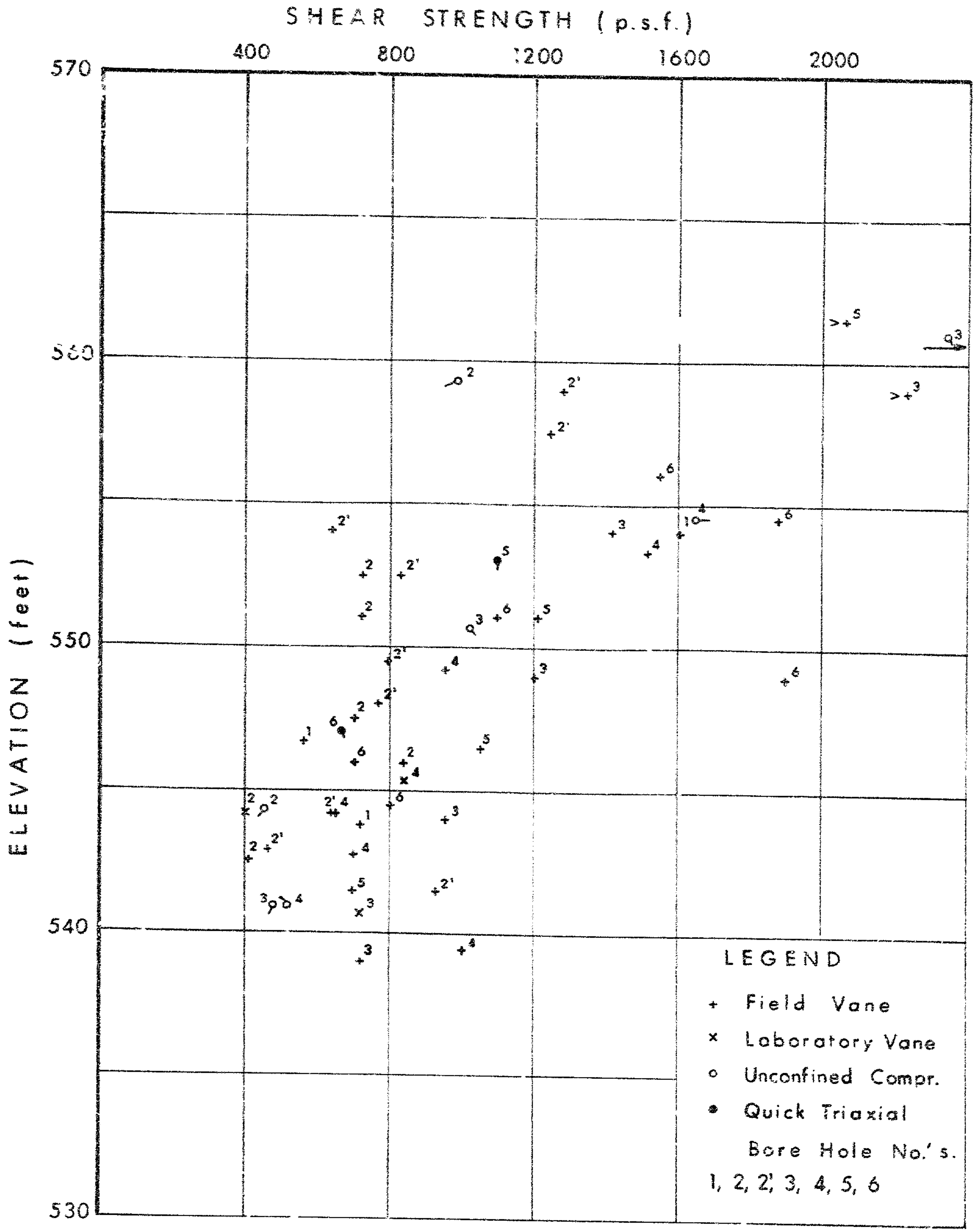
LEGEND		
BH No.	SAMPLE No.	SYMBOL
1	2 - 8	•
2	2 - 9	x
3	2 - 10	o
4	2 - 11	+

DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION
ONTARIO

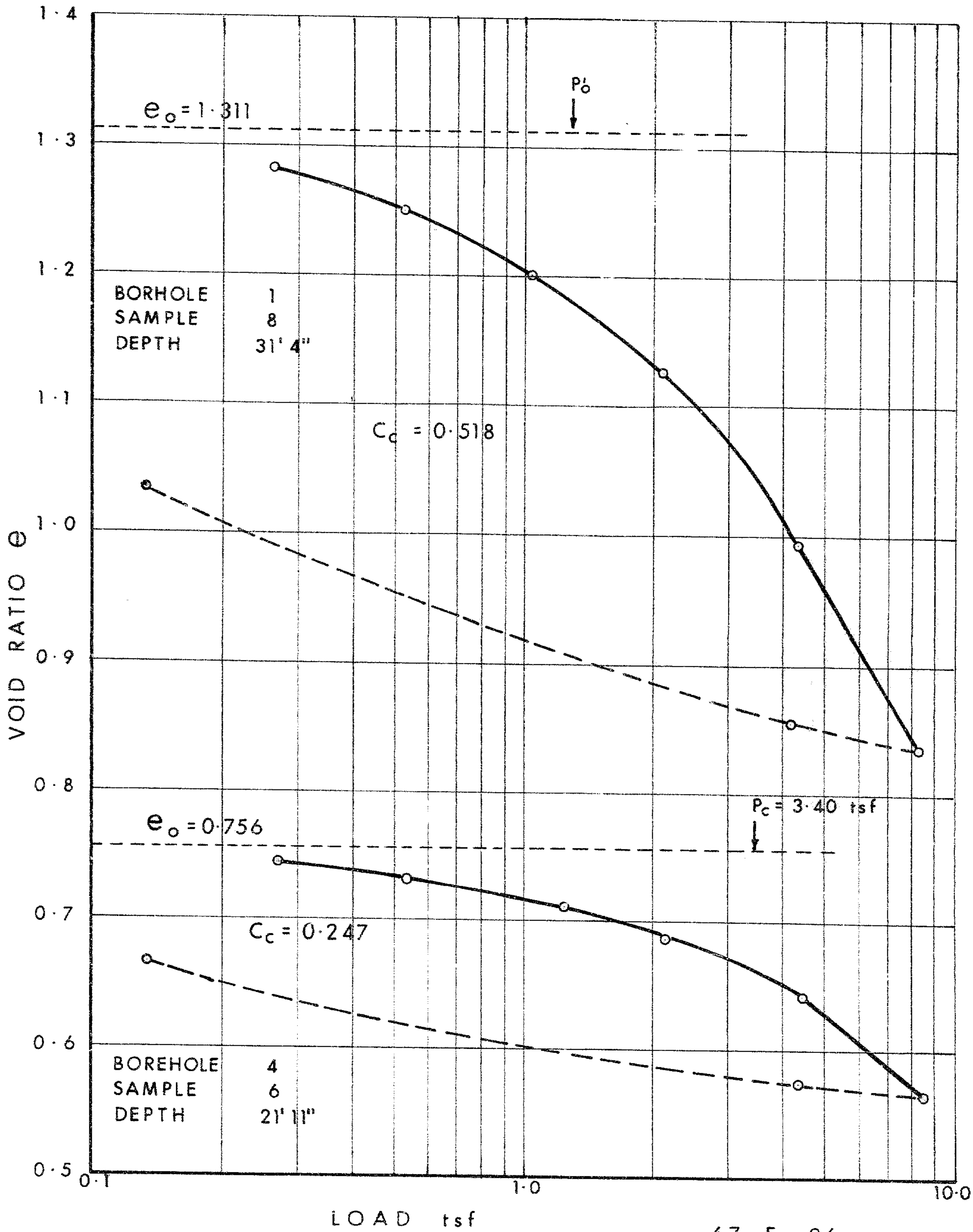
PLASTICITY CHART

W.P. No. 445-65
JOB No. 67 - F - 96

SHEAR STRENGTH vs DEPTH



JOB No. 67- F - 96


1·4
1·3
1·2
1·1
1·0
0·9
0·8
0·7
0·6
0·5
VOID RATIO e
$e_o = 1·311$
P_o'
BOREHOLE 1
SAMPLE 8
DEPTH 31' 4"
$C_c = 0·518$
$e_o = 0·756$
$P_c = 3·40$ tsf
$C_c = 0·247$
BOREHOLE 4
SAMPLE 6
DEPTH 21' 11"
0·1
1·0
10·0
LOAD tsf

67 - F - 96

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

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

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

DESCRIPTION OF SOIL

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

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

TYPE OF SAMPLE

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

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

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

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

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

GENERAL

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

STRESS AND STRAIN

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

EARTH PRESSURE

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

FOUNDATIONS

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

SLOPES

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

67-F-96

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

Attention: Mr. M. Devata.

From: Bridge Division,
Downsview, Ontario.

Date: September 8th, 1967.

Our File Ref.

In reply to

Subject: Baker Road Underpass,
W.P. 445-65, Site 34-219,
Q.E.W., District 4.

Job Number 67-F-96

Herewith are two prints of site plan E-4792 on which the probable location of footings has been marked in red.

Please arrange for a foundation investigation of sufficient scope to enable us to proceed with the design. No preliminary site investigation has been made due to the urgency of the project.

Joseph F. Walshe

J. F. Walshe,
for W. S. Melinyshyn,
Regional Bridge Location Engineer.

JFW/cew
Attach.
cc R. Forrest
A. Crowley

Oct 18/67
Dec 13/67

Assigned to Per Schamabel on Oct 1/1967.

B

HAMN DOWN 1 OCT 4/67 9.00 A VR

H GREENLAND DIST ENGR

ATT D A WALLER MTCE ENGR

COPY TO T J KOWICH REG MATLS ENGR SOIL SECT LAB BLDG DOWN

RE BAKER ROAD UNDERPASS WP-445-65 SITE 34-219 WJ-67-F-96

Q E W DISTRICT 4 HAMILTON.

FOUNDATION INVESTIGATION WORK FOR THE ABOVE MENTIONED PROJECT

WILL COME.IN ON OCT 3/67 THIS IS FOR YOUR INFORMATION.

M DEVATA SUPRVSG FOUND ENGR FOR A G STERMAC PRINC FOUND ENGR

MATLS AND TESTG DIV

RB

401 & Keele Street
Downsview, Ontario

October 4, 1967

Dominion Soil Investigation Ltd.
77 Crockford Blvd.
Scarborough, Ontario

Dear Sir:

This is to confirm our request of Oct. 3, 1967 for the supply of a Diamond Drill together with all necessary equipment, as specified under the terms our Contract Agreement, at Baker Rd. & Q.E.W. near Niagara Falls, Ontario, on October 4, 1967.

This job bears number 67-F-96.

Yours truly,

M. Devata

MD:mt

M. Devata
Supervising Foundation Engineer
for: A. G. Stermac
Principal Foundation Engineer

cc: H. Konings
Foundation Files 110
General File

Department of Highways Ontario
Copy for the information of

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

Mr. D. A. Barr,
Advance Program Engineer,
Program Section,
Admin. Bldg.

Bridge Division,
Downsview, Ontario.

January 10th. 1968.

Q.E.W. - Welland River to Fort Erie,
District 44.

The Foundation Section of the Materials and Testing Division has carried out subsoil investigations at the following structure locations:

W.P. 158-64-1	Lyons Creek Road Interchange
W.P. 442-65	Beck Road Underpass
W.P. 443-65	Bossert Road Underpass
W.P. 159-64	Sodom Road Interchange
W.P. 445-65	Baker Road Underpass 67-F-96

The reports indicate that a substantial amount of consolidation settlement will occur due to the approach fills. In order to reduce the effect of this on the structures they recommend that consideration should be given to constructing the approach embankments well in advance of the construction of the bridges.

It should however, be borne in mind that these structures, except for Lyons Creek Road, are on existing road alignments and consequently some detouring arrangement would have to be provided during the consolidation period.

RE: Q.E.W. - Welland River to Fort Erie,
District #4.

Investigations for the structures from Townline Road (W.P. 167-64-1) through to Gilmore Road (W.P. 448-65) have not yet been carried out. The need for pre-grading of the approaches is therefore not known at this time. However, settlement problems seem to diminish as we approach Fort Erie.

We would recommend that consideration be given to implementing the recommendations of the Foundation Section with regards to the calling of a grading contract approximately 12 months prior to the bridge construction.

