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DIST. 2 REGION

W.P. No. 88-69-07

CONT. No.

W. O. No.

STR. SITE No. 5-217

HWY. No. 3N

LOCATION PROPOSED CNR CROSSING

No. of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

Ontario  
Department of Transportation and Communications

XXXXXXXXXXXXXXXXXXXX

MEMORANDUM

40I-68

TO: A. P. Watt, (2) FROM: Foundations Office,  
Regional Bridge Planning Engineer, Design Services Branch,  
Southwestern Region, Central Bldg., Downsview.  
London, Ontario.

ATTENTION: T. P. Hodgson, DATE: September 30, 1971.  
Regional Location Eng. IN REPLY TO OCT 12 1971

OUR FILE REF:

SUBJECT:

FOUNDATION INVESTIGATION REPORT  
For

Proposed C.N.R. Subway  
St. Thomas Expressway Crossing  
City of St. Thomas; County of Elgin  
District #2 (London, Ont.)  
W.O. 71-11066 -- W.P. 88-69-07



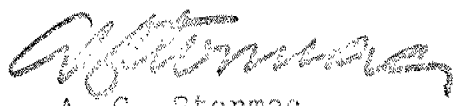
5-217

Attached, we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above structure site.

We believe that the factual data and recommendations contained therein, will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

AGS/ao  
Attach.

cc: Messrs. B. R. Davis  
A. Rutke  
D. W. Pavren  
W. A. Zonnenberg  
L. E. Walker  
B. J. Giroux  
J. R. Roy  
G. A. Wrong  
B. A. Singh

  
A. G. Stermac,  
PRINCIPAL FOUNDATION ENGINEER.

Foundations Files ✓  
Documents

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FOUNDATION INVESTIGATION REPORT  
For  
Proposed C.N.R. Subway  
St. Thomas Expressway Crossing  
City of St. Thomas; County of Elgin  
District #2 (London, Ont.)  
W.O. 71-11066 -- W.P. 83-69-07

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1. INTRODUCTION:

A request for a foundation investigation at the crossing of the proposed St. Thomas Expressway and C.N. R. was received from Mr. T. P. Hodgson, Regional Bridge Location Engineer, in a memorandum dated June 23, 1971.

Following this request, a field investigation was carried out by the Foundation Section to determine the subsoil conditions existing at the site. This report contains the results of this investigation and our recommendations pertaining to the design of the proposed structure foundations and approach embankments.

2. DESCRIPTION OF THE SITE:

The site of the proposed C.N.R. subway structure is located in the City of St. Thomas.

Topographically the general area is flat, the average elevation being at the 750 level. However, the eroding effects of the numerous creeks in this area left the region divided with wide and deep valleys. At this particular location the valley is some 400 ft. wide and approximately 60 ft. deep. The valley walls are relatively steep, covered with bush and trees.

An approximate 50 ft. high, and some 50 years old, single railway line embankment is spanning the valley at the present time. A 6' x 6' concrete box culvert is provided underneath this embankment for drainage purposes.

Physiographically, the site is located in the region referred to as the Mount Elgin Ridges.

### 3. FIELD AND LABORATORY INVESTIGATION PROCEDURES:

A total of five sampled boreholes was carried out during the course of the field work. Boring was achieved by means of conventional diamond drilling equipments adapted for soil sampling purposes. During field work, disturbed samples were obtained by means of a standard split-spoon sampler. The energy used in driving it, conformed to the requirements of the Standard Penetration Test.

The surveying was carried out by personnel from London Region, Engineering Surveys Section. The locations and elevations of the borings are shown on Drawing No. 71-11066A which accompanies this report.

All samples were visually examined and classified at the site as well as in the laboratory. Following this inspection, laboratory tests were carried out on selected samples to determine the following physical properties:

Atterberg Limits

Moisture Content

Grain-Size Distribution

The test results are summarized on the Record of Borehole sheets contained in the Appendix of this report.

