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WEBSTERVILLE BRIDGE

SIMCOE CTY.

NOTTAWASAGA TWP.

UNIVERSAL
GEOTECHNIQUE
LIMITED



REPORT

on

FOUNDATION INVESTIGATION

for

WEBSTERVILLE BRIDGE

NOTTAWASAGA TOWNSHIP

COUNTY OF SIMCOE

ONTARIO

87-F-25314

Report N° T.585/67

100 University Avenue,
Toronto 1, Ontario.



REPORT

on

FOUNDATION INVESTIGATION

for

WEBSTERVILLE BRIDGENOTTAWASAGA TOWNSHIPCOUNTY OF SIMCOEONTARIOINTRODUCTION

The Engineer for Simcoe County, Mr. L. E. Clark, is proposing the replacement of the single lane bridge that at present carries County Road N° 9 over the Mad River west of Creemore.

Designs for the new bridge are being prepared by McCormick, Rankin & Associates Limited, Consulting Engineers of Port Credit, Ontario, and Universal GEOTECHNIQUE Limited were requested by the County Engineer to carry out subsurface exploration to ascertain the soil conditions in relation to foundation design and this Report contains the pertinent data and relevant information.

AVAILABLE INFORMATION

The existing bridge is a single lane and single span structure and the new bridge will be built in the same location as shown on the Consulting Engineers' drawing N° 317-1 which also shows the tentative positions of proposed exploratory boreholes.

THE SITE

The site of the proposed new bridge is at the location of the existing structure which is given as lots 9 & 10 of concession V1 of Nottawasaga Township. This location is a little over a mile from Creemore and a little less than a mile East of the junction of the Mad River with the Noisy River.

SUBSURFACE EXPLORATION

Subsurface exploration was carried out during the period 30th June - 5th July, 1967, and comprised 4 exploratory boreholes in locations as shown on drawing N° 2 accompanying this Report.

The positions of the boreholes were staked and the ground surface elevations obtained by the Staff of Geotechnique, the elevations being related to the Benchmark shown on the Engineers' drawing and given as elevation 908.38.

During the operation of soil boring, soil samples were obtained at frequent intervals and where noticeable changes of strata occurred, the depths of such changes were recorded.

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 tests are given on the borehole logs which form part of this Report. Also included with the Report are the results of the standard penetration tests plotted graphically, key plan, borehole location plan, and geological section.

Subsurface conditions given in this Report are those indicated by material encountered in the boreholes. The accuracy of interpolation and 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 in a valley formed by the Niagara Escarpment to the south and an outlier of the Escarpment to the North. The northern end of this valley is blocked by a moraine which forces the Mad River near Glen Huron to flow south and then east through Creemore in a circuitous route to Georgian Bay. The entire area was subjected to glaciation and as the glacier retreated from the area towards the north-east kame terraces formed adjacent to the Niagara Escarpment and melt waters created a glacial spillway through this area and the Niagara Escarpment is now mantled by glacial deposits as a result of deglaciation.

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

FILL

Road fill composed of essentially sand and gravel was encountered in the upper few feet of boreholes BH.1, 2 & 4.

SAND, GRAVEL & BOULDERS

Beneath the fill in boreholes BH.1, 2 & 4 and from close to the ground surface in borehole BH.3 there was encountered material under this heading and which necessitated diamond core drilling in borehole BH.3 in order to pass through large size gravel and boulders.

SAND

This material underlies the site in all the boreholes and exists in a very dense state of compaction.

GROUND WATER

Free ground water was encountered at approximately elevation 904 in all the boreholes during the period of exploration.

DISCUSSION

The results of the subsurface exploration and subsequent study have revealed that the site of the proposed bridge is underlain by cohesionless strata in a dense to very dense state of compaction.

Types of Foundations

For the soil conditions existing at this site, spread footings are a natural choice from an economic standpoint when considerations of adequate bearing capacity and tolerable settlement are considered. However, construction of such foundations at any considerable depth below the water table presents certain difficulties in such permeable strata. It would therefore appear that spread footings could be considered for the support of the abutments provided safety against scour could be assured, but steel pipe pile bents for the river piers are likely to be a more suitable solution.

