

Geotechnical
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Building Science

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Proposed Residential Development
Half Moon Bay West
Greenbank Road at Cambrian Road
Ottawa, Ontario

Prepared For

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1.0 Introduction

Paterson Group (Paterson) was commissioned by Mattamy Homes (Mattamy) to conduct a geotechnical investigation for the proposed residential development Half Moon Bay West to be located north of Cambrian Road, and west of the future Greenbank Road re-alignment, in the City of Ottawa (refer to Figure 1 - Key Plan presented in Appendix 2).

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the proposed development as it is understood at the time of writing this report.

Investigating the presence or potential presence of contamination on the subject property was not part of the scope of work of the present investigation. Therefore, the present report does not address environmental issues.

Previous geotechnical investigations were completed by John D. Paterson and Associates (JDPA) and Paterson Group (Paterson) at the subject site and surrounding areas. The relevant Soil Profile and Test Data sheets and Unidimensional Consolidation Testing Results Sheets from previous geotechnical investigations are presented in Appendix 1.

2.0 Proposed Development

It is understood that the current phase of the proposed residential development will consist of townhouses, single family residential dwellings and parklands. It is expected that the development will be municipally serviced with local paved roadways.

The current phase of Half Moon Bay west is located north of Cambrian Road and west of the future Greenbank Road re-alignment.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field programs for the geotechnical investigations were carried out on November 26, 27 2003, December 1, 2003, April 15 and 20, 2004, June 28, 2005, October 6, 2005, December 14 and 18, 2006, January 4 to 11, 2007, June 1, 4 and 14, 2007, March 17 to 26, 2008, April 1 and 2, 2008, October 27 to 29, 2010, November 1, 2, 12, 15, 16 and 17, 2010, February 11, 14 to 16, 18, and 22 to 25, 2011 and February 27 to 29, 2012 and March 1, 2 and 5, 2012. The locations of all test holes completed in the immediate vicinity of the subject site are illustrated on Drawing PG2246-4 - Test Hole Location Plan included in Appendix 2.

The boreholes were drilled using a track-mounted auger drill rig operated by a two person crew. The test pits were completed using a hydraulic shovel at selected locations. The test hole procedure consisted of augering or excavated to the required depths at the selected locations and sampling the overburden soils. All fieldwork was conducted under the full-time supervision of personnel from Paterson's geotechnical division under the direction of a senior engineer.

Sampling and In Situ Testing

Soil samples were collected from the boreholes using a 50 mm diameter split-spoon (SS) sampler, or using 73 mm diameter thin walled (TW) Shelby tubes in conjunction with a piston sampler. Soil samples from the test pits were recovered from the side walls of the open excavation and all soil samples were initially classified on site. The split-spoon and grab samples were placed in sealed plastic bags and the Shelby tubes were sealed at both ends on site. All samples were transported to our laboratory for further examination and classification. The depths at which the split-spoon, grab and Shelby tube samples were recovered from the boreholes are shown as SS, G and TW, respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

The grab samples were placed in sealed plastic bags and all samples were transported to our laboratory. The depths at which the grab samples were recovered from the test holes are shown as 'G', on the Soil Profile and Test Data sheets presented in Appendix 1.

Standard Penetration Testing (SPT) was conducted in conjunction with the recovery of the split-spoon samples. The SPT results are recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split-spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

Undrained shear strength testing was carried out in cohesive soils using a field vane apparatus.

Also, undrained shear strength testing was carried out using a frictionless vane borer apparatus at BH 1-12, BH 3-12, BH 5-12, BH 6-12, BH 8-12, BH 9-12, BH 11-12, BH 12-12 and BH 14-12. The undrained shear strength readings were recorded by a crank operated torque head device, which prepares a complete, accurate and permanent test record. The vane resistance, rod friction and angular rotation are all recorded as part of the test record. The calibrated undrained shear strength readings from the frictionless vane apparatus are presented on the Soil Profile and Test Data sheets in Appendix 1.

The subsurface conditions observed in the test holes were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets in Appendix 1 of this report.

Groundwater

Flexible polyethylene standpipes or monitoring wells were installed in all boreholes to permit monitoring of the groundwater levels subsequent to the completion of the sampling program.

Sample Storage

All samples from the current investigation will be stored in the laboratory for a period of one month after issuance of this report. They will then be discarded unless we are directed otherwise. The samples collected from the site during the previous investigations have already been discarded.

3.2 Field Survey

The test hole locations along with ground surface elevations were determined in the field by J.D. Barnes Limited and ASL. It is understood that the ground surface elevations at the borehole locations are referenced to a geodetic datum.

The locations of the boreholes and the ground surface elevations for each test hole location are presented on Drawing PG2246-4 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soil samples were collected from the subject site during the investigation and were visually examined in our laboratory to review the results of the field logging. A total of thirty-seven (37) Shelby tube samples were submitted for unidimensional consolidation testing. The results of the testing are shown on the Consolidation Test sheets in Appendix 1.

The results of the geotechnical laboratory testing program are discussed in Subsections 4.2 and 5.3 of this report.

3.4 Analytical Testing

Three (3) soil samples were submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The samples were submitted to determine the concentration of sulphate and chloride, the resistivity and the pH of the sample. The results are presented in Appendix 1 and are discussed further in Subsection 6.8.

4.0 Observations

4.1 Surface Conditions

Currently, the majority of the site has been stripped of topsoil. The site consisted formerly of agricultural fields with the exception of the southwest portion of the site where a treed area formerly existed. The former treed area located within the southwest portion of the site was stripped of topsoil and peat in late 2008. Five (5) test fill piles, which are approximately 30 m by 30 m and 1.7 to 2.1 m high, are distributed throughout the subject phase. Also, the east portion of the site is currently occupied by a surcharge fill pile within a future roadway and housing area adjacent to Greenbank Road. The surcharge pile is approximately 2 m above the proposed finished grades and covers an area of approximately 65 m by 125 m.

4.2 Subsurface Profile

Subsoil Conditions

Generally, the soil profile at the test hole locations consists of silty sand to silty clay fill or topsoil at ground surface underlain by a relatively deep deposit of silty clay overlying glacial till.

Reference should be made to the Soil Profile and Test Data sheets presented in Appendix 1 for details of the soil profiles encountered at the test hole locations completed during the geotechnical investigation.

Silty Clay

A total of thirty-seven (37) samples of silty clay were subjected to unidimensional consolidation (oedometer) testing. The test results are presented in Subsection 5.3 and on the Consolidation Test sheets in Appendix 1. The consolidation test results indicate that the silty clay is overconsolidated with overconsolidation ratios (OCR) for the tested samples varying between 1.3 and 3.2. The OCR is the ratio of the preconsolidation pressure to the effective pressure at the sample depth. This is further discussed in Subsection 5.3.

Thirteen (13) silty clay samples were submitted for Atterberg Limits testing. The tested material was classified as Inorganic Clays of Low Plasticity (CL). The results are summarized in Table 1 and presented on the Atterberg Limits Results sheet in Appendix 1.

Table 1 - Summary of Atterberg Limits Tests					
Sample	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index %	Classification
BH23-10 TW6	51.7	31	20	11	CL
BH12-10 TW3	49.2	30	18	13	CL
BH7-10 TW3	54.3	34	20	13	CL
BH3-10 TW7	63.6	41	26	15	CL
BH1-10 TW7	60.8	38	19	19	CL
BH18A-06 TW5	50.4	32	20	12	CL
BH17-06 TW5	57	31	20	10	CL
BH16-06 TW6	60.8	27	19	8	CL
BH5-06 TW2	56.4	26	18	8	CL
BH12-05 TW6	66.1	38	23	15	CL
BH11A-05 TW3	45.6	29	17	11	CL
BH11A-05 TW1	39.4	33	18	15	CL
BH10-5 TW5	62	37	19	18	CL

4.3 Groundwater

Groundwater levels (GWLs) were measured in the piezometers and monitoring wells installed in the boreholes and results are presented in the Soil Profile and Test Data sheets in Appendix 1. Based on the groundwater readings at the monitoring wells, it is suspected that artesian pressure, which is present at depth, influenced the groundwater readings observed within the deeper monitoring wells. The groundwater level can also be estimated based on moisture levels and colour of the recovered soil samples. Based on these observations at the borehole locations, the groundwater table is expected between 1 to 2 m below original ground surface. It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater levels could vary at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

Due to the presence of the sensitive silty clay layer, the subject site will be subjected to grade raise restrictions. Permissible grade raise areas are outlined in Drawing PG2246-5 - Permissible Grade Raise Plan - Housing and Drawing PG2246-6 - Permissible Grade Raise Plan - Roadways based on the existing borehole information and test fill settlement program data.

The above and other considerations are further discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and organic containing soils should be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures.

Fill Placement

Fill used for grading beneath the building areas should consist of a clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. This material should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building areas should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD).

5.3 Foundation Design

Lightly loaded structures, such as the buildings anticipated, could be founded on shallow footings placed on an undisturbed, stiff silty clay bearing surface. Strip footings, up to 2 m wide, and pad footings, up to 3 m wide, placed on an undisturbed, stiff silty clay bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **100 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **225 kPa**. A geotechnical resistance factor of 0.5 was applied to the bearing resistance values at ULS.

The above noted bearing resistance values should be considered applicable for footings placed on select subgrade material or engineered fill as described in Subsection 5.2.

Strip footings, up to 2 m wide, and pad footings, up to 4 m wide, placed on an undisturbed, firm silty clay bearing surface can be designed using a bearing resistance value at SLS of **60 kPa** and a factored bearing resistance value at ULS of **180 kPa**.

An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to an engineered fill, stiff to firm silty clay or engineered fill above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Settlement/Grade Raise

Consideration must be given to potential settlements which could occur due to the presence of the silty clay deposit and the combined loads from the proposed footings, any groundwater lowering effects, and grade raise fill. The foundation loads to be considered for the settlement case are the continuously applied loads which consist of the unfactored dead loads and the portion of the unfactored live load that is considered to be continuously applied. For dwellings, a minimum value of 50% of the live load is often recommended by Paterson.

Thirty seven (37) site specific consolidation tests were carried out for the subject site. The results of the consolidation tests are presented in Tables 2 to 5 on the following pages and in Appendix 1.

Value p'_c is the preconsolidation pressure of the sample and p'_o is the effective overburden pressure. It should be noted that the effective overburden pressure has been calculated from original ground surface at borehole locations. The difference between these values is the theoretical available preconsolidation.

The values C_{cr} and C_c are the recompression and compression indices, respectively, and are a measure of the compressibility of the soil due to stress increases below and above the preconsolidation pressures. The higher values for the C_c , as compared to the C_{cr} , illustrate the increased settlement potential above, as compared to below, the preconsolidation pressure.

Table 2 - Summary of Consolidation Test Results (PG2246)

Borehole No.	Sample	Elevation (m)	p'_c (kPa)	p'_o (kPa)	C_{cr}	C_c	Q (*)
BH 1-10	TW 7	84.54	93.0	58.3	0.019	1.228	A
BH 2-10	TW 4	89.13	67.7	36.0	0.023	1.024	G
BH 3-10	TW 7	76.39	153.1	116.0	0.012	1.208	A
BH 4-10	TW 8	86.66	100.0	49.6	0.020	1.585	G
BH 5-10	TW 5	88.27	87.2	41.0	0.019	1.186	G
BH 5-10	TW 7	82.87	118.7	74.4	-	1.114	G
BH 7-10	TW 3	88.67	101.0	41.2	0.022	0.927	G
BH 10-10	TW 3	90.37	55.5	29.1	0.012	0.472	A
BH 11-10	TW 6	80.97	141.0	85.0	0.014	1.259	G
BH 12-10	TW 3	89.09	92.0	39.8	0.022	0.721	G
BH 14-10	TW 7	83.25	90.0	67.7	0.021	0.961	G
BH 15-10	TW 4	86.11	87.0	55.2	0.021	1.133	P
BH 15-10	TW 4	86.01	87.9	55.0	0.015	0.778	G
BH 18-10	TW5	89.05	73.0	40.5	0.023	1.010	A
BH 20-10	TW 7	88.78	90.0	38.0	0.019	0.763	G
BH 23-10	TW 6	89.66	74.0	35.8	0.022	0.903	G
BH 24-10	TW 4	86.52	90.0	55.3	0.017	0.784	G
* - Q - Quality assessment of sample - G: Good A: Acceptable P: Likely disturbed							

Table 3 - Summary of Consolidation Test Results (PG1618)

Borehole No.	Sample	Elevation (m)	p' _c (kPa)	p' _o (kPa)	C _{cr}	C _c	Q (*)
BH 14-08	TW 6	87.85	92.0	44.5	0.016	1.214	G
BH 15-08	TW 5	89.00	69.0	30.5	0.011	0.761	A
BH 20-08	TW 6	88.26	88.0	42.2	0.015	0.763	A
BH 22-08	TW 4	87.99	85.0	45.5	0.010	0.902	G
BH 29-08	TW 5	84.79	78.0	48.3	0.014	0.905	G

* - Q - Quality assessment of sample -
G: Good A: Acceptable P: Likely disturbed

Table 4 - Summary of Consolidation Test Results (PG0177)

Borehole No.	Sample	Elevation (m)	p' _c (kPa)	p' _o (kPa)	C _{cr}	C _c	Q (*)
BH 2A	TW 3	-	88.0	52.9	0.022	0.850	G
BH 2B	TW 1	-	107.0	77.7	0.026	1.420	G
BH 10-05	TW 5	86.96	82.0	48.2	0.017	1.460	G
BH 11A-05	TW 1	89.41	83.0	25.8	0.020	0.737	G
BH 11A-05	TW 3	84.71	110.0	54.9	0.014	0.942	G
BH 12-05	TW 6	82.44	115.0	75.8	0.020	2.510	G
BH 5-06	TW 2	88.24	96.0	38.5	0.026	1.185	G
BH 16-06	TW 6	84.74	89.0	64.8	0.022	1.483	G
BH 17-06	TW 5	82.71	106.0	72.9	0.310	1.671	A
BH 18A-06	TW 5	87.73	75.0	44.8	0.017	0.606	P
BH 20-06	TW 4	85.65	71.0	49.0	0.020	0.943	G
BH 24-06	TW 3	86.53	84.0	54.9	0.018	1.309	G

* - Q - Quality assessment of sample -
G: Good A: Acceptable P: Likely disturbed

Table 5 - Summary of Consolidation Test Results (G9132)

Borehole No.	Sample	Depth (m)	p'_c (kPa)	p'_o (kPa)	C_{cr}	C_c	Q (*)
BH 1	TW 4	2.80	82.0	36.2	0.018	0.702	G
BH 3	TW 3	2.65	50.0	31.7	0.019	0.252	G
BH 3	TW 5	5.80	90.0	51.2	0.029	1.090	G
* - Q - Quality assessment of sample - G: Good A: Acceptable P: Likely disturbed							

It should be noted that the values of p'_c, p'_o, C_{cr} and C_c are determined using standard engineering practices and are estimates only. In addition, natural variations within the soil deposit would also affect the results. Furthermore, the p'_o parameter is directly influenced by the groundwater level. While the groundwater levels were measured at the time of the fieldwork, the levels vary with time and this has an impact on the available preconsolidation. Lowering the groundwater level increases the p'_o and therefore reduces the available preconsolidation. Unacceptable settlements could be induced by a significant lowering of the groundwater level. The p'_o values for the consolidation tests carried out for the present investigation are based on the long term groundwater level observed at each borehole location. The long term groundwater level is based on the colour and undrained shear strength profile of the silty clay.

The total and differential settlements will be dependent of the characteristics of the buildings. For design purposes, the total and differential settlements associated with the combination of proposed grade raises and design footing loading conditions are estimated to be 25 mm and 20 mm, respectively. A post-development groundwater lowering of 0.5 m was assumed.

The potential post construction total and differential settlements are dependent on the position of the long term groundwater level when building over deposits of compressible silty clay. While efforts can be made to reduce the impacts of the development on the long term level of the groundwater by placing clay dykes in the service trenches, reducing the sizes of paved areas, leaving green spaces to allow for groundwater recharge, limiting planting of trees to areas away from the buildings, it is not economically possible to control the level of the groundwater.

To reduce potential long term liabilities, consideration should be given to accounting for a larger groundwater lowering and to providing means to reduce long term groundwater lowering (e.g. clay dykes, restriction on planting around the stores, etc). It should be noted that building over silty clay deposits increases the likelihood of building movements and therefore of cracking. The use of steel reinforcement in foundations placed at key structural locations will tend to reduce foundation cracking as compared to unreinforced foundations.

5.4 Test Fill Piles and Settlement Monitoring Programs

In June 2016, a test fill pile program consisting of five (5) test fill piles (Piles A to E) were strategically placed across the subject site to provide additional information regarding our permissible grade raise recommendations for the area. The test fill piles consisted of a 30 m x 30 m pile, ranging in height from 1.7 to 2.1 m. Two (2) settlement plates were installed in each of the five (5) test fill piles. At that time, a settlement monitoring program was implemented, with the initial survey taking place on June 27, 2016.

In July 2017, an additional six (6) test fill piles were constructed as part of our settlement monitoring program and an additional 0.3 m of fill was placed over the existing test fill piles.

The test fill pile areas are outlined in Drawing PG2246-4 - Test Hole Location Plan in Appendix 2. The periodic readings, including most recent results, from our test fill settlement monitoring program are presented in Figures 2A and 2B - Test Fill Settlement Monitoring Program in Appendix 2.

A former settlement monitoring program between December 2007 and August 2011, consisting of three (3) test fill piles with a total of nine (9) settlement plates (SP1, SP2, SP3, SP4, SP5, SP6, SP7, SP8, and SP9) was completed within the west portion of subject site. The settlement plates were installed on December 13, 2007 and initially surveyed on December 14, 2007. The purpose of the program was to monitor potential settlement resulting from preloading the soils with various fill heights.

The results of the 2007 to 2011 test fill pile program can be summarized as follows: the 1.5 m surcharge pile (SP1 to SP3) indicated negligible settlement (maximum 8 mm). The 2.5 m surcharge pile (SP4 to SP6) indicated settlement up to 92 mm. The 3.5 m surcharge pile (SP7 to SP9) indicated settlement up to 189 mm. The results of the four year settlement monitoring program are presented in Figure 3 - Test Fill Pile (2007 to 2011) Settlement Monitoring Program in appendix 2.

Based on the results of the former and current settlement monitoring programs and existing borehole data, our permissible grade raise recommendations have been updated. Our permissible grade raise recommendations are presented in Drawing PG2246-5 - Permissible Grade Raise Plan - Housing and Drawing PG2246-6 - Permissible Grade Raise Plan - Roadways in Appendix 2.

A settlement surcharge program was initiated in an area where finished grades had exceeded our original permissible grade raise recommendations. The current surcharge area is outlined in Drawing PG2246-4 - Test Hole Location Plan in Appendix 2.

The settlement monitoring began in September 2016 upon completion of the fill placement for the surcharge pile within the subject section of River Run Avenue. Four (4) settlement monitoring plates (SP15, SP16, SP17, SP18) were installed within the surcharge pile on September 1, 2016 with the initial survey taking place on September 2, 2016. The settlement surcharge program was designed to eliminate the excessive settlement anticipated due to the proposed grading and the underlying silty clay deposit. The surcharge pile height was determined based on the proposed grading information at that time. The surcharge pile height provides a 2.0 m high surcharge at the housing based on the current grading information.

To date, settlement of up to 220 mm has been recorded at the four (4) settlement plates (SP15, SP16, SP17 and SP18). Based on the results of our current settlement survey and existing soils information the settlement survey program is still on going. The results are presented in Figure 4 - Settlement Surcharge Monitoring Program.

5.5 Design for Earthquakes

The proposed site can be taken as seismic site response **Class E** as defined in the Ontario Building Code 2012 (OBC 2012; Table 4.1.8.4.A) for foundations considered at this site. The soils underlying the site are not susceptible to liquefaction.

5.6 Basement Slab

With the removal of all topsoil and fill containing organic matter within the footprints of the proposed buildings, the native soil surface or engineered fill will be considered to be an acceptable subgrade surface on which to commence backfilling for floor slab construction. Provision should be made for proof-rolling the soil subgrade using heavy vibratory compaction equipment prior to placing any fill. Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular B Type II is recommended for backfilling below the floor slab. It is recommended that the upper 200 mm of sub-slab fill consist of 19 mm clear crushed stone.

5.7 Pavement Structure

For design purposes, the pavement structure presented in the following tables could be used for the design of car parking areas and local roadways.

Table 6 - Recommended Pavement Structure - Driveways	
Thickness (mm)	Material Description
50	Wear Course - HL 3 or Superpave 12.5 Asphaltic Concrete
150	BASE - OPSS Granular A Crushed Stone
300	SUBBASE - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 7 - Recommended Pavement Structure - Local Residential Roadways	
Thickness (mm)	Material Description
40	Wear Course - HL-3 or Superpave 12.5 Asphaltic Concrete
50	Binder Course - HL-8 or Superpave 19.0 Asphaltic Concrete
150	BASE - OPSS Granular A Crushed Stone
450	SUBBASE - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil	

Table 8 - Recommended Pavement Structure - Residential Collectors and Arterial Roadways with Bus Traffic	
Thickness (mm)	Material Description
40	Wear Course - HL-3 or Superpave 12.5 Asphaltic Concrete
50	Upper Binder Course - HL-8 or Superpave 19.0 Asphaltic Concrete
50	Lower Binder Course - HL-8 or Superpave 19.0 Asphaltic Concrete
150	BASE - OPSS Granular A Crushed Stone
600	SUBBASE - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for local roadways and PG64-34 for residential collectors and arterial roadways. If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. Weak subgrade conditions may be experienced over service trench fill materials. This may require the use of a geotextile, thicker subbase or other measures that can be recommended at the time of construction as part of the field observation program.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

It is recommended that a perimeter foundation drainage system be provided for proposed structures. The system should consist of a 150 mm diameter, geotextile-wrapped, perforated, corrugated, plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer or direct the collected water to the building sump pit, which should be connected to the storm sewer. Recommendations regarding the building sump pump and pit are presented in Subsection 6.5.

Backfill against the exterior sides of the foundation walls should consist of free-draining, non frost susceptible granular materials. The site materials will be frost susceptible and, as such, are not recommended for re-use as backfill unless a composite drainage system (such as system Platon or Miradrain G100N) connected to a drainage system is provided.

6.2 Protection Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect of frost action. A minimum 1.5 m thick soil cover (or equivalent) should be provided in this regard.

A minimum of 2.1 m thick soil cover (or equivalent) should be provided for other exterior unheated footings.

6.3 Excavation Side Slopes

The excavation for the proposed development will be mostly through sand fill and/or silty clay. Above the groundwater level, for excavations to depths of approximately 3 m, the excavation side slopes should be stable in the short term at 1H:1V. The lowermost 1.2 m can be vertical provided the material consists of stiff in situ silty clay. Flatter slopes could be required for deeper excavations or for excavation below the groundwater level. Where such side slopes are not permissible or practical, temporary shoring should be used. The subsoil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

The slope cross-sections recommended above are for temporary slopes. Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box approved by a structural engineer be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by “cut and cover” methods and excavations will not be left open for extended periods of time.

6.4 Pipe Bedding and Backfill

The pipe bedding for sewer and water pipes should consist of at least 150 mm of OPSS Granular A material. Where the bedding is located within the soft to firm grey silty clay, the thickness of the bedding material should be increased to a minimum of 300 mm. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD. The bedding material should extend at least to the spring line of the pipe.

The cover material, which should consist of OPSS Granular A, should extend from the spring line of the pipe to at least 300 mm above the obvert of the pipe. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD.

It should generally be possible to re-use the moist (not wet) brown silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. Wet silty clay materials will be difficult to re-use, as the high water contents make compacting impractical without an extensive drying period.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD.

To reduce long-term lowering of the groundwater level at this site, clay seals should be provided in the service trenches. The seals should be at least 1.5 m long (in the trench direction), and should extend from trench wall to trench wall. Generally, the seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material. The barriers should consist of relatively dry and compactable brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the material's SPMDD. The clay seals should be placed at the site boundaries and at strategic locations at no more than 60 m intervals in the service trenches.

6.5 Groundwater Control

Construction Phase

It is anticipated that groundwater infiltration into the excavations should be low and controllable using open sumps. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

A temporary Ministry of the Environment and Climate Change (MOECC) permit to take water (PTTW) may be required for this project if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase. A minimum 4 to 5 months should be allowed for completion of the PTTW application package and issuance of the permit by the MOECC.

For typical ground or surface water volumes, being pumped during the construction phase, between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MOECC review of the PTTW application.

Groundwater Control Using Sump Pits

It is understood that the proposed residential buildings within the subject site will include a basement level and sump pit and pump installed below the basement slab to provide an outlet for any storm water or spring melt water collected from the perimeter foundation drainage system. Based on our observations of the recovered soil samples from the borehole locations, the long-term groundwater level varies between 89.7 to 90.5 m elevation across the site. It is recommended that the design underside of footing elevation be placed at least 0.3 m above the long-term groundwater level to ensure adequate separation between the design underside of footing elevation. It is anticipated that the subject site is suitable for a development, which includes the use of sump pumps, from a geotechnical perspective provided the abovenoted separation distance is adhered to.

6.6 Winter Construction

The subsoil conditions at this site mostly consist of frost susceptible materials. In presence of water and freezing conditions ice could form within the soil mass. Heaving and settlement upon thawing could occur. Precautions should be taken if winter construction is considered for this project.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters and tarpaulins or other suitable means. In this regard, the base of the excavations

should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

The trench excavations should be carried out in a manner that will avoid the introduction of frozen materials into the trenches. As well, pavement construction is difficult during winter. The subgrade consists of frost susceptible soils which will experience total and

differential frost heaving as the work takes place. In addition, the introduction of frost, snow or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure. Additional information could be provided, if required.

6.7 Landscaping and Exterior Structure Considerations

Tree Planting Restrictions

Based on the results of the representative soil samples tested between the design underside of footing (USF) and 3.5 m from the proposed design grades at the residential dwellings, the subject site is considered as a low/medium sensitive area for tree planting according to the City of Ottawa Tree Planting in Sensitive Marine Clay Soils (2017 Guidelines)

Since the modified plasticity limit (PI) does not exceed 40% based on our testing results, large trees (mature height over 14 m) can be planted at Half Moon Bay West provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g. in a park or other green space). Tree planting setback limits may be reduced to 4.5 m for small (mature tree height up to 7.5m) and medium size trees (mature tree height 7.5 m to 14 m) provided that the following conditions are met:

- ☐ The underside of footing (USF) is 2.1 m or greater below the lowest finished grade must be satisfied for footings within 10 m from the tree, as measured from the centre of the tree trunk and verified by means of the Grading Plan as indicated procedural changes below.
- ☐ A small tree must be provided with a minimum of 25 m³ of available soil volume while a medium tree must be provided with a minimum of 30 m³ of available soil volume, as determined by the Landscape Architect. The developer is to ensure that the soil is generally un-compacted when backfilling in street tree planting locations.
- ☐ The tree species must be small (mature tree height up to 7.5 m) to medium size (mature tree height 7.5 m to 14 m) as confirmed by the Landscape Architect.
- ☐ The foundation walls are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall).
- ☐ Grading surrounding the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree), as noted on the subdivision Grading Plan.

In-Ground Swimming Pools

The in-situ soils are considered to be acceptable for the installation of in-ground swimming pools. The soil removed to accommodate an in-ground swimming pool weighs more than the water filled in-ground pool. Therefore, no additional load is being applied to the underlying sensitive clays.

Aboveground Swimming Pools, Hot Tubs and Exterior Decks

If consideration is given to construction of an above ground swimming pool, a hot tub or an exterior deck, a geotechnical consultant should be retained by the homeowner to review the site conditions. No additional grading should be placed around the exterior structure. The swimming pool should be located at least 3 m away from the existing foundation to avoid adding localized loading to the foundation and the hot tub should be located at least 2 m away from the existing foundation. Otherwise, construction is considered routine, and can be constructed in accordance with the manufacturer's specifications.

6.8 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. These results are indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The results of the chloride content, pH and resistivity indicate the presence of a non-aggressive to aggressive environment for exposed ferrous metals.

7.0 Recommendations

It is recommended that the following be carried out during the development stage:

- ☐ Review detailed grading plan(s) from a geotechnical perspective.
- ☐ Observation of all bearing surfaces prior to the placement of concrete.
- ☐ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- ☐ Observation of all subgrades prior to backfilling.
- ☐ Field density tests to ensure that the specified level of compaction has been achieved.
- ☐ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that the above program has been conducted in general accordance with our recommendations could be issued upon request, following the completion of a satisfactory material testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be permitted to review the grading plan once available and our recommendations when the drawings and specifications are complete.

A geotechnical investigation of this nature is a limited sampling of a site. The recommendations are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around the test locations. The extent of the limited area depends on the soil, bedrock and groundwater conditions, as well the history of the site reflecting natural, construction, and other activities. Should any conditions at the site be encountered which differ from those at the test locations, we request notification immediately in order to permit reassessment of our recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Mattamy Homes or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.



Faisal I. Abou-Seido, P.Eng.



David J. Gilbert, P. Eng.

Report Distribution:

- ☐ Mattamy Homes (6 copies)
- ☐ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

UNIDIMENSIONAL CONSOLIDATION TEST RESULTS

ATTERBERG LIMITS' RESULTS

ANALYTICAL TESTING RESULTS

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

DATUM Ground surface elevations provided by ASL.

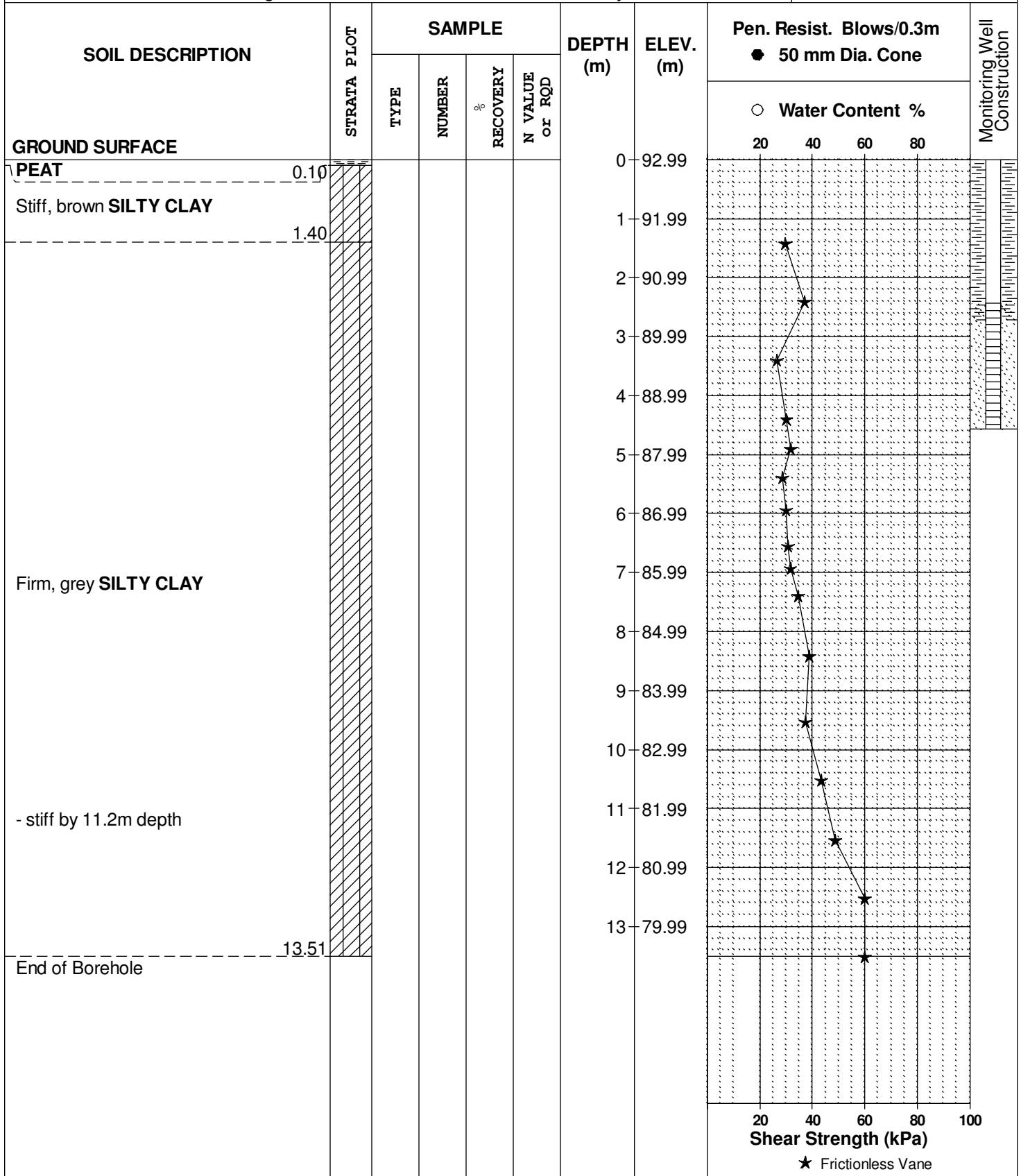
REMARKS

BORINGS BY CME 75 Power Auger

DATE February 27, 2012

FILE NO. PG2246

HOLE NO. BH 1-12



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

DATUM Ground surface elevations provided by ASL.

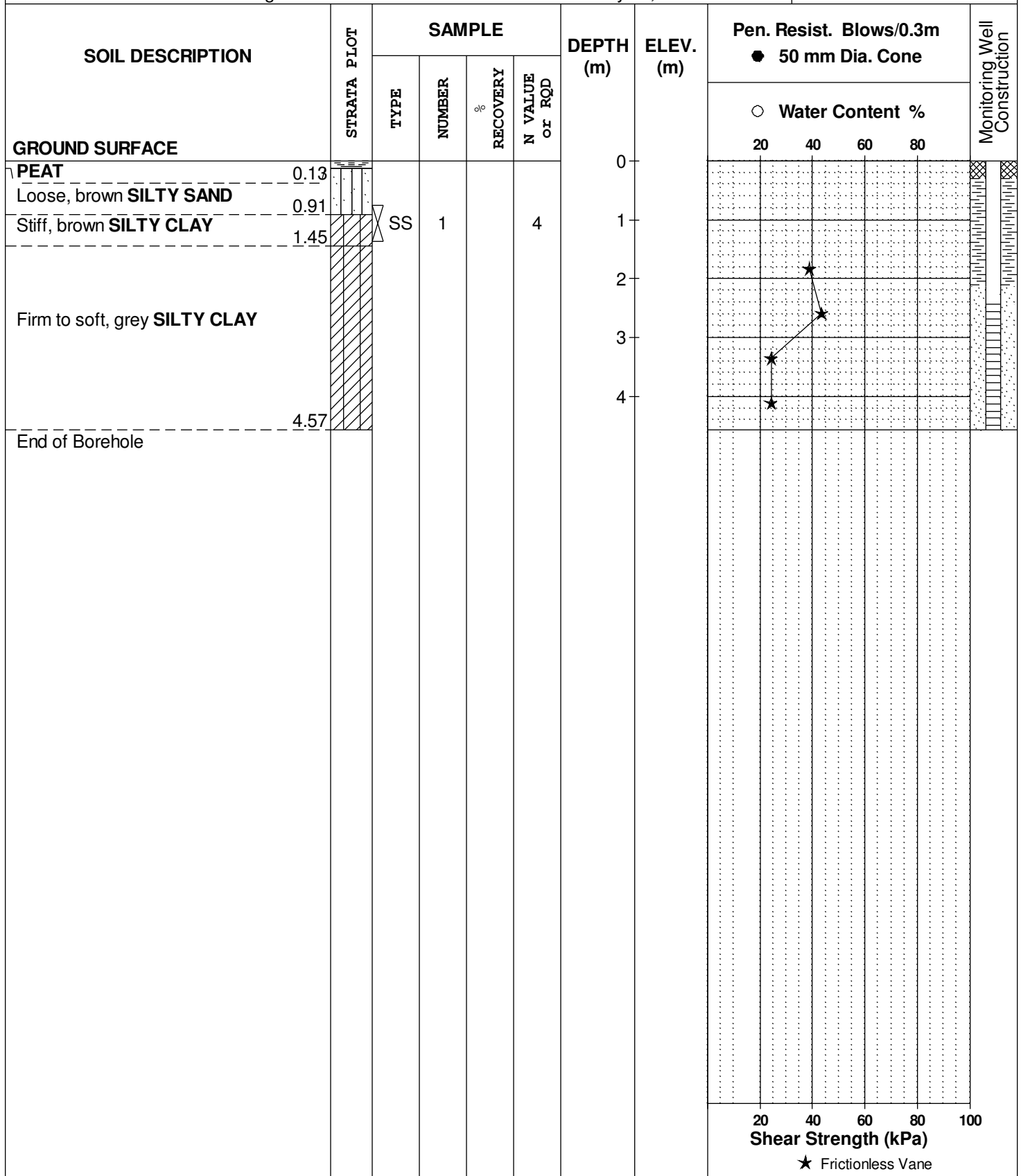
REMARKS

BORINGS BY CME 55 Power Auger

DATE February 28, 2012

FILE NO. PG2246

HOLE NO. BH 2-12



DATUM Ground surface elevations provided by ASL.

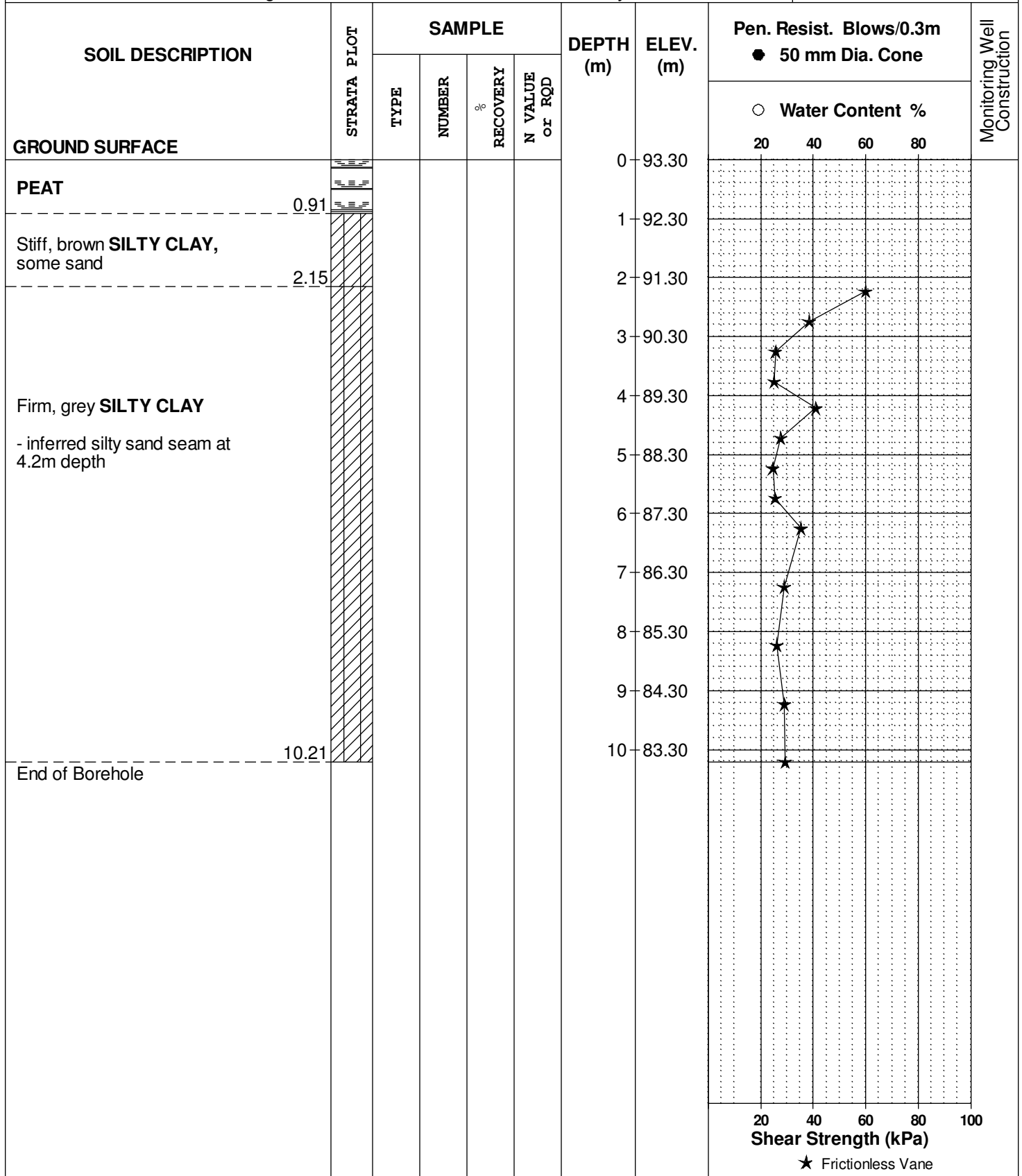
REMARKS

BORINGS BY CME 55 Power Auger

DATE February 28, 2012

FILE NO. PG2246

HOLE NO. BH 3-12



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

DATUM Ground surface elevations provided by ASL.

