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G.I.-30 SEPT. 1976

GEOCRES No. 40I 15 - 24

DIST. 2 REGION SOUTHWESTERN

W.P. No. _____

CONT. No. _____

W. O. No. _____

STR. SITE No. _____

HWY. No. _____

LOCATION LOT 1 CONCESSION 6
NORTH NORWICH TOWNSHIP

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: DOCUMENTS TO BE UNFOLDED BEFORE MICROFILMED

BH. 2041

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V. R. ASTROP LTD.

CONSULTING ENGINEER

ANCASTER - ONTARIO

SOIL CONDITIONS

AND

FOUNDATIONS

PROPOSED WRIGHT BRIDGE

TOWNSHIP OF NORTH NORWICH

ONTARIO

SUBMITTED BY

DOMINION SOIL INVESTIGATION LIMITED

77 CROCKFORD BLVD.

SCARBOROUGH ONTARIO

REFERENCE 5-2-10

MARCH 1965

INTRODUCTION

At the request of Mr. V. R. Astrop, Consulting Engineer, Dominion Soil Investigation Limited has carried out a subsurface investigation at the site of the existing Wright Bridge in the Township of North Norwich.

The north abutment of the existing bridge was undermined by a recent flood resulting eventually in the total collapse of the structure which, therefore, has to be replaced.

The purpose of the investigation was to determine the relevant subsoil conditions at the site for the design of the foundations of the new structure.

SUBSURFACE CONDITIONS

Two boreholes, penetrating to a depth of 32 feet, were put down at the locations indicated on the attached site plan. The borings indicate uniform and consistent soil conditions consisting of fine grained, non-cohesive granular soils. The subsoil is essentially a massive, non-stratified sand deposit in which the grain sizes range between the silt and the coarse sand sizes while fine sand is in preponderance.

The relative density of the sand stratum is however variable and appears to increase with depth. From the ground surface down to elevation 84 ± ft., both the standard and cone penetration tests indicate that the relative

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density of the sand in this zone is only loose (N = 3 to 8 blows per foot). Between elevations 84 ± ft. and 66 ± ft. the relative density of stratum ranges from compact (N = 11 blows per foot) to dense (N = 36 blows per foot) with an average "N" value of 26 blows per foot. At elevation 66 ± ft. both cone tests encountered a very high driving resistance and the standard penetration test performed in borehole No. 2 below this level indicates a very dense relative density (N = 92 blows per foot).

GROUND WATER CONDITIONS

The free-standing water levels in the boreholes upon completion were at about elevation 95.0 ft. This corresponds approximately with the top of the ice in the river at the time the investigation was carried out. Although wash-water was used in the borings, the subsoil is quite permeable and it is believed that these observations represent the true ground water level conditions at the site at the time that the investigation was carried out.

DISCUSSION

It is understood that the new bridge will be a simply supported structure, having a span of about 40 feet. The finished deck elevation will be at about 100.0 ft. Under normal flow conditions the creek bed is at elevation 95 ± ft. but under extreme high water conditions, as during the recent flood, the creek bed might be scoured to elevation 81.0 ± ft.

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The subsurface investigation has indicated that the site is underlain by deep sand deposits of loose to dense relative density. The sand stratum is considered to be suitable to support normal spread and strip footing foundations below elevation 84 ft.

However, the normal requirement of a bridge structure is that its foundations be protected against scour by taking the footings below the depth of maximum scour. In the present case it is known that the creek bed might be scoured to elevation 81.0 ft. and therefore it is recommended that the footings be placed at or below elevation 80.0 ft.

The allowable bearing pressure for a 6 foot or wider continuous strip footing is 4000 pounds per square foot. For footings less than 6 feet wide the allowable bearing pressure should be reduced in proportion to the width of the footings. This bearing value incorporates a safety factor of 3.0 against general shear failure of the underlying soil.

Furthermore it is estimated that the maximum total settlement under a 6 foot wide continuous strip footing will not exceed 1.5 inches and similarly the maximum differential settlement will be within 0.67 inches. The amount of both the total and differential settlement is considered to be within the tolerable limits.

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In order to avoid the deep excavations necessary for the spread and strip footing foundation discussed above, it is recommended that consideration be given to alternative foundation treatment such as pile foundations. It is estimated that 12-inch diameter timber piles, driven to elevation 75 ± ft., will develop a safe working capacity of 16 tons. In case the piles are driven further, i.e. to elevation 70 ± ft., the safe carrying capacity is estimated to increase to about 25 tons. In view of the uncertainty involved in the estimating of pile capacities from static formulae, it is recommended that the piles be driven to the proper set as indicated by an approved dynamic formula such as Hiley's. It is recommended that the pile caps be carried below the lowest position of the ground water level and/or the maximum depth of frost penetration.

