

G.I.F-30 SEPT. 1976

GEOCRES No. 4072-42DIST. 32 REGION W.P. No. 167-96-00CONT. No. W. O. No. STR. SITE No. HWY. No. 401LOCATION Hwy 401 from Hwy 3 to
0.8 km East of IC 14No of PAGES - =====OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:

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DRAFT REPORT ON

FOUNDATION INVESTIGATION AND DESIGN

HIGH MAST LIGHTING

HIGHWAY 401, WINDSOR

FROM HIGHWAY 3 TO 0.8 KM EAST

OF INTERCHANGE 14

W.P. 167-96-01

PROJECT NO. 3005-A-000085

Submitted to:

Ministry of Transportation, Ontario
Geotechnical Section, Southwestern Region
659 Exeter Road, 3rd Floor
London, Ontario
N6E 1L3

DISTRIBUTION:

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1 Copy - Golder Associates Ltd.

November 1999

991-3204

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LIST OF ABBREVIATIONS

LIST OF SYMBOLS

RECORDS OF BOREHOLES

- FIGURE 1 - Key Plan
- FIGURE 2 - Location Plan
- FIGURE 3 - Location Plan
- FIGURE 4 - Grain Size Distribution

PART A – FOUNDATION INVESTIGATION

HIGH MAST LIGHTING
HIGHWAY 401, WINDSOR
FROM HIGHWAY 3 TO 0.8 KM EAST
OF INTERCHANGE 14

W.P. 167-96-01

November 1999

991-3204

Golder Associates

1.0 INTRODUCTION

Golder Associates Ltd. has been retained by the Ministry of Transportation, Ontario (MTO) to carry out a foundation investigation for the high mast lighting to be installed as part of W.P. 167-96-01. The project involves pavement design work for Highway 401 from Highway 3 to 0.8 kilometres east of Interchange 14, for a total distance of 4.3 kilometres. The foundation component of the project includes thirteen (13) high mast lights (HML) to be located between Walker Road (Essex County Road 11) and Station 14+300, near Eight Concession Road. The location of the site is shown on the Key Plan, Figure 1.

The purpose of the foundation investigation is to determine the subsurface conditions at the site by means of a limited number of boreholes, in situ tests and laboratory tests on selected samples. Based on our interpretation of the data obtained, recommendations on the foundation aspects of design of the proposed works are provided. Comments are also provided on anticipated construction problems where they may affect design of the high mast lighting.

The terms of reference for the scope of work provided by the MTO are outlined in our proposal letter P91-3125, dated September 21, 1999. The scope of work provided called for 5 boreholes for the 13 high mast lighting locations. The work was carried out in accordance with our Quality Control Plan for Foundation Design Services, dated May 10, 1999.

2.0 SITE DESCRIPTION

The site extends along Highway 401 from Highway 3 to 0.8 kilometres east of Interchange 14 in Windsor, Ontario, within MTO District *X*. ³²

With the exception of the roadway embankments the topography of the site is relatively flat. The ground surface at the borehole locations varies from elevation 188.8 to 190.9 metres. The grade of the existing highway within the project area varies even more at the existing structures. Vegetation cover adjacent to the existing highway consists of grass, shrubs and localized swamp grasses with occasional trees and treed areas.

3.0 INVESTIGATION PROCEDURES

The field work for this foundation investigation was carried out on October 21 and 22, 1999. At this time, five (5) boreholes were put down at the site at the locations shown on the Location Plans, Figures 2 and 3. The boreholes were drilled at the approximate locations of five of the HML's, as shown on ^{Figures 2 and 3} Figure 1, to a depth of 11.1 metres each. The table below summarizes the locations and ground surface elevations of the boreholes drilled as part of this investigation. ✕

<u>BOREHOLE</u>	<u>CHAINAGE</u> (m)	<u>GROUND SURFACE ELEVATION</u> (m)	<u>BOREHOLE DEPTH</u> (m)
1	13+944, 28m LT	188.83	11.13
2	13+217, 100m LT	189.78	11.13
3	12+873, 19m RT	190.93	11.13
4	13+345, 98m RT	190.01	11.13
5	14+137, 32m RT	189.07	11.13

NOTES: RT – right of the centreline of the median

LT – left of the centreline of the median

The investigation was carried out using a drilling rig supplied and operated by a specialist drilling contractor. In the boreholes, soil samples were obtained at regular intervals of depth using 50 millimetre outside diameter split-spoon samplers in accordance with the standard penetration test procedures. The boreholes were terminated at 11.1 metres depth below existing ground surface within a silty clay till stratum. Groundwater conditions in the open boreholes were observed throughout the drilling operations. Piezometers were installed in Boreholes 2 and 4 to permit monitoring of the groundwater levels at the site.

