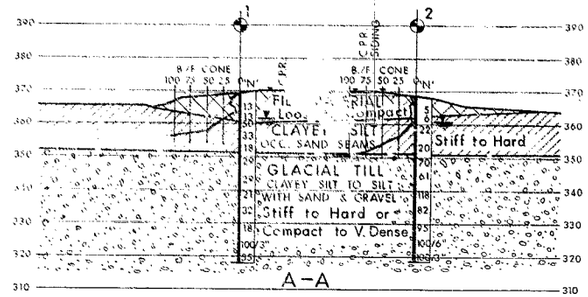
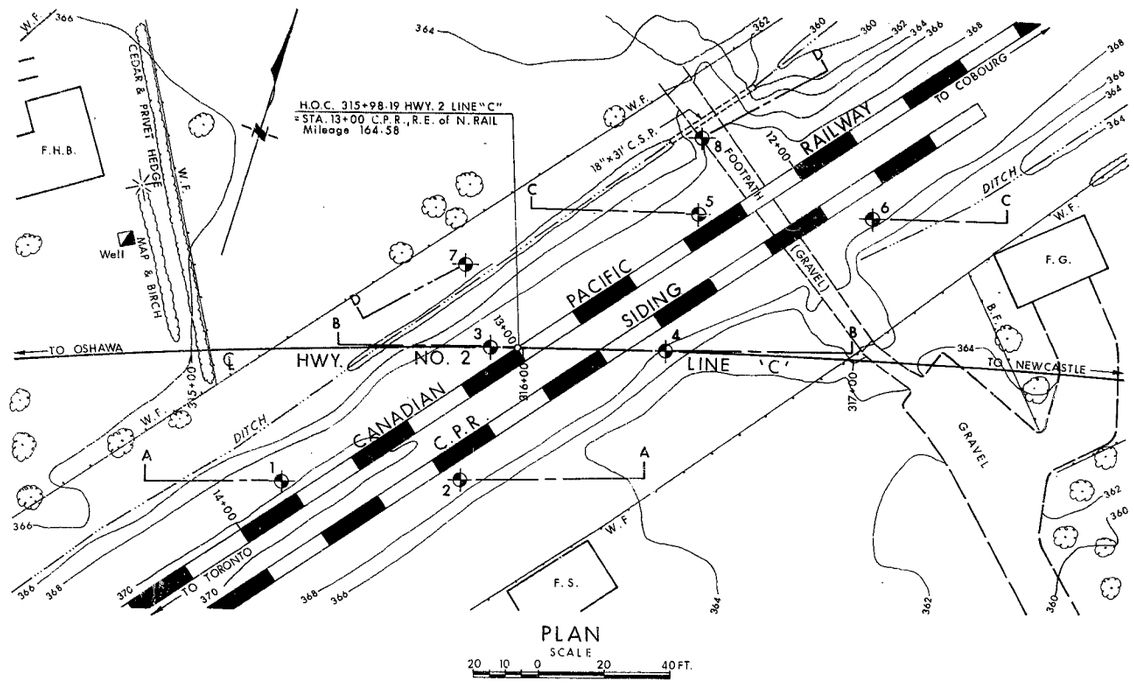
W.P. 420-65

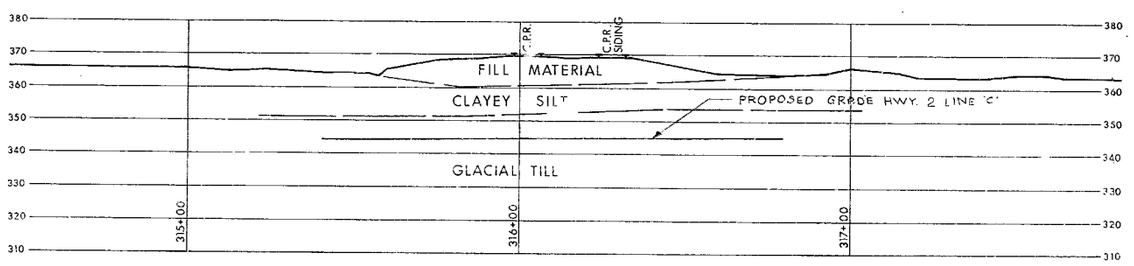
HWY. 2

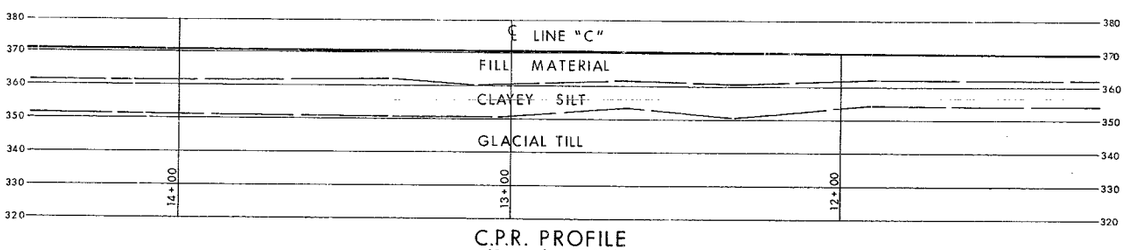
& C.P.R.

30M15-25

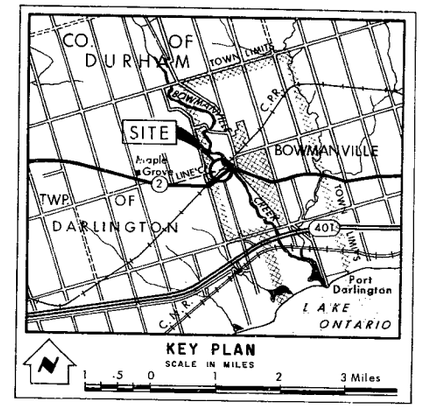








SECTIONS
SCALE
20 10 0 20 40FT.



LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. JULY 1968

NO.	ELEVATION	STATION	OFFSET
1	369.3	315+26	40' RT.
2	369.0	315+81	40' RT.
3	368.8	315+89	℄
4	368.4	316+43	℄
5	368.5	316+50	42' LT.
6	368.4	317+03	43' LT.
7	364.8	315+82	25' LT.
8	367.1	316+50	65' LT.

