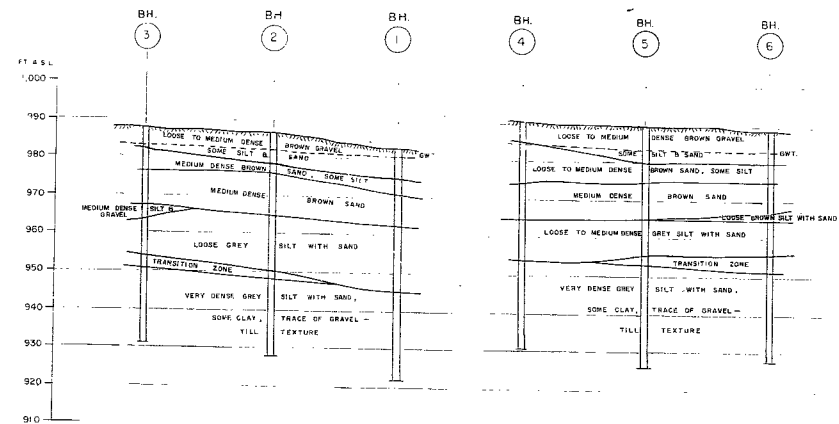
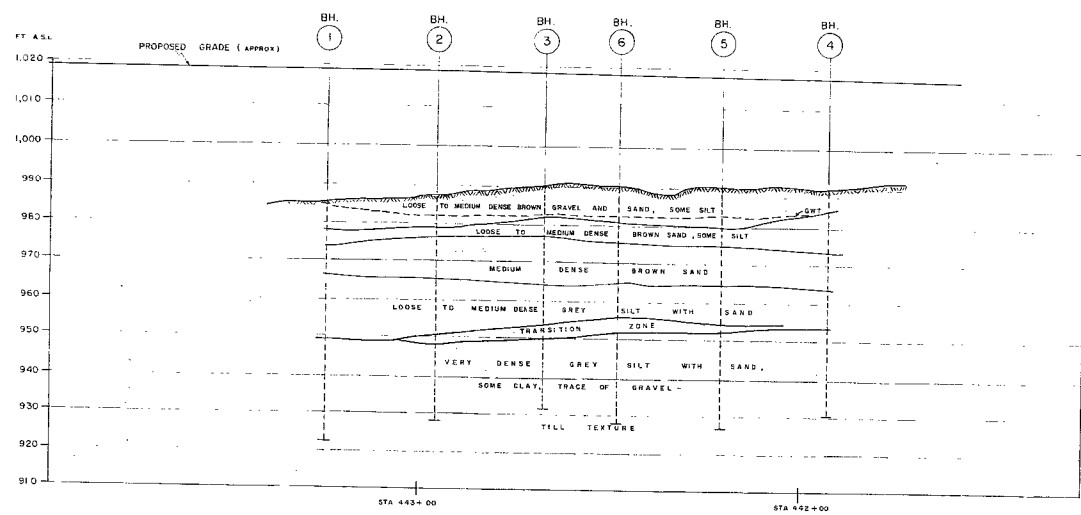
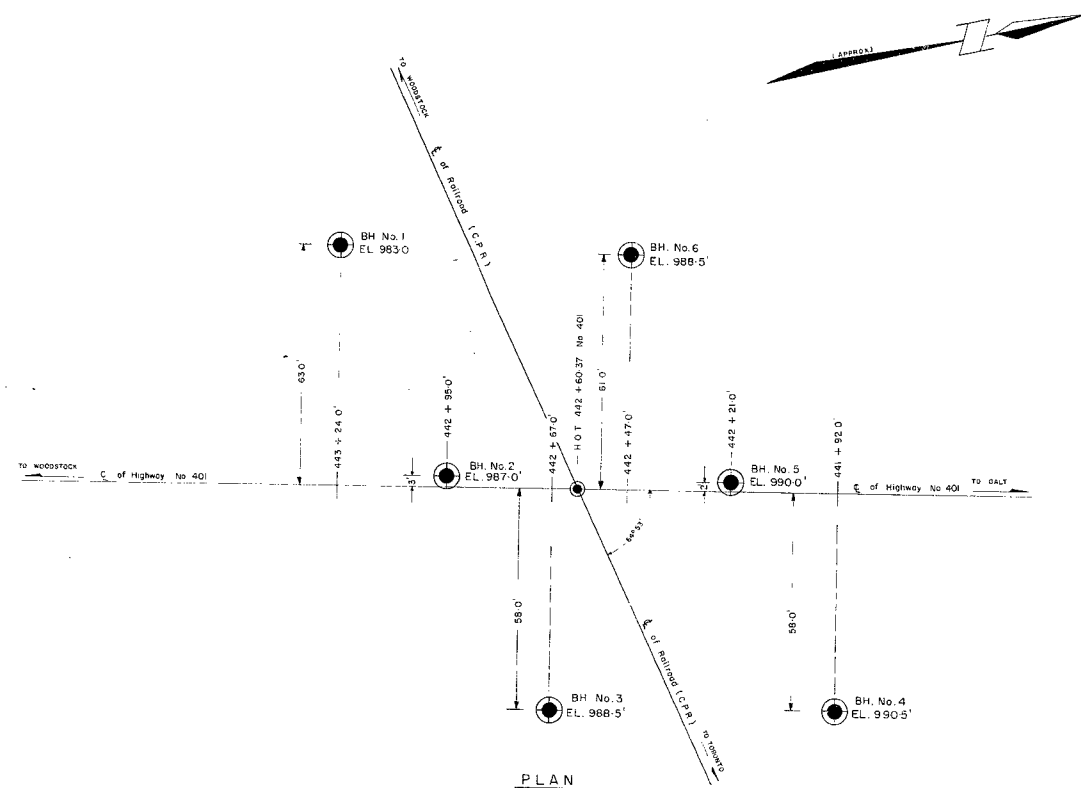


#58-F-219-C
W.P. 148-58
HWY. # 401 OVER-
HEAD, TWP. OF
BLENHEIM



SCALE - HOR. - 1" = 40'
VER. - 1" = 20'

HUNTING TECHNICAL & EXPLORATION SERVICES LTD TORONTO		
DEPARTMENT OF HIGHWAYS - ONTARIO		
LOCATION OF BOREHOLES AND SOIL PROFILES FOR PROPOSED CROSSING OF HIGHWAY No. 401 OVERPASSING C.P.R. RAILROAD, BLENHEIM TWP.		
BRIDGE SITE		
SCALE - 1 in. = 20 ft. (EXCEPT NOTED)	DRAWN BY - C / B	DATE - SEPT 1968
REFERENCE DRAWINGS - PROFILE F-3526-7 PLAN F-3526-9		

Toronto 5,
Sept. 22, 1958.

MEMORANDUM TO:

Mr. A. Rutka,
Acting Materials & Research Engineer,
Downsview, Ontario.

