

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 31E-33

DIST 11 REGION Northern

W.P. No. 149-73-01


CONT. No. 76-67

W. O. No. _____

STR. SITE No. _____

HWY. No. 11

LOCATION Unnamed Creek &
Bullen (Lancelot) Creek

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 

REMARKS: documents to be unfolded
before microfilming

FOUNDATION INVESTIGATION REPORT

For

The Proposed Crossing

At

Unnamed Creek and Bullen (Lancelot) Creek

Highway 11, Line E (North Bound Lane)

District 11 (Huntsville)

W.P. 149 - 73 - 01

1. INTRODUCTION:

A request for a foundation investigation at the above two sites was received from Mr. J. C. McAllister, Regional Structural Planning Supervisor, in a memo dated October 1, 1974.

A field investigation was subsequently carried out by the Soil Mechanics Section to determine the subsoil conditions at the two sites. This report contains the results of the investigation and our recommendations pertaining to the foundation for the proposed culverts.

2. FIELD AND LABORATORY INVESTIGATIONS:

At Unnamed Creek two sampled boreholes (B.H. # 1 and 2) supplemented by two dynamic cone penetration tests adjacent to them were carried out. At Bullen Creek two sampled boreholes (B.H. # 3 and 4) and two dynamic cone penetration tests (B.H. # 3 and 5) were put down.

All boreholes were advanced using a Bombardier mounted hollow stem auger (CME 55) machine. Disturbed Samples were obtained using a 2-inch O.D. Split-Spoon Sampler driven according to the specifications of the Standard Penetration Test. Undisturbed samples at the Unnamed Creek were recovered with 2-inch I.D. Shelby tube pushed manually into the soil. In order to measure undrained shear strength of the soil, field vane tests were carried out, 18 inches below the samples, wherever possible. Driving energy to advance the cone was 350 ft./lbs.

Samples were examined visually in the field and again in the laboratory to determine :

Grain-Size Distribution

Atterberg Limits

Natural Moisture Content

Organic Content

The locations and elevations of the boreholes and the stratigraphical profiles are shown on Drawings 1497301 - A and B accompanying this report.

3. SITE DESCRIPTION:

The Unnamed Creek is located about 6 miles south of Huntsville and the Bullen (Lancelot) Creek is located about 7 miles south of Huntsville.

The proposed culverts which will eventually carry the north-bound traffic are situated slightly east of the existing culverts carrying Highway 11. The present culverts were constructed in 1956 and appear to be in good condition. The existing culvert at the Unnamed Creek is a 20' x 8' x 100' concrete rigid frame box, while the existing culvert at the Bullen (Lancelot) Creek is a 20' x 12' x 110' concrete rigid frame open type. The surrounding ground at the Unnamed Creek is flat while at the Bullen Creek it is flat to gently rolling. Both sites are covered with trees except the north side of the Bullen Creek. Bedrock outcrops can be seen 500 - 1,000 ft. away from the sites.

An attempt was made to find out the type of foundations provided for the two existing culverts. However, a search failed to turn up any drawings or documents either at the District or Head Office, and no information about these culverts is available.

4. UNNAMED CREEK:

4.1) Subsoil Conditions

4.1 (a) General

The subsoil consists of a silt deposit about 50 ft deep followed by a non-cohesive silt to sandy silt deposit. Within the silt layer at a depth of 3 to 6 ft, a stratum of organic silt was encountered. This layer varied from 5.5 to 20.0 ft in thickness. Borehole # 1 was terminated at a depth of 84.0 ft where refusal to augering and also to driving the cone was reached. Borehole # 2 was advanced to a depth of 95 ft. but no refusal was met.

4.1 (b) Silt

The silt deposit contains traces to some sand and traces of clay. The material consists of fine laminations, in general less than 1/8" thick. Atterberg Limit tests carried out on the overall material indicate that at most places the material possesses slight plasticity,

and at some places it is non-plastic in nature. The Field Vane Tests show that the undrained shear strength of the deposit varies from 300 to 900 lbs./sq.ft, indicating a soft to firm consistency. At places the material was so soft that the Split-Spoon sampler went down into the soil under the weight of hammer, without any blows being given to it. The N-values varied from 0 to 6 blows per ft. This also confirms that where the material possesses plasticity its consistency varies from soft to firm and wherever it is non-plastic its relative density varies from very loose to loose.

4.1 (c) Organic Silt

This layer was found in both boreholes. In borehole 1 this extended from a depth of 3.0 to 8.5 ft. below ground level, and in borehole 2 it extended from 6.0 to 20.0 ft. below ground level. The material consists of organic silt with traces of sand and clay. The consistency varies from soft to firm.

4.1 (d) Silt to Sandy Silt

This stratum was encountered and sampled in borehole 1, from a depth of 48.0 to 84.0 ft. where refusal to further penetration was reached. In borehole 2 this stratum was inferred from the cone test from a depth of 50.0 ft. to 95.0 ft. where the borehole was terminated. The material consists of silt to sandy silt. The N-values varied from 4 to 7 blows/ft. indicating a loose to very loose relative density.

4.2 Groundwater Conditions

Groundwater was measured at the following elevations

BH	Ground level	Ground water
1	923.0	923.0
2	924.4	921.4

However, in borehole 1 artesian water condition was encountered at elevation 853 and the water head rose 7 ft above the ground level to elevation 930.0

4.3) Discussions and Recommendations

4.3 (a) General

It is proposed to place a new culvert for the future north-bound lane of Highway 11. The culvert may be a large structural plate

pipe and or a concrete box culvert equivalent in size to the existing one in the south bound lane. The present culvert at this site is a 20' x 8' x 100' concrete rigid frame box. The future grade of the north bound lane would be approximately the same as the present grade. This would result in a total height of embankment of about 7-8 ft. above the creek bed.

As already mentioned, the underlying subsoil is soft to firm (where plastic) and loose to very loose (where non-plastic). There is no suitable bearing stratum at this location. The proposed culvert (concrete box or structural pipe arch) should be designed for a net bearing pressure of 800 lbs./sq. ft.

4.3 (b) Structural Plate Pipe Arch

The culvert should be designed and placed according to the appropriate Ministry Standards. All soft organic material under the proposed culvert should be excavated and replaced with a free-draining granular material. A minimum 2 ft. thick Granular 'B' bedding should be placed beneath the culvert. The maximum thickness of bedding will be governed by the availability of cover inside the pipe. The bottom of the bedding should extend below the maximum frost penetration depth. Pipe arches exert greater pressures against the soil at the corner plates than elsewhere around the conduit. Excessive pressures at the corners require material of better bearing capacity which should extend far enough to transfer distributed pressures to the abutting embankment at acceptable bearing pressures.

Backfill for the pipe should also consist of Granular "B" and should extend to a minimum height of 2 ft. above the pipe. Above this level native backfill may be used. To prevent piping through the bedding and backfill, 3 ft. thick clay seal should be provided at the upstream end of the culvert and a suitable filter blanket 3 ft. thick placed at the downstream end.

A dewatering scheme will be required to excavate below the ground level and place the bedding in the dry.

4.3 (c) Reinforced Concrete Box Culvert

The proposed box culvert can be designed assuming an

allowable net bearing pressure of 800 p.s.f. In order to fulfill frost protection requirements it is recommended that the culvert be founded on free-draining granular material. The thickness of the granular material and the base slab of the concrete culvert should be at least equal to the maximum frost penetration depth.

A suitable dewatering scheme will be required to place the concrete in the dry.

No stability problems are anticipated if the final grade of the north-bound lane is not higher than the present grade of Highway 11.

5. BULLEN (LANCELOT) CREEK

5.1) Subsoil Conditions

5.1 (a) General

The subsoil at this site consists of a deposit of silt and sandy silt overlying bedrock. Bedrock was encountered at depths varying from 56.5 to 60.0 ft.

5.1 (b) Sandy Silt (Upper Stratum)

This material was found in all boreholes from ground surface down. Its thickness varied from 8.5 to 15.0 ft. The material consists of Sandy Silt with organics and traces of clay. The 'N' - values vary from 1 blow for 1 ft. to 1 blow for 2 ft., indicating a very loose relative density. This material is highly susceptible to boiling under an imbalanced hydrostatic head.

5.1 (c) Silt

This was the predominant deposit at this site. The thickness of the deposit varied from 40 - 45 ft. The material consists of non-plastic silt with traces of sand and clay. The N-values, in general, vary from 5 - 9 blows per ft. indicating a loose relative density. This material is highly susceptible to 'boiling' under an unbalanced hydrostatic head. In boreholes 4 and 5, this deposit was underlain by bedrock. In borehole 3 it was underlain by a layer of sandy silt. A 1 ft. thick boulder was found in borehole 3 at a depth of 52 ft.

5.1 (d) Sandy Silt (lower stratum)

This 11 ft. thick layer was intersected in borehole 3 only. The material consists of sandy silt with traces of gravel and clay. An N-value of 15 blows/ft. indicates a compact relative density.

5.1 (e) Bedrock

Bedrock was cored in borehole 4 for a distance of 5.7 ft. The recovery was almost 100%. The bedrock was identified as sound granitic gneiss. In boreholes 3 and 5 bedrock was assumed to be at the elevations where refusal to driving the cone was reached. The bedrock surface varied between elevation 866.6 to 870.8 ft.

5.2 Groundwater Conditions

Groundwater level was found to be 2 ft. below ground surface. However in borehole 4 an artesian water condition was noticed in or immediately above the bedrock. The water level in the casing rose to 1 ft. above the ground.

5.3 Discussion and Recommendations

5.3 (a) General

It is proposed to place a new culvert for the future north bound lane of Highway 11. The culvert may be a large structural plate pipe arch or a concrete culvert equivalent in size to the existing one in the south bound lane. The present culvert at this site is a 20' x 12' x 110' concrete rigid frame open type. The future grade of the north bound lane would be approximately the same as the present grade. This would result in a total height of embankment of about 20 ft. above the creek bed.

As already mentioned, the underlying subsoil is very loose to compact silt and sandy silt deposits overlying bedrock.

5.3 (b) Structural Plate Pipe Arch

The comments contained in Section 4.3 (b) are applicable at this site also. However, because the subsoil is susceptible to 'boiling' under an unbalanced hydrostatic head, it is possible that short sheet piles may have to be driven to achieve satisfactory dewatering.

5.3 (c) Reinforced Concrete Rigid Frame Box Culvert

The comments contained in Section 4.3 (c) are applicable at this site also, except that an allowable net bearing pressure of 1,000 p.s.f. may be used for design purposes.

A suitable dewatering scheme will be required to prevent 'boiling' of the base of excavation. This may be achieved by driving sheet piles.

5.3 (d) Concrete Rigid frame Culvert (Open Type)

Because of the very loose nature of the subsoil, it is not suitable for spread footing type foundations. Bedrock was encountered at depths 56.5 to 60.0 ft. below the prevailing ground level. Therefore, it is recommended that the culvert may be supported on end-bearing piles driven to bedrock. Maximum allowable load for the type of pile chosen may be used for design purposes. A suitable dewatering scheme will be required to pour pile caps in the dry.

Since the structure will be designed as a rigid frame, a coefficient of earth pressure at rest (K_0) of 0.5 should be used for the granular material placed behind the wall. In all cases the full effect of the surcharge located above the top of the wall should be included in the design.

No stability problems are anticipated for 2:1 slopes of the embankment.

6. MISCELLANEOUS:

The field investigation for this project was carried out during the period Oct. 28 - Nov. 5, 1974 under the supervision of Mr. A. Prakash, Senior Engineer.

The drilling equipment used was owned and operated by Atcost Drilling Company, Concord, Ont.

This report was prepared by Mr. A. Prakash and reviewed by Mr. K. G. Selby, Supervising Engineer.

A. Prakash

A. Prakash
Senior Engineer

K. G. Selby

K. G. Selby
Supervising Engineer



AP:jw

ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

W.P. 149-73-01 LOCATION Sta. 500 + 56 O/s 10' RT. & Highway 11 Line 'B' ORIGINATED BY A.P.
DIST. 11 HWY. 11 BORING DATE October 28th and October 29th, 1974 COMPILED BY G.P.
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY G.P.

