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GEOCRES No. 30M15-65

DIST. 7 REGION

W.P. No. 36-82-02

CONT. No. 83-67

W. O. No.

STR. SITE No. 21-437

HWY. No. 35/115

LOCATION Lovekin Property Connection  
Underpass

No. of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



**Ministry of  
Transportation and  
Communications**

*Ben Stanley  
623-1897  
Contract 82-03*

**FILE No.** \_\_\_\_\_ **DATE** \_\_\_\_\_

**REMARKS** \_\_\_\_\_  
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Ministry of  
Transportation and  
Communications

# foundation investigation and design report

**ENGINEERING MATERIALS OFFICE  
PAVEMENT & FOUNDATION DESIGN SECTION**

WP 36-82-02

DIST 7

HWY 35/115

STR SITE 21-437

Clarke Township Road Underpass

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# FOUNDATION INVESTIGATION REPORT

For

W.P. 36-82-02, Site 21-437

Clarke Township Road Underpass

Hwy. 35/115, District 7, Port Hope

## INTRODUCTION:

This report contains the results of a foundation investigation carried out at the above mentioned site for a proposed structure. Initial fieldwork was carried out between 82 07 08 and 82 07 09, with additional work performed on 82 09 28. The fieldwork consisted of advancing five sampled boreholes to depths ranging from 9.0 to 12.0 metres. In addition, two dynamic cone penetration tests were also carried out during the investigation in the vicinity of two of the five boreholes.

## SITE DESCRIPTION AND GEOLOGY

The site is located on Hwy. 35/115, some 700 metres south of Hwy. 2, west of the Town of Newcastle in the Regional Municipality of Durham.

The site is located in the physiographic region known as the Iroquois Plain, which is a mosaic of till plains, drumlins, and areas of silty lacustrine deposits.

Topography across the site is gently undulating, with land use primarily agricultural.

## SUBSURFACE CONDITIONS

Generally competent subsurface conditions were encountered across the site. The surficial deposit, beneath approximately 1.6 metres of roadway fill (sand with silt and gravel), is composed of a very dense sandy silt with traces of gravel and clay, and varies in thickness from 2.9 to 4.7 metres. This stratum is underlain by a slightly cohesive hard glacial till comprised of a heterogeneous mixture of silty clay, sand, and gravel. The till material was penetrated to a maximum thickness of 7.7 metres at which point borings were terminated.

Reference should be made to the Record of Borehole Sheets contained in the Appendix of this report. These sheets contain the description and

extent of the soil types encountered, and in summarized form, field and laboratory test results. The stratigraphical profile shown on Drawing No. 368202-A is based on this information and shows the location and elevation of the borings.

A detailed description of the various strata are given below:

#### Fill Material

Encountered in four sampled boreholes was an approximate 1.6 metre thick layer of fine sand with silt and gravel. Cobble-size fragments were also found towards the bottom of this fill material.

This roadway fill had been placed during the original construction of Hwy. 35/115, and upon completion of initial borings, additional Granular 'A' fill was placed for the roadway base during the double-laning of Hwy. 35/115 under Contract 82-03.

Visual observations of augering operations indicated the fill material had undergone a moderate degree of compaction.

#### Sandy Silt, Trace of Gravel and Clay

Immediately below the fill material in a stratum consisting of sandy silt with traces of gravel and clay. Overall, the deposit ranged in thickness from 2.9 to 4.7 metres.

Typical grain size distribution curves for the deposit are shown in envelope form on Figure 1.

Results of Atterberg Limits and water content testing indicates the deposit exhibits very slight plasticity (SM-ML). Based on augering operations and Standard Penetration Test 'N' values, which were generally in excess of 100 blows per 0.3 metres, the deposit is assessed as being very dense throughout.

#### Silty Clay, Sand, and Gravel (Glacial Till)

Immediately underlying the sandy silt stratum is a slightly cohesive

glacial till that was explored to a maximum depth of 12.4 metres below ground surface. The till consists of a heterogeneous mixture of silty clay, sand and gravel.

Typical grain size distribution curves for this deposit appear in Figure 2. Although the grain size distribution curves are very similar to those of the overlying sandy silt deposit, visual identification indicates the deposit to be glacially derived with slight plasticity.

Atterberg Limit tests indicate the matrix of the till deposit to range from an inorganic sandy silt of very slight plasticity to an inorganic silty clay and sand of slight to low plasticity (ML to CL-ML).

Based on an interpretation of 'N' values and augering operations, the consistency of the till deposit is assessed as being very stiff to hard, but predominantly hard throughout, with 'N' values in excess of 100 blows per 0.3 metres below elevation 94.0.

#### Groundwater Conditions

An overnight stabilized water level reading taken in one open borehole was found at elevation 102.1. This approximately corresponds to the observed highway ditch water level.

## DISCUSSION AND RECOMMENDATIONS

In order to provide private access to properties on both the east and west sides of Hwy. 35/115, a two span 30 x 46 metre underpass is proposed to carry the Clarke Township Rd. over Hwy. 35/115 at elevation 110.0.

A proposed township road profile grade of 110.0 and existing Hwy. 35/115 pavement elevation of 103.0 will necessitate fills in the order of 7.0 metres.

In consideration of the competent subsoil conditions across the site, recommendations pertaining to the foundation of the new structure and related earthworks are summarized below.

### Spread Footings on Compacted Granular 'A' Core

Foundations for perched abutments can be founded on spread footings located on a well compacted Granular 'A' core within the approach embankment as per MTC standard. Spread footings on a Granular 'A' core can be designed to a factored capacity at the U.L.S. of 750 kPa, and an allowable capacity at the S.L.S. Type II of 300 kPa.

All fill material placed under Contract 82-03 for the double laning of Hwy. 35/115 should be removed within the plan limits of the core to a minimum depth corresponding to elevation 102.0 prior to placement of Granular 'A'.

### Spread Footings on Original Ground

The centre pier, and alternatively full height abutment foundations, can be founded on spread footings located within the very dense sandy silt deposit. For pier and abutment foundations founded at or below elevation 102.0, the following O.H.B.D.C. parameters can be used for design purposes:

Factored Capacity at U.L.S.	850 kPa
Allowable Capacity at S.L.S. Type II	400 kPa



In consideration of the highly permeable surficial sandy silt deposit, a dewatering scheme will be necessary to carry excavations below the prevailing water level. This can be achieved by advancing perimeter ditches and pumping from corner sumps prior to excavation operations.

Earth pressure against the abutment wall should be computed as per Subsection 6.6.1.2.2 of the O.H.B.D.C. Manual.

Resistance to sliding of the abutment footings can be calculated assuming a co-efficient of friction of 0.7 between the underside of the concrete footing and the Granular 'A' core or the sandy silt founding stratum.

The underside of all footing elements should be provided with a minimum 1.3 metres of earth cover for frost protection purposes.

No stability problems are anticipated for permanent embankment slopes constructed to a 2:1 geometry.

#### MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Mr. R. Zammit, Student Field Technician, and Mr. K. Chak, Trainee Engineer, utilizing equipment owned and operated by Atcost Soil Investigations, Toronto. This report was written by Mr. K. Chak under the direction of Mr. T. J. Kazmierowski, Foundation Engineer, and reviewed by Mr. M. Devata, Senior Foundation Engineer.



*Kennel D. Chak*

K. D. Chak  
Trainee Engineer

*M. Devata*

M. Devata, P. Eng.  
Senior Foundations Engineer

## APPENDIX



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# RECORD OF BOREHOLE No 1

METRIC

W P 36-82-02 LOCATION Co-ords. N 4 863 179.8; E 375 417.2 ORIGINATED BY RZ  
DIST 7 HWY 35/115 BOREHOLE TYPE Hollow Stem Augers and Cone Test COMPILED BY RZ  
DATUM Geodetic DATE 82 07 08 CHECKED BY RS

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					
103.0	Fill Surface													GR SA SI CL
0.0	Brown Fill		1	SS	28		102							
101.5	Sand with Silt & Gravel, Compact		2	SS	100/	25 cm								8 42 43 7
1.5	Sandy Silt		3	SS	100/	10 cm								7 34 49 10
	Trace of Gravel & Clay		4	SS	100/	25 cm	100							
98.4	Very Dense		5	SS	100/	25 cm								4 35 51 10
4.6	(Glacial Till)		6	SS	100		98							4 46 43 7
	Het. Mixture of Silty Clay, Sand and Gravel		7	SS	22		96							
	Grey		8	SS	31		94							
	Very Stiff to Hard		9	SS	100/	28 cm	92							6 43 44 7
			10	SS	100/	23 cm								
90.7			11	SS	100/	13 cm								
12.3	End of Borehole													















+3, x5: Numbers refer to Sensitivity

20  
15  
10  
5  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 2

METRIC

W P 36-82-02 LOCATION Co-ords. N 4 863 207.0, E 375 400.4 ORIGINATED BY RZ  
 DIST 7 HWY 35/115 BOREHOLE TYPE Hollow Stem Augers COMPILED BY RZ  
 DATUM Geodetic DATE 82 07 09 CHECKED BY RZ


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			SHEAR STRENGTH			WATER CONTENT (%)				
								○ UNCONFINED	+ FIELD VANE						
								● QUICK TRIAXIAL	x LAB VANE						
103.0	Fill Surface													GR SA SI CL	
0.0	Brown Fill Sand With Silt & Gravel					*	102								
101.3	Compact														
1.7	Sandy Silt		1	SS	100										
	Brown		2	SS	100/	23 cm	100							5 21 72 2	
	Trace of		3	SS	100/	28 cm								9 44 37 10	
	Grey		4	SS	100/	28 cm									
	Gravel & Clay		5	SS	100/	23 cm	98							5 40 45 10	
97.8	Very Dense														
5.2	(Glacial Till)		6	SS	33									4 39 49 8	
	Het. Mixture of		7	SS	43		96								
	Silty Clay, Sand and Gravel		8	SS	100/	20 cm	94								
	Grey		9	SS	100/	23 cm	92							8 40 34 18	
	Hard		10	SS	100/	25 cm									
90.6	End of Borehole														
12.4	<u>Note:</u> Water Level not established														

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 3

METRIC

W P 36-82-02 LOCATION Co-ords. N 4 863 193.0; E 375 409.9 ORIGINATED BY KC  
 DIST 7 HWY 35/115 BOREHOLE TYPE Hollow Stem Augers COMPILED BY KC  
 DATUM Geodetic DATE 82 09 28 CHECKED BY RS

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			20	40	60	80	100					
103.5	Pavement Surface																
0.0	Brown Fill					*											
	Sand with Silt and Gravel		1	SS	100/	20 cm	102										
102.0	Very Dense		2	SS	100/	15 cm											
1.5	Grey-Brown Sandy Silt		3	SS	100												
	Trace of Gravel and Clay		4	SS	100/	25 cm	100										
98.9	Very Dense																
4.6	(Glacial Till)		5	SS	98		98										
	Het. Mixture of Silty Clay, Sand and Gravel		6	SS	45												
	Grey		7	SS	65		96										
93.9	Hard		8	SS	100/	27 cm	94										
9.6	End of Borehole																
	* Note: Water Level not Established																

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 4

METRIC

W P 36-82-02 LOCATION Co-ords. N 4 863 187.1; E 375 427.8 ORIGINATED BY KC  
DIST 7 HWY 35/115 BOREHOLE TYPE Solid Stem Augers and Cone Test COMPILED BY KC  
DATUM Geodetic DATE 82 09 28 CHECKED BY RS

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 * LAB VANE	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									
102.3	Ditch Surface													
0.0	Grey Sandy Silt Trace of Gravel and Clay		1	SS	100/	8 cm	102							
	Very Dense						100							
99.2			2	SS	100/	10 cm								
3.1	(Glacial Till)						98							
	Het. Mixture of		3	SS	100/	15 cm								
	Silty Clay, Sand and Gravel		4	SS	52		96							
	Grey						94							
	Hard		5	SS	100/	15 cm								
92.7														
9.6	End of Borehole													
	* Note: Water Level not Established													

OFFICE REPORT ON SOIL EXPLORATION



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# RECORD OF BOREHOLE No 5

METRIC

W P 36-82-02 LOCATION Co-ords. N 4 863 200.0; E 375 412.6 ORIGINATED BY KC  
DIST 7 HWY 35/115 BOREHOLE TYPE Solid and Hollow Stem Augers COMPILED BY KC  
DATUM Geodetic DATE 82 09 28 CHECKED BY RS

SOIL PROFILE		STRAT PLOT	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		NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
103.5	Pavement Surface																
0.0	Brown Fill					*											
102.1	Sand with Silt & Gravel Very Dense																
1.4	Grey-Brown Sandy Silt		1	SS	100/	25 cm	102										
	Trace of Gravel and Clay		2	SS	100		100										
	Very Dense		3	SS	100/	8 cm	98										
97.4	(Glacial Till) Het. Mixture of Silty Clay, Sand and Gravel Grey		4	SS	63		96										
			5	SS	35												
94.4	Hard		6	SS	50/	5 cm											
9.2	End of Borehole  * Note: Water Level not Established																

