ONTARIO

DEPARTMENT OF HIGHWAYS

Memo to Mr. A. M. Toye, Bridge Engineer.

Date February 26, 1959.

Subject Foundation Investigation.

From Materials & Research Section.

Attention: Mr. S. McCombie.

Re: Proposed Overpass, Hwy. 401,
3 miles west of Shedden,
Lot 10, (Conc.III), Southwold Twp.,
W.P. 19-59.

Submitted herewith is our report on the subsoil conditions existing at the above noted structure location.

Reference to the contents of this report show that:-

(1) A surface layer of sand varying in thickness from one foot to 9.5 feet was found to overlie a deep deposit of hard clayey till.

(2) Due to the variable thickness of the upper sand layer, it is recommended that all footings be carried down to elevation 745.0 At this elevation, footings will be founded upon the hard clay layer and a bearing capacity of 3.5 T/sq.ft. can be used in footing design. Settlements consequent upon the application of this footing pressure to the clay stratum will be well within tolerable limits.

(3) A perched water table condition was observed in the upper sand stratum. This is believed to be seasonal but will necessitate shoring and pumping if encountered.

(4) Embankment instability will not be a problem for the proposed grade line.

If we can be of assistance in clarifying or substantiating data presented in this report, please contact us.

LGS/MdeF
Attach.
cc: Messrs. A. M. Toye
H. A. Tregaskes
D. G. Ramsay
W. L. Fraser
A. Watt
Dr. P. Karrow

Foundation Section File

A. Rutka,
ACTING MAT'LS. & RESEARCH ENGR.
per:

L. G. Soderman

(L. G. Soderman,
PRINCIPAL SOILS & FOUNDATION ENGR

FOUNDATION REPORT

on

Proposed Overpass Bridge at Hwy. 401
Line 'A' and C.N.R. Crossing about
3 miles North-west of Shedden, Lot 10,
(Conc. III), Twp. of Southwold.

Plan No. F-3530-1

Station: 322+91

Distribution:

Mr. A. Toye,
Bridge Engineer (2)

Mr. H. Tregaskes,
Construction Engineer (1)

Mr. D. G. Ramsay,
Design Engineer (1)

Mr. W. L. Fraser,
District Engineer,
London. (1)

Mr. A. Watt,
Water Resources Commission (1)

Dr. P. Karrow,
Department of Mines. (1)

Foundation Section (1)

File (1)

W.P. 19-59

W.J. F-58-40

I. INTRODUCTION:

Reported herein are the results of a sub-surface exploration completed at the above noted site. This report contains the detailed results of field and laboratory findings and recommendations for the foundations of the proposed bridge.

The location of the site is where the proposed Hwy. 401 line 'A' overpasses the C.N.R., some 3 miles north-west of Shedden, Conc. III, lot 10 (station 322+91, profile no. F-3530-2), Twp. of Southwold.

The work started on Oct. 28, 1958 and was completed on Nov. 6, 1958.

II. DESCRIPTION OF SITE AND GEOLOGY:

The site under consideration is located in a physiographical area referred to as St. Thomas till moraine. From an inspection of the site and available geological information, it is known that the site is covered with brown sand overlying hard till moraine. The till moraine formation in this area is attributed to the movements of late Wisconsin glacier.

III. FIELD AND LABORATORY WORK:

The field investigations at this site were carried out during the period of October 28 to November 6, 1958. During this investigation, four boreholes with adjacent dynamic cone penetration tests were driven at locations shown on drawing no. F-58-40 A.

The borings were carried out by means of a standard diamond drill adapted for soil sampling. The boreholes were advanced by alternately driving and washing 3 inch BX casing. Boreholes No. 1 and 2 were placed on the western side and No. 3 and 4 on the eastern side of the C.N.R. track. The holes were carried to a depth sufficier

to determine all strata horizons and to obtain sufficient samples of each stratum.

In non-cohesive type soils a 2 inch O.D. split spoon sampler was used, and standard penetration resistance (number of blows required to drive the spoon sampler one foot) was registered. In cohesive material, sampling was carried out by means of thin walled Shelby tube samplers.

The investigations at the site revealed the following stratigraphy:-

Brown Medium Sand:

Underneath the top soil in boreholes No. 1, 3 and 4, a layer of fine brown sand was encountered. The depth of this layer was 9.5, 1.5 and 7 ft. respectively, in holes No. 1, 3 and 4. The standard penetration test results indicate that the material is firm (N = 28). The brown fine sand is generally clean and contains a small percentage of gravel.

Grey Silty Clay Till:

Underlying the fine sand a layer of grey silty clay till was intersected in each borehole. The boreholes terminated in this layer.

The material is described as stiff to very hard. The laboratory shear value measurements indicated average shear strength of 3000 p.s.f. in boreholes No. 3 and 4, and 6000 p.s.f. in boreholes No. 1 and 2.

The moisture content in the layer was fairly uniform and gave an average value of 20%. The bulk density of the material was measured to be 130 to 140 p.c.f.

Atterberg limit tests gave average liquid limit 32% and plastic limit 16%. The exact values of all test results are summarized in Table No. 1.

IV. SUBSOIL WATER:

During the boring no definite ground water table was recorded. Subsequent observations showed a perched water table condition in the upper sand stratum. This condition is probably seasonal and seepage into the footing excavation can be expected.

V. FOUNDATION CONSIDERATIONS:

The top sand layer was intersected in holes 1 and 3 to a depth of 10 - 8 ft. below the ground level. In borehole No. 2 the upper sand layer was found to be only 1.5 ft. thick; in hole No. 4 the sand layer was not evidenced. Field observations indicate that the sand layer is saturated.

The underlying hard grey silty clay till layer is considered ideal for the direct support of simple spread footings. In cohesive materials the bearing capacity assessment is calculated from Meyerhof's formula - i.e. -

$$Q = \frac{C\ N_c}{F_s} + P_o$$

Q = allowable bearing value.
C = average apparent cohesion of the layer.
N_c = bearing capacity factor.
F_s = factor of safety.
P_o = existing total overburden pressure at footing elevation.

Assuming a typical footing width of 7 feet placed at elevation 745.0 substitution in the above bearing capacity using

C = 3000, N = 7, and a safety factor of 3 gives an allowable safe bearing pressure of 3.5 tons/sq.ft.

Settlements resulting from the application of a footing pressure intensity of 3.5 T/sq.ft. will be well within tolerable limits.

VI. CONCLUSIONS AND RECOMMENDATIONS:

From the above discussion it will follow that:-

1. At the site the terrain is basically grey silty clay till overlain by fine brown sand intersected mainly in boreholes No. 1 and 3.

2. The silty clay till layer can provide a safe bearing value of 3.5 t.s.f. for supporting spread footing type foundations.

3. It will be convenient to suppert the proposed structure on spread footing type foundations placed at elevation about 745 ft. where a safe bearing value of 3.5 t.s.f. with a safety factor of 3 can be provided by the layer.

4. A perched water table condition was noted in the upper layer of sand. It is believed that this condition is seasonal; however, provision should be made for excavation shoring and low capacity sump pump operation during placing of the footings.

5. The approach fills to the new structure do not present a stability problem.

V. KORIU.
FOUNDATION ENGINEER.

APPENDIX I.

FORM OB-ML-22E
FEB 56

SUMMARY OF FIELD & LABORATORY TESTS

JOB F-58-40
W.P. 19-59

HOLE NO.	SAMP. NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
1	S1	5 - 6.5	Brown medium sand	29	15.2	-	-	-	-	
1	T2	10 - 11.8	Grey silty clay	34 for 9"	18.9	18.7	34.1	5750	128.5	
1	S3	15 - 16.5	" " " - (Till)	25	21.7	17.0	33.2	5100	138.0	
1	S4	20 - 21.5	" " " "	47	16.8	10.9	19.3	6700	141.5	
1	S5	25 - 26.5	" " " "	62	17.8	24.2	34.0	7000	135.5	
1	S6	30 - 31.5	" " " "	52	12.2	10.8	20.3	5850	139.0	
1	S7	34 - 35.5	" " " "	35	21.8	17.0	34.4	5500	137.3	
2	T1	5 - 6.7	Brownish grey silty clay	27 for 8"	18.2	18.8	38.3	6000	134.3	
2	T2	10 - 12	" " " "	40	20.7	19.6	38.0	5400	130.8	
2	S3	15 - 16.5	Grey silty clay - (Till)	24	22.5	15.5	32.8	4300	131.5	
2	S4	20 - 21.5	" " " "	25	21.9	14.2	34.5	5700	141.3	
2	S5	25 - 26.5	" " " "	24	18.9	15.4	32.2	5850	139.7	
2	S6	30 - 31.5	" " " "	24	19.1	16.2	34.4	4250	140.0	
2	S7	34 - 35.5	" " " "	24	21.7	18.7	31.6	4650	141.3	
3	T1	5 - 7	Brown clayey sand	27	37.2	-	-	-	-	
3	S2	10 - 11.5	Grey silty clay	41	18.9	17.1	30.7	5600	138.0	
3	S3	15 - 16.5	" " " (Till)	52	19.1	17.8	32.4	7000	135.5	
3	S4	20 - 21.5	" " " "	25	7.8	17.3	35.1	1850	139.0	
3	S5	25 - 26.5	" " " "	20	20.8	14.2	29.9	1850	137.0	
3	S6	30 - 31.5	" " " "	14	19.3	11.1	21.8	2600	137.0	
3	S7	34 - 35	" " " "	10	25.6	-	-	1650	137.0	

cont'd. page 2 ...