### 4. SOIL TYPES AND SOIL CONDITIONS:

#### 4.1) General:

Generally, uniform subsoil conditions exist over the site area. Subsoil consists of fill material for the existing embankment, followed by clayey silt which is underlain by a very dense heterogeneous mixture of granular and cohesive type deposit.

A detailed description of the different deposits is given on the Record of Borehole sheets contained in the Appendix of this report. The estimated stratigraphical profile shown on Drawing 71-11066A, is based upon this information. From ground level downwards, the different soil deposits described in some detail are as follows:

4. SOIL TYPES AND SOIL CONDITIONS: (cont'd) ...

4.2) Fill Material.

This deposit consists of zones of silty clay, clayey silt with sand and gravel, and also occasional layers of sand and gravel, and is the fill material contained in the existing embankment. The vertical extent of the deposit varies, depending on the topography of the original ground. The maximum observed depth (B.H. #5) is approx. 42 ft., but the deepest portion of the valley (creek bed) is approx. 55 ft. The obtained 'N' values (5 to 20 blows/ft.) indicate that consistency of the deposit ranges from firm to very stiff.

A thin layer of organics is underlying this fill material at borehole locations No. 1 and 5.

4.3) Clayey Silt with Sand and Trace of Gravel:

This stratum was encountered immediately below the above described fill material or at original ground level (B.H. #3 and #4). The lower boundary varies between El. 677 and El. 680.

The material in the deposit consists mainly of clayey silt with sand and trace of gravel.

Physical properties of the overall deposit, as determined from field and laboratory tests, are as follows:

	<u>Min.</u>	<u>Max.</u>	<u>Average</u>
Natural Moisture Content (%)	12	27	19
Liquid Limit (%)	20	35	29
Plastic Limit (%)	13	20	16
'N' Values (Blows/ft.)	12	59	27

Typical grain-size distribution curves are included in the Appendix of this report (Fig. 1). Based on Standard Penetration Tests the consistency of the material may be described as stiff to hard.

4.4) Mixture of Clay, Silt, Sand & Gravel:

This deposit underlies the clayey silt stratum at each borehole location and extends for a depth of at least 8 ft. The lower boundary was not determined since the borings were terminated in this layer.

4. SOIL TYPES AND SOIL CONDITIONS: (cont'd) ...

4.4) Mixture of Clay, Silt, Sand & Gravel: (cont'd) ...

The material in the deposit consists of a heterogeneous mixture of clay, silt, sand and gravel, with the following average proportions: clay - 8%, silt - 24%, sand - 58% and gravel - 10%. The natural moisture content ranges from 7 to 15%, the average value being in the order of 10%. Standard penetration tests carried within this zone indicate that the relative density is very dense, the 'N' values being in the order of 87 to over 100 blows per foot.

5. GROUNDWATER CONDITIONS:

The following groundwater levels were observed during the field work:

B.H. #1	El. 712.3
B.H. #2	El. 716.6
B.H. #3	El. 690.6
B.H. #4	El. 690.5
B.H. #5	El. 721.2

It is pointed out that the foregoing quoted figures may not represent the true groundwater levels due to the impermeable nature of the subsoil and the short duration of the field work.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to build a four-span (35'-685'-685'-35') single line overhead railway structure at this location. The proposed structure will be located some 40 ft. west of the existing railway embankment, and the elevation of the future rails will be the same (748.5) as the existing ones.

The construction of the roadway of the St. Thomas Expressway will require the partial excavation of the embankment to the grade level (El. 717+), filling the low-lying valley floor (El. 690+) up to El. 717 and trimming of the natural slopes.

6. DISCUSSION AND RECOMMENDATIONS: (cont'd)

6.1) General: (cont'd) ...

In addition to the construction of a structure, cuts and fills, it will be also necessary to construct some form of a waterway for the creek and the surface run-off water.

6.2) Structure Foundation:

The field investigation has revealed that the upper portion of the subsoil at the proposed footing locations consists of fill material of varying consistency which is considered to be undesirable for spread footing type foundations. To achieve a safe bearing capacity of about 2.0 t.s.f. assuming a safety factor of 3.0, the excavation for this type of footing would have to be carried down to an approximate depth of 25 to 30 ft., which is uneconomical.

