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DIST. 6 REGION

W.P. No. 124-92-00

CONT. No. 95-36

W. O. No.

STR. SITE No.

HWY. No. 401

LOCATION Hwy 401 / Dixon Rd.

M.M.L.

No of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FOUNDATION INVESTIGATION REPORT

CONTRACT NO. 95-36



Ontario

**Ministry of
Transportation**

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Note: For purposes of the contract, this report supersedes all other Foundation Reports prepared by, or for the Ministry in connection with the above mentioned project.

EXPLANATION OF TERMS USED IN REPORT

2

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	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 ³	SEEPAGE FORCE
γ'	kN/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

FOUNDATION INVESTIGATION REPORT

For

High Mast Lighting

Hwy. 401/Dixon Road Interchange

W.P. 124-92-00

Hwy. 401, District 6, Toronto

INTRODUCTION

This report presents soil information for the proposed high mast lights at the above mentioned sites. Soil information was obtained from previous subsurface investigations in the area (Geocres 30M11-62, W.P. 251-61) and supplemented by drilling 9 new boreholes (BH 1 through BH 9). This report is produced at the request of Central Region Structural Section.

SITE DESCRIPTION

The high mast lighting poles will be located at and near Hwy 401 and Dixon Road interchange. The area is situated in the City of Etobicoke in the Region of Metro Toronto.

The site lies within the physiographic region known as the South Slope (after Chapman and Putnam, 1984) and it consists largely of glacial deposits.

INVESTIGATION PROCEDURES

The fieldwork for the supplementary investigation was carried out between 94 10 18 and 94 10 20 and consisted of 9 sampled boreholes (BH 1 through BH 9) advanced to depths ranging from 7.8m to 11.1m below ground surface.

The boreholes were advanced using a CME 55 track-mounted auger machine equipped with solid stem augers.

Sampling was carried out at each borehole location by means of a 50mm O.D. split spoon sampler driven into the soil according to the specifications of the Standard Penetration Test (ASTM D 1586).

Groundwater levels were obtained by monitoring the levels in the open boreholes throughout the duration of the field investigation. All boreholes were backfilled at the completion of the fieldwork.

SUBSURFACE CONDITIONS

General

The soil generally consists of glacial till deposits as the native soil. However, at most of the locations (BH 1 through BH 6) the glacial till is overlain by fill material which is 1.4m to 6.9m thick. The native soil generally consists of clayey silt with layers of silt, sandy silt and silty sand. The glacial deposits occasionally contain cobbles and boulders. The subsurface conditions at HML locations may be inferred from the closest borehole.

The locations of the boreholes are shown on the attached drawings DWG 1249200-A.

Groundwater Conditions

In the previous and recent studies, groundwater was encountered in almost all boreholes. Groundwater table elevation ranged from 153.2m (BH 4) to 162.0 (BH 12). The groundwater depth below ground surface ranged from 1.5m (BH 10) to 7.4m (BH 4). However, in some boreholes groundwater didn't establish shortly after their completion. For groundwater information at each HML locations reference is made to the attached borehole logs.

MISCELLANEOUS

The soil information for this project was obtained from previous Foundation Investigation in this area (Geocres 30M11-62, W.P. 251-61) and supplemented by drilling 9 new boreholes (BH 1 through BH 9). The fieldwork for the supplementary investigation was carried out under the supervision of K.S.Q. Ahmad, using equipment owned and operated by Canadian Soil Drilling. This report was prepared by K.S.Q. Ahmad, Foundation Engineer, reviewed and approved by D. Dundas, Senior Foundation Engineer.



D. Dundas
D. Dundas, P. Eng.
Senior Foundation Engineer

APPENDIX

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 124-92-00 LOCATION coords.: N 4 838 405.0, E 298 945.0 ORIGINATED BY KA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1994 10 20 CHECKED BY KA

[illegible]

+3, x5; Numbers refer to Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coords.: N 4 838 495.0, E 298 984.0 ORIGINATED BY KA

DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA

DATUM Geodetic DATE 1994 10 20 CHECKED BY KA

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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
160.7	Ground Surface																
0.0																	
	Silty Clay to Clayey Silt with Sand Stiff to V. Stiff (Fill)		1	SS	8												
			2	SS	8												
			3	SS	16												
			4	SS	12												
			5	SS	8												
	Sand		6	SS	0												
155.2																	
5.5			7	SS	16												
	Clayey Silt Grey, moist V. Stiff to Hard (Glacial Till)		8	SS	32												
151.1			9	SS	32												
9.6	End of Borehole																

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coords.: N 4 838 790.0, E 299 209.0 ORIGINATED BY KA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1994 10 20 CHECKED BY KA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100		
166.1	Ground Surface												
0.0													
	Clayey Silt Some Sand Trace of Roots, Trace of Brick Fragments Stiff to V. Stiff (Fill)		1	SS	25	165							
			2	SS	21	164							
			3	SS	12	163							
			4	SS	25	162							
161.7			5	SS	28	161							
4.4			6	SS	50	160							
	Clayey Silt Trace of Gravel Brown to Grey Hard (Glacial Till)		7	SS	89	159							
			8	SS	36	158							
156.5			9	SS	34	157							
9.6	End of Borehole												

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coords.: N 4 838 897.0, E 299 315.0 ORIGINATED BY KA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1994 10 19 CHECKED BY KA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100		
160.6	Ground Surface												
0.0	Clayey Silt Brown, Firm (Fill)		1	SS	5								
159.2			2	SS	27								
1.4			3	SS	58								
	Clayey Silt with Silt Zones Brown to Grey, Moist V. Stiff to Hard (Glacial Till)		4	SS	45								
			5	SS	78								
			6	SS	42								
			7	SS	35	/10cm							
154.7			8	SS	50	/10cm							
5.9			9	SS	59								
	Sandy Silt to Gravelly Sand Wet, V. Dense (Glacial Till)		10	SS	59								
151.0													
9.6	End of Borehole												

