

# 62-F-202-C

W.P. # 39-62

HWY. # 86 J

KIRKLAND  
CREEK

Mr. A. M. Toye,  
Bridge Engineer.

Materials & Research Division,  
(Foundation Section)

Attention: Mr. J. McCaslin.

May 30, 1962.

FOUNDATION INVESTIGATION REPORT  
By: Associated Geotechnical  
Services, Ltd.

Re: (W.P. 39-62) Highway 66,  
Kirkland Creek, 4.2 Mi. W. of Nimira,  
District No. 1, Stratford, Ontario.

attached, we are forwarding to you the above-mentioned report submitted by the consultant, Associated Geotechnical Services, Ltd. We have reviewed the report and found the factual data adequate and well presented.

In view of the generalization and simplification of the subsoil stratigraphy used for the bearing capacity calculation, we are of the opinion that the refinement as presented in Table A of the report, is unjustified. It is recommended that a bearing pressure of 3.0 T/sq.ft. be used, irrespective of footing width, provided normal design standards are used.

AGS/HMF  
Attach.

cc: Messrs. A. M. Toye (2)  
H. A. Tregaskes  
H. B. McMillan  
A. Gater  
L. B. Barrett  
J. Roy  
T. J. Levich  
J. E. Crispier  
R. A. Saint  
F. Korman  
A. Watt  
Foundations Office  
Gen. Files.

*A. G. Sternac*  
A. G. Sternac,  
PRINCIPAL FOUNDATION ENGINEER

FOUNDATION INVESTIGATION REPORT

W.P. 39-62, HIGHWAY 86,  
KIRKLAND CREEK, 4.2 MI. W. OF ELMIRA  
DISTRICT NO. 3, STRATFORD

DEPARTMENT OF HIGHWAYS OF ONTARIO

Submitted By

ASSOCIATED GEOTECHNICAL SERVICES LIMITED  
211 Davenport Road, Toronto 5, Ontario.

May 23, 1962.

62 F202C 23-6x-125

## INTRODUCTION

The purpose of this report is to present the results of a foundation investigation carried out in connection with the proposed new bridge on Highway 86 over Kirkland Creek, 4.2 miles west of Elmira. The site is located on Lot 17, Concessions I and XIV, W.S., Townships of Peel and Waterloo.

The work was authorized by Mr. A. Rutka, Materials and Research Engineer, On April 16, 1962.

## SUMMARY OF RESULTS

The soils at the site were found to consist of two to five feet of sand, silt and gravel, overlying one to seven feet of till textured soil, overlying four to eight feet of hard clay overlying a very dense gravel.

The proposed structure may be founded on spread footings located about 6 feet below the stream bed. No problems are anticipated with scour or approach fill stability.

## FIELD PROCEDURES

The borehole layout for this investigation was established by the field Soils Engineer. The locations of the boreholes are shown on the plan (Figure I) in the Appendix. The borings were laid out by a transit and chain survey using the existing structure as a reference. The elevation of each borehole and probe was established by spirit level.

The field drilling program consisted of two soil borings and four dynamic cone probes. One skid mounted Boyles screw feed drilling rig was

used on this project. All soil boring and sampling operations were completed by an experienced soil sampling crew under the full time supervision of a qualified Soils Engineer.

The soil boring was carried out using normal wash boring techniques. Samples of cohesionless soil were obtained in split spoon samplers in conjunction with the standard penetration test. In the cohesive clay layers an attempt was made to obtain shelby tube samples but the material was too hard to penetrate by pushing, and the shelby tube had to be driven. This clay layer was also found to be too stiff for insitu vane shear testing. Dynamic cone probes were made by using a 2-inch O.D. 60 degree cone point attached to the end of an A-rod. The probe was advanced into the soil by ramming, using a 140 lb hammer falling freely 30 inches. The number of blows for each foot of penetration was recorded. The depths at which samples were taken in each borehole and the dynamic cone probe penetration resistance have been plotted on the borehole logs included in the Appendix.

#### LABORATORY PROCEDURES

Moisture content, unit weight, mechanical analysis and Atterberg limits laboratory tests were carried out on representative samples of soil from beneath the proposed structure. All soil tests were carried out in the soils laboratory of Associated Geotechnical Services Limited. In general, the methods used were those outlined in "Soil Testing for Engineers" by T. W. Lambe. The unit weights were determined by the mercury immersion method. The results of these tests are shown on the borehole logs and on the charts in the Appendix.

## DISCUSSION OF THE SITE

The soils at the site are shown in profile in Figure 1 in the Appendix. The soil details for each boring are shown on the borehole logs and in the laboratory test results. Bedrock was not encountered in any of the borings at the site.

The main types of soils encountered in the soil borings are listed below in order of their occurrence below ground surface.

1. Two to five feet of very dense brown silt, sand and gravel, trace of organic material. Grain size analyses of this stratum have been carried out on Sample 2, Borehole No. 1 and Sample 1, Borehole No. 2 and are illustrated on the mechanical analysis charts included in the Appendix.
2. One to seven feet of very dense brown sand with silt, some gravel, and clay, till texture. Mechanical analyses have been carried out on the following samples of this soil - Borehole No. 1, Sample 3; Borehole No. 3, Sample 4. Apparent unit weights have also been determined for this soil by the mercury immersion method. The unit weight and moisture contents are listed below.

<u>Borehole No.</u>	<u>Sample No.</u>	<u>Apparent Unit Weight</u>	<u>Percen Moisture Content</u>
1	3	132.6	12.0
2	2	137.8	12.2
3	4	138.1	9.8

For design purposes, we recommend that an angle of internal friction of 30 degrees and zero cohesion be used for this soil.

3. Four to eight feet of hard reddish brown clay, trace of gravel. Unit weight, natural moisture and Atterberg limit determinations were carried out on representative samples of this soil stratum. The results of these determinations are listed as follows:

Borehole No.	Sample No.	Apparent Unit Weight (lbs/cft)	Moisture Content %	Liquid Limit	Plastic Limit	Plastic Index
1	5	115.5	29.4	48.7	25.0	23.7
2	3	-	23.4	-	-	-
2	4	119.4	24.4	41.1	20.0	21.1
3	5	122.4	22.9	50.6	21.7	28.9

Attempts were made to measure the insitu shear strength with vane shear apparatus, however, it was found impossible to push a 1.5 inch diameter vane into the soil. Attempts were also made to obtain shelby tube samples of this soil, and it was found necessary to hammer the shelby tube into the soil in order to obtain penetration. It was also found necessary to hammer up in order to free the shelby tube from the soil. No soil recovery was made in these attempts.

For design purposes, we recommend that a conservative shear strength of 3,000 lbs per square foot be used for this clay stratum.

4. Below the clay layer, a stratum of very dense brown gravel, some sand, trace of silt was encountered. Grain size determinations were carried out on representative samples from this stratum, i.e., Borehole No. 1, Sample 7; Borehole No. 3, Samples 3 and 10. An apparent unit weight and moisture content determination were carried out on Sample 10 from Borehole No. 3 and found to be 135 lb/cft and 13%.