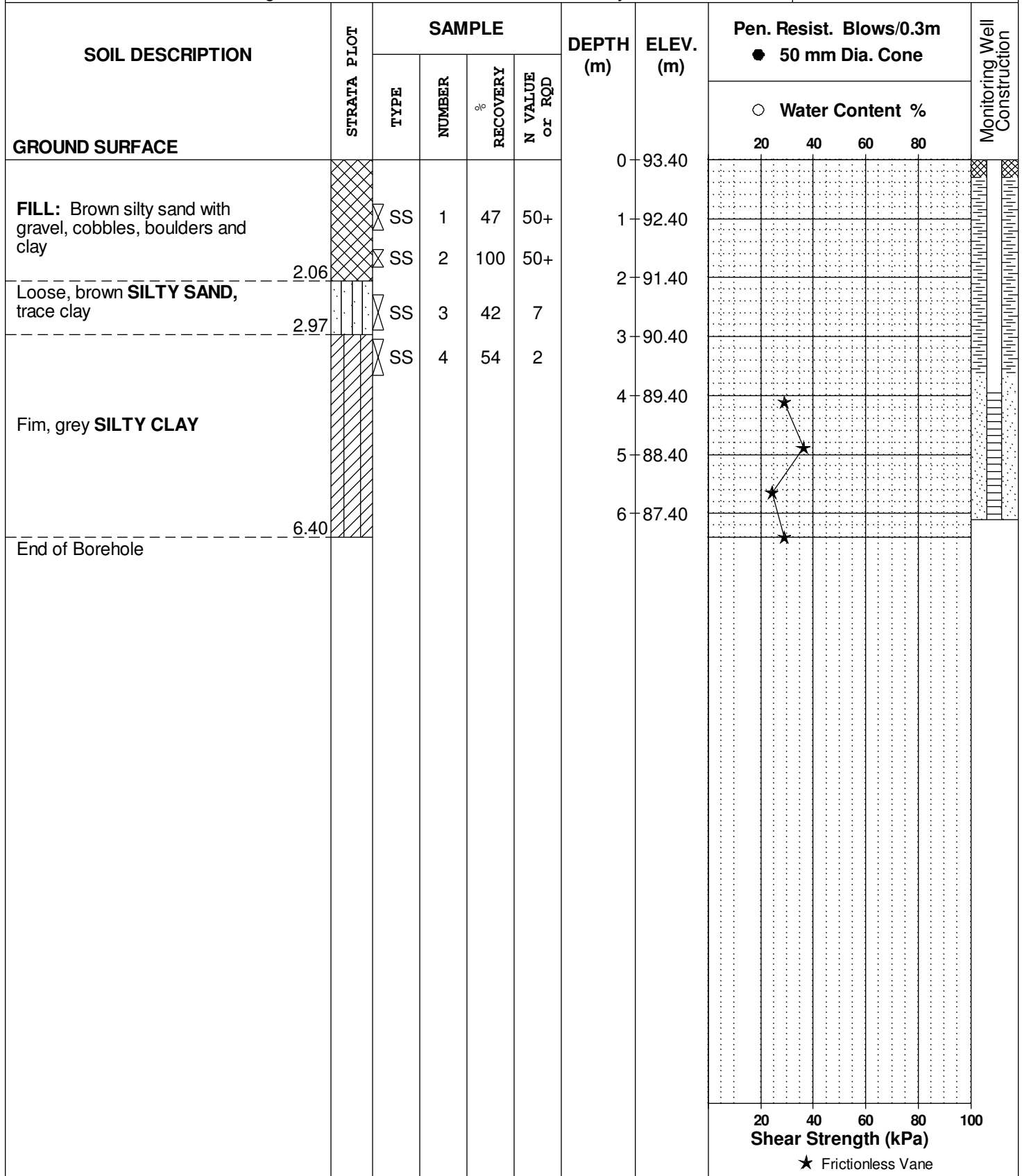
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DATE February 28, 2012

FILE NO. PG2246

HOLE NO. BH 4-12



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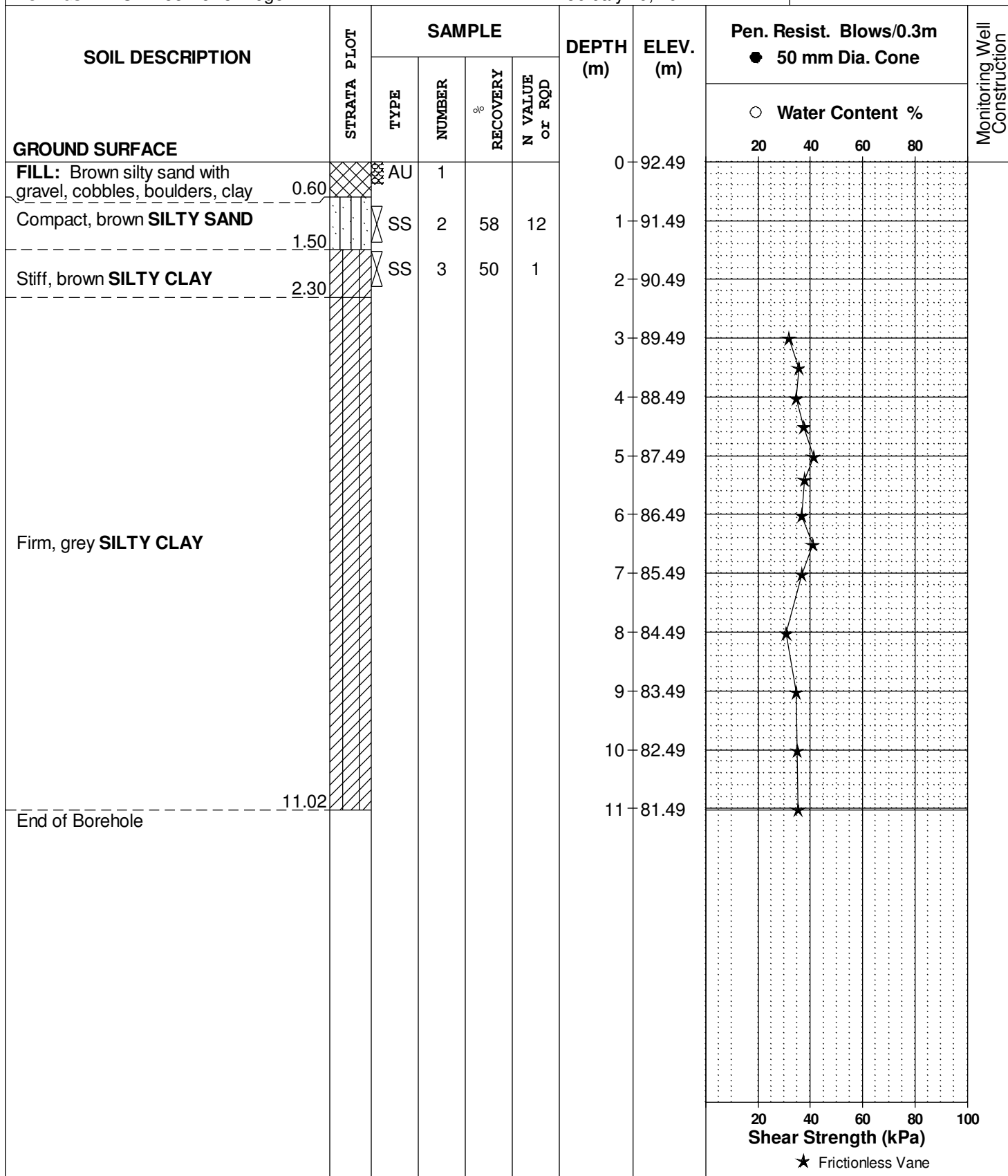
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BORINGS BY CME 55 Power Auger

DATE February 29, 2012

FILE NO. PG2246

HOLE NO. BH 5-12



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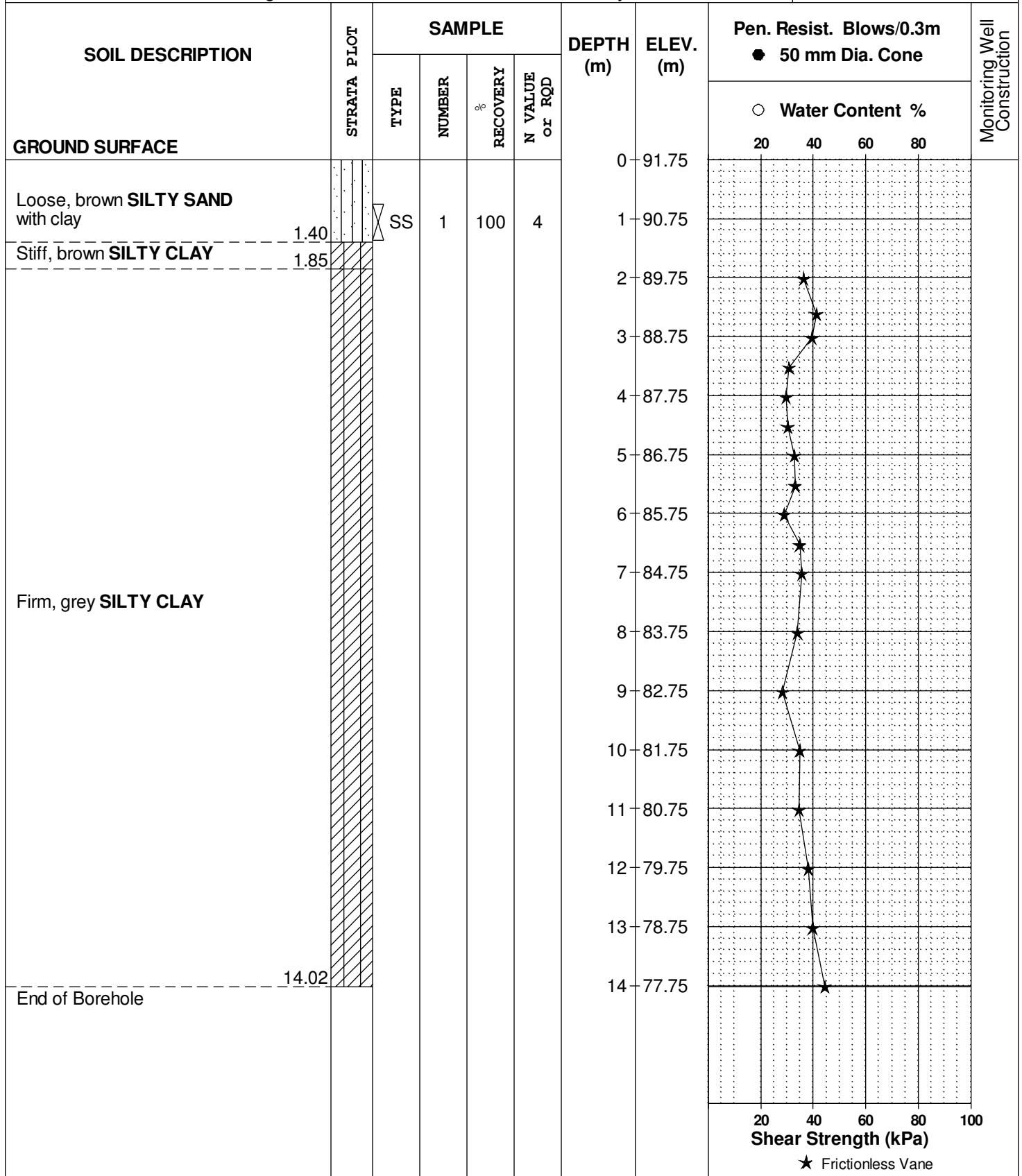
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DATE February 29, 2012

FILE NO. PG2246

HOLE NO. BH 6-12



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

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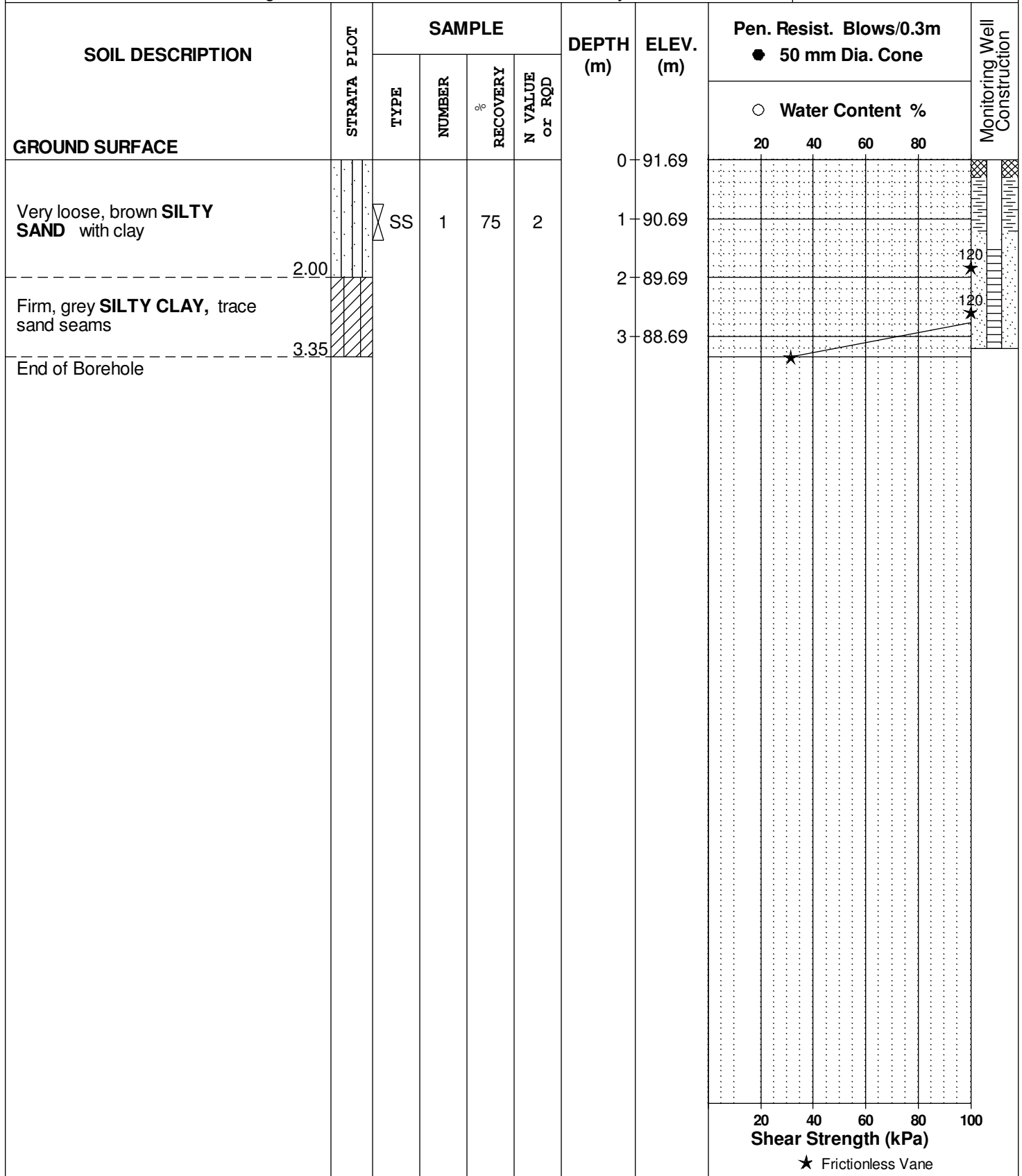
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DATE February 29, 2012

FILE NO. PG2246

HOLE NO. BH 7-12



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

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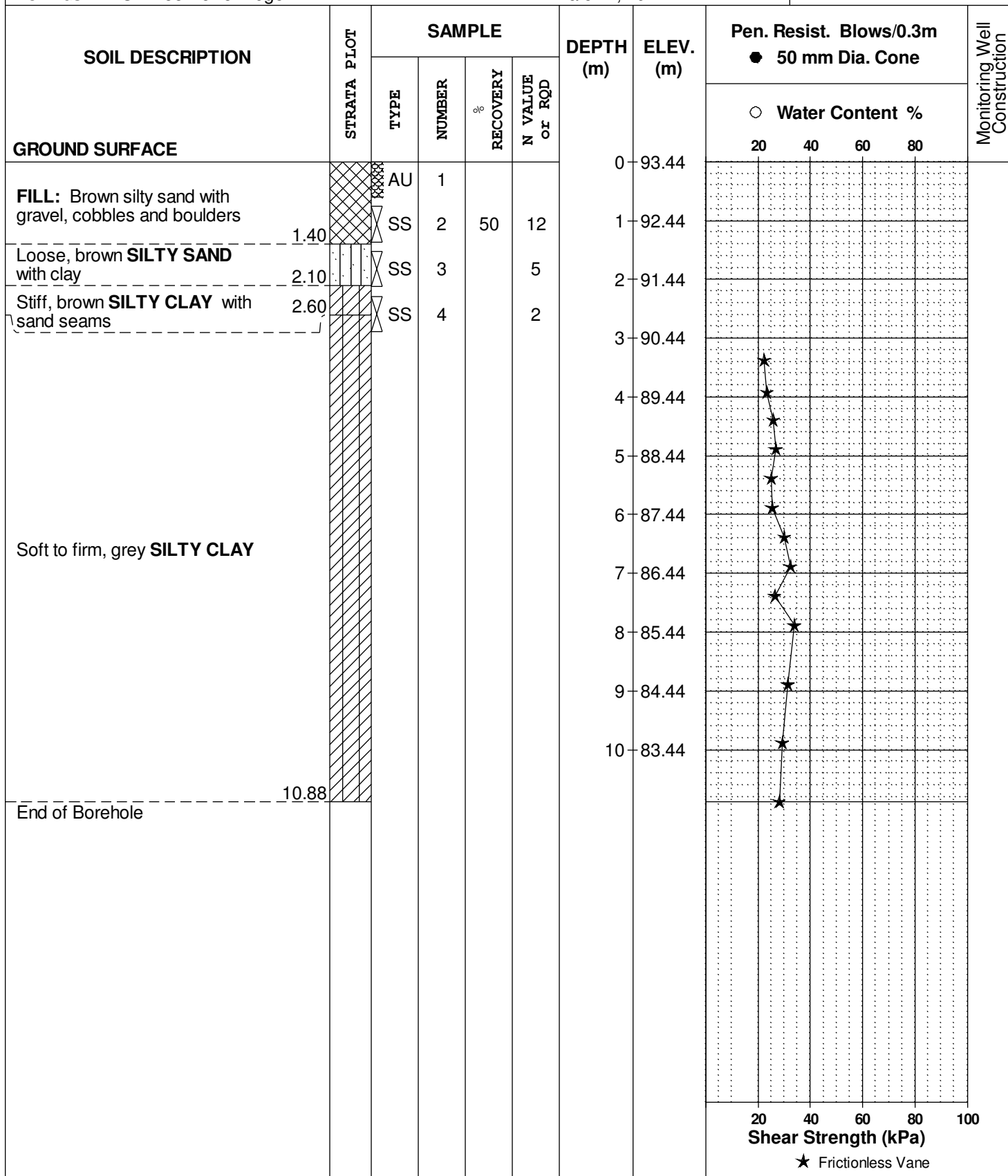
REMARKS

BORINGS BY CME 55 Power Auger

DATE March 1, 2012

FILE NO. PG2246

HOLE NO. BH 8-12



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

DATUM Ground surface elevations provided by ASL.

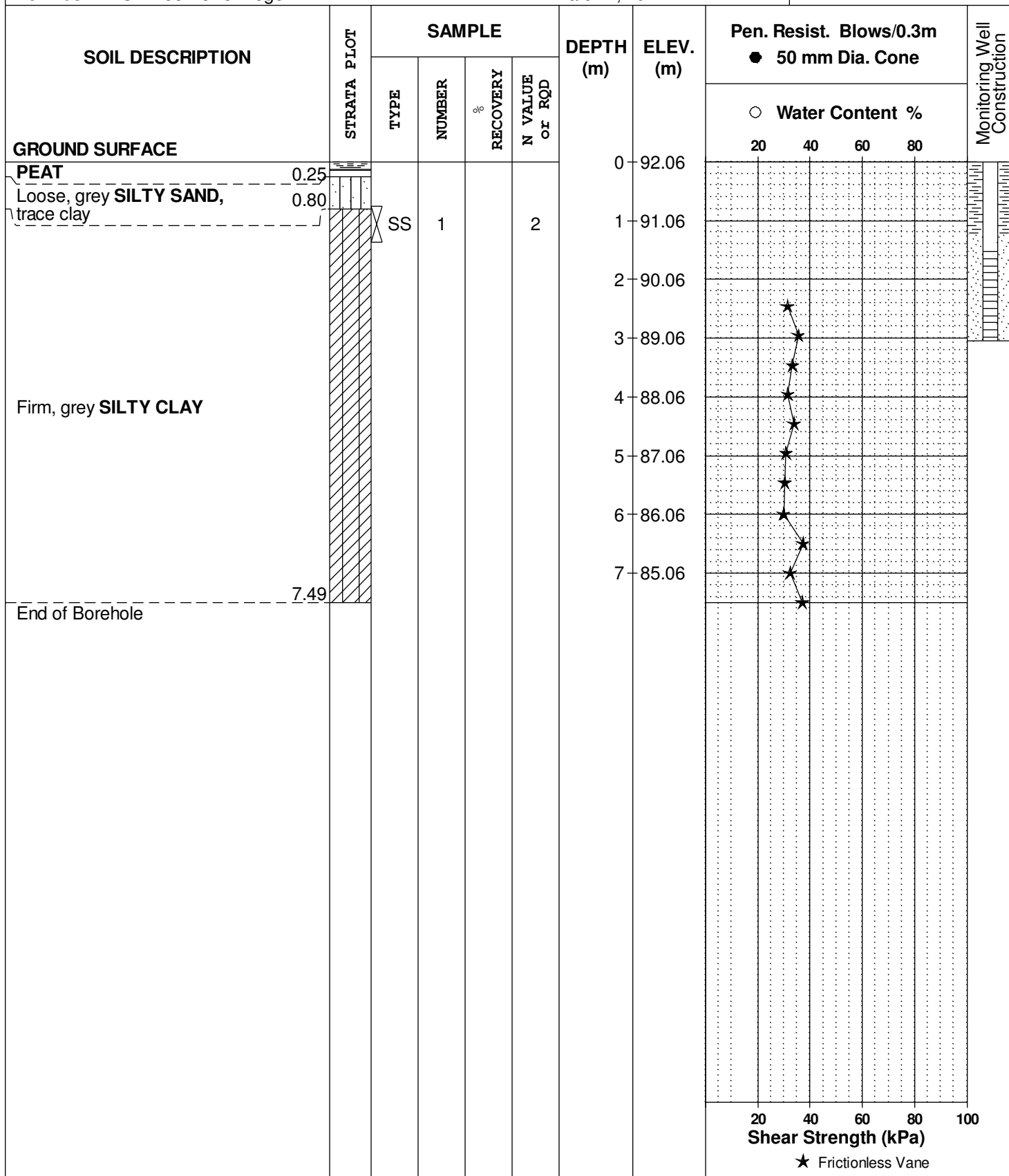
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BORINGS BY CME 55 Power Auger

DATE March 1, 2012

FILE NO. PG2246

HOLE NO. BH 9-12



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

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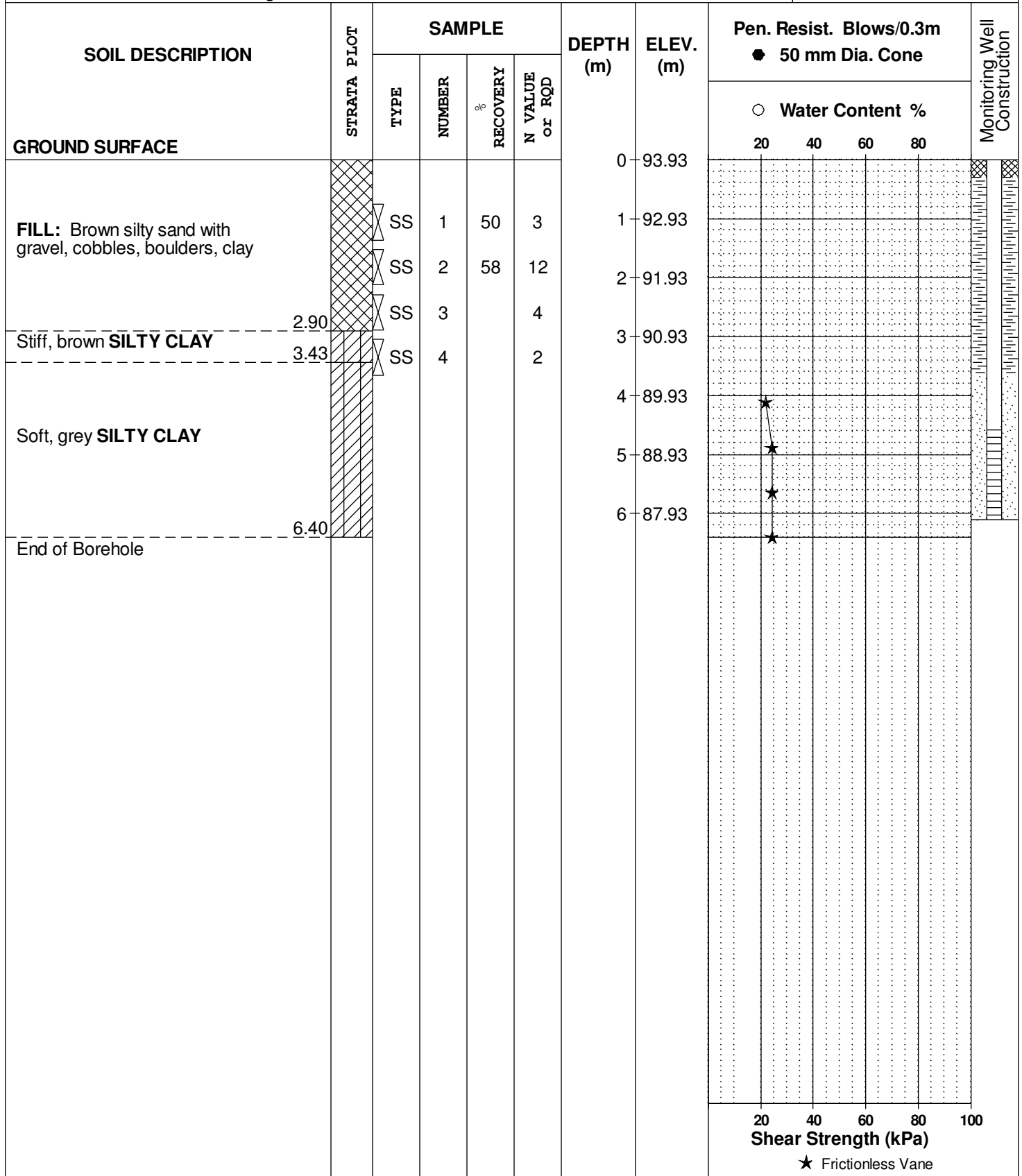
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DATE March 1, 2012

FILE NO. PG2246

HOLE NO. BH10-12



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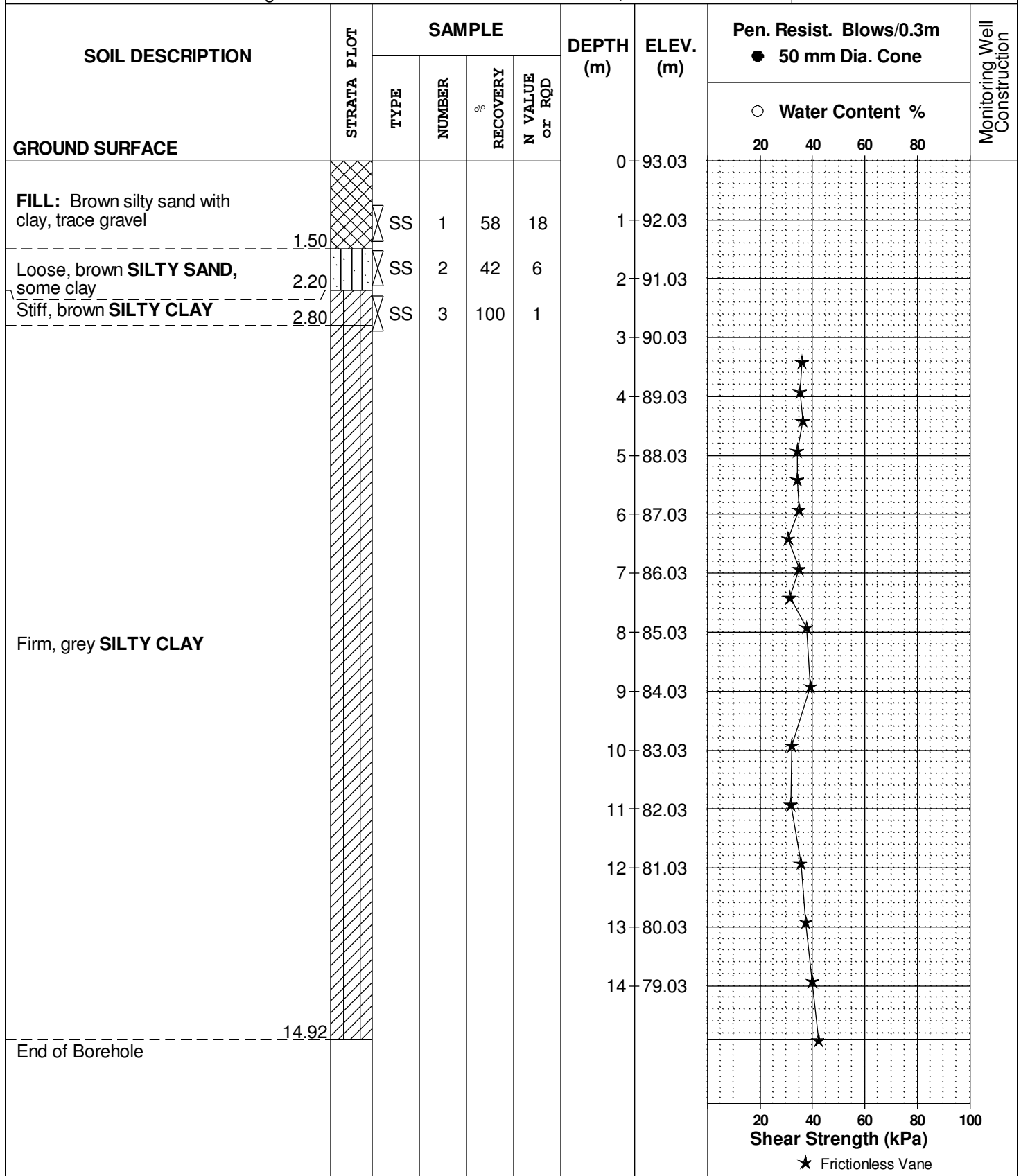
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BORINGS BY CME 55 Power Auger

DATE March 2, 2012

FILE NO. PG2246

HOLE NO. BH11-12



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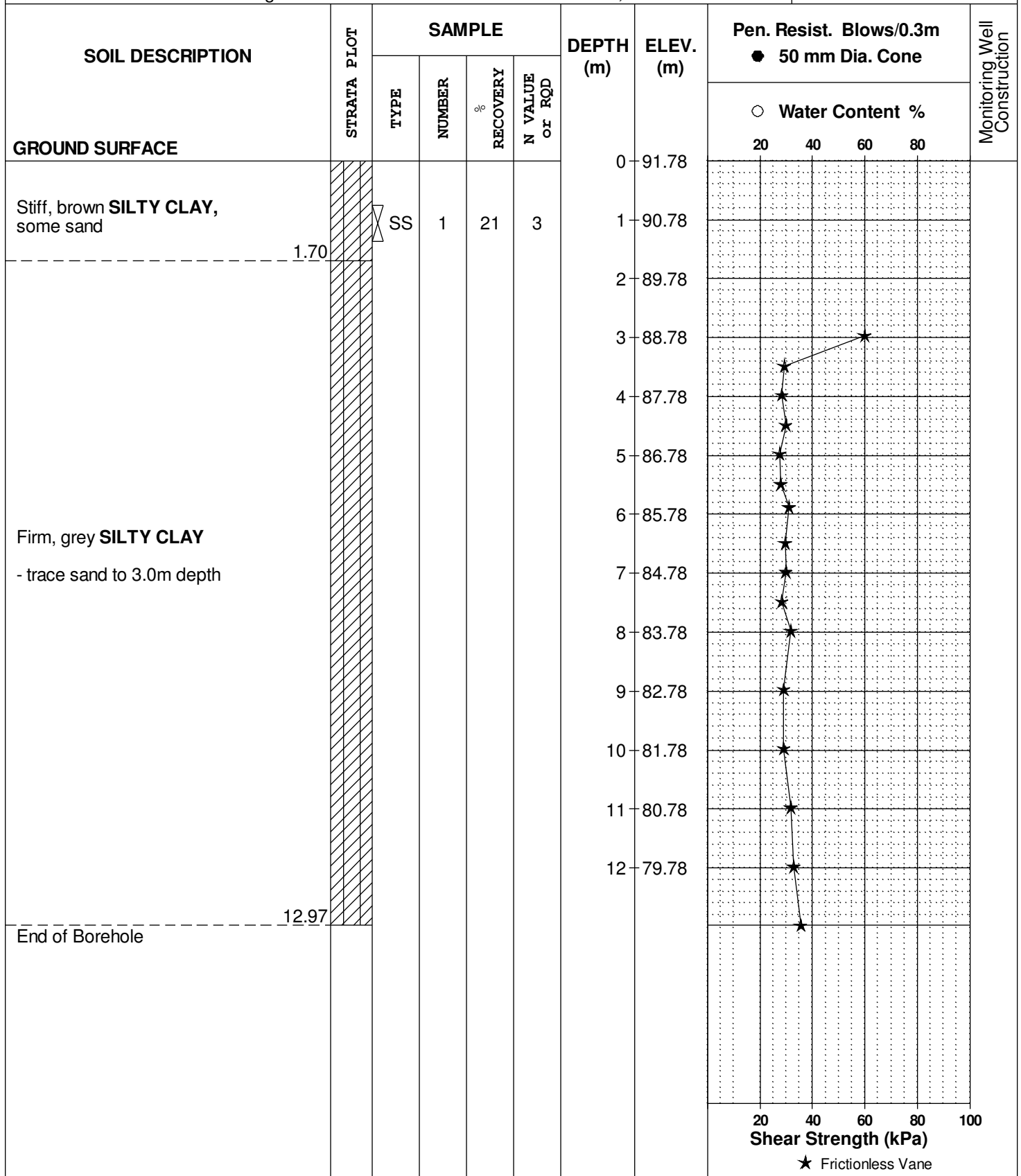
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DATE March 2, 2012

FILE NO. PG2246

HOLE NO. BH12-12



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

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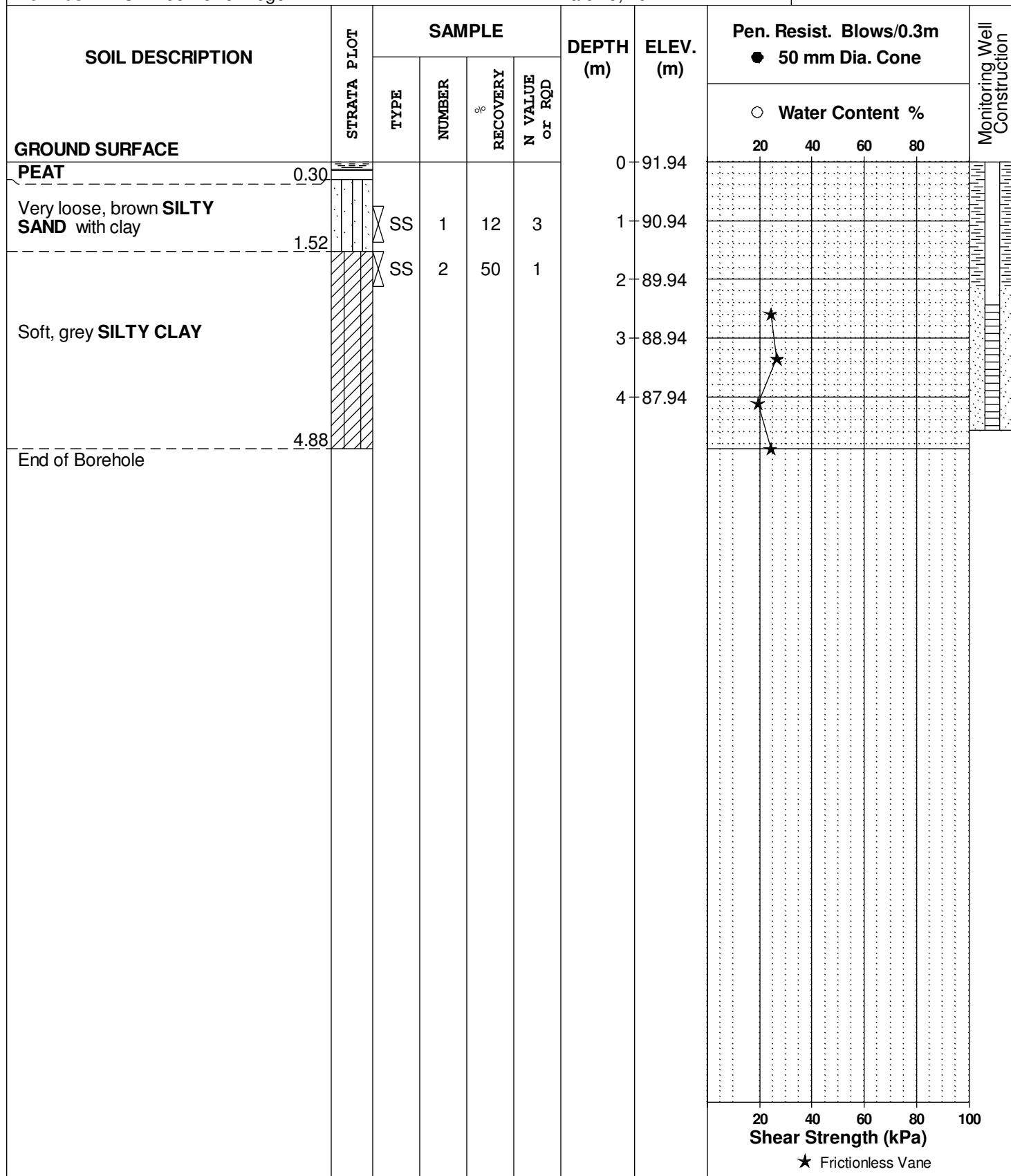
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BORINGS BY CME 55 Power Auger

