DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

23-65-239.

To. Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

Attention: Mr. S. McCombie

From: Mr. A. G. Stermac,
Principal Foundation Engr.,
Foundation Section,
Materials & Research Division.

Date: October 24, 1963

Our File Ref.

In reply to

Subject:

FOUNDATION INVESTIGATION REPORT

For

Proposed Black Creek Structure,
Hwy. #400, District 6, Toronto.
W.J. 63-F-95A -- W.P. 114-63

ALSO 63-F-95B (ADDITIONAL REPORT)
FEB. 1964.

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

We believe that you will find the factual data and recommendations contained therein, adequate for your future design work. Should further information be required, please feel free to call on our Office.

K. Y. Lo,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

KYL/MdeF
Attach.
cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
G. K. Hunter (2)
C. Fraser
T. J. Kovich
A. Watt

Foundations Office
Gen. Files

TABLE OF CONTENTS

FOUNDATION INVESTIGATION REPORT

For

Proposed Black Creek Structure,
Hwy. #400. District 6, Toronto.
W.J. 63-F-95 -- W.P. 113-63

1. INTRODUCTION:

A request for a foundation investigation at the site of the proposed crossing of the Northeast ramp of Hwy.#400 and Black Creek, was received verbally from Mr. J. Curtis of the Bridge Location Section.

A field investigation was subsequently carried out by this Section in order to determine the subsoil conditions at the site of the proposed structure. Presented in this report are the results of this investigation, together with recommendations pertaining to the design of structure foundations and approach embankments.

2. DESCRIPTION OF THE SITE:

The proposed structure is located adjacent to Jane Street about one-half mile South of Hwy. #401.

The topography of the site is generally flat, covered with weeds and small bush.

Physiographically, the site lies in the South Slope Region, which is the South slope of an interlobate moraine. This moraine consists of a clayey-silty till deposited during the Pleistocene Ice Epoch.

cont'd. /2 ...

3. FIELD INVESTIGATION PROCEDURE:

A total of 4 sampled boreholes and 7 dynamic cone penetration tests was carried out during the course of the field investigation. Boring was achieved by means of conventional diamond drilling equipment adapted for soil sampling purposes. Undisturbed soil samples were obtained by means of 2-inch I.D. Shelby tubes, some of which were pushed manually and some of which had to be gently hammered into the soil. Disturbed samples were recovered by means of a standard 2" O.D. split-spoon sampler. In-situ vane tests were carried out wherever possible, in cohesive deposits.

The locations and elevations of all boreholes are shown on Dwg. No. 63-F-95A which accompanies this report.

4. LABORATORY TESTS:

Samples were visually examined and identified in the laboratory as well as in the field. Tests were carried out in the laboratory, on a selection of both disturbed and undisturbed samples, for the determination of Atterberg limits, moisture contents, bulk densities, grain size distributions and shear strength measurements.

The laboratory test results have been summarized and are included in this report in Appendix I.

5. SUBSOIL CONDITIONS:

5.1) General:

The subsoil conditions at the site were found to be quite variable. Detailed descriptions of different soil types encountered in each boring are given in Appendix I of this report. The estimated

cont'd. /3 ...

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

stratigraphical profile of Dwg. 63-F-95A is based upon this information.

From ground level downwards, the various soil types encountered are as follows:

5.2) Silty Fine Sand:

This layer was encountered in all boreholes immediately below a thin layer of topsoil. The depth of the layer varied between 7.5 ft. in B.H.'s #3 and #4 and 10.5 ft. in B.H. #2. In borehole #2, some traces of organics were observed within the deposit approximately 6 ft. below ground.

Standard Penetration test values ranged from 1 to 13 blows/ft., indicating a relative density of very loose to compact.

5.3) Silty Clay to Clayey Silt:

On the North side of the Black Creek (B.H. #1 and #4) a deposit of silty clay to clayey silt was observed immediately below the silty sand and above the glacial till stratum. This was encountered between approximate elev. 390.0 and elev. 376.0. Laboratory tests indicated that the liquid limits of this material ranged from 24% to 38% and plastic limits ranged from 19% to 22%. Moisture content was found to vary between 23% and 26%.

The undrained shear strength obtained from laboratory tests varies between 1190 and 1940 p.s.f. with an average of 1500 p.s.f. In-situ vane tests carried out in this deposit, ranged from a minimum of 1680 p.s.f. to over 2000 p.s.f. Based on these values, the consistency of the stratum may be described as stiff to very stiff.

cont'd. /4 ...

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

5.4) Glacial Till (Heterogeneous Mixture of Clayey Silt with Sand and Traces of Gravel) - Occasional pockets of Sand and Silt:

A stratum of glacial till extends immediately below the deposit of silty sand in B.H.'s #2 and #3, where as in B.H.'s #1 and #4 (North side of Black Creek), this extends from below the silty clay to clayey silt. The lower boundary of the till stratum was not determined, but extends at least to a depth of 74 ft. from the ground surface. Occasional pockets and thin seams of silt and sand were observed in samples from the stratum. The upper boundary of the till stratum ranged between elev. 390.0 and elev. 376.0.

The results of the field and laboratory tests are given in the borehole logs appended to this report. A study of the liquid and plastic limits shows that the soil is heterogeneous. The liquid limit varies between 17% and 41%, while the plastic limit ranges from 11% to 23%. The liquidity index generally varies from between 0.2 and 0.5.

The laboratory unconfined and quick triaxial tests vary between 1180 and 2275 p.s.f. whereas the in-situ vane tests vary from 1680 to over 2000 p.s.f. In general, the laboratory shear strength results are lower than the field vane tests. The sensitivity of the deposit, as determined by vane, is 2.5. In B.H.'s #2 and #3, this deposit is found to be generally hard with 'N' values ranging from 16 to 51 blows/ft. Standard Penetration resistances or 'N' values in this deposit in B.H.'s #1 and #4 ranged from 14 blows/ft. to 35 blows/ft. Based on the 'N' values, together with shear strength measurements, the consistency of the overall deposit may be described as stiff to hard.

cont'd. /5 ...

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

5.4) Glacial Till: (cont'd.) ...

As in the case of Atterberg limits or undrained tests, no definite pattern can be found within the deposit. This can be attributed to the presence of numerous seams or pockets of silt and sand within the stratum.

6. GROUND WATER:

During the foundation investigation, water level observations were carried out in the boreholes. These indicate that the ground water elevation varies little over the site.

The exact water levels observed during the investigation are shown on Dwg. 63-F-95A.

7. DISCUSSION AND RECOMMENDATIONS:

It is proposed to extend Hwy. #400 to Jane Street, approximately one-half mile South of Hwy. #401. An interchange is planned at the crossing of future Hwy. #400 and Jane Street. This requires construction of several ramps as well as structures. A 3-span structure (30 ft. - 50 ft. - 30 ft.) is proposed, where the Northeast ramp crosses the relocated Black Creek.

Subsoil at the site consists of a stratum of very loose to compact silty fine sand, followed by a stiff to hard stratum of glacial till. On the North side of Black Creek, a stiff to very stiff stratum of silty clay to clayey silt, approximately 11 ft. thick, was found between the silty sand and till strata.

Because of the presence of very loose to compact silty sand in the upper 10 ft. over the entire site, adequate bearing

cont'd. /6 ...

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

capacity may not be achieved. Therefore, the following alternatives are suggested to support the structure:

1) Spread footings supported on the glacial till, approximately 12 ft. below ground level.

2) Footings supported on large displacement piles driven into the till stratum.

1) Spread Footings -

The structure may be supported on spread footings founded on the glacial till. It is suggested that the footings be located at or below elevation 385, in which case, a safe bearing capacity of 1.5 tons/sq.ft. may be used.

Excessive seepage of water from the side slopes of the footing excavation may be anticipated. However, this could be controlled by ordinary pumping methods. Care should be taken to prevent any possible softening of the foundation material from the surface run-off.

2) Displacement Piles -

The footings may be supported on large displacement friction piles, driven into the glacial till stratum. A safe design load of 25 tons/pile may be used for #14 untreated (if the pile cutoffs are located below ground or creek water levels) timber piles driven to an estimated tip elevation of ± 355. In view of the variable consistency of the subsoil, some variation in the final pile lengths must be expected. It is believed, however, that 45-ft. long piles would satisfy the average condition of the subsoil.

cont'd. /7 ...

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

This investigation was carried out with the assumption that the footings will be located as shown on Dwg. 63-F-95A. If there is any change in the location of the footings, the Foundation Section should be informed so that necessary additional investigation may be carried out.

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

8. SUMMARY:

Subsoil at the site consists of loose silty sand followed by stiff to hard glacial till.

The following two alternatives for footing design are recommended:

1) The structure may be supported on spread footings founded on the glacial till at or below elevation 385. A safe bearing pressure of 15 tons/sq.ft. may be used.

2) The structure may be supported on large displacement piles driven into the glacial till. For #14 timber piles driven to approximate elevation 355, a safe load of 25 tons/pile may be used.

If there is any change in the location of the proposed footings, additional investigation of the subsoil may be required.

No stability problems with regard to the approach fills are anticipated.

cont'd. /8 ...

9. MISCELLANEOUS:

The field work, performed from August 26 to September 6, 1963, together with the preparation of this report, was undertaken by Mr. R. Magi, Project Foundation Engineer. The investigation was carried out under the general supervision of Mr. M. Devata, Sr. Foundation Engineer, who also reviewed this report.

Equipment was owned and operated by Dominion Soil Investigation, Ltd. of Toronto.

October 1963

APPENDIX I.

FORM 08-ML-126 REV. 1961 OFFICE REPORT ON SOIL EXPLORATION

61-1391

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 63-F-95 LOCATION Sta. 159+00 (220' Rt.) ORIGINATED BY B.K.

W.P. 113-63 BORING DATE Aug. 28/63 COMPILED BY B.K.

DATUM 397.8 BOREHOLE TYPE Washboring CHECKED BY M.D.

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	BULK DENSITY Y P.C.F.	REMARKS
397.8	Groundlevel							
0.0	Silty fine sand		1	SS	5			▼ G.W.L. = 4.0'
	Loose		2	SS	5	390		
387.8			3	SS	7			
10.0	Clayey silt		4	TW	P		128.0	Sa 3% Si 57% Cl 40%
			5	TW	P		127.0	
	Stiff to v. stiff					380		
375.8			6	TW	P		130.0	
22.0	Glacial till (Het. mixture clayey silt, sand & tracesof fine gravel)- occasional seams and pockets of sand and silt.		7	TW	P		137.0	
			8	TW	P	370	134.0	Gr 2% Si 58% Sa 15% Cl 25%
			9	TW	P	360		
			10	TW	P			Gr 3% Si52% Sa23% Cl22%
			11	SS	35			
			12	SS	20	350		
			13	TW	P			Gr 1% Si55% Sa26% Cl18%
			14	SS	21			
			15	TW	P			
			16	SS	24	340		
			17	TW	P			
			18	SS	21			
			19	TW	H			
	Stiff to hard		20	SS	33	330		
			21	TW	H			
323.3			22	SS	22			
74.5	End of borehole.					320		

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100

SHEAR STRENGTH P.S.F.
● - Triaxial Test + - Field Vane
○ - Unconfined Compr. Test
500 1000 1500 2000 2500

2.5 2.5 2.0 2.2 2.0 >2000 1.5 >2000 1.2 >2000 1.3 >2000 >2000 >2000 >2000

LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT ——— w
w_P w w_L
WATER CONTENT % 10 20 30 40

FORM OB-ML-128 REV. 1961

61-4391

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. (2.

FOUNDATION SECTION

JOB 63-F-95 LOCATION Sta. 159+30 (115' Rt) ORIGINATED BY B.K.

W.P. 113-63 BORING DATE Sept. 3, 1963. COMPILED BY B.K.

DATUM 397.3 BOREHOLE TYPE Washboring CHECKED BY M.D.

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
397.3	Groundlevel					
0.0	Silty fine sand with traces of organics.		1	SS	9	
			2	SS	5	390
386.8	Loose to compact.		3	SS	13	
10.5	Glacial till (Het. mixture of clayey silt with sand and traces of fine gravel) with occasional seams and pockets of sand and silt.		4	TW	P	
			5	SS		
			6	SS	16	380
			7	SS	31	
			8	SS	32	370
			9	SS	31	
			10	SS	51	360
			11	SS	47	
	Stiff to hard.		12	SS	49	350
345.8			13	SS	28	
51.5	End of borehole.					340

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100

SHEAR STRENGTH P.S.F. 500 1000 1500 2000 2500

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

▼ W.L. 4.0

Gr 11% Si47%
Sa28% Cl14%

FORM OB-ML-126 REV. 1961
61-4391

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 63-F-95 LOCATION Sta. 159+70 (145' Rt.) ORIGINATED BY B.K.

