#58-F-217-C

COLLINS CK. BRIDGE, NEAR KINGSTON

PRELIMINARY SITE INVESTIGATION

for the

PROPOSED COLLINS CREEK BRIDGE ON HIGHWAY #401

near

KINGSTON, ONTARIO

for the

DEPARTMENT OF HIGHWAYS - ONTARIO

by the

Engineering Division

HUNTING TECHNICAL AND EXPLORATION SERVICES LIMITED

Toronto, Ontario

June, 1958

ORDER OF CONTENTS

SECTION 1.1

PURPOSE OF REPORT

1.11 General

The purpose of this report is to present the results of a subsurface soil investigation for the proposed Collins Creek bridge on Highway #401 near Kingston, Ontario.

The investigation consisted of two parts;

a) Foundation for the bridge

b) Foundation of the fill approaches.

SECTION 1.2

DISCUSSION OF PROCEDURES

1.21 Location of Boreholes

The borehole locations for this investigation were established from center line stakes placed by Department of Highways surveyors on both sides of Collins Creek. Ground elevations at the boreholes were obtained from the bridge site plan. At the completion of the work each borehole was marked with a large stake denoting the hole number for future reference. The borehole locations are shown on the plan in Appendix 1.51.

1.22 Subsurface Drilling and Sampling

A primary program specified by the client, of 6 soil borings was initiated at the site of the proposed Collins Creek bridge. The program was later enlarged to include 2 additional holes to cover the bridge approach fill foundations.

A skid mounted, hydraulic head Junior Longyear and a trailer mounted, hydraulic head Junior Longyear diamond drilling rig were used on this project. All boring and sampling operations were completed by experienced soil sampling crews under the supervision of a geologist and engineer experienced in soil sampling procedures.

All soil borings were performed by the standard wash boring procedure. By this method, drill casing was driven into the soil by a 250 lb. hammer to a depth of 5 feet or change in strata. All the contained soil was thoroughly washed out to the bottom of the casing. Sampling tools were then lowered on the end of the rods to the bottom of the hole. The sample was then taken and the sampling tools removed from the hole. An additional 5 foot length of casing was added and the procedure repeated.

In the cohensionless soils, an attempt was made to obtain samples 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 penetration with the split spoon sampler. Special care had to be taken to avoid sand rising in the casing and even then, the sand often rose in the bottom of the casing for approximately 6 inches. This sometimes caused the split spoon to jam in the casing during driving and distorted the results of the standard penetration tests. When this happened, it was noted on the borehole log. When necessary, samples for identification and correlation were obtained with a side slit sample or from the wash water.

"Undisturbed" samples were taken in 2 inch Shelby Tubes which were pushed into the soil and extracted. In order that samples with a minimum of disturbance might be obtained for laboratory consolidation tests, a hydraulically operated 3 inch Osterberg piston sampler was used. All tube samples were classified, tagged and sealed immediately upon recovery from the hole.

Undisturbed and remolded in situ vane shear tests were conducted in the cohesive soils using 2 inch and 3 inch diameter vanes. Pocket penetrometer tests were performed on all cohesive soils. The results of these tests are shown on the borehole logs.

1.23 Water Observation and Surface Drainage

Water levels in the boreholes were measured after all the boreholes were completed on June 6th, 1958.

After pulling the casing from Hole #4, the hole bacame a flowing well that provided clear, odourless, tasteless water.

The flat topography together with the poor internal drainage of the area keeps most of the precipitation in the 12 to 18 inch thick topsoil layer, where it is protected from evaporation.

1.24 Soil Testing

All disturbed samples, i.e. split spoon samples, side slit samples and wash samples were visually examined and classified on the site, then placed in jars and brought to the engineering office. Selective disturbed and undisturbed samples from each strata were forwarded to the laboratory as a check on the visual field classification, and for unconfined compression and consolidation tests.

The results of all tests are given in the Appendices.

The laboratory tests were performed by:

Prof. W. L. Sagar,
University of Toronto.

SECTION 1.3

DISCUSSION OF SITE

1.31 Geographic Location

The bridge site is located in the Kingston district of the Department of Highways - Ontario at the proposed crossing of Highway No. 401 and Collins Creek.

1.32 Bedrock Geology

Collins Creek valley is bounded by a horizontally bedded limestone bedrock under a very shallow overburden cover (generally in the order of 2 feet deep). This rock is expected to extend under the valley below the lacustrine and glacial filling.

1.33 Overburden Geology

The landform in the vicinity of the site is that of a partly filled glacial valley in a limestone bedrock. The valley is approximately 2000 feet wide in the vicinity of the site. The soil strata in the valley represent glacial, glacio-fluvial and glacio-lacustrine depositional periods.

1.34 Soil Conditions

Soil conditions encountered at the site consisted generally of three structural types which overlaid bedrock in the following order:

1) Very dense, silty grey till
2) Medium dense grey sand and gravel
3) Soft to medium grey clay.

The physical properties of the major soil types at the site are summarized below in order of their occurrence above bedrock.

1. Very Dense Silty Grey Till

This stratum was encountered in all boreholes thus is presumed to underlie the entire site area. The till is a coarse silty soil relatively low in clay and gravel size fractions. It has an average penetration resistance on the standard split spoon of about 100 blows per foot and a top elevation range of from 219 feet to 238 feet.

2. Medium Dense Grey Sand and Gravel

This stratum overlies the till over most of the site area. It was encountered in all boreholes except number 7. The stratum varies in thickness in the boreholes from 5 feet to 13 feet with a top elevation range of from 230 feet to 245 feet. The penetration resistance of the layer varied from 16 to 35 blows per foot.

The soil in this stratum varies in texture from a coarse silt with fine sand to a coarse sand with fine gravel, however it is predominately a silty medium sand.

3. Soft to Medium Grey Clay

This stratum overlies the entire site area in depths ranging from 35 feet to 50 feet. It consists predominately of a soft grey clay with silty varves, however the top 3 to 4 feet of the layer have been desiccated or otherwise altered so that it has a higher shearing strength. The field vane shear tests indicate that the soft clay has a sensitivity of 4 whereas laboratory completely remolded samples are in the order of 10.*

Representative Osterberg limits of this stratum are shown in the appendix.