DATE March 5, 2012

FILE NO.
PG2246

HOLE NO.
BH13-12



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

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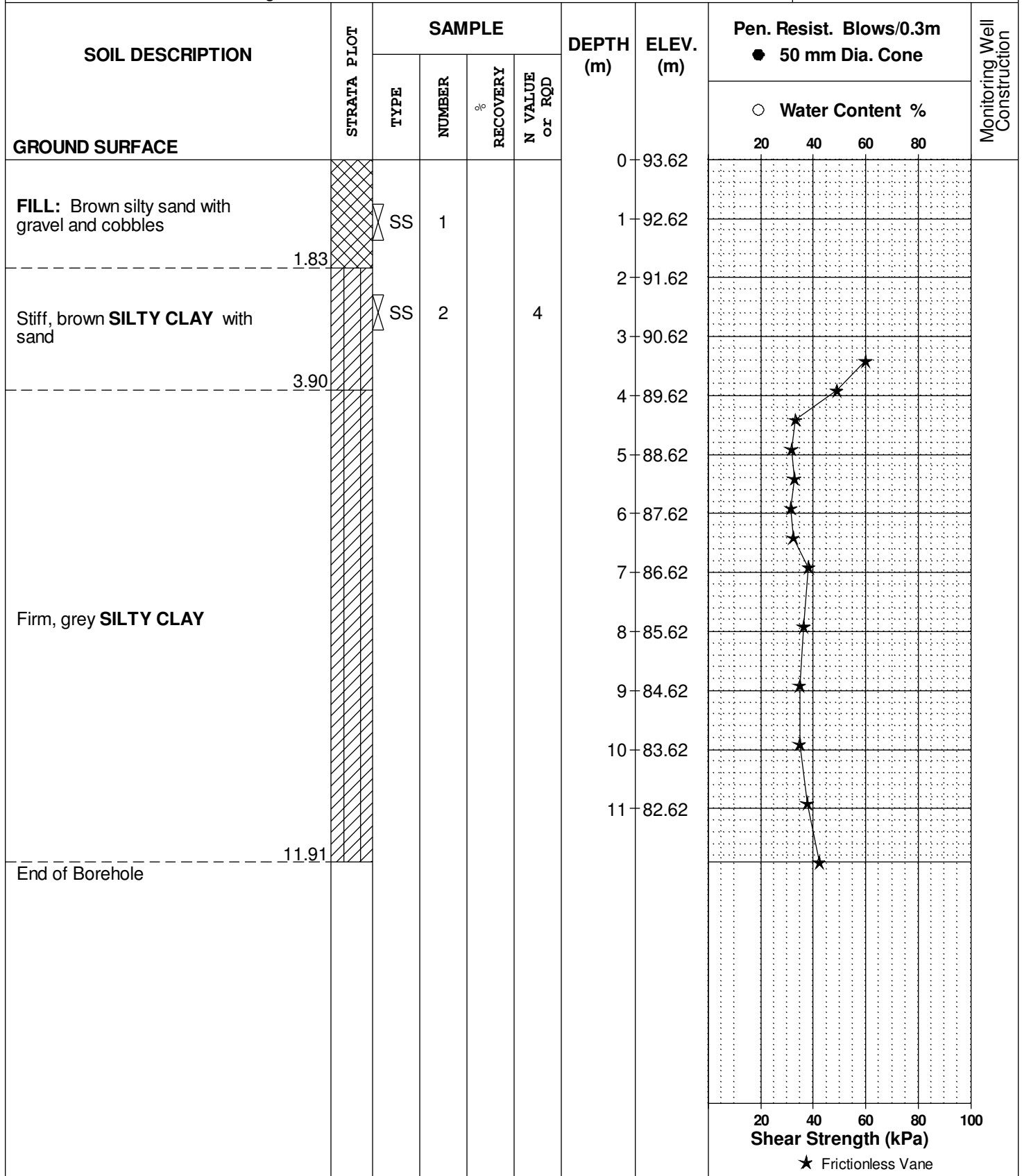
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DATE March 5, 2012

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HOLE NO. BH14-12



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

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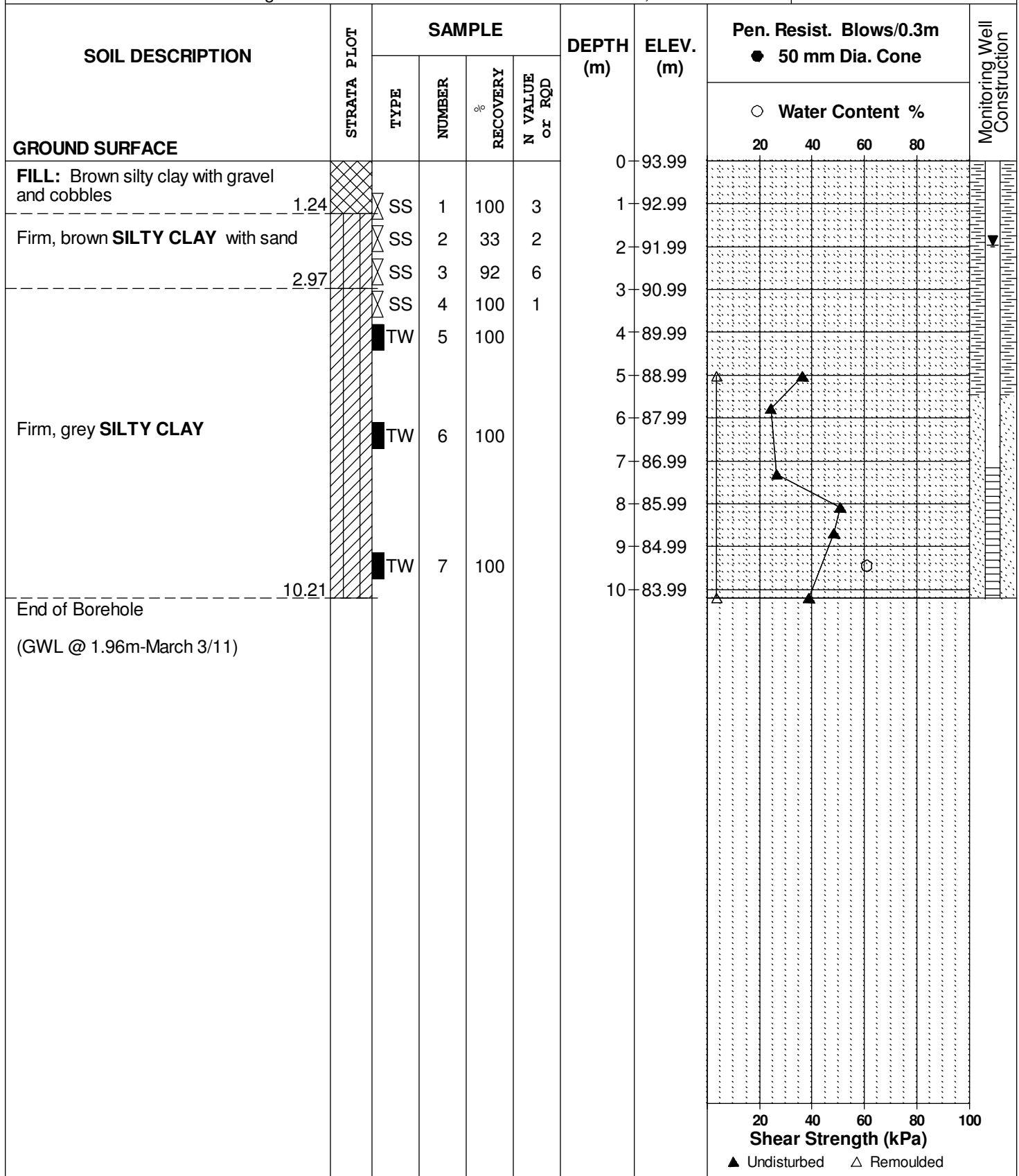
REMARKS

BORINGS BY CME 55 Power Auger

DATE October 27, 2010

FILE NO. PG2246

HOLE NO. BH 1-10



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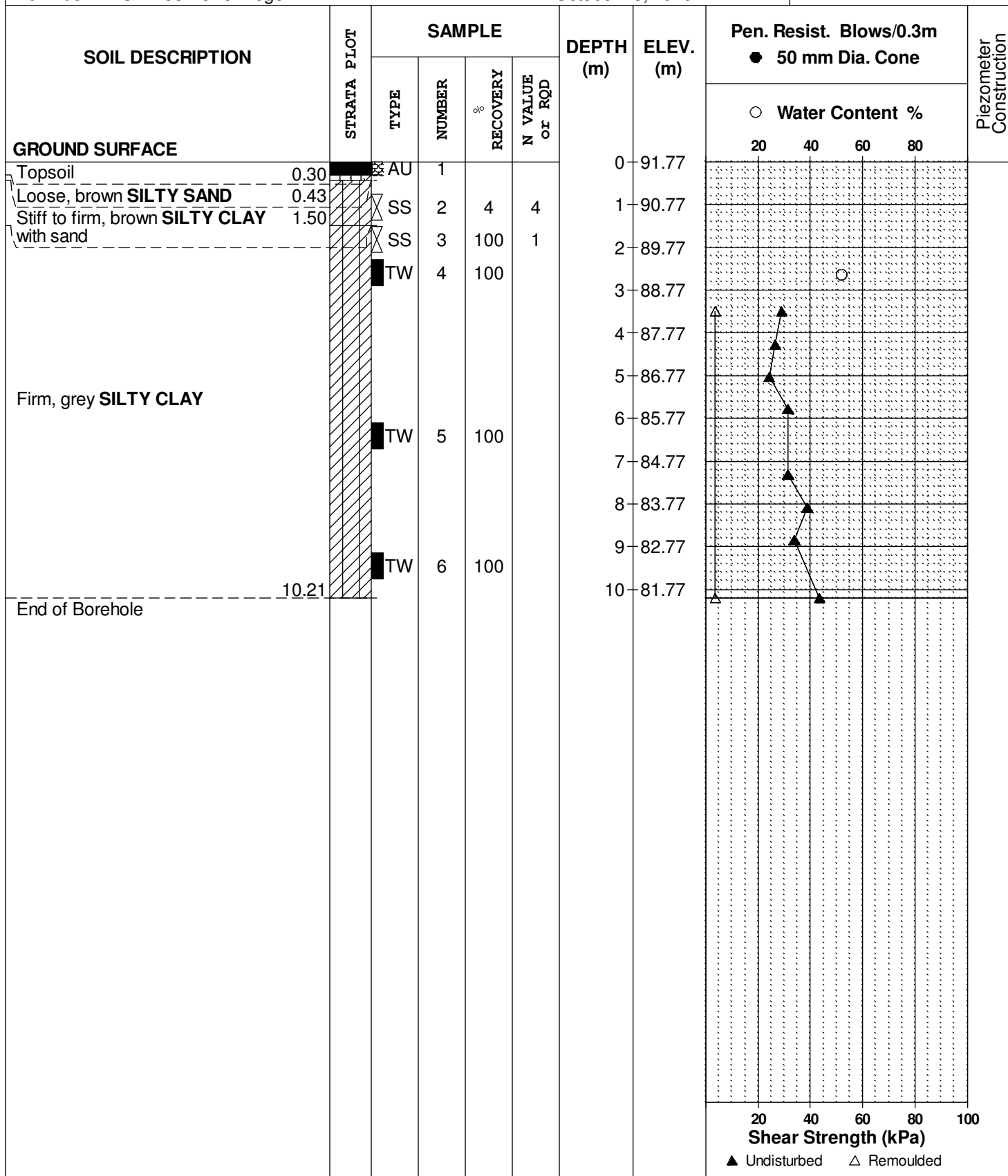
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DATE October 28, 2010

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HOLE NO. BH 2-10



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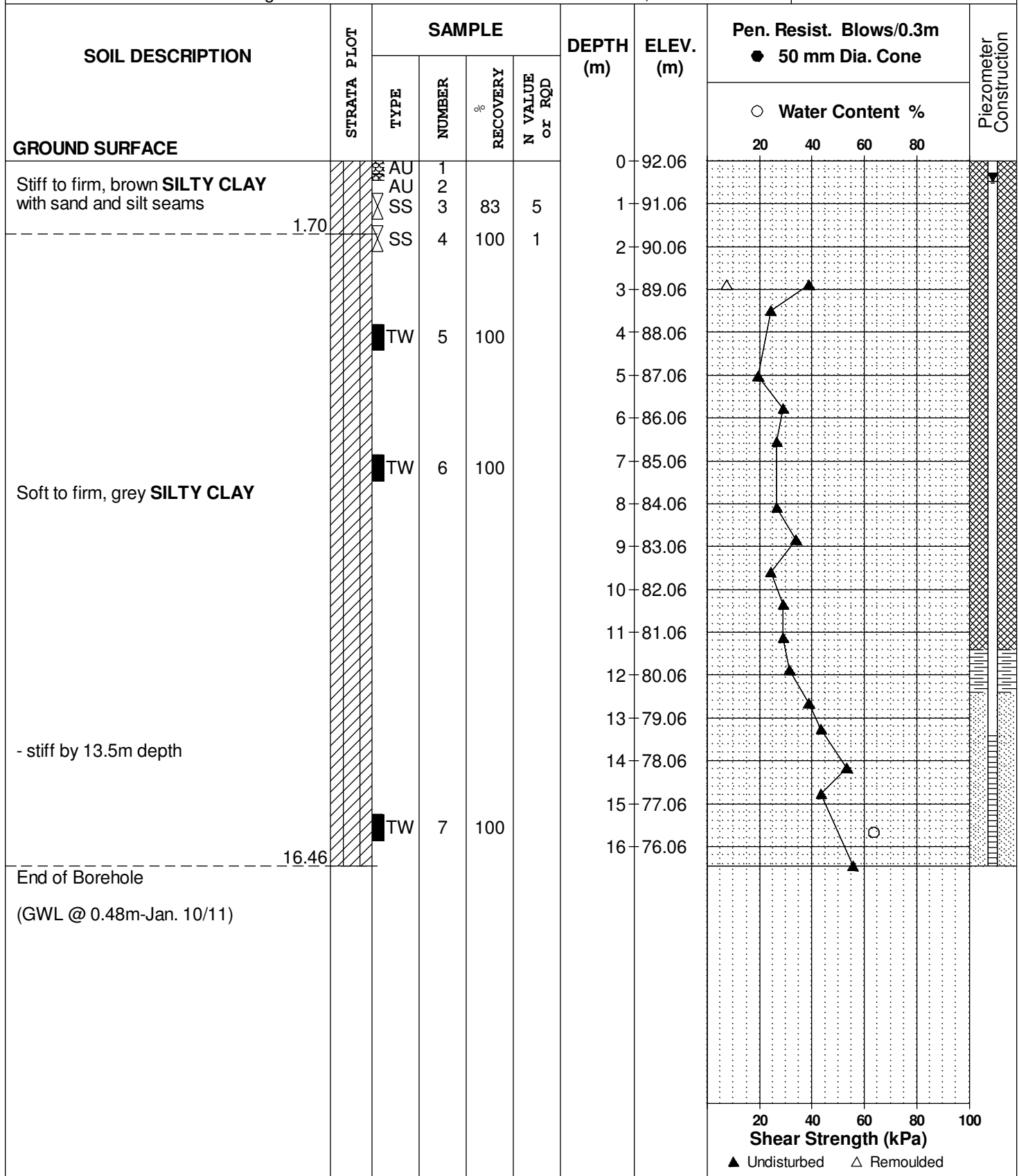
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DATE October 28, 2010

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HOLE NO. BH 3-10



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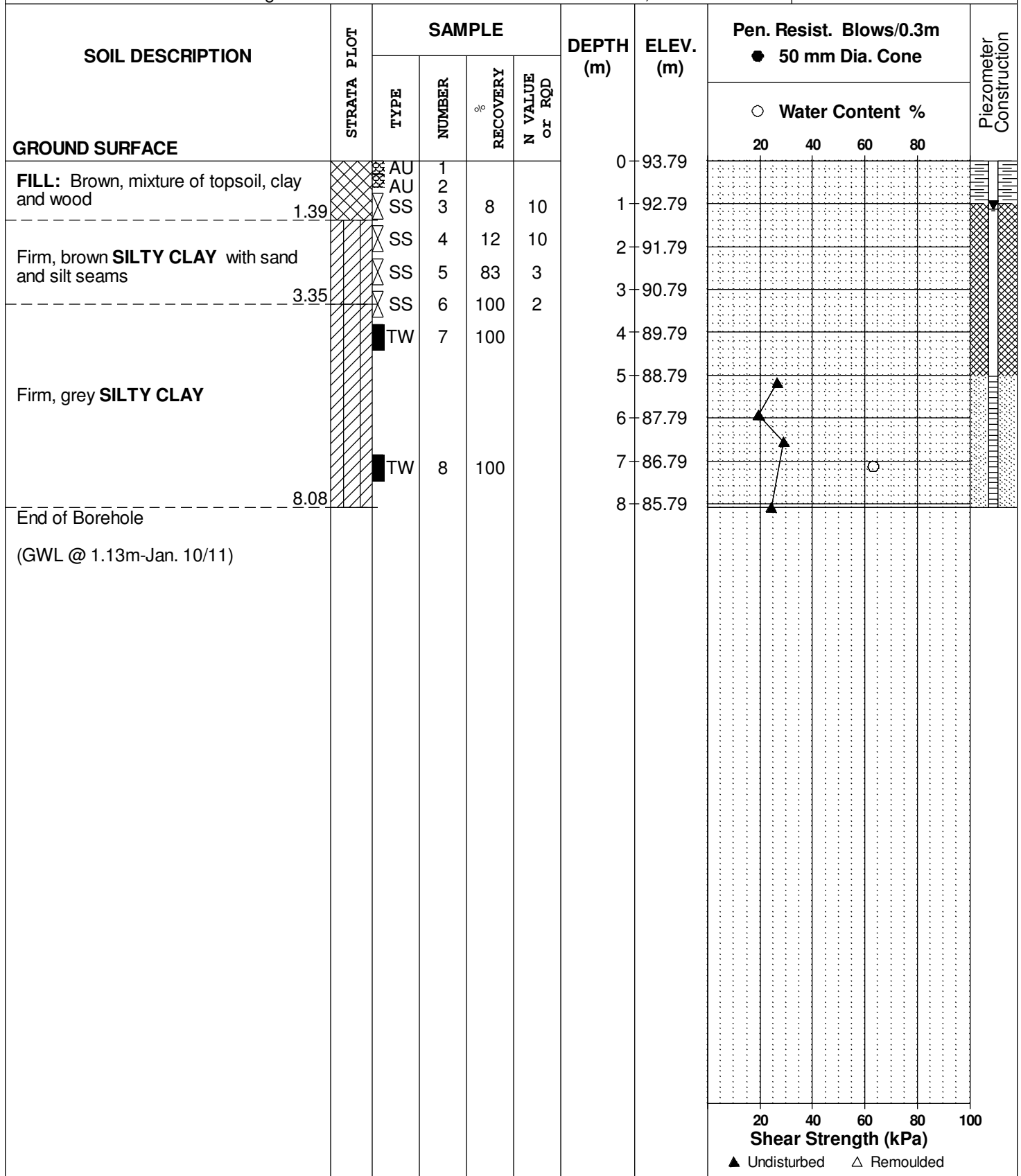
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DATE October 29, 2010

FILE NO. PG2246

HOLE NO. BH 4-10



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

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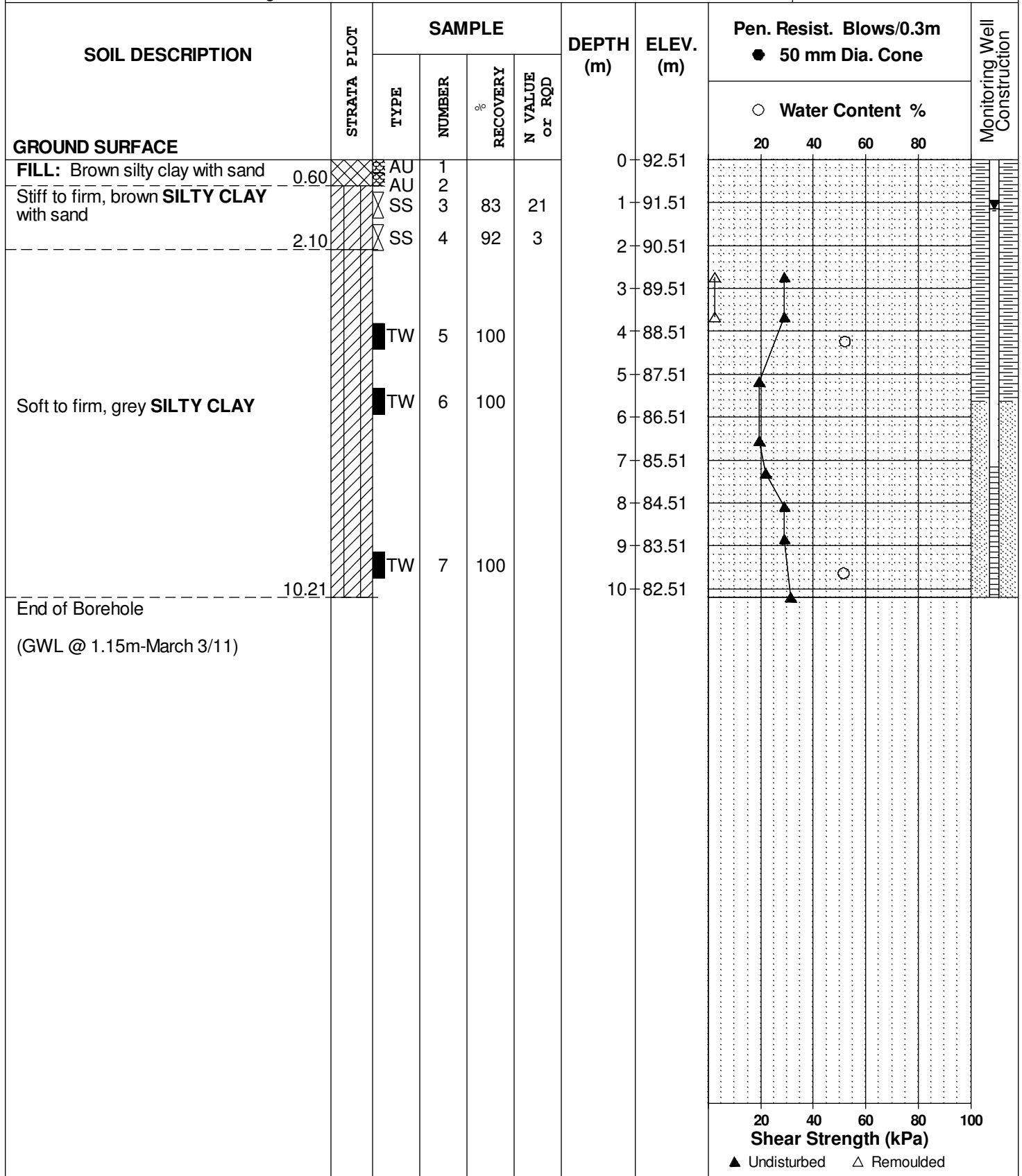
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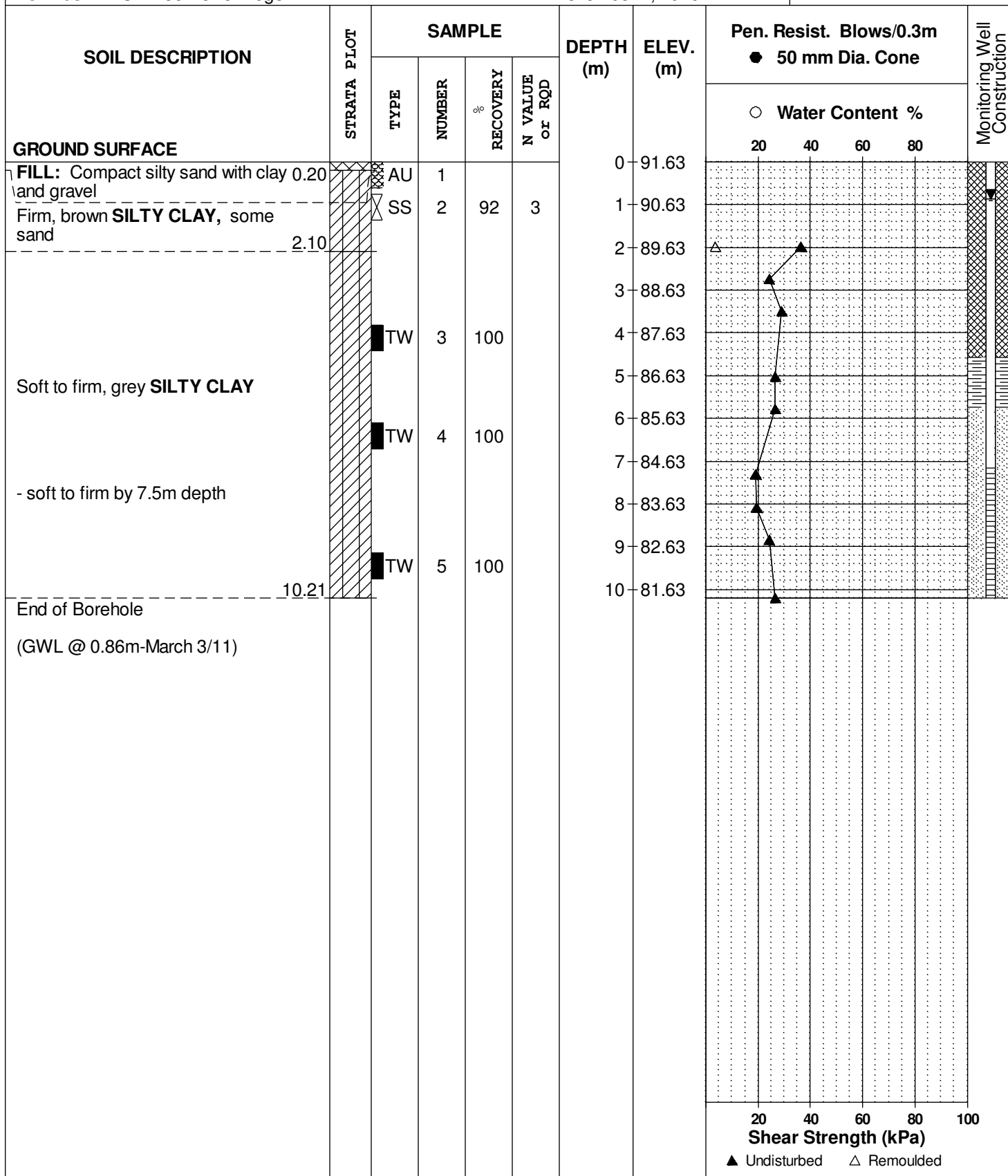
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BORINGS BY CME 55 Power Auger

DATE November 1, 2010

FILE NO. PG2246

HOLE NO. BH 6-10



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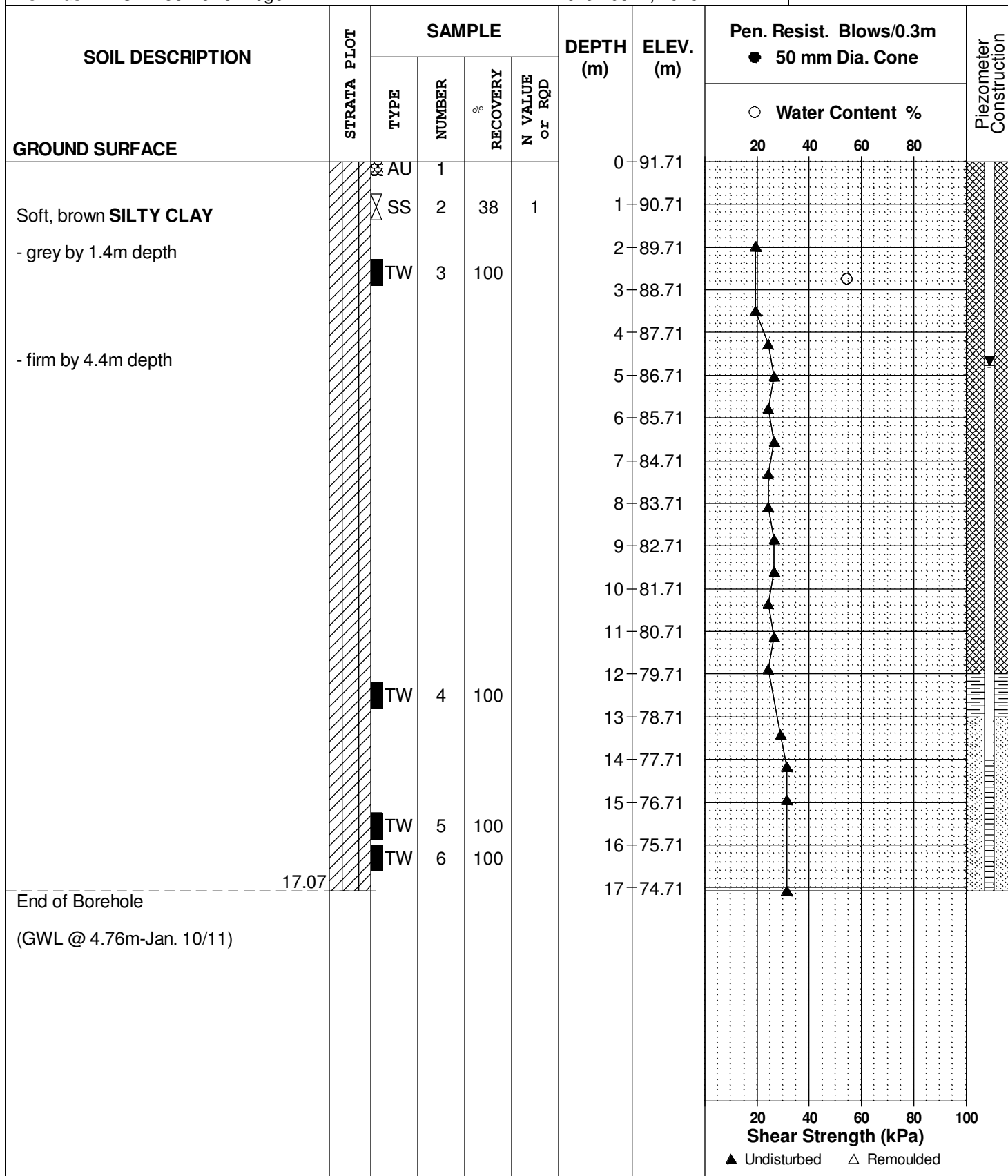
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DATE November 1, 2010

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HOLE NO. BH 7-10



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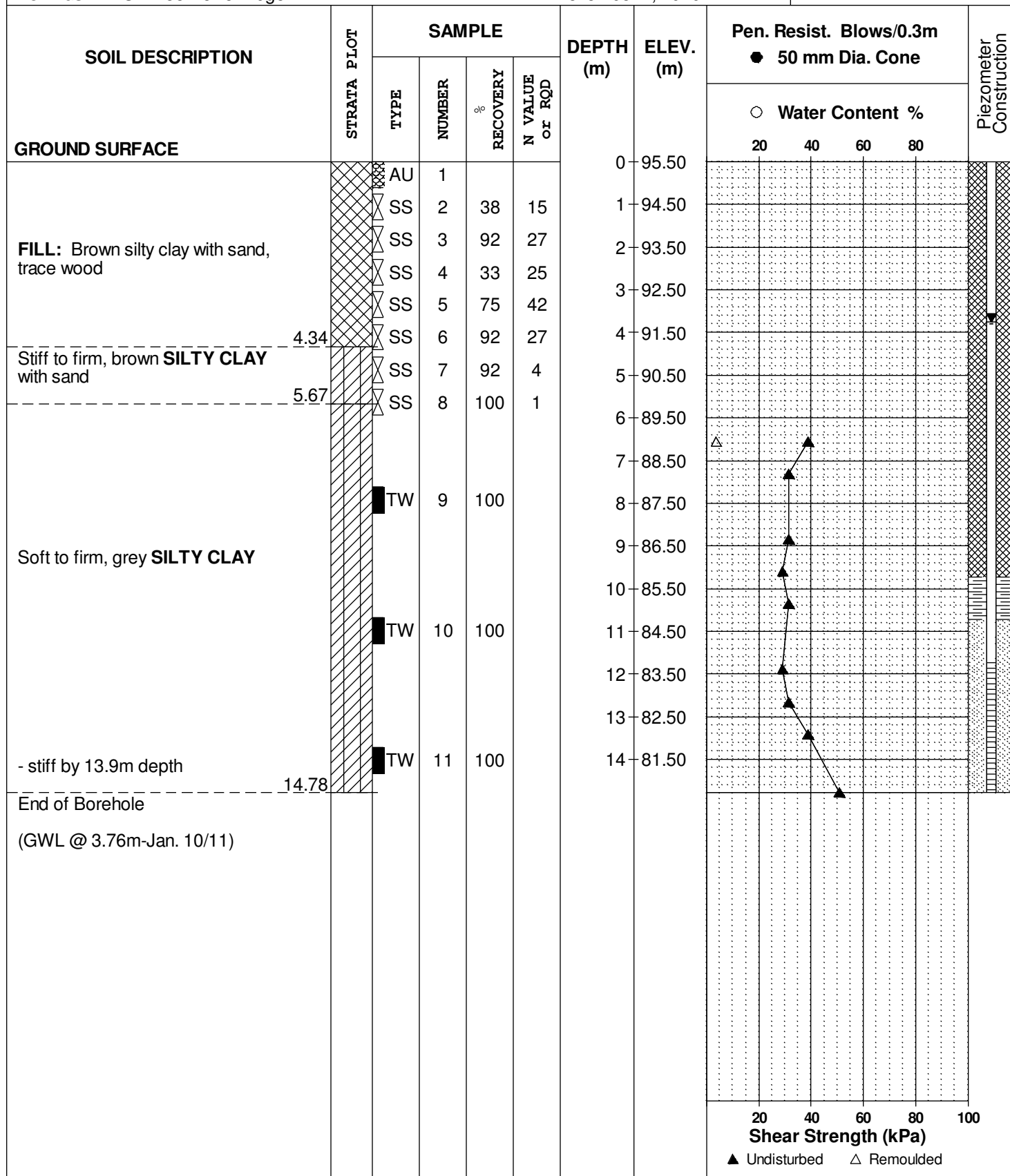
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DATE November 2, 2010

FILE NO. PG2246

HOLE NO. BH 8-10



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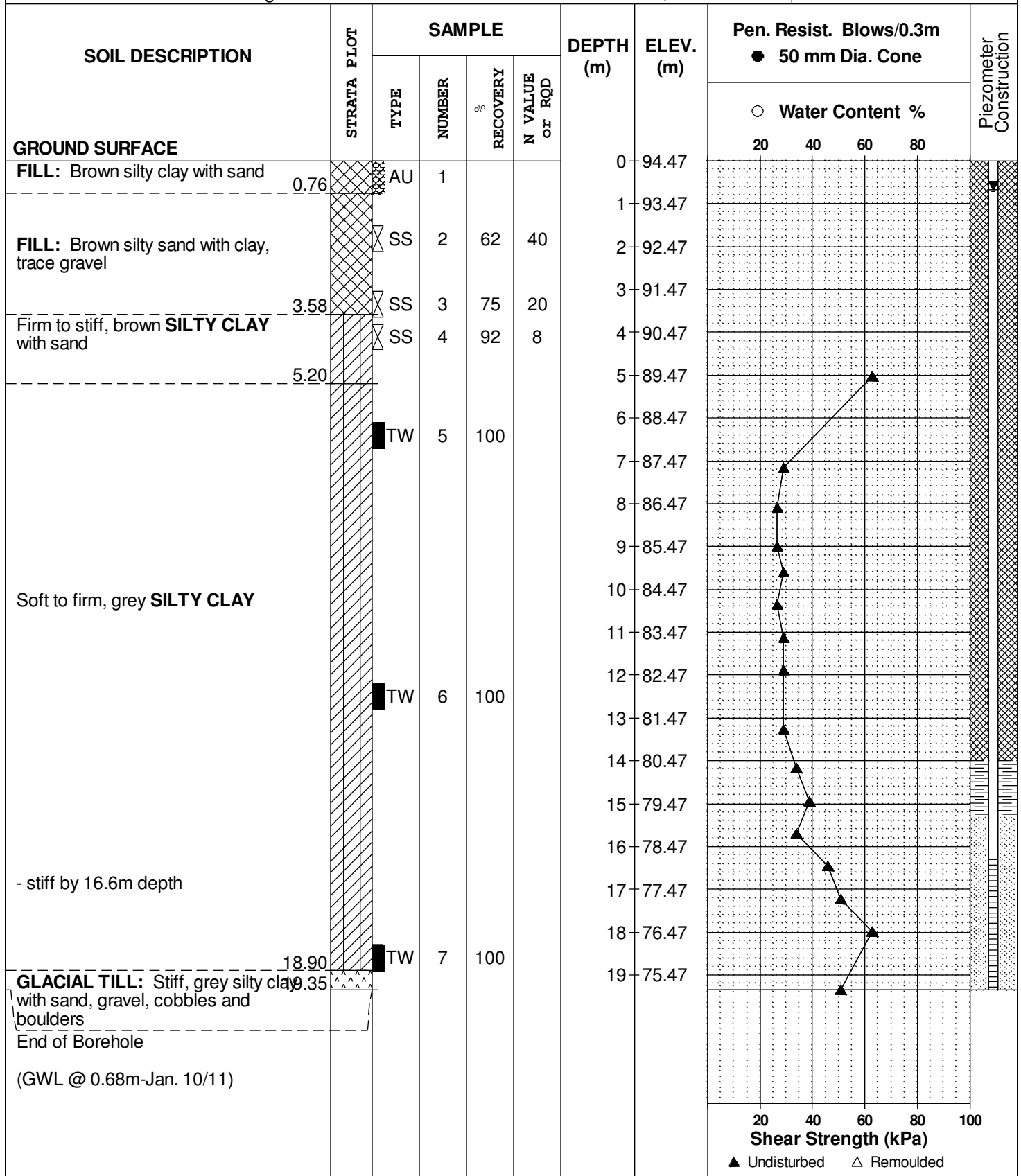
REMARKS

BORINGS BY CME 55 Power Auger

DATE November 16, 2010

FILE NO. PG2246

HOLE NO. BH 9-10



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

DATUM Ground surface elevations provided by ASL.

