DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 30M5-143

DIST. 4 REGION

W.P. No. 83-74-19

CONT. No. 86-74

W. O. No.

STR. SITE No. 36-1336-62

HWY. No. Q.E.W.

LOCATION Redhill Creek

No of Pages -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 86 - 74

Ontario

Ministry of
Transportation and
Communications


RECEIVED
MAY 23 1986
Foundation Design Section

INDEX

Note: For purposes of the contract these reports supersede all other foundation reports prepared by or for the Ministry in connection with the above-mentioned projects.

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 (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 - 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				k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_P}$	j	kN/m^3	SEEPAGE FORCE
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL	e_{max}	1,%	VOID RATIO IN LOOSEST STATE			

FOUNDATION INVESTIGATION REPORT

For

W.P. 83-74-19; Site 36-1336-62

Red Hill Creek Crossing Widening

Hwy. QEW, District 4, (Burlington)

INTRODUCTION:

This report summarizes the results of a foundation investigation required for the proposed bridge widening and its approaches.

The fieldwork was conducted during the period from 84 05 10 to 84 05 14 utilizing continuous-flight auger machines equipped with 82 mm I.D. hollowstem augers. Wash-boring techniques were employed where necessary.

This fieldwork consisted of 4 dynamic cone penetration tests/sampled boreholes.

SITE DESCRIPTION

The site is located in the City of Hamilton, Regional Municipality of Hamilton-Wentworth at the intersection of Red Hill Creek backwater and the QEW between the Woodward Ave. and Burlington St. exists.

There is an existing bridge at this location.

According to Chapman & Putnam (1966), the site lies within the 'Iroquois Plain' physiographic area, at this location bordering the south end of the Burlington Bar.

The local topography is relatively flat, with the channel of Red Hill Creek approximately 3 m below the grade of the QEW.

SUBSURFACE CONDITIONS

General

The Record of Borehole Sheets (Appendix), illustrate the conditions at the borehole locations. The locations of the boreholes, and stratigraphical profiles based on the borehole data, are shown on Drawing No. 3 of the Contract Drawings.

The thickness of overburden is approximately 18 m. The bedrock surface dips gently towards the northeast.

The sequences (from the surface downwards to bedrock) of subsurface materials at this site is summarized below:

Material	Thickness
silty clay fill	1.1 - 4.0 m
silty sand	1.0 - 4.7 m
silty clay	11.0 -15.5 m

SILTY CLAY (CL); SOME SAND, TRACE/SOME GRAVEL

This very soft to stiff fill material was encountered at the surface at all borehole locations, where its thickness ranges from 1.1 to 4.0 m. The material also contains occasional zones of silty sand.

Physical properties of the material, as determined from laboratory test, are summarized as follows:

	Range	Average
Natural Moisture Content (w)	20.5 - 26.5%	24.3%
Liquid Limit (w_L)	17.5 - 29.5%	25.0%
Plastic Limit (w_P)	14.0 - 19.0%	16.2%

Figure 1 illustrates a typical grain size distribution for this material.

SILTY SAND; SOME/WITH GRAVEL, TRACE CLAY

This very loose to very dense material underlies the SILTY CLAY at all borehole locations, where its thickness ranges from 1.0 to 4.7 m. The material also contains occasional zones of organics.

Physical properties of the material, as determined from laboratory tests, are summarized as follows:

	Range	Average
Natural Moisture Content (w)	8.0 - 29.0%	14.9%

Figure 2 illustrates a typical grain size distribution for this material.

SILTY CLAY (CL); SOME/WITH SAND, TRACE/SOME GRAVEL

This stiff to hard material underlies the SILTY SAND at all borehole locations where its thickness ranges from 11.0 to 15.5 m. Transitional zones, grading from silty clay with shaly layers to weathered shale were encountered within this deposit, immediately above the bedrock.

Bedrock

The bedrock is shale of the Queenston formation.

Groundwater

At the time of the field investigation the elevation of the groundwater was 75.1 ± m.

P. Payer, P. Eng.
Senior Foundations Engineer

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

APPENDIX

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 1 METRIC

W P 83-74-19 LOCATION Co-ords. N 4 791 021.0; E 282 854.5 ORIGINATED BY DD
DIST 4 HWY QEW BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY TM
DATUM Geodetic DATE 84 05 10 - 11 CHECKED BY SO

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.0	Ground Surface										
0.0 / 74.9	Silty Clay *		1	SS	2	▼					
1.1 / 73.9	Silty Sand **		2	SS	2						
2.1	Silty Clay (CL) some/with sand trace/some gravel Stiff to Hard		3	SS	14		74				0 17 52 31
			4	SS	56						
			5	SS	56		72				
			6	SS	69						
			7	SS	52		70				0 17 50 33
			8	SS	38						
			9	SS	22		68				
			10	SS	16						
	occ. shaly layers		11	SS	14		66				
			12	SS	39		64				
			13	SS	35		62				
58.4			14	SS	60/8 cm		60				
17.6	Probable Bedrock Shale End of Borehole										

* some sand trace/some gravel very soft

** some/with gravel trace clay very loose

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 2 METRIC

W P 83-74-19 LOCATION Co-ords. N 4 791 037.5; E 282 846.0 ORIGINATED BY DD
DIST 4 HWY QEW BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY TM
DATUM Geodetic DATE 84 05 11 CHECKED BY SO

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.0	Ground Surface										
0.0	Silty Clay (CL) some sand trace/some gravel Very Soft to Soft		1	SS	2	▼					
			2	SS	2				a		16 25 39 20
73.9							74				
2.1	Silty Sand some/with gravel trace clay occ.organic (peat) zones Very Loose to Loose		3	SS	5						
			4	SS	2				o H		0 83 -17-
71.2							72				
			5	SS	9						
4.8	Silty Clay (CL) some/with sand trace/some gravel Stiff to Hard										
69.4			6	SS	37		70				
6.6	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

20
15 ☼ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 3 METRIC

W P 83-74-19 LOCATION Co-ords. N 4 791 055.5; E 282 895.0 ORIGINATED BY TM
DIST 4 HWY QEW BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY TM
DATUM Geodetic DATE 84 05 11 - 14 CHECKED BY SO

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.0	Ground Surface							
0.0	Silty Clay (CL) some sand trace/some gravel Firm to Stiff occ. silty sand zones		1	SS	5	▼	74	
			2	SS	11			
			3	SS	6			1 69 22 8
72.0			4	SS	7		72	
4.0	Silty Sand some/with gravel trace clay Dense to Very Dense		5	SS	41			29 48 17 6
			6	SS	57		70	
			7	SS	66			42 42 15 1
67.5			8	SS	68		68	
8.5			9	SS	13		66	
			10	SS	18			3 34 40 23
	Silty Clay (CL) some/with sand trace/some gravel Stiff to Hard						64	
							62	
							60	
56.5							58	
19.5	Probable Bedrock End of Borehole							

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT Wp | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W_L
WATER CONTENT (%) 20 40 60

UNIT WEIGHT γ

$+^3$, $\times^5$: Numbers refer to Sensitivity

20
15 ⊕ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 4 METRIC

W P 83-74-19 LOCATION Co-ords. N 4 791 039.3; E 282 903.5 ORIGINATED BY TM
DIST 4 HWY QEW BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY TM
DATUM Geodetic DATE 84 05 11 CHECKED BY SO

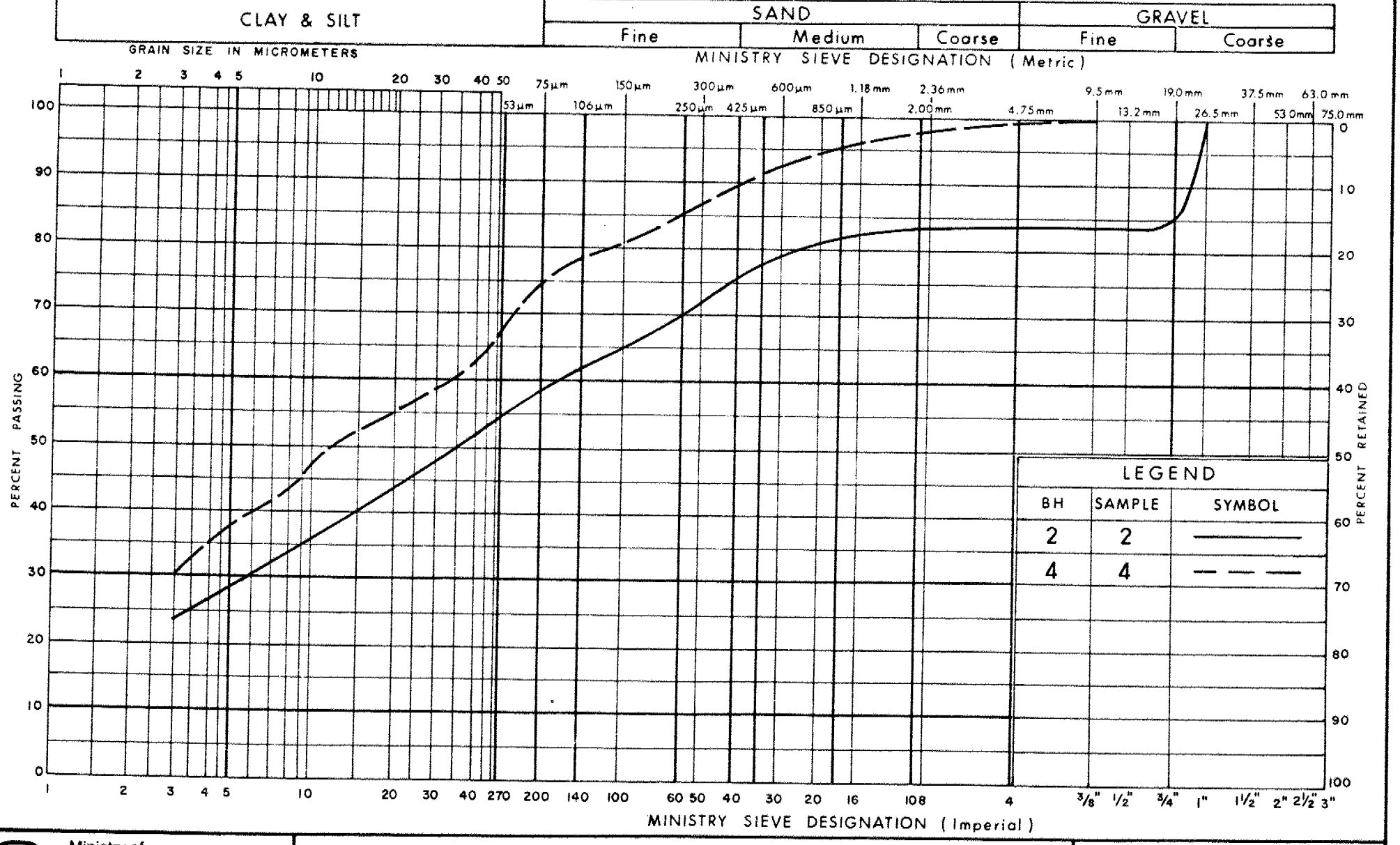
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.0	Ground Surface										
0.0	Silty Clay (CL) some sand trace/some gravel Soft to Firm		1	SS	5	▼	74				
			2	SS	2						
			3	SS	4						
72.3			4	SS	3						1 24 52 23
3.7	Silty Sand some/with gravel trace clay Compact to Very Dense		5	SS	20		72				
			6	SS	17						
			7	SS	67						
69.0			8	SS	38		70		○		52 32 14 2
7.0	Silty Clay (CL) some/with sand trace/some gravel Stiff to Very Stiff		9	SS	18		68				
			10	SS	16		66				
			11	SS	11						
63.4			12	SS	21		64				
12.6	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