– NOTE –

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

PRINT RECORD		
NO.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

REF. NO. E–49–15–1

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

CANADIAN PACIFIC RAILWAYS

KING'S HIGHWAY NO. 2 LINE "C" DIST. NO. 7
CO. DURHAM TOWN OF BOWMANVILLE
TWP. DARLINGTON LOT ____ CON. ____

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D. V. K.	CHECKED	W.P. NO. 420–65	M.B.T. DRAWING NO.
DRAWN G. P.	CHECKED	JOB NO. 68–F–48	68–F–48A
DATE AUG 2, 1968		SITE NO	BRIDGE DRAWING NO.
APPROVED (PRINCIPAL FOUNDATION ENGINEER)		CONT. NO.	

30M15–25

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: August 2, 1968

Our File Ref.

In reply to

Subject:

FOUNDATION INVESTIGATION REPORT
For
Proposed C.P.R. Subway
Highway #2, Revision Line 'C'
Bowmanville, Ontario
District No. 7 (Port Hope)
W.J. 68-F-48 -- W.P. 420-65

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.

for 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)
D. P. Collins
W. S. Melinyshyn
T. J. Kovich
B. A. Singh

Foundations Files
Gen. Files

TABLE OF CONTENTS

FOUNDATION INVESTIGATION REPORT
For
Proposed C.P.R. Subway
Highway #2, Revision Line 'C'
Bowmanville, Ontario
District No. 7 (Port Hope)
W.J. 68-F-48 -- W.P. 420-65

1. INTRODUCTION:

The Foundation Section was requested to carry out a subsurface investigation at the site of the proposed crossing of the C.P.R. and Highway #2, Revision Line 'C' in Bowmanville, Ontario. The request was contained in a memo from the Bridge Division (Mr. W. S. Melinyshyn, Regional Bridge Location Engineer) dated May 24, 1968. Subsequently an investigation was carried out by this Section to determine the subsoil conditions at the above 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 approaches.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located in the Town of Bowmanville, some 1500 feet north of the existing Hwy. #2 and C.P.R. crossing. At this site, the C.P.R. tracks and siding are carried on an embankment which is some 5 to 8 feet in height. The surrounding ground is generally flat to undulating and is occupied by orchards and farm dwellings.

The site is located in the "Iroquois Sand Plain" physiographic region which consists of glacial till plains overlain by lacustrine clay deposited in glacial Lake Iroquois.

cont'd. /2 ...

3. FIELD AND LABORATORY WORK:

A total of eight boreholes, each accompanied by a dynamic cone penetration test, was carried out at the site by means of a standard diamond drill rig adapted for soil sampling purposes. Samples were recovered at required depths in a 2-inch O.D. split-spoon sampler which was 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 sampler conformed to the requirements of the Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests. Where possible, field vane tests were carried out at various depth intervals in order to determine the undrained shear strengths of the cohesive strata.

The locations and elevations of all borings were surveyed in the field by personnel from the Central Region Engineering Surveys Section, and are shown on Drawing #68-F-48A, together with the estimated stratigraphical profile. This drawing is included in the Appendix to the report.

All samples were subjected to a careful visual examination in the field and subsequently in the laboratory, after which the following physical properties of the soil were determined by testing representative samples:

Natural Moisture Content
Atterberg Limits
Bulk Densities
Grain-Size Distributions
Undrained Shear Strengths

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

cont'd. /3 ...

4. SUBSOIL CONDITIONS:

4.1) General:

Underlying a surficial deposit of fill material is a stratum of stiff to very stiff clayey silt which varies in thickness from 8 to 13 feet. This stratum is underlain by a very stiff to hard cohesive glacial till deposit.

4.2) Fill Material:

A surficial stratum of fill material consisting of a heterogeneous mixture of clayey silt, sand and gravel with a trace of organics and cinders, was encountered at all the boreholes, except Borehole #7. The thickness of this stratum varied between about 6 and 10 ft. This stratum is believed to represent the fill material used in the construction of the existing railway embankment. The Standard Penetration Resistance 'N' values in this deposit ranged between 4 and 13 blows/ft.

4.3) Clayey Silt:

Underlying the fill material at Boreholes #1, 2, 3, 4, 5, 6 and 8 and immediately below a surficial cover of topsoil at Borehole #7, an 8 to 13 ft. thick deposit of brown clayey silt was encountered down to about elevation 352. The deposit contains occasional sand seams up to 1/8 inch in thickness. The physical properties of the soil are summarized below:

	Range	(Average)
Natural Moisture Content (W) - %	15 - 23	(20)
Liquid Limit (W_L) - %	21 - 26	(23)
Plastic Limit (W_P) - %	15 - 16	(15)
Bulk Density (γ) - p.c.f.	128 - 136	(132)
Undrained Shear Strength (C_u) - p.s.f.	1100 - 2900	-
Standard Penetration Resistance - 'N' Values - Blows/ft.	16 - 33	(23)

Based on the above, the deposit is classified as a stiff to very stiff clayey silt.

cont'd. /4 ...

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

4.4) Clayey Silt to Silt with some Sand and Gravel - (Glacial Till):

A deposit of glacial till consisting of grey clayey silt to silt with some sand and gravel was encountered at all the boreholes at depths of 13 to 18 ft. below the existing ground surface. The total thickness of this deposit was not established. However, it was penetrated to a depth of 51.5 ft. - i.e., down to about elevation 318 at Boreholes 1 to 6. The deposit is essentially cohesive, consisting mainly of a mixture of clayey silt, sand and gravel. However, random zones of silty sand with gravel were also encountered within this stratum. The lower portions of the deposit contained occasional boulders up to 24 inches in size. The range in physical properties of the cohesive portions of the deposit are summarized below:

Natural Moisture Content (W) - %	:	6 - 13
Liquid Limit (W_L) - %	:	14 - 23
Plastic Limit (W_P) - %	:	10 - 13

Typical grain-size distribution curves are shown in the Appendix. The Standard Penetration Resistance 'N' values ranged between 18 blows/ft. to well over 100 blows/ft., indicating the consistency of the cohesive portions of the deposit to be very stiff to hard, the localized granular zones being compact to very dense.