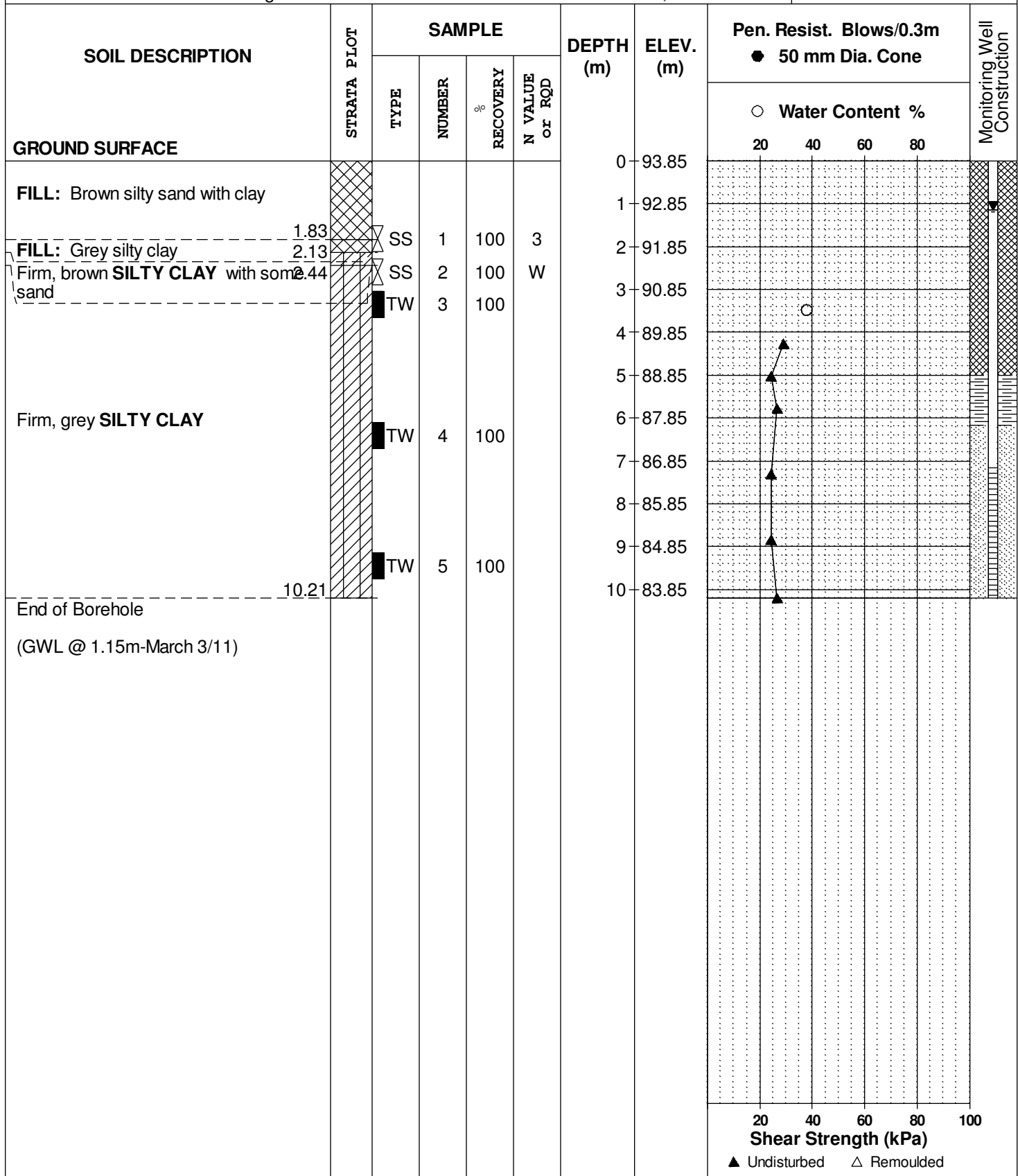
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BORINGS BY CME 55 Power Auger

DATE November 12, 2010

FILE NO. PG2246

HOLE NO. BH10-10



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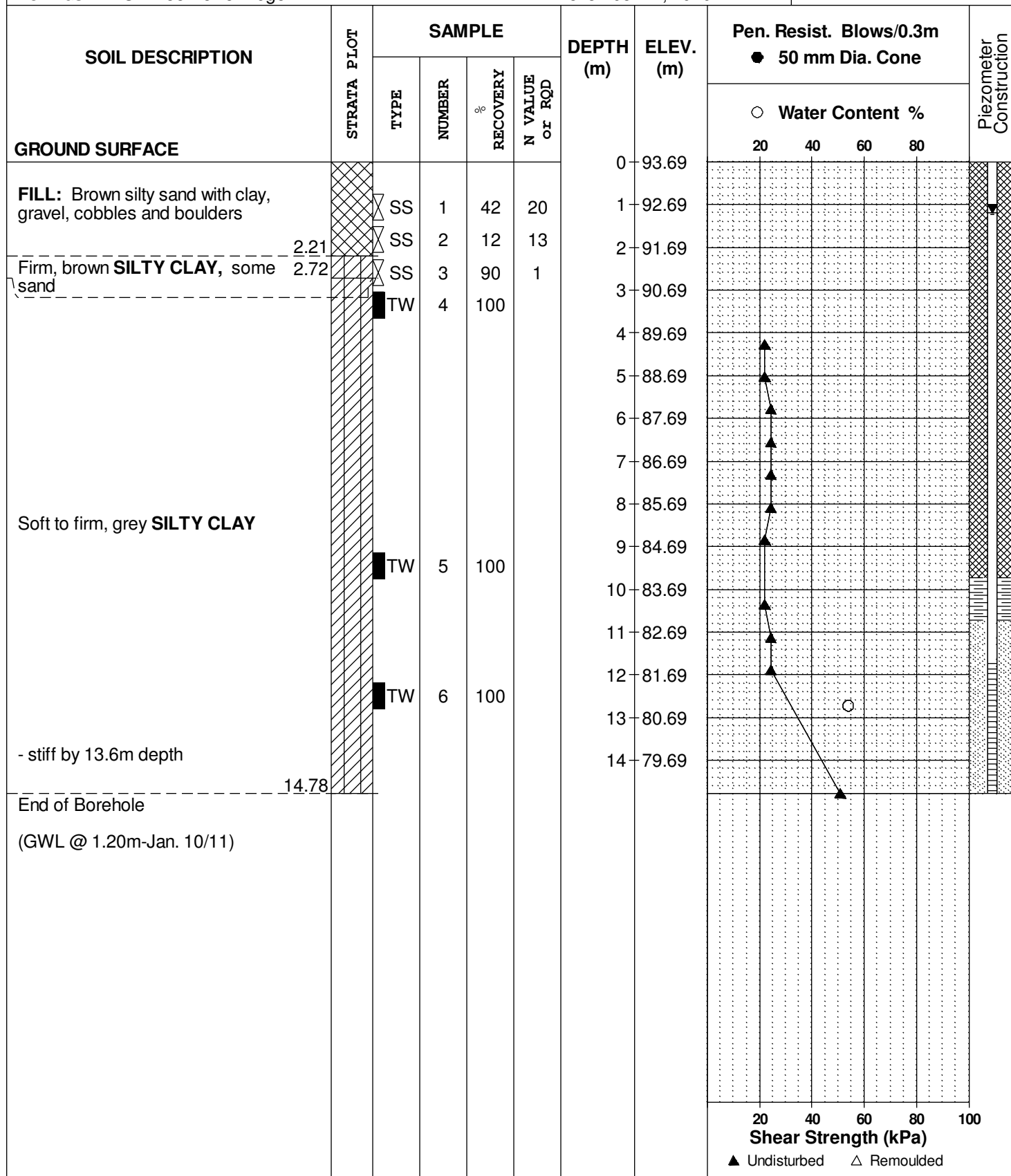
REMARKS

BORINGS BY CME 55 Power Auger

DATE November 12, 2010

FILE NO. PG2246

HOLE NO. BH11-10



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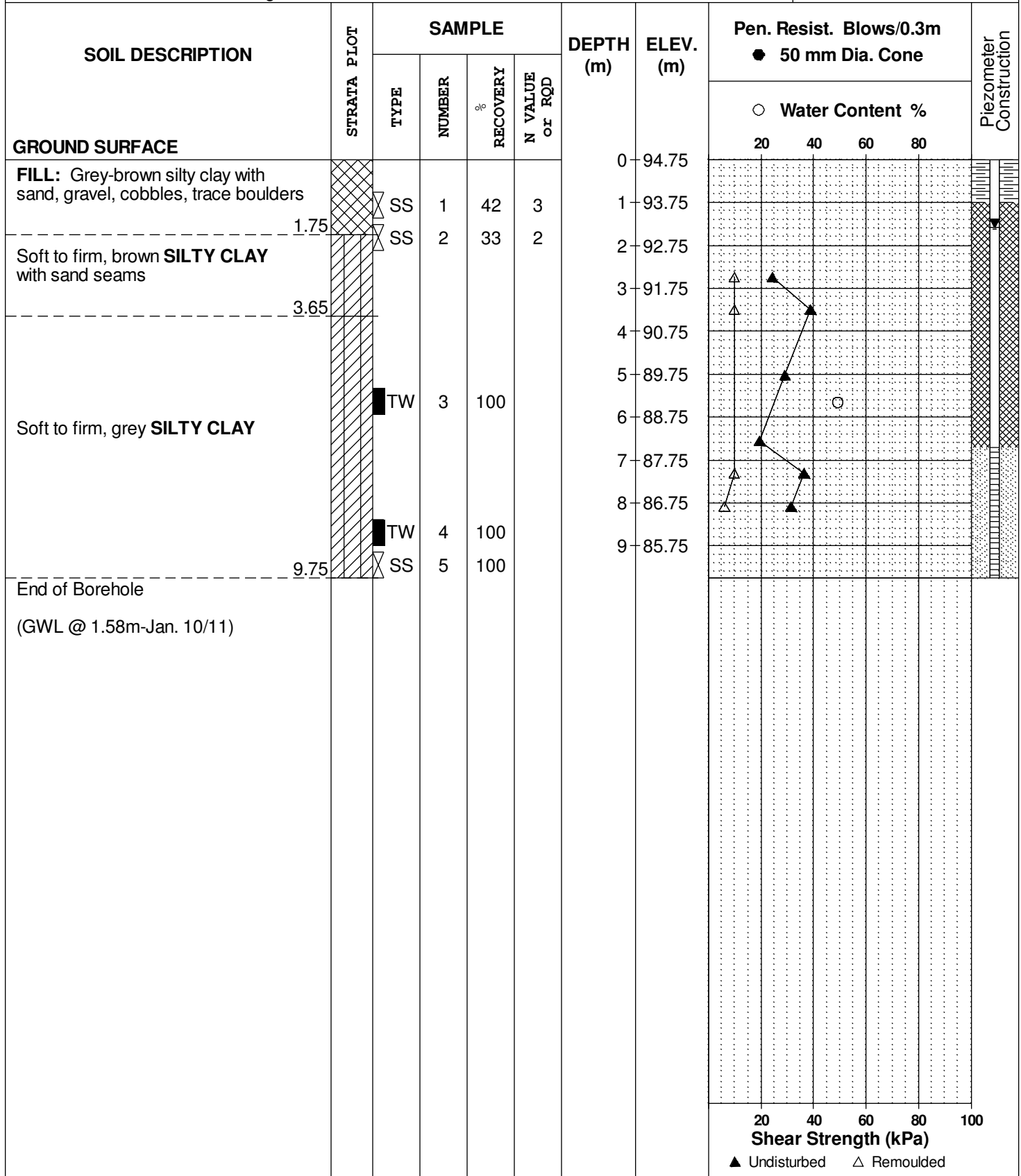
REMARKS

BORINGS BY CME 55 Power Auger

DATE November 15, 2010

FILE NO. PG2246

HOLE NO. BH12-10



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

DATUM Ground surface elevations provided by ASL.

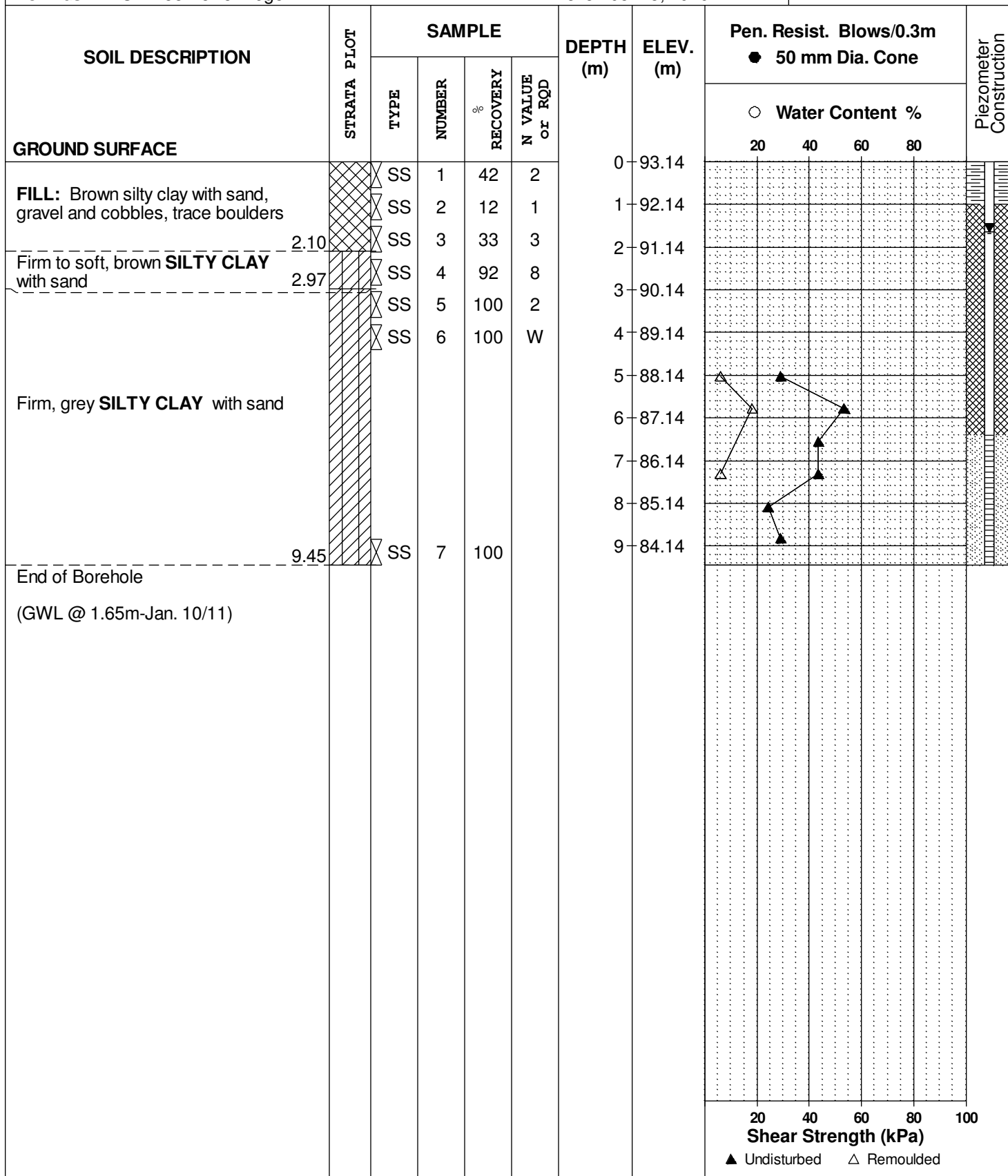
REMARKS

BORINGS BY CME 55 Power Auger

DATE November 15, 2010

FILE NO. PG2246

HOLE NO. BH13-10



DATUM Ground surface elevations provided by ASL.

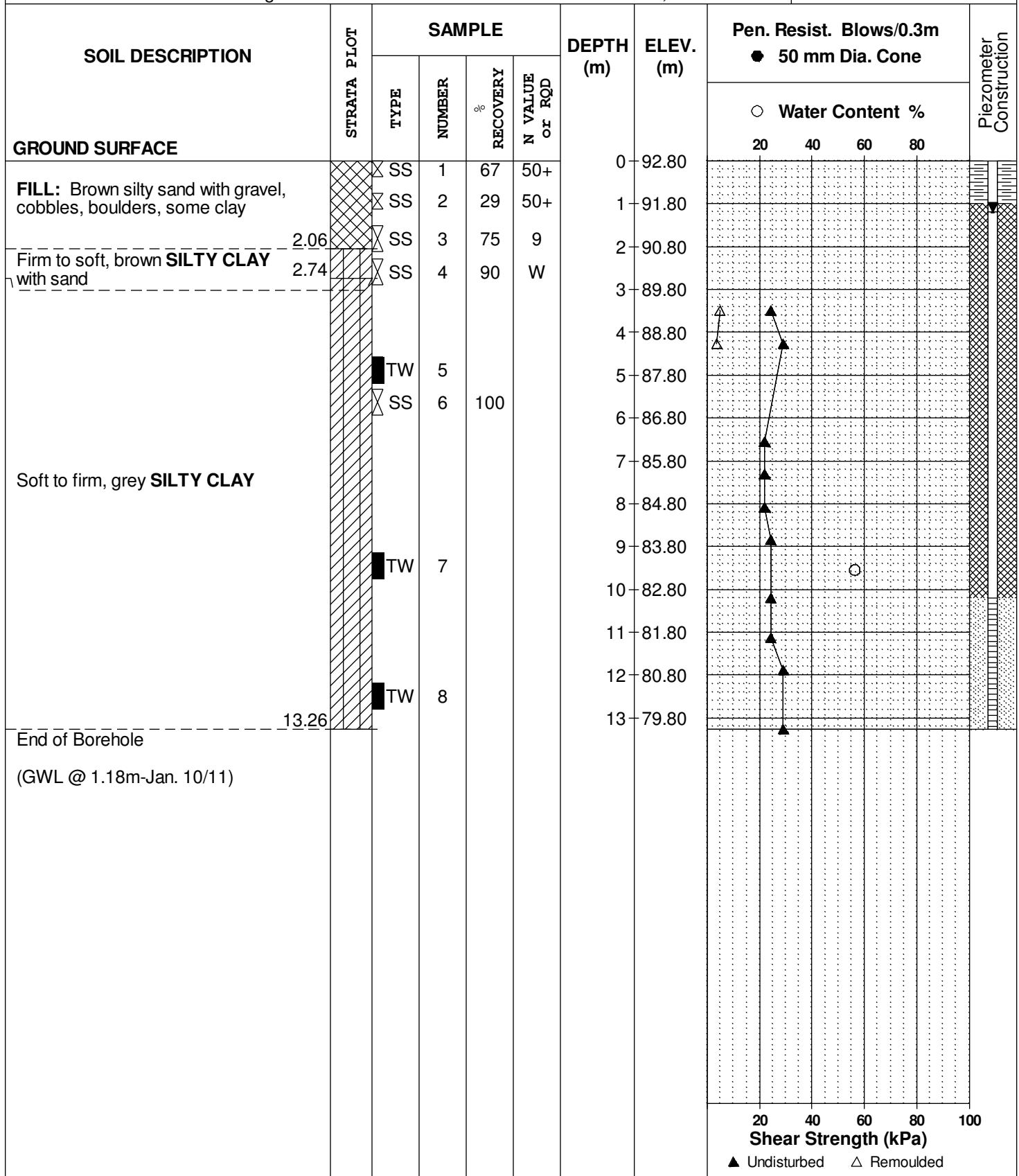
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DATE November 16, 2010

FILE NO. PG2246

HOLE NO. BH14-10



SOIL PROFILE AND TEST DATA

FILE NO. PG2246

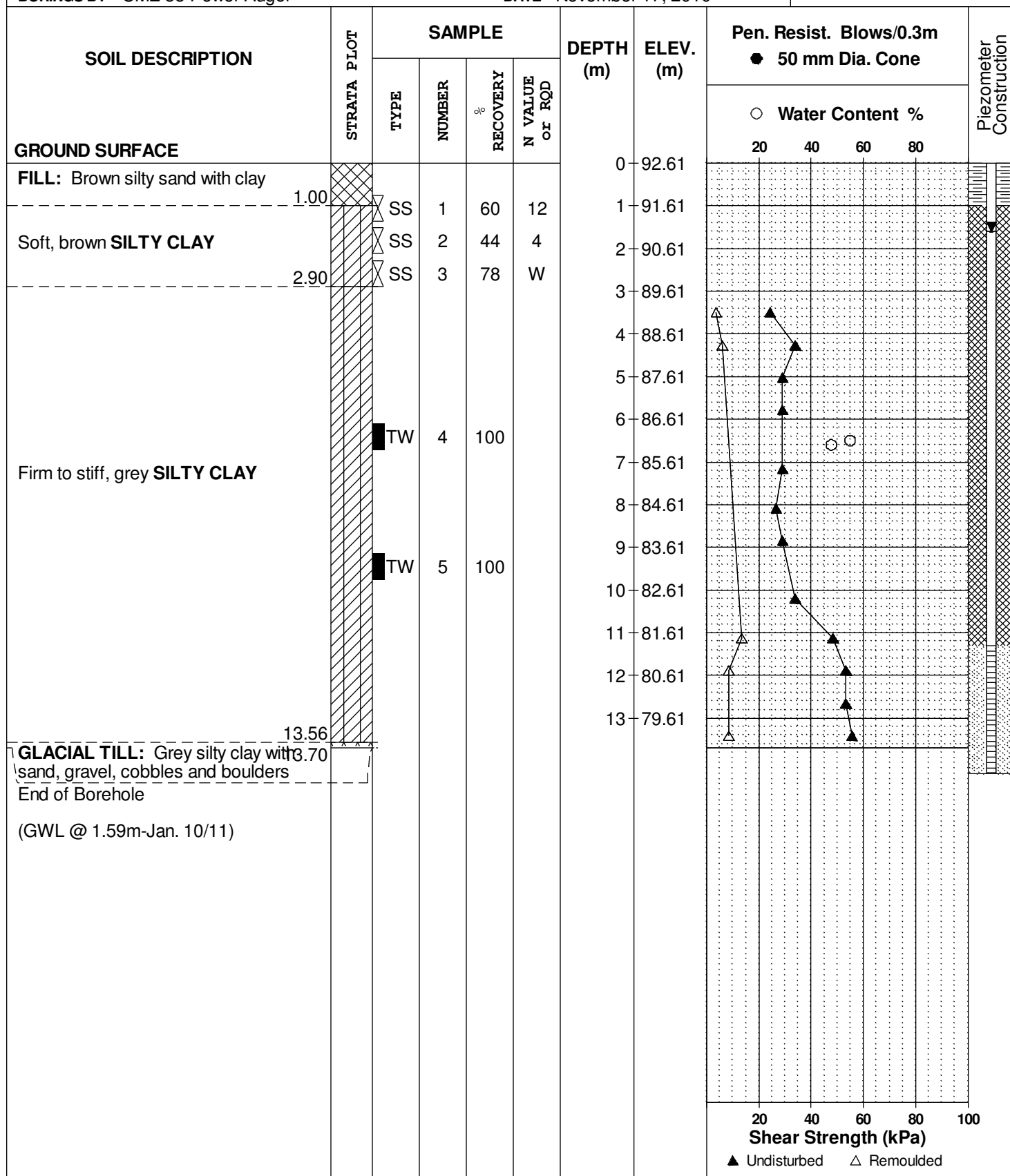
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DATUM Ground surface elevations provided by ASL.

REMARKS

BORINGS BY CME 55 Power Auger

DATE November 17, 2010



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

DATUM Ground surface elevations provided by ASL.

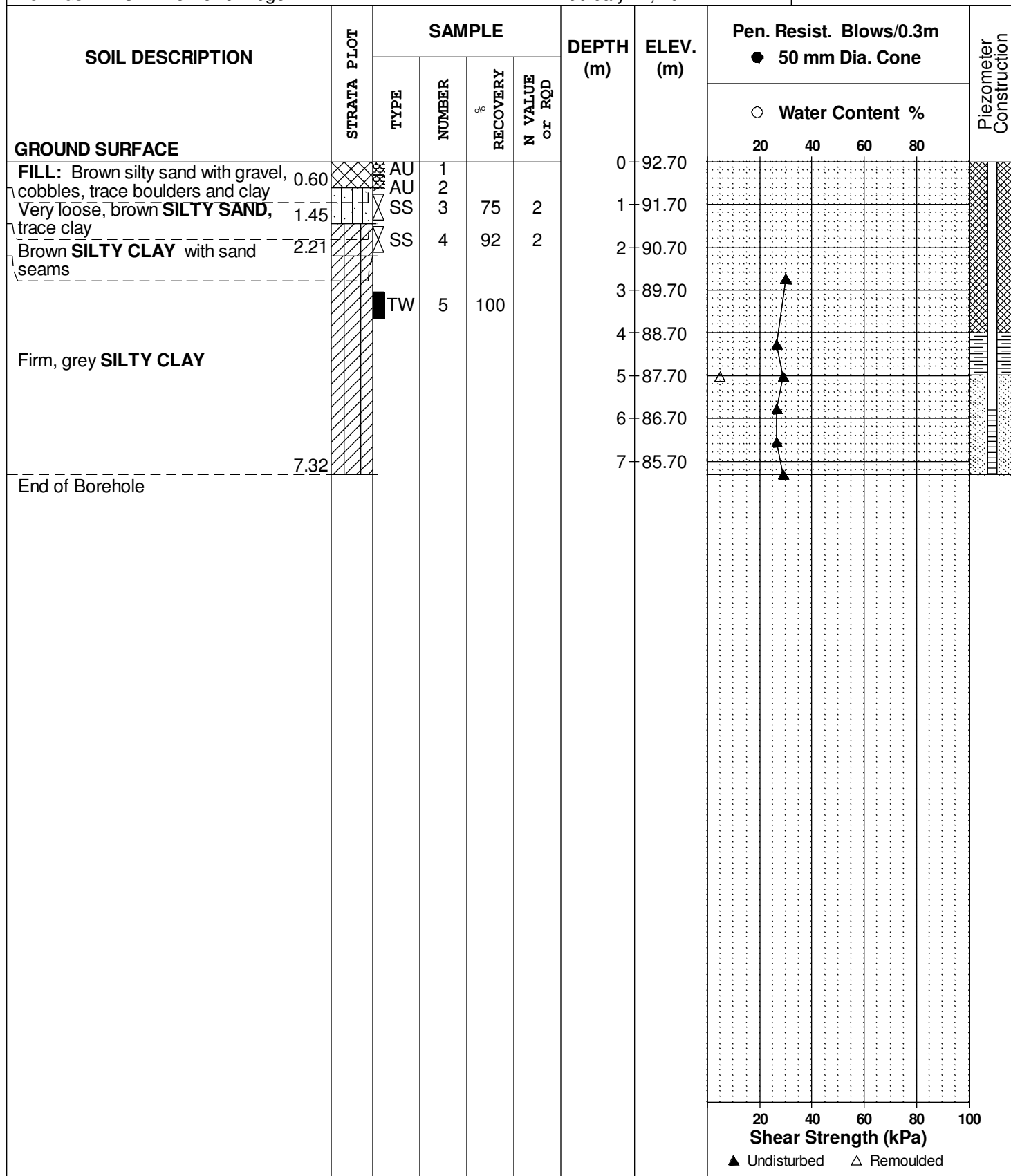
REMARKS

BORINGS BY CME 75 Power Auger

DATE February 11, 2011

FILE NO. PG2246

HOLE NO. BH16-10



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

DATUM Ground surface elevations provided by ASL.

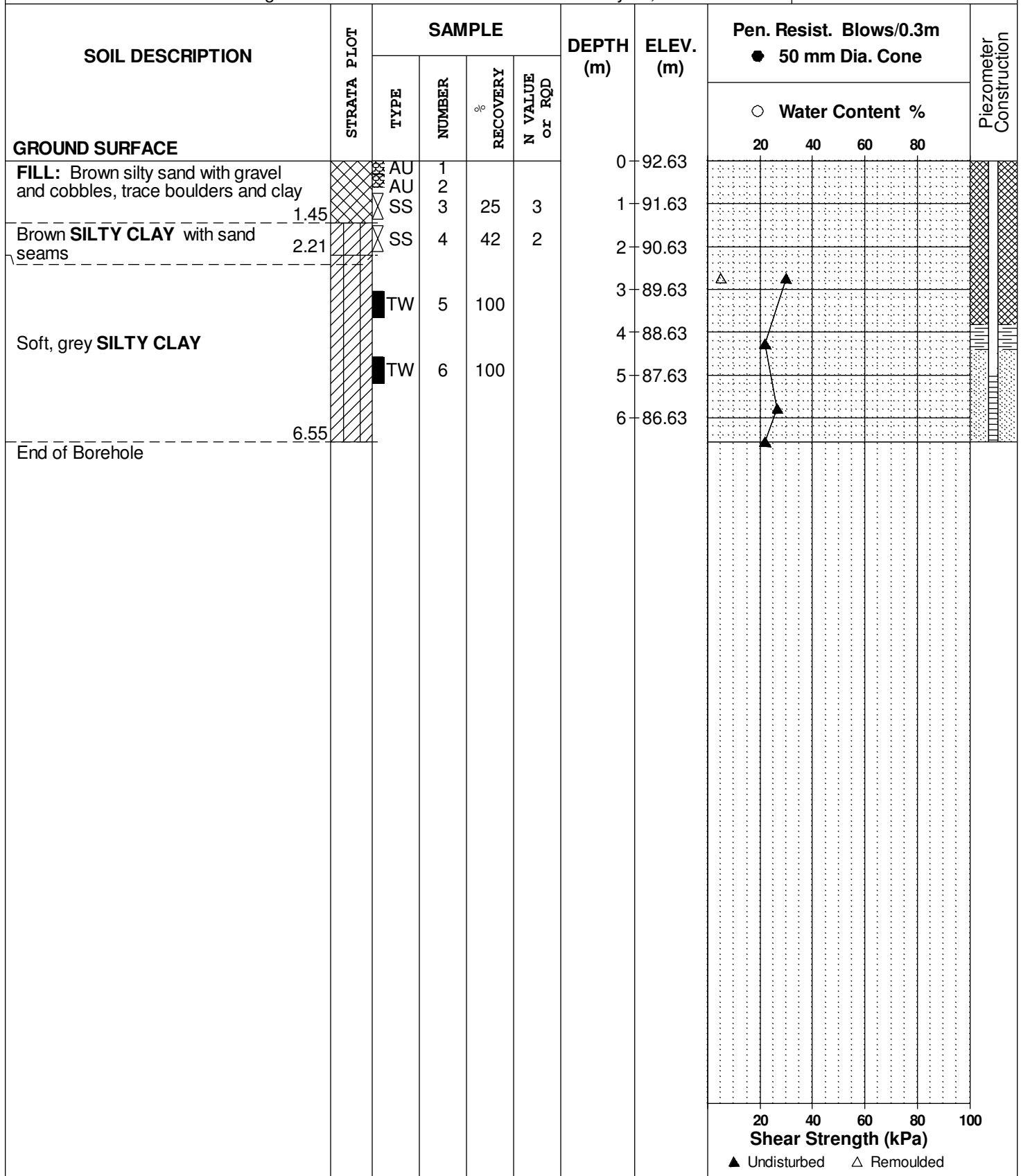
REMARKS

BORINGS BY CME 75 Power Auger

DATE February 11, 2011

FILE NO. PG2246

HOLE NO. BH17-10



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

DATUM Ground surface elevations provided by ASL.

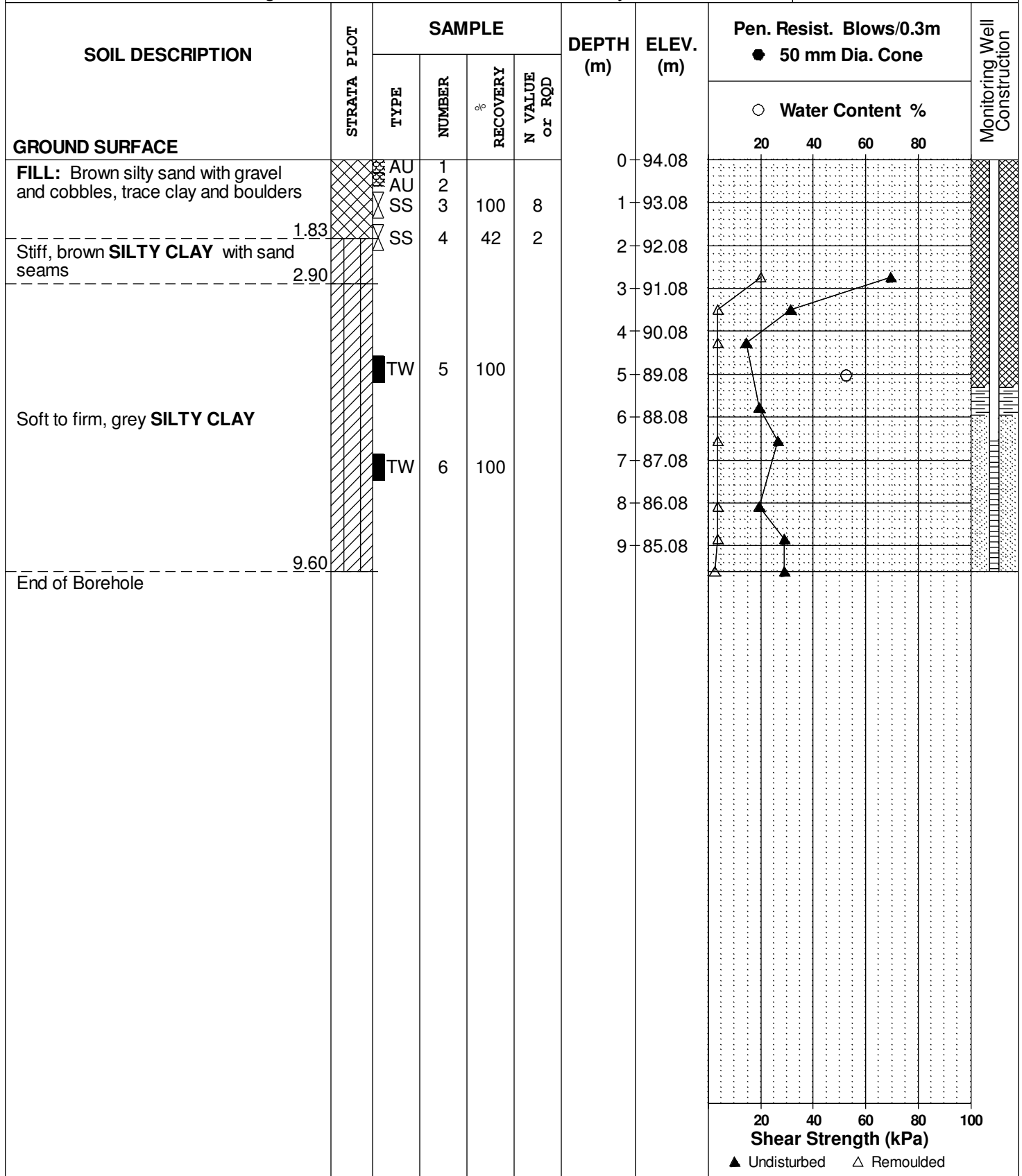
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DATE February 14, 2011

FILE NO. PG2246

HOLE NO. BH18-10



DATUM Ground surface elevations provided by ASL.

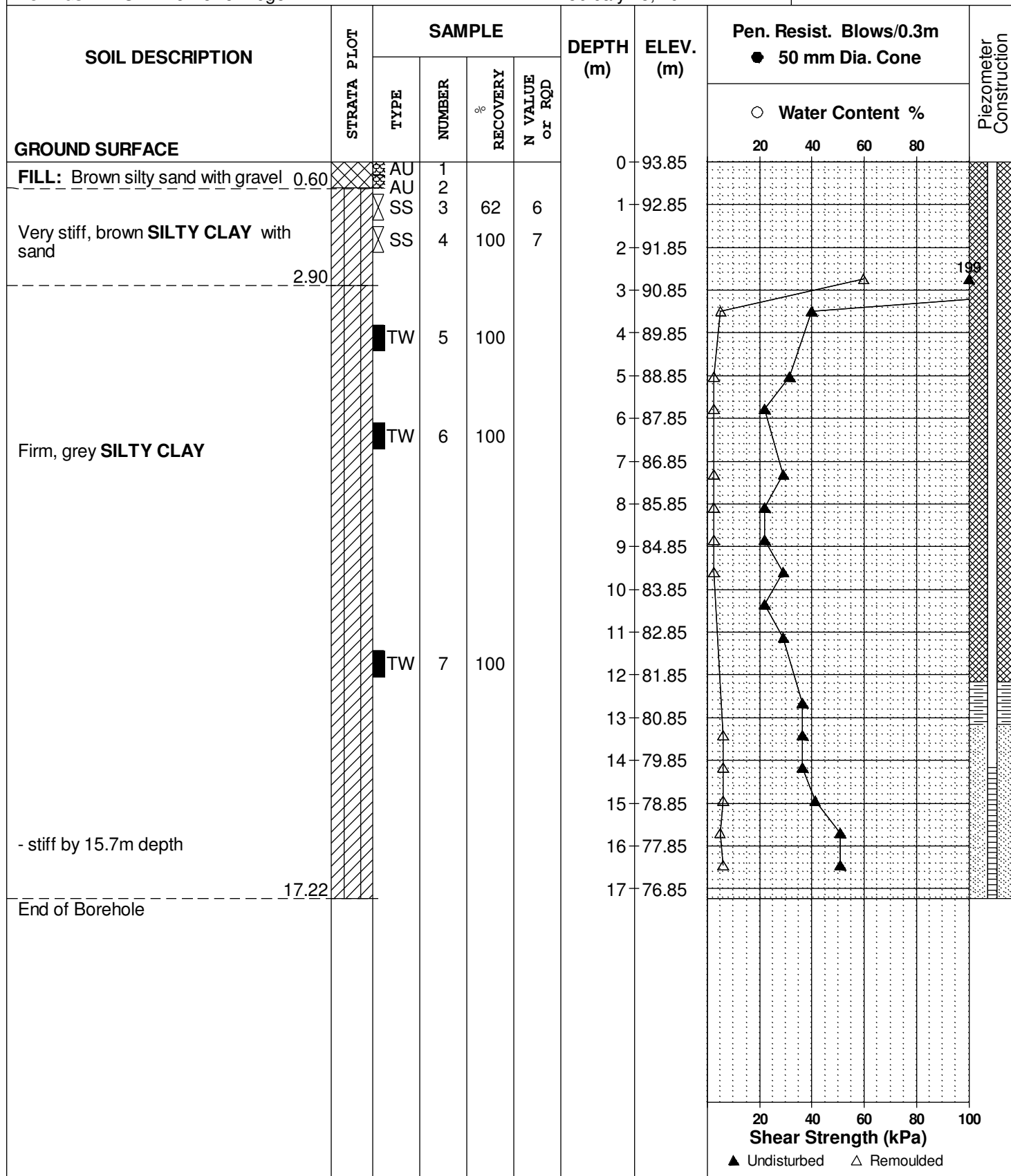
REMARKS

BORINGS BY CME 75 Power Auger

DATE February 15, 2011

FILE NO. PG2246

HOLE NO. BH19-10



DATUM Ground surface elevations provided by ASL.

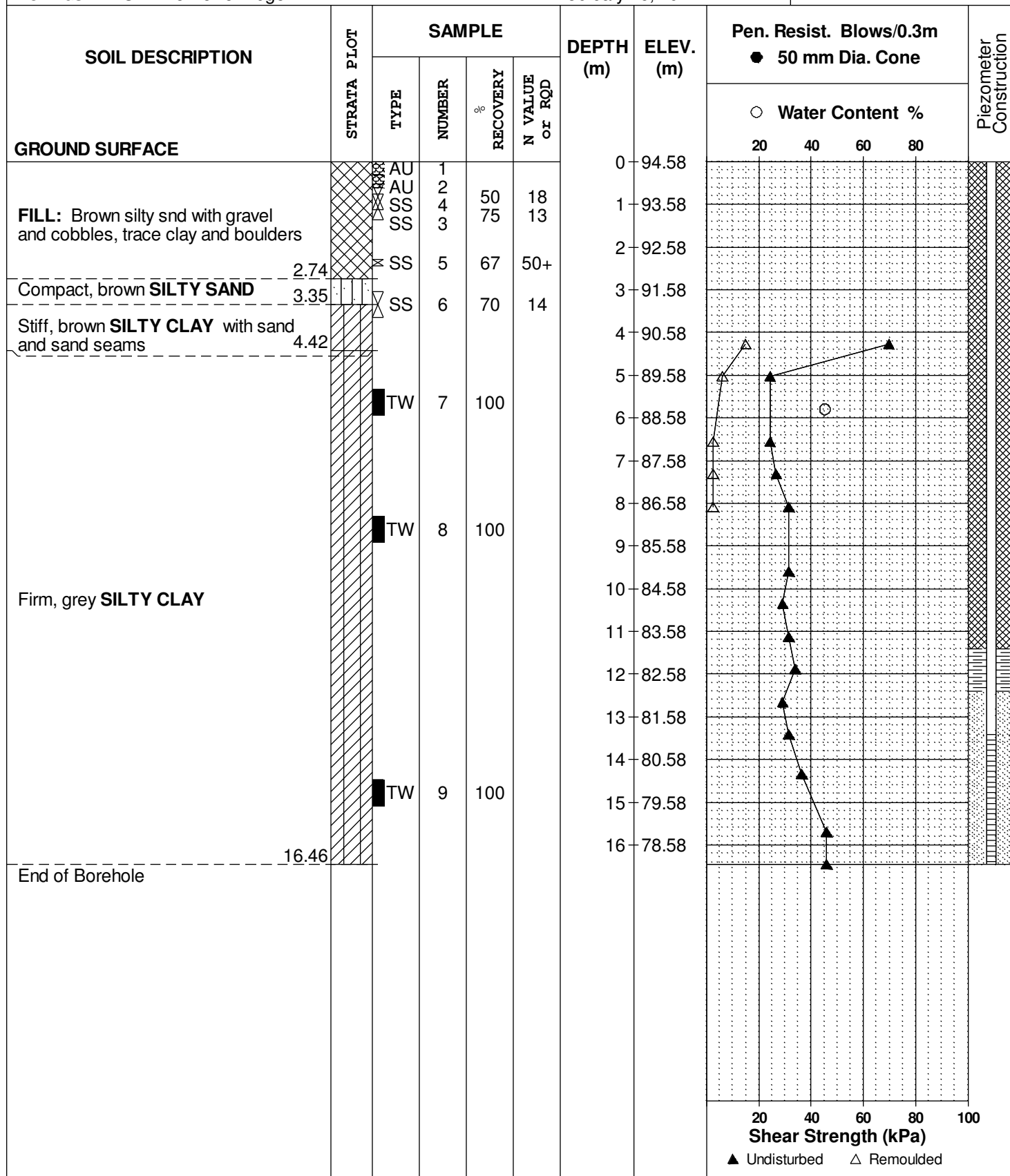
REMARKS

BORINGS BY CME 75 Power Auger

DATE February 16, 2011

FILE NO. PG2246

HOLE NO. BH20-10



DATUM Ground surface elevations provided by ASL.