The field work was supervised on a full-time basis by a member of our engineering staff who located the boreholes in the field, obtained utility locates, directed the drilling, sampling and in situ testing operations, and logged the boreholes. The samples were identified in the field, placed in labelled containers and transported to our laboratory in London, Ontario for further

examination and laboratory testing. Index and classification tests were carried out on selected samples. The results of the testing are shown on the Record of Borehole sheets and on Figure 4.

The as drilled borehole locations were determined by our personnel relative to the chainages provided by MTO. Elevations at the borehole locations were determined based on MTO benchmark 73 8541. This benchmark is understood to have an elevation of 190.439 metres, referenced to geodetic datum. The locations of the boreholes are shown on the Record of Borehole sheets and on Figures 2 and 3, attached.

4.0 GENERAL SITE GEOLOGY AND STRATIGRAPHY

4.1 Site Geology

From published geologic information, the soils in the area of the site were deposited during the Pleistocene Epoch and consist of glaciofluvial sediments over clayey silt/silty clay tills deposited during the Wisconsin or last ice age. The overburden is underlain by Middle Devonian limestone, dolomite and shale at depths between 60 and 110 metres below existing ground surface.

4.2 Site Stratigraphy

The detailed subsurface soil and groundwater conditions encountered in the boreholes, together with the results of the laboratory tests carried out on selected soil samples, are given on the attached Record of Borehole sheets and on Figure 4, following the text of this report. The stratigraphic boundaries shown on the borehole sheets are inferred from non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. Subsoil conditions will vary between and beyond the borehole locations.

In summary, the existing fill materials overlay silty clay till deposits. A detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.2.1 Fill Materials

Layers of brown and black silty sand, topsoil and silty clay fill with varying amounts of gravel were encountered at ground surface in boreholes 1, 3 and 5. The fill layers extended to depths between 1.1 and 1.4 metres. Standard penetration test 'N' values ranging from 9 to 14 blows per 0.3 metres of penetration were measured within the fill, indicating a generally compact or stiff condition. The fill samples had measured water contents of 8 to 18 per cent.

4.2.2 Silty Clay Till

Layers of brown and grey silty clay till with sand and occasional gravel particles were encountered in all boreholes. The till has a stiff to hard crust/layer between about elevations 185.8 and 189.9 metres, with standard penetration test 'N' values between 12 and 38 blows per

— based on Atterberg limits — would classify as clayey silt till according to "MTC Soil Classification System" (USCS, modified by Casagrande and adjusted by MTO)

0.3 metres penetration. At depths below 3.1 to 4.1 metres, the silty clay till layers were firm to very stiff with standard penetration test 'N' values between 5 and 24 blows per 0.3 metre penetration, with an average of about 11 blows per 0.3 metres. Field vane testing carried out in the lower silty clay till indicated shear strengths of 85 to over 120 kilopascals with sensitivities of between 1.3 and 1.9.

The silty clay till had measured water contents between about 10 and 17 per cent. Atterberg limit tests on five samples of the till indicated liquid limits ranging from 28 to 32 per cent and plasticity indices ranging from 12 to 16 per cent. Grain size distribution curves for the silty clay till samples are summarized on the Record of Boreholes and are shown on Figure 4.

4.2.3 Silty Sand

Isolated thin layers of grey silty sand were encountered in the lower till layers in boreholes 4 and 5. The sand layers were between 0.3 and 0.5 metres thick and had standard penetration test 'N' values of 10 and 19 blows per 0.3 metres of penetration. The silty sand layers had measured natural water contents of about 9 and 13 per cent.

4.3 Groundwater Conditions

Groundwater conditions were observed during drilling operations and on completion of drilling. Piezometers were installed in Boreholes 2 and 4 to monitor for the groundwater conditions at the site. Details of the piezometer installations are provided on the attached Record of Borehole sheets. The table below summarizes the groundwater conditions in the boreholes. Groundwater levels are expected to fluctuate seasonally and are expected to be higher during wet periods of the year.

<u>BOREHOLE</u>	<u>GROUND SURFACE ELEVATION</u> (m)	<u>GROUNDWATER LEVEL IN OPEN BOREHOLE ON COMPLETION OF DRILLING</u>	<u>GROUNDWATER LEVEL IN PIEZOMETERS ON OCTOBER 29, 1999</u>	
			<u>Depth Below Existing Ground Surface</u> (m)	<u>Elevation</u> (m)
1	188.83	Dry	-	-
2	189.78	Dry	Dry	-
3	190.93	Dry	-	-
4	190.01	Dry	6.45	183.56
5	189.07	Dry	-	-

PART B – FOUNDATION DESIGN

HIGH MAST LIGHTING
HIGHWAY 401, WINDSOR
FROM HIGHWAY 3 TO 0.8 KM EAST
OF INTERCHANGE 14

W.P. 167-96-01

5.0 ENGINEERING RECOMMENDATIONS

5.1 General

This section of the report provides our recommendations on the foundation aspects of design for this project. Our recommendations are based on our interpretation of the factual information obtained during the investigation. It should be noted that the interpretation and recommendations are intended for use only by the design engineer. Where comments are made on construction they are provided only in order to highlight those aspects which could affect the design of the project. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods and scheduling. The works described in this report are associated with the construction of HML.

