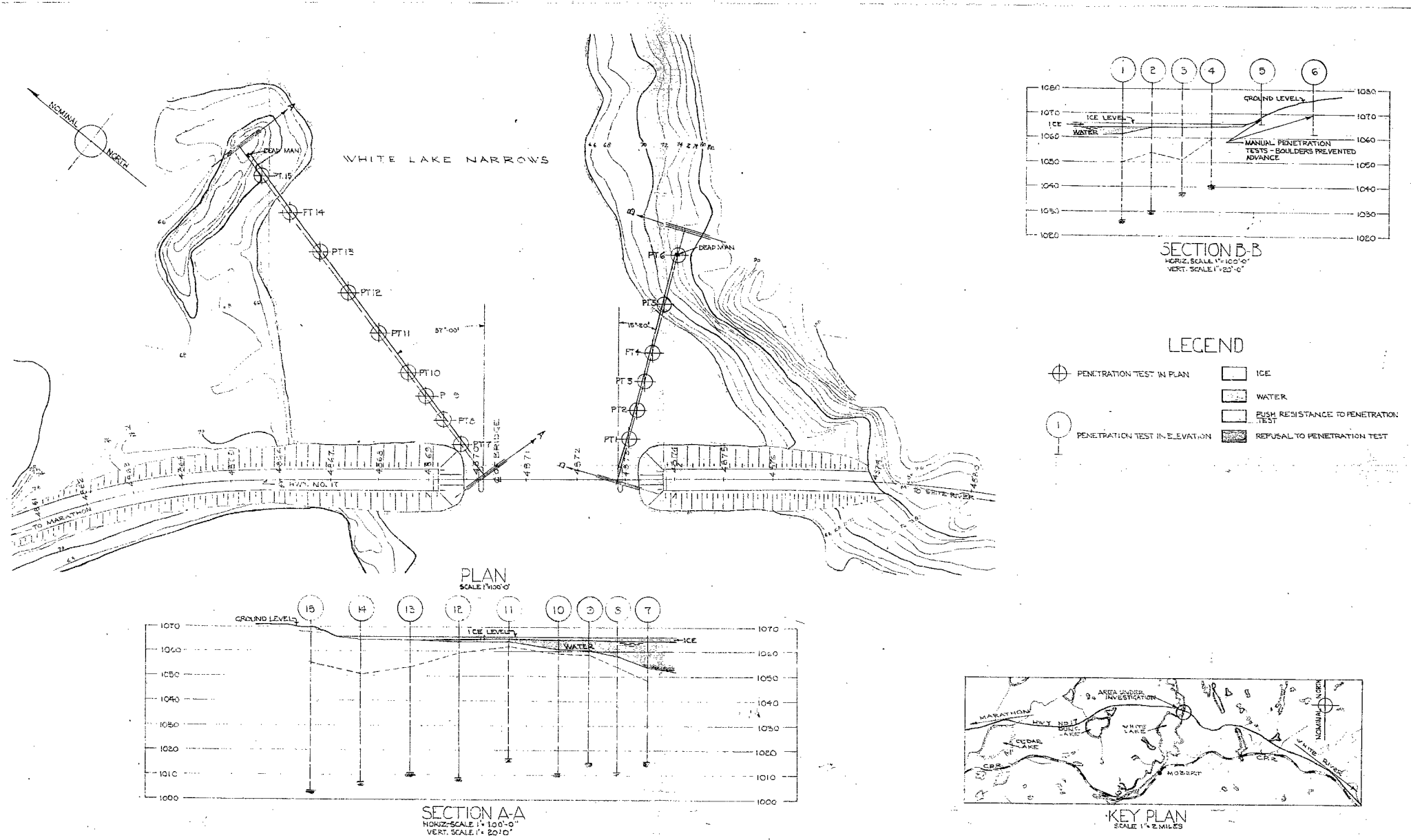


60-F-233C

Hwy # 17

WHITE LAKE NARROWS

NEAR REGAN



REVISIONS			REFERENCE			REFERENCE		
MARK	DATE	DESCRIPTION	DWG. NO.	DESCRIPTION	DWG. NO.	DESCRIPTION	DATE	SCALE
					1602-T-3	DEPARTMENT OF HIGHWAYS, ONT. - PROPOSED BRIDGE OVER WHITE LAKE NARROWS.	MAR. 14, 1958	AS SHOWN
						FOUNDATION OF CANADA ENGINEERING CORPORATION LIMITED	GEOCON LTD.	
						PROPOSED WHITE LAKE NARROWS BRIDGE	DATE MAR. 14, 1958	
						DYNAMIC PENETRATION TESTS	MADE BY M.W. 3/3	
						LOCATION PLAN AND SECTIONS	APPROVED BY P.H. 7/4	
							No. 56637-1	

B.A. 525

RACEY, MacCALLUM AND ASSOCIATES LIMITED

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A COMPANY OWNED, DIRECTED AND OPERATED BY

**Consulting Engineers
AND ASSOCIATED STAFF**



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TORONTO: 33 BLOOR STREET EAST, WALNUT 2-9071

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THE E. B. ALLEN INSPECTION COMPANY

ISOTOPE PRODUCTS LIMITED,
RADIOGRAPHERS

IRVING P. KRICK, PH.D.,
METEOROLOGIST

JACQUES POULIN,
QUEBEC LAND SURVEYOR

THE VIBRATION ENGINEERING COMPANY

REPORT NO: S-500/T-253

310 Odeon Building,
20 Carlton Street,
Toronto, Ontario.

9 May 1956.

Mr. A.M. Foye,
Bridge Engineer,
Bridge Office, 13th Floor,
East Block, Parliament Buildings,
Queens Park,
TORONTO, Ontario.

Attention: Mr. S. McCombie

RE: FOUNDATION INVESTIGATION OF
THE PROPOSED BRIDGE SITE AT
WHITE LAKE NARROWS, NEAR
REGAN, ONTARIO.

Dear Sirs:

We have completed our foundation investigation for the proposed White Lake Narrows Bridge, on the section of No. 17 Highway that will join the towns of White River and Marathon. We are submitting our report herewith.

The report discusses the subsoil conditions at the location of the abutments and piers. It recommends that pile foundation be carried down to bedrock at the eastern abutment, to a very dense layer of sand at both piers and, if possible, to a similarly dense layer of sand at the western abutment. At the eastern abutment, the bedrock was found at a relatively shallow depth.

Since it is impossible to accurately appraise the capacity of a pile foundation bearing in granular materials, without pile loading tests, the calculated theoretical bearing value shown on pages 4 and 5 of the report, should be modified by a large factor of safety. In this case, a factor of safety of 4 was arbitrarily chosen. Due to the isolated location of the site, it will probably not be possible to carry out pile loading tests.

A clay layer encountered at the western abutment made a stability analysis for the embankment desirable. The analysis proved that there is no danger of a failure.

9 May 1956.

The attached report was written by Mr. B.F. Welsh. I have reviewed its contents and concur with them. If there are any queries regarding foundation conditions at the site, we shall be pleased to discuss them with you, at your convenience.

Yours very truly,
RACEY, MACCALLUM AND ASSOCIATES LIMITED

W.A. Trow

W.A. Trow, P. Eng.

WAT/MD

Original and 3 copies - Mr. A.M. Toye, Department of Highways of Ontario,
Attention: Mr. S. McCombie.

c.c.'s.

- 1 - Racey, MacCallum and Associates Limited, Montreal.
- 3 - Soils Engineers.

FOUNDATION INVESTIGATION OF
THE PROPOSED BRIDGE SITE AT
WHITE LAKE NARROWS, NEAR
REGAN, ONTARIO.

Report No: S-500/T-253

Racey, MacCallum and Associates Limited

8 May 1956

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8 May 1956.

FOUNDATION INVESTIGATION OF
THE PROPOSED BRIDGE SITE AT
WHITE LAKE NARROWS, NEAR
REGAN, ONTARIO.

SCOPE

This report covers the foundation investigation carried out for a proposed bridge over White Lake Narrows, on No.17 Highway. Included in the report are the results of field and laboratory tests. Design loads for pile foundations have been theoretically estimated and the stability of the embankment at the western abutment was checked and found to be safe.

LOCATION OF THE SITE AND OF THE BOREHOLES

The site is located on the proposed section of Highway No.17 (Trans-Canada Highway), between the towns of White River and Marathon and approximately two miles north of Regan, Ontario. The location of the proposed bridge, relative to White Lake and Regan, is shown on enclosure no.1. The locations of the boreholes and probings are shown on enclosure no.2.

The area surrounding the site is covered with dense birch woods; the shore of the lake, in the immediate vicinity, is strewn with large boulders, up to six feet in diameter. Outcropping bedrock was reported to be a few hundred yards west of the site, however, deep snow prevented the confirmation of this report and also hindered the general visual examination of the site. At the time the drilling work was finished, on April 7, there was still a snow cover up to six feet deep over the area.

THE DRILLING WORK

The drilling crews and soil technician were quartered at the Abitibi Power and Paper Company Limited Camp, at Regan. Access to the site could be obtained either by land via a trail through the bush, or over the ice on the lake. The latter route was used exclusively for transporting the men and equipment to and from the site. The drilling work was begun on 16 March. Prior to this however, several days were spent in transporting the equipment and supplies to the site, and in locating the holes.

A snowmobile was hired from the Abitibi Power and Paper Company, to transport the men and supplies to the site each day. This was the most practical and economical method of transport. The deep snow covering on the ice obviated the use of trucks, and snowshoeing back and forth would have been both arduous and time consuming. By April 2, the condition of the ice was such that the Abitibi Power and Paper Company

8 May 1956

were unwilling to risk their snowmobiles on the rapidly deteriorating ice. A team of horses and a sleigh were used for transportation for the remainder of the work. In conformance with your authorization of 23 March, a second drill was brought to the site on 26 March, in order to expedite the work before the ice broke. The work was finished and the drills removed from the site on April 7.

From the information obtained in the first boreholes, it was apparent that the structure would have to be carried on piles. Therefore, extensive use was made of soundings with a two inch diameter cone, driven by a 140 lb. hammer falling 30 inches. By this means the elevation of a firm bearing stratum was established much more economically than could have been accomplished solely by boreholes. Some boreholes, of course, were required to classify the soil. The boreholes were carried into the bedrock only at the eastern abutment.

THE SUBSOIL

Conditions over the site are variable. Only on the eastern shore was bedrock found near the surface. At the location for the eastern and western piers and the western abutment, bedrock was not definitely established because of the difficulty experienced in penetrating the overlying boulders.

The Western Abutment - The results of boreholes and soundings carried out at the proposed site of the western abutment are shown on enclosures nos. 3, 4, 5 and 6. The site is overlain by a layer of loose, somewhat organic sand, between 4.5 and 14 feet thick. Below this is a layer of stiff grey silty varved clay, with sand partings. This layer varies in thickness from 4 to 9.5 feet. Following this is a mixture of medium dense to dense silty sand and gravel. This extends to varying depths in the three boreholes, as shown on the engineering data sheets, (enclosures 3, 4 and 5). In borehole no. 6, boulders were encountered and the borehole had to be abandoned before this layer had been passed. Below it was a very dense layer of grey sand. Refusal was encountered in the probe holes after very little penetration into this layer.

Enclosure no. 7 shows the contours of the very dense stratum, as interpolated between the elevations determined by the probings and boreholes.

Boreholes 1 and 9 were continued into this layer by washing ahead to absolute refusal at El. 988.5 and 986.5 respectively. This may possibly be bedrock.

The Western Pier - The very dense sand stratum mentioned above was also encountered at the site of the western pier, as shown on the engineering data sheet for borehole 13 (enclosure no. 8), and as inferred from the results of probenoles nos. 10, 13 and 16 (enclosure no. 9). The elevation at which this layer was encountered ranged from

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1043 feet in probehole 16, to 1026 feet in probehole 13. Overlying the very dense layer, is a layer of medium dense to dense sand and gravel. Borehole 13 was discontinued at El.1020 feet, when it became impractical to continue it because of boulders.

The Eastern Pier - From the engineering data sheet for borehole no.21 (enclosure no.10), and as inferred from the results of probeholes nos. 18,19,21,23 and 24 (enclosure no.11), the dense bearing stratum was found to vary between El.1043 and 1036 feet. This was overlain by a layer of medium dense to dense sand and silt layers, as shown on enclosure no.10. Contours of the dense stratum, as interpolated from the elevations determined by the probeholes and boreholes, is shown on enclosure no.12.

The Eastern Abutment - Bedrock was established at the eastern abutment and boreholes 28,32 and 33 were carried five feet into it, as shown on enclosures nos. 13,14 and 15. The contours of the bedrock shown on enclosure no.17, were interpolated from the bedrock elevations determined in the boreholes, as well as those presumed from the probeholes (enclosure no.16). The bedrock is overlain by medium dense to very dense sand and gravel.

THE ABUTMENT AND PIER FOUNDATIONS

In view of the length of the bridge spans and the resulting footing loads, it is felt that it would be desirable to carry the loads down to the very dense stratum at the western abutment, and at the two piers, and to bedrock at the eastern abutment, by means of piles. This would minimise differential settlement and also offer protection against the somewhat remote possibility of scour. The contours of the very dense bearing stratum are shown on enclosures nos. 9 and 12, at the western abutment and eastern pier respectively. Enclosure no.17 shows the contours of bedrock at the eastern abutment. These contour plans must be taken as indicative only. There is considerable variation in the elevations of the dense layers and bedrock, and it is therefore probable that variations occur that are not shown by the contours. However, the contours should prove a valuable guide in estimating the total length of piling required.

Steel shell concrete piles were used in estimating the capacities of the piles. This type of pile has several advantages over other piles, for this particular site. The pile length can be readily suited to the depth at which refusal is encountered by either welding on additional lengths or burning off the surplus lengths. They are also capable of withstanding the hard driving that will be encountered in reaching the dense layer.

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It is difficult, if not impossible, to estimate accurately the bearing capacity of piles bearing in a granular material such as at the western abutment, and the two piers, without pile loading tests. However, in view of the isolated location of the site, it will probably be more economical to estimate the bearing values theoretically and apply a large factor of safety, than to carry out load tests. The estimated bearing values for the various locations are detailed below. It is assumed that a minimum pile spacing of not less than three diameters will be used.

The Western Abutment - The average elevation of the bearing stratum at the western abutment is 1026 feet, and the average elevation of the top of the medium dense to dense sand stratum is about 1052 feet. Using Meyerhof's formulae and charts, the ultimate bearing value for a pile with 26 feet embedment, can be calculated. The bearing capacity would be increased if any appreciable penetration were obtained in the dense material, and less if the dense layer is not reached. A minimum factor of safety of four should be applied to these values. Although this is somewhat conservative, it is deemed necessary in the absence of load tests. Table I shows the theoretical ultimate and safe bearing capacities for average point elevations, four feet below, at, six feet above and eleven feet above the surface of the dense stratum, for a 12 inch diameter pile.

TABLE I

THEORETICAL BEARING VALUES - WESTERN ABUTMENT

Average point elevation	Ultimate bearing capacity, tons	Safe bearing capacity, Factor of safety 4, tons.
1022	306	74
1026	248	62
1032	154	38.5
1037	94	23.5

The Eastern Pier - The average elevation of the dense stratum at the eastern pier is 1039 feet, and the average cover of fairly dense sand and gravel can be taken as approximately 13 feet. The average bearing value for piles, founded at the dense stratum and four feet below it, are shown in Table II.

* G.G. Meyerhof - The Ultimate Bearing Capacity of Foundations, Geotechnique 1951, pages 301-332

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TABLE II
THEORETICAL BEARING VALUES - EASTERN
AND WESTERN PIERS

Average point elevation	Ultimate bearing capacity, tons	Safe bearing capacity, Factor of safety 4, tons
1035	118	29.5
1039	72	18.0

Eastern Abutment - Since the piles of this abutment will be driven to bedrock, the structural capacity of the pile will govern the allowable loads. The bedrock is a gneiss and, from the drill cores, appears to be solid.

The Western Pier - The elevation of the dense stratum at the western pier shows considerable variation, (see enclosure no.9). Predetermination of the pile lengths, even roughly, will be very approximate. It is suggested that safe bearing values for piles founded at the dense stratum and at four feet below it, be taken the same as those for the eastern pier; i.e. 22½ tons and 37½ tons respectively. The depth of the dense stratum will be readily observable from the resistance of each pile during driving.

STABILITY OF THE WESTERN ABUTMENT

The clay layer encountered in the three boreholes at the site of the western abutment, (see enclosures nos. 3, 4 and 5), together with the height of the proposed embankment, suggested that a stability analysis was in order. Since the clay layer was only about eight feet below the surface and had an average thickness in the order of ten feet, it was felt that the sliding block analysis approximated the way in which the embankment would fail if a critical condition existed. As can be seen from enclosure no.18, the factor of safety obtained was 2.15. Since a factor of safety of 1.5 is generally considered to be sufficient, it was felt that further analyses by simple and compound slip circles, would be redundant.

In the analysis shown on enclosure no.18, a hypothetical section was assumed. The height of the embankment was taken as 30 feet and the thickness of the loose sand covering the clay as 8 feet. A conservative angle of internal friction of 33° - 41' (1½-1 slope) and no cohesion was assumed for the fill. The loose sand was assumed to have an angle of internal friction = 30°. Since the water level would be a material factor in calculating the active and passive pressures, a very conservative assumption was made for the analysis shown.

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For calculation of the active pressure, the water table was assumed to be at the surface of the clay, while for the calculation of the passive pressure, it was taken eight feet higher at the surface of the loose sand. If the preliminary analysis had shown a critical condition, a series of analyses with a more realistic assumption for the water level, would have been undertaken.

From field vane tests and unconfined compression tests, the shear strength of the clay was taken as 900 p.s.f. One unconfined compression test, in hole 6 (see enclosure no.4), gave a shear strength in the order of 300 p.s.f. However, the sensitivity of this sample was only 1.1, compared with sensitivities of from 3 to 11.8 for the clay from the vane tests. This indicates that the sample must have been severely disturbed and the result of the test must be completely disregarded.

RECOMMENDATIONS AND CONCLUSIONS

1. The foundation of the western and eastern piers should be carried down to the very dense sand stratum, by piles. The western abutment should be supported on piles also, but whether or not it will be possible to reach the very dense sand stratum at this location, will depend on the size of the pile driving hammer and other factors. The eastern abutment should be supported ~~on piles~~ on bedrock, which was found at a relatively shallow depth at this location. A few piles may be obstructed by boulders, at the various locations.

2. Pile loading tests should be carried out to determine the allowable bearing value but, due to the remote location of the site, it will probably be preferable to use the conservative theoretical allowable design values tabulated on pages 4 and 5 of this report, than to carry out tests.

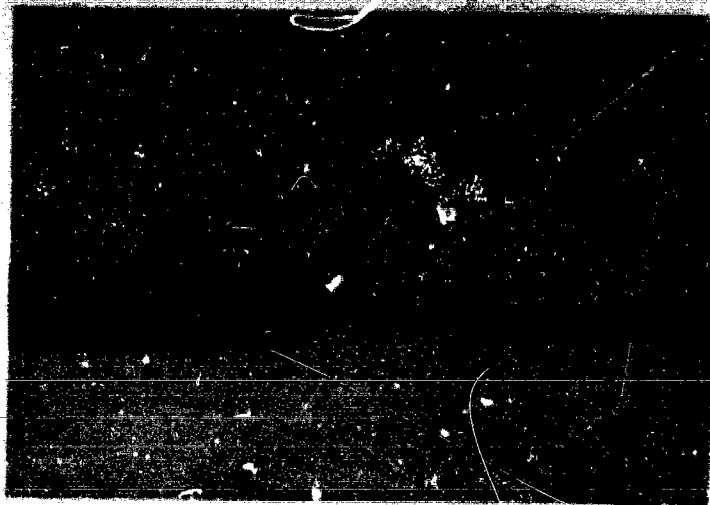
3. There does not appear to be any serious danger from scour, at this site; founding the structure on piles will, however, protect it if scouring should ever occur.

4. There is no danger of an embankment failure at the western abutment.



B.F. Welsh, P. Eng.

BFW/ND



VLM OF THE SITE LOOKING EAST
FROM THE WESTERN ABUTMENT



VARVED CLAY FROM
BOREHOLE NO. 6.7.5'-8.5'

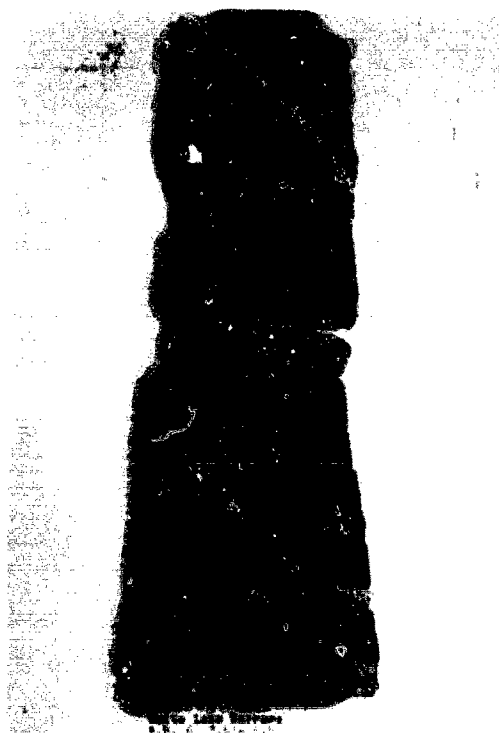


TYPICAL DRILL SET-UP
AT THE WESTERN ABUTMENT

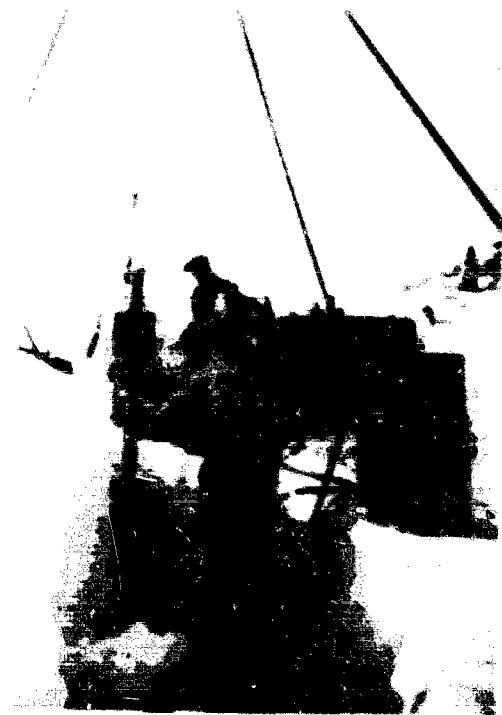
SUPER IMPOSED DOCUMENT MAY
APPEAR AS MULTIFIED ON FILM.



