



**Geotechnical Investigation
Proposed Trunk Sewer Twinning
Hwy 403 & Main Street West
Hamilton, Ontario**

Prepared for:

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1. Introduction

Trow Associates Inc. (Trow) was retained by the City of Hamilton to conduct a geotechnical investigation for the proposed Trunk Sewer Twinning west of Hwy 403 and Main Street West intersection, in the City of Hamilton, Ontario.

It is understood that the proposed Trunk sewer Line will twin the existing 900 mm diameter trunk sewer line, which is running along the south side of the MTO Right Of Way (ROW), just west of Main Street West. It is also our understanding that the proposed sewer line will be installed by trenchless techniques.

The invert for the proposed line, based on our understanding, will be similar to the existing line, which ranges between 3.0 m (~ Elev. 82.5 m – BH - 12) and 6.1 m (~ Elev. 81.1 m – BH - 1) below the existing grade at the area investigated. The diameter of the proposed sanitary sewer is 900 mm and the investigated length will be approximately 450 m.

The purpose of this geotechnical investigation was to determine the subsurface soil and groundwater conditions at the site by drilling 12 boreholes (Borehole Nos. 1 through 12 inclusive), along the proposed sewer alignment to a depth ranging between 9.6 and 17.2 m below the existing grade, and based on this information, to provide an engineering report with geotechnical recommendations pertaining to the proposed construction.

The comments and recommendations given in this report are based on the assumption that the above-described design concept will proceed into construction. If changes are made either in the design phase or during construction, this office must be retained to review these modifications. The result of this review may be a modification of our recommendations or it may require additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint.

2. Site Description

The proposed Trunk Sewer Line is located at the area west of the intersection of Hwy 403 and Main Street West in the City of Hamilton, Ontario. The proposed alignment will be running parallel to the existing sewer line for approximately 600 m.

The area of the investigation was the south side of the Ministry of Transportation Right of Way (ROW) west of the Main Street West Overpass to Hwy 403. The east section of the proposed alignment is approximately 250 m stretch, located at the south side of the chain link fence south of Main Street West Exit Ramp, and north of the Hamilton Spectator Building. The ground surface at this section of the site is covered with grass (landscaped), and has a slope of approximately 2.1H:1V to 2.7H:1V. The west section of the proposed alignment extends for approximately 200 m into a valley. The valley is bounded from the north by a chain link fence, followed by Hwy 403 east bound lanes. A slope of approximately 2.6H:1V to 2.7H:1V bound the valley area from the south and west sides. The slope is followed by some industrial/commercial developments to the south and the McMaster Innovation Park to the southwest. A stream is present at the bottom of the valley and running in an east westerly direction into a box culvert below the Hwy 403 travel lanes. Some construction debris (i.e. chunks of concrete, pieces of reinforcement steel, and bricks) as well as rubber tires and garbage were scattered around the valley area. The area is heavily vegetated with mature trees, shrubs, and bushes. Evidence of an abandoned railroad tracks are present at the west edge of the valley area.

3. Investigation Program

3.1 Fieldwork

The fieldwork for this investigation was carried out between December 9, 2009 and January 14, 2010. Staging the Site for drilling was carried out on December 9, 10, and 11, 2009. The drilling operation was carried out on December 14, 23, 24, 2009, and January 11 through 15, 2010. In general accordance with the MTO specification, subsurface conditions were explored at 12 borehole locations (as illustrated on Drawing Nos.1A & B). Boreholes were advanced to termination depths that ranged from approximately 9.6 to 17.2 m below existing grades.

The fieldwork was supervised by a member of Trow's engineering staff who cleared the underground utilities, obtained the necessary permits, directed the drilling and sampling operations, documented the stratigraphy encountered at the boreholes, and observed the groundwater conditions. Drilling operations were carried out by a local contractor (Walker Drilling Ltd.) in compliance with the conditions of the MTO Encroachment Permit No. EC-2009-20T-244, dated October 14, 2009 and the MTO Temporary Conditions Manual Book 7.

Representative samples of the subsoils were recovered in the boreholes at 0.75 and 1.5 m depth intervals using a split spoon sampler driven in accordance with the Standard Penetration Test (SPT) procedure. All soil samples were preserved in plastic bags, labeled accordingly and returned to Trow's Hamilton laboratory for visual, textural and olfactory classification. The groundwater conditions in the open boreholes were closely monitored during and upon completion of drilling. In addition, piezometers were installed in Boreholes 2 and 13 for long term groundwater monitoring. The water levels in the piezometers were read on January 22, and January 29, 2010. All boreholes were backfilled upon completion of drilling with a bentonite mix as per MOE regulations, with the exception of the boreholes where piezometers were installed. The locations and ground surface elevations of the boreholes were established in the field by Trow.

3.2 Laboratory Testing

The geotechnical laboratory testing program consisted of the following:

- Natural moisture content determination on all recovered soil samples,
- Unit weight determination on selected cohesive soil samples,
- Undrained shear strength of cohesive samples using pocket penetrometer, and
- Atterberg limits and grain size analysis on selected samples

The laboratory test for determination of moisture content for soil samples was carried out in accordance to with the MTO Test Method LS-701. The test procedures were performed in accordance with ASTM Standard D2216.

The laboratory testing for Atterberg Limits (Liquid Limit, Plastic Limit, and Plasticity Index) were carried out in accordance with MTO Test Methods LS-703, and LS-704. The test procedure was performed in accordance with ASTM Standard D4318.

The laboratory test for particle size analysis of soil samples was carried out in accordance with MTO Test Method LS-702.

The results of the moisture content, unit weight, and Atterberg Limits tests are summarized on the borehole logs. The results of the Atterberg Limits tests and grain size analyses are shown plotted in Figures 1 to 16 attached in Appendix A.

4. Subsurface Conditions

4.1 Subsoil Conditions

Details of the fieldwork including soil descriptions, inferred stratigraphy, standard penetration 'N' values, and groundwater observations in the boreholes during and following completion of drilling are given on the Log of Borehole sheets, (Drawing Nos. 2 to 13).

It should be noted that the boundaries of soil indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect transition zones for the purposes of geotechnical design and should not be interpreted as exact planes of geological change. It should also be noted that the "Notes on Sample Description", preceding the borehole logs, forms an integral part of the report and should be read in conjunction with it.

A brief description of the soil stratigraphy encountered at the borehole locations is presented in the following sections.

4.1.1 Fill

Heterogeneous fill was encountered at the surface in all boreholes. The material generally consisted of clayey silt and/or silty clay mixed with some organics, sand and gravel. In Borehole No.11 sand and gravel deposit was encountered. This fill was also noted to contain some construction debris. The fill extended to a depth of between 1.5 m (~Elev. 84.2 m) and 7.6 m (~Elev. 77.2 m) below the existing grade. The standard penetration "N" values ranged between 0 and 35 blows per 305 mm of penetration, indicating very loose to dense in compactness. It should be noted that the elevated "N" values are likely due to the existence of gravel and/or debris within the fill layer. The moisture contents were in the order of 10 to 54%.

4.1.2 Possible Fill

In Borehole No. 10 below the fill 2.3 m thick grey silty clay with organic inclusions was detected. We classified this material as possible fill. The standard penetration blow counts were in the order of 3 to 4 blows per 305 mm penetration, indicating soft consistency. The unit weight was 18.8 kN/m^3 , and the natural moisture content was in the order of 29 to 31%. Atterberg limits were 26.7% for liquid limit, 20.5% for plastic limit, and 6.2% for plastic index.

4.1.3 Silty Clay

The fill and possible fill in all boreholes, was underlain by a greyish brown to grey silty clay deposit. Generally, this is a well graded deposit composed of 0 to 2% gravel, 6 to 39% sand, 12 to 44% silt, and 47 to 62% clay size particles. The unit weight for this deposit ranged from 19 to 20 kN/m^3 .

The natural moisture content of the native silty clay ranged from 12 to 32%. The liquid limit, plastic limit, and plasticity index of eight samples of the silty clay deposit were found to range from 20 to 27%, 15 to 21%, and 5 to 10, respectively. These results are typical of inorganic clays of low plasticity.

The native silty clay in Borehole No.1 was underlain by brown to greyish clayey silt. The standard penetration blow count was 22 blows per 305 mm of penetration, indicating very stiff consistency. The natural moisture content was 15%.

4.2 Groundwater Conditions

Groundwater conditions were assessed in the open boreholes during the course of the fieldwork. Table 1 below summarizes our observations during and shortly upon the completion of drilling.

**Table 1: Water Level Measurements in the Drilled Boreholes
upon the completion of Drilling**

BH No.	Depth of Borehole	Groundwater Depth/Elevation (m)	Depth to Cave (m)
BH1	17.2 m	2.3 / 77.6	No cave
BH2	12.2 m	8.6/78.7	No cave
BH3	11.1 m	No free water	No cave
BH4	11.1 m	3.7/81.9	4.0
BH5	11.1 m	3.0/82.6	3.3
BH6	9.6 m	5.0/80.1	5.4
BH7	9.6 m	No free water	No cave
BH8	9.6 m	5.0/79.6	7.3
BH9	9.6 m	3.2/81.6	6.7
BH10	9.6 m	1.6/83.5	7.3
BH11	11.1 m	1.3/84.2	2.4
BH12	9.6 m	No free water	No cave

These short term observations may not represent the true groundwater conditions at this site due to the short period of observation and the low permeability of the site soils. However, the color change of the silty clay in the boreholes from brown to grey may indicate stabilized groundwater conditions at these locations.

Piezometers were installed in Boreholes 2 and 12, and the water levels in the piezometers were measured on January 22 and 29, 2010, with the results shown in Table 1 below.

Table 2: Water Level Measurements in the Installed Piezometer

BH No.	Depth of Borehole	Groundwater Depth/Elevation (m) January 22, 2010	Groundwater Depth/Elevation (m) January 29, 2010
BH2(P1)	12.2 m	5.5/81.0	4.6/81.9
BH12(P2)	9.6 m	8.0/79.2	Piezometer was damaged

In the long term, seasonal fluctuations of the groundwater level and change in response to major weather events at the site should also be anticipated.

5. Discussions and Recommendations

5.1 Engineering Evaluation of Subsurface Conditions

The stratigraphy comprises heterogeneous fill material, consisting mainly of clayey silt/silty clay, and sand and gravel (Boreholes 8 and 11). The fill extended to a depth ranged between 1.5m and 7.6 m below the existing grade, but was more typically noted to be between 1.5 to 3.0 m. The fill was underlain by an inorganic low plasticity silty clay deposit with very soft to stiff/hard consistency at the upper portion. However, the lower portion of the silty clay deposit is generally firm and becomes more plastic with depth. Groundwater level at the time of the investigation was inconsistent i.e. 1.3 m (BH-11) and 8.6 m (BH -2), below existing ground surface.

5.2 Comments on the Sewer Line Installation using Trenchless Technique

We understand that the invert of the proposed 900 mm diameter sanitary sewer will be between Elevation 81.1 m (BH-1) and 82.5 m (BH12). The length of the proposed sewer line within the investigated area will be approximately 450 m. The diameter of the proposed tunnel including the liner is expected to be in the order of 1500 mm.

Trenchless Technique is being considered as the installation method for the sewer line.

Based on the borehole data, we anticipate that the drill hole for the proposed installation of the new sewer will encounter mostly stiff to very stiff silty clay (Borehole Nos. 1, 2, 3, 4), loose to compact silty sand/sand and gravel fill (Borehole Nos. 5, 9, and 11), and generally soft to firm clayey silt/silty clay fill (Borehole Nos. 6, 7, 8, 10, and 12).

The silty clay has a slight apparent cohesion, and is classified as squeezing soil, while the silty sand/sand and gravel fill is classified as flowing soil in Terzaghi's Tunnelman's Ground Classification. At the proposed invert depth, the undrained shear strength for the native silty clay is estimated to be in the range of 50 to 170 kPa.

The overload factor (ratio of overburden pressure at spring line to undrained shear strength of the clay) is less than 2. However, the silty clay below the ground water table and/or the heterogeneous fill materials would not be stable at the face or crown of an unsupported tunnel.

Microtunneling should be feasible to install the proposed sewer line. Microtunneling is a 2-stage process, which provides continuous support to the excavation face. The Microtunneling Boring Machine (MTBM) should be equipped with a slurry spoil removal system to control the ground water inflow and counterbalance the earth and hydrostatic pressure while tunneling through the mixed face conditions. The mixed face and/or changing face condition consisting of flowing sand/sand and gravel over stiff clay layer can result in an overexcavation of the flowing cohesionless soil as the stiff clay is excavated. The over excavation of the flowing soil can result in ground settlement. Overexcavation can be minimized with very careful control of the slurry pressure and rate of excavation by the operator. The presence of cobbles and boulders, which

could be up to 0.3 m or larger could be expected within the fill layer. Past experience indicates that boulders size up to about 20 to 30% the drill hole diameter could be pushed to the side or removed by the drilling fluid, but larger boulders must be broken down into smaller pieces before they can be removed. The boulders are much harder than the soil matrix and will cause more wear and tear to the cutting head.

If alignment and grades are not critical, horizontal directional drilling (HDD) may be considered for sewer installation, provided the drill hole is at all times supported with a properly designed drilling fluid. The drilling fluid should be designed by a specialist contractor, based on such factors as the soil type, diameter and depth of the opening, rate of drilling etc., and may have to be adjusted as construction proceeds. The fluid pressure should not exceed the in situ overburden pressure. Higher pressure could cause fracturing of the clay and loss of the drilling fluid, which in turn could cause instability and even collapse of the drill hole. The cutting tool and the drilling fluid must be able to handle the different materials and the mixed face condition. However, alignment and grade control could be difficult as the drill hole passes from the clay to the fill section, as such, the HDD method may not be suitable for typical sewer application where alignment and grade control is required.

With good construction control and no loss of drilling fluid, settlement at the area directly above the center line of the drill hole should be kept at minimum. However, due to the tunnel excavation into a sloped area, especially at the west section of the proposed alignment, settlement monitoring procedure should be carried out for the adjacent property at the top of the slope and the method and equipment of construction modified as necessary. Trow will be pleased to provide further recommendations for the monitoring program when requested.

5.3 Construction Aspects

During the planning and design stages all aspects of construction require consideration, including temporary support provisions, excavation methods, ground improvement techniques, and in urban areas, the need to control on the surrounding structures.

5.4 Excavation

Excavation will be required for Manhole(s) installation, ingress and egress shafts. Based on the results of the investigation, the excavation for the most part will generally be carried out within the clayey silt/silty clay – sand and gravel mixed fills, and partially in the natural deposits of silty clay. It should be noted that the conditions can be significantly different from those indicated in the boreholes if there are existing service trenches immediately adjacent to the excavations. If such is the case, more filling material should be anticipated during excavations. It is mandatory that the excavation must comply with the requirements of the current Occupational Health and Safety Act (OHSA). For guidance the native silty clay is considered to be a Type 2 soil and the fill portion is considered as a Type 3 soil. According to the OSHA regulations if an excavation contains more than one type of soil, the soil shall be classified as the type with the highest number. The silty clay should therefore, be classified as Type 3 soil for this site.

The OSHA requires that excavation slopes be cut at predetermined inclinations, based on the soil types. Locally, where loose/soft materials are encountered, or within zones of persistent seepage at depth, it may be necessary to flatten the side slopes further. It is anticipated that excavations can be carried out in open cuts using conventional large backhoe type equipment. Side slopes of temporary excavations must conform to the most recent Occupational Health and Safety Act (OHSA) and local regulations.

5.5 Backfilling Operations

Backfill used around manholes should consist of approved free draining granular material.

The excavated native soils are expected to be a cohesive, which is likely to be blocky in nature and would be difficult to compact in confined areas or where large compactors cannot be used. The soil will also require partial drying to reach the optimum moisture. The use of this material should therefore be limited. Imported granular or other non-cohesive soils should be considered.

Backfilling procedures and materials should also meet the provincial and local requirements and specifications.

Any organic, excessively wet, or otherwise deleterious material should not be used for backfilling purposes. Any shortfall of suitable on-site excavated material can be made up with imported and approved materials.

Backfill should be placed in lifts not exceeding 250 mm and compacted to satisfy the local and provincial requirements.

All backfill and compaction operations should be monitored by qualified geotechnical personnel to approve material, to evaluate placement operations, and to verify that the specified degree of compaction is being achieved throughout the fill.

6. Environmental Testing Results

Chemical analysis for metals and inorganics as carried out on selected samples and suspected fill materials encountered during our geotechnical investigation. It is our understanding that the environmental testing was requested to determine disposal options for excess soil generated during the construction of the proposed municipal services.

Fourteen (14) samples, including two (2) duplicate samples, were submitted for metals and inorganics analysis. A summary of the soil sample locations and approximate depths is provided in the following Table 3.

Table No. 3
Sample Locations and approximate depths

Sample ID	Sample Location	Depth Below the Existing Grade (m)	Parameter Tested
BH1 (5-6½)	Borehole No. 1	1.5-2.0	Metals and Inorganics
BH2 (5-6½)	Borehole No. 2	1.5-2.0	Metals and Inorganics
BH3 (2½-4)	Borehole No. 3	0.8-1.2	Metals and Inorganics
BH103 (2½-4)	Duplicate of Borehole No. 3	0.8-1.2	Metals and Inorganics
BH4 (2½-4)	Borehole No. 4	0.8-1.2	Metals and Inorganics
BH5 (7½-9)	Borehole No. 5	2.3-2.7	Metals and Inorganics
BH6 (5-6½)	Borehole No. 6	1.5-2.0	Metals and Inorganics
BH7 (5-6½)	Borehole No. 7	1.5-2.0	Metals and Inorganics
BH8 (10-11½)	Borehole No. 8	3.0-3.5	Metals and Inorganics
BH9 (2½-4)	Borehole No. 9	0.8-1.2	Metals and Inorganics
BH109 (2½-4)	Duplicate of Borehole No. 9	0.8-1.2	Metals and Inorganics
BH10 (5-6½)	Borehole No. 10	1.5-2.0	Metals and Inorganics
BH11 (7½-9)	Borehole No. 11	2.3-2.7	Metals and Inorganics
BH12 (5-6½)	Borehole No. 12	1.5-2.0	Metals and Inorganics

6.1 Regulation 153 Metals and Inorganics

6.1.1 General

As part of this investigation soil samples were submitted for chemical analysis for metals and inorganics, which is required to determine disposal options for excess material generated during construction.

