Peto MacCallum Ltd.
CONSULTING ENGINEERS

FOUNDATION INVESTIGATION REPORT
FOR
WHITE CHURCH ROAD UNDERPASS
HIGHWAY 6 (NEW)
FROM HIGHWAY 403 SOUTHERLY TO EXISTING HIGHWAY 6
W.P. 603-00-01, STRUCTURE SITE NO. 36-494
CITY OF HAMILTON, ONTARIO

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PML Ref: 00HF108
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March, 2002

PetoMacCallum Ltd.
CONSULTING ENGINEERS

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For
White Church Road Underpass
Highway 6 (New)
From Highway 403 Southerly to Existing Highway 6
W.P. 603-00-01, Structure Site No. 36-494
City of Hamilton, Ontario

INTRODUCTION

This report summarizes the results of the foundation investigation carried out for the underpass structure to be constructed at White Church Road and Highway 6 (New) in the former Township of Glanbrook, now in the City of Hamilton, Ontario. The investigation was conducted for Delcan Corporation on behalf of the Ontario Ministry of Transportation.

The alignment of Highway 6 (New) will cross under White Church Road at approximate Station 16+626, Highway 6 (New) chainage.

The report pertains to the proposed bridge structure and approach embankments within about 20 m of the abutments between approximate Station 9+940 and 10+060, White Church Road chainage.

SITE DESCRIPTION

The site is situated some 35 m north of existing White Church Road, approximately 650 m west of existing Highway 6 in the former Township of Glanbrook. The structure will carry White Church Road traffic over the proposed Highway 6 (New). At the proposed location of the structure, Highway 6 (New) runs roughly north-south.

The lands adjacent to the site are primarily agricultural.

The site is situated approximately 10 km south of the Niagara Escarpment, south of the west end of Lake Ontario, in the broad physiographic region known as the Haldimand Clay Plain. In general, the topography on the plain is gently rolling.

The overburden is some 20 to 25 m thick and typically comprises glaciolacustrine silts and clays deposited in glacial Lake Warren. The underlying bedrock consists of dolostone of the Guelph Formation.

INVESTIGATION PROCEDURES

The fieldwork was carried out during the period November 7 to 9, 2000 and December 14 to 21, 2001 and comprised five boreholes (numbered 16 to 20) drilled at the locations indicated on Drawing 1, appended. The boreholes at the foundation units were extended some 3.5 to 4.1 m into bedrock to total depths of 26.5 to 27.8 m. Two boreholes were drilled to 6.6 m depth in the east and west approach embankments, some 20 m beyond the abutment locations.

The alignment of the abutments and approaches were staked in the field by J.D. Barnes Limited. The position of the boreholes along the staked alignments was selected by Peto MacCallum Ltd. with regard for access limitations and utility lines. The locations of and ground surface elevations at the boreholes were determined relative to the survey stakes.

The boreholes were advanced using continuous flight solid and hollow stem augers, powered by track-mounted CME-75 and 55 drillrigs, supplied and operated by a specialist drilling contractor, working under the full-time supervision of a member of our engineering staff.

Representative samples of the overburden were recovered at frequent depth intervals using a conventional split spoon sampler during drilling. Standard penetration tests were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata. Penetrometer testing was carried out on the recovered samples to determine the undrained shear strength of the cohesive soils.

In the deep boreholes drilled at the foundation units, casing was extended to the bedrock surface and a 3.5 to 4.1 m length of rock core was recovered from each hole using NQ rock coring equipment.

The groundwater conditions in the boreholes were closely monitored during the course of the fieldwork. In addition, standpipes were installed in two boreholes to monitor groundwater levels. Details of the installation and subsequent water level readings are recorded on the Record of Borehole Sheets.

All of the recovered samples were returned to our laboratory for detailed visual examination, classification and routine moisture content determinations. Grain size distribution analyses and Atterberg Limits tests were carried out on selected samples and are presented on the Record of Borehole Sheets and Figures 1 to 3 attached.

SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Record of Borehole sheets for details of the subsurface conditions including soil classifications, inferred stratigraphy, boundary elevations, standard penetration test "N" values, penetrometer shear strength results, and groundwater observations. The results of laboratory grain size distribution analyses, Atterberg Limits tests, and moisture content determinations are also shown.

The borehole locations and a stratigraphic profile prepared from the borehole data are presented on Drawing 1.

The subsurface stratigraphy revealed at the bridge site generally comprised a surficial topsoil layer overlying native clay and silt units, underlain by clay. Dolostone bedrock was contacted below the overburden at 22.4 to 24.3 m depths. The strata encountered are summarized below:

Topsoil

Clayey silt/silty clay topsoil was encountered surficially in four boreholes. The topsoil layer was 100 to 270 mm thick.

Upper Silty Clay

A unit of stiff to very stiff cohesive silty clay was encountered below the topsoil in four boreholes and surficially in borehole 20. The 'N' values of the deposit ranged from 8 to 25. The undrained shear strength of the clay determined by penetrometer testing ranged from about 150 to 210 kPa. Moisture contents in this deposit ranged from 17 to 24%. The upper clay unit was penetrated at 3.3 to 4.9 m depth in all boreholes.

The results of the particle size distribution analyses conducted on the clay are presented on Figure 2. Liquid and plastic limits of 35 and 47 and 16 and 23 respectively with plasticity indices ranging from 16 to 24 were measured indicating a low to medium plastic clay (refer to Figure 3).

