

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M14-185

DIST. 6 REGION

W.P. No. 67-85-01

CONT. No. 87-92

W. O. No.

STR. SITE No.

HWY. No. 401

LOCATION HML at Bayview Interchange

No of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 67-85-01

DIST 6

HWY 401

STR SITE N/A

High Mast Lighting
Bayview Interchange

DISTRIBUTION

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FOUNDATION INVESTIGATION REPORT
For
High Mast Lighting
Hwy. 401 at Bayview Avenue
W.P. 67-85-01; Site N/A
District 6, Toronto

INTRODUCTION

This report summarizes the foundation investigation required for the above-noted high mast lighting (HML).

The fieldwork was conducted between 87 02 04 - 06 and between 87 06 22 - 07 07 utilizing a continuous flight auger machine equipped with 82 mm I.D. hollow stem augers.

This work consisted of advancing sampled boreholes at or near all proposed HML locations.

Boreholes pertaining to this project are numbered BH 1 to 6, corresponding to the identifying number of the associated HML. Borehole locations are shown in plan on Figure 1 in the Appendix.

SITE DESCRIPTION

Physiographically, the site lies within the region known as the South Slope (Ref: Chapman and Putnam, 'The Physiography of Southern Ontario', 3rd Edition, 1984). Specifically, the site is located in a till plain north of the past Lake Iroquois shoreline. The soil is a ground moraine which originated in the Pleistocene Age. Bedrock across the site consists of black and grey shale of the Georgian Bay Formation and is estimated to occur at 70 to 80 m below the ground surface. Boreholes in this investigation were not advanced to these depths.

SUBSURFACE CONDITIONS

The native deposits across the site are of glacial origin. Deposits of silty clay till, sand and silt till, fine sand, and silt are among the most predominant encountered within the investigation limits.

The boundaries between the various soil types, in-situ and laboratory test results, as well as groundwater levels are shown on the Record of Borehole Sheets in the Appendix.

Detailed descriptions of the various soils deposits are not given in this report. However, reference should be made to the appropriate Record of Borehole Sheet for subsurface conditions near each HML location.

Laboratory tests were carried out on samples in order to determine composition and behaviour. The results are indicated on the Record of Borehole Sheets.

The groundwater elevation at each borehole was measured after the completion of the hole.

Survey locations for BH #1, #2, and #3, were provided by the Central Region Region Surveys and Plans Section. Surveyed locations were not provided for BH #4, #5 and #6 as the work could not be scheduled by the Central Region Surveys and Plans Section. Hence the elevations which have been indicated on the borehole sheets for these boreholes are approximate.

The investigation revealed that the subsurface conditions across the site are not consistent, as both cohesive and cohesionless deposits are encountered throughout. In addition, it was noted that some of the cohesive deposits contain random zones and seams of cohesionless or slightly plastic material, some of which are water-bearing. Note that concrete was encountered at HML #5 at depths below 6 m.

In zones where the soil is slightly plastic or non-cohesive, and below the groundwater level, it is likely that the sides of an unsupported augered hole will cave in, and seepage will occur. In situations where excavations (or augered holes) extend into cohesionless soils below the groundwater table, 'boiling' may be experienced at the base.

Groundwater levels were measured at the completion of each borehole. The measured levels are shown on each Record of Borehole Sheet. In view of the hard and very dense nature of glacial deposits, it is believed that the measured groundwater levels do not represent stabilized conditions and the actual levels may, in fact, be higher than those indicated on the Record of Borehole Sheets.

DISCUSSION AND RECOMMENDATIONS

A foundation investigation was carried out at the above-noted sites in order to establish soil parameters for the design of HML foundations. The investigation consisted of advancing 1 (one) borehole at, or near each of the HML locations.

Table 1 indicates the proposed locations of the 30 m high HML at the Bayview Avenue - Hwy. 401 Interchange.

Table 1 - HML Locations

<u>HML Number</u>	<u>Station</u>	Distance from <u>☛ Hwy. 401</u>
1	23 + 533	63.5 LT.
2	23 + 629	108.0 LT.
3	23 + 737	67.5 LT.
4	23 + 378	66.0 RT.
5	23 + 495	109.5 RT.
6	23 + 606	58.5 RT.