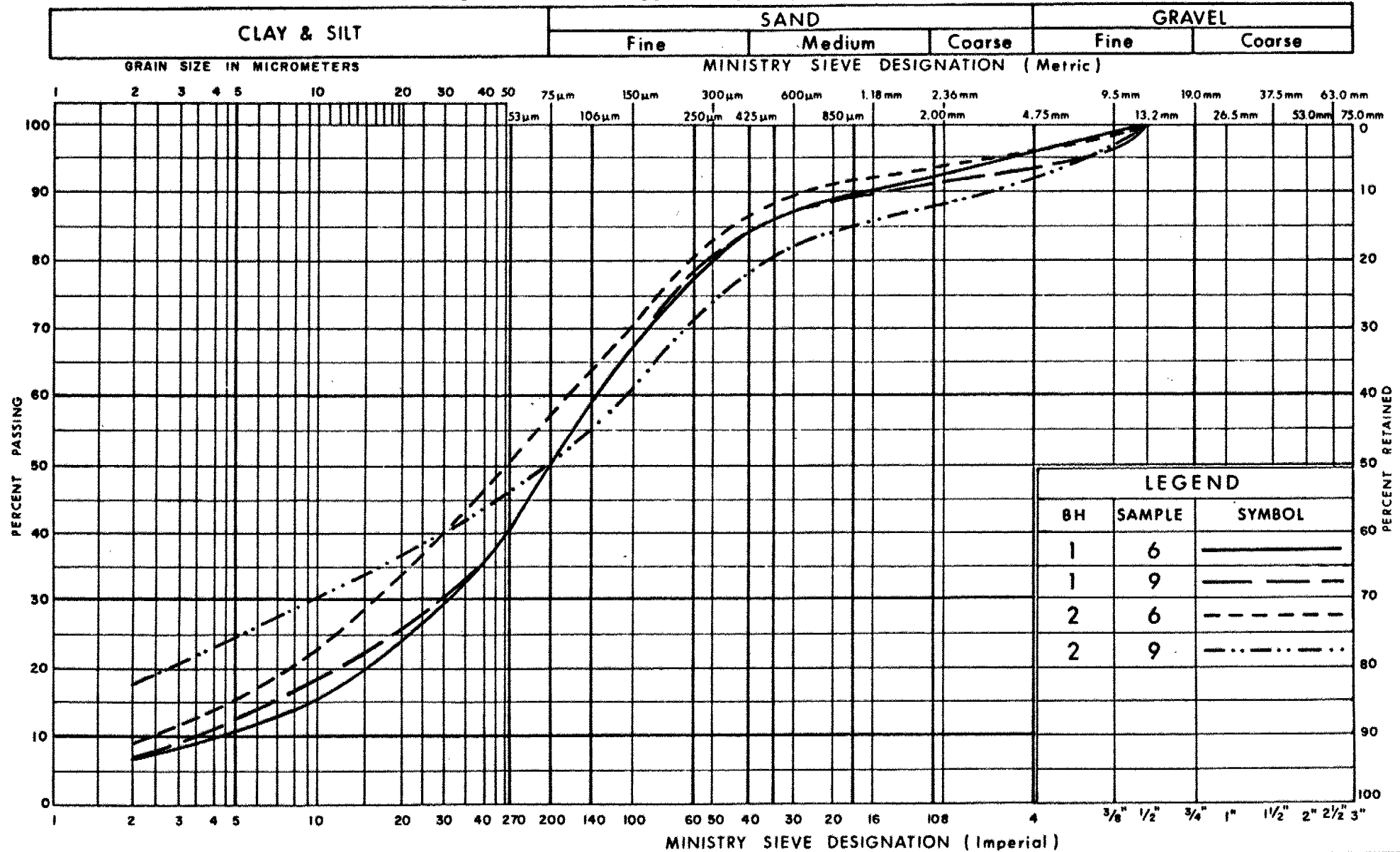
+3, x5: Numbers refer to Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE





## UNIFIED SOIL CLASSIFICATION SYSTEM



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**GRAIN SIZE DISTRIBUTION**  
**HET MIXTURE OF SILTY CLAY, SAND & GRAVEL**  
 ( GLACIAL TILL )

FIG No 2

W P 36-82-02

## EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

**JOINTING AND BEDDING:**

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

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

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

### 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
$\sigma'_{v0}$	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
$S_f$	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

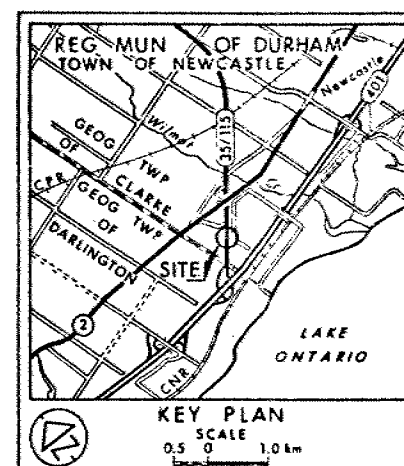
$\rho_s$	$\text{kg}/\text{m}^3$	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{\min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{\max} - e}{e_{\max} - e_{\min}}$
$\rho_w$	$\text{kg}/\text{m}^3$	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
$\rho_{\text{sat}}$	$\text{kg}/\text{m}^3$	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{\text{sat}}$	$\text{kN}/\text{m}^3$	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						

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

CONT No  
WP No 36-82-02

CLARKE TWP RD U'PASS  
(LOVEKIN PROPERTY)  
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)
- WL at time of investigation 82 07 & 09
- WL Not Established for Bore Holes 2, 3, 4 and 5.

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	103.0	4 863 179.8	375 417.2
2	103.0	4 863 207.0	375 400.4
3	103.5	4 863 193.0	375 409.9
4	102.3	4 863 187.1	375 427.8
5	103.5	4 863 200.0	375 412.6