VIEW OF THE SEA, LOOKING EAST
FROM THE WESTERN SUBMERGIBLE



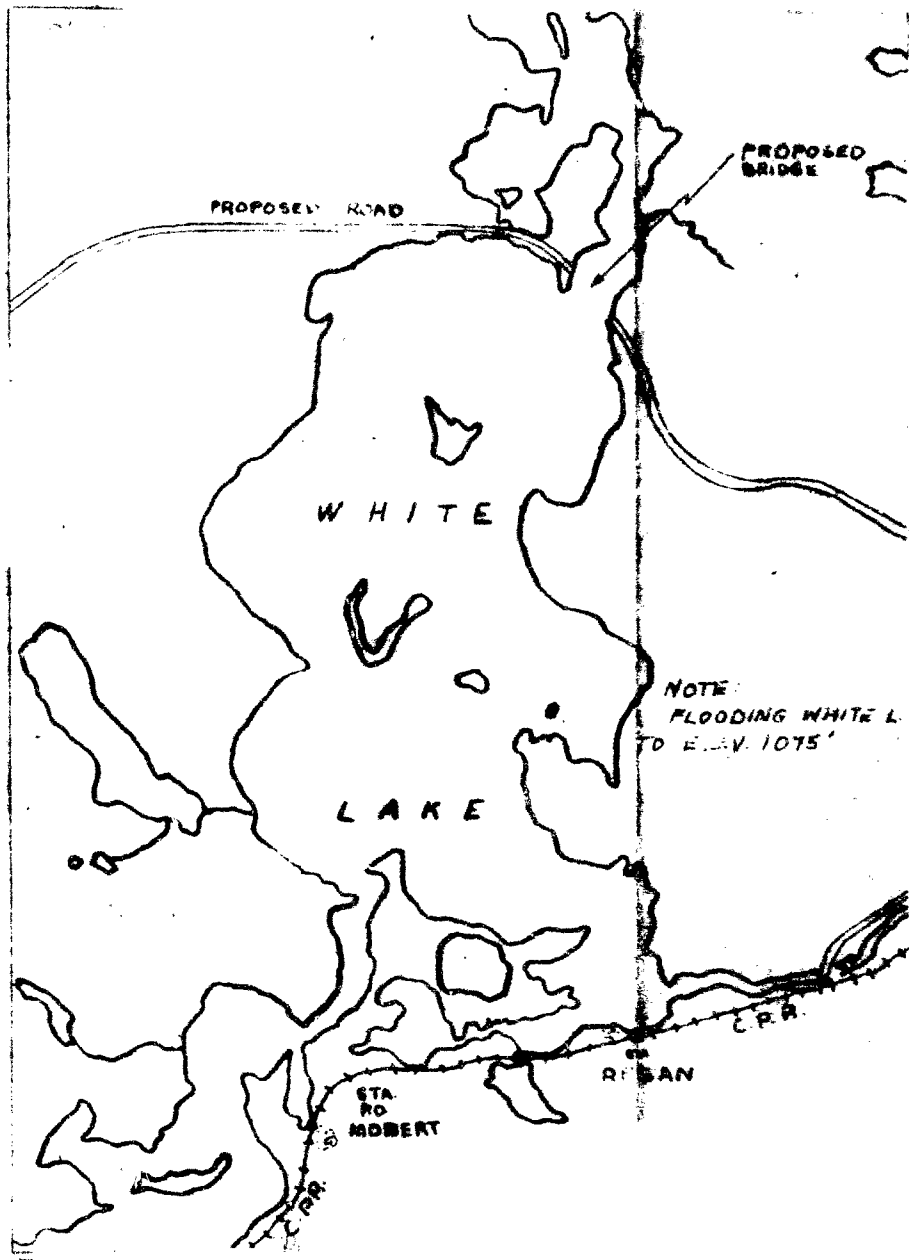
VIEW OF THE SEA, LOOKING EAST
FROM THE WESTERN SUBMERGIBLE



TYPICAL DRILL SET-UP
AT THE WESTERN SUBMERGIBLE

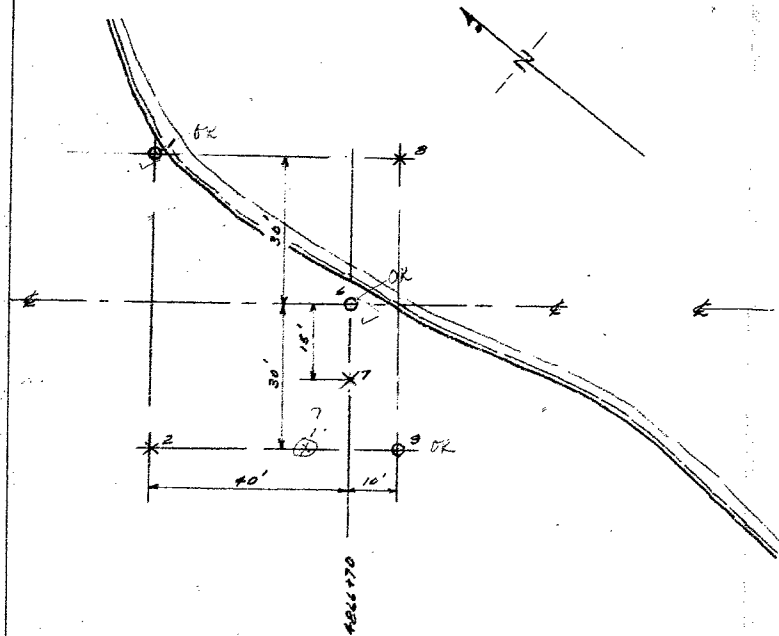
SUPERIMPOSED DOCUMENT MAY
APPEAR AS UNRECOGNIZED ON FILM.

Prep. By B.F.W.

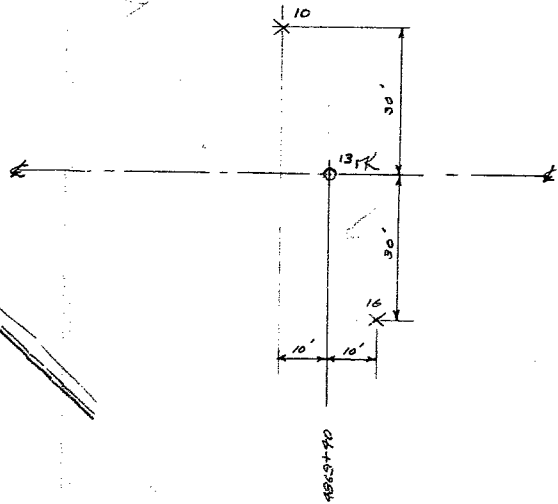


LOCATION CHART

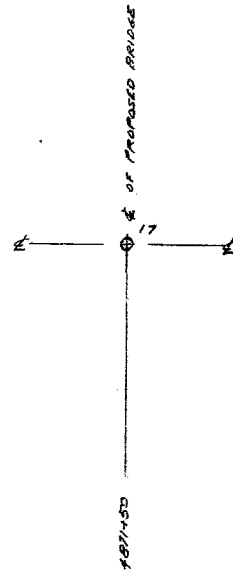
SCALE 1" = 40 CH.



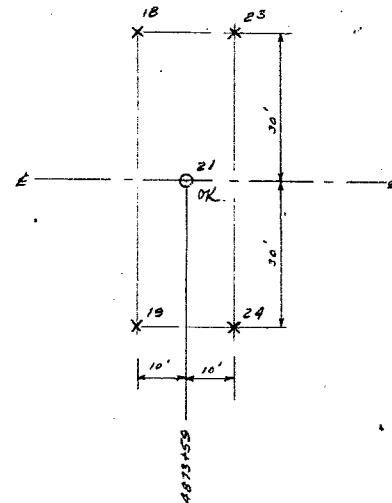
WESTERN ABUTMENT



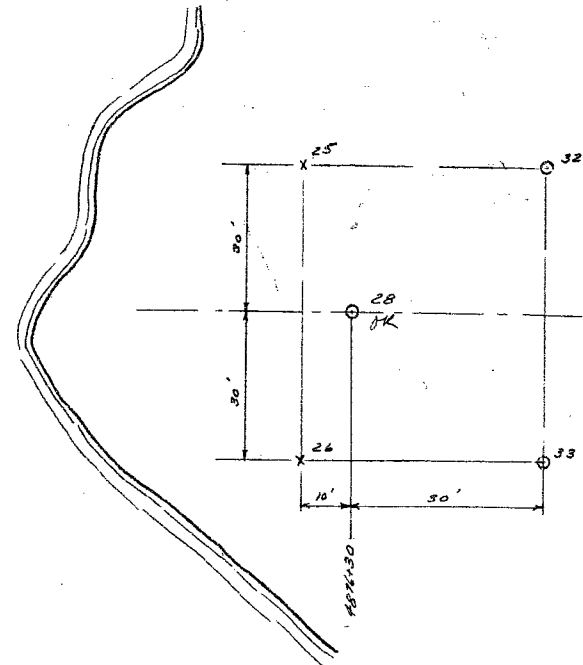
WESTERN PIER



E. OF BRIDGE



EASTERN PIER



EASTERN ABUTMENT

LOCATION OF BOREHOLES

SCALE: - 1"=20'

Order No. S50017453Enclosure No. 3**RACEY MacCALLUM AND ASSOCIATES LTD.**

Foundation Engineering Division

Engineering Data Sheet for Borehole: /

Project: White Lake NarrowsField Supervision: J. N.Location: Appr. 2 Mi. N. of Repton Ont.Driller: L. SelleyHole Location: As shown on attached sketchPrep.: B. F. W.Hole Elevation and Datum: 67° GeodeticChecked: W. T.Field Work Begun: March 19, 1956 Ended: March 22, 1956 Date: April 20, 1956**LEGEND**Sampling Method
2" Dia. split tube
2" Shelby tubePenetration Resistance
2" Split tube
2" Dia. Cone
Casing

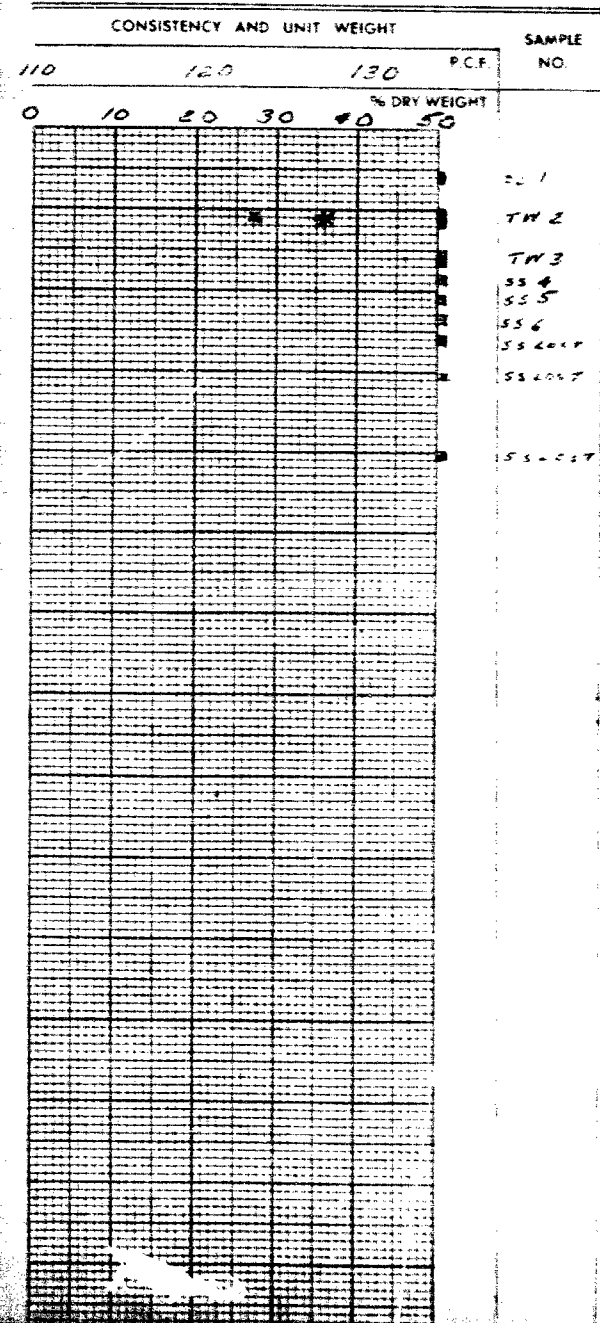
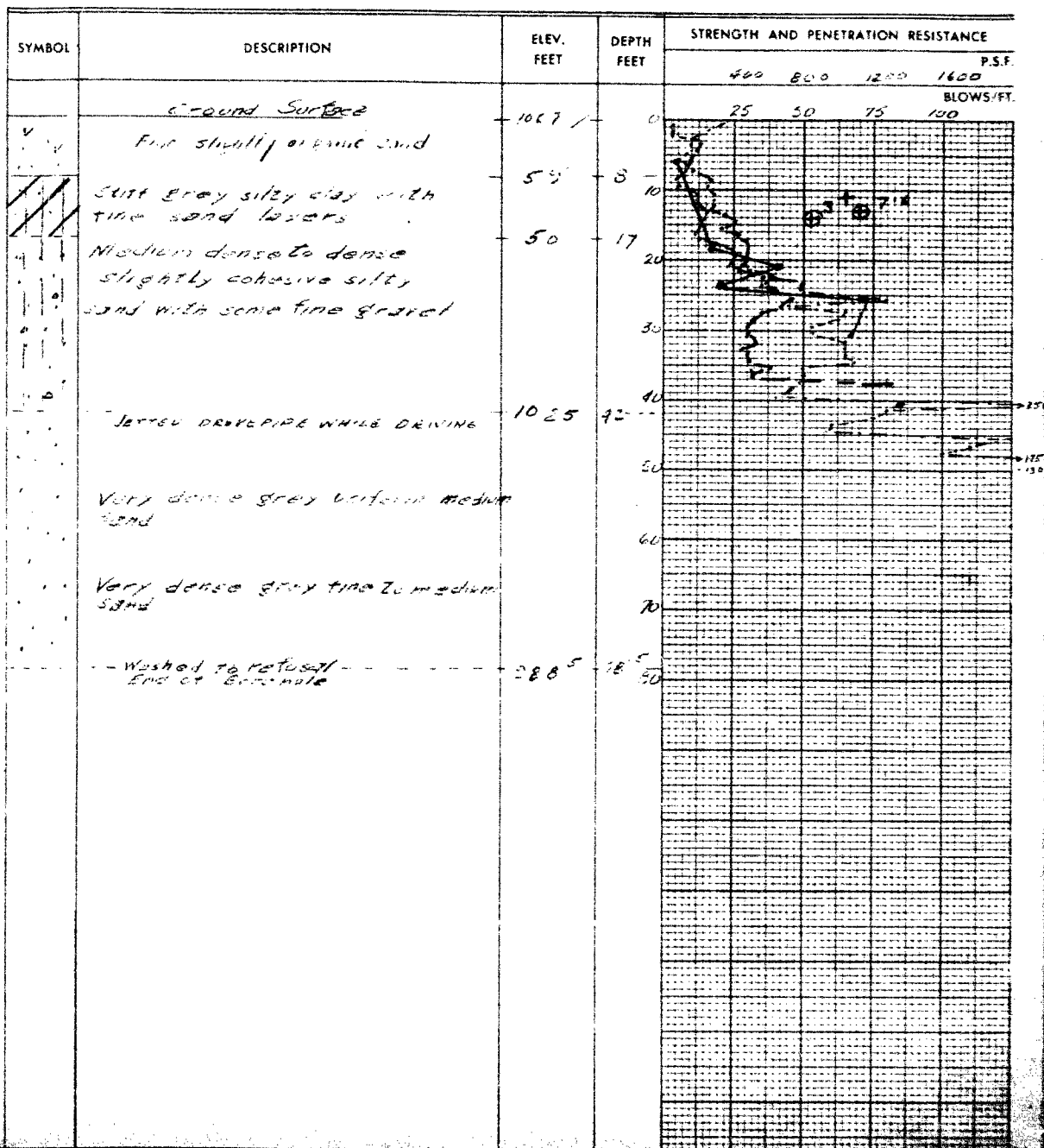
Strength

1/2 Unconfined compression
Vane test and sensitivity

Consistency

Natural moisture
Liquid limit
Plastic limit

Natural Unit Weight



RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 6 ✓

Project: *White Lake Narrows*

Location: Apr. 2 mi. N. of Regan, Ont

Hole Location *As shown on attached sketch*

Hole Elevation and Datum: 67 *Geodetic*

Field Work Begun Mar. 22, 1956 Ended Mar. 26, 1956 Date: April 20, 1956

Field Supervision: ☒ *N*

Driller: *L. Bailey*

Prep.: E. F. W.

Checked: *W* *7*

Date: April 20, 1956

LEGEND

Sampling Method

2" Dia split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia Cone

Casing

Strength

Unconfined compression

Vane test and sensitivity

Consistency

Natural moisture

Liquid Limit

Plastic film

Natural Unit Weight

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE			
				400	800	1200	1600
				P.S.F.			
				BLOWS/FT			
	Ground Surface	67.0	0	25	50	75	100
✓	Very loose very fine slightly organic sand with shells	✓	0.5				
	Stiff grey varved clay		10				
	Some sand partings	53	16.0				
	Medium dense slightly cohesive silty sand		40				
			45				
	Medium dense to dense mixture of sand and fine to coarse gravel with boulders		50				
			40				
	Refusal on Sampler penetration 0.3'		50				
	Drilled & Blasted Boulder		50				
	Refusal on Sampler penetration 0.1'		50				
	Drilled & Blasted Boulder		56.0				
	Refusal on Sampler penetration 0.1'	11.0	56.0				
	End of Corehole		60				
			70				
			80				

CONSISTENCY AND UNIT WEIGHT

PCF

SAMPLE

NO.

110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490 500 510 520 530 540 550 560 570 580 590 600 610 620 630 640 650 660 670 680 690 700 710 720 730 740 750 760 770 780 790 800 810 820 830 840 850 860 870 880 890 900 910 920 930 940 950 960 970 980 990 1000

DRY WEIGHT

531

538

TW9

TW910.5T
L.885

TW5

526

507

524NT

538

524NT

524NT

53.22T

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 9

Project: White Lake Narrows

Location: Approx 2 mi. N. of Rejoan Ont.

Hole Location As shown on attached sketch

Hole Elevation and Datum: 1070 Geodetic

Field Work Begun Mar. 2, 1956 Ended Mar. 28, 1956 Date: Apr. 20

Field Supervision: J. N.

Driller: L. Bailey

Prep.: P. F. W.

Checked: W. T.

Date: Apr. 20

LEGEND

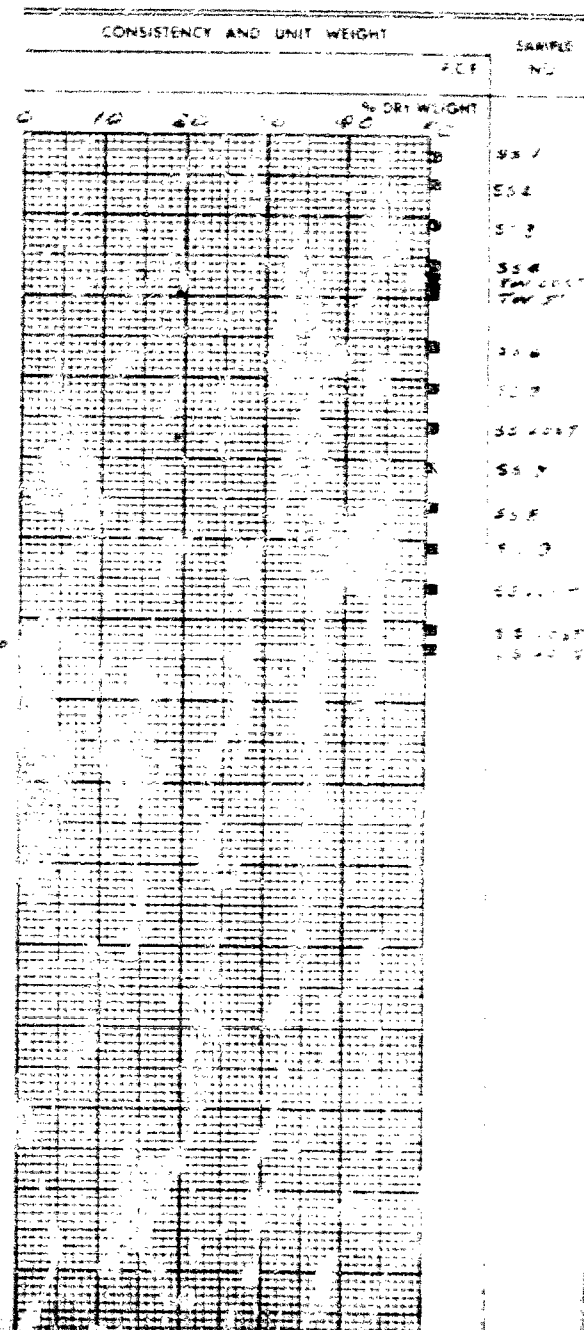
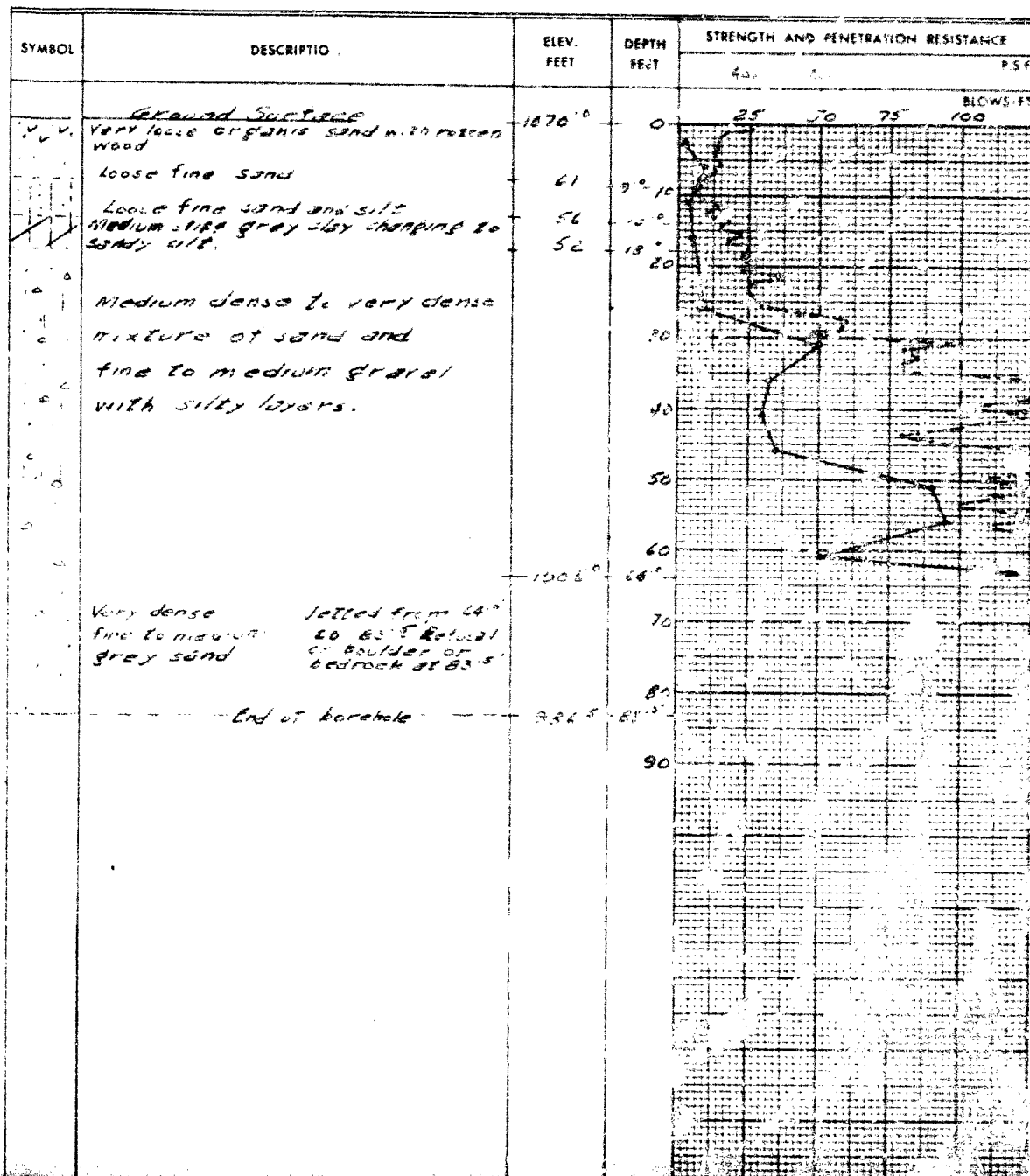
Sampling Method
 2" Dia. split tube
 2" Shelby tube

Penetration Resistance
 2" Split tube
 2" Dia. Cone
 Casing

Strength
 Unconfined compression
 Vane test and sensitivity

Consistency
 Natural moisture
 Liquid limit
 Plastic limit

Natural Unit Weight



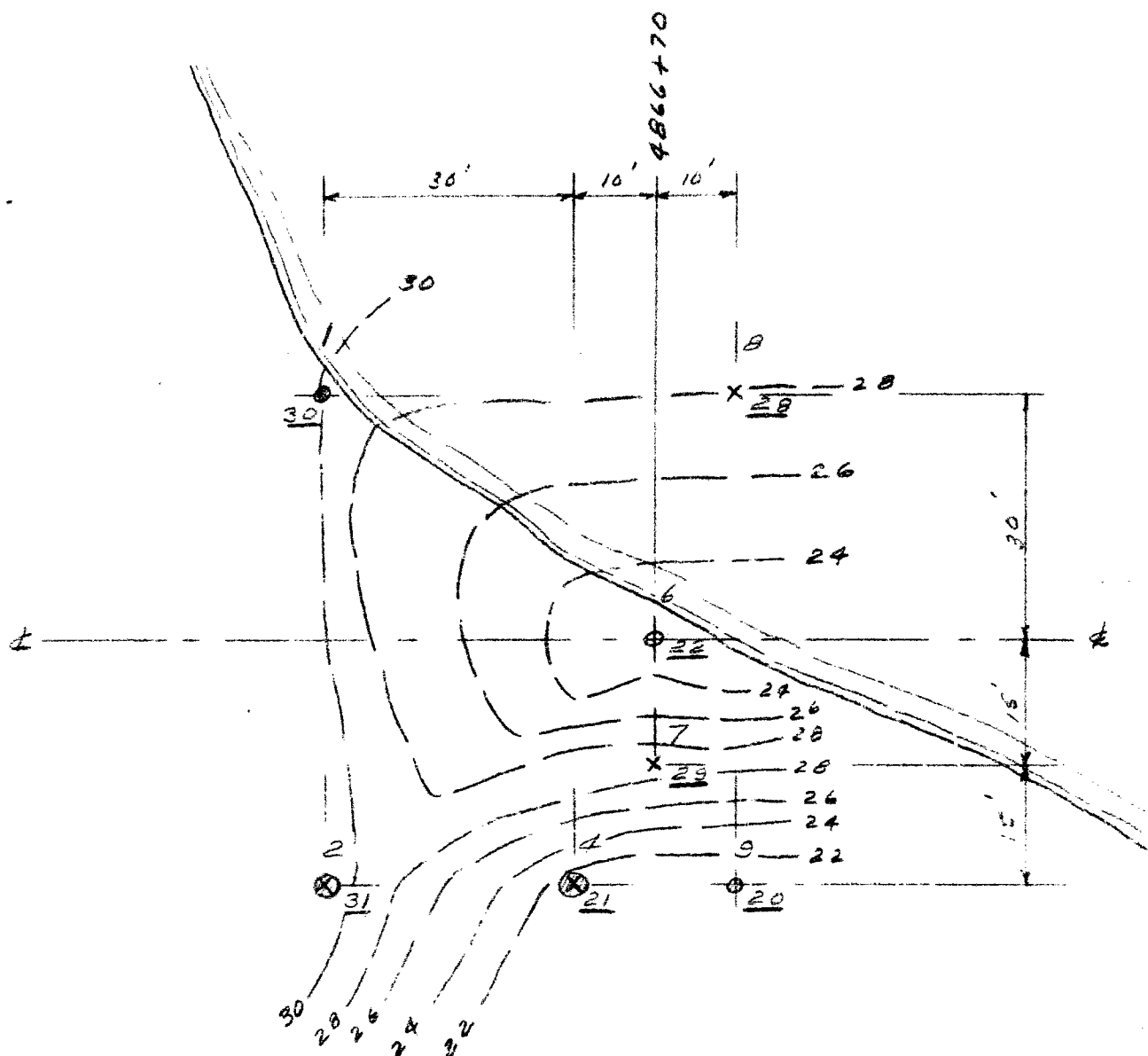
PROBE HOLE RESULTS - WESTERN ABUTMENT, PENETRATION TEST - BLOWS/FT.

