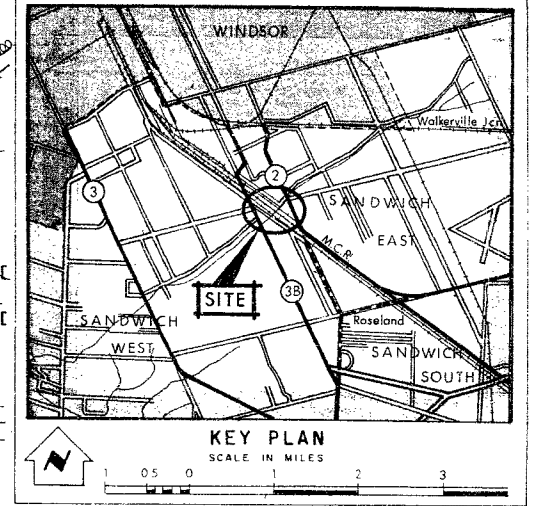


68-F-15-2

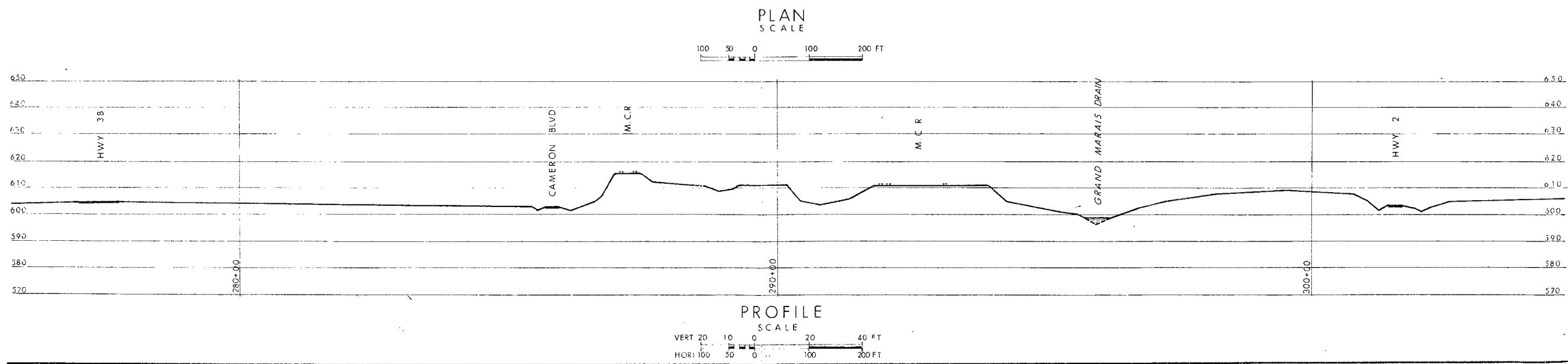
W.P. 257-66-020

Hwy 3B to Hwy 2
E.C. Row
EXPWAY.



- LEGEND**
- Bore Hole
 - ⊕ Cone Penetration Hole
 - ⊕ Bore & Cone Penetration Hole
 - ≡ Water Levels established at time of field investigation.

NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	603.0	99,632	67,891
2	602.5	99,565	68,640
3	603.0	99,392	68,895
4	604.0	99,711	67,373
22	604.2	99,471	67,090
23	604.9	99,548	67,240
24	604.0	99,572	67,316
25	603.5	99,457	67,355
26	603.5	99,560	67,255
27	603.3	99,448	67,526
28	603.6	99,530	67,576
29	604.2	99,416	67,680
30	604.5	99,500	67,760
31	604.9	99,375	67,816
32	605.4	99,490	67,827
33	605.4	99,395	67,926
34	602.7	99,470	67,946
35	602.9	99,386	68,091
36	611.1	99,454	68,141
37	610.5	99,350	68,286
38	610.7	99,448	68,280
39	610.6	99,461	68,378
40	610.2	99,358	68,416
41	600.3	99,355	68,550
42	606.0	99,425	68,562
43	609.6	99,355	68,685
44	610.1	99,440	68,688
45	610.9	99,366	68,796
46	599.7	99,498	69,085
47	607.7	99,460	68,808
48	603.9	99,460	68,900
49	607.7	99,381	69,025
50	603.5	99,458	69,684
51	602.9	99,425	69,081
52	602.6	99,680	69,195
53	604.0	99,760	69,232
54	603.9	99,809	69,346
55	606.6	99,438	69,522
56	607.8	99,438	69,230
57	608.6	99,385	69,165
58	603.2	99,874	69,420
59	606.1	99,550	69,425
60	603.8	100,220	69,770
61	606.7	99,486	69,270
62	608.0	99,381	69,381



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

HWY 3B TO HWY 2

KING'S HIGHWAY NO. E.C. ROW EXPWAY DIST. NO. 1
CO. ESSEX
TWP. SANDWICH EAST LOT CON.

BORE HOLE LOCATIONS

SUBWD. K S	CHECKED <input checked="" type="checkbox"/>	WP. NO. 257-66-020	M.B.T. DRAWING NO.
DRAWN A. B.	CHECKED <input checked="" type="checkbox"/>	JOB NO. 68-F-15-2	68-F-15-2A
DATE APRIL 19, 1968	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>A. G. Thomas</i>	CONT. NO.		

 **KEY PLAN**
SCALE IN MILES



- 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.

[illegible]

KING'S HIGHWAY NO. E.C. ROW EXP'WAY DIST. NO. 1
CO. ESSEX
TWP. SANDWICH EAST LOT _____ CON. _____

SUBM'D. K.S.	CHECKED <input checked="" type="checkbox"/>	W.P. NO. 257-66-020	M.B.T. DRAWING NO.
DRAWN S.O.	CHECKED <input checked="" type="checkbox"/>	JOB NO. 68-F-15-2	68-F-15-2C
DATE 27 JUNE 1968	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>A. B. Thomas</i>	CONT. NO.		

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION
JOB 68-F-15-2
W P 257-66-020
DATUM Geodetic

RECORD OF BOREHOLE NO. 38
LOCATION N. 99,448 E. 68,280
BORING DATE March 18, 1968
BOREHOLE TYPE Cont. Flight Auger
ORIGINATED BY AP
COMPILED BY AMS
CHECKED BY

FOUNDATION SECTION

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W			BULK DENSITY PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	20	40	60	80	100	WP	WL		
610.7	Ground Level														
0.0	Fill material Gravel, sand & cinders		1	SS	6	610									Dr. Sa. Si. Cl.
	Loose		2	SS	5										3 29 38 30
599.7			3	SS	4	600									
11.0			4	SS	31										
			5	SS	46										
	Clayey silt with sand		6	SS	25	590									
586.7	and traces of gravel.		7	SS	13										
2.4	Firm to hard.		8	TW	PM	580								136.5	3 30 42 25
			9	TW	PM									136	
			10	TW	PM	570								135	
			11	TW	PM									132	
564.2			12	TW	PM	560									4 44 36 16
46.5	Silty sand with some clay & traces of gravel.		13	SS	7	550									
558.2			14	TW	PM	540								130.5	
52.5			15	TW	PM	530								117	4 15 46 35
			16	TW	PM	520								119	
			17	TW	PM	510								134	
			18	SS	17	500									
490.2															
120.5	End of Borehole Probable Bedrock					490									

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOA 68-F-15-2

W. P. 257-66-020

DATUM Geodetic

LOCATION N. 99,461 E. 68,378

BORING DATE March 18, 1968

BOREHOLE TYPE Cont. Flight Auger

RECORD OF BOREHOLE NO. 39

FOUNDATION SECTION

ORIGINATED BY AP

COMPILED BY **AMS**

CHECKED BY _____

[illegible]

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL		BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P S F	PLASTIC LIMIT — WP	WATER CONTENT — W		
610.4	Ground Level											
0.0	Mixture of gravel, sand, silt, clay and cinder.	[Hatched Pattern]	1	SS	9	610						Gr. Sa. Si. Cl
			2	SS	5							
598.9	Fill material		3	SS	5	600						
11.5	Clayey silt with sand, traces of gravel.		4	SS	30							
			5	SS	38	590						
	Very stiff to hard.		6	SS	27							
			7	TW	PH	580						
			8	SS	19							
571.4												
39.0	Silty sand with gravel, some clay.		9	SS	12	570						
	Compact											
558.9												
51.5	End of Borehole	10	SS	10	560							
						550						

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 41

FOUNDATION SECTION

JOB 68-F-15-2 LOCATION N. 99,355 E. 68,550 ORIGINATED BY AP
W P 257-66-020 BORING DATE March 19 & 20, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY Y P.C.F.	REMARKS Gr.Sa.Si.Cl
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	20	40	60	80	100	WP	WL		
600.3	Ground Level														
0.0	Fill material Sand and gravel with silt and clay.		1	SS	21										
590.3	Compact		2	SS	25	590									
10.0			3	SS	10										
			4	TW	PH	580								133	
			5	TW	PH									135	
			6	TW	PM	570								135	
			7	TW	PM									135	
563.3	Sandy Silt		8	TW	PM	560								134	
37.0			9	TW	PM									132	
560.3	Clayey silt with sand, traces of gravel.		10	TW	PM	550								130	
40.0			11	TW	PM	540								130	
	Firm to very stiff.		12	TW	PM	530								116	
	Occasional silty clay layers.		13	TW	PM	520								139	
			14	TW	PM	510								134	4 20 45 31
						500									
						490									
486.3	Sand & gravel.														
485.0	Bedrock														
115.3	Limestone														
480.0															
120.3	End of Borehole														

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOA 68-F-15-2

W P 257-66-020

DATUM Geodetic

LOCATION N. 99.355 E. 68.685

BORING DATE March 19, 1968

BOREHOLE TYPE Cont. Flight Auger

ORIGINATED BY PP

COMPILED BY AMS

CHECKED BY

RECORD OF BOREHOLE NO. 43

FOUNDATION SECTION

[illegible]

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 68-F-15-2

W P 257-66-020

DATUM Geodetic

LOCATION N. 99.435 E. 68,562

BORING DATE March 20, 1968

BOREHOLE TYPE Cont. Flight Auger

FOUNDATION SECTION

ORIGINATED BY AP

COMPILED BY AMS

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LQUID LIMIT ——— W _L	PLASTIC LIMIT ——— W _P	WATER CONTENT ——— W	BULK DENSITY P C F	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P S F + Field Vane ○ Unconfined	WATER CONTENT % 10 20 30				
							20 40 60 80 100					
606.0	Ground Level											Gr.Sa.Si.Cl.
0.0			1	SS	5	600						▼ 600.8
	Clayey silt with sand,		2	SS	16							
	traces of gravel.		3	SS	43							
	Occasional sand seams.		4	SS	24	590						
	Firm to hard.		5	TW	PM						137	2 29 40 29
			6	TW	PM	580	+1.6				136	
			7	TW	PM		+1.8				134	
			8	TW	PM	570	+1.6				132	2 71 (27)
			9	TW	PM		+1.6				134.5	
			10	TW	PM	560	+1.9				134.5	2 29 37 32
			11	TW	PM		+1.8					
553.0												
53.0	End of Borehole					550						

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 68-F-15-2

LOCATION N. 99,366 E. 68,796

ORIGINATED BY PP

W P 257-66-020

BORING DATE March 20 & 21, 1968

COMPILED BY AMS

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

RECORD OF BOREHOLE NO. 45

FOUNDATION SECTION

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P S F					WATER CONTENT %										
							+ Field Vane o Unconfined					W _P — W — W _L										
610.9	Ground Level						500	1000	1500	2000	2500	10	20	30		Gr.Sa.Si.Cl						
0.0	Fill Material					610																
	Mixture of gravel, sand, silt, clay and organics.		1	SS	36																	1 22 43 34
			2	SS	26 1/2"																	603.4
			3	SS	6																	
			4	SS	14																	
	Loose to Dense.		5	SS	16																	
592.0			6	TW	PH																140	4 29 41 26
18.9	Clayey silt with sand, traces of gravel.		7A	SS	-																	
			8	TW	PM																	
	Firm to very stiff.		9	TW	PM																	
			10	TW	PM																	
			11	TW	PM																	
559.9																						
557.9	Silty sand with some gravel.	12A	SS	-																		
53.0	End of Borehole																					

FOUNDATION SECTION

CHECKED BY

[illegible]

RECORD OF BOREHOLE NO. 47

FOUNDATION SECTION

JOB 68-F-15-2

LOCATION N. 99,460 E. 68,808

ORIGINATED BY AP

W. P. 257-66-020

BORING DATE March 21, 22 & 25, 1968

COMPILED BY AMS

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 68-F-15-2

LOCATION N. 29.460 E. 68.900

ORIGINATED BY PP

W. P. 257-66-020

BORING DATE March 22 & 25, 1968

COMPILED BY AMS

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY 42

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— w _L PLASTIC LIMIT ——— w _P WATER CONTENT ——— w			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							+ Field Vane ○ Unconfined					w _P	w	w _L		
603.9	Ground Level					500	1000	1500	2000	2500	10	20	30		Gr.Sa.Si.Cl	
0.0	Sand with traces of gravel, silt, clay and occasional clayey silt layers.															
	Fill material.		1	TW	PH											0 90 (10)
			2	TW	PH					b					138 3 87 (10)	
583.7			3	TW	PH											
20.2	Clayey silt with sand and traces of gravel.		4	SS	12			+1.4								
			5	TW	PH			b								132 3 28 40 29
			6	TW	PH			b	+2.4							135
	Firm to stiff.		7	TW	PH			b	+2.5							134.5
			8	TW	PH			q	+2.3							134
			9	TW	PH			b	+2.2							140
			10	TW	PH				+2.1							1 30 39 30
									+2.3							
550.9																
53.0	End of Borehole							0 15-5 10								

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 49

FOUNDATION SECTION

JOA 68-F-15-2

LOCATION N. 99,381 E. 69,025

ORIGINATED BY PP

W. P. 257-66-020

BORING DATE March 22 & 25, 1968

COMPILED BY AMS

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO			RECORD OF BOREHOLE NO. 50				FOUNDATION SECTION			
MATERIALS & TESTING DIVISION										
JOB 68-F-15-2			LOCATION N. 99,458 E. 69.684				ORIGINATED BY PP			
W.P. 257-66-020			BORING DATE March 25, 1968				COMPILED BY PP			
DATUM Geodetic			BOREHOLE TYPE Cont. Flight Auger				CHECKED BY <i>HR</i>			

