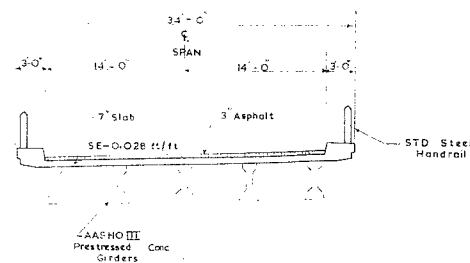
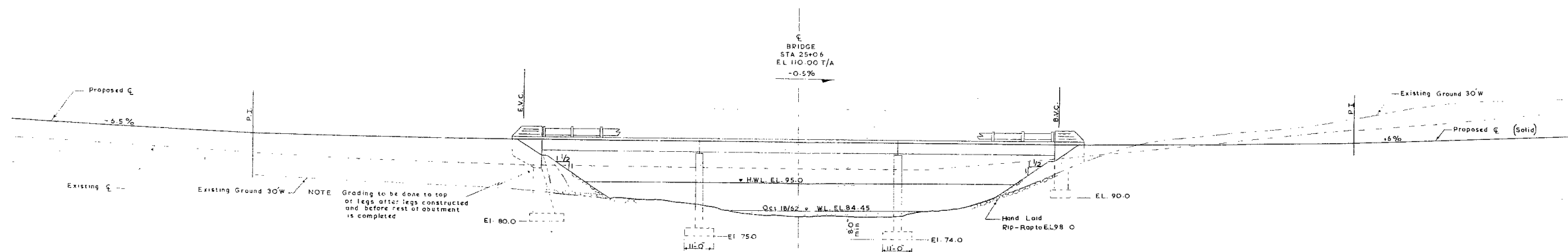
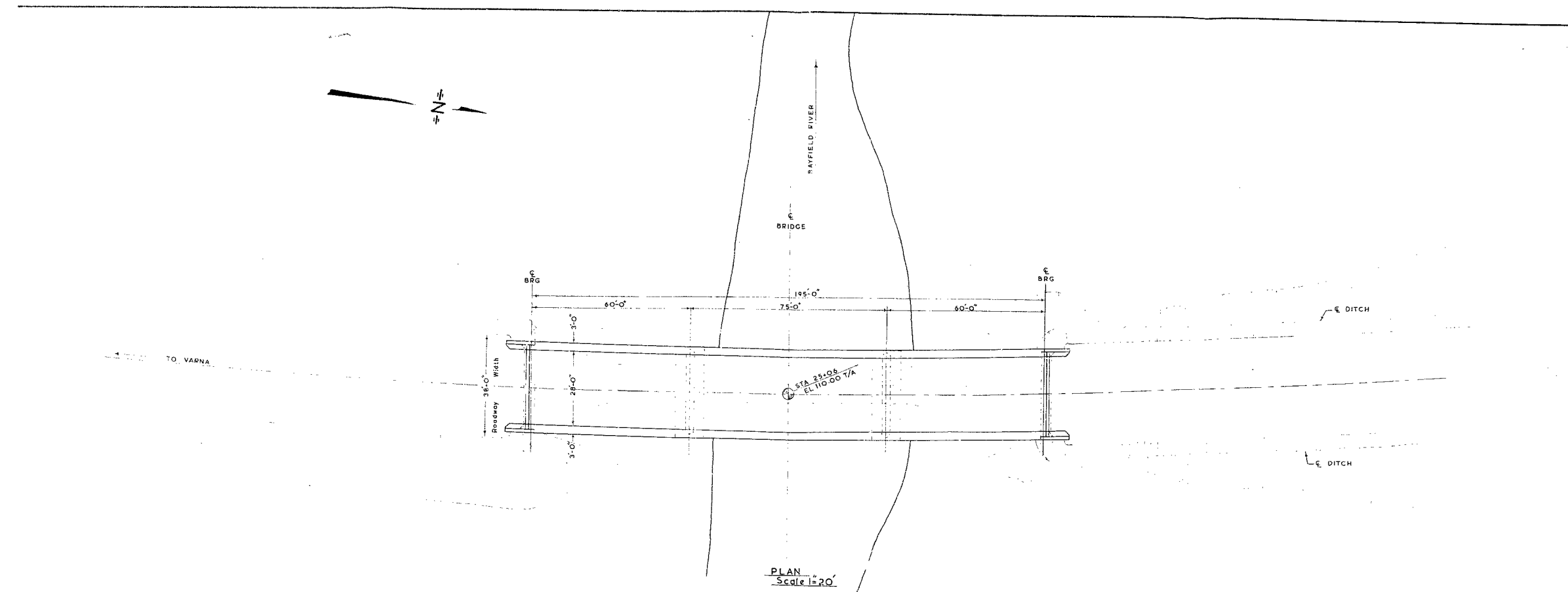
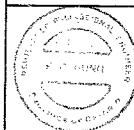


