

G.I.-30 SEPT. 1976

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 40P2-36

W.P. No. 186-58

CONT. No. _____

W. O. No. _____

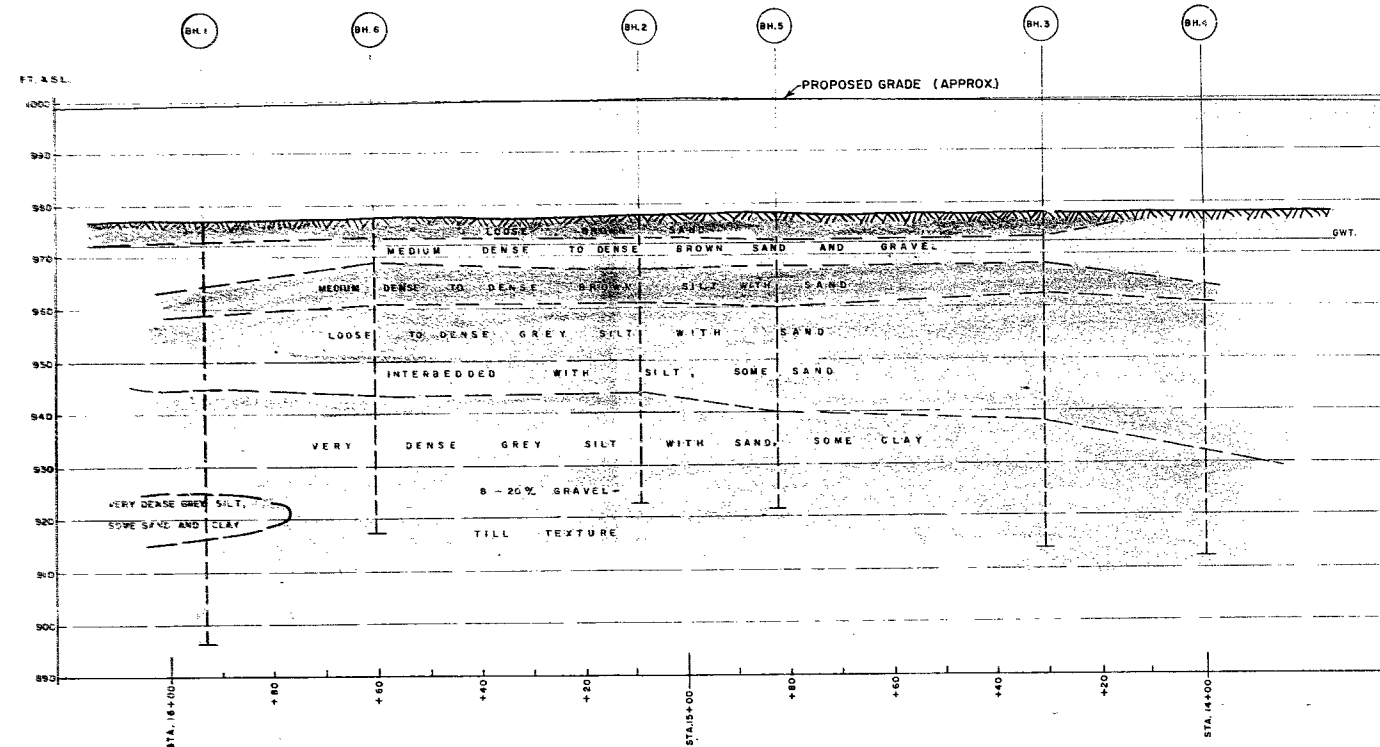
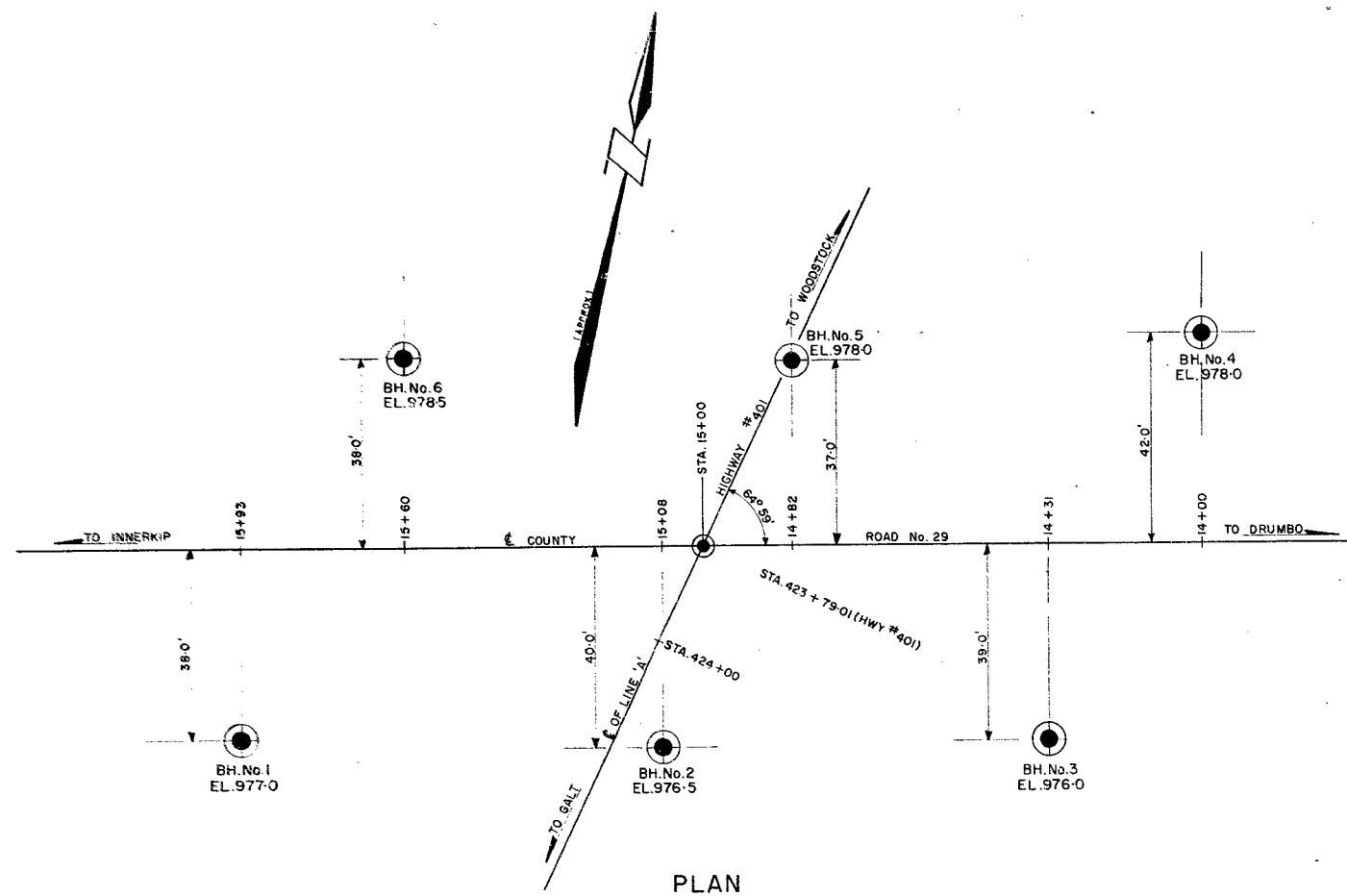
STR. SITE No. _____

HWY. No. 401, Dist. 2

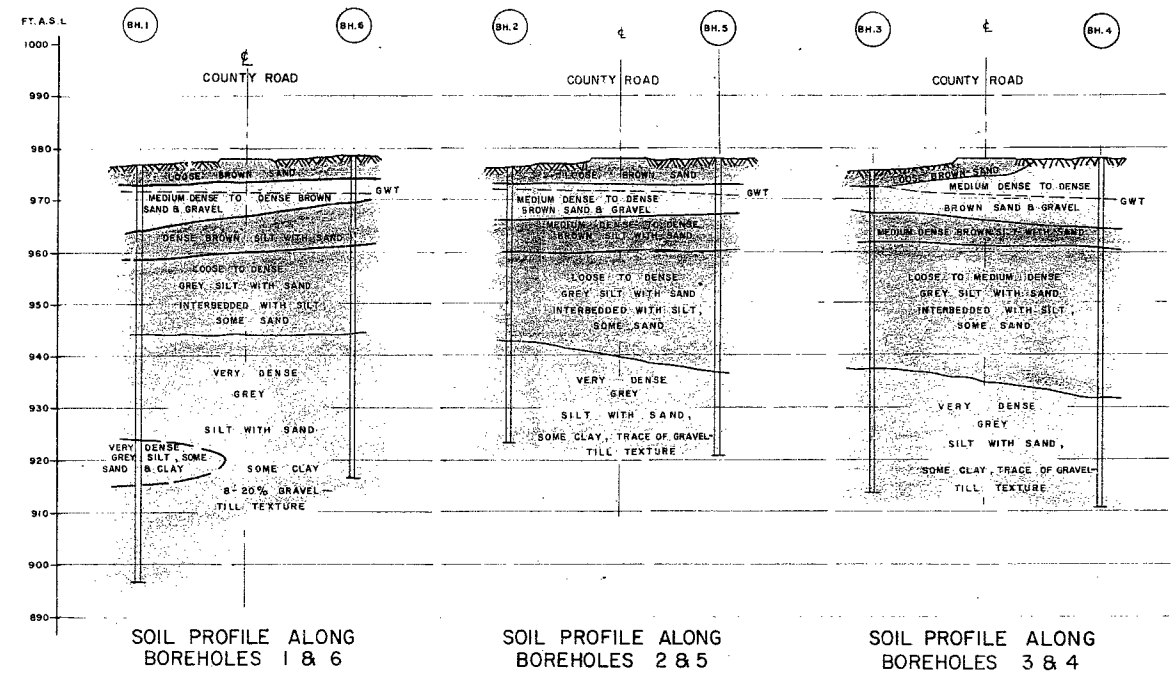
LOCATION Co. Road # 29,
BLenheim TWP.