5. GROUNDWATER CONDITIONS:

Observations carried out in the open boreholes upon completion of the field work indicate a groundwater level at about elevation 360 - i.e., some 6 to 8 ft. below the existing ground surface.

cont'd. /5 ...

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct a two-span (41'-41') subway at the crossing of Highway #2, Revision Line 'C' and the existing C.P.R. tracks. The design grade of Hwy. #2, Line 'C' is at about elevation 345. Maximum depths of cut of the order of 25 ft. will therefore be required at the approaches assuming that the railway grade will be the same as the existing grade (elevation 370 ±). A detour will be required to re-route the C.P.R. for the proposed construction.

The investigation reveals that the embankment fill material, which is some 6 to 10 ft. in thickness, is underlain by an 8 to 13 ft. thick stratum of very stiff to hard clayey silt, followed by a competent glacial till deposit. The groundwater level at the site is at a depth of 6 to 8 ft. below the existing ground surface.

6.2) Structure Foundations:

Subsoil below the future grade of Hwy. #2 - i.e., elev. 345 ±, consists of essentially a cohesive glacial till which is capable of providing economical spread footing support. Also, from the geometry of the proposed structure, it is assumed that closed-type abutments will be used at this location. It is therefore recommended that the proposed abutments and pier be founded on spread footings located at or below about elevation 340 and designed for a safe bearing value of 3.0 t.s.f. A soil cover of at least 4 ft. should be provided above the footings for frost protection.

As mentioned earlier, the groundwater level at the site is at about elevation 360, whereas the future grade of Hwy. #2 will be at elevation 345 ±. In order to simplify dewatering of the excavation for the subway, it is recommended that the approach cuts be completed to profile grade before construction of the subway commences. However, the possibility exists that localized

cont'd. /6 ....

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

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

granular zones may be encountered within the cohesive glacial till as discussed earlier. Excavations for the proposed footings, when carried out in such localized granular zones, may become susceptible to "boiling". Some dewatering scheme will therefore be required where such a condition is encountered during construction.

6.3) Approach Cuts:

No major stability problems are anticipated for the approach cuts excavated with standard 2:1 slopes. In view of the relatively high groundwater level, however, adequate drainage measures will be required to prevent seepage through the cut slopes both during and after construction.

6.4) Proposed Detour:

The subsoil conditions at the location of the proposed detour are generally favourable for the contemplated scheme. No major stability problems are foreseen for the construction of the embankment fills and the proposed trestle bridge.

7. MISCELLANEOUS:

The field work, performed during the period July 5 - July 17, 1968, was carried out by Mr. V. Korlu, Project Foundation Engineer.

Equipment used was owned and operated by F. E. Johnston Drilling Co. Ltd.

This report was prepared by Mr. C. Mirza, Project Foundation Engineer.

The project was under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who also reviewed the report.

August, 1968.

APPENDIX I

FORM 08-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 68-F-48 | LOCATION Sta. 315 + 26 ℄ Hwy 2 Line 'C' O/S 40.0' Rt. | ORIGINATED BY V.K.
W P 420-65 | BORING DATE July 15, 1968 | COMPILED BY V.K.
DATUM Geodetic | BOREHOLE TYPE Diamond Drill - NX-BX Casing | CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE
369.3	Ground Level					
0.0	Fill Material (Clayey silt, sand & gravel with Tr. of organics) Compact, DkBr		1	SS	13	
361.8			2	SS	13	
7.5	Clayey Silt with occ. Sand seams Stiff to Hard Brown		3	SS	50	360
			4	SS	33	
351.3			5	SS	18	
18.0	Glacial Till Clayey silt to silt with sand and gravel. Very Stiff to Hard or Compact to Very Dense		6	SS	29	350
			7	SS	29	
			8	SS	21	340
	Grey		9	SS	32	
			10	SS	18	330
324.3						
45.0	Occ. Boulders up to 10" in size		11	SS	100/3"	
						320
317.8			12	SS	55	
51.5	End of Borehole					310

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100
SHEAR STRENGTH P S F

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT %
15 30 45

BULK DENSITY γ P C F

REMARKS

WL 361.8

FORM CB-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO 2

FOUNDATION SECTION

JOB 68-F-48 LOCATION Sta. 315 + 81 ℄ Hwy 2 Line 'C' O/S 40.0' Rt. ORIGINATED BY V.K.

W P 420-65 BORING DATE July 15, 1968 COMPILED BY V.K.

DATUM Geodetic BOREHOLE TYPE Diamond Drill - NX-BX Casing CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
369.0	Ground Level					
0.0	Fill Material (Silty Sand with some Gravel)		1	SS	5	
362.5	Loose, Dark Brown		2	SS	6	
6.5	Clayey Silt Occ. Sand and Silty Clay Seams Very Stiff Brown		3	TW	PM	360
			4	SS	22	
351.0			5	SS	20	
18.0	Glacial Til		6	SS	70	350
	Clayey silt to silt with sand and gravel		7	SS	61	
			8	SS	118	340
	Hard or very dense		9	SS	82	
	Grey		10	SS	95	330
			11	SS	100/6"	
318.5			12	SS	100/3"	320
50.5	End of Borehole					310

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100
SHEAR STRENGTH P S F
○ Unconfined Compression
500 1000 1500 2000 2500