Attention is drawn to the problem of excavating below the ground water level at this site. Firstly, the subsoil is quite permeable and the water inflow into excavations is likely to be heavy. Secondly, because of this high permeability, the ground water level will reflect closely the water level in the creek and this is liable to considerable fluctuation particularly in the spring run-off period. The soil in the excavations beneath the water table will have to be protected by closed sheeting

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driven to a penetration below the bottom equal to 1½ times the height of the water above the base of the excavation.

CONCLUSIONS

The investigation has indicated that the site is underlain by deep sand deposits of loose to very dense relative density.

The sand stratum is suitable to support spread and strip footing foundations at or below elevation 84.0 ft. However, because it is believed that under extreme high water conditions the creek bed might be scoured to elevation 81.0 ft., it is recommended that the footings be founded at elevation 80.0 ft., for which the maximum allowable bearing pressure is given as 4000 pounds per square foot.

Alternatively the structure could be supported by piles. The estimated carrying capacity of piles ranges between 16 and 25 tons depending on the depth of penetration.

Dewatering problems during construction are discussed in the text.

DOMINION SOIL INVESTIGATION LTD.,

I. P. Lieszkowszky, P.Eng.,
Project Engineer.

IPL/is

REGISTERED PROFESSIONAL ENGINEER
CIVIL
I. P. LIESZKOWSZKY
PROVINCE OF ONTARIO

APPENDIX "A"

PROCEDURES

The work was authorized by a letter dated February 16th, 1965, following which the work in the field was carried out on February 23rd and March 1st, 1965.

A total of two (2) exploratory boreholes were put down each with an adjacent cone penetration test. The holes were advanced by a diamond drill machine and standard wash-boring technique. Standard penetration tests were performed at 2.5 and 5.0 ft. intervals of depth, both to determine the relative density of the encountered strata and to recover disturbed soil samples.

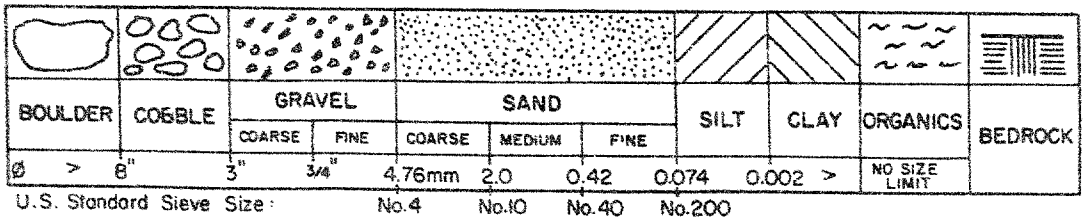
The location of the boreholes is shown on the attached site plan (Enclosre No. 2). All elevations mentioned in this report are referred to a temporary benchmark located 33 feet right of station 5 + 53. The benchmark is described as a spike in a tree and its elevation was given by the Client as 100.0 ft.

The results of the borings are given on the enclosed Geotechnical Data Sheets comprising Enclosures 3 and 4.

Enclosures

LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

SOIL COMPONENTS AND GROUND WATER CONDITIONS.



SAMPLE TYPES.

AS	Auger sample	RC	Rock core	TP	Piston, thin walled tube sample
CS	Sample from casing	%	Recovery	TW	Open, thin walled tube sample
ChS	Chunk sample	SS	Split spoon sample	WS	Wash sample

SAMPLER ADVANCED BY static weight : w
" pressure : p
" tapping : t

OBSERVATIONS MADE WHILE CORING: Steady pressure; No pressure; Intermittent pressure

Washwater returns

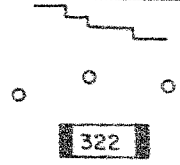
Washwater lost

PENETRATION RESISTANCES.

DYNAMIC PENETRATION RESISTANCE : to drive a 2"ϕ, 60° cone attached to the end of the drilling rods into the ground, expressed in blows per foot.

STANDARD PENETRATION RESISTANCE, -..- : to drive a 2" outside dia, split spoon sampler 1 foot into the ground, expressed in blows per foot.

SYMBOL:



EXTRAPOLATED -N- VALUE

The energy for the penetration resistances is supplied by a 140 lb. hammer falling 30 inches

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SOIL PROPERTIES.

W %	Water content	γ	Natural bulk density (unit weight)	k	Coeff. of permeability
LL %	Liquid limit	e	Void ratio	C	Shear strength — in terms of total stress
PL %	Plastic limit	RD	Relative density	ϕ	Angle of int. friction — in terms of total stress
PI %	Plasticity index	C_v	Coeff. of consolidation	C'	Cohesion — in terms of effective stress
LI	Liquidity index	m_v	Coeff. of volume compressibility	ϕ'	Angle of int. friction — in terms of effective stress

UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —

TRIAXIAL COMPRESSION — UNCONFINED TEST — St

LABORATORY VANE TEST — St

FIELD VANE TEST — St

POCKET PENETROMETER TEST — St

Strain at failure is represented by direction of stem: 20%, 15%, 5%, 10%

St : sensitivity = $\frac{\text{shear strength in undisturbed state}}{\text{shear strength in remoulded state}}$

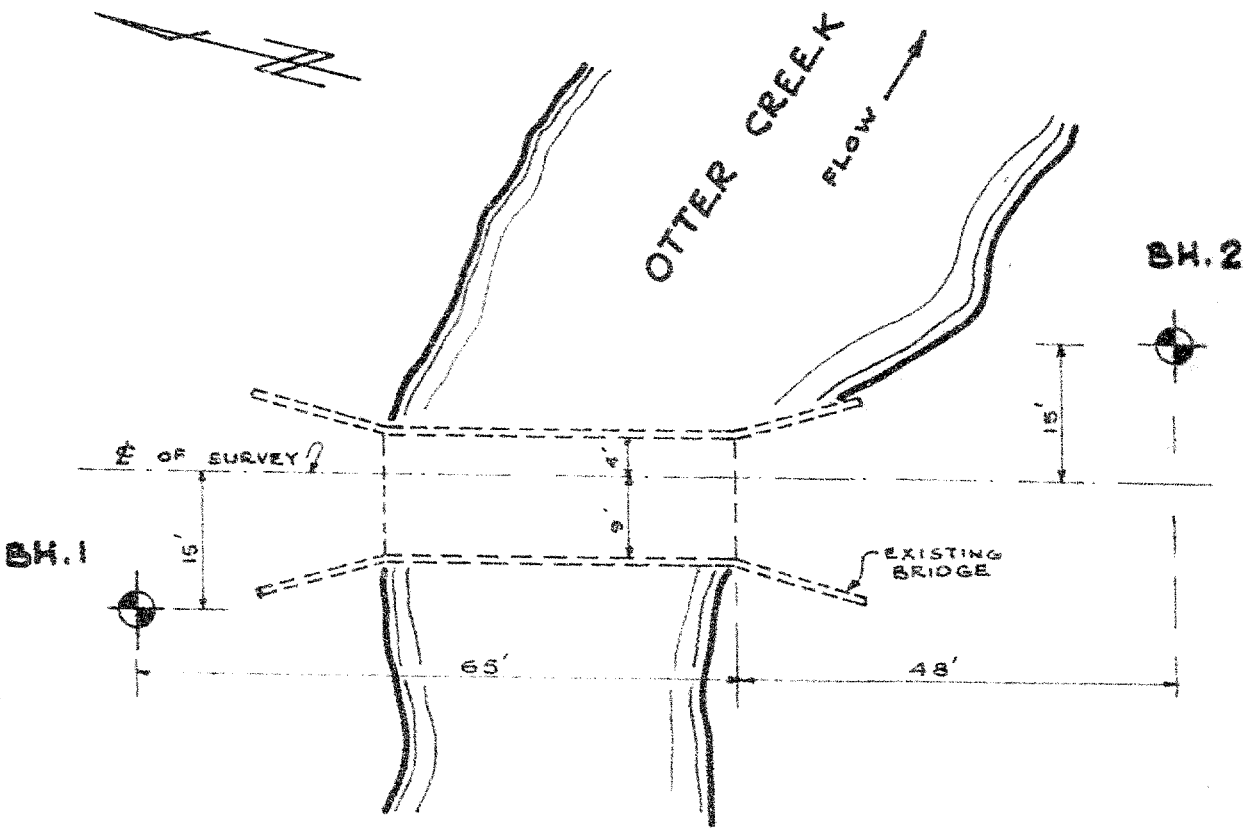
SOIL DESCRIPTION.

COHESIONLESS SOILS :	RD :	COHESIVE SOILS :	C lbs/sq.ft
Very loose	0 – 15 %	Very soft	less than 250
Loose	15 – 35 %	Soft	250 – 500
Compact	35 – 65 %	Firm	500 – 1000
Dense	65 – 85 %	Stiff	1000 – 2000
Very dense	85 – 100 %	Very stiff	2000 – 4000
		Hard	over 4000

Our Ref. No. 5-2-10

Enclosure No. 2.

Prep. By W. G.



BOREHOLE LOCATION PLAN

SCALE: 1" = 20'

DOMINION SOIL INVESTIGATION LIMITED

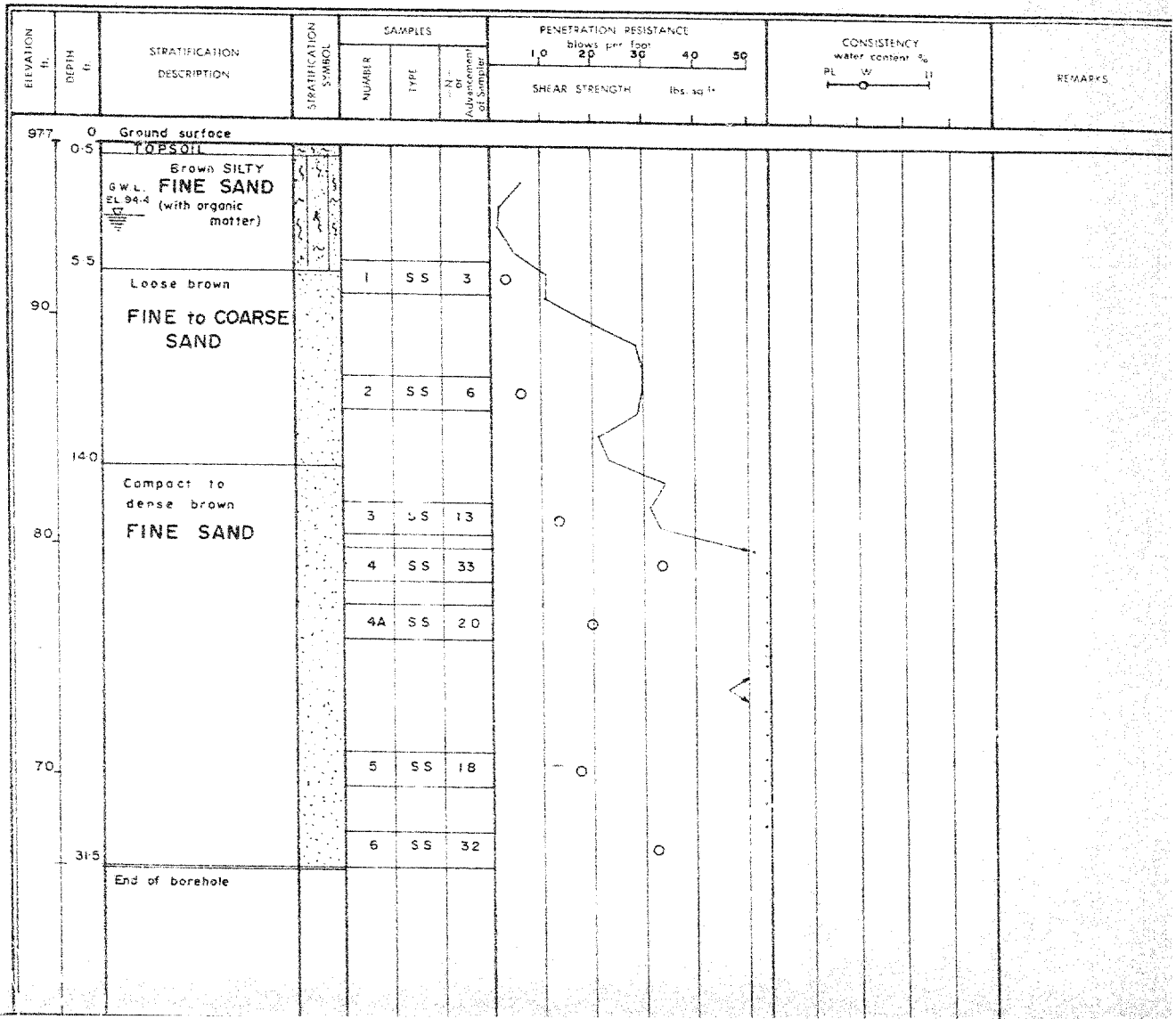
GEOTECHNICAL DATA SHEET FOR BOREHOLE . ! . . .

OUR REFERENCE NO 5-2-10

CLIENT: V. R. ASTROP
PROJECT: WRIGHT BRIDGE
LOCATION: N. NORWICH TWP.
DATUM ELEVATION: LOCAL

METHOD OF BORING: WASHBORING
DIAMETER OF BOREHOLE: 2 3/8"
DATE: FEB. 23-25, 1965

ENCLOSURE NO 3



OUR REFERENCE NO. 5-2-10

GEOTECHNICAL DATA SHEET FOR BOREHOLE . . 2 . . .

CLIENT: V. R. ASTROP
PROJECT: WRIGHT BRIDGE
LOCATION: N. NORWICH TWP.
DATUM ELEVATION: LOCAL

METHOD OF BORING: WASHBORING
DIAMETER OF BOREHOLE: 2 3/8"
DATE: MARCH 1, 1965

ENCLOSURE NO. 4