Elevation	H O L E S				
	1	2	4	7	8
71		50	12		
70		34	10		
69		13	8		
68		14	6	12	
67	6	13	7	13	3
66	6	14	8	15	2
65	6	12	10	14	3
64	13	6	6	11	2
63	12	4	6	8	3
62	9	3	4	3	5
61	8	5	8	7	5
60	7	4	8	8	17
59	4	5	9	10	12
58	5	6	9	12	13
57	12	5	8	13	22
56	12	6	8	12	24
55	14	6	11	14	20
54	22	7	12	16	24
53	26	7	10	10	38
52	20	8	11	16	18
51	19	18	32	14	20
50	20	30	21	43	25
49	27	30	18	40	28
48	30	25	17	28	21
47	30	22	18	22	22
46	27	14	20	25	24
45	36	17	22	25	26
44	50	28	20	20	23
43	50	23	16	27	29
42	45	17	16	27	26
41	42	35	31	25	14
40	35	35	27	30	19
39	32	35	32	38	20
38	30	35	27	50	21
37	30	40	21	40	35
36	33	42	21	42	41
35	28	40	25	55	52
34	30	34	20	57	25
33	31	38	21	53	24
32	38	36	22	54	49
31	32	75	32	53	60
30	82	120	30	55	60
29		125	33	55	62
28			26	100	63
27			24	120	135
26			23	125	
25			24	125	
24			26		
23			35		
22			40		
21			80		
20			75		
19			82		

Pushed with weight

140 #
30" dia

Prep. By B.F.W.



Elevs. BEARING STRATUM SHOWN THUS 28
 PILE PENETRATION 5'± INTO BEARING STRATUM
 O' BOREHOLE # NUMBER X² SOUNDING # NUMBER

WESTERN ABUTMENT
 CONTOURS OF DENSE BEARING STRATUM
 SCALE 1" = 20'

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 13 ✓

Project: *White Lake Narrows*Location: *Appt 2 mi N of Ragon, Ont.*Hole Location: *As shown on attached sketch*Hole Elevation and Datum: *67 Geodetic*Field Work Begun: *Mar 29, 1956* Ended: *Mar 30, 1956* Date: *Apr 20, 1956*Field Supervision: *J.N.*Driller: *M. Leger*Prep.: *B.F.V.*Checked: *M.T.***LEGEND****Sampling Method**

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

Strength

Unconfined compression

Vane test and sensitivity

Consistency

Natural moisture

Liquid limit

Plastic limit

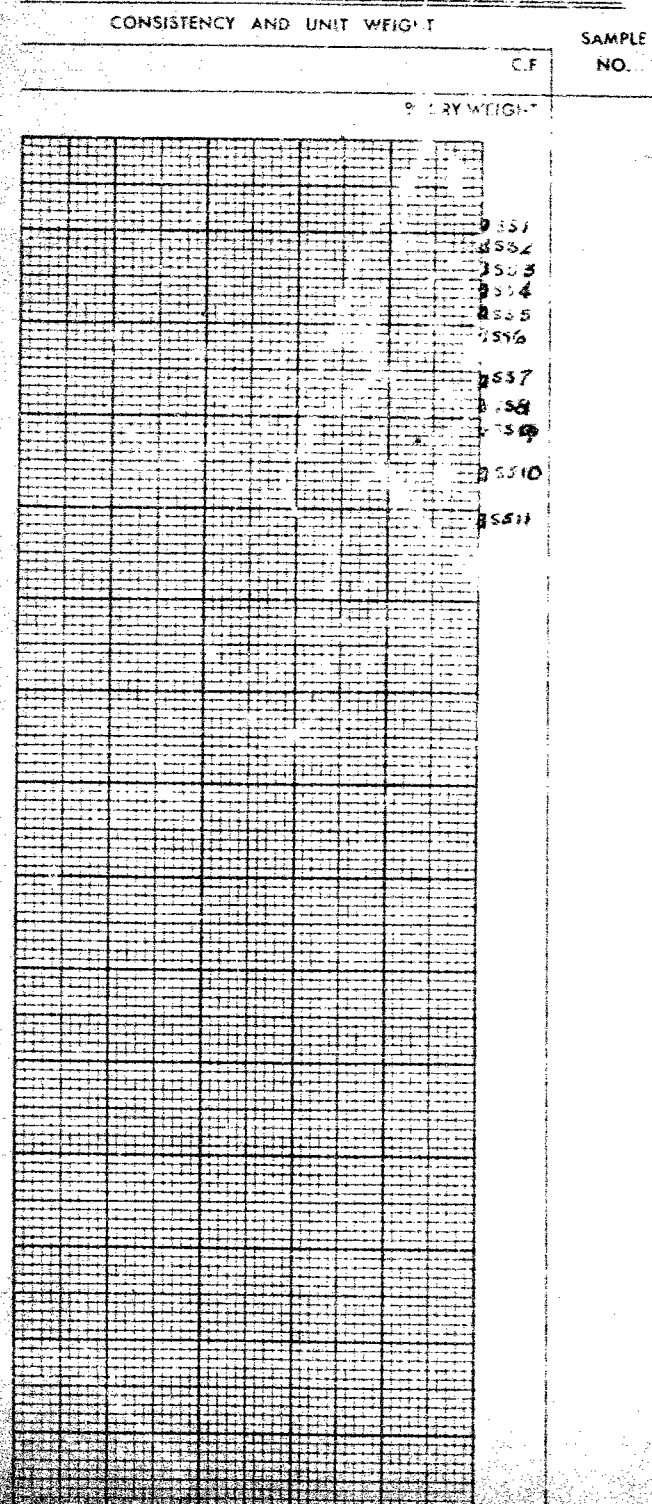
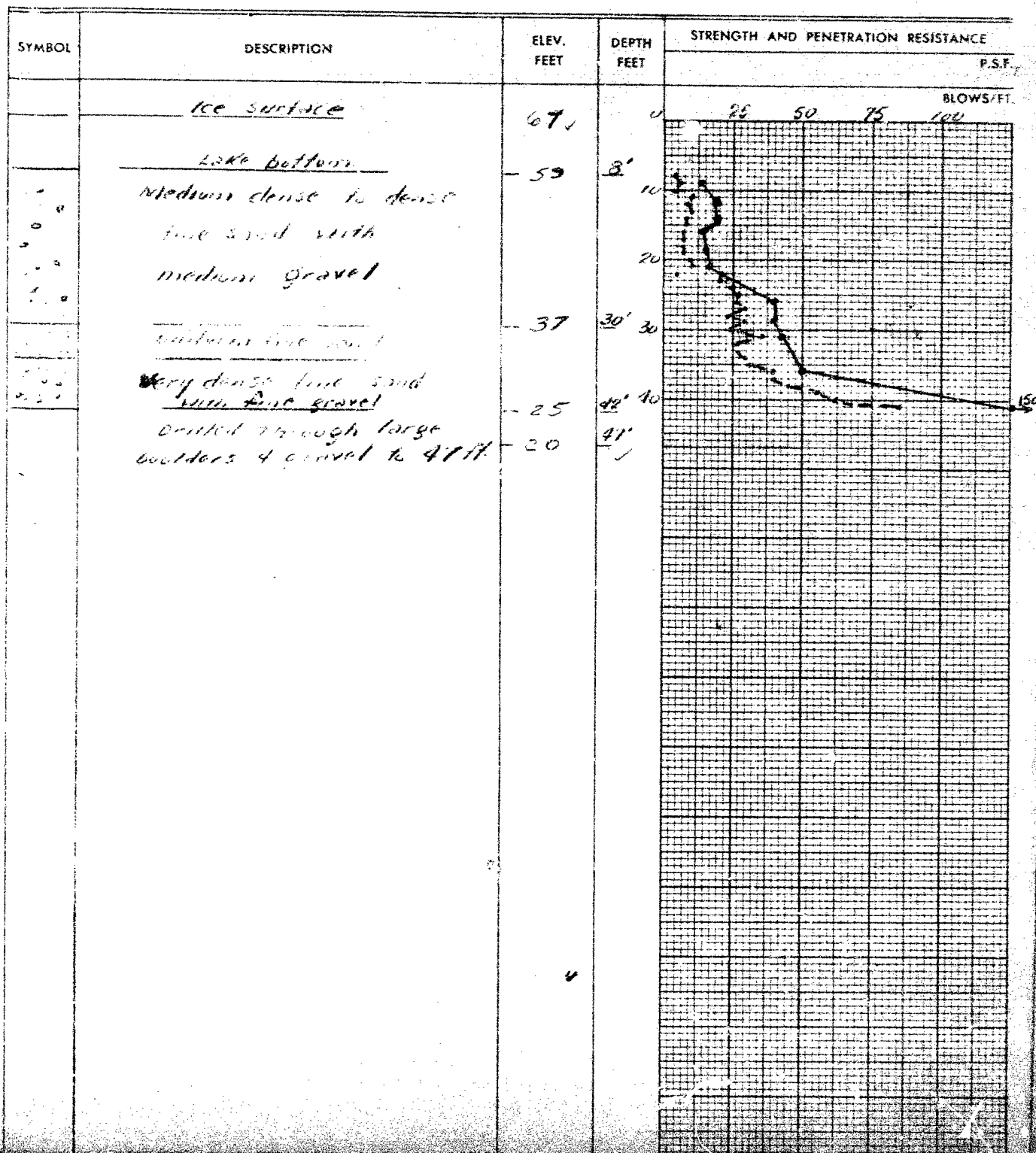
Natural Unit Weight

TABLE - CONE PENETRATION RESULTS - WEST PIER

Blows / ft.

Elevation	H O L F S		
	16	13	10
67			
66			
65			
64			
63			
62			
61			
60			
59			
58			
57			
56			
55			
54			
53			
52			
51			
50			
49			
48			
47			
46			
45			
44			
43			
42			
41			
40			
39			
38			
37			
36			
35			
34			
33			
32			
31			
30			
29			
28			
27			
26			

Surface of the ice

Water

Lake Bottom

3

12

14

15

20

19

17

20

27

22

17

19

22

21

34

22

19

17

23

44

30

26

47

48

84

85

57

56

55

54

53

52

51

50

49

48

47

46

45

44

43

42

41

40

39

38

37

36

35

34

33

32

31

30

29

28

27

26

Order No. S-500/T-253Enclosure No. 10**RACEY MacCALLUM AND ASSOCIATES LTD.**

Foundation Engineering Division

Engineering Data Sheet for Borehole: 21Project: White Lake NarrowsLocation: Approx 2 mi. North Regan OntHole Location: See attached sketchHole Elevation and Datum: 67 feetField Work Begun: Mar 21, 1956 Ended: Apr 2, 1956 Date: April 20, 1956Field Supervision: J. N.Driller: L. BELLEYPrep.: B. F. W.Checked: W. T.**LEGEND****Sampling Method**

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

Strength

Unconfined compression

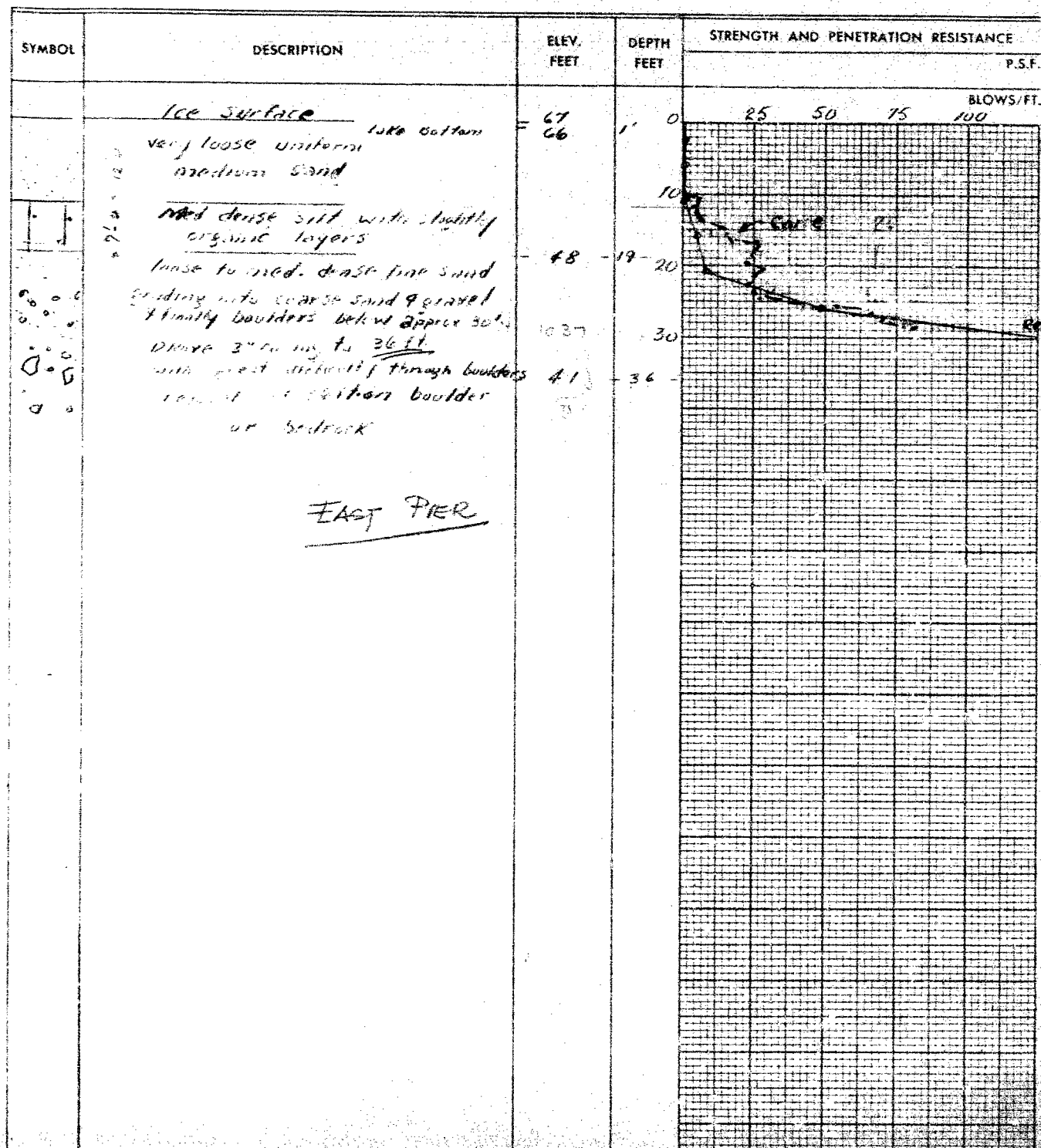
Vane test and sensitivity

Consistency

Natural moisture

Liquid limit

Plastic limit

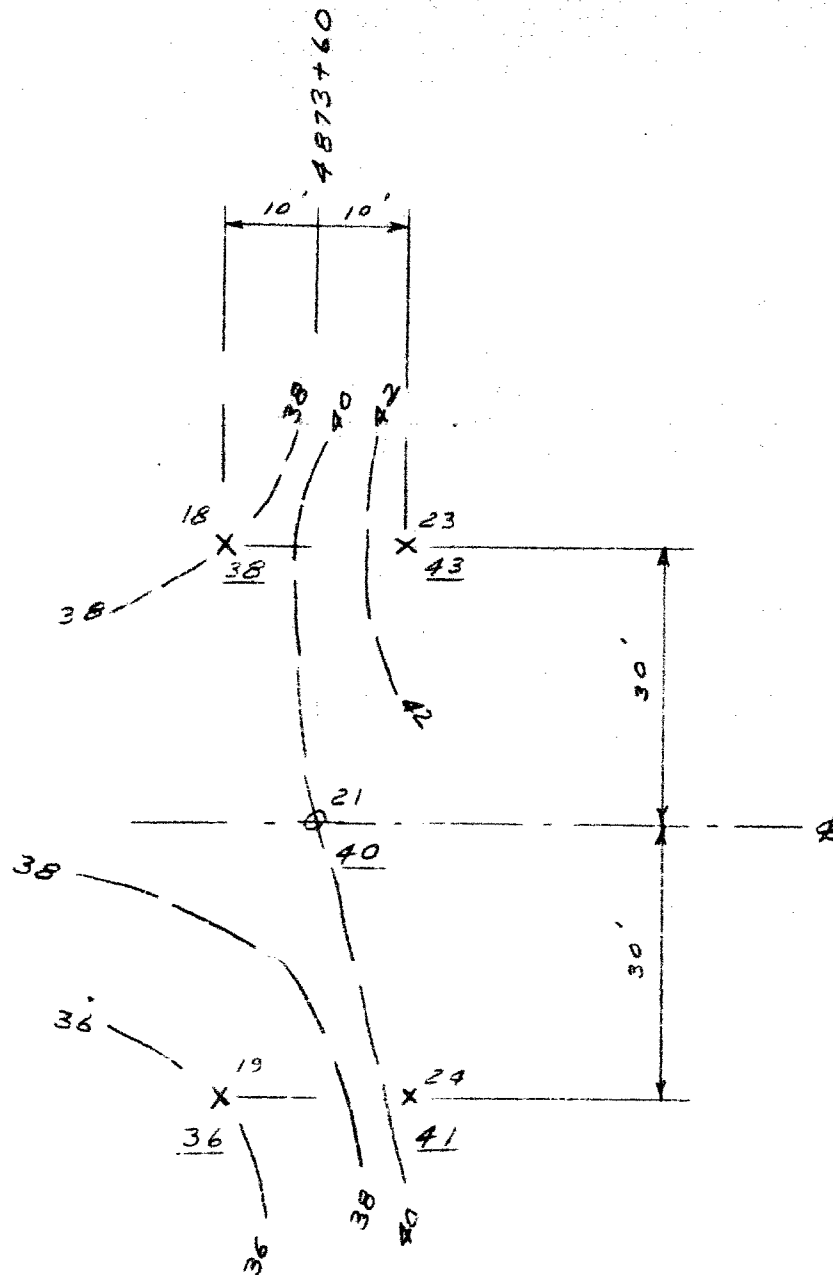
Natural Unit Weight

CONSISTENCY AND UNIT WEIGHT		SAMPLE NO.
	P.C.F.	
	% DRY WEIGHT	
		SS.1
		SS.2
		SS.3
		SS.4
		T.W.5
		SS.6
		SS.7

TABLE - CONE PENETRATION MEASUREMENTS - EAST PIER.

Elevation	H O L E S				
	18	19	21	23	24
67					
66					
65	Lake Bottom.		Lake Bottom.		Lake Bottom.
64	8				
63	2				
62	2				
61	1	Pushed with weight of 140 lb. hammer to			
60	2	Elevation 57			
59	4				
58	4				
57	4				
56	5	4	6	6	2
55	6	5	4	6	4
54	6	6	5	6	6
53	10	6	6	6	6
52	11	9	13	7	8
51	12	12	15	10	10
50	18	15	26	11	13
49	26	17	26	16	17
48	26	20	24	17	27
47	23	24	22	22	40
46	27	30	28	90	26
45	23	26	25	50	24
44	20	23	22	60	30
43	21	47	24	95	32
42	28	24	27	Refusal	48
41	50	24	55		107
40	85	23	67		66
39	47	22	70		70
38	76	35	82		95
37	74	45	Refusal		Refusal
36	95	89	(Borehole encountered refusal on rock or boulder at El. 31)		
	Refusal	Refusal			

Prep. By B.F.W.



ELEV. BEARING STRATUM SHOWN THUS 36

PILE PENETRATION 5' INTO BEARING STRATUM

0' BOREHOLE # NUMBER X¹⁹ SOUNDING # NUMBER

EASTERN PIER
 CONTOURS OF DENSE BEARING STRATUM
 SCALE 1"=20'

Order No. S500.1T253Enclosure No. 13**RACEY MacCALLUM AND ASSOCIATES LTD.**

Foundation Engineering Division

Engineering Data Sheet for Borehole: 28 ✓Project: White Lake NarrowsLocation: Approx 2 miles North Regin, OntHole Location: See attached sketchHole Elevation and Datum: 70.3 102.12Field Work Begun: 5-4-56 Ended: 6-4-56Field Supervision: J.N.Driller: M.L.Prep.: B.W.Checked: H.T.Date: 20-4-56**LEGEND**

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

Strength

Unconfined compression

Vane test and sensitivity

Consistency

Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight



SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
				P.S.F.	BLOWS/FT.
	<u>Ground Surface</u>	<u>70.3</u>			
	<u>Dense to very dense</u>				
	<u>silty sand with fine gravel</u>				
		<u>54.8</u>	<u>15.5</u>		
	<u>Bed rock - Gneiss (No recovery)</u>	<u>49.8</u>	<u>20.5</u>		
	<u>End of</u>				
	<u>Bore</u>				

CONSISTENCY AND UNIT WEIGHT

P.C.F.

% DRY WEIGHT

SAMPLE
NO.

SS1

SS2

SS3

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 32Project: White Lake NarrowsField Supervision: J. N.Location: Approx 2 mi. N. of Rogan Ont.Driller: L. BelleyHole Location: As shown on attached sketchPrep.: B. F. W.Hole Elevation and Datum: 72.5 GeodeticChecked: W. T.Field Work Begun: Apr. 6, 1956Ended: Apr. 6, 1956 Date: Apr. 20, 1956**LEGEND****Sampling Method**2" Dia. split tube
2" Shelby tube**Penetration Resistance**2" Split tube
2" Dia. Cone
Casing**Strength**U confined compression
Vane test and sensitivity**Consistency**Natural moisture
Liquid limit
Plastic limit**Natural Unit Weight**

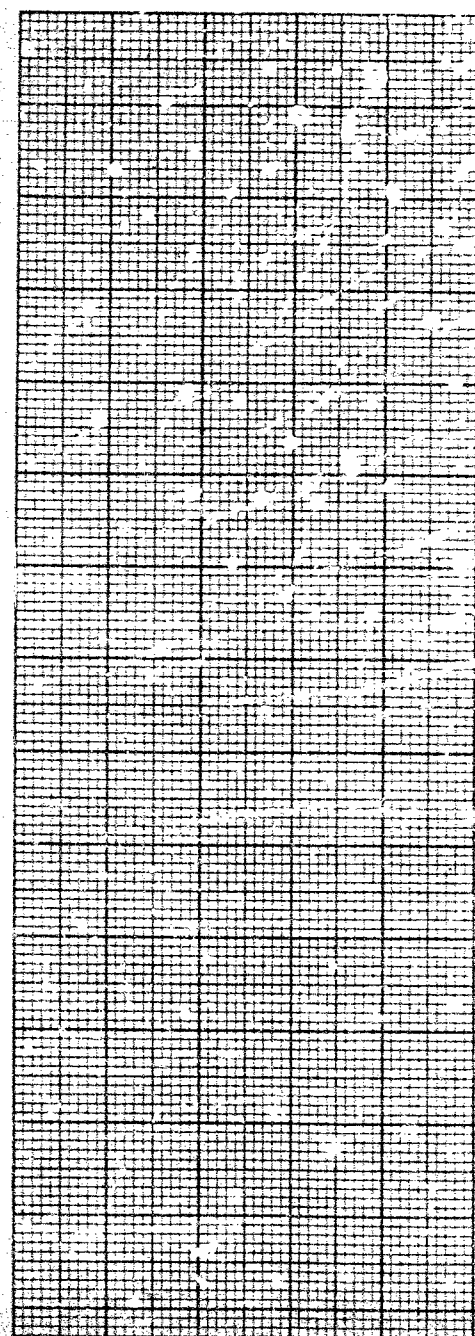
SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE			
				P.S.F.			
				BLOWS/FT.			
	Ground Surface	72.5	0	25	50	75	100
4.1.1	Medium dense silty organic sand						
4.1.2	Medium dense silty sand with fine gravel						
	----- Bedrock -----	62.0	10.5				
	Gneiss - 100% core recovery						
	----- End of Borehole -----	57.0	15.5				
			20				

CONSISTENCY AND UNIT WEIGHT

SAMPLE NO.

P.C.F.

