



**DRAFT
DETAILED FOUNDATION INVESTIGATION AND DESIGN REPORT
for
HIGHWAY 407 EAST
BROCK ROAD COMMUTER CARPOOL LOT
STORMWATER MANAGEMENT POND
BUS SHELTER AND PYLON SIGN
HIGHWAY 407 EAST
PICKERING, ONTARIO
GWP 2355-13-00**

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PML Ref.: 12TF007D
Index No.: 053DIR and 054DDR
GEOCRES No.: Not Assigned
February 4, 2014



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Appendix A – Record of Pavement Borehole Logs from Draft Pavement Design Report

DRAFT
DETAILED FOUNDATION INVESTIGATION REPORT

For
Highway 407 East
Brock Road Commuter Carpool Lot
Stormwater Management Pond, Bus Shelter and Pylon Sign
Pickering, Ontario
GWP 2355-13-00

1. INTRODUCTION

This report summarizes the results of a foundation investigation carried out for the proposed Brock Road Commuter Carpool Lot in Pickering, Ontario. The proposed carpool lot is part of the Highway 407 East extension and is located in the southwest quadrant of the proposed Highway 407 East and Brock Road interchange. The proposed works at the carpool lot includes construction of a new stormwater management (SWM) pond, bus shelter and pylon sign. The study was carried out by Peto MacCallum Ltd. (PML) for Delcan Corporation (Delcan), on behalf of the Ministry of Transportation of Ontario (MTO).

The proposed SWM pond is planned to be constructed on the east side of the carpool lot and is expected to contain two cells. The proposed pylon sign will be constructed at the south east corner of the proposed carpool lot and the proposed bus shelter is to be constructed immediately west of the bus access road. The proposed structures are shown on the attached Drawing BR-1.

The purpose of this report is to summarize the subsurface stratigraphy encountered at the location of the SWM pond, pylon sign and bus shelter. A pavement investigation was conducted alongside this investigation with the results presented under a separate cover.

Since the construction activities for the realigned Brock Road were underway at the time of the investigation, the near surface site conditions may be affected by the on-going site activities.

2. SITE DESCRIPTION AND GEOLOGY

Land use in the vicinity of the site primarily comprises farmland, however at the time of the investigation, construction activities for the realigned Brock Road were underway. The local



topography is generally sloping downward from west to east towards the proposed realigned Brock Road.

The project site is located within the Physiographic Region known as the South Slope. This Region typically includes calcareous clay till with lacustrine clay and silt reworked by glaciers, with numerous scattered drumlins and deep valley cuts caused by flowing streams towards Lake Ontario.

3. INVESTIGATION PROCEDURES

The field work for this study was carried out on November 8, 11 and 12, 2013. Seven boreholes designated 1 to 7 were drilled for the SWM pond and pylon sign to depths of 4.6 to 8.2 m at the locations shown on Drawing BR-1, appended. This investigation also used 7 pavement boreholes, numbered 8 to 14 to supplement the foundation data and characterize the area of the proposed bus shelter.

The borehole locations were selected through consultation with Delcan and based on the Preliminary General Arrangement (GA) drawings prepared by Delcan in July 2013. The borehole locations and elevations were surveyed in the field by J.D. Barnes. All elevations in this report are expressed in metres.

The boreholes were advanced using continuous flight solid stem augers advanced by a track-mounted CME-55 drill rig, supplied and operated by a specialist drilling contractor, working under the full-time supervision of a PML field technician.

Soil samples were recovered from the boreholes at regular 0.75, 1.5 or 3.0 m intervals together with standard penetration testing that was conducted to assess the strength characteristics of the substrata. The recovered soils were identified in accordance with the MTO soil classification manual procedures.



The groundwater conditions in the boreholes were assessed during drilling by visual examination of the soil, the sampler and drill rods as the samples were retrieved. The groundwater levels in boreholes were obtained during and upon completion of drilling and in piezometers were installed in boreholes 1, 4 and 7 upon completion of drilling.

The boreholes were backfilled with a bentonite/grout mixture where required in accordance with the MTO guidelines and MOE Reg. 903 for borehole abandonment procedures.

The recovered soil samples were returned to our laboratory in Toronto for detailed visual examination, laboratory testing and classification. The laboratory testing program included the following tests:

- Natural moisture content determinations (43)
- Grain size distribution analyses (8)
- Atterberg Limit Test (8)

The charts prepared using the results of the laboratory grain size distribution analyses and Atterberg Limit Test are presented in Figures BR-GS-1 and BR-PC-1, respectively. All of the test results are summarized on the Record of Borehole sheets. In addition the results of a Moisture-Density Relationship Test from the pavement investigation has also been included in this report.

4. SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Record of Borehole sheets for details of the subsurface conditions including soil classifications, inferred stratigraphy, standard penetration test data and groundwater observations. The results of laboratory grain size distributions, Atterberg limit tests moisture-density relationship test and moisture content determinations are also shown on the Record of Borehole sheets.

The borehole locations and stratigraphic profile prepared from the borehole data are shown on Drawings BR-1 and BR-2. The boundaries between soil strata have been established at the borehole locations only. Between and beyond the boreholes, the boundaries are assumed and may vary.



The results of the boreholes completed near the SWM pond and bus shelter for the concurrent pavement investigations are also presented in Appendix A and shown on the attached Drawing BR-1. For ease of reference the pavement boreholes have been renumbered boreholes 8 through 14, as indicated on Drawing BR-1. Pavement boreholes at the following locations have been referenced:

- 9+962 (centreline) on the collector road (renamed borehole 8);
- All pavement boreholes on the bus access route (renamed boreholes 9 to 12);
- 7+050 (centreline) on the bus loop (renamed borehole 13);
- 29+290 (45.0 m right of centreline) on the parking lot road (renamed borehole 14).

The subsurface stratigraphy revealed in the boreholes drilled at the site generally comprised the 100 to 400 mm of topsoil over sandy silt to silty sand till that extended to the 4.6 to 8.2 m investigations depth. Locally an approximately 0.5 m thick layer of clayey silt fill was revealed surficially or beneath the topsoil at the east side of the site near construction activities for the realigned Brock Road. Cobbles and boulders were encountered locally within the silty sand to sandy silt till. Locally a compact to very dense silty sand to sand layer was revealed below the topsoil in pavement boreholes 13 and 14.

A summary of the subsurface soil and groundwater findings is given below.

4.1 Topsoil

A 100 to 400 mm thick topsoil layer was contacted surficially in boreholes 1 to 6 that extended to elevations 172.7 to 173.9.

A 200 to 360 mm thick topsoil layer was typically contacted surficially in all the nearby pavement boreholes, except borehole 12 where fill was encountered surficially. The topsoil extended to elevations 174.1 to 176.8.



4.2 Fill

A 0.5 to 0.6 m thick clayey silt fill layer was encountered surficially in borehole 7 and beneath the topsoil at 0.1 and 0.4 m (elevation 172.7 and 173.9) in boreholes 1 and 5. The fill extended to the sandy silt to silty sand till at 0.6 to 0.9 m (elevation 172.1 to 173.4). The fill was firm (SPT-'N' values of 4 and 5) and moist (moisture contents of 11 and 12%).

The pavement investigation also revealed a 1.5 m thick fill layer that was contacted surficially in borehole 12 that extended to elevation 173.9. The fill comprised silty sand, was loose (SPT-'N' values of 5 and 7) and moist (moisture contents of 9 and 10%).

4.3 Silty Sand to Sand

Locally, the pavement investigation revealed a 0.3 to 2.5 m thick silty sand to sand deposit below the topsoil in boreholes 8, 11, 13 and 14 at 0.2 to 0.4 m (elevations 174.1 to 176.8). The silty sand to sand was penetrated at 0.6 and 0.9 m (elevation 173.9 and 173.6) in boreholes 11 and 8, respectively, and extended to the 2.6 and 2.9 m (elevation 174.4 and 174.0) borehole termination depth in boreholes 13 and 14, respectively. The material was compact to very dense (SPT-'N' values of 13 to 51) and moist to wet (moisture contents of 9 to 25%). Organic inclusions were noted in boreholes 8 and 11.

4.4 Sandy Silt to Silty Sand Till

A 3.9 to 7.4 m thick sandy silt to silty sand till deposit was contacted beneath the topsoil at 0.2 to 0.4 m (elevation 172.9 to 173.3) in boreholes 2, 3, 4 and 6 and beneath the clayey silt fill at 0.6 to 0.9 m (elevation 172.1 to 173.4) in boreholes 1, 5 and 7. The sandy silt to silty sand till extended to the 4.6 to 8.2 m (elevation 165.9 to 168.9) borehole termination depth in all boreholes. The material was typically compact to very dense, although locally loose in the upper portion of boreholes 1 and 7, with SPT-'N' values of 6 blows to 50 blows for 3 cm. The material was moist with moisture contents typically between 4 and 11%, although moisture contents of 14 and 17% were noted in the bottom samples of boreholes 4 and 6.



The results of grain size distribution analyses and Atterberg Limit Testing conducted on 8 samples of the deposit are presented in respective Figures BR-GS-1 and BR-PC-1, respectively. Additionally a ASTM D-698 Moisture-Density Relationship Test (standard Proctor) was conducted on a sample of this layer during the concurrent pavement investigation. The results from the Proctor test are presented in the pavement investigation report and indicated a maximum dry density of 2.094 t/m^3 , maximum wet density of 2.272 t/m^3 and an optimum moisture content of 8.5%.

Silty sand till was typically contacted beneath the topsoil, fill or silty sand at 0.3 to 1.5 m (elevation 173.6 to 174.2) in the pavement boreholes, except in boreholes 13 and 14, where no glacial till was encountered to their termination depths. The till extended to the 1.8 to 4.9 m (elevation 169.6 to 172.8) borehole termination depth in all boreholes. The material was compact to very dense (SPT-“N” values of 10 blows to 82 blows for 15 cm) and was moist (moisture contents of 6 to 13%).

4.5 Groundwater

In the process of augering, water strikes were observed at 1.4 to 6.7 m (elevation 167.0 to 171.9) in boreholes 1, 4, 5 and 6. Upon completion of drilling, groundwater was measured in boreholes 1, 4, 5 and 6 at 4.3 to 7.3 m (elevation 166.7 to 168.9) and the remaining boreholes were dry upon completion of drilling.

Upon completion of drilling piezometers were installed in boreholes 1, 4 and 7 with respective filter sand and screens extending from elevations 168.8, 168.2, and 171.0 to the borehole termination depths. The water levels in the piezometers were at 0.8 to 1.8 m (elevation 172.2 to 172.9) on December 16, 2013.

The water levels observed piezometers likely resulted from artesian groundwater conditions in the wet sand seams within the sandy silt to silty sand till.

The groundwater levels at the site are subject to seasonal fluctuation and rainfall patterns.



5. CLOSURE

Mr. F. Portela out the field investigation for this study under the supervision of Mr. A. DeSira, M. Eng, P. Eng. and Mr. C. M. P. Nascimento, P. Eng., Project Manager. Fisher Environmental Ltd. supplied the drill rig for the subsurface exploration. The laboratory testing of the selected samples was carried out in the PML laboratory in Toronto.

This Foundation Investigation report was prepared by Mr. A. DeSira, MEng, P.Eng., and reviewed by Mr. Brian R. Gray, MEng, P.Eng., Principal Consultant. Mr. C. M. P. Nascimento, P. Eng., MTO Designated Principal Contact, conducted an independent review of the report.

Yours very truly

Peto MacCallum Ltd.

A blue ink signature of Andrew DeSira, consisting of a stylized 'A' followed by a large, flowing 'D'.

Andrew DeSira, MEng, P.Eng.
Project Engineer, Geotechnical Services

A black ink signature of Brian R. Gray, written in a cursive style.

A small, stylized black ink signature or set of initials, possibly 'BRG', located below the main signature of Brian R. Gray.

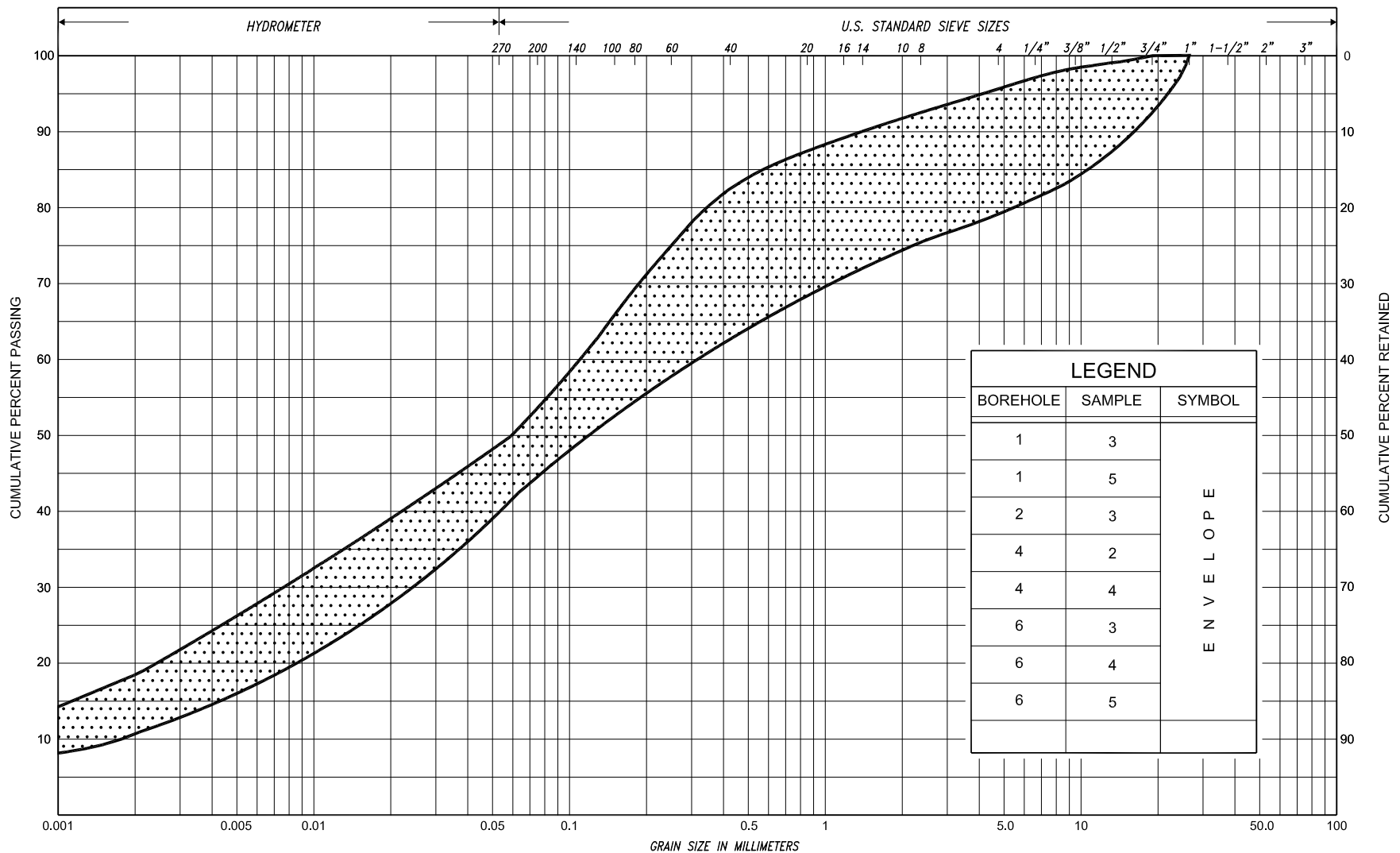
Brian R. Gray, MEng, P.Eng.
Principal Consultant

A black ink signature of Carlos M.P. Nascimento, written in a cursive style.