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS				
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	500	1000	1500			2000	2500	10	20
603.5	Ground Level																			
0.0	Clayey silt with sand and traces of gravel. Stiff to Hard.		1	SS	14	600														
			2	SS	29															
			3	SS	41															
			4	SS	38															
			5	SS	14															
			6	TW	PH															
			7	TW	PH															
			8	TW	PH															
			9	TW	PH															
			10	TW	PH															
			11	TW	PH															
			12	TW	PH															
555.5	Sand Layer																			
550.5																				
53.0	End of Borehole																			

End of cone test

Gr. Sa. Si. Cl

5 28 41 26

13 1/2 5

14 0

3 36 43 18

0 15 5 10

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 51

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 68-F-15-2

LOCATION N. 99.625 E. 69.081

ORIGINATED BY AP

W. P. 257-66-020

BORING DATE March 25, 1968

COMPILED BY _____ PP

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY P C F	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT %
							20	40	60	80	100	+ Field Vane	o Unconfined	W _P			
							500	1000	1500	2000	2500	10 20 30					
602.9	Ground Level																
0.0	Silt, some sand and clay.		1	SS	6	600											
	Loose to compact.		2	SS	13												
592.9			3	SS	30												
10.0	Clayey silt with sand, and traces of gravel.		4	SS	63	590											
			5	SS	17												
582.9	Stiff to hard.		6	SS	17												
20.0			7	SS	32	580											
			8	TW	PM												
574.9																	
28.0	End of Borehole					570											
						</											

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 52

FOUNDATION SECTION

JOB 68-F-15-2

LOCATION

N. 99,680 E. 69,195

ORIGINATED BY AP

W P 257-66-020

BORING DATE

March 25, 1968

COMPILED BY

DATUM Geodetic

BOREHOLE TYPE

Cont. Flight Auger

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 68-F-15-2

LOCATION

N. 99.780

E. 69.232

ORIGINATED BY AP

W. P. 257-66-020

BORING DATE

March 26, 1968

COMPILED BY

DATUM Geodetic

BOREHOLE TYPE

Cont. Flight Auger

CHECKED BY

[illegible]

FOUNDATION SECTION

ORIGINATED BY AP

COMPILED BY _____ PF

BOREHOLE TYPE

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 68-F-15-2

LOCATION N. 99.438 E. 69.230

ORIGINATED BY PP

W.P. 257-66-020

BORING DATE March 26, 27 28, 1968

COMPILED BY PP

DATUM Geodetic

BOREHOLE TYPE Washbore - NX & BX Casing

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — W L PLASTIC LIMIT — W P WATER CONTENT — W			BULK DENSITY X P C F	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	SHEAR STRENGTH P S F + Field Vane o Unconfined					WATER CONTENT % 10 20 30			
607.8	Ground Level						500	1000	1500	2000	2500				Gr.Sa.Si.Cl
0.0	Fill Material														
603.3															
4.5	Clayey silt with sand traces of gravel.		1	SS	8	600									
			2	SS	18										
	Stiff to very stiff.		3	SS	26	590									1 33 46 20
586.5			4	SS	13										
21.3	Sand with traces of gravel & clay.		5	SS	70/10"	580									
580.8	Very dense.														
27.0			6	SS	13					+1.6					
			7	TW	PM	570				+1.4					
			8	TW	PM										134.5 2 36 42 20
564.8										+1.6					
43.0	Sandy silt with gravel.		9	SS	41	560									
561.3			10	SS	53										
46.5	Clayey silt with sand and traces of gravel.		11	SS	12					+1.5					
						550									
	Stiff to very stiff.		12	TW	PM										
			13	SS	8					+1.8					4 23 42 31
						540									
			14	TW	PM										
						530				+1.75					
			15	TW	PM										
						520									
			16	TW	PM										3 27 47 23
						510									
			17	TW	PM										
			18	SS	31										
						500									
			19	SS	27										3 19 48 30
						490									
488.8															
119.0	Limestone Bedrock		20	RC	AXT 85%										
481.3															
123.5	End of Borehole														

RECORD OF BOREHOLE NO. 57

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 68-F-15-2

LOCATION N. 99,385 E. 69,165

ORIGINATED BY PP

W. P. 257-66-020

BORING DATE March 26 & 27, 1968

COMPILED BY AMS

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOE 68-F-15-2

LOCATION N. 99,874 E. 69,420

ORIGINATED BY AP

W. P. 257-66-020

BORING DATE. March 26, 1968

COMPILED BY **AMS**

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT ——— w _L PLASTIC LIMIT ——— w _p WATER CONTENT ——— w			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	20 40 60 80 100	SHEAR STRENGTH P.S.F.	WATER CONTENT % 10 20 30				
603.2	Ground Level												Gr.Sa.Ci.C
0.0	Clayey silt with sand and traces of gravel. v Stiff to hard.		1	SS	9	600							2 31 39 28 1 30 39 30 4 30 43 23
			2	SS	59								
			3	SS	43				120/9"				
			4	SS	25	590							
			5	SS	41								
			6	SS	28								
			7	SS	22	580							
578.2													
25.0	End of Borehole					570							

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB <u>68-F-15-2</u>	LOCATION <u>N. 99.550 E. 69.425</u>	ORIGINATED BY <u>PP</u>
W.P. <u>257-66-020</u>	BORING DATE <u>March 26 & 27, 1968</u>	COMPILED BY <u>AMS</u>
DATUM <u>Geodetic</u>	BOREHOLE TYPE <u>Cont. Flight Auger</u>	CHECKED BY <u>LC</u>

RECORD OF BOREHOLE NO. 59

FOUNDATION SECTION

[illegible]

RECORD OF BOREHOLE NO. 61

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 68-F-15-2

LOCATION N. 99.486 E. 69.270

ORIGINATED BY PP

W. P. 257-66-020

BORING DATE March 27, 1968

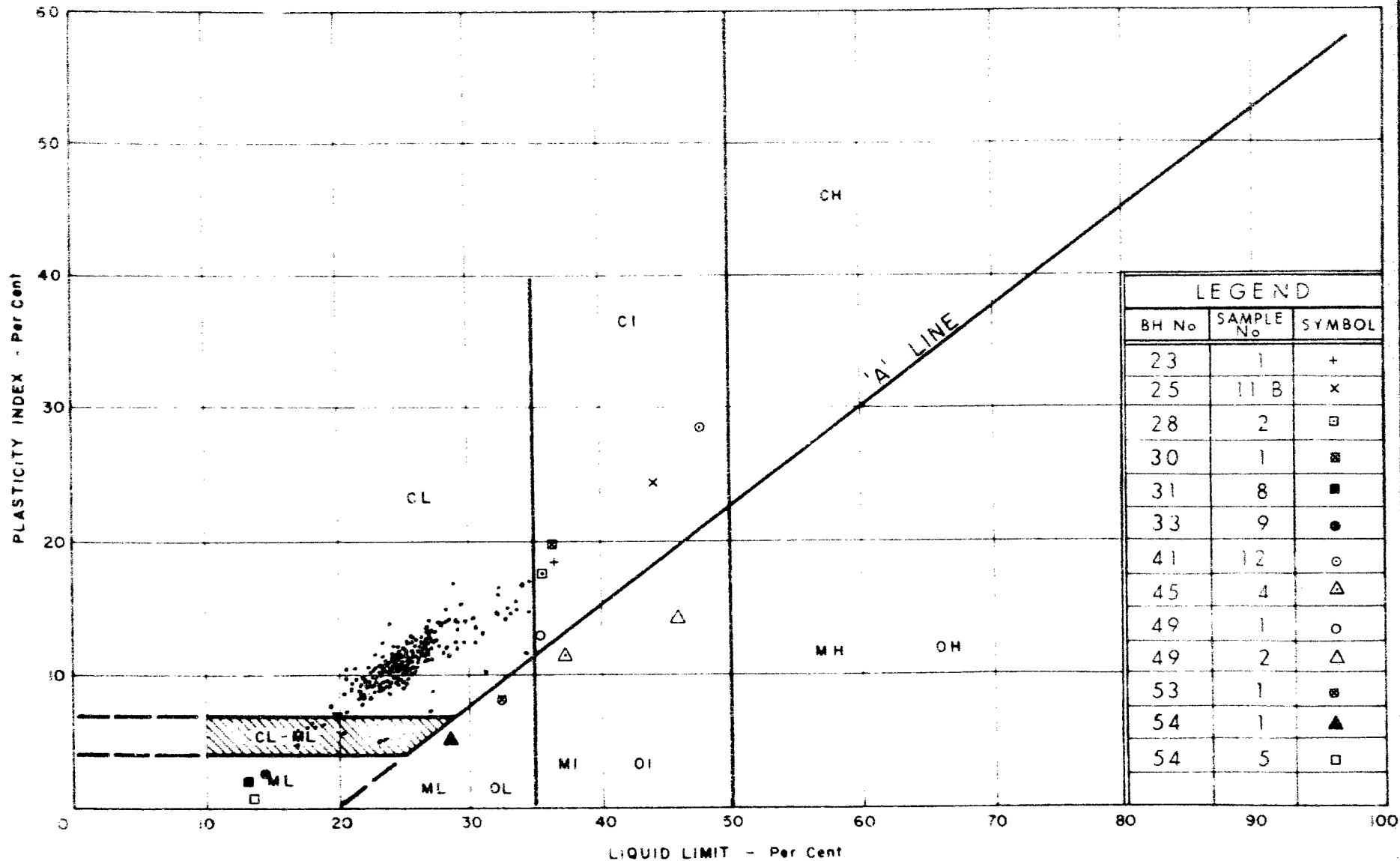
COMPILED BY AMS

DATUM Geodetic

BONEHOLE TYPE Cont. Flight Auger

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DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

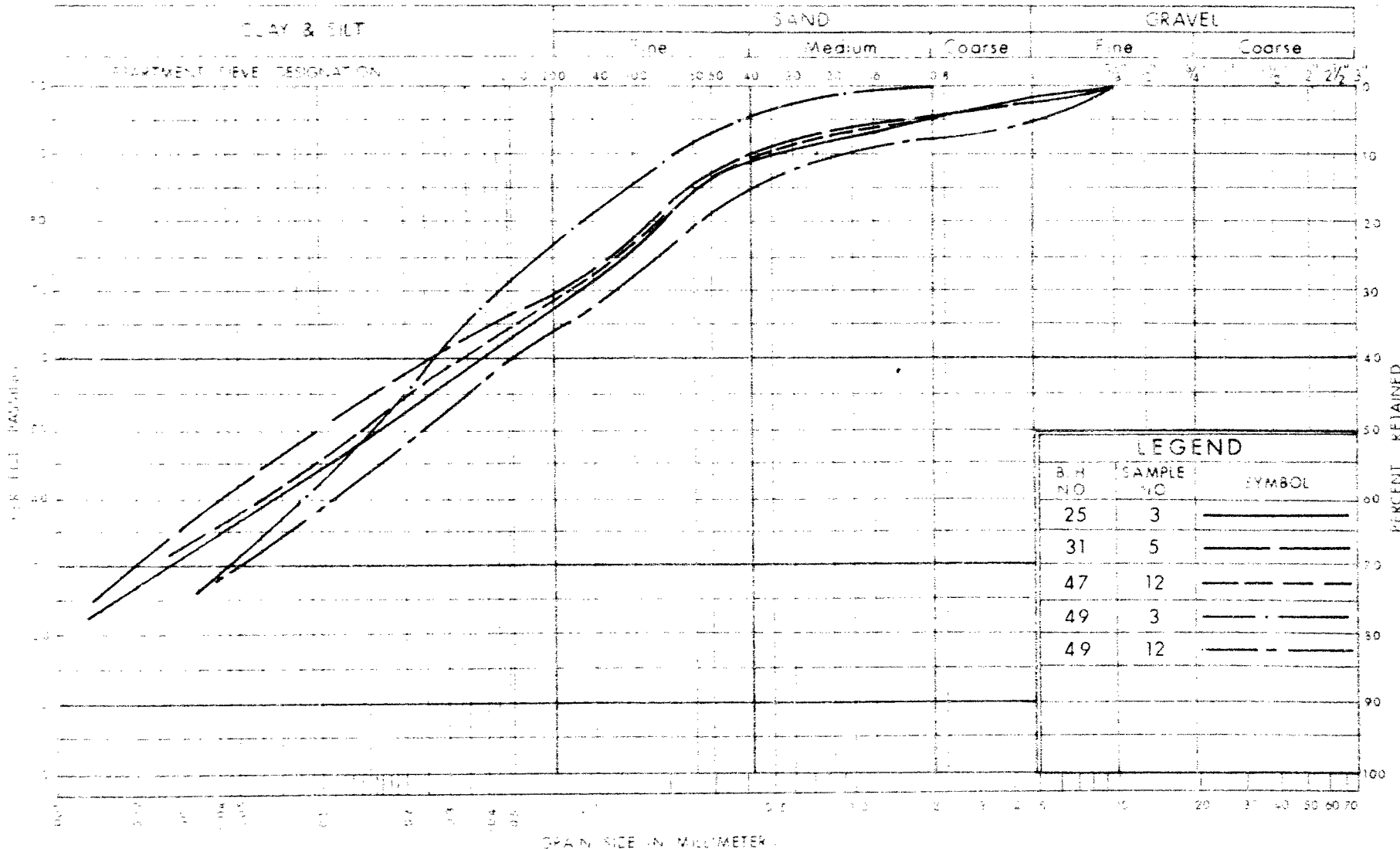
PLASTICITY CHART CLAYEY SILT

WP No.

JOB No. 68-F-15-2

FIGURE No 1

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION CLAYEY SILT

W.P. No.

JOB No. 68-F-15-2

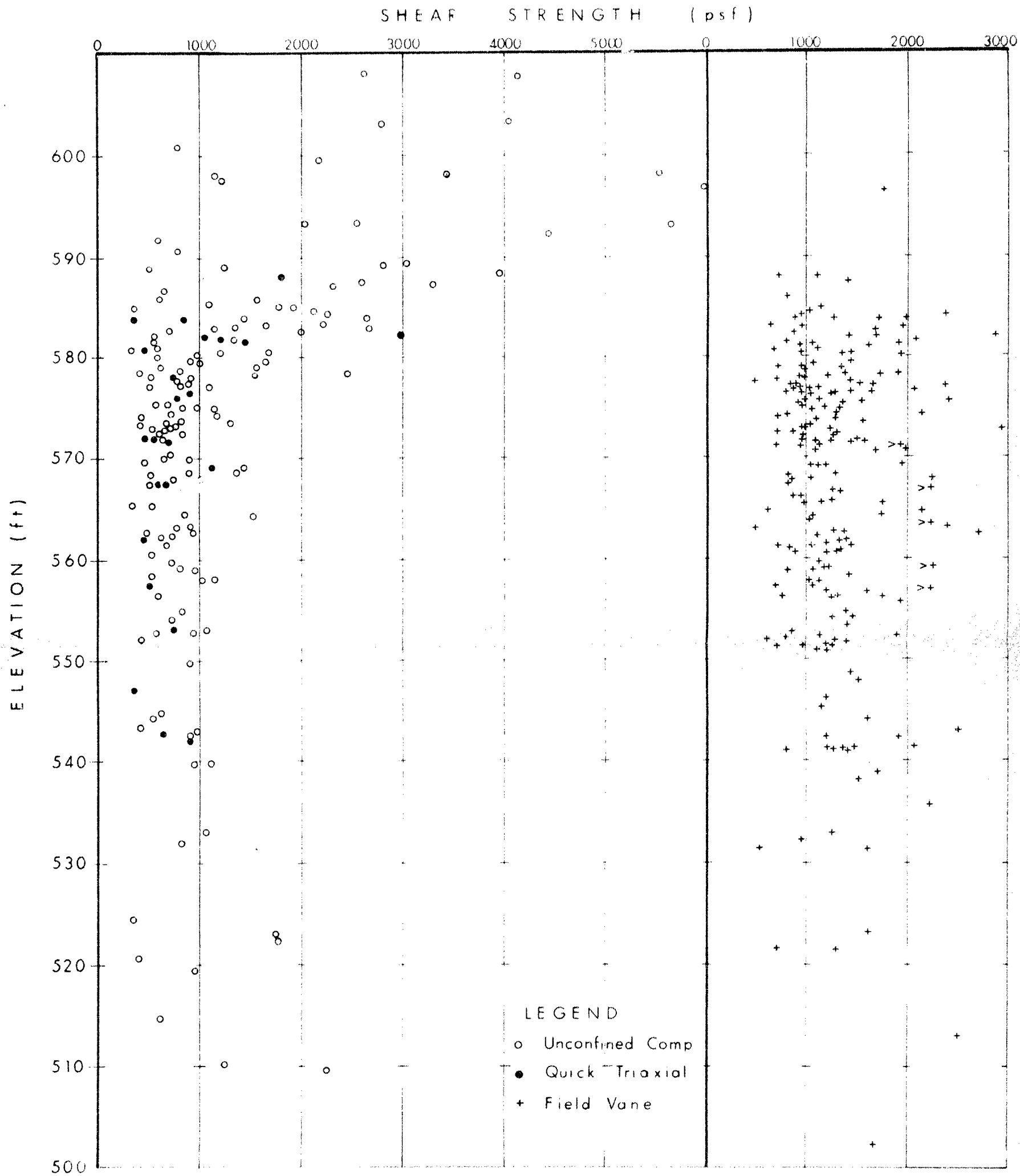
FIG. 2

SHEAR STRENGTH vs ELEVATION

WP No. 257-66-020

JOB No. 68-F-15-2

FIGURE No 3



UNCONFINED COMPRESSION TEST - TYPICAL STRESS STRAIN CURVES

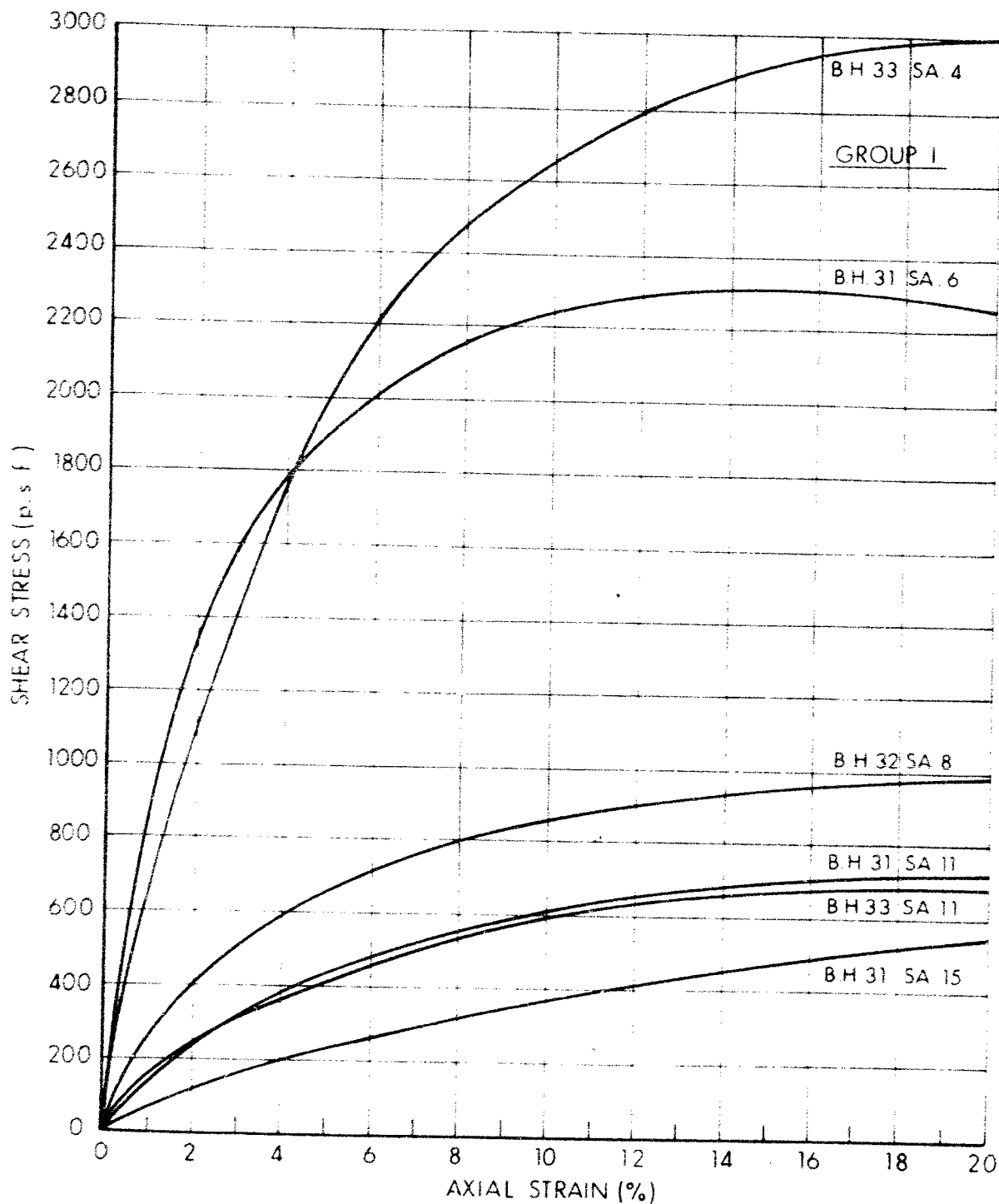


FIG. 4

UNCONFINED COMPRESSION TEST - TYPICAL STRESS STRAIN CURVES

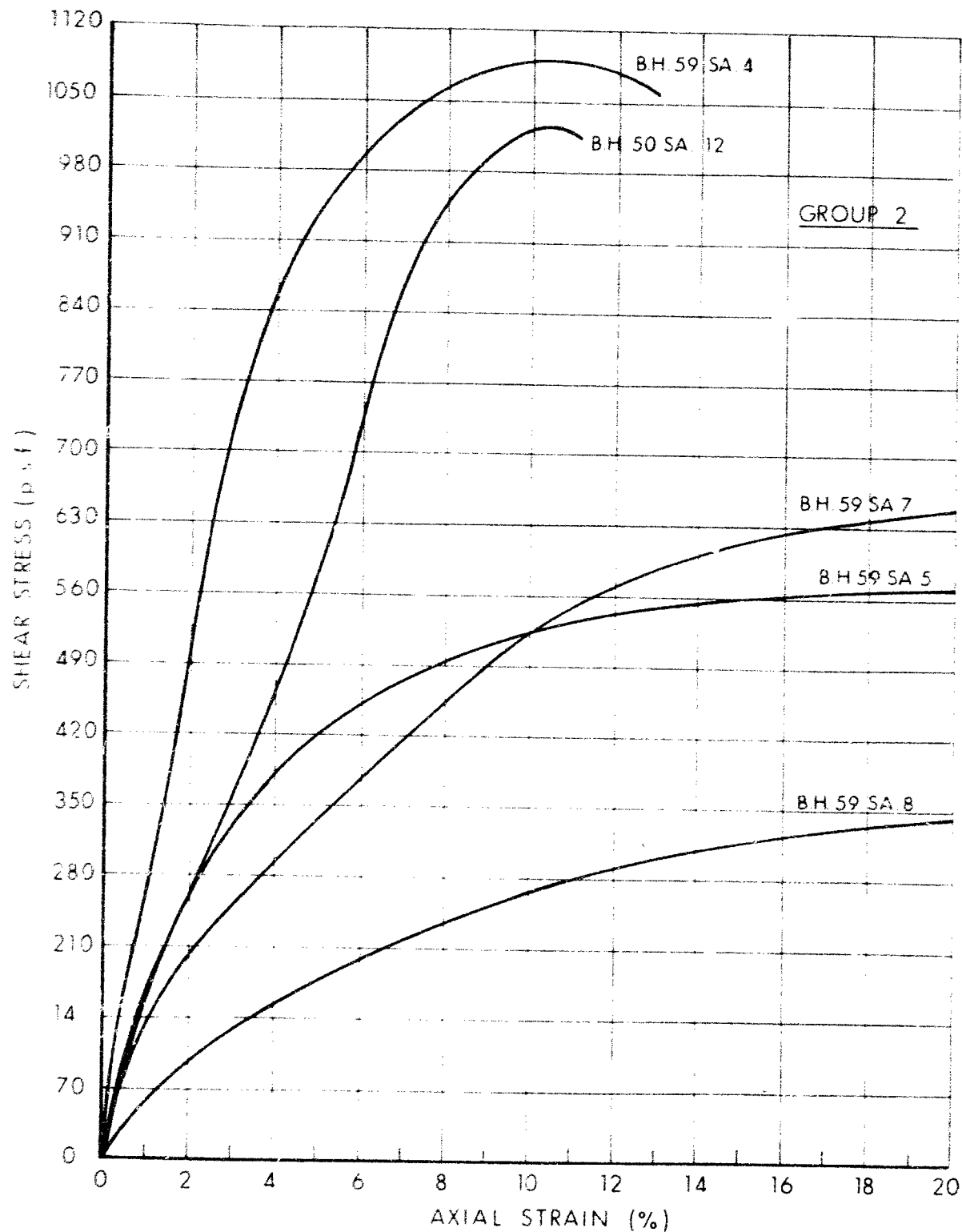


FIG. 5

VOID RATIO vs PRESSURE

$W_L = 23.5$

$W_p = 12.2$

$W = 13.9$

$C_c = 0.73$

BORE HOLE 28

SAMPLE 6

DEPTH 21'

ELEV. 582.6

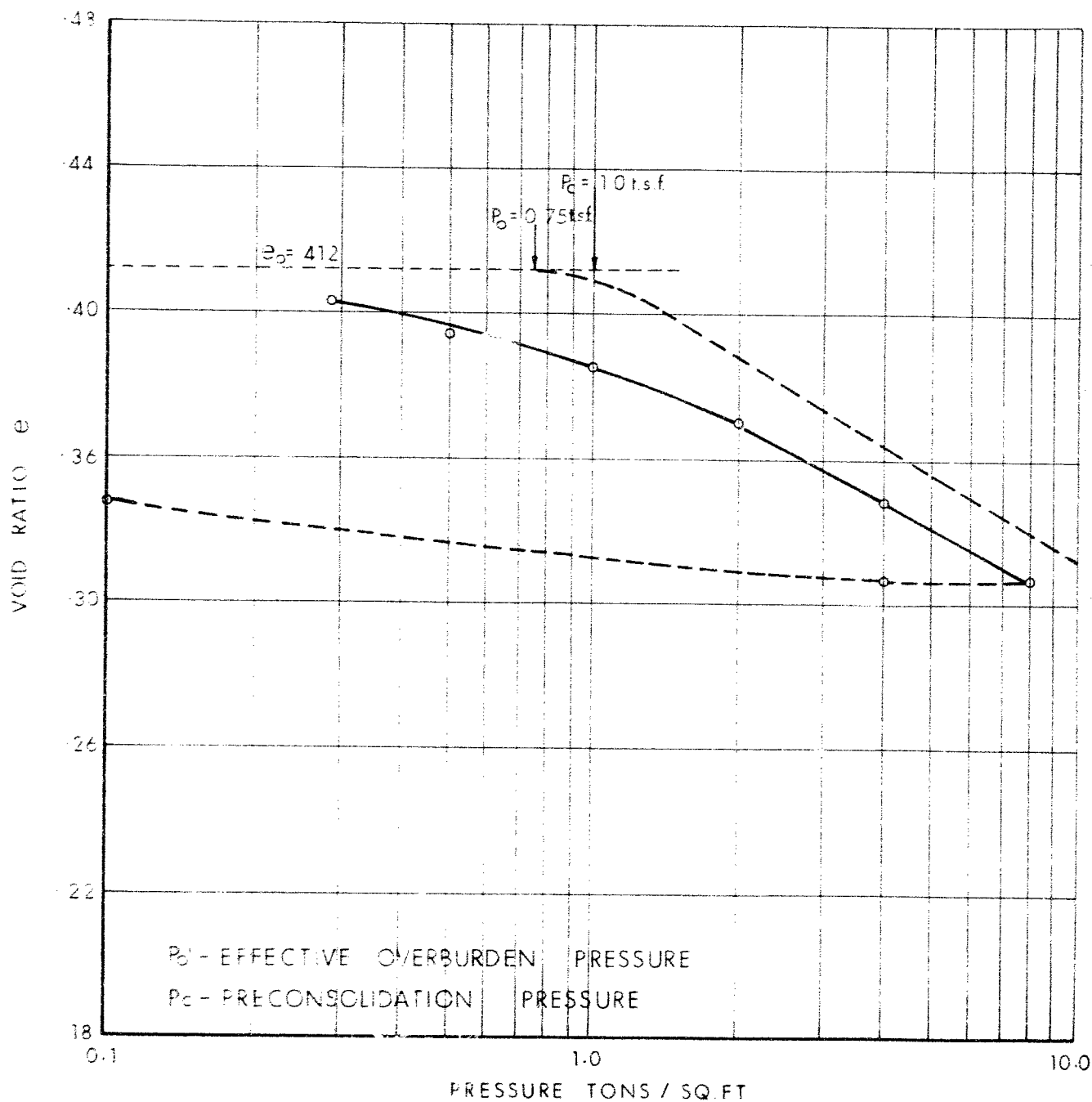


FIG. 6

VOID RATIO vs PRESSURE

$W_L = 23.8$

$W_p = 13.0$

$W = 10.8$

$C_c = 1.38$

BORE HOLE 31

SAMPLE 10

DEPTH 41'-4"

ELEV. 563.5

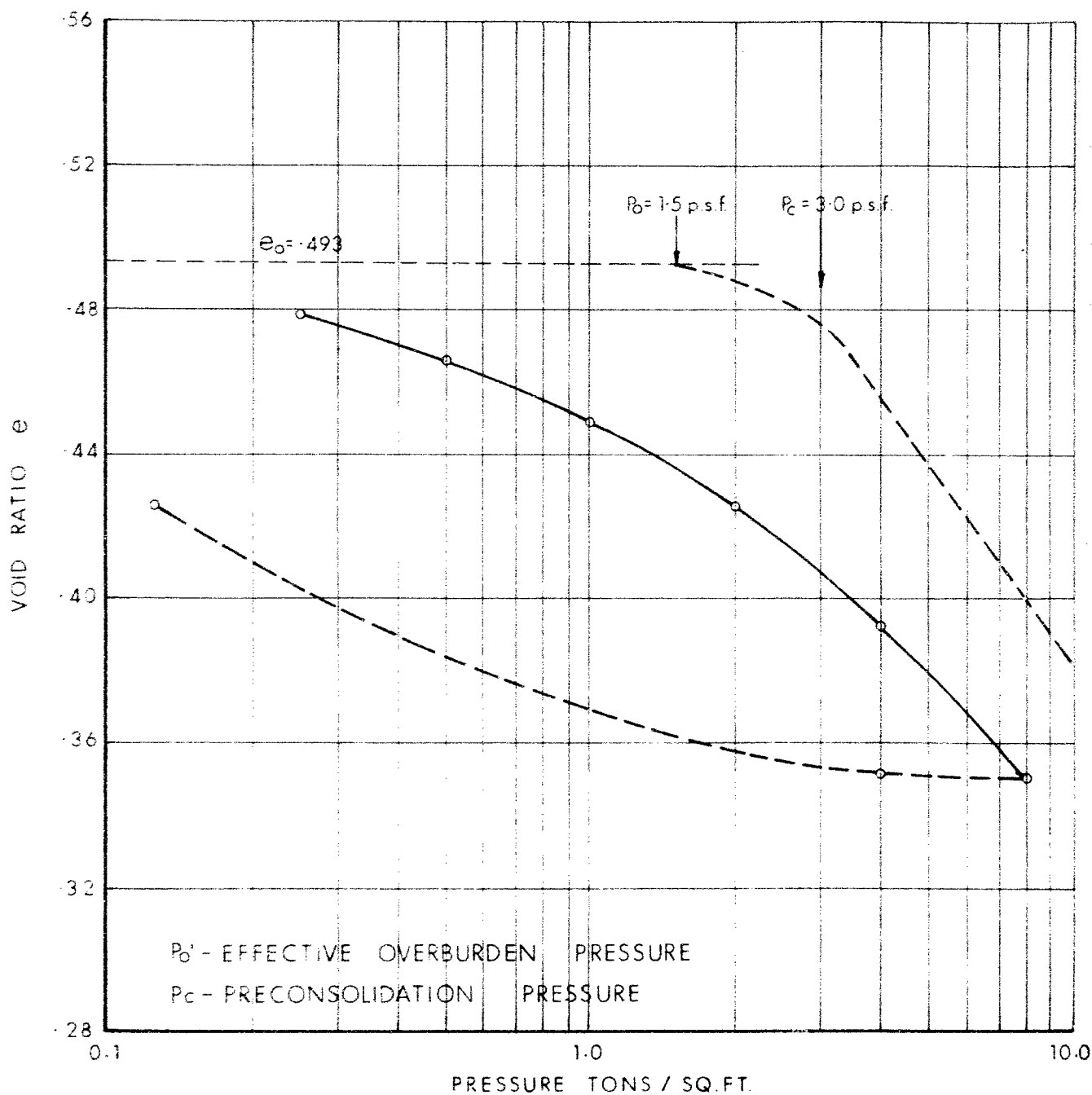


FIG. 7

VOID RATIO vs PRESSURE

$W_L = 32.2$

$W_p = 16.0$

$W = 20.4$

$C_c = 13.9$

BORE HOLE 31

SAMPLE 12

DEPTH 61'-4"

ELEV. 543.5

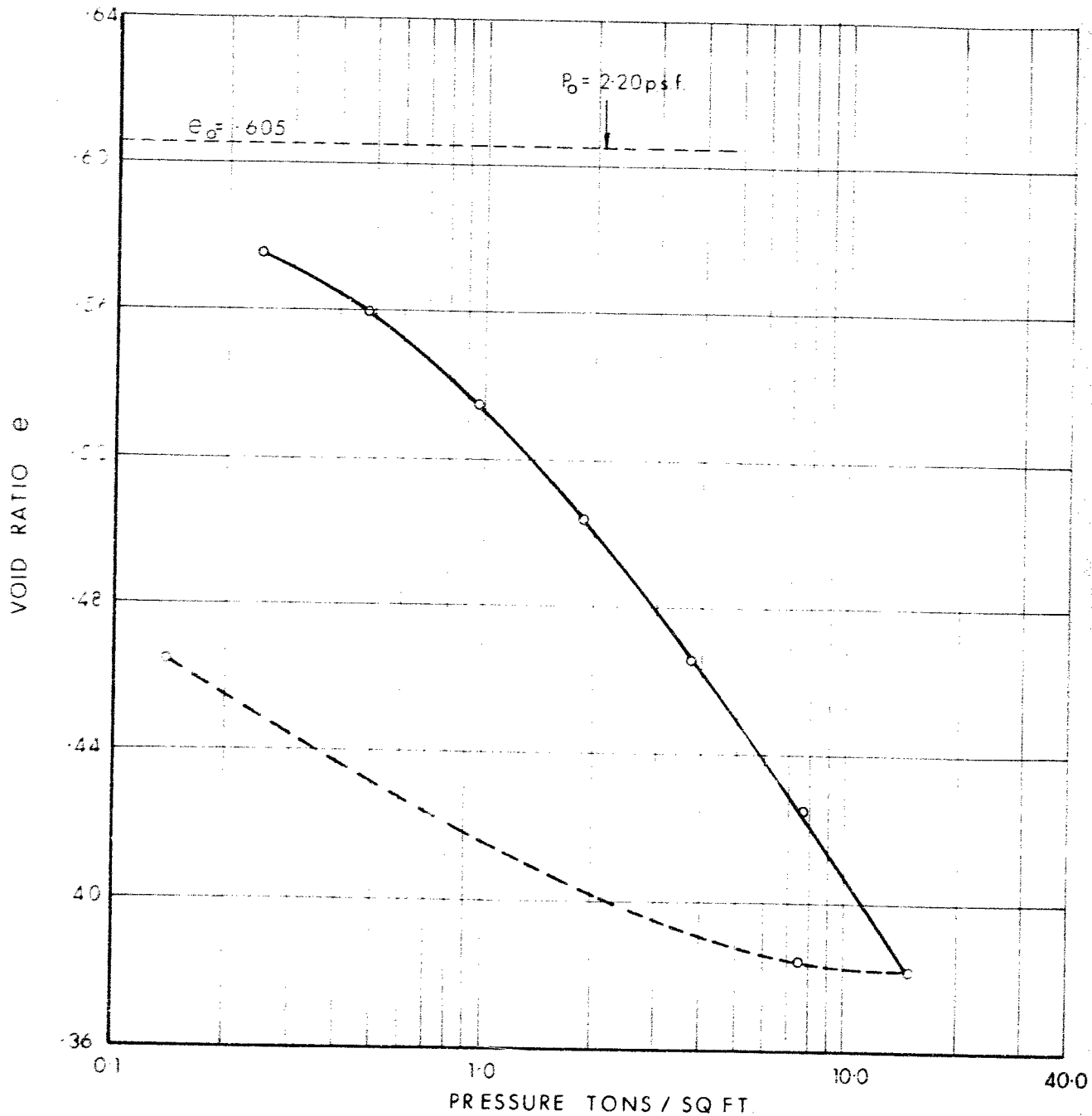


FIG. 8

VOID RATIO vs PRESSURE

$W_L = 29.7$

$W_p = 15.7$

$W = 23.0$

$C_c = 1.40$

BORE HOLE 31

SAMPLE 14

DEPTH 81'-4"

ELEV. 523.5

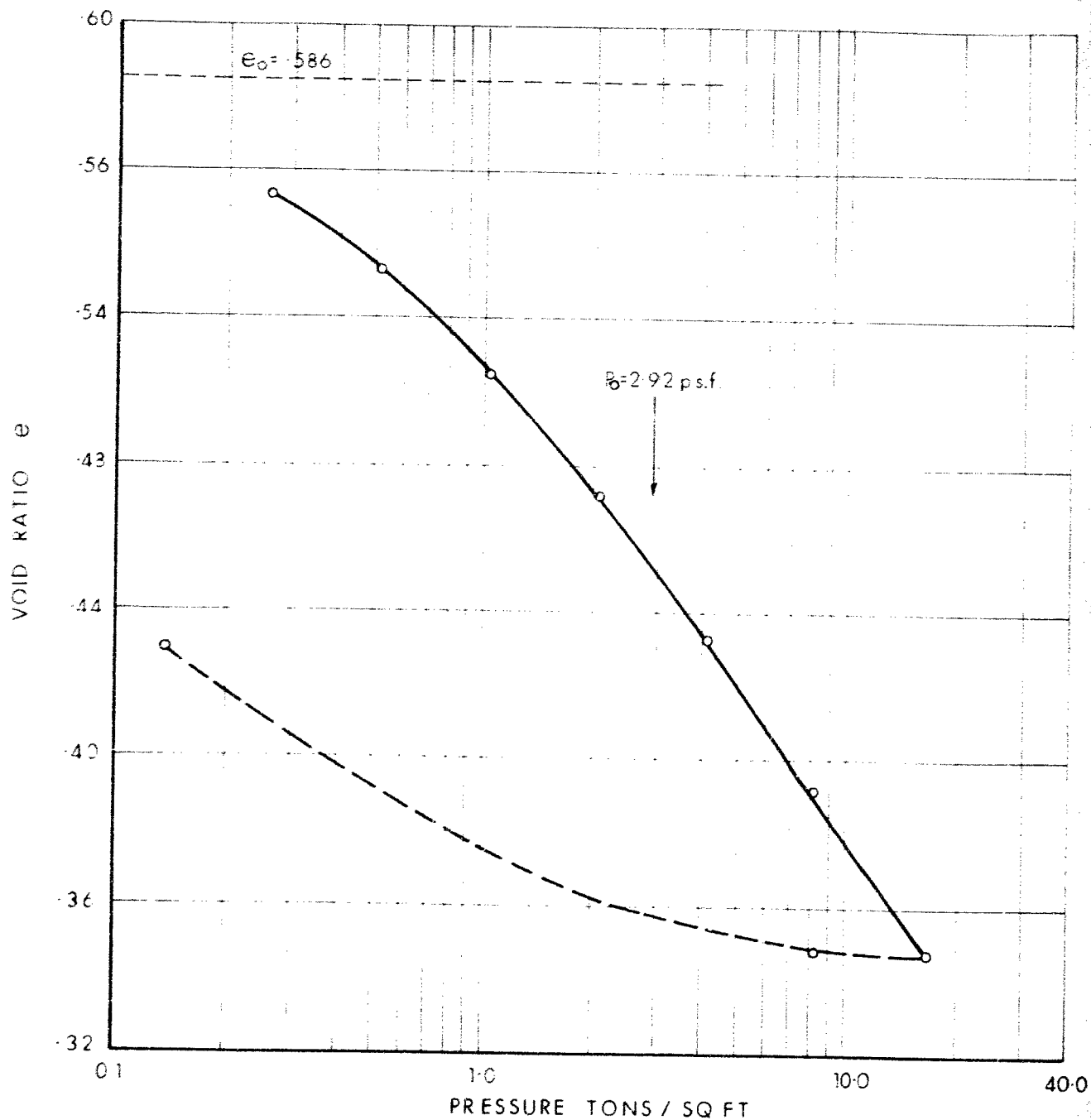


FIG. 9

VOID RATIO vs PRESSURE

$W_L = 26.9$

$W_p = 15.2$

$W = 17.7$

$C_c = 0.155$

BORE HOLE S1

SAMPLE 10

DEPTH 30'-2"

ELEV. 140.5

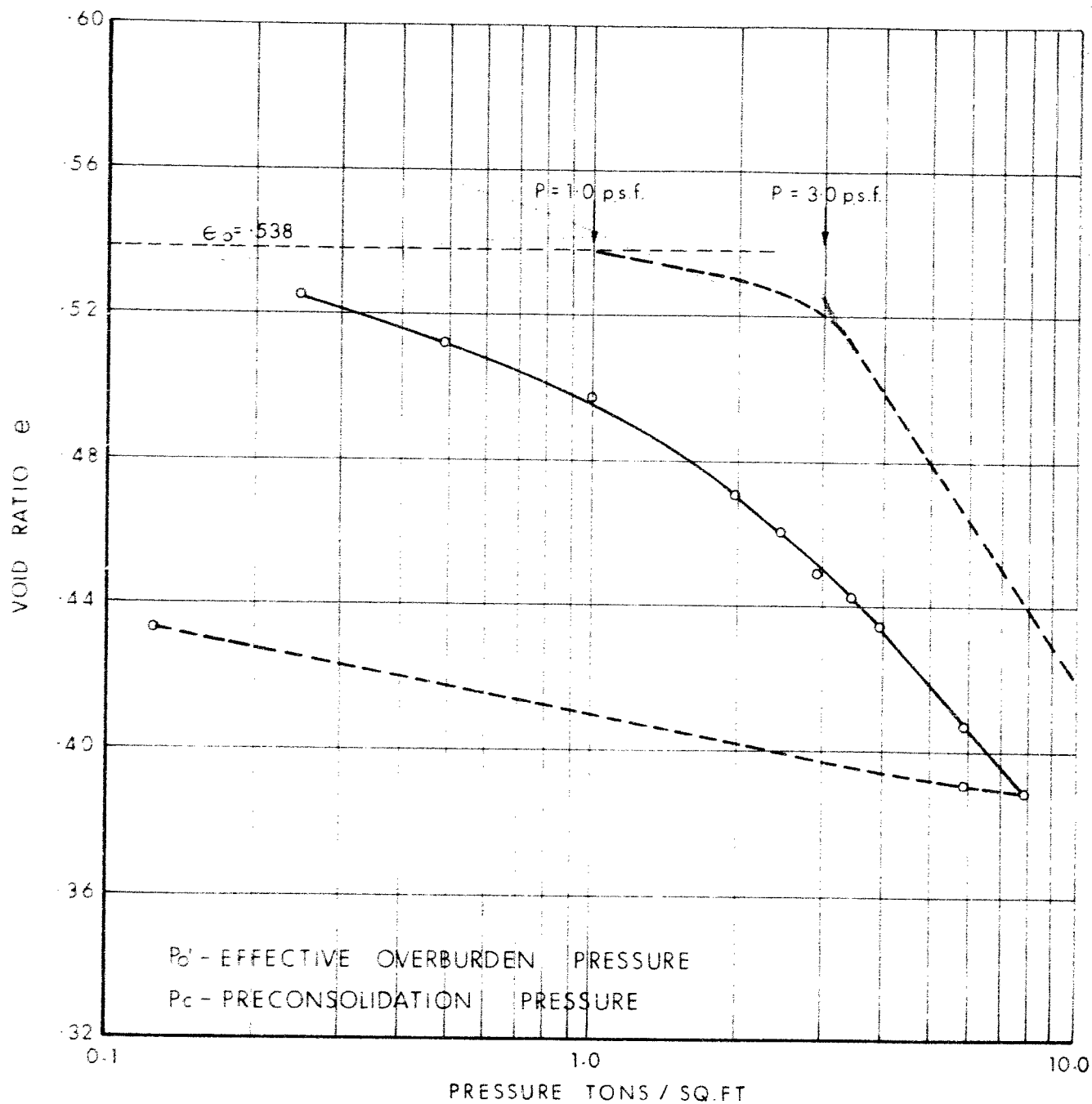


FIG. 10

SETTLEMENT UNDER FILL

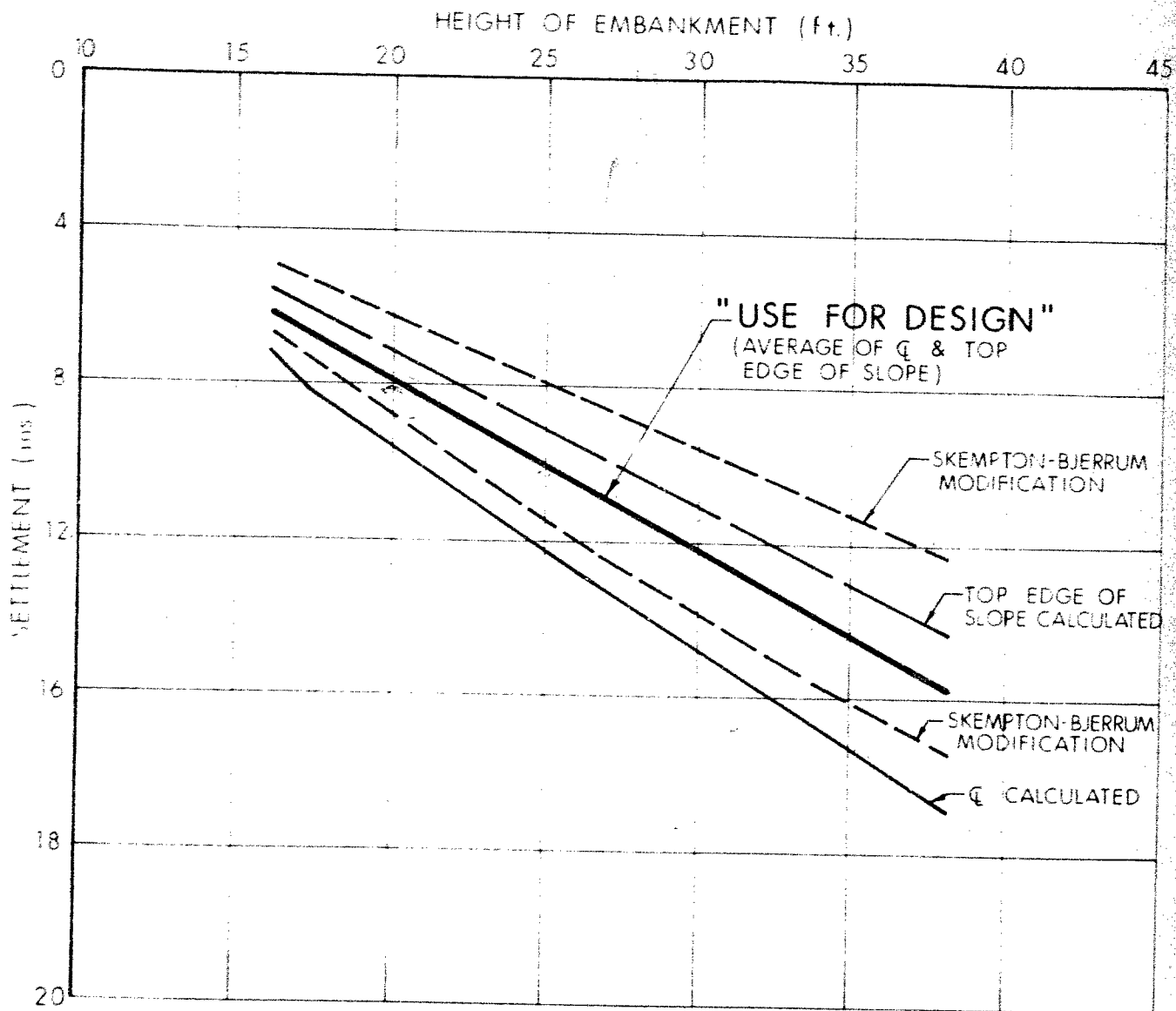


FIG. 11

TIME RATE OF SETTLEMENT

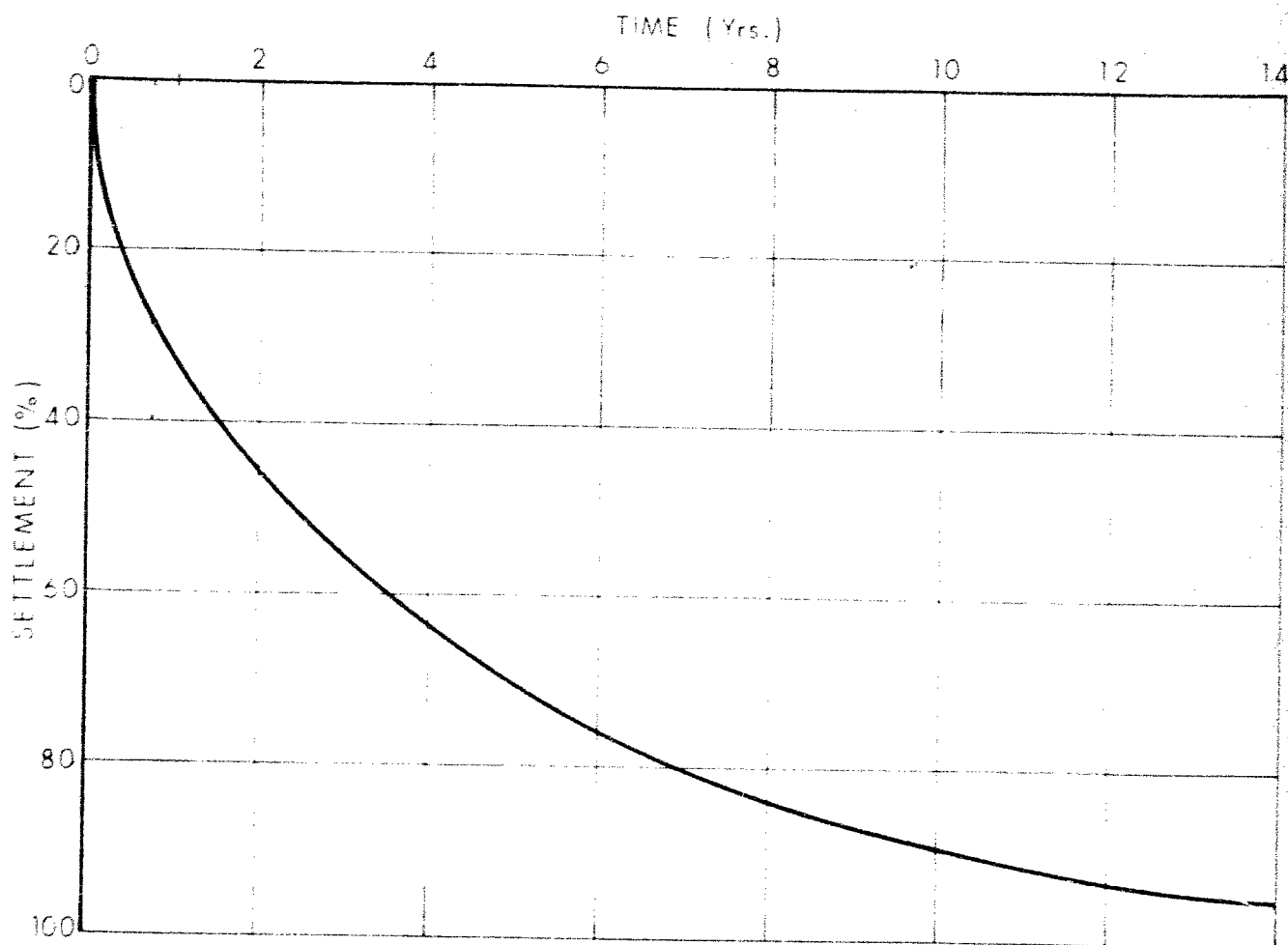


FIG. 13

B.H. No.	FIELD VANE		UNCON. COMP.		TRIAXIAL		
	Avg.	Min.	Avg.	Min.	Avg.	Min.	
1	1050(11)	800	585(3)	400	765(5)	475	66-F-92
2	1048(10)	720	750(7)	425	620(6)	250	
3	1080(11)	640	670(5)	350	575(5)	350	
4	1240(10)	960	1175(2)	1000	990(7)	750	
22	640(1)	640	1955(10)	900			
23			1919(2)	1178			
24	1580(7)	800	2510(9)	1448			
25	1150(7)	720	1010(7)	576			
26	1040(1)	1040	3400(4)	860			
27	1360(3)	1040	1550(3)	885	1273(2)	731	
28	920(8)	560	1280(4)	689	1320(4)	491	
29	830(6)	480	2520(4)	1130			
30	720(2)	480	835(6)	776			
31	2150(8)	1280	1420(8)	330			
32	960(3)	920	1510(3)	986			
33	2400(5)	1920	1940(3)	679			
34	1600(2)	1520	1430(3)	634			
35	1290(6)	1120	726(1)	726			
36			1670(1)	1670			
37							
38	1540(5)	1280	970(8)	384			
39	1370(3)	1040					
40							
41	1280(9)	1000	1010(11)	726			
42	1350(7)	1040	870(6)	529			
43	1190(6)	680	504(1)	504			
44	970(6)	640	482(1)	482			
45	820(5)	720	1730(3)	340			
46	1130(6)	880	924(4)	612			
47	1220(4)	880	619(2)	434			
48	1300(7)	960	938(6)	514			
49	1310(7)	880	760(4)	566			
50	1490(8)	1120	884(2)	744			
51	1280(2)	1120	1095(1)	1095			
52	1440(1)	1440	1428(1)	1428			
53	1410(3)	880					
54	1500(2)	1440	416(1)	416			
55	1480(7)	960	870(3)	829			
56	2220(7)	1600	884(1)	884			
57	960(3)	800	635(3)	507			
58							
59	1150(7)	1000	1480(6)	345			
60	1640(1)	1640					
61	1390(5)	960	1076(2)	589			
62	1180(5)	1040	671(2)	511			

TABLE NO 1 — UNDRAINED SHEAR STRENGTH (p.s.f.)
JOB No. 68-F-15-2

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

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

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

DESCRIPTION OF SOIL

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

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

TYPE OF SAMPLE

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

SOIL TESTS

Q _u	UNCONFINED COMPRESSION	L V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F V	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

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

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

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

EARTH PRESSURE

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

FOUNDATIONS

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

SLOPES

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

MEMORANDUM

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

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

Attention: Mr. S. McCombie

DATE: August 14, 1968

OUR FILE REF.

IN REPLY TO

AUG 21 1968

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For

Proposed E. C. Row Expressway
Howard Avenue to Hwy. 3B
District No. 1 (Chatham)

W.J. 68-F-15-2 -- W.P. 257-66-020 ✓

Attached, please find two (2) copies of the above mentioned report for your use.

When studying the report you will realize that in certain portions the report cannot be considered as final, since all the necessary information was not available at the time of the writing of this report.

Whenever the remaining problems are resolved and final decisions reached, we will then submit our final recommendations.

Should you, however, wish to discuss the report or any part of it, please feel free to contact this Office.

AGS/MdeP

Attach.

Messrs. B. R. Davis (2)

H. A. Tregaskes

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W. Zonnenberg

F. C. Brown

A. P. Watt

J. Roy (2)

B. A. Singh

A. G. Stermac
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PRINCIPAL FOUNDATION ENGINEER

Foundations Files ✓
Gen. Files

TABLE OF CONTENTS

1. INTRODUCTION.
 2. DESCRIPTION OF SITE:
 - 2.1) Topography.
 - 2.2) Physiography.
 3. FIELD WORK.
 4. LABORATORY TESTING.
 5. SOIL TYPES AND SOIL CONDITIONS:
 - 5.1) General.
 - 5.2) Fill Material.
 - 5.3) Clayey Silt with Sand and Traces of Gravel.
 - 5.4) Bedrock.
 - 5.5) Groundwater Conditions.
 6. DISCUSSION AND RECOMMENDATIONS:
 - 6.1) General.
 - 6.2) Embankment Stability.
 - 6.3) Structure Foundations.
 - 6.4) Settlements.
 7. MISCELLANEOUS.
-

FOUNDATION INVESTIGATION REPORT
For
Proposed E. C. Row Expressway
Howard Avenue to Hwy. 3B
District No. 1 (Chatham)
W.J. 68-P-15-2 -- W.P. 257-66-020

1. INTRODUCTION:

The Foundation Section has recently carried out detailed site investigations at the locations of structures and embankments to be constructed on the proposed E. C. Row Expressway in Windsor, Ontario. The request for this work was contained in a memo dated February 27, 1968, from Mr. J. B. Switzer, Expressway Design Engineer, London Region. A preliminary foundation report covering the area from Howard Ave. to Hwy. 3B, was carried out by this Section and reported in November, 1966. Recommendations in this report, which indicated stability and settlement problems, were incorporated into the Functional Report since prepared by M. M. Dillon Ltd.

On the section of the Expressway considered in this report, three main crossings are required: Howard Avenue, N.Y.C. Main Line & Railway Yards, and Hwy. 3B. In addition, a culvert and lined channel for the Grand Marais Drain will be required where it crosses the future Expressway; also, a bridge or culvert under Howard Avenue. At the present time, studies are underway to determine the most economical method of spanning this whole area. Certain considerations other than foundation conditions may well affect the final decision. The present detailed foundation investigation has, therefore, been carried out with a number of alternative methods of spanning the area in mind, and with a view to answering the following questions:

cont'd. /2 ...

1. INTRODUCTION: (cont'd.) ...

(1) For embankments, what is the section required to maintain stability?

(2) What alternative methods of founding the structure(s) are feasible from an engineering point of view?

(3) What will be the magnitude and duration of settlements which will occur under the structure(s) and embankments?

During the field and subsequent laboratory investigations the ultimate stage of the Expressway, as shown in the Functional Report, has been assumed to be applicable. The following pages of this report, therefore, include a description of soil conditions along the Expressway between Howard Avenue and Hwy. 3B, together with specific recommendations relating to structure foundations and the stability and performance of embankments.

2. DESCRIPTION OF SITE:

2.1) Topography:

The site is located in the south part of the City of Windsor and lies just south of a line joining E. C. Row Blvd. and 3rd Concession Road between Howard Avenue and Hwy. 3B. The N.Y.C. Main Line and Railway Yards traverse the approximate centre of the area with the tracks, six in all, running in a north-west to south-east direction. The Grand Marais Drain crosses the area and flows in a southwesterly direction and is about 3 ft. deep and about 15 ft. wide. Apart from the drain channel and the railway embankments which range in height from 10 ft. to 15 ft., the general area is relatively flat. Buildings in the area are mainly industrial apart from residential dwellings at the west side of the site along Hwy. 3B.

2.2) Physiography:

This site is located within the physiographical area known as the St. Clair Clay Plain. The glacial lakes Whittlesey and Warren which covered this area, effected a general levelling

cont'd. /3 ...

2. DESCRIPTION OF SITE: (cont'd.) ...

2.2) Physiography: (cont'd.) ...

of the basic clay till by covering its undulating surface with deposits of the clay. Later, this area was submerged again by Lake Michigan and received a deeper covering of clay and silt deposits.

3. FIELD WORK:

A total of 41 boreholes, together with 38 dynamic cone penetration tests, was carried out during the course of the field work. The depths of the borings ranged from 25 ft. to 120 ft. Drilling was carried out utilizing continuous flight auger machines for the shallower holes and conventional diamond drilling machines adapted for soil sampling purposes for the deeper holes. Undisturbed samples were recovered using 2-inch I.D. Shelby tubes which were pushed into the soil hydraulically or by hand. Disturbed samples were recovered using split-spoon samplers which were driven into the soil according to the requirements of the Standard Penetration Test. Where possible, field vane tests were carried out at elevations generally 12 inches below sample depths. Rock core samples were recovered in certain boreholes using AXT rock coring equipment. During drilling and sampling operations detailed logs of the boreholes were recorded which included descriptions of all soil types encountered, measurements of field vane tests, depths and types of samples recovered, and observations relating to groundwater conditions. This information is shown on the Record of Borelog sheets which form part of this report.

In order to provide additional information for settlement prediction purposes, two other boreholes were carried out at a nearby structure, Jackson's Park Overhead, where settlement measurements have been made over the last 5 years. One borehole was carried out through the 28-ft. high embankment where the largest settlement has occurred, and the other at the side of the

cont'd. /4 ...

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

fill where no settlements have taken place. These boreholes are numbered S 1 and S 2 and the logs are included in the report Appendix.

All boreholes were located in the field by personnel from District #1 Construction staff working in conjunction with London Region Engineering Surveys Section. The locations and elevations of the borings are shown on the attached Drawing 68-P-15-2A.

4. LABORATORY TESTING:

All samples were subjected to a careful visual inspection in the laboratory and classified according to soil type. Following this inspection, laboratory tests were carried out on selected samples to determine the following physical properties:

- Atterberg Limits
- Moisture Content
- Undrained Shear Strength
- Grain-Size Distribution
- Bulk Density
- Consolidation Characteristics
- Effective Stress Parameters

In order to determine the effect of the 28-ft. high embankment at Jackson's Park Overhead, on the underlying subsoil layers, consolidation tests were carried out on selected samples from B.H. S 1 and on samples from the same elevations from B.H. S 2. Compression tests were also carried out on samples at corresponding elevations to determine the effect of the embankment on the undrained shear strength of the subsoil.

The results of the various tests are summarized in the Appendix of this report, and are discussed in some detail under 'Soil Types and Soil Conditions'.

cont'd. /5 ...

5. SOIL TYPES AND SOIL CONDITIONS:

5.1) General:

Generally uniform subsoil conditions were found to prevail over the site area. Deposits of fill material highly variable in constituent material and vertical extent, however, were found to overlie the natural deposits. The subsoil consists of a deep deposit of clayey silt with sand and traces of gravel overlying limestone bedrock. The boundaries between different deposits are shown on the Record of Borehole sheets attached to the Appendix. The estimated stratigraphical profiles of Drawing 68-F-15-2A, B and C are based upon this information. From ground level downward, the various strata are described in detail with regard to soil types and soil properties, as follows:

5.2) Fill Material:

This material was encountered in most of the borings located east of Cameron Blvd. The thickness varies from 2 ft. to 19 ft., the highest contact elevation being 618.0 ft., and the lowest, 582.0 ft. The material in the deposit consists of various mixtures of gravel, sand, silt, clay and rubble, such as cinders and debris from old buildings. Since the material consists of such a heterogeneous mixture of soils and rubble, no general description of soil types and properties is applicable. The Record of Borelog sheets, however, contains descriptions of the particular soil encountered in each borehole, together with the results of laboratory tests carried out on individual samples.

5.3) Clayey Silt with Sand and Traces of Gravel:

This deposit was intersected in all borings and is the main subsoil stratum at the site. It extends from immediately below the topsoil, or the above mentioned fill material, down to the bedrock surface for depths of 100 ft. to 125 ft. The material in the deposit consists of clayey silt with sand and traces of gravel. A plot of Plasticity Index versus Liquid Limit (Fig. 1) shows the great majority of the points to fall within the CL zone.

cont'd. /6 ...

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

5.3) Clayey Silt with Sand and Traces of Gravel: (cont'd.) ...

In some boreholes thin layers of granular soils were found to occur within the main deposit. A desiccated zone with a thickness ranging from 15 ft. to 20 ft. was found in the majority of boreholes to extend from the upper surface of the stratum. This zone is brown in colour due to oxidation and apart from the upper 3 to 5 ft. (frost affected zone), has a very stiff to hard consistency: Standard Penetration Test 'N' values ranged from 26 to 75 blows/ft. Below the desiccated layers the colour of the soil is grey and the consistency ranges somewhat randomly from firm to very stiff. Although conditions over the whole site area may be regarded as generally uniform, some differences, particularly with regard to surface deposits and, in particular, undrained shear strength, are apparent in the vicinity of the existing Grand Marais Drain. Here, the conditions were found to be more unfavourable than elsewhere.

Physical properties of the deposit as determined from field and laboratory tests, are discussed separately below under the appropriate heading:

Undrained Shear Strength:

The consistency or undrained shear strength of the overall deposit was found to range from soft at the extreme surface to hard in the desiccated zone to firm to very stiff in the layers below the desiccated zone. Within the desiccated zone, and based on Standard Penetration Test results only, the undrained shear strength is estimated to be in the order of 2,500 p.s.f. to 10,000 p.s.f. For the soil below the desiccated zone field vane tests, unconfined compression tests and triaxial compression tests were carried out to determine the undrained shear strength. All of these results are plotted on Fig. 3 of the Appendix. Table I shows the computed numerical average results for each borehole for each type of test, together with the minimum results

cont'd. /7 ...

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

5.3) Clayey Silt with Sand and Traces of Gravel: (cont'd.) ...

Undrained Shear Strength: (cont'd.) ...

obtained. From all of these results it can be seen that the undrained shear strength of the undesiccated portion of the overall deposit ranges from about 650 p.s.f. to about 3000 p.s.f.

In order to arrive at suitable estimates of undrained shear strength values for design purposes, all of the test results have been carefully reviewed and have been separated into two main groups. Group I consists of all results obtained from borings not in the vicinity of the Grand Marais Drain. At these locations the estimated soil parameters are as follows:

El. 602 - El. 582	:	C = 2500 p.s.f.	$\gamma = 135$ p.c.f.
582 - 572	:	1250	135
572 - 552	:	750	135
552 - 542	:	850	135
542 - 532	:	1050	135
532 - 522	:	1250	135

Group II consists of all results obtained from borings in the vicinity of the Grand Marais Drain. Here the estimated soil parameters are as follows:

El. 603 - El. 600	:	$\phi = 35^\circ$	$\gamma = 130$ p.c.f.
600 - 591	:	C = 2250 p.s.f.	$\gamma = 135$ p.c.f.
591 - 582	:	1050	135
582 - 550	:	900	135
550 - 539	:	1000	135

Typical stress-strain curves obtained from unconfined compression tests, are shown on Figures 4 and 5 of the Appendix.

cont'd. /8 ...

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

5.3) Clayey Silt with Sand and Traces of Gravel: (cont'd.)

Consolidation:

A number of consolidation tests were carried out on samples from various depths. The Void Ratio - Log Pressure Curves obtained from these tests are shown on Figures 6 - 10 inclusive of the Appendix. Since the original curves produced from the laboratory tests indicated some degree of 'disturbance' of the soil structure, a procedure of correction using a method proposed by Schmertmann in 1955, was followed. From the corrected curves the following has been deduced:

Apart from the desiccated zone which is overconsolidated to a high degree, the upper 50 ft. of the deposit is overconsolidated by about 1.5 t.s.f. Below this level the deposit is normally consolidated.

Plasticity:

The following results were obtained from Atterberg Limit Tests:

Plastic Limit	:	11% to 25%
Liquid Limit	:	17% to 35%
Moisture Content	:	8% to 29%

These results are plotted on Figure 1.

Bulk Density:

The bulk density was found to range from 127 p.c.f. to 141 p.c.f.

Grain-Size Distribution:

Typical grain-size distribution curves are shown on Figure 2 of the Appendix.

cont'd. /9 ...

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

5.4) Bedrock:

Bedrock was proved at 7 locations by obtaining AXT rock core samples. The rock was found to be sound limestone. A description of the rock cores made by Mrs. Z. Koniuszy, Materials and Testing Division, Geologist, follows:

"The bore holes of the project 68-F-15-2 from the Howard Avenue and Hwy. 3B area were drilled in Detroit River Formation of the Middle Devonian System.

"The rock intersected in both holes is: high in calcium, medium crystalline limestone, medium in hardness. In colour it ranges from light grey to tan and contains abundant fossils.

"Drilling samples show sound unweathered rock, and it is reasonably certain that holes were drilled in the bedrock."

5.5) Groundwater Conditions:

No artesian pressures were observed during the field investigation. Groundwater levels, as observed in the borings, are shown on the Record of Borelog sheets in the Appendix. These levels ranged from el. 594.0 to el. 609.0, but may be expected to vary seasonally.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

The section of the E. C. Row Expressway covered in this report, extends from Howard Avenue to Hwy. 3B. On this section three main crossings are required: Howard Avenue, N.Y.C. Main Line & Railway Yards, and Hwy. 3B. In addition, culverts and lined channels will be required to carry the Grand Marais Drain under the Expressway and Howard Avenue. At the present time a number of uncertainties exist regarding the exact location of the centre-line

cont'd. /10 ...

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

6.1) General: (cont'd.) ...

of Expressway, the lengths and locations of the various structures, and the exact location of the Grand Marais Drain. It is felt, however, that due to the general uniformity of soil conditions over the whole of the site area, foundation recommendations can be made which will be generally valid for a variety of possible lines and structure locations. Nevertheless, it may be necessary, when the final scheme is definitely decided upon, to obtain additional field information and to revise some of the recommendations.

The main foundation problems which present themselves at this site are those relating to slope stability, settlement of the subsoil under imposed loads and the safe bearing capacity of the subsoil. Since the subsoil consists, in the main, of a deep cohesive deposit with consistencies ranging from soft to hard, all of these problems warrant consideration and are discussed separately below, under appropriate headings:

6.2) Embankment Stability:

The highest proposed embankment at the present time is in the vicinity of the N.Y.C. Main Line (approx. Sta. 286+00). There, the maximum height is 38 ft. Stability analyses, in terms of total stresses, have been carried out with the following assumptions of soil properties:

Fill Material	γ = 135 p.c.f.
	C = Zero ϕ = Zero
Subsoil (Clayey Silt)	γ = 135 p.c.f.
	C = 2500 p.s.f. (el. 602 - 582)
	C = 1250 p.s.f. (el. 582 - 572)
	C = 750 p.s.f. (el. 572 - 552)
	C = 850 p.s.f. (el. 552 - 542)
	C = 1050 p.s.f. (el. 542 - 532)
	C = 1250 p.s.f. (el. 532 - 522)
	C = 1450 p.s.f. (el. 522 - 512)

cont'd. /11 ...

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

6.2) Embankment Stability: (cont'd.) ...

The results of these stability analyses indicated that, even with the assumption of zero strength in the fill and with fairly conservative assumptions regarding the undrained shear strength of the subsoil, 38 ft. high fills constructed with 2:1 side and forward slopes would be stable. It therefore follows that elsewhere on the project, apart from the immediate vicinity of the Grand Marais Drain where less favourable conditions prevail, there are no stability problems with regard to the proposed embankments, all of which are less than 38 ft. in height.

In the vicinity of the existing Grand Marais Drain the problem of slope stability is somewhat more critical than elsewhere. Stability analyses have been carried out, in terms of total stresses, with the following assumptions:

Fill Material	γ = 135 p.c.f. (Height = 35 ft. above Channel Bed)
	C = 500 p.s.f.
Subsoil (Sand)	γ = 130 p.c.f.
	ϕ = 35°
(Clayey Silt)	γ = 135 p.c.f.
	C = 2250 p.s.f. (el. 600 - 591)
	C = 1050 p.s.f. (el. 591 - 582)
	C = 900 p.s.f. (el. 582 - 550)
	C = 1000 p.s.f. (el. 550 - 539)

It was found that for circular arcs at right angles to the centre-line of Expressway and passing under the proposed channel for the drain, the safety factor was not acceptable. To achieve a stable section, therefore, it may be necessary to construct berms which will result in the culvert being lengthened somewhat. Specific recommendations cannot of course be made until the exact location of the drain is known, and it may also be necessary to obtain additional field information.

cont'd. /12 ...

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

6.3) Structure Foundations:

At the present time, it is not exactly certain what form the proposed structure or structures are likely to take. A scheme has been prepared by the Regional Bridge Design Engineer, Mr. J. L. Keen, assuming the entire area in question, to be crossed by a multispan structure. Borings were carried out at each of the proposed pier locations. The following Table shows the recommended footing elevations for each of the proposed piers, together with the estimated safe bearing pressures at these elevations. In studying this Table, reference should be made to Drawing 68-F-15A for borehole locations.

<u>Pier No.</u>	<u>B.H. No.</u>	<u>Footing El.</u>	<u>Pier No.</u>	<u>B.H. No.</u>	<u>Footing El.</u>
1	4	597	21	39	600
2	23	598	22	41	595
3	23	598	23	42	595
4	24	598	24	43	599
5	25	598	25	44	598
6	26	598	26	45	-
7	27	597	27	47	593
8	28	597	28	3	595
9	29	597	29	3	595
10	30	597	30	49	-
11	31	597	31	46	-
12	32	599	32	57	596
13	33	598	33	56	594
14	34	593	34	61	597
15	35	593	35	62	598
16	36	597	36	59	595
17	36	598	37	55	597
18	37	602	38	55	597
19	38	598	39	2	597
20	40	598	40	50	597

Safe Pressure 2.5 T.S.F.

cont'd. /13 ...

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

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

At Piers 26, 30 and 31, spread footings are not recommended since the depth of excavation would be prohibitive.

As an alternative to spread footing type foundations, piled foundations may be considered. For end-bearing piles the most suitable type would be steel H-piles driven to bedrock in which case the maximum allowable load for the particular steel section may be assumed. For friction piles it is believed that treated timber piles would be the most efficient and hence economical. For design purposes, it can be assumed that No.14 timber piles with embedded lengths of 50 feet will support safe loads of about 30 tons per pile. In this case it would be extremely advantageous to carry out pile loading tests to more accurately determine a suitable working load.

In the event that footings are supported on spread footings, or on friction piles, the question of settlement must be taken into consideration. This is fully discussed below.

6.4) Settlements:

Because of the compressible nature of the subsoil, it is inevitable that consolidation settlements will occur over a long-term period due to the imposed loads of structures and embankments. It has been found from experience that purely theoretical calculations generally result in overestimates of settlements. For this project, therefore, case histories of two sites with similar soil conditions where settlements have actually been measured, have been taken into account. These sites are Jackson's Park Overhead in Windsor, and the C.N.R. Overhead on Hwy. 40A near Sarnia. As a result of our study of the settlements at Jackson's Park and the soil properties at that site, it is believed that by using the following procedure, settlements can be predicted with reasonable accuracy:-

cont'd. /14 ...

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

6.4) Settlements: (cont'd.) ...

Initially, the laboratory e log p curves are corrected using the method proposed by Schmertmann in 1955. Settlements are then calculated in the conventional manner, then corrected according to the method proposed by Skempton & Bjerrum (1957):

$$P_f = P_i + \mu P_{oed}$$

where P_f = final settlement
 P_i = immediate settlement
 P_{oed} = settlements calculated from oedometer test results.
 μ = a factor depending chiefly on the pore pressure coefficient 'A' and the past geological history.

A value of $\mu = 0.75$ has been assumed. The immediate settlement P_i has been estimated from the time-settlement records of Jackson's Park Overhead.

Settlements have been calculated, using the foregoing procedures, for various heights of fill, under the centre and the outside edge of shoulder. In these calculations, it is assumed that the desiccated portion of the subsoil is, to all intents and purposes, incompressible. Figure 11 shows a graphical representation of settlement versus embankment height. It is suggested that the Skempton-Bjerrum curves be assumed to be applicable, and that the average settlement be taken to be the mean of that at the centre and that at the edge of shoulder. Past experience has shown that the settlements at the centre and at the edge are approximately equal. Figure 13 shows the time versus the % of total settlement expected to occur. This curve has been constructed from theoretical considerations and from a study of the Jackson's Park settlements. The curves on Figures 11 and 13 may be used to estimate settlements of the embankments along the entire length of the Expressway from Hwy. 3B to Howard Avenue.

cont'd. /15 ...

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

6.4) Settlements: (cont'd.) ...

Using the same procedures, settlements under abutment footings constructed in the same way as Jackson's Park Overhead, have been computed and are shown graphically on Figure 12. Again the Skempton - Bjerrum Curve should be assumed to be applicable. The time effect may be determined from Figure 13. It will be noticed that the settlement of an abutment is theoretically somewhat less than the fill immediately behind it. This is of course due to the fact that the load imposed by the embankment is greater than that imposed by the structure. However, this difference is not expected to show up as a sudden break, but as a smooth transition over a distance of 20 or 30 feet.

For the structure piers, it is estimated that settlements of spread footings or of footings supported on friction piles will be in the order of 1-1/2 to 2 inches.

It should be noted that the above mentioned settlements of approach fills do not include the settlements within the fill material itself. Depending on the degree of compaction achieved, settlements of the fills up to about 2% of the total height, can be possible. A case of an embankment constructed of a clayey silt sand and gravel mixture which settled about 2% of its total height, has been recorded. It is recommended that this point be taken up with the Regional Soils Engineer.

It would be extremely advantageous to construct the embankments well in advance of the structures in order to minimize future differential settlements. Consideration should also be given to surcharging at critical locations, such as abutments. As a means of checking the predicted settlements, settlement plates should be installed prior to placing fill material. Measurements may then be carried out and, if necessary, the curves of predicted settlement shown on Figures 11, 12, and 13 modified.

cont'd. /16 ...

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

6.4) Settlements: (cont'd.) ...

Various utilities may be located under the Expressway before and even after the fills are constructed. The settlement curves of Figures 11, 12, and 13 may be used to determine the amount of settlement that utilities may be subjected to at any given time. It should be borne in mind that the upper 20 ft. of subsoil has been assumed to be incompressible, and will therefore settle the full amount shown on the curves since the underlying undesiccated soil is the zone which compresses. Where possible, utilities should be routed through the structure openings, and it can be assumed that about 10 ft. away from the toes of embankment slopes, no settlement will occur.

7. MISCELLANEOUS:

The field work for this project was carried out during the period February and March, 1968. Equipment used was owned and operated by Canadian Longyear Ltd. The project was supervised by Mr. P. Payer, Project Foundation Engineer, who also prepared this report with the assistance of Mr. A. Prakash. Mr. K. G. Selby reviewed the report.

August, 1968.

REFERENCES

1. SCHMERTMANN, J. M. (1955), "The Undisturbed Consolidation Behavior of Clay," Transactions, American Society of Civil Engineers, Vol. 120, pp. 1201 - 1233.
2. SKEMPTON, A. W. and BJERRUM, L. (1957), "A contribution to the Settlement Analysis of Foundations on Clay," Geotechnique, Vol. 7, No. 4, pp. 168-178.

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION
JOB 68-F-15
W P
DATUM Geodetic

LOCATION Jackson Park Overhead
BORING DATE March 28, 29, 30, 1968
BOREHOLE TYPE Continuous Flight Auger & Washbore

FOUNDATION SECTION
ORIGINATED BY PP
COMPILED BY PP
CHECKED BY

RECORD OF BOREHOLE NO. S-1

SOIL PROFILE		SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W			BULK DENSITY PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE		SHEAR STRENGTH P S F ○ Unconfined • Quick Triaxial + Field Vane					WATER CONTENT % 10 20 30				
614.4	Ground Level					500	1000	1500	2000	2500					Gr.Sa.Si.Cl
0.0	Clayey silt with sand and traces of gravel Occasional layers of silty clay and sandy silt. Firm to Hard		1	TW	PH									126	4 26 41 29 2 27 46 25 5 28 41 26 2 26 41 31 6 26 40 28 3 27 42 28 2 26 41 31 2 24 44 30 0 2 39 59
			2	TW	PH									124	
			3	TW	PH									137	
			4	SS	7L										
			5	SS	36										
			6	TW	PH									136	
			7	TW	PH										
			8	TW	PH									133.5	
			9	TW	PH									134.0	
			10	TW	PH									133	
			11	TW	PH									133	
			12	TW	PH									133	
			13	TW	PH									133	
			14	TW	PH									135	
			15	TW	PH									133	
			16	TW	PH									134	
			17	TW	PH									131	
			18	TW	PH									133	
			19	TW	PH									130	
			20	TW	PH									131	
			21	TW	PH									129	
			22	TW	PM									130	
			23	TW	PM									131	
			24	TW	PM										
			25	TW	PM									131	
			26	TW	PM										
			27	TW	PM										
			28	TW	PM									115	
			29	TW	PM									117.5	
			30	TW	PM									115	
			31	SS	40										
			32	SS	57										
			33	SS	25										
			34	TW	PM									132	
			35	TW	PM									130	
			36	TW	PM										
			37	TW	PM										
484.3	Probable Bedrock End of Borehole														
130.1															
						480									

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. S-2

FOUNDATION SECTION

JOB 68-F-15 LOCATION Jackson Park Overhead ORIGINATED BY PP
W P BORING DATE COMPILED BY PP
DATUM Geodetic BOREHOLE TYPE Washbore - NX & BX Casing CHECKED BY

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — WL			BULK DENSITY PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P S F					WATER CONTENT %				
							+ Field Vane Test					WP — W — WL				
633.7	Ground Level						500	1000	1500	2000	2500	10	20	30		Gr.Sa.Si.Cl
0.0																
	Clayey silt with sand and traces of gravel.		1	TW	12	630										8 33 40 19
			2	TW	10											1 93 (6)
			3	TW	29											0 94 (6)
			4	TW	38	620										0 96 (4)
			5	TW	46											
	Occ. layers of silty clay and sandy silt.		6	SS	58/7"											
			7	SS	29	610										
			8	SS	16											
			9	SS	53											
			10	SS	87											
			11	SS	89	600										
			12	SS	35											
	Firm to Hard.		13	TW	PM										140	2 29 41 28
			14	TW	PM											4 23 43 30
			15	TW	PM	590										
			16	TW	PM										133.5	3 73 17 7
			17	TW	PM										134	2 27 40 31
			18	TW	PM										133	2 26 44 28
			19	TW	PM	580									134	
			20	TW	PM											
			21	TW	PM										132	4 29 39 28
			22	TW	PM										137	
			22A	TW	32	570										
			23	SS	11											
			24	TW	PM											
			25	TW	PM											
			26	TW	PM	560									139	1 34 51 14
			27	TW	PM											
			28	TW	PM											
			29	SS	51	550										
			30	TW	PM										133	
			31	TW	PM											
			32	TW	PM	540										
			33	TW	PM											
			34	TW	PM											
			35	SS	8										122	1 12 40 47
			36	TW	PM	530										
			37	TW	PM											
			38	TW	PM											
			39	TW	PM	520										
			40	TW	PM										137	5 22 52 21
			41	TW	PM										138	10 30 40 20
			42	TW	PM											
			43	TW	PM	510										
			44	TW	PM											
			45	TW	PM											
			46	TW	PM	500										
			47	TW	PM											
			48	TW	PM											
			49	TW	PM	490										
			50	TW	PM											
			51	SS	50/8"											
484.6	Probable Bedrock															
440.7	End of Borehole															

DEFECTS IN RECORDING DATA TO
CONDITION OF ORIGINAL RECORDING

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1 (66-F-92)

FOUNDATION SECTION

JOB 68-F-15-2

LOCATION _____ Co-ords 99.632 N; 67.891 E.

ORIGINATED BY PP

W. P. 257-66-020

BORING DATE Oct. 26, 27 & 28, 1966

COMPILED BY _____ PF _____

DATUM Geodetic

BOREHOLE TYPE Washbore NX & BX Casing

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 68-F-15-2

LOCATION

Co-ords. 99,392 N; 68,895 E.

FOUNDATION SECTION

W.P. 257-66-020

BORING DATE

November 3 & 4, 1966

ORIGINATED BY PP

DATUM Geodetic

BOREHOLE TYPE

Washboring - NX & BX Casing

COMPILED BY PP

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT						LIQUID LIMIT — L PLASTIC LIMIT — P WATER CONTENT — W			BULK DENSITY P C F	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P S F ○ Unconfined • Quick triaxial + Field Vane					WATER CONTENT %					
603.0	Ground Level						500	1000	1500	2000	2500	10	20	30		Gr.Sa.Si.Cl	
0.0	Gravelly Sand					600											
597.5	Fill		1	SS	20											594.3	
5.5	Clayey silt with sand & traces of gravel. Brown & Grey Soft to Hard. Firm		2	SS	18											5 61 23 11	
			3	SS	41												
			4	SS	31	590											
			5	SS	9												
			6	TW	PM			+2.5								132	5 29 40 26
			7	TW	PM			+2.0								131	
			8	TW	PM	580		+2.0								133	
			9	TW	PM			+2.0								132	
			10	TW	PM			+2.2								136	5 33 37 25
			11	TW	PM	570		+2.5								136	
			12	TW	PM			+2.4									
			13	TW	PM	560		+2.6								133	3 27 41 29
			14	TW	PM			+2.3									
			15	TW	PM	550		+3.4								125	
					540										127.5		
		16	SS	6	530												
					520												
		17	SS	19	510												
		18	SS	24	500												
					490												
485.5																	
487.5	Limestone																
480.5	Bedrock																
482.5	End of Borehole					480											

DEFECTS IN REPRODUCTION
CONDITION OF ORIGINAL DOCUMENT

FOUNDATION SECTION

ORIGINATED BY PP

COMPILED BY RR

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 22

FOUNDATION SECTION

JOB 69-F-15-2 LOCATION N. 99,471 E. 67,090 ORIGINATED BY AP
W P 257-66-020 BORING DATE March 5 & 6, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY 122

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE						LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W			BULK DENSITY PCF	REMARKS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	BLOWS / FOOT 20 40 60 80 100					SHEAR STRENGTH P S F o Unconfined Comp. + Field Vane					WATER CONTENT % 10 20 30																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
604.2	Ground Level							500	1000	1500	2000	2500																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

DEPARTMENT OF HIGHWAYS - ONTARIO		RECORD OF BOREHOLE NO. 23		FOUNDATION SECTION	
MATERIALS & TESTING DIVISION					
JOB <u>68-F-15-2</u>	LOCATION <u>N. 99.598 E. 67.240</u>	ORIGINATED BY <u>AP</u>			
W. P. <u>257-66-020</u>	BORING DATE <u>March 27, 1968</u>	COMPILED BY <u>AMS</u>			
DATUM <u>Geodetic</u>	BOREHOLE TYPE <u>Cont. Flight Auger</u>	CHECKED BY <u>LL</u>			

[illegible]

CHECKED BY

FOUNDATION SECTION

[illegible]

MATERIALS & TESTING DIVISION

FOUNDATION SECTION

ORIGINATED BY AP

COMPILED BY **AMS**

CHECKED BY

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

FOUNDATION SECTION

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 27

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 68-F-15-2

LOCATION N. 99,448 E. 67,526

ORIGINATED BY AP

W. P. 257-66-020

BORING DATE March 7, 1968

COMPILED BY AMS

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

[illegible]

SOIL PROFILE			SAMPLES	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	Liquid Limit --- W _L Plastic Limit --- W _P	BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER TYPE BLOWS / FOOT	20 40 60 80 100 Shear Strength P.S.F.	WATER CONTENT % --- W _p --- W _L	P.C.F.	
603.6	Ground Level						Gr.Sa.St.Cl
0.0	VSTH Clayey silt with sand, traces of gravel.		1 TW PH	600			Δ 602.1
			2 TW PH/9"				3 28 35 34
			3 SS 100/9"		100/7"		
			4 SS 33	590			
			5 TW PH				
			6 TW PH				139
				580			138
			7 TW PH	+ 1.6			
	Firm to Hard.		8 TW PM	+ 2.2			135
			9 TW PH				
	Firm to Dense.		10 TW PM	+ 1.5			133
				560			
			11 TW PM	+ 2.0			133
				550			
			12 TW PM	+ 1.9			134
				540			
			13 TW PM	+ 2.3			
				530			
			14 TW PM	+ 1.6			129
				520			137
			15 TW PM				
				510			
			16 SS 31		1.8		
				500			
423.7							
109.7	Silty sand with traces of gravel. Dense.		17 SS 36				
489.9							
113.7	Limestone			490			
484.9	Bedrock						
118.7	End of Borehole			480			

**DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT**

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 68-F-15-2

LOCATION N. 99,416 E. 67,680

ORIGINATED BY AP

W P 257-66-020

BORING DATE March 8, 1968

COMPILED BY AMS

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 30

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 68-F-15-2

LOCATION N. 99,500 E. 67.760

ORIGINATED BY AP

W P 257-66-020

BORING DATE March 11, 1968

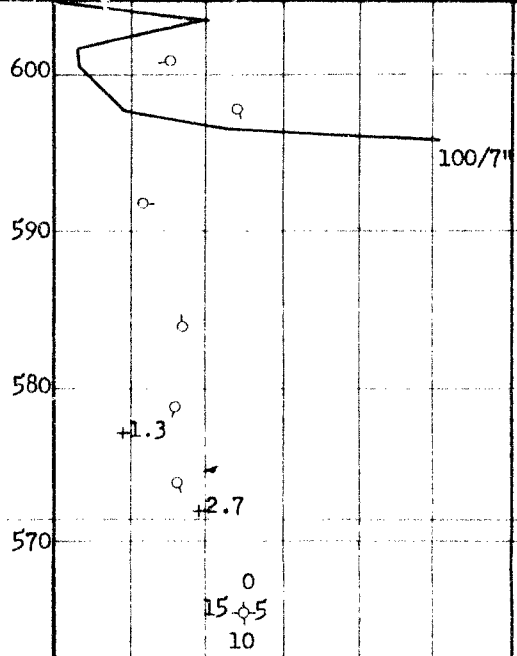
COMPILED BY AMS

DATUM Geodetic

BOREHOLE TYPE Cont. flight aguer

CHECKED BY

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— WL			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	20	40	60	80	100	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W		
604.5	Ground Level														
0.0	Clayey silt with sand		1	TW	PH										
	traces of gravel		2	TW	PH										
	VSIM		3	TW	PH										
	Firm to hard.		4	TW	PH										
			5	SS	60										
			6	TW	PH										
			7	TW	PH										
			8	TW	PH										
571.5															
33.0	End of Borehole														



Dr. Sa. Si. Cl.

602.8

3 29 41 27

0
15
10

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO 31

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 68-F-15-2

LOCATION N. 99.375 E.67.818

ORIGINATED BY AP

W P 257-66-202

BORING DATE March 11 & 12, 1968

COMPILED BY AMS

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W			BULK DENSITY pcf	REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	20	40	60	80	100	WATER CONTENT % 10 20 30				
60.9	Ground Level						SHEAR STRENGTH P S F + Field Vane ○ Unconfined 500 1000 1500 2000 2500									Gr.Sa.Si.Cl
0.0			1	SS	13	600										3 36 37 24
			2	SS	52											
			3	SS	62						100/5"					
			4	SS	32											
			5	TW	PH	590					6				139	3 28 39 30
			6	TW	PH						6				138	
			7	TW	PH	580					1.9 +				143	
576.4											+ 3.7					
28.5	Sandy silt to silty sand with layers of clayey silt & traces of gravel.		8	SS	34											
566.4	Dense.		9	SS	21	570										
38.5	Clayey silt with sand and traces of gravel.		10	TW	PH	560					+2.1				135	3 29 39 29
			11	TW	PH	550					+3.0				137	2 30 38 30
	Stiff to hard.		12	TW	PM	540					+2.2				127.5	
			13	TW	PM	530					+2.7					
			14	TW	PM	520					+1.3				130	
			15	TW	PM	510					+3.1				135	
493.9																
111.0																
490.9	Sand & Gravel															
114.0	Probable Bedrock and of Borehole					500										

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 32

FOUNDATION SECTION

JOB 68-F-15-2 LOCATION N. 99,490 E. 67,827 ORIGINATED BY AP
W. P. 257-66-020 BORING DATE March 11 & 12, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY AM

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W			BULK DENSITY Y P C F	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	W _P	W _L	W		
605.4	Ground Level															
0.0	Clayey silt with sand and traces of gravel.		1	SS	17											
			2	SS	41											
			3	SS	65											
	Firm to hard.		4	SS	36											
			5	SS	15											
			6	TW	PH											
			7	TW	PH											
			8	TW	PH											
572.4																
33.0	End of Borehole															

600
590
580
570

100/10"

+ 3.0
+ 3.3
+ 2.5

0
15
10

601.5
1 29 42 28
138
137 3 29 40 28
137

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 33

FOUNDATION SECTION

JOB 68-F-15-2

LOCATION N. 99.395 E. 67.926

ORIGINATED BY AP

W.P. 257-66-020

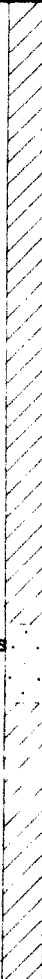
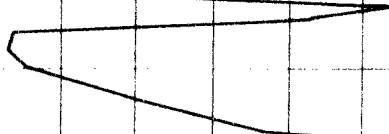





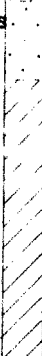


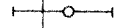
BORING DATE March 14, 1968

COMPILED BY AMS

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY PCF	REMARKS		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.			WATER CONTENT %						
							○ Unconfined + Field Vane			WP	WL	W				
605.4	Ground Level						500	1000	1500	2000	2500	10	20	30	Gr. Sa. Sl. Cl.	
0.0	Clayey silt with sand and traces of gravel. Firm to Hard.		1	SS	13	600							139	601.1		
2			SS	19												
3			SS	41		100/7"						138				
4			TW	PH	590											
5			TW	PH		b +1.9										
6			SS	32	580											
7			SS	22		1.2+										
8			SS	19	570	+1.3										
565.4	Silty sand with traces of gravel & clay. Compact.		9	SS	19		+2.5								2 51 39 8	
40.0																
560.4																
45.0																
			10	SS	12	560										
542.4	End of Borehole		11	TW	PM	550	b						127.5			
63.0								+1.8								
						540	0 15+5 10									

MATERIALS & TESTING DIVISION

FOUNDATION SECTION

JOB 68-F-15-2

LOCATION N. 99.470 E. 67.946

ORIGINATED BY AP

w p 257-66-020

BORING DATE March 14, 1968

COMPILED BY AMS

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— % PLASTIC LIMIT ——— % WATER CONTENT ——— %			BULK DENSITY P C F	REMARKS		
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	SHEAR STRENGTH P S F					WATER CONTENT %					
602.7	Ground Level						500 1000 1500 2000 2500					10 20 30				Gr.Sa.S1.Cl	
0.0	Clayey silt with sand and traces of gravel.		1	SS	14	600										600.2	
			2	SS	18												
	Brown and grey.		3	SS	35	590											3 34 38 25
	V. Stiff Firm to hard.		4	TW	PH											138	
SR 8.7			5	TW	PH	580										135	
19.0			6	SS	12												
			7	TW	PM												3 30 38 29
569.7						570											
33.0	End of Borehole																
						560											

MATERIALS & TESTING DIVISION

FOUNDATION SECTION

JOA 68-F-15-2

LOCATION N. 99,386 E. 68,091

ORIGINATED BY AP

W P 257-66-02

BORING DATE March 13 & 14, 1968

COMPILED BY AMS

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

[illegible]

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DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 68-F-15-2

LOCATION N. 99.350 E. 68.286

ORIGINATED BY AP

W. P. 257-66-020


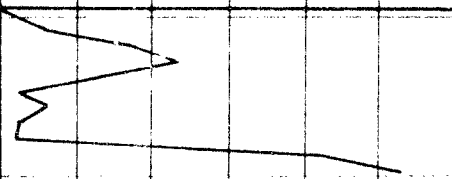
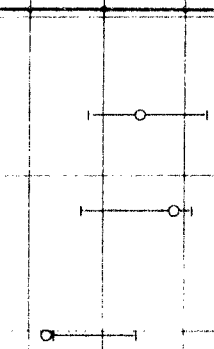
BORING DATE March 15, 1968

COMPILED BY AMS

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP SHRINKAGE CONTENT — WS			BULK DENSITY PCF	REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	20	40	60	80	100	WATER CONTENT % 10 20 30				
610.5	Ground Level														Gr.Sa.Si.Cl	
0.0	Sand & gravel with cinders and clay.		1	SS	23	600									607.8	
603.5	Fill material		2	SS	10											6 39 36 19
7.0	Clayey silt with sand and traces of gravel		3	SS	10											
			4	SS	14											
	Brown and Grey		5	SS	47											
	Stiff to hard.		6	SS	37											
			7	SS	27											
579.0			8	SS	13											
31.5	End of Borehole					570										