Abutments

It is understood that the new bridge may consist of 3 spans of about 50 feet, and it would appear that the abutments would be supported on normal spread footings at about elevation 903 and designed for an allowable bearing capacity of 2.5 tons/sq.ft. provided such footings would not be subjected to any danger from scour. Alternatively, as the two river piers will probably be composed of pipe pile bents, it may be desirable to also support the abutments on pile foundations. Suitable pile foundations could consist of 12" nominal diameter steel pipe piles of 0.375" thickness driven to penetrate to about elevation 875 and designed to support a working load of 60 tons per pile when filled with concrete. Due to the very dense underlying strata such piles would encounter very high driving resistance and in order to reach a minimum penetration it may be expedient to drive such piles open-ended as this would allow some measure of control over the driving resistance. If such piles are driven open-ended some reinforcement at the toe of the pile may be desirable. If the piles are driven open-ended they should subsequently be filled with concrete down to within 10 feet of the toe of the pile.

River Piers

Although river piers could be adequately supported on spread footings, the difficulties of constructing such foundations below water level in permeable strata makes further consideration of this type of construction probably unnecessary and accordingly it is suggested that pile foundations probably extending to the bridge deck and capped to form a pile bent would provide a more satisfactory solution. Pile foundations to the river piers could take the form of 12" nominal diameter steel pipe piles of 0.375" minimum thickness and driven to about elevation 875 if it is reasonable to assume that scour will never extend below about elevation 890. Such pipe piles could be designed to support a working load of 60 tons per pile in the dense underlying cohesionless strata and due to the high driving resistance that would be encountered in the very dense sands, the piles may be driven open-ended to allow some measure of control of the driving resistance.

If it is necessary to consider the possibility of an ice jam occurring at the site of this bridge, or if drifting ice is a potential hazard, it would be expedient to increase the size of the piles to 14" diameter with a thickness of 0.375".

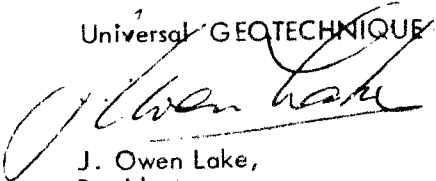
CONCLUSIONS

From the results of the subsurface exploration and subsequent study in relation to foundation design for the new bridge, the following conclusions have been obtained:

1. The site of the proposed bridge is underlain by essentially cohesionless strata that exists in a generally very dense state of compaction and therefore no problems of settlement need be anticipated.
2. Adequate support for normal spread footings designed for an allowable bearing capacity of 2.5 tons/sq.ft. can readily be obtained for the abutments when the underside of such foundations are at about elevation 903 or lower. If such foundations are adopted they should be suitably protected against any possible danger from scour. An alternative to such foundations would be 12" nominal diameter steel pipe piles of 0.375" thickness and designed to support a working load of 60 tons per pile.

3. Assuming that scour will never extend below an elevation of 890, the river piers could be formed of steel pipe piles designed to carry a working load of 60 tons per pile and driven to penetrate to about elevation 875.

