

ENGINEERING MATERIALS OFFICE  
PAVEMENT & FOUNDATION DESIGN SECTION

W'0 82-26025

DIST 4

HWY GO-ALRT

STR SITE 10

- GO-ALRT, West Extension, Oakville Project
- Third Line CNR Subway
  - Third Line GO-ALRT Subway
  - Associated Retaining Walls

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FOUNDATION INVESTIGATION REPORT  
FOR  
W.O. 82-26025, Site 10  
District 4, Hamilton  
GO-ALRT, West Extension, Oakville Project  
- Third Line CNR Subway  
- Third Line GO-ALRT Subway  
- Associated Retaining Walls

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INTRODUCTION

This report summarizes the results of the foundation investigations required for the proposed structures.

The fieldwork was conducted during the period from 83 10 26 to 83 11 14 utilizing continuous flight auger machines equipped with hollow-stem and solid-stem augers, BX casing and BXL core barrels.

This work consisted of:

- 9 dynamic cone penetration tests/sampled boreholes/rock cores,
- 1 borehole/rock core
- 4 dynamic cone penetration tests/sampled boreholes,
- 8 dynamic cone penetration tests.

SITE DESCRIPTION

This site is located at the Third Line in the Town of Oakville, approximately 650 m south of the QEW. The GO-ALRT alignment is on the existing Ontario Hydro right-of-way, with the CNR to the south.

The area is described physiographically by Chapman and Putnam (1969) as the South Slope, which, in the vicinity of the site, consists generally of a shale plain overlain by a veneer of glacial drift. These soils have originated, to a large extent, from the underlying bedrock, although some imported glacial material is also present.

The topography at this site is flat.

The land use in the area is light industrial/commercial.

## SUBSURFACE CONDITIONS

### General

The Record of Borehole Sheets, (Appendix) illustrate the conditions at the borehole locations. The locations and elevations of the boreholes, and stratigraphical profiles based on the borehole data, are shown on the Borehole Locations & Soil Strata Drawing for Third Line.

The overburden generally consists of 1 to 2 metres of stiff to hard silty clay overlying the Queenston Formation shale bedrock. The elevation of the bedrock surface at this site is in the order of 102.0 m to 103.5 m - the upper 1± m being weathered. Below the weathered zone, the bedrock is generally sound and intact.

A union gas trench crosses the site at GO-ALRT Sta. 14 + 740±.

It was necessary to interpolate the subsurface conditions for the footing locations on the CNR right-of-way because of property and utility constraints. However, due to the generally uniform nature of the bedrock topography in this area, interpolation can be made with a reasonable amount of confidence.

### Overburden

#### SILTY SAND

This material is non-cohesive. Up to 0.6 m of this loose to compact material was encountered under the asphalt pavement at the Procar parking lot on the west side of Third Line, and at the Al's Trucking parking lot on the east side of Third Line.

Up to 0.8 m of loose to compact silty sand, containing some gravel, was encountered at BH #5, under the asphalt pavement of Third Line.

#### SILTY CLAY (CL)

This material is cohesive with low plasticity. Silty clay, containing occasional shaley layers, traces to some sand, and traces of gravel, overlies the bedrock. Outside of the paved areas, this material is at the surface.

The consistency ranges from firm to hard; the thickness generally ranges from 0.3 to 1.2 m.

At BH #13, 2.7 m of this material was encountered; at BH #32 none of this material was encountered; at BH #33 a 0.15 m thick layer of silty sand was encountered between the silty clay and the bedrock.

Physical properties of the material, as determined from field and laboratory tests, are summarized as follows:

	<u>Range</u>	<u>Average</u>	<u>Median</u>
Natural Moisture Content (w)	8.5 - 12.0 %	10.7 %	11.5 %
Liquid Limit ( $W_L$ )	24.0 - 30.5 %	28.2 %	30.0 %
Plastic Limit ( $W_p$ )	16.5 - 17.5 %	16.8 %	16.5 %

Figure 1 illustrates a typical grain size distribution for this material.

#### Bedrock

The site is underlain by shale of the Queenston Formation. The shale is predominantly red containing occasional (approximately 5%) green shale and siltstone layers. The upper bedrock is weathered to varying degrees (see borehole logs), and becomes sound with depth. The sound bedrock is generally massive (i.e. it is not intersected by natural discontinuities) and is estimated to be of low unconfined compressive strength (i.e. 4 - 15 MPa). Refer to Table 1 (Appendix) for descriptions of the rock core that was recovered at this site.

#### Groundwater

Stabilized groundwater conditions were difficult to establish because of the impermeable nature of the overburden and the generally intact nature of the bedrock. At the time of the field investigation the groundwater elevation was estimated at 103.5± m at this site. Slight fluctuations in this level are expected to occur seasonally.

## DISCUSSION AND RECOMMENDATIONS

It is proposed to construct two subways to carry the proposed GO-ALRT and the existing CNR over Third Line at a grade of 104± m.

This project will involve the following proposed structures:

- 1) GO-ALRT 2-span subway and associated retaining walls. Refer to Figure A and Figure B-1 (Section Z-Z).
- 2) CNR 2-span subway and associated retaining walls. Refer to Figure A and Figure B-2 (Section Y-Y).
- 3) Third Line west side retaining walls. Refer to Figure A and Figure C-1 (Section W-W).
- 4) Third Line east side retaining walls. Refer to Figure A and Figure C-2 (Section V-V).

The following general recommendations and design details refer to all structures.

### General Recommendations

- Earth pressure acting on abutments and retaining walls should be computed as per Subsection 6.6.1.2.2 of the O.H.B.D.C. assuming a non-yielding foundation with  $K_o = 0.43$  and  $\gamma = 22.0 \text{ kN/m}^3$  for Granular A backfill;  $K_o = 0.5$  and  $\gamma = 21.2 \text{ kN/m}^3$  for Granular C backfill.
- For frost protection, cover should be greater than 1.2 m.
- No stability problems are anticipated for embankments or cuts with slopes of 2:1 or flatter. If steeper slopes are required please contact this section for recommended slope angles and erosion protection.
- Differential settlements in the structures will be negligible.

- Dewatering is not anticipated to be a major problem because of the impermeable nature of the overburden and the generally intact nature of the bedrock. It is believed that groundwater entering the excavations can be controlled by conventional pumping techniques.
- Excavations in bedrock may be accomplished without blasting techniques

### Design Details

Two alternatives are recommended.

All structures may be founded on spread footings (Refer to Figs. A, B, and C);

- i) within Zone 2 (weathered bedrock),
- or ii) within Zone 3 (sound bedrock).

For these alternatives, all soft or loose material at the proposed footing locations should be removed, and the foundation surface should be covered within 12 hours of exposure with a 15 cm pad of mass concrete.

Where trenches (e.g. underground utilities) are encountered they should be excavated to sound bedrock and backfilled (within 12 hours of exposure) with mass concrete.

For resistance to lateral forces,

- a) key footing into bedrock a minimum of 0.5 m and use a friction coefficient of 0.25 between the bedrock and the footing, or
- b) dowel into bedrock a minimum of 1.5 m (as a design example a 5 cm diameter dowel installed as recommended will provide a safe shearing resistance of approximately 20 kN per dowel).

The following design values are recommended for footings within the indicated foundation zones:

- net safe bearing pressure  
for Zone 2 = 670 kPa  
for Zone 3 = 1000 kPa

and for the purposes of the O.H.B.D.C.:

- Factored Bearing Capacity at U.L.S.  
for Zone 2 = 1000 kPa  
for Zone 3 = 1500 kPa
- Bearing Capacity at S.L.S. Type II  
will not govern design.

MISCELLANEOUS

The fieldwork for this project was carried out under the supervision of Mr. P. Dempsey, Student Specialist, and Mr. D. H. Dundas, Foundations Engineer. The description and evaluation of the bedrock was carried out by Mr. E. Magni, Geologist.