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coords.: N 4 838 986.0, E 299 203.0 ORIGINATED BY KA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1994 10 19 CHECKED BY KA

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 kN/m ³	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						
166.2	Ground Surface																
0.0																	
	Clayey Silt with Sand Some Gravel Firm to Stiff (Fill)		1	SS	14												
			2	SS	9												
			3	SS	7												
			4	SS	8												
161.0			5	SS	10												
5.2	Clayey Silt Brown to Grey Trace of Gravel V. Stiff to Hard (Glacial Till)		6	SS	26												
			7	SS	40												
			8	SS	68												
			9	SS	95												
156.6																	
9.6	End of Borehole																
	* W.L. did not establish																

RECORD OF BOREHOLE No 6

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coords.: N 4 839 040.0, E 299 350.0 ORIGINATED BY KA

DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA

DATUM Geodetic DATE 1994 10 20 CHECKED BY KA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
162.2	Ground Surface						162							
0.0			1	SS	14		161							
	Clayey Silt Trace of Organic Brown / Gray Stiff to V. Stiff (Fill)		2	SS	16		160							
			3	SS	10		159							
156.5			4	SS	11		158							
3.7			5	SS	32		157							
	Clayey Silt to Silt with Trace of Clay Brown to Gray Hard (Glacial Till)		6	SS	38		156							
			7	SS	100	/13cm	155							
	Silty Sand Trace of Gravel Brown, Wet		8	SS	50	/13cm								
154.3			9	SS	56	/15cm								
7.9	End of Borehole													

RECORD OF BOREHOLE No 7

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coords.: N 4 839 155.0, E 299 300.0 ORIGINATED BY KA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1994 10 19 CHECKED BY KA

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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
159.3	Ground Surface													
0.0														
	Clayey Silt Brown, Moist Trace of Gravel V. Stiff to Hard (Glacial Till)		1	SS	16									
			2	SS	19									
			3	SS	43									
			4	SS	50									
			5	SS	55									
			6	SS	57									
			7	SS	45									
			8	SS	46									
152.3														
7.0														
	Sandy Silt to Silty Sand Gray, Wet Dense to V. Dense (Glacial Till)		9	SS	30									
149.7			10	SS	108									
9.6	End of Borehole													

RECORD OF BOREHOLE No 8

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coords.: N 4 839 244.0 E 299 367.0 ORIGINATED BY KA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1994 10 18 CHECKED BY KA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100		
158.8	Ground Surface												
0.0													
			1	SS	27								
			2	SS	26								
	Clayey Silt Brown to Grey, Moist V. Stiff to Hard (Glacial Till)		3	SS	50								
			4	SS	54								
			5	SS	50								
			6	SS	27								
			7	SS	21								
152.9			8	SS	35								
5.9													
	Sandy Silt to Silty Sand Grey, Moist to Wet Dense to V. Dense (Glacial Till)		9	SS	44								
149.2			10	SS	65								
9.6	End of Borehole												

RECORD OF BOREHOLE No 9

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coords.: N 4 839 433.0, E 299 491.0 ORIGINATED BY KA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1994 10 18 CHECKED BY KA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100		
158.8	Ground Surface												
0.0													
	Clayey Silt with Silt Seams Trace of Gravel Brown, Damp to Moist V. Stiff to Hard (Glacial Till)		1	SS	26	158							
			2	SS	73	157							
			3	SS	83	156							
			4	SS	33	155							
155.1													
3.7			5	SS	63	155							
			6	SS	88	154							
	Silty Sand to Silt Trace of Gravel Grey, V. Dense (Glacial Till)		7	SS	62	153							
			8	SS	74	152							
151.0													
			9	SS	70	151							
7.8	End of Borehole												

RECORD OF BOREHOLE No 10 *

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coord.: N 4 838 775.0 : E 299 118.0 ORIGINATED BY VK

DIST 6 HWY 401 BOREHOLE TYPE Penn-Drill COMPILED BY VK

DATUM Geodetic DATE 1964 06 12 CHECKED BY MD

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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
163.5	Ground Surface							20 40 60 80 100		W _P	W	W _L					
0.0	Heterogeneous mixture of Clayey Silt, Sand with Gravel Stiff to Hard, Brown to Grey (Glacial Till)		1	SS	10												
			2	SS	41												
			3	SS	107												
			4	SS	95												
			5	SS	69												
			6	SS	74												
			7	SS	74												
			8	SS	42												
			9	SS	100		/10cm										
153.9	End of Borehole																
9.6	End of Borehole																
* NOTE: Previous Borehole No. 1 W.P. 251-81, Geocres 30M11-62																	

+3, x⁵: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 11 * 1 OF 1 METRIC

W.P. 124-92-00 LOCATION Coord.: N 4 838 700.0 : E 299 090.0 ORIGINATED BY VK
DIST 6 HWY 401 BOREHOLE TYPE Penn-Drill COMPILED BY VK
DATUM Geodetic DATE 1964 06 16 CHECKED BY MD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ 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/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE							
164.1	Ground Surface										
0.0											
	Heterogeneous mixture of of clayey silt, sand with some gravel V. stiff to hard Brown to Grey (Glacial Till)		1	SS	27					17.3	8 18 50 24
			2	SS	54						
			3	SS	65					21.4	3 28 53 16
			4	SS	101						
			5	SS	100						
			6	SS	57						
			7	SS	60						16 30 40 14
			8	SS	40						
			9	SS	68						
			10	SS	130						
153.0											
11.1	End of Borehole										
	NOTE Previous borehole No. 3 W.P. 251-61, Geocres 30M11-62										

RECORD OF BOREHOLE No 12 *

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coord.: N 4 838 615.0 ; E 299 118.0 ORIGINATED BY VK
DIST 6 HWY 401 BOREHOLE TYPE Penn-Drill COMPILED BY VK
DATUM Geodetic DATE 1964 06 19 CHECKED BY MD