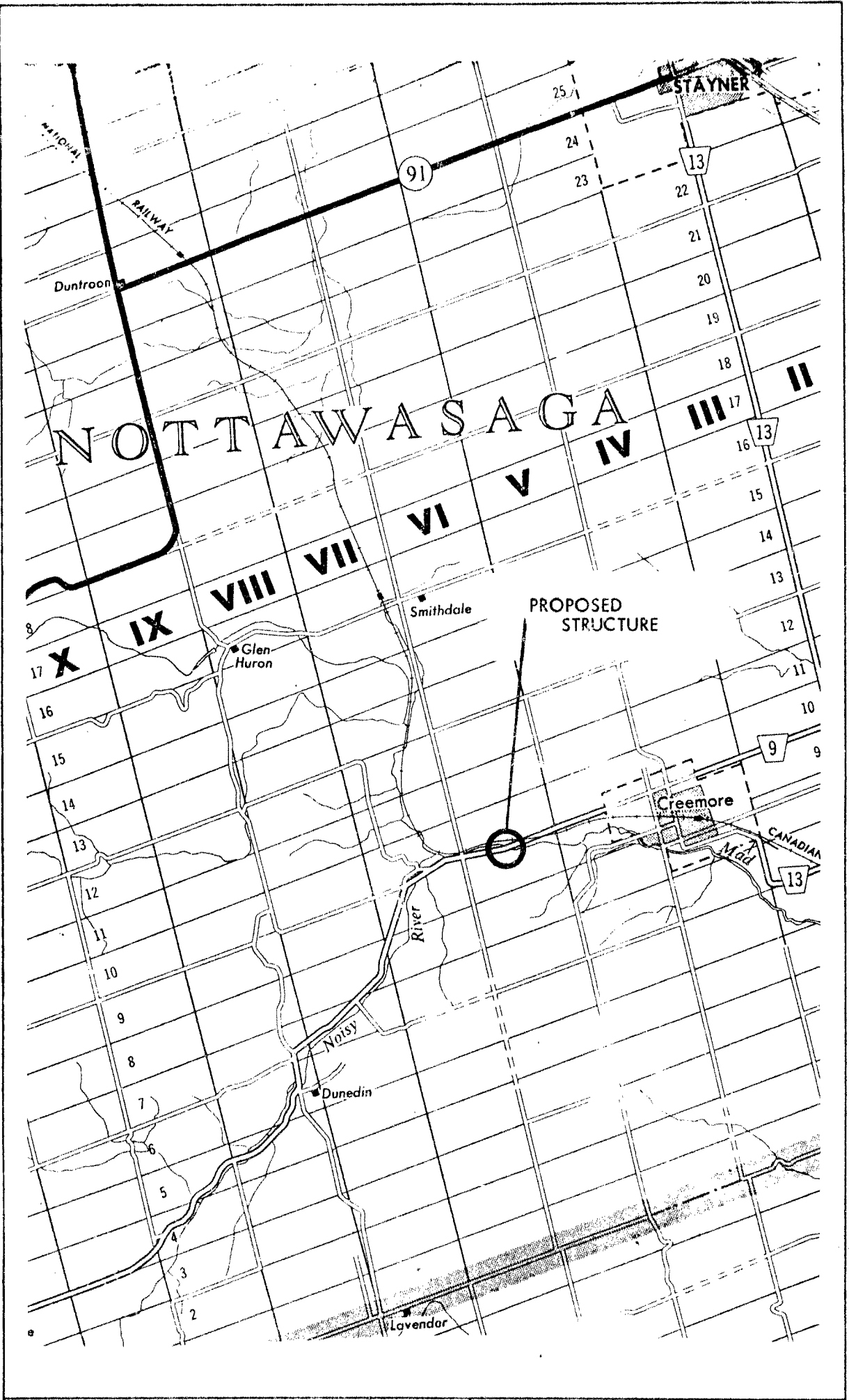
Universal GEOTECHNIQUE Limited,



J. Owen Lake,
President.

Report N° T.585/67