SUMMARY OF FIELD & LABORATORY TESTS

JOB F-58-40
W.P. 19-59

HOLE NO.	SAMP. NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
4	T1	5 - 7	Silty grey clay	62	17.9	14.6	33.5	6000	134.8	
4	S2	10 - 11.5	" " "	50	20.2	16.8	33.2	4750	136.5	
4	S3	15 - 16.5	" " " - (Till)	29	21.9	13.5	32.9	3300	130.0	
4	S4	20 - 21.5	" " " "	20	23.4	16.5	34.7	2150	131.3	
4	S5	25 - 26.5	" " " "	20	-	-	-	-	-	
4	S6	30 - 31.5	" " " "	20	24.4	15.5	32.9	1750	130.0	

T1 - Denotes thin walled shelby sample.

S1 - Denotes split spoon sample.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & RESEARCH BRANCH - FOUNDATIONS SECTION - DOWNSVIEW

OFFICE REPORT ON SOIL EXPLORATION

DRILL RIG 54-5 OPERATION BORE&PENET'N JOB F-58-40 W.P. 19-59 BORING 1 STA. 323+41 (36' LT)

CASING BX&AX (standard samplers to fit unless noted) DATUM GEODETIC DATE REPORT JAN. 1959

SAMPLER HAMMER WT. 250 LBS. DROP 19 INCHES COMPILED BY H.S. CHECKED BY A.L. DATE BORING 30 OCT. 1958.

ABBREVIATIONS

V - INSITU VANE SHEAR TEST
M - MECHANICAL ANALYSIS
U - UNCONFINED COMPRESSION
Q_C - TRIAXIAL CONSOLIDATED QUICK
Q - TRIAXIAL QUICK
S - TRIAXIAL SLOW
WL - WATER LEVEL IN CASING
WT - WATER TABLE IN SOIL
K - PERMIABILITY
C - CONSOLIDATION
CA - CASING
γ - UNIT WEIGHT

SAMPLE TYPES

CS - CHUNK
DO - DRIVE OPEN
DF - DRIVE FOOT VALVE
TO - THIN WALLED OPEN
SS - SLEEVE SAMPLE
PS - PISTON SAMPLE
WS - WASHED SAMPLE
RC - ROCK CORE

SAMPLE CONDITION

- DISTURBED
- FAIR
- GOOD
- LOST

SOIL PROFILE

ELEVATION DEPTH | WATER CONDITIONS | DESCRIPTION | STRAT PLOT | ELEVATION SCALE

SHEAR STRENGTH LBS. PER S.Q. FT. * 2000 4000 6000 8000

WATER CONTENT W % 10 20 30 40 O - NAT. □ - PW Δ - LW

PENETRATION TEST RESISTANCE BLOWS PER FOOT AT STANDARD ENERGY (4200 IN. LBS. PER BLOW)

D. CONE PEN. X------X------X STAND. PEN. •------•------• 50 100 150 200

CASING BLOWS (ACTUAL) | OTHER TESTS | CONDITION | TYPE | NO. | PENETRATION RESISTANCE | ELEV. RECOV. % | SAMPLES

WATER FLOWING OVER TOP OF CASING 9-OCT-1958

Depth	Description	Elevation	Casing blows	Other tests	Condition	Type	No.	Penetration resistance	Elev. Recov. %	Samples
	GROUND LEVEL	756.05'							756.05'	
1.0' (755.05')	TOPSOIL									1
	FINE BROWN SAND	755	6 9 10 22 34						751.05'	
6		750	22 35 21 23 41		X	D.O.	1	29	100	6
9.3' (746.75')									746.05'	
11		745	49 93 149 180 225	γ=122.5 p.c.f.		T.O.	2	34 form	86	11
		740		γ=138.6 p.c.f.		S.S.	3	25	61	16
16	REFUSAL AT ELEV 740.55' 10'S BLOWS FOR 6"									
	HARD GREY CLAY	735		γ=141.5 p.c.f.	X	D.O.	4	47	89	21
21									731.05'	
26		730		γ=135.6 p.c.f.	X	D.O.	5	62	100	26
									726.05'	
31		725		γ=139.0 p.c.f.	X	D.O.	6	52	100	31
									722.05'	
				γ=131.5 p.c.f.	X	D.O.	7	35	100	
36 (720.95')	END OF BOREHOLE	720								36

CASING BLOWS SHOWN VARY FROM ENERGY OF ABOVE

FORM OB-ML-126

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & RESEARCH BRANCH - FOUNDATIONS SECTION - DOWNSVIEW

OFFICE REPORT ON SOIL EXPLORATION

DRILL RIG 54-5 OPERATION BORE & PENETN JOB F-59-40 WP 19-159 BORING 2 STA. 324+00 (33' RT)

CASING BX & AW (standard samplers to fit unless noted) DATUM GEODETIC DATE REPORT JAN. 1959

SAMPLER HAMMER WT. 250 LBS. DROP 18 INCHES COMPILED BY H.S. CHECKED BY A.L. DATE BORING 31 OCT. 1958

ABBREVIATIONS

V - INSITU VANE SHEAR TEST; M - MECHANICAL ANALYSIS; U - UNCONFINED COMPRESSION; U_{CQ} - TRIAXIAL CONSOLIDATED QUICK; Q - TRIAXIAL QUICK; S - TRIAXIAL SLOW; WL WATER LEVEL IN CASING; WT - WATER TABLE IN SOIL; K - PERMIABILITY; C - CONSOLIDATION; CA - CASING; γ - UNIT WEIGHT

SAMPLE TYPES

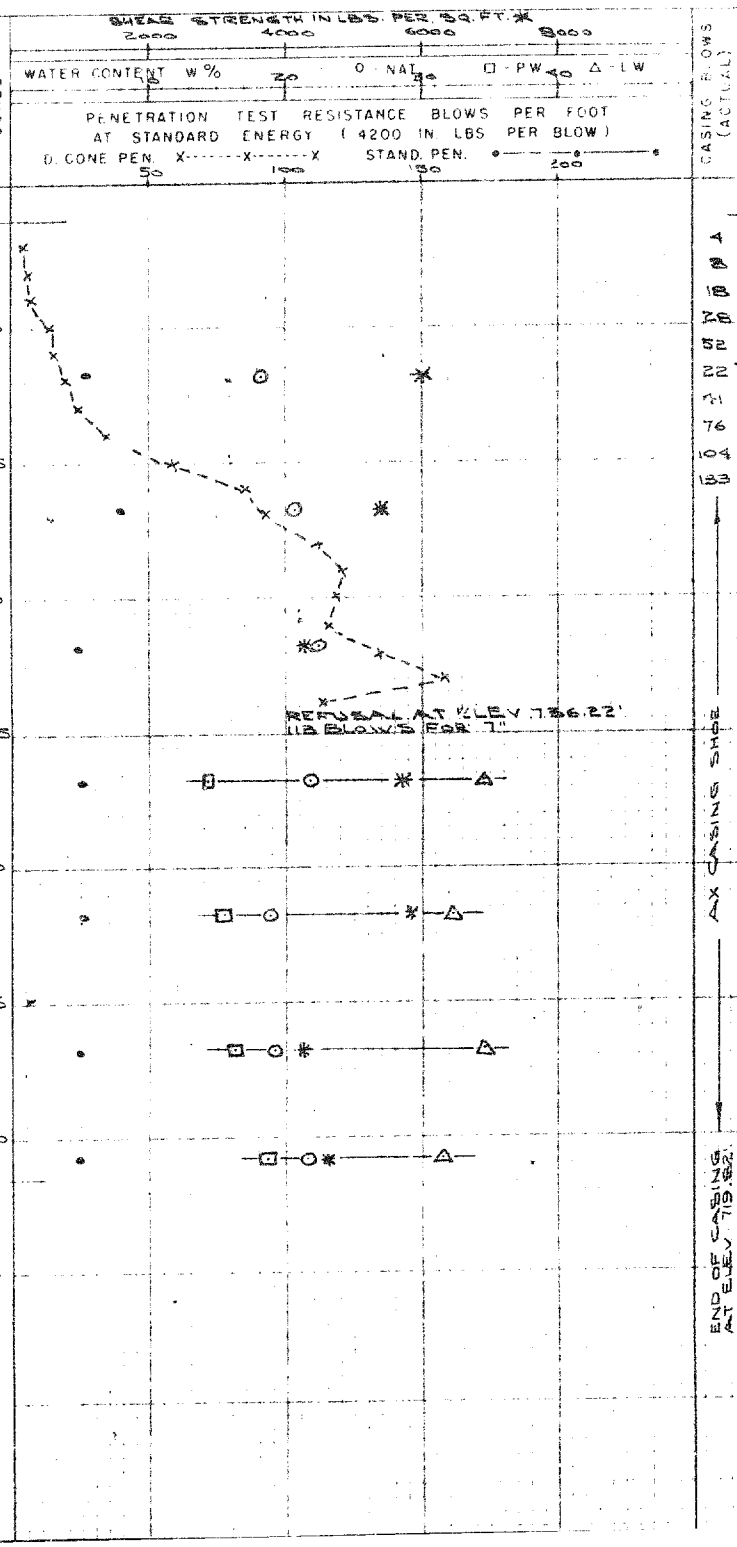
CS - CHUNK; DO - DRIVE OPEN; DF - DRIVE FOOT VALVE; TO - THIN WALLED OPEN; SS - SLEEVE SAMPLE; PS - PISTON SAMPLE; WS - WASHED SAMPLE; RC - ROCK CORE

SAMPLE CONDITION

- DISTURBED
- FAIR
- GOOD
- LOST

SOIL PROFILE

ELEVATION / DEPTH	WATER CONDITIONS	DESCRIPTION
753.92		GROUND LEVEL
752.92 / 1.0'		TOPSOIL
	WATER FLOWING OVER TOP OF CASING	HARD BROWNISH GREY CLAY
		HARD GREY CLAY
718.22 / 35.5'		END OF BOREHOLE



SAMPLES

ELEV.	OTHER TESTS	CONDITION	TYPE	NO.	PENETRATION RESISTANCE	RECOV. %
753.92'						
749.92'	γ=124.3 p.c.f.		T.O.	1	27 for 8"	95
743.92'	γ=130.8 p.c.f.		T.O.	2	40	83
738.92'	γ=131.5 p.c.f.	X	D.O.	3	24	100
733.92'	γ=141.3 p.c.f.	X	D.O.	4	25	100
728.92'	γ=129.7 p.c.f.	X	D.O.	5	24	100
723.92'	γ=140.0 p.c.f.	X	D.O.	6	24	100
718.92'	γ=141.3 p.c.f.	X	D.O.	7	24	100

FORM OB-ML-126

DEPARTMENT OF HIGHWAYS ONTARIO

MATERIALS & RESEARCH BRANCH - FOUNDATIONS SECTION - DOWNSVIEW

OFFICE REPORT ON SOIL EXPLORATION

DRILL RIG 54-5 OPERATION BORE & PENET'N JOB F-58-40 W.P. 19-59 BORING 3 STA. 322+48 (51' RT)

CASING BX & AX (standard samplers to fit unless noted) DATUM GEODETIC DATE REPORT JAN. 1959

SAMPLER HAMMER WT. 250 LBS. DROP 19 INCHES COMPILED BY H.S. CHECKED BY A.L. DATE BORING 3 NOV. 1958

ABBREVIATIONS

V - INSITU VANE SHEAR TEST
M - MECHANICAL ANALYSIS
U - UNCONFINED COMPRESSION
Q_C TRIAXIAL CONSOLIDATED QUICK
Q - TRIAXIAL QUICK
S - TRIAXIAL SLOW
WL - WATER LEVEL IN CASING
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DF - DRIVE FOOT VALVE
TO - THIN WALLED OPEN
SS - SLEEVE SAMPLE
PS - PISTON SAMPLE
WS - WASHED SAMPLE
RC - ROCK CORE

SAMPLE CONDITION

- DISTURBED
- FAIR
- GOOD
- LOST

SOIL PROFILE

ELEVATION / DEPTH	WATER CONDITIONS	DESCRIPTION	STRAT PLOT
753.08		GROUND LEVEL	
752.08' 1.0'		TOPSOIL	
749.58' 3.5'		FINE BROWN SAND	
745.25' 7.8'		BROWNISH-GREY SAND	
717.58' 35.5'		HARD GREY CLAY	
		END OF BOREHOLE	

SHEAR STRENGTH IN LBS. PER SQ. FT.

WATER CONTENT W % — ○ - NAT. □ - P.W. Δ - L.W.

PENETRATION TEST RESISTANCE BLOWS PER FOOT AT STANDARD ENERGY (4200 IN LBS PER BLOW)

○ CONE PEN X STAND PEN.

ELEVATION SCALE: 750, 745, 740, 735, 730, 725, 720, 715

REFUSAL AT ELEV 741.58' (13 BLOWS FOR 6")

CASING BLOWS (ACTUAL): 7, 11, 18, 36, 17, 39, 62, 90, 122

CASING SHOE

END OF CASING

SAMPLES

OTHER TESTS	CONDITION	TYPE	NO.	PENETRATION RESISTANCE	ELEV. RECOV. %
					753.08'
					748.08'
	X	T.O.	1	27	33
					743.08'
γ=139.0 p.c.f.		S.S.	2	41	67
					738.08'
γ=135.5 p.c.f.	X	D.O.	3	52	100
					733.08'
γ=139.0 p.c.f.	X	D.O.	4	25	100
					728.08'
γ=137.0 p.c.f.	X	D.O.	5	20	100
					723.08'
γ=137.0 p.c.f.	X	D.O.	6	14	100
					719.08'
γ=137.0 p.c.f.	X	D.O.	7	10	100

FORM OB-ML-126

H.D.R.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & RESEARCH BRANCH - FOUNDATIONS SECTION - DOWNSVIEW

OFFICE REPORT ON SOIL EXPLORATION

DRILL RIG 54-5 OPERATION BORE & PENET'N JOB F-58-40 W.P. 19-59 BORING 4 STA. 321+95 (29' LT)

CASING BX & AX (standard samplers to fit unless noted) DATUM GEODETIC DATE REPORT JAN. 1959.

SAMPLER HAMMER WT. 250 LBS. DROP 19 INCHES COMPILED BY H.S. CHECKED BY A.L. DATE BORING 5 NOV 1958.

ABBREVIATIONS

V - INSITU VANE SHEAR TEST; M - MECHANICAL ANALYSIS; U - UNCONFINED COMPRESSION; Q_C TRIAXIAL CONSOLIDATED QUICK; Q - TRIAXIAL QUICK; S - TRIAXIAL SLOW; WL WATER LEVEL IN CASING; WT WATER TABLE IN SOIL; K - PERMIABILITY; C - CONSOLIDATION; CA CASING; γ - UNIT WEIGHT

SAMPLE TYPES

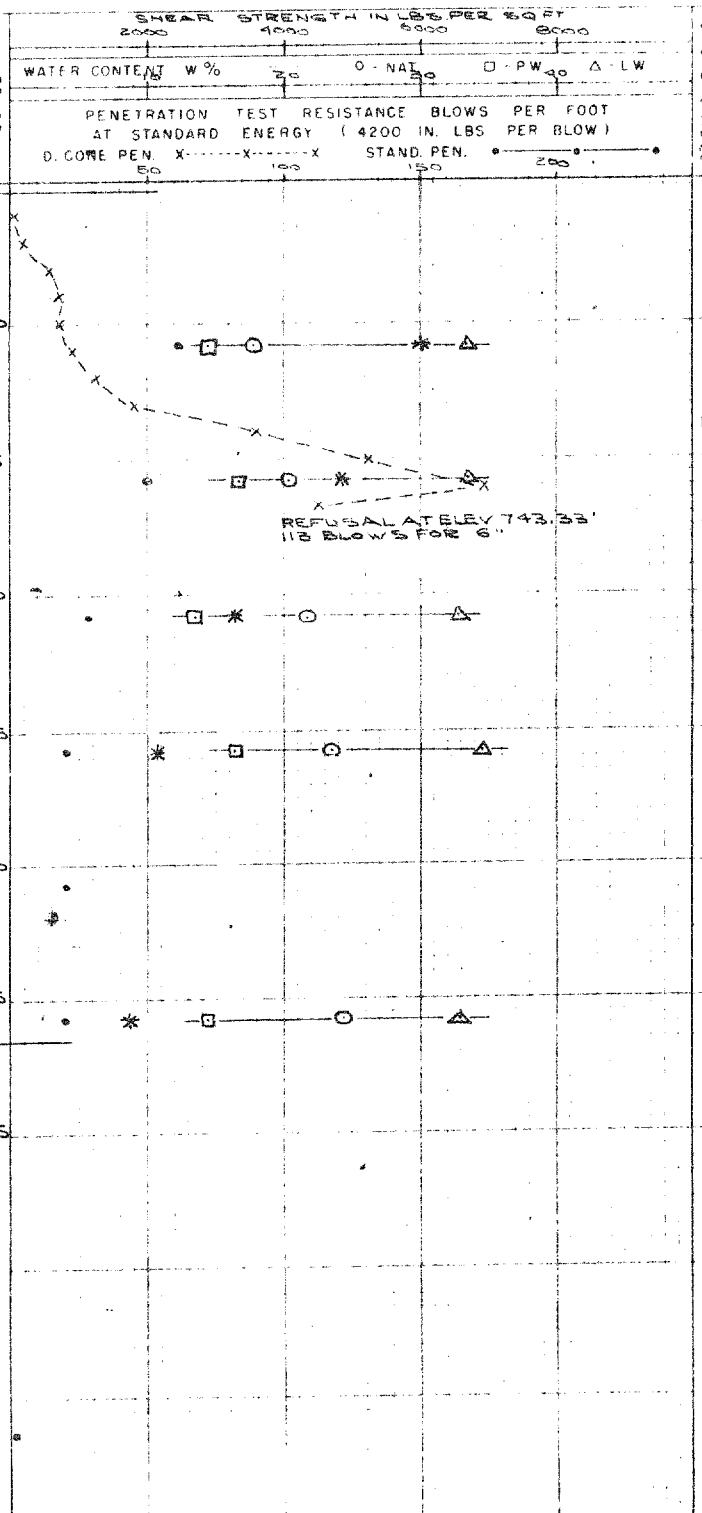
CS - CHUNK; DO - DRIVE OPEN; DF - DRIVE FOOT VALVE; TO - THIN WALLED OPEN; SS - SLEEVE SAMPLE; PS - PISTON SAMPLE; WS - WASHED SAMPLE; RC - ROCK CORE

SAMPLE CONDITION

- DISTURBED
- FAIR
- GOOD
- LOST

SOIL PROFILE

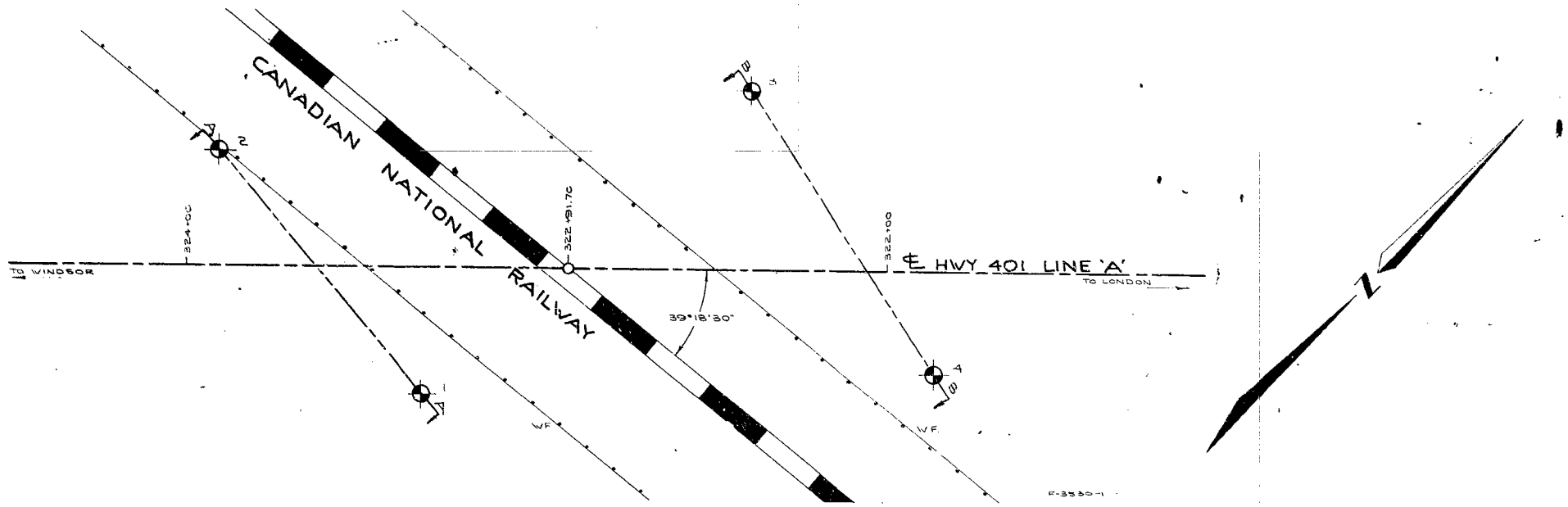
ELEVATION / DEPTH	DESCRIPTION
754.83'	GROUND LEVEL
753.83' (1.0')	TOPSOIL
752.33' (2.5')	FINE BROWN SAND
	HARD GREY CLAY
723.33' (31.5)	END OF BOREHOLE



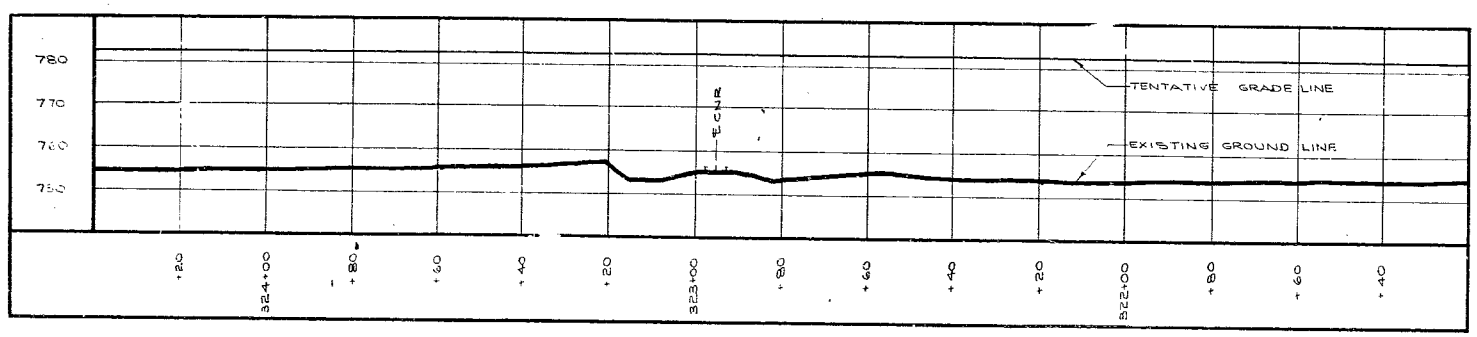
SAMPLES

OTHER TESTS	CONDITION	TYPE	NO	PENETRATION RESISTANCE	ELEV. / RECOV. %
					754.83'
γ=134.8 p.c.f.		T.O.	1	62	749.83' 39
γ=130.5 p.c.f.		S.S.	2	50	744.83' 89
γ=130.0 p.c.f.		D.O.	3	29	739.83' 100
γ=81.3 p.c.f.		D.O.	4	20	734.83' 100
		D.O.	5	20	729.83' POOR
γ=130+ p.c.f.		D.O.	6	20	724.83' 100

58-F-40
W.P. # 19-59
Hwy. # 401
LINE 'A' & C.N.R.
CROSSING
3 MILES N.W. OF
SHEDDEN



PLAN



PROFILE

LEGEND

BORE HOLE

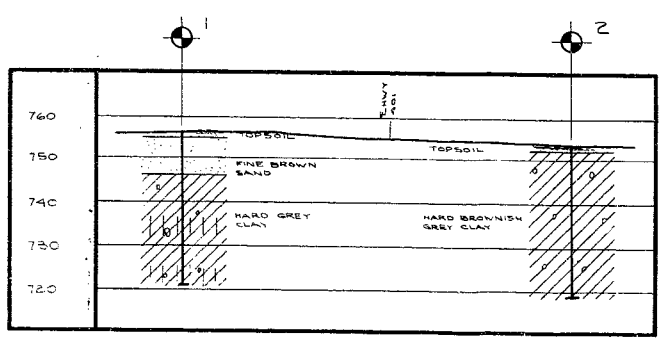
PENET'N HOLE

BORE & PENET'N HOLE

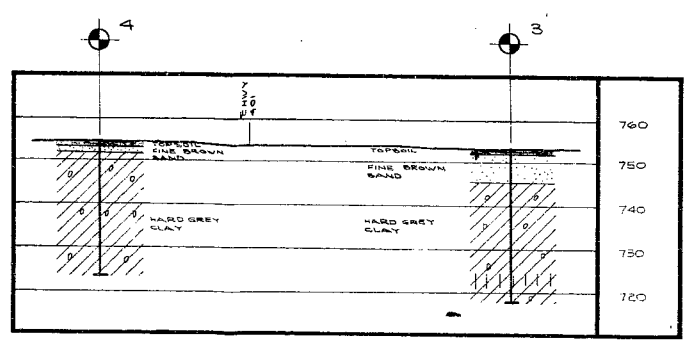
HOLE NO	ELEVATION	STATION	DISTANCE FROM ℄
1	756+05	323+41	36' LT.
2	753+82	324+00	33' RT
3	753+08	322+48	51' RT.
4	754.83	321+95	29' LT.

— 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.



A-A



B-B

DEPARTMENT OF HIGHWAYS — ONTARIO

MATERIALS & RESEARCH SECTION DOWNSVIEW

CNR
PROPOSED CROSSING
APP. 3 MI. W of SHEDDEN

SHOWING POSITION & ELEVATION OF HOLES

HWY NO. 401 W.P. 19-59 LOT 10
CO. ELGIN CON. III DIV. 2
TWP. SOUTHWOLD

SCALE	SUBMITTED BY	DATE
1" = 20'		2 FEB. 59
DRAWN BY T. MELLORS	APPROVED BY	DRAWING NO. F 58-40A