In view of the foregoing, it is recommended that the entire structure be supported on piled foundations. For 12 BP 74 Steel 'H' piles a safe design load of 95 tons may be achieved at El. 675±. The pile driving should be controlled by means of the Hiley formula. The footing bases of the abutments may be placed within the approach fills. Care should be taken to ensure that no bouldery fill is placed within the approaches through which piles have to be driven, and it is recommended that this portion of the fill contain no larger grain sizes than 3 inches.

A temporary retaining wall should be provided for the footing excavations to protect the existing railway embankment.

All foundations should be protected against frost action by at least 4 feet of earth cover.

No dewatering problems are anticipated.

6.3) Approach Embankments:

The shear strength of the subsoil is such that it will be able to support the approach embankments constructed with 2:1 forward slopes and 2:1 side slopes. The fill should consist of well compacted acceptable material.

It is estimated that the settlement due to the consolidation of the subsoil caused by embankment loading will be of a minor nature.



6. DISCUSSION AND RECOMMENDATIONS: (cont'd) ...

6.3) Approach Embankments: (cont'd) ...

The topsoil and any soft organic material should be removed in accordance with the pertinent standards within the construction area.

No stability problems are anticipated for the proposed roadway cuts in the original ground provided with 2:1 slopes.

7. MISCELLANEOUS:

The field work was carried out during the period of August 2 - 18, 1971, under the supervision of Mr. P. Payer, Project Foundation Engineer, who also prepared this report.

Equipment was owned and operated by P.V.K. and Sons Drilling Co.

This report was reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

September 1971.

APPENDIX I

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 71-11066 LOCATION 549,138 N; 351,879 E. ORIGINATED BY PP  
 W.P. 88-69-07 BORING DATE August 3 & 4, 1971 COMPILED BY PP  
 DATUM Geodetic BOREHOLE TYPE Washbore, NX & BX Casing CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$				BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %					
												$w_p$ — $w$ — $w_L$					
717.7	Ground Level																
0.0	Fill Material																
	Zones of granular and cohesive type soil		1	SS	15	710										13 37 29 16	
			2	TW	PM												
			3	SS	12	730										10 84 (6)	
			4	SS	10												
			5	SS	5	720											
			6	TW	PM												
			7	SS	12	710										712.3	
707.9	Organics		8	TW	PM											1 13 48 38	
39.8	Clayey silt with traces of sand.		9	SS	56	700											
	Very Stiff to Hard		10	SS	35												
			11	SS	47	690										0 1 55 1	
			12	SS	27												
680.6			13	SS	31												
67.1	Mixture of clay, silt, sand and gravel.		14	SS	162/3"	680										16 42 30 12	
	Very Dense		15	SS	100/3"											0 42 39 10	
668.6			16	SS	100/3"	670											
79.1	End of Borehole					660											

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 71-11066

LOCATION 548,934 N; 351,902 E.

ORIGINATED BY PP

W.P. 88-69-07

BORING DATE August 10 & 11, 1971

COMPILED BY PP

DATUM Geodetic

BOREHOLE TYPE Washbore, NX & BX Casing

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— $w_L$ PLASTIC LIMIT ——— $w_p$ WATER CONTENT ——— $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT % 10 20 30				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE									
748.0	Ground Level															
0.0	Fill Material		1	SS	19	740										15 45 28 12
738.7	Zones of silty clay & clayey silt with sand and gravel.		2	SS	17											
9.3			3	SS	32											4 14 54 28
	Clayey silt with sand and trace of gravel.		4	SS	31	730										
			5	SS	21											
	Firm to Hard.		6	SS	12	720										716.6 ▼
			7	TW	PM											
			8	TW	PM	710									134	1 20 48 31
			9	SS	22											
			10	SS	29	700										1 14 45 50
			11	TW	PM										140	5 17 48 30
			12	SS	31	690										
			13	SS	31											
677.4			14	SS	59	680										
70.6	Mixture of clay, silt, sand & gravel.		15	SS	87											3 90 ( 7 )
670.2	Very Dense															
77.8	End of Borehole					670										