Silt

Non-plastic silt was contacted below the upper clay unit in all boreholes. The non cohesive silt was compact to very dense, with 'N' values ranging from 11 to 77, and moisture contents ranging from 15 to 21%, locally 24 to 26% in the upper 1.0 m in borehole 17. The results of grain size distribution analyses conducted on the silt are presented on Figure 1 appended.

Representative samples of the silt were examined by the project engineer and were deemed to be non-plastic, consequently Atterberg Limits tests were not conducted.

Drilling was terminated within the silt at 6.6 m depth in boreholes 16 and 20. The silt deposit was penetrated at 9.5 to 10.8 m depths in the remaining boreholes.

Lower Silty Clay

Cohesive silty clay was contacted below the silt in boreholes 17, 18 and 19. The consistency of the clay was stiff to very stiff, with 'N' values ranging from 8 to 28. The undrained shear strength of the clay determined by penetrometer testing ranged from 25 to 130 kPa. Moisture contents varied from 20 to 34%. The clay deposit mantled bedrock.

The results of a particle size distribution analysis conducted on a sample of the clay are presented on Figure 2. Liquid and plastic limits of 33 to 41 and 20 to 21 respectively, with plasticity indices ranging from 13 to 20 were measured, indicating a low to medium plastic clay (refer to Figure 3).

Bedrock

Dolostone bedrock was contacted below the clay overburden in boreholes 17, 18 and 19 at the following depths:

Borehole	Depth to Bedrock (m)	Elevation
17	22.4	194.7
18	23.6	194.5
19	24.3	192.9

Rock core lengths of 3.5 to 4.1 m were recovered from boreholes 17, 18 and 19.

A description of the recovered rock core is provided on Table I. Core recovery was 48 and 58% in the first two 1.5 m lengths of core retrieved in borehole 17, and 70% in the upper 1.1 m length of core retrieved in borehole 18. The core recovery in the upper lengths of borehole 19 was 100%. The core recovery increased to 97 to 100% in the lower 1.1 to 3.0 m of recovery in

boreholes 17, 18 and 19. The RQD determined from the upper 3.0 m of all core recovered ranged from 13 to 62%, indicating a very poor to fair quality rock. The RQD improved to between 69 to 84% (fair to good quality) in the next 1.1 to 1.5 m.

The unconfined compressive strengths of selected core samples were as follows:

Borehole	Depth (m)	Unconfined Compressive Strength (MPa)
17	22.6	85.0
17	25.6	63.0

Groundwater

Water was encountered after sampling to 3.5 m in boreholes 16 and 17. Upon completion of augering, water was observed in the west and east embankment approach holes at 3.0 and 5.8 m depths. The following water levels were measured in the standpipes:

Borehole No.	November 14, 2000		January 29, 2002	
	Depth to Water (m)	Elevation	Depth to Water (m)	Elevation
16	0.9	216.2	Standpipe Destroyed	
17	2.1	215.0	4.8	212.3

Observed groundwater levels are subject to seasonal fluctuations and rainfall patterns.

CLOSURE

The fieldwork was carried out under the supervision of Mr. M. Rapsey and direction of Mr. M.R. Anderson, P.Eng. The equipment was supplied by Bart Chaston Water Haulage and Malone's Soil Samples Co. Ltd.

The report was prepared by Mr. P. Cullen, B.Eng. and Mr. M.R. Anderson, M.Eng., P.Eng., Senior Project Engineer and reviewed by Mr. B.R. Gray, M.Eng., P.Eng., President. Mr. D.W. Kerr, M.Eng., P.Eng., Manager of Geotechnical and Geo-Environmental Services, Hamilton carried out an independent review of the report.

Yours very truly

Peto MacCallum Ltd.

REGISTERED PROFESSIONAL ENGINEER
D. W. KERR
PROVINCE OF ONTARIO

Dennis W. Kerr, M.Eng., P.Eng.
Manager Geotechnical and
Geo-Environmental Services
Hamilton

REGISTERED PROFESSIONAL ENGINEER
B. R. GRAY
PROVINCE OF ONTARIO

Brian R. Gray, M.Eng., P.Eng.
President

PC:ld

APPENDIX A

TABLE I - ROCK CORE DESCRIPTION

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PML Ref: 00HF108

TABLE I

ROCK CORE DESCRIPTION
WHITE CHURCH ROAD UNDERPASS AT HIGHWAY 6 (NEW)
W.P. 603-00-01, STRUCTURE SITE NO. 36-494
CITY OF HAMILTON, ONTARIO