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
WATER CONTENT %
15 30 45

0
15 ◇ 5 % Strain at Failure
10

BULK DENSITY
γ
P C F

REMARKS %	Gr.	Sa.	Si.	Cl.
▼WL 361.0				
	0	32	58	10
	26	34	30	10

FORM OB MT 126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

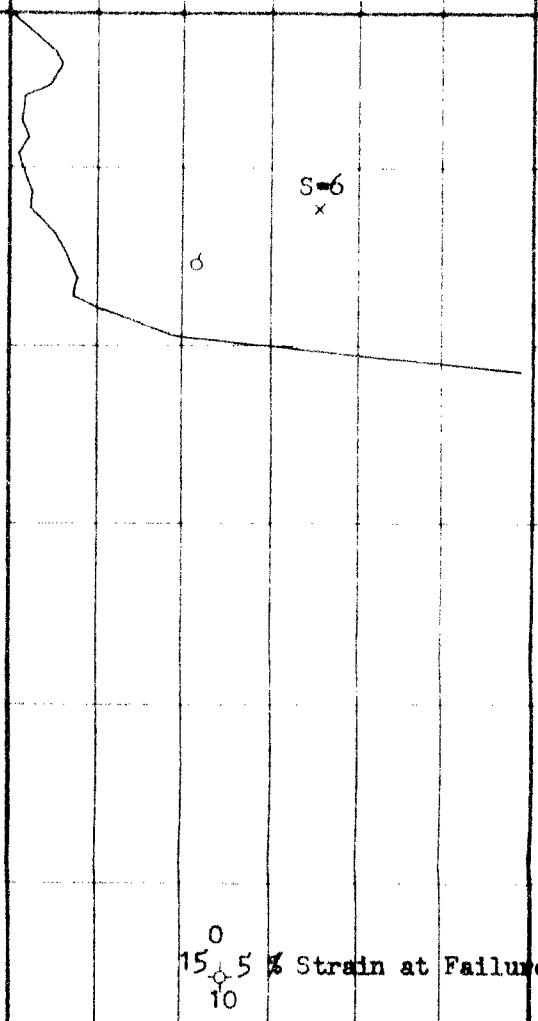
RECORD OF BOREHOLE NO 3

FOUNDATION SECTION

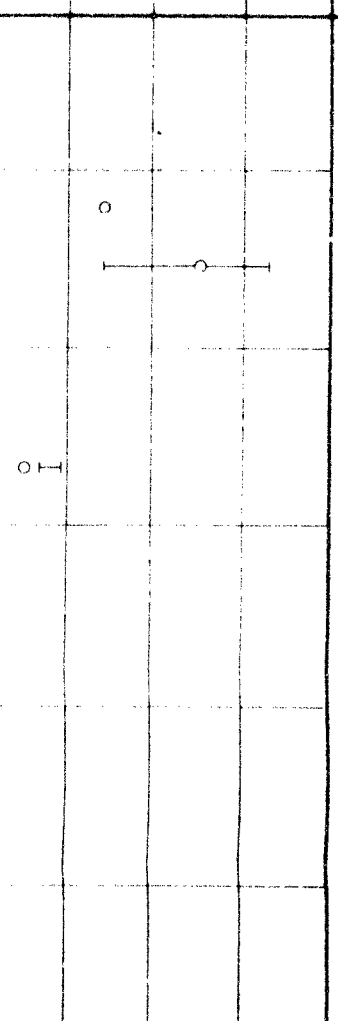
JOB 68-F-48 | LOCATION Sta. 315 + 89 ℘ Hwy 2 Line 'C' on ℄ | ORIGINATED BY V.K.
W P 420-65 | BORING DATE July 11, [illegible] | COMPILED BY C.M.
DATUM Geodetic | BOREHOLE TYPE Diamond Drill - NX-BX Casing | CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
368.8	Ground Level					
0.0	Fill Material (Clayey silt, sand & gravel with Tr. of organics) Compact, DkBr		1	SS	10	
			2	SS	13	
359.3			3	SS	3	360
9.5	Clayey Silt Occ. sand seams. Stiff Brown		4	TW	PM	
			5	TW	PM	
350.8						350
18.0	Glacial Till Clayey silt to silt with sand & gravel. Hard or very dense Grey		6	SS	80	
			7	SS	38	
			8	SS	59	340
333.8						
35.0	Occ. boulders up to 12" in size		9	SS	29	
			10	SS	124/4"	330
			11	SS	110/6"	
						320
317.3			12	SS	112/6"	
51.5	End of Borehole					

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100
SHEAR STRENGTH P S F
× Lab Vane
○ Unconfined Compression
500 1000 1500 2000 2500



LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
WATER CONTENT %
15 30 45



BULK DENSITY γ PCF

REMARKS

WL
Elev. 360.3

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 68-F-48 | LOCATION Sta. 316 + 43 ℄ Hwy 2 Line 'C' on ℄ | ORIGINATED BY V.K.
W P 420-65 | BORING DATE July 11, 1968 | COMPILED BY C.M.
DATUM Geodetic | BOREHOLE TYPE Diamond Drill - NX-BX Casing | CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
368.4	Ground Level					
0.0	Fill Material (Silty sand with some gravel) Loose, Brown		1	SS	4	
362.4						
6.0	Clayey Silt Occ. Sand seams Stiff to very stiff Brown		2	TW	PM	360
			3	SS	14	
354.4			4	SS	28	
14.0	Glacial Till Clayey silt to silt with sand & gravel. Hard or very dense Grey		5	SS	35	
			6	SS	30	350
341.4			7	SS	100/3"	
27.0	Occ. boulders up to 24" in size		7A	BXL RC	95% Rec	340
			8	SS	62	
			9	SS	130/6"	330
			10	SS	140/6"	
			11	SS	165	320
316.9			12	SS	120/6"	
51.5	End of Borehole					310

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100

SHEAR STRENGTH P S F
○ Unconfined Compression
500 1000 1500 2000 2500

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w
w_P w w_L
WATER CONTENT %
15 30 45

BULK DENSITY γ P C F

REMARKS
%
Gr.Sa.Si.Cl.

