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foundation investigation and design report

30M12-120
GEOCRES No.

PRELIMINARY
FOUNDATION INVESTIGATION & DESIGN REPORT

W. .O. 76-11005

DIST. 6 (Toronto)

HWY. 403

STR. SITE

Proposed Structures-VariouS Locations
From Hwy. 10 Westerly &
Southerly to QEW at Ford Drive

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INTRODUCTION

The preliminary design for the above mentioned project is now in progress. According to the proposed alignment this portion of the Hwy. 403 is located between junction of QEW and 9th line in Oakville, eastward as far as intersection of Hwy. 10, in the city of Mississauga, Regional Municipality of Peel. The design requires structures at the following locations:

<u>Hwy. 403 Intersection at:</u>	<u>W.P. No.</u>
1. QEW & 9th. line jct.	159-75-05
2. Hwy. 5 (Dundas St.)	159-75-01
3. Burnhamthorpe	158-75-01
4. Winston Churchill Rd.	
5. Erin Mills Rd.	
6. Mullett Cr.	157-75-01
7. Mississauga Rd.	
8. Credit River	157-75-03
9. Ravine (Probable !)	
10. C.P.R. Crossing	157-75-01
11. Creditview	
12. Mavis Rd.	156-75-01

In order to assess the foundation considerations, a preliminary subsurface investigation was initiated by the Soil Mechanics Section as per request from Regional Structural Planning Office (memo dated June 10, 1976 from G.C.E. Burkhardt, Regional Structural Planning Engineer). The main purpose of the investigation is to provide sufficient information for the study of this project. The results of this investigation will also guide Planning and Design Sections in their quest for a balanced design.

After completion of the field work meetings were held on July 13, 1976 at Giffles, Consulting Engineers Office and subsequently a second meeting on Sept. 3, 1976 at DeLeuw Cather, Consulting Engineers Office, to discuss the subsurface conditions and the preliminary assessment of the foundation requirements.

This report presents all the factual information obtained from this investigation. Included are recommendations pertaining to foundation design at the various structure sites, as well as stability and settlement considerations associated with the approach fills or cuts.

DESCRIPTION OF SITE AND GEOLOGY

The area under investigation is bounded by the following:

North - Hwy. 401
South - QEW
East - Hwy. 10
West - 9th. Line

The area is in the city of Mississauga, Regional Municipality of Peel. The ground surface of the general area varies from elevation 391.0 to 595.0 and is generally sloping towards Lake Ontario. The land is primarily used for farming purposes. The area under investigation is drained by Credit River and its tributaries.

The site is located in the physiographic region known as the 'Peel Plain'. The characteristic deposit, in the vicinity of the area under investigation, is composed of cohesive glacial till with occasional granular deposits. The overburden is underlain by shale bedrock. This physiographic region is well drained by Credit, Oakville and Etobicoke Creeks, which have cut deep valleys into the overburden. There is, therefore no large undrained depression, swamp or bog areas, although in many of the inter-stream areas drainage is still imperfect.

The shale bedrock is of the Meaford-Dundas formation, Ordovician Period.

FIELD AND LABORATORY WORK

Fourteen sampled boreholes, each accompanied by dynamic cone penetration test, were put down during the course of this field investigation. The borings were advanced by continuous Flight Auger machine (commercially known as C.M.E. 55, H.S.M.V.) adapted for soil sampling purposes. During the period of July 2 to July 8, 1976 a second similar machine was also employed.

Samples of the overburden were obtained in a 2" O.D. split-spoon sampler at required depths. The sampler was hammered into the soil according to the specifications of Standard Penetration Test. Bedrock was proven in boreholes, where possible, by obtaining BXL size rock core samples.

Groundwater level observations were carried out during the time of investigation, in the open boreholes. The soil, bedrock and groundwater conditions encountered at the boring locations, are presented in the Record of Borehole sheets. The location and elevation of the various boreholes were provided by personnel from Engineering Surveys, Central Region. The elevations in this report are referred to a Geodetic datum. Boring locations and elevations are shown on drawing No. W.O. 7611005 A.

All samples were subjected to careful visual examination in the field and subsequently in the laboratory. Following this examination, laboratory tests were carried out on selected representative samples to determine the physical properties of the various soil types encountered, namely:

Natural Moisture Content
Atterberg Limits
Grain-Size Distribution

The results of this testing are plotted on the Record of Borehole Sheets and summarized on Figs. 1 to 3, all contained in Appendix 1 of this report.

SUBSURFACE

General

The predominant stratum across the site is composed of a heterogeneous mixture of hard clayey silt, sand and gravel (glacial till) which in turn is underlain by shale bedrock. In certain locations a deposit of silt or silty sand with gravel of 11 ft. to 27 ft. in thickness was observed either immediately above or below the glacial till. The overburden is underlain by shale bedrock.

In limited areas where boreholes were put down near the existing roadway fill material up to 7 ft. in thickness was encountered.

Fill Material

Fill material was encountered in BH's 5,6 (Erin Mills Parkway) and BH 13 (Creditview Rd.) and this may be the embankment material. The thickness of the material varied from 5 ft. (BH 13) to 7 ft. (BH 6). The material is made up of clayey silt with some sand and gravel mixed with occasional organic material. The 'N' values of the fill material range from 8 to 18 blows per foot, indicating that the fill is moderately compacted.

Glacial Till (Heterogeneous mixture of clayey silt, sand and gravel)

This stratum was encountered in all boring locations, except in BH 5 where the deposit was found to be granular in composition. The glacial till is a heterogeneous mixture of clayey silt, sand and gravel. The thickness of this stratum varies from 3 ft. (BH 10) to 60 ft. (BH 4). Occasional silty sand layers up to 3 ft. in thickness were also encountered within this stratum. Grain-size distribution curves, for the samples of this stratum, are plotted on Figs. 2 and 3, Appendix 1.

