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G.I.-30 SEPT. 1976

GEOCRES No. 40I 13-48

DIST. 2 REGION southwestern

W.P. No.

CONT. No.

W. O. No.

STR. SITE No.

HWY. No.

LOCATION LOT 4 CONCESSION 9

METCALFE TWP.

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS: DOCUMENTS TO BE UNFOLDED BEFORE MICROFILMED

A. N. SPRIET & ASSOCIATES LIMITED
264 WELLINGTON STREET
LONDON ONTARIO

Report on

SOIL INVESTIGATION

for

BRIDGE NO 20

LOT 4, CONCESSION 9

TOWNSHIP OF METCALFE

by

DOMINION SOIL INVESTIGATION LIMITED
369 Queens Avenue
LONDON ONTARIO

Reference No. 6-1-L1
January 20th, 1966

CONTENTS

ENCLOSURES

SUMMARY

The two borings showed the following ground succession:- stiff silty clay fill (9'-0" to 11'-0"); compact fine sand (4'-6" borehole 1); and very stiff to hard silty clay (18'-0" maximum penetrated).

It is recommended that the structure be supported on spread footings at or below El. 83.3 using a maximum allowable soil pressure of 6000 pounds per square foot. The estimated total settlement is less than 1-inch.

No unusual construction problems are anticipated.

I INTRODUCTION

Verbal authorization was received from A. M. Spriet & Assoc., consulting engineers, to carry out a soil investigation at a site in the Township of Metcalfe where it is proposed to replace an existing road bridge with a new structure.

The existing structure is located on Lot 4, Concession 9 of the Township where the road crosses a tributary of the Sydenham River.

It is understood that the proposed structure will have the same longitudinal and transverse centre lines as the existing bridge. The requirements of the project were discussed with Mr. A. J. Devos, P. Eng., who supplied the foregoing information.

The purpose of this investigation was to reveal the subsurface conditions at the site and to determine the relevant soil properties for the design and construction of the new foundations.

II FIELD WORK

The field work, consisting of 2 boreholes, was carried out during the period January 14 - 17, 1966, at the locations shown on Enclosure 2. The holes were advanced by washboring methods, and were lined with Bx casing.

Standard Penetration Tests using a 2-inch outside diameter split-spoon sampler were performed at frequent intervals of depth, using a driving force of a 140 lb. hammer falling freely through 30-inches. The tube is first driven an initial 6-inches to allow for the presence of disturbed material at the bottom of the borehole. The number of standard blows required to drive the sampler a further 12-inches was recorded as the standard penetration resistance (or 'N' value). This test determines the relative density of granular strata and gives an indication of the consistency of cohesive strata. It also enables samples to be obtained for classification purposes.

Dynamic cone penetration tests were performed adjacent to each borehole location to obtain an indication of soil density changes with depth.

The results of the field tests are presented on the Geotechnical Data Sheets, Enclosures 3 and 4. Elevations were referred to a benchmark which was established by the client (Spike in tree, 100 feet East of Sta. 0+10S, El. 100 feet).

III LABORATORY TESTS

A series of laboratory tests were performed on samples of the silty clay stratum in which spread footings will bear, if such a design is used.

Atterberg Limit and moisture content tests were carried out on 3 samples as a means of classification and as a guide to the probably behaviour of the soil. These gave values of Liquid Limit between 31% and 33%; Plastic Limit between 18% and 19%; and Plasticity Index between 21% and 23% indicating that the soil is a clay of low plasticity and compressibility. The Liquidity Indices which relate the natural moisture content of the clay to the Atterberg Limits ranged between 0.14 and 0.62 indicating a 'stiff' to 'very stiff' consistency.

The results of the Atterberg Limit and moisture content tests are plotted graphically on the Geotechnical Data Sheet for each borehole.

IV SUBSURFACE CONDITIONS

Detailed descriptions of the strata encountered in each borehole are given on the Geotechnical Data Sheets, comprising Enclosures 3 and 4, and a general picture of the soil stratigraphy is given in the form of a Subsurface Profile on Enclosure 2.

The boreholes revealed the following general ground succession:-

		Thickness	
		B.H.1.	B.H.2.
(a)	Stiff brown (weathered) silty clay (Fill).	9'-0"	11'-0"
(b)	Compact brown fine sand, trace of silt.	4'-6"	not encountered
(c)	Brown/grey silty clay with fine sand seams. The consistency of this stratum is described as 'very stiff' to 'hard' as indicated by standard penetration test results ranging from 14 to 156 blows per foot.	penetrated 18'-0"	penetrated 15'-6"

V GROUNDWATER CONDITIONS

The groundwater in the two boreholes reached equilibrium at an average El. 92.5 which was 9-inches higher than the ice level in the adjacent creek at the time of the investigation.