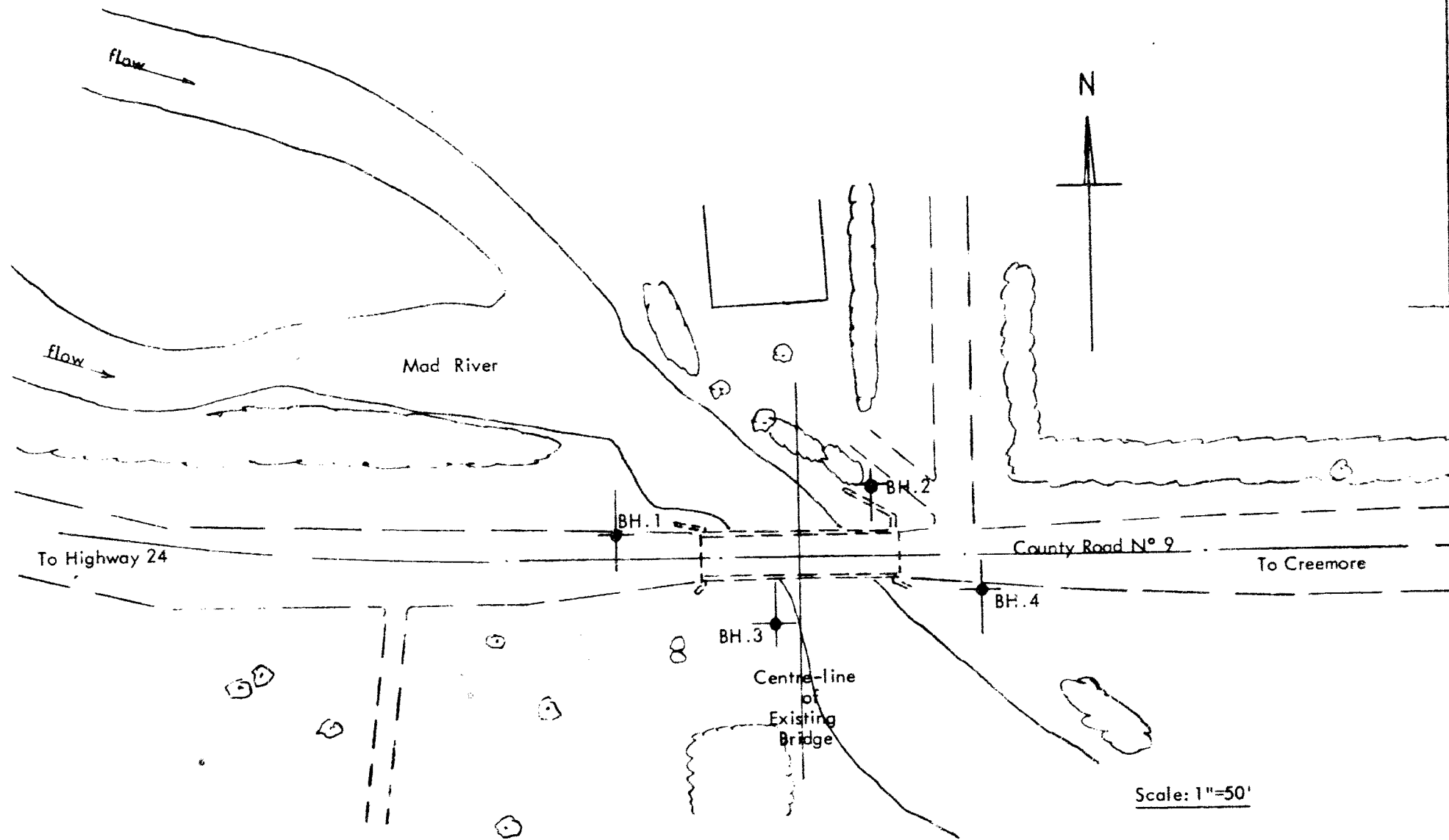
July, 1967.



PROJECT Websterville Bridge, Nottawasaga Twp.
TITLE Key Plan
DRG. NO. 1 ORDER NO. T.585/67



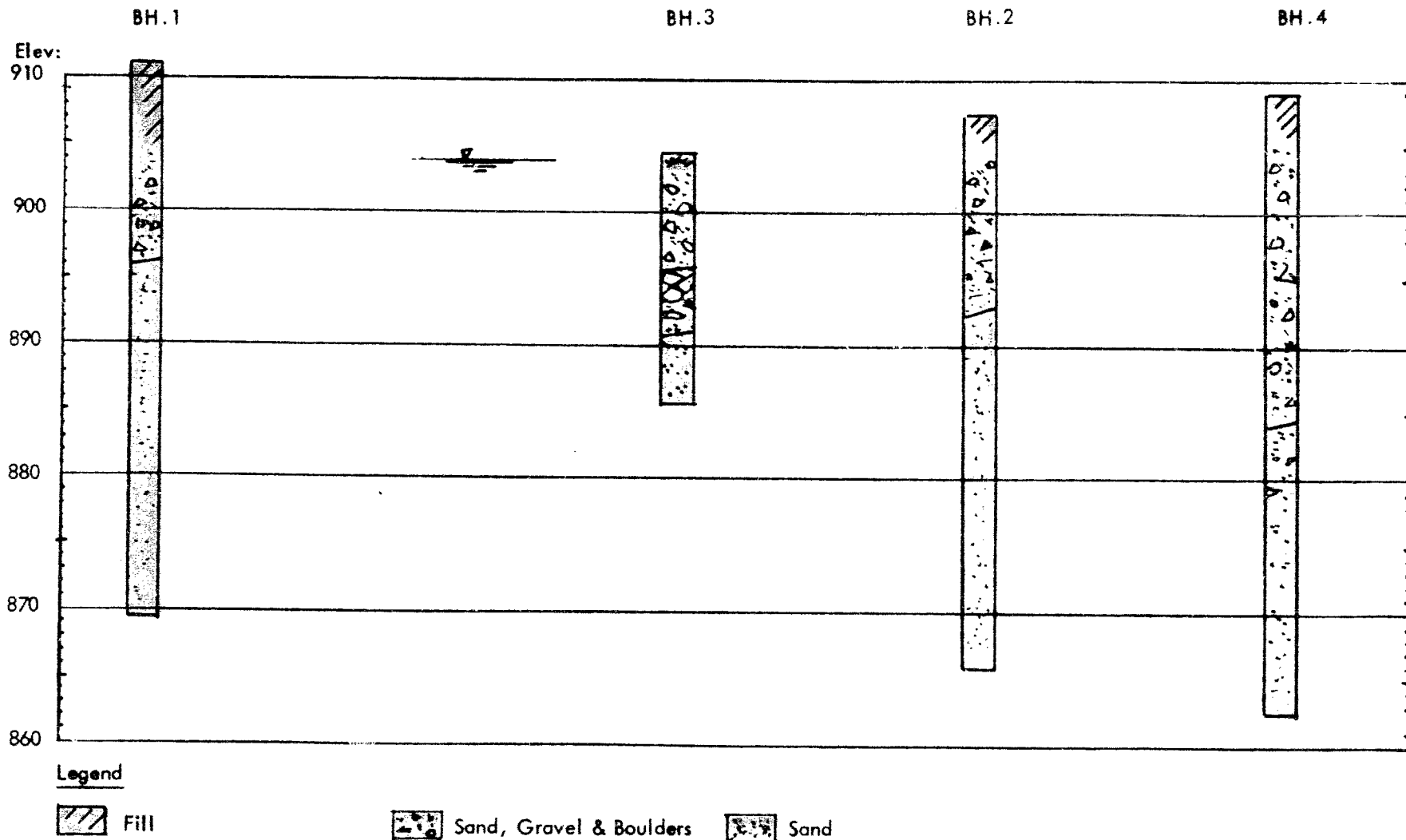
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PROJECT Websterville Bridge, Nottawasaga Twp.
TITLE Borehole Location Plan
DRG. NO. 2 ORDER NO. T.585/67



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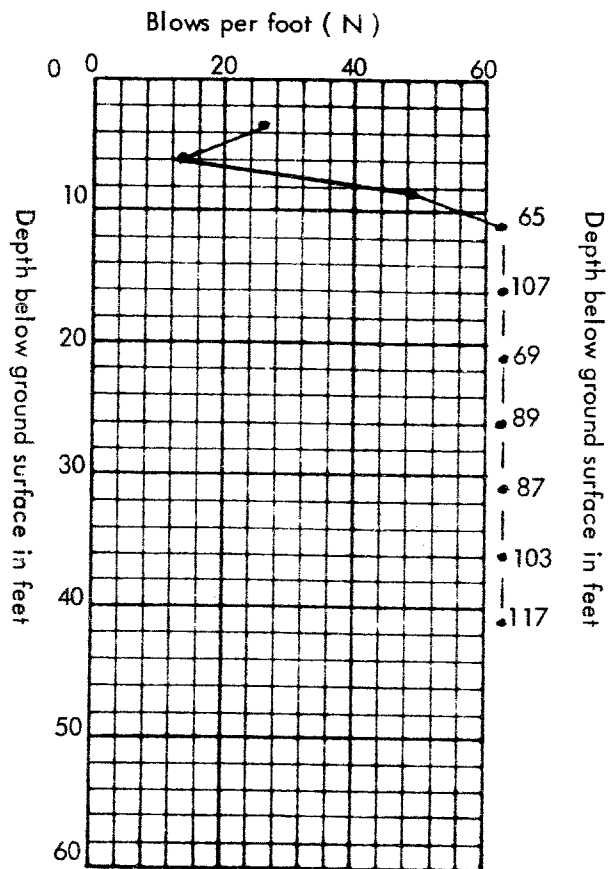
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PROJECT Websterville Bridge, Nottawasaga Twp.
 TITLE Standard Penetration Tests
 DRG. NO. 4 ORDER NO. T.585/67