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 71-11066 LOCATION 549,100 N; 351,751 E.ORIGINATED BY PPW.P. 88-69-07 BORING DATE Aug. 10, 1971COMPILED BY PPDATUM Geodetic BOREHOLE TYPE Washbore, NX CasingCHECKED BY PP

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT %				
							○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB. VANE	$w_p$	$w$	$w_L$		
694.9	Ground Level												
0.0	Clayey silt with sand & trace of gravel. Very Stiff to Hard		1	TW	TM	690		3255				129	690.6
			2	SS	31								
677.9			3	SS	60	680							
176.4	Mix. of clay, silts, & gr. 82%		4	SS	254								
19.3	End of Borehole					670							

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 11

FOUNDATION SECTION

JOB 71-11066 LOCATION 510,043 N; 351,754 E.ORIGINATED BY PPW.P. 88-69-07 BORING DATE August 11, 1971COMPILED BY PPDATUM Geodetic BOREHOLE TYPE Washbore, NX CasingCHECKED BY PP

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.				WATER CONTENT % 10 20 30				
697.3	Ground Level														
0.0	Clayey silt with sand & trace of gravel.		1	SS	30	690									690.5
	Very Stiff to Hard		2	SS	36										2 16 57 25
678.5			3	SS	37	680									
18.8	Mixture of clay, silt, sand and gravel.		4	SS	96/6"										
671.0	Very Dense		5	SS	71/2 6"										
26.3	End of Borehole					670									

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 71-11066

LOCATION 549,036 N; 351,893 E.

ORIGINATED BY PP

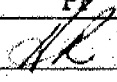
W.P. 88-69-07

BORING DATE August 16 & 17, 1971

COMPILED BY PP

DATUM Geodetic

BOREHOLE TYPE Washbore-NX & BX Casing

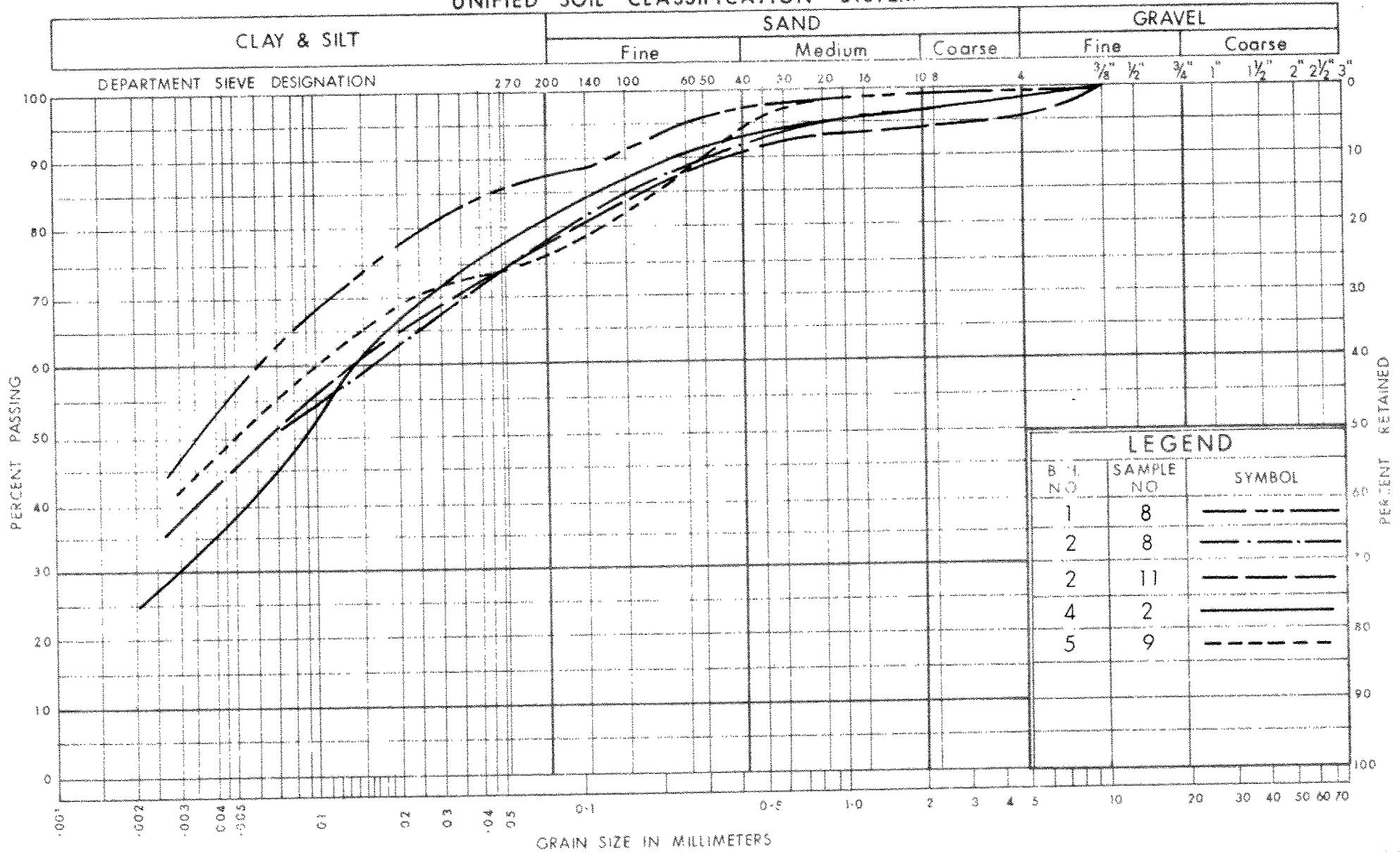
CHECKED BY 

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— w <sub>L</sub> PLASTIC LIMIT ——— w <sub>p</sub> WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT % w <sub>p</sub> ——— w ——— w <sub>L</sub>				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE									
748.2	Ground Level															
0.0	Fill Material		1	SS	13											
	Zones of silty clay and clayey silt with sand and gravel		2	SS	20	740									3 7 45 45	
			3	SS	6											
			4	TW	FM	730								122	1 27 50 22	
			5	SS	5											
			6	SS	10	720									721.7 1 10 45 44	
			7	SS	11											
			8	SS	16	710										
706.2			9	SS	32											
42.0	Clayey silt with sand and trace of gravel.		10	SS	30	700									1 25 39 35	
	Very Stiff to Hard		11	SS	27											
			12	SS	30	690										
			13	SS	46											
680.4			14	SS	83.4"	680										
67.8	Mixture of clay, silt, sand and gravel.		15	SS	82.6"											
	Very Dense		16	SS	92.9"	670										
668.4																
79.8	End of Borehole					660										

20  
15-5 % STRAIN AT FAILURE  
10



# UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT  
OF  
TRANSPORTATION AND COMMUNICATIONS



DESIGN SERVICES  
BRANCH

GRAIN SIZE DISTRIBUTION  
CLAYEY SILT  
SAND & TRACE OF GRAVEL

W.P. No. 88-69-07

JOB No. 71-11066

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 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
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
$C_o$	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
$K_o$	COEFFICIENT OF EARTH PRESSURE AT REST

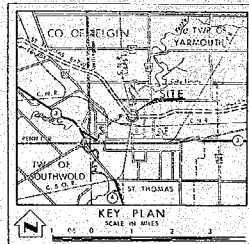
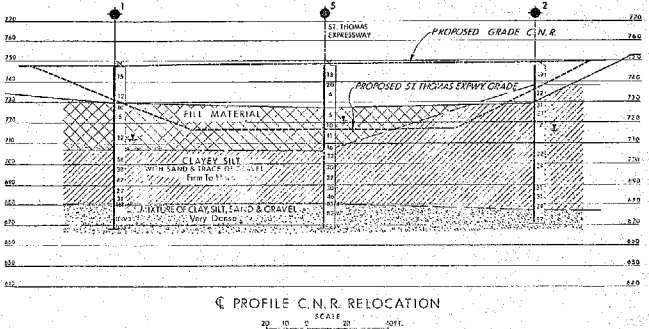
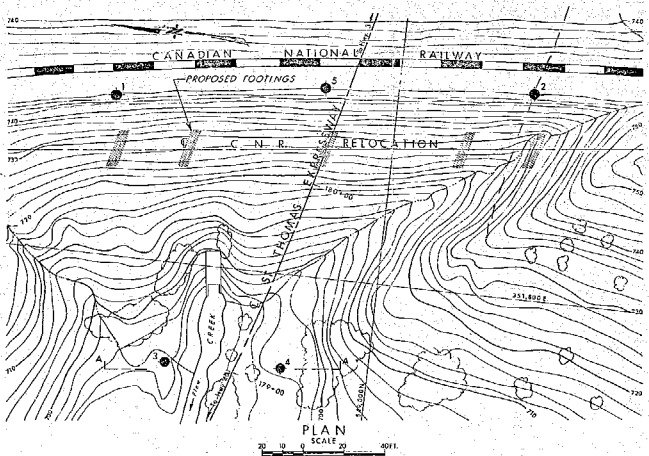
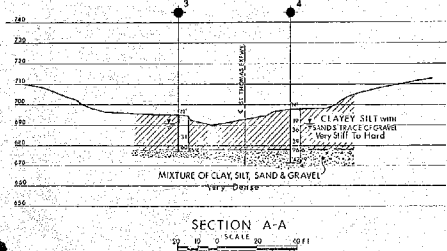
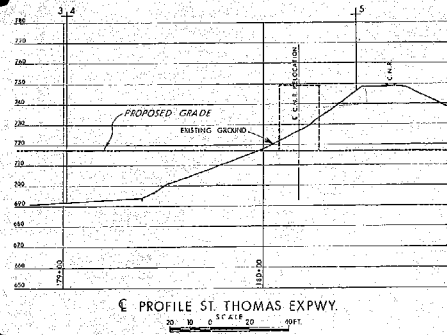
### FOUNDATIONS

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

# OVERSIZE DRAWING



# LEGEND

- ◆ Bore Hole
- ◆ Core Restoration Test
- ◆ Bore Hole & Core Test
- ◆ Water Level established at time of field investigation (AUGUST 1971)

NO.	ELEVATION	CO-ORDINATES	NO.	ELEVATION	CO-ORDINATES
1	247.2	545,131	5	248.2	551,879
2	248.0	548,834	6	251.922	551,922
3	249.9	549,100	7	251,721	551,721
4	247.2	549,043	8	249.036	551,843
5	248.2	549,036	9	251,843	551,843

NOTE

The boundaries between soil strata have been established by the Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

NO.	ELEVATION	CO-ORDINATES	NO.	ELEVATION	CO-ORDINATES
1	247.2	545,131	5	248.2	551,879
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DEPARTMENT OF TRANSPORTATION & COMMUNICATIONS  
DESIGN, RESEARCH BRANCH - FORM 100-1 (REV. 1964)

C.N.R. SUBWAY

HIGHWAY NO. ST. THOMAS EXPY. DIST. NO. 2  
CO. ELGIN CITY OF ST. THOMAS  
TWP. YARNOOTH DIST. 100-1

BORE HOLE LOCATIONS & SOIL STRATA

STANDARD P.P. 100-1 DIST. NO. 2  
DATE OF INVESTIGATION 7-1-1966  
PROJECT NO. 71-11066  
SHEET NO. 1 OF 1  
APPROVED BY [Signature] DATE 7-1-1966  
DRAWN BY [Signature] DATE 7-1-1966  
CHECKED BY [Signature] DATE 7-1-1966  
REVISION NO. 1

71-11066A