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DIST. 4 REGION

W.P. No. 65-67-01

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. 403

LOCATION Proposed Structures on Hwy  
403 FROM BRANTFORD to  
ANCASTER

No of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FOUNDATION INVESTIGATION & DESIGN REPORT

W.P. 65-67-01/66-67-01

DIST. 4

HWY. 403

STR. SITE

From Hwy. 2, Ancaster  
Westerly to Brantford Diversion

W P 65-67-01 & 66-67-01

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GEO. NO. 40P1-82

W.P. 65-67-01  
From Hwy. 2, Ancaster W'ly to  
0.8 km. West of Sunny Ridge Road  
Hwy. 403, District 4, Hamilton

W.P. 66-67-01  
From 0.8 km. West of Sunny Ridge Rd.  
Westerly to Brantford Diversion  
Hwy. 403, District 4, Hamilton

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## 1. INTRODUCTION

The Soil Mechanics Section was requested to carry out a Foundation Investigation to determine the feasibility of structures along the proposed route of Hwy. 403 between Ancaster and Brantford.

Following this request a field investigation was carried out by this office to determine the subsoil and groundwater conditions which are of significance to the planning and design of the proposed route.

This report contains the results obtained from our investigations together with our recommendations pertaining to the foundations, cuts, and fills proposed.

Each site was considered individually and presented in order from west to east. Two sites, however, were not investigated since permission to enter the properties involved could not be granted.

## 2. SITE DESCRIPTION, SUBSOIL CONDITIONS, AND RECOMMENDATIONS

### 2.1 Site #1 - Garden Avenue Underpass

- 2.1.1 Site description - Proposed is an underpass to accommodate Garden Ave. Profile grade of Hwy. 403 is proposed to be approximately 702'  $\pm$  with a Garden Avenue elevation of 724'  $\pm$ . Existing ground is relatively flat with some rolling hills within the adjacent area. Ground elevation is 708'  $\pm$  therefore cuts of approximately 6' and fills of approximately 16' will be

required.

- 2.1.2 Subsoil conditions - Ground elev. 708.1', borehole location -  $\phi$  Hwy. 403, 35' east of  $\phi$  Garden Ave. - The entire subsoil stratigraphy consists of firm to stiff clayey silt with seams of silt and layers of varying thickness of silty clay and silt. In addition between 81' and 84' exists layers of very fine sandy silt.

Bedrock was found at 100.5' (elev. 607.6') which consists of moderately fractured, hard, light grey to white dolomite. Groundwater was found at approximate elevation 694'.

- 2.1.3 Approaches - Approaches will consists of fills of 16 feet  $\pm$  maximum height which may undergo estimated long term settlements of 3"-4". No slope stability problems are anticipated.

#### Piers and Abutments

- A) Spread Footings - May be founded at approximate elevation 698'  $\pm$  with a safe bearing capacity of 2 t.s.f. With this scheme an estimated long term settlement of 5 to 6 inches may occur at the abutments and 1 to 2 inches at the pier.

In addition, the abutment footings may be founded within the compacted Granular 'A' fills. This scheme should provide a safe bearing capacity of 2.5 t.s.f. See perched abutment detail Fig. 1.

- B) End Bearing Piles - 12 HP @ 74 piles driven to bedrock may be utilized. These should provide a safe capacity of 95 tons per pile.

Excavations - Due to the relatively impermeable nature of the subsoil in which excavations may be made for footings or pile caps, no major unwatering problems are anticipated.

## 2.2 Site#2 - Johnson Rd. Underpass

- 2.2.1 Site description - Hwy. 403 profile grade will be 684'  $\pm$ . Johnson Road elev. will be 707'  $\pm$ . Existing ground elev. is 693  $\pm$ . Existing ground is

relatively flat with some rolling hills within the adjacent area. Cuts of approximately 9'  $\pm$  and fills of approximately 14'  $\pm$  will be required.

- 2.2.2 Subsoil conditions - Ground elev. 692.6', borehole location - 30' north of  $\angle$  Hwy. 403, 20' east of  $\angle$  Johnson Rd. The subsoil from 0 - 69' consists of firm to very stiff clayey silt with seams of silt and layers of silty clay. Within the top 4.5' exists a trace of organics (0.42%). Zone 69' - 85.5' consists of very stiff clayey silt with layers of silt and a trace of gravel (glacial till).

Bedrock was found at 85.5' (elev. 607.1') which consists of moderately fractured, hard, light grey to white dolomite. Groundwater was found at approximate elevation 680'.

- 2.2.3 Approaches - The proposed approaches will consist of fills of 14'  $\pm$  max. height. These are estimated to undergo long term settlements of approximately 3 to 4 inches. No slope stability problems are anticipated.

#### Piers and Abutments

For support of the piers and abutments 12 HP @ 74 piles driven to bedrock are recommended. These should provide a safe capacity of 95 tons per pile.

Excavations - No major unwatering problems are anticipated due to the relatively impermeable nature of the subsoil.

### 2.3 Site #3 - Fairchild Creek Crossing

- 2.3.1 Site description - Hwy. 403 profile grade will be 660'  $\pm$ . Existing stream bed elevation is 635'  $\pm$  with the banks at approximately 645'  $\pm$ . Site located within a river valley in an area of gently rolling terrain. This site requires fills of approximately 15'  $\pm$ .

- 2.3.2 Subsoil conditions - Ground elev. 643.8', borehole location  $\angle$  Hwy. 403, 30' east of  $\angle$  Fairchild Creek - Zone 0' - 13' consists of very loose silt with some very fine sand and a trace of clay and organics (1.83%) evidenced by wood chips. Zone 13' - 44.5' consists of firm to stiff clayey silt with seams of silt. Zone 44.5' - 47.5' consists of firm clayey silt, some sand

and gravel (glacial till). Bedrock was found at 47.5' (elev. 596.3') which consists of moderately fractured, hard, light grey to white dolomite. Groundwater was found at approximate elevation 641'.

- 2.3.3 Approaches - The proposed approaches will consist of maximum fills of 15'  $\pm$  which are estimated to undergo long term settlements of approximately 3 to 4 inches. No slope stability problems are anticipated.

#### Piers and Abutments

12 HP @ 74 piles driven to bedrock are recommended. These should provide a safe capacity of 95 tons per pile. Assuming that the pile caps will be founded within the compacted granular 'A' fill of the approaches, no dewatering scheme will be required.

### 2.4 Site #4 - T.H. & B. Railway Subway

- 2.4.1 Site description - Hwy. 403 profile grade will be 648'  $\pm$ . The T.H.&B. Railway elevation at this site will be 671'  $\pm$ . Existing ground elevation is 666'  $\pm$  within a gently rolling terrain. Cuts of approximately 18'  $\pm$  and fills of approximately 5'  $\pm$  will be required.

- 2.4.2 Subsoil conditions- Ground elev. 666.2, borehole location -  $\neq$  Hwy. 403, 40' east of  $\neq$  T.H. & B. Railway. - Zone 0' - 7' consists of stiff clayey silt, trace of coarse sand and organics (0.46%). Zone 7' - 62.7' consists of firm to stiff clayey silt with seams of silt and layers of silty clay.

Bedrock was found at 62.7' (elev. 603.5') which consists of moderately fractured, hard, light grey dolomite. Groundwater was found at approximate elevation 664'.

- 2.4.3 Approaches - These will consist of fills of 5 feet  $\pm$  maximum height which are estimated to undergo long term settlements of approx. 1 to 2 inches. No slope stability problems are anticipated.

#### Piers and Abutments

12 HP @ 74 end bearing piles driven to bedrock are recommended. These should provide a safe capacity of 95 tons per pile.

Excavations - Due to the relatively impermeable nature of the subsoil at this site, no dewatering scheme should be required during construction.

Caution must be taken, however, to ensure that some method of track protection be utilized to ensure stability of the T.H. & B. Railway embankment.

## 2.5 Site #5 - Jerseyville Road Underpass

2.5.1 Site description - Hwy. 403 profile grade will be approximately 716'  $\pm$ . The Jerseyville Rd. profile grade will be approximately 737'  $\pm$ . The existing ground elevation is 717'  $\pm$  within a relatively flat area. This site may require fills of approximately 20'  $\pm$ .

2.5.2 Subsoil conditions - Ground elev. 716.8', borehole location -  $\neq$  Hwy. 403, 50' west of  $\neq$  Jerseyville Rd. - Zone 0' - 15' consists of very loose to dense silt, trace of clay with a trace of organics (0.24%) within the top 11'  $\pm$ . Zone 15' - 38' consists of very stiff silty clay with layers of clayey silt to silt. The predominant layer from 38' - 118' consists of firm to stiff clayey silt to silt with layers of silty clay to clay. The layer from 118' - 121.5' consists of hard clayey silt, trace of medium sand and coarse gravel (glacial till). Investigations were ended at this depth at elev. 595.3'. Groundwater was found at approximate elevation 707'.

2.5.3 Approaches - The approaches will consist of fills of 20 feet  $\pm$  max. height. These are estimated to undergo long term settlements of approximately 3 to 4 inches. No slope stability problems are anticipated.

### Piers and Abutments

A) Spread Footings - Spread footings may be founded at approximate elev. 711'  $\pm$  with a safe bearing capacity of 2 t.s.f. With this scheme an estimated long term settlement of 4 to 5 inches may occur at the abutments and 1 to 2 inches at the pier.

In addition, the abutment footings may also be founded within the compacted granular 'A' fill within the approaches. This scheme should provide a safe bearing capacity of 2.5 t.s.f. See perched abutment detail Fig. 1.

- B) End Bearing Piles - 12 HP @ 74 piles driven to bedrock (approx. elev. 590'  $\pm$ ) are recommended. These should provide a safe capacity of 95 tons per pile.

Excavations - No major unwatering problems are envisaged since groundwater is located at a relatively low elevation of 707'. Since the groundwater may vary due to seasonal fluctuations, a dewatering scheme may be required.

2.6 Site #6 - Big Creek Crossing at Sta. 592  $\pm$

- 2.6.1 Site Description - Hwy. 403 profile grade will be 732'  $\pm$ . Existing stream bed elevation is 685'  $\pm$  with the banks at approximately 687'  $\pm$ . Site located within a river valley in an area of gently rolling terrain. This site may require fills of approximately 45'  $\pm$ .

- 2.6.2 Subsoil conditions - Ground elev. 687.2, borehole location -  $\neq$  Hwy. 403, 25' east of  $\neq$  Big Creek - The predominating subsoil from 0' - 97', consists of firm to very stiff layers of silty clay to clayey silt with various layers of clay and seams of silt. The layer from 97' - 101.1' consists of dense silt, some medium to coarse sand, trace of gravel and clay (glacial till). Bedrock was found at 101.1' (elev. 586.1') which consists of moderately fractured, hard, light grey to white dolomite. Groundwater was found at approximate elevation 686'.

- 2.6.3 Approaches - No slope stability problems are anticipated. It is estimated that the approach fills may undergo long term settlements of approximately 18". Thus it is recommended to place the fills approximately 6 months prior to bridge construction.

Piers and Abutments

12 HP @ 74 piles driven through the fill material to bedrock are recommended. These should provide a safe capacity of 95 tons per pile.

Excavations - No major unwatering problems are envisaged due to the relatively impermeable nature of the subsoil.



## 2.7 Site #7 - Lynden Road Underpass

- 2.7.1 Site description - Hwy. 403 profile grade will be 714'  $\pm$  with a Lynden Rd. profile grade of approximately 734'  $\pm$ . The site is located in a depression within a gently rolling terrain. The proposed scheme would require fills of approximately 23'  $\pm$ .
- 2.7.2 Subsoil conditions- Ground elev. 708.8', borehole location - 40' north of  $\neq$  Hwy. 403,  $\neq$  Lynden Rd. - Zone 0' - 12' consists of firm to stiff silty clay with seams of silt. Within the top 7', test results indicated a trace of organics (0.56%) and very fine sand. Zone 12' - 33' consists of firm clayey silt with layers of silty clay. Zone 33' - 50.5' consists of loose silt with seams of clayey silt. Zone 50.5' - 101.5' consists of firm clayey silt with layers of silty clay to clay. Although sampling was discontinued at this depth, a dynamic cone further penetrated the subsoil. However, bedrock was not located. Groundwater was found at approximate elevation 700'.
- 2.7.3 Approaches - The approaches will consist of fills of 23 feet  $\pm$  max. height which are estimated to undergo long term settlements of approximately 3 to 4 inches. No slope stability problems are anticipated.

### Piers and Abutments

- A) Spread Footings - Spread footings for the abutments may be placed within the compacted granular 'A' fill. See Fig. 1. This scheme should provide a safe bearing capacity of 2 t.s.f. Total long term settlements of 5 to 6 inches may be anticipated.
- B) End Bearing Piles - It is anticipated that 12 HP @ 74 piles may be driven to bedrock (Approx. elev. 580' - 590'). These should provide a safe capacity of 95 tons per pile.

## 2.8 Site #8 - Sunny Ridge Road Underpass

- 2.8.1 Site description - Hwy. 403 profile grade will be 713'  $\pm$  with a Sunny Ridge Rd. grade elevation of 736'  $\pm$ . The existing ground elevation is 733'  $\pm$ . The site is located within a relatively flat area. This requires fills of approximately 3'  $\pm$  and cuts of approximately 20'  $\pm$ .
- 2.8.2 Subsoil conditions- Ground elev. 732.5', borehole location - 30' north of  $\neq$

Hwy. 403, 25' east of Sunny Ridge Rd. - Zone 0' - 4.5' consists of loose fine sand some silt, trace of organics. Zone 4.5' - 53.5' consists of stiff clayey silt to silt with intermittent layers of silt and clay. In addition, within this layer, from 4.5' to 7', exists a trace of organics (1.41%). Zone 53.5' - 85' consists of loose to compact silt with intermittent layers of clayey silt and clay. Zone 85' - 91.5' consists of firm to stiff clayey silt with layers of clay. Sampling was discontinued at this depth after which a dynamic cone was driven to refusal at a depth of 139.0' (elev. 593.5).

By the nature of complete refusal, it is anticipated that this is the probable location of bedrock. Groundwater was found at approximate elev. 730'.

- 2.8.3 Approaches - The approach to the site will be almost entirely in a cut section. Due to the high groundwater condition and the relatively high permeability of the intermittent silt layers, it is recommended that a permanent dewatering scheme on the cut slopes be required for stability purposes. This may consist of permanent toe drains.

No settlement at the approaches are anticipated.

#### Piers and Abutments

12 HP @ 74 piles driven to bedrock are recommended for support of the footings. These should provide a safe capacity of 95 tons per pile.

Excavations - As previously mentioned, due to the relatively high groundwater condition and the highly permeable silt layers, a dewatering scheme should be utilized during construction.

### 2.9 Site #11 - Big Creek Crossing at Sta. 775 ±

- 2.9.1 Site description - Hwy. 403 profile grade is proposed to be 722' ±. Existing stream bed elevation is approximately 684' ± with the banks at an approximate elevation of 685' ±. This may result in fills 37' in height.

- 2.9.2 Subsoil conditions - Ground elev. 684.8', borehole location ½ Hwy. 403, 25' west of ½ Big Creek - The predominating layer from 0' - 71.5' consists of firm to stiff layers of clayey silt and silt with intermittent layers of silty clay. Zone 71.5' - 81.5' consists of very dense silt with fine to coarse sand and some gravel (glacial till).

Probable bedrock was found at 81.5' (elev. 603.3'). However, a sample core was unobtainable. Groundwater was found at approximate elevation 682'.

- 2.9.3 Approaches - The approach fills at this site may be approximately 37' in height. No slope stability problems are anticipated.

In this situation estimated long term settlements of approximately 6 to 8 inches may be anticipated.

#### Piers and Abutments

12 HP @ 74 piles driven to bedrock (elev. 603.3) are recommended. These should provide a safe capacity of 95 tons per pile.

Excavations - No major unwatering problems are anticipated at this time due to the relatively impereable nature of the subsoil.

#### 2.10 Site#12 - Alberton Road Underpass

- 2.10.1 Site description - Hwy. 403 profile grade will be 731'  $\pm$  with an Alberton Rd. profile grade of 752'  $\pm$ . The existing ground elevation is approximately 721'  $\pm$  within a relatively flat terrain.

This would require fills of approximately 31'  $\pm$  and 10'  $\pm$  for Alberton Rd. and Hwy. 403 respectively.

- 2.10.2 Subsoil conditions - Ground elev. 721.0'; borehole location - 20' north of  $\neq$  Hwy. 403, 30' east of  $\neq$  Alberton Rd. - Zone 0' - 17' consists of stiff to very stiff clayey silt with intermittent varves of silt and silty clay. Within the top 13' of this layer, test results also indicated a trace of organics (0.56%). Zone 17' - 41' consists of loose to compact silt with seams of clayey silt. Zone 41' - 92.0' consists of layers of loose silt and firm to stiff clayey silt.

Bedrock was found at 92.0' (elev. 629.0') which consists of moderately fractured, hard, light grey to white dolomite. Groundwater was found at approximate elevation 710'.

- 2.10.3 Approaches - The approaches will consist of fills of 31'  $\pm$  max. height.

No stability problems are anticipated at this site.

The approach fills are estimated to undergo an immediate settlement of approximately 3 to 4 inches. In addition, estimated long term settlements of 1" to 1½" may be anticipated.

#### Piers and Abutments

12 HP @ 74 piles may be driven to bedrock through the compacted fill material. These should provide a safe capacity of 95 tons per pile.

Excavations - No major unwatering problems are anticipated.

### 2.11 Site #13 - Highway #52 Underpass

- 2.11.1 Site description - Hwy. 403 profile grade will be 758'  $\pm$  with a highway #52 profile grade of 735'  $\pm$ . The existing ground elevation is approximately 756' on Hwy. #52 and approximately 731' on original ground within a valley with stable 2:1 side slopes.

This would require fills of approximately 27'  $\pm$  (as existing).

- 2.11.2 Subsoil conditions - Ground elev. 756.6' - Hwy. #52, borehole location -  $\phi$  Hwy. 403, 17' east of  $\phi$  Hwy. 52 - Zone 0' - 24' consists of loose to dense silt with fine sand, trace of fine gravel. This is the extent of the fill material for Hwy. 52. Zone 24' - 35.5' consists of compact silt, some fine sand, trace of clay. Zone 35.5' - 38.5' consists of very stiff varves of silt and clayey silt. Zone 38.5' - 91' consists of loose to very dense silt, trace of clay and fine sand. Zone 91' - 122.5' consists of stiff clayey silt with layers of silty clay. Sampler encountered refusal at 122.5' (elev. 634.1'). Sampler probably struck boulder rather than bedrock.

An exact determination of groundwater location was not possible due to the borehole being located in the N.B.L. of Hwy. 52 and timing was thus critical. However, we estimate that the water table is located at an approximate elev. of 730'  $\pm$ .

- 2.11.3 Approaches - The approaches will consist of fills 27' max. height which are existing. Based on the assumption that the existing Hwy. 52 alignment will remain unchanged, no significant settlement is anticipated. In addition, no slope stability problems are anticipated.

Piers and Abutments

12 HP @ 74 piles may be driven to bedrock (approx. elev. 625'  $\pm$ ). These should provide a safe capacity of 95 tons per pile.

Excavations - A dewatering scheme may be required during construction if pile caps are to be constructed within the original soil.

2.12. Site #14 - Shaver Road Overpass

- 2.12.1 Site description - Hwy. 403 profile grade will be 788'  $\pm$  with a Shaver Rd. profile grade of 765'  $\pm$ . Existing ground elevation is approximately 758'  $\pm$  in a small valley within a moderately rolling terrain. This would require max. fills of approximately 30'  $\pm$ .

- 2.12.2 Subsoil conditions - Ground elev. 757.6', borehole location -  $\neq$  Hwy. 403, 40' east of  $\neq$  Shavers Rd. - Zone 0' - 17' consists of loose to compact silt, trace to some fine sand. The top 4.5'  $\pm$  contains a trace of organics (1.98%). Zone 17' - 21' consists of firm clayey silt, seams of silt. Zone 21' - 35.5' consists of loose to compact silt, trace of very fine sand. Zone 35.5' - 39' consists of compact silt to very fine sandy silt. Zone 60.5' - 81.5' consists of compact silt, trace of very fine sand with intermittent varves of clayey silt.

Location of bedrock was not determined at this site due to adverse working conditions. Groundwater was found at approximate elevation 757'.

- 2.12.3 Approaches - The approaches will consist of fills 30'  $\pm$  max. height. These are expected to undergo an instantaneous settlement of 3" to 4". No slope stability problems or long term settlements anticipated.

The top organic stratum should be removed and replaced with granular material

before the approach fills are placed.

### Piers and Abutments

- A) Spread Footings - Spread footings may be found within the compacted granular 'A' fills for support of the abutments. (See Fig. 1) This is expected to provide a safe bearing capacity of 2.5 t.s.f. (239.4 kPa)

The abutments are estimated to undergo an immediate settlement of approximately 1 to 2 inches after application of the loads.

- B) Friction Piles - No. 14 timber piles embedded approximately 50' in the original soil providing a safe bearing capacity of 25 tons per pile may be used for support of the piers and abutments. Total long term settlements of approximately 1" are estimated to occur.
- C) End Bearing Piles - 12 HP @ 74 piles driven to bedrock with estimated tip elevations of 630'  $\pm$ . This scheme should provide a safe capacity of 95 tons per pile.

Excavations - No major unwatering problems are anticipated. However, excess surface water may present considerable problems. The area may be required to be drained before construction.

### 3. GENERAL

All settlement predictions are approximate only since footing dimensions and exact locations have yet to be established.

All slope stability predictions are based upon assumed forward and side slopes of 2 horizontal to 1 vertical.

The top of all footings and pile caps should be located at least 4' below finished grade for the purpose of frost protection.

R. Van Veen  
R. Van Veen  
Project Engineer

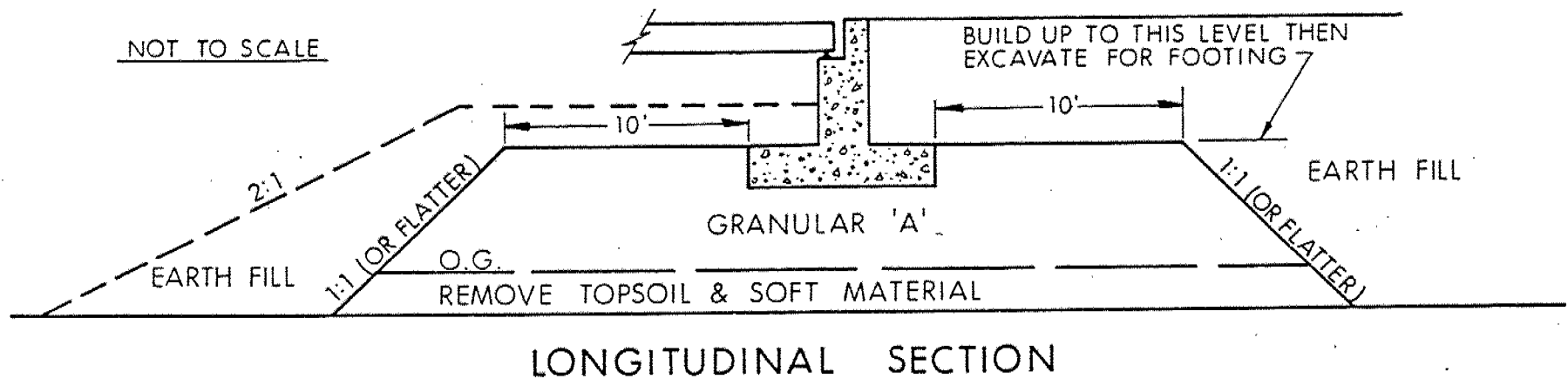
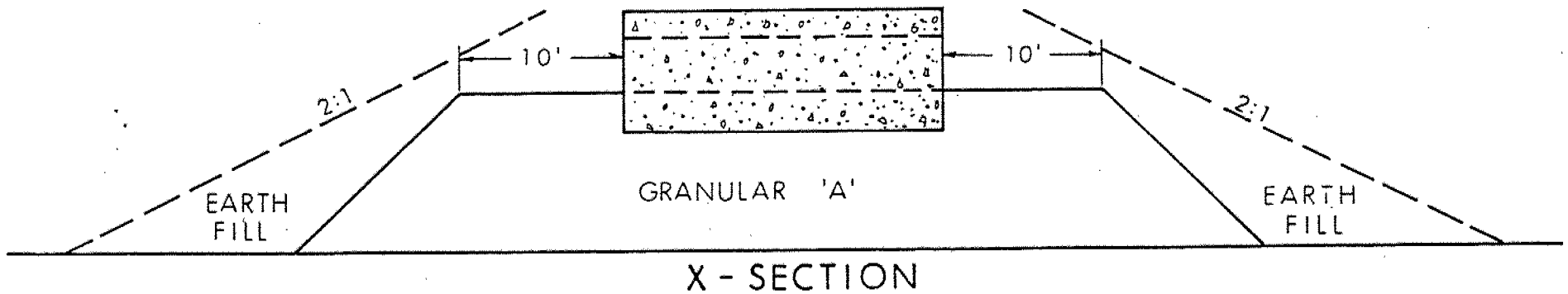
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K.G. Selby, P. Eng.  
Supervising Engineer

RV:bp  
June, 1976

APPENDIX



## ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



### NOTES

- 1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A'.
- 2 - PLACE GRANULAR 'A' TO TOP OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M.T.C. STANDARDS.
- 3 - EXCAVATE COMPACTED GRANULAR 'A' MATERIAL FOR FOOTING.