Results of Atterberg Limit tests, performed on samples recovered in this stratum were plotted on the Record of Borehole Sheets, as well as on the Plasticity Chart, Fig. 1 and are tabulated as below:

		<u>Range</u>
Liquid Limit (W_L)	%	19 to 32
Plastic Limit (W_P)	%	12 to 20
Natural Moisture Content (W)	%	9 to 22

The above results indicate that the cohesive glacial till is inorganic and of low plasticity. Based on the 'N' value range of 15 to over 100 blows per foot, obtained from the Standard Penetration Tests, it is estimated that the consistency of the cohesive glacial till varies from very stiff increasing with depth to hard.

Granular Deposit

This granular deposit was encountered immediately above the glacial till stratum in same location also below the glacial till at certain locations in BH 3, 5, 6 and 10. The presence of the granular deposit in the bore-

holes as encountered are as follows:

<u>BH No.</u>	<u>Thickness of Layer</u>	<u>Position</u>
3	27 Ft.	Underlying glacial till
5	18 Ft.	Underlying top fill
6	21 Ft.	Underlying glacial till
10	11 Ft.	Overlying glacial till

The composition of the material varied from silt with trace of sand (BH 3) to silty sand with gravel and traces of clay (BH's 6 and 10). The 'N' values obtained in this granular material varied from 12 to in excess of 100 blows per foot. Based on these values, it is estimated that the relative density of the granular deposit varies from compact to very dense.

Shale Bedrock

Bedrock was found underlying the glacial tillstratum, or the granular deposit in boreholes no. 1, 2, 7, 8, 9, 10, 13 and 14. The bedrock was proven by obtaining BXL size rock core samples.

The dominant type of bedrock encountered across the site is a dark grey shale with occasional bands of limestone. The bedrock surface along the stretch of the proposed centerline of Hwy. 403 varies from elevation 377 (BH 10, Credit River) to 532.0 ft. (BH 2, Hwy. 5). The bedrock appears to dip in a south to southeast direction. The bedrock in general was found to be in a sound condition. In certain locations, however, the upper 1.5 to 2.0 ft. appeared to be weathered and also fractured.

GROUNDWATER CONDITIONS

Groundwater level observations were carried out during the period of investigation by recording the water level in the open boreholes. The observations are recorded on the Borehole Sheets and summarized on Drawing No. W.O. 7611005 A. The results of the measurements in the open boreholes indicate that the groundwater level ranges from 1 ft. (BH 10) to 21.5 ft. (BH 11) below existing ground surface. The water in Credit River during the time of investigation was observed to be at elev. 390 which corresponds to the water level in BH 10.

DISCUSSION AND RECOMMENDATIONS

General

This report deals with the proposed Hwy. 403 extension from QEW and 9th Line junction in Oakville eastward to Hwy. 10 in the city of Mississauga.

A number of structures are proposed for this project specifically:

1. Hwy. 403 and QEW and 9th Line junction
2. Hwy. 403 and Hwy. 5 (Dundas St.)
3. Hwy. 403 and Burnhamthorpe Road
4. Hwy. 403 and Winston Churchill Road
5. Hwy. 403 and Erin Mills Parkway
6. Hwy. 403 and Mullett Creek
7. Hwy. 403 and Mississauga Road
8. Hwy. 403 and Credit River
9. Hwy. 403 and Ravine (?)
10. Hwy. 403 and C.P.R.
11. Hwy. 403 and Creditview Road
12. Hwy. 403 and Mavis Road

The subsoil, bedrock and groundwater conditions, encountered in the area under investigation, have been discussed previously in this report (Sections 4 and 5). Inferred stratigraphical profiles, along the proposed alignment, are shown on Drawing No. W.O. 7611005 A.

At this stage, the profile grades at the various structure crossings, as well as other pertinent data, have not been finalized. Preliminary grade lines along Hwy. 403 and the related crossings are given in the appropriate tables discussing the recommendation of the pertinent structures contained in the report.

Foundations and Embankments

See the information in tabular form as follows:

SUMMARY

The subsurface and groundwater conditions encountered within the area to be encompassed by the proposed Hwy. 403 extension (between QEW and 9th Line junction and Hwy. 10) are generally favourable from a foundation point of view, when considering the interchange locations and the preliminary profile grades. The predominant stratum is a competent, cohesive glacial till of variable thickness. At Burnhamthorpe, Erin Mills and Credit River crossings silty sand deposits of 27 ft., 18 to 21 ft. and 11 ft. thick respectively were encountered. The granular deposit relative density varied from compact to very dense. The overburden is underlain by shale bedrock. At all the structure crossings the following apply:

Piers founded on spread footings located in the glacial till.

Abutments founded on spread footings 'perched' within the approach fills, or alternately on end-bearing piles driven into the glacial till stratum in the overburden or to sound shale bedrock.

Approaches of the heights contemplated (up to 30 ft.) will be stable provided standard 2:1 slopes are used. The settlement, induced in the foundation subsoil by the fill loadings, will be well within tolerable limits.

It should be stressed that the recommendations given in this report are of a preliminary nature. A complete foundation investigation will be required at all the sites, once the alignment for the highway has been finalized and the design details become available.

MISCELLANEOUS

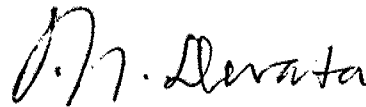
The field work, performed during the period of June 28, 1976 to July 7, 1976 was carried out under the supervision of Mr. V. Korlu, Project Engineer, who also prepared this report. Engineering III student Lynda Crocker assisted in the field work.

The drilling equipment and operation was provided by Atcost Drilling Co. of Toronto.

This report was reviewed by Mr. M. Devata, Supervising Engineer.


V. Korlu
Project Engineer




M. Devata
Supervising Engineer

MD/VK/bp/gs
October, 1976

APPENDIX

Hwy. 403 and 9th Line (W.B. Lane) Crossing - (Ref. BH 1)

A. Approx. Existing Ground Elevation B. Approx. Grade of Hwy. 403	Predominant overburden strata Approx. thickness in feet	Recommendations		
		Structure	Approaches: fills 1. Longitudinal - 20 2. Transverse - -	Remarks
A. Elev. 472.0 - 478.0 B. Elev. 490.0	<u>Glacial Till</u> - 0 to 8 ft. - cohesive - hard <u>Shale Bedrock</u> - 8 - 9.5 ft. weathered - 9.5 ft. and below sound <u>Water Level</u> - 3 ft. below ground (elev. 469)	<u>Piers</u> - Spread footings founded within the glacial till. Allowable bearing pressure up to 5 tsf <u>Abutments</u> 1. 'Perched' on spread footings in the approach fills, within a force composed of well compacted granular 'A' material using an allowable bearing pressure of 2.5 tsf 2. Alternately, supported on end bearing piles driven to shale bedrock (approx. elev. 464.0) Max. allowable load of the pile section selected.	no stability problems for the proposed fills with 2:1 slopes	

Hwy. 403 and Hwy. 5 (Dundas St. Crossing) (Ref BH 2)

A. Approx. Existing Ground Elevation B. Approx. Grade of Hwy. 403	Predominant overburden strata Approx. thickness in feet	Recommendations		
		Structure	Approaches: fills & 1. Longitudinal - 23 ^{cut} 2. Transverse - 15 ft.	Remarks
<p>A. Elev. 562.0</p> <p>B. Elev. 554.0</p> <p>Grade of Hwy. 5 elev. 577.0</p>	<p><u>Glacial Till</u></p> <ul style="list-style-type: none"> - 0 to 30 ft. - cohesive - hard <p><u>Granular Layer</u> (elev 557 - 554)</p> <ul style="list-style-type: none"> - silty sand trace of clay - compact <p><u>Shale Bedrock</u></p> <ul style="list-style-type: none"> - 30 to 32 ft. weathered - 32 ft. sound <p><u>Water Level</u></p> <ul style="list-style-type: none"> - 6.0 ft. below ground- level (elev 556) 	<p><u>Hwy. 5 and Hwy. 403 Underpass</u></p> <p><u>Piers</u></p> <p>Spread footing within the glacial till. Allowable bearing pressure up to 5 tsf (Below elev. 550.0)</p> <p><u>Abutments</u></p> <p>1. 'Perched' on spread footings in the approach fills, within a zone com- posed of well compacted granular 'A' material, using an allowable bearing pressure of 2.5 tsf.</p> <p>2. Alternately, supported on short end bearing piles driven to shale bedrock (approx. elev. 530.0 ft.)</p>	<p>no stability pro- blems for the pro- posed approach fills and cuts</p>	

Hwy. 403 and Burnhamthorpe Rd. Crossing (Ref. B.H. 3)

A. Approx. Existing Ground Elevation B. Approx. Grade of Hwy. 403	Predominant overburden strata Approx. thickness in feet	Recommendations		
		Structure	Approaches: fills (fill & cut) 1. Longitudinal - 23 ft. 2. Transverse - 21 ft. (fill)	Remarks
A. Elev. 596 B. Elev. 588 Grade of Burnhamthorpe Rd. Elev. 611	<u>Glacial Till</u> - 0 to 34 ft. - cohesive - hard <u>Granular With Seams of Clayey Silt</u> - 34 to 60 ft. - silt with trace of sand - occasional seams of gravelly sand - very dense - <u>Water Level</u> - 12.0 below ground surface (elev. 583)	<u>Hwy. 403 and Burnhamthorpe Rd. Overpass</u> <u>Piers</u> Footings founded within the glacial till. Allowable bearing pressure up to 5 tsf (below elev. 584.0 ft.) <u>Abutments</u> 1. "Perched" on spread footings in the approach fills within a zone composed of well compacted granular 'A' material using an allowable bearing pressure of 2.5 tsf. 2. Alternatively on end bearing driven into the hard glacial till stratum (estimated tip elev. 585). Maximum allowable load of the pile section selected.	No stability problems with 2:1 slopes for the proposed approach fills and cuts.	

Hwy. 403 and Winston Churchill Blvd. Crossing Ref. B.H. 4

A. Approx. Existing Ground Elevation B. Approx. Grade of Hwy. 403	Predominant overburden strata Approx. thickness in feet	Recommendations		
		Structure	Approaches: fills 1. Longitudinal - 22 ft. 2. Transverse - 23 ft.	Remarks
A. Elev. 566.0 B. Elev. 567.0 Grade of Winston Churchill Blvd. Elev. 590.0	<u>Glacial Till</u> - 0 to 60 ft. - cohesive - very stiff to hard <u>Water Level</u> 12 ft. below ground (elev. 553)	<u>Winston Churchill Blvd. Underpass</u> <u>Piers</u> Spread footings within the glacial till. Allowable bearing pressure up to 4 tsf. (below elev. 563.0 ft.) <u>Abutments</u> "Perched" on spread footings in the approach fills, within a zone composed of well compacted granular 'A' material using an allowable bearing pressure of 2.5 tsf.	<u>Embankments</u> No stability problems with 2:1 slopes.	

Hwy. 403 and Erin Mills Pkwy. Crossing (Ref. B.H.'s 5 and 6)

A. Approx. Existing Ground Elevation B. Approx. Grade of Hwy. 403	Predominant overburden strata Approx. thickness in feet	Recommendations		
		Structure	Approaches: fills 1. Longitudinal - 23.0 2. Transverse - 23.0	Remarks
A. Elev. 538 B. Elev. 532.5 Grade of Erin Mills Pkwy. Elev. 555.0	<u>B.H. 5</u> - 0 to 6.5 ft. fill material <u>B.H. 6</u> - 0 to 7.0 ft. fill mat'l - 7.0 to 30.5 ft. - cohesive glacial till - stiff to hard <u>Granular</u> <u>B.H. 5</u> - 6.5 to 24.7 ft. - silty sand with occasional gravel - very dense <u>B.H. 6</u> - 30.5 to 51.5 ft. - gravelly sand to sandy gravel with trace of clay	<u>Erin Mills Pkwy. Underpass</u> <u>Piers</u> Spread footings founded within the glacial till or granular deposit. Allowable bearing pressure up to 4 tsf (below elev. 531.0) <u>Abutments</u> 1. "Perched" on spread footings in the approach fills within a zone composed of well compacted granular 'A' material using an allowable bearing pressure of 2.5 tsf. 2. Alternately, supported on end bearing piles driven into the glacial till (approx. elev: south elev. 513.0 and north elev. 503.0). Maximum allowable load of the pile section chosen.	No stability problems with 2:1 slopes for the proposed embankments of 23 ft. in height.	Perched water on the east side of Erin Mills Pkwy. is causing loc- alized swamp conditions. It is assumed that this will be cor- rected by proper drainage measures during construction If footings are located in the silty sand stratum below water level a dewatering scheme will be necessary.

A. Approx. Existing Ground Elevation B. Approx. Grade of Hwy.	Predominant overburden strata Approx. thickness in feet	Recommendations		
		Structure	Approaches: fills 1. Longitudinal - 2. Transverse -	Remarks
	<ul style="list-style-type: none"> - occasional boulders - very dense <u>Water Level</u> 2 - 6.5 ft. below ground			

Hwy. 403 and Mullet Creek Crossing (Ref. B.H. 7)

A. Approx. Existing Ground Elevation B. Approx. Grade of Hwy. 403	Predominant overburden strata Approx. thickness in feet	Recommendations		
		Structure	Approaches: fills 1. Longitudinal - 36 ft. 2. Transverse -	Remarks
A. Elev. 447 B. Elev. 484	<ul style="list-style-type: none"> - 0-6.5 ft. - clayey silt, sand and gravel - trace of organics (old creek bed) - very stiff <u>Shale Bedrock</u> <ul style="list-style-type: none"> - 6.5 to 9.0 ft. weathered - sound <u>Water Level</u> 2.5 ft. below ground (elev. 447.5)	<u>Mullet Creek Structure</u> <u>Piers or Abutment Footings</u> Spread footings founded within the weathered shale bedrock. Allowable bearing pressure up to 5 tsf.	<u>Embankments</u> No stability problems with 2:1 slopes.	Final recommendations will depend on Mullet Creek relocation at this site and structural geometrics.

Hwy. 403 and Mississauga Rd. Crossing (Ref. B.H. 8)

A. Approx. Existing Ground Elevation B. Approx. Grade of Hwy. 403	Predominant overburden strata Approx. thickness in feet	Recommendations		
		Structure	Approaches: fills 1. Longitudinal - 23 ft. 2. Transverse - 23 ft.	Remarks
A. Elev. 466.0 B. Elev. 465.0 Grade of Mississauga Road Elev. 488.0	<u>Glacial Till</u> - 0 to 27.0 ft. - cohesive - very stiff to hard <u>Shale Bedrock</u> - 27 to 28.5 ft. weathered - 28.5 sound <u>Water Level</u> 3.0 ft. below ground (elev. 461)	<u>Mississauga Road Underpass</u> <u>Piers</u> Spread footings founded within the glacial till. Allowable bearing pressure up to 5 tsf (below elev. 461) <u>Abutments</u> 1. "Perched" on spread footings in the approach fills within a zone composed of well compacted Granular 'A' material using an allowable bearing pressure of 2.5 tsf. 2. Alternately supported on end bearing piles driven to shale bedrock (approx. elev. 437.0). Maximum allowable load of the pile section selected.	No stability problems are anticipated for the pro- posed approaches of the order 23 ft. in height with 2:1 slopes.	Footings should have a minimum earth cover of 4 ft. for frost protection purposes.

Hwy. 403 and Credit River Crossing (Ref. B.H. 's 9 and 10)

A. Approx. Existing Ground Elevation B. Approx. Grade of Hwy. 403	Predominant overburden strata Approx. thickness in feet	Recommendations		
		Structure	Approaches: fills 1. Longitudinal - up to 2. Transverse - 70 ft.	Remarks
<p>A. Valley floor elev. 390 Valley Bank top elev. 465 (west) elev. 478 (east)</p> <p>B. Elev. 465 (west) Elev. 458 (east)</p>	<p><u>Glacial Till</u></p> <p><u>B.H. 9</u></p> <ul style="list-style-type: none"> - 0 to 24.5 ft. - cohesive - hard <p><u>B.H. 10</u></p> <ul style="list-style-type: none"> - 11.0 to 14.0 ft. - cohesive - hard <p><u>Granular</u></p> <p><u>B.H. 10</u></p> <ul style="list-style-type: none"> - 0 to 11.0 ft. silty sand and gravel with trace of clay. - compact to dense 	<p><u>Credit River Structure</u></p> <p><u>Piers (B.H. 10)</u></p> <p>Spread footings founded within silty sand and gravel with an allowable load up to 4.0 tsf. Alternatively the piers can be founded on sound shale bedrock with an allowable load up to 10 tsf.</p> <p><u>Abutments (B.H. 9)</u></p> <p>1. "Perched" on spread footings in the approach fills within a zone composed of well compacted granular 'A' material using an allowable bearing pressure of 2.5 tsf.</p> <p>2. Alternatively supported on end bearing piles driven to shale bedrock.</p>	<p><u>Embankments and Cuts</u></p> <p>No stability problems are anticipated. Fills up to 35 ft. in height with 2:1 slopes. Fills in excess of 35 ft. will require midheight berm. The length of the berm will be decided upon the type of fill material, etc. during the preliminary design stage.</p>	<p>Final recommendations will depend on a final geometry and other related considerations. A detailed subsurface investigation will be necessary.</p> <p>A dewatering scheme will be necessary for the construction of the pier foundation in the river bed.</p>

Hwy. 403 and Credit River Crossing (Ref. B.H.'s 9 and 10)

A. Approx. Existing Ground Elevation B. Approx. Grade of Hwy.	Predominant overburden strata Approx. thickness in feet	Recommendations		
		Structure	Approaches: fills 1. Longitudinal - 2. Transverse -	Remarks
	<u>Shale Bedrock</u> <u>B.H. 9</u> - 24.5 sound shale <u>B.H. 10</u> - 14 - 16 ft. weathered - 16 ft. sound shale			

Hwy. 403 and Ravine East of Credit River Crossing
Sta. 1047+30 to Sta. 1050+40 (Ref. B.H. 11)

A. Approx. Existing Ground Elevation B. Approx. Grade of Hwy. 403	Predominant overburden strata Approx. thickness in feet	Recommendations		
		Structure	Approaches: fills 1. Longitudinal - 20 ft. 2. Transverse - 15 ft.	Remarks
A. Elev. 430 - Elev. 450 B. Elev. 450	<u>Glacial Till</u> - 0 to 58 ft. - cohesive - very stiff to hard <u>Water Level</u> 35 ft. below ground surface (elev. 395)	<u>Possible Structure for Hwy. 403 Between Sta. 1047+80 and Sta. 1049+80</u> <u>Piers</u> Spread footings founded within the glacial till. Allowable bearing pressure of 3 tsf. <u>Abutments</u> Footings may be located within the approaches in the natural subsoil (glacial till) with an allowable load of 3 tsf.	No stability problems for the proposed approach cuts with 2:1 slopes.	A minimum earth cover of 4 ft. should be provided to the underside of the footings for frost pro- tection purposes. No dewatering problems antici- pated. The existing ap- proaches of the ravine should not be cut any steeper than the existing slopes.

Hwy. 403 and C.P.R. Crossing (Ref. B.H. 12)

A. Approx. Existing Ground Elevation B. Approx. Grade of Hwy. 403	Predominant overburden strata Approx. thickness in feet	Recommendations		
		Structure	Approaches: fills 1. Longitudinal - up to 2. Transverse - 24 ft.	Remarks
A. Elev. 483.0 B. Elev. 459.0 Grade of C.P.R. Elev. 483.0	<u>Glacial Till</u> - 0 to 20 ft. - cohesive - hard <u>Granular</u> - 20 to 27.0 ft. - silty sand with gravel and trace of clay - very dense	<u>C.P.R. Subway</u> <u>Piers</u> Spread footings founded within the silty sand stratum. Allowable bearing pressure up to 5 tsf. <u>Abutments</u> Spread footings founded within the glacial till as high as possible. Allowable bearing pressure 5 tsf.	Proposed cuts up to 24 ft. will be stable with 2:1 slopes.	A minimum earth cover of 4 ft. should be provided for footings for frost protection purposes.

Hwy. 403 and Creditview Rd. Crossing (Ref. B.H. 13)

A. Approx. Existing Ground Elevation B. Approx. Grade of Hwy. 403	Predominant overburden strata Approx. thickness in feet	Recommendations		
		Structure	Approaches: fills (fill & cut) 1. Longitudinal - 23 ft. 2. Transverse - (fill) 16 ft.	Remarks
A. Elev. 540.0 B. Elev. 534.0 Grade of Creditview Rd. Elev. 556.5	- 0-5 ft. fill - 5-18.0 glacial till - dense or hard <u>Bedrock - Shale</u> 18.0 ft. below ground surface (elev. 522.0) <u>Water Level</u> 8.0 ft. below ground (elev. 532.0)	<u>Piers of Creditview Rd. Underpass</u> Spread footings founded within the glacial till stratum below elev. 534.0 with an allowable bearing pressure up to 4 tsf. <u>Abutments</u> 1. "Perched" on spread footings in the approach fills within a zone composed of well compacted granular 'A' material using an allowable bearing pressure of 2.5 tsf. 2. Alternately supported on end bearing piles driven to shale bedrock (approx. elev. 522.0). Maximum allowable load of the pile section chosen.	<u>Embankments and Cuts</u> 1. 2:1 side slopes 2. No stability problems	Footings should have a minimum cover of 4 ft. for frost protection requirements. A dewatering scheme will be required if pier footings are located below the ground water in the granular portion of the glacial till.

Hwy. 403 and Mavis Rd. Crossing (Ref. B.H. 14)

A. Approx. Existing Ground Elevation B. Approx. Grade of Hwy. 403	Predominant overburden strata Approx. thickness in feet	Recommendations		
		Structure	Approaches: fills (fill & cut) 1. Longitudinal - 23 ft. 2. Transverse - (fill) 12 ft.	Remarks
A. Elev. 549.0 B. Elev. 537.0 Grade of Mavis Rd. Elev. 560.5	<u>Glacial Till</u> - 0 to 17.5 ft. - cohesive - very stiff to hard <u>Granular</u> - 17.5 to 22.5 ft. silty sand with traces of gravel - very dense <u>Bedrock - Shale</u> 22.5 ft. below ground <u>Water Level</u> 5.0 ft. below ground surface (elev. 544.0)	<u>Piers of Mavis Rd. Underpass</u> Spread footings founded within the glacial till stratum or silty sand deposit. An allowable bearing pressure up to 3 tsf. in glacial till and up to 5.0 tsf. in silty sand stratum. <u>Abutments</u> 1. "Perched" on spread footings in the approach fills within a zone composed of well compacted granular material, (Granular 'A') using an allowable bearing pressure of 2.5 tsf. 2. Alternately supported on end bearing piles driven to shale bedrock (approx. elev. 596.5) and designed for the maximum capacity of the pile section chosen.	<u>Stability of Fills & Cuts</u> Proposed fills in the order of 12 ft. in height and cuts about 11 ft. in depth will be stable if 2:1 slopes are used.	A dewatering scheme will be necessary if footings are located in granular stratum below prevailing ground water level

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

WP 159-75-05 (W.O.76-11005) LOCATION Co-ord's. 15,805,410 N. 953,570 E. Q.E.W. & 9th
DIST 6 HWY 403 BORING DATE 28-06-76 Line Jct.
DATUM Geodetic BOREHOLE TYPE H.S. 3 1/2" Augers - core with BXL
ORIGINATED BY VK
COMPILED BY VK
CHECKED BY *e.j.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_P	W	W_L		
472.0	Ground Level															
0 0.0	Het. mix. of clayey silt with sand (Glacial Till)		1	SS	73	470										
464.0	Hard		2	SS	95											
8.0	weathered sound		3	BXL	100%	460										
458.0	Shale Bedrock															
14.2	End of Borehole															

20
15 ϕ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

WP 159-75-01 (W.O.76-11005) LOCATION Co-ord's. 15,810,120N; 948,750E; Hwy. #5 & Dundas St. ORIGINATED BY VK
DIST 6 HWY 403 BORING DATE June 29, 1976 COMPILED BY VK
DATUM Geodetic BOREHOLE TYPE H.S. 3 1/2" Auger - core with BXL CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT % 10 20 30	UNIT WEIGHT γ	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
562.0	Ground Level					560								
0.0	Brown silty sand compact Grey		1	SS	107									0 11 78 11
			2	SS	25									0 66 33 1
			3	SS	63									0 21 68 11
	Het. mix. of clayey silt with sand, occasional gravel (Glacial Till)		4	SS	90	550								
			5	SS	64									0 4 67 29
			6	SS	90	540								
	Hard													
532.0			7	SS	80	530								0 6 69 25
30.0	weathered sound		8	BXL	80%									
526.0	Shale Bedrock													
36.0	End of Borehole													

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ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

WP 158-75-01 (W.O.76-11005) LOCATION Co-ord's. 15.814.050N:942.940E: Hwy.403 & Burnhamthorpe Rd. ORIGINATED BY VK
 DIST 6 HWY 403 BORING DATE June 30, 1976 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE H.S. 3 1/2" Auger (CME#55) CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	W_P	W	W_L		
595.0	Ground Level															
0.0	Topsoil															
	Het. mix. of clayey silt with sand, occasional gravel (Glacial Till)		1	SS	45	590										0 34 52 14
			2	SS	100	9"										
			3	SS	98	9"										
	Brown		4	SS	50	2"										
	Grey		5	SS	120	6"	580									
			6	SS	125	6"										
	Hard		7	SS	50	3"	570									
			8	SS	55	6"										0 11 47 42
561.0			9	SS	54		560									0 23 68 9
34.0	Silt with trace of sand, occ. clayey silt layers		10	SS	90	6"										22 75 (3)
	Very Dense gravelly sand Dense		11	SS	80	5"	550									
			12	SS	50	3"										0 2 87 11
	clayey silt Hard		13	SS	45	5"	540									0 3 95 2
534.0	clayey silt Hard		14	SS	90	5"										0 1 89 10
61.0	End of Borehole															

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RECORD OF BOREHOLE NO 4

WP 158-75-01 (W.O. 76-11005) LOCATION Co-ord's. 15,821,610N; 944,370E. Hwy. 403 & W. Churchill Blvd. ORIGINATED BY VK
DIST 6 HWY 403 BORING DATE July 5, 1976 COMPILED BY VK
DATUM Geodetic BOREHOLE TYPE H.S. 3 1/2" Auger (CME 55 M.V.) CHECKED BY P.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w w_p — w — w_L WATER CONTENT % 10 20 30	UNIT WEIGHT γ	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
565.0	Ground Level													
0.0			1	SS	26	560								0 28 53 19
			2	SS	30									0 35 49 16
			3	SS	72									
	Brown Grey		4	SS	60									
	Het. mix. of clayey silt with sand, occasional gravel (Glacial Till) Very Stiff to Hard		5	SS	36	550								0 1 79 20
			6	SS	70	6"								
			7	SS	50	5"								
			8	SS	120									
	clayey silt with trace of sand Hard		9	SS	55	3"								0 2 86 12
			10	SS	60	6"								
			11	SS	95	9"								
						510								
505.0														
60.0	End of Borehole													

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ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 5

WP 157-75-01 (W.O.76-11005) LOCATION Co-ord's 15,825,280N: 947,850E, Hwy.403 & Erin Mills Rd. ORIGINATED BY VK
 DIST 6 HWY 403 BORING DATE July 2, 1976 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE H.S. 3 1/4" Ø Auger - CME 55 CHECKED BY J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
538.0	Ground Level															
0.0	Fill Material (mix. of clayey silt with sand, trace of gravel & organics)		1	SS	8										Org. 1.70%	5 19 52 24
531.5			2	SS	60											
6.5	Silty sand with occasional gravel		3	SS	70	530										0 88 (12)
	Very Dense		4	SS	41											
			5	SS	123											2 65 (33)
	occasional layers of clayey silt below elev. 520		6	SS	136	520										4 65 25 6
513.3	shale fragments		7	SS	150/4"											
24.7	End of Borehole															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 6

WP 157-75-01 (W.O.76-11005) LOCATION Co-ord's. 15,825,540N; 947,760E. Hwy. 403 & Erin Mills Rd. ORIGINATED BY VK
 DIST 6 HWY 403 BORING DATE July 5, 1976 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE H.S 3 1/2" Ø Auger - core with BXL CHECKED BY a.j.

SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	Wp	W	Wt		
538.0	Ground Level					ELEV										
0.0	Fill Material-clayey silt with some sand & traces of gravel and organics. Stiff		1	SS	9										Org. .54%	4 19 51 26
531.0			2	SS	18											
7.0			3	SS	35											
	Brown		4	SS	41											
	Grey		5	SS	40											
	Het. mix. of clayey silt with sand and occasional gravel (Glacial Till)		6	SS	35											
	Hard		7	SS	38											
507.5			8	SS	148	11"										
30.5	Gravelly sand to sandy gravel with trace of clay		9	SS	165	11"										
	Very Dense					500										
	with occasional boulders		10	BXL	50% Rec.	490										
486.5																
51.5	End of Borehole															

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ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 7

WP 157-75-03 (W.O.76-1100) LOCATION Co-ord's. 15,827,330N; 950,020E. Hwy. 403 & Mullett Cr. ORIGINATED BY VK
DIST 6 HWY 403 BORING DATE July 6, 1976 COMPILED BY VK
DATUM Geodetic BOREHOLE TYPE H.S. 3 1/4" Ø Auger - Core with BXL CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
450.0	Ground Level															
0.0	Clayey silt, sand & gravel, trace of organics (old creek bed)		1	SS	26											
443.5	Very Stiff		2	BXL	No Rec.											
6.5	weathered sound		3	BXL	80% Rec.	440										
436.8	Shale Bedrock															
13.2	End of Borehole															
						430										

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ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 8

WP 157-75-03 (W.O.76-11005) LOCATION Co-ord's. 15,827,900N; 950,730E. Hwy. 403 & Mississauga ORIGINATED BY VK
 DIST 6 HWY 403 BORING DATE July 6, 1976 Rd. COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE H.S. 3 1/2" Ø Augers - Core with EXL CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
464.0	Ground Level															
0.0	Het. mix. of clayey silt with sand and occasional gravel (Glacial Till)		1	SS	20											5 23 51 21
			2	SS	58											3 20 52 25
			3	SS	77											
	Brown		4	SS	59											
	Grey		5	SS	28											
	Very Stiff to Hard		6	SS	70											7 29 44 20
437.0			7	SS	91											
27.0	weathered sound		8	BXL	70% Rec.											
432.0	Shale Bedrock															
32.0	End of Borehole															

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RECORD OF BOREHOLE NO 10

WP 157-75-03(W.O.76-11005) LOCATION Co-ord's. 15,828,540N; 951,260E. Hwy. 403 & Credit R.E. ORIGINATED BY VK
 DIST 6 HWY 403 BORING DATE July 8, 1976 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE H.S. 3 1/4" Ø Auger - core with BXL CHECKED BY *SPJ*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W			UNIT WEIGHT Y	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	Wp	W	WL		
392.0	Ground Level															
0.0	Silty sand & gravel with trace of clay		1	SS	42	390						o				52 31 13 4
	Compact to Dense		2	SS	34							o				
381.0			3	SS	12							o				25 56 14 5
11.0	Ret. mix. of clayey silt sand & grav. (Glacial till)		4	SS	93	380						o				25 9 52 14
378.0	Hard															
14.0	weathered sound															
371.7	Shale Bedrock		5	BXL	80% Rec.											
20.3	End of Borehole					370										

RECORD OF BOREHOLE NO 11

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT	LIQUID LIMIT ——— w _L	UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20 40 60 80 100	PLASTIC LIMIT —— w _p WATER CONTENT ——— W		
430.0	Ground Level						SHEAR STRENGTH	w _p ——— w ——— w _L		
0.0							O UNCONFINED + FIELD VANE	WATER CONTENT %		
							● QUICK TRIAXIAL x LAB VANE	10 20 30		
								% GR SA SI CL		
	Brown Grey		1	SS	37					7 26 46 23
	Het.mix.of clayey silt with sand and gravel		2	SS	29					
	(Glacial Till)		3	SS	32	420				8 30 44 18
	Very Stiff to Hard silty sand & gravel		4	SS	24					
			5	SS	30					43 37 18 2
			6	SS	56	410				
			7	SS	95					
			8	SS	130	6"400				
372.0	End of Borehole					370				

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ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 12

WP 157-75-01(W.O.76-11005) LOCATION Co-ord's. 15,830,880N;953,210E. Hwy.403 & C.P.R.(E)
 DIST 6 HWY 403 BORING DATE July 8, 1976
 DATUM Geodetic BOREHOLE TYPE H.S. 3 1/2" Ø Auger - CME 55 M.V.

ORIGINATED BY VK
 COMPILED BY VK
 CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	w_p	w	w_L		
483.0	Ground Level															
0.0	Het. mix. of clayey silt with sand and occasional gravel (Glacial Till)		1	SS	31	480										4 15 58 23
			2	SS	62											
			3	SS	90	9"										4 23 52 21
			4	SS	105	470										
	Brown Grey		5	SS	82	6"										29 42 20 9
463.0	Hard															
20.0	Silty sand with gravel trace of clay		6	SS	100	3"										
			7	SS	50	3"	460									
456.0	Very Dense															
27.0	End of Borehole															
	Water Level not established															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 13

WP 157-75-01(W.O.76-11005) LOCATION Co-ord's. 15,833,750N; 954,940E. Hwy. 403 & Creditview ORIGINATED BY VK
 DIST 6 HWY 403 BORING DATE July 12, 1976 Rd. COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE H.S. 3 1/2" Ø Auger - core with BXL CHECKED BY V.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT <u>W_L</u> PLASTIC LIMIT <u>W_P</u> WATER CONTENT <u>W</u>			UNIT WEIGHT <u>γ</u>	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W _P	W	W _L		
540.0	Ground Level															
0.0	Clayey silt with grav & some sand, trace of organics - Fill		1	SS	11											33 20 28 19
535.0	Stiff															
5.0	Het. mix. of clayey si. with sa. & grav. (Glac Till)		2	SS	44											14 20 49 17
532.0																
8.0	Sand with trace of silt		3	SS	49											0 94 (6)
526.0	Dense		4	SS	37											
14.0																
522.0	Hard		5	SS	107											43 19 29 9
18.0	Sound															
517.0	Shale Bedrock		6	BXL	100%											
23.0	End of Borehole															

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ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 14

WP 157-75-01(W.O.76-11005) LOCATION Co-ord's. 15,836,960N; 957,570E, Hwy. 403 & Mavis Rd. ORIGINATED BY VK
 DIST 6 HWY 403 BORING DATE July 12, 1976 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE H.S. 3 1/2" Ø Auger - core with BXL CHECKED BY *W.F.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L	
549.0	Ground Level														
0.0	Het. mix. of clayey silt with sand and occasional gravel (Glacial Till)	Brown Grey	1	SS	15	540									2 19 64 15
			2	SS	31										0 2 80 18
			3	SS	24										0 2 (98)
	Very Stiff to Hard		4	SS	28										
531.5			5	SS	31										
17.5	Silty sand with traces of gravel.		6	SS	80/6"	530									10 76 10 4
526.5	Very Dense														
22.5	Sound		7	BXL	100% Rec.										
521.5	Shale Bedrock														
27.5	End of Borehole					520									

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

PENETRATION RESISTANCE

'N' STANDARD PENETRATION RESISTANCE - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS 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:-

<u>CONSISTENCY</u>	<u>c LB./SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 250	VERY LOOSE	0 - 4
SOFT	250 - 500	LOOSE	4 - 10
FIRM	500 - 1000	COMPACT	10 - 30
STIFF	1000 - 2000	DENSE	30 - 50
VERY STIFF	2000 - 4000	VERY DENSE	> 50
HARD	> 4000		

TERMS TO BE USED IN DESCRIBING SOILS:-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC

TYPE OF SAMPLE

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

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
CIU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
w_s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_c	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$
T_v	TIME FACTOR = $\frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

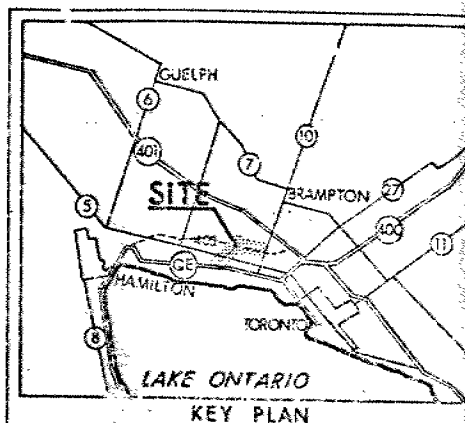
H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

CONT No
W O No 76-11005

PROP HWY. 403
PRELIMINARY INVESTIGATION
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N° Blows/ft (Std. Pen. Test: 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- ∇ Wt at time of investigation July 1976
NO Wt established
B.H. No. 12

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	472.0	15,803,410	953,570
2	562.0	810,120	948,750
3	595.0	814,050	942,940
4	565.0	821,610	944,370
5	538.0	825,280	947,350
6	538.0	825,540	947,760
7	450.0	827,330	950,020
8	464.0	827,900	950,730
9	462.0	828,140	950,880
10	392.0	828,540	951,260
11	430.0	830,170	952,720
12	483.0	833,880	953,210
13	540.0	833,750	954,940
14	549.0	836,960	957,570

-NOTE-

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

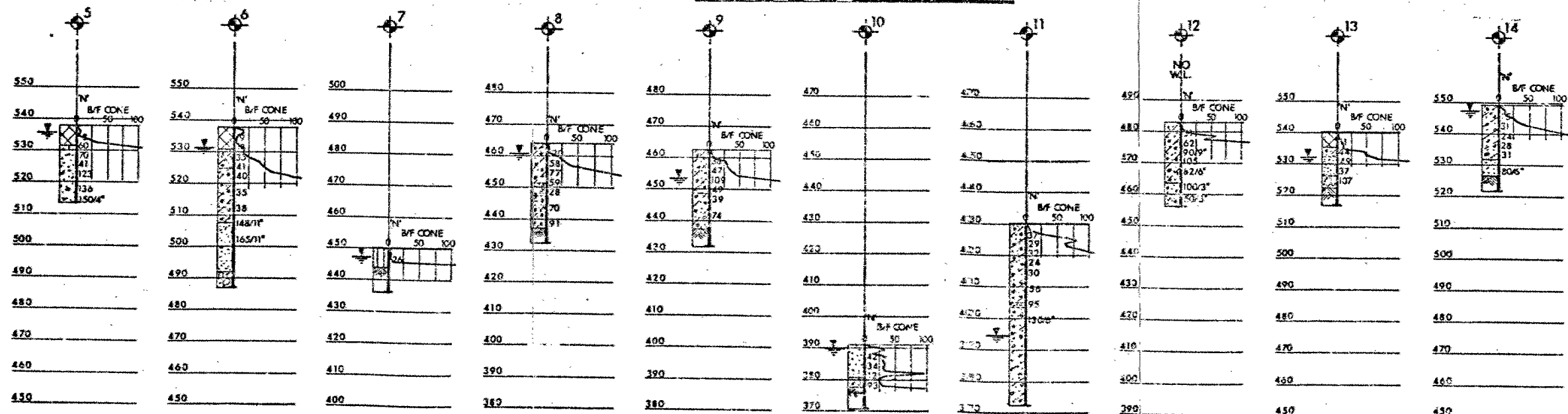
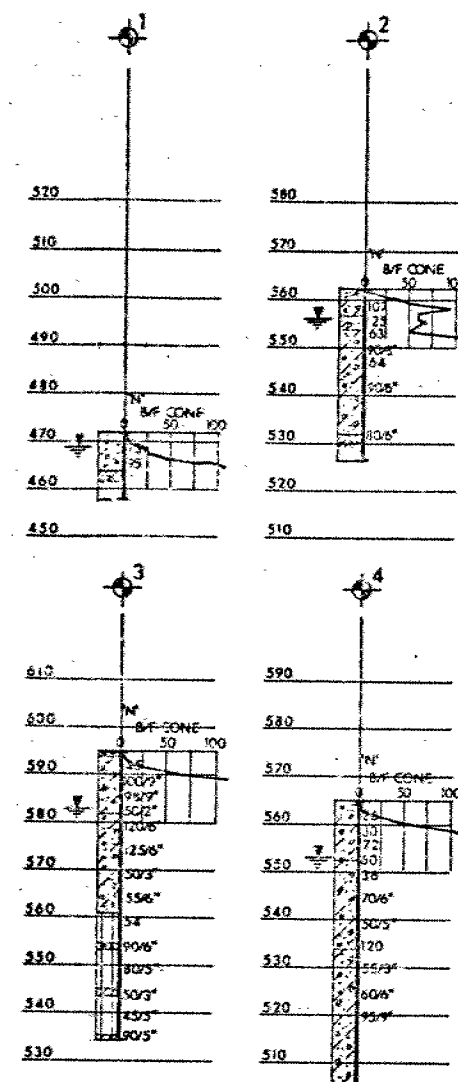
REVISIONS	DATE	BY	DESCRIPTION

HWY No 403
SUBMD. V. K. CHECKED
DRAWN Q. L. CHECKED
DATE 10-09-75
SITE
DWG 76-11005-A



PLAN

SCALE 0 0.5 1 MI.



BOREHOLES

SCALE 20 10 0 20 FT.

LEGEND

- GLACIAL TILL
HET. MIX. OF CLAYEY SILT WITH SAND & GRAVEL
V. Stiff to Hard
- SILT & CLAYEY SILT
CLAYEY SILT
SAND & GRAVEL
Stiff or Dense to V. Dense
- FILL
CLAYEY SILT WITH GRAVEL & SAND TR. OF ORGANICS
Stiff
- SILTY SAND
TRACES OF GRAVEL
Comp. to V. Dense
- WEATHERED SOUND SHALE BEDROCK