Carlos M.P. Nascimento, P.Eng.
Project Manager and
MTO Designated Principal Contact

AD/GD/CN:ad-mi-nk

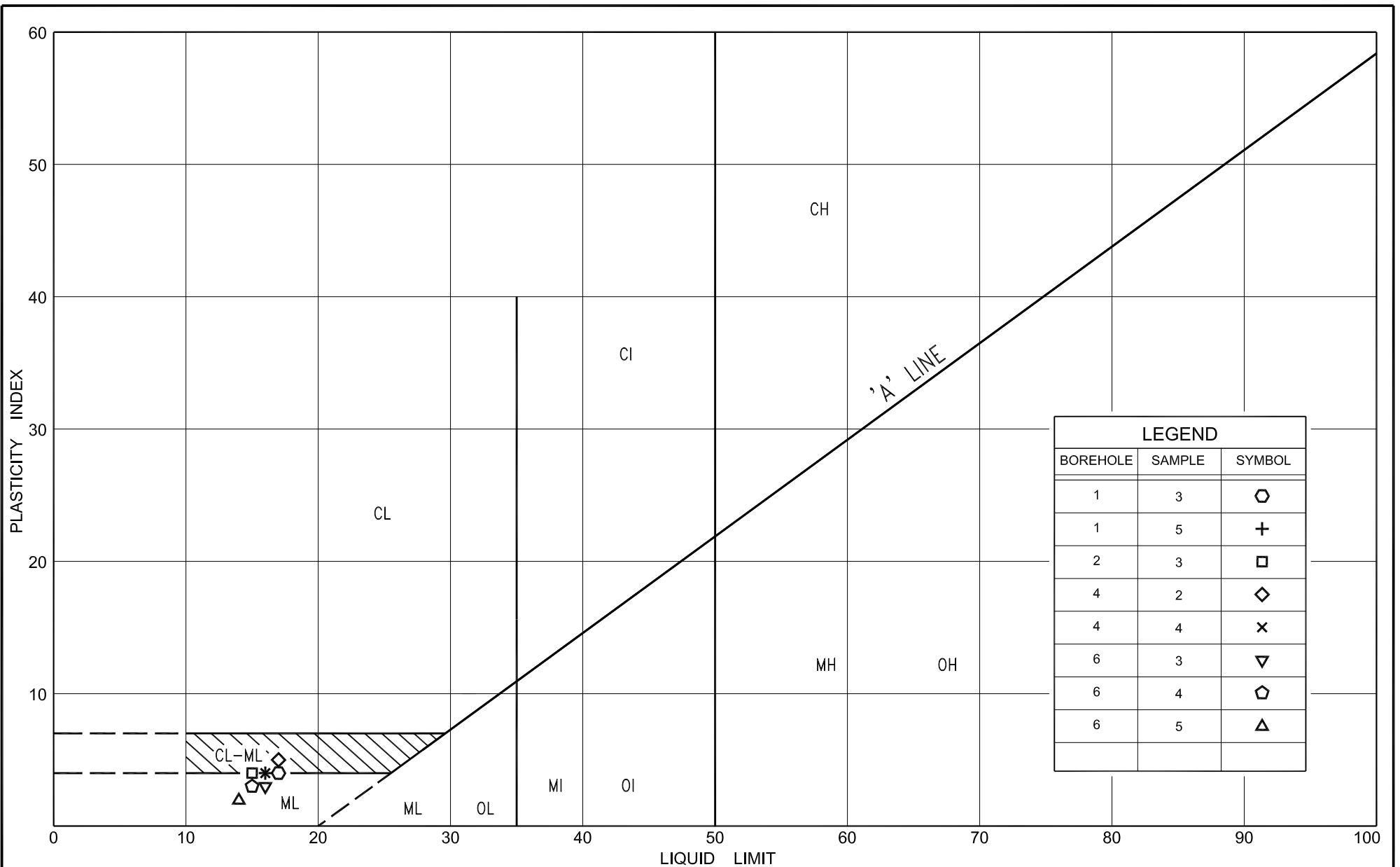
NOTE: The Final Report will be signed and stamped by two Professional Engineers licensed by PEO, one of whom shall be the Designated Principal Contact for MTO foundation projects



SILT & CLAY				FINE		MEDIUM		COARSE	GRAVEL		COBBLES	UNIFIED
CLAY	FINE		MEDIUM	COARSE	SAND							
CLAY		SILT		V. FINE		FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
						SAND						

GRAIN SIZE DISTRIBUTION
 SILTY SAND to SANDY SILT, some clay, trace to some gravel
 (TILL)

FIG No. BR-GS-1
 HWY: 407E
 W.P. No. 07-20016



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.

COMPOSITION: SECONDARY SOIL COMPONENTS ARE DESCRIBED ON THE BASIS OF PERCENTAGE BY MASS OF THE WHOLE SAMPLE AS FOLLOWS:

PERCENT BY MASS	0 - 10	10 - 20	20 - 30	30 - 40	> 40
	TRACE	SOME	WITH	ADJECTIVE (SILTY)	AND (AND SILT)

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 (R Q D), FOR MODIFIED RECOVERY, IS:

R Q D (%)	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
F V	FIELD VANE		

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
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'_{v0}	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_i	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

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

RECORD OF BOREHOLE No 1

1 of 1

METRIC

G.W.P. _____ LOCATION _____ Coords: 4 863 672.0 N; 337 267.1 E ORIGINATED BY _____ F.P.

DIST _____ HWY _____ BOREHOLE TYPE _____ Continuous Flight Solid Stem Augers COMPILED BY _____ A.D.

DATUM _____ Geodetic DATE _____ November 08, 2013 CHECKED BY _____
















SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
174.3	Ground Surface							20	40	60	80	100					
0.0	Topsoil		1	SS	4		174										
173.9	Clayey silt trace sand, trace gravel topsoil inclusions Firm Brown Moist (FILL) Sandy silt to Silty sand some clay trace to some gravel Loose to Brown Moist compact (TILL) _____ seams of sand, trace gravel Dense to very dense ____ Grey _____ wet sand layer																
0.4																	
173.4			2	SS	7		173										
0.9																	
			3	SS	26												
			4	SS	28		172										
			5	SS	36		171										
		6	SS	60/15cm		170											
		7	SS	55		169											
		8	SS	43		168											
															</		

RECORD OF BOREHOLE No 2

1 of 1

METRIC

G.W.P. _____ **LOCATION** Coords: 4 863 697.8 N; 337 260.6 E **ORIGINATED BY** F.P.
DIST Central **HWY** 407E **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.
DATUM Geodetic **DATE** November 08, 2013 **CHECKED BY** _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
173.7 0.0	Ground Surface						20	40	60	80	100						
173.3 0.4	Topsoil		1	SS	5		173							○			6 42 38 14
	Sandy silt to Silty sand some clay, trace gravel						172							○ H			
	Compact to Brown Moist very dense (TILL)		2	SS	27		171										
			3	SS	88		170										
			4	SS	58/15cm		169										
							168										
			5	SS	50/15cm		167										
																	
			6	SS	55/15cm												
			7	SS	50/15cm												
																	
																	
			8	SS	50/15cm												
																	
166.6 7.1	End of borehole		9	SS	50/5cm												
	* Borehole dry																

RECORD OF BOREHOLE No 3

1 of 1

METRIC

G.W.P. _____ **LOCATION** _____ Coords: 4 863 716.3 N; 337 280.0 E **ORIGINATED BY** F.P.
DIST Central **HWY** 407E **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.
DATUM Geodetic **DATE** November 11, 2013 **CHECKED BY** _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ 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 × LAB VANE												
173.3	Ground Surface						20	40	60	80	100									
0.0	Topsoil		1	SS	4															
172.9	Sandy silt to Silty sand some clay, trace gravel																			
0.4	Loose to Brown Moist very dense (TILL)		2	SS	24															
			3	SS	39															
			4	SS	50/8cm															
			5	SS	69/15cm															
	cobbles and boulders Grey																			
			6	SS	50/15cm															
			7	SS	58/15cm															
168.6	End of borehole																			
4.7																				
	* Borehole dry																			

RECORD OF BOREHOLE No 4

1 of 1

METRIC

G.W.P. _____ **LOCATION** _____ Coords: 4 863 744.0 N; 337 270.8 E **ORIGINATED BY** F.P.
DIST Central **HWY** 407E **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.
DATUM Geodetic **DATE** November 11, 2013 **CHECKED BY** _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE										○		
								● QUICK TRIAXIAL × LAB VANE												
173.7	Ground Surface						20	40	60	80	100	20	40	60	kN/m³	GR SA SI CL				
0.0	Topsoil		1	SS	5							○								
173.3	Sandy silt to Silty sand some to with gravel some clay		2	SS	20							○H				14 35 33 18				
0.4	Compact to Brown Moist very dense (TILL)		3	SS	56							○								
			4	SS	84/20cm							○H				21 34 31 14				
			5	SS	63/15cm							○								
			6	SS	60/15cm							○								
			7	SS	65/15cm							○								
	cobbles and boulders Grey		8	SS	50/15cm							○								
	wet sand layers																			
165.9			9	SS	50/8cm							○								
7.8	End of borehole																			
</																				

RECORD OF BOREHOLE No 5

1 of 1

METRIC

G.W.P. _____ **LOCATION** Coords: 4 863 795.8 N; 337 297.5 E **ORIGINATED BY** F.P.
DIST Central **HWY** 407E **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.
DATUM Geodetic **DATE** November 11, 2013 **CHECKED BY** _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE										○		
								● QUICK TRIAXIAL × LAB VANE												
172.8	Ground Surface						20	40	60	80	100	20	40	60	kN/m³	GR SA SI CL				
0.0	Topsoil																			
172.7	Clayey silt		1	SS	4							○								
0.1	trace sand, trace gravel																			
172.1	Firm to Brown Moist																			
0.7	stiff		2	SS	17		172					○								
	Sandy silt to Silty sand																			
	some clay, some gravel																			
	Compact to Brown Moist																			
	dense		3	SS	38		171					○								
	(TILL)																			
			4	SS	28		170					○								
			5	SS	23							○								
	Very dense																			
			6	SS	47		169					○								
168.2	End of borehole		7	SS	50/3cm															
4.6																				
	* 2013 11 11																			
	▽ Water level observed during drilling																			
	▼ Water level measured after drilling																			

RECORD OF BOREHOLE No 6

1 of 1

METRIC

G.W.P. _____ **LOCATION** Coords: 4 863 807.1 N; 337 285.8 E **ORIGINATED BY** F.P.
DIST Central **HWY** 407E **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.
DATUM Geodetic **DATE** November 11, 2013 **CHECKED BY** _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
					WATER CONTENT (%)												
173.3	Ground Surface																
0.0	Topsoil																
173.1 0.2	Sandy silt to Silty sand some clay trace to some gravel Compact to Brown Moist very dense (TILL)		1	SS	4	▽*	173										
			2	SS	23		172										
			3	SS	40												
			4	SS	42		171										
		5	SS	86	170												
		6	SS	36	169												
		7	SS	82													
168.3	End of borehole																
5.0																	
	* 2013 11 11 ▽ Water level observed during drilling ▼ Water level measured after drilling																

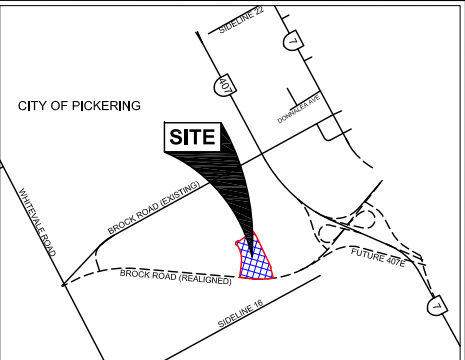
RECORD OF BOREHOLE No 7

1 of 1

METRIC

G.W.P. _____ **LOCATION** Coords: 4 863 823.0 N; 337 276.1 E **ORIGINATED BY** F.P.
DIST Central **HWY** 407E **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** A.D.
DATUM Geodetic **DATE** November 12, 2013 **CHECKED BY** _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
173.7	Ground Surface					*											
0.0	Clayey silt, trace sand trace gravel		1	SS	5												
173.1	Firm Brown Moist (FILL)		2	SS	6												
0.6	Sandy silt to Silty sand some clay, some gravel		3	SS	27												
	Loose to Brown Moist dense (TILL)		4	SS	37												
			5	SS	35												
	Grey		6	SS	43												
168.9	Very dense		7	SS	50/8cm												
4.8	End of borehole																
* Borehole dry																	
Piezometer Reading:																	
Date Depth Elev.																	
Nov. 12/'13 Dry -----																	
Dec. 02/'13 0.7 173.0																	
Dec. 16/'13 0.8 172.9																	
Piezometer Legend:																	
<div><div></div> Cuttings and Bentonite mixed</div> <div><div></div> Bentonite seal</div> <div><div></div> Filter sand</div> <div><div></div> Screen</div>																	



KEY PLAN
SCALE
0 0.5 1.0 km

LEGEND

- Borehole
- Pavement Borehole
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WH Penetration due to weight of rods and hammer
- WL at time of investigation Nov. 2013
- Head
- ARTESIAN WATER
- Encountered
- PIEZOMETER

BH No	ELEVATION	CO-ORDINATES	
		NORTHINGS	EASTINGS
1	174.3	4 863 672.0	337 267.1
2	173.7	4 863 697.8	337 260.6
3	173.3	4 863 716.3	337 280.0
4	173.7	4 863 744.0	337 270.8
5	172.8	4 863 795.8	337 297.5
6	173.3	4 863 807.1	337 285.8
7	173.7	4 863 823.0	337 276.1
8	174.5	4 863 650.0	337 253.4
9	174.6	4 863 695.7	337 238.7
10	174.5	4 863 734.9	337 246.7
11	174.5	4 863 783.9	337 256.7
12	175.4	4 863 835.6	337 299.6
13	177.0	4 863 723.3	337 193.3
14	176.9	4 863 767.8	337 199.9

