GEOCREDS No.
30M13-156

FINAL
FOUNDATION INVESTIGATION REPORT
PROPOSED HUMBER RIVER ARCH CULVERT EXTENSION
HIGHWAY 400 INTERIM WIDENING
VAUGHAN, ONTARIO
W.P. 192-00-00, CENTRAL REGION

Submitted to:

Ministry of Transportation
Pavements and Foundations Section
Foundations Group
Room 223, Building C
1201 Wilson Avenue,
Downsview, Ontario M3M 1J8
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Submitted by:

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8 September 2003

TT22852B

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RECORD OF BOREHOLE SHEETS ..... Borehole Numbers: HR 1 to HR 3

APPENDIX 'A'

Borehole Logs extracted from report prepared by Golder Associates Limited dated May 2001
GEOCRES File No. 30M13-51

APPENDIX 'B'

Site Photographs

1.0 INTRODUCTION

AMEC Earth & Environmental Limited, Consulting Geotechnical, Materials Quality Control and Environmental Engineers, has been retained by the Ministry of Transportation to conduct a foundation investigation for the extension of the existing Humber River Arch Culvert in King Township, Regional Municipality of York, Ontario. The site location is as shown on the Key Plan of Drawing No. 1. This project is in conjunction with the proposed interim widening of Highway 400 from Major Mackenzie Drive to South Canal Road.

The purpose of this investigation is to determine the sub-surface conditions at the site of the proposed culvert extension by means of a number of boreholes, in-situ tests and laboratory tests on selected samples. Based on our interpretation of the data obtained, recommendations are provided on the geotechnical aspects of foundation design. Comments are also provided on anticipated construction issues where they may affect the geotechnical design of the proposed culvert extension. The work carried out for this geotechnical investigation was completed in accordance with AMEC's proposal (ref. P-22280, dated 20 June 2002).

The proposed plan and profile for the proposed culvert extension were provided to us by the Ministry of Transportation.

Existing subsurface information and laboratory testing results contained in the following report was used to supplement this investigation

- Golder Asscoiates Limited. *Preliminary Foundation Investigation and Design Report, Humber River Arch Culvert Extension, Highway 400 Widening from North of Major Mackenzie Drive to South Canal Road, G.W.P. 222-97-00, Agreement No. 2005-A-000106*. dated May 2001 – GEOCRES File No. 30M13-51.

2.0 SITE DESCRIPTION AND PHYSIOGRAPHY

2.1 SITE DESCIPRTION

The existing Humber River Arch Culvert is located about 1.5 km south of Ling Road in King Township, Regional Municipality of York. We understand that the culvert has been assigned as MTO Structure Site 37-094.

The river banks at the structure location are at about Elevation 255 to 256m, while at the crest of the valley the ground rises to Elevation 274 to 275m. Highway 400 grade over the culvert is about Elevation 267m. The Humber River flows to the west through the culvert.

.../...

The existing concrete arch culvert is about 12 m wide with a maximum height at the center of about 6.1m. The original culvert was constructed in the late 1940s under Contract 46-11 to a length of about 43.7m. The culvert was extended about 29m to the east in the late 1950s. The total length of the existing culvert is about 72.7m. The culvert is founded on spread footings at about Elevation 252.4m, and about 2.4m wide (ref. MTO Drawing TWP No. 74-94-2-8, dated March, 1955). The wingwall retaining walls are also founded at the same elevation. The stream bed is at about Elevation 254.1 within the culvert, overlain by about 0.1 to 0.2m of sediment. Below the sediment the stream bed within the culvert has been infilled with grout or concrete. Photographs of the site are included in Appendix C.

2.2 PHYSIOGRAPHY

Based on available geologic information, the site is located in the South Slope of the Oak Ridges Moraine. Generally after the last glacial withdrawal, glacial till deposits of the Halton Till formation (clayey silt to silty clay till) were deposited over the ice contact and glacial outwash sediments (sands, silts and gravels) of the Oak Ridge Moraine(ORM). The glacial till and ORM were then eroded by the Humber River and recent alluvial deposits and organics were laid down along watercourses. The entire interbedded sequence of sands, silts and gravels of the ORM is generally in the order of about 100 m in thickness in the area of the site. Shale bedrock is generally in the order of about 160 m below existing grade. The cohesionless sands and silts in the Oak Ridges moraine is a water bearing aquifer that is used as a source of water for domestic, industrial and municipal water supply and is known to be under excessive hydrostatic pressure.

3.0 INVESTIGATION PROCEDURES

The fieldwork for the current investigation was carried out on 16 to 18 September 2002, and consisted of drilling and sampling three boreholes (Boreholes HR1, HR2 and HR3) to depths of 11.3 to 12.7m below the existing ground surface. Dynamic cone penetration tests were carried out adjacent to each borehole to depths of 11.3 to 18.3m.

Also referenced in this report in Appendix A, is one borehole (Borehole 90) advanced by Golder Associates in 2001 for a preliminary foundation investigation (GEOCRES No. 30M13-51, referenced in Section 1.0).

Borehole 90, advanced by Golder Associates in 2001, was advanced to a depth of 12.5 m and extended to a depth of about 16.8m by the dynamic cone penetration test method.

The plan locations of the boreholes advanced in the current and previous investigations, and

.../...

selected stratigraphic sections are shown on Drawing No. 1. Details of sub-surface conditions encountered at each borehole location advanced by AMEC, including the results of in-situ testing, are presented on the Record of Borehole sheets.

The boreholes for the current investigation were advanced, using hollow stem continuous flight augers with a track-mounted power auger drill rig (CME 75) owned and operated by Master Soil Investigation Limited, under the full-time supervision of experienced geotechnical personnel from AMEC Earth & Environmental Limited.

Sampling in the AMEC boreholes were carried out at regular intervals of depth (0.75 to 1.5m) by the Standard Penetration Test Method, as specified in American Standards for Testing and Materials Method Number: D-1586. This consists of freely dropping a 63.5 kilogram hammer for a vertical distance of 0.76 m to drive a 51 mm outside diameter split barrel (split-spoon) sampler into the ground. The number of blows of the hammer to drive the sampler into the relatively undisturbed ground for a vertical distance of 0.30 m is recorded as the Standard Penetration Resistance or the 'N'-values of the soil, and this gives an indication of the consistency or the relative density of the soil deposit.

The dynamic cone penetration test was carried out from the ground surface adjacent to Boreholes HR1, HR2 and HR3, and at the bottom of Borehole 90. This test consists of continuously dr iving a 60° p oint, 50 m m diam eter c one at tached t o t he dr ill r od, int o t he undisturbed ground with a driving energy of 475 kJ (63.5 kilogram hammer free falling for a distance of 76 cm) per blow. The number of blows for each 30 cm of penetration is recorded, providing an indication of the relative changes in the soil density with depth.

The soil samples recovered by AMEC were transported to our g eotechnical laboratory in Toronto (Scarborough) for further examination and classification. A laboratory testing programme, consisting of natural moisture content determinations and grain size analyses, was performed on selected representative soil samples from the current investigation. The results of the laboratory tests are presented on the appropriate Record of Borehole Sheets and also on Figure Nos. 1 to 11, inclusive.

Groundwater conditions in the current investigation open boreholes were observed throughout and immediately after the drilling operations. A standpipe piezometer was installed in Boreholes HR1 and HR2, to permit long term monitoring of groundwater levels at the site. All boreholes were adequately backfilled with auger cuttings and bentonite on completion of the fieldwork.

The borehole locations for the current investigation were initially established in the field by our field personnel based on existing features. The borehole locations in terms of northing and easting co-ordinates, and elevations were surveyed by Holding Jones Vanderveen Inc. We

.../...

understand that these elevations are referenced to the geodetic datum. The locations and co-ordinates of the boreholes are shown on Drawing No. 1; the co-ordinates and elevations are indicated on the Record of Borehole Sheets.

4.0 SUB-SURFACE CONDITIONS

Details of sub-surface conditions encountered at each borehole location for the current and previous investigations by others, including the results of in-situ testing, groundwater observations and laboratory test results are presented on the Record of Borehole Sheets and in Appendix A.

4.1 Alluvial Sands with Organics

All boreholes encountered brown to grey alluvial sands underlying the thin (less than 0.1m thick) vegetation cover on the ground surface to depths ranging from 0.6 to 2.2m below existing ground surface. This deposit ranged in composition from sand to silty sand with varying amounts of gravel, clay, rootlets, and interbedded organics. Measured 'N'-values range from 3 to 47 blows per 0.3m, indicating a very loose to dense relative density, but generally loose.

4.2 Sands and Silts

Below the surficial alluvial sands, all boreholes encountered a sand to silt deposit. Boreholes HR1, HR2 and 90 were terminated within this deposit at depths of 11.3 to 12.5m below existing ground surface (or Elevation 242.5 to 243.3m). The deposit is generally composed of fine sand with trace to some silt, with interbeds of silt, silty sand and sandy silt. Measured 'N'-values range from 3 to 47 blows per 0.3m, but generally between 10 and 20 blows. It should be noted that after every auger advance and prior to split spoon sampling, between1.5 to 4.6 m below existing ground surface in various boreholes, sand was "blown" into the hollow stem augers. This disturbance has likely resulted in lower 'N'-values.

Dyanmic cone penetration test results adjacent to Boreholes HR1, HR2 and HR 3 range from 10 to 30 blows per 0.3m to a depth of about 5 to 6m. Adjacent to Boreholes HR1 and HR2 the blows increase to 70 blows per 0.3m at a depth of 7m and reach over 100 blows per 0.3m at depths of 10 to 11m. Adjacent to Borehole HR3 the blows increase to 70 blows per 0.3m at a depth o f abo ut 11m . The dy namic c one p enetration t ests ad jacent t o t he bo reholes w ere terminated at depths of 18.3m (or Elevation 236.6m) 11.3m (Elevation 243.3m) and 12.2m (Elevation 242.5m). Based on the measured 'N'-values and the dynamic cone test results, the sands and silts can be considered to have a relative density of loose to compact to a depth of about 5 to 6m (Elevation 249 to 250m), increasing to compact to dense to a depth of about 10 to 11m (Elevation 244 to245m).

.../...

Laboratory tests carried out on the sands and silts are summarized on the various Record of Boreholes, in Appendix A and in Figure Nos. 1 to 11, inclusive. The laboratory results are summarized below.

Natural Moisture Content 17 to 23%

Grain Size Distribution

Fine Sand, trace Silt (7 samples) – Figure Nos. 1 to 5 and Appendix A

Gravel	0 to 1%
Sand	83 to 96%
Silt	4 to 10%
Clay	0 to 6%

Silty Sand (6 samples) – Figure Nos. 6 to 11

Gravel	0 to 8%
Sand	50 to 78%
Silt	14 to 43%
Clay	5 to 8%

4.3 Clayey Silt Glacial Till

Underlying the sands and silts, a grey clayey silt glacial till deposit was encountered in Borehole HR3 at a depth of 11.6m (Elevation 241.1m) and the borehole was terminated within this deposit at a depth of 12.7m (or Elevation 252.0m). A measured 'N'-value of 60 blows per 0.3m was obtained within this till indicating a hard consistency. The glacial till is a heterogeneous mixture of clay and silt with sand and trace gravel size particles. The dynamic cone penetration test was terminated within this deposit with blows ranging from 75 to 95 blows per 0.3m.

It should be noted that cobbles and boulders may be encountered within this deposit due to its nature of formation.

.../...

4.4 Groundwater Conditions

Groundwater levels in the open boreholes were observed during drilling and upon completion of each borehole. To permit long term monitoring of groundwater levels at the site, standpipe piezometers were installed in Boreholes HR1 and HR2.

Based on the observations in the piezometers and from tactile and visual observations of the recovered soil samples, in our opinion, the groundwater table at the culvert location is at a depth of about 0.6m, or at about Elevation 254m ±.

In Borehole HR2, the morning after completion of the borehole, when removing the hollow stem augers, groundwater was overflowing the top of the augers. Artesian groundwater conditions were not observed during drilling. After installation of the standpipe piezometer, the groundwater level within the pipe stabilized at about 0.3m above ground surface. Groundwater measurements about seven weeks later indicate a groundwater level 0.2m above ground surface. Excessive hydrostatic pressure (artesian condition) was observed from the piezometer indicates an upward groundwater flow gradient.

It should, however, be pointed out that the groundwater at the site would fluctuate seasonally and can be expected to be somewhat higher during the spring months and in response to major weather events.

.../...

5.0 CLOSURE

Sincerely,

Andrew Drevininkas, P. Eng.
Assistant Manager
Geotechnical Services

LICENSED PROFESSIONAL ENGINEER
A. R. DREVININKAS
PROVINCE OF ONTARIO

Kai-Sing Ho, Ph.D., P.Eng.,
Principal Geotechnical Consultant,
MTO Designated Contact.

LICENSED PROFESSIONAL ENGINEER
K. S. HO
PROVINCE OF ONTARIO

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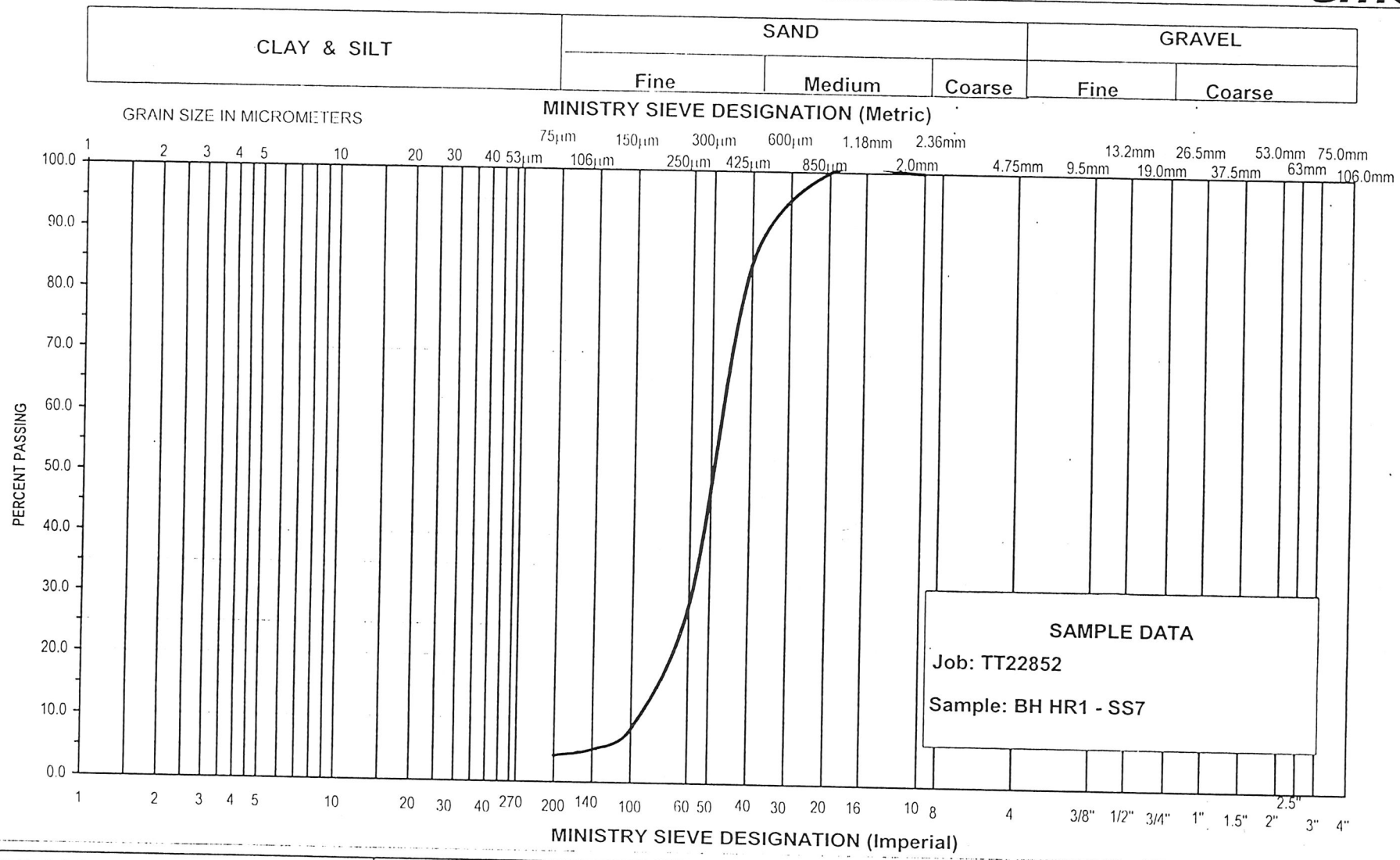
.../...

FIGURES

UNIFIED SOIL CLASSIFICATION SYSTEM

amec



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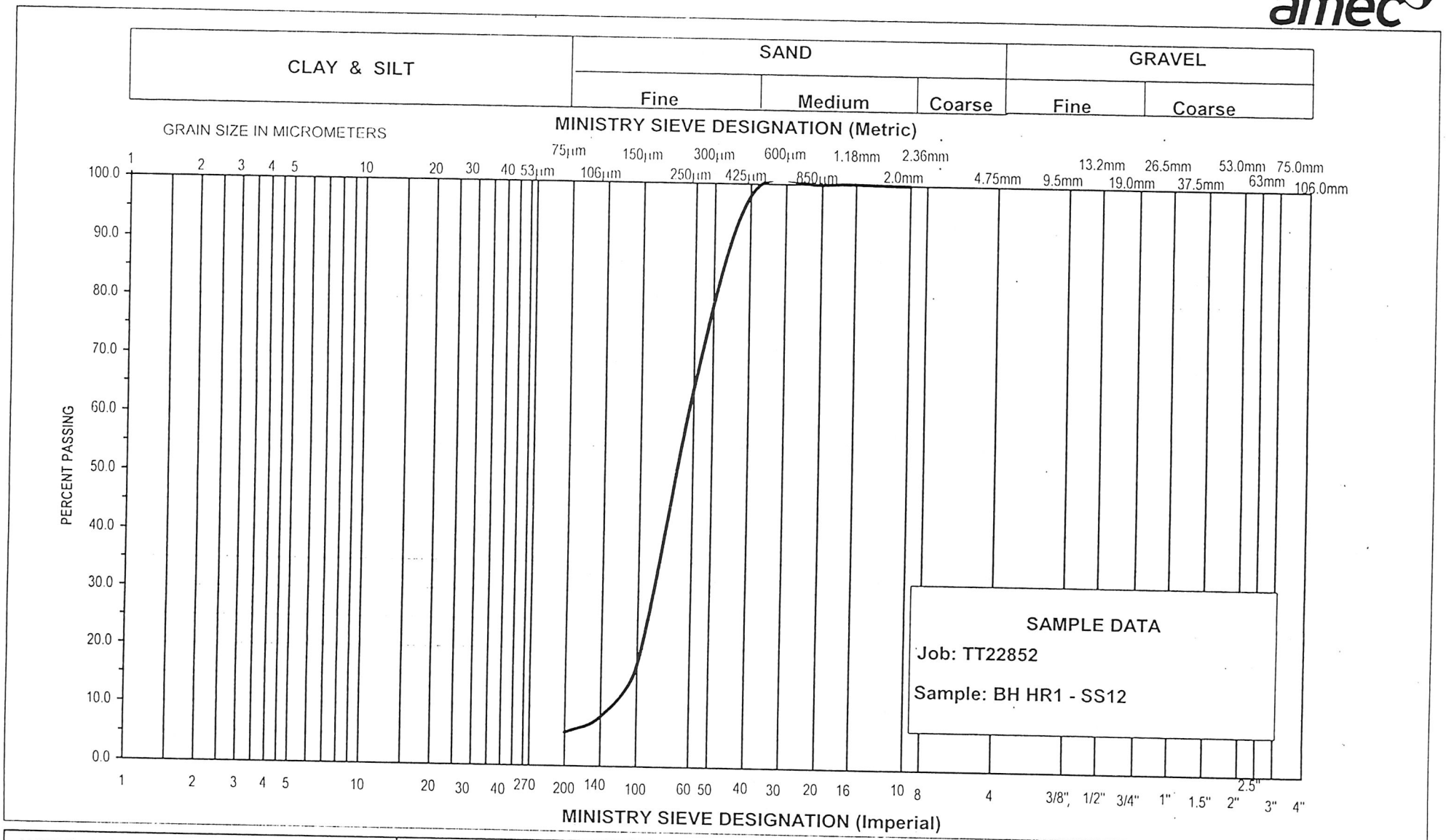
GRAIN SIZE DISTRIBUTION	Client :- Ministry of Transportation Ontario
	Project:- Highway 400 Interim Widening
SAND	Location:- Vaughan, Ontario
trace Silt	Depth :- / Date :- 30-Sep-2002

UNIFIED SOIL CLASSIFICATION SYSTEM



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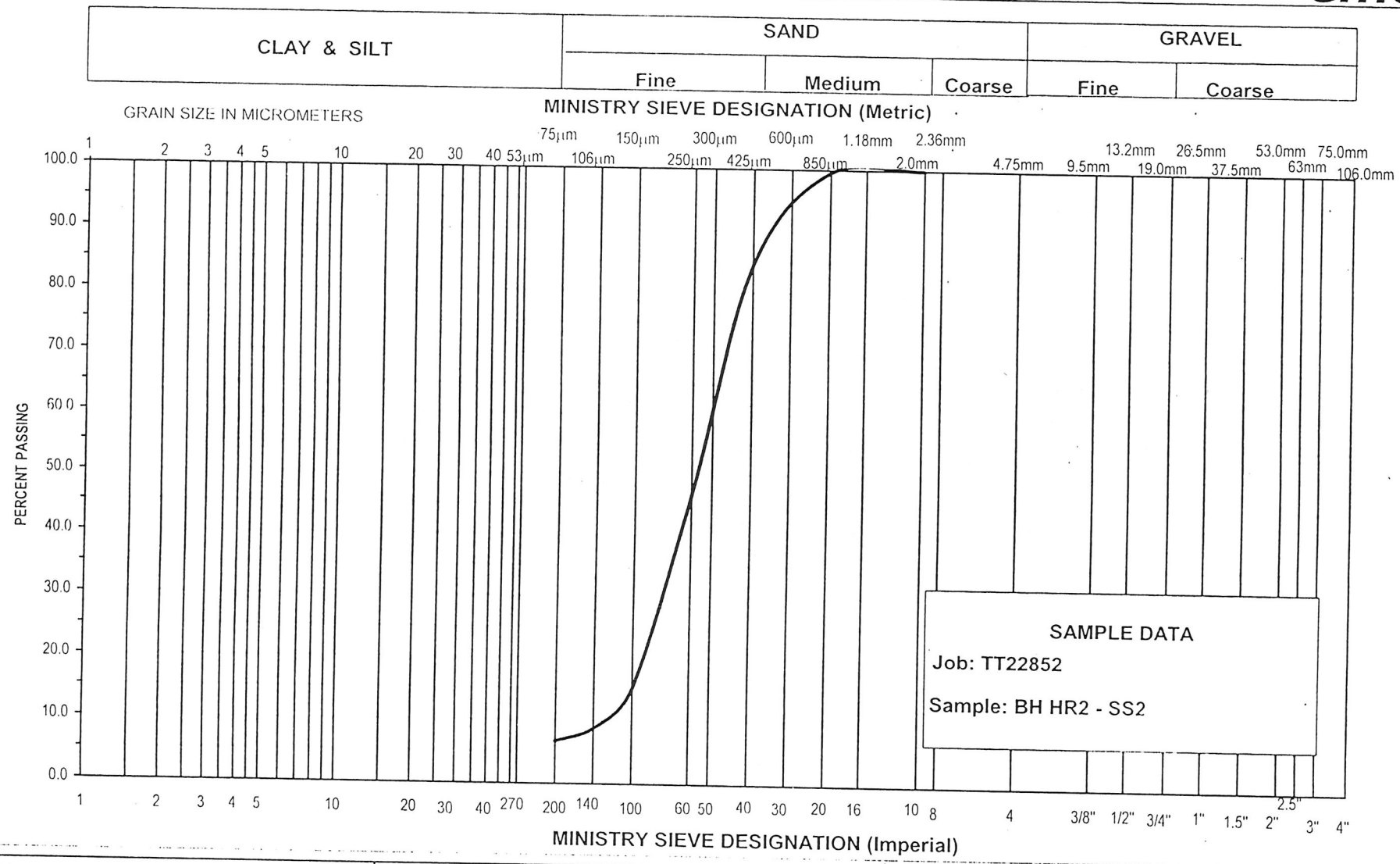

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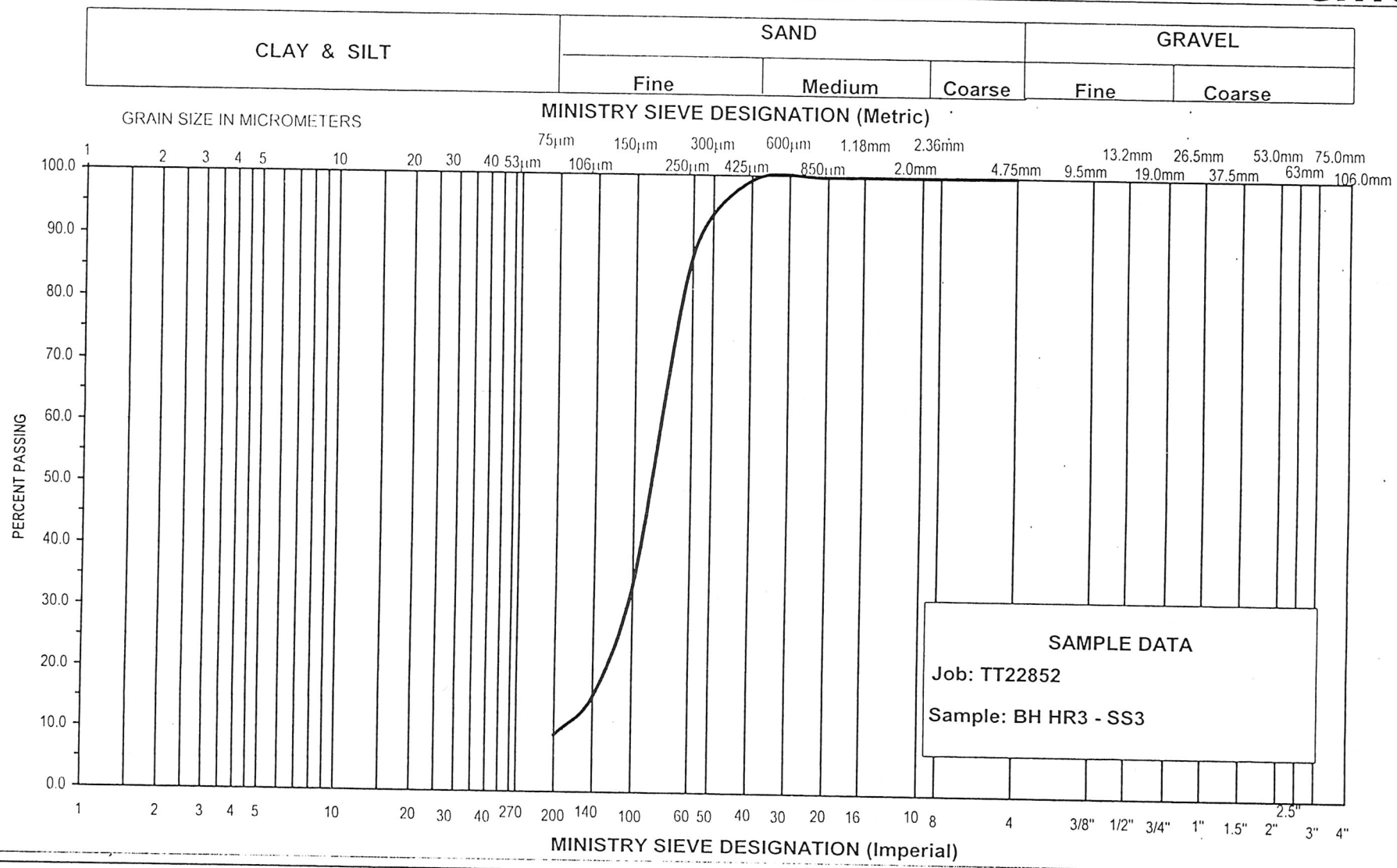

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	Project:- Highway 400 Interim Widening
SAND	Location:- Vaughan, Ontario
trace Silt	Depth :- / Date :- 30-Sep-2002

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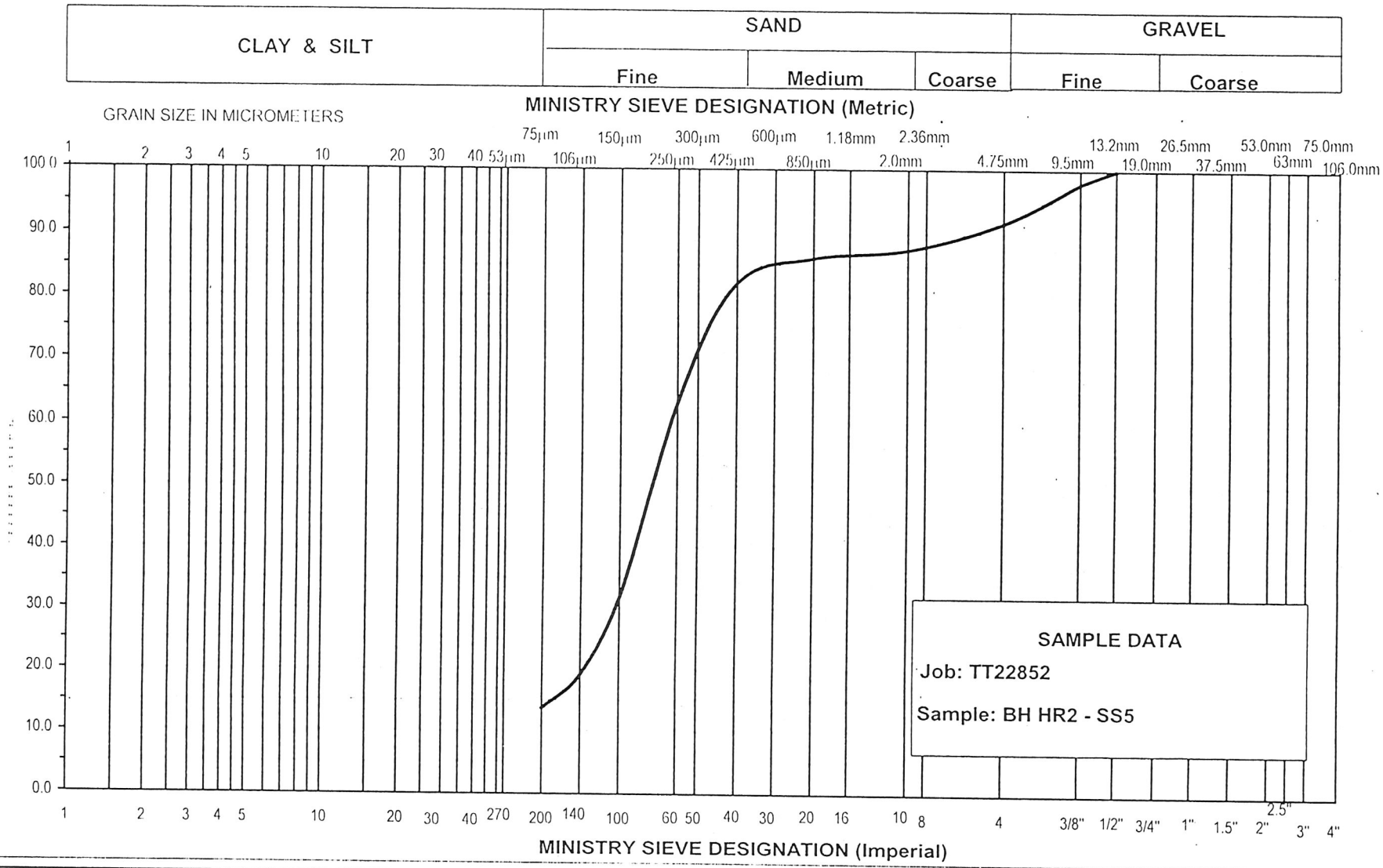

AMEC Earth & Environmental Limited 104 Crockford Blvd., Scarborough, Ontario Canada, M1R 3C3 Tel +1 (416) 751 6565, Fax +1 (416) 751 7592 www.amec.com	GRAIN SIZE DISTRIBUTION	Client :- Ministry of Transportation Ontario
		Project:- Highway 400 Interim Widening
	SAND some Silt trace Gravel	Location:- Vaughan, Ontario
		Depth :- / Date :- 30-Sep-2002

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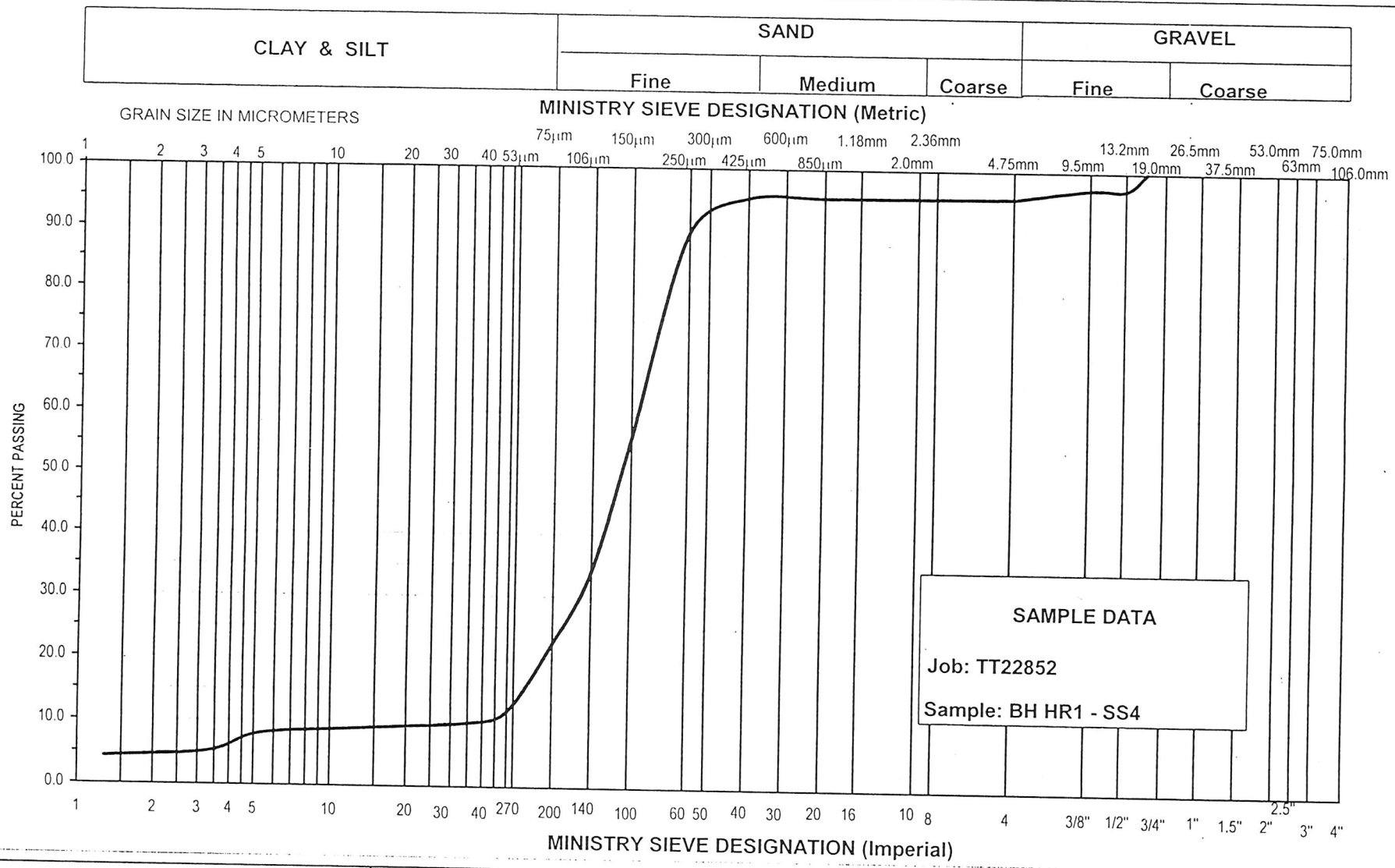

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GRAIN SIZE DISTRIBUTION	Client :- Ministry of Transportation Ontario
	Project:- Highway 400 Interim Widening
SAND	Location:- Vaughan, Ontario
some Silt trace Gravel and Clay	Depth :- / Date :- 30-Sep-2002

UNIFIED SOIL CLASSIFICATION SYSTEM

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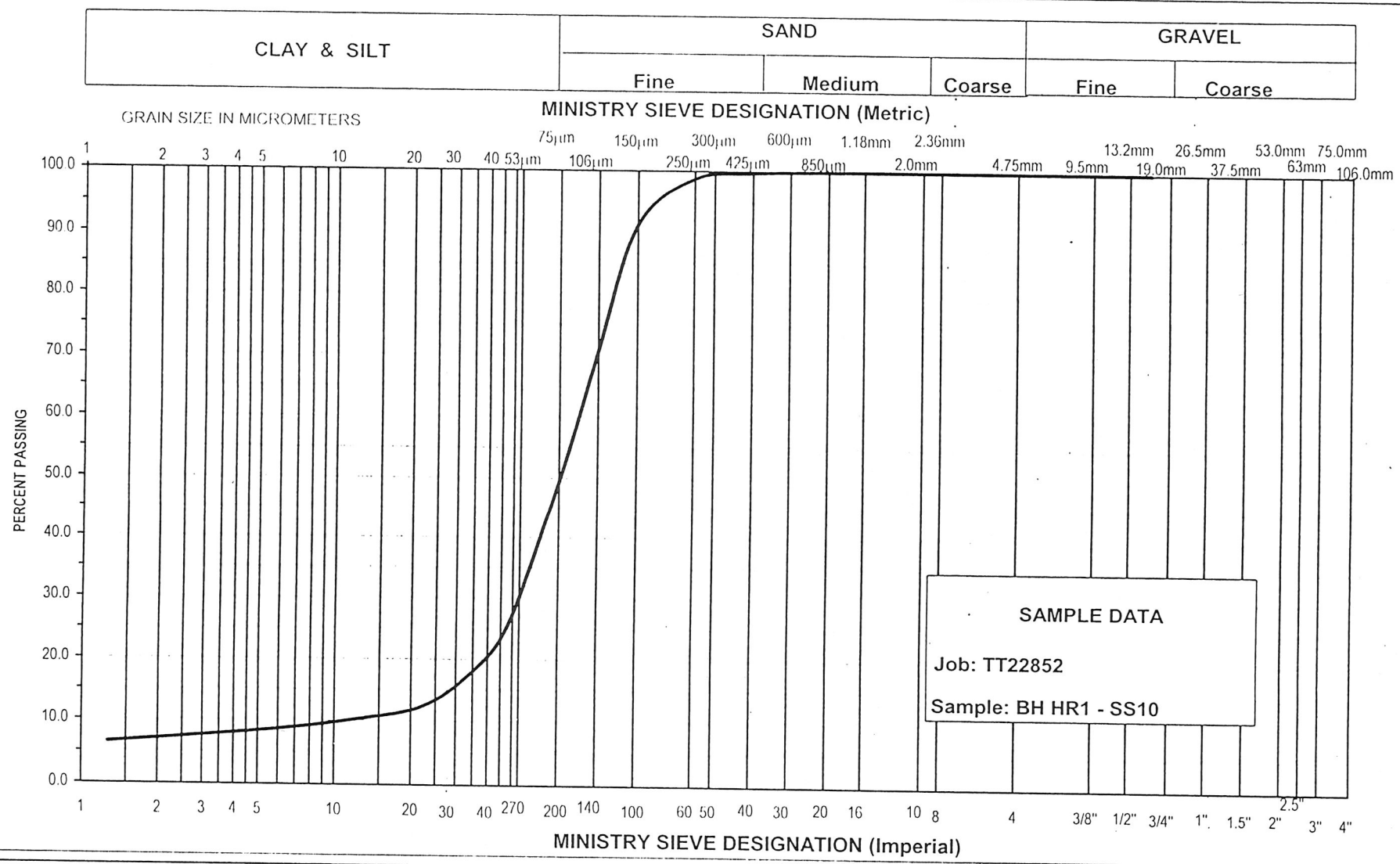

AMEC Earth & Environmental Limited 104 Crockford Blvd., Scarborough, Ontario Canada, M1R 3C3 Tel +1 (416) 751 6565, Fax +1 (416) 751 7592 www.amec.com	GRAIN SIZE DISTRIBUTION	Client :- Ministry of Transportation Ontario
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	SAND and SILT trace Clay	Location:- Vaughan, Ontario
		Depth :- / Date :- 30-Sep-2002

UNIFIED SOIL CLASSIFICATION SYSTEM

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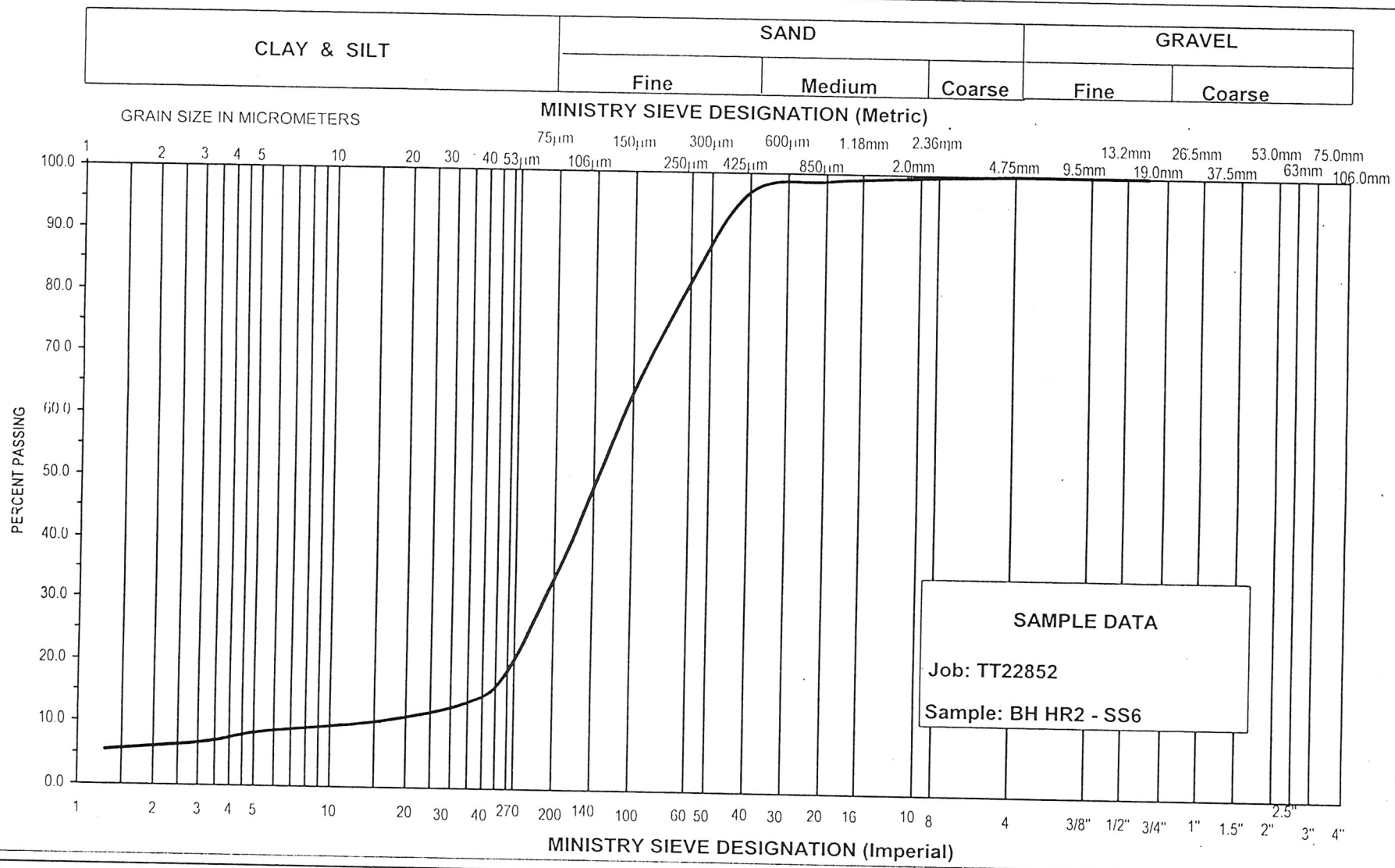

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GRAIN SIZE DISTRIBUTION	Client :- Ministry of Transportation Ontario
	Project:- Highway 400 Interim Widening
SAND	Location:- Vaughan, Ontario
with Silt trace Clay	Depth :- / Date :- 30-Sep-2002

UNIFIED SOIL CLASSIFICATION SYSTEM

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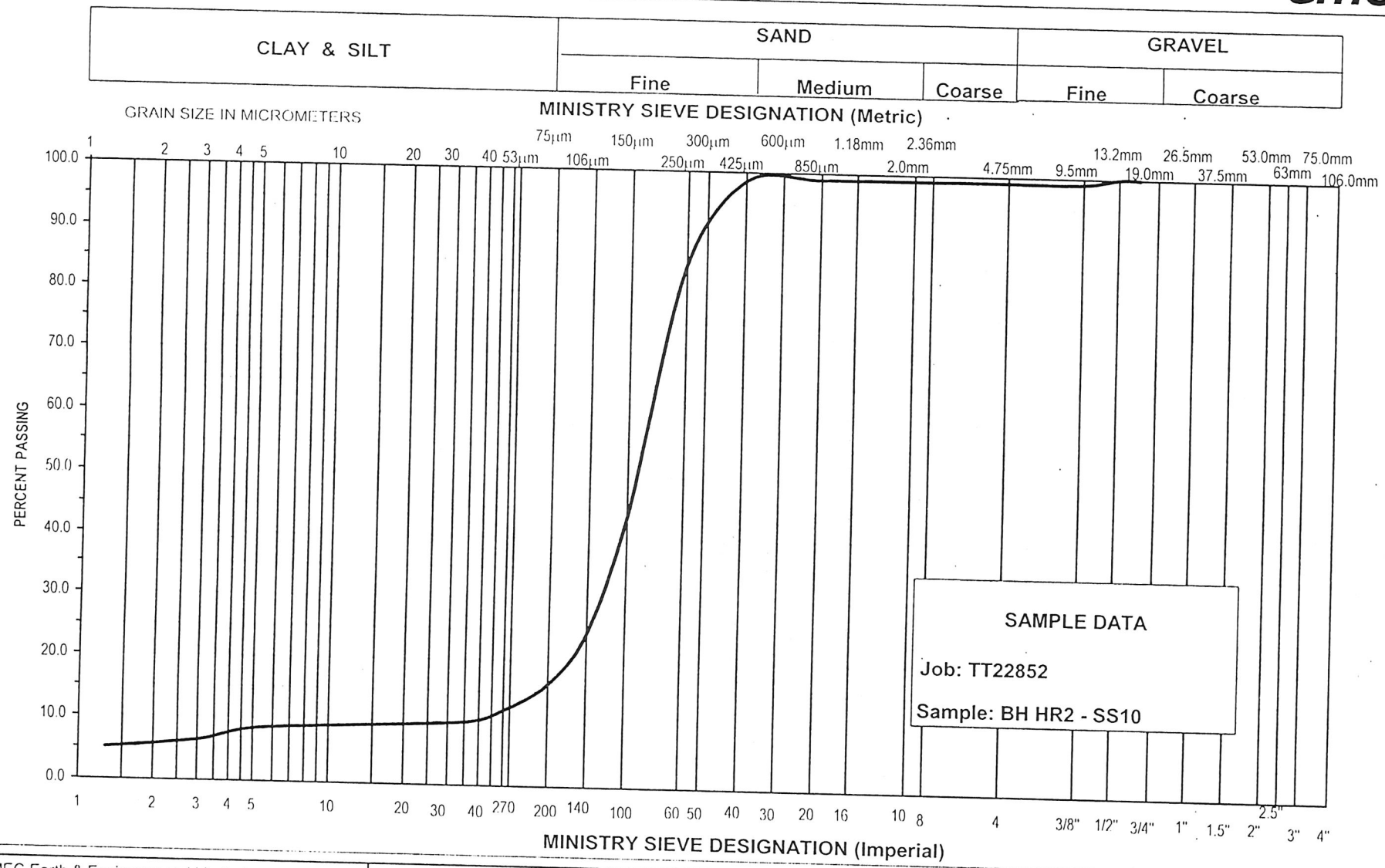

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SAND	Location:- Vaughan, Ontario
some Silt trace Gravel and Clay	Depth :- / Date :- 30-Sep-2002

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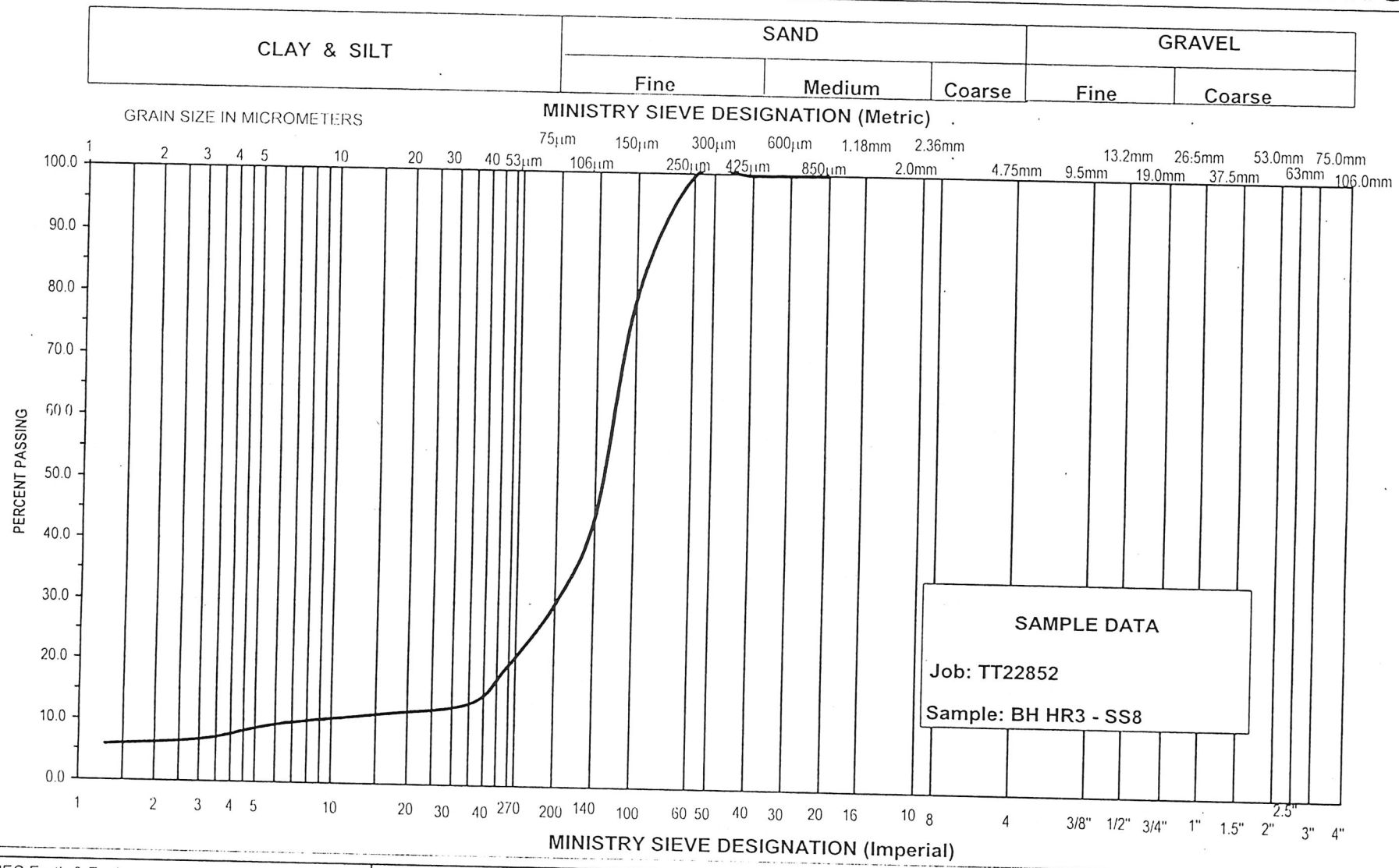

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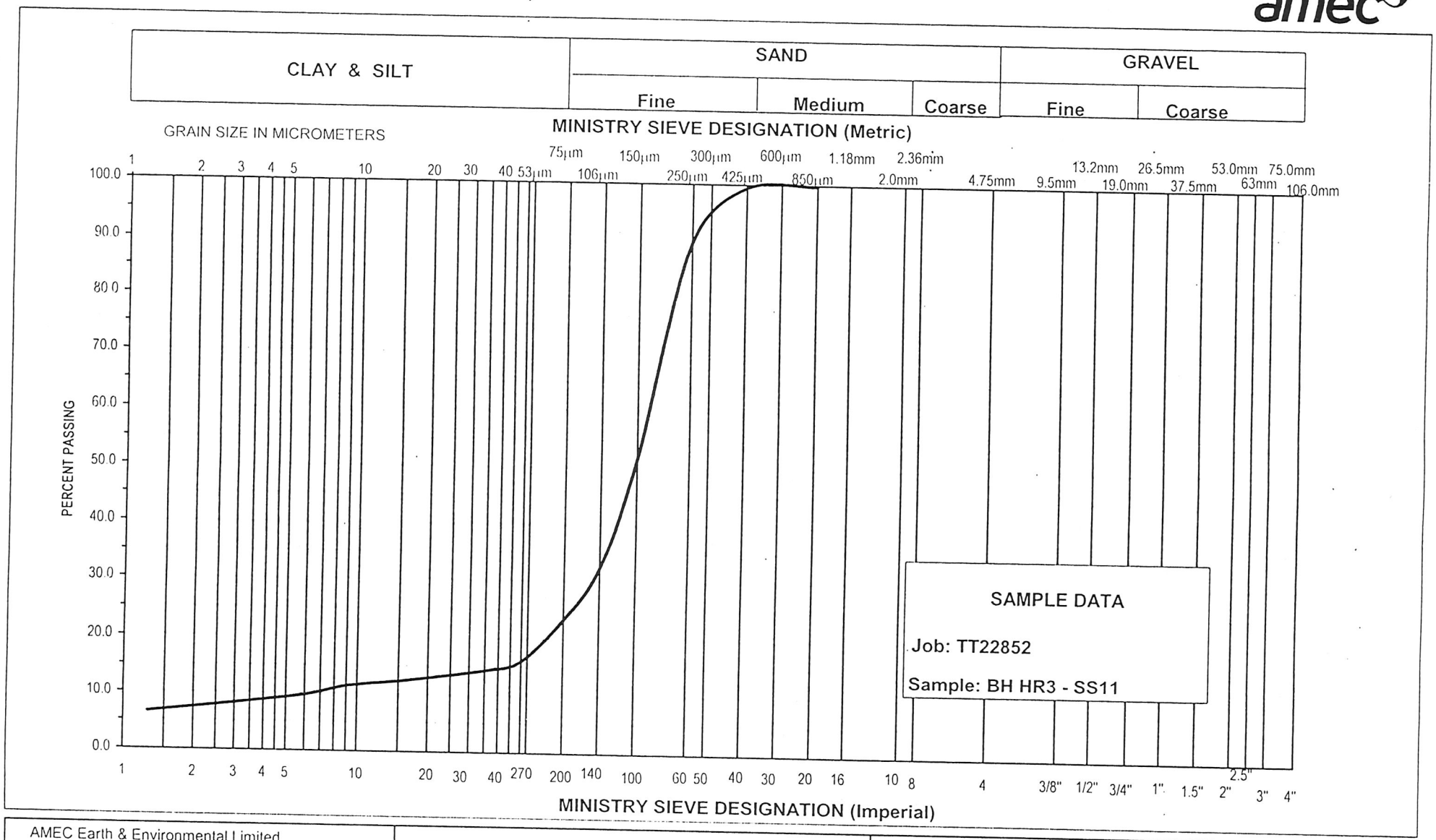
	Project:- Highway 400 Interim Widening
SAND	Location:- Vaughan, Ontario
with Silt trace Clay	Depth :- / Date :- 30-Sep-2002

UNIFIED SOIL CLASSIFICATION SYSTEM



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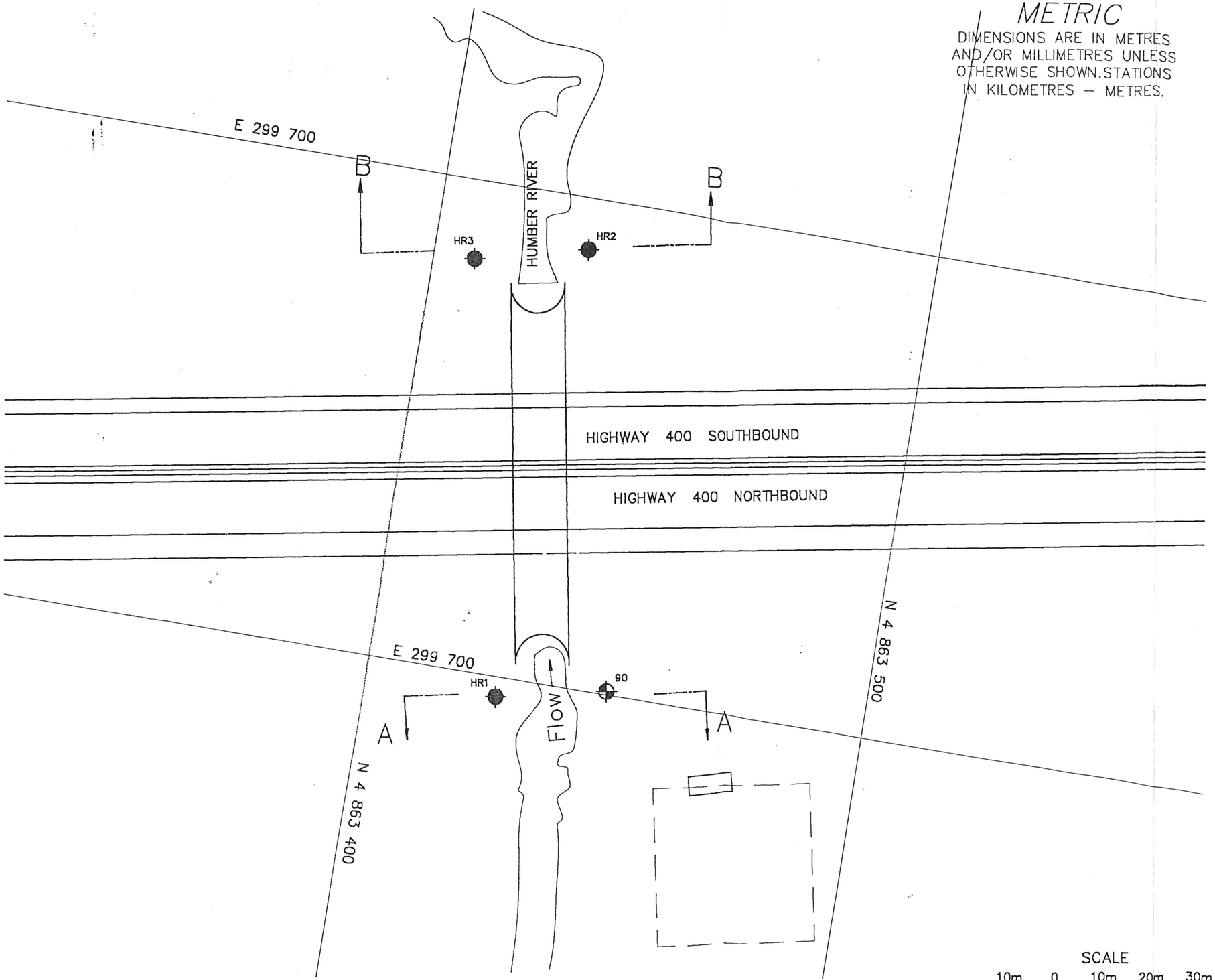
GRAIN SIZE DISTRIBUTION	Client :- Ministry of Transportation Ontario
	Project:- Highway 400 Interim Widening
SAND	Location:- Vaughan, Ontario
some Silt trace Clay	Depth :- / Date :- 30-Sep-2002

DRAWINGS



METRIC

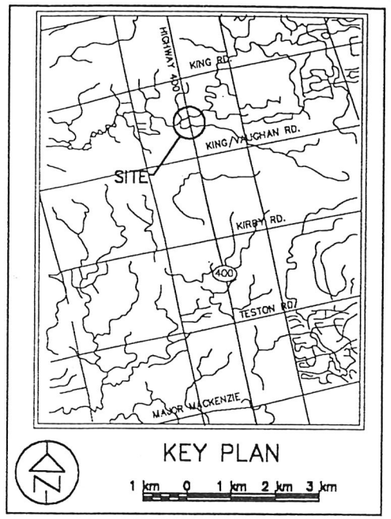
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES – METRES.

W.P. No. 192-00-00

HUMBER RIVER ARCH CULVERT
HIGHWAY 400
BORE HOLE LOCATIONS

SHEET

AMEC Earth & Environmental Limited



KEY PLAN

1 km 0 1 km 2 km 3 km

LEGEND

- Bore Hole – AMEC Investigation
- Bore Hole & Cone – previous investigations done by others
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W.L. at time of investigation
- W.L. in Piezometer
- Piezometer
- End of Borehole

No	ELEV.	CO-ORDINATES NORTH	CO-ORDINATES EAST
90	255.0	4 863 549	299 699
HR1	254.9	4 863 533	299 710
HR2	254.6	4 863 526	299 616
HR3	254.7	4 863 515	299 616

–NOTE–

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

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen.Cond.

REV.	DATE	BY	DESCRIPTION

HWY No 400		DIST
SUBM'D PPM CHECKED AD	DATE Oct, 2002	SITE
DRAWN VK CHECKED KSH APPROVED		DWG 1

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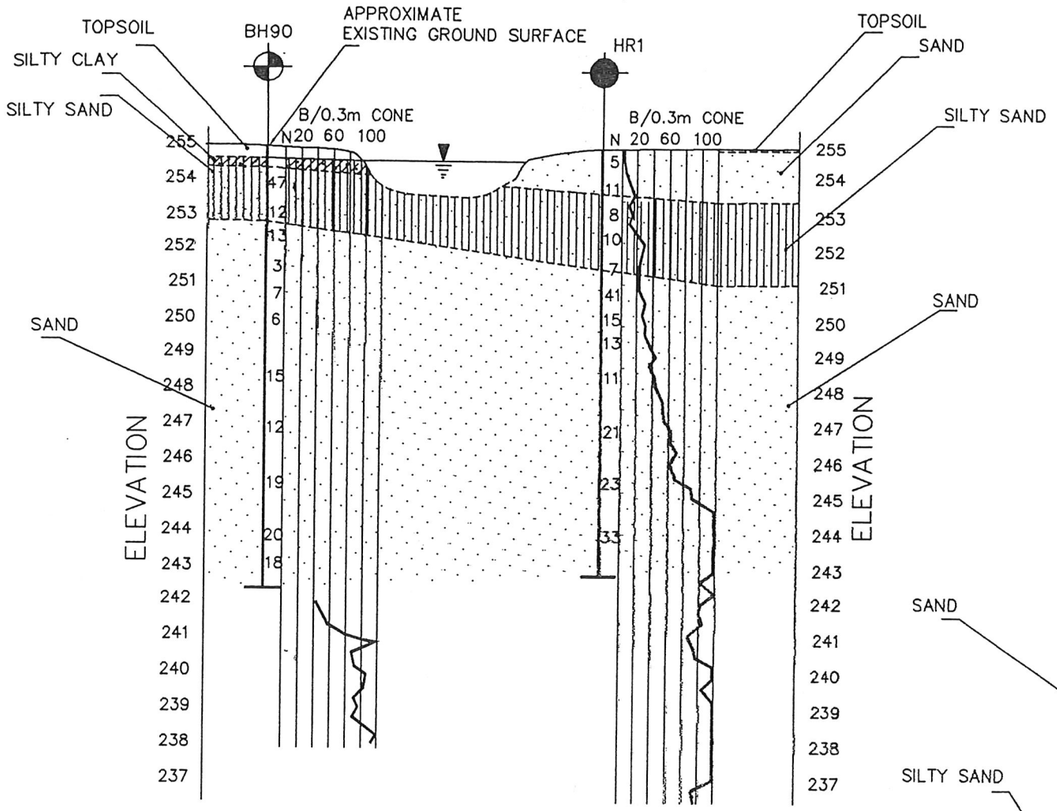
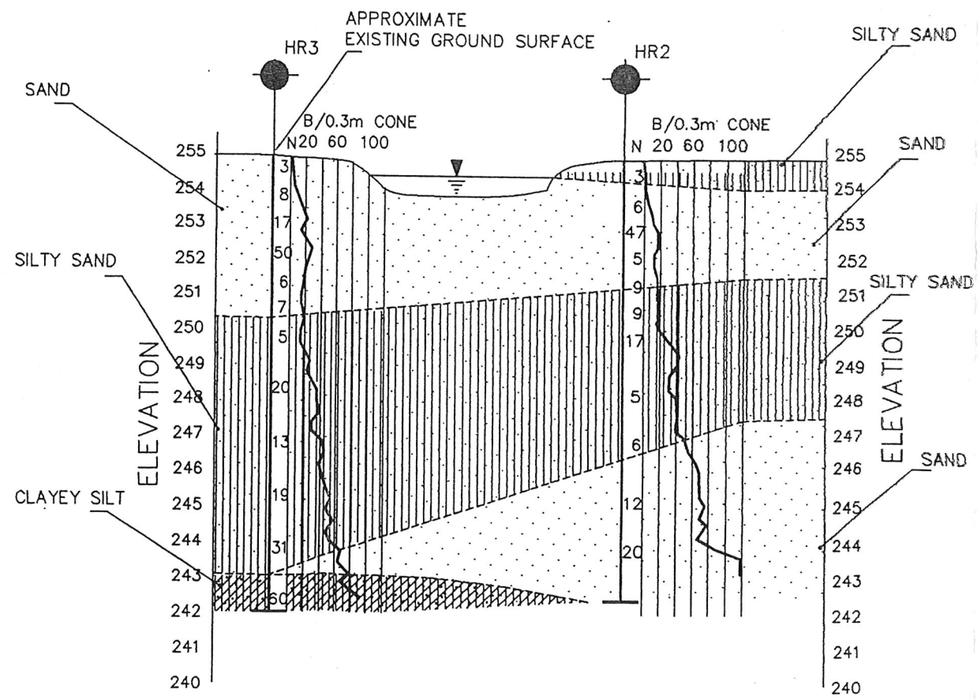


SECTION A–A



SECTION B–B

METRIC

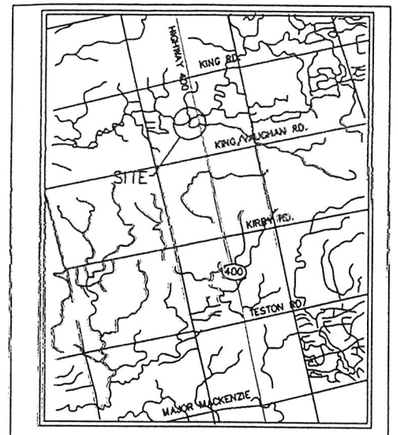
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES – METRES.

W.P. No. 192-00-00

HUMBER RIVER ARCH CULVERT
HIGHWAY 400
SOIL STRATA

SHEET

AMEC Earth & Environmental Limited



KEY PLAN

1 km 0 1 km 2 km 3 km

LEGEND

- Bore Hole – this investigation
- Bore Hole & Cone – previous investigations done by others
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m ('60°' Cone, 475 J/blow)
- WL at time of investigation
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEV.	CO-ORDINATES NORTH	CO-ORDINATES EAST
90	255.0	4 863 549	299 699
HR1	254.9	4 863 533	299 710
HR2	254.6	4 863 526	299 696
HR3	254.7	4 863 515	299 696

–NOTE–

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

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen.Cond.

SOIL STRATIGRAPHY LEGEND

- SAND, TRACE SILT, Very Loose to Very Dense
- CLAYEY SILT TILL, Hard
- SILTY SAND, TRACE CLAY, Very Loose to Dense

HORIZONTAL SCALE

5m 0 5m 10m 15m

2.5m 0 2.5m 5m 7.5m

VERTICAL SCALE

REV.	DATE	BY	DESCRIPTION

HWY No 400			DIST
SUBM'D PPM	CHECKED AD	DATE Oct, 2002	SITE
DRAWN VK	CHECKED KSH	APPROVED	DWG 2

FILE: K:\DGED-TRANSPORT\Projects\20002\TT22652-Hwy400-mto\Drawings\Hwy400 set 2.dwg

RECORD OF BOREHOLE SHEETS

RECORD OF BOREHOLE No HR1

amec

W.P. 192-00-00 LOCATION 4863532.7N 299710.2E ORIGINATED BY PPM

DIST HWY 400 BOREHOLE TYPE Hollow Stem Augering COMPILED BY IH

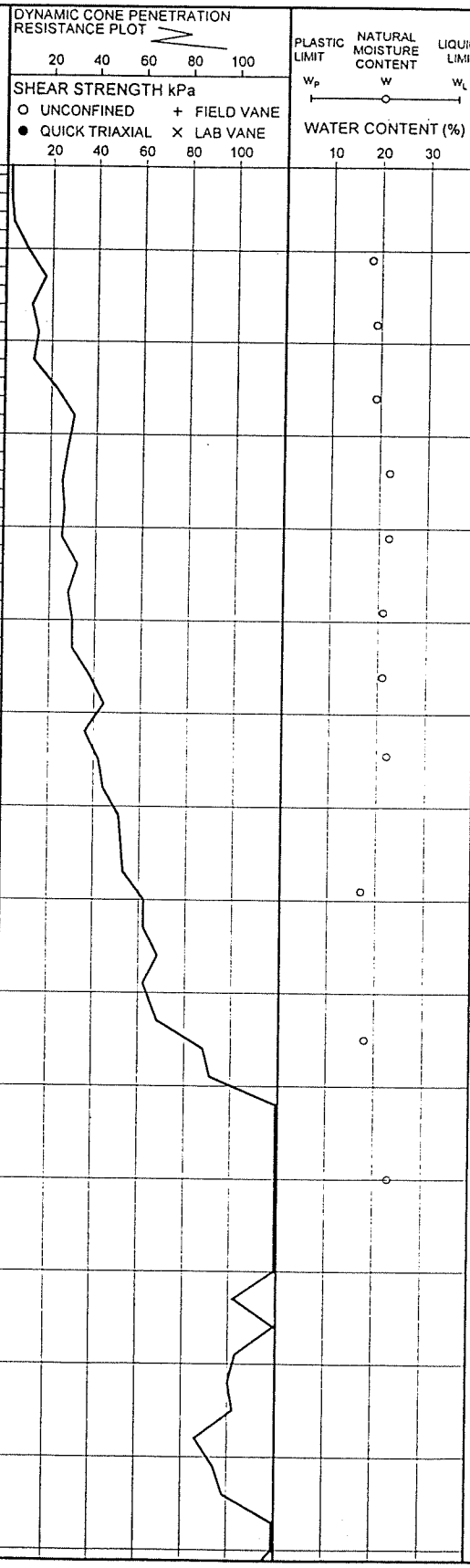
DATUM Geodetic DATE 16 September 2002 - 16 September 2002 CHECKED BY AD

PROJECT HWY 400 Widening, Vaughan, Ontario JOB NO. TT22852

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	"N" VALUES	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
254.9 / 0.0	0.1m TOPSOIL				
0.1	Sand, with rootlets, organics, trace Silt, wet, grey, loose to compact	1	SS	5	
		2	SS	11	
253.5 / 1.4	Silty Sand, trace Gravel, Clay, wet, grey, loose to compact	3	SS	8	
		4	SS	10	4 73 18 5
		5	SS	7	
251.2 / 3.7	Sand, trace silt, wet, grey, compact to dense	6	SS	41	
		7	SS	15*	0 96 4 0
		8	SS	13*	* Below 4.6m depth, sand was "blown back" inside the hollow stem augers after each auger advance. The sand was washed out of the augers prior to sampling and subsequent auger advance. 'N' values are likely not representative due to blowing sands.
248.9 / 6.0	Silt, wet, grey, compact				
248.5 / 6.4	Sand and Silt, trace Clay, wet, grey, compact to dense	9	SS	11*	
		10	SS	21*	0 50 43 7
246.3 / 8.6	Sand, trace silt, wet, grey, compact to very dense	11	SS	23*	
		12	SS	33*	0 94 6 0
242.9 / 12.0	End of Borehole				

Water Level in Open Bore On Completion: 0.1m

Water Level in Piezometer on November 05, 2002: 0.1m



Continued Next Page

$+^3, \times^3$: Numbers refer to Sensitivity

O 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No HR1

amec

W.P. 192-00-00 LOCATION 4863532.7N 299710.2E ORIGINATED BY PPM

DIST HWY 400 BOREHOLE TYPE Hollow Stem Augering COMPILED BY IH

DATUM Geodetic DATE 16 September 2002 - 16 September 2002 CHECKED BY AD

PROJECT HWY 400 Widening, Vaughan, Ontario JOB NO. TT22852

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		m	m	20 40 60 80 100	w_P w w_L WATER CONTENT (%) 10 20 30	γ kN/m³	GR SA SI CL
							16	239				
							17	238				
236.6							18	237				
18.3	End of DCPT DCPT carried out about 2m east of borehole											

SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE

$+^3, \times^3$: Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No HR2

amec

W.P. 192-00-00 LOCATION 4863525.9N 299615.6E ORIGINATED BY IH

DIST HWY 400 BOREHOLE TYPE Hollow Stem Augering COMPILED BY IH

DATUM Geodetic DATE 17 September 2002 - 17 September 2002 CHECKED BY AD

PROJECT HWY 400 Widening, Vaughan, Ontario JOB NO. TT22852

ELEV / DEPTH (m)	SOIL PROFILE: DESCRIPTION	SAMPLES: NUMBER	TYPE	"N" VALUES	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
254.6 / 0.0	**Silty Sand**, with Gravel, trace clay, rootlets, damp, brown, very loose	1	SS	3	
254.0 / 0.6	**Sand**, trace silt, wet, brown to grey, loose	2	SS	6	0 93 7 0
		3	SS	47	
		4	SS	5*	
251.6 / 3.0	**Silty Sand**, trace Gravel, Clay, wet, grey, loose to compact	5	SS	9*	8 78 (14)
		6	SS	9*	0 67 27 6
		7	SS	17*	* Below 2.3m depth, sand was "blown back" inside the hollow stem augers after each auger advance. The sand was washed out of the augers prior to sampling and subsequent auger advance 'N' values are likely not representative due to blowing sands.
		8	SS	5*	
247.6 / 7.0	**Sand**, trace Silt, Clay, wet, grey, loose to compact	9	SS	6*	
		10	SS	12*	1 83 10 6
		11	SS	20*	
243.3 / 11.3	End of DCPT DCPT carried out about 2m west of borehole				
242.4 / 12.2	End of Borehole Water Level in Open Bore On Completion : 1.2m September 18, 2002: 0.3m above augers November 05, 2002: 0.2 m above ground				

GROUND WATER CONDITIONS

DEPTH (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

ELEVATION SCALE (m): 254, 253, 252, 251, 250, 249, 248, 247, 246, 245, 244, 243

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: O UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, X LAB VANE (20 40 60 80 100)

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

UNIT WEIGHT γ kN/m³

+³, X³: Numbers refer to Sensitivity O³% STRAIN AT FAILURE

RECORD OF BOREHOLE No HR3

amec

W.P. 192-00-00 LOCATION 4863514.9N 299615.6E ORIGINATED BY IH

DIST HWY 400 BOREHOLE TYPE Hollow Stem Augering COMPILED BY IH

DATUM Geodetic DATE 17 September 2002 - 18 September 2002 CHECKED BY AD

PROJECT HWY 400 Widening, Vaughan, Ontario JOB NO. TT22852

ELEV / DEPTH (m)	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL	REMARKS & GRAIN SIZE DISTRIBUTION (%)
254.7														
0.0 / 254.0	**Sand**, with Gravel, some Organics, Rootlets damp, brown to grey, very loose		1	SS	3									
0.7 / 253.3	**Sand**, with Gravel moist, grey, loose		2	SS	8	▽	1	254						
1.4	**Sand**, trace Silt wet, grey, loose to dense		3	SS	17		2	253		0	91	9	0	
			4	SS	50		3	252						
			5	SS	6*									* Below 3.0m depth, sand was "blown back" inside the hollow stem augers after each auger advance. The sand was washed out of the augers prior to sampling and subsequent auger advance. 'N' values are likely not representative due to blowing sands.
250.3			6	SS	7*		4	251						
4.4	**Silty Sand**, trace Clay wet, grey, loose to compact		7	SS	5*		5	250						
			8	SS	20*		6	249		0	70	24	6	
			9	SS	13*		7	248						
			10	SS	19*		8	247						
	---------- dense		11	SS	31*		9	246		0	77	15	8	
243.1							10	245						
11.6 / 242.5	**CLAYEY SILT**, with Sand, trace gravel (TILL) moist, grey, hard						11	244						
12.2 / 242.0	**End of DCPT** DCPT carried out about 2m west of borehole		12	SS	60		12	243						
12.7	**End of Borehole**							242						

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

Water Level in Open Bore
On Completion : 0.9 m

+³, ×³: Numbers refer to Sensitivity ○³% STRAIN AT FAILURE

amec

APPENDIX 'A'

Borehole Logs extracted from report
prepared by Golder Associates Limited dated May 2001
GEOCRES File No. 30M13-51

RECORD OF BOREHOLE No 90

1 OF 2 METRIC

PROJECT 001-1122F
W.P. 222-97-00
DIST Central HWY 400
DATUM Geodetic

LOCATION N 4863549 E 299699
BOREHOLE TYPE 108mm I D Hollow Stem Augers
DATE October 16 & 17 2000

ORIGINATED BY AZ
COMPILED BY LCC
CHECKED BY ASP

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
255.0	GROUND SURFACE							
0.0 / 254.7	Topsoil (silty clay with organics)							
254.4	Silty Clay, trace organics Brown							
0.5	Silty Sand, trace gravel, trace clay, trace organics Compact to dense Brown to grey Wet below 1.5m depth 20mm layer of organics at about 1.8m depth	1	SS	47				
		2	SS	12				
252.8								
2.2	Sand, trace to some silt Compact to dense Brown becoming grey at 4.5m depth Wet	3	SS	13				
	SPT "N" values are considered to be impacted by blowing sands (See Note 1)	4	SS	3				
		5	SS	7	0	93	7	
		6	SS	6				
		7	SS	15	0	94	7	
	Layer of grey sandy silt, trace clay encountered at 7.5m depth	8	SS	12				
		9	SS	19				
		10	SS	20				
		11	SS	18				
242.5 / 12.5	Probably compact to dense sand							

STRAT PLOT

GROUND WATER CONDITIONS

ELEVATION SCALE: 254, 253, 252, 251, 250, 249, 248, 247, 246, 245, 244, 243, 242, 241

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa
O UNCONFINED + FIELD VANE
● QUICK TRIAXIAL X REMOULDED
20 40 60 80 100

PLASTIC LIMIT w_p — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%) 10 20 30

UNIT WEIGHT γ kN/m³

+³ ×³ Numbers refer to Sensitivity 20 40 60 80 100 STRAIN AT FAILURE

Continued Next Page

RECORD OF BOREHOLE No 90

2 OF 2 METRIC

PROJECT 001-1122F
W.P. 222-97-00
DIST Central HWY 400
DATUM Geodetic

LOCATION N 4863549 E 299699
BOREHOLE TYPE 108mm I.D. Hollow Stem Augers
DATE October 16 & 17 2000

ORIGINATED BY AZ
COMPILED BY LCC
CHECKED BY ASP

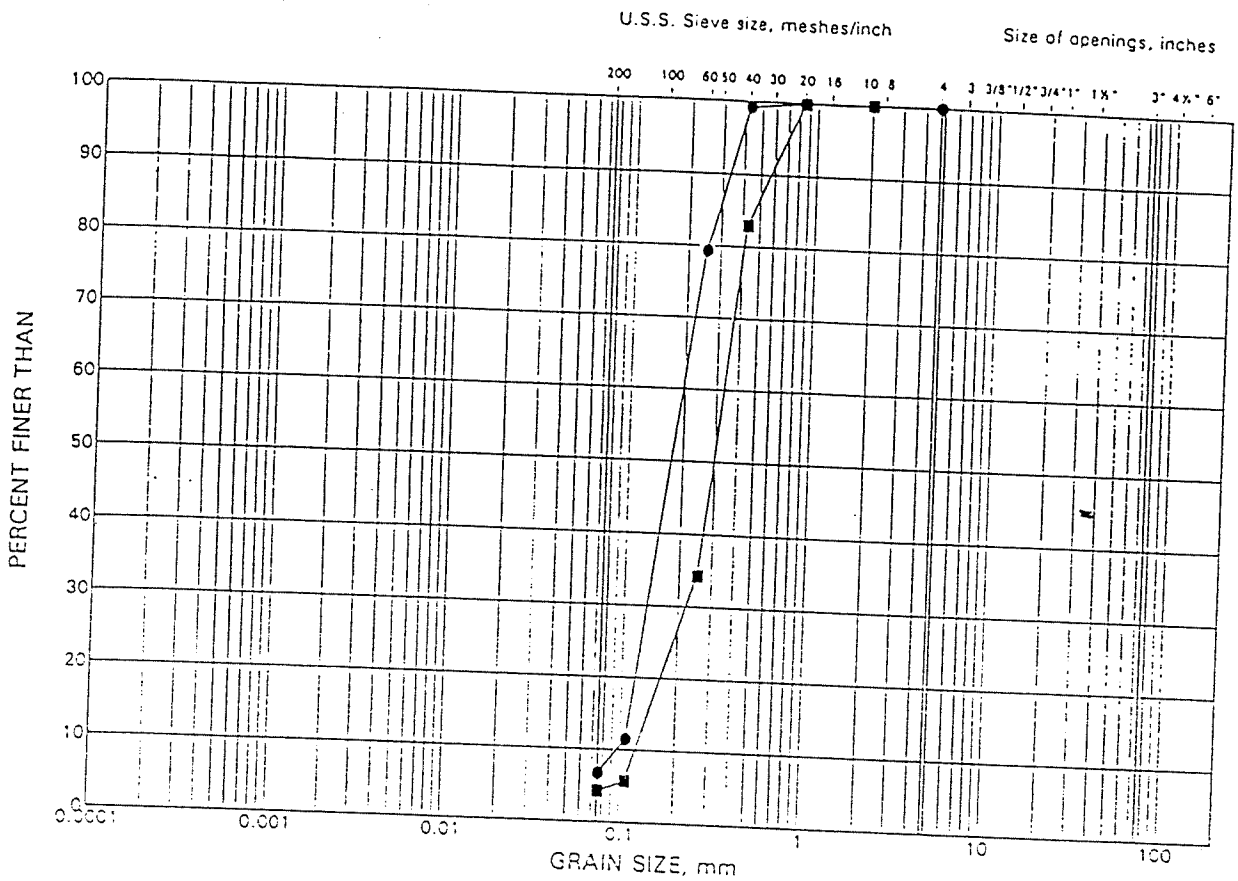
ELEV / DEPTH	DESCRIPTION — CONTINUED FROM PREVIOUS PAGE —	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_p / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Probably compact to dense sand						239				
238.2 / 16.8	END OF BOREHOLE										

Notes:
1. Below about 2.5m depth, between 1.5m and 3.5m of sand was "blown back" inside the hollow stem augers after each auger advance. This material was washed out of the augers prior to sampling and subsequent auger advance.
2. Water level in open borehole at 1.5m depth (Elev.253.5m) during drilling and at 1.1m depth (Elev.253.9m) on completion of drilling.
3. Water level in piezometer at 0.2m depth (Elev.254.8m) on January 18, 2001.

$+^{3}$ $\times^{3}$ Numbers refer to Sensitivity $O^{3\%}$ STRAIN AT FAILURE

GRAIN SIZE DISTRIBUTION
Sand

FIGURE 1



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (m)
●	90	5	4.4
■	90	.7	6.7

Project 001-1122F

Golder Associates

APPENDIX 'B'

Site Photographs

Photo 1: Looking north at west end of Humber River Arch Culvert.

Photo 2: Looking north at east end of Humber River Arch Culvert.