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. ONE

REMARKS: _____



PROJECTED SOIL PROFILE ALONG CENTRE LINE OF COUNTY ROAD NO.29



SOIL PROFILE ALONG
BOREHOLES 1 & 6

SOIL PROFILE ALONG
BOREHOLES 2 & 5

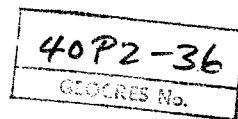
SOIL PROFILE ALONG
BOREHOLES 3 & 4

SCALE — HOR. 1" = 40'
VER. 1" = 20'

40P2-36
GEOCRE5 No.

HUNTING		TECHNICAL		8		EXPLORATION		SERVICES LTD.	
TORONTO									
DEPARTMENT			OF		HIGHWAYS - ONTARIO				
LOCATION OF				BOREHOLES					
SUBSURFACE				AND SOIL		PROFILES			
				FOR					
PROPOSED CROSSING OF COUNTY ROAD NO. 29									
OVERPASSING									
HIGHWAY NO. 401, BLENHEIM TWP.									
BRIDGE SITE									
SCALE 1" = 20'.				DRAWN BY -			DATE - SEPT. 1958		
EXCEPT NOTED									
REFERENCE				DRAWINGS		PROFILE F-3526-7 PLAN F-3526-9			

40P2-36
GEOCRES No.



REPORT ON FOUNDATION INVESTIGATION
FOR THE
PROPOSED CROSSING OF COUNTY ROAD NO. 29
OVERPASSING HIGHWAY NO. 401
TOWNSHIP OF BLENHEIM, ONTARIO

for the

DEPARTMENT OF HIGHWAYS - ONTARIO

by the

Engineering Division
HUNTING TECHNICAL AND EXPLORATION SERVICES LIMITED
Toronto, Ontario

September, 1958.

ORDER OF CONTENTS

<u>Section</u>		<u>Page</u>
1.1	PURPOSE OF REPORT	
	1.11 General	1
1.2	DISCUSSION OF PROCEDURES	
	1.21 Location of Boreholes	2
	1.22 Subsurface Drilling and Sampling	2
	1.23 Soil Testing	3
1.3	DISCUSSION OF SITE	
	1.31 Geographic Location	4
	1.32 Site Geology	4
	1.33 Water Conditions	4
	1.34 Soil Conditions	5
1.4	COMMENTS ON FOUNDATIONS OF STRUCTURE	
	1.41 General	8
	1.42 Spread Footing Foundation	8
	1.43 Pile Foundation	9
	1.44 Recommendations	10
1.5	PERSONNEL	11
1.6	APPENDICES	12
	1.61 General Plan of Site and Subsurface Sections	
	1.62 Office Logs of Boreholes	
	1.63 Photos of Site	
	1.64 Soil Classification Charts	

Section 1.1

PURPOSE OF REPORT

1.11 General

The purpose of this report is to present the results of a subsurface soil investigation on the site of the proposed crossing of County Road No. 29 overpassing Highway No. 401 in the Township of Blenheim and to offer recommendations regarding a safe foundation for the new structure.

Section 1.2DISCUSSION OF PROCEDURES1.21 Location of Boreholes

The field location of the site for this investigation was established by Department of Highways surveyors. Hunting Technical and Exploration Services Limited engineers established the actual borehole locations by chaining to all boreholes from the centre line of County Road No. 29. Elevations for all boreholes were established by spirit level from B. M. Elevation 978.47 located 200'-0 left of station 422+36. Borehole locations differ in some cases from the originally proposed locations because of headroom limitations imposed by overhead power and telegraph lines. At the completion of the work, each borehole was marked with a large stake denoting the hole number for future reference. The locations, with reference to centre line of County Road No. 29, and elevations of top of the boreholes are shown on the plan in Appendix 1.61.

1.22 Subsurface Drilling and Sampling

A primary program, specified by the client, of 6 soil borings was carried out in the vicinity of the proposed site of the new County Road No. 29 bridge overpassing No. 401 Highway.

Two Longyear U. G. straight-line with "A" twin hydraulic head and Perkins P4 diesel motor skid-mounted diamond drilling rigs were used on this project. All boring and sampling operations were completed by experienced soil sampling crews under the supervision of engineering personnel experienced in soil sampling procedures.

All soil borings were performed by the standard wash boring method. In this procedure drill casing is driven into the soil by a 350 lb.

hammer to a depth of 5 feet or change in stratum. Comparative stratum and density changes were observed by recording the number of blows required to drive each foot of casing. All the soil contained inside the casing during this operation was thoroughly washed out to the bottom of the casing and the resultant washwater was observed to further determine stratum changes. Sampling tools were then lowered to the bottom of the hole. The sample was then taken and the sampling tools removed from the hole. Additional lengths of casing were added as required and the procedure repeated. To expedite the advance of the casing into the dense stratum of till, the bottom end of the casing was fitted with a diamond shoe bit and the casing fed into the ground by diamond drilling techniques. Water is used in this method to clean and cool the diamond drill bit as well as carry the sludge out of the hole during the actual drilling operations.

Attempts were made to obtain samples in the cohesionless soils by means of a 2-inch O. D. standard split-spoon sampler. The standard penetration test using a 140 lb. hammer falling 30 inches was recorded for each foot of sampler penetration. When necessary, recovery of samples for identification and correlation was obtained with a side-slit sampler. All samples were visually examined and classified on the site, then placed in jars and forwarded to the engineering office. Where samples obtained were representative and relatively undisturbed, apparent density tests were made on site to obtain the approximate specific weight of the material.

1.23 Soil Testing

Selective samples from each stratum were forwarded to the laboratory as a check on the visual field classification.

The results of all tests are given in the Appendices. The laboratory tests on the samples were performed by:

Donald Inspection Limited,
340 Richmond Street West,
Toronto 1, Ontario.

Section 1.3

DISCUSSION OF SITE

1.31 Geographic Location

The proposed bridge site is located on the Queen's Highway No. 401 at the proposed crossing of Oxford County Road No. 29. The site is in the County of Oxford, Township of Blenheim, on Lot 19 between Concessions VI and VII.

1.32 Site Geology

Physiographically, the site lies within a region known as the Waterloo Hills. The region is made up of sandy hills some of which are ridges of sandy till while others are kames. Outwash sand occupies the hollows between these hills. The region is characterized by the predominance of fine sand in the soil profile. Underlying a depth of about 30 feet of sand, a dense silty till was found. This till can be related to the Oxford till plain which outcrops in the more westerly and southerly portions of Oxford County.

Bedrock was not encountered in the boreholes. However, well logs in the general vicinity of the site indicate that limestone bedrock of the Salina Formation should be encountered at an approximate depth of 175 feet.

1.33 Water Conditions

At the time of the investigation (September, 1958), the water table in the boreholes was found to be at approximately El. 972.

It is interesting to note that water for boring purposes was obtained from a well on the Wood's property about 200 feet north of the site location. Two thousand gallons of water per hour were drawn from this well for about 7 days without appreciably lowering the water table in the boreholes or drawing

down the water level in the well by more than one foot.

Artesian water was encountered at El. 909 in Borehole No. 1 with a head above ground level slightly in excess of 5 feet. The flow encountered was low and was estimated at 25 gallons per hour.

1.34 Soil Conditions

The soils encountered at the site consisted generally of five structural types in the following order of their occurrence below ground surface.

1. Loose brown sand
2. Medium dense to dense brown sand and gravel
3. Medium dense brown silt with sand
4. Loose to dense grey silt with sand interbedded with silt, some sand.
5. Very dense grey silt with sand, some clay, trace of gravel - till texture

The approximate physical properties of each stratum are listed as follows.

1. Loose brown sand:

This material underlies the ground surface throughout most of the site and was encountered in all boreholes except Borehole No. 4. This soil has a fairly uniform texture with a tendency to become gravelly with increasing depth. The physical properties of this soil are summarized as follows:

Average Thickness	3.6 feet
Top Elevation Range	973 feet to 976.5 feet
Bottom Elevation Range	968 feet to 976.3 feet
Penetration Resistance Average	5.2 blows/foot
Range	3 to 7 blows/foot

2. Medium dense to dense brown sand and gravel:

This material underlies the loose brown sand described in 1 above and is encountered in all boreholes. The stratum is well stratified into beds of sand and sandy gravel with occasional thin layers of silty fine sand. The penetration test results have a wide range and depend upon the size and abundance of gravel particles. The physical properties of this soil are outlined below:

Average Thickness	8.1 feet
Top Elevation Range	964.3 feet to 976.3 feet
Bottom Elevation Range	960.0 feet to 967.9 feet
Penetration Resistance Average	34 blows/foot
Range	16 to 46 blows/foot

3. Medium dense to dense brown silt with sand:

This soil was encountered in all boreholes at the site. It probably was originally contained within the underlying stratum described in 4 below and presently represents the oxidized phase. The soil varies texturally with stratification of the silt and sand. The stratum was noted to become less dense toward the east. The physical properties of the layer are listed below:

Average Thickness	11.1 feet
Top Elevation Range	960.0 feet to 967.9 feet
Bottom Elevation Range	930.4 feet to 962.0 feet
Penetration Resistance Average	36.3 blows/foot
Range	24 to 57 blows/foot

4. Loose to dense grey silt with sand interbedded with silt, some sand:

This soil was characterized by numerous thin layers of silt containing varying amounts of sand. An occasional thin layer of clay was also

encountered. The physical properties of this material are listed as follows:

Average Thickness	20.7 feet
Top Elevation Range	930.4 feet to 962.0 feet
Bottom Elevation Range	917.0 feet to 944.6 feet
Penetration Resistance Average	28.8 blows/foot
Range	7 to 78 blows/foot

5. Very dense grey silt with sand, some clay, trace of gravel - till texture:

This material was encountered in all boreholes at the site. This soil was found to be fairly homogeneous in density throughout. The variation of penetration test results to extremely high values was thought to be due to the result of pebbles and cobbles. The physical properties of this soil are summarized as follows:

Top Elevation Range	917.0 feet to 944.6 feet
Penetration Resistance Average	59+ blows/foot

encountered. The physical properties of this material are listed as follows:

Average Thickness	20.7 feet
Top Elevation Range	930.4 feet to 962.0 feet
Bottom Elevation Range	917.0 feet to 944.6 feet
Penetration Resistance Average	28.8 blows/foot
Range	7 to 78 blows/foot

5. Very dense grey silt with sand, some clay, trace of gravel - till texture:

This material was encountered in all boreholes at the site. This soil was found to be fairly homogeneous in density throughout. The variation of penetration test results to extremely high values was thought to be due to the result of pebbles and cobbles. The physical properties of this soil are summarized as follows:

Top Elevation Range	917.0 feet to 944.6 feet
Penetration Resistance Average	59+ blows/foot

Section 1.4COMMENTS ON FOUNDATIONS OF STRUCTURE1.41 General

Our understanding of the proposed bridge structure is it will be supported at each end on abutments in the vicinity of chainages 14+30 and 15+70 and at the centre on a pier about chainage 15+00. The structure will have a skew angle of $64^{\circ}59'$ with respect to County Road No. 29.