The assessment criteria, Site Condition Standards (SCS), applicable to a given site in Ontario are established under subsection 168.4(1) of the Environmental Protection Act. Tabulated generic criteria are provided in “Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act” (“the SGWS Standards”), MOE, March 2004. These criteria are based on site sensitivity (sensitive or non-sensitive), groundwater use (potable or non-potable), property use (residential, parkland, institutional, commercial, industrial, community and agricultural/other), soil type (coarse or medium/fine textured) and restoration depth (full or stratified restoration). In addition, site specific criteria may be established on the basis of the findings of a Risk Assessment carried out in accordance with Part IX and Schedule C of Ontario Regulation 153/04 (O.Reg. 153/04).

The SGWS Standards specify SCS for soil, groundwater and sediment that are tabulated as follows:

Table 1 – applicable to sites where background concentrations must be met (full depth) such as sensitive sites where site-specific criteria have not been derived;

Table 2 – applicable to sites with potable groundwater and full depth restoration;

Table 3 – applicable to sites with non-potable groundwater and full depth restoration;

Table 4 – applicable to sites with potable groundwater and stratified restoration;

Table 5 – applicable to sites with non-potable groundwater and stratified restoration; and,

Table 6 – used to determine if a site with less than 2 m of overburden above bedrock is a sensitive site or not.

For assessment purposes, Trow compared the analytical results to the Table 1 and Table 3 SCS for all types of property use.

During the field investigation all soil samples were placed in sealed plastic bags. Soil samples selected for laboratory analysis were transported to our subcontracted laboratory, Maxxam Analytics (Maxxam) of Mississauga, Ontario, in the laboratory supplied glass jars. The samples were transported/submitted under Chain of Custody documentation.

6.1.2 Results

Certificates of Analysis for the soil chemistry results are presented in Appendix B.

The analytical results of soil samples analysed for pH were within the Table 3 SCS range between 5 to 9.

Table 4 below indicates exceedences under the specified O. Reg. 153 Table:

Table 4: Soil Exceedences

Sample ID	Soil Type	Exceeding Parameter	O. Reg. 153 Table	Property Use
BH1 (5-6½)	Silty clay fill	SAR	1	Agricultural
		Conductivity	1	All property uses
BH2 (5-6½)	Silty clay fill	SAR	1	Agricultural
BH3 (2½-4)*	Clayey silt fill	SAR	1	All property uses
		Conductivity	1	Agricultural
BH9 (2½-4)*	Clayey silt fill	Antimony	1	All property uses
		Arsenic	3**	All property uses
		Barium	1	All property uses
BH11 (7½-9)	Sand and gravel fill	Arsenic	1	Agricultural

Notes: SAR – Sodium Adsorption Ratio

* The results of BH3 and BH9 are based on the average of the original sample and the duplicate sample.

** Where an exceedence of MOE Table 3 is noted, the same parameter exceeds for all property uses under Table 1.

All other detectable concentrations of metals and inorganics are below the applicable O.Reg. 153 Table 1 and Table 3 for all types of property use. A summary of the analytical data is provided in Appendix A.

The analytical results indicate that any excess material in the vicinity of Borehole No. 9 should be disposed of at a registered landfill. Depending on landfill requirements, a Toxicity Characteristic Leaching Procedure (TCLP) should be conducted on the soil in the area of Borehole No. 9 to determine if the soil is non-hazardous. It should be noted that each landfill may have their own specific requirements for waste acceptance.

Two field duplicate soil samples were collected and analyzed for metals and inorganics. The soil samples labeled “BH103 (2½-4)” and “BH109 (2½-4)” in the laboratory Certificate of Analysis are duplicates of soil samples “BH3 (2½-4)” and “BH9 (2½-4)”, respectively.

The analytical results of the soil duplicate samples generally follow similar trends with their respective soil samples; however the results of the soil duplicate samples are not considered to be in acceptable range for relative percent difference (RPD) for several parameters. This is likely to due soil heterogeneity.

7. General Comments

The information presented in this report is based on a limited investigation designed to provide information to support an overall assessment of the current geotechnical conditions of the subject property. The conclusions presented in this report reflect site conditions existing at the time of the investigation. The results reflect only limited environmental conditions of the site or subsoil.



The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigation, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.



Trow Associates Inc. should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, Trow Associates Inc. will assume no responsibility for interpretation of the recommendations in the report.

We trust this information is satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

Yours very truly,

Trow Associates Inc.



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Geotechnical Division Manager


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3/30/10
PROVINCE OF ONTARIO

Drawings:
Drawings 1 A&B: Borehole Location Plan
Drawings 2 to 13: Borehole Logs

403 EASTBOUND

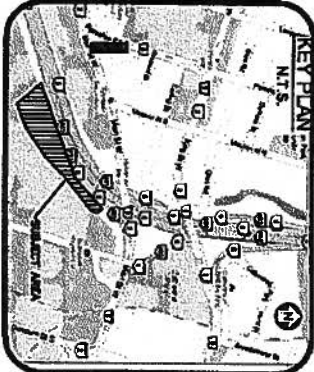


MAIN STREET ROAD

SEE DWG No. 1B



BOREHOLE NO.	NORTHING	EASTING	ELEVATION
BH 12	4790064.28	588459.00	85.50
BH 11	4790062.25	588487.91	85.50
BH 10	4790067.58	588507.19	85.10
BH 9	4790074.50	588532.25	84.80
BH 8	4790089.41	588575.98	84.70
BH 7	4790125.58	588608.63	85.30
BH 6	4790142.40	588618.75	85.10
BH 5	4790160.51	588651.22	85.60
BH 4	4790190.78	588703.39	85.60
BH 3	4790223.63	588736.69	85.70
BH 2	4790260.45	588774.32	87.30
BH 1	4790298.88	588813.05	87.20

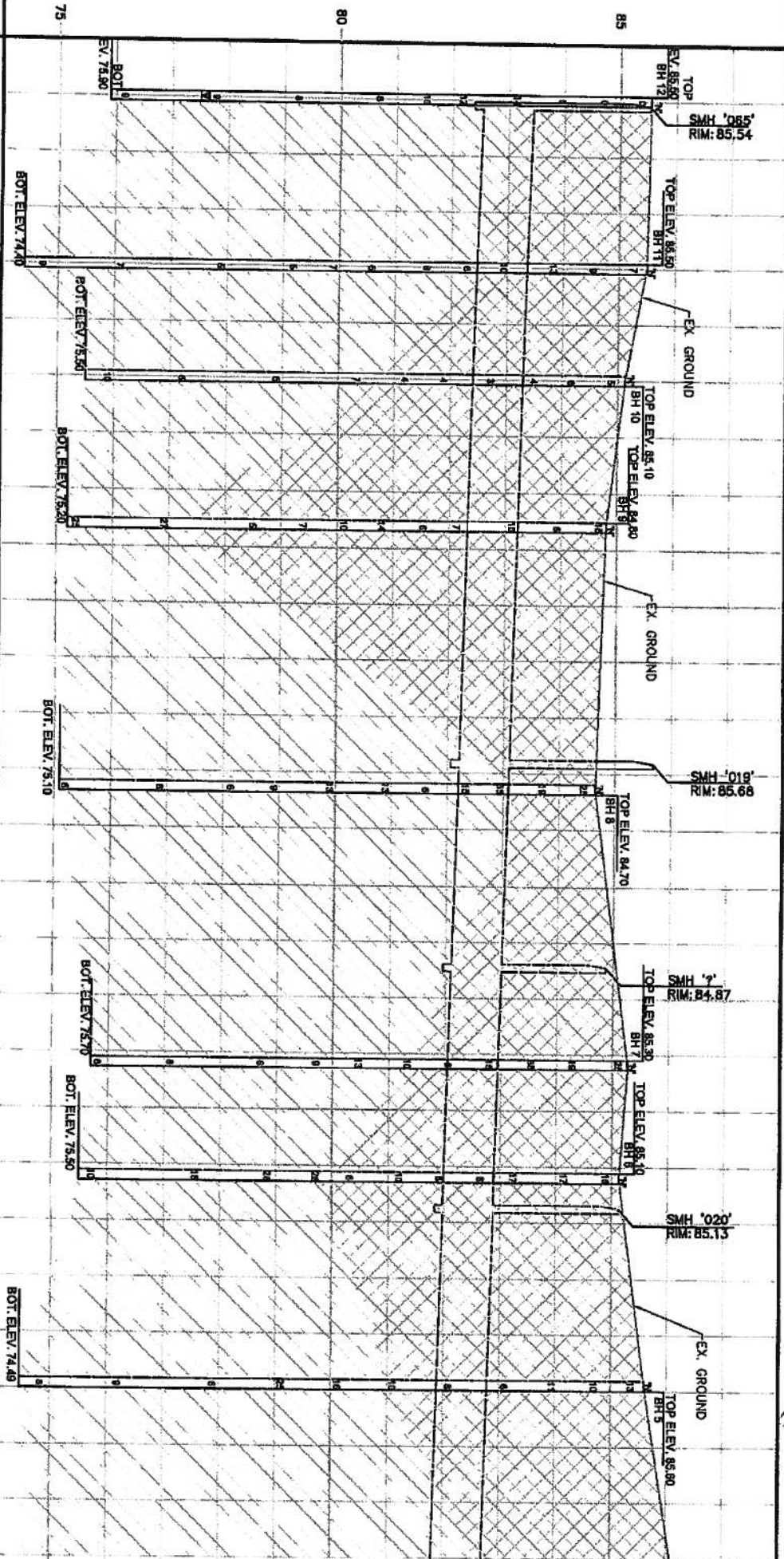


LEGEND

- BH 5 SANITARY MANHOLE
- SANITARY SEWER
- BORISHE LOCATION
- BLDN/BLDN (Std. Pen. Test, 475 J/blow)
- W WATER LEVEL

SOIL STRATA SYMBOLS

- PILE
- SILTY CLAY
- CLAYEY SILT



75 80 85

NOTE:
SEWER ELEVATIONS ARE PROVIDED FOR REFERENCE PURPOSES ONLY. CERTAIN INFORMATION IS ASSUMED. TROW ASSOCIATES INC. ACCEPTS NO LIABILITY FOR THE APPLICATION OF THESE GRADES TO FURTHER WORKS.

NOTES:
BORISHE: KING STREET BRIDGE OVER HIGHWAY NO. 403, 10.7m EAST OF HOUSE NO. 724, TABLET IN SOUTH FACE OF GROUND WALL AT WEST END OF BRIDGE ON NORTH SIDE OF ROAD, 0.6m FROM WEST END, 0.6m BELOW TOP.
BH 1-BH 12 ELEVATION 84.55m (310.233 ft.)

SCALE:
DRAWN BY: DS
CHECKED BY: DS
DATE: JANUARY 2010

PROJECT NO.:
2082

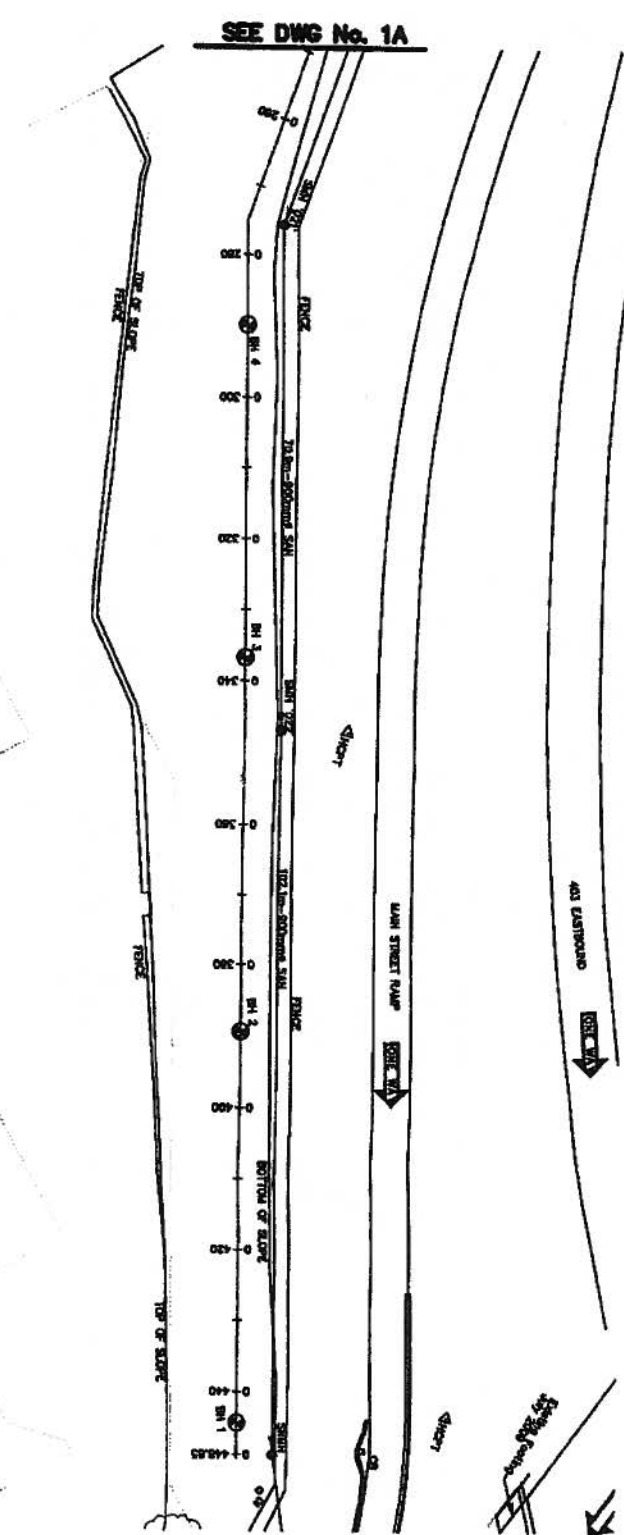
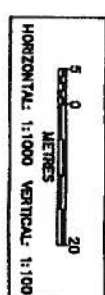
DATE:
1A

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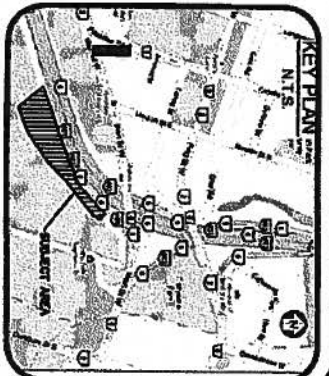
BORISHE LOCATION PLAN
HWY 403 TRUNK SEWER
PLAN AND PROFILE
0+000.00 TO 0+260.00

SANITARY INVERT DATA	114.8m-900mm ³ SAN	35.1m-900mm ³ SAN	44.4m-900mm ³ SAN	78.1m-900mm ³ SAN
82.54	82.24	81.10	81.10	81.10

X-REF. - 04/01/20	
ROAD VERTICAL	ROAD HORIZONTAL
85.54	0+000
86.20	0+020
85.82	0+040
85.00	0+060
84.74	0+080
84.39	0+100
84.64	0+120
84.68	0+140
85.13	0+160
85.22	0+180
85.44	0+200
86.22	0+220
86.39	0+240
86.08	0+260



BOREHOLE NO.	NORTHING	EASTING	ELEVATION
BH 12	479054.28	589458.00	85.50
BH 11	479052.25	589487.91	85.50
BH 10	479057.58	589507.19	85.10
BH 9	479074.50	589532.25	84.80
BH 8	479089.41	589575.98	84.70
BH 7	479125.98	589608.63	85.30
BH 6	479142.40	589619.75	85.10
BH 5	479180.51	589651.22	85.60
BH 4	479190.78	589703.38	85.60
BH 3	479223.63	589736.69	85.70
BH 2	479260.45	589774.32	87.30
BH 1	479298.88	589813.65	87.20



- LEGEND
- BH 5 SANITARY MANHOLE
 - BH 7 SANITARY SEWER
 - BOREHOLE LOCATION
 - W BLOW/0.3m (Std. Pen. Test, 475 J/blow)
 - W WATER LEVEL

- SOIL STRATA SYMBOLS
- FILL
 - SILTY CLAY
 - CLAYEY SILT

REMARKS:
LONG STREET BRIDGE OVER HIGHWAY No. 403, 10.2m EAST OF HOUSE No. 734, TABLET IN SOUTH FACE OF GUARD WALL AT WEST END OF BRIDGE ON NORTH SIDE OF ROAD, 0.6m FROM WEST END, 0.9m BELOW TOP.
No. 65-U-021, ELEVATION 84.559m (310.233 ft.)

NOTE:
SEWER ELEVATIONS ARE PROVIDED FOR INFORMATION PURPOSES ONLY; CERTAIN TROW ACCEPTS NO LIABILITY FOR THE APPLICATION OF THESE GRADES TO FURTHER WORKS.