Design Considerations

As per current MTC design guidelines, each HML pole will be supported on a single concrete caisson. For the design of the caisson, the Structural Office has adopted the method 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 Foundation Division, ASCE,
Volume 90, Number SM2
Paper 3825, March 1964

and

Lateral Resistance of Piles in Cohesionless Soils,
Journal of the Soil Mechanics and Foundation Division, ASCE,
Volume 90, Number SM3
Paper 3909, May 1964

It should also be assumed that material in the zone of frost penetration does not provide any lateral resistance. At this site, the depth of frost penetration through earth cover is approximately 1.2 m. For design purposes, the most critical surface elevations should be assumed so that the required frost penetration cover is provided at all times.

The soil parameters in Table 2 are recommended for the design of the HML foundations. The following notation has been adopted:

ϕ = apparent angle of friction for cohesionless soils

q_u = unconfined compressive strength in kPa ($q_u = 2 \times C_u$) for cohesive soils

γ = bulk unit weight in kN/m

Table 2 - Soil Parameters

	HML Pole	Depth (m) From To	Type of Soil	ϕ	q_u kPa	γ kN/m ³	Pole No. (Caisson depth)
BH 1	1	0.0- 2.1	Non Cohesive	30	0	19.5	C-22-6 6.6 m
		2.1- 2.9	Cohesive	0	350	20.5	
		2.9- 4.0	Non Cohesive	30	0	19.5	
		4.0- 8.1	Cohesive	0	400	20.5	
		8.1-15.7	Non Cohesive	32	0	19.5	
BH 2	2	0.0- 3.4	Non Cohesive	27	0	19.5	C-23-6 9.0 m
		3.4- 6.3	Cohesive	0	450	20.5	
		6.3- 7.9	Non Cohesive	32	0	19.5	
		7.9-11.9	Cohesive	0	400	20.5	
		11.9-14.2	Non Cohesive	32	0	19.5	

Table 2 - Soil Parameters

	HML Pole	Depth (m) From To	Type of Soil	ϕ	q_u kPa	γ kN/m ³	Pole #
BH 3	3	0.0- 1.4	Non Cohesive	27	0	19.5	C-24-6 7.6m
		1.4- 2.7	Cohesive	0	450	20.5	
		2.7- 6.1	Cohesive	0	300	20.0	
		6.1- 7.1	Non Cohesive	30	0	19.5	
		7.1-10.1	Cohesive	0	300	20.0	
		10.1-14.0	Non Cohesive	32	0	19.5	
		14.0-17.2	Cohesive	0	400	20.5	
BH 4	4	0.0- 1.2	Non Cohesive	30	0	19.5	C-19-6 7.6m
		1.2- 4.3	Cohesive	0	80	18.5	
		4.3- 5.3	Cohesive	0	180	19.5	
		5.3- 6.6	Cohesive	0	350	20.5	
		6.6- 7.9	Non Cohesive	35	0	20.0	
		7.9-12.6	Cohesive	0	500	20.5	
BH 5	5	0.0- 4.0	Cohesive	0	150	19.0	C-20-8 7.6m
		4.0- 5.3	Cohesive	0	200	19.0	
		5.3- 9.2	Cohesive	0	400	20.5	
		9.2-12.6	Non Cohesive	35	0	20.0	
BH 6	6	0.0- 1.8	Cohesive	0	90	17.5	C-21-6 7.6m
		1.8- 3.1	Cohesive	0	250	19.0	
		3.1- 5.8	Cohesive	0	400	20.5	
		5.8- 6.6	Non Cohesive	32	0	19.5	
		6.6-10.7	Cohesive	0	500	20.5	
		10.7-11.0	Non Cohesive	35	0	20.0	

Construction Considerations

In zones where the soil is slightly plastic or cohesionless, and below the groundwater level, it is possible that the sides of an unsupported augered hole will cave in. If caving, and as a result, disturbance occurs, the lateral resistance of the soil may be drastically reduced. Therefore, it is recommended that all caissons be constructed utilizing a temporary liner which could be withdrawn as the concrete is being placed.