UNIFIED SOIL CLASSIFICATION SYSTEM

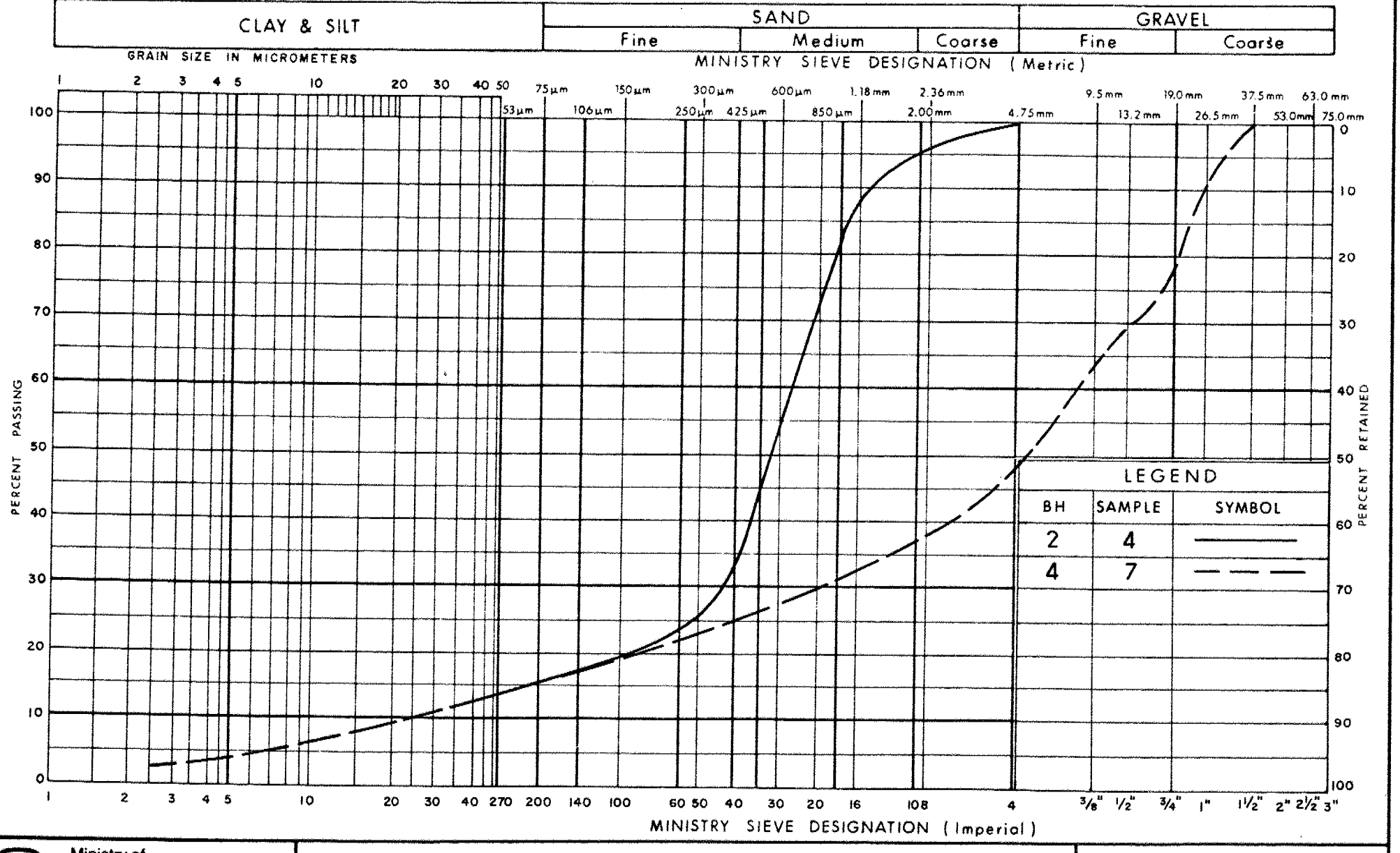


Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION
SILTY CLAY
SOME SAND, TRACE / SOME GRAVEL

FIG No 1
W P 83-74-19

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION
SILTY SAND
SOME/WITH GRAVEL, TRACE CLAY

FIG No 2
W P 83-74-19

FOUNDATION INVESTIGATION REPORT
For
W.P. 83-74-20; Site 36-1336-61
Beach Boulevard Overpass Widening
Hwy. QEW, District 4, (Burlington)

INTRODUCTION:

This report summarizes the results of a foundation investigation required for the proposed overpass widening and its approaches.

The fieldwork was conducted during the period from 84 05 01 to 84 05 10 utilizing continuous-flight auger machines equipped with 82 mm I.D. hollow-stem augers. Wash-boring techniques were employed where necessary.

This fieldwork consisted of 6 dynamic cone penetration test/sampled boreholes.

SITE DESCRIPTION

The site is located in the City of Hamilton, Regional Municipality of Hamilton-Wentworth at the intersection of Beach Boulevard and the QEW.

There is an existing overpass at this location.

According to Chapman & Putnam (1966), the site lies within the 'Iroquois Plain' physiographic area, at this location near the south end of the Burlington Bar.

The local topography is relatively flat, with the level of Beach Boulevard approximately 6 m below the grade of the QEW.

SUBSURFACE CONDITIONS

General

The Record of Borehole Sheets (Appendix), illustrate the conditions at the borehole locations. The locations of the boreholes, and stratigraphical profiles based on the borehole data, are shown on Drawing No. 3 of the Contract Drawings.

The thickness overburden is approximately 23 m. The bedrock surface dips gently towards the north.

The sequence (from the surface downwards to bedrock) of subsurface materials at this site is summarized below:

Material	Thickness
silty clay to silty sand fill	1.5 - 5.5 m
silty sand to sand	10.0 - 12.2 m
silty clay	4.6 - 8.7 m

SILTY CLAY (CL); SOME/WITH SAND, TRACE/SOME GRAVEL

This soft to stiff fill material was encountered at the surface at BH #1, #2, #5 and #6, where its thickness ranges from 1.8 to 4.9 m. The material also contains occasional boulders and occasional zones of organic material.

Physical properties of the material, as determined from laboratory tests, are summarized as follows:

	Range	Average
Natural Moisture Content (w)	13.0 - 56.5%	24.7%
Liquid Limit (w_L)	21.5 - 54.5 %	34.6%
Plastic Limit (w_P)	14.5 - 33.0%	18.9%

Figure 1 illustrates a typical grain size distribution for this material.

SILTY SAND; TRACE/SOME GRAVEL, TRACE CLAY

This very loose to compact fill material was encountered at the surface at BH #3 and #4, where it ranges in thickness from 4.9 to 5.5 m. The material also contains occasional boulders, occasional zones of gravel, occasional zones of organics, and occasional zones of silty clay.

Physical properties of the material, as determined from laboratory tests, are summarized as follows:

	Range	Average
Natural Moisture Content (w)	4.0 - 7.0%	5.5%

Figure 2 illustrates a typical grain size distribution for this material.

SILTY SAND TO SAND; TRACE/SOME GRAVEL

This compact to very dense material underlies the fill at all the borehole locations, where its thickness ranges from 10.0 to 12.2 m. The material also contains occasional gravelly zones.

SILTY CLAY (CL); SOME SAND, TRACE/SOME GRAVEL

This very stiff to hard material underlies the SILTY SAND TO SAND at all borehole locations where its thickness ranges from 4.6 to 8.7 m. Transitional zones, grading from silty clay with shaly layers to weathered shale were encountered within this deposit, immediately above the bedrock.

Bedrock

The bedrock is shale of the Queenston formation.

Groundwater

At the time of the field investigation the elevation of the groundwater was 75.4 ± m.

P. Payer

P. Payer, P. Eng.
Senior Foundations Engineer

K. G. Selby

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

APPENDIX

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 1 METRIC

W P 83-74-20 LOCATION Co-ords. N 4 791 286.0; E 282 695.5 ORIGINATED BY TM
DIST 4 HWY QEW BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY DD
DATUM Geodetic DATE 84 05 01 - 03 CHECKED BY SO

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.7	Ground Surface										
0.0	Silty Clay (CL) some/with sand trace/some gravel occ. boulders Soft to Stiff		1	SS	14						
			2	SS	7	▼	76				8 40 40 12
			3	SS	5						
			4	SS	5						
	and sand		5	SS	3		74				
72.8			6	SS	7						
4.9			7	SS	7						0 91 9
			8	SS	12		72				
	Silty Sand to Sand trace/some gravel occ. traces of clay Compact to Very Dense		9	SS	67		70				
			10	SS	48		68				
			11	SS	62						
			12	SS	15		66				
			13	SS	60		64				
			14	SS	24		62				
60.6			15	SS	78						
17.1	Silty Clay (CL) some sand trace/some gravel Hard		16	SS	54		60				19 25 41 15
	occ. shaly layers		17	SS	112		58				
56.0			18	SS	60/ 8cm		56				
21.7	Probable Bedrock Shale End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 2 METRIC

W P 83-74-20 LOCATION Co-ords. N 4 791 260.0; E 282 709.0 ORIGINATED BY TM
DIST 4 HWY QEW BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY DD
DATUM Geodetic DATE 84 05 03 - 09 CHECKED BY SO

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.7	Ground Surface										
0.0	Silty Clay (CL) some/with sand trace/some gravel occ. boulders Soft to Stiff		1	SS	13						
			2	SS	7		76				20 19 43 18
			3	SS	6						
	occ. zones of organics (peat)		4	SS	3						0 18 60 22
73.7			5	SS	7		74				
4.0	Silty Sand to Sand trace/some gravel occ. traces of clay Compact to Very Dense		6	SS	3						
			7	SS	27		72				
			8	SS	62						
	Occ. gravelly zones		9	SS	37		70				
			10	SS	52				o H		52 35 9 4
			11	SS	32		68				
			12	SS	91		66				
			13	SS	100		64				
62.8											
14.9			14	SS	41		62				
	Silty Clay (CL) some sand trace/some gravel Hard		15	SS	60						
			16	SS	96		60				
	occ. shaly layers		17	SS	102		58				
57.0			18	SS	80/15 cm						
20.7	Probable Bedrock shale End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 3 METRIC

W P 83-74-20 LOCATION Co-ords. N 4 791 318.5; E 282 666.0 ORIGINATED BY TM
DIST 4 HWY QEW BOREHOLE TYPE H-S Auger, Cone Test COMPILED BY TM
DATUM Geodetic DATE 84 05 03 - 04 CHECKED BY SO

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH: o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.6	Ground Surface										
0.0	Silty Sand trace/some gravel trace clay occ. boulders Loose to Compact		1	SS	27						
			2	SS	6	▼	76		o		25 60 15
			3	SS	5						
	occ. gravelly zones		4	SS	7				o		67 23 10
			5	SS	21		74				
	occ. silty clay zones		6	SS	5						
72.1											
5.5	Silty Sand to Sand trace/some gravel occ. traces of clay Compact to Very Dense		7	SS	28		72				
			8	SS	57						
			9	SS	50		70				
	occ. gravelly zones		10	SS	101		68				
			11	SS	47		66				
			12	SS	46		64				
			13	SS	9		62				
60.5											
17.1	Silty Clay (CL) some sand trace/some gravel Hard		14	SS	127		60				
			15	SS	48						
			16	SS	647/10 cm		58				
			17	SS	607/10 cm		56				
	occ. shaly layers		18	SS	787/15 cm		54				
53.1			19	SS	837/15 cm						
24.5	Probable Bedrock Shale End of Borehole										

$+^3$, $\times^5$: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 4 METRIC

W P 83-74-20 LOCATION Co-ords. N 4 791 312.0; E 282 678.0 ORIGINATED BY DD
DIST 4 HWY QEW BOREHOLE TYPE H-S Auger, Cone Test COMPILED BY TM
DATUM Geodetic DATE 84 05 09 - 10 CHECKED BY SO

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.6	Ground Surface										
0.0	Silty Sand trace/some gravel trace clay occ. boulders Very Loose to Compact occ. zones of organics		1	SS	11						
			2	SS	6	▼					
			3	SS	5						
			4	SS	3						
			5	SS	2						
72.7											0 29 55 16
4.9	Silty Sand to Sand trace/some gravel occ. traces of clay Compact to Very Dense		6	SS	7						
			7	SS	21						
			8	SS	7						
			9	SS	24						
			10	SS	29						
	occ. gravelly zones		11	SS	124						
			12	SS	38						
			13	SS	40						
62.7											
14.9	Silty Clay (CL) some sand trace/some gravel Very Stiff to Hard		14	SS	23						
			15	SS	120						
			16	SS	77						3 18 54 25
53.9											
23.7	Probable Bedrock Shale End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 5