* Compare National Research Council paper 4490 "Field Vane Apparatus in Sensitive Clay", March, 1958.

1.35 Comments

Our understanding of the initial bridge design is that abutments are contemplated at approximately chainages 237+75 and 238+05. The approaches to the bridge are to be made on fill, contained and protected by wing walls. Except for the granular backfill at the bridge, the approaches are expected to be constructed for the greater part of limestone from the adjacent rock cut sections.

With reference to this proposal, we would like to make the following comments for your consideration.

1) Structures:

a) Considering the possibility of using spread footings for the base of abutments and wing walls, we estimate the safe soil pressure (with a surcharge of 5 feet) to be in the order of 700 lbs. per square foot. It can therefore be concluded that the soil does not have adequate bearing capacity for this type of foundation, not considering the settlement to be expected under consolidation of the load.

b) It will be necessary to support the bridge abutment on piles. H piles could be used if it were decided to get the support from the very dense till. However, precast concrete piles or wood piles could probably be driven to refusal in the silty medium sand and gravel overlying the till. No friction support should be assumed for the soft silty clay and consolidation under the approach fill load may in time even increase the load on the piles.

Horizontal loads on the piles should be kept to an absolute minimum because the thick soft clay and silt may gradually give way to even small horizontal loads. Moreover, the lateral earth pressures developed in the subsoil below the abutment footing due to the vertical load produced by the backfill will tend to act as a horizontal load on the piles. Our preliminary investigation indicates that fills much greater than 10 feet in height adjacent to the structure will tend to cause progressive movement of the subsoil around the piles. However, as it is understood that the approach fill at the structure will be only 10 feet high, no progressive movement is to be expected. In our opinion, all horizontal loads can be adequately handled by the use of batter piles.

B. Approach Fills

Slope stability computations for base failute of the approach fill were carried out. Our investigations indicate that no stability problems are to be expected with fills up to 10 feet high. With fills of from 10 to 15 feet in height, it will be necessary to provide stabilizing berms 3 feet high and 45 feet wide on each side of the fill.

Considering that the approach fill at the structure will be about 10 feet high, a differential settlement between the structure and the top of the fill should be expected not to exceed 3 inches.

During construction, care should be taken so that the firm crust at the top of the clay layer is not disturbed. The use of heavy equipment in even slightly wet periods should be avoided. In order to avoid local stress conditions which may damage the firm crust when large rocks are used for fill, a sand cushion on top of the subsoil is recommended.

C. General Comments

While it is beyond the scope of this report to investigate other locations for the structure, we would like to recommend that consideration be given to relocating the creek to the east side of the valley as close to the limestone side hill as possible. At this location, it may be possible to construct a structure similar to the

20 ft. standard type culvert on Highway No. 38 at Collins Creek. This culvert, according to information obtained from the Kingston District Office has a narrow spread footing foundation. It is possible that the structure could be built in this location without piles.

SECTION 1.4

PERSONNEL

The field work was performed under the supervision of I. E. Thurber, B.Sc.

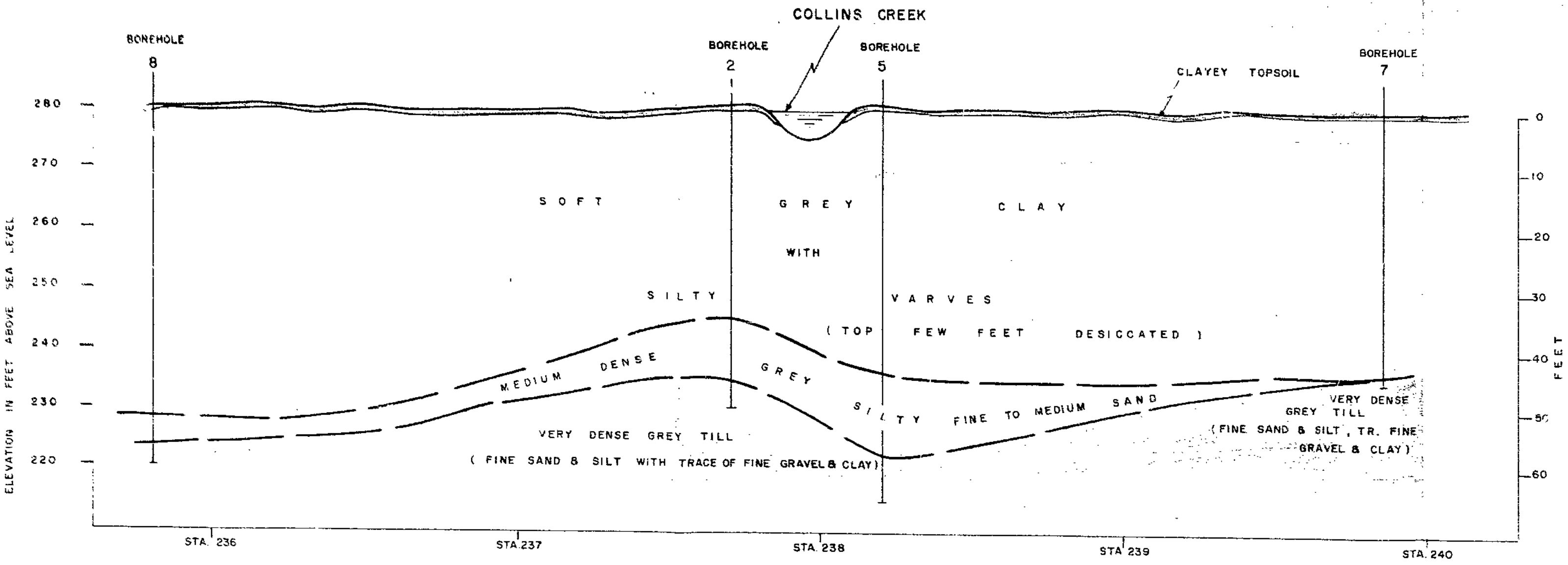
This report was written by J. Kilgour, P.Eng., P. Arkema, P.Eng., and N.W.E. Lee, P.Eng.