15 ²⁰ 5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

W.P. 149-73-01 LOCATION Sta. 500 + 74 0/s 110' RT. E Highway 11 Line "E" ORIGINATED BY A.P.
 DIST. 11 HWY. 11 BORING DATE October 30th and 31st, 1974 COMPILED BY G.R.
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY [Signature]

SOIL PROFILE		STRAT. PLOT	SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT		LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w		UNIT WEIGHT γ	REMARKS	
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	'N' VALUES		2'0	4'0	6'0	8'0			10'0
924.4	Ground Level												
0.0	Silt		1	SS	2	920	+s=4.0						
918.4	Some sand, traces of clay soft		2	TW	PM								
6.0			3	SS	0		+s=2.7						
	Organic silt		4	SS	0								
	Traces of sand and clay		5	TW	PM		+s=2.2						
			6	SS	0	910	+s=4.0						
	Soft to firm		7	TW	PM								
904.4			8	SS	0		+s=5.5						
20.0	Silt		9	SS	4		+s=9.6						
	traces of sand and clay		10	TW	PM	900							
	Finely laminated (possesses slight plasticity)		11	SS	0		+s=6.7						
	Soft to firm or very loose to loose					890	+s=4.0						
881.4			12	TW	PM		+s=3.2						
43.0	End of Borehole					880							
873.4													
51.0	probable silt to sandy silt					870							
	loose to very loose					860							
						850							
						840							
829.4						830							
95.0	End of cone test												

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

W.P. 149-73-01

LOCATION Sta. 453+40 O/S 22' RT. & Highway 11 Line "E"
Co-ords. 16,444,048 N. 1,052,135E.

ORIGINATED BY A.P.

DIST. 11 HWY. 11

BORING DATE October 31st, and November 1st, 1974

COMPILED BY G.P.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N° VALUES		20	40	60	80	100	w_p	w	w_L		
929.2	Ground Level															
0.0	Sandy silt traces of clay very loose		1	SS	1/18"											0 41 (59)
920.7	organics		2	SS	2/15"											Org. cont. 2-78%
8.5	Silt traces of sand and clay loose		3	SS	9	920										0 0 91 9
			4	SS	13											0 3 96 1
			5	SS	9	910										
			6	SS	8											
			7	SS	6	900										0 8 91 1
			8	SS	8											
			9	SS	13	890										0 1 93 6
			10	SS	5											
880.2	Sandy silt traces of gravel and clay compact		11	SS	15	880										4 42 49 5
869.2			12	SS	6/6"	870										
60.0	End of borehole Refusal Probable bedrock										100/0" refusal					

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 4

W.P. 149-73-01

LOCATION Sta. 453+34 O/S 82' RT. 4 Highway 11 Line "E"

ORIGINATED BY A.P.

DIST. 11 HWY. 11

BORING DATE November 4th and 5th, 1974

COMPILED BY G.P.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger, Axt Core

CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L			UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	PLASTIC LIMIT — w_p	WATER CONTENT — w			
928.8	Ground Level															
0.0	Sandy silt with organics Traces of clay		1	SS	1										0	26 13 1
			2	SS	1	920									0	49 17 4
	very loose		3	SS	1											
913.8			4	SS	1										0	39 57 4
15.0	Silt		5	SS	8	910									0	9 87 4
	Traces of sand and clay		6	SS	8											
			7	SS	8											
	Loose		8	SS	6	900									0	3 96 1
			9	SS	6											
	1 ft. boulder					890										
						880										
872.3			10	Axt RC	Rec 48%	870										
56.5	Granitic Gneiss bedrock															Artesian encountered Elev. 871.3
866.6	sound		11	Axt RC	Rec 100%											
62.2	End of borehole															

Sta. 452+90 O/S 117' RT. @ Highway 11 Line "E"

LOCATION Co-ords. 16.443.985 N. 1.052.222E

ORIGINATED BY A.P.

BORING DATE November 5th, 1974

COMPILED BY G.P.