RE: W.P. 147-58	BA 792 Waterloo Twp. Br. #10, Hwy. #401, Dist. #4.
W.P. 150-58	BA 793 Blenheim Twp. Br. #5, Hwy. #401, Dist. #2.
W.P. 190-58	BA 795 W. Dunfries Twp. Br. #5, Hwy. #401, Dist. #2.
W.P. 182-58	BA 796 Puslinch Twp. Br. #11, Hwy. #401, Dist. #4.
W.P. 181-58	BA 798 Puslinch Twp. Br. #17, Hwy. #401, Dist. #4.
W.P. 117-58	BA 797 Puslinch Twp. Br. #19, Hwy. #401, Dist. #4.
W.P. 197-58	BA 799 Waterloo Twp. Br. #3, Hwy. #401, Dist. #4.
W.P. 207-58	BA 800 Waterloo Twp. Br. #1, Hwy. #401, Dist. #4.
X W.P. 148-58	BA 801 Blenheim Twp. Br. #9, Hwy. #401, Dist. #2.
W.P. 186-58	BA 802 Blenheim Twp. Br. #8, Hwy. #401, Dist. #2.
W.P. 189-58	BA 803 W. Dunfries Twp. Br. #8, Hwy. #401, Dist. #2.

Page - 2 -

Attached please find the above soil reports
for your file.

JCH:AMW

J. C. McAllister,
for S. McComb,
Bridge Planning Engineer.

REPORT ON FOUNDATION INVESTIGATION
FOR THE
PROPOSED CROSSING OF HIGHWAY NO. 401
OVERPASSING C. P. R. RIGHT OF WAY
TOWNSHIP OF BLENHEIM, ONTARIO

for the

DEPARTMENT OF HIGHWAYS - ONTARIO

by the

Engineering Division
HUNTING TECHNICAL AND EXPLORATION SERVICES LIMITED
Toronto, Ontario

September, 1958.

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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 Highway No. 401 overpassing the C. P. R. right of way in the Township of Elenheim 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 the C. P. R. right of way. Elevations for all boreholes were established by spirit level from B. M. 992.79 located on signal box 100-0 left of station 442+00. 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 work each borehole was marked with a large stake denoting the hole number for future reference. The locations, with reference to centre line of No. 401 Highway 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 No. 401 Highway bridge overpassing the C. P. R. Railway.

One trailer-mounted and one skid-mounted junior Longyear hydraulic head 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 the Canadian Pacific Railway right of way. The site lies in the County of Oxford, Township of Blenheim, Lot 20, Concession VI.

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. .983. The water table is not expected to vary very much from this elevation with seasonal changes in climate.

1.34 Soil Conditions

Soil conditions at the site consisted generally of fine structural types as follows:

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

The physical properties of each of these major soil types are summarized as follows in order of occurrence below ground level.

1. Loose to medium dense brown gravel , some silt and sand:

This material was encountered below ground surface in all bore-holes at the site. This soil varied considerably in texture from a gravel with 20% fines to a silt and sand with about 20% gravel. The penetration resistance was found to be quite variable due to textural changes in the bedding. The physical properties of this soil are listed below:

Average Thickness	5.3 feet
Top Elevation Range	980 feet to 989.5 feet
Bottom Elevation Range	975 feet to 985 feet
Penetration Resistance Average	15.5 blows/foot
Range	2 to 29 blows/foot

2. Loose to medium dense brown sand , some silt:

This material underlies the soil described as 1 above. This soil varied considerably in texture and was made up of numerous thin beds of fine sand and silty fine sand. In places , the silty fine layers became clayey. Elsewhere gravel was encountered with the fine sand layers. The penetration resistance varied considerably and appeared to increase in value with increases of gravel or clay content in the soil. The physical properties of this soil are

listed below:

Average Thickness	5.7 feet
Top Elevation Range	975 feet to 985 feet
Bottom Elevation Range	971 feet to 976 feet
Penetration Resistance Average	15.4 blows/foot
Range	9 to 27 blows/foot

3. Medium dense brown sand:

This material underlies the soil described as 2 above and was encountered in all boreholes. This soil for the most part was stratified into thin beds of fine to medium sand. Occasional thin beds of silty sand and of fine gravel were found throughout the stratum. The physical properties of this soil are listed below:

Average Thickness	9.6 feet
Top Elevation Range	971 feet to 977 feet
Bottom Elevation Range	963 feet to 967 feet
Penetration Resistance Average	18.5 blows/foot
Range	12 to 27 blows/foot

4. Loose to medium dense grey silt with sand:

This material was encountered in all boreholes at the site and was found to underlie the soil described in 3 above. For the most part, this soil was found to be fairly uniform, however, in borehole No. 1, some clay was encountered at a depth of about 30 feet. The physical properties of this stratum are listed below:

Average Thickness	11.8 feet
Top Elevation Range	963 feet to 965.4 feet
Bottom Elevation Range	946 feet to 956 feet

Penetration Resistance	11.4 blows/foot
Average	
Range	4 to 28 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, except for a transition zone with the overlying stratum, was found to be fairly homogeneous in density. In borehole No. 5, the soil became somewhat finer with depth. Penetration resistances were noted to become extremely high when pebbles were encountered. The physical properties of this stratum are summarized below:

Top Elevation Range	946 feet to 954.4 feet
Penetration Resistance	83 + blows/foot
Average	

Section 1.4

COMMENTS ON FOUNDATIONS OF STRUCTURE

1.41 General

Our understanding of the proposed bridge structure is that abutments are contemplated in the vicinity of chainages 442+30 and 442+90 with a skew angle of $64^{\circ}53'$ with respect to the C. P. R. right of way.

The maximum height of fill adjacent to the structure is assumed to be in the order of 35 feet.

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

1.42 Spread Footing Foundations

Consideration has been given to the possibility of placing spread footings for the base of the structure at about El. 983 which is 6 feet, more or less, below the present ground level. With a width of footing of 15 feet placed at El. 983, we have determined that the soil can safely support a load of 1.4 tons per square foot, given a safety factor of 3.

As the soil beneath the proposed elevation of the footings varies somewhat erratically from very loose to dense, it is difficult to evaluate the settlement behaviour of the structure. Although we expect differential settlement to be negligible, we would like to suggest that the design of this bridge be of a simply-supported type.

1.43 Pile Foundations

Pile foundations have also been investigated and found to be appropriate in the case where a higher design load carrying capacity is desirable.

The till material encountered below El. 952 (more or less) is expected to provide excellent support for bearing piles.

We have estimated that steel H-piles of 12 x 12 section driven to refusal into the till layer will provide a load carrying capacity of up to 45 tons per pile.

It is anticipated that hard driving may be encountered through the sand and silt. When such difficulties arise, the jetting of water down the side of the pile simultaneously with the driving may be used. All piles should be driven without jetting at least 5 feet before the required elevation is attained.

