

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 40P7-46

DIST. 3 REGION

W.P. No. 49-82-05

CONT. No. 88-12

W. O. No.

STR. SITE No. 33-165-125

HWY. No. 7/8

LOCATION Niila River / Hwy 7 & 8

No of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST. 3 HWY. 7&8

CONT No

WP No 49-82-05

NITH RIVER BRIDGE
3.2 KM WEST OF REG. RD. 6
GENERAL ARRANGEMENT

SHEET

Fenco

FENCO ENGINEERS INC.

NOTES:

CLASS OF CONCRETE

FOOTINGS & ROADWAY PROTECTION 20 MPa
REMAINDER EXCEPT AS NOTED 30 MPa

REINFORCING STEEL

REINFORCING STEEL SHALL BE GRADE 400
UNLESS OTHERWISE SPECIFIED. BAR MARKS
WITH THE SUFFIX 'C' DENOTE COATED BARS.

CLEAR COVER TO REINF. STEEL

FOOTINGS 100 ± 25
ABUTMENTS
FRONT FACE 80 ± 20
BACK FACE 70 ± 20
PIERS 80 ± 20
DECK - TOP 70 ± 20
- BOTTOM 40 ± 10
BARRIER WALLS & APPROACH SLABS 70 ± 20
UNLESS OTHERWISE NOTED.

CONSTRUCTION NOTES

THE CONTRACTOR SHALL FINISH THE
BEARING SEATS DEAD LEVEL TO THE
SPECIFIED ELEVATION WITH A
TOLERANCE OF ± 3 mm.

NAVIGATIONAL CLEARANCE NEED NOT
BE PROVIDED DURING CONSTRUCTION

CONSTRUCTION SEQUENCE

STAGE I

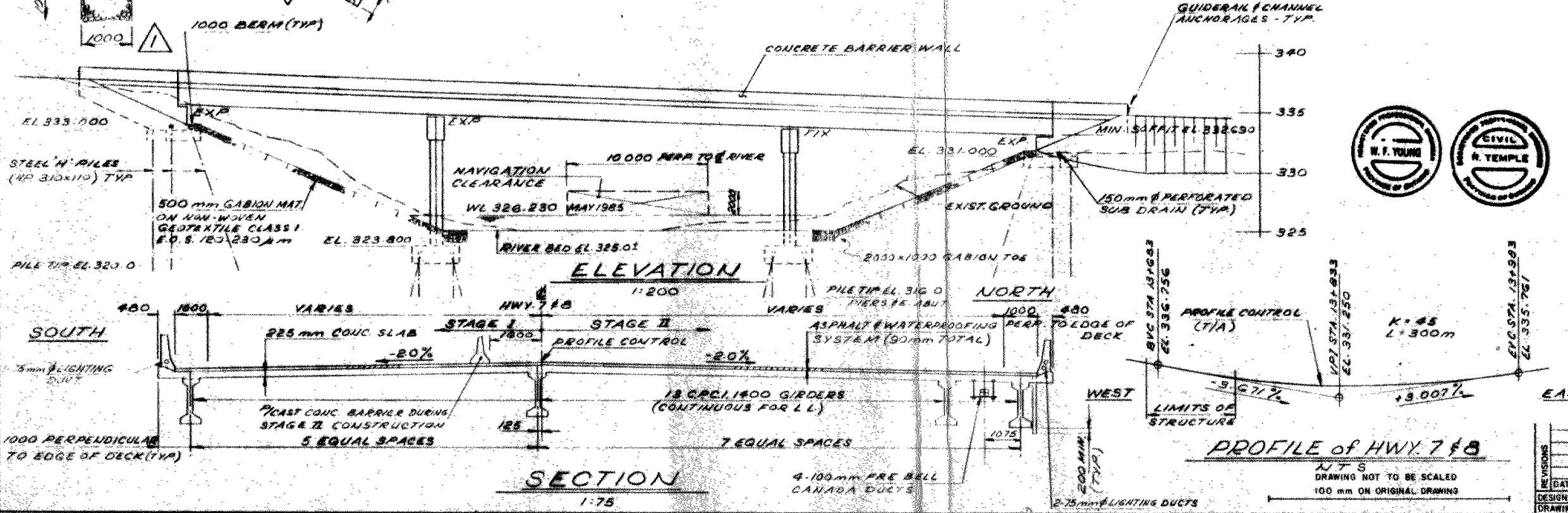
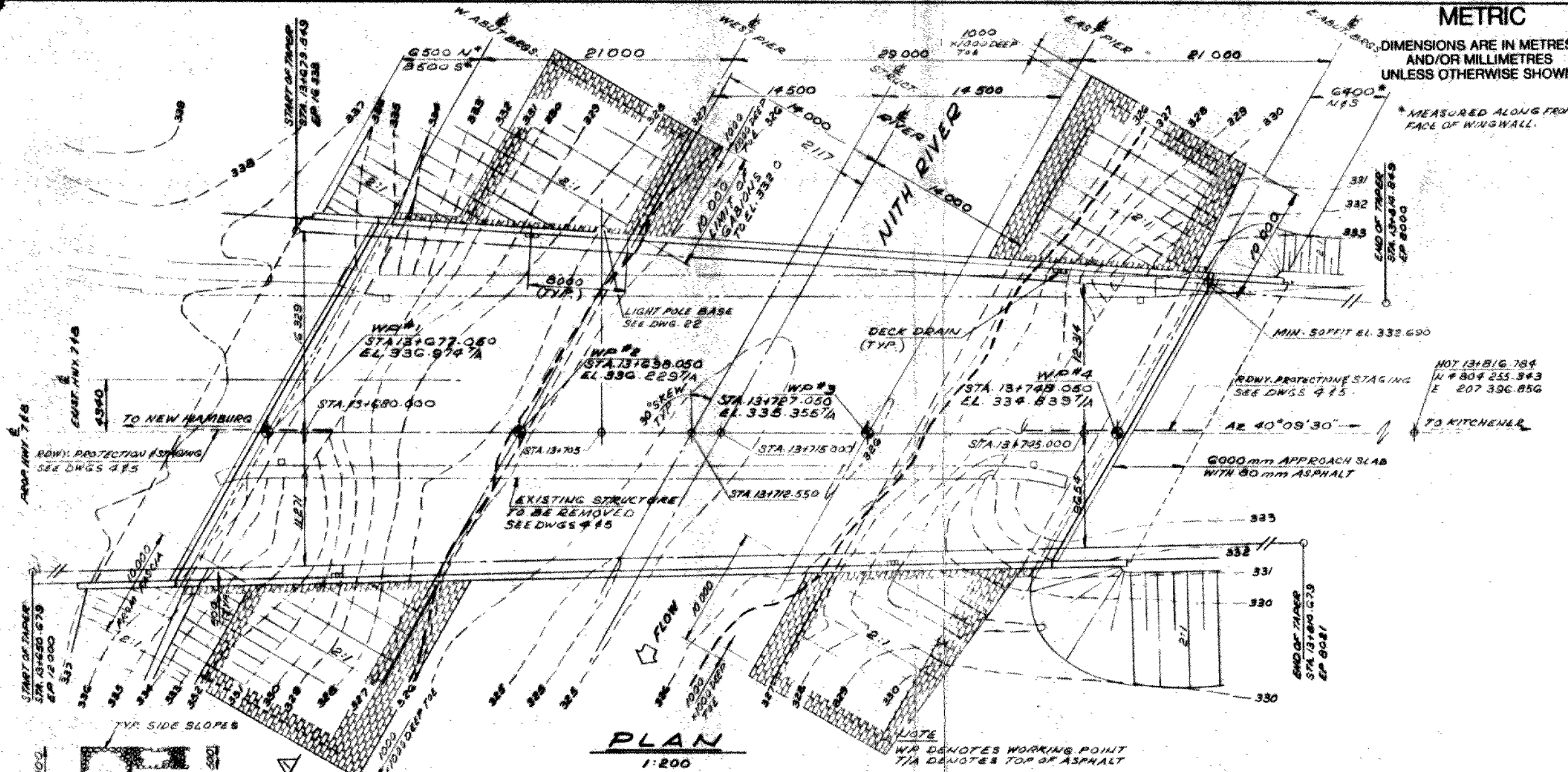
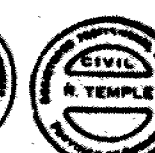
1. ERECT TEMPORARY PRECAST BARRIERS AND
INSTALL ROADWAY PROTECTION TO MAINTAIN
TWO LANES OF TRAFFIC ON THE
NORTH SIDE OF EXISTING STRUCTURE.
PEDESTRIAN TRAFFIC MAINTAINED ON
EXISTING SIDEWALK.
2. REMOVE SOUTH PORTION OF EXIST BRIDGE.
3. CONSTRUCT SOUTH HALF OF NEW BRIDGE.

STAGE II

1. ERECT TEMPORARY PRECAST BARRIERS
AND DIVERT TRAFFIC ONTO NEW BRIDGE.
ADJUST ROADWAY PROTECTION TO SUIT.
2. DIVERT PEDESTRIANS ONTO NEW PED-
ESTRIAN BRIDGE.
3. REMOVE REMAINDER OF EXIST BRIDGE.
4. CONSTRUCT NORTH HALF OF NEW BRIDGE.
5. OPEN COMPLETED BRIDGE TO FOUR
LANE TRAFFIC.

LIST OF DRAWINGS

- 33-165-105-1 GENERAL ARRANGEMENT
- 2 BOREROLE LOCATION & SOIL STRATA
- 3 FOUNDATION LAYOUT
- 4 ROADWAY PROTECTION STAGING I
- 5 ROADWAY PROTECTION STAGING II
- 6 WEST ABUTMENT LAYOUT
- 7 WEST ABUTMENT WINGWALLS
- 8 EAST ABUTMENT LAYOUT
- 9 EAST ABUTMENT WINGWALLS
- 10 WEST PIER DETAILS
- 11 EAST PIER DETAILS
- 12 GIRDER LAYOUT
- 13 PARS. GRESSED GIRDERS & BRGS
- 14 DECK LAYOUT & ELEVATIONS
- 15 DECK REINFORCING I
- 16 DECK REINFORCING II
- 17 6000 mm APPROACH SLAB
- 18 SOUTH BARRIER WALL
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- 20 JOINT ANCHORAGE & REINFORCING
- 21 PILE DRIVING - STANDARD LAYOUT
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- 24 AS CONSTRUCTED ELEV. & DIM.
- 25 ELECTRICAL EMBEDDED WORK
- 26 QUANTITIES - STRUCTURES
- 27 QUANTITIES - STRUCTURES



DATE	BY	CHECK	DESCRIPTION
DESIGN	W.F. YOUNG	W.F. YOUNG	LOADING ON BRIDGE
DRAWING	R. TEMPLE	R. TEMPLE	SITE NO 33-165-105-1

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST. 3 HWY. 7&8
CONT No
WP No 49-82-05

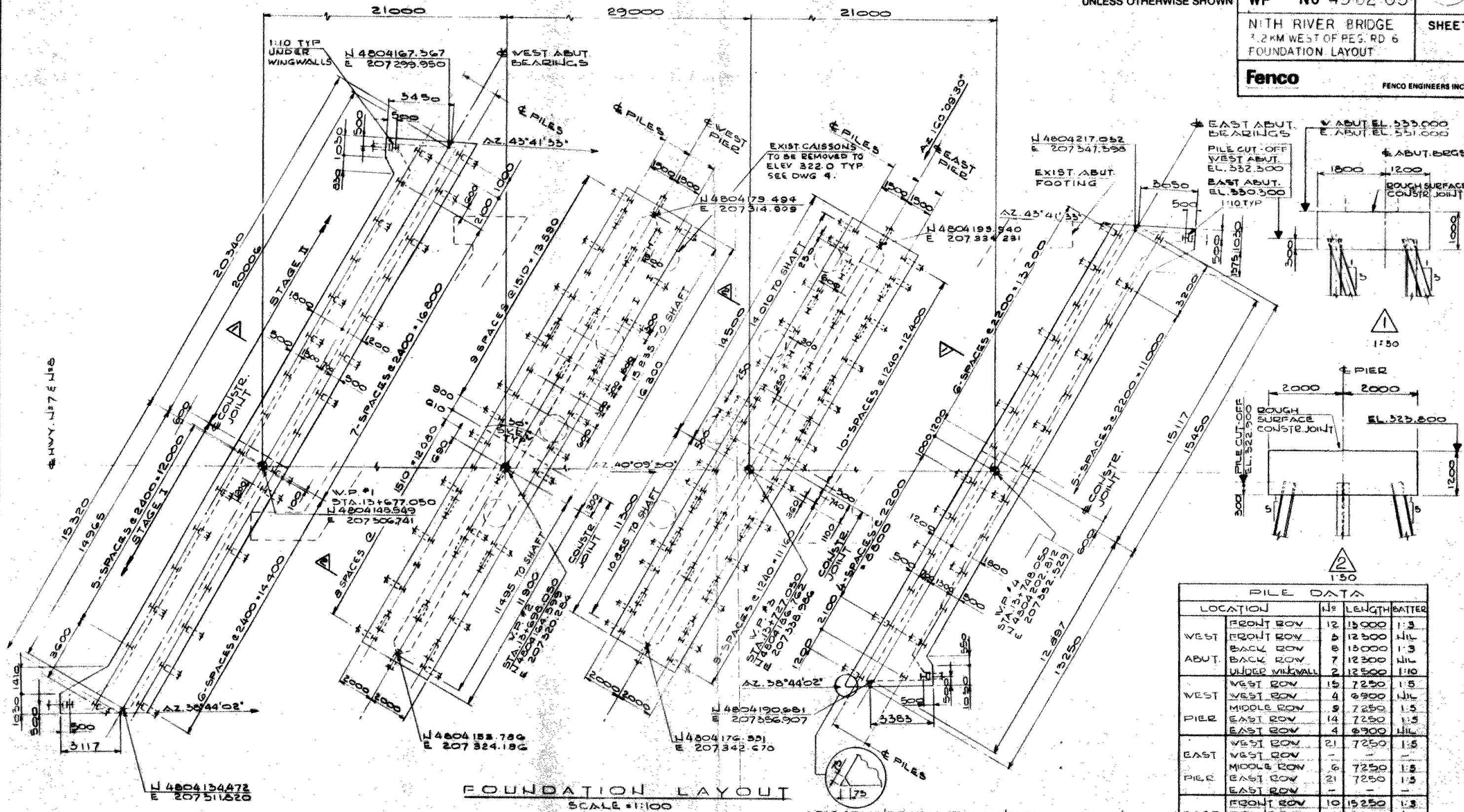


NITH RIVER BRIDGE
1.2 KM WEST OF REG. RD 6
FOUNDATION LAYOUT

SHEET

Fenco

FENCO ENGINEERS INC.



FOUNDATION LAYOUT
SCALE = 1:100

PILE DATA				
LOCATION		N°	LENGTH	BATTER
WEST ABUT.	FRONT ROW	12	13000	1:3
	BACK ROW	8	13000	1:3
	UNDER WINGWALL	2	12500	1:10
	WEST ROW	15	7250	1:5
PIER	FRONT ROW	4	6900	1:5
	MIDDLE ROW	9	7250	1:5
	EAST ROW	14	7250	1:5
	EAST ROW	4	6900	1:5
EAST ABUT.	FRONT ROW	21	7250	1:5
	BACK ROW	6	7250	1:5
	UNDER WINGWALL	2	14500	1:10
	FRONT ROW	10	15250	1:3

- PILE SPACING IS MEASURED AT UNDERSIDE OF FOOTING
- ALL PILES SHALL BE HP 310X110 STEEL 'H' PILES.
- PILE TO BE DRIVEN IN ACCORDANCE WITH STANDARD SS 103-10 OR SS 103-11 USING AN ULTIMATE CAPACITY OF 2550 kN PER PILE.
- THE PILE DRIVING HAMMER SHALL HAVE AN ACTUAL CAPACITY OF NOT LESS THAN 50,000 kJ.
- PILE LENGTHS SHOWN ARE THEORETICAL LENGTHS BELOW PILE CUT-OFF.
- CAPACITY AT SLT TYPE I = 850 kN.
- FACTORED CAPACITY AT ULS = 1200 kN.
- ALL PILES TO BE FITTED WITH DRIVING SHOES.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	V.P.Y.	CHECK	M.F.
DRAWING	V.A.T.	CHECK	W.F.Y.

LOADING OF 150C-A-85 DATE MAR 86
SITE No 55-125-125 DWG 3

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 88-12



Ontario

Ministry of
Transportation and
Communications

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NOTE: For purposes of the contract, these reports supercede all other foundation reports prepared by or for the Ministry in connection with the above-noted project.

EXPLANATION OF TERMS USED IN REPORT

2

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 31mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5 kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (31mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 1" SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 200mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_r	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kn/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kn/m ³	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kn/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ³ /s	RATE OF DISCHARGE
γ_d	kn/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kn/m ³	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kn/m ²	SEEPAGE FORCE
γ'	kn/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

3

FOUNDATION INVESTIGATION REPORT
For
Structure Replacement
Nith River and Hwy. #7 & #8
W.P. 49-82-05; Site: 33-165-125
District #3 (Stratford)

INTRODUCTION

This report contains the results of the Foundation Investigation carried out at the aforementioned site between 85 03 27 and 85 04 14. The field work consisted of six sampled boreholes and two dynamic cone penetration tests. The borings were advanced by a continuous flight auger machine mounted on an all-terrain vehicle and equipped either with hollow stem augers or with BX casings and rock coring (BXL & AX) equipment.

SITE DESCRIPTION

The site is located just outside of New Hamburg at the crossing of Highway #7 & #8 and Nith River.

Physiographically, the site is located in a region referred to as the Stratford Till Plain.

SUBSURFACE CONDITIONS

The field investigation carried out at this site revealed the presence of fluvial deposits such as gravels, sands, silts and also silty clay to clay stratum in the vicinity of the original ground surface. Below Elev. 317± frequent boulders and cobbles were also observed. Diamond drilling techniques were required to advance the borings below this depth. Due to the complexity (elevation, thickness, composition etc.) of the encountered different deposits, it is not practical to give detailed description for the individual strata. References should be made to the Record of Borehole Sheets where details of the stratification at particular boring locations are given.

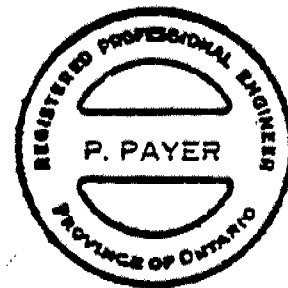
In addition, these sheets also contain the observed groundwater levels, together with the obtained field and laboratory tests results. A summarized stratigraphical profile is shown on Sheet No. 106 of the Contract Drawings.

GROUNDWATER CONDITIONS

The following groundwater levels were observed during the time of field investigation:

<u>Borehole No.</u>	<u>Elevation</u>
1	327.6
2	331.2
3	336.3
4	334.2
5	329.0
6	NOT OBSERVED

It is believed, that the groundwater levels are subject to seasonal fluctuations.



P. Payer

P. Payer, P.Eng.
Senior Foundations Engineer

K. G. Selby

K. G. Selby, P.Eng.
Chief Foundations Engineer (West)

APPENDIX

METRIC

W P 49-82-05 LOCATION Co-ords. N 4 804 221.0 E 207 374.0

ORIGINATED BY DG

DIST 3 HWY 7 & 8 BOREHOLE TYPE Cont. Flight Auger & Washbore - B.W. Casing

COMPILED BY PP

DATUM Geodetic DATE 85 03 28 and 29

CHECKED BY

[illegible]

OFFICE REPORT ON SOIL EXPLORATION

*3, x5 : Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 2

METRIC

W P 49-82-05 LOCATION Co-ords. N 4 804 245.0 E 207 356.5 ORIGINATED BY DG
 DIST 3 HWY 7 & 8 BOREHOLE TYPE Cont. Flight Auger (R.S.) COMPILED BY PP
 DATUM Geodetic DATE 85 03 27 CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	SIRAT PLOT	NUMBER	TYPE			'N' VALUES	20						40	60	80	100
							SHEAR STRENGTH							WATER CONTENT (%)			
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					10 20 30						
331.2	Ground Level																
0.0	Silty Clay trace of sand Very Stiff	⊗	1	SS	22		330						0 5 65 30				
329.1	Fill Material	⊗	2	SS	25												
2.1	Silty Clay trace of sand	⊗	3	SS	12												
327.5	Firm	⊗	4	SS	7		328										
3.7	Silty sand, some gravel	⊗	5	SS	13								21 41 32 6				
325.8	trace of clay Compact	⊗	6	SS	41								50 36 11 3				
4.4	Sandy Gravel to Gravelly Sand traces of silt clay	⊗	7	SS	25		326										
	Compact to Very Dense	⊗	8	SS	39								52 41 6 1				
323.1		⊗	9	SS	18		324										
		⊗	10	SS	17								21 70 8 1				
8.1	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

METRIC

W P 4C-82-05 LOCATION Co-ords. N 4 804 136.5 E 207 284.5 ORIGINATED BY DC
 DIST 3 HWY 7 & 8 BOREHOLE TYPE Cont. Flight Auger & Washbore- B.W. Casing COMPILED BY PP
 DATUM Geodetic DATE 85 04 04 to 85 04 09 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIF WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE								
238.9	Ground Level										
0.0	Silty Clay to Clay Some/Trace of Sand trace of gravel Stiff (Low to High Plasticity)	1	SS	12							2 14 41 43
		2	SS	12							
		3	SS	13							
		4	SS	14							0 6 43 52
334.5		5	SS	13							
4.4	Sandy Silt to Silty Sand Some/Trace of Gravel, some clay Dense to Very Dense	6	SS	31							23 23 43 11
		7	SS	40	8 cm						
		8	SS	75	15 cm						5 44 37 14
331.4		9	SS	85	23 cm						
7.5	Silty Clay to Clay Trace of Sand gravel Hard (Low to High Plasticity)	10	SS	54							1 5 33 60
		11	SS	48							
327.2		12	SS	106							0 7 44 49
11.7		13	SS	109							
		14	SS	15	15 cm						27 44 27 7
	Silty Sand some gravel trace of clay	15	SS	21	8 cm						
		16	SS	15	15 cm						
	Frequent Cobbles and Boulders	17	SS	15	15 cm						
		18	SS	15	15 cm						
	Very Dense	19	SS	48	15 cm						27 44 25 5
		20	SS	72							
		21	SS	100	5 cm						
314.5											
24.4	End of Borehole										

+3, x5: Numbers refer to
Sensitivity

20
15 \div 5 (%) STRAIN AT FAILURE
10

METRIC

ORIGINATED BY DC
COMPILED BY PP
CHECKED BY [Signature]

OFFICE REPORT ON SOIL EXPLORATION

*3, *5: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 5

METRIC

W P 44-82-05 LOCATION Co-ords. N 4 804 228.5 E 207 344.5
 DIST 3 HWY 7 & 8 BOREHOLE TYPE Cont. Flight Auger (H.S.) & Washbore-B.W. Casing
 DATUM Geodetic DATE 85 04 02 to 85 04 04

ORIGINATED BY DC

COMPILED BY PP

CHECKED BY Le

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	SIRAL PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100								WATER CONTENT (%)				
								SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE								10 20 30				
330.4	Ground Level														GR SA 51 CL					
0.0	Sandy Silt Some Gravel some clay occ. silty clay and sandy gravel layers Very Loose to Compact		1	SS	22		330								20 32 37 11					
			2	SS	11		328								0 24 59 17					
			3	SS	2															
			4	SS	2															
			5	SS	3		326								0 30 52 15					
325.2			6	SS	17										55 38 6 1					
5.2	Silty Clay		7	SS	9															
324.5	Stiff		8	SS	29		324													
5.9			9	SS	23															
	Silty Sand to Sandy Silt trace/some gravel trace/some clay Compact to Very Dense		10	SS	41		322								9 56 21 14					
			11	SS	52		320								0 91 7 2					
			12	SS	38															
			13	SS	63		318													
			14	SS	70/15		316								28 31 37 4					
314.4			15	SS	15															
16.0	Sandy Gravel, some silt, trace of clay		16	SS	35/15		314								50 37 12 1					
313.5	Very Dense																			
16.9	End of Borehole																			

+3, x5: Numbers refer to
Sensitivity

20
15 + 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 6

METRIC

W P 49-82-05 LOCATION Co-ords. N 4 804 176.5 E 207 311.0 ORIGINATED BY DG
DIST 3 HWY 7 & 8 BOREHOLE TYPE Cont. Flight Auger (H.S.) & Washbore-B.W. Casing COMPILED BY PP
DATUM Geodetic DATE 85 04 10 to 85 04 11 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
SIEV DEPTH	DESCRIPTION	SINAI PLOT	NUMBER	TYPE	VALUES			20	40	60	80	100					
322.7	Ground Level																
0.0	Silty Clay some sand gravel occasional silty sand layers		1	SS	42		326										0 4 (36)
			2	SS	65												3 9 53 35
	Hard (Low Plasticity)		3	SS	40		324										
323.3			4	SS	100/	25 B											
4.4			5	SS	90												5 24 60 11
	Sandy Silt to Silty Sand		6	SS	69		322										0 70 29 1
	trace of gravel and clay		7	ss	62												
			9	SS	74		320										0 60 39 1
			10	SS	76												
			11	SS	77	13 B	318										
	Frequent Boulders and Cobbles		12	SS	130	13 B	316										
			13	SS	307	15 B	314										
						13 CB	312										
310.4						8 B											
17.3			16	AX	152		310										
	Boulders Cobbles Gravel		17	RC AX	REC 182		308										
			18	RC AX	REC 22		306										
305.5																	
22.2	End of Borehole																
	* Groundwater Level not Observed																

OFFICE REPORT ON SOIL EXPLORATION

FOUNDATION INVESTIGATION REPORT
For
Nith River Pedestrian Bridge
at New Hamburg
Bleams Road
W.P. 352-85-01, Site: 33-165-350
District 3, Stratford

INTRODUCTION

This report contains the results of the Foundation Investigation carried out at the above noted site between 85 10 25 and 85 10 30. The field work consisted of two sampled boreholes both accompanied with dynamic cone penetration tests. The depth of the borings was 18.4 m and 18.8 m in boreholes 1 and 2 respectively and both borings were advanced utilizing a track-mounted auger machine.

SITE DESCRIPTION

The site is located approximately 120 m north of the existing Nith River Bridge on Hwy. 7 and 8 in the Township of Wilmot, Regional Municipality of Waterloo.

It is proposed to construct a four (24 m) span pedestrian crossing of the Nith River along the unopened road allowance for Bleam's Road. The west approach is located at the terminus of Bleam's Road in a residential and light industrial area. The east approach is located in a small park. Physiographically the site is located in a glacial spillway in a region referred to as the Stratford Till Plain.

SUBSURFACE CONDITIONS

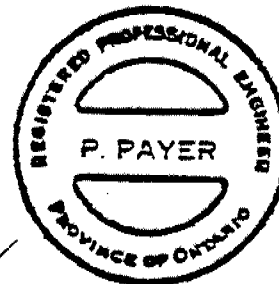
The field investigation carried out at this site revealed the presence of glacio-fluvial deposits such as gravels, sands, silts as well as a silty clay stratum near the ground surface. Occasional cobbles and/or boulders were encountered below Elev. 318± m. Diamond drilling techniques were required to advance the boreholes beyond this depth.

Owing to the complexity of the various deposits encountered (ie. elevation, thickness, composition etc.), it is not practical to give detailed descriptions here for each individual stratum. Reference should be made to the

Record of Borehole Sheets located in the Appendix for details of the stratification at each borehole location. These sheets also contain the results of all field and laboratory tests performed.. A summarized stratigraphical profile is shown on Sheet No. 133 of the Contract Drawings.

GROUNDWATER CONDITIONS

The groundwater level was established at elevations 329.1 m and 327.6 m at boreholes 1 and 2 respectively by taking overnight readings in the open boreholes. However, owing to the fairly pervious nature of the soils, and the proximity of the Nith River, it is likely that these levels are subject to seasonal fluctuations.



P. Payer

P. Payer, P.Eng.
Senior Foundations Engineer

K. G. Selby

K. G. Selby, P.Eng.
Chief Foundations Engineer (West)

APPENDIX

RECORD OF BOREHOLE No 1

METRIC

W P 352-85-01 LOCATION Sta: 9 - 905.3 0/s 3.9 m Lc.
 DIST 3 HWY Bleams Rd BOREHOLE TYPE Hollow Stem Auger and Washboring
 DATUM Geodetic DATE 85 10 25 / 28
 ORIGINATED BY B.R.
 COMPILED BY B.R.
 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIE WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
331.8	Ground Surface																
0.0	Fill Silty Clay with Gravel		1	SS	5												
	Fill to Surface		21	SS	15												
	Silty Sand trace Gravel		31	SS	7												
328.2	Loose *		41	SS	4												
3.0	Silty Sand																
	Very Loose trace Clay		51	SS	2												
325.0																	
5.8	Sand and Gravel with seams of fine to medium Sand		61	SS	22												
323.2	Compact		71	SS	18												
8.5	Mixture of Silt, Sand and Gravel **																
322.4			81	SS	92												
9.4	Silty Sand to Sand Dense to Very Dense *		91	SS	63												
			10	SS	32												
318.6																	
13.2	Heterogeneous mixture of Sand, Gravel, Silt and Clay - slightly cemented Very Dense (Glacial Till)		111	SS	77												
			121	SS	100												
313.4	*																
18.4	End of Borehole																
	* Occasional cobbles and/or boulders																
	** Very Dense (Glacial Till)																

3, x 5: Numbers refer to Sensitivity

20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 2

METRIC

W P 352-85-01 LOCATION STA: 9 + 978.8 °/s 0.8 m Rt. ORIGINATED BY J.Y.
 DIST 3 HWY Bleoms Rd BOREHOLE TYPE Hollow Stem Auger - Washboring COMPILED BY B.R.
 DATUM Geodetic DATE 85 10 29 / 30 CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20 40 60 80 100						
330.7	Ground Surface												
0.0	Sandy Silt to Silty Clay Trace Organics Firm to Stiff (slightly cohesive)		1	SS	11								
328.1			2	SS	7								
2.6	Sand Compact		3	SS	12								
327.4			4	SS	22								
3.3	Sand and Gravel with seams of Fine to Medium Sand Dense		5	SS	38								
324.0			6	SS	33								
6.7	Mixture of Silt Sand and Gravel Very Dense (Glacial Till)		7	SS	90								
322.1			8	SS	71								
8.6	Silty Sand to Sandy Silt Dense to Very Dense		9	SS	45								
			10	SS	83								
316.1			11	SS	72								
10.6	Heterogeneous mixture of Silty Sand, Gravel and Clay Very Dense (Glacial Till)		12	SS	70								
311.9													
18.8	End of Borehole												
	Boulders * Occasional Cobbles and/or Boulders												

OFFICE REPORT ON SOIL EXPLORATION



Ministry of
Transportation and
Communications

P. PAYER

FOUNDATION DESIGN SECTION

foundation investigation and design report

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

CONT 88-12
WP 49-82-05 DIST 3
HWY 7 & 8 STR SITE 33-165-125

Structure Replacement
Nith River and Hwy. #7 & #8

DISTRIBUTION

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Foundation Investigation Report
for
Structure Replacement
Nith River and Hwy. #7 & #8
W.P. 49-82-05; Site: 33-165-125
District #3 (Stratford)

INTRODUCTION

This report contains the results of the Foundation Investigation carried out at the aforementioned site between 85 03 27 and 85 04 14. The field work consisted of six sampled boreholes and two dynamic cone penetration tests. The borings were advanced by a continuous flight auger machine mounted on an all-terrain vehicle and equipped either with hollow stem augers or with BX casings and rock coring (BXL & AX) equipment.

SITE DESCRIPTION

The site is located just outside of New Hamburg at the crossing of Highway #7 & #8 and Nith River.

Physiographically the site is located in a region referred to as the Stratford Till Plain.

SUBSURFACE CONDITIONS

The field investigation carried out at this site revealed the presence of fluvial deposits such as gravels, sands, silts and also silty clay to clay stratum in the vicinity of the original ground surface. Below Elev. 317⁺ frequent boulders and cobbles were also observed. Diamond drilling techniques were required to advance the borings below this depth. Due to the complexity (elevation, thickness, composition etc.) of the encountered different deposits, it is not practical to give detailed description for the individual strata. References should be made to the Record of Borehole Sheets where details of the stratification at particular boring locations are given.

In addition, these sheets also contain the observed groundwater levels, together with the obtained field and laboratory test results. A summarized stratigraphical profile is shown on Drawing No. 498205-A of the Appendix.

DISCUSSION AND RECOMMENDATIONS

GENERAL

It is proposed to replace the existing 71 m long three-span reinforced concrete continuous beams bridge. The C of the new structure will be located some 4 m south of the existing bridge C and the new abutments will be moved back by about 14 m on the west side and by about 12 m on the east side. However, the exact footing locations are not available at the time of the report writing (September 12, 1985.) It is anticipated that the new structure will consist of three spans and the existing profile grade will remain unchanged.

STRUCTURE FOUNDATION

It is recommended that the new structure be founded on end-bearing steel 'H' piles (HP 310 x 110) driven into the bouldery zone of the subsoil, using a safe design load of 850 kN (HP 310 x 110) per pile. The pile tips should be reinforced with pile driving shoes. The piles should be driven in accordance with Standards SS 103-10 or SS 103-11 using an ultimate capacity of 2550 kN per pile but must be driven below Elev. 320 (west abutment) and below Elev. 316 (west pier, east pier, east abutment). The pile driving hammer should have an actual capacity of not less than 50,000 kilojoule (kJ).

For purposes of the O.H.B.D.C. the following values are recommended:

Factored Capacity at U.L.S.: 1200 kN

Capacity at S.L.S. Type II: 850 kN

The granular backfill requirements should be as outlined on current M.T.C. standards. For the backfill material, the following parameters are recommended:

	<u>Granular</u>	
	"A"	"B"
Angle of Internal Friction:	$\phi = 35^\circ$	$\phi = 30^\circ$
Unit Weight (kN/m^3):	$\gamma = 22.8$	$\gamma = 21.2$

Earth pressure should be computed (assuming 'active' condition) as per Subsection 6.6.1.2.2 of the code.

APPROACH EMBANKMENTS

The existing approaches will be widened towards the south. The new fill should be benched into the existing embankment as per M.T.C. Standard DD-414. The slopes of the approaches (new and existing) should not be steeper than 2:1. The material in the embankments should not contain larger grain-sizes than 75 mm at locations where piles have to be driven. No stability problems are anticipated.

OTHER CONSIDERATIONS

The frost protection requirement in this area is a minimum of 1.2 m of earth cover. The abutments may be perched within the approaches.

The pile caps should be formed 'in the dry'. Therefore, the excavations should be unwatered if they are carried out below the river or groundwater level. The river bed and the banks should be protected against erosion as per hydrology requirements.

MISCELLANEOUS

The fieldwork for this project was supervised by Mr. D. Graham, Co-op Student. The equipment used was owned and operated by Dominion Soil Investigation Inc. This report was prepared by P. Payer and reviewed by Mr. K.G. Selby.

P. Payer

P. Payer, P. Eng.
Foundations Engineer



K. G. Selby

K.G. Selby, P. Eng.
Chief Foundations Engineer
(West)

APPENDIX

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3 m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

SS	SPLIT SPOON	TP	THINWALL PISTON
WS	WASH SAMPLE	OS	OSTERBERG SAMPLE
ST	SLOTTED TUBE SAMPLE	RC	ROCK CORE
BS	BLOCK SAMPLE	PH	TW ADVANCED HYDRAULICALLY
CS	CHUNK SAMPLE	PM	TW ADVANCED MANUALLY
TW	THINWALL OPEN	FS	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_f	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m^3	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m^3	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kN/m^3	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m^3	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m^3/s	RATE OF DISCHARGE
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kN/m^3	SEEPAGE FORCE
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL						



RECORD OF BOREHOLE No 1

METRIC

W P 49-82-05 LOCATION Co-ords. N 4 804 221.0 E 207 374.0 ORIGINATED BY DG
DIST 3 HWY 7 & 8 BOREHOLE TYPE Cont. Flight Auger & Washbore - B.W. Casing COMPILED BY PP
DATUM Geodetic DATE 85 03 28 and 29 CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH						
333.1	Ground Level							20 40 60 80 100		10 20 30				GR SA SI CL
0.0	Silty Sand, some gravel, some clay Compact		1	SS	13		332							23 37 30 10
331.7	Fill Material		2	SS	15									
1.4	Silty Clay (Low Plasticity) some sand trace of gravel Stiff		3	SS	13		330							4 36 36 24
328.7	Fill Material		4	SS	13									
4.4	Silty Clay		5	SS	16		328							
327.9	Firm		6	SS	7									59 25 13 3
5.2	Gravelly Sand traces of silt clay Compact to Very Dense Frequent Cobbles and Boulders		7	SS	24		326	129/30 cm						24 73 2 1
			8	SS	57									
			9	SS	43		324							
			10	SS	40									
			11	SS	39		322							28 65 6 1
			12	SS	10									
			13	SS	12		320							
			14	SS	37									
			15	SS	45		318							
			16	SS	29		316							
			17	SS	69	18 cm	314							
			18	SS	70	8 cm								
			19	SS	40	3 cm	312							
311.8	End of Borehole													
21.3														

+3, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 2

METRIC

W P 49-82-05 LOCATION Co-ords. N 4 804 245.0 E 207 356.5 ORIGINATED BY DG
DIST 3 HWY 7 & 8 BOREHOLE TYPE Cont. Flight Auger (H.S.) COMPILED BY PP
DATUM Geodetic DATE 85 03 27 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
331.2	Ground Level																
0.0	Silty Clay trace of sand Very Stiff		1	SS	22		330										0 5 65 30
329.1	Fill Material		2	SS	25												
2.1	Silty Clay trace of sand		3	SS	12		328										
327.5	Firm		4	SS	7												
3.7	Silty Sand, some gravel		5	SS	13												21 41 32 6
326.8	trace of clay Compact		6	SS	41		326										50 36 11 3
4.4	Sandy Gravel to Gravelly Sand traces of silt clay Compact to Very Dense		7	SS	25												52 41 6 1
			8	SS	39		324										21 70 8 1
			9	SS	18												
323.1			10	SS	17												
8.1	End of Borehole																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 3

METRIC

W P 49-82-05 LOCATION Co-ords. N 4 804 156.5 E 207 284.5 ORIGINATED BY DG
DIST 3 HWY 7 & 8 BOREHOLE TYPE Cont. Flight Auger & Washbore- B.W. Casing COMPILED BY PP
DATUM Geodetic DATE 85 04 04 to 85 04 09 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60						80	100
								SHEAR STRENGTH								WATER CONTENT (%)	
							○ UNCONFINED + FIELD VANE										
							● QUICK TRIAXIAL x LAB VANE										
338.9	Ground Level														GR SA SI CL		
0.0	Silty Clay to Clay Some/Trace of Sand trace of gravel		1	SS	12		338								2 14 41 43		
			2	SS	12												
	Stiff (Low to High Plasticity)		3	SS	13		336								0 6 43 52		
			4	SS	14												
334.5			5	SS	13												
4.4	Sandy Silt to Silty Sand Some/Trace of Gravel, some clay Dense to Very Dense		6	SS	31		334								23 23 43 11		
			7	SS	40	8 cm											
			8	SS	75	15 cm									5 44 37 14		
331.4			9	SS	85	23 cm	332										
7.5	Silty Clay to Clay Trace of Sand gravel Hard (Low to High Plasticity)		10	SS	54		330								1 5 33 60		
			11	SS	48												
			12	SS	106		328								0 7 44 49		
327.2			13	SS	109		326										
11.7			14	SS	106	15 cm	324								27 44 27 7		
	Silty Sand some gravel trace of clay		15	SS	63	8 cm	322										
			16	SS	123	15 cm	320										
	Frequent Cobbles and Boulders		17	SS	98	15 cm	318										
	Very Dense		18	SS	48	15 cm	316								27 44 25 5		
			19	SS	72												
			20	SS	100	5 cm											
314.5							314										
24.4	End of Borehole																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 4

METRIC

W P 49-82-05 LOCATION Co-ords. N 4 804 131.5 E 207 301.0 ORIGINATED BY DG
DIST 3 HWY 7 & 8 BOREHOLE TYPE Cont. Flight Auger (H.S.) COMPILED BY PP
DATUM Geodetic DATE 85 04 04 and 85 04 05 CHECKED BY *So*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
336.8	Ground Level																GR SA SI CL
0.0	Silty Clay to Clay some/trace of gravel some/trace of sand occasional silty sand layers Stiff to Hard (Low to Medium Plasticity)		1	SS	13	15 cm	336										1 20 45 34
			2	SS	19												0 0 50 50
			3	SS	23		334										10 40 35 15
			4	SS	69												18 34 30 18
			5	SS	69		332										2 6 31 61
			6	SS	70/												15 6 25 54
			7	SS	70												29 45 18 8
			8	SS	57		330										
			9	SS	32												
			10	SS	39												
			11	SS	57		328										
			12	SS	73												
			13	SS	103												
			14	SS	72		326										
325.7	Sandy Silt to Silty Sand some gravel trace of clay Very Dense		15	SS	100/	15 cm	324										
11.1			16	SS	100/	18 cm											
			17	SS	100/	25 cm	322										
320.8	Mixture of Gravel, Cobbles and Boulders Very Dense		18	RC BX	REC 5%	10 cm	320										
16.2			19	SS	100/												
			20	RC BX	REC 34%		318										
317.2	End of Borehole						316										
19.8																	



RECORD OF BOREHOLE No 5

METRIC

W P 49-82-05 LOCATION Co-ords. N 4 804 228.5 E 207 344.5 ORIGINATED BY DG
DIST 3 HWY 7 & 8 BOREHOLE TYPE Cont. Flight Auger (H.S.) & Washbore-B.W. Casing COMPILED BY PP
DATUM Geodetic DATE 85 04 02 to 85 04 04 CHECKED BY Sc

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100								
								SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE								
330.4	Ground Level															
0.0	Sandy Silt Some Gravel some clay occ. silty clay and sandy gravel layers Very Loose to Compact		1	SS	22		330									20 32 37 11
			2	SS	11											0 24 59 17
			3	SS	2		328									0 30 52 18
			4	SS	2											55 38 6 1
			5	SS	3											
325.2			6	SS	17		326									
5.2	Silty Clay		7	SS	9											
324.5	Stiff		8	SS	29		324									9 56 21 14
5.9	Silty Sand to Sandy Silt trace/some gravel trace/some clay Compact to Very Dense		9	SS	23											0 91 7 2
			10	SS	41		322									
			11	SS	52											
			12	SS	38		320									
			13	SS	63		318									
			14	SS	70/15 cm		316									28 31 37 4
314.4			15	SS	106/15 cm											
16.0	Sandy Gravel, some silt, trace of clay		16	SS	36/15 cm		314									50 37 12 1
313.5	Very Dense															
16.9	End of Borehole															

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 6

METRIC

W P 49-82-05 LOCATION Co-ords. N 4 804 176.5 E 207 311.0 ORIGINATED BY DG
DIST 3 HWY 7 & 8 BOREHOLE TYPE Cont. Flight Auger (H.S.) & Washbore-B.W. Casing COMPILED BY PP
DATUM Geodetic DATE 85 04 10 to 85 04 11 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40						60	80	100
327.7	Ground Level																
0.0						*											
	Silty Clay some sand gravel occasional silty sand layers		1	SS	42											0	4 (96)
			2	SS	65												
			3	SS	40											3	9 53 35
323.3	Hard (Low Plasticity)		4	SS	100/	25 cm											
4.4			5	SS	90											5	24 60 11
	Sandy Silt to Silty Sand		6	SS	69											0	70 29 1
	trace of gravel and clay		7	SS	63												
			9	SS	74											0	60 39 1
			10	SS	76												
			11	SS	77/	13 cm											
	Frequent Boulders and Cobbles		12	SS	100/	13 cm											
			13	SS	50/	15 cm											
			14	SS	100/	13 cm											
310.4			15	SS	100/	8 cm											
17.3			16	RC AX	REC 35%												
	Boulders Cobbles Gravel		17	RC AX	REC 18%												
			18	RC AX	REC 2%												
305.5																	
22.2	End of Borehole																
	* Groundwater Level not Observed																

METRIC
DIMENSIONS ARE IN METRES
UNLESS OTHERWISE NOTED
OTHERWISE STATIONS
IN KILOMETRES

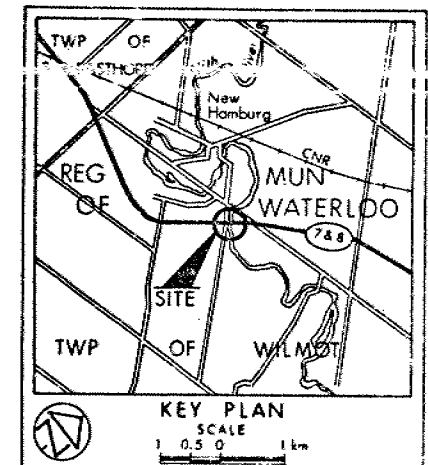
CONT No
WP No 49-82-05

NITH RIVER

BORE HOLE LOCATIONS & SOIL STRATA



SHEET



LEGEND

- ◆ Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation 85 03 & 04

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	333.1	4 804 221.0	207 374.0
2	331.2	4 804 245.0	207 356.5
3	338.9	4 804 156.5	207 284.5
4	336.8	4 804 131.5	207 301.0
5	330.4	4 804 228.5	207 344.5
6	327.7	4 804 176.5	207 311.0

NOTE

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

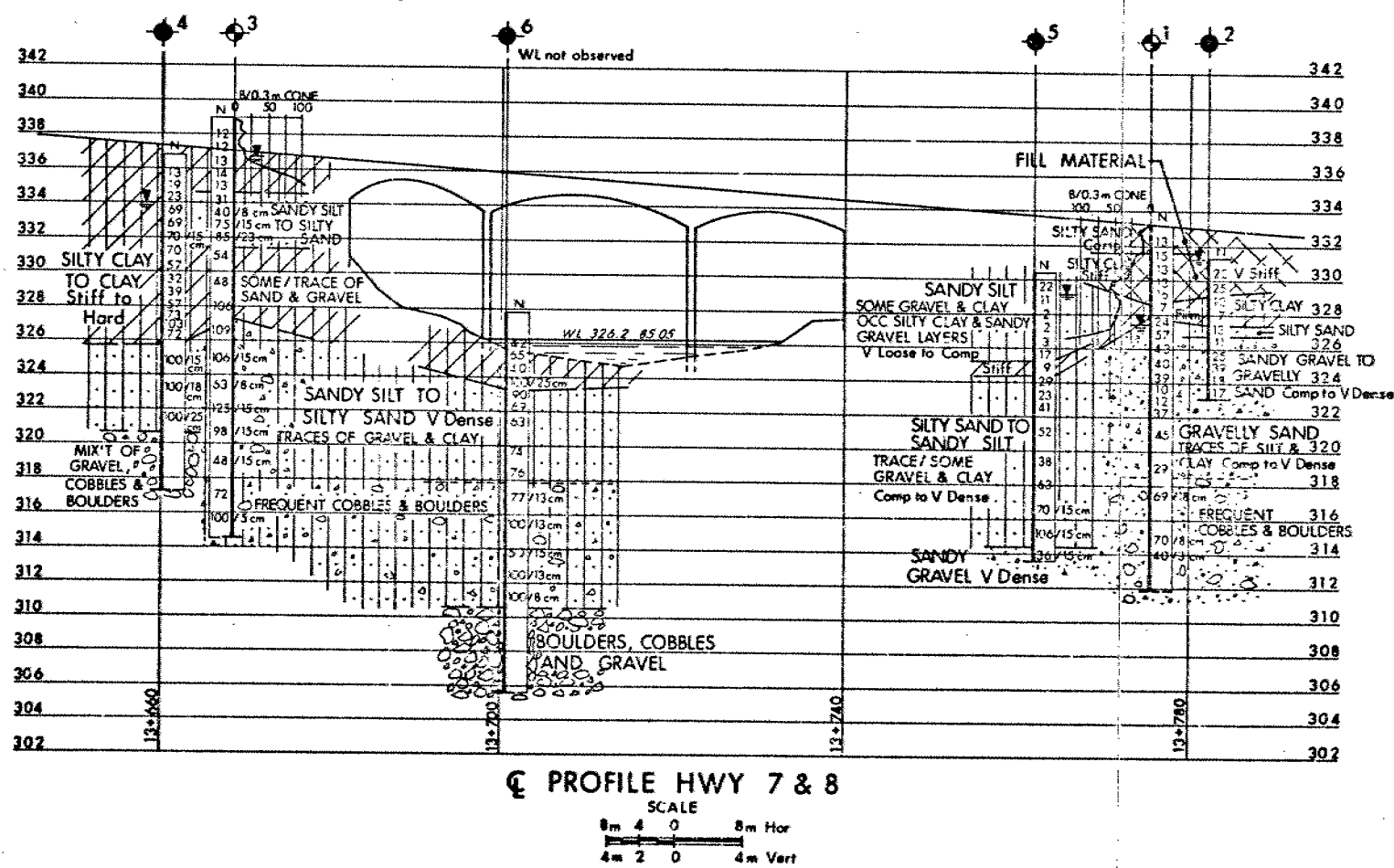
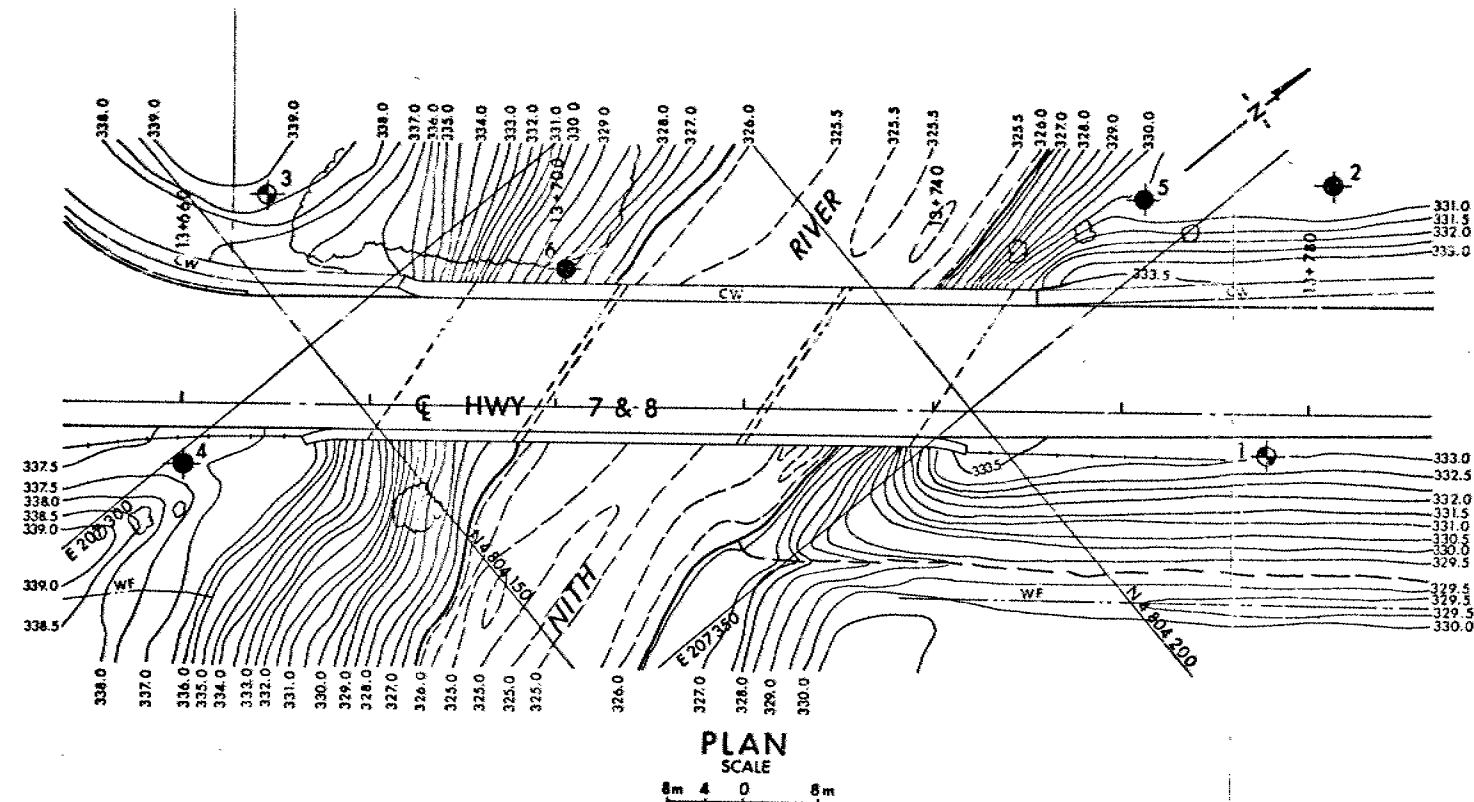
NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REV.	DATE	BY	DESCRIPTION
1			

Geocres No 40P7-46

HWY No 7 & 8	DIST 3
SUBMD PP CHECKED	DATE 1985 09 05
DRAWN SO CHECKED	APPROVED

SITE 33-165-125
DWG 498205-A



DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 40P7-46

DIST. 3 REGION

W.P. No. 49-82-03

CONT. No.

W. O. No.

STR. SITE No. N/A

HWY. No. 7

LOCATION HWY 7 FROM STRATFORD

EASTERLY 2.9 KM

=====
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



Ministry
of
Transportation

FILE

FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

**ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION**

WP 49-82-05

DIST 3

HWY 7 & 8

STR SITE 33-165-125

Structure Replacement
Nith River and Hwy. #7 & #8

DISTRIBUTION

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R. Hore
A. Crowley (Cover Only)
T.J. Kovich (Cover Only)

Foundation Investigation Report
for
Structure Replacement
Nith River and Hwy. #7 & #8
W.P. 49-82-05; Site: 33-165-125
District #3 (Stratford)

INTRODUCTION

This report contains the results of the Foundation Investigation carried out at the aforementioned site between 85 03 27 and 85 04 14. The field work consisted of six sampled boreholes and two dynamic cone penetration tests. The borings were advanced by a continuous flight auger machine mounted on an all-terrain vehicle and equipped either with hollow stem augers or with BX casings and rock coring (BXL & AX) equipment.

SITE DESCRIPTION

The site is located just outside of New Hamburg at the crossing of Highway #7 & #8 and Nith River.

Physiographically the site is located in a region referred to as the Stratford Till Plain.

SUBSURFACE CONDITIONS

The field investigation carried out at this site revealed the presence of fluvial deposits such as gravels, sands, silts and also silty clay to clay stratum in the vicinity of the original ground surface. Below Elev. 317⁺ frequent boulders and cobbles were also observed. Diamond drilling techniques were required to advance the borings below this depth. Due to the complexity (elevation, thickness, composition etc.) of the encountered different deposits, it is not practical to give detailed description for the individual strata. References should be made to the Record of Borehole Sheets where details of the stratification at particular boring locations are given.

In addition, these sheets also contain the observed groundwater levels, together with the obtained field and laboratory test results. A summarized stratigraphical profile is shown on Drawing No. 498205-A of the Appendix.

DISCUSSION AND RECOMMENDATIONS

GENERAL

It is proposed to replace the existing 71 m long three-span reinforced concrete continuous beams bridge. The C of the new structure will be located some 4 m south of the existing bridge C and the new abutments will be moved back by about 14 m on the west side and by about 12 m on the east side. However, the exact footing locations are not available at the time of the report writing (September 12, 1985.) It is anticipated that the new structure will consist of three spans and the existing profile grade will remain unchanged.

STRUCTURE FOUNDATION

It is recommended that the new structure be founded on end-bearing steel 'H' piles (HP 310 x 110) driven into the bouldery zone of the subsoil, using a safe design load of 850 kN (HP 310 x 110) per pile. The pile tips should be reinforced with pile driving shoes. The piles should be driven in accordance with Standards SS 103-10 or SS 103-11 using an ultimate capacity of 2550 kN per pile but must be driven below Elev. 320 (west abutment) and below Elev. 316 (west pier, east pier, east abutment). The pile driving hammer should have an actual capacity of not less than 50,000 kilojoule (kJ).

For purposes of the O.H.B.D.C. the following values are recommended:

Factored Capacity at U.L.S.: 1200 kN

Capacity at S.L.S. Type II: 850 kN

2550 kN ULTIMATE

The granular backfill requirements should be as outlined on current M.T.C. standards. For the backfill material, the following parameters are recommended:

	<u>Granular</u>	
	"A"	"B"
Angle of Internal Friction:	$\phi = 35^\circ$	$\phi = 30^\circ$
Unit Weight (kN/m^3):	$\gamma = 22.8$	$\gamma = 21.2$

Earth pressure should be computed (assuming 'active' condition) as per Subsection 6.6.1.2.2 of the code.

APPROACH EMBANKMENTS

The existing approaches will be widened towards the south. The new fill should be benched into the existing embankment as per M.T.C. Standard DD-414. The slopes of the approaches (new and existing) should not be steeper than 2:1. The material in the embankments should not contain larger grain-sizes than 75 mm at locations where piles have to be driven. No stability problems are anticipated.


OTHER CONSIDERATIONS

The frost protection requirement in this area is a minimum of 1.2 m of earth cover. The abutments may be perched within the approaches.

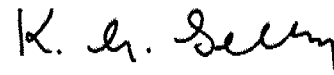
The pile caps should be formed 'in the dry'. Therefore, the excavations should be unwatered if they are carried out below the river or groundwater level. The river bed and the banks should be protected against erosion as per hydrology requirements.

MISCELLANEOUS

The fieldwork for this project was supervised by Mr. D. Graham, Co-op Student. The equipment used was owned and operated by Dominion Soil Investigation Inc. This report was prepared by P. Payer and reviewed by Mr. K.G. Selby.


P. Payer, P. Eng.
Foundations Engineer




K.G. Selby, P. Eng.
Chief Foundations Engineer
(West)

APPENDIX

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m^3	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m^3	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kN/m^3	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m^3	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m^3/s	RATE OF DISCHARGE
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kN/m^2	SEEPAGE FORCE
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL						



RECORD OF BOREHOLE No 1

METRIC

W P 49-82-05 LOCATION Co-ords. N 4 804 221.0 E 207 374.0 ORIGINATED BY DG
DIST 3 HWY 7 & 8 BOREHOLE TYPE Cont. Flight Auger & Washbore - B.W. Casing COMPILED BY PP
DATUM Geodetic DATE 85 03 28 and 29 CHECKED BY So

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	WATER CONTENT (%)					
333.1	Ground Level													
0.0	Silty Sand, some gravel, some clay													
331.7	Compact Fill Material		1	SS	13		332							23 37 30 10
1.4	Silty Clay (Low Plasticity) some sand		2	SS	15									
	trace of gravel		3	SS	13									
	Stiff		4	SS	13		330							4 36 36 24
328.7	Fill Material		5	SS	16									
4.4	Silty Clay		6	SS	7		328							
327.9	Firm		7	SS	24									59 25 13 3
5.2			8	SS	57									
	Gravelly Sand		9	SS	43		326							
	traces of silt		10	SS	40									24 73 2 1
	clay		11	SS	39									
	Compact		12	SS	10		324							
	to		13	SS	12									
	Very Dense		14	SS	37		322							28 65 6 1
			15	SS	45									
			16	SS	29		320							
			17	SS	69	18 cm	318							
	Frequent Cobbles and Boulders		18	SS	70	8 cm	316							
			19	SS	40	3 cm	314							
311.8							312							
21.3	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15 \div 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 2

METRIC

W P 49-82-05 LOCATION Co-ords. N 4 804 245.0 E 207 356.5 ORIGINATED BY DG
DIST 3 HWY 7 & 8 BOREHOLE TYPE Cont. Flight Auger (H.S.) COMPILED BY PP
DATUM Geodetic DATE 85 03 27 CHECKED BY 20

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH										WATER CONTENT (%)				
								20 40 60 80 100										10 20 30				
								○ UNCONFINED	+	FIELD VANE												
								● QUICK TRIAXIAL	x	LAB VANE												
331.2	Ground Level																					
0.0	Silty Clay trace of sand Very Stiff Fill Material		1	SS	22		330									0 5 65 30						
329.1			2	SS	25																	
2.1	Silty Clay trace of sand Firm		3	SS	12		328															
327.5			4	SS	7																	
3.7	Silty Sand, some gravel		5	SS	13											21 41 32 6						
326.8	trace of clay Compact		6	SS	41		326									50 36 11 3						
4.4	Sandy Gravel to Gravelly Sand traces of silt clay Compact to Very Dense		7	SS	25											52 41 6 1						
			8	SS	39		324															
			9	SS	18																	
323.1			10	SS	17											21 70 8 1						
8.1	End of Borehole																					

+³, x⁵: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 3

METRIC

W P 49-82-05 LOCATION Co-ords. N 4 804 156.5 E 207 284.5 ORIGINATED BY DG
DIST 3 HWY 7 & 8 BOREHOLE TYPE Cont. Flight Auger & Washbore- B.W. Casing COMPILED BY PP
DATUM Geodetic DATE 85 04 04 to 85 04 09 CHECKED BY *so*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60						80	100	WATER CONTENT (%)
								SHEAR STRENGTH										
338.9	Ground Level																	
0.0	Silty Clay to Clay Some/Trace of Sand trace of gravel		1	SS	12										2 14 41 43			
			2	SS	12													
	Stiff (Low to High Plasticity)		3	SS	13													
			4	SS	14										0 6 43 52			
334.5			5	SS	13													
4.4	Sandy Silt to Silty Sand Some/Trace of Gravel, some clay Dense to Very Dense		6	SS	31										23 23 43 11			
			7	SS	40/8 cm													
			8	SS	75/15 cm										5 44 37 14			
331.4			9	SS	85/23 cm													
7.5	Silty Clay to Clay Trace of Sand gravel Hard (Low to High Plasticity)		10	SS	54										1 5 33 60			
			11	SS	48													
			12	SS	106										0 7 44 49			
327.2			13	SS	109													
11.7			14	SS	106/15 cm										27 44 27 7			
	Silty Sand some gravel trace of clay		15	SS	68/8 cm													
			16	SS	123/15 cm													
	Frequent Cobbles and Boulders		17	SS	98/15 cm													
	Very Dense		18	SS	48/15 cm										27 44 25 5			
			19	SS	72													
			20	SS	100/5 cm													
314.5																		
24.4	End of Borehole																	

+3, x5: Numbers refer to
Sensitivity

20
15 → 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 4

METRIC

W P 49-82-05 LOCATION Co-ords. N 4 804 131.5 E 207 301.0 ORIGINATED BY DG
DIST 3 HWY 7 & 8 BOREHOLE TYPE Cont. Flight Auger (H.S.) COMPILED BY PP
DATUM Geodetic DATE 85 04 04 and 85 04 05 CHECKED BY *so*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
336.8	Ground Level																GR SA SI CL
0.0	Silty Clay to Clay some/trace of gravel some/trace of sand occasional silty sand layers Stiff to Hard (Low to Medium Plasticity)		1	SS	13	15 cm	336										1 20 45 34
			2	SS	19												0 0 50 50
			3	SS	23		334										10 40 35 15
			4	SS	69												18 34 30 18
			5	SS	69		332										2 6 31 61
			6	SS	70/												15 6 25 54
			7	SS	70												29 45 18 8
			8	SS	57		330										
			9	SS	32												
			10	SS	39												
			11	SS	57		328										
			12	SS	73												
			13	SS	103												
			14	SS	72		326										
325.7	Sandy Silt to Silty Sand some gravel trace of clay Very Dense		15	SS	1007	15 cm	324										
11.1			16	SS	1007	18 cm											
			17	SS	1007	25 cm	322										
320.8	Mixture of Gravel, Cobbles and Boulders Very Dense		18	RC BX	REC 5%	10 cm	320										
16.2			19	SS	1007												
			20	RC BX	REC 34%		318										
317.2	End of Borehole																
19.8							316										



RECORD OF BOREHOLE No 5

METRIC

W P 49-82-05 LOCATION Co-ords. N 4 804 228.5 E 207 344.5 ORIGINATED BY DG
DIST 3 HWY 7 & 8 BOREHOLE TYPE Cont. Flight Auger (H.S.) & Washbore-B.W. Casing COMPILED BY PP
DATUM Geodetic DATE 85 04 02 to 85 04 04 CHECKED BY So

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100												
								SHEAR STRENGTH										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE										10 20 30		
330.4	Ground Level																			
0.0	Sandy Silt Some Gravel some clay occ. silty clay and sandy gravel layers Very Loose to Compact		1	SS	22		330													
			2	SS	11		328									20 32 37 11				
			3	SS	2											0 24 59 17				
			4	SS	2															
			5	SS	3		326									0 30 52 18				
325.2			6	SS	17											55 38 6 1				
5.2	Silty Clay		7	SS	9															
324.5	Stiff		8	SS	29		324													
5.9			9	SS	23															
	Silty Sand to Sandy Silt trace/some gravel trace/some clay Compact to Very Dense		10	SS	41		322									9 56 21 14				
			11	SS	52											0 91 7 2				
			12	SS	38		320													
			13	SS	63		318													
			14	SS	70/15 cm		316									28 31 37 4				
314.4			15	SS	105/15 cm															
16.0	Sandy Gravel, some silt, trace of clay		16	SS	36/15 cm		314									50 37 12 1				
313.5	Very Dense																			
16.9	End of Borehole																			

+³, x⁵: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 6

METRIC

W P 49-82-05 LOCATION Co-ords. N 4 804 176.5 E 207 311.0 ORIGINATED BY DG
DIST 3 HWY 7 & 8 BOREHOLE TYPE Cont. Flight Auger (H.S.) & Washbore-B.W. Casing COMPILED BY PP
DATUM Geodetic DATE 85 04 10 to 85 04 11 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH						WATER CONTENT (%)	
327.7	Ground Level							○ UNCONFINED + FIELD VANE		10 20 30						
0.0	Silty Clay some sand gravel occasional silty sand layers Hard (Low Plasticity)		1	SS	42	25 cm	326							0 4 (96)		
			2	SS	65											
			3	SS	40											
			4	SS	100/											3 9 53 35
323.3	Sandy Silt to Silty Sand trace of gravel and clay ----- Frequent Boulders and Cobbles		5	SS	90	13 cm	324									
4.4			6	SS	69											5 24 60 11
			7	SS	63											0 70 29 1
			9	SS	74											
			10	SS	76											
			11	SS	77/											
			12	SS	100/											
			13	SS	50/											
			14	SS	100/											
			15	SS	100/											
310.4	Boulders Cobbles Gravel		16	RC AX	REC 35%	8 cm	312									
17.3			17	RC AX	REC 18%											
			18	RC AX	REC 2%											
305.5	End of Borehole						306									
22.2	* Groundwater Level not Observed															

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

METRIC

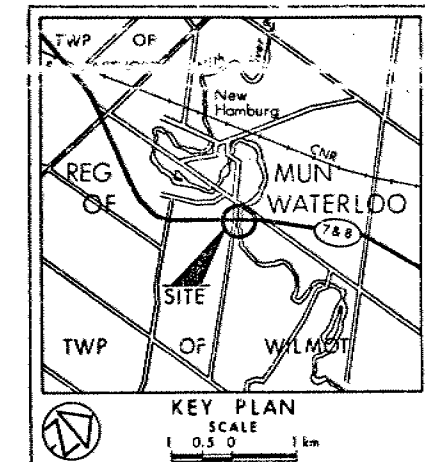
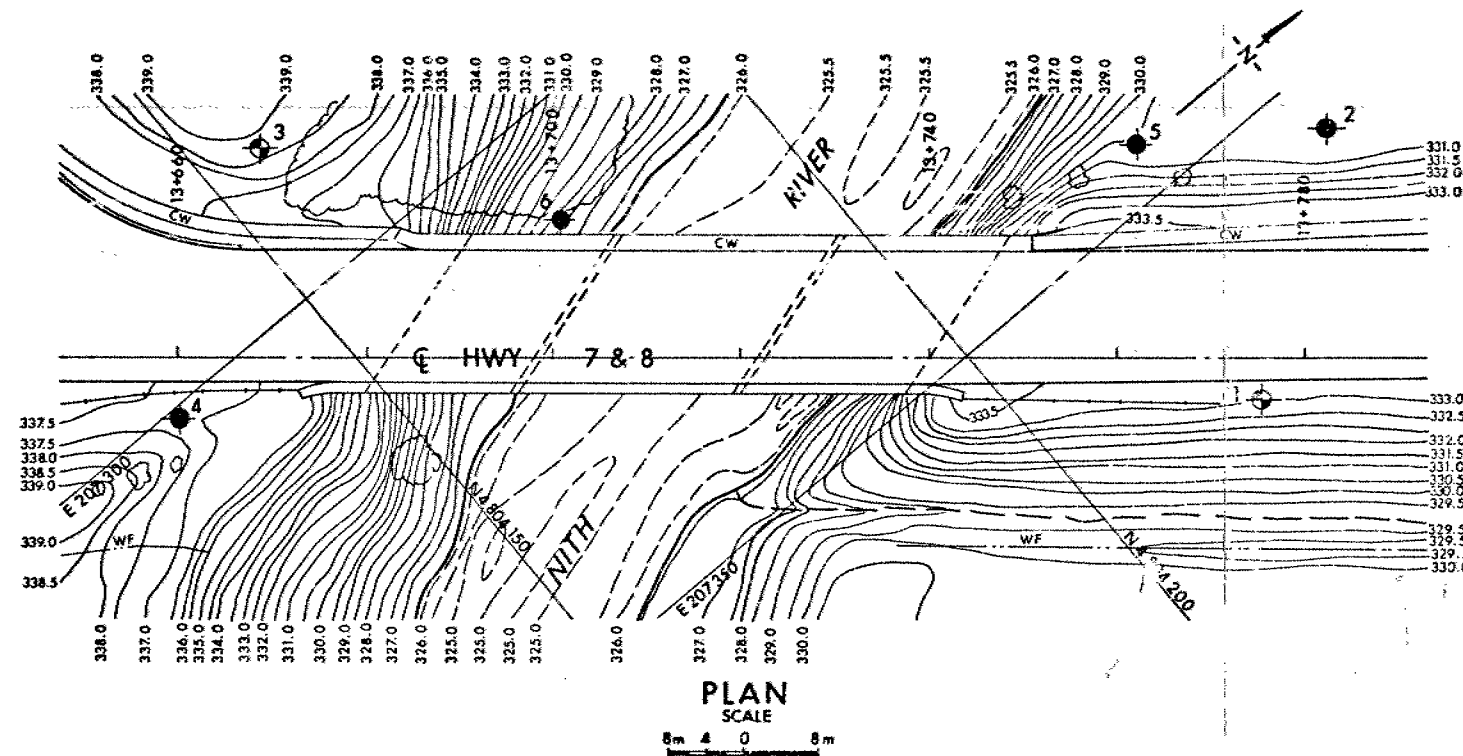
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

CONT No
WP No 49-82-05

NITH RIVER
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



LEGEND

- ◆ Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation 85 03 & 04

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	333.1	4804 221.0	207 374.0
2	331.2	4804 245.0	207 356.5
3	338.9	4804 156.5	207 284.5
4	336.8	4804 131.5	207 301.0
5	330.4	4804 228.5	207 344.5
6	327.7	4804 176.5	207 311.0

NOTE

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

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REV	DATE	BY	DESCRIPTION
Geocres No 40P7-46			
HWY No 7 & 8		DIST 3	
SUBWD PP	CHECKED	DATE 1985 09 05	SITE 33-165-125
DRAWN SO	CHECKED	APPROVED	DWG 498205-A

REF NO E-10020-1 1985 05

