

# 67 - F - 273 M

SEIFRIED BRIDGE WEST

LOTS 5/6 , CON. 9

MINTO TWP.

B.M. ROSS AND ASSOCIATES LIMITED  
CONSULTING ENGINEERS  
GODERICH ONTARIO

67-F-273M

Report on  
SOIL INVESTIGATION  
for  
SEIFRIED BRIDGE WEST  
LOTS 5&6, CONCESSION 9  
TOWNSHIP OF MINTO

by  
DOMINION SOIL INVESTIGATION LIMITED  
369 Queens Avenue  
LONDON ONTARIO  
Reference No. 7-11-L19

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SUMMARY

The two boreholes revealed the following natural soil succession: compact to very dense sand and gravel with silt seams (5 to 7 feet thick), compact fine and medium sand with some fine gravel ( 5 feet thick in borehole 1 only), very stiff to hard silty clay (13 feet thick), and very stiff to hard clayey silt (maximum penetrated 16.5 feet).

It is recommended that the structure be supported on spread footing foundations at or below El.64 using a maximum net soil pressure of 4500 p.s.f. at El.64, and an additional 200 p.s.f. for each additional foot the footings are placed below El.64. Total settlement is estimated to be 1.0 inch.

Dewatering problems are discussed in the report.

1. INTRODUCTION.

In accordance with authorization from B.M. Ross & Associates Limited, Consulting Engineers, a soil investigation has been carried out in the Township of Minto where it is proposed to replace an existing road bridge with a new structure.

The existing 42 foot span concrete arch structure is located at Lots 5 and 6, Concession 8 of the Township where the side-road crosses a small creek.

It is understood that the proposed structure is a concrete rigid frame and that the centre line will be moved 138 feet to the north of the existing bridge centre line. 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 conditions at the site and to determine the relevant soil properties for the design and construction of the new foundations.

11. FIELD WORK.

The field work, consisting of 2 boreholes was carried out on December 4 & 5, 1967, at the locations indicated on Enclosure 1. The holes were advanced to the sampling depths by washboring methods and were lined with Bx size casing.

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.

Dynamic cone penetration tests were performed adjacent to each borehole location to obtain an indication of soil density and strata changes with depth.

Elevations were referred to a benchmark which was established by the client (Nail in 2' Elm. Sta. 26 + 50, El.75.10 feet).

#### 111. SUBSURFACE CONDITIONS.

Detailed descriptions of the strata encountered in each borehole are given on the borehole logs, comprising Enclosures 2 and 3, and a general picture of the soil stratigraphy is presented in the form of a Subsurface Profile on Enclosure 1. The following notes are intended only to amplify this data.

##### Sand and gravel with silt seams.

This stratum extends to a depth of about 6 feet below the creek bed in both boreholes. The relative density of the material is described as 'compact' to 'very dense' as estimated from 'N' values ranging from 18 to 80 blows per foot.

A grain size analysis of a typical sample of the stratum is presented as a grain size distribution curve on Enclosure 4.

Fine to medium sand with some fine gravel.

This stratum was encountered in borehole 1 only and revealed a thickness of 5 feet. The relative density of the material is described as 'compact' as estimated from 'N' values of 14 and 31 blows per foot.

A grain size analysis of a typical sample of the stratum is presented as a grain size distribution curve on Enclosure 5.

Grey silty clay.

This material is of glacial origin and is commonly referred to as Glacial Till. Due to the clay content the material exhibits plasticity and cohesion, and the consistency is described as 'very stiff' to 'hard' as indicated by 'N' values ranging from 20 to 56 blows per foot.

Atterberg Limit tests were performed on one sample of the clay till giving values of Liquid Limit and Plastic Limit of 31% and 13% respectively. These indicate that the clay has a low to medium plasticity and compressibility. The Liquidity Index which relates the natural moisture content to the Atterberg Limits was 0.5, indicating a generally stiff consistency.

Grey clayey silt.

This stratum was encountered at a depth of 18.5 feet below the creek bed in borehole 2, and was penetrated 16.5 feet. The material exhibits some cohesion and the consistency is described as

'very stiff' to 'hard' as indicated by 'N' values ranging from 20 to 40 blows per foot.