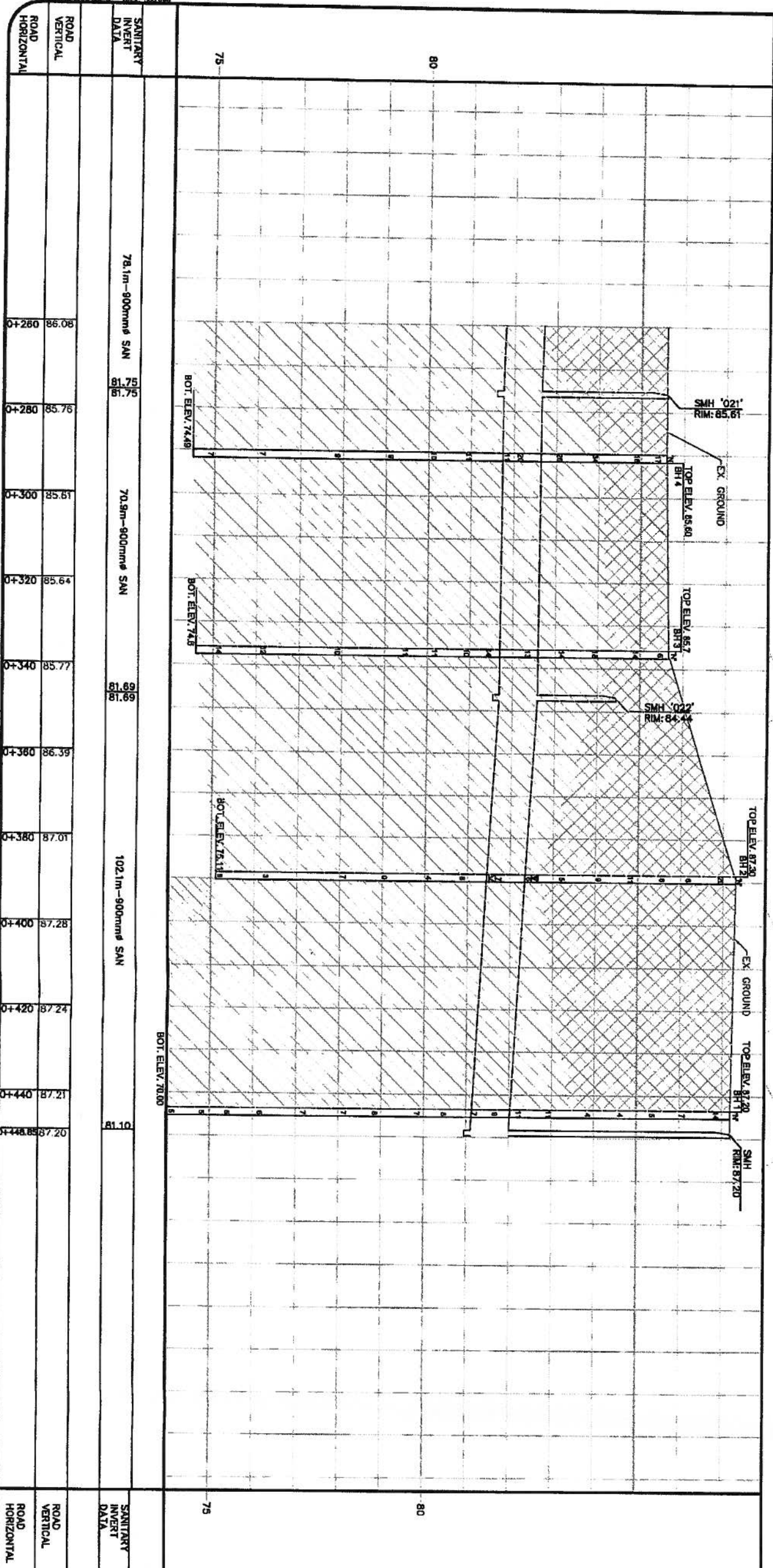
NO.	Revision	Date	By	Approved

NOT FOR CONSTRUCTION, ASSESS, STAKEOUT AND QUOTE
CITY OF HAMILTON
BOREHOLE LOCATION PLAN
HWY 403 TRUNK SEWER
PLAN AND PROFILE
0+260.00 TO 0+448.95

Trow Associates Inc.

90 SANDHURST STREET
VALENTIA, ONTARIO
L6E 2N5
TEL: 905-573-4400
FAX: 905-573-7885

SCALE:	HORIZONTAL: 1:500	VERTICAL: 1:50
DESIGNED BY:	DS	PROJECT NO.
CHECKED BY:	AS	2082
DATE:	JANUARY 2010	DRAWING NO.
		1B



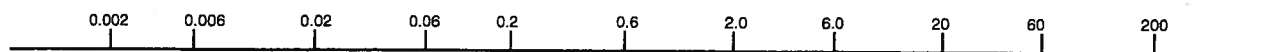
SANITARY INVERT DATA	78.1m-900mm \varnothing SAN	81.75 81.75	70.9m-900mm \varnothing SAN	81.69 81.69	102.1m-900mm \varnothing SAN	81.10	SANITARY INVERT DATA																
ROAD VERTICAL	0+260	85.08	0+280	85.76	0+300	85.81	0+320	85.64	0+340	85.77	0+360	86.39	0+380	87.01	0+400	87.28	0+420	87.24	0+440	87.21	0+448.85	87.20	ROAD VERTICAL
ROAD HORIZONTAL																						ROAD HORIZONTAL	

Notes On Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by Trow Consulting Engineers Limited also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE			MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)				SAND		GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.
3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

RECORD OF BOREHOLE No 1

SHEET 1 OF 1

METRIC

PROJECT NO. HAGE00392871A

LOCATION N4790288.88, E589813.65

ORIGINATED BY A.M.

DIST Central HWY 403

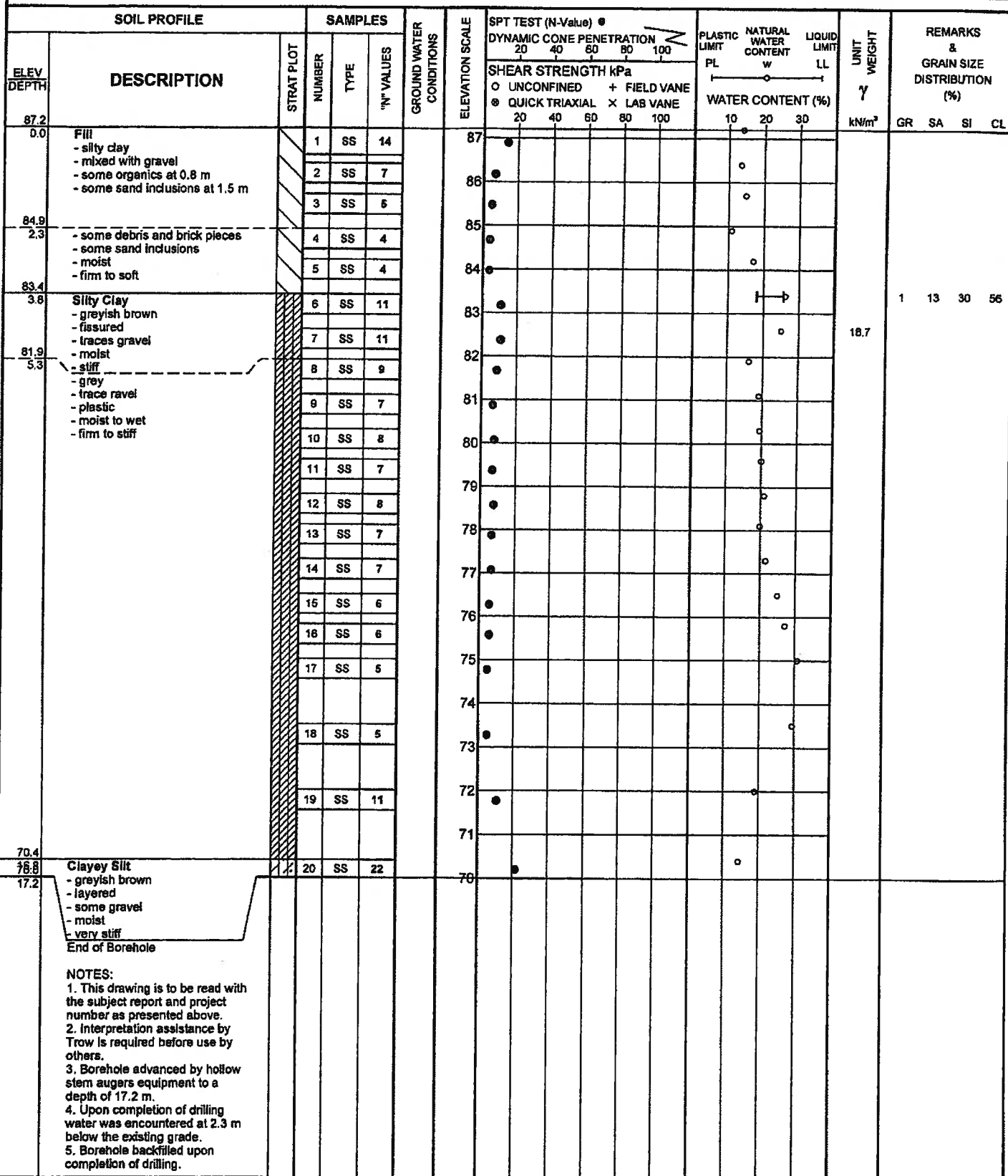
BOREHOLE TYPE Hollow Stem Augers

COMPILED BY A.A.

DATUM GEODETIC

DATE 12/14/2009 - 12/14/2009

CHECKED BY



NOTES:

1. This drawing is to be read with the subject report and project number as presented above.
2. Interpretation assistance by Trow is required before use by others.
3. Borehole advanced by hollow stem augers equipment to a depth of 17.2 m.
4. Upon completion of drilling water was encountered at 2.3 m below the existing grade.
5. Borehole backfilled upon completion of drilling.

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



Trow Associates Inc.
80 Bancroft Street
Hamilton, ON L8E 2W5

RECORD OF BOREHOLE No 2

SHEET 1 OF 1

METRIC

PROJECT NO. HAGE00392871A LOCATION N4790260.45, E589774.32 ORIGINATED BY A.M.
DIST Central HWY 403 BOREHOLE TYPE Hollow Stem Augers COMPILED BY A.A.
DATUM GEODETIC DATE 1/11/2010 - 1/11/2010 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	SPT TEST (N-Value) *		DYNAMIC CONE PENETRATION	PLASTIC LIMIT PL	NATURAL WATER CONTENT w	LIQUID LIMIT LL	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
87.3 0.0	Fill - silty clay - mixed with some organics - wooden logs, gravel - moist to wet - firm to stiff		1	SS	20		87															
82.7 4.6			2	SS	6		86															
81.2 6.1			3	SS	8		85															
			4	SS	11		84															
			5	SH	9		83															
			6	SS	5		82															
81.2 6.1	Silty Clay - greyish brown - fissured - silt and sand seams - some gravel - moist - firm - grey - layered - plastic - moist to wet - very soft to firm		7	SS	6		81															
80			8	SS	7		80															
79			9	SS	6		79															
78			10	SS	4		78															
77			11	SS	0		77															
76			12	SS	7		76															
75.1 12.2			13	SS	3		75															
75.1 12.2	End of Borehole		14	SS	8																	

NOTES:
1. This drawing is to be read with the subject report and project number as presented above.
2. Interpretation assistance by Trow is required before use by others.
3. Borehole advanced by hollow stem augers equipment to a depth of 12.2 m.
4. upon completion of the drilling a 25 mm (1 inch) diameter P.V.C. standpipe was installed to 7.6 m depth; screened portion from 4.6 to 7.6 m depth, sand filter pack from 4.3 to 7.6 m depth, bentonite seal from 0.0 to 4.3 m depth.

ON MOT LOGS_MTO.GPJ ON MOT.GDT 2/18/10

+3, X3. Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE



Trow Associates Inc.
80 Bancroft Street
Hamilton, ON L8E 2W5

RECORD OF BOREHOLE No 3

SHEET 1 OF 1

METRIC

PROJECT NO. HAGE00392871A

LOCATION N4790223.63, E589736.69

ORIGINATED BY A.M.

DIST Central HWY 403

BOREHOLE TYPE Solid Stem Augers

COMPILED BY A.A.

DATUM GEODETIC

DATE 12/23/2009 - 12/23/2009

CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	SPT TEST (N-Value) •		PLASTIC LIMIT PL	NATURAL WATER CONTENT w	LIQUID LIMIT LL	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			DYNAMIC CONE PENETRATION 20 40 60 80 100	WATER CONTENT (%)					
85.7 0.0	Fill - clayey silt - brown to grey - mixed with organics - some sand - moist to wet - firm to stiff		1	SS	8								
84.2 1.5	Silty Clay - greyish brown - fissured to layered at 2.3 m - silt and sand seams - trace gravel - moist to wet - stiff		2	SS	14							19.4	
			3	SS	18								
			4	SS	14								
			5	SS	13								
			6	SS	14								
			7	SS	10							20.2	
			8	SS	11								
			9	SS	11								
			10	SS	10								
			11	SS	12								
74.8 11.1	End of Borehole		12	SS	14								
NOTES: 1. This drawing is to be read with the subject report and project number as presented above. 2. Interpretation assistance by Trow is required before use by others. 3. Borehole advanced by solid stem augers equipment to a depth of 11.1 m. 4. Upon completion of drilling water was not encountered. 5. Borehole backfilled upon completion of drilling.													

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



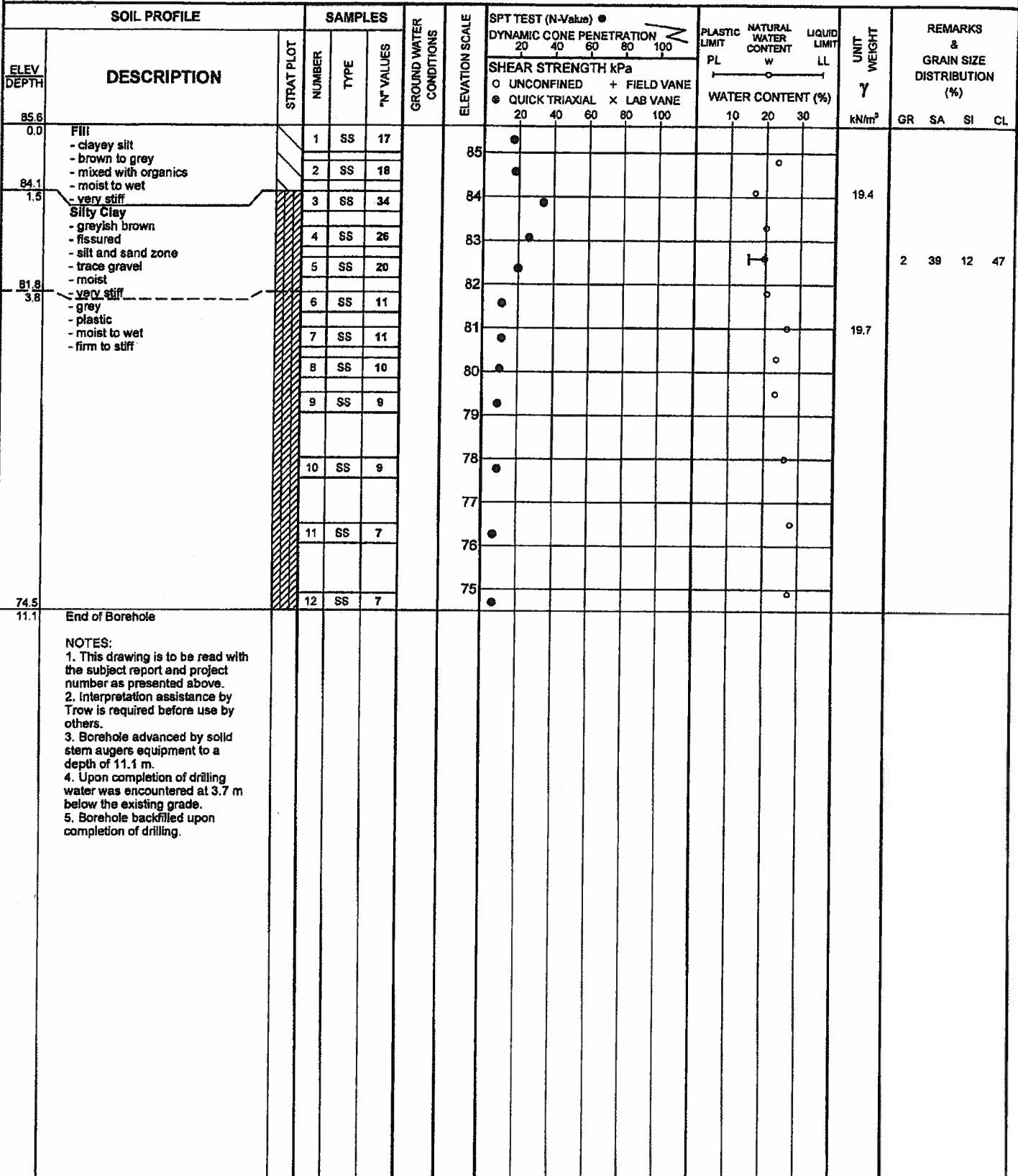
Trow Associates Inc.
80 Bancroft Street
Hamilton, ON L8E 2W5

RECORD OF BOREHOLE No 4

SHEET 1 OF 1

METRIC

PROJECT NO. HAGE00392871A LOCATION N4790190.78, E589703.39 ORIGINATED BY A.M.
DIST Central HWY 403 BOREHOLE TYPE Solid Stem Augers COMPILED BY A.A.
DATUM GEODETIC DATE 12/23/2009 - 12/23/2009 CHECKED BY _____



NOTES:
1. This drawing is to be read with the subject report and project number as presented above.
2. Interpretation assistance by Trow is required before use by others.
3. Borehole advanced by solid stem augers equipment to a depth of 11.1 m.
4. Upon completion of drilling water was encountered at 3.7 m below the existing grade.
5. Borehole backfilled upon completion of drilling.

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



Trow Associates Inc.
80 Bancroft Street
Hamilton, ON L8E 2W5

RECORD OF BOREHOLE No 5

SHEET 1 OF 1

METRIC

PROJECT NO. HAGE00392871A LOCATION N4790160.51, E589651.22 ORIGINATED BY A.M.
DIST Central HWY 403 BOREHOLE TYPE Solid Stem Augers COMPILED BY A.A.
DATUM GEODETIC DATE 12/23/2009 - 12/23/2009 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	SPT TEST (N-Value) • DYNAMIC CONE PENETRATION		PLASTIC LIMIT PL	NATURAL WATER CONTENT w	LIQUID LIMIT LL	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
85.6 0.0	Fill - clayey silt - brown - some organics - some gravel - moist to wet - stiff - silty sand - clay seams - wet - compact to loose		1	SS	13								20.0	0 6 44 50	
84.1 1.5			2	SS	10										
			3	SS	11										
			4	SS	6										
			5	SS	8										
			6	SS	10										
81.0 4.8	Silty Clay - grey - traces gravel - moist to wet - stiff to very stiff		7	SS	11										
			8	SS	16										
			9	SS	25										
79.5 6.1	- saturated silt and sand zone - compact														
78.0 7.6	- silty clay - plastic - moist to wet - firm to stiff		10	SS	6										
			11	SS	9										
74.5 11.1	End of Borehole		12	SS	8										
NOTES: 1. This drawing is to be read with the subject report and project number as presented above. 2. Interpretation assistance by Trow is required before use by others. 3. Borehole advanced by solid stem augers equipment to a depth of 11.1 m. 4. Upon completion of drilling water was encountered at 3.0 m below the existing grade. 5. Borehole backfilled upon completion of drilling.															