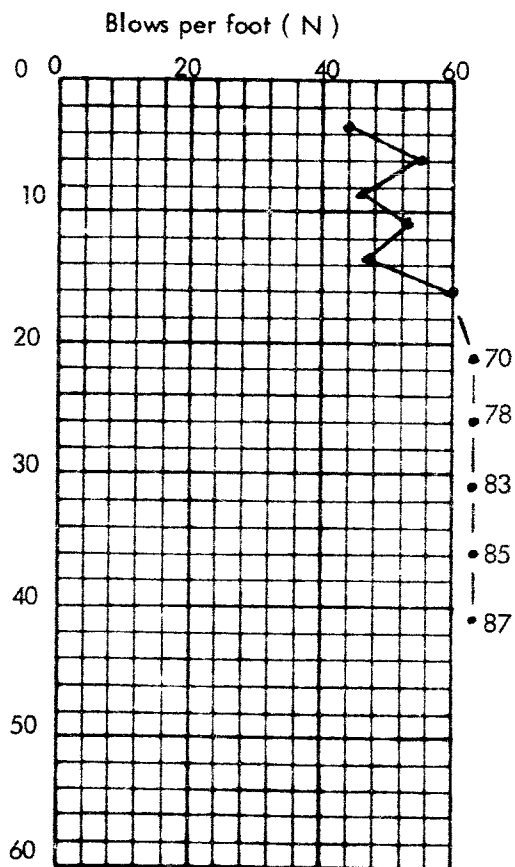


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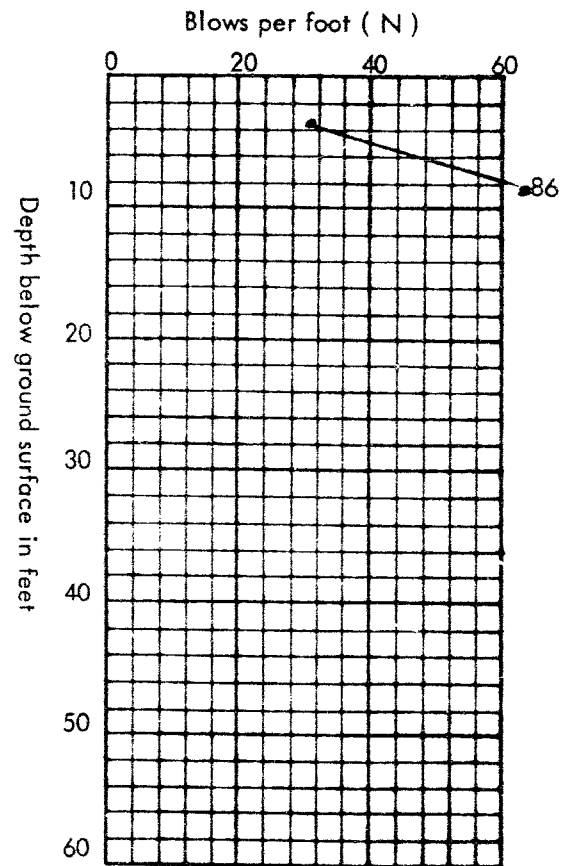
BH.1



