

GEOCRES No. 40P14-8DIST. 3 REGION W.P. No. CONT. No. W. O. No. 73-F-220MSTR. SITE No. 12-53HWY. No. LOCATION Lots 30 & 31CONCESSION 1 - VILLAGE OFNO. OF PAGES - BLUEVALE

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



73-F-220M

DOMINION SOIL INVESTIGATION LIMITED

CONSULTING ENGINEERS

TORONTO

KITCHENER

LONDON

WINDSOR

THUNDER BAY



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40P14-8

GEOCREs No.

Report On
SOIL INVESTIGATION
for
PROPOSED NEW BRIDGE
LOTS 30 & 31, CONCESSION 1
VILLAGE OF BLUEVALE
TOWNSHIP OF TURNBERRY

DIST. 3

M.T.P. Site No 12-53
73-~~4~~-220 m

by

Dominion Soil Investigation Limited
1220 Trafalgar Street
London Ontario

Ref: 73-9-L14
December 6, 1973

Rec'd Jan 24/74

Si

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I

INTRODUCTION

In accordance with a letter of authorization dated November 19, 1973, from B.M. Ross & Associates Limited, Consulting Engineers, a soil investigation has been carried out in the Village of Bluevale, where it is proposed to replace an existing bridge with a new structure.

The existing structure is located on the road allowance between Lots 30 and 31 in Concession 1 of the Township of Turnberry, where the road crosses the Little Mailland River.

It is understood that the new bridge will be a 3 span structure with the proposed north abutment to be located in the same position as the existing north abutment, and the south abutment approximately 40 feet to the south of the existing south abutment. The requirements of the project were discussed with Mr. K.G. Dunn, P.Eng. who supplied the foregoing information.

The purpose of the investigation was to reveal the subsurface soil and groundwater conditions, and to determine the relevant soil properties for the design of the new foundations.

II

FIELD WORK

The field work, consisting of three boreholes and two dynamic cone penetration tests, was carried out at the locations shown on Enclosure 2. The holes were advanced to the sampling depths by a continuous flight power auger machine.

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 dynamic cone penetration tests were performed adjacent to boreholes 1 and 2 to obtain an indication of soil density and strata changes with depth. The energy used to drive the cone was the same as was used for the standard penetration tests.

The field work was supervised by a soils engineer, who also determined the ground surface elevations. These were referred to a nail in a hydro pole opposite Station 16+34, which was established by the client as having a Geodetic El. 1062.93 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, and a general picture of the soil stratigraphy is presented in the form of a Subsurface Profile on Enclosure 2. The following notes are intended only to amplify this data.

Boreholes 1 and 3 were put down on the bank of the existing river and therefore encountered natural subsoil from the ground surface. Borehole 2 was put down through the existing road fill and revealed sandy silt fill to a depth of 14 feet.

The natural soil profile consists of a thin layer of silty sand and gravel overlying glacial till deposits which extend to the limits of boreholes 1 and 2. At borehole 1 location the till consists of a granular sandy silt material which exhibits some cementation due to its very high density. The till also contains some gravel size particles and a trace of clay as indicated by a grading analysis of a representative sample which is shown on Enclosure 5. At borehole 2 and 3 locations the till consists of cohesive clayey silt which also contains some sand and gravel. The consistency of the clayey silt is described as 'hard' based on 'N' values in excess of 100 blows per foot. Atterberg Limit tests were performed on a sample of the clayey silt giving values of Liquid Limit of 33%, Plastic Limit of 18%, and Plasticity Index of 15%. The natural moisture content of the clayey silt was determined to be 20%, which is close to the Plastic Limit of the soil and confirms the 'hard' consistency obtained from visual and tactile examination.

Borehole 3 was terminated in a 'very dense' sand and gravel stratum, and a grading analysis of a representative sample of the sand and gravel is shown as a grain

size distribution curve on Enclosure 5. The sand and gravel was observed to be in a dry condition.