The maximum height of approach fill was assumed to be 23 feet at the structure.

We have also assumed that the fills along the approaches to the bridge will be made up of selected granular fill contained and protected where necessary by wing-walls and retaining-walls.

1.42 Spread Footing Foundations

We have investigated the possibility of placing spread footings for the base of the structure at about El. 972 which is about 6 feet below the present ground level. With a footing width of 15 feet placed at El. 972, we have determined that the soil can safely support a load of 4 tons per square foot, given a safety factor of 3.

For a bridge, supported at each end on abutments and at the centre by a pier, a design bearing load of 4.0 tons/sq. foot may be used, assuming that the spans are simply supported.

If a single span rigid-frame structure is contemplated, this bearing load should be reduced to a value which will tolerate any rise in internal stresses in the structure members as a result of differential settlement. As the soil beneath the proposed elevation of the footings varies from loose to

very dense, it is difficult to evaluate the settlement behaviour of the subsoil during any phase of the construction period or after the structure has been built. We expect, however, that any settlement within the soil mass would be nearly complete before the bridge structure is totally erected. Nevertheless, due to the possibility of some degree of subsidence of the subsoil either during the construction period or after the bridge has been put into service, we recommend that a maximum bearing capacity of 3.0 tons per square foot be used for the design of a rigid-frame structure.

1.43 Pile Foundation

The till layer found below El. 940 should provide a very good support for bearing piles.

Steel H-piles of section 12 x 12 driven to refusal into the till layer are expected to provide an end bearing capacity up to 45 tons per pile.

If difficulties are encountered while driving through the sand and silt, jetting of water by the side of the pile simultaneously with the driving may be used. All piles should be finally driven without jetting at least 5 feet before the required elevation is attained.

Concrete cast-in-situ piles may be used to give a higher carrying load per pile. Such piles should be driven at least 5 feet into the till layer. Cased concrete piles, cast-in-place, with highly compressed base section are expected to provide up to 100 tons or more per pile. However, the length required of such piles may range from 30 feet to 40 feet depending on the irregularity of the till layer.

In either case, the exact length requirements and the desired design carrying capacity of piles should be checked with established driving formulae or load tests.

1.44 Recommendations

1. In our opinion, spread footing foundations should provide the most satisfactory method of support for the structure.

We suggest that the footings be established at about El. 972 which is approximately 6 feet below the present ground surface.

At El. 972 we recommend the use of 4.0 tons/sq. foot as the design bearing load on the soil for a simply supported type of structure.

For a rigid-frame type of structure, we recommend the use of 3.0 tons/sq. foot as maximum design bearing load.

2. Pile foundations for the bridge structure may be used as an alternative when design requirements warrant the choice of piles to carry heavier loads. Our comments under Section 1.43 outlined the use of several types of heavy piles. This Engineering Office will be pleased to furnish further information relating to such piles.

3. We do not envisage any stability problem with the approach fills. In our opinion, a 1 to $\frac{3}{2}$ slope for the embankment will provide an adequate factor of safety. *See letter*

Adequate fill drainage facilities should be provided along abutments, wing-walls or retaining-walls.

4. It would be advisable to keep the elevation of the footings or pile cap for the structure above the water table as lowering the water table will likely be an expensive pumping proposition (see Section 1.33).

Section 1.5

PERSONNEL

The field work for this project was performed under the supervision of Mr. A. B. MacArthur, B.A.Sc. and J. Kilgour, P. Eng.

This report was written by Mr. A. B. MacArthur, W.W.F. Wong, P. Eng., and J. Kilgour, P. Eng.

Section 1.6

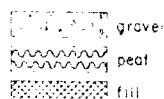
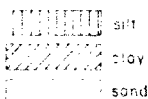
APPENDICES

1.61 General Plan of Site and Subsurface Sections

1.62 Office Logs of Boreholes

JOB No. H594/58 LOCATION NEAR DRUMBO - ONTARIO
 CLIENT DEPARTMENT OF HIGHWAYS - ONTARIO
 COORDINATES CH. 15+93.0 OFFSET 38'0" LEFT OF C.
 ELEV. (surface): 977.0 (LOCAL) Datum D.H.O.
 BOREHOLE NUMBER 1
 DATE (started): 4 SEP 58 (finished): 7 SEP 58
 RIG No. 2 TYPE LONGYEAR UG ST LINE

HUNTING TECHNICAL AND EXPLORATION SERVICES



x standard penetr. 2 s.s.
 Δ vane shear
 ○ pocket penetrometer

SAMPLE CONDITION
 undisturbed
 disturbed but
 represent.
 fair
 lost

BORING LOG

FIELD TESTS

SCALE	DEPTH	ELEV	WATER OBSERVATION	LOG	DESCRIPTION	SHEAR STRENGTH (TENS. PER SQUARE FOOT)		STANDARD PENETRATION TEST (BLOWS PER FOOT)		SAMPLES		RECOVERY LENGTH REC DIST. DRIV	PENETRATION RESISTANCE (BLOWS PER FOOT)	ATTERBERG		LIMITS	WP	X	O	W
						1/2		1/2		N	COND.	DEPTH FROM TO								
0	0	977.0																		
	15	975.5			ORGANIC MATERIAL					1		0 2.0'	SS	20/24	6					
5	40	973.0			LOOSE BROWN SAND															
					MEDIUM DENSE TO DENSE					2		5.0' 7.0'	SS	13/24	24					
10					BROWN SAND															
					AND GRAVEL					3		10.0' 12.0'	SS	16/24	40					
15					DENSE BROWN															
					SILT WITH SAND					4		15.0' 17.0'	SS	20/24	50					
20					DENSE GREY															
					SILT WITH SAND					5		20.0' 22.0'	SS	20/24	21					
25					INTERBEDDED WITH															
					MEDIUM DENSE					6		25.0' 27.0'	SS	20/24	33					
30					SILT, SOME SAND															
										7		30.0' 32.0'	SS	20/24	23					
35																				
					DENSE TO VERY DENSE					8		35.0' 37.0'	SS	19/24	50					
40					GREY															
					SILT WITH SAND					9 & 10		39.0' 41.0'	SS	22/24	44					
45					SOME GRAVEL AND CLAY															
					- TILL TEXTURE -					11		43.0' 44.7'	SS	18/20	197					
50																				
55					VERY DENSE GREY					12		52.3 54.3	SS	21/24	123					
					SILT, SOME SAND															
60					AND CLAY															
										13		60.0' 62.0'	SS	22/24	330					
65																				
					VERY DENSE															
					GREY															
70					SILT WITH SAND															
					SOME CLAY															
					TRACE OF GRAVEL					14		70.0' 71.0'	SS	10/12	480					
75					- TILL TEXTURE -															
80	80.9	896.1			END OF BORING AT 80.9'															

NOTE: PENETRATION RESISTANCE AT
 END OF HOLE: 460 BLOWS FOR 10"

BOREHOLE No. 1

x -- standard penetrometer
 Δ -- vane shear
 ○ -- pocket penetrometer

SAMPLE CONDITION

- undisturbed
- disturbed but represent.
- fair
- lost

SS	split spoon
ST	shelby tube
TWP	thin walled piston
O.B.	diamond bit

C = consolidation test
M = mechanical analysis
T = triaxial shear
K = permeability
U = unconfined compression

FIELD TESTS

LABORATORY TESTS

SAMPLES

N	COND.	DEPTH		TYPE	RECOVERY
		FROM	TO		

PENETRATION
RESISTANCE
BLOWS PER FOOT

ATTERBERG
LIMITS WDX OWI

NATURAL
WATER CONTENT

REMARKS

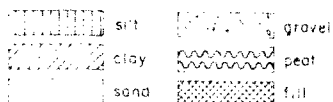
OCCASIONAL THIN LAYER
OF SAND ENCOUNTERED
IN THIS STRATUM

ARTESIAN WATER ENCOUNTERED
BETWEEN 680' AND 770'

NOTE: PENETRATION RESISTANCE AT
END OF HOLE = 460 BLOWS FOR 10"

JOB No. H 594/58 LOCATION NEAR DRUMBO - ONTARIO
 CLIENT DEPARTMENT OF HIGHWAYS - ONTARIO
 COORDINATES CH 15+08.0 OFFSET 400' LEFT OF C
 ELEV. (surface) 976.5 (collar) Datum C.H.O.
 BOREHOLE NUMBER 2
 DATE (started) 7 SEP 58 (ended) 9 SEP 58
 RIG No. 2 TYPE LONGYEAR UG ST LINE