W.P 113-63 BORING DATE Sept. 5, 1963. COMPILED BY B.K.

DATUM 397.4 BOREHOLE TYPE Washboring CHECKED BY M.D.

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV SCALE
397.4	Groundlevel					
0.0	Silty fine sand					
			1	SS	1	
389.9	Very loose		2	SS	3	390
7.5	Glacial till (Het. mixture of clayey silt, sand and traces of fine gravel)- occasional seams and pockets of sand and silt.		3	TW	P	
			4	TW	P	
			5	SS	26	
			6	SS	24	380
			7	SS	41	
			8	SS	38	370
			9	SS	28	
360.9	Stiff to hard.		10	SS	40	360
36.5	End of borehole.					

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100

SHEAR STRENGTH P.S.F.
●- Triaxial compr. + - Field Vane
○- Unconf. compr.
500 1000 1500 2000 2500

>2000

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
	W.L. 4.6'
129.7	
133.0	Gr5% Si66%
136.9	Sa4% Cl25%
	Gr4% Si45% Cl28% Sa23%

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 63-F-95 LOCATION Sta. 158/65 (180' Rt.) ORIGINATED BY B.K.

W.P 113-63 BORING DATE Sept. 6, 1963. COMPILED BY B.K.

DATUM 397.8 BOREHOLE TYPE Washboring CHECKED BY M.D.

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE
397.8	Groundlevel					
0.0	Silty fine sand.		1	SS	5	
390.3	Loose		2	SS	9	390
7.5	Silty clay to clayey silt.		3	TW	P	
			4	SS	15	
380.3	Stiff to very stiff.		5	TW	P	
17.5	Glacial till (Het. mixture of clayey silt, sand and traces of fine gravel)-Occasional seams and pockets of sand and silt.		6	SS	15	380
			7	SS	15	
			8	TW	H	
			9	SS	17	370
			10	SS	15	
			11	SS	14	
	Stiff to very stiff.					360
354.8			12	SS	16	
43.0	End of borehole.					350

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100

SHEAR STRENGTH P.S.F.
● - Triaxial comp + - Field Vane
○ - Unconf. compr.
500 1000 1500 2000 2500

>2000
>2000
>2000
>2000
>2000

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w
w_P w w_L

WATER CONTENT %
10 20 30

BULK DENSITY
P.C.F.

123.9
131.8
129.2

REMARKS

▼ W.L. 4.0'

Si 96%
Cl 4%

FORM OB-ML-[illegible]6 REV. 1961

61-4391

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

JOB 63-F-95 LOCATION 220' Rt. Sta. 158+60 ORIGINATED BY R.M.

W P 113-63 BORING DATE Oct. 3, 1963. COMPILED BY R.M.

DATUM 398.0 BOREHOLE TYPE Cone Penetration CHECKED BY M.D.

SOIL PROFILE			SAMPLES				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 %	BULK DENSITY P.C.F.	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE				
398.0	Groundlevel					390				
						380				
						370				
367.0										
31.0	End of borehole.					360				

FORM OB-ML-126 REV. 1961
61-4391

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 63-F-95 LOCATION 180' Rt. Sta. 159+20 ORIGINATED BY R.M.

W.P 113-63 BORING DATE Oct. 4, 1963. COMPILED BY R.M.

DATUM 397.7 BOREHOLE TYPE Cone Penetration. CHECKED BY M.D.

SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE			BULK DENSITY	
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	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 %		P.C.F.	REMARKS
397.7	Groundlevel					390					
						380					
						370					
360.7						360					
37.0	End of borehole.										

FORM QB - ML - 126 REV. 1961

81-4391

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

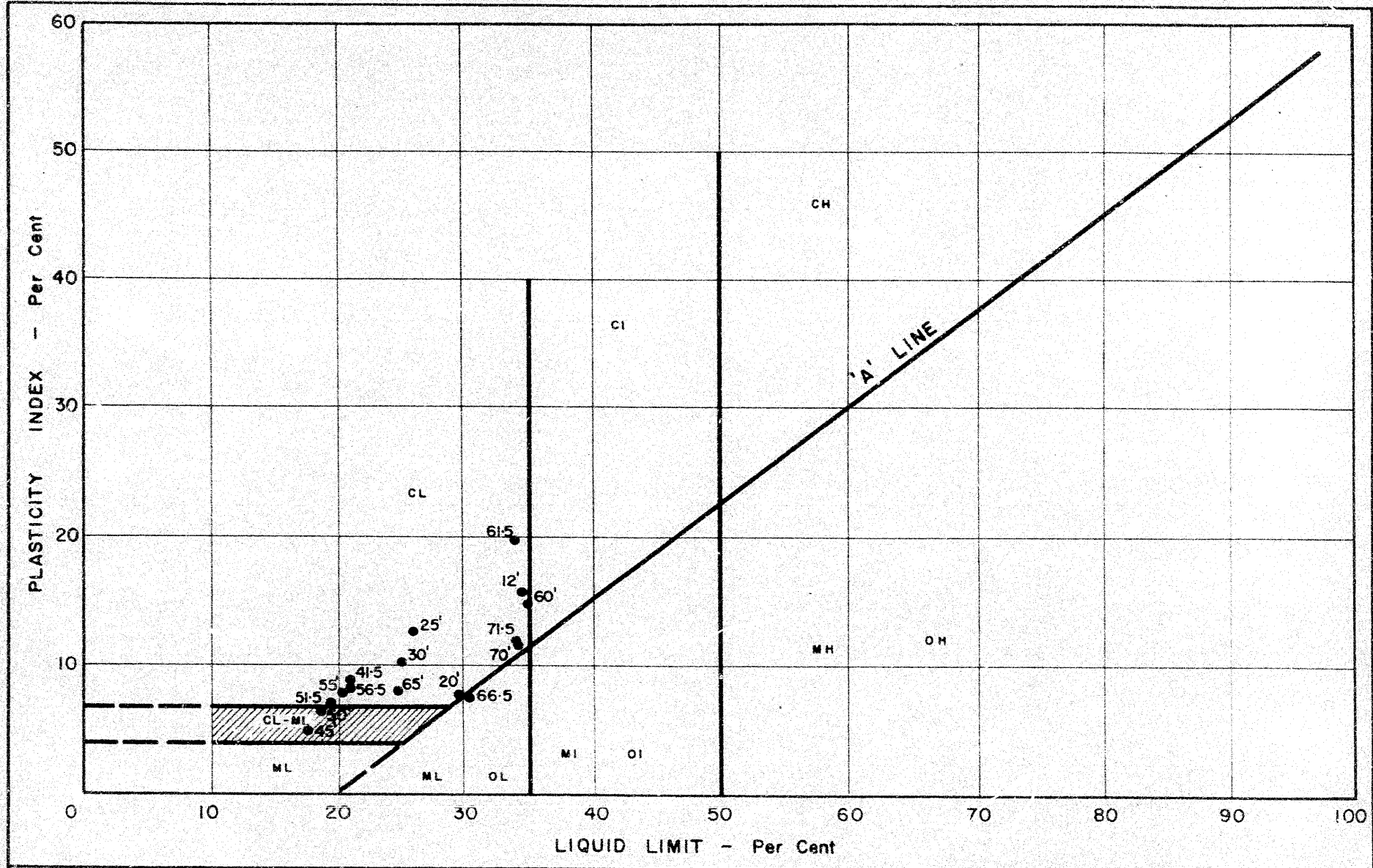
JOB 63-F-95 LOCATION 120' Rt. (Sta. 159+90) ORIGINATED BY R.M.

W P 113-63 BORING DATE Oct. 8, 1963. COMPILED BY R.M.

DATUM 398.2 BOREHOLE TYPE Cone Penetration CHECKED BY M.D.

SOIL PROFILE			SAMPLES			ELEV SCALE	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 %	BULK DENSITY γ P.C.F.	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
398.2	Groundlevel					390				
378.2						380				
20.0	End of borehole.					370				

FORM OB-ML 252 (REV. MARCH 62)



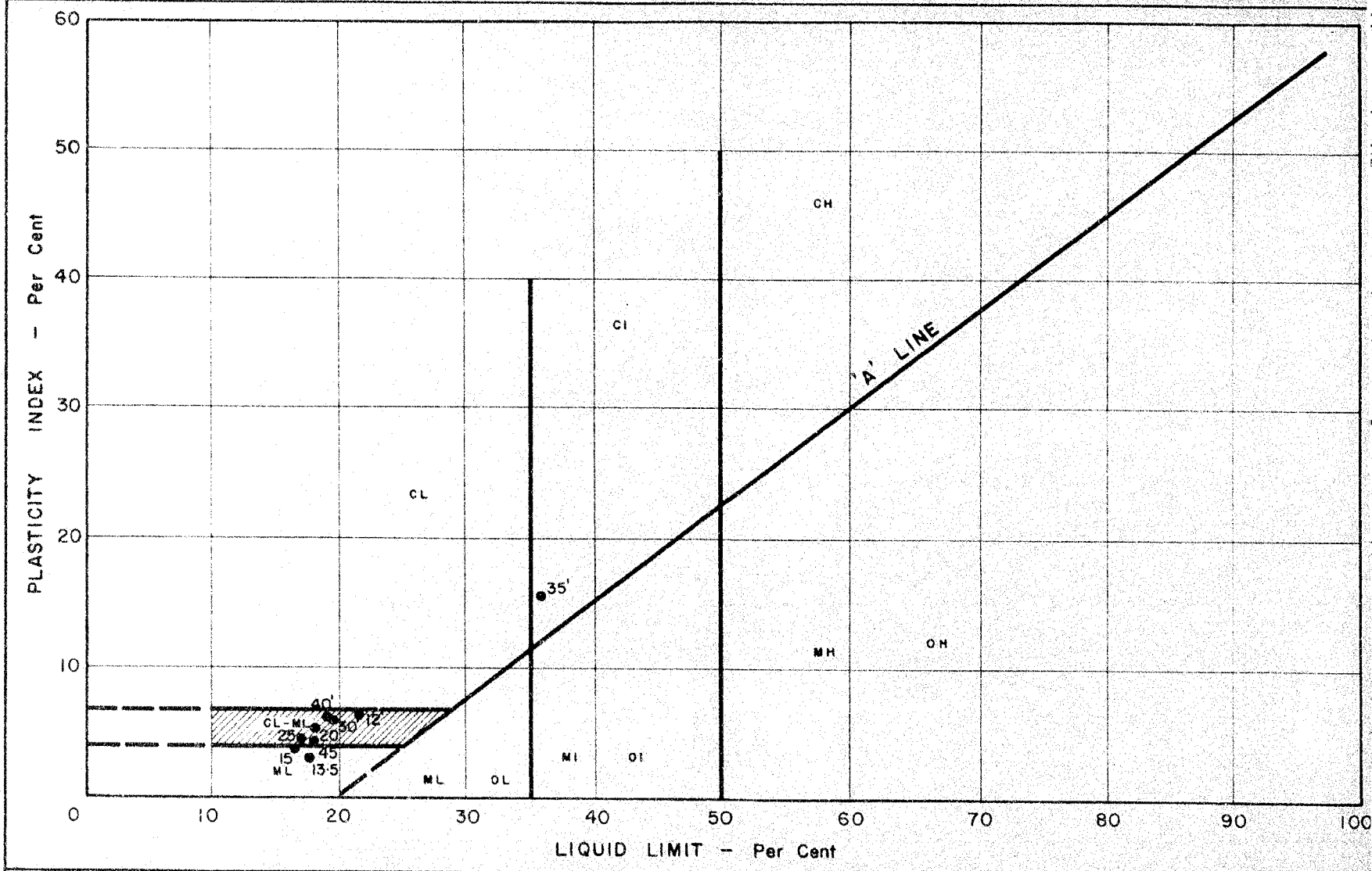
NOTES BORE HOLE NO. 1

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
PLASTICITY CHART

Job No. 63-F-95 W.P. No. 113-63

Location BLACK CREEK & HWY. NO. 400

FORM OB-ML-252 (REV. MARCH 62)