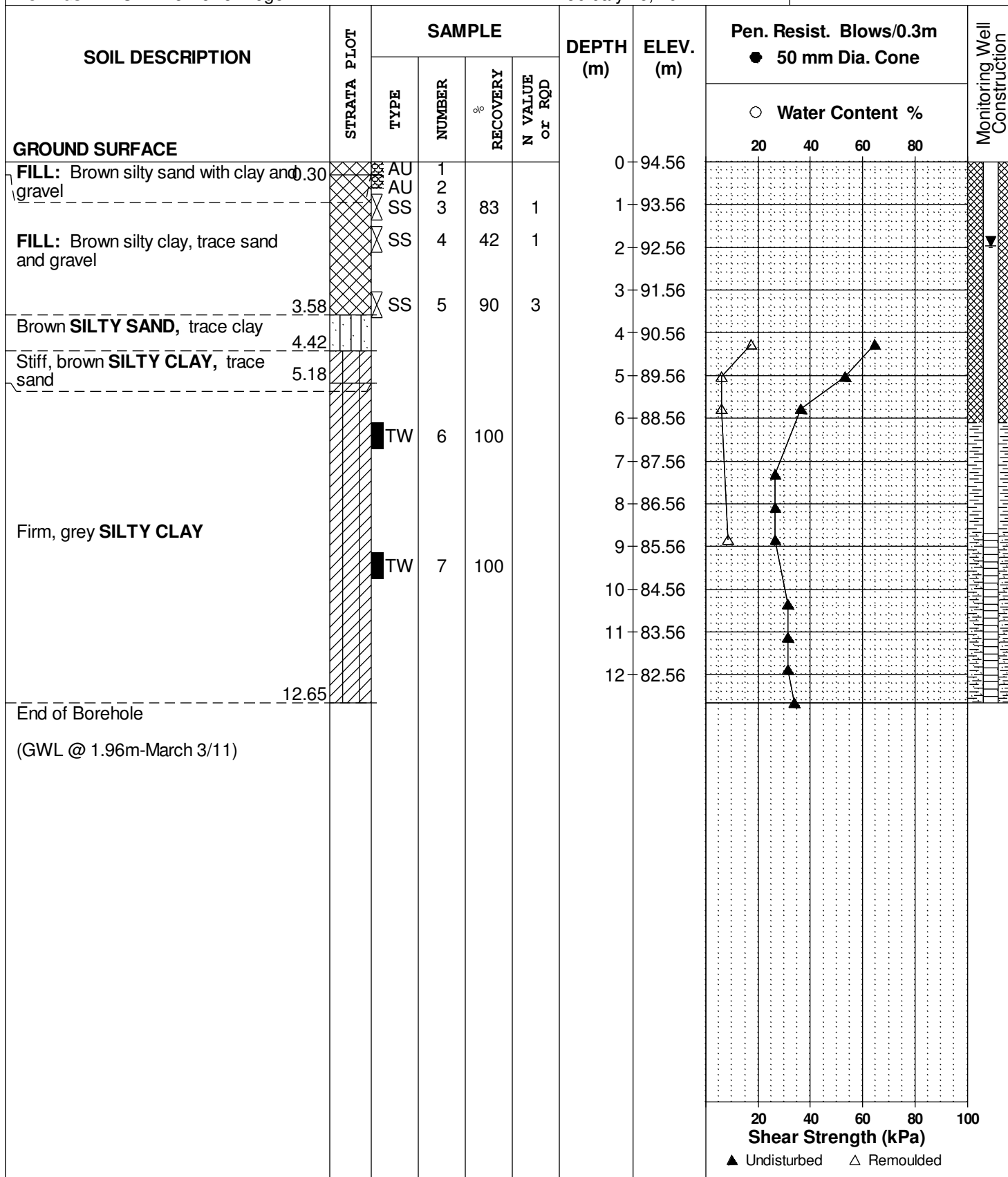
REMARKS

BORINGS BY CME 75 Power Auger

DATE February 16, 2011

FILE NO. PG2246

HOLE NO. BH21-10



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

DATUM Ground surface elevations provided by ASL.

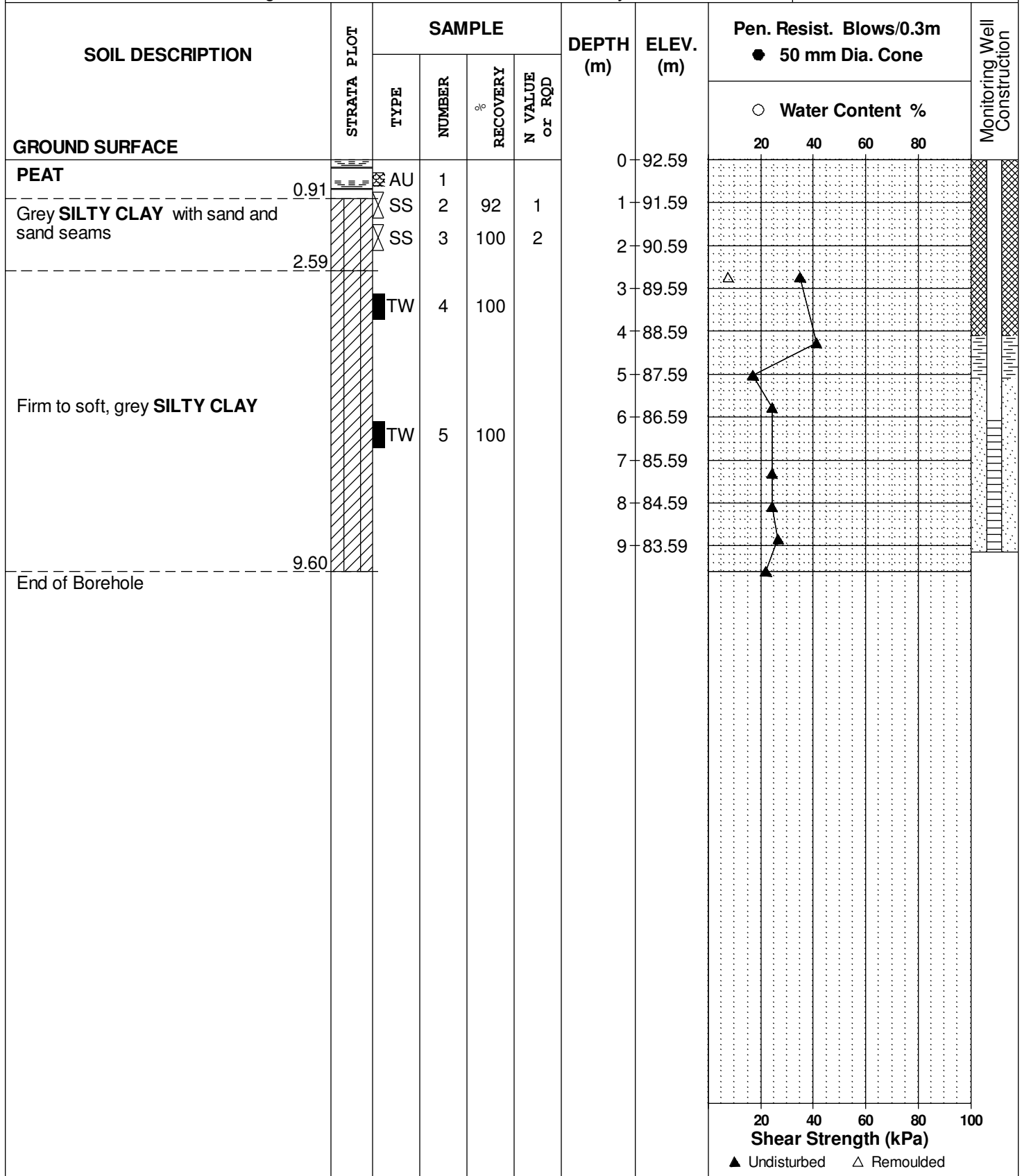
REMARKS

BORINGS BY CME 75 Power Auger

DATE February 11, 2011

FILE NO. PG2246

HOLE NO. BH22-10



DATUM Ground surface elevations provided by ASL.

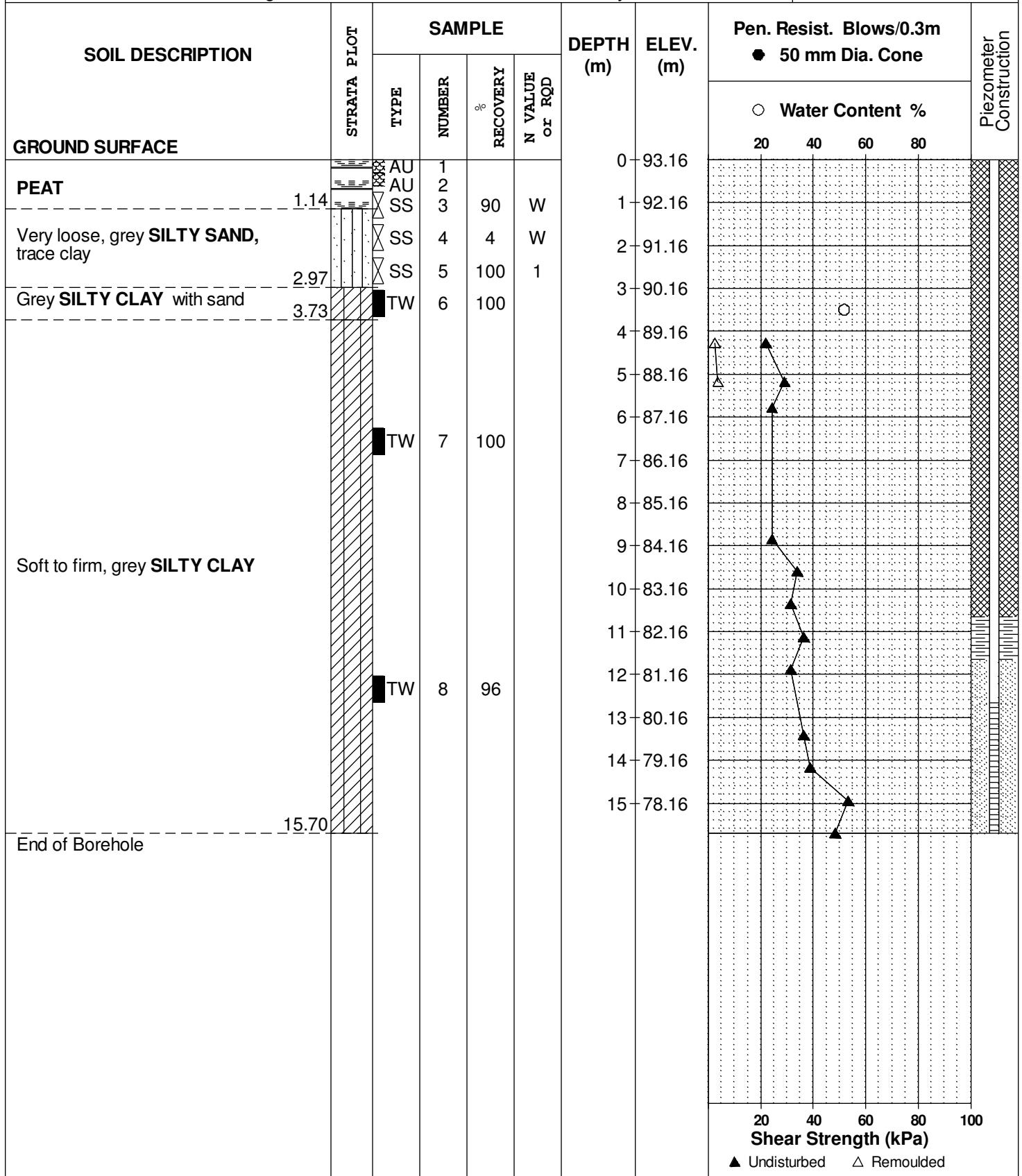
REMARKS

BORINGS BY CME 75 Power Auger

DATE February 18, 2011

FILE NO. PG2246

HOLE NO. BH23-10



DATUM Ground surface elevations provided by ASL.

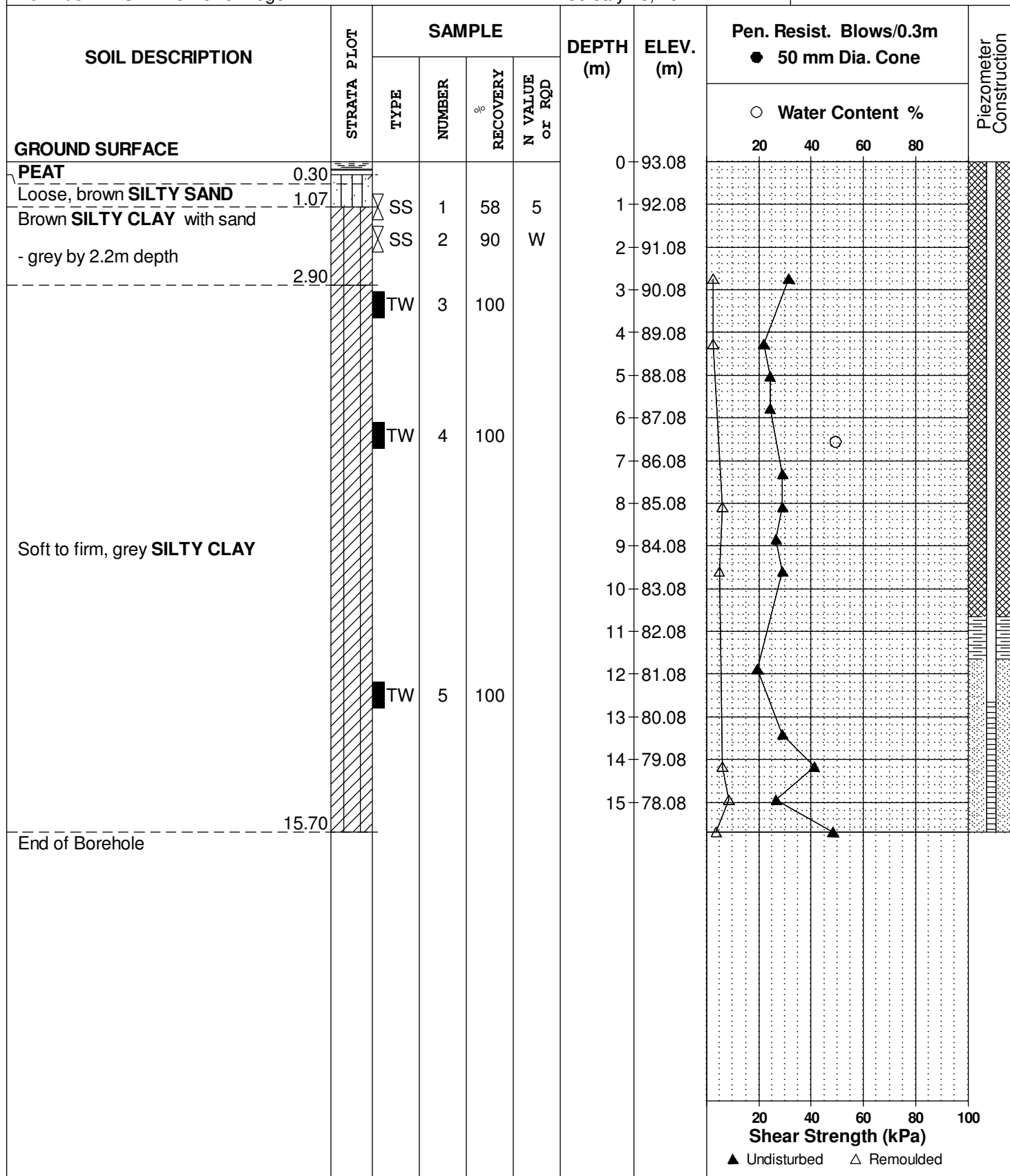
REMARKS

BORINGS BY CME 75 Power Auger

DATE February 18, 2011

FILE NO. PG2246

HOLE NO. BH24-10



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

DATUM Ground surface elevations provided by ASL.

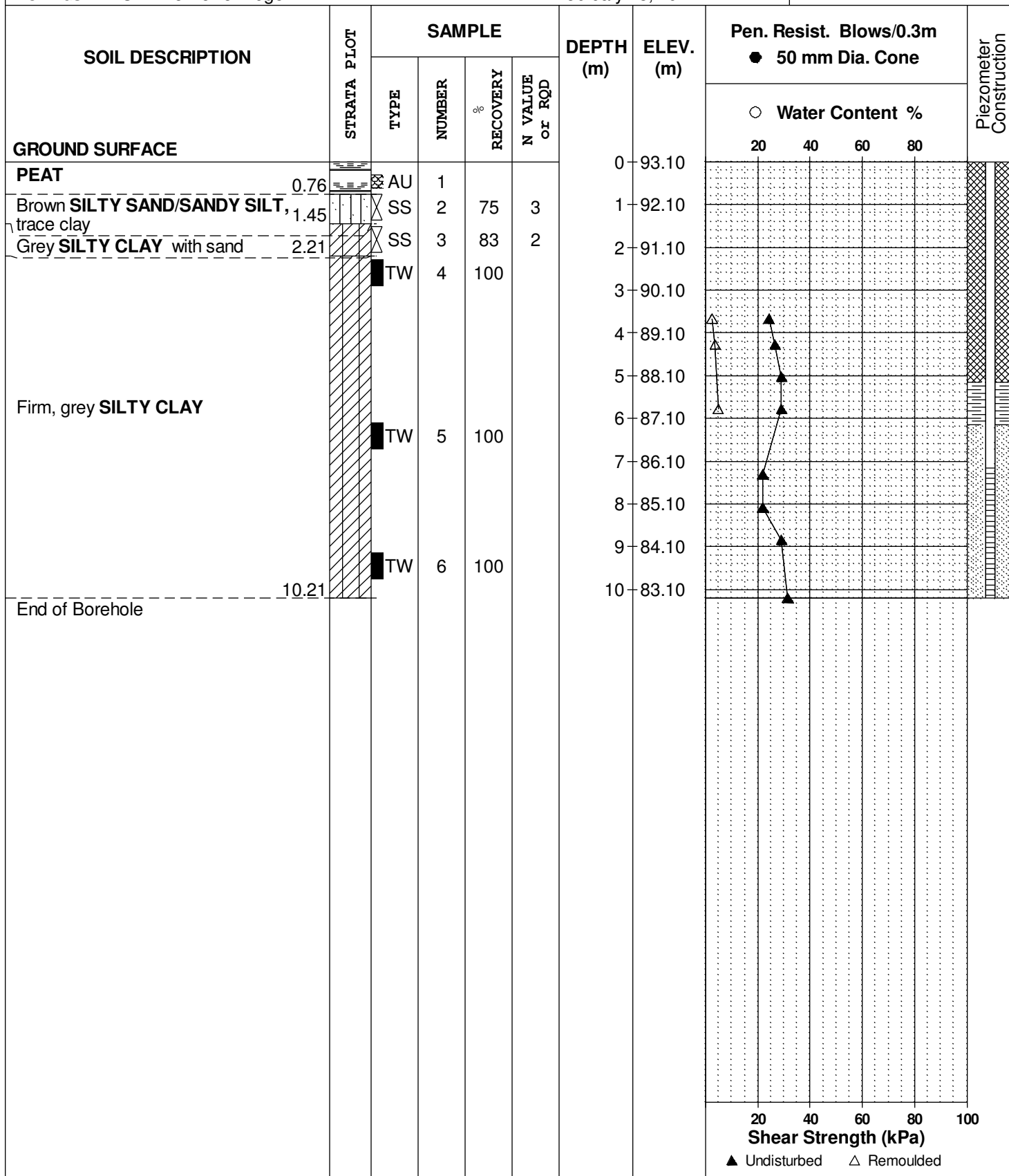
REMARKS

BORINGS BY CME 75 Power Auger

DATE February 18, 2011

FILE NO. PG2246

HOLE NO. BH25-10



DATUM Ground surface elevations provided by ASL.

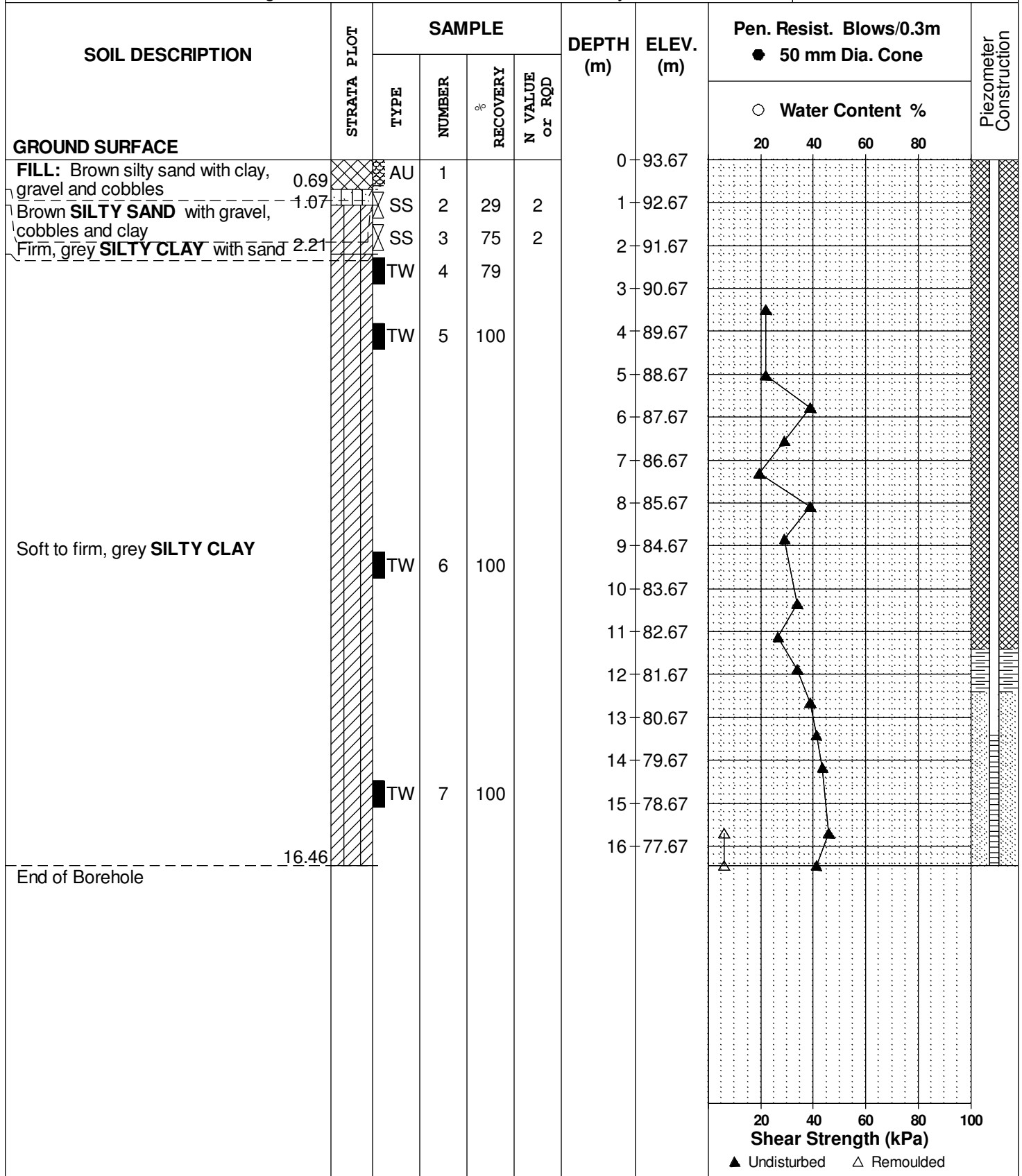
REMARKS

BORINGS BY CME 75 Power Auger

DATE February 24, 2011

FILE NO. PG2246

HOLE NO. BH26-10



DATUM Ground surface elevations provided by ASL.

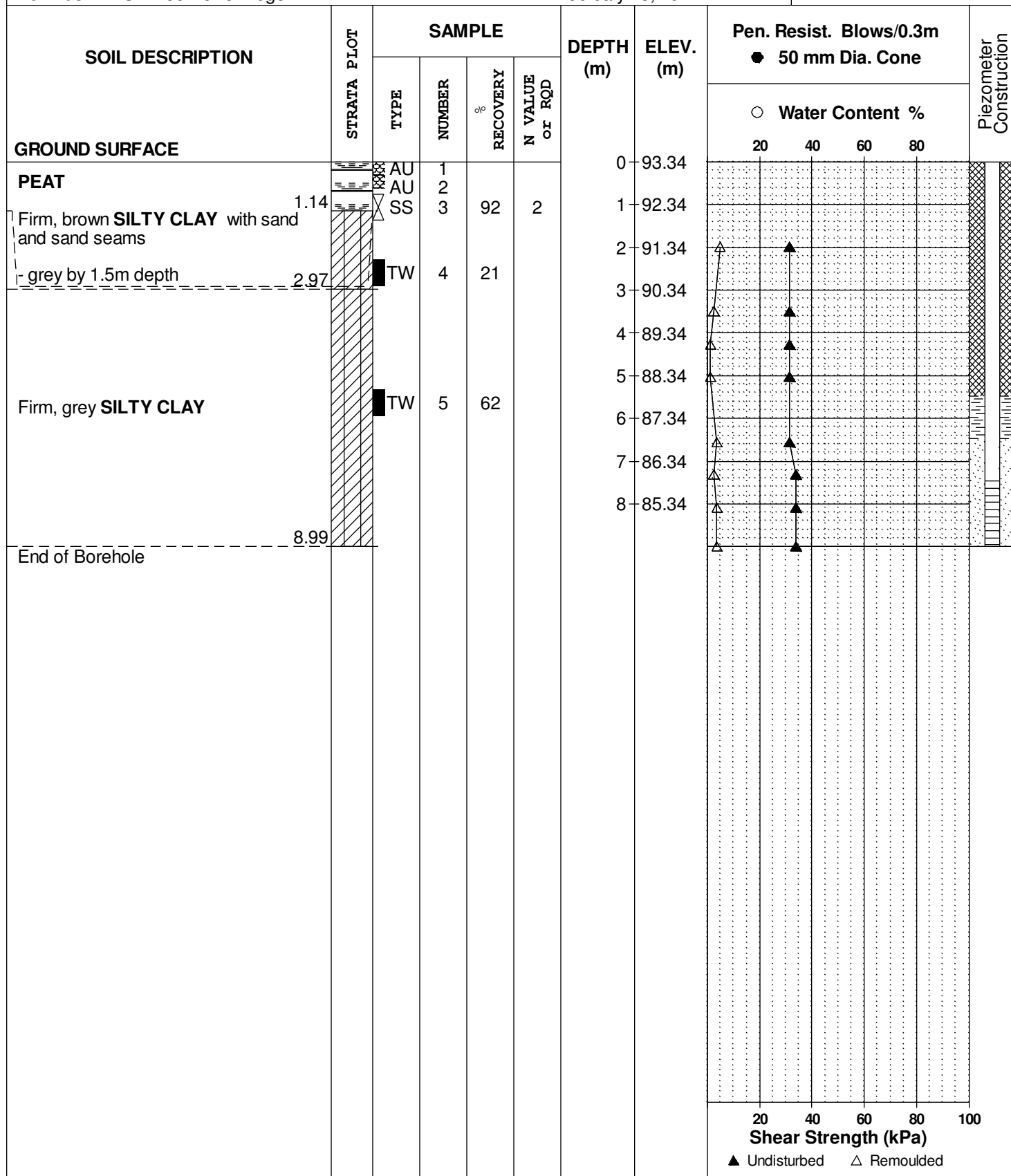
REMARKS

BORINGS BY CME 55 Power Auger

DATE February 23, 2011

FILE NO. PG2246

HOLE NO. BH27-10



SOIL PROFILE AND TEST DATA

**Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario**

DATUM Ground surface elevations provided by ASL.

FILE NO. **PG2246**

REMARKS

HOLE NO. **BH27A-10**

BORINGS BY CME 55 Power Auger

DATE February 23, 2011

[illegible]

DATUM Ground surface elevations provided by ASL.

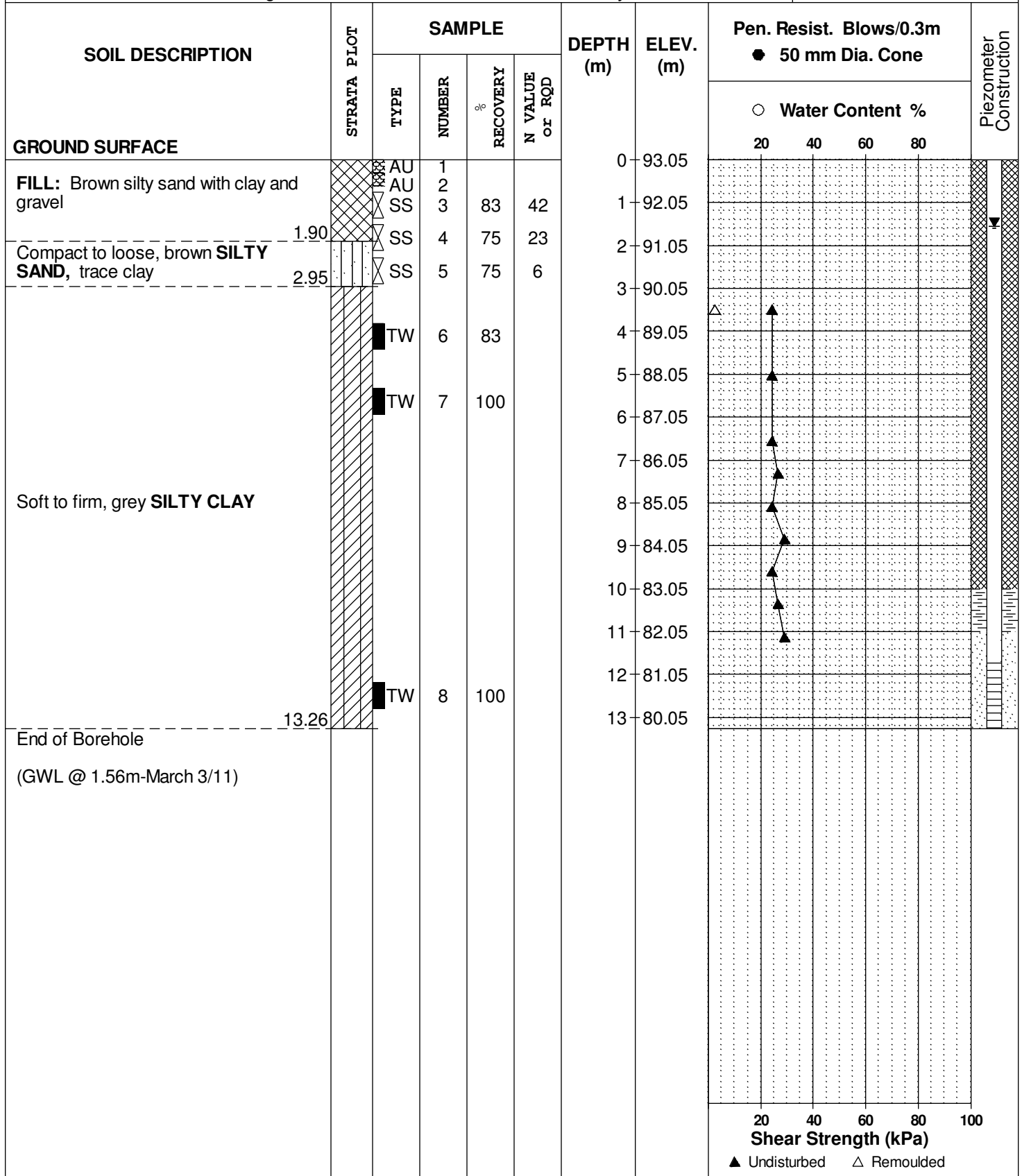
REMARKS

BORINGS BY CME 55 Power Auger

DATE February 25, 2011

FILE NO. PG2246

HOLE NO. BH28-10



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevation at borehole locations provided by JD Barnes.

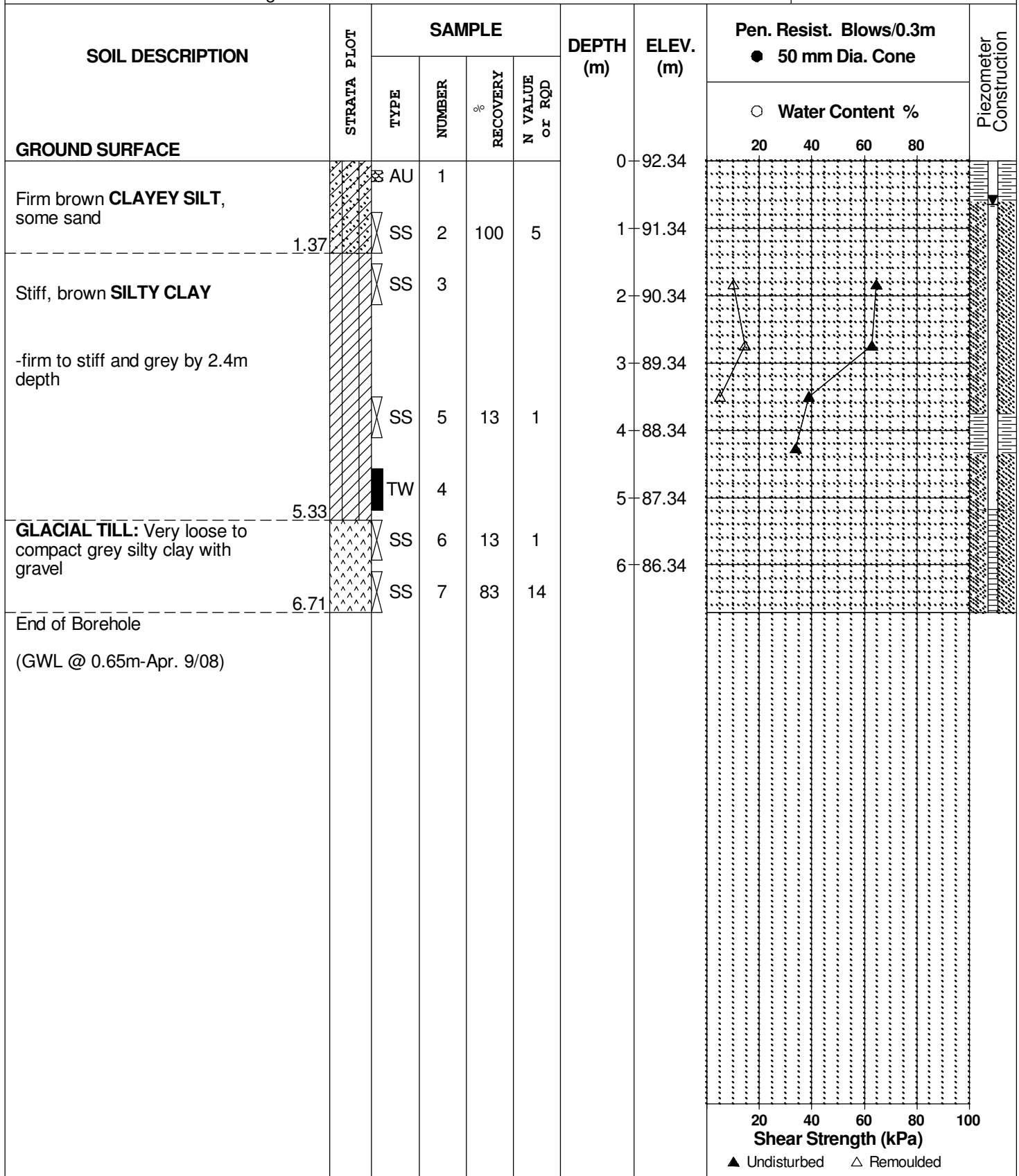
REMARKS

BORINGS BY CME 55 Power Auger

DATE 25 March 2008

FILE NO.
PG1618

HOLE NO.
BH10-08



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevation at borehole locations provided by JD Barnes.

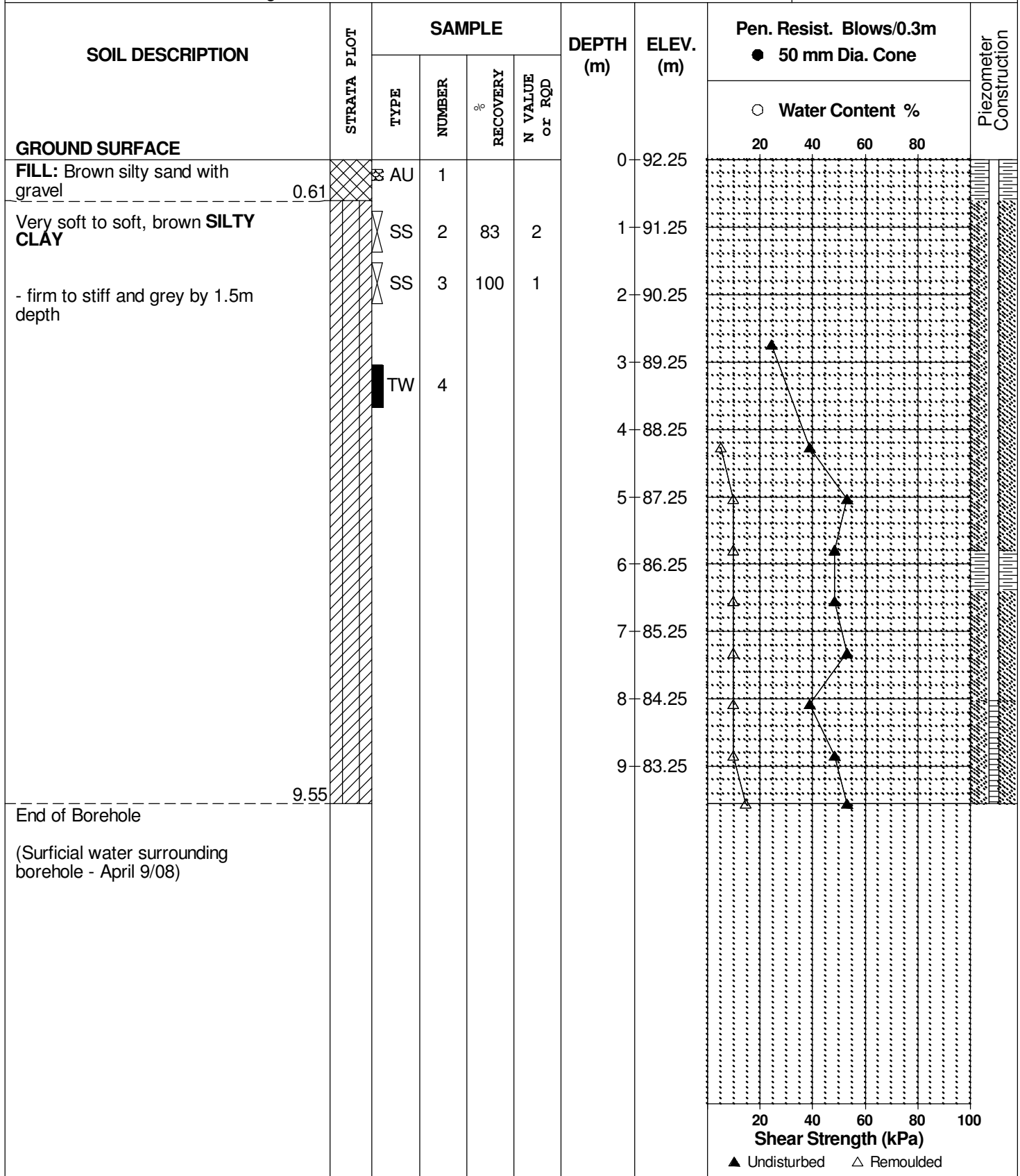
REMARKS

BORINGS BY CME 55 Power Auger

DATE 20 March 2008

FILE NO.
PG1618

HOLE NO.
BH11-08



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevation at borehole locations provided by JD Barnes.

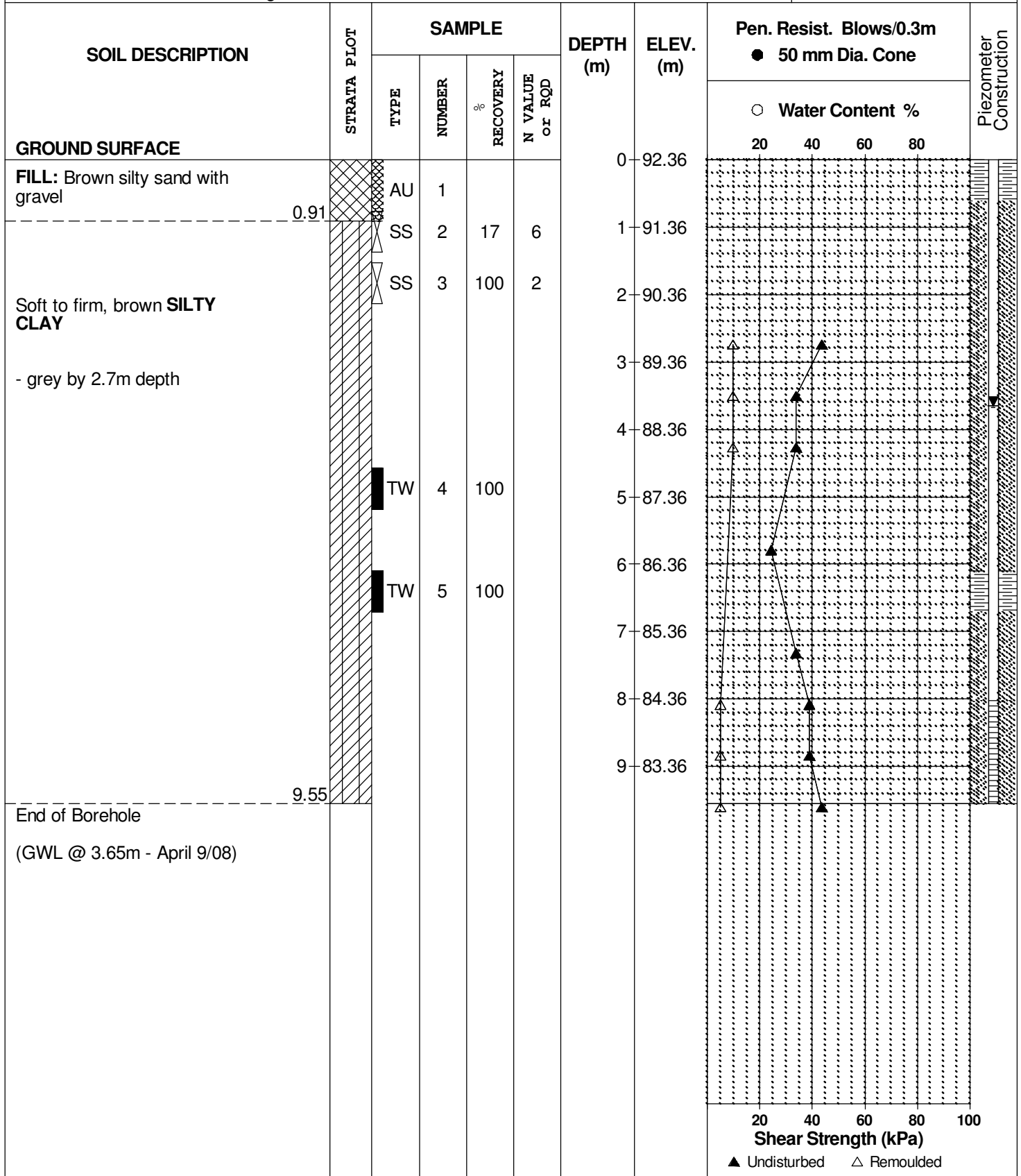
REMARKS

BORINGS BY CME 55 Power Auger

DATE 24 March 2008

FILE NO.
PG1618

HOLE NO.
BH12-08



DATUM Ground surface elevation at borehole locations provided by JD Barnes.

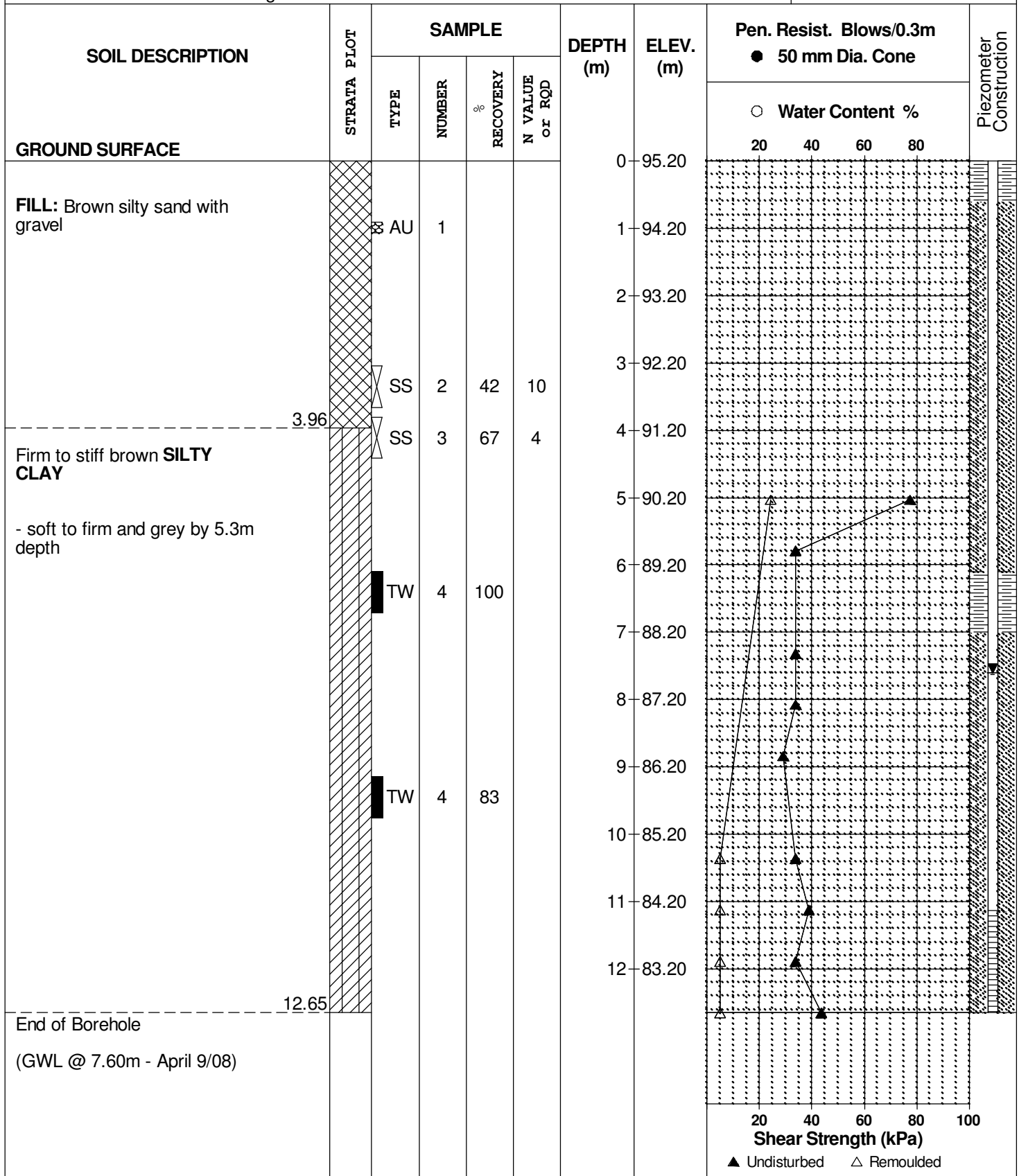
REMARKS

BORINGS BY CME 55 Power Auger

DATE 24 March 2008

FILE NO.
PG1618

HOLE NO.
BH13-08



DATUM Ground surface elevation at borehole locations provided by JD Barnes.

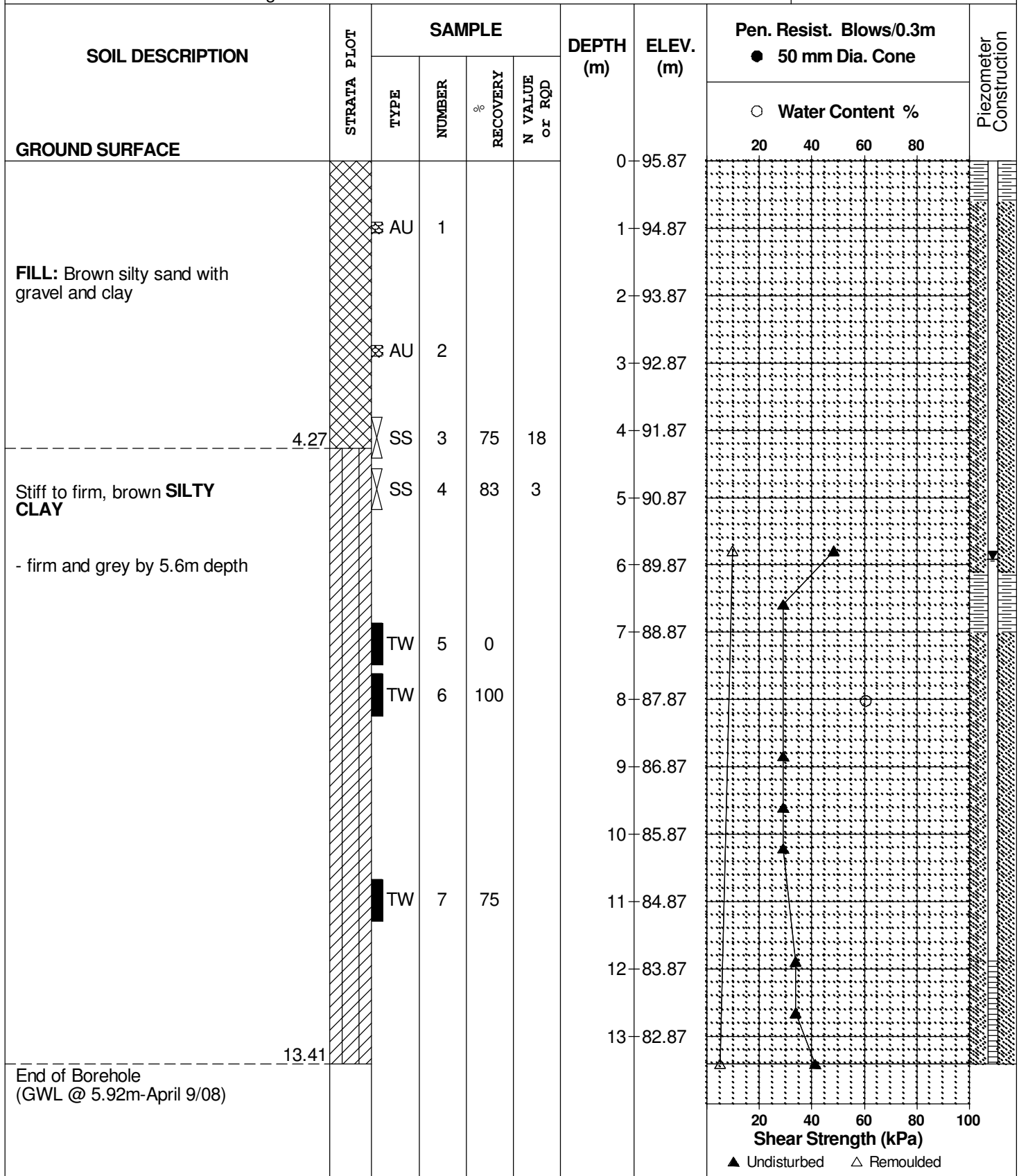
REMARKS

BORINGS BY CME 55 Power Auger

DATE 25 March 2008

FILE NO.
PG1618

HOLE NO.
BH14-08



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevation at borehole locations provided by JD Barnes.

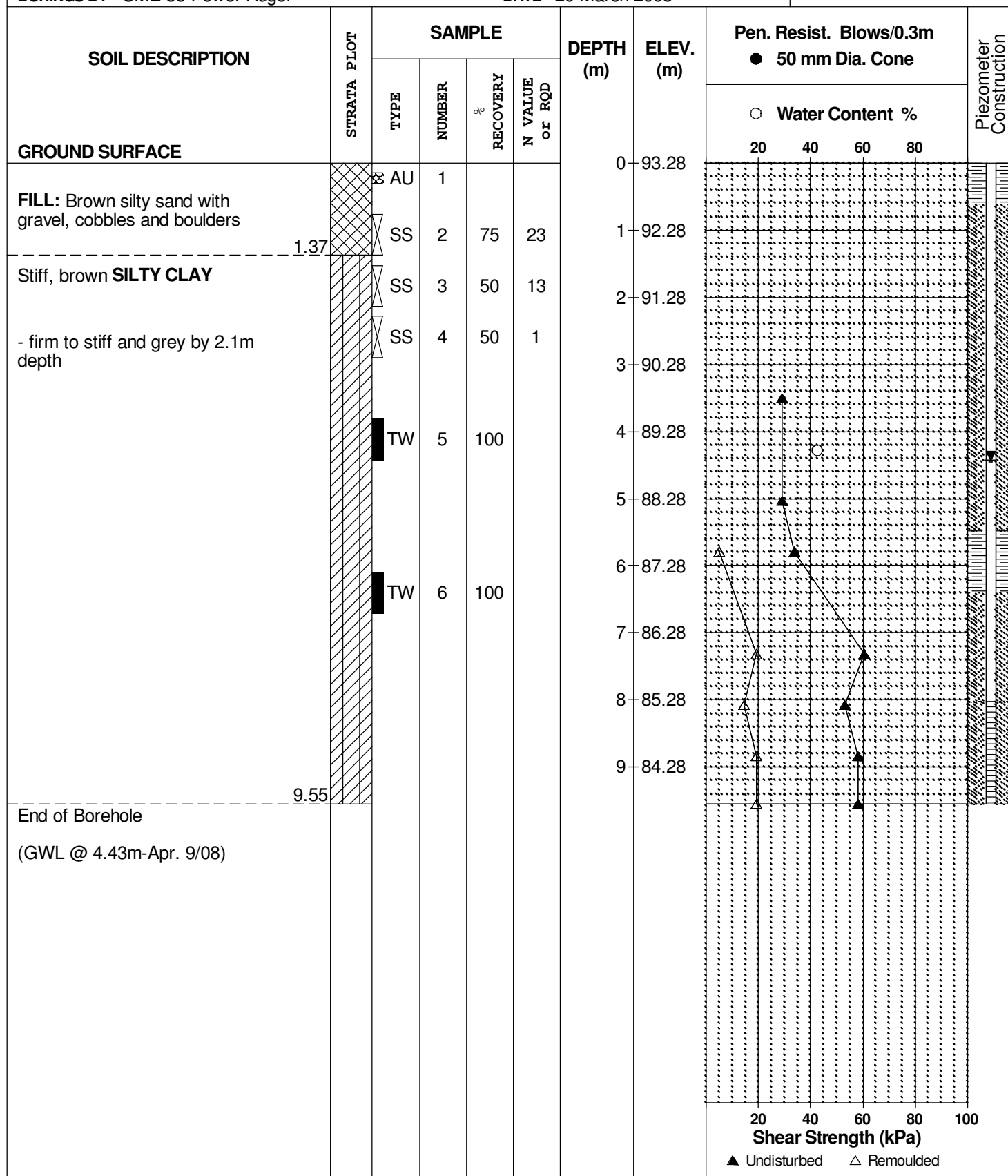
FILE NO.
PG1618

REMARKS

HOLE NO.
BH15-08

BORINGS BY CME 55 Power Auger

DATE 20 March 2008



DATUM Ground surface elevation at borehole locations provided by JD Barnes.

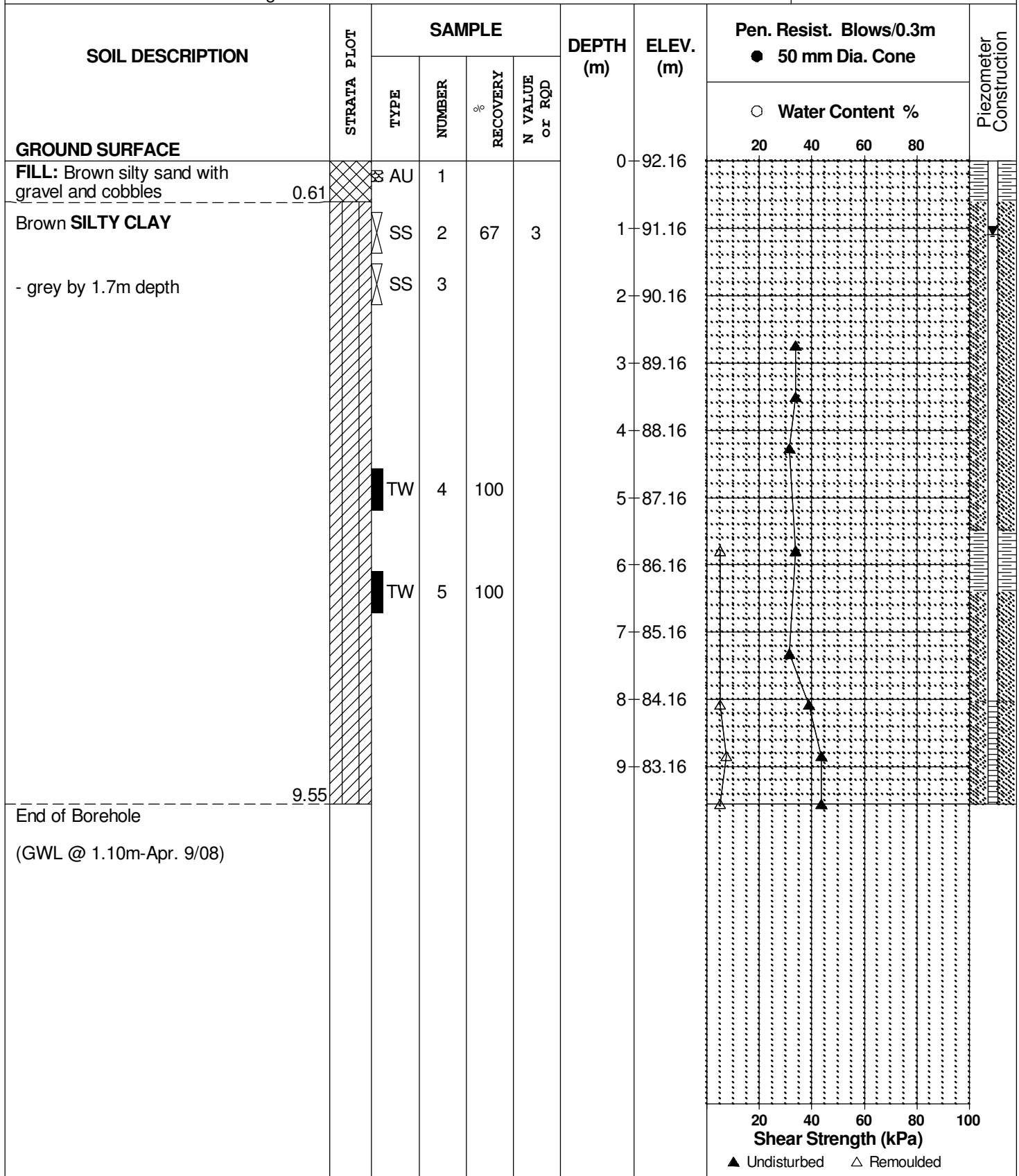
REMARKS

BORINGS BY CME 55 Power Auger

DATE 20 March 2008

FILE NO.
PG1618

HOLE NO.
BH16-08



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevation at borehole locations provided by JD Barnes.

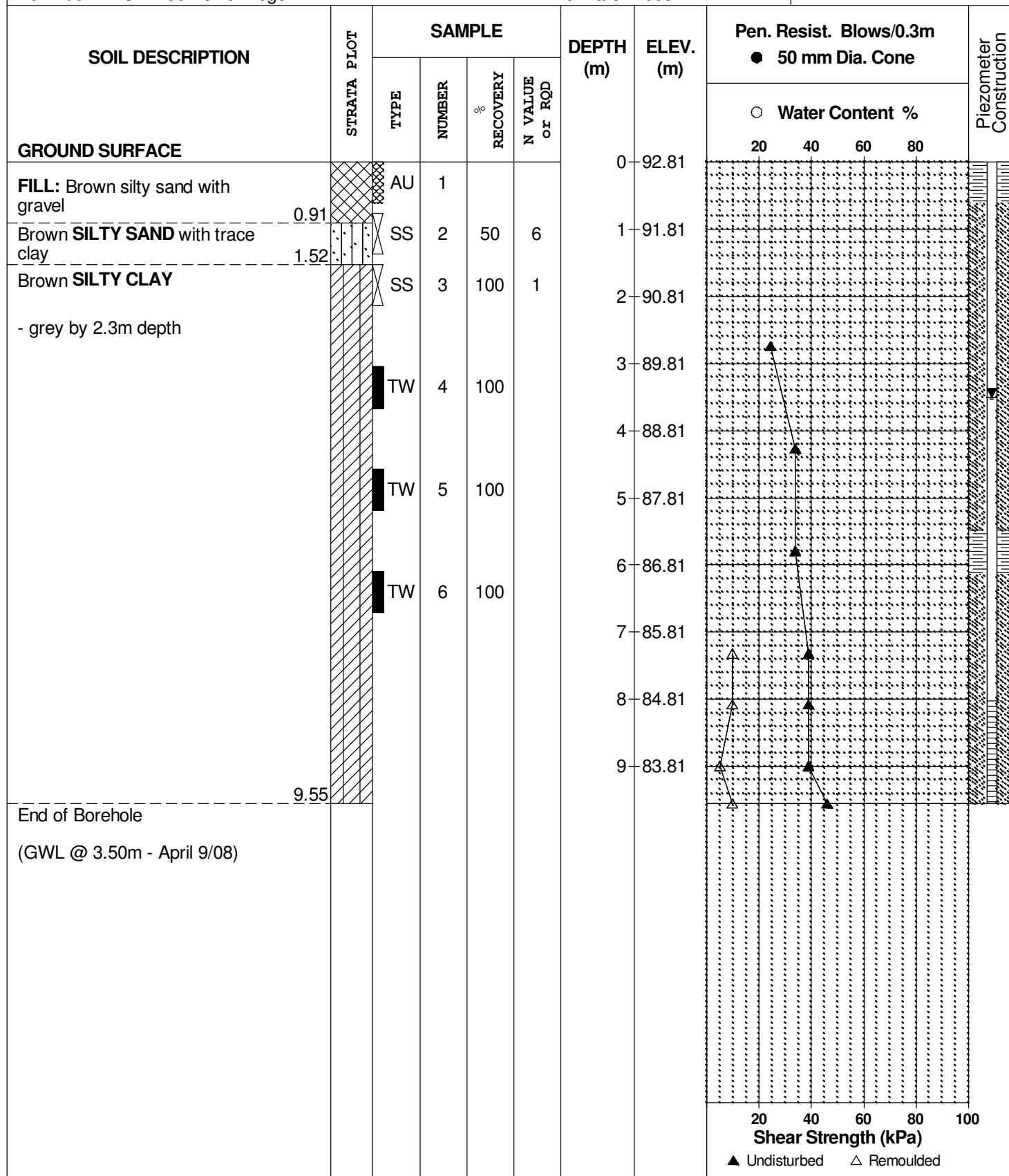
FILE NO.
PG1618

REMARKS

HOLE NO.
BH19-08

BORINGS BY CME 55 Power Auger

DATE 19 March 2008



DATUM Ground surface elevation at borehole locations provided by JD Barnes.

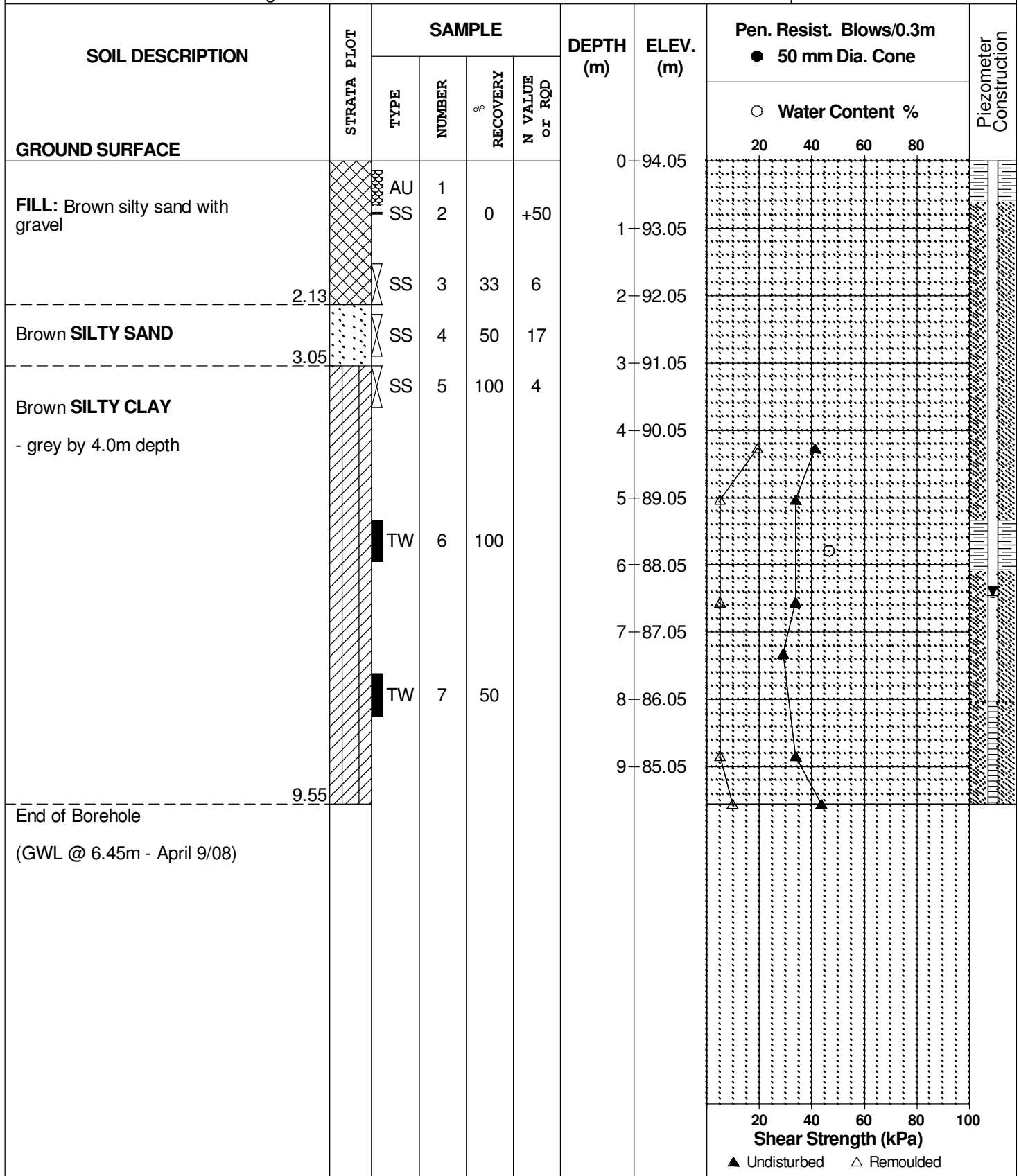
REMARKS

BORINGS BY CME 55 Power Auger

DATE 18 March 2008

FILE NO.
PG1618

HOLE NO.
BH20-08



DATUM Ground surface elevation at borehole locations provided by JD Barnes.

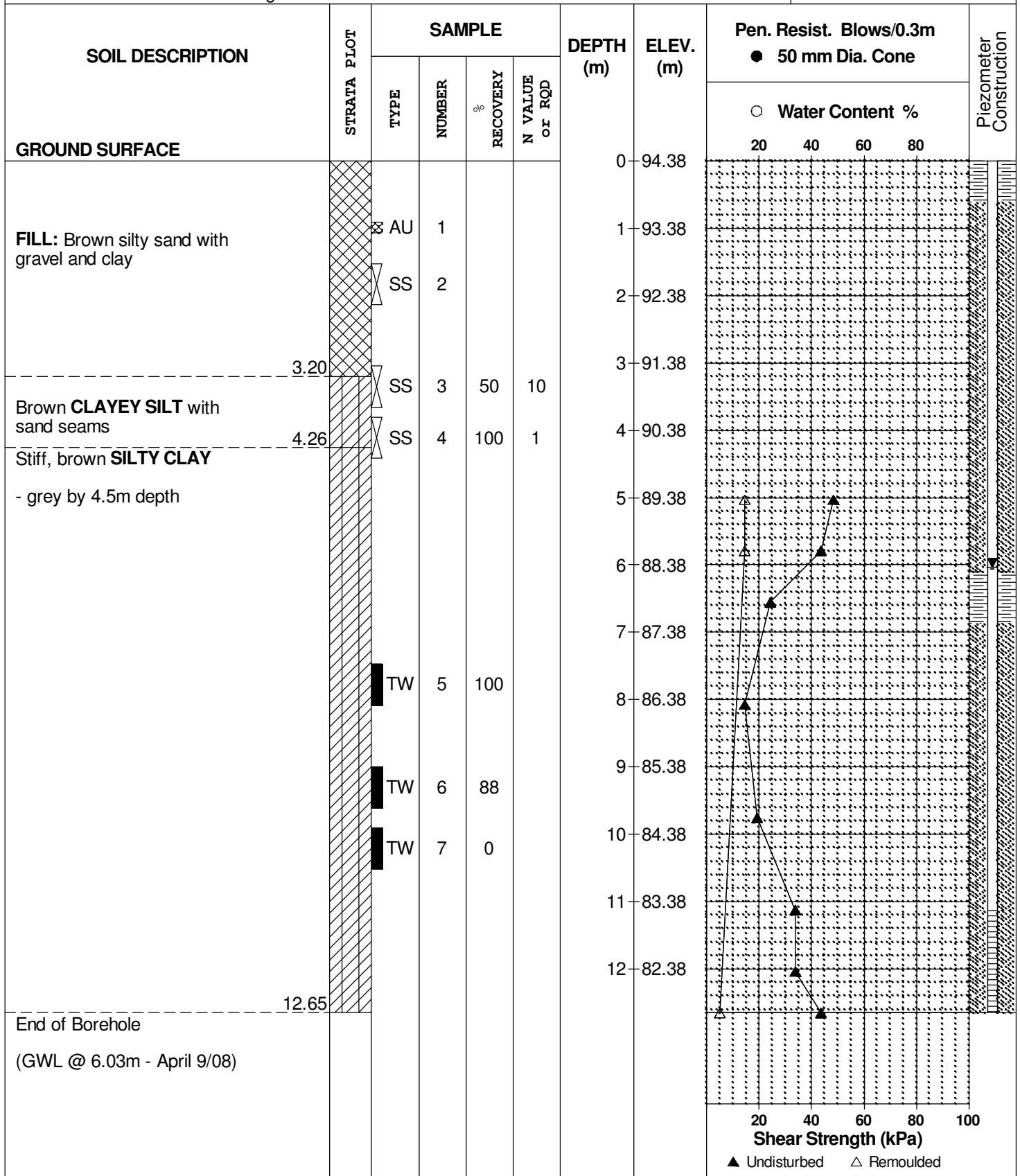
REMARKS

BORINGS BY CME 55 Power Auger

DATE 24 March 2008

FILE NO.
PG1618

HOLE NO.
BH21-08



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevation at borehole locations provided by JD Barnes.

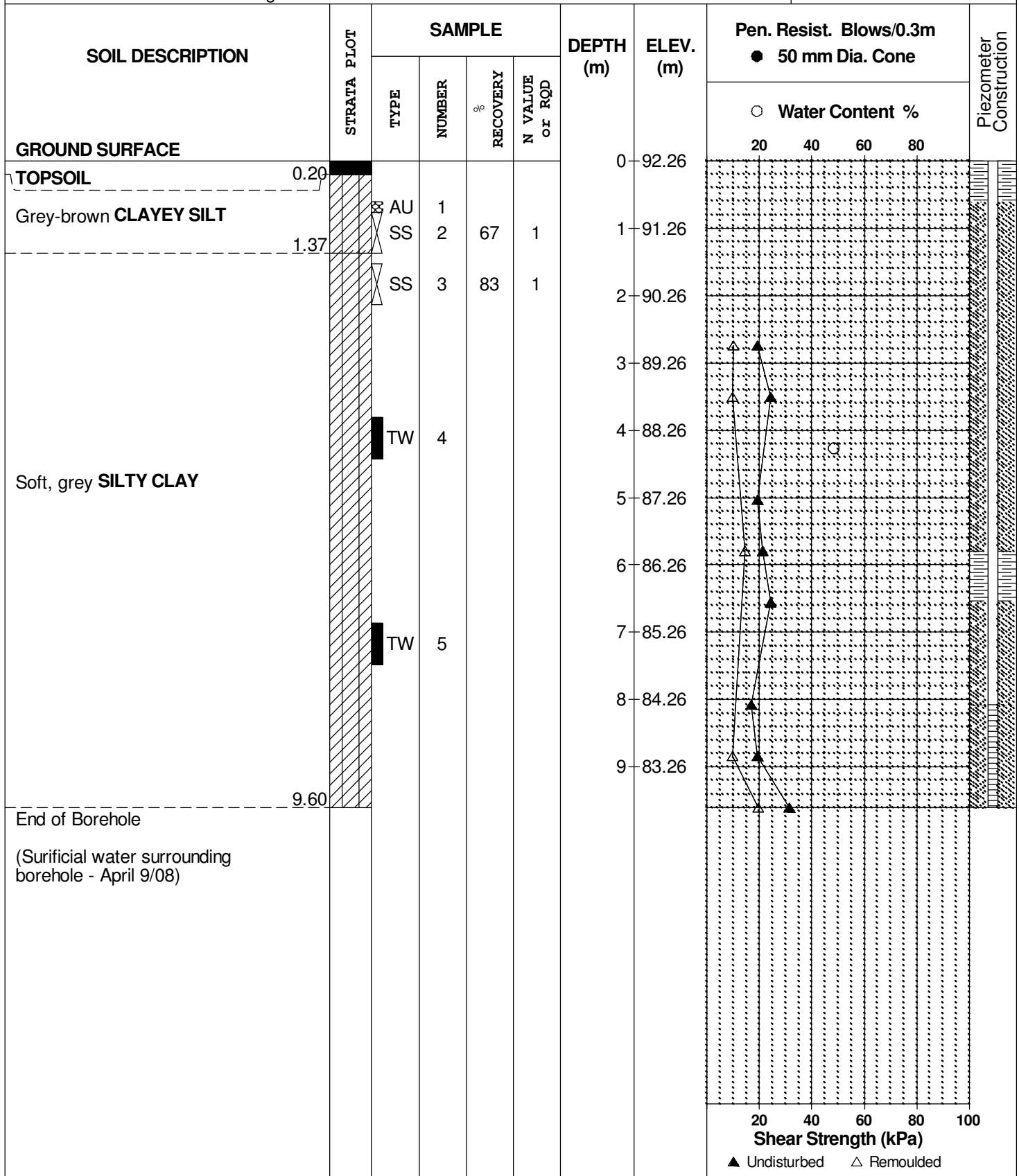
REMARKS

BORINGS BY CME 55 Power Auger

DATE 17 March 2008

FILE NO.
PG1618

HOLE NO.
BH22-08



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevation at borehole locations provided by JD Barnes.

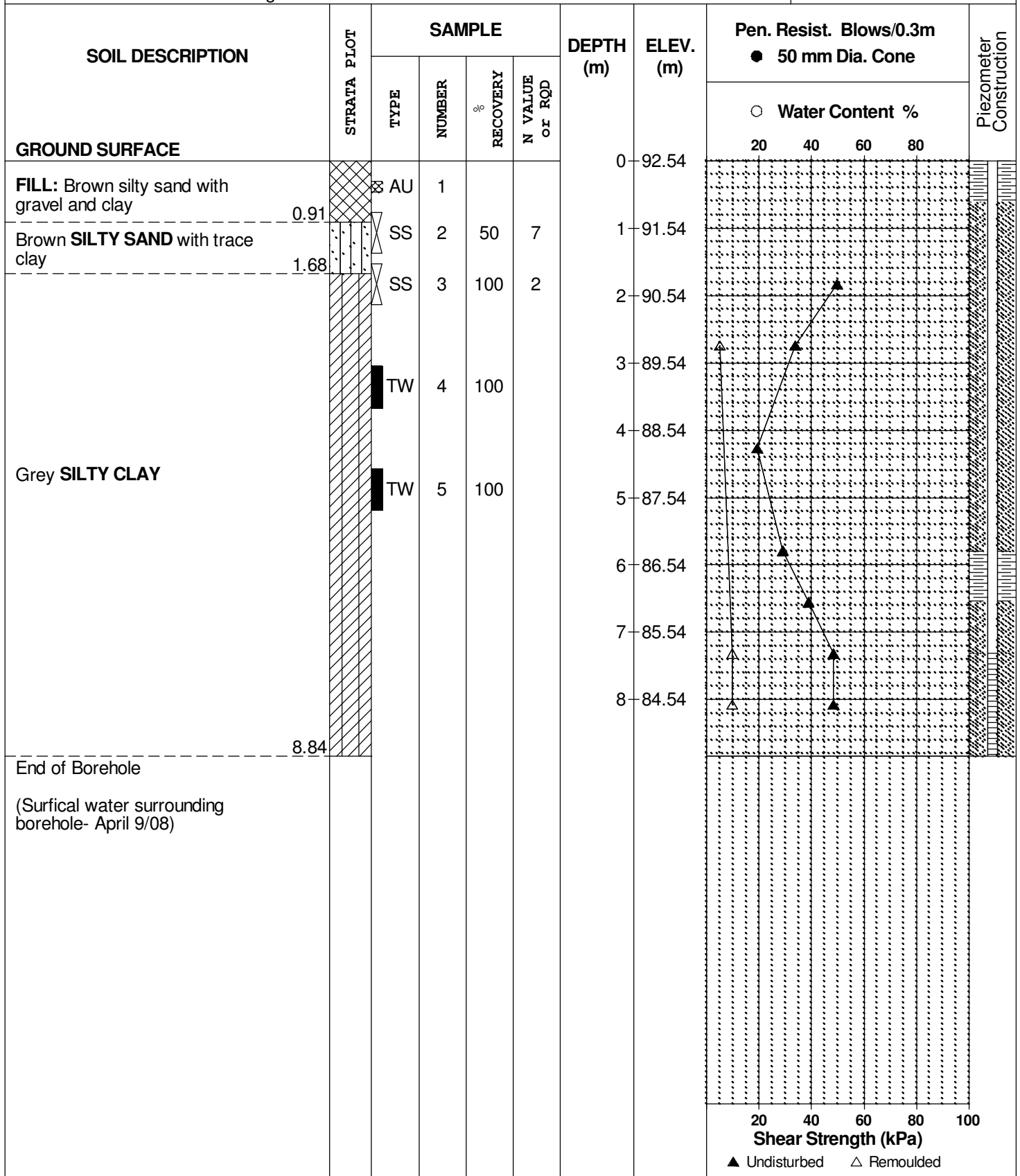
REMARKS

BORINGS BY CME 55 Power Auger

DATE 26 March 2008

FILE NO.
PG1618

HOLE NO.
BH23-08



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevation at borehole locations provided by JD Barnes.

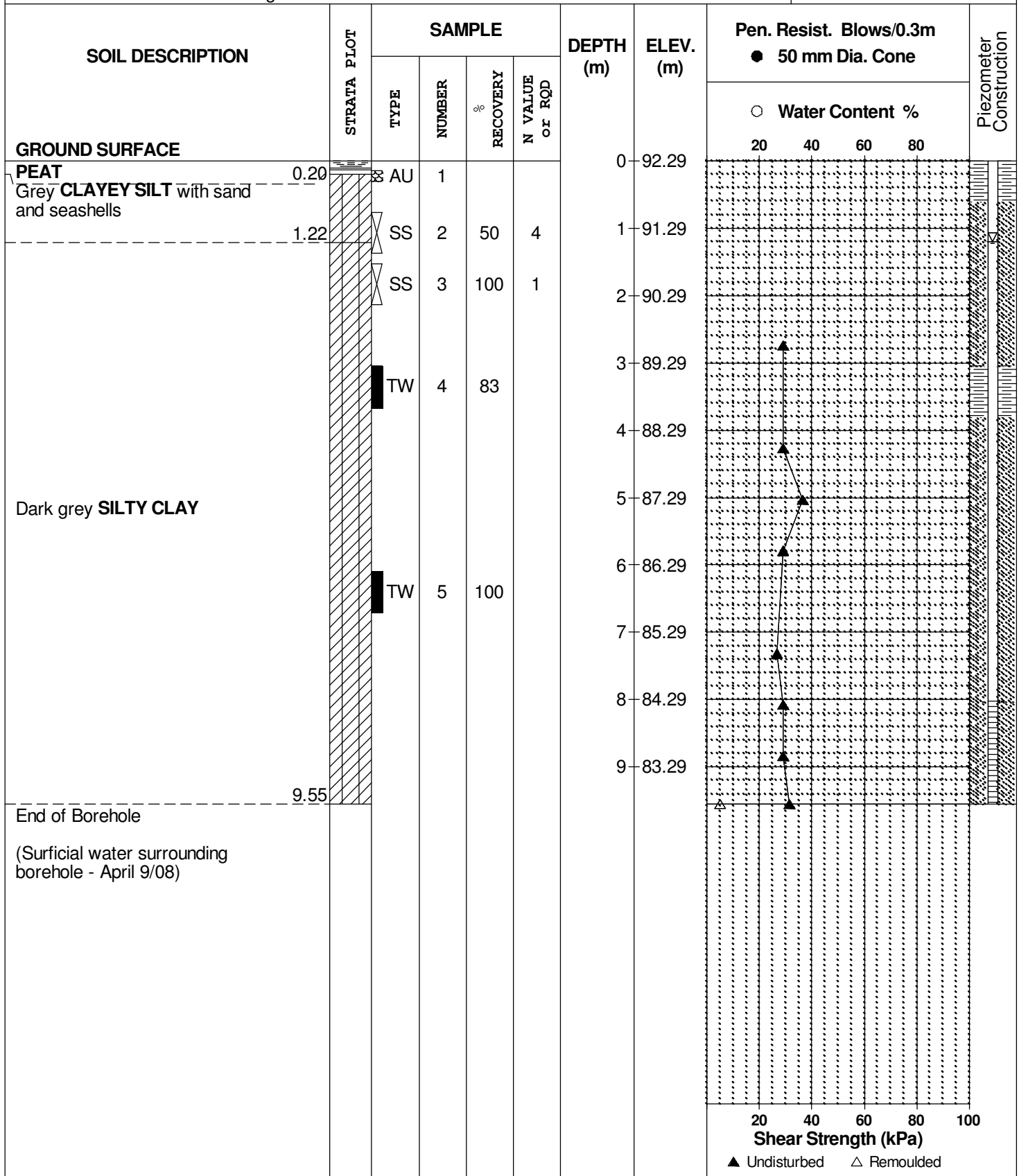
REMARKS

BORINGS BY CME 55 Power Auger

DATE 17 March 2008

FILE NO.
PG1618

HOLE NO.
BH24-08



DATUM Ground surface elevation at borehole locations provided by JD Barnes.

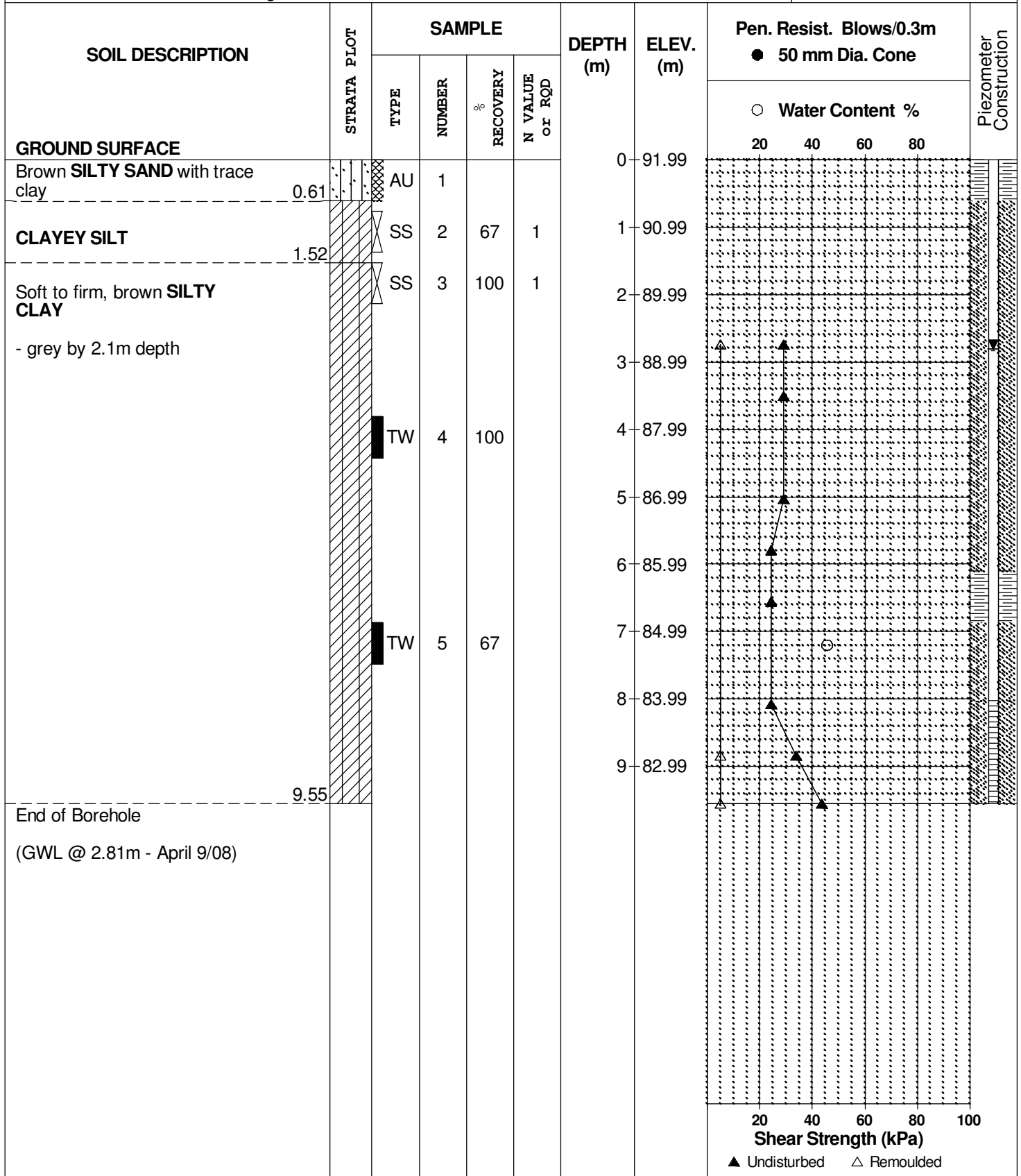
FILE NO. PG1618

REMARKS

HOLE NO. BH29-08

BORINGS BY CME 55 Power Auger

DATE 18 March 2008



DATUM Ground surface elevation at borehole locations provided by JD Barnes.

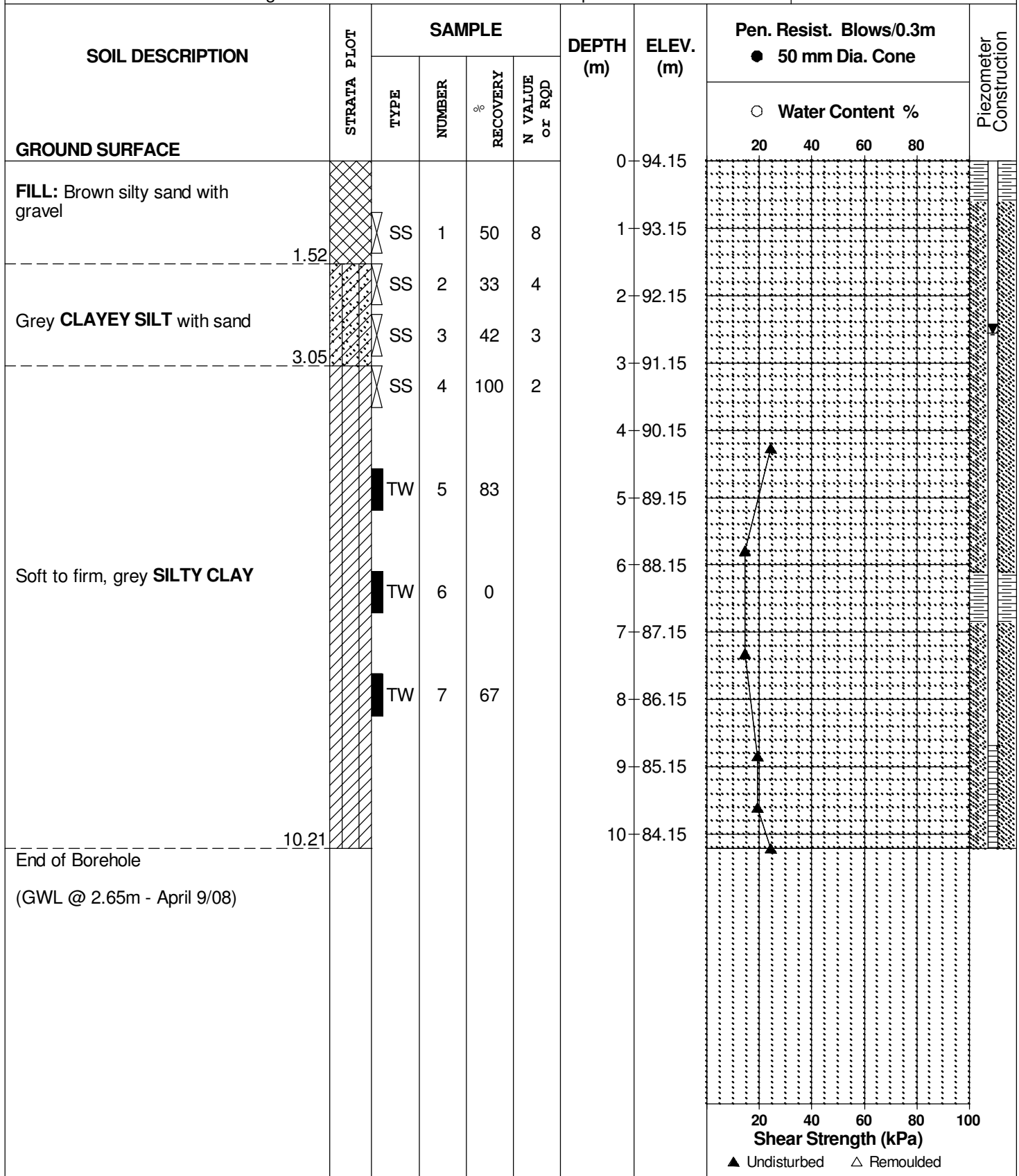
REMARKS

BORINGS BY CME 55 Power Auger

DATE 1 April 2008

FILE NO. PG1618

HOLE NO. BH32-08



DATUM Ground surface elevation at borehole locations provided by JD Barnes.

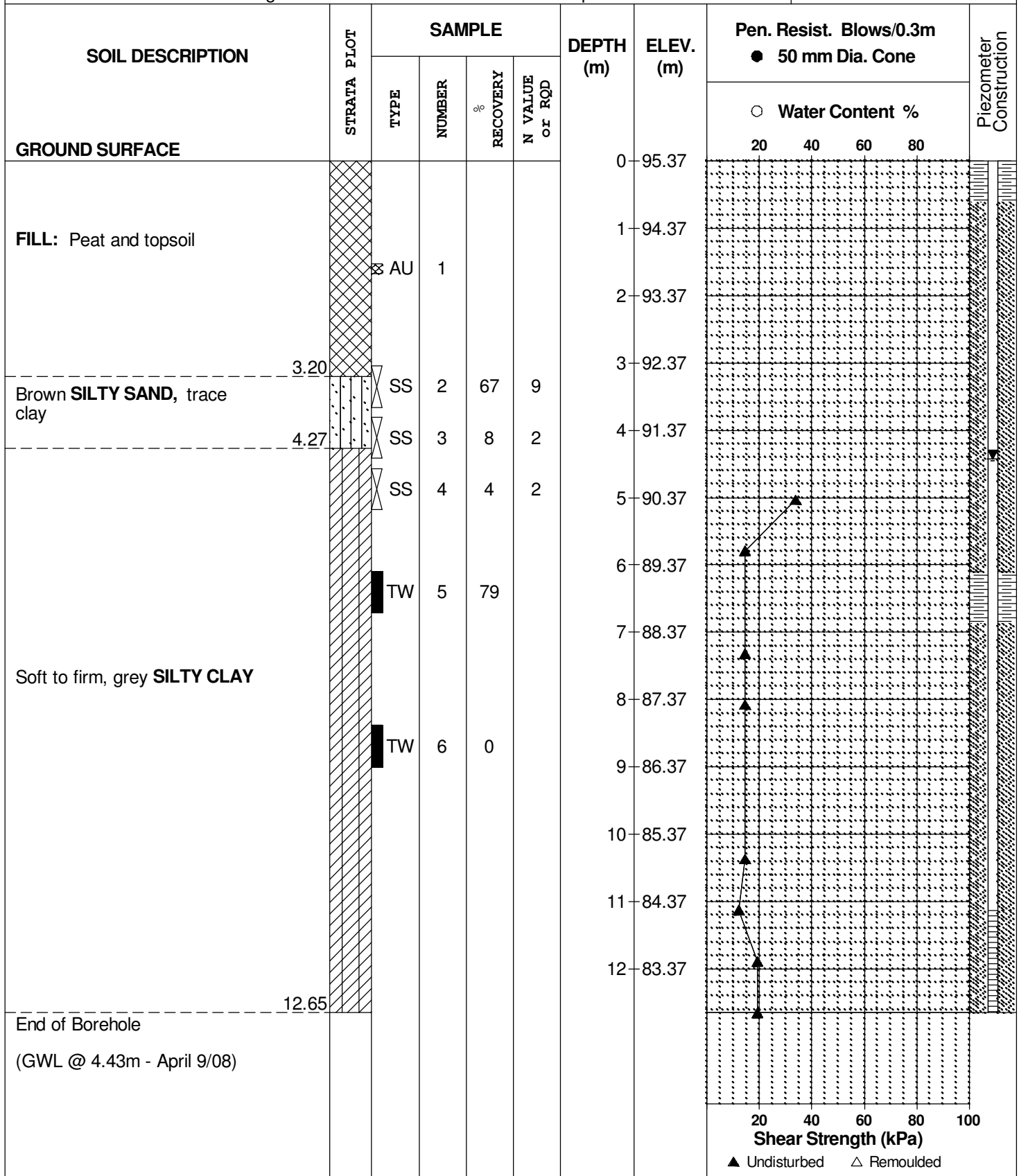
REMARKS

BORINGS BY CME 55 Power Auger

DATE 2 April 2008

FILE NO.
PG1618

HOLE NO.
BH33-08



DATUM Ground surface elevations provided by J.D. Barnes Limited.

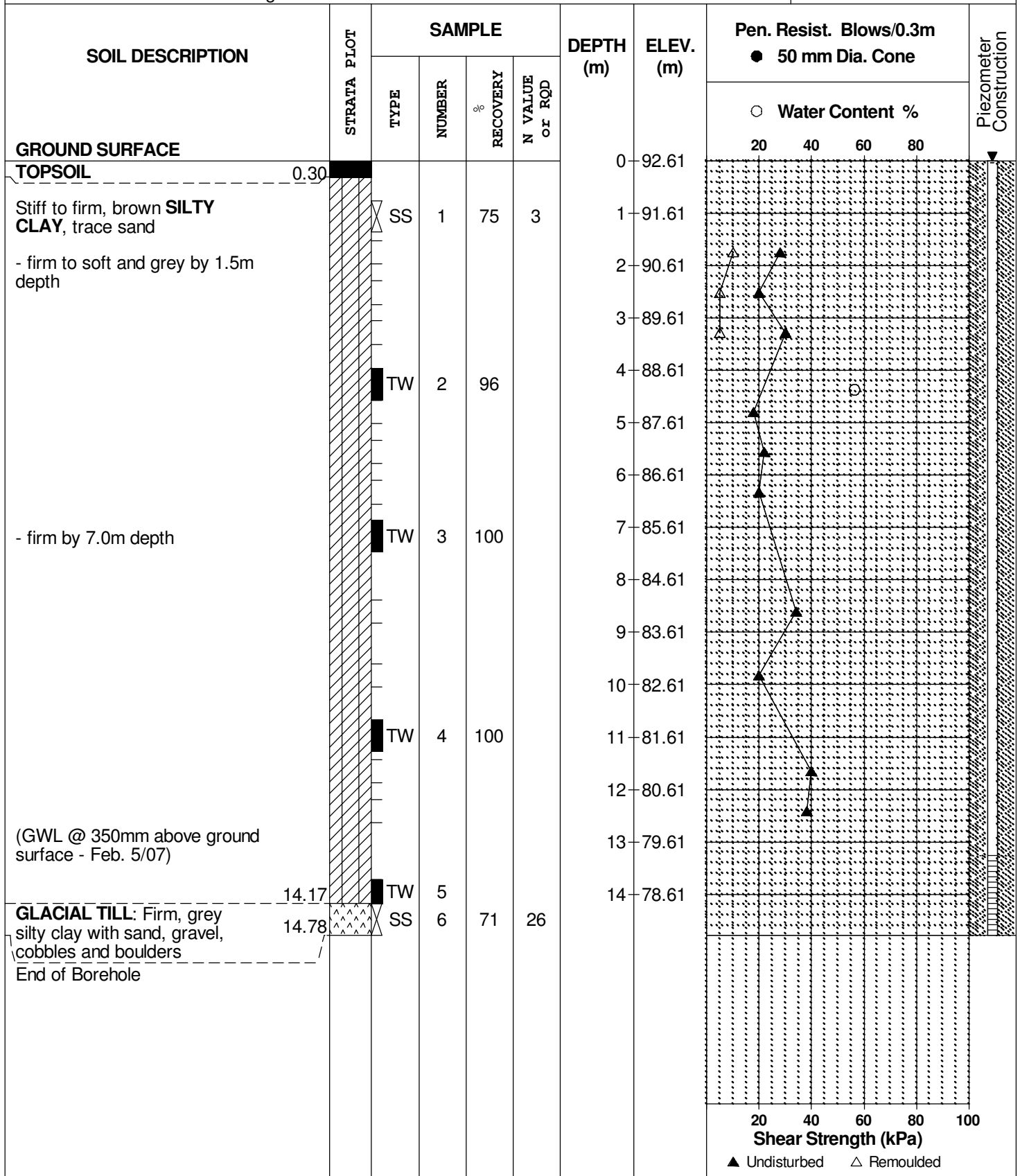
REMARKS

BORINGS BY CME 55 Power Auger

DATE 14 December 2006

FILE NO.
PG0177

HOLE NO.
BH 5-06



DATUM Ground surface elevations provided by J.D. Barnes Limited.

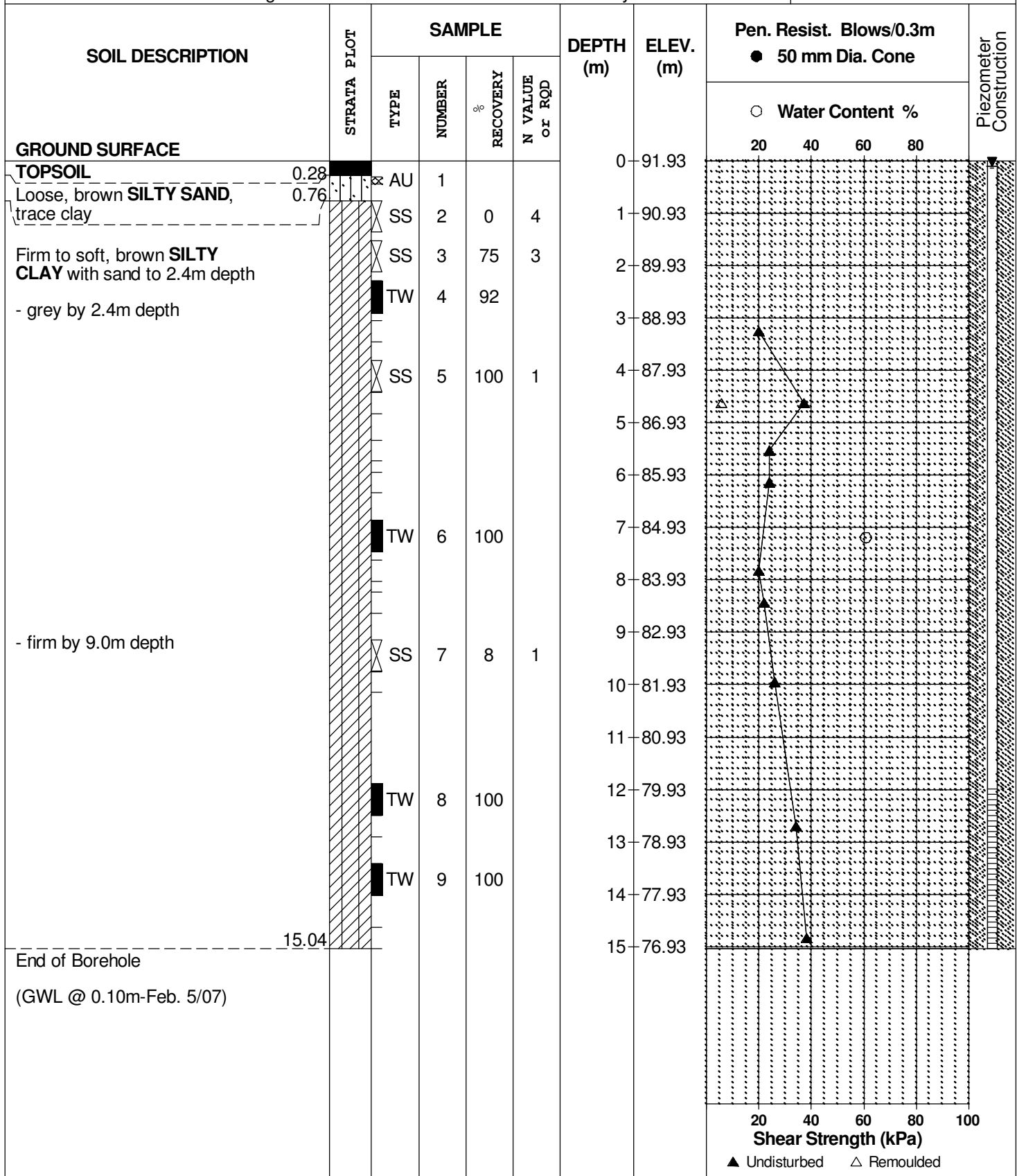
REMARKS

BORINGS BY CME 75 Power Auger

DATE 4 January 2007

FILE NO. PG0177

HOLE NO. BH16-06



DATUM Ground surface elevations provided by J.D. Barnes Limited.

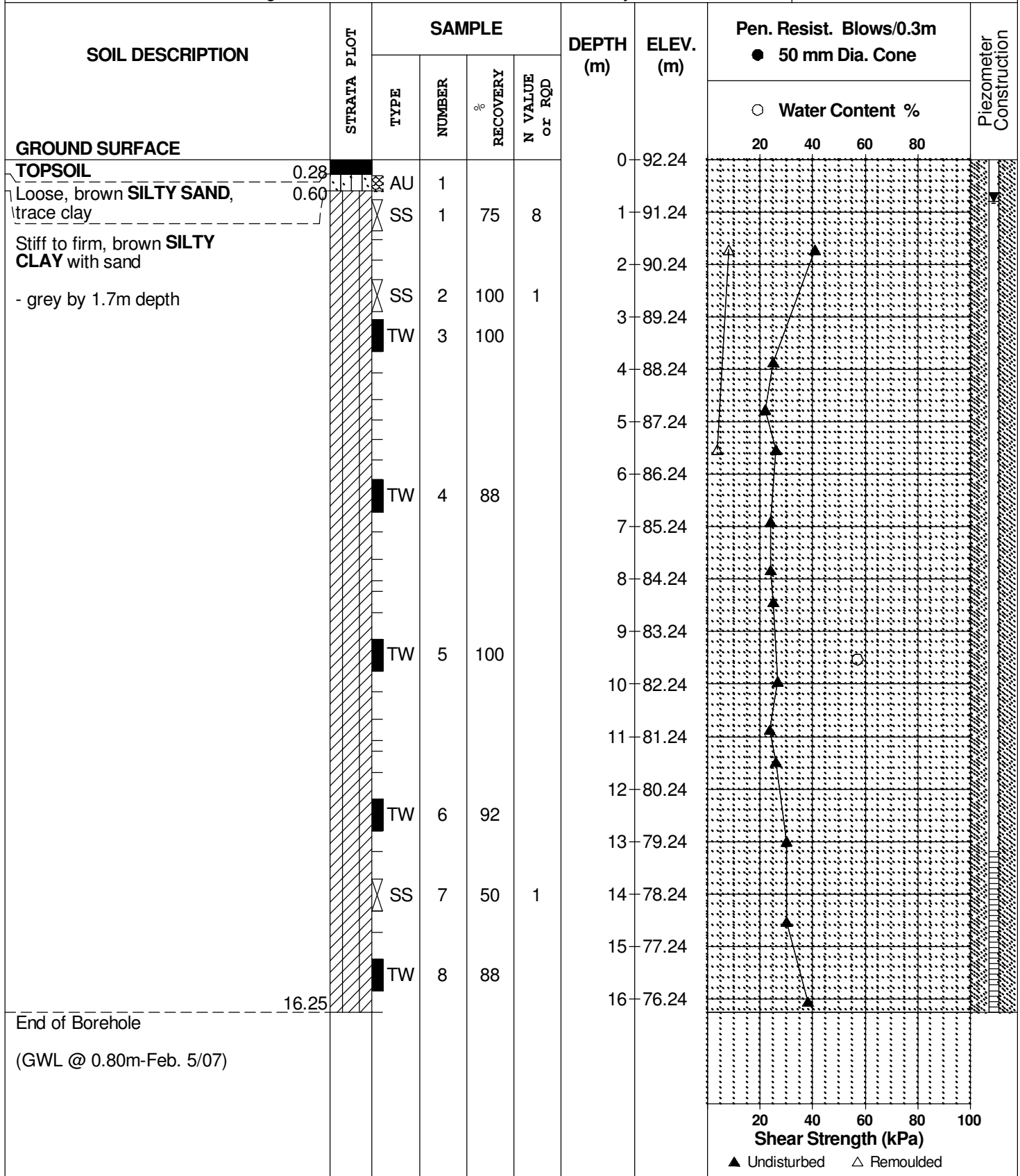
REMARKS

BORINGS BY CME 75 Power Auger

DATE 3 January 2007

FILE NO. PG0177

HOLE NO. BH17-06



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

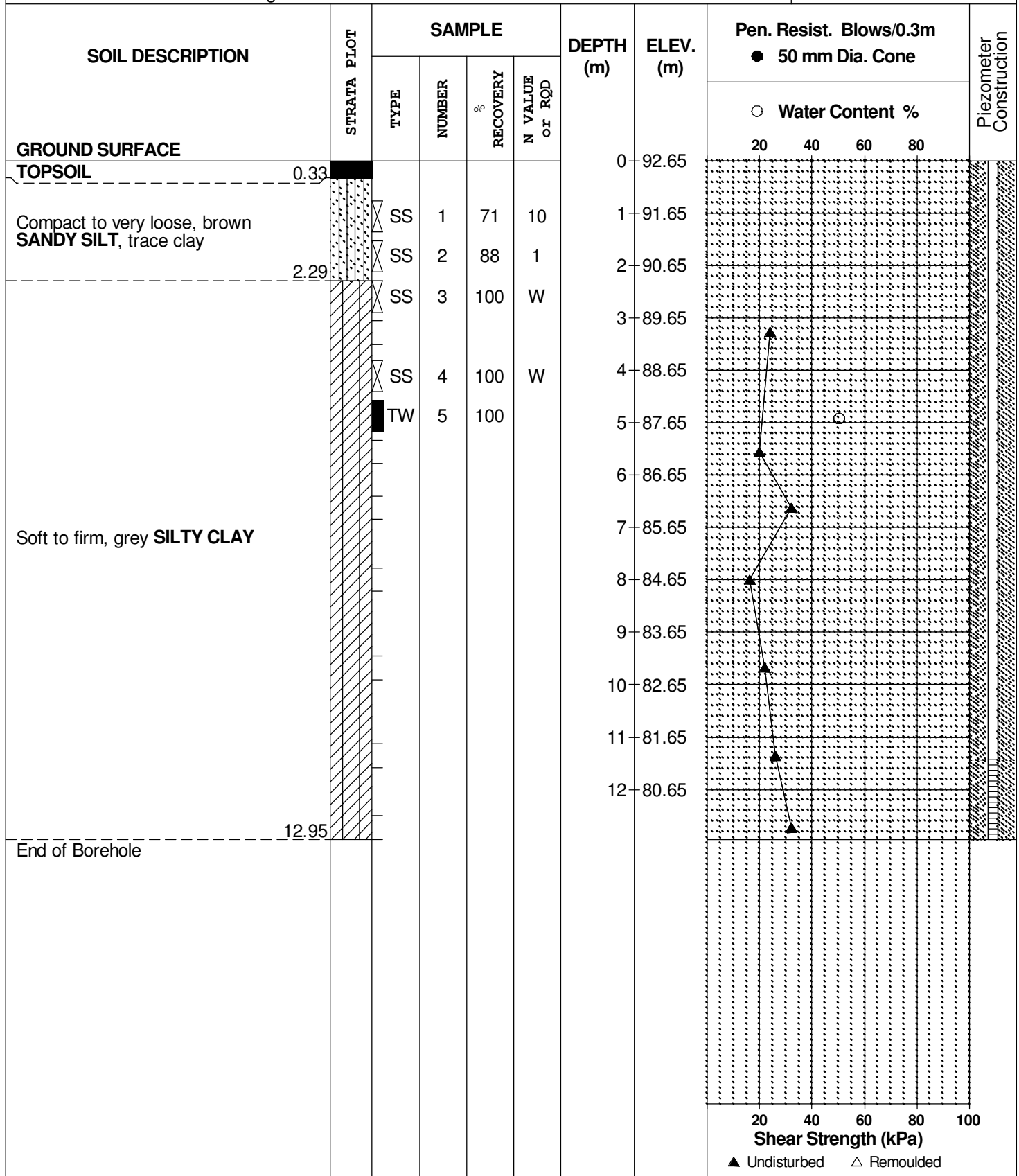
REMARKS

BORINGS BY CME 55 Power Auger

DATE 18 December 2006

FILE NO.
PG0177

HOLE NO.
BH18A-06



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

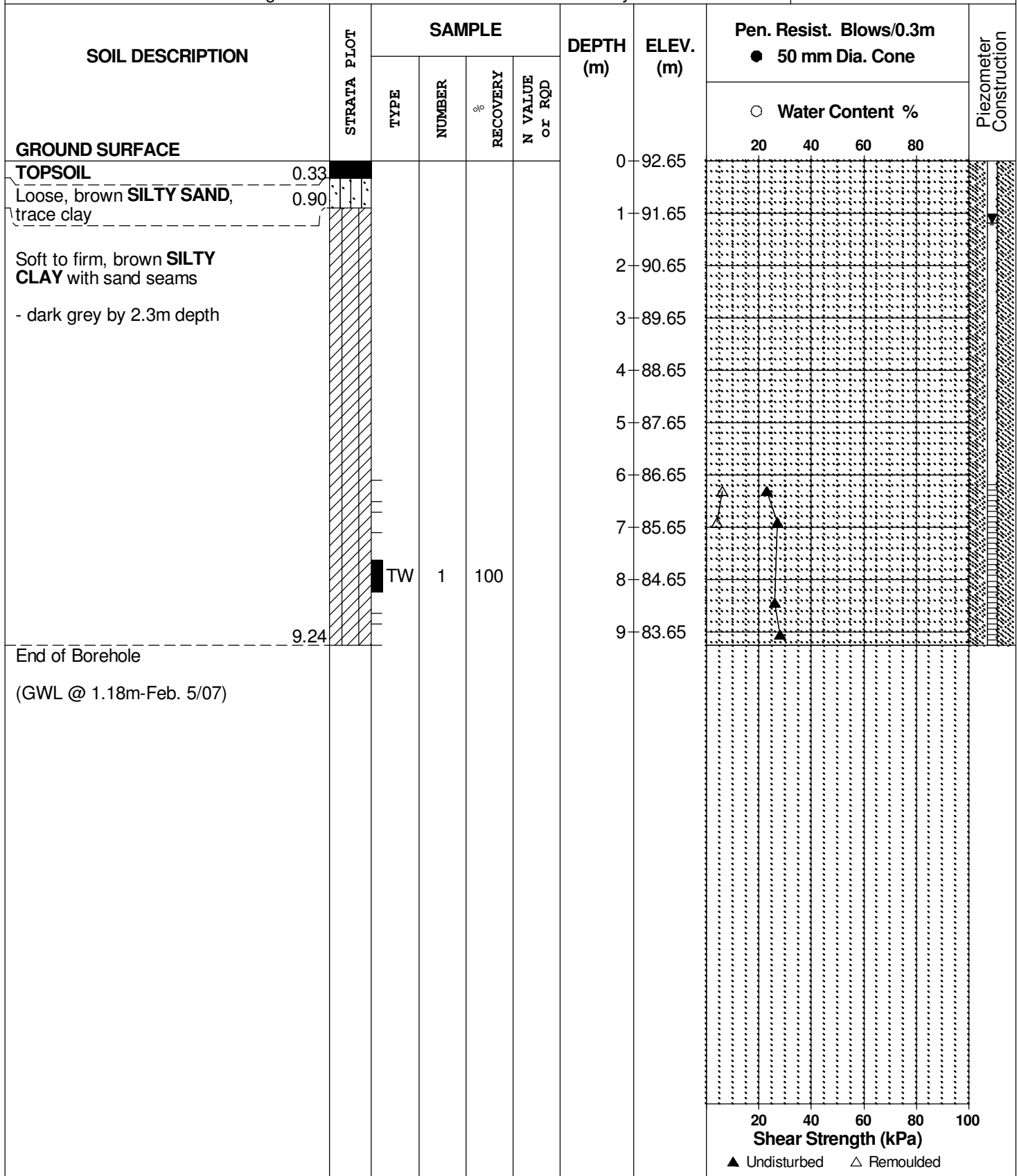
REMARKS

BORINGS BY CME 75 Power Auger

DATE 5 January 2007

FILE NO. PG0177

HOLE NO. BH18B-06



DATUM Ground surface elevations provided by J.D. Barnes Limited.

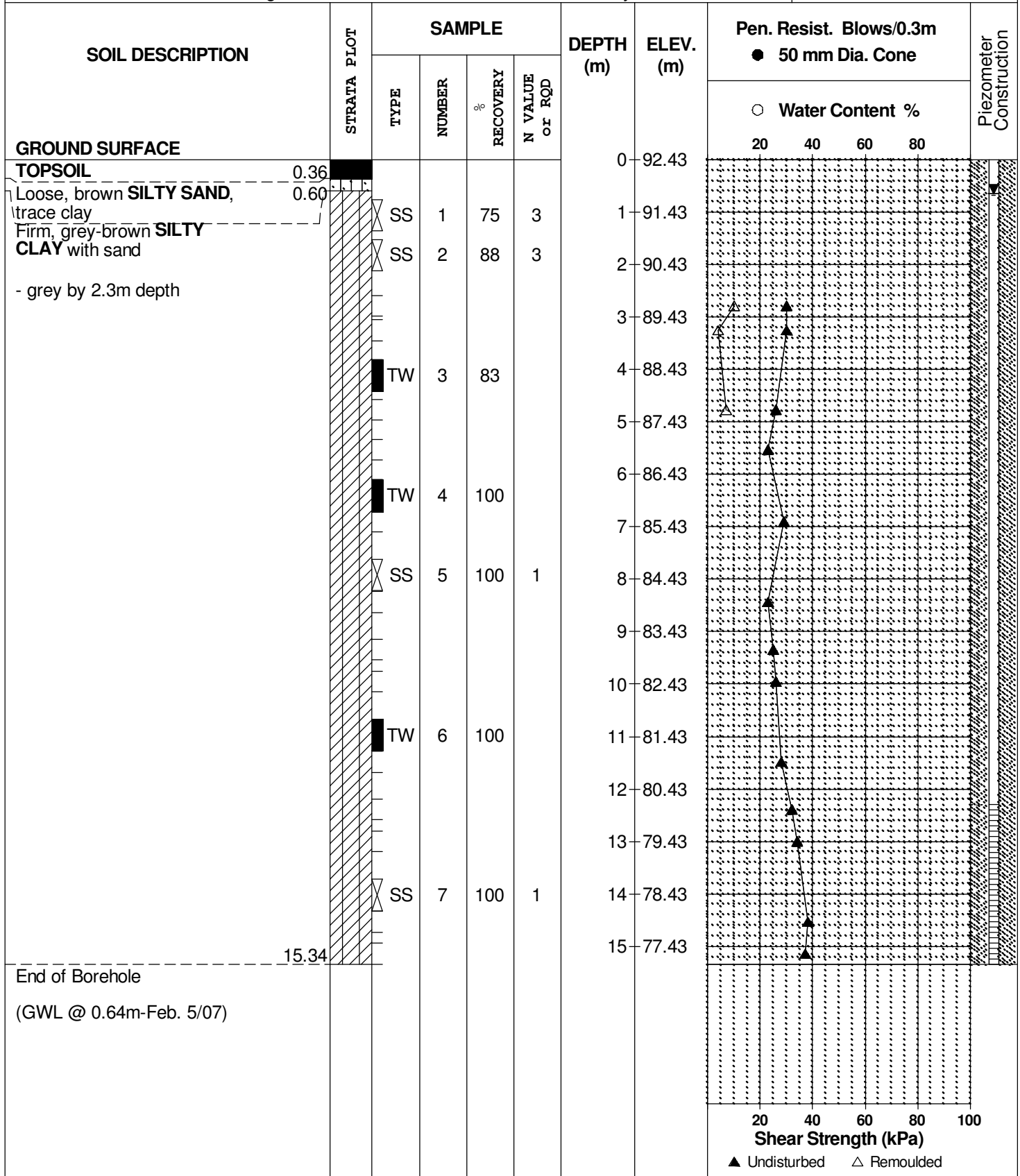
REMARKS

BORINGS BY CME 75 Power Auger

DATE 5 January 2007

FILE NO. PG0177

HOLE NO. BH19-06



DATUM Ground surface elevations provided by J.D. Barnes Limited.

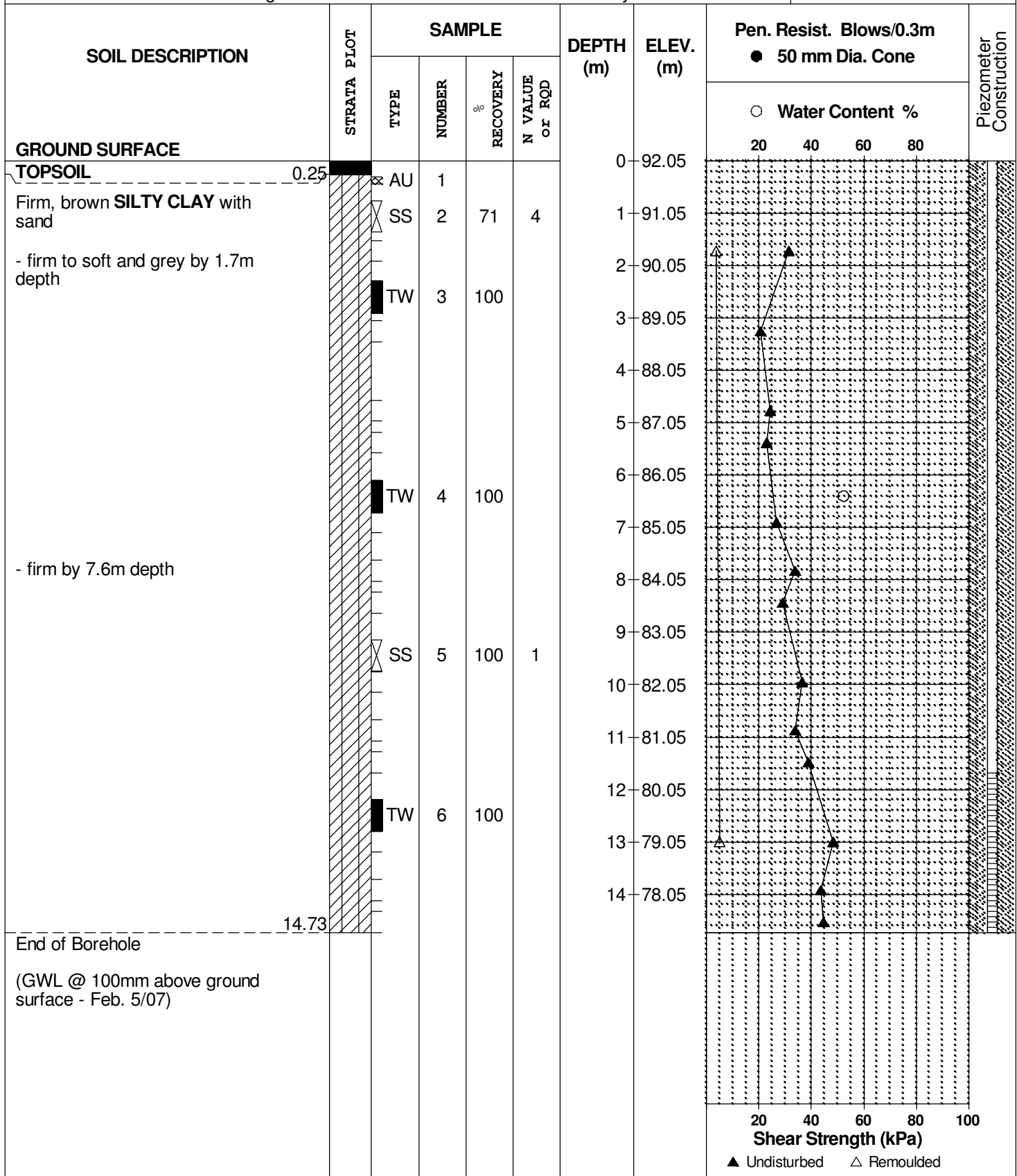
REMARKS

BORINGS BY CME 75 Power Auger

DATE 9 January 2007

FILE NO. PG0177

HOLE NO. BH20-06



DATUM Ground surface elevations provided by J.D. Barnes Limited.