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



Trow Associates Inc.
80 Bancroft Street
Hamilton, ON L8E 2W5

RECORD OF BOREHOLE No 6

SHEET 1 OF 1

METRIC

PROJECT NO. HAGE00392871A LOCATION N4790142.40, E589619.75 ORIGINATED BY A.M.
DIST Central HWY 403 BOREHOLE TYPE Solid Stem Augers COMPILED BY A.A.
DATUM GEODETIC DATE 12/24/2009 - 12/24/2009 CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	SPT TEST (N-Value) ● DYNAMIC CONE PENETRATION 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT PL	NATURAL WATER CONTENT W	LIQUID LIMIT LL	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
85.1 0.0	Fill - clayey silt - brown to grey - mixed with some sand - some gravel - moist - very stiff - silty clay - grey - some sand and silt pockets - moist to wet - firm to stiff		1	SS	16	85	●				19.6	0 2 43 55
83.6 1.5			2	SS	17	84	●					
			3	SS	17	83	●					
			4	SS	8	82	●					
			5	SS	8	81	●					
			6	SS	10	80	●					
			7	SS	6	79	●					
79.8 5.3	Silty Clay - grey - layered - trace gravel - moist - very stiff		8	SS	26	78	●			19.1		
77.5 7.6			9	SS	28	77	●					
	- plastic - moist to wet - stiff to very stiff		10	SS	15	76	●					
11			SS	10								
75.5 9.6	End of Borehole											
<p>NOTES:</p> <p>1. This drawing is to be read with the subject report and project number as presented above.</p> <p>2. Interpretation assistance by Trow is required before use by others.</p> <p>3. Borehole advanced by solid stem augers equipment to a depth of 9.6 m.</p> <p>4. Upon completion of drilling water was encountered at 5.0 m below the existing grade.</p> <p>5. Borehole backfilled upon completion of drilling.</p>												

NOTES:
1. This drawing is to be read with the subject report and project number as presented above.
2. Interpretation assistance by Trow is required before use by others.
3. Borehole advanced by solid stem augers equipment to a depth of 9.6 m.
4. Upon completion of drilling water was encountered at 5.0 m below the existing grade.
5. Borehole backfilled upon completion of drilling.

ON MOT LOGS MTO.GPJ ON MOT.GDT 2/18/10

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



METRIC

ORIGINATED BY A.M.

COMPILED BY A.A.

CHECKED BY

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



Trow Associates Inc.
80 Bancroft Street
Hamilton, ON L8E 2W5

RECORD OF BOREHOLE No 8

SHEET 1 OF 1

METRIC

PROJECT NO. HAGE00392871A LOCATION N4790089.41, E589575.98 ORIGINATED BY A.M.
DIST Central HWY 403 BOREHOLE TYPE Solid Stem Augers COMPILED BY A.A.
DATUM GEODETIC DATE 1/12/2010 - 1/12/2010 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	SPT TEST (N-Value) ●		PLASTIC LIMIT PL	NATURAL WATER CONTENT w	LIQUID LIMIT LL	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			DYNAMIC CONE PENETRATION							SHEAR STRENGTH kPa
								20	40						

84.7 0.0	Fill - sand and gravel - brown to reddish brown - mixed with organic and topsoil - some clayey lumps - moist - dense to compact - clayey silt - brown with black staining - some sand and gravel - moist to wet - firm to stiff		42	SS	25										
83.2 1.5			10	SS	19										
			12	SS	35										
			14	SS	15										
			12	SS	8										
80.9 3.8	Silty Clay - grey - layered - some gravel - shale inclusion - plastic - moist to wet - firm to very stiff becoming hard at 9.1 m		7	SS	10										
			12	SS	13										
				SS	9										
			6	SS	6										
			16	SS	8										
75.1 9.6	End of Borehole		33	SS	6										

84	●													
83	●													
82	●													
81	●													
80	●													
79	●													
78	●													
77	●													
76	●													

0	24	22	55
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NOTES:
1. This drawing is to be read with the subject report and project number as presented above.
2. Interpretation assistance by Trow is required before use by others.
3. Borehole advanced by solid stem augers equipment to a depth of 9.6 m.
4. Upon completion of drilling water was encountered at 5.0 m below the existing grade.
5. Borehole backfilled upon completion of drilling.

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

**METRIC**

ORIGINATED BY A.M.

COMPILED BY A.A.

CHECKED BY _____

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



Trow Associates Inc.
80 Bancroft Street
Hamilton, ON L8E 2W5

RECORD OF BOREHOLE No 10

SHEET 1 OF 1

METRIC

PROJECT NO. HAGE00392871A

LOCATION N4790067.58, E589607.19

ORIGINATED BY A.M.

DIST Central HWY 403

BOREHOLE TYPE Solid Stem Augers

COMPILED BY A.A.

DATUM GEODETIC

DATE 1/13/2009 - 1/13/2009

CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	SPT TEST (N-Value) ●		PLASTIC LIMIT PL	NATURAL WATER CONTENT w	LIQUID LIMIT LL	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	DYNAMIC CONE PENETRATION					
							20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
							20 40 60 80 100						
85.1 0.0	Fill - clayey silt - brown to gray with some black staining - some organics - mixed with some gravel - wet		1	SS	5							18.8 19.9	0 4 46 50
			2	SS	5								
			3	SS	4								
82.8 2.3			4	SS	3								
			5	SS	4								
			6	SS	4								
80.5 4.6	Silty Clay - grey - layered - trace gravel - plastic - wet - firm to stiff		7	SS	7								
			8	SS	8								
			9	SS	8								
75.5 9.6			10	SS	10								
End of Borehole													
NOTES: 1. This drawing is to be read with the subject report and project number as presented above. 2. Interpretation assistance by Trow is required before use by others. 3. Borehole advanced by solid stem augers equipment to a depth of 9.6 m. 4. Upon completion of drilling water was encountered at 1.6 m below the existing grade. 5. Borehole backfilled upon completion of drilling.													

ON MOT LOGS MTO.GPJ ON MOT.GDT 2/18/10

+³, x³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE



Trow Associates Inc.
80 Bancroft Street
Hamilton, ON L8E 2W5

RECORD OF BOREHOLE No 11

SHEET 1 OF 1

METRIC

PROJECT NO. HAGE00392871A LOCATION N4790062.25, E589487.91 ORIGINATED BY A.M.
DIST Central HWY 403 BOREHOLE TYPE Solid Stem Augers COMPILED BY A.A.
DATUM GEODETIC DATE 1/13/2009 - 1/13/2009 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	SPT TEST (N-Value) ●		PLASTIC LIMIT PL	NATURAL WATER CONTENT w	LIQUID LIMIT LL	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			DYNAMIC CONE PENETRATION							WATER CONTENT (%)	
								SHEAR STRENGTH kPa								
							20	40	60	80	100	10	20	30		
							○ UNCONFINED	+ FIELD VANE								
							● QUICK TRIAXIAL	× LAB VANE								
85.5 0.0	Fill - sand and gravel - brown to grey - some clay lumps - wet - loose to compact		1	SS	7		●									
			2	SS	9		●									
			3	SS	13		●									
			4	SS	10		●									
82.5 3.0	Silty Clay - grey - layered - trace gravel - plastic - moist to wet - firm to stiff		5	SS	6		●							19.7		
			6	SS	8		●								19.6	
			7	SS	8		●									1
			8	SS	7		●									11
			9	SS	5		●									30
			10	SS	5		●									58
			11	SS	7		●									
			12	SS	9		●									
74.4 11.1	End of Borehole															
NOTES: 1. This drawing is to be read with the subject report and project number as presented above. 2. Interpretation assistance by Trow is required before use by others. 3. Borehole advanced by solid stem augers equipment to a depth of 11.1 m. 4. Upon completion of drilling water was encountered at 1.3 m below the existing grade. 5. Borehole backfilled upon completion of drilling.																

NOTES:
1. This drawing is to be read with the subject report and project number as presented above.
2. Interpretation assistance by Trow is required before use by others.
3. Borehole advanced by solid stem augers equipment to a depth of 11.1 m.
4. Upon completion of drilling water was encountered at 1.3 m below the existing grade.
5. Borehole backfilled upon completion of drilling.

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



Trow Associates Inc.
80 Bancroft Street
Hamilton, ON L8E 2W5

RECORD OF BOREHOLE No 12

SHEET 1 OF 1

METRIC

PROJECT NO. HAGE00392871A LOCATION N4790064.26, E689459.00 ORIGINATED BY A.M.
DIST Central HWY 403 BOREHOLE TYPE Solid Stem Augers COMPILED BY A.A.
DATUM GEODETIC DATE 1/14/2009 - 1/14/2009 CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	SPT TEST (N-Value) ●		PLASTIC LIMIT PL	NATURAL WATER CONTENT w	LIQUID LIMIT LL	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		DYNAMIC CONE PENETRATION	✓					
85.5							20 40 60 80 100						
0.0	Fill - clayey silt - brown to grey - mixed with some gravel - mixed with organics at 1.5 m - wet - very soft to firm		1	SS	0								
			2	SS	0								
			3	SS	5								
83.2			4	SS	14								
2.3	Silty Clay - grey - layered - trace gravel - plastic - moist to wet - stiff		5	SS	12								
			6	SS	10								
			7	SS	8								
			8	SS	8								
			9	SS	9								
			10	SS	9								
75.9													
9.6	End of Borehole												
NOTES: 1. This drawing is to be read with the subject report and project number as presented above. 2. Interpretation assistance by Trow is required before use by others. 3. Borehole advanced by solid stem augers equipment to a depth of 9.6 m. 4. upon completion of the drilling a 25 mm (1 inch) diameter P.V.C. standpipe was installed to 7.6 m depth; screened portion from 4.6 to 7.6 m depth, sand filter pack from 4.3 to 7.6 m depth, bentonite seal from 0.0 to 4.3 m depth.													

+³, X³. Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Appendix A:
Figures 1 – 4: Atterberg Limits
Figures 5-16 Grain Size Analysis Results
Chemical Analysis Results