HUNT NG TECHNICAL AND EXPLORATION SERVICES

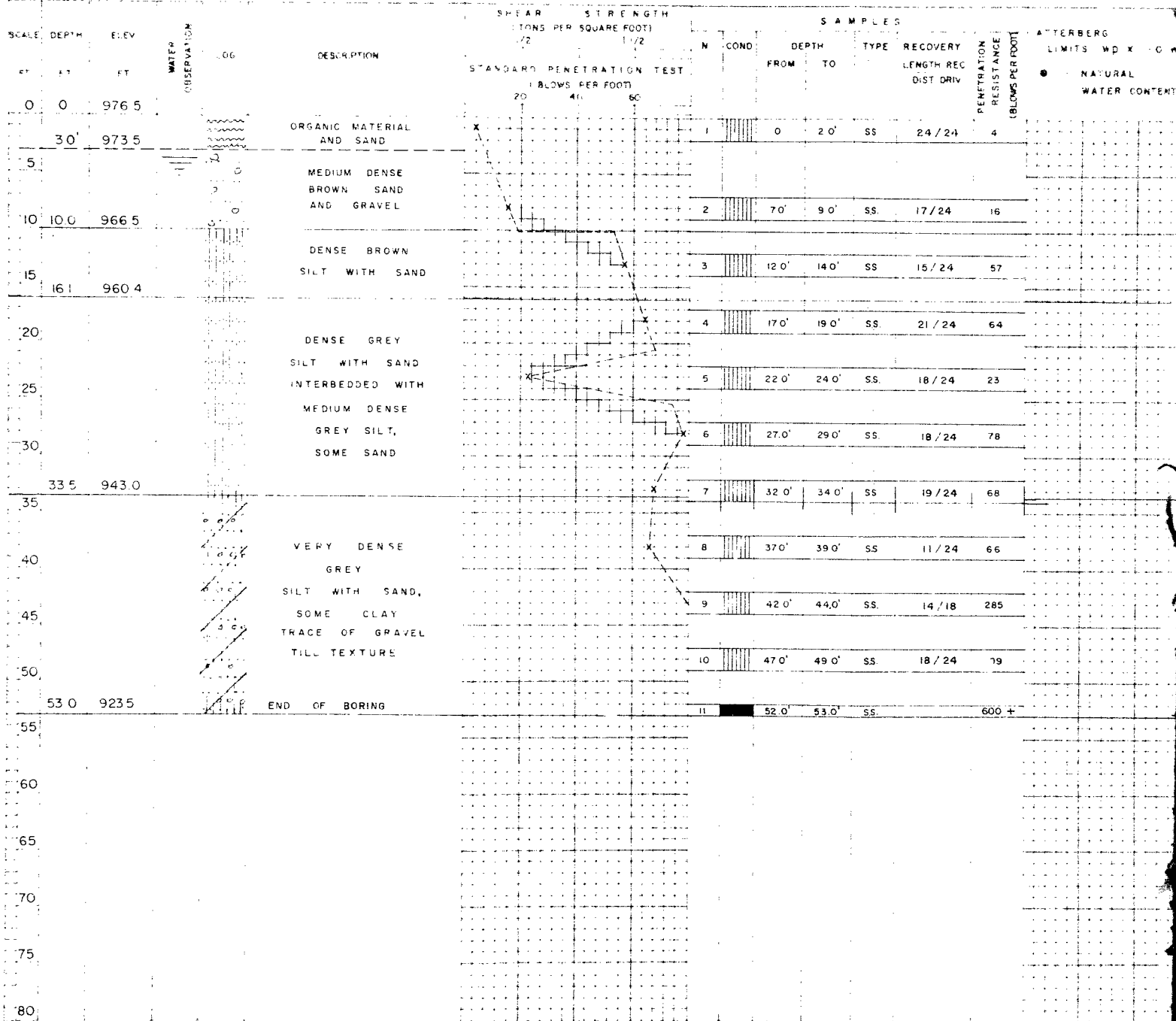


x standard penetr 2 s.s.
 Δ vane shear
 ○ pocket penetrometer

SAMPLE CONDITION
 undisturbed
 disturbed but
 represent
 fair
 0.5'

BOREHOLE LOG

FIELD TESTS



3000

11

SAMPLE COND'T CN

und storbet
disturbed but
represent
four
ast

15

split spoon
shelby tube
thin walled piston
diamond bit

C	consolidation test
M	mechanical analysis
I	internal shear
n	permeability
U	unconfined compression

FIELD TESTS

LABORATORY TESTS

SAMPLES

N COND

COND

DEPTM

TYPE

RECOVERY
LENGTH REQ
DIST. DRIV

PENETRATION
RESISTANCE

ATTERBERG

UNITED STATES OF AMERICA

● NATURAL
WATER CONTENT

REMARKS:

STANDARD PENETRATION TEST

1 BLOWS PER FOOT

20 40 60

100-10 10 10 1000

→ =

•

• • • • •





• • • • •

OCCASIONAL GRAVEL
LAYER







INCREASE IN SILT CONTENT

HUNTING TECHNICAL AND EXPLORATION SERVICES

SAMPLE CONDITION

 -- undisturbed
 — disturbed, but represent
 - - fair
 --- lost

X standard penetr. 2 s s
Δ vane shear
O pocket penetrometer

	silt		gravel
	clay		peat
	sand		fill

BORING LOG

FIELD TESTS

[illegible]

silt gravel x — standard penetr 2 s.s.
 clay peat Δ — vane shear
 sand fill o — pocket penetrometer

SAMPLE CONDITION

undisturbed
 disturbed but
 represent
 for
 lost

SS — split spoon
 ST — shelby tube
 TWP — thin walled piston
 D.B. — diamond bit




C — consolidation test
 M — mechanical analysis
 T — triaxial shear
 K — permeability
 U — unconfined compression

FIELD TESTS





LABORATORY TESTS

SHEAR STRENGTH (TONS PER SQUARE FOOT)		SAMPLES						ATTENDING		REMARKS	
1/2	1 1/2	N	COND	DEPTH FROM TO	TYPE	RECOVERY LENGTH REC DIST DRIV	PENETRATION RESISTANCE (BLOWS PER FOOT)	LIMITS Wp - Cw			
STANDARD PENETRATION TEST (BLOWS PER FOOT)											
20	40	60									
			1		0 2 0'	SS	14/24	3			
X			2		5 0' 7 0'	SS	13/24	30			
X			3		10 0' 12 0'	SS	19/24	30			
X			4		15 0' 17 0'	SS	17/24	29			
			5		20 0' 22 0'	SS	21/24	24			
X			6		25 0' 27 0'	SS	8/24	12			
X			7		30 0' 32 0'	SS	22/24	9			
			8		35 0' 37 0'	SS	19/24	30			
			9		40 0' 42 0'	SS	18/24	59			
			10		45 0' 47 0'	SS	17/24	101			
			11		50 0' 50 9'	SS	8/11	200			
			12		60 0' 60 9'	SS	11/11	320			

RIG No. TYPE LONGYEAR U G. ST. LINE

 gravel
 peat
 fill

SAMPLE CONDITION

 — undisturbed
 — disturbed but represent.
 — fair
 — lost

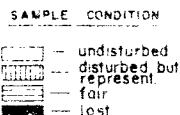
FIELD TESTS

FIELD TESTS										SAMPLES										ATTERBERG	
SCALE FT	DEPTH FT	ELEV. FT	WATER OBSERVATION	LOG	DESCRIPTION	SHEAR STRENGTH (TONS PER SQUARE FOOT)			N	COND.	DEPTH		TYPE	RECOVERY LENG., REC. DIST. DRIV.	PENETRATION RESISTANCE (BLOWS PER FOOT)	LIMITS WP X					
						STANDARD PENETRATION TEST (BLOWS PER FOOT)					FROM	TO									
						1/2	1/2	1/2													
	0	978.0				20	40	60													
	17	976.3			DECOMPOSED ORGANIC MATERIAL																
	5				DENSE BROWN SAND AND GRAVEL				1		4.4'	6.4'	SS	20/24	42						
	10																				
	13.7	964.3			MEDIUM DENSE BROWN SILT WITH SAND				2		12.9'	14.9'	SS	16/24	16						
	17.0	961.0																			
	20				MEDIUM DENSE GREY SILT WITH SAND INTERBEDDED WITH LOOSE GREY SILT, SOME SAND				3		18.3'	20.3'	S.S.	19/24	34						
	25								4		23.5'	25.5'	S.S.	18/24	24						
	30								5		28.8'	30.8'	S.S.W.		7						
	35								6		33.8'	35.8'	S.S.	21/24	15						
	40								7		38.2'	40.2'	S.S.	24/24	8						
	45	932.2							8		43.5'	45.5'	S.S.	24/24	11						
	50				VERY DENSE GREY SILT WITH SAND SOME CLAY TRACE OF GRAVEL TILL TEXTURE				9		48.0'	48.8'	S.S.	10/10							
	55								10		48.8'	50.3'	S.S.	18/18	110						
	60								11		54.0'	55.0'	S.S.	12/12	400						
	65	912.5			END OF BORING				12		64.5'	65.5'	S.S.	9.5/11.5	400						
	70																				
	75																				
	80																				