% DRY WEIGHT

SS 1
S 20.5

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 33Project: White River Nat. ParkLocation: APPR 2 mi N. of Redon Ont.Hole Location: As shown on attached sketchHole Elevation and Datum: 70.5 GeodeticField Work Begun: APR 4, 1956 Ended: APR 6, 1956 Date: APR 20, 1956Field Supervision: J. N.Driller: L. BERRYPrep.: B. F. V.Checked: W. T.Date: APR 20, 1956**LEGEND****Sampling Method**

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

Strength

Unconfined compression

Vane test and sensitivity

Consistency

Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight



SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
				P.S.F.	BLOWS/FT.
	Ground Surface	70.5	0	25 50 75 100	
	Medium to very dense silty sand with fine to med. m gravel				
	Bedrock	60.0	10.5		
	Gneiss - 100% core recovery	55.0	15.5		
	End of Borehole				

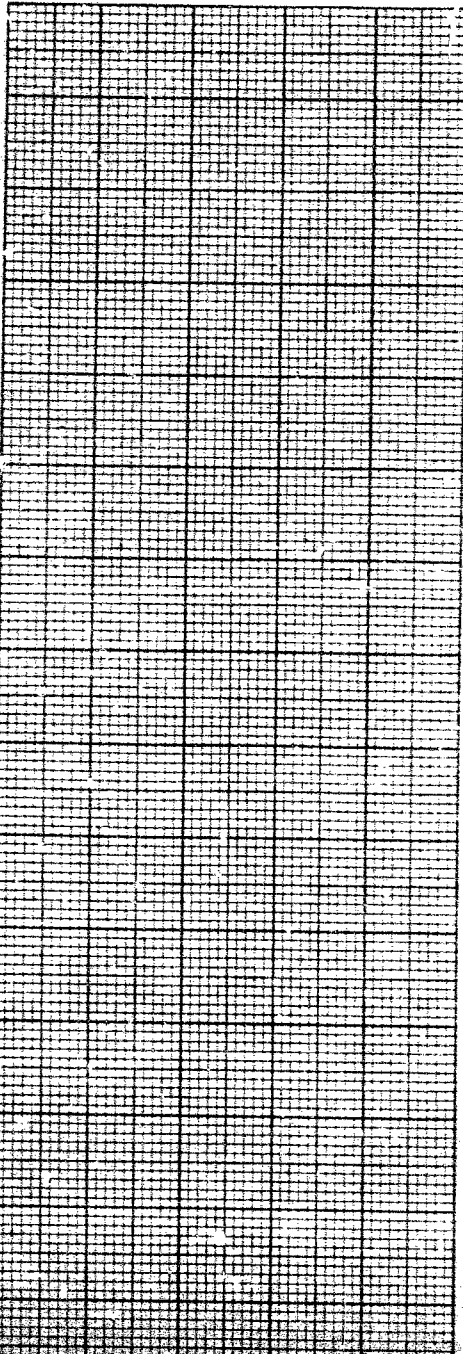
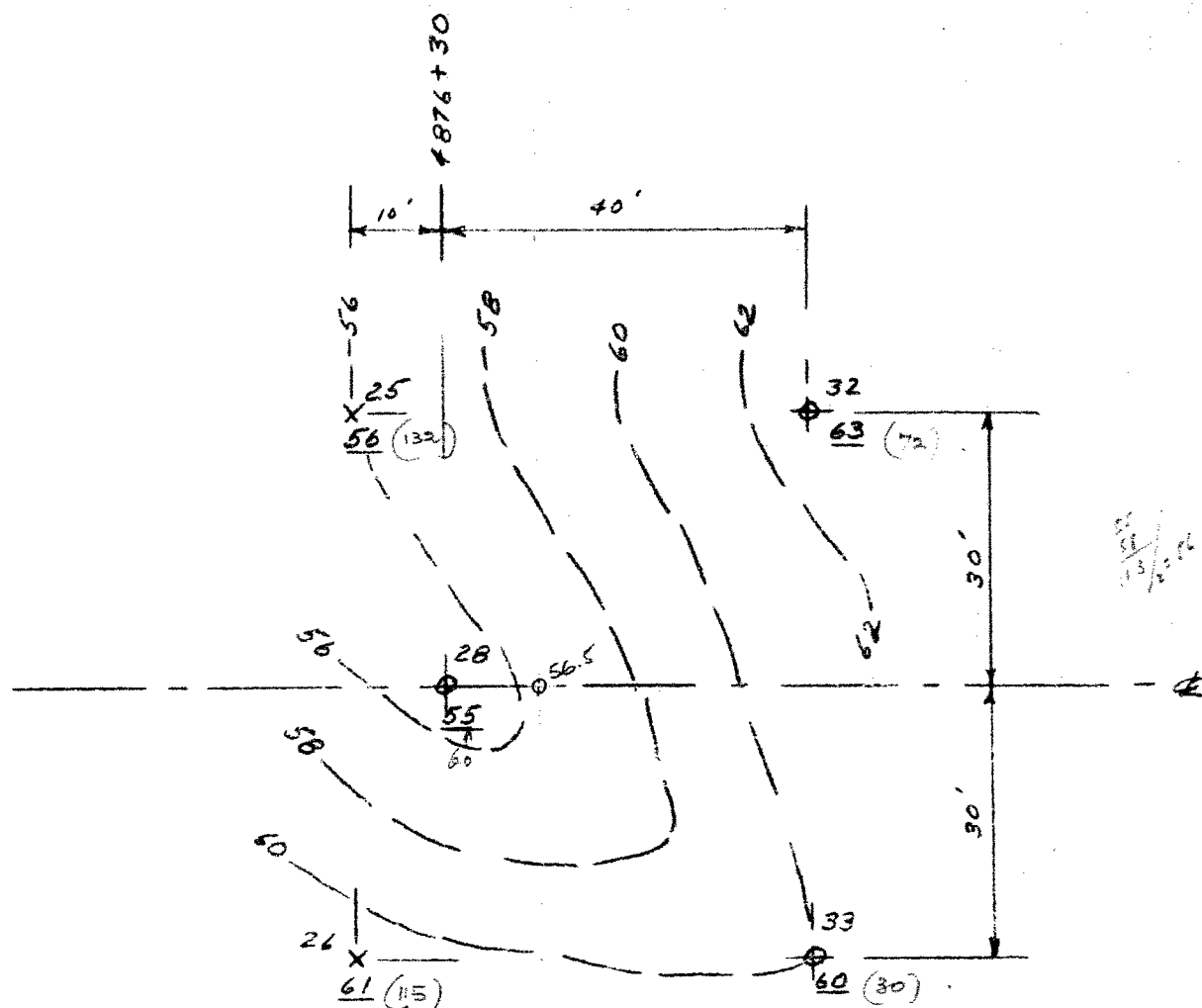
CONSISTENCY AND UNIT WEIGHT		SAMPLE NO.
		P.C.F.
% DRY WEIGHT		
		SS 1
		SS 1037

TABLE - CONE PENETRATION MEASUREMENTS - EAST
ABUTMENT

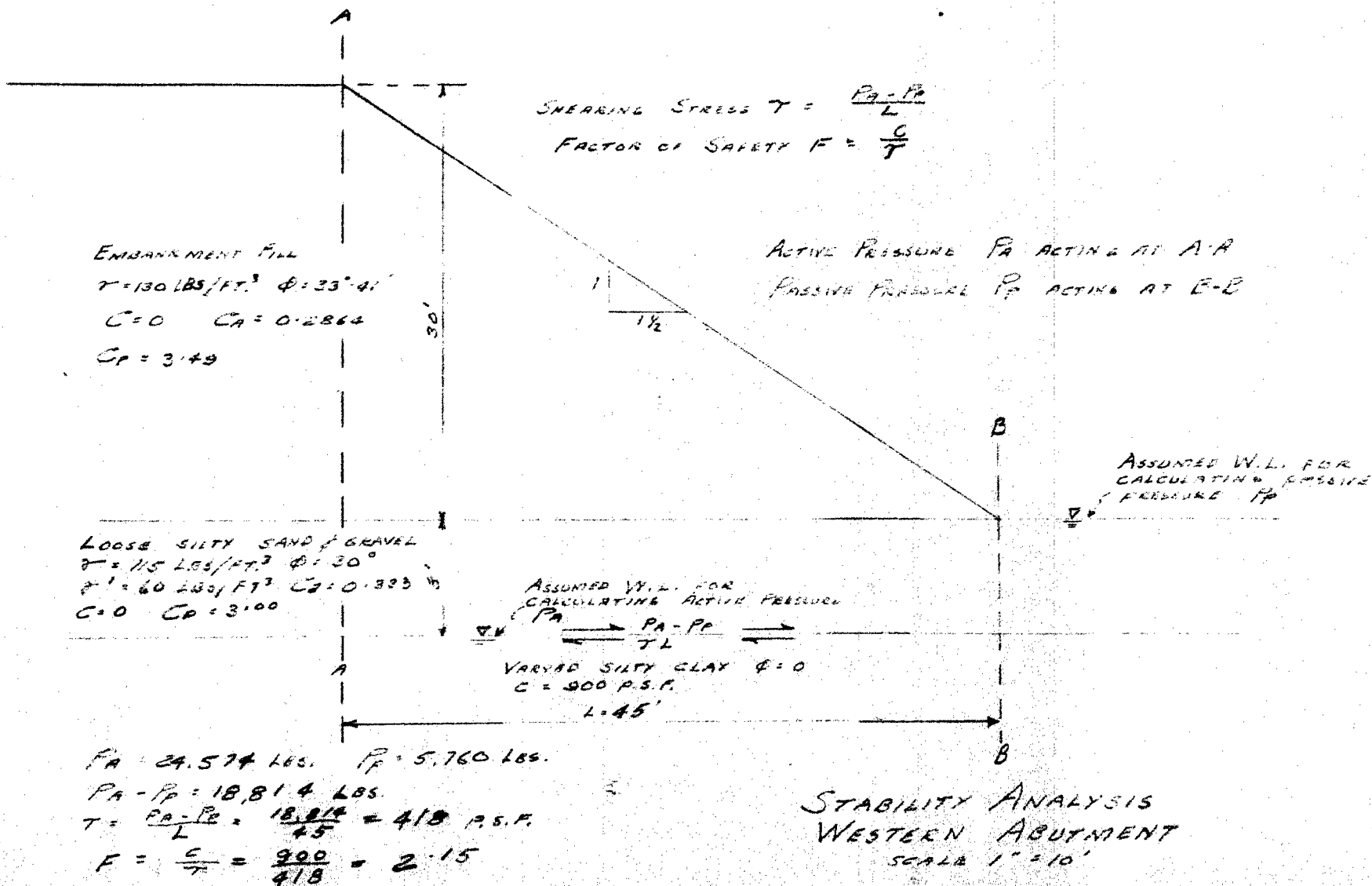
Elevation	H O L E S				
	25	26	28	32	33
71				8	
70				6	
69	1		6	9	30 ✓
68	5	14	12	17	85
67	7	19	30	17	138
66	6	30	15	16	75
65	4	20	30	20	52
64	23	39	52	22	178
63	34	69	68	72	44
62	25	104	74		40
61	31	115	82		42
60 ✓	19		118 ✓		30 Refusal
59	26				59.7 ✓
58	27				
57	51				
56	132 ✓				

Prep. By B.F.W.



Elevs. BEDROCK SHOWN THUS 60
 Ⓢ²⁸ BOREHOLE # NUMBER X²⁶ SOUNDING # NUMBER

EASTERN ABUTMENT
 CONTOURS OF BEDROCK
 SCALE 1" = 20'



RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 17

Project: *White Lake Narrows*

Location: *Appt. 2 mi. N. of Redzn, Ont.*

Hole Location *As shown on attached sketch*

Hole Elevation and Datum: 67 Geddatic

Field Work Begun MAR 27, 1956 Ended APR 2, 1956 Date: April 20, 1956

Field Supervision: ☒ ☒












Driller: M. L. L. L. L.

Prep.: 12.15 W

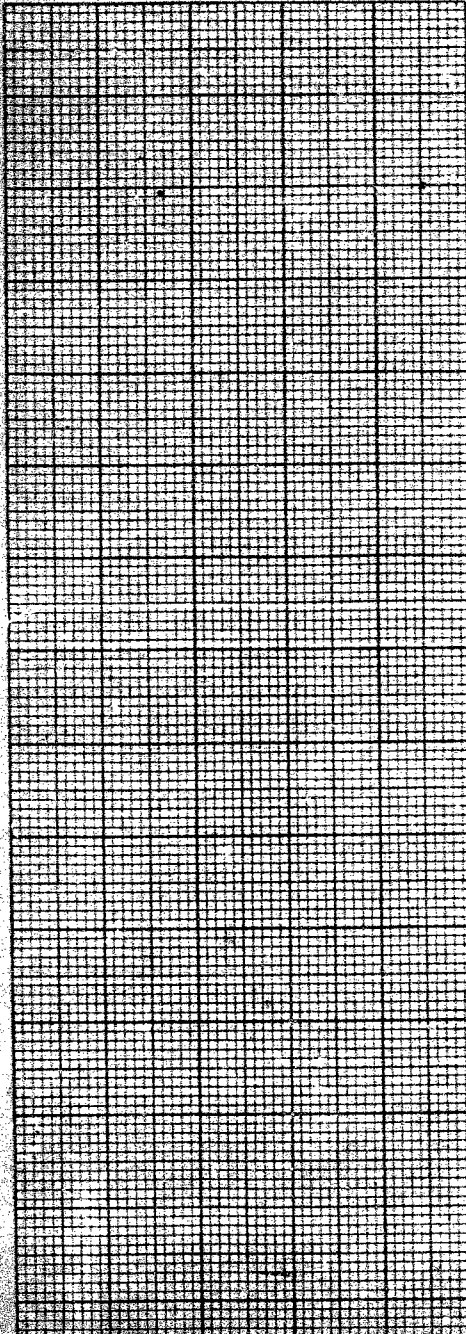
Checked: *h. 5*

Date: April 20, 1956

LEGEND

<u>Sampling Method</u>	
2" Dia. Split tube	
2" Shelby tube	
<u>Penetration Resistance</u>	
2" Split tube	
2" Dia. Cone	
Casing	
<u>Strength</u>	
Unconfined compression	
Vane test and sensitivity	
<u>Consistency</u>	
Natural moisture	
Liquid limit	
Plastic limit	
<u>Natural Unit Weight</u>	

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
				P.S.F.	BLOWS/FT
	Ice surface	67	0	0	25 50 75 100
	Lake Bottom	39	28		
	Loose fine sand & silt	— 35 —	32 34		
	Numerous large boulders in sand and gravel (drilled through boulders 1 to 2 ft. thick)		40		
	Diagram: 				
	Hole	Depth, ft.			
	Coublers or dense Soil	Refused			
	17	34	40 ±		
	17A	32	32		
	17B	≈ 34	42		
	17C	33			
	17D	34	44		
	No Sampling Possible				

CONSISTENCY AND UNIT WEIGHT		SAMPLE NO.
	P.C.F.	
% DRY WEIGHT		
		

S6637
REPORT
TO
FOUNDATION OF CANADA ENGINEERING CORPORATION LIMITED
ON
DYNAMIC PENETRATION TESTS
PROPOSED WHITE LAKE NARROWS BRIDGE
REGAN ONTARIO

Distribution:

- 3 copies - Foundation of Canada Engineering Corporation Limited,
Toronto, Ontario.
- 3 copies - Geocon Ltd,
Toronto, Ontario.

GEOCON

GEOCON LTD

HEAD OFFICE
180 VALLÉE ST., MONTREAL 18, QUEBEC
TELEPHONE UN. 6-7632

Rexdale, Ontario,
March 24th, 1958.

BA 525-A
DISTRICT OFFICES
14 HAAS ROAD
REXDALE, TORONTO, ONT.
TEL. CH. 4-8641
3355 WEST BROADWAY AVE.
VANCOUVER 8, B.C.
TEL. CH. 5510

Foundation of Canada Engineering
Corporation Limited,
8 Spadina Road,
Toronto 4, Ontario.

Attention: Mr. W.E. Mickey, P.Eng.,
Vice-President.

Re: Dynamic Penetration Tests,
Proposed White Lake Narrows Bridge,
Rexdale, Ontario.

Dear Sirs:

This letter accompanies the results of the above dynamic penetration tests carried out at the locations shown on the Department of Highways Drawing No. 1692-T-3.

A detailed log of each dynamic penetration test is given in Appendix I.

Drawing S6637-1, at the rear of this report, shows the dynamic penetration test locations and the depth of penetration.

We believe that this report gives all the information necessary for determining pile lengths required for support of logging boom structures north of the proposed bridge.

If we can be of any further assistance, we would be pleased if you would call us.

Yours very truly,

GEOCON LTD

V. Milligan
V. Milligan, P. Eng.,
District Engineer.

VH/dv
S-6637



ST. JOHN'S

HALIFAX

LONDON

QUEBEC

VANCOUVER

MONTREAL

TORONTO



APPENDIX I
PENETRATION TESTS





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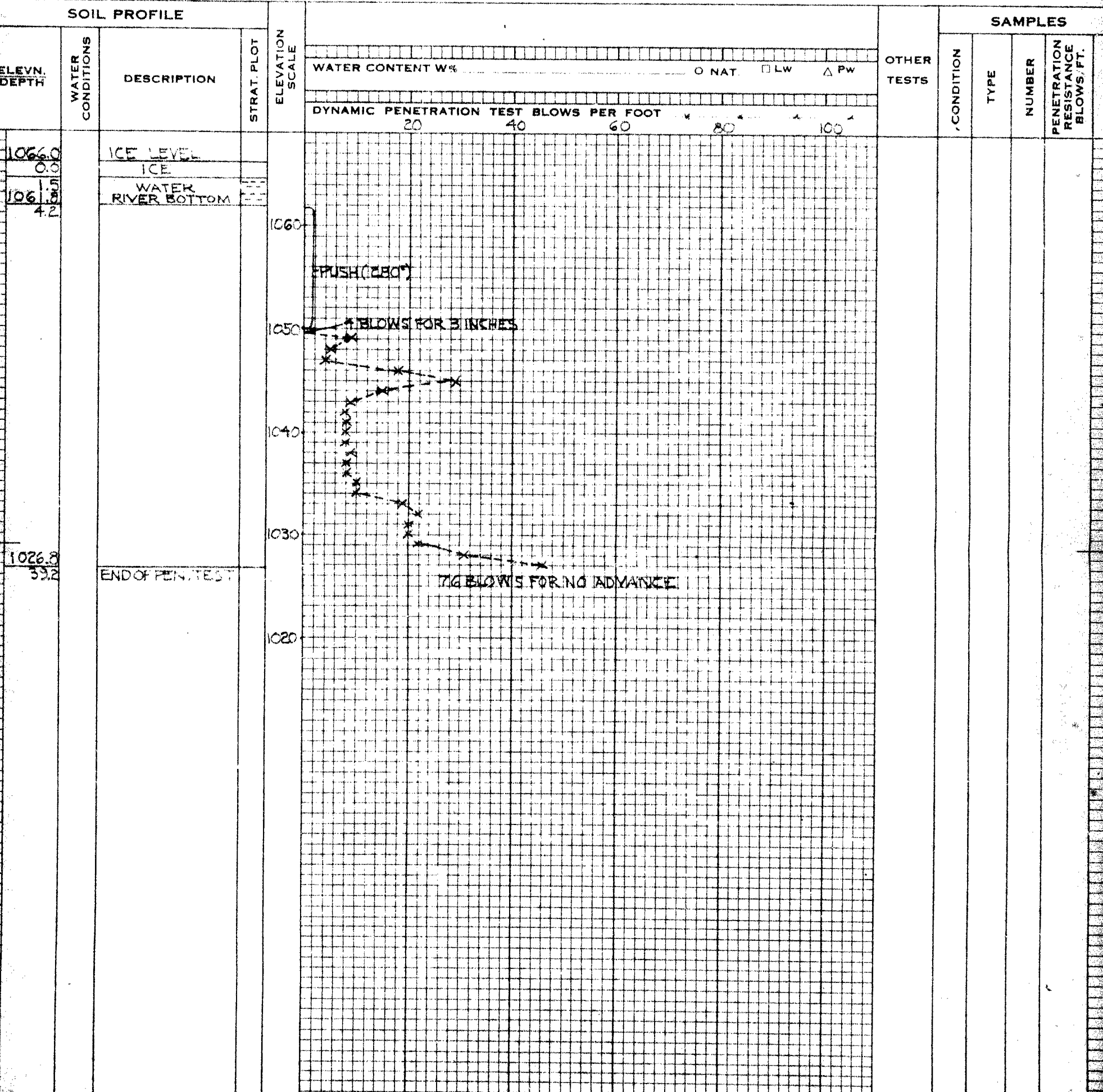
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OFFICE REPORT ON SOIL EXPLORATION

APPENDIX I

CONTRACT 56637 PEN. TEST APPEX. I BORING # 1 DATUM D.H.O. CASING 1
 BORING DATE MAR. 7, 1958 REPORT DATE MAR. 12, 1958 COMPILED BY M.W. CHECKED BY J.L.
 SAMPLER HAMMER WT. 410 LBS. DROP 13 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS ENERGY)

SAMPLE CONDITION		SAMPLE TYPES		ABBREVIATIONS	
	DISTURBED	A.S. - AUGER SAMPLE	F.S. - FOIL SAMPLE	V - IN-SITU VANE TEST	γ - WET UNIT WEIGHT
	FAIR	S.T. - SLOTTED TUBE	S.O. - SLEEVE-OPEN	M - MECHANICAL ANALYSIS	K - PERMEABILITY
	GOOD	W.S. - WASHED SAMPLE	S.F. - SLEEVE-FOOT VALVE	U - UNCONFINED COMPRESSION	C - CONSOLIDATION
	LOST	D.O. - DRIVE-OPEN	T.O. - THIN WALLED OPEN	QC - TRIAXIAL CONSOLIDATED QUICK	
		D.F. - DRIVE-FOOT VALVE	R.C. - ROCK CORE	Q - TRIAXIAL QUICK	WL - WATER LEVEL IN CASING
		C.S. - CHUNK SAMPLE		S - TRIAXIAL SLOW	WT - WATER TABLE IN SOIL



OFFICE REPORT ON SOIL EXPLORATION

SAMPLE CONDITION

SAMPLE TYPES

ABBREVIATIONS

DISTURBED
FAIR
GOOD
LOST

A.S. - AUGER SAMPLE
S.T. - SLOTTED TUBE
W.S. - WASHED SAMPLE
D.O. - DRIVE-OPEN
D.F. - DRIVE-FOOT VALVE
C.S. - CHUNK SAMPLE

F.S. - FOIL SAMPLE
S.O. - SLEEVE-OPEN
S.F. - SLEEVE-FOOT VALVE
T.O. - THIN WALLED OPEN
R.C. - ROCK CORE

- V - IN-SITU VANE TEST
- M - MECHANICAL ANALYSIS
- U - UNCONFINED COMPRESSION
- QC - TRIAXIAL CONSOLIDATED QUICK
- Q - TRIAXIAL QUICK
- S - TRIAXIAL SLOW

γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION

WL - WATER LEVEL IN CASING
WT - WATER TABLE IN SOIL

SOIL PROFILE

ELEV. N.
DEPTH

WATER CONDITIONS

DESCRIPTION

STRAT. PLOT

EVALUATION
SCALE

WATER CONTENT W%

☒ NAT. ☐ LW ☐ PW

DYNAMIC PENETRATION TEST BLOWS PER FOOT

20 40 60 80 100

OTHER
TESTS

SAMPLES

CONDITION

ЭДЛ

NUMBER

**PENETRATION
RESISTANCE
BLOWS/FT.**

10640
00
1.6

ICE LEVEL
ICE
RIVER BOTTOM

1060

PUSH (Z80*)

PUSH(460)

1050

1040

1030

END OF PEN. TEST

76 BLOWS FOR LAST 4 INCHES
BOTTOM ROD BENT APPROX. 45°
EASILY BEDROCK

1155
1156
1157
1158

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OFFICE REPORT ON SOIL EXPLORATION

APPENDIX I

CONTRACT 56637 PEN. TEST BORING # 3 DATUM D.H.O. CASING
 BORING DATE MAR. 7, 1958 REPORT DATE MAR. 12, 1958 COMPILED BY M.W. CHECKED BY J.H.S.
 SAMPLER HAMMER WT. 410 LBS. DROP 13 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN. LBS. ENERGY)

SAMPLE CONDITION

DISTURBED
 FAIR
 GOOD
 LOST

SAMPLE TYPES

A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE
 F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

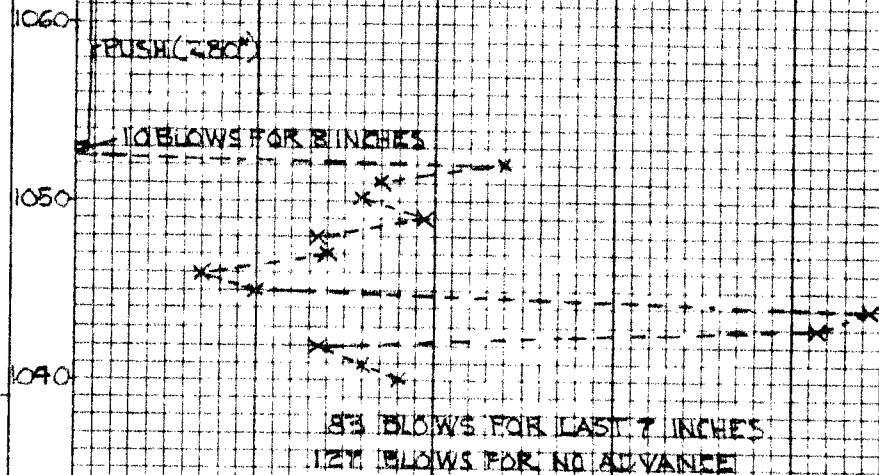
V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 QC - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL

SOIL PROFILE

ELEV. DEPTH	WATER CONDITIONS	DESCRIPTION	STRAT. PLOT	ELEVATION SCALE
1066.0		ICE LEVEL		
0.0		ICE		
1.5		RIVER BOTTOM		
1038.9		END OF PEN. TEST		
27.1				

WATER CONTENT W% NAT. LW PW

DYNAMIC PENETRATION TEST BLOWS PER FOOT 20 40 60 80 100



SAMPLES

OTHER TESTS

CONDITION TYPE NUMBER PENETRATION RESISTANCE BLOWS/FT.