Concrete cast-in-situ piles may be used to provide design load up to 100 tons per pile. Such piles should be driven at least 5 feet into the till layer. The settlement on these piles is usually regarded as very small or negligible because of the highly compressed bulb section at the toe.

In any case, driven piles should be checked with respect to required length and allowable carrying capacity by established driving formulae or load tests.

1.44 Recommendation

1. In our opinion a satisfactory foundation for this bridge structure may be secured either by spread footings or pilings, depending on design requirements.

2. For spread footing foundation, we suggest the bottom elevation of footings be located at El. 983. This, we expect, will allow excavations to be completed above the water table.

A soil bearing capacity of 1.4 tons/sq. foot is recommended for use in design of a simply-supported type of structure.

3. If pile foundations are desirable, piles should be driven into the till layer located at more or less El. 952.

Steel H-piles of section 12 x 12, driven to refusal in the till layer are expected to provide up to 45 tons per pile.

Concrete cast-in-situ piles, driven at least 5 feet into the till layer to form highly compressed base sections may provide carrying loads up to 100 tons or more per pile.

The required length and load carrying capacity of driven piles should be checked with established driving formulae or load tests.

4. We do not envisage any stability problems in connection with the approach fills provided the top soil, consisting of decomposed organic material, has been removed.

The slope of embankments should not be made greater than 1 in

3

2:1

It is advisable to build up the fills simultaneously on both approaches.

5. When retaining walls are necessary, the footings may be designed with a soil bearing value of 1.4 tons/sq. foot. Adequate drainage facilities should be provided behind the walls.

6. It would be advisable to redetermine the elevation of the ground water table just prior to excavation so that the bottom of the footings can be kept "in the dry". Excavation below the water table is likely to result in "quick" conditions in the finer grained soils.

Section 1.5

PERSONNEL

The field work for this project was performed under the supervision of I. E. Thurber, B.Sc. and W. Naumko, M.A.Sc., P. Eng.

This report was written by A. B. MacArthur, B.A.Sc., 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

BOREHOLE No. 1

S.S.W. — side slit
S.S. — split spoon
S.T. — shelby tube
T.W.P. — thin walled piston
D.B. — diamond bit - rock core

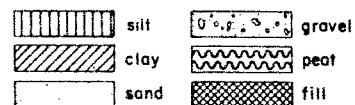
C — consolidation test
M — mechanical analysis
T — triaxial shear
K — permeability
U — unconfined compression

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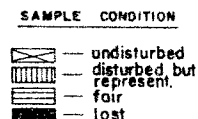
JOB No. H593/58 LOCATION NEAR DRUMBO - ONTARIO
CLIENT DEPARTMENT OF HIGHWAYS - ONTARIO
COORDINATES CH. 442 + 95' ; OFFSET 3' RT. OF C.
ELEV. (surface) 987.1 (collar) Datum D.H.O.
BOREHOLE NUMBER 2
DATE (started) (finished)
RIG No. 1 TYPE LONGYEAR JR. A.

HUNTING TECHNICAL AND EXPLORATION SERVICES

BOREHOLE No. 2



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



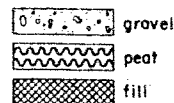
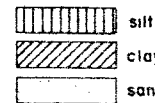
S.S.W. — side slit
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T.W.P. — thin walled piston
D.B. — diamond bit — rock core
C — consolidation test
M — mechanical analysis
T — triaxial shear
K — permeability
U — unconfined compression

BORING LOG					FIELD TESTS						LABORATORY TESTS			
SCALE	DEPTH	ELEV.	WATER OBSERVATION	LOG	DESCRIPTION	SHEAR STRENGTH (TONS PER SQUARE FOOT) 1/2 1/2	SAMPLES						ATTERBERG LIMITS wp x — o wl	REMARKS
FT.	FT.	FT.				STANDARD PENETRATION TEST (BLOWS PER FOOT) 20 40 60	No.	COND.	DEPTH FROM TO	RECOVERY LENGTH REC. DIST. DRIV.	PENETRATION RESISTANCE (BLOWS PER FOOT)			
0	0	987.1			ORGANIC MATERIAL AND SAND		1		10 1.5	S.S.	2			
5					LOOSE TO MEDIUM DENSE BROWN GRAVEL SOME SILT AND SAND		2		2.5 4.0	S.S.	6			BOULDER FROM 1.5' TO 2.5'
10	8.0	979.1			MEDIUM DENSE BROWN SAND, SOME SILT		3		5.5 7.0	S.S.	15 / 18	21		
15					MEDIUM DENSE BROWN SAND		4		10.0 11.5	S.S.	15 / 18	19		OCCASIONAL THIN SILT LAYER
20							5		15.0 16.5	SSW.		15		
25	21.7	965.4					6		20.0 21.5	S.S.	14 / 18	26		SILTY GRAVEL LAYER 19.6' TO 20.2'
30					LOOSE TO MEDIUM DENSE GREY SILT WITH SAND		7		25.0 26.5	S.S.	14 / 18	6		
35							8		30.0 31.5	S.S.	8 / 18	4		
40	36.1	951.0			TRANSITION ZONE		9		35.0 36.5	S.S.	11 / 18	15		
45	38.5	948.6			VERY DENSE GREY		10		40.0 41.5	S.S.	8 / 18	126		
50					SILT WITH SAND SOME CLAY		11		48.0 49.5	S.S.	13 / 18	200		
55					TRACE OF GRAVEL — TILL TEXTURE									
60	58.4	928.7			END OF BORING		12		58.0 58.4	S.S.	5 / 5	200		

JOB No. H 593/58 LOCATION NEAR DRUMBO - ONTARIO
CLIENT DEPARTMENT OF HIGHWAYS - ONTARIO
COORDINATES CH. 442 + 67.0 ; OFFSET 58.0' L. OF d
ELEV. (surface) 988.5 (collar) Datum O.H.O.
BOREHOLE NUMBER 3
DATE (started) (finished)
R/G No. 1 TYPE LONGYEAR J.N.A

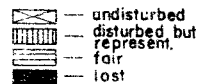
HUNTING TECHNICAL AND EXPLORATION SERVICES