METRIC

W P 83-74-20 LOCATION Co-ords. N 4 791 332.5; E 282 719.0 ORIGINATED BY TM

DIST 4 HWY QEW BOREHOLE TYPE H-S Auger, Cone Test COMPILED BY TM

DATUM Geodetic DATE 84 05 09-10 CHECKED BY SO

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
77.5	Ground Surface						
0.0	Silty Clay (CL) some/with sand trace/some gravel occ. boulders Soft to Stiff		1	SS	6		76
			2	SS	2	▼	
			3	SS	2		
74.1			4	SS	20		74
3.4			5	SS	28		
			6	SS	41		
			7	SS	86		72
			8	SS	71		
	Silty Sand to Sand trace/some gravel occ. traces of clay Compact to Very Dense		9	SS	87		70
			10	SS	121		68
			11	SS	101/25 cm		
			12	SS	80		66
			13	SS	24		64
62.0							
15.5			14	SS	72		62
	Silty Clay (CL) some sand trace/some gravel Very Stiff to Hard						60
							58
							56
53.7							54
23.8	Probable Bedrock Shale End of Bedrock						

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE

PLASTIC LIMIT W_P | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W_L

WATER CONTENT (%) 20 40 60

UNIT WEIGHT γ

REMARKS & GRAIN SIZE DISTRIBUTION (%)	GR	SA	SI	CL
	13	13	50	24

$+^3$, $\times^5$: Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 6

METRIC

W P 83-74-20 LOCATION Co-ords. N 4 791 364.5; E 282 701.5 ORIGINATED BY TM

DIST 4 HWY QEW BOREHOLE TYPE H-S Auger, Cone Test COMPILED BY TM

DATUM Geodetic DATE 84 05 09 - 10 CHECKED BY SO

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS
77.5	Ground Surface					
0.0	Silty Clay (CL) * Soft to Stiff		1	SS	16	
75.7			2	SS	6	▼
1.8	Silty Sand to Sand trace/some gravel occ. traces of clay Compact to Very Dense		3	SS	5	
			4	SS	10	
			5	SS	18	
			6	SS	61	
			7	SS	36	
			8	SS	59	
			9	SS	56	
			10	SS	100/23 cm	
			11	SS	75/23 cm	
61.8			12	SS	43	
15.7	End of Borehole					

ELEVATION SCALE: 76, 74, 72, 70, 68, 66, 64, 62

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT W_P | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W_L
WATER CONTENT (%)

UNIT WEIGHT γ

REMARKS & GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

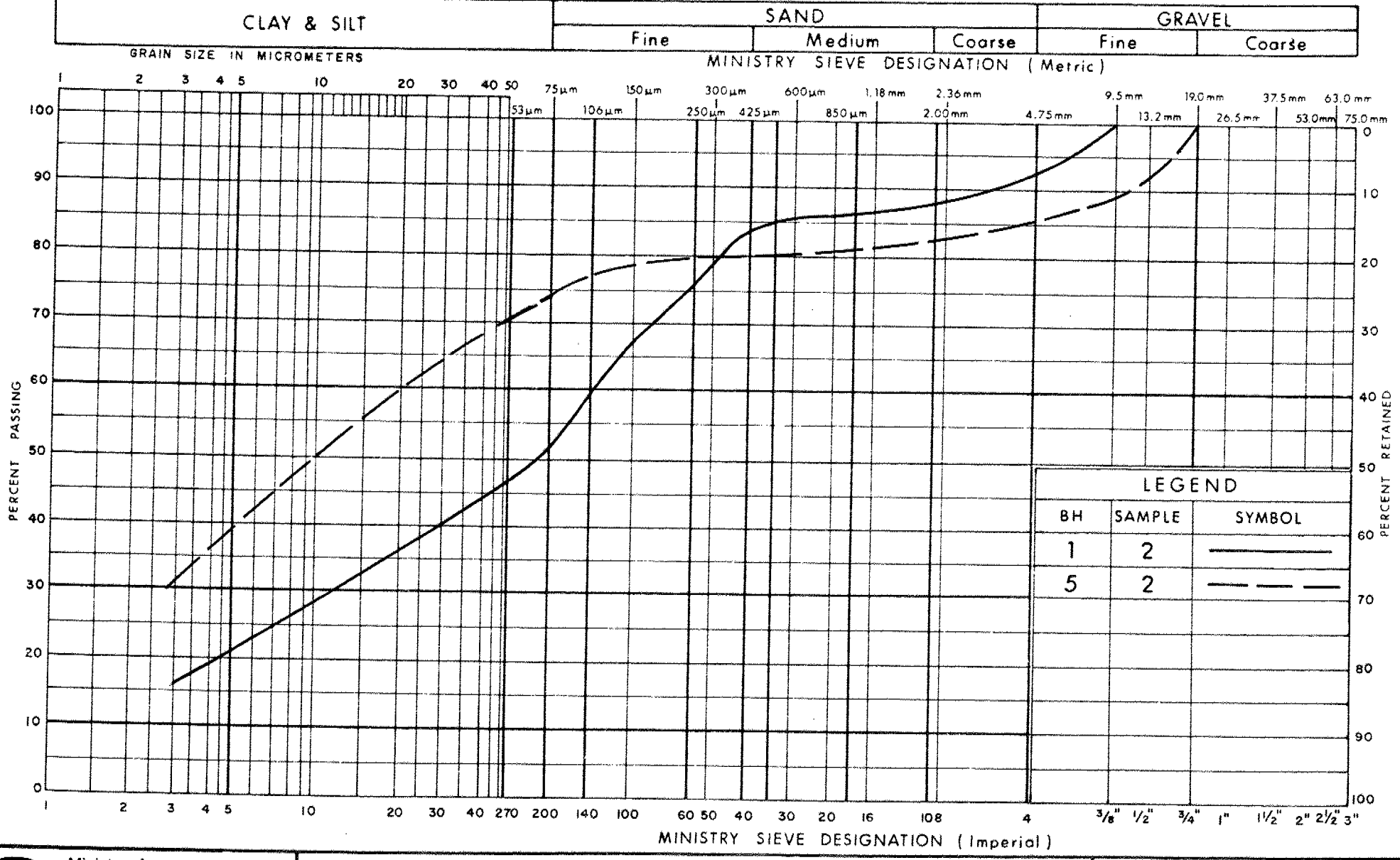
* some/with sand trace/some gravel occ. boulders

$+^3$, $\times^5$: Numbers refer to Sensitivity

20
15 ⊹ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

UNIFIED SOIL CLASSIFICATION SYSTEM

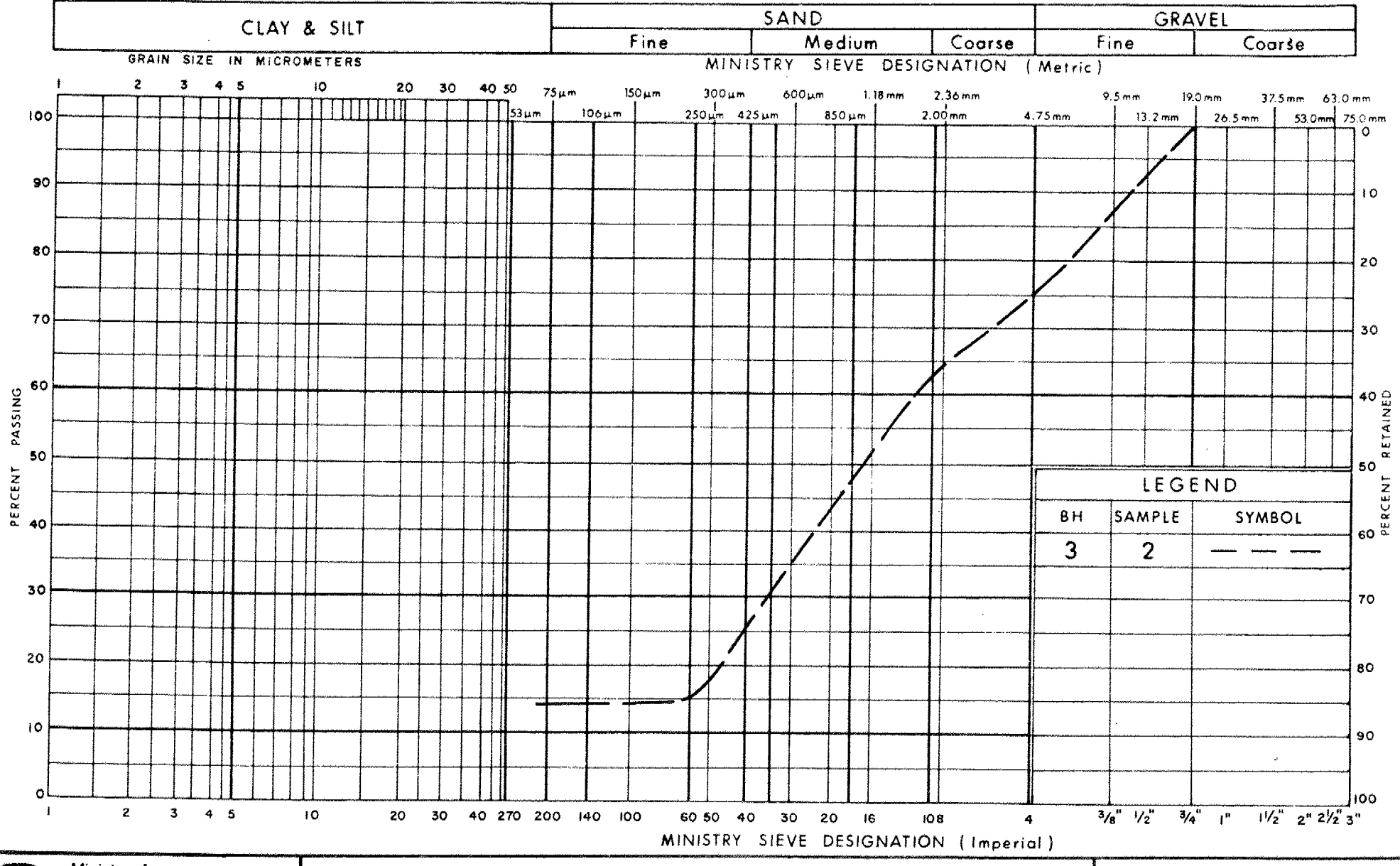


Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION
SILTY CLAY
SOME/ WITH SAND , TRACE / SOME GRAVEL

FIG No 1
W P 83-74-20

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION
SILTY SAND
TRACE / SOME GRAVEL , TRACE CLAY

FIG No 2
W P 83-74-20

CONT 86-74

Ontario

Ministry of
Transportation and
Communications

foundation investigation and design report

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 83-74-19 DIST 4

HWY QEW STR SITE 36-1336-62

Red Hill Creek

DISTRIBUTION

MAST 1,2
DOM 3,4

G.C.E. Burkhardt (3)
R.D. Gunter
A. Wittenberg
J. Smrcka (2)
K. Bassi
J.H. Peer
R. Hore
R. Fitzgibbon (Cover Only)
T.J. Kovich (Cover Only)

GEOCRES 30M5-143

DATE JUN 27 1984

FOUNDATION INVESTIGATION REPORT

For

W.P. 83-74-19; Site 36-1336-62

Red Hill Creek Crossing Widening

Hwy. QEW, District 4, Hamilton

INTRODUCTION:

This report summarizes the results of a foundation investigation required for the proposed bridge widening and its approaches.

The fieldwork was conducted during the period from 84 05 10 to 84 05 14 utilizing continuous-flight auger machines equipped with 82 mm I.D. hollow-stem augers. Wash-boring techniques were employed where necessary.

This fieldwork consisted of 4 dynamic cone penetration tests/sampled boreholes.

SITE DESCRIPTION

The site is located in the City of Hamilton, Regional Municipality of Hamilton-Wentworth at the intersection of Red Hill Creek backwater and the QEW between the Woodward Ave. and Burlington St. exits.

There is an existing bridge at this location.

According to Chapman & Putnam (1966), the site lies within the 'Iroquois Plain' physiographic area, at this location bordering the south end of the Burlington Bar.

The local topography is relatively flat, with the channel of Red Hill Creek approximately 3 m below the grade of the QEW.

SUBSURFACE CONDITIONS

General

The Record of Borehole Sheets (Appendix), illustrate the conditions at the borehole locations. The locations of the boreholes, and stratigraphical profiles based on the borehole data, are shown on Drawing No. 837419-A.

The thickness of overburden is approximately 18 m. The bedrock surface dips gently towards the northeast.

The sequence (from the surface downwards to bedrock) of subsurface materials at this site is summarized below:

Material	Thickness
silty clay fill	1.1 - 4.0 m
silty sand	1.0 - 4.7 m
silty clay	11.0 -15.5 m

Subsurface Material Descriptions

SILTY CLAY (CL); SOME SAND, TRACE/SOME GRAVEL

This very soft to stiff fill material was encountered at the surface at all borehole locations, where its thickness ranges from 1.1 to 4.0 m. The material also contains occasional zones of silty sand.

Physical properties of the material, as determined from field and laboratory tests, are summarized as follows:

	Range	Average	Median
Natural Moisture Content (w)	20.5 - 26.5%	24.3%	26.0%
Liquid Limit (w_L)	17.5 - 29.5%	25.0%	28.0%
Plastic Limit (w_P)	14.0 - 19.0%	16.2%	15.5%

Figure 1 illustrates a typical grain size distribution for this material.

SILTY SAND; SOME/WITH GRAVEL, TRACE CLAY

This very loose to very dense material underlies the SILTY CLAY at all borehole locations, where its thickness ranges from 1.0 to 4.7 m. The material also contains occasional zones of organics.

Physical properties of the material, as determined from field and laboratory tests, are summarized as follows:

	Range	Average	Median
Natural Moisture Content (w)	8.0 - 29.0%	14.9%	12.0%

Figure 2 illustrates a typical grain size distribution for this material.

SILTY CLAY (CL); SOME/WITH SAND, TRACE/SOME GRAVEL

This stiff to hard material underlies the SILTY SAND at all borehole locations where its thickness ranges from 11.0 to 15.5 m. Transitional zones, grading from silty clay with shaly layers to weathered shale were encountered within this deposit, immediately above the bedrock.

Bedrock

The bedrock is shale of the Queenston formation.

Groundwater

At the time of the field investigation the elevation of the groundwater was 75.1 ± m.

DISCUSSION AND RECOMMENDATIONS

It is proposed to widen the existing QEW. At the Red Hill Creek Crossing this proposal will involve the extension of the existing abutments by 7± m on the west side, and 5± m on the east side. The proposal will also involve widening the existing 4.5± m high (above creek bottom) approach embankments.

The existing bridge is a rigid-frame structure, probably supported on spread footings (with concrete pedestals at the north abutment), or possibly on piles. The probable footing/pedestal base elevations are indicated below:

North Abutment (Toronto Side)			South Abutment (St.Catharine Side)	
	Pedestal	Footing		Footing
N.E. Corner -	elev. 69.0± m	elev. 72.0± m	S.E. Corner -	elev. 72.0± m
N.W. Corner -	elev. 69.0± m	elev. 72.0± m	S.W. Corner -	elev. 72.0± m

General Recommendations

EARTH PRESSURE CALCULATIONS

Backfill to structures should consist of granular material in accordance with MTC Standard Special Provision #121 (83 10). Computation of earth pressures should be in accordance with Section 6.6.1.2 of the O.H.B.D.C.

For design purposes, the physical properties of the backfill are as follows:

MATERIAL	ϕ	γ
GRANULAR 'A'	35°	22.0 kN/m^3
GRANULAR 'B'	30°	21.2 kN/m^3

SETTLEMENT CONSIDERATIONS

Differential settlements for the proposed abutment extensions will be negligible. Therefore the abutment extensions may be rigidly connected to the existing structure, providing the foundation recommendations are followed.

FINAL SLOPE STABILITY

No stability problems are anticipated for embankments or cuts with slopes of 2:1 or flatter. If steeper slopes are required, please contact this section for recommended slope angles.

FROST PROTECTION

The minimum cover required for frost protection is 1.2 m.

DE-WATERING

Since de-watering operations would create a danger of material loss under the existing footings, a tremie concrete design is recommended, which will simplify de-watering operations

Design Details

STRUCTURE

The proposed abutment extensions should be supported on steel H-piles equipped with reinforced tips and driven to bedrock, with pile caps founded at the elevation of the existing footing bases, or at a higher structurally-convenient elevation.

The following design values are recommended for the H-piles:

Working Stress Design Method:

Pile Type	Safe Capacity
310 HP 110	1150 kN per pile
310 HP 79	830 kN per pile

O.H.B.D.C. Method:

Pile Type	Factored Capacity at U.L.S.	Capacity at S.L.S. Type II
310 HP 110	1600 kN per pile	1150 kN per pile
310 HP 79	1150 kN per pile	830 kN per pile

Since the material under the existing foundations must be protected, the pile cap excavation for the proposed extensions should be enclosed by a sheet-pile cofferdam. The excavation should extend at least to elev. 72 m, but also to a depth sufficient to balance the prevailing hydrostatic head by means of tremie concrete.

APPROACHES

All soft or loose material beneath the proposed embankment widening should be removed and replaced with suitable embankment material. The existing QEW must be protected during construction of the proposed widening, by completing the excavations and embankment construction in section 5± m long or by steel sheeting where necessary.

MISCELLANEOUS

The fieldwork for this project was carried out under the supervision of Mr. T.W. Miller, Student Engineer, and Mr. D.H. Dundas, Foundations Engineer.

The report was written by Mr. Dundas and reviewed by Mr. K.G. Selby, Chief Foundations Engineer.

The equipment used was owned and operated by Dominion Soil Investigation Inc., and by Master Soil Investigation Ltd.

D. H. Dundas

D. H. Dundas, P.Eng.
Foundations Engineer

K. G. Selby

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

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 = $\frac{c_u}{\tau_r}$

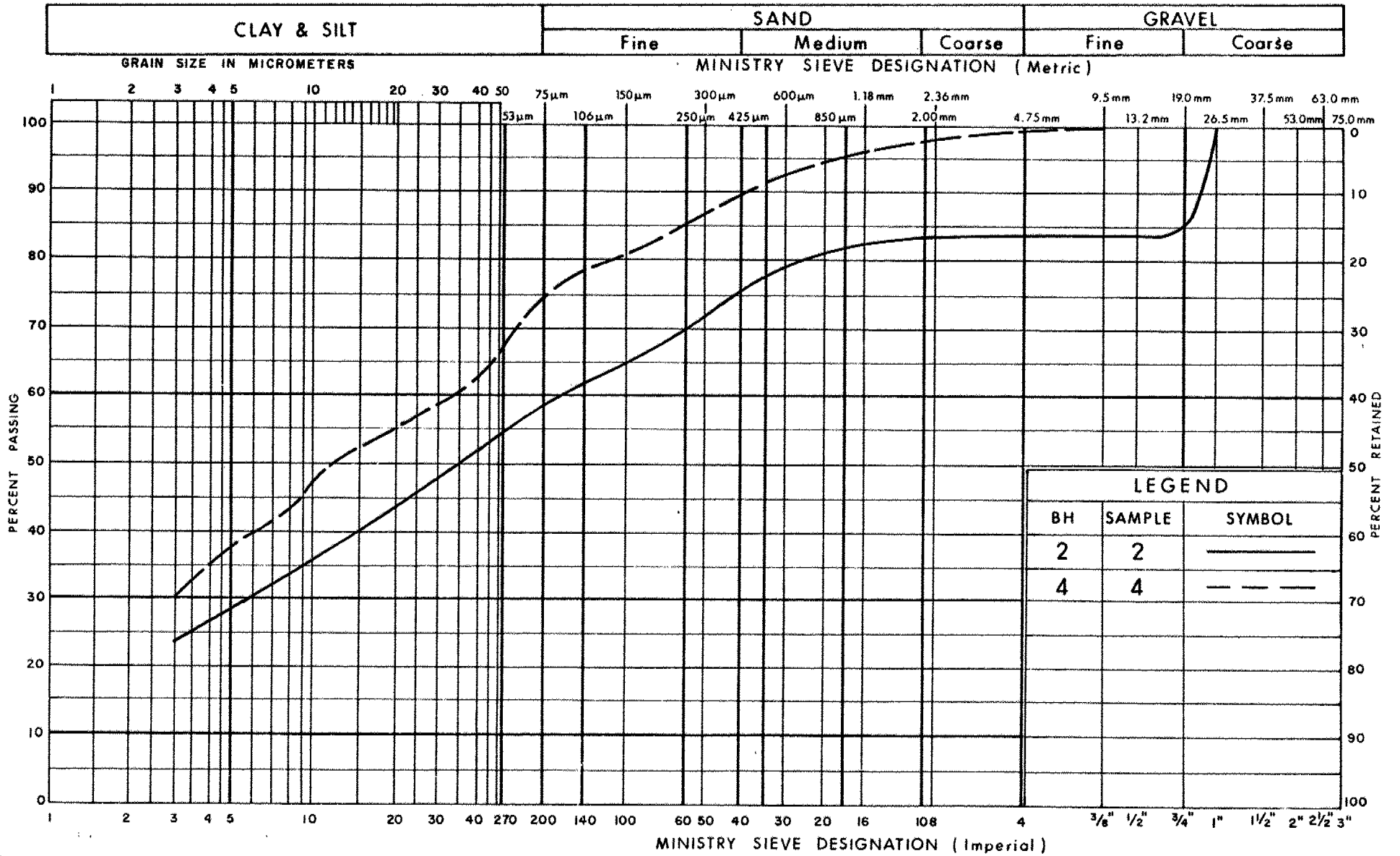
PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

e	1,%	VOID RATIO
n	1,%	POROSITY
w	1,%	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_p	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_p	%	PLASTICITY INDEX = $w_L - w_P$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_P}{I_p}$
I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	1,%	VOID RATIO IN LOOSEST STATE

e_{min}	1,%	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

UNIFIED SOIL CLASSIFICATION SYSTEM

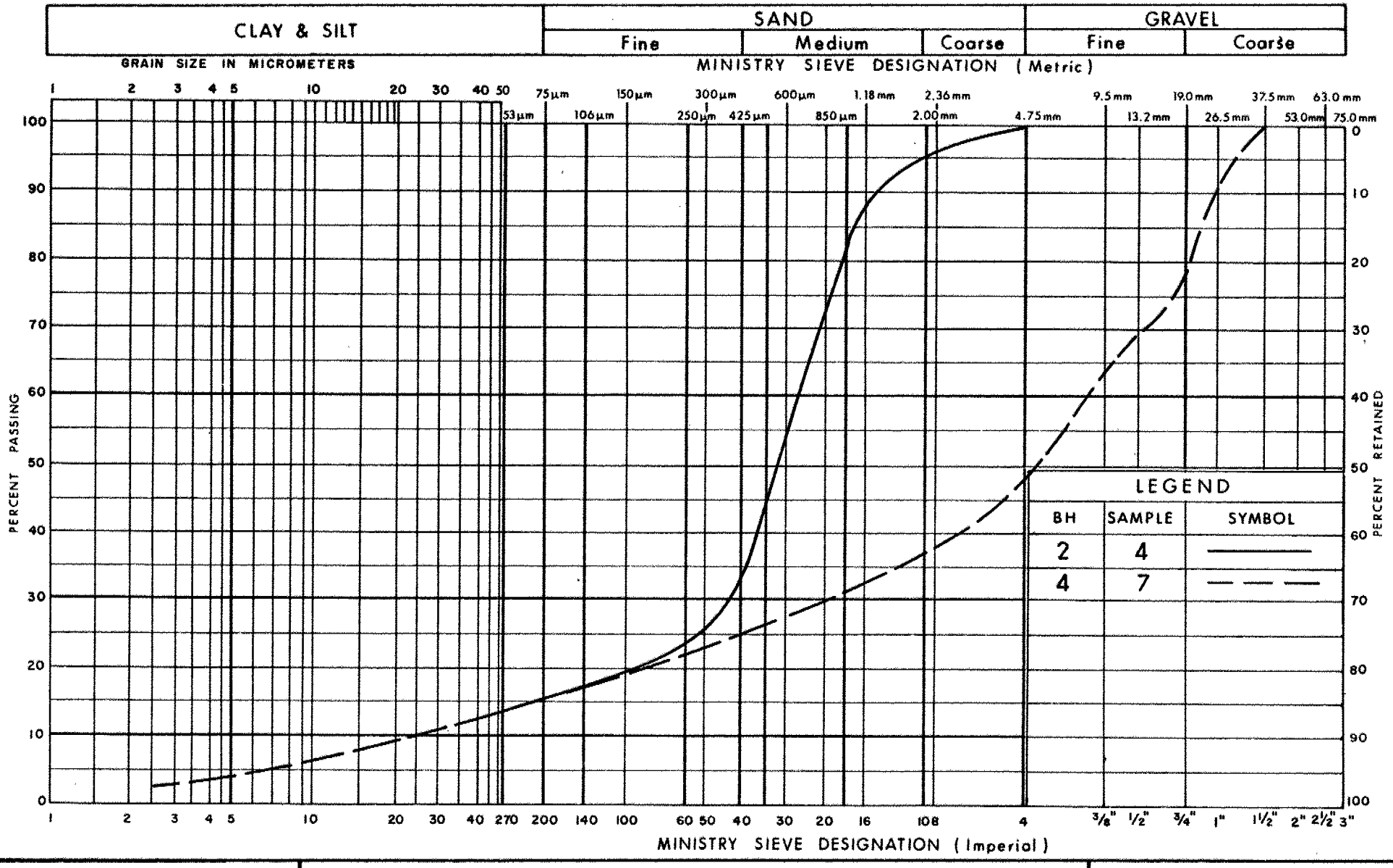


Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION
SILTY CLAY
SOME SAND, TRACE / SOME GRAVEL

FIG No 1
W P 83-74-19

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION
SILTY SAND
SOME/WITH GRAVEL, TRACE CLAY

FIG No 2
W P 83-74-19

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 1 METRIC

W P 83-74-19 LOCATION Co-ords. N 4 791 021.0; E 282 854.5 ORIGINATED BY DD
DIST 4 HWY QEW BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY TM
DATUM Geodetic DATE 84 05 10 - 11 CHECKED BY SO

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS
76.0	Ground Surface					
0.0 / 74.9	Silty Clay *		1	SS	2	▼
1.1 / 73.9	Silty Sand **		2	SS	2	
2.1	Silty Clay (CL) some/with sand trace/some gravel Stiff to Hard		3	SS	14	
			4	SS	56	
			5	SS	56	
			6	SS	69	
			7	SS	52	
			8	SS	38	
			9	SS	22	
			10	SS	16	
			11	SS	14	
			12	SS	39	
	occ. shaly layers					
			13	SS	35	
58.4			14	SS	60/8 cm	
17.6	Probable Bedrock Shale End of Borehole					

ELEVATION SCALE: 74, 72, 70, 68, 66, 64, 62, 60

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT W_p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W_L
WATER CONTENT (%) 20 40 60

UNIT WEIGHT γ

REMARKS & GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL
0 17 52 31
0 17 50 33

* some sand trace/some gravel very soft

** some/with gravel trace clay very loose

$+^3$, $\times^5$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 2 METRIC

W P 83-74-19 LOCATION Co-ords. N 4 791 037.5; E 282 846.0 ORIGINATED BY DD
DIST 4 HWY QEW BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY TM
DATUM Geodetic DATE 84 05 11 CHECKED BY SO

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.0	Ground Surface										
0.0	Silty Clay (CL) some sand trace/some gravel Very Soft to Soft		1	SS	2	▼					
73.9			2	SS	2		74		a		16 25 39 20
2.1	Silty Sand some/with gravel trace clay occ.organic (peat) zones Very Loose to Loose		3	SS	5						
			4	SS	2				○ H		0 83 -17-
71.2			5	SS	9		72				
4.8	Silty Clay (CL) some/with sand trace/some gravel Stiff to Hard										
69.4			6	SS	37		70				
6.6	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

20
15 ⊹ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 3 METRIC

W P 83-74-19 LOCATION Co-ords. N 4 791 055.5; E 282 895.0 ORIGINATED BY TM
DIST 4 HWY QEW BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY TM
DATUM Geodetic DATE 84 05 11 - 14 CHECKED BY SO

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.0	Ground Surface										
0.0	Silty Clay (CL) some sand trace/some gravel Firm to Stiff		1	SS	5	▼					
	occ. silty sand zones		2	SS	11		74		H ○		1 69 22 8
			3	SS	6						
72.0			4	SS	7		72				
4.0	Silty Sand some/with gravel trace clay Dense to Very Dense		5	SS	41				○		29 48 17 6
			6	SS	57		70				
			7	SS	66				○		42 42 15 1
67.5			8	SS	68		68				
8.5			9	SS	13		66				
			10	SS	18				⊢○⊣		3 34 40 23
	Silty Clay (CL) some/with sand trace/some gravel Stiff to Hard						64				
							62				
							60				
56.5							58				
19.5	Probable Bedrock End of Borehole	BEDR									

+3, ×5 : Numbers refer to Sensitivity

15 20 5 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 4

METRIC

W P 83-74-19 LOCATION Co-ords. N 4 791 039.3; E 282 903.5 ORIGINATED BY TM
DIST 4 HWY QEW BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY TM
DATUM Geodetic DATE 84 05 11 CHECKED BY SO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT W_p / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						GR SA SI CL
76.0	Ground Surface										
0.0	Silty Clay (CL) some sand trace/some gravel Soft to Firm		1	SS	5	▼	74				
			2	SS	2						
			3	SS	4						
72.3			4	SS	3						1 24 52 23
3.7	Silty Sand some/with gravel trace clay Compact to Very Dense		5	SS	20		72				
			6	SS	17						
			7	SS	67						52 32 14 2
69.0			8	SS	38		70				
7.0	Silty Clay (CL) some/with sand trace/some gravel Stiff to Very Stiff		9	SS	18		68				
			10	SS	16						
			11	SS	11		66				
63.4			12	SS	21		64				
12.6	End of Borehole										

$+^3$, $\times^5$: Numbers refer to Sensitivity

20
15 -○- 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

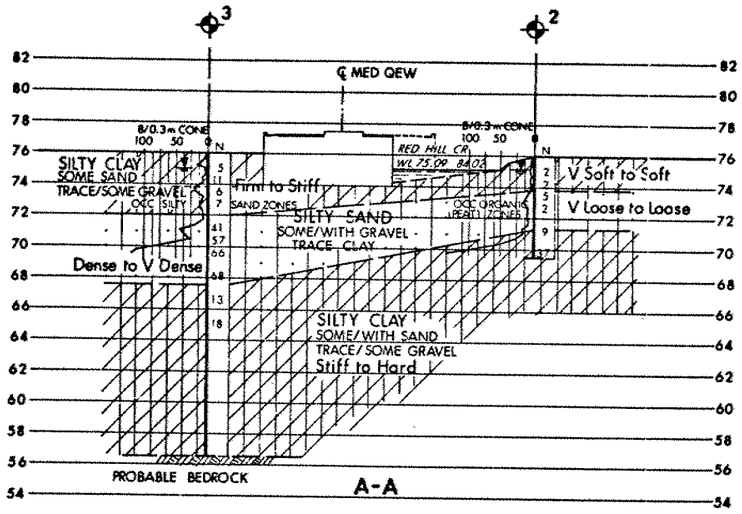
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

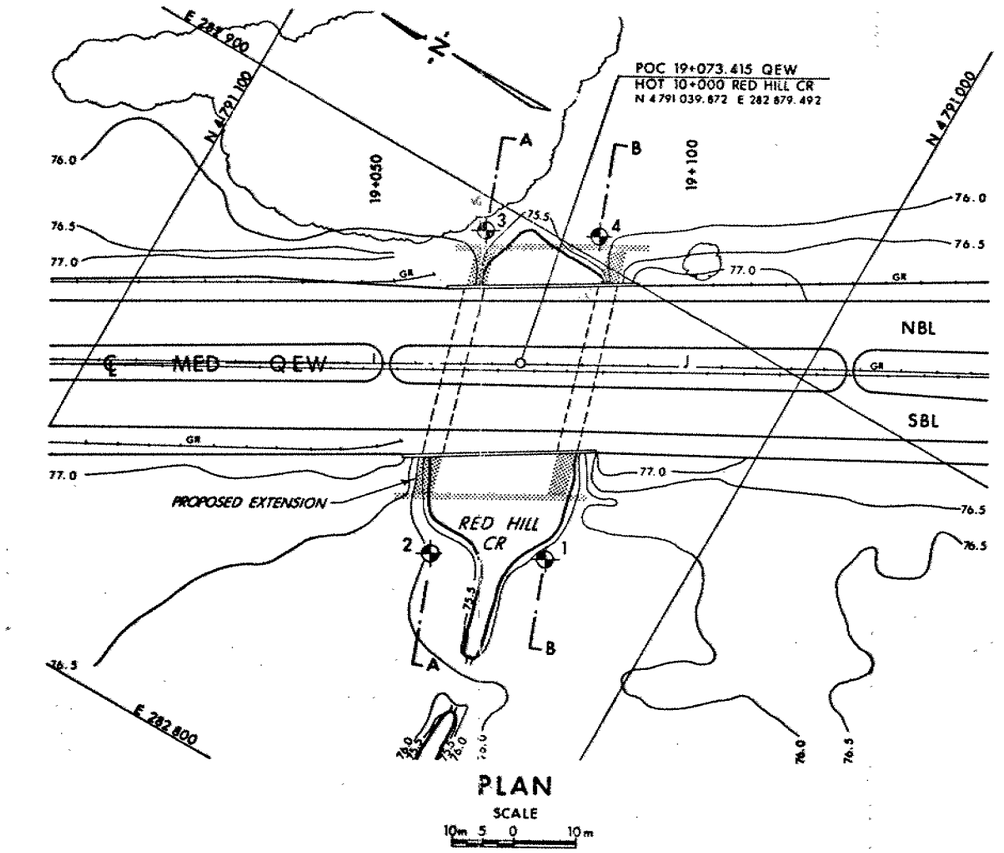
CONT No
WP No 83-74-19

RED HILL CREEK

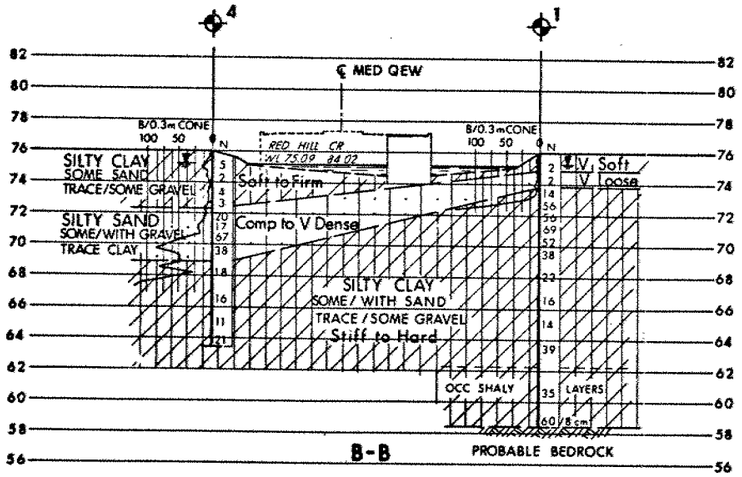
BORE HOLE LOCATIONS & SOIL STRATA

SHEET

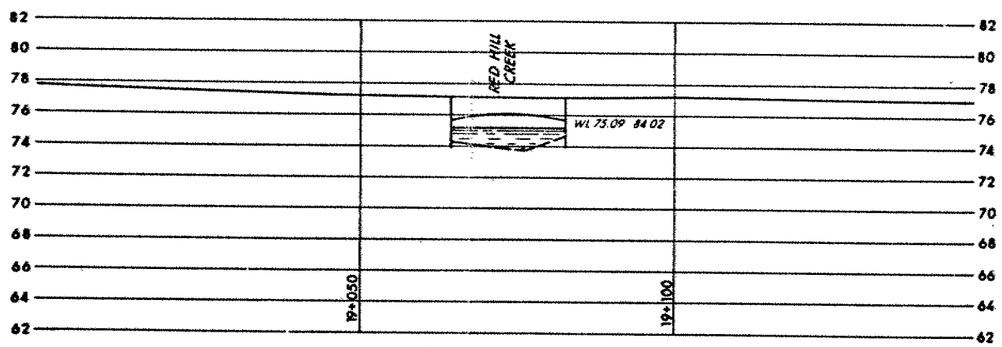




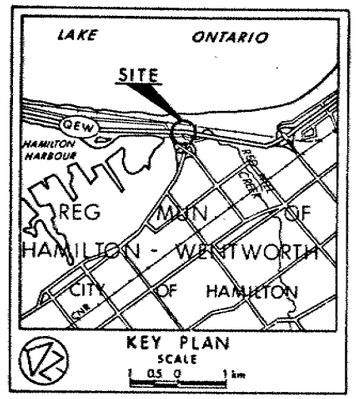
PLAN
SCALE
10m 5 0 10m



SECTIONS
SCALE
10m 5 0 10m Hor
4m 2 0 4m Vert



℄ PROFILE QEW
SCALE
10m 5 0 10m Hor
4m 2 0 4m Vert



KEY PLAN
SCALE
1 0.5 0 1 km

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 84 05

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	76.0	4 791 021.0	282 854.5
2	76.0	4 791 037.5	282 846.0
3	76.0	4 791 055.5	282 895.0
4	76.0	4 791 039.3	282 903.5

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 30M5-143

HWY No QEW			DIST 4
SUBM'D DD	CHECKED	DATE 84 06 25	SITE 36-1336-62
DRAWN SO	CHECKED	APPROVED	DWG 837419-A

REF NO S-2183-2 COLE, SHERMAN & ASSOC

memorandum

Ontario

To: G.C.E. Burkhardt
Head, Structural Section
Central Region

Date: 1984 05 17

Atten: M.D.Bendayan

From: Foundation Design Section
Room 315, Central Building

RE: Foundation Investigation
Preliminary Recommendations
W.P. 83-74-19, Site 36-1336-62
Red Hill Creek Crossing Widening
Hwy. Q.E.W., District 4, Hamilton

Fieldwork for the above-noted project has been completed.

This memo contains recommendations pertaining to the design and construction of the foundations for the proposed bridge widening. These recommendations are intended to be sufficient to allow the design of this project to proceed to completion. Our complete foundation investigation and design report will be submitted in the near future. If there are any questions, please contact this office.

SUBSURFACE CONDITIONS

At this site, the thickness of overburden is 18± m.

The sequence (from the surface downwards) of subsurface materials at the proposed abutment extensions is summarized below:

NORTH ABUTMENT: (Toronto side)

N.E. Corner

- elev. 76.0± m to elev. 74.0± m
- cohesive silty clay, some sand, traces of gravel and organics, and occasional non-cohesive silty sand zones
- firm to stiff

- elev. 74.0± m to elev. 67.5± m
- non-cohesive silty sand containing occasional gravelly zones and occasional cohesive silty clay and organic zones above elev. 72.1± m
- loose to very dense

- elev. 67.5± m to elev. 56.5± m
- cohesive silty clay, some sand, trace gravel
- stiff to hard

.....2

NORTH ABUTMENT (cont'd)

- below elev. 56.5±m
- shale bedrock

N.W. Corner

- elev. 76.0± m to elev. 73.5± m
- cohesive silty clay, some sand, trace gravel
- very soft to soft

- elev. 73.5+ m to elev. 71.0+ m
- non-cohesive silty sand containing occasional zones of organic material
- very loose to loose

- below elev. 71.0± m
- cohesive silty clay, some sand, trace gravel
- very stiff to hard
- estimated bedrock elev. 58.0± m

SOUTH ABUTMENT: (St. Catherines Side)

S.E. Corner

- elev. 76.0± m to elev. 72.0± m
- cohesive silty clay, some sand, trace gravel
- soft to firm

- elev. 72.0± m to elev. 69.0± m
- non-cohesive silty sand, containing occasional gravelly zones
- compact to very dense

- below elev. 69.0± m
- cohesive silty clay, some sand, trace gravel
- stiff to hard
- estimated bedroc elev. 57.5 ± m

S.W. Corner

- elev. 76.0± m to elev. 75.0± m
- cohesive silty clay, some sand, traces of gravel and organics
- very soft to soft

.....3

S.W. Corner (Cont'd)

- elev. 75.0± m to elev. 74.0± m
- non-cohesive silty sand
- very loose

- elev. 74.0± m to elev. 58.5± m
- cohesive silty clay, some sand, trace gravel
- stiff to hard

- below elev. 58.5 ± m
- shale bedrock

At the time of the field investigation the elevation of the groundwater was 75.1± m.

DISCUSSION AND RECOMMENDATIONS

It is proposed to widen the existing Q.E.W. At the Red Hill Creek Crossing this proposal will involve the extension of the existing abutments by 7± m on the west side, and 5± m on the east side. The proposal will also involve widening the existing 4.5± m high (above creek bottom) approach embankments.

The existing bridge is a rigid-frame structure, probably supported on spread footings (with concrete pedestals at the north abutment) or possibly on piles. The probable footing/pedestal base elevations are indicated below:

	North Abutment (Toronto Side)		South Abutment (St.Catherine Side)
	Pedestal	Footing	Footing
N.E. Corner	elev. 69.0± m	elev. 72.0± m	SE corner - elev. 72.0± m
N.W. Corner	elev. 69.0± m	elev. 72.0± m	SW corner - elev. 72.0± m

(reference: plan 1336-38-1, Dwg.No. D 2578-1, Cont. No. 38-23)

General Recommendations

EARTH PRESSURE CALCULATIONS

Backfill to structures should consist of granular material in accordance with MTC Standard Special Provision #121 (83 10). Computation of earth pressures should be in accordance with Section 6.6.1.2 of the O.H.B.D.C.

For design purposes, the physical properties of the backfill are as follows:

MATERIAL	ϕ	γ
GRANULAR 'A'	35°	22.0 kN/m^3
GRANULAR 'B'	30°	21.2 kN/m^3

.....4

SETTLEMENT CONSIDERATIONS:

Differential settlements for the proposed abutment extensions will be negligible. Therefore the abutment extensions may be rigidly connected to the existing structure, providing the foundation recommendations are followed.

FINAL SLOPE STABILITY:

No stability problems are anticipated for embankments or cuts with slopes of 2:1 or flatter. If steeper slopes are required, please contact this section for recommended slope angles.

FROST PROTECTION:

The minimum cover required for frost protection is 1.2 m.

DE-WATERING:

Since de-watering operations would create a danger of material loss under the existing footings, a tremie concrete design is recommended, which will simplify de-watering operations.

DESIGN DETAILS

Structure

The proposed abutment extensions should be supported on steel H-piles equipped with reinforced tips and driven to bedrock, with pile caps founded at the elevation of the existing footing bases, or at a higher structurally-convenient elevation.

The following design values are recommended for the H-piles:

Working Stress Design Method:

Pile Type	Safe Capacity
310 HP 110	1150 kN per pile
310 HP 79	830 kN per pile

O.H.B.D.C. Method:

	Factored Capacity at U.L.S.	Capacity at S.L.S. Type II
310 HP 110	1600 kN per pile	1150 kN per pile
310 HP 79	1150 kN per pile	830 kN per pile

Since the material under the existing foundations must be protected, the pile cap excavations for the proposed extensions should be enclosed by a sheet-pile cofferdam. The excavations should extend at least to elev. 72 m, but also to depth sufficient to balance the prevailing hydrostatic head by means of tremie concrete.

.....5

Approaches
~~APPROACHES~~

All soft or loose material beneath the proposed embankment widenings should be removed and replaced with suitable embankment material. The existing Q.E.W. must be protected during construction of the proposed widening, by completing the excavations and embankment construction in sections 5± m long or by steel sheet where necessary.

SIGNED FOR D.H. DUNDAS

D.H. Dundas
Foundations Engineer

DHD/mmj

memorandum

Ontario

To: G.C.E. Burkhardt
Head, Structural Section
Central Region
5000 Yonge Street

Date: 1984 11 16

Atten: M.D. Bendayan

From: Foundation Design Section
Room 315, Central Building

RE: Preliminary Review
Red Hill Creek Crossing Widening
Hwy. Q.E.W., Dist. 4, Burlington
WP 83-74-19, Site 36-1336-62

This Section has reviewed the submitted preliminary drawings P-1 and P-2.

Our comments are as follows:

1) The provisions required to protect the existing footings during construction of the extensions do not appear to have been detailed in this design. Please refer to Pg. 5 (Design Details-Structure) of the Foundation Investigation and Design Report for our recommendations concerning protection of the existing structure during construction. The proposed protection scheme should be submitted to this Section for our review.

2) Please refer to Pg. 5 of the Foundation Design Report for our recommendations concerning construction of the approach embankments for this widening.

3) Piles should be equipped with reinforced and driven to bedrock (est. elev. of bedrock surface = 56 m to 58 m).

If there are any questions please contact this office.

D. H. Dundas

D.H. Dundas
Foundations Engineer

DHD/mmj

memorandum

F

Ontario

To: G.C.E. Burkhardt
Head, Structural Section
5000 Yonge Street

Date: 1985 01 15

Atten: M.D. Bendayan

From: Foundation Design Section
Room 315, Central Building

RE: Q.E.W. Widening of Red Hill Creek Crossing
W.P. 83-74-19, Site 36-1336-62
District 4, Hamilton

We have reviewed final drawings 36-1336-62-1, 5 and 6 for the above-mentioned project and note that the foundation design appears to conform with recommendations made previously by this Section.

We have informed Mr. M. Sherlock of Gregg and Edens Ltd. by telephone of an error in the pile type designation on drawings 1 and 5. Drawing 1 specifies HP 310 x 110 piles whereas drawing 5 calls for HP 310 x 79. We also informed Mr. Sherlock that the note regarding the piles on drawing 1 is incomplete.

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

KGS/mmj

METRIC

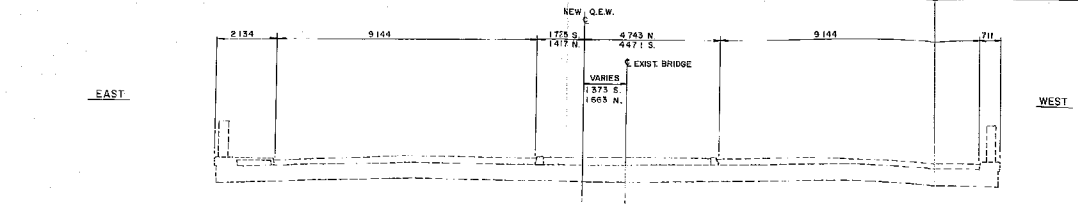
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DIST No 4
CONT No
WP No 83-74-19

SHEET

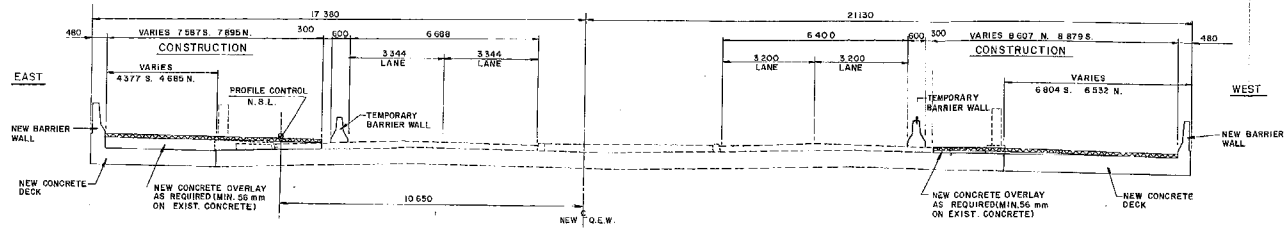
Q.E.W. WIDENING
RED HILL CREEK CROSSING
CONSTRUCTION STAGING

Gregg and Edens Limited
engineers : planners : economists.



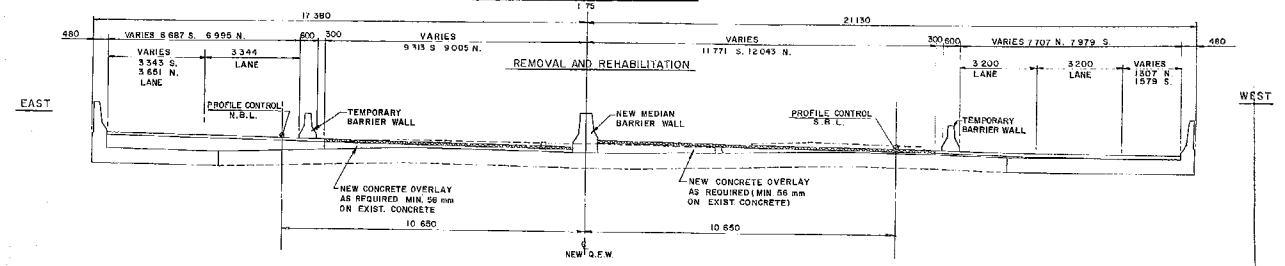
EXISTING CONDITIONS

1:75



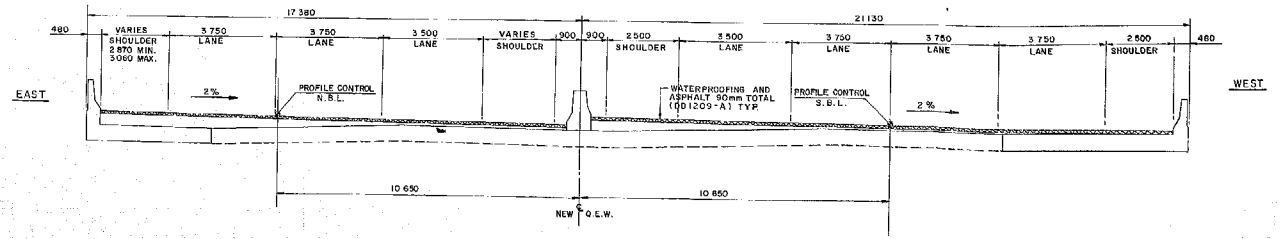
STAGE I CONSTRUCTION

1:75



STAGE II CONSTRUCTION

1:75



FINAL CONDITIONS

1:75

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

CONSTRUCTION SEQUENCE

STAGE 1

1. PLACE TEMPORARY CONCRETE BARRIER WALLS AT THE WEST AND EAST SIDES OF THE EXISTING DECK & MAINTAIN TWO Q.E.W. LANES PER DIRECTION (THE OUTSIDE S.B. LANE WILL SERVE AS AN EITHER/OR LANE TO ACCOMMODE THE OFF-RAMP TO BURLINGTON STREET)
2. REMOVE ASPHALT AND WATERPROOFING MEMBRANE FROM DECK AREAS BEYOND THE TEMPORARY BARRIER WALLS. REMOVE THE PERMANENT CURB AND SIDEWALK PLUS CONCRETE POSTS AND STEEL RAILINGS. REMOVE WINGWALLS TO 600mm BELOW FINAL GRADE.
3. SCARIFY 6mm MIN. AND REMOVE FAULTY CONCRETE FROM AREAS OF DECK ABOVE DESCRIBED.
4. WIDEN BOTH SIDES OF THE BRIDGE AS REQUIRED (DOWEL CONNECTION TO BE PROVIDED BETWEEN EXISTING AND NEW ABUTMENT AND DECK)
5. PLACE APPROACH SLABS ON WIDENED SECTIONS
6. SANDBLAST AND PLACE 30 MPa CONCRETE OVERLAY OVER THE EXISTING DECK AREAS. THICKNESS OF THE OVERLAY IS 56mm MIN. AND VARIES TO SATISFY THE DEFINED PAVEMENT ELEVATIONS AND PROVIDE FOR 90mm FOR WATERPROOFING AND ASPHALT. EXTEND THE OVERLAY 600mm ON THE APPROACH SLABS.
7. APPLY RUBBER MEMBRANE OVER JOINTS BETWEEN DECK AND APPROACH SLABS AS WELL AS BETWEEN OLD AND NEW DECK AREAS.
8. WATERPROOF AND PAVE, 90mm TOTAL.

STAGE 2

1. RELOCATE TEMPORARY CONCRETE BARRIER WALLS AND DETOUR Q.E.W. N.B. AND S.B. TRAFFIC TO SECTIONS OF BRIDGE DECK COMPLETED ON STAGE I AND PROCEED WITH DECK REHABILITATION WORK OF CENTRAL SECTION
2. REMOVE MEDIAN GUIDERAIL AND RAISED MEDIAN PLUS ASPHALT AND WATERPROOFING MEMBRANE.
3. SCARIFY 6mm MIN. AND REMOVE FAULTY CONCRETE.
4. PLACE APPROACH SLABS ON EXISTING MEDIAN SECTION OF DECK . (DOWEL THE HOOKS.)
5. SANDBLAST AND PLACE 30 MPa CONCRETE OVERLAY. THICKNESS OF THE OVERLAY IS 56mm MIN. AND VARIES TO SATISFY THE DEFINED PAVEMENT ELEVATIONS AND PROVIDE FOR 90mm FOR WATERPROOFING AND ASPHALT. EXTEND THE OVERLAY 600mm ON THE APPROACH SLABS.
6. PLACE DOWELS AND REINFORCEMENT ALONG CENTRELINE OF DECK AS PER STD. DD-918-E (CONCRETE BARRIER ON BRIDGE DECK) AND POUR MEDIAN BARRIER WALL TYPE D-1 (STD. DD-917-B)
7. APPLY RUBBER MEMBRANE OVER JOINTS BETWEEN DECK AND APPROACH SLABS.
8. WATERPROOF AND PAVE 90mm TOTAL
9. REMOVE TEMPORARY CONCRETE BARRIER WALLS AND OPEN BRIDGE DECK TO Q.E.W. TRAFFIC.

PRELIMINARY
Not To Be Used
For Construction

OCT 26 1984

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN		CHECK	LOADING ONBDC - A - 83	DATE OCT. 84
DRAWING S.G.		CHECK B.D.	SITE No 36-1336-62	DWG 2

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

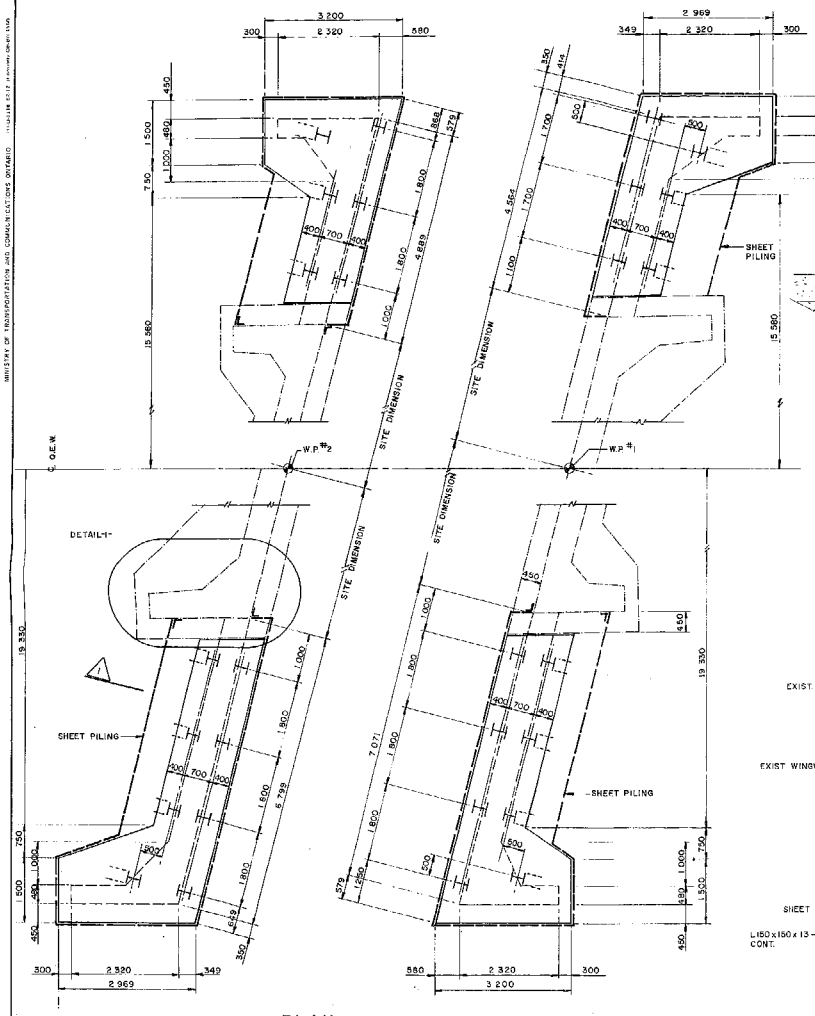
DIST No 4
CONT No
WP No 83-74-19

Q.E.W. WIDENING
RED HILL CREEK CROSSING
PILING

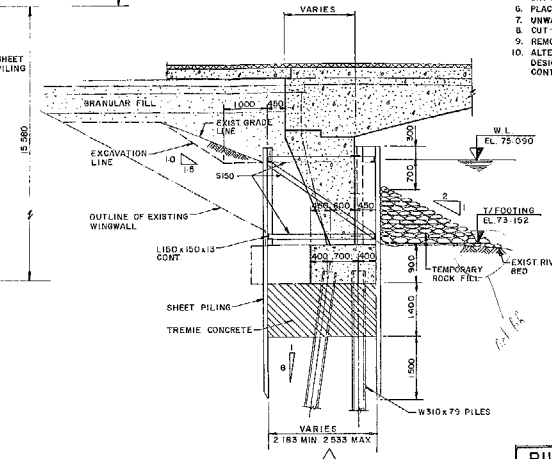
SHEET

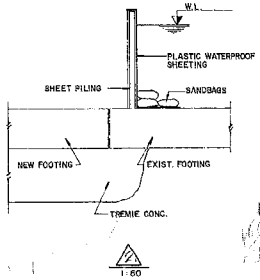
SUGGESTED PROCEDURE FOR TEMPORARY COFFERDAMS

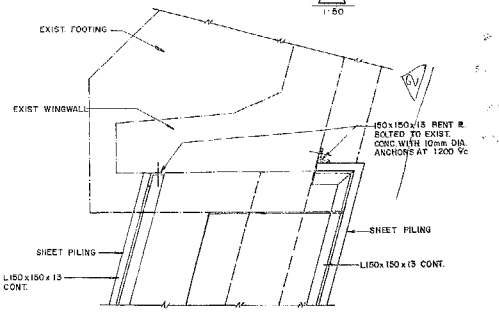
1. CONTRACTOR TO SUBMIT SHOP DRAWINGS OF COFFERDAMS FOR APPROVAL OF THE ENGINEER. NO WORK TO BE COMMENCED UNTIL THE ENGINEER HAS GIVEN HIS APPROVAL IN WRITING.
2. CARRY OUT INITIAL EXCAVATION OF EARTH WHERE NECESSARY TO APPROXIMATE WATER LEVEL AND DRIVE MAIN PILING WHERE REQUIRED.
3. PLACE TOP FRAME AND DRIVE SHEET PILING.
4. PLACE TEMPORARY ROCK FILL BERM AT RIVER BED TO STABILIZE COFFERDAM.
5. EXCAVATE WITHIN COFFERDAM AND INSTALL WALING AND STRUTS.
6. PLACE TREMIE CONCRETE AND PROVIDE SUMP
7. UNWATER COFFERDAM TO PERMIT CONSTRUCTION OF NEW FOOTING & WALLS & REMOVE BRACING
8. CUT-OFF AS INDICATED OR WITHDRAW SHEETING.
9. REMOVE TEMPORARY ROCK FILL FROM RIVER BED.
10. ALTERNATIVE PROCEDURES AND METHODS WILL BE CONSIDERED BY THE ENGINEER.FULL DESIGN AND DETAILS OF ANY ALTERNATIVE SCHEMES TO BE SUBMITTED BY THE CONTRACTOR FOR APPROVAL.



PLAN
1:50







DETAIL -1-
1:25

PILE DATA						DESIGN DATA	
LOCATION	TYPE	QTY.	BATTER	LENGTH	CUT OFF ELEVATION	LOAD AT SLS TYPE II	FACTORED CAPACITY ULS
N. EAST	HP 310x79	3	—	16 352	72 552	—	1150 kN
N. EAST	HP 310x79	3	1:8	16 483	72 552	—	1150 kN
N. WEST	HP 310x79	4	—	16 352	72 552	—	1150 kN
N. WEST	HP 310x79	4	1:8	16 483	72 552	—	1150 kN
S. EAST	HP 310x79	3	—	14 352	72 552	—	1150 kN
S. EAST	HP 310x79	3	1:8	14 464	72 552	—	1150 kN
S. WEST	HP 310x79	4	—	14 352	72 552	—	1150 kN
S. WEST	HP 310x79	4	1:8	14 464	72 552	—	1150 kN

NOTES

1. PILE LENGTHS SHOWN ARE THE THEORETICAL LENGTHS BELOW THE CUT-OFF ELEVATION
2. PILE LAYOUT DIMENSIONS ARE TO BE MEASURED AT THE UNDERSIDE OF THE FOOTING
3. ALL PILES TO BE DRIVEN TO BEDROCK.
4. DENOTES BATTERED PILE
   DENOTES VERTICAL PILE

RECEIVED JAN-1 1985 CONTRACT STRUCTURAL SECTION

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	M.G.S.	CHECK	N.M.	LOADING OHBDC-A - 83	DATE DEC. 84
DRAWING	S.G.	CHECK	B.D.	SITE No 30-1339-82	DWG -4-

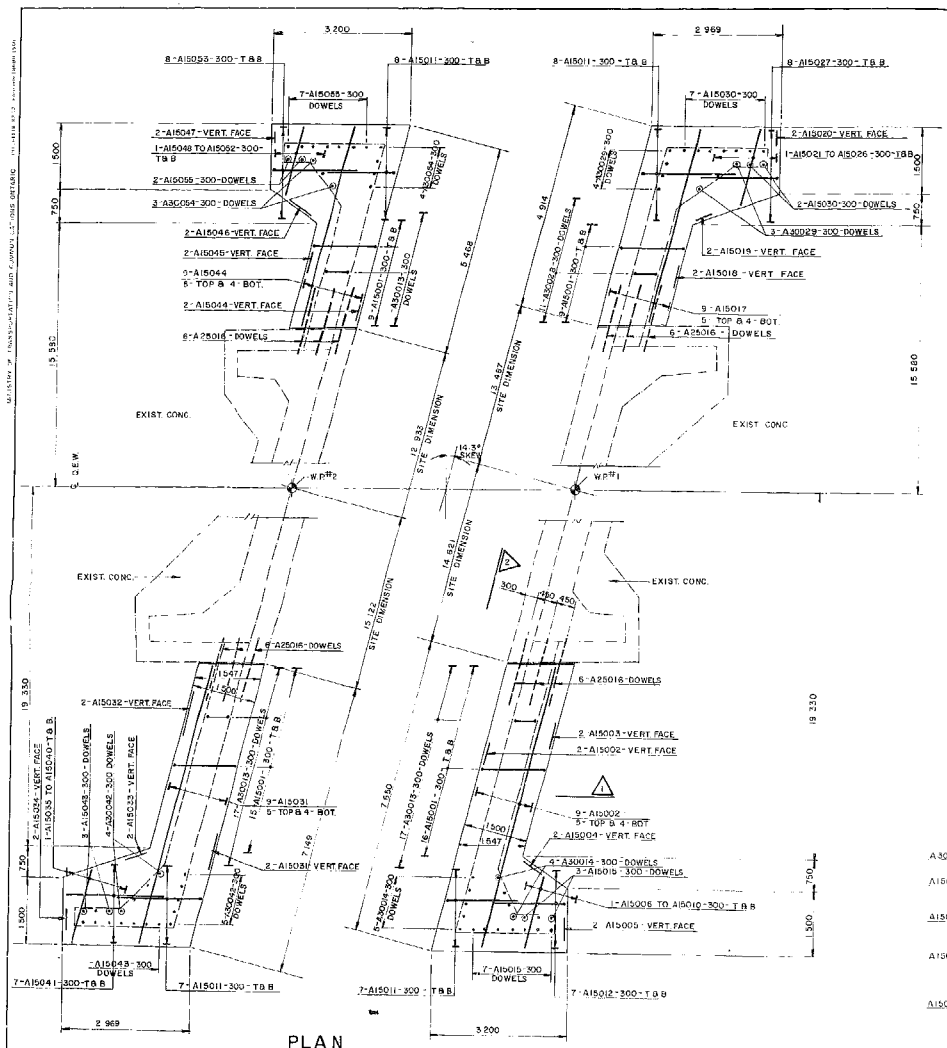
METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

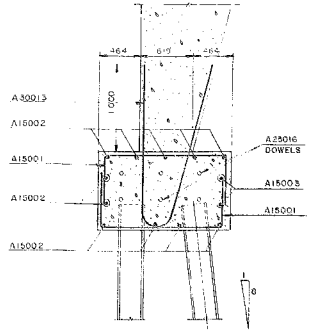
DIST No 4
CONT No
WP No 83-74-19

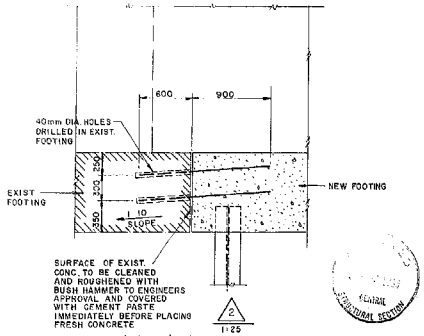
Q.E.W. WIDENING
RED HILL CREEK CROSSING
FOOTINGS

SHEET



PLAN
1:50





DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

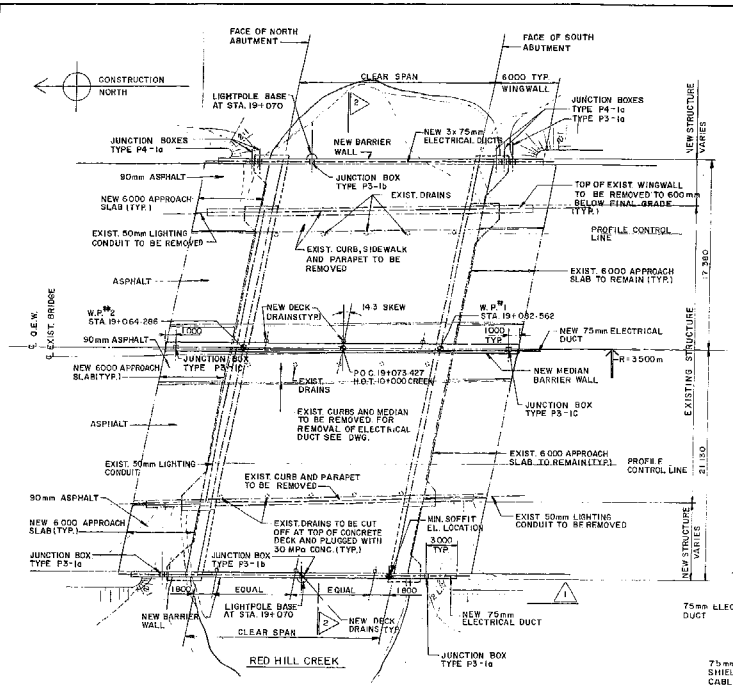
REVISIONS			
	DATE	BY	DESCRIPTION
DESIGN M.G.S.	CHECK N.M.	LOADING OHBDC - A - 83	DATE DEC. 84
DRAWING S.G.	CHECK B.D.	SITE No. 36-1336-62	DWG 8

METRIC

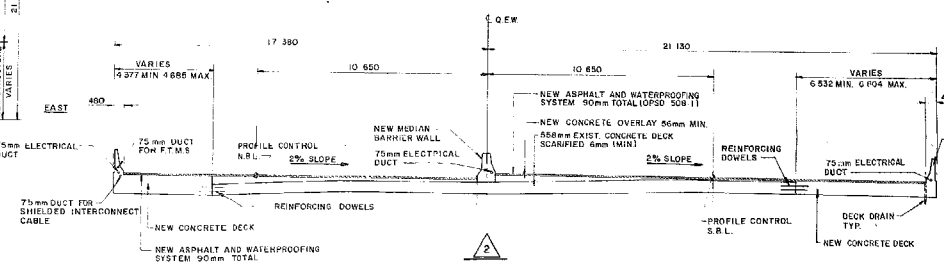
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DIST No 4	
CONT No	
WP No 83-74-19	
Q.E.W. WIDENING RED HILL CREEK CROSSING GENERAL ARRANGEMENT	SHEET

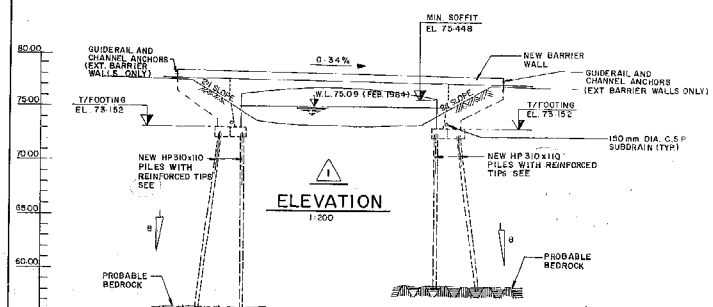
Gregg and Edens Limited
engineers : planners : economists.



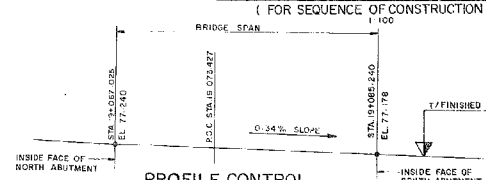
PLAN
1:200



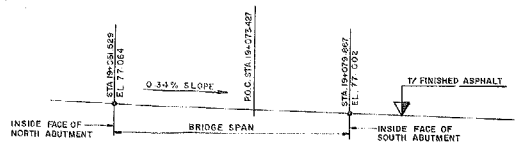
TYPICAL FINAL DECK CROSS-SECTION
(FOR SEQUENCE OF CONSTRUCTION SEE DWG. 2)



ELEVATION
1:200



PROFILE CONTROL
NORTHBOUND LANES



PROFILE CONTROL
SOUTHBOUND LANES

GENERAL NOTES

1. CLASS OF CONCRETE
   FOOTINGS & APPROACH SLAB . . . . 20 MPa
   REMAINDER . . . . . 30 MPa
2. REINFORCING STEEL
   GRADE 400
   COATED BARS TO HAVE A SUFFIX 'C'
3. CLEAR COVER TO REINFORCING STEEL
   FOOTINGS . . . . . 100 ± 25mm
   ABUTMENTS, WINGWALLS AND RETAINING WALLS — FRONT FACE . . . . . 80 ± 20mm; BACK FACE . . . . . 70 ± 20mm
   DECK — TOP . . . . . 70 ± 20mm; BOTTOM . . . . . 50 ± 10mm
   REMAINDER
   UNLESS OTHERWISE NOTED . . . . . 70 ± 20mm
4. W.P. DENOTES 'WORKING POINT'
   T/ DENOTES 'TOP OF'

CONSTRUCTION NOTES

1. BACKFILL SHALL BE PLACED SIMULTANEOUSLY BEHIND BOTH ABUTMENTS, KEEPING THE HEIGHT OF THE BACKFILL APPROXIMATELY THE SAME AT NO TIME SHALL THE DIFFERENCE IN ELEVATIONS BE GREATER THAN 0.8 m.
2. CONTRACTOR TO VERIFY EXISTING DIMENSIONS AND ELEVATIONS OF EXISTING STRUCTURE.

LIST OF DRAWINGS

1. GENERAL ARRANGEMENT
2. CONSTRUCTION STAGING
3. CONCRETE REMOVAL
4. PILING
5. FOOTINGS
6. FRAME EAST SIDE
7. FRAME WEST SIDE I
8. FRAME WEST SIDE II
9. APPROACH SLABS
10. BARRIER WALL
11. MISCELLANEOUS DETAILS
12. BRIDGE DATE & SITE NUMBER
13. P.Q.P. QUANITY SHEET

RECEIVED JAN-4 1985 CENTRAL STRUCTURAL SECTION

RECOMMENDED Jan 04 '85
for Michael Sherlock

REVISIONS	DATE	BY	DESCRIPTION

DESIGN M.G.S.	CHECK N.M.	LOADING OHBDC-A-83	DATE SEPT. 84
DRAWING S.G.	CHECK B.D.	SITE No 36-1336-62	DWG.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING