

**ADDENDUM NO. 1<sup>2</sup>**

**FOUNDATION  
INVESTIGATION  
REPORT**

**CONTRACT NO. 2001- 3011**

*NOTE : This F.I.R. shall be read in conjunction with the original F.I.R distributed to plan takers . This report is considered to precede the F.I. Addendum Report \**

*( \* See page 103 of the original F.I.R. )*

**FOUNDATION INVESTIGATION AND DESIGN REPORT  
PROPOSED E-S RAMP STRUCTURE  
STRUCTURE 33-393  
W.P. 363-94-00, AGREEMENT NO. 9730-7411-3178  
HWY8/CONESTOGA PARKWAY INTERCHANGE AND  
HWY 8 FROM CONESTOGA PARKWAY TO FERGUS AVENUE**

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## 1. INTRODUCTION

This report presents the results of a foundation investigation carried out by AGRA Earth & Environmental Limited (AGRA) on behalf of Morrison Hershfield Limited at the site of the proposed E-S Ramp Structure (Structure 33-393). The structure will carry 2 lanes of traffic from the westbound traffic lanes on Conestoga Parkway (KW Expressway) onto the southbound lanes of Highway 8.

The purpose of the investigation was to obtain information about the subsurface conditions at the site by means of boreholes and, based on this information, to provide geotechnical recommendations for the foundation elements of:

- the E-S Ramp retaining wall/embankment adjacent to Montgomery Creek (east end of the site),
- the new 7 span overpass bridge structure over the KW Expressway, and
- the E-S Ramp retaining wall/embankment in the Highway 8 median (south end of the site).

The E-S Ramp is a "third level", 7 span, and approximately 390 m long (Station 10+338 to 10+728) bridge structure. The structure will be 13.5 m wide and approximately 13 m above the adjacent ground surface at the proposed east abutment adjacent to Montgomery Creek. The proposed structure will be constructed of post-tensioned concrete, double cell box girder.

The two-lane exit ramp from the westbound KW Expressway will be approximately 340 m long (from Station 10+000 to 10+338). The roadway is elevated from the westbound lanes of the KW Expressway along the south side of Montgomery Creek. As the exit ramp approaches the east abutment of the overpass bridge structure, the height reaches 13 m, necessitating construction of retaining wall on both sides to support the elevated roadway. The total length of the retaining wall is approximately 325 m along Montgomery Creek. The portion of the retaining wall along the KW Expressway side is shorter, with the length yet to be finalized.

At the south end of the E-S Ramp structure, the approach embankment will be approximately 6 m high. Due to the limited space available in the Highway 8 median, retaining walls on both sides will be required. The retaining wall system will be approximately 200 m long each side.

A new storm water sewer, ranges in depth from 3 to 6 m, will be constructed along the new Highway 8 median to replace the existing storm system. The new storm sewer will be typically 1.5 m in diameter and will be located immediately adjacent to the east side of the retaining wall.

The work presented herein was undertaken under MTO W.P. 363-94-00, Agreement No. 9730-7411-3178, and authorized by Morrison Hershfield Limited, in a letter dated November 2, 1998.

Previous investigation work at this site for the existing KW Expressway overpass structures was undertaken by E.M. Peto and Associates in 1964 and Terraprobe Limited in 1995. This information was reviewed to supplement the present investigation.

## **2. SITE DESCRIPTION**

### **2.1 Site Location**

The site is located in the City of Kitchener at the intersection of Highway 8 and KW Expressway. The existing overpass structures over King Street and Weber Street were constructed in 1966-1967. Widening of the KW Expressway involving the widening of the King Street and Weber Street bridges is presently being carried out by Dufferin Construction under MTO Contract 98-05.

Based on available drawings, the two existing bridge structures are supported on driven pile foundations.

The proposed "third level" overpass structure will span over the KW Expressway. The east approach abutment will be located immediately south of Montgomery Creek within the existing KW Expressway embankment. The invert of Montgomery Creek is near Elevation 314 m whereas the grade at KW Expressway is between Elevations 320 and 325 m. At the Highway 8 median, the grade is between Elevations 322 and 324 m.

### **2.2 Physiography and Topography**

The site is located within the Physiographic Region known as the Waterloo Sandhills. The area is characterized by a flat topography, heavy textured soil and poor drainage (Chapman and Putnam, 1984). The area also has a preponderance of fine sand, particularly on the surface. The hilly region is an extensive area of alluvial terraces of the Grand River spillway system which, although more nearly horizontal, contains similar but more uniform sandy and gravelly materials. Several till sheets underlie the area and are, in order from oldest to youngest, the Catfish Creek Till, Maryhill Till, and Port Stanley Till.

## **3. INVESTIGATION PROCEDURES**

### **3.1 Field Investigation**

Between December 14, 1998 and February 7, 1999, a CME 75 drill rig was used on site for drilling and Standard Penetration Testing (SPT, following the procedures of ASTM D 1586). The drilling involved twenty-eight (28) boreholes along Highway 8, at the KW Expressway and along Montgomery Creek. It is noted that a borehole could not be drilled in the centerline of KW Expressway (proposed Pier 3 of the bridge structure) due to traffic restriction.

Subsequently, nine (9) shallow boreholes (numbered 98-29 to 98-37) were drilled and sampled manually to obtain soil data at the edge of Montgomery Creek (toe of existing embankment).

The locations of the boreholes are shown on Drawings A, B, C and D.

The boreholes were numbered 98-01 through 98-37. The stations and depths of the boreholes are as follows:

Borehole No.	Station No.	Depth of Borehole (m)
98-01	10 + 998 9.0 LT	6.4
98-02	10 + 958 11.5 LT	6.6
98-03	10 + 933 11.0 LT	7.3
98-04	10 + 909 12.0 LT	8.0
98-05	10 + 877 Centerline	8.1
98-06	10 + 850 0.5 RT	8.8
98-07	10 + 825 Centerline	9.6
98-08	10 + 800 Centerline	9.6
98-09	10 + 766 Centerline	11.2
98-10	10 + 733 1.0 RT	30.6
98-11	10 + 689 6.0 RT	29.0
98-12	10 + 619 1.0 RT	26.1
98-13	10 + 560 3.0 RT	26.0
98-14	10 + 457 8.5 LT	27.0
98-15	10 + 370 Centerline	18.4
98-16	10 + 338 Centerline	18.4
98-17	10 + 248 2.0 RT	19.8
98-18	10 + 335 2.0 RT	11.9
98-19	10 + 315 2.0 RT	15.7
98-20	10 + 292 0.5 LT	14.2
98-21	10 + 272 2.5 LT	13.3
98-22	10 + 221 6.0 RT	12.7
98-23	10 + 198 7.5 RT	11.7
98-24	10 + 175 8.0 RT	11.0
98-25	10 + 137 7.0 RT	9.6
98-26	10 + 110 3.0 RT	8.1
98-27	10 + 079 1.0 LT	8.0
98-28	10 + 060 1.0 RT	5.8
98-29	10 + 356 18.5 RT	1.7
98-30	10 + 336 18.0 RT	2.3
98-31	10 + 316 18.0 RT	1.7
98-32	10 + 290 11.0 RT	1.8
98-33	10 + 253 19.0 RT	1.2
98-34	10 + 220 19.0 RT	1.7
98-35	10 + 185 22.0 RT	1.1
98-36	10 + 130 18.0 RT	1.2
98-37	10 + 082 14.0 RT	1.1

The boreholes were drilled using hollow stem augers. Water and/or drilling mud were used to counter-balance the hydrostatic pressure within the hollow stem augers to prevent "blow back" of sands and silts during the borehole advancement and sampling operations.

Soil samples were retrieved at selected intervals of depths throughout the boreholes in conjunction with Standard Penetration Tests (SPT). Samples were generally taken at intervals of 0.75 m in the upper 6 m and thereafter at intervals of 1.5 m to the maximum depth of exploration.

Seepage and water levels were noted in each borehole during and at the completion of drilling and sampling. Standpipe piezometers were installed in Boreholes 98-11, 98-13, 98-14 and 98-17 to 98-28 for future monitoring of the groundwater levels. All boreholes were grouted with bentonite mix at completion of sampling.

The fieldwork was supervised by a member of our field engineering staff under the direction of the project engineer. Our field staff cleared the location of buried utilities and logged the boreholes. The soil samples obtained were placed in labeled containers and transported to our Waterloo Office for further examination and laboratory testing.

The stations, offsets and ground surface elevations at the as drilled borehole locations were surveyed by Morrison Hershfield Limited and provided to AGRA for the purpose of this report.

The results of the drilling, sampling, in-situ testing and water level measurements are summarized on the Record of Borehole sheets, enclosed in Appendix "A".

### **3.2 Laboratory Analysis**

Geotechnical laboratory testing consisted of natural moisture content determinations and visual classifications of all retrieved soil samples. In addition, grain size analyses, unit weight determinations, quick triaxial compression tests, Atterberg Limits and shear box tests were performed on selected samples.

The results of the laboratory testing are summarized on the Record of Borehole presented in Appendix "A" and in Figures 1 to 29 in Appendices "B", "C", "D" and "E".

## **4. SUBSURFACE CONDITIONS**

### **4.1 South Retaining Wall/Embankment (Boreholes 98-01 to 98-10)**

The E-S Ramp retaining wall/embankment, which is located at the south end of the site, was investigated by ten (10) boreholes and the geotechnical information is summarized on Drawing A.

In general, the subsurface deposits within the upper 6 to 10 m at the site consist of the existing pavement structure and fill which are underlain, in turn, by sand, an upper silt,

an upper silty clay and a lower silt layer. Underlying these near surface deposits, Borehole 98-10, which was drilled to a greater depth, contacted lower silty clay and an underlying silt till deposit.

The upper sand and silt deposits range in thickness from 0.8 m at Borehole 98-10 to over 6.4 m at Borehole 98-01, increasing in a southerly direction. An upper silty clay stratum in Boreholes 98-04 to 98-10 underlies these cohesionless deposits, with measured thickness of 1.7 to over 3.5 m.

A lower silt deposit in Boreholes 98-07 to 98-10 follows the upper silty clay, with measured thickness of 8.5 m locally in the deep Borehole 98-10. In Borehole 98-10, the silt is underlain by a lower silty clay stratum (contacted at Elevation 309.0 m), followed by the basal silt till at Elevation 294.7 m.

#### **4.1.1 Pavement, Fill, Topsoil**

All boreholes were drilled within the pavement of Highway 8. The pavement structure consists of 160 to 320 mm of asphalt underlain by granular fill to depths between 0.8 and 2.3 m.

The upper 200 to 500 mm thick granular fill is crushed granular road base material and is underlain by a sand and gravel fill, which is assessed to be the granular sub-base course. A grain size distribution of the granular fill material is shown in Figure 1 of Appendix "B".

The granular fill appears to have received compaction as indicated by "N" values in the range of 15 to 56 blows per 0.3 m. Locally at Borehole 98-04, a dark brown sandy silt to sandy silt fill was contacted to 2.3 m depth. This fill was in very loose condition as indicated by an "N" value of 2 blows per 0.3 m.

The fill materials were generally damp to moist with natural moisture contents measured between 3 and 15 %, with an average of 7%.

#### **4.1.2 Sand**

A major sand deposit was encountered in all the boreholes immediately underlying the granular fill materials. It extended to depths ranging between 2.6 and in excess of 6.6 m below the ground surface or to elevations ranging from 319.5 and 317.3 m. The measured thickness at the borehole locations ranged from 0.8 to in excess of 6 m.

It is a predominantly fine to medium sand with traces to some silt. However, there are silty and gravelly seams within the sand deposit. Nine (9) grain size analyses were performed on samples obtained from this granular deposit and the results are shown in Figures 2 and 3 of Appendix "B".

Standard penetration tests yielded "N" values from 10 to 100 blows per 0.3 m. The majority of the "N" values are however in the range of 30 to 50, indicative of a dense

condition. There are however occasional compact layers in the upper zones of the deposit, generally immediately below the fill soils.

The sand deposit was in damp to moist condition above the water table with moisture contents recorded in the range of 3 to 8 %, with an average of 5%. Below the water table, the material was wet to saturated with moisture contents measured between 10 and 20 %, with an average of 16 %.

#### 4.1.3 Upper Silt

Immediately underlying the sand deposit in Boreholes 98-01 and 98-03 is a layer of grey silt. This layer was encountered below Elevations 318 to 319 m and was not fully penetrated at the borehole termination depths.

One (1) grain size analysis was performed and the results are shown in Figure 4 of Appendix "B".

Standard penetration tests conducted in this basically fine grained granular (i.e. cohesionless) deposit yielded "N" values from 48 to 115 blows per 0.3 m indicating a dense to very dense condition. The silt was saturated with moisture contents measured between 11 and 20 %, with an average of 16 %.

#### 4.1.4 Upper Silty Clay

A stratum of grey silty clay was contacted underlying the upper sand in Boreholes 98-04 to 98-10 below Elevations 318 to 319 m, with measured thickness of 1.7 to over 3.5 m.

Seven (7) grain size analyses were performed and the results are shown in Figures 5 and 6 of Appendix "B".

The Liquid Limit and Plastic Limit were determined on seven (7) samples (see Figure 9 of Appendix "B") and the results are summarized below:

Liquid Limit	27.0 to 36.3 %, average at 32%
Plastic Limit	16.4 to 18.9 %, average at 17%
Plasticity Index	9.9 to 17.8 %, average at 15%

These results are characteristic of clayey soils of low plasticity. The measured natural moisture contents of samples from the deposit range from 12 to 21 % and as such are close to or below the measured Plastic Limits. Based on the results of natural moisture content and Atterberg Limits, the material can therefore be expected to be pre-consolidated.

Four (4) unconfined compression tests and four (4) unit weight tests were conducted and the results are as follows:

Borehole No.	Sample No.	Undrained Shear Strength (kPa)	Unit Weight (kN/m <sup>3</sup> )
98-05	5	585	22.5
98-06	6	550	22.4
98-07	7	573	23.2
98-10	4	313	22.0

Standard penetration tests yielded "N" values from 17 to in excess of 100 blows per 0.3 m. Based on the "N" values and other laboratory test results, the silty clay deposit has a very stiff to hard, but generally hard consistency.

#### 4.1.5 Lower Silt

A lower silt deposit was encountered underlying the upper silty clay below Elevations 315 to 319 m in Boreholes 98-07 to 98-10. Boreholes 98-07, 98-08 and 98-09 were terminated in this deposit while in Borehole 98-10 (i.e. the deep borehole) the deposit is underlain by a lower silty clay deposit at Elevation 309.0 m

Four (4) grain size analyses were performed and the results are shown in Figure 7 of Appendix "B".

Standard penetration tests conducted in this basically fine grained granular deposit gave "N" values from 14 to 120 blows per 0.3 m, indicating a compact to very dense condition. The measured natural moisture contents were between 12 and 22 % (with an average of 17%), indicative of moist to wet moisture condition.

#### 4.1.6 Lower Silty Clay

A stratum of grey silty clay was contacted below the lower silt and above the basal till layer in Borehole 98-10. This deposit was encountered at Elevation 309.0 m and extended to Elevation 294.7 m (i.e., 14.3 m thick).

One (1) grain size analysis was performed in this cohesive deposit and the results are shown in Figure 8 of Appendix "B".

Standard penetration tests yielded "N" values from 58 to 105 blows per 0.3 m indicating a hard consistency. The measured natural moisture contents are in the range of 6 to 15 %, indicative of damp to moist condition. The Liquid Limit and Plastic Limit were determined on one sample (Sample 11 of Borehole 10, see Figure 9 of Appendix "B") to be 30.5 and 17.2 %, respectively. Based on the results of natural moisture content and Atterberg Limits, the deposit is therefore considered to be pre-consolidated.

#### 4.1.7 Silt Till

A heterogeneous mixture of sandy silt, gravel and clay (glacial till) was contacted in Borehole 98-10 at Elevation 294.7 m. The basically granular silt till was penetrated 3.5 m where the borehole was terminated. "N" values in excess of 100 blows per 0.3 m were measured in this deposit and based on these test results, the silt till is classified as very dense.

The measured natural moisture contents were between 5 and 10 %, with an average of 7%.

Boulders and/or cobbles are frequently embedded within glacial till deposits. The very high blow counts and augering resistance within the silt till may infer the presence of cobbles and boulders.

#### 4.2 Seven Span Bridge Structure (Boreholes 98-10 to 98-18)

The seven (7) span bridge structure was investigated by eight (8) boreholes and the geotechnical information is summarized on Drawing B.

In general, the subsurface conditions at the site consist of the existing pavement and embankment fills which are underlain by an upper sand to silty sand interbedded with silty clay, a lower silt, a lower silty clay layer and an underlying silt till.

The upper sand to silty sand deposits range in thickness from 0.8 m at Borehole 98-10 to approximately 8 m at Borehole 98-16, increasing in thickness in a northeasterly direction. These cohesionless materials are interbedded with silty clay layers in Boreholes 98-10 and 98-16, with measured thickness between 1 and 3 m. The upper sand to silty sand is followed by a 4 to 8 m thick lower silt deposit in Boreholes 98-10, 98-11, 98-13 and 98-14.

Underlying the sand and silt deposits, a lower silty clay deposit was contacted all in boreholes, with measured thickness of 6.3 to 18.5 m, followed by the basal silt till which was contacted at elevations ranging from 302.5 m at Borehole 98-15 to 294.7 m at Borehole 98-10.

##### 4.2.1 Pavement, Fill, Topsoil

The boreholes were drilled either within the pavement or from the embankment of Highway 8 and KW Expressway. The pavement structure (Borehole 98-10) consists of 190 mm of asphalt underlain by granular fill to a depth of 1.8 m.

Boreholes 98-11, 98-15, 98-16 and 98-18 contacted typically 200 mm of topsoil at the ground surface.

Below the pavement and topsoil layers, fill was encountered which ranges in thickness from 1.2 to 6.4 m. The thickest (i.e. 6.4 m) was encountered in Borehole 98-14. This borehole was drilled within KW Expressway and consequently was located at a higher elevation compared with the other boreholes. In fact, the fill in this borehole extends to a similar elevation as the remaining boreholes.

The embankment fill materials consist of sand to silty sand. Two (2) typical grain size distributions are shown in Figure 10 of Appendix "C".

The granular fill was generally compact to very dense as indicated by "N" values in the range of 7 to 78 blows per 0.3 m. Local loose layers were contacted at Boreholes 98-11 and 98-18.

The fill materials were generally in damp to moist condition with natural moisture contents measured between 2 and 12 %, with an average of 8 %.

#### **4.2.2 Sand and Silty Sand**

The major native soil deposit underlying the fill at the site is a sand to silty sand deposit, which is predominantly fine to medium sand with traces to some silt. There are however some silty and gravelly seams within the sand deposit. The sand deposit extends to depths of 4.3 m (Borehole 98-10) to 12.5 m (Borehole 98-14) or to elevations ranging from 312.1 to 317.5 m.

Figure 11 of Appendix "C" shows a typical grain size distribution of the sand deposit. Figure 12 of Appendix "C" shows a typical grain size distribution of a silt layer, which is interbedded within the sand deposit.

Standard penetration tests yielded "N" values from 10 to 68 blows per 0.3 m. The majority of the "N" values are in the range of 20 to 50, indicative of a compact to dense condition, with occasional compact layers in the upper stratum of the deposit, generally immediately below the fill soils.

The sand deposit was in damp to moist condition above the water table with moisture contents recorded in the range of 3 to 8 %, with an average of 5%. Below the water table, the material was wet to saturated with moisture contents measured between 10 and 20 %, with an average of 16%.

#### **4.2.3 Silty Clay**

The upper cohesionless deposits are interbedded with silty clay layers in Boreholes 98-10 and 98-16 between Elevations 309 and 319 m, with measured thickness between 1 and 3 m.

Two (2) grain size analyses were performed and the results are shown in Figure 13 of Appendix "C".

The Liquid Limit and Plastic Limit were determined on two (2) samples (see Figure 17 of Appendix "C") and the results are summarized below:

Liquid Limit	29.9 and 38.0 %
Plastic Limit	16.4 and 21.3 %
Plasticity Index	13.5 and 16.7 %

One (1) unconfined compression test and one (1) unit weight test were conducted and the results are as follows:

Borehole No.	Sample No.	Undrained Shear Strength (kPa)	Unit Weight (kN/m <sup>3</sup> )
98-10	4	313	22.0

Standard penetration tests yielded "N" values from 19 to 49 blows per 0.3 m. Based on the "N" values and laboratory test results, the silty clay deposit is considered to have a very stiff to hard consistency.

The natural moisture contents were in the range of 15 to 22 % (with an average of 18%), indicative of moist condition. Therefore, this deposit is considered to be pre-consolidated.

#### 4.2.4 Lower Silt

A lower silt deposit was encountered below the sand to silty sand deposits in Boreholes 98-10, 98-11, 98-13 and 98-14 between Elevations 311 and 317 m. The thickness of this stratum ranges from 4.4 to 8.5 m and it is underlain by lower silty clay deposit at elevations ranging from 309 and 306 m.

Two (2) grain size analyses were performed and the results are shown in Figure 14 of Appendix "C".

Standard penetration tests yielded "N" values from 49 to 120 blows per 0.3 m, indicating dense to generally very dense condition. The measured natural moisture content values are between 6 and 22 %, indicative of moist to wet moisture condition.

#### 4.2.5 Lower Silty Clay

A major stratum of grey silty clay was contacted below the sand and silt strata and above the basal till layer across the site. This deposit was generally contacted between Elevations 310 and 306 m, except in Borehole 98-12 where it was encountered locally at

a considerably higher elevation of 314.7 m. The thickness of the deposit at the borehole locations range from 6.3 to 18.5 m.

Three (3) grain size analyses were performed and the results are shown in Figure 15 of Appendix "C".

The Liquid Limit and Plastic Limit were determined on four (4) samples (see Figure 17 of Appendix "C") and the results are summarized below:

Liquid Limit	30.5 to 38.3 %, average at 34.0%
Plastic Limit	16.5 to 19.3 %, average at 17.5%
Plasticity Index	13.3 to 19.0 %, average at 16.5%

These results are indicative of clayey soils of generally low plasticity. The measured natural moisture contents of samples retrieved from the deposit range from 6 to 15 % (with an average of 11 %) and are below the measured Plastic Limits, indicating that the material is pre-consolidated.

Six (6) unconfined compression tests and six (6) unit weight tests were conducted and the results are as follows:

Borehole No.	Sample No.	Undrained Shear Strength (kPa)	Unit Weight (kN/m <sup>3</sup> )
98-11	12	400	21.5
98-11	13	403	21.9
98-15	10	273	21.6
98-18	8	240	22.3
98-18	9	405	22.6
98-18	11	440	22.4

Standard penetration tests yielded "N" values from 35 to 105 blows per 0.3 m indicating a hard consistency.

A "shear box" test was conducted on Sample 6 of Borehole 98-12. The results are presented on Figures 28 and 29 of Appendix "E".

#### 4.2.6 Silt Till

A heterogeneous mixture of sandy silt, gravel and clay (glacial till) was contacted in all the deep boreholes at Elevation 302.0 m at Borehole 98-16 to Elevation 294.7 m at Borehole 98-10, or at depths ranging from 16 to 27 m below ground surface. Borehole 98-18 which was terminated at a higher elevation (i.e. at 11.4 m depth or Elevation 306.9 m) did not encounter this deposit.

The silt till was penetrated 2.0 to 4.5 m where the boreholes were terminated. Standard penetration tests yielded "N" values over 100 blows per 0.3 m. Natural moisture contents were between 5 and 10 %. Based on these test results, the silt till is classified as very dense.

Boulders and/or cobbles are frequently embedded within glacial till deposits. The presence of cobbles and boulders may be inferred from the very high blow counts and the augering resistance while drilling. In any event, due to their mode of formation, the presence of cobbles and boulders can always be expected in the glacial till deposits.

#### **4.3 East Retaining Wall/Embankment (Boreholes 98-16 to 98-37)**

The east retaining wall/embankment area was investigated by thirteen (13) deep boreholes and nine (9) shallow manually advanced boreholes. The geotechnical information is summarized on Drawings C and D.