Joseph F. Walshe

JFW:ss

J. F. Walshe,
for W. S. Melinyshyn,
Reg. Bridge Location Engineer.

cc. G. K. Hunter
A. G. Stermac
E. Cross

M. Devata

Telephone: 248-3446

Mr. W. Wigle,
Program Engineer,
Administration Bldg.

E.J. McCabe,
Toronto Regional Road Design.

March 13, 1968.

Re: Queen Elizabeth Way from Highway 405 to Fort Erie, <u>District 4, Hamilton.</u>

Your letter of February 12, 1968 requesting a program for placement of early fills as recommended by the Foundation Section has been passed on to me for comment.

This afternoon Mr. Devata, Foundations Section, Mr. Melinyshyn, Bridge Planning Section, and the writer met to consider our needs for early fill placement. It was determined that early fill would be placed:

1) If required for bridge construction.

2) If required for grading purposes. A 6" settlement or more was used as a basis to determine the need for early fill placement for grading purposes.

The following is a summary of our conclusions:

1) <u>Mountain Road Interchange - W.P. 154-64.</u>

   Bridge Office to decide in one month whether early fill placement required for bridge purposes.

2) <u>Thorold Stone Road - W.P. 155-64-03.</u>

   No early fill placement required.

3) McLeod Road - W.P. 156-64.
4) <u>Northbound West Service Road - W.P. 157-64-2.</u>

   Both bridges will be on piles. An $8\frac{1}{2}$" settlement is predicted. We propose delaying the final paving of the fill areas from one to two years.

Continued .... /2

March 13, 1968.

Mr. W. Wigle - Re: Queen Elizabeth Way.

5) Lyons Creek - W.P. 158-64-01.
6) Beck Road - W.P. 442-65.
7) Bossert Road - W.P. 443-65.
8) Sodom Road - W.P. 159-64.
9) Baker Road - W.P. 445-65. 67-F-96
10) Townline Road, Black Creek, Service Road - W.P. 167-64.
11) Ridgemount Road - W.P. 165-64.
12) Bowen Road
13) Sunset Drive - W.P. 447-65.
14) Gilmore Road - W.P. 448-65.

Considerable settlement can be anticipated for the above structure sites and approach thereto. We propose that early fill placement be considered two years in advance of the current construction program year.

15) West-North and South Ramp - W.P. 162-64-2.
16) Thompson Road - W.P. 162-64-1.
17) - W.P. 162-64-3.
18) C.N.R. Widening - W.P. 162-64-05.
19) Concession Road (Erie St.) - W.P. 161-64.
20) North Street Revision - W.P. 160-64.

No early fill placement required at these sites.

EJMcCabe

E.J. McCabe
Expressway Consultant Control Engineer
For:
G.K. Hunter
Regional Road Design Engineer

EJM/GB

c.c. M. Devata
W. Melinyshyn
A.J. Fletcher
E.A. Fletcher

Department of Highways Ontario
Copy for the information of
Mr. A. Stermac

Mr. W. Melinyshyn,
Reg. Bridge Location Engineer,
Central Region,
Admin. Building

C.S. Grebski

May 21, 1969

Baker Road Underpass
9.7 Miles South of Hwy. 20
W.P. 445-65-03, Site 34-219
Q.E.W., District No. 4

67-F-96

Attached herewith are prints of the Preliminary Bridge Plan Drawing D-6413-P1 for the above-mentioned structure.

The estimated cost of the proposed structure is $121,000. This cost includes tender, materials, engineering and sundry construction.

Any comments or revisions you may have should be submitted within three weeks.

C.S. Grebski,
Bridge Design Engineer

CSG:rd

Attach.

c.c. S. McCombie
A. Stermac (2)
J. Anderson

No comments.
M. Devata
May 26/69

Department of Highways Ontario
Copy for the information of

Foundation Section

Mr. A. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Building

C.S. Grebski,
Bridge Office

December 22, 1969

Baker Road Underpass
9.7 Miles South of Hwy. 20
W.P. 445-65-03, Site No. 3A-219
Q.E.W., District No. 4

67-F-96

Attached herewith we are submitting the final bridge drawings which show the foundation design for this structure.

Kindly give us your comments at your earliest convenience.

C.S. Grebski,
Bridge Design Engineer

CSG:rd

Attach.

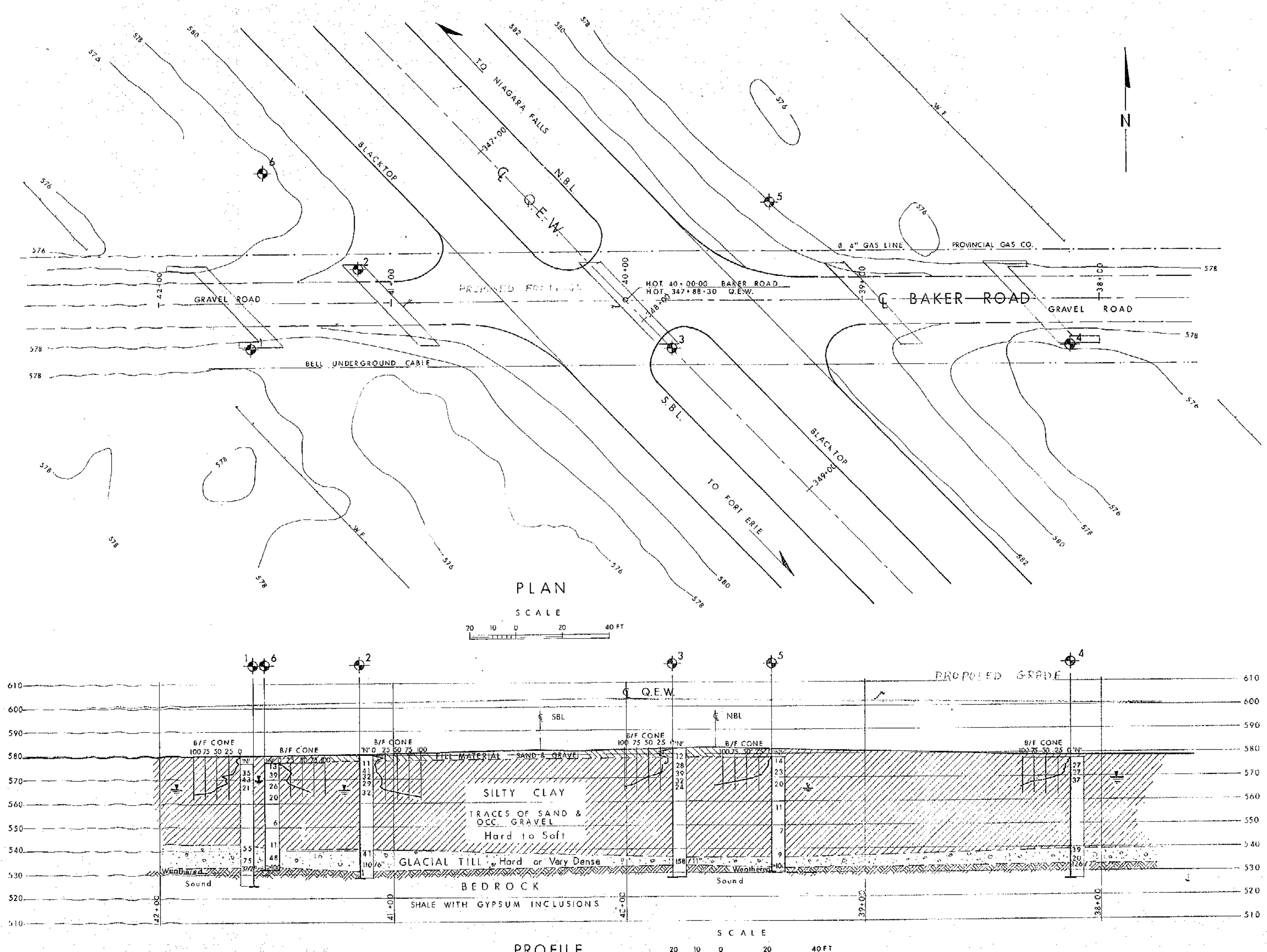
c.c. Foundation Section

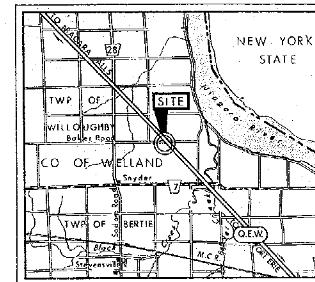
no comments

Cm
~~Dec 31/69.~~

M. Devata
Jan 5th /67.

#67-F-96
W.P. #445-65-03
Q.E.W.
BAKER ROAD
UNDERPASS





KEY PLAN

SCALE IN MILES

LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. OCT. 1967

NO.	ELEVATION	STATION	OFFSET
1	576·95	41+60	19' LT
2	580·42	41+14	14' RT
3	582·13	39+80	20' LT
4	577·27	38+12	19' LT
5	578·20	39+39	41' RT
6	577·40	41+55	55' 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.

PRINT RECORD		
NO.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS – ONTARIO

MATERIALS & TESTING DIVISION – FOUNDATION SECTION

BAKER ROAD

KING'S HIGHWAY NO. Q.E.W. DIST. NO. 4

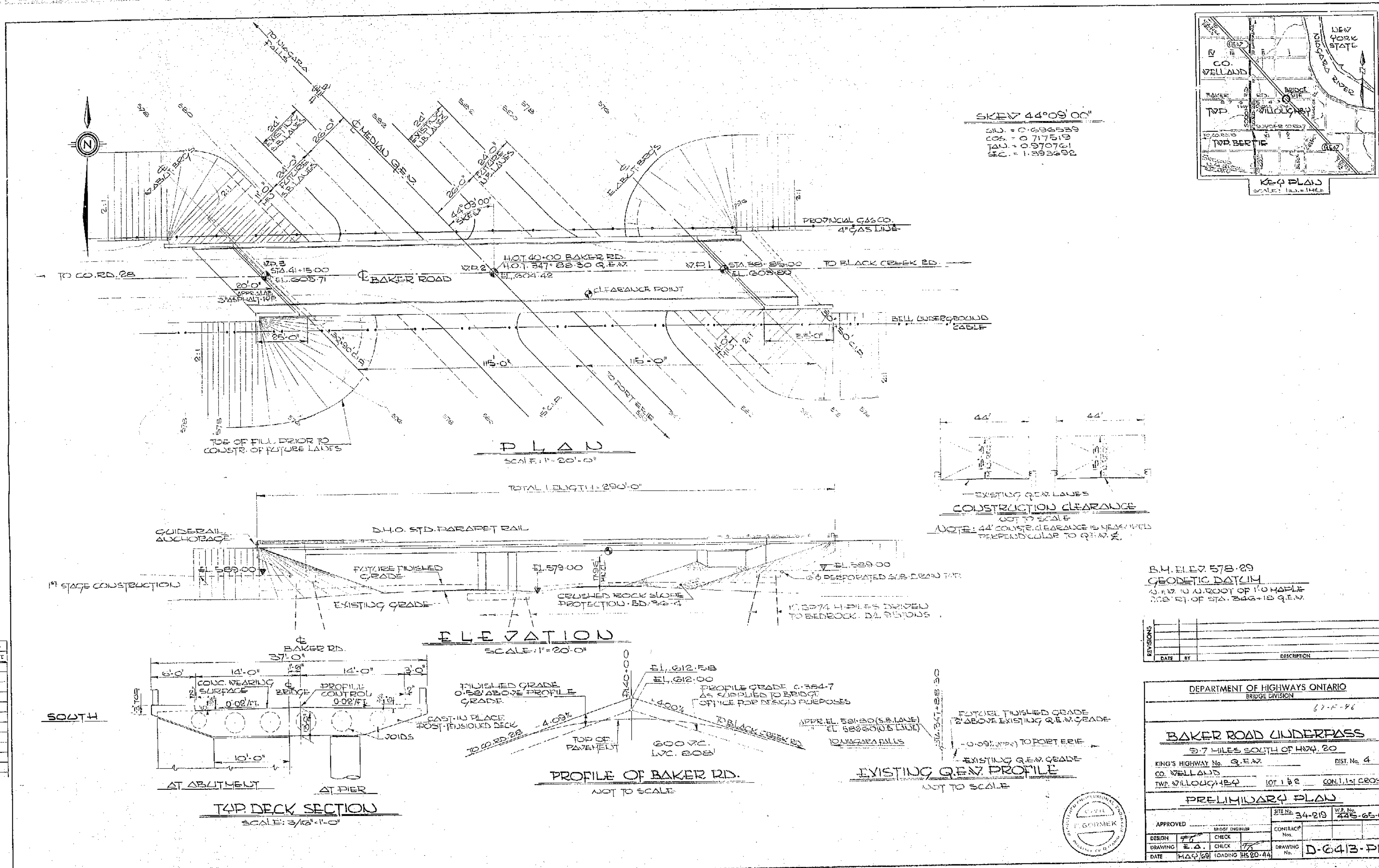
CO. ~~WELLAND~~ NIAGARA

TWP. ~~WILLOUGHBY~~ N.FALLS LOT 1 & 2 CON. 1

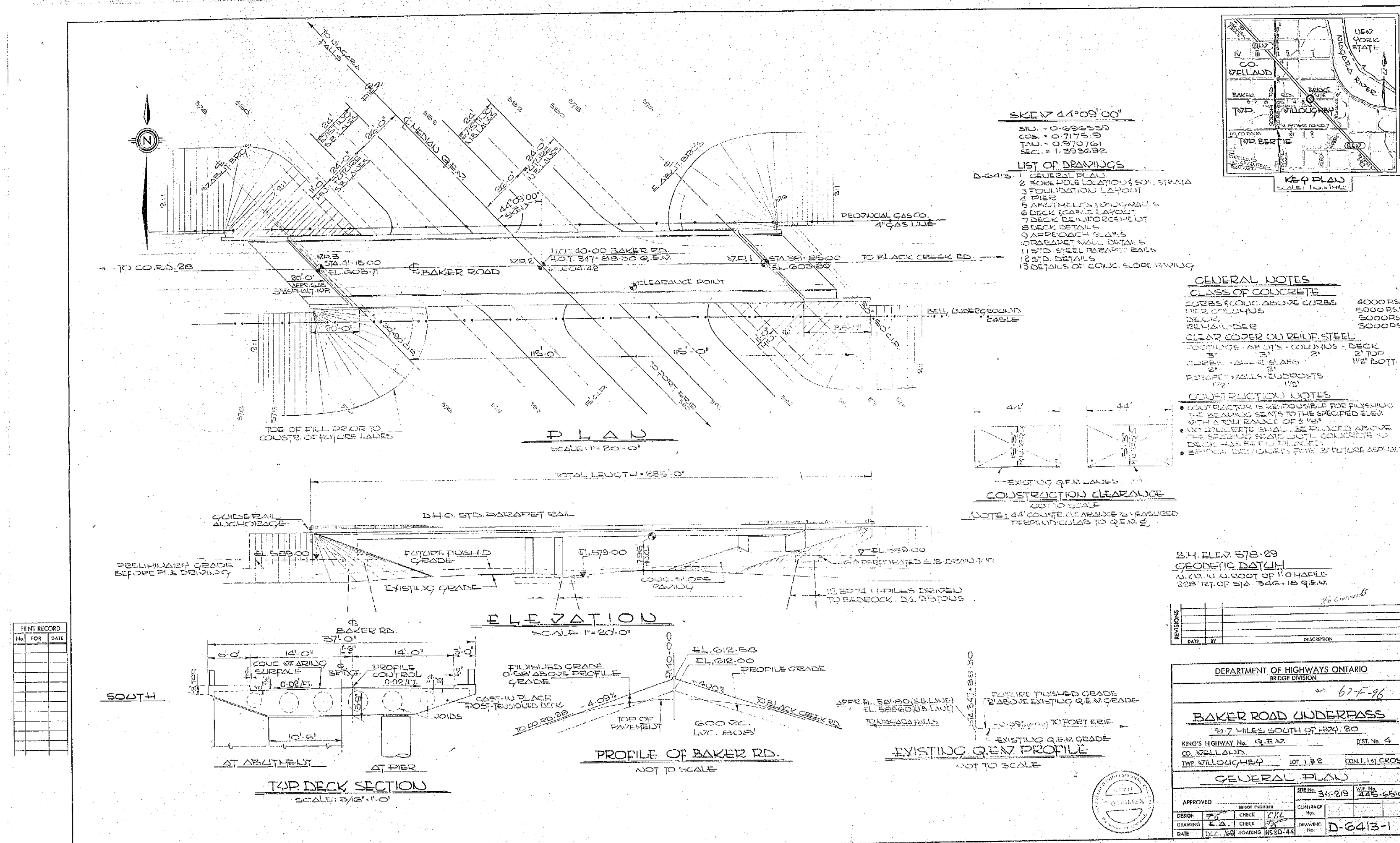
BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D. P. S.	CHECKED	W.P. NO. 445-65-03	M.& T. DRAWING NO. 67-F-96 A
DRAWN A. B.	CHECKED	JOB NO. 67-F-96	
DATE NOV 30, 1967		SITE NO.	BRIDGE DRAWING NO.
APPROVED (signature) PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	