BOREHOLE No. 3



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

SAMPLE CONDITION



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

BORING LOG

FIELD TESTS

LABORATORY TESTS

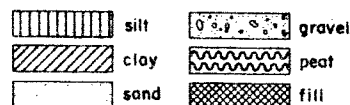
SCALE	DEPTH	ELEV	WATER OBSERVATION	LOG	DESCRIPTION	SHEAR STRENGTH (TONS PER SQUARE FOOT)		SAMPLES						ATTERBERG LIMITS wp x — o w!		REMARKS
						1/2	1 1/2	No.	COND.	DEPTH FROM TO	TYPE	RECOVERY LENGTH REC. DIST. DRIV	PENETRATION RESISTANCE (BLOWS PER FOOT)			
0	0	988.5														
	1.3	987.2			DECOMPOSED ORGANIC MATERIAL LOOSE TO MEDIUM DENSE BROWN GRAVEL, SOME SILT & SAND			1		0	1.5	S.S.	10/18	2		
5	5.5	983.0			MEDIUM DENSE TO LOOSE BROWN SAND, SOME SILT			2		5.0	6.5	S.S.	10/18	22		
10	11.1	977.4						3		10.0	11.5	S.S.	18/18	9		
15					MEDIUM DENSE BROWN SAND			4		15.0	16.5	S.S.W.		17		
20	21.0	987.0						5		20.0	21.5	S.S.	8/18	27		
25	24.0	964.5			MEDIUM DENSE SILT AND GRAVEL			6		25.0	26.5	S.S.	16/18	5		
30					LOOSE GREY SILT WITH SAND			7		30.0	31.5	S.S.	15/18	4		
35	37.0	951.5			TRANSITION PHASE			8		35.0	36.5	S.S.	14/18	43		
40					VERY DENSE GREY SILT WITH SAND SOME CLAY TRACE OF GRAVEL TILL TEXTURE			9		39.0	40.0	S.S.	10/12	250		
50								10		50.0	51.0	S.S.	6/12	206		
55	56.2	932.3			END OF BORING			11		55.0	56.2	S.S.	13/14	250		
60																
65																
70																
75																
80																

PENETRATION RESISTANCE = 12 BLOWS/FT.
PENETRATION RESISTANCE = 27 BLOWS/FT.

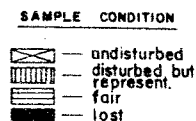
JOB No. H593/58 LOCATION NEAR DRUMBO, ONTARIO
 CLIENT DEPARTMENT OF HIGHWAYS - ONTARIO
 COORDINATES CH. 441 + 72', OFFSET 58 L. OF C
 ELEV. (surface) 990.5 (collar) Datum D.H.O.
 BOREHOLE NUMBER 4
 DATE (started) (finished)
 RIG No. 2 TYPE LONGYEAR JR. A

HUNTING TECHNICAL AND EXPLORATION SERVICES

BOREHOLE No. 4



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







S.S.W. — side slit
 S.S. — split spoon
 ST. — Shelby tube
 T.W.P. — thin walled piston
 D.B. — diamond bit-rock core
 C — consolidation test
 M — mechanical analysis
 T — triaxial shear
 K — permeability
 U — unconfined compression

BORING LOG					FIELD TESTS							LABORATORY TESTS					
SCALE FT.	DEPTH FT.	ELEV. FT.	WATER OBSERVATION	LOG	DESCRIPTION	SHEAR STRENGTH (TONS PER SQUARE FOOT)			SAMPLES							ATTERBERG LIMITS wp x — o wl ● — NATURAL WATER CONTENT	REMARKS
						1/2	1 1/2	STANDARD PENETRATION TEST X (BLOWS PER FOOT)	No.	COND.	DEPTH		TYPE	RECOVERY LENGTH REC. DIST. DRIV. %	PENETRATION RESISTANCE (BLOWS PER FOOT)		
											FROM	TO					
0	0	990.5															
					TOPSOIL												
5	5.5	985.0			MEDIUM DENSE BROWN SAND AND GRAVEL TRACE OF ORGANIC				1		1-0	2-5	S.S.	17 / 18	12		
10					MEDIUM DENSE BROWN SAND, SOME SILT				2		5-0	6-5	S.S.	12 / 18	15		
15									3		9-9	11-4	S.S.	12 / 18	22		
20	16-0	974.5			MEDIUM DENSE BROWN SAND				4		15-1	16-6	S.S.	13 / 18	29		GRAVEL STRATUM
25									5		20-1	21-6	SSW.		19		
30	25-8	964.7			MEDIUM DENSE GREY SILT WITH SAND				6		25-0	26-5	S.S.	14 / 18	43		GRAVEL STRATUM
35									7		30-0	31-5	S.S.	13 / 18	17		
40	36-1	954.4			VERY DENSE GREY SILT WITH SAND SOME CLAY TRACE OF GRAVEL — TILL TEXTURE				8		35-0	36-5	S.S.	16 / 18			PENETRATION RESISTANCE = 28 BLOWS/FOOT PENETRATION RESISTANCE = 81 " "
45									9		40-2	41-7	S.S.	14 / 18	268		
50									10		46-0	47-5	S.S.	14 / 18	234		
55									11		52-0	53-5	S.S.	13 / 18	215		
60	59-5	931.0			END OF BOREHOLE				12		58-0	59-5	S.S.	12 / 18	346		

BOREHOLE No. 5

SAMPLE CONDITION

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

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





[illegible]

JOB No. H 593 / 58 LOCATION NEAR DRUMBO, ONTARIO
CLIENT DEPARTMENT OF HIGHWAYS, - ONTARIO
COORDINATES CH. 15 + 39.0', OFFSET 38.0' RT. OF +
ELEV. (surface) 988.5 (collar) _____ Datum D.H.O.
BOREHOLE NUMBER _____ 6
DATE (started) _____ (finished) _____
RIG No. 2 TYPE LONGYEAR JR. A

	silt		gravel
	clay		peat
	sand		fill

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

SAMPLE CONDITION

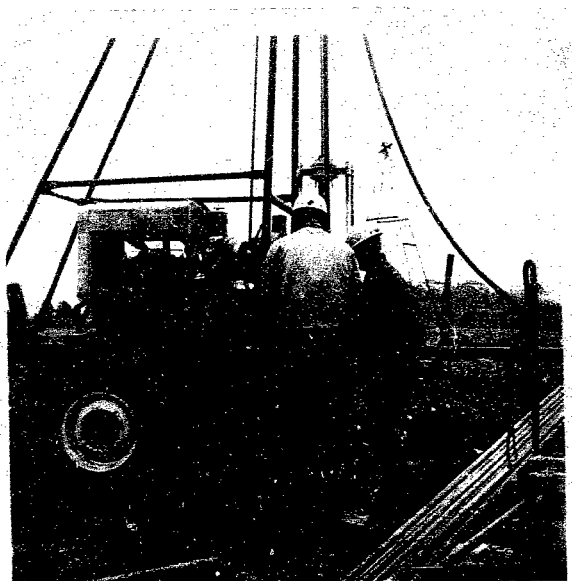
	undisturbed
	disturbed but represent.
	fair
	lost

S.S. — split spoon
ST. — shelby tube
T.W.P. — thin walled piston
D.B. — diamond bit

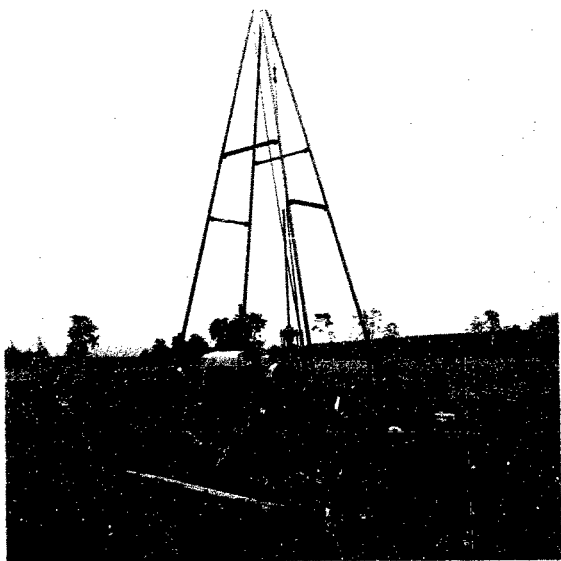
C — consolidation test
M — mechanical analysis
T — triaxial shear
K — permeability
U — unconfined compression

[illegible]

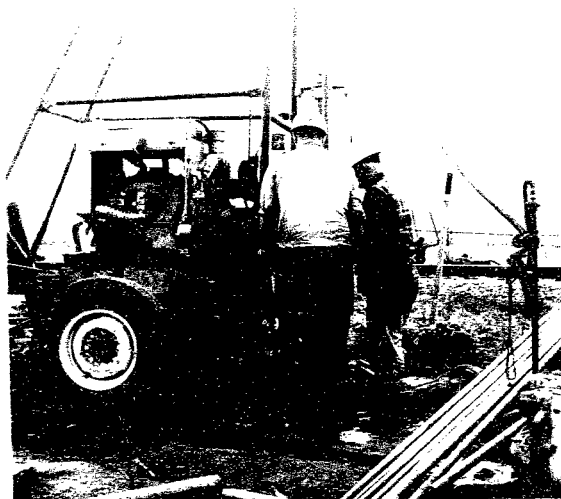
1.63 Photos of Site



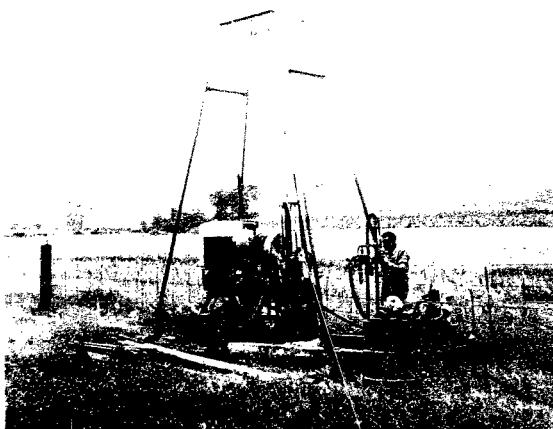
General View of Drill Set-up on borehole No. 5.



General View of Drill Set-up on borehole No. 3.

