LOT 19.

RANGE II N.

& GORE CON.

EKFRID TWP.

LOT 13-37

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CONSULTING SOIL & FOUNDATION ENGINEERS
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CONSULTING ENGINEERS
LONDON ONTARIO

Report On SOIL INVESTIGATION for PROPOSED NEW BRIDGE LOT 19, RANGE II NORTH and GORE CONCESSION TOWNSHIP OF EKFRID

by

Dominion Soil Investigation Limited
1220 Trafalgar Street
London Ontario

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I INTRODUCTION

In accordance with a letter of authorization dated November 29, 1973, from J. P. McIntyre Engineering Limited, Consulting Engineers, a soil investigation has been carried out in the Township of Ekfrid, where it is proposed to replace an existing bridge with a new structure. The existing structure is located on Lot 19, Range II North and Gore Concession, where the road crosses Newbiggen Creek. It is understood that the new structure will be centred on the existing bridge, and the requirements of the project were supplied by Mr. J. P. McIntyre, P.Eng.

The purpose of the investigation was to reveal the subsurface soil and groundwater 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 two boreholes, was carried out on December 7 and 8, 1973, at the locations

shown on Enclosure 2. The holes were advanced by a continuous flight auger machine, which was equipped for soil sampling.

Standard penetration tests were performed at frequent intervals of depth, as detailed in Appendix 'A', and the results are recorded on the borehole logs as 'N' values. The split-spoon samples were stored in air-tight containers and transferred to our London laboratory for classification, testing and storage.

The field work was supervised by a soils technician who also related the ground surface elevations to a local benchmark. The benchmark was established by the client as a painted cross or top of the northwest wingwall of the existing bridge, and it was given a value El. 99.57 feet.

III SUBSURFACE CONDITIONS

Detailed descriptions of the strata, which were encountered in each borehole, are given on the borehole logs comprising Enclosures 3 and 4. The following notes are intended only to amplify this data.

The boreholes encountered surface layers of fill which extend to depths of 6½ and 6 feet in boreholes 1 and 2 respectively. The fill is associated with the construction of the approaches to the existing bridge, and it consists of a mixture of gravel overlying silty clay.

The natural subsoil consists of glacial silty clay which contains little or no sand and gravel size particles. This type of subsoil is commonly referred to as 'Glacial Till'. Due to the clay content the till should be regarded as a plastic and cohesive material, and the consistency is described as 'very stiff' to 'hard' based on 'N' values ranging from 12 to 53 blows per foot, which were confirmed by undrained shear strength values ranging from 1860 to 3900 p.s.f. Atterberg Limit tests were performed on a sample of the silty clay giving values of Liquid Limit of 43%, Plastic Limit of 21% and Plasticity Index of 22%. The natural moisture content of the silty clay was found to range from 21% to 26%, which is close to the Plastic Limit of the soil and confirms the 'very stiff' consistency obtained from visual and tactile examination.

The boreholes were terminated in the 'very stiff' silty clay at depths of 26½ feet below the ground surface.

IV GROUNDWATER CONDITIONS

Due to the impervious nature of the silty clay subsoil the boreholes remained dry throughout the boring operation, however it may be assumed that the prevailing groundwater level is influenced by the water level in the creek at any particular time. The creek level was observed at El. 40.9 at the time the field work was carried out.

V DISCUSSION AND RECOMMENDATIONS

The natural soil profile below the creek bed consists of 'very stiff' to 'hard' silty clay till, which is suitable for the support of normal spread footing foundations. It is recommended that the footing grade be established at a minimum depth of 4 feet below the creek bed level to provide sufficient protection against frost action, and on the basis of the borehole results a maximum allowable soil pressure of 4000 p.s.f. is appropriate for the design of footings. This soil pressure incorporates a factor of safety of

3 against shear failure of the underlying soil, and total settlement of footings 5 feet in width is estimated to be 0.5 inch or less. Also due to the uniformity of the subsoil below the footing grade, no appreciable differential settlement is anticipated.

The adhesion between the footings and the subsoil may be taken as 1500 p.s.f. or 35% of the vertical load, whichever is the lower value and the factor of safety against horizontal sliding of the footings must be at least 1.5.

The 'very stiff' cohesive subsoil will cause no unusual construction problems, and it is anticipated that seepage into excavations will be controlled by normal pumping procedures using sumps in the bottom of the excavation.

The existing site material is not considered suitable for backfill behind abutments, therefore approved free-draining material should be used to prevent an out-of-balance hydrostatic pressure being exerted on the abutment by entrapped water.

Pipe Culvert

The silty clay subsoil is also suitable for the support of a pipe culvert if this type of construction is acceptable. It is recommended that the pipe be placed on a pad of compacted granular fill to provide a uniform support, and that the fill be compacted to at least 100% of the standard Proctor dry density. The fill at the ends of the pipe should be sealed with a clay plug to prevent erosion of the granular material below the pipe.

Yours very truly,

DOMINION SOIL INVESTIGAGION LTD.

CJWA:eg

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

APPENDIX 'A'

THE STANDARD PENETRATION TEST

In order to determine the relative density of non-cohesive soils, such as sands and gravels, the standard penetration test has been adopted. The test also gives an indication of the consistency of cohesive soils.

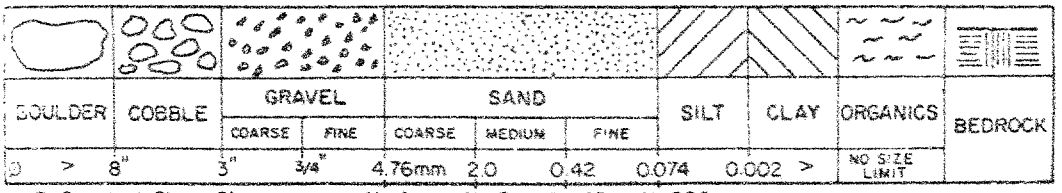
A two inch external diameter thick-walled sample tube is driven into the ground at the bottom of the borehole by means of a 140 lb. hammer falling freely through 30 inches. The tube is first driven an initial 6 inches to allow for the presence of disturbed material at the bottom of the borehole. The number of standard blows 'N) required to drive the sampler a further 12 inches is recorded. The sample tube is one originally developed by Raymond Concrete Pile Company in the United States, where a sufficient number of tests have been made in conjunction with field investigations to show that the results, although essentially empirical, may be applied to foundation design.

For Sands:-

Values of 'N'	Density
Less than 10	Loose
Between 10 and 30	Compact
Between 30 and 50	Dense
Greater than 50	Very Dense

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

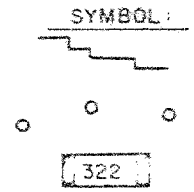
OBSERVATIONS MADE WHILE CORING: Steady pressure; No pressure; Intermittent pressure; Washwater returns; Washwater lost

PENETRATION RESISTANCES.

DYNAMIC PENETRATION RESISTANCE : to drive a 2"¢, 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

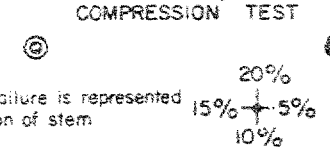
SOIL PROPERTIES.

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 —

TRIAXIAL COMPRESSION TEST; UNCONFINED TEST; LABORATORY VANE TEST; FIELD VANE TEST; POCKET PENETROMETER TEST



Strain at failure is represented by direction of stem

St = sensitivity = undisturbed shear strength / remoulded shear strength

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

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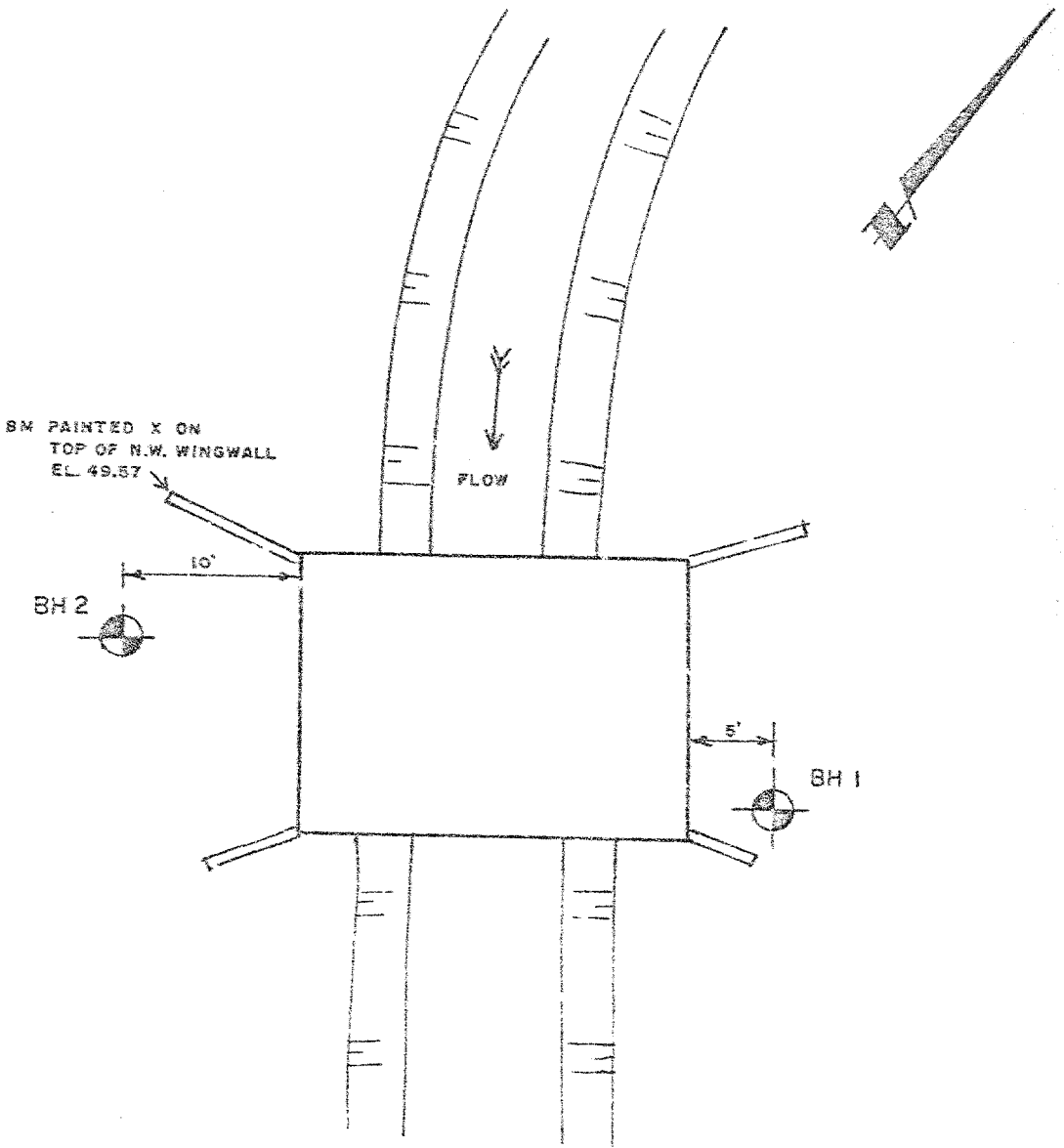
Our Ref. No. 73-12-L3

Enclosure No. 2

Prep. By



LOCATION OF BOREHOLES

SCALE 1" = 10'

40 I 13-37

GEOCRES No.

DOMINION SOIL INVESTIGATION LIMITED

LOG OF BOREHOLE 1

Our Reference No. 73-12-L3

Enclosure No. 3

CLIENT: J.P. McIntyre Engineering Ltd.,
PROJECT: Proposed Bridge 0004, Twp. of Ekfrid
LOCATION: Lot 19, Range II North and Gore Concession
DATUM ELEVATION: Cross on N.W. wingwall, El. 49.57 feet

DRILLING DATA
Method: Auger
Diameter: 4½ inch
Date: December 7, 1973

ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' Blows/Ft.
503	0.0	Ground Surface					
	1.0	Gravel. Fill.					
		Silty clay.					
45		Fill.			1	SS	46
	6.5						
40		Very stiff to hard brown grey silty clay.			2	SS	53
					3	SS	35
35					4	SS	23
					5	SS	43
30					6	SS	31
25					7	SS	12
	26.5						

PENETRATION RESISTANCE Blows/Ft. 20 40 60 80 100

UNDRAINED SHEAR STRENGTH 100 p.s.f.
+ FIELD VANE TEST @ COMPRESSION TEST
20 40 60 80 100

WATER CONTENT %
PLASTIC LIMIT W_P — NATURAL W — LIQUID LIMIT W_L
10 20 30 40 50

REMARKS

Hole dry.

LOG OF BOREHOLE 2

Ou. Reference No. 73-12-13

Enclosure No. 4

CLIENT: J.P. McIntyre Engineering Ltd.,
PROJECT: Proposed Bridge 0004, Twp. of Ekfrid
LOCATION: Lot 19, Range II North and Gore Concession
DATUM ELEVATION: Cross on N.W. wingwall, El. 49.57 feet

DRILLING DATA
Method: Auger
Diameter: 4½ inch
Date: December 8, 1973

ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' Blows/Ft.	REMARKS
50.9	0.0	Ground Surface						
		Gravel. Fill.						Hole dry.
	1.5	Silty clay. Fill.						
45	6.0				1	SS	10	
40		Very stiff silty brown ~~grey~~ clay.			2	SS	32	
					3	SS	27	
35					4	SS	17	
					5	SS	18	
30					6	SS	28	
25	26.5				7	SS	19	

PENETRATION RESISTANCE Blows/Ft.: 20 40 60 80 100

UNDRAINED SHEAR STRENGTH 100 p.s.f.
+ FIELD VANE TEST @ COMPRESSION TEST
20 40 60 80 100

WATER CONTENT %
PLASTIC LIMIT W_P — NATURAL W — LIQUID LIMIT W_L
10 20 30 40 50