TESTING TECHNICAL AND EXPLORATION SERVICES

 BOREHOLE No. 4


x — standard penetr. 2 s.s.
 Δ — vane shear
 o — pocket penetrometer

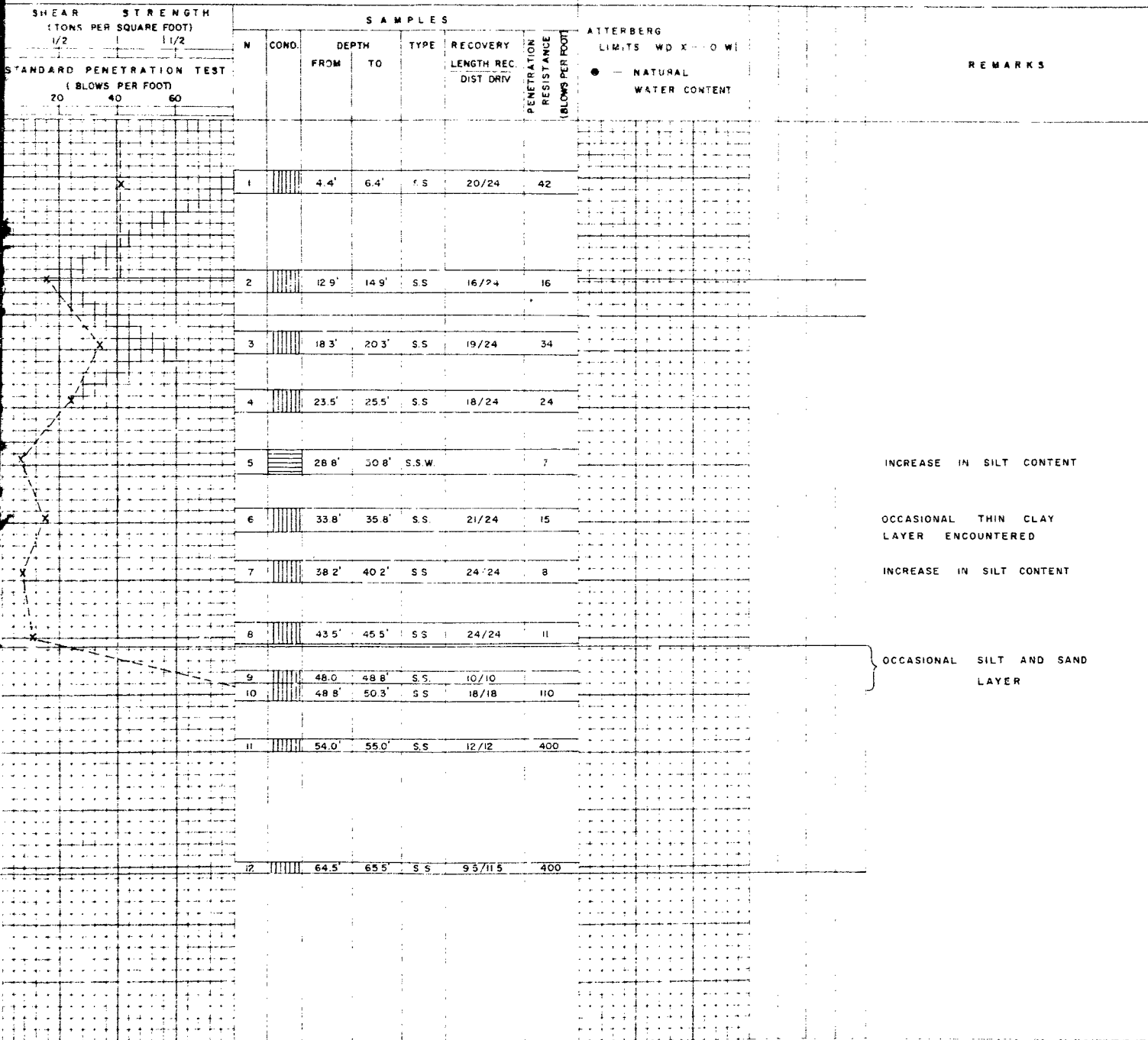


S.S.W. — side slit
 S.S. — split spoon
 S.T. — Shelby tube
 T.W.P. — thin walled piston
 D.B. — diamond bit

C — consolidation test
 M — mechanical analysis
 T — triaxial shear
 K — permeability
 U — unconfined compression

FIELD TESTS

LABORATORY TESTS



HUNTING TECHNICAL AND EXPLORATION SERVICES

SAMPLE CONDITION

..... undisturbed
 ----- disturbed but
 ----- represent.
 ----- fair
 ----- lost

S.S
S
S
TW
D

x — standard penetr. 2 s.s.
 Δ — vane shear
 ○ — pocket penetrometer

BORING LOG

FIELD TESTS

[illegible]



x --- standard penetr. 2 s.s.
 Δ --- vane shear
 ○ --- pocket penetrometer

SAMPLE CONDITION

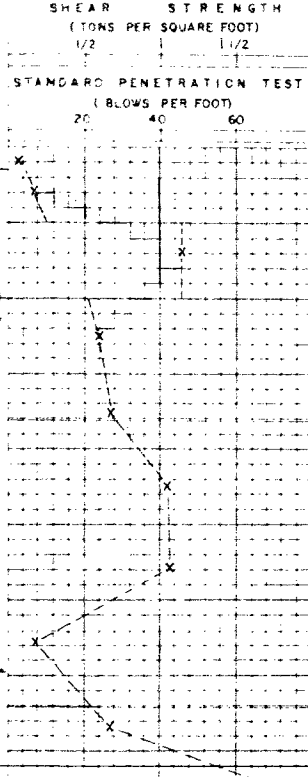
undisturbed
 disturbed but
 represent
 fair
 100%

SSW --- side slit
 SS --- split spoon
 ST --- Shelby tube
 TWP --- thin walled piston
 DB --- diamond bit

C --- consolidation test
 M --- mechanical analysis
 T --- triaxial shear
 K --- permeability
 U --- unconfined compression

FIELD TESTS

LABORATORY TESTS

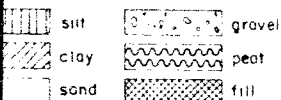
SHEAR STRENGTH (TONS PER SQUARE FOOT) 1/2 1 1/2		SAMPLES						ATTENBERG LIMITS WP X - O W		REMARKS
STANDARD PENETRATION TEST (BLOWS PER FOOT) 20 40 60		N	COND.	DEPTH FROM TO	TYPE	RECOVERY LENGTH REC DIST. DRIV	PENETRATION RESISTANCE (BLOWS PER FOOT)	● NATURAL WATER CONTENT		
		1		0' 20'	SS	14/24	3			
		2		20' 40'	SS	21/24	7			
		3		60' 80'	SS	16/24	46			
		4		115' 135'	SS	16/24	24			
		5		165' 185'	SS	18/24	27			
		6		215' 235'	SS	20/24	42			
		7		265' 285'	SS	19/24	43			
		8		319' 339'	SS	16/24	8			
		9		372' 392'	SS W		27			
		10		422' 442'	SS	13/23	97			
		11		517' 527'	SS		200			
		12		563' 571'	SS	10/10	364			

OCCASIONAL THIN CLAY
LAYER ENCOUNTERED
INCREASE IN SILT CONTENT

OCCASIONAL THIN CLAY
 LAYER ENCOUNTERED
 INCREASE IN SILT CONTENT

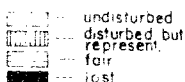
--- undisturbed
 --- disturbed but represent.
 --- fair
 --- lost

SCALE FT	DEPTH FT	ELEV. FT	WATER OBSERVATION	LOG	DESCRIPTION	SHEAR STRENGTH (TONS PER SQUARE FOOT)		SAMPLES						ATTERRBERG LIMITS ● --- NATURAL WATER CONTE	
						1/2	1 1/2	N	COND.	DEPTH FROM TO	TYPE	RECOVERY LENGTH REC DIST DRIV	PENETRATION RESISTANCE (BLOWS PER FOOT)		
0	0	978.5			ORGANIC MATERIAL			1		0'	20'	SS	18/24	6	
5	4.0	974.5			LOOSE BROWN SAND			2		50'	70'	SS	19/24	39	
10	8.5	970.0			DENSE BROWN SAND AND GRAVEL			3		112'	132'	SS	18/24	30	
15	16.4	962.1			DENSE BROWN SILT WITH SAND			4		162'	182'	SS	22/24	41	
20					DENSE GREY SILT WITH SAND			5		209'	229'	SS	22/24	35	
25					INTERBEDDED WITH LOOSE SILT, SOME SAND			6		262'	282'	SS	23/24	9	
30	32.0	946.5						7		310'	330'	SS	10/24	92	
35	34.0	944.5			TRANSITION ZONE			8		347'	363'	SS	18/18	264	
40					VERY DENSE GREY SILT WITH SAND, SOME CLAY, TRACE OF GRAVEL TILL TEXTURE			9		386'	396'	SS	12/12	147	
50								10		507'	515'	SS	9/9	248	
60	61.5	917.0			END OF BORING			11		607'	615'	SS	10/10	434	



x — standard penetr 2 s.s.
 a — vane shear
 o — pocket penetrometer

SAMPLE CONDITION



SS — split spoon
 ST — shelly tube
 TWP — thin walled piston
 DB — diamond bit

C — consolidation test
 M — mechanical analysis
 T — triaxial shear
 K — permeability
 U — unconfined compression