IV. GROUNDWATER CONDITIONS.

The water levels in the boreholes reached equilibrium at El.71.8 and El.71.0 in boreholes 1 and 2 respectively.

V. DISCUSSION & RECOMMENDATIONS.

The natural soil profile consists of compact to very dense granular deposits extending to a depth of 6 to 11 feet below the creek bed, and overlying very stiff to hard silty clay and clayey silt strata.

The creek bed extends down to El.68 therefore, allowing 4 feet of cover for frost protection, consideration should be given to a footing grade at or below El.64. This level lies within the layers of compact sand and gravel, and on the basis of the borehole results a maximum net soil pressure of 4500 p.s.f. may be used for the design of footings. An additional 200 p.s.f. may be added to the above value for each additional foot of depth of the footing grade below El.64.

The design soil pressures recommended above are based on settlement criteria of 1.0 inch total settlement, and 0.75 inch differential settlement between abutments

The coefficient of friction between the footings and the underlying soil may be taken as 0.55 and the factor of safety against horizontal sliding of the abutments should be at least 1.5.



Construction.

A major problem in the prevailing soil conditions will be to control the groundwater and it is most important that proper dewatering procedures be used. There would be a tendency for the sides of an unprotected excavation to 'slough-in' and for the bottom of the excavation to heave or 'boil' when the water level is lowered.

The developement of this condition must be prevented, otherwise excessive weakening of the subgrade is likely to result. Because of the successive reduction in permeability of the strata with depth, the most suitable method will be to carry out the excavation inside a sheet pile enclosure which should be driven into the silty clay stratum to seal the bottom of the excavation. The water level can then be lowered by pumping inside the excavation from sumps dug below the footing grade.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED.

A handwritten signature in dark ink, appearing to read "C.J.W. Atkinson". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

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

CJWA/j

## APPENDIX A.

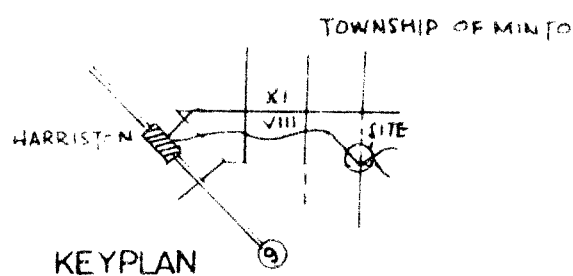
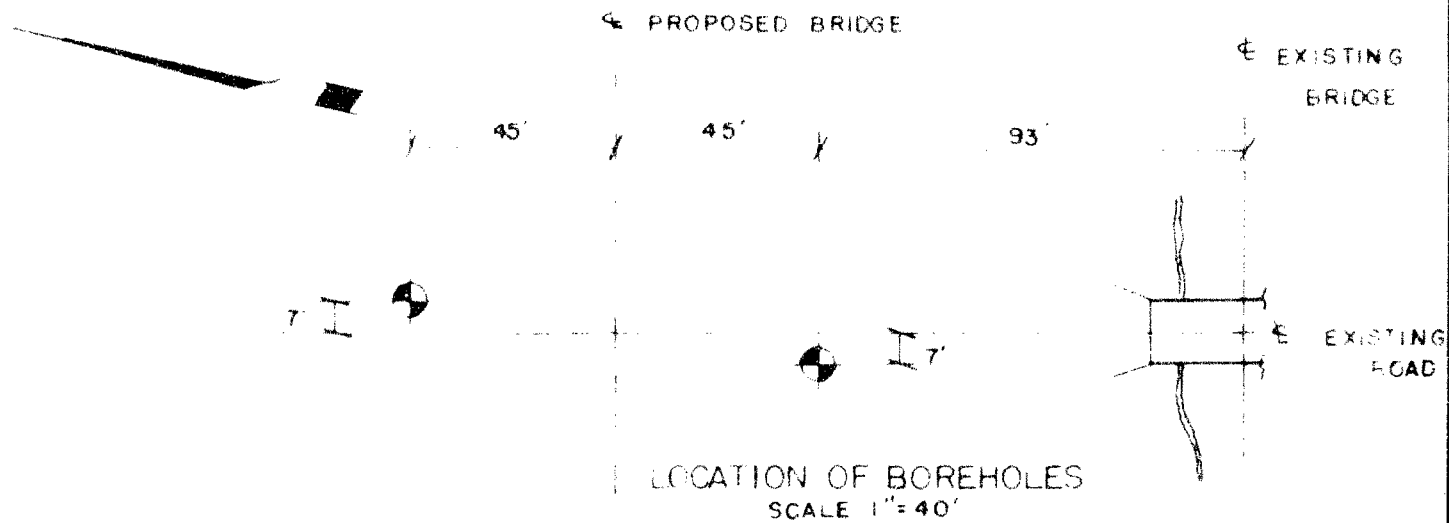
### THE STANDARD PENETRATION TEST.

