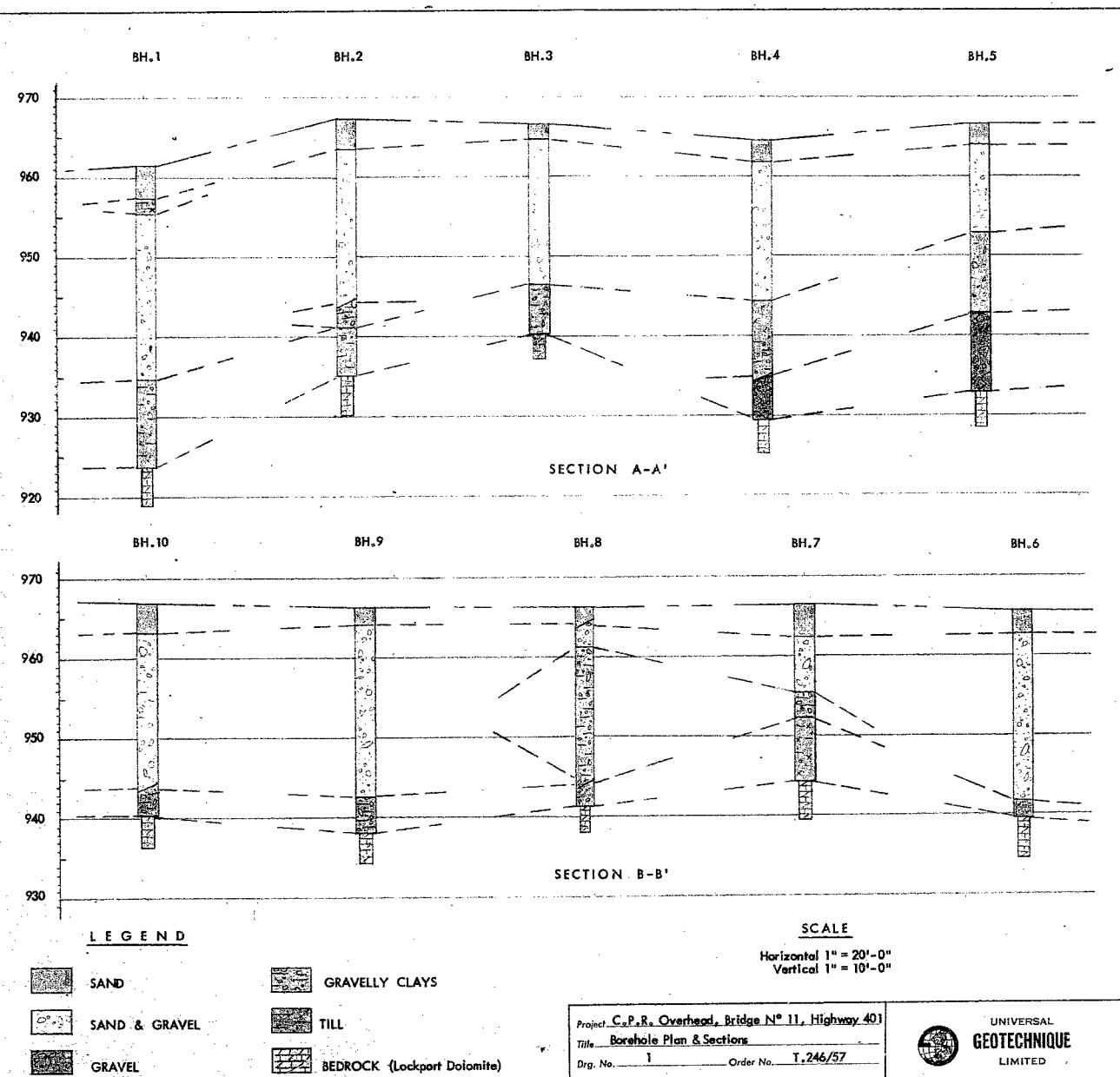
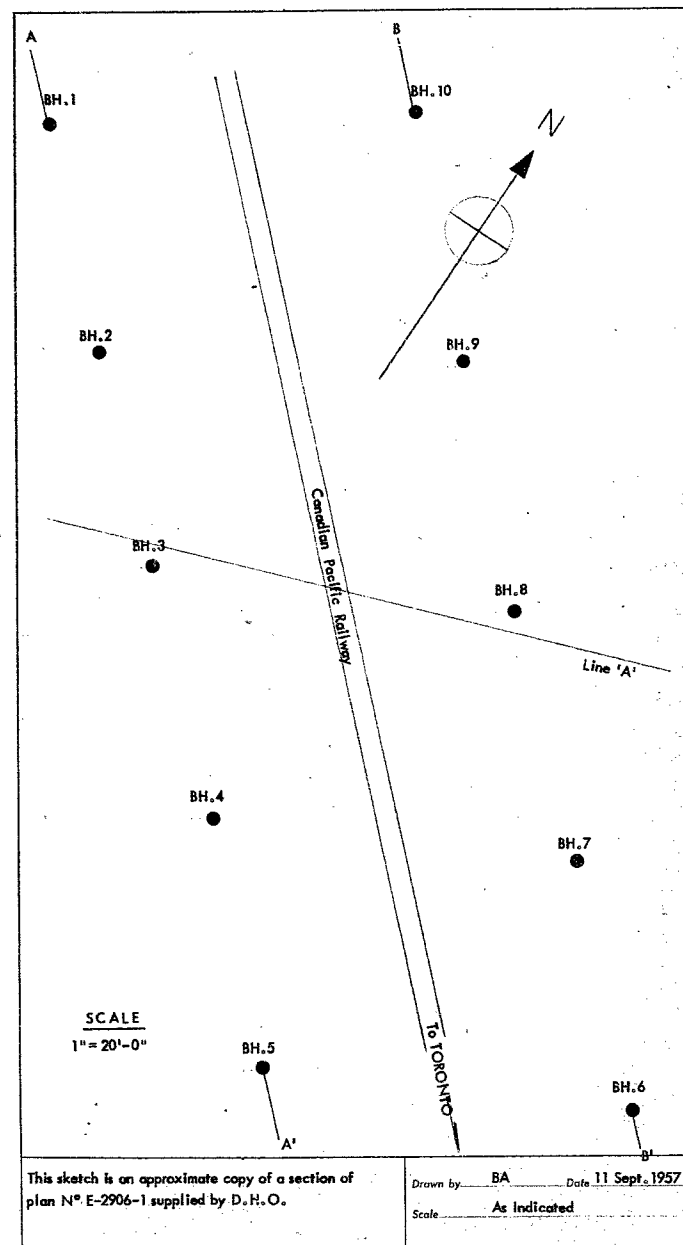


# 57-F-219C  
Hwy # 401  
C.P.R. OVERHEAD  
NASSAGAWAYA  
Twp

NOTED  
FOR MICROFILMING  
BY M.D. DATE 1-11-72



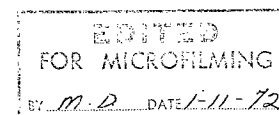
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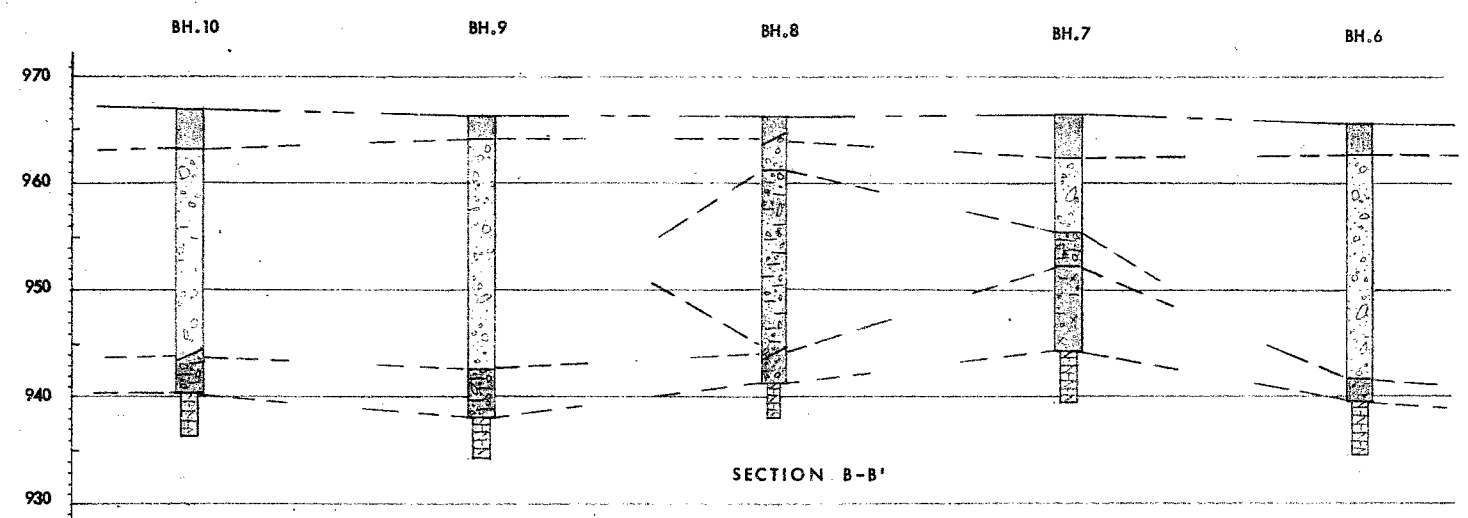
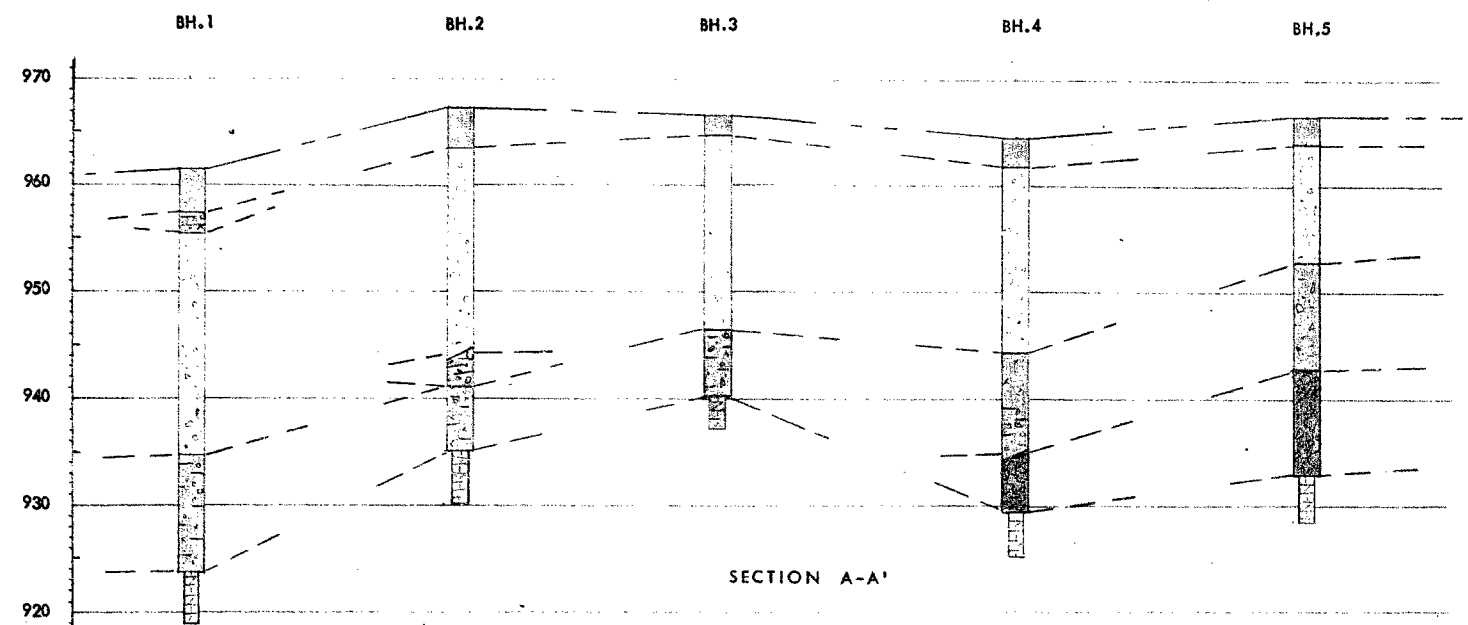
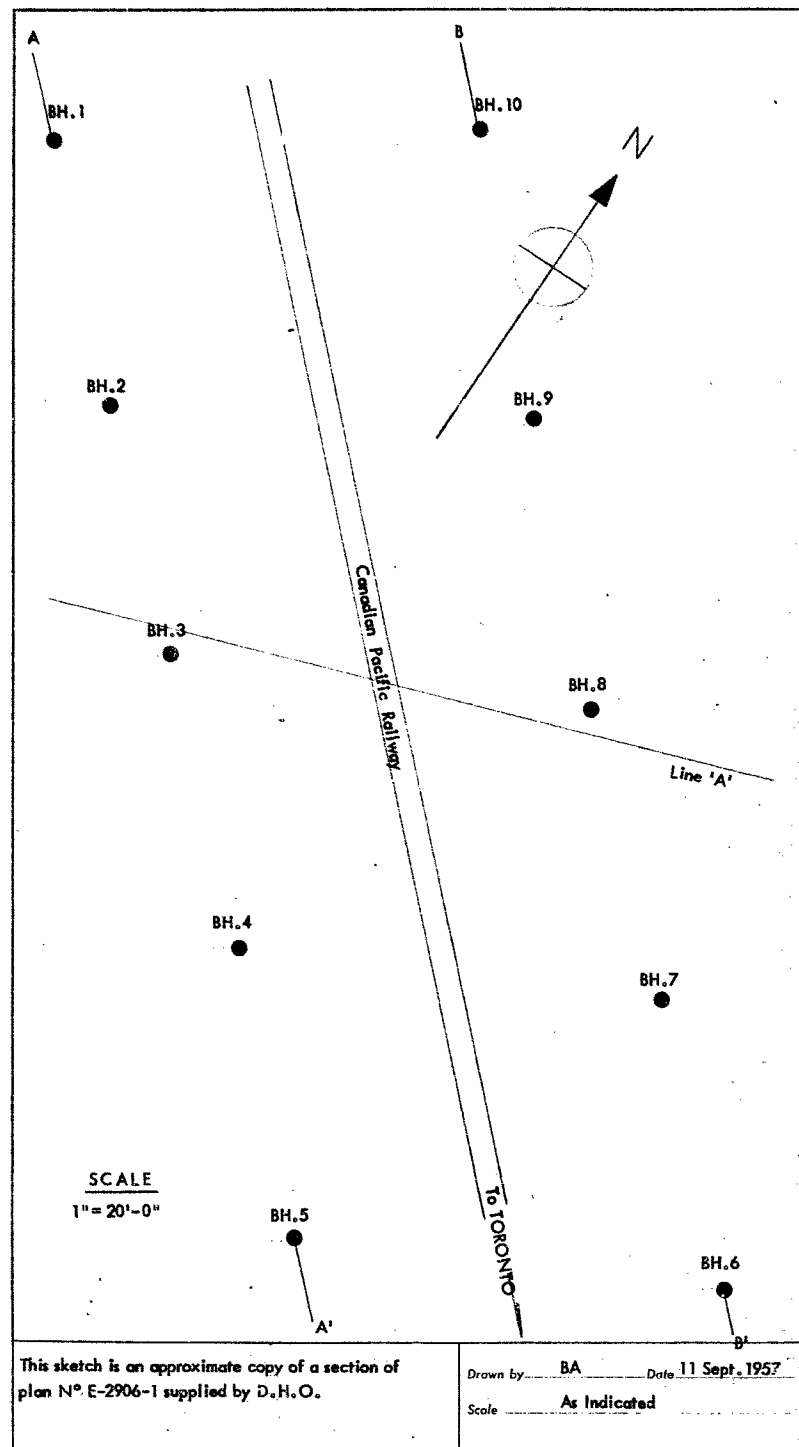
Hwy # 401