BOREHOLE TYPE Dynamic Cone Penetration Test

CHECKED BY CP

20
15-0.5 % STRAIN AT FAILURE

GRAIN SIZE DISTRIBUTION

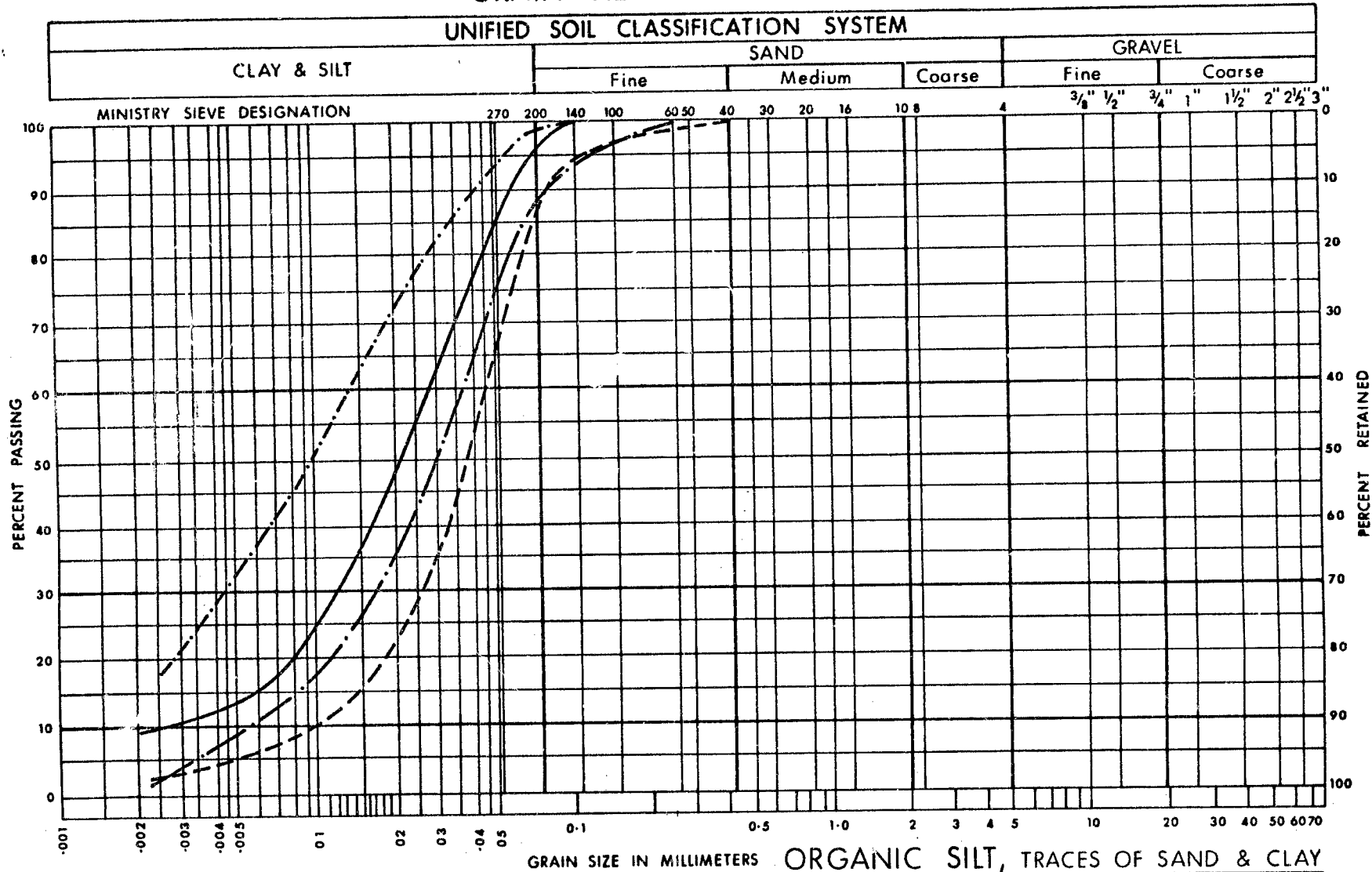


FIG. 1

GRAIN SIZE DISTRIBUTION

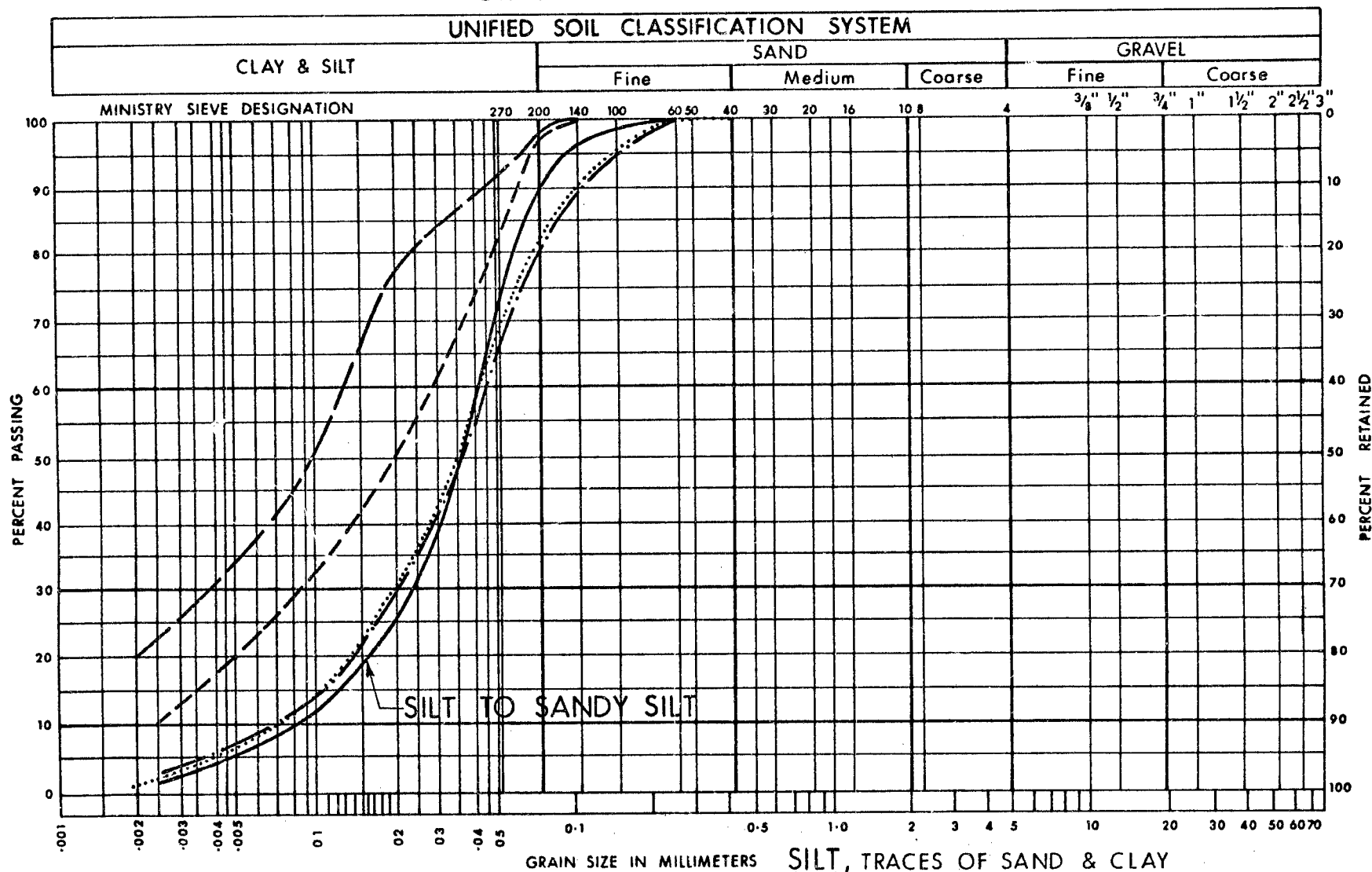
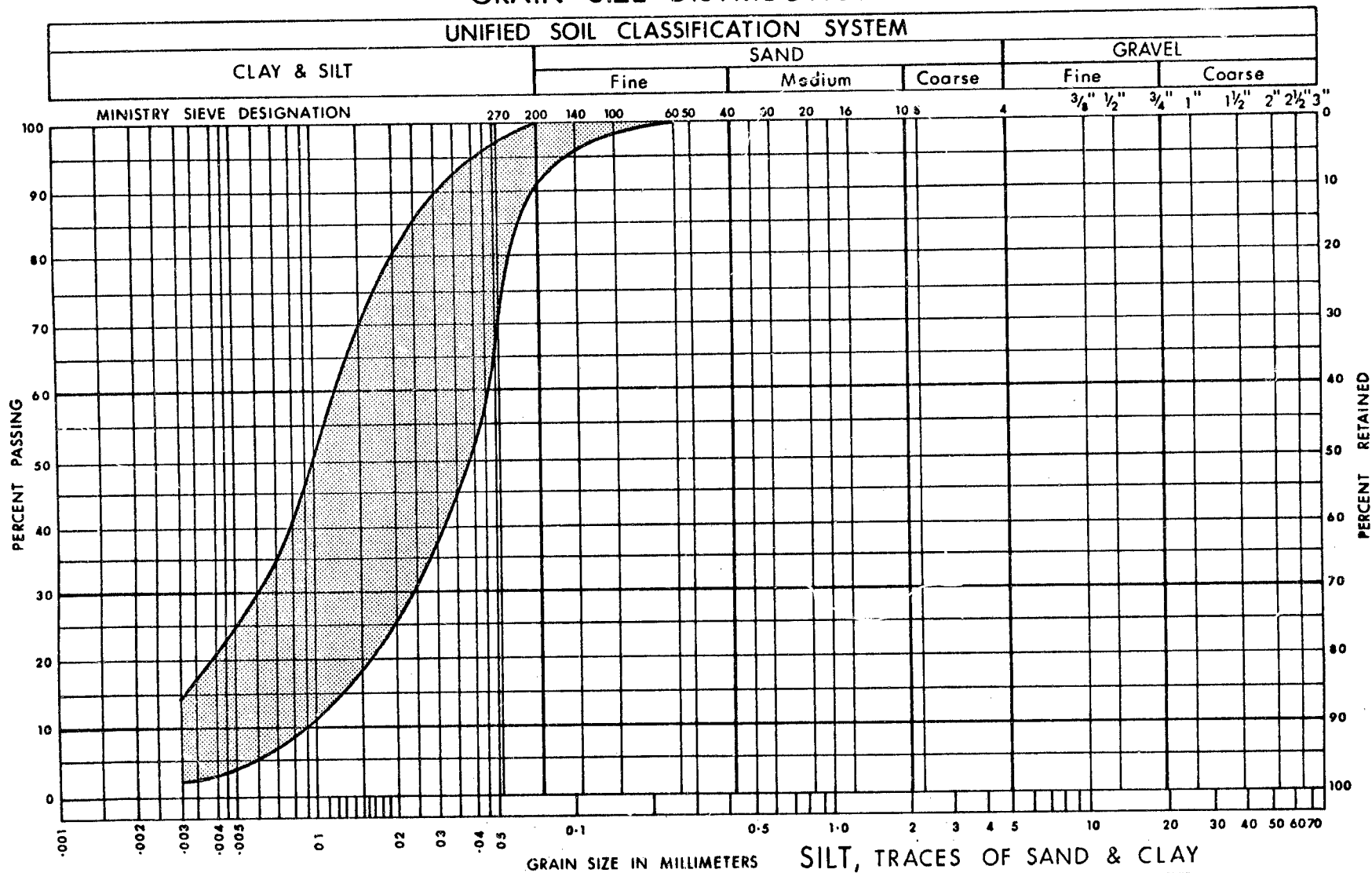