ATTERBERG LIMITS

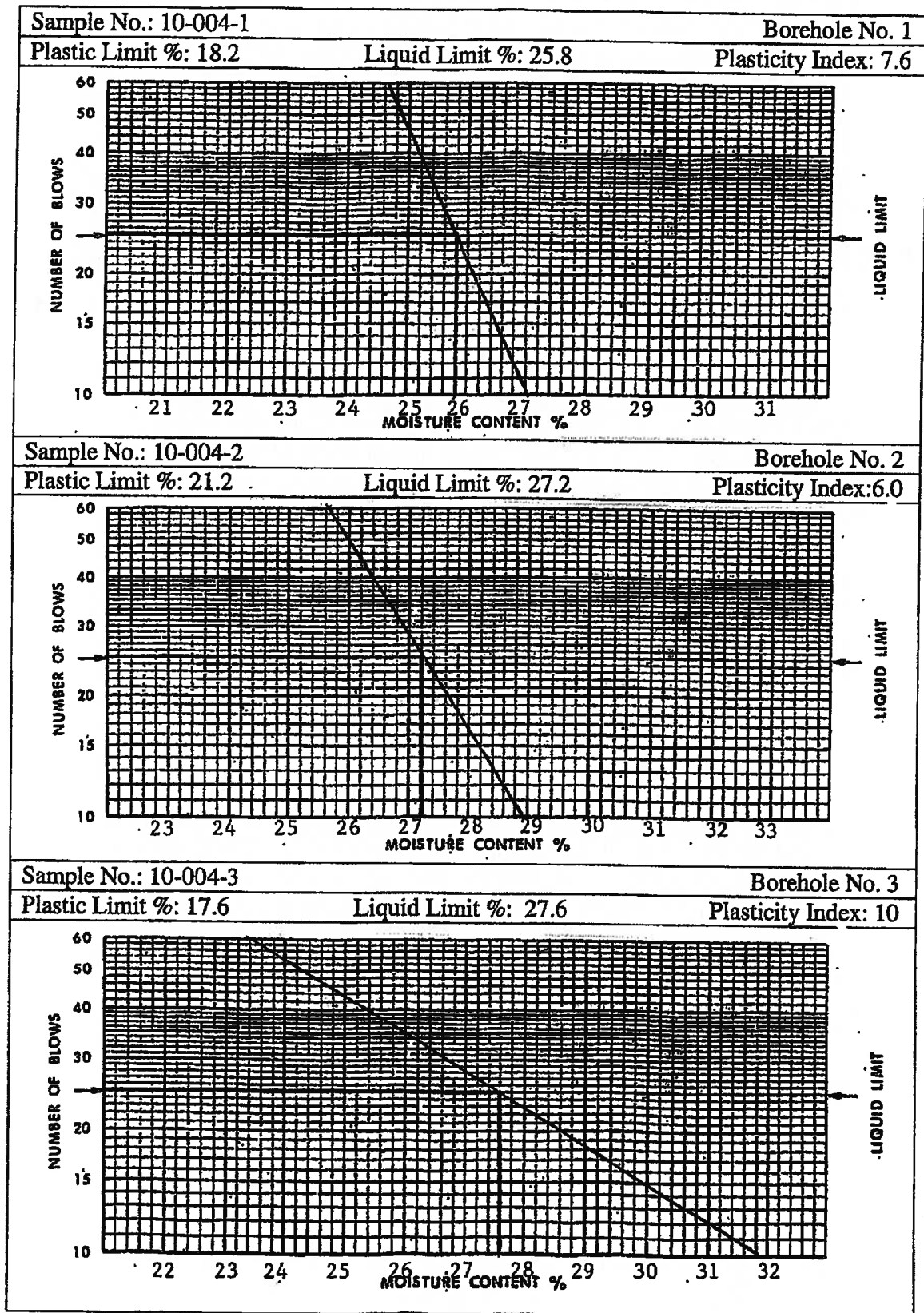


Figure 1

ATTERBERG LIMITS

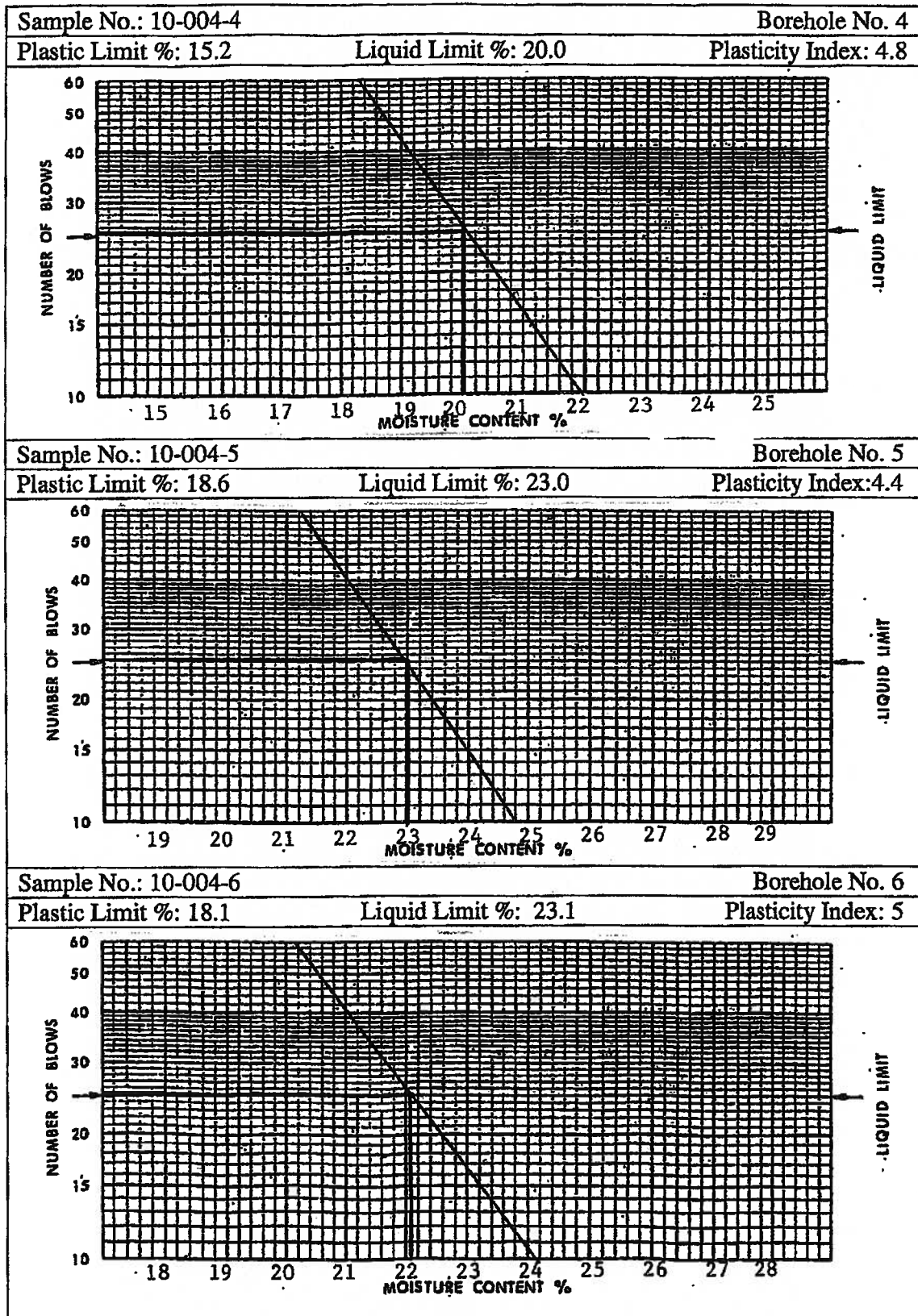


Figure 2

ATTERBERG LIMITS

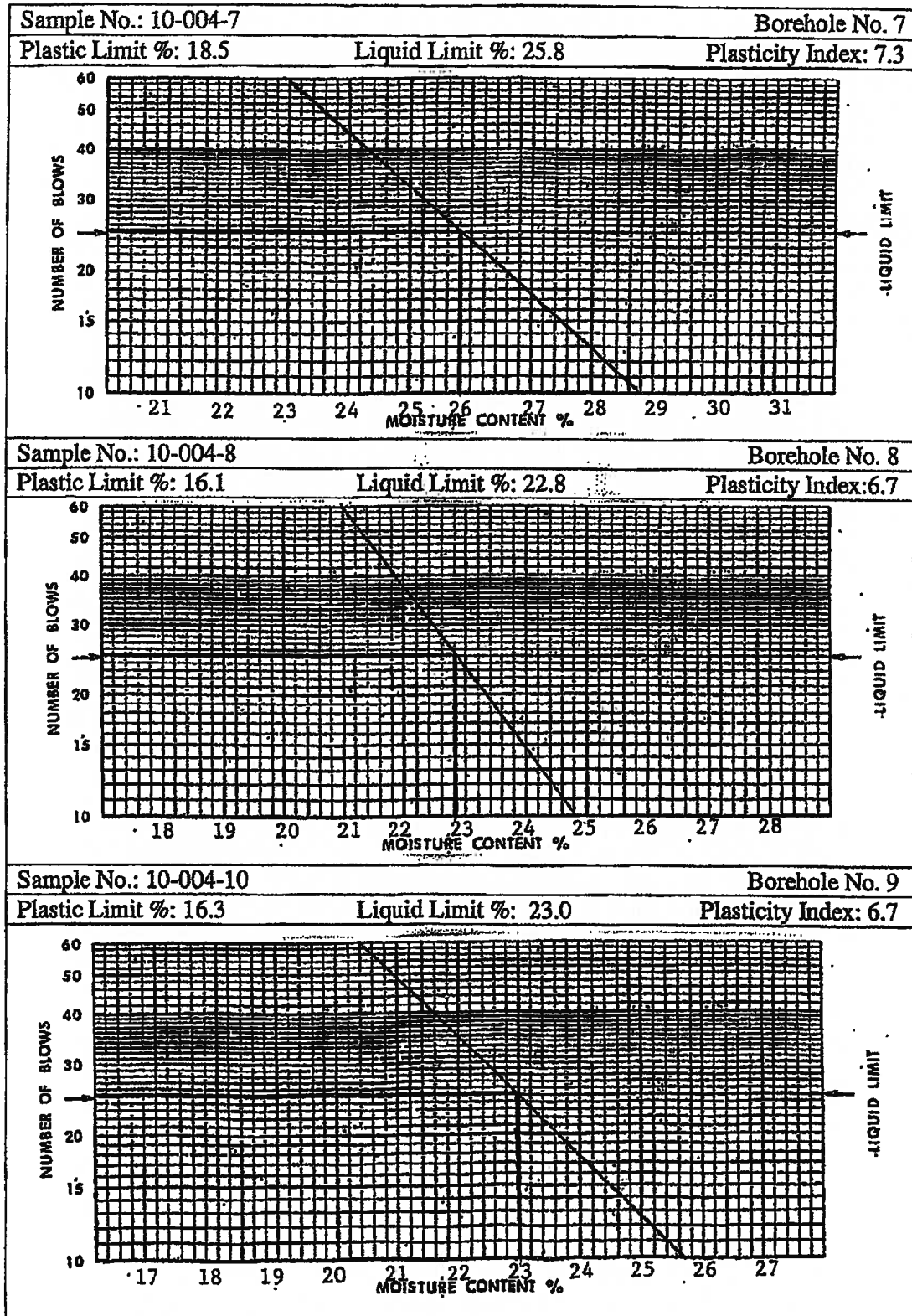


Figure 3

ATTERBERG LIMITS

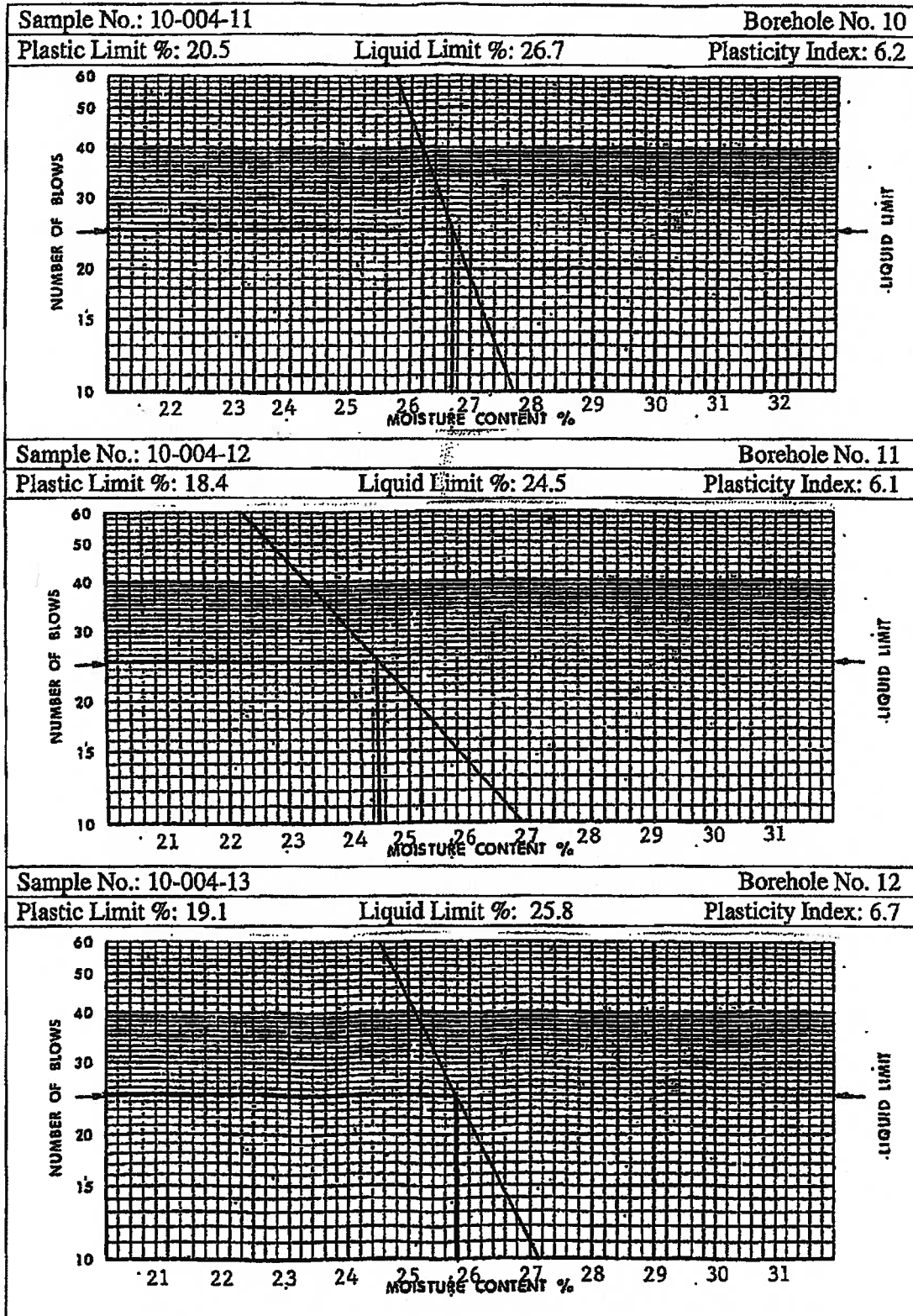
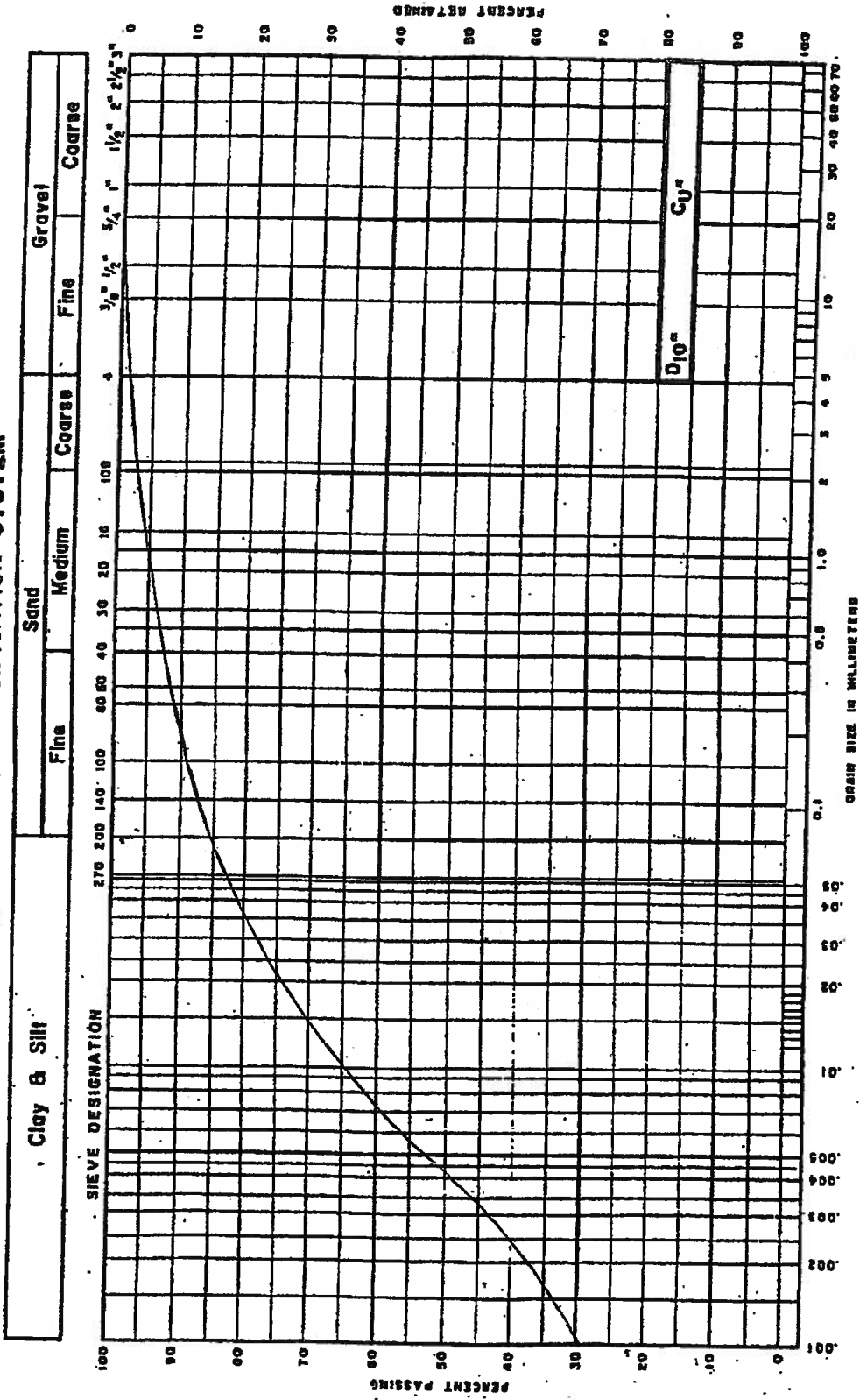



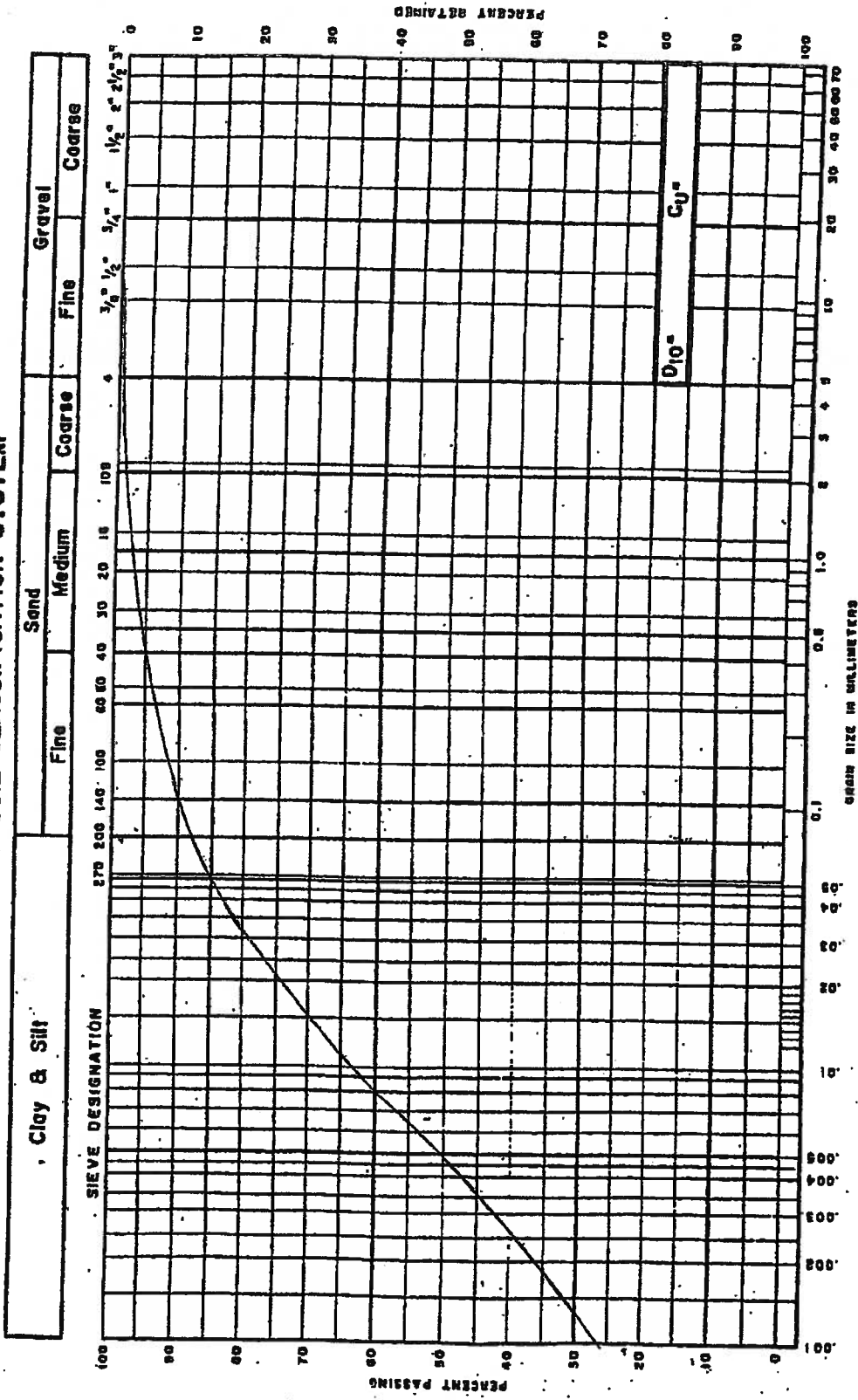
Figure 4

UNIFIED SOIL CLASSIFICATION SYSTEM



CLIENT:	City of Hamilton		Figure 5	Borehole #1 at 3.8-4.3m
JOB NO.:	HAGE00392871A			
		SAMPLE ID: DATE SAMPLED:		

UNIFIED SOIL CLASSIFICATION SYSTEM



CLIENT: City of Hamilton JOB NO.: HAGE00392871A	Trow Figure 6	SAMPLE ID: Borehole #2 at 5.3-5.8m
		DATE SAMPLED:

UNIFIED SOIL CLASSIFICATION SYSTEM

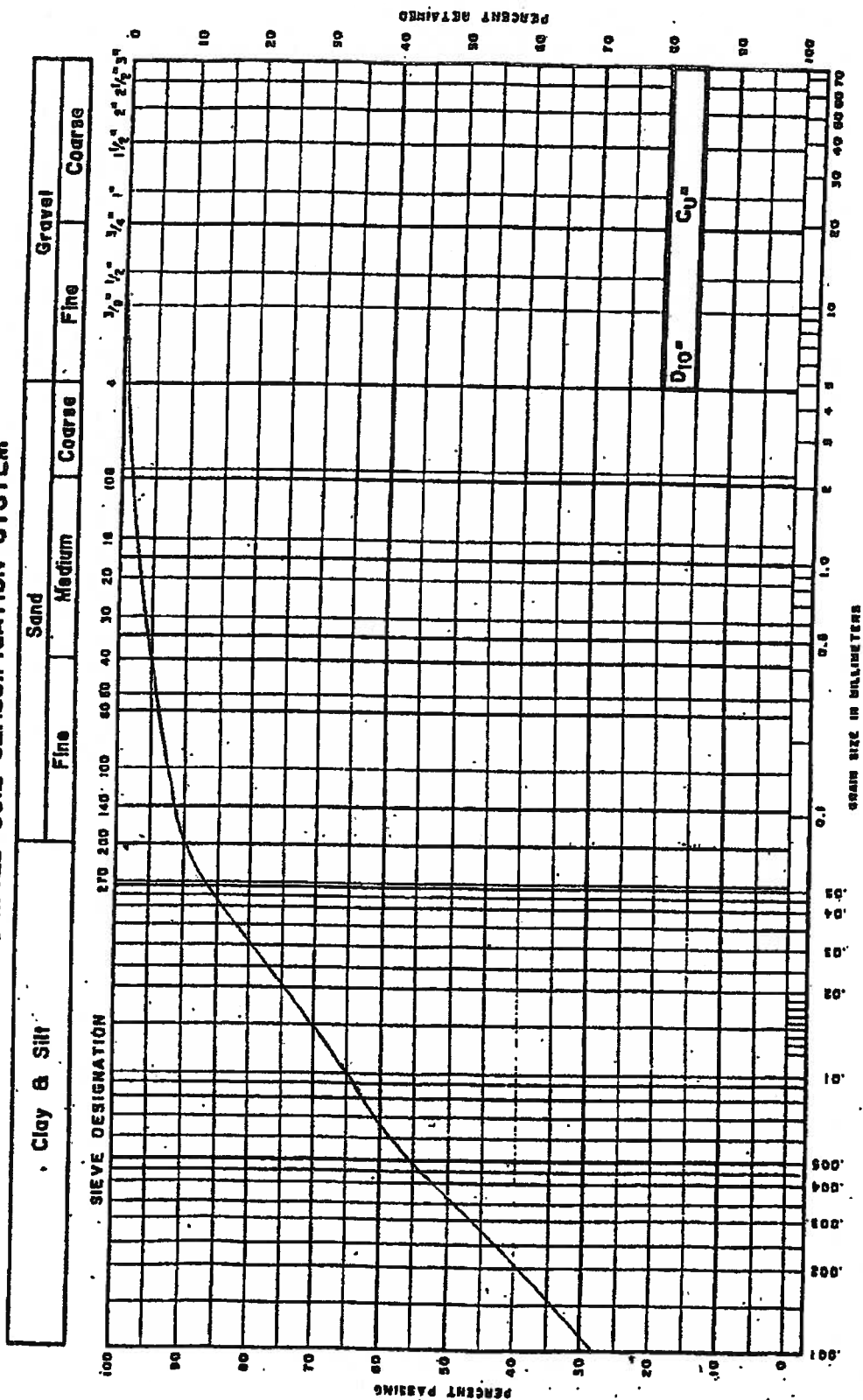


Figure 7

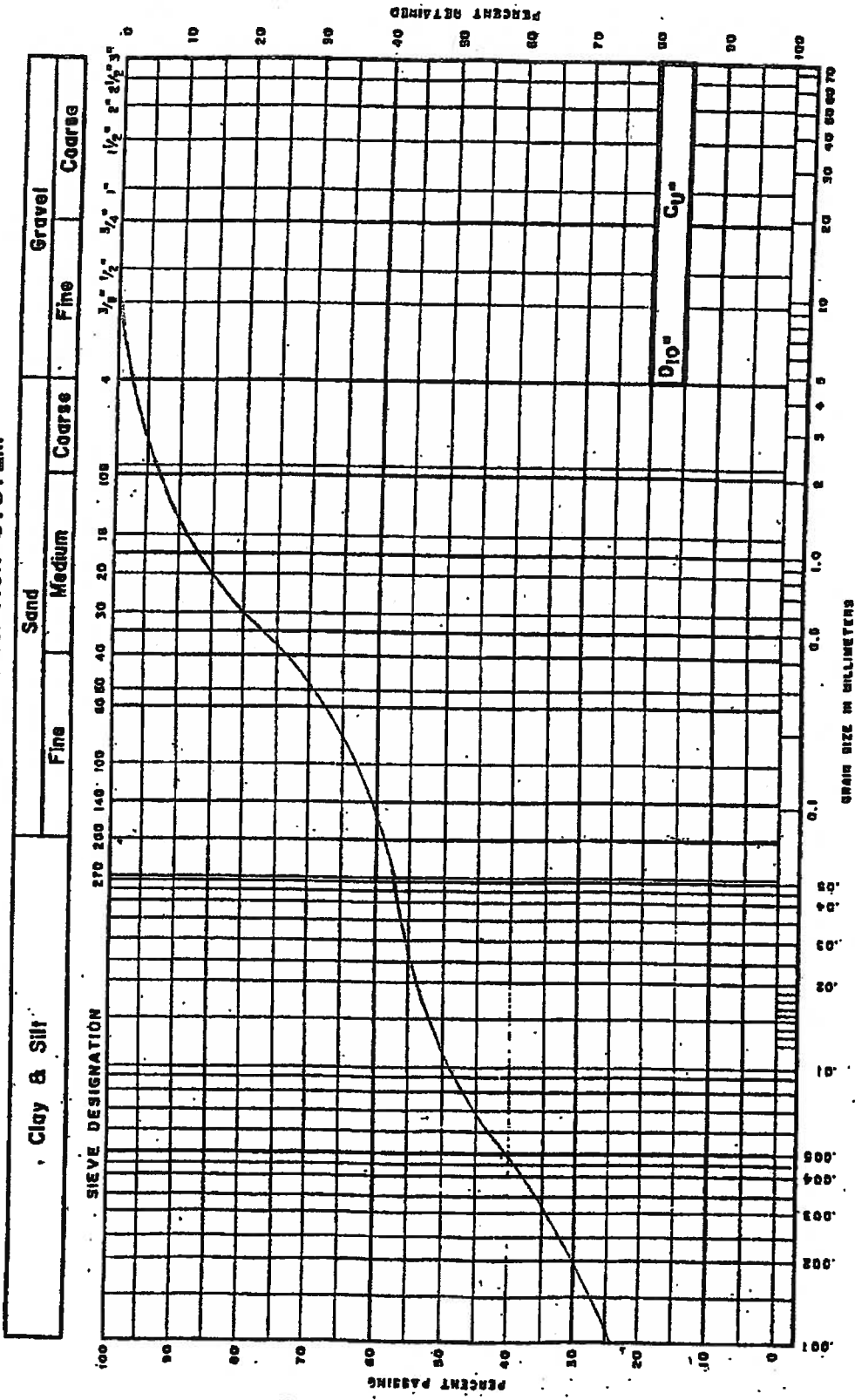
CLIENT: City of Hamilton

JOB NO.: HAGE00392871A

SAMPLE ID: Borehole #3 at 3.8-4.3m

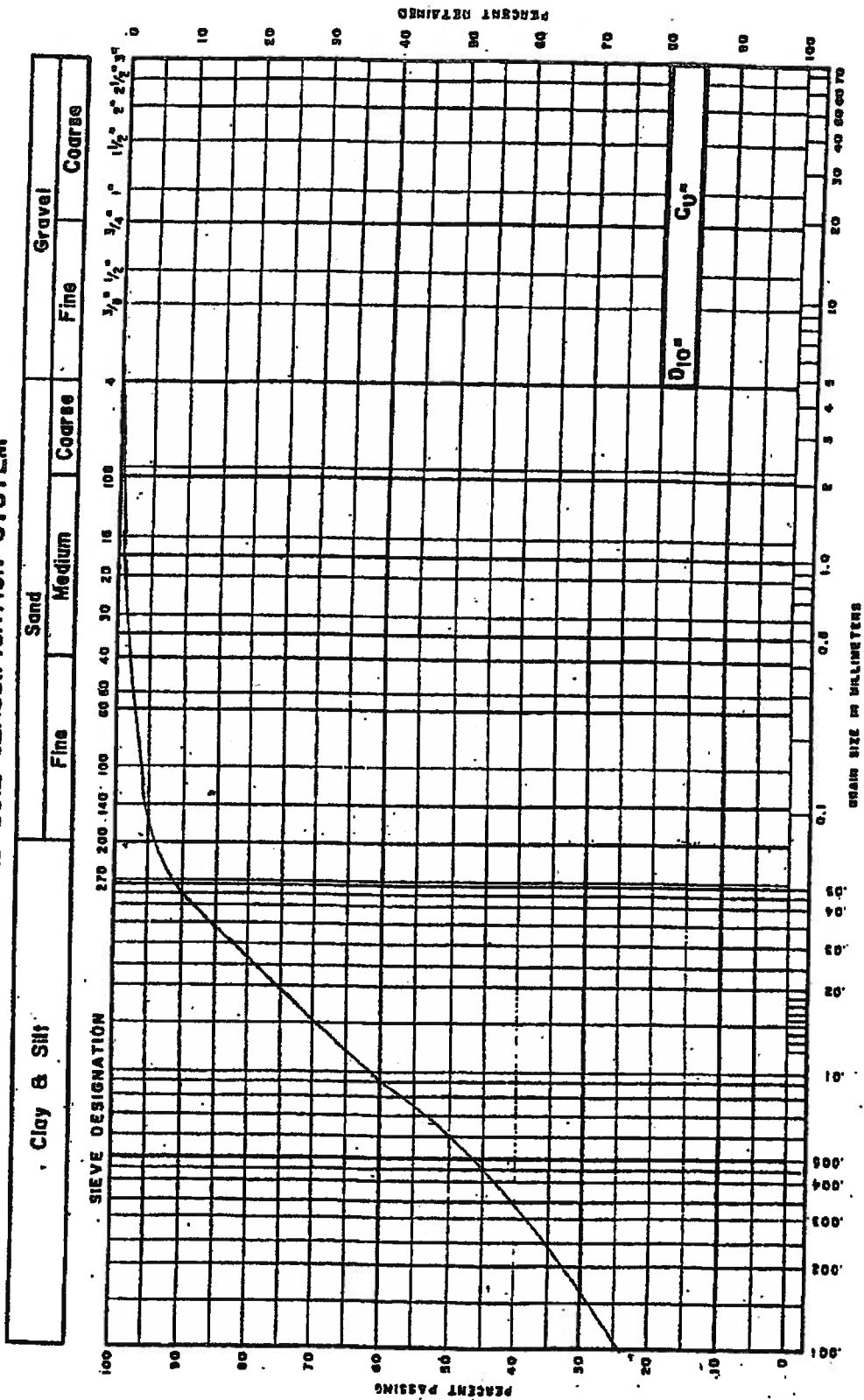
DATE SAMPLED:


UNIFIED SOIL CLASSIFICATION SYSTEM



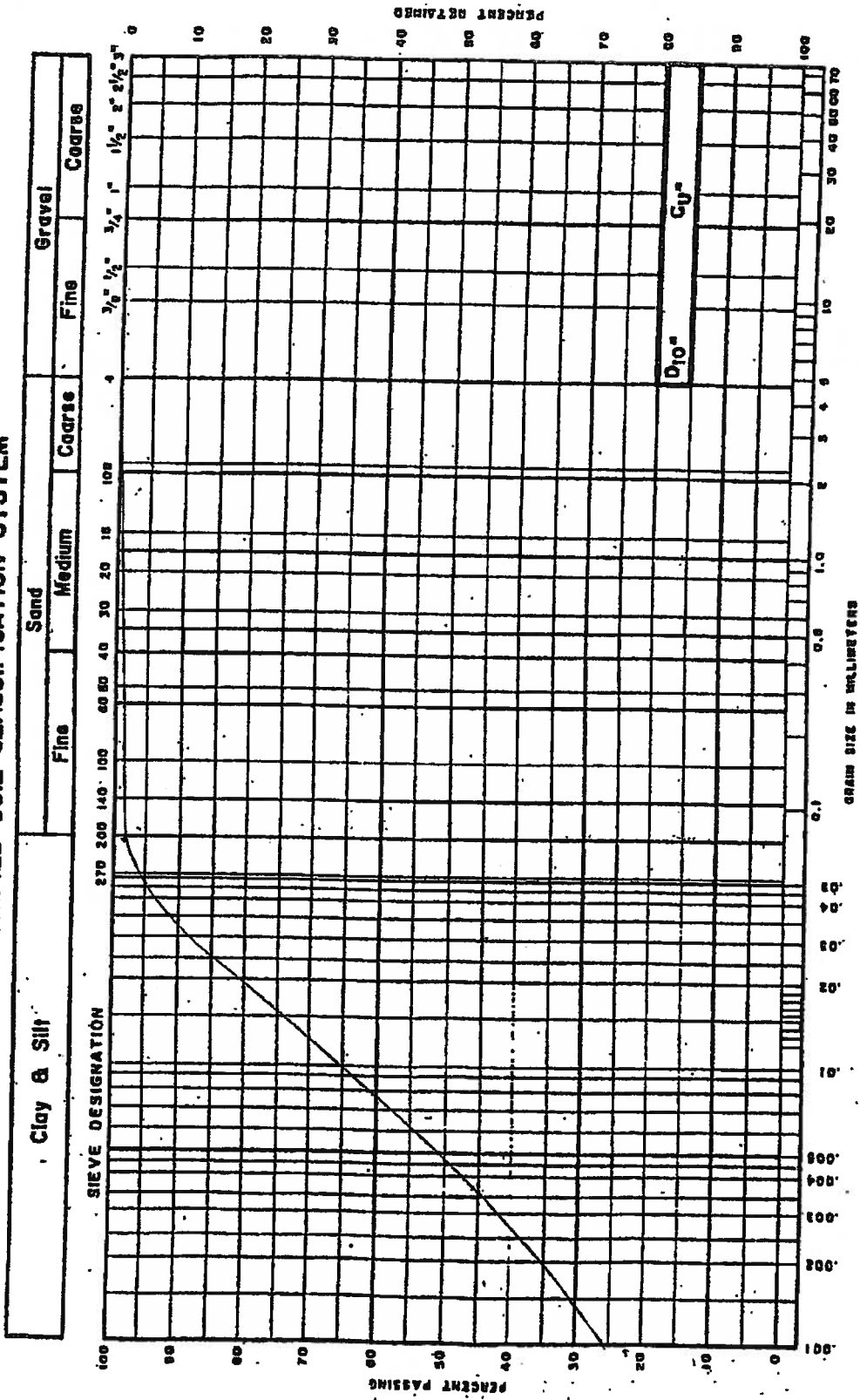
CLIENT: City of Hamilton		Figure 8	
JOB NO.: HAGE00392871A		SAMPLE ID: Borehole #4 at 3.0-3.5m	
DATE SAMPLED:		DATE SAMPLED:	


UNIFIED SOIL CLASSIFICATION SYSTEM



CLIENT: City of Hamilton	 <p>Figure 9</p>	SAMPLE ID: Borehole #5 at 4.6-5.0m
JOB NO.: HAGE00392871A		DATE SAMPLED:

UNIFIED SOIL CLASSIFICATION SYSTEM



CLIENT: City of Hamilton	 <p>Figure 10</p>	SAMPLE ID: Borehole #6 at 3.0-3.5m
JOB NO.: HAGE00392871A		DATE SAMPLED:

UNIFIED SOIL CLASSIFICATION SYSTEM

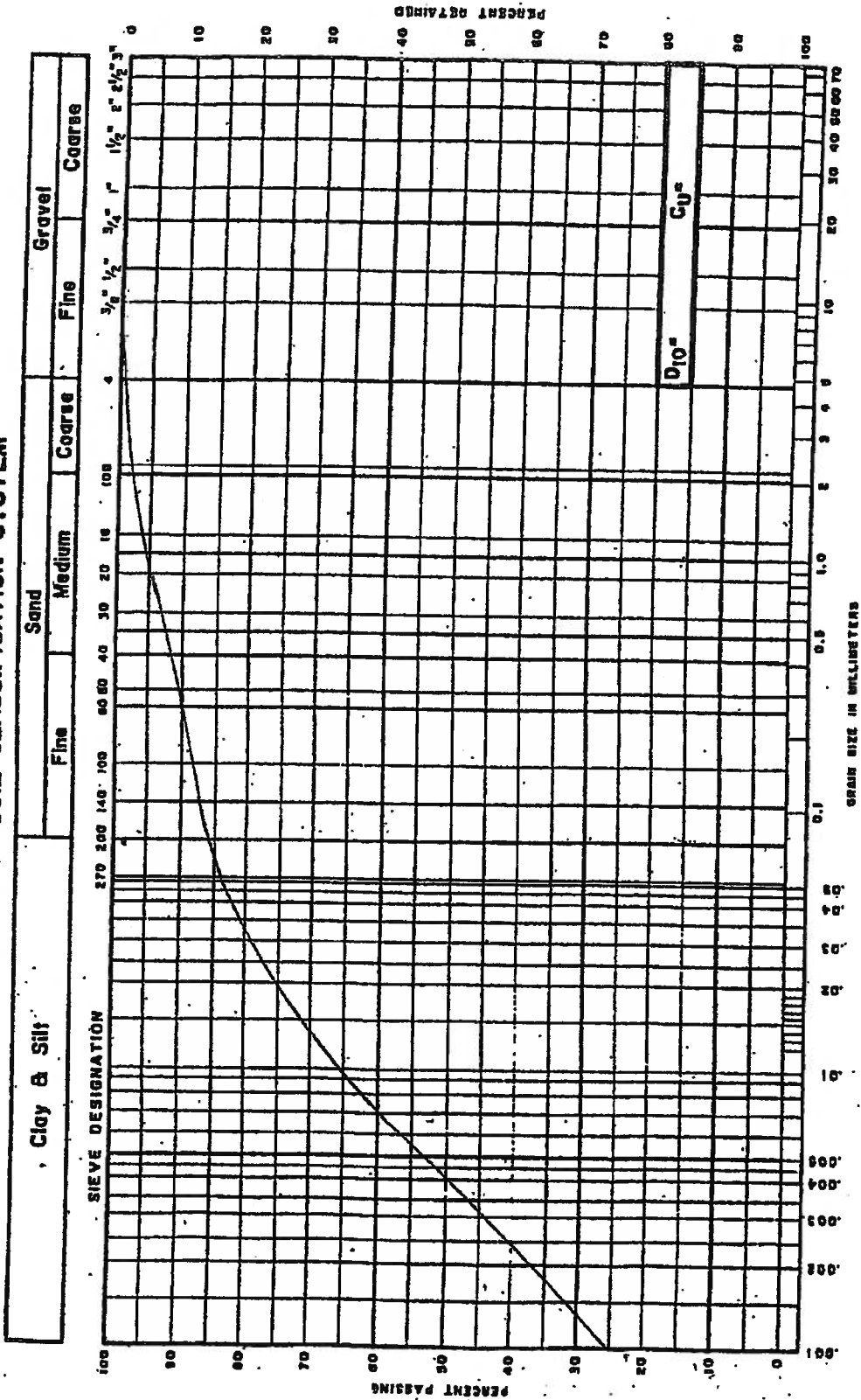


Figure 11

CLIENT: City of Hamilton

JOB NO.: HAGE00392871A

SAMPLE ID: Borehole #7 at 3.8-4.3m

DATE SAMPLED:

UNIFIED SOIL CLASSIFICATION SYSTEM

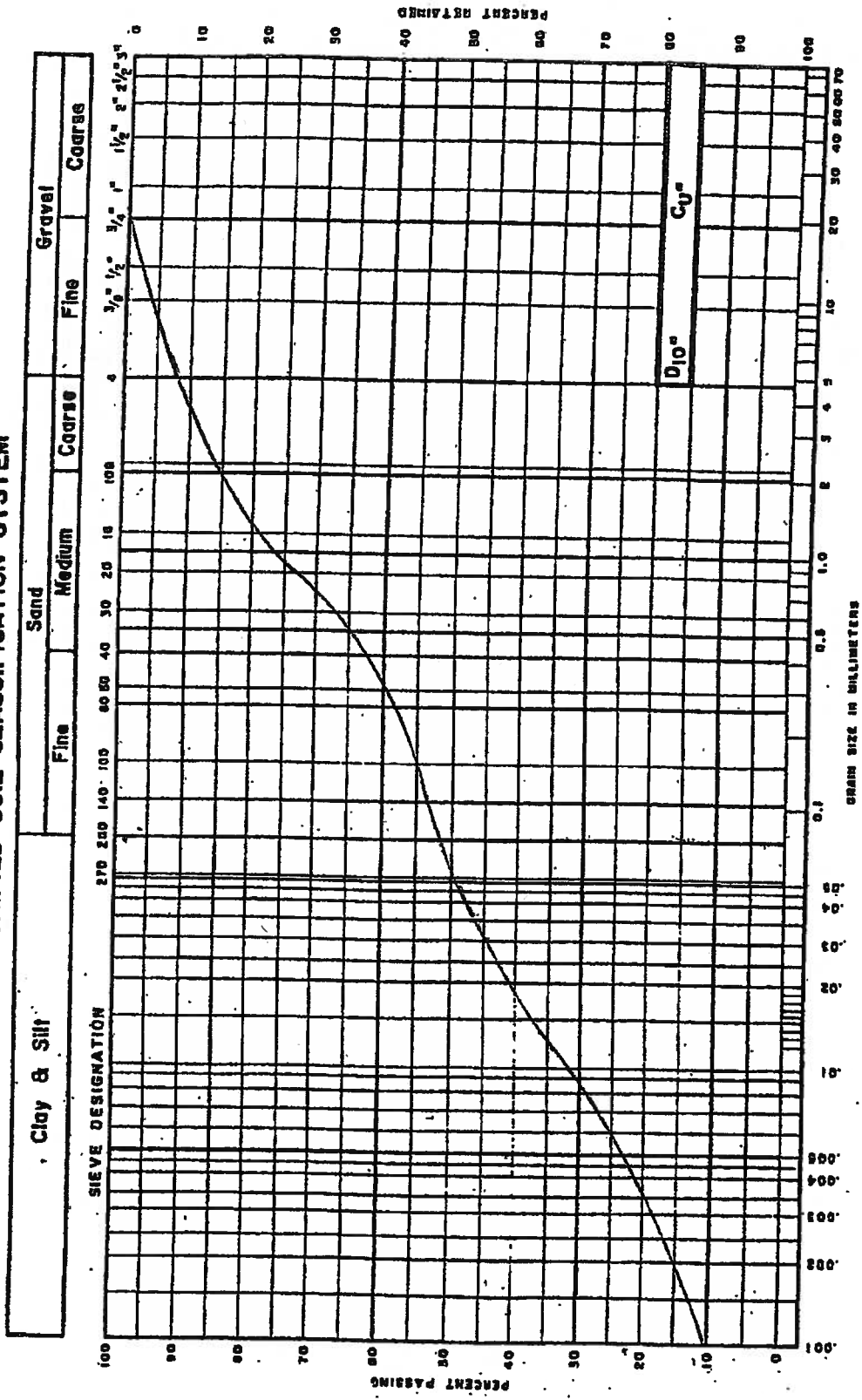


Figure 13

CLIENT: City of Hamilton	SAMPLE ID: Borehole #9 at 3.0-3.5m
JOB NO.: HAGE00392871A	
DATE SAMPLED:	

UNIFIED SOIL CLASSIFICATION SYSTEM

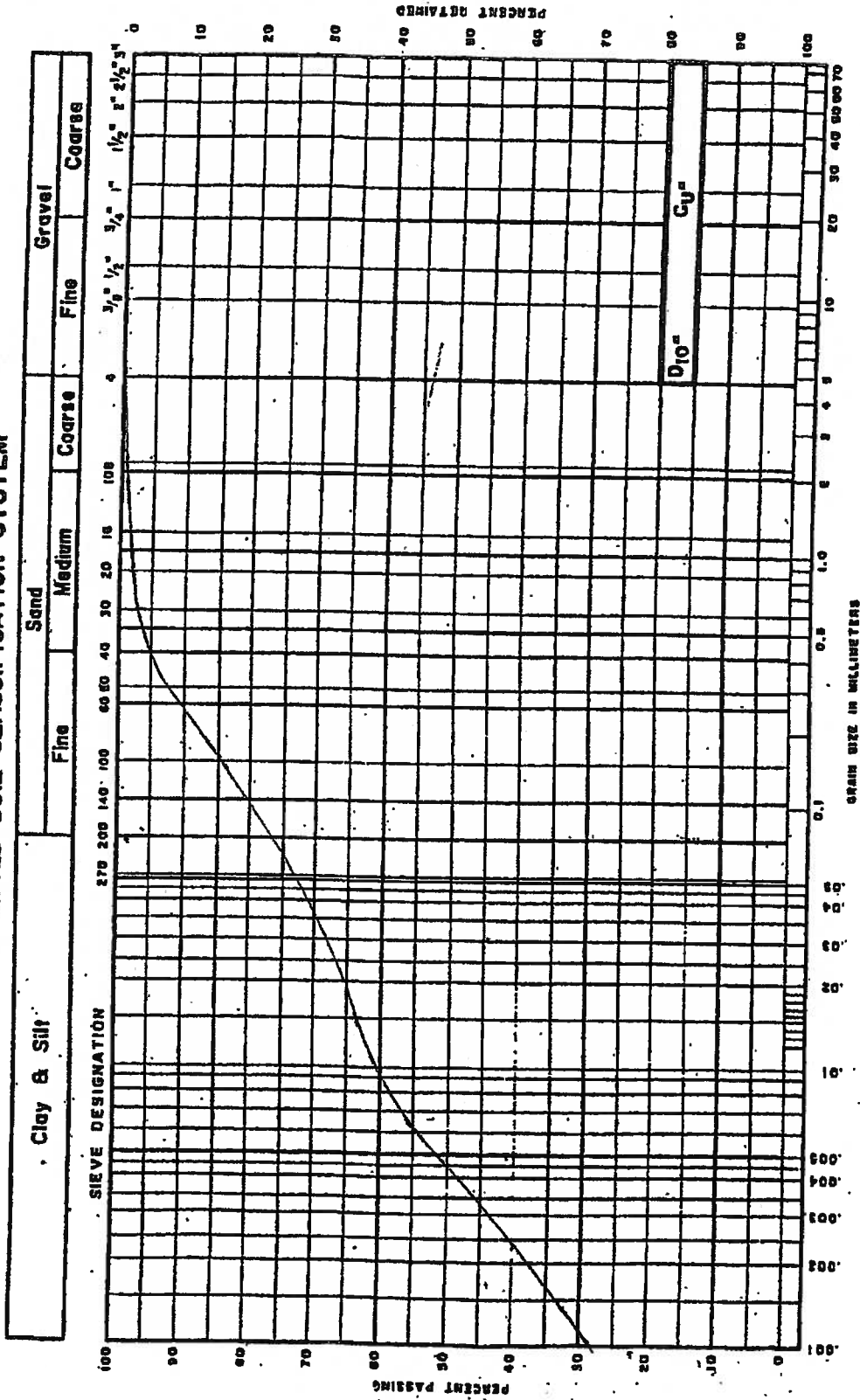


Figure 12

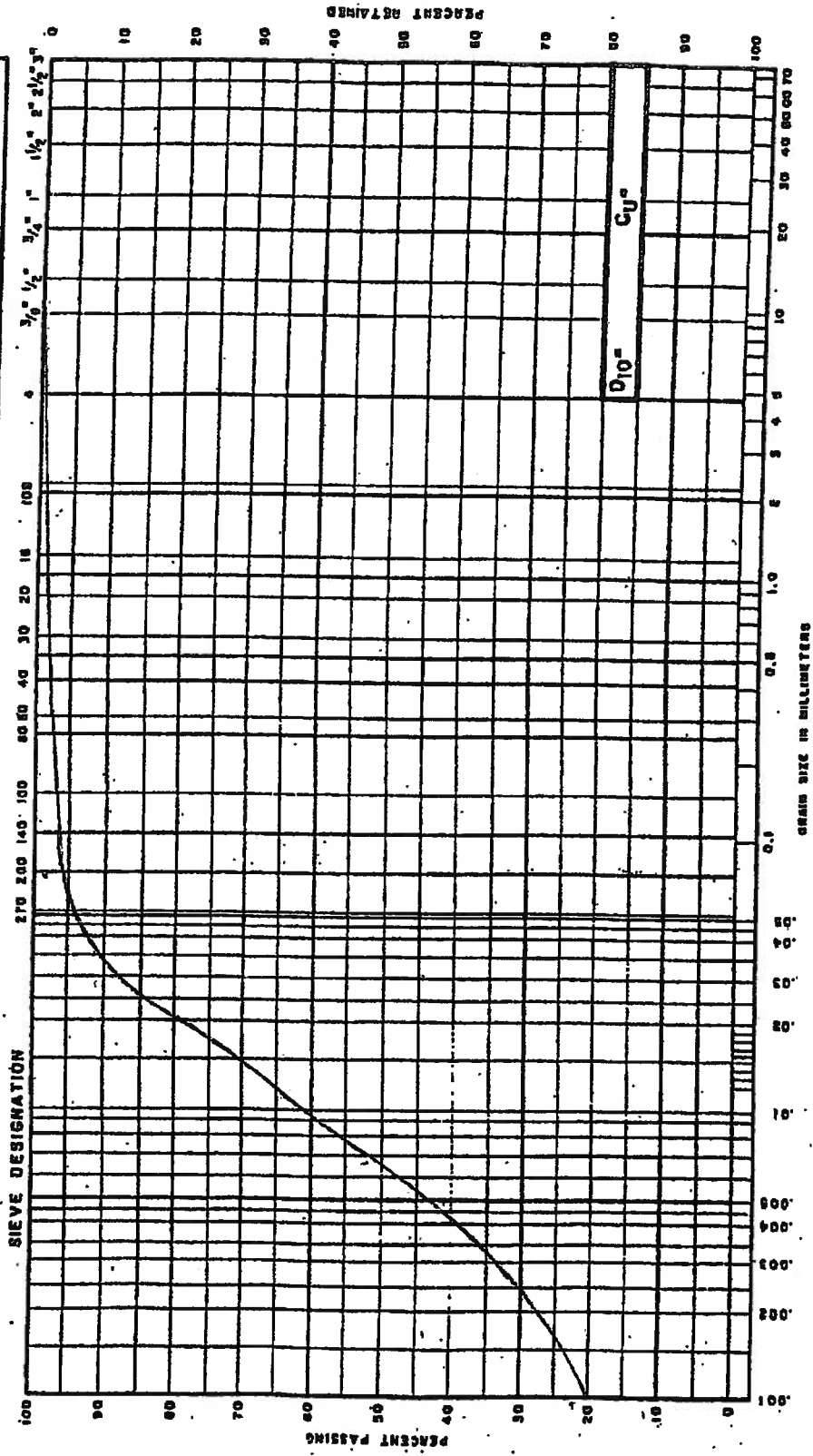
CLIENT: City of Hamilton

JOB NO.: HAGE00392871A

SAMPLE ID: Borehole #8 at 3.8-4.3m

DATE SAMPLED:

Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse



DATE SAMPLED:

UNIFIED SOIL CLASSIFICATION SYSTEM

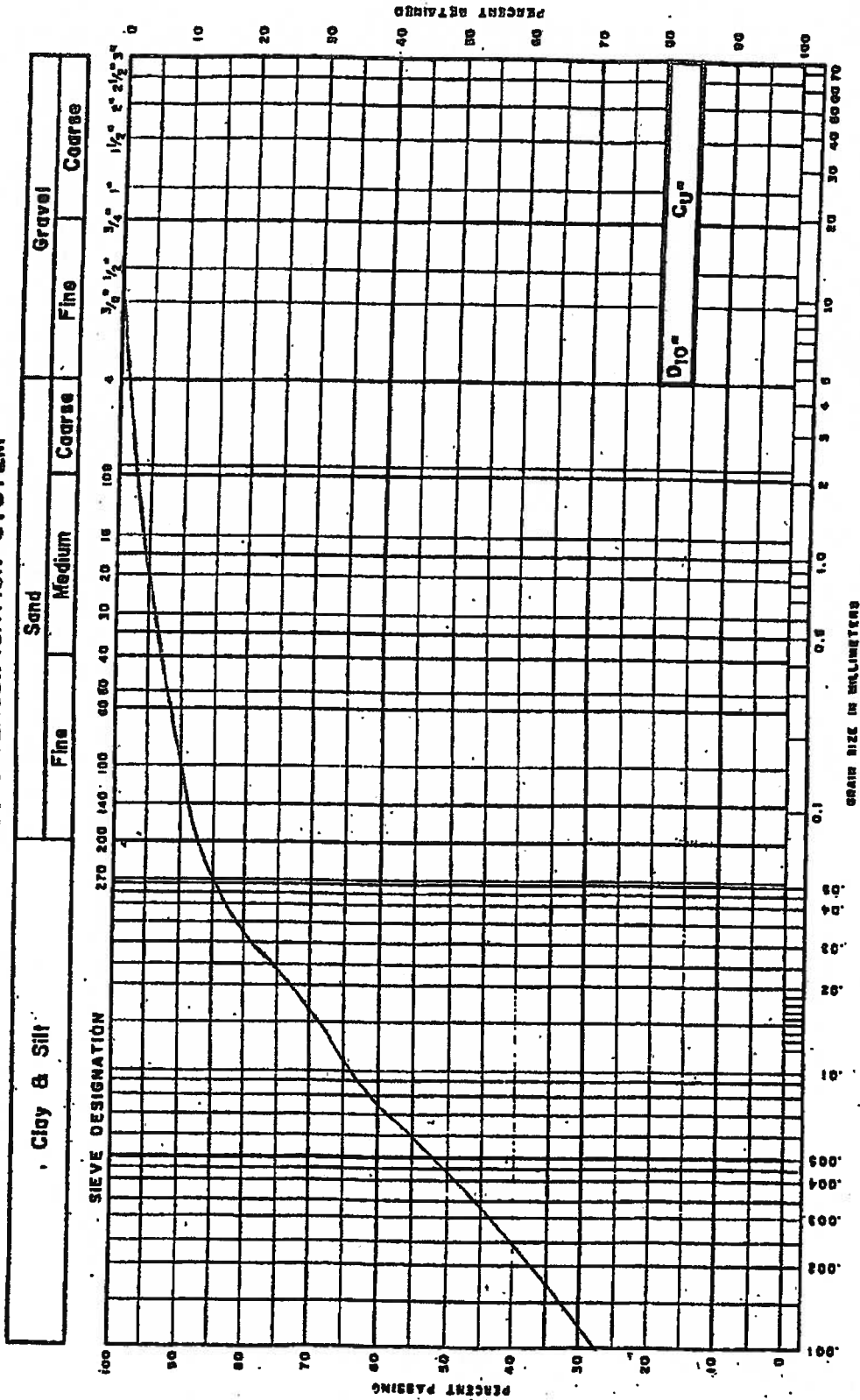


Figure 15

CLIENT: City of Hamilton

JOB NO.: HAGE00392871A

SAMPLE ID: Borehole #11 at 4.6-5.0m

DATE SAMPLED:

UNIFIED SOIL CLASSIFICATION SYSTEM

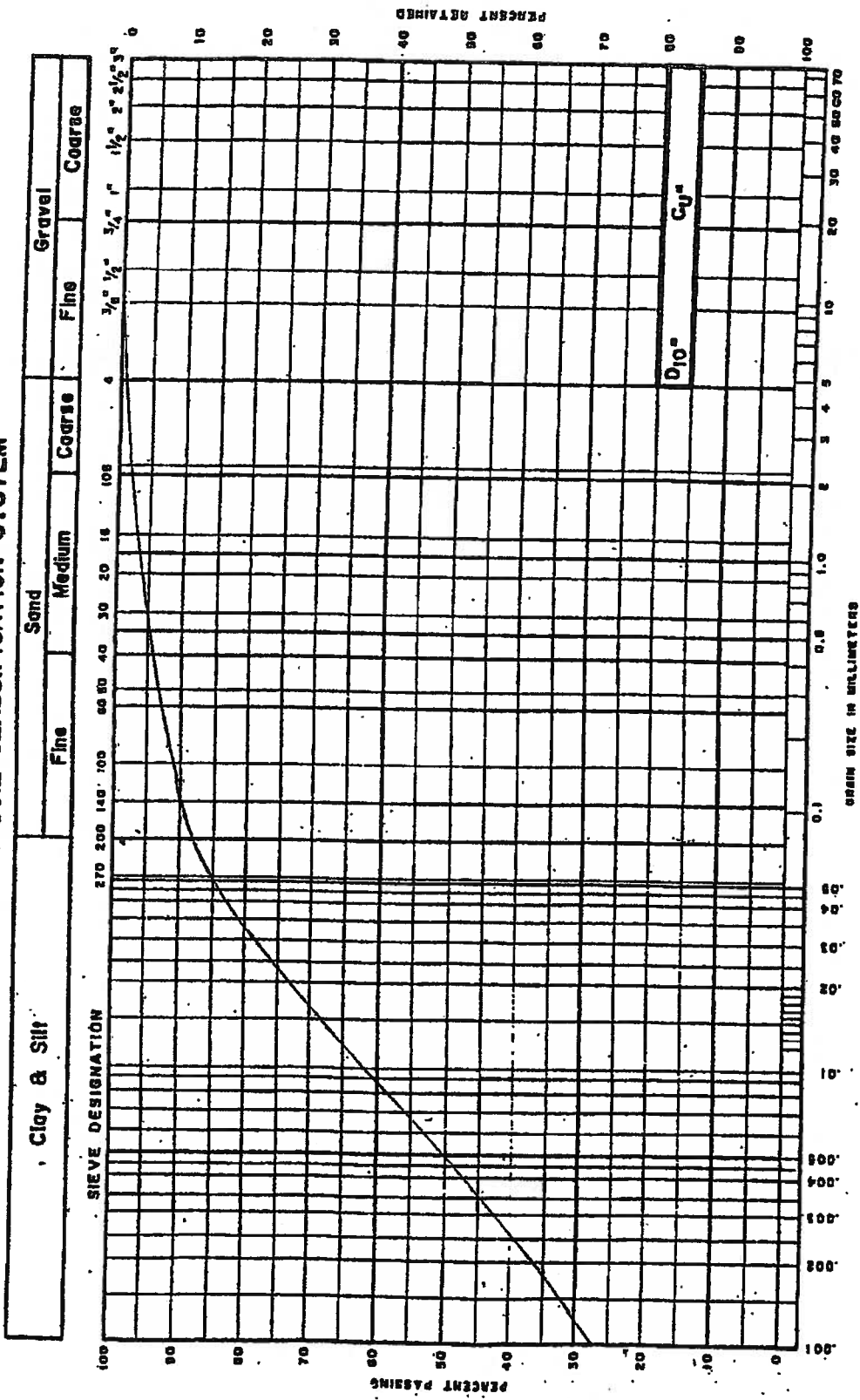


Figure 16

CLIENT: City of Hamilton

JOB NO.: HAGE00392871A

SAMPLE ID: Borehole #12 at 3.0-3.5m

DATE SAMPLED:

O'REG 153 METALS & INORGANICS SHORT LIST (SOIL)

SOIL TYPE																			
SAMPLE ID	Units	Silty clay fill	Silty clay fill	Clayey silt fill	Duplicate of	Clayey silt fill	Silty sand fill	Silty clay fill	Clayey silt fill	Clayey silt fill	Clayey silt fill	Duplicate of	Clayey silt fill	Sand and gravel fill	Clayey silt fill	O. Reg 153 Table 3 SCS	O. Reg 153 Table 1 SCS		
		BH1 (5-6 1/2)	BH2 (5-6 1/2)	BH3 (2 1/2-4)	BH103 (2 1/2-4)	BH4 (2 1/2-4)	BH5 (7 1/2-9)	BH6 (5-6 1/2)	BH7 (5-6 1/2)	BH8 (10-11 1/2)	BH9 (2 1/2-4)	BH109 (2 1/2-4)	BH10 (5-6 1/2)	BH11 (7 1/2-9)	BH12 (5-6 1/2)				
PARAMETER																Commercial/ Industrial/ Community	Residential/ Parkland/ Institutional	All other land uses	Agricultural
Calculated Parameters																			
Sodium Adsorption Ratio	N/A	1.3	1.2	3.9	4.5	0.33	0.23	0.27	0.24	0.47	0.43	0.37	0.20	0.25	0.26	12	5	2.4	1.0
Inorganics																			
Conductivity	mS/cm	0.59	0.46	0.47	0.51	0.47	0.22	0.16	0.27	0.38	0.52	0.40	0.25	0.19	0.42	1.4	0.7	0.57	0.47
pH	pH	7.74	7.72	7.68	7.69	7.50	7.52	7.61	7.61	7.70	7.60	7.56	7.53	7.76	7.66	5-9	5-9	5-9	5-9
Metals																			
Antimony (Sb)	ug/g	0.5	0.9	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	2.8	1.3	<0.2	<0.2	<0.2	(44) 40	13	1.0	1.0
Arsenic (As)	ug/g	5	5	9	6	4	5	3	7	9	150	94	3	16	4	(50) 40	(25) 20	17	14
Barium (Ba)	ug/g	88	67	96	130	99	77	81	100	150	850	440	76	130	100	(200) 1500	(1000) 750	210	190
Beryllium (Be)	ug/g	0.6	0.4	0.5	0.7	0.5	0.6	0.5	0.4	0.5	0.4	0.3	0.6	0.4	0.6	1.2	1.2	1.2	1.2
Cadmium (Cd)	ug/g	0.3	0.2	<0.1	<0.1	0.1	<0.1	<0.1	0.1	0.1	0.3	0.2	0.1	0.1	<0.1	12	12	1.0	1.0
Chromium (Cr)	ug/g	18	15	17	20	17	15	16	17	15	13	14	19	14	20	(1000) 750	(1000) 750	71	67
Chromium (V)	ug/g	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	(10) 8	(10) 8	2.5	2.5
Cobalt (Co)	ug/g	11	8.7	11	11	9.7	7.7	9.5	9.0	8.6	12	10	12	7.8	11	(100) 80	(50) 40	21	19
Copper (Cu)	ug/g	43	31	35	33	26	41	24	48	33	27	29	35	44	28	(300) 225	(300) 225	85	56
Lead (Pb)	ug/g	45	36	11	12	13	12	10	14	13	12	9	13	12	13	1000	200	120	55
Mercury (Hg)	ug/g	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	10	10	0.23	0.16
Molybdenum (Mo)	ug/g	0.6	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	0.5	3.0	1.9	<0.5	0.5	<0.5	40	40	2.5	2.5
Nickel (Ni)	ug/g	22	19	24	25	20	19	21	19	18	13	16	27	17	24	(200) 150	(200) 150	43	43
Selenium (Se)	ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.6	0.5	<0.5	<0.5	<0.5	10	10	1.9	1.4
Silver (Ag)	ug/g	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	(50) 40	(25) 20	0.42	0.35
Thallium (Tl)	ug/g	0.10	0.09	0.10	0.12	0.09	0.08	0.09	0.11	0.08	0.09	0.07	0.12	0.08	0.07	32.0	4.1	2.5	2.5
Vanadium (V)	ug/g	24	23	27	28	25	27	24	26	21	18	20	27	21	25	(250) 200	(250) 200	91	91
Zinc (Zn)	ug/g	120	77	58	60	58	56	51	69	70	73	66	71	63	61	(800) 600	(800) 600	160	150

Note: Bold indicates exceedence of MOE Table 1 SCS for Agricultural Use
Reverse bold indicates exceedence of MOE Table 3 SCS for Residential/Parkland Use, with coarse-grained soil
Criteria in brackets are applicable for medium- to fine-grained soils

Your Project #: HAGE00392871A
Your C.O.C. #: 00591256

Attention: Ashraf Abass

Trow Associates Inc
80 Bancroft St
Hamilton, ON
L8E 2W5

Report Date: 2010/04/08

This report supersedes all previous reports with the same Maxxam job number

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B008312

Received: 2010/01/22, 14:48

Sample Matrix: Soil

Samples Received: 14

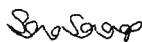
Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Conductivity	14	N/A	2010/01/28	CAM SOP-00414	APHA 2510
Chromium (VI) in Soil	14	2010/01/26	2010/01/26	CAM SOP-00420	EPA 3060A
Acid Extr. Metals (aqua regia) by ICPMS	5	2010/01/27	2010/01/28	CAM SOP-00447	EPA 6020
Acid Extr. Metals (aqua regia) by ICPMS	9	2010/01/28	2010/01/28	CAM SOP-00447	EPA 6020
MOISTURE	14	N/A	2010/01/27	CAM SOP-00445	McKeague 2nd ed 1978
pH CaCl2 EXTRACT	14	2010/01/27	2010/01/28	CAM SOP-00413	SM 4500 H
Sodium Adsorption Ratio (SAR)	14	2010/01/22	2010/01/29	CAM SOP-00102	EPA 6010

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

* Results relate only to the items tested.

Encryption Key

Sara Saroop



08 Apr 2010 16:35:25 -04:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

KRISTEN BURMEISTER, Project Manager

Email: Kristen.Burmeister@maxxamanalytics.com

Phone# (905) 817-5700 Ext:5816

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

Page 1 of 10

Maxxam Job #: B008312
Report Date: 2010/04/08

Trow Associates Inc
Client Project #: HAGE00392871A

O'REG 153 METALS & INORGANICS SHORT LIST (SOIL)

Maxxam ID	EX4653	EX4654	EX4654	EX4655	EX4656	EX4657	EX4658	
Sampling Date	2010/01/14	2010/01/11	2010/01/11	2009/12/23	2009/12/23	2009/12/23	2009/12/24	
Units	BH1 (5-6 1/2)	BH2 (5-6 1/2)	BH2 (5-6 1/2)	BH3 (2 1/2-4)	BH4 (2 1/2-4)	BH5 (7 1/2-9)	BH6 (5-6 1/2)	QC Batch
Calculated Parameters			Lab-Dup					
Sodium Adsorption Ratio	N/A	1.3	1.2	3.9	0.33	0.23	0.27	N/A
Inorganics								
Conductivity	mS/cm	0.59	0.46	0.47	0.47	0.22	0.16	0.002
Moisture	%	9.8	15	14	16	19	16	0.2
Available (CaCl2) pH	pH	7.74	7.72	7.68	7.50	7.52	7.61	2065789
Metals								
Chromium (VI)	ug/g	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.2
Acid Extractable Antimony (Sb)	ug/g	0.5	0.9	<0.2	<0.2	<0.2	<0.2	0.2
Acid Extractable Arsenic (As)	ug/g	5	5	9	4	5	3	1
Acid Extractable Barium (Ba)	ug/g	88	67	96	99	77	81	0.5
Acid Extractable Beryllium (Be)	ug/g	0.6	0.4	0.5	0.5	0.6	0.5	0.2
Acid Extractable Cadmium (Cd)	ug/g	0.3	0.2	<0.1	0.1	<0.1	<0.1	0.1
Acid Extractable Chromium (Cr)	ug/g	18	15	17	17	15	16	1
Acid Extractable Cobalt (Co)	ug/g	11	8.7	11	9.7	7.7	9.5	0.1
Acid Extractable Copper (Cu)	ug/g	43	31	35	26	41	24	0.5
Acid Extractable Lead (Pb)	ug/g	45	36	11	13	12	10	1
Acid Extractable Molybdenum (Mo)	ug/g	0.6	0.6	<0.5	<0.5	<0.5	<0.5	0.5
Acid Extractable Nickel (Ni)	ug/g	22	19	24	20	19	21	0.5
Acid Extractable Selenium (Se)	ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Acid Extractable Silver (Ag)	ug/g	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.2
Acid Extractable Thallium (Tl)	ug/g	0.10	0.09	0.10	0.09	0.08	0.09	0.05
Acid Extractable Vanadium (V)	ug/g	24	23	27	25	27	24	5
Acid Extractable Zinc (Zn)	ug/g	120	77	58	58	56	51	5
Acid Extractable Mercury (Hg)	ug/g	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	0.05

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Job #: B008312
Report Date: 2010/04/08

Trow Associates Inc
Client Project #: HAGE00392871A

O'REG 153 METALS & INORGANICS SHORT LIST (SOIL)

Maxxam ID	EX4659	EX4660	EX4661	EX4662	
Sampling Date	2010/01/12	2010/01/12	2010/01/13	2010/01/13	
Units	BH7 (5-6 1/2)	BH8 (10-11 1/2)	BH103 (2.5-4)	BH109 (2 1/2-4)	QC Batch
Calculated Parameters					
Sodium Adsorption Ratio	N/A	0.24	0.47	0.37	N/A
Inorganics					
Conductivity	mS/cm	0.27	0.38	0.51	0.002
Moisture	%	7.8	16	17	0.2
Available (CaCl2) pH	pH	7.61	7.70	7.69	0.2
Metals					
Chromium (VI)	ug/g	<0.2	<0.2	<0.2	0.2
Acid Extractable Antimony (Sb)	ug/g	<0.2	<0.2	<0.2	0.2
Acid Extractable Arsenic (As)	ug/g	7	9	6	1
Acid Extractable Barium (Ba)	ug/g	100	150	130	0.5
Acid Extractable Beryllium (Be)	ug/g	0.4	0.5	0.7	0.2
Acid Extractable Cadmium (Cd)	ug/g	0.1	0.1	<0.1	0.1
Acid Extractable Chromium (Cr)	ug/g	17	15	20	1
Acid Extractable Cobalt (Co)	ug/g	9.0	8.6	11	0.1
Acid Extractable Copper (Cu)	ug/g	48	33	33	0.5
Acid Extractable Lead (Pb)	ug/g	14	13	12	1
Acid Extractable Molybdenum (Mo)	ug/g	0.5	0.5	<0.5	0.5
Acid Extractable Nickel (Ni)	ug/g	19	18	25	0.5
Acid Extractable Selenium (Se)	ug/g	<0.5	<0.5	<0.5	0.5
Acid Extractable Silver (Ag)	ug/g	<0.2	<0.2	<0.2	0.2
Acid Extractable Thallium (Tl)	ug/g	0.11	0.08	0.12	0.05
Acid Extractable Vanadium (V)	ug/g	26	21	28	5
Acid Extractable Zinc (Zn)	ug/g	69	70	60	5
Acid Extractable Mercury (Hg)	ug/g	<0.05	<0.05	<0.05	0.05

N/A = Not Applicable

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Maxxam Job #: B008312
Report Date: 2010/04/08

Trow Associates Inc
Client Project #: HAGE00392871A

O'REG 153 METALS & INORGANICS SHORT LIST (SOIL)

Maxxam ID	EX4663	EX4664	EX4665	EX4666	EX4668	
Sampling Date	2010/01/14	2010/01/15	2010/01/14	2010/01/15	2010/01/15	
Units	BH9 (2 1/2-4)	BH10 (5-6 1/2)	BH11 (7 1/2-9)	BH12 (5-6 1/2)	BH12 (5-6 1/2)	QC Batch
QC Batch						
Lab-Dup						
Calculated Parameters						
Sodium Adsorption Ratio	N/A	0.43	0.20	0.25	0.26	N/A
Inorganics						
Conductivity	mS/cm	0.52	0.25	0.19	0.42	0.002
Moisture	%	39	22	13	20	0.2
Available (CaCl2) pH	pH	7.60	7.53	7.76	7.66	7.62
Metals						
Chromium (VI)	ug/g	<0.2	2064196	<0.2	<0.2	2064196
Acid Extractable Antimony (Sb)	ug/g	2.8	2065767	<0.2	<0.2	2065767
Acid Extractable Arsenic (As)	ug/g	150	2065767	3	4	3
Acid Extractable Barium (Ba)	ug/g	850	2065767	76	100	100
Acid Extractable Beryllium (Be)	ug/g	0.4	2065767	0.6	0.6	0.5
Acid Extractable Cadmium (Cd)	ug/g	0.3	2065767	0.1	<0.1	<0.1
Acid Extractable Chromium (Cr)	ug/g	13	2065767	19	20	20
Acid Extractable Cobalt (Co)	ug/g	12	2065767	12	11	11
Acid Extractable Copper (Cu)	ug/g	27	2065767	35	28	29
Acid Extractable Lead (Pb)	ug/g	12	2065767	13	13	13
Acid Extractable Molybdenum (Mo)	ug/g	3.0	2065767	<0.5	<0.5	<0.5
Acid Extractable Nickel (Ni)	ug/g	13	2065767	27	24	23
Acid Extractable Selenium (Se)	ug/g	1.6	2065767	<0.5	<0.5	<0.5
Acid Extractable Silver (Ag)	ug/g	<0.2	2065767	<0.2	<0.2	<0.2
Acid Extractable Thallium (Tl)	ug/g	0.09	2065767	0.12	0.07	0.07
Acid Extractable Vanadium (V)	ug/g	18	2065767	27	25	25
Acid Extractable Zinc (Zn)	ug/g	73	2065767	71	61	59
Acid Extractable Mercury (Hg)	ug/g	<0.05	2065767	<0.05	<0.05	<0.05

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Job #: B008312
Report Date: 2010/04/08

Trow Associates Inc
Client Project #: HAGE00392871A

GENERAL COMMENTS

Revised report: As per request, additional sample IDs have been updated. AWH 2010/04/08.

Revised report: As per clients request sample Id BH9(2.5-4) has been revised to BH103(2.5-4). AWH 2010/03/11

Revised report: Sample IDs updated as per request. AWH 2010/03/10.

Sample EX4657: SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample EX4658: SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample EX4659: SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample EX4664: SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample EX4665: SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Maxxam Job #: B008312
Report Date: 2010/04/08

Trow Associates Inc
Client Project #: HAGE00392871A

QUALITY ASSURANCE REPORT

QC Batch	Parameter	Date	Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2064196	Chromium (VI)	2010/01/28	95	75 - 125	101	75 - 125	<0.2	ug/g	NC	35	95	85 - 115
2065350	Moisture	2010/01/27							1.8	50		
2065531	Moisture	2010/01/27							11.7	50		
2065767	Acid Extractable Antimony (Sb)	2010/01/28	102	75 - 125			<0.2	ug/g			100	75 - 125
2065767	Acid Extractable Arsenic (As)	2010/01/28	101	75 - 125			<1	ug/g			99	75 - 125
2065767	Acid Extractable Barium (Ba)	2010/01/28	NC	75 - 125			<0.5	ug/g			101	75 - 125
2065767	Acid Extractable Beryllium (Be)	2010/01/28	110	75 - 125			<0.2	ug/g			101	75 - 125
2065767	Acid Extractable Cadmium (Cd)	2010/01/28	106	75 - 125			<0.1	ug/g			102	75 - 125
2065767	Acid Extractable Chromium (Cr)	2010/01/28	103	75 - 125			<1	ug/g			98	75 - 125
2065767	Acid Extractable Cobalt (Co)	2010/01/28	101	75 - 125			<0.1	ug/g			100	75 - 125
2065767	Acid Extractable Copper (Cu)	2010/01/28	NC	75 - 125			<0.5	ug/g			98	75 - 125
2065767	Acid Extractable Lead (Pb)	2010/01/28	103	75 - 125			<1	ug/g	0.4	35	102	75 - 125
2065767	Acid Extractable Molybdenum (Mo)	2010/01/28	105	75 - 125			<0.5	ug/g			101	75 - 125
2065767	Acid Extractable Nickel (Ni)	2010/01/28	103	75 - 125			<0.5	ug/g			101	75 - 125
2065767	Acid Extractable Selenium (Se)	2010/01/28	101	75 - 125			<0.5	ug/g			99	75 - 125
2065767	Acid Extractable Silver (Ag)	2010/01/28	104	75 - 125			<0.2	ug/g			100	75 - 125
2065767	Acid Extractable Thallium (Tl)	2010/01/28	101	75 - 125			<0.05	ug/g			100	75 - 125
2065767	Acid Extractable Vanadium (V)	2010/01/28	103	75 - 125			<5	ug/g			95	75 - 125
2065767	Acid Extractable Zinc (Zn)	2010/01/28	NC	75 - 125			<5	ug/g			101	75 - 125
2065767	Acid Extractable Mercury (Hg)	2010/01/28	110	75 - 125			<0.05	ug/g			114	75 - 125
2065795	Conductivity	2010/01/28					<0.002	mS/cm	1.2	35	106	75 - 125
2066025	Acid Extractable Antimony (Sb)	2010/01/28	92	75 - 125			<0.2	ug/g	NC	35	99	75 - 125
2066025	Acid Extractable Arsenic (As)	2010/01/28	97	75 - 125			<1	ug/g	NC	35	100	75 - 125
2066025	Acid Extractable Barium (Ba)	2010/01/28	NC	75 - 125			<0.5	ug/g	1.4	35	99	75 - 125
2066025	Acid Extractable Beryllium (Be)	2010/01/28	103	75 - 125			<0.2	ug/g	NC	35	104	75 - 125
2066025	Acid Extractable Cadmium (Cd)	2010/01/28	99	75 - 125			<0.1	ug/g	NC	35	101	75 - 125
2066025	Acid Extractable Chromium (Cr)	2010/01/28	94	75 - 125			<1	ug/g	3.8	35	99	75 - 125
2066025	Acid Extractable Cobalt (Co)	2010/01/28	95	75 - 125			<0.1	ug/g	0.6	35	100	75 - 125
2066025	Acid Extractable Copper (Cu)	2010/01/28	NC	75 - 125			<0.5	ug/g	2.8	35	99	75 - 125
2066025	Acid Extractable Lead (Pb)	2010/01/28	97	75 - 125			<1	ug/g	0.6	35	104	75 - 125
2066025	Acid Extractable Molybdenum (Mo)	2010/01/28	98	75 - 125			<0.5	ug/g	NC	35	102	75 - 125
2066025	Acid Extractable Nickel (Ni)	2010/01/28	92	75 - 125			<0.5	ug/g	5.3	35	100	75 - 125
2066025	Acid Extractable Selenium (Se)	2010/01/28	94	75 - 125			<0.5	ug/g	NC	35	99	75 - 125
2066025	Acid Extractable Silver (Ag)	2010/01/28	97	75 - 125			<0.2	ug/g	NC	35	100	75 - 125
2066025	Acid Extractable Thallium (Tl)	2010/01/28	92	75 - 125			<0.05	ug/g	NC	35	103	75 - 125
2066025	Acid Extractable Vanadium (V)	2010/01/28	NC	75 - 125			<5	ug/g	NC	35	97	75 - 125
2066025	Acid Extractable Zinc (Zn)	2010/01/28	NC	75 - 125			<5	ug/g	3.6	35	103	75 - 125

Maxxam Job #: B008312
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QUALITY ASSURANCE REPORT

QC Batch	Parameter	Date	Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2066025	Acid Extractable Mercury (Hg)	2010/01/28	111	75 - 125			<0.05	ug/g	NC	35	107	75 - 125
2066269	Conductivity	2010/01/28					<0.002	mS/cm	4.6	35	109	75 - 125

N/A = Not Applicable

RPD = Relative Percent Difference

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.

NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

Validation Signature Page

Maxxam Job #: B008312

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Cristina Carriere

CRISTINA CARRIERE, Scientific Services

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.