

G.I.-30 SEPT. 1976

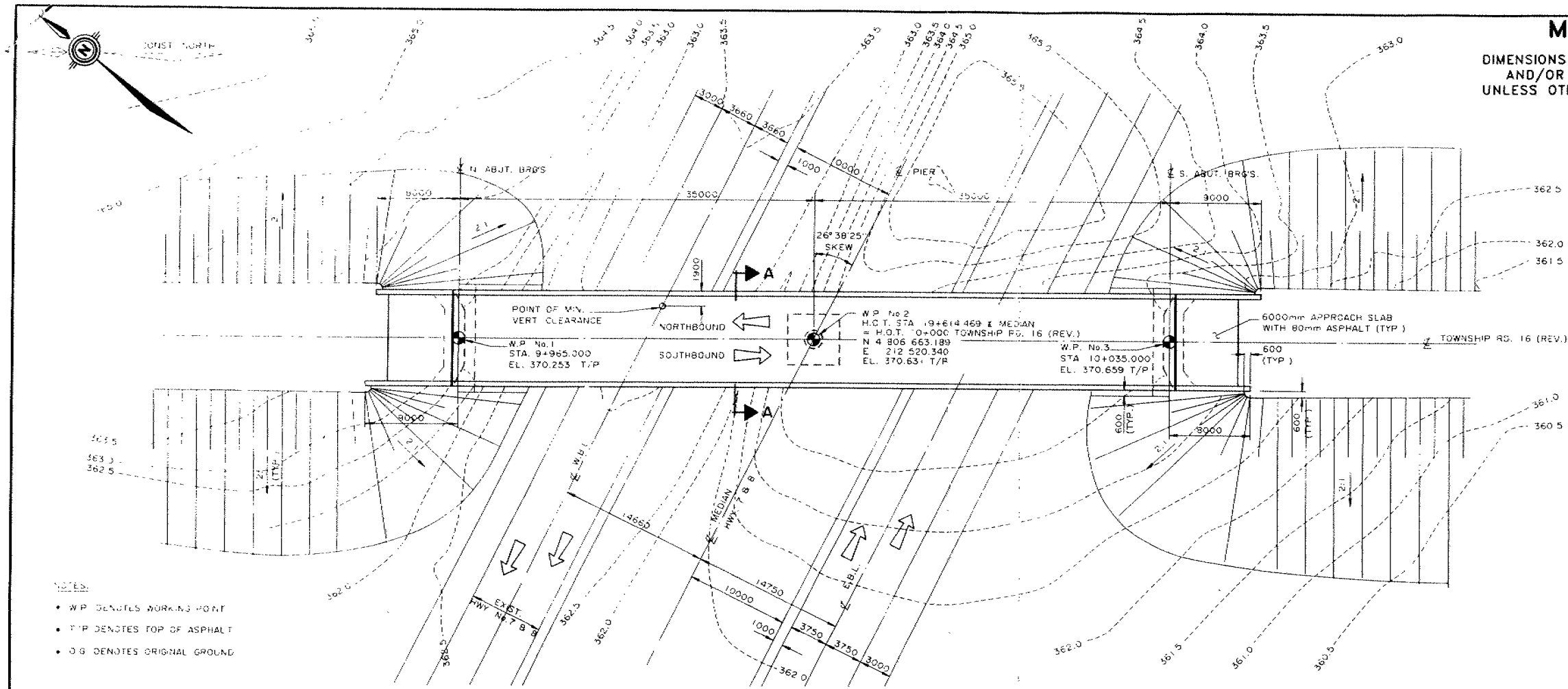
GEOCRES No. 40P7-49DIST. 3 REGION           W.P. No. 16Z-88-01CONT. No. 44-12W. O. No.           STR. SITE No. 33-360HWY. No. 7 & 8LOCATION Hwy 7 & 8 / Twp Rd. 16  
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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.           REMARKS:

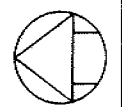


- NOTES:
- W.P. DENOTES WORKING POINT
  - T.P. DENOTES TOP OF ASPHALT
  - O.G. DENOTES ORIGINAL GROUND

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

**DISTRICT No. 3**  
**CONT No**  
**WP No 162-88-01**

**TOWNSHIP ROAD 16 UNDERPASS**  
**HWY. 7 & 8**  
**GENERAL ARRANGEMENT**



**totten sims hubicki associates**  
 ENGINEERS ARCHITECTS AND PLANNERS

**GENERAL NOTES**

**CLASS OF CONCRETE**

- DECK AND PIER COLUMNS 35MPa
- REMAINDER 30MPa

**CLEAR COVER TO REINFORCING STEEL**

- FOOTINGS 100 ±25mm
- ABUTMENTS, WINGWALLS  
 FRONT FACE 80 ±20mm  
 BACK FACE 70 ±20mm
- PIER COLUMNS 80 ±20mm
- DECK  
 TOP SLAB TOP 70 ±20mm  
 BOTTOM SLAB TOP 40 ±10mm  
 BOTTOM SLAB BOTTOM 40 ±10mm  
 50 ±10mm
- REMAINDER 70 ±20mm

**REINFORCING STEEL**

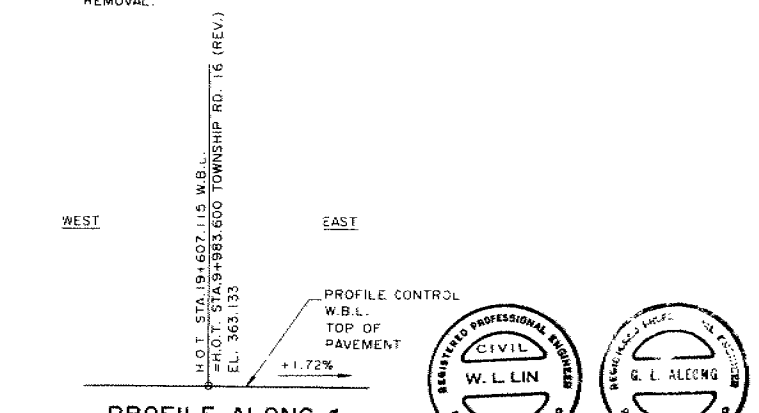
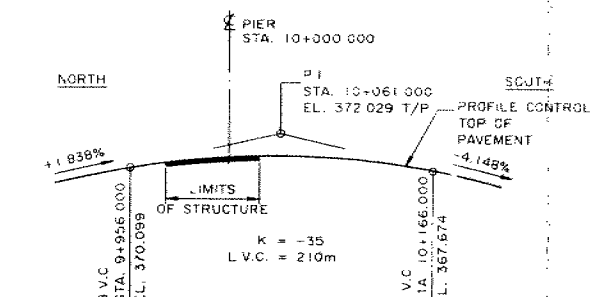
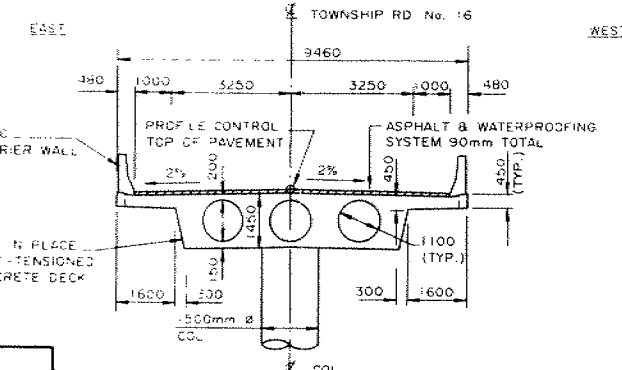
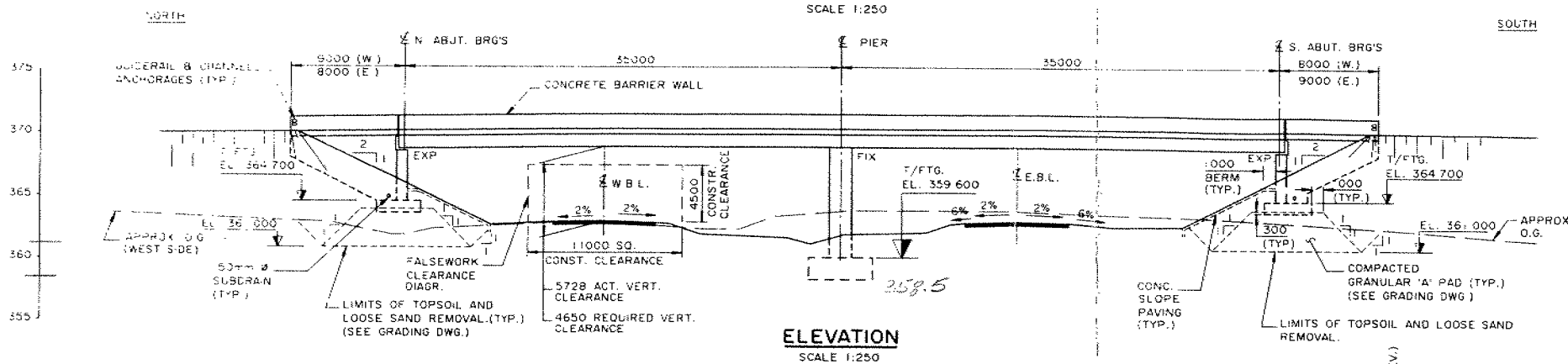
- REINFORCING STEEL SHALL BE GRADE 400 UNLESS NOTED OTHERWISE. BAR MARKS WITH SUFFIX "C" DENOTE COATED BARS

