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DIST. 2 REGION

W.P. No. 479-89-03

CONT. No. 92-06

W. O. No.

STR. SITE No. 19-316

HWY. No. 401

LOCATION Hwy 401 & Dereham Townline Overpass

No OF PAGES - 1

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 479-89-03 DIST 2

HWY 401 STR SITE 19-316

Dereham Townline Overpass

CONT 92-06

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GEOCRES 40I15-28 DATE JAN 25 1991

FOUNDATION INVESTIGATION REPORT
For
Dereham Townline Overpass
W.P. 479-89-03, Site 19-316
Hwy. 401, District 2, London

INTRODUCTION

This report contains the results of a soil investigation carried out at the above mentioned site to provide information for the design and construction of the proposed widening of Dereham Townline overpass.

The field work for this project was carried out between 90 07 23 and 90 07 26, and comprised of four sampled boreholes and Dynamic Cone Penetration Test adjacent to these holes.

Boreholes were advanced to a maximum depth of 21.8 m (El. 273.7 m) below the existing ground level using a continuous flight hollow stem auger.

SITE DESCRIPTION

The site under investigation is located at the crossing of Hwy. 401 and Dereham Townline Road in the Township of Southwest Oxford.

The terrain is gradually sloping in the northeast to southwest direction with undulations and ridges to the north and south. It appears that the site in question is located on a ridge which was modified to the present condition by the construction of the existing bridge.

The ridges are moraines of calcareous clay or silty clay while in the valley it is common to find alluvium of gravel, sand or silt. Physiographically the area is located in the region known as the "Mount Elgin Ridges".

SUBSURFACE CONDITIONS

General

The underlying subsoil at this site consists of stiff to hard clayey silt underlain by dense to very dense non-cohesive glacial till which overlies very dense sand with varying proportions of silt sized particles. For classification purposes, the soils encountered at this site can be divided into three different zones.

a) Clayey Silt, trace Sand and trace Gravel
b) Heterogeneous Mixture of Gravel, Sand and Silt (Glacial Till)
c) Sand, some Silt

The subsurface conditions encountered during the course of the investigation, together with the field and laboratory test results are shown on the Record of Borehole sheets contained in the Appendix of this report. Two stratigraphical sections are shown on Drwg. No. 4798903-A. This drawing also shows the locations and elevations of the borings. Description of the strata encountered are given below.

a) Clayey Silt, trace Sand, and Trace Gravel

This clayey silt layer was encountered immediately below the topsoil. The thickness of this layer varies from 9.8 m to 12.0 m and extends to El. 285.9 m to 283.5 m. The natural moisture content varies from 14.5% to 18.0% with and average value of 15.6%. The results of the Atterberg Limit Test carried out on representative soil samples are shown on Figure 1. The liquid limit varies between 27 and 29 with the plasticity index varying from 13 to 16. The Standard Penetration Test results were observed to vary widely ('N' values 9 blows/30 cm to 59 blows/30 cm) indicating stiff to hard consistency.

b) Heterogeneous Mixture of Gravel, Sand and Silt (Glacial Till)

The clayey silt layer is underlain by this non-cohesive glacial till deposit. The thickness of this deposit varies between 5.4 m and 6.7 m, and extends to El. 279.2 m to 278.1 m. The Gradation Test results are shown on Figure 2 in an envelope form. These results indicate 1% to 14% gravel, 35% to 75% sand and 26% to 52% silt. The natural moisture content varies from 3% to 10.5% with an average value of 7.0%. The Standard Penetration Test results in this deposit vary from 23 blows/30 cm to over 100 blows/30 cm indicating compact to very dense state of compaction.

c) Sand, some Silt

This sandy deposit was encountered in all the boreholes immediately below the glacial till deposit. The Gradation Test results are shown on Figure 3 in an envelope form. These test results indicate that this deposit is predominantly composed of sand with varying proportions of silt sized particles (sand 84% to 91%, silt 8% to 16%). The Standard Penetration Test results were observed to vary from 72 blows/30 cm to over 100 blows/ 30 cm indicating very dense state of compaction. This layer extends to the depth probed (i.e. El. 273.7 m), however, the full extent of this deposit was not proven.

Groundwater Conditions

The groundwater level was not encountered in any of the boreholes and the boreholes were observed to be dry. However, the observation made at the well close to site in question indicate that the groundwater level may be expected at about 27 m (approximately El. 268.5 m) below the existing ground level.

DISCUSSION AND RECOMMENDATIONS

General

It is proposed to widen the existing bridge at the crossing of Hwy. 401 and Dereham Townline road to provide additional lane on both sides of the Hwy. 401.

The existing structure is a structural steel simple span beams bridge. The clear span between the face of the abutments is about 11.5 m. The toe walls as well as the side slopes appear in very good condition. However, a few noticeable cracks running from the top of the wall to the road level were observed on both abutment walls.

It appears from the structural drawings of the existing bridge that the abutments as well as the wing walls are supported on spread footings. The footing of the east abutment is about 3.5 m wide and placed at EL. 290.6 m, whereas the footing of the west abutment is placed at about El. 289.2 m. The foundations of the wing walls are stepped and placed at four different levels.

Structure Foundations

Considering the subsoil conditions at this site, it is recommended that the structures for the proposed widening be supported on spread footings. In order to match the founding levels of the existing footings, the bearing preassures for the design of the foundations are recommended separately.

East Abutment

The following bearing pressures are recommended for footings placed at about El. 290.6 m.

Factored Bearing Capacity at U.L.S. = 450 kPa
Bearing Capacity at S.L.S. Type II = 250 kPa

West Abutment

The following bearing capacities may be assumed for the design of the footings placed at about El. 289.2 m.

Factored Bearing Capacity at U.L.S. = 550 kPa
Bearing Capacity at S.L.S. Type II = 300 kPa

The allowable bearing pressures (S.L.S. Type II) recommended above are based on the assumption that the footings will be at least 3.0 m wide and will not be placed at a level higher than the elevations indicated above. The total settlement for these bearing pressures should be in the order of 25 mm.

If the settlements are to be restricted or heavier loads are expected, the structures may be supported on steel H-piles driven to very dense sandy strata in the depth range of El. 278.0 to EL. 276.0. The following bearing capacity values are recommended for the design of the piles:

	Pile Type	
	HP 310x79	HP 310x110
Factored Bearing Capacity at U.L.S.	1150 kN	1600 kN
Bearing Capacity at S.L.S. Type II	900 kN	1150 kN

Driving of piles shall be carefully monitored and controlled employing the Hiley Dynamic Pile Driving Formula driven in accordance with MTO Standards SS103-10 or SS103-11 assuming an ultimate capacity as follows:

Pile Type	Ultimate Capacity (kN)
HP 310x79	2700
HP 310x110	3450

Earth pressure for the design of the abutments should be computed as per Section 6.1.2.2 of the O.H.B.D.C. and an unyielding foundation condition may be assumed for the computations. However, for the design of wing walls

and toe walls, yielding condition may be assumed. The Granular 'A' or 'B' backfill should be in accordance with the Special Provision No. 109F03. The following parameters are recommended for the granular fill.

		Granular 'A'	Granular 'B'
Angle of Internal Friction	ϕ	35°	30°
Unit Weight (kN/m^3)	γ	22.8	21.2

The sliding resistance may be estimated based on effective angle of internal friction neglecting the effective shear strength of the founding soil. An unfactored coefficient of friction value of tan 26° may be assumed for the estimate.

Other Considerations

As indicated before the foundations of the existing wing walls are stepped and founded at four different elevations. The stability of these walls may be endangered during the construction of the proposed wing walls. In order to maintain the integrity of the existing foundations, the excavation for the proposed wing walls should be carried out in stages as the construction proceeds or else the design may be modified to avoid any excavation close to the existing wing walls.

The footings should have a minimum of 1.2 m earth cover to protect against the frost penetration.

Some differential settlement is expected to take place between the new and existing structure. In view of this, it is advisable to provide either a "Slip or Isolation" joint between the existing and the new structures to accommodate the differential settlement.

If the structures are supported on piles, the piles should be lowered in pre-augered holes extending to a depth of 3 m below the founding level of the existing footings. These holes should be backfilled with granular material.

MISCELLANEOUS

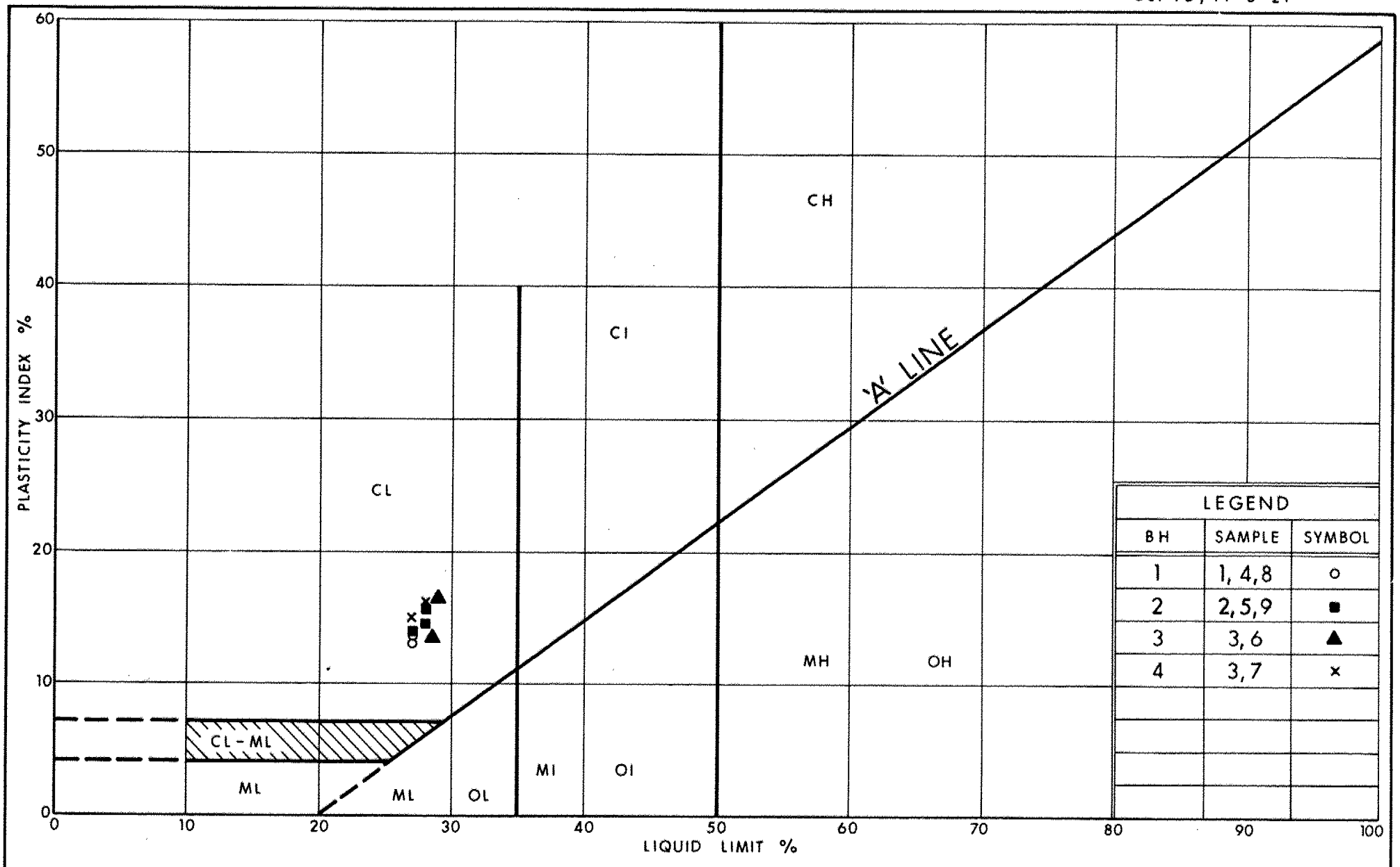
The field work for this investigation was carried out under the supervision of M. Vasavithasan, Foundation Engineer, and J. LeMessurier, Student Engineer trainee. The equipment used was owned and operated by Master Soil Investigation Ltd. This report was prepared by M. Vasavithasan, reviewed by P. Payer, Senior Foundation Engineer, and approved by M. Devata, Chief Foundation Engineer.

M. Vasavithasan, P.Eng.
Foundation Engineer

M. Devata, P.Eng.
Chief Foundation Engineer

APPENDIX

Oct 75, FF-S-21



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PLASTICITY CHART

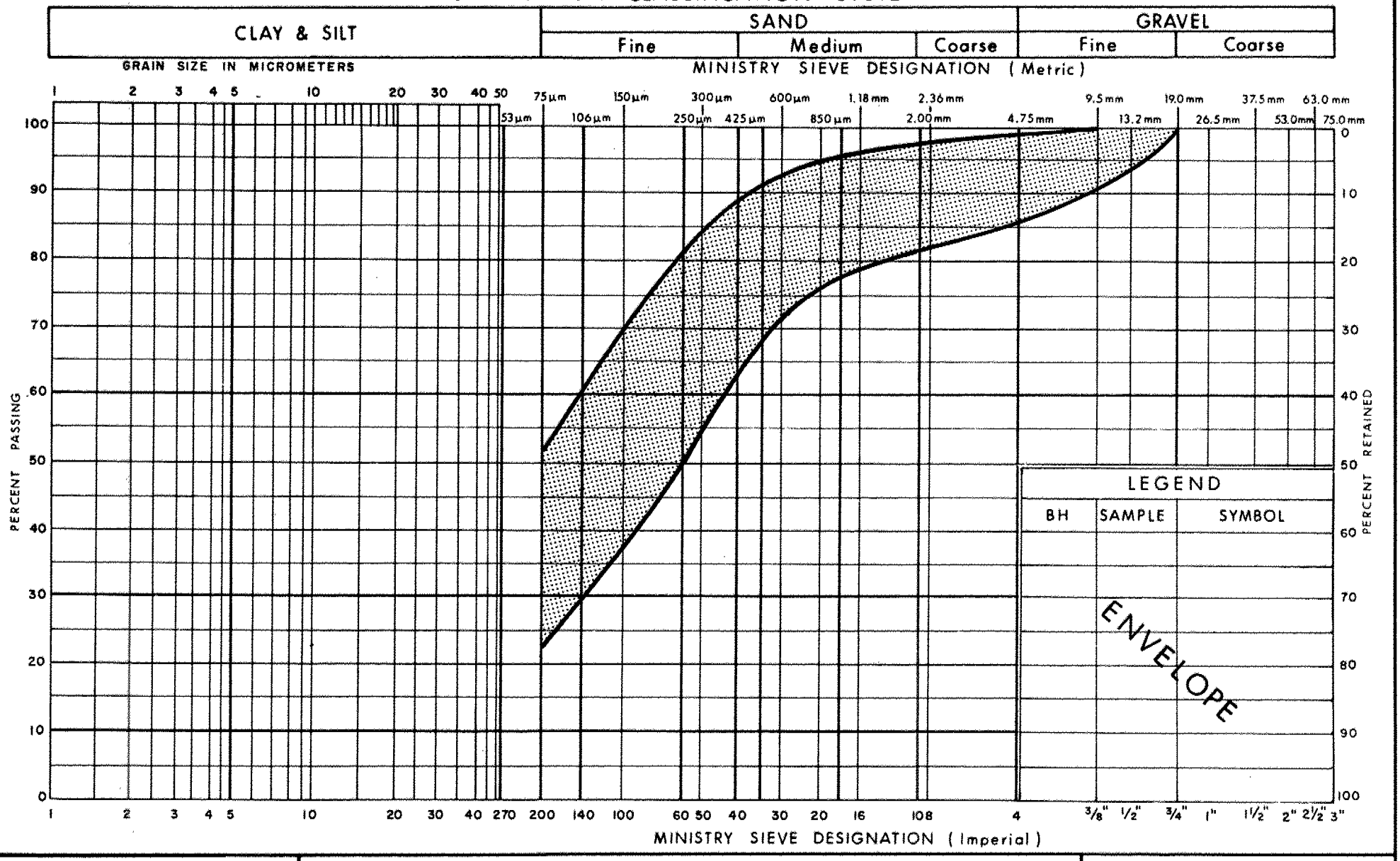
CLAYEY SILT, TRACE OF SAND & GRAVEL

FIG No 1

W P 479-89-03

78 12 M

UNIFIED SOIL CLASSIFICATION SYSTEM



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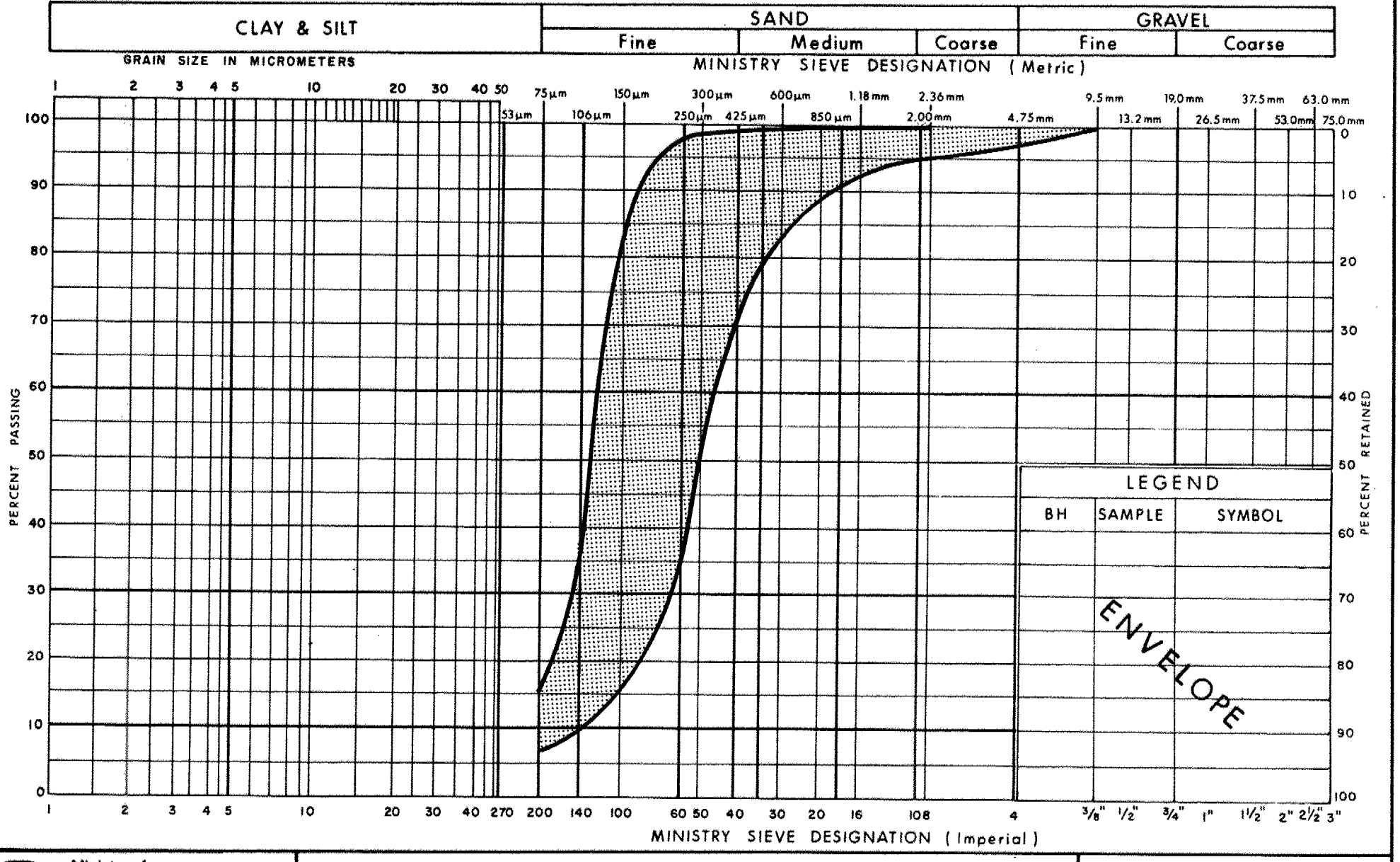
GRAIN SIZE DISTRIBUTION
HET. MIX. OF GRAVEL, SAND & SILT
(Glacial Till)

FIG No 2

W P 479 89 03

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
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GRAIN SIZE DISTRIBUTION

SAND, TRACE TO SOME SILT

FIG No 3

W P 479-89-03

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

RECORD OF BOREHOLE No 1 1 OF 1 METRIC

W.P. 479 - 89 - 03 LOCATION CO - ORDS. N 4 761 149.8; E 189 200.6 ORIGINATED BY M V&J L

DIST 2 HWY 401 BOREHOLE TYPE CONE TEST & HOLLOW STEM AUGER COMPILED BY M V

DATUM GEODETIC DATE 90 07 23 & 90 07 24 CHECKED BY P P

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 kPa (o UNCONFINED, * QUICK TRIAXIAL, + FIELD VANE, x LAB VANE; 20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
296.2	Ground Surface										
0.0	Topsoil					DRY	296				
			1	SS	20						
			2	SS	9		294				
	CLAYEY SILT, Trace of Sand, Trace of Gravel, Stiff to Very Stiff		3	SS	12		292				
			4	SS	16		290				
			5	SS	19						
			6	SS	25		288				
			7	SS	24						
			8	SS	28						
285.2			9	SS	26		286				
11.0			10	SS	82						
			11	SS	120						
			12	SS	117		284		o		4 49 (47)
	Heterogeneous Mixture of GRAVEL, SAND and SILT, Very Dense (Glacial Till)		13	SS	52		282				
			14	SS	115				o		3 71 (26)
278.6			15	SS	111		280				
17.6			16	SS	95		278				0 91 (9)
	SAND, Trace of Silt, Very Dense						276				
274.5			17	SS	120	/25cm					
21.7	End of Borehole										

+3, x5 : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 2 1 OF 1 METRIC

W.P. 479 - 89 - 03 LOCATION CO - ORDS. N 4 761 123.6; E 189 171.1 ORIGINATED BY M V&J L

DIST 2 HWY 401 BOREHOLE TYPE CONE TEST & HOLLOW STEM AUGER COMPILED BY M V

DATUM GEODETIC DATE 90 07 24 & 90 07 25 CHECKED BY P P

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 kPa (o UNCONFINED, + FIELD VANE, • QUICK TRIAXIAL, x LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
295.5	Ground Surface										
0.0	Topsoil					DRY					
	CLAYEY SILT, Trace of Sand, Trace of Gravel, Very Stiff to Hard		1	SS	36		294				
			2	SS	26		292				
			3	SS	29		290				
			4	SS	22						
			5	SS	29		288				
			6	SS	20						
			7	SS	46						
			8	SS	30		286				
			9	SS	34						
			10	SS	33						
283.5			11	SS	42		284				
12.0	Heterogeneous Mixture of GRAVEL, SAND and SILT, Dense to Very Dense (Glacial Till)		12	SS	70				o		1 75 (24)
			13	SS	116		282				
			14	SS	39		280				
278.1			15	SS	74				o		9 38 (53)
17.4	SAND, Trace of Silt,						278				
277.1	Very Dense		16	SS	120	/13cm					
18.4	End of Borehole										

+^{3}, x^5 : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 3 1 OF 1 METRIC

W.P. 479 - 89 - 03 LOCATION CO - ORDS. N 4 761 087.2; E 189 202.4 ORIGINATED BY M V&J L

DIST 2 HWY 401 BOREHOLE TYPE CONE TEST & HOLLOW STEM AUGER COMPILED BY M V

DATUM GEODETIC DATE 90 07 25 & 90 07 26 CHECKED BY P P

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 kPa (o UNCONFINED, + FIELD VANE, * QUICK TRIAXIAL, x LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
295.5	Ground Surface										
0.0	Topsoil					DRY					
	CLAYEY SILT, Trace of Sand, Trace of Gravel, Very Stiff to Hard		1	SS	28		294				
			2	SS	30		292	120/27cm			
			3	SS	27		290		w_P		
			4	SS	20						
			5	SS	23		288				
			6	SS	29				w		
			7	SS	59						
285.7			8	SS	34		286				
9.8	Heterogeneous Mixture of GRAVEL, SAND and SILT, Dense to Very Dense (Glacial Till)		9	SS	55						
			10	SS	55						
			11	SS	51		284		o		8 41 (51)
			12	SS	35						
			13	SS	42		282		o		14 35 (51)
			14	SS	70						
279.1							280				
16.4	SAND, Some Silt, Very Dense		15	SS	72						0 84 (16)
			16	SS	120	/23cm	278				
							276				
273.7			17	SS	147		274				3 89 (8)
21.8	End of Borehole										

+3, x5 : Numbers refer to Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 4 1 OF 1 METRIC

W.P. 479 - 80 - 03 LOCATION CO - ORDS. N 4 781 118.7; E 189 233.6 ORIGINATED BY M V&J L

DIST 2 HWY 401 BOREHOLE TYPE CONE TEST & HOLLOW STEM AUGER COMPILED BY M V

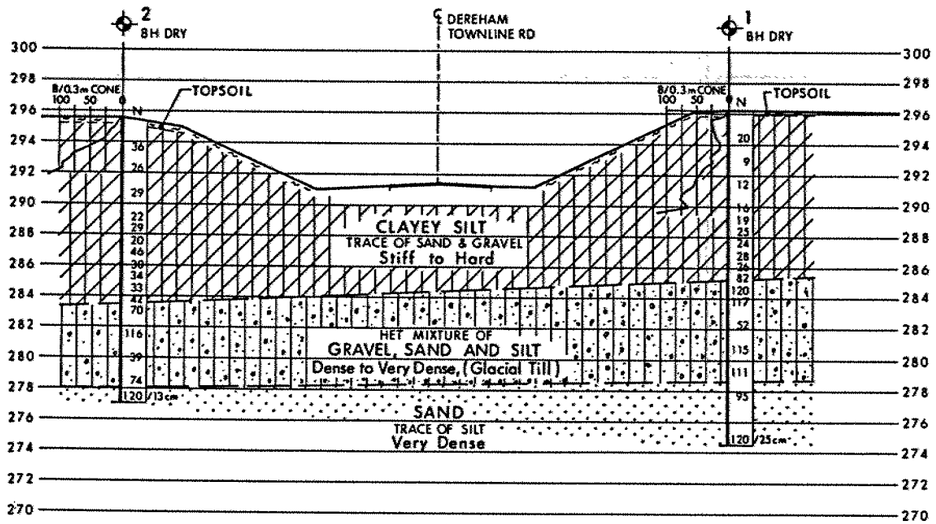
DATUM GEODETIC DATE 90 07 25 & 90 07 26 CHECKED BY P P

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 kPa (o UNCONFINED, + FIELD VANE, • QUICK TRIAXIAL, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
297.0	Ground Surface										
0.0	Topsoil					DRY	296				
			1	SS	24						
			2	SS	13		294				
	CLAYEY SILT, Trace of Sand, Trace of Gravel, Stiff to Very Stiff		3	SS	13		292				
			4	SS	18						
			5	SS	18		290				
			6	SS	18						
			7	SS	22		288				
			8	SS	25						
			9	SS	23						
285.9			10	SS	41		286				
11.1			11	SS	98				o		10 59 (31)
			12	SS	91		284				
	Heterogeneous Mixture of GRAVEL, SAND and SILT, Compact to Very Dense (Glacial Till)		13	SS	23				o		12 36 (52)
			14	SS	120		282				
279.2			15	SS	120	/18cm	280				
17.8			16	SS	120	/28cm					0 87 (13)
	SAND, Some Silt, Trace of Gravel, Very Dense						278				
275.2			17	SS	120	/28cm	276				
21.8	End of Borehole										

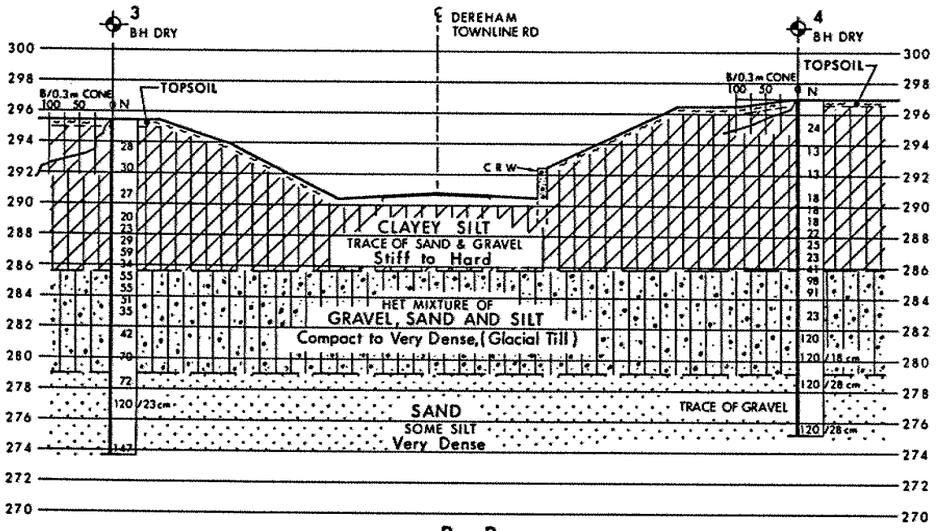
+3, ×5 : Numbers refer to Sensitivity

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

MINISTRY OF TRANSPORTATION, ONTARIO PH-0-207 88 10



A – A

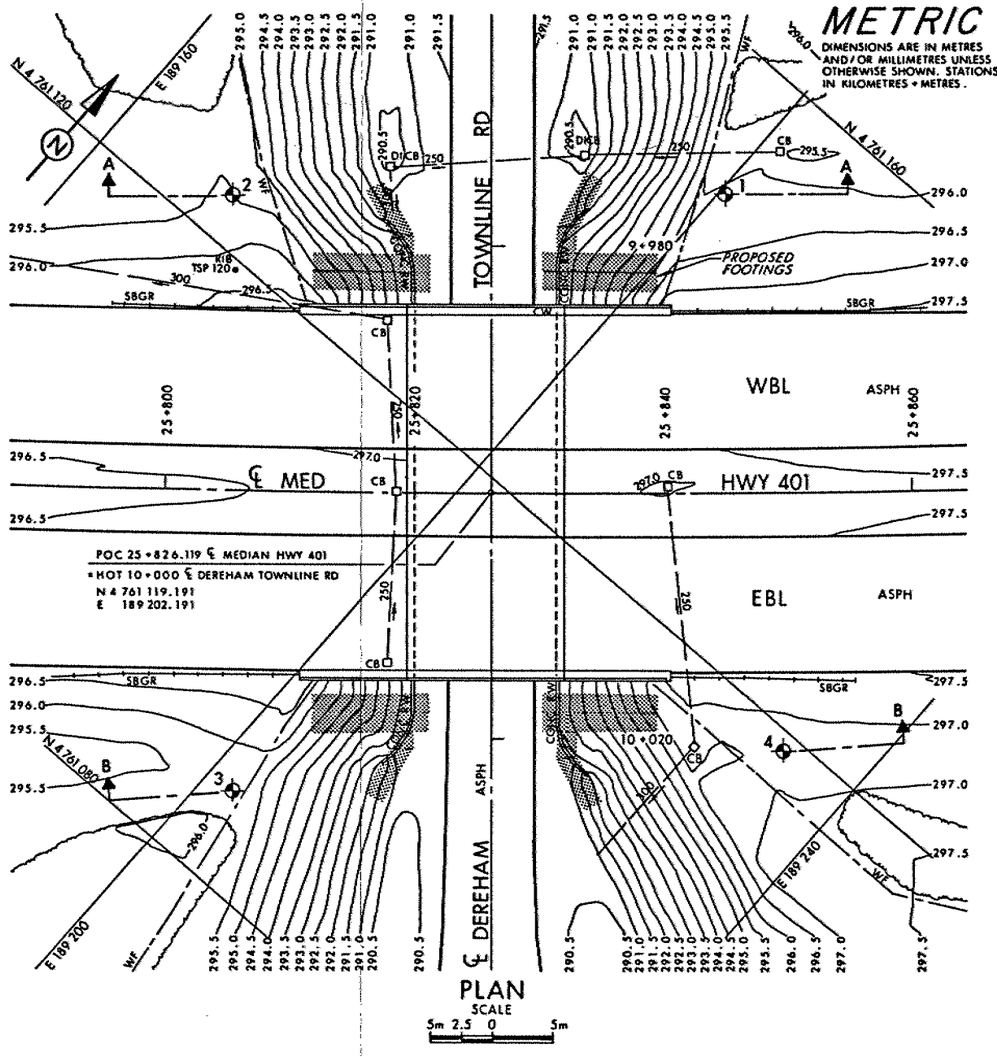


B – B

SECTIONS

SCALE

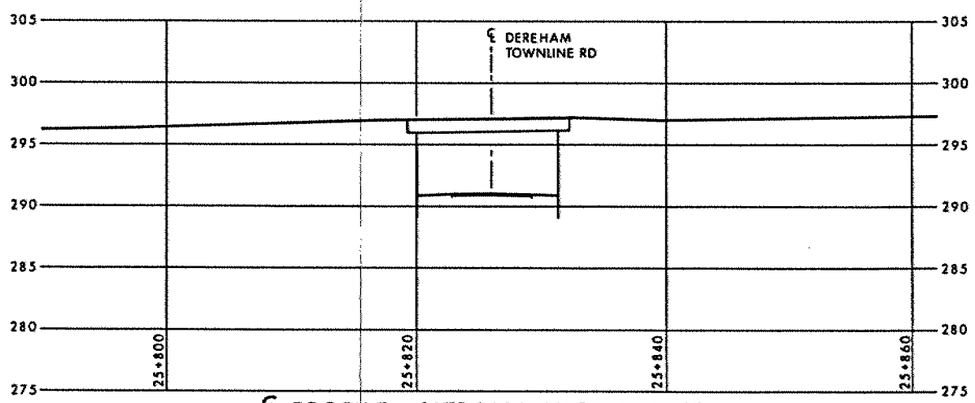
4m 2 0 4m



PLAN

SCALE

5m 2.5 0 5m



℄ PROFILE – MEDIAN HIGHWAY 401

SCALE

5m 2.5 0 5m

METRIC

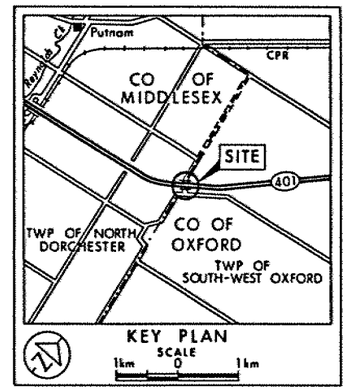
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No
WP No 479-89-03

DEREHAM TOWNLINE O'PASS

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 1990 07

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	296.2	4 761 149.8	189 200.6
2	295.5	4 761 123.6	189 171.1
3	295.5	4 761 087.2	189 202.4
4	297.0	4 761 118.7	189 233.6

-≡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 40115-28

HWY No 401			DIST 2
SUBMD M V	CHECKED	DATE 90 12 12	SITE 19-316
DRAWN R S	CHECKED	APPROVED	DWG 4798903-A

REF No E-92-401-4; 1990 05