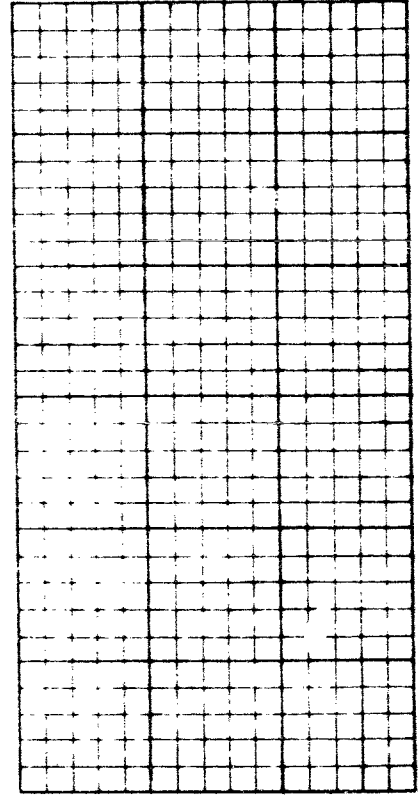
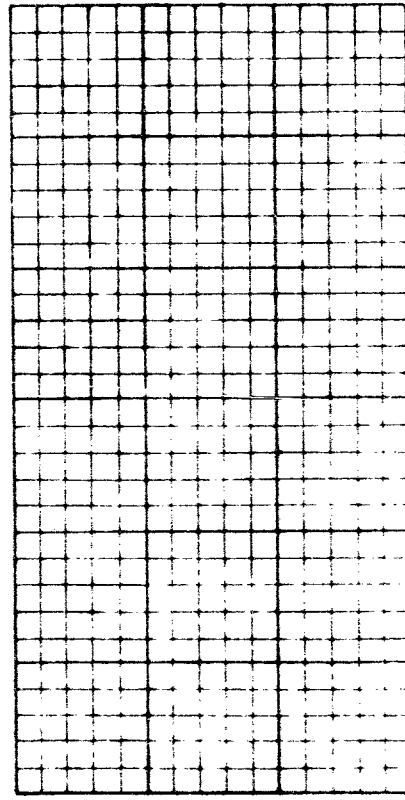
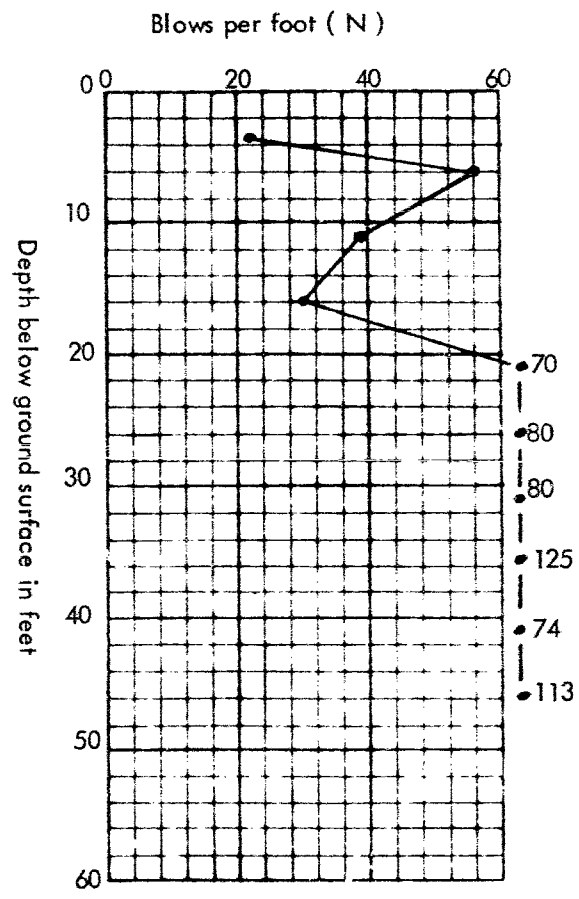
BH.2



BH.3



BH. 4



PROJECT Websterville Bridge, Notrawasaga Twp.
TITLE Standard Penetration Tests
DRG. NO. 5 ORDER NO. T.585/67