FIG. 2

GRAIN SIZE DISTRIBUTION



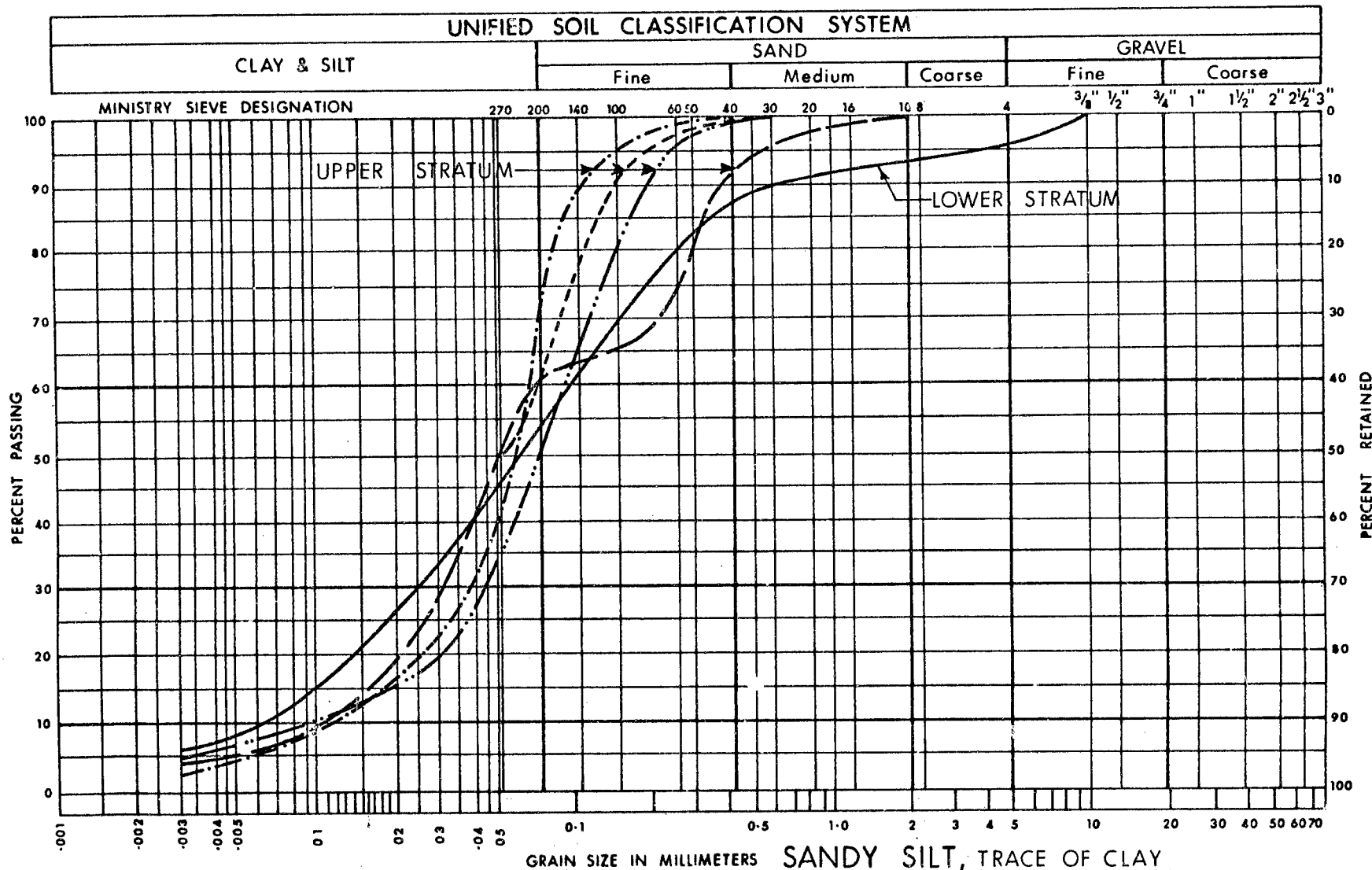
B.H.# 3 & 4

FIG. 3

W.P. 149-73-01

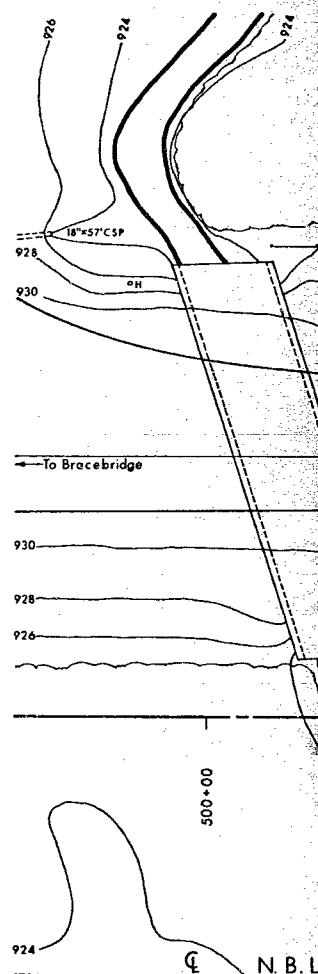
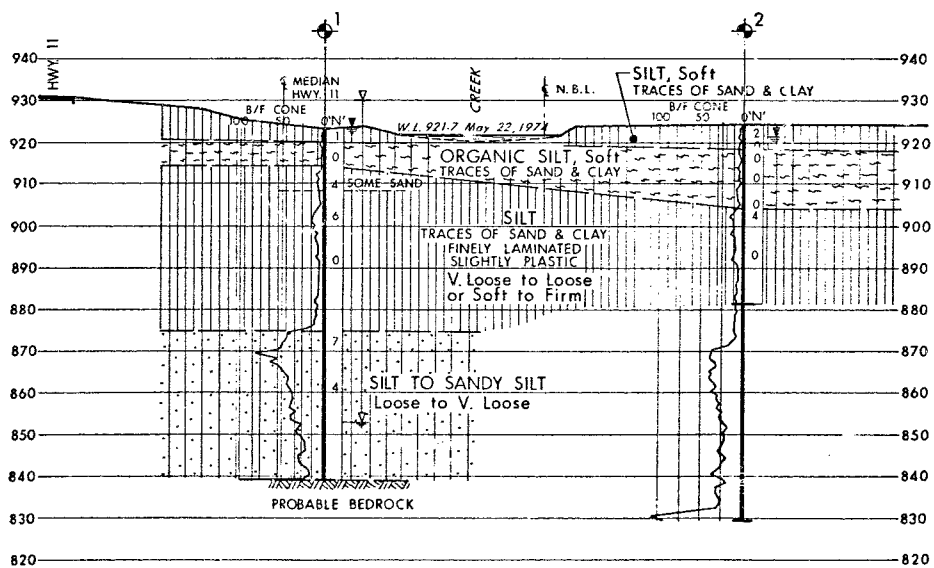
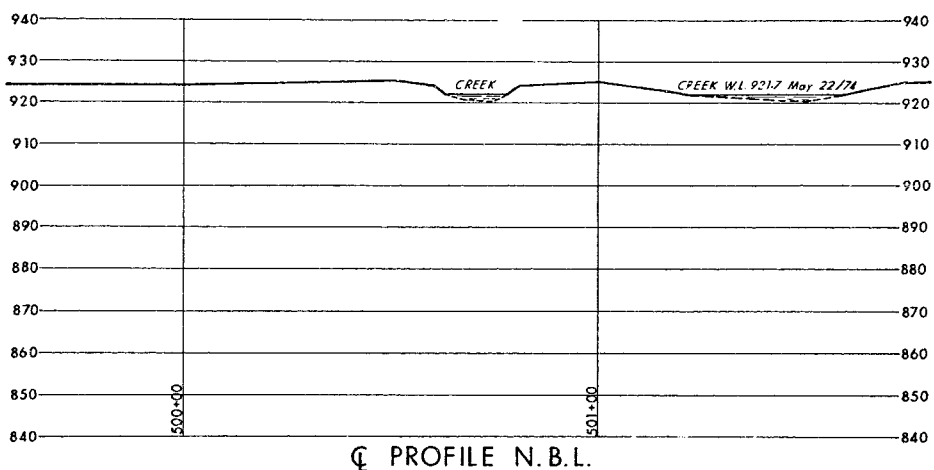
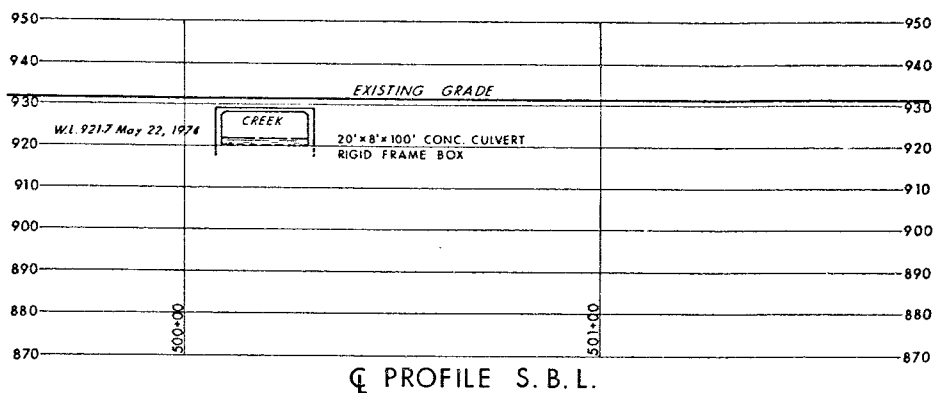
GRAIN SIZE DISTRIBUTION