IV

GROUNDWATER CONDITIONS

The following equilibrium water levels were observed in the boreholes after completion of the drilling:

<u>Borehole</u>	<u>Groundwater Elevation</u> <u>(feet)</u>
1	1046.8
2	1047.6
3	1048.2

The groundwater in the adjacent river was observed to be at El. 1045 at the time the field work was carried out.

V

DISCUSSION AND RECOMMENDATIONS

The investigation has shown that the natural subsoil consists of a thin surface layer of sand and gravel 3 to 7 feet thick, overlying 'very dense' glacial till



deposits which consist of cemented sandy silt and cohesive clayey silt materials. The existing creek bed extends down to El. 1043, therefore to provide sufficient protection against heave due to frost action it is recommended that the footing grade be established at or below El. 1039. This grade lies within the 'very dense' till deposits, and on the basis of the borehole results a maximum allowable soil pressure of 5 tons per square foot is appropriate for the design of footings. The soil pressure incorporates a factor of safety of at least 3 against shear failure of the underlying soil, and total settlement of footings 5 to 10 feet in width is estimated to be in the range 0.25 to 0.5 inch.

The coefficient of friction between the footings and the sandy silt or clayey silt materials may be taken as 0.35 up to a maximum value of 2000 p.s.f. The factor of safety against horizontal sliding of the abutments must be at least 1.5.

It is anticipated that excavations into the 'very dense' or 'hard glacial till materials can be

carried out by normal open cut methods, and that dewatering will be achieved by pumping from sumps dug in the bottom of the excavation.

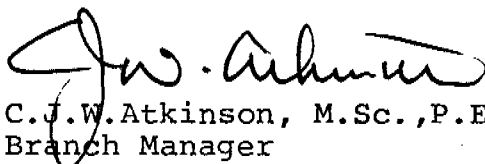
The existing sand and gravel materials are suitable as backfill behind abutments however the glacial sandy silt and clayey silt materials should not be used due to their poor permeability. All granular fill should be compacted in place to at least 95% of the maximum standard Proctor dry density to minimize settlement of the fill and damage to the finished road surface.

Yours very truly,

DOMINION SOIL INVESTIGATION 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.

BOULDER	COBBLE	GRAVEL		SAND			SILT	CLAY	ORGANICS	BEDROCK	GROUND WATER LEVEL	DEPTH OF CAVE-IN
		COARSE	FINE	COARSE	MEDIUM	FINE						
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
 " pressure : p
 " tapping : t

OBSERVATIONS MADE WHILE CORING
 Steady pressure
 No pressure
 Intermittent pressure

Washwater returns
 Washwater lost

PENETRATION RESISTANCES.

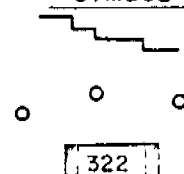
DYNAMIC PENETRATION RESISTANCE : to drive a 2" ϕ , 60° cone attached to the end of the drilling rods into the ground, expressed in blows per foot.

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 :

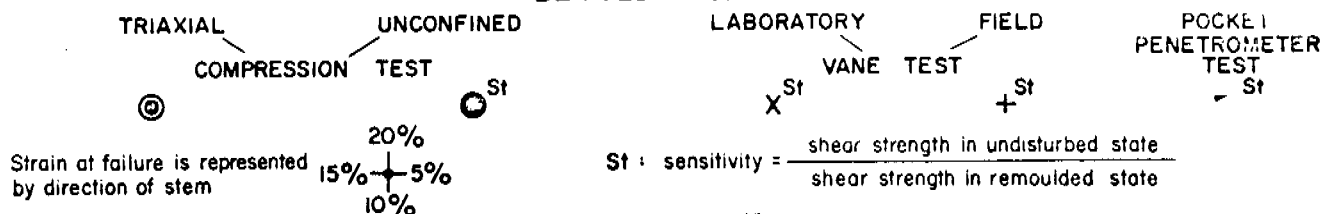


SOIL PROPERTIES.