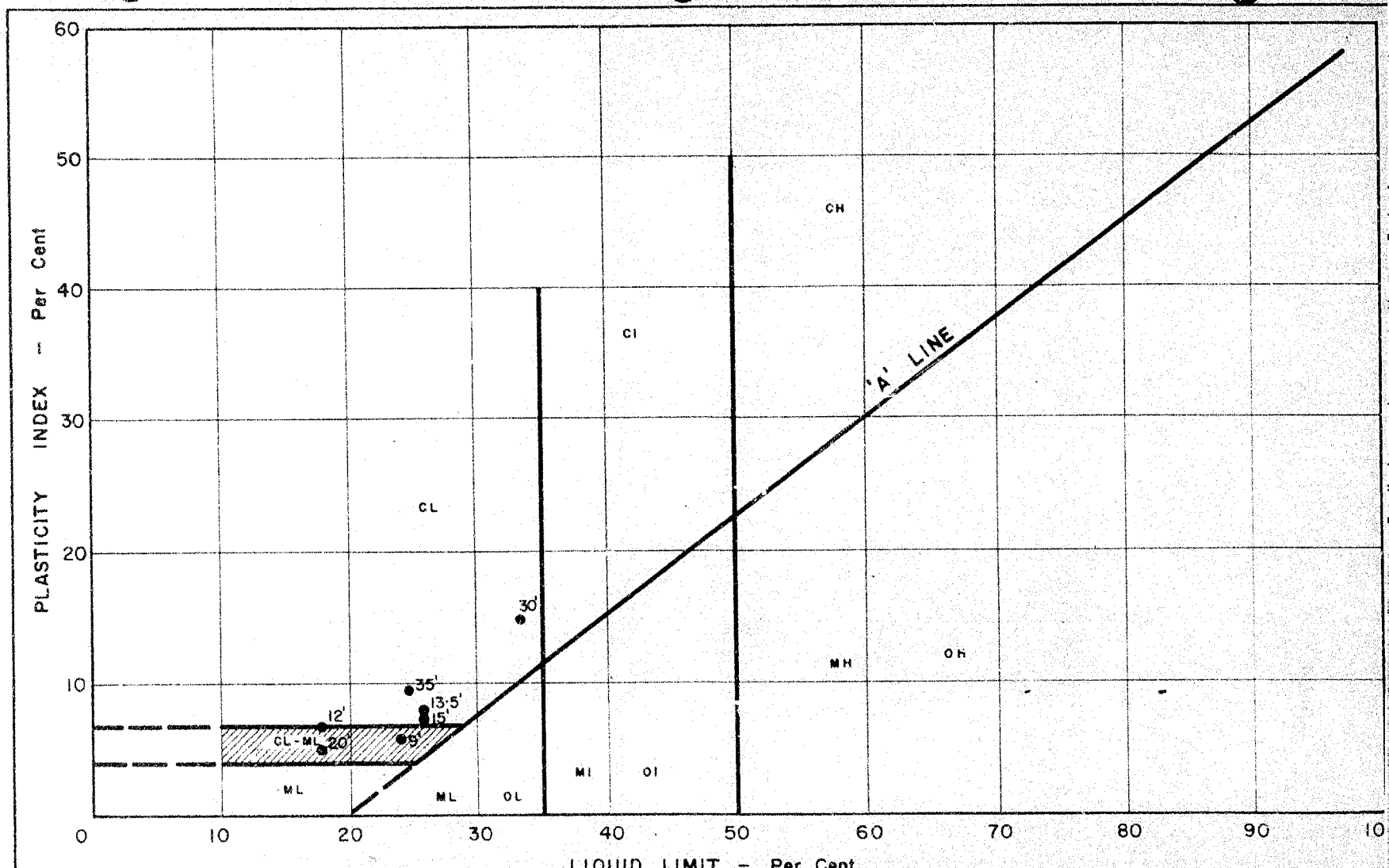
NOTES BORE HOLE NO. 2

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
PLASTICITY CHART

Job No. 63 - F - 95 W.P. No. 113 - 63

Location BLACK CREEK & HWY. NO. 400

FORM 08-ML-252 (REV. MARCH 62)



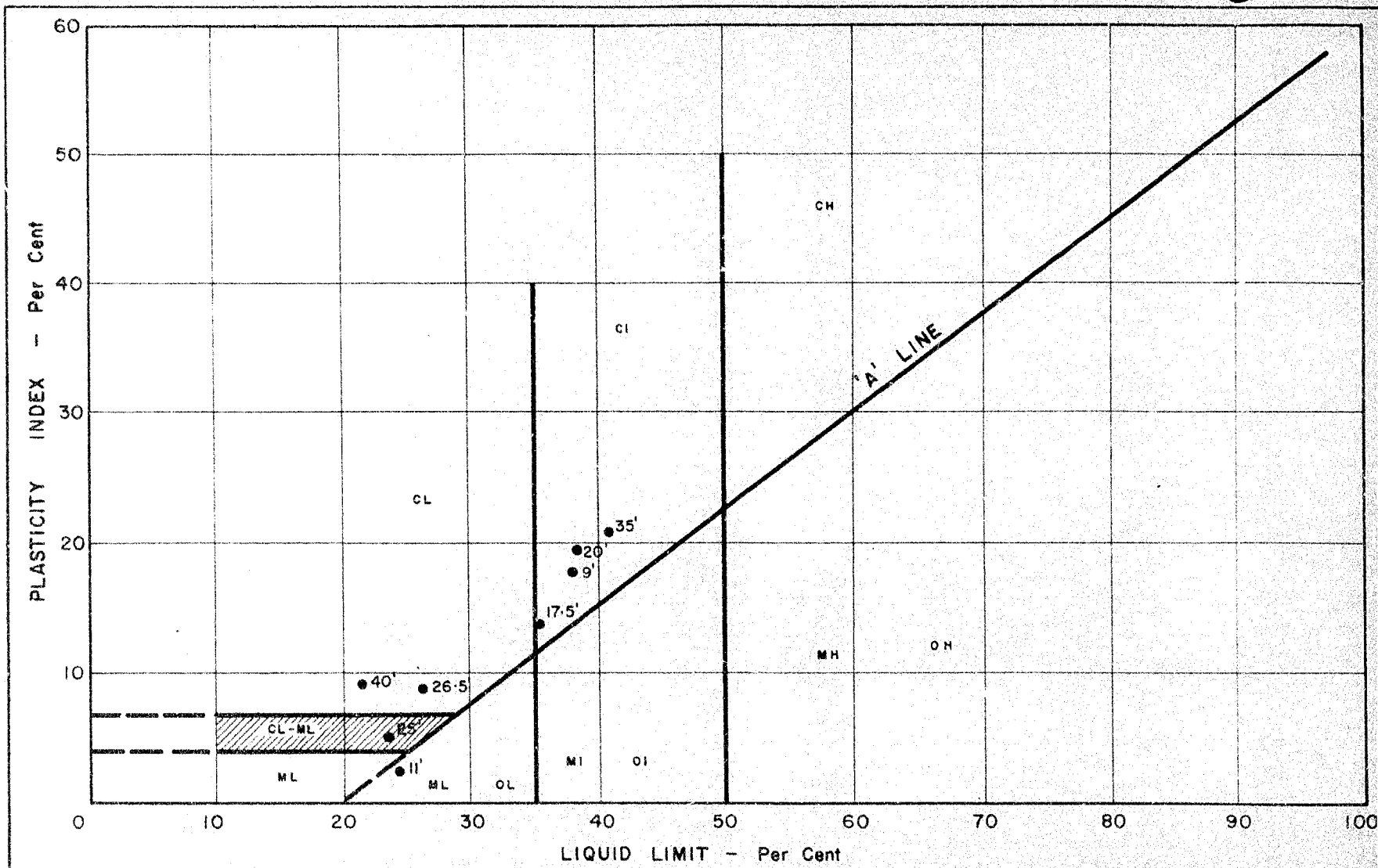
NOTES BORE HOLE NO. 3

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
PLASTICITY CHART

Job No. 63 - F - 95 W.P. No. 113 - 63

Location BLACK CREEK & HWY. NO. 400

FORM 08-ML-252 (REV. MARCH 62)

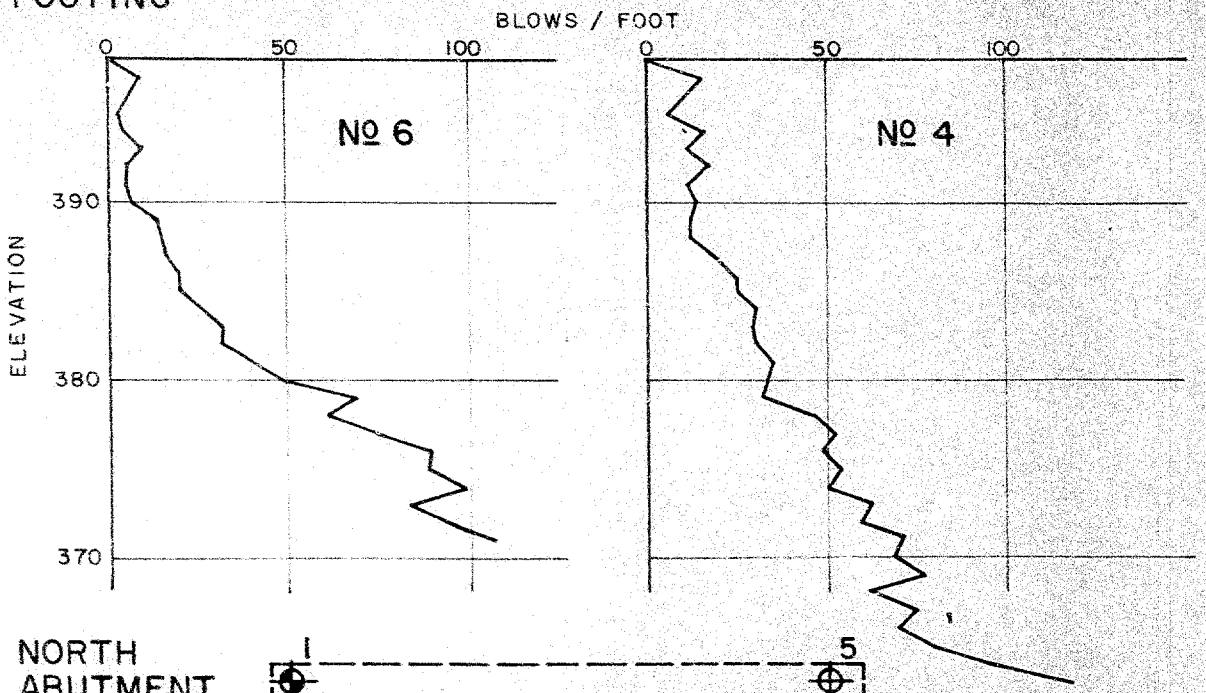


NOTES BORE HOLE NO. 4

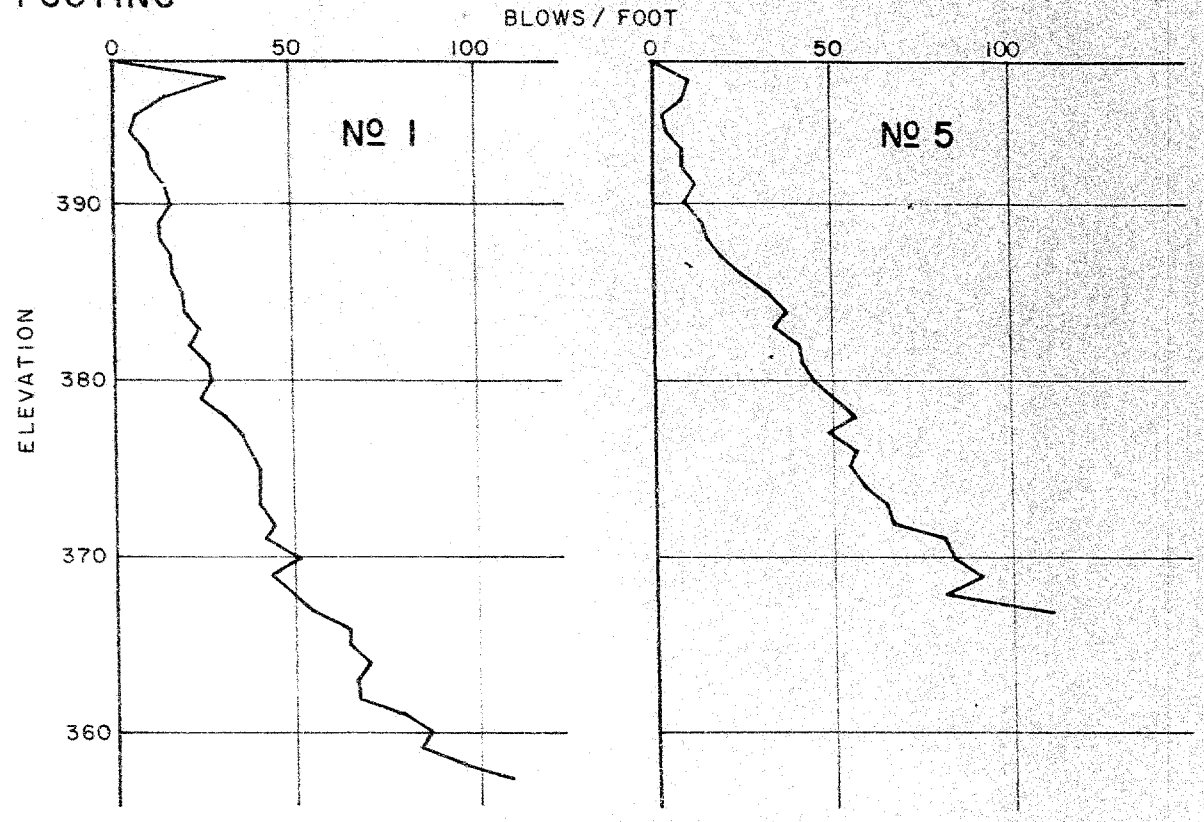
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
PLASTICITY CHART