The proposed locations of the HML were provided to us on a preliminary site location plan previously prepared by others. It is understood that the HML will be spaced at approximately 150 metres on alternating sides of Highway 401 between Walker Road and Eight Concession Road.

5.2 High Mast Lighting

In summary, the soils underlying the surficial fills at the site consist of ^{cl. silt} silty-clay till with a 'crust' extending from a depth of as little as 1.1 metres to as much as 4.1 metres, or between elevations 185.8 and 189.9 metres. The soil stratigraphies are shown on the Record of Borehole sheets and discussed in Section 4 above. The anticipated conditions at the HML locations can be inferred from the results of the closest boreholes, as shown on Figures 2 and 3.

It is expected that foundation design for the overhead signs and HML will be governed by horizontal loading and overturning load cases. Therefore, it has been assumed that the foundations will consist of drilled, cast-in-place, concrete piers. Based on the results of the boreholes, it is expected that these piers may extend into the lower silty clay till.

Application of horizontal loads such as wind and earthquake are intermittent and generally of short duration. For 'undrained' or 'short-term' conditions applicable to the fill and the native

silty clay till, the ultimate or nominal geotechnical resistance along the shaft is represented by a constant distribution with depth and given by $4.5 c_u B$, where c_u = undrained shear strength (kilopascals) and B is the diameter of the shaft (metres). The factored lateral force resisted by a shaft L metres long at ULS (P_{ULS}) is given by:

$$P_{ULS} = \Phi 4.5 c_u B (L - 1.5 B)$$

The above equation is based on the assumption that the lateral geotechnical resistance acts over a width equal to three times the shaft diameter. Further, large deformation (lateral movement) would be required to fully mobilize lateral shaft resistance.

The upper portion of the shaft for a distance equal to 1.5 diameters of the pile ($1.5 B$ in the above formula) or the frost depth of 1.0 metres, ^{appropriate for Windsor?} whichever is larger, should be neglected. A resistance factor, Φ , equal to 0.5 should be applied to the above formula.

The following design parameters may be assumed:

Fill Materials:

SANDY FILL

Φ = angle of internal friction = 28°

γ = unit weight = 19 kN/m^3

CLAYEY FILL

q_u = unconfined compressive strength = 100 kPa

γ = unit weight = 19 kN/m^3

^{Cl. Silt}
Silty Clay Till Crust:

q_u = unconfined compressive strength = 400 kPa

γ = unit weight = 21 kN/m^3

Cl. Silty
Lower Silty Clay Till:

q_u = unconfined compressive strength = 150 kPa

γ = unit weight = 20 kN/m³

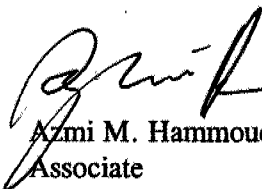
The water level for design should be taken as being at a depth of 3 metres.

The axial capacity of the concrete piers is achieved by a combination of end bearing and shaft resistance. For the design of the drilled shafts, the factored end bearing resistances at ULS of 450 and 150 kilopascals may be used for drilled, cast-in-place piers terminated in the 'crust' till and in the lower till, respectively.

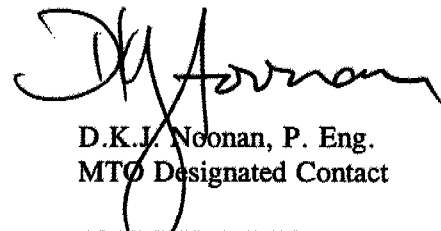
We trust that this draft foundation report provides all the information currently required by the MTO. If any point requires additional clarification before issuance of the final report, please contact our office.

Yours truly,

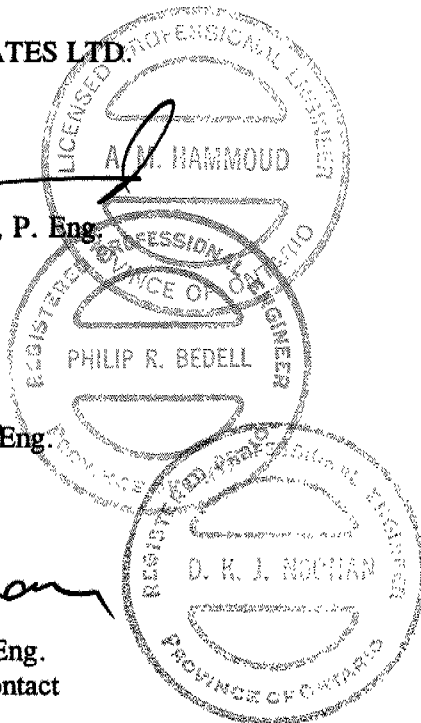
GOLDER ASSOCIATES LTD.


