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64-F-265 m

BRIDGE ~~#~~ 20

BETWEEN LOT 13,

CON. IV & V

BIDDULPH

Twp.

**BA 1972**

**19-20**

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MIDDLESEX COUNTY ENGINEER  
COUNTY BUILDINGS  
LONDON ONTARIO

Report on  
SOIL INVESTIGATION  
for  
BRIDGE NO. 20  
BETWEEN LOT 13, CONCESSION IV  
AND CONCESSION V  
TOWNSHIP OF BIDDULPH

by

DOMINION SOIL INVESTIGATION LIMITED  
363 Queens Avenue  
LONDON ONTARIO  
Reference No. 4-11-L5  
December 2nd, 1964

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SUMMARY

The strata consist of about 1 foot 6 inches of topsoil and 1 foot to 2 feet 6 inches of cobbles and boulders overlying a cohesive glacial till which increases in strength from firm to hard with depth.

It is recommended that the structure should be supported on spread footings at El. 84.0 and that the maximum net soil pressure should not exceed 8,000 pounds per square foot. The estimated consolidation settlement is 1.0 inch and no appreciable differential settlement is expected.

No unusual construction problems are anticipated.

## I INTRODUCTION

In accordance with a letter of authorization dated November the 5th, 1964 from the Middlesex County Engineer's office, a soil investigation has been carried out at the site of Bridge no. 20 in the Township of Biddulph. It is proposed to replace the existing road bridge with a new structure.

The purpose of this investigation has been to reveal the sub-surface conditions at the site and to determine the relevant soil properties for the design and construction of the new foundations.

## II FIELD WORK

Two boreholes were put down to a maximum depth of 21 feet during the period November 18th to 20th, 1964. The holes were advanced by washboring and lined with 8x casing.

Standard penetration tests were performed at frequent intervals of depth to determine the consistency or relative density of the soil and to recover representative samples. The results are plotted as 'N' values on the geotechnical data sheet for each borehole at the depths to which they refer.

A dynamic cone penetration test was performed adjacent to borehole 2.

The locations of the boreholes are shown on the site plan, enclosure 2. Elevations have been referred to Bench Mark 1 (6" spike in 18" tree Lt. 4 - 00, El. 100.00).

## III SUBSURFACE CONDITIONS

Detailed descriptions of the strata encountered at each borehole are shown on enclosure 3 and a general picture of soil stratigraphy is given in a form of a section on enclosure 2.

The general soil profile consists of about 1 foot 6 inches of topsoil and 1 foot to 2 feet 6 inches of cobbles and boulders overlying a clay till deposit which was penetrated a maximum depth of 17 feet. The clay till is generally sandy, very silty and contains gravel, cobbles and small boulders. The consistency changes from firm to hard with depth.

## IV GROUNDWATER CONDITIONS

From observations of the water levels taken in the boreholes it would appear that the groundwater table varies from 1 foot to 4 feet below the ground level. The level of the water in the river at the time of field work was about El. 90.5.

V DISCUSSION

The soil profile at each abutment is generally similar and consists of about 1 foot 6 inches of topsoil and 1 foot to 2 foot 6 inches of boulders and cobbles overlying the cohesive glacial till deposit.

The bed of the river extends to El. 88.0 and allowing for scour it is recommended that the footings bear at El. 84.0. This level lies within the very stiff clay till stratum and on the basis of the field observations a net allowable soil pressure of 8,000 pounds per square foot would be appropriate for the design of footings. It is estimated that the total consolidation settlement for a five foot wide footing under the above loading will not exceed 1 inch, and in view of the very similar conditions encountered in the 2 boreholes the differential settlement between the abutments will be negligible.

The coefficient of friction between the footings and the clay till should be taken as 0.35 and the factor of safety against horizontal sliding of the abutments should be at least 1.5.

The permeability of the clay is very low and it is anticipated that the discharge of ground water into the excavation will be easily controlled by pumping from a sump. The excavation in the clay till can be made with vertical sides which will require a minimum of bracing.

Yours very truly

DOMINION SOIL INVESTIGATION LIMITED



C. J. W. Atkinson, M. Sc.,  
Project Engineer.

CA/sg

# LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

## SOIL COMPONENTS AND GROUND WATER CONDITIONS.

												
<b>BOULDER</b>	<b>COBBLE</b>	<b>GRAVEL</b>		<b>SAND</b>			<b>SILT</b>	<b>CLAY</b>	<b>ORGANICS</b>	<b>BEDROCK</b>	<b>GROUND WATER LEVEL</b>	<b>DEPTH OF CAVE-IN</b>
Ø	> 8"	3"	3/8"	4.75mm	2.0	0.42	0.074	0.002	>	NO SIZE LIMIT		
U.S. Standard Sieve Size		No. 4		No. 10		No. 40		No. 200				

## SAMPLE TYPES.

AS Auger sample CS Sample from casing CHS Chunk sample	RC Rock core % Recovery SS Split spoon sample	TP Piston, thin walled tube sample TW Open, thin walled tube sample WS Wash sample
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<b>SAMPLER ADVANCED BY</b> " static weight " pressure " tapping	<b>OBSERVATIONS MADE WHILE CORING</b> Steady pressure No pressure Intermittent pressure	Washwater returns Washwater lost
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## PENETRATION RESISTANCES.

**DYNAMIC PENETRATION RESISTANCE** - to drive a 2" dia., 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

**EXTRAPOLATED -N- VALUE**

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

**SYMBOL**



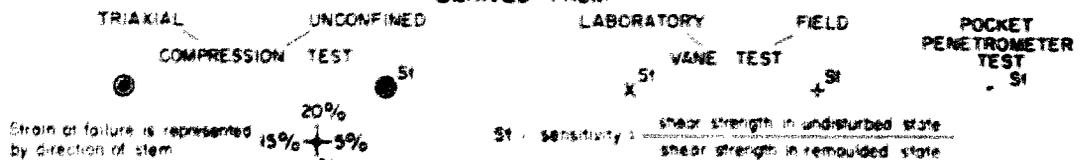
322

## SOIL PROPERTIES.

W % Water content LL % Liquid limit PL % Plastic limit PI % Plasticity index LI Liquidity index	γ Natural bulk density (unit weight) e void ratio RD Relative density C <sub>v</sub> Coeff. of consolidation m <sub>v</sub> Coeff. of volume compressibility	k Coeff. of permeability C Shear strength - in terms of total stress φ Angle of int. friction - total stress C' Cohesion - in terms of effective stress φ' Angle of int. friction - effective stress
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## UNDRAINED SHEAR STRENGTH.

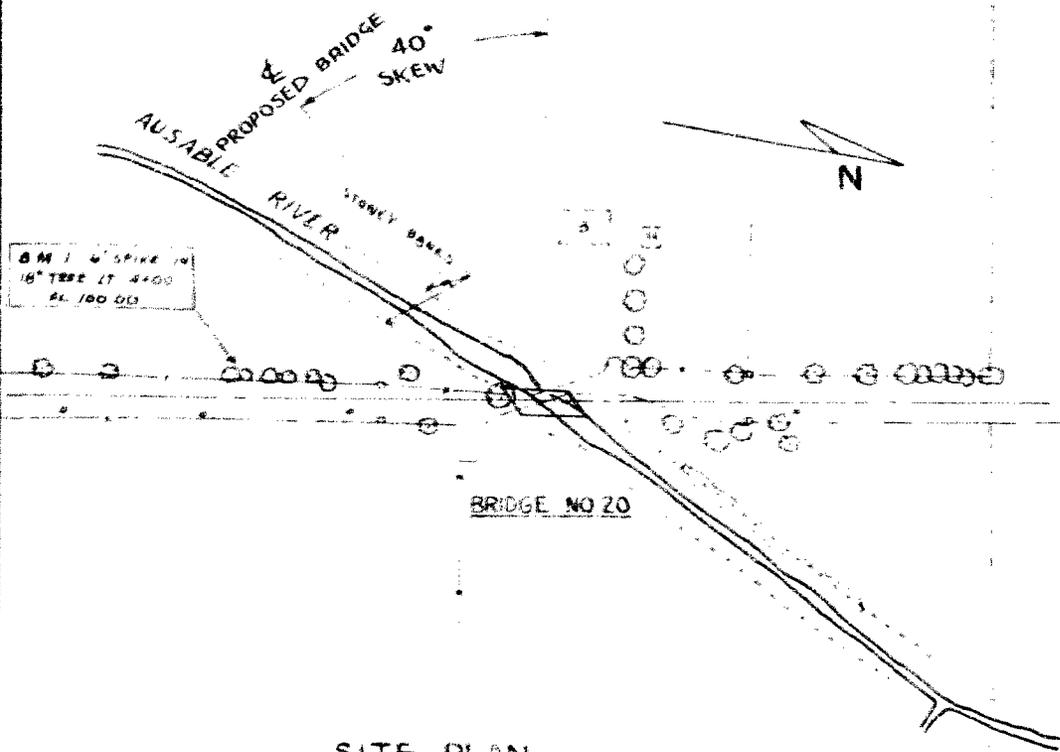
- DERIVED FROM -



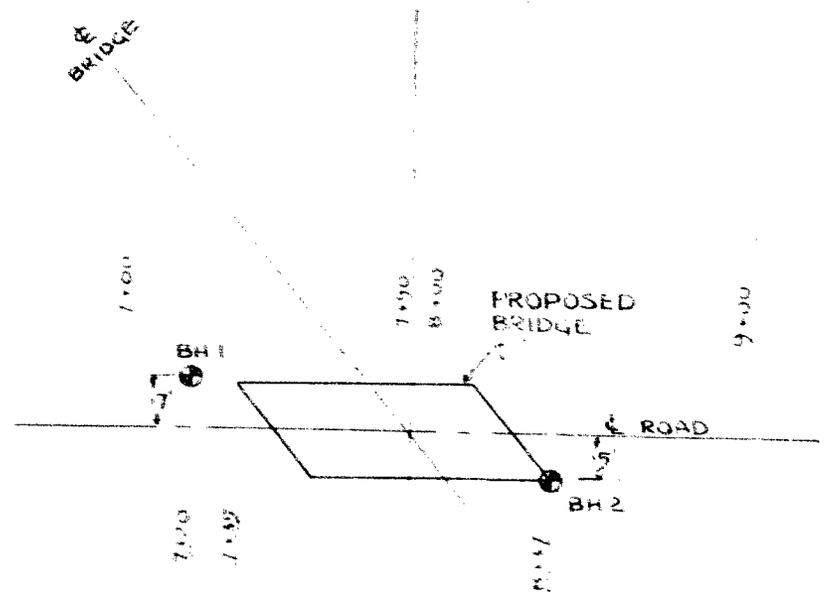
## SOIL DESCRIPTION.

<b>COHESIONLESS SOILS</b>	<b>RD</b>	<b>COHESIVE SOILS</b>	<b>C</b> lb/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

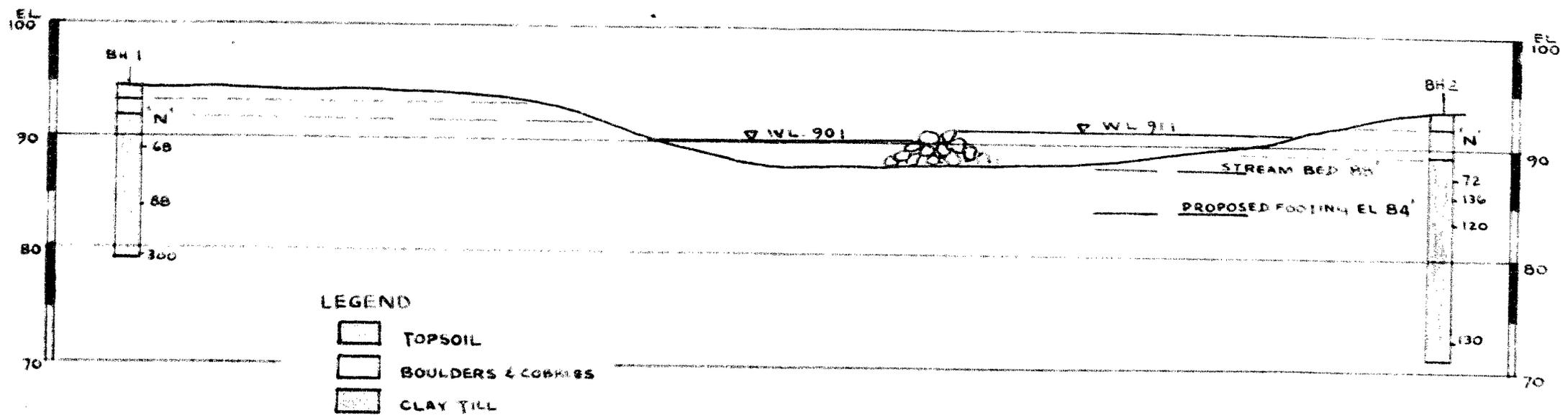
LOT 13 CONCESSION IV



**SITE PLAN**  
 SCALE 1 INCH TO 200 FEET



**BOREHOLE LOCATION PLAN**  
 SCALE 1 INCH TO 50 FEET



**SUBSURFACE PROFILE**  
 SCALE 1 INCH TO 10 FEET

# GEOTECHNICAL DATA SHEET FOR BOREHOLE

DATA REFERENCE NO. 4-11-15

CLIENT: County of Middlesex  
 PROJECT: Bridge No. 20  
 LOCATION: Lot 13 Township of Middlesex  
 DATUM ELEVATION: 100.0 feet, B.M. 1

METHOD OF BORING: Washbottle  
 DIAMETER OF BOREHOLE: 1 1/2 INCHES  
 ENCLOSURE NO. 5  
 DATE: November 18th to 20th, 1964

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLE			PENETRATION RESISTANCE		CONSISTENCY water content %	REMARKS	
				NUMBER	TYPE	WATER CONTENT (%)	20	40			60
94.6	0.0	Ground Surface									
	1.3	Topsoil									
	2.9	Cobbles	C								
		Very stiff brown sandy silty clay containing gravel, cobbles and small boulders (Glacial till)	S	1	SS	68				<div style="text-align: center;"> </div>	<div style="text-align: center;"> </div>
	2			BXT							
	3			SS	88						
	4			BXT							
	5			SS	50						
80.3	15.3	End of Borehole									
93.9	0.0	Ground Surface									
	1.5	Topsoil									
	4.0	Boulders & cobbles in matrix of loamy soil	C								
		Very stiff brown sandy silty clay containing gravel, cobbles & small boulders (Glacial till)	S	1	SS	75				<div style="text-align: center;"> </div>	<div style="text-align: center;"> </div>
	2			BXT							
	3			SS	60						
	4			BXT							
	5			SS	65						
	6			BXT							
	7			BXT							
	8			SS	65						
72.5	21.0	End of Borehole									

$\nabla$  W.L.  
 1700 hrs.  
 20th November

Details of Extrapolated 'N' values  
 Sample 1  
 32/6"  
 34/6"  
 60/4"  
 Sample 3  
 44/6"  
 60/3"  
 Sample 5  
 100/5"

$\nabla$  W.L.  
 1400 hrs.  
 20th November

Details of Extrapolated 'N' values  
 Sample 1  
 58/6"  
 60/4"  
 Sample 3  
 65/6"  
 Sample 5  
 60/6"  
 Sample 8  
 19/6"  
 65/6"