Job No. 63-F-95 W.P. No. 113-63
Location BLACK CREEK & HWY. NO. 400

NORTH PIER FOOTING

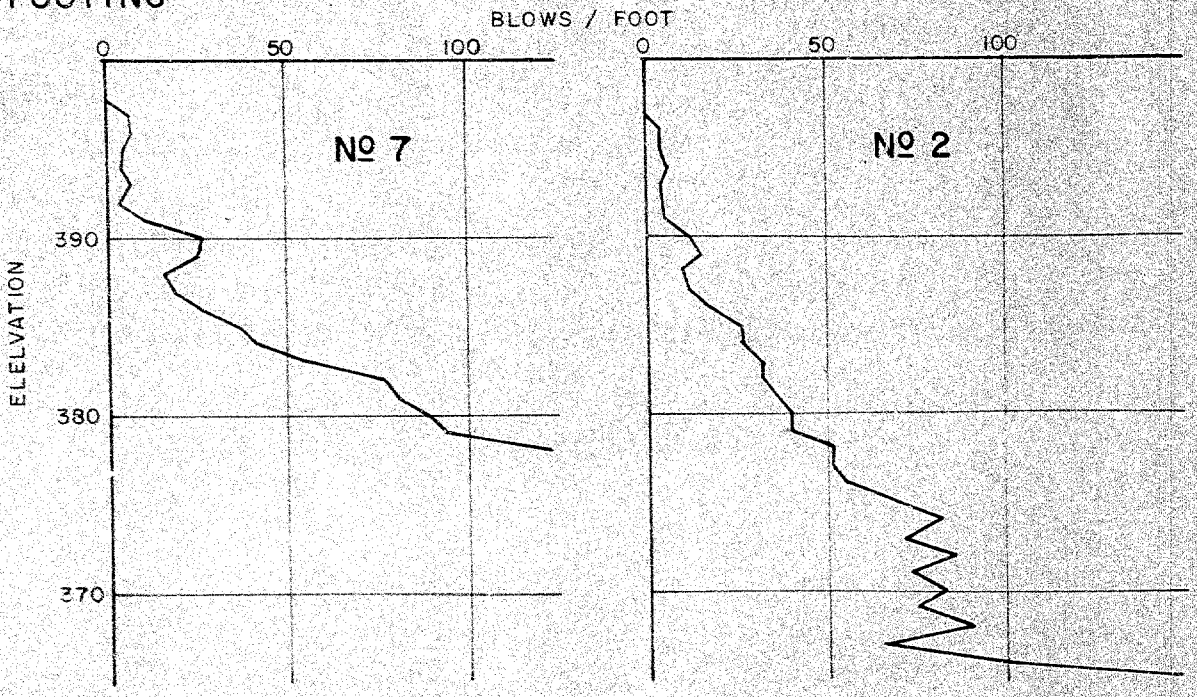


NORTH ABUTMENT FOOTING

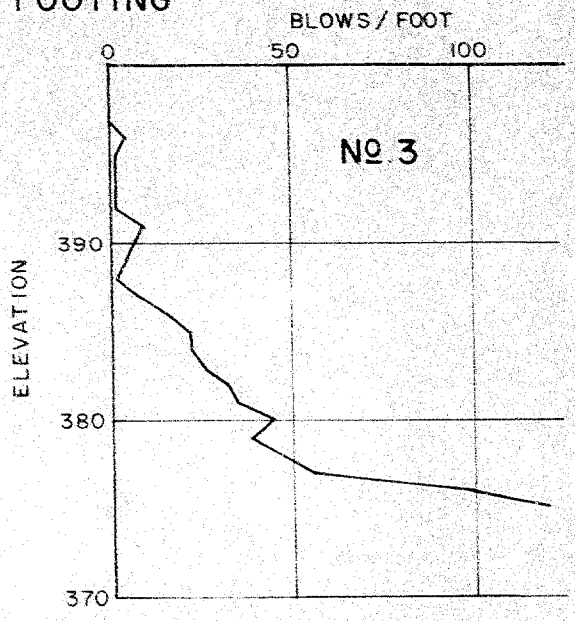


ORIGINATED	M. DEVATA	DEPARTMENT OF HIGHWAYS - ONTARIO	SCALE
DRAWN	H. D. REED	MATERIALS & RESEARCH SECTION	W. P. NO. 113-63
CHECKED		DYNAMIC CONE PENETRATION TESTS AT PROPOSED NORTH FOOTING LOCATIONS	JOB NO. 63-F-95
APPROVED			DWG. NO.
DATE	29 OCT. 1963		

SOUTH ABUTMENT FOOTING



SOUTH PIER FOOTING



ORIGINATED M. DEVATA	DEPARTMENT OF HIGHWAYS - ONTARIO	SCALE	
DRAWN H D REED	MATERIALS & RESEARCH SECTION	W. P. NO. 113-63	
CHECKED	DYNAMIC CONE PENETRATION TESTS AT PROPOSED SOUTH FOOTING LOCATIONS	JOB NO. 63-F-95	
APPROVED		DWG. NO.	
DATE 29, OCT. 1963			

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
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
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

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

Attention: Mr. S. McCombie

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

Date: February 28, 1964

Our File Ref.

In reply to

Subject:

ADDITIONAL
FOUNDATION INVESTIGATION REPORT
For
Proposed Black Creek Structure,
Hwy. #400, District #6, Toronto.
W.J. 63-F-95B-2 -- W.P. 114-63

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

We believe that you will find the factual data and recommendations contained therein, adequate for your future design work. Should further information be required in connection with this project, please feel free to contact our Office.

KYL/MeF
Attach.
cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
G. K. Hunter (2)
C. Fraser
T. J. Kovich
A. Watt

Foundations Office
Gen. Files

K. Y. Lo,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

ADDITIONAL

FOUNDATION INVESTIGATION REPORT

For

Proposed Black Creek Structure,
Hwy. #400, District #6, Toronto.
W.J. 63-F-95 -- W.P. 114-63

1. INTRODUCTION:

A foundation investigation at the site of the proposed crossing of the north-east ramp of Hwy. #400 and Black Creek was carried out in August 1963. The results of this investigation, together with our recommendations, were submitted in a report W.J. 63-F-95.

Subsequently, the Bridge Office revised the alignment at the above-mentioned location and requested this Section to carry out additional investigation. A field investigation was subsequently carried out at the revised location of the proposed structure site during December 1963 and January 1964. This report contains the results of this investigation, together with our recommendations and should be filed with our Foundation Report 63-F-95.

2. FIELD INVESTIGATION PROCEDURE:

The additional investigation consisted of 2 sampled boreholes and 7 dynamic cone penetration tests. In addition, two of the original boreholes were extended some 90 ft.

The locations and elevations of all boreholes are shown on Dwg. 63-F-95B which accompanies this report.

cont'd. /2 ...

3. SUBSOIL CONDITIONS:

Subsoil at the site consists of a stratum of very loose to compact silty sand, followed by a stratum of glacial till. On the north side of Black Creek, a stiff to very stiff stratum of silty clay to clayey silt, approximately 11 ft. thick, was found between the silty sand and the glacial till strata.

The glacial till deposit consists of a cohesive heterogeneous mixture of clay, silt, sand and some fine gravel in the upper portions, and of a non-cohesive heterogeneous mixture of sand and silt in the lower portions. It was not possible to determine a definite boundary between the cohesive and non-cohesive portions in B.H. #2, since the transition is gradual. An arbitrary boundary line was therefore chosen to most closely satisfy the soil information obtained from the transition zone. Overall, the boundary was found to vary from approximate elevation 315 on the north side to approximate elevation 290 on the south side of Black Creek.

The 'N' values, together with the results of the undrained shear strength measurements, indicate the consistency of the cohesive portion of the glacial till deposit varies from stiff to hard. The relative density of the lower portion of the glacial till stratum was found to be compact to very dense, with 'N' values ranging from 12 to 90.

Water level observations carried out during the time of investigation, showed the water to be approximately 4 ft. below ground level (approx. elevation 394). The water of Black Creek was found to be at elev. 393.

cont'd. /3 ...

4. DISCUSSION AND RECOMMENDATIONS:

It is proposed to extend Hwy. 400 to Jane St., approximately one-half mile south of Hwy. 401. An interchange is planned at the crossing of future Hwy. 400 and Jane St. This requires construction of several ramps and retaining walls as well as structures. A 3-span structure is proposed where the northeast ramp crosses the relocated Black Creek.

Subsoil at the site consists of a stratum of loose to dense silty sand, followed by a stratum of glacial till, which is stiff to hard in its upper cohesive portion and compact to very dense in its lower non-cohesive portion. On the north side of Black Creek, a stiff to very stiff stratum of silty clay to clayey silt was found between the silty sand and glacial strata.

Because of the presence of the silty sand in the upper 10 ft. over the entire site, adequate bearing capacity may not be achieved. Therefore, the following alternatives are suggested:

1) Spread footings supported on the glacial till, approximately 12 ft. below ground level.

2) Footings supported on long tubular displacement piles driven into the till stratum.

1) Spread Footings:

The structure may be supported on spread footings founded on the glacial till. It is suggested that the footings be located at or below elevation 385, in which case a safe bearing capacity of 1.5 T.S.F. may be used.

cont'd. /4 ...

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

1) Spread Footings: (cont'd.) ...

Excessive seepage of water from the side slopes of the footing excavation may be anticipated. However, this could be controlled by ordinary pumping methods. Care should be taken to prevent any possible softening of the foundation material from the surface run-off.

2) Large Tubular Displacement Piles:

The footings may be supported on large tubular displacement piles driven into the till stratum.

In view of the variable nature of the subsoil conditions, it is very difficult to predict the precise pile lengths nor the probable bearing loads for these piles. It is therefore recommended that pile loading tests should be carried out at the above-mentioned structure location in order to evaluate the probable bearing loads and the tip elevations of these piles. After the completion of the proposed pile load tests, this Section will submit the test results to the Bridge Design Section for any possible revision.

However, for preliminary design purposes, a design load of 50 tons/pile may be used for 12¾" O.D. x 1/2" steel tube piles driven to an estimated tip elevation of ± 330.

February 1964

APPENDIX I.