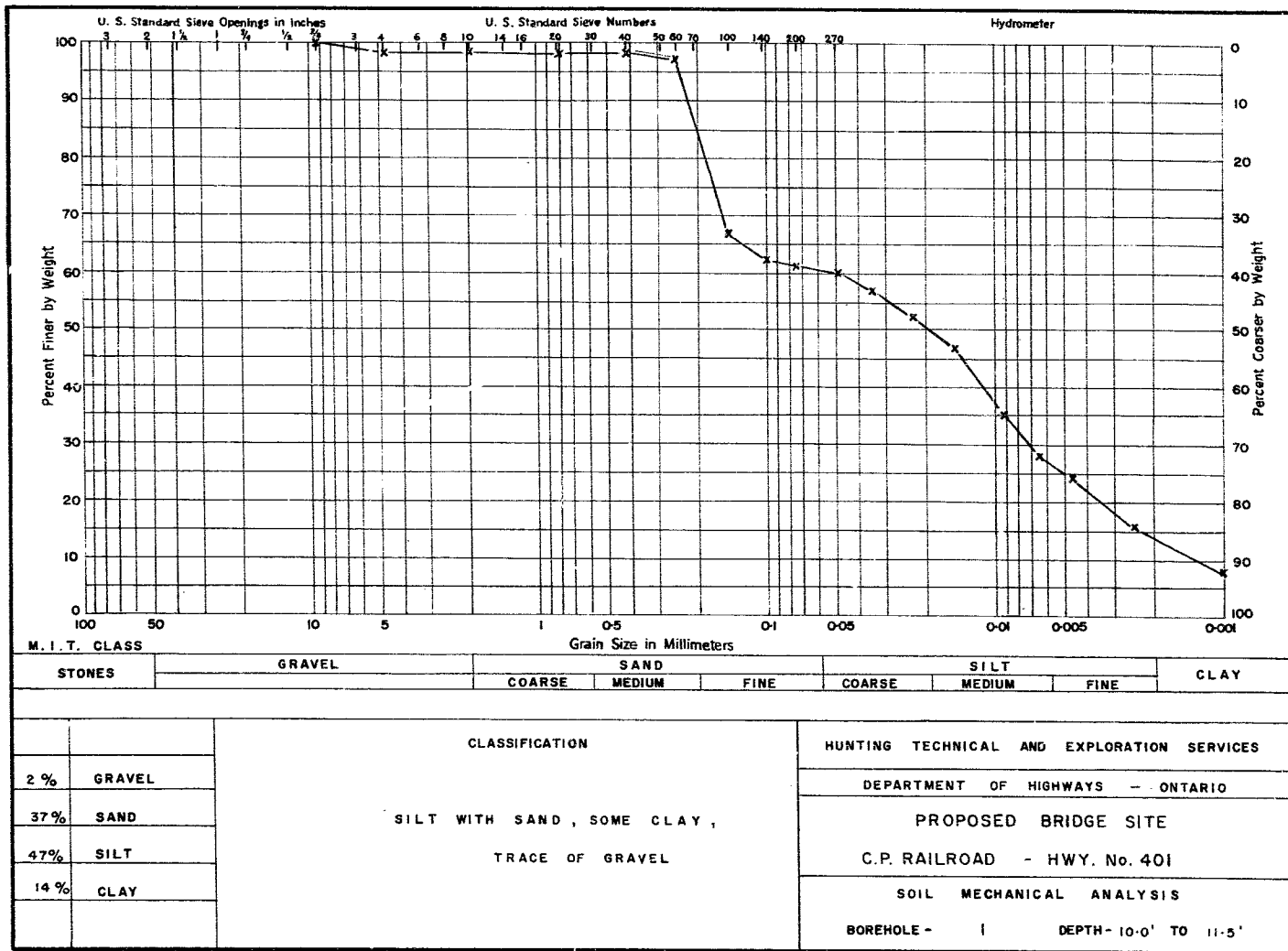


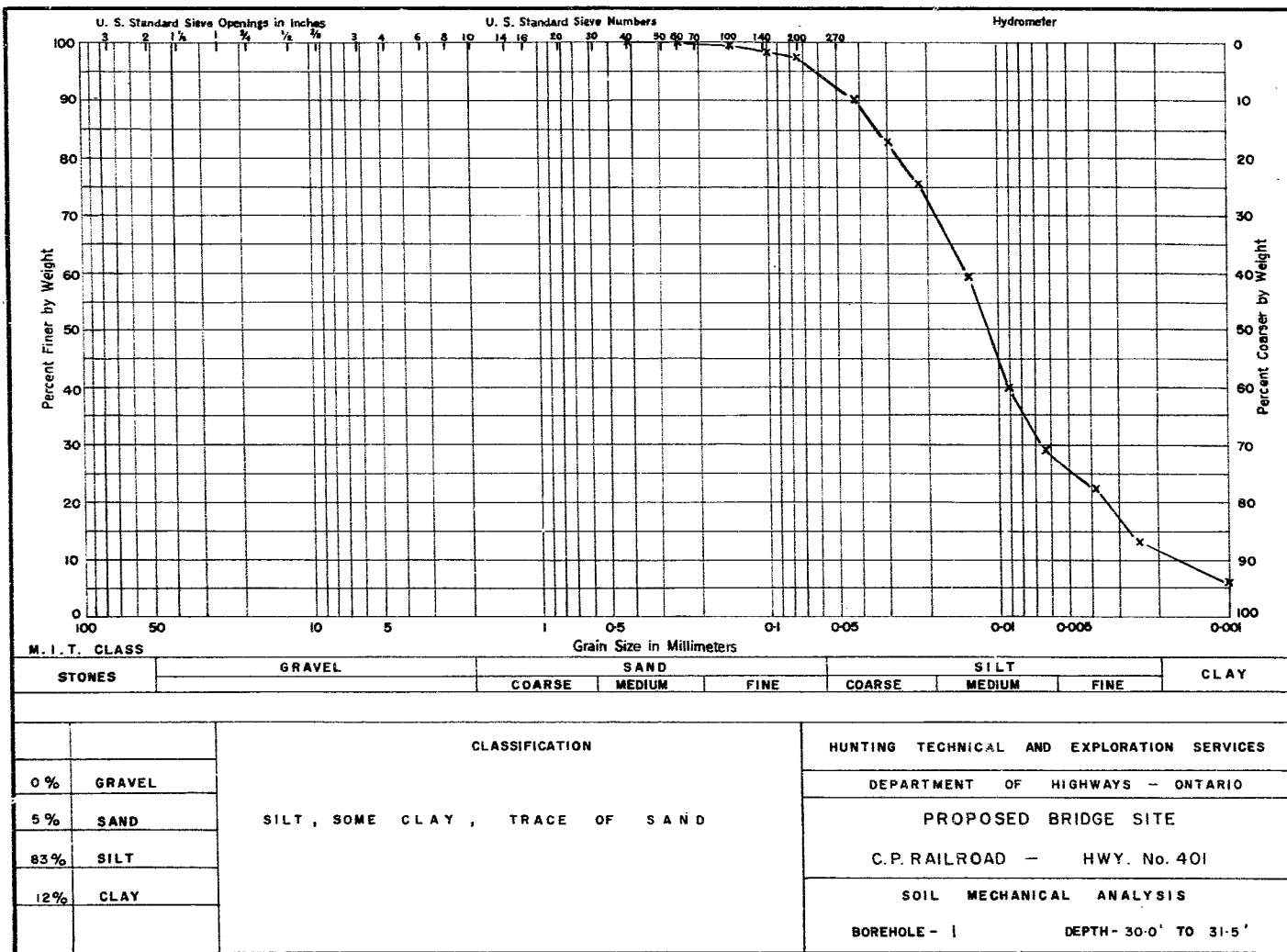
General View of Drill Set-up on borehole No. 5.