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 KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								20 40 60 80 100										
163.7	Ground Surface																	
0.0	Heterogeneous mixture of clayey silt, sand with some gravel Hard brown to grey (glacial till)		1	SS	6													
			2	SS	6													
			3	SS	48													
			4	SS	100													
			5	SS	150													
			6	SS	60													
			7	SS	53													
155.6			8	SS	50													
8.1	End of Borehole																	
	* NOTE: Previous borehole No. 8 W.P. 251-61, Geocres 30M11-62																	

+3, x5: Numbers refer to Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 13 * 1 OF 1 METRIC

W.P. 124-92-00 LOCATION Coord.: N 4 838 961.0 ; E 299 060.0 ORIGINATED BY VK
DIST 6 HWY 401 BOREHOLE TYPE Penn-Drill COMPILED BY VK
DATUM Geodetic DATE 1964 06 24 CHECKED BY MD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								20	40	60	80	100			W _p	W	W _L
163.1	Ground Surface																
0.0	Heterogeneous mixture of clayey silt, sand with some gravel. Hard, Brown to Grey (Glacial till)		1	SS	47												
			2	SS	59												
			3	SS	91												
			4	SS	80												
			5	SS	62												
			6	SS	58												
			7	SS	52												
			8	SS	74												
			9	SS	159												
153.5																	
9.6	End of Borehole																
	* NOTE: Previous borehole No. 10 W.P. 251-61, Geocres 30M11-62																

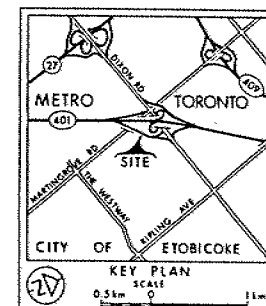
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

CONT No 95-36
WP No 124-92-00



HML HWY 401 / DIXON RD
INTERCHANGE
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



LEGEND

- ◆ Bare Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ◆ Bare Hole & Cone
- N Blows/0.3m [Std Pen Test, 475 J/blow]
- CONE Blows/0.3m [60° Cone, 475 J/blow]
- ⊕ Well at time of investigation 1964 Ob and 1994 10

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	159.8	4838 4050	298 9452
2	160.7	4839 4950	298 9846
3	166.1	4838 7900	299 2090
4	160.6	4838 8970	299 3150
5	166.2	4838 9860	299 2030
6	162.2	4839 0400	299 3500
7	159.3	4839 1550	299 3000
8	158.8	4839 2440	299 3670
9	158.8	4839 4230	299 4910
10	163.5	4838 7750	299 1160
11	164.1	4838 7000	299 0900
12	163.7	4838 6150	299 1180
13	163.1	4838 9610	299 0600

⇒ NOTE ⇒

The boundaries between soil areas 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 viewed at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen. Cond.

DATE	BY	DESCRIPTION
Geocore No 30M11-193		
HWY No 401		DIST 6
SUBMIT K A	CHECKED	DATE 1998 11 09
CLAWNS RS	CHECKED	DATE 1998 11 09
		DWG 1249200-A



PLANS

SCALE
40 m 0 40 m

FILE COPY



Ministry
of
Transportation

FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

CONT 95-36
ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 124-92-00 DIST 6
HWY 401 STR SITE -

High Mast Lighting
Hwy. 401/Dixon Road Interchange

DISTRIBUTION

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File ✓

GEOCRES 30M11-193

DATE NOV 30 1994

FOUNDATION INVESTIGATION REPORT

For
High Mast Lighting
Hwy. 401/Dixon Road Interchange
W.P. 124-92-00
Hwy. 401, District 6, Toronto

INTRODUCTION

This report presents soil information for the proposed high mast lights at the above mentioned sites. Soil information was obtained from previous subsurface investigations in the area (Geocres 30M11-62, W.P. 251-61) and supplemented by drilling 9 new boreholes (BH 1 through BH 9). This report is produced at the request of Central Region Structural Section.

SITE DESCRIPTION

The high mast lighting poles will be located at and near Hwy 401 and Dixon Road interchange. The area is situated in the City of Etobicoke in the Region of Metro Toronto.

The site lies within the physiographic region known as the South Slope (after Chapman and Putnam, 1984) and it consists largely of glacial deposits.

INVESTIGATION PROCEDURES

The fieldwork for the supplementary investigation was carried out between 94 10 18 and 94 10 20 and consisted of 9 sampled boreholes (BH 1 through BH 9) advanced to depths ranging from 7.8m to 11.1m below ground surface.

The boreholes were advanced using a CME 55 track-mounted auger machine equipped with solid stem augers.

Sampling was carried out at each borehole location by means of a 50mm O.D. split spoon sampler driven into the soil according to the specifications of the Standard Penetration Test (ASTM D 1586).

Groundwater levels were obtained by monitoring the levels in the open boreholes throughout the duration of the field investigation. All boreholes were backfilled at the completion of the fieldwork.

SUBSURFACE CONDITIONS

General

The soil generally consists of glacial till deposits as the native soil. However, at most of the locations (BH 1 through BH 6) the glacial till is overlain by fill material which is 1.4m to 6.9m thick. The native soil generally consists of clayey silt with layers of silt, sandy silt and silty sand. The glacial deposits occasionally contain cobbles and boulders. For soil condition details at any high mast light location, reference is made to the attached log sheets and Table 1 (Reference Borehole Numbers).

The locations of the boreholes are shown on the attached drawings DWG 1249200-A.

Groundwater Conditions

In the previous and recent studies, groundwater was encountered in almost all boreholes. Groundwater table elevation ranged from 153.2m (BH 4) to 162.0 (BH 12). The groundwater depth below ground surface ranged from 1.5m (BH 10) to 7.4m (BH 4). However, in some boreholes groundwater didn't establish shortly after their completion. For groundwater information at each HML locations reference is made to the attached borehole logs.