DEPARTMENT OF PUBLIC WORKS ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO 2

FOUNDATION SECTION

JOB 63-F-95 LOCATION 115 Rt. Sta. 159+30 ORIGINATED BY R.M.
W P 114-63 BORING DATE Sept. 3, 1963 and Jan. 6, 1964. COMPILED BY R.M.
DATUM 397.3 BOREHOLE TYPE Washboring and Cone Penetration. CHECKED BY M D

ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F	LIQUID LIMIT WL / PLASTIC LIMIT WP / WATER CONTENT W / WATER CONTENT % 10 20 30	BULK DENSITY P.C.F.	REMARKS
397.3	Groundlevel									
0	Silty sand.		1	SS	7					
			2	SS	5	390				
386.3	Loose to compact.		3	SS	11					
10.5	Het. mixture of clay, silt, sand and traces of fine gravel with occasional seams and pockets of sand and silt.		4	TW	P					
			5	SS	8					
			6	SS	10	380				
			7	SS	31					
			8	SS	32	370				
			9	SS	31					
			10	SS	51	360				Gr11% Si 47% Sa28% Cl 14%
			11	SS	47					
			12	SS	49	350				
			13	SS	28					
			14	SS	42	340				
			15	SS	31					Sa13% Si 60% Cl 27%
	GLACIAL TILL		16	SS	40	330				
			17	SS	33					
			18	SS	27	320				
317.3	Stiff to Hard.		19	SS	25					Sa40% Si45% Cl 15%
80			20	SS	21	310				
	Het. mixture of sand and silt with some fine gravel.		21	SS	36					
			22	SS	21	300				
			23	SS	23					
			24	SS	44	290				
			25	SS	21					Sa39% Si52% Cl 9%
			26	SS	-	280				
			27	SS	-					
			28	SS	13	270				
			29	SS	52					
			30	SS	45	260				
			31	SS	13					
			32	SS	26	250				Gr1% Sa53% Si33% Cl 13%
245.8	Comp. to v. dense		33	SS	40					
151.5	End of borehole.									

DEPARTMENT OF HIGHWAYS, ONTARIO
MATERIALS & RESEARCH

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 63-F-95 LOCATION 180 Rt. Sta. 158+65 ORIGINATED BY R.M.

W P 114-63 DRILLING DATE Sept. 6, 1963 and Jan. 17, 1964. COMPILED BY R.M.

DATUM 397.8 BOREHOLE TYPE Washboring and Cone Penetration. CHECKED BY M.D.

ELEV. / DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100	SHEAR STRENGTH P.S.F. ○ UNCON COMP ● TRIAXIAL COMP + FIELD VANE 500 1000 1500 2000 2500	LIQUID LIMIT WL PLASTIC LIMIT WP WATER CONTENT W	WATER CONTENT % 10 20 30	BULK DENSITY P.C.F.	REMARKS
397.8	Groundlevel											
0	Silty sand.		1	SS	5							W.L. 4.0'
390.3	Loose		2	SS	9	390						
7.5	Silty clay to clayey silt.		3	TW	P						123.9	
			4	SS	15							
380.3	Stiff to v. stiff.		5	TW	P	380					131.8	
17.5	Het. mixture of clay silt, sand and traces of fine gravel. Occasional seams and pockets of sand and silt.		6	SS	15							
			7	SS	15							
			8	TW	P						129.2	
			9	SS	17	370						Sa 96% Cl 4%
			10	SS	15							
			11	SS	14							
			12	SS	16	360						
			13	SS	31							
			14	SS	37	350						
	GLACIAL TILL		15	SS	36							
			16	SS	24	340						Gr 2% Sa 26% Si 47% Cl 25%
			17	SS	37							
			18	SS	20	330						
			19	SS	22							Sa 6% Si 50% Cl 44%
			20	SS	22	320						
			21	SS	19							
			22	SS	48	310						
			23	SS	71							Si 76% Sa 24%
			24	SS	80	300						
			25	SS	86							Sa 7% Si 57% Cl 36%
287.8	Stiff to hard.					290						
110	Het. mixture of sand and silt.		26	SS	73							
			27	SS	34	280						
			28	SS	18							
271.3	Compact to v. dense		29	SS	15	270						Gr 3% Sa 52% Si 39% Cl 6%
126.5	End of borehole.											

FORM OB-ML-56
(5-58)

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 8

FOUNDATION 62 SECTION

JOB 63-F-95 | LOCATION 80 Rt. Sta. 159+10 | ORIGINATED BY R.M.

W P 114-63 | BORING DATE Jan. 6, 1964. | COMPILED BY R.M.

DATUM 398.5 | BOREHOLE TYPE Cone Penetration. | CHECKED BY M.D.

SOIL PROFILE			SAMPLES			ELEV SCALE	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 %	BULK DENSITY γ P.C.F.	REMARKS
ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
398.5	Groundlevel									
0						390				
						380				
372.5										
26	End of borehole.					370				

DEPARTMENT OF HIGHWAYS ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 9

FOUNDATION SECTION

JOB 63-F-95 LOCATION 105 Rt. Sta. 158+70 ORIGINATED BY R.M.
W P 114-63 BORING DATE Dec. 13, 1963. COMPILED BY R.M.
DATUM 398.2 BOREHOLE TYPE Washboring and Cone Penetration CHECKED BY M.D.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE	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 % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS
398.2 0	Groundlevel									
	Silty sand.		1	SS	8	390				▽ W.L. 4.1'
			2	SS	24					Gr 2% Sa 33% Si 47% Cl 18%
			3	SS	49	380				
378.2 20	Loose to dense. Het. mixture of clay, silt, sand and traces of fine gravel with occasional seams and pockets of sand and silt.		4	SS	33					
			5	SS	26	370				Sa 2% Si 77% Cl 21%
			6	SS	24					
			7	SS	24	360				
			8	SS	28					Gr 4% Sa 19% Si 49% Cl 28%
			9	SS	18					
			10	SS	19	350				
			11	SS	31					
	GLACIAL TILL		12	SS	24	340				
			13	SS	36					Sa 36% Si 47% Cl 17%
			14	SS	38	330				
			15	SS	60					
	V. stiff to hard.		16	SS	>100	320				Sa 33% Si 49% Cl 18%
313.2 85	Het. mixture of sand and silt.		17	SS	72					Gr 3% Sa 71% Si 19% Cl 7%
			18	SS	70	310				
			19	SS	35					
			20	SS	40	300				
			21	SS	30					
			22	SS	66	290				
			23	SS	34					
			24	SS	90	280				
			25	SS	28					Sa 90% Si 8% Cl 2%
			26	SS	29	270				
			27	SS	49					
	Dense to v. dense.		28	SS	35	260				Gr 7% Sa 63% Si 19% Cl 11%
256.2 142	End of borehole.									

FORM OB-M[illegible]
E-392

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 10

FOUNDATION SECTION

JOB 63-F-95 LOCATION 140' Rt. Sta. 159+00 ORIGINATED BY R.M.

W P 114-63 BORING DATE Jan. 2, 1964. COMPILED BY R.M.

DATUM 394.8 BOREHOLE TYPE Cone Penetration. CHECKED BY M.D

SOIL PROFILE			SAMPLES				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 %	BULK DENSITY γ P.C.F.	REMARKS
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE				
394.8	Groundlevel									
0						390				
						380				
						370				
361.8										
33	End of borehole.					360				

FORM OD-ML-126
6-63P

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 11

FOUNDATION SECTION

JOB 63-F-95 LOCATION 200 Rt. Sta. 158/50 ORIGINATED BY R.M.

W.P. 114-63 BORING DATE Jan. 2, 1964. COMPILED BY R.M.

DATUM 397.5 BOREHOLE TYPE Cone Penetration. CHECKED BY M.D

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT
397.5 0	Groundlevel				
362.5 35	End of borehole.				

ELEV SCALE: 390, 380, 370, 360

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 %

BULK DENSITY
γ
P.C.F.

REMARKS

FORM GEOME 126
63 9M3

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 12

FOUNDATION SECTION

JOB 63-F-95 LOCATION 235 Rt. Sta. 158/35 ORIGINATED BY R.M.

W P 114-63 BORING DATE Jan. 2, 1964. COMPILED BY R.M.

DATUM 398.5 BOREHOLE TYPE Cone Penetration. CHECKED BY M.D.

SOIL PROFILE			SAMPLES				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 %	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE				
398.5 0	Groundlevel					390				
						380				
						370				
367.5 31	End of borehole.									

FORM 06 ML 126
63-384

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 13

FOUNDATION SECTION

JOB 63-F-95 LOCATION 185 Rt. Sta. 158/15 ORIGINATED BY R.M.

W P 114-63 BORING DATE Jan. 2, 1964. COMPILED BY R.M.

DATUM 397.3 BOREHOLE TYPE Cone Penetration. CHECKED BY M.D

SOIL PROFILE			SAMPLES				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 %	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE				
397.3 0	Groundlevel					390				
						380				
						370				
362.3 35	End of borehole.					360				

DEPARTMENT OF HIGHWAYS, ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 14

FOUNDATION SECTION

JOB 63-F-95 | LOCATION 230' Rt. Sta. 158+00 | ORIGINATED BY R.M.
H.P. 444-63 | BORING DATE Jan. 7, 1964. | COMPILED BY R.M.
DATUM 398.0 | BOREHOLE TYPE Washboring and Cone Penetration. | CHECKED BY M.D.

ELEV. / DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
398.0	Groundlevel					
0	Silty sand.		1	SS	8	
387.5	Loose		2	SS	11	390
10.5	Clayey silt.		3	SS	13	
378.0	Stiff		4	SS	18	380
20	Het. mixture of clay, silt, sand traces of fine gravel with occasional seams and pockets of sand and silt.		5	SS	17	
			6	SS	31	370
			7	SS	24	
			8	SS	21	360
			9	SS	23	
			10	SS	28	350
			11	SS	20	
	GLACIAL TILL		12	SS	21	340
			13	SS	22	
			14	SS	23	330
			15	SS	23	
			16	SS	36	320
			17	SS	34	
			18	SS	54	310
			19	SS	52	
			20	SS	63	300
			21	SS	49	
290.0	Stiff to Hard.					290
100	Het. mixture of sand and silt.		22	SS	76	
			23	SS	51	280
			24	SS	32	
			25	SS	23	270
			26	SS	23	
261.5	Compact to v. dense.		27	SS	12	
136.5	End of borehole.					

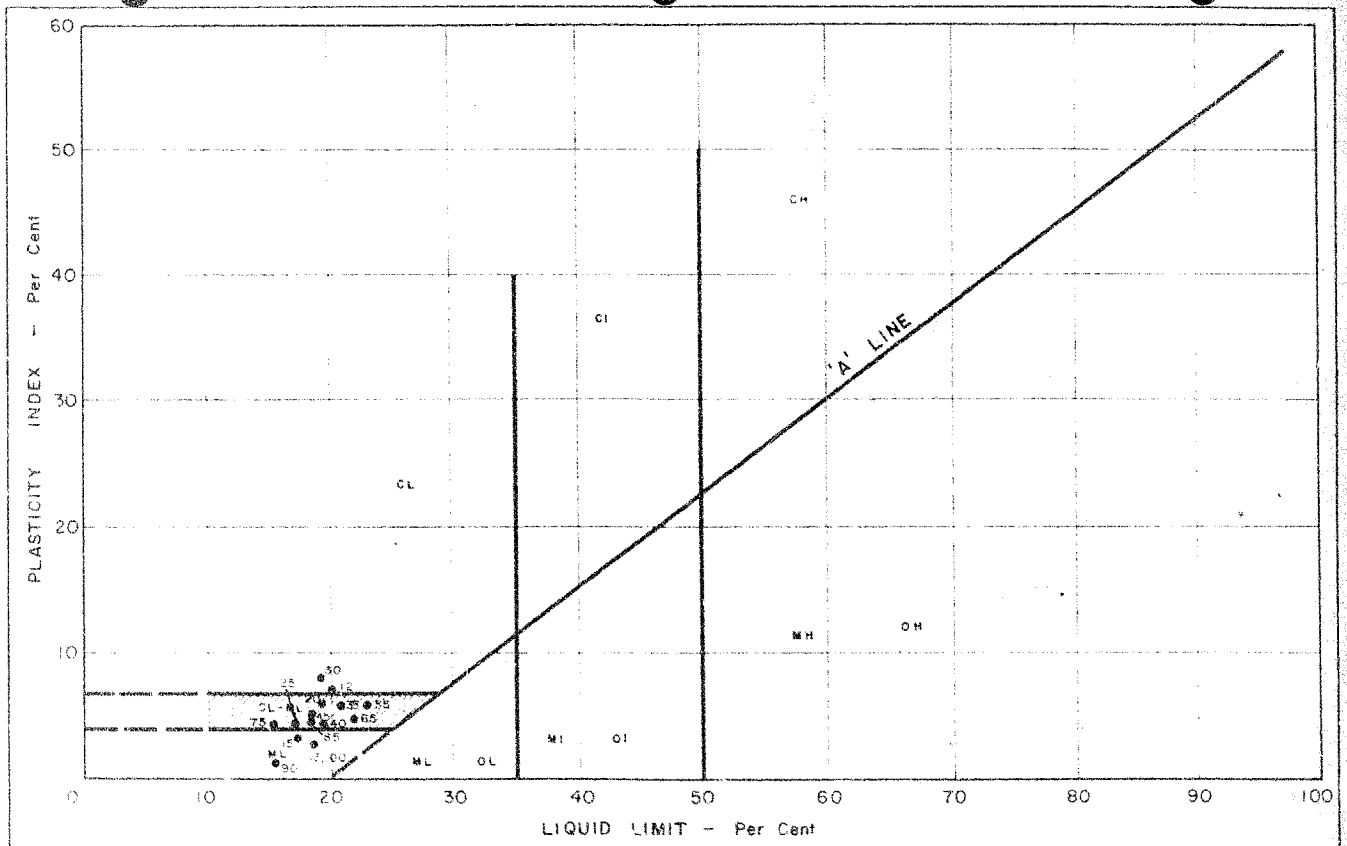
DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P.S.F.
+ Vane Test
500 1000 1500 2000 2500