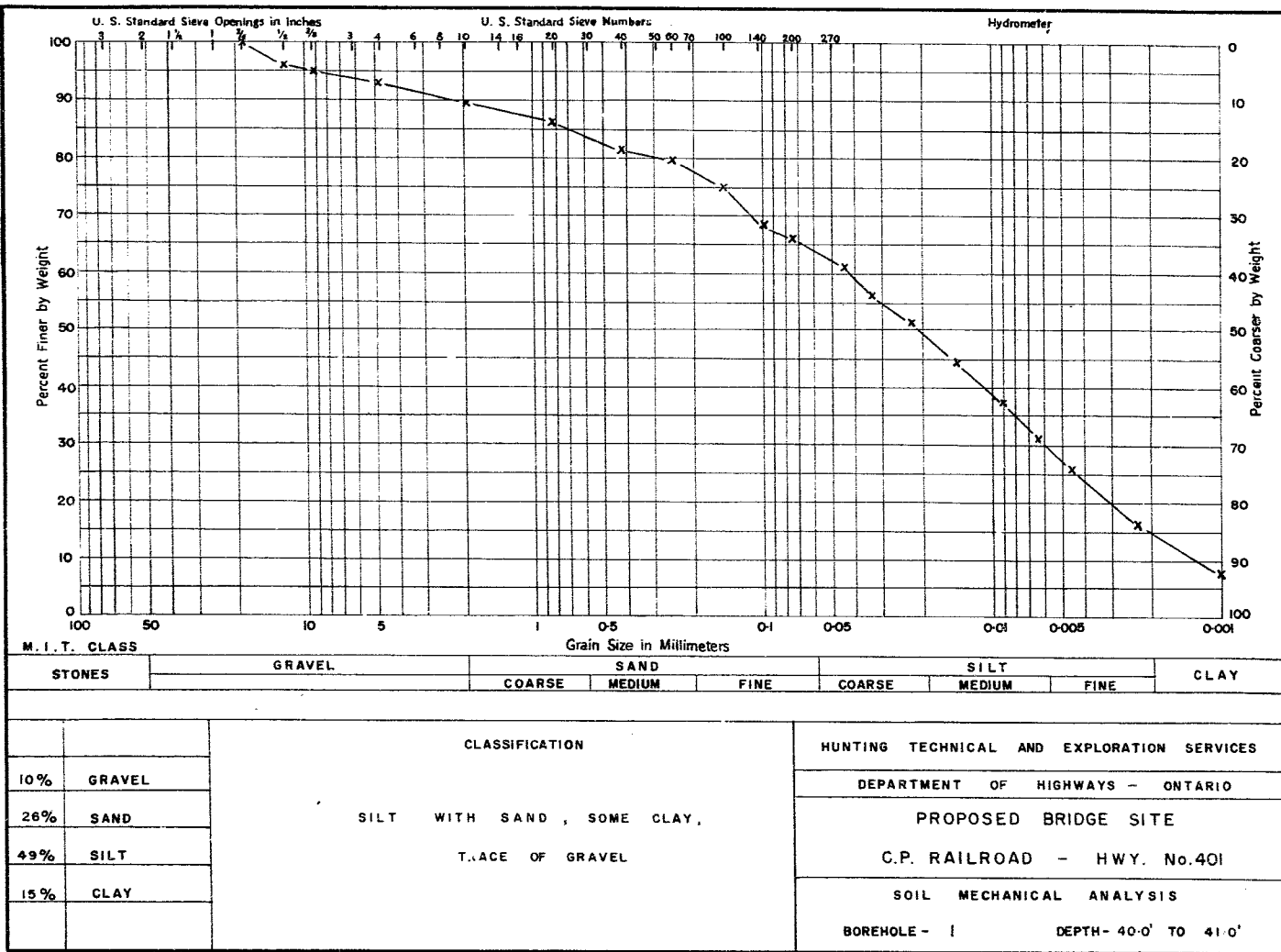


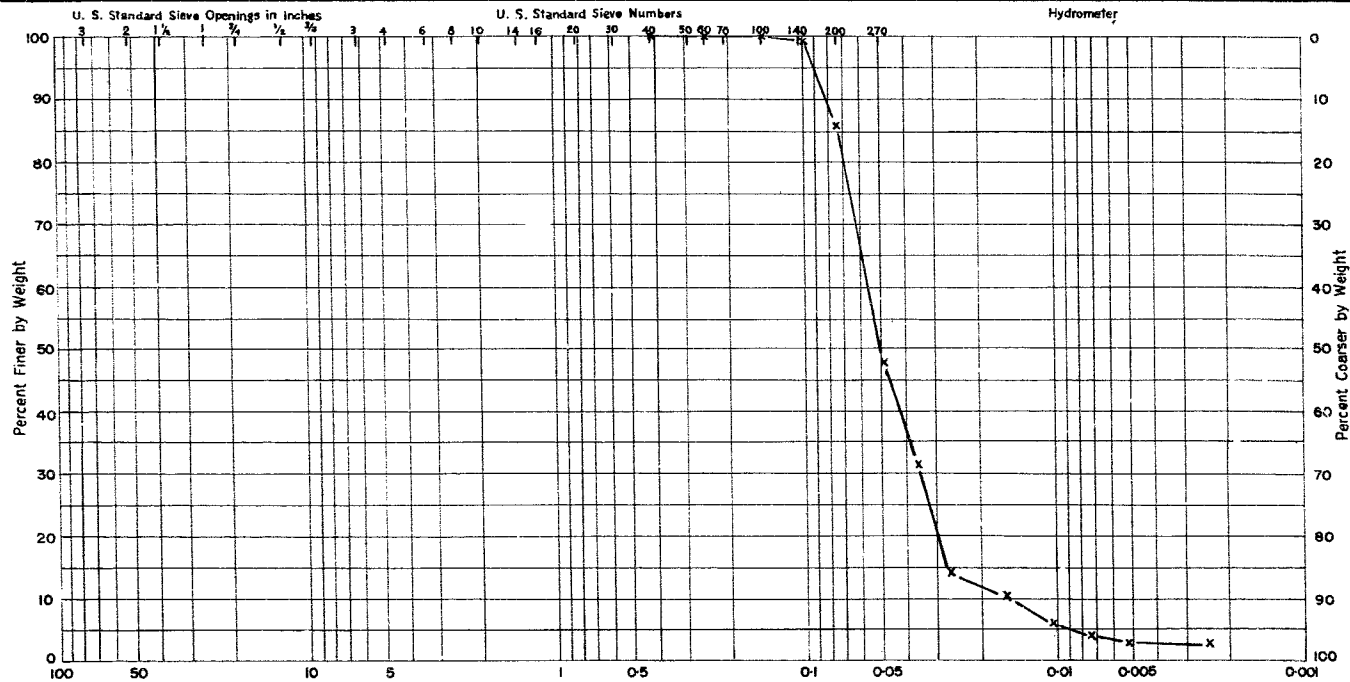
General View of Drill Set-up on borehole No. 3.

