

64-F-253M

Lot II, Con. 2 & 3

HULLETT

1 WP

BA. 1990

L. ROSS
ENGINEER
ONTARIO

STRUCTURE SITE No. 12-203

Report on
SOIL INVESTIGATION
for a
PROPOSED NEW BRIDGE
LOT II, CONCESSIONS 2 & 3
TOWNSHIP OF HULLETT

64 - F - 20319

by

DOMINION SOIL INVESTIGATION LIMITED
363 Queens Avenue
LONDON ONTARIO

Reference No. 4-11-L14
December 28th, 1964

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SUMMARY

The strata consist of about 9 feet to 14 feet of silty clay fill associated with the construction of the approaches to the existing bridge overlying very stiff to hard glacial till deposits.

It is recommended that the structure should be supported on spread footings at or below El. 969.0 using a maximum net soil pressure of 6,000 pounds per square foot. The estimated consolidation settlement is less than 1.0 inch.

No unusual construction problems are anticipated but the possibility of bottom heave in the excavation is discussed should it be found necessary to lower the foundation level.

I INTRODUCTION

Verbal authorization was received from Mr. B.M. Ross's office to carry out a soil investigation at a site in the Township of Hullett where it is proposed to replace an existing road bridge with a new structure.

The existing steel-truss structure has a clear span of 81 feet. It is understood that the new bridge will have a span of about 100 feet and the exact location will be decided after a study of hydrologic observations during spring floods.

The purpose of this investigation was 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 30 feet 5 inches during the period 26th and 27th of November, 1964. The holes were advanced by washboring methods and lined with Bx casing.

Standard penetration tests using a 2" O.D. split-spoon sampler were performed at frequent intervals of depth to determine the relative density or consistency of the soil and to recover representative samples. The results are plotted as 'N' values on the geotechnical data sheets for each borehole at the depths to which they refer.

Dynamic cone penetration tests were performed adjacent to each borehole.

The locations of the boreholes are shown on the site plan enclosure 2, and elevations have been referred to a Geodetic Bench Mark established by the client (low steel of existing bridge El. 984.65).

III SUBSURFACE CONDITIONS

Detailed descriptions of the strata encountered in each borehole are given on the 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 deposit of fill which was 9 feet 6 inches thick in borehole 1 and 11 feet thick in borehole 2. The fill has generally a clay texture in borehole 1 and a silty texture in borehole 2. The consistency of the fill is estimated to be stiff based on 'N' values of 7 to 14 blows per foot.

Underlying the fill in borehole 1 is a 2 foot layer of slightly decomposed wood and in borehole 2, a 3 foot layer of clayey sand and gravel. These strata may also be fill deposits.

Natural soil was encountered at El. 975 in borehole 1 and at El. 973 in borehole 2. This stratum consists of brown very silty clay containing embedded fine gravel. 'N' values obtained in the clay till range from 17 to 48 blows per foot and thus the consistency is estimated to be very stiff to hard. This clay till stratum becomes more sandy with depth and is underlain by a clayey fine to coarse sand and gravel which was shown to be 5 feet thick in borehole 1. The relative density is compact. Borehole 1 also penetrated 1 foot 6 inches into a hard brown clay till.

IV GROUNDWATER CONDITIONS

From an observation of the water level taken in borehole 2, it would appear that the ground water table is at the same elevation as the water level in the stream. (El. 973.5 at the time of the field work). Free groundwater was not observed in borehole 1 but this caved-in at about elevation 976.

V DISCUSSION

The soil profile at each abutment is generally similar and consists of 9 feet 6 inches to 11 feet of fill overlying the very stiff to hard clay till which extends to 24 feet depth in borehole 1 and 27 feet 6 inches in borehole 2. Underlying the clay till is a layer of compact clayey fine to coarse sand and gravel which is shown to be 5 feet thick in borehole 1.

The bed of the stream extends to El. 973.5 and allowing for scour it is recommended that the footings should bear at or below El. 969.0. This level lies within the stratum of very stiff to hard clay till and on the basis of the borehole results a maximum net soil pressure of

6,000 pounds per square foot would be appropriate for the design of footings. It is estimated that long term settlement due to consolidation of the soil below a footing 5 feet wide loaded to 6,000 pounds per square foot will be less than 1 inch and in view of the very similar conditions at the two boreholes, no appreciable differential settlement is anticipated. Furthermore the footings will have a factor of safety of at least three against general shear failure.

If it is found necessary to lower the footing elevation after studying the hydrology observations during spring floods, there would be a danger of causing a heave in the bottom of the excavation due to the excess hydrostatic pressure in the clayey sand and gravel strata beneath. To avoid this, the excavation would have to be carried out inside a sheet pile enclosure which should be driven at least an equivalent distance below the footing elevation as the water level is above it or the hydrostatic uplift relieved by means of a well or deep sump.

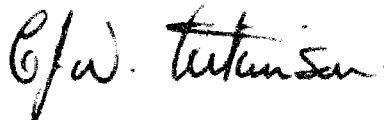
The coefficient of friction between the footings and the clay till should be taken as 0.35, and the factor of safety against horizontal sliding of the abutments should be at least 1.5.

It is anticipated that seepage into the excavation will easily be controlled by pumping. Excavations through the fill should be sloped at 1:1 and excavations through the clay till will stand almost vertically without support.

It is understood that the new road may be 5 feet higher than the existing road grade and it is estimated that settlement due to consolidation of the soil beneath the abutment, because of this added overburden, will be less than 1/2 inch.

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.

BOULDER	COBBLE	GRAVEL		SAND			SILT	CLAY	ORGANICS	BEDROCK	GROUND WATER LEVEL	DEPTH OF CAVE-IN
		COARSE	FINE	COARSE	MEDIUM	FINE						
Ø	> 8"	3"	¾"	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

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.

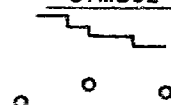
DYNAMIC PENETRATION RESISTANCE : to drive a 2" ϕ , 60° cone attached to the end of the drilling rods into the ground, expressed in blows per foot.

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_s

Natural bulk density (unit weight)

 e

Void ratio

RD

Relative density

 C_v

Coeff. of consolidation

 m_v

Coeff. of volume compressibility

 k

Coeff. of permeability

 C

Shear strength

 ϕ

Angle of int. friction — in terms of total stress

 C'

Cohesion

 ϕ'

Angle of int. friction — in terms of effective stress

UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —

TRIAXIAL

UNCONFINED

LABORATORY

FIELD

COMPRESSION TEST

St

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 :

Very loose

0 - 15 %

Loose

15 - 35 %

Compact

35 - 65 %

Dense

65 - 85 %

Very dense

85 - 100 %

COHESIVE SOILS :

C lbs/sq.ft.