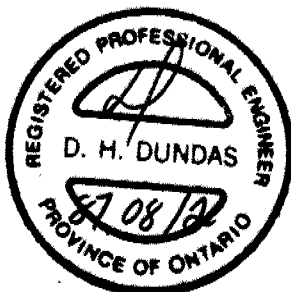
When fine-grained cohesionless soils are subject to unbalanced hydrostatic pressures, 'boiling' will be experienced. Boiling (or quick) conditions result in the complete loss of intergranular friction and the supporting capacity of the soil mass. It will therefore be necessary to prevent such conditions from developing.

Quick conditions could be controlled by balancing the hydrostatic pressures by using either slurry-drilling techniques or balancing the hydraulic head by means of water. The contractor should be informed of the potential of boiling and should be required to prevent the condition from occurring.

MISCELLANEOUS

Part of the fieldwork for this project was carried out between 87 02 04 and 87 02 06 utilizing equipment owned and operated by Master Soil Inv. Ltd. The remainder of the fieldwork for this investigation was carried out between 87 06 22 and 87 07 07 utilizing equipment owned and operated by Dominion Soil Investigation Limited. The first portion of the fieldwork was carried out under the supervision of G. Petruzzello. The second portion of the fieldwork was carried out under the supervision of D. Protulipac.

The report was written by D. Protulipac and reviewed by D. Dundas, Senior Foundation Engineer.



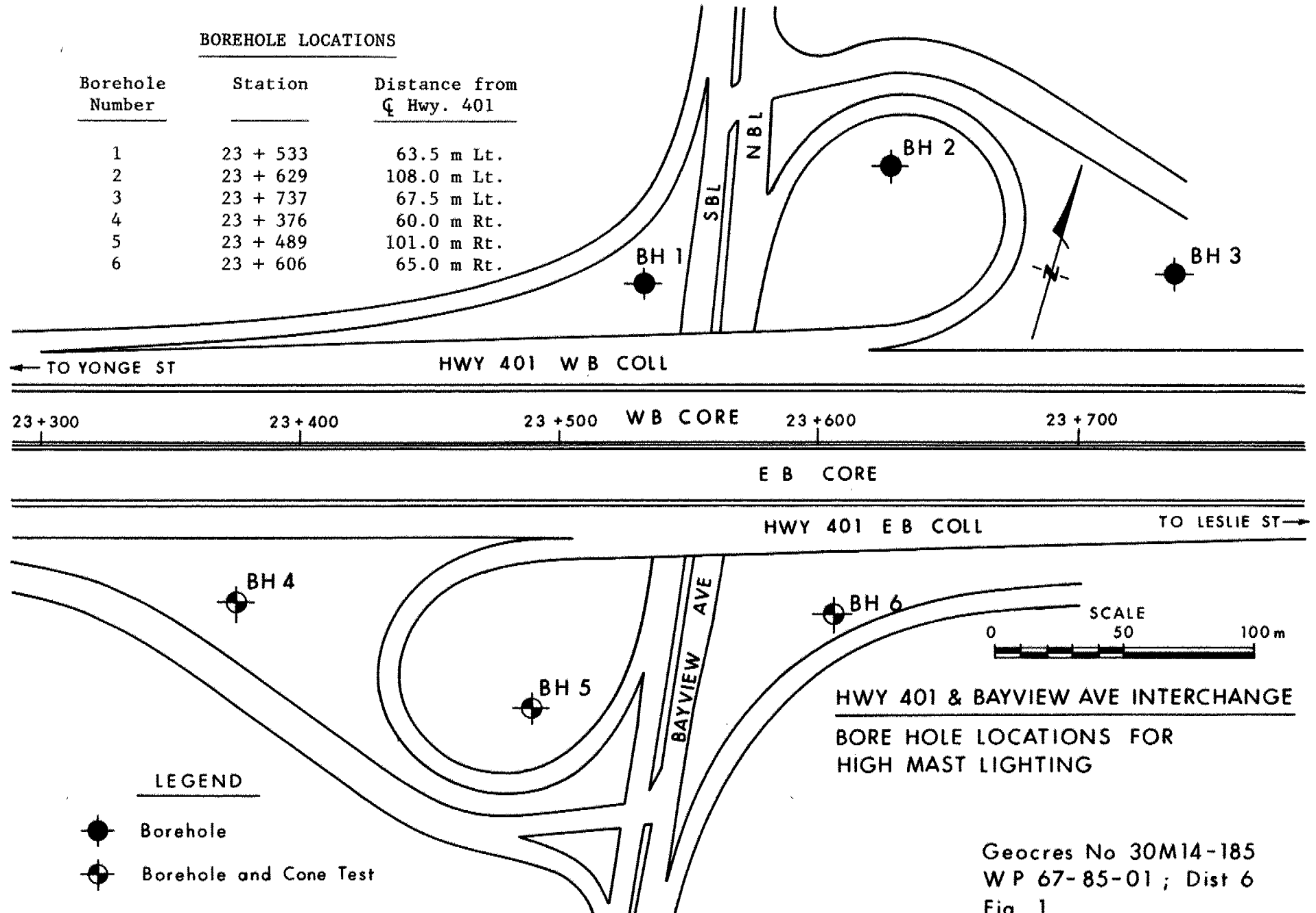
D. Protulipac
D. Protulipac,
Student Engineer

D. H. Dundas
D. H. Dundas, P.Eng.
Senior Foundations Engineer

APPENDIX

BOREHOLE LOCATIONS

Borehole Number	Station	Distance from Ct Hwy. 401
1	23 + 533	63.5 m Lt.
2	23 + 629	108.0 m Lt.
3	23 + 737	67.5 m Lt.
4	23 + 376	60.0 m Rt.
5	23 + 489	101.0 m Rt.
6	23 + 606	65.0 m Rt.





RECORD OF BOREHOLE No 1

METRIC

W P 67-85-01 LOCATION Sta. 23 + 533; O/S 63.5 m Lt. of Hwy. 401 ORIGINATED BY GP
DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DD
DATUM Geodetic DATE 1987 02 04 CHECKED BY DD

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
169.5	Ground Surface																GR SA SI CL
0.0	Silty Sand Very Dense		1	SS	79		168										
167.4			2	SS	85												
2.1	Silty Clay (CL), Hard		3	SS	50												
166.6			4	SS	35		166										
2.9	Silty Sand		5	SS	28												
165.5	Dense		6	SS	50												
4.0			7	SS	74		164										
	Silty Clay (CL) With Sand Occ. Silt Seams Hard		8	SS	68												
161.4			9	SS	59		162										
8.1			10	SS	20												
			11	SS	36		160										
	Silty Sand to Sandy Silt Compact to Very Dense		12	SS	110		158										
			13	SS	14	*											
			14	SS	61		156										
153.8	Silty Clay		15	SS	77		154										
15.7	End of Borehole																
	* Disturbed N Value																

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 2

METRIC

W P 67-85-01 LOCATION Sta. 23 + 629; O/S 108.0 m Lt. of Hwy. 401 ORIGINATED BY GP
DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DD
DATUM Geodetic DATE 1987 02 05 CHECKED BY DD

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
172.2	Ground Surface						172									
0.0																
	Silty Sand Compact		1	SS	7											
			2	SS	7											
			3	SS	6											
168.8			4	SS	14											
3.4			5	SS	104/	25 cm										
	Silty Clay (CL) Hard		6	SS	125/	22 cm										
			7	SS	43											
165.9			8	SS	54											
6.3	Silty Sand Very Dense															
164.3			9	SS	64											
7.9																
	Silty Clay (CL) With Sand Occ. Silt Seams Hard		10	SS	70											
			11	SS	72											
160.3																
11.9	Silty Sand Very Dense		12	SS	0	*										
158.0			13	SS	122											
14.2	End of Borehole * Disturbed N Values															

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 3

METRIC

W P 67-85-01 LOCATION Sta. 23 + 737; O/S 67.5 m Lt. of Hwy. 401 ~~2~~ ORIGINATED BY GP
DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DD
DATUM Geodetic DATE 1987 02 05 and 06 CHECKED BY DD

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100									
								SHEAR STRENGTH									
174.5	Ground Surface																
0.0	Mixture of Sand, Silt Clay and Gravel (Fill) Loose		1	SS	9		174										
173.1			2	SS	100/	25 cm											
1.4			3	SS	64		172										
			4	SS	49												
			5	SS	54												
	Silty Clay (CL) With Sand Occ. Silt Seams Very Stiff to Hard		6	SS	56		170										
			7	SS	27												
	Silty Sand		8	SS	17		168										
			9	SS	48	87020											
			10	SS	32		166										
164.4																	
10.1			11	SS	67		164										
	Silty Sand to Sandy Silt Very Dense		12	SS	52		162										
160.5			13	SS	64												
14.0							160										
	Silty Clay (CL) With Sand Occ. Silt Seams Hard		14	SS	60												
157.3			15	SS	45		158										
17.2	End of Borehole																

+³, x⁵: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 4

METRIC

W P 67-85-01 LOCATION Sta. 23 + 376; O/S 60.0 m Rt. of Hwy. 401 ORIGINATED BY DP
DIST 6 HWY 401 BOREHOLE TYPE Cone Test, Hollow Stem Auger COMPILED BY DP
DATUM Geodetic DATE 1987 06 25-26 CHECKED BY DD

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			20 40 60 80 100						
171.0	Ground Surface												
0.0	Silty Sand Compact		1	SS	26								
169.8			2	SS	8								
1.2	Silty Clay (CL) With Sand Occ. Silt Seams Firm to Hard		3	SS	8								
			4	SS	11								
	Occ. Organics		5	SS	10								
			6	SS	18								
			7	SS	30								
164.4			8	SS	103/	28 cm							
6.6	Sandy Silt Very Dense		9	SS	120/	10 cm							
163.1			10	SS	92								
7.9	Silty Clay (CL) With Sand Occ. Silt Seams Hard		11	SS	120/	12.5 cm							
158.4			12	SS	129								
12.6	End of Borehole												
	* Groundwater Level measured on 87 06 29												

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 5

METRIC

W P 67-85-01 LOCATION Sta. 23 + 489; O/S 101.0 m Rt. of Hwy. 401 ORIGINATED BY DP
 DIST 6 HWY 401 BOREHOLE TYPE Cone Test, Hollow Stem Auger COMPILED BY DP
 DATUM Geodetic DATE 1987 06 20-07 02 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
171.0	Ground Surface												
0.0			1	SS	13		170						
			2	SS	17								
			3	SS	17								
			4	SS	18		168						
	Occ. Organics		5	SS	18								
			6	SS	40		166						
	Silty Clay (CL) With Sand Occ. Silt Seams Stiff to Hard		7	SS	81								
			8	SS	89								
			9	SS	57		164						
	Concrete **		10	SS	93								
161.8							162						
9.2			11	SS	123	25 cm							
	Silty Sand to Sandy, Silt Very Dense		12	SS	122	12.5 cm	160						
158.4			13	SS	125								
12.6	End of Borehole												
	* Groundwater Level measured on 87 07 02												
	** Note Concrete encountered in BH												

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 6

METRIC

W P 67-85-01 LOCATION Sta. 23 + 606; O/S 65.0 m Rt. of Hwy. 401 ORIGINATED BY DP
DIST 6 HWY 401 BOREHOLE TYPE Cone Test, Hollow Stem Auger COMPILED BY DP
DATUM Geodetic DATE 87 07 03 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 10 20 30	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
170.2	Ground Surface						170				
0.0			1	SS	10						
	Occ. Organics		2	SS	17						
	Silty Clay (CL) With Sand Occ. Silt Seams Stiff to Hard		3	SS	36						
			4	SS	123/	28 cm					
			5	SS	72/	25 cm					
			6	SS	75						
164.4			7	SS	45						
5.8	Sandy Silt		8	SS	82						
163.6	Very Dense										
6.6			9	SS	118/	25 cm					
	Silty Clay (CL) With Sand Occ. Silt Seams Hard		10	SS	122/	23 cm					
159.5											
159.2	Silty Sand V. Dense		11	SS	122/	23 cm					
11.0	End of Borehole										
	* Groundwater Level measured on 87 07 07										

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

memorandum



To: C.G.E. Burkhardt
Head, Structural Office
Central Region
5000 Yonge Street

Date: 1987 10 19

Atten: P.K. Roy

From: Foundation Design Section
Room 315, Central Building

RE: Non-Standard Special Provision
Concrete Footings for Highmast Lighting
W.P. 67-85-01

Further to your request of 87 10 09, the Special Provision for 'Concrete Footings in Earth for High Mast Poles' should be as follows:

"The contractor shall install concrete footings in earth for high mast poles as shown on the contract drawings. At the various pole locations, soil deposits consist of mixtures of silts, sands and gravels in varied proportions separated by cohesive layers of silty clay of varying thickness. Groundwater is likely to be encountered from one to two metres below the existing ground surface. The soil is highly susceptible to conditions of unbalanced hydrostatic head and seepage forces and is likely to 'boil' and become unstable under such conditions. The contractor shall maintain the stability of the soil in the sides and bases of the holes for the concrete footings at all times from commencement of their construction to the placing of concrete".