CORE RECOVERY					CORE DESCRIPTION	
BOREHOLE	CORE NO.	RUN (m)	RECOVERY (%)	RQD (%)	DEPTH (m)	DESCRIPTION
17	14 15 16	22.40 – 23.95 23.95 – 25.45 25.45 – 26.50	48 58 98	27 28 69	22.40 – 26.50	**DOLOSTONE:** Grey, fine crystalline, high strength; unweathered; highly porous layers, some voids, occ. shaley partings; close spaced flat partings, rough planar, tight and dipping to vertical joint, smooth planar, tight; very poor to poor quality.
18	14 15 16	23.60 – 24.70 24.70 – 26.20 26.20 – 27.70	70 97 100	13 57 63	23.60 – 27.70	**DOLOSTONE:** Grey, fine grained, medium to high strength; unweathered; occ. black shale partings, styolitic partings, occ. vugs and pitting with calcite encrustation/infilling; close spaced flat bedding layers, smooth to rough planar, tight; very poor to fair quality. (Guelph Formation)
19	14 15 16	24.30 – 24.70 24.70 – 26.20 26.20 – 27.80	100 100 100	44 62 84	24.30 – 27.80	**DOLOSTONE:** Grey, fine grained, medium to high strength; unweathered; occ. irregular black shale partings, styolitic partings, occ. vugs and pitting with calcite encrustation/infilling; close to moderate spaced flat bedding layers, rough planar, tight; poor to good quality. (Guelph Formation)

Logged by J.F. Wright using the Provincial Highways "A Guide to the Description of Rock for Engineering Purposes" dated October, 1982.

RQD = Rock Quality Designation

APPENDIX B

FIGURES 1 TO 3

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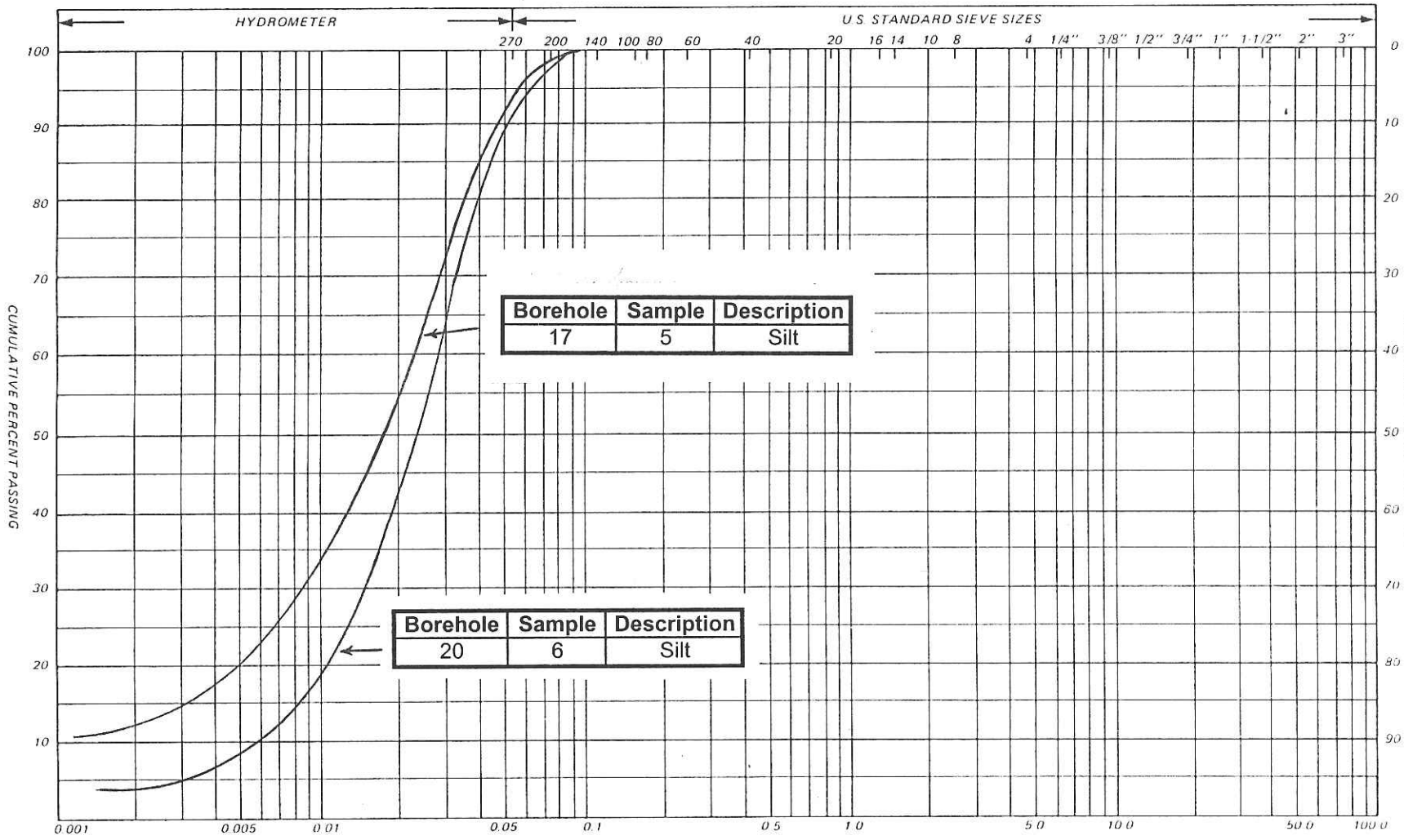
PARTICLE SIZE DISTRIBUTION CHART

PML REF. 00HF108
REPORT NO. -
FIGURE 1



Borehole	Sample	Description
17	5	Silt

Borehole	Sample	Description
20	6	Silt

REMARKS Silt

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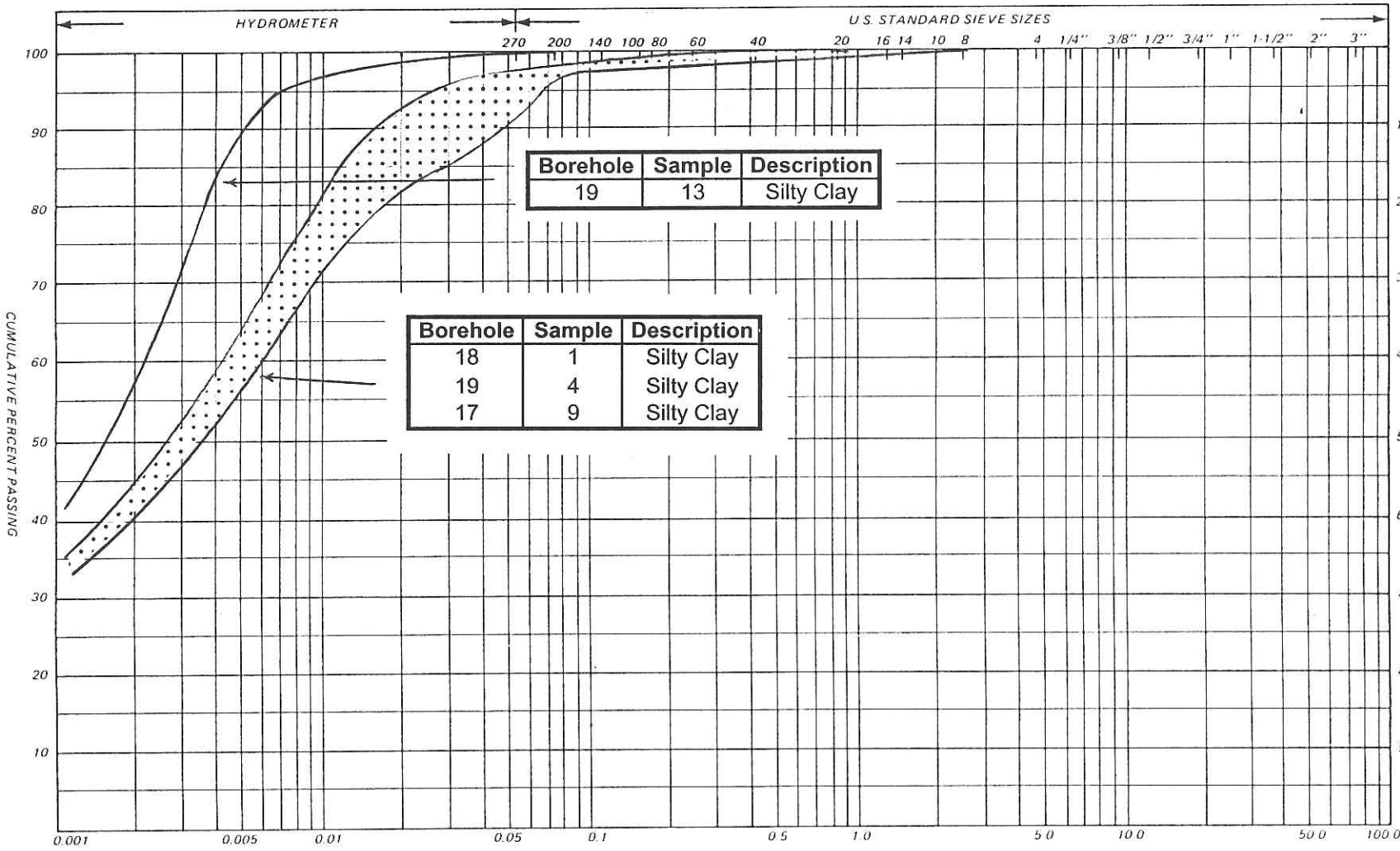
PARTICLE SIZE DISTRIBUTION CHART

PML REF. 00HF108
REPORT NO. -
FIGURE 2



Borehole	Sample	Description
19	13	Silty Clay

Borehole	Sample	Description
18	1	Silty Clay
19	4	Silty Clay
17	9	Silty Clay

REMARKS Silty Clay

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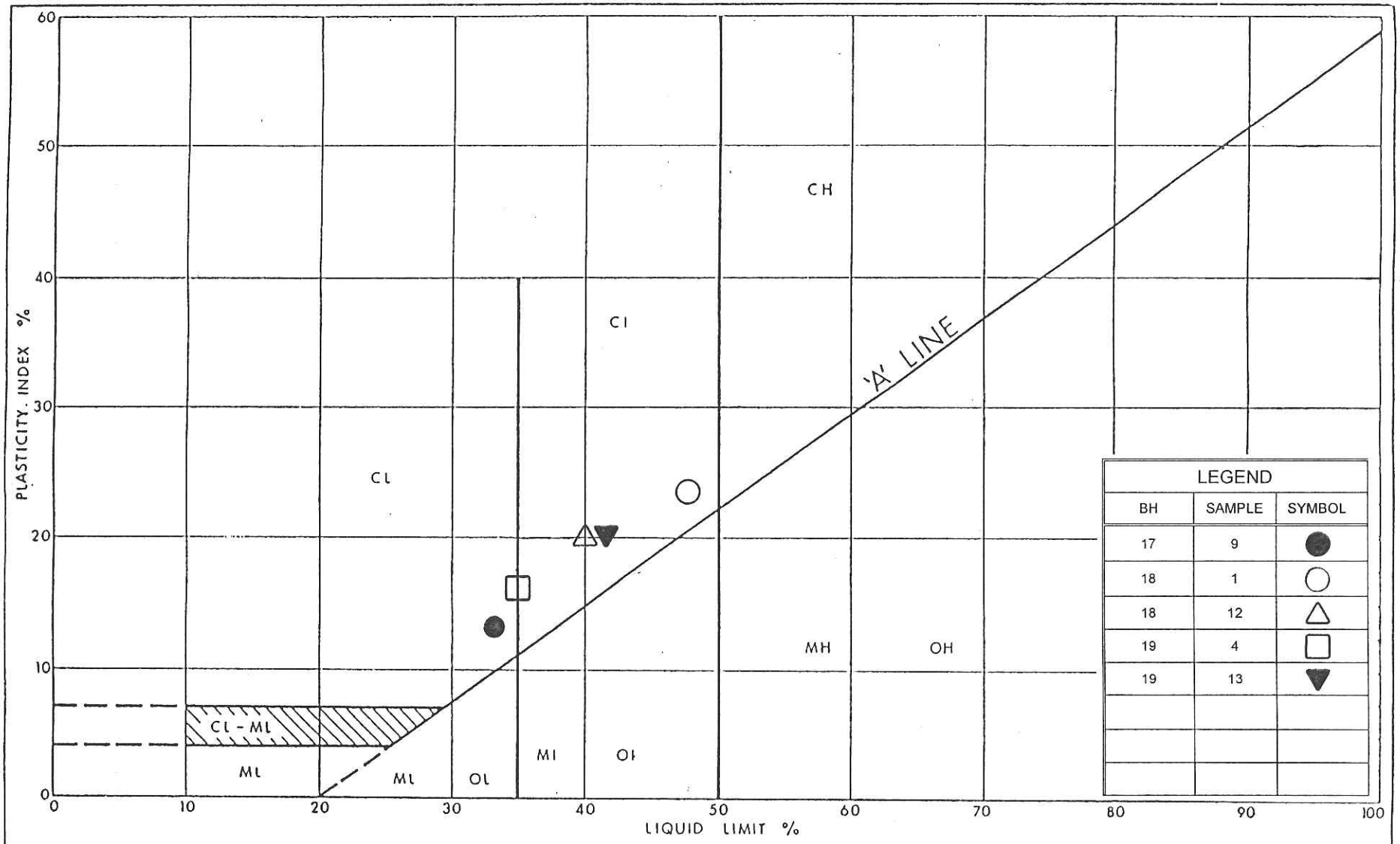

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PLASTICITY CHART

Silty Clay

FIG No 3

PML Ref. 00HF108

White Church Road

APPENDIX C

RECORD OF BOREHOLE SHEETS
DRAWING NO. 1

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LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N', - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 0.3m INTO THE SUBSOIL. DRIVEN BY MEANS OF A 63.5kg HAMMER FALLING FREELY A DISTANCE OF 0.76m.

DYNAMIC PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 51mm, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS. 0.3m INTO THE SUBSOIL. THE DRIVING ENERGY BEING 475 J PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

CONSISTENCY	'N' BLOWS/0.3 m	c kPa	DENSENESS	'N' BLOWS/0.3 m
VERY SOFT	0 - 2	0 - 12	VERY LOOSE	0 - 4
SOFT	2 - 4	12 - 25	LOOSE	4 - 10
FIRM	4 - 8	25 - 50	COMPACT	10 - 30
STIFF	8 - 15	50 - 100	DENSE	30 - 50
VERY STIFF	15 - 30	100 - 200	VERY DENSE	> 50
HARD	> 30	> 200		

W.T.P.L. WETTER THAN PLASTIC LIMIT D.T.P.L. DRIER THAN PLASTIC LIMIT

A.P.L. ABOUT PLASTIC LIMIT

TYPE OF SAMPLE

S.S	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T	SLOTTED TUBE SAMPLE		

P.H SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL		

▲,△ - Undisturbed and remoulded shear strength determined from in situ vane test.

■ - Undrained shear strength determined from pocket penetrometer test.

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RECORD OF BOREHOLE No 16 1 of 1 METRIC

G.W.P. 603-00-01 LOCATION Co-ords. 4 778 462 N; 269 969 E ORIGINATED BY P.C.

DIST CR HWY 6 (NEW) BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY M.R.A.

DATUM Geodetic DATE November 09, 2000 CHECKED BY D.W.K.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
217.11	Ground surface						217				
0.00	Topsoil										
0.27	Silty Clay, trace of sand and gravel		1	SS	20		216	>>			
			2	SS	17			>>			
							215				
			3	SS	14			>>			
213.81			4	SS	13	▽	214				
3.30	Silt, trace of clay and fine sand Very dense Greyish brown										Water encountered after sample 4
			5	SS	77		213				
							212				
							211				
210.56			6	SS	57						
6.55	End of borehole DATE Groundwater Elevation 11/14/00 216.2 Standpipe destroyed										

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+7, ×5: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No 17 1 of 2 METRIC

G.W.P. 603-00-01 LOCATION Co-ords. 4 778 459 N; 269 988 E ORIGINATED BY P.C.

DIST CR HWY 6 (NEW) BOREHOLE TYPE Continuous Flight Hollow Stem Augers, NQ Coring COMPILED BY M.R.A.

DATUM Geodetic DATE November 07, 2000 CHECKED BY D.W.K.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
217.14							217				
0.00	Topsoil										
0.20	Silty Clay, trace of sand Stiff to very stiff Khaki brown		1	SS	16		216	>>			
			2	SS	13			>>			
214.74							215				
2.40	Silt, trace of clay and fine sand Compact Brown and grey		3	SS	11						
			4	SS	11		214				Water encountered after sample 4
			5	SS	28		213				0 1 87 12
	Dense to very dense						212				
			6	SS	42		211				
			7	SS	51		210				
207.69							209				
9.45	Silty Clay, trace of sand Stiff to very stiff Grey		8	SS	44		208				
			9	SS	14		207				0 2 53 45
			10	SS	16		206				
	Cont'd						205				
							204				
							203				

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20 / 15 5 / 10 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No 17 2 of 2 METRIC

G.W.P. 603-00-01 LOCATION Co-ords. 4 778 459 N; 269 988 E ORIGINATED BY P.C.

DIST CR HWY 6 (NEW) BOREHOLE TYPE Continuous Flight Hollow Stem Augers, NQ Coring COMPILED BY M.R.A.

DATUM Geodetic DATE November 07, 2000 CHECKED BY D.W.K.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (O UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
217.14							202				
	occasional partings of silt		11	SS	9		201				
							200				
			12	SS	28		199				
							198				
							197				
			13	SS	8		196				
194.74							195				
22.40	Dolostone bedrock		14	RC			194				Run=1550mm Rec=48% RQD=27% Drill Water Return=0%
			15	RC			193				Run=1500mm Rec=58% RQD=28% Drill Water Return=0%
							192				
			16	RC			191				Run=1050mm Rec=98% RQD=69% Drill Water Return=0%
190.64											
26.50	End of borehole										

DATE Groundwater Elevation

9 Nov. 2000 214.7
14 Nov. 2000 215.0
29 Jan. 2002 212.3

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$+^{7}$, $\times^{5}$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No 18 1 of 2 METRIC

G.W.P. 603-00-01 LOCATION Co-ords. 4 778 458 N; 270 022 E ORIGINATED BY M.R.

DIST CR HWY 6 (New) BOREHOLE TYPE Continuous Flight Hollow Stem Augers & NQ Coring COMPILED BY P.C.

DATUM Geodetic DATE December 14, 2001 CHECKED BY B.R.G.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
218.10							218				
0.00	Topsoil										
0.10	Silty clay, trace of sand, with bluish grey fissures Very Brown Stiff		1	SS	15		217				0 3 52 45
			2	SS	18		216				
			3	SS	16		215				
			4	SS	16		214				
213.20			5	SS	21		213				
4.90	Silt, trace of clay and fine sand Compact Brown										
	Compact Grey to very dense		6	SS	26		212				
			7	SS	53		211				
			8	SS	52		210				
207.30							209				
10.80	Silty clay, trace of sand, with thin partings of silt Stiff Grey		9	SS	22		208				
			10	SS	12		207				
	layers of silty clays and silts Very stiff to stiff						206				
	Cont'd						205				
							204				

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+7 ,×5 : Numbers refer to Sensitivity

20
15 — 5 (%) STRAIN AT FAILURE
10

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RECORD OF BOREHOLE No 18 2 of 2 METRIC

G.W.P. 603-00-01 LOCATION Co-ords. 4 778 458 N; 270 022 E ORIGINATED BY M.R.

DIST CR HWY 6 (New) BOREHOLE TYPE Continuous Flight Hollow Stem Augers & NQ Coring COMPILED BY P.C.

DATUM Geodetic DATE December 14, 2001 CHECKED BY B.R.G.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
218.10							203				
			11	SS	17		202		○		
							201				
			12	SS	20		200		>>■ ○—		
							199				
							198				
							197				
			13	SS	10				○		
194.50							196				
23.60	Dolostone Bedrock						195				
			14	RC			194				Run=1100mm Rec=70% RQD=13% Drill Water Return=0%
			15	RC			193				Run=1525mm Rec=97% RQD=57% Drill Water Return=100%
							192				
			16	RC			191				Run=1525mm Run=100% RQD=63% Drill Water Return=100%
190.40											
27.70	End of Borehole										

ON_MOT 00HF108.GPJ ON_MOT.GDT 11/02/2002 12:23:13 PM

$+^7$, $\times^5$: Numbers refer to Sensitivity

20
15 — 5 (%) STRAIN AT FAILURE
10

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Ontario

Foundation Design

RECORD OF BOREHOLE No 19 1 of 2 METRIC

G.W.P. 603-00-01 LOCATION Co-ords. 4 778 443 N; 270 053 E ORIGINATED BY R.B

DIST CR HWY 6 (New) BOREHOLE TYPE Continuous Flight Hollow Stem Augers & NQ Coring COMPILED BY P.C.

DATUM Geodetic DATE December 20, 2001 CHECKED BY B.R.G.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
217.22											
0.00	Topsoil										
0.10	Silty clay, trace of sand, with bluish grey fissures Stiff to very stiff Brown		1	SS	8		217				
			2	SS	21		216				
			3	SS	19		215				
			4	SS	16		214				0 2 58 40
213.22											
4.00	Silt, trace of sand, trace of gravel Dense Grey Damp		5	SS	43		213				
			6	SS	42		212				
			7	SS	42		211				
	Wet						210				
			8	SS	32		209				
207.12							208				
10.10	Silty clay, trace of sand, mottled Stiff Grey		9	SS	10		207				
			10	SS	12		206				
	Wet						205				
	Cont'd						204				
							203				

ON_MOT 00HF108.GPJ ON_MOT.GDT 11/02/2002 12:23:56 PM

$+^7$, $\times^5$: Numbers refer to Sensitivity

20
15 — 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 19

2 of 2 **METRIC**

G.W.P. 603-00-01 LOCATION Co-ords. 4 778 443 N; 270 053 E ORIGINATED BY R.B

DIST CR HWY 6 (New) BOREHOLE TYPE Continuous Flight Hollow Stem Augers & NQ Coring COMPILED BY P.C.

DATUM Geodetic DATE December 20, 2001 CHECKED BY B.R.G.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
217.22											
	without sand		11	SS	12		202	■	○		
							201				
							200				
			12	SS	16		199		○		
							198				
							197				
			13	SS	10		196	■	⊢○⊣		0 0 43 57
							195				
							194				
192.92							193				
24.30	Dolostone Bedrock		14	RC							Run=400mm Rec=100% RQD=44% Drill Water Return=100%
			15	RC			192				Run=1525mm Rec=100% RQD=62% Drill Water Return=100%
			16	RC			191				Run=1600mm Rec=100% RQD=84% Drill Water Return=100%
189.52							190				
27.70	End of Borehole										

$+^{7}$, $\times^{5}$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 20

1 of 1 **METRIC**

G.W.P. 603-00-01 LOCATION Co-ords. 4 778 443 N; 270 073 E ORIGINATED BY R.B.

DIST CR HWY 6 (New) BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY P.C.

DATUM Geodetic DATE December 21, 2001 CHECKED BY B.R.G.

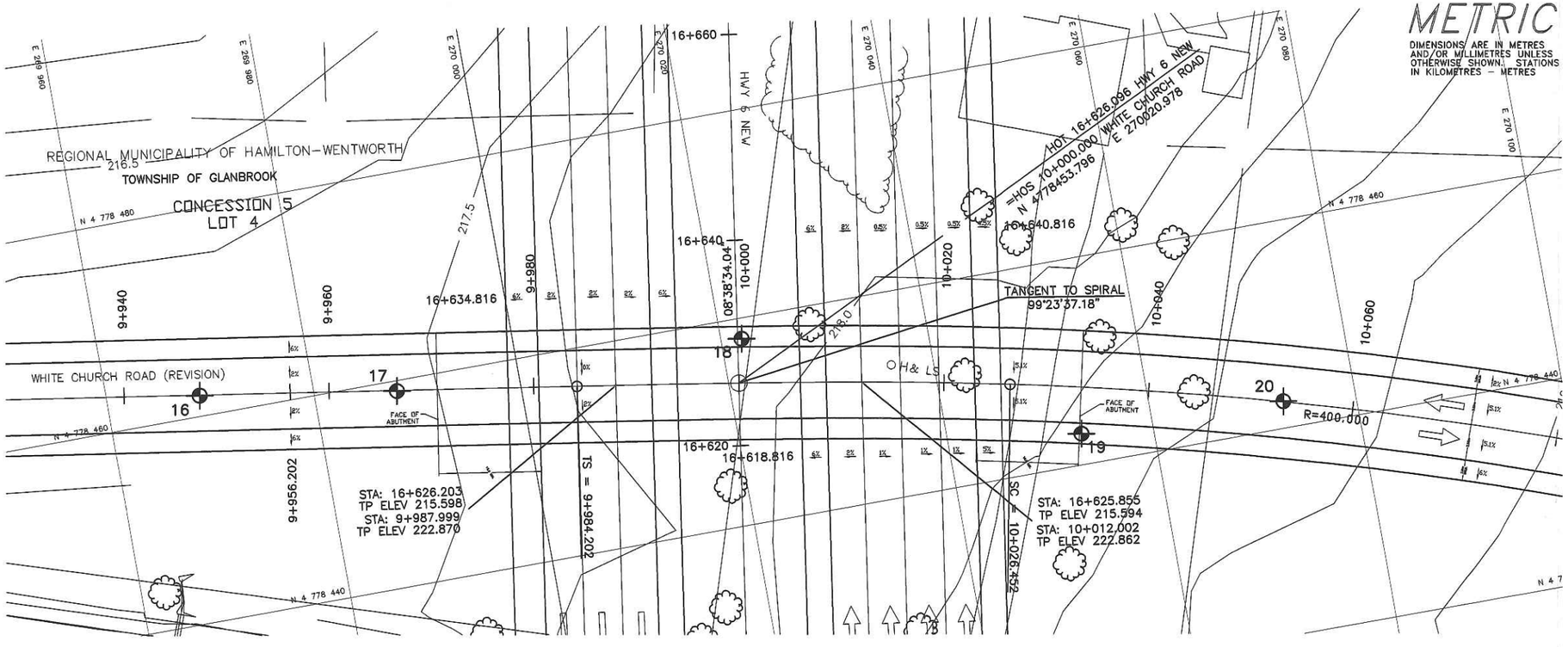
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
216.68											
0.00	Silty clay, trace of sand, trace of gravel Very stiff Brown						216				
			1	SS	22				○		
			2	SS	22		215		○		
			3	SS	25		214		○		
			4	SS	19				○		
212.68							213				
4.00	Silt, trace of fine sand, trace of clay Dense Brown Damp to grey to moist		5	SS	44	▽	212		○		
210.08			6	SS	30		211		○		0 2 94 4
6.60	End of Borehole										

