

65-F- 279 M

R D. BRIDGE

LOT 11 , CON. VIII

McGILLIVRAY TWP.

A. M. SPRIET AND ASSOCIATES
CONSULTING ENGINEERS
264 WELLINGTON STREET
LONDON ONTARIO

STRUCTURE 17-37

BA 2240

Report on
SOIL INVESTIGATION
for
ROAD BRIDGE
LOT 11, CONCESSION VIII
TOWNSHIP OF MCGILLIVRAY

by
DOMINION SOIL INVESTIGATION LIMITED
369 Queens Avenue
LONDON ONTARIO
Reference No. 5-9-L6
October 8th, 1965.

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SUMMARY

The natural soil profile consists of firm organic clayey silt (3'-6" to 4'-0" thick), stiff to very stiff silty clay (4'-6" to 9'-0" thick), very dense silt (5'-6" to 9'-0" thick), very dense fine sand (4'-0" maximum penetrated).

It is recommended that the structure be supported on spread footings at or below El. 82.0 using a maximum net 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 and Associates, consulting engineers, to carry out a soil investigation at a site in the Township of McGillivray where it is proposed to construct a new bridge to replace a structure which has recently failed.

The site is located on Lot 11, Concession VIII of the Township, where the road crosses a tributary of the Ausable River. It is understood that the proposed structure will have the same longitudinal and transverse centre lines as the existing bridge.

The purpose of this investigation has been to reveal the subsurface conditions and to determine the relevant soil properties in order to make recommendations for the design of foundations.

II FIELD WORK

The field work, consisting of 2 boreholes to depths of 31 feet 6 inches was carried out on September 29 and 30, 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 diameter split-spoon sampler were performed at frequent intervals of depth. The number of blows required to drive the sampler one foot, (after an initial penetration of 6 inches) using an energy of 350 foot pounds per blow, were 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 a continuous indication of soil density changes with depth.

The results of the field tests are shown on the Geotechnical Data Sheets, Enclosures 3 and 4. Elevations have been referred to a site benchmark which was established by the client (Nail in tree root, 140 feet east of bridge, El. 100 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.

The boreholes revealed the following general ground succession:-

	<u>Thickness</u>
(a) Road Ballast	1'-0"
(b) Loose brown sandy silt (Fill).	9'-0"
(c) Firm grey/brown clayey silt, trace of organics.	3'-6" to 4'-0"
(d) Grey silty clay, containing silt seams. The consistency of this stratum is described as 'stiff' to 'very stiff' as indicated by Standard Penetration test results ranging from 14 to 20 blows per foot.	4'-6" to 9'-0"
(e) Grey non-cohesive silt. The relative density of this stratum is described as 'very dense' as estimated from Standard Penetration test results ranging from 60 blows per foot to a refusal value of 100 blows for 8-inch penetra- tion.	5'-6" to 9'-0"
(f) Grey fine sand. Silt and medium sand were found in this stratum at borehole 2 location. The relative density of the stratum is described as 'very dense' as estimated from Standard Penetration test results of 72 and 79 blows per foot. Both boreholes were terminated in this stratum.	penetrated 4'-0" in borehole 2.

IV GROUNDWATER CONDITIONS

The water level in the creek at the time the field work was carried out was at El. 87.8.

After completion of the drilling, a cave-in was observed in borehole 1 at El. 88.0 and the water level in borehole 2 stood at El. 86.0, indicating that the ground water table is closely related to the water level in the creek at any particular time.

V LABORATORY TESTING

Atterberg Limit and natural moisture content tests were performed on one sample of the silty clay stratum from each borehole as a means of classification and as a guide to the probable behaviour of the soil. The values of Liquid Limit were 30.6% and 34.1%; Plastic Limit 15.3% and 17.7%; and Plasticity Index 15.3% and 16.4%. These classify the soil as a clay of low plasticity and compressibility. The corresponding Liquidity Indices which relate the natural moisture content of the clay to its Liquid and Plastic Limits, were 0.63 and 0.27 confirming the stiff to very stiff consistency.

VI DISCUSSION

Below the stratum of organic clayey silt which probably formed a previous ground surface, the strata are generally very dense and are therefore suitable for the use of normal spread footing foundations.

The bed of the creek extends to El. 86.4 and allowing for scour it is recommended that the footings bear at or below El. 82.0. A hydrological study should be made to clarify this point. This elevation lies within the very dense silt stratum at borehole 1 location and within the very stiff silty clay stratum at borehole 2 location, and on the basis of the field test results a maximum net soil pressure of 6000 pounds per square foot will be appropriate for the design of footings. The estimated total settlement is less than 1-inch and the maximum differential settlement between abutments should be less than 1/2 inch.