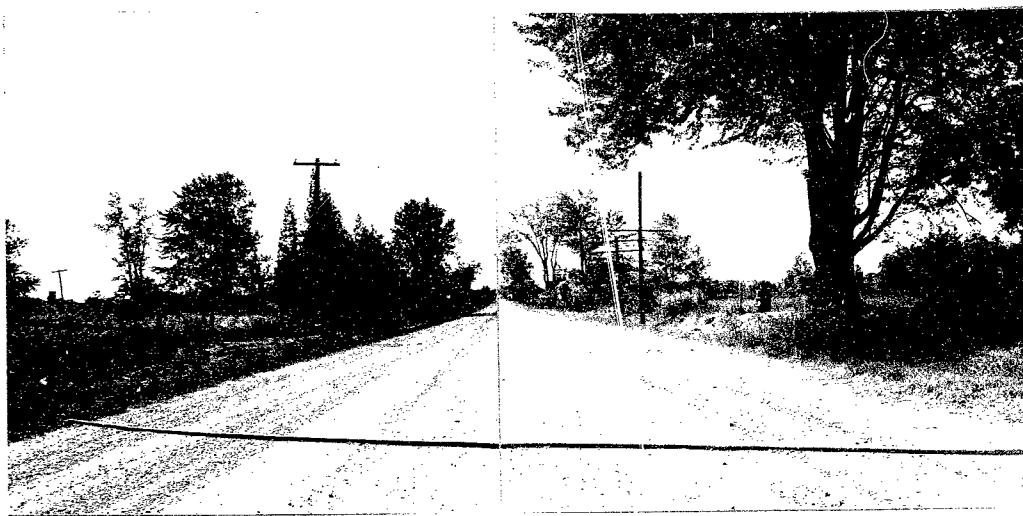
FIELD TESTS

LABORATORY TESTS

SHEAR STRENGTH (TONS PER SQUARE FOOT) 1/2		SAMPLES		RECOVERY		PENETRATION RESISTANCE (BLOWS PER FOOT)		ATTERBERG LIMITS wp x - G.W.		REMARKS
STANDARD PENETRATION TEST (BLOWS PER FOOT)		N	COND.	DEPTH FROM TO	TYPE	LENGTH REC DIST DRIV				
20	40	60								
1				0' 2' 0'	SS	18/24	6			
2				5' 0' 7' 0'	SS	19/24	39			
3				11' 2' 13' 2'	SS	18/24	30			
4				16' 2' 18' 2'	SS	22/24	41			
5				20' 9' 22' 9'	SS	22/24	35			
6				26' 2' 28' 2'	SS	23/24	9			
7				31' 0' 33' 0'	SS	10/24	92			
8				34' 7' 36' 3'	SS	18/18	264			
9				38' 6' 39' 6'	SS	12/12	147			
10				50' 7' 51' 5'	SS	9/9	248			
11				60' 7' 61' 5'	SS	10/10	433			

OCCASIONAL THIN CLAY LAYER
 ENCOUNTERED IN THIS STRATUM

1.63 Photos of Site

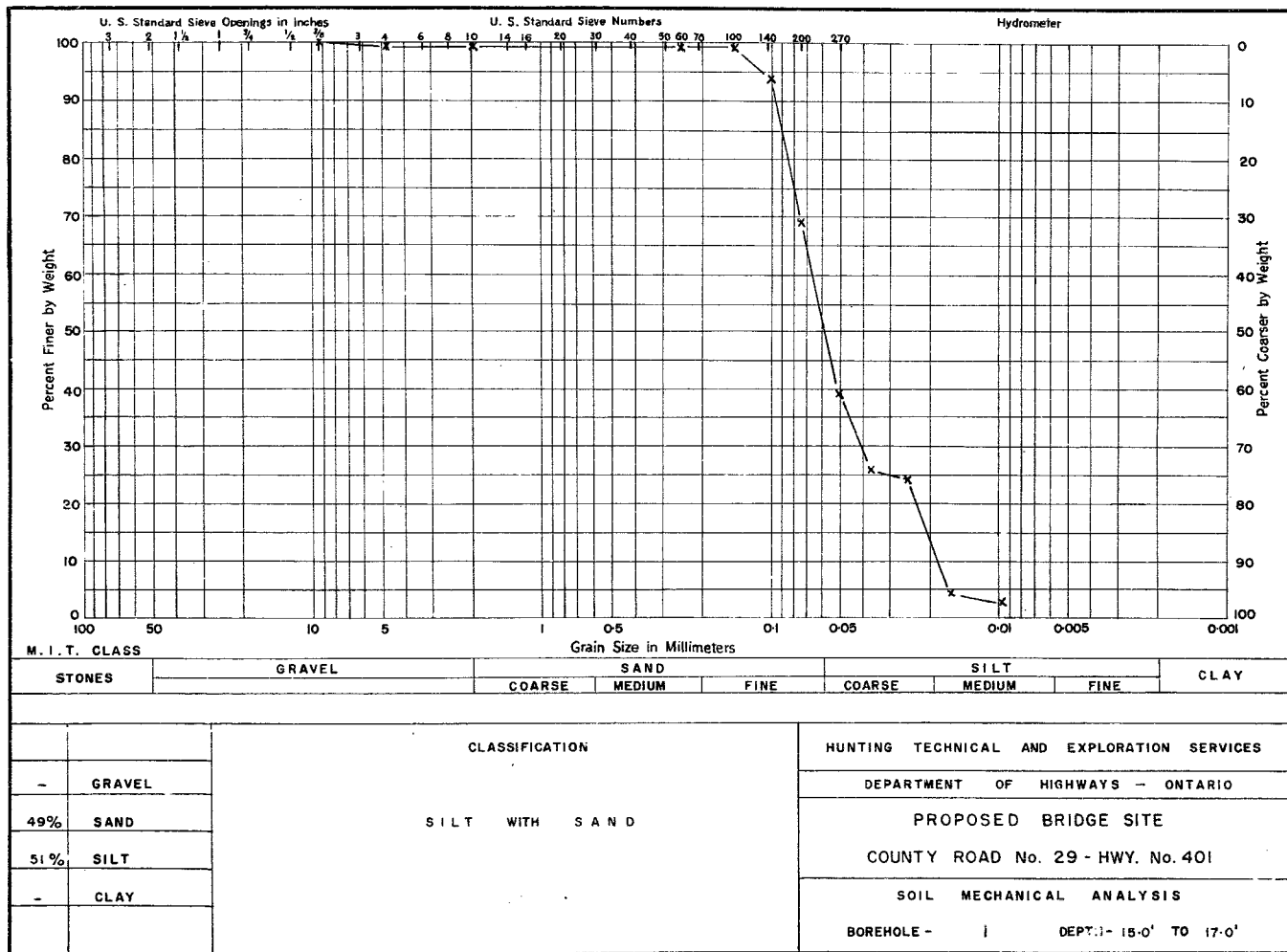


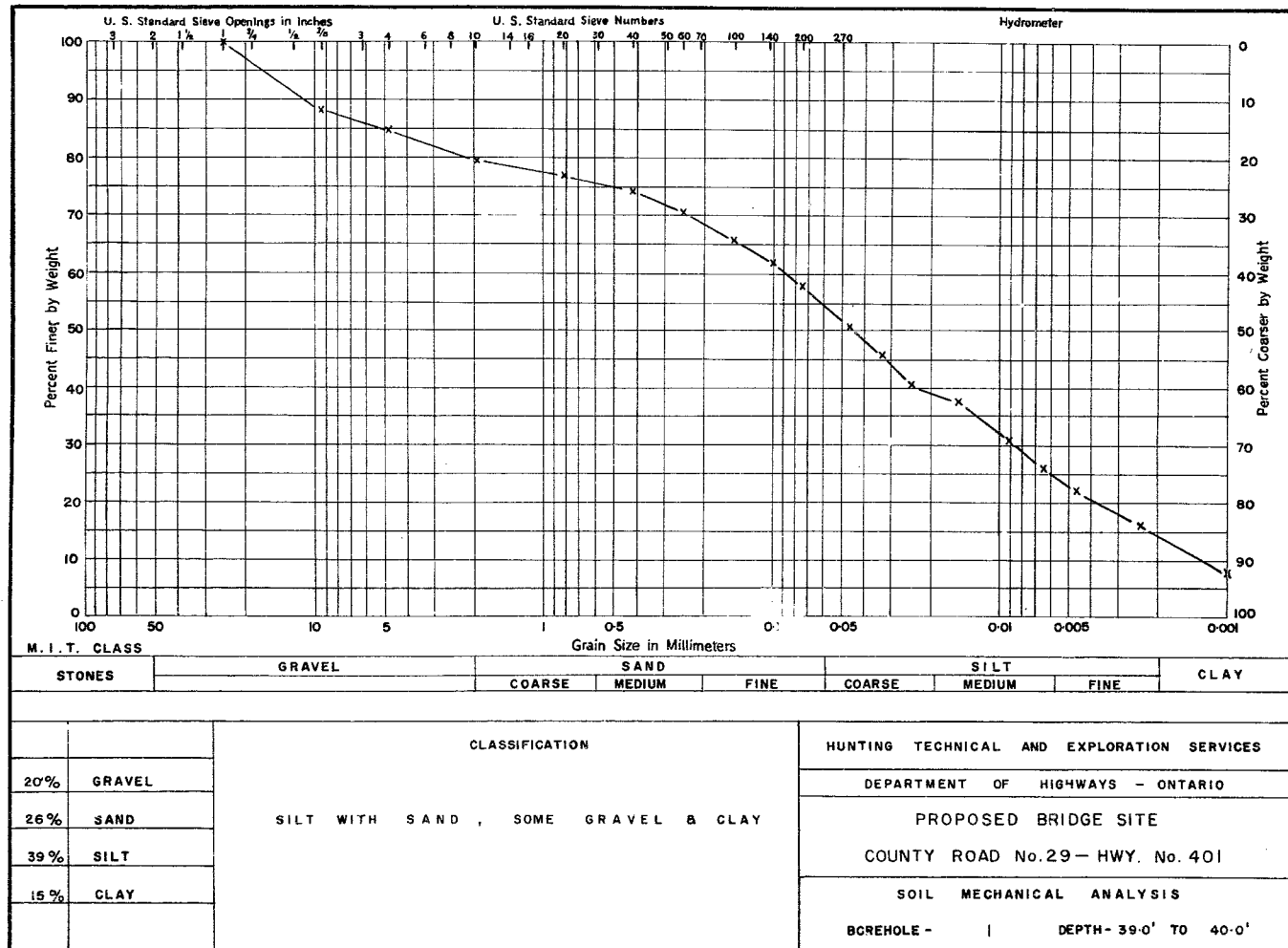
General View of Site from East Abutment looking West. Hose stretched across road represents approximate centre line Highway No. 401.

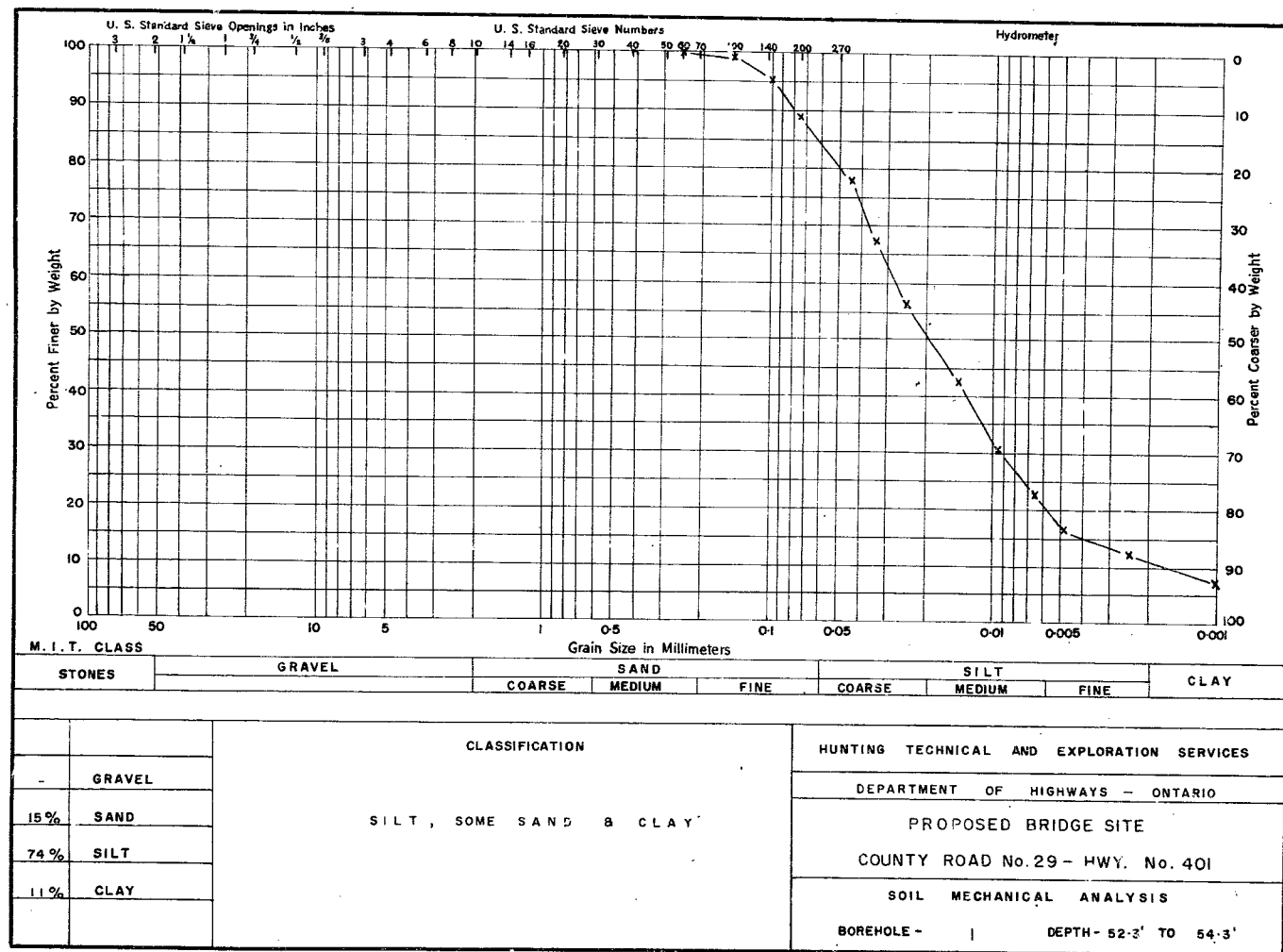


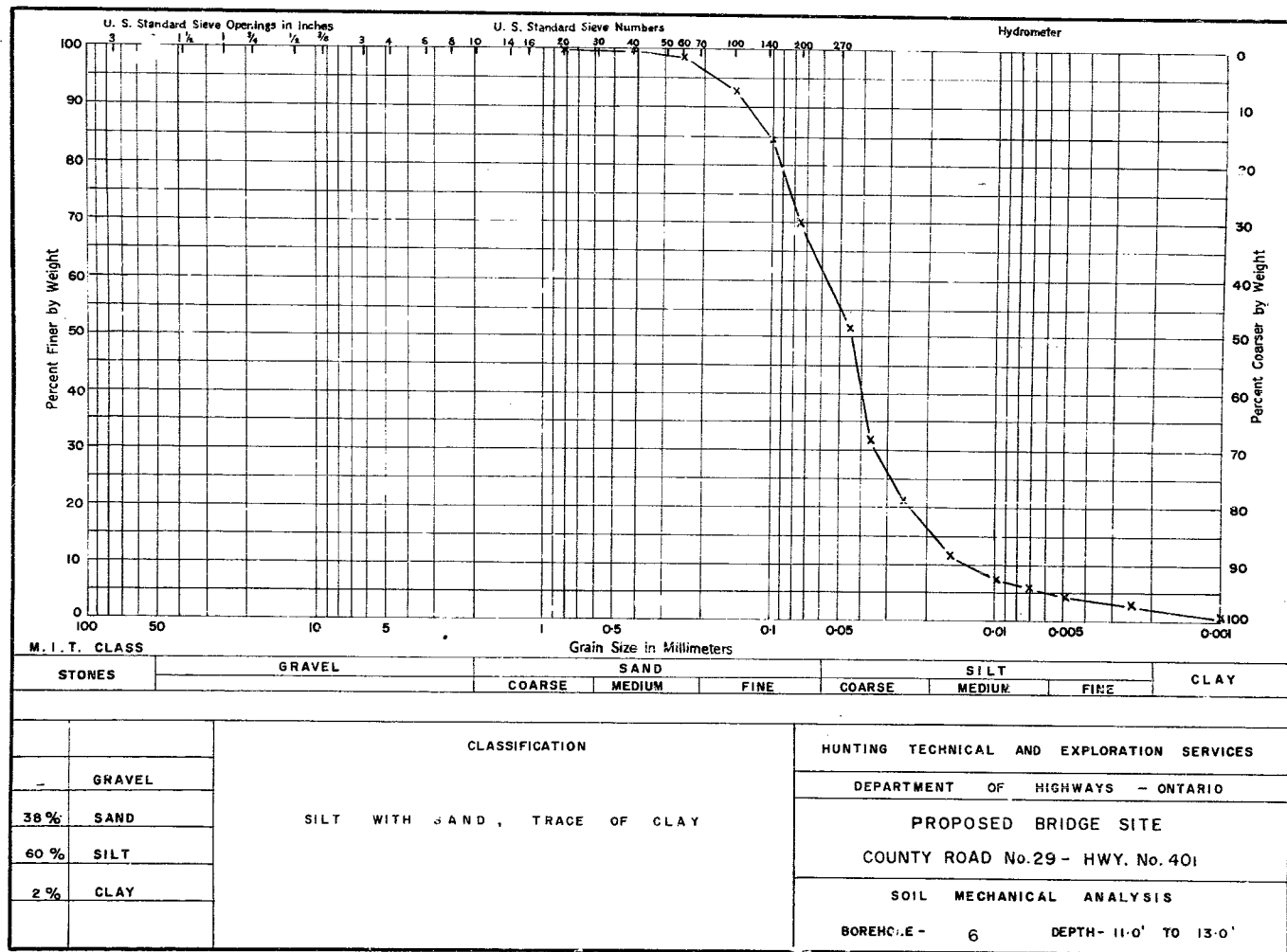
General View of Drill Set-up on borehole No. 4.

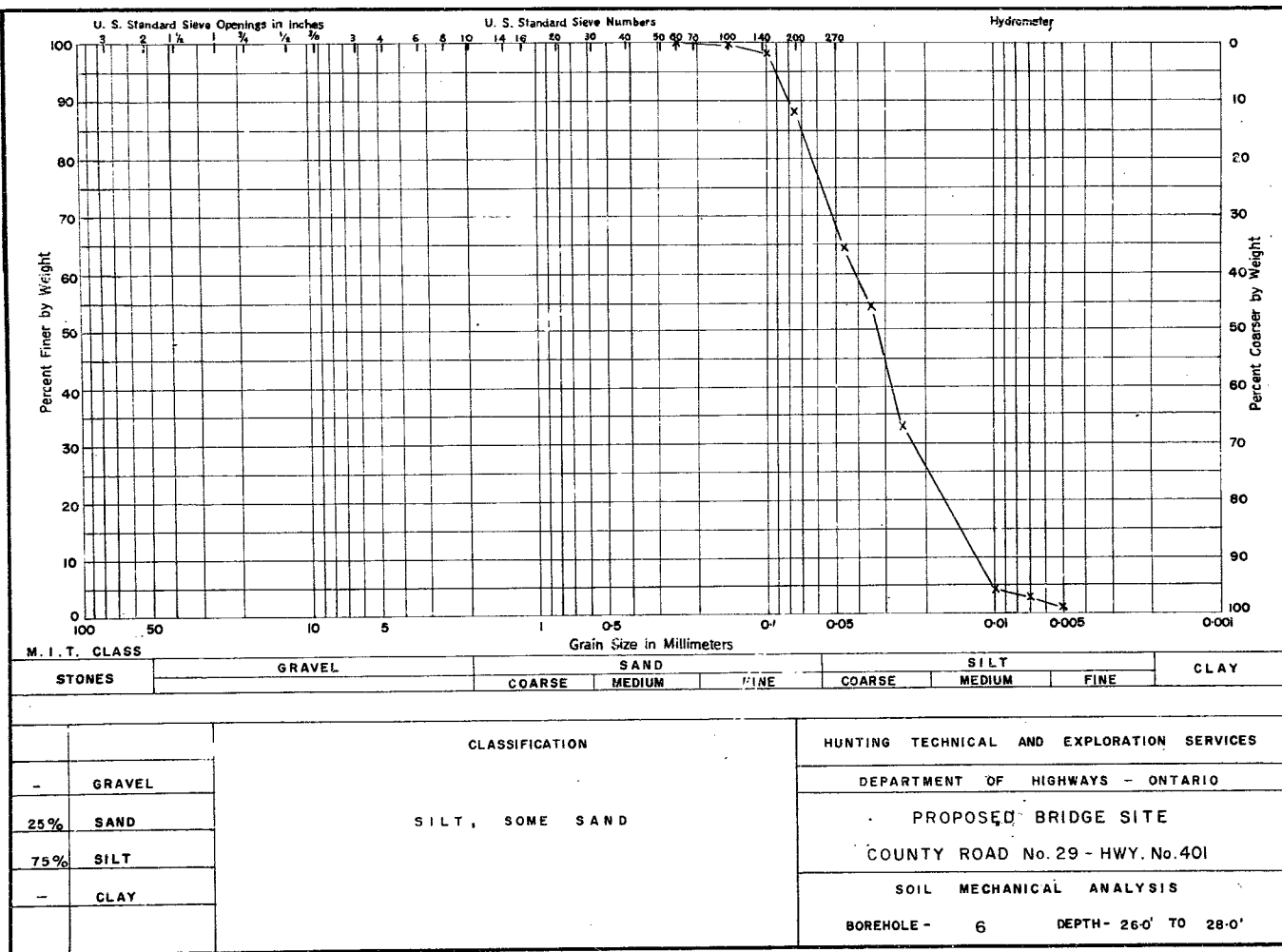
1.64 Soil Classification Charts

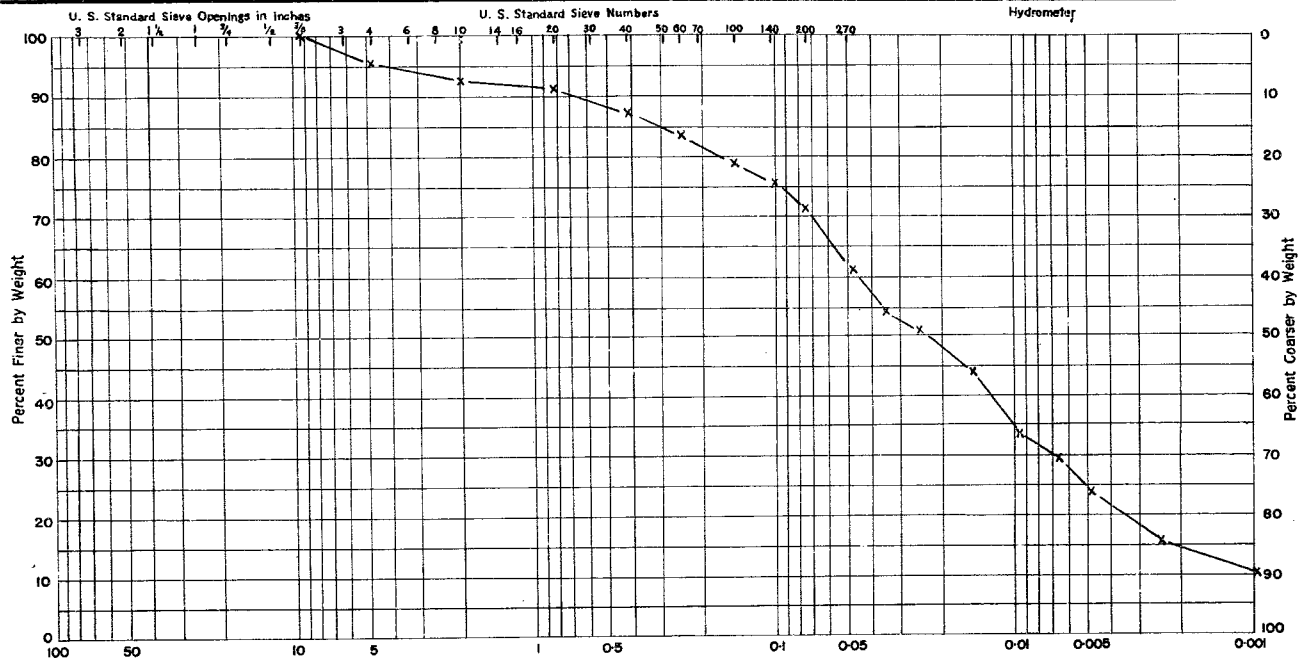












M. I. T. CLASS									
STONES	GRAVEL		SAND			SILT			CLAY
			COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	

7 %	GRAVEL
27 %	SAND
51 %	SILT
15 %	CLAY

CLASSIFICATION

SILT WITH SAND, SOME CLAY,
TRACE OF GRAVEL

HUNTING TECHNICAL AND EXPLORATION SERVICES

DEPARTMENT OF HIGHWAYS - ONTARIO

PROPOSED BRIDGE SITE
COUNTY ROAD No. 29 - HWY. No. 401

SOIL MECHANICAL ANALYSIS

BOREHOLE - 6 DEPTH - 39'-0" TO 40'-0"

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

Soils encountered in sub surface exploration for engineering purposes are composed of organic or inorganic materials, water, air and dissolved salts. The water and air are generally considered to be uniform so that identification is primarily in the nature of organic or inorganic (mineral grains) and dissolved salts.

In the field a soil is generally identified in terms of grain size characteristics, color and mineral content -- properties of the mineral grains. Occasionally, the origin of a soil is included in the identification.

The systems used to describe soils in terms of engineering properties are called classification systems. In the system described below, the soils are first identified and then classified in terms of strength characteristics which are of prime importance in utilizing the soil boring data in designing a safe and economical foundation.

Penetration measured by dropping 140 lb. hammer 30" on 2" O.D. split spoon sampler.

Identification (Soil Type)	Classification	Classification Criteria	
		Unconfined Compressive Strength	
Clay	Soft	Less than 0.50 Tons/Sq. Ft.	
	Medium	0.50 to 1.00 Tons/Sq. Ft.	
	Stiff	1.00 to 2.00 Tons/Sq. Ft.	
	Very Stiff	2.00 to 4.00 Tons/Sq. Ft.	
	Hard	Greater than 4.00 Tons/Sq. Ft.	
Silt	Loose	Density	
	Medium Dense	Less than 80 lbs./Cu. Ft.	
	Dense	80 to 95 lbs./Cu. Ft.	
Sand		Greater than 95 lbs./Cu. Ft.	
		Relative Density	Penetration Resist.
	Loose	0 - 30%	0 - 10 Blows/Ft.
	Medium Dense	30 - 60%	10 - 30 Blows/Ft.
	Dense	60 - 90%	30 - 50 Blows/Ft.
Very Dense	90 -100%	Over 50 Blows/Ft.	
Gravel	Loose	Penetration Resist.	
	Dense	Less than 30 Blows	
Hardpan		Over 30 Blows/Ft.	
		Cemented or partially cemented sandy gravels, sands, gravels with or without some clay and silt and having unconfined compression strength greater than 5 tons/sq. ft.	
Fill	Organic	Very Loose	0 - 4 Blows/Ft.
		Loose	4 - 10 Blows/Ft.
		Medium	10 - 30 Blows/Ft.
	Inorganic	Dense	30 - 50 Blows/Ft.
		Very Dense	Over 50 Blows/Ft.
Peat		Unconfined Compressive Strength	
	Very Soft	Less than 0.30 Tons/Sq. Ft.	
	Soft	0.30 to 0.60 Tons/Sq. Ft.	
	Stiff	Greater than 0.60 Tons/Sq. Ft.	
Organic Silt (Muck)	Loose	Density	
	Medium Dense	Less than 30 lbs./Cu. Ft.	
		Greater than 80 lbs./Cu. Ft.	

HUNTING TECHNICAL & EXPLORATION SERVICES

1450 O'Connor Drive Toronto, Ontario

SOIL TYPES

The following system was used in classifying the various soils by name:

100%	Predominant
	Material
50%	And
40%	With
25%	Some
10%	Trace
0%	

Example:

Medium dense grey silt with fine sand
(Penet. resist.) (colour) (pred. type) (25%-40%) (other type)
or relative density

Unless believed to have a significant effect on the soil characteristics the minor soil types (i.e. traces) present are disregarded in the name used on the boring log and cross-sections. The complete classification is given with the gradation analysis.

In all cases the strength characteristics (e.g. penetration resistance) is quoted first, followed by the colour and finally the descriptive name based on the mechanical analysis.

HUNTING TECHNICAL AND EXPLORATION SERVICES LIMITED

RESOURCES AND DEVELOPMENT STUDIES

1450 O'CONNOR DRIVE
TORONTO 16, CANADA
PLYMOUTH 5-1141

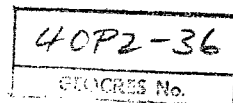
MONTREAL
VANCOUVER
CALGARY
OTTAWA

CABLES: HUNTECHNIC - TORONTO

NEW YORK
CARACAS
RIO DE JANEIRO
BUENOS AIRES

September 26th, 1958.

Mr. A. M. Tove,
Bridge Engineer,
Department of Highways - Ontario,
280 Davenport Road,
Toronto 2, Ontario.



Attention: Mr. S. McCombie.


Re: WP 186 -58 Blenheim Township, Bridge #8,
Highway #401, District #2.

Dear Sir:

Further to our telephone conversation of yesterday afternoon, we have investigated the stability of a 2:1 slope on the approach fills to the above structure and found that these slopes are safe for the foundation conditions encountered at the site.

Yours very truly,

HUNTING TECHNICAL AND EXPLORATION SERVICES LIMITED.


J. KILGOUR, P. ENG.

JK/bd.



ASSOCIATE OF THE WORLD-WIDE HUNTING GROUP