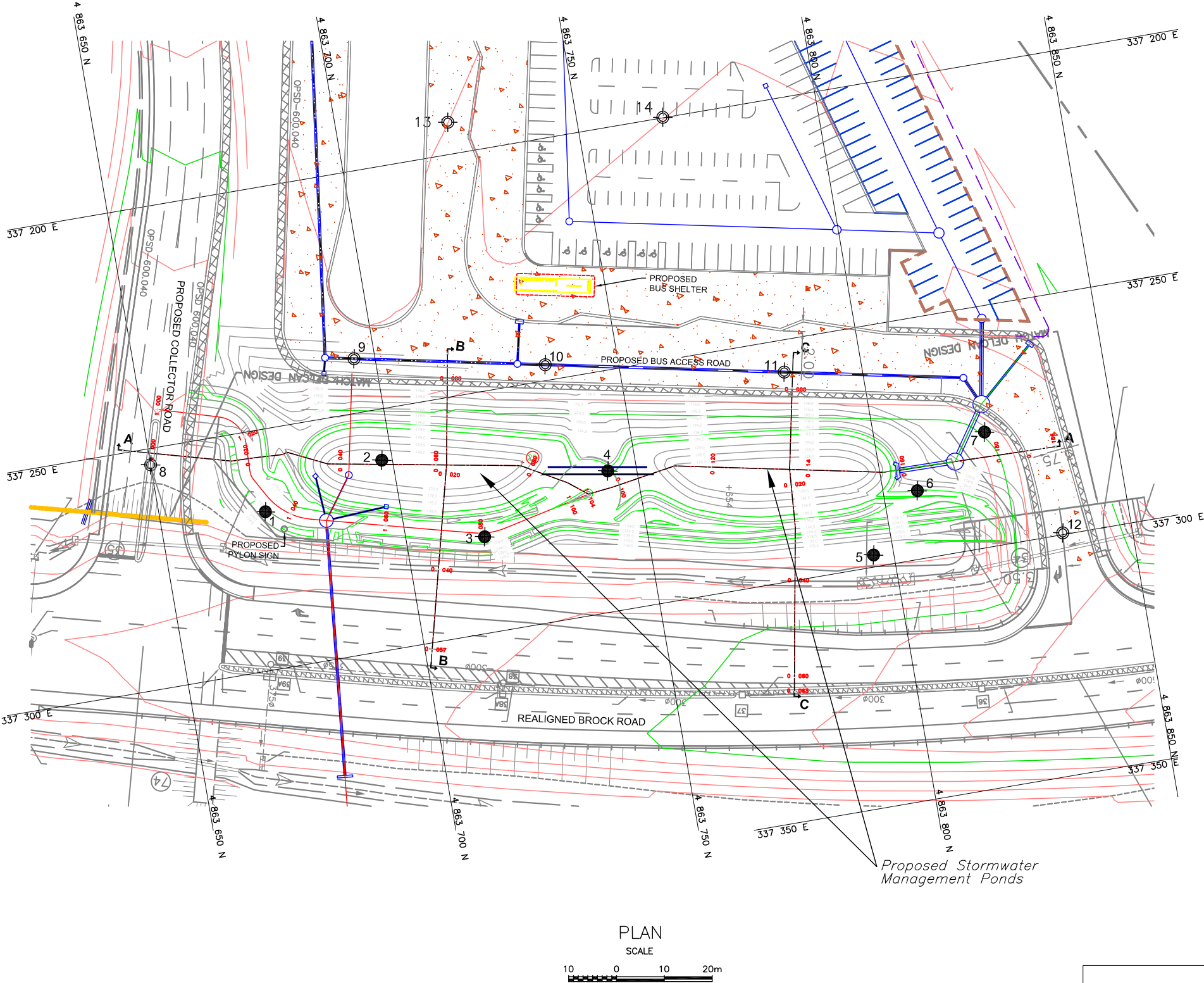
NOTE

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

DATE	BY	DESCRIPTION

Geocres No. XXX-XXX

HWY No	407E	DIST	Central
SUBM'D	NA	CHECKED	AD
DATE	FEB. 04, 2014	SITE	
DRAWN	NA	CHECKED	BRG
APPROVED	CN	DWG	BR-1



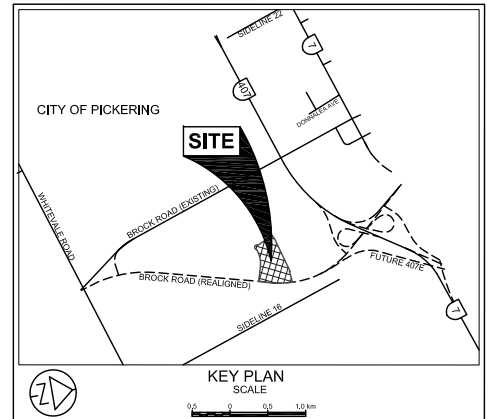
PLAN
SCALE
10 0 10 20m

NOTES:

- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
- REFER TO DRAWING BR-2 FOR PROFILE A-A AND SECTIONS B-B AND C-C.
- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
- DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

DRAFT NOTE :
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FOR FINAL REPORT.

DRAFT NOTE :
STAMP TO BE ADDED
FOR FINAL REPORT.



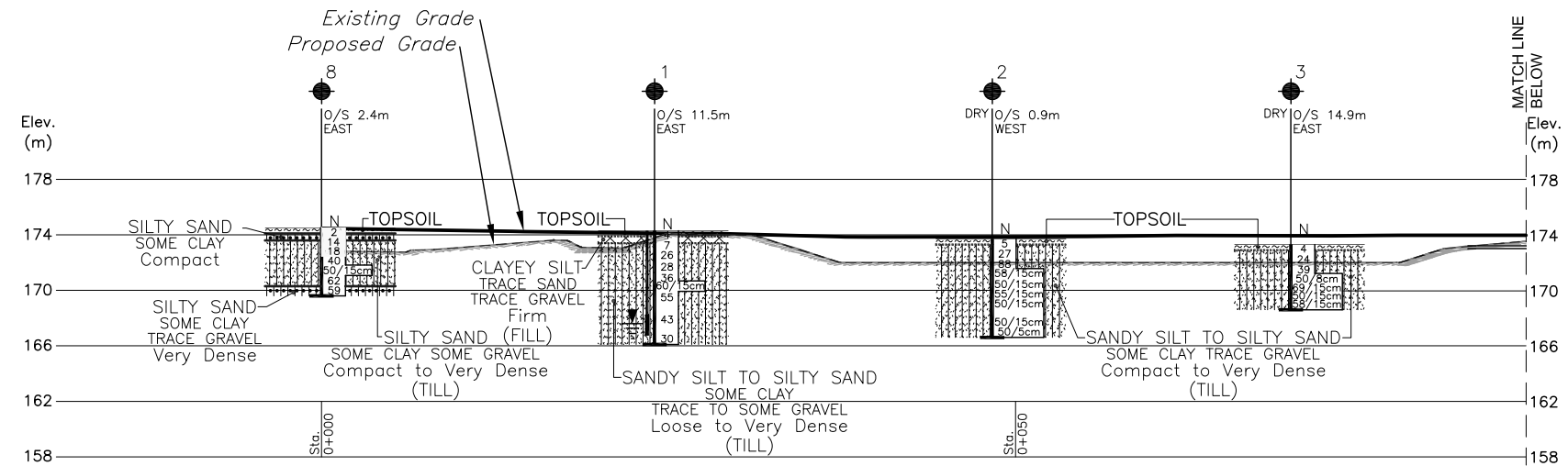
LEGEND			
	Borehole		
	Pavement Borehole		
	Borehole & Cone		
N	Blows/0.3m (Std. Pen Test, 475 J/blow)		
CONE	Blows/0.3m (60° Cone, 475 J/blow)		
WH	Penetration due to weight of rods and hammer		
	WL at time of investigation Nov. 2013		
	Head		
	ARTESIAN WATER Encountered		
	PIEZOMETER		

BH No	ELEVATION	CO—ORDINATES	
		NORTHINGS	EASTINGS
REFER TO DRAWING BR-1 FOR DETAILS			

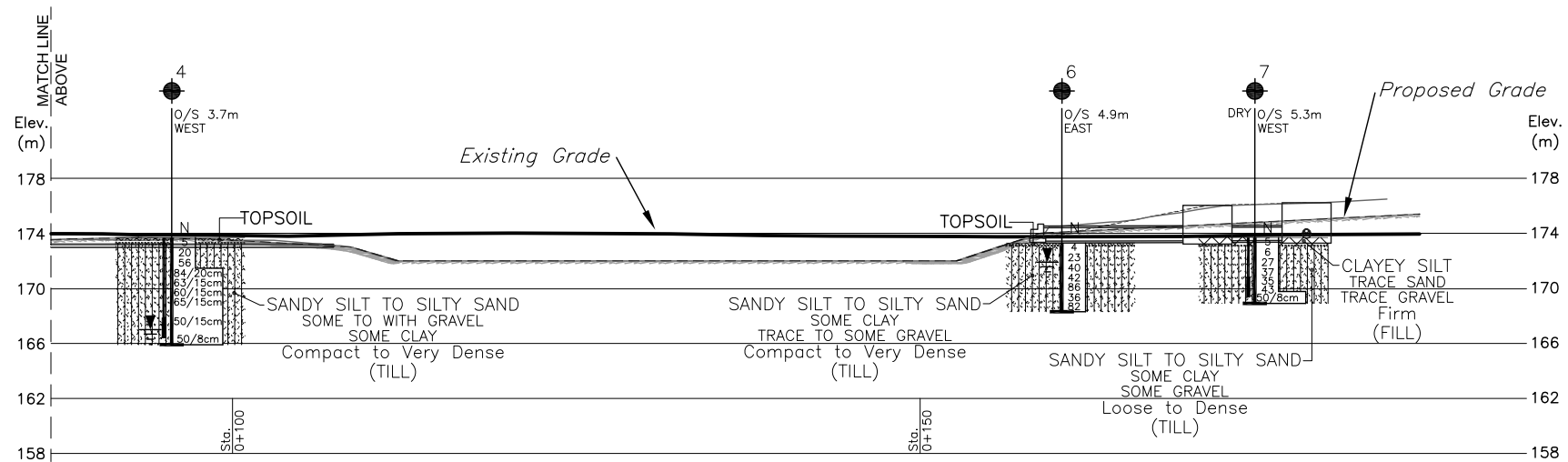
— NOTE —
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

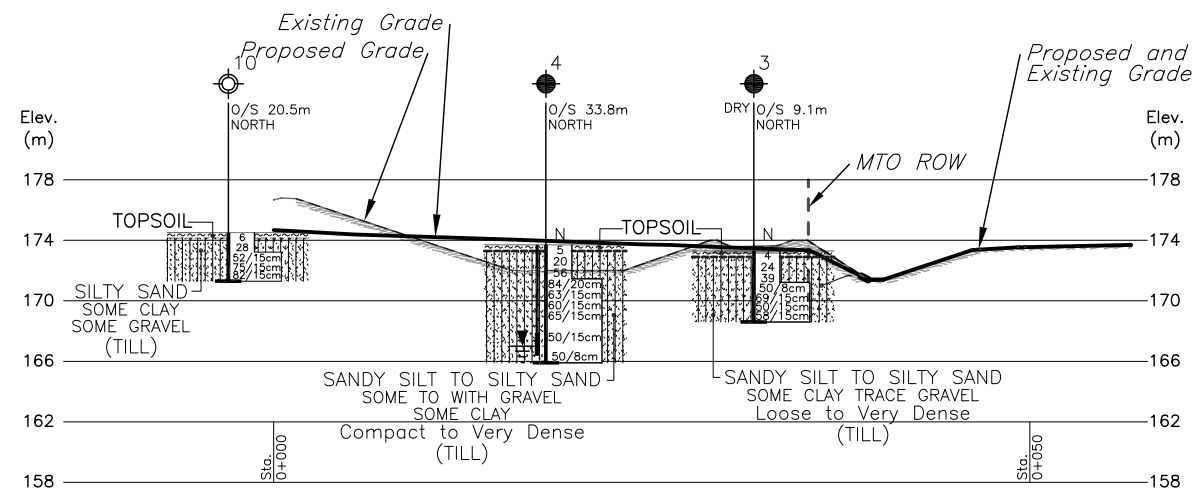
Geocres No. XXX-XXX			
HWY No	407E	DIST	Central
SUBM'D	NA	CHECKED AD	DATE FEB. 04, 2014 SITE
DRAWN	NA	CHECKED BRG	APPROVED CN DWG BR-2



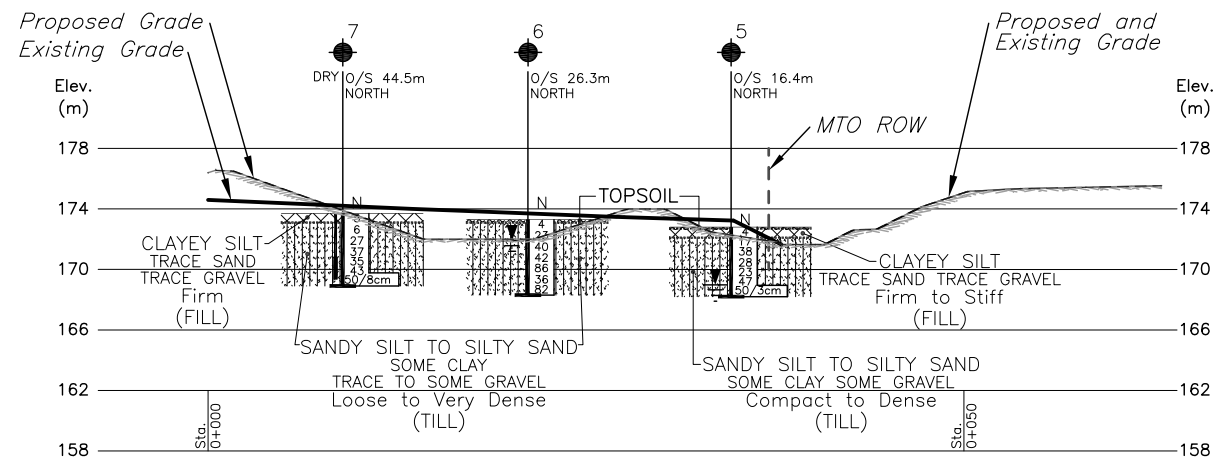
PROFILE A-A' ALONG Q STORMWATER PONDS



PROFILE A-A' ALONG Q STORMWATER PONDS (CONTINUED)



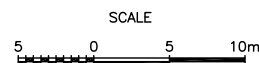
SECTION B-B'



SECTION C-C'

NOTES:

- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
- REFER TO DRAWING BR-1 BOREHOLE AND SECTION LOCATIONS.
- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
- DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.