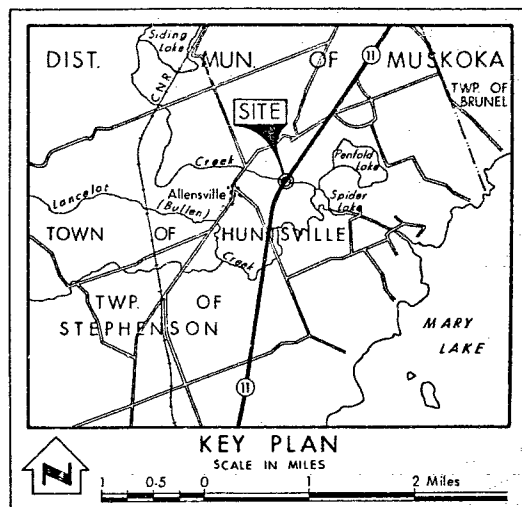
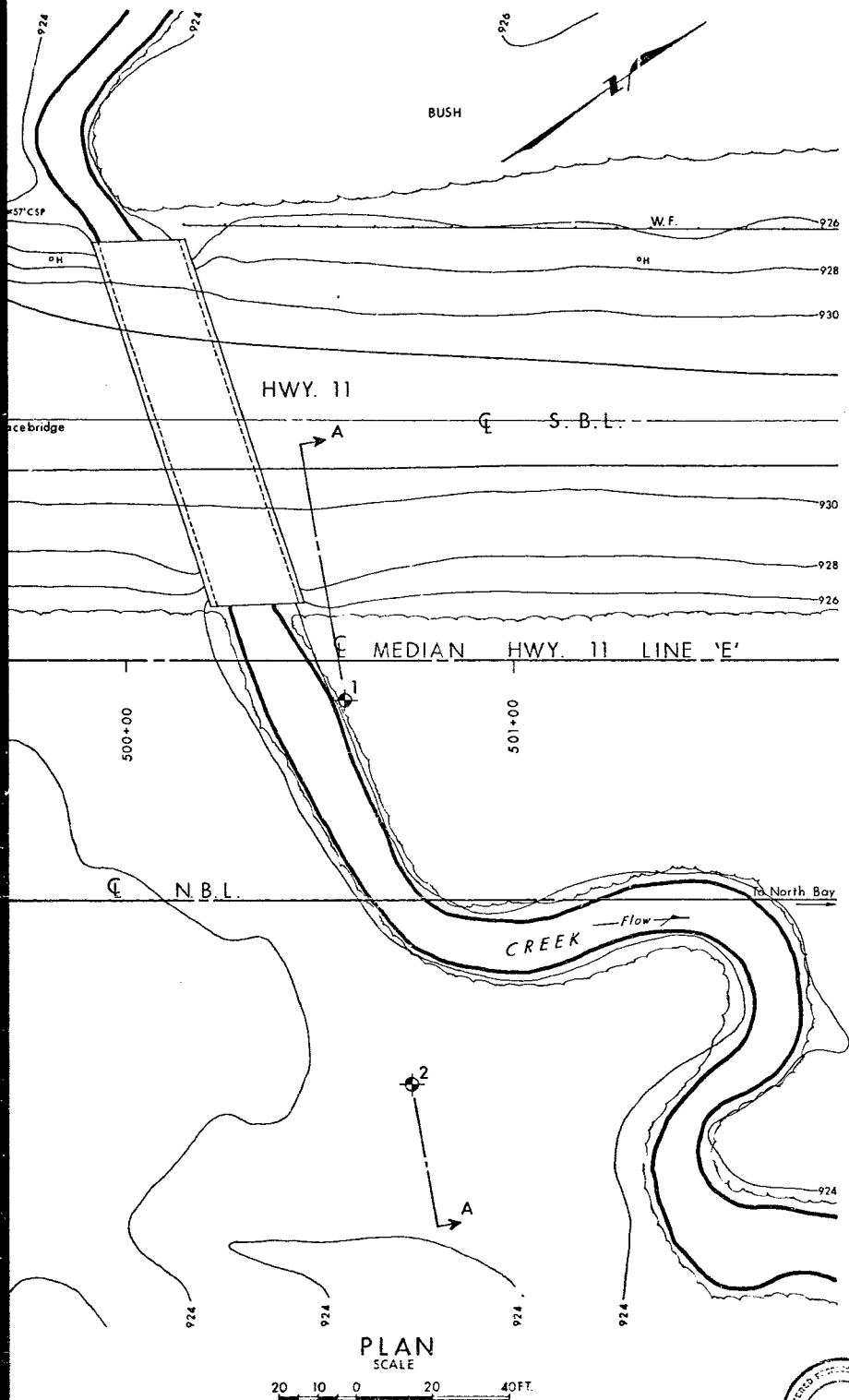
UNIFIED SOIL CLASSIFICATION SYSTEM



SANDY SILT, TRACE OF CLAY
B.H.# 3 & 4

FIG. 4





LEGEND			
	Bore Hole		
	Cone Penetration Test		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation, Oct 31, 1974		
	Head ARTESIAN CONDITIONS Encountered		
NO.	ELEVATION	STATION	OFFSET
1	923.0	500+56	10' RT.
2	924.4	500+74	110' RT.

NOTE: FOR CONTRACT DOCUMENT

The complete foundation investigation report for this structure may be examined at the Structural Office and Foundations Office, Downsview, and at the HUNTSVILLE District Office.

— NOTE —

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
ENGINEERING SERVICES BRANCH—GEOTECHNICAL OFFICE

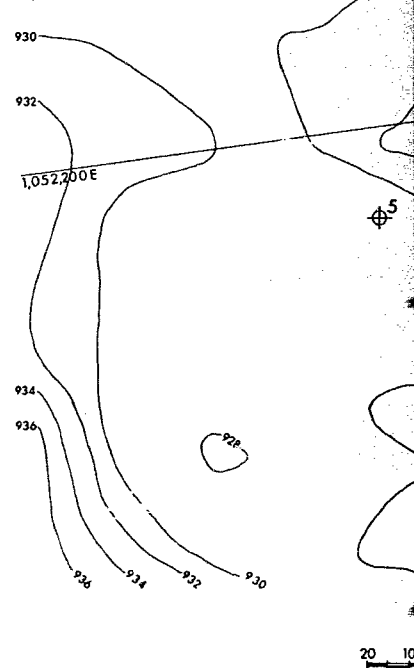
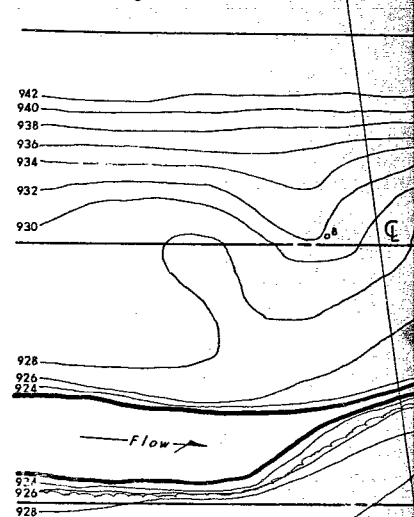
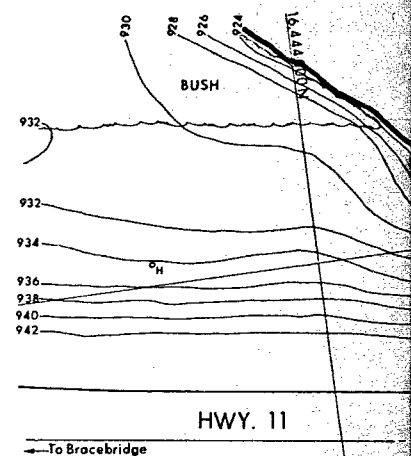
CREEK
APPROX. 0.85 MILE NORTH OF LANCELOT (BULLEN) CREEK