The 13 deep boreholes (Boreholes 98-16 to 98-28) were located along the centerline of the future ramp/embankment, in about the mid-height of the existing KW Expressway embankment. The 9 shallow boreholes (Boreholes 98-29 to 98-37) were advanced at the toe of the existing embankment (on the south side of Montgomery Creek) to determine the thickness of topsoil and fill at the creek bed level.

In general, the subsurface deposits at the site consist of the existing embankment fill which is underlain by sand and gravel, fine sand, silty sand, sandy silt to silt deposits in the upper 5 to 10 m zone. An upper grey silty clay deposit was found within these cohesionless deposits with measured thickness between 1 and 7 m. The above soil strata are underlain by a lower silty clay layer (contacted near Elevations 308 and 309 m) and the underlying silt till (contacted near Elevation 302 m) in Boreholes 98-16 and 98-17 (i.e. deep boreholes).

The boreholes drilled along the south bank at the toe of Montgomery Creek penetrated typically 200 to 450 mm topsoil/peat over a discontinuous layer of granular fill, followed by native sand, sand and gravel and silty clay deposits.

##### **4.3.1 Topsoil and Fill**

All boreholes were drilled within the existing embankment of KW Expressway and as such contacted a veneer of topsoil. The surficial topsoil at the borehole locations ranges in thickness from 200 to 300 mm. Along the edge of Montgomery Creek, the topsoil/peat was 200 to 450 mm thick.

The topsoil is underlain by embankment fill, which consist predominantly sand to silty sand with traces of gravel. There are sand and gravel layers within the sand fill materials. The fill contains traces of topsoil, and there are occasional topsoil layers within the fill materials.

The fill ranges in thickness from 0.8 to 5.2 m, decreasing in thickness towards the east where the existing embankment crosses over Montgomery Creek. The fill extends at the borehole locations to elevations generally ranging from 317.9 to 315.8 m. Locally at Borehole 98-21, the 5.2 m thick fill (Elevation 315.6 m) is probably related to backfilling of the existing concrete pipe culvert that crosses KW Expressway.

Two typical grain size distributions are shown in Figure 18 of Appendix "D". Six unit weight determinations were conducted on the fill materials. The unit weight ranges from 19.3 to 20.7 kN/m<sup>3</sup>, with an average of 20.0 kN/m<sup>3</sup>.

Standard Penetration Tests provided "N" values in the range of 7 to 49 blows per 0.3 m, generally between 15 and 35 blows per 0.3 m. The fill can therefore be considered in a compact to dense condition, with local loose layers

The fill materials were generally in moist to saturated condition with natural moisture contents measured between 8 and 25 %, with an average of 14 %.

#### **4.3.2 Sand/Silt**

The native soil deposits immediately underlying the embankment fill consist of predominately fine sand to sandy silt, with minor inclusions of sand and gravel and silt layers. The native soil deposits generally exist between Elevations 316.5 and 317.5 m and range in thickness from 5 to 10 m. These soil strata were not fully penetrated in Boreholes 98-20 through 98-25.

Twelve (12) grain size analyses were performed and the results are shown in Figures 19, 20 and 21 of Appendix "D". Seven unit weight determinations were conducted on the sand/silt materials. The unit weight ranges from 18.6 to 22.7 kN/m<sup>3</sup>, with an average of 21.0 kN/m<sup>3</sup>.

Standard penetration tests yielded "N" values from 8 to 99 blows per 0.3 m. The majority of the "N" values are in the range of 30 to 60, indicative of a dense to very dense condition. There are, however, occasional loose to compact layers in the upper stratum of the deposit, generally immediately below the fill soils.

The sand/silt deposit was in damp to moist condition above the water table with natural moisture contents recorded in the range of 3 to 8 %, with an average of 5 %. Below the water table, the material was wet to saturated with moisture contents measured between 10 and 20 %, with an average of 16 %.

#### **4.3.3 Upper Silty Clay**

A major layer of grey silty clay was contacted within the upper sand/silt layers in Boreholes 98-16, 98-17, 98-19, 98-20 to 98-24, and 98-26 to 98-28 as well as the shallow boreholes at the toe of the embankment along Montgomery Creek.

This layer is about 1 to 5 m thick and was encountered approximately between Elevations 313 and 311 m. In Boreholes 98-19 and 98-21, the silty clay lies immediately beneath the embankment fill. Boreholes 98-26 to 98-28 were terminated within this upper silty clay deposit.

Ten (10) grain size analyses were performed and the results are shown in Figures 22 and 23 of Appendix "D".

The Liquid Limit and Plastic Limit were determined on ten (10) samples (see Figures 26 and 27 of Appendix "D") and the results are summarized below:

Liquid Limit	26.3 to 44.1 %, average at 35%
Plastic Limit	14.4 to 21.4 %, average at 17%
Plasticity Index	11.9 to 23.2 %, average at 18%

These results are indicative of clayey soils of generally low plasticity. The measured natural moisture contents obtained from the deposit range from 12 to 21 % (with an average of 17 %) which are very close to or below the measured Plastic Limits and this indicates that the material is likely to be pre-consolidated.

Six (6) unconfined compression tests and six (6) unit weight tests were conducted and the results are as follows:

Borehole No.	Sample No.	Undrained Shear Strength (kPa)	Unit Weight (kN/m <sup>3</sup> )
98-17	6	310	21.8
98-19	4	140	21.1
98-19	7	255	21.8
98-20	6	143	21.1
98-23	7	179	20.8
98-27	7	455	22.8

Standard penetration tests yielded "N" values from 19 to 88 blows per 0.3 m. Based on the "N" values, the laboratory test results together with a visual and tactile examination of the soil samples, the silty clay deposit is considered to have a very stiff to hard consistency.

#### 4.3.4 Lower Silty Clay

A major stratum of grey silty clay was contacted below the upper sand/silt and upper silty clay strata in the relatively deep boreholes (Boreholes 98-16, 98-17, 98-18 and 98-19) between Elevations 307 and 310 m. Boreholes 98-18 and 98-19 were terminated in this deposit at depth ranging between 12 and 16 m thick below the ground surface (Elevation 306.4 and 302.9 m) while in Boreholes 98-16 and 98-17, it extended to about 16 to 18 m or about Elevation 302 m.

One (1) grain size analysis was performed and the results are shown in Figure 24 of Appendix "D".

The Liquid Limit and Plastic Limit were determined on three (3) samples (see Figures 26 and 27 of Appendix "D") and the results are summarized below:

Liquid Limit	31.0 to 37.5 %, average at 34.5%
Plastic Limit	15.5 to 19.3 %, average at 17.5%
Plasticity Index	15.5 to 18.2 %, average at 17.0%

These index values indicate clayey soils of low plasticity and from the measured natural moisture contents of 5 to 16 % (with an average of 13 %). This material is at or below the measured Plastic Limits and, therefore, it can be inferred that the material is pre-consolidated.

Three (3) unconfined compression tests and three (3) unit weight tests were conducted and the results are as follows:

Borehole No.	Sample No.	Undrained Shear Strength (kPa)	Unit Weight (kN/m <sup>3</sup> )
98-18	8	240	22.3
98-18	9	405	22.6
98-18	11	440	22.4

Standard penetration tests yielded "N" values from 50 to 110 blows per 0.3 m indicating a hard consistency.

A "shear box" test was conducted on Sample 9 of Borehole 98-18. The results are presented in Figures 28 and 29 of Appendix "E".

#### 4.3.5 Silt Till

A heterogeneous mixture of sandy silt, gravel and clay (glacial till) was contacted in Boreholes 98-16 and 98-17 (i.e. two deepest boreholes), below about Elevation 302 m. The silt till was penetrated 2 m where the boreholes were terminated. Standard penetration tests in this basal till deposit yielded "N" values over 100 blows per 0.3 m. Based on these test results, the silt till is classified as very dense. The measured natural moisture contents were between 5 and 10 %.

Boulders and/or cobbles are frequently embedded within glacial till deposits. The very high blow counts and augering resistance within the silt till may infer the presence of cobbles and boulders.

#### 4.4 Groundwater Conditions

On completion of drilling, the following observations of groundwater levels were made:

Borehole No.	Depth of Borehole (m)	Station No.	Observation
98-01	6.4	10 + 998 9.0 LT	Free water at 4.7 m, Elevation 318.9 m upon completion
98-02	6.6	10 + 958 11.5 LT	Free water at 5.5 m, Elevation 318.3 m upon completion
98-03	7.3	10 + 933 11.0 LT	Free water at 5.5 m, Elevation 318.4 m upon completion
98-04	8.0	10 + 909 12.0 LT	Free water at 6.1 m, Elevation 317.7 m upon completion
98-05	8.1	10 + 877 Centerline	Free water at 7.5 m, Elevation 316.3 m upon completion
98-06	8.8	10 + 850 0.5 RT	No free water upon completion
98-07	9.6	10 + 825 Centerline	Free water at 8.7 m, Elevation 314.6 m upon completion
98-08	9.6	10 + 800 Centerline	Free water at 6.1 m, Elevation 316.9 m upon completion
98-09	11.2	10 + 766 Centerline	Free water at 6.7 m, Elevation 315.7 m upon completion
98-10	30.6	10 + 733 1.0 RT	Free water at 4.3 m, Elevation 317.5 m upon completion
98-11	29.0	10 + 689 6.0 RT	Water at 5.1 m, Elevation 315.5 m on 2/2/99, in standpipe
98-12	26.1	10 + 619 1.0 RT	No free water upon completion
98-13	26.0	10 + 560 3.0 RT	Water at 6.4 m, Elevation 314.1 m on 2/2/99, in standpipe
98-14	27.0	10 + 457 8.5 LT	Water at 9.1 m, Elevation 315.5 m on 2/2/99, in standpipe
98-15	18.4	10 + 370 Centerline	Free water at 3.5 m, Elevation 315.0 m upon completion
98-16	18.4	10 + 338 Centerline	Free water at 3.4 m, Elevation 315.0 m 24 hours after completion
98-17	19.8	10 + 248 2.0 RT	Water at 4.1 m, Elevation 316.3 m on 2/2/99, in standpipe
98-18	11.9	10 + 335 2.0 RT	Water at 3.7 m, Elevation 314.6 m on 2/2/99, in standpipe
98-19	15.7	10 + 315 2.0 RT	Water at 3.7 m, Elevation 314.9 m on 2/2/99, in standpipe
98-20	14.2	10 + 292 0.5 LT	Water at 3.9 m, Elevation 316.1 m on 2/2/99, in standpipe
98-21	13.3	10 + 272 2.5 LT	Water at 4.5 m, Elevation 316.3 m on 2/2/99, in standpipe

98-22	12.7	10 + 221 6.0 RT	Water at 2.9 m, Elevation 317.1 m on 2/2/99, in standpipe
98-23	11.7	10 + 198 7.5 RT	Water at 2.7 m, Elevation 317.0 m on 2/2/99, in standpipe
98-24	11.0	10 + 175 8.0 RT	Water at 2.1 m, Elevation 317.2 m on 2/2/99, in standpipe
98-25	9.6	10 + 137 7.0 RT	Water at 1.7 m, Elevation 317.2 m on 2/2/99, in standpipe
98-26	8.1	10 + 110 3.0 RT	Free water at 3.4 m, Elevation 315.2 m upon completion
98-27	8.0	10 + 079 1.0 LT	Water at 2.7 m, Elevation 315.7 m on 2/2/99, in standpipe
98-28	5.8	10 + 060 1.0 RT	Water at 2.8 m, Elevation 315.4 m on 2/2/99, in standpipe
98-29	1.7	10 + 356 18.5 RT	Free water at 0.3 m, Elevation 314.3 m upon completion
98-30	2.3	10 + 336 18.0 RT	Free water at 0.3 m, Elevation 314.2 m upon completion
98-31	1.7	10 + 316 18.0 RT	Free water at 0.3 m, Elevation 314.9 m upon completion
98-32	1.8	10 + 290 11.0 RT	Free water at 0.3 m, Elevation 314.9 m upon completion
98-33	1.2	10 + 253 19.0 RT	Free water at 0.3 m, Elevation 315.4 m upon completion
98-34	1.7	10 + 220 19.0 RT	Free water at 0.3 m, Elevation 315.2 m upon completion
98-35	1.1	10 + 185 22.0 RT	Free water at 0.3 m, Elevation 315.2 m upon completion
98-36	1.2	10 + 130 18.0 RT	Free water at 0.3 m, Elevation 315.4 m upon completion
98-37	1.1	10 + 082 14.0 RT	Free water at 0.3 m, Elevation 315.4 m upon completion

The recorded water levels were some 4.3 to 8.7 m below the Highway 8 grade (Boreholes 90-01 to 98-10), corresponding to Elevations 314.6 to 318.9 m. These water levels indicate that the groundwater flows in a northwest direction towards Montgomery Creek.

Along Montgomery Creek, the creek bed is near Elevation 314 m with the water level in the creek near Elevation 314.5 m. Boreholes along the existing embankment revealed water level at the time of investigation typically 3 to 4 m below grade, corresponding to Elevations 315 to 317 m. The observed water levels indicate the shallow groundwater table, and the level of ground saturation due to capillary action.

Fluctuations in the groundwater table can be expected seasonally and in response to major weather events.

**6. STATEMENT OF LIMITATION**

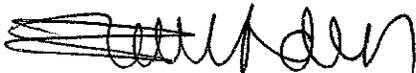
We recommend that once the details of the proposed structure are finalized, our recommendations should be reviewed for their specific applicability.

The Limitation of Report, as quoted in Appendix "G", is an integral part of this report.

Yours truly,  
AGRA Earth & Environmental Limited



Eric Y. Chung, M.Eng., P.Eng.  
Kitchener-Waterloo Branch Manager



Zuhtu S. Ozden, P.Eng.  
Designated MTO Contact



## EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

**JOINTING AND BEDDING:**

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

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

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

### MECHANICAL PROPERTIES OF SOIL

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

### STRESS AND STRAIN

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

### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	$kg/m^3$	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	$kN/m^3$	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\rho_w$	$kg/m^3$	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	$kN/m^3$	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
$\rho$	$kg/m^3$	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	$kN/m^3$	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	$kg/m^3$	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	q	$m^3/s$	RATE OF DISCHARGE
$\gamma_d$	$kN/m^3$	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
$\rho_{sat}$	$kg/m^3$	DENSITY OF SATURATED SOIL	$i_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{sat}$	$kN/m^3$	UNIT WEIGHT OF SATURATED SOIL	$i_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	$kg/m^3$	DENSITY OF SUBMERGED SOIL	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE	j	$kN/m^2$	SEEPAGE FORCE
$\gamma'$	$kN/m^3$	UNIT WEIGHT OF SUBMERGED SOIL						

# APPENDIX "A"

## Record of Borehole Sheets

RECORD OF BOREHOLE No 98-01

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4810976N,227744E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 29.12.98 - 29.12.98 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100
323.6	ASPHALT 300mm Crushed Granular 200 mm sand and gravel FILL																
322.9	Dense, brown Fine SAND, trace gravel damp		1	SS	35												
322.1	Compact to Dense, brown Fine SAND, trace silt damp		2	SS	23											0 90 10 0	
			3	SS	40												
320.6			4	SS	36												
318.9	grey saturated		5	SS	48												
318.3	Very Dense, grey SILT, trace to some fine sand wet																
317.2			6	SS	115												
6.4	END OF BOREHOLE @ 6.4 m NOTE: Water Level @ 4.7 m Upon Completion																

EXPRESS: 33-393.GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-02

1 OF 1

METRIC

W.P. 363-94-00 SITE 33-393 LOCATION E-S Ramp, 4810994N,227708E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 29.12.98 - 29.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
323.8 0.0	ASPHALT 320 mm Crushed Granular 200 mm																
323.3 0.5	Dense brown, sand and gravel FILL damp		1	SS	31												
322.3 1.5	Compact to Dense, brown Fine SAND, trace silt damp		2	SS	18												
			3	SS	38											0 87 13 0	
			4	SS	46												
319.1 4.7	Very Dense, brown medium-fine SAND wet		5	SS	59												
318.3 5.5	grey, trace gravel saturated																
317.3 6.6	END OF BOREHOLE @ 6.6 m NOTE: Water Level @ 5.5 m Upon Completion		6	SS	57												

EXPRESS 33-393.GPJ EXPRESS.GDT 24/08/99

**RECORD OF BOREHOLE No 98-03**

1 OF 1

**METRIC**

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4610999N, 227697E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 29.12.98 - 29.12.98 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100
323.9 0.0	ASPHALT 310 mm Crushed Granular 200 mm Compact, brown sand and gravel FILL damp		1	SS	24												
322.4 1.5	Compact to Very Dense, brown Fine SAND, trace silt damp		2	SS	26												
			3	SS	32											0 93 7 0	
				4	SS	42											
				5	SS	74											
319.0 4.9	Dense to Very Dense grey, SILT, trace fine sand wet to saturated		6	SS	110											0 16 82 2	
				7	SS	48											
316.6 7.3	END OF BOREHOLE @ 7.3 m NOTE: Water Level @ 5.5 m Upon Completion																

+ 3 3 Numbers refer to 3% STRAIN AT FAILURE  
Sensitivity

EXPRESS: 33-393 GPJ EXPRESS GDT: 24/06/99

RECORD OF BOREHOLE No 98-04

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811017N, 227665E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 29.12.98 - 29.12.98 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE
323.8	ASPHALT 170 mm Crushed Granular 200 mm Compact, dark brown sandy silt to silty sand FILL damp	[Cross-hatched pattern]	1	SS	15													
	Very loose		2	SS	2													
321.5	Dense to Very Dense, brown medium-fine SAND, trace silt and gravel damp	[Vertical lines pattern]	3	SS	32													
321			4	SS	53												7 83 10 0	
320																		
319			5	SS	100													
318																		
317.7	Very Dense, grey Silty Fine SAND saturated	[Vertical lines pattern]	6	SS	80													
317																		
316.8	Hard, grey Silty CLAY moist	[Diagonal lines pattern]																
7.0			7	SS	100												0 3 60 37	
315.8	END OF BOREHOLE @ 8.0 m NOTE: Water Level @ 6.1 m Upon Completion																	
8.0																		

EXPRESS, 33-393.GPJ EXPRESS.GDT 24/09/99

+ 3 . 3. Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

**RECORD OF BOREHOLE No 98-05**

1 OF 1

**METRIC**

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811017N, 227632E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 20.01.99 - 20.01.99 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	SHEAR STRENGTH kPa
323.8	ASPHALT 160 mm Crushed Granular 350 mm Compact, brown sand and gravel FILL			AUGER												GR SA SI CL		
322.9	Compact, brown medium-fine SAND damp		1	SS	25													
322.9			2	SS	19													
321			3	SS	24													
320																		
319.0	Very Dense, some gravel damp		4	SS	51											12 77 11 0		
318.4			5	SS	32													
315.7	Hard, grey Silty CLAY, occasional wet sand seams moist		6	SS	38											0 5 55 40 585 kPa		
316																		
8.1	END OF BOREHOLE @ 8.1 m NOTE: Water Level @ 7.5 m Upon Completion																	

EXPRESS: 33-393.GPJ EXPRESS.GDT 24/08/99

+ 3 3 Numbers refer to Sensitivity 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 98-06

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811029N, 227605E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 20.01.99 - 20.01.99 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
323.5														
0.0	ASPHALT 250 mm Crushed Granular 500 mm													
322.8														
0.8	Compact, brown medium fine SAND		1	SS	10									
			2	SS	15									
			3	SS	24									
320.4														
3.1	Dense													
319.6														
4.0	trace to some gravel damp		4	SS	36									13 78 9 0
318.2														
5.3	Hard, grey Silty CLAY moist		5	SS	60									0 28 44 28
			6	SS	42							22.4		0 5 55 40 550 kPa
			7	SS	34									
314.7														
8.8	END OF BOREHOLE @ 8.8 m NOTE: No Free Water @ Completion													

EXPRESS: 33-393.GPJ EXPRESS.GDT: 24/08/99

RECORD OF BOREHOLE No 98-07

1 OF 1

METRIC

W.P. 363-94-00 SITE 33-393 LOCATION E-S Ramp, 4811039N, 227583E ORIGINATED BY SY  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 21.01.99 - 21.01.99 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	w <sub>p</sub>	w	w <sub>L</sub>			GR
323.3	ASPHALT 175 mm sand and gravel FILL 400 mm Compact, dark brown to black medium-fine sand FILL, trace gravel moist																
0.0		1	SS	27													
321.8	Dense, brown medium SAND, trace gravel damp																
1.5		2	SS	27													
		3	SS	43													
		4	SS	49													
319.8		5	SS	47													
3.5	wet to saturated																
318.9	Hard, grey Silty CLAY moist																
4.4		6	SS	65													
		7	SS	65													
315.5	Compact, grey SILT, trace sand wet																
7.8		8	SS	26													
314.6	saturated																
8.7		9	SS	22													
313.7	END OF BOREHOLE @ 9.6 m NOTE: Water Level @ 8.7 m Upon Completion																
9.6																	

EXPRESS: 33-363 GPJ EXPRESS.GDT 24/08/99

**RECORD OF BOREHOLE No 98-08**

1 OF 1

**METRIC**

W.P. 383-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811049N, 227560E ORIGINATED BY SY  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 20.01.99 - 20.01.99 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
323.0	ASPHALT 215 mm sand and gravel FILL 385mm Dense to Very Dense, dark brown to black cobbly sand and gravel FILL damp		1	SS	56										
321.2			2	SS	46										
1.8	Dense, brown medium-fine SAND damp		3	SS	32										
320			4	SS	30										0 85 15 0
318.7			6	SS	50										0 3 60 37
4.3	Hard, grey Silty CLAY, occasional silt partings moist		7	SS	24										
316.6			8	SS	14										0 55 45 0
6.4	Compact, grey SILT, trace sand saturated		9	SS	18										
313.4															
9.6	END OF BOREHOLE @ 9.6 m NOTE: Water Level @ 8.7 m Upon Completion														

EXPRESS\_33-393.GPJ EXPRESS.GDT 24/08/99

+ 3, 3. Numbers refer to Sensitivity ( ) 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 98-09

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811063N, 227530E ORIGINATED BY SY  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 20.01.99 - 20.01.99 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	SHEAR STRENGTH kPa			WATER CONTENT (%)	
											○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	10	20	30	GR	SA	SI	CL	
322.4	ASPHALT 175 mm sand and gravel FILL Compact to Dense, dark brown to black cobbly silty sand and gravel FILL damp																					
320.7	Compact to Dense, brown medium-fine SAND damp		1	SS	37																	
319.5	Very Stiff, brown Silty CLAY		2	SS	28																	
319.1	grey moist		3	SS	34																	
317.8	Compact to Very Dense, grey SILT, trace sand moist		4	SS	17																	0 3 62 35
315.7	saturated		5	SS	17																	
311.2	END OF BOREHOLE @ 11.2 m NOTE: Water Level @ 6.7 m Upon Completion		6	SS	22																	
			7	SS	50																	0 37 60 3
			8	SS	55																	
			9	SS	57																	
			10	SS	55																	

EXPRESS 33-393 GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-10

1 OF 2

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811077N,227500E ORIGINATED BY SY/SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 21.01.99 - 05.02.99 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
						20	40	60	80	100	10	20	30	GR SA SI CL
321.8	190 mm ASPHALT sand and gravel FILL. 610mm Compact, dark brown to black cobbly sand and gravel FILL		1	SS	29									
320.0	Compact, brown Medium SAND damp		2	SS	19									
319.2	Hard, grey Silty Clay moist		3	SS	22									
317.5	Silt Seam		4	SS	49								22.0	0 11 49 40 313 kPa
317.5	Dense to Very Dense, grey SILT, trace sand wet to saturated		5	SS	58									0 32 60 8
312.6	occasional saturated sand seams		6	SS	79									
309.0	Hard, grey Silty Clay moist		9	SS	85									
309.0	Hard, grey Silty Clay moist		11	SS	78									0 3 57 40
306			12	SS	105									

EXPRESS: 33-393.GPJ EXPRESS.GDT 24/08/99

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

**RECORD OF BOREHOLE No 98-10**

2 OF 2

**METRIC**

W.P. 363-94-00 SITE 33-393 LOCATION E-S Ramp, 4811077N, 227500E ORIGINATED BY SY/SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 21.01.99 - 05.02.99 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100
	Hard, grey Silty CLAY moist		13	SS	64												
305																	
304																	
303					14	SS	58										
302																	
301																	
300			15	SS	77												
299																	
298																	
297			16	SS	75												
296																	
295																	
294.7	Very Dense, grey Sandy SILT TILL damp		17	SS	116												
27.1																	
294																	
293																	
292																	
291.2	END OF BOREHOLE @ 30.6 m NOTE: inferred water level @ 4.3 m No Free Water @ Completion		18	SS	125												
30.6																	

EXPRESS\_33-393.GPJ EXPRESS.GDT 24/08/99

**RECORD OF BOREHOLE No 98-11**

1 OF 2

**METRIC**

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811094N, 227458E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 21.01.99 - 05.02.99 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60						80	100	10
320.6 0.0	TOPSOIL 200mm sand and gravel FILL damp	1	AUGER											38	44	18	0
		2	SS	8													
319.1 1.5	Compact to Dense, brown Medium Fine SAND, trace to some gravel damp	3	SS	10													
		4	SS	31													
		5	SS	26													
		6	SS	38													
315.5 5.1	saturated																
		7	SS	33													
		8	SS	100													
313.6 7.0	Very Dense, grey SILT, trace sand saturated																
		9	SS	100													
		10	SS	93													
309.0 11.6	Hard, grey Silty CLAY moist																
		11	SS	53													
		12	SS	50										21.5			400 kPa
		13	SS	82										21.9	0	0	48 52
																	403 kPa

EXPRESS: 33-393.GPJ EXPRESS.GDT 24/08/99

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+ 3 3. Numbers refer to  
Sensitivity

3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 98-11

2 OF 2

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811094N,227458E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 21.01.99 - 05.02.99 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)			
						20	40	60	80	100		10	20	30	GR	SA	SI	CL		
	Hard, grey Silty CLAY		14	SS	59															
304																				
303																				
302					15	SS	70													
301																				
300					16	SS	56													
299																				
298					17	SS	62													
297																				
296	Very Dense, grey Sandy SILT TILL damp																			
296																				
295																				
294					19	SS	135													
293																				
292																				
291.6	END OF BOREHOLE @ 29.0 m NOTE: Water Level @ 5.1 m on 02/02/99		20	SS	100/75mm															
29.0																				

EXPRESS 33-393.GPJ EXPRESS.GDT 24/08/99



RECORD OF BOREHOLE No 98-12

2 OF 2

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811142N, 227407E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 06.02.99 - 06.02.99 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)	
						20	40	60	80	100								
303	Hard, grey Silty CLAY																	
302																		
301			11	SS	57													
300																		
299																		
298			12	SS	53													
297																		
296.2	Very Dense grey, Sandy SILT TILL damp		13	SS100/1250mm														
22.9																		
295			14	SS100/1500mm													8 42 48 2	
294																		
293.0	END OF BOREHOLE @ 26.1 m NOTE: No Free Water @ Completion		15	SS 100/50mm														
26.1																		

EXPRESS: 33-393.GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-13

1 OF 2

METRIC

W.P. 363-94-00 SITE 33-393 LOCATION E-S Ramp, 4811188N, 227370E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 07.02.99 - 07.02.99 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40
320.5 0.0	Dark brown silty sand FILL, some gravel, topsoil seam	[Hatched]												
319.7 0.8	Compact to Very Dense, brown gravelly sand FILL moist	[Hatched]	1	SS	55									
317			2	SS	24									
316.7 3.8	Dense, brown, Fine SAND, trace to some gravel wet to saturated	[Dotted]												
					3	SS	36							
					4	SS	42							
					5	SS	48							
311.3 9.2	Very Dense, grey SILT saturated	[Vertical Lines]												
					6	SS	52							
306.1 14.3	Hard, grey Silty CLAY moist	[Diagonal Lines]												
			7	SS	62									

EXPRESS: 33-393 GFJ EXPRESS.GDT 24/08/99

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+ 3 3. Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

**RECORD OF BOREHOLE No 98-13**

2 OF 2

**METRIC**

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811168N,227370E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 07.02.99 - 07.02.99 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	SHEAR STRENGTH kPa
											○ UNCONFINED	+ FIELD VANE						
											● QUICK TRIAXIAL	× LAB VANE						
											WATER CONTENT (%)							
											20	40	60	80	100	10	20	30
304	Hard, grey Silty CLAY																	
303																		
302.2 18.3	trace imbedded fine gravel		8	SS	80													
301																		
300																		
299.0 21.5	Very Dense, grey Sandy SILT TILL damp																	
298																		
297																		
296																		
295																		
294.5 26.0	END OF BOREHOLE @ 26.0 m NOTE: Water Level @ 6.4 m on 02/02/99																	

EXPRESS: 33-393.GPJ EXPRESS.GDT 24/08/99





**RECORD OF BOREHOLE No 98-15**

1 OF 2

**METRIC**

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811372N 227333E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 31.12.98 - 31.12.98 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	$w_p$	$w$			$w_L$
318.5	TOPSOIL 200 mm Dense, dark grey silty sand FILL moist		1	SS	47												
316.8																	
1.7			Dense, brown fine sand FILL wet	2	SS	45											
316.2	Dense, mottled brown SAND, some gravel saturated		3	SS	41												
2.3																	
315.6	Compact, grey SILT and Fine SAND saturated		4	SS	19											0 48 52 0	
313.9																	
4.8			Dense to Very Dense, grey medium-fine SAND saturated	5	SS	30											
			6	SS	56												
309.5	Hard, grey Silty CLAY		7	SS	51												
9.0																	0 2 58 40
307.8	trace imbedded coarse sand moist		8	SS	42												
10.7																	
			9	SS	54												
			10	SS	35										21.6	273 kPa	
			11	SS	75												
			12	SS	50												
302.5																	

EXPRESS: 33-393.GPJ EXPRESS.GDT: 24/08/99

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3 3 Numbers refer to Sensitivity  $\circ$  3% STRAIN AT FAILURE

**RECORD OF BOREHOLE No 98-15**

2 OF 2

**METRIC**

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811372N,227333E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 31.12.98 - 31.12.98 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100
16.0	Very Dense, grey Sandy SILT TILL clay		13	SS120/150mm		302											
							301										
300.1			14	SS115/125mm													
18.4	END OF BOREHOLE @ 18.4 m NOTE: Water Level @ 3.5 m Upon Completion																

EXPRESS. 33-393.GPJ EXPRESS.GDT. 24/08/99

**RECORD OF BOREHOLE No 98-16**

1 OF 2

**METRIC**

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811404N, 227339E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 30.12.98 - 30.12.98 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
318.4 0.0	TOPSOIL 200 mm dark grey to black sandy silt and silty sand FILL wet													
317.2 1.2	Dense, brown SAND wet		1	AS										
316.3 2.1	Very Stiff, grey Silty CLAY moist		2	SS	31									
			3	SS	28								0 8 57 35	
			4	SS	19									
313.3 5.0	Dense to Very Dense, grey Fine SAND saturated		5	SS	28									
			6	SS	30									
310.6 7.8	Hard, grey Silty CLAY moist		7	SS	105									
309.3 9.1	Very Dense, grey SAND saturated		8	SS	62									
308.3 10.1	Hard, grey Silty CLAY		9	SS	75									
306.2 12.2	trace to some imbedded coarse sand moist		10	SS	95									
			11	SS	81									
			12	SS	78									

EXPRESS: 33-393.GPJ EXPRESS.GDT: 24/08/99

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+ 3 . 3. Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 98-16

2 OF 2

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811404N,227339E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stern Auger COMPILED BY SY  
 DATUM Geodetic DATE 30.12.98 - 30.12.98 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	WATER CONTENT (%)
302.0																		
16.4	Very Dense, grey Sandy SILT TILL		13	SS130/125mm														
300.0																		
18.4	END OF BOREHOLE @ 18.4 m NOTE: Water Level @ 3.4 m 24 hrs After Completion		14	SS100/100mm														

EXPRESS 33-393.GPJ EXPRESS.GDT 24/08/99

+ 3 3 Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 98-17

1 OF 2

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811498N,227365E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 15.12.98 - 16.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						SHEAR STRENGTH kPa			WATER CONTENT (%)	
											○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	10	20	30	GR	SA	SI	CL	
320.4 0.0	TOPSOIL 200 mm Compact to Dense, dark brown silty sand FILL, trace to some gravel, occasional cobbles, occasional topsoil layer moist	[Cross-hatched]	1	SS	23																	
			2	SS	39																	
317.8 2.6	Compact to Dense, grey Fine SAND wet to saturated	[Diagonal lines]	3	SS	15																	
			4	SS	28																	
316.6 3.8	some gravel	[Diagonal lines]	5	SS	38																	
315.8 4.6	Very Stiff to Hard, grey Silty CLAY moist	[Diagonal lines]	6	SS	23																	
			7	SS	57																	
311.3 9.1	Very Dense, grey Sandy SILT saturated	[Diagonal lines]	8	SS	36																	
			9	SS	55																	
309.7 10.7	Very Dense, grey Fine SAND, trace to some silt saturated	[Diagonal lines]	10	SS	78																	
			11	SS	87																	
307.9 12.5	Hard, grey Silty CLAY moist	[Diagonal lines]	12	SS	93																	
			13	SS	75																	

EXPRESS. 33-393 GPJ EXPRESS.GDT 24/08/99

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+ 3 / 3 Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 98-17

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METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811498N, 227365E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 15.12.98 - 16.12.98 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W <sub>p</sub>	W			W <sub>L</sub>	GR
302.4	Hard, grey Silty CLAY moist	[Hatched]	14	SS	110													
18.0	Very Dense grey Sandy SILT TILL damp	[Vertical Lines]	15	SS	150/50mm										13	45	42	0
300.6	END OF BOREHOLE @ 19.8 m NOTE: Water Level @ 4.1 m on 02/02/99	[Vertical Lines]	16	SS	150/50mm													

EXPRESS. 33-393 G.F.J. EXPRESS.GDT 24/08/99

+ 3 / 3 Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 98-18

1 OF 1

METRIC

W.P. 383-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811387N, 227334E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 05.01.99 - 05.01.99 CHECKED BY EYC

SOIL PROFILE		STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)											
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	"N" VALUES			20	40						60	80	100	20	40	60	80	100	10	20	30
318.3 0.0	TOPSOIL 200 mm Compact, brown silty sand FILL moist to wet	[Cross-hatched]	1	SS	18	[Water level indicator]	318																		
316.8 1.5 316.3	loose		2	SS	7		317																		
316.3 1.8	Compact brown Fine SAND, occasional grey clay seams wet	[Diagonal lines]	3	SS	22		316																		
315.3 3.1	saturated, grey		4	SS	19		315																		
313.1 5.2	Dense grey Silty SAND saturated		5	SS	15		314																		
313.1 5.2	Dense grey Silty SAND saturated	[Diagonal lines]	6	SS	38		313																		
311.0 7.0			7	SS	30		312																		
310.0 8.0			8	SS	42		311																		
309.8 8.5	Hard, grey Silty CLAY, layers and pockets of silt	[Diagonal lines]	9	TW			310																		
308.0 10.0			10	SS	60		309																		
308.0 10.0			11	SS	82		308																		
306.4 11.4	moist silt		12	TW			307																		
306.4 11.9	END OF BOREHOLE @ 11.9 m NOTE: Water Level @ 3.7m on 02/02/99																								

EXPRESS: 33-393.GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-19

1 OF 2

METRIC

W.P. 383-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811426N, 227344E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 14.12.98 - 14.12.98 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
						20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	10 20 30	10 20 30	10 20 30	kN/m <sup>3</sup>	GR SA SI CL	
315.6 0.0	TOPSOIL 200 mm Compact, brown fine sand FILL moist to wet		1	SS	24									
			2	SS	18									
			3	SS	15									
315.8 2.8	Very Stiff to Hard, brown/grey Silty CLAY, occasional saturated sand and silt seams moist		4	SS	29							21.1	140 kPa	
			5	SS	46								0 10 60 30	
			6	SS	30									
			7	SS	40							21.8	255 kPa	
			8	SS	43							22.9		
311.0 7.6	Dense, grey Silty Fine SAND saturated		9	SS	0								Very loose due to hydrostatic disturbance	
			10	SS	46									
307.2 11.4	Hard, grey Silty CLAY moist		11	SS	50								0 2 58 40	
			12	SS	82									
			13	SS	79									
302.9 15.7	END OF BOREHOLE @ 15.7 m													

EXPRESS: 33-393.GPJ EXPRESS.GDT 24/08/99

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+ 3 3 Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

**RECORD OF BOREHOLE No 98-19**

2 OF 2

**METRIC**

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811426N, 227344E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 14.12.98 - 14.12.98 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	10
	NOTE: Water Level @ 3.7m on 02/02/99																	

EXPRESS 33-393.GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-20

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811448N, 227353E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 14.12.98 - 14.12.98 CHECKED BY EYC

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	"N" VALUES			20	40	60					
320.0	TOPSOIL, 200 mm Compact to Dense, dark brown silty sand, fine sand, sandy silt FILL moist to wet														
0.0			1	SS	23		319								
318.2			2	SS	31		318						20.7		
1.8	topsoil FILL seam medium-fine sand FILL														
317.4			3	SS	35		318								
2.8	Dense, grey fine sand FILL, very cobbly														
317.0			4	SS	26		317						18.6	0 62 33 5	
3.1	Compact to Dense, grey Silty Fine SAND, trace to some silt seams wet														
316.1							316						18.6		
3.9	saturated														
315.1			5	SS	31		315								
4.9	Dense, grey medium-fine SAND														
314.5							314								
5.5	cobbly/gravelly														
314.1			6	SS	25		314						21.1	0 0 50 50	143 kPa
5.9	Very Stiff, grey Silty CLAY moist														
313.3							313								
6.7	Very Dense, grey Sandy SILT saturated														
			7	SS	78		312								
			8	SS	84		311								
			9	SS	85		310								
			10	SS	85		309								
			11	SS	87		308								
							307								
							306								
305.8															
14.2	END OF BOREHOLE @ 14.2 m NOTE: Water Level @ 3.9m on 02/02/99														

EXPRESS: 33-393.GPJ EXPRESS.GDT 24/09/99

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

RECORD OF BOREHOLE No 98-21

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811466N, 227361E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 15.12.98 - 15.12.98 CHECKED BY EYC

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 $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20	40	60
320.8	TOPSOIL 200 mm mixed gravel and topsoil FILL																			
320.2	Compact, brown gravelly sand FILL																			
319.7	topsoil FILL @ 1.1 m moist		1	SS	16															
318.5	Compact to Dense, black stained sandy silt FILL, some gravel, wood fragments wet		2	AUGER	11															
317.0			3	SS	47															
316.2	Compact, grey sand FILL, some cobbles wet		4	SS	23															19.9
315.6			5	SS	27															
312.6	Dense, grey medium-coarse sand and gravel FILL saturated		6	SS	44															
312.6			7	SS	48															
312.6			8	SS	88															
309.4	Very Dense		9	SS	50															
307.5			10	SS	27															
307.5	END OF BOREHOLE @ 13.3 m NOTE: Water Level @ 4.5m on 02/02/99 Borehole Adjacent to Culvert		11	SS	87															
307.5			12	SS	88															

EXPRESS, 33-393 GPJ EXPRESS.GDT 24/09/99

+ 3 3. Numbers refer to Sensitivity  $\circ$  3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 98-22

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811517N, 227366E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 16.12.98 - 16.12.98 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)						
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL	
320.0	TOPSOIL 300 mm Compact, dark brown silt FILL, some sand and topsoil moist to wet																						
			1	SS	20																		
			2	SS	25																		
317.9	topsoil FILL @ 1.8 m																						
2.1	Compact, dark brown fine sand FILL wet to saturated		3	SS	26																		
316.8																							
316.2	Very Dense, SAND and GRAVEL saturated		4	SS	84																		
316.2																							
315.1	Compact, grey SAND, some silt saturated		5	SS	22																		
315.1																							
4.9	Hard, grey Silty CLAY moist		6	SS	29																		
			7	SS	44																		
			8	SS	32																		
311.8																							
8.2	Compact, grey Fine SAND saturated		9	SS	28																		
310.2																							
9.8	sandy silt layer																						
309.6																							
10.4	Very Dense, SAND, occasional silt seam saturated		10	SS	66																		
307.3																							
12.7	END OF BOREHOLE @ 12.7 m NOTE: Water Level @ 2.9m on 02/02/99		11	SS	93																		

EXPRESS: 33-393 GPJ EXPRESS.GDT 24/08/99

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



RECORD OF BOREHOLE No 98-24

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811563N, 227374E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 17.12.98 - 17.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
											○ UNCONFINED	+ FIELD VANE	WATER CONTENT (%)				
											● QUICK TRIAXIAL	× LAB VANE	10	20	30		
319.3 0.0	TOPSOIL 200 mm Compact, dark brown sandy silt FILL	[Cross-hatched]															
317.9 1.4	topsoil FILL @ 1.1m Compact to Dense, brown Fine SAND, some silt to silty wet to saturated	[Diagonal lines]	1	SS	14											0 75 25 0	
316.2 3.1	Compact grey Sandy SILT, trace clay moist	[Diagonal lines]	2	SS	36											0 40 50 10	
			3	SS	15												
			4	SS	16												
			5	SS	19												
			6	SS	23												
314.1 5.2	Compact, grey SAND, some gravel saturated	[Diagonal lines]															
313.0 6.3	Very Stiff, grey Silty CLAY moist	[Diagonal lines]	7	SS	28											0 4 56 40	
			8	SS	47												
311.4 7.9	Very Dense, grey Fine SAND, occasional silt layers saturated	[Diagonal lines]															
			9	SS	99												
308.3 11.0	END OF BOREHOLE @ 11.0 m NOTE: Water Level @ 2.1m on 02/02/99		10	SS	79												

EXPRESS 33-393 GPJ EXPRESS.GDT 24/08/99

+ 3 / 3. Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

**RECORD OF BOREHOLE No 98-26**

1 OF 1

**METRIC**

W.P. 363-94-00 SITE 33-393 LOCATION E-S Ramp, 4811625N, 227386E ORIGINATED BY SW  
 DIST 2 HWY 7 & 6 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 18.12.98 - 18.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60	80	100	10	20
318.6	0.0	TOPSOIL 200mm Dense, dark brown sandy silt and fine sand FILL, trace gravel moist																						
	317.4		1	SS	39																			
	1.2	Dense, brown cobbly sand and gravel FILL moist																						
	316.3		2	SS	49																			
	2.3	Compact grey Fine SAND, some gravel moist																						
	315.2		3	SS	15																			
	3.4	Compact grey Silty SAND, trace gravel saturated																						
	314.3		4	SS	15																			
	4.3	Compact to Dense, Fine SAND, trace silt saturated																						
	311.0		5	SS	13																			
	7.6	Dense, grey Silty CLAY, some silt seams. moist																						
	310.5		6	SS	41																			
	8.1	END OF BOREHOLE @ 8.1 m NOTE: Water level @ 3.4 m upon completion standpipe broken below ground level at second reading																						

EXPRESS: 33-393.GPJ EXPRESS.GDT: 24/08/99

RECORD OF BOREHOLE No 98-27

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811657N,227394E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 17.12.98 - 17.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
318.4 0.0	TOPSOIL 200 mm sand and gravel FILL moist	[Hatched]													
317.6 0.8	Loose to Compact rust brown, Silty SAND, some gravel moist	[Vertical Lines]	1	SS	25										
316.5			2	SS	8										
316.5 1.8	Compact grey Fine SAND to medium-fine SAND, trace silt, occasional silt seams wet to saturated	[Vertical Lines]	3	SS	16										
314.6			4	SS	13										
314.6 3.8			5	SS	48										
314.0 4.4	Compact, grey Fine SAND, trace silt saturated Dense	[Vertical Lines]													
312.6 5.8	Hard, grey Silty CLAY moist	[Hatched]	6	SS	53										
310.4 8.0			7	SS	45										
310.4 8.0	END OF BOREHOLE @ 8.0 m NOTE: Water Level @ 2.7m on 02/02/99														

EXPRESS: 33-393.GPJ EXPRESS:GDT 24/08/99

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

**RECORD OF BOREHOLE No 98-28**

1 OF 1

**METRIC**

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811676N, 227394E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SY  
 DATUM Geodetic DATE 17.12.98 - 17.12.98 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	w <sub>p</sub>	w		
318.2 0.0	TOPSOIL 200 mm Compact, brown sand and gravel FILL moist															
317.1 1.1	Compact to Dense, brown to grey Sandy SILT moist		1	SS	20											
			2	SS	16											
315.6 2.6			3	SS	33											
315.2 3.1	Dense Fine SAND saturated															0 10 90 0
314.4 3.8	Dense grey Silt, trace sand saturated		4	SS	39											
	Very Dense		5	SS	84											
313.5 4.7	Hard, grey Silty CLAY, thin saturated sand seams moist		6	SS	52											0 40 60 0
312.4 5.8		END OF BOREHOLE @ 5.8 m NOTE: Water Level @ 2.9m on 02/02/99		7	SS	60										

EXPRESS 33-393.GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-29

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811387N, 227321E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hand Hammer COMPILED BY SY  
 DATUM Geodetic DATE 21.12.98 - 21.12.98 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
314.6 0.0	TOPSOIL 200 mm															
314.4 0.2	Loose, brown Sand, trace gravel saturated		1	SS	9	▼										
313.9 0.8	Compact to Dense, grey Sandy SILT saturated		2	SS	22											0 20 80 0
			3	SS	38											
312.9 1.7	END OF HANDHOLE @ 1.7 m  NOTE: Water Level @ 0.3 m Upon Completion *Blow Counts Converted to SPT Values															

EXPRESS. 33-393 GPJ EXPRESS.GDT 24/08/99

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

RECORD OF BOREHOLE No 98-30

1 OF 1

METRIC

W.P. 363-94-00 SITE 33-393 LOCATION E-S Ramp, 4811409N,227322E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hand Hammer COMPILED BY SY  
 DATUM Geodetic DATE 21.12.98 - 21.12.98 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
						20	40	60	80	100					
						○ UNCONFINED									
						● QUICK TRIAXIAL									
						+ FIELD VANE									
						× LAB VANE									
314.5 0.0	PEAT 300 mm														
314.2 0.3	Loose, Fine SAND, occasional peat layers, some cobbles saturated		1	SS	4										
			2	SS	4										
313.3 1.2	Compact, grey Silty SAND saturated		3	SS	29									0	79 21 0
312.5 2.0	Hard, grey Silty CLAY moist		4	SS	37										
312.2 2.3	END OF HANDHOLE @ 2.3 m  NOTE: Water Level @ 0.3 m Upon Completion *Blow Counts Converted to SPT Values														

EXPRESS: 33-393 GP.J EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-31

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811429N, 227327E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hand Hammer COMPILED BY SY  
 DATUM Geodetic DATE 21.12.98 - 21.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60	80	100	10	20
314.6 0.0	PEAT 300 mm																							
314.3 0.3	Loose, grey SAND saturated		1	SS	26																			
313.7 0.9	trace Cobbles below 0.9 m		2	SS	4																			
313.1 1.5	Very Stiff, grey Silty CLAY, thin sand seams moist		3	SS	26																			
312.9 1.7	END OF HANDHOLE @ 1.7 m  NOTE: Water Level @ 0.3 m Upon Completion *Blow Count Converted to SPT Values																							

