

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 40P13-9

W.P. No. _____

CONT. No. _____

W. O. No. _____

STR. SITE No. 2-289

HWY. No. _____

LOCATION PROP. BR., LUDGARD
ST., LUCKNOW,

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

NONE

REMARKS: _____

B.A. 2192

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CONSULTING ENGINEERS
41 WEST STREET
GODERICH - ONTARIO



STRUCTURE SITE No. 2-289

REPORT ON
SOIL INVESTIGATION
FOR
PROPOSED BRIDGE
LUDGARD STREET
LUCKNOW, ONTARIO

SUBMITTED BY
DOMINION SOIL INVESTIGATION LIMITED
369 QUEENS AVE.
LONDON - ONTARIO

REFERENCE

5-9-L11

OCTOBER - 1965

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I INTRODUCTION

In accordance with a letter of authorization dated September 24, 1965, a soil investigation has been carried out in the village of Lucknow, where it is proposed to replace an existing road bridge with a new structure.

The existing steel-beam structure is located on Ludgard Street where the road crosses the Nine Mile River.

It is understood that the proposed structure is a rigid-frame with about a 30 foot span. The longitudinal and transverse centre line will be the same as the existing bridge. The requirements of the project were discussed with Mr. K. G. Dunn, 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 October 7 - 9, 1965, 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 sampler is first driven an initial 6 inches to allow for the presence of disturbed

material at the bottom of the borehole. The number of 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 Geodetic site bench mark, top of S.I.B. El. 882.51 feet.

III

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.

Both boreholes penetrated a fill deposit, 8 to 9 feet thick, which is associated with the construction of the approaches to the existing bridge.

Underlying the fill is a stratum of sand and gravel, 3 feet to 4 feet 9 inches in thickness, and the surface of this stratum coincides with the level of the stream bed. The relative density is described as "very dense" as estimated from Standard Penetration test results in excess of 50 blows per foot.

Between El. 872 and El. 862 the boreholes penetrated a stratum of clayey silt which can be considered as a cohesive material. The consistency is described as "very stiff" as indicated by Standard Penetration test results ranging from 20 to 28 blows per foot.

Both boreholes were terminated in a glacial deposit of very dense sandy clayey silt.

IV GROUNDWATER CONDITIONS

The water level of the river at the time the field work was carried out was El. 877.6.

The ground water in the two boreholes reached equilibrium at an average level of El. 877.3.

V DISCUSSION

The natural soil profile consists of very dense and very stiff fluvio-glacial deposits extending down to El. 862, overlying very dense glacial till in which the boreholes were terminated. The strata will, therefore, provide adequate support for a spread footing design.

The bed of the river extends to El. 875.9 and allowing for scour it is recommended that footings should bear at or below El. 871.

The actual footing depth should be decided after a hydrological study has been made to determine the maximum depth of scour. This proposed level lies within the stratum of very stiff clayey silt and on the basis of the borehole results a maximum net soil pressure of 5,000 pounds per square foot is appropriate for the design of footings. 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 two boreholes, no appreciable differential settlement is anticipated.

The adhesion between the footings and the clayey silt 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.

Construction

Dewatering of the excavation should not be especially difficult once the stream is diverted away from the site through some temporary channel. The sand and gravel stratum will require lateral bracing to prevent a flow of water and soil into excavations and probably the most suitable method to do this will be to install temporary sheeting keyed into the impervious silt stratum below.

The volume of seepage will then be small and should be collected in sumps dug below the footing level and removed by pumping.

DOMINION SOIL INVESTIGATION LIMITED,

C. J. W. Atkinson
per K.A.K.

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

CJWA/is
Encls.

E n c l o s u r e s

LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

SOIL COMPONENTS AND GROUND WATER CONDITIONS.

BOULDER	COBBLE	GRAVEL		SAND			SILT	CLAY	ORGANICS	BEDROCK	GROUND WATER LEVEL	DEPTH OF CAVE-IN
		COARSE	FINE	COARSE	MEDIUM	FINE			NO SIZE LIMIT			
Ø	> 8"	3"	3/4"	4.76mm	2.0	0.42	0.074	0.002	>			
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

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.

EXTRAPOLATED -N- VALUE

The energy for the penetration resistances is supplied by a 140 lb. 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

Cv

Coeff. of consolidation

mv

Coeff. of volume compressibility

k Coeff. of permeability

C Shear strength — in terms of total stress

 ϕ Angle of int. friction — in terms of effective stress

C' Cohesion — in terms of effective stress

 ϕ' Angle of int. friction — in terms of effective stress

UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —

TRIAXIAL

UNCONFINED

LABORATORY

FIELD

COMPRESSION TEST

VANE TEST

POCKET PENETROMETER TEST



St

XSt+St

St

Strain at failure is represented by direction of stem

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

SOIL DESCRIPTION.

COHESIONLESS SOILS :

RD :

Very loose

Loose

Compact

Dense

Very dense

0 - 15 %

15 - 35 %

35 - 65 %

65 - 85 %

85 - 100 %

COHESIVE SOILS :

C lbs/sq.ft.

Very soft

Soft

Firm

Stiff

Very stiff

Hard

less than 250

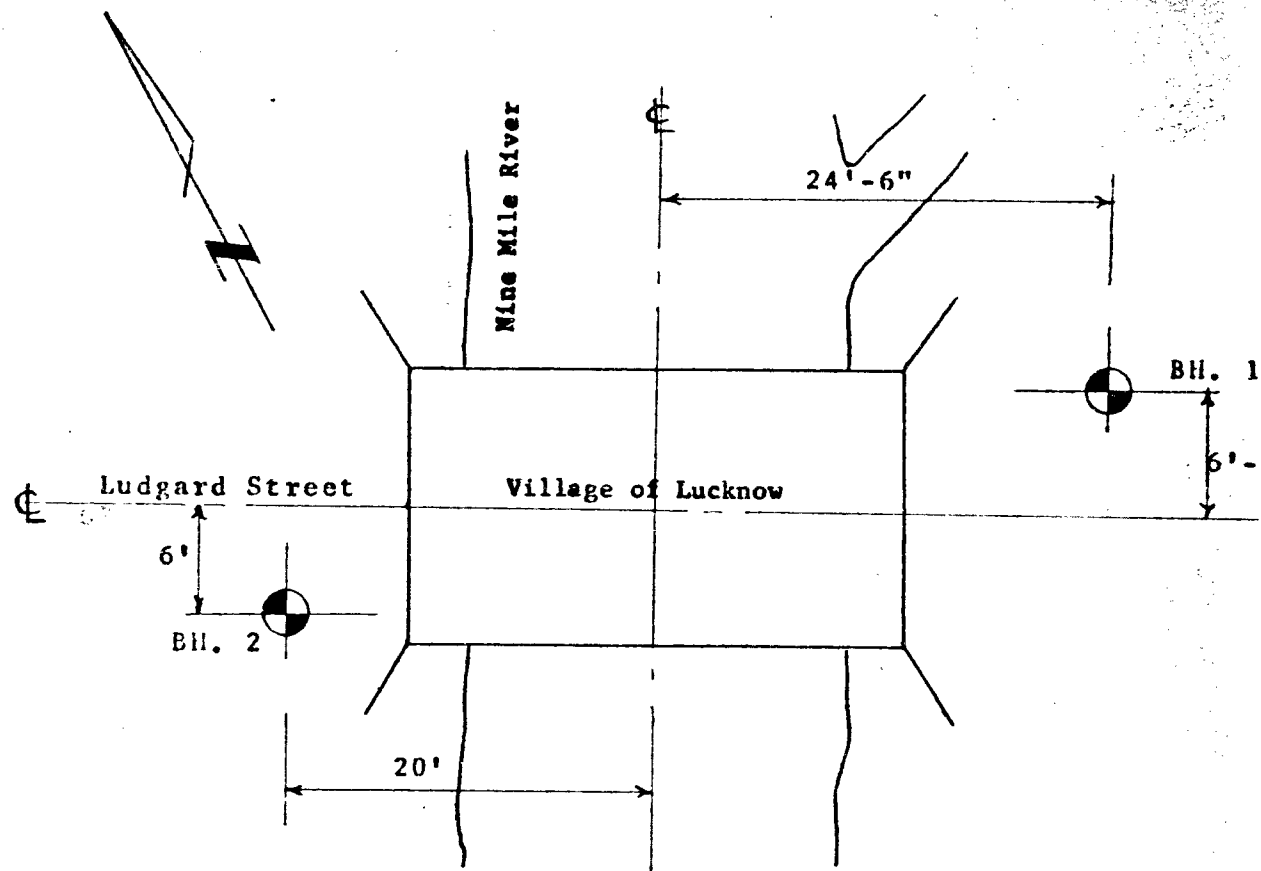
250 - 500

500 - 1000

1000 - 2000

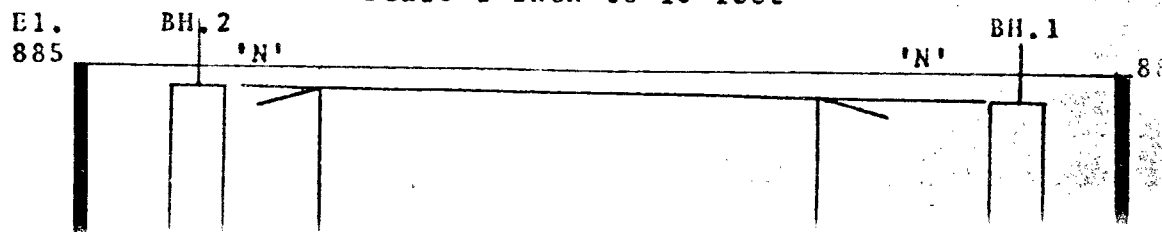
2000 - 4000

over 4000



LOCATION OF BOREHOLES

Scale 1-inch to 10 feet



LEGEND

Fill



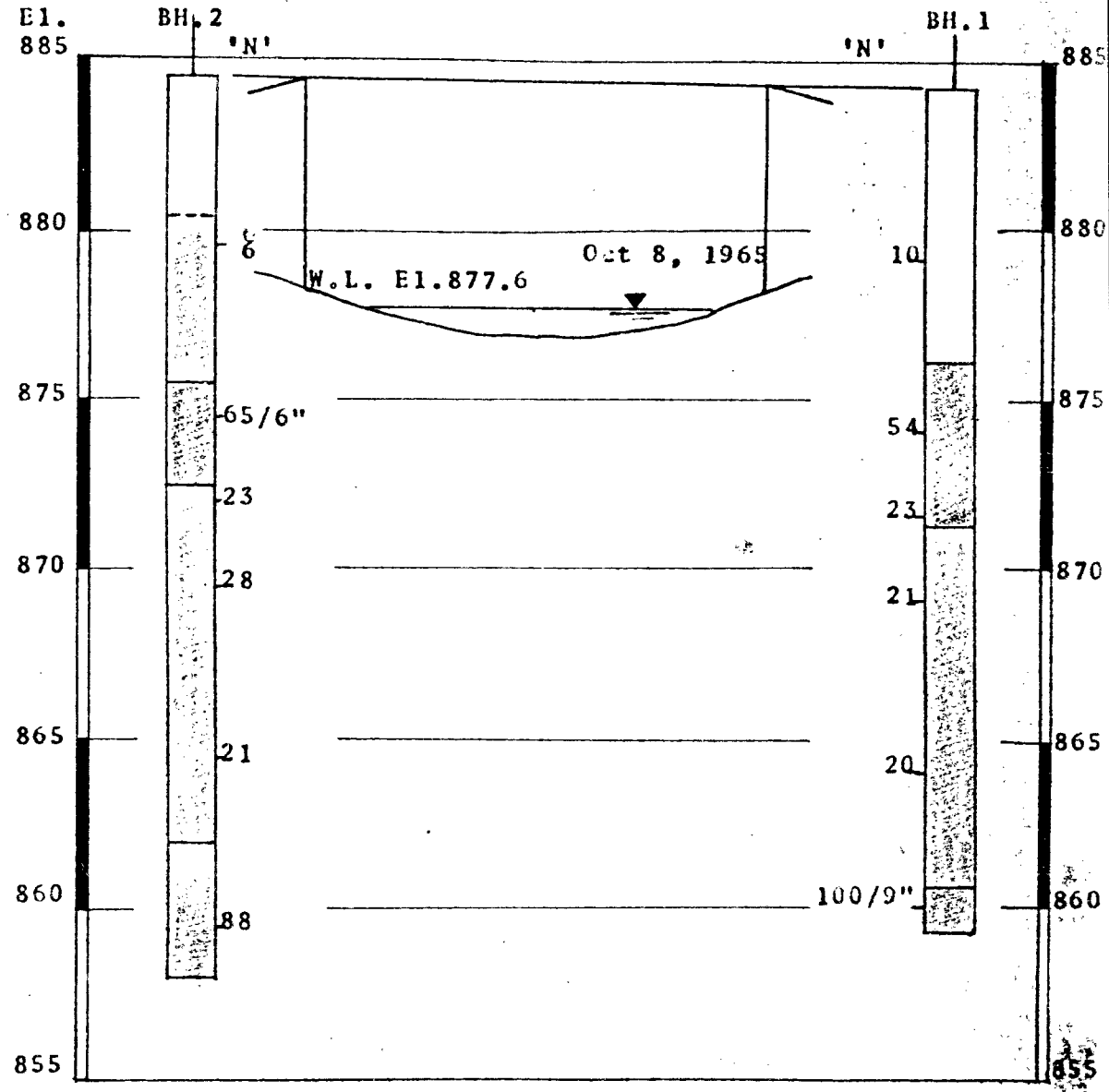
LOCATION OF BOREHOLES

Scale 1-inch to 10 feet

LEGEND

- Fill
- Very dense sand and gravel
- Very stiff clayey silt
- Very dense silt Till.

Note: Figures at boreholes denote standard penetration resistance (blows per foot).



GEOTECHNICAL DATA SHEET FOR BOREHOLE 1....

OUR REFERENCE NO. 5-9-L11

CLIENT: B. M. Ross

PROJECT: Road Bridge

LOCATION: Ludgard Street, Lucknow

DATUM ELEVATION: 882.51 feet Geodetic

METHOD OF BORING: Washboring

DIAMETER OF BOREHOLE: Bx (3-inch)

DATE: October 6, 1965

ENCLOSURE NO. 3

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %			REMARKS
				NUMBER	TYPE	N ₆₀ Advancement of Sampler	20	40	60	80	100	PL	W	LI	
884.2	0.0	Ground Surface													
		Compact brown sandy silt (Fill)		1	SS	10									
880															
	8.0	Very dense brown silty sandy gravel.		2	SS	54									
875															
	12.8	Very stiff grey slightly clayey silt.		3	SS	23									
870															
				4	SS	21									
865															
				5	SS	20									
	23.5	Very dense clayey silt Till		6	SS	100/9"									
860															
	24.8	End of Borehole													

W. L.
 El. 876.4
 1900 hrs.
 Oct. 6,
 1965

GEOTECHNICAL DATA SHEET FOR BOREHOLE#

OUR REFERENCE NO. 5-9-L11

CLIENT: B. M. Ross
 PROJECT: Road Bridge
 LOCATION: Ludgard Street, Lucknow
 DATUM ELEVATION: 882.51 feet Geodetic

METHOD OF BORING: Washboring
 DIAMETER OF BOREHOLE: 3-inch
 DATE: October 7-8, 1965

ENCLOSURE NO. 4

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %			REMARKS
				NUMBER	TYPE	N- or Advancement of Sampler	20	40	60	80	100	PL	W	LI	

884.5	0.0	Ground Surface													
		Compact brown gravelly sand. (Fill).													
880	4.0	Firm brown clayey silt (Fill).		1	SS	6									
875	9.0	Very dense brown sand & fine gravel.		2	SS	65/	6"								
	12.0	Very stiff grey clayey silt, with silt seams.		3	SS	23									
870				4	SS	28									
865				5	SS	21									
	22.5	Very dense brown sandy clayey silt. (Glacial Till).		6	SS	88									
860															
26.5		END OF BOREHOLE													

W. L.
El. 878.3
1200 hrs.
Oct. 8,
1965.

W. L.
 El. 878.3
 1200 hrs.
 Oct. 8,
 1965.