60-F-325M  
COUNTY RD. # 31  
BAYFIELD RIVER  
BRIDGE B-54



COUNTY OF HURON J. W. BRITNELL COUNTY ENGINEER B. M. ROSS CONSULTING ENGINEER		
OWNER CO OF HURON		
C.O. HURON	ROAD No 31	
TWP GODERICH	LOT 28	BAYFIELD CON
<div style="display: flex; justify-content: space-between;"> <div>  </div> <div> <div>DATE Jan. 3, 1953</div> <div>DESIGN ENGINEER B. M. ROSS</div> </div> </div>		
LOADING H20 S16	BRIDGE No BR-71	DWG No BR-71-3

MEMORANDUM

TO: Mr. A. Stermac,  
Principal Foundations Engineer,  
Materials & Research Section.

FROM: Mr. G.C.E. Burkhardt,  
Bridge Division.

DATE: February 27th, 1963.

OUR FILE REF.


IN REPLY TO

SUBJECT: County of Huron,  
Bridge over Bayfield River,  
Township of Goderich,  
Lot 28, Bayfield Con.,  
Structure Site No. 13-190,  
Our File No. B.A. 1583.

Attached please find one copy of the Foundation Report, by Universal Geotechnique Limited, and one copy of the Preliminary plans for your comments.

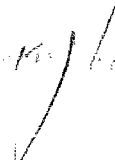
We intend to approve the plans as soon as possible. Therefore we would appreciate it very much, if we could have your comments at your earliest convenience.

GB:ap

  
G. C. E. Burkhardt,  
for K. L. Kleinsteinber,  
Municipal Bridge Liaison Engineer.

*Reviewing plans*

*No comment*

*OK*  
  
*27/2/63*

BA 1583

UNIVERSAL  
**GEOTECHNIQUE**  
LIMITED



REPORT

on

FOUNDATION INVESTIGATION

at

BRIDGE B-54

near VARNA

COUNTY OF HURON

ONTARIO

C. E. 100/1

Report N° T. 457/60

100 University Avenue  
Toronto 1, Ontario.

REPORT

on

FOUNDATION INVESTIGATION

at

BRIDGE B-54near VARNACOUNTY OF HURONONTARIOINTRODUCTION

The County Engineer of Huron, Mr. J. W. Britnell, is proposing the replacement of the existing steel truss bridge B-54 carrying the County Road over the Bayfield River at a point about one and a quarter miles north of Varna, and Universal GEOTECHNIQUE Limited were requested to carry out subsurface exploration to ascertain the soil conditions with regard to foundation design and this Report contains the pertinent data and recommendations.

AVAILABLE INFORMATION

It is understood that tentative designs for the new bridge envisage a structure having an overall length of about 180 feet and comprising three spans with construction either in continuous steel or reinforced concrete beams.

THE SITE

The new bridge will be located on the same site as the existing structure situated about 1-1/4 miles north of Varna and carrying the County Road N° 31 across the Bayfield River as shown on the Key Plan, drawing N° 1.

SUBSURFACE EXPLORATION

Subsurface exploration was carried out during the period 24th to the 30th of September, 1960 and consisted of 4 exploratory boreholes in locations as shown on drawing N° 2 accompanying this Report.

The borings were staked and the ground surface elevations obtained by the Staff of GEOTECHNIQUE, the elevations being relative to the centre of the deck of the existing bridge at mid-span with an assumed elevation of 100.0.

Soil samples were obtained at intervals of 2-1/2 feet down to a depth of 15 feet and thereafter the spacing was increased to about 5 feet and where noticeable changes of strata occurred the depths of such changes were recorded.

A borehole was located near the proposed position of each abutment and the two piers.

The state of compaction of essentially cohesionless strata and the general consistency of cohesive strata was determined by means of standard penetration tests 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 the results of such examination together with the values of the standard penetration test are given on the borehole logs which form part of this Report. Also included is a geological section A-A', a key plan, and a borehole location plan.

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

The site of the proposed bridge is situated in a valley that was eroded by the Bayfield River in the central section of the Wyoming moraine. The southern section of this moraine is known to have been buried under the waters of glacial Lake Whittlesey, and judging from the results of the exploration at the site it is quite possible that some horizons in the central part of the moraine were also formed under submerged conditions.

From the information obtained from the investigation it may be concluded that the strata down to the explored depths can be classified as follows:

### TOP SOIL

A thin cover of brown loam containing organic matter exists in the vicinity of borehole BH.2B and beneath the fill in boreholes BH.1 and 3.

### FILL

Loose to firm sand and gravel to a thickness of about 10 feet was recorded in boreholes BH.1 and 3.

### ALLUVIAL DEPOSITS

From 2 to nearly 5 feet of sand, gravel and boulders sometimes containing lenses of clay and organic concentrations were encountered in boreholes BH.2B, 3 and 4.

LACUSTRINE DEPOSITS

Up to 17 feet of very stiff to hard silty brown clays interbedded with dense silts containing occasional gravel was recorded in boreholes BH.2B, 3 and 4.

TILL

Firm to dense brown clayey silty sand and hard brown sandy clay containing fine to coarse gravel underlie the fill and topsoil in borehole BH.1 and the alluvial and lacustrine deposits in BH.2B.

GROUND WATER

Free water was encountered in boreholes BH.2B and 4 at approximately the level of the river during the period of exploration. No free water was encountered in boreholes BH.1 and 3 during the period of exploration but this is not surprising in view of the relatively impermeable nature of the strata below the elevation of the river level.

LABORATORY TESTS

In addition to visual examination of all soil samples in the laboratory certain of the samples were tested for index properties and the results are given in the appendix in Table N° 1. In addition 4 samples were tested for shear strength and the following results obtain:

Borehole N°	Sample N°	Depth Below Ground Surface	Unconfined Compression Strength lbs./sq.ft.	Remarks
BH.2B	3	10'-3" - 11'-3"	4800	Failure in silt seam
	4	13'-0" - 13'-9"	14000	Yield at 7600 lbs./sq.ft.
BH.4	2	5'-0" - 6'-0"	7600	
	3	7'-3" - 8'-3"	11600 *	Yield at 8000 lbs./sq.ft.

\* At 20% Strain

Shear strength tests on the foregoing samples in all cases showed a very distinct and unusual yield point.

## DISCUSSION

The object of the investigation was to ascertain the soil conditions for purposes of foundation design and the subsurface exploration revealed that the site of the proposed bridge is situated within a valley that has been eroded in glacial till and subsequently partially refilled by lacustrine and alluvial deposits.

The presence of the underlying glacial till was proved in boreholes BH.1 and 2B but it was not reached in boreholes BH.3 and 4 which terminated in the lacustrine deposits.

Both the till and lacustrine deposits have been subjected to considerable precompression and consequently both these materials would provide adequate support for normal spread footings.

From a consideration of the geological section and the present depth of the river it is presumed that the underside of the foundations for the river piers would not be at a higher elevation than 75.0 where they would be supported on the lacustrine deposits consisting essentially of hard brown silty clay. Some minor variations in the consistency of the lacustrine deposits has been noted but it is considered that an allowable bearing capacity of 3.0 tons/sq.ft. would be a satisfactory figure for design purposes.

Referring to the abutments it would appear that the foundations for the north and south abutments should not be located at higher elevations than 85.0 and 80.0 respectively.

The allowable bearing capacity for the design of the foundations to the abutments may be taken as 3.0 tons/sq.ft.

It will be observed that the southern abutment and the two piers would be founded on lacustrine deposits whilst the northern abutment would be on till. This condition is not however considered to be an objection to the use of spread footings as both deposits have been subjected to considerable precompression, and provided a slight long term differential settlement amounting to perhaps one inch is tolerable then it should be perfectly satisfactory to adopt an allowable bearing capacity of 3.0 tons/sq.ft. for both piers and both abutments.

## CONCLUSIONS

From the results of the subsurface exploration and subsequent study the following conclusions may be stated.

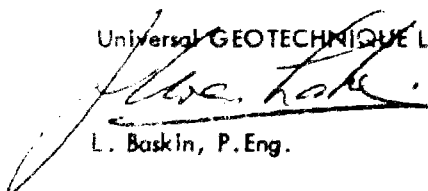
- (1) The site of the proposed bridge is underlain by essentially hard strata and at the proposed foundation levels the material consists of lacustrine deposits except in the vicinity of the northern abutment where the hard underlying glacial till exists at a much higher elevation.
- (2) Normal spread footings for both the piers and abutments to the proposed three span bridge will provide satisfactory foundations at the following elevations, assuming these are satisfactory after due consideration has been given to possible depths of scour.

RIVER PIERS	-	Elevation 75.0
NORTH ABUTMENT	-	Elevation 85.0
SOUTH ABUTMENT	-	Elevation 80.0



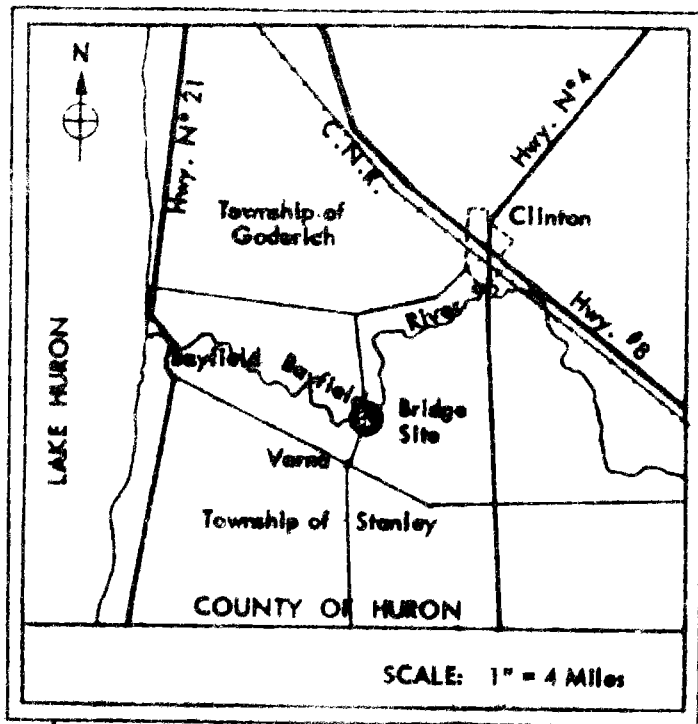
- (3) Provided the contemplated design for the bridge will allow the possibility of a long term differential settlement amounting to possibly one inch, a uniform allowable bearing capacity of 3.0 tons/sq.ft. may be used for the design of all the footings. Even with a continuous structure a differential settlement of up to one inch may be of small importance when it is considered that such settlement requires a considerable period of time and that its effect is mitigated with time by creep in the materials of the superstructure.

Universal GEOTECHNIQUE Limited,

  
L. Baskin, P. Eng.

Report N° T. 457/60

October, 1960.