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DRAFT Detailed Foundation Investigation Report

Highway 407 East, Brock Road Commuter Carpool Lot – SWM Pond, Bus Shelter and Pylon Sign

GWP 2355-13-00, Index No.: 053DIR

PML Ref.: 12TF007D, February 4, 2014



APPENDIX A

Record of Pavement Borehole Logs from Draft Pavement Design Report



Collector Road

DATUM: Proposed Centreline

09+962.0 (8) C/L Elev. 174.5

0	-	380	Dk Br Tps Wet
380	-	900	Br Si(y) Sa Some Cl Tr Org Moist w @ 600 = 25%
900	-	4.2	Br Si(y) Sa Till Some Gr Some Cl Moist SM-SC w @ 1.4 = 13% w @ 2.1 = 9% w @ 2.9 = 7% w @ 3.4 = 7% % Pass 4.75 mm = 83 2.00 mm = 79 425 µm = 72 75 µm = 47 5 µm = 21 2 µm = 15 LSFH WL = 17 IP = 6 MWD = 2.272 t/m ³ MDD = 2.094 t/m ³ Wopt = 8.5% K Factor = 0.29
4.2	-	4.9	Gry Si(y) Sa Some Cl Tr Gr Moist Perched Wat @ 300 w @ 4.4 = 7% w @ 4.9 = 7% N @ 300 = 2 N @ 1.05 = 14 N @ 1.85 = 18 N @ 2.60 = 40 N @ 3.20 = 50 blows/150 N @ 4.10 = 62 N @ 4.60 = 59

**Bus Access****DATUM: Proposed Centreline**

29+800.0	(9)	C/L	Elev. 174.6
0	-	360	Dk Br Tps Wet
360	-	1.8	Br Si(y) Sa Till Some Gr Some Cl Moist-Wet
			Perched Wat @ 1.5
			w @ 600 = 33%
			w @ 1.4 = 9%
			w @ 1.8 = 6%
			N @ 300 = 3
			N @ 1.00 = 23
			N @ 1.70 = 50 blows/150
29+840.0	(10)	C/L	Elev. 174.5
0	-	360	Dk Br Tps Moist
360	-	2.7	Br Si(y) Sa Till Some Gr Some Cl Moist
			w @ 600 = 12%
			w @ 1.4 = 8%
			w @ 1.7 = 7%
			w @ 2.4 = 6%
2.7	-	3.2	Gry Si(y) Sa Till Some Gr Some Cl Moist
			N @ 300 = 6
			N @ 1.05 = 28
			N @ 1.60 = 52 blows/150
			N @ 2.35 = 75 blows/150
			N @ 3.10 = 82 blows/150
29+890.0	(11)	C/L	Elev. 174.5
0	-	340	Dk Br Tps Moist
340	-	610	Br Si(y) Sa Some Gr Some Cl Tr Org Moist
			w @ 600 = 16%
610	-	2.0	Br Si(y) Sa Till Some Gr Some Cl Moist
			w @ 1.4 = 7%
			w @ 2.0 = 7%
			N @ 300 = 7
			N @ 1.05 = 40
			N @ 1.80 = 82
29+970.0	(12)	C/L	Elev. 175.4
0	-	1.5	Br Si(y) Sa Fill Some Gr Some Cl Moist
			w @ 600 = 9%
			w @ 1.1 = 10%
1.5	-	3.7	Br Si(y) Sa Till Some Gr Some Cl Moist
			w @ 2.1 = 10%
			w @ 2.9 = 13%
			w @ 3.7 = 15%
			N @ 300 = 5
			N @ 1.05 = 7
			N @ 1.80 = 17
			N @ 2.60 = 13
			N @ 3.35 = 10



Bus Loop

DATUM: Proposed Centreline

07+050.0 (13) C/L Elev. 177.0

0	-	200	Br Tps Moist
200	-	1.4	Br Si(y) Sa Tr Gr Tr Cl Moist w @ 600 = 11% w @ 1.4 = 9%
1.4	-	2.6	Br Si(y) Sa Tr Gr Tr Cl Wet Fr Wat @ 1.5 w @ 2.1 = 19% N @ 300 = 6 N @ 1.05 = 13 N @ 1.85 = 24

Parking Lot Road

DATUM: Proposed Centreline

20+290.0 (14) 45.0 Rt C/L Elev. 176.9

0	-	360	Dk Br Tps Moist
360	-	1.5	Br Si(y) Sa Some Gr Some Cl Moist w @ 600 = 12% w @ 1.5 = 10%
1.5	-	2.9	Br Sa Tr Gr Tr Si Wet Fr Wat @ 1.5 w @ 2.3 = 11% w @ 2.4 = 10% N @ 300 = 2 N @ 1.15 = 15 N @ 1.90 = 30 N @ 2.60 = 51



**DRAFT
DETAIL FOUNDATION DESIGN REPORT
for
HIGHWAY 407 EAST
BROCK ROAD COMMUTER CARPOOL LOT
STORMWATER MANAGEMENT POND
BUS SHELTER AND PYLON SIGN
HIGHWAY 407 EAST
PICKERING, ONTARIO
GWP 2355-13-00**

PETO MacCALLUM LTD.
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2 cc: Delcan Corporation
1 cc: PML Kitchener
1 cc: PML Toronto

PML Ref.: 12TF007D
Index No.: 054DDR
GEOCRES No.: Not Assigned
February 4, 2014



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Table 1 – List of Standard Specifications Referenced in Report

Figures 1 and 2 – Slope Stability Analysis Results

Drawing 1 – Foundations on Sloping Ground

Appendix A – Metrolinx Standard Drawings

Appendix B – Draft Non-Standard Specific Provision (NSSP)

Appendix C – Engineered Fill

**DRAFT
DETAIL FOUNDATION DESIGN REPORT**

for
Highway 407 East
Brock Road Commuter Carpool Lot
Stormwater Management Pond, Bus Shelter and Pylon Sign
Pickering, Ontario
GWP 2355-13-00

1. ENGINEERING RECOMMENDATIONS

1.1 General

This report provides the foundation engineering design recommendations and comments for the proposed Brock Road Commuter Carpool Lot in Pickering, Ontario. The proposed works at the carpool lot includes construction of a new stormwater management (SWM) pond, bus shelter and pylon sign. Peto MacCallum Ltd. (PML) conducted the foundation investigation for Delcan Corporation (Delcan) on behalf of the Ministry of Transportation of Ontario (MTO).

According to drawings received from Delcan on January 15, 2014, the proposed SWM pond will include two cells. These two cells are oval in shape and have lengths of about 60 m and widths of about 20 m. The bottom elevation of the cells is proposed to be at elevation 172.0. The ponds are planned to be constructed with a top berm level near elevation 176.5 on the west and near elevation 174.0 on the east. It is understood that the pond berms will have slopes inclined at 3 horizontal to 1 vertical (3H:1V).

In addition to the SWM pond, a Metrolinx pylon sign is also being proposed for the south east corner of the carpool lot. It is understood that the sign height has not been finalized and that either a 6 or 12m high pylon sign will be constructed. For the purpose of this report both sign heights have been considered. It is understood that the signs are to be designed in accordance Metrolinx standards, with foundation details according to drawings, PYLON-6m-001 and PYLON-6m-002 for the 6 m high sign and PYLON-12m-001 and PYLON-12m-002 for the 12 m sign (included in Appendix A). Based on Metrolinx drawings PYLON-6m-001 and PYLON-12m-001, a geotechnical engineer is required to verify that the "minimum allowable soil pressure is 100 kPa with no organics present" in the founding soils.



A bus shelter is also proposed immediately west of the bus access road near station 28+840 with a finished floor at about elevation 176.9. The bus shelter is to be constructed on a slab-on-grade foundation with a length of approximately 15 m and a width of about 3 m.

In summary, the soil stratigraphy revealed in the boreholes generally comprised 100 to 400 mm of topsoil over typically compact to very dense sandy silt to silty sand till that extended to the 4.6 to 8.2 m borehole termination depth. Locally, an approximately 0.5 m thick clayey silt fill layer was contacted beneath the topsoil or surficially at the east side of the site near construction activities for the realigned Brock Road. Additionally, a compact to very dense silty sand to sand layer was contacted locally in pavement boreholes 13 and 14 beneath the topsoil that extended to the 4.9 and 2.9 m exploration depth, respectively. The water contents of the upper silty sand to sandy silt till were typically within about 3% of the optimum water content of the standard Proctor test.

The groundwater strike observations indicated the presence of groundwater at or below the proposed base elevation 172.0 for the SWM pond. It is noted that piezometers installed at the site showed water levels at elevation 172.2 to 172.9 that were above the bottom pond elevation. This is expected to reflect artesian conditions within the wet sand seams found in the sandy silt to silty sand till. It should be noted that groundwater levels and the perched water levels in particular are subjected to fluctuations due to seasonal and rainfall patterns.

2. SWM POND DESIGN CONSIDERATIONS

2.1 General

Based on the subsurface investigation data, the bottom of both SWM pond cells will be placed at elevation 172.0 and will be established at the level of the compact to very dense sandy silt to silty sand till. It is envisaged that construction of the SWM pond in these soils is feasible.

It is considered to be feasible to re-use the existing silty sand to sandy silt till soils to construct the berm and for general fill purposes. It is considered that the native silty sand to sandy silt till has a hydraulic conductivity in the order of 4×10^{-4} to 4×10^{-5} cm/s and it is estimated that the material is typically within 3% of the optimum water content of the standard Proctor curve which is an



adequate condition for the purposes intended. The permeability value is based on routine laboratory testing and empirical relationships which are considered to be adequate for the current application. It is noted that during excavation moisture within the soil may be lost. If too much moisture is lost and the material cannot be compacted to 95% of the ASTM D-698 standard Proctor maximum dry density (as detailed below), water may need to be added or excessively dry may need to be discarded.

The soils should be carefully handled to avoid excessive loss of moisture which would make it difficult to achieve the recommended degree of compaction. To this end the excavated materials should not be stockpiled or allowed to dry out during the dry summer months.

It is considered that the native silty sand to sandy silt till is considered too pervious to be used for an impervious clay liner or clay core. Since the subsurface investigation failed to reveal any soils which could be suitable for use as an impervious clay core, it is recommended that where an impervious clay liner or clay core is required, material with characteristics in accordance with OPSS 1205 be imported to the site. The imported material should be free of organics and have a permeability of less than 1×10^{-6} cm/s after compaction in place. A Non-Standard Specific Provision (NSSP) should be added to the contract documents. The recommended NSSP is attached in Appendix B.

2.2 Side Slope Stability

The current plans call for side slopes of 3H:1V. It is considered that the proposed SWM pond side slopes of 3H:1V will be stable. For the analysis, the least favourable hydraulic condition was implemented with the water level at the 100 year water level (elevation 173.5 m). Additionally rapid draw-down conditions were also considered and the analysis showed the banks to be adequately safe. The results of a slope stability analysis carried out for the SWM pond side slopes at the 3H:1V configuration indicated a Factor of Safety of 1.72 in the long term (effective stress) analysis and 1.39 in the short term (total stress) analysis with a rapid drawdown condition, which exceed the respective minimum values of 1.5 and 1.3. The results are presented in the attached Figures 1 and 2.

Where the exposed subsoil comprises of fill or topsoil at the berms of the SWM pond, these exposed materials should be removed and replaced with native silty sand to sandy silt till



compacted to at least 95% of the ASTM D-698 maximum dry density using maximum 200 mm thick loose lifts (OPSS 501). Following excavation of the topsoil and fill material below, the subgrade beneath the proposed berms should be proof rolled, to ensure no loose zones are present. If loose zones are encountered the material should be excavated and replaced with native silty sand to sandy silt as described above.

For the forebay berm, between the pond cells, it is recommended that Granular 'A' material meeting OPS. PROV 1010 and comprise between 5 to 8% fines be used. The Granular 'A' should be compacted to at least 98% of the ASTM D-698 maximum dry density using maximum 200 mm thick loose lifts to ensure stability and prevent mitigation of fines into the berm.

All backfilling and compaction operations should be supervised on a full-time basis by geotechnical personnel to examine and approve backfill materials, evaluate placement operations and verify that the specified degree of compaction is achieved uniformly throughout the fill.

All side slopes should be protected against erosion and slope degradation. For this purposes, sodding, hydro seeding and mulching placement should be considered according to OPSS 803 and OPSS 804. Rip-rap should be provided at the forebay berm and pipe inlets/outlets. In addition since the groundwater level was encountered at the bottom of the pond in some of the boreholes, Rip-rap should be provided along the interface between the side slopes and pond bottom. The Rip-rap should extend up the side slopes a minimum of 0.3 m and as determined by inspection during construction. Rip-rap protection should be provided in accordance with OPSS 511. As per OPSS 511, Geotextile shall be nonwoven, Class II according to OPSS 1860, with an filter opening size of 75-150 µm.

3. PYLON SIGN DESIGN CONSIDERATIONS

A 6 or 12 m Metrolinx high pylon sign is proposed for the south east corner of the Brock Road Commuter Parking Lot. It is considered that the pylon sign will be constructed on top of the SWM pond berm near the location of borehole 1 as shown on the appended Drawing BR-1. It is understood that the signs are to be designed in accordance Metrolinx standards, with foundation



details according to drawings: PYLON-6m-001 and PYLON-6m-002 for the 6 m high sign and PYLON-12m-001 and PYLON-12m-002 for the 12 m sign. Based on these standards, construction of the pylon sign is considered feasible.

It is understood that both the 6 and 12 m high pylon signs will have 915 mm diameter caisson foundation. According to the drawings PYLON-6m-002 and PYLON-12-002, the 6 and 12 m high pylon signs would be founded a minimum of 2.1 and 3.6 m below the top of the proposed grade, respectively. It is understood that the pylon sign will be constructed at the top of SWM pond berm, where the proposed grade will be at elevation 174.0. Therefore it is considered that the 6 and 12 m high pylon signs will be founded at or below elevations 171.9 and 170.4, respectively.

Based on the subsurface conditions revealed in borehole 1, it is considered that the caisson foundations will extend through the new SWM pond berm and would be founded on the compact to very dense sandy silt to silty sand till. It is considered that the native sandy silt to silty sand till material is capable of providing the minimum “100 kPa soil pressure” required by the Metrolinx standards (Drawing PYLON-12m-001, Excavation Note 2). This evaluation considers that the “soil pressure” refers to the lateral soil resistance at SLS.

The upper 1.2 m of the subgrade should not be considered for the caisson embedment due to frost considerations. Any resisting earth pressure within the frost depth layer should be discounted.

Since the proposed pylon sign is to be constructed adjacent to the sloping pond berm it is considered that lateral resistance of berm soil will be reduced. Where a minimum of 3 m of earth cover on the sloping ground cannot be provided, lateral resistance provided by the sloping soil should be discounted, as shown on Drawing 1, appended.

It is recommended that the pylon sign foundation not be constructed through the clay core unit to preserve its integrity.



4. BUS SHELTER DESIGN CONSIDERATIONS

4.1 General

A bus shelter is to be constructed immediately west of the bus access road near station 29+840 with a finished floor grade and at about elevation 176.9. It is understood that the bus shelter will be constructed on a slab-on-grade foundation that has a length of approximately 15 m and a width of approximately 3 m. It is planned that the proposed slab on grade will be 200 mm thick and have a 300 mm thick bedding course of OPSS Granular 'A'. Based on this design it is anticipated that the proposed bus shelter will be founded at about elevation 176.4 (bottom of bedding). Given that the ground surface elevation at the location of the bus shelter is at about elevation 175.6, the bus shelter will be founded approximately 0.8 m, above existing grade.

4.2 Foundations

Since construction of the bus shelter will require the ground surface to be raised by 0.8 m it is expected that the bus shelter will be constructed on an engineered fill pad. Based on pavement boreholes 10, 13 and 14, the existing surficial topsoil or any loose silty sand / silty sand till containing organics is unsuitable to support the engineer fill pad and should be excavated. It is therefore recommended that the engineered fill be pad be constructed on top of the compact silty sand or silty sand till, which is expected to be encountered approximately 0.2 to 0.4 m below existing grade making the thickness of the engineered fill pad about 1.3 to 1.5 m thick (including bedding course).

A slab on grade constructed on an engineered fill pad placed on the compact silty sand or sandy silt till and constructed as described below and in Appendix C, may be designed using a factored geotechnical bearing resistance at ULS of 225 kPa and a geotechnical bearing reaction at SLS of 150 kPa.

The following general procedures are recommended for the construction of engineered fill areas. Reference is made to Appendix C for recommendations regarding engineered fill.



- The organic or excessively loose materials should be sub-excavated and removed from the areas of the proposed foundations;
- To reduce differential settlement of the bus shelter, the subgrade should be excavated to the same elevation across the entire engineered fill pad;
- The exposed subgrade surface should be proof rolled with a tandem truck or equivalent and inspected by geotechnical personnel from PML. Any soft/loose areas encountered during the process should be sub-excavated and replaced with approved on-site or imported material, compacted to at least 98% of the ASTM D-698 (Standard Proctor) Maximum Dry Density (SPMDD).
- The areas can then be brought up to the final grade level with approved imported Granular A material meeting OPS.PROV 1010, placed in lifts not exceeding 200 mm and compacted to at least 98% of SPMDD.
- All backfilling and compaction operations should be supervised on a full-time basis by geotechnical personnel to examine and approve backfill materials, evaluate placement operations and verify that the specified degree of compaction is achieved uniformly throughout the fill.

Total and differential settlement of the foundation founded on the engineered fill pad designed as outlined herein and imposing the specified soil bearing resistance, should not exceed 20 and 10 mm respectively, provided that the subgrade is not loosened by construction activities or prolonged exposure to the elements.

Since placement of the engineered fill pad may create a pooling effect, given the low permeability of the fill expected to be used adjacent to the pad, frost action beneath the slab will need to be considered. It is therefore recommended that a subdrain be installed at the base of the engineering fill pad to facilitate flow away from the foundation. Alternatively, the equivalent of 1.2 m of earth cover in thermal insulation could be placed directly beneath the slab to prevent freezing of the subgrade. The thermal insulation should be placed directly beneath the slab and should extend laterally a minimum of 2.0 m beyond the slab in all directions. A 25 mm thick layer of polystyrene insulation is thermally equivalent to 0.6 m of soil cover.



Since the proposed bus shelter is anticipated to be a relatively light structure, additional uplift resistance may be required to counteract the uplift forces on the structure. Should additional uplift be required, consideration should be given to increasing the dead load of the structure by possibly increasing the slab thickness, installation of a spread footing foundation buried at lower level, or by installation of soil anchors.

5. CONSTRUCTION CONSIDERATIONS

5.1 Excavation

It is anticipated that the excavation of the native soils and fill will be straightforward using conventional equipment. The possibility of encountering cobbles and boulders within the silty sand to sandy silt till should be considered, particularly when installing the caisson foundation for the pylon sign.

All excavation at the stormwater management pond site should be carried out in accordance with the Occupational Health and Safety Act (OHSA), local and MTO regulations. For this purpose, the fill and loose to compact silty sand to sandy silt till are considered Type 3 soils and the dense silty sand to sandy silt and very dense silty sand to sandy silt till are considered Type 2 soils.

5.2 Groundwater Control

Groundwater was encountered at or below the proposed base elevation for the SWM pond and below the founding depth of the pylon sign and bus shelter during the investigation. It is noted that piezometers installed at the site showed water levels above the bottom pond level and this is expected to reflect artesian conditions within the wet sand seams in the sandy silt to silty sand till.

It is considered that any perched water or surface water run-off that enters from the excavations should be readily handled by conventional sump pumping techniques. It is recommended that excavations for the pylon sign do not remain open for long prior to placement of the concrete to prevent loosening of the subgrade from infiltration of surface water run-off. The concrete for this

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foundation should be placed immediately upon the inspection and approval are carried out. A temporary steel liner will be required to minimize sloughing of the caisson foundation wall. It is noted that groundwater levels are subjected to fluctuations due to seasonal and rainfall patterns and these may influence the volume of water to be removed.

6. CLOSURE

This Detail Foundation Design Report was prepared Mr. A. DeSira, MEng, P.Eng., and reviewed by Mr. Brian R. Gray, Principal Consultant. Mr. C. M. P. Nascimento, P. Eng., Project Manager and MTO Designated Principal Contact, conducted an independent review of the report.


Yours very truly

Peto MacCallum Ltd.

A blue ink signature of Andrew DeSira, written in a cursive style.

Andrew DeSira, Meng, P.Eng.
Project Engineer, Geotechnical Services

A black ink signature of Brian R. Gray, written in a cursive style.

 Brian R. Gray, Meng, P.Eng.
Principal Consultant

A black ink signature of Carlos M.P. Nascimento, written in a cursive style.

Carlos M.P. Nascimento, P.Eng.
Project Manager and
MTO Designated Principal Contact

AD/GD/CN:ad-mi-nk

NOTE: The Final Report will be signed and stamped by two Professional Engineers licensed by PEO, one of whom shall be the Designated Principal Contact for MTO foundation projects



TABLE 1
LIST OF STANDARD SPECIFICATIONS REFERENCED IN REPORT

DOCUMENT	TITLE
OPSS 501	Construction Specification for Compacting
OPSS 511	Construction Specification for Rip-Rap, Rock Protection, and Granular Sheeting
OPSS 803	Construction Specification for Sodding
OPSS 804	Construction Specification for Seed and Cover
OPSS 1205	Material Specification for clay liners
OPSS 1860	Material Specifications for Geotextiles
OPS. PROV 1010	Material Specification for Aggregates

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GWP 2355-13-00, Index No.: 054DDR

PML Ref.: 12TF007D, February 4, 2014

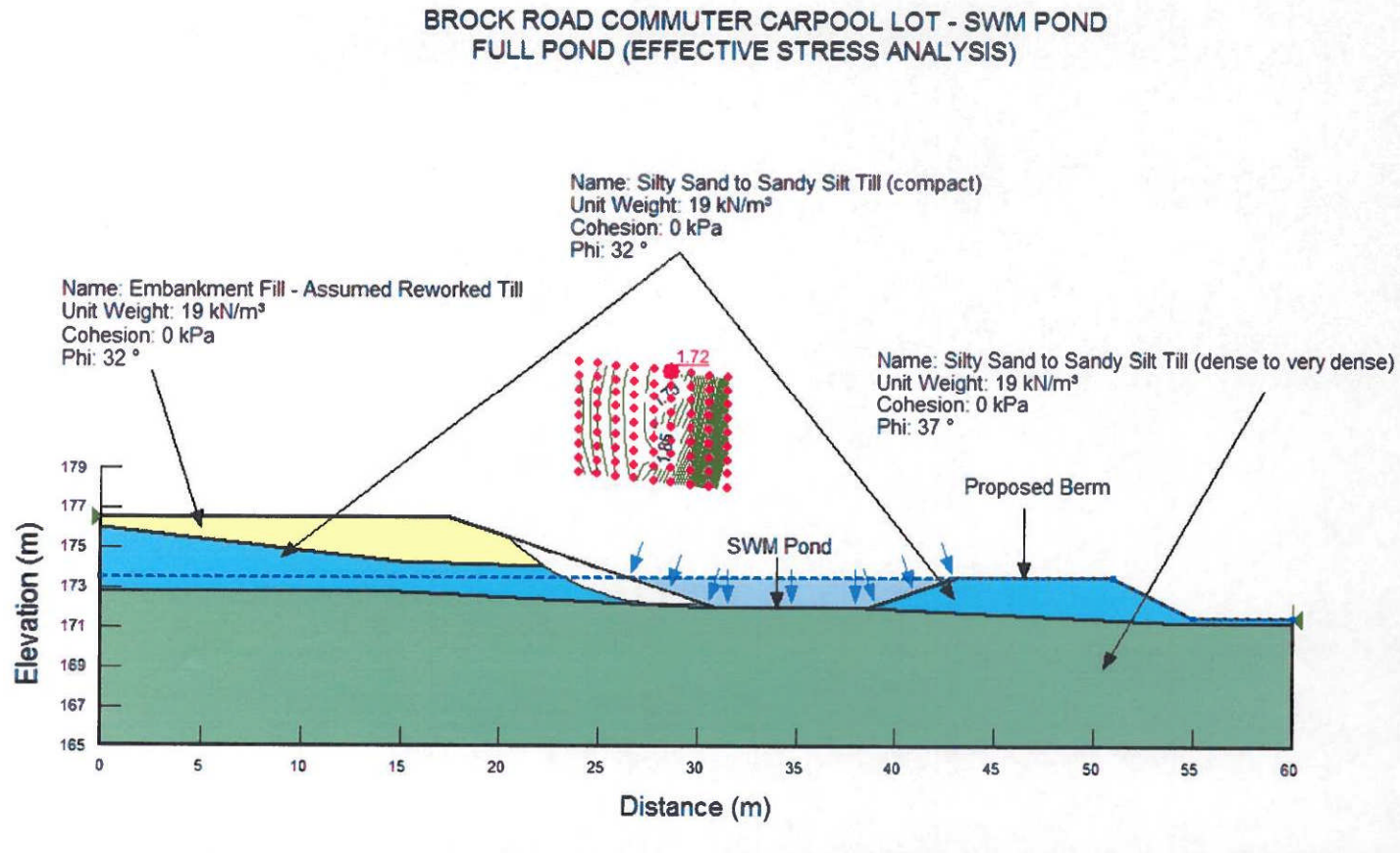


FIGURE 1

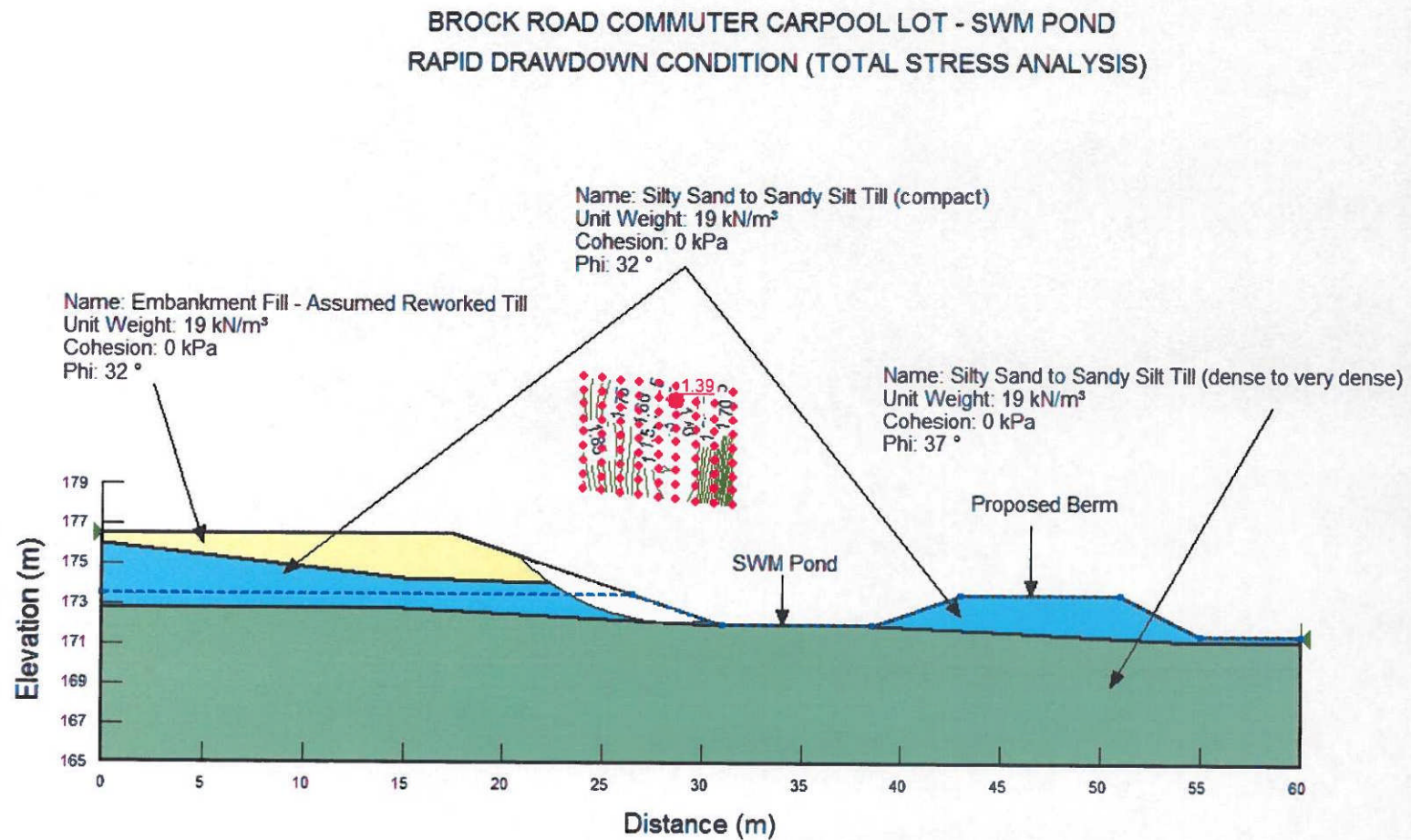
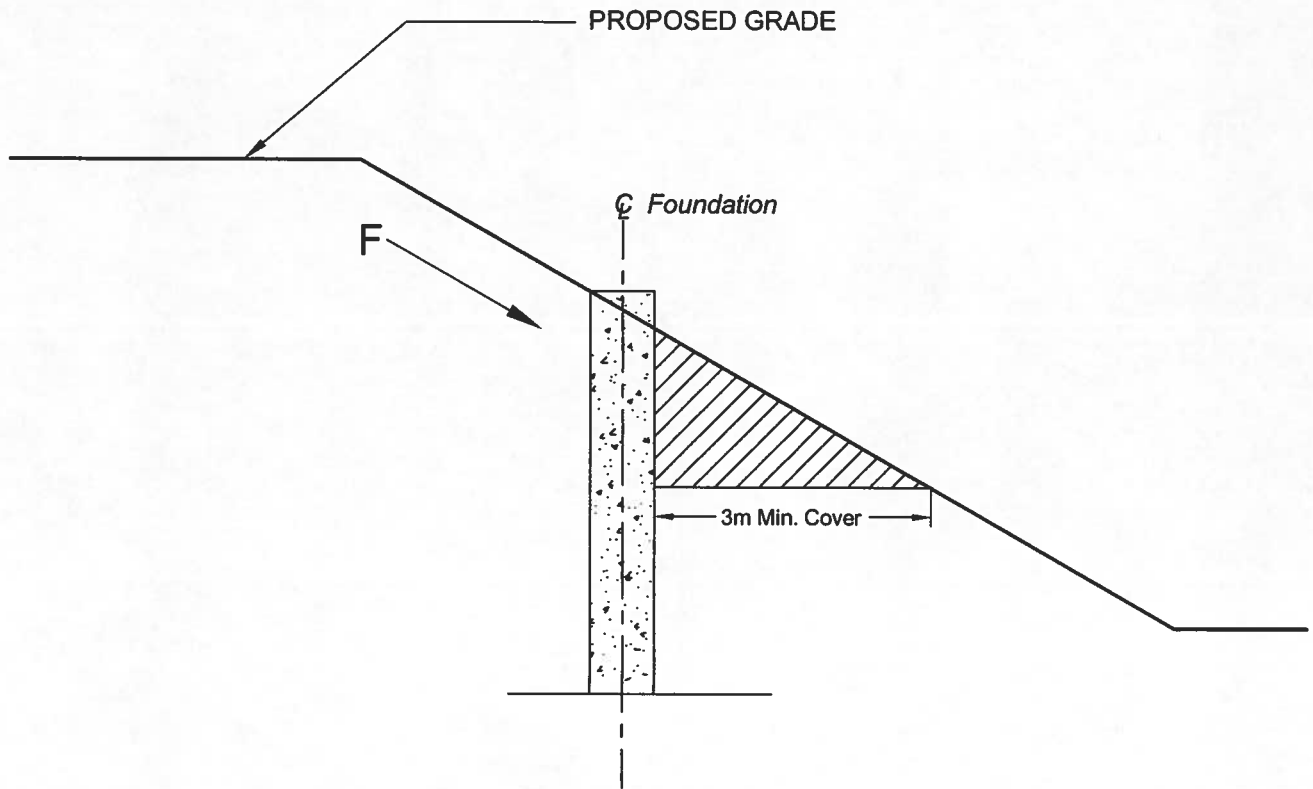


FIGURE 2



LEGEND:

F

ADDITIONAL SLOPING SURFACE
EARTH PRESSURE THRUST



SOIL INCAPABLE OF
HORIZONTAL CAPACITY



PROJECT:

BROCK ROAD COMMUTER CARPOOL LOT
PYLON SIGN

TITLE:

FOUNDATIONS ON SLOPING GROUND

DATE:

FEB. 2014

DRAWN BY:

NA

CHECKED BY:

AD

APPROVED BY:

CN

PROJECT NUMBER:

12TF007D

SCALE:

NTS

DRAWING NUMBER:

1

DRAFT Detailed Foundation Design Report

Highway 407 East, Brock Road Commuter Carpool Lot – SWM Pond, Bus Shelter and Pylon Sign

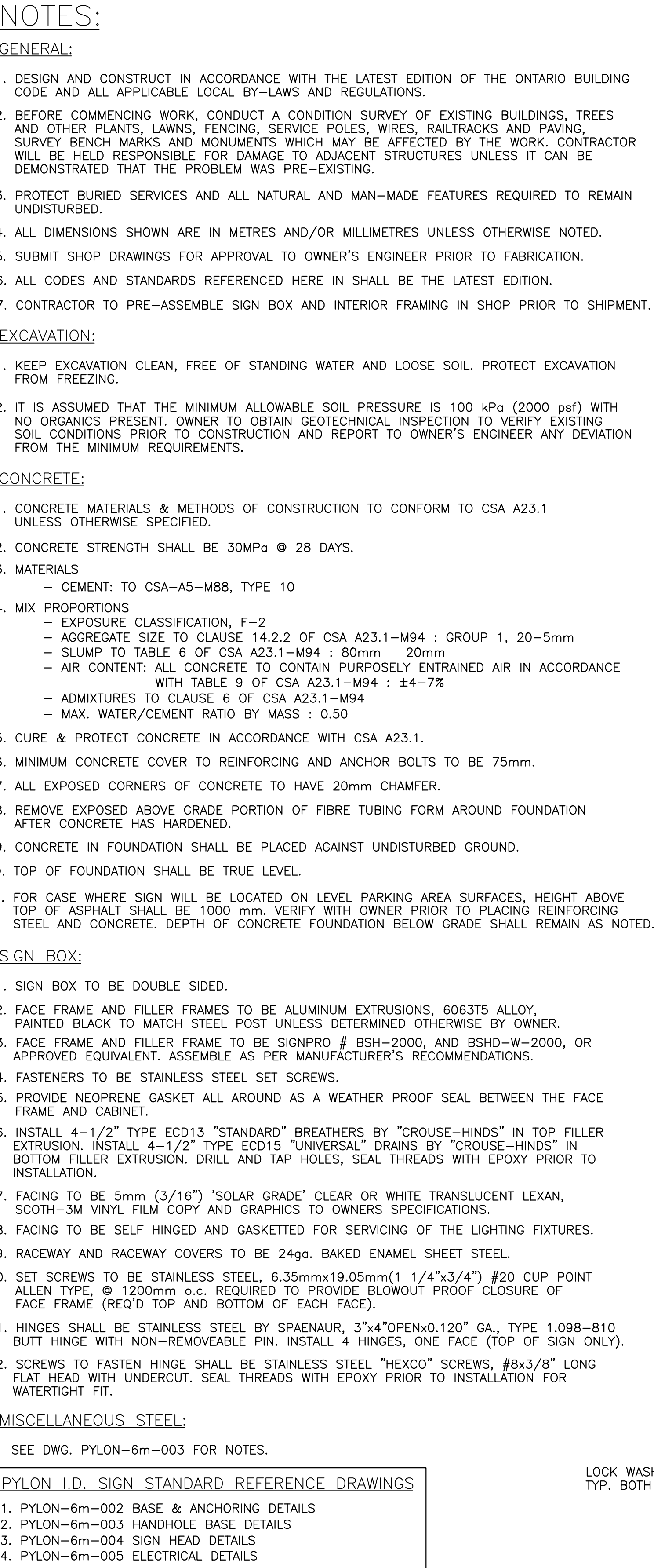
GWP 2355-13-00, Index No.: 054DDR


PML Ref.: 12TF007D, February 4, 2014



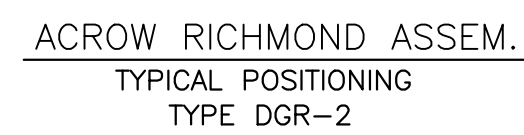
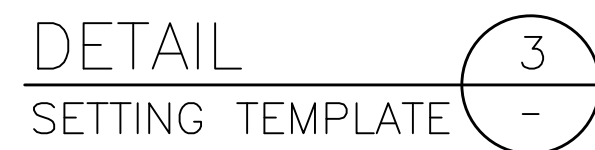
APPENDIX A

Metrolinx Standard Drawings



REFERENCE DRAWINGS		ISSUE		REVISIONS		DRAWN BY: X.X.X. YY/MM/DD	DESIGNED BY: YY/MM/DD			 A Division of METROLINX	XXXXXXXXX STATION GO PYLON ID SIGN (6m) LAYOUTS AND ELEVATIONS				
						CHECKED BY: YY/MM/DD	APPROVED BY: YY/MM/DD								
				3	12.07.01	NOMENCLATURE REVISION									
				2	09.09.11	SIGN GRAPHIC UPDATED									
				1	03.05.22	TITLE/BLOCK UPDATED		SCALE: 1:XXX	FULL SIZE ONLY						
DWG. NO.	TITLE	NO.	DATE	ISSUED FOR	REV.	DATE						CONTRACT NO. XX-200X-EN-XXX	DWG. NO. PYLON-6m-001	REV. 3	SHEET

ALL DIMENSIONS SHOWN ARE
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UNLESS OTHERWISE NOTED.



DETAIL

ANCHOR BOLTS


4
-

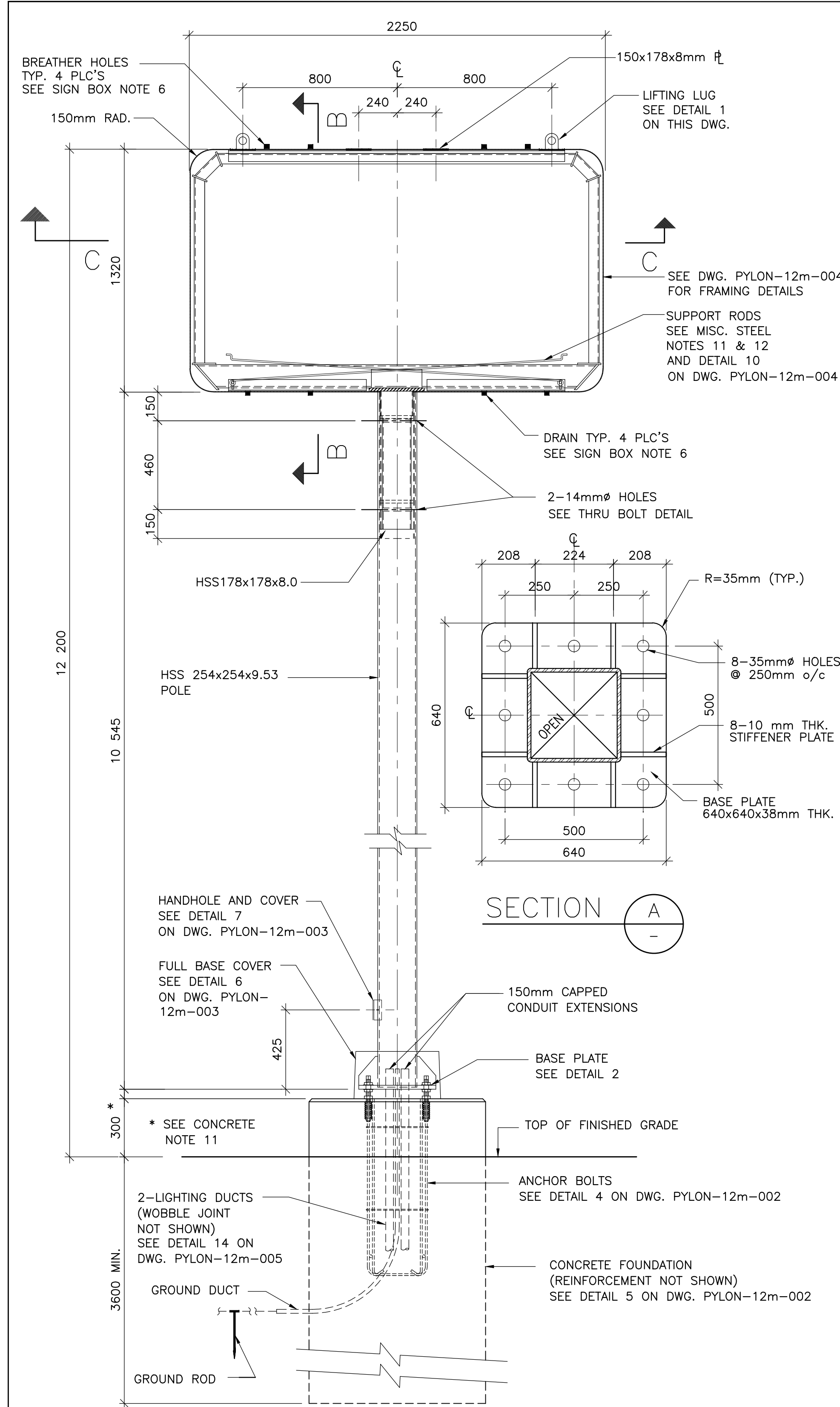
USE SETTING TEMPLATE (SEE DETAIL 3)
FOR POSITIONING ANCHOR BOLTS AND
CONDUITS WITHIN THE FORM.

1. SS-100 LAYOUTS & ELEVATION
2. SS-102 HANDHOLE BASE DETAILS
3. SS-103 SIGN HEAD DETAILS
4. SS-104 ELECTRICAL DETAILS



DETAIL	5
CONCRETE FOUNDATION REINFORCEMENT	-

REFERENCE DRAWINGS		ISSUE		REVISIONS		DRAWN BY: X.X.X. YY/MM/DD		DESIGNED BY: YY/MM/DD		<div></div> <div>A Division of METROLINX</div>	XXXXXXX STATION GO PYLON ID SIGN (6m) CONC. BASE AND ANCHORING DETAILS					
						CHECKED BY: YY/MM/DD		APPROVED BY: YY/MM/DD			CONTRACT NO. XX-200X-EN-XXX		DWG. NO. PYLON-6m-002		REV. 2	SHEET
						SCALE: 1:XXX		FULL SIZE ONLY								
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				1	03.05.22	TITLEBLOCK UPDATED										
DWG NO.	TITLE	NO.	DATE	ISSUED FOR	REV.	DATE										



ELEVATION
TYPICAL STATION SIGN
ASSEMBLY

NOTES:

GENERAL:

- DESIGN AND CONSTRUCT IN ACCORDANCE WITH THE LATEST EDITION OF THE ONTARIO BUILDING CODE AND ALL APPLICABLE LOCAL BY-LAWS AND REGULATIONS.
- BEFORE COMMENCING WORK, CONDUCT A CONDITION SURVEY OF EXISTING BUILDINGS, TREES AND OTHER PLANTS, LAWNS, FENCING, SERVICE POLES, WIRES, RAILTRACKS AND PAVING, SURVEY BENCH MARKS AND MONUMENTS WHICH MAY BE AFFECTED BY THE WORK. CONTRACTOR WILL BE HELD RESPONSIBLE FOR DAMAGE TO ADJACENT STRUCTURES UNLESS IT CAN BE DEMONSTRATED THAT THE PROBLEM WAS PRE-EXISTING.
- PROTECT BURIED SERVICES AND ALL NATURAL AND MAN-MADE FEATURES REQUIRED TO REMAIN UNDISTURBED.
- ALL DIMENSIONS SHOWN ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE NOTED.
- SUBMIT SHOP DRAWINGS FOR APPROVAL TO OWNER'S ENGINEER PRIOR TO FABRICATION.
- ALL CODES AND STANDARDS REFERENCED HERE IN SHALL BE THE LATEST EDITION.
- CONTRACTOR TO PRE-ASSEMBLE SIGN BOX AND INTERIOR FRAMING IN SHOP PRIOR TO SHIPMENT.

EXCAVATION:

- KEEP EXCAVATION CLEAN, FREE OF STANDING WATER AND LOOSE SOIL. PROTECT EXCAVATION FROM FREEZING.
- IT IS ASSUMED THAT THE MINIMUM ALLOWABLE SOIL PRESSURE IS 100 kPa (2000 psf) WITH NO ORGANICS PRESENT. OWNER TO OBTAIN GEOTECHNICAL INSPECTION TO VERIFY EXISTING SOIL CONDITIONS PRIOR TO CONSTRUCTION AND REPORT TO OWNER'S ENGINEER ANY DEVIATION FROM THE MINIMUM REQUIREMENTS.