SECTION 1.5

APPENDICES

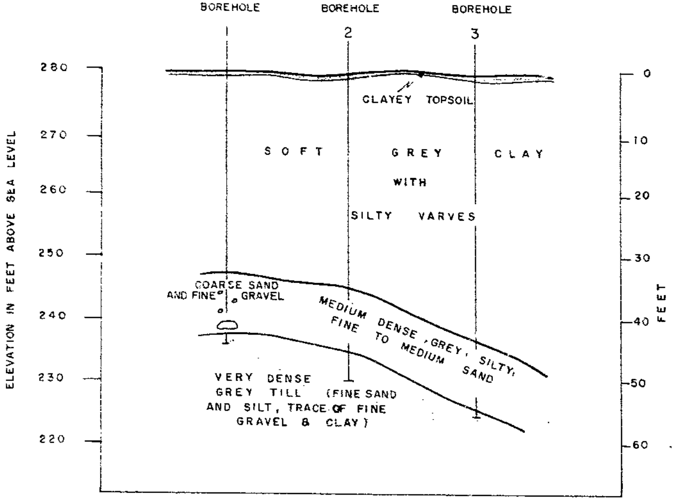
1.51 GENERAL PLAN OF SITE

1.52 SUBSURFACE SECTIONS



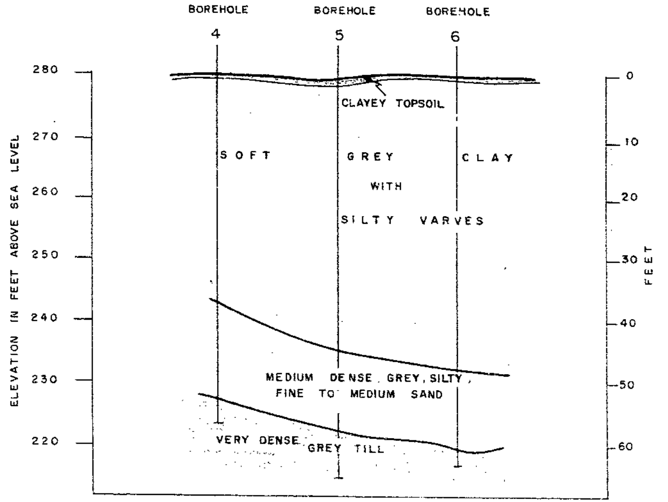
SUBSURFACE SECTION ALONG PROPOSED CENTERLINE

Scale -
hor. - 1" = 40'
vert. - 1" = 20'



SUBSURFACE SECTION ALONG PROPOSED WEST ABUTMENT

LOOKING EAST



SUBSURFACE SECTION ALONG PROPOSED EAST ABUTMENT

LOOKING EAST

PROPOSED CROSSING OF COLLINS CREEK

AND KINGS HIGHWAY No. 401

1.53 OFFICE LOGS OF BOREHOLES

JOB No. H 416/58 LOCATION HWY. 401 COLLINS CREEK
CLIENT DEPARTMENT OF HIGHWAYS – ONTARIO
COORDINATES STA. 237 + 50 40' L. OF CL
ELEV. (surface) 280·0 (collar) — Datum GEOD.
BOREHOLE NUMBER 1
DATE (started) JUNE 2, 1958 (finished) JUNE 3, 1958
RIG No. 2 TYPE JUN. LONGYEAR (TRAILER MOUNTED)

HUNTING TECHNICAL AND EXPLORATION SERVICES

BOREHOLE No. 1

Legend: silt; clay; sand; gravel; peat; fill

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

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

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

SAMPLE CONDITION
— undisturbed
— disturbed but represent.
— fair
— lost

BORING LOG

Depth FT.	Elev. FT	Water Observation	Description
	280·0		
1·0	279·0		DARK TOPSOIL
		G.W.L. JUNE 6	TOP 3 - 4 FEET DESICCATED SOFT, GREY CLAY WITH SILTY VARVES
33·2	246·8		MEDIUM DENSE GREY SAND & ANGULAR FINE GRAVEL (SOME SILT POCKETS)
42·4	237·6		
43·4	236·6		VERY DENSE GREY TILL
			END OF BOREHOLE

FIELD TESTS

SHEAR STRENGTH (TONS PER SQUARE FOOT) 1/2, 1, 1 1/2
STANDARD PENETRATION TEST (BLOWS PER FOOT) 20, 40, 60

SAMPLES

No.	Cond.	Depth From	Depth To	Type	Recovery Length Rec. / Dist. Driv.	Penetration Resistance (Blows per Foot)	Remarks
1	disturbed but represent.	5·0	7·0	S S	22/24	2	
2	lost	15·0	17·0	S T	LOST	–	EASILY PUSHED BY HAND 30 LBS.
3	undisturbed	25·0	27·0	S T	24/24	–	PUSHED BY HAND 80 LBS.
							VANE SHEAR INFLUENCED BY SAND BELOW
4	lost	35·0	37·0	S S	LOST	20	
5	fair	37·0	40·0	WASH	–	–	
6		40·4	43·4	D B	22/36	–	GRANITE GNEISS BOULDER CORE

LABORATORY TESTS

ATTERBERG LIMITS wp x—o wl
● — NATURAL WATER CONTENT

REMARKS

PIECE OF LIMESTONE GOT STUCK IN BIT AT 43' AND GROUND UNDERLYING MATERIAL

USED BX CASING TO 40'-6"

HUNTING TECHNICAL AND EXPLORATION SERVICES

BOREHOLE No. 2

JOB No. H416/58 LOCATION HWY. 401 - COLLINS CREEK
CLIENT DEPARTMENT OF HIGHWAYS - ONTARIO
COORDINATES STA. 237 + 69 CL
ELEV. (surface) 280·0 (collar) — Datum GEOD.
BOREHOLE NUMBER 2
DATE (started) MAY 30, 1958 (finished) MAY 30, 1958
RIG No. 2 TYPE JUN. LONGYEAR (TRAILER MOUNTED)