**NOTE**

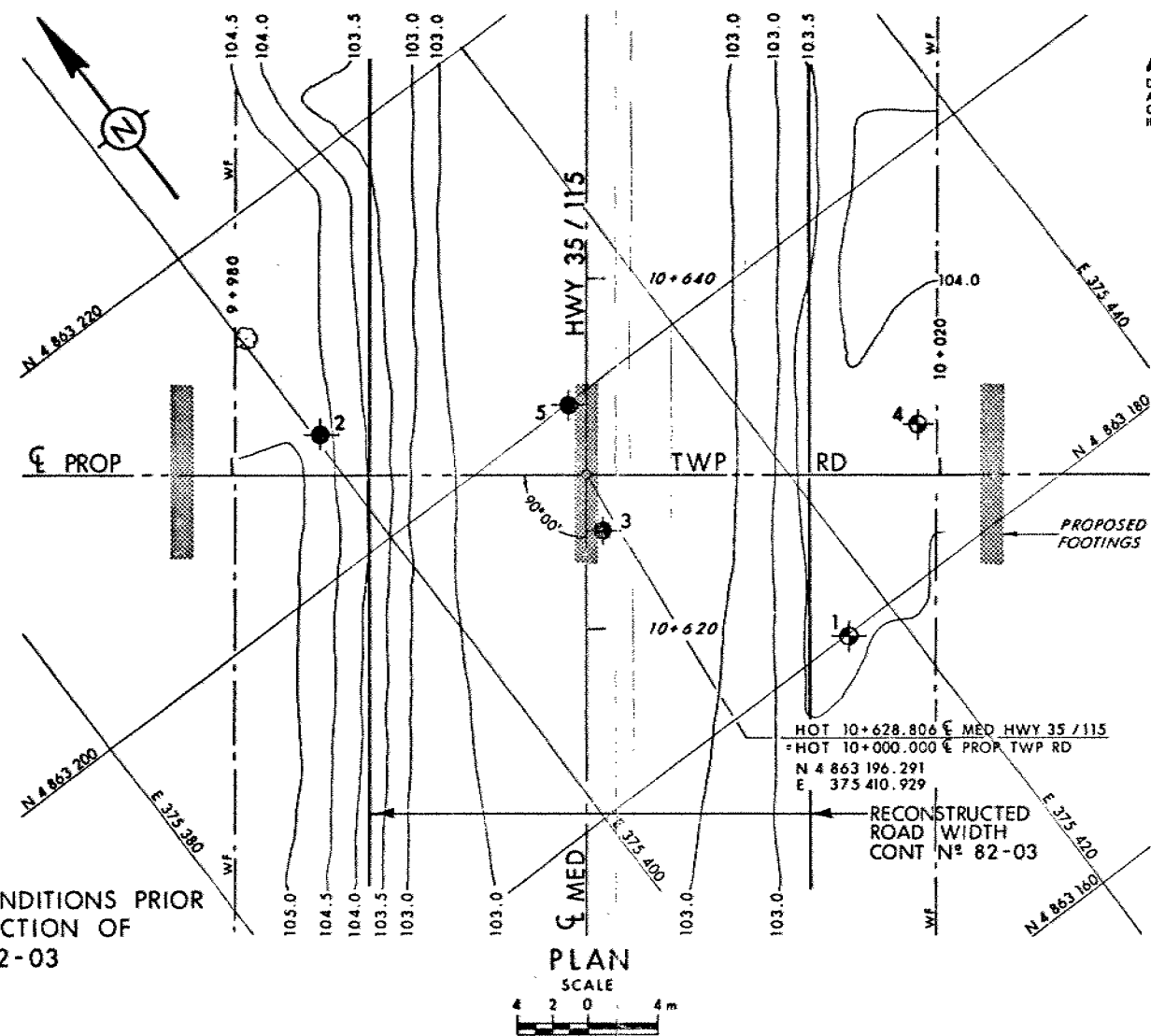
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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.

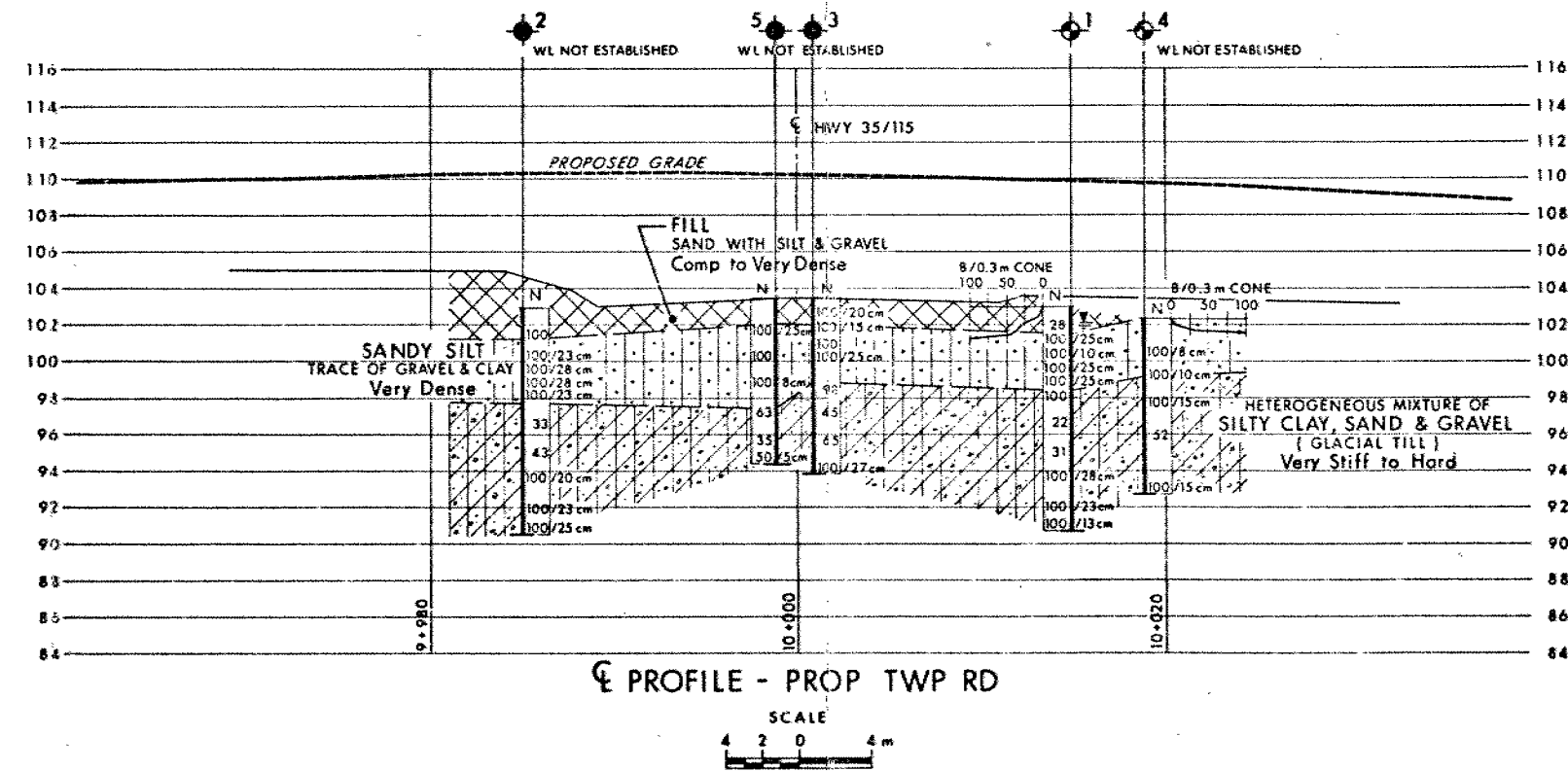
REV	DATE	BY	DESCRIPTION
-----	------	----	-------------

Geocres No 30M15-65			
HWY No 35/115			DIST 7
SUBM D.T.J.K. CHECKED	DATE 1982 10 19		SITE 21-437
DRAWN R.S. CHECKED	APPROVED		DWG 368202-A

REF No E-6016-1, 1982 05



NOTE: GROUND CONDITIONS PRIOR TO CONSTRUCTION OF CONT N° 82-03



Geocres No 30M15-65			
HWY No 35/115			DIST 7
SUBM D.T.J.K. CHECKED	DATE 1982 10 19		SITE 21-437
DRAWN R.S. CHECKED	APPROVED		DWG 368202-A

DISTRICT No 7  
CONT No  
WP No 36-82-02

HIGHWAY 35/115 UNDERPASS  
BETWEEN HWY 2 & HWY 401  
GENERAL ARRANGEMENT

KILBORN

METRIC

DIMENSIONS ARE IN MILLIMETRES  
UNLESS OTHERWISE SHOWN.  
ELEVATIONS, COORDINATES, CURVE  
AND ALIGNMENT DATA ARE IN METRES.  
STATIONS ARE IN KILOMETRES + METRES.