132

▼ WL
Elev. 360.4

7 35 44 14

15 ○ 0 5 % Strain at Failure
10

FORM DB-MT-126
66-454A

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO 5

FOUNDATION SECTION

JOB 68-F-48 LOCATION Sta. 316 + 50 C Hwy 2 Line 'C' O/S 42.0' Lt. ORIGINATED BY V.K.
W P 420-65 BORING DATE July 5, 1968 COMPILED BY C.M.
DATUM Geodetic BOREHOLE TYPE Diamond Drill - NX-BX Casing CHECKED BY

ELEV. / DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
368.5	Ground Level					
0.0	Fill Material (Clayey silt with some sand & Tr.organics) Firm, Dark Brown		1	SS	7	
363.0			2	TW	PM	
5.5	Clayey Silt Occ. sand seams. Firm to hard Brown		3	SS	32	360
			4	SS	16	
350.0			5	SS	19	
18.5	Glacial Till Clayey silt to silt with sand & gravel. Very stiff to hard or very dense Grey		6	SS	27	350
			7	SS	105	
			7A	BX RC	0 % Rec	340
			8	SS	78	
325.5			9	SS	130/10"	330
			10	SS	129	
43.0	Occ. boulders up to 6" in size		11	SS	104	320
317.0			12	SS	125	
51.5	End of Borehole					310

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P S F
+ Field Vane
× Lab Vane
500 1000 1500 2000 2500
S=4 (+) S=6 (×) >2000

LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT ——— w
WATER CONTENT % 15 30 45

BULK DENSITY γ P C F

REMARKS
WL Elev.360.0

FORM GB-MT-12a
66 4246

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 68-F-48 LOCATION Sta. 317 + 03 ℄ Hwy 2 Line 'C', O/S 43.0' Lt. ORIGINATED BY V.K.
W P 420-65 BORING DATE July 9, 1968 COMPILED BY C.M.
DATUM Geodetic BOREHOLE TYPE Diamond Drill - NX-BX Casing CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
368.4						
0.0	Fill Material (Clayey silt with some sand & Tr. organics)		1	SS	4	
362.4	Firm, Dark Brown					
6.0	Clayey Silt		2	TW	PM	360
	Occ. Sand Seams.		3	TW	PM	
	Stiff to Very Stiff					
354.4	Brown		4	SS	51	
14.0	Glacial Till		5	SS	56	
	Clayey silt to silt		6	SS	66	350
	with sand & gravel.		7	SS	85	
	Hard or very dense.		8	SS	118	340
			9	SS	183	
			10	SS	105	330
			11	SS	98	
316.9			12	SS	55	320
51.5	End of Borehole					310

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT
20 40 60 80 100
SHEAR STRENGTH P S F
+ Field Vane ○ Unconfined Comp.
× Lab Vane
500 1000 1500 2000 2500

S=8 S=5 + > 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT — w
w_P w w_L
WATER CONTENT %
15 30 45

BULK DENSITY
136 PCF

REMARKS
WL 359.9

0
15 ✧ 5 % Strain at Failure
10

FORM 08 MT-128
66 4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

JOB 68-F-48 LOCATION Sta. 315 + 82 ℄ Hwy 2 Line 'C', O/S 25.0' Lt. ORIGINATED BY V.K.
W P 420-65 BORING DATE July 17, 1968 COMPILED BY C.M.
DATUM Geodetic BOREHOLE TYPE Diamond Drill - NX-BX Casing CHECKED BY

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
364.8	Ground Level					
0.0	Clayey Silt Occ. sand seams. Very stiff to hard. Brown		1	SS	25	360
			2	SS	30	
351.8			3	SS	31	
13.0	Glacial Till Clayey silt to silt with sand & gravel. Very stiff to hard or Compact to very dense Grey		4	SS	22	350
			5	SS	19	
			6	SS	20	340
			7	SS	50	
			8	SS	104	330
			9	SS	127	
323.3			10	SS	150/9"	
41.5	End of Borehole					320

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P S F

LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT ——— w
WATER CONTENT % 15 30 45

BULK DENSITY γ P C F

REMARKS

WL 359.8

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO 8

FOUNDATION SECTION

JOB 68-F-48 LOCATION Sta. 316 + 50 ℄ Hwy 2 Line 'C', O/S 65.0' Lt. ORIGINATED BY V.K.
W P 420-65 BORING DATE July 10, 1968 COMPILED BY C.M.
DATUM Geodetic BOREHOLE TYPE Diamond Drill - NX-BX Casing CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
367.1	Ground Level					
0.0	Fill Material (Clayey silt, sand & gravel w/Tr. organics)		1	SS	8	
361.6	Loose, Dark Brown					
5.5	Clayey Silt		2	SS	13	360
	Occ. sand seams.					
	Stiff to very stiff.		3	SS	21	
	Brown		4	SS	18	
352.1						
15.0	Glacial Till		5	SS	47	350
	Clayey silt to silt with sand & gravel.		6	SS	50	
	Hard or very dense.		7	SS	123	340
	Occ. boulders up to 12" in size.					
335.6			8	SS	116/6"	
31.5	End of Borehole					330

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P.S.F

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w
WATER CONTENT % 15 30 45

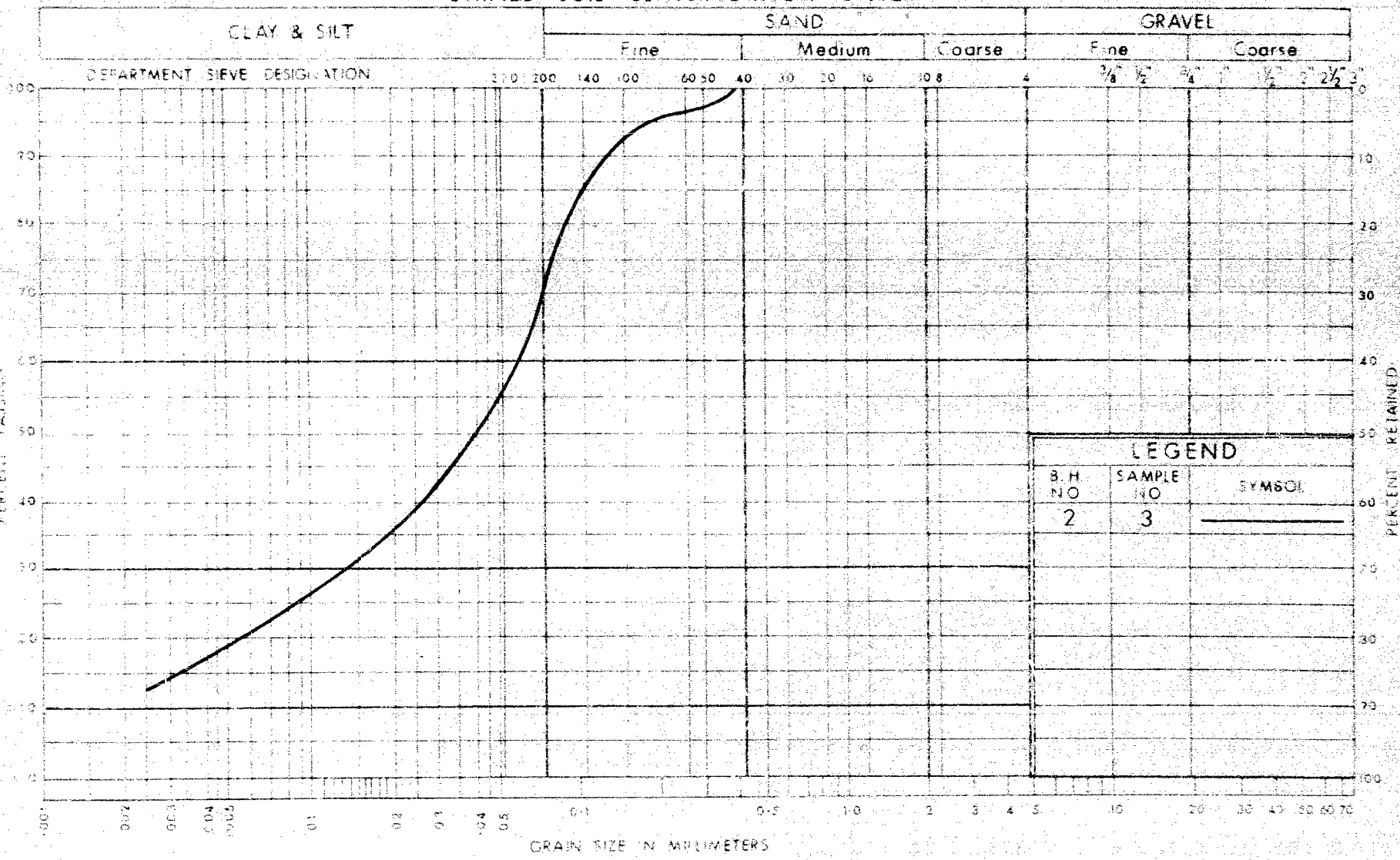
BULK DENSITY P C F

REMARKS

▼WL 358.1

FORM 08 MT-17
REV. APR. 965

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

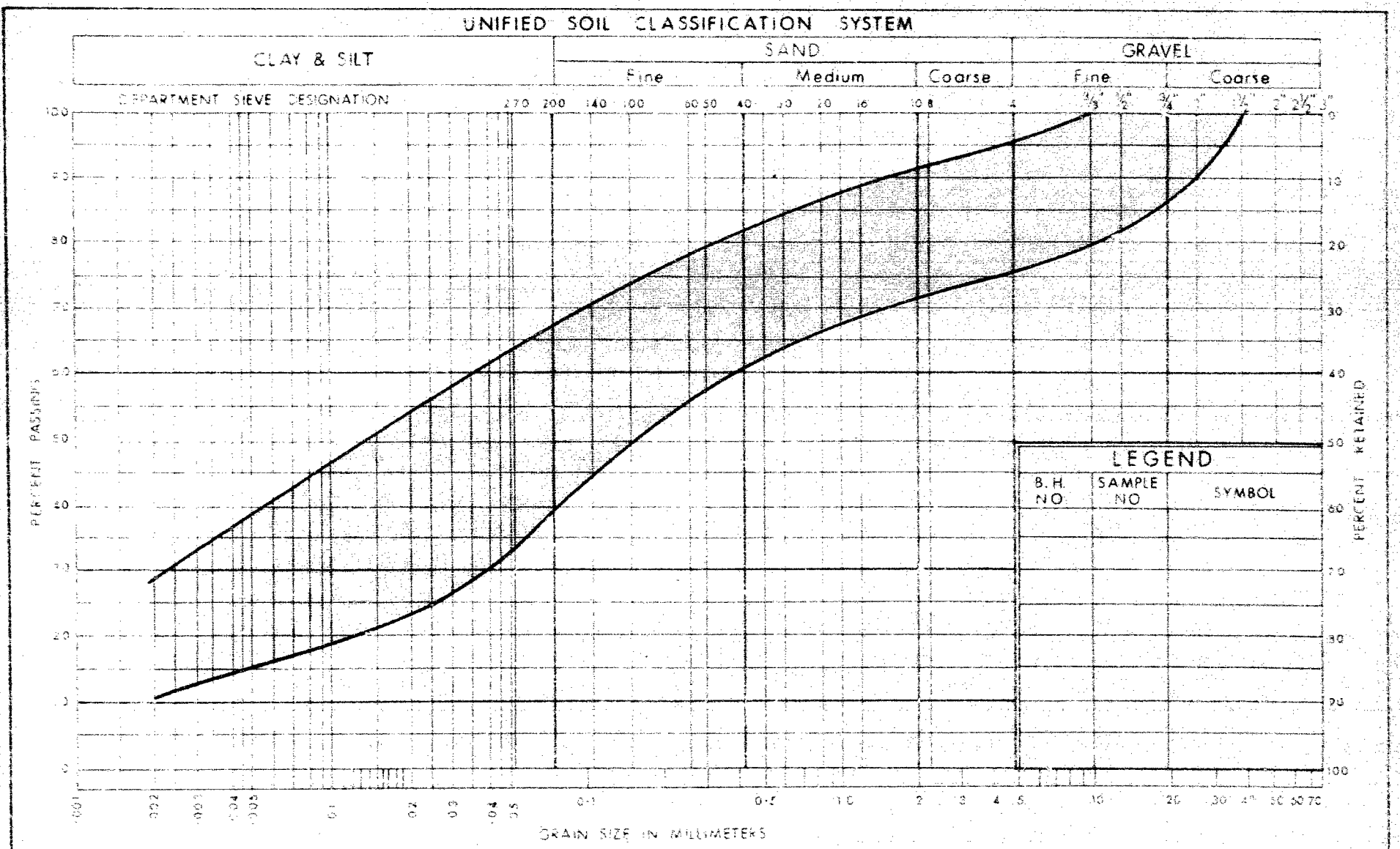
GRAIN SIZE DISTRIBUTION

CLAYEY SILT

W.P. No. 420 – 65

JOB No. 68 – F – 48

FORM DB MT - 17
REV. APR. 1965



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT

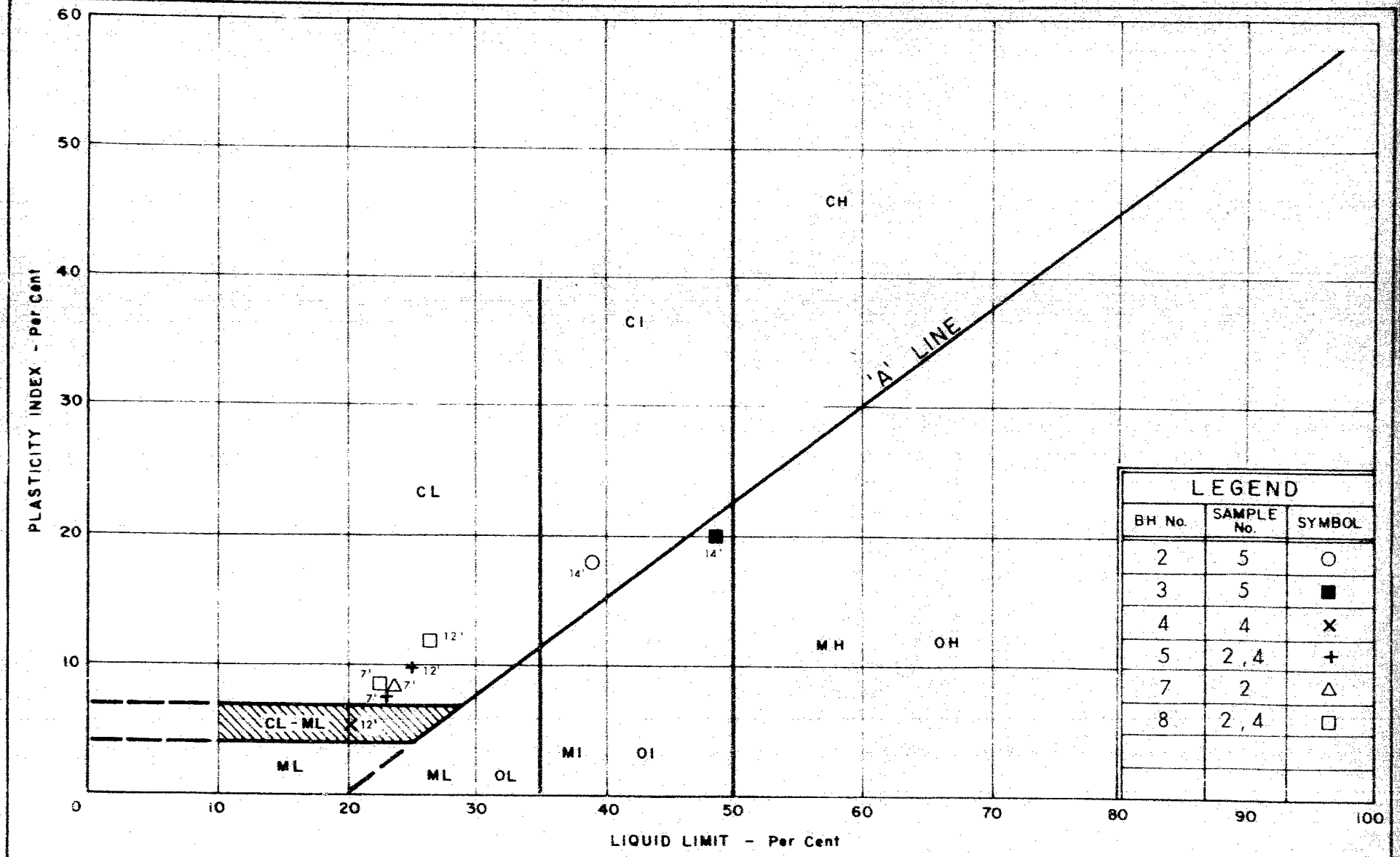
GRAIN SIZE DISTRIBUTION

GLACIAL TILL

W.P. No. 420 – 65

JOB No. 68 – F – 48

REVISED JUL[illegible] 1966



LEGEND		
BH No.	SAMPLE No.	SYMBOL
2	5	○
3	5	■
4	4	×
5	2, 4	+
7	2	△
8	2, 4	□

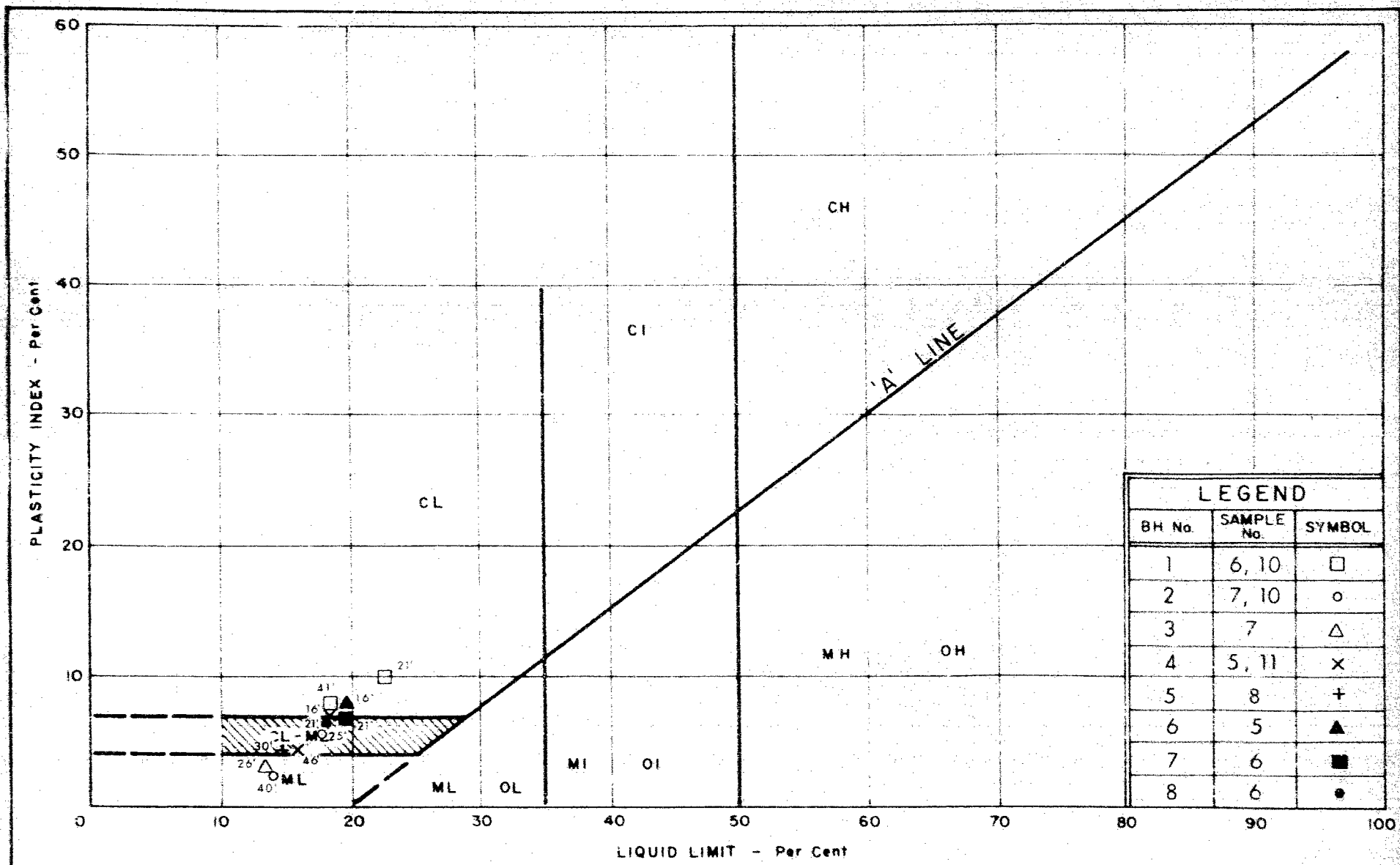
DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

PLASTICITY CHART
CLAYEY SILT

W.P. No. 420-65
JOB No. 68-F-48

DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT

FORM 08-MT-252
REVISED JUL 966



LEGEND		
BH No.	SAMPLE No.	SYMBOL
1	6, 10	□
2	7, 10	o
3	7	△
4	5, 11	×
5	8	+
6	5	▲
7	6	■
8	6	●

DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

PLASTICITY CHART

GLACIAL TILL

W.P. No. 420-65
JOB No. 68-F-48

DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT

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	= 3·1416
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

cc: Foundations Files (Mr. Lin)

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. C. R. Crabtree,
Bridge Design Engineer,
Bridge Office,
Admin. Bldg.

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

Attention: Mr. M. Lin

Date: March 9, 1970

Our File Ref.

In reply to

Subject: C.P.R. Subway at Bowmanville --
Hwy. #2, District #7 (Port Hope),
W.O. 68-F-48, W.P. 420-65, Site 21-375

We have reviewed your Drawing D-6563-3 (details of proposed detour) for the above mentioned site and submit the following comments:

The timber piles for the temporary detour structure may not penetrate below elev. 350.0, since the glacial till deposit is generally very dense or hard below elev. 350.0. In view of this, at certain locations where piles have to be driven below elev. 350.0, preboring techniques will be necessary in order to reach the specific tip elevation to comply with the construction requirements. It is suggested that initially, holes not larger in diameter than the pile tip, be pre-augered down to the required elevation (one foot higher than the tip elevation shown on Dwg. D-6563-3). If trouble is experienced due to holes caving in during driving, thus preventing adequate penetration by the piles, it will be necessary to auger larger holes, ensuring that after driving, any voids remaining around the piles are filled up with sand, or perhaps concrete to ensure lateral stability.

D/mlmF

A. Devata,
SUPERVISING FOUNDATION ENGR.
For:
A. S. Stermac,