CONCRETE:

- CONCRETE MATERIALS & METHODS OF CONSTRUCTION TO CONFORM TO CSA A23.1 UNLESS OTHERWISE SPECIFIED.
- CONCRETE STRENGTH SHALL BE 30MPa @ 28 DAYS.
- MATERIALS
 - CEMENT: TO CSA-A5-M88, TYPE 10
- MIX PROPORTIONS
 - EXPOSURE CLASSIFICATION, F-2
 - AGGREGATE SIZE TO CLAUSE 14.2.2 OF CSA A23.1-M94 : GROUP 1, 20-5mm
 - SLUMP TO TABLE 6 OF CSA A23.1-M94 : 80mm 20mm
 - AIR CONTENT: ALL CONCRETE TO CONTAIN PURPOSELY ENTRAINED AIR IN ACCORDANCE WITH TABLE 9 OF CSA A23.1-M94 : ±4-7%
 - ADMIXTURES TO CLAUSE 6 OF CSA A23.1-M94
 - MAX. WATER/CEMENT RATIO BY MASS : 0.50
- CURE & PROTECT CONCRETE IN ACCORDANCE WITH CSA A23.1.
- MINIMUM CONCRETE COVER TO REINFORCING AND ANCHOR BOLTS TO BE 75mm.
- ALL EXPOSED CORNERS OF CONCRETE TO HAVE 20mm CHAMFER.
- REMOVE EXPOSED ABOVE GRADE PORTION OF FIBRE TUBING FORM AROUND FOUNDATION AFTER CONCRETE HAS HARDENED.
- CONCRETE IN FOUNDATION SHALL BE PLACED AGAINST UNDISTURBED GROUND.
- TOP OF FOUNDATION SHALL BE TRUE LEVEL.
- FOR CASE WHERE SIGN WILL BE LOCATED ON LEVEL PARKING AREA SURFACES, HEIGHT ABOVE TOP OF ASPHALT SHALL BE 1000 mm. VERIFY WITH OWNER PRIOR TO PLACING REINFORCING STEEL AND CONCRETE. DEPTH OF CONCRETE FOUNDATION BELOW GRADE SHALL REMAIN AS NOTED.

SIGN BOX:

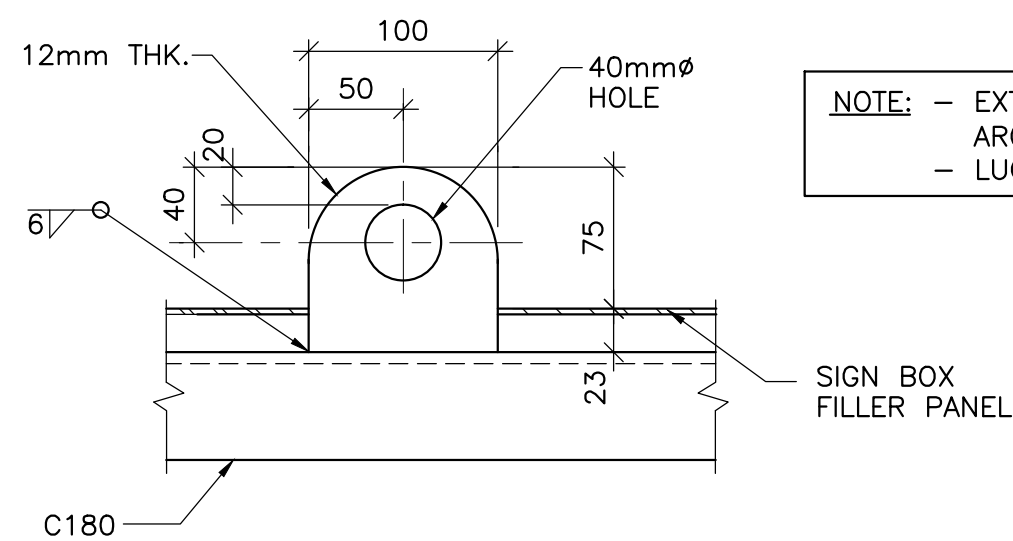
- SIGN BOX TO BE DOUBLE SIDED.
- FACE FRAME AND FILLER FRAMES TO BE ALUMINUM EXTRUSIONS, 6063T5 ALLOY, PAINTED BLACK TO MATCH STEEL POST UNLESS DETERMINED OTHERWISE BY OWNER.
- FACE FRAME AND FILLER FRAME TO BE SIGNPRO # BSH-2000, AND BSHD-W-2000, OR APPROVED EQUIVALENT. ASSEMBLE AS PER MANUFACTURER'S RECOMMENDATIONS.
- FASTENERS TO BE STAINLESS STEEL SET SCREWS.
- PROVIDE NEOPRENE GASKET ALL AROUND AS A WEATHER PROOF SEAL BETWEEN THE FACE FRAME AND CABINET.
- INSTALL 4-1/2" TYPE ECD13 "STANDARD" BREATHERS BY "CROUSE-HINDS" IN TOP FILLER EXTRUSION. INSTALL 4-1/2" TYPE ECD15 "UNIVERSAL" DRAINS BY "CROUSE-HINDS" IN BOTTOM FILLER EXTRUSION. DRILL AND TAP HOLES, SEAL THREADS WITH EPOXY PRIOR TO INSTALLATION.
- FACING TO BE 5mm (3/16") 'SOLAR GRADE' CLEAR OR WHITE TRANSLUCENT LEXAN, SCOTH-3M VINYL FILM COPY AND GRAPHICS TO OWNERS SPECIFICATIONS.
- FACING TO BE SELF HINGED AND GASKETTED FOR SERVICING OF THE LIGHTING FIXTURES.
- RACEWAY AND RACEWAY COVERS TO BE 24ga. BAKED ENAMEL SHEET STEEL.
- SET SCREWS TO BE STAINLESS STEEL, 6.35mmx19.05mm(1 1/4"x3/4") #20 CUP POINT ALLEN TYPE, @ 1200mm o.c. REQUIRED TO PROVIDE BLOWOUT PROOF CLOSURE OF FACE FRAME (REQ'D TOP AND BOTTOM OF EACH FACE).
- HINGES SHALL BE STAINLESS STEEL BY SPAENAU, 3"x4"OPENx0.120" GA., TYPE 1.098-810 BUTT HINGE WITH NON-REMOVEABLE PIN. INSTALL 4 HINGES, ONE FACE (TOP OF SIGN ONLY).
- SCREWS TO FASTEN HINGE SHALL BE STAINLESS STEEL "HEXCO" SCREWS, #8x3/8" LONG FLAT HEAD WITH UNDERCUT. SEAL THREADS WITH EPOXY PRIOR TO INSTALLATION FOR WATERTIGHT FIT.

MISCELLANEOUS STEEL:

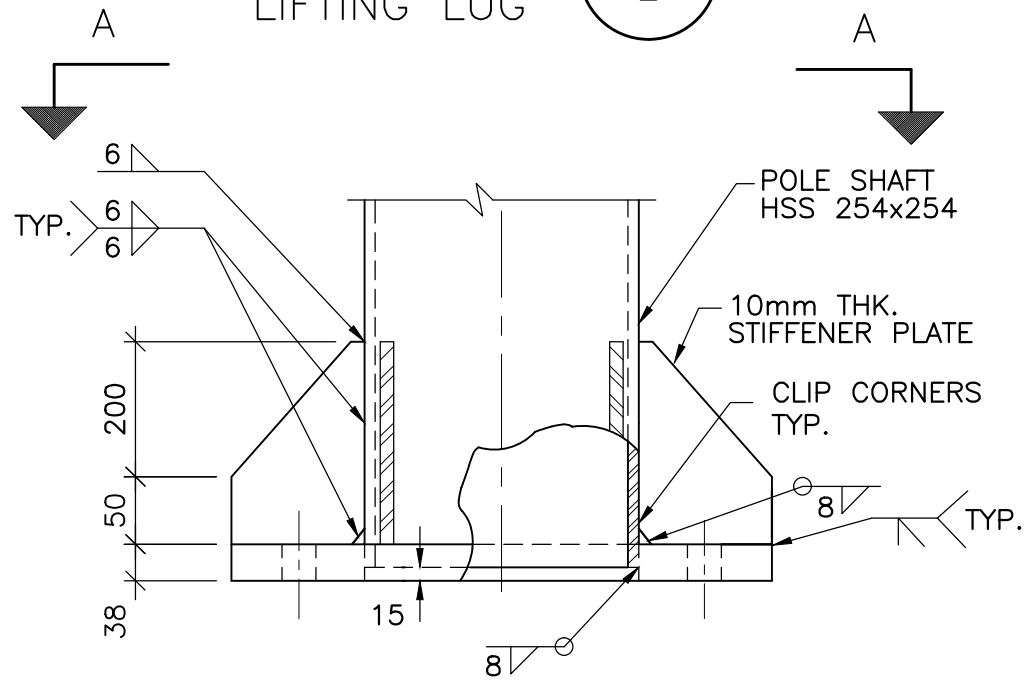
SEE DWG. PYLON-12m-003 FOR NOTES.

PYLON I.D. SIGN STANDARD REFERENCE DRAWINGS

- PYLON-12m-002 CONC. BASE & ANCHORING DETAILS
- PYLON-12m-003 HANDHOLE BASE DETAILS
- PYLON-12m-004 SIGN HEAD DETAILS
- PYLON-12m-005 ELECTRICAL DETAILS

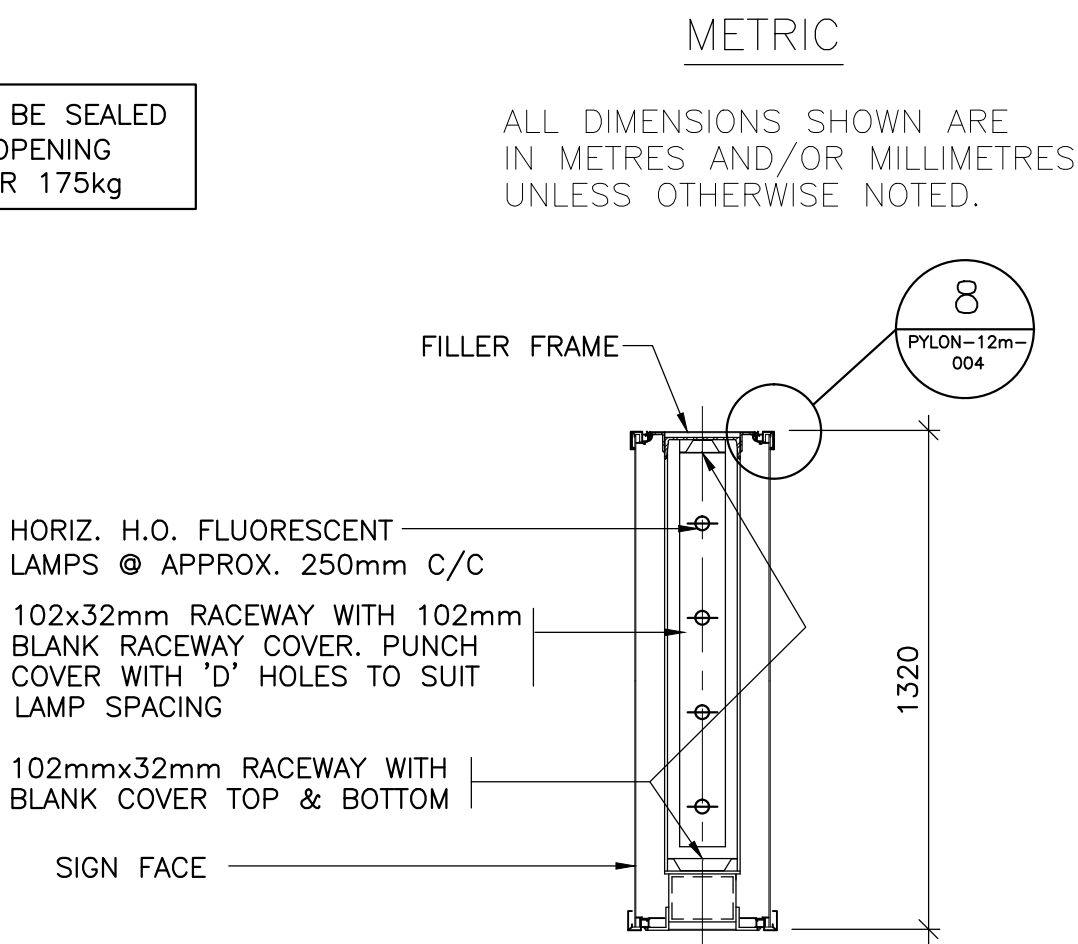


DETAIL 1
LIFTING LUG

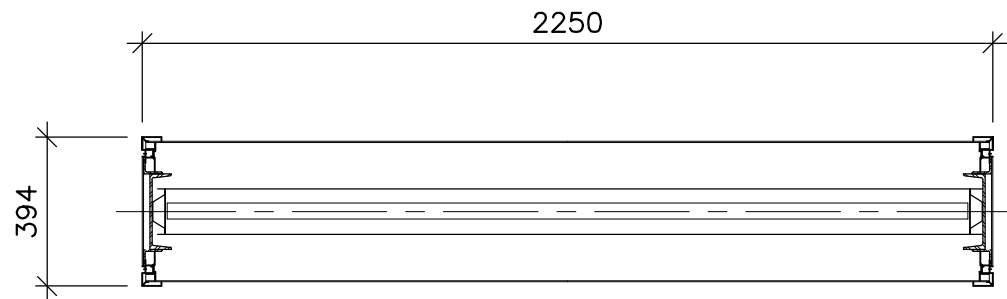


PART ELEVATION

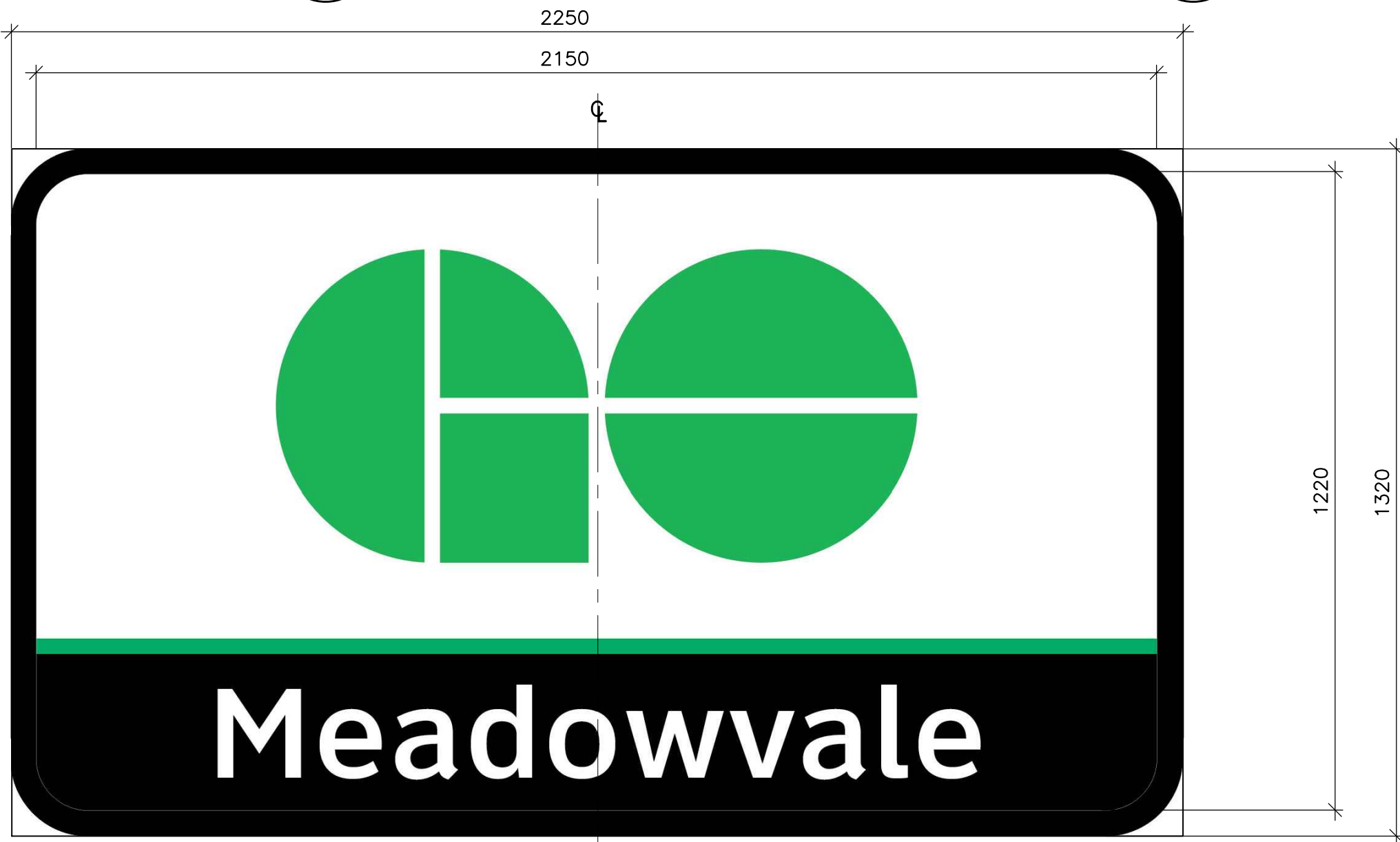
DETAIL 2
BASE PLATE



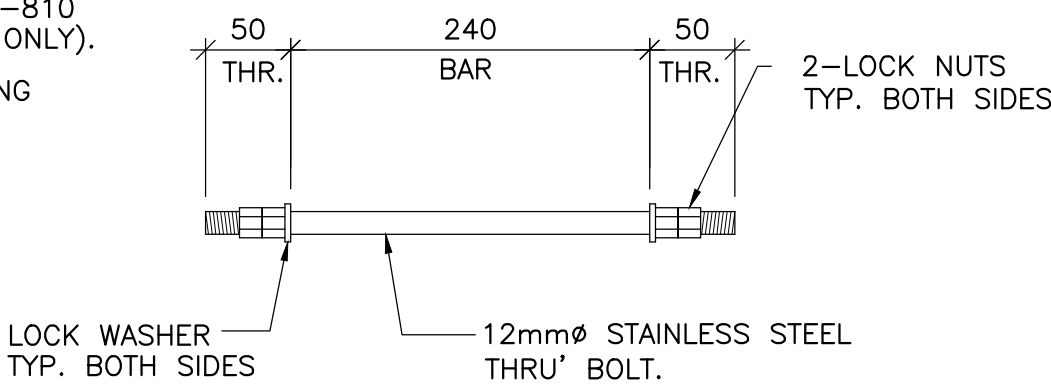
SECTION B



SECTION C



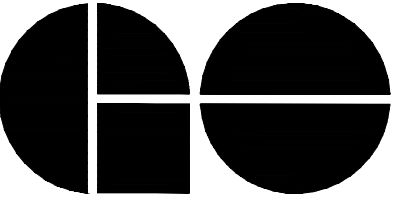
SIGN GRAPHICS DETAIL
FRONT VIEW



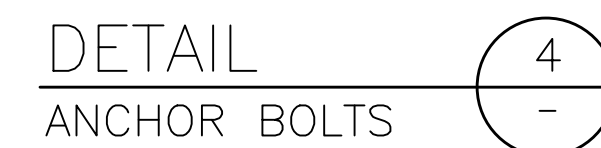
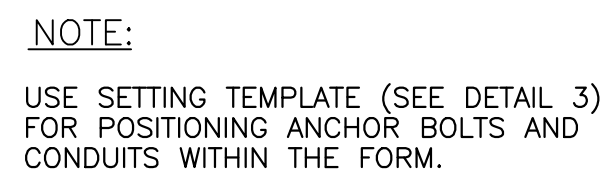
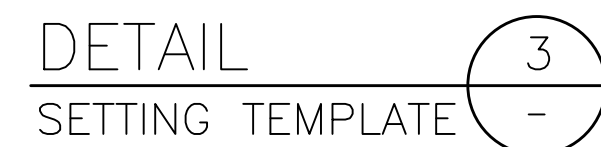
THRU BOLT DETAIL



METROLINX PROJECT NO. XXXXXX

REFERENCE DRAWINGS			ISSUE			REVISIONS			DRAWN BY:	DESIGNED BY:								
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									YY/MM/DD	YY/MM/DD								
									YY/MM/DD	YY/MM/DD								
						3	12.07.01	NOMENCLATURE REVISION										
						2	09.09.11	SIGN GRAPHIC UPDATED										
						1	03.05.22	TITLEBLOCK UPDATED										
DWG. NO.	TITLE	NO.	DATE	ISSUED FOR	REV.	DATE			SCALE: 1:XXX	FULL SIZE ONLY								

 A Division of METROLINX		XXXXXXXXX STATION GO PYLON ID SIGN (12m) LAYOUTS AND ELEVATIONS	
CONTRACT NO. XX-200X-EN-XXX	DWG. NO. PYLON-12m-001	REV. 3	SHEET

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REFERENCE DRAWINGS		ISSUE		REVISIONS		DRAWN BY: X.X.X. YY/MM/DD		DESIGNED BY: YY/MM/DD		<div><p>A Division of METROLINX</p></div>	XXXXXXXXX STATION GO PYLON ID SIGN (12m) CONCRETE BASE AND ANCHORING DETAILS								
						CHECKED BY: YY/MM/DD		APPROVED BY: YY/MM/DD			<div><p>A Division of METROLINX</p></div>	CONTRACT NO. XX-200X-EN-XXX		DWG. NO. PYLON-12m-002		REV. 2		SHEET	
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DWG NO.	TITLE	NO.	DATE	ISSUED FOR	REV.	DATE													



APPENDIX B

Draft Non-Standard Specific Provision (NSSP)



DRAFT NON-STANDARD SPECIAL PROVISIONS (NSSP)

NSSP – Re-use of existing soils as clay liner or core

The Contractor shall be advised that the native silty sand to sandy silt till is considered too pervious to be used for an impervious clay liner or clay core. Since the subsurface investigation failed to reveal any soils which could be suitable for use as an impervious clay core, it is recommended that where an impervious clay liner or core is required, material with characteristics in accordance with OPSS 1205 be imported to the site. The imported material should be free of organics and have a permeability of less than 1×10^{-6} cm/s after compaction in place.



APPENDIX C

Engineered Fill



ENGINEERED FILL

The information presented in this appendix is intended for general guidance only. Site specific conditions and prevailing weather may require modification of compaction standards, backfill type or procedures. Each site must be discussed, and procedures agreed with Peto MacCallum Ltd. prior to the start of the earthworks and must be subject to ongoing review during construction. This appendix is not intended to apply to embankments. Steeply sloping ravine residential lots require special consideration.

For fill to be classified as engineered fill suitable for supporting structural loads, a number of conditions must be satisfied, including but not necessarily limited to the following:

1. Purpose

The site specific purpose of the engineered fill must be recognized. In advance of construction, all parties should discuss the project and its requirements and agree on an appropriate set of standards and procedures.

2. Minimum Extent

The engineered fill envelope must extend beyond the footprint of the structure to be supported. The minimum extent of the envelope should be defined from a geotechnical perspective by:

- at founding level, extend a minimum 1.0 m beyond the outer edge of the foundations, greater if adequate layout has not yet been completed as noted below; and
- extend downward and outward at a slope no greater than 45° to meet the subgrade

All fill within the envelope established above must meet the requirements of engineered fill in order to support the structure safely. Other considerations such as survey control, or construction methods may require an envelope that is larger, as noted in the following sections.

Once the minimum envelope has been established, structures must not be moved or extended without consultation with Peto MacCallum Ltd. Similarly, Peto MacCallum Ltd. should be consulted prior to any excavation within the minimum envelope.

3. Survey Control

Accurate survey control is essential to the success of an engineered fill project. The boundaries of the engineered fill must be laid out by a surveyor in consultation with engineering staff from Peto MacCallum Ltd. Careful consideration of the maximum building envelope is required.

During construction it is necessary to have a qualified surveyor provide total station control on the three dimensional extent of filling.



4. Subsurface Preparation

Prior to placement of fill, the subgrade must be prepared to the satisfaction of Peto MacCallum Ltd. All deleterious material must be removed and in some cases, excavation of native mineral soils may be required.

Particular attention must be paid to wet subgrades and possible additional measures required to achieve sufficient compaction. Where fill is placed against a slope, benching may be necessary and natural drainage paths must not be blocked.

5. Suitable Fill Materials

All material to be used as fill must be approved by Peto MacCallum Ltd. Such approval will be influenced by many factors and must be site and project specific. External fill sources must be sampled, tested and approved prior to material being hauled to site.

6. Test Section

In advance of the start of construction of the engineered fill pad, the Contractor should conduct a test section. The compaction criterion will be assessed in consultation with Peto MacCallum Ltd. for the various fill material types using different lift thicknesses and number of passes for the compaction equipment proposed by the Contractor.

Additional test sections may be required throughout the course of the project to reflect changes in fill sources, natural moisture content of the material and weather conditions.

The Contractor should be particularly aware of changes in the moisture content of fill material. Site review by Peto MacCallum Ltd. is required to ensure the desired lift thickness is maintained and that each lift is systematically compacted, tested and approved before a subsequent lift is commenced.

7. Inspection and Testing

Uniform, thorough compaction is crucial to the performance of the engineered fill and the supported structure. Hence, all subgrade preparation, filling and compacting must be carried out under the full time inspection by Peto MacCallum Ltd.

All founding surfaces for all buildings and residential dwellings or any part thereof (including but not limited to footings and floor slabs) on structural fill or native soils must be inspected and approved by PML engineering personnel prior to placement of the base/subbase granular material and/or concrete. The purpose of the inspection is to ensure the subgrade soils are capable of supporting the building/house foundation and floor slab loads and to confirm the building/house envelope does not extend beyond the limits of any structural fill pads.



8. Protection of Fill

Fill is generally more susceptible to the effects of weather than natural soil. Fill placed and approved to the level at which structural support is required must be protected from excessive wetting, drying, erosion or freezing. Where adequate protection has not been provided, it may be necessary to provide deeper footings or to strip and recompact some of the fill.

9. Construction Delay Time Considerations

The integrity of the fill pad can deteriorate due to the harsh effects of our Canadian weather. Hence, particular care must be taken if the fill pad is constructed over a long time period.

It is necessary therefore, that all fill sources are tested to ensure the material compatibility prior to the soil arriving at site. When there has been a lengthy delay between construction periods of the fill pad, it is necessary to conduct subgrade proof rolling, test pits or boreholes to verify the adequacy of the exposed subgrade to accept new fill material.

When the fill pad will be constructed over a lengthy period of time, a field survey should be completed at the end of each construction season to verify the areal extent and the level at which the compacted fill has been brought up to, tested and approved.

In the following spring, subexcavation may be necessary if the fill pad has been softened attributable to ponded surface water or freeze/thaw cycles.

A new survey is required at the beginning of the next construction season to verify that random dumping and/or spreading of fill has not been carried out at the site.

10. Approved Fill Pad Surveillance

It should be appreciated that once the fill pad has been brought to final grade and documented by field survey, there must be ongoing surveillance to ensure that the integrity of the fill pad is not threatened.

Grading operations adjacent to fill pads can often take place several months or years after completion of the fill pad.

It is imperative that all site management and supervision staff, the staff of Contractors and earthwork operators be fully aware of the boundaries of all approved engineered fill pads.

Excavation into an approved engineered fill pad should never be contemplated without the full knowledge, approval and documentation by the geotechnical consultant.

If the fill pad is knowingly built several years in advance of ultimate construction, the areal limits of the fill pad should be substantially overbuilt laterally to allow for changes in possible structure location and elevation and other earthwork operations and competing interests on the site. The overbuilt distance required is project and/or site specified.



Iron bars should be placed at the corner/intermediate points of the fill pad as a permanent record of the approved limits of the work for record keeping purposes.

11. Unusual Working Conditions

Construction of fill pads may at times take place at night and/or during periods of freezing weather conditions because of the requirements of the project schedule. It should be appreciated therefore, that both situations present more difficult working conditions. The Owner, Contractor, Design Consultant and Geotechnical Engineer must be willing to work together to revise site construction procedures, enhance field testing and surveillance, and incorporate design modifications as necessary to suit site conditions.

When working at night there must be sufficient artificial light to properly illuminate the fill pad and borrow areas.

Placement of material to form an engineered fill pad during winter and freezing temperatures has its own special conditions that must be addressed. It is imperative that each day prior to placement of new fill, the exposed subgrade must be inspected and any overnight snow or frozen material removed. Particular attention should be given to the borrow source inspection to ensure only nonfrozen fill is brought to the site.

The Contractor must continually assess the work program and have the necessary spreading and compacting equipment to ensure that densification of the fill material takes place in a minimum amount of time. Changes may be required to the spreading methods, lift thickness, and compaction techniques to ensure the desired compaction is achieved uniformly throughout each fill lift.

The Contractor should adequately protect the subgrade at the end of each shift to minimize frost penetration overnight. Since water cannot be added to the fill material to facilitate compaction, it is imperative that densification of the fill be achieved by additional compaction effort and an appropriate reduced lift thickness. Once the fill pad has been completed, it must be properly protected from freezing temperatures and ponding of water during the spring thaw period.

If the pad is unusually thick or if the fill thickness varies dramatically across the width or length of the fill pad, Peto MacCallum Ltd. should be consulted for additional recommendations. In this case, alternative special provisions may be recommended, such as providing a surcharge preload for a limited time or increase the degree of compaction of the fill.