Very soft

less than 250

Soft

250 - 500

Firm

500 - 1000

Stiff

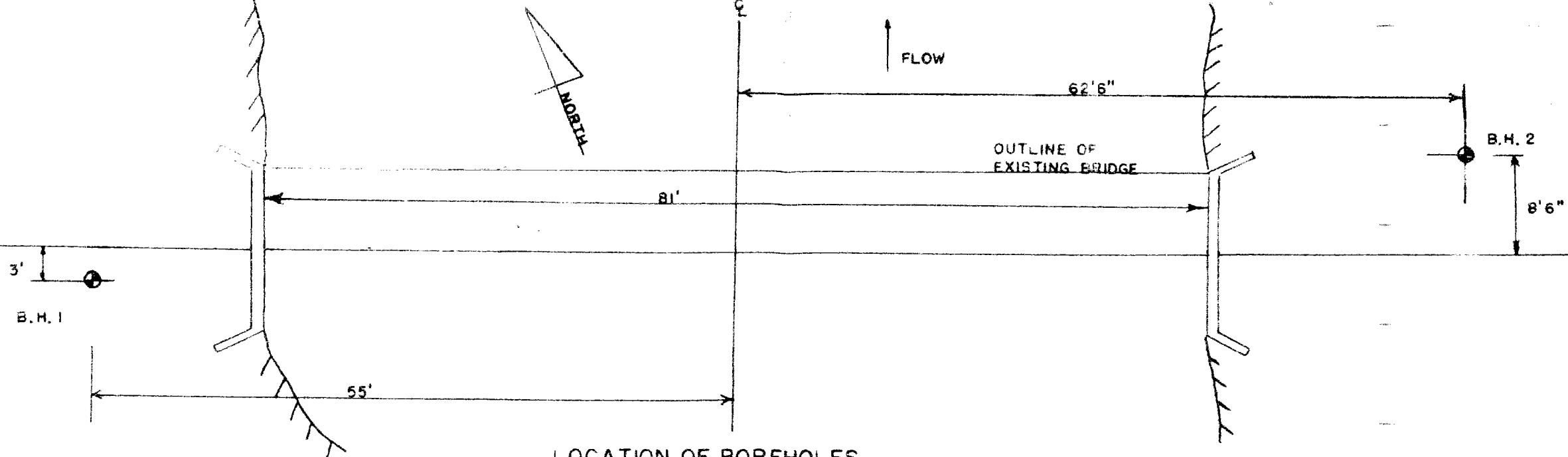
1000 - 2000

Very stiff

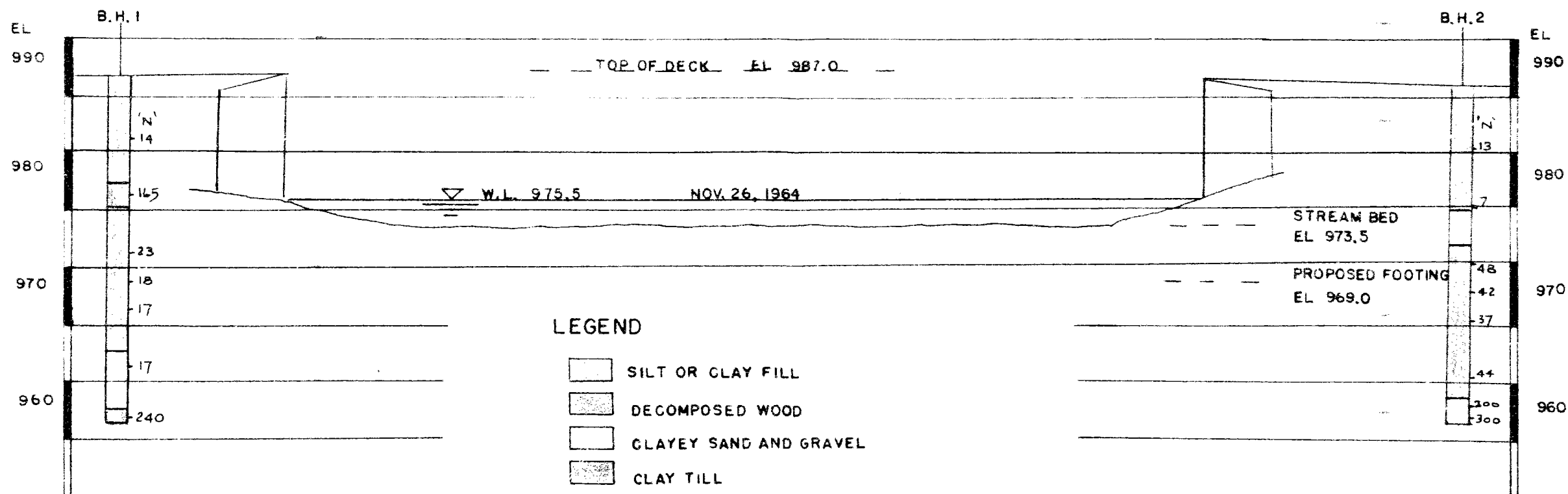
2000 - 4000

Hard

over 4000



LOCATION OF BOREHOLES
SCALE: 1 INCH TO 10 FEET



SUBSURFACE PROFILE
SCALE: 1 INCH TO 10 FEET

GEOTECHNICAL DATA SHEET FOR BOREHOLE

OUR REFERENCE NO. 4-11-L14

CLIENT: B.M. Ross
PROJECT: Bridge
LOCATION: Township of Hullett, Lot 11, Conc. 2-3
DATUM ELEVATION: Geodetic 984.65 (low steel)

METHOD OF BORING: Washboring
DIAMETER OF BOREHOLE: 8x (5-inch)
DATE: November 26th, 1964

ENCLOSURE

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %				
				NUMBER	TYPE	No. of Advancement of Sampler	20	40	60	80	100	PL — W — LI				
986.6	0.0	Ground Surface														
985.0	2.0	Sand & Gravel (Fill)														
980.0	9.5	Stiff brown silty clay (Fill)		1	SS	14										
975.0	11.5	Slightly decomp- osed wood		2	SS	165										
970.0		Very stiff brown very silty clay with embedded fine gravel (Till)		3	SS	23										
		becoming sandy near base		4	SS	18										
965.0				5	SS	17										
	24.0															
960.0		Compact brown clayey fine to coarse sand and gravel		6	SS	17										
	29.0			7	WS											
	30.5	Hard brown clay (Till)		8	SS	240										
955.0		End of Borehole														

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE: CH'D:

GEOTECHNICAL DATA SHEET FOR BOREHOLE ...2...

OUR REFERENCE NO. 4-11-L14

CLIENT: B.M. Ross

PROJECT: Bridge

LOCATION: Township of Hullett, Lot II, Conc. 2-3

DATUM ELEVATION: Geodetic 984.65 (low steel)

METHOD OF BORING: Washboring

DIAMETER OF BOREHOLE: BX (5-inch)

ENCLOSURE NO. 4

DATE: November 27th, 1964

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE					CONSISTENCY			REMARKS
				NUMBER	TYPE	N- or Advancement of Sampler	blows per foot					water content %			
							20	40	60	80	100	PL W LI			
							SHEAR STRENGTH					lbs/sq ft			
986.0	0.0	Ground Surface													
985.0		Compact brown sandy clayey silt, trace of organics (Fill)													
980.0			1	SS	13										
975.0	11.0	Brown clayey sand and gravel		2	SS	7									
14.0															
970.0		Hard brown very silty clay with embedded fine gravel (Till)		3	SS	48									
				4	SS	42									
965.0				5	SS	37									
960.0				6	SS	44									
27.5		Very dense clayey sand & gravel		7	SS	200									
29.7				8	SS	300									
955.0		End of Borehole													

2" dia. cone

Borehole 2

W.L.
El. 975.5
Cave-in
El. 974.5
1730 hours
November 27th

Extrapolated
'N' Values

Sa. #7 100/3"

Sa. #8 90/6"
50/2"

2" dia. cone

Borehole 2

W.L.
El. 975.5
Cave-in
El. 974.5
1730 hours
November 27th

Extrapolated
'N' Values

Sa. #7 100/3"

Sa. #8 90/6"
50/2"