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DIST. 6 REGION

W.P. No. 89-78-00

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. 407

LOCATION Hwy 407 FROM JANE ST
To WOODBINE AVE

No. of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



Ontario

Ministry of
Transportation and
Communications

foundation investigation and design report

ENGINEERING MATERIALS OFFICE
SOIL MECHANICS SECTION

WP 89-78-00

DIST. 6

HWY 407

STR SITE

Feasibility Study of Hwy. 407
From East of Jane Street
to East of Woodbine Avenue

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FOUNDATION INVESTIGATION REPORT

For

Feasibility Study
of Hwy. 407 From East of
Jane Street to East of Woodbine Avenue
W.P. 89-78-00, District 6, Toronto

INTRODUCTION

This report contains the results of a feasibility foundation investigation performed at structural project sites along the above mentioned route study. The field investigation was carried out during the period from November 6 to November 23, 1978 and consisted of a total of 23 boreholes. The borings were advanced to depths ranging from 26 to 132 feet by means of continuous flight hollow stem augers. In addition, a thorough literature search of subsoil information within the study area resulted in the use of data from 5 additional borings, B.H. 24 to B.H. 28, advanced previously by this Section at nearby site locations.

ROUTE DESCRIPTION AND GEOLOGY

The study route extends east-west immediately north of the Metropolitan Toronto boundary through the Towns of Vaughan, Richmond Hill and Markham, within the Regional Municipality of York. The area for this portion of the Hwy. 407 study roughly parallels the existing Hwy. 7 between the C.N.R. Concord Marshalling Yard and Woodbine Avenue.

Topography in general can be described as gently undulating, except where the creeks and rivers have cut steep valleys into the surficial deposits. Predominant land use along the proposed right of way consists of cultivated open fields except for localized residential and light industrial uses along the major arterial roads.

Physiographically, the study area is wholly located within the region known as the "Peel Plain". The plain is characterized by drumlinized till plains or boulder clay modified by basins of

lacustrine sedimentation and dissected by branches of the Don River. Lake deposits consist of stratified to varved sands, silts and clay that are widespread in the area and overlie the till. Where the drainageways have cut deep valleys, modern stream alluvium generally consisting of stratified sand and some gravel can be found. Slope-wash deposits of sand and silt occur along the bottom of many of the rivers and streams.

SUBSURFACE CONDITIONS

Generally, two prominent subsurface soils were encountered throughout the study area

- i) clayey silt till
- ii) silty sand to sandy silt

The predominant subsurface stratum over most of the study area consists of a glacial till composed of a heterogeneous mixture of clayey silt, some sand and traces of gravel. Results from testing indicate the clayey silt to be inorganic, generally of low plasticity. This ground moraine till deposit was explored to a maximum depth of 78 feet with consistency ranging from stiff to hard but generally very stiff throughout. This competent till is usually unsorted and well graded, but zones of sand and/or silt inclusions were found throughout.

The lacustrine deposits of silty sand to sandy silt were found to be more dominant in the eastern portion of the study area. Occasional silt and gravel layers or silt lenses were found in various locations. The denseness of these materials based on Standard Penetration Test results was found to vary from loose to very dense, but generally dense throughout. Often this stratum was interrupted by beds of clay silt generally firm to stiff in consistency. The granular deposit was explored to a maximum depth of 42 feet.

The glacial till overlies bedrock in the area, however, bedrock was not encountered in any of the borings. Generally, bedrock has a southward slope in the study area and can be found at depths in excess of 200+ feet.

Groundwater was encountered at depths ranging from 7 to 35 feet below ground surface, except adjacent to waterways where the groundwater level would approximate the river water level.

The boundaries between various soil types, the groundwater conditions, and the results of physical testing on representative samples are shown on the attached Record of Borehole Sheets. The locations and elevations of the borings, as well as site locations, are shown on the attached Drawings 897800-A and B.

DISCUSSION AND RECOMMENDATIONS

At present the regional planning and design staff is involved in the preliminary design phase for Hwy. 407, a provincial freeway link to serve both as a northern east-west traffic corridor and a Metropolitan Toronto bypass. This report concerns itself with the Hwy. 407 study section from west of Keele Street to east of Woodbine Avenue. This section also addresses itself to a major relocation of Hwy. 7 north from west of Dufferin Street to east of Bayview Avenue. Twenty-eight structure sites including five river crossings were investigated for this program. Presently proposed grades for Hwy. 407 in the area will involve roadway cuts to 25 feet in depth and fills up to 40 feet in height.

In general, subsurface conditions over the site are uniform and competent for structure foundation and embankment loadings.

Our comments for the feasibility, design and construction of the various structures are given on the Foundation Data Sheets included in the Appendix. A data sheet is supplied for each of 28 areas; the area location is described on these sheets and is also shown on Drawing No. 897800-A and B. An explanation of information supplied on the data sheet is outlined below.

1. The site number given (i.e. B-1, B-2, etc.) is a numbering system developed for the purposes of the feasibility study only. The actual location is shown on Drawing No. 897800-A and B.
2. The original ground elevation range given is based on a small scale \varnothing profile and as such the accuracy is not great.
3. The proposed roadway-railway grades are based on a small scale \varnothing profile at the intersection of centrelines. The grade given is understood to be preferred by Planning and Design.
4. Subsurface conditions are described here very briefly and are based on generally not more than one boring per area.

Consistencies and relative densities, where applicable, are given.

5. Recommendations - Structure

The recommendations are discussed separately for abutments and piers. The options for structure foundations are given in preferential order based on geotechnical/economical considerations. Further elaboration of structure recommendations made on the data sheets are given below.

Compacted Granular Pad - This option is for abutments only where subsurface conditions are competent. This option is not recommended for water crossings. The minimum requirements of a compacted granular pad are shown on Figure 1 in the Appendix. Furthermore, the footing for this scheme could be designed to a maximum allowable pressure of 3.0 t.s.f.

Spread Footings - This option is given for abutments and piers where subsurface conditions are competent. The maximum elevation and corresponding maximum design load is given. It is to be noted the spread footings should be provided with a minimum of 4 feet of earth cover for frost protection purposes. In addition, where the spread footing is to be founded on a cohesive deposit, subject to softening upon exposure to construction or weather conditions, it would be necessary to protect the base of the footing excavation from softening by placing a working slab of lean concrete immediately upon completion of the footing excavation. Also, where the footing is located in a granular deposit and the water table is at or above the footing founding level, it will be necessary to prevent the base of the footing from boiling due to an unbalanced excess hydrostatic head. In this case a dewatering scheme would be required. Two alternative dewatering schemes are shown on Figure 2 and Figure 3.

End-Bearing Piles - This founding scheme is recommended for abutments and piers where appropriate. The recommendation gives the estimated pile tip elevation. Generally, the end bearing piles can be designed for the maximum allowable

structural capacity which is dependent on the pile section chosen. For example, the maximum allowable load for a 12BP74 steel 'H' pile would be 110 tons per pile. It is generally assumed steel 'H' piles will be used, however, if a certain pile section is not suitable at the specific area, this fact is mentioned in the data sheet. Pile driving would be field controlled by the Hiley Formula unless it is being driven to the bedrock surface or in clayey subsoil.

Friction Piles - This foundation is recommended for abutments and piers where it is considered to be suitable and economically competitive with an end bearing pile. The loading recommendations are given for a #14 timber pile of specified length. If a different type of friction pile is contemplated the maximum allowable load could be prorated by comparing the surface area of the pile in question and the timber pile.

6. Recommendation - Approaches

The recommendations for fill slopes, cut slopes and berm requirements, are based on the proposed preliminary grades assuming fills are constructed of acceptable earth borrow according to current M.T.C. Specifications. Any changes in profile grade would require a reassessment of these recommendations. Also discussed under this heading is special treatment, i.e. benching, slope protection, etc., that is anticipated at this location. No excessive settlements of embankments at the proposed fill heights are anticipated at this stage.

7. Remarks

In this column assumptions made and geotechnical preference of schemes if appropriate, are discussed, as well as other options or considerations to be evaluated during this stage of design.

MISCELLANEOUS

The various comments outlined in this report are for feasibility study purposes based on limited field data. It will be necessary

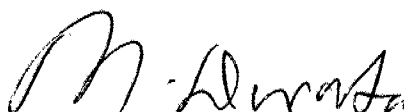
to carry out a detailed subsurface investigation at each of the structure sites when the design details and geometries are finalized and approved. In some areas, groundwater studies and special in-situ field testing may be warranted.

The fieldwork for this investigation was carried out under the supervision of Mr. T.J. Kazmierowski, Project Engineer, using equipment rented from Dominion Soil Investigation Limited.

This report was written by Mr. T.J. Kazmierowski and reviewed by Mr. M. Devata, Supervising Engineer



T.J. Kazmierowski, P. Eng.
Project Engineer



M. Devata, P. Eng.
Supervising Engineer

February, 1979

APPENDIX

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-1 LOCATION Hwy. 407 Crossing C.N.R. Concord Marshalling Yard
ORIGINAL GROUND ELEV. 688-691 PROPOSED HWY. 407 GRADE ELEV. 714-720+

[illegible]

FOUNDATION DATA SHEET

W. P. 89-78-00 SITE B-2 LOCATION Hwy. 407 at Keele Street
ORIGINAL GROUND ELEV. 666 PROPOSED HWY. 407 GRADE ELEV. 626+
Proposed Keele St. Grade Elevation 647+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>Reference Boreholes</u> 21 0-45' + clayey silt very stiff to hard	<u>Abutments and Piers</u> 1) Abutments on compacted granular pad within fills 2) Spread footings founded at elevation 659 to give allowable bearing pressure of 4.0 t.s.f.	Fill heights up to 28 ft. will be stable with forward and side slopes of 2:1.	
<u>Groundwater</u> Water level not established at time of investigation.			

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-3 LOCATION Hwy. 407 Crossing C.N.R. Newmarket Subdivision
ORIGINAL GROUND ELEV. 646 PROPOSED HWY. 407 GRADE ELEV. 622
Proposed C.N.R. 'Newmarket' Subdivision Grade Elevation 645

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>Reference Boreholes</u> 20 0-13' clayey silt very stiff to hard 13'-40.5' silty sand to sandy silt Loose to dense 40.5'-50' + clayey silt hard	<u>Abutments and Piers</u> 1) End-bearing steel 'H' piles driven to a minimum tip elevation 595+ designed for the maximum allowable structural capacity of the given pile section. 2) Abutments may be perched on spread footings located in the cut slopes at elevation 636 for an allowable loading of 3.0 t.s.f.	Fill heights up to N/A ft. will be stable with forward and side slopes of 2:1. Cuts up to a depth of 25 feet will prove stable with 2:1 slopes and berm geometry. However, due to the granular nature of the subsoil and groundwater level an extensive temporary and permanent dewatering system and slope treatment will be required. Further, if cuts are contemplated, a detailed hydrogeological study should be carried out to evaluate the effects of such cuts on the groundwater regime.	In view of the recommendations, a structure to carry Hwy. 407 over the C.N.R. Newmarket Subdivision is preferred from a geotechnical cost viewpoint.
<u>Groundwater</u> Water level encountered at 15' below ground surface.			

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-4 LOCATION Hwy. 407 Crossing West Don River
 ORIGINAL GROUND ELEV. 609 PROPOSED HWY. 407 GRADE ELEV. 624[±]
 West Don River High Water Level 613

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>Reference Boreholes</u> 19 0-5.5' silty sand loose 5.5-41' + clayey silt very stiff to hard <u>Groundwater</u> Water level at river level approximately 4' below ground surface.	A soil-steel structure i.e. C.S.P. or S.P.P.A. with minor stream realignment is recommended at this site. Alternatively, abutments and pier(s) can be founded on spread footings at elevation 601 [±] for an allowable 3.0 t.s.f. bearing pressure.	Fill heights up to 10 ft. will be stable with forward and side slopes of 2:1. Cuts to a depth of 10 feet will be stable with 2:1 slopes.	A temporary de- watering system for footing excavation or pipe placement will be required at this site.

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-5 LOCATION Hwy. 7N Crossing West Don River
ORIGINAL GROUND ELEV. 613.5 PROPOSED HWY. 7N GRADE ELEV.

[illegible]

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-6 LOCATION Hwy. 407 at Proposed Hwy. 7 (west of Dufferin St.)
ORIGINAL GROUND ELEV. 627 PROPOSED HWY. 407 GRADE ELEV. 632
Proposed Hwy. 7 Grade Elevation 652

[illegible]

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-7 LOCATION N-S Ramp off Dufferin St. to Hwy. 407
ORIGINAL GROUND ELEV. 628.5 PROPOSED HWY. 407 GRADE ELEV. _____

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>Reference Boreholes 17</u> 0-12' clayey silt to silty clay stiff to very stiff 12-15' silt very dense 15-26'+ clayey silt hard	<u>Abutments</u> 1) On compacted granular pad within fills 2) Footings perched on friction timber piles driven to tip elevation of 615+ for an allowable load of 30 tons per pile.	Fill heights up to 20 ft. will be stable with forward and side slopes of 2:1.	Assumed fill heights in the order of 20 feet.
<u>Groundwater</u> Water level encountered at 7' below ground surface			

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-8 LOCATION Hwy. 407 at Dufferin St.
ORIGINAL GROUND ELEV. 660 PROPOSED HWY. 407 GRADE ELEV. 666+
Proposed Dufferin St. Grade Elevation 688+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>Reference Boreholes</u> 16 0-67' clayey silt firm to hard 67-97' silty sand compact 97-131' + clayey silt hard	<u>Abutments and Piers</u> 1) Abutments on compacted granular pad within fills. 2) Footings for pier and abutments on end-bearing steel 'H' piles driven to elevation 540 ₊ .	Fill heights up to 25 ft. will be stable with forward and side slopes of 2:1. Cuts to a depth of 5 feet will be stable with 2:1 side slopes.	
<u>Groundwater</u> Weekend water level at 11' below ground surface.			

FOUNDATION DATA SHEET

W. P. 89-78-00 SITE B-9 LOCATION Hwy. 7N at Dufferin St.

ORIGINAL GROUND ELEV. 674 PROPOSED HWY. 407 GRADE ELEV. 693

Proposed Dufferin St. Grade Elevation 672

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>Reference Boreholes</u> 15 0-42' clayey silt firm to hard	<u>Abutments and Piers</u> 1) Abutment footings on compacted granular pad within fills. 2) Footings on treated timber piles driven to a tip elevation of 640 can be designed for 25 tons per pile.	Fill heights up to 25 ft. will be stable with forward and side slopes of 2:1.	
<u>Groundwater</u> Overnight water level at 17' below ground surface.			

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-10 LOCATION Hwy. 407 at Bathurst St.
ORIGINAL GROUND ELEV. 631 PROPOSED HWY. 407 GRADE ELEV. 638
Proposed Bathurst St. Grade Elevation 661

[illegible]

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-11 LOCATION Hwy. 7N at Bathurst St.
ORIGINAL GROUND ELEV. 635 PROPOSED HWY. 7N GRADE ELEV. 625+
Proposed Bathurst St. Grade Elevation 644+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>Reference Boreholes</u> 13 0-11' clayey silt very stiff 11-41.5' + silt compact to dense	<u>Abutments</u> 1) On compacted granular pad within approach fills. <u>Piers</u> 1) Spread footings founded at elevation 627 for an allowable bearing pressure of 3.5 t.s.f.	Fill heights up to 15 ft. will be stable with forward and side slopes of 2:1. Cuts to a depth of 10 feet will be stable with 2:1 side slopes.	
<u>Groundwater</u> Overnight water level at 25' below ground surface			

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-12 LOCATION Hwy. 407 Crossing East Don River
ORIGINAL GROUND ELEV. 554 PROPOSED HWY. 407 GRADE ELEV. 600+

[illegible]

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-13 LOCATION Hwy. 407 at Hwy. 11 (Yonge St.)
ORIGINAL GROUND ELEV. 630 PROPOSED HWY. 407 GRADE ELEV. 646+
Proposed Hwy. 11 Grade Elevation 620+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>Reference Boreholes</u> 12 0-30' clayey silt very stiff to hard 30-41.5' + silty clay hard	<u>Abutments</u> 1) Footings on compacted granular pad within the fills. <u>Abutments and Piers</u> 1) Perched footings on timber piles driven to tip elevation 595 can be designed for 30 tons per pile.	Fill heights up to 25 ft. will be stable with forward and side slopes of 2:1. Proposed fills up to 40 feet east of the site should prove stable, however, a 10 foot wide mid-height bench incorporating an inter- cepting ditch should be con- sidered in order to minimize future slope maintenance problems. Cuts to a depth of 5 feet will be stable with 2:1 side slopes.	
<u>Groundwater</u> Water level not established.			

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-14 LOCATION Hwy. 7N and Hwy. 11
ORIGINAL GROUND ELEV. 636.5 PROPOSED HWY. 7N GRADE ELEV. 657+
Proposed Hwy. 11 Grade Elevation 635+

[illegible]

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-15 LOCATION Hwy. 7N Crossing C.N.R. Bala Subdivision
 ORIGINAL GROUND ELEV. 655 PROPOSED HWY. 7N GRADE ELEV.

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>Reference Boreholes</u> 10 0-8.5' clayey silt, stiff to very stiff 8.5-26' + layered sandy silt to silty sand, dense to very dense <u>Groundwater</u> Overnight water level at 20'+ below ground surface.	<u>Abutments</u> 1) On compacted granular pads within the fills. <u>Piers</u> 1) Spread footings at or below elevation 648 for an allowable design pressure of 4.0 t.s.f.	Fill heights up to 30 ft. will be stable with forward and side slopes of 2:1.	Due to lack of vertical alignment data, it is assumed fills in the order of 30 feet are required at this site.

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-18 LOCATION Proposed Hwy. 7N and Bayview Avenue Structure and Retaining Wall
ORIGINAL GROUND ELEV. 674.5 PROPOSED HWY. 7N GRADE ELEV. 700+
Proposed Bayview Avenue Grade Elevation 680+

[illegible]

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-19 LOCATION Proposed Hwy. 7N Alternative Route (Town of Richmond Hill)
connecting to Bayview Ave.
 ORIGINAL GROUND ELEV. 680+ PROPOSED HWY. 7N GRADE ELEV.

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>Reference Boreholes</u> Subsurface conditions for this site were interpreted from boreholes 8 and 9. They consist generally of a shallow deposit of loose to compact silty sand overlying a stiff to hard clayey silt deposit.	<u>Abutments and Piers</u> 1) Perched footings on short displacement piles (i.e. 12 $\frac{1}{4}$ " O.D. tubular piles) driven to a depth of 20 to 25 feet can be expected to develop 50 tons per pile.	Fill heights up to 20 ft. will be stable with forward and side slopes of 2:1.	
<u>Groundwater</u> Not established.			

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-20 LOCATION Proposed Hwy. 7N Alternative Route (Town of Richmond Hill)
Crossing German Mills Creek
 ORIGINAL GROUND ELEV. 649 PROPOSED HWY. 7N GRADE ELEV.

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 9</p> <p>0-15.5' sandy silt to silty sand compact to very dense</p> <p>15.5'-30.5' clayey silt very stiff to hard</p> <p>30.5-41.5' + silt, compact to very dense</p> <p><u>Groundwater</u></p> <p>Water level approximate creek level at 4 feet below ground surface.</p>	<p>1) A soil-steel structure either CSP or S.P.P.A. with minor stream re-alignment is suggested.</p> <p>2) A single span CRF supported on spread footings at or below elevation 644 with an allowable design pressure of 3 t.s.f.</p>	<p>Fill heights up to 30 ft. will be stable with forward and side slopes of 2:1.</p>	<p>Insufficient data was available for this route location, however, it is assumed that fills in the order of 25 to 30 feet will be required to carry Hwy. 7N over German Mills Creek.</p>

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-21 LOCATION Hwy. 407 Crossing German Mills Creek
ORIGINAL GROUND ELEV. 620 PROPOSED HWY. 407 GRADE ELEV. 655
German Mills Creek Water Level 620+ (H.W.L.)

[illegible]

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-22 LOCATION Hwy. 407 at Leslie Street
ORIGINAL GROUND ELEV. 609 PROPOSED HWY. 407 GRADE ELEV. 626
Proposed Leslie St. Grade Elevation 607+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>Reference Boreholes</u> 5 0-26' + clayey silt stiff to hard	<u>Abutments</u> 1) Compacted granular pad within the approach fills. <u>Piers</u> 1) Spread footings founded at or below elevation 600 within the hard clayey silt deposit can be designed for an allowable bearing pressure of 4.0 t.s.f.	Fill heights up to 25 ft. will be stable with forward and side slopes of 2:1. Cuts to a depth of 10 feet will be stable with 2:1 slopes.	
<u>Groundwater</u> Water level not established.			

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-23 LOCATION Hwy. 407 and Hwy. 404
ORIGINAL GROUND ELEV. 608 PROPOSED HWY. 407 GRADE ELEV. 616+
Hwy. 404 Grade Elevation 595+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 2</p> <p>0-8.5' clayey silt very stiff</p> <p>8.5-41.5' + sandy silt to silty sand</p> <p>dense to very dense</p> <p><u>Groundwater</u></p> <p>Water level not encountered.</p>	<p><u>Abutments and Piers</u></p> <p>1) Spread footings located at or below elevation 598 in the dense granular deposit can be designed for a maximum bearing pressure of 4 t.s.f.</p>	<p>Fill heights up to 15 ft. will be stable with forward and side slopes of 2:1.</p> <p>Cuts to a depth of 15 feet will be stable with 2:1 side slopes.</p>	

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-24 LOCATION Hwy. 404 E,W-N and S-E,W Ramps at Hwy. 404
ORIGINAL GROUND ELEV. 609 PROPOSED HWY. 407 GRADE ELEV. ?

[illegible]

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-25 LOCATION Hwy. 407 E-N Ramp to Hwy. 404 at Hwy. 7
Hwy. 404 S-W Ramp to Hwy. 407 at Hwy. 7
 ORIGINAL GROUND ELEV. 624 to 629 PROPOSED HWY. 407 GRADE ELEV.

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>Reference Boreholes 27 & 28</u> Borehole 27 (west) 0-8.5' clayey silt, hard 8.5-19' sandy silt compact to hard 19-61' + clayey silt, stiff to hard Borehole 28 (east) 0-11.5' sandy silt, dense to very dense 11.5-20' silty clay to clayey silt, hard 20-36' + clayey silt very dense <u>Groundwater</u> Water level at 1' below ground surface.	<u>East Structure: Abutments</u> 1) On compacted granular pad within fills. 2) End-bearing piles driven to tip elevation 600+ for maximum structural capacity of pile section. <u>West Structure: Abutments</u> 1) On compacted granular pad within fills. 2) End-bearing piles driven to tip elevation 570+ for maximum structural capacity of pile section.	Fill heights up to 20 ft. will be stable with forward and side slopes of 2:1.	

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-26 and B-27 LOCATION Hwy. 404 N, S-E Hwy. 407 and Woodbine N, S-W Hwy. 407 Ramps
ORIGINAL GROUND ELEV. 600 PROPOSED HWY. 407 GRADE ELEV. _____

[illegible]

FOUNDATION DATA SHEET

W.P. 89-78-00 SITE B-28 LOCATION Hwy. 407 at Woodbine Avenue
ORIGINAL GROUND ELEV. 593 PROPOSED HWY. 407 GRADE ELEV. 595+
Proposed Woodbine Ave. Grade Elevation 618+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 1</p> <p>0-53' clayey silt, some sand, trace gravel soft to hard</p> <p>53-59.5' + silty sand</p> <p><u>Groundwater</u></p> <p>Water level at 10' below ground surface.</p>	<p><u>Abutments and Piers</u></p> <p>Friction Piles-No. 14 treated timber piles with an embedded length of 45 feet can be designed for a maximum of 30 tons per pile.</p>	<p>Fill heights up to 20 ft. will be stable with forward and side slopes of 2:1.</p> <p>Cuts to a depth of 10 feet will be stable with 2:1 side slopes.</p>	



RECORD OF BOREHOLE No 1 (Site B-28)

W P 89-78-00 LOCATION Coords. N 15 929 960; E 1 037 920 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Continuous Flight Auger COMPILED BY TK
DATUM Geodetic DATE November 6, 1978 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
592.9	Ground Level																
0.0																	
	Trace of Organics		1	SS	5		590										
			2	SS	5												
	Clayey Silt Some Sand Trace of Gravel Soft to Hard		3	SS	17												
			4	SS	16		580										0 3 81 16
			5	SS	8												
			6	SS	9												
	Silty Clay		7	SS	4		570										2 6 20 72
			8	SS	2												
			9	SS	29												
	Sand and Silt Seams Throughout		10	SS	30		560										6 30 40 24
			11	SS	4		550										
539.9			12	SS	53												
53.0	Silty Sand						540										
533.4			13	SS	69												
59.5	End of Borehole																



RECORD OF BOREHOLE No 2 (Site B-23)

W P 89-78-00 LOCATION Coords. N 15 929 100; E 1 034 550 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Continuous Flight Auger COMPILED BY TK
DATUM Geodetic DATE November 6, 1978 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT: W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
607.8	Ground Level																
0.0	Clayey Silt Trace Sand and Organics Very Stiff Brown		1	SS	17		600										
			2	SS	22												
599.3			3	SS	7												
8.5	Sandy Silt to Silty Sand Trace Gravel and Clay		4	SS	36												0 9 89 2
			5	SS	84												
			6	SS	67												5 62 28 5
			7	SS	115/	9"	590										
	Brown																
	Dense to Very Dense		8	SS	100/	3"	580										
							570										
567.3			9	SS	109												0 74 25 1
41.5	End of Borehole Water Level Not Encountered																



RECORD OF BOREHOLE No 3 (Site B-24)

W P 89-78-00 LOCATION Coords. N 15 930 860; E 1 034 030 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Continuous Flight Auger COMPILED BY TK
DATUM Geodetic DATE November 7, 1978 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100									
								SHEAR STRENGTH							PLASTIC LIMIT Wp	NATURAL MOISTURE CONTENT W	LIQUID LIMIT Wl
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
							WATER CONTENT (%)										
							10 20 30										
608.8	Ground Level																
606.8	Topsoil																
2.0	Clayey Silt, Trace Sand and Gravel		1	SS	4												
600.8	Soft to Firm		2	SS	7												
8.0	Sandy Silt		3	SS	10									0 18 81 1			
			4	SS	8												
595.3	Loose		5	SS	11												
13.5	Clayey Silt		6	SS	60									16 29 37 18			
	Some Sand																
	Trace Gravel		7	SS	81												
	Sand and Silt Seams Throughout																
	Very Stiff to Hard		8	SS	21												
			9	SS	107									0 1 58 41			
562.3																	
46.5	End of Borehole		10	SS	102												



RECORD OF BOREHOLE No 4 (Sites B-26 & B-27)

W P 89-78-00 LOCATION Coords. N 15 929 250; E 1 035 930 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Continuous Flight Auger COMPILED BY TK
DATUM Geodetic DATE November 7, 1978 CHECKED BY *JP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100									
								SHEAR STRENGTH									
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT (%)					
600.4	Ground Level						600										
0.0	Topsoil																
597.4			1	SS	21												
3.0	Clayey Silt, Some Sand, Trace of Gravel		2	SS	22												
592.4	Very Stiff		3	SS	19												
8.0	Silt to Sandy Silt		4	SS	14		590							0 3 94 3			
	Trace Clay and Gravel		5	SS	22									0 7 92 1			
			6	SS	12									7 42 42 9			
577.4	Compact		7	SS	16		580										
23.0	Clayey Silt Some Sand Trace of Gravel		8	SS	51												
	Sand and Silt Seams		9	SS	35		570										
	Very Stiff to Hard		10	SS	19		560										
551.9			11	SS	707	6"											
48.5	End of Borehole																

RECORD OF BOREHOLE No 5 (Site B-22)

W P 89-78-00 LOCATION Coords. N 15 928 610; E 1 031 470 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Continuous Flight Auger COMPILED BY TK
DATUM Geodetic DATE November 8, 1978 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT Σ					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
608.9	Ground Level																
606.9	Topsoil																
2.0	Clayey Silt Some Sand Trace Gravel		1	SS	14		600										0 14 61 25
			2	SS	14												
			3	SS	24												
			4	SS	40												
	Occasional Silt and Sand Seams Throughout		5	SS	38												
			6	SS	46												10 33 43 14
	Stiff to Hard		7	SS	81		590										
582.9			8	SS	60												
26.0	End of Borehole Note: Water Level Not Established																

*³, x⁵: Numbers refer to
Sensitivity

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

RECORD OF BOREHOLE No 6 (Site B-21)

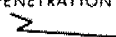


W P 89-78-00 LOCATION Coords. N 15 928 820; E 1 025 940 ORIGINATED BY TK
 DIST 6 HWY 407 BOREHOLE TYPE Continuous Flight Auger COMPILED BY TK
 DATUM Geodetic DATE November 8, 1978 CHECKED BY CF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
620.3	Ground Level																
0.0	Clayey Silt Trace of Sand		1	SS	32		620										
			2	SS	37												
			3	SS	32												
			4	SS	16												
	Sand Seams		5	SS	16		610										
			6	SS	29												
	Cobbles																
599.3	Very Stiff to Hard		7	SS	60		600										
21.0	Sandy Silt Trace of Clay Dense to Very Dense		8	SS	46												
			9	SS	33		590										
578.8			10	SS	73		580										
41.5	End of Borehole																



RECORD OF BOREHOLE No 7 (Site B-17)

W P 89-78-00 LOCATION Coords. N 15 929 020; E 1 024 770 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Continuous Flight Auger COMPILED BY TK
DATUM Geodetic DATE November 8, 1978 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH									WATER CONTENT (%)	
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					10 20 30						
666.6	Ground Level																	
0.0	Clayey Silt With Sand Trace of Gravel Occasional Sand Seams Very Stiff to Hard Cobbles		1	SS	15		9"	660									4 28 52 16	
			2	SS	22													
			3	SS	53													
			4	SS	79													
			5	SS	110													
			6	SS	56													
			7	SS	86													
			8	SS	125													
640.6																0 6 (94)		
26.0	End of Borehole																	



RECORD OF BOREHOLE No 8 (Site B-18)

W P. 89-78-00 LOCATION Coords. N 15 929 580; E 1 024 760 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Continuous Flight Auger COMPILED BY TK
DATUM Geodetic DATE November 9, 1978 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
674.5	Ground Level																
0.0	Silty Sand Trace of Gravel and Clay Brown		1	SS	15		670										8 46 41 5
			2	SS	11												
665.0	Loose to Compact		3	SS	7												
9.5	Clayey Silt With Sand Trace of Gravel		4	SS	10												6 32 46 16
			5	SS	25		660										
	Stiff to Hard		6	SS	120												
			7	SS	71/6"		650										4 28 44 24
643.0																	
31.5	End of Borehole		8	SS	97												



RECORD OF BOREHOLE No 9 (Sites B-19 & B-20)

W P 89-78-00 LOCATION Coords. N 15 931 070; E 1 024 820 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Continuous Flight Auger COMPILED BY TK
DATUM Geodetic DATE November 9, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
648.7	Ground Level																
0.0	Sandy Silt to Silty Sand Some Gravel Trace of Clay Compact to Very Dense		1	SS	18		640										20 36 40 4
			2	SS	58												14 44 33 9
			3	SS	27												63 27 (10)
			4	SS	69												
			5	SS	42												
633.2			6	SS	25												
15.5	Clayey Silt Trace of Sand and Gravel Very Stiff to Hard		7	SS	24		630										1 0 53 46
			8	SS	56												
618.2			9	SS	25		620										0 12 82 6
30.5	Silt Some Sand Trace of Clay Compact to Very Dense						610										
607.2			10	SS	62												
41.5	End of Borehole																

RECORD OF BOREHOLE No 10 (Site B-15)

W P 89-78-00 LOCATION Coords. N 15 929 470; E 1 019 970 ORIGINATED BY TK
 DIST 6 HWY 407 BOREHOLE TYPE Continuous Flight Auger COMPILED BY TK
 DATUM Geodetic DATE November 9, 1978 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
655.0	Ground Level																GR SA SI CL
0.0	Clayey Silt With Sand		1	SS	13		650										0 27 52 21
	Trace of Gravel		2	SS	17												
646.5	Stiff to Very Stiff		3	SS	49												
8.5	Layered		4	SS	81												0 19 79 2
	Sandy Silt to Silty Sand		5	SS	55												
	Some Gravel		6	SS	37		640										0 84 15 1
	Trace of Clay		7	SS	86/												
	Dense to Very Dense																
628.9			8	SS	68/		630										22 36 38 4
26.1	End of Borehole																



RECORD OF BOREHOLE No 11 (Site B-14)

W P 89-78-00 LOCATION Coords. N 15 928 630; E 1 018 500 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Continuous Flight Auger COMPILED BY TK
DATUM Geodetic DATE November 14, 1978 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT Σ					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
636.4	Ground Level																
0.0	Clayey Silt Some Sand Trace of Gravel Stiff to Very Stiff		1	SS	12		630										2 18 50 30
			2	SS	19												
			3	SS	35												
			4	SS	30												
			5	SS	29												0 7 68 25
			6	SS	22		620										
617.9																	
18.5	Silt Trace of Sand and Clay Loose to Very Dense		7	SS	23												0 6 92 2
			8	SS	7		610										
			9	SS	44												
600.2			10	SS	76/9"												
36.2	End of Borehole Note: Water Level Not Established																

RECORD OF BOREHOLE No 12 (Site B-13)

W P 89-78-00 LOCATION Coords. N 15 927 550; E 1 018 670 ORIGINATED BY TK
 DIST 6 HWY 407 BOREHOLE TYPE Continuous Flight Auger COMPILED BY TK
 DATUM Geodetic DATE November 14, 1978 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100					
630.0	Ground Level												
0.0	Clayey Silt Some Sand Trace of Gravel		1	SS	21		620						3 29 31 37
			2	SS	23								
			3	SS	17								
			4	SS	18								
	Occasional Sand Seams		5	SS	25								3 14 62 21
			6	SS	31								
	Very Stiff to Hard		7	SS	30		610						
			8	SS	22								
600.0													
30.0	Silty Clay Trace of Sand Hard		9	SS	40		600						0 5 43 52
588.5													
41.5	End of Borehole Note: Water Level Not Established		10	SS	90		590						

RECORD OF BOREHOLE No 13 (Site B-11)

W P 89-78-00 LOCATION Coords. N 15 925 770; E 1 012 000 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Continuous Flight Auger COMPILED BY TK
DATUM Geodetic DATE November 15, 1978 CHECKED BY [Signature]

[illegible]

OFFICE REPORT ON SOIL EXPLORATION

+3, x5; Numbers refer to Sensitivity



RECORD OF BOREHOLE No 14 (Site B-10)

W P 89-78-00 LOCATION Coords. N 15 925 080; E 1 012 130 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Continuous Flight Auger COMPILED BY TK
DATUM Geodetic DATE November 15, 1978 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
630.8	Ground Level						630							
0.0	Clayey Silt With Sand		1	SS	8									
625.3	Stiff		2	SS	10									
5.5	Sandy Silt Trace of Clay		3	SS	19									0 30 61 9
			4	SS	45		620							
	Occasional Sand Seams Throughout		5	SS	44									
			6	SS	39									
			7	SS	-		610							0 36 56 8
	Loose to Very Dense		8	SS	2									
			9	SS	4									0 36 53 11
			10	SS	22		600							
			11	SS	133									0 55 43 2
585.1			12	SS	50/ 3"		590							
45.7	End of Borehole													



RECORD OF BOREHOLE No 15 (Site B-9)

W P 89-78-00 LOCATION Coords. N 15 923 000; E 1 005 750 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Continuous Flight Auger COMPILED BY TK
DATUM Geodetic DATE November 15, 1978 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
673.7	Ground Level																
0.0	Topsoil																
671.7																	
2.0	Clayey Silt Trace to Some Sand Trace of Gravel		1	SS	7		670										4 20 46 30
			2	SS	19												
			3	SS	16												
			4	SS	11												
	Sand and Silt Inclusions Throughout		5	SS	21		660										10 42 38 10
			6	SS	8												
			7	SS	16												
	Firm to Hard		8	SS	33		650										12 26 48 14
			9	SS	38												
							640										
632.2			10	SS	37												0 61 37 2
41.5	End of Borehole																

RECORD OF BOREHOLE No 16 (Site B-8)

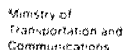
W P 89-78-00 LOCATION Coords. N 15 921 650; E 1 005 890 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Continuous Flight Auger COMPILED BY TK
DATUM Geodetic DATE November 16, 17 & 20, 1978 CHECKED BY [Signature]

[illegible]

Continued

+3, x5: Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 16 Continued (Site B-8)

W P 89-78-00 LOCATION Coords. N 15 921 650; E 1 005 890 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Continuous Flight Auger COMPILED BY TK
DATUM Geodetic DATE November 16, 17 and 20, 1978 CHECKED BY [Signature]

[illegible]

+3, x5 : Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 17 (Site B-7)

W P 89-78-00 LOCATION Coords. N 15 916 580; E 1 006 730 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Auger COMPILED BY TK
DATUM Geodetic DATE November 20, 1978 CHECKED BY JP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
628.5	Ground Level																
0.0	Clayey Silt to Silty Clay Trace of Sand and Gravel Sand Seams Stiff to Very Stiff		1	SS	10		620										0 7 37 56
616.5			2	SS	12												
12.0			3	SS	14												
613.5	Silt, Some Sand		4	SS	28												0 14 85 1
			5	SS	104												
15.0	Clayey Silt Trace of Sand and Gravel		6	SS	35		610										1 5 43 51
			7	SS	46												
602.0	Hard																
			8	SS	50												
26.5	End of Borehole																

W P 89-78-00 LOCATION Coords. N 15 916 740; E 1 005 000 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Auger COMPILED BY TK
DATUM Geodetic DATE November 20, 1978 CHECKED BY [Signature]

+3, x5 : Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 19 (Site B-4)

W P 89-78-00 LOCATION Coords. N 15 915 000; E 1 004 180 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Auger COMPILED BY TK
DATUM Geodetic DATE November 21, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
608.8	Ground Level																
0.0	Silty Sand		1	SS	5												
603.3	Loose		2	SS	18												0 7 68 25
5.5	Clayey Silt Trace of Sand and Gravel		3	SS	31												
			4	SS	29												
			5	SS	61												0 2 93 5
	Very Stiff to Hard		6	SS	21												
			7	SS	30												
			8	SS	41												3 7 45 45
			9	SS	39												
567.3			10	SS	55												
41.5	End of Borehole																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 20 (Site B-3)

W P 89-78-00 LOCATION Coords. N 15 913 090; E 1 003 420 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Auger COMPILED BY TK
DATUM Geodetic DATE November 21, 1978 CHECKED BY JP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
646.4	Ground Level																
0.0	Clayey Silt With Sand Trace of Gravel		1	SS	19		640										1 18 45 36
			2	SS	26												
			3	SS	48												
633.4	Brown Very Stiff to Hard		4	SS	78/	10"											
13.0	Silty Sand to Silt Some Sand Trace of Gravel and Clay Loose to Dense		5	SS	54		630										0 69 30 1
			6	SS	-												
			7	SS	34												
			8	SS	14		620										
			9	SS	38												
			10	SS	8		610										2 16 79 3
605.9																	
40.5	Clayey Silt Some Sand Trace of Gravel Hard		11	SS	30		600										
595.6																	
50.8	End of Borehole		12	SS	100/ 3"												

RECORD OF BOREHOLE No 21 (Site B-2)

W P 89-78-00 LOCATION Coords. N 15 912 220; E 1 000 690 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Auger COMPILED BY TK
DATUM Geodetic DATE November 22, 1978 CHECKED BY *JP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
666.2	Ground Level																
0.0	Clayey Silt With Sand Trace of Gravel Very Stiff		1	SS	19		660										3 42 38 17
659.2			2	SS	24												
7.0	Clayey Silt		3	SS	63												5 40 41 14
			4	SS	86												
			5	SS	46												0 34 55 11
			6	SS	33												
			7	SS	33												
			8	SS	18												
			9	SS	61												
			10	SS	108												
			11	SS	83												
			12	SS	100/ 9"												
633.2	Clayey Silt Some Sand Trace of Gravel Hard						630										
620.4	End of Borehole Note: Water Level Not Established																

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 22 (Site B-1)

W P 89-78-00 LOCATION Coords. N 15 911 360; E 998 210 ORIGINATED BY TK
DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Auger COMPILED BY TK
DATUM Geodetic DATE November 22 and 23, 1978 CHECKED BY *EP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100							WATER CONTENT (%)					
								SHEAR STRENGTH							10 20 30					
								○ UNCONFINED	+ FIELD VANE											
								● QUICK TRIAXIAL	x LAB VANE											
690.7	Ground Level																			
688.7	Topsoil						690													
2.0	Clayey Silt With Sand Trace of Gravel Brown Grey Stiff to Hard		1	SS	14									2 20 46 32						
			2	SS	17															
			3	SS	25															
			4	SS	27															
			5	SS	30															
			6	SS	34															
			7	SS	22															
			8	SS	19															
			9	SS	14															
			10	SS	19															
			11	SS	14															
642.7	Some Sand Seams												22 31 38 9							
48.0	Clayey Silt With Silt Inclusions With Sand Trace of Gravel Stiff to Hard		12	SS	15															
			13	SS	11															
			14	SS	95															
609.9			15	SS	100/ 4"		610						8 36 39 17							
80.8	End of Borehole																			

RECORD OF BOREHOLE No 23 (Site B-1)

W P 89-78-00 LOCATION Coords. N 15 911 130; E 997 650 ORIGINATED BY TK
 DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Auger COMPILED BY TK
 DATUM Geodetic DATE November 23, 1978 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
687.9	Ground Level																
686.2	Topsoil																
1.5			1	SS	24		680										0 32 47 21
			2	SS	21												
			3	SS	20												
			4	SS	29												
			5	SS	22												
			6	SS	13		670										10 33 43 14
			7	SS	11												
			8	SS	12		660										
			9	SS	24												
			10	SS	60		650										
			11	SS	100/ 5"		640										5 36 43 16
638.0																	
49.9	End of Borehole																
	Note: Water Level Not Established																

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 24 (Site B-5) Formerly BH^F1
W.P. 222-60

W P 89-78-00 LOCATION Coords. N 15 916 450; E 1 004 340 ORIGINATED BY BMG
DIST 6 HWY 407 BOREHOLE TYPE Washboring and Cone Test COMPILED BY BK
DATUM Geodetic DATE August 2, 1960 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L		
613.5	Ground Level												
0.0	Topsoil												
	Sand and Gravel Some Organic Material Loose to Dense		1	SS	6		610						
605.5			2	SS	18								
8.0	Clayey Silt With Sand and Gravel		3	SS	32								
	Hard						600						
596.0			4	SS	98								
17.5	Silty Sand												
	Dense		5	AS	35								
588.5							590						
25.0	Clayey Silt With Sand and Gravel		6	SS	45								
	Hard		7	SS	112		580						
572.0			8	AS	77								
41.5	End of Borehole												

RECORD OF BOREHOLE No 25 (Site B-12)

Formerly BH 1
W.P. 100-58

W P 89-78-00 LOCATION Coords. N 15 926 390; E 1 015 180 ORIGINATED BY AL
DIST 6 HWY 407 BOREHOLE TYPE Washboring and Cone Test COMPILED BY AL
DATUM Geodetic DATE June 29, 1958 CHECKED BY *OP.*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	PSF					
553.8	Ground Level													
0.0	Silty Sand With Organics		1	TW	Pushed		550							
544.2														
9.6	Clayey Silt Traces of Silt and Sandy Silt Stiff to Very Stiff		2	TW	16		540							
			3	TW	19									
			4	TW	12		530							
			5	TW	13									
520.8														
33.0	Fine Silty Sand Compact to Dense		6	SS	7		520							
			7	PS	Pushed									
			8	PS	Pushed		510							
			9	PS	Pushed									
			10	SS	21		500							
498.8			11	SS	-									
55.0	End of Borehole						490							
							480							
476.2														
77.6	End of Cone Test								115/7"					



RECORD OF BOREHOLE No 26 (Site B-16)

Formerly BH #2
W.P. 148-67-03

W P 89-78-00 LOCATION Coords. N 15 928 520; E 1 020 530 ORIGINATED BY VK
DIST 6 HWY 407 BOREHOLE TYPE Washboring, BX Casing and Cone Test COMPILED BY VK
DATUM Geodetic DATE January 26, 1970 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
637.9	Ground Level															
0.0	Clayey Silt Some Sand Occasional Gravel		1	SS	9											
			2	SS	39											
			3	SS	49											
			4	SS	54											
			5	SS	97											
619.4	Stiff to Hard															
18.5	Silty Sand Occasional Gravel		6	SS	100/ 5"											
			7	SS	100/ 6"											
			8	SS	100/ 6"											
			9	SS	100/ 4"											
599.9	Very Dense															
38.0	Clayey Silt Occasional Gravel Random Seams of Silty Sand		10	SS	100/ 5"											
			11	SS	150											
			12	SS	140											
			13	SS	100/ 6"											
576.4	Hard															
			14	SS	146/ 11"											
61.5	End of Borehole															



RECORD OF BOREHOLE No 27 (Site B-25)

Formerly BH #1

W P 89-78-00

LOCATION Coords. N 15 932 198; E 1 033 786

W.P. 160-74-15
Cont. 76-107
ORIGINATED BY DM

DIST 6 HWY 407

BOREHOLE TYPE Continuous Flight Auger and Washboring and Cone

COMPILED BY AKB

DATUM Geodetic

DATE March 13, April 2, 1970

Test

CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT Σ		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	PSF					
624.6	Ground Level													
0.0	Clayey Silt Some Sand and Gravel, Hard Brown		1	SS	32		620							
616.1			2	SS	51									
8.5	Sandy Silt Some Gravel Compact to Dense		3	SS	27									
			4	SS	39									
			5	SS	30		610							
605.6														
19.0	Clayey Silt Some Sand and Gravel		6	SS	22									
			7	SS	13		600							
	Stiff to Hard Grey		8	TW	PM									
			9	TW	PM		590							
			10	SS	15									
							580							
			11	SS	134									
			12	SS	243		570							
563.1			13	SS	140/ 4"									
61.5	End of Borehole													

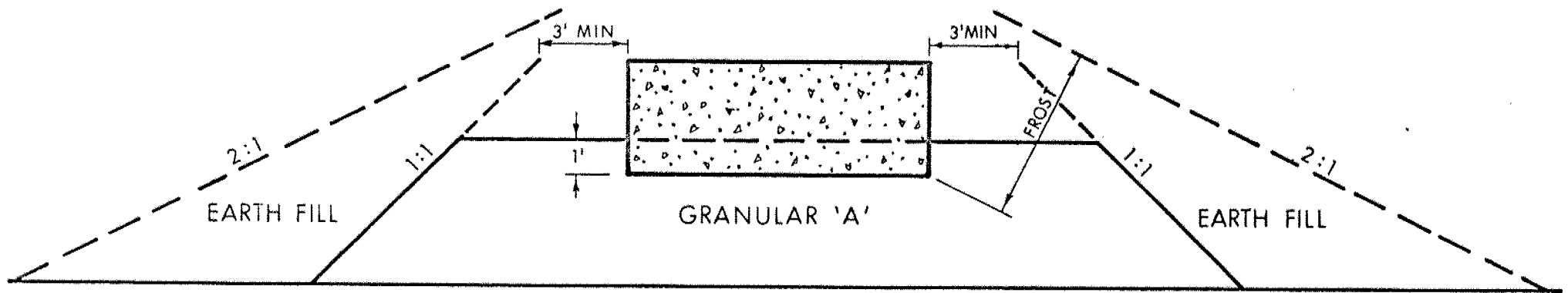


RECORD OF BOREHOLE No 28 (Site B-25) (Formerly BH #2
W.P. 160-74-15
Cont. 76-107)

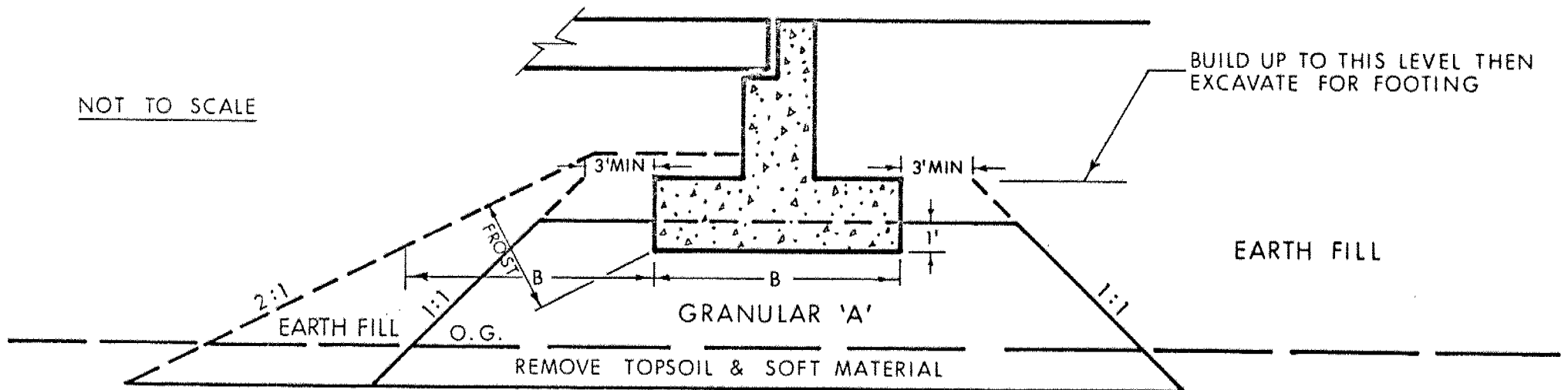
W P 89-78-00 LOCATION Coords. N 15 932 312; E 1 034 150 ORIGINATED BY Dm
DIST 6 HWY 407 BOREHOLE TYPE Washboring, NX Casing COMPILED BY AKB
DATUM Geodetic DATE April 6, 1970 CHECKED BY *JP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
								SHEAR STRENGTH									
629.1	Ground Level																
0.0	Sandy Silt Some Clay Dense to Very Dense		1	SS	35												2 42 (56)
			2	SS	80												5 42 42 11
617.6			3	SS	72												
11.5	Silty Clay to Clayey Silt Some Gravel Hard, Grey		4	SS	57												
			5	SS	110												
609.1			6	SS	132												
20.0	Clayey Silt With Sand and Gravel Hard Grey		7	SS	142												30 15 31 24
			8	SS	162												
592.6			9	SS	100/ 4"												
36.5	End of Borehole																

ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



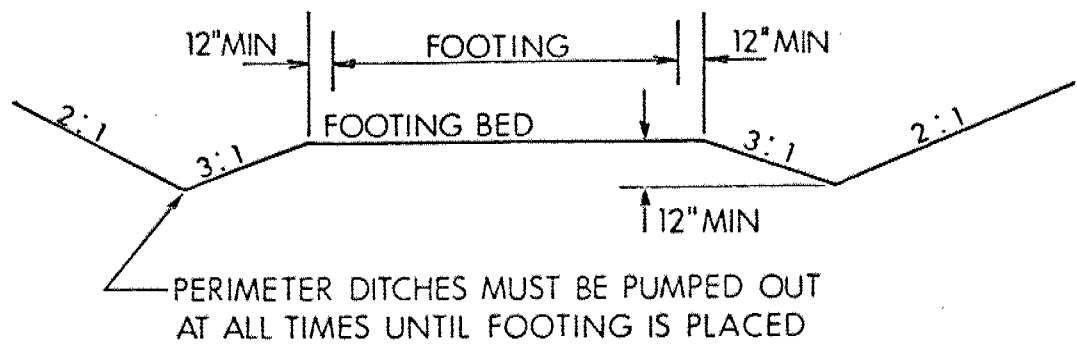
X SECTION



LONGITUDINAL SECTION

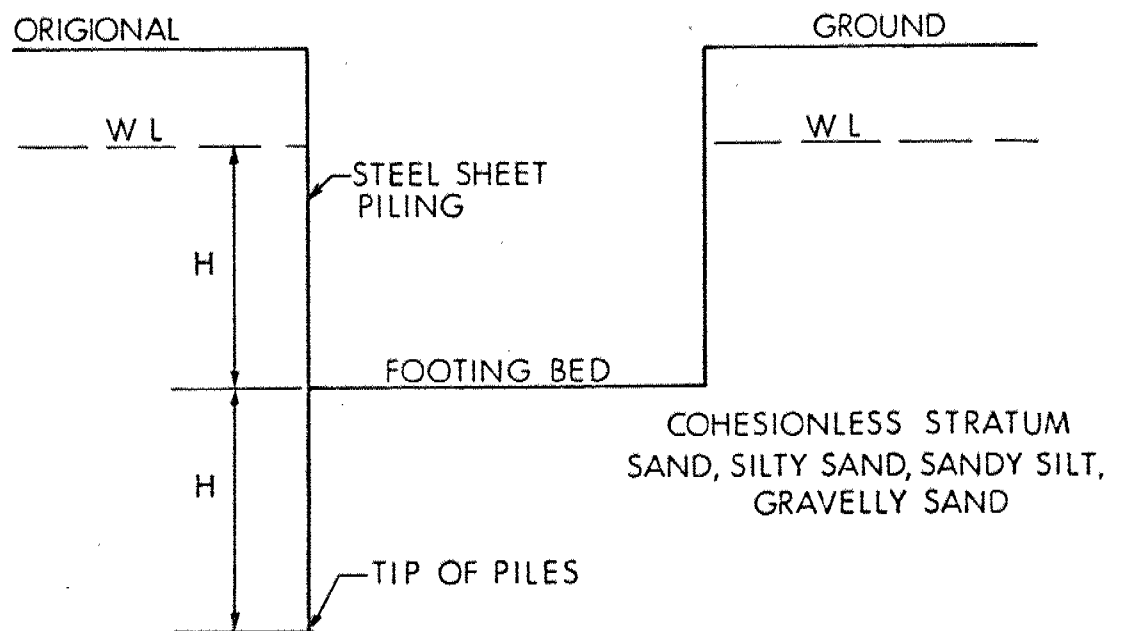
NOTES:

- 1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.
- 2 - PLACE GRANULAR 'A' & EARTH FILL TO TOP OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M.T.C. STANDARDS.
- 3 - EXCAVATE COMPACTED GRANULAR 'A' & EARTH FILL FOR FOOTING.



OVERSIZE EXCAVATION WITH PERIMETER DRAINS

FIG No 2



STEEL SHEET PILING

FIG No 3

EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS N_c .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

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

S_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

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

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCK QUALITY: 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 DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

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

JOINTING AND BEDDING:

SPACING	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAxIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG. $\bar{C}IU$ = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

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

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ ANGLE OF WALL FRICTION
 k_o COEFFICIENT OF EARTH PRESSURE AT REST
 k_A COEFFICIENT OF ACTIVE EARTH PRESSURE
 k_P COEFFICIENT OF PASSIVE EARTH PRESSURE
 i ANGLE OF INCLINATION OF SURCHARGE
 w SLOPE ANGLE-BACKFACE OF WALL
 β ANGLE OF SLOPE
 N, N_q, N_c BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_o INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e IN DENSEST STATE
 D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_P PLASTIC LIMIT
 w_S SHRINKAGE LIMIT
 I_P PLASTICITY INDEX = $w_L - w_P$
 I_L LIQUIDITY INDEX = $\frac{w - w_P}{I_P}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w}{I_P}$
 A_c ACTIVITY = $\frac{I_P \text{ of soil}}{I_P \text{ of } 2\mu m \text{ Soil Fraction}}$
 Om ORGANIC MATTER CONTENT
 S_r DEGREE OF SATURATION
 S SENSITIVITY = $\frac{S_u (\text{undisturbed})}{S_u (\text{remoulded})}$

STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_F PEAK SHEAR STRENGTH
 τ_R RESIDUAL SHEAR STRENGTH
 c COHESION INTERCEPT
 $\sigma_1, \sigma_2, \sigma_3$ NORMAL PRINCIPAL STRESSES
 u PORE WATER PRESSURE
 u_e EXCESS u
 r_u PORE PRESSURE RATIO
 q_u UNCONFINED COMPRESSIVE STRENGTH
 s_u UNDRAINED SHEAR STRENGTH
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_s MODULUS OF SUBGRADE REACTION
 m, n STABILITY COEFFICIENTS
A, B PORE PRESSURE COEFFICIENTS

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
 ϕ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE;
 σ' = EFFECTIVE NORMAL STRESS

HYDRAULIC TERMS

h HYDRAULIC HEAD OR POTENTIAL
 q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 j SEEPAGE FORCE PER UNIT VOLUME
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 m_v COEFFICIENT OF VOLUME CHANGE
 c_v COEFFICIENT OF CONSOLIDATION
 C_c COMPRESSION INDEX
 C_r RECOMPRESSION INDEX
 d DRAINAGE PATH DISTANCE
 T_v TIME FACTOR
 U DEGREE OF CONSOLIDATION
 O_r OVERCONSOLIDATION RATIO (OCR)

OVERSIZE DRAWING