

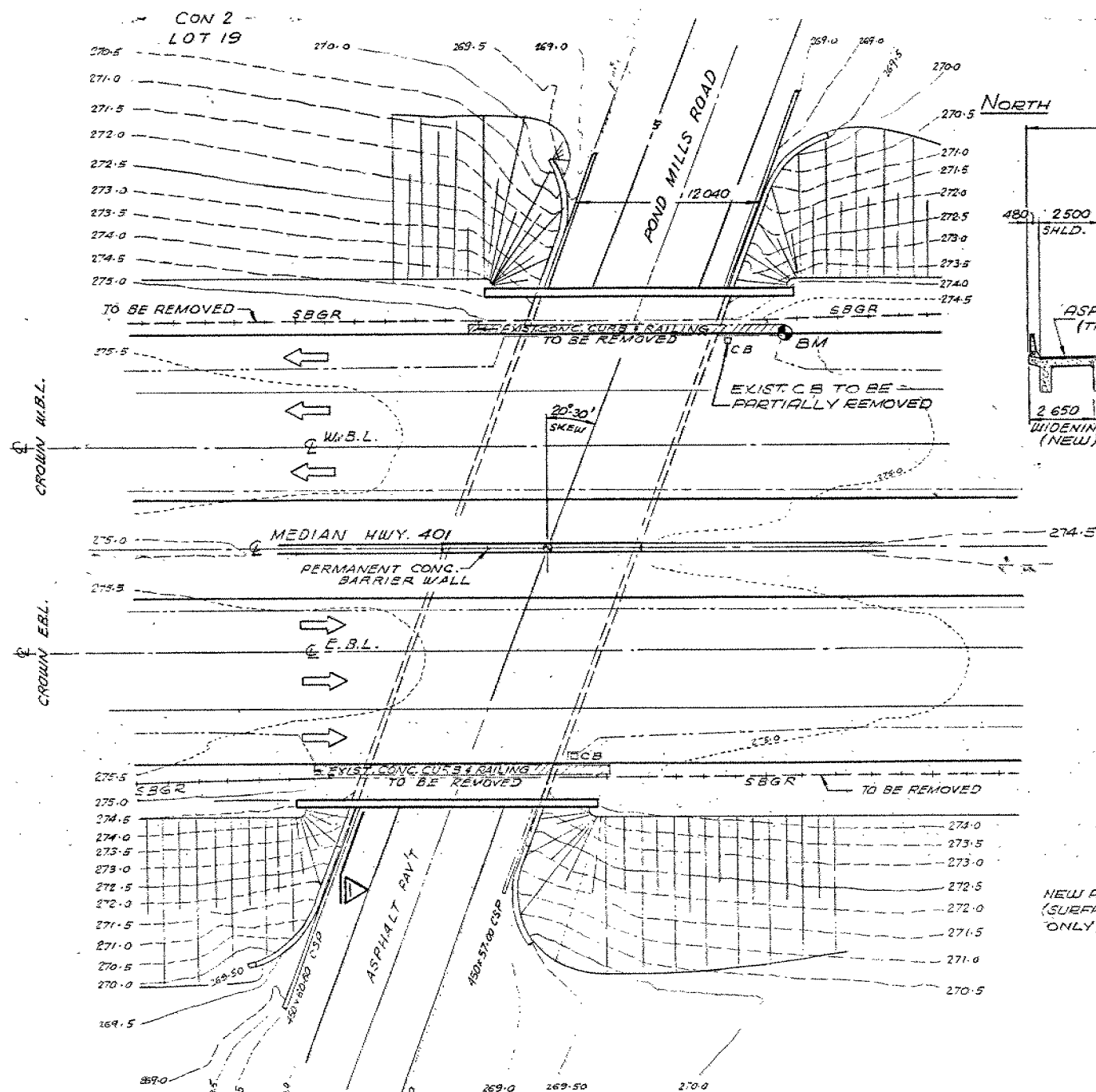
GEOCRES No. 40I+4-111DIST. 2 REGION _____W.P. No. 139-86-02CONT. No. 89-11

W. O. No. _____

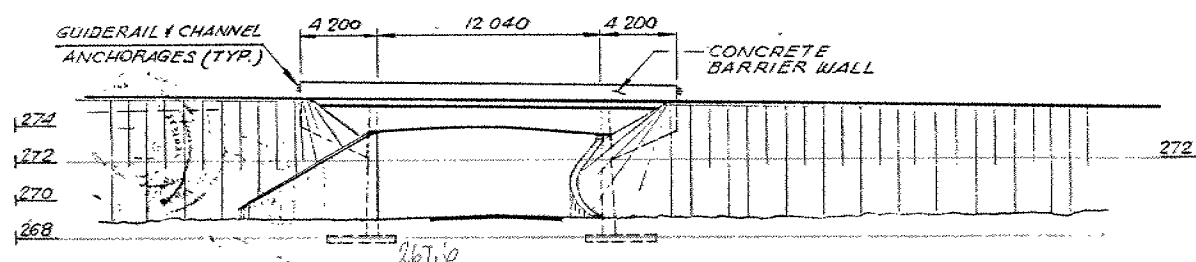
STR. SITE No. 19-94-372HWY. No. 401LOCATION Hwy 401 & Pond Mills Rd.
(1.0 km W of Hwy 126)No of PAGES -

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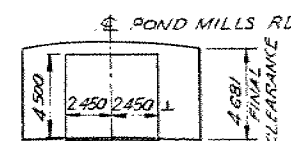
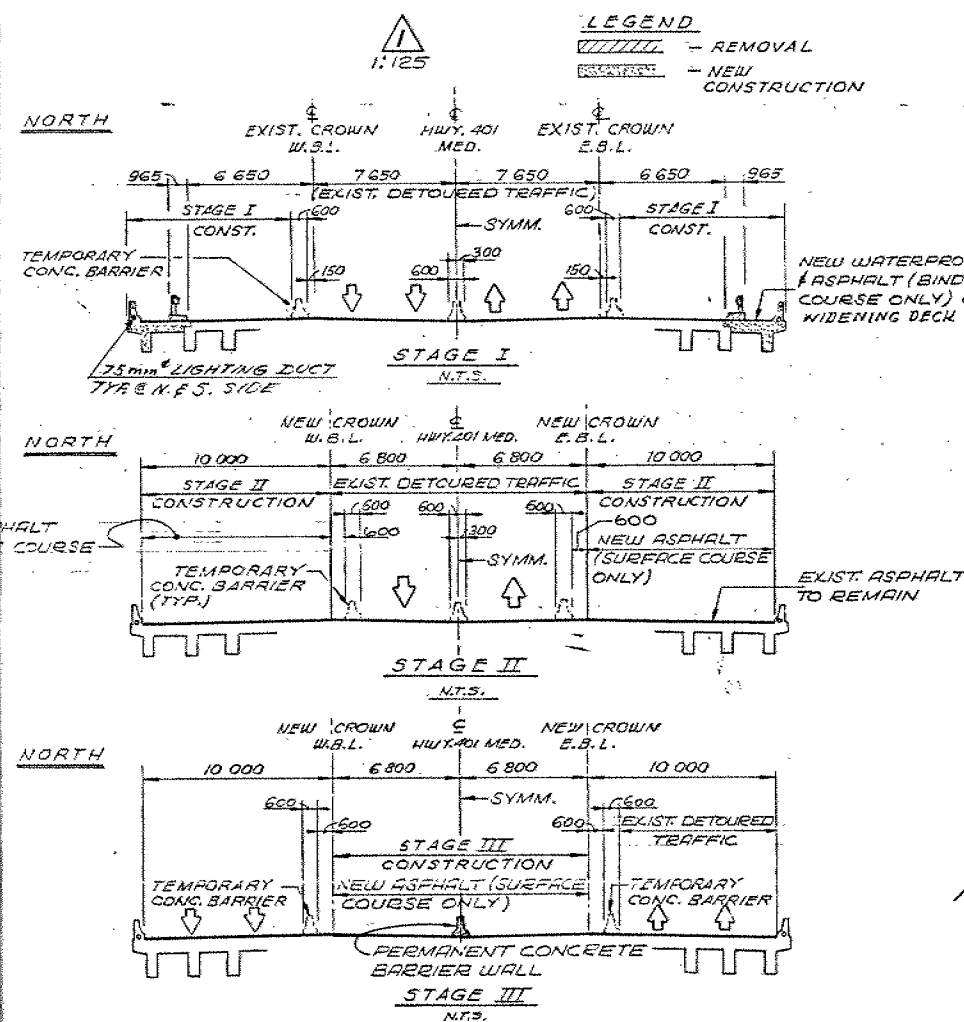
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____REMARKS: _____



PLAN
1:200



SOUTH ELEVATION
1:200



CONSTRUCTION
CLEARANCE DIAGRAM
N.T.S.

BM 275.209
GEODETIC DATUM
NE COR BRIDGE
OVER POND MILLS RD.
14.6 LT 25+647.0

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST. 2, Hwy. 401
CONT No
WP No 139-86-02



POND MILLS ROAD OVERPASS
WIDENING
(1.0 Km. WEST OF HWY. 126)
GENERAL ARRANGEMENT

SHEET

NOTES

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

CLASS OF CONCRETE
UNLESS OTHERWISE NOTED 30 MPa

CLEAR COVER TO REINFORCING STEEL

ABUTMENT & WINGWALLS
FRONT FACE 80 ± 20 mm
BACK FACE 70 ± 20 mm
DECK: TOP 70 ± 20 mm
BOTTOM 40 ± 10 mm

WORK DESCRIPTION AND STAGING

STAGE I

- ERECT TEMPORARY CONCRETE BARRIERS AS SHOWN ON SECTION FOR STAGE I.
- REMOVE CONCRETE RAIL, POSTS, CURBS AND TOP PORTION OF WINGWALLS ON BOTH NORTH AND SOUTH SIDES.
- WIDEN EXISTING STRUCTURE ON BOTH NORTH AND SOUTH SIDES.
- PLACE ASPHALT AND WATERPROOFING SYSTEM (90 mm) OVER WIDENING DECK BOTH NORTH AND SOUTH SIDE

STAGE II

- RELOCATE TEMPORARY CONCRETE BARRIERS AS SHOWN ON SECTION FOR STAGE II AND RESTRICT TRAFFIC TO ONE LANE IN EACH DIRECTION.
- PLACE SURFACE COURSE ASPHALT TO FORM THE NEW CROWN ON BOTH EASTBOUND AND WESTBOUND LANES.

STAGE III

- RELOCATE TEMPORARY CONCRETE BARRIERS AS SHOWN ON SECTION FOR STAGE III AND DIVERT TRAFFIC.
- CONSTRUCT CONCRETE BARRIER WALL IN MEDIAN. REPAVE EXISTING SURFACE TO ACCOMMODATE NEW CROSSFALL ON ASPHALT PAVEMENT.
- REMOVE TEMPORARY CONCRETE BARRIERS AND OPEN THE ENTIRE STRUCTURE TO TRAFFIC.

LIST OF DRAWINGS

- 19-94-372-1 GENERAL ARRANGEMENT
- 2 BORE HOLE LOCATIONS & SOILS STRATA
- 3 REMOVALS
- 4 WIDENING DETAILS
- 5 BARRIER WALL
- 6 BRIDGE DATE & SITE NUMBER DATA
- 7 AS CONSTRUCTED ELEV. & DIMENSIONS
- 8 STANDARD DETAILS
- 9 QUANTITIES-STRUCTURE



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

DATE	BY	DESCRIPTION
DESIGN 1.32	CHECK 1/14	LOADING HS 20-44
DRAWING 2.5	CHECK 2.5	SITE No 19-94-372/2 OWG - 1

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 139-86-02

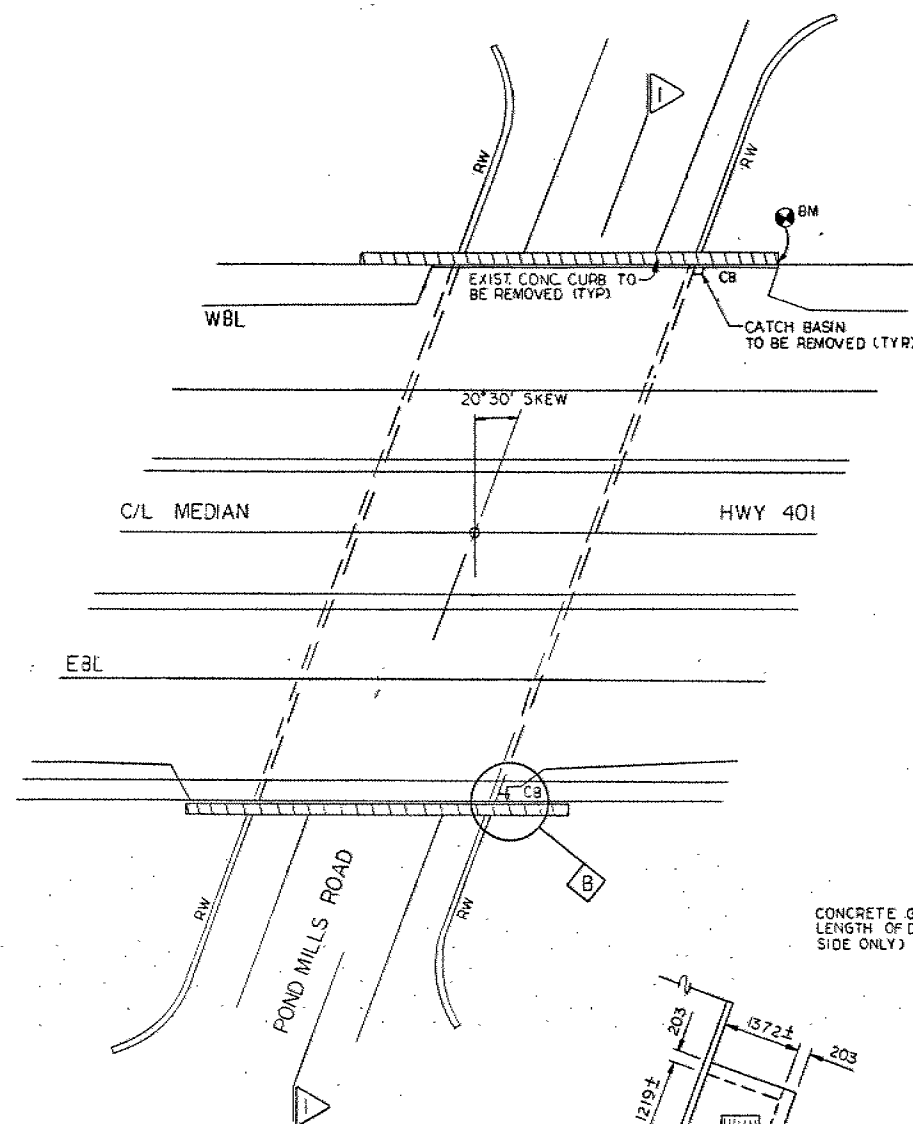
POND MILLS ROAD OVERPASS
WIDENING
(1.0 Km WEST OF HWY 126)
REMOVALS



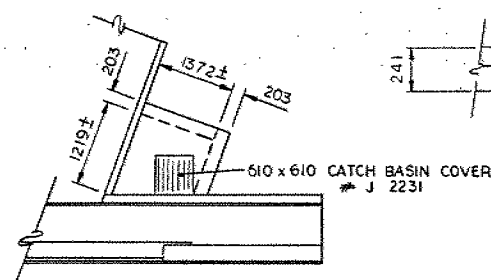
SHEET

SOUTH FOR W. ABUT.
NORTH FOR E. ABUT.

LEGEND
REMOVAL

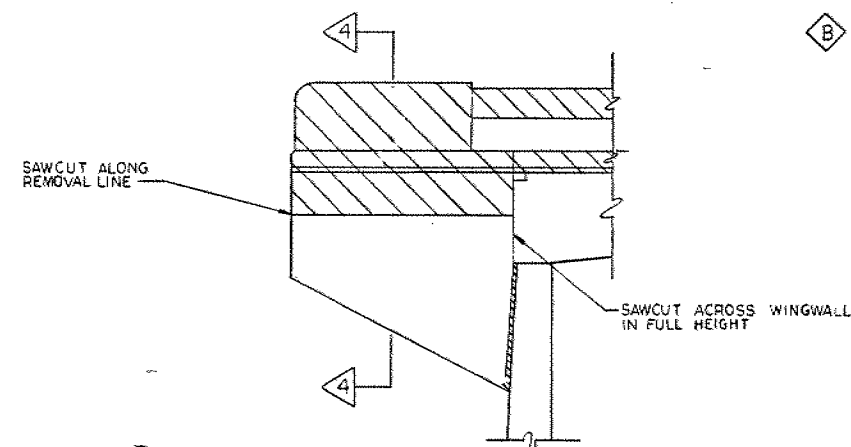


PLAN
1:200

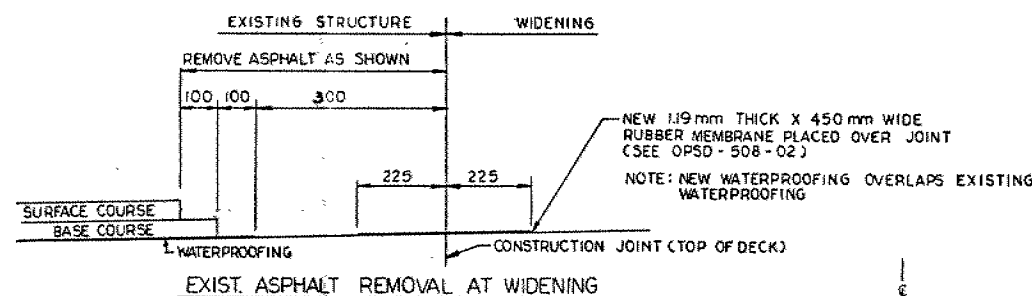


CATCH BASIN AT EAST END
OF BRIDGE ONLY

B N.T.S.

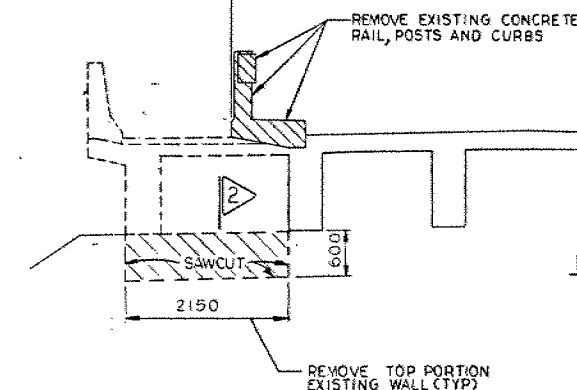


ELEVATION OF EXIST. WINGWALL
(N.T.S.)

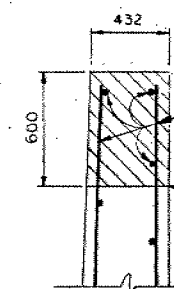


EXIST. ASPHALT REMOVAL AT WIDENING

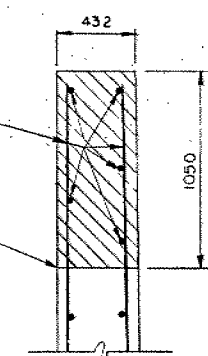
NORTH FOR W. ABUT.
SOUTH FOR E. ABUT.



EXIST. DECK SECTION
1:50



2 1:20



3 1:20

NOTES:

- 1 ABRASIVE BLAST ALL EXPOSED REBAR SHOWN LEFT IN PLACE AND CONSTRUCTION JOINTS.
- 2 APPLY A THIN COATING OF NEAT CEMENT PASTE TO CONSTRUCTION JOINT SURFACES IMMEDIATELY BEFORE PLACING NEW CONCRETE



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION	DATE
DESIGN J. SZ	CHECK W.M.	LOADING HS 20-44		
DRAWING F.B.	CHECK J. SZ	SITE No 13-43-372/23	DWG 3	

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 139-86-02

DIST 2

HWY 401

STR SITE 19-94-372

Pond Mills Road Overpass Widening

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FOUNDATION INVESTIGATION REPORT
For
Pond Mills Road Overpass Widening
Hwy. 401, 1.0 km West of Hwy. 126
W.P.139-86-02; Site No. 19-94-372
District 2, London

INTRODUCTION

This report contains the results obtained from the foundation investigation carried out at the above-mentioned site for the proposed overpass widening. The fieldwork was conducted during the period from 86 11 11 to 86 12 08 utilizing a continuous flight auger machine equipped with 83 mm I.D. hollow stem augers, solid stem augers, and BX sized casings. A diamond drill equipped with BX and NX casings was also used at the approach embankments. The fieldwork consisted of eight sampled boreholes and two dynamic cone penetration tests. Two boreholes were advanced through the approach embankments and the remaining six were advanced in the vicinity of the footings for the overpass widenings.

In addition to the results of the field investigation, this report contains recommendations for the design and construction of the proposed widening of the bridge and approaches.

SITE DESCRIPTION

The site is located on Hwy. 401, 1.0 km West of Hwy. 126. It is proposed to widen the approaches and the existing structure crossing Pond Mills Road. The terrain in the immediate vicinity is flat. Land use is largely industrial and commercial. The site lies in the physiographic region of the Stratford Till Plain.

SUBSURFACE CONDITIONS

General

The subsoil encountered at this location consisted largely of silty clay. The two boreholes advanced at the approaches contained fill material that varied in depth from 5.2 m to 6.7 m, overlying a silty clay deposit. The remaining six boreholes contained surficial deposits of silty clay with traces of sand, gravel and organics that ranged in thickness from 3.5 m to 10.7 m. Below the layer of silty clay, a deposit of silt was encountered

that varied in thickness from 3 m to 3.2 m. In BH's 3, 4 and 5, sandy silt to silty sand was found below the silty clay and silt layers and extended for the full length of the borehole. In BH 2, which was advanced to the greatest depth, the silt deposit was underlain by 3.1 m of silty clay followed by 4.7 m of silt, 4.4 m of silty sand and ending in a silty clay deposit that extended for the remaining length of the borehole.

The boundaries of the different strata encountered at the boring locations together with the obtained field and laboratory test results are shown on the Record of Borehole sheets located in the Appendix of this report. A stratigraphical profile across the site is shown on Dwg. No. 1398602-A.

Subsurface Material Descriptions

Silty Clay (Fill Material)

The fill material encountered in BH's 4 and 102 was silty clay containing traces of sand and gravel that extended to a depth of 5.2 m. The 'N' values ranged from 4 to 24 reflecting a firm to very stiff material. Laboratory tests performed on the fill material yielded the following physical properties:

		<u>RANGE %</u>
Natural Moisture Content	(W)	14.5 - 17.5
Liquid Limit	(W _L)	22.0 - 30.0
Plastic Limit	(W _p)	13.5 - 15.5

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

Sand (Fill Material)

BH 101 contained non-cohesive fill material comprised of sand, some gravel and a trace of silt. Occasional cobbles were encountered throughout the 6.7 m thick deposit. The denseness of the fill ranged from loose to very dense, with 'N' values of 7 to 120 obtained from field testing. From laboratory testing, the natural moisture content obtained for the fill material ranged from 5.5% to 13.5%.

Refer to Figure 2 for a typical grain size distribution envelope for this material.

Silty Clay; Trace Sand, Trace Gravel

A layer of silty clay was encountered as the surficial deposit in BH's 1 through 5 and as the underlying deposit in BH 101 and BH 102. The material contained varying proportions of sand and gravel in each borehole. Organic material was present in BH's 1 and 4. 'N' values ranging from 3 to 86 were encountered, reflecting a consistency of soft to hard.

Laboratory tests performed on the samples yielded the following physical properties:

		<u>RANGE %</u>
Natural Moisture Content	(W)	12.5 - 17.5
Liquid Limit	(W _L)	17.0 - 37.0
Plastic Limit	(W _p)	11.5 - 18.5

Refer to Figure 3 for a typical grain size distribution envelope for this material.

Silt

A thin stratum of silt was found below the silty clay deposit in BH's 2, 4 and 3B. The silt layer contained occasional pockets of silty clay and trace amounts of sand and gravel. The denseness of the material ranged from compact to very dense, with 'N' values varying from 24 to 84. The natural moisture content obtained from laboratory testing ranged from 11.5% to 19%.

Silty Clay; Trace Sand

In BH 2, a 3.1 m layer of silty clay was encountered below the stratum of silt. The 'N' value obtained was 35, reflecting a material that is hard in consistency.

Silt

A stratum of silt was present below the thin layer of silty clay and found only in BH 2. The silt contained a trace of sand. It is described as very dense, the 'N' value obtained being greater than 120 blows.

Sandy Silt to Silty Sand

A deposit of sandy silt to silty sand was encountered in BH's 1 to 5 inclusive. The lower boundary of the non-cohesive deposit was not established in BH's 3B, 4 and 5 since the boring was terminated within the deposit,

however, the extent of the deposit in the boreholes was found to be 9.3 m or greater. In BH 2, the stratum of sandy silt extended only 4.4 m. The silty sand to sandy silt contained a trace of clay. 'N' values ranged from 13 to 120, reflecting a material that is compact to very dense. The natural moisture content of the deposit ranged from 13.5% to 20.5%.

Refer to Figure 4 for a typical grain size distribution envelope of this material.

Silty Clay; Some Sand, Trace Gravel

Sampling in BH 2 extended to a depth of 40.1 m, terminating in a thick deposit of silty clay. The material can be described as hard, the 'N' values obtained ranging from 30 to 84.

Laboratory tests performed on the material yielded the following physical properties:

		<u>RANGE %</u>
Natural Moisture Content	(w)	12.5 - 15.5
Liquid Limit	(W _L)	23.0 - 23.5
Plastic Limit	(W _p)	12.5

GROUNDWATER CONDITIONS

The following groundwater levels were observed during the field investigation:

<u>Borehole</u>	<u>G. W. Elevations</u>
1	268.3
2	268.2
3	268.8
3A	268.8
3B	268.7
4	269.3
5	-
101	268.8
102	273.9

No artesian water conditions were encountered.

DISCUSSION AND RECOMMENDATIONS

Existing Structure & Foundations

The existing structure is a single span (11.6 m) reinforced concrete rigid frame beam bridge which was constructed under Contract 55-70. The bridge and retaining walls are founded on spread footings 3.66 m wide at El. 267.8 at the west abutment and El. 267.6 at the east abutment.

Foundations

It is proposed to widen the existing bridge on the north and south sides by 3.48 m. This will require removal of the existing retaining walls at the four corners of the bridge, construction of extensions to the abutments and rebuilding the retaining walls or constructing new wing walls parallel to Hwy. 401. At the elevations of the existing footings it is estimated that the net safe bearing capacity of the foundation soil is 350 kPa. It is recommended that abutment and retaining wall extensions be founded also on spread footings at the same elevation as the existing ones. For purposes of the O.H.B.D.C. the following design values are recommended:

Factored Bearing Capacity at U.L.S. 525 kPa

Bearing Capacity at S.L.S. Type II 350 kPa

For the proposed wing walls parallel to Hwy. 401 it is recommended that they are founded on Steel 'H' piles driven to approximate El. 252.00 at which depth it is estimated that a design capacity of 450 kN will be achieved. For purposes of the O.H.B.D.C. the following design values are recommended for HP 310 x 79 steel sections.

Factored Bearing Capacity at U.L.S. 675 kPa

Bearing Capacity at S.L.S. Type II 450 kPa

Piles should be driven in accordance with MTC Standards SS-103-10/11 to achieve an ultimate capacity of 1350 kN.

Lateral Forces

For the new wingwalls, if constructed, lateral forces should be resisted by suitably battered piles. For the new abutment extensions and for the new retaining walls, if constructed later resistance will be provided by the adhesion between the footings and the foundation soil for which a value of

75 kPa may be assumed to apply. Backfill to the abutment extensions and to the new wingwalls or retaining walls should consist of Granular 'A' or 'B' in accordance with SPP No. 121 Oct. 1983. Earth pressures may be computed in accordance with Section 6.6.1.2.1 of the O.H.B.D.C. assuming a yielding foundation in which case the "active" condition applies. The physical properties to be assumed for the backfill, are as follows:

Granular 'A' $\phi = 35^\circ$ $\gamma = 22.8 \text{ kN/m}^3$

Granular 'B' $\phi = 30^\circ$ $\gamma = 21.2 \text{ kN/m}^3$

Road Protection

It will be necessary to provide road protection during the period when the soil behind the existing retaining walls is removed to construct the new abutment extensions and new retaining walls or wing walls. This can be achieved by constructing temporary walls of interlocking sheet piling or anchor piles placed in pre-augered holes, with timber lagging. Design parameters for either scheme will be provided on request when the desired locations of the walls are known. The steepest temporary slope in the fill material (which is non-cohesive) should be 1-1/2 horizontal to 1 vertical. Exposed surfaces of temporary slopes may require protection such as polyethylene sheeting against erosion.

Dewatering

Groundwater level was found to be just below the original ground surface during the field investigation. Excavations required for footings below the original ground surface will be in cohesive soil of very low permeability hence no problems are anticipated.

Frost Protection

All footings and/or pile caps require a minimum of 1.2 m of earth cover for frost protection.

Embankment Widening

New fill for the widening should be placed in accordance with appropriate MTC standards. All topsoil should be removed from slopes before placing the new fill.

MISCELLANEOUS

The fieldwork for this investigation was carried out by D. Carr, a University of Waterloo Co-op Student, under the supervision of P. Payer, Senior Foundations Engineer. The equipment was owned and operated by Master Soil Investigation Limited. The report was written by Mrs. B. Bennett and Mr. K. G. Selby.

B. Bennett

B. Bennett
Jr. Foundations Engineer

K. G. Selby

K. G. Selby
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

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

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_f	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

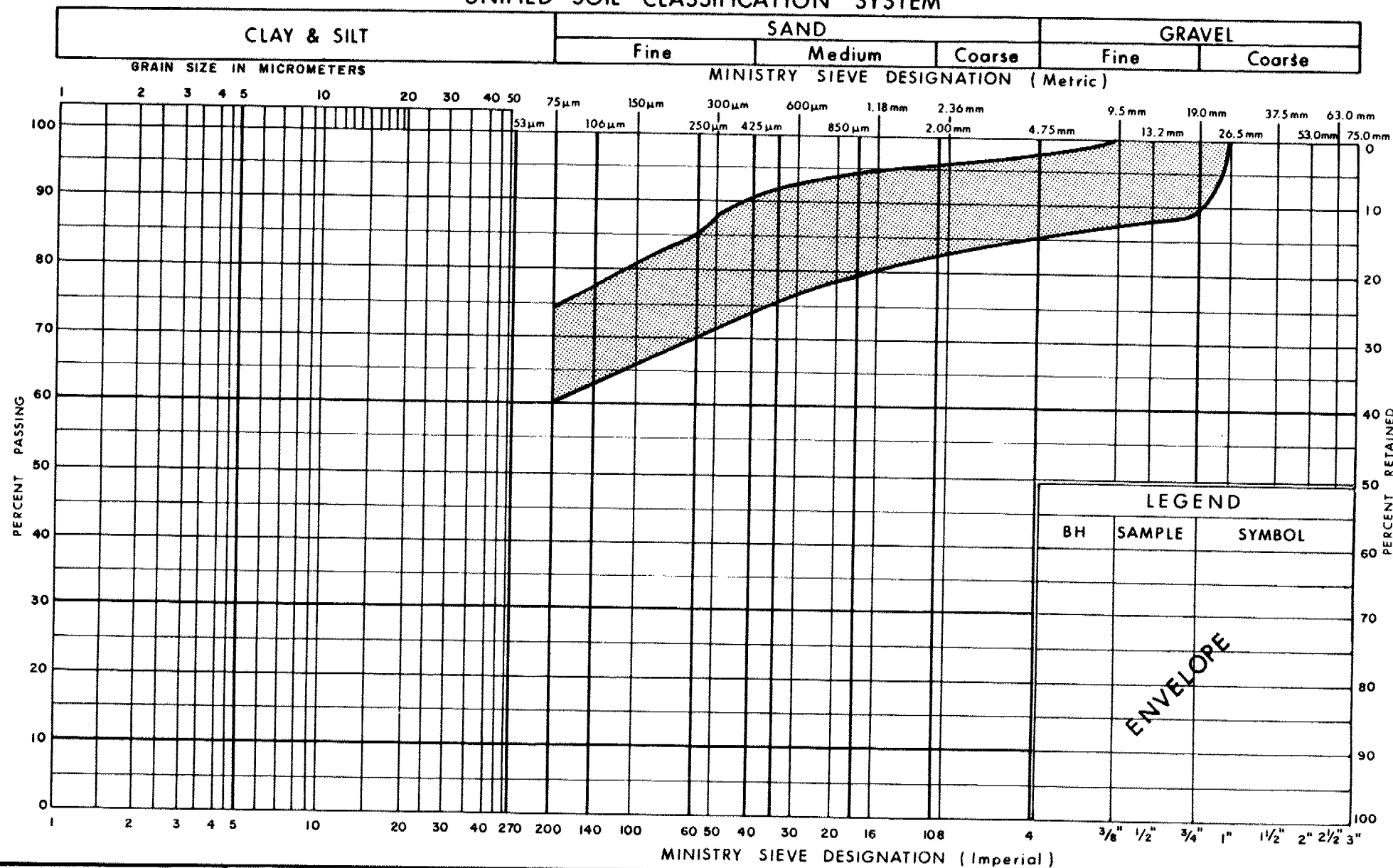
STRESS AND STRAIN

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

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						

UNIFIED SOIL CLASSIFICATION SYSTEM

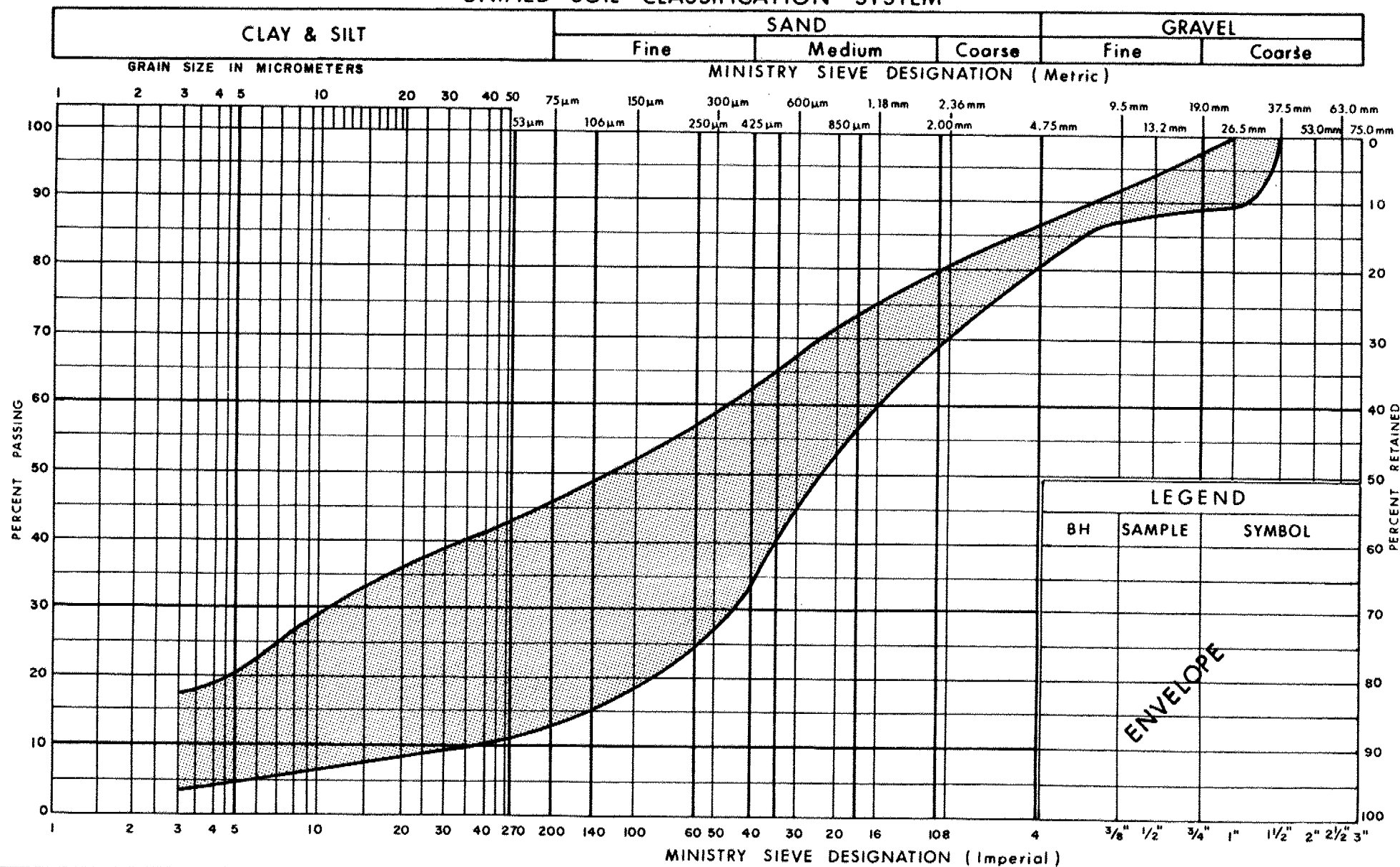
Ministry of
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Communications

GRAIN SIZE DISTRIBUTION
SILTY CLAY (FILL MATERIAL)

FIG No 1

W P 139 -86 -02

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

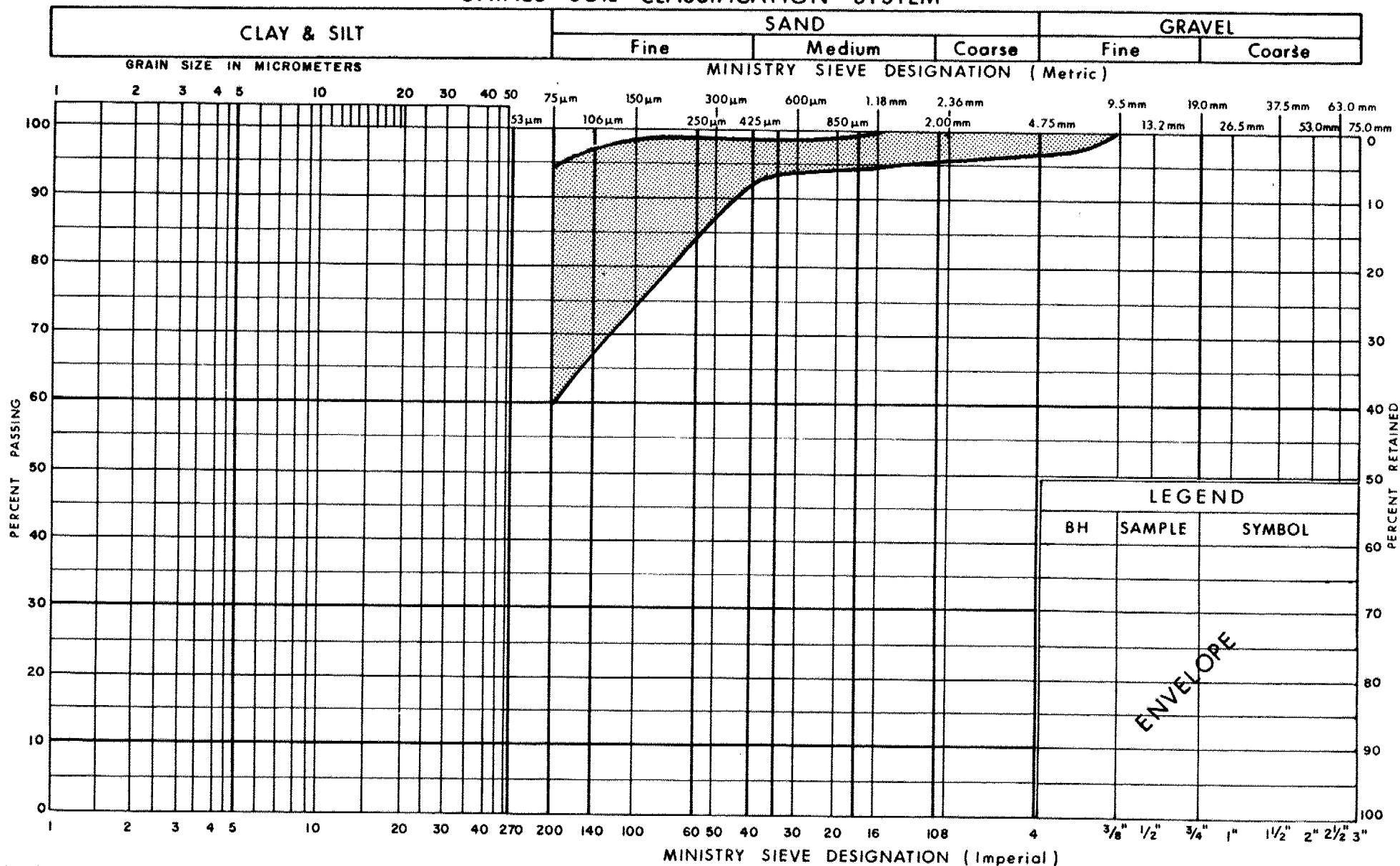
**Ministry of
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Communications**

GRAIN SIZE DISTRIBUTION SAND (FILL MATERIAL)

FIG No 2

W P 139 - 86 - 02

UNIFIED SOIL CLASSIFICATION SYSTEM



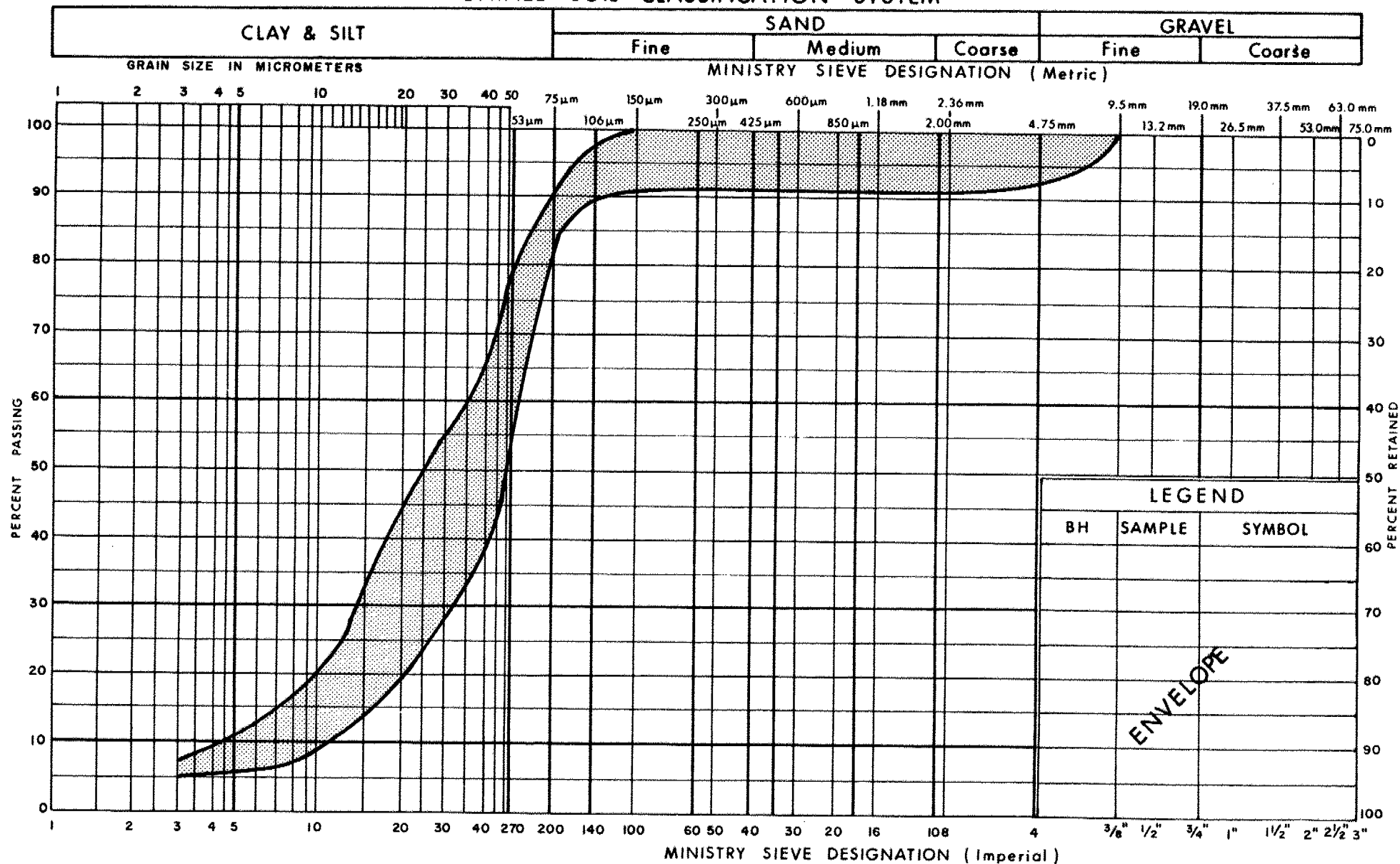
Ministry of
Transportation and
Communications

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

FIG No 3

W P 139-86-02

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION
SANDY SILT TO SILTY SAND

FIG No 4

W P 139 - 86 - 02



RECORD OF BOREHOLE No 1

METRIC

W P 139-86-02 LOCATION Co-ords. N 4 755 438.0; E 411 554.3 ORIGINATED BY DC
DIST 2 HWY 401 BOREHOLE TYPE Cont. Flight Auger (H.S.) COMPILED BY PP
DATUM Geodetic DATE 86 11 11 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH						
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE					
268.3	Ground Level													
0.0							268							
	Silty Clay traces of sand traces of organics Very Stiff to Hard		1	SS	42									
			2	SS	45									
			3	SS	45									
			4	SS	29									
			5	SS	27									
264.0							266							
4.3	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 2

METRIC

W P 139-86-02

LOCATION Co-ords: N 4 755 427.4; E 411 549.2

ORIGINATED BY DC

DIST 2 HWY 401

BOREHOLE TYPE Cont. Flight Auger (H.S.) & Washbore - BW Casing

COMPILED BY PP

DATUM Geodetic

DATE 86 11 11 - 86 11 13

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					
269.0	Ground Level													
0.0														
	Silty Clay		1	SS	86									
	traces of sand		2	SS	27									
	traces of gravel		3	SS	23									
			4	SS	20									
	Very Stiff to Hard		5	SS	24									
			6	SS	17									
258.3														
10.7	Silt		7	SS	31									
	traces of sand													
	some clay													
	Dense													
255.3														
13.7	Silty Clay		8	SS	35									
	traces of sand													
	Hard													
252.2														
16.8	Silt		9	SS	60	13 cm								
	trace/some sand													
	trace clay													
	Very Dense													
247.5														
21.5	Sandy Silt		10	SS	100	28 cm								
	traces of clay													
	Very Dense													
243.1														
25.9														
	Silty Clay		12	SS	84									

Continued

+3, x5 : Numbers refer to Sensitivity

15 ϕ 5 (%) STRAIN AT FAILURE

Continued



RECORD OF BOREHOLE No 2 (Cont'd)

METRIC

W P 139-86-02 LOCATION Co-ords. N 4 755 427.4; E 411 549.2 ORIGINATED BY DC
DIST 2 HWY 401 BOREHOLE TYPE Cont. Flight Auger (H.S.) & Washbore - BW Casing COMPILED BY PP
DATUM Geodetic DATE 86 11 11 - 86 11 13 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
238.8	Continued		13	SS	15		238					
	Some Sand						236					
	traces of gravel		14	SS	74		234					
	Hard		15	SS	60		232					
228.9			16	SS	30		230					
40.1	End of Borehole											4 16 (80)

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 3A

METRIC

W P 139-86-02 LOCATION Co-ords: N 4 755 507.3; E 411 554.8 ORIGINATED BY DC

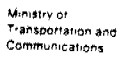
DIST 2 HWY 401 BOREHOLE TYPE Cont. Flight Auger (S.S.) COMPILED BY DC

DATUM Geodetic DATE 86 12 03 CHECKED BY

[illegible]

+³, x⁵ : Numbers refer to Sensitivity

15 \pm 5 (%) STRAIN AT FAILURE



METRIC

W P 139-86-02 LOCATION Co-ords.N4 755 513.1; E 411 554.2 ORIGINATED BY DC
DIST 2 HWY 401 BOREHOLE TYPE Cont. Flight Auger (S.S.) COMPILED BY PP
DATUM Geodetic DATE 86 12 04 CHECKED BY PT

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	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100							WATER CONTENT (%) 10 20 30			
								SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE										
269.0 0.0	Ground Level																	
	Probably Silty Clay						268											
265.3 3.7	Silt Occasional Silty Clay Pockets traces of sand Very Dense		5	SS	68					○			0	3 83 14				
			6	SS	55		264											
			7	SS	84					○			0	4 79 17				
262.0 7.0	Sandy Silt traces of clay traces of gravel Compact to Very Dense		8	SS	17		262			○			9	10 76 5				
			9	SS	31		260											
			10	SS	49		258			○			0	16 79 5				
			11	SS	100/28 cm		256											
							254											
							252											
250.4 18.6	End of Borehole		12	SS	60/15 cm													

+3, x5 : Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 4

METRIC

W P 139-86-02 LOCATION Co-ords. N 4 755 516.7; E 411 569.3 ORIGINATED BY DC
DIST 2 HWY 401 BOREHOLE TYPE Cont. Flight Auger (S.S.) COMPILED BY DC
DATUM Geodetic DATE 86 12 05 CHECKED BY DC

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						
269.5	Ground Level													
0.0	Silty Clay traces of organics traces of gravel some (Fill Material) sand Very Stiff to Hard		1	SS	15		268							4 21 (75)
			2	SS	40									
			3	SS	30									
265.8			4	SS	25		266							1 11 (88)
3.7	Silt traces of gravel traces of sand Occasional Silty Clay Seams Compact to Very Dense		5	SS	45									
			6	SS	61									8 4 79 9
			7	SS	24		264							
			8	SS	30		262							0 2 (98)
261.6			9	SS	13		260							
7.9	Sandy Silt to Silty Sand traces of clay Compact to Very Dense		10	SS	71		258							
			11	SS	49		256							
			12	SS	59		254							
250.8							252							
18.7	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 5

METRIC

W P 139-86-02 LOCATION Co-ords. N 4 755 445.9; E 411 573.6 ORIGINATED BY DC
DIST 2 HWY 401 BOREHOLE TYPE Cont. Flight Auger (S.S.) COMPILED BY PP
DATUM Geodetic DATE 86 12 08 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			20 40 60 80 100								
								SHEAR STRENGTH								
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	WATER CONTENT (%)							
269.5	Ground Level														GR SA SI CL	
0.0	Silty Clay trace/some sand traces of gravel		1	SS	32	*	268	120 (25 cm)							2 38 (60)	
			2	SS	40		266									
			3	SS	41											
			4	SS	25											
			5	SS	54											
	Hard		6	SS	55		264							0 2 (98)		
263.1	Sandy Silt to Silty Sand traces of clay		7	SS	19		262									
6.4								260								
								258								
			Compact to Dense		8	SS	50	256								
					9	SS	45	254								7 38 (55)
253.8	End of Borehole															
15.7	* Groundwater Level not observed															

+³, x⁵: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 101

METRIC

W P 139-86-02 LOCATION Co-ords: N 4 755 456.3; E 411 548.6 ORIGINATED BY DM
DIST 2 HWY 401 BOREHOLE TYPE Washbore - NX Casing COMPILED BY PP
DATUM Geodetic DATE 86 11 18 - 86 11 20 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			20	40	60	80	100					
274.7	Ground Level																
0.0	Sand Some Gravel Occasional Cobbles traces of silt traces of clay Loose to Very Dense (Fill Material)		1	SS	28		274										
			2	SS	11												19 67 10 4
			3	SS	7		272										
			4	SS	7												
			5	SS	14												14 41 29 16
			6	SS	60/7.5 cm		270										
			7	SS	60/10 cm												
268.0			8	SS	45		268										13 73 10 4
6.7			9	SS	44												1 30 (69)
	Silty Clay trace/with sand traces of gravel Occasional Silt Seams and Layers Hard		10	SS	67		266										
			11	SS	32												
			12	SS	60		264										0 5 (95)
			13	SS	46		262										
259.0			14	SS	46		260										
15.7	End of Borehole																

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 102

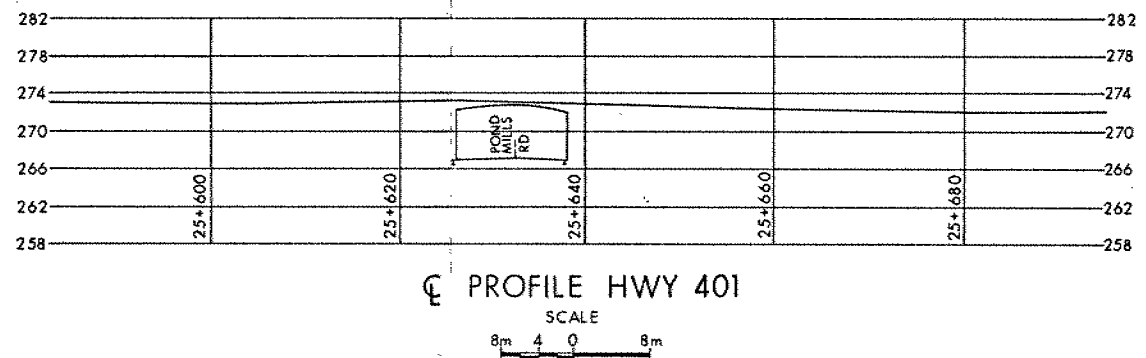
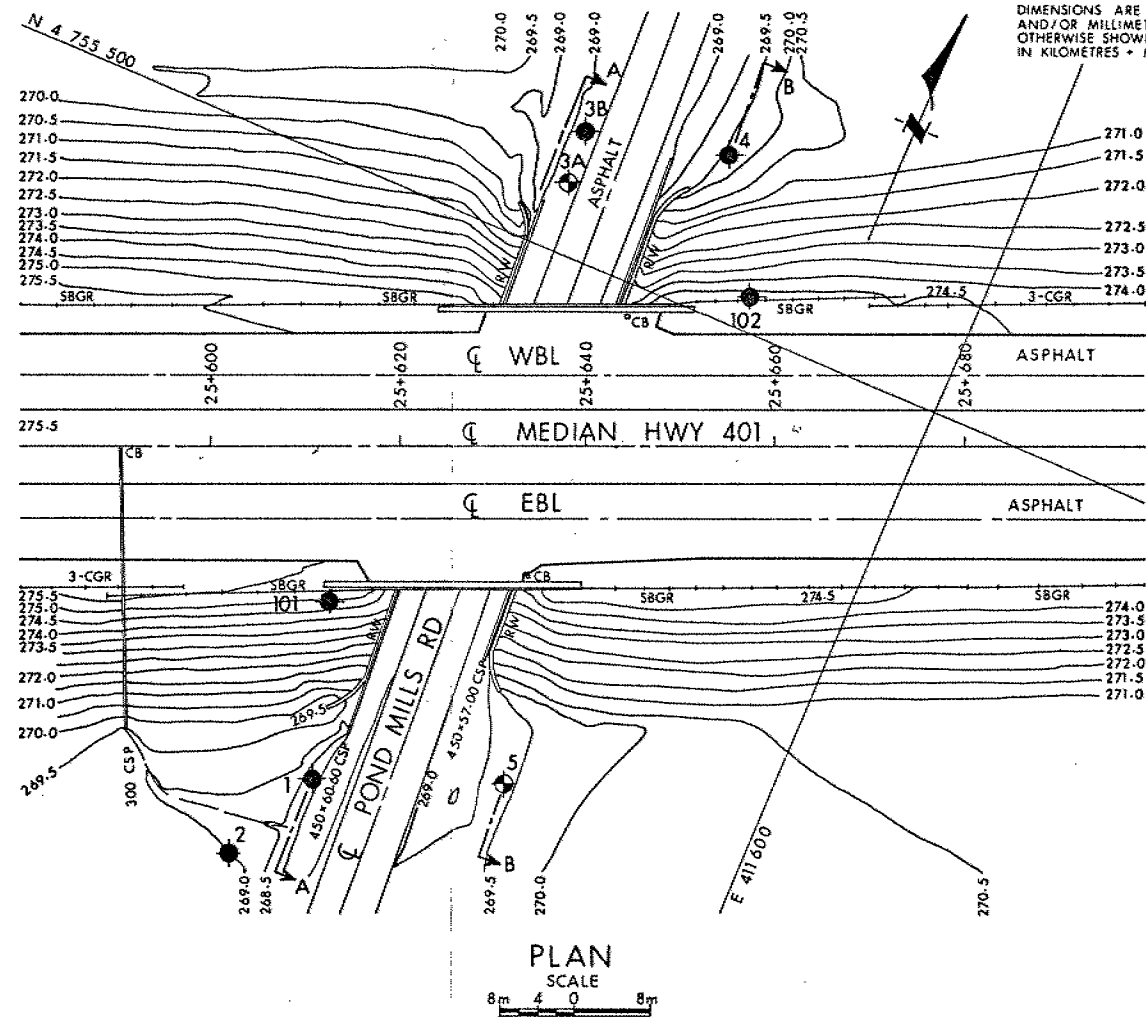
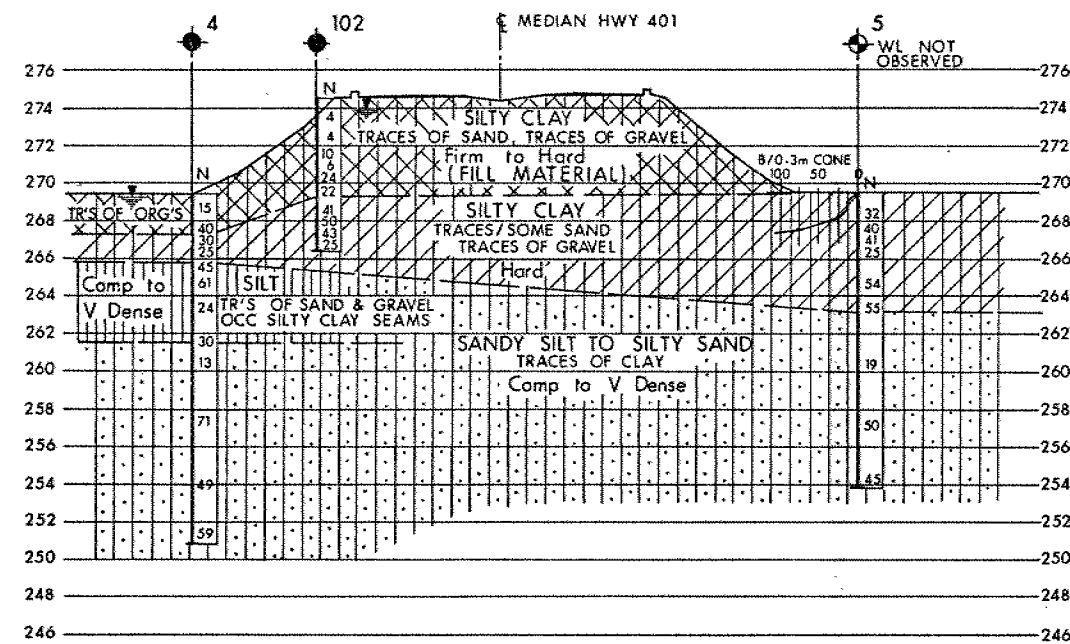
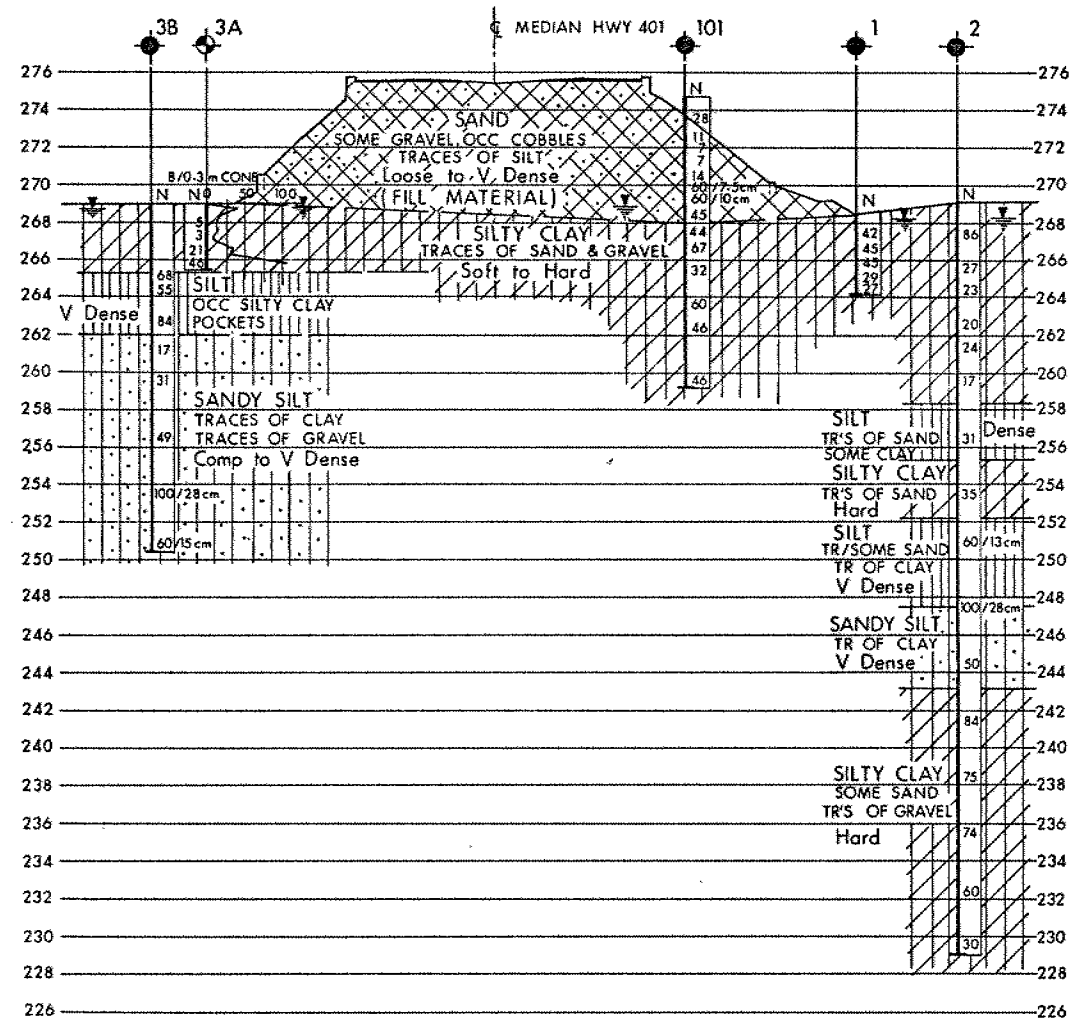
METRIC

W P 139-86-02 LOCATION Co-ords: N 4 755 503.6; E 411 577.0 ORIGINATED BY DM
 DIST 2 HWY 401 BOREHOLE TYPE Washbore - NX Casing COMPILED BY DM
 DATUM Geodetic DATE 86 11 21 - 86 11 24 CHECKED BY DM

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				
274.5	Ground Level														
0.0	Silty Clay some/with sand trace/some gravel Firm to Very Stiff (Fill Material)		1	SS	4										13 28 (59)
			2	SS	4										
			3	SS	10										
			4	SS	6										
			5	SS	24										
269.3			6	SS	22										3 35 (62)
5.2	Silty Clay trace/some sand traces of gravel Hard		7	SS	41										1 12 (87)
			8	SS	50										
			9	SS	43										
266.4			10	SS	25										6 16 (78)
8.1	End of Borehole * Water Level was observed to be 0.6 m below ground level, one day after the removal of casings.														

+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.

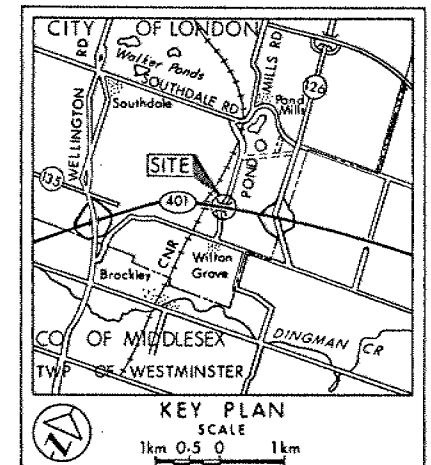
CONT No
WP No 139-86-02

POND MILLS ROAD

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 86 11

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	268.3	4 755 438.0	411 554.3
2	269.0	4 755 427.4	411 549.2
3A	269.0	4 755 507.3	411 554.8
3B	269.0	4 755 513.1	411 554.2
4	269.5	4 755 516.7	411 569.3
5	269.5	4 755 445.9	411 573.6
101	274.7	4 755 456.3	411 548.6
102	274.5	4 755 503.6	411 577.0

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 40114-111

HWY No 401	SUBM'D PP	CHECKED	DATE 87 03 26	DIST 2
	DRAWN DT	CHECKED	APPROVED	SITE 19-372
				DWG 1398602-A