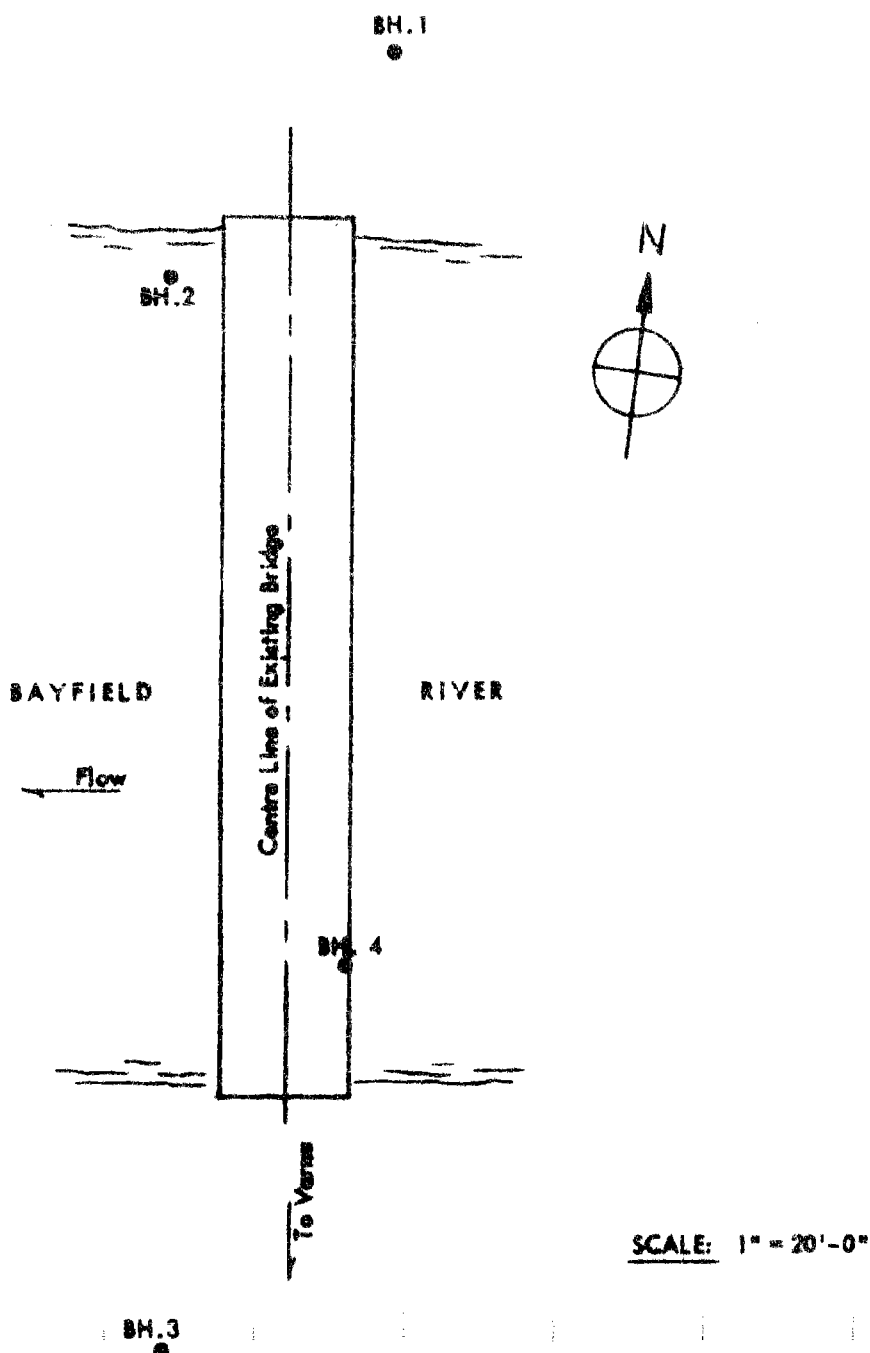
PROJECT Huron County Bridge B-54, Ontario