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AMH/PRB/DKJN/cb



ABBREVIATIONS FOR BORING AND TEST DATA

Accep	Acceptable	Gry	Grey	Psty	Polystyrene
Agg	Aggregate	H	Heavy	Poss	Possible
Amor	Amorphous	Hi	Highly	PST	Prime & Surface Treated
Asph	Asphalt	HP	High Plasticity	Quant	Quantity
BR	Bedrock	HM	Hot Mix	Reinf	Reinforced
Blk	Black	Lt	Light	RSS	Remoulded Shear Strength
Bl	Blue	Liq	Liquid	RF	Rock Fill
BH	Borehole	W _L	Liquid Limit	Sa	Sand
Bld (y)	Boulder (y)	Lo	Loam	Sat	Saturated
Blds	Boulders	L	Loose	SH	Shale
BU	Break Up	Mrl	Marl	St	Sensitivity
Br	Brown	Matl	Material	SSM	Select Subgrade Material
CF	Channel Face	Max	Maximum	Sh Rk	Shot Rock
Cl	Clay	MDD	Maximum Dry Density	Si (y)	Silt (y)
Co	Coarse	MWD	Maximum Wet Density	Sl (y)	Slight (ly)
Cob	Cobbles	Med	Medium	SP	Slight Plasticity
Comp	Compact	MP	Medium Plasticity	Stn (y)	Stoney
Conc	Concrete	Mod	Moderate	Dr	Relative Density
Contam	Contaminated	Mott	Mottled	Stks	Streaks
Cord	Corduroy	Mul	Mulch	Surf	Surface
Cr	Crushed	NFP	No Further Progress	Temp	Temperature
Dk	Dark	NFP (Blds)	No Further Progress (Boulders)	TH	Test Hole
Decomp	Decomposed	Num	Numerous	TP	Test Pit
D	Dense	OCC	Occasional	Tps	Topsoil
E	Earth	Wopt	Optimum Moisture Content	Tr	Trace
Fib	Fibrous	Ora	Orange	USS	Undisturbed Shear Strength
w	Field Moisture Content	Org	Organic	Unreinf	Unreinforced
F	Fine	Org M	Organic Matter	Varv	Varved
Fr Wat	Free Water	Ob	Overburden	VF	Very Fine
FB	Frost Boil	Pavt	Pavement	WT	Water Table
FH	Frost Heave	Pedo	Pedological	Weath	Weathered
Gran	Granular	Pen Mac	Penetration Macadam	W	With
Gr	Gravel (ly)	Wp	Plastic Limit	Wd (y)	Wood (y)
Grn	Green	Ip	Plasticity Index	Yel	Yellow

SUSCEPTIBILITY TO FROST HEAVING

HSFH - High
MSFH - Medium
LSFH - Low

ONTARIO PROVINCIAL STANDARD DRAWING

ABBREVIATIONS GEOTECHNICAL

Date	1986 07 18	Rev	
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Date _____

OPSD - 100.06

PROJECT 991-3204			RECORD OF BOREHOLE No 1			1 OF 1			METRIC			
W.P. 167-96-01			LOCATION STA 13+955, 28m LT OF MEDIAN C/L			ORIGINATED BY C. Collins						
DIST 1 HWY 401			BOREHOLE TYPE CME 750 Power Auger (Hollow stem)			COMPILED BY B.A.G.						
DATUM GEODETIC			DATE 10.21.99			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					
188.83	GROUND SURFACE		1	50 DO	9							
0.00	Silty sand and trace gravel, trace clayey pockets (FILL), loose to compact, brown and black		2	50 DO	11							
187.46			3	50 DO	32							
1.37	SILTY CLAY, fissured, oxidized, some sand, trace gravel, (TILL), hard, brown		4	50 DO	30							
185.78			5	50 DO	14							
3.05	SILTY CLAY, some sand, trace gravel, (TILL), stiff, grey		6	50 DO	10							
			7	50 DO	12							
			8	50 DO	8							
			9	50 DO	8							
			10	50 DO	14							
177.70	END OF BOREHOLE											
11.13	Borehole dry during drilling Oct. 21, 1999											

based on
Atterberg's -
would classify
as clayey silt
under MTD
system

PROJECT 991-3204				RECORD OF BOREHOLE No 2				1 OF 1		METRIC				
W.P. 167-96-01				LOCATION STA. 13+217, 100m LT OF MEDIAN C/L				ORIGINATED BY C. Collins						
DIST 1 HWY 401				BOREHOLE TYPE CME 750 Power Auger (Hollow stem)				COMPILED BY B.A.G.						
DATUM GEODETIC				DATE 10.21.99				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			20 40 60 80 100	20 40 60 80 100					
189.78 0.00	GROUND SURFACE		1	50 DO	7									
	SILTY CLAY, mottled, some sand, trace gravel (TILL), firm to stiff, brown and grey		2	50 DO	12									
188.26 1.52			3	50 DO	31									
	SILTY CLAY, fissured, oxidized, some sand, trace gravel, (TILL), very stiff to hard, brown		4	50 DO	36									
			5	50 DO	28									
185.97 3.81			6	50 DO	11									
	SILTY CLAY, some sand, trace gravel, (TILL), firm to stiff, grey		7	50 DO	8									
			8	50 DO	5									
			9	50 DO	7									
			10	50 DO	9									
178.65 11.13	END OF BOREHOLE													
	Borehole dry during drilling Oct. 21, 1999													
	Piezometer dry on Oct. 29, 1999													

ON MOT 3204.GPJ ON MOT GDT 11/26/99 DATA INPUT

PROJECT 991-3204				RECORD OF BOREHOLE No 3				1 OF 1		METRIC				
W.P. 167-96-01		LOCATION STA 12+873, 19m RT OF MEDIAN C/L				ORIGINATED BY C. Collins								
DIST 1 HWY 401		BOREHOLE TYPE CME 750 Power Auger (Hollow stem)				COMPILED BY B.A.G.								
DATUM GEODETIC		DATE 10.22.99				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			20 40 60 80 100	20 40 60 80 100					
190.93	GROUND SURFACE													
0.00	Silty clay, mottled, some sand, trace gravel, topsoil pockets (FILL), stiff, brown and grey		1	50 DO	14									
189.86			2	50 DO	10									
1.07	SILTY CLAY, mottled, some sand, trace gravel, (TILL), stiff, brown and grey													
189.41														
1.52	SILTY CLAY, fissured, oxidized, some sand, trace gravel, (TILL), stiff to hard, brown		3	50 DO	12									
			4	50 DO	28									
			5	50 DO	38									
187.12														
3.61	SILTY CLAY, some sand, trace gravel, (TILL), stiff to very stiff, grey		6	50 DO	18									
			7	50 DO	13									
			8	50 DO	12									
			9	50 DO	10									
			10	50 DO	10									
179.80	END OF BOREHOLE													
11.13	Borehole dry during drilling Oct. 22, 1999													

ON MOT 3204 GP1 ON MOT GDT 11/26/99 DATA INPUT:

PROJECT 991-3204				RECORD OF BOREHOLE No 4				1 OF 1		METRIC				
W.P. 167-96-01				LOCATION STA. 13+345.98m RT OF MEDIAN C/L				ORIGINATED BY C. Collins						
DIST 1 HWY 401				BOREHOLE TYPE CME 750 Power Auger (Hollow stem)				COMPILED BY B.A.G.						
DATUM GEODETIC				DATE 10.22.99				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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
190.01	GROUND SURFACE													
0.00	SILTY CLAY, mottled some sand, trace gravel, trace silt pockets, (TILL), stiff to hard, brown and grey		1	50 DO	9									
			2	50 DO	12									
188.03			3	50 DO	30									
1.98	SILTY CLAY, fissured, oxidized, some sand, trace gravel, with sand partings, (TILL), very stiff to hard, brown		4	50 DO	29									1 30 39 30
			5	50 DO	31									
185.90														
4.11	SILTY CLAY, some sand, trace gravel, (TILL), stiff, grey		6	50 DO	13									
180.87			7	50 DO	8									
9.14	SILTY SAND, trace gravel, compact, grey		8	50 DO	7									
180.56														
9.45	SILTY CLAY, some sand, trace gravel, (TILL), very stiff to stiff, grey		9	50 DO	19									
178.88			10	50 DO	10									
11.13	END OF BOREHOLE													
	Borehole dry during drilling Oct. 21, 1999													
	Water level measured in Piezometer at elev. 183.56m Oct. 29, 1999													

ON MOT 3204.GPJ ON MOT GDT 11/26/99 DATA INPUT:

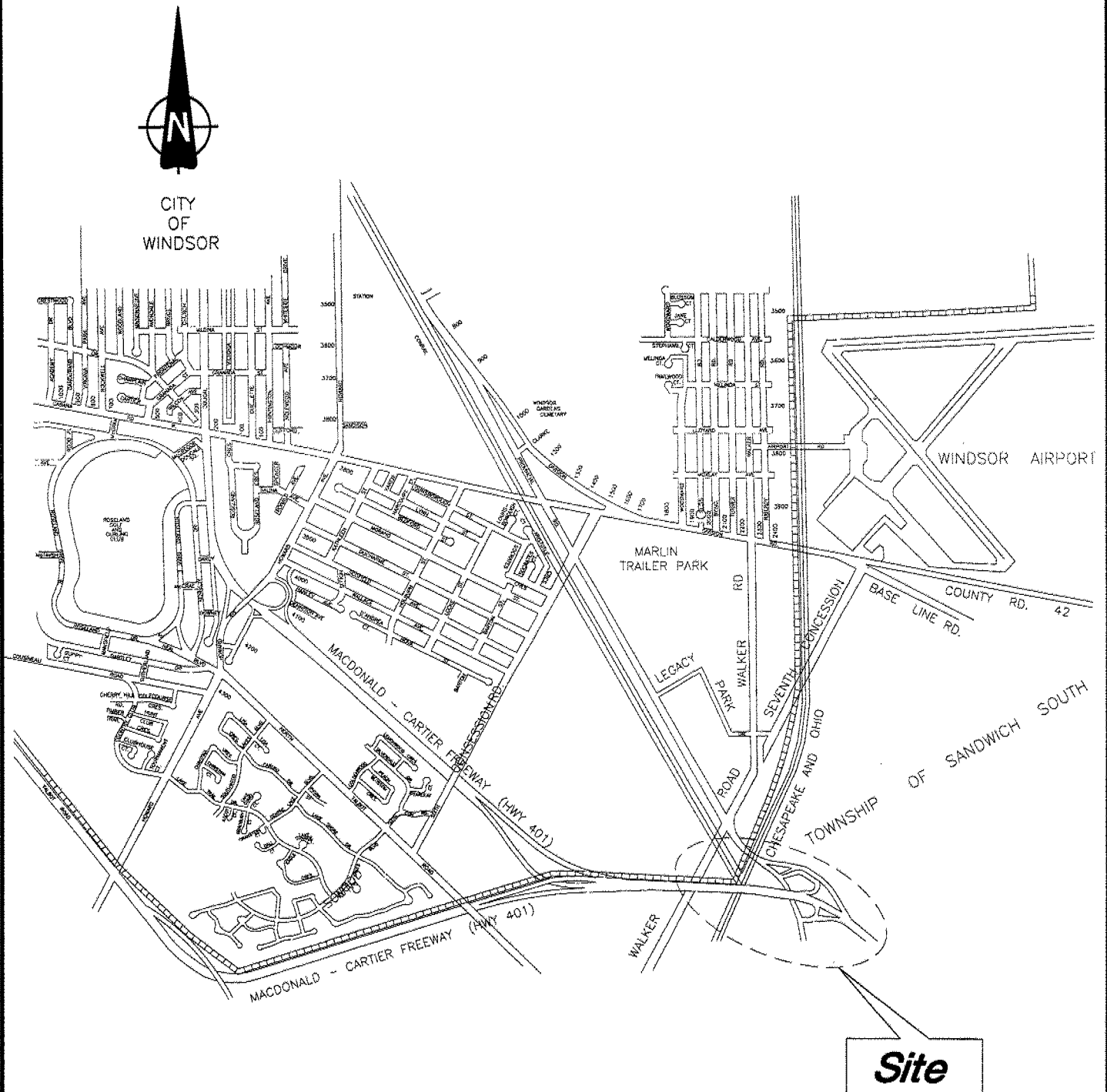
PROJECT 991-3204			RECORD OF BOREHOLE No 5			1 OF 1		METRIC					
W.P. 167-96-01		LOCATION STA. 14+137, 32m RT OF MEDIAN C/L		ORIGINATED BY C. Collins									
DIST 1 HWY 401		BOREHOLE TYPE CME 750 Power Auger (Hollow stem)		COMPILED BY B.A.G.									
DATUM GEODETIC		DATE 10.22.99		CHECKED BY									
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					
189.07	GROUND SURFACE						20 40 60 80 100						
0.00	Silty sand, mixed with topsoil, with clayey pockets (FILL), compact, brown		1	50 DO	12								
187.70			2	50 DO	14								
1.37	SILTY CLAY, fissured, oxidized, some sand, trace gravel, with sand partings (TILL), hard, brown		3	50 DO	32								
			4	50 DO	33								
186.02			5	50 DO	24								
3.05	SILTY CLAY, some sand, trace gravel, (TILL), very stiff to stiff, grey												
			6	50 DO	15								
			7	50 DO	12								
			8	50 DO	8								
179.93													
179.77	SILTY SAND, trace gravel, compact, grey		9	50 DO	10								
9.30	SILTY CLAY, some sand, trace gravel, with sand partings, (TILL), stiff to firm, grey												
			10	50 DO	7								
177.94													
11.13	END OF BOREHOLE												
	Borehole dry during drilling Oct. 22, 1999												

ON_MOT_3204.GPJ ON_MOT_GDI 11/26/99 DATA INPUT

KEY PLAN

FIGURE 1

WP 167-96-01 HIGHWAY 401, WINDSOR



KEY PLAN
Not to Scale



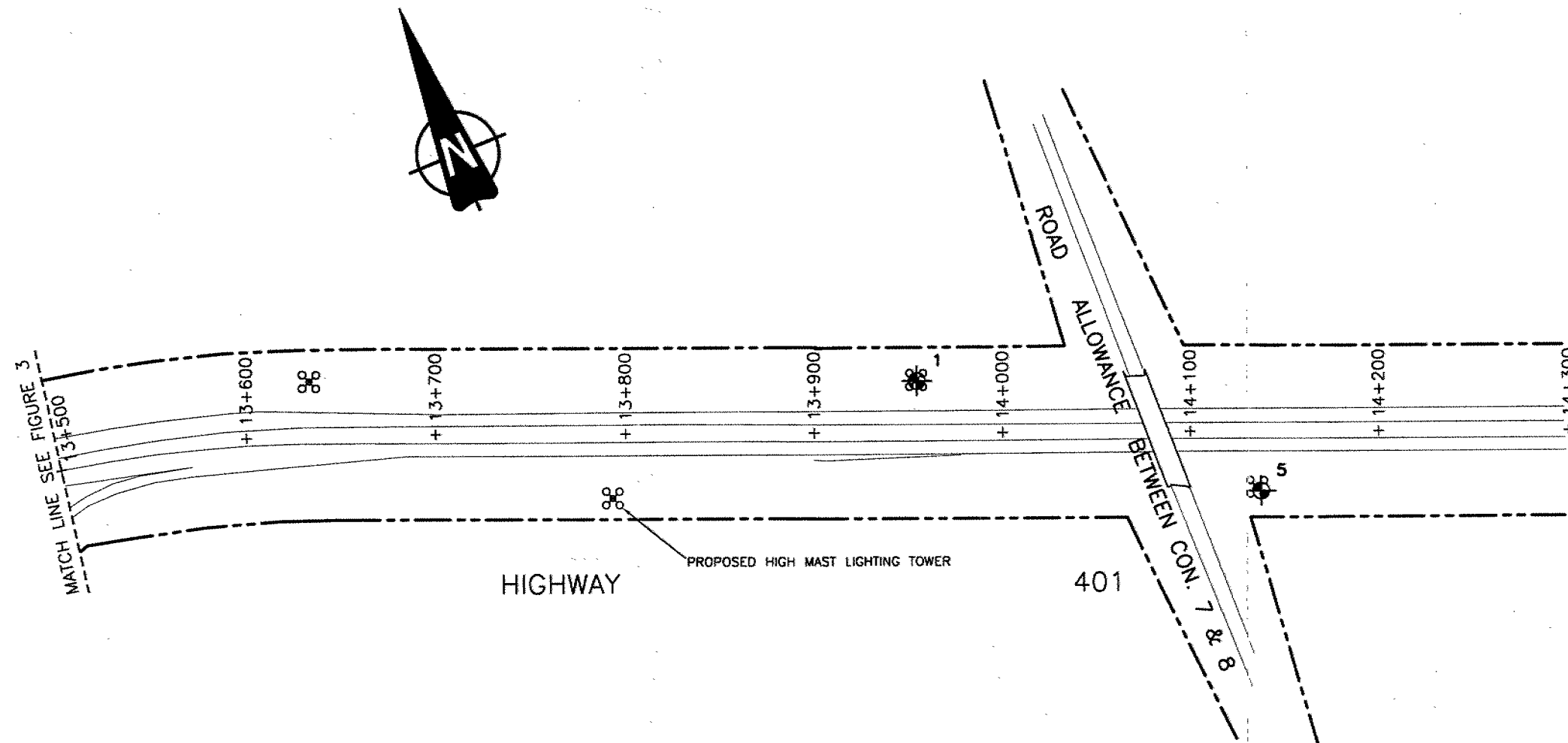
Date NOV. 24, 1999
Project 991-3204

Drawn B.G.
Chkd

LOCATION PLAN

FIGURE 2

WP 167-96-01 HIGHWAY 401, WINDSOR



LEGEND

SCALE: 1:3000

LEGEND

 BOREHOLE LOCATION IN PLAN

REFERENCE

PLAN BY: MINISTRY OF TRANSPORTATION AND
COMMUNICATIONS ONTARIO
ENTITLED: ENGINEERING & TITLE RECORDS
KING'S HIGHWAY 401
TOWNSHIP SANDWICH SOUTH,
COUNTY ESSEX
10+000 TO 20+191.074 (S.LEG)
10+000 TO 13+310.839 (N.LEG)
SCALE: 1:2000
SURVEY DATE: 83-09

Date NOV. 25, 1999
Project 991-3204

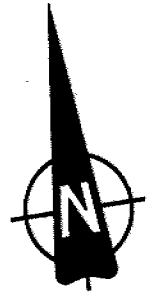
 **Golder
Associates**
LONDON, ONTARIO, CANADA

Drawn B.G.
Chkd

LOCATION PLAN

FIGURE 3

WP 167-96-01 HIGHWAY 401, WINDSOR



LEGEND

1 BOREHOLE LOCATION IN PLAN

REFERENCE

PLAN BY: MINISTRY OF TRANSPORTATION AND
COMMUNICATIONS ONTARIO
ENTITLED: ENGINEERING & TITLE RECORDS
KING'S HIGHWAY 401
TOWNSHIP SANDWICH SOUTH,
COUNTY ESSEX
10+000 TO 20+191.074 (S.LEG)
10+000 TO 13+310.839 (N.LEG)
SCALE: 1:2000
SURVEY DATE: 83-09

PROPOSED HIGH MAST LIGHTING TOWER

LEGEND

SCALE: 1:3000



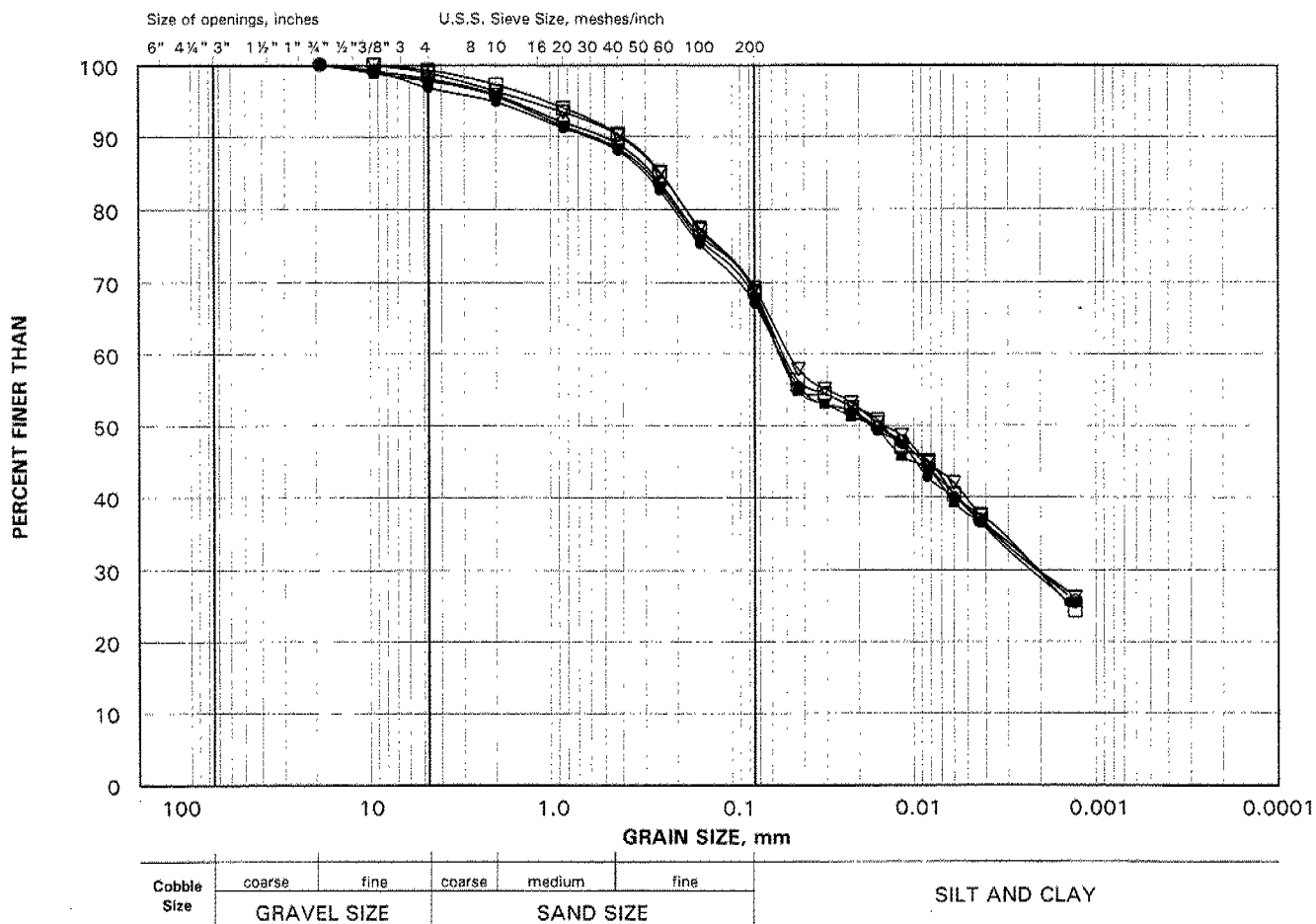
Date NOV. 25, 1999
Project 991-3204

Drawn B.G.
Chkd

GRAIN SIZE DISTRIBUTION

FIGURE 4

SILTY CLAY (TILL)



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV. (m)
●	1	6	184.0
■	2	5	186.5
○	3	7	184.6
□	4	4	187.5
▽	5	6	184.3