Legend: silt, clay, sand, gravel, peat, fill

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

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

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

SAMPLE CONDITION
— undisturbed
— disturbed but represent.
— fair
— lost

BORING LOG

Depth (ft)	Elev (ft)	Water observation	Description
0	280·0	G.W.L. JUNE 6	TOP 6 - 7 FEET DESICCATED
			SOFT, GREY CLAY WITH SILTY VARVES
35·7	244·3		LOOSE TO MEDIUM DENSE GREY SILTY MEDIUM SAND
38·5	241·5		MEDIUM DENSE GREY SAND, SOME FINE GRAVEL
45·0	235·0		VERY DENSE GREY TILL (SEE REMARKS)
49·0	231·0		END OF BOREHOLE

FIELD TESTS / LABORATORY TESTS

SHEAR STRENGTH (TONS PER SQUARE FOOT) 1/2, 1, 1 1/2
STANDARD PENETRATION TEST (BLOWS PER FOOT) 20, 40, 60
ATTERBERG LIMITS wp x—o wl; ● — NATURAL WATER CONTENT 30, 60, 90

No.	Cond	Depth From	Depth To	Type	Recovery Length Rec. / Dist. Driv.	Penetration Resistance (Blows per foot)	U undist. t/ft²	U remolded	Remarks
									6" DARK BROWN CLAYEY TOPSOIL
1		0	2·0	SS	12/24	5			
2		5·0	7·0	SS	18/24	5			
3		10·0	12·0	ST	20/24	–			PUSHED BY HAND 80 LBS.
4		15·0	17·0	ST	20/24	–			PUSHED BY HAND 80 LBS.
5		18·5	19·5	WASH	–	–			LARGE CHUNKS CLAYEY SILT EXTRUDED
6		25·0	27·0	ST	19/20	–	0·45	0·04	3" OSTERBERG
7		31·0	32·5	SS	5/18	–			PUSHED BY HAND 150 LBS.
8		35·0	36·7	ST	15/19	–			PUSHED BY HAND 35' – 35·7 70 LBS. 35' – 36·7' 500 LBS. (EXTRUDED SAMPLE IN FIELD)
9		40·0	40·6	SS	RECOVERED WITH SIDE SLIT	50/6"*			
10		45·0	47·0	SS	17/24	115			TILL CONSISTS OF SILT & FINE SAND WITH TRACE OF FINE GRAVEL & CLAY
11		48·0	49·0	SS	10/12	150			

H CASING TO 25'
BX CASING TO 48'

* WASHED-IN SAND JAMMED SS IN BX CASING AFTER 2" DRIVING

HUNTING TECHNICAL AND EXPLORATION SERVICES

BOREHOLE No. 3

JOB No. H 416/58 LOCATION HWY 401- COLLINS CREEK
CLIENT DEPARTMENT OF HIGHWAYS ONTARIO
COORDINATES STA. 237+90 43' RT. CL
ELEV. (surface) 280·0 (collar) — Datum GEOD.
BOREHOLE NUMBER 3
DATE (started) JUNE 3, 1958 (finished) JUNE 3, 1958
RIG No. 2 TYPE JUN. LONGYEAR (TRAILER MOUNTED)

Legend: silt, clay, sand, gravel, peat, fill

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

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

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

SAMPLE CONDITION: — undisturbed; — disturbed but represent.; — fair; — lost

BORING LOG / FIELD TESTS / LABORATORY TESTS

Shear strength (tons per square foot): 1/2, 1, 1 1/2
Standard penetration test (blows per foot): 20, 40, 60
Atterberg limits wp x—o wl; ● — natural water content

Depth (ft)	Elev. (ft)	Water observation	Description	Sample No.	Depth From	Depth To	Type	Recovery (Length Rec./Dist. Driv.)	Penetration Resistance (blows per foot)	Remarks
	280·0									
1·5	278·5		BLACK ORGANIC TOPSOIL							
		G.W.L. JUNE 6	TOP 3-4 FEET DESICCATED; SOFT, GREY CLAY WITH SILTY VARVES	1	5·0	7·0	SS	24/24	–	PUSHED BY HAND 250 LBS.
				2	15·0	17·0	ST	20/22	–	3" OSTERBERG
				3	25·0	27·0	ST	24/24	–	PUSHED BY HAND 100 LBS.
										VANE SANK UNDERWEIGHT RODS; VANE SANK AFTER UNDISTURBED TEST
44'0"	236·0		MEDIUM DENSE, GREY SILTY FINE & MEDIUM SAND SOME FINE GRAVEL	4	45·0	47·0	SS	9/24	35	SS WITH SAND TRAP
55·2	224·8		END OF BOREHOLE							

REFUSAL OF CASING } AT 55·2'
REFUSAL OF CHOPPING BIT }
PROBABLY BOULDER NEAR TILL CONTACT

BX CASING PUSHED BY HAND TO A DEPTH OF 43'

H CASING 0 – 15·0'
BX CASING 15' – 55·2'

JOB No. H416 / 58 LOCATION HWY 401 COLLINS CREEK
CLIENT DEPARTMENT OF HIGHWAYS - ONTARIO
COORDINATES STA. 238 + 09 40' L. OF CL
ELEV. (surface) 280·0 (collar) — Datum GEOD.
BOREHOLE NUMBER 4
DATE (started) MAY 27, 1958 (finished) MAY 29, 1958
RIG No. 1 TYPE JUN. LONGYEAR

HUNTING TECHNICAL AND EXPLORATION SERVICES

BOREHOLE No. 4

silt — clay — sand — gravel — peat — fill

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

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

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

SAMPLE CONDITION
— undisturbed
— disturbed but represent.
— fair
— lost

BORING LOG

DEPTH FT	ELEV FT	WATER OBSERVATION	DESCRIPTION
	280·0		
1·0	279·0	G.W.L. JUNE 6	DARK BROWN TOPSOIL
			TOP 3-4 FEET DESICCATED
37·8	242·2		SOFT, GREY CLAY WITH SILTY VARVES
53·0	227·0		LOOSE TO MEDIUM GREY SILTY FINE & MEDIUM SAND
56·0	224·0		VERY DENSE GREY TILL
			END OF BOREHOLE

FIELD TESTS

SHEAR STRENGTH (TONS PER SQUARE FOOT) 1/2, 1, 1 1/2
STANDARD PENETRATION TEST (BLOWS PER FOOT) 20, 40, 60

SAMPLES

No.	DEPTH FROM	DEPTH TO	TYPE	RECOVERY LENGTH REC. / DIST. DRIV.	PENETRATION RESISTANCE (BLOWS PER FOOT)	REMARKS
1	1·0	2·5	ST	11/18	–	3" OSTERBERG
2	5·0	6·5	ST	18/18	–	" "
3	10·0	11·5	ST	18/18	–	" "
4	15·0	16·5	ST	18/18	–	" " VANE SANK UNDER WEIGHT OF RODS
5	20·0	21·5	ST	18/18	–	3" OSTERBERG
6	25·0	26·5	ST	LOST	–	" " (JAR SAMPLE RECOVERED BY SIDE SLIT SAMPLER)
7	30·0	32·0	ST	22/22	–	" "
8	35·0	37·0	ST	22/22	-	" " VANE INFLUENCED BY MATERIAL BELOW
9	40·0	41·5	SS	15/18	5	
10	45·0	46·5	SS	18/18	16	
11	50·0		SIDE SLIT			SAMPLE TAKEN IN CASING AT 48' 200 BLOWS ON BX CASING FOR 1' PENETRATION
12	54·0	56·0	DB	16/24	–	

LABORATORY TESTS

ATTERBERG LIMITS WP X—O WL
● — NATURAL WATER CONTENT
30 60 90
U undist. t/ft²
U remolded

REMARKS

H CASING 0 - 40'
BX CASING 40' - 54'

HUNTING TECHNICAL AND EXPLORATION SERVICES

BOREHOLE No. 5

JOB No. H416/58 LOCATION HWY. 401 COLLINS CREEK
CLIENT DEPARTMENT OF HIGHWAYS - ONTARIO
COORDINATES STA. 238 + 20 2' L. OF CL.
ELEV (surface) 279.5 (collar) — Datum GEOD.
BOREHOLE NUMBER 5
DATE (started) MAY 20, 1958 (finished) MAY 24, 1958
RIG No. 1 TYPE JUN. LONGYEAR

Legend: silt, clay, sand, gravel, peat, fill

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

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

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

SAMPLE CONDITION: undisturbed; disturbed but representative; fair; lost

BORING LOG

DEPTH FT.	ELEV. FT.	WATER OBSERVATION	DESCRIPTION
	279.5		
1.0	278.5	G.W.L. JUNE 6	DARK BROWN TOPSOIL
45.0	234.5		TOP 4 - 5 FEET DESICCATED; SOFT, GREY CLAY WITH SILTY VARVES
58.0	221.5		LOOSE TO MEDIUM DENSE GREY SILTY FINE & MEDIUM SAND
65.0	214.5		VERY DENSE GREY TILL (SEE REMARKS)
			END OF BOREHOLE

FIELD TESTS — SAMPLES / LABORATORY TESTS

No.	COND.	DEPTH FROM	DEPTH TO	TYPE	RECOVERY LENGTH REC. / DIST. DRIV.	PENETRATION RESISTANCE (BLOWS PER FOOT)	U undist. t/ft.	U remolded	REMARKS
1	disturbed but representative	0	1.5	SS	13 / 18	4			
2	disturbed but representative	3.0	4.5	ST	6 / 18	5			
3	undisturbed	9.0	10.5	ST	16 / 18	-			PUSHED BY HAND
4	undisturbed	14.0	15.5	ST	18 / 18	—	0.33	0.04	3" OSTERBERG
5	undisturbed	19.0	20.5	ST	17 / 18	—			3" OSTERBERG
6	undisturbed	24.0	25.5	ST	18 / 18	—			3" OSTERBERG
7	lost	29.0	30.5	ST	LOST	—			3" OSTERBERG (JAR SAMPLE BY SIDE SLIT)
8	lost	34.0	35.5	ST	LOST	—			3" OSTERBERG " " " "
9	lost	39.0	40.5	ST	LOST	—			3" OSTERBERG " " " "
10	undisturbed	44.0	45.5	ST	18 / 18				
11	disturbed but representative	46.0	48.0	SS	22 / 24	-			TAKEN FROM CASING
12	fair	54.0	55.0	SIDE SLIT SAMPLE					
13		59.0	59.2	SS	2.5 / 2.5	51/2.5"			TILL CONSISTS OF SILT & FINE SAND WITH TRACE OF FINE GRAVEL & CLAY
14		59.0	65.0	DB	15 / 72				

H CASING 0 — 45'
BX CASING 45' — 59'

JOB No. H416/58 LOCATION HWY. 401 COLLINS CREEK
CLIENT DEPARTMENT OF HIGHWAYS - ONTARIO
COORDINATES STA. 238 + 33 37 RT. OF CL
ELEV (surface) 280·7 (collar) — Datum GEOD.
BOREHOLE NUMBER 6
DATE (started) MAY 31, 1958 (finished) JUNE 3, 1958
RIG No. 2 TYPE JUN. LONGYEAR (SKID MOUNTED)

HUNTING TECHNICAL AND EXPLORATION SERVICES

BOREHOLE No. 6

silt — clay — sand — gravel — peat — fill

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

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

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

SAMPLE CONDITION
— undisturbed
— disturbed but represent.
— fair
— lost

BORING LOG

Depth (ft)	Elev (ft)	Water observation	Description
	280·7		
0·7	280·0		DARK TOPSOIL
		G.W.L. JUNE 6	TOP 4-5 FEET DESICCATED
			SOFT, GREY CLAY WITH SILTY VARVES
47·5	232·8		
			MEDIUM DENSE GREY SILTY FINE & MEDIUM SAND
61·0	219·7		
			VERY DENSE GREY TILL ☼
62·9	217·8		END OF BOREHOLE

FIELD TESTS

SHEAR STRENGTH (TONS PER SQUARE FOOT) 1/2, 1, 1 1/2
STANDARD PENETRATION TEST (BLOWS PER FOOT) 20, 40, 60

SAMPLES

No.	Cond.	Depth From	Depth To	Type	Recovery Length Rec. / Dist. Driv.	Penetration Resistance (Blows per foot)	Remarks
1		0	2·0	S S	24/24	6	
2		4·0	6·0	S T	24/24	—	
3		9·0	10·5	S T	14/18	—	
4	lost	14·0	15·5	S T	LOST	—	
5		16·0	17·5	S T	18/18	—	3" OSTERBERG
6		20·0	22·0	S T	21/24	—	
7		25·0	27·0	S S	24/24	—	
8		30·0	32·0	S T	21/21	—	3" OSTERBERG
9		35·0	36·5	S S	18/18	—	PUSHED BY HAND
10		40·0	41·5	S T	16/18	—	
11		45·0	47·0	S S	24/24	—	PUSHED BY HAND; VANE SHEAR AT 47·5' INFLUENCED BY MATERIAL BELOW.
12		50·0	52·0	S S	24/24	16	
13		58·0	60·0	W.O	—	-	
14		61·8	62·9	S S	14/14	95	REFUSAL ON S S AT 62·9'

LABORATORY TESTS

ATTERBERG LIMITS wp x—o wl
● — NATURAL WATER CONTENT

REMARKS

H CASING 0 – 40'
BX CASING 40' – 61·8'

☼ TILL CONSISTS OF SILT & FINE SAND WITH TRACE OF FINE GRAVEL & CLAY

HUNTING TECHNICAL AND EXPLORATION SERVICES

JOB No. H 416/58 LOCATION HWY. 401 - COLLINS CREEK
CLIENT DEPARTMENT OF HIGHWAYS - ONTARIO
COORDINATES STA. 239 + 86 CL
ELEV. (surface) 280·8 (collar) — Datum GEOD.
BOREHOLE NUMBER 7
DATE (started) JUNE 4, 1958 (finished) JUNE 5, 1958
RIG No. 2 TYPE JUN. LONGYEAR (SKID MOUNTED)

BOREHOLE No. 7

Legend: silt, clay, sand, gravel, peat, fill

x — standard penetr. 2 S.S.
▵ — vane shear
o — pocket penetrometer

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

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

SAMPLE CONDITION
— undisturbed
— disturbed but represent.
— fair
— lost

BORING LOG / FIELD TESTS / LABORATORY TESTS

Field test column headings: SHEAR STRENGTH (TONS PER SQUARE FOOT) 1/2, 1, 1 1/2; STANDARD PENETRATION TEST (BLOWS PER FOOT) 20, 40, 60

Laboratory test column headings: ATTERBERG LIMITS wp x—o wl; ● — NATURAL WATER CONTENT

DEPTH FT	ELEV. FT	WATER OBSERVATION	DESCRIPTION
	280·8		
1·0	279·8		DARK TOPSOIL
		G.W.L. JUNE 6	TOP 3-4 FEET DESICCATED SOFT, GREY CLAY WITH SILTY VARVES
43·5	237·3		VERY DENSE GREY TILL
44·5	236·3		END OF BOREHOLE

SAMPLES

No.	COND.	DEPTH FROM	DEPTH TO	TYPE	RECOVERY LENGTH REC. / DIST. DRIV.	PENETRATION RESISTANCE (BLOWS PER FOOT)	REMARKS
1		5·0	7·0	S S	24 / 24	2	SLIGHTLY SANDY
2		15·0	17·0	S T	22 / 22	–	3" OSTERBERG
3		20·0	22·0	S S	24 / 24	–	PUSHED BY HAND
4		30·0	32·0	S T	24 / 24	–	PUSHED BY HAND
5		40·0	42·0	S T	24 / 24	–	PUSHED BY HAND, SOME SMALL STONES IN SAMPLE

H CASING TO 15'
BX CASING TO 44·5'

JOB No. H 416/58 LOCATION HWY. 401 - COLLINS CREEK
CLIENT DEPARTMENT OF HIGHWAYS - ONTARIO
COORDINATES STA. 235 + 80 2' RT. OF CL.
ELEV. (surface) 280·0 (collar) — Datum GEOD.
BOREHOLE NUMBER 8
DATE (started) JUNE 5, 1958 (finished) JUNE 6, 1958
RIG No. 2 TYPE JUN. LONGYEAR (TRAILER MOUNTED)

HUNTING TECHNICAL AND EXPLORATION SERVICES

BOREHOLE No. 8

Legend: silt, clay, sand, gravel, peat, fill

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

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

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

SAMPLE CONDITION
— undisturbed
— disturbed but represent.
— fair
— lost

BORING LOG

DEPTH FT	ELEV FT	WATER OBSERVATION	DESCRIPTION
	280·0		
1·0	279·0		DARK TOPSOIL
		G.W.L. JUNE 6	TOP 3-4 FEET DESICCATED SOFT, GREY CLAY WITH SILTY VARVES
51·3	228·7		GREY MEDIUM SAND WITH FINE GRAVEL WITH SILT POCKETS
56·3	223·7		VERY DENSE GREY TILL
58·0	222·0		END OF BOREHOLE

FIELD TESTS

SHEAR STRENGTH (TONS PER SQUARE FOOT) 1/2, 1, 1 1/2
STANDARD PENETRATION TEST (BLOWS PER FOOT) 20, 40, 60

SAMPLES

No.	COND.	DEPTH FROM	DEPTH TO	TYPE	RECOVERY LENGTH REC. / DIST. DRIV.	PENETRATION RESISTANCE (BLOWS PER FOOT)
1	disturbed	9·0	11·0	W.O.	—	—
2	undisturbed	15·0	17·0	ST	20/20	—
3	undisturbed	31·0	33·0	ST	24/24	-

LABORATORY TESTS

ATTERBERG LIMITS wp x—o wl
● — NATURAL WATER CONTENT

REMARKS

FROM LARGE CHUNKS OF SOFT SILTY CLAY PUSHED UP IN CASING BY WASH WATER PRESSURE

3" OSTERBERG

PUSHED BY HAND

INFLUENCED BY FINE GRAVEL BELOW

H CASING 0 - 15' DRIVEN
BX CASING 15'- 31' PUSHED BY HAND
BX CASING 31'- 58' DRIVEN

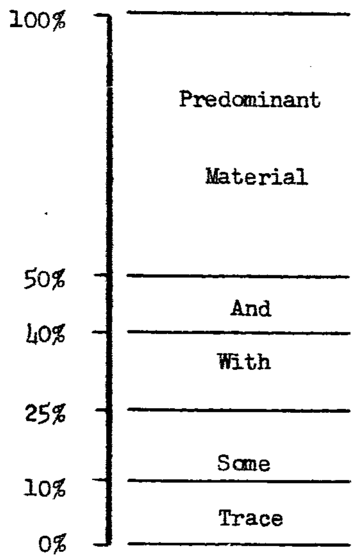
1.54 SOIL CLASSIFICATION CHARTS

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.) or relative density	(colour)	(pred. type)	(25%-40%)	(other type)	

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 & EXPLORATION SERVICES

1450 O'Connor Drive   Toronto, Ontario

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.	
		Density	
Silt	Loose	Less than 80 lbs./Cu. Ft.	
	Medium Dense	80 to 95 lbs./Cu. Ft.	
	Dense	Greater than 95 lbs./Cu. Ft.	
		Relative Density	Penetration Resist.
Sand	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.
			Penetration Resist.
Gravel	Loose		Less than 30 Blows
	Dense		Over 30 Blows/Ft.
Hardpan		Cemented on 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.
		Unconfined Compressive Strength	
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.	
		Density	
Organic Silt (Muck)	Loose	Less than 30 lbs./Cu. Ft.	
	Medium Dense	Greater than 80 lbs./Cu. Ft.	

LABORATORY TESTS - INTERBEDDED SILT AND CLAY STRATUM

Unconfined compression tests together with classification tests were conducted on 4 samples; including the two samples tested for consolidation. The results of these tests are listed below.

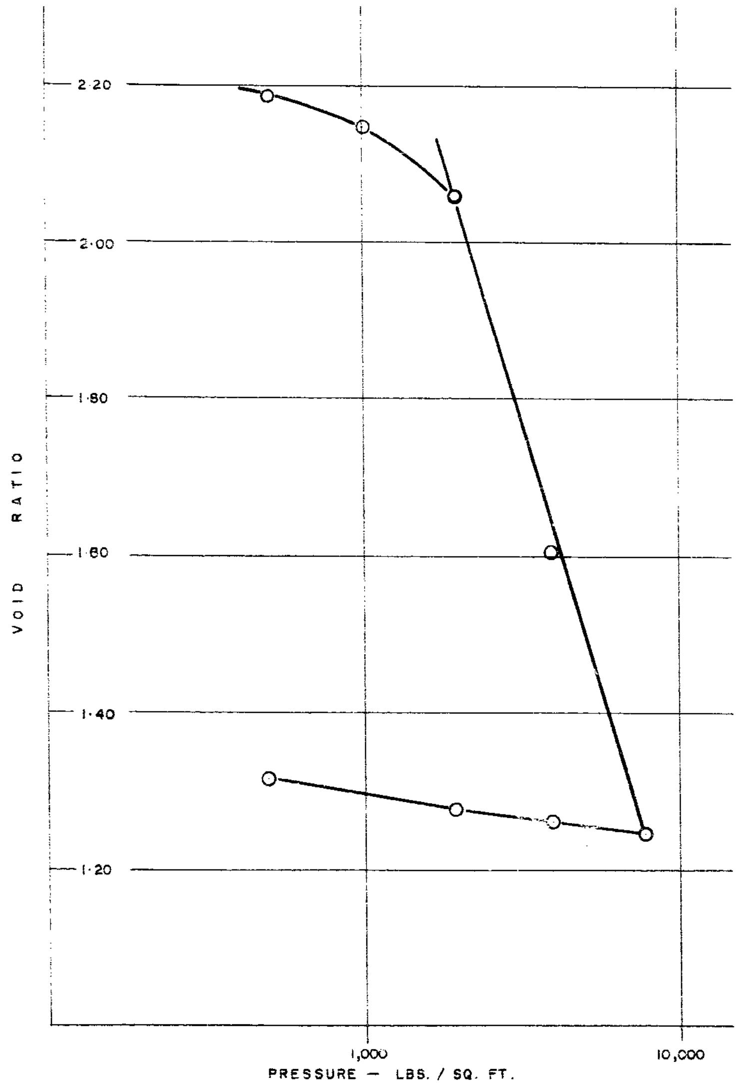
Hole	2	2	4	5
Sample	3	6	7	4
Depth (feet)	10-12	25-27	30-31.5	14-15.5
Natural Moisture Content (%)	66.9	77.9	67.5	46.3
Liquid Limit	50.8	54.9	49.0	37.6
Plastic Limit	21.1	24.6	21.7	16.4
Plasticity Index	29.7	30.3	27.3	21.2
Compressive Strength				
Undisturbed (p.s.i.)	3.0	6.4	6.0	4.5
Remolded (p.s.i.)	0.4	0.5	0.5	0.5
Sensitivity	7.5	12.8	12.0	9.0

CONSOLIDATION TESTS

Two consolidation tests were completed on separate Osterberg samples from the "clayey" strata. The results of these tests are listed below.

Hole	2	5
Sample	6	4
Depth (feet)	25-27	14-15.5
Specific Gravity	2.72	2.74
Compression Index Cc	1.36	0.52
Natural Water Content	78%	46%
Load increment of		
500 - 1000 p.s.f., Cv =	0.0174	0.0202
1000 - 2000 p.s.f., Cv=	0.0087	0.00726
2000 - 4000 p.s.f., Cv=	0.0134	0.00387
4000 - 8000 p.s.f., Cv=	0.0033	0.00608

The consolidation (load and unload) relationship between applied pressure (P) and log e (void ratio) is presented overleaf.