TITLE Key Plan

DRG. NO. 1 ORDER NO. T.457/60



UNIVERSAL  
GEOTECHNIQUE  
LIMITED



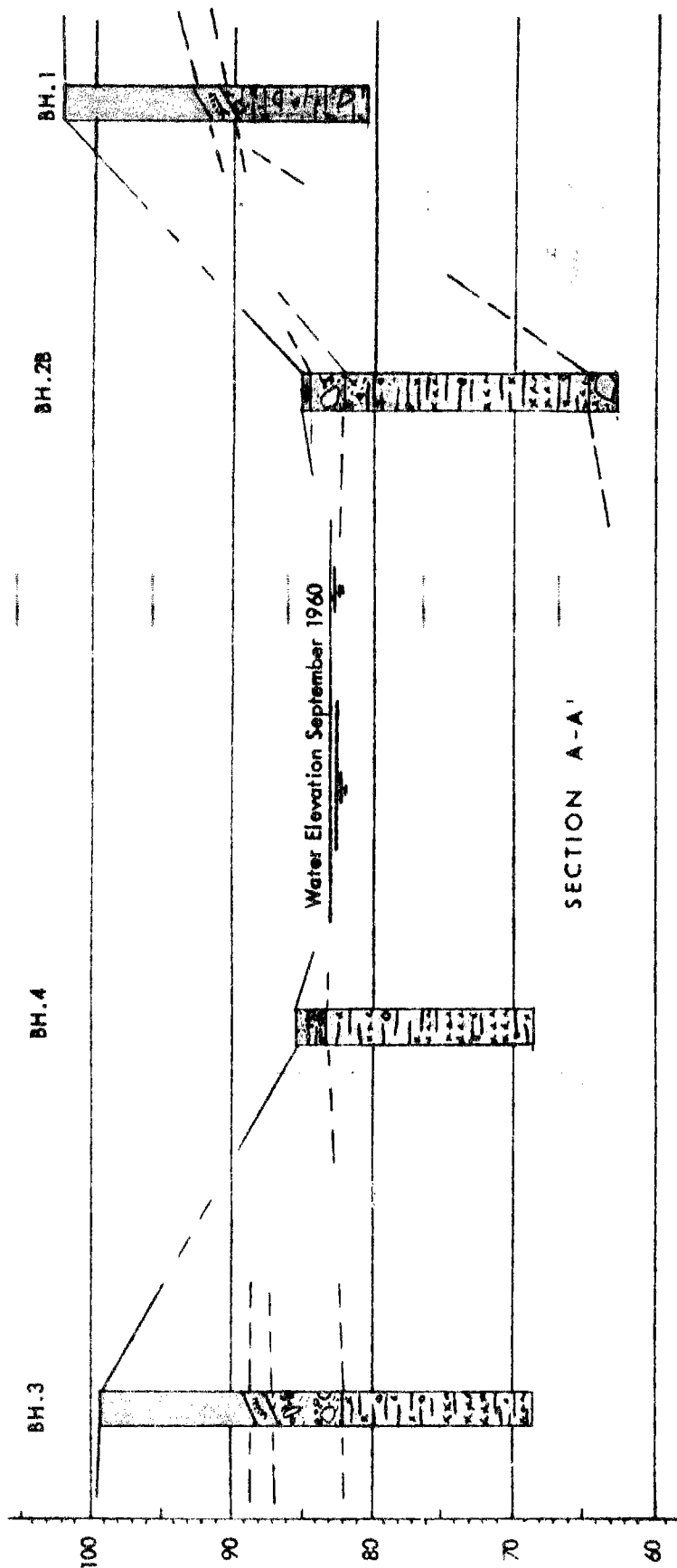
PROJECT Huron County Bridge 8-54, Ontario,

TITLE Borehole Location Plan

DRG. NO. 2 ORDER NO. T.457/40



UNIVERSAL  
GEOTECHNIQUE  
LIMITED



LEGEND

	TOP SOIL		LACUSTRINE DEPOSITS
	FILL		TILL
	ALLUVIAL DEPOSITS		

SCALE

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

PROJECT Huron County Bridge B-54, Ontario

TITLE Geological Section

DRG. NO. 3 ORDER NO. T.457/60



UNIVERSAL  
GEOTECHNIQUE  
LIMITED

## SOIL MECHANICS LABORATORY

**BOREHOLE LOG**PROJECT Huron County Bridge 8-54, OntarioORDER NO. I-457/60CLIENT County of Huron (Mr. J. W. Britnell, County Engineer)BOREHOLE NO. BH.1DIAMETER 2-1/2"CASING 2-1/2"BOREHOLE LOCATION See PlanINCLINATION VerticalBEARING FORM 6-14 Rev.  
UNITED DISTRICT OF S.S.












DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
Brown sandy loam with organic matter. FILL.	102.4			Zero			
Loose sand & gravel. FILL.	100			1'-6"			
do			• 1			8	Dry to Damp.
Firm do			• 2			7	do
Firm do			• 3			13	do
Fine brown silty SAND with fine to medium gravel, little clay and some organic matter.	90		• 4			29	Damp. Medium dry strength.
Hard brown desiccated very sandy CLAY with fine to coarse subangular gravel, iron stained.			• 5			48	Damp, Medium to high dry strength.
do			• 6			60(3")	do
Hard brown sandy silty CLAY with fine to medium subangular gravel.			• 7			45(6")	Damp. High dry strength.
do	80		• 8	21'-9"		40(6")	
			End of Borehole				

SCALE: 1" = 5'-0" • DISTURBED SAMPLE

UNDISTURBED SAMPLE

## SOIL MECHANICS LABORATORY

**BOREHOLE LOG**PROJECT Huron County Bridge B-54, Ontario.ORDER NO. T. 457/60CLIENT County of Huron (Mr. J. W. Britnell, County Engineer)BOREHOLE NO. BH.2, 2A & 2BDIAMETER 2-1/2"CASING 2-1/2"BOREHOLE LOCATION See PlanINCLINATION VerticalBEARING —FORM B-1A REV.  
UNIVERSAL GEOTECHNIQUE CO.

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
<u>BH.2</u> Sand, gravel & boulders.	85.2			Zero 1'-6" End of Borehole			Refusal Conditions. Presumed Boulder.
<u>BH.2A</u> Sand, gravel & boulders.	85.2			Zero 2'-0" End of Borehole			Refusal Conditions. Presumed Boulder.
<u>BH.2B</u> Brown loam with organic matter. Brown sand, gravel and boulders.	85.2			Zero 0'-6" 3'-0"			
Dense light brown fine silty SAND with layers of silty clay.	80		• 1			65	Moist. Silt: Medium dry strength. Clay: High dry strength.
Hard brown silty CLAY, somewhat desiccated with layers of sandy silt, occasional fine gravel.			• 2			40	Damp. Silt: Medium dry strength. Clay: High dry strength.
Hard brown silty CLAY with silt partings, occasional fine gravel.			• 3			60	do
do			• 4			50 (9")	do
do	70		• 5			43 (3")	do
do							do
Dense brown clayey silty SAND with fine to medium subangular gravel.			• 6	20'-3"		73 (6")	Damp. Medium dry strength.
			• 7	22'-3" End of Borehole		77 (3")	do

SCALE: 1" = 5'-0" • DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

SOIL MECHANICS LABORATORY

**BOREHOLE LOG**

PROJECT Huron County Bridge B-54, Ontario. ORDER NO. T.457/80

CLIENT County of Huron (Mr. J. W. Brimell, County Engineer)

BOREHOLE NO. BH.3 DIAMETER 2-1/2" CASING 2-1/2"

BOREHOLE LOCATION See Plan INCLINATION Vertical BEARING ---

FORM G-1A (REV. 1/79)  
LIMITED STATEMENT (G-1)

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
Brown silty SAND & GRAVEL, some organic matter. FILL.	99.3			Zero			
Firm brown silty sand & gravel. FILL.			• 1			18	Dry to Damp.
Loose brown sand & gravel. FILL.			• 2			7	do
do			• 3			5	do
Firm brown SAND with gravel, some organic matter.	90		• 4			10	No recovery.
			• 5			10	Moist. Low dry strength.
Dense light brown fine to coarse SAND with fine to coarse gravel. Gravel subangular to subrounded.			• 6			38 (9")	Damp. No dry strength.
				17'-0"			
Hard brown silty CLAY with occasional fine gravel.	80		• 7			46	Damp. High dry strength.
do			• 8			30 (6")	do
Dense light brown sandy SILT, interbedded with brown silty clay.			• 9			37 (6")	Damp. Silt: Medium dry strength. Clay: High dry strength.
Hard brown silty CLAY with silt partings.	70		• 10			70	do
				31'-9"			
				End of Borehole			Refusal Conditions. Presumed Boulder.

SCALE 1" = 5'-0" • DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

## SOIL MECHANICS LABORATORY

**BOREHOLE LOG**PROJECT Huron County Bridge B-54, Ontario ORDER NO. I. 457/60CLIENT County of Huron (Mr. J. W. Britnell, County Engineer)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
Brown SAND & GRAVEL with lenses of clay and dark organic concentrations.	85.4			Zero			
Very stiff brown silty CLAY with occasional fine to medium gravel, exhibits lamination.			• 1	2'-0"		25	Wet. Damp. High dry strength.
do	80		• 2			30	do
Hard brown silty CLAY with silt partings, occasional fine gravel.			• 3			35	do
Very stiff brown silty CLAY with occasional gravel and layers of sandy silt.			• 4			37	Damp. Silt: Medium dry strength. Clay: High dry strength.
do			• 5			38	do
do	70		• 6			40	do
				16'-9"			Refusal Conditions. Presumed Boulder.
				End of Borehole			

FORM G-1A 800  
UNIVERSAL GEOTECHNIQUE CO.



1-800-451-7273

SHEET NO. \_\_\_\_\_

ALL SAMPLES FROM 2" DIAMETER SPLIT BARREL SAMPLER.

**UNIVERSAL  
GEOTECHNIQUE  
LIMITED**