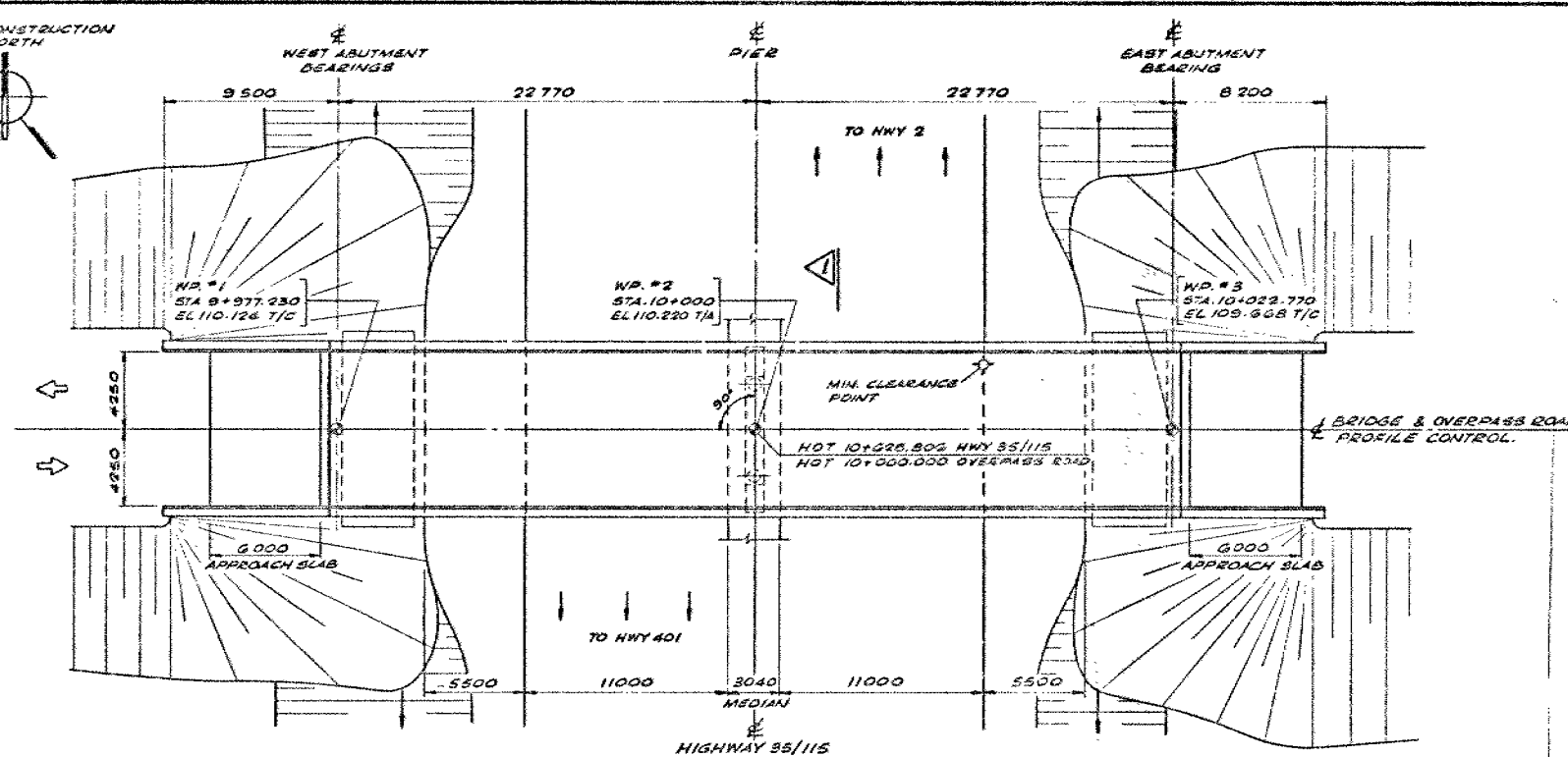


GENERAL NOTES:

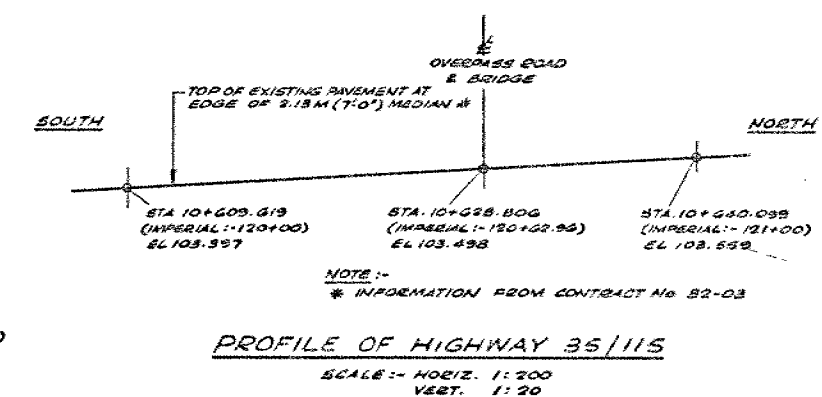
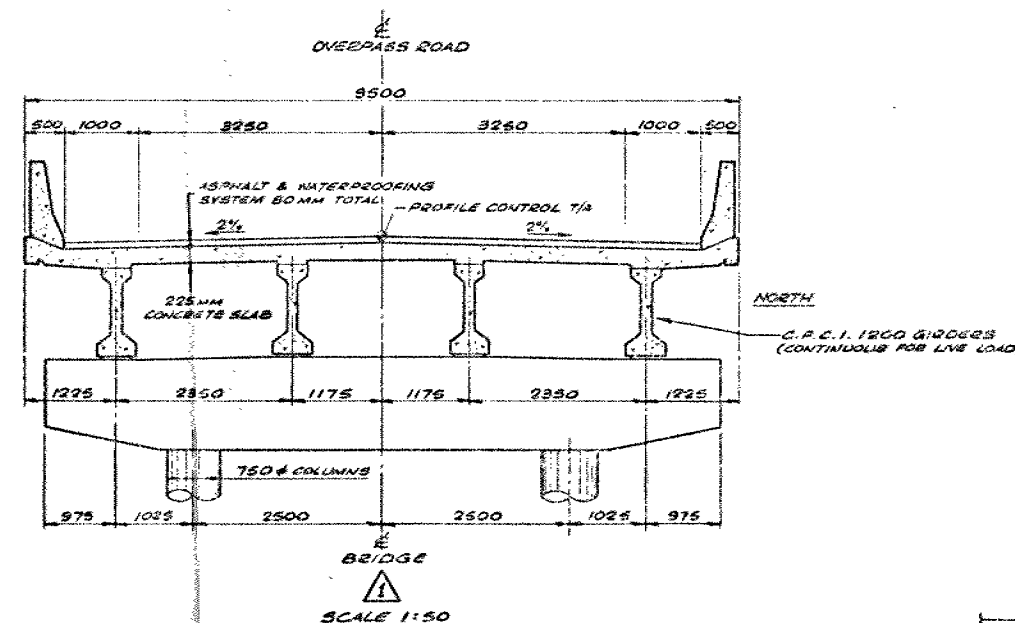
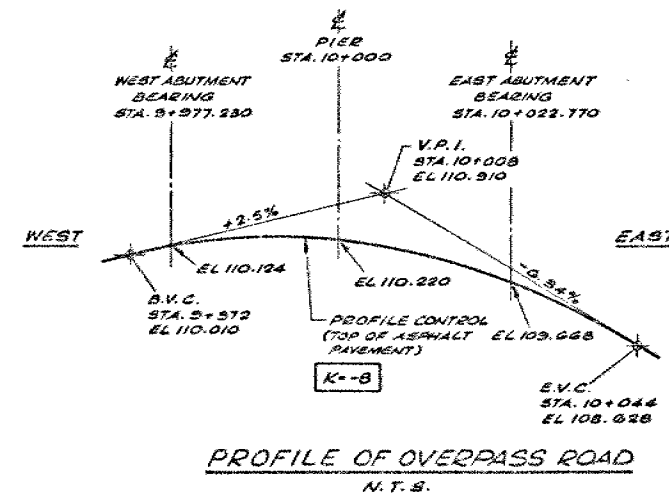
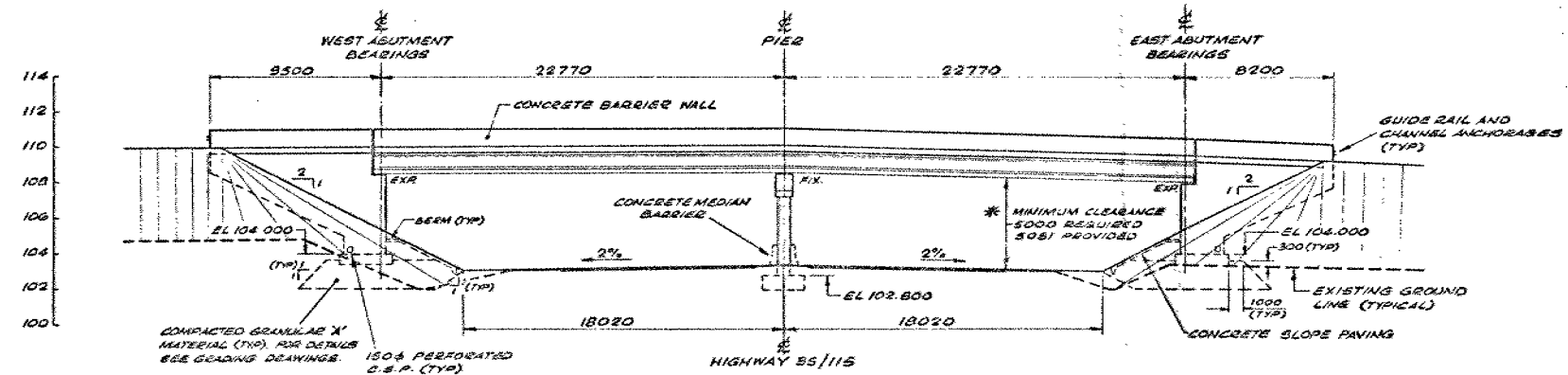
- CLASS OF CONCRETE:
  - PRESTRESSED GIRDERS - 35 MPa
  - DECK, DIAPHRAGMS, PIER, ABUTMENTS AND BARRIER WALLS - 30 MPa
  - APPROACH SLABS, FOOTINGS AND REMAINDER - 20 MPa
- CLEAR COVER TO REINFORCING STEEL:
  - FOOTINGS, 100MM ± 25MM
  - PIER, ABUTMENTS AND WINGWALLS FRONT SURFACES 80MM ± 20MM
  - ABUTMENTS AND WINGWALLS BACK SURFACES 70MM ± 20MM
  - DECK, TOP 70MM ± 20MM AND BOTTOM 40MM ± 10MM
  - BARRIER WALLS AND APPROACH SLABS 70MM ± 20MM
  - REMAINDER 70MM ± 20MM UNLESS OTHERWISE NOTED.
- REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED.  
BARS MARKED WITH THE SUFFIX 'C' SHALL BE COATED BARS.
- CONSTRUCTION NOTES:
  - THE CONTRACTOR SHALL FINISH THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS TO A TOLERANCE OF ± 3MM
- CONCRETE QUANTITIES:
  - CONCRETE QUANTITIES LISTED BELOW ARE FOR THE APPROPRIATE LUMP SUM TENDER ITEMS.
  - CONCRETE IN PIER, ABUTMENTS AND WINGWALLS - 142 M<sup>3</sup>
  - CONCRETE IN DECK AND DIAPHRAGMS - 117 M<sup>3</sup>
  - CONCRETE IN BARRIER WALLS - 33 M<sup>3</sup>
  - CONCRETE IN APPROACH SLABS - 26 M<sup>3</sup>
  - CONCRETE IN SLOPE PAVING - 16 M<sup>3</sup>

LIST OF DRAWINGS:

- 21-437-1 GENERAL ARRANGEMENT  
2 BOREHOLE LOCATIONS AND SOIL STRATA  
3 FOOTINGS  
4 WEST ABUTMENT  
5 EAST ABUTMENT  
6 WINGWALL DETAILS  
7 PIER AND BEARING DETAILS  
8 DECK LAYOUT AND SCALED ELEVATIONS  
9 PRESTRESSED GIRDERS  
10 DECK AND DIAPHRAGM DETAILS  
11 BARRIER WALLS  
12 6000MM APPROACH SLABS  
13 DETAILS OF CONCRETE SLOPE PAVING  
14 STANDARD DETAILS  
15 BRIDGE DATA & SITE NUMBER DATA  
16 AS CONSTRUCTED ELEVATIONS & DIMENSIONS



NOTE:- W.P. DENOTES WORKING POINT  
T/A DENOTES TOP OF ASPHALT  
T/C DENOTES TOP OF CONCRETE  
& MINIMUM VERTICAL & HORIZONTAL  
CLEARANCE AS PER DO 4502



DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN 4/8	CHECK 4/8	LOADING 4/8	DATE OCT 82
DRAWING 2/0	CHECK 4/8	1 SITE 21-437	1206



SHEET

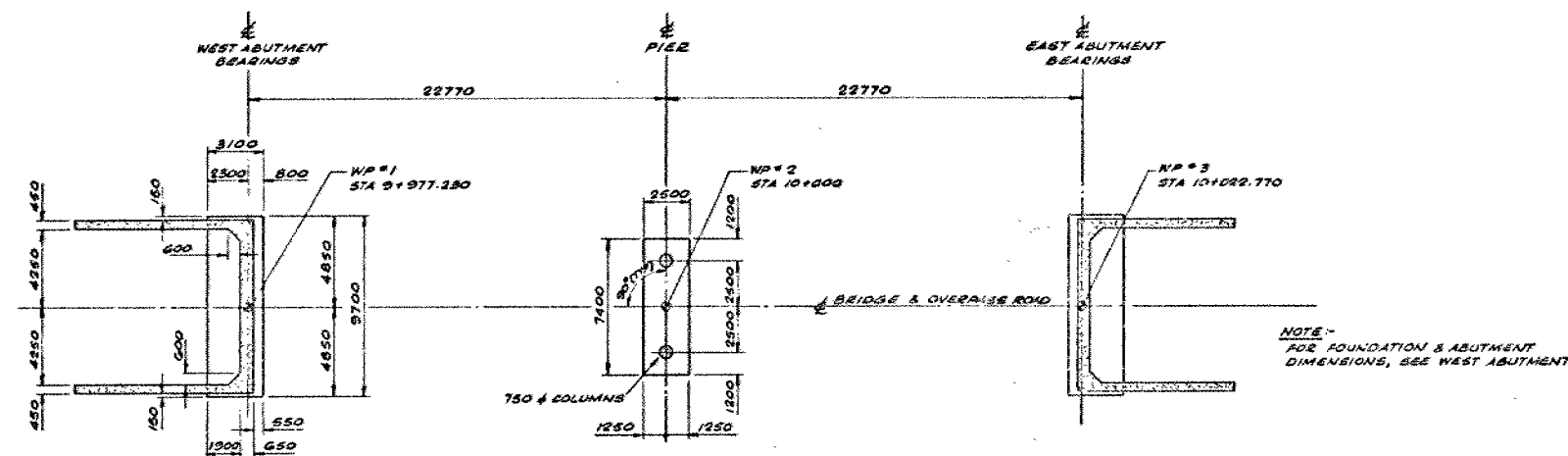


DIMENSIONS ARE IN MILLIMETRES  
UNLESS OTHERWISE SHOWN.  
ELEVATIONS, COORDINATES, CURVE  
AND ALIGNMENT DATA ARE IN METRES.  
STATIONS ARE IN KILOMETRES + METRES

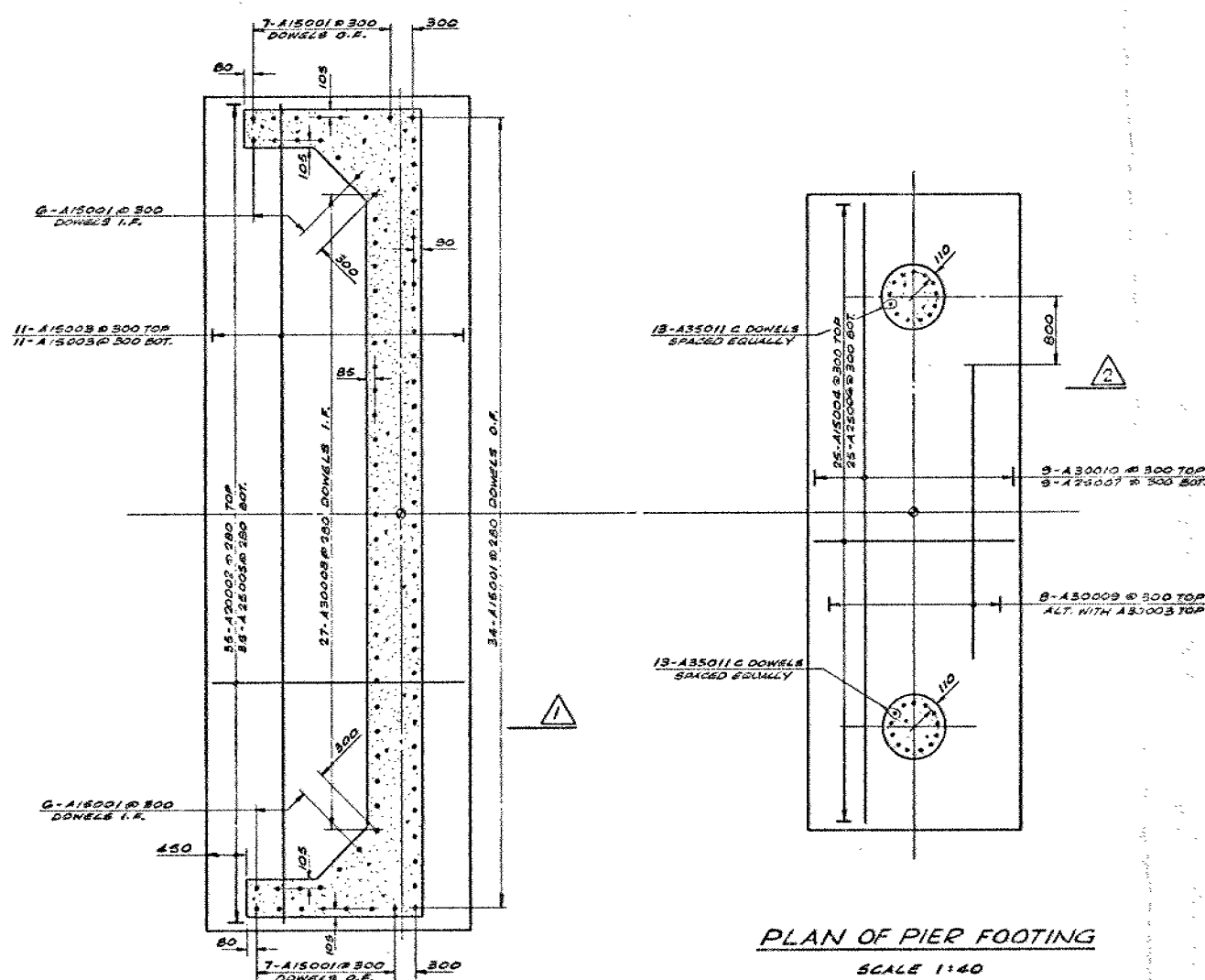
1. E.A.F - DENOTES EACH FACE  
I.F. - DENOTES INSIDE FACE  
O.F. - DENOTES OUTSIDE FACE

2. UNLESS OTHERWISE NOTED MINIMUM LAP LENGTHS FOR REINFORCING BARS ARE AS FOLLOWS:-

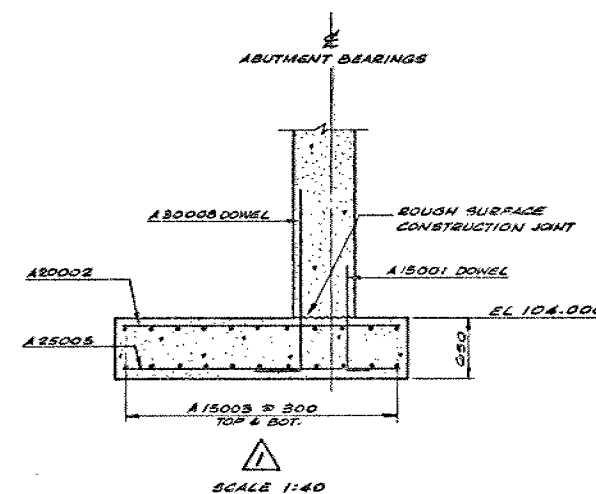
15M	= 510 MM
20M	= 620 MM
25M	= 850 MM
30M	= 1350 MM



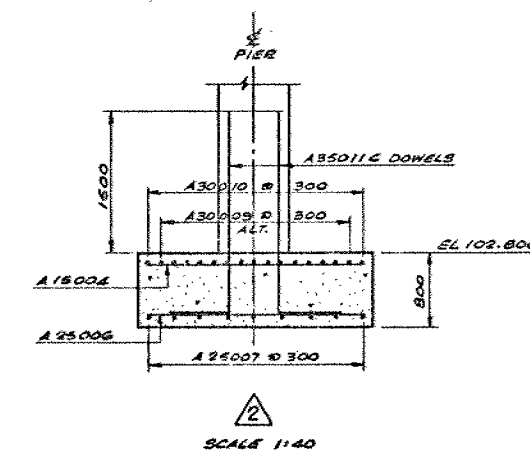
NOTE:-  
FOR FOUNDATION & ABUTMENT  
DIMENSIONS, SEE WEST ABUTMENT



PLAN OF PIER FOOTING  
SCALE 1:40



SCALE 1:40



SCALE 1:40

PLAN OF WEST ABUTMENT FOOTING  
PLAN OF EAST ABUTMENT FOOTING (OPPOSITE HAND)  
SCALE 1:40

DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

REVISIONS				
	DATE	BY	DESCRIPTION	
1	DESIGN A-B	CHECK V-K-B	LOADING CHB ROOM 79	DATE DEC
	DRAWING RCD	CHECK A-B	SITE 21-257	DWG 3

# memorandum




To: Mr. M. Holowka  
Design Engineer (Eastern)  
Structural Office  
3501 Dufferin St., 4th Floor

Date: 83 02 22

From: Pavement & Foundation Design Section  
Room 315, Central Bldg.  
Downsview

Re: Highway 35/115 Underpass  
W.P. 36-82-02, Site 21-437  
Hwy. 35/115, District 7

We have reviewed the final design drawings for the above-mentioned site and note that a special provision for dewatering will be required for pier excavations below the prevailing water table.

A handwritten signature in cursive script, appearing to read "K.D. Chak".

K.D. Chak  
Trainee Engineer

For: M. Devata, P. Eng.  
Senior Foundations Engineer

KDC:syc

# memorandum



To: Mr. M. Holowka  
Design Engineer  
Design Section  
Structural Office  
3501 Dufferin St., 4th Floor

Date: 82 12 08

From: Pavement & Foundation Design Section  
Room 315, Central Bldg.  
Downsview

Re: Clarke Township Road Underpass  
W.P. 36-82-02, Site 21-437  
Hwy. 35/115, District 7

We have reviewed the general arrangement drawing 21-437-P1 for the above-mentioned site and have no additional comments, other than those in our Foundation Report, at the present time.

  
Tom Kazmierowski, P. Eng.  
Foundations Engineer

TK:syc

# memorandum



To: Mr. G. Burkhardt  
Head, Structural Section  
Central Region

Date: 82 09 15

From: Pavement & Foundation Design Section  
Room 315, Central Bldg.  
Downsview

Re: Clarke Township Rd. Underpass  
(formerly Lovekin property access)  
W.P. 36-82-02, Site 21-437  
Hwy. 35/115, District 7

This memo will summarize the results of a foundation investigation program carried out for the original single span geometry scheme at the above-mentioned location and provides preliminary design recommendations for the revised two span structure based on this data.

The fieldwork was carried out between 82 07 08 and 82 07 09 and consisted of advancing two sampled boreholes, one accompanied by a dynamic cone penetration test, for depths of approximately 12.0 m each.

## SUBSURFACE CONDITIONS

In general competent subsurface conditions were encountered across the site. The surficial deposit, beneath approximately 1.6 metres of moderately compacted fine sand fill material, is composed of a very dense sandy silt whose thickness varies from 3.1 to 3.5 metres. The stratum is underlain by a slightly cohesive hard glacial till containing silty clay with an excess of sand. The till material was penetrated for a maximum thickness of 7.7 metres at which point borings were terminated.

An overnight stabilized water level reading taken in one open borehole was found at an elevation 102.1. This approximately corresponds to the observed highway ditch water levels at the time of investigation.

## DISCUSSION AND RECOMMENDATIONS

In consideration of the competent subsoil conditions across the site, recommendations pertaining to the foundations of the new structure and related earthworks are summarized below.

Foundations for perched abutments can be founded on spread footings located on a well compacted Granular "A" core within the approaches

. . . . . 2



as per current M.T.C. Standards. Spread footings on a Granular "A" pad can be designed to a factored capacity at the U.L.S. of 750 kPa and an allowable capacity at the S.L.S. Type II of 300 kPa.

All fill material, placed under Contract 82-03 for the double laning of Highway 35/115, should be removed within the plan limits of the core to a minimum depth corresponding to elevation 101.0 prior to placement of Granular "A".

Pier, and alternatively abutment, foundations can be founded on spread footings located within the very dense sandy silt deposit. For pier and abutment footings founded at or below elevation 101.0, the following O.H.B.D.C. parameters can be used for design purposes:

Factored Capacity at U.L.S.	850 kPa
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Allowable Capacity at S.L.S. Type II	400 kPa
--------------------------------------	---------

In consideration of the highly permeable surficial sandy silt deposit, an unwatering scheme will be necessary to carry excavations below the prevailing water level. This can be achieved by advancing perimeter ditches and pumping from corner sumps, prior to excavation operations.

Earth pressure against the abutment wall should be computed as per Subsection 6.6.1.2.2. of the O.H.B.D.C. Manual.

Resistance to sliding of the abutment footings can be calculated assuming a co-efficient of friction of 0.7 between the underside of the concrete footing and the Granular "A" core or the sandy silt founding stratum.

The underside of all footing elements should be provided with a minimum 1.3 metres of earth cover for frost protection purposes.

No stability problems are anticipated for permanent embankment slopes constructed to a 2:1 geometry.



Tom Kazmierowski, P. Eng.  
Foundations Engineer

TK:cr