LIQUID LIMIT —— W_L
PLASTIC LIMIT —— W_P
WATER CONTENT —— W
W_P × W_L
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS
W.L. 3.8'
Gr 5% Sa 16% Si 56% Cl 23%
Gr 5% Sa 31% Si 47% Cl 17%
Sa 29% Si 49% Cl 22%
Sa 5% Si 70% Cl 25%
Sa 8% Si 75% Cl 17%
Gr 2% Sa 28% Si 52% Cl 21%
Gr 43 Sa 16% Si 59% Cl 21%
Gr 1% Sa 46% Si 40% Cl 13%

FORM 08 - ML 252 (REV. MARCH 62)



NOTES

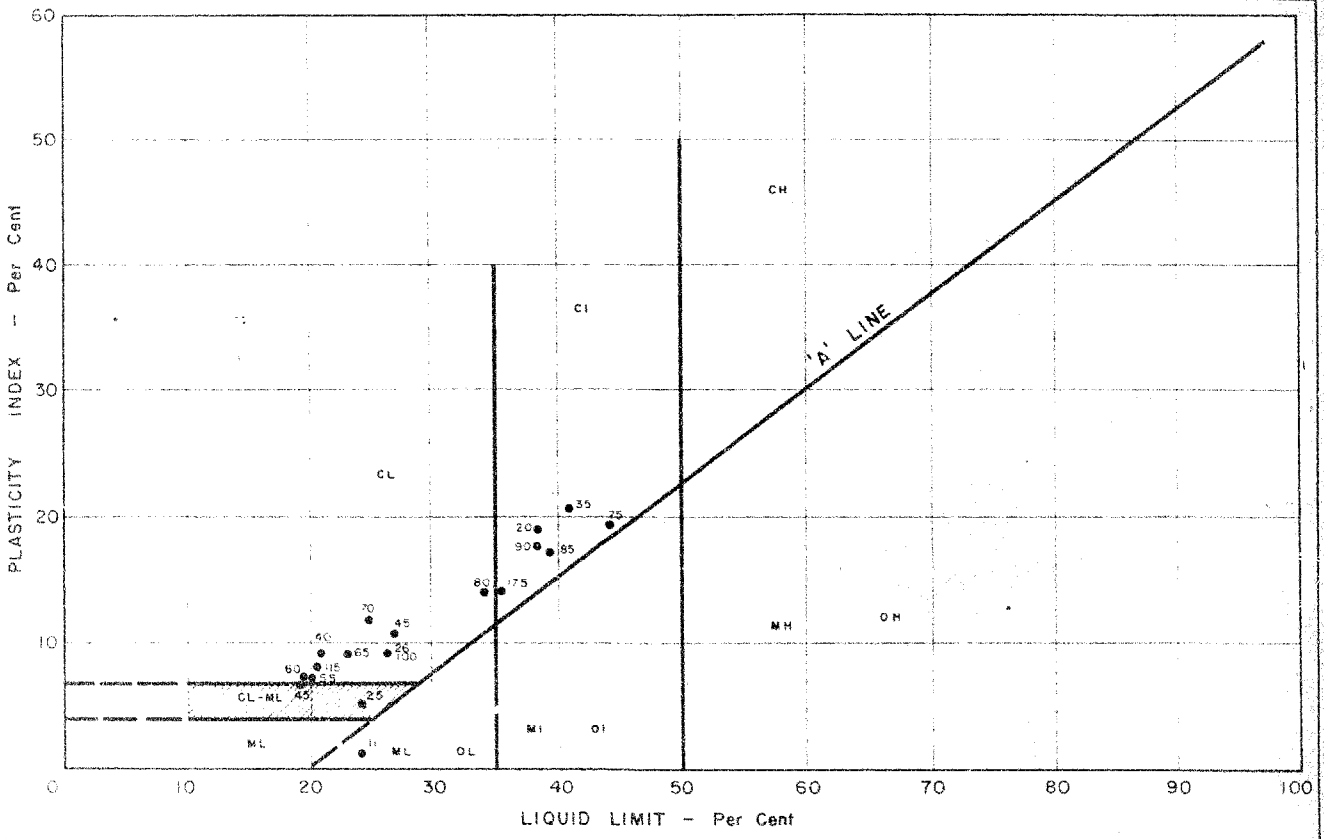
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

PLASTICITY CHART

Job No. 63-F-95 W.P. No. 114-63

Location BH No. 2

FORM 08-ML-252 (REV MARCH 62)

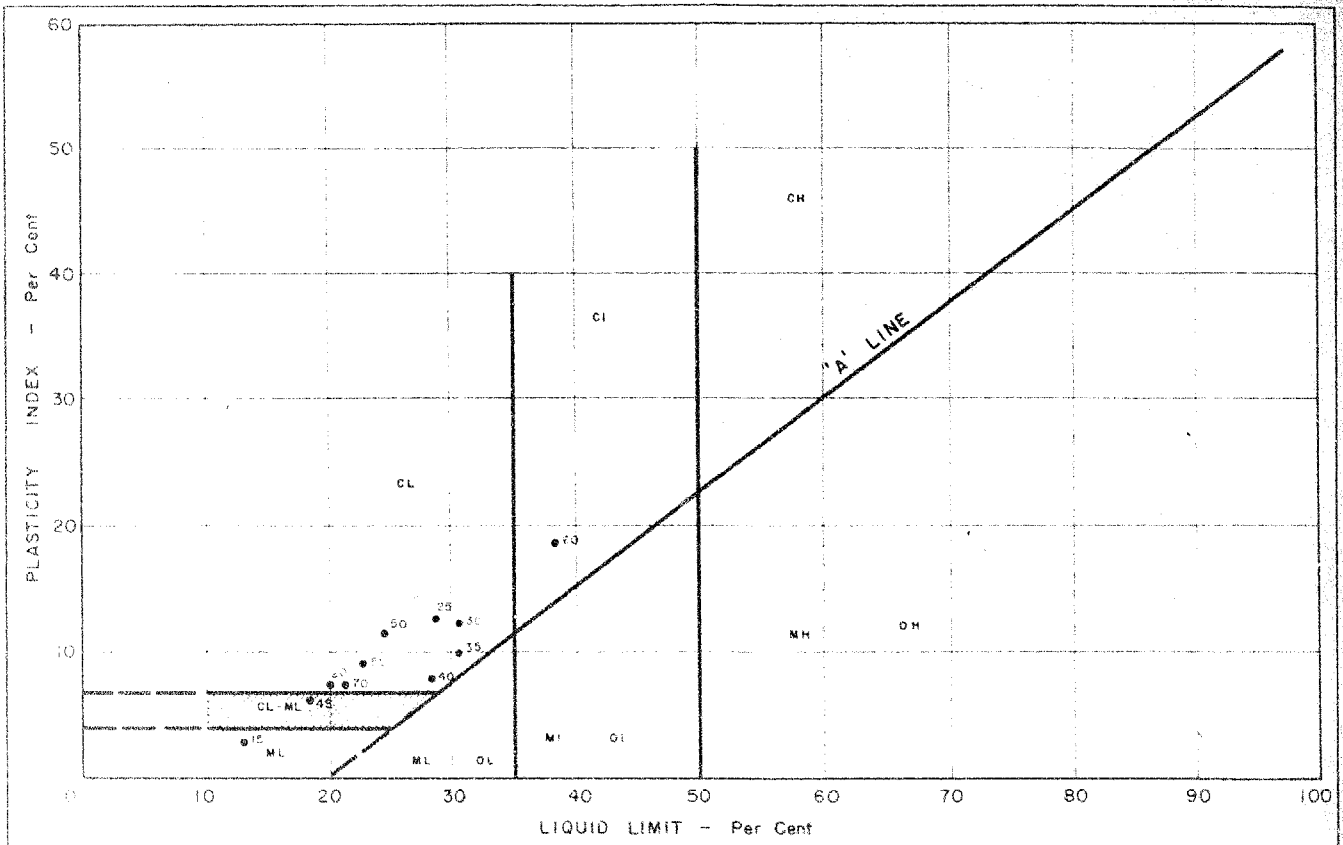


NOTES

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
PLASTICITY CHART

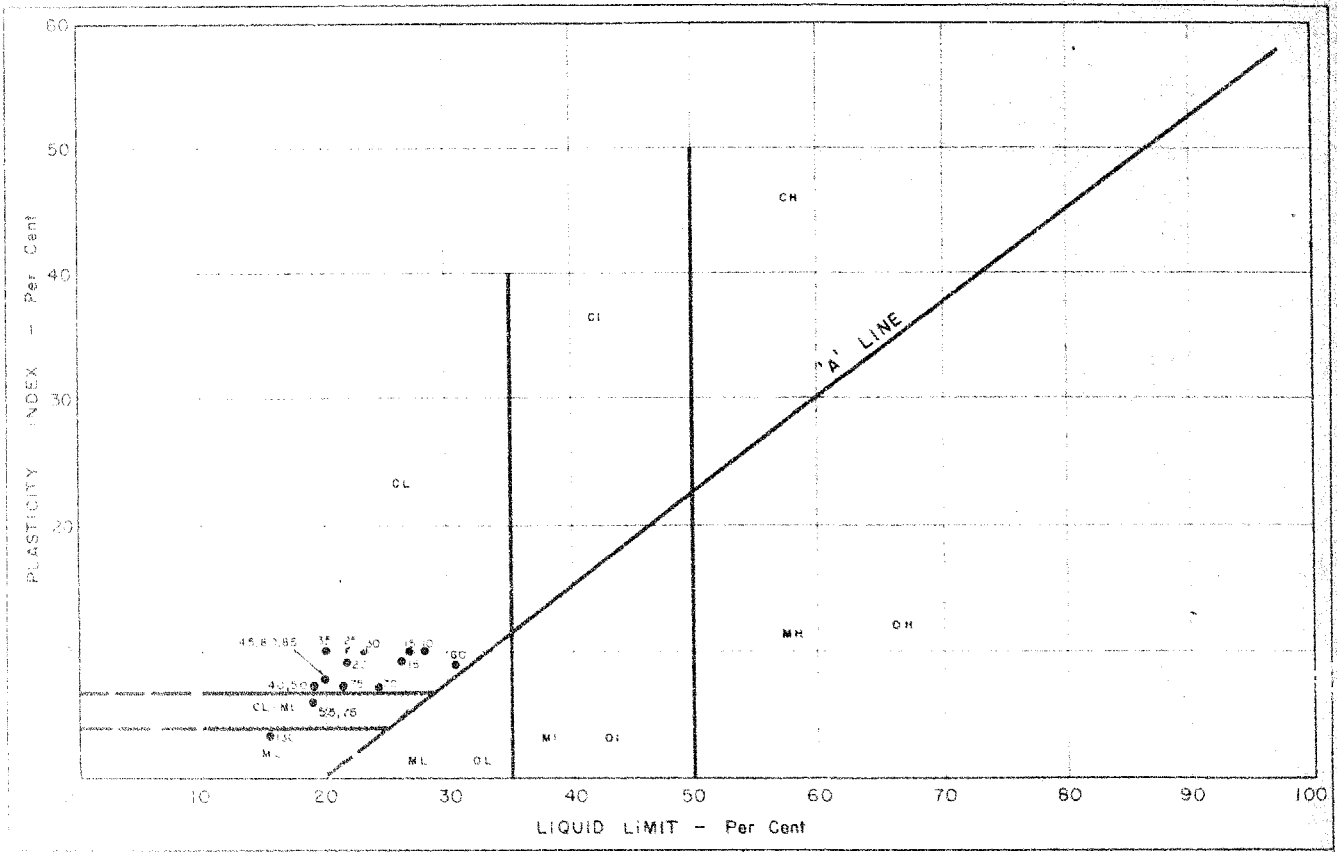
Job No. 63-F-95 W.P. No. 114-63
Location BH. No. 4

FORM OB - ML 252 (REV. MARCH 62)



NOTES

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
PLASTICITY CHART
Job No. 63 - F - 95 W.P. No. 114 - 63
Location SH. № 9



DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
PLASTICITY CHART

Job No. 63-F-95 W.P. No. 114-63

Location BH. Nº 14

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 20 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
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
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
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF σ 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

Mr. B. R. Davis,
Bridge Design Engineer,
Bridge Division.

Attention: Mr. J. L. Keen

Foundation Section,
Materials & Research Div.,
Room 107, Lab. Bldg.

May 20, 1964

Your memo - May 13/64

Black Creek Bridge on Ramp from Jane Street
South to W. B. Hwy. #400,
W.P. 114-63, District #6, Toronto.

From Drawing D-5400-3 it appears that the shortest distance between the sewer and the battered piles will be in the order of 25 feet.

It is our opinion that because of this distance, no damage should be caused to the sewer by pile driving. Should this distance change due to some future requirement, we feel that the whole matter should be re-examined.

A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

AGS/MdeF

cc: Foundations Office
Gen. Files

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: A. Stermac, P. Eng., Principal Foundation Engineer, Room 107, Lab. Bldg., Downsview, Ontario.

From: Bridge Division, Downsview, Ontario.

Date: May 13, 1964.

Att.: M. Devata, P. Eng.

Our File Ref.

In reply to

Subject: Black Creek Bridge on Ramp from Jane Street South to W. B. Hwy. #400
W.P. 114-63 District #6

Enclosed herewith is a print of Drg. D 5400-3 indicating approximate location of the existing 54" I.D. Sanitary Sewer in relation to the proposed piles.

Would you please investigate the possibility of the sewer being damaged due to ground heave during pile driving, and let us know what precautions (if any) should be taken to avoid the damage.

K. G. Bassi, P. Eng.,
Bridge Project Engineer,
for J. L. Keen, P. Eng.,
Sr. Bridge Project Engineer.

KGB:go
c.c. J. B. Curtis
M. Stoyanoff

#63-F-95 A & B

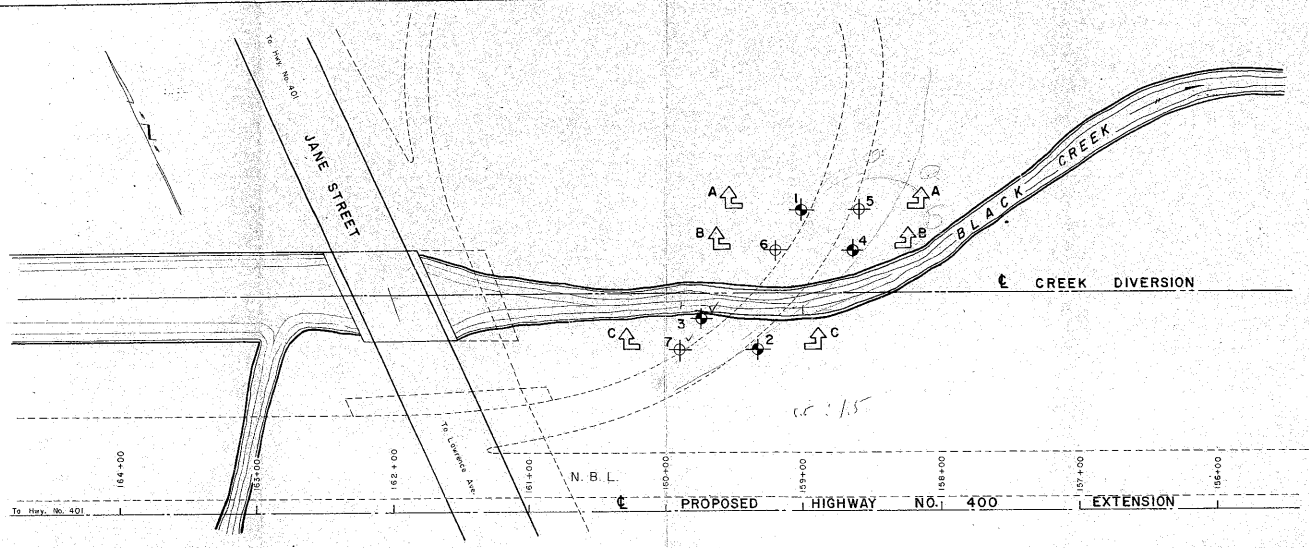
W.P.# 113-63

W.P.# 114-63

Hwy. # 400 &

BLACK CREEK

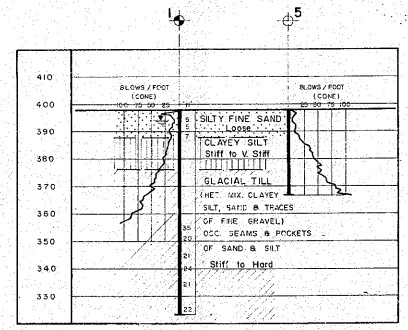
STRUCTURE



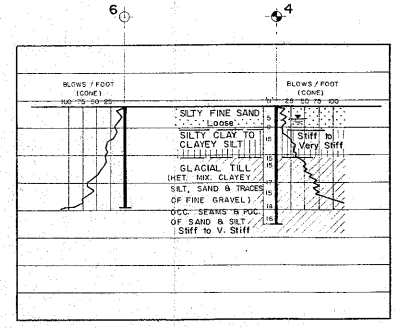
PLAN

SCALE

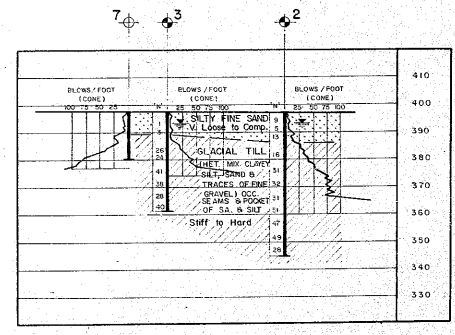
40 20 10 0 40 80 120 FT.



A-A



B-B

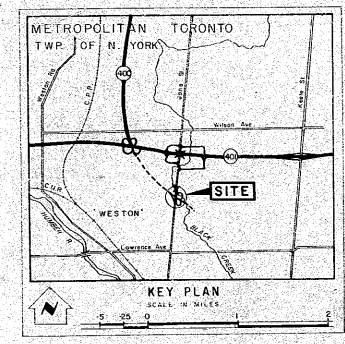


C-C

SECTIONS

SCALE

20 10 0 20 40 60 FT.



LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. AUG. 28, 1963

NO.	ELEVATION	STATION	OFFSET
1	397.8	159+00	220' RT.
2	397.3	159+30	115' RT.
3	397.4	159+70	145' RT.
4	397.8	158+65	180' RT.
5	398.0	158+60	220' RT.
6	397.7	159+20	190' RT.
7	398.2	159+90	120' 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 & RESEARCH DIVISION - FOUNDATION SECTION

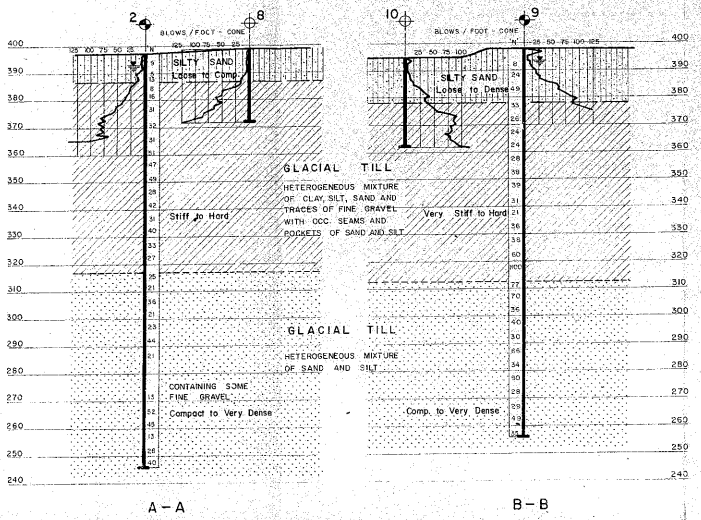
BLACK CREEK

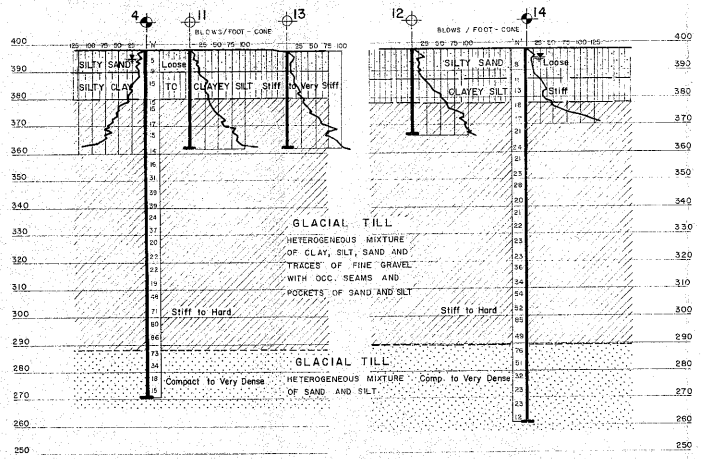
KING'S HIGHWAY NO. 400 (PROPOSED LEG.) DIST. NO. 6
CO. METROPOLITAN TORONTO
TWP. NORTH YORK LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

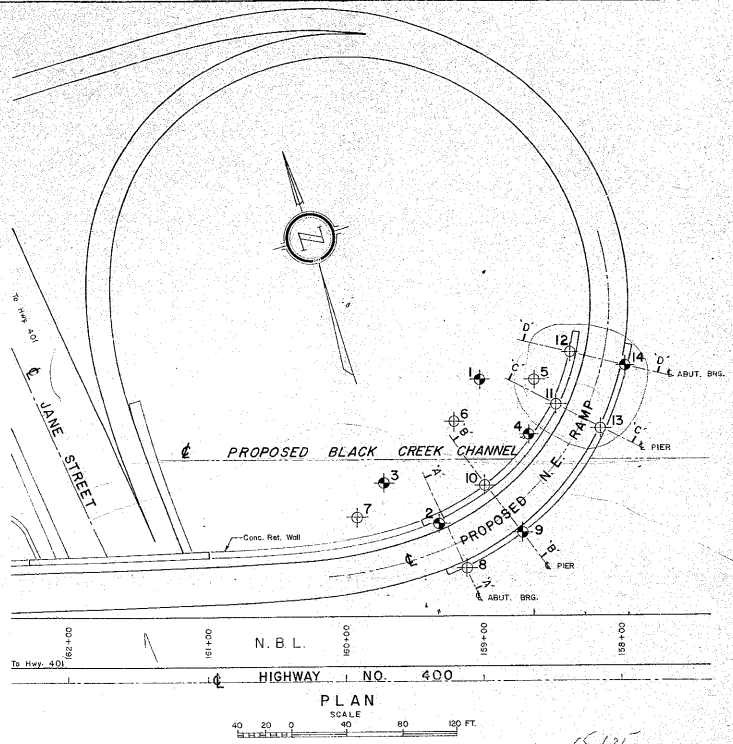
SUBM'D. R.M.	CHECKED	W.P. NO. 11-63	M.B.R. DRAWING NO.
DRAWN JC	CHECKED	JOB NO. 63-F-95	63-F-95A
DATE OCT. 1, 1963		SITE NO.	BRIDGE DRAWING NO.
APPROVED		CONT. NO.	