PRINCIPAL FOUNDATION ENGR.

cc: Messrs. G. LaCombie
W. S. Kelinyshyn
Foundations Files
Gen. Files

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. M. Devata,
Foundation Office,
Room 107, Lab. Building

From: W. Lin,
Bridge Office

Attention:

Date: March 2, 1970

Our File Ref.

In reply to

Subject: W.P. 420-65, Site 21-375
C.P.R. Subway at Bowmanville
Highway 2, District No. 7

05-F-48

As you know, we are requested by the C.P.R. to provide details of excavation and pile installation for the railway detour, using the C.P.R. trestle standards.

Attached herewith is the revised detour drawing. We would like to have your comments before we can submit the proposed scheme for the Railway's approval.

As this project is scheduled for the present construction year your early attention will be most appreciated.

W. Lin,
Regional Bridge Design Engineer

WL:rd

Attach.

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

From: C.S. Grebski,
Bridge Office

Attention:

Date: July 8, 1969

Our File Ref.

In reply to

Subject: C.P.R. Subway - Town of Bowmanville
W.P. 420-65, Site No. 21-375
Highway 2, District No. 7

68-F-48

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

Discussed tests & const'n details w/ Kun & Gruppe on July 21/69. Suggested that a drainage ditch be provided at bot. of cut between existing & proposed tracks to take care of any seepage from likely granular zones.

C Mirza/
/Ren H O.