DISCUSSION AND RECOMMENDATIONS

It is proposed to install 16 high mast lighting poles (P1 through P16) at the interchange of Hwy 401 and Dixon Rd. The details of high mast lighting poles locations and elevations are attached to this report in Appendix A.

The High Mast Lighting poles will be founded on single reinforced concrete caissons. The foundations for HML should be designed in accordance with the methods described by B.B. Broms in the following two papers:

Broms, B.B.; Lateral Resistance of Piles in Cohesive Soils,
Journal of the Soil Mechanics and Foundations Division,
ASCE, Vol.90, No.SM2, Paper 3825, March 1964.

Broms, B.B.; Lateral Resistance of Piles in Cohesionless Soils,
Journal of the Soil Mechanics and Foundations Division,
ASCE, Vol.90, No.SM3, Paper 3909, May 1964.

There will be minor grade changes at the HML pole locations. Generally, the fill height will be between 0.1m to 0.4m and the cut depth will be 0.2m to 0.4m. The details of grade changes are as follows:

<u>HML Pole</u>	<u>Change in Grade</u>	<u>HML Pole</u>	<u>Change in Grade</u>
P1	Fill 0.1m	P8	Fill 0.1m
P2	Fill 0.1m	P10	Fill 0.4m
P3	Fill 0.1m	P11	Cut 0.2m
P4	Cut 0.3m	P12	Fill 0.1m
P5	Fill 0.1m	P13	Fill 0.1m
P6	Fill 0.2m	P14	Cut 0.4m
P7	Fill 0.3m	P15	Cut 0.4m

Cut Considerations

If the grade is to be lowered at the pole locations then, the most critical lowest surface elevations should be assumed for design purposes.

Fill Considerations

It should be assumed that the existing or proposed fill will not provide any lateral resistance unless it is carefully engineered.

Any organic and soft material should be removed before placing the fill material. The fill material should consist of acceptable soil free of organics. The fill should be placed and compacted as per MTO standard.

For design purposes following parameters should be used taking into consideration that only half of the fill height would provide lateral support:

$$\begin{aligned}\phi &= 30^\circ \\ \gamma &= 20 \text{ kN/m}^3\end{aligned}$$

It should be assumed that soil in the zone of frost penetration does not provide any lateral resistance. The depth of frost penetration at this site is 1.2m.

Slope Considerations

For HML poles near slopes, the caisson should be a minimum 3m from the crest of the 2H:1V down slope. The upper 50% of the embedment length within the embankment (taken from frost penetration depth) should be disregarded for lateral resistance. If the caisson for HML foundations are constructed at a distance of 3m from the crest of a 3H:1V and 4H:1V slopes the reduction in embedment length would be 25% and 0% respectively.

The design values at each of the HML locations are as follows:

SOIL PARAMETERS AT EACH HIGH MAST LIGHT POLES

HML Poles	W.L. Elev (m)	Elev (m) From - To	Soil Type	ϕ (Deg)	Q_u kPa	γ kN/m ³
P1	155.8	159.8 - 152.9	Fill	30	0	20.0
		152.9 - 148.7	Cohesive	0	250	20.2
P2	157.0	160.7 - 155.2	Fill	30	0	20.0
		155.2 - 151.1	Cohesive	0	250	20.2
P3	157.0	160.7 - 155.2	Fill	30	0	20.0
		155.2 - 151.1	Cohesive	0	250	20.2
P4	NE	164.1 - 153.0	Cohesive	0	300	20.4
P5	162.0	163.7 - 161.5	Cohesive	0	50	19.6
		161.5 - 155.6	Cohesive	0	500	21.2
P6	162.0	163.5 - 161.5	Cohesive	0	150	19.8
		161.5 - 153.9	Cohesive	0	400	20.8
P7	161.4	166.1 - 161.7	Fill	30	0	20.0
		161.7 - 156.5	Cohesive	0	350	20.6
P8	NE	163.1 - 153.5	Cohesive	0	500	21.2
P9	153.2	160.6 - 159.2	Fill	30	0	20.0
		159.2 - 154.7	Cohesive	0	250	20.2
		154.7 - 151.0	Non Cohesive	32	0	21.2
P10	NE	166.2 - 161.0	Fill	30	0	20.0
		161.0 - 156.6	Cohesive	0	250	20.2
P11	156.3	162.2 - 158.5	Fill	30	0	20.0
		158.5 - 154.3	Cohesive	0	300	20.4

P12	154.9	159.3 - 157.0	Cohesive	0	150	19.8
		157.0 - 152.2	Cohesive	0	400	20.8
		152.2 - 149.7	Non Cohesive	32	0	20.4
P13	154.9	159.3 - 157.0	Cohesive	0	150	19.8
		157.0 - 152.2	Cohesive	0	400	20.8
		152.2 - 149.7	Non Cohesive	32	0	20.4
P14	158.8	158.8 - 152.9	Cohesive	0	250	20.2
		152.9 - 149.2	Non Cohesive	32	0	20.6
P15	155.3	158.8 - 155.2	Cohesive	0	350	20.6
		155.2 - 151.0	Non Cohesive	32	0	21.2
P16	155.3	158.8 - 155.2	Cohesive	0	350	20.6
		155.2 - 151.0	Non Cohesive	32	0	21.2

Where:

HML	= High Mast Lighting
ϕ	= Apparent angle of internal friction for non-cohesive Soils
Q_u	= Unconfined Compressive Strength (kPa)
γ	= Unit Weight (kN/m^3)
NE	= Water level not established

Construction Consideration:

It is recommended that a non-standard special provision for the construction of HML foundations, should be incorporated in the contract. A copy of the latest NSSP from other project is appended in this report (Appendix 'B') for reference. The contractor should be advised that variable types of subsurface material may be encountered at the high mast light pole locations; and that the soil descriptions in this report are generalized and not site specific. For construction planning purposes it may be assumed that;

- Groundwater is at or near the surface.
- Cohesionless material may be encountered and it would be susceptible to disturbance under conditions of unbalanced hydrostatic head.