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OFFICE REPORT ON SOIL EXPLORATION

CONTRACT 56637 PEN. TEST APPEX. I BORING # 4 DATUM D.H.O. CASING
 BORING DATE MAR. 7, 1958 REPORT DATE MAR. 12, 1958 COMPILED BY M.W. CHECKED BY
 SAMPLER HAMMER WT. 10 LBS. DROP 13 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN. - LBS. ENERGY)

SAMPLE CONDITION



A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE

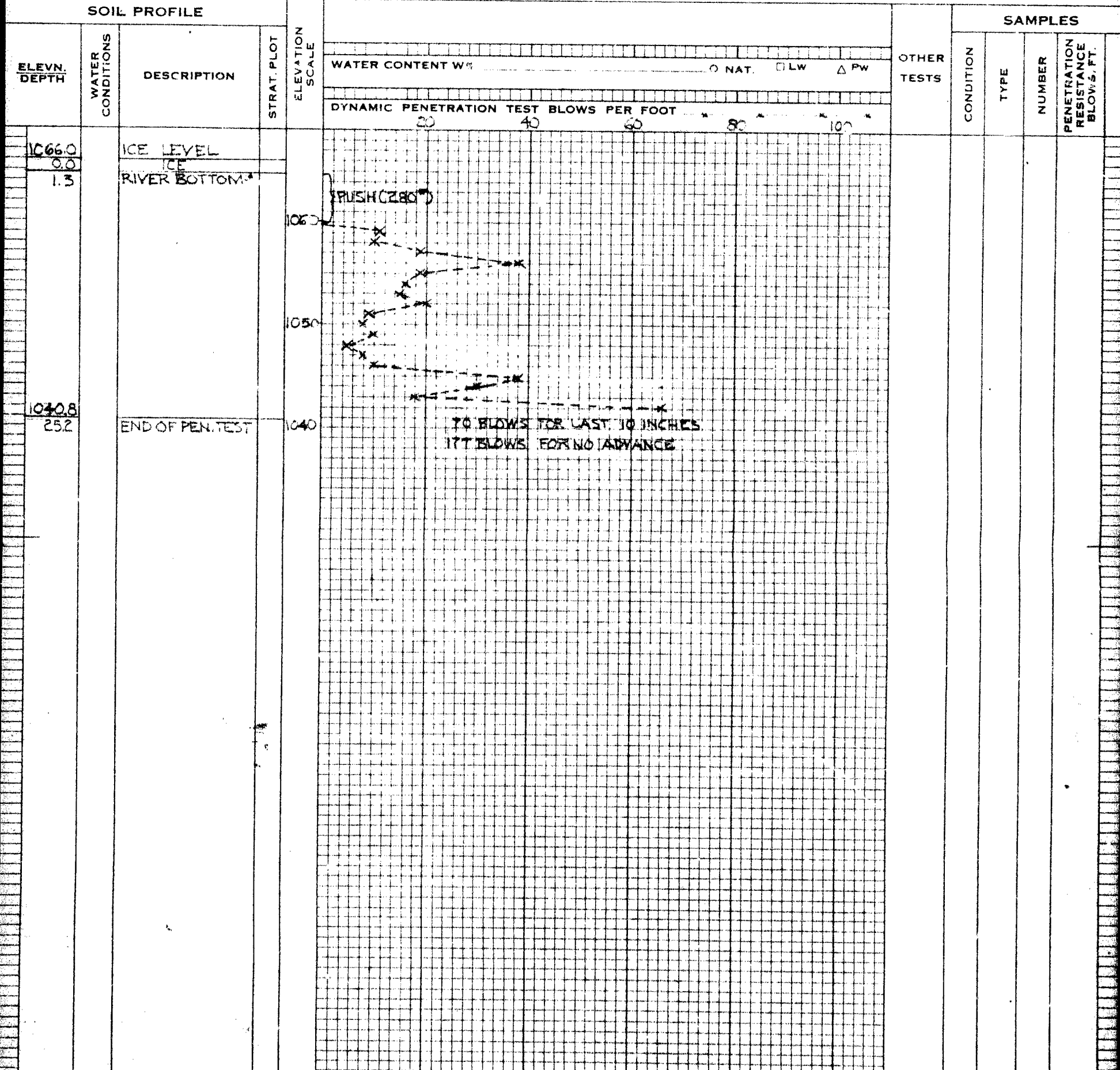
SAMPLE TYPES

F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 QC - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL

SOIL PROFILE



GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT 56637 PEN TEST APPEX I BORING # 7 DATUM D.H.O. CASING —
 BORING DATE MAR. 7, 1958 REPORT DATE MAR. 12, 1958 COMPILED BY MMV CHECKED BY JLS
 HAMMER WT. 410 LBS. DROP 13 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION



A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE

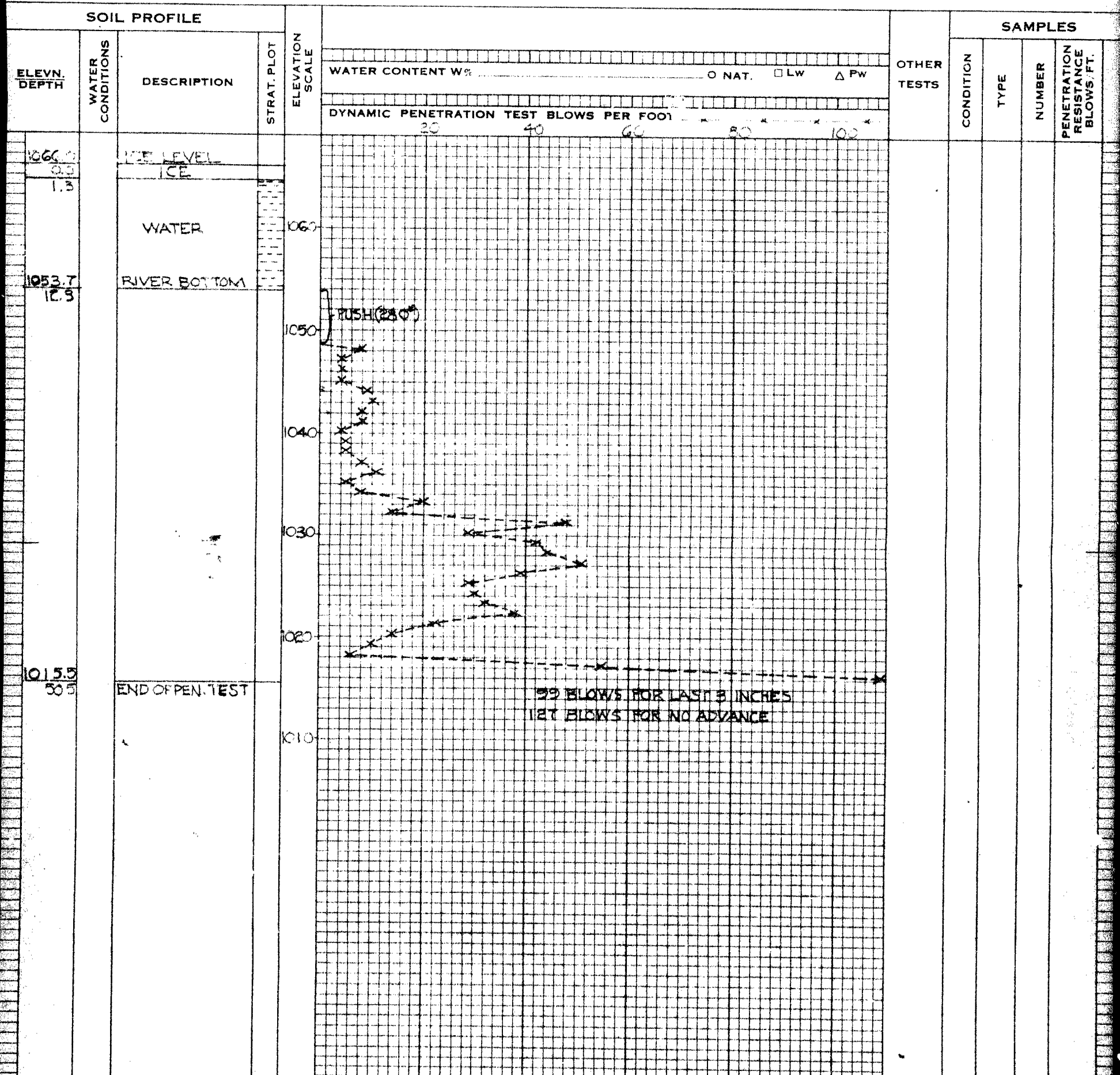
SAMPLE TYPES

F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 QC - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL

SOIL PROFILE



GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT 56637 PEN-TEST APPLICABLE
BORING DATE MAR. 7, 1958 REPORT DATE MAR. 12, 1958 DATUM D.H.O. CASING
HAMMER WT. 410 LBS. DROP 13 INCHES COMPILED BY M.W. CHECKED BY JLS
(PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION



DISTURBED
FAIR
GOOD
LOST

SAMPLE TYPES

A.S. - AUGER SAMPLE
S.T. - SLOTTED TUBE
W.S. - WASHED SAMPLE
D.O. - DRIVE OPEN
D.F. - DRIVE-FOOT VALVE
C.S. - CHUNK SAMPLE

F.S. - FOIL SAMPLE
S.O. - SLEEVE-OPEN
S.F. - SLEEVE-FOOT VALVE
T.O. - THIN WALLED OPEN
R.C. - ROCK CORE

ABBREVIATIONS

- V - IN-SITU VANE TEST
- M - MECHANICAL ANALYSIS
- U - UNCONFINED COMPRESSION
- QC - TRIAXIAL CONSOLIDATED QUICK
- Q - TRIAXIAL QUICK
- S - TRIAXIAL SLOW

J - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL

SOIL PROFILE

[illegible]

GEOCON

OFFICE REPORT ON SOIL EXPLORATION

APPEX. I

CONTRACT SG53T PEN. TEST 9 DATUM D.H.O. CASING ---
 BORING DATE MAR. 7, 1958 REPORT DATE MAR. 12, 1958 COMPILED BY M.W. CHECKED BY JLS
~~SAMPLE~~ HAMMER WT. 410 LBS. DROP 13 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION



A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE

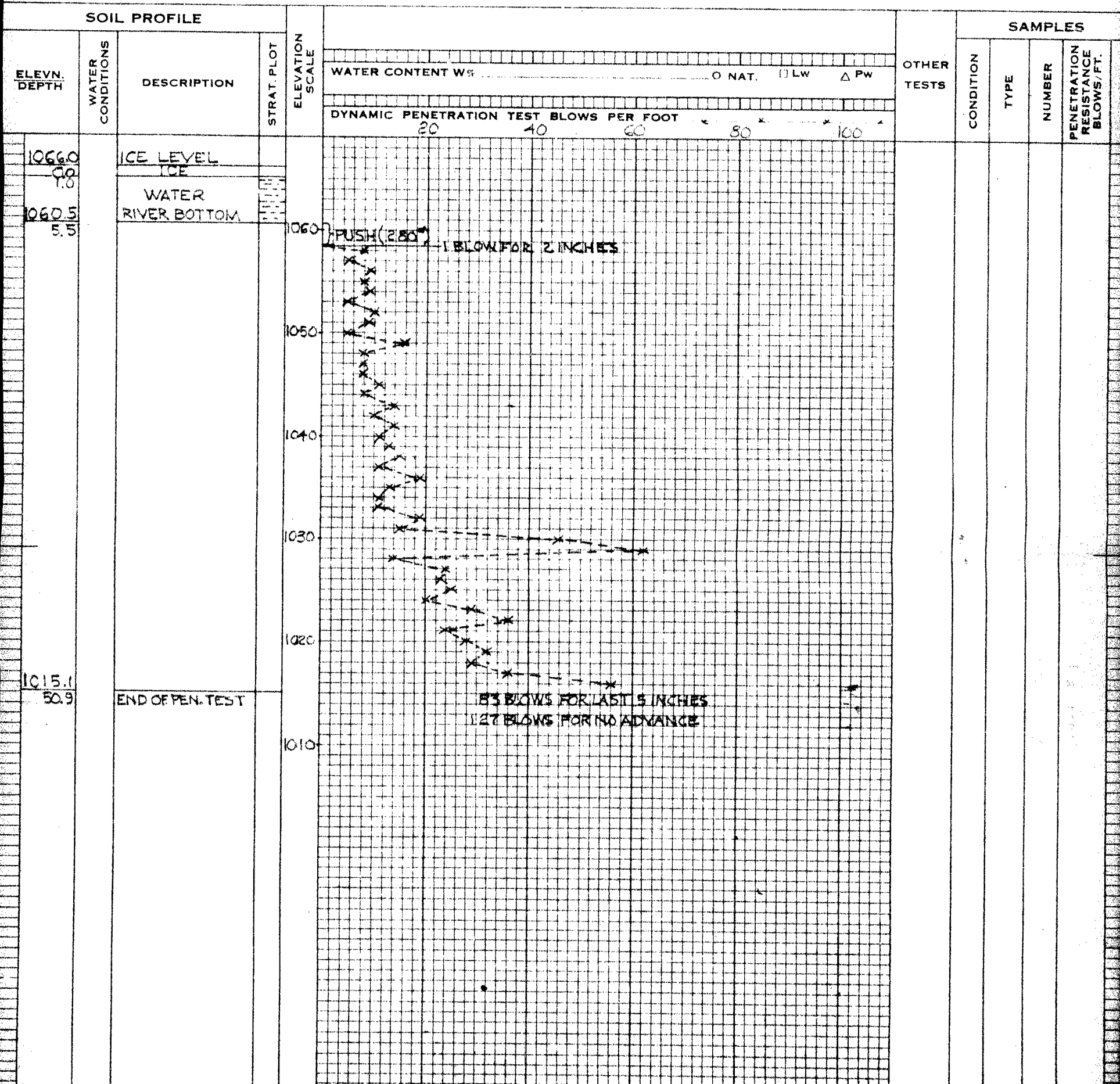
SAMPLE TYPES

F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 Qc - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL

SOIL PROFILE



OFFICE REPORT ON SOIL EXPLORATION

SAMPLE CONDITION

SAMPLE TYPES

ABBREVIATIONS



DISTURBED
FAIR
GOOD
LOST

A.S. - AUGER SAMPLE
S.T. - SLOTTED TUBE
W.S. - WASHED SAMPLE
D.O. - DRIVE-OPEN
D.F. - DRIVE-FOOT VALVE
C.S. - CHUNK SAMPLE

F.S. - FOIL SAMPLE
S.O. - SLEEVE-OPEN
S.F. - SLEEVE-FOOT VALVE
T.O. - THIN WALLED OPEN
R.C. - ROCK CORE

V - IN-SITU VANE TEST
M - MECHANICAL ANALYSIS
U - UNCONFINED COMPRESSION
QC - TRIAXIAL CONSOLIDATED QUICK
Q - TRIAXIAL QUICK
S - TRIAXIAL SLOW

γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION

WL - WATER LEVEL IN CASING
WT - WATER TABLE IN SOIL

SOIL PROFILE

GENERAL DATA					WATER CONTENT W _n			OTHER TESTS	SAMPLES						
ELEV. DEPTH	WATER CONDITIONS	DESCRIPTION	STRAT. PLOT	ELEVATION SCALE	O NAT. □ LW ▲ PW				CONDITION	TYPE	NUMBER	PENETRATION RESISTANCE BLOWS/FT.			
					DYNAMIC PENETRATION TEST BLOWS PER FOOT										
					20 40 60 80 100										
1066.0 0.0		ICE LEVEL													
1.1		ICE													
1061.0 5.0		WATER RIVER BOTTOM													
					89 BLOWS FOR LAST 5 INCHES 72 BLOWS FOR NO ADVANCE										
1010.7 55.3		END OF PEN. TEST													

GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT 56637 PEN TEST APPEX. I
 BORING DATE MAR. 8, 1958 BORING # 11 DATUM D.H.O.
 REPORT DATE MAR. 11, 1958 COMPILED BY M.W. CHECKED BY
 SAMPLER HAMMER WT. 410 LBS. DROP 13 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN. LBS. ENERGY)

SAMPLE CONDITION



A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE

SAMPLE TYPES

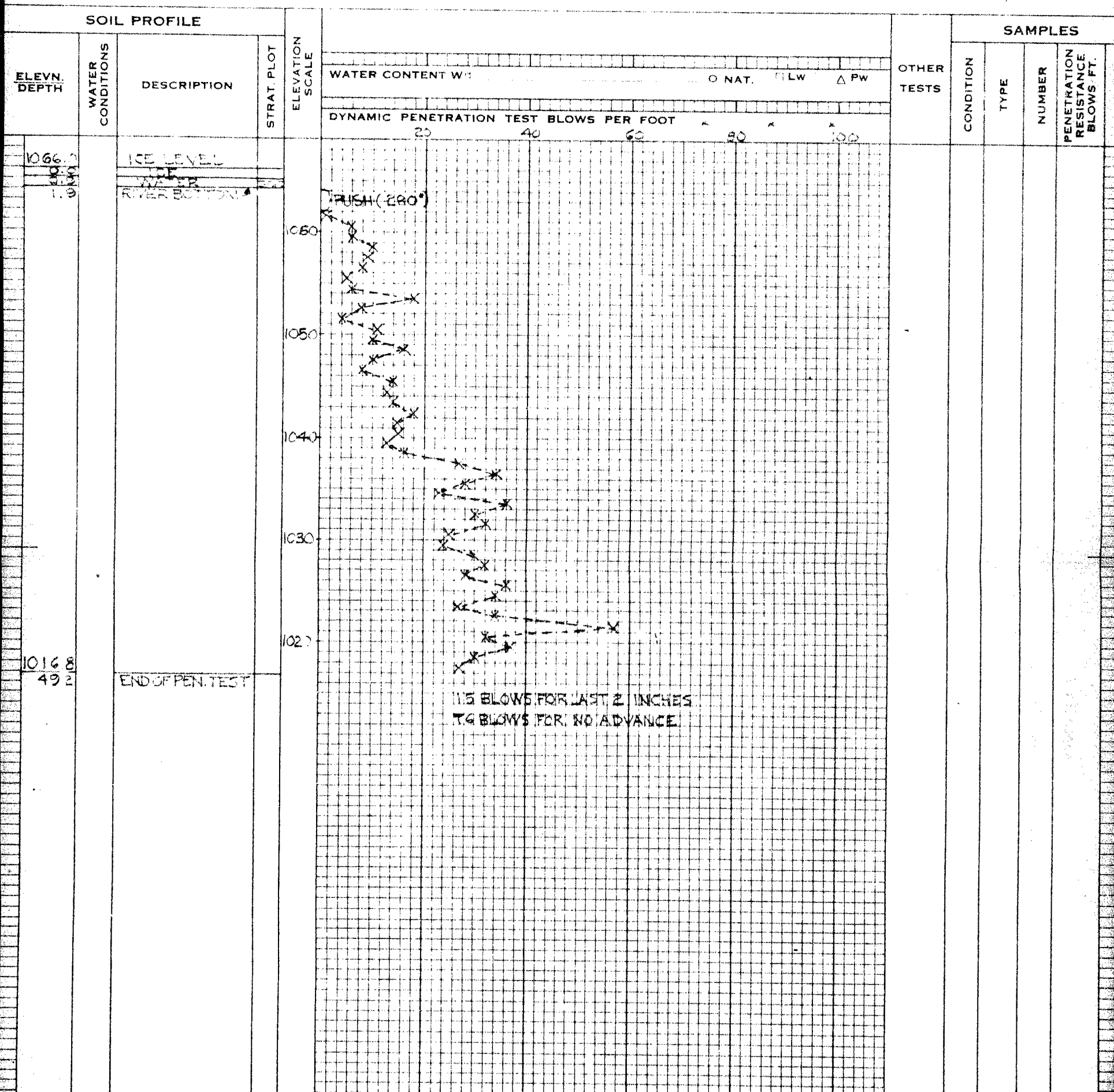
F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 QC - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL

SOIL PROFILE

SAMPLES



GEOCON

OFFICE REPORT ON SOIL EXPLORATION

APPEX. I

CONTRACT 56637
BORING DATE MAR. 8, 1958
SAMPLER HAMMER WT. 410

PEN. TEST BORING # 12
REPORT DATE MAR. 11, 1958
LBS. DROP 13 INCHES

DATUM D.H.O.
COMPILED BY M.W.
CASING
CHECKED BY

(PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION

DISTURBED
FAIR
GOOD
LOST

SAMPLE TYPES

A.S. - AUGER SAMPLE
S.T. - SLOTTED TUBE
W.S. - WASHED SAMPLE
D.O. - DRIVE-OPEN
D.F. - DRIVE-FOOT VALVE
C.S. - CHUNK SAMPLE
F.S. - FOIL SAMPLE
S.O. - SLEEVE-OPEN
S.F. - SLEEVE-FOOT VALVE
T.O. - THIN WALLED OPEN
R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
M - MECHANICAL ANALYSIS
U - UNCONFINED COMPRESSION
QC - TRIAXIAL CONSOLIDATED QUICK
Q - TRIAXIAL QUICK
S - TRIAXIAL SLOW
γ - WET UNIT WEIGHT
K - PERMEABILITY
C - CONSOLIDATION
WL - WATER LEVEL IN CASING
WT - WATER TABLE IN SOIL

SOIL PROFILE

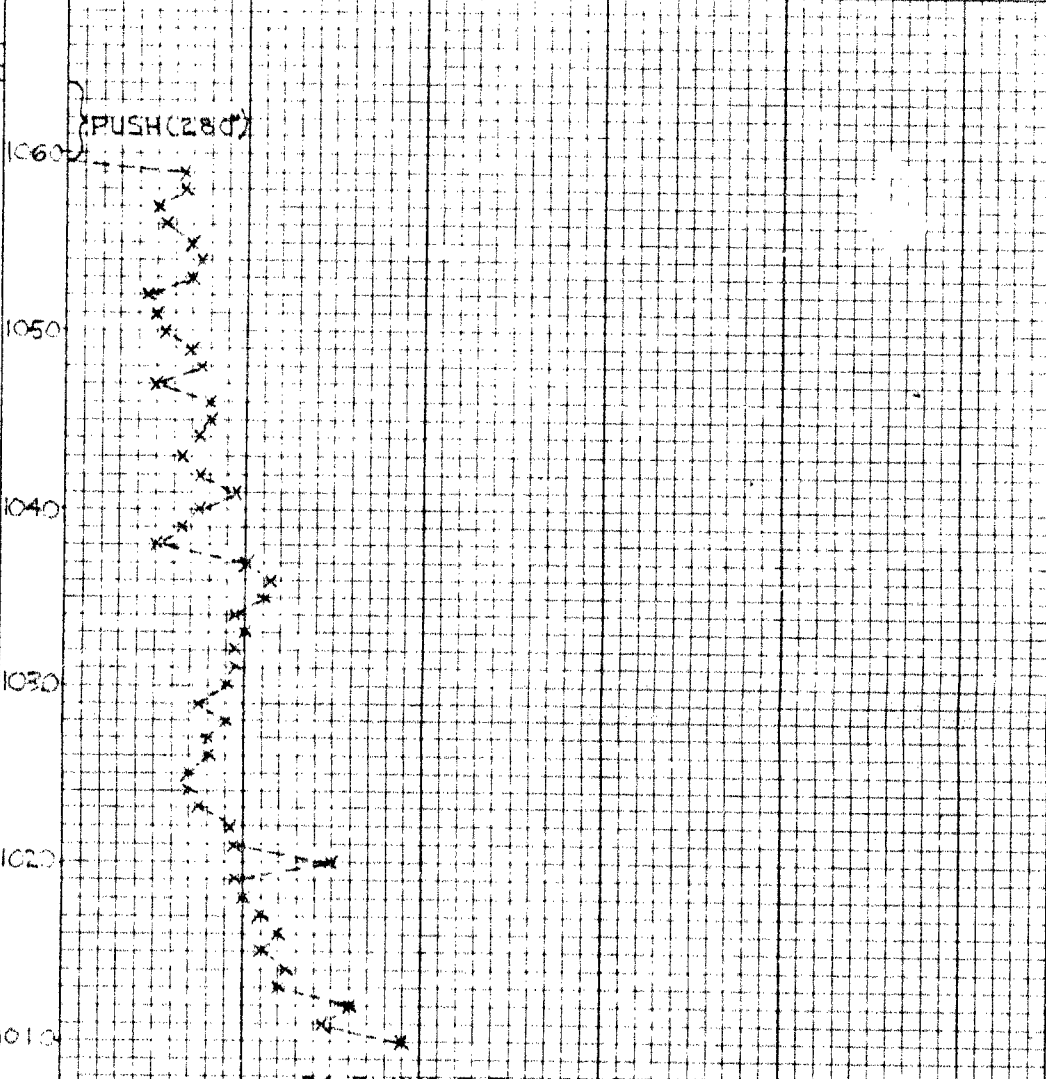
ELEV. DEPTH
WATER CONDITIONS
DESCRIPTION
STRAT. PLOT
ELEVATION SCALE

WATER CONTENT W%
DYNAMIC PENETRATION TEST BLOWS PER FOOT
NAT. LW PW

SAMPLES

OTHER TESTS
CONDITION
TYPE
NUMBER
PENETRATION RESISTANCE BLOWS/FT.

10660
ICE LEVEL
ICE
WATER RIVER BOTTOM
10659
57.1
END OF PEN. TEST



36 BLOWS FOR LAST 8 INCHES
127 BLOWS FOR NO ADVANCE

GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT 56637 PEN. TEST APPROX. 13 DATUM D.H.O. CASING
BORING # 13
BORING DATE MAR. 8, 1958 REPORT DATE MAR. 11, 1958 COMPILED BY M.W. CHECKED BY
SAMPLER HAMMER WT. 410 LBS DROP 13 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION

	DISTURBED
	FAIR
	GOOD
	LOST

SAMPLE TYPES

A.S. - AUGER SAMPLE	F.S. - FOIL SAMPLE
S.T. - SLOTTED TUBE	S.O. - SLEEVE-OPEN
W.S. - WASHED SAMPLE	S.F. - SLEEVE-FOOT VALVE
D.O. - DRIVE-OPEN	T.O. - THIN WALLED OPEN
J.F. - DRIVE-FOOT VALVE	R.C. - ROCK CORE
C.S. - CHUNK SAMPLE	

ABBREVIATIONS

ABREVIATIONS

V - IN-SITU VANE TEST	γ - WET UNIT WEIGHT
M - MECHANICAL ANALYSIS	K - PERMEABILITY
U - UNCONFINED COMPRESSION	C - CONSOLIDATION
QC - TRIAXIAL CONSOLIDATED QUICK	
Q - TRIAXIAL QUICK	WL - WATER LEVEL IN CASING
S - TRIAXIAL SLOW	WT - WATER TABLE IN SOIL

SOIL PROFILE

SOIL PROFILE				WATER CONTENT W _q				OTHER TESTS				
ELEV. DEPTH	WATER CONDITIONS	DESCRIPTION	STRAT. PLOT	ELEVATION SCALE	DYNAMIC PENETRATION TEST BLOWS PER FOOT				CONDITION	TYPE	NUMBER	PENETRATION RESISTANCE BLOWS/FT.
					O NAT. □ LW △ PW							
					20 40 60 80 100							
10660 0.0 1.3		ICE LEVEL 1.3 RIVER BOTTOM										
				1060	PUSH (230°)							
					5 BLOWS FOR FIRST 3 INCHES							
				1050								
				1040								
				1030								
				1020								
				1010								
10110 55.0		END OF PEN. TEST			5 BLOWS FOR LAST 3 INCHES 5 BLOWS FOR NO ADVANCE							

GEOCON

OFFICE REPORT ON SOIL EXPLORATION

APPENDIX I

CONTRACT 56837 PEN. TEST 14 DATUM D.H.Q. CASING ---
 BORING DATE MAR. 2, 1958 REPORT DATE MAR. 12, 1958 COMPILED BY M.W. CHECKED BY ---
 SAMPLER HAMMER WT. 410 LBS. DROP 18 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION

☐ DISTURBED
☐ FAIR
☐ GOOD
☐ LOST

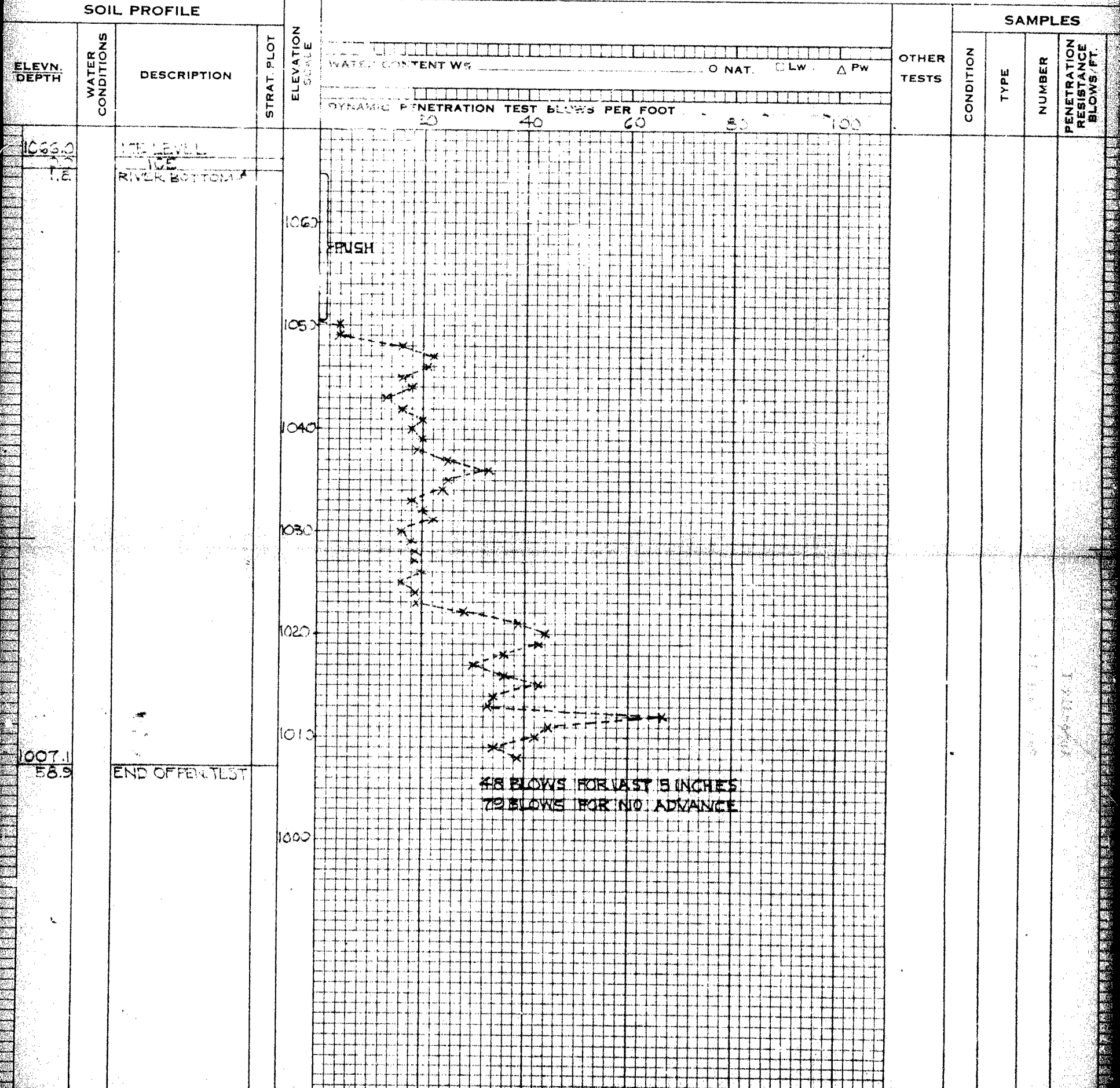
SAMPLE TYPES

A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE
 F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 QC - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL

SOIL PROFILE



GEOCON

OFFICE REPORT ON SOIL EXPLORATION

APPEX. I

CONTRACT 86637 PEN. TEST 15 DATUM D.H.O. CASING JL
 BORING DATE MAR 9, 1958 REPORT DATE MAR 12, 1958 COMPILED BY MM CHECKED BY JL
~~SAMPLE~~ HAMMER WT. 410 LBS. DROP 13 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN. LBS. ENERGY)

SAMPLE CONDITION

☐ DISTURBED
☐ FAIR
☐ GOOD
☐ LOST

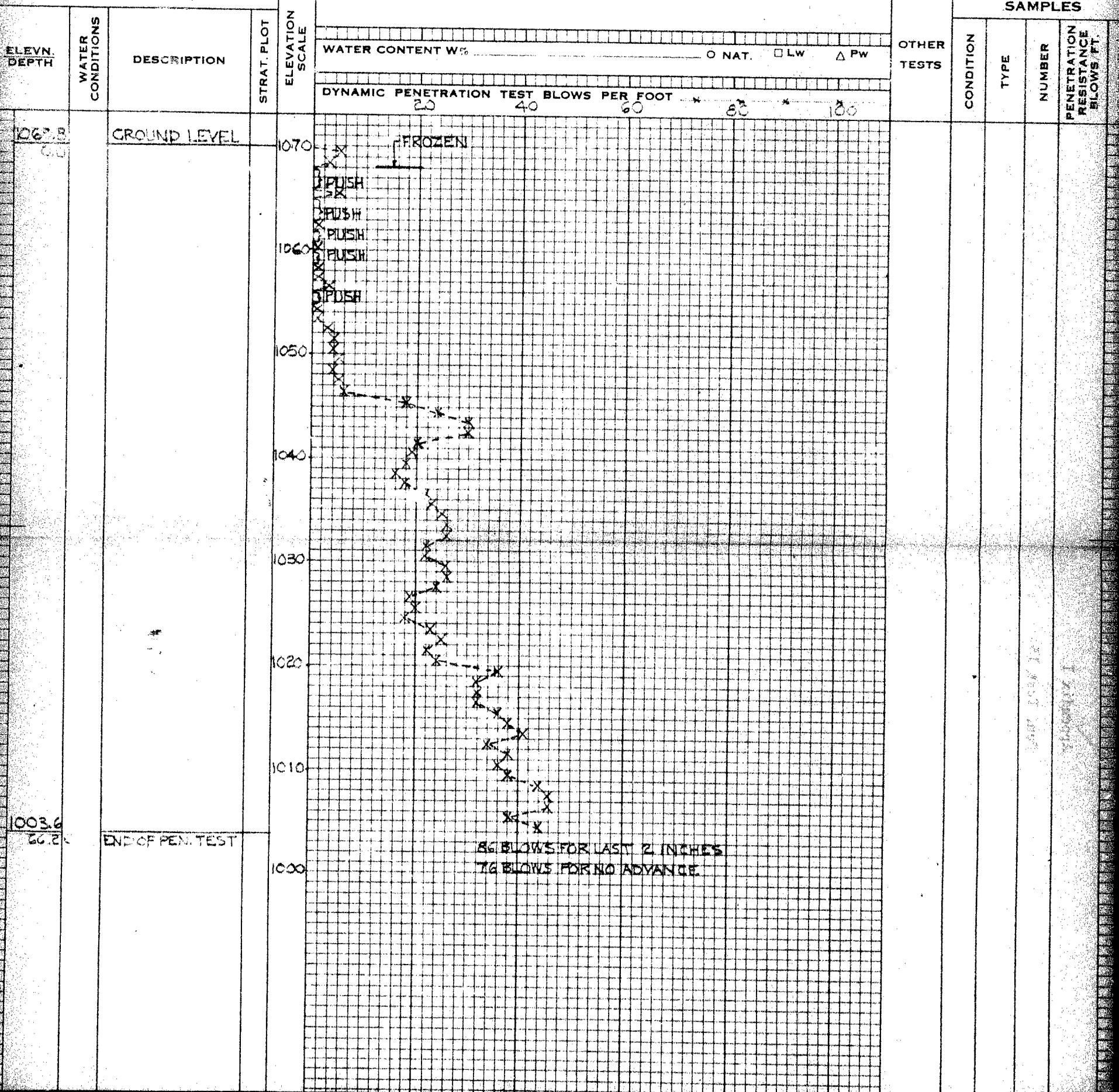
SAMPLE TYPES

A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE
 F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

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 M - MECHANICAL ANALYSIS
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 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL

SOIL PROFILE



60-F-233

W.P. # 91-56

Hwy. # 17

WHITE LAKE

NARROWS BR.

NEAR MARATHON

Mr. A. H. Toye,

September 2, 1960.

Bridge Engineer.

SUBSOIL INVESTIGATION REPORT

Materials & Research Section.

by: Geoccon, Limited.

Attention: Mr. H. McCombie.

Re: Soil Conditions and Engineering Study
East Abutment, White Lake Narrows Bridge,
Highway No. 17, Near Marathon, Ontario.

Enclosed, please find two copies of a report submitted by Geoccon, Ltd., dealing with the cause of movements which have been experienced at the East abutment at White Lake Narrows Bridge.

At the time that these movements were brought to our attention by Mr. Casper of the Foundation Engineering Company, it was our concern that these movements might have resulted from a general instability of the fill section due to inadequate sub-excavation in the abutment area.

The results of this investigation reported by Geoccon, show quite conclusively, that a general instability of the approach fill does not, in fact, exist. There has been no movement of the East abutment since May 27th. The results of the borings indicate that the most probable cause of the movement which has taken place, has resulted from frozen material, or ice fragments which were trapped in the fill during construction.

The provision of the maximum gap in the expansion joint, which is understood to be 6 inches, is considered adequate to allow for any future movement which may occur.

M. C. Foster (nec)

LCC/ldsf
attach.

L. C. Soderman,
PRINCIPAL FOUNDATIONS ENGINEER

cc: Messrs. A. H. Toye (2)

E. A. Iregaskes

D. G. Hansay

C. K. Hunter

J. Garland

E. R. Saint

Foundations Office ✓ (1)

Gen. Files.

GEOCON LTD

HEAD OFFICE

180 VALLÉE ST., MONTREAL 18, QUEBEC
TELEPHONE UN. 6-7632

Rexdale, Ontario,
August 25th, 1960.

23-58-215
Dist. 18
DISTRICT OFFICES

14 HAAS ROAD
REXDALE, TORONTO, ONT.
TEL. CH. 4-8641

1425 WEST PENDER ST.
VANCOUVER 5, B.C.
TEL. MU. 1-8926

Department of Highways, Ontario,
Materials and Research Section,
Downsview, Ontario.

Attention: Mr. L. G. Soderman, P. Eng.,
Principal Foundation Engineer.

Re: Soil Conditions and Engineering Study,
East Abutment,
White Lake Narrows Bridge,
Highway 17,
Near Marathon, Ontario. WP. 31-56

Dear Sirs:

This letter accompanies our detailed report covering the engineering study concerning the movement of the east abutment of White Lake Narrows Bridge. This study and investigation was restricted to the east abutment of the bridge, which had been completed approximately one year ago. It was determined that the embankment fill directly beneath and east of the abutment is underlain by a loose to compact silty fine sand about 5 feet in thickness, which grades into a coarse sand stratum with depth. The sand strata are underlain by bedrock. To the south and west of the abutment, however, the embankment fill is separated from the silty fine sand stratum by a wedge-shaped layer of organic silt, which has a maximum thickness of about 6 feet.

Possible reasons for the movements observed of the east abutment are discussed in the report. It is considered that future horizontal movements should be relatively minor, although some additional settlement of the fill should take place. It has been recommended that the deck of the bridge structure be placed with some allowance for lateral movement, and it is considered that this measure will be completely adequate.

If there are any points of discussion concerning this structure, we would be pleased if you would call us.

Yours very truly,

GEOCON LTD

V. Milligan

V. Milligan, P. Eng.,
Assistant Chief Engineer.

VM/dw
S7096

ST. JOHN'S

HALIFAX

MONTREAL

TORONTO

VANCOUVER

S7096
REPORT
TO
DEPARTMENT OF HIGHWAYS, ONTARIO
ON
SOIL CONDITIONS AND ENGINEERING STUDY
EAST ABUTMENT
WHITE LAKE NARROWS BRIDGE
HIGHWAY 17
NEAR MARATHON, ONTARIO

Distribution:

- ✓ 10 copies - Department of Highways, Ontario,
Downsview, Ontario.
- 1 copy - Department of Highways, Ontario,
White River, Ontario.
- 4 copies - Foundation of Canada Engineering
Corporation Limited,
Toronto, Ontario.
- 2 copies - Geocon Ltd,
Rexdale, Ontario.

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Conclusions and Recommendations	5
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Water Conditions	
Office Reports on Soil Exploration	
Appendix II	
Figures - Laboratory Testing	
Drawings at rear of report:	
S7096-1 Boring Plan, Soil Stratigraphy and Stability Analyses	

INTRODUCTION

Geocon Ltd has been retained by the Department of Highways, Ontario to conduct a soils investigation and engineering study of the east abutment of the White Lake Narrows Bridge on Highway 17. The purpose of the investigation was to determine the reason for recorded movements of the east abutment towards the river. Information concerning construction procedures and observations were provided by Foundation of Canada Engineering Corporation Limited.

SITE AND GEOLOGY

The site is located on Highway 17 at the White Lake Narrows crossing about 18 miles west of White River, Ontario. The soil investigation was restricted to the east abutment of the bridge which was completed about one year ago.

The geology of the site was generally known from a previous soil investigation performed by Racey, MacCallum and Associates Ltd. It is known that about 10 feet of very loose to compact sands and organic silt, overlaid denser sands and gravel at the site prior to construction. The bottom of the organic layer occurred at about elevation 1049 feet directly beneath the proposed location of the east abutment. At the time of the present investigation, the east abutment had been completed and the top of the embankment was about 3 feet below final grade which is to be approximately at elevation 1100.

SUMMARIZED SOIL CONDITIONS

All borings in the present investigation passed through from 15 to 49 feet of very loose to loose fine to coarse gravelly sand fill. Towards the toe of the embankment, the lower part of the fill changes to a fine grained sand. This fine sand fill is probably reworked lake

bottom material disturbed during excavation of the organic silt. The base of the embankment fill material occurs at a fairly constant elevation of about 1049 feet.

The embankment fill, directly beneath and east of the east abutment, is underlain by a loose to compact grey silty fine sand stratum which averages 5 feet in thickness. South and west of the abutment, however, the fill is separated from the silty fine sand stratum by a wedge-shaped layer of organic silt which increases in thickness from 0 to 6.5 feet towards the toe of the slopes.

The silty fine sand stratum is underlain by a compact grey gravelly fine to coarse sand stratum. This layer changes rather abruptly in composition directly beneath the abutment where it consists predominantly of boulders with interstitial sand. The stratum averages about 11 feet in thickness in the two borings that passed through it into bedrock.

Bedrock at the site is a gneiss consisting chiefly of hornblende and feldspar with a little quartz.

DISCUSSION

It is understood that at the time of the present investigation, the east abutment and embankment had been in place about 15 months. During this time, periodic movements of the abutment were observed. The details of both the construction procedure and the history of movement provide an insight into the reasons for the movements. Both are discussed under separate headings below.

Construction Procedure

During January and February, 1959, the ice surface in the area of construction was removed and the organic silt stratum was excavated to about elevation 1050 at the east abutment location. As excavation proceeded below water level granular fill was end dumped into the excavation until grade was brought up to about 4 feet above the water level at that time. The end-dumped material was spread by a dozer and the excavating equipment advanced over the new fill to excavate more organic material. The fill above this level was placed in about 12 inch lifts and compacted by a dozer up to elevation 1082.

Steel H piles were driven through the embankment fill during April, 1959. The pile cap and bridge seat were completed by May 3rd, 1959. The embankment was brought up to grade in front of the east abutment by the end of June, 1959.

History of Movement

The movement was first noticed on August 8th, 1959 when the distance between the east pier and the east abutment was found to be short by 0.6 inches. The east pier, which was checked on August 26th, 1959, showed no tilting so it was assumed that the east abutment had moved. Further readings taken until October, 1959, showed no further movement. On May 27th, 1960 when the job was reopened after winter shutdown, a total movement of about 2 inches was measured. The embankment at the east abutment was brought up to final grade on about July 22nd, 1960 and the bridge was opened to traffic shortly after. Weekly readings taken from May 27th, 1960 show that no further movement of the east abutment has taken place.

It was further observed that the fill material immediately adjacent to the south side of the east abutment had settled about 4 feet vertically during the spring.

Explanation of the Movements

The standard penetration resistance values within the embankment fill indicate that it is very loose to loose. Downward seepage of melt water run off during the spring of 1960 may have resulted in some settlement of this loose material. Most of this settlement would be vertical possibly with a very small horizontal component.

The greater portion of the vertical settlement adjacent to the east abutment may be due to melting of ice chunks trapped within the fill. One such chunk was encountered in borehole 2 directly below this location. It is suggested that the chunks may have been trapped in the fill during placement by end dumping in the winter of 1959. It is possible that as much as 2 feet of additional differential settlement may develop as the rest of this chunk and other frozen areas thaw out. Due to shear stresses within the embankment, settlements resulting from the melting of the ice chunks must necessarily have horizontal as well as vertical components. It is impossible to say, however, how much of the recorded horizontal movements are due to this cause. It may be considerable, however, because the ice blocks would probably melt faster in the spring during downward seepage of the melt water and the greater portion of the movement to date appears to have occurred during the spring of 1960.

Stability computations were carried out on the east approach embankment. Both sliding block and circular analyses were performed. The critical locations are shown on Drawing S7096-1 at the rear of the report. These analyses indicate that the present factor of safety is about 1.25. It is probable that the embankment was in a more critical state immediately after construction than it is now due to high pore pressures in the organic silt.

Explanation of the Movements (continued)

The high shear stresses which act in the organic silt no doubt resulted in high pore pressures immediately after construction. It is considered that these pore pressures have had time to dissipate and that the organic silt is fully consolidated under the existing state of stress. The resulting settlement under the shear stresses must have had both horizontal and vertical components that probably resulted in some of the movement of the abutment.

CONCLUSIONS AND RECOMMENDATIONS

1. The soil stratigraphy previously determined was in general confirmed by this investigation. The organic silt stratum, however, the extent of which was not previously determined, was found to have a considerable lateral extent and to thicken towards the river.
2. The total horizontal movement of the east abutment towards the river at the time of the investigation was of the order of 2 inches.
3. Differential vertical settlements in the embankment reach a maximum of 4 feet adjacent to the east abutment.
4. Possible reasons for these movements are summarized as follows:
 - a) Compaction of the loose fill under vertical seepage forces during spring run-off.
 - b) Horizontal and vertical movements associated with melting chunks of ice which must have been trapped in the fill during placement in the winter of 1959.
 - c) Anisotropic consolidation of the organic silt under both overburden pressure and possible shear stresses.

CONCLUSIONS AND RECOMMENDATIONS (continued)

6.

5. It is probable that further local vertical movements as great as 2 feet could occur as the remaining frozen inclusions thaw. Additional horizontal movement could also occur but the magnitude of this, in view of the pattern of movement to date, should be minor. It has however, been recommended that the deck be placed with the maximum allowable expansion gap, which is understood to be of the order of 6 inches.

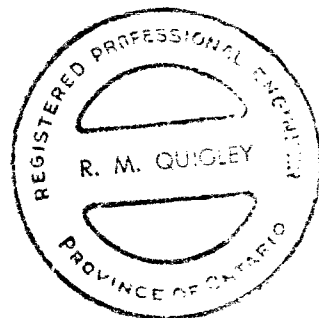
PERSONNEL

The field work for this investigation was supervised by Mr. A. Tilk and Mr. J. L. Seychuk. The report was written by Mr. R. M. Quigley, checked by Mr. V. Milligan and reviewed by Mr. M. A. J. Matich.

R. M. Quigley

R. M. Quigley, P. Eng.

RMQ/dw
S7096



GEOCON

APPENDIX I

Procedure

Soil Conditions

Water Conditions

Office Reports on Soil Exploration

PROCEDURE

The field work was carried out between June 9th and 27th, 1960. Eight boreholes with accompanying dynamic penetration tests were put down using a skid-mounted machine drillrig. Disturbed samples of the granular material were taken with 2 inch sampling equipment for identification purposes. Undisturbed 2 inch Shelby tube samples were taken in boreholes 4, 5, 6 and 7 in the organic silt stratum.

The locations of the borings and the inferred soil stratigraphy are shown on Drawing S7096-1 located in the pocket at the rear of this report. Detailed logs of the boreholes are given on the Office Reports on Soil Exploration in this Appendix.

The laboratory testing was carried out in the Toronto Soil Mechanics Laboratory of Geocon Ltd. The laboratory test results are given on the Office Reports and on the Figures in Appendix II. The samples remaining after testing will be stored until March 1st, 1961, at which time you will be notified regarding their disposal.

Elevations are Geodetic and were supplied by Foundation of Canada Engineering Corporation Limited surveyors at the site.

SOIL CONDITIONS

The principal soil strata encountered by the borings are as follows:

Very Loose to Loose Granular Fill

In the eight boreholes 15 to 49 feet of very loose to loose brown gravelly fine to coarse sand fill was encountered. The base of the fill occurs at a nearly constant elevation of about 1049 feet. At the time of the investigation, the fill varied in thickness from about 49 feet at the centre of the

Very Loose to Loose Granular Fill (continued)

abutment to 0 feet at the toe of the embankment. It is understood that the embankment at this time was about 3 feet below final grade.

Generally the fill material consists of well graded angular sand with gravel. In borehole 6, near the toe of the embankment the lower 8 feet of the fill was found to consist of very loose grey-brown fine sand.

Standard penetration resistance or "N" values obtained in the fill varied from 2 to 12 blows per foot and average 6 blows per foot. Two higher values of 59 and greater than 100 were obtained in the stratum and are shown on the Office Reports. The higher value was obtained in a 2 foot thick block of ice within the fill. The lower value was obtained in frozen sand. Both frozen areas are located at about elevation 1064 feet and probably represent ice blocks trapped in the fill during construction in the winter of 1959. The "N" values in the fill indicate that it is generally very loose to loose.

Two "N" values of 2 and 3 blows per foot, obtained in the fine sand fill near the toe indicate that it is also very loose.

For computation purposes, it is estimated that the fill has wet and submerged unit weights of 130 and 68 pounds per cubic foot respectively. The angle of internal friction, ϕ , is estimated to be 33 degrees.

Organic Silt

A stratum of dark brown organic silt was encountered beneath the embankment fill in all but boreholes 1, 2 and 8. The upper

Organic Silt (continued)

portion of the organic silt was excavated to about elevation 1049 feet so that it was effectively removed directly beneath the abutment location. Towards the toe of the embankment the thickness was found to increase from 0 to about 6.5 feet.

Two standard penetration resistance or "N" values of 3 and 7 blows per foot were obtained in the stratum.

Three wet unit weights of about 106, 109 and 119 pounds per cubic foot were obtained for the material at natural moisture contents of about 43, 58 and 33 percent respectively. For the computations the wet unit weight was taken as 105 pounds per cubic foot. Three organic content determinations showed that the solid portion of the silt consists of about 15 percent of organic matter.

Two liquid limit values of 42 and 70 and corresponding plastic limits of 30 and 39 were obtained for the silt. These give plasticity index values of 12 and 31 respectively.

Two grain size analyses were run on the natural silt. The corresponding curves which are given on Figure 1 in Appendix II show that the material consists chiefly of silt with a small amount of both fine sand and clay sizes. One grain size curve was obtained on the silt from which the organic matter had been removed. This curve shows that the non-organic fraction consists of 100 percent silt sizes.

Three consolidated undrained triaxial tests with pore pressure measurements were run on the silt. The corresponding total stress and effective stress Mohr circles are given on Figure 2 in Appendix II. The total stress and effective stress

Organic Silt (continued)

strength envelopes, also shown on the Figure, give ϕ_{cu} and ϕ' values of 18 and 36 degrees respectively.

Loose to Compact Silty Fine Sand

A stratum of grey silty fine sand underlies the organic silt stratum or the embankment fill in all but boreholes 7 and 8 where it is absent. The stratum has an average thickness of about 7.5 feet in the 6 boreholes where it was encountered.

The stratum which is grey throughout, contains numerous tiny shells and fragments of organic matter.

The standard penetration resistance or "N" values obtained in the stratum range from 5 to 28 and average 14 blows per foot. They indicate that the material is loose to compact and generally compact in relative density.

Assumed saturated and submerged unit weights of 120 and 58 pounds per cubic foot were used for computation purposes. The angle of internal friction, ϕ , was assumed to be 25 degrees.

Compact Gravelly to Bouldery Sand

The silty fine sand stratum is underlain at all locations by a layer of grey gravelly to bouldery sand. In borehole 8, where both the organic silt and the silty fine sand are absent, the gravelly sand stratum underlies the embankment fill material. At most borehole locations this layer consists of compact grey gravelly fine to coarse sand. In boreholes 1 and 2, however, the stratum consists predominantly of boulders of gneiss up to 1.5

Compact Gravelly to Bouldery Sand (continued)

feet in diameter with interstitial fine sand. The layer was fully penetrated by boreholes 2 and 6 where it was found to be 13 and 9.5 feet thick respectively.

Standard penetration resistance or "N" values obtained on the less bouldery part of the stratum ranged from 9 to 23 and averaged 16 blows per foot. These values indicate that the material is loose to compact and generally compact in relative density.

Gneiss Bedrock

Bedrock was drilled in AXT size in boreholes 2 and 6 for distances of 1.7 and 10.0 feet respectively. It consists predominantly of hornblende and feldspar with a little mica and quartz.

WATER CONDITIONS

Groundwater level in all boreholes was at lake level at the time of the investigation. On June 21st, 1960, lake level was at elevation 1068.1 feet.

EXPLANATION OF THE FORM "OFFICE REPORT ON SOIL EXPLORATION"

The object of this form is to enable a comprehensive study of the soil to be made by combining on one sheet all of the information obtained from the boring. An explanation of the various columns of the report follows.

ELEVATION AND DEPTH

This column gives the elevation and depth of boundaries between the various soil strata. The elevation is referred to the datum shown in the general heading.

WATER CONDITIONS

In this column the water level in the casing at the time of boring or the water table in the ground, determined by a series of observations in a piezometer or standpipe, is indicated to scale by a horizontal line with the symbol W.L. or W.T. above the line. A notation of any complicated groundwater conditions will be made in this column.

DESCRIPTION

A description of the soil, using standard terminology, is contained in this column. The consistency of cohesive soils and the relative density of non-cohesive soils are described by the following terms:

Consistency	U-Strength Tons/sq. ft.	Relative Density	Standard Penetration Resistance. Blows/ft.
Very soft	0.03 to 0.25	Very loose	0 to 4
Soft	0.25 to 0.5	Loose	4 to 10
Firm	0.5 to 1.0	Compact	10 to 30
Stiff	1.0 to 2.0	Dense	30 to 50
Very stiff	2.0 to 4.0	Very dense	over 50
Hard	over 4.0		

STRATIGRAPHIC PLOT

The stratigraphic plot follows the standard symbols of the National Research Council, Canada.

ELEVATION SCALE

The information in all columns is plotted to a true elevation scale which is shown in this column.

GRAPHS

The main body of the report forms a graph which is used to plot to correct elevation the important soil properties which are obtained through field and laboratory tests. The scales and symbols for the plotting are shown at the head of the column.

OTHER TESTS

In this column are shown, by symbol, the other field or laboratory tests which have been performed on the soil and for which the results have not been plotted on the above graph.

SAMPLES

The first three columns describe the condition, type and number of each sample obtained from the boring. The location and extent of each sample is plotted to scale.

In the last column is shown the penetration resistance in blows of 4200 inch-pounds required to drive one foot of the sampler into the ground. When a 2 inch Drive Sampler is used the result obtained is termed the "Standard Penetration Resistance".

GEOCON

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OFFICE REPORT ON SOIL EXPLORATION

CONTRACT 57096 BORING # 1 DATUM GEODETIC CASING
 BORING DATE JUNE REPORT DATE JUNE 27, 1960 COMPILED BY J.A. CHECKED BY J.A.
 SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION



A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE

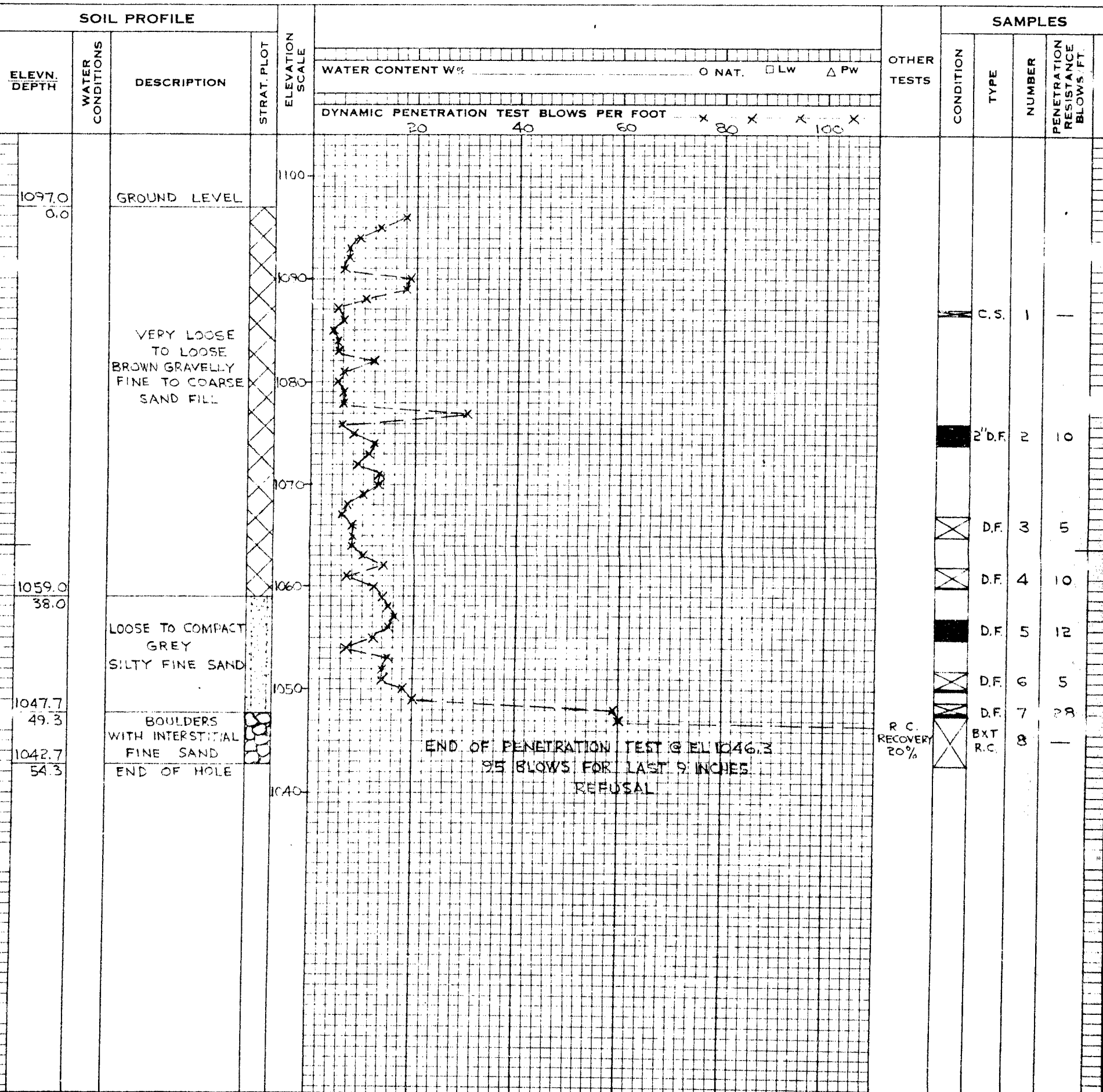
SAMPLE TYPES

F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 QC - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL

SOIL PROFILE



GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT 57096 BORING # 2 DATUM GEODETIC CASING BX
 BORING DATE JUNE 14-16, 1960 REPORT DATE JULY 12, 1960 COMPILED BY J.A. CHECKED BY
 SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION



SAMPLE TYPES

A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE

F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

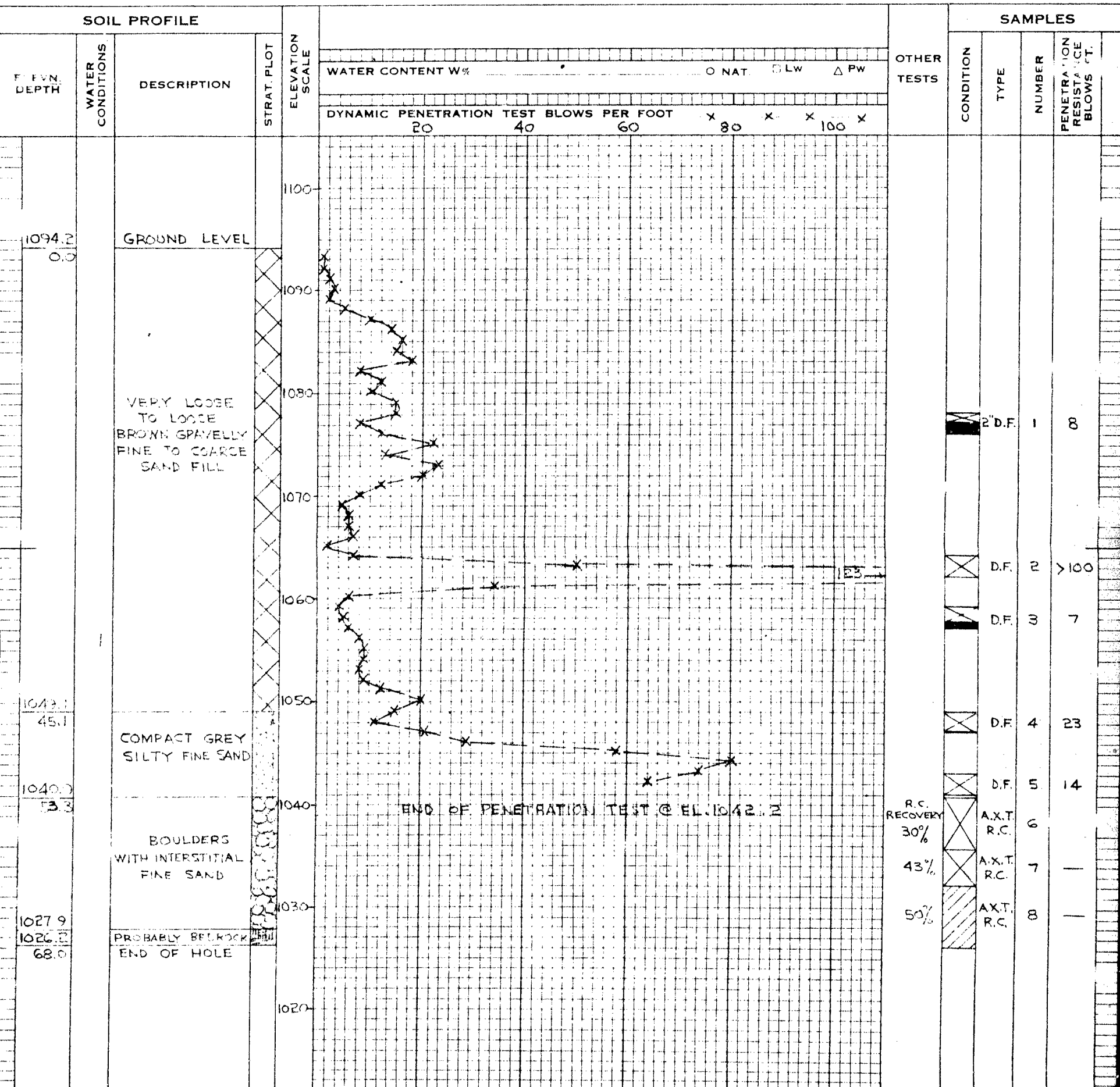
ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 Qc - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW

γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL

SOIL PROFILE

SAMPLES



GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT 57096 BORING # 3 DATUM GEODETIC CASING BX
 BORING DATE JUNE 16, 17, 1960 REPORT DATE JULY 12, 1960 COMPILED BY J.A. CHECKED BY
 SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION



A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE

SAMPLE TYPES

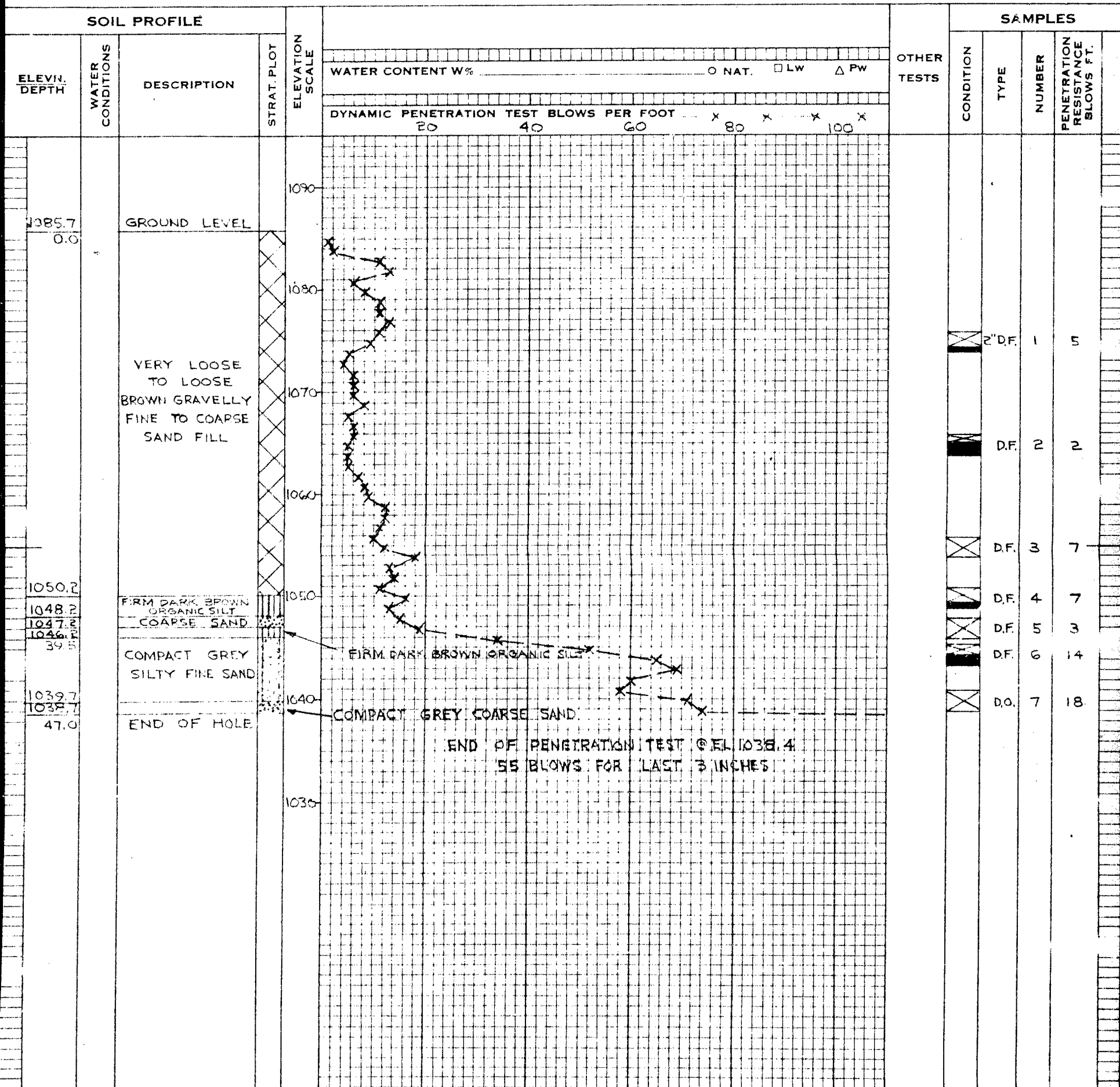
F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 Qc - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL

SOIL PROFILE

SAMPLES



GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT S7096 BORING # 4 DATUM GEODETIC CASING BX
 BORING DATE JUNE 18, 20, 1960 REPORT DATE JULY 13, 1960 COMPILED BY J.A. CHECKED BY
 SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION



A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE

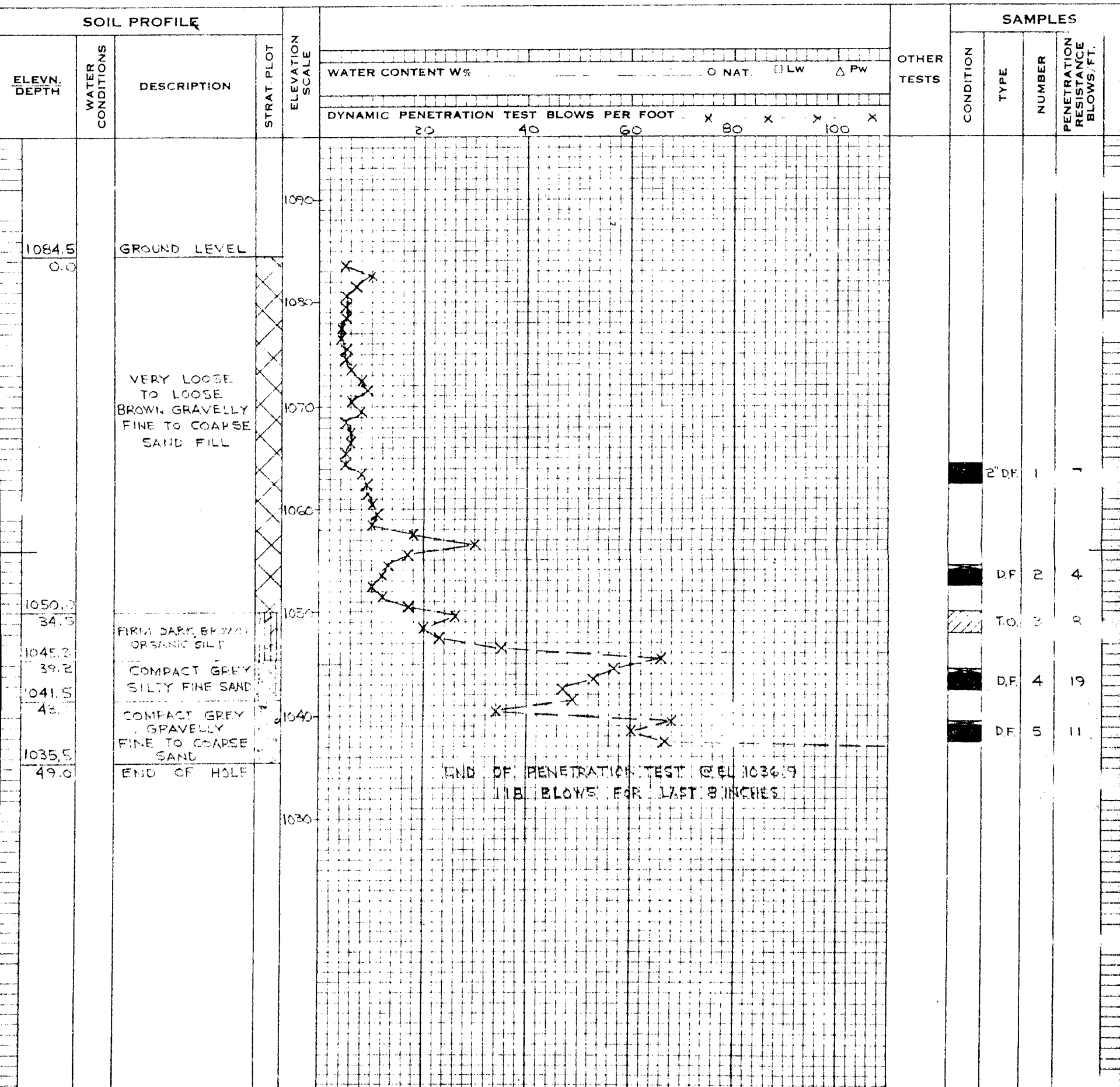
SAMPLE TYPES

F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 QC - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL

SOIL PROFILE



GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT S 7096 BORING # 5 DATUM GEODETIC CASING BX
 BORING DATE JUNE 20, 21, 1962 REPORT DATE JULY 13, 1962 COMPILED BY J.A. CHECKED BY J.A.
 SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION



A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE

SAMPLE TYPES

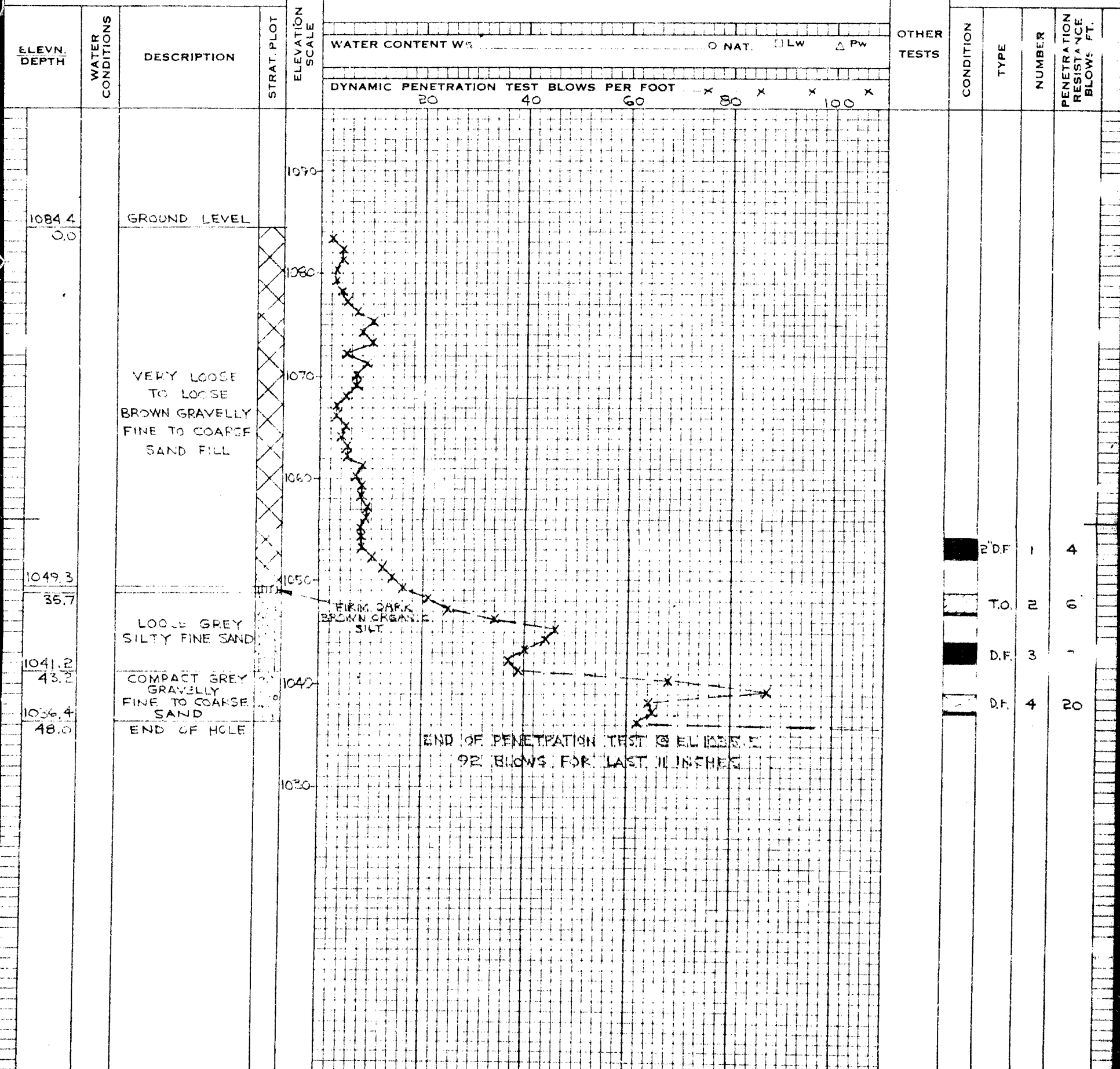
F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 QC - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL

SOIL PROFILE

SAMPLES



GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT 57096 BORING # 6 DATUM GEODETIC CASING BX
 BORING DATE JUNE 22-24, 1960 REPORT DATE JULY 13, 1960 COMPILED BY J.A. CHECKED BY
 SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION



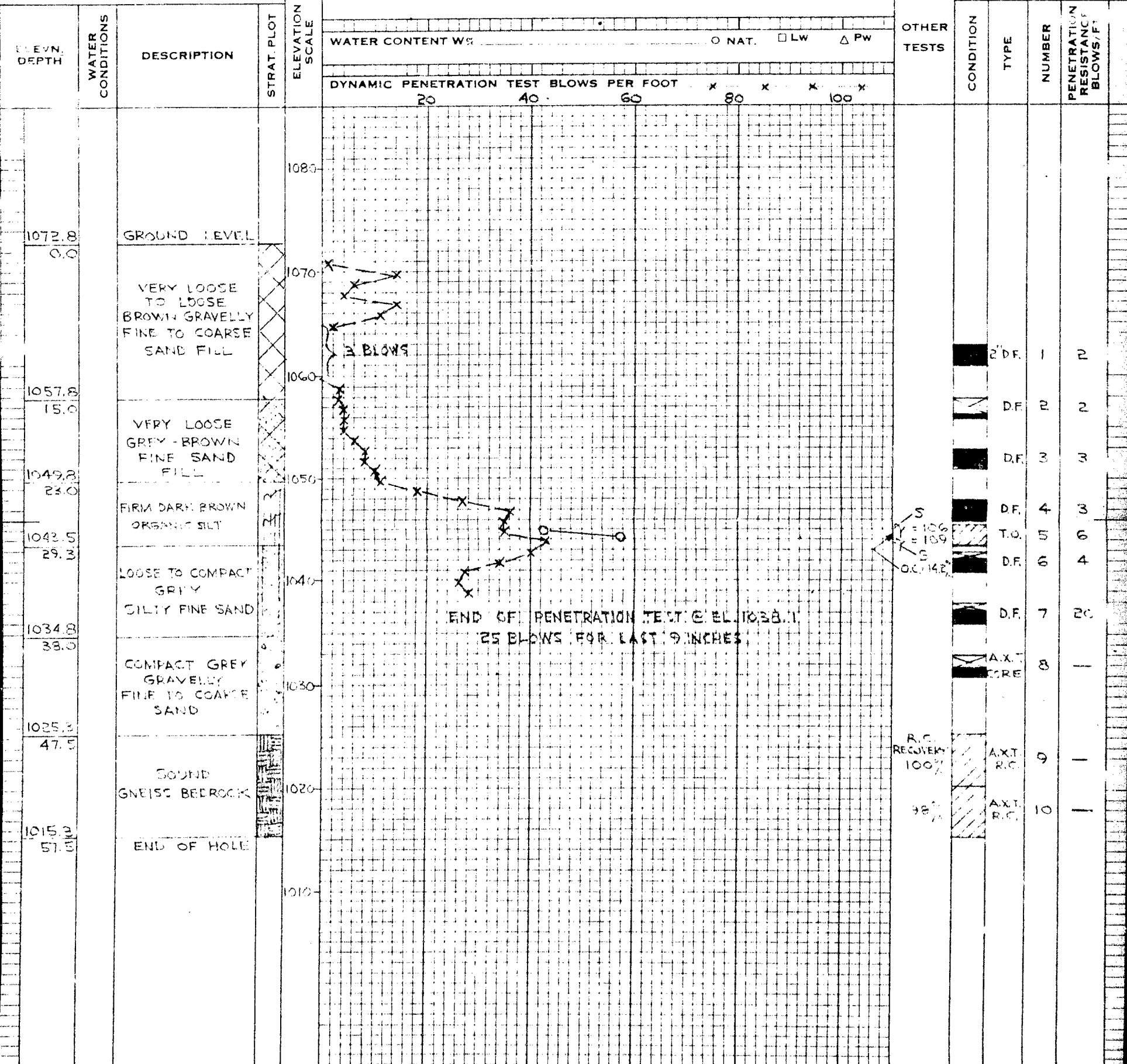
SAMPLE TYPES

A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE
 F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 Qc - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 O.C. - ORGANIC CONTENT
 γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL

SOIL PROFILE



GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT 57096 BORING # 7 DATUM GEODETIC CASING BX
 BORING DATE JUNE 25-27, 1960 REPORT DATE JULY 13, 1960 COMPILED BY J.A. CHECKED BY J.A.
 SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION



A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE

SAMPLE TYPES

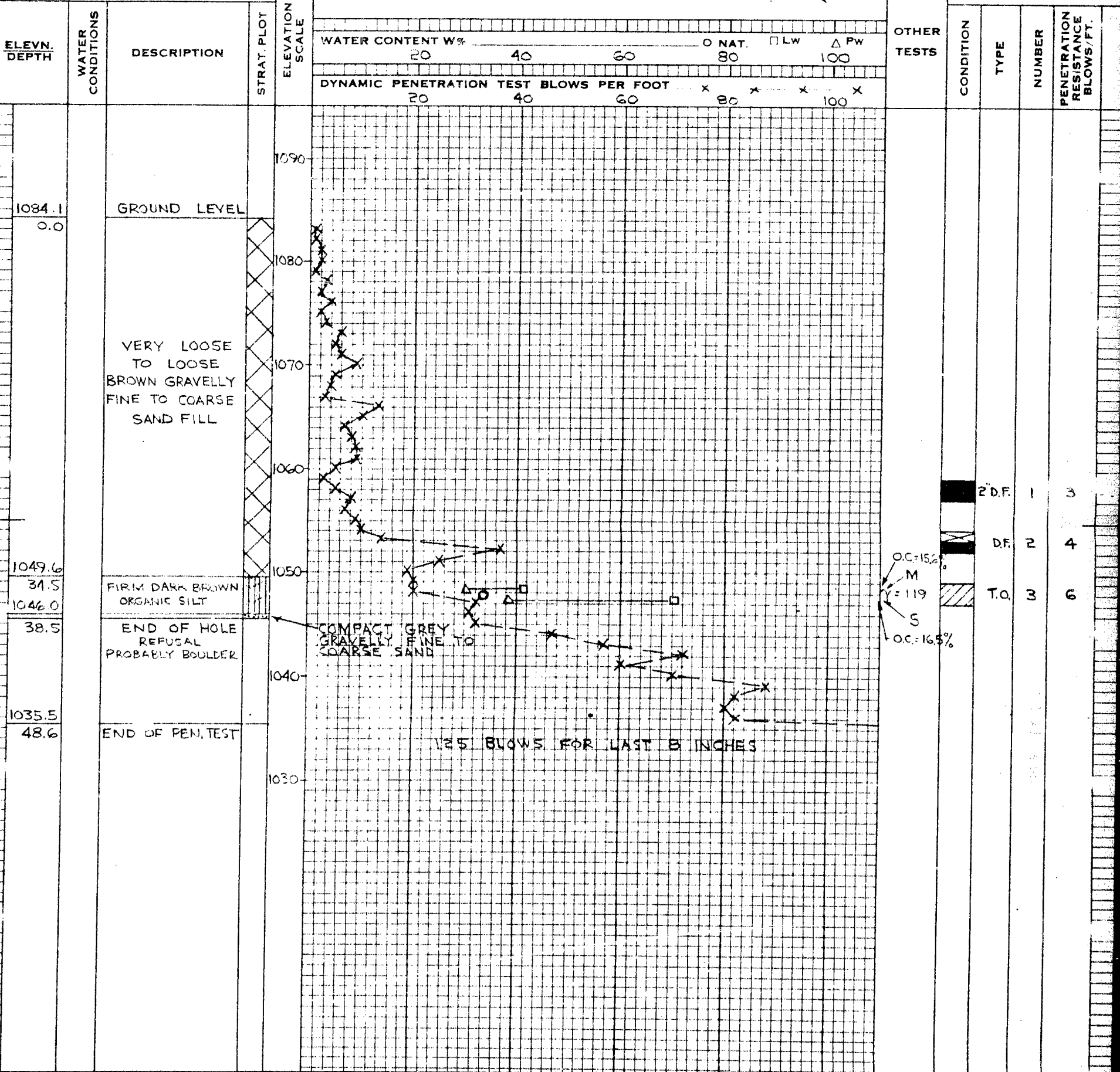
F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 QC - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 O.C. - ORGANIC CONTENT
 γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL

SOIL PROFILE

SAMPLES



GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT 57096 BORING # 8 DATUM GEODETIC CASING BX
 BORING DATE JUNE 27, 1960 REPORT DATE JULY 13, 1960 COMPILED BY J.A. CHECKED BY
 SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION



A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE

SAMPLE TYPES

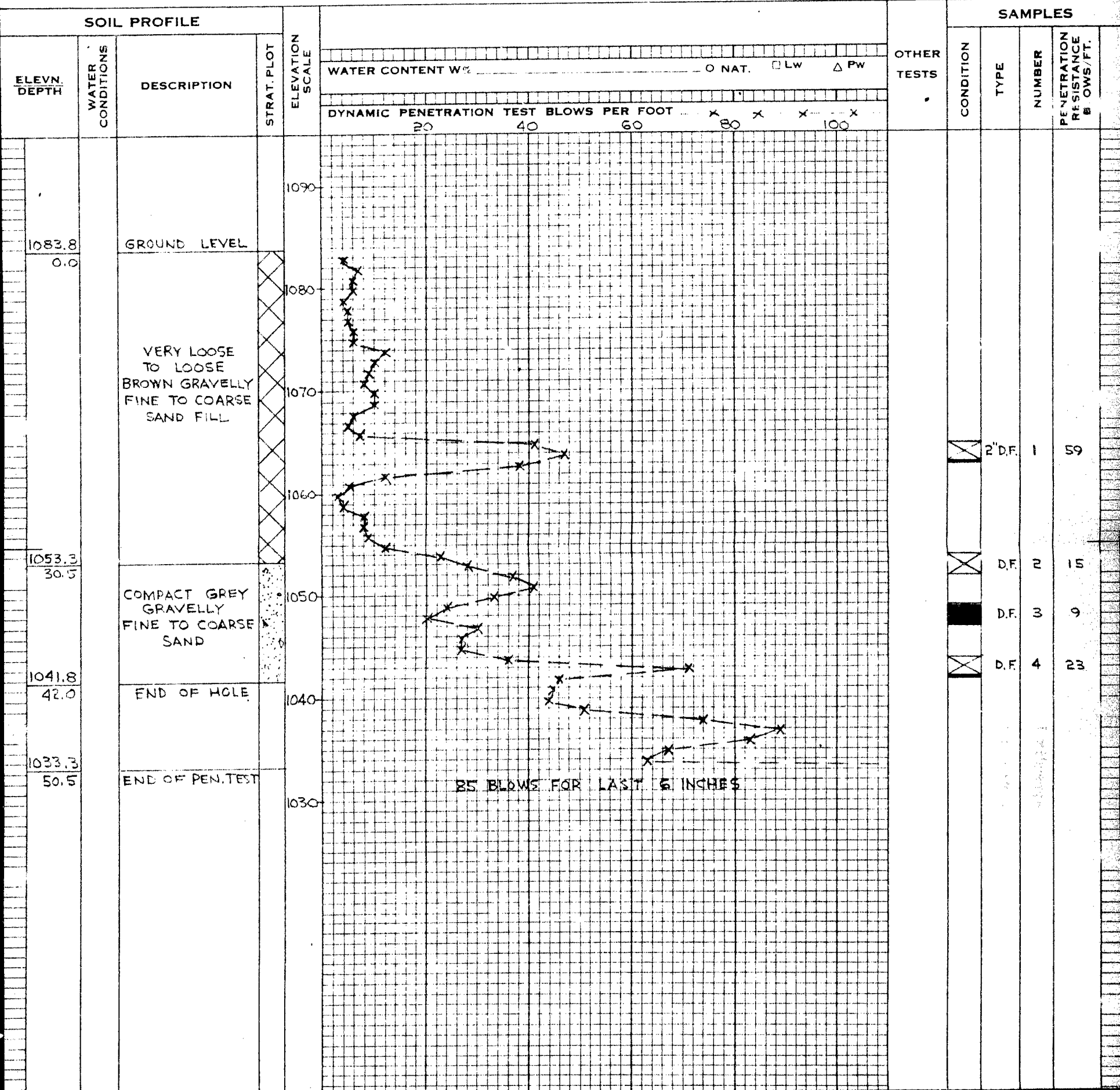
F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
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 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW

γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION

WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL

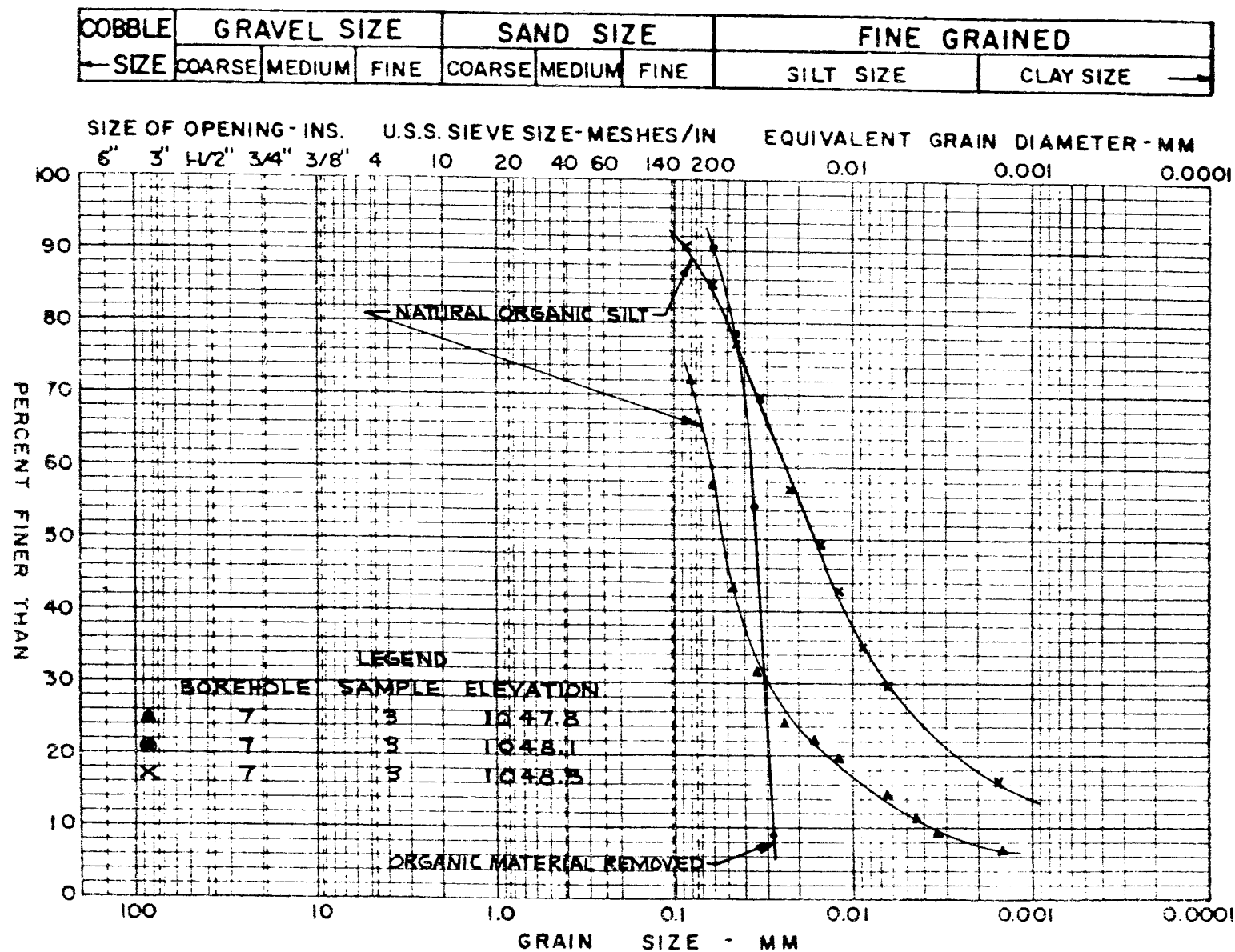


APPENDIX II

FIGURES - LABORATORY TESTING

GRAIN SIZE DISTRIBUTION

APPENDIX II
FIGURE 1
PROJECT S 7096



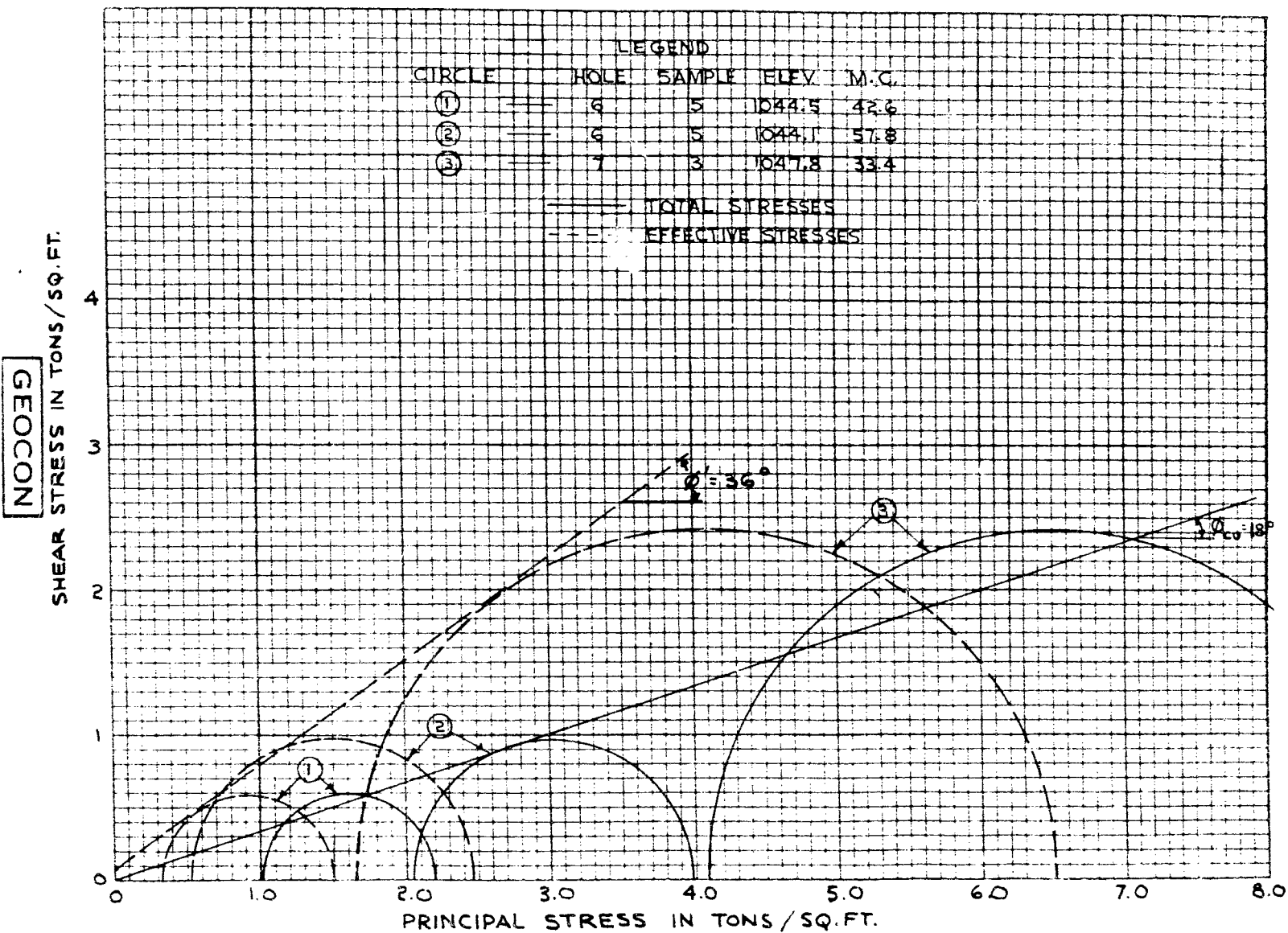
M.I.T. GRAIN SIZE SCALE

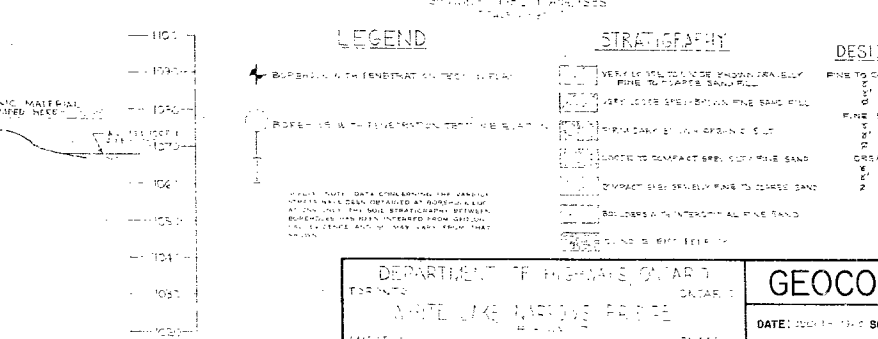
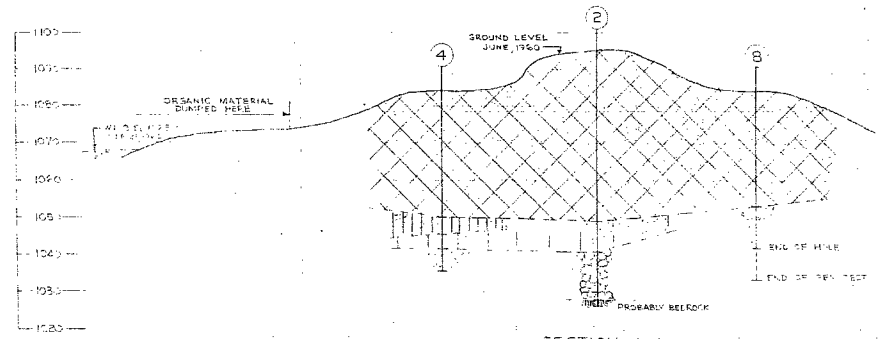
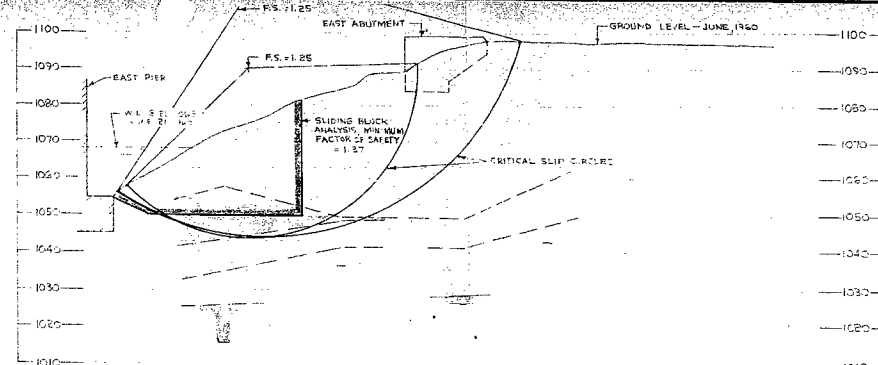
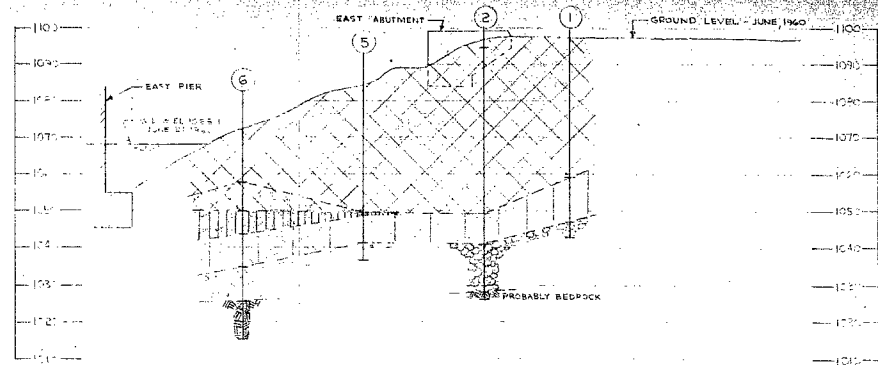
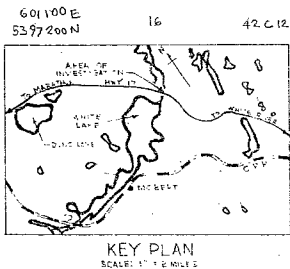
GEOCON

CONSOLIDATED UNDRAINED TRIAXIAL TESTS

ORGANIC SILTY CLAY
MOHR'S CIRCLES

APPENDIX II
FIGURE 2
PROJECT S 7096





DEPARTMENT OF HIGHWAYS, ONTARIO
 TORONTO ONTARIO
 WHITE LAKE MARSHES PROJECT
 TORONTO ONTARIO
 ROBERTSON COLLEGIATE HAWK MOUNTAIN

GEOCON LTD

DATE: 2000-10-10 **SCALE:** AS SHOWN

MADE	CHKD.	APPD.	
1	6	10	No S7096-1