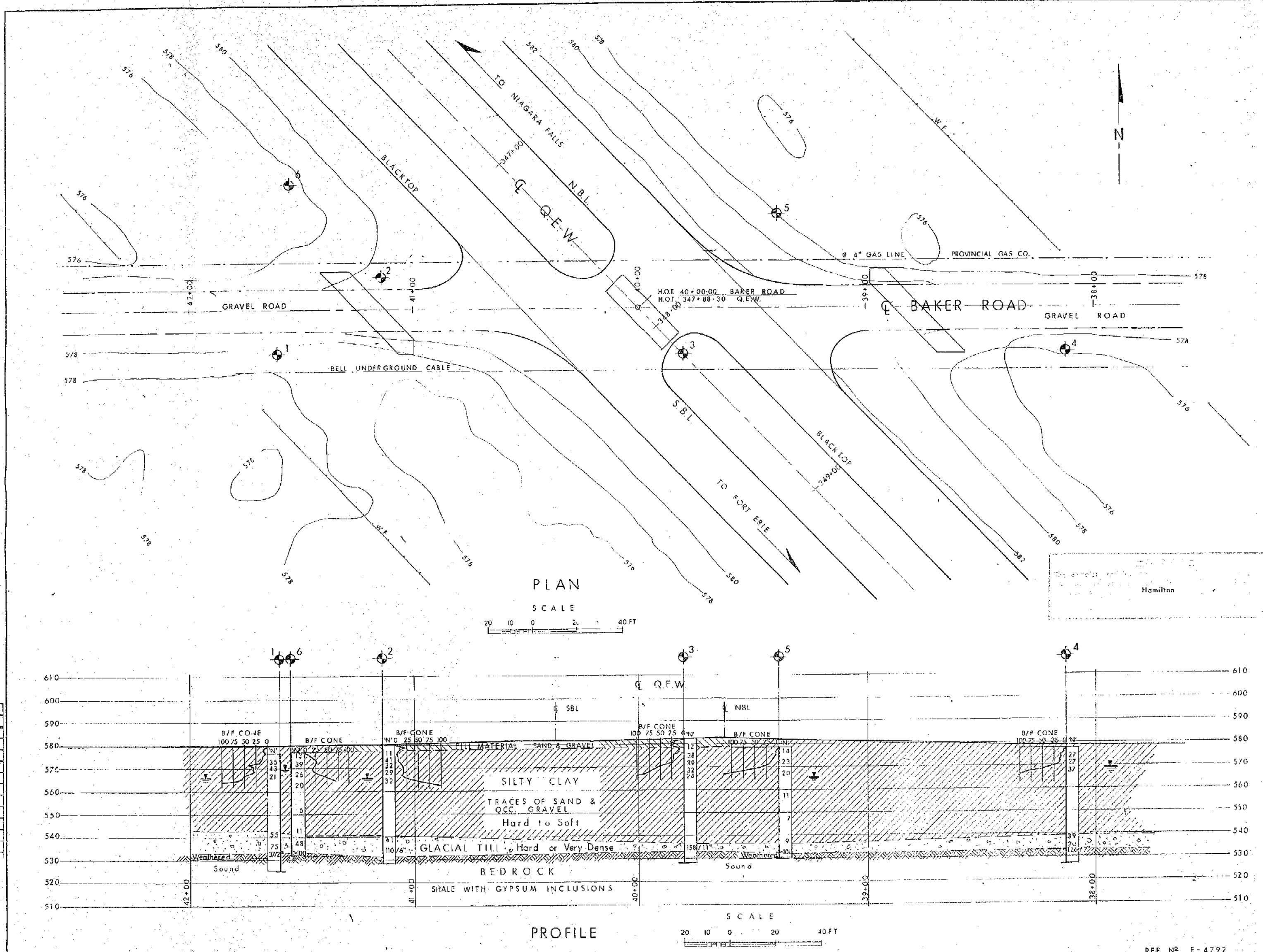
REF Nº E-4792

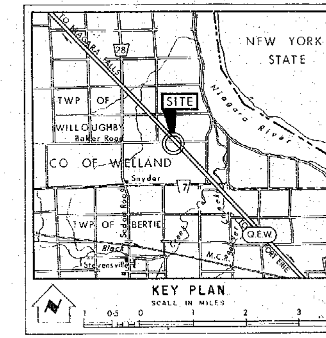


SKEW 44°09'00"
SIN. = 0.696539
COS. = 0.717519
TAN. = 0.970761
SEC. = 1.393692
KEY PLAN
NEW YORK STATE
NIAGARA RIVER
CO. WELLAND
TWP. WILLOUGHBY
TWP. BERTIE
BAKER RD.
BRIDGE SITE
TO NIAGARA FALLS
℄ MEDIAN Q.E.W.
24' EXISTING S.B. LANES
24' EXISTING N.B. LANES
24'-0" FUTURE S.B. LANES
24'-0" FUTURE N.B. LANES
44°09'00" SKEW
PROVINCIAL GAS CO. 4" GAS LINE
TO CO. RD. 28
W.P. 3 STA. 41+15.00 EL. 603.71
W.P. 2 H.O.T. 40+00 BAKER RD. H.O.T. 347+88.30 Q.E.W. EL. 604.42
W.P. 1 STA. 38+85.00 EL. 603.80
TO BLACK CREEK RD.
℄ BAKER ROAD
CLEARANCE POINT
BELL UNDERGROUND CABLE
115'-0"
115'-0"
TO FORT ERIE
TOE OF FILL PRIOR TO CONSTR. OF FUTURE LANES
PLAN
SCALE: 1" = 20'-0"
TOTAL LENGTH - 290'-0"
D.H.O. STD. PARAPET RAIL
GUIDERAIL ANCHORAGE
EL. 589.00
1st STAGE CONSTRUCTION
FUTURE FINISHED GRADE
EXISTING GRADE
EL. 579.00
CRUSHED ROCK SLOPE PROTECTION - SD-36-4
EL. 589.00
6" PERFORATED SUB-DRAIN TYP.
10 BP74 H-PILES DRIVEN TO BEDROCK. DIA. PISTONS
ELEVATION
SCALE: 1" = 20'-0"
44'
44'
EXISTING Q.E.W. LANES
CONSTRUCTION CLEARANCE
NOT TO SCALE
NOTE: 44' CONSTR. CLEARANCE IS MEASURED PERPENDICULAR TO Q.E.W. ℄
B.M. ELEV. 578.29
GEODETIC DATUM
N.&W. IN N. ROOT OF 1'-0 MAPLE 208' RT. OF STA. 346+18 Q.E.W.
℄ BAKER RD.
37'-0"
3'-0"
14'-0"
14'-0"
3'-0"
CONC. WEARING SURFACE
℄ BRIDGE
PROFILE CONTROL
0.02'/FT.
0.02'/FT.
CAST-IN PLACE POST-TENSIONED DECK
VOIDS
10'-0"
SOUTH
AT ABUTMENT
AT PIER
TYP. DECK SECTION
SCALE: 3/16" = 1'-0"
FINISHED GRADE 0.58' ABOVE PROFILE GRADE
EL. 612.58
EL. 612.00
PROFILE GRADE C-384-7 AS SUPPLIED TO BRIDGE OFFICE FOR DESIGN PURPOSES
4.09%
4.00%
TO CO. RD. 28
TO BLACK CREEK RD.
TOP OF PAVEMENT
600 V.C.
L.V.C. 808'
PROFILE OF BAKER RD.
NOT TO SCALE
APPR. EL. 581.80 (S.B. LANE)
FUTURE FINISHED GRADE 2' ABOVE EXISTING Q.E.W. GRADE
TO NIAGARA FALLS
TO FORT ERIE
EXISTING Q.E.W. GRADE
EXISTING Q.E.W. PROFILE
NOT TO SCALE
PRINT RECORD
No. FOR DATE
REVISIONS
DATE BY DESCRIPTION
DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION
BAKER ROAD UNDERPASS
3.7 MILES SOUTH OF HWY. 20
KING'S HIGHWAY No. Q.E.W.
DIST. No. 4
CO. WELLAND
TWP. WILLOUGHBY
LOT 1 & 2
CON. 1, 1st CROSS
PRELIMINARY PLAN
SITE No. 34-219
W.P. No. 445-65-03
APPROVED
BRIDGE ENGINEER
CONTRACT Nos.
DESIGN
CHECK
DRAWING E.A.
CHECK
DATE MAY/69
LOADING HS20-44
DRAWING No. D-6413-P1