620350 E
4860700 N 17 30M 12E

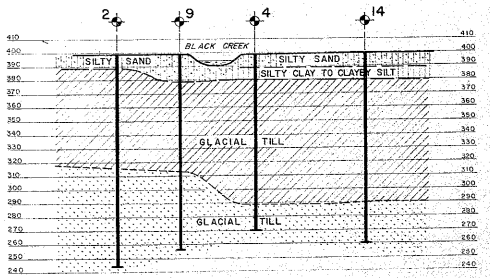




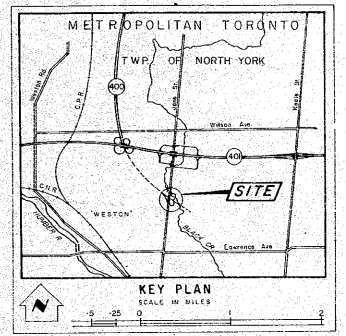
SECTIONS
SCALE
20 10 0 20 40 60 FT.



PLAN
SCALE
40 20 0 40 80 120 FT.



℄ PROFILE - (RAMP)
SCALE
40 20 0 40 80 120 FT.



KEY PLAN
SCALE IN MILES
·5 ·25 0 1 2

LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. (AUG./63 TO JAN./64)

NO.	ELEVATION	STATION	OFFSET
1	397.5	159+00	220'RT.
2	397.3	159+30	115'RT.
3	397.4	159+70	145'RT.
4	397.8	158+65	180'RT.
5	398.0	158+60	220'RT.
6	397.7	159+20	190'RT.
7	398.2	159+90	120'RT.
8	398.5	159+10	80'RT.
9	398.2	158+70	105'RT.
10	394.8	159+00	140'RT.
11	397.5	158+50	200'RT.
12	398.5	158+35	235'RT.
13	397.3	158+15	185'RT.
14	398.0	158+00	230'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.

65/84

PRINT RECORD		
NO.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

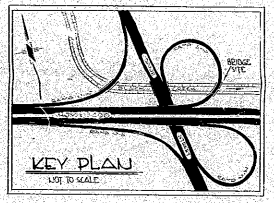
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION - FOUNDATION SECTION

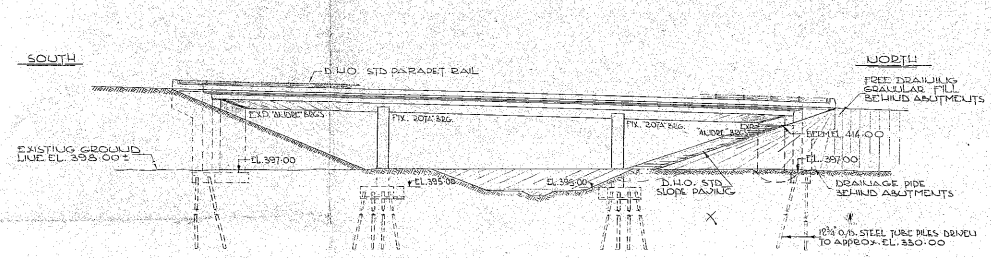
BLACK CREEK

KING'S HIGHWAY NO. 400 PROP. N.E. RAMP DIST NO. 6
CO. YORK METROPOLITAN TORONTO
TWP. NORTH YORK LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

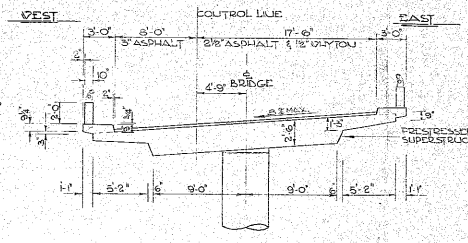
SUBM'D R.N.	CHECKED	W.P. NO. 114-63	M.S.R. DRAWING NO. 63-F-95B
DRAWN JC	CHECKED JP	JOB NO. 63-F-95	
DATE MARCH 3, 1964		SITE NO.	BRIDGE DRAWING NO.





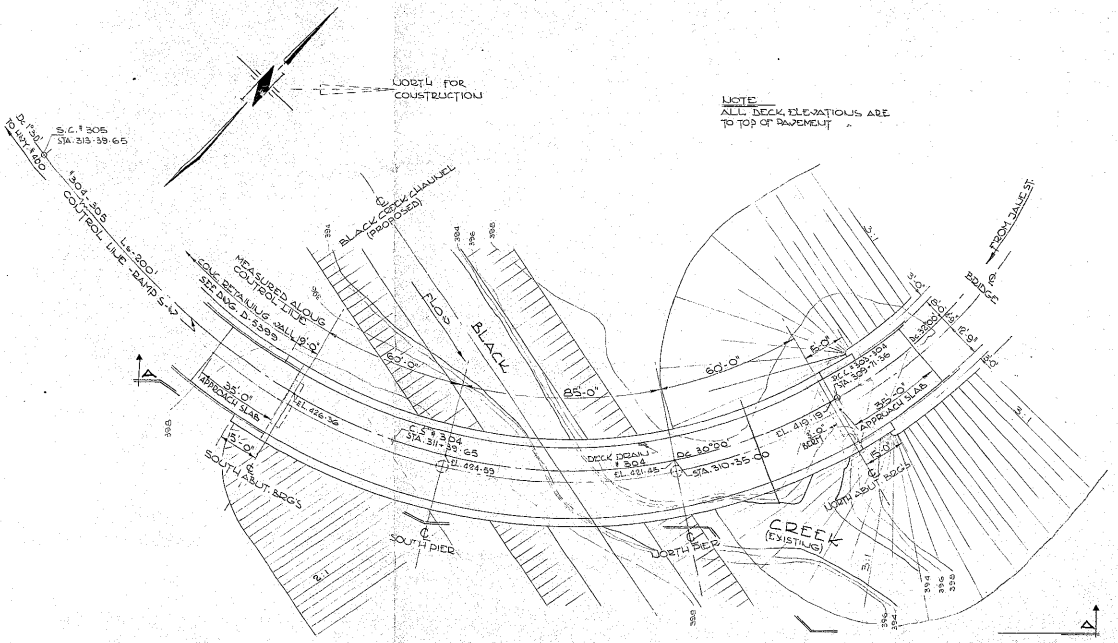
ELEVATION A-A

SCALE: 1"=20'-0"



TYPICAL DECK SECTION

SCALE: 3/16"=1'-0"

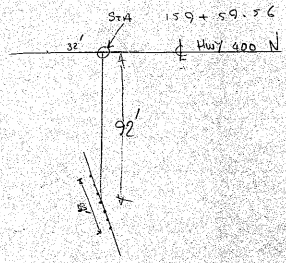


PLAN

SCALE: 1"=20'-0"

Piles at 312+00

311+39.65
62.5
310+77.15



PRINT RECORD

No.	FOR	DATE

REVISIONS

DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

BLACK CREEK BRIDGE

OU RAMP FROM JANE ST. SOUTH TO WESTBOUND HWY. 400

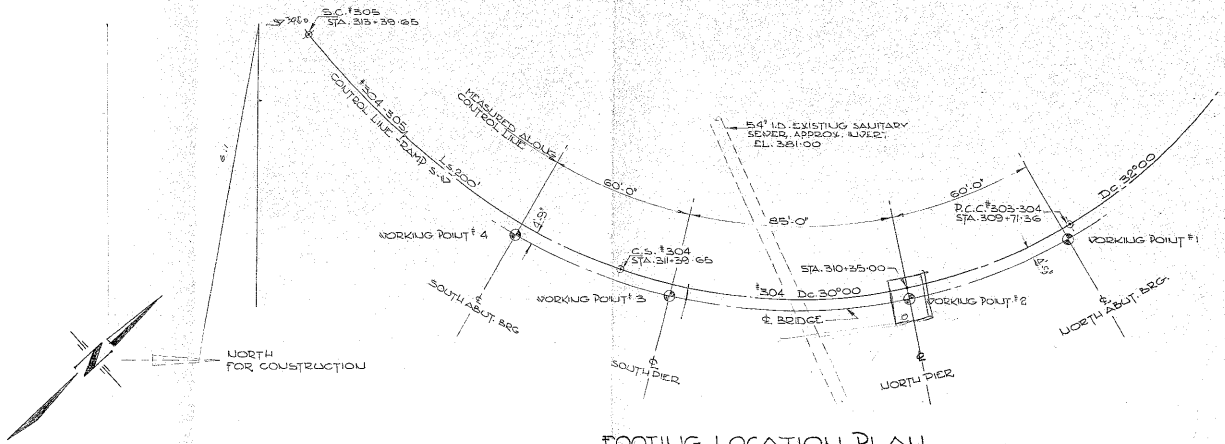
KING'S HIGHWAY No. 400 DIST. No. 6

CO. OF YORK

TWP. NORTH YORK LOT CON.

PRELIMINARY PLAN

APPROVED BRIDGE ENGINEER		SITE No. 38-344	W.P. No. 114-63
		CONTRACT Nos.	
DESIGN K.G.E.	CHECK		
DRAWING C.A.	CHECK	DRAWING No.	D-5400-P2
DATE APRIL/64	LOADING H20 S16		



FOOTING LOCATION PLAN

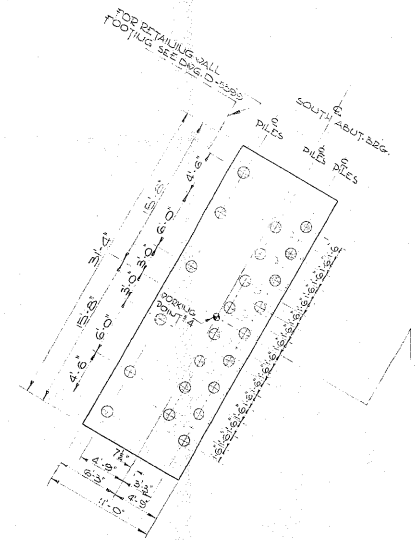
SCALE: 1" = 20'-0"

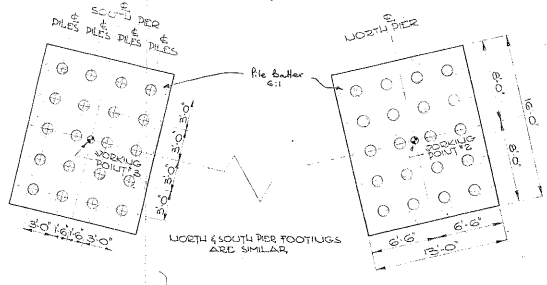
NOTES

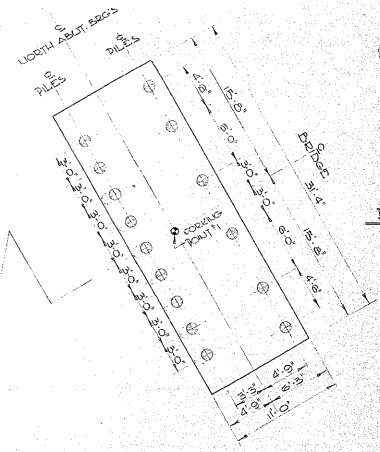
1. DESIGN LOAD PER PILE = 50 TONS
2. STEEL TUBE PILES TO BE FILLED WITH 3000 P.S.I. CONCRETE

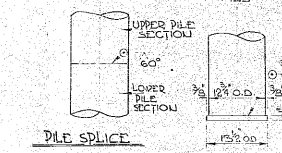
PILES SUPPLIED

LOCATION	U/S	LENGTH	TYPE
SOUTH ABUT.	23	66'-00"	12 3/4" O.D. x 0.25" THICK STEEL TUBE PILES
" PIER	20	63'-00"	
NORTH PIER	20	63'-00"	
" ABUT.	15	66'-00"	









PILE SPLICE

PILE SHOE

FOR PILE BATTERS SEE DWGS D-5400-4 TO 6

SPACING OF PILES IS MEASURED AT UNDERSIDE OF FOOTING.

FOUNDATION & PILE LAYOUT

SCALE: 3/16" = 1'-0"

LONGITUDINAL SPACING NOT TO SCALE

SCALE: 1" = 1'-0"

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

BLACK CREEK BRIDGE
ON RAMP FROM JANE ST. SOUTH TO WESTBOUND HWY 400

KING'S HIGHWAY No. 400 DIST. No. 6
CO. YORK
TWP. NORTH YORK LOT. CON.

FOUNDATION & PILE LAYOUT

APPROVED BRIDGE ENGINEER		SITE No. 38-344	W.P. No. 114-63
DESIGN K.G.B.	CHECK	CONTRACT No.	
DRAWING E.A.I.	CHECK	DRAWING No.	D-5400-3
DATE	LOADING H20-S16		

PRINT RF.		CORD
No.	FOR	DATE