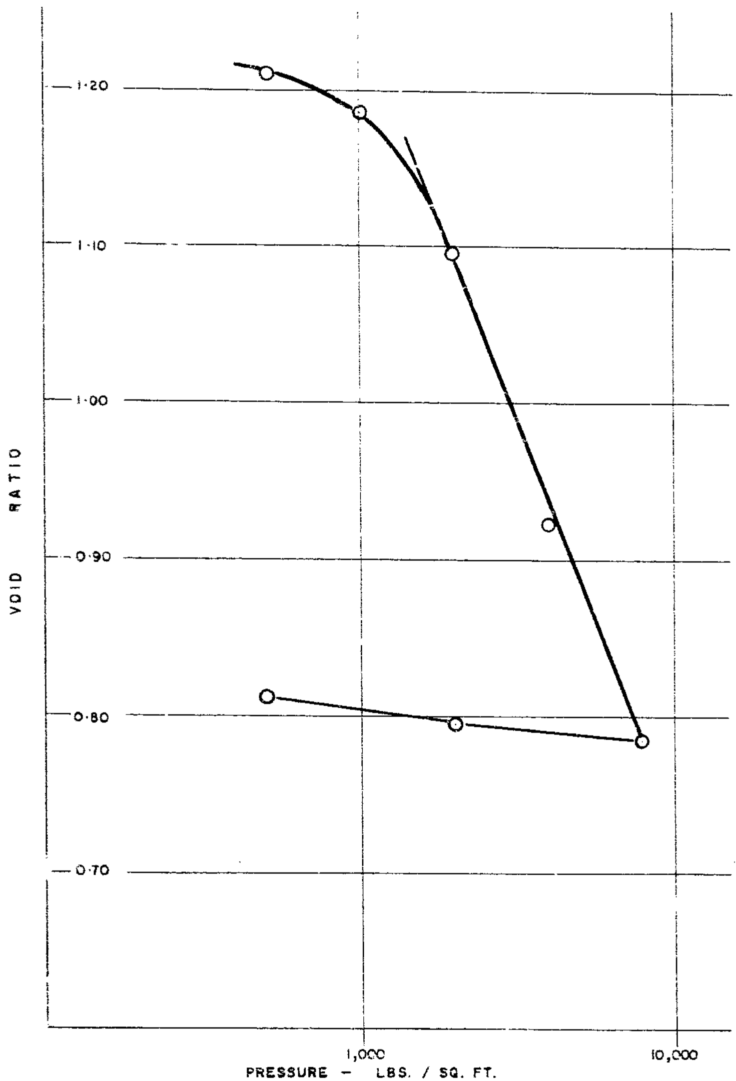
CONSOLIDATION TEST

e log. P CURVE

HOLE No.2 SAMPLE 6

COLLINS CREEK SITE

Job No. H416/58 - June 1958



CONSOLIDATION TEST

e log. P CURVE

HOLE No. 5 SAMPLE 4

COLLINS CREEK SITE

Job No. H416 / 58 -- June 1958

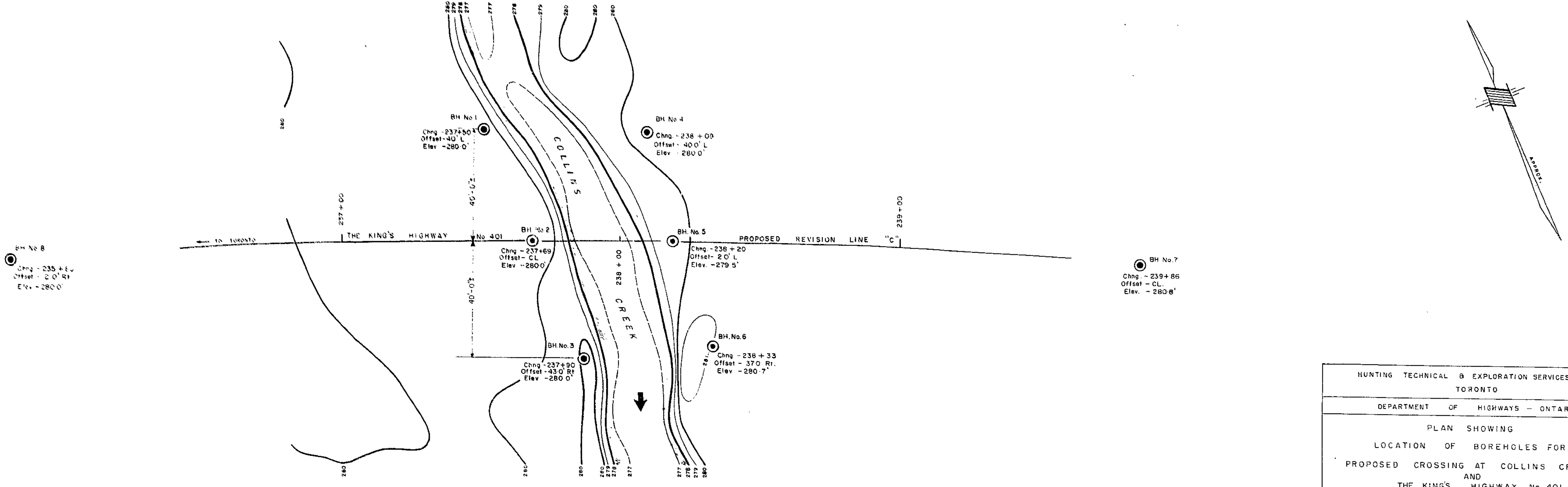
1.55 PHOTOS OF SITF

General View of Site Looking East From
Sta. 235+75 Approx.
Drill Rig #2 Set Up at Hole #1

Soft Grey Interbedded Clay and Silt
Extruded from H Casing by Wash Water Pressure

General View of Site Looking East From
Sta. 235+75 Approx.
Drill Rig #2 Set Up at Hole #1

Soft Grey Interbedded Clay and Silt
Extruded from H Casing by Wash Water Pressure



HUNTING TECHNICAL & EXPLORATION SERVICES LTD.
TORONTO

DEPARTMENT OF HIGHWAYS — ONTARIO

PLAN SHOWING
LOCATION OF BOREHOLES FOR
PROPOSED CROSSING AT COLLINS CREEK
AND
THE KING'S HIGHWAY No. 401
PROPOSED LINE "C"
BRIDGE SITE

SCALE – 1 in = 20 ft.	DRAWN BY – C.I.B.	DATE – MAY 1958

Reference – PLAN-E-3337-1