Should you require further clarification on this subject, please feel free to contact us.

A handwritten signature in dark ink, appearing to read "M. Devata".

M. Devata, P. Eng.
Chief Foundations Engineer
(East)

MD/mmj

FOUNDATION INVESTIGATION REPORT

For

High Mast Lighting
Hwy. 401 at Bayview Avenue
W.P. 67-85-01; Site N/A
District 6, Toronto

INTRODUCTION

This report summarizes the foundation investigation required for the above-noted high mast lighting (HML).

The fieldwork was conducted between 87 06 22 and 87 07 07 utilizing a continuous flight auger machine equipped with 82 mm I.D. hollow stem augers.

This work consisted of advancing sampled boreholes at or near all proposed HML locations.

Boreholes pertaining to this project are numbered BH 1 to 6, corresponding to the identifying number of the associated HML. Borehole locations are shown in plan on Dwg. No. 678501-A in the Appendix.

SITE DESCRIPTION

Physiographically, the site lies within the region known as the South Slope (Ref: Chapman and Putnam, 'The Physiography of Southern Ontario', 3rd Edition, 1984). Specifically, the site is located in a till plain north of the past Lake Iroquois shoreline. The soil is a ground moraine which originated in the Pleistocene Age. Bedrock across the site consists of black and grey shale of the Georgian Bay Formation and is estimated to occur at 70 to 80 m below the ground surface. Boreholes in this investigation were not advanced to these depths.

SUBSURFACE CONDITIONS

The native deposits across the site are of glacial origin. Deposits of silty clay till, sand and silt till, fine sand, and silt are among the most predominant encountered within the investigation limits.

The boundaries between the various soil types, in-situ and laboratory test results, as well as groundwater levels are shown on the Record of Borehole Sheets in the Appendix.

Detailed descriptions of the various soils deposits are not given in this report. However, reference should be made to the appropriate Record of Borehole Sheet for subsurface conditions near each HML location.

Laboratory tests were carried out on samples in order to determine composition and behaviour. These include Atterberg Limits, Grain Size Distribution and Moisture Content Tests. The results are indicated on the Record of Borehole Sheets.

The groundwater elevation at each borehole was measured after the completion of the hole.

Surveyed locations were not provided, as the work could not be scheduled by the Central Region Surveys and Plans Section. Hence the elevations which have been indicated on the borehole sheets are approximate.

The investigation revealed that the subsurface conditions across the site are not consistent, as both cohesive and cohesionless deposits are encountered throughout. In addition, it was noted that some of the cohesive deposits contain random zones and seams of cohesionless or slightly plastic material, some of which are water-bearing.

In zones where the soil is slightly plastic or non-cohesive, and below the groundwater level, it is likely that the sides of an unsupported augered hole will cave in, and seepage will occur. In situations where excavations (or augered holes) extend into cohesionless soils below the groundwater table, 'boiling' may be experienced at the base.

Groundwater levels were measured at the completion of each borehole. The measured levels are shown on each Record of Borehole Sheet. In view of the hard and very dense nature of glacial deposits, it is believed that the measured groundwater levels do not represent stabilized conditions and the actual levels may, in fact, be higher than those indicated on the Record of Borehole Sheets.

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Table 1 indicates the proposed locations of the 30 m high HML at the Bayview Street - Hwy. 401 Interchange.

Table 1 - HML Locations

<u>HML Number</u>	<u>Station</u>	<u>Distance from Station</u>
1	23 + 533	63.5 LT.
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Design Considerations

As per current MTC design guidelines, each HML pole will be supported on a single concrete caisson. For the design of the caisson, the Structural Office has adopted the method described by B. B. Broms in the following two papers:

Broms, B. B.

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Volume 90, Number SM2
Paper 3825, March 1964

and

Lateral Resistance of Piles in Cohesionless Soils,
Journal of the Soil Mechanics and Foundation Division, ASCE,
Volume 90, Number SM3
Paper 3909, May 1964

It should also be assumed that material in the zone of frost penetration does not provide any lateral resistance. At this site, the depth of frost penetration through earth cover is approximately 1.2 m. For design purposes, the most critical surface elevations should be assumed so that the required frost penetration cover is provided at all times.

The soil parameters in Table 2 are recommended for the design of the HML foundations. The following notation has been adopted:

ϕ = apparent angle of friction for cohesionless soils

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γ = bulk unit weight in kN/m

Table 2 - Soil Parameters

<u>HML Pole</u>	<u>Depth (m) From To</u>	<u>Type of Soil</u>	<u>ϕ</u>	<u>q_u kPa</u>	<u>γ kN/m³</u>
1	0.0- 2.1	Non Cohesive	30	0	19.5
	2.1- 2.9	Cohesive	0	350	20.5
	2.9- 4.0	Non Cohesive	30	0	19.5
	4.0- 8.1	Cohesive	0	400	20.5
	8.1-15.7	Non Cohesive	32	0	19.5
2	0.0- 3.4	Non Cohesive	27	0	19.5
	3.4- 6.3	Cohesive	0	450	20.5
	6.3- 7.9	Non Cohesive	32	0	19.5
	7.9-11.9	Cohesive	0	400	20.5
	11.9-14.2	Non Cohesive	32	0	19.5

Table 2 - Soil Parameters

HML Pole	Depth (m) From To	Type of Soil	ϕ	qu kPa	γ kN/m ³
3	0.0- 1.4	Non Cohesive	27	0	19.5
	1.4- 2.7	Cohesive	0	450	20.5
	2.7- 6.1	Cohesive	0	300	20.0
	6.1- 7.1	Non Cohesive	30	0	19.5
	7.1-10.1	Cohesive	0	300	20.0
	10.1-14.0	Non Cohesive	32	0	19.5
	14.0-17.2	Cohesive	0	400	20.5
4	0.0- 1.2	Non Cohesive	30	0	19.5
	1.2- 4.3	Cohesive	0	80	18.5
	4.3- 5.3	Cohesive	0	180	19.5
	5.3- 6.6	Cohesive	0	350	20.5
	6.6- 7.9	Non Cohesive	35	0	20.0
	7.9-12.6	Cohesive	0	500	20.5
5	0.0- 4.0	Cohesive	0	150	19.0
	4.0- 5.3	Cohesive	0	200	19.0
	5.3- 9.2	Cohesive	0	400	20.5
	9.2-12.6	Non Cohesive	35	0	20.0
6	0.0- 1.8	Cohesive	0	90	17.5
	1.8- 3.1	Cohesive	0	250	19.0
	3.1- 5.8	Cohesive	0	400	20.5
	5.8- 6.6	Non Cohesive	32	0	19.5
	6.6-10.7	Cohesive	0	500	20.5
	10.7-11.0	Non Cohesive	35	0	20.0

Construction Considerations

In zones where the soil is slightly plastic or cohesionless, and below the groundwater level, it is possible that the sides of an unsupported augered hole will cave in. If caving, and as a result, disturbance occurs, the lateral resistance of the soil may be drastically reduced. Therefore, it is recommended that all caissons be constructed utilizing a temporary liner which could be withdrawn as the concrete is being placed.

When fine-grained cohesionless soils are subject to unbalanced hydrostatic pressures, 'boiling' will be experienced. Boiling (or quick) conditions result in the complete loss of intergranular friction and the supporting capacity of the soil mass. It will therefore be necessary to prevent such conditions from developing.

Quick conditions could be controlled by balancing the hydrostatic pressures by using either slurry-drilling techniques or balancing the hydraulic head by means of water. The contractor should be informed of the potential of boiling and should be required to prevent the condition from occurring.

MISCELLANEOUS

The fieldwork for this investigation was carried out between 87 06 22 and 87 07 07 utilizing equipment owned and operated by Dominion Soil Investigation Limited. The fieldwork was carried out under the supervision of D. Protulipac of the Foundation Design Section.

The report was written by D. Protulipac and reviewed by D. Dundas, Senior Foundation Engineer.

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