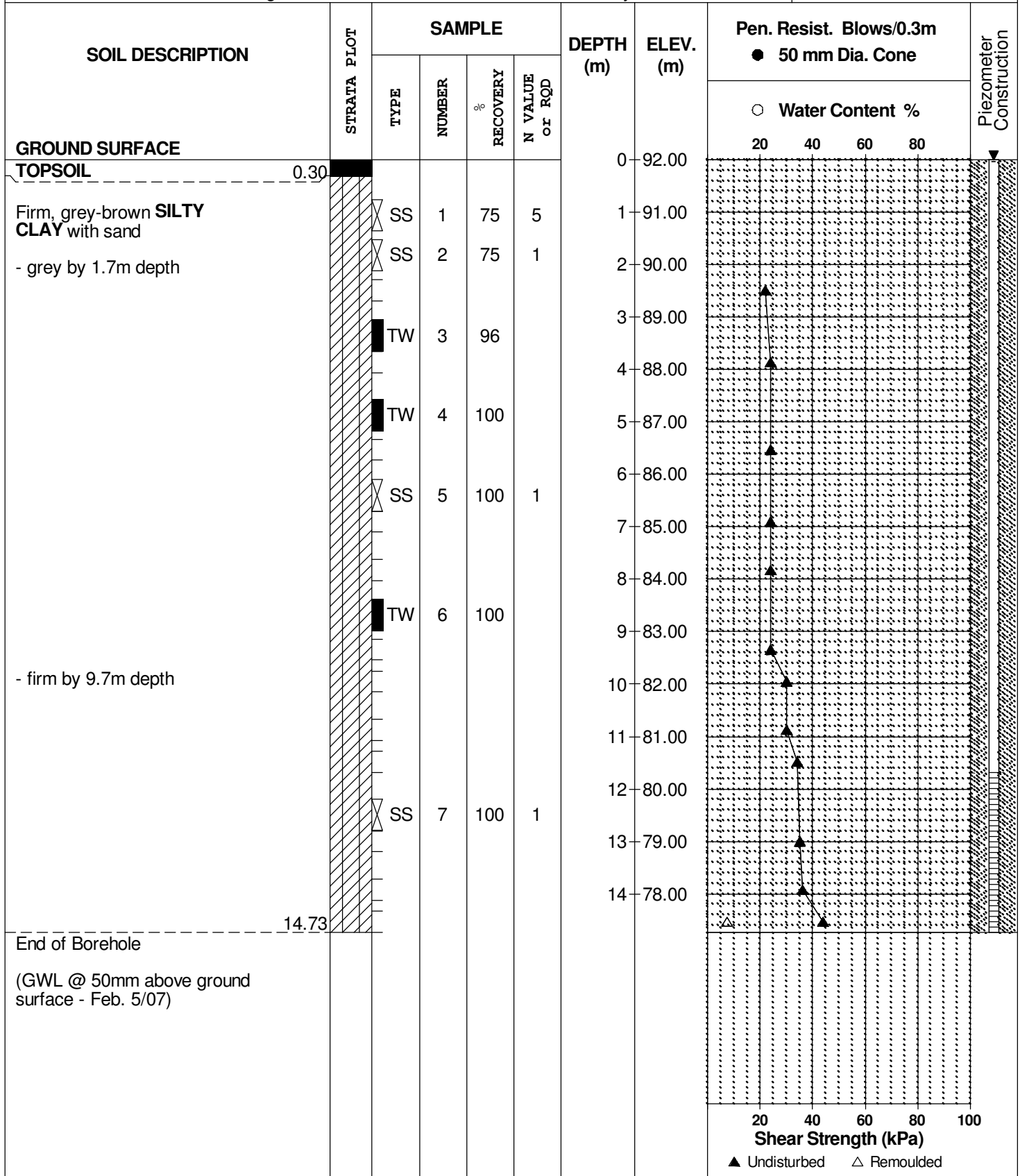
REMARKS

BORINGS BY CME 75 Power Auger

DATE 8 January 2007

FILE NO.
PG0177

HOLE NO.
BH21-06



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

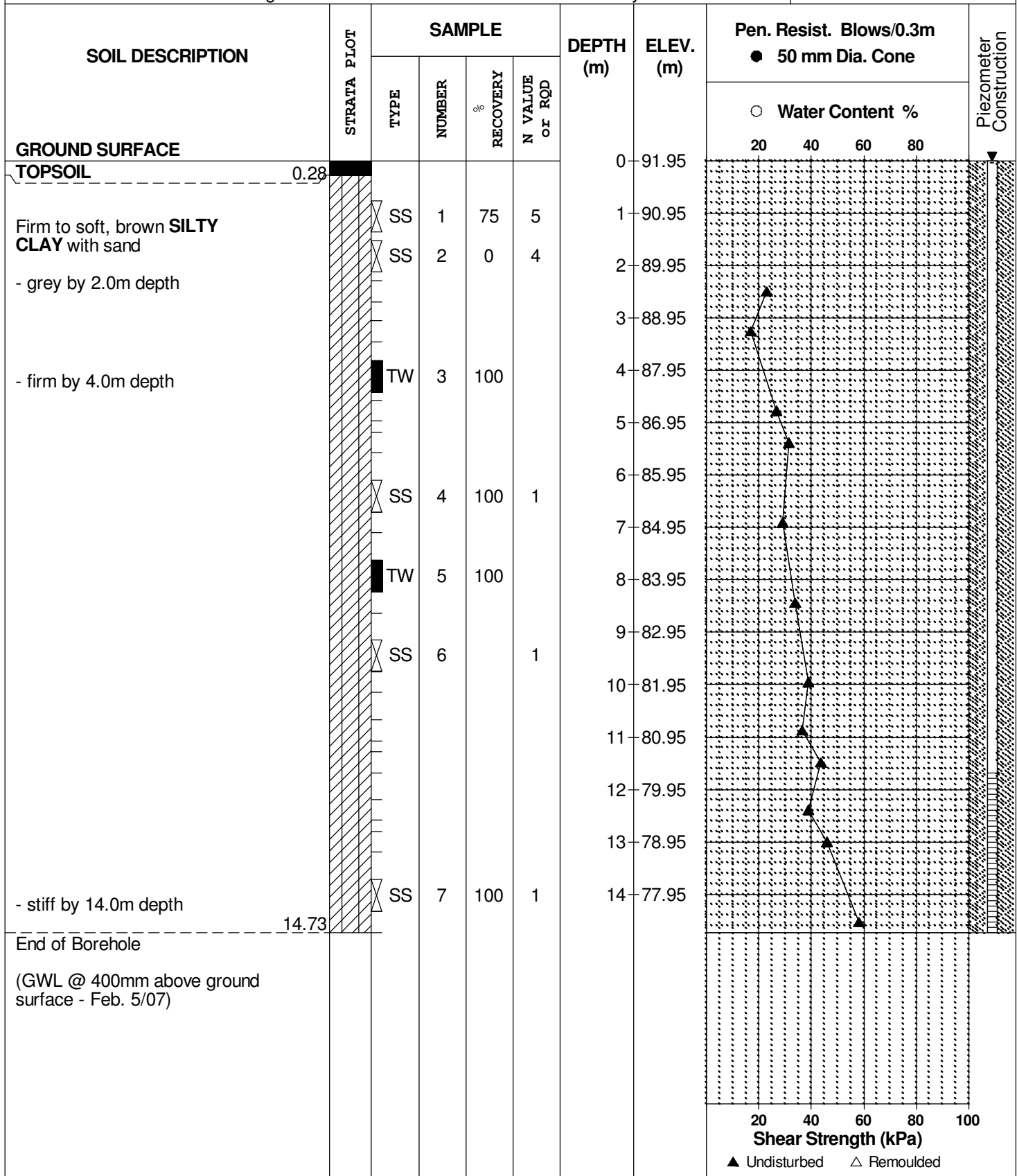
REMARKS

BORINGS BY CME 75 Power Auger

DATE 10 January 2007

FILE NO. PG0177

HOLE NO. BH22-06



DATUM Ground surface elevations provided by J.D. Barnes Limited.

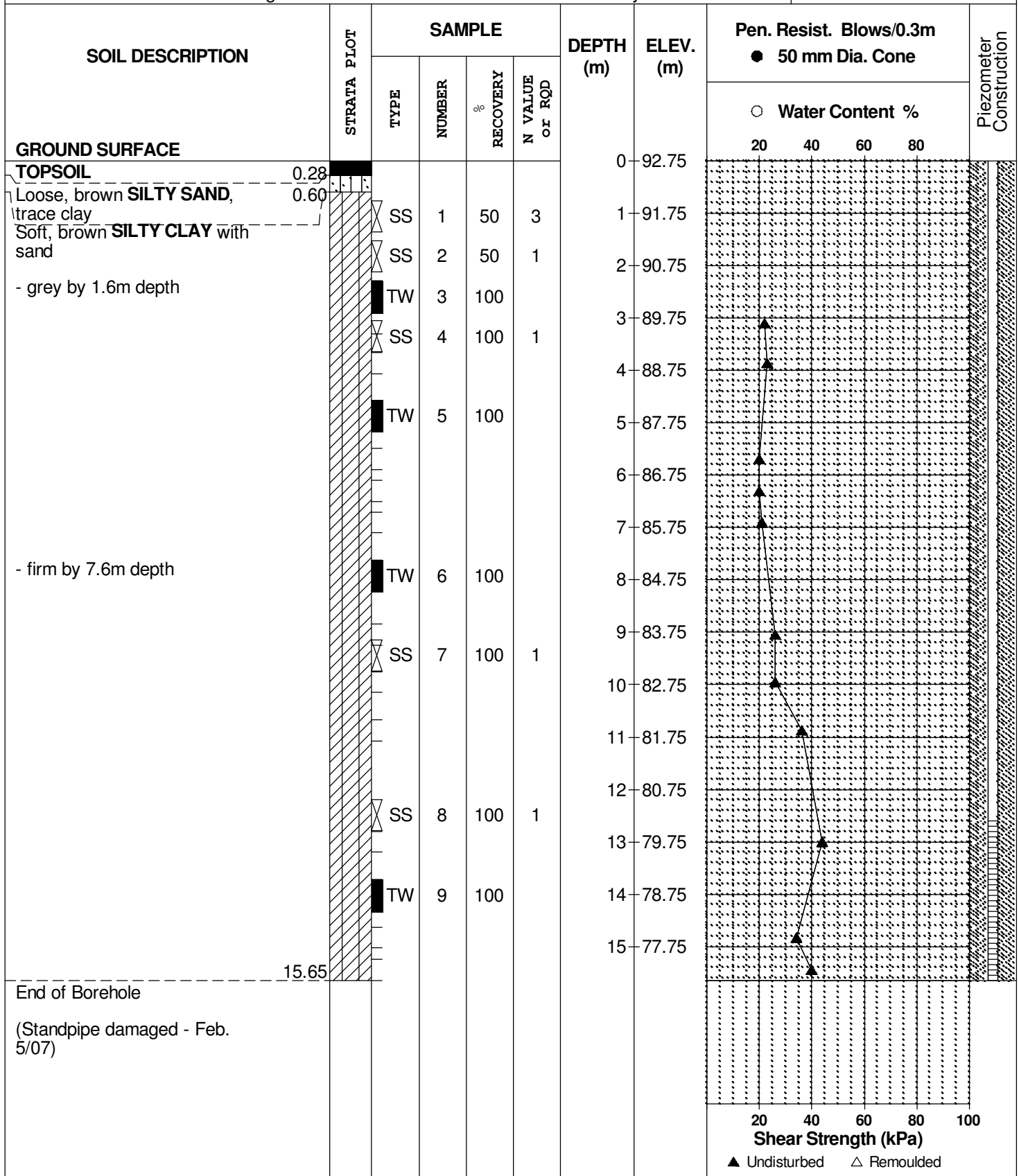
REMARKS

BORINGS BY CME 75 Power Auger

DATE 12 January 2007

FILE NO. PG0177

HOLE NO. BH23-06



DATUM Ground surface elevations provided by J.D. Barnes Limited.

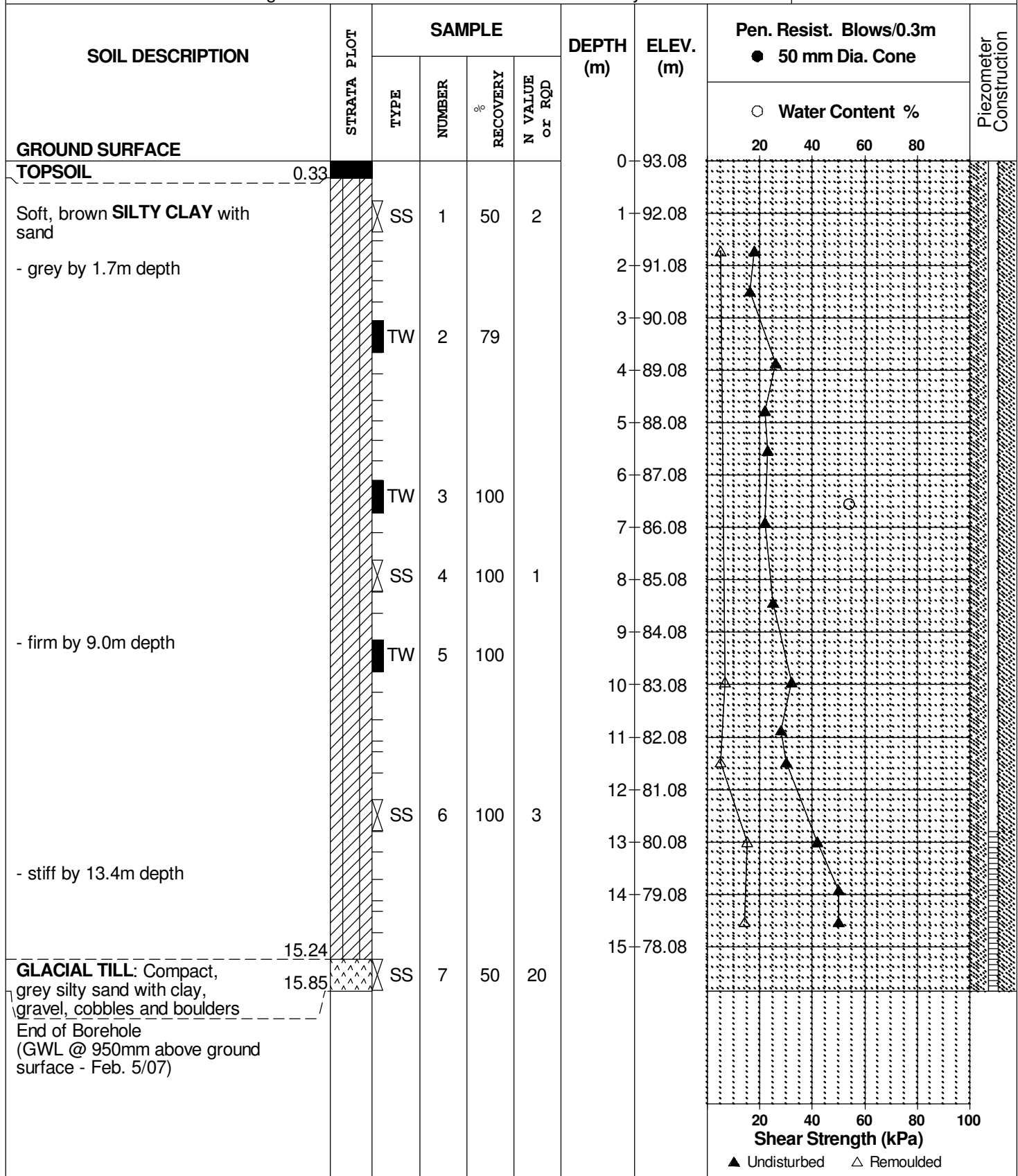
REMARKS

BORINGS BY CME 75 Power Auger

DATE 11 January 2007

FILE NO. PG0177

HOLE NO. BH24-06



DATUM Ground surface elevations provided by J.D. Barnes Limited.

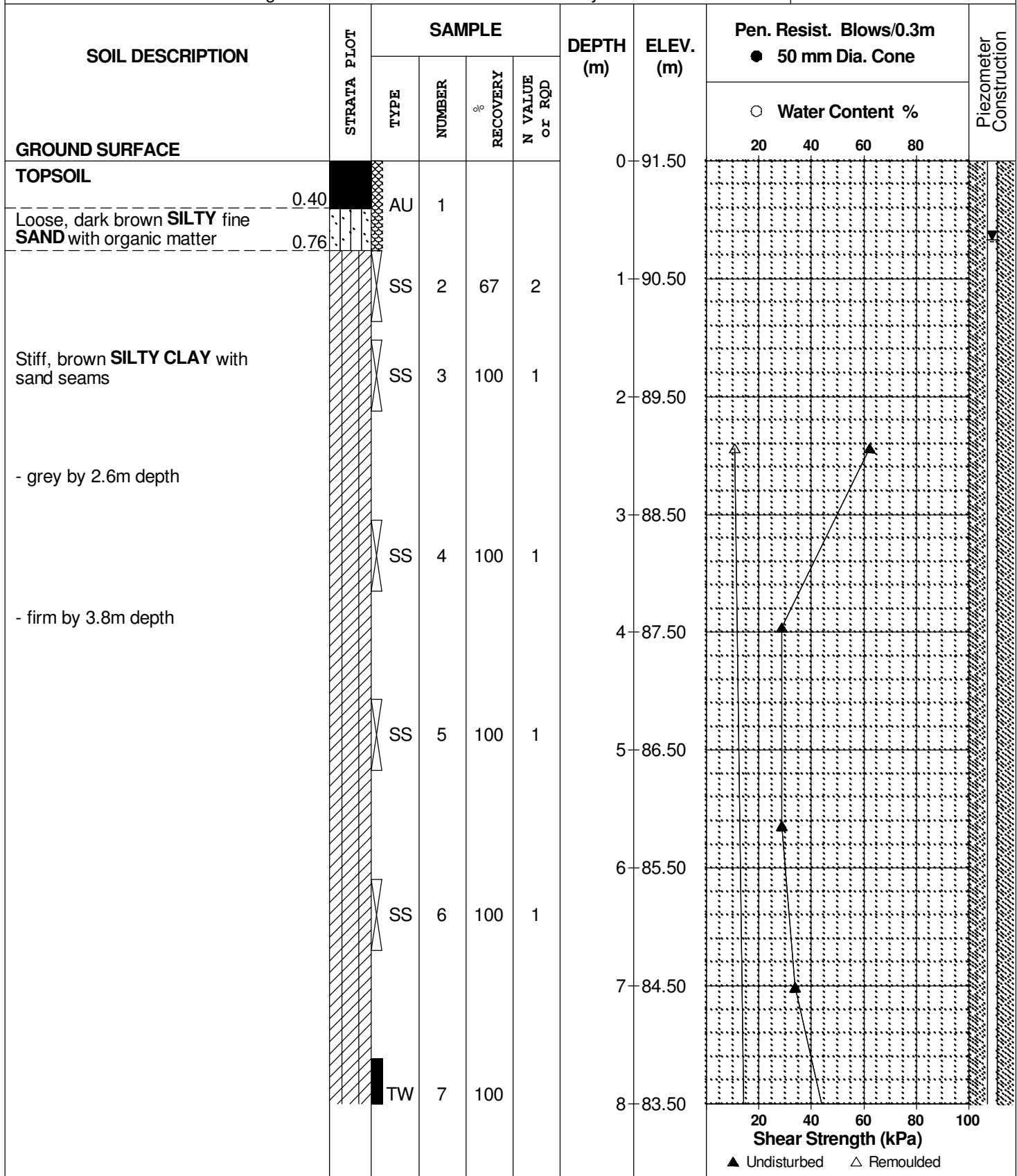
REMARKS

BORINGS BY CME 55 Power Auger

DATE 5 July 2005

FILE NO.
PG0177

HOLE NO.
BH 4-05



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

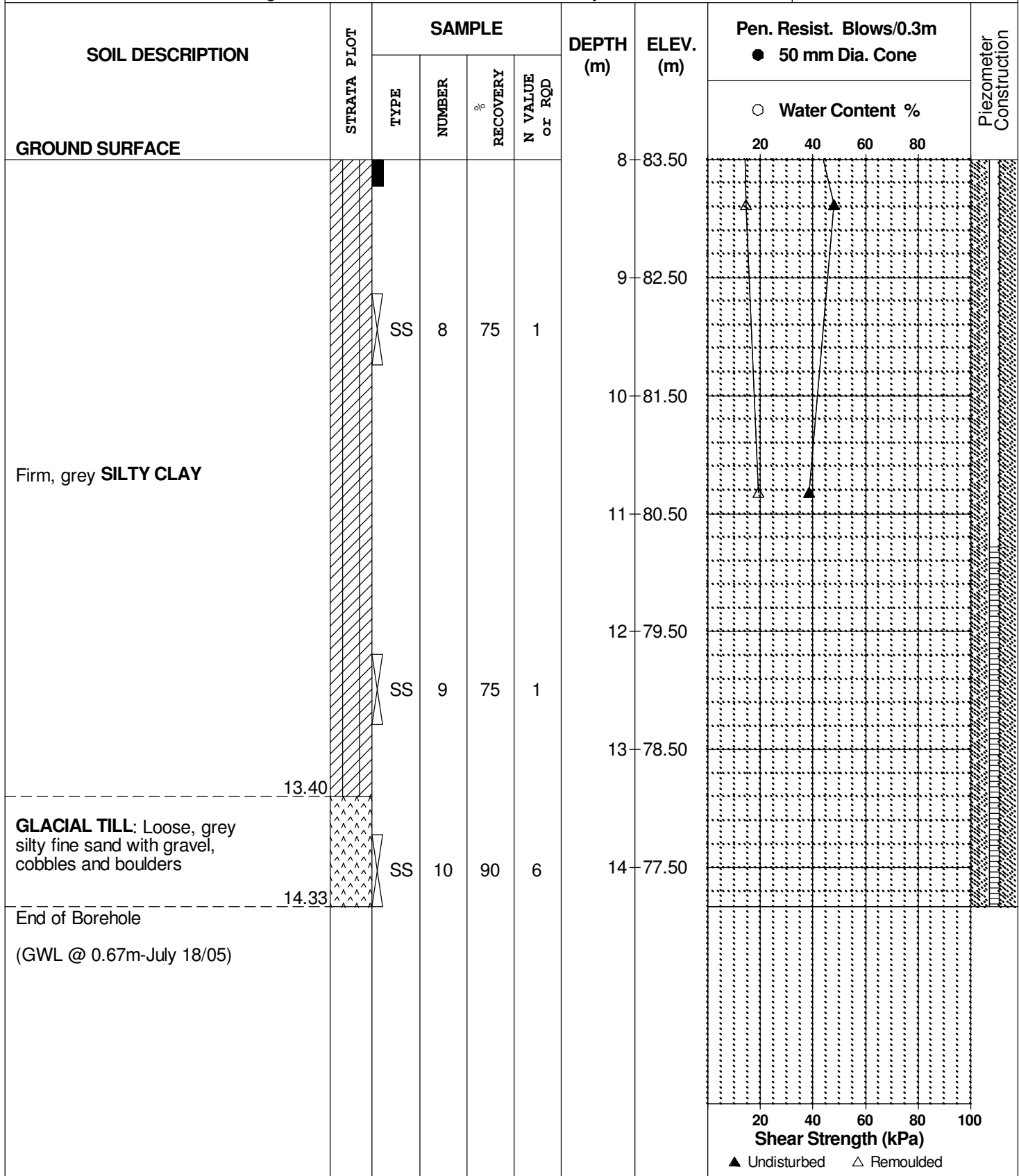
REMARKS

BORINGS BY CME 55 Power Auger

DATE 5 July 2005

FILE NO.
PG0177

HOLE NO.
BH 4-05



DATUM Ground surface elevations provided by J.D. Barnes Limited.

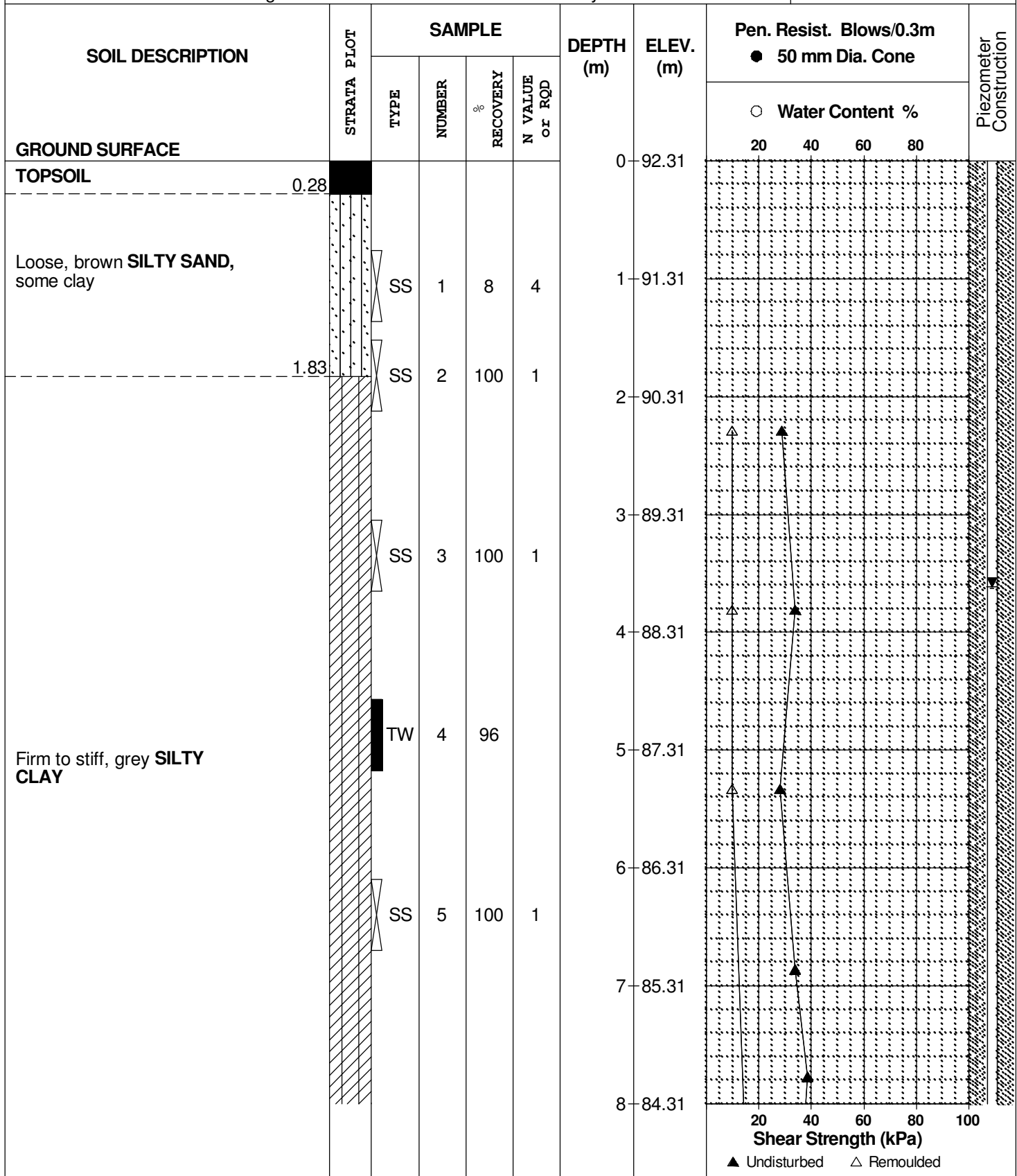
REMARKS

BORINGS BY CME 55 Power Auger

DATE 5 July 2005

FILE NO.
PG0177

HOLE NO.
BH 5-05



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

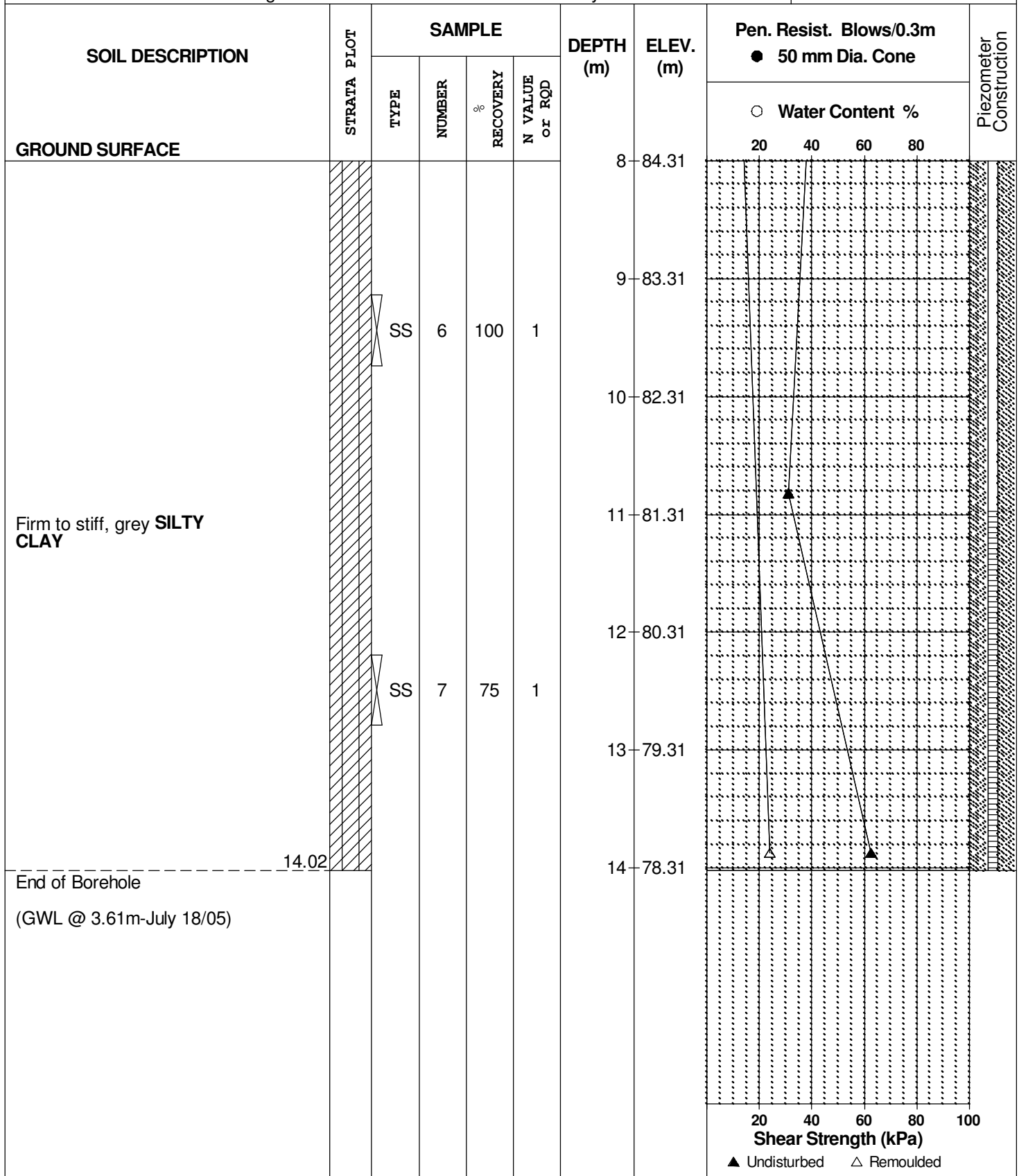
REMARKS

BORINGS BY CME 55 Power Auger

DATE 5 July 2005

FILE NO. PG0177

HOLE NO. BH 5-05



DATUM Ground surface elevations provided by J.D. Barnes Limited.

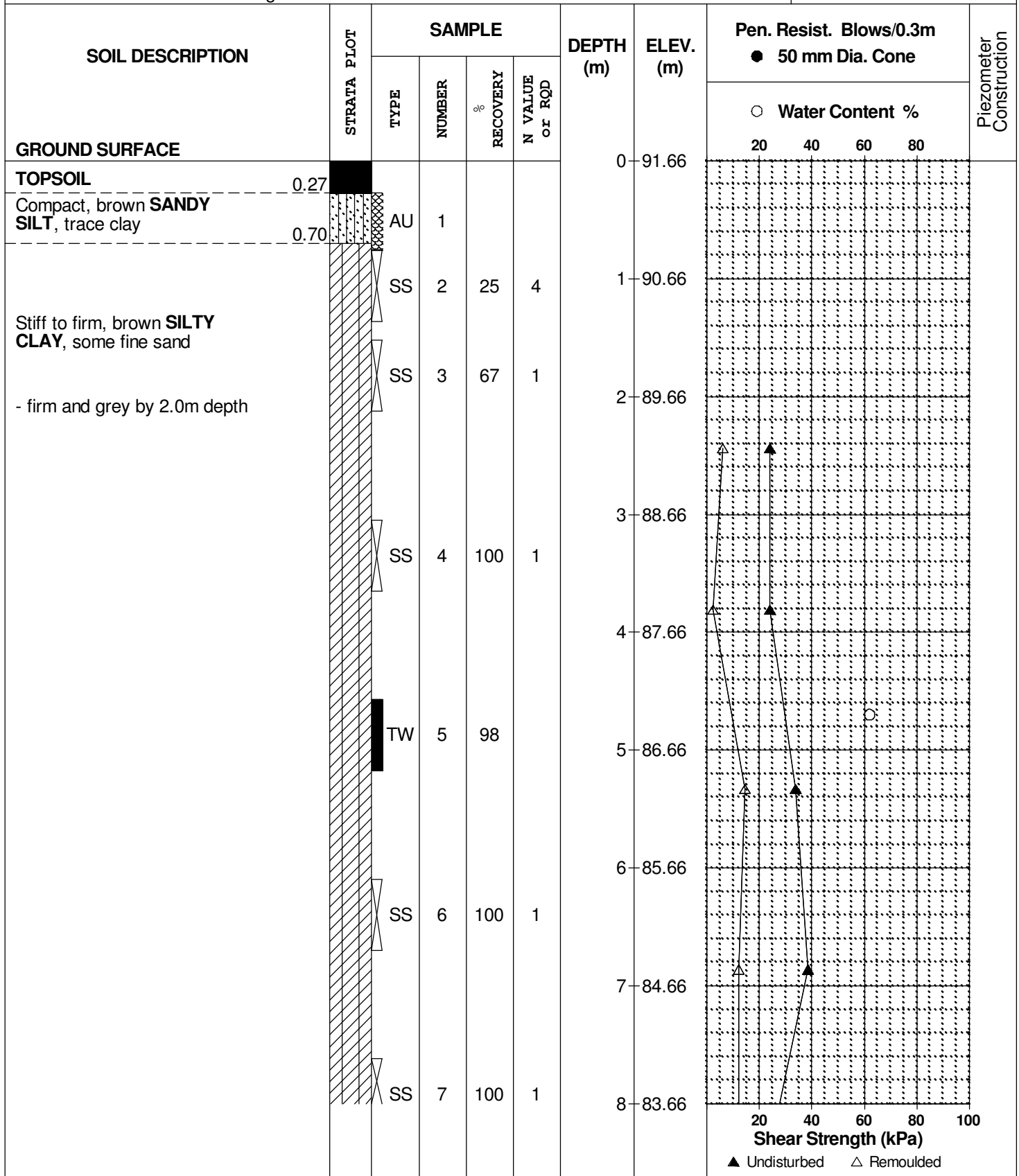
REMARKS

BORINGS BY CME 55 Power Auger

DATE 28 June 2005

FILE NO.
PG0177

HOLE NO.
BH10-05



DATUM Ground surface elevations provided by J.D. Barnes Limited.

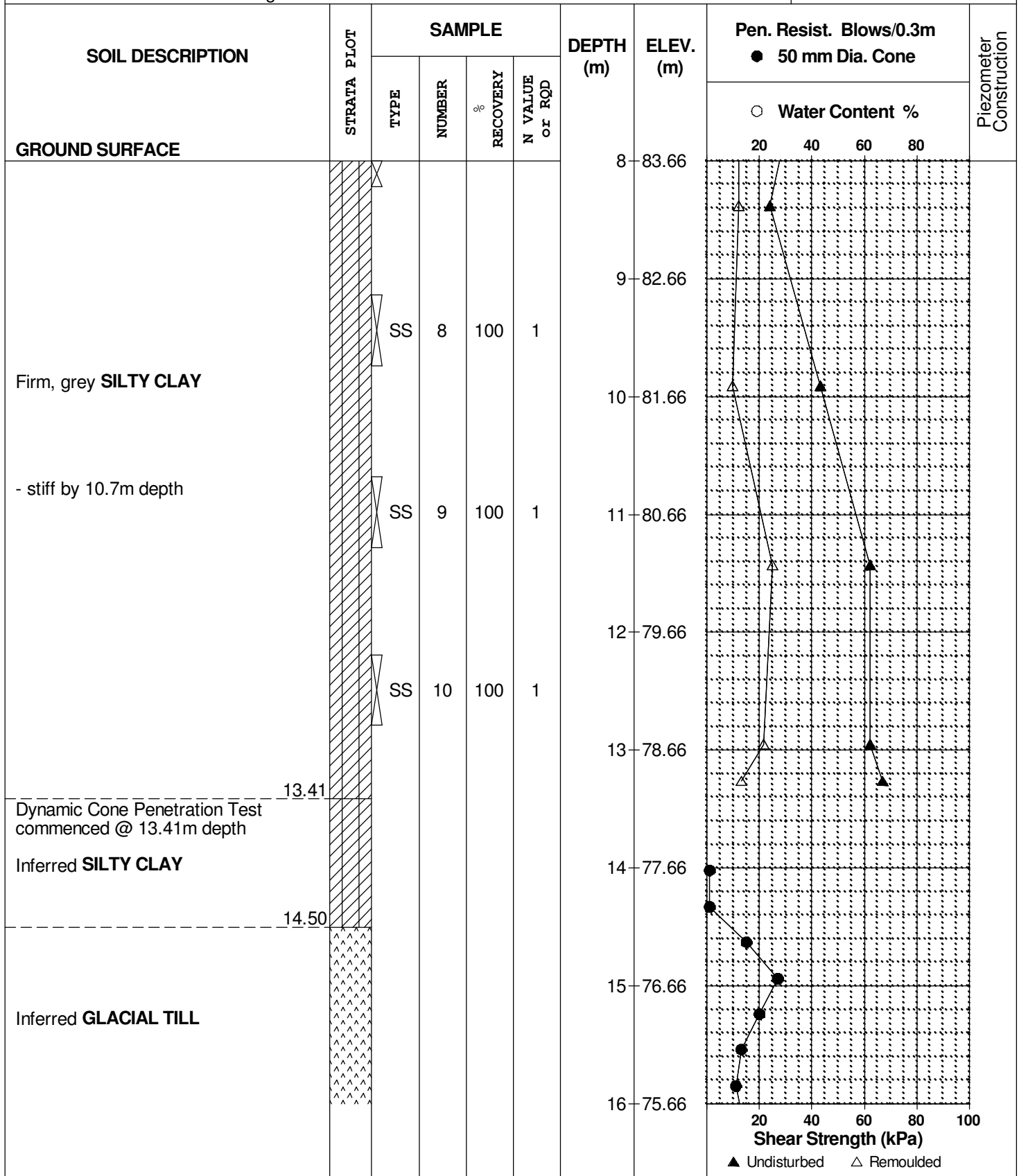
REMARKS

BORINGS BY CME 55 Power Auger

DATE 28 June 2005

FILE NO.
PