

#66-F-64

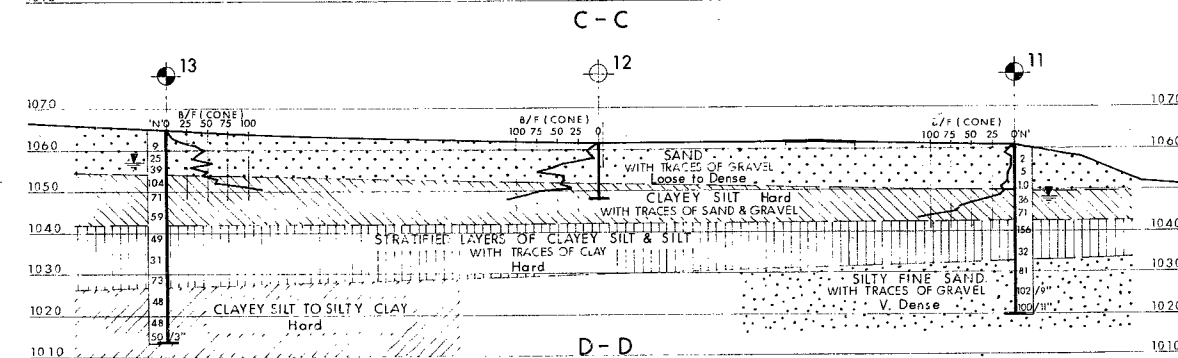
W.P. #640-64

KITCHENER

WATERLOO

EXPRESSWAY

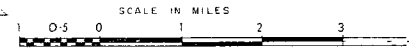
BRIDGEPORT  
ROAD







20 10 0 SCALE 20 40 FT.



A horizontal graphic scale bar with tick marks. The numbers 20, 10, 0, 20, and 40 are placed above the bar. The word "SCALE" is centered above the bar. The unit "FT" is at the far right end.



 Bore Hole  
 Cone Penetration Hole  
 Bore & Cone Penetration Hole  
 Water Levels established at time of field investigation. JUNE 1966

- NOTE -

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

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION - FOUNDATION SECTION

BRIDGEPORT ROAD

KING'S HIGHWAY NO. KITCHENER-WATERLOO EXPRY. DIST. NO. 4  
CO. WATERLOO CITY OF KITCHENER  
TWP. LOT CON.

BORE HOLE LOCATIONS &amp; SOIL STRATA

SUBMD D. W.	CHECKED	W. P. NO.	640 - 64	M. B. T. DRAWING NO
DRAWN S. O.	CHECKED	JOB NO.	66 - F - 64	66 - F - 64A
DATE	24 AUG 1966	SITE NO		BRIDGE DRAWING NO
APPROVED	<i>[Signature]</i>	CONT NO		

cc: GEN. FILES 23-68-62

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. B. R. Davis,  
Bridge Engineer,  
Bridge Division.

Attention: Mr. S. McCombie

FROM: Foundation Section,  
Materials & Testing Div.,  
Room 107, Lab. Bldg.

DATE: August 17, 1966

OUR FILE REF.

IN REPLY TO

AUG 31 1966

SUBJECT:

FOUNDATION INVESTIGATION REPORT  
For

Bridgeport Road Overpass  
Kitchener-Waterloo Expressway  
District #4 (Hamilton)

W.J. 66-F-64 -- W.P. 640-64

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 be adequate for your design requirements. Should additional information be required, please feel free to contact our Office.

AGS/MdeF  
Attach.

cc: Messrs. B. R. Davis (2)  
H. A. Tregaskes  
D. W. Farren  
A. Gater  
H. Greenland  
J. Roy  
W. S. Melinyshyn  
W. L. Bradley  
A. D. Margison Ltd.  
University of Waterloo  
Foundations Office  
Gen. Files

*A. G. Stermac*  
A. G. Stermac,  
PRINCIPAL FOUNDATION ENGINEER

## TABLE OF CONTENTS

1. INTRODUCTION.
2. SITE DESCRIPTION.
3. FIELD WORK.
4. LABORATORY TESTING.
5. SOIL TYPES AND SOIL CONDITIONS:
  - 5.1) General.
  - 5.2) Sand with traces of Silt.
  - 5.3) Clayey Silt.
  - 5.4) Silty Fine Sand to Sandy Gravel.
6. GROUNDWATER.
7. DISCUSSION AND RECOMMENDATIONS:
  - 7.1) General.
  - 7.2) Structure.
  - 7.3) Dewatering of Excavation.
  - 7.4) Stability of the Approach Fills.
8. SUMMARY.
9. MISCELLANEOUS.