C.P.R. OVERHEAD

NASSAGAWEYA

Twp





- LEGEND**
- |  |               |  |                             |
|--|---------------|--|-----------------------------|
|  | SAND          |  | GRAVELLY CLAYS              |
|  | SAND & GRAVEL |  | TILL                        |
|  | GRAVEL        |  | BEDROCK (Lockport Dolomite) |

**SCALE**  
 Horizontal 1" = 20'-0"  
 Vertical 1" = 10'-0"

Project C.P.R. Overhead, Bridge N° 11, Highway 401  
 Title Borehole Plan & Sections  
 Drg. No. 1 Order No. T.246/57



UNIVERSAL  
**GEOTECHNIQUE**

LIMITED



REPORT

on

SUBSURFACE EXPLORATION

for

PROPOSED C.P.R. OVERHEAD

BRIDGE N° 11, HIGHWAY 401

District N° 4

NASSAGAWEYA TOWNSHIP

ONTARIO

2924 Bloor Street West,  
Toronto 18, Ontario.

REPORT

on

SUBSURFACE EXPLORATION

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PROPOSED C.P.R. OVERHEAD

BRIDGE N° 11, HIGHWAY 401

District N° 4

NASSAGAWEYA TOWNSHIP

ONTARIO

INTRODUCTION

The Highways Department of the Province of Ontario are planning the construction of a bridge at the junction of the proposed Highway 401 and the Canadian Pacific Railway Line in Nassagaweya Township.

In order to determine the subsurface conditions for purposes of engineering design, the D.H.O. authorized Universal GEOTECHNIQUE Limited to carry out exploration at the proposed site. Test borings were accordingly carried out during the period 21st of August to 1st of September, 1957, in accordance with the requirements of the Department as shown on drawing N° E-2906-1.

PHYSIOGRAPHIC FEATURES

Physiographically the site is part of the shallow drifts of the Flamborough Plain. A few hundred feet from the site outcrops of the underlying rock formation are to be observed together with a number of somewhat swampy depressions which suggest the possible presence of sink-holes beneath the overburden.

To the East of the site the undulating topography is caused partly by the underlying bedrock and partly by a series of small drumlins following one another and creating an impression of low continuous ridges.

SUBSURFACE EXPLORATION

Subsurface exploration comprised a total of 10 exploratory boreholes located in positions as shown on the plan accompanying this Report. The proposed locations of the boreholes were staked by a D.H.O. Survey Crew,

in accordance with the information given on plan N<sup>o</sup> E-2706-1, and subsequently the positions were slightly revised to facilitate exploration.

Soil samples were obtained at intervals of about 5 feet and where noticeable changes of strata occurred the depths of such changes were recorded.

The state of compaction and consistency were determined by the standard penetration test taken during the operation of soil sampling. (The standard penetration test, as referred to in this Report, involves the recording of the number of blows (N) of a 140 lb. hammer falling 30 inches that are required to drive a 2 inch diameter split barrel sampler 1 foot into the soil at the bottom of the borehole).