The ground water level was measured at elevation 1165.8 in Boreholes Nos. 2 and 3 several days after completion. This compares with a normal water level in the Creek of 1166.6.

#### DISCUSSION OF PROPOSED STRUCTURE

At the time of writing this report it had been proposed to replace the existing bridge with a 24 foot span structure having a deck elevation of 1179.0 feet. Considering this proposal, the following aspects of the foundation conditions are discussed.

##### (a) Scour

In the opinion of the field Soils Engineer, there was little sign of scour erosion at the existing structure. It can therefore be assumed that scour action at the new bridge will also be minor. Thus for design purposes, we have assumed that scour erosion will not likely extend more than one foot below the bottom of the existing stream bed, (i.e., 1166) during the life of the new structure. However, this assumption should be checked by Department of Highways hydrologists who are more expert in matters pertaining to scour than we are.



(b) Spread Footing Bearing Capacity

Considering the use of spread footings for this structure, we have assumed that the footings will be placed at least 5 feet below the maximum depth of probable scour. This would place the footings at elevation 1160. The allowable bearing capacities for various footing widths are shown below in Table A.

<u>TABLE NO. A.</u> <u>ALLOWABLE BEARING CAPACITY - ABUTMENT FOOTINGS</u> <u>ELEVATION OF FOOTING - 1160</u> <u>MINIMUM SOIL SURCHARGE = 5 FT</u>						
Effective Footing Width (Ft.)	3.0	3.5	4.0	4.5	5.0	5.5
Allowable Reactive Pressure (Kips per sq.ft.)	7.2	6.9	6.7	6.4	6.3	6.2
Allowable Reactive Load (Kips per ft.)	21.6	24.1	26.8	28.8	31.5	34.1

Settlements should not exceed one inch if the above values of bearing capacity are used.

(c) Dewatering

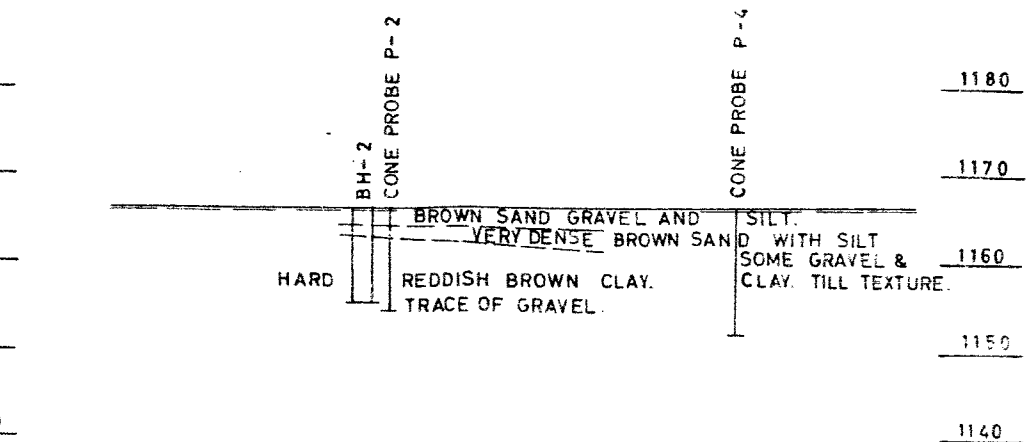
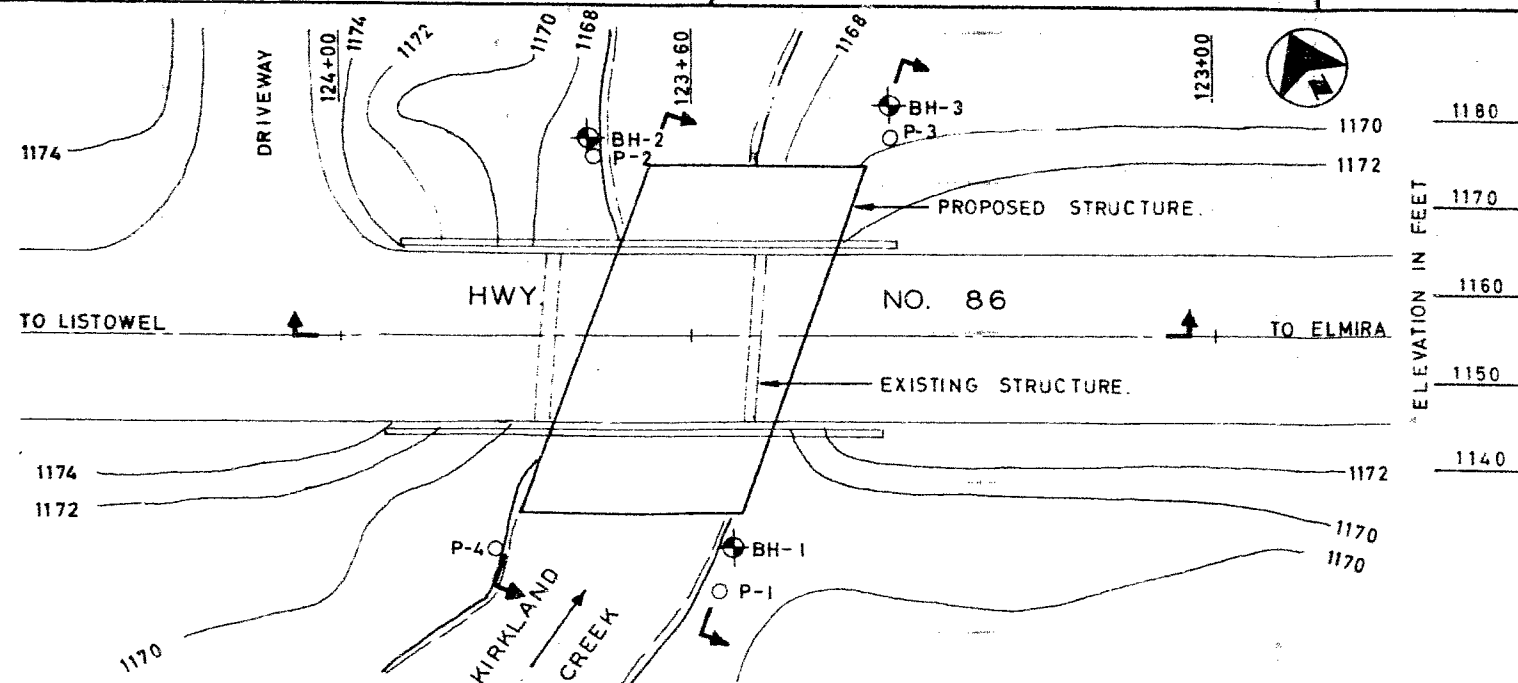
Material will have to be removed down to elevation 1160 during excavation for the footings. This is a depth of about 7 feet below the ground water table. However, it is expected that the excavation can be satisfactorily drained to the required elevation from open sumps.