HIGHWAY NO. 11 LINE 'E' DIST. NO. 11
Dist. Mun. of MUSKOKA Town of HUNTSVILLE
TWP. STEPHENSON LOT 27 CON. XI

BORE HOLE LOCATIONS & SOIL STRATA

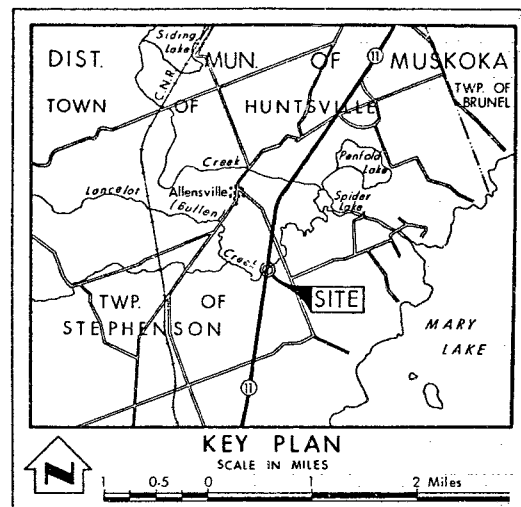
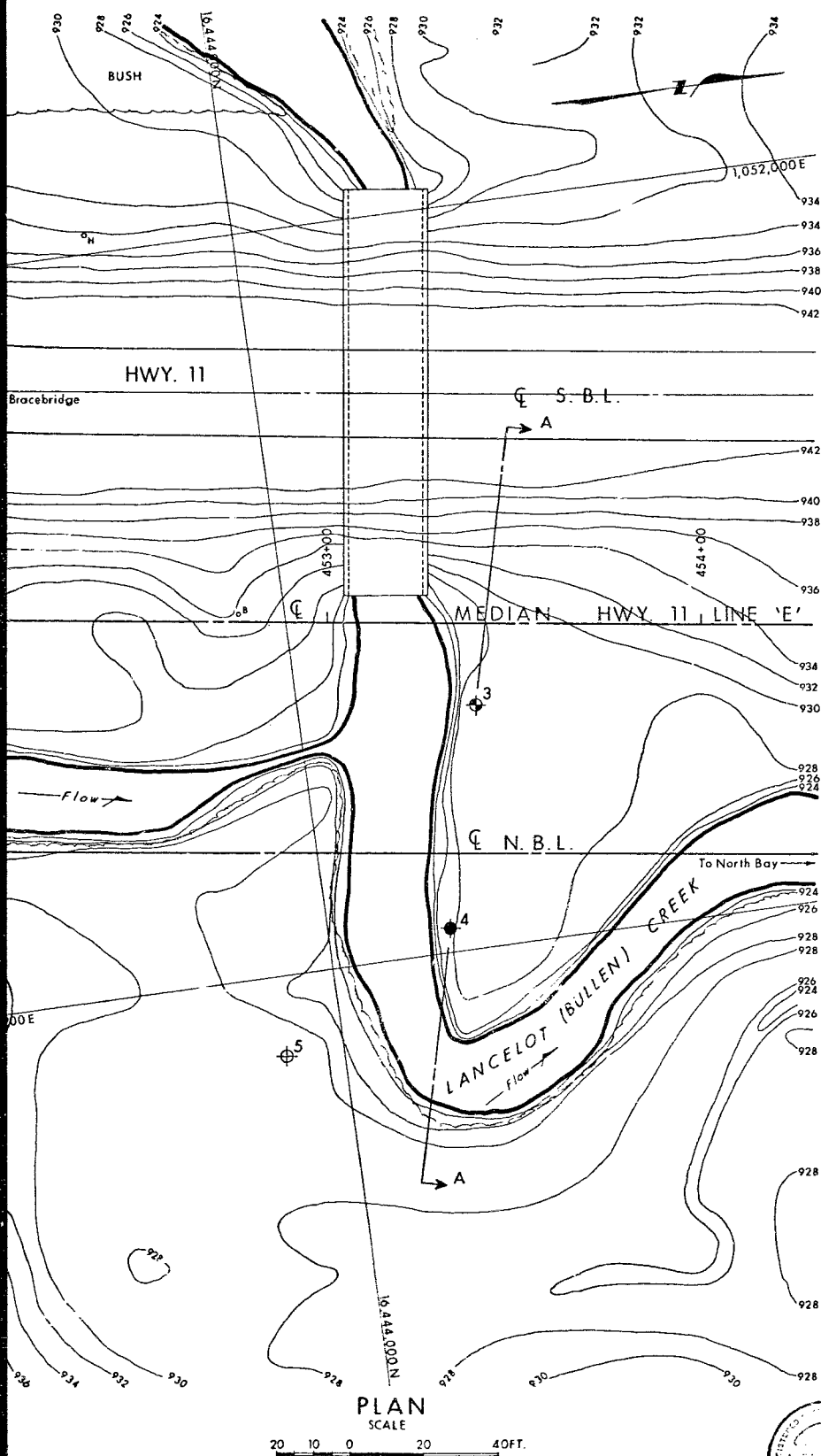
SUBMD A.P.	CHECKED	WP NO. 149-73-01	DRAWING NO.
DRAWN	CHECKED	WO NO.	1497301-A
DATE Dec. 16, 1974	SITE NO.	BRIDGE DRAWING NO.	
APPROVED	CONT. NO.		





SCALE FOR SECTION & PROFILES





LEGEND

- Bore Hole
- ⊕ Cone Penetration Test
- ⊕ Bore Hole & Cone Test
- ≡ Water Levels established at time of field investigation, Nov. 1974
- ⊕ Head ARTESIAN CONDITIONS Encountered

NO.	ELEVATION	STATION	OFFSET
3	929.2	453+80	22' RT.
4	928.8	453+34	82' RT.
5	928.3	452+90	117' RT.

NOTE FOR CONTRACT DOCUMENT

The complete foundation investigation report for this structure may be examined at the Structural Office and Foundations Office, Downsview, and at the HUNTSVILLE District Office.

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
ENGINEERING SERVICES BRANCH—GEOTECHNICAL OFFICE

LANCELOT CREEK (BULLEN CREEK)

HIGHWAY NO. 11 LINE 'E' DIST. NO. 11
Dist. Mun. of MUSKOKA Town of HUNTSVILLE
TWP. STEPHENSON LOT 25 CON X

BORE HOLE LOCATIONS & SOIL STRATA

SUSWD A P	CHECKED	WP NO. 149-73-01	DRAWING NO.
DRAWN	CHECKED	W.O. NO.	1497301-B
DATE Dec. 18, 1974	SITE NO.	BRIDGE DRAWING NO.	
APPROVED	CON. NO.		