TO NIAGARA FALLS
℄ MEDIAN Q.E.W.
24' EXISTING S.B. LANES
24'-0" FUTURE S.B. LANES
26'-0"
24' EXISTING N.B. LANES
24'-0" FUTURE N.B. LANES
44°09'00" SKEW
PROVINCIAL GAS CO. 4" GAS LINE
TO CO. RD. 28
℄ BAKER ROAD
V.P. 3 STA. 41+15.00 EL. 603.71
V.P. 2
H.O.T. 40-00 BAKER RD.
H.O.T. 347+88.30 Q.E.W.
V.P. 1 STA. 38+85.00 EL. 603.60
TO BLACK CREEK RD.
CLEARANCE POINT
20'-0" APPR. SLAB 3" ASPHALT TOP
BELL UNDERGROUND CABLE
115'-0"
115'-0"
TO FORT ERIE
TOE OF FILL PRIOR TO CONSTR. OF FUTURE LANES
PLAN
SCALE: 1" = 20'-0"
SKEW 44°09'00"
SIN. = 0.696539
COS. = 0.71759
TAN. = 0.970761
SEC. = 1.393692
LIST OF DRAWINGS
D-6413-1 GENERAL PLAN
2 BORE HOLE LOCATION & SOIL STRATA
3 FOUNDATION LAYOUT
4 PIER
5 ABUTMENTS & WINGWALLS
6 DECK & CABLE LAYOUT
7 DECK REINFORCEMENT
8 DECK DETAILS
9 APPROACH SLABS
10 PARAPET WALL DETAILS
11 STD. STEEL PARAPET RAILS
12 STD. DETAILS
13 DETAILS OF CONC. SLOPE PAVING
CO. WELLAND
NEW YORK STATE
NIAGARA RIVER
BAKER RD.
BRIDGE SITE
TWP. WILLOUGHBY
TWP. BERTIE
KEY PLAN
GENERAL NOTES
CLASS OF CONCRETE
CURBS & CONC. ABOVE CURBS 4000 P.S.I.
PIER COLUMNS 5000 P.S.I.
DECK 5000 P.S.I.
REMAINDER 3000 P.S.I.
CLEAR COVER ON REINF. STEEL
FOOTINGS - ABUT'S - COLUMNS - DECK
3" 3" 2" 2" TOP 1½" BOTT.
CURBS - APPR. SLABS
2" 3"
PARAPET WALLS - ENDPOSTS
1½" 1½"
CONSTRUCTION NOTES
CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS TO THE SPECIFIED ELEV. WITH A TOLERANCE OF ± ⅛"
NO CONCRETE SHALL BE PLACED ABOVE THE BEARING SEATS UNTIL CONCRETE TO DECK HAS BEEN PLACED.
BRIDGE DESIGNED FOR 3" FUTURE ASPHALT
44'
44'
EXISTING Q.E.W. LANES
CONSTRUCTION CLEARANCE
NOT TO SCALE
NOTE: 44' CONSTR. CLEARANCE IS MEASURED PERPENDICULAR TO Q.E.W. ℄
TOTAL LENGTH = 285'-0"
GUIDERAIL ANCHORAGE
D.H.O. STD. PARAPET RAIL
PRELIMINARY GRADE BEFORE PILE DRIVING
EL. 589.00
FUTURE FINISHED GRADE
EXISTING GRADE
EL. 579.00
CONC. SLOPE PAVING
EL. 589.00
6" ⌀ PERFORATED SUB-DRAIN TYP.
13 BP74 H-PILES DRIVEN TO BEDROCK. D.L. 95 TONS
ELEVATION
SCALE: 1" = 20'-0"
B.M. ELEV. 578.29
GEODETIC DATUM
℄ BAKER RD.
37'-0"
6'-0" 14'-0" 14'-0" 3'-0"
CONC. WEARING SURFACE
℄ BRIDGE
PROFILE CONTROL
0.02'/FT.
0.02'/FT.
CAST-IN PLACE POST-TENSIONED DECK
VOIDS
10'-6"
SOUTH
AT ABUTMENT
AT PIER
TYP. DECK SECTION
SCALE: 3/16" = 1'-0"
FINISHED GRADE 0.58' ABOVE PROFILE GRADE
EL. 612.58
EL. 612.00
PROFILE GRADE
40+00
-4.00%
+4.00%
TO CO. RD. 28
TO BLACK CREEK RD.
TOP OF PAVEMENT
600 V.C.
L.V.C. 600'
PROFILE OF BAKER RD.
NOT TO SCALE
APPR. EL. 581.90 (S.B. LANE)
EL. 580.60 (N.B. LANE)
FUTURE FINISHED GRADE 2' ABOVE EXISTING Q.E.W. GRADE
TO NIAGARA FALLS
TO FORT ERIE
EXISTING Q.E.W. GRADE
EXISTING Q.E.W. PROFILE
NOT TO SCALE
REVISIONS
DATE
BY
DESCRIPTION
DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION
67-F-96
BAKER ROAD UNDERPASS
5.7 MILES SOUTH OF HWY. 20
KING'S HIGHWAY No. Q.E.W.
DIST. No. 4
CO. WELLAND
TWP. WILLOUGHBY
LOT 1 & 2
CON. 1, 1st CROSS
GENERAL PLAN
SITE No. 34-219
W.P. No. 445-65-03
APPROVED
BRIDGE ENGINEER
CONTRACT Nos.
DESIGN
CHECK
C.Y.L.
DRAWING
E.A.
CHECK
DATE
DEC. /68
LOADING
HS20-44
DRAWING No.
D-6413-1
PRINT RECORD
No.
FOR
DATE





LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. OCT. 1967

NO.	ELEVATION	STATION	OFFSET
1	576·95	41+60	19' LT
2	580·42	41+14	14' RT
3	582 13	39+80	20' LT
4	577·27	38+12	19' LT
5	578·30	39+39	41' RT
6	577 40	41+55	55' 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 HIGHWAYS – ONTARIO
MATERIALS & TESTING DIVISION – FOUNDATION SECTION

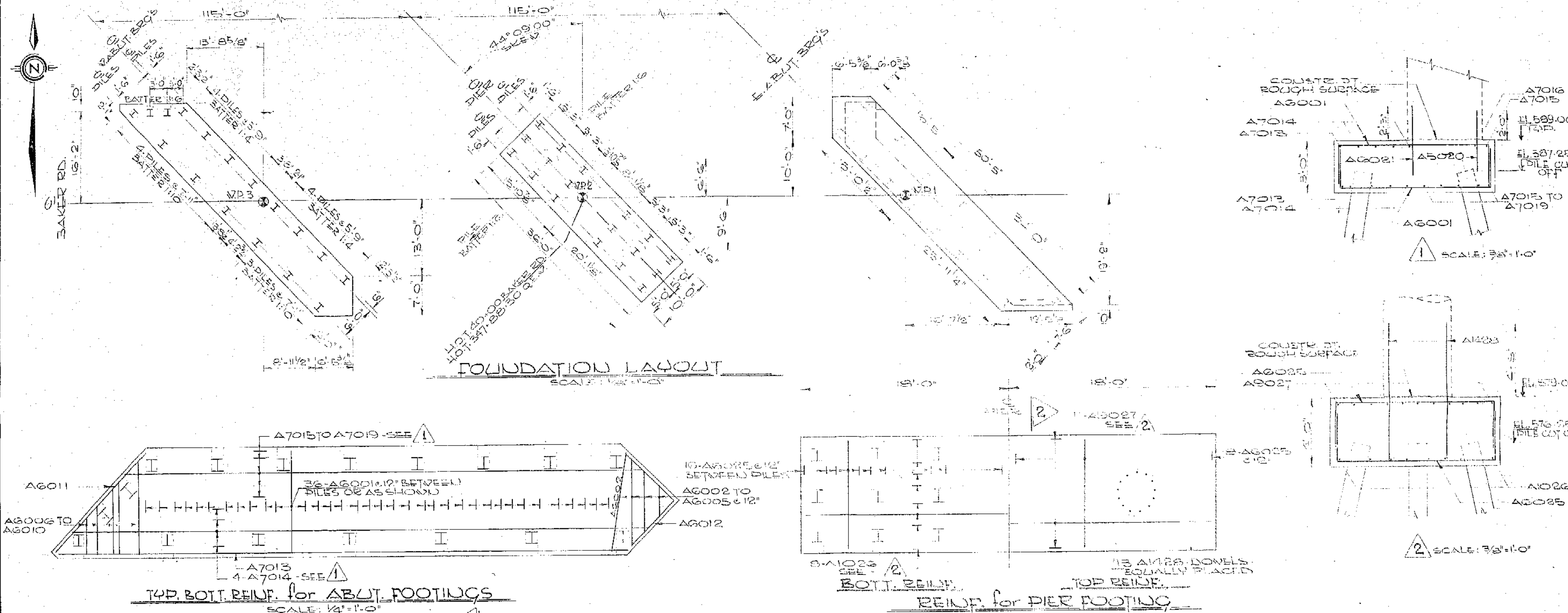
BAKER ROAD

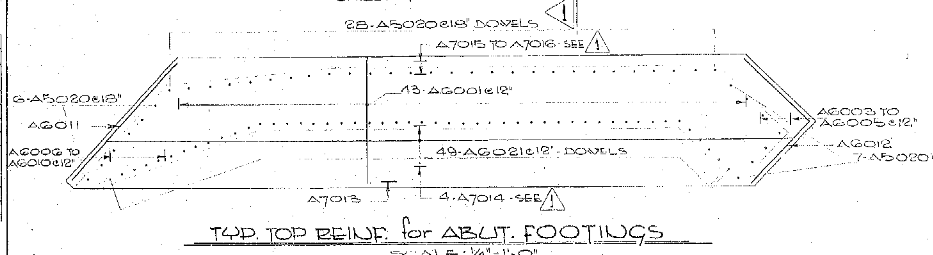
KING'S HIGHWAY NO. Q.E.W. DIST. NO. 4
CO. WELLAND
TWP. WILLOUGHBY LOT 1&2 CON. 1

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D. P.S.	CHECKED	W.P. NO. 445-65-03	M.&T. DRAWING NO. 67-F-96 A
DRAWN A.B.	CHECKED	JOB NO. 67-F-96	
DATE NOV 30, 1967		SITE NO. 34-219	BRIDGE DRAWING NO. D6413-2
APPROVED A.G. [signature] PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	

PRINT RECORD		
NO.	FOR	DATE





PILES SUPPLIED

LOCATION	No	LENGTH	TYPE
E. ABUT.	17	55'-0"	12BP74-H-PILES
PIER	18	45'-0"	
W. ABUT.	17	55'-0"	

NOTE:
- PILE LAYOUT ... ON FOUNDATION PLAN & LAYOUT.
- PILE LAYOUT DIMENSIONS ARE MEASURED ON ... OF ...
- PILE SPLICE DETAIL SEE DWG. D-6413-12
- DESIGN LOAD: 35 TONS PER PILE.
- CONTRACTOR TO ACCURATELY LOCATE GAS LINE BEFORE DRIVING PILES.

PRINT RECORD

No.	FOR	DATE

REVISIONS	DATE	BY	DESCRIPTION

FOR REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

67-F-96

BAKER ROAD UNDERPASS
9.7 MILES SOUTH OF HWY. 20

KING'S HIGHWAY No. Q.E.W. DIST. No. 4
CO. WELLAND
TWP. WILLOUGHBY LOT 1 & 2 CON. 1, 1ST CROSS

FOUNDATION LAYOUT

APPROVED	BRIDGE ENGINEER			SITE No. 34-219	W.P. No. 445-65-03
DESIGN		CHECK	C.Y.L.	CONTRACT Nos.	
DRAWING	E.A.	CHECK	R.F.H.	DRAWING No.	D-6413-3
DATE	DEC. '69	LOADING	HS20-44		