1.64 Soil Classification Charts



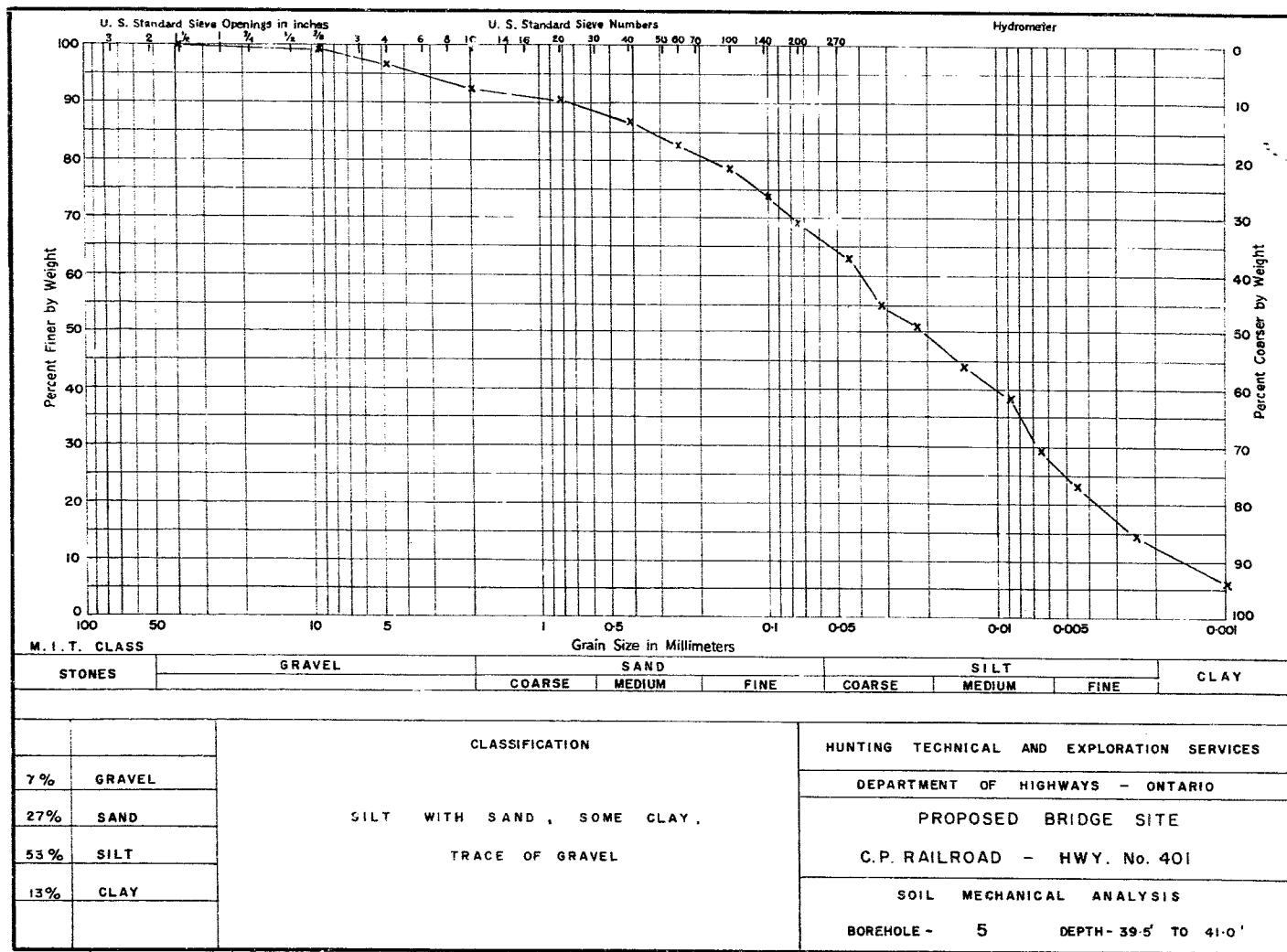


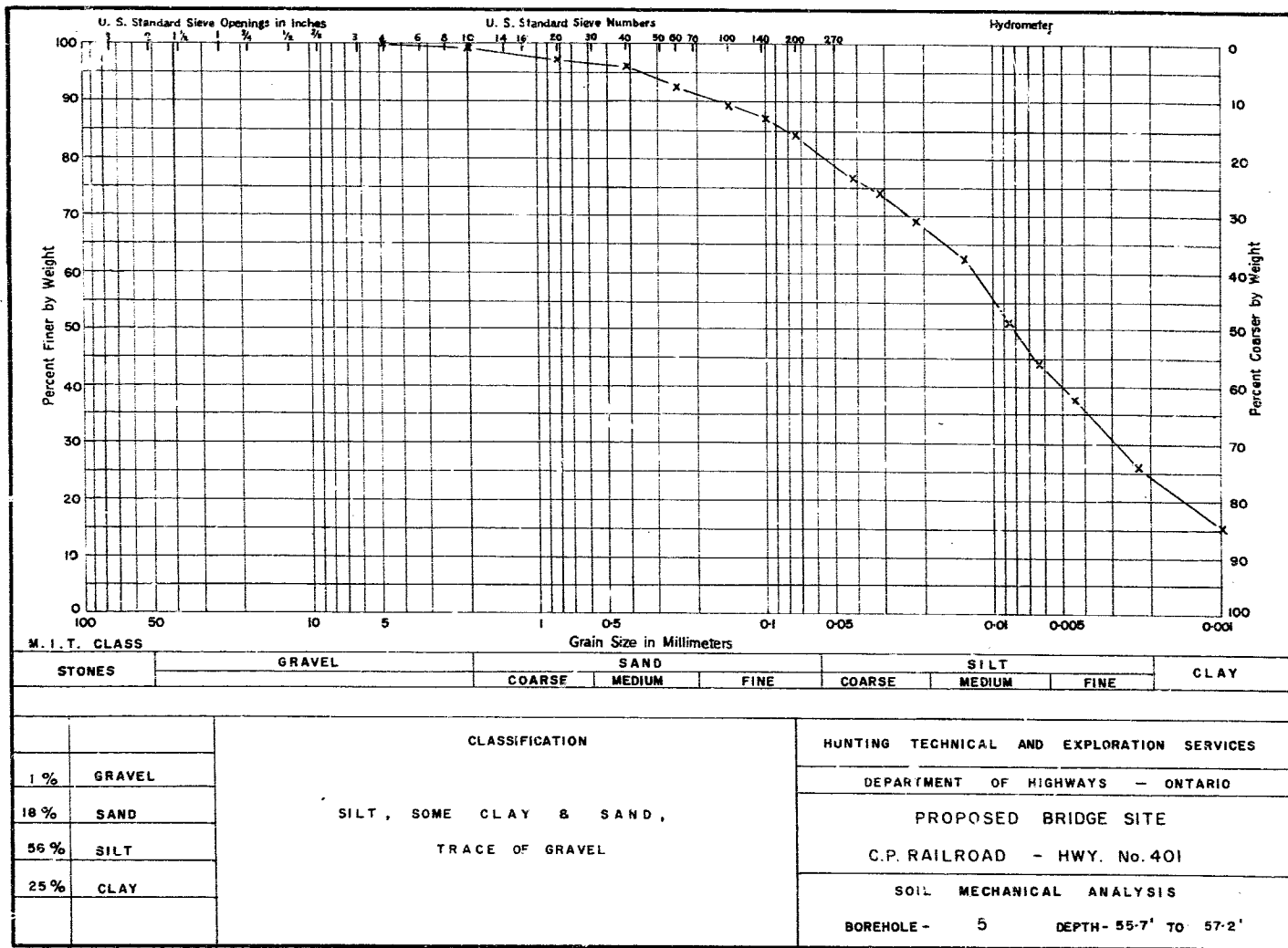




M. I. T. CLASS		Grain Size in Millimeters						
STONES	GRAVEL	SAND			SILT			CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	

		CLASSIFICATION	HUNTING TECHNICAL AND EXPLORATION SERVICES	
0 %	GRAVEL		DEPARTMENT OF HIGHWAYS - ONTARIO	
34 %	SAND		PROPOSED BRIDGE SITE	
63 %	SILT		C.P. RAILROAD - HWY. No. 401	
3 %	CLAY		SOIL MECHANICAL ANALYSIS	
		SILT WITH SAND, TRACE OF CLAY	BOREHOLE - 5	DEPTH - 29-7' TO 31-2'





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.

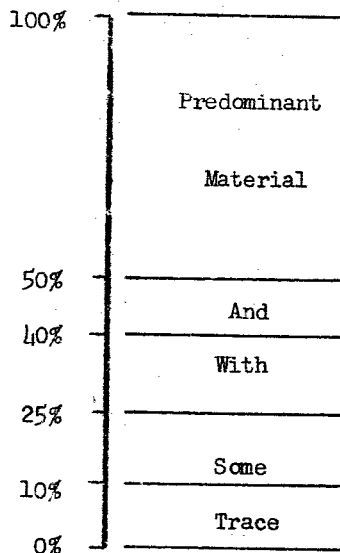
Identification (Soil Type)	Classification	<u>Classification Criteria</u>	
		Unconfined Compressive Strength	
Clay	Soft	Less than 0.50 Tons/Sq. Ft.	
	Medium	0.50 to 1.00 Tons/Sq. Ft.	
	Stiff	1.00 to 2.00 Tons/Sq. Ft.	
	Very Stiff	2.00 to 4.00 Tons/Sq. Ft.	
	Hard	Greater than 4.00 Tons/Sq. Ft.	
Silt		<u>Density</u>	
	Loose	Less than 80 lbs./Cu. Ft.	
	Medium Dense	80 to 95 lbs./Cu. Ft.	
	Dense	Greater than 95 lbs./Cu. Ft.	
Sand		<u>Relative Density</u>	<u>Penetration Resist.</u>
	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			<u>Penetration Resist.</u>
	Loose		Less than 30 Blows
	Dense		Over 30 Blows/Ft.
Hardpan		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.
		<u>Unconfined Compressive Strength</u>	
Peat	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)		<u>Density</u>	
	Loose	Less than 30 lbs./Cu. Ft.	
	Medium Dense	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:



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.