(d) Approach Fills

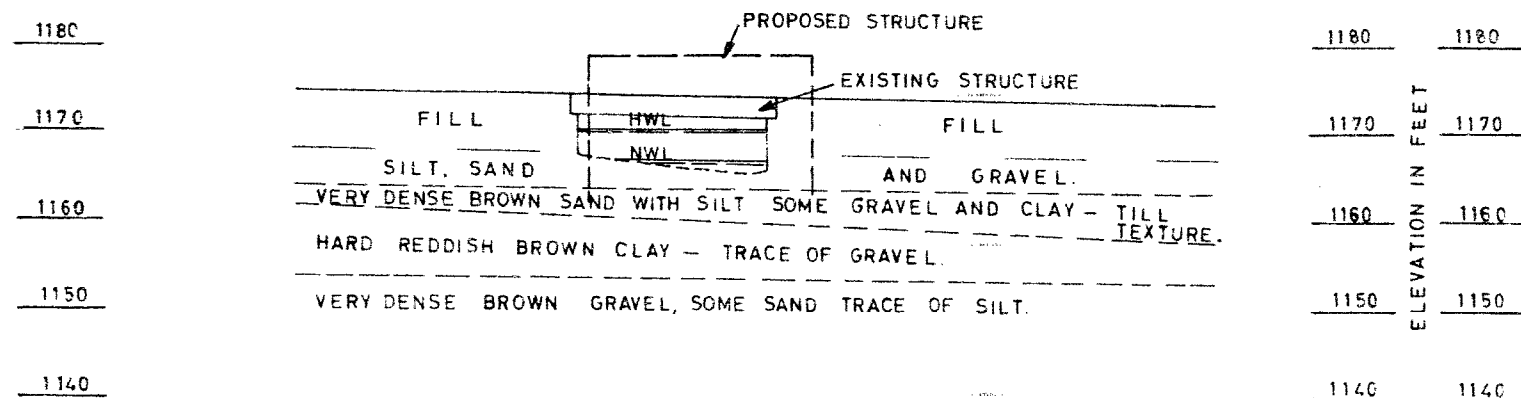
No stability problems are to be expected with the approach fills for this structure provided that a cohesionless soil is used for the embankment and that the side slopes of the embankment are not steeper than 2 horizontal to 1 vertical.

## APPENDIX

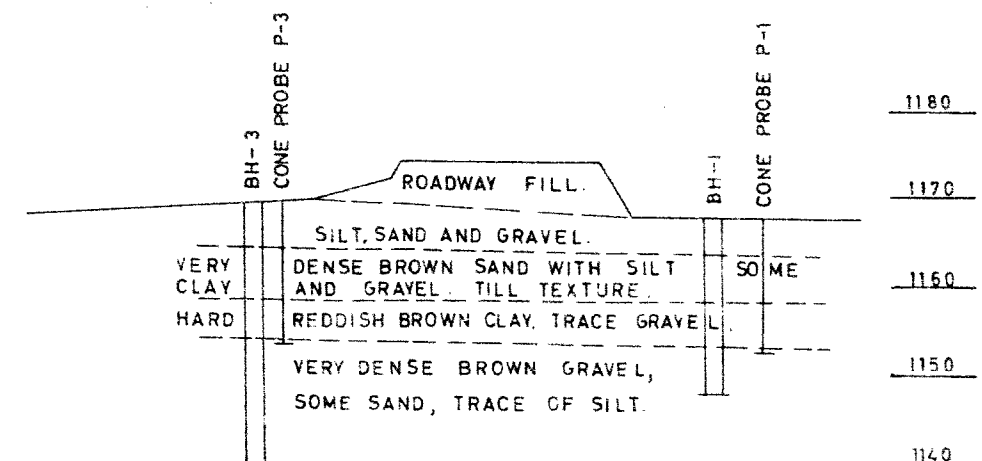
CLIENT <u>DEPARTMENT OF HIGHWAYS - ONTARIO.</u> JOB NO. <u>6211.</u> LOCATION <u>WP 39 - 62</u> PROJECT <u>KIRKLAND CREEK BRIDGE.</u> DATE FIELD INVESTIGATION <u>MAY 1962</u> DATE REPORT _____ BY _____ CHKD. _____	LEGEND ⊕ SOIL BORING. ○ DYNAMIC CONE PROBE.	SCALES HORIZONTAL <u>1 INCH = 20 FEET</u> VERTICAL <u>1 INCH = 20 FEET</u>	ASSOCIATED GEOTECHNICAL SERVICES Limited  PLAN AND SOIL PROFILES
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PROBABLE SOILS PROFILE THROUGH WEST ABUTMENT.

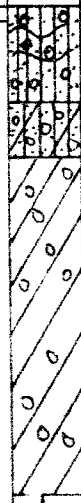
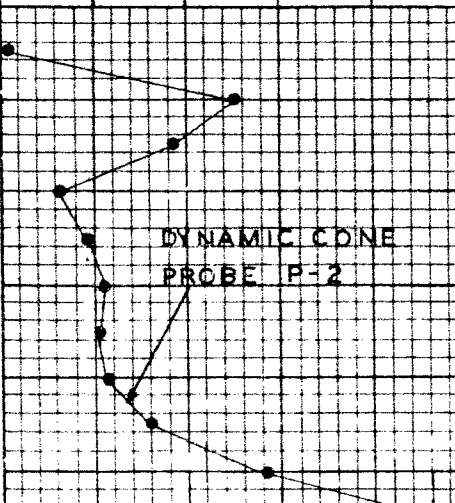
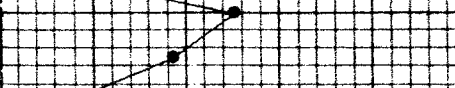

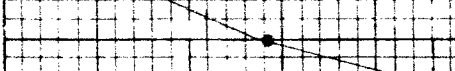


PROBABLE SOILS PROFILE ALONG ROAD CENTRELINE.

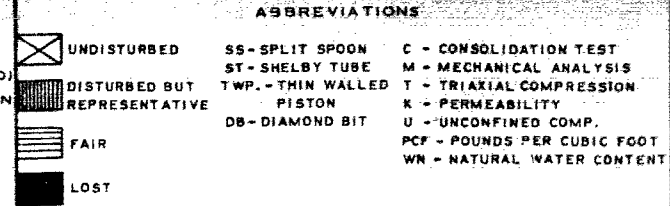
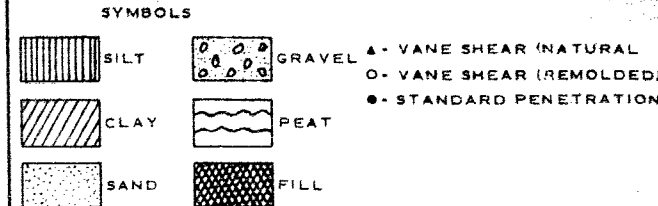


PROBABLE SOILS PROFILE THROUGH EAST ABUTMENT.



