#62-F-323 M

WETZEL BRIDGE

CONESTOGO RIVER

MARYBOROUGH TWP.

D O M I N I O N S O I L I N V E S T I G A T I O N L I M I T E D
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Scarborough, Ontario,
December 20th, 1962.

Mr. V. R. Astrop,
Consulting Engineer,
4 Hughson Street South,
Hamilton, Ont.

Re: Subsoil Investigation for Wetzel Bridge over the Conestogo River in Maryborough Township - Our Ref: 2-10-17

ADDENDA TO THE REPORT

Dear Mr. Astrop:

We further investigated the dewatering of the excavation during the construction of the foundations for the above bridge as requested by you on December 19th, 1962. Our comments are summarised in the following paragraphs:

Considering that the silty-sandy-gravel ("crushed limestone till") is well graded and densely packed, an alternative dewatering method is suggested, that is, pumping out the seepage waters from a sump cut into one corner of the open excavation. It is emphasised that the construction of foundations must be done with the utmost expediency because the longer the bottom of the pit is unprotected, the greater the danger of the washing out of fine particles which in turn may loosen the whole soil structure, possibly causing excessive settlements later. Should the inflow of water be at a high rate, however, two alternative procedures are recommended:

(i) Underwater excavation. The bottom thereof should go about a foot deeper than the proposed footing grade. The difference should be filled out with concrete which will seal the bottom and prevent the loosening of the subsoil. The water can be pumped out thereafter and the footings constructed in the reasonably dry excavation.

(ii) Lowering the ground water table. One or two (depending on need) temporary pits should be excavated near the proposed excavation. (The bottom of these temporary holes should be about 2 ft. deeper than that of the excavation for the footing), and backfilled with poorly graded, preferably coarse gravel or crushed stone. Water should be pumped out of these holes - thereby the ground water level lowered over a larger area. The need for dewatering in the main excavation can thus be avoided.

We trust that the foregoing meets with your requirements but should you have any further questions, please do not hesitate to contact us again.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED

L S. Rolko

L. S. Rolko, P. Eng.,
CHIEF SOILS ENGINEER.

LSR/oed

BA 1554

M A R Y B O R O U G H   T O W N S H I P

c/o V. R. Astrop

Consulting Engineer

STRUCTURE SITE No. 36-90

WETZEL BRIDGE

OVER THE CONESTOGO RIVER

IN MARYBOROUGH TOWNSHIP

S U B S O I L   C O N D I T I O N S

Submitted by

DOMINION SOIL INVESTIGATION LIMITED
77 Crockford Boulevard
SCARBOROUGH - ONTARIO

OUR REFERENCE: 2-10-17

NOVEMBER 1962

C O N T E N T S

E N C L O S U R E S

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INTRODUCTION

A letter of authorization dated October 24th, 1962 was received from Mr. V. R. Astrop, Consulting Engineer, to conduct a foundation investigation at the site of the proposed Wetzel Bridge over the Conestogo River in Maryborough Township. The proposed bridge will replace the existing one.

Number and location of the boreholes were as directed on a drawing provided to us.

The purpose of the investigation was to reveal the sub-surface conditions and determine the necessary soil properties for the design and construction of foundations.

SUMMARY

(1) Densely packed silty sandy, angular gravel was encountered at the site.

(2) The abutments can be supported on spread footings.

(3) The dewatering should be done by pumping the water out from an excavation enclosed by sheet piles.

(4) For details, see Section IV - "Discussion and Recommendations".

I. DESCRIPTION OF SITE AND GEOLOGY

The existing bridge carries a township road over the Conestogo River. It is located about one mile west of Moorefield. The surround-ing area is gently rolling with no prominent topographic features. The land is mainly agricultural.

Geological research established the fact that practically the whole of Canada was covered with ice varying in thickness up to several thousand feet. (Ontario was overlain by the so-called Labrador Ice Shield). The glaciers advanced and retreated four times during the Pleistocene Epoch. The latest cold period is generally referred to as the "Wisconsin Glacial Stage". Most of the deposits into which the foundations of the present engineering structures are placed originate' from this time.

The moving glaciers picked up the loose and unconsolidated material and abraded the bedrock wherever encountered. (It is estimated that glaciation removed on the average probably as much as 100 feet from the top of the Precambrian rock now known as the Canadian Shield). The material transported by glaciers varies from the largest type of boulder to clays; all gradations from one to the other being included and as deposited directly from the ice, thoroughly mixed together. The resulting unstrati-fied mixture is called a till, compressed by the enormous weight of the ice to a great degree.

The Conestogo River flows in the bed of a past spillway which cut its meandering course into the surrounding till plain. (Spillways originated near the end of the ice shields and drained the meltwaters).

..... 4

II. FIELD AND LABORATORY WORK

Field work was carried out during the period November 1st to 3rd, 1962 and comprised two boreholes and four dynamic cone penetration tests at the locations shown on Enclosure #2. The positions of the test holes were set out on the site with the assistance of a drawing (referred to in the Introduction) provided to us. Elevations were measured relative to the bridge deck (=74.00 ft.).

The boreholes were of 2 7/8 in. diameter. They were lined or partly lined with Bx casing advanced to the required sampling depths by the repetitious procedure of alternately driving and washing.

Standard penetration tests were made at frequent intervals using a 2 in. outside diameter split spoon driven into the bottom of the clean borehole by a constant driving energy (140 pound hammer dropping 30 ins.). The dynamic cone penetration test is one type of deep sounding in which the Ax rods with a 2 in. diameter 60 degree apex cone driving point are driven into the subsoil without casing and applying the same driving energy as above. The former test provided disturbed samples of the sub-strata indicating their relative density and consistency and the latter a continuous record of soil density.

In addition to the split spoon samples, some subsurface material brought up by the washwater was also preserved.

Where boulder was encountered, the holes were advanced by diamond drilling. BxT size 1-5/8 in. diameter core was recovered.

The samples were shipped to our laboratory where they were thoroughly examined and classified. The results of this analysis together with all the observations made and findings obtained in the field comprise the basis on which the geotechnical properties of the substrata are being evaluated.

The stratification of the subsoil, sampling depths and the results of the penetration tests are recorded on geotechnical data sheets comprising enclosures #3 and #4.

III. SUBSURFACE CONDITIONS

Recent alluvial deposits were encountered first in both boreholes. The preponderantly granular material (sand and silty fine sand) is in a compact state.

The subsoil proper is a silty, sandy gravel. It was derived from limestone and because of the angularity of the fragments, the term "crushed limestone till" may illustrate the nature of the material in the best way. The grain size distribution ranges from coarse gravel to silt. Although densely packed and well graded, it still can be considered as permeable to water because of the lack of clay-size particles.

Less gravel and excess silt or sand content was found around 20 to 25 feet depth. This layer or pocket, however, is at a substantial depth and being in a very dense state, it does not alter the general subsoil conditions.

The ground water level in the boreholes corresponds to that in the river.

IV. DISCUSSION AND RECOMMENDATIONS

The subsoil conditions at the site are favourable and the abutments can be supported on spread footings. The "crushed limestone till" has a high bearing capacity combined with low compressibility. Therefore, footings placed at or below Elevation 58 feet can be designed using a gross allowable bearing pressure of 8,000 psf and this value yields a safety factor of more than three. No measureable settlements are anticipated.

The proposed base level will most probably be below the ground water table - hence the necessity of dewatering should be considered. The excavation area should be enclosed in advance by sheet piles driven to a depth below the foundation elevation equal to the distance between the outside water level and the foundation elevation. (This measure will preserve the hydraulic stability of the footing grade). Then, after the proposed base level has been reached, the water can be pumped out of a temporary sump and the bottom of the excavation sealed with a lean concrete blanket. The construction of the footing proper can begin thereafter.

DOMINION SOIL INVESTIGATION LIMITED

L. S. Rolko

LSR/oed

L. S. Rolko, P.Eng.,
Senior Soils Engineer.

VI. REFERENCES

(1) Procedures for Testing Soils, ASTM, April 1958, pp 186 to 198. (Unified Soil Classification System - by A. A. Wagner).

(2) Terzaghi and Peck: Soil Mechanics in Engineering Practice, John Wiley and Sons, New York 1948.

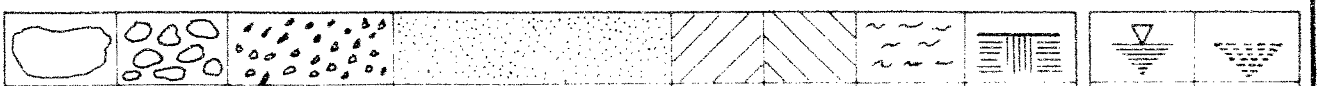
(3) The Physiography of Southern Ontario by L.J.Chapman- and D.F.Putnam of the Ontario Research Foundation - University of Toronto Press 1951.

(4) Strength and Deformation Characteristics of Various Glacial Tills in New England, by Kenneth A. Linell and H.F.Shea - Proc. Research Conference on the Shear Strength of Cohesive Soils, Boulder, Colorado, June 1960.

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						
Ø > 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.

SYMBOL

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 — 322

The energy for the penetration resistances is supplied by a 140 lb hammer falling 30 inches

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
PL %	Plastic limit	RD	Relative density	ϕ	Angle of int. friction — total stress
PI %	Plasticity index	C_v	Coeff. of consolidation	C'	Cohesion — in terms of
LI	Liquidity index	m_v	Coeff. of volume compressibility	ϕ'	Angle of int. friction — effective stress

UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —

TRIAXIAL COMPRESSION TEST ◉ — UNCONFINED COMPRESSION TEST ● St — LABORATORY VANE TEST × St — FIELD VANE TEST + St — POCKET PENETROMETER TEST ▼ St

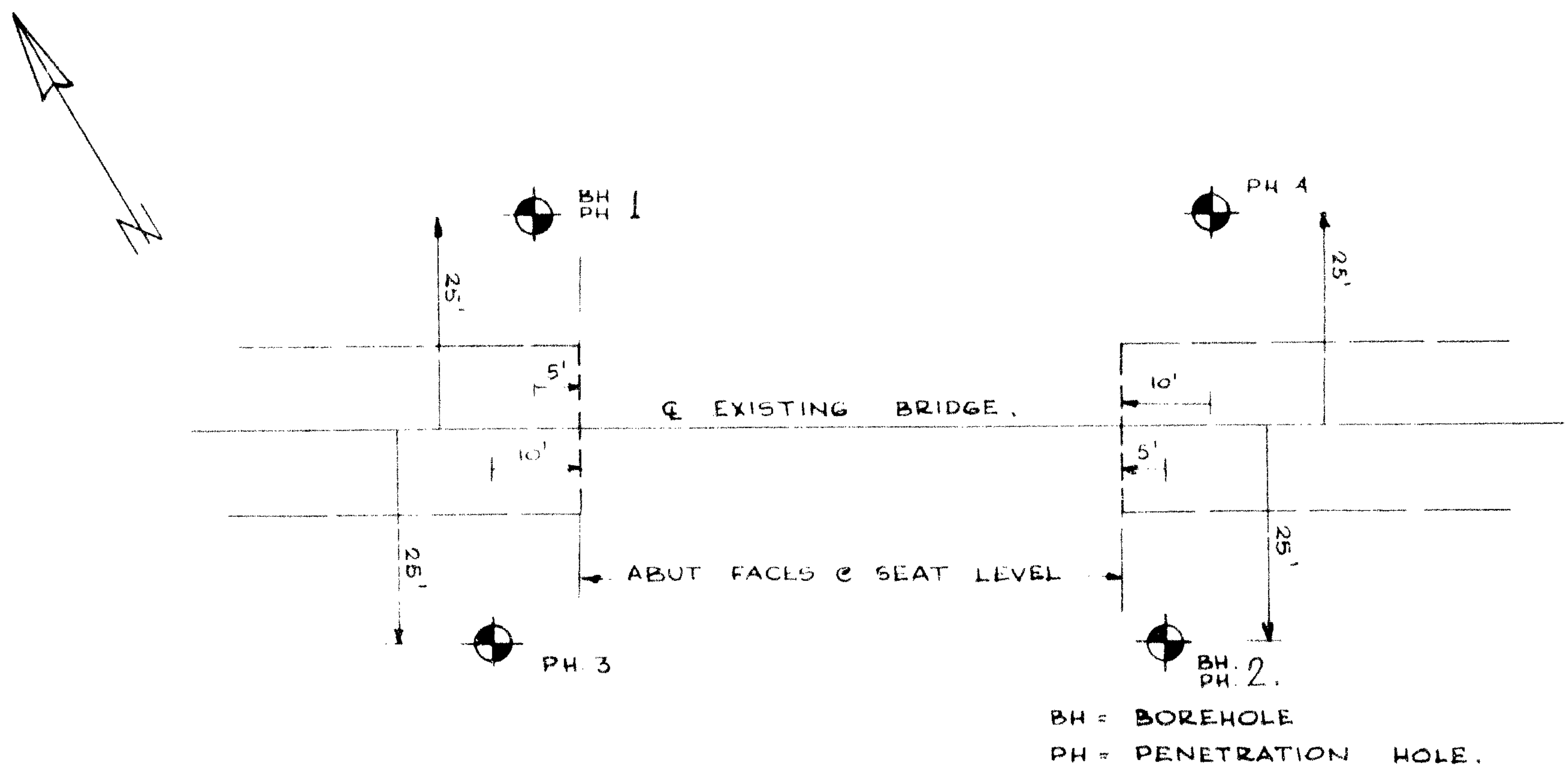
Strain at failure is represented by direction of stem: 20% (up), 5% (right), 10% (down), 15% (left)

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

SOIL DESCRIPTION.

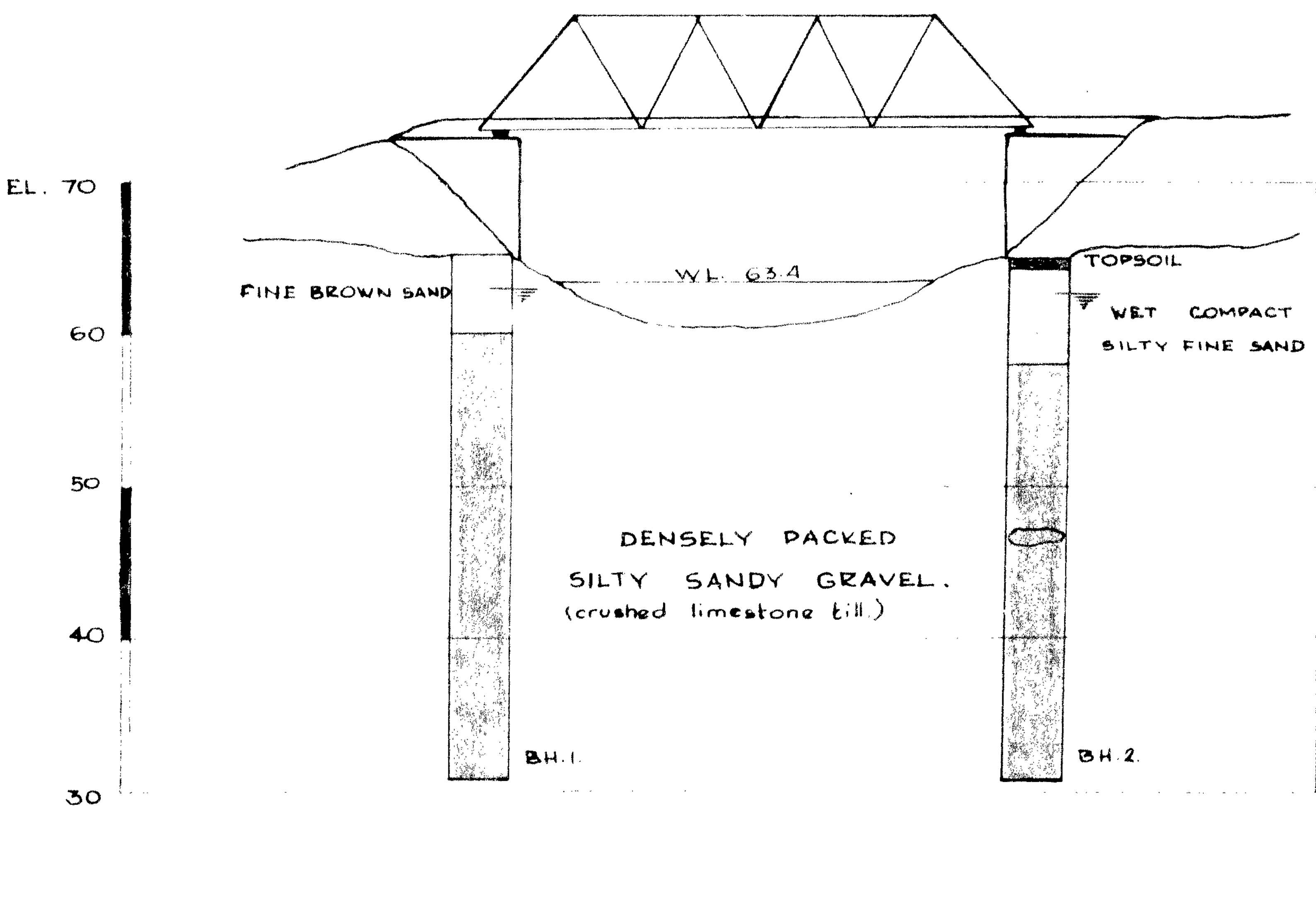
COHESIONLESS SOILS	RD
Very loose	0 - 15 %
Loose	15 - 35 %
Compact	35 - 65 %
Dense	65 - 85 %
Very dense	85 - 100 %

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 PLAN.

SCALE: 1" = 20'



SUBSURFACE PROFILE.

SCALES: HORIZ. 1"-20' VERT. 1"-10'

OUR REF. NO: 2-10-17 DOMINION SOIL INVESTIGATION LIMITED. ENCLOSURE: 2

GEOTECHNICAL DATA SHEET FOR BOREHOLE 1 & CONE 3.

2 - 10 - 17

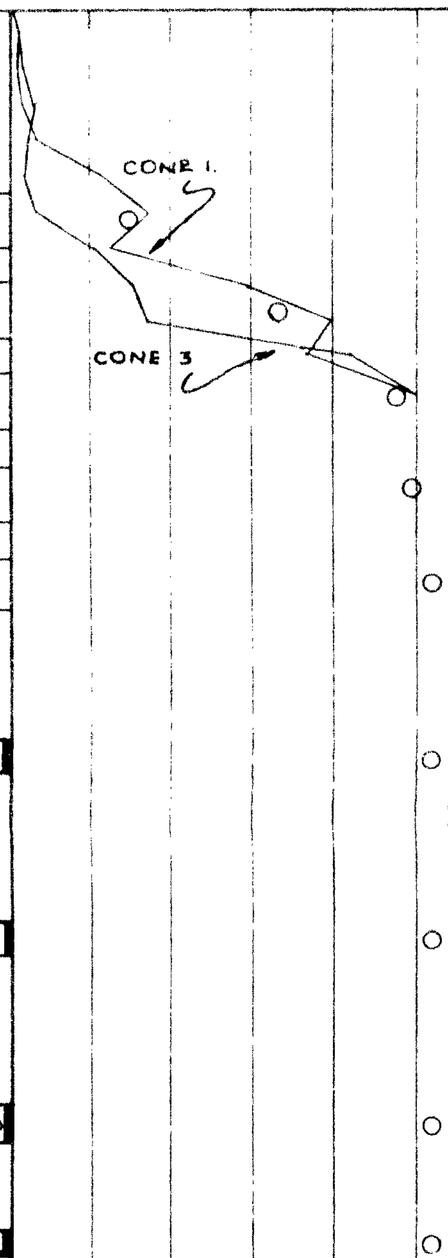
V. R. ASTROP CONS. ENG.
WETZEL BRIDGE.
MARYBOROUGH TOWNSHIP ONT.
65.3

WASHBORING
2 7/8"
NOVEMBER 1-2, 1962.

3.

ELEVATION	DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE		REMARKS
65.3	0	FINE BROWN SAND				
60	5	DENSELY PACKED SILTY SANDY GRAVEL. (crushed limestone till.)	1	SS	28	
			2	SS	67	
55	10		3.	SS	94	
			4	SS	98	
50	15		5	SS	106	
45	20	less gravel excess silt	6	SS	240	
40	25		7	SS	240	
35	30		8	SS	200	
			8A	WS	-	
			9	SS	300	
30	35					
25						

0 20 40 60 80 100



REMARKS

DETAILS OF EXTRAPOLATED N - VALUES:

SA #	BLOWS
6	72/6"-100/5"
7	80/6"-100/5"
8	78/6"-100/6"
9	100/4"

VERTICAL SCALE 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE L.E. CHD LSR

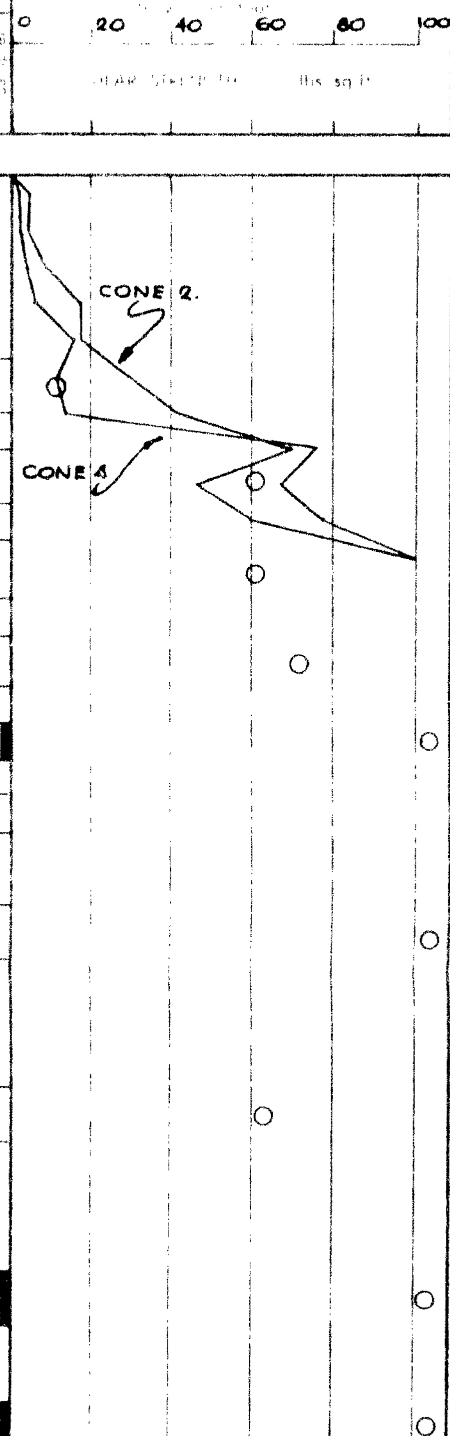
GEOTECHNICAL DATA SHEET FOR BOREHOLE 2 & CONE 4

2-10-17

V. R. ASTROP CONS. ENG.
WETZEL BRIDGE
MARYBOROUGH TOWNSHIP ONT.
65.0

WASHBORING
2 7/8"
NOVEMBER 2-3. 1962.
4.

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	SAMPLE No.	TYPE	N VALUE	REMARKS
65.0	0	TOPSOIL.				
		WET COMPACT SILTY FINE SAND (water level ▽)				
60	5		1	SS	11	
		DENSELY PACKED SILTY SANDY GRAVEL (crushed limestone till.)	2	SS	61	
55	10		3	SS	61	
			4	SS	72	
50	15		5	SS	160	
			5A	RC		
45	20	less gravel excess silt	6	SS	118	
40	25	less gravel excess sand	7	SS	63	
35	30		8	SS	200	
			9	SS	174	
30	35					



DETAILS OF EXTRAPOLATED N - VALUES

SA #	BLOWS
5	58/6"-80/6"
8	100/6"
9	56/6"-87/6"

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE L.E. CHD L.S.R.