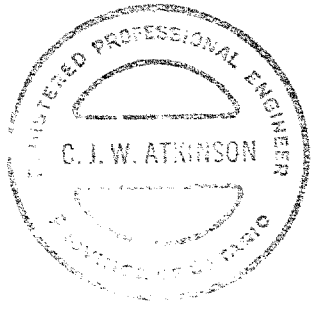
VI DISCUSSION

The bed of the creek extends to El. 88.3 and allowing for scour it is recommended that footings should bear at or below El. 83.3. The footing depth should be decided after a hydrological study has been made to determine the maximum depth of scour. This level lies within the stratum of hard silty clay and on the basis of the borehole results a maximum net soil pressure of 6000 pounds per square foot is appropriate for the design of footings up to 12 feet in width. Furthermore the footings will have a factor of safety of 3 against shear failure of the underlying soil.

It is estimated that total settlement will not exceed 1-inch and in view of the similar conditions encountered in the boreholes, no appreciable differential settlement is anticipated.

The adhesion between the footings and the silty clay stratum may be taken as 2000 p.s.f. and the factor of safety against horizontal sliding of the abutments should be at least 1.5.

The hard cohesive soil will present no unusual construction problems. The volume of seepage into excavations will probably be small and should be collected in sumps dug below the footing level and removed by pumping.



Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED

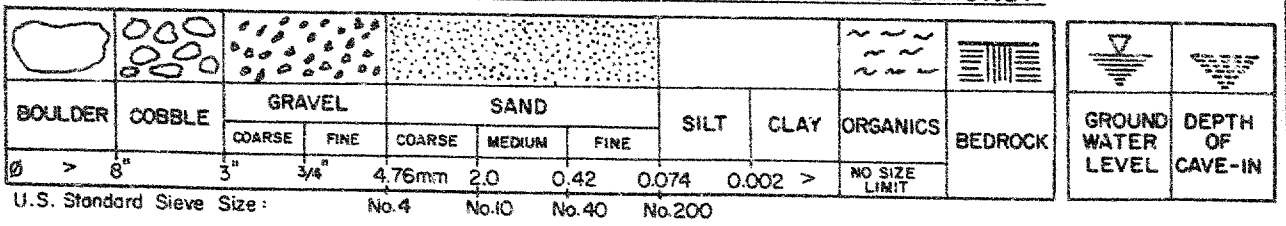
C.J.W. Atkinson, M.Sc., P.Eng.,
Branch Manager

CJWA:jms

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

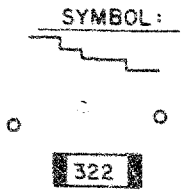
OBSERVATIONS MADE WHILE CORING: Steady pressure; No pressure; Intermittent pressure; Washwater returns; Washwater lost

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

SYMBOL:



EXTRAPOLATED -N- VALUE

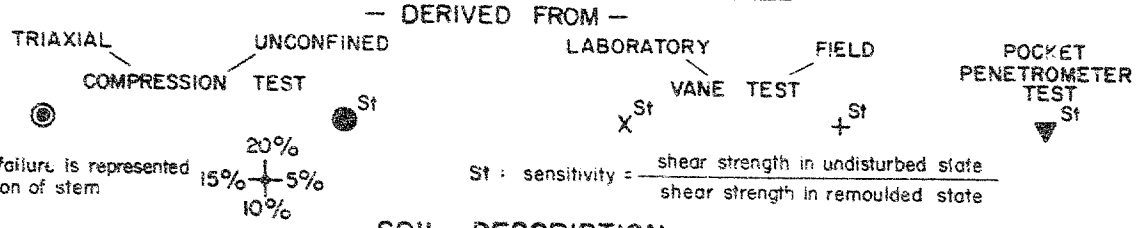
The energy for the penetration resistances is supplied by a 140 lb. hammer falling 30 inches

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.

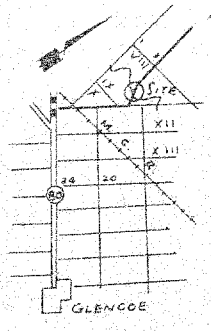
— DERIVED FROM —



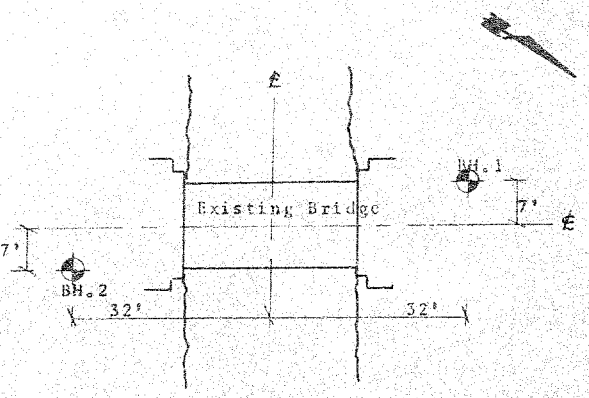
St : sensitivity = $\frac{\text{shear strength in undisturbed state}}{\text{shear strength in remoulded state}}$

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

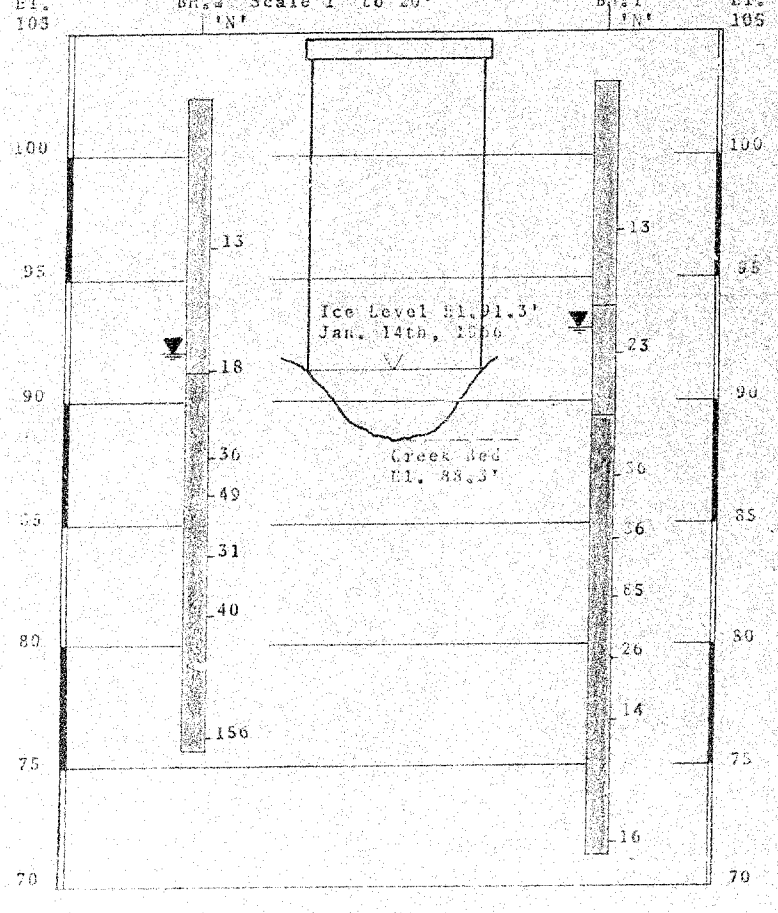


KEYPLAN



BM. Spike in Tree
100' E. of Sta. 0+10S
El. 100'

LOCATION OF BOREHOLES



LEGEND

- Stiff silty clay
- Compact Fine Sand
- Very stiff to hard Silty Clay & Sand Seams.

SUBSURFACE PROFILE

Scale 1-inch to 5 feet

401 13-48
GEOCRES No.

OUR REFERENCE NO 6-1-1.1

GEOTECHNICAL DATA SHEET FOR BOREHOLE 1

CLIENT A. N. Spriet & Associates
PROJECT Road Bridge #20
LOCATION Lot 4, Conc. 9, Twp. of Metcalfe
DATUM ELEVATION 100 feet

METHOD OF BORING Washboring
DIAMETER OF BOREHOLE (3-inch)
DATE January 14 & 15, 1966

ENCLOSURE NO. 3

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES Pen. or Advancement of sampler	PENETRATION RESISTANCE blows per foot 20 40 60 80 100 / SHEAR STRENGTH lbs/sq ft	CONSISTENCY water content % PL W LL 10 20 30 40	REMARKS
103.0	0.0	Ground Surface							
100		Stiff brown (weathered) silty clay		1	SS	13			
95	9.0	Compact brown fine sand, trace of silt		2	SS	25			W.L. El. 93.0
90	13.5	Grey silty clay, fine sand seams, hard very stiff		3	SS	36			
				4	SS	36			
85				5	SS	85			
				6	SS	26			
80				7	SS	14			
75				8	SS	16			
	21.5	End of Borehole							
70									

GEOTECHNICAL DATA SHEET FOR BOREHOLE . 2 . . .

OUR REFERENCE NO 6-1-L1

CLIENT A. N. Spriet & Associates
PROJECT Road Bridge #20
LOCATION Lt 4, Conc. 9, Twp. of Cartwright
DATUM ELEVATION 100 feet

METHOD OF BORING Washboring
DIAMETER OF BOREHOLE Bx (3-inch)
DATE January 15 & 17, 1960

ENCLOSURE NO. 4

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES N Adjustment of Sampler	PENETRATION RESISTANCE blows per foot / SHEAR STRENGTH lbs/sq ft	CONSISTENCY water content % Pl W Ll (10 20 30 40)	REMARKS
102.4	0.0	Ground Surface							
100		Stiff brown (weathered) silty clay		1	SS	13			
95									
	11.0			2	SS	18			W.L. El. 92.1
90		organics							
		Hard brown silty clay, fine sand seams.		3	SS	36			
				4	SS	49			
85				5	SS	31			
				6	SS	40			
80									
				7	SS	156			
75	26.5	End of Borehole							