EXPRESS: 33-393.GPJ EXPRESS.GDT: 24/08/98

RECORD OF BOREHOLE No 98-32

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811452N, 227337E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hand Hammer COMPILED BY SY  
 DATUM Geodetic DATE 21.12.98 - 21.12.98 CHECKED BY EYC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					PLASTIC LIMIT w <sub>p</sub>	WATER CONTENT (%) w			LIQUID LIMIT w <sub>L</sub>	GR	SA	SI
315.2 0.0	Loose to Compact, brown, sand FILL saturated		1	SS	4	▼														
			2	SS	13															31 69 0 0
314.1 1.1	Compact, medium SAND, some gravel saturated			3	SS		17													
313.7 1.5	Very Stiff, grey Silty CLAY moist																			
313.4 1.8	END OF HANDHOLE @ 1.8 m NOTE: Water Level @ 0.3 m Upon Completion  *Blow Counts Converted to SPT Values																			

EXPRESS, 33-393.GPJ EXPRESS.GDT 24/08/99

+ 3 / 3. Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

64

RECORD OF BOREHOLE No 98-33

1 OF 1

METRIC

W.P. 383-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811486N,227345E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hand Hammer COMPILED BY SY  
 DATUM Geodetic DATE 21.12.98 - 21.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
315.2 0.0	TOPSOIL 200 mm														
315.0 0.2	Firm, grey Silty CLAY, occasional sand seams wet		1	SS	4		315								
314.6 0.6	Hard moist		2	SS	37										
314.0 1.2	END OF HANDHOLE @ 1.2 m NOTE: Water Level @ 0.3 Upon Completion *Blow Counts Converted to SPT Values														

EXPRESS. 33-393.GPJ EXPRESS.GDT 24/09/99

**RECORD OF BOREHOLE No 98-34**

1 OF 1

**METRIC**

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811523N, 227355E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hand Hammer COMPILED BY SY  
 DATUM Geodetic DATE 21.12.98 - 21.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
315.7 0.0	Very loose dark brown sand FILL																
315.4 0.3	Loose to Compact, brown medium-fine SAND saturated		1	SS	5											0 92 8 0	
314.8 0.9	Compact, grey Sandy SILT, some gravel saturated		2	SS	18												
314.2 1.5	Hard, grey Silty CLAY moist		3	SS	45												
314.0 1.7	END OF HANDHOLE @ 1.7 m NOTE: Water Level @ 0.3 Upon Completion *Blow Counts Converted to SPT Values																

EXPRESS: 33-393 GPJ EXPRESS.GDT 24/08/99

RECORD OF BOREHOLE No 98-35

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811555N, 227360E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hand Hammer COMPILED BY SY  
 DATUM Geodetic DATE 21.12.98 - 21.12.98 CHECKED BY EYC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60	80	100
315.5 0.0	TOPSOIL 450 mm		1	SS	2	▼	315															
315.1 0.5	Very Loose SAND saturated																					
314.9 0.8	Compact, grey Sandy SILT, trace clay saturated		2	SS	28																	0 46 44 10
314.5 1.1	END OF HANDHOLE @ 1.1 m NOTE: Water Level @ 0.3 Upon Completion *Blow Counts Converted to SPT Values		3	SS	28																	

EXPRESS: 33-393.GPJ EXPRESS.GDT 24/09/98

RECORD OF BOREHOLE No 98-36

1 OF 1

METRIC

W.P. 363-94-00 SITE: 33-393 LOCATION E-S Ramp, 4811607N, 227372E ORIGINATED BY SW  
 DIST 2 HWY 7 & 8 BOREHOLE TYPE Hand Hammer COMPILED BY SY  
 DATUM Geodetic DATE 21.12.98 - 21.12.98 CHECKED BY EYC

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
315.5 0.0	TOPSOIL 300 mm																
315.2 0.3	Loose, SAND saturated		1	SS	5	▼											10 77 13 0
314.9 0.6	Compact, grey Sandy SILT, some gravel saturated		2	SS	29		315										
314.3 1.2	END OF HANDHOLE @ 1.2 m NOTE: Water Level @ 0.3 Upon Completion *Blow Counts Converted to SPT Values																

EXPRESS: 33-393.GPJ EXPRESS.GDT 24/08/99

+ 3 / 3. Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE



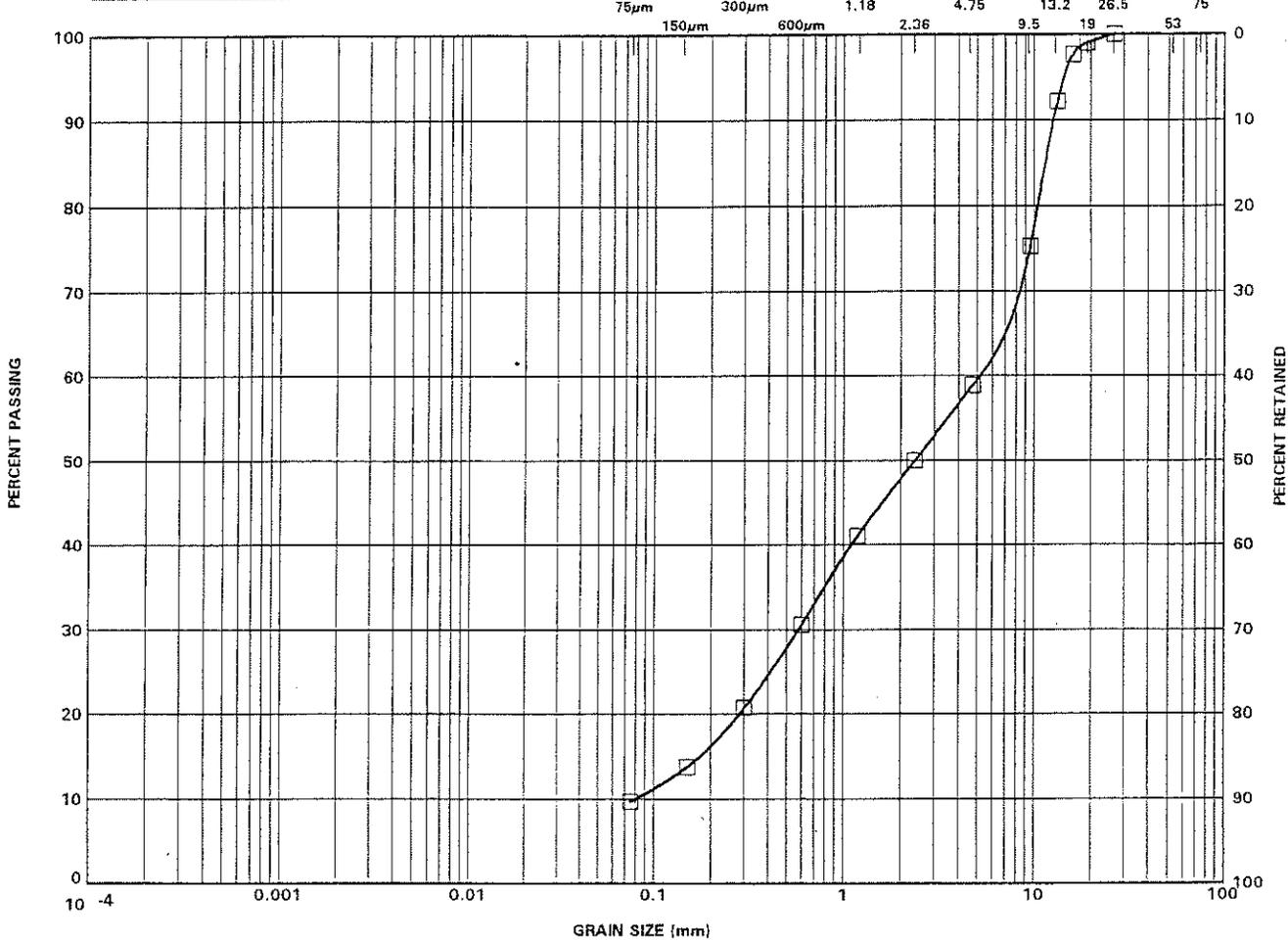
# **APPENDIX “B”**

## **Laboratory Test Results South Retaining Wall/Embankment**

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

<b>SILT and CLAY</b>	<b>SAND</b>			<b>GRAVEL</b>	
	Fine	Medium	Coarse	Fine	Coarse

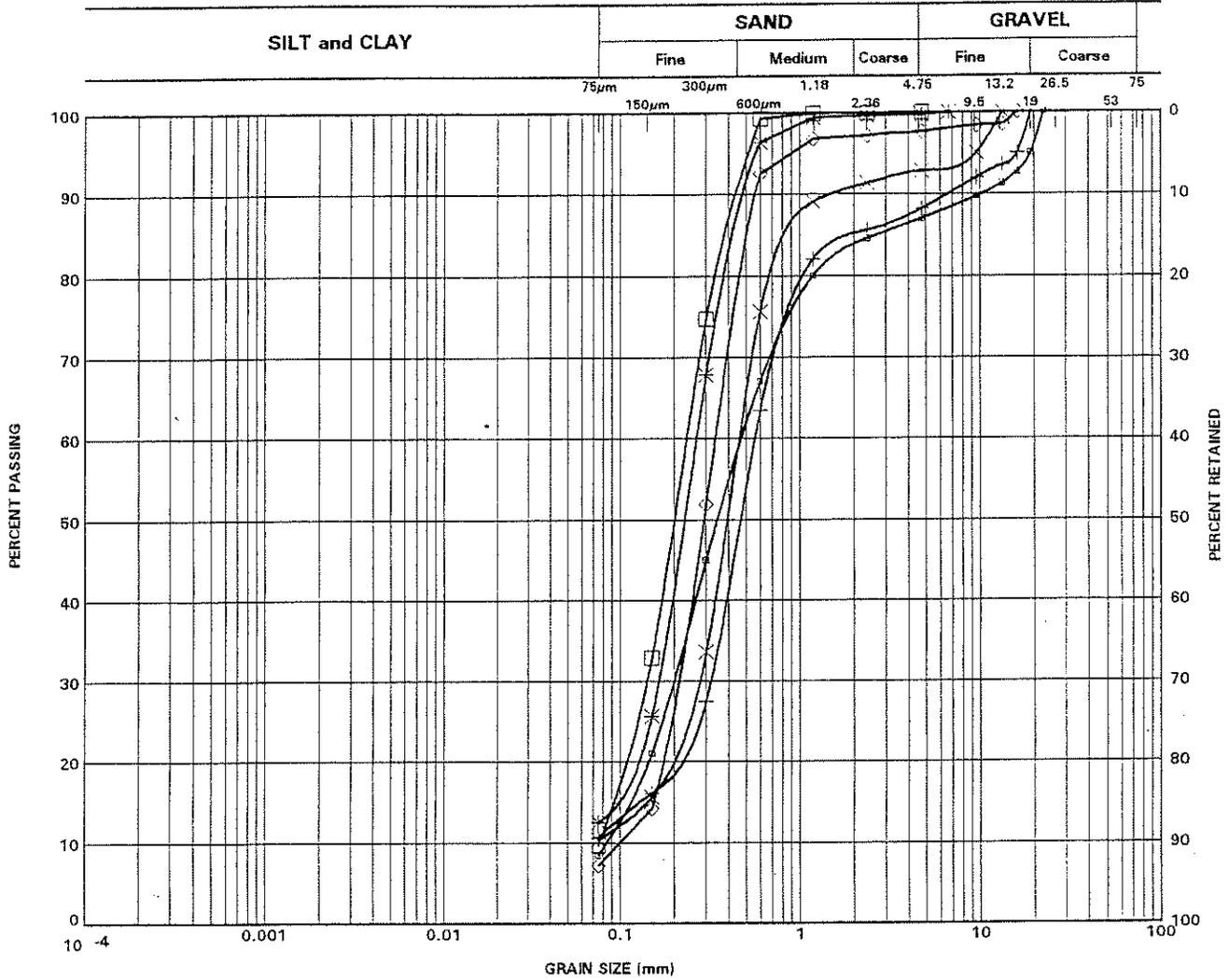


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-05	0.2

**SAND and GRAVEL FILL**

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

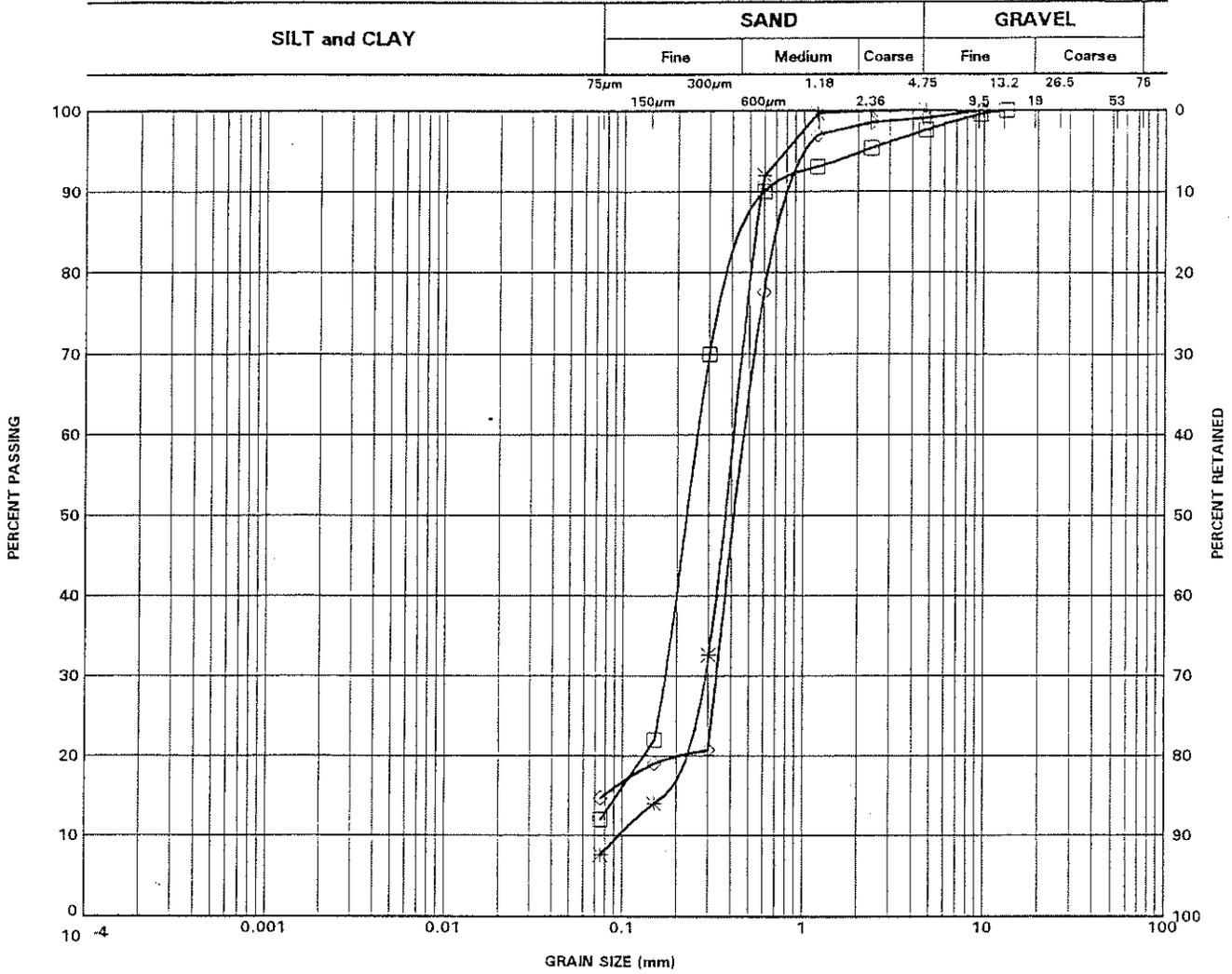


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-01	1.5
*	98-02	2.3
◇	98-03	2.3
×	98-04	3.1
+	98-05	4.7
◻	98-06	4.0

SAND

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

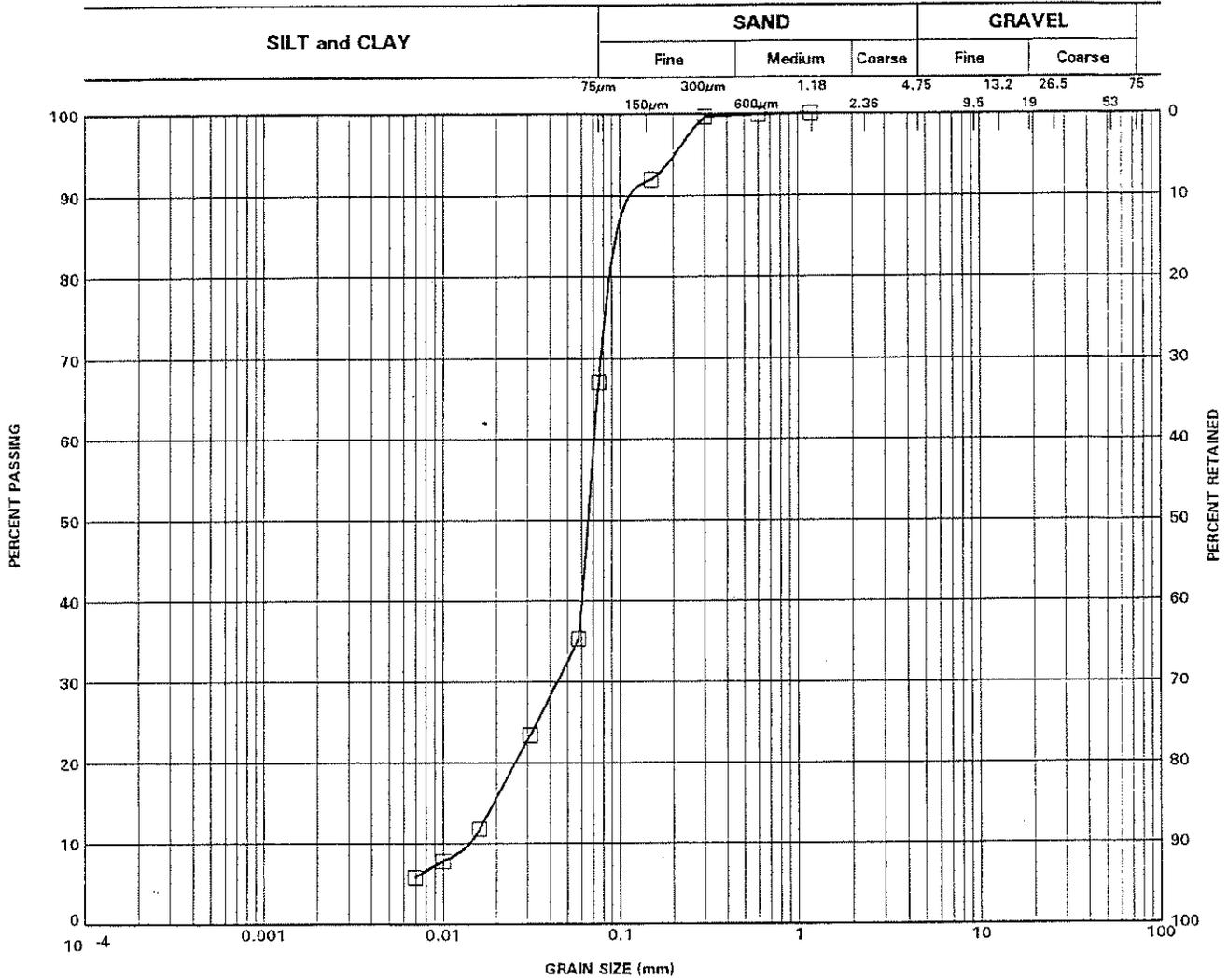


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-06	2.3
*	98-07	2.3
◇	98-08	3.1

SAND

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



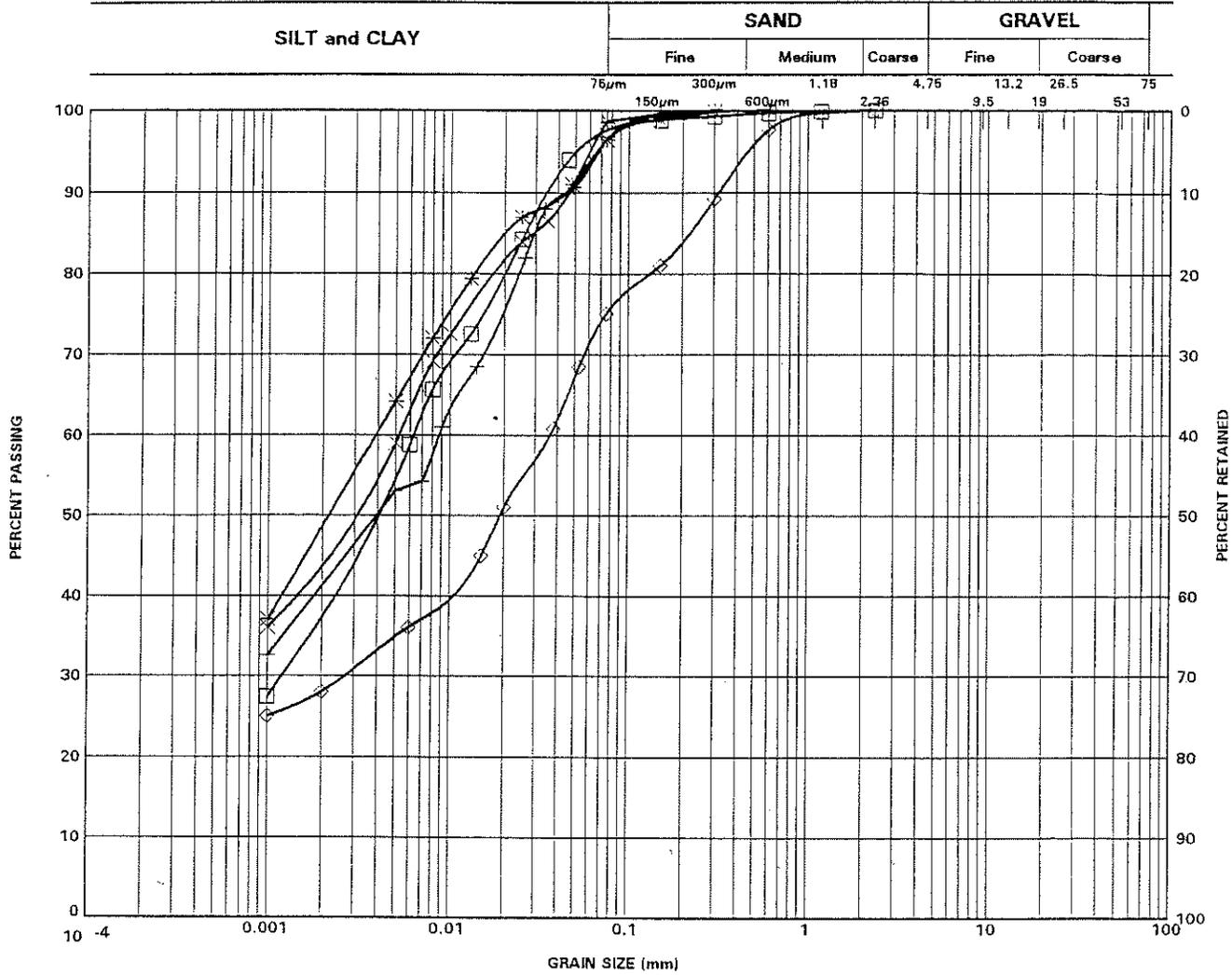
LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-03	5.8

UPPER SILT

<b>WP</b> 363-94-00	<b>SITE</b> 33-393	<b>Figure No.</b> 4
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# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

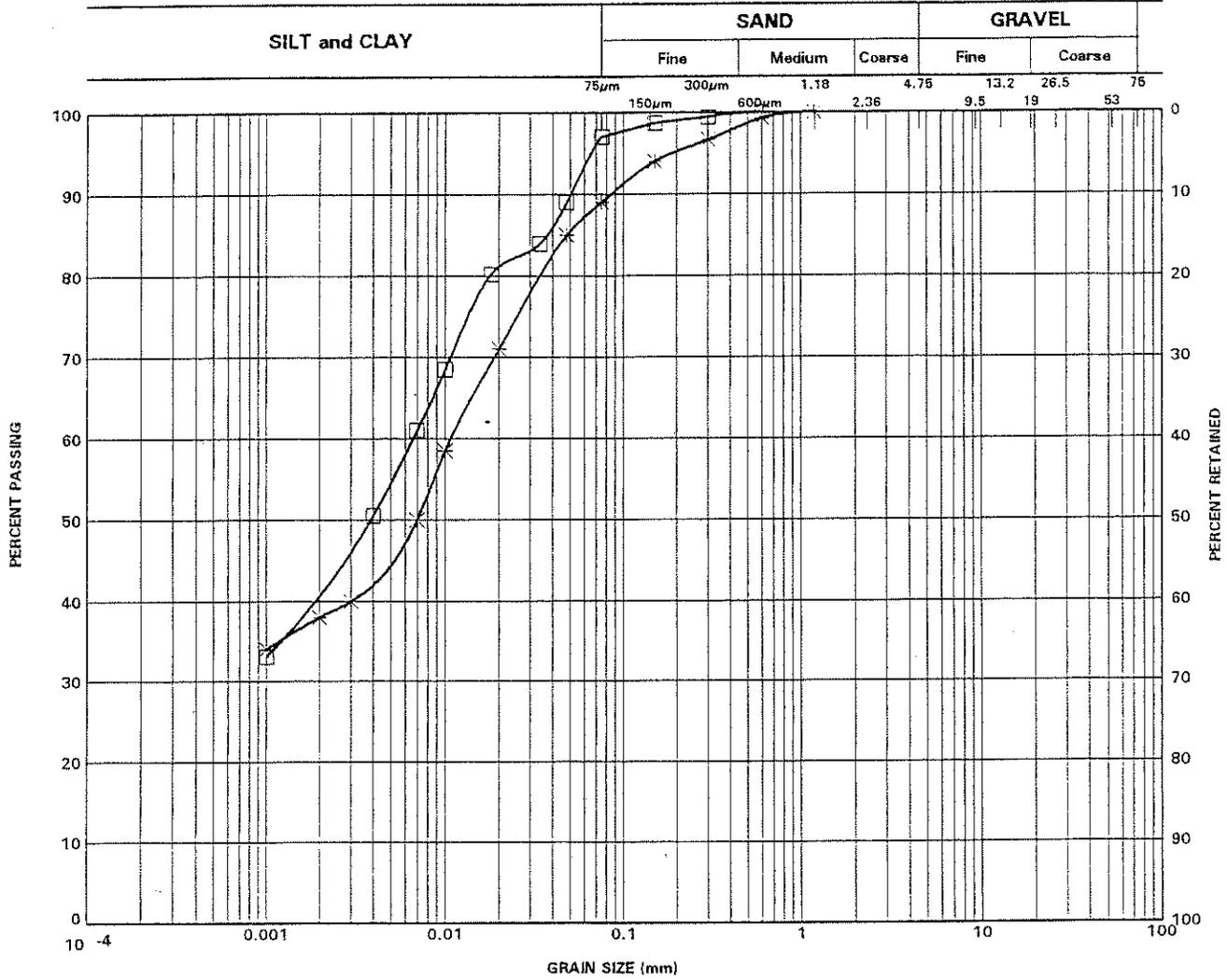


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-04	7.6
*	98-05	6.1
◇	98-06	5.3
×	98-06	7.6
+	98-07	5.8

UPPER SILTY CLAY

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

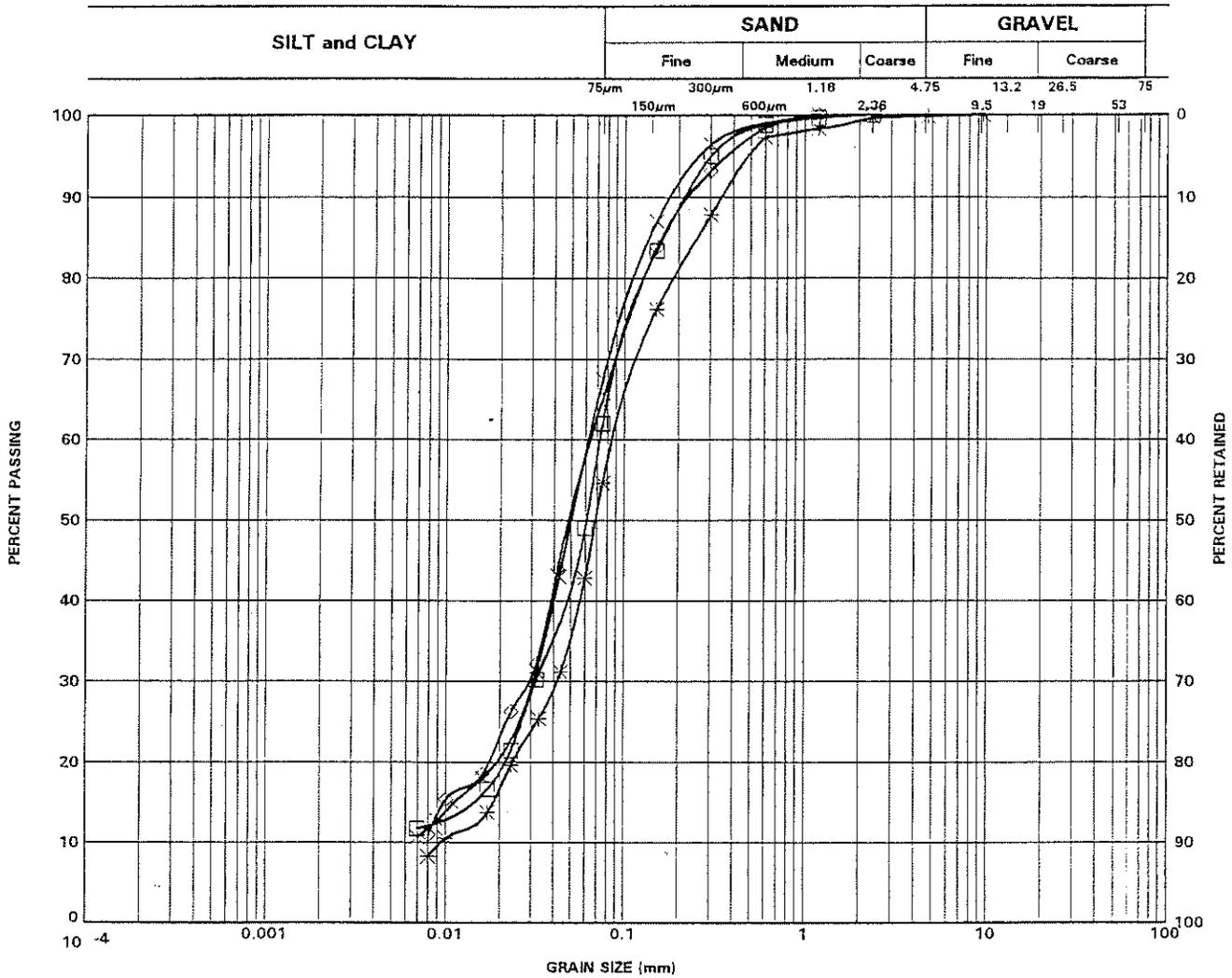


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-09	3.1
*	98-10	3.1

**UPPER SILTY CLAY**

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

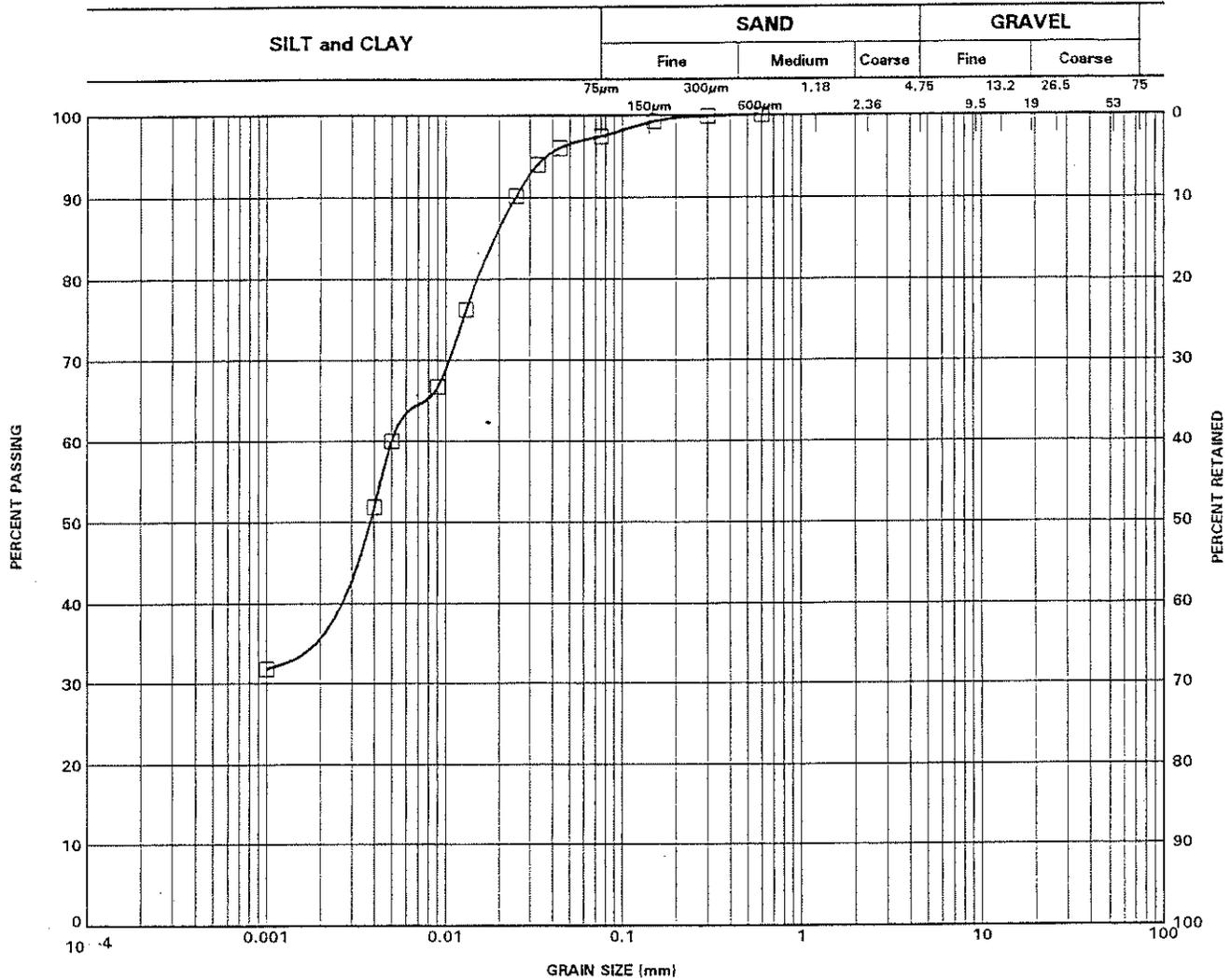


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-07	7.8
*	98-08	4.6
◇	98-09	6.1
×	98-10	4.6

LOWER SILT

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-10	13.7

**LOWER SILTY CLAY**

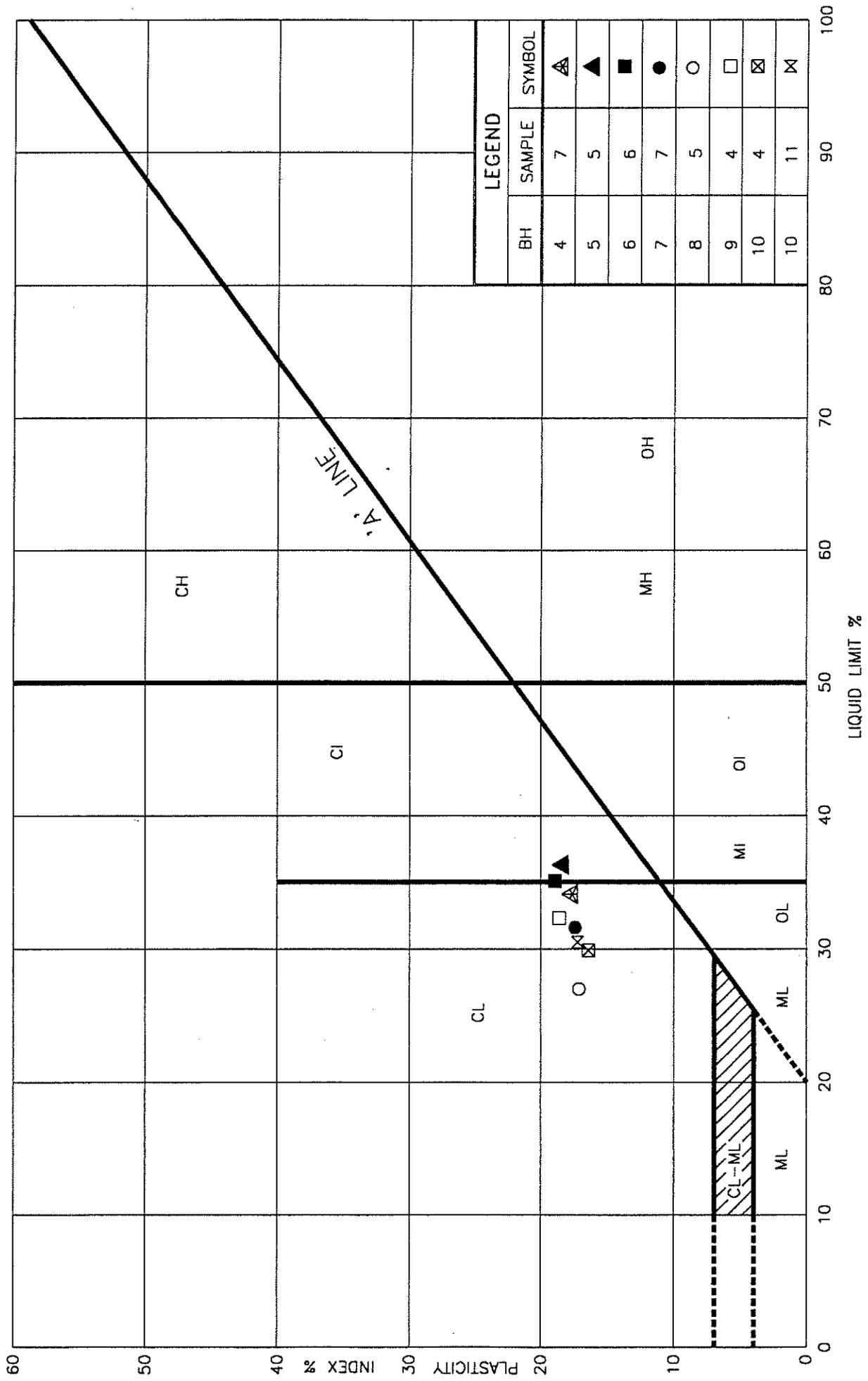


FIG No.: 9  
 W P 363-94-00  
 Site: 33-393

Silty Clay

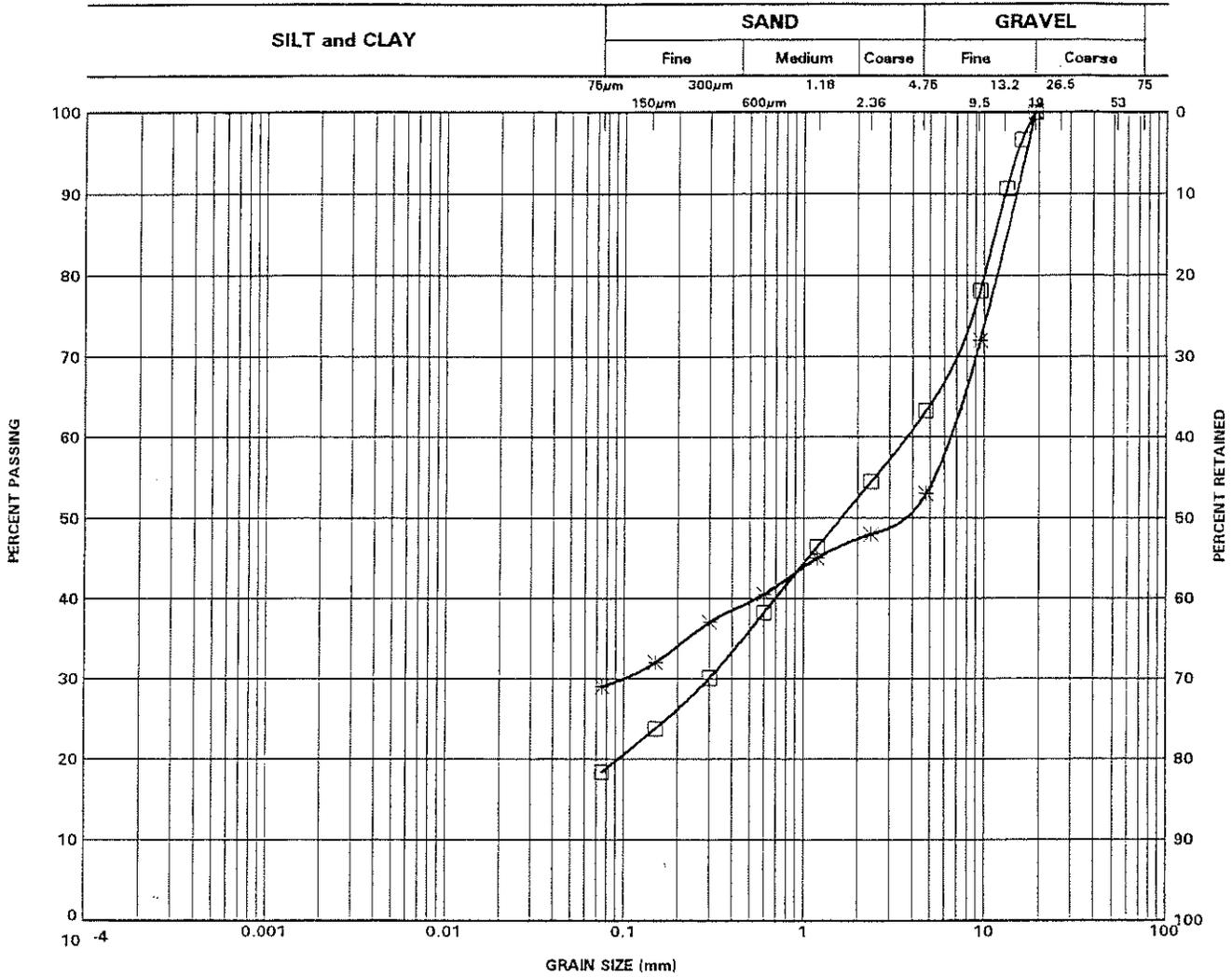
# **APPENDIX “C”**

## **Laboratory Test Results**

### **Seven Span Bridge Structure**

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

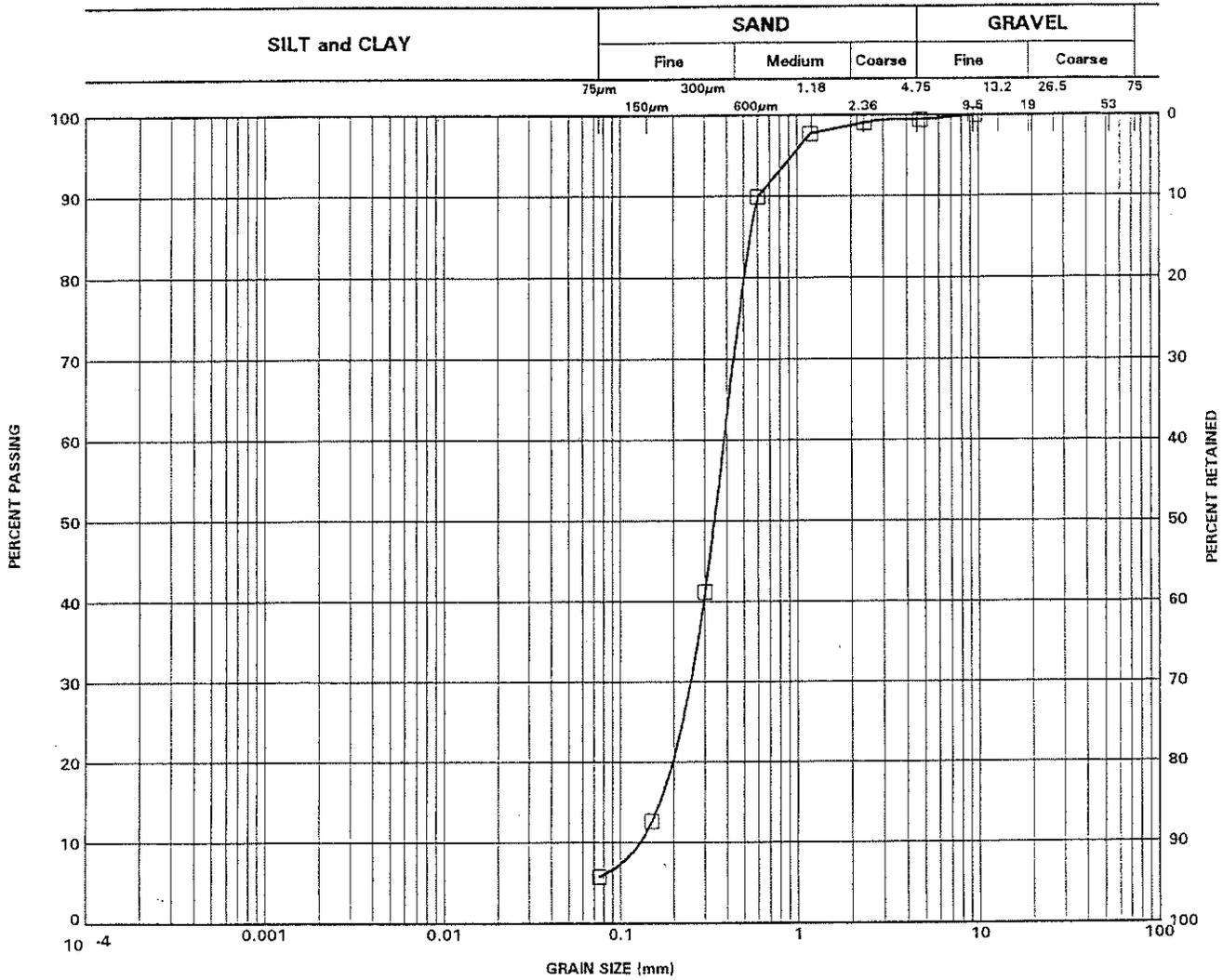


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-11	0.2
*	98-14	0.2

FILL

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



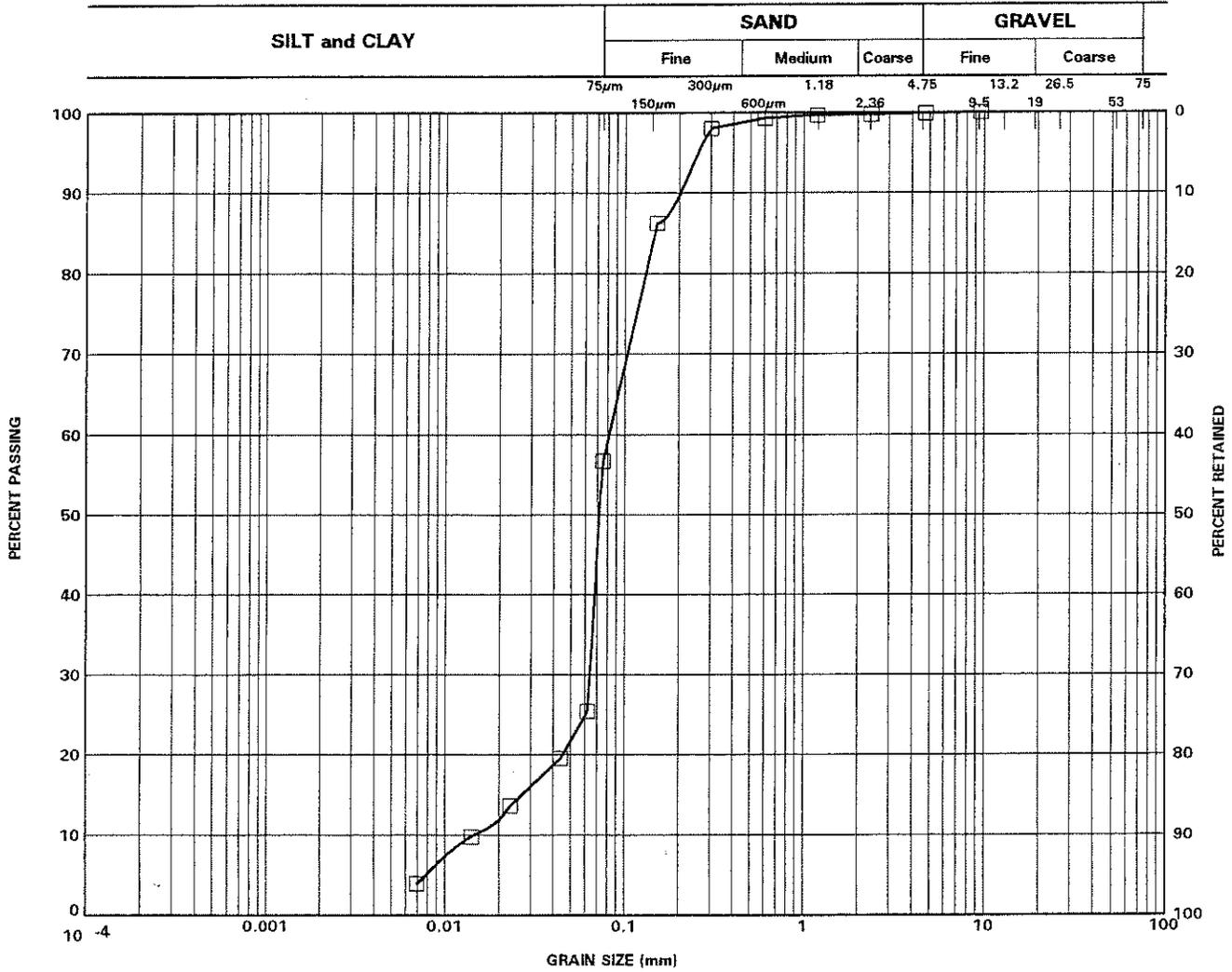
LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-11	6.1

**SAND**

<b>WP</b> 363-94-00	<b>SITE</b> 33-393	<b>Figure No.</b> 11
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# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

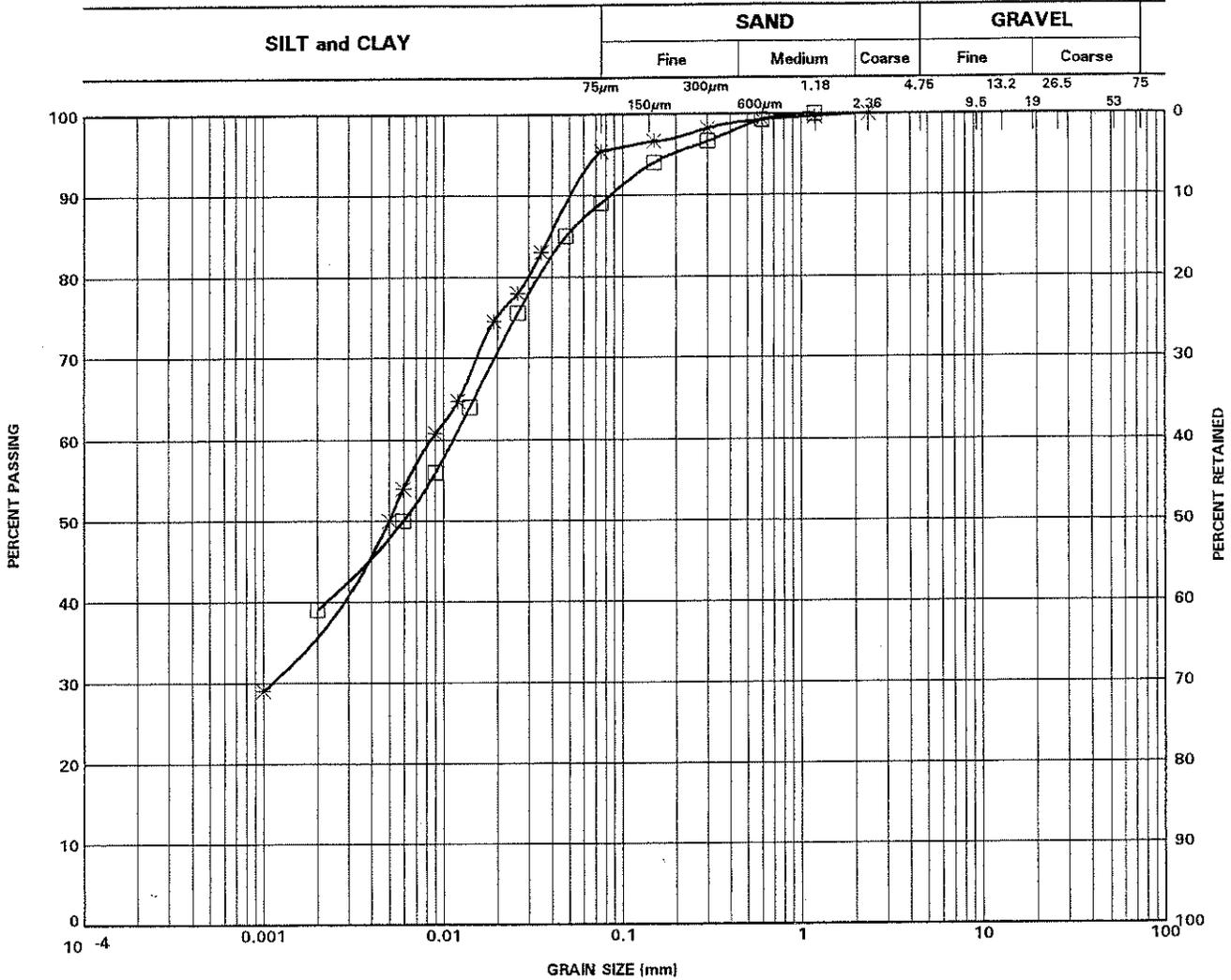


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-15	3.1

SILT

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

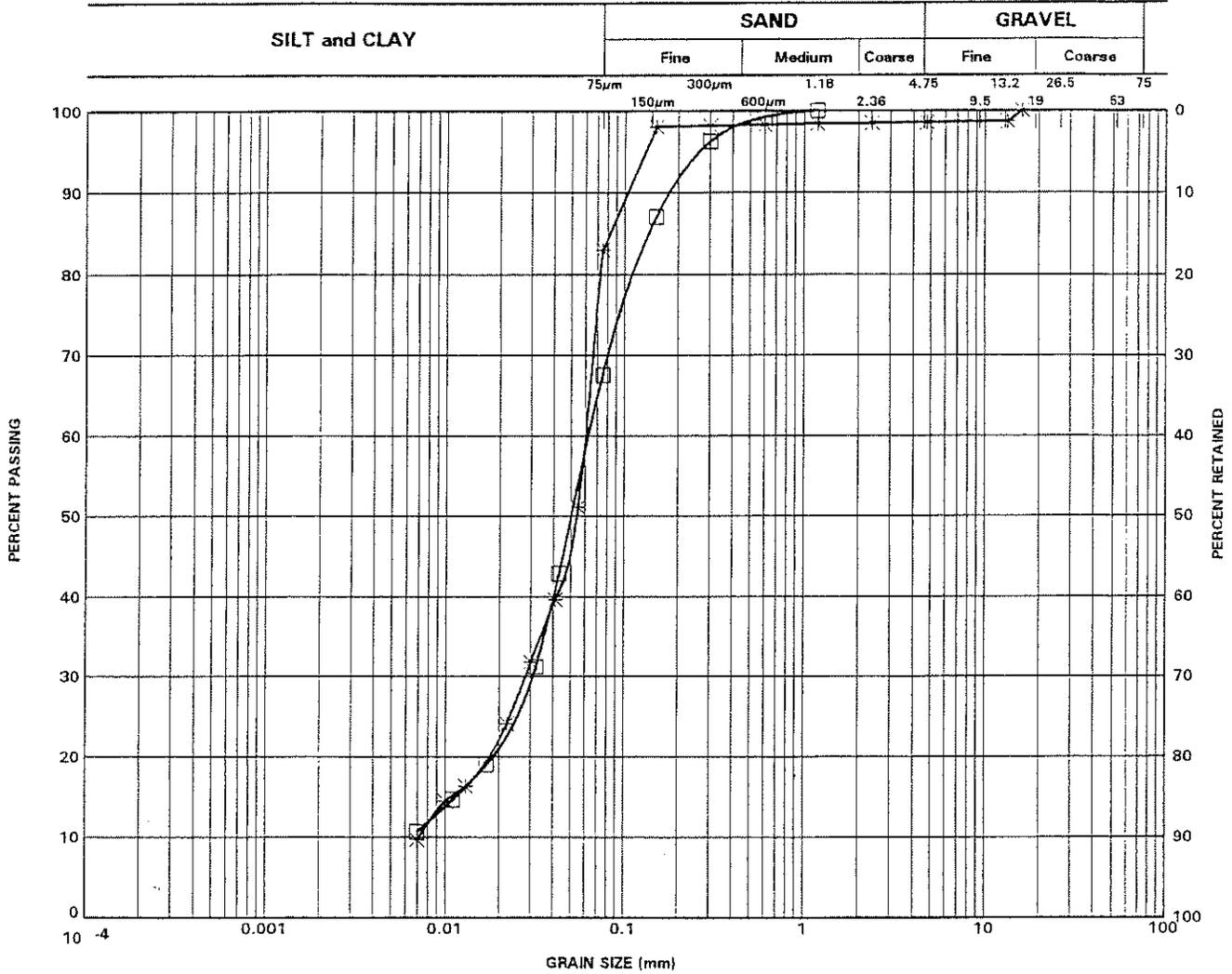


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-10	3.1
*	98-16	2.3

**SILTY CLAY**

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

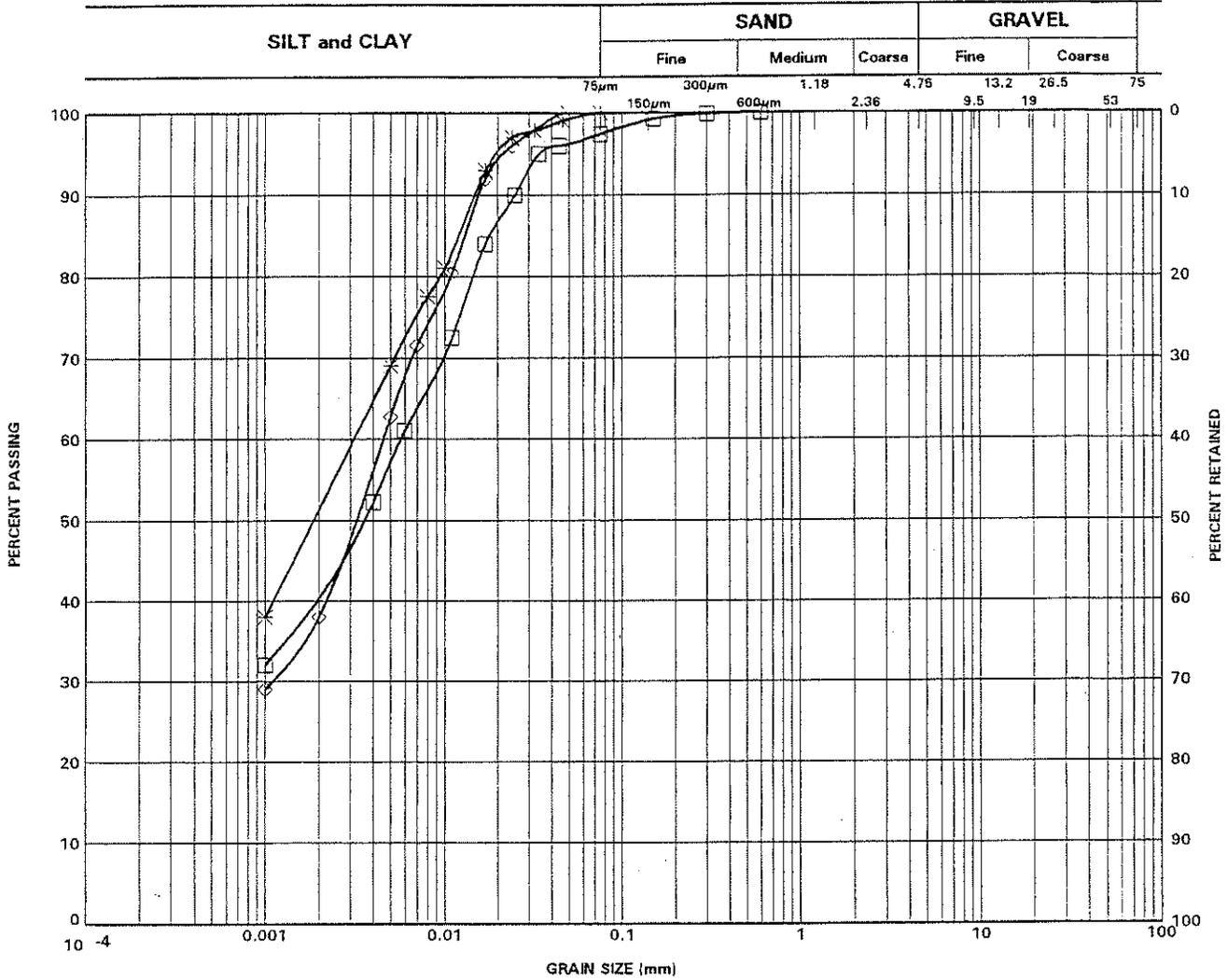


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-10	4.6
*	98-11	9.2

LOWER SILT

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

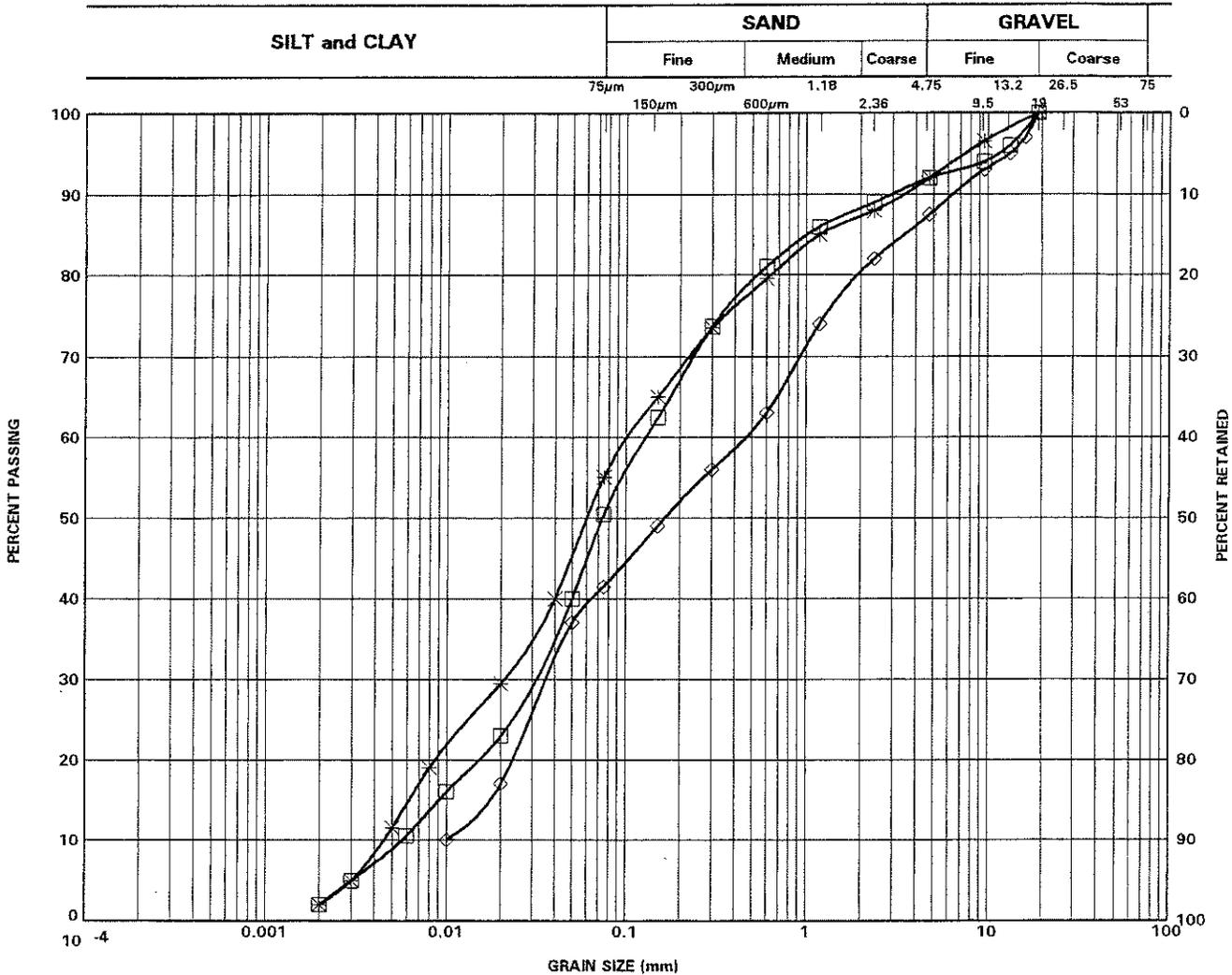


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-10	13.7
*	98-11	15.3
◇	98-15	9.3

LOWER SILTY CLAY

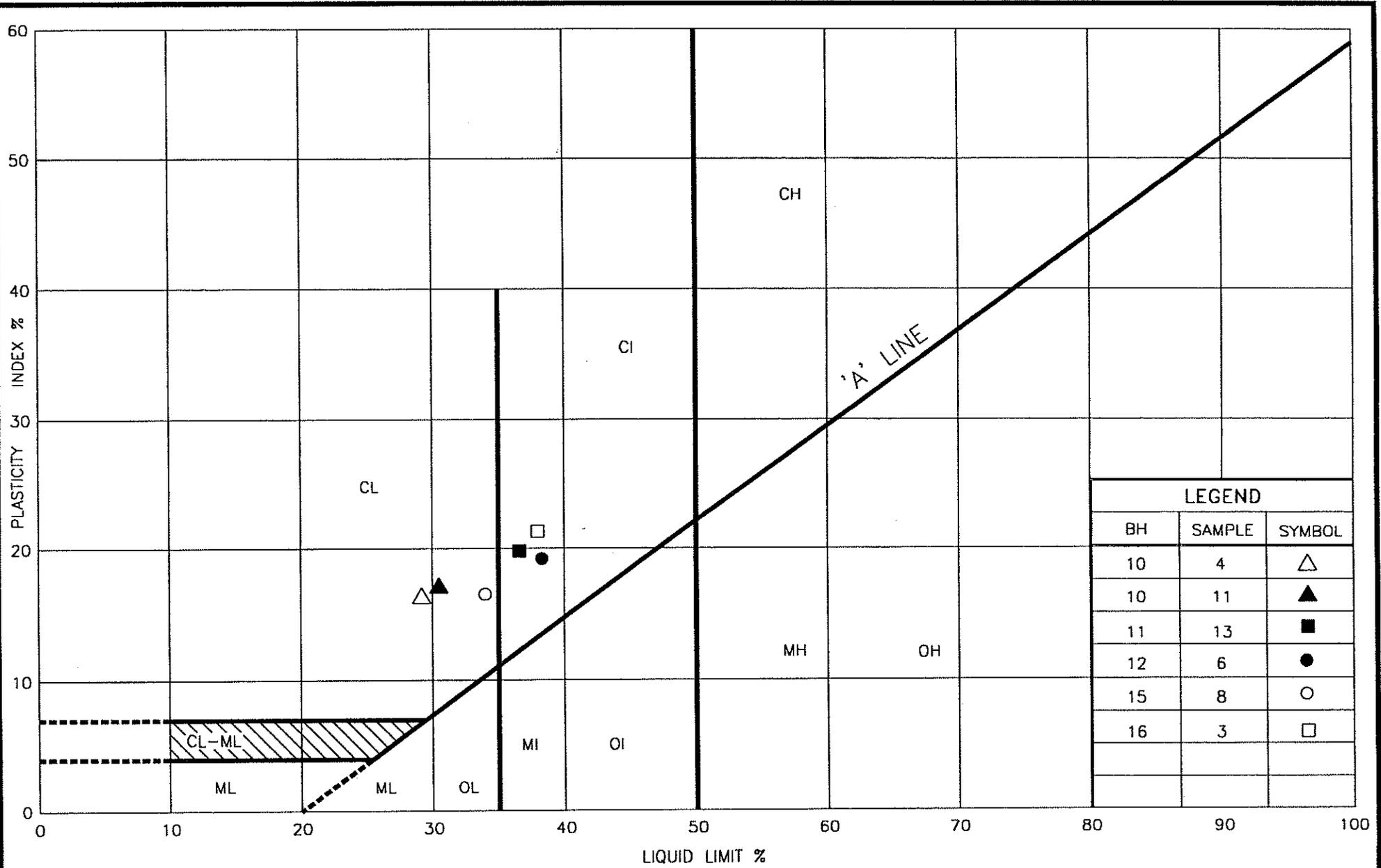
# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



<b>LEGEND</b>		
<b>SYMBOL</b>	<b>BOREHOLE</b>	<b>DEPTH (m)</b>
□	98-12	24.5
*	98-13	23.0
◇	98-17	18.3

**SANDY SILT TILL**

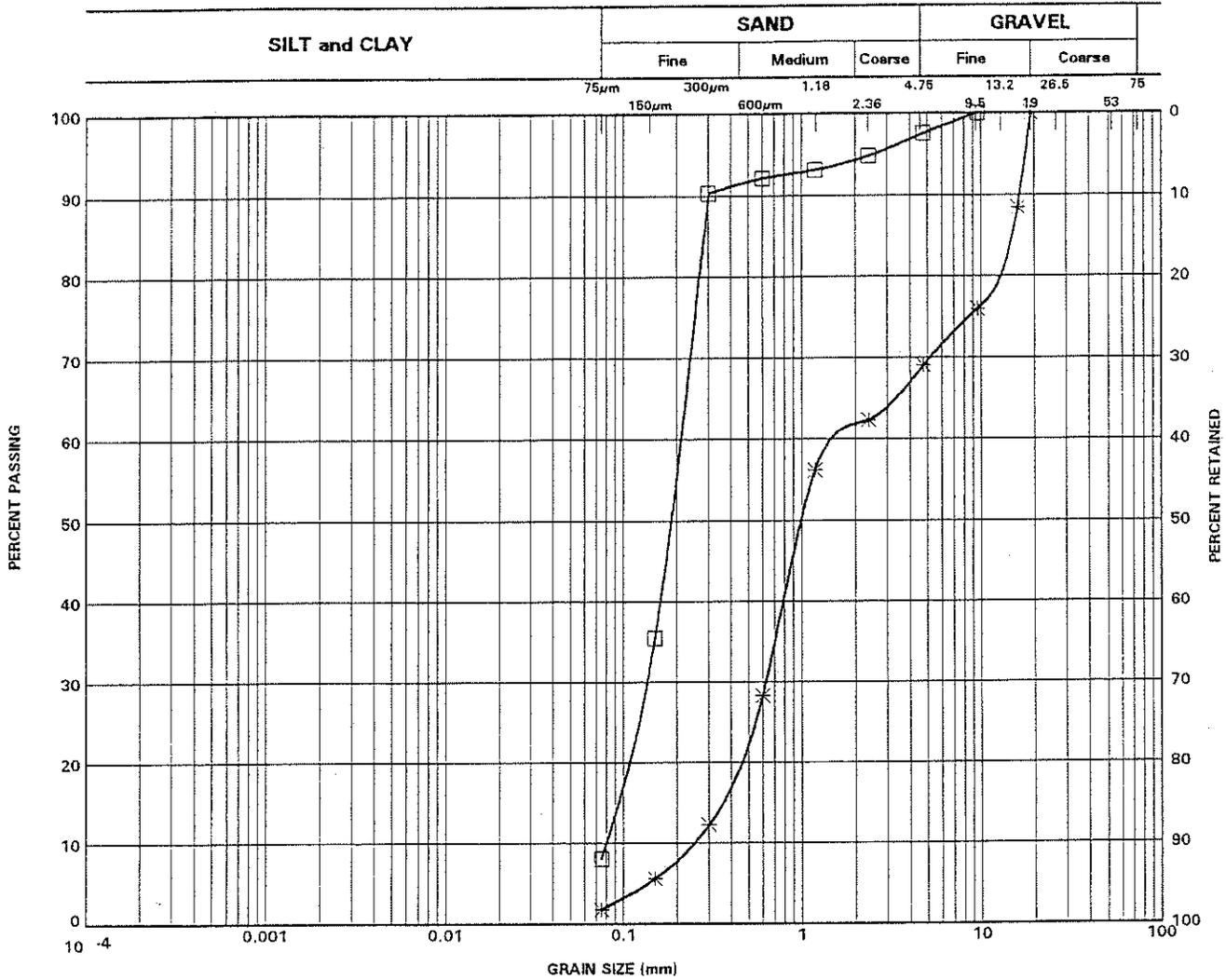


# **APPENDIX “D”**

## **Laboratory Test Results East Retaining Wall/Embankment**

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

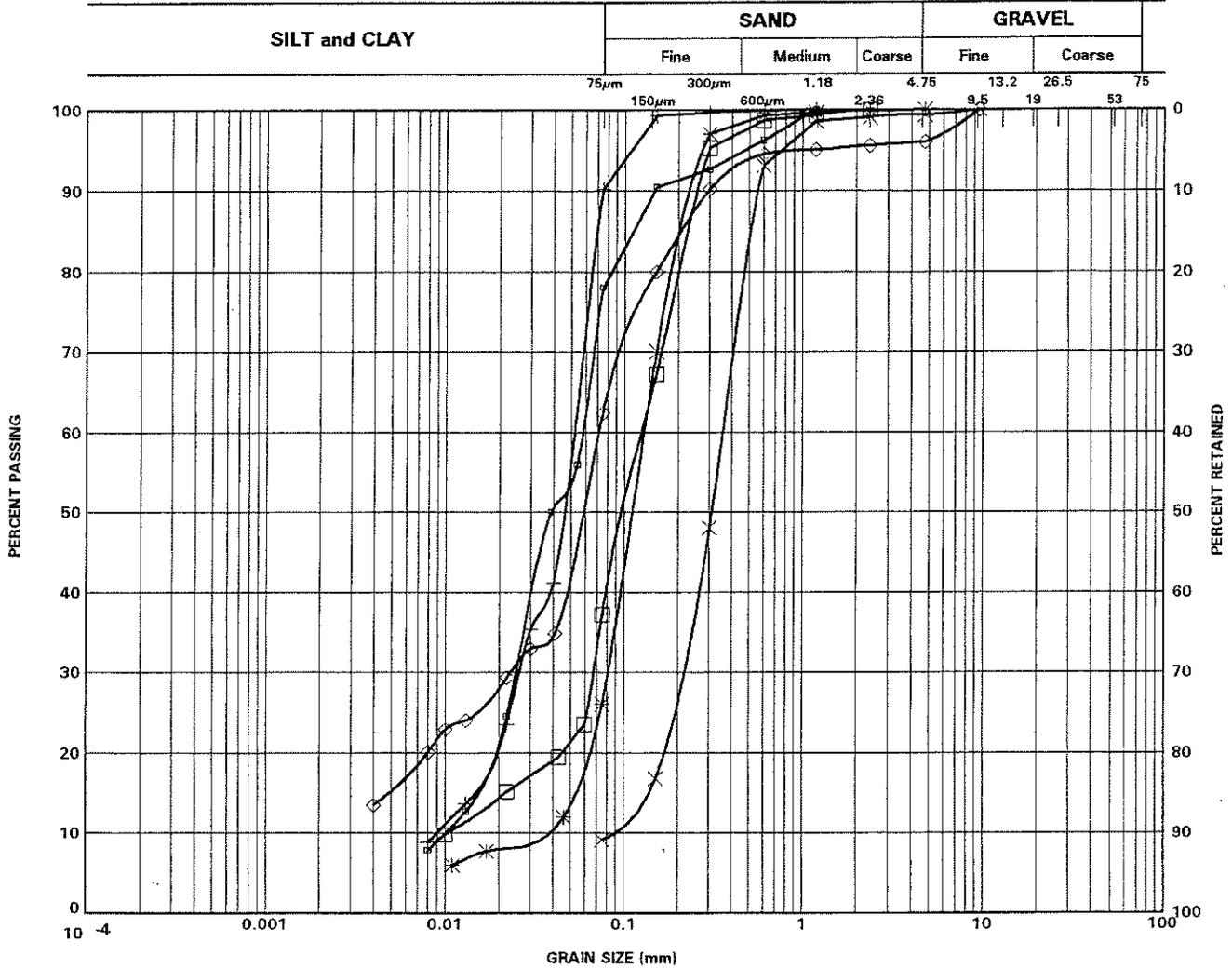


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-25	1.5
*	98-32	0.8

FILL

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

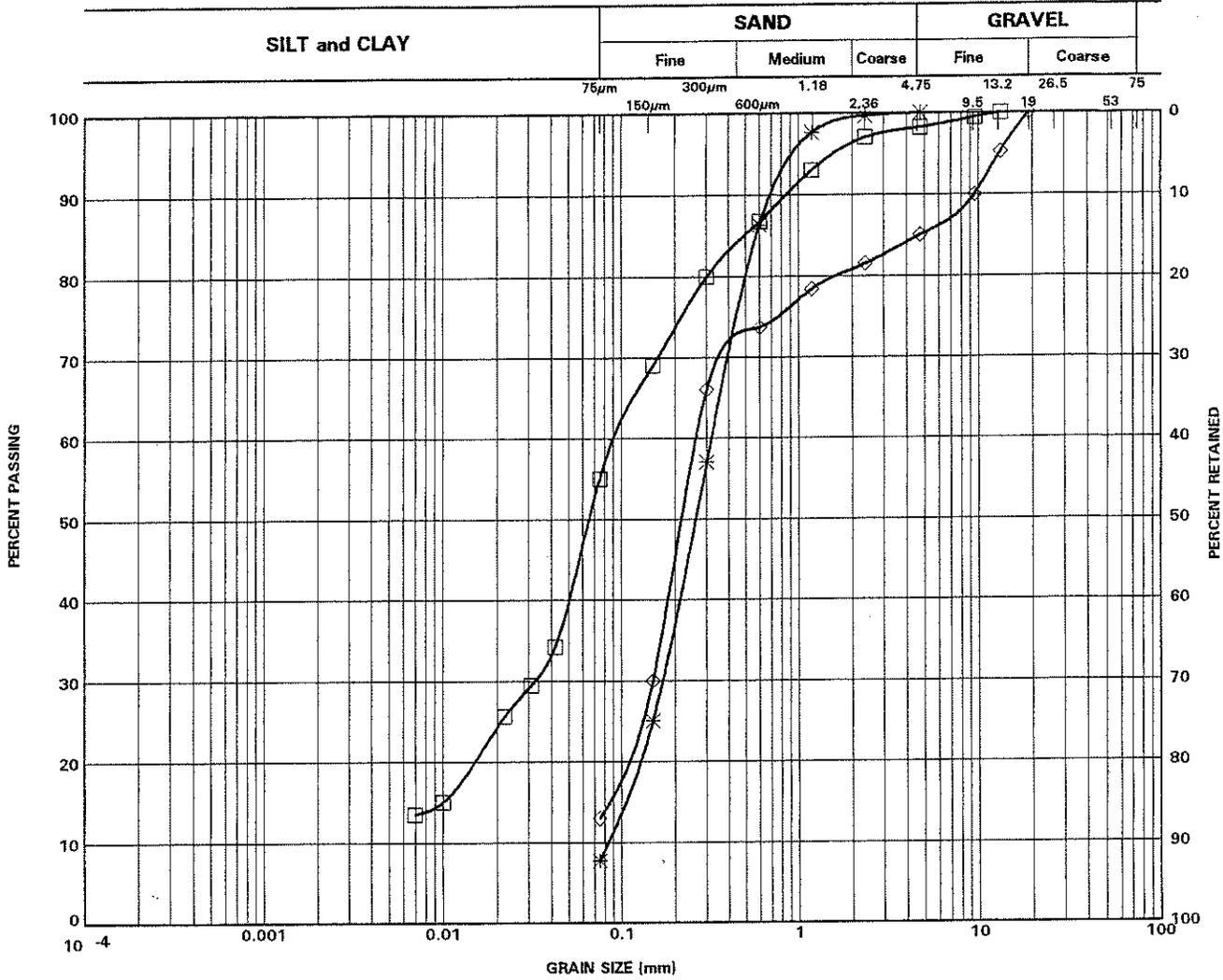


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-20	3.1
*	98-24	1.5
◇	98-24	3.1
×	98-26	4.6
+	98-28	3.1
◻	98-29	1.0

**SILT / SAND**

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

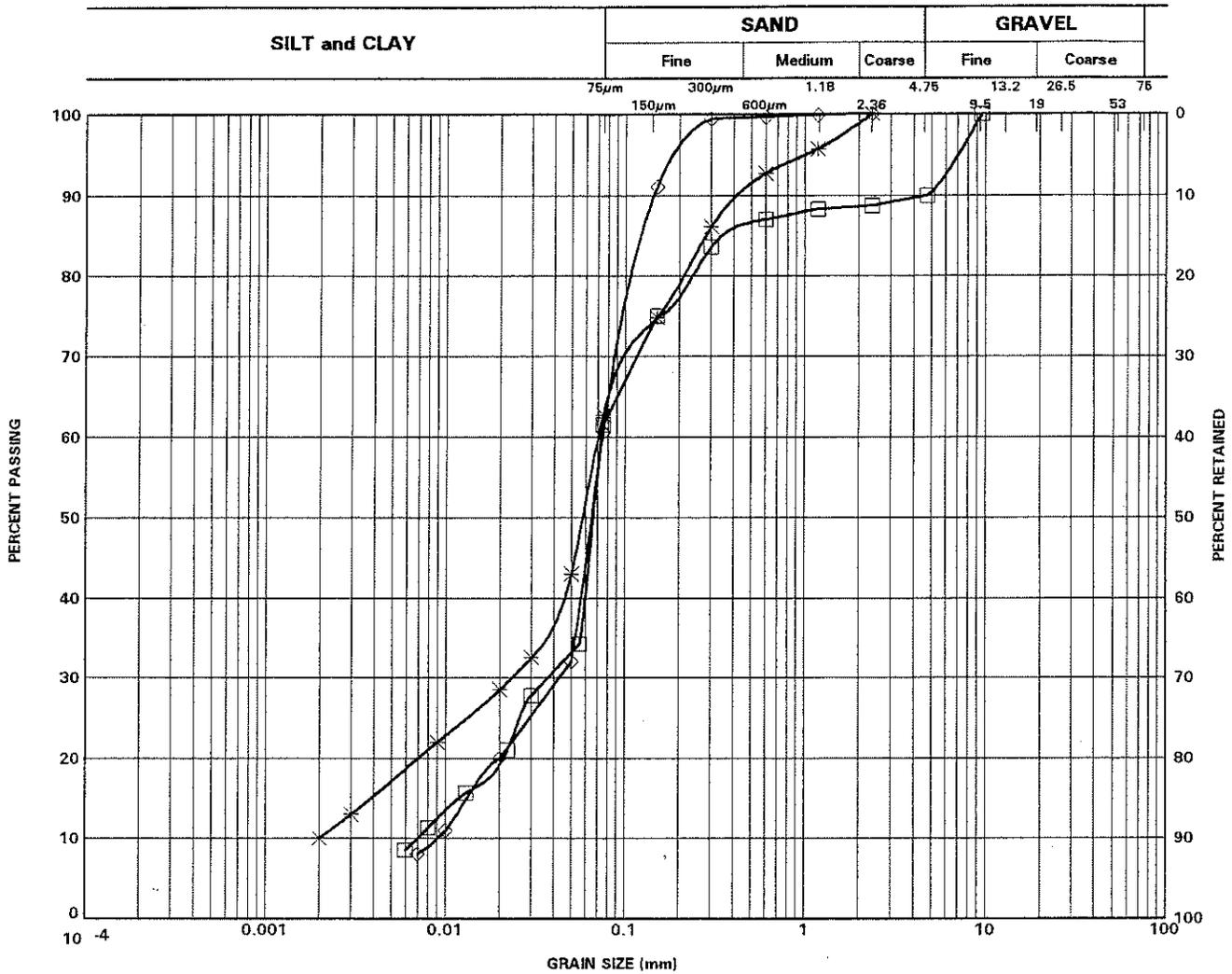


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-30	1.4
*	98-34	1.0
◇	98-36	0.4

--	--	--

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

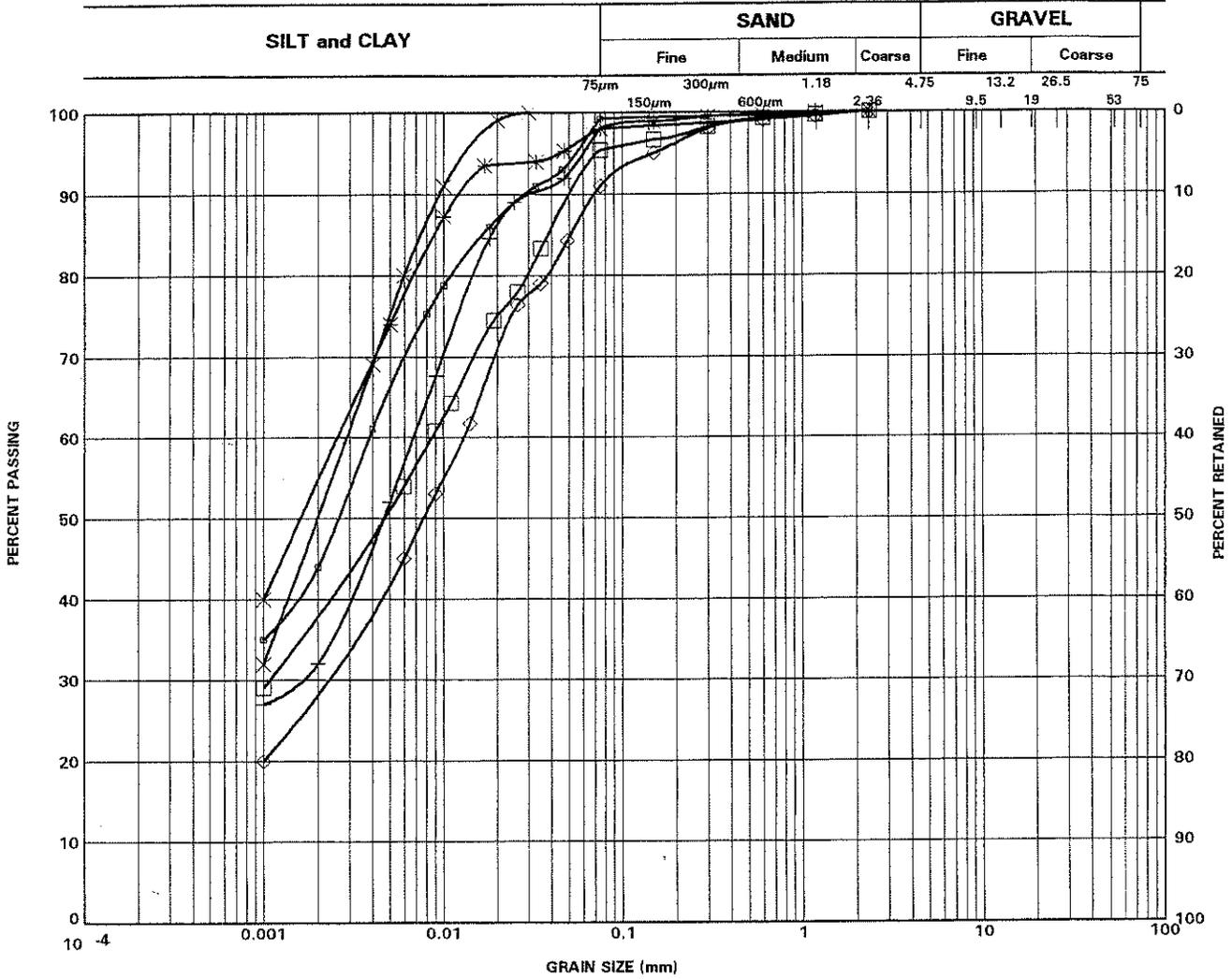


<b>LEGEND</b>		
<b>SYMBOL</b>	<b>BOREHOLE</b>	<b>DEPTH (m)</b>
□	98-23	3.1
*	98-25	7.6
◇	98-28	5.4

**SILT / SAND**

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM



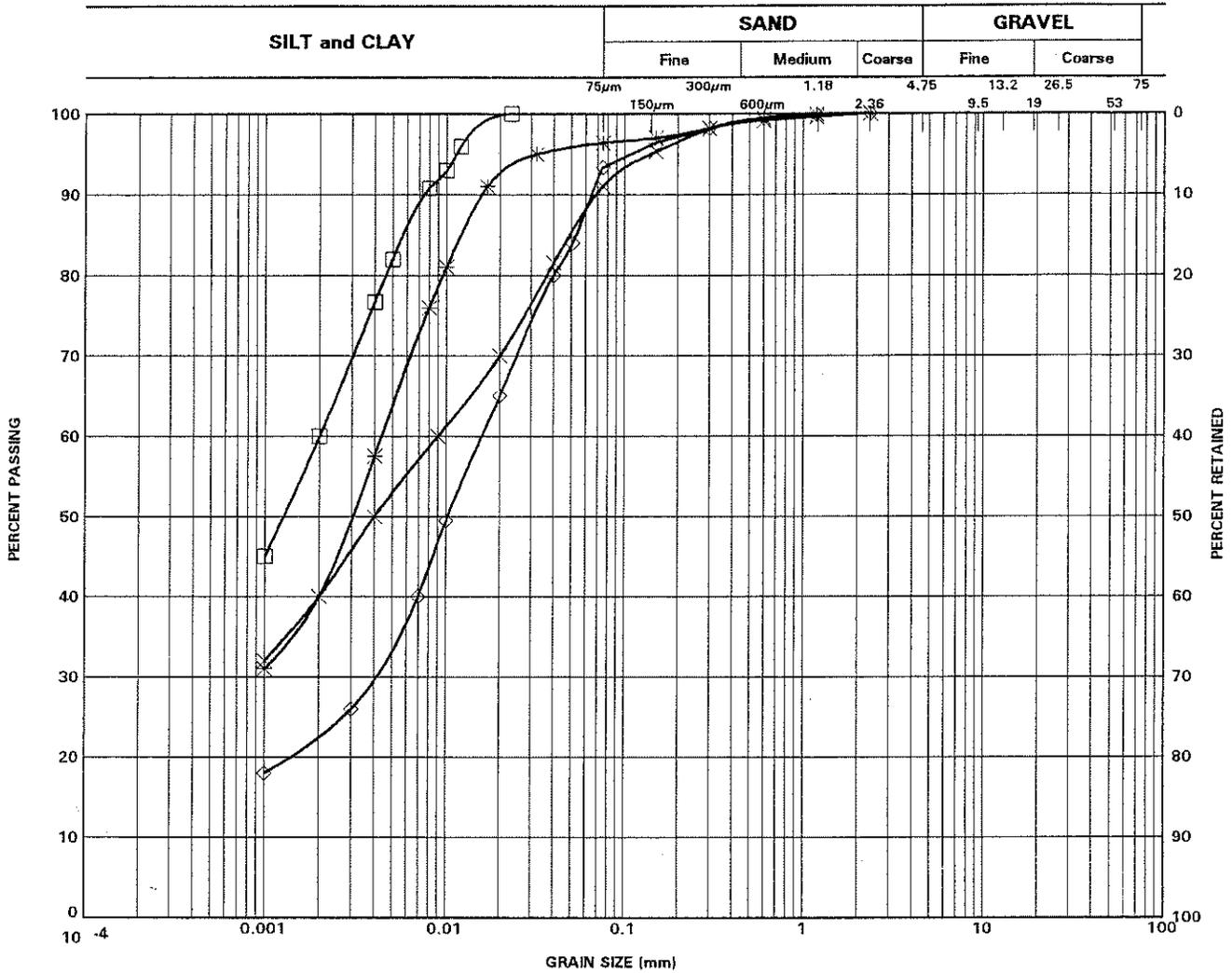
LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-16	2.3
*	98-17	4.6
◇	98-19	3.8
×	98-20	6.1
+	98-21	5.3
◻	98-22	6.1

**UPPER SILTY CLAY**

94

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

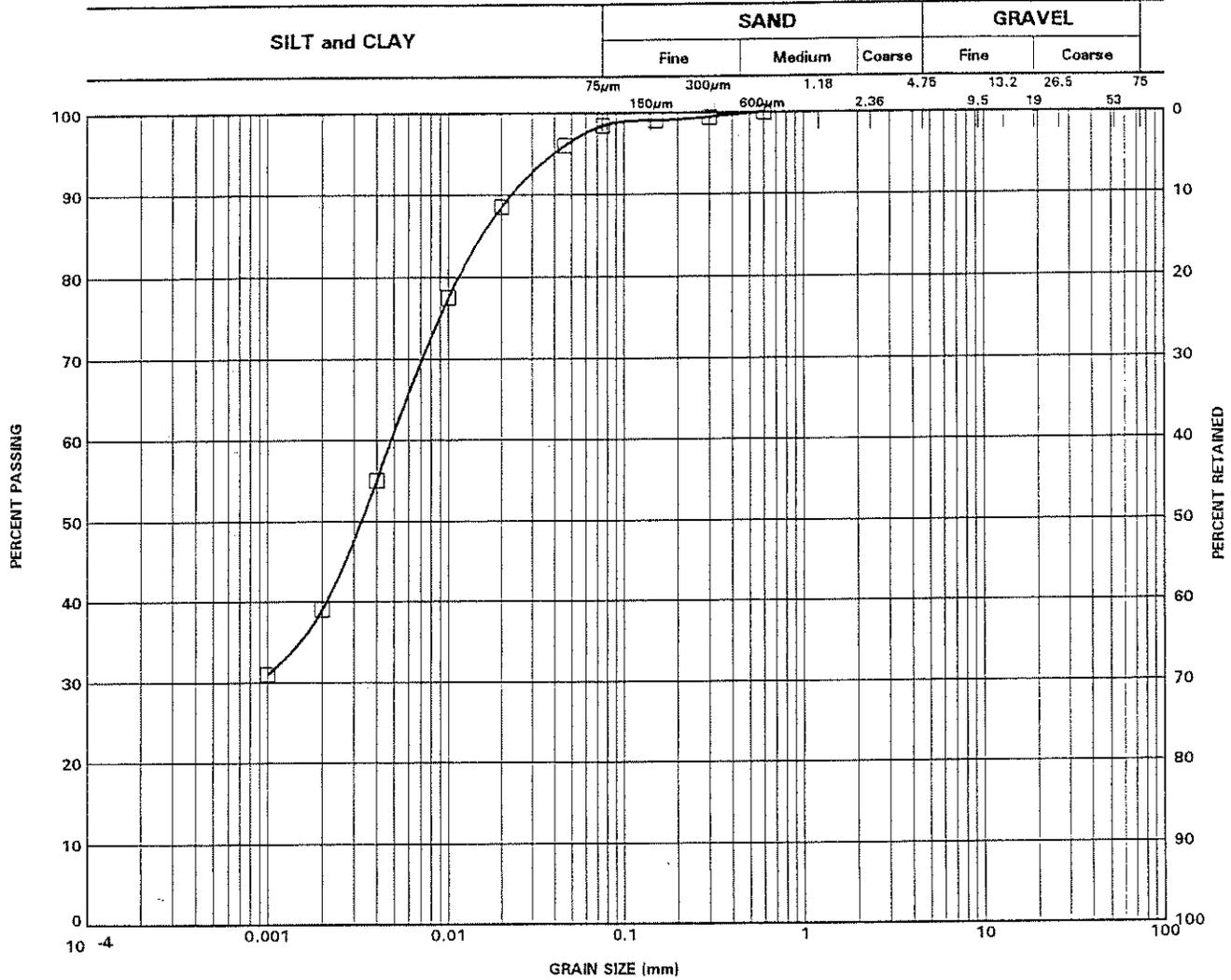


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-23	6.9
*	98-24	6.5
◇	98-26	7.6
×	98-27	7.8

**UPPER SILTY CLAY**

# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

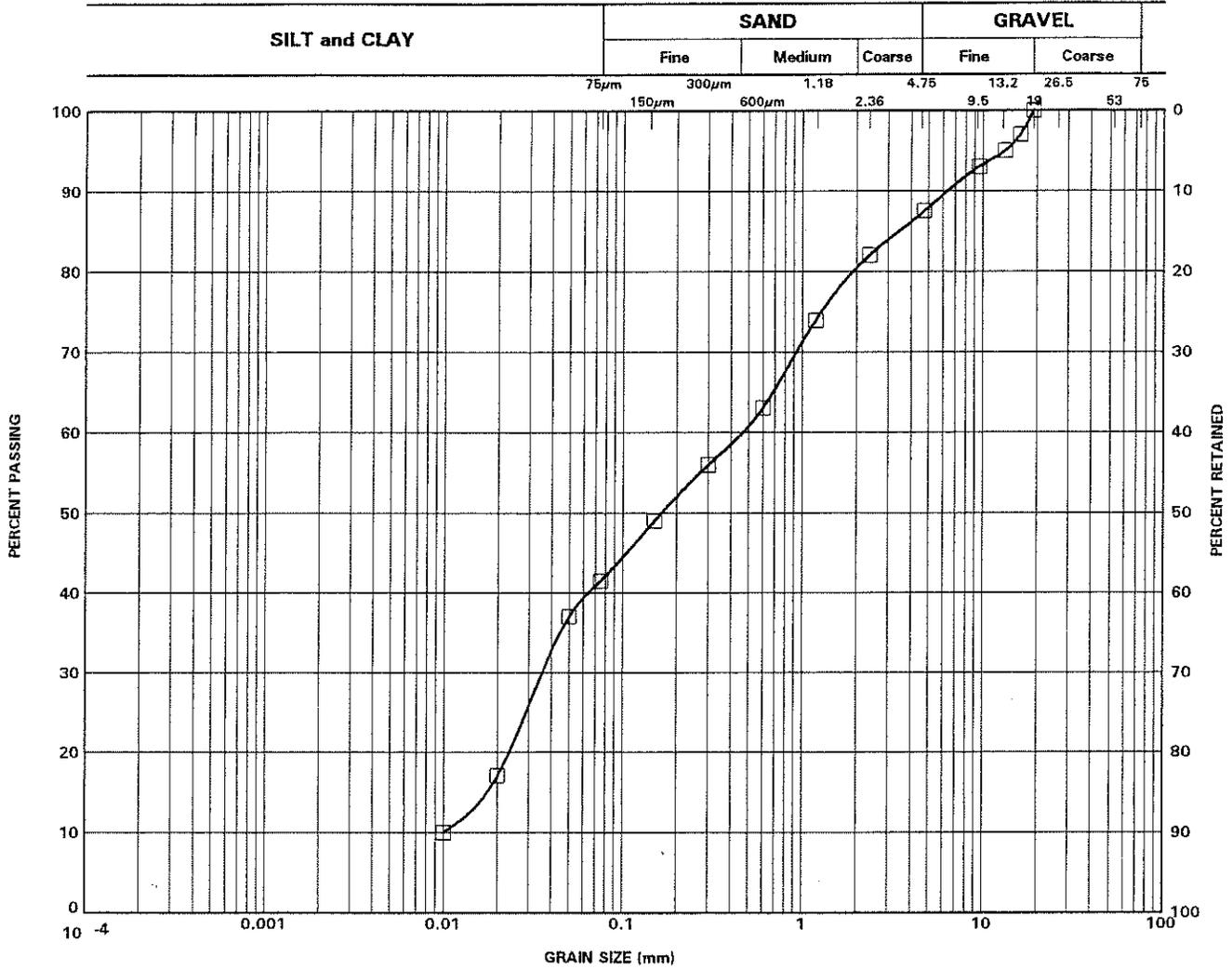


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-19	12.3

**LOWER SILTY CLAY**

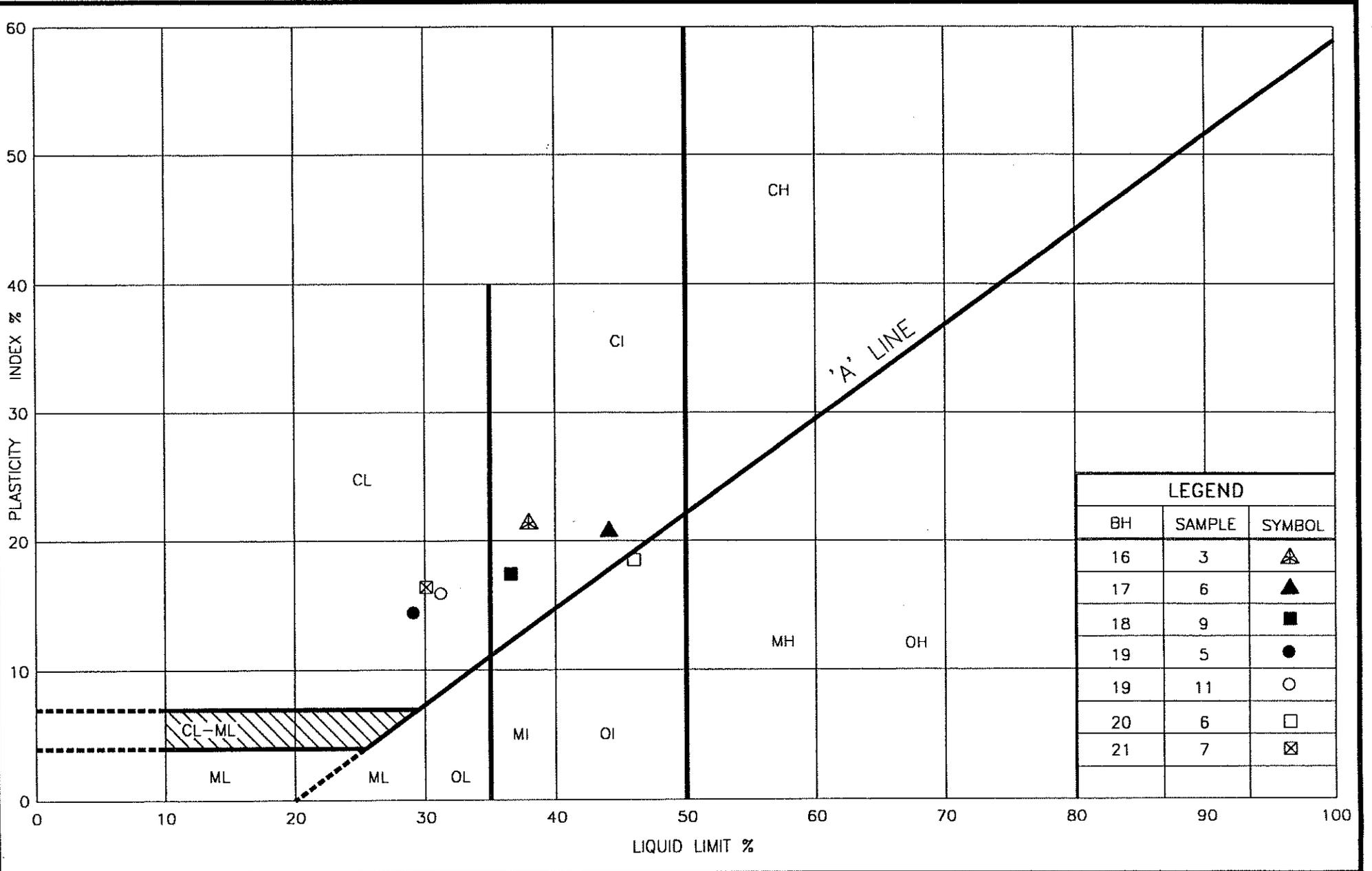
# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

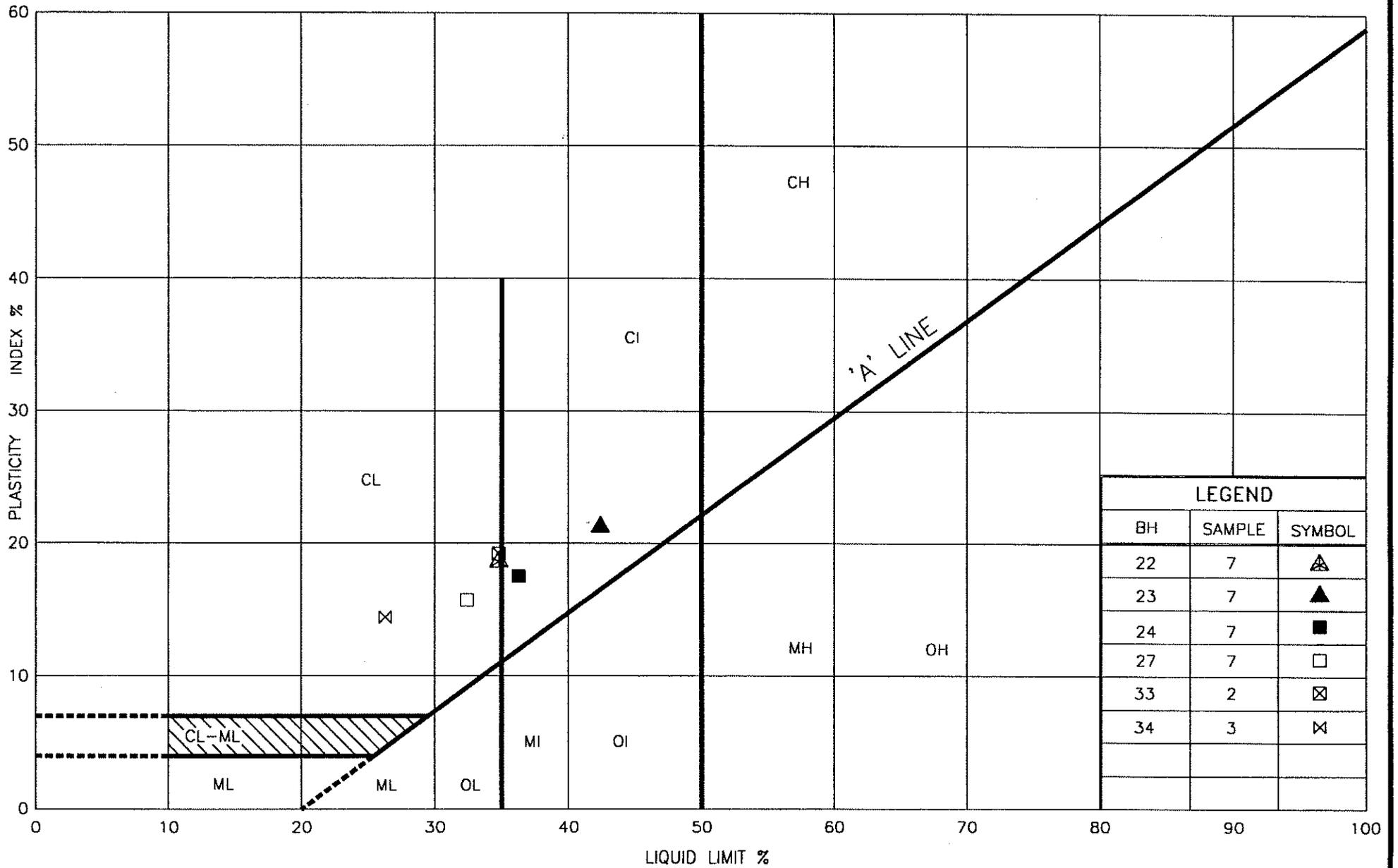


LEGEND		
SYMBOL	BOREHOLE	DEPTH (m)
□	98-17	18.3

**SANDY SILT TILL**



LEGEND		
BH	SAMPLE	SYMBOL
16	3	△
17	6	▲
18	9	■
19	5	●
19	11	○
20	6	□
21	7	⊗



LEGEND		
BH	SAMPLE	SYMBOL
22	7	△
23	7	▲
24	7	■
27	7	□
33	2	⊠
34	3	⊗

# APPENDIX "E"

## Shear Box Test Results

Project Name :- Hwy 7 & 8  
 Client :- Agra- Waterloo

Job #:- TK98-10-3  
 Date :- March 16, 1999.

Characteristic Properties of Soil

BH #	Sample No.	Atterberg Limits			Specimen #	Unit Weight kN/m <sup>3</sup>	Initial Moisture Content%	Remarks
		Plastic Limit %	Liquid Limit %	Plasticity Index %				
18	TW9 (@ 9.2m depth)	17.4	36.6	19.2	A1	19.8	15.0	TW9 is being denoted as 'A'
					A2	20.1	15.1	
					A3	21.0	16.1	
					A4	20.7	15.9	
CI					C1	20.2	18.6	TW6 is being denoted as 'C'
12	TW6 (@ 4.8 to 5.2m depth)	19.2	38.3	19.1	C2	21.6	14.3	
					C3	21.3	13.7	
					C4	21.5	15.0	
CI								

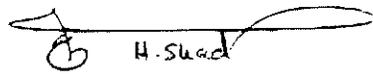
Test Conditions

BH #	Sample No.	Specimen #	Settlement during initial consolidation (mm)	Final Moisture Content%	Normal Loading (kPa)	Shear Rate (mm/min)	Remarks
18	TW9 (@ 9.2m depth)	A1	1.462	19.2	180	2.0	TW9 is being denoted as 'A'
		A2	1.504	19.3	180	0.008	
		A3	2.496	17.4	550	2	
		A4	2.838	17.7	550	0.008	
12	TW6 (@ 4.8 to 5.2m depth)	C1	2.054	20.6	180	2	TW6 is being denoted as 'C'
		C2	0.842	16.1	180	0.008	
		C3	3.010	15.0	550	2	
		C4	2.416	17.5	550	0.008	

Prepared By

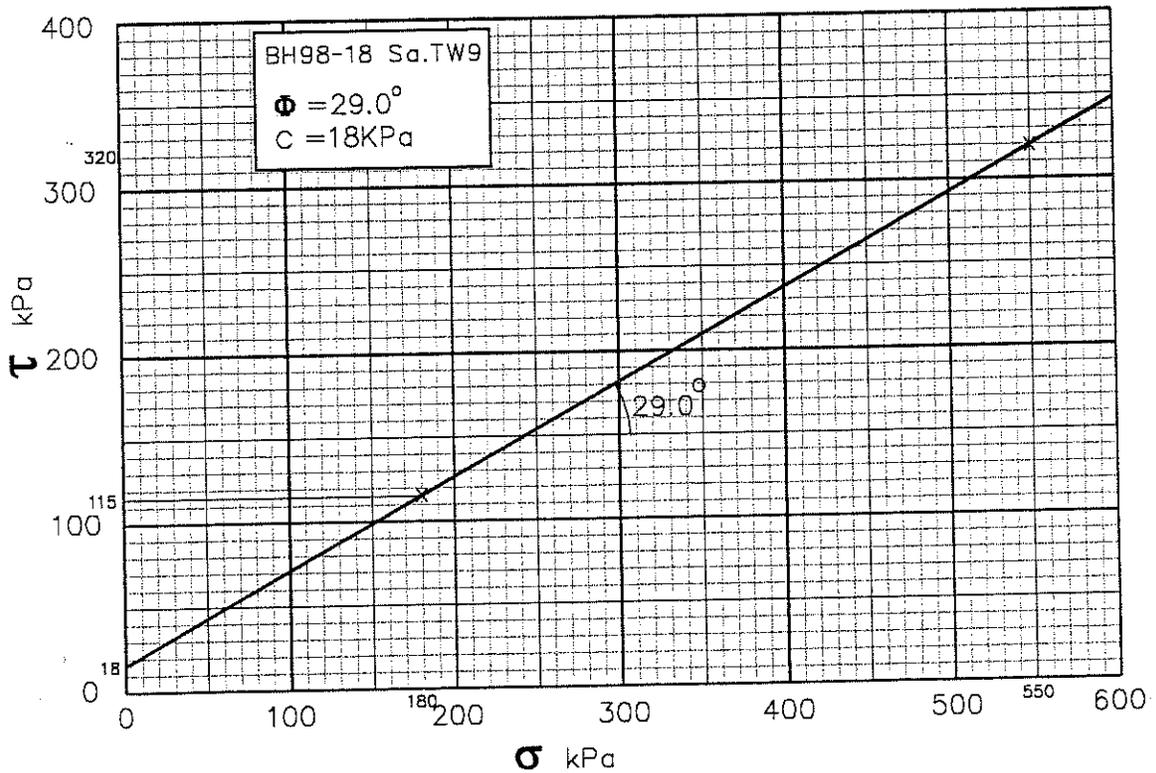
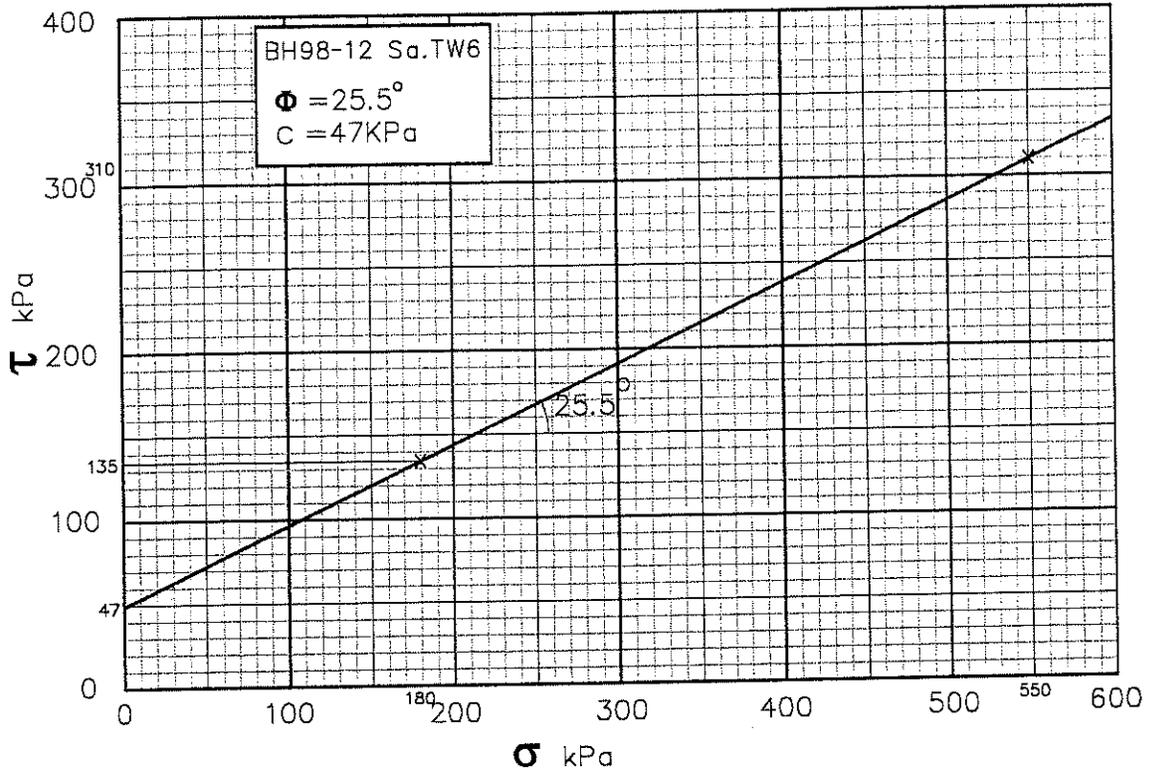
  
 S. Baskaran P. Eng.

Reviewed By

  
 Houshang Shad Ph.D.

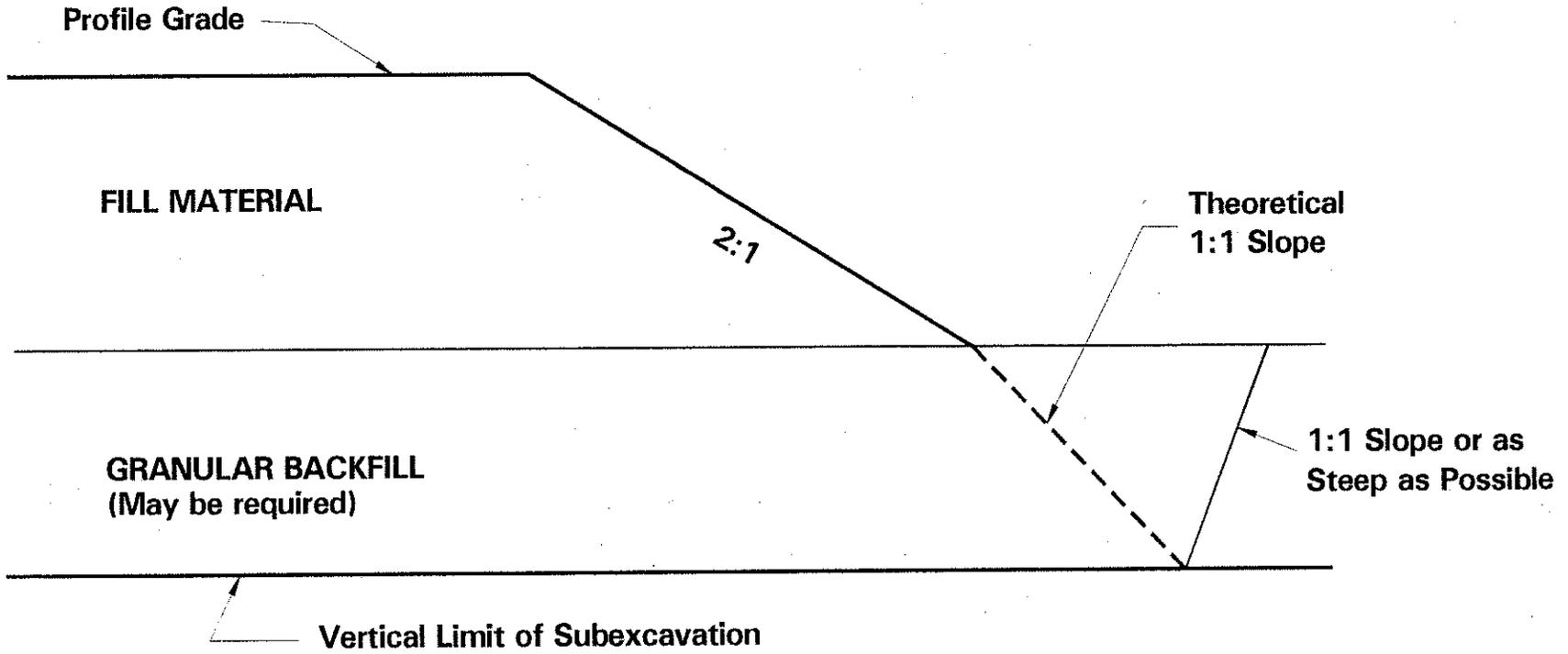
# SHEAR BOX TEST RESULTS

(Drained Condition)



## **APPENDIX “F”**

# **Removal of Unsuitable Soils from Beneath Approach Fills**



**REMOVAL OF UNSTABLE SOILS FROM BENEATH APPROACH FILLS**

NTS

# APPENDIX “G”

## Statement of Limitations

## LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Soils Engineer be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

The benchmark and elevations mentioned in this report were obtained strictly for use in the geotechnical design of the project and by this office only, and should not be used by any other parties for any other purposes.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. AGRA Earth & Environmental Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

This report does not reflect the environmental issues or concerns unless otherwise stated in the report. The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.