For footings supported in the silty clay stratum the adhesion between the footing and the underlying soil may be taken as 2000 p.s.f., and for footings supported in the silt stratum the coefficient of friction between the footings and the underlying soil may be taken as 0.35. The factor of safety against horizontal sliding of the abutments should be at least 1.5.

The soil is relatively impervious so that no difficulty should be experienced in forming the shallow foundations required for the footings. It is anticipated that seepage into excavations will be controlled by pumping.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED



C. J. W. Atkinson






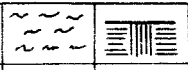




C.J.W. Atkinson, M.Sc., P.Eng.,
Branch Manager

CJWA:jms

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
ϕ	> 8"	3"	3/4"	4.76mm	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	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	OBSERVATIONS	Steady pressure	Washwater returns
"	pressure : p	MADE WHILE CORING	No pressure	Washwater lost
"	tapping : t		Intermittent pressure	

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 :



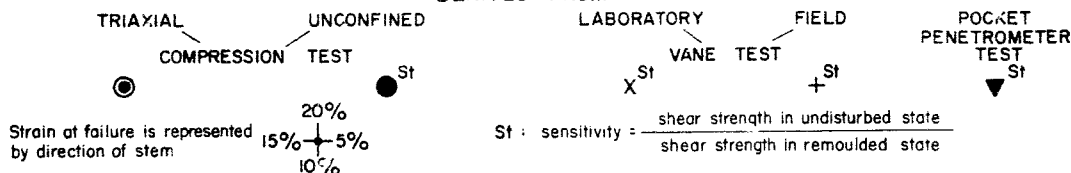
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SOIL PROPERTIES.

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 effective stress
PI % Plasticity index	C_v Coeff. of consolidation	C' Cohesion
LI Liquidity index	m_v Coeff. of volume compressibility	ϕ' Angle of int. friction

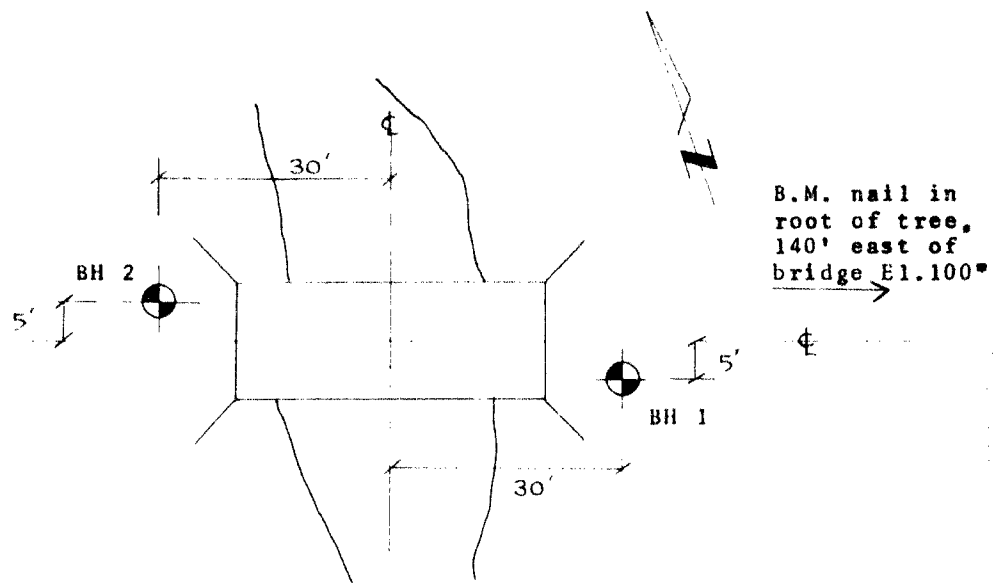
UNDRAINED SHEAR STRENGTH.

- DERIVED FROM -



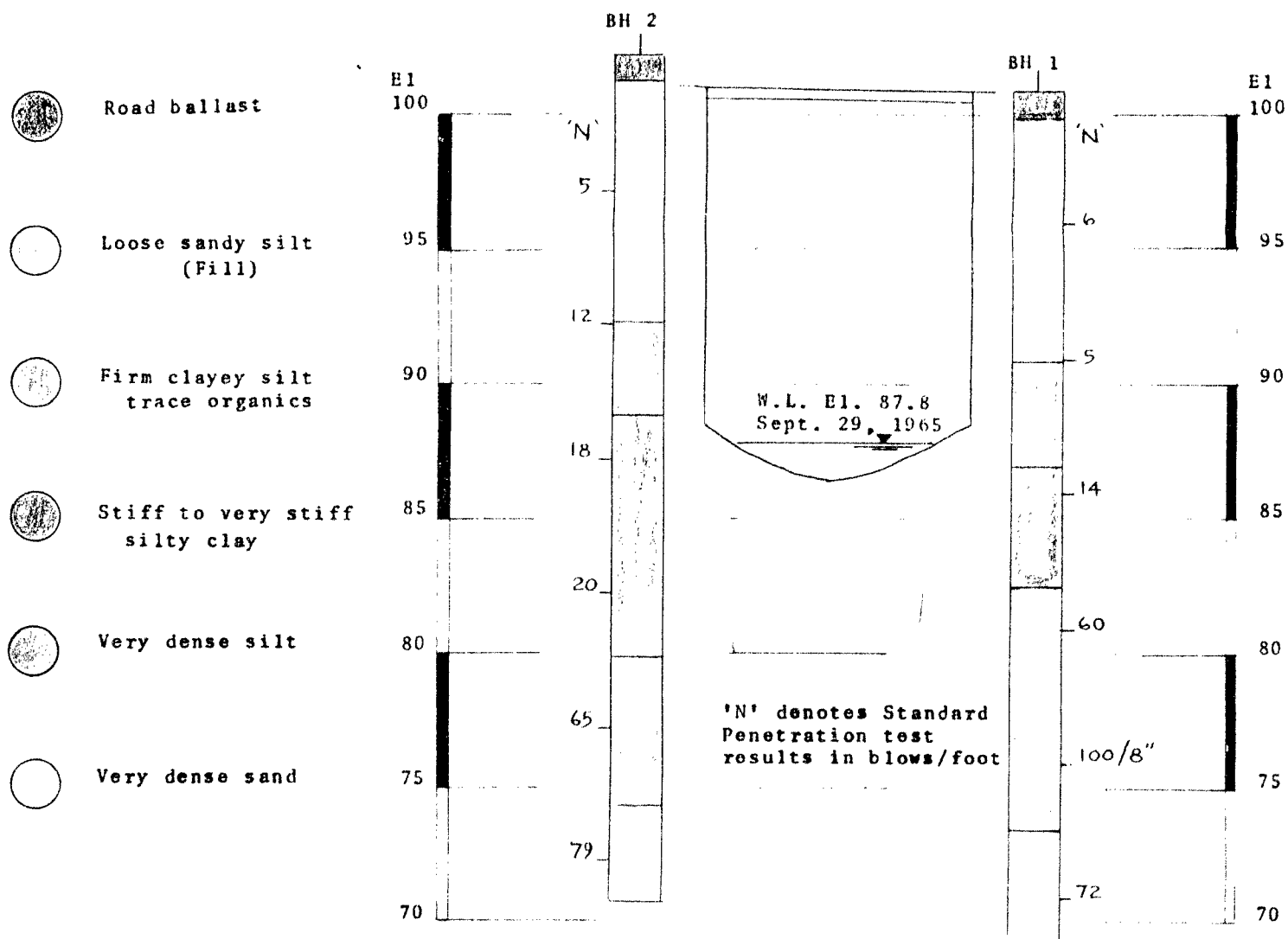
SOIL DESCRIPTION.

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



LOCATION OF BOREHOLES

Scale: 1 inch to 20 feet



SUBSURFACE PROFILE

Scale hor. 1 inch to 20 feet
vert. 1 inch to 5 feet

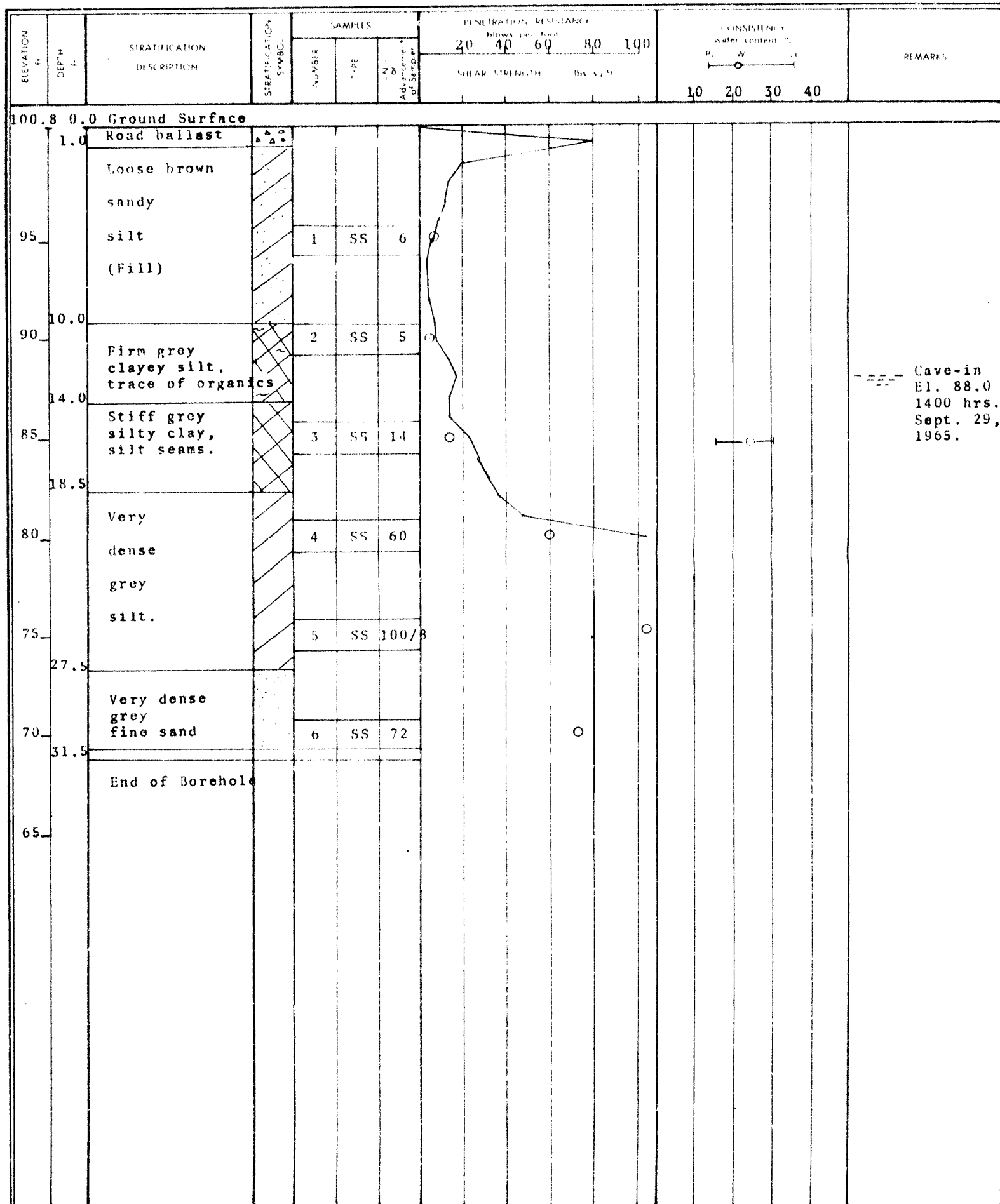
GEOTECHNICAL DATA SHEET FOR BOREHOLE 4

OUR REFERENCE NO. 5-9-L6

CLIENT A. M. Spriet & Associates
 PROJECT Road Bridge
 LOCATION Twp. of McGillivray
 DATUM ELEVATION 100 feet (nail in tree root)

METHOD OF BORING Washboring
 DIAMETER OF BOREHOLE Bx (5-inch)
 DATE September 29, 1965

ENCLOSURE NO. 3



GEOTECHNICAL DATA SHEET FOR BOREHOLE 2

OUR REFERENCE NO 5-9-L6

CLIENT A. M. Spriot & Associates
PROJECT Road Bridge
LOCATION Twp. of McGillivray
DATUM ELEVATION 100 feet (nail in tree root)

METHOD OF BORING Washboring
DIAMETER OF BOREHOLE Bx (3-inch)
DATE September 29 & 30,
1965.

ENCLOSURE NO 4

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE					CONSISTENCY				REMARKS
				NUMBER	TYPE	N ₆₀ or Advancement of Sampler	20	4	60	80	100	water content % PI W LI				
							SHEAR STRENGTH lbs. sq. ft.					10 20 30 40				
102.30.0		Ground Surface														
	1.0	Road ballast	Δ Δ Δ Δ													
100		Loose brown sandy silt (Fill)	▧	1	SS	5										
95																
10.0		Firm brown clayey silt, trace of organics.	▨	2	SS	12										
90																
13.5		Very stiff grey silty clay, silt seams	▩	3	SS	18										
85																
				4	SS	20										
80	22.5	Very dense grey silt.	▩	5	SS	65										
75	28.0	Very dense grey silty fine & medium sand	▧	6	SS	79										
70	31.5	End of Borehole														

W. L.
El. 86.0
1045 hrs
Sept. 30
1965.

W. L.
E1. 86.0
1045 hrs
Sept. 30
1965.

VERTICAL SCALE: 1 IN. TO

5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE

CH'D