$+^{7}$, $\times^{5}$: Numbers refer to Sensitivity

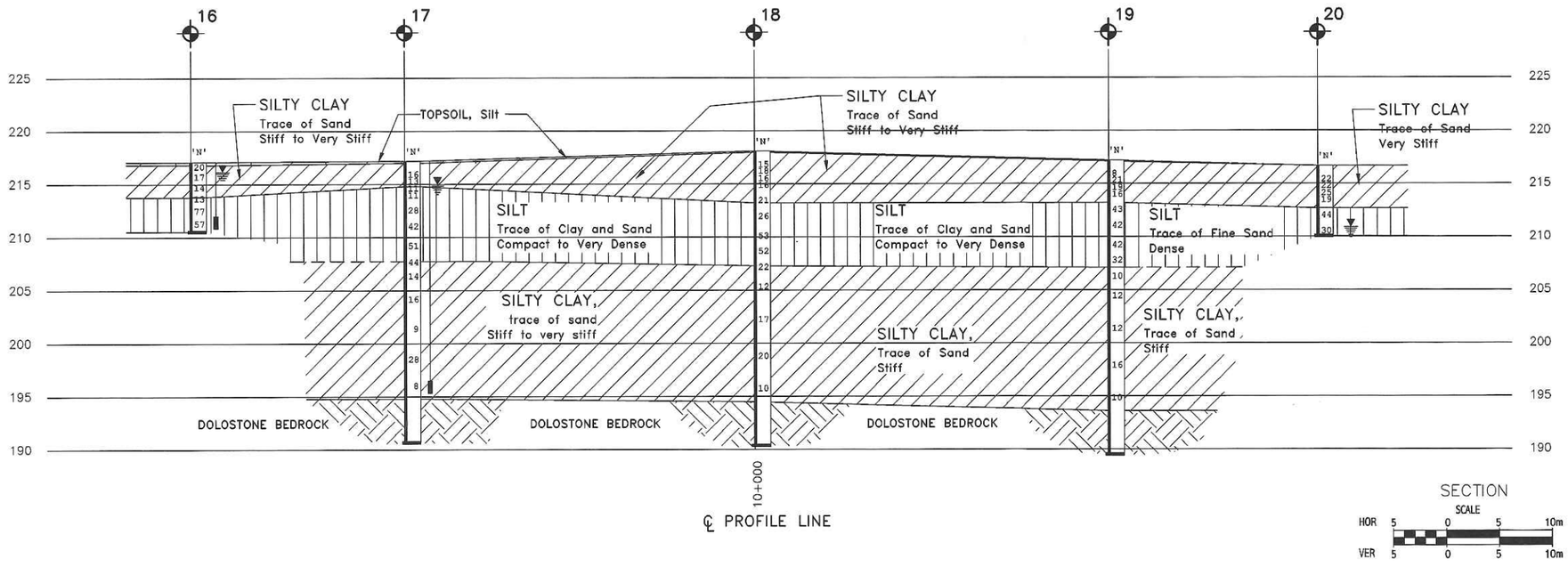
20 / 15 5 / 10 (%) STRAIN AT FAILURE

METRIC

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



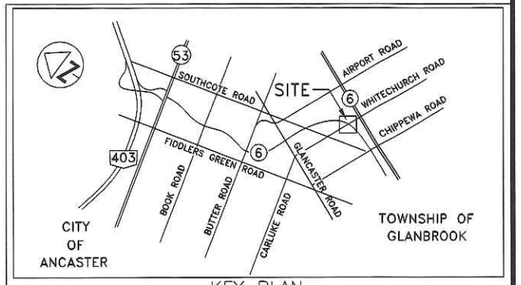
PLAN
SCALE
5 0 5 10m
HORIZONTAL



SECTION
SCALE
HOR 5 0 5 10m
VER 5 0 5 10m

CONT No.	
WP No. 603-00-01	SHEET
HWY 6 (NEW) FROM HWY 403 TO EXISTING HWY 6 WHITECHURCH ROAD UNDERPASS BOREHOLE LOCATION & SOIL STRATA	

Peto MacCallum Ltd.
CONSULTING ENGINEERS



KEY PLAN
N.T.S.

LEGEND

- Borehole
- N Blows/0.3m (Std. Pen Test, 475 J / blow)
- W L at time of investigation or in piezometer
- Piezometer

No	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
16	217.11	4 778 462	269 969
17	217.14	4 778 459	269 988
18	218.10	4 778 458	270 022
19	217.22	4 778 443	270 053
20	216.68	4 778 443	270 073

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

REV.	DATE	BY

Geocres No. 30M4-96

HWY No. 6			DIST
SUBM'D P.C.	CHECKED M.R.A.	DATE FEB. 2002	SITE 36-494
DRAWN C.B.	CHECKED B.R.G.	APPROVED D.W.K.	DWG 1