82-26025

PETO MACCALLUM LTD.
CONSULTING ENGINEERS

OAKVILLE-HAMILTON SECTION

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WO 82-26025 DIST 4

HWY GO-ALRT STR SITE

Oakville Project - West Extension
- Bronte Road Subway

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GEOCRES MARCH, 1984

PETO MacCALLUM LTD.
165 CARTWRIGHT AVENUE, TORONTO, ONTARIO M6A 1V5
CONSULTING ENGINEERS 'Phone (416) 789-4105

Job No. 84 F 20 March 7, 1984

GO-ALRT
c/o Ministry of Transportation and Communications
Pavement and Foundation Design Section
Room 315, Central Building
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8

Attention: Mr. K. Selby, P. Eng.

Gentlemen:

Re: Geotechnical Investigation
GO-ALRT Programme
Oakville Project, West Extension
W.O. 82-26025, Bronte Road Subway
District 4, Hamilton

We are pleased to present our report for the geotechnical investigation carried out for the above referenced Bronte Road Subway as authorized in Agreement No. WGG001-20A.

The attached report provides complete details of the field and laboratory work carried out, the subsurface and groundwater conditions encountered at the proposed bridge site and engineering discussion and recommendations for foundation design and construction.

The stratigraphy at the bridge site comprises surficial fill at the abutments and roadway pavement at the central pier location overlying red shale bedrock.

The proposed bridge structure can be supported by spread footings founded on the weathered shale or on the underlying sound shale bedrock. The factored bearing capacities at Ultimate Limit States, which govern the design of the unyielding shale bedrock, are 1000 kPa and 1500 kPa for weathered and sound shale, respectively.

The report presents parameters for design of abutment walls and discusses problems that might be encountered during bridge construction including excavation procedures in the weathered shale, excavation slopes and groundwater control.

We trust this report satisifies your requirements and thank you for the opportunity to be of service to the Ontario Ministry of Transporation and Communications. If you have any questions, or when we may be of further assistance to you during the construction phase of the project, please do not hesitate to contact our office.

Yours very truly,
PETO MacCALLUM LTD.

Brian R. Gray

BRG/cob

Brian R. Gray, P. Eng.
Manager Geotechnical Services

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1. INTRODUCTION

Peto MacCallum Ltd. was authorized by The Ministry of Transportation and Communications, Agreement Number WGG001-20A to carry out a geotechnical investigation at the site of the proposed Bronte Road Subway structure in Oakville, Ontario. The subject project constitutes part of the westerly extension of the GO-ALRT programme.

A summary of the proposed development plans and the probable location of footings was provided in a copy of The Ministry of Transportation and Communications internal memorandum to Mr. K.G. Selby, Senior Foundation Entineer, dated November 30, 1983, and the accompanying drawings P-010 and ZP-010. The development plans were subsequently discussed in the meeting of January 17, 1984.

The proposed GO-ALRT Bronte Road Subway will comprise a two-span, superstructure each about 25 m long, over Bronte Road. The proposed structure will slope on a 1% gradient to the west and will be located immediately north of the existing CNR Bronte Road bridge.

The purpose of this investigation is to determine the sub-surface soils and groundwater conditions at the proposed bridge site and based on this information to provide geo-technical engineering recommendations pertinent to the design and construction of the proposed GO-ALRT Bronte Road Subway.

A preliminary letter report dated February 17, 1984 was issued following completion of field work which presented a summary of foundation recommendations for the project.

2. FIELD WORK

The scope of the present investigation was established based on the subsurface information available in the general area. The original field programme included a total of seven (7) boreholes, three (3) at each abutment and one (1) at the central pier with one (1) borehole in each foundation area extended below the underside of the footing. Due to unforeseen difficulties in coring the highly weathered shale which exists to well below the proposed founding levels, a single borehole was drilled at each footing area extending into the underlying sound shale bedrock.

The field work was carried out during the period of January 31 to February 8, 1984, at the locations shown on the appended plan. The boreholes were advanced to depths of 4.14 to 8.89 m, some 2.40 to 4.55 m below the proposed founding levels, using a CME-45 track mounted drillrig equipped with continuous flight solid stem augers and rock coring capabilities, supplied and operated by a specialist drilling contractor.

Representative samples of the overburden and the weathered shale bedrock were obtained at frequent intervals of depth using a conventional split spoon sampler in conjunction with standard penetration tests. BXL core samples of the bedrock were recovered. The groundwater conditions in the open boreholes were monitored during and on completion of drilling.

The field work was supervised throughout by a member of our engineering staff who directed the drilling and sampling operations, documented the soil and bedrock stratigraphy monitored the groundwater conditons in the open boreholes and cared for the recovered soil and rock cores.

The clearance of underground utilities and the survey control at the boreholes were carried out by Peto MacCallum Ltd. A benchmark, provided by The Ministry of Transportation and Communications, was used as reference for vertical control:

B.M. Top of bolt (painted yellow) at the southeast corner of C.N.R. bridge over Bronte Creek, 26.4 m left of station 17+072.0;
Elevation 104.184

3. LABORATORY TESTING PROGRAMME

All of the recovered samples were brought to our laboratory for detailed visual examination and routine testing to confirm field visual descriptions. Natural moisture content tests were conducted on all overburden recovered samples. In addition, six (6) unconfined compression tests were performed on shale rock cores; results are presented in Table I appended.

4. SITE DESCRIPTION AND GEOLOGY

As a result of the recent grade separation project at Bronte Road and the C.N.R. Tracks, Bronte Road is presently a subway under the C.N.R. bridge. The abutments of the proposed GO-ALRT structure are located near the crest of the existing cut slope on either side of Bronte Road. The central pier will be located in the median of the roadway.

At the location of the west abutment, a watermain, gasmain and Bell cables were buried to about 4.0 m depth.

The bedrock at the site is a red shale with thin green bands parallel to the bedding known as Queenston Formation which was deposited during the Upper Ordovician Geologic period.

During the Wisconsinan Geological period, the area was subjected to intense glacial activity with erosional processes predominating. As a result, a thin till sheet developed. The underlying shale bedrock is currently degrading to weathered shale through continuing weather processes.

5. SUBSURFACE SOIL AND GROUNDWATER CONDITIONS

Reference is made to the appended Record of Borehole sheets for detailed soil and bedrock descriptions, inferred stratigraphy, standard penetration 'N' values, results of moisture contents and groundwater observations. A summarized subsurface profile condition is shown on the appended drawing.

The stratigraphy at the bridge site comprises surficial fill at the east and west abutments and roadway pavement at the central pier location overlying the red shale bedrock.

5.1 FILL

Boreholes 1 and 3 drilled at the east and west abutments encountered typically firm to hard brownish red silty clay fill to 2.89 and 3.40 m respectively, corresponding to elevation 103.08 and 101.30. The fill in borehole 1 which contains pockets of topsoil, sand and gravel and asphaltic concrete, is probably resulted from the construction of the C.N.R. bridge. The fill in borehole 3 is the trench backfill associated with the installation of the adjacent watermain.

The natural moisture contents of the fill ranged from 4 to 15%, indicative of a damp to moist condition.

5.2 PAVEMENT

Borehole 2, which was located in the footing area of the central pier, penetrated the pavement structure of Bronte Road. The pavement consists of 200 mm asphaltic concrete overlying a 450 mm sand and gravel base course. There was no free groundwater in the granular base course at the time of the investigation.

5.3 BEDROCK

Red Queenston shale bedrock was contacted under the fill in boreholes 1 and 3 and the pavement in borehole 2. Based on augering resistance and recovered rock core samples, the upper 2.22 to 4.67 m of the shale is weathered, becoming sound below this depth. The sound shale levels are elevations 99.87, 95.68 and 96.63 in boreholes 1, 2, and 3 respectively.

The red shale contains harder greyish green bands, generally 50 mm thick, which constitute 10 to 20% of the shale. The weathered shale is described as moderately to highly weathered, very poor to poor quality and has very low to low strength. The sound shale is slightly to moderately weathered, fair to excellent quality and of low to medium strength. The results of unconfined compression tests on sound rock cores show the compressive strength (σ_c) lies in the range of 9.8 to 26.7 MPa, Table I appended.

The moisture content of the weathered shale is in the range of 4 to 8%. The unit weight of the sound shale is between 25.4 and 25.9 kN/m^3.

5.4 GROUNDWATER CONDITIONS

Groundwater was not encountered in the overburden and the weathered shale prior to rock coring. The natural moisture contents of the overburden and weathered shale are relatively low, suggesting damp to moist conditions. On the face of the cut slope adjacent to boreholes 1 and 3, there was no evidence of groundwater seepage. Although the stabilized groundwater level could not be established due to the limited time of observations, we believe that the groundwater should be below the maximum depth of exploration elevation 94.41.

6. ENGINEERING DISCUSSION AND RECOMMENDATIONS

The proposed GO-ALRT structure over Bronte Road will be a two span bridge located immediately to the north of the existing C.N.R. bridge. The subsurface conditions at the site are favourable for the use of shallow spread footings.

6.1 SPREAD FOOTINGS

In accordance with Drawing P-010, the proposed founding level of the east and west abutments and the central pier are elevations 101.15, 100.36 and 96.81 respectively. Based on the results of the boreholes, the proposed bridge structure can be supported on conventional spread footings founded in the weathered shale. The footing founding levels in the weathered shale bedrock should be a minimum 1.0 m into the weathered shale. These footings should be poured neat against the bedrock, without the use of forms.

Should higher bearing capacity be required for the footing design, the footings can be set on the underlying sound shale. However, the footings of the existing C.N.R. Bridge located about 2 m to the south should not be undermined by the new footing excavations. A minimum of 1 horizontal to 2 vertical excavation slope below the existing C.N.R. bridge footing should be maintained.

The factored bearing capacities at Ultimate Limit States (ULS) for spread footings founded on the weathered and sound shale bedrock are 1000 kPa and 1500 kPa, respectively. Since the weathered and sound shale are considered unyielding, the Servicibility Limit States Type II bearing capacities will be much higher; therefore, the ULS bearing capacities govern the footing design.

The following table summarizes the depths and elevations of the weathered and sound shale bedrock and recommended founding elevations at each footing area:

Location	Ground Surface Elevation	Proposed Founding Elevation	RECOMMENDED FOUNDING ELEVATIONS Weathered Shale		Sound Shale	
			Depth (m)	Elevation	Depth (m)	Elevation
East Abutment Borehole 1	105.97	101.15	3.89	102.08	6.10	99.87
Central Pier Borehole 2	98.55	96.81	1.65	96.90	2.87	95.68
West Abutment Borehole 3	104.70	100.36	4.40	100.30	8.07	96.63

6.2 ABUTMENTS

Both closed or open ended type abutments are feasible depending on the spacial limitation and bridge design chosen. Free draining granular backfill and installation of weepholes or weeping tiles behind the abutment walls should be provided in accordance with MTC standard Special Provision 121, October, 1983.

Abutment walls should be designed to resist the unbalanced lateral forces acting on the wall in accordance with 6.6.1.2 of The Ontario Highway Bridge Design Code. The following geotechnical parameters are recommended for abutment wall design:

Friction angle between footing and shale bedrock.

$\delta = 25^{\circ}$ sound shale
$\delta = 22^{\circ}$ weathered shale

Friction angle between Granular 'A' backfill and Concrete.

$\delta = 24^{\circ}$

Bulk density of Granular 'A' backfill

$\gamma = 22$ kN/m^3

Internal Friction angle of Granular 'A' backfill

$\phi = 35^{\circ}$

If Granular 'B' backfill is to be used, a wide range of values for γ and ϕ exist. Unless the exact source of the material is known and appropriate tests are performed, both γ and ϕ may be subject to considerable error. In this case, it will be necessary to compute earth pressures in accordance with 6.6.1.2.2 of Ontario Highway Bridge Design Code using equivalent fluid pressures.

It should be noted that for earth pressure coefficients, the at rest condition applies since the foundation is non-yielding.

6.3 CONSTRUCTION AND GROUNDWATER CONTROL

Footing excavations at the site are expected to be straightforward. Excavation slopes can be cut near vertical for the bottom 1.2 m above which 1 horizontal to 1 vertical in the fill and 1 horizontal to 2 vertical in the shale bedrock. All excavation should be carried out in compliance with The 1978 Ontario Occupational Health and Safety Act.

Excavation in the weathered shale bedrock can be carried out using a heavy duty backhoe assisted by a ripper. The generally harder greyish green limey bands will be more difficult to excavation and may require pneumatic hammers. The degree of difficulty of excavation will increase with depth.

Caution should be exercised during footing excavation at the west abutment where underground utilities are present.

Groundwater should not pose any special problems. Local nuisance seepage from the fill or surface runoff that enters the footing excavations should be handled readily by conventional sump pumping.

PETO MacCALLUM LTD.

Eric Y. Chung, P. Eng.

S. Pilch, P. Eng.
Chief Geotechnical Engineer

EYC/cob

TABLE I

UNCONFINED COMPRESSION TEST RESULTS
ON SHALE BEDROCK CORE
GO-ALRT PROGRAMME
OAKVILLE PROJECT
WEST EXTENSION
W.O. 82-26025, BRONTE ROAD SUBWAY
DISTRICT 4, HAMILTON

Borehole No.	Depth (m)	Elevation	Unit Weight (γ) (kN/m³)	Unconfined Compression Strength σc (MPa)	Strain at Failure (%)
1	6.70	99.27	25.7	16.5	0.9
1	7.05	98.92	25.9	26.7	1.7
2	3.30	95.25	25.4	25.2	0.7
2	4.10	94.45	25.5	19.8	1.4
3	8.45	96.25	25.6	9.8	0.6
3	8.60	96.10	25.8	13.8	2.4

NOTE: Unconfined compression tests were performed in accordance with ASTM-D2938

PETO MacCALLUM LTD.
JOB NO. 84 F 20
MARCH, 1984

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS $\bar{N}$.

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	>200
	VERY SOFT	*SOFT*	*FIRM*	*STIFF*	*VERY STIFF*	*HARD*

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	>50
	VERY LOOSE	*LOOSE*	*COMPACT*	*DENSE*	*VERY DENSE*

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	*POOR*	*FAIR*	*GOOD*	*EXCELLENT*

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	>3m
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY $= \frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

e	1, %	VOID RATIO
n	1, %	POROSITY
w	1, %	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX $= w_L - w_P$
I_L	1	LIQUIDITY INDEX $= \frac{w - w_P}{I_P}$
I_C	1	CONSISTENCY INDEX $= \frac{w_L - w}{I_P}$
e_{max}	1, %	VOID RATIO IN LOOSEST STATE

e_{min}	1, %	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_u	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 1

METRIC

W O 82-26025 LOCATION Co-ords. 4,807,106 N; 285,819 E. ORIGINATED BY EYC

DIST 4 HWY Bronte Road BOREHOLE TYPE Solid Stem Auger, BXL Rock Core COMPILED BY EYC

DATUM Geodetic DATE January 31, February 1 and 2, 1984 CHECKED BY SP

ELEV DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	'N' VALUES	ELEVATION SCALE	WEATHERING	STRENGTH	RQD %
105.97 0.00	Fill-silty clay, trace gravel, pockets of topsoil, sand & gravel, asphaltic concrete, very stiff to hard, brownish red	1	SS	30				
		2	SS	20	104			
103.08		3	SS	50				
2.89	Shale-red with occasional greyish green layers (50 mm) horizontally bedded very poor quality thin bedding	4	SS	85/200 mm		high	very low	
		5	SS	100/130 mm	102			
100.79		6	RC BXL	REC 40%				0
5.18 99.87	poor quality thin bedding	7	RC BXL	25%	100	moderate	low	33
6.10 98.55	sound excellent quality medium to thick bedding	8	RC BXL	100% 100%		slight	low to medium	100
7.42	End of Borehole				98			

Note:
Before rock coring no free water in open borehole

Upon completion of rock coring, cave at elevation 105.32

Drill Water at elevation 105.37

Stabilized groundwater level not established

Column headings: SOIL PROFILE (ELEV DEPTH, DESCRIPTION, STRAT PLOT); SAMPLES (NUMBER, TYPE, 'N' VALUES); GROUND WATER CONDITIONS; ELEVATION SCALE; DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; PLASTIC LIMIT Wp, NATURAL MOISTURE CONTENT W, LIQUID LIMIT WL; WATER CONTENT (%) 10 20 30; UNIT WEIGHT γ; REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

15 ◇ 5 (%) STRAIN AT FAILURE (20 above, 10 below)

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 2

METRIC

W O 82-26025 LOCATION Co-ords, 4,807,085 N; 285,803 E. ORIGINATED BY EYC

DIST 4 HWY Bronte Road BOREHOLE TYPE Solid Stem Auger, BXL Rock Core COMPILED BY EYC

DATUM Geodetic DATE February 8, 1984 CHECKED BY SP

ELEV DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	WEATHERING	STRENGTH	RQD %	WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
98.55												
0.20	Asphaltic Concrete											
97.90	Fill-sand & gravel (Base Course)	1	SS	100/80 mm		98						
0.65	Shale-red with occasional greyish green layers (50 mm) horizontally bedded very poor quality thin bedding	2	RC BXL	REC 60%		96	moderate	low	0			
95.68 / 2.87	sound fair quality thin to medium bedding	3	RC BXL	100%			moderate to slight	low to medium	62			
94.14		4	RC BXL	100%		94			50			
4.41	End of Borehole											

Note
Before rock coring no free water in open borehole

Upon completion of rock coring, drill water at ground surface

Stabilized groundwater level not established

Dynamic Cone Penetration Resistance Plot: 20 40 60 80 100
Shear Strength: ○ Unconfined + Field Vane ● Quick Triaxial × Lab Vane
Plastic Limit W_p — Natural Moisture Content W — Liquid Limit W_L; Water Content (%) 10 20 30

+3, ×5 : Numbers refer to Sensitivity

15 ◇ 5 (%) STRAIN AT FAILURE (20 above, 10 below)

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 3

METRIC

W O 82-26025 LOCATION Co-ords. 4,807,056 N; 285,781 E. ORIGINATED BY EYC

DIST 4 HWY Bronte Road BOREHOLE TYPE Solid Stem Auger, BXL Rock Core COMPILED BY EYC

DATUM Geodetic DATE February 6 and 7, 1984 CHECKED BY SP

ELEV / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	'N' VALUES	ELEVATION SCALE	WEATHERING	STRENGTH	RQD %
104.70								
0.00	Fill-silty clay trace gravel, pockets of topsoil, sand & gravel; firm to hard, brownish red	1	SS	22	104			
		2	SS	7				
		3	SS	43	102			
101.30		4	SS	100/280 mm				
3.40	Shale-red with occasional greyish green layers (50 mm) horizontally bedded very poor quality thin bedded	5	SS	100/130 mm	100	high	very low	
		6	SS	100/50 mm				
		7	RC BXL	REC 52%	98	moderate	low	0
96.63	vertical fissures; from 7.40 to 7.85 m	8	RC BXL	REC 40%				
8.07 / 95.81	sound, fair quality thin to medium bedding	9	RC BXL	REC 100%	96	moderate to slight	low	60
8.89	End of Borehole							

Other column headings: SOIL PROFILE; STRAT PLOT; SAMPLES; GROUND WATER CONDITIONS; DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH: o UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE; PLASTIC LIMIT W_p, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30; UNIT WEIGHT γ; REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL.

Note
Before rock coring no free water in open borehole

Upon completion of rock coring, cave at elevation 101.50

Drill water at elevation 101.65

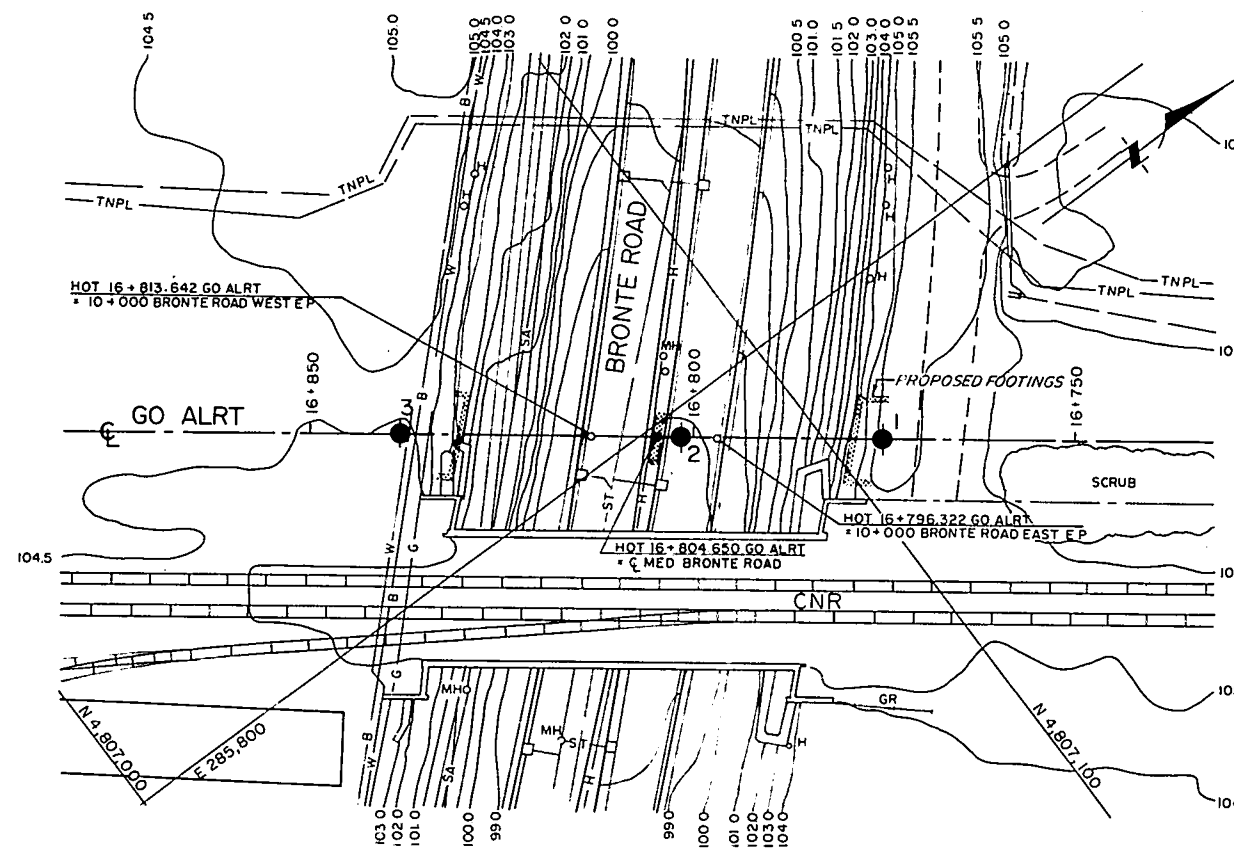
Stabilized groundwater level not established

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity — 15 ◇ 5 (20 above, 10 below) (%) STRAIN AT FAILURE

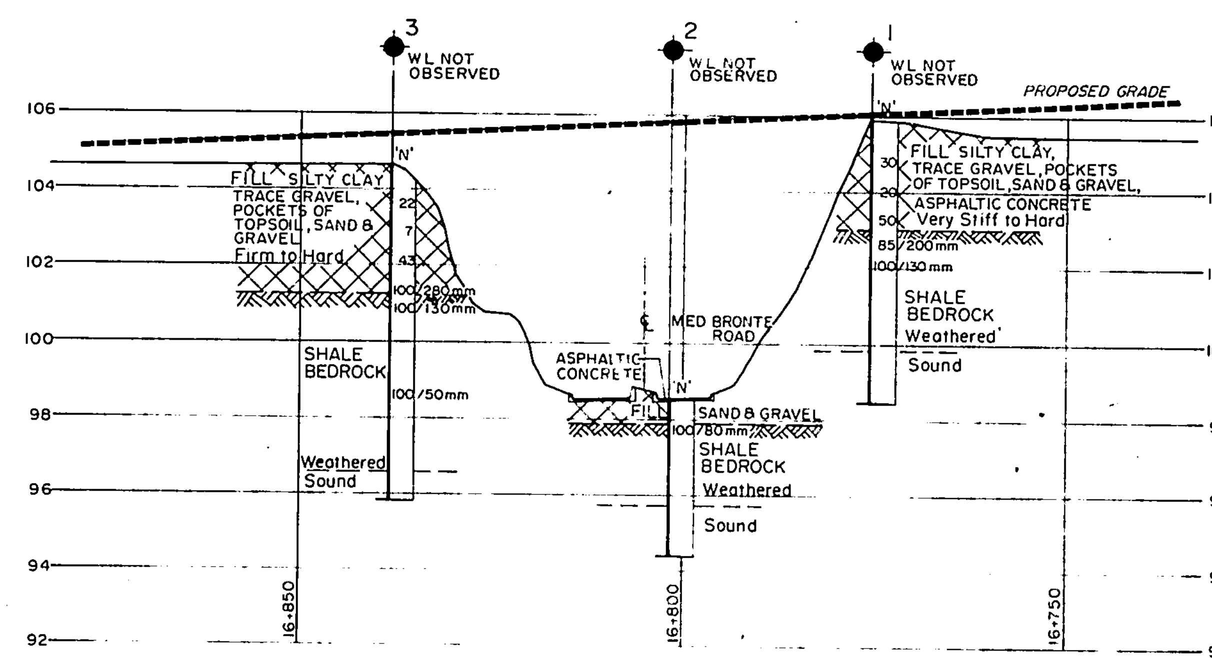
METRIC

ALL DIMENSIONS SHOWN ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE NOTED.



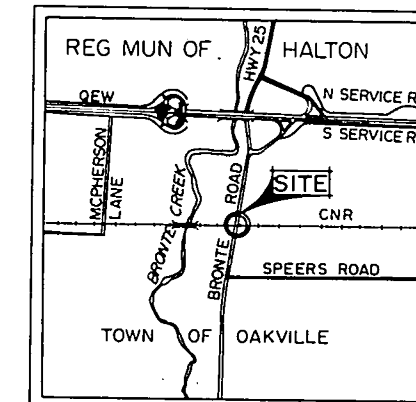
PLAN

SCALE 10 5 0 10 20m



℄ PROFILE GO-ALRT

SCALE 10 5 0 10 20m



KEY PLAN

SCALE 0.5 0 1km

LEGEND

- ◆ Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation Feb 1984

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	105.97	4 807 106	285 819
2	98.55	4 807 085	285 803
3	104.70	4 807 056	285 781

Geocres No

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100

GO-ALRT REF P-010

REFERENCE DRAWINGS	REVISIONS	DRAWN BY: K.K 84 03 0_	DESIGNED BY:
		CHK'D BY: EYC 84 03 0_	APPROVED BY:
		SCALE: 1:500 FULL SIZE ONLY	

E. Y. CHUNG — PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

PETO MacCALLUM LTD.

GO-ALRT

Ministry of Transportation and Communications

OAKVILLE PROJECT-WEST EXTENSION

PROJECT MANAGER

HALTON REGION

BRONTE ROAD SUBWAY

BORE HOLE LOCATIONS & SOIL STRATA

STA 16+804.650

CONTRACT NO	DWG NO	REV	SHEET