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	Cv	Coeff. of consolidation	C'	Cohesion
LI	Liquidity index	m _v	Coeff. of volume compressibility	ϕ'	Angle of int. friction

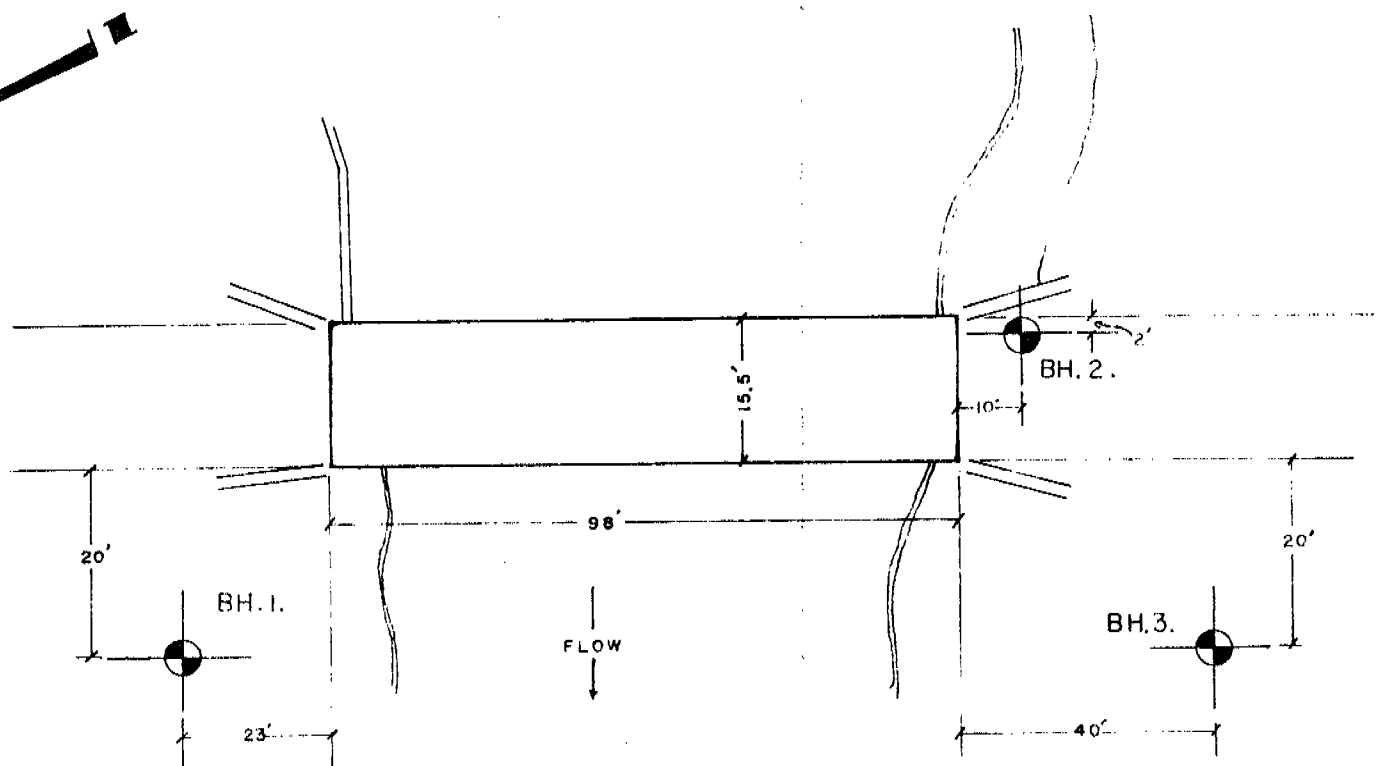
UNDRAINED SHEAR STRENGTH.

- DERIVED FROM -

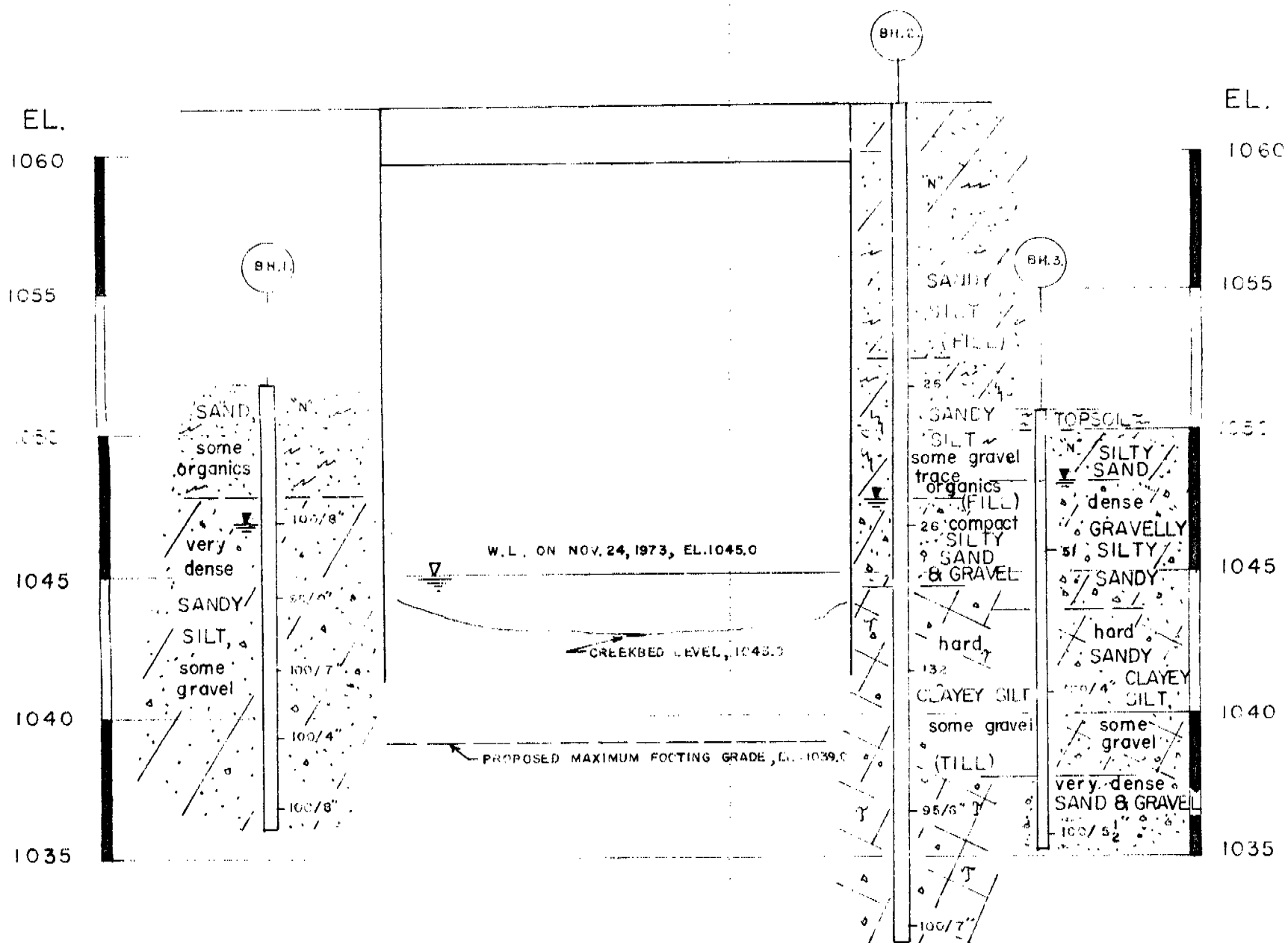


SOIL DESCRIPTION.

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" = 20'



SUBSURFACE PROFILE
SCALE HOR.: 1" = 20'
VERT.: 1" = 5'

LOG OF BOREHOLE 1 & 2

Our Reference No. 73-9-L14

Enclosure No. 2

CLIENT: B.M. Ross & Associates Ltd.
PROJECT: County of Huron Bridge,
LOCATION: Village of Bluevale, Twp. of Turnberry
DATUM ELEVATION: Geodetic

DRILLING DATA
Method: Auger
Diameter: 4 1/2 inch
Date: November 23 and 24, 1973

SUBSURFACE		PROFILE		SAMPLES			PENETRATION RESISTANCE					Blows/Ft.			WATER CONTENT %			REMARKS
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' Blows/Ft.	UNDRAINED SHEAR STRENGTH 100 p.s.f.					PLASTIC LIMIT W _p	NATURAL W	LIQUID LIMIT W _L			
								+ FIELD VANE TEST • COMPRESSION TEST										
								20	40	60	80	100						
								20	40	60	80	100						
1051.8	0.0	Ground Surface																
50		Brown sand some organics.																
45	4.0	Very dense grey sandy silt, some gravel, trace of clay.			1	SS	100/8"											
40					2	SS	60-no penetration											
35					3	SS	100/7"											
30					4	SS	100/4"											
20	20.7	End of Borehole			5	SS	100/8"											
1061.6	0.0	Ground Surface																
60		Brown sandy silt, some gravel.			1	AS												
55		(FILL)																
50	9.0	Brown slightly cohesive sandy silt, some gravel, trace of organics.			2	SS	26											
45	14.0	Compact silty sand & gravel.			3	SS	26											
40	17.0	Hard grey clayey silt, some sand and gravel.			4	SS	132											
35		(Glacial Till)			5	SS	256"											
29.6		End of Borehole			6	SS	100/7"											

VERTICAL SCALE: 1 inch to 5 ft.

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DRAWN:

CHECKED:

Our Reference No. 73-9-L14

LOG OF BOREHOLE3.....

Enclosure No. 4

CLIENT: B.M. Ross & Associates Ltd.
 PROJECT: County of Huron Bridge,
 LOCATION: Village of Bluevale, Twp. of Turnberry
 DATUM ELEVATION: Geodetic

DRILLING DATA

Method: Auger
 Diameter: 4½ inch
 Date: November 24, 1973

SUBSURFACE		PROFILE		SAMPLES			PENETRATION RESISTANCE					Blows/Foot			WATER CONTENT			%	REMARKS	
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' Blows/Ft.	20	40	60	80	100	PLASTIC LIMIT	NATURAL	LIQUID LIMIT	W _P	W	W _L		
								UNDRAINED SHEAR STRENGTH 100 p.s.f.												
								+ FIELD VANE TEST ● COMPRESSION TEST												
								20	40	60	80	100				10	20	30	40	50
103.17	0.0	Ground Surface																		
50		9" Topsoil																		
	25	Silty sand.																		
45		Dense yellowish-brown gravelly silty sand.			1	SS	51													
	7.0																			
40		Hard grey sandy clayey silt, some sand and gravel.			2	SS	100 4"													
	13.0																			
35		Very dense sand & gravel, trace of silt.			3	SS	100 5 1/2"													
	15.5																			
		End of Borehole																		

VERTICAL SCALE: 1 inch to 5 feet

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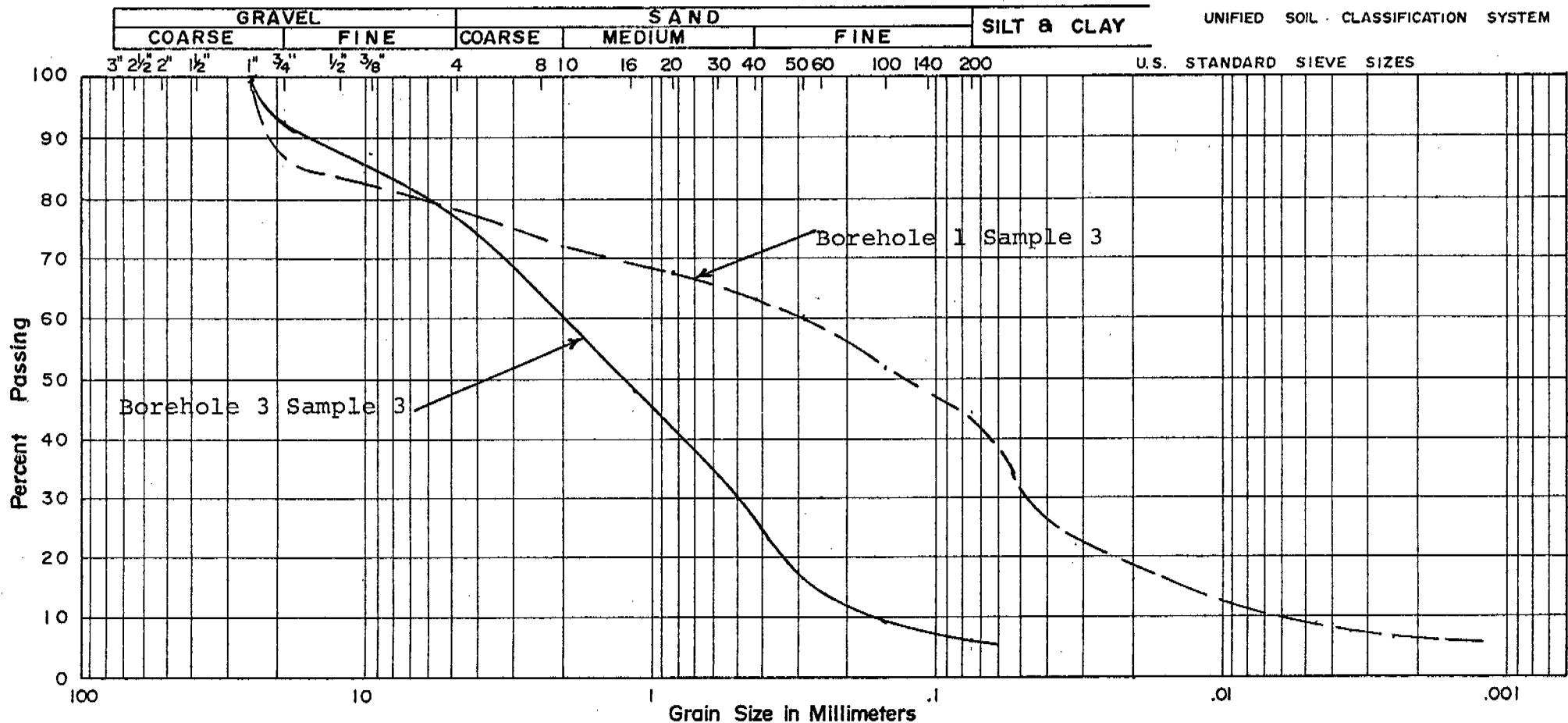
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DOMINION SOIL INVESTIGATION LIMITED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE No 73-9-L14



PROJECT: Huron County Bridge
 LOCATION: Village of Bluevale
 BOREHOLE No:
 SAMPLE No:
 DEPTH:
 ELEVATION:

COEFFICIENT OF UNIFORMITY:
 COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:
 1/3 Sandy silt, some gravel, trace of clay.
 3/3 Sand and gravel, trace of silt.

PLASTIC PROPERTIES
 LIQUID LIMIT % =
 PLASTIC LIMIT % =
 PLASTICITY INDEX % =
 MOISTURE CONTENT % =