**CONSTRUCTION NOTES**

- IF THE ACTUAL BEARING THICKNESSES ARE DIFFERENT FROM THOSE GIVEN IN THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE BEARING SEAT ELEVATIONS AND THE REINFORCING STEEL TO SUIT.

**LIST OF DRAWINGS**

1. GENERAL ARRANGEMENT
2. BOREHOLE LOCATION & SOIL STRATA
3. FOOTING DETAILS & REINFORCEMENT
4. NORTH ABUTMENT
5. SOUTH ABUTMENT
6. N.E. & N.W. WINGWALLS
7. S.E. & S.W. WINGWALLS
8. PIER DETAILS
9. DECK DETAILS
10. LONGITUDINAL TENDONS
11. TRANSVERSE TENDONS
12. DECK REINFORCING I
13. DECK REINFORCING II
14. BARRIER WALL W/O RAILING
15. JOINT ANCHORAGE & ARMOURING
16. 6000mm APPROACH SLAB
17. DETAILS OF CONCRETE SLOPE PAVING
18. STANDARDS I
19. STANDARDS II
20. AS CONSTRUCTED ELEV. & DIM.
21. QUANTITIES - STRUCTURE



**B.M.**  
**EL. 358.796**  
 GEODETIC DATUM  
 TOP OF RIB  
 41.2m LT 19+408.7 (C/L MED.)

**SECTION A-A**  
 SCALE 1:100  
 NOTE: DIMENSIONS SHOWN NORMAL TO E STRUCTURE

**PROFILE ALONG E TOWNSHIP RD. No. 16**  
 N.T.S.

**PROFILE ALONG E E.B.L. & W.B.L. HWY. 7 & 8**  
 N.T.S.



DRAWING NOT TO BE SCALED  
 100 mm ON ORIGINAL DRAWING

**APPLICABLE STANDARD DRAWINGS**

- 33-3553 MINIMUM GRANULAR PAD FOR PAVEMENT
- 33-4802 FALSEWORK CLEARANCE

REVISIONS	DATE	BY	DESCRIPTION

DESIGN W.L. CHKS. W.L. CODE OHBDC 83/LOAD CLASS A/DATE NOV. 91  
 DRAWN P.S. CHKS. L.A. SITE 33-360/STRUCT. SCHEME DWG. 1



# METRIC

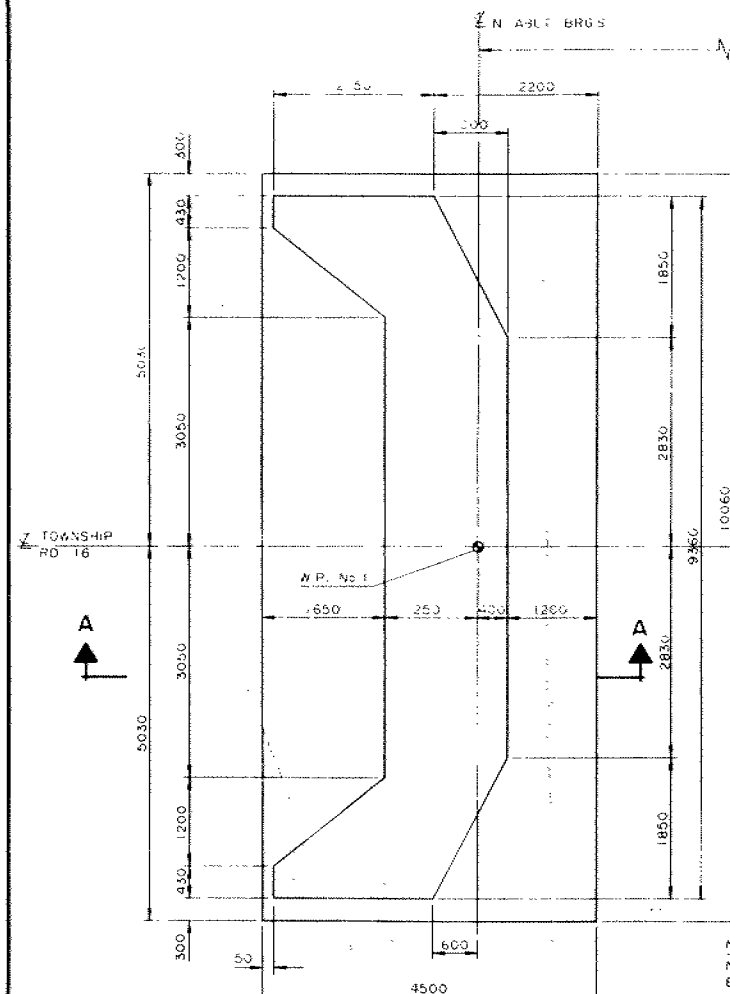
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
WP No 162-88-01

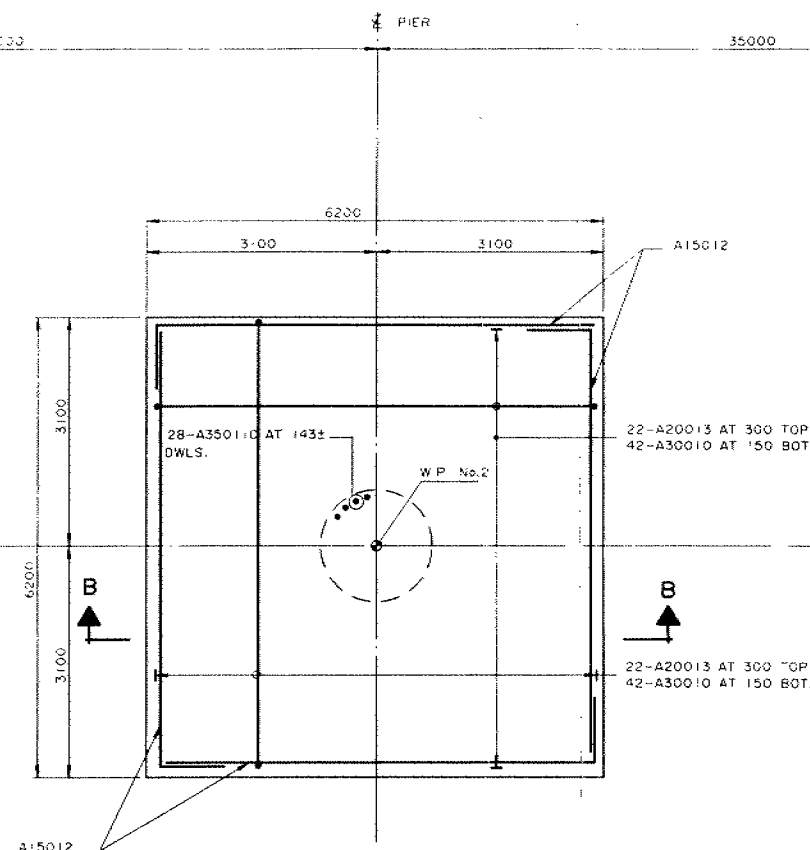


TOWNSHIP ROAD 16 UNDERPASS  
HWY. 7 & 8  
FOOTING DETAILS & REINFORCEMENT

**totten sims hubicki associates**  
ENGINEERS ARCHITECTS AND PLANNERS

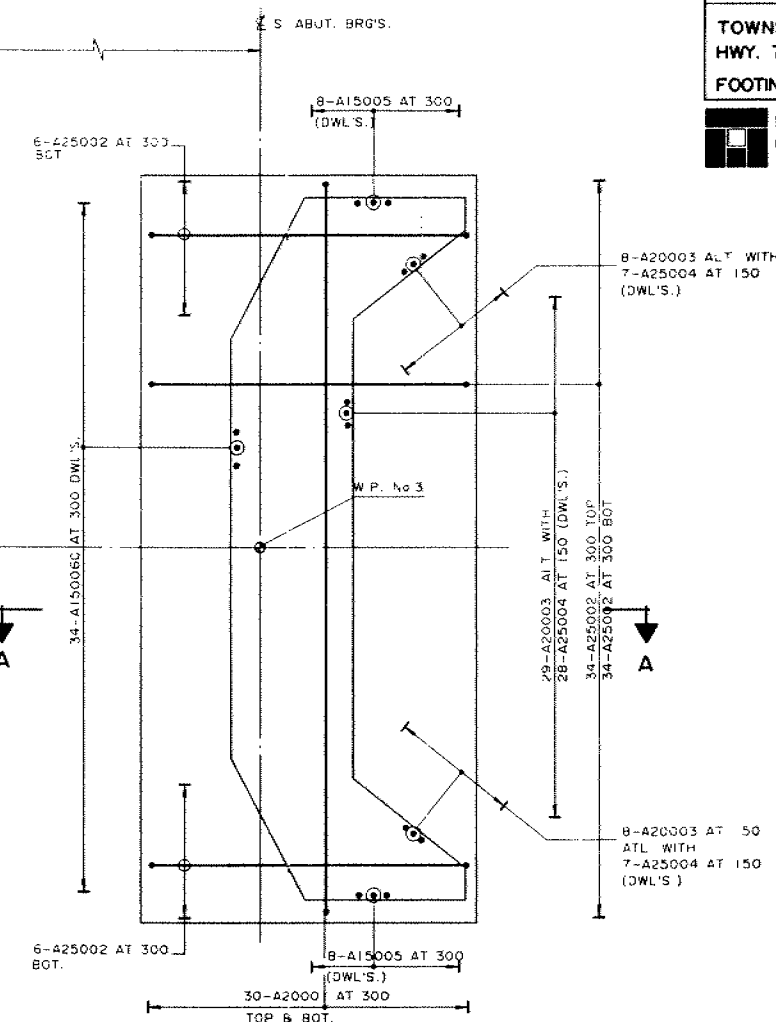


**DIMENSION**

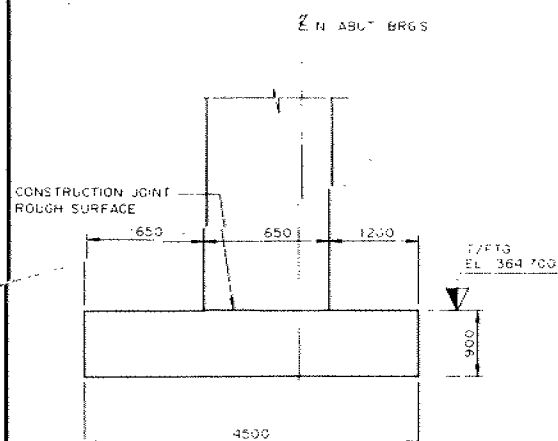


**PLAN**

SCALE 1:50

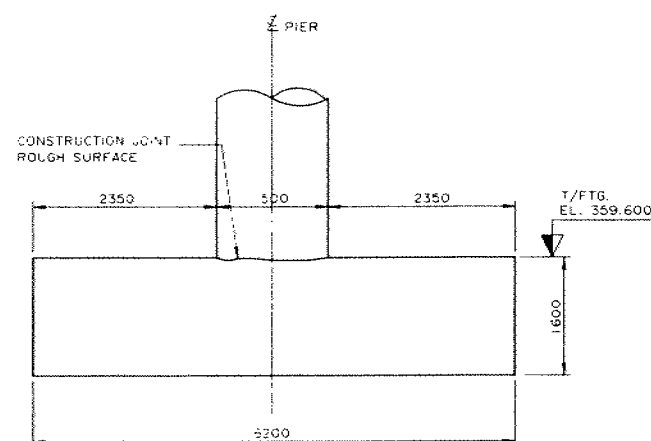


**REINFORCING**



**SECTION A-A**

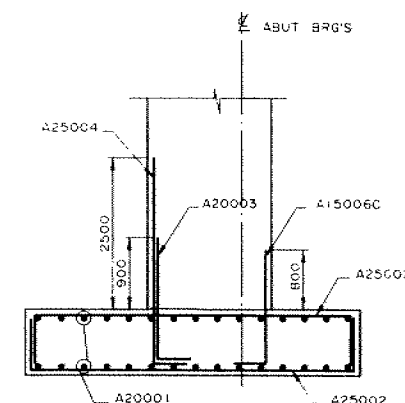
SCALE 1:50



**SECTION B-B**

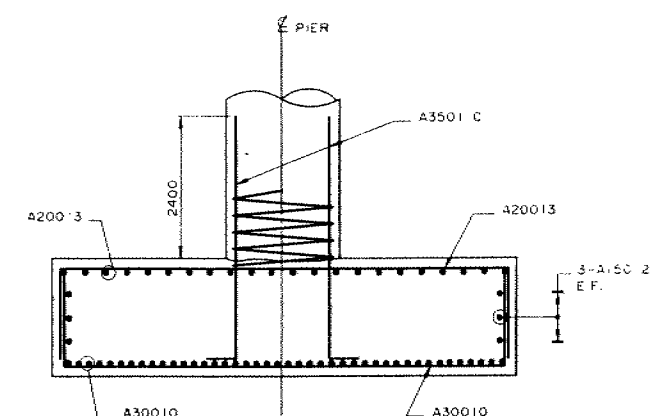
SCALE 1:50

**DIMENSIONS**



**SECTION A-A**

SCALE 1:50



**SECTION B-B**

SCALE 1:50



**REINFORCEMENT**

DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	W. L.	CHKG. W. L.	CODE: OHBDC B3   LOAD CLASS: A   DATE: NOV. 91
DRAWN	P. S. H.	CHKG. L. A.	SITE: 33-360   STRUCT. SCHEME: DWG. 3

FILE COPY



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## **FOUNDATION DESIGN SECTION**

**foundation  
investigation and  
design report**

ENGINEERING MATERIALS OFFICE  
FOUNDATION DESIGN SECTION

*CONT. 94-12*

WP 162-88-01

DIST 3

HWY 7 & 8

STR SITE 33-360

Township Road 16 Underpass

DISTRIBUTION

A. Ho (2)  
C.M. Bond  
A.E. Irving  
E.J. Zavitski (2)  
K.G. Bassi  
S.J. Dunham  
E.A. Joseph  
G. Laithwaite (Cover Only)  
I. Bullen (Cover Only)  
File

# FOUNDATION INVESTIGATION REPORT

For

Township Road 16 Underpass  
Hwy. 7 & 8, Township of Wilmot  
W.P. 162-88-01, Site 33-360  
District 3, Stratford

## INTRODUCTION

This report contains the results of a soils investigation carried out at the above mentioned site to provide information for the design and construction of the proposed underpass.

The field work for this project was carried out between 90 12 03 and 90 12 13, and comprised of five sampled boreholes and Dynamic Cone Penetration Test adjacent to these boreholes.

Boreholes were advanced to a maximum depth of 40.1 m (elevation 323.0 m) below the existing ground level using a continuous flight hollow stem auger and BW casing.

## SITE DESCRIPTION

The site under investigation is located approximately 40 m east of the present intersection of Hwy. 7 & 8 and Township Road 16 in the Township of Wilmot.

The topography of the site is generally undulating with isolated knolls. Physiographically the area is located in the Region known as the "Waterloo Hills". The surface is composed of sandy hills, some of these being ridges of sandy till while others are kames and kame moraines with outwash sands occupying the intervening hollows.

## SUBSURFACE CONDITIONS

The underlying subsoil at this site consists of stratified silty sand to sandy silt deposit interbedded with dense to very dense sand and gravel and very stiff to hard clayey silt layers. For classification purposes, the soils encountered at this site can be divided into four different zones.

- a) Silty Sand to Sandy Silt
- b) Sand and Gravel, some Silt
- c) Clayey Silt
- d) Silty Sand

The soils 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. A stratigraphical profile is shown on Drawing No. 1628801-A. This drawing also shows the locations and elevations of the borings. Description of the strata encountered at this site are given below.

#### Silty Sand to Sandy Silt

This sandy deposit was encountered in all the boreholes immediately below the topsoil. The thickness of this deposit varies from 14.1 m to 18.1 m and extends to elevation 346.0 m to elevation 343.8 m. The Grain Size Distribution Test results are shown on Figure 1 in an envelope form. The gradation analyses indicate that this deposit is predominantly composed of sand and silt and the composition varies over a wide range (sand 22% to 91% and silt 9% to 78%). The Standard Penetration Test results of this deposit up to a depth of 4 m to 7 m below ground level vary from 2 blows/0.3 m to 28 blows/0.3 m and below this depth, it was observed to be in dense to very dense state of compaction ('N' values 31 blows/0.3 m to 77 blows/0.3 m).

#### Sand and Gravel, some Silt

This stratum intersect the silty sand to sandy silt deposit at depth varying from 1.3 m to 6.6 m below the existing ground level. The thickness of this stratum varies from a few centimetres to a maximum of 5.2 m within the area where this layer was fully penetrated. The Grain Size Distribution Test results are shown on Figure 2 in an envelope form. The test results indicate that this deposit is predominantly composed of sand and gravel (gravel 33% to 50%, sand 41% to 58%). The Standard Penetration Test results vary over a wide range (17 blows/0.3 m to over 100 blows/0.3 m).

### Clayey Silt

This clayey deposit was encountered immediately below the silty sand to sandy silt layer at about elevation 346.0 m to elevation 343.8 m. The thickness of this deposit varies from 3.6 m to 7.9 m and extends to elevation 341.0 m to elevation 338.1 m. The natural moisture content was observed to vary from 12% to 17.5% with an average value of 14.4%. The Atterberg Limits determined for the representative soil samples of this deposit are shown on Figure 3. The consistency of this stratum was observed to be very stiff to hard, however, the Standard Penetration Test results were observed to vary very widely ('N' values 17 blows/0.3 m to over 100 blows/0.3 m).

### Silty Sand, trace of Gravel

The clayey silt layer is underlain by this silty sand deposit. The Grain Size Distribution Test results are shown on Figure 4 in an envelope form. The Standard Penetration Test results of this deposit vary from 31 blows/0.3 m to 104 blows/0.3 m indicating dense to very dense state of compaction. The full extent of this deposit was not proven, however, this layer extends to the depth probed (i.e. elevation 323.0 m).

### Groundwater Conditions

The groundwater level was encountered in all the boreholes, and was observed between 9.6 m and 13.3 m (elevation 353.3 m and 349.8 m) below the existing ground level. The groundwater level at each borehole location is as follows:

<u>BH. No.</u>	<u>Elevation</u>
1	350.6
2	349.8
3	353.3
4	352.6
5	352.8



## DISCUSSION AND RECOMMENDATIONS

### General

It is proposed to construct an underpass to carry the Township Road 16 traffic over Hwy. 7 and 8. The structure will be a two span post-tensioned voided concrete deck with a pier column along the Hwy. 7 and 8 median. Each span will be approximately 36 m. The proposed profile grade of Township Road is set at about elevation 370.6± m. The proposed underpass will be located approximately 40 m east of the present intersection and the existing Hwy. 7 and 8 will serve as the future westbound lanes.

### Structure Foundation

#### Pier

Considering the subsoil conditions at this site, it is recommended that the piers be supported on spread footings placed at about elevation 358.0± m. Alternatively, the soil down to elevation 358.0± m may be removed and replaced with compacted granular material and the footing may be placed a minimum of 1.5 m below the proposed finished grade. The engineered fill should be placed as per attached Figure 5.

The following bearing capacity values are recommended for the design of the footing placed on natural ground as well as on compacted granular material.

Factored Bearing Capacity at U.L.S. = 900 kPa

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

The allowable bearing pressures (S.L.S. Type II) recommended above are based on the assumption that the footing will not be less than 4 m wide and on natural ground, it will not be placed at a level higher than elevation 358.0. In addition, the footing will be founded on compacted granular material placed on competent ground. The total settlement for this bearing pressure is expected to be within 25 mm.

### Abutments

The foundation for the abutments may be founded on Granular 'A' core placed on competent ground. The soil down to elevation 361.0± m should be removed before placing the engineered fill. The engineered fill for abutment foundations should be placed as per Figure 6 attached to this report. The following bearing capacity values are recommended for the design of the abutment foundations.

Factored Bearing Capacity at U.L.S. = 900 kPa

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

Alternatively, the pier as well as the abutments may be supported on driven piles. Since high bearing capacity values are recommended for both pier and abutment foundations, the aspect of deep foundation is not discussed.

Earth pressure 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. The Granular 'A' or 'B' backfill should be in accordance with the Special Provision No. 109F03. The following parameters are recommended for the granular backfill.

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

If the structure is placed on spread footings, an unfactored coefficient of friction value of  $\tan 30^\circ$  may be assumed for the estimate of the sliding resistance.

### Approach Embankment

The proposed finished grade of the Township Road 16 is set at about elevation 370.6± m and the maximum height of approach fill above the existing ground level is expected to be about 8.4 m. No major stability

problems are anticipated for the approach embankments constructed with 2H:1V side slopes. However, considering the fill height and the presence of very loose to compact material up to about 4 m below the existing ground level, settlement in the order of 20 mm to 30 mm may be expected due to the load imposed by the embankment. This settlement is expected to complete upon completion of the construction of the approach fill. The fill material should consist of well compacted acceptable material. The topsoil as well as any spongy or soft area observed within the base width of the embankment should be removed before placing the fill.

#### Other Considerations

The spread footings should have a minimum of 1.5 m earth cover to protect against frost penetration.

#### MISCELLANEOUS

The field work for this investigation was carried out under the supervision of M. Vasavithasan and Michael Plant, Foundation Engineers. The equipment used was owned and operated by London Soil Test. This report was prepared by M. Vasavithasan, reviewed by P. Payer, Senior Foundation Engineer and approved by M. Devata, Chief Foundation Engineer.

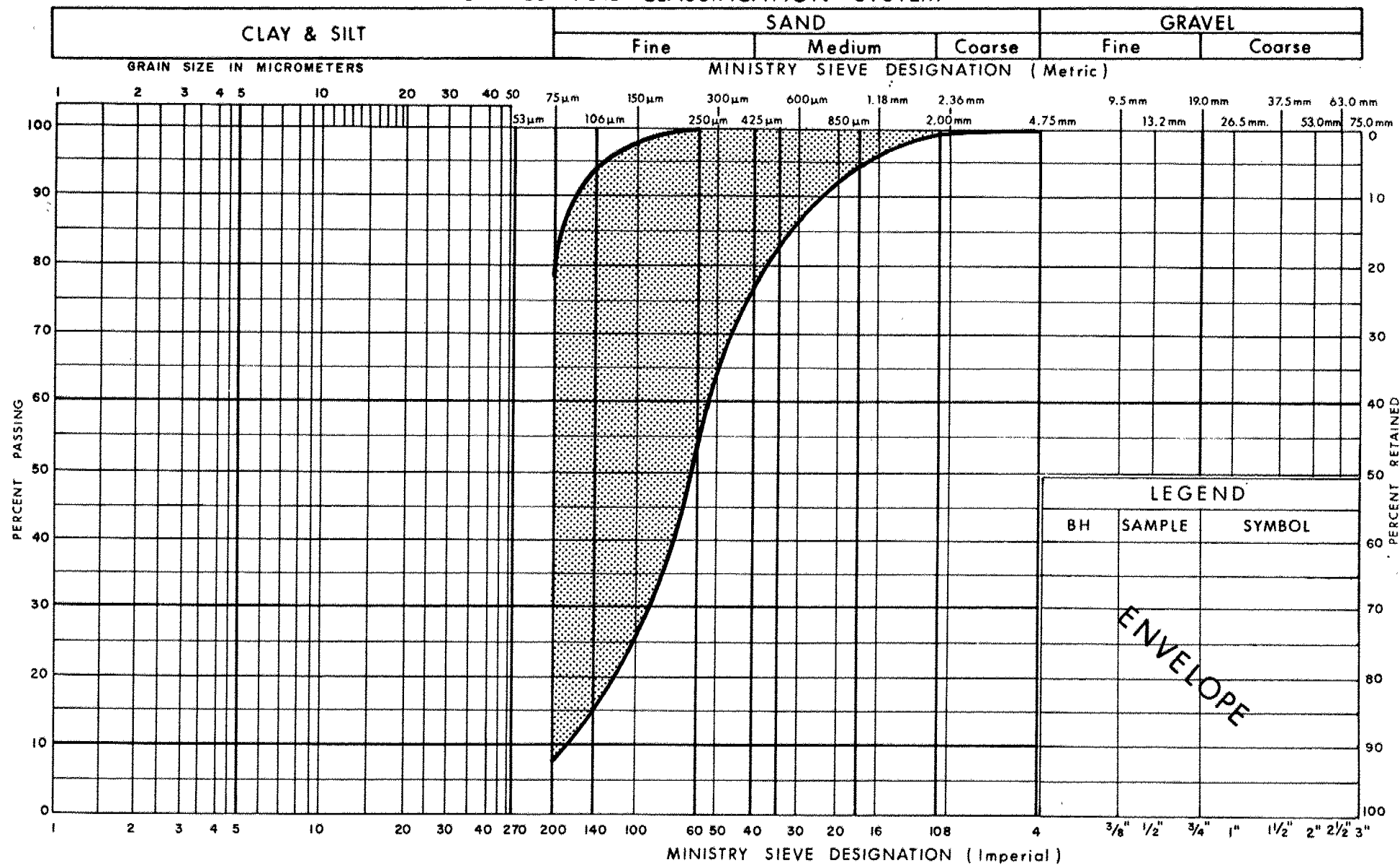


*M. Vasavithasan*  
M. Vasavithasan, P.Eng.  
Foundation Engineer

*M. Devata*  
M. Devata, P.Eng.  
Chief Foundation Engineer

## APPENDIX

## UNIFIED SOIL CLASSIFICATION SYSTEM



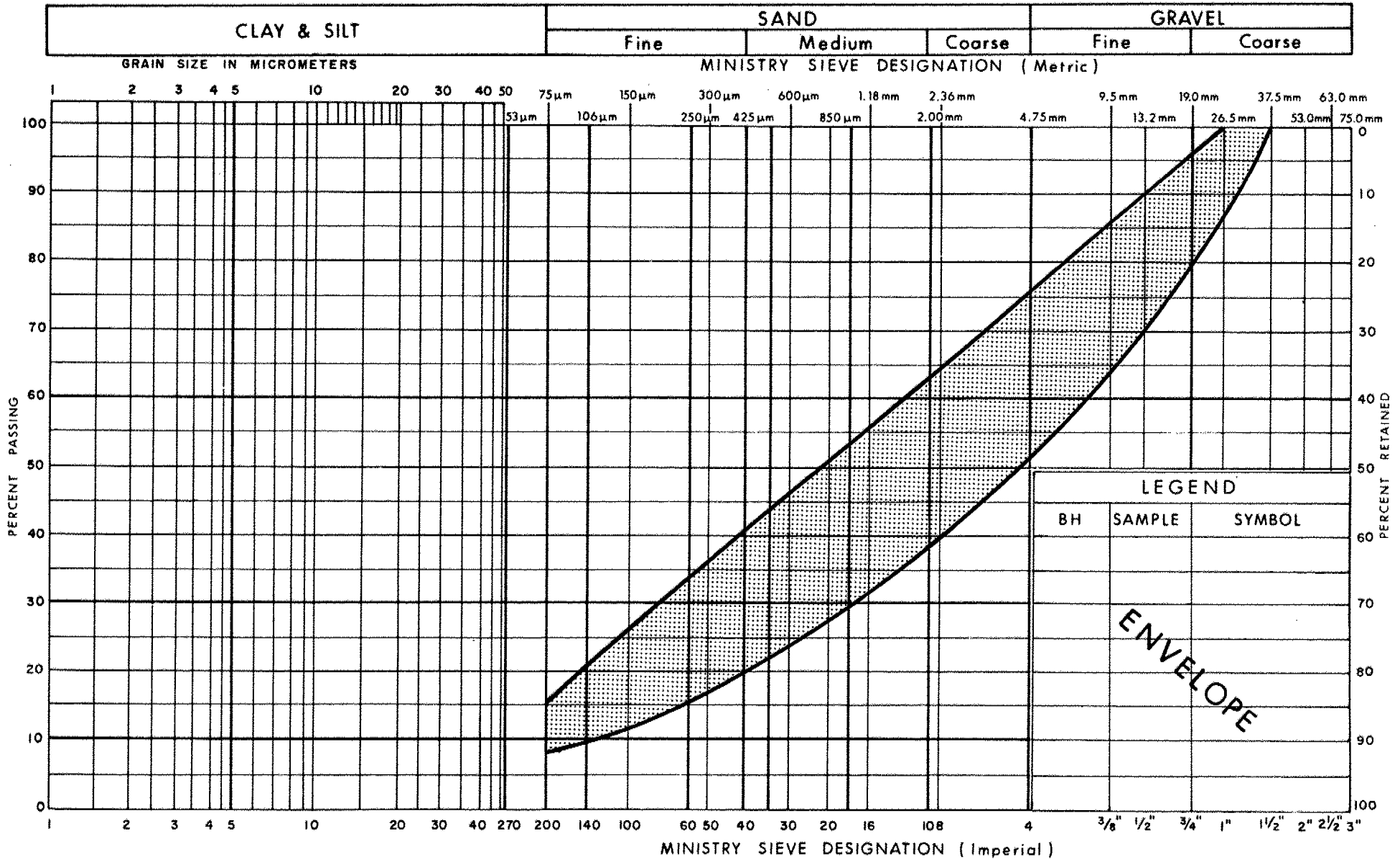
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GRAIN SIZE DISTRIBUTION  
SILTY SAND TO SANDY SILT

FIG No 1

W P 162-88-01

# UNIFIED SOIL CLASSIFICATION SYSTEM

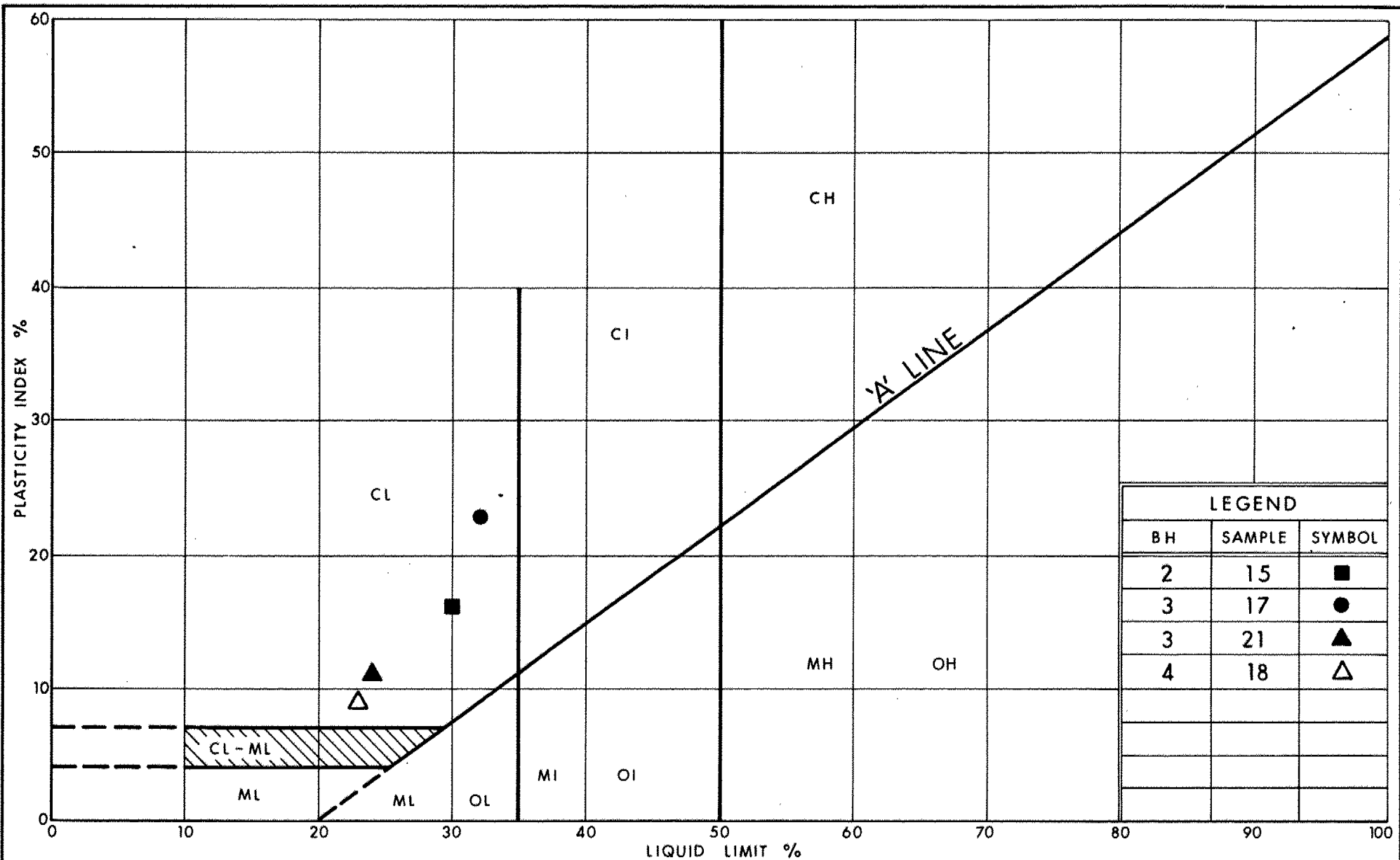


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GRAIN SIZE DISTRIBUTION  
SAND & GRAVEL, SOME SILT

FIG No 2

W P 162 - 88 - 01



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## PLASTICITY CHART CLAYEY SILT

FIG No 3

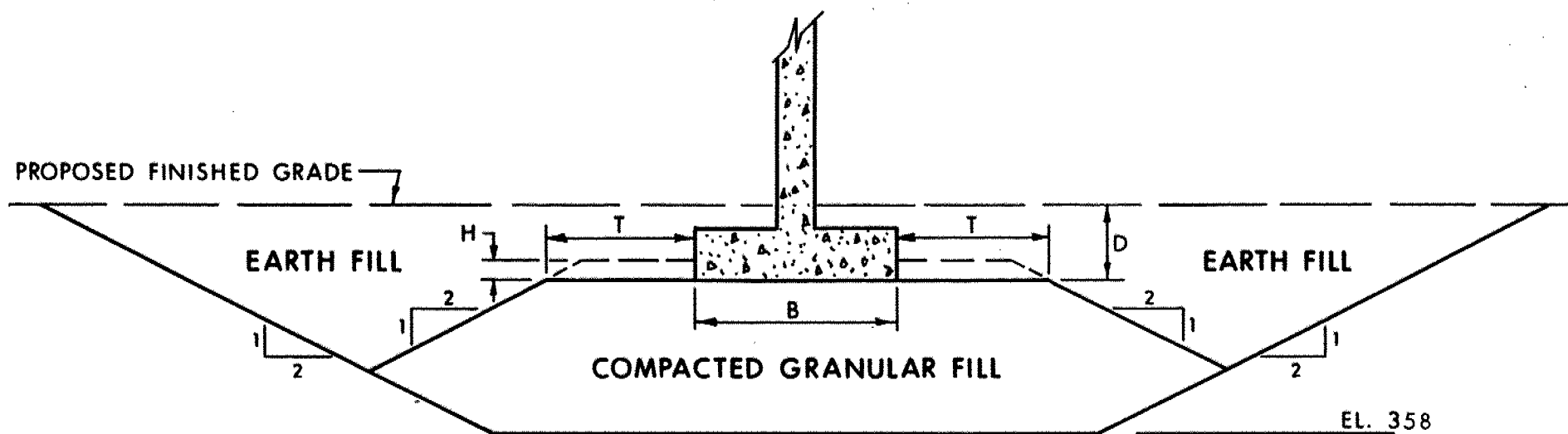
W P 162-88-01



GRAIN SIZE DISTRIBUTION  
SILTY SAND, TRACE OF GRAVEL

W P 162-88-01





#### NOTES:

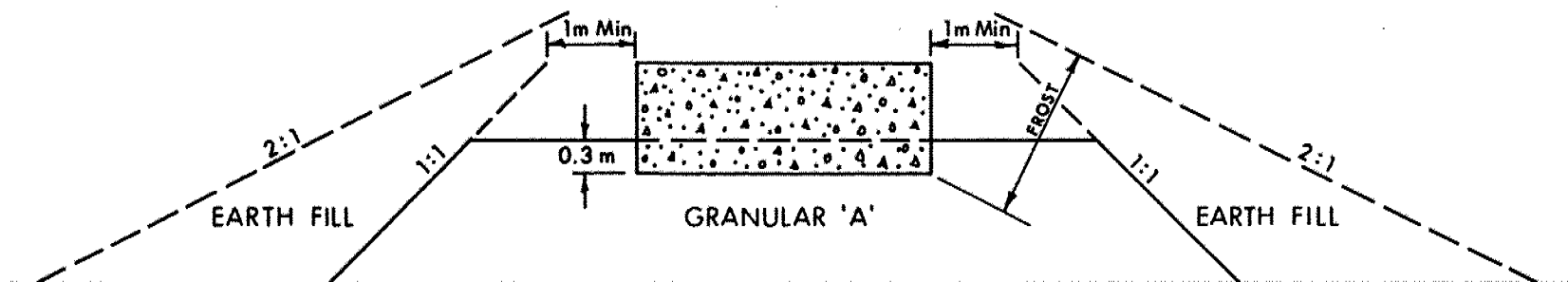
- 1) SUB-EXCAVATE UP TO EL. 358 UNDER AREA OF COMPACTED GRANULAR FILL.
- 2) PLACE GRANULAR FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT MTO STANDARDS.
- 3) CONSTRUCT CONCRETE FOOTING.
- 4) PLACE REMAINDER OF EARTH FILL.

#### LEGEND:

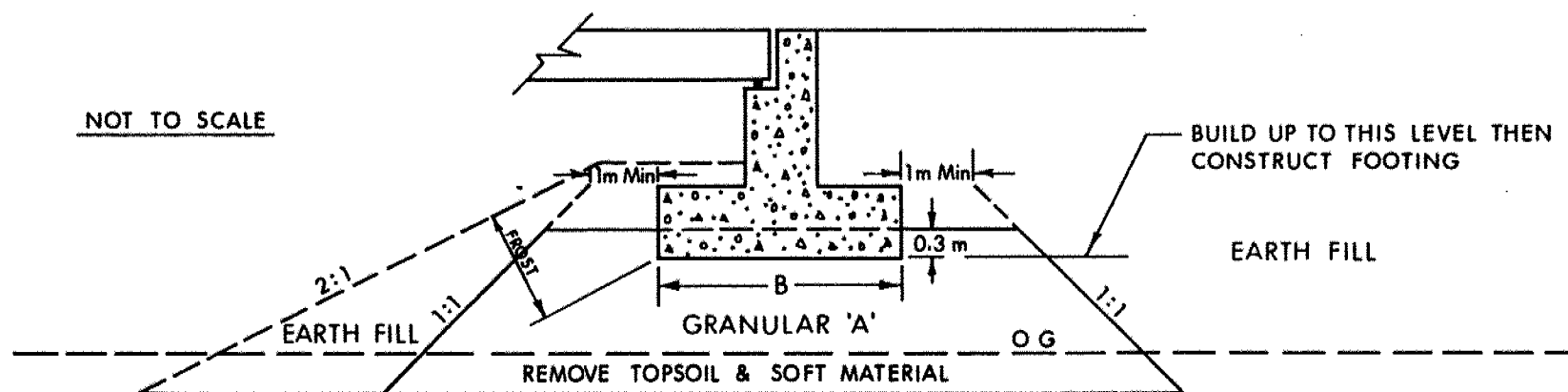
- H = 0.3m
- T = 3.0m Minimum
- D = 1.5m Minimum
- B = Footing Width

FIG No 5  
WP 162 - 88 - 01

PIER ON COMPACTED GRANULAR FILL



X SECTION



LONGITUDINAL SECTION

NOTES:

- 1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.
- 2 - PLACE GRANULAR 'A' & EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M T O STANDARDS.
- 3 - CONSTRUCT CONCRETE FOOTING.
- 4 - PLACE REMAINDER OF GRANULAR 'A' & EARTH FILL AS REQUIRED.



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ABUTMENT ON COMPACTED FILL  
SHOWING GRANULAR 'A' CORE

FIG No 6

W P 162 - 88 - 01

## 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

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

### STRESS AND STRAIN

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

### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	$\text{kg}/\text{m}^3$	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	$\text{KN}/\text{m}^3$	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\rho_w$	$\text{kg}/\text{m}^3$	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	$\text{KN}/\text{m}^3$	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
$\rho$	$\text{kg}/\text{m}^3$	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	$\text{KN}/\text{m}^3$	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	$\text{kg}/\text{m}^3$	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	q	$\text{m}^3/\text{s}$	RATE OF DISCHARGE
$\gamma_d$	$\text{KN}/\text{m}^3$	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
$\rho_{sat}$	$\text{kg}/\text{m}^3$	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{sat}$	$\text{KN}/\text{m}^3$	UNIT WEIGHT OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	$\text{kg}/\text{m}^3$	DENSITY OF SUBMERGED SOIL	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE	j	$\text{KN}/\text{m}^2$	SEEPAGE FORCE
$\gamma'$	$\text{KN}/\text{m}^3$	UNIT WEIGHT OF SUBMERGED SOIL						

# RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 162 - 88 - 01 LOCATION CO - ORDS. N 4 806 703.8; E 212 489.5 ORIGINATED BY M V  
DIST 3 HWY 7 & 8 BOREHOLE TYPE CONE TEST & CONTINUOUS FLIGHT AUGER ( H.S ) COMPILED BY M V  
DATUM GEODETIC DATE 90 12 04 CHECKED BY P P

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
363.9	Ground Surface													
0.0	Organics		1	SS	25									
			2	SS	7									
			3	SS	3									
	Compact to Very Loose		4	SS	17									
	Sand & Gravel, Some Silt		5	SS	41									
			6	SS	60									
			7	SS	38									
			8	SS	42									
			9	SS	42									
	SILTY SAND to SANDY SILT		10	SS	52									
	Dense to Very Dense		11	SS	60									
			12	SS	60									
348.2			13	SS	54									
15.7	End of Borehole													

# RECORD OF BOREHOLE No 2 1 OF 2 METRIC

W.P. 162 - 88 - 01 LOCATION CO - -ORDS. N 4 806 689.3; E 212 496.1 ORIGINATED BY M.V.  
 DIST 3 HWY HWY. 7 & 8 BOREHOLE TYPE CONE TEST, CONTINUOUS FLIGHT AUGER & B.W. CASING COMPILED BY M.V.  
 DATUM GEODETIC DATE 90 12 04 TO 90 12 07 CHECKED BY P.P.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT 7 kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40						60	80
363.1	Ground Surface															
0.0	Organics															
	Loose		1	SS	5											
	Sand & Gravel, Some Silt		2	SS	17											39 46 (15)
			3	SS	10											
			4	SS	17											0 86 (14)
			5	SS	15											
	Compact		6	SS	17											0 87 (13)
			7	SS	22											
			8	SS	20											
			9	SS	32											
			10	SS	60											0 84 (16)
			11	SS	48											
			12	SS	42											
	SILTY SAND to SANDY SILT, With Occasional Silt Seams, Dense to Very Dense		13	SS	58											0 22 (78)
			14	SS	49											
344.6			15	SS	53											
18.5	CLAYEY SILT Very Stiff to Hard															
341.0			16	SS	26											
22.1			17	SS	-											
	SILTY SAND, Trace of Gravel, Dense to Very Dense															
			18	SS	31											
332.6																

Continued

+3, x5; Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10

Continued

# RECORD OF BOREHOLE No 2 2 OF 2 METRIC

W.P. 162 - 88 - 01 LOCATION CO - -ORDS. N 4 806 689.3; E 212 496.1 ORIGINATED BY M.V.  
 DIST 3 HWY HWY. 7 & 8 BOREHOLE TYPE CONE TEST, CONTINUOUS FLIGHT AUGER & B.W. CASING COMPILED BY M.V.  
 DATUM GEODETIC DATE 90 12 04 TO 90 12 07 CHECKED BY P.P.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100	20 40 60 80 100	W <sub>P</sub> W W <sub>L</sub>	10 20 30		
332.6 30.5	Continued		19	SS	104								
			20	SS	37								
			21	SS	78								
323.0			22	SS	57								
40.1	End of Borehole												

# RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 162 - 88 - 01 LOCATION CO - ORDS. N 4 806 661.8; E 212 521.3 ORIGINATED BY M. V&M P

DIST 3 HWY HWY. 7 & 8 BOREHOLE TYPE CONE TEST & CONTINUOUS FLIGHT AUGER (H.S.) COMPILED BY M V

DATUM GEODETIC DATE 90 12 13 CHECKED BY P P

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa						
364.1	Ground Surface							20 40 60 80 100	10 20 30					
0.0	Organics		1	SS	26									
	SILTY SAND, Some Gravel, Compact to Dense		2	SS	28									
361.4			3	SS	34									
2.7			4	SS	15									
	SILTY SAND to SANDY SILT, Compact		5	SS	15									0 91 (9)
			6	SS	18									
358.2			7	SS	21									
5.9			8	SS	54									
	SAND and GRAVEL, Some Silt, Dense		9	SS	49									33 58 (9)
355.9			10	SS	44									
8.2			11	SS	22									
			12	SS	26									
			13	SS	31									
			14	SS	40									0 29 (71)
	SILTY SAND to SANDY SILT, Compact to Very Dense		15	SS	77									
			16	SS	74									
346.0			17	SS	37									
18.1			18	SS	40									
	CLAYEY SILT, Very Stiff to Hard		19	SS	34									
			20	SS	18									
			21	SS	115									
338.1														
337.7	SILTY SAND, Tr. Gravel, Very Dense		22	SS	73									
26.4	End of Borehole													

# RECORD OF BOREHOLE No 4 1 OF 2 METRIC

W.P. 162 - 88 - 01 LOCATION CO - ORDS. N 4 806 634.8; E 212 542.3 ORIGINATED BY M.V.  
 DIST 3 HWY HWY. 7 & 8 BOREHOLE TYPE CONE TEST, CONTINUOUS FLIGHT AUGER & B.W. CASING COMPILED BY M.V.  
 DATUM GEODETIC DATE 90 12 10 TO 90 12 12 CHECKED BY P.P.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
363.5	Ground Surface													
0.0	Organics													
	SILTY SAND to SANDY SILT, Compact		1	SS	15									
			2	SS	10									
			3	SS	14									
			4	SS	15									
			5	SS	19									
			6	SS	23									
357.5			7	SS	27									
6.0			8	SS	34									
	SAND and GRAVEL, Same Silt, Dense to Very Dense		9	SS	33									
			10	SS	42									
			11	SS	144									0 39 (61)
352.3			12	SS	29									
11.2			13	SS	41									
	SILTY SAND to SANDY SILT, Dense to Very Dense		14	SS	44									
			15	SS	55									
			16	SS	47									
343.8			17	SS	17									
19.7	CLAYEY SILT, With Occasional Sand Seams, Very Stiff to Hard		18	SS	34									
338.4			19	SS	—									
25.1	SILTY SAND, Trace of Gravel, Very Dense													
333.0														

30.5 Continued

+3, x5, Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10

Continued



# RECORD OF BOREHOLE No 4 2 OF 2 METRIC

W.P. 162 - 88 - 01 LOCATION CO - ORDS. N 4 806 634.8; E 212 542.3 ORIGINATED BY M.V.  
 DIST 3 HWY HWY. 7 & 8 BOREHOLE TYPE CONE TEST, CONTINUOUS FLIGHT AUGER & B.W. CASING COMPILED BY M.V.  
 DATUM GEODETIC DATE 90 12 10 TO 90 12 12 CHECKED BY P.P.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT 7 kn/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa									
								20 40 60 80 100									
333.0	Continued		20	SS	63											1 83 (16)	
30.5	SILTY SAND, Trace of Gravel, Very Dense	•••••															
							332										
							330										
328.0		•••••	21	SS	74												
35.5	End of Borehole																

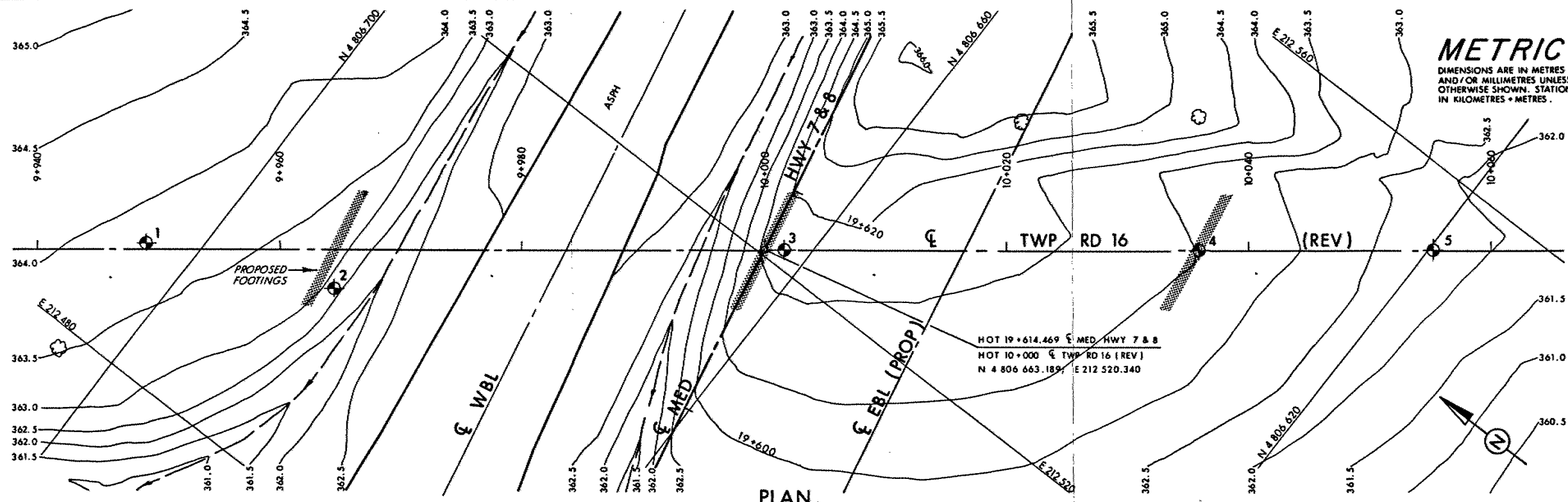
# RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 162 - 88 - 01 LOCATION CO - ORDS. N 4 806 619.6; E 212 554.1 ORIGINATED BY M.V.  
 DIST 3 HWY HWY. 7 & 8 BOREHOLE TYPE CONE TEST & CONTINUOUS FLIGHT AUGER ( H.S ) COMPILED BY M.V.  
 DATUM GEODETIC DATE 90 12 10 CHECKED BY P.P.

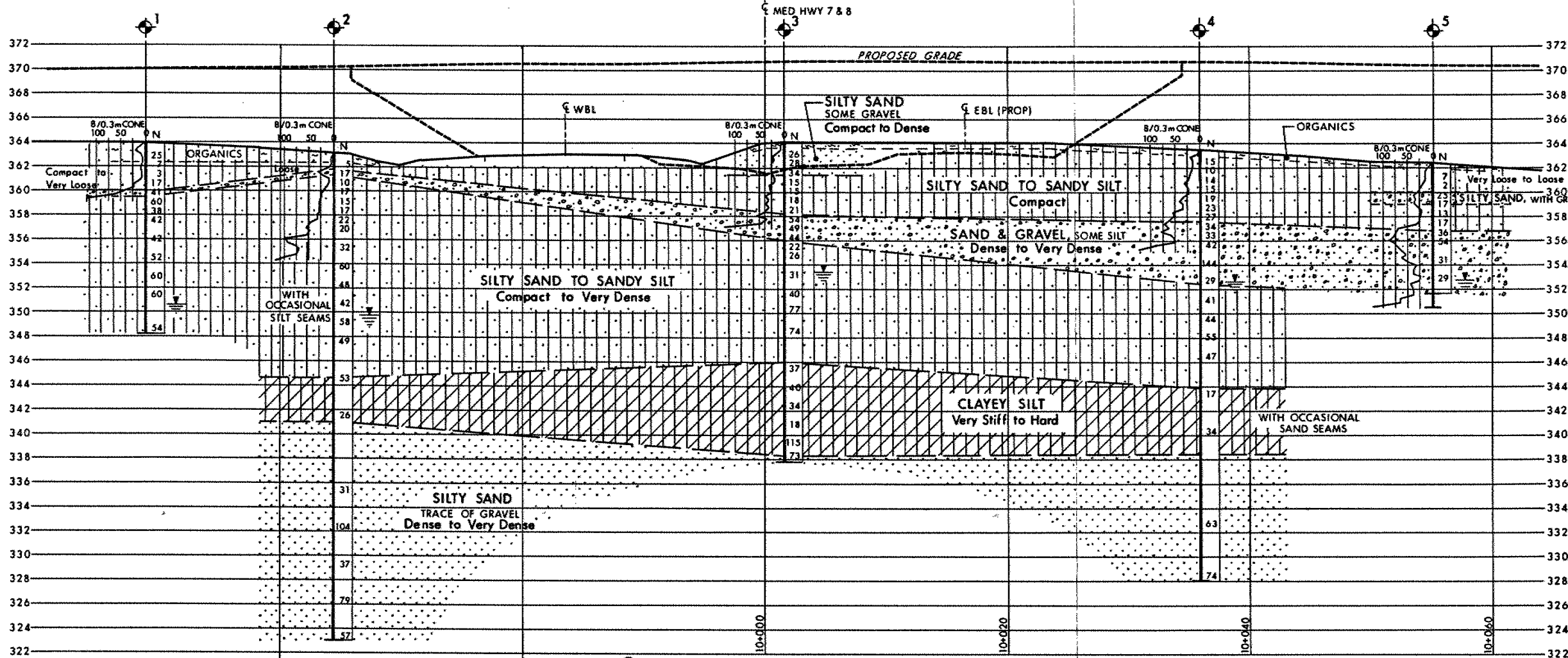
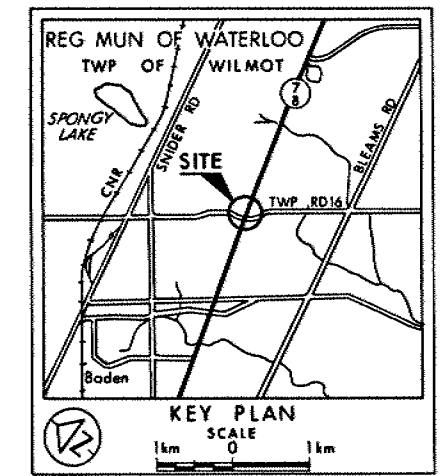
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH kPa					
362.4	Ground Surface												
0.0	Organics												
	Very Loose to Loose		1	SS	7								
			2	SS	2								
	Silty Sand, With Gravel		3	SS	25								
			4	SS	17								
	SILTY SAND to SANDY SILT, Compact		5	SS	13								
			6	SS	17								
356.8			7	SS	36								
5.6			8	SS	54								
	SAND and GRAVEL, Some Silt, Dense to Very Dense		9	SS	31								
			10	SS	29								
351.7													
10.7	End of Borehole												
350.5													
11.9	End of Cone Test												



**CONT No**  
WP No 162-88-01

**TWP ROAD 16 UNDERPASS**

**BORE HOLE LOCATIONS & SOIL STRATA**



**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 12

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	363.9	4 806 703.8	212 489.5
2	363.1	4 806 689.3	212 496.1
3	364.1	4 806 661.9	212 521.3
4	363.5	4 806 634.8	212 542.3
5	362.4	4 806 619.6	212 554.1

**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.

DATE	BY	DESCRIPTION

Geocres No 40P7-49

HWY No 7 & 8	CHECKED <input checked="" type="checkbox"/>	DATE 1991 02 18	DIST 3
SUBMD MV	CHECKED <input checked="" type="checkbox"/>	APPROVED	SITE 33-360
DRAWN RS	CHECKED <input checked="" type="checkbox"/>	APPROVED	DWG 1628801-A