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 in. 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 in. 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.

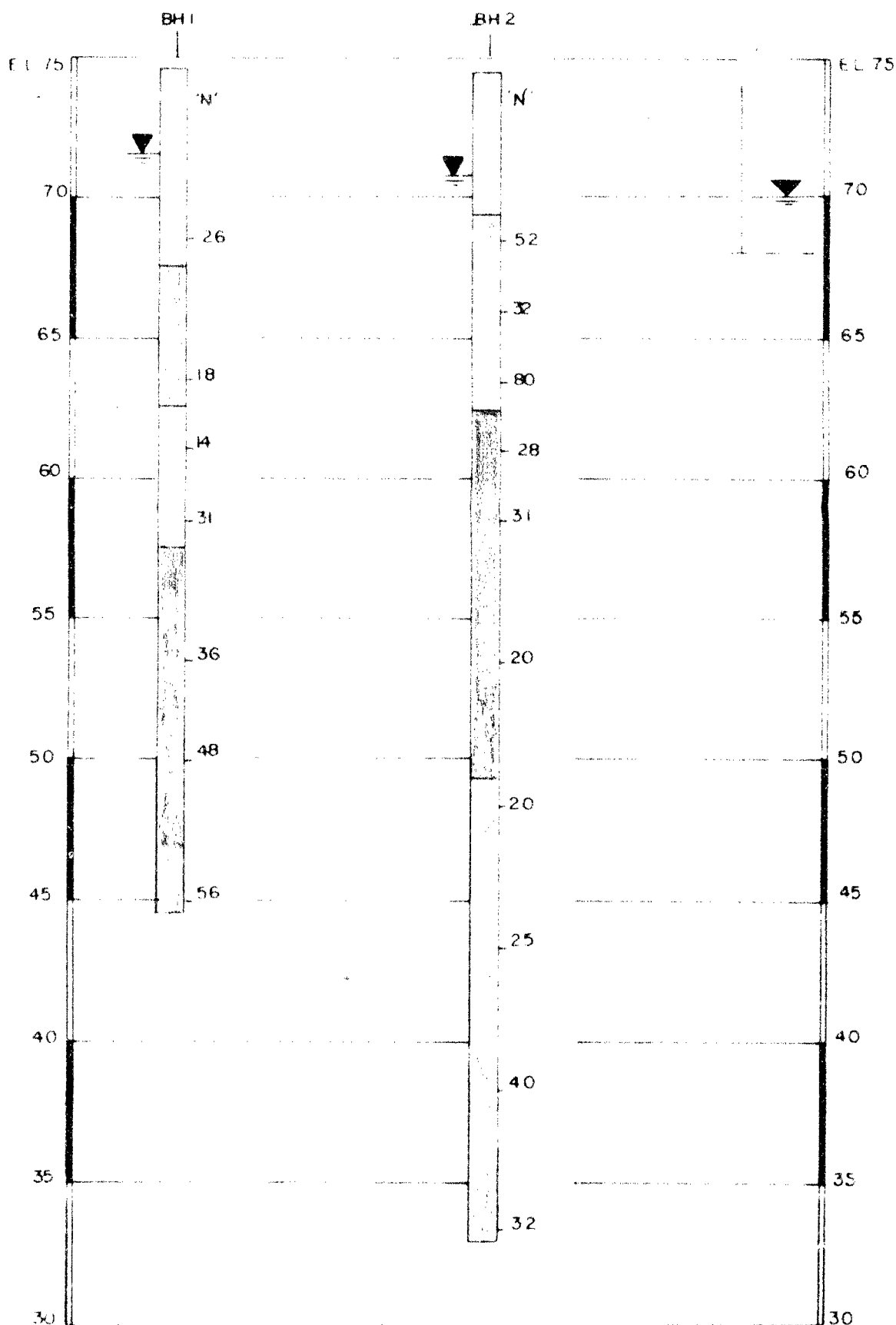
For Sands:-

Values of N	Density
Less than 10	Loose
Between 10 and 30	Compact
Between 30 and 50	Dense
Greater than 50	Very dense.



# LEGEND

- SAND AND GRAVEL, FILL
- COMPACT TO VERY DENSE SAND AND GRAVEL
- COMPACT FINE AND MEDIUM SAND
- VERY STIFF TO HARD SILTY CLAY, TILL
- VERY STIFF TO HARD CLAYEY SILT



SUBSURFACE PROFILE

VERT SCALE 1" = 5'

# LOG OF BOREHOLE 1

Our Reference No 7-11-L19

Enclosure No 2

CLIENT B.M. Ross and Assoc. Ltd.

PROJECT Soifried Bridge West

LOCATION Lots 5-6, Con. 9, Township of Ninto

DATUM ELEVATION Spoke in 2' Elm, Sta. 20+50, El. 75.10

## DRILLING DATA

Method Washboring

Diameter 3x(3-inch)

Date December 4, 1967.

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE					WATER CONTENT %			REMARKS
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	NUMBER	TYPE	Z Blows/foot	20	40	60	80	100	PLASTIC LIMIT	NATURAL	LIQUID LIMIT	
							UNDRAINED SHEAR STRENGTH • FIELD VANE TEST					W <sub>p</sub>	W	W <sub>L</sub>	
74.00		Ground Surface													
70		Sand and gravel (fill)		1	SS	26									
65		Compact sand and gravel, seams of silt		2	SS	18									
60		Compact fine and medium sand with some fine gravel		3	SS	14									
55		Very stiff to hard grey silty clay, (Glacial Till)		5	SS	36									
50				6	SS	48									
45				7	SS	56									
		End of Borehole													

VERTICAL SCALE 1 inch to 5 feet

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MADE

CHECKED

# LOG OF BOREHOLE 2.....

Our Reference No 7- 11-L19

Enclosure No 3

CLIENT B.M. Ross and Assoc. Ltd.

PROJECT Seifried Bridge West

LOCATION lots 5-6, Con. 9, Township of Hinto

DATUM ELEVATION Spike in 2<sup>nd</sup> Elm, Sta. 26+50, El. 75.10

## DRILLING DATA

Method Washboring

Diameter 3-inch

Date December 5, 1967/

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE					WATER CONTENT %			REMARKS
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	IN Blows/Foot	20	40	60	80	PLASTIC LIMIT	NATURAL	LIQUID LIMIT	
								UNDRAINED SHEAR STRENGTH				W <sub>p</sub>	W	W <sub>L</sub>	
								+ FIELD VANE TEST							
745.00		Ground Surface													
		Sand and gravel (Fill)													
70	50				1	SS	52								
		Compact to very dense sand and gravel, with silt seams			2	SS	32								
65					3	SS	80								
120					4	SS	28								
60		Very stiff to hard grey silty clay (Glacial Till)			5	SS	31								
55					6	SS	20								
50					7	SS	20								
250					8	SS	25								
45		Very stiff to hard grey clayey silt			9	SS	40								
40					10	SS	32								
35															
41.5		End of Borehole													

VERTICAL SCALE: 1 inch to 5 feet

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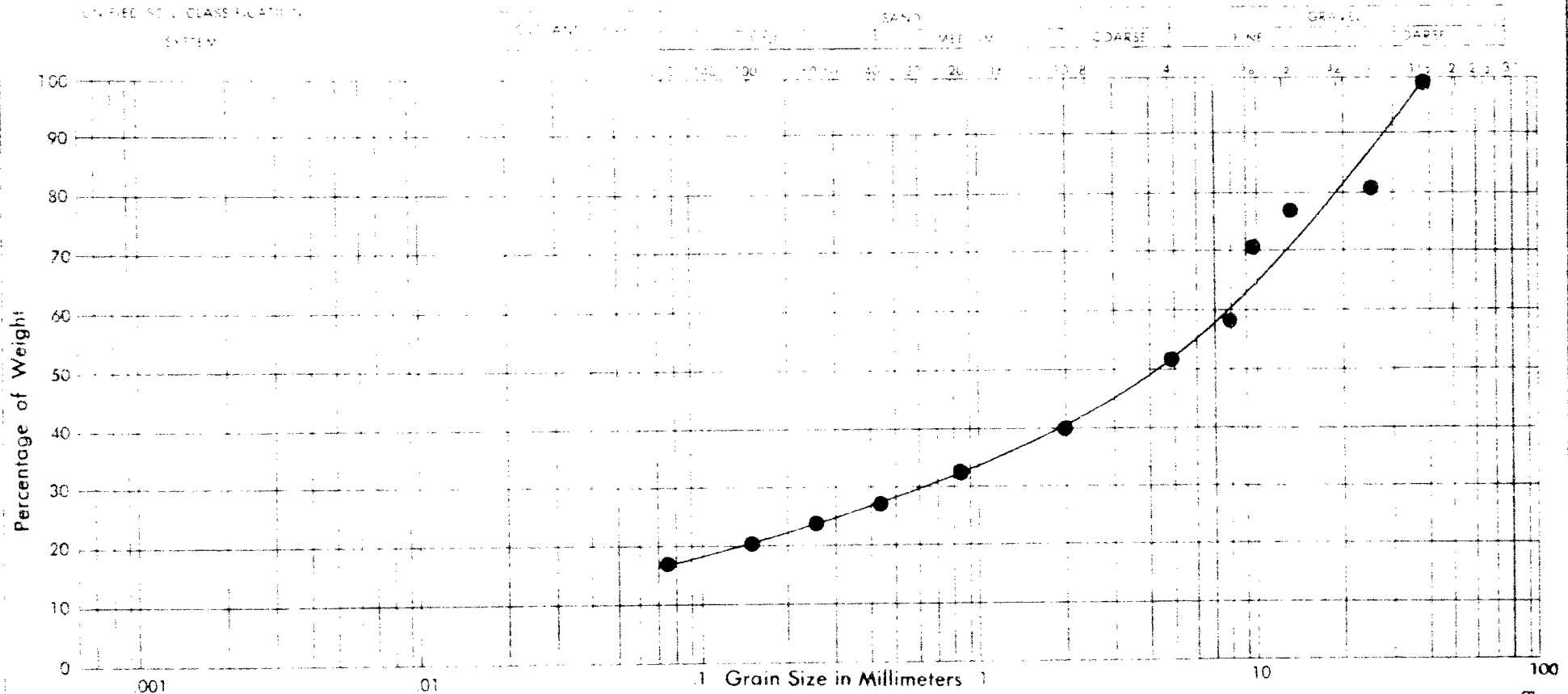
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# DOMINION SOIL INVESTIGATION LIMITED

## GRAIN SIZE DISTRIBUTION

OUR REFERENCE NO. 7-11-L19



PROJECT **Seifried Bridge West**

LOCATION **Twp. of Minto.**

BOREHOLE NO. **1**

SAMPLE NO. **2**

DEPTH OF SAMPLE **11 feet**

ELEVATION OF SAMPLE **63.6 feet**

COEFFICIENT OF UNIFORMITY

COEFFICIENT OF CURVATURE

Classification of Sample and Group Symbol:

**Sand and gravel  
with some silt**

PLASTIC PROPERTIES

LIQUID LIMIT %

PLASTIC LIMIT %

PLASTICITY INDEX %

MOISTURE CONTENT %

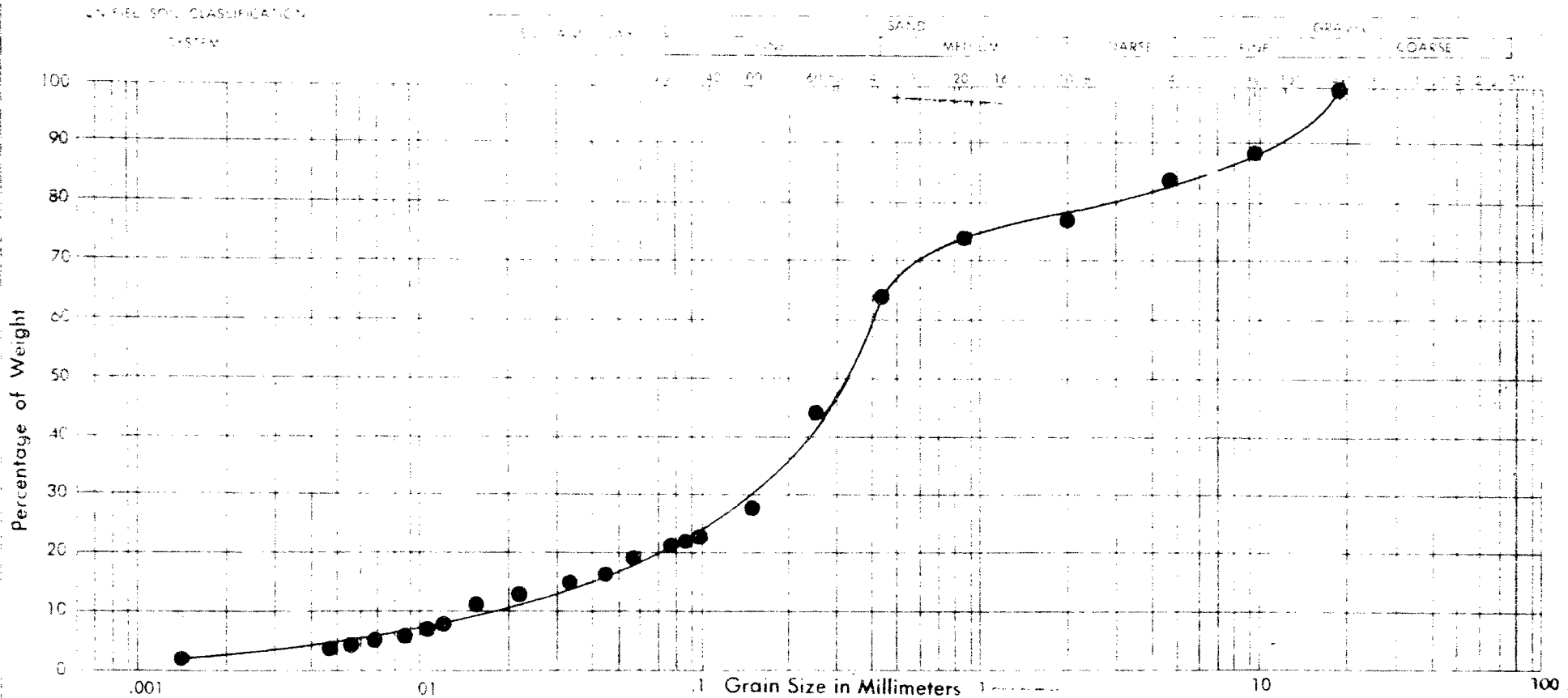
ACTIVITY

Enclosure No. 4

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## GRAIN SIZE DISTRIBUTION

7-11419



PROJECT **Seifried Bridge West**  
 LOCATION **Twp. of Minto**  
 BOREHOLE NO. **1**  
 SAMPLE NO. **3**  
 DEPTH OF SAMPLE **13.5 feet**  
 ELEVATION OF SAMPLE **61.1 feet**

COEFFICIENT OF UNIFORMITY  
 COEFFICIENT OF CURVATURE

**Classification of Sample and Group Symbol:**

**Silty fine and medium  
sand with some fine gravel.**

PLASTIC PROPERTIES

LIQUID LIMIT %  
 PLASTIC LIMIT %  
 PLASTICITY INDEX %  
 MOISTURE CONTENT %  
 ACTIVITY

Enclosure No. 2