Visual examination and classification of all soil samples was carried out in the laboratory and details of the strata encountered and the results of standard penetration tests, together with borehole sections A-A' and B-B' and a borehole location plan, form part of this Report.

Subsurface conditions given in this Report are those indicated by material encountered in the boreholes. The accuracy of extrapolation to obtain the soil profile should be associated directly with the geological conditions and inversely with the spacing of the boreholes.

### GEOLOGICAL FEATURES

From the information derived from the boreholes, it may be concluded that the strata down to the explored depth can be divided into the following categories:

(a) SAND

Under this heading we have included a few inches of topsoil as well as the generally silty fine brown sand which contains limited quantities of organic matter. This material was found to cover the extensive sand and gravel deposits underlying the area.

(b) SAND & GRAVEL

These deposits underlying the site and extensive surrounding areas are, in our opinion, beach deposits of the Lake Warren period. The particle size of the sand varies from fine to coarse whilst the gravel generally does not exceed the medium size. The evidence of bedding observed in the neighbouring gravel pits and the subrounded appearance of the constituent particles is evidence of its lacustrine origin.

(c) GRAVEL

Encountered in borehole BH.4 and BH.5, this deposit is composed essentially of the broken fragments of weathered limestone with occasional subangular to subrounded gravel derived from the overlying till. It is to be noticed that this deposit seems to fill a depression in the bedrock and has escaped the usual transportation by glacial action.

**(d) GRAVELLY CLAYS**

Pockets of gravelly clay were found in boreholes BH.1, 2, 7 and 8. They were found at varying elevations and are purely the product of very limited local depositional changes. We do not believe that such material belongs to the category of glacial till.

**(e) TILL**

This generally reddish brown till of extremely variable composition overlies the bedrock and was encountered in all the boreholes. It varies in composition from a silty fine sand to a gravelly clay and we suspect it to be an accumulation of reworked material belonging to an older till and a series of fluvial and probably lacustrine deposits that have been overridden by the earlier Wisconsin glaciers.

**(f) BEDROCK**

The top few feet of the palaeozoic strata underlying the site are represented here by the Gasport or middle member of the Lockport formation. It consists of nearly white to gray porous dolomite with some horizons exhibiting extensive small solution cavities showing some refilling and secondary crystallization. The dolomite is rather fossiliferous containing an abundance of crinoids and occasional brachiopods. With the exception of the top one or two feet it can be classified as a porous but comparatively sound rock.

During the period of exploration free ground water was encountered generally at an elevation of approximately 54 feet.

**DISCUSSION**

The results of the subsurface exploration indicate that generally essentially cohesionless strata exists at the normal elevation at which spread footings would be located. Below this material there generally exists a small amount of glacial till above the bedrock but in certain boreholes, BH.8 being a particular example, the strata consisted principally of gravelly clay and this has been attributed to local depositional changes.

If it is assumed that the foundations to the proposed bridge will be located at approximately elevation 956, normal spread footings could be adopted but the allowable bearing capacity would be limited to 3000 lbs./sq.ft. Such a low intensity of pressure would result in fairly large footings if the structure was of substantial size and because of the relative lack of density at certain elevations in the sand and gravel, it is thought advisable to consider the possibility of compacting the strata. It is, therefore, suggested that sand piles could be driven beneath the intended positions of the footings so as to compact the cohesionless material to a greater and more uniform relative density and if such an expedient was adopted then a safe bearing capacity of 6000 lbs./sq.ft. could be adopted.

The safe bearing capacity is higher than indicated in the previous paragraph but considerations of settlement make the foregoing limiting values advisable.



Probably the most satisfactory alternative to the foregoing proposal would be steel bearing piles driven to rock but if the loading from the proposed structure is not unduly severe, it is considered that spread footings can be adopted with satisfactory results.

Referring now to the approaches to the bridge, we foresee no particular problems unless the fill was to encroach on the area of swampy ground adjacent to the bridge site.

### CONCLUSIONS

If spread footings are to be adopted for the foundations of this bridge, it is considered that sand piles driven below the locations of such footings may possibly be a useful expedient in increasing the allowable bearing capacity and at the same time reducing settlement due to the variation in density of the material as it exists in its natural state.

At the moment the allowable bearing capacity should not be taken as more than 3000 lbs./sq.ft. but by proper compaction with sand piles the allowable bearing capacity could easily be increased to 6000 lbs./sq.ft.

If the structure is particularly heavily loaded then the alternative would be to drive steel piles to bedrock.

Universal GEOTECHNIQUE Limited,



L. Baskin, P.eng.,  
Engineering Geologist.

Report N° T.246/57

September, 1957.

## SOIL MECHANICS LABORATORY

## BOREHOLE LOG

PROJECT C.P.R. Overhead, Bridge N° 11, Highway 401, Nassagaweya Twp. ORDER NO. T.246/57  
 CLIENT Department of Highways, Ontario.

BOREHOLE NO. BH.1 DIAMETER 2-1/2" CASING 2-1/2"  
 BOREHOLE LOCATION See Plan INCLINATION Vertical BEARING       

FORM G-1A 500  
 (UNITED STATES OF AMERICA)

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
Firm brown fine to coarse SAND. Little clay and some organic matter.	961.4		● 1	Zero		12	Damp. Low to medium dry strength.
Firm brown very sandy CLAY with fine rounded GRAVEL and black organic concentrations.			● 2	4'-0"	Water Seepage	6	Wet. Medium to high dry strength.
Dense brown fine to coarse SAND and fine subrounded GRAVEL, little clay.			● 3	6'-0"	Free Water	39	Wet. Medium dry strength.
Firm do			● 4			23	do
Dense do			● 5			33	do
Firm brown fine to coarse subrounded to subangular SAND.			● 6			21	Wet. No dry strength.
Dense reddish brown calcareous clayey SAND & GRAVEL. Gravel generally fine subangular to subrounded.			● 7	26'-6"		30	Wet. Medium dry strength.
Firm reddish brown calcareous clayey silty fine SAND.			● 8			22	do
White grey to grey porous dolomite, jointed. Joints generally parallel to core length and slightly stained. Solution cavities exhibit secondary crystallization. Rock weathered and somewhat broken. Gasport member of the Lockport formation.				37'-6"			37'-6" to 42'-6" Core Recovery 56%
				42'-6"			End of Borehole

SCALE: 1" = 5'-0"

● DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

## SOIL MECHANICS LABORATORY

**BOREHOLE LOG**PROJECT C.P.R. Overhead, Bridge N° 11, Highway 401, Nassagaweya Twp. ORDER NO. I.246/57CLIENT Department of Highways, Ontario.BOREHOLE NO. BH.2 DIAMETER 2-1/2" CASING 2-1/2"BOREHOLE LOCATION See Plan INCLINATION Vertical BEARING —FORM G-1A 500  
(UNIDISTURBED)

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
Loose brown fine silty SAND with little organic matter.	967.2		● 1	Zero		7	Damp. No dry strength.
Dense brown fine to coarse SAND with fine to medium subangular to subrounded GRAVEL.			● 2	3'-9"		37	do
Very dense do			● 3			57	do
Dense do			● 4			29	do
do			● 5			45	Moist. No dry strength.
Hard brown calcareous very sandy gravelly CLAY. Gravel angular to subangular.			● 6	26'-0"		35	Moist. Medium to high dry strength.
Very stiff reddish brown clayey sand and gravel.			● 7	27'-6"		29	Wet Medium dry strength.
Dense reddish brown calcareous silty clayey fine SAND.							
White grey to grey porous dolomite. Some jointing at 45° to core length. Exhibits partly refilled solution cavities and fossiliferous horizons. (Crinoids and brachiopods). Broken rock 31' to 32'. Weathered rock 32' to 37'. Gasport member of the Lockport formation.				32'-0"			32'-0" to 37'-0" Core Recovery 50%.
				37'-0"			
			End of Borehole				

SCALE: 1" = 5'-0" • DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

SOIL MECHANICS LABORATORY

BOREHOLE LOG

PROJECT

C.P.R. Overhead, Bridge N° 11, Highway 401, Nassagaweya Twp.

ORDER NO.

T.246/57

CLIENT

Department of Highways, Ontario.

BOREHOLE NO.

BH.3

DIAMETER

2-1/2"

CASING

2-1/2"






BOREHOLE LOCATION

See plan

INCLINATION

Vertical

BEARING

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
Loose brown fine to medium SAND with gravel. Some organic matter.	966.6		• 1	Zero		8	Damp No dry strength.
			• 2	2'-0"		37	do
			• 3			32	do
			• 4			38	do
do				Free Water			
Firm do with clayey concentrations			• 5			26	Wet. Low to medium dry strength.
Firm brown medium to coarse SAND with fine gravel.			• 6	18'-6" 20'-0"		23	Wet No dry strength.
Hard reddish brown calcareous very sandy gravelly CLAY. Gravel subangular to subrounded.			• 7			31	Wet. Medium to high dry strength.
White gray porous dolomite with partly refilled solution cavities. Fossiliferous horizons. (Crinoids). Gasport member of Lockport formation.				26'-3" 29'-3"			26'-3" to 29'-3" Core Recovery 92%
			End of Borehole				

## SOIL MECHANICS LABORATORY

**BOREHOLE LOG**

PROJECT C.P.R. Overhead, Bridge N° 11, Highway 401, Nassagaweya Twp. ORDER NO. T.246/57  
 CLIENT Department of Highways, Ontario.

BOREHOLE NO. BH.4 DIAMETER 2-1/2" CASING 2-1/2"  
 BOREHOLE LOCATION See Plan INCLINATION Vertical BEARING —

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
	964.5			Zero			
Loose brown fine silty SAND with some organic matter.			● 1	2'-5"		7	Damp. No dry strength.
Firm brown fine to coarse SAND with fine subangular to subrounded GRAVEL.			● 2			16	do
do			● 3			19	do
do			● 4			19	Moist No dry strength.
do With little clay.			● 5			16	Wet. Low dry strength.
do			● 6	20'-0"		15	do
Firm reddish brown fine calcareous silty SAND.			● 7			18	do
Hard reddish brown calcareous very sandy gravelly CLAY, gravel fine to medium subangular to subrounded.			● 8	25'-9"		35	do
Dense GRAVEL with fragments of badly weathered dolomite.			● 9			47	
Light grey porous dolomite. Exhibits partly refilled solution cavities and fossiliferous horizons (Crinoids). Fairly sound rock. Gasport member of the Lockport formation.				35'-0"			
				39'-0"			35'-0" to 39'-0" Core Recovery 75%
				End of Borehole			

SCALE: 1" = 5'-0"

● DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

## SOIL MECHANICS LABORATORY

**BOREHOLE LOG**PROJECT C.P.R. Overhead, Bridge N° 11, Highway 401, Nassagaweya ORDER NO. T.246/57CLIENT Department of Highways, Ontario. Twp.BOREHOLE NO. BH.5 DIAMETER 2-1/2" CASING 2-1/2"BOREHOLE LOCATION See Plan INCLINATION Vertical BEARING ---

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
Loose brown fine silty SAND. Traces of organic matter.	966.6		• 1	Zero		5	Damp. No dry strength.
Loose brown fine to coarse SAND and fine to medium GRAVEL, subangular to subrounded.			• 2	2'-7"		7	do
Firm do			• 3			19	do
do With little clay.			• 4			28	Moist. Low dry strength.
					Free Water		
Firm brown to reddish brown fine to coarse SAND with fine to medium gravel, subangular to subrounded. Little clay.			• 5	13'-8"		19	Wet. Low dry strength.
do			• 6			19	do
Dense fine to medium GRAVEL. Fragments of weathered dolomite.			• 7	23'-9"		53	
do			• 8			49	
Grayish white to grey porous dolomite. Partly filled solution cavities. Rock weathered and broken. Gasport member of the Lockport formation.				33'-7"			33'-7" to 38'-0" Core Recovery 33%.
				38'-0"			
				End of Borehole			

FORM G-1A 500  
UNITED STATIONERS, CO.

SCALE: 1" = 5'-0" • DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

## SOIL MECHANICS LABORATORY

**BOREHOLE LOG**PROJECT C.P.R. Overhead, Bridge N° 11, Highway 401, Nassagaweya Twp. ORDER NO. T.246/57CLIENT Department of Highways, Ontario.BOREHOLE NO. BH.6 DIAMETER 2-1/2" CASING 2-1/2"BOREHOLE LOCATION See Plan INCLINATION Vertical BEARING ---

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
Loose brown silty fine SAND with little organic matter.	965.7		● 1	Zero		8	Damp. No dry strength.
Firm brown fine to coarse SAND and fine to medium GRAVEL, subangular to subrounded.			● 2	3'-0"		18	do
Dense do			● 3	Free Water		34	do
Loose do With clayey concentrations			● 4			14	Wet Medium dry strength.
Dense do With little clay.			● 5			45	Wet. Low to medium dry strength.
Very dense reddish brown calcareous fine silty SAND.			● 6	24'-0"		66	do
Greyish white to grey porous dolomite. Exhibits partly filled solution cavities. Sound rock. Gasport member of the Lockport formation.				26'-0"			26'-0" to 31'-0" Core Recovery 93%
				31'-0"			End of Borehole

SCALE: 1" = 5'-0" ● DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

## SOIL MECHANICS LABORATORY

**BOREHOLE LOG**PROJECT C.P.R. Overhead, Bridge N° 11, Highway 401, Nassagaweya Twp. ORDER NO. T.246/57CLIENT Department of Highways, Ontario.BOREHOLE NO. BH.7 DIAMETER 2-1/2" CASING 2-1/2"BOREHOLE LOCATION See Plan INCLINATION Vertical BEARING —

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
Loose brown fine silty SAND with little organic matter.	966.4		• 1	Zero		10	Damp No dry strength.
Dense brown fine to coarse SAND and fine to medium GRAVEL, subangular to subrounded.			• 2	4'-0"		37	do
Firm do			• 3	11'-0"	Free Water	12	do
Stiff yellow brown sandy gravelly CLAY. Gravel subangular to subrounded.			• 4	14'-3"		27	Wet. Low to medium dry strength.
Firm purplish brown silty fine SAND with little clay and occasional fine to medium subangular to rounded gravel.			• 5				
Dense do			• 6	22'-0"		44	
Grey somewhat porous dolomite. Occasional stained jointing at about 15° to core length. Some solution cavities. Gasport member of the Lockport formation.				27'-0"			22'-0" to 27'-0" Core Recovery 87%.
				End of Borehole			

FORM G-1A 500  
LIMITED STATION BY G.S.