- Glacial deposits are anticipated and there is a probability that occasional cobbles and boulders may be encountered within the deposit.

The Contractor is responsible for constructing the high mast pole foundations without disturbing the material at the sides or bases of the foundations. His proposal should be capable of dealing with the above-noted site condition. The Contractor shall submit eight copies of his proposed construction method to the Engineer for review a minimum of 15 working days prior to the commencement of construction of these foundation elements.

Miscellaneous

The soil information for this project was obtained from previous Foundation Investigation in this area (Geocres 30M11-62, W.P. 251-61) and supplemented by drilling 9 new boreholes (BH1 through BH 9). The fieldwork for the supplementary investigation was carried out under the supervision of K.S.Q. Ahmad, using equipment owned and operated by Canadian Soil Drilling. This report was prepared by K.S.Q. Ahmad, Foundation Engineer, reviewed and approved by D. Dundas, Senior Foundation Engineer.



K.S.Q. Ahmad

K.S.Q. Ahmad, P. Eng.
Foundation Engineer



D. Dundas

D. Dundas, P. Eng.
Senior Foundation Engineer

TABLE 1

REFERENCE BOREHOLE NUMBERS AND GRADE DETAILS

HML Pole Numbers	Reference B.H. No	Ground Elev. at Boreholes	Existing Grade at HML	Final Grade
P1	1	159.8	159.3	159.4
P2	2	160.7	160.3	160.4
P3	2	160.7	161.0	161.1
P4	11	164.1	166.5	166.2
P5	12	163.7	165.5	165.6
P6	10	163.5	163.1	163.3
P7	3	166.1	165.6	165.9
P8	13	163.1	163.5	163.6
P9	4	160.6	160.6	160.6
P10	5	166.2	166.0	166.4
P11	6	162.2	162.0	161.8
P12	7	159.3	161.0	161.1
P13	7	159.3	159.5	159.6
P14	8	158.8	158.5	158.1
P15	9	158.8	157.5	157.1
P16	9	158.8	155.9	155.9

APPENDIX 'A'

DETAILS OF HIGH MAST LIGHTING POLES

POLE STATION, OFFSET AND COORDINATES

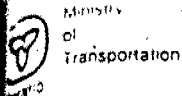
POLE NO.		STATION	BASE ELEVATION (M)	OFFSET E/P	NEW COORDINATES	OLD COORDINATES
NEW	OLD					
P1	P1	401 W.B. 12 + 650	159-370	15.0 m	N 4,838,332 E 298,916	N 4,838,343 E 298,927
P2	P2	401 W.B. 12 + 765	160-450	15.0 m	N 4,838,438 E 298,959	N 4,838,445 E 298,966
P3	P3	401 W.B. 12 + 880	161-150	13.0 m	N 4,838,544 E 299,001	N 4,838,550 E 299,005
P4	P4	401 W.B. 13 + 059	166-150	8.0 m	N 4,838,705 E 299,085	N 4,838,705 E 299,083
P5	P5	401 E.B. 12 + 994	165-650	12.0 m	N 4,838,614 E 299,124	N 4,838,614 E 299,124
P6	NEW	401 W.B. 13 + 172	163-325	17.0 m	N 4,838,817 E 229,122	---
P7	P6	401 E.B. 13 + 180	165-900	40.5 m	N 4,838,778 E 299,216	N 4,838,786 E 299,205
P8	P8	Ramp Dixon to 401 West	163-650	10.5 m	N 4,838,930 E 299,068	N 4,838,943 E 299,104
P9	P7	Dixon Road S.B.	160-650	32.0 m	N 4,838,875 E 299,317	N 4,838,885 E 299,312
P10	P9	401 W.B. 13 + 353	166-420	40.0 m	N 4,838,985 E 299,187	N 4,838,992 E 299,218
P11	P10	401 E.B. 13 + 470	161-850	8.0 m	N 4,839,021 E 299,350	N 4,839,038 E 299,349
P12	NEW	401 W.B. 13 + 495	161-150	12.0 m	N 4,839,106 E 299,272	---
P13	P11	401 W.B. 13 + 605	159-650	12.0 m	N 4,839,196 E 299,339	N 4,839,166 E 299,324
P14	P12	401 W.B. 13 + 715	158-150	13.0 m	N 4,839,287 E 299,401	N 4,839,256 E 299,387
P15	P13	401 W.B. 13 + 830	157-150	13.0 m	N 4,839,378 E 299,460	N 4,839,348 E 299,446
P16	P14	401 W.B. 13 + 945	155-950	13.0 m	N 4,839,471 E 299,520	N 4,839,441 E 299,506

APPENDIX 'B'

NSSP FOR HIGH MAST LIGHTING POLES CONSTRUCTION

(AN EXAMPLE FROM ANOTHER REPORT)

NON-STANDARD SPECIAL PROVISION



Sheet _____ of _____

DATE _____

SP NO 368-87-00 CONTRACT NO _____ DISTRICT NO 6 HWY NO 407LOCATION 407/427 Interchange TYPE OF WORK _____This S P is new (✓) ☐This S P replaces No. N/A

Remarks:

Explanation of Intent:

To define High Mast Pole foundation construction

Item No	Spec No	Title or Item Description
45	631	CONCRETE FOOTING FOR HIGH MAST POLES

CONSTRUCTION

The Contractor is advised that variable types of subsurface material may be encountered at the high mast light pole locations; for additional information regarding soil conditions the Contractor is referred to the Foundation Investigation Report.

For bidding purposes it may be assumed that:

- Ground water is at or near the surface.
- If cohesionless material is encountered, it would be susceptible to disturbance under conditions of unbalanced hydrostatic head.
- If glacial deposits are encountered, there is a probability that occasional cobbles and boulders may be encountered within the deposit.

The Contractor is responsible for constructing the high mast pole foundations without disturbing the material at the sides or bases of the foundations. The Contractor shall submit eight copies of the proposed construction method to the Engineer for review a minimum of 15 working days prior to the commencement of construction of these foundation elements.

BASIS OF PAYMENT

Payment at the contract price for the above tender item shall be full compensation for all labour, equipment and materials required to do the work.

Structural Section

D. Wong

Initiated by _____

Detailed by _____

Approved by _____

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 124-92-00 LOCATION coords.: N 4 838 405.0, E 298 945.0 ORIGINATED BY KA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1994 10 20 CHECKED BY KA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80	100	W _p	W		
159.8	Ground Surface															
0.0																
			1	SS	15											
			2	SS	13											
			3	SS	11											
			4	SS	8											
			5	SS	7											
			6	SS	2											
			7	SS	6											
152.9			8	SS	26											
6.8			9	SS	30											
			10	SS	14											
148.7																
11.1	End of Borehole															

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coords.: N 4 838 495.0, E 298 984.0 ORIGINATED BY KA
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
 DATUM Geodetic DATE 1994 10 20 CHECKED BY KA

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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
160.7	Ground Surface																
0.0																	
	Silty Clay to Clayey Silt with Sand Stiff to V. Stiff (Fill)		1	SS	8												
			2	SS	8												
			3	SS	16												
			4	SS	12												
			5	SS	8												
	Sand		6	SS	0												
155.2																	
5.5																	
	Clayey Silt Grey, moist V. Stiff to Hard (Glacial Till)		7	SS	16												
			8	SS	32												
			9	SS	32												
151.1																	
9.6	End of Borehole																

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coords.: N 4 838 790.0, E 299 209.0 ORIGINATED BY KA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1994 10 20 CHECKED BY KA

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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _P	W	W _L		
166.1	Ground Surface																
0.0	Clayey Silt Some Sand Trace of Roots, Trace of Brick Fragments Stiff to V. Stiff (Fill)		1	SS	25												
			2	SS	21												
			3	SS	12												
			4	SS	25												
			5	SS	28												
161.7	Clayey Silt Trace of Gravel Brown to Grey Hard (Glacial Till)		6	SS	50												
4.4																	
			7	SS	69												
			8	SS	36												
			9	SS	34												
156.5	End of Borehole																

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coords.: N 4 838 897.0, E 299 315.0 ORIGINATED BY KA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1994 10 19 CHECKED BY KA

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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
160.6	Ground Surface																
0.0	Clayey Silt Brown, Firm (Fill)		1	SS	5												
159.2			2	SS	27												
1.4			3	SS	58												
	Clayey Silt with Silt Zones Brown to Grey, Moist V. Stiff to Hard (Glacial Till)		4	SS	45												
			5	SS	78												
			6	SS	42												
			7	SS	35	/10cm											
154.7			8	SS	50	/10cm											
5.9			9	SS	59												
	Sandy Silt to Gravelly Sand Wet, V. Dense (Glacial Till)		10	SS	59												
151.0																	
9.6	End of Borehole																

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coords.: N 4 838 986.0, E 299 203.0 ORIGINATED BY KA
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
 DATUM Geodetic DATE 1994 10 19 CHECKED BY KA

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					
166.2	Ground Surface																
0.0							166										
			1	SS	14		165										
	Clayey Silt with Sand Some Gravel Firm to Stiff (Fill)		2	SS	9		164										
			3	SS	7		163										
			4	SS	8		162										
			5	SS	10		161										
161.0			6	SS	26		160										
5.2			7	SS	40		159										
	Clayey Silt Brown to Grey Trace of Gravel V. Stiff to Hard (Glacial Till)		8	SS	68		158										
			9	SS	95		157										
155.8																	
9.6	End of Borehole																
	• W.L. did not establish																

RECORD OF BOREHOLE No 6

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coords.: N 4 839 040.0 E 299 350.0 ORIGINATED BY KA
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
 DATUM Geodetic DATE 1994 10 20 CHECKED BY KA

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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80	100	W _p	W		
162.2	Ground Surface															
0.0																
	Clayey Silt Trace of Organic Brown / Grey Stiff to V. Stiff (Fill)		1	SS	14											
			2	SS	16											
			3	SS	10											
			4	SS	11											
158.5																
3.7	Clayey Silt to Silt with Trace of Clay Brown to Grey Hard (Glacial Till)		5	SS	32											
			6	SS	38											
			7	SS	100											
			8	SS	50											
	Silty Sand Trace of Gravel Brown, Wet															
154.3			9	SS	58											
7.9	End of Borehole															

RECORD OF BOREHOLE No 7

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coords.: N 4 839 155.0, E 299 300.0 ORIGINATED BY KA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1994 10 19 CHECKED BY KA

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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
159.3	Ground Surface																
0.0	Clayey Silt Brown, Moist Trace of Gravel V. Stiff to Hard (Glacial Till)		1	SS	16												
			2	SS	19												
			3	SS	43												
			4	SS	50												
			5	SS	55												
			6	SS	57												
			7	SS	45												
			8	SS	46												
152.3	Sandy Silt to Silty Sand Grey, Wet Dense to V. Dense (Glacial Till)		9	SS	30												
7.0																	
149.7	End of Borehole		10	SS	108												
9.6																	

RECORD OF BOREHOLE No 8

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coords.: N 4 839 244.0, E 299 367.0 ORIGINATED BY KA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1994 10 18 CHECKED BY KA

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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80	100	W _p	W			W _L
158.8	Ground Surface																
0.0	Clayey Silt Brown to Grey, Moist V. Stiff to Hard (Glacial Till)		1	SS	27												
			2	SS	26												
			3	SS	50												
			4	SS	54												
			5	SS	50												
			6	SS	27												
			7	SS	21												
152.9	Sandy Silt to Silty Sand Grey, Moist to Wet Dense to V. Dense (Glacial Till)		8	SS	35												
5.9																	
			9	SS	44												
149.2			10	SS	65												
9.6	End of Borehole																

RECORD OF BOREHOLE No 9

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coords.: N 4 839 433.0, E 299 491.0 ORIGINATED BY KA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1994 10 18 CHECKED BY KA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80	100	W _p	W		
158.8	Ground Surface															
0.0																
	Clayey Silt with Silt Seams Trace of Gravel Brown, Damp to Moist V. Stiff to Hard (Glacial Till)		1	SS	26											
			2	SS	73											
			3	SS	83											
			4	SS	33											
155.1																
3.7																
	Silty Sand to Silt Trace of Gravel Grey, V. Dense (Glacial Till)		5	SS	63											
			6	SS	88											
			7	SS	62											
			8	SS	74											
151.0																
			9	SS	70											
7.8	End of Borehole															

RECORD OF BOREHOLE No 10 *

1 OF 1

METRIC

W.P. 124-92-00 LOCATION Coord.: N 4 838 775.0 : E 299 118.0 ORIGINATED BY VK
DIST 6 HWY 401 BOREHOLE TYPE Penn-Drill COMPILED BY VK
DATUM Geodetic DATE 1984 06 12 CHECKED BY MD

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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						
163.5	Ground Surface							20 40 60 80 100	20 40 60 80 100	10 20 30						
0.0	Heterogeneous mixture of Clayey Silt, Sand with Gravel Stiff to Hard, Brown to Grey (Glacial Till)		1	SS	10		163							22.5	14 36 34 16	
2			SS	41	162											
3			SS	107	161											
4			SS	95	160											
5			SS	69	159											
6			SS	74	158											
7			SS	74	157											
8			SS	42	156											
153.9				9	SS		100	/10cm	155							
9.6	End of Borehole						154									
NOTE: Previous Borehole No. 1 W.P. 251-81, Geocres 30M11-62																

RECORD OF BOREHOLE No 11 * 1 OF 1 METRIC

W.P. 124-92-00 LOCATION Coord.: N 4 838 700.0 : E 299 090.0 ORIGINATED BY VK
 DIST 6 HWY 401 BOREHOLE TYPE Penn-Drill COMPILED BY VK
 DATUM Geodetic DATE 1964 06 16 CHECKED BY MD

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	20 40 60 80 100					
164.1	Ground Surface												
0.0	Heterogeneous mixture of of clayey silt, sand with some gravel V. stiff to hard Brown to Grey (Glacial Till)		1	SS	27							17.3	8 18 50 24
			2	SS	54								
			3	SS	65							21.4	3 28 53 18
			4	SS	101								
			5	SS	100								
			6	SS	57								
			7	SS	60								16 30 40 14
			8	SS	40								
			9	SS	68								
			10	SS	130								
153.0	End of Borehole												
11.1	NOTE Previous borehole No. 3 W.P. 251-61, Geocres 30M11-62												

RECORD OF BOREHOLE No 12 * 1 OF 1 METRIC

W.P. 124-92-00 LOCATION Coord.: N 4 838 615.0 : E 299 118.0 ORIGINATED BY VK
 DIST 6 HWY 401 BOREHOLE TYPE Penn-Drill COMPILED BY VK
 DATUM Geodetic DATE 1964 06 19 CHECKED BY MD

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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100						SHEAR STRENGTH kPa					WATER CONTENT (%)			
													○ UNCONFINED					+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE						
163.7	Ground Surface																									
0.0	Heterogeneous mixture of clayey silt, sand with some gravel Hard brown to grey (glacial till)		1	SS	6		163																			
			2	SS	6		162															5 25 47 23				
			3	SS	48		161																			
			4	SS	100		160																			
			5	SS	150		159																3 28 48 21			
			6	SS	60		158																			
			7	SS	53		157																			
			8	SS	50		156																			
155.6																										
8.1	End of Borehole																									
	NOTE: Previous borehole No. 8 W.P. 251-61, Geocres 30M11-62																									

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

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kN/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m ³	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kN/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ³ /s	RATE OF DISCHARGE
γ_d	kN/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kN/m ³	UNIT WEIGHT OF SATURATED SOIL	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 ³	SEEPAGE FORCE
γ'	kN/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

METRIC

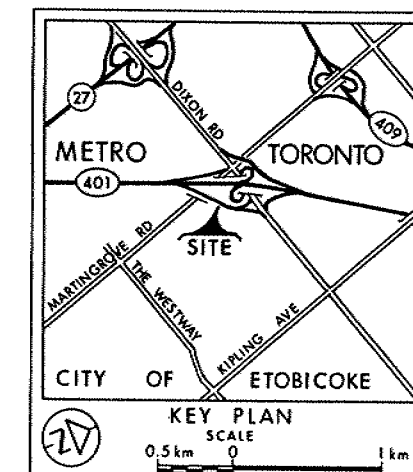
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

CONT No
WP No 124-92-00

H.M.L HWY 401 / DIXON RD
INTERCHANGE
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 1964 06 and 1994 10

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	159.8	4838 405.0	298 945.0
2	160.7	4838 495.0	298 984.0
3	166.1	4838 790.0	299 209.0
4	160.6	4838 897.0	299 315.0
5	166.2	4838 986.0	299 203.0
6	162.2	4839 040.0	299 350.0
7	159.3	4839 155.0	299 300.0
8	158.8	4839 244.0	299 367.0
9	158.8	4839 433.0	299 491.0
10	163.5	4838 775.0	299 118.0
11	164.1	4838 700.0	299 090.0
12	163.7	4838 615.0	299 118.0
13	163.1	4838 961.0	299 060.0

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 GC 2.01 of OPS Gen. Cond.



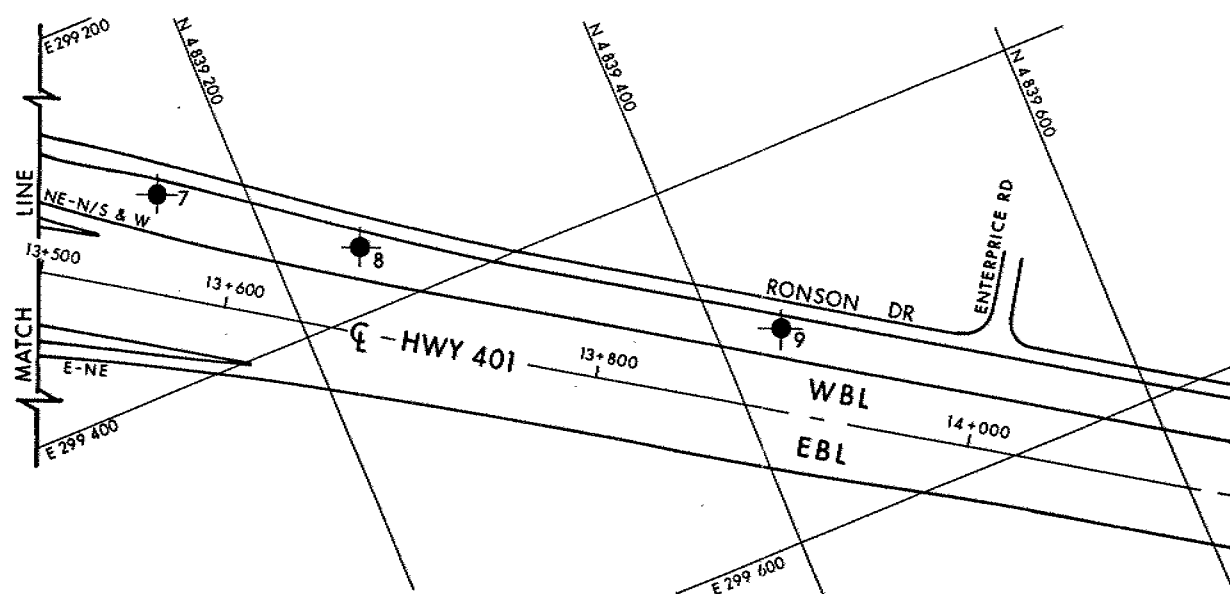
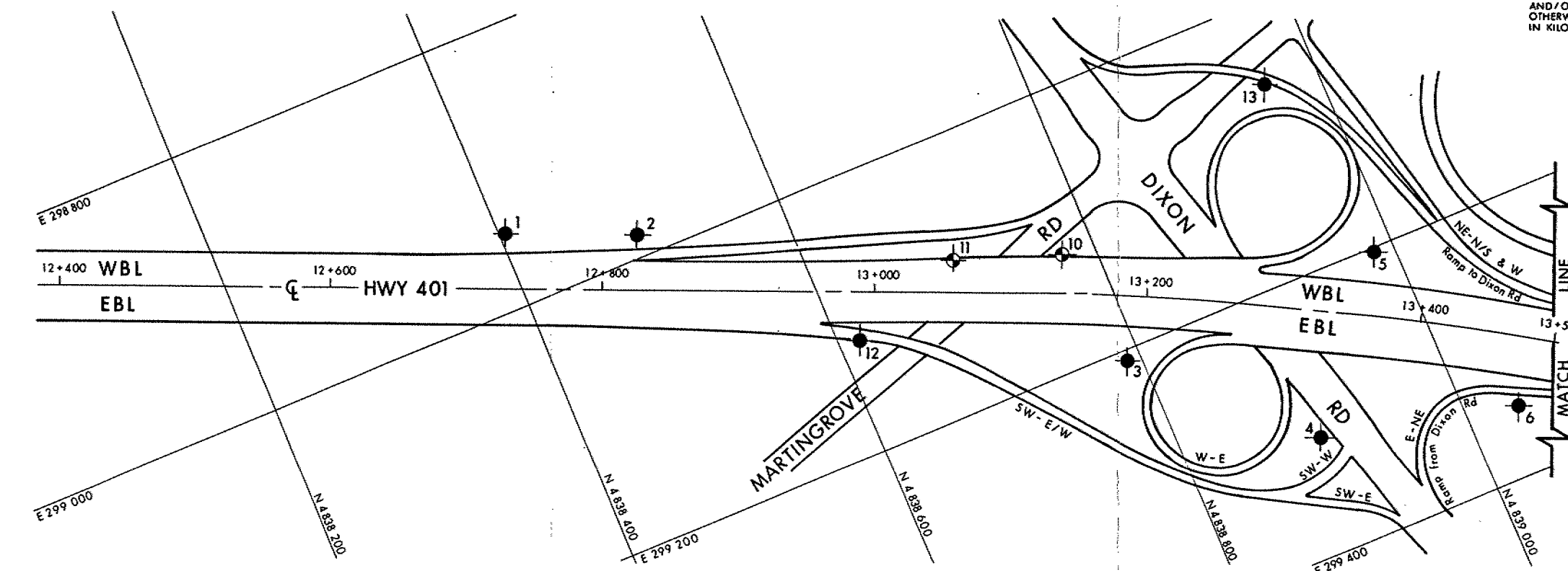
REV	DATE	BY	DESCRIPTION

Geocres No 30 M 11 - 193

HWY No 401	DIST 6
SUBM'D K.A. [CHECKED] DATE 1994 11 09	SITE
DRAWN R.S. [CHECKED] APPROVED	DWG 1249200-A

NOTE

For Subsoil Information Refer to Record of Borehole Sheets.



PLANS

SCALE
40m 0 40m