FIG. 1

## ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

### PENETRATION RESISTANCE

'N' STANDARD PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL. THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

### DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

<u>CONSISTENCY</u>	<u>c LB./SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 250	VERY LOOSE	0 - 4
SOFT	250 - 500	LOOSE	4 - 10
FIRM	500 - 1000	COMPACT	10 - 30
STIFF	1000 - 2000	DENSE	30 - 50
VERY STIFF	2000 - 4000	VERY DENSE	> 50
HARD	> 4000		

TERMS TO BE USED IN DESCRIBING SOILS:-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC.

### TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.T.	SLOTTED TUBE SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE

P.H. SAMPLE ADVANCED HYDRAULICALLY  
P.M. SAMPLE ADVANCED MANUALLY

### SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
CIU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		

# ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

## SOIL PROPERTIES

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
$S_r$	DEGREE OF SATURATION
$w_L$	LIQUID LIMIT
$w_p$	PLASTIC LIMIT
$I_p$	PLASTICITY INDEX
$w_s$	SHRINKAGE LIMIT
$I_L$	LIQUIDITY INDEX $= \frac{w - w_p}{I_p}$
$I_C$	CONSISTENCY INDEX $= \frac{w_L - w}{I_p}$
$e_{max}$	VOID RATIO IN LOOSEST STATE
$e_{min}$	VOID RATIO IN DENSEST STATE
$I_D$	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY $D_r$ IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
$m_v$	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta\sigma}$
$c_v$	COEFFICIENT OF CONSOLIDATION
$C_c$	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma}$
$T_v$	TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
$\tau_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION INTERCEPT
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_t$	SENSITIVITY

## GENERAL

$\pi$	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

## STRESS AND STRAIN

u	PORE PRESSURE
$\sigma$	NORMAL STRESS
$\sigma'$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

## EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
$K_0$	COEFFICIENT OF EARTH PRESSURE AT REST

## FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
$k_s$	MODULUS OF SUBGRADE REACTION

## SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
$\rho$	ANGLE OF SLOPE TO HORIZONTAL

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION  
**RECORD OF SITE No 1**

WP 66-67-01 LOCATION Co-ords. 15,685,290 N; 809,685 E. ORIGINATED BY MK  
DIST 4 HWY 403 BORING DATE March 11 - 15, 1976 COMPILED BY MK  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.T.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
708.0	Ground Level															
0.0	Clayey silt, seams of silt, layers of silty clay and silt  Firm to Stiff		1	SS	13											0 0 54 46
			2	SS	16											
			3	TW	PH											
			4	SS	11											0 0 70 30
			5	SS	8											0 0 84 16
			6	TW	PH											
			7	SS	8											
			8	SS	11											
			9	TW	PH											
			10	SS	30											0 14 66 20
			11	SS	9											
	Layers of very fine sandy silt		12	SS	11											0 0 67 33
			13	TW	PH											
			14	SS	8											
			15	TW	PH											
			16	SS	13											
			17	RC BXL	Rec 98%											
627.0																
81.0																
624.0																
84.0																
607.6																
100.5	Bedrock - moderately fractured dolomite															
604.0																

20  
15 5 % STRAIN AT FAILURE  
10

(CONTINUED)

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE NO 1 (CONT'D)

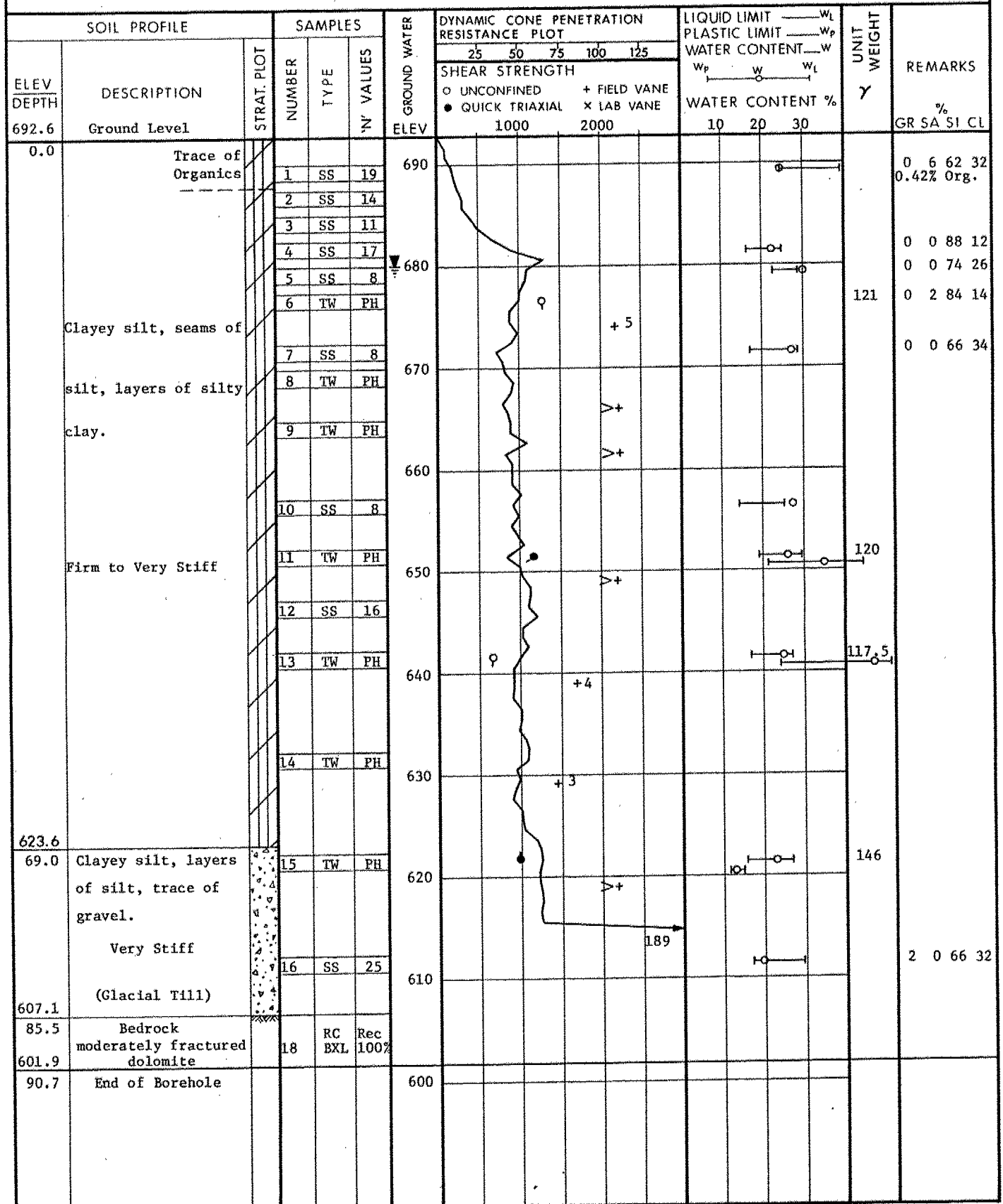
WP 66-67-01 LOCATION Co-ords. 15,685,290 N; 809,685 E. ORIGINATED BY MK  
 DIST 4 HWY 403 BORING DATE March 11 - 15, 1976 COMPILED BY MK  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY MS

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
604.0	continued															
104.0	Moderately fractured dolomite Bedrock		18	RC EXL	Rec 98%	600										
597.6																
110.5	End of Borehole															
						590										

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

## RECORD OF SITE NO 2

WP 66-67-01 LOCATION Co-ords. 15,685,480 N; 815,860 E. ORIGINATED BY BVV  
DIST 4 HWY 403 BORING DATE March 5-11, 1976 COMPILED BY BVV  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.J.



MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE NO 3

WP 66-67-01 LOCATION Co-ords. 15,685,480 N; 817,110 E. ORIGINATED BY BVV  
DIST 4 HWY 403 BORING DATE March 18, 1976 COMPILED BY BVV  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		25	50	75	100	125	$W_P$	$W$	$W_L$		
643.8	Ground Level															
0.0	Silt, some very fine sand, trace of clay and organics (wood chips)		1	SS	3	640									Org. 1.83%	0 9 79 12
			2	SS	2											
			3	SS	3											
	Very Loose		4	SS	4										Org. 1.38%	0 18 67 15
630.8			5	SS	4	630										1 2 73 24
13.0	Clayey Silt		6	SS	3											
	Seams of Silt		7	TW	PH											
			8	TW	PH	620									122	
	Firm to Stiff		9	SS	10	610									122	
			10	TW	PH											
			11	SS	5											
			12	SS	4	600										
599.3																
44.5	Clayey silt, some sand & grav. (Glac. Till) Firm		13	SS	5											24 12 36 28
596.3																
47.5	Bedrock-moderately fractured dolomite		14	RC BXL	Rec 87%											
591.3																
52.5	End of Borehole					590										

RECORD OF SITE NO 4

WP 66-67-01 LOCATION Co-ords. 15,685,520 N; 817,770 E. ORIGINATED BY BVV  
 DIST 4 HWY 403 BORING DATE March 16 & 17, 1976 COMPILED BY BVV  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY N.Y.

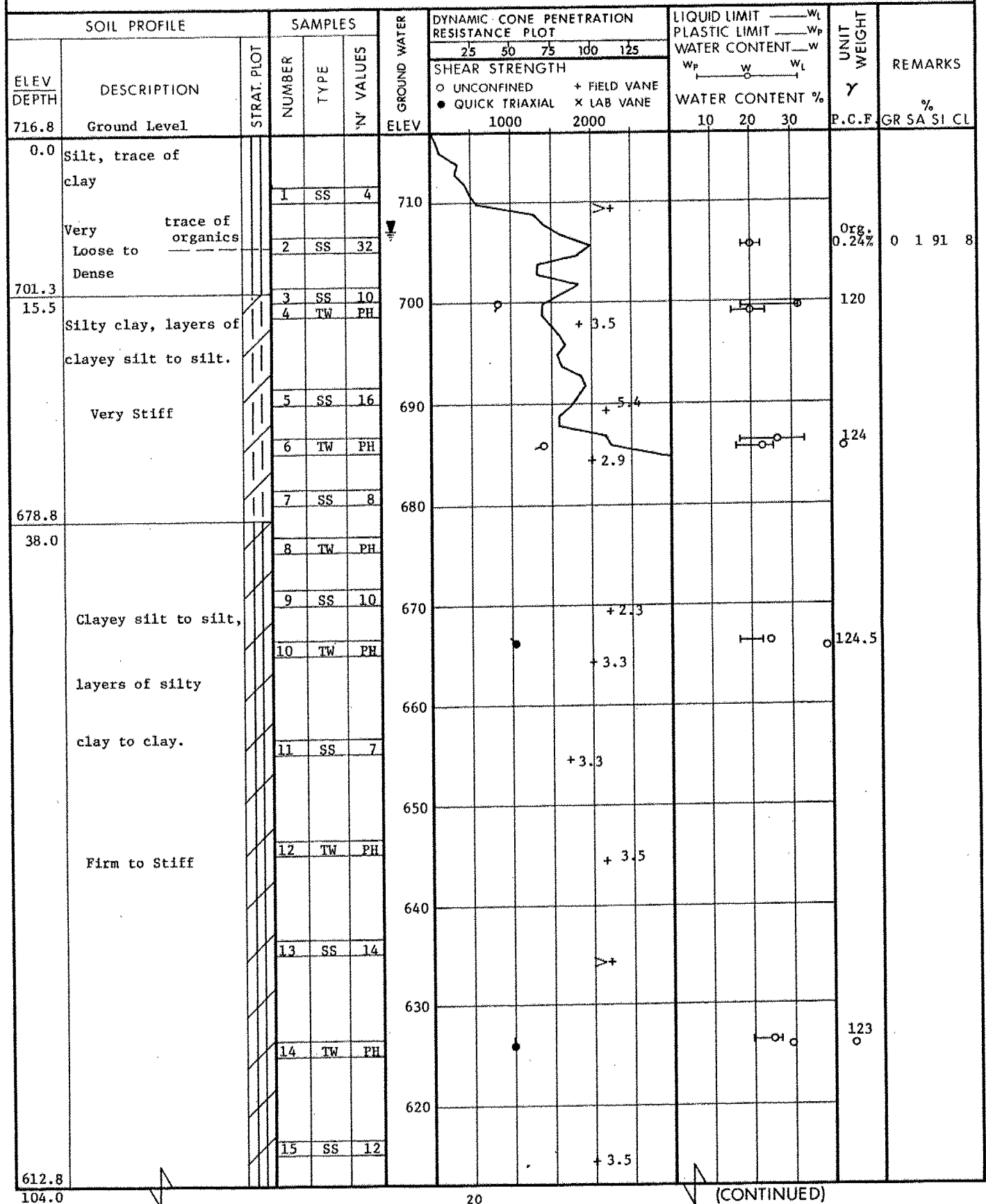
SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N° VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
666.2	Ground Level															
0.0	Clayey silt, trace of coarse sand & organics		1	SS	10											
659.2	Stiff		2	SS	11											
7.0			3	SS	9											
			4	SS	7											
	Clayey silt, seams of silt, layers of silty clay.		5	SS	5											
			6	TW	PH											
			7	SS	7											
			8	SS	6											
	Firm to Stiff		9	TW	PH											
			10	SS	8											
			11	TW	PH											
			12	SS	11											
603.5			13	TW	PH											
62.7	Bedrock - moderately fractured dolomite		14	RC BXL	Rec 91%											
598.5																
67.7	End of Borehole															



MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE NO 5

WP 66-67-01 LOCATION Co-ords. 15,686,595 N; 821,170 E. ORIGINATED BY MK  
DIST 4 HWY 403 BORING DATE March 15, 16, 1976 COMPILED BY MK  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY *MS*



MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

## RECORD OF SITE NO 5 (CONT'D)

WP 66-67-01 LOCATION Co-ords. 15,686,595 N; 821,170 E. ORIGINATED BY MK  
DIST 4 HWY 403 BORING DATE March 15, 16, 1976 COMPILED BY MK  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.T.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$ P.C.F	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$W_P$	$W$	$W_L$		
612.8	continued															
104.0	Clayey silt to silt, layers of silty clay to clay.  Firm to Stiff		16	TW	PH	610									123 126	
598.8						600										
118.0	Clayey silt, trace of medium sand & coarse grav. (Gl. till) Hard		17	SS	38											20 21 44 15
595.3																
121.5	End of Borehole					590										

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE No 6

WP 66-67-01 LOCATION Co-ords. 15,688,495 N; 826,675 E.  
DIST 4 HWY 403 BORING DATE March 18-22, 1976  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger

ORIGINATED BY MK  
COMPILED BY MK  
CHECKED BY M.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$ P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		75	50	75	100	125	$w_p$	$w$	$w_L$		
687.2	Ground Level															
0.0																
	Trace of organics		1	SS	5										Org. 0.40%	
			2	SS	14											0 0 67 33
			3	TW	PH											
	Layered silty clay		4	SS	6											
	and clayey silt		5	TW	PH											
	various layers of clay		6	SS	5											
	seams of silt.		7	TW	PH										125	
			8	SS	7											
			9	TW	PH											
	Firm to Very Stiff		10	SS	4	6"										
			11	TW	PH										123	
			12	SS	22											
			13	SS	8											
			14	TW	PH											
			15	SS	13											12 33 39 16
590.2																
97.0	Silt, some medium to coarse sand, trace of grav. & clay (Gl. Till)		16	TW	PH											
586.1																
101.1	Bedrock-moderately fractured		17	RC BXL	Rec 100%											

20  
15-0-5 % STRAIN AT FAILURE  
10

(CONTINUED)

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

# RECORD OF SITE NO 7

WP 65-67-01 LOCATION Co-ords. 15,690,370 N; 831,990 E. ORIGINATED BY BVV  
 DIST 4 HWY 403 BORING DATE March 19-23, 1976 COMPILED BY BVV  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY H. J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
708.8	Ground Level															
0.0	Silty clay, trace of seams of organics & very fine silt. sand		1	SS	11										0.56%	0 14 62 24
	Firm to Stiff		2	SS	9											0 0 55 45
696.8			3	SS	5											
12.0	Clayey silt, layers of silty clay.		4	SS	5										123	
	Firm		5	TW	PH											
			6	TW	PH											
			7	SS	8											
			8	TW	PH										119	
675.8			9	TW	PH											
33.0	Silt seams of clayey silt		10	SS	7											0 0 78 22
	Loose		11	SS	5											
			12	TW	PH											
658.3			13	SS	7											0 0 81 19
50.5	Clayey silt, layers of silty clay to clay.		14	TW	PH											
	Firm		15	TW	PH										125	
			16	SS	10											
			17	TW	PH											
			18	TW	PH										117.5	
607.3			19	TW	PH											
101.5	End of Borehole															

20  
15 5 % STRAIN AT FAILURE  
10

(CONTINUED)

RECORD OF SITE NO 7(CONT'D)

WP 65-67-01 LOCATION Co-ords. 15,690,370 N: 831,990 E. ORIGINATED BY BVV  
 DIST 4 HWY 403 BORING DATE March 19 - 23, 1976 COMPILED BY BVV  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.F.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
	continued															
589.8						600										
119.0	End of Cone Test					590										

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE NO 8

N. 4783 368.1; E 255 667.8

WP 65-67-01

LOCATION

Co-ords. 15,693,465 N; 838,805 E.

ORIGINATED BY BVV

DIST 4 HWY 403

BORING DATE

February 27, March 1 - 4, 1976

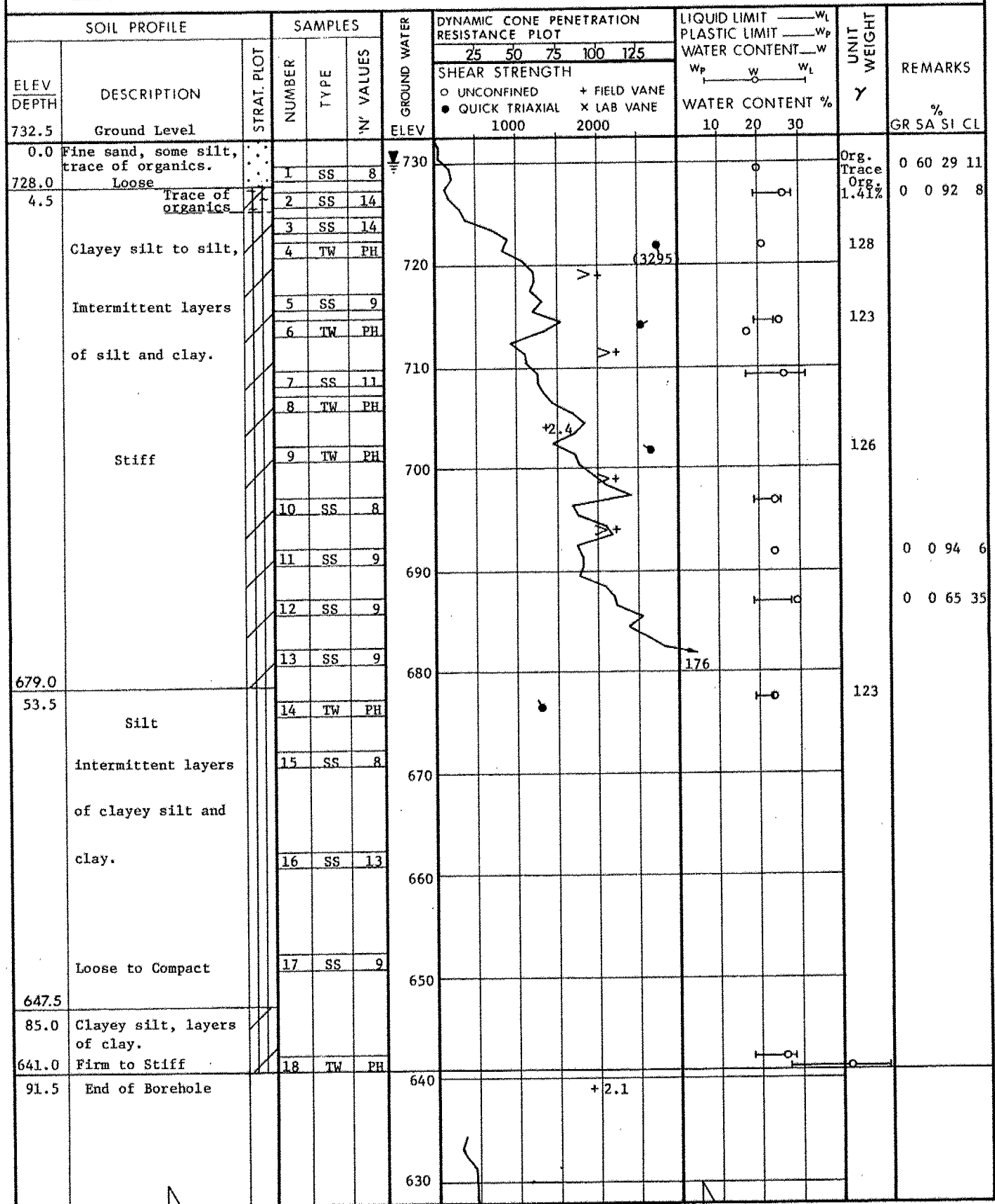
COMPILED BY BVV

DATUM Geodetic

BOREHOLE TYPE

Hollow Stem Auger

CHECKED BY *[Signature]*



MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE No 8 (CONT'D)

N 4783 368.1 E 255 667.8

WP 65-67-01 LOCATION Co-ords. 15,693,465 N; 838,805 E. ORIGINATED BY BVV  
DIST 4 HWY 403 BORING DATE February 27, March 1 - 4, 1976 COMPILED BY BVV  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY J.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
							SHEAR STRENGTH					WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
							1000 2000					10 20 30				
593.5																
139.0	Probable Bedrock					590										

20  
15 5 % STRAIN AT FAILURE  
10



MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE No. 11

WP 65-67-01 LOCATION Co-ords. 15,694,520 N; 844,115 E. ORIGINATED BY MK  
DIST 4 HWY 403 BORING DATE March 23 & 24, 1976 COMPILED BY MK  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY H.L.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
684.8	Ground Level															
0.0	Layered clayey silt and silt, intermittent layers of silty clay.  Firm to Stiff		1	SS	5	680										0 0 92 8
			2	SS	7			+ 4.6								0 0 79 21
			3	TW	PH	670			+ 4.4							
			4	SS	6					V+						
			5	TW	PH	660				+ 5.0						
			6	SS	7					V+						
			7	TW	PH	650				V+						
			8	SS	8											
			9	SS	10	640										
			10	TW	PH											
			11	SS	9	630										
613.3			12	TW	PH	620										
71.5	Silt with fine to coarse sand, some gravel (Glacial Till) Very Dense					610										
603.3	Probable Bedrock		13	SS	64/6"											8 25 61 6
81.5	End of Borehole					600										

20  
15 0-5 % STRAIN AT FAILURE  
10

RECORD OF SITE NO 12

N 4 783 662.2 ; E 258 159.5

WP 65-67-01

LOCATION

Co-ords. 15,694,430 N; 846,980 E.

ORIGINATED BY BVV

DIST 4 HWY 403

BORING DATE

March 24 - 25, 1976

COMPILED BY BVV

DATUM Geodetic

BOREHOLE TYPE

Hollow Stem Auger

CHECKED BY NT

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N <sup>o</sup> VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
721.0	Ground Level															
0.0	Clayey silt, varves of silt and silty clay		1	SS	23	720									Org. 10.42%	
			2	SS	12											
			3	SS	14											
	trace of organics		4	SS	16	710									Org. 0.56%	
704.0	Stiff to Very Stiff		5	SS	17											0 0 92 8
17.0	Silt		6	SS	7											
	seams of clayey silt		7	TW	PH	700									120	
			8	TW	PH											
	Loose to Compact		9	SS	7	690										0 0 93 7
			10	SS	7											
680.0			11	SS	9	680										
41.0			12	TW	PH											
	Layered Silt		13	SS	8	670										
	(Loose)		14	SS	9											
			15	SS	10	660										
			16	SS	9	650										
	Clayey Silt		17	SS	10	640										
	(Firm to Stiff)															
629.0			18	SS	8	630										0 1 80 19
92.0	Bedrock		19	RC	Rec											
623.7	moderately fractured dolomite			BXL	100%											
97.3	End of Borehole					620										

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE No 13

N 4784 515.7 E 260 511.0

WP 65-67-01

LOCATION

Co-ords. 15,697,230 N; 854,695 E.

ORIGINATED BY MK

DIST 4 HWY 403

BORING DATE

March 25 & 26, 1976

COMPILED BY MK

DATUM Geodetic

BOREHOLE TYPE

Hollow Stem Auger

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
756.6	Ground Level															
0.0	Silt with fine sand, trace of fine gravel  (Fill Material)  Loose to Dense		1	SS	8	750										0 20 74 6
			2	SS	39											
			3	SS	17	740										6 47 41 6
			4	SS	33											
732.6																
24.0	Silt, some fine sand, trace of clay.  Compact		5	SS	9	730										0 17 76 7
			6	SS	17											0 18 76 6
721.1																
35.5	Varved silt & clayey		7	SS	19	720										0 1 69 30
718.1	silt. Very Stiff															0 0 92 8
38.5			8	SS	39											0 0 99 1
			9	SS	54	710										0 0 98 2
	Silt, trace of clay  and fine sand.		10	SS	83											0 7 87 6
						700										
			11	SS	20											
	Loose to Very Dense					690										
			12	SS	24											0 0 95 5
						680										
			13	SS	6											
						670										
665.6			14	SS	9											
91.0	Clayey silt, layers of silty clay.  Stiff					660										
			15	SS	11											
652.6																
104.0																

20  
15 5 % STRAIN AT FAILURE  
10

(CONTINUED)

RECORD OF SITE NO 13 (CONT'D)

N 4784 515.7; E 260 511.0

WP 65-67-01 LOCATION Co-ords. 15,697,230 N: 854,695 E. ORIGINATED BY MK  
 DIST 4 HWY 403 BORING DATE March 25 & 26, 1976 COMPILED BY MK  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY JT

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
652.6	continued															
104.0	Clayey silt, layers of silty clay.  Stiff		16	TW	PH	650										
						640										
634.1	Refusal (Boulder)		17	SS	9/12"											
122.5	End of Borehole					630										

# RECORD OF SITE NO 14

N 4785288.3 ; E 262896.1

WP 65-67-01

LOCATION Co-ords. 15,699,765 N; 862,520 E.

ORIGINATED BY BVV

DIST 4 HWY 403

BORING DATE February 25 & 26, 1976

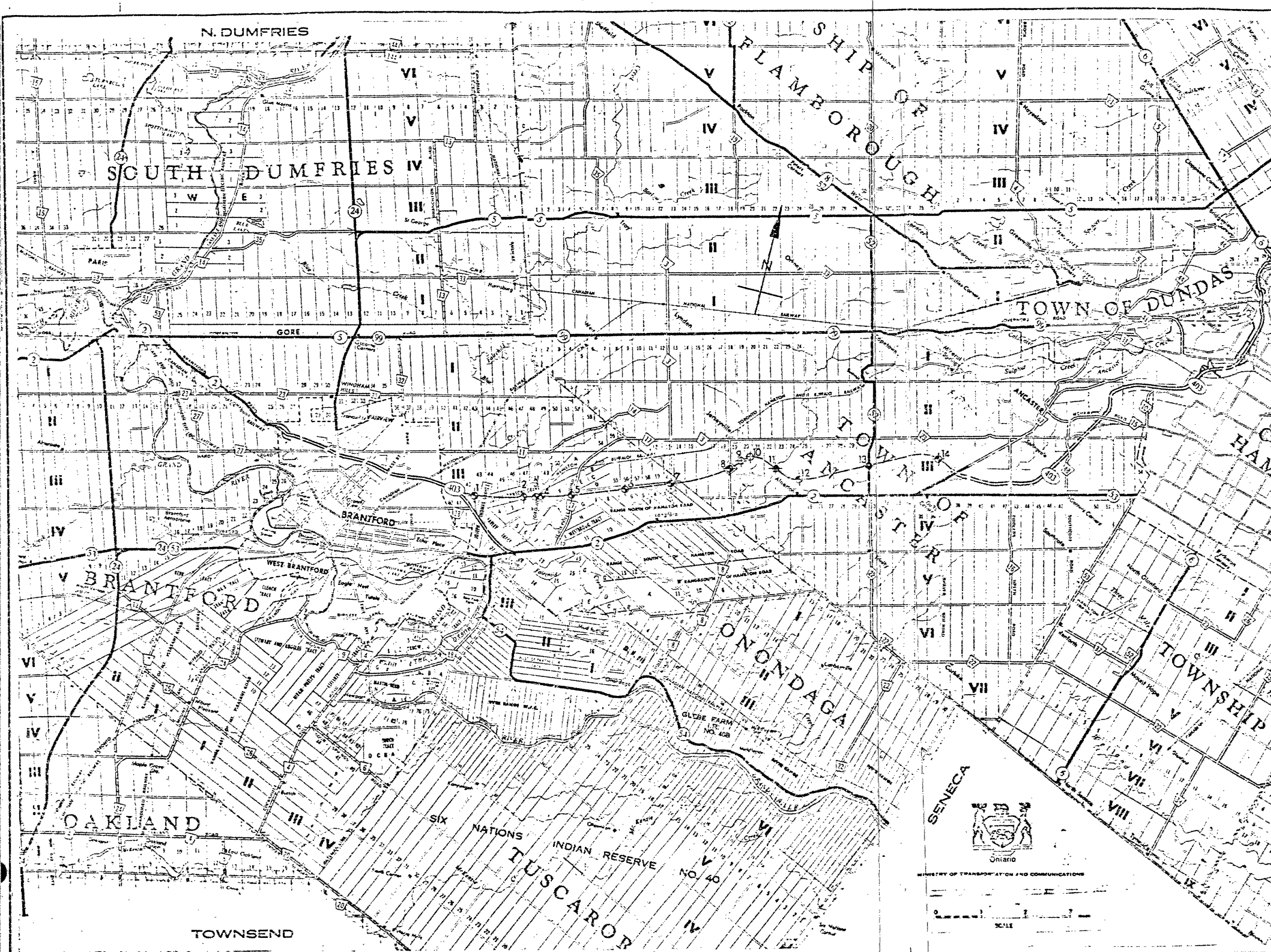
COMPILED BY BVV

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY R.S.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
757.6	Ground Level															
0.0	Silt, trace of trace to some fine sand.		1	SS	6										Org. 1.98%	0 27 70 3
			2	SS	8											0 21 77 2
			3	SS	12	750										
	Loose to Compact		4	SS	8											
			5	SS	10											
740.6			6	SS	6											0 1 92 7
17.0	Clayey silt, seams of silt. Firm		7	SS	6	740									129.5	
736.6			8	TW	PH											
21.0	Silt, trace of very fine sand.		9	TW	PH	730									122	0 3 96 1
	Loose to Compact		10	SS	18											0 0 98 2
722.1			11	SS	10	720										
35.5	Clayey silt, layers of silt. Firm		12	TW	PH											0 28 71 1
718.6			13	TW	PH	710										0 15 81 4
39.0	Silt to very fine sandy silt.		14	SS	25											
	Compact		15	SS	13											0 0 98 2
697.1			16	SS	18	700										0 0 55 45
60.5	Silt, trace of very fine sand, intermit- tent varves of clayey silt.		17	SS	12	690										0 4 94 2
	Compact					680										0 0 99 1
676.1			18	SS	9											
81.5	End of Borehole					670										



ROAD JURISDICTIONS	
KING'S HIGHWAY	
COUNTY ROAD	
COUNTY SUBURBAN ROAD	
OTHER ROAD	
ROAD LEGALLY OPEN BUT NOT NECESSARILY PASSABLE	
INDIAN RESERVE BOUNDARY	
URBAN CORPORATE LIMIT	
RAILWAY AND STATION	
TOWNSHIP BOUNDARY	
COUNTY BOUNDARY	
BUILT UP AREA	

LEGEND

Bore Hole

Dynamic Cone Penetration Test (Cone)

Bore Hole & Cone

Note:  
Site Nos 9 & 10 not investigated

Well at time of investigation

No	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
1	708.1	15,685,290	807,685
2	692.6	15,685,480	815,960
3	643.5	15,685,480	817,110
4	666.2	15,685,520	817,770
5	716.8	15,686,595	821,170
6	687.2	15,688,495	825,675
7	708.6	15,690,370	831,990
8	732.5	15,693,465	838,905
11	684.8	15,694,520	844,115
12	721.0	15,694,430	846,980
13	754.6	15,697,230	854,695
14	757.5	15,699,765	862,520

**-NOTE-**  
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS

DATE	BY	DESCRIPTION

HWY No 403  
DESIGNED BY: [ ] CHECKED: [ ] DATE: JUNE 29, 1973  
DRAWN BY: [ ] CHECKED BY: [ ] DATE: [ ]

POST A  
FILE  
DWG 65-67-01-01

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 40PI-82

DIST. 4 REGION

W.P. No. 66-67-01  
65-67-01

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. 403

LOCATION PROP. STRUCTURES ON HWY. 403  
FROM BRANTFORD TO ANCASTER

No. of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FOUNDATION INVESTIGATION & DESIGN REPORT

W.P. 65-67-01/66-67-01

DIST. 4

HWY. 403

STR. SITE

From Hwy. 2, Ancaster  
Westerly to Brantford Diversion

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40P1-82

DATE



W.P. 65-67-01  
From Hwy. 2, Ancaster W'ly to  
0.8 km. West of Sunny Ridge Road  
Hwy. 403, District 4, Hamilton

W.P. 66-67-01  
From 0.8 km. West of Sunny Ridge Rd.  
Westerly to Brantford Diversion  
Hwy. 403, District 4, Hamilton

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## 1. INTRODUCTION

The Soil Mechanics Section was requested to carry out a Foundation Investigation to determine the feasibility of structures along the proposed route of Hwy. 403 between Ancaster and Brantford.

Following this request a field investigation was carried out by this office to determine the subsoil and groundwater conditions which are of significance to the planning and design of the proposed route.

This report contains the results obtained from our investigations together with our recommendations pertaining to the foundations, cuts, and fills proposed.

Each site was considered individually and presented in order from west to east. Two sites, however, were not investigated since permission to enter the properties involved could not be granted.

## 2. SITE DESCRIPTION, SUBSOIL CONDITIONS, AND RECOMMENDATIONS

### 2.1 Site #1 - Garden Avenue Underpass

- 2.1.1 Site description - Proposed is an underpass to accommodate Garden Ave. Profile grade of Hwy. 403 is proposed to be approximately 702'  $\pm$  with a Garden Avenue elevation of 724'  $\pm$ . Existing ground is relatively flat with some rolling hills within the adjacent area. Ground elevation is 708'  $\pm$  therefore cuts of approximately 6' and fills of approximately 16' will be

required.

- 2.1.2 Subsoil conditions - Ground elev. 708.1', borehole location -  $\phi$  Hwy. 403, 35' east of  $\phi$  Garden Ave. - The entire subsoil stratigraphy consists of firm to stiff clayey silt with seams of silt and layers of varying thickness of silty clay and silt. In addition between 81' and 84' exists layers of very fine sandy silt.

Bedrock was found at 100.5' (elev. 607.6') which consists of moderately fractured, hard, light grey to white dolomite. Groundwater was found at approximate elevation 694'.

- 2.1.3 Approaches - Approaches will consists of fills of 16 feet  $\pm$  maximum height which may undergo estimated long term settlements of 3"-4". No slope stability problems are anticipated.

#### Piers and Abutments

- A) Spread Footings - May be founded at approximate elevation 698'  $\pm$  with a safe bearing capacity of 2 t.s.f. With this scheme an estimated long term settlement of 5 to 6 inches may occur at the abutments and 1 to 2 inches at the pier.

In addition, the abutment footings may be founded within the compacted Granular 'A' fills. This scheme should provide a safe bearing capacity of 2.5 t.s.f. See perched abutment detail Fig. 1.

- B) End Bearing Piles - 12 HP @ 74 piles driven to bedrock may be utilized. These should provide a safe capacity of 95 tons per pile.

Excavations - Due to the relatively impermeable nature of the subsoil in which excavations may be made for footings or pile caps, no major unwatering problems are anticipated.

## 2.2 Site#2 - Johnson Rd. Underpass

- 2.2.1 Site description - Hwy. 403 profile grade will be 684'  $\pm$ . Johnson Road elev. will be 707'  $\pm$ . Existing ground elev. is 693'  $\pm$ . Existing ground is

relatively flat with some rolling hills within the adjacent area. Cuts of approximately 9'  $\pm$  and fills of approximately 14'  $\pm$  will be required.

- 2.2.2 Subsoil conditions - Ground elev. 692.6', borehole location - 30' north of  $\phi$  Hwy. 403, 20' east of  $\phi$  Johnson Rd. The subsoil from 0 - 69' consists of firm to very stiff clayey silt with seams of silt and layers of silty clay. Within the top 4.5' exists a trace of organics (0.42%). Zone 69' - 85.5' consists of very stiff clayey silt with layers of silt and a trace of gravel (glacial till).

Bedrock was found at 85.5' (elev. 607.1') which consists of moderately fractured, hard, light grey to white dolomite. Groundwater was found at approximate elevation 680'.

- 2.2.3 Approaches - The proposed approaches will consist of fills of 14'  $\pm$  max. height. These are estimated to undergo long term settlements of approximately 3 to 4 inches. No slope stability problems are anticipated.

#### Piers and Abutments

For support of the piers and abutments 12 HP @ 74 piles driven to bedrock are recommended. These should provide a safe capacity of 95 tons per pile.

Excavations - No major unwatering problems are anticipated due to the relatively impermeable nature of the subsoil.

### 2.3 Site #3 - Fairchild Creek Crossing

- 2.3.1 Site description - Hwy. 403 profile grade will be 660'  $\pm$ . Existing stream bed elevation is 635'  $\pm$  with the banks at approximately 645'  $\pm$ . Site located within a river valley in an area of gently rolling terrain. This site requires fills of approximately 15'  $\pm$ .

- 2.3.2 Subsoil conditions - Ground elev. 643.8', borehole location  $\phi$  Hwy. 403, 30' east of  $\phi$  Fairchild Creek - Zone 0' - 13' consists of very loose silt with some very fine sand and a trace of clay and organics (1.83%) evidenced by wood chips. Zone 13' - 44.5' consists of firm to stiff clayey silt with seams of silt. Zone 44.5' - 47.5' consists of firm clayey silt, some sand

and gravel (glacial till). Bedrock was found at 47.5' (elev. 596.3') which consists of moderately fractured, hard, light grey to white dolomite. Groundwater was found at approximate elevation 641'.

- 2.3.3 Approaches - The proposed approaches will consist of maximum fills of 15'  $\pm$  which are estimated to undergo long term settlements of approximately 3 to 4 inches. No slope stability problems are anticipated.

#### Piers and Abutments

12 HP @ 74 piles driven to bedrock are recommended. These should provide a safe capacity of 95 tons per pile. Assuming that the pile caps will be founded within the compacted granular 'A' fill of the approaches, no de-watering scheme will be required.

### 2.4 Site #4 - T.H. & B. Railway Subway

- 2.4.1 Site description - Hwy. 403 profile grade will be 648'  $\pm$ . The T.H.&B. Railway elevation at this site will be 671'  $\pm$ . Existing ground elevation is 666'  $\pm$  within a gently rolling terrain. Cuts of approximately 18'  $\pm$  and fills of approximately 5'  $\pm$  will be required.

- 2.4.2 Subsoil conditions- Ground elev. 666.2, borehole location -  $\phi$  Hwy. 403, 40' east of  $\phi$  T.H.& B. Railway. - Zone 0' - 7' consists of stiff clayey silt, trace of coarse sand and organics (0.46%). Zone 7' - 62.7' consists of firm to stiff clayey silt with seams of silt and layers of silty clay.

Bedrock was found at 62.7' (elev. 603.5') which consists of moderately fractured, hard, light grey dolomite. Groundwater was found at approximate elevation 664'.

- 2.4.3 Approaches - These will consist of fills of 5 feet  $\pm$  maximum height which are estimated to undergo long term settlements of approx. 1 to 2 inches. No slope stability problems are anticipated.

#### Piers and Abutments

12 HP @ 74 end bearing piles driven to bedrock are recommended. These should provide a safe capacity of 95 tons per pile.

Excavations - Due to the relatively impermeable nature of the subsoil at this site, no dewatering scheme should be required during construction.

Caution must be taken, however, to ensure that some method of track protection be utilized to ensure stability of the T.H. & B. Railway embankment.

## 2.5 Site #5 - Jerseyville Road Underpass

2.5.1 Site description - Hwy. 403 profile grade will be approximately 716'  $\pm$ . The Jerseyville Rd. profile grade will be approximately 737'  $\pm$ . The existing ground elevation is 717'  $\pm$  within a relatively flat area. This site may require fills of approximately 20'  $\pm$ .

2.5.2 Subsoil conditions - Ground elev. 716.8', borehole location -  $\mu$  Hwy. 403, 50' west of  $\mu$  Jerseyville Rd. - Zone 0' - 15' consists of very loose to dense silt, trace of clay with a trace of organics (0.24%) within the top 11'  $\pm$ . Zone 15' - 38' consists of very stiff silty clay with layers of clayey silt to silt. The predominant layer from 38' - 118' consists of firm to stiff clayey silt to silt with layers of silty clay to clay. The layer from 118' - 121.5' consists of hard clayey silt, trace of medium sand and coarse gravel (glacial till). Investigations were ended at this depth at elev. 595.3'. Groundwater was found at approximate elevation 707'.

2.5.3 Approaches - The approaches will consist of fills of 20 feet  $\pm$  max. height. These are estimated to undergo long term settlements of approximately 3 to 4 inches. No slope stability problems are anticipated.

### Piers and Abutments

A) Spread Footings - Spread footings may be founded at approximate elev. 711'  $\pm$  with a safe bearing capacity of 2 t.s.f. With this scheme an estimated long term settlement of 4 to 5 inches may occur at the abutments and 1 to 2 inches at the pier.

In addition, the abutment footings may also be founded within the compacted granular 'A' fill within the approaches. This scheme should provide a safe bearing capacity of 2.5 t.s.f. See perched abutment detail Fig. 1.

- B) End Bearing Piles - 12 HP @ 74 piles driven to bedrock (approx. elev. 590'  $\pm$ ) are recommended. These should provide a safe capacity of 95 tons per pile.

Excavations - No major unwatering problems are envisaged since groundwater is located at a relatively low elevation of 707'. Since the groundwater may vary due to seasonal fluctuations, a dewatering scheme may be required.

## 2.6 Site #6 - Big Creek Crossing at Sta. 592 $\pm$

- 2.6.1 Site Description - Hwy. 403 profile grade will be 732'  $\pm$ . Existing stream bed elevation is 685'  $\pm$  with the banks at approximately 687'  $\pm$ . Site located within a river valley in an area of gently rolling terrain. This site may require fills of approximately 45'  $\pm$ .

- 2.6.2 Subsoil conditions - Ground elev. 687.2, borehole location -  $\phi$  Hwy. 403, 25' east of  $\phi$  Big Creek - The predominating subsoil from 0' - 97', consists of firm to very stiff layers of silty clay to clayey silt with various layers of clay and seams of silt. The layer from 97' - 101.1' consists of dense silt, some medium to coarse sand, trace of gravel and clay (glacial till). Bedrock was found at 101.1' (elev. 586.1') which consists of moderately fractured, hard, light grey to white dolomite. Groundwater was found at approximate elevation 686'.

- 2.6.3 Approaches - No slope stability problems are anticipated. It is estimated that the approach fills may undergo long term settlements of approximately 18". Thus it is recommended to place the fills approximately 6 months prior to bridge construction.

### Piers and Abutments

12 HP @ 74 piles driven through the fill material to bedrock are recommended. These should provide a safe capacity of 95 tons per pile.

Excavations - No major unwatering problems are envisaged due to the relatively impermeable nature of the subsoil.

## 2.7 Site #7 - Lynden Road Underpass

2.7.1 Site description - Hwy. 403 profile grade will be 714' ± with a Lynden Rd. profile grade of approximately 734' ±. The site is located in a depression within a gently rolling terrain. The proposed scheme would require fills of approximately 23' ±.

2.7.2 Subsoil conditions- Ground elev. 708.8', borehole location - 40' north of Hwy. 403, Lynden Rd. - Zone 0' - 12' consists of firm to stiff silty clay with seams of silt. Within the top 7', test results indicated a trace of organics (0.56%) and very fine sand. Zone 12' - 33' consists of firm clayey silt with layers of silty clay. Zone 33' - 50.5' consists of loose silt with seams of clayey silt. Zone 50.5' - 101.5' consists of firm clayey silt with layers of silty clay to clay. Although sampling was discontinued at this depth, a dynamic cone further penetrated the subsoil. However, bedrock was not located. Groundwater was found at approximate elevation 700'.

2.7.3 Approaches - The approaches will consist of fills of 23 feet ± max. height which are estimated to undergo long term settlements of approximately 3 to 4 inches. No slope stability problems are anticipated.

### Piers and Abutments

A) Spread Footings - Spread footings for the abutments may be placed within the compacted granular 'A' fill. See Fig. 1. This scheme should provide a safe bearing capacity of 2 t.s.f. Total long term settlements of 5 to 6 inches may be anticipated.

B) End Bearing Piles - It is anticipated that 12 HP @ 74 piles may be driven to bedrock (Approx. elev. 580' - 590'). These should provide a safe capacity of 95 tons per pile.

## 2.8 Site #8 - Sunny Ridge Road Underpass

2.8.1 Site description - Hwy. 403 profile grade will be 713' ± with a Sunny Ridge Rd. grade elevation of 736' ±. The existing ground elevation is 733' ±. The site is located within a relatively flat area. This requires fills of approximately 3' ± and cuts of approximately 20' ±.

2.8.2 Subsoil conditions- Ground elev. 732.5', borehole location - 30' north of

Hwy. 403, 25' east of Sunny Ridge Rd. - Zone 0' - 4.5' consists of loose fine sand some silt, trace of organics. Zone 4.5' - 53.5' consists of stiff clayey silt to silt with intermittent layers of silt and clay. In addition, within this layer, from 4.5' to 7', exists a trace of organics (1.41%). Zone 53.5' - 85' consists of loose to compact silt with intermittent layers of clayey silt and clay. Zone 85' - 91.5' consists of firm to stiff clayey silt with layers of clay. Sampling was discontinued at this depth after which a dynamic cone was driven to refusal at a depth of 139.0' (elev. 593.5).

By the nature of complete refusal, it is anticipated that this is the probable location of bedrock. Groundwater was found at approximate elev. 730'.

- 2.8.3 Approaches - The approach to the site will be almost entirely in a cut section. Due to the high groundwater condition and the relatively high permeability of the intermittent silt layers, it is recommended that a permanent dewatering scheme on the cut slopes be required for stability purposes. This may consist of permanent toe drains.

No settlement at the approaches are anticipated.

#### Piers and Abutments

12 HP @ 74 piles driven to bedrock are recommended for support of the footings. These should provide a safe capacity of 95 tons per pile.

Excavations - As previously mentioned, due to the relatively high groundwater condition and the highly permeable silt layers, a dewatering scheme should be utilized during construction.

### 2.9 Site #11 - Big Creek Crossing at Sta. 775 ±

- 2.9.1 Site description - Hwy. 403 profile grade is proposed to be 722' ±. Existing stream bed elevation is approximately 684' ± with the banks at an approximate elevation of 685' ±. This may result in fills 37' in height.

- 2.9.2 Subsoil conditions - Ground elev. 684.8', borehole location ¼ Hwy. 403, 25' west of ¼ Big Creek - The predominating layer from 0' - 71.5' consists of firm to stiff layers of clayey silt and silt with intermittent layers of silty clay. Zone 71.5' - 81.5' consists of very dense silt with fine to coarse sand and some gravel (glacial till).



Probable bedrock was found at 81.5' (elev. 603.3'). However, a sample core was unobtainable. Groundwater was found at approximate elevation 682'.

- 2.9.3 Approaches - The approach fills at this site may be approximately 37' in height. No slope stability problems are anticipated.

In this situation estimated long term settlements of approximately 6 to 8 inches may be anticipated.

#### Piers and Abutments

12 HP @ 74 piles driven to bedrock (elev. 603.3) are recommended. These should provide a safe capacity of 95 tons per pile.

Excavations - No major unwatering problems are anticipated at this time due to the relatively impereable nature of the subsoil.

### 2.10 Site#12 - Alberton Road Underpass

- 2.10.1 Site description - Hwy. 403 profile grade will be 731'  $\pm$  with an Alberton Rd. profile grade of 752'  $\pm$ . The existing ground elevation is approximately 721'  $\pm$  within a relatively flat terrain.

This would require fills of approximately 31'  $\pm$  and 10'  $\pm$  for Alberton Rd. and Hwy. 403 respectively.

- 2.10.2 Subsoil conditions - Ground elev. 721.0', borehole location - 20' north of  $\neq$  Hwy. 403, 30' east of  $\neq$  Alberton Rd. - Zone 0' - 17' consists of stiff to very stiff clayey silt with intermittent varves of silt and silty clay. Within the top 13' of this layer, test results also indicated a trace of organics (0.56%). Zone 17' - 41' consists of loose to compact silt with seams of clayey silt. Zone 41' - 92.0' consists of layers of loose silt and firm to stiff clayey silt.

Bedrock was found at 92.0' (elev. 629.0') which consists of moderately fractured, hard, light grey to white dolomite. Groundwater was found at approximate elevation 710'.

- 2.10.3 Approaches - The approaches will consist of fills of 31'  $\pm$  max. height.

No stability problems are anticipated at this site.

The approach fills are estimated to undergo an immediate settlement of approximately 3 to 4 inches. In addition, estimated long term settlements of 1" to 1½" may be anticipated.

#### Piers and Abutments

12 HP @ 74 piles may be driven to bedrock through the compacted fill material. These should provide a safe capacity of 95 tons per pile.

Excavations - No major unwatering problems are anticipated.

### 2.11 Site #13 - Highway #52 Underpass

- 2.11.1 Site description - Hwy. 403 profile grade will be 758'  $\pm$  with a highway #52 profile grade of 735'  $\pm$ . The existing ground elevation is approximately 756' on Hwy. #52 and approximately 731' on original ground within a valley with stable 2:1 side slopes.

This would require fills of approximately 27'  $\pm$  (as existing).

- 2.11.2 Subsoil conditions - Ground elev. 756.6' - Hwy. #52, borehole location -  $\phi$  Hwy. 403, 17' east of  $\phi$  Hwy. 52 - Zone 0' - 24' consists of loose to dense silt with fine sand, trace of fine gravel. This is the extent of the fill material for Hwy. 52. Zone 24' - 35.5' consists of compact silt, some fine sand, trace of clay. Zone 35.5' - 38.5' consists of very stiff varves of silt and clayey silt. Zone 38.5' - 91' consists of loose to very dense silt, trace of clay and fine sand. Zone 91' - 122.5' consists of stiff clayey silt with layers of silty clay. Sampler encountered refusal at 122.5' (elev. 634.1'). Sampler probably struck boulder rather than bedrock.

An exact determination of groundwater location was not possible due to the borehole being located in the N.B.L. of Hwy. 52 and timing was thus critical. However, we estimate that the water table is located at an approximate elev. of 730'  $\pm$ .

- 2.11.3 Approaches - The approaches will consist of fills 27' max. height which are existing. Based on the assumption that the existing Hwy. 52 alignment will remain unchanged, no significant settlement is anticipated. In addition, no slope stability problems are anticipated.

#### Piers and Abutments

12 HP @ 74 piles may be driven to bedrock (approx. elev. 625'  $\pm$ ). These should provide a safe capacity of 95 tons per pile.

Excavations - A dewatering scheme may be required during construction if pile caps are to be constructed within the original soil.

#### 2.12. Site #14 - Shaver Road Overpass

- 2.12.1 Site description - Hwy. 403 profile grade will be 788'  $\pm$  with a Shaver Rd. profile grade of 765'  $\pm$ . Existing ground elevation is approximately 758'  $\pm$  in a small valley within a moderately rolling terrain. This would require max. fills of approximately 30'  $\pm$ .

- 2.12.2 Subsoil conditions - Ground elev. 757.6', borehole location -  $\neq$  Hwy. 403, 40' east of  $\neq$  Shavers Rd. - Zone 0' - 17' consists of loose to compact silt, trace to some fine sand. The top 4.5'  $\pm$  contains a trace of organics (1.98%). Zone 17' - 21' consists of firm clayey silt, seams of silt. Zone 21' - 35.5' consists of loose to compact silt, trace of very fine sand. Zone 35.5' - 39' consists of compact silt to very fine sandy silt. Zone 60.5' - 81.5' consists of compact silt, trace of very fine sand with intermittent varves of clayey silt.

Location of bedrock was not determined at this site due to adverse working conditions. Groundwater was found at approximate elevation 757'.

- 2.12.3 Approaches - The approaches will consist of fills 30'  $\pm$  max. height. These are expected to undergo an instantaneous settlement of 3" to 4". No slope stability problems or long term settlements anticipated.

The top organic stratum should be removed and replaced with granular material

before the approach fills are placed.

### Piers and Abutments

- A) Spread Footings - Spread footings may be found within the compacted granular 'A' fills for support of the abutments. (See Fig. 1) This is expected to provide a safe bearing capacity of 2.5 t.s.f.

The abutments are estimated to undergo an immediate settlement of approximately 1 to 2 inches after application of the loads.

- B) Friction Piles - No. 14 timber piles embedded approximately 50' in the original soil providing a safe bearing capacity of 25 tons per pile may be used for support of the piers and abutments. Total long term settlements of approximately 1" are estimated to occur.

- C) End Bearing Piles - 12 HP @ 74 piles driven to bedrock with estimated tip elevations of 630'  $\pm$ . This scheme should provide a safe capacity of 95 tons per pile.

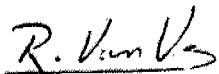
Excavations - No major unwatering problems are anticipated. However, excess surface water may present considerable problems. The area may be required to be drained before construction.

### 3. GENERAL

All settlement predictions are approximate only since footing dimensions and exact locations have yet to be established.

All slope stability predictions are based upon assumed forward and side slopes of 2 horizontal to 1 vertical.

The top of all footings and pile caps should be located at least 4' below finished grade for the purpose of frost protection.



R. Van Veen  
Project Engineer

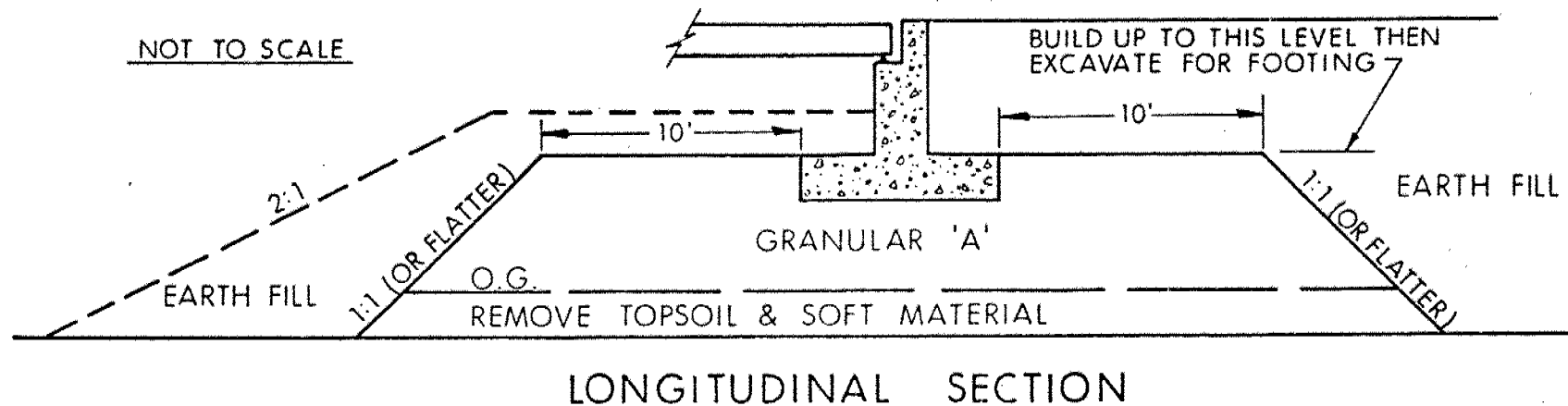
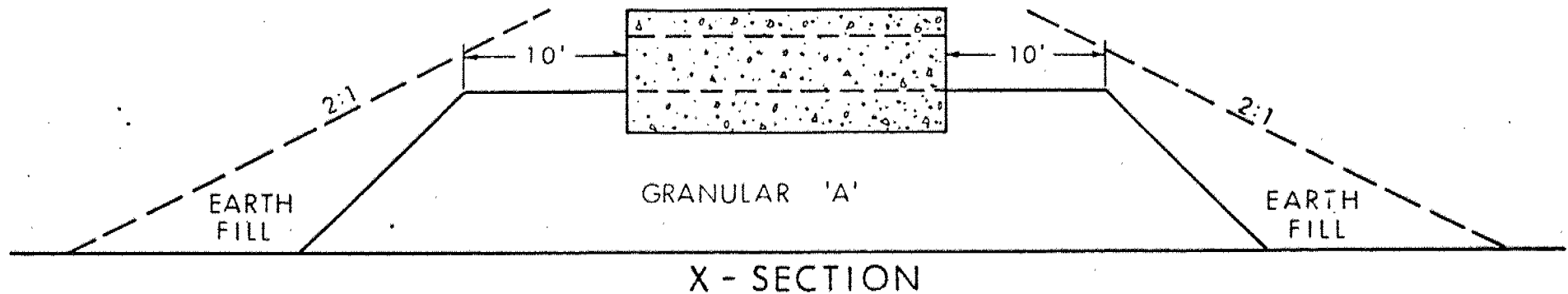


K.G. Selby, P. Eng.  
Supervising Engineer

RV:bp  
June, 1976

## APPENDIX

# ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



## NOTES

- 1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A'.
- 2 - PLACE GRANULAR 'A' TO TOP OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M.T.C. STANDARDS.
- 3 - EXCAVATE COMPACTED GRANULAR 'A' MATERIAL FOR FOOTING.

FIG. 1

## ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

### PENETRATION RESISTANCE

'N' STANDARD PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140. POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

### DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

<u>CONSISTENCY</u>	<u>c LB/SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 250	VERY LOOSE	0 - 4
SOFT	250 - 500	LOOSE	4 - 10
FIRM	500 - 1000	COMPACT	10 - 30
STIFF	1000 - 2000	DENSE	30 - 50
VERY STIFF	2000 - 4000	VERY DENSE	> 50
HARD	> 4000		

TERMS TO BE USED IN DESCRIBING SOILS:-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC.

### TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.T.	SLOTTED TUBE SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

### SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
CIU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		



## ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

### SOIL PROPERTIES

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
$S_r$	DEGREE OF SATURATION
$w_L$	LIQUID LIMIT
$w_p$	PLASTIC LIMIT
$I_p$	PLASTICITY INDEX
$w_s$	SHRINKAGE LIMIT
$I_L$	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
$I_c$	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
$e_{max}$	VOID RATIO IN LOOSEST STATE
$e_{min}$	VOID RATIO IN DENSEST STATE
$I_D$	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY $D_r$ IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
$m_v$	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma}$
$c_v$	COEFFICIENT OF CONSOLIDATION
$C_c$	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$
$T_v$	TIME FACTOR = $\frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
$\tau_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION INTERCEPT
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_t$	SENSITIVITY

### GENERAL

$\pi$	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

### STRESS AND STRAIN

u	PORE PRESSURE
$\sigma$	NORMAL STRESS
$\bar{\sigma}$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

### EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
$K_0$	COEFFICIENT OF EARTH PRESSURE AT REST

### FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
$k_s$	MODULUS OF SUBGRADE REACTION

### SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
$\beta$	ANGLE OF SLOPE TO HORIZONTAL

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE No 1

WP 66-67-01 LOCATION Co-ords. 15,685,290 N: 809,685 E. ORIGINATED BY MK  
 DIST 4 HWY 403 BORING DATE March 11 - 15, 1976 COMPILED BY MK  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY N. J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — W <sub>L</sub> PLASTIC LIMIT — W <sub>P</sub> WATER CONTENT — W			UNIT WEIGHT γ P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N VALUES		25	50	75	100	125	W <sub>P</sub>	W	W <sub>L</sub>		
708.0	Ground Level															
0.0	Clayey silt, seams of silt, layers of silty clay and silt		1	SS	13											0 0 54 46
			2	SS	16											
			3	TW	PH											
			4	SS	11											0 0 70 30
			5	SS	8											0 0 84 16
			6	TW	PH											
			7	SS	8											
			8	SS	11											
			9	TW	PH											
			10	SS	30											0 14 66 20
	Firm to Stiff		11	SS	9											
			12	SS	11											
			13	TW	PH											0 0 67 33
			14	SS	8											
627.0	Layers of very fine sandy silt		15	TW	PH											
81.0																
624.0																
84.0			16	SS	13											
607.6	Bedrock - moderately fractured dolomite		17	RC	Rec											
100.5				BXL	98%											
604.0																

20  
15 5 % STRAIN AT FAILURE  
10

(CONTINUED)

## ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE -- SOIL MECHANICS SECTION

WP 66-67-01 LOCATION Co-ords. 15,685,290 N; 809,685 E. ORIGINATED BY MK  
DIST 4 HWY 403 BORING DATE March 11 - 15, 1976 COMPILED BY MK  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY N.S.

SOIL PROFILE		SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT	LIQUID LIMIT ——— $w_L$	UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		'N' VALUES	20 40 60 80 100		
604.0	continued /					SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 1000 2000	$w_p \quad w \quad w_L$ WATER CONTENT % 10 20 30	% GR SA SI CL	
104.0	Moderately fractured dolomite Bedrock		18	RC EXL	Rec 98%	600			
597.6									
110.5	End of Borehole					590			

15  $\frac{20}{\phi}$  5 % STRAIN AT FAILURE  
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE No 2

WP 66-67-01 LOCATION Co-ords. 15,685,480 N; 815,860 E. ORIGINATED BY BVV  
 DIST 4 HWY 403 BORING DATE March 5-11, 1976 COMPILED BY BVV  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.T.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
692.6	Ground Level															
0.0	Trace of Organics		1	SS	19	690										0 6 62 32 0.42% Org.
			2	SS	14											
			3	SS	11											
			4	SS	17											
			5	SS	8	680										0 0 88 12 0 0 74 26
	Clayey silt, seams of		6	TW	PH										121	0 2 84 14
	silt, layers of silty		7	SS	8											0 0 66 34
	clay.		8	TW	PH	670										
			9	TW	PH											
			10	SS	8	660										
			11	TW	PH	650									120	
	Firm to Very Stiff		12	SS	16											
			13	TW	PH	640									117.5	
			14	TW	PH	630										
623.6																
69.0	Clayey silt, layers of silt, trace of gravel.		15	TW	PH	620									146	
	Very Stiff															
	(Glacial Till)		16	SS	25	610										2 0 66 32
607.1																
85.5	Bedrock moderately fractured dolomite		18	RC BXL	Rec 100%											
601.9																
90.7	End of Borehole					600										

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE No 3

WP 66-67-01 LOCATION Co-ords. 15,685,480 N; 817,110 E. ORIGINATED BY BVV  
DIST 4 HWY 403 BORING DATE March 18, 1976 COMPILED BY BVV  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$W_P$	$W$	$W_L$		
643.8	Ground Level															GR SA SI CL
0.0	Silt, some very fine sand, trace of clay and organics (wood chips)		1	SS	3	640									Org. 1.83%	0 9 79 12
	Very Loose		2	SS	2											
			3	SS	3											
630.8			4	SS	4										Org. 1.38%	0 18 67 15
13.0	Clayey Silt		5	SS	4	630										1 2 73 24
	Seams of Silt		6	SS	3											
			7	TW	PH											
	Firm to Stiff		8	TW	PH	620									122	
			9	SS	10											
599.3			10	TW	PH	610									122	
			11	SS	5											
			12	SS	4											
44.5	Clayey silt, some sand & grav. (Glac. Till) Firm		13	SS	5	600										24 12 36 28
596.3																
47.5	Bedrock-moderately fractured dolomite		14	RC EXL	Rec 87%											
591.3																
52.5	End of Borehole					590										

## RECORD OF SITE No 4

SITE No 4  
249 256.3 E (METRIC)

LOCATION

Co-ords. 15,685,520 N; 817,770 E.

ORIGINATED BY BVV

DIST 4 HWY 403

BORING DATE March 16 &amp; 17, 1976

COMPILED BY BVV

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY N.S.

15  $\overset{20}{\underset{10}{\circ}}$  5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE No 5

WP 66-67-01 LOCATION Co-ords. 15,686,595 N; 821,170 E. ORIGINATED BY MK  
DIST 4 HWY 403 BORING DATE March 15, 16, 1976 COMPILED BY MK  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY *N.L.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$ P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	W VALUES		25	50	75	100	125	$W_P$	$W$	$W_L$		
716.8	Ground Level															
0.0	Silt, trace of clay		1	SS	4	710										
	Very Loose to Dense		2	SS	32											
701.3	trace of organics		3	SS	10											
15.5	Silty clay, layers of clayey silt to silt.		4	TW	PH	700										
	Very Stiff		5	SS	16	690										
			6	TW	PH											
678.8			7	SS	8	680										
38.0	Clayey silt to silt, layers of silty clay to clay.		8	TW	PH											
	Firm to Stiff		9	SS	10	670										
			10	TW	PH											
			11	SS	7	660										
			12	TW	PH	650										
			13	SS	14	640										
			14	TW	PH	630										
			15	SS	12	620										
612.8																
104.0																

20  
15 5 % STRAIN AT FAILURE  
10

(CONTINUED)

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

## RECORD OF SITE NO 5 (CONT'D)

WP 66-67-01 LOCATION Co-ords. 15,686,595 N; 821,170 E. ORIGINATED BY MK  
DIST 4 HWY 403 BORING DATE March 15, 16, 1976 COMPILED BY MK  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.S.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$ P.C.F.	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
612.8	continued															
104.0	Clayey silt to silt, layers of silty clay to clay.  Firm to Stiff		16	TW	PH	610									123 126	
598.8						600										
118.0	Clayey silt, trace of medium sand & coarse															
595.3	grav. (Gl. fill) Hard		17	SS	38											20 21 44 15
121.5	End of Borehole					590										



MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE No 6

WP 66-67-01

LOCATION

Co-ords. 4,781,835.3 251,970.5

ORIGINATED BY MK

DIST 4 HWY 403

BORING DATE

March 18-22, 1976

COMPILED BY MK

DATUM Geodetic

BOREHOLE TYPE

Hollow Stem Auger

CHECKED BY M. J.

Q Hwy 403  
25' EAST of Q B6600

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$ P.C.F	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
687.2	Ground Level															
0.0																
	Trace of organics		1	SS	5	680										Org. 0.40%
			2	SS	14											0 0 67 33
			3	TW	PH	670										
	Layered silty clay		4	SS	6											
	and clayey silt		5	TW	PH	660										
	various layers of clay		6	SS	5											
	seams of silt.		7	TW	PH	650										125
			8	SS	7											
			9	TW	PH	640										
	Firm to Very Stiff		10	SS	4	6"										
			11	TW	PH	630										123
			12	SS	22	620										
			13	SS	8	610										
			14	TW	PH	600										
			15	SS	13	590										12 33 39 16
590.2																
97.0	Silt, some medium to coarse sand, trace of grav. & clay (Gl. Till)		16	TW	PH											
586.1																
101.1	Bedrock-moderately fractured		17	RC BXL	Rec 100%											

20  
15 5 % STRAIN AT FAILURE  
10

(CONTINUED)

## RECORD OF SITE No 6 (CONT'D)

SOIL PROFILE		SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT		LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$		UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		'N' VALUES	20 40 60 80 100	SHEAR STRENGTH	$w_p$ — $w$ — $w_L$		
583.2	continued										
581.1	Dolomite bedrock		17	BXL	100%						
106.1	End of Borehole					580					

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE NO 7

WP 65-67-01 LOCATION Co-ords. 15,690,370 N; 831,990 E. ORIGINATED BY BVV  
 DIST 4 HWY 403 BORING DATE March 19-23, 1976 COMPILED BY BVV  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY H. D.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W			UNIT WEIGHT Y	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	Wp	W	WL		
708.8	Ground Level															
0.0	Silty clay, trace of seams of organics & very fine silt. sand		1	SS	11										Org. 0.56%	0 14 62 24
	Firm to Stiff		2	SS	9											0 0 55 45
696.8			3	SS	5											
12.0	Clayey silt, layers of silty clay.		4	SS	5											
	Firm		5	TW	PH											
			6	TW	PH											
			7	SS	8											
			8	TW	PH											
675.8			9	TW	PH											
33.0	Silt seams of clayey silt		10	SS	7											
	Loose		11	SS	5											0 0 78 22
			12	TW	PH											
658.3			13	SS	7											0 0 81 19
50.5	Clayey silt, layers of silty clay to clay.		14	TW	PH											
	Firm		15	TW	PH											125
			16	SS	10											
			17	TW	PH											
			18	TW	PH											117.5
607.3			19	TW	PH											
101.5	End of Borehole															

20  
15 5 % STRAIN AT FAILURE  
10

(CONTINUED)

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE NO 7 (CONT'D)

WP 65-67-01 LOCATION Co-ords. 15,690,370 N: 831,990 E. ORIGINATED BY BVV  
DIST 4 HWY 403 BORING DATE March 19 - 23, 1976 COMPILED BY BVV  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.T.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	WATER CONTENT % $w_p$ — $w$ — $w_L$				
	continued															
						600										
589.8						590										
119.0	End of Cone Test															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

## RECORD OF SITE NO 8

WP 65-67-01 LOCATION Co-ords. 15,693,465 N; 838,805 E. ORIGINATED BY BVV  
DIST 4 HWY 403 BORING DATE February 27, March 1 - 4, 1976 COMPILED BY BVV  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$ $W_P - W - W_L$	UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		25	50	75	100	125			
732.5	Ground Level													
0.0	Fine sand, some silt, trace of organics.		1	SS	8	730								Org. Trace
728.0	Loose		2	SS	14									Org. 1.41%
4.5	Trace of organics		3	SS	14									
	Clayey silt to silt,		4	TW	PH									
	Intermittent layers		5	SS	9									
	of silt and clay.		6	TW	PH									
			7	SS	11									
			8	TW	PH									
	Stiff		9	TW	PH									
			10	SS	8									
			11	SS	9									0 0 94 6
			12	SS	9									0 0 65 35
			13	SS	9									
679.0			14	TW	PH									
53.5	Silt		15	SS	8									
	intermittent layers		16	SS	13									
	of clayey silt and		17	SS	9									
	clay.													
	Loose to Compact													
647.5														
85.0	Clayey silt, layers													
641.0	of clay.													
	Firm to Stiff		18	TW	PH									
91.5	End of Borehole													

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

(CONTINUED)

RECORD OF SITE N<sup>o</sup> 8 (CONT'D)

WP 65-67-01 LOCATION Co-ords. 15,693,465 N; 838,805 E. ORIGINATED BY BVV  
 DIST 4 HWY 403 BORING DATE February 27, March 1 - 4, 1976 COMPILED BY BVV  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	WATER CONTENT % $W_P$ — $W$ — $W_L$				
							SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE 1000 2000									
						620										
						610										
						600										
593.5																
139.0	Probable Bedrock					590	150/12"									

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE No 11

WP 65-67-01 LOCATION Co-ords. 15,694,520 N; 844,115 E ORIGINATED BY MK  
DIST 4 HWY 403 BORING DATE March 23 & 24, 1976 COMPILED BY MK  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.S.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
684.8	Ground Level															
0.0	Layered clayey silt and silt, intermittent layers of silty clay.  Firm to Stiff		1	SS	5	680										0 0 92 8
			2	SS	7			+ 4.6								0 0 79 21
			3	TW	PH	670				+ 4.4						
			4	SS	6					V +						
			5	TW	PH	660				+ 5.0						
			6	SS	7					V +						
			7	TW	PH	650				V +						
			8	SS	8											
			9	SS	10	640										
			10	TW	PH											
			11	SS	9	630										
613.3			12	TW	PH	620										
71.5	Silt with fine to coarse sand, some gravel (Glacial Till) Very Dense		13	SS	64/6"	610										8 25 61 6
603.3	Probable Bedrock															
81.5	End of Borehole					600										

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

## RECORD OF SITE NO 12

WP 65-67-01 LOCATION Co-ords. 15,694,430 N; 846,980 E. ORIGINATED BY BVV  
DIST 4 HWY 403 BORING DATE March 24 - 25, 1976 COMPILED BY BVV  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY MS

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$ $w_p$ — $w$ — $w_L$ WATER CONTENT % 10 20 30	UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125			
721.0	Ground Level													
0.0	Clayey silt, varves of silt and silty clay  trace of organics		1	SS	23	720							Org. 0.42%	
			2	SS	12								Org. 0.56%	
			3	SS	14									
			4	SS	16	710								
704.0	Stiff to Very Stiff		5	SS	17									0 0 92 8
17.0	Silt  seams of clayey silt  Loose to Compact		6	SS	7									
			7	TW	PH	700								
			8	TW	PH									
			9	SS	7	690								
			10	SS	7									0 0 93 7
680.0			11	SS	9	680								
41.0			12	TW	PH									
	Layered Silt (Loose)		13	SS	8	670								
			14	SS	9									
			15	SS	10	660								
	Clayey Silt (Firm to Stiff)		16	SS	9	650								
			17	SS	10	640								
629.0			18	SS	8	630								0 1 80 19
92.0	Bedrock moderately fractured dolomite		19	RC BXL	Rec 100%									
623.7														
97.3	End of Borehole					620								



MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF SITE No 13

WP 65-67-01 LOCATION Co-ords. 15,697,230 N; 854,695 E. ORIGINATED BY MK  
 DIST 4 HWY 403 BORING DATE March 25 & 26, 1976 COMPILED BY MK  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY 7/7

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS  % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$W_P$	$W$	$W_L$		
756.6	Ground Level															
0.0	Silt with fine sand, trace of fine gravel  (Fill Material)  Loose to Dense		1	SS	8	750										0 20 74 6
			2	SS	39											
			3	SS	17	740										
			4	SS	33											6 47 41 6
732.6																
24.0	Silt, some fine sand, trace of clay.  Compact		5	SS	9	730										0 17 76 7
			6	SS	17											0 18 76 6
721.1																
35.5	Varved silt & clayey		7	SS	19	720										0 1 69 30
718.1	silt. Very Stiff															0 0 92 8
38.5			8	SS	39											0 0 99 1
			9	SS	54	710										0 0 98 2
			10	SS	83											0 7 87 6
	Silt, trace of clay  and fine sand.					700										
			11	SS	20											
						690										
	Loose to Very Dense		12	SS	24											0 0 95 5
						680										
			13	SS	6	670										
665.6																
91.0	Clayey silt, layers of silty clay.  Stiff		14	SS	9	660										
652.6			15	SS	11											
104.0																

20  
15 5 % STRAIN AT FAILURE  
10

(CONTINUED)

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

## RECORD OF SITE No 13 (CONT'D)

WP 65-67-01 LOCATION Co-ords. 15,697,230 N; 854,695 E. ORIGINATED BY MK  
DIST 4 HWY 403 BORING DATE March 25 & 26, 1976 COMPILED BY MK  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY NT

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$W_P$	$W$	$W_L$		
652.6	continued															
104.0	Clayey silt, layers of silty clay.  Stiff		16	TW	PH	650										
634.1	Refusal (Boulder)		17	SS	9/12"	640										
122.5	End of Borehole					630										

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

## RECORD OF SITE No 14

WP 65-67-01 LOCATION Co-ords. 15,699,765 N; 862,520 E. ORIGINATED BY BBV  
DIST 4 HWY 403 BORING DATE February 25 & 26, 1976 COMPILED BY BBV  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY RT

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
757.6	Ground Level															
0.0	Silt, trace of some fine sand.	trace of organics	1	SS	6										Org. 1.98%	0 27 70 3
			2	SS	8											0 21 77 2
			3	SS	12											
	Loose to Compact		4	SS	8											
			5	SS	10											
740.6			6	SS	6											0 1 92 7
17.0	Clayey silt, seams of silt. Firm		7	SS	6										129.5	
736.6			8	TW	PH											
21.0	Silt, trace of very fine sand.		9	TW	PH										122	0 3 96 1
	Loose to Compact		10	SS	18											0 0 98 2
722.1			11	SS	10											
35.5	Clayey silt, layers of silt. Firm		12	TW	PH											0 28 71 1
718.6			13	TW	PH											0 15 81 4
39.0	Silt to very fine sandy silt.		14	SS	25											
	Compact		15	SS	13											0 0 98 2
697.1			16	SS	18											0 0 55 45
60.5	Silt, trace of very fine sand, intermittent varves of clayey silt.		17	SS	12											0 4 94 2
	Compact		18	SS	9											0 0 99 1
676.1																
81.5	End of Borehole															



FOUNDATION INVESTIGATION & DESIGN REPORT

W.P. 65-67-01/66-67-01

DIST. 4

HWY. 403

STR. SITE

From Hwy. 2, Ancaster  
Westerly to Brantford Diversion

W P 65-67-01 & 66-67-01

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40P1-82

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JUN 29 1976

GEO. NO. 40P1-82

W.P. 65-67-01  
From Hwy. 2, Ancaster W'ly to  
0.8 km. West of Sunny Ridge Road  
Hwy. 403, District 4, Hamilton

W.P. 66-67-01  
From 0.8 km. West of Sunny Ridge Rd.  
Westerly to Brantford Diversion  
Hwy. 403, District 4, Hamilton

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## 1. INTRODUCTION

The Soil Mechanics Section was requested to carry out a Foundation Investigation to determine the feasibility of structures along the proposed route of Hwy. 403 between Ancaster and Brantford.

Following this request a field investigation was carried out by this office to determine the subsoil and groundwater conditions which are of significance to the planning and design of the proposed route.

This report contains the results obtained from our investigations together with our recommendations pertaining to the foundations, cuts, and fills proposed.

Each site was considered individually and presented in order from west to east. Two sites, however, were not investigated since permission to enter the properties involved could not be granted.

## 2. SITE DESCRIPTION, SUBSOIL CONDITIONS, AND RECOMMENDATIONS

### 2.1 Site #1 - Garden Avenue Underpass

- 2.1.1 Site description - Proposed is an underpass to accommodate Garden Ave. Profile grade of Hwy. 403 is proposed to be approximately 702'  $\pm$  with a Garden Avenue elevation of 724'  $\pm$ . Existing ground is relatively flat with some rolling hills within the adjacent area. Ground elevation is 708'  $\pm$  therefore cuts of approximately 6' and fills of approximately 16' will be

required.

- 2.1.2 Subsoil conditions - Ground elev. 708.1', borehole location -  $\phi$  Hwy. 403, 35' east of  $\phi$  Garden Ave. - The entire subsoil stratigraphy consists of firm to stiff clayey silt with seams of silt and layers of varying thickness of silty clay and silt. In addition between 81' and 84' exists layers of very fine sandy silt.

Bedrock was found at 100.5' (elev. 607.6') which consists of moderately fractured, hard, light grey to white dolomite. Groundwater was found at approximate elevation 694'.

- 2.1.3 Approaches - Approaches will consists of fills of 16 feet  $\pm$  maximum height which may undergo estimated long term settlements of 3"-4". No slope stability problems are anticipated.

#### Piers and Abutments

- A) Spread Footings - May be founded at approximate elevation 698'  $\pm$  with a safe bearing capacity of 2 t.s.f. With this scheme an estimated long term settlement of 5 to 6 inches may occur at the abutments and 1 to 2 inches at the pier.

In addition, the abutment footings may be founded within the compacted Granular 'A' fills. This scheme should provide a safe bearing capacity of 2.5 t.s.f. See perched abutment detail Fig. 1.

- B) End Bearing Piles - 12 HP @ 74 piles driven to bedrock may be utilized. These should provide a safe capacity of 95 tons per pile.

Excavations - Due to the relatively impermeable nature of the subsoil in which excavations may be made for footings or pile caps, no major unwatering problems are anticipated.

## 2.2 Site#2 - Johnson Rd. Underpass

- 2.2.1 Site description - Hwy. 403 profile grade will be 684'  $\pm$ . Johnson Road elev. will be 707'  $\pm$ . Existing ground elev. is 693'  $\pm$ . Existing ground is

relatively flat with some rolling hills within the adjacent area. Cuts of approximately 9'  $\pm$  and fills of approximately 14'  $\pm$  will be required.

- 2.2.2 Subsoil conditions - Ground elev. 692.6', borehole location - 30' north of  $\neq$  Hwy. 403, 20' east of  $\neq$  Johnson Rd. The subsoil from 0 - 69' consists of firm to very stiff clayey silt with seams of silt and layers of silty clay. Within the top 4.5' exists a trace of organics (0.42%). Zone 69' - 85.5' consists of very stiff clayey silt with layers of silt and a trace of gravel (glacial till).

Bedrock was found at 85.5' (elev. 607.1') which consists of moderately fractured, hard, light grey to white dolomite. Groundwater was found at approximate elevation 680'.

- 2.2.3 Approaches - The proposed approaches will consist of fills of 14'  $\pm$  max. height. These are estimated to undergo long term settlements of approximately 3 to 4 inches. No slope stability problems are anticipated.

#### Piers and Abutments

For support of the piers and abutments 12 HP @ 74 piles driven to bedrock are recommended. These should provide a safe capacity of 95 tons per pile.

Excavations - No major unwatering problems are anticipated due to the relatively impermeable nature of the subsoil.

### 2.3 Site #3 - Fairchild Creek Crossing

- 2.3.1 Site description - Hwy. 403 profile grade will be 660'  $\pm$ . Existing stream bed elevation is 635'  $\pm$  with the banks at approximately 645'  $\pm$ . Site located within a river valley in an area of gently rolling terrain. This site requires fills of approximately 15'  $\pm$ .

- 2.3.2 Subsoil conditions - Ground elev. 643.8', borehole location  $\neq$  Hwy. 403, 30' east of  $\neq$  Fairchild Creek - Zone 0' - 13' consists of very loose silt with some very fine sand and a trace of clay and organics (1.83%) evidenced by wood chips. Zone 13' - 44.5' consists of firm to stiff clayey silt with seams of silt. Zone 44.5' - 47.5' consists of firm clayey silt, some sand



and gravel (glacial till). Bedrock was found at 47.5' (elev. 596.3') which consists of moderately fractured, hard, light grey to white dolomite. Groundwater was found at approximate elevation 641'.

- 2.3.3 Approaches - The proposed approaches will consist of maximum fills of 15'  $\pm$  which are estimated to undergo long term settlements of approximately 3 to 4 inches. No slope stability problems are anticipated.

#### Piers and Abutments

12 HP @ 74 piles driven to bedrock are recommended. These should provide a safe capacity of 95 tons per pile. Assuming that the pile caps will be founded within the compacted granular 'A' fill of the approaches, no de-watering scheme will be required.

#### 2.4 Site #4 - T.H. & B. Railway Subway

- 2.4.1 Site description - Hwy. 403 profile grade will be 648'  $\pm$ . The T.H.&B. Railway elevation at this site will be 671'  $\pm$ . Existing ground elevation is 666'  $\pm$  within a gently rolling terrain. Cuts of approximately 18'  $\pm$  and fills of approximately 5'  $\pm$  will be required..

- 2.4.2 Subsoil conditions- Ground elev. 666.2, borehole location -  $\neq$  Hwy. 403, 40' east of  $\neq$  T.H.& B. Railway. - Zone 0' - 7' consists of stiff clayey silt, trace of coarse sand and organics (0.46%). Zone 7' - 62.7' consists of firm to stiff clayey silt with seams of silt and layers of silty clay.

Bedrock was found at 62.7' (elev. 603.5') which consists of moderately fractured, hard, light grey dolomite. Groundwater was found at approximate elevation 664'.

- 2.4.3 Approaches - These will consist of fills of 5 feet  $\pm$  maximum height which are estimated to undergo long term settlements of approx. 1 to 2 inches. No slope stability problems are anticipated.

#### Piers and Abutments

12 HP @ 74 end bearing piles driven to bedrock are recommended. These should provide a safe capacity of 95 tons per pile.

Excavations - Due to the relatively impermeable nature of the subsoil at this site, no dewatering scheme should be required during construction.

Caution must be taken, however, to ensure that some method of track protection be utilized to ensure stability of the T.H. & B. Railway embankment.

## 2.5 Site #5 - Jerseyville Road Underpass

2.5.1 Site description - Hwy. 403 profile grade will be approximately 716'  $\pm$ . The Jerseyville Rd. profile grade will be approximately 737'  $\pm$ . The existing ground elevation is 717'  $\pm$  within a relatively flat area. This site may require fills of approximately 20'  $\pm$ .

2.5.2 Subsoil conditions - Ground elev. 716.8', borehole location -  $\frac{1}{2}$  Hwy. 403, 50' west of  $\frac{1}{2}$  Jerseyville Rd. - Zone 0' - 15' consists of very loose to dense silt, trace of clay with a trace of organics (0.24%) within the top 11'  $\pm$ . Zone 15' - 38' consists of very stiff silty clay with layers of clayey silt to silt. The predominant layer from 38' - 118' consists of firm to stiff clayey silt to silt with layers of silty clay to clay. The layer from 118' - 121.5' consists of hard clayey silt, trace of medium sand and coarse gravel (glacial till). Investigations were ended at this depth at elev. 595.3'. Groundwater was found at approximate elevation 707'.

2.5.3 Approaches - The approaches will consist of fills of 20 feet  $\pm$  max. height. These are estimated to undergo long term settlements of approximately 3 to 4 inches. No slope stability problems are anticipated.

### Piers and Abutments

A) Spread Footings - Spread footings may be founded at approximate elev. 711'  $\pm$  with a safe bearing capacity of 2 t.s.f. With this scheme an estimated long term settlement of 4 to 5 inches may occur at the abutments and 1 to 2 inches at the pier.

In addition, the abutment footings may also be founded within the compacted granular 'A' fill within the approaches. This scheme should provide a safe bearing capacity of 2.5 t.s.f. See perched abutment detail Fig. 1.

- B) End Bearing Piles - 12 HP @ 74 piles driven to bedrock (approx. elev. 590'  $\pm$ ) are recommended. These should provide a safe capacity of 95 tons per pile.

Excavations - No major unwatering problems are envisaged since groundwater is located at a relatively low elevation of 707'. Since the groundwater may vary due to seasonal fluctuations, a dewatering scheme may be required.

2.6 Site #6 - Big Creek Crossing at Sta. 592  $\pm$

2.6.1 Site Description - Hwy. 403 profile grade will be 732'  $\pm$ . Existing stream bed elevation is 685'  $\pm$  with the banks at approximately 687'  $\pm$ . Site located within a river valley in an area of gently rolling terrain. This site may require fills of approximately 45'  $\pm$ .

2.6.2 Subsoil conditions - Ground elev. 687.2, borehole location -  $\neq$  Hwy. 403, 25' east of  $\neq$  Big Creek - The predominating subsoil from 0' - 97', consists of firm to very stiff layers of silty clay to clayey silt with various layers of clay and seams of silt. The layer from 97' - 101.1' consists of dense silt, some medium to coarse sand, trace of gravel and clay (glacial till). Bedrock was found at 101.1' (elev. 586.1') which consists of moderately fractured, hard, light grey to white dolomite. Groundwater was found at approximate elevation 686'.

2.6.3 Approaches - No slope stability problems are anticipated. It is estimated that the approach fills may undergo long term settlements of approximately 18". Thus it is recommended to place the fills approximately 6 months prior to bridge construction.

Piers and Abutments

12 HP @ 74 piles driven through the fill material to bedrock are recommended. These should provide a safe capacity of 95 tons per pile.

Excavations - No major unwatering problems are envisaged due to the relatively impermeable nature of the subsoil.

## 2.7 Site #7 - Lynden Road Underpass

- 2.7.1 Site description - Hwy. 403 profile grade will be 714'  $\pm$  with a Lynden Rd. profile grade of approximately 734'  $\pm$ . The site is located in a depression within a gently rolling terrain. The proposed scheme would require fills of approximately 23'  $\pm$ .
- 2.7.2 Subsoil conditions- Ground elev. 708.8', borehole location - 40' north of  $\neq$  Hwy. 403,  $\neq$  Lynden Rd. - Zone 0' - 12' consists of firm to stiff silty clay with seams of silt. Within the top 7', test results indicated a trace of organics (0.56%) and very fine sand. Zone 12' - 33' consists of firm clayey silt with layers of silty clay. Zone 33' - 50.5' consists of loose silt with seams of clayey silt. Zone 50.5' - 101.5' consists of firm clayey silt with layers of silty clay to clay. Although sampling was discontinued at this depth, a dynamic cone further penetrated the subsoil. However, bedrock was not located. Groundwater was found at approximate elevation 700'.
- 2.7.3 Approaches - The approaches will consist of fills of 23 feet  $\pm$  max. height which are estimated to undergo long term settlements of approximately 3 to 4 inches. No slope stability problems are anticipated.

### Piers and Abutments

- A) Spread Footings - Spread footings for the abutments may be placed within the compacted granular 'A' fill. See Fig. 1. This scheme should provide a safe bearing capacity of 2 t.s.f. Total long term settlements of 5 to 6 inches may be anticipated.
- B) End Bearing Piles - It is anticipated that 12 HP @ 74 piles may be driven to bedrock (Approx. elev. 580' - 590'). These should provide a safe capacity of 95 tons per pile.

## 2.8 Site #8 - Sunny Ridge Road Underpass

- 2.8.1 Site description - Hwy. 403 profile grade will be 713'  $\pm$  with a Sunny Ridge Rd. grade elevation of 736'  $\pm$ . The existing ground elevation is 733'  $\pm$ . The site is located within a relatively flat area. This requires fills of approximately 3'  $\pm$  and cuts of approximately 20'  $\pm$ .
- 2.8.2 Subsoil conditions- Ground elev. 732.5', borehole location - 30' north of  $\neq$

Hwy. 403, 25' east of Sunny Ridge Rd. - Zone 0' - 4.5' consists of loose fine sand some silt, trace of organics. Zone 4.5' - 53.5' consists of stiff clayey silt to silt with intermittent layers of silt and clay. In addition, within this layer, from 4.5' to 7', exists a trace of organics (1.41%). Zone 53.5' - 85' consists of loose to compact silt with intermittent layers of clayey silt and clay. Zone 85' - 91.5' consists of firm to stiff clayey silt with layers of clay. Sampling was discontinued at this depth after which a dynamic cone was driven to refusal at a depth of 139.0' (elev. 593.5).

By the nature of complete refusal, it is anticipated that this is the probable location of bedrock. Groundwater was found at approximate elev. 730'.

- 2.8.3 Approaches - The approach to the site will be almost entirely in a cut section. Due to the high groundwater condition and the relatively high permeability of the intermittent silt layers, it is recommended that a permanent dewatering scheme on the cut slopes be required for stability purposes. This may consist of permanent toe drains.

No settlement at the approaches are anticipated.

#### Piers and Abutments

12 HP @ 74 piles driven to bedrock are recommended for support of the footings. These should provide a safe capacity of 95 tons per pile.

Excavations - As previously mentioned, due to the relatively high groundwater condition and the highly permeable silt layers, a dewatering scheme should be utilized during construction.

### 2.9 Site #11 - Big Creek Crossing at Sta. 775 ±

- 2.9.1 Site description - Hwy. 403 profile grade is proposed to be 722' ±. Existing stream bed elevation is approximately 684' ± with the banks at an approximate elevation of 685' ±. This may result in fills 37' in height.

- 2.9.2 Subsoil conditions - Ground elev. 684.8', borehole location ≠ Hwy. 403, 25' west of ≠ Big Creek - The predominating layer from 0' - 71.5' consists of firm to stiff layers of clayey silt and silt with intermittent layers of silty clay. Zone 71.5' - 81.5' consists of very dense silt with fine to coarse sand and some gravel (glacial till).

Probable bedrock was found at 81.5' (elev. 603.3'). However, a sample core was unobtainable. Groundwater was found at approximate elevation 682'.

- 2.9.3 Approaches - The approach fills at this site may be approximately 37' in height. No slope stability problems are anticipated.

In this situation estimated long term settlements of approximately 6 to 8 inches may be anticipated.

Piers and Abutments

12 HP @ 74 piles driven to bedrock (elev. 603.3) are recommended. These should provide a safe capacity of 95 tons per pile.

Excavations - No major unwatering problems are anticipated at this time due to the relatively impereable nature of the subsoil.

2.10 Site#12 - Alberton Road Underpass

- 2.10.1 Site description - Hwy. 403 profile grade will be 731'  $\pm$  with an Alberton Rd. profile grade of 752'  $\pm$ . The existing ground elevation is approximately 721'  $\pm$  within a relatively flat terrain.

This would require fills of approximately 31'  $\pm$  and 10'  $\pm$  for Alberton Rd. and Hwy. 403 respectively.

- 2.10.2 Subsoil conditions - Ground elev. 721.0', borehole location - 20' north of  $\neq$  Hwy. 403, 30' east of  $\neq$  Alberton Rd. - Zone 0' - 17' consists of stiff to very stiff clayey silt with intermittent varves of silt and silty clay. Within the top 13' of this layer, test results also indicated a trace of organics (0.56%). Zone 17' - 41' consists of loose to compact silt with seams of clayey silt. Zone 41' - 92.0' consists of layers of loose silt and firm to stiff clayey silt.

Bedrock was found at 92.0' (elev. 629.0') which consists of moderately fractured, hard, light grey to white dolomite. Groundwater was found at approximate elevation 710'.

- 2.10.3 Approaches - The approaches will consist of fills of 31'  $\pm$  max. height.

No stability problems are anticipated at this site.

The approach fills are estimated to undergo an immediate settlement of approximately 3 to 4 inches. In addition, estimated long term settlements of 1" to 1½" may be anticipated.

Piers and Abutments

12 HP @ 74 piles may be driven to bedrock through the compacted fill material. These should provide a safe capacity of 95 tons per pile.

Excavations - No major unwatering problems are anticipated.

2.11 Site #13 - Highway #52 Underpass

- 2.11.1 Site description - Hwy. 403 profile grade will be 758'  $\pm$  with a highway #52 profile grade of 735'  $\pm$ . The existing ground elevation is approximately 756' on Hwy. #52 and approximately 731' on original ground within a valley with stable 2:1 side slopes.

This would require fills of approximately 27'  $\pm$  (as existing).

- 2.11.2 Subsoil conditions - Ground elev. 756.6' - Hwy. #52, borehole location -  $\phi$  Hwy. 403, 17' east of  $\phi$  Hwy. 52 - Zone 0' - 24' consists of loose to dense silt with fine sand, trace of fine gravel. This is the extent of the fill material for Hwy. 52. Zone 24' - 35.5' consists of compact silt, some fine sand, trace of clay. Zone 35.5' - 38.5' consists of very stiff varves of silt and clayey silt. Zone 38.5' - 91' consists of loose to very dense silt, trace of clay and fine sand. Zone 91' - 122.5' consists of stiff clayey silt with layers of silty clay. Sampler encountered refusal at 122.5' (elev. 634.1'). Sampler probably struck boulder rather than bedrock.

An exact determination of groundwater location was not possible due to the borehole being located in the N.B.L. of Hwy. 52 and timing was thus critical. However, we estimate that the water table is located at an approximate elev. of 730'  $\pm$ .

- 2.11.3 Approaches - The approaches will consist of fills 27' max. height which are existing. Based on the assumption that the existing Hwy. 52 alignment will remain unchanged, no significant settlement is anticipated. In addition, no slope stability problems are anticipated.

Piers and Abutments

12 HP @ 74 piles may be driven to bedrock (approx. elev. 625'  $\pm$ ). These should provide a safe capacity of 95 tons per pile.

Excavations - A dewatering scheme may be required during construction if pile caps are to be constructed within the original soil.

2.12. Site #14 - Shaver Road Overpass

- 2.12.1 Site description - Hwy. 403 profile grade will be 788'  $\pm$  with a Shaver Rd. profile grade of 765'  $\pm$ . Existing ground elevation is approximately 758'  $\pm$  in a small valley within a moderately rolling terrain. This would require max. fills of approximately 30'  $\pm$ .

- 2.12.2 Subsoil conditions- Ground elev. 757.6', borehole location -  $\neq$  Hwy. 403, 40' east of  $\neq$  Shavers Rd. - Zone 0' - 17' consists of loose to compact silt, trace to some fine sand. The top 4.5'  $\pm$  contains a trace of organics (1.98%). Zone 17' - 21' consists of firm clayey silt, seams of silt. Zone 21' - 35.5' consists of loose to compact silt, trace of very fine sand. Zone 35.5' - 39' consists of compact silt to very fine sandy silt. Zone 60.5' - 81.5' consists of compact silt, trace of very fine sand with intermittent varves of clayey silt.

Location of bedrock was not determined at this site due to adverse working conditions. Groundwater was found at approximate elevation 757'.

- 2.12.3 Approaches - The approaches will consist of fills 30'  $\pm$  max. height. These are expected to undergo an instantaneous settlement of 3" to 4". No slope stability problems or long term settlements anticipated.

The top organic stratum should be removed and replaced with granular material



before the approach fills are placed.

#### Piers and Abutments

- A) Spread Footings - Spread footings may be found within the compacted granular 'A' fills for support of the abutments. (See Fig. 1) This is expected to provide a safe bearing capacity of 2.5 t.s.f.

The abutments are estimated to undergo an immediate settlement of approximately 1 to 2 inches after application of the loads.

- B) Friction Piles - No. 14 timber piles embedded approximately 50' in the original soil providing a safe bearing capacity of 25 tons per pile may be used for support of the piers and abutments. Total long term settlements of approximately 1" are estimated to occur.
- C) End Bearing Piles - 12 HP @ 74 piles driven to bedrock with estimated tip elevations of 630'  $\pm$ . This scheme should provide a safe capacity of 95 tons per pile.

Excavations - No major unwatering problems are anticipated. However, excess surface water may present considerable problems. The area may be required to be drained before construction.

### 3. GENERAL

All settlement predictions are approximate only since footing dimensions and exact locations have yet to be established.

All slope stability predictions are based upon assumed forward and side slopes of 2 horizontal to 1 vertical.

The top of all footings and pile caps should be located at least 4' below finished grade for the purpose of frost protection.

R. Van Veen

R. Van Veen  
Project Engineer

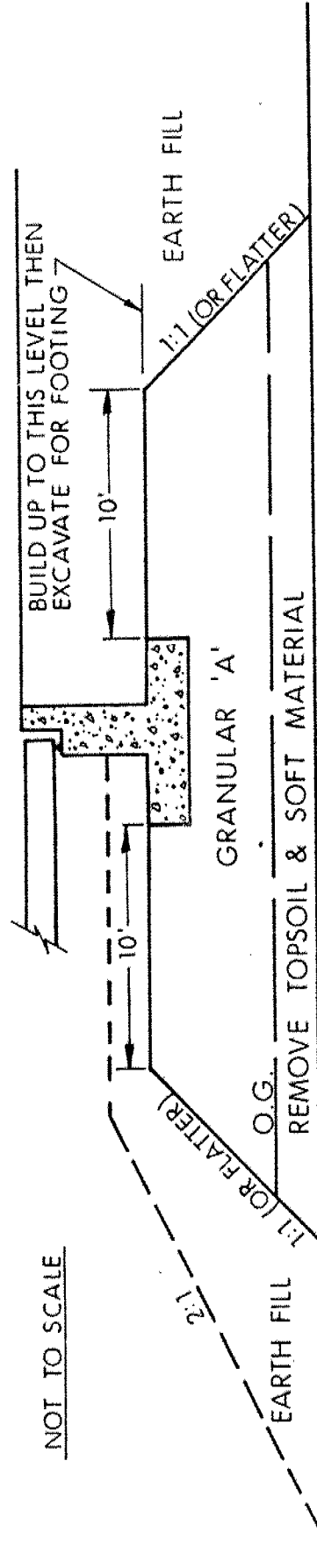
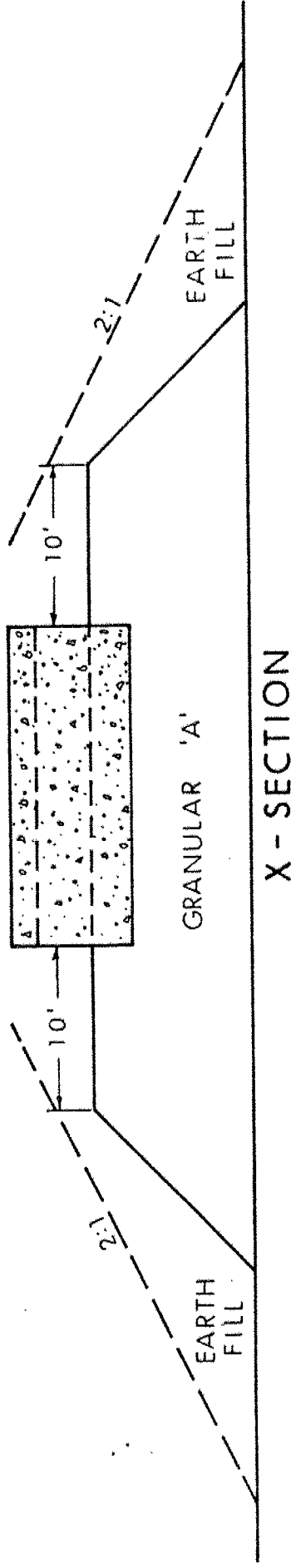
K.G. Selby

K.G. Selby, P. Eng.  
Supervising Engineer

RV:bp  
June, 1976

## APPENDIX

# ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



## NOTES

- 1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A'.
- 2 - PLACE GRANULAR 'A' TO TOP OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M.T.C. STANDARDS.
- 3 - EXCAVATE COMPACTED GRANULAR 'A' MATERIAL FOR FOOTING.

FIG. 1

ABBREVIATIONS & SYMBOLS USED IN THIS REPORTPENETRATION RESISTANCE

'N' STANDARD PENETRATION RESISTANCE - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS:-

<u>CONSISTENCY</u>	<u>c LB./SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 250	VERY LOOSE	0 - 4
SOFT	250 - 500	LOOSE	4 - 10
FIRM	500 - 1000	COMPACT	10 - 30
STIFF	1000 - 2000	DENSE	30 - 50
VERY STIFF	2000 - 4000	VERY DENSE	> 50
HARD	> 4000		

TERMS TO BE USED IN DESCRIBING SOILS:-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC.

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.T.	SLOTTED TUBE SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
CIU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		

# ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

## SOIL PROPERTIES

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
$S_r$	DEGREE OF SATURATION
$w_L$	LIQUID LIMIT
$w_p$	PLASTIC LIMIT
$I_p$	PLASTICITY INDEX
$w_s$	SHRINKAGE LIMIT
$I_L$	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
$I_C$	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
$e_{max}$	VOID RATIO IN LOOSEST STATE
$e_{min}$	VOID RATIO IN DENSEST STATE
$I_D$	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY $D_r$ IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
$m_v$	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma}$
$c_v$	COEFFICIENT OF CONSOLIDATION
$C_c$	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$
$T_v$	TIME FACTOR = $\frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
$\tau_t$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION INTERCEPT
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_t$	SENSITIVITY

## GENERAL

$\pi$	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

## STRESS AND STRAIN

u	PORE PRESSURE
$\sigma$	NORMAL STRESS
$\sigma'$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

## EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
$K_0$	COEFFICIENT OF EARTH PRESSURE AT REST

## FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
$k_s$	MODULUS OF SUBGRADE REACTION

## SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
$\beta$	ANGLE OF SLOPE TO HORIZONTAL

# RECORD OF SITE No 1

WP 66-67-01 LOCATION Co-ords. 15,685,290 N; 809,685 E. ORIGINATED BY MK  
 DIST 4 HWY 403 BORING DATE March 11 - 15, 1976 COMPILED BY MK  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY N.S.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$ P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
708.0	Ground Level															
0.0																
	Clayey silt, seams of silt, layers of silty clay and silt		1	SS	13											0 0 54 46
			2	SS	16											
			3	TW	PH											125
			4	SS	11											0 0 70 30
			5	SS	8											0 0 84 16
			6	TW	PH											
			7	SS	8											
	Firm to Stiff		8	SS	11											127
			9	TW	PH											
			10	SS	30											0 14 66 20
			11	SS	9											
			12	SS	11											
			13	TW	PH											123
			14	SS	8											
			15	TW	PH											124
627.0			16	SS	13											
81.0	Layers of very fine sandy silt															
624.0																
84.0																
607.6																
100.5	Bedrock - moderately fractured dolomite		17	RC EXL	Rec 98%											
604.0																

20  
15 5 % STRAIN AT FAILURE  
10

(CONTINUED)

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE NO 1 (CONT'D)

WP 66-67-01  
DIST 4 HWY 403  
DATUM Geodetic

LOCATION Co-ords. 15,685,290 N; 809,685 E.  
BORING DATE March 11 - 15, 1976  
BOREHOLE TYPE Hollow Stem Auger

ORIGINATED BY MK  
COMPILED BY MK  
CHECKED BY *MS*

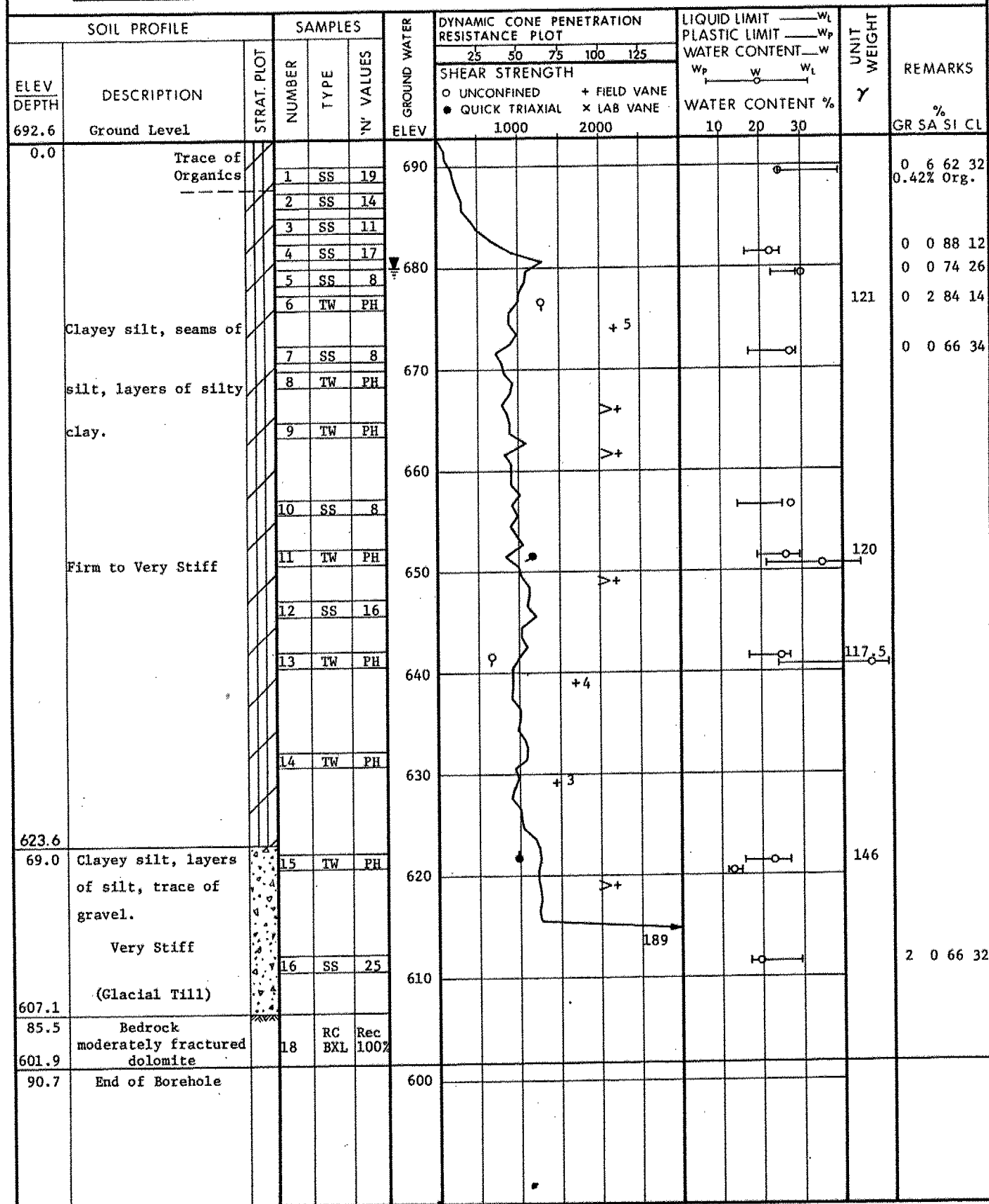
SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
604.0	continued															
104.0	Moderately fractured dolomite Bedrock		18	RC EXL	Rec 98%	600										
597.6																
110.5	End of Borehole															
						590										



## ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

## RECORD OF SITE NO 2

WP 66-67-01 LOCATION Co-ords. 15,685,480 N; 815,860 E. ORIGINATED BY BVV  
 DIST 4 HWY 403 BORING DATE March 5-11, 1976 COMPILED BY BVV  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.T.



MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE NO 3

WP 66-67-01 LOCATION Co-ords. 15,685,480 N; 817,110 E. ORIGINATED BY BVV  
DIST 4 HWY 403 BORING DATE March 18, 1976 COMPILED BY BVV  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.J.

SOIL PROFILE		STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$ $w_p$ — $w$ — $w_L$ WATER CONTENT % 10 20 30	UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	N' VALUES		25	50	75	100	125			
643.8	Ground Level													
0.0	Silt, some very fine sand, trace of clay and organics (wood chips)		1	SS	3	640							Org. 1.83%	0 9 79 12
	Very Loose		2	SS	2									
			3	SS	3									
630.8			4	SS	4								Org. 1.38%	0 18 67 15
13.0	Clayey Silt		5	SS	4	630								1 2 73 24
	Seams of Silt		6	SS	3									
			7	TW	PH									
			8	TW	PH	620							122	
	Firm to Stiff		9	SS	10									
599.3			10	TW	PH	610							122	
44.5			11	SS	5									
596.3			12	SS	4	600								
47.5	Clayey silt, some sand & grav. (Glac. Till) Firm		13	SS	5									24 12 36 28
591.3	Bedrock-moderately fractured dolomite		14	RC EXL	Rec 87%									
52.5	End of Borehole					590								

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE NO 4

WP 66-67-01 LOCATION Co-ords. 15,685,520 N; 817,770 E. ORIGINATED BY BVV  
 DIST 4 HWY 403 BORING DATE March 16 & 17, 1976 COMPILED BY BVV  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.S.

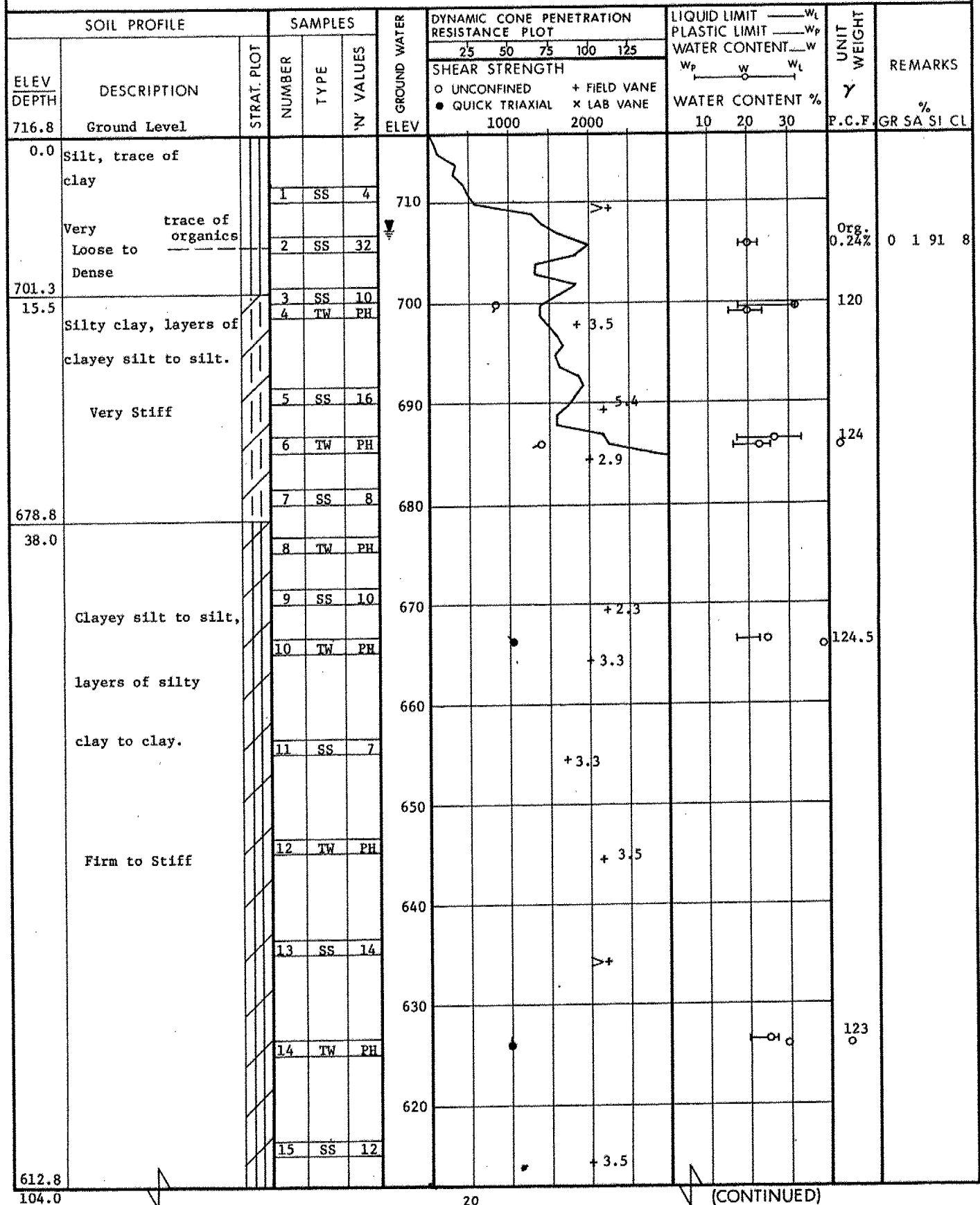
SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
666.2	Ground Level															
0.0	Clayey silt, trace of coarse sand & organics		1	SS	10											
659.2	Stiff		2	SS	11											
7.0			3	SS	9											
	Clayey silt, seams of silt, layers of silty clay.		4	SS	7											
			5	SS	5											
			6	TW	PH											
			7	SS	7											
	Firm to Stiff		8	SS	6											
			9	TW	PH											
			10	SS	8											
			11	TW	PH											
			12	SS	11											
603.5			13	TW	PH											
62.7	Bedrock - moderately fractured dolomite		14	RC BXL	Rec 91%											
598.5																
67.7	End of Borehole															

20  
15 0.5 % STRAIN AT FAILURE  
10

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE NO 5

WP 66-67-01 LOCATION Co-ords. 15,686,595 N; 821,170 E. ORIGINATED BY MK  
DIST 4 HWY 403 BORING DATE March 15, 16, 1976 COMPILED BY MK  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY ML



ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE No 5 (CONT'D)

WP 66-67-01 LOCATION Co-ords. 15,686,595 N; 821,170 E. ORIGINATED BY MK  
 DIST 4 HWY 403 BORING DATE March 15, 16, 1976 COMPILED BY MK  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.S.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$ P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		25	50	75	100	125	$W_P$	$W$	$W_L$		
612.8	continued															
104.0	Clayey silt to silt, layers of silty clay to clay.  Firm to Stiff		16	TW	PH	610									123 126	
598.8						600										
118.0	Clayey silt, trace of medium sand & coarse grav. (Gl. till) Hard		17	SS	38											20 21 44 15
595.3																
121.5	End of Borehole					590										

RECORD OF SITE NO 6

WP 66-67-01 LOCATION Co-ords. 15,688,495 N; 826,675 E. ORIGINATED BY MK  
 DIST 4 HWY 403 BORING DATE March 18-22, 1976 COMPILED BY MK  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.F.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_P$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$ P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_P$	$w$	$w_L$		
687.2	Ground Level															
0.0																
	Trace of organics		1	SS	5											Org. 0.40%
			2	SS	14											0 0 67 33
			3	TW	PH											
	Layered silty clay		4	SS	6											
	and clayey silt		5	TW	PH											
	various layers of clay		6	SS	5											
	seams of silt.		7	TW	PH											125
			8	SS	7											
			9	TW	PH											
	Firm to Very Stiff		10	SS	4	6"										
			11	TW	PH											123
			12	SS	22											
			13	SS	8											
			14	TW	PH											
			15	SS	13											12 33 39 16
590.2																
97.0	Silt, some medium to coarse sand, trace of grav. & clay (Gl. Till)		16	TW	PH											
586.1	Dense															
101.1	Bedrock-moderately fractured		17	RC BXL	Rec 100%											

20  
15 5 % STRAIN AT FAILURE  
10

(CONTINUED)

WP 66-67-01 LOCATION Co-ords. 15,688,495 N; 826,675 E. ORIGINATED BY MK  
DIST 4 HWY 403 BORING DATE March 18-22, 1976 COMPILED BY MK  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY H.F.

20  
15 5 % STRAIN AT FAILURE  
10

RECORD OF SITE NO 7

WP 65-67-01  
DIST 4 HWY 403  
DATUM Geodetic

LOCATION Co-ords. 15,690,370 N; 831,990 E.  
BORING DATE March 19-23, 1976  
BOREHOLE TYPE Hollow Stem Auger

ORIGINATED BY BVV  
COMPILED BY BVV  
CHECKED BY J. L.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
708.8	Ground Level															
0.0	Silty clay, trace of seams of organics & very fine silt. sand Firm to Stiff		1	SS	11										Org. 0.56%	0 14 62 24
			2	SS	9											0 0 55 45
			3	SS	5											
696.8			4	SS	5											
12.0	Clayey silt, layers of silty clay.  Firm		5	TW	PH										123	
			6	TW	PH											
			7	SS	8											
			8	TW	PH										119	
675.8			9	TW	PH											
33.0	Silt seams of clayey silt  Loose		10	SS	7											
			11	SS	5											0 0 78 22
			12	TW	PH											
658.3			13	SS	7											
50.5	Clayey silt, layers of silty clay to clay.  Firm		14	TW	PH											
			15	TW	PH										125	
			16	SS	10											
			17	TW	PH											
			18	TW	PH										117.5	
607.3			19	TW	PH											
101.5	End of Borehole															

20  
15 0.5 % STRAIN AT FAILURE  
10

(CONTINUED)



ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE NO 7(CONT'D)

WP 65-67-01 LOCATION Co-ords. 15,690,370 N: 831,990 E. ORIGINATED BY BVV  
 DIST 4 HWY 403 BORING DATE March 19 - 23, 1976 COMPILED BY BVV  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M. L.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	WATER CONTENT % $w_p$ $w$ $w_L$				
	continued															
589.8						600										
119.0	End of Cone Test					590										

RECORD OF SITE NO 8

WP 65-67-01 LOCATION Co-ords. 15,693,465 N; 838,805 E. ORIGINATED BY BVV  
 DIST 4 HWY 403 BORING DATE February 27, March 1 - 4, 1976 COMPILED BY BVV  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY J.P.

SOIL PROFILE		STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	N' VALUES		25	50	75	100	125	Wp	W	Wl		
732.5	Ground Level															
0.0	Fine sand, some silt, trace of organics.		1	SS	8	730										Org. Trace
728.0	Loose		2	SS	14											Org. 1.41%
4.5	Trace of organics		3	SS	14											
	Clayey silt to silt,		4	TW	PH											
	Intermittent layers		5	SS	9											
	of silt and clay.		6	TW	PH											
			7	SS	11											
			8	TW	PH											
	Stiff		9	TW	PH											
			10	SS	8											
			11	SS	9											0 0 94 6
			12	SS	9											0 0 65 35
			13	SS	9											
679.0			14	TW	PH											
53.5	Silt		15	SS	8											
	intermittent layers		16	SS	13											
	of clayey silt and															
	clay.		17	SS	9											
	Loose to Compact															
647.5																
85.0	Clayey silt, layers															
	of clay.															
641.0	Firm to Stiff		18	TW	PH											
91.5	End of Borehole															

RECORD OF SITE NO 8 (CONT'D)

WP 65-67-01 LOCATION Co-ords. 15,693,465 N; 838,805 E. ORIGINATED BY BVV  
 DIST 4 HWY 403 BORING DATE February 27, March 1 - 4, 1976 COMPILED BY BVV  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M. J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		25	50	75	100	125	WATER CONTENT % $w_p$ $w$ $w_L$				
							SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 1000 2000					WATER CONTENT % 10 20 30				
593.5																
139.0	Probable Bedrock					590	150/12"									

RECORD OF SITE No 11

WP 65-67-01 LOCATION Co-ords. 15,694,520 N; 844,115 E. ORIGINATED BY MK  
 DIST 4 HWY 403 BORING DATE March 23 & 24, 1976 COMPILED BY MK  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.S.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	Wp	w	WL		
684.8	Ground Level															
0.0																
			1	SS	5	680										0 0 92 8
	Layered clayey silt															
			2	SS	7											0 0 79 21
	and silt,															
	intermittent layers		3	TW	PH	670										
	of silty clay.		4	SS	6											
			5	TW	PH	660										
			6	SS	7											
	Firm to Stiff		7	TW	PH	650										125
			8	SS	8											
			9	SS	10	640										
			10	TW	PH											126
						630										
			11	SS	9	620										
613.3			12	TW	PH											
71.5	Silt with fine to coarse sand, some gravel (Glacial Till) Very Dense					610										
603.3	Probable Bedrock		13	SS	64/6"											8 25 61 6
81.5	End of Borehole					600										

RECORD OF SITE NO 12

WP 65-67-01 LOCATION Co-ords. 15,694,430 N; 846,980 E. ORIGINATED BY BVV  
 DIST 4 HWY 403 BORING DATE March 24 - 25, 1976 COMPILED BY BVV  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY M.J.

SOIL PROFILE		STRAT. PLT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
721.0	Ground Level															
0.0	Clayey silt, varves of silt and silty clay trace of organics		1	SS	23	720									Org. 0.42%	
			2	SS	12											
			3	SS	14											
			4	SS	16	710									Org. 0.56%	
704.0	Stiff to Very Stiff		5	SS	17											0 0 92 8
17.0	Silt		6	SS	7											
	seams of clayey silt		7	TW	PH	700									120	
	Loose to Compact		8	TW	PH											
			9	SS	7	690										0 0 93 7
			10	SS	7											
680.0			11	SS	9	680										
41.0			12	TW	PH											121
	Layered Silt (Loose)		13	SS	8	670										
			14	SS	9											
			15	SS	10	660										
	Clayey Silt (Firm to Stiff)		16	SS	9	650										
			17	SS	10	640										
629.0			18	SS	8	630										0 1 80 19
92.0	Bedrock moderately fractured dolomite		19	RC BXL	Rec 100%											
623.7																
97.3	End of Borehole					620										

20  
15 0-5 % STRAIN AT FAILURE  
10

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE No 13

WP 65-67-01 LOCATION Co-ords. 15,697,230 N; 854,695 E. ORIGINATED BY MK  
 DIST 4 HWY 403 BORING DATE March 25 & 26, 1976 COMPILED BY MK  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY *JK*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N <sup>o</sup> VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
756.6	Ground Level															
0.0	Silt with fine sand, trace of fine gravel  (Fill Material)  Loose to Dense		1	SS	8	750										0 20 74 6
			2	SS	39											
			3	SS	17	740										6 47 41 6
			4	SS	33											
732.6																
24.0	Silt, some fine sand, trace of clay.  Compact		5	SS	9	730										0 17 76 7
			6	SS	17											0 18 76 6
721.1																
35.5	Varved silt & clayey		7	SS	19	720										0 1 69 30
718.1	silt. Very Stiff															0 0 92 8
38.5			8	SS	39											0 0 99 1
			9	SS	54	710										0 0 98 2
	Silt, trace of clay  and fine sand.		10	SS	83											0 7 87 6
						700										
			11	SS	20											
	Loose to Very Dense					690										0 0 95 5
			12	SS	24											
						680										
			13	SS	6											
						670										
665.6			14	SS	9											
91.0	Clayey silt, layers of silty clay.  Stiff					660										
			15	SS	11											
652.6																
104.0																

20  
15 5 % STRAIN AT FAILURE  
10

(CONTINUED)

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF SITE NO 13 (CONT'D)

WP 65-67-01 LOCATION Co-ords. 15,697,230 N; 854,695 E. ORIGINATED BY MK  
DIST 4 HWY 403 BORING DATE March 25 & 26, 1976 COMPILED BY MK  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY 117

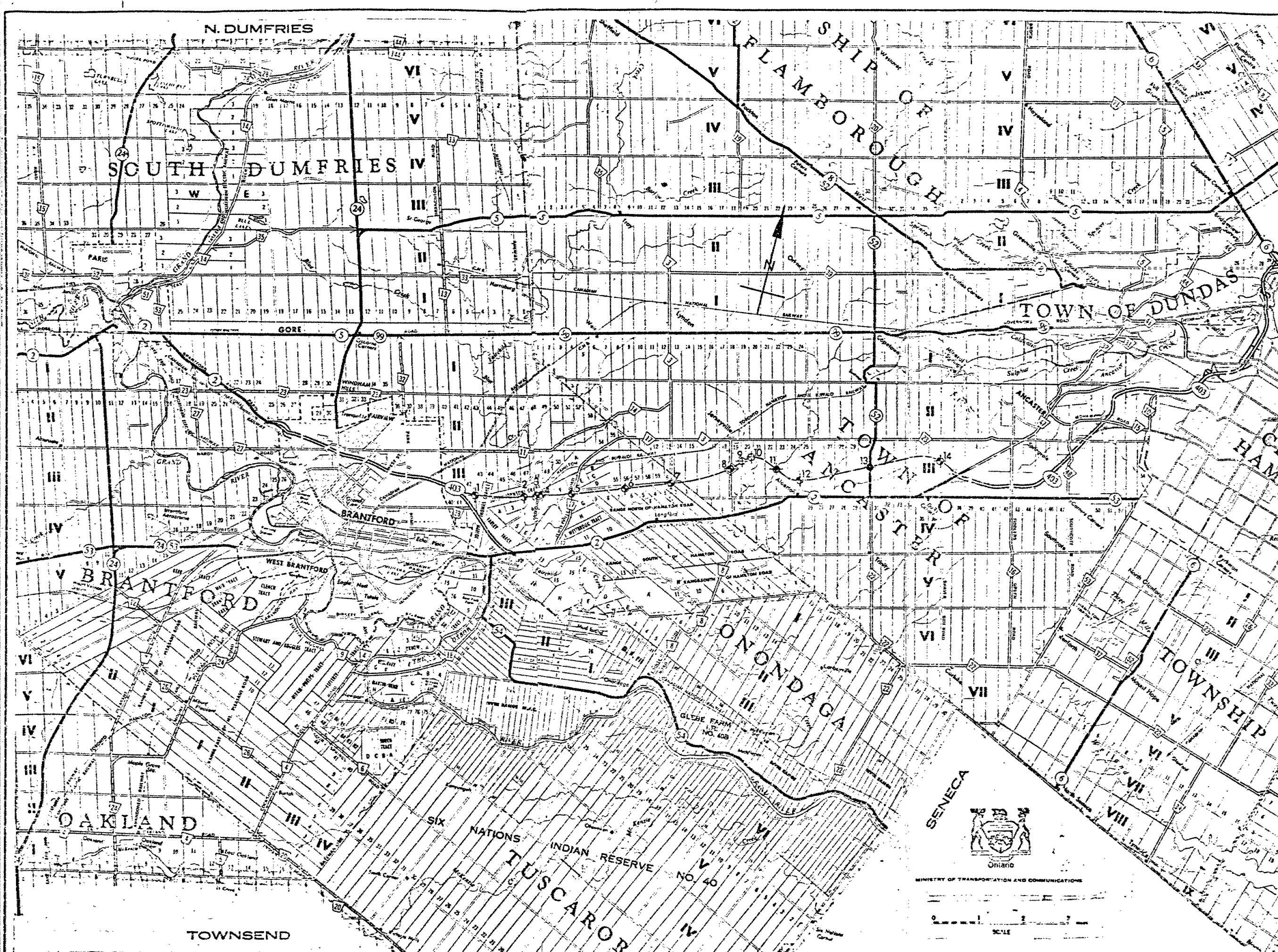
SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$W_p$	$W$	$W_L$		
652.6	continued															
104.0	Clayey silt, layers of silty clay.  Stiff		16	TW	PH	650										
						640										
634.1	Refusal (Boulder)		17	SS	9/12"	630										
122.5	End of Borehole															

RECORD OF SITE N914

WP 65-67-01 LOCATION Co-ords. 15,699,765 N; 862,520 E. ORIGINATED BY BVV  
 DIST 4 HWY 403 BORING DATE February 25 & 26, 1976 COMPILED BY BVV  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY *N.F.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		25	50	75	100	125	$W_P$	$W$	$W_L$		
757.6	Ground Level															
0.0	Silt, trace of trace to some fine sand.	trace of organics	1	SS	6										Org. 1.98%	0 27 70 3
			2	SS	8											0 21 77 2
			3	SS	12	750										
	Loose to Compact		4	SS	8											
			5	SS	10											
740.6			6	SS	6											0 1 92 7
17.0	Clayey silt, seams of silt. Firm		7	SS	6	740									129.5	
736.6			8	TW	PH											
21.0	Silt, trace of very fine sand.		9	TW	PH	730									122	0 3 96 1
	Loose to Compact		10	SS	18											0 0 98 2
722.1			11	SS	10	720										
35.5	Clayey silt, layers of silt. Firm		12	TW	PH											0 28 71 1
718.6			13	TW	PH											0 15 81 4
39.0	Silt to very fine sandy silt.		14	SS	25	710										
	Compact		15	SS	13											0 0 98 2
697.1			16	SS	18	700										0 0 55 45
60.5	Silt, trace of very fine sand, intermit- tent varves of clayey silt.		17	SS	12	690										0 4 94 2
	Compact					680										0 0 99 1
676.1			18	SS	9											
81.5	End of Borehole					670										





CONT No  
WP No 65-67-01  
66-67-01



HIGHWAY 403 FEASIBILITY STUDY  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET

ROAD JURISDICTIONS

LINE'S HIGHWAY	
COUNTY ROAD	
COUNTY SUBURBAN ROAD	
OTHER ROAD	
ROAD LEGALLY OPEN BUT NOT NECESSARILY PASSABLE	
INDIAN RESERVE BOUNDARY	
URBAN CORPORATE LIMIT	
RAILWAY AND STATION	
TOWNSHIP BOUNDARY	
COUNTY BOUNDARY	
BUILT UP AREA	

LEGEND

- Bore Hole
  - Dynamic Cone Penetration Test (Cone)
  - Bore Hole & Cone
- Note:
- Site Nos 9 & 10 not investigated
  - Wt. at time of investigation

No	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
1	708.1	15,685,290	802,685
2	592.6	15,585,480	815,960
3	643.5	15,685,480	817,110
4	666.2	15,685,520	817,770
5	716.8	15,686,595	821,170
6	687.2	15,688,495	825,675
7	708.6	15,690,370	831,990
8	732.5	15,693,465	838,805
11	684.8	15,694,520	844,115
12	721.0	15,694,430	846,980
13	756.6	15,697,230	854,695
14	757.6	15,699,765	862,520

-NOTE-

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS		DESCRIPTION
DATE	BY	

HWY No 403  
SUBMITTED BY: [ ] CHECKED: [ ] DATE: JUNE 25, 1976  
DRAWN BY: [ ] CHECKED: [ ] DATE: [ ]



## Memorandum

To: Mr. R.D. Gunter  
Head, Geotechnical Section  
Central Region  
3501 Dufferin St., Downsview

From: Soil Mechanics Section  
Engineering Materials Office  
Room 315, Central Building

Attention: Mr. D.A. Mullett

Date: 79 07 20

Our File Ref.

In Reply to

Subject: Re: W.P. 66-67-01, Hwy. 403  
Proposed Culvert and Approach Fill  
at Big Creek and Hwy. 403

As requested we are forwarding your comments and recommendations for the proposed culvert and approach fill at Big Creek and Hwy. 403, Sta. 16+025.0.

It is proposed to construct a box culvert with an effective opening of 4.3 x 2.1 metres to carry Big Creek beneath Hwy. 403. The profile grade of Hwy. 403 at this location is such that a fill of up to 8.0 metres will be required.

Big Creek is approximately 2 metres in width with the stream bed located at elevation 208.8+ and the banks at elevation 209.4+. One borehole was advanced at this site during the period March 18 to 22, 1976 for the preliminary study (refer to B.H. #6 attached to this letter). The subsoil consists of a layered deposit 29.6 metres thick of firm to very stiff silty clay and clayey silt with layers of clay and seams of silt. The upper 2.5 metres contain occasional organics. The cohesive stratum is followed by a 1.2 metre thick deposit of dense silt, some medium to coarse sand with traces of gravel and clay (glacial till). The till overlies sound dolomite bedrock at elevation 178.6. The ground-water level was observed to be at elevation 209.1.

With respect to the approach fill no stability problems are anticipated for a fill height of up to 8.0 metres. It is estimated that the fill will undergo long-term settlements of up to 200 mm. Therefore, it is recommended the fill be constructed six months prior to final grading and paving.

It is estimated that the box culvert may be subjected to differential settlements of up to 150 mm in a distance of 16 metres between the toe of slope and a point vertically below the roadway shoulder. Therefore, the culvert should be designed to accommodate this degree of settlement. Due to the presence of organics the subsoil immediately below the box culvert should be excavated to elevation 208 as a minimum requirement and replaced with granular material. An allowable bearing pressure of 150 kPa may be used for design of the box culvert.

cont'd.....

Alternatively, a circular C.S.P. or equivalent size elliptical pipe may be used. The bedding should be Type 5 as per M.T.C. Standard DD-808-A (1979) with the bedding grade at a minimum elevation of 208.

No major dewatering problems are anticipated at this site.



C.T. Johnson  
Project Engineer

For: K.G. Selby  
Supervising Engineer

CTJ/KGS/gs

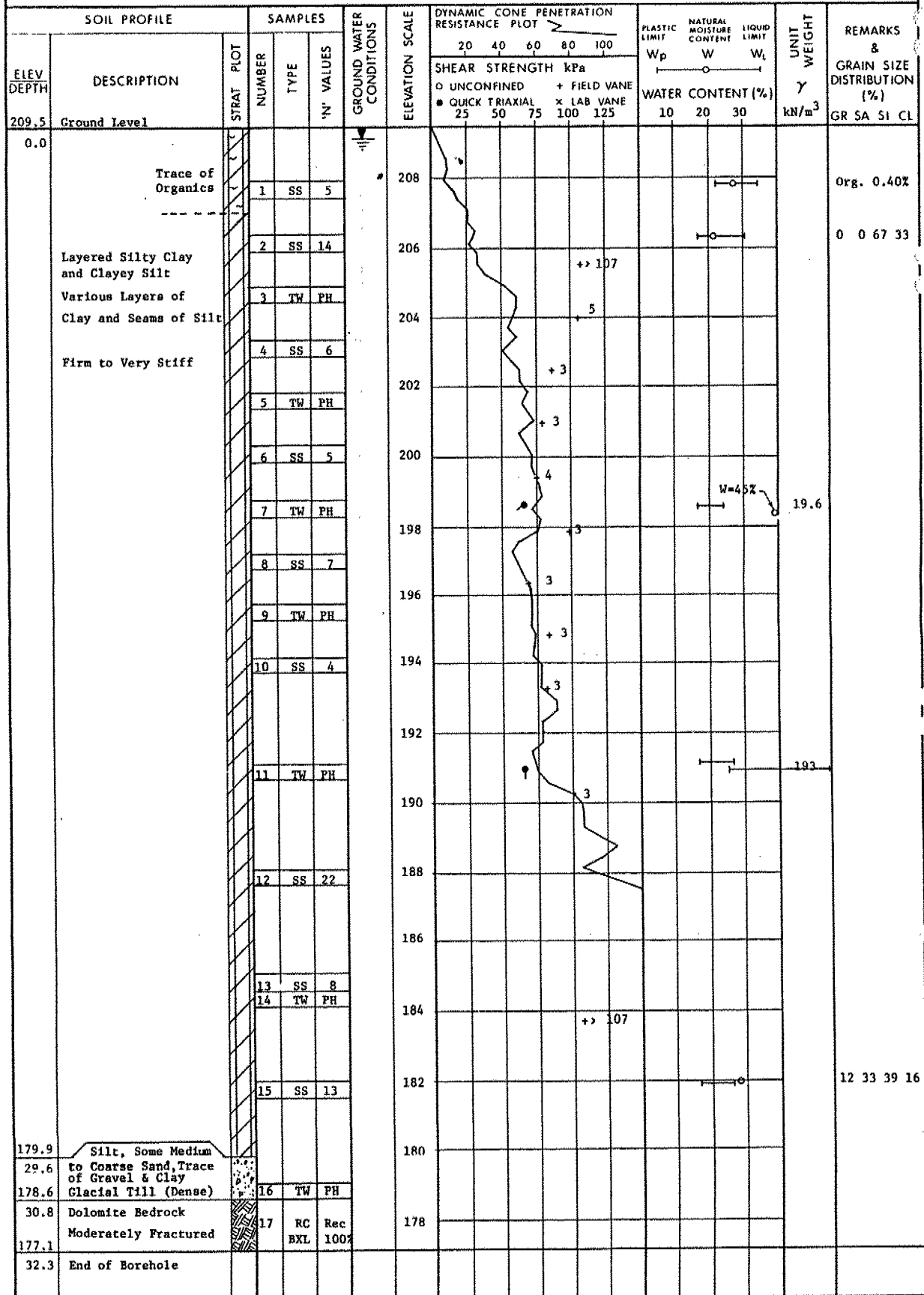
Attach.

cc: R.C. McCormick (McCormick, Rankin & Assoc. Ltd.)  
Files ✓

## RECORD OF BOREHOLE No 6

METRIC

W P 66-67-01 LOCATION Big Creek Coords. 4 781 874.0 N; E 252 016.8 ORIGINATED BY MK  
 DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger, BXL Rock Core & Cone Test COMPILED BY CTJ  
 DATUM Geodetic DATE 1979 03 18 to 22 CHECKED BY



**McCORMICK, RANKIN & ASSOCIATES  
LIMITED**  
consulting engineers

January 21, 1980

Mr. P. Payer, P. Eng.  
Senior Engineer  
Soils Mechanics Section  
Highway Engineering Division  
Ministry of Transportation  
and Communications  
1201 Wilson Ave.,  
Downsview, Ontario  
M3M 1J8

RE: W.P. 66-67 - HWY. 403  
From Brantford to Lynden Road  
Concrete Culverts  
District 4 - Hamilton  
Our File: W.O. 1012-78

Dear Sir:

As requested by Mr. D. Mullet of the Regional Geotechnical Section, we are forwarding to you three prints each of the profiles for concrete culverts on the above-noted work project. These profiles are to accompany the plans left with you by Mr. Mullet.

We require foundation recommendations for the following culverts as soon as possible as our contract submission to the MTC is September 1980.

Plan	Station	Location	Size	Type
1012-9121	17+730	Hwy. 403	2.4x1.8x81	Conc. Box
1012-9121	10+063	Lynden Road	1800x71	CSP
1012-9231	10+273	Garden Ave.	6.1x3.0x73	Conc. Box

We require foundation recommendations for the following culverts by August 1st, 1980 as our contract submission to the MTC is February 1981.

.....

-2-

Mr. P. Payer, P.Eng.

Plan	Station	Location	Size	Type
1012-9341	11+395	Hwy. 403	2.4x1.8x88.4	Conc. Box
1012-9351	11+945	Hwy. 403	1.5x1.5x92.6	Conc. Box
1012-9361	14+410	Hwy. 403	2.4x1.8x57.2	Conc. Box
1012-9371	10+782	Garden Ave.	1.85x1.85x8	Extension
1012-9381	10+442	Hwy. 403	5.5x3.0x168	Conc. Box
1012-9381	0+400	Ramp W-NS	5.5x3.0x61	Conc. Box

Yours very truly,

McCORMICK, RANKIN &amp; ASSOCIATES LIMITED

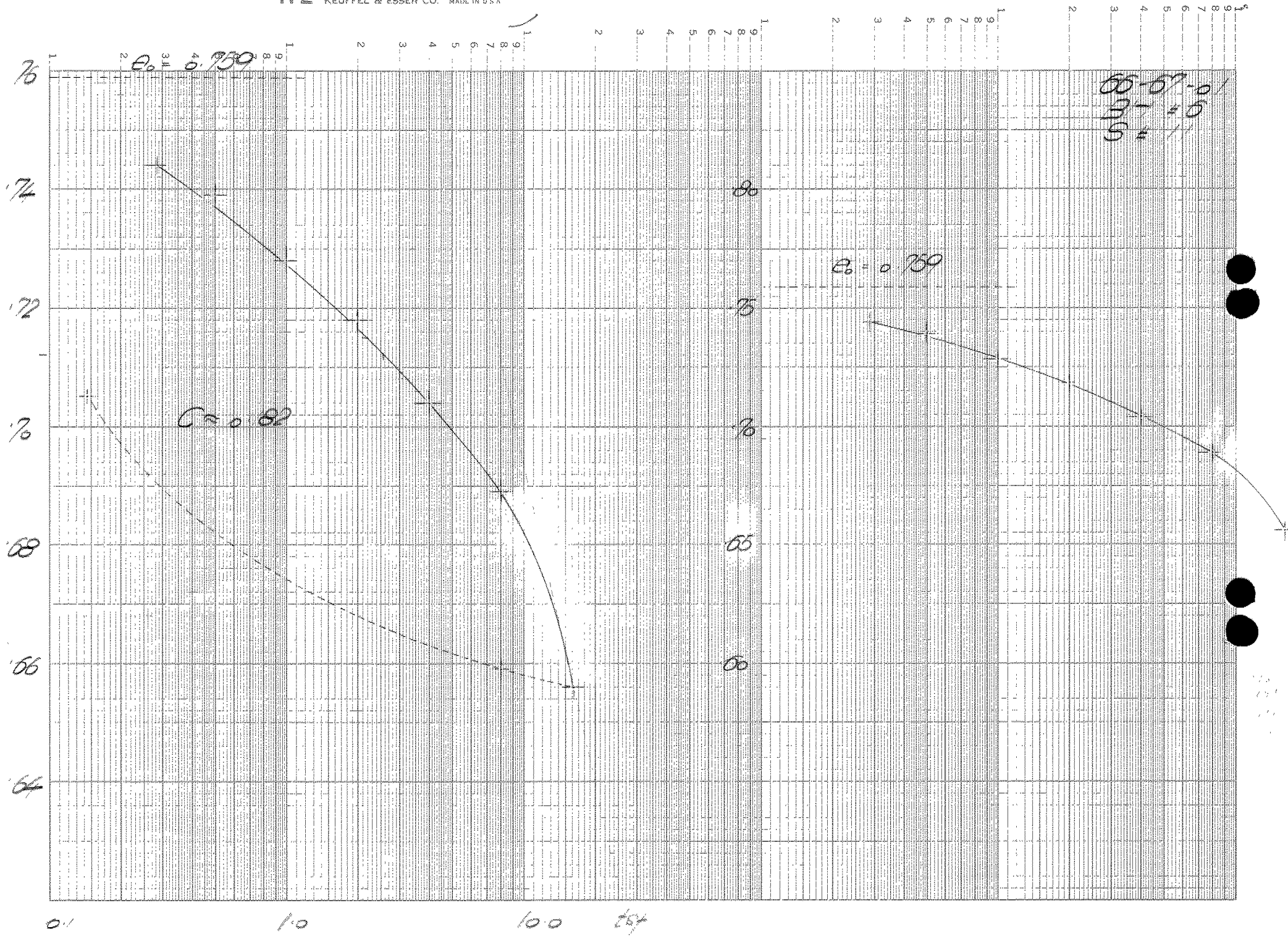
RCM:lec

Encl.

cc: Mr. W. Lankinen

Mr. D. Mullet

  
for R. C. McCormick, P. Eng.







# CONSOLIDATION TEST

LABORATORY SERVICES OFFICE

30638  
PRESS "E"

Project 66-67-01 Borehole No. 6 Sample No. 11 Depth         

Lab. work by          Calculations by          Checked by         

Sample description Grey Clayey silt.

Specific Gravity 2.71 (Determined / Assumed)

## DIMENSIONS OF APPARATUS:-

Ring No. 2 Height 4.90 (inches) Diameter 1.87 (inches) Area (A) 2.76 (sq. inches)

## WATER CONTENT DETERMINATION:-

LOCATION	WHOLE SAMPLE BEFORE TEST	WHOLE SAMPLE AFTER TEST	TOP	BOTTOM	SIDE
Container number					
Weight of wet soil & tare (gms.)	90.75	89.73			
Weight of dry soil & tare (gms.)	81.17	81.17			
Weight of water (gms.)	9.58	8.56			
Weight of tare (gms.)	47.00	47.00			
Weight of dry soil (gms.)	34.17	34.17 (Ws)			
Water content %	28.6	25.1			

## INITIAL CALCULATIONS:-

Dry Density          (p.c.f.)

Initial Solids Height (2H<sub>o</sub>) =  $\frac{W_s \times 0.061}{G_s \times A} = \frac{2786}{12.62} = 22.20$  (inches)

Wet Density          (p.c.f.)

Void Ratio         

## FINAL CALCULATIONS:-

Cv (Coefficient of Consolidation) =  $\frac{0.848 \times (2H)^2}{4 \times t_{90}}$  sq.in./min.

LOAD (t.s.f.)	DIAL READING (inches)	CORRECT READING (inches)	SAMPLE HEIGHT 2H (ins.)	2H - 2H <sub>o</sub> (inches)	VOID RATIO $\frac{2H - 2H_o}{2H_o}$	FITTING TIME (minutes)	COEFFICIENT OF CONSOLIDATION Cv	
							sq.in./min.	sq.ft./day
0	0	0	0.4900	2115	759			
0.287	0.0077	0.0039	0.4861	2076	744			
0.502	0.0026	0.0016	0.4845	2060	739			
1.01	0.0040	0.0028	0.4817	2032	728			
2.0	0.0048	0.0031	0.4786	2001	718			
4.02	0.0081	0.0041	0.4745	1960	704			
8.04	0.0096	0.0041	0.4704	1919	689			
16	0.0188	0.0091	0.4613	1828	656			
8.04	0.0037	0.0009	0.4622	1837	659			
0.144	0.0238	0.0126	0.4748	1963	705			



# CONSOLIDATION TESTS

Job No. 66-67-01 Borehole No. 6 Sample No. 11

Depth \_\_\_\_\_ Press No. E Tested By \_\_\_\_\_

SCALE LOAD (in Lbs.)	1			175			35			70			
LOAD (in T.S.F.)	287			502			1.01			2.01			
DATE START.	MAY 19/76			MAY 20/76			MAY 21/76			MAY 25/76			
T	TIME	DIAL 2500	Δ H (inches)	TIME	DIAL	Δ H (inches)	TIME	DIAL	Δ H (inches)	TIME	DIAL	Δ H (inches)	√ T
0	2:05	0		9:08	0		9:35	20	0	10:03	0		0
10 SEC.		45			8			33	13		22		.41
20		50			10			36	16		24		.58
30		53			11			37	17		26		.71
40		-			11.8			38	18		27		.81
50		56.5			12.0			38.5	18.5		27.5		.91
1 MIN.		57.5			-			39	19		-		1
1 1/4		58.5			12.5			39	19		28.5		1.120
1 1/2		59.5			12.5			39.5	19.5		28.5		1.225
2		60.5			12.5			40	20		29		1.41
2 1/2		61.5			13.5						29.5		1.58
3		61.5			14.0								1.73
3 1/2		61.5			14.0								1.87
4					14.5								2
5					14.5								2.25
6 1/4					15.0								2.5
9													3
12 1/4													3.5
16													4.0
20 1/4													4.5
25													5
36													6
49													7
64													8
81													9
100													10
200													14.1
300													
400													
FINAL	9:06	77		9:32	20		11:01	60	40	8:35	48		

MAY 20/76

MAY 21/76

MAY 25/76

MAY 26/76

# CONSOLIDATION TESTS

Job No. 66-67-01 Borehole No. 6 Sample No. 11

Depth \_\_\_\_\_ Press No. E Tested By \_\_\_\_\_

SCALE LOAD (in Lbs.)	14			28			56			UNLOAD 28			
LOAD (in T.S.F.)	4.02			8.04			16.1			8.04			
DATE START.	May 26/76			MAY 27/76			MAY 28/76			MAY 31			
T	TIME	DIAL 2500	Δ H (inches)	TIME	DIAL 2500	Δ H (inches)	TIME	DIAL	Δ H (inches)	TIME	DIAL	Δ H (inches)	√ T
0	8:44	0		9:17	0		9:33	2500	0	9:12	2500	0	0
10 SEC.		40		Needle Quite Erratic	61			2594	94		2469.5	30.5	.41
20		45			67			2601	101		68	32	.58
30		47			70			2606	106		67	33	.71
40		48			72			2608.5	108.5		68.5	33.5	.81
50		48.8			73.2			10.5	110.5		66.5	33.5	.91
1 MIN.		49.8			68			12	112		66	34	1
1 1/4		50			66			13.5	113		66	34	1.120
1 1/2		51.2			63			15	115		66	34	1.225
2		52			-			17.5	117.5		65.7	34.3	1.41
2 1/2					57.5			19	119		65.7	34.3	1.58
3				57			20.5	120.5				1.73	
3 1/2				-			21	121				1.87	
4				59			22	122				2	
5				60			23.5	123.5				2.25	
6 1/4				60.5			24.5	124.5				2.5	
9				62.5								3	
12 1/4												3.5	
16												4.0	
20 1/4												4.5	
25												5	
36												6	
49												7	
64												8	
81												9	
100												10	
200												14.1	
300													
400													
FINAL	9:15	81		9:28	2596	96	9:10	2688	188	10:15	2463	37	

MAY 27/76 MAY 28/76

MAY 31/76

MAY 31/76

# CONSOLIDATION TESTS

Job No. 66-67-01 Borehole No. 6 Sample No. 11

Depth \_\_\_\_\_ Press No. E Tested By \_\_\_\_\_

SCALE LOAD (in Lbs.)	1/2 UNLOAD												
LOAD (in T.S.F.)	144												
DATE START.	MAY 31/76												
T	TIME	DIAL	Δ H (inches)	TIME	DIAL	Δ H (inches)	TIME	DIAL	Δ H (inches)	TIME	DIAL	Δ H (inches)	√ T
0	10:16	2500	0										0
10 SEC.													.41
20		2352	148										.58
30		40	160										.71
40		32	168										.81
50		265	1735										.91
1 MIN.		22	178										1
1 1/4		16	184										1.120
1 1/2		12	188										1.225
2		7	193										1.41
2 1/2		3	197										1.58
3		2300	200										1.73
3 1/2		2298	202										1.87
4		96	204										2
5		93	207										2.25
6 1/4													2.5
9													3
12 1/4													3.5
16													4.0
20 1/4													4.5
25													5
36													6
49													7
64													8
81													9
100													10
200													14.1
300													
400													
FINAL	10:04	2262	238										

JUNE 1-76  
June 2 1976

66-67-01  
 84-#6  
 S # 11

0.144 ts/ unit.

0.502 ts/

1.01 ts/

2.01 ts/

4.02 ts/

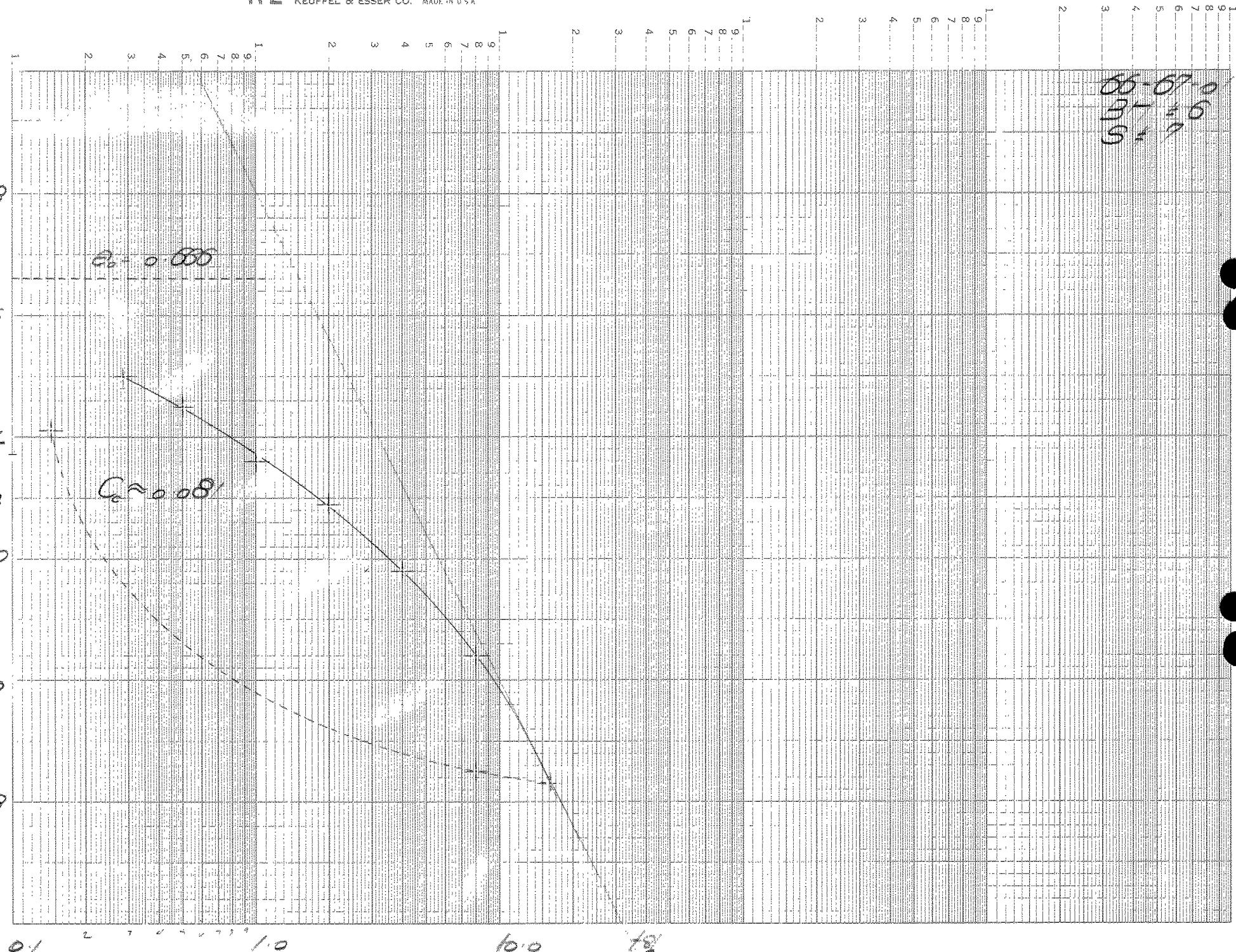
0.287 ts/

0.04 ts/

187 / 91

804 ts/ unit.

66-67-0  
1.6  
9.9  
5.4





# CONSOLIDATION TEST

LABORATORY SERVICES OFFICE

30634  
PRESS "F"

Project 66-67-01 Borehole No. 6 Sample No. 7 Depth       

Lab. work by        Calculations by        Checked by       

Sample description grey cl.

Specific Gravity 2.72 (Determined / Assumed)

## DIMENSIONS OF APPARATUS :-

Ring No. 1 Height 4.90 (inches) Diameter 1.873 (inches) Area (A) 2.76 (sq. inches)

## WATER CONTENT DETERMINATION :-

LOCATION	WHOLE SAMPLE BEFORE TEST	WHOLE SAMPLE AFTER TEST	TOP	BOTTOM	SIDE
Container number					
Weight of wet soil & tare (gms.)	91.82	90.735			
Weight of dry soil & tare (gms.)	82.93	82.93			
Weight of water (gms.)	8.89	7.805			
Weight of tare (gms.)	46.74	46.74			
Weight of dry soil (gms.)	36.19	36.19 (Ws)			
Water content %	24.6	21.6			

## INITIAL CALCULATIONS :-

Dry Density        (p.c.f.) Initial Solids Height (2H<sub>0</sub>) =  $\frac{W_s \times 0.061}{G_s \times A} = \underline{0.295}$  (inches)

Wet Density        (p.c.f.)

Void Ratio       

22.2  
8.89  
13.31

## FINAL CALCULATIONS :-

$$C_v \text{ (Coefficient of Consolidation)} = \frac{0.848 \times (2H)^2}{4 \times t_{90}} \text{ sq.in./min.}$$

LOAD (t.s.f.)	DIAL READING (inches)	CORRECT READING (inches)	SAMPLE HEIGHT 2H (ins.)	2H - 2H <sub>0</sub> (inches)	VOID RATIO $\frac{2H - 2H_0}{2H_0}$	FITTING TIME (minutes)	COEFFICIENT OF CONSOLIDATION C <sub>v</sub>	
							sq.in./ min.	sq.ft./ day
0	0	0	4900	1960	666			
287	0067	0048	4852	1912	65			
502	0065	0044	4838	1898	645			
1.01	0032	0026	4812	1872	636			
2.01	0034	0022	4790	1850	626			
4.02	0059	0033	4757	1817	618			
8.04	0089	0040	4717	1777	604			
16.1	0142	0063	4654	1714	588			
8.04	007	0006	4660	1720	585			
0.144	0188	0164	4824	1884	641			

# CONSOLIDATION TESTS

Job No. 66-67-01 Borehole No. 6 Sample No. 7

Depth \_\_\_\_\_ Press No. F Tested By \_\_\_\_\_

SCALE LOAD (in Lbs.)	1			1.75			3.5			7			
LOAD (in T.S.F.)	.287			.502			1.01			2.01			
DATE START.	MAY 19/76			MAY 20/76			MAY 21/76			MAY 25/76			
T	TIME	DIAL 2500	Δ H (inches)	TIME	DIAL 2500	Δ H (inches)	TIME	DIAL 2500	Δ H (inches)	TIME	DIAL 2500	Δ H (inches)	√ T
0	11:18	0		9:00	0		7:39	2516	0	10:57	0		0
10 SEC.		28			15			-	-		16		.41
20		32			20			24	9		135		.58
30		33			23			26	11		215		.71
40		34			30			37.5	12.5		22.5		.81
50		35			40			30	15		24.0		.91
1 MIN.		36			46			32	17		24.5		1
1 1/4		37			60			33.5	18.5		26.0		1.120
1 1/2		38			62			34.0	19		26.5		1.225
2		39.5			70			35.0	20		27		1.41
2 1/2		40.5			90			35.5	20.5		27		1.58
3		41			110			36	21		28		1.73
3 1/2		-			-			36	21		28		1.87
4		41.5			120			36	21				2
5		42			130			37	22				2.25
6 1/4		42			135			37.5	22.5				2.5
9		42.5						38.5	23.5				3
12 1/4													3.5
16													4.0
20 1/4													4.5
25													5
36													6
49													7
64													8
81													9
100													10
200													14.1
300													
400													
FINAL	8:57	67		9:38	15		10:55	2547	32	8:50	34		

MAY 30/76

MAY 21/76

MAY 25/76 MAY 25/76



# CONSOLIDATION TESTS

30634

Job No. 66-67-01 Borehole No. 6 Sample No. 7

Depth \_\_\_\_\_ Press No. F Tested By \_\_\_\_\_

SCALE LOAD (in Lbs.)	14			28			56			28 <sup>UNLOAD</sup>			
LOAD (in T.S.F.)	4.02			8.04			16.1			8.04			
DATE START.	May 26/76			MAY 27/76			MAY 28/76			MAY 31/76			
T	TIME	DIAL 2500	ΔH (inches)	TIME	DIAL 2500	ΔH (inches)	TIME	DIAL	ΔH (inches)	TIME	DIAL 2500	ΔH (inches)	√T
0	8:52	0		9:22	0		10:24	2500	0	9:06	2500		0
10 SEC.		32			51			2581	81		24865	136	.41
20		34.5			54.5			86	86		85	15	.58
30		36.5			58			87.5	87.5		85	15	.71
40		37			58			89.5	89.5		84.8	15.2	.81
50		37.5			60			90	90		84	16	.91
1 MIN.		38			60.8			91.5	91.5		837	16.3	1
1 1/4		38.3			61.3			92	92		83	17	1.120
1 1/2		39			62.0			93	93		830	17	1.225
2		40			63			94.5	94.5		83.0	17	1.41
2 1/2		40			63.5			96	96		83.0	17	1.58
3					64.0			97	97		-	-	1.73
3 1/2					64.5			98	98		83.0	17	1.87
4					65.0			98.5	98.5				2
5								2600	100				2.25
6 1/4								2601	101				2.5
9													3
12 1/4													3.5
16													4.0
20 1/4													4.5
25													5
36													6
49													7
64													8
81													9
100													10
200													14.1
300													
400													
FINAL	9:24	59		10:20	2589	89	9:04	2642	142	10:08	2483	17	

MAY 27/76

MAY 28/76

MAY 31/76

MAY 31/76



# CONSOLIDATION TESTS

Job No. 66-67-01 Borehole No. 6 Sample No. 7

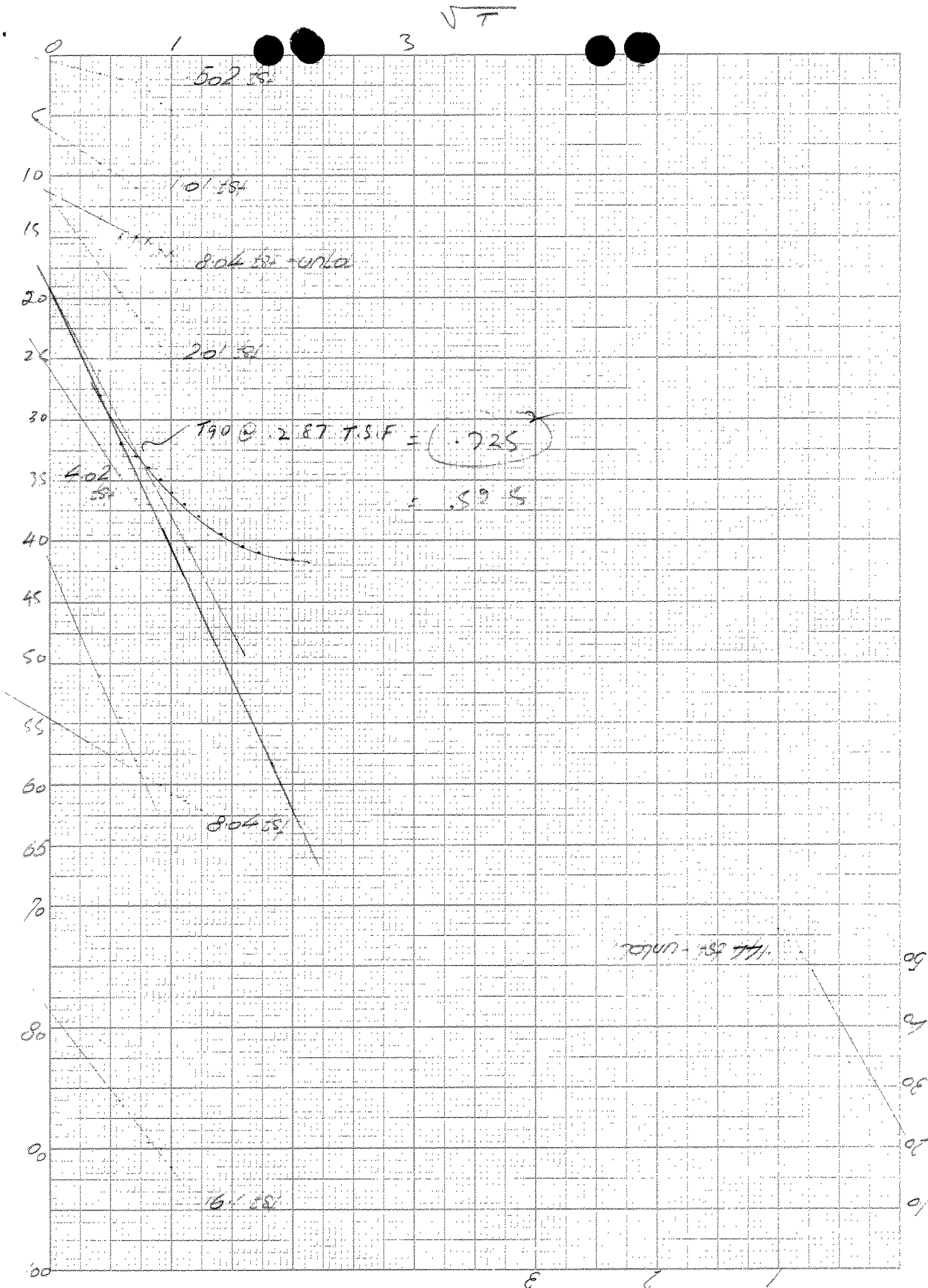
Depth \_\_\_\_\_ Press No. F Tested By \_\_\_\_\_

SCALE LOAD (in Lbs.)	1/2 UNLOAD												
LOAD (in T.S.F.)	.144												
DATE START.	MAY/31/76												
T	TIME	DIAL	Δ H (inches)	TIME	DIAL	Δ H (inches)	TIME	DIAL	Δ H (inches)	TIME	DIAL	Δ H (inches)	√ T
0	10:09	2500	0										0
10 SEC.		2366	34										.41
20		2356	44										.58
30		51	49										.71
40		48	52										.81
50		46	54										.91
1 MIN.		44	56										1
1 1/4		42	58										1.120
1 1/2		40	60										1.225
2		38	62										1.41
2 1/2		36.5	63.5										1.58
3		35.0	65.0										1.73
3 1/2		34.	66										1.87
4													2
5													2.25
6 1/4													2.5
9													3
12 1/4													3.5
16													4.0
20 1/4													4.5
25													5
36													6
49													7
64													8
81													9
100													10
200													14.1
300													
400													
FINAL	10:05	2312.5	187.5										

JUNE 2 1976

46 1240

22 X 20 TO THE INCH • 7 X 13 ICES  
KEUFFEL & ESSER CO. MADE IN U.S.A.



REVISED MAY, 1968

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS

## PROPERTY DAMAGE REPORT

REGION: Central

DATE: March 31, 1976

IDENTIFICATION OF:



OWNER



TENANT

NAME: Karl Koeppe &amp; Herman Koeppe

POST OFFICE ADDRESS: R.R. #1, Jerseyville

LOCATION:

DISTRICT #4, Burlington

HIGHWAY #403

TOWNSHIP, LOT AND CONCESSION ETC.

Town of Ancaster  
Lot 25, Concession III

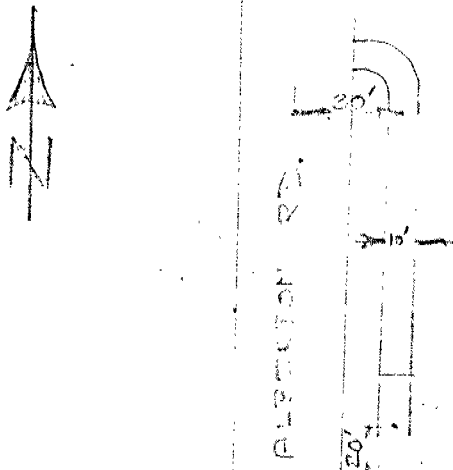
DETAIL OF DAMAGE:

DATE DAMAGE DONE: March 24,25/76

TYPE(S) OF DAMAGE: (CROP, TREES, FENCES, LAWNS, FLOWER BEDS, ORNAMENTAL PLANTINGS ETC.)

- Moved in Off Road Across Firm Plowed Field With C.M.E. Drill Rig (10' x 80')
- Augered Hole 6"  $\phi$  at 20' North of Centreline Hwy. 403 & 30' East of Centreline Alberton Rd. (10' x 20')

DETAILED DESCRIPTION OF EACH TYPE OF DAMAGE: (USE ADDED SHEETS IF REQUIRED)



PROPERTY REQUEST

WORK ORDER 66-67-01

PARTY CHIEF R. Van Veen

SECTION