SCALE: 1" = 5'-0"

• DISTURBED SAMPLE

■ UNDISTURBED SAMPLE



## SOIL MECHANICS LABORATORY

**BOREHOLE LOG**

PROJECT C.P.R. Overhead, Bridge N° 11, Highway 401, Nassagaweya Twp. ORDER NO. I.246/57  
 CLIENT Department of Highways, Ontario.

BOREHOLE NO. BH.8 DIAMETER 2-1/2" CASING 2-1/2"  
 BOREHOLE LOCATION See Plan INCLINATION Vertical BEARING —

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
Loose brown fine silty SAND with little organic matter.	966.2		1	Zero		6	Damp Low dry strength,
Firm brown fine silty SAND with fine to medium subangular to rounded gravel. Little organic matter.			2	5'-0"		13	do
Dense brown fine to coarse clayey SAND with fine to medium subangular to subrounded gravel.			3			37	Moist. High dry strength.
Stiff reddish brown to light brown sandy gravelly CLAY. Gravel fine to medium, subangular to rounded.			4			13	do
Very Stiff do With sandy concentrations.			5			29	do
Dense reddish brown fine silty SAND with some gravel.			6	25'-0"		43	Wet. Low dry strength.
Greyish white to grey somewhat porous dolomite. Stained jointing at about 30° to core length. Exhibits fossiliferous horizons (Crinoids). Broken rock. Gasport member of the Lockport formation.				28'-0"			25'-0" to 28'-0" Core Recovery 55%.
		End of Borehole					

SCALE: 1" = 5'-0"

• DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

## SOIL MECHANICS LABORATORY

**BOREHOLE LOG**PROJECT C.P.R. Overhead, Bridge N° 11, Highway 401, Nasagaweya Twp. ORDER NO. T.246/57CLIENT Department of Highways, Ontario.BOREHOLE NO. BH.9 DIAMETER 2-1/2" CASING 2-1/2"BOREHOLE LOCATION See Plan INCLINATION Vertical BEARING       FORM G-1A 500  
LIMITED STATUTORY CORP.

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
Loose brown silty fine to medium SAND with fine gravel. Traces of organic matter.	966.3		• 1	Zero		6	Damp. No dry strength.
Dense brown fine to coarse SAND and fine to medium subangular to subrounded GRAVEL.			• 2	2'-1"		39	do
do			• 3			37	do
do			• 4			33	do
				Free Water			
Firm do With little clay.			• 5			16	Wet. Low dry strength.
do			• 6			16	do
Stiff light brown to reddish brown sandy gravelly CLAY. Gravel fine to medium, subangular to subrounded.			• 7	23'-9"		14	Wet. Medium to high dry strength.
Greyish white to grey porous dolomite. Exhibits partly filled solution cavities and fossiliferous horizons (Crinoids and brachiopods). Gasport member of the Lockport formation.				28'-3"			28'-3" to 32'-0" Core Recovery 89%.
				32'-0"			End of Borehole

SCALE: 1" = 5'-0"

• DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

## SOIL MECHANICS LABORATORY

**BOREHOLE LOG**

PROJECT C.P.R. Overhead, Bridge N° 11, Highway 401, Nassagaweya Twp. ORDER NO. T.246/57  
 CLIENT Department of Highways, Ontario.

BOREHOLE NO. BH. 10 DIAMETER 2-1/2" CASING 2-1/2"

BOREHOLE LOCATION See Plan INCLINATION Vertical BEARING ————

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
Loose brown SAND with fine gravel. Traces of organic matter.	966.9		• 1	Zero		5	Damp No dry strength.
Cavity.				1'-10"			
Firm brown fine to coarse SAND and fine to medium gravel, subangular to subrounded.			• 2	4'-0"		12	do
Dense do			• 3			30	do
do			• 4	10'-6"		31	Moist. No dry strength.
Firm do With clayey concentrations.			• 5			25	Moist. Low to medium dry strength.
do Little clay.			• 6			16	Wet Low dry strength.
Stiff reddish brown calcareous sandy gravelly CLAY. Gravel fine to medium, subangular to rounded.			• 7	26'-6"		14	Wet. Medium to high dry strength.
Grayish white porous dolomite with fossiliferous horizons. Extensive solution cavities partly filled. Exhibits secondary crystallization. Some jointing at 30° and perpendicular to core length, slight staining. Sound rock. Gasport member of the Lockport formation.				30'-6"			26'-6" to 30'-6" Core Recovery 92%
				End of Borehole			

FORM G-1A 500  
UNIVERSITY OF TORONTO

SCALE: 1" = 5'-0" • DISTURBED SAMPLE

■ UNDISTURBED SAMPLE