The report was written by Mr. Dundas, and reviewed by Mr. K. G. Selby, Senior Foundations Engineer.

The equipment used was owned and operated by Atcost Soil Drilling Inc.



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

*K. G. Selby*  
K. G. Selby, P.Eng.  
Senior Foundations Engineer

APPENDIX

### RECORD OF BOREHOLE No 5

METRIC

Third Line Subways  
 WO 82-26025 LOCATION Co-ords: N 4 808 714.0, E 287 022.0 ORIGINATED BY DD  
 DIST 4 HWY GO-ALRT BOREHOLE TYPE Cone Test, S.S. Auger, BXL Core COMPILED BY DD  
 DATUM Geodetic DATE 83 10 28 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80	100	W <sub>p</sub>	W		
104.6	Ground Surface															
0.0	Asphalt	[Pattern]														
103.8	Silty Sand some gravel loose to compact	[Pattern]	1	SS	23											
0.8	Silty Clay (CL) occ. shaly layers stiff to hard	[Pattern]														
103.2			2	SS	85											
1.4	Weathered Sound	[Pattern]	3	RC	100%											
				BXL												
	Bedrock Queenston Formation Shale		4	RC	100%											
				BXL												
100.6																
4.0	End of Borehole															
	* trace/some sand trace/some gravel															

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to Sensitivity      20  
 15  $\diamond$  5 (%) STRAIN AT FAILURE  
 10



## RECORD OF BOREHOLE No 12

METRIC

Third Line Subways  
 WO 82-26025 LOCATION Co-ords: N 4 808 678.0, E 287 000.5 ORIGINATED BY PD  
 DIST 4 HWY GO-ALRT BOREHOLE TYPE Cone Test, S-S Auger, BXL Core COMPILED BY DD  
 DATUM Geodetic DATE 83 10 26 CHECKED BY SO

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
104.7	Ground Surface											
0.0	Silty Clay (CL) occ. shaly layers *Firm to Stiff	//										
103.9		//	1	SS	90	23 cm						
0.8	Weathered Sound	//	2	RC BXL	100%							
	Bedrock Queenston Formation Shale	//	3	RC BXL	95%							
100.3	End of Borehole											
4.4	* trace/some sand trace/some gravel											

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to 20  
Sensitivity 15  $\pm$  5 (%) STRAIN AT FAILURE  
10

### RECORD OF BOREHOLE No 13

METRIC

Third Line Subways  
 WO 82-26025 LOCATION Co-ords: N 4 808 735.0, E 287 039.0 ORIGINATED BY DD  
 DIST 4 HWY GO-ALRT BOREHOLE TYPE Cone Test, S-S Auger, BXL Core COMPILED BY DD  
 DATUM Geodetic DATE 83 10 26 CHECKED BY So

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES									
104.2	Ground Surface													
0.0	Silty Clay (CL) occ. shaly layers trace/some sand trace gravel Firm to Hard		1	SS	32								0 9 66 25	
			2	SS	38									0 6 74 20
101.5			3	SS	40									
2.7	Weathered Sand		4	SS	90									
	Bedrock Queenston Formation Shale		5	RC BXL	100%									
98.7			6	RC BXL	100%									
5.5	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

+3, x<sup>5</sup>: Numbers refer to Sensitivity  
 20  
 15-5 (%) STRAIN AT FAILURE  
 10

**RECORD OF BOREHOLE No 14** **METRIC**

Third Line Subways  
 WO 82-26025 LOCATION Co-ords: N 4 808 697.5, E 287 009.0 ORIGINATED BY PD  
 DIST 4 HWY GO-ALRT BOREHOLE TYPE Cone Test, S-S Auger, BXL Core COMPILED BY DD  
 DATUM Geodetic DATE 83 10 26 CHECKED BY SO

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
104.6	Ground Surface											
0.0	Silty Clay (CL) * occ. shaly layers Soft to Stiff											
103.7			1	SS	72							
0.9	Weathered Sound		3	RC BXL	80%							
	Bedrock Queenston Formation Shale		4	RC BXL	98%							
100.5	End of Borehole											
4.1	* trace/some sand trace gravel											

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to Sensitivity 20  
 15  $\frac{1}{5}$  (%) STRAIN AT FAILURE 10

**RECORD OF BOREHOLE No 15** **METRIC**

Third Line Subways

WO 82-26025 LOCATION Co-ords: N 4 808 738.5, E 287 035.0 ORIGINATED BY DD

DIST 4 HWY GO-ALRT BOREHOLE TYPE Cone Test COMPILED BY DD

DATUM Geodetic DATE 83 10 28 CHECKED BY SO

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
104.1	Ground Surface											
0.0	Probable Silty Clay (CL) occ. shaly layers trace/some sand trace gravel	//										
103.0												
1.1	*Probable Bedrock	//										
102.7												
1.4	End of Cone Test  * Weathered Queenston Formation Shale  ** water level not observed											

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to Sensitivity

20  
15  $\diamond$  5 (%) STRAIN AT FAILURE  
10

### RECORD OF BOREHOLE No 16

METRIC

Third Line Subways  
 WO 82-26025 LOCATION Co-ords: N 4 808 693.5, E 287 012.5 ORIGINATED BY PD  
 DIST 4 HWY GO-ALRT BOREHOLE TYPE Cone Test COMPILED BY DD  
 DATUM Geodetic DATE 83 10 26 CHECKED BY SO

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
104.5	Ground Surface											
0.0	Probable Silty Clay (CL) occ. shaly layers trace/some sand trace gravel				**	104						
103.3												
103.1	*Probable Bedrock											
1.4	End of Cone Test  * Weathered Queenston Formation Shale  ** water level not observed											

OFFICE REPORT ON SOIL EXPLORATION

### RECORD OF BOREHOLE No 17

METRIC

Third Line Subways  
 WO 82-26025 LOCATION Co-ords: N 4 808 731.5, E 287 042.0 ORIGINATED BY DD  
 DIST 4 HWY GO-ALRT BOREHOLE TYPE Cone Test COMPILED BY DD  
 DATUM Geodetic DATE 83 10 26 CHECKED BY SO

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
104.2	Ground Surface											
0.0	Probable Silty Clay(CL) occ. shaly layers trace/some sand trace gravel	/ / / / /				**						
103.3												
103.0	*Probable Bedrock	/ / / / /										
1.2	End of Cone Test  * Weathered Queenston Formation Shale  ** water level not observed											

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to Sensitivity      20  
 15 5 (%) STRAIN AT FAILURE  
 10

### RECORD OF BOREHOLE No 18

METRIC

Third Line Subways  
 WO 82-26025 LOCATION Co-ords: N 4 808 700.5, E 287 005.5 ORIGINATED BY PD  
 DIST 4 HWY GO-ALRT BOREHOLE TYPE Cone Test COMPILED BY DD  
 DATUM Geodetic DATE 83 10 26 CHECKED BY SO

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH						
104.5	Ground Surface													
0.0	Probable Silty Clay (CL) occ. shaly layers trace/some sand													
103.4	trace gravel													
103.3	* Probable Bedrock													
1.2	End of Cone Test													
	* Weathered Queenston Formation Shale													
	** water level not observed													

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

### RECORD OF BOREHOLE No 24

METRIC

Third Line Subways  
 WO 82-26025 LOCATION Co-ords: N 4 808 686.0, E 287 073.5 ORIGINATED BY PD  
 DIST 4 HWY GO-ALRT BOREHOLE TYPE Cone Test, S-S Auger, BXL Core COMPILED BY DD  
 DATUM Geodetic DATE 83 11 02 CHECKED BY SO

SOIL PROFILE		STRAT PLOT	SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE			'N' VALUES	20					
104.2 0.0	Ground Surface Silty Clay (CL) occ. shaly layers *Firm to Very Stiff												
103.3 0.9	Weathered Sound  Bedrock Queenston Formation Shale		1	SS	68								
			2	RC BXL	56%								
				3	RC BXL	96%							
				4	RC BXL	100%							
				5	RC BXL	96%							
				6	RC BXL	100%							
96.7 7.5	End of Borehole * trace/some sand trace gravel												

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
5  
0

(%) STRAIN AT FAILURE



## RECORD OF BOREHOLE No 25

METRIC

Third Line Subways

WO 82-26025 LOCATION Co-ords: N 4 808 672.5 E 287 086.0

ORIGINATED BY DD

DIST 4 HWY GO-ALRT BOREHOLE TYPE Cone Test

COMPILED BY DD

DATUM Geodetic DATE 83 10 28

CHECKED BY SO

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					
104.2	Ground Surface															
0.0	Probable Silty Clay (CL) occ. shaly layers trace/some sand trace gravel															
103.0																
1.2	* Probable Bedrock															
102.5																
1.7	End of Cone Test  * Weathered Queenston Formation Shale  ** water level not observed															

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to Sensitivity

20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10

## RECORD OF BOREHOLE No 26

METRIC

Third Line Subways  
 WO 82-26025 LOCATION Co-ords: N 4 808 590.5, E 287 125.0 ORIGINATED BY PD  
 DIST 4 HWY GO-ALRT BOREHOLE TYPE Cone Test, S-S Auger, BXL Cone COMPILED BY DD  
 DATUM Geodetic DATE 83 11 01 CHECKED BY SO

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20					
103.7	Ground Surface												
0.0	Asphalt												
103.1	Silty Sand Loose												
0.6	Silty Clay (CL) occ. shaly layers *Very Stiff to Hard		1	SS	27								
102.0			2	SS	79								
1.7	Weathered Sound		3	RC BXL	100%								0 7 74 19
	Bedrock Queenston Formation Shale		4	RC BXL	100%								
99.3													
4.4	End of Borehole  * trace/some sand trace gravel												

OFFICE REPORT ON SOIL EXPLORATION

\* 3, x 5 : Numbers refer to  
Sensitivity

20  
15 - 5 (%) STRAIN AT FAILURE  
10

## RECORD OF BOREHOLE No 27

METRIC

Third Line Subways  
 WO 82-26025 LOCATION Co-ords: N 4 808 603.0, E 287 111.5 ORIGINATED BY PD  
 DIST 4 HWY GO-ALRT BOREHOLE TYPE Cone Test COMPILED BY DD  
 DATUM Geodetic DATE 83 10 31 CHECKED BY SO

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40					
103.9 0.0	Ground Surface Asphalt													
103.3 0.6	Probable Silty Sand * Probable Silty Clay (CL)	▨												
102.7 1.2	Probable Bedrock Weathered Queenston Formation Shale	▩												
102.0 1.9	End of Cone Test  * occ. shaly layers trace/some sand trace gravel  ** water level not observed													

OFFICE REPORT ON SOIL EXPLORATION

<sup>3</sup>, x<sup>5</sup>: Numbers refer to Sensitivity  
 20  
 15 5 (%) STRAIN AT FAILURE  
 10

## RECORD OF BOREHOLE No 28

METRIC

Third Line Subways  
 WO 82-26025 LOCATION Co-ords: N 4 808 590.5, E 287 100.0 ORIGINATED BY PD  
 DIST 4 HWY G0-ALRT BOREHOLE TYPE Cone Test, S-S Auger COMPILED BY DD  
 DATUM Geodetic DATE 83 11 02 CHECKED BY SO

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					
											○ UNCONFINED	+ FIELD VANE	WATER CONTENT (%)			
											● QUICK TRIAXIAL	x LAB VANE				
103.8	Ground Surface															
0.0	Asphalt					**										
103.2	Silty Sand Loose to Compact															
0.6	Silty Clay (CL) occ. shaly layers		1	SS	52											
102.6	* Stiff to Hard															
1.2	Bedrock, Weathered Queenston Formation Shale		2	SS	108/	23 cm										
101.9	End of Borehole															
1.9	* trace/some sand trace gravel  ** water level not observed															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 29										METRIC			
Third Line Subways			LOCATION Co-ords: N 4 808 598.0, E 287 094.5				ORIGINATED BY PD						
WO 82-26025			BOREHOLE TYPE Cone Test				COMPILED BY DD						
DIST 4 HWY GO-ALRT			DATE 83 10 31				CHECKED BY SO						
DATUM Geodetic													
ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
			NUMBER	TYPE	'N' VALUES			20	40	60			80
103.9 0.0	Ground Surface Asphalt												
103.3 0.6	Probable Silty Sand					**							
102.7 0.6	Probable Silty Clay (CL)												
102.7 1.2	occ. shaly layers												
101.9 1.2	Probable Bedrock												
101.9 2.0	Weathered Queenston Formation Shale												
	End of Cone Test												
	* trace/some sand trace gravel												
	** water level not observed												

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

### RECORD OF BOREHOLE No 30

METRIC

Third Line Subways  
 WO 82-26025 LOCATION Co-ords: N 4 808 610.0, E 287 105.5 ORIGINATED BY PD  
 DIST 4 HWY GO-ALRT BOREHOLE TYPE Cone Test, S-S Auger COMPILED BY DD  
 DATUM Geodetic DATE 83 10 31 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40					
104.0	Ground Surface													
0.0	Asphalt	[Pattern]												
103.4	Silty Sand Loose to Compact	[Pattern]												
0.6	Silty Clay (CL)	[Pattern]												
103.1	* Hard	[Pattern]	1	SS	83	23 cm								
0.9	Bedrock Weathered Queenston Formation Shale	[Pattern]	2	SS	98	23 cm								
102.2	End of Borehole													
1.8	* trace/some sand trace gravel  ** water level not observed													

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to Sensitivity      20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10

**RECORD OF BOREHOLE No 31** **METRIC**

Third Line Subways  
 WO 82-26025 LOCATION Co-ords: N 4 808 632.0, E 287 082.0 ORIGINATED BY PD  
 DIST 4 HWY GO-ALRT BOREHOLE TYPE Cone Test COMPILED BY DD  
 DATUM Geodetic DATE 83 10 31 CHECKED BY SO

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20					
104.1	Ground Surface												
0.0	Asphalt				***	104							
103.5	Probable Silty Sand												
0.6	Probable Silty Clay (CL)												
103.1	* occ. shaly layers												
1.0	Probable Bedrock					103							
102.7	**												
1.4	End of Cone Test												
	* trace/some sand trace gravel												
	** Weathered Queenston Formation Shale												
	*** water level not observed												

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to Sensitivity  
 20  
 15  $\phi$  5 (%) STRAIN AT FAILURE  
 10

## RECORD OF BOREHOLE No 32

METRIC

Third Line Subways  
 W 82-26025 LOCATION Co-ords: N 4 808 650.0, E 287 063.0 ORIGINATED BY PD  
 DIST 4 HWY GO-ALRT BOREHOLE TYPE Cone Test, S-S Auger, BXL Core COMPILED BY DD  
 DATUM Geodetic DATE 83 11 01 CHECKED BY SO

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			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
104.4	Ground Surface													
0.0	Asphalt	[Pattern]												
103.6	Silty Sand	[Pattern]												
0.8	Weathered Sound	[Pattern]	1	SS	91									
	Bedrock Queenston Formation Shale		2	RC BXL	92%									
			3	RC BXL	94%									
100.7	End of Borehole													
3.7														

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to Sensitivity      20  
15 - 5 (%) STRAIN AT FAILURE  
10

### RECORD OF BOREHOLE No 33

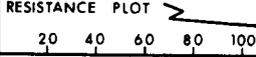
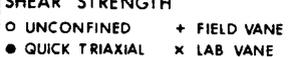
METRIC

Third Line Subways  
 WO 82-26025 LOCATION Co-ords: N 4 808 630.0, E 287 059.0 ORIGINATED BY PD  
 DIST 4 HWY GO-ALRT BOREHOLE TYPE Cone Test, S-S Auger COMPILED BY DD  
 DATUM Geodetic DATE 83 10 31 CHECKED BY SO

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
							SHEAR STRENGTH									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100					
104.2	Ground Surface															
0.0	Silty Clay (CL) trace/some sand trace gravel	//				**										
103.4	Firm to Stiff silty sand	//														
0.8	*Bedrock	//														
103.0																
1.2	End of Borehole  * Weathered Queenston Formation Shale  ** water level not observed															

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to Sensitivity      20  
15 - 5 (%) STRAIN AT FAILURE  
10

Third Line Subways		RECORD OF BOREHOLE No 34					METRIC				
WO <u>82-26025</u>		LOCATION		Co-ords: N 4 808 656.0, E 287 100.0		ORIGINATED BY <u>PD</u>					
DIST <u>4</u> HWY <u>GO-ALRT</u>		BOREHOLE TYPE		<u>Cone Test, S-S Auger, BXL Core</u>		COMPILED BY <u>DD</u>					
DATUM <u>Geodetic</u>		DATE		<u>83 11 02</u>		CHECKED BY <u>SD</u>					
ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE			'N' VALUES	20	40		
104.4	Ground Surface										
0.0	Asphalt										
103.8	Silty Sand Loose to Compact						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				
0.6	Silty Clay (CL)						WATER CONTENT (%) 10 20 30				
103.5	* Hard		1	SS	45						
0.9	Weathered Sound		2	SS	40						
			3	SS	60	15 cm					
			4	RC BXL	100%						
100.4	Bedrock Queenston Formation Shale										
4.0	End of Borehole										
	* occ. shaly layers trace/some sand trace gravel										

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
 Sensitivity

20  
 15  $\diamond$  5 (%) STRAIN AT FAILURE  
 10

### RECORD OF BOREHOLE No 35

METRIC

Third Line Subways  
 W O 82-25026 LOCATION Co-ords: N 4 808 700.0, E 287 083.0 ORIGINATED BY PD  
 DIST 4 HWY GO-ALRT BOREHOLE TYPE Cone Test, S-S Auger COMPILED BY DD  
 DATUM Geodetic DATE 83 11 01 CHECKED BY SO

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					
104.3	Ground Surface															
0.0	Asphalt	▨														
103.7	Silty Sand Loose to Compact	▧														
0.6	Silty Clay (CL)	▩														
103.2	* Very Stiff	▩	1	SS	28											
1.1	Bedrock Weathered Queenston Formation	▩														
102.4	Shale	▩	2	SS	86	/23 cm										
1.9	End of Borehole															
	* occ. shaly layers trace/some sand trace gravel															
	** water level not observed															

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to Sensitivity      20  
15-5 (% STRAIN AT FAILURE)  
10

**RECORD OF BOREHOLE No 43** **METRIC**

Third Line Subways  
 WO 82-26025 LOCATION Co-ords: N 4 808 696.0, E 287 010.5 ORIGINATED BY DD  
 DIST 4 HWY GO-ALRT BOREHOLE TYPE S-8 Auger, BXL Core COMPILED BY DD  
 DATUM Geodetic DATE 83 11 14 CHECKED BY SO

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					
104.6	Ground Surface															
0.0	Probable Silty Clay (CL) occ. silty layers trace/some sand trace clay	▨														
103.7		▨														
0.9	Weathered Sand	▨	1	RC BXL	82%											
	Bedrock Queenston Formation Shale		2	RC BXL	98%											
			3	RC BXL	98%											
			4	RC BXL	100%											
			5	RC BXL	100%											
96.7	End of Borehole															
7.9																

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to Sensitivity      20  
 15  $\phi$  5 (%) STRAIN AT FAILURE  
 10

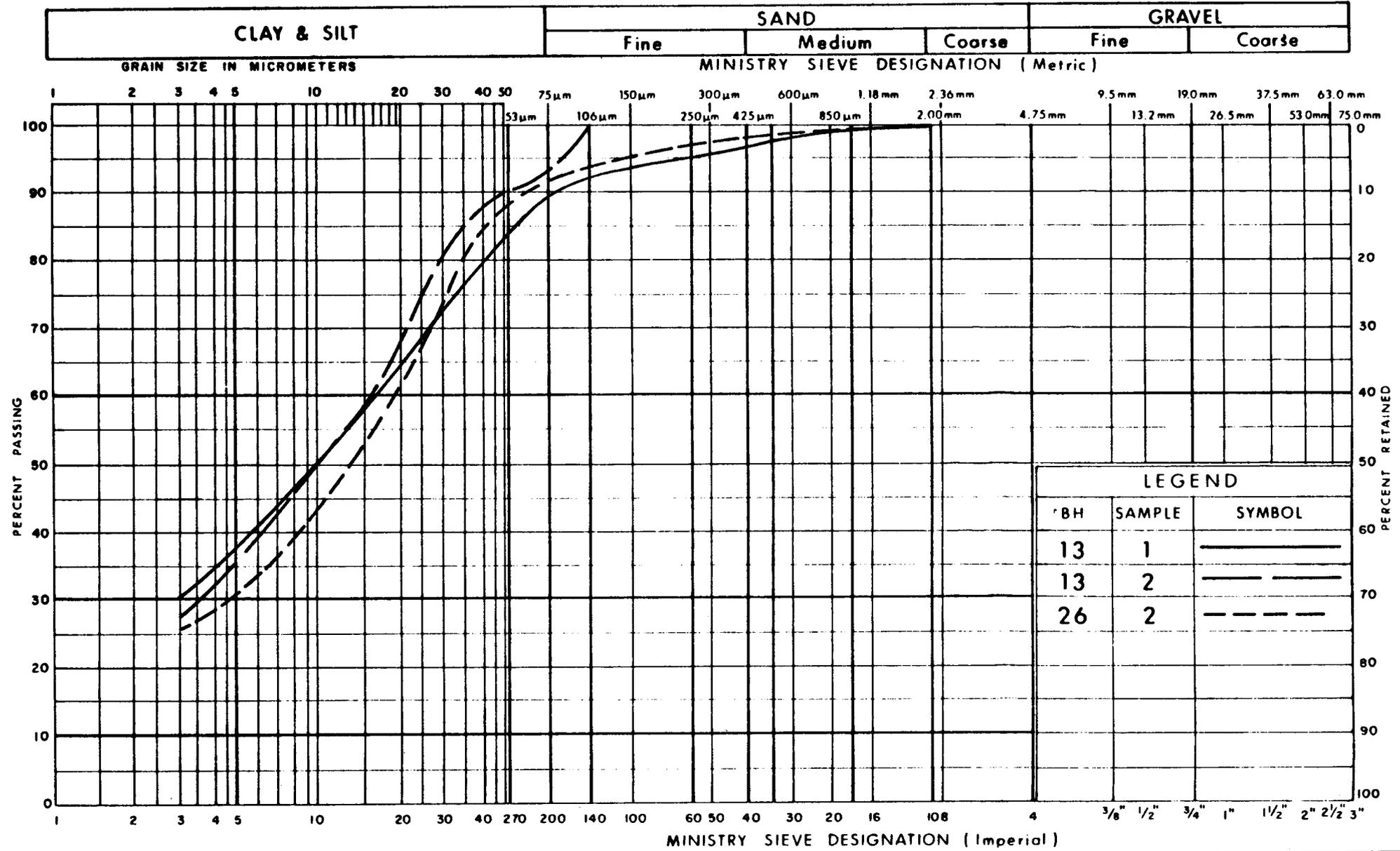
TABLE 1  
DESCRIPTION OF ROCK CORE - THIRD LINE

BOREHOLE NUMBER	CORE RECOVERY		CORE DESCRIPTION	
	DEPTH (m)	%	DEPTH (m)	DESCRIPTION
5	1.8 - 2.7	100	1.8 - 2.0	Shale, red (Queenston Fm), slightly weathered
	- 4.0	100	2.0 - 4.0	Shale, red (Queenston Fm), sound; 2.6 - 2.7 m, moderately weathered zone
11	1.8 - 3.3	98	1.8 - 1.9	Shale, red (Queenston Fm), slightly weathered
			1.9 - 3.3	Shale, red (Queenston Fm), sound
12	1.4 - 2.9	100	1.4 - 1.8	Shale, red (Queenston Fm), moderately weathered
	- 4.4	95	1.8 - 4.4	Shale, red (Queenston Fm), sound
13	3.4 - 4.9	100	3.4 - 3.43	Shale, red (Queenston Fm), slightly weathered
			3.43- 4.9	Shale, red (Queenston Fm), sound
14	1.1 - 2.6 - 4.1	80	1.1 - 1.7	Shale, red (Queenston Fm), highly weathered
		98	1.7 - 2.1	Shale, red (Queenston Fm), slightly weathered
			2.1 - 4.1	Shale, red (Queenston Fm), sound
24	1.2 - 2.4	56	1.2 - 2.3	Shale, red (Queenston Fm), moderately weathered
	- 3.8	96		
	- 5.3	100	2.3 - 7.5	Shale, red (Queenston Fm), sound, containing approximately 5% silt-stone layers
	- 6.7	96		
	- 7.5	100		
26	1.9 - 3.4	100	1.9 - 2.4	Shale, red (Queenston Fm), highly weathered
	- 4.4	100	2.4 - 4.4	Shale, red (Queenston Fm), sound

TABLE 1  
DESCRIPTION OF ROCK CORE - THIRD LINE - continued

BOREHOLE NUMBER	CORE RECOVERY		CORE DESCRIPTION	
	DEPTH (m)	%	DEPTH (m)	DESCRIPTION
32	1.2 - 2.7	92	1.2 - 1.7	Shale, red occasional green (Queenston Fm), highly weathered
	- 3.7	94	1.7 - 3.7	Shale, red (Queenston Fm), sound
34	2.4 - 4.0	100	2.4 - 2.5	Shale, red (Queenston Fm), slightly weathered
			2.5 - 4.0	Shale, red (Queenston Fm), sound
43	1.1 - 2.7	82	1.1 - 2.8	Shale, red (Queenston Fm), slightly to highly weathered
	- 4.2	98		
	- 5.7	98		
	- 7.2	100	2.8 - 7.9	Shale, red (Queenston Fm), sound, containing approximately 5% green siltstone layers
	- 7.9	100		

### UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
BH	SAMPLE	SYMBOL
13	1	—————
13	2	—————
26	2	- - - - -



**GRAIN SIZE DISTRIBUTION**  
**SILTY CLAY**  
 OCC SHALY LAYERS, TRACE/SOME SAND, TRACE OF GRAVEL

FIG No 1  
 GO-ALRT  
 THIRD LINE SUBWAYS

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

R Q D (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

**JOINTING AND BEDDING:**

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

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
WS	WASH SAMPLE	OS	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
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

### MECHANICAL PROPERTIES OF SOIL

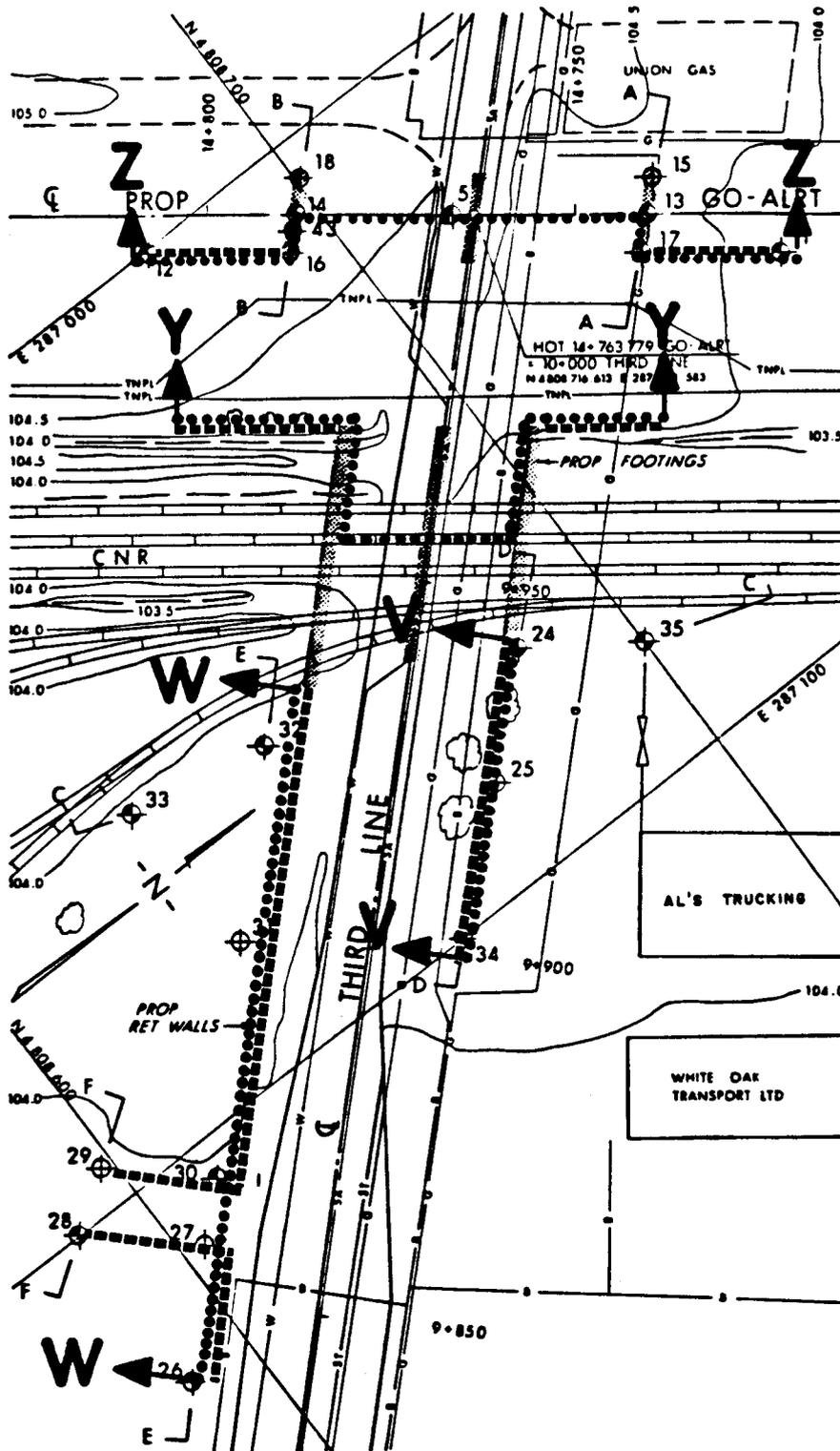
$m_v$	kPa <sup>-1</sup>	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	m <sup>2</sup> /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_t$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	kg/m <sup>3</sup>	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	kn/m <sup>3</sup>	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\rho_w$	kg/m <sup>3</sup>	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	kn/m <sup>3</sup>	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
$\rho$	kg/m <sup>3</sup>	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	kn/m <sup>3</sup>	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	kg/m <sup>3</sup>	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	q	m <sup>3</sup> /s	RATE OF DISCHARGE
$\gamma_d$	kn/m <sup>3</sup>	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $\frac{w_L - w_p}{w - w_p}$	v	m/s	DISCHARGE VELOCITY
$\rho_{sat}$	kg/m <sup>3</sup>	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{sat}$	kn/m <sup>3</sup>	UNIT WEIGHT OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	kg/m <sup>3</sup>	DENSITY OF SUBMERGED SOIL	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE	j	kn/m <sup>3</sup>	SEEPAGE FORCE
$\gamma'$	kn/m <sup>3</sup>	UNIT WEIGHT OF SUBMERGED SOIL						

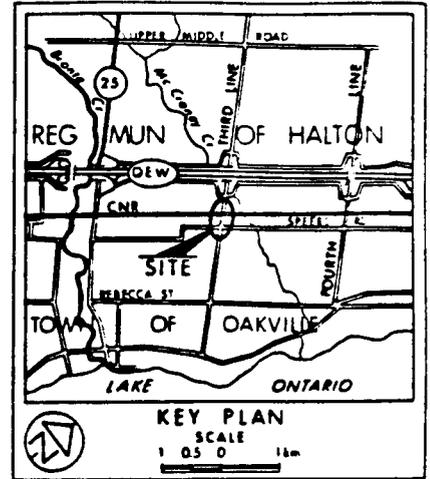
**METRIC**

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



**FIGURE A**

SCALE  
10m 5 0 10m



**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)
- W L at time of investigation 83 10 & 11  
W L not observed in Bore Holes 28, 30, 33, 35 & Cone Tests

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
5	104.6	4 808 714.0	287 022.0
11	103.8	4 808 747.0	287 053.0
12	104.7	4 808 678.0	287 000.5
13	104.2	4 808 735.0	287 039.0
14	104.6	4 808 697.5	287 009.0
15	104.1	4 808 738.5	287 035.0
16	104.5	4 808 693.5	287 012.5
17	104.2	4 808 731.5	287 042.0
18	104.5	4 808 700.5	287 005.5
24	104.2	4 808 686.0	287 073.5
25	104.2	4 808 672.5	287 086.0
26	103.7	4 808 590.5	287 125.0
27	103.9	4 808 603.0	287 111.5
28	103.8	4 808 590.5	287 100.0
29	103.9	4 808 598.0	287 094.5
30	104.0	4 808 610.0	287 105.5
31	104.1	4 808 632.0	287 082.0
32	104.4	4 808 650.0	287 063.0
33	104.2	4 808 630.0	287 059.0
34	104.4	4 808 656.0	287 100.0
35	104.3	4 808 700.0	287 083.0
43	104.6	4 808 696.0	287 010.5

Geocres No 30M5-138

**-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. Downview information contained in this report and related documents is specifically included in accordance with the conditions of Section 102-2 of Form 100

60-ALRT REF PD2-300-

**PLAN SHOWING RECOMMENDATIONS SECTIONS**

	 Ministry of Transportation and Communications OAKVILLE PROJECT - WEST EXTENSION	HALTON REGION THIRD LINE SUBWAY BORE HOLE LOCATIONS STA 14+763.779
PROJECT MANAGER	CONTRACT NO	DWS NO
	REV	SHEET

# THIRD LINE SUBWAYS - SUBSURFACE CONDITIONS

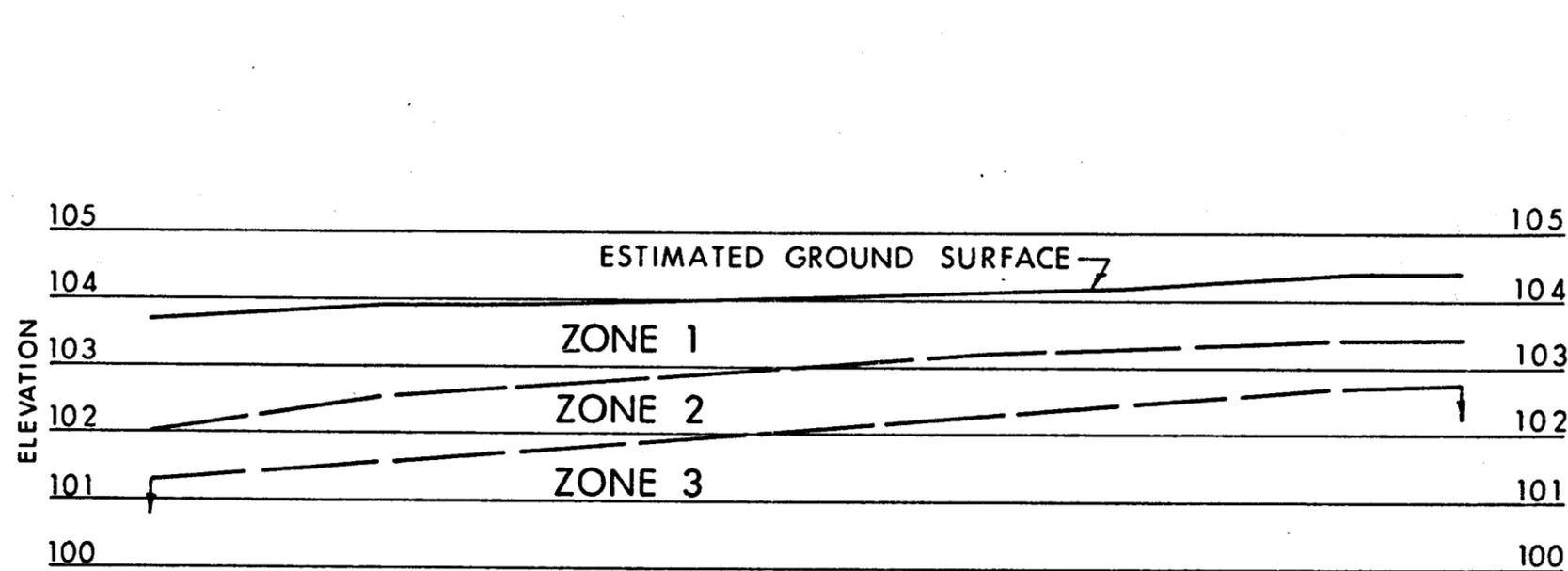


FIG B-1 - LONGITUDINAL SECTION W-W  
THIRD LINE WEST-SIDE RETAINING WALL

SCALE HOR 1:500  
VERT 1:100

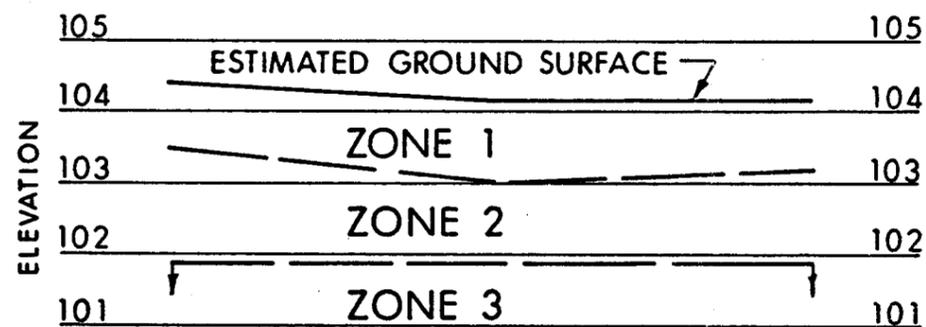
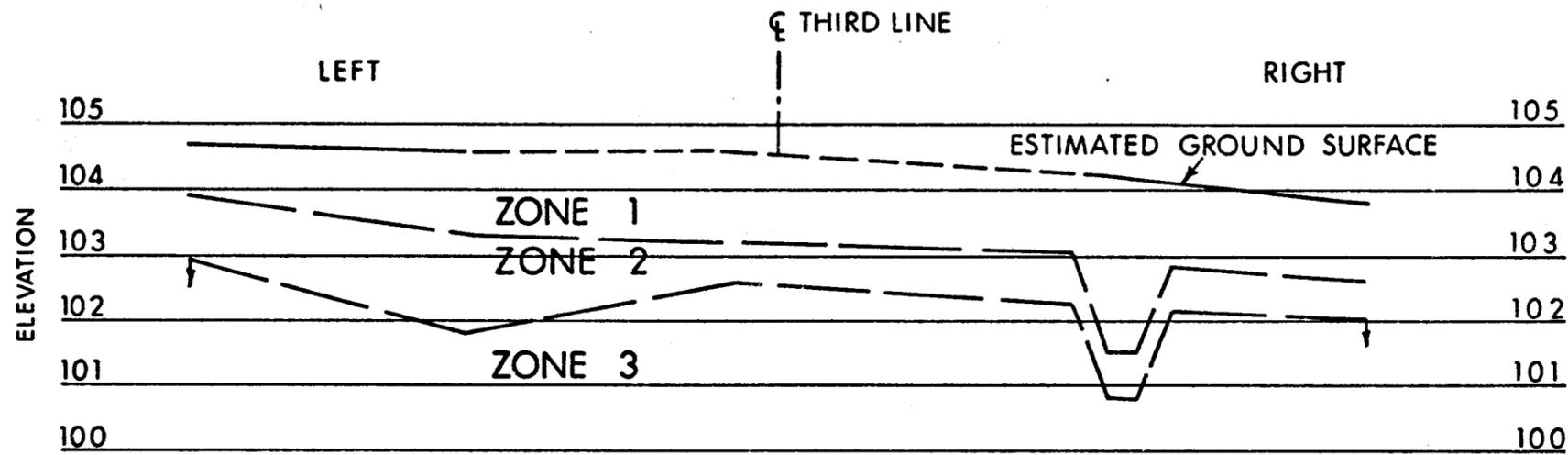


FIG B-2 - LONGITUDINAL SECTION V-V  
THIRD LINE EAST-SIDE RETAINING WALL

SCALE HOR 1:500  
VERT 1:100

FIGURE B

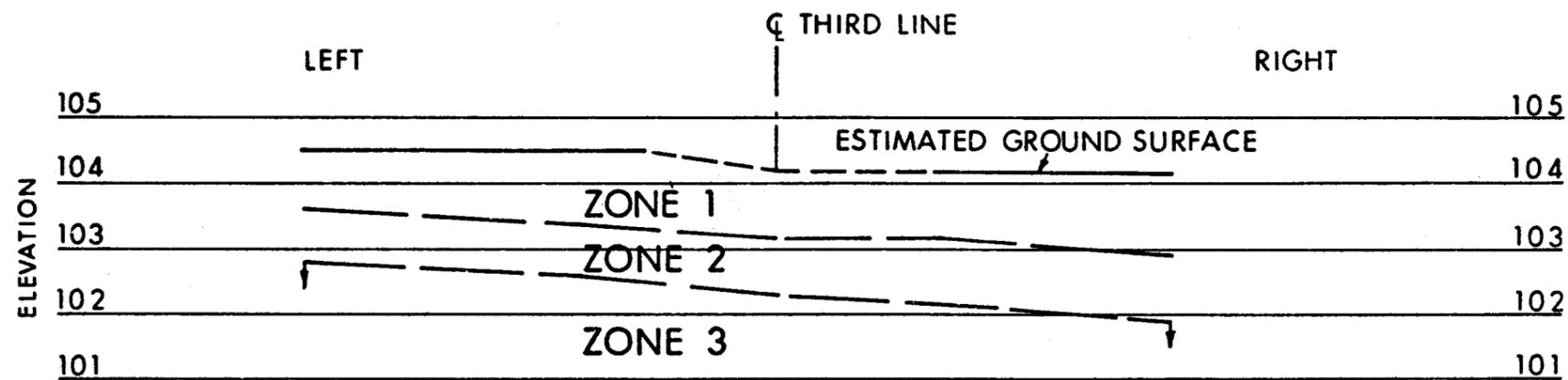
# THIRD LINE SUBWAYS - SUBSURFACE CONDITIONS



CONSTRUCTION NORTH →

FIG C-1 - LONGITUDINAL SECTION Z-Z  
GO-ALRT SUBWAY & RETAINING WALLS

SCALE HOR 1:500  
VERT 1:100



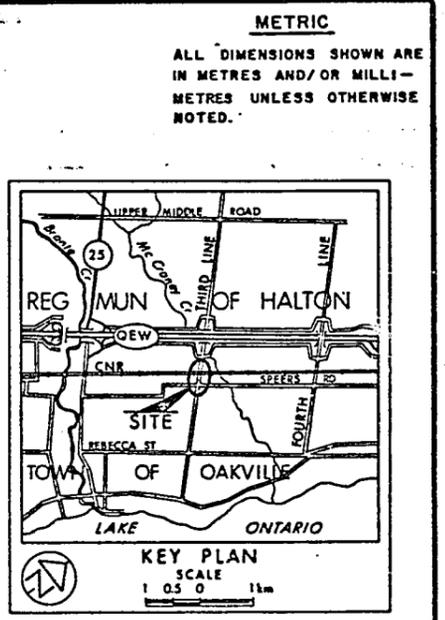
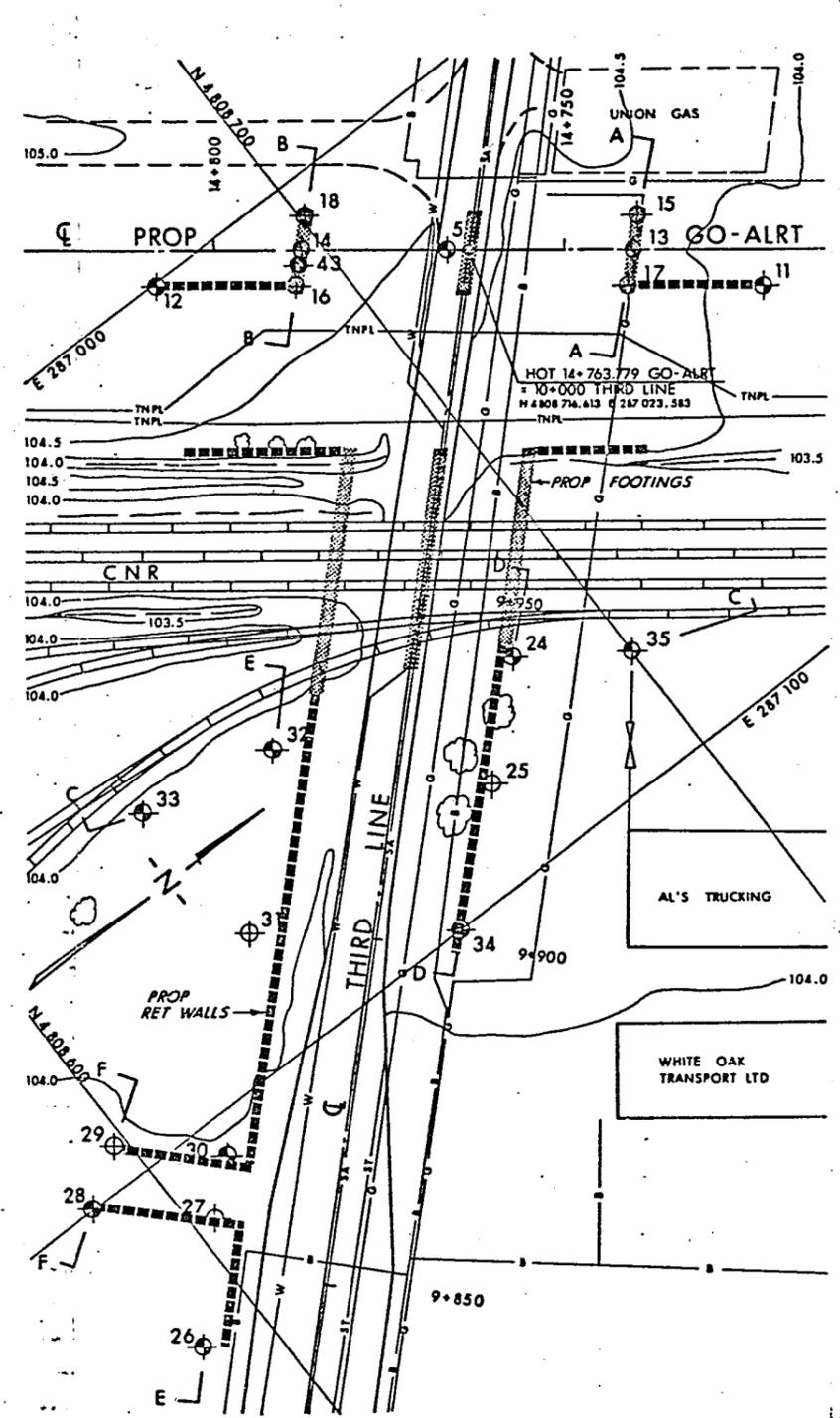
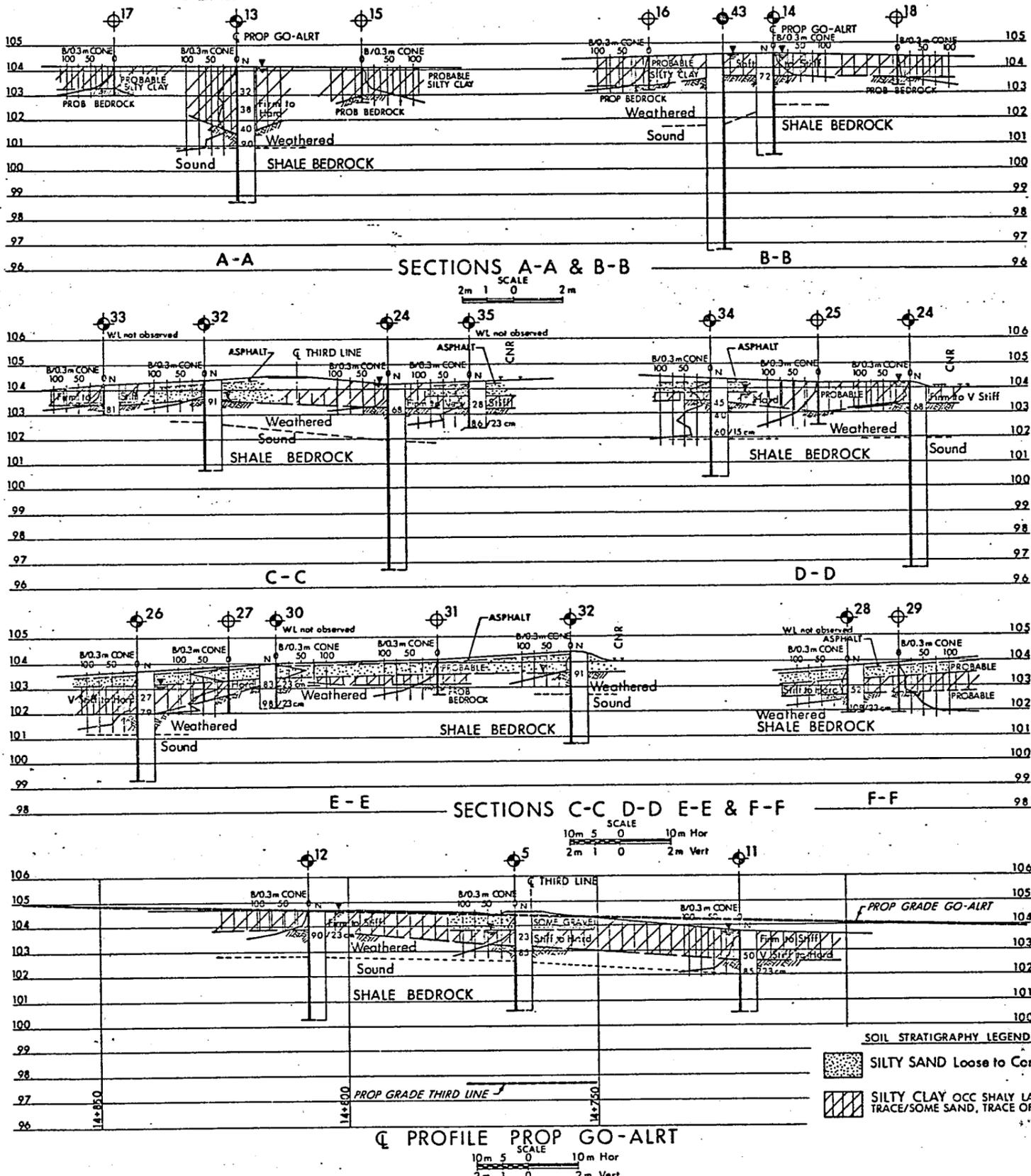
CONSTRUCTION NORTH →

FIG C-2 - LONGITUDINAL SECTION Y-Y  
CNR SUBWAY & RETAINING WALLS

SCALE HOR 1:500  
VERT 1:100

## FIGURE C

GO-ALRT WEST EXTENSION - OAKVILLE PROJECT



**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)
- W.L. at time of investigation 83 10 & 11
- W.L. not observed in Bore Holes 28, 30, 33, 35 & Cone Tests

No	ELEVATION	CO-ORDINATES NORTH	EAST
5	104.6	4 808 714.0	287 022.0
11	103.8	4 808 747.0	287 053.0
12	104.7	4 808 678.0	287 000.5
13	104.2	4 808 735.0	287 039.0
14	104.6	4 808 697.5	287 009.0
15	104.1	4 808 738.5	287 035.0
16	104.5	4 808 693.5	287 012.5
17	104.2	4 808 731.5	287 042.0
18	104.5	4 808 700.5	287 005.5
24	104.2	4 808 686.0	287 073.5
25	104.2	4 808 672.5	287 086.0
26	103.7	4 808 590.5	287 125.0
27	103.9	4 808 603.0	287 111.5
28	103.8	4 808 590.5	287 100.0
29	103.9	4 808 598.0	287 094.5
30	104.0	4 808 610.0	287 105.5
31	104.1	4 808 632.0	287 082.0
32	104.4	4 808 650.0	287 063.0
33	104.2	4 808 630.0	287 059.0
34	104.4	4 808 656.0	287 100.0
35	104.3	4 808 700.0	287 083.0
43	104.6	4 808 696.0	287 010.5

**SOIL STRATIGRAPHY LEGEND**

- SILTY SAND Loose to Comp
- ▨ SILTY CLAY OCC SHALY LAYERS, TRACE/SOME SAND, TRACE OF GRAVEL

**PLAN**  
SCALE 10m 5 0 10m



**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.

60-ALRT REF PD2-300-

REFERENCE DRAWINGS	REVISIONS	DRAWN BY: SO 1983 12 28 CHK'D BY: [Signature]	DESIGNED BY: [Signature] APPROVED BY: K. G. S.	ENGINEERING MATERIALS OFFICE FOUNDATION DESIGN SECTION	 Ministry of Transportation and Communications OAKVILLE PROJECT - WEST EXTENSION	<b>HALTON REGION</b> <b>THIRD LINE SUBWAYS</b> <b>BORE HOLE LOCATIONS &amp; SOIL STRATA</b> <b>STA 14+763.779</b>	
		SCALE: FULL SIZE ONLY AS SHOWN				CONTRACT NO	DWG NO