FOUNDATION INVESTIGATION REPORT  
For  
Bridgeport Road Overpass  
Kitchener-Waterloo Expressway  
District #4 (Hamilton)  
W.J. 66-F-64    --    W.P. 640-64

1. INTRODUCTION:

A request was received from the Bridge Location Section (in a memorandum from Mr. W. S. Melinyshyn, dated April 15, 1966), to conduct a foundation investigation for the proposed Bridgeport Rd. overpass, Kitchener-Waterloo Expressway. Presented in this report are the results of the subsequent field investigation, together with laboratory test results and recommendations pertaining to the proposed structure foundations.

2. SITE DESCRIPTION:

The site is located some 1,000 feet west of the east boundary of the Waterloo City Limits on Bridgeport Road. The area in the vicinity of the site is generally flat or gently rolling, with a depression on the east extremes of the two footings on the north side of Bridgeport Road.

Physiographically, the site is located in the region referred to as the "Waterloo Hills." Soils in this region consist generally of well-drained glacio-fluvial deposits.

3. FIELD WORK:

Six sampled boreholes and twelve dynamic cone penetration tests were carried out during the course of field work.

Drilling equipment consisted of a conventional diamond drill adapted for soil sampling purposes. 'Disturbed' samples were recovered at required depths by means of a standard split-spoon sampler driven into the soil by means of a 140-lb. hammer imparting an energy of 350 ft.-lbs. per blow.

3. FIELD WORK: (cont'd.) ...

Samples were visually examined in the field before being transported to the laboratory, and were classified and recorded on field borelog sheets, together with all observed data relating to changes in soil stratigraphy and groundwater conditions.

The borehole locations were set out and surveyed in the field by personnel from A. D. Margison and Associates, Consultant Professional Engineers, Toronto, Ontario. The locations and the ground elevations of the borings are shown on Drawing 66-F-64A, which is contained in the Appendix of this report.

4. LABORATORY TESTING:

Tests were carried out on a number of selected representative samples, primarily for classification purposes. All samples were again carefully visually examined in the laboratory. A summary of these tests is shown on the Record of Borelog sheets appended in this report.

5. SOIL TYPES AND SOIL CONDITIONS:

5.1) General:

Subsoil at the site consists of sand overlying clayey silt and silty fine sand. The boundaries between the different soil strata are shown on the borelog sheets contained in the Appendix of this report. The estimated stratigraphical profiles shown on Drawing #66-F-64A, are based upon this information. A description of the different soil types encountered in the boreholes follows:

cont'd. /3 ...

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

5.2) Sand with traces of Silt:

This deposit consists mainly of fine sand with traces of silt and occasional gravel. It is very thick on the south side of Bridgeport Rd. and extends to 50 feet in B.H. #5 and 33 feet in B.H. #3. On the north side it is much shallower, ranging from 8 ft. deep in B.H. #9 to 11 ft. deep in B.H.'s #11 and 13. The relative density is generally loose for the first few feet near the ground surface and becomes dense to very dense at greater depths. The 'N' values obtained from Standard Penetration tests, ranged from 2 to 140 blows/ft.

5.3) Clayey Silt:

This deposit underlies the sand. It consists mainly of clayey silt, occasionally with traces of sand and gravel. It is essentially a cohesive soil, ranging in degree of plasticity from low to intermediate. The material accordingly is classified as clayey silt (CL) to silty clay (CI). The Standard Penetration tests showed the 'N' values ranged from 36 to more than 100 blows/ft., indicating a hard consistency. Atterberg limit tests are summarized as follows:

	<u>Max.</u>	<u>Min.</u>	<u>Average</u>
Liquid Limit	48.3	23.5	31.0
Plastic Limit	20.0	13.4	16.0
Moisture Content	23.7	10.8	17.0

The moisture content within this deposit was found to be generally close to the plastic limit.

Based on the foregoing, the undrained shear strength is estimated to be more than 4,000 p.s.f.

cont'd. /4 ...

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

5.4) Silty Fine Sand to Sandy Gravel:

This non-cohesive deposit was found underlying the clayey silt or interbedded between two layers of clayey silt. The average moisture content is about 18%. The 'N' values obtained from Standard Penetration tests, ranged from 45 to 114 blows/ft., indicating a very dense relative density.

6. GROUNDWATER:

Groundwater levels observed during the period of field investigation, ranged from El. 1057.0 in B.H. #13 to El. 1048.3 in B.H. #11. The exact groundwater levels in each borehole are shown in the Record of Borelog sheets.

7. DISCUSSION AND RECOMMENDATIONS:

7.1) General:

It is proposed to construct an overpass structure at this site. The bridge presently proposed is a four-span structure. The grade on Bridgeport Road will be unchanged and the finished Expressway approaches will be approximately 20 ft. in height.

7.2) Structure:

It is recommended that the structure be founded on large displacement piles. For this purpose, 12-3/4" O.D. steel tubes or 12" Ø precast concrete piles may be used and should be driven to approximate elevation 1040 for the South abutment, 1045 for the North abutment, and 1030 for both piers #1 and 2. A safe capacity of 50 tons/pile may be used for design purposes. The pile caps should be placed at about 5 ft. below finished ground level for frost protection purposes.

As an alternative, piers #1 and 2 may be founded on spread footings at or below elevation 1050, in which case, a safe



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

7.2) Structure: (cont'd.) ...

net pressure of 2.5 t.s.f. may be assumed for design purposes.

Due to the depression at the East extreme of Pier #2, the one adjacent to the North abutment, soft material may be encountered below elevation 1050, which should be removed and replaced with mass concrete.

If the above recommendations are followed, differential settlements are expected to be of negligible order.

7.3) Dewatering of Excavation:

If spread footings are constructed for Piers #1 and 2, permeable soils may be encountered in the excavations. The ground-water level observed during the time of the field investigation at Pier #1 was about elevation 1050 and higher for Pier #2.

A sump-and-pump operation is considered to be adequate to dewater Pier #1, while at Pier #2, steel sheeting driven to a depth equal to the unbalanced water head below the excavation is recommended to prevent 'boiling' of the bottom of the excavation.

7.4) Stability of the Approach Fills:

No stability problems for the proposed approach fills are anticipated provided standard 2:1 slopes are constructed.

8. SUMMARY:

A foundation investigation at the proposed crossing of Bridgeport Rd. and Kitchener-Waterloo Expressway is reported.

Subsoil at the site consists of sand with traces of silt extending to varying depths from 33 ft. to 50 ft. below ground surface on the south side of Bridgeport Rd. and very shallow, about 8 ft. deep, on the north side of Bridgeport Rd., overlying the deposit of clayey silt which in turn, overlies or is interbedded with silty fine sand to sandy gravel.

cont'd. /6 ...

8. SUMMARY: (cont'd.) ...

It is recommended that the proposed structure be founded on large displacement piles. The piers, as an alternative, may be supported by spread footings.

Differential settlements are expected to be of a negligible order.

Schemes for dewatering at various locations are discussed.

No stability problems are anticipated for the proposed approach fills provided standard 2:1 slopes are constructed.

9. MISCELLANEOUS:

The field work for this project was carried out during the period of June 16 - 22, 1966, under the supervision of Mr. D. T. Wan, Project Foundation Engineer, who also prepared this report. Mr. K. G. Selby, Supervising Foundation Engineer, generally supervised the entire project and reviewed this report.

Equipment used was owned and operated by Dominion Soil Investigation Limited.

August 1966

APPENDIX I.

**A. D. MARGISON AND ASSOCIATES LIMITED**  
**CONSULTING PROFESSIONAL ENGINEERS**

1155 LESLIE STREET, DON MILLS, ONTARIO

TELEPHONE TORONTO 447-9171

ASSOCIATE

WILLIAM A. STEWART, B.A. SC., P. ENG. TRANSPORTATION AND MUNICIPAL  
HARLE B. LONG, M.R.A.I.C. CHIEF ARCHITECT  
CHARLES S. WIFFEN, P. ENG. INDUSTRIAL AND POWER  
JOHN H. DOUGLAS, B.A., P. ENG. MINING

ASSOCIATE

HAROLD E. SUNDSTROM, B. ARCH., M.R.A.I.C. ARCHITECTURAL  
GERALD P. MASON, B. SC., P. ENG. STRUCTURAL  
JOHN T. THORPE, B. ENG., P. ENG. MECHANICAL  
ROBERT A. CUNNINGHAM, B. SC., P. ENG. SUPERVISION OF CONSTRUCTION

7th February, 1967

Mr. K. G. Selby, P. Eng.,  
Supervising Foundation Engineer,  
Department of Highways, Ontario,  
Downsview, Ontario.

Re: Kitchener-Waterloo Expressway  
Projects Nos. 2119 and 2143

Dear Sir:

Please find enclosed tables listing elevations and  
coordinates for boreholes for structures on the above projects.

Yours very truly,

A. D. MARGISON AND ASSOCIATES LIMITED

Encls.  
GS:rm

  
G. Solty, P. Eng.

A. D. Margison and Associates Limited  
Consulting Professional Engineers

RETAINING WALLS AT LANCASTER STREET

W. P. 639-64

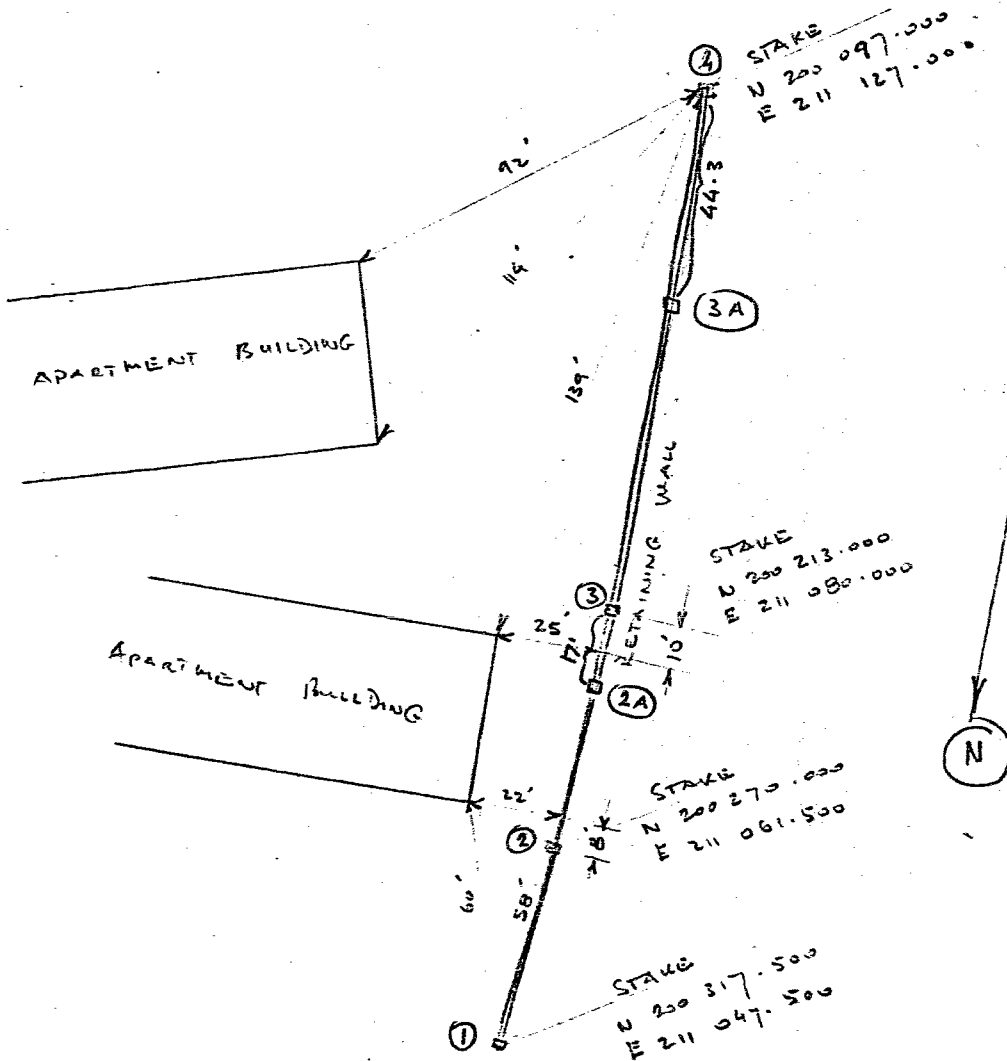
Project No. 2125

66-F-64

<del>STAKE</del> No.	North Coordinate	East Coordinate	Ground Elevation
1	206,426.500	207,378.600	1064.25
2	206,460.500	207,379.000	1062.16
3	206,636.000	207,378.400	1053.51
4	206,751.500	207,375.700	1053.75

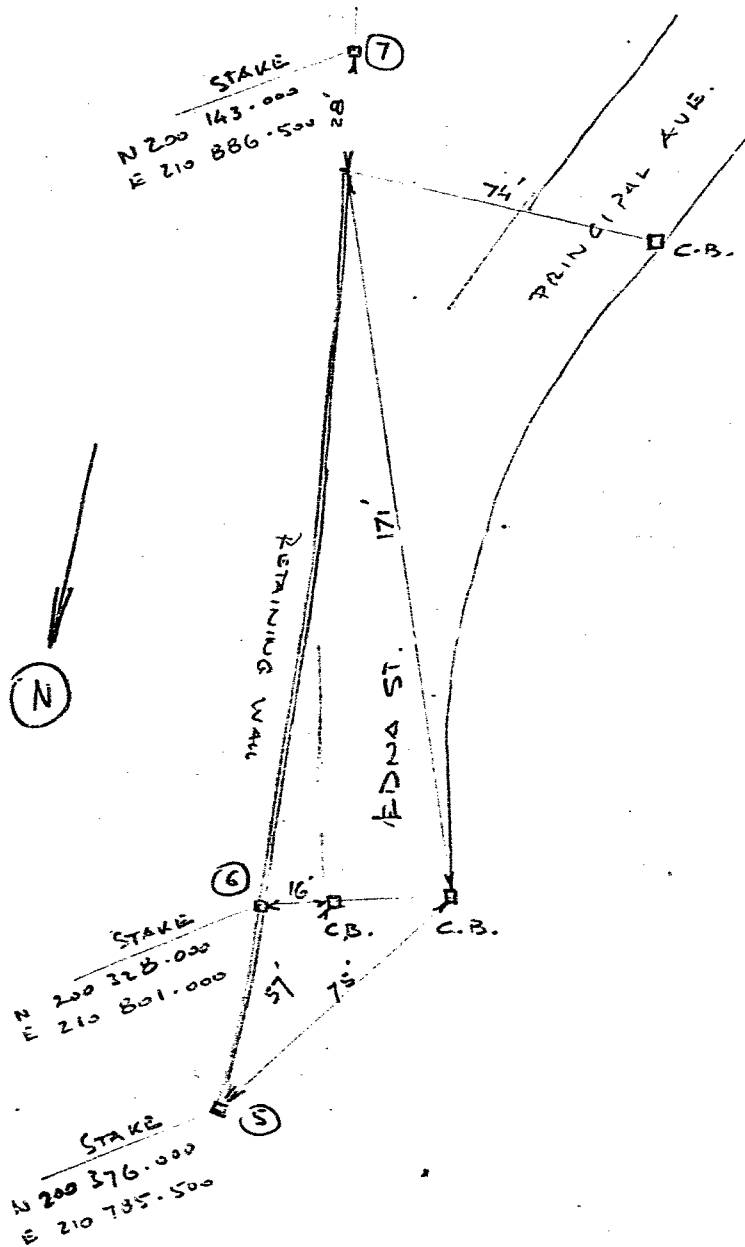
# RETAINING WALL AT EDNA ST

EAST SIDE



# RETAINING WALL AT EDNA ST.

WEST SIDE



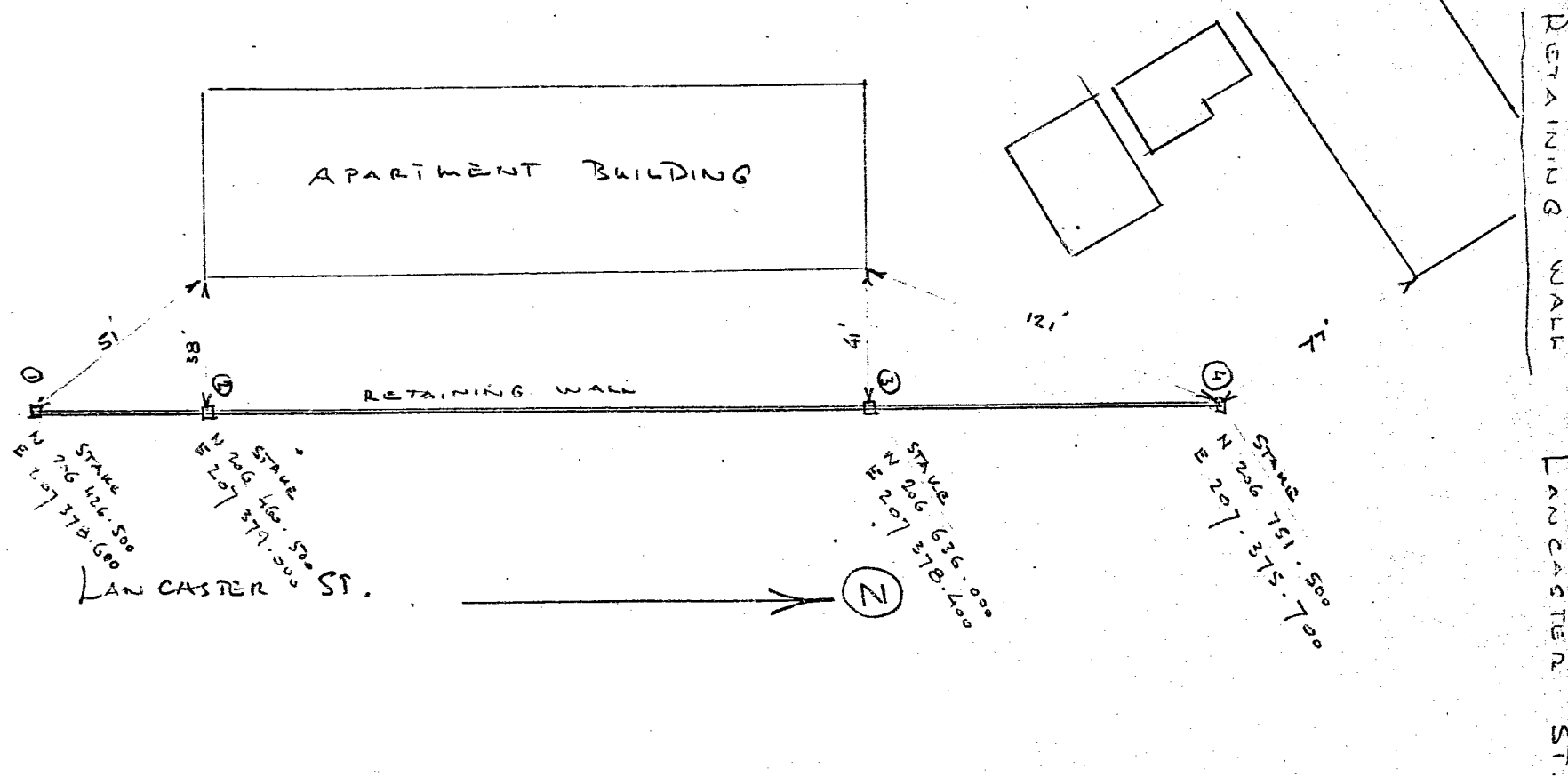
# 66-F-64

BH #15	1064.3	206,426 N	207,378 E
BH #14	1059.8	206,511 N.	207,378 E
BH #13	1055.5	206,592 N.	207,378 E.
BH #12	1053.5	206,678 N.	207,378 E
BH #11	1053.5	206,731 N	207,371 E.

BH.'s are shown as green circles



NOT TO SCALE



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

# RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 66-F-64

LOCATION N 206,435.562 E 205,093.423

ORIGINATED BY D.W.

W.P. 640-64

BORING DATE June 16, 1966

COMPILED BY W.E.

DATUM Geodetic

BOREHOLE TYPE Washboring & Penetration

CHECKED BY K.G.S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WP	WL	W		
1062.4 0.0	Groundlevel															
	Sand with traces of silt.  Dense to very dense.		1	SS	63	1060										
			2	SS	83											
			3	SS	70											
			4	SS	61	1050										
			5	SS	57											
			6	SS	71	1040										
			7	SS	44											
			8	SS	41	1030										
			9	SS	103											
			10	SS	106	1020										
			11	SS	140	1011"										
1006.4 48.0	Silt with traces of clay, v. dense		12	SS	114	1010										
1010.9 51.5	End of borehole.															

100/6"

▽ G.W.L.  
E1. 1049.3  
Sa 83%  
Si 17%

Gr 1%  
Sa 88%  
Si 11%

Sa 1%  
Si 88%  
Cl 11%



### FOUNDATION SECTION

JOB 66-F-64 LOCATION N 206.376.041 E 204.961.447 ORIGINATED BY D.W.  
W.P. 640-64 BORING DATE June 17, 1966 COMPILED BY W.E.  
DATUM Geodetic BOREHOLE TYPE Washboring & Penetration CHECKED BY K.G.S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT ——— WL	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W	BULK DENSITY  P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20    40    60    80    100					
							SHEAR STRENGTH P.S.F.					
								WP         W         WL				
1060.2	Groundlevel					1060						
0.0												
	Sand with traces of silt to fine sandy silt.		1	SS	8							Sa 92%
			2	SS	17							Si 8%
			3	SS	17	1050						$\nabla$ G.W.L.
	Loose to dense.		4	SS	35							El. 1050.3
			5	SS	31							
			6	SS	35	1040						
			7	SS	22							
			8	SS	42	1030						
1027.2												
33.0	Clayey silt		9	SS	36							
1022.2	Hard											
	Brownish grey.											
38.0						1020						
	Silty fine sand		10	SS	49							
	Very dense		11	SS	45							
1012.2												
48.0	Sandy gravel		12	SS	89	1010						
	Very dense											
1007.2												
53.0	Sand		13	SS	67							
1004.2	Very dense											
	Clayey silt. Hard											
1003.7	End of borehole											
56.5						1000						

DEPARTMENT OF HIGHWAYS - ONTARIO

# RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 66-F-64 LOCATION N 206,451.168 E 205,071.359 ORIGINATED BY D.W.  
W.P. 640-64 BORING DATE June 22, 1966 COMPILED BY W.E.  
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY K.G.S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WATER CONTENT % WP — W — WL				
1061.7	Groundlevel					1060										
0.0						1050										
1046.8																
14.9	End of Penetration.					1040										

110/11"



DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS & TESTING DIVISION

## RECORD OF BOREHOLE NO. 6

### FOUNDATION SECTION

JOB 66-F-64

LOCATION N 206.375.080 E 204.899.038

ORIGINATED BY D.W.

W. P. 640-64

BORING DATE June 22, 1966

COMPILED BY W.E.

DATUM Geodetic

BOREHOLE TYPE Dynamic Cone Penetration Test

CHECKED BY K.G.S.

[illegible]

FOUNDATION SECTION

CHECKED BY K.G.S.

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT	PLASTIC LIMIT ——— WP			
							20 40 60 80 100	WATER CONTENT ——— W			
							SHEAR STRENGTH P.S.F.		WP ——— WL		
									WATER CONTENT %		
1060.8	Groundlevel										
0.0						1060					
						1050					
1044.2											
16.6	End of Penetration					1040					



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS &amp; TESTING DIVISION

## RECORD OF BOREHOLE NO. 9

FOUNDATION SECTION

JOB 66-F-64

LOCATION N 206,464.162, E 204,899.052

ORIGINATED BY D.W.

W.P. 640-64

BORING DATE June 20, 1966

COMPILED BY W.E.

DATUM Geodetic

BOREHOLE TYPE Washboring and Penetration

CHECKED BY K.G.S. *K.R.*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	20	40	60	80	100	WP		
1061.4	Groundlevel					1060									
0.0	Sand (Topsoil)		1	SS	4										
1056.4	Loose		2	SS	5										
5.0	Sand with traces of silt, loose.		3	SS	38										
1053.4			4	SS	65	1050									
8.0			5	SS	54										
	Clayey silt with occasional sand and gravel.		6	SS	54	1040									
	Very stiff to hard.		7	SS	30										
	Brownish grey.		8	SS	38	1030									
			9	SS	21										
1022.9															
38.5	Silty fine sand		10	SS	51	1020									
1018.4	Very dense														
43.0	Sandy gravel		11	SS	45										
1014.9	Very dense														
46.5	End of borehole.					1010									

50/4.5"

Gr 42%  
Sa 48%  
Si 10%

▽ G.W.L.  
El. 1054.3

DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS &amp; TESTING DIVISION

RECORD OF BOREHOLE NO. 10

FOUNDATION SECTION

JOB 66-F-64 LOCATION N 206,426.302 E 204,821.344 ORIGINATED BY D.W.  
W.P. 640-64 BORING DATE June 22, 1966 COMPILED BY W.E.  
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY K.G.S. *W*

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT ——— WL			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W	WATER CONTENT %		
							20 40 60 80 100		WP ——— WL	W ——— WL			
1062.7	Groundlevel												
0.0						1060							
1049.7						1050							
13.0	End of Penetration					1040							

DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS &amp; TESTING DIVISION

JOB 66-F-64

LOCATION N 206,542,461 E 204,961,237

ORIGINATED BY D.W.

W.P. 640-64

BORING DATE June 21, 1966

COMPILED BY W.E.

DATUM Geodetic

BOREHOLE TYPE Washboring and Penetration

CHECKED BY K.G.S. AR

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W		
							20 40 60 80 100				
							SHEAR STRENGTH P.S.F.		WATER CONTENT % 15 30 45		
1060.8	Groundlevel					1060					
	Sand (fill)										
	Very loose		1	SS	2						
1055.8	Sand (topsoil)		2	SS	5						
5.0	Loose										
1052.8	Sand with some silt		3	SS	10	1050					
8.0	Loose										
1049.8	Clayey silt with traces of sand and gravel.		4	SS	36						
11.0	Hard		5	SS	71						
1042.8	Silt with traces of clay. Hard.		6	SS	156	1040					
18.0	Clayey silt		7	SS	32						
1037.8	Hard										
23.0	Brownish grey		8	SS	81	1030					
1032.8	Silty fine sand with traces of gravel.		9	SS	100/9"						
28.0	Very dense										
1019.4	End of borehole.		10	SS	100/11"	1020					
41.4						1010					

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W		
							20 40 60 80 100		WP WL		
							SHEAR STRENGTH P.S.F.		WATER CONTENT %		
061.7	Groundlevel										
0.0						1060					
047.9						1050					
13.8	End of Penetration					1040					

[illegible]

## ABBREVIATIONS USED IN THIS REPORT

### PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - 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>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

### TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H.		SAMPLE ADVANCED HYDRAULICALLY
	P.M.		SAMPLE ADVANCED MANUALLY

### SOIL TESTS

Q <sub>u</sub>	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Q <sub>cu</sub>	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q <sub>d</sub>	DRAINED TRIAXIAL	S	SENSITIVITY

## 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
$C_c$	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
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE OR FRICTION
$c_u$	APPARENT COH
$\phi_u$	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

MEMORANDUM

66-F-64

To: Mr. A. G. Stermac,  
Principal Foundation Engineer,  
Room 107, Lab. Bldg.

FROM: Bridge Division,  
Downsview, Ontario.

DATE: October 27, 1966.

OUR FILE REF.

IN REPLY TO:

SUBJECT: The Kitchener-Waterloo Expressway,  
Frederick Street Underpass,  
66-F-531 W.P. 634-64,  
66-F-36 The Victoria Street Underpass,  
W.P. 635-64,  
66-F-43 The Wellington Street Underpass,  
W.P. 637-64,  
and the Bridgeport Road Overpass,  
66-F-64 W.P. 640-64,  
District No. 4.

Attached please find prints of our preliminary bridge drawings for each of the above structures.

Would you please review our plans to see that they conform with the recommendations of your Foundation Investigations and inform us of your comments and/or approval at your earliest convenience.

WSL/im  
Attach.

*J. E. Melnyshyn*  
J. E. Melnyshyn,  
Regional Bridge Location Engineer.



66-F64

Mr. S. McCombie,  
Bridge Planning Engineer,  
Bridge Division.

Foundation Section,  
Materials & Testing Div.,  
Room 107, Lab. Bldg.

Attention: Mr. W. S. Melinyshyn,  
Regional Bridge  
Location Engr.

November 15, 1966

Review of Preliminary Plans --	Kitchener-Waterloo Expressway	
Frederick Street Underpass	.....	W.P. 634-64-66-F-5
Victoria Street Underpass	.....	W.P. 635-64-66-F-36
Wellington Street Underpass	.....	W.P. 637-64-66-F-4
Bridgeport Road Overpass	.....	W.P. 590-64-66-F-64
--	District #4 (Hamilton)	--

We have reviewed the preliminary plans for the above mentioned proposed structures. We note that the designers have complied with the recommendations contained in the pertinent foundation report.

For Frederick Street Underpass, no footing elevations are shown: however, Mr. W. S. Melinyshyn advises us that the footing levels are as recommended in the foundation report.

RSS/MieF

cc: Foundations Office  
Gen. Files

A. G. Selby,  
SUPERVISING FOUNDATION ENGR.  
For:  
A. G. Starnac,  
PRINCIPAL FOUNDATION ENGR.