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SOIL MECHANICS LABORATORY

BOREHOLE LOG

PROJECT Websterville Bridge, Ontario ORDER NO. T.585/67

CLIENT County of Simcoe

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

BOREHOLE LOCATION See Plan INCLINATION Vertical BEARING _____

FORM G-1A 800
UNITED STATES GEOLOGICAL SURVEY

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
	911.0 910			Zero			
Brown fine to medium sand - FILL.			• 1			26	damp; slight dry strength
Brown silty fine sand; trace rounded medium gravel - FILL.			• 2			13	do do
Dense brown silty fine to medium SAND & fine to coarse GRAVEL.			• 3			49	Wet; do
do do	900		• 4			65	do do
Very dense grey & brown fine to medium SAND; trace fine angular gravel.			• 5			107	do no dry strength.
Very dense grey & brown fine to medium SAND; sign of bedding.	890		• 6			69	do do
do do			• 7			89	Wash sample.
Very dense greyish-brown fine SAND.	880		• 8			87	Wet. No dry strength.
do do			• 9			103	do do
do do	870		• 10	41'-6"		117	do do
			End of Borehole				

SCALE: 1" = 5'-0" • DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

SOIL MECHANICS LABORATORY

BOREHOLE LOGPROJECT Websterville Bridge, Ontario.ORDER NO. T.585/67CLIENT County of SimcoeBOREHOLE NO. BH.2DIAMETER 3-1/2"CASING NXBOREHOLE LOCATION See PlanINCLINATION Vertical

BEARING _____

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
	907.7			Zero			
Brown silty sand & coarse gravel.			• 1			44	Damp; slight dry strength
Dense brown fine to coarse silty SAND, some fine to coarse angular GRAVEL & trace of clay.			• 2			55	Wet; do
do do	900		• 3			46	do low dry strength
do do			• 4			53	do medium dry strength.
do do			• 5			47	do do
Very dense brown fine to medium SAND.			• 6			60	do no dry strength
	890						
do do			• 7			70	
do do with trace of fine gravel.			• 8			78	Wash sample
	880						
Very dense brown fine to medium SAND.			• 9			83	
do do			• 10			85	Wash sample
	870						
do do			• 11			87	
				41'-6"			
				End of Borehole			

SCALE: 1" = 5'-0" • DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

SOIL MECHANICS LABORATORY

BOREHOLE LOG

PROJECT Websterville Bridge, Ontario.ORDER NO. T.585/67CLIENT County of SimcoeBOREHOLE NO. BH.3DIAMETER 3-1/2"CASING NXBOREHOLE LOCATION See PlanINCLINATION Vertical

BEARING _____

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
	904.4			Zero			
Dense fine to coarse angular GRAVEL with fine to coarse sand	900		• 1			31	Wet; low dry strength
			• 2				no recovery. Drilled boulder 7' to 7'-4".
Dense fine to coarse SAND and fine to coarse GRAVEL & boulders.			• 3			86	Wet; no dry strength. Drilled AXT core 9' to 14' in sand & gravel. Washed with core barrel 14' to 19'.
	890			19'-0"			
				End of Borehole			

SCALE: 1" = 5'-0" • DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

SOIL MECHANICS LABORATORY

BOREHOLE LOGPROJECT Websterville Bridge, OntarioORDER NO. T.585/67CLIENT County of SimcoeBOREHOLE NO. BH.4DIAMETER 3-1/2"CASING NXBOREHOLE LOCATION See PlanINCLINATION Vertical

BEARING

Form G-10 Rev. 1-7-66
UNIVERSAL GEOTECHNIQUE

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
Dark brown silty sand - FILL.	909.1		• 1	Zero		22	damp; medium dry strength.
Dense brown & grey fine to coarse SAND & angular fine to coarse GRAVEL.			• 2			56	do slight dry strength
Dense brown fine to coarse angular GRAVEL & silty fine SAND.	900		• 3			39	do do
do do			• 4			30	Wet, do
Very dense brown silty fine to coarse SAND & fine to coarse angular GRAVEL.	890		• 5			70	do medium dry strength.
Very dense brown fine to medium SAND, trace of coarse gravel.			• 6			80	do no dry strength.
Very dense brown fine to medium SAND, trace of fine gravel.	880		• 7			80	do do
Very dense greyish-brown silty fine SAND, trace of fine gravel.			• 8			125	do low dry strength
do do	870		• 9			74	do do
do do			• 10	46'-6"		113	do do
			End of Borehole				

SCALE: 1" = 5'-0"

• DISTURBED SAMPLE

■ UNDISTURBED SAMPLE