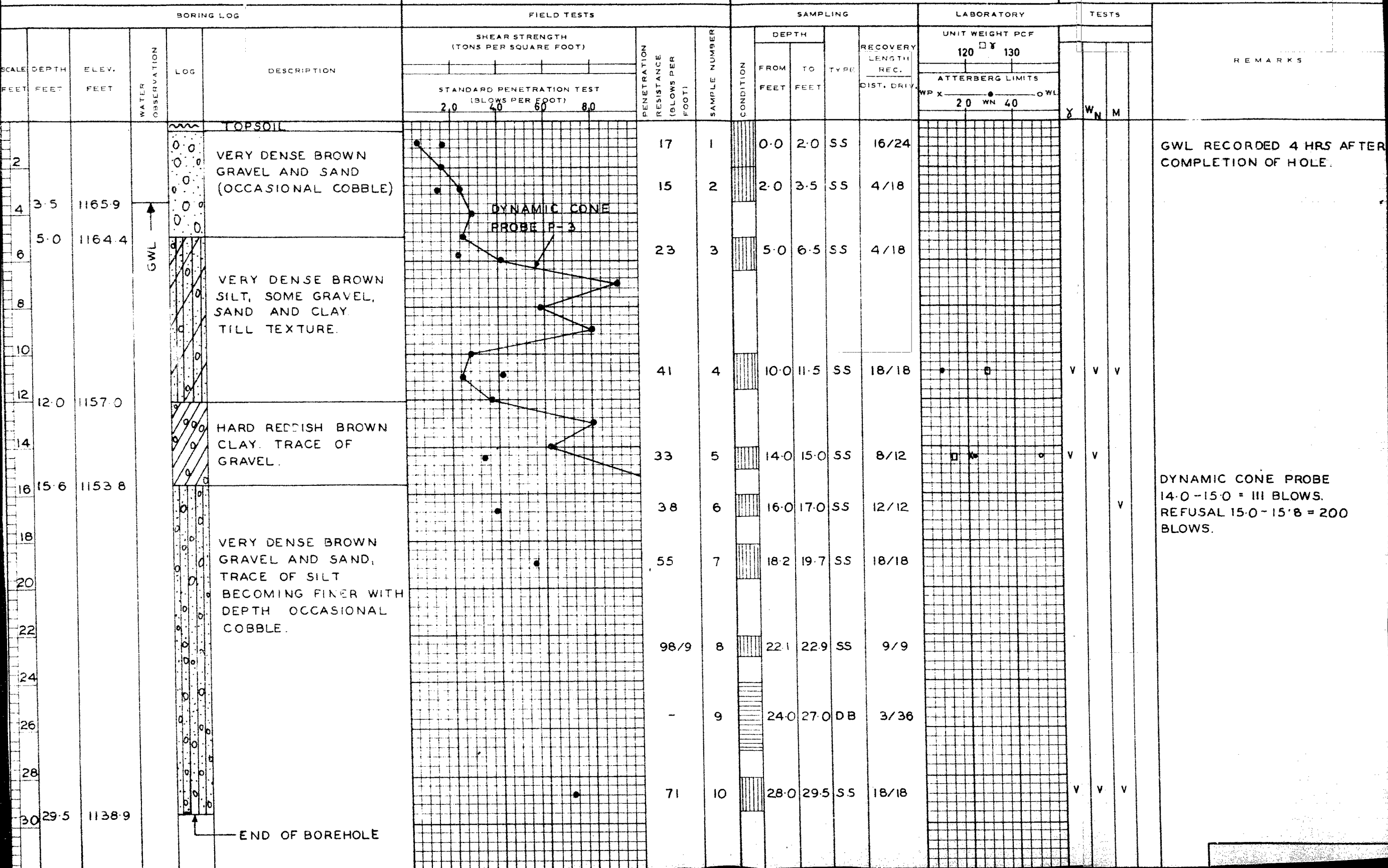
BORING LOG					FIELD TESTS			SAMPLING			LABORATORY		TESTS			REMARKS		
DEPTH FEET	ELEV. FEET	WATER OBSERVATION	LOG	DESCRIPTION	SHEAR STRENGTH (TONS PER SQUARE FOOT)		PENETRATION RESISTANCE (BLOWS PER FOOT)	SAMPLE NUMBER	DEPTH		RECOVERY LENGTH REC. DIST. DRIV.	UNIT WEIGHT PCF		ATTERBERG LIMITS				
					STANDARD PENETRATION TEST (BLOWS PER FOOT)				FROM FEET	TO FEET		TYPE	120 130		WP X WN OWL			
					2.0	4.0							2.0	4.0	W		N	M
0-3	1165.8	GWL		BROWN SAND, SOME GRAVEL AND SILT. TRACE OF ORGANIC.			32	1	0.0	2.0	SS	9/24					GWL RECORDED 4 DAYS AFTER COMPLETION.   SAMPLE 3 LOST - REDROVE TO 8.3 - RECOVERED 3"   DYNAMIC CONE PROBE REFUSAL 11.0 - 11.2 = 200 BLOWS.	
2-3.2	1164.1			BROWN SAND WITH SILT SOME GRAVEL AND CLAY. TILL TEXTURE.			41	2	2.0	3.5	SS	15/18						
6-8	1155.6			HARD REDDISH BROWN CLAY. TRACE OF GRAVEL.			13/6"	3	5.7	6.3	ST	0/8						
10-12							62	4	8.5	10.5	SS	18/24						
END OF BOREHOLE.																		

CLIENT **DEPARTMENT OF HIGHWAYS - ONTARIO**  
JOB NO. **6211** LOCATION **WP 39-62**  
CO-ORDINATES **CHNG. 123+37.4** OFFSET **26.3' RT.**  
ELEVATION (SURFACE) **1169.4** (COLLAR) DATUM **D.H.O.**  
DATE (STARTED) **MAY 4/62** (FINISHED) **MAY 7/62** (COMPILED) **R.J.G.**  
RIG. NO. **1** TYPE **BBS-1** FIELD SUP. **D.S.O.**



**ASSOCIATED GEOTECHNICAL SERVICES**  
Limited

**OFFICE BOREHOLE LOG**  
BOREHOLE NO. 3

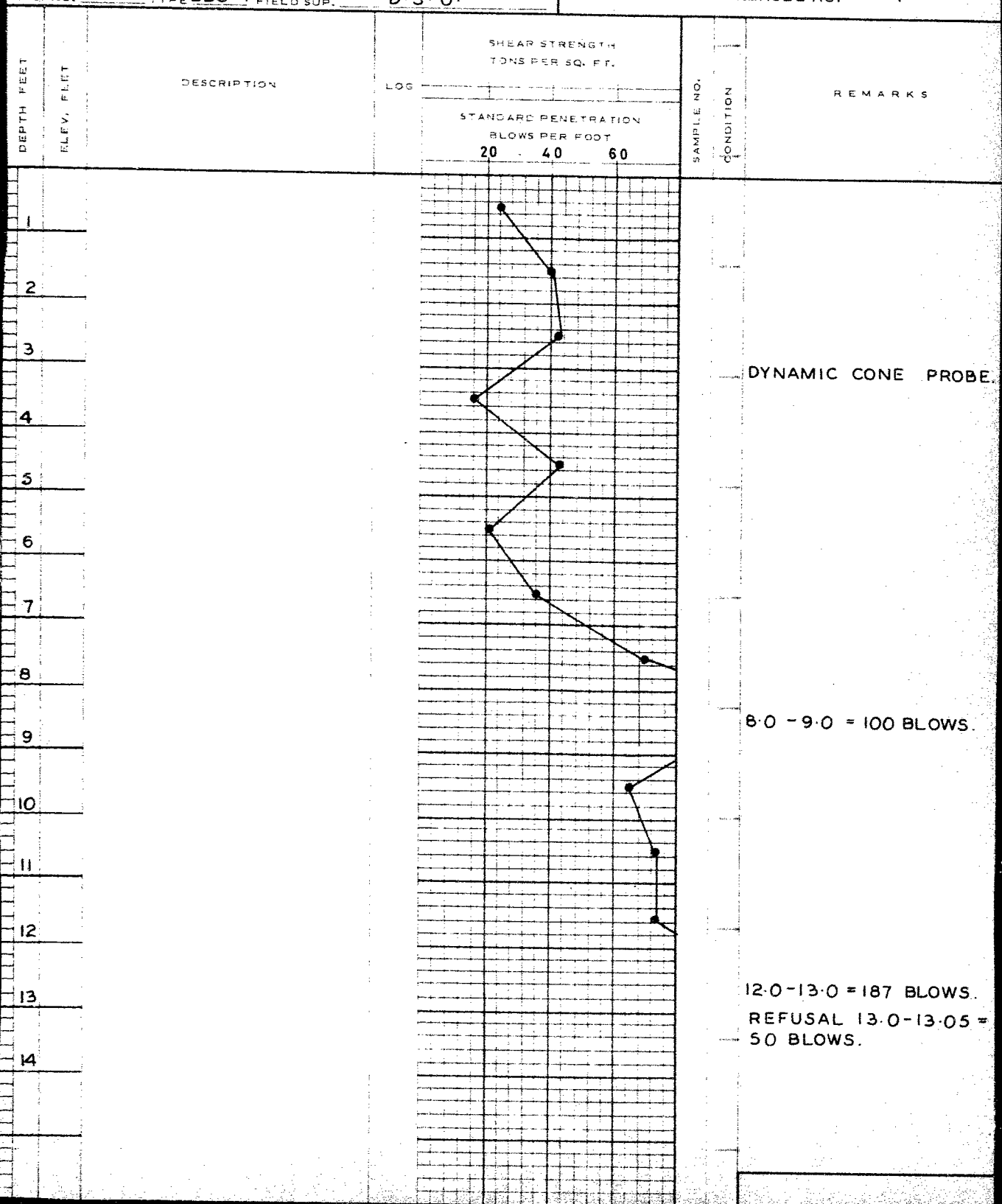


JOB NO. **6211** LOCATION **WP 39 - 62**  
 CO-ORDINATES **CHNG 123+82.6** OFFSET **23.5' LT.**  
 ELEVATION (SURFACE) **1167.3** (COLLAR) \_\_\_\_\_ DATUM **D.H.O.**  
 DATE (STARTED) **MAY 2/62** (FINISHED) **MAY 2/62** (COMPILED) **RJG**  
 RIG. NO. **1** TYPE **BBS-1** FIELD SUP. **D.S.O.**

ASSOCIATED GEOTECHNICAL SERVICES  
 Limited

OFFICE BOREHOLE LOG

BOREHOLE NO. **P - 4**







[illegible]

CLIENT **DEPARTMENT OF HIGHWAYS - ONTARIO**

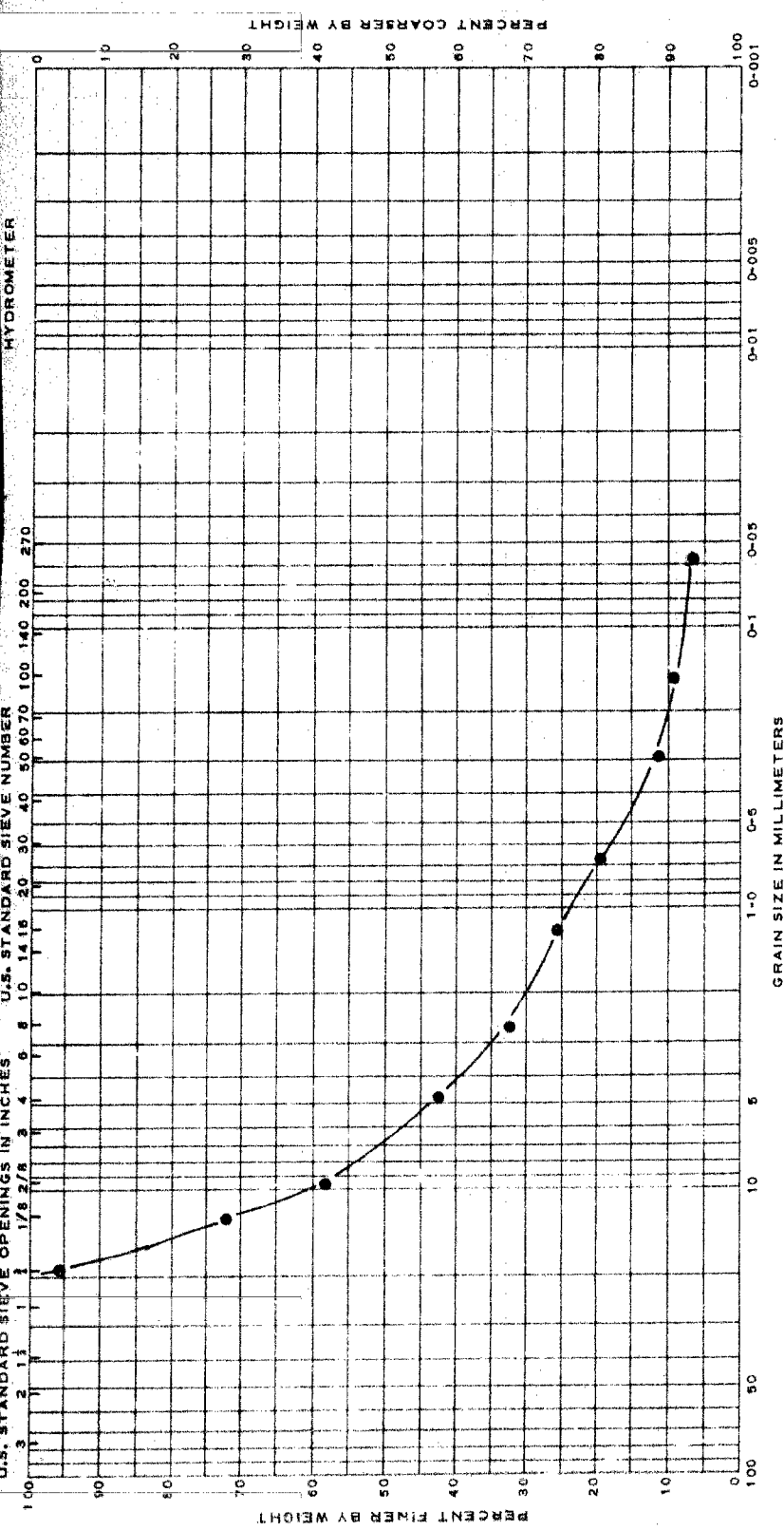
JOB. NO. **6211** LOCATION **WP 39-62**

BOREHOLE NUMBER **1** DEPTH **19.1-19.8**

SAMPLE NUMBER **7** DATE **MAY 1962**

**ASSOCIATED GEOTECHNICAL SERVICES**  
**Limited**

**SOIL MECHANICS LABORATORY**  
**MECHANICAL ANALYSIS**



**M.I.T. CLASSIFICATION**

STONES	GRAVEL		SAND			SILT			CLAY
	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE			

**CLASSIFICATION**

**GRAVEL - SOME SAND**  
**TRACE SILT.**

**70% GRAVEL**  
**23% SAND**  
**7% SILT.**

SOIL MECHANICAL ANALYSIS

DEPTH -

BOREHOLE -

CLIENT DEPARTMENT OF HIGHWAYS - ONTARIO

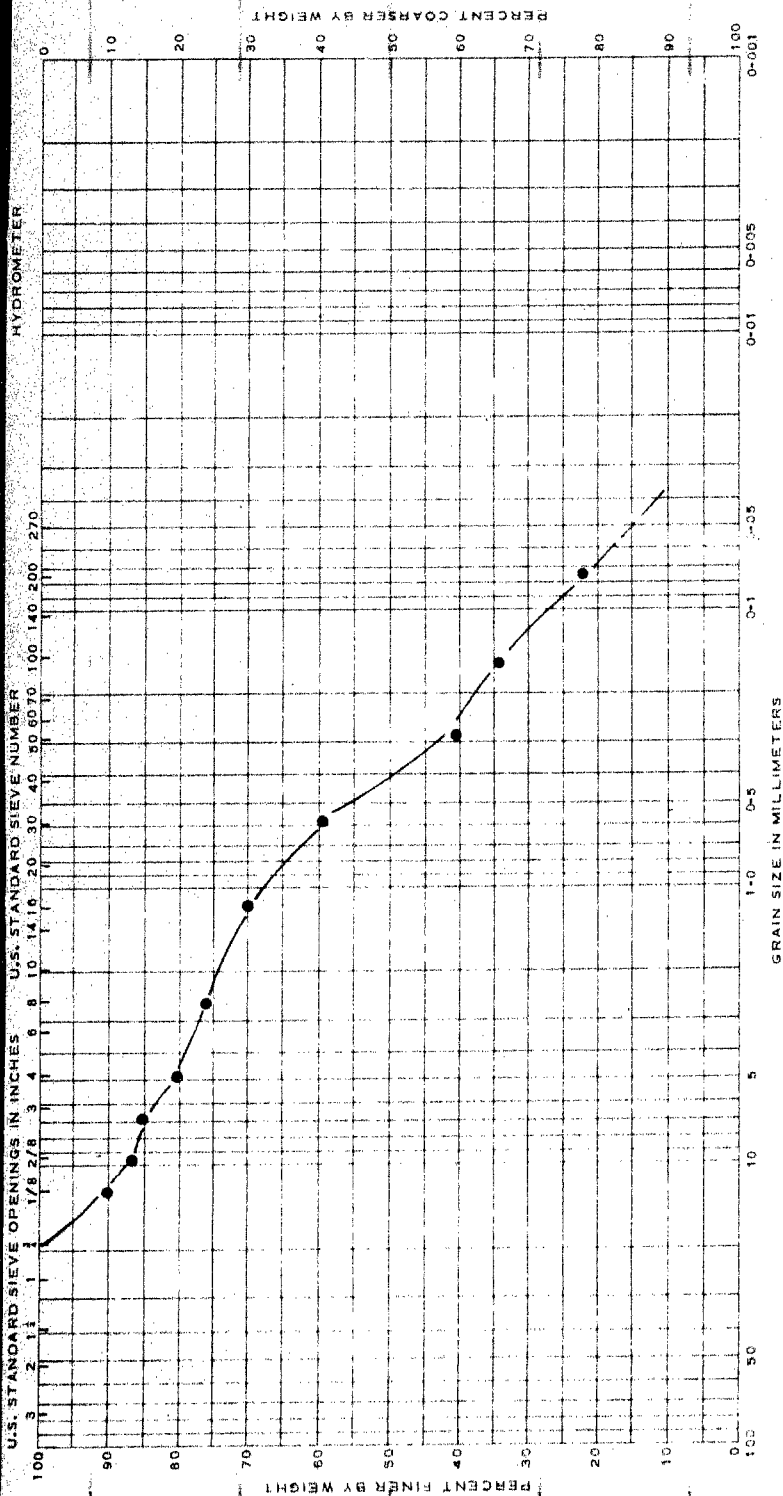
JOB. NO. 6211 LOCATION WP 39 - 62

BOREHOLE NUMBER 2 DEPTH 0.0 - 2.0

SAMPLE NUMBER 1 DATE MAY 1962

ASSOCIATED GEOTECHNICAL SERVICES  
Limited

SOIL MECHANICS LABORATORY  
MECHANICAL ANALYSIS



M.I.T. CLASSIFICATION		GRAVEL				SAND				SILT			CLAY	
STONES		COARSE	MEDIUM	FINE		COARSE	MEDIUM	FINE		COARSE	MEDIUM	FINE		

CLASSIFICATION

SAND SOME GRAVEL  
AND SILT.

15% GRAVEL

68% SAND

17% SILT

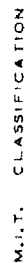
SOIL MECHANICAL ANALYSIS

BOREHOLE -

DEPTH -

DATE **MAY 19 62**

## MECHANICAL ANALYSIS



GRAIN SIZE IN MILLIMETERS

STORIES

GRAVEL

**COARSE**

**MEDIUM**  
**SAND**

www.elsevier.com/locate/jmb

COVER

# SILT

[illegible]

LAY

## CLASSIFICATION

17% CLAY

SILT - SOME GRAVEL, SAND  
AND CLAY.

SOIL MECHANICAL ANALYSIS

**BORERHOLE.**

DEPT 44.

CLIENT DEPARTMENT OF HIGHWAYS - ONTARIO

ASSOCIATED GEOTECHNICAL SERVICES

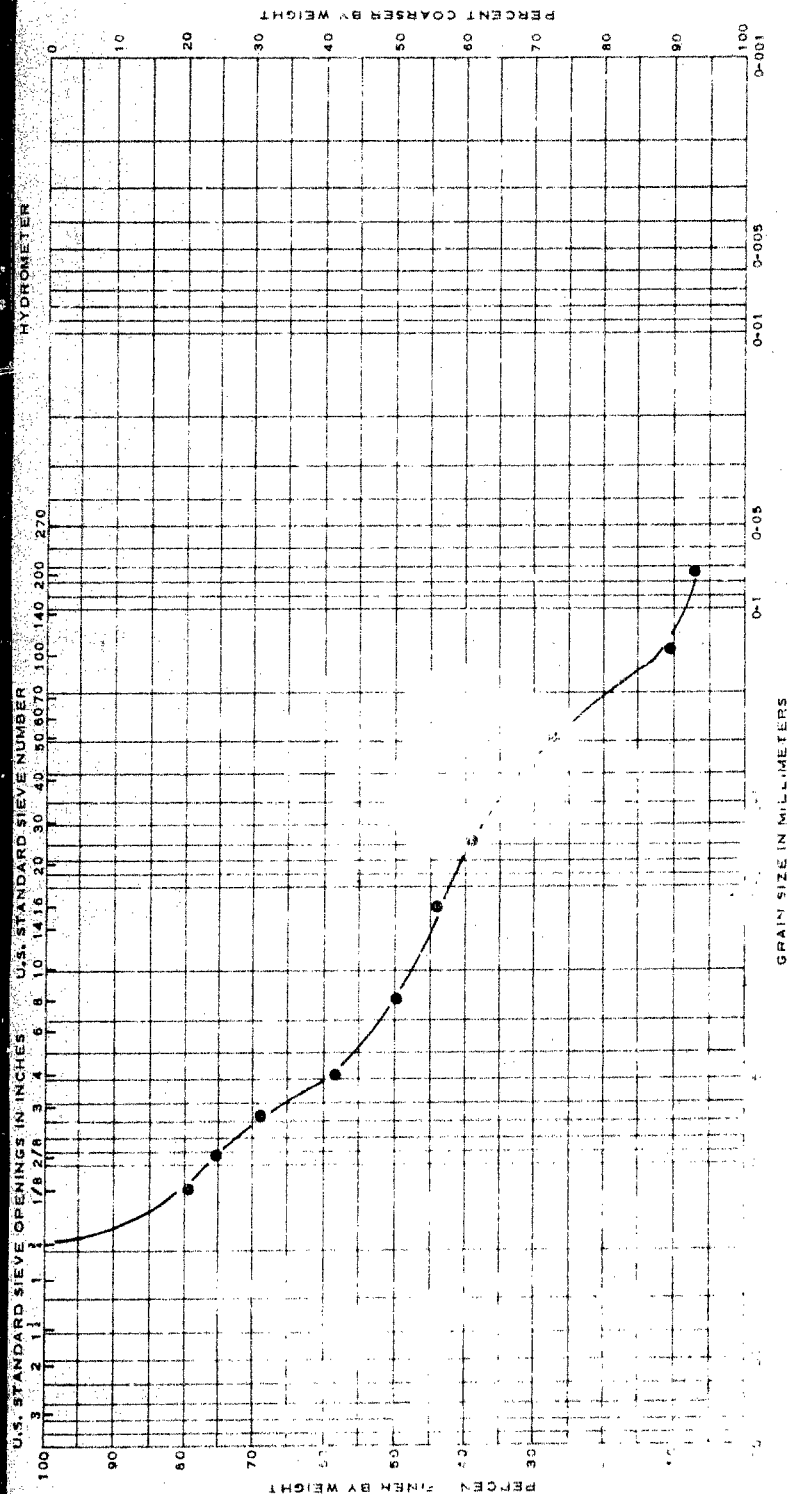
Limited

JOB NO. 6211 LOCATION WP 39 - 62

BOREHOLE NUMBER 3 DEPTH 16.0 - 17.0

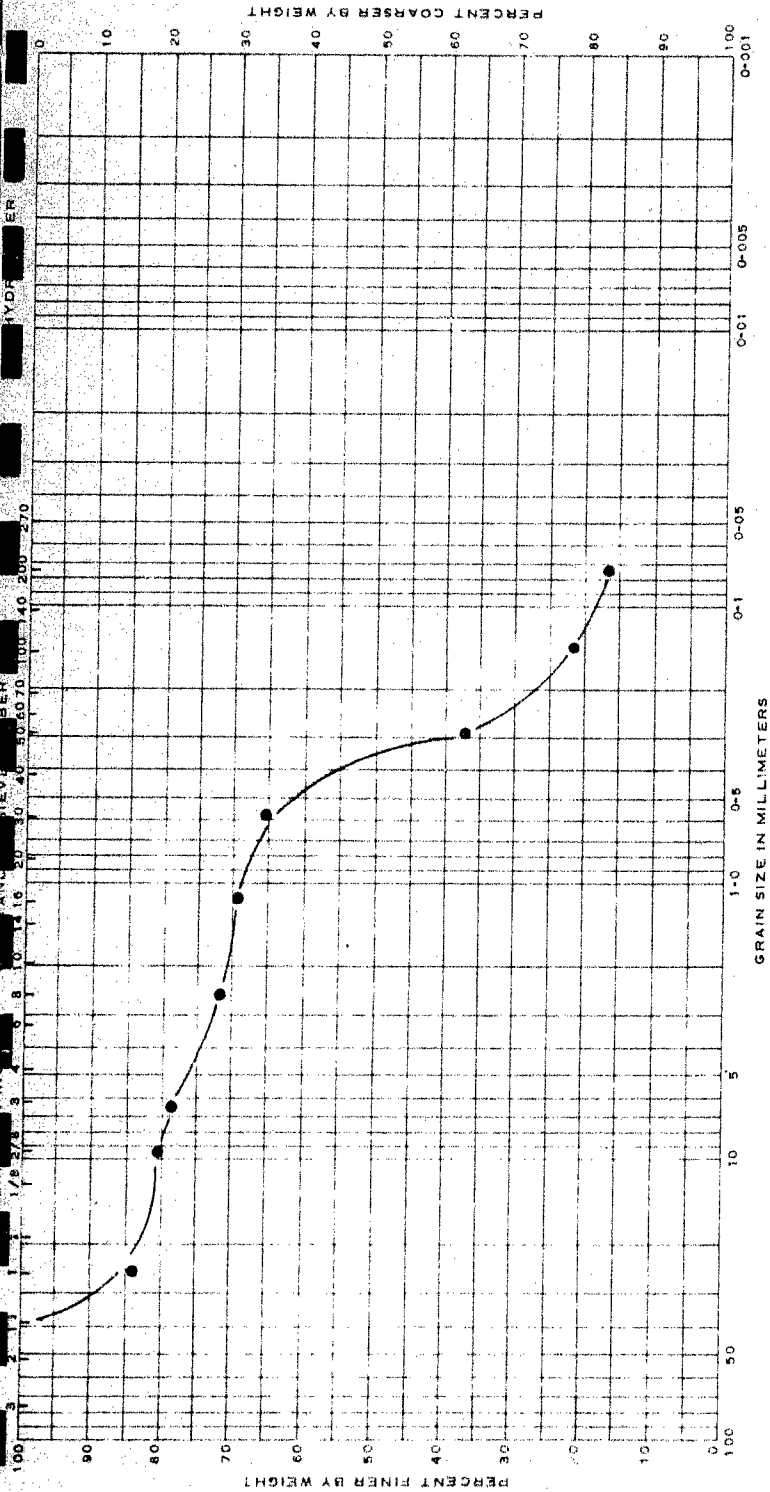
SAMPLE NUMBER 6 DATE MAY 1962

SOIL MECHANICS LABORATORY  
MECHANICAL ANALYSIS



JOB NO. 6211 LOCATION WP 39 - 62  
 COREHOLE NUMBER 3 DEPTH 280-295  
 SAMPLE NUMBER 10 DATE MAY 1962

SOIL MECHANICS LABORATORY  
MECHANICAL ANALYSIS



M.I.T. CLASSIFICATION

STONES	GRAVEL	SAND			SILT		CLAY
		COARSE	MEDIUM		COARSE	MEDIUM	
			FINE	FINE			

## CLASSIFICATION

SAND - WITH GRAVEL  
SOME SILT.

57%	SAND
-----	------

28% GRAVEL.

15% SILT

## SOIL MECHANICAL ANALYSIS

DEPTH.	BOREHOLE.
10	10
20	20
30	30
40	40
50	50
60	60
70	70
80	80
90	90
100	100
110	110
120	120
130	130
140	140
150	150
160	160
170	170
180	180
190	190
200	200
210	210
220	220
230	230
240	240
250	250
260	260
270	270
280	280
290	290
300	300
310	310
320	320
330	330
340	340
350	350
360	360
370	370
380	380
390	390
400	400
410	410
420	420
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840	840
850	850
860	860
870	870
880	880
890	890
900	900
910	910
920	920
930	930
940	940
950	950
960	960
970	970
980	980
990	990
1000	1000

## SOIL CLASSIFICATION SYSTEM

The following system was used to describe the various soils encountered at the site as determined by visual field examination and test. It was also used to classify those soils upon which a laboratory grain size determination had been made.

### Soil Components

### Particle Size

Clay	$< .002$ mm
Silt	$> .002$ mm $< .06$ mm
Sand	$> .06$ mm $< 2.0$ mm
Gravel	$> 2.0$ mm $< 2$ in.
Cobbles	$> 2$ in. $< 6$ in.
Boulders	$> 6$ in.

### Descriptive Terms

### Range of Proportions

and	greater than 40%
with	25% to 40%
some	10% to 25%
trace	less than 10%

### Example

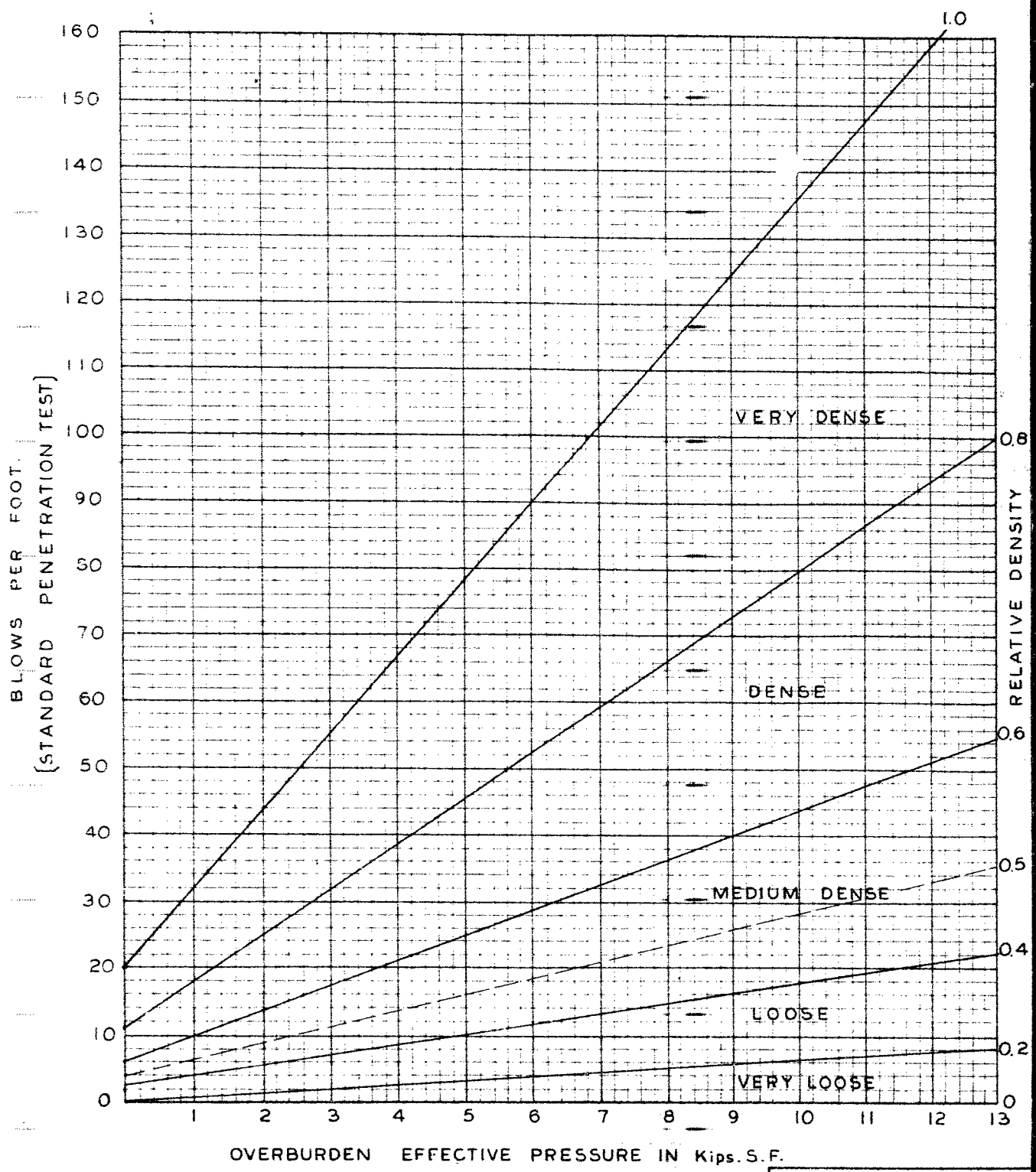
1. Silt (predominant type) with (25% - 40%) sand.
2. Sand and silt (predominant types), some (10% - 25%) gravel, trace ( $< 10\%$ ) clay.



CLIENT \_\_\_\_\_  
JOB NO. \_\_\_\_\_ LOCATION \_\_\_\_\_  
BOREHOLE NUMBER \_\_\_\_\_ DATE \_\_\_\_\_  
SAMPLE NUMBER \_\_\_\_\_ DEPTH \_\_\_\_\_

ASSOCIATED GEOTECHNICAL SERVICES  
Limited

SOIL MECHANICS LABORATORY  
DENSITY CHART



Telephone inquiry March 29, 1963  
Bill Hashisume

Q: What would be the allowable bearing capacity at elev. 1162.0 i.e. two feet above the elevation recommended by the Consultant.

A: The same i.e. 3.0 T/sq ft.

Explanation:

Very dense till commences already above elev. 1162.0. The consultant has arrived at elev. 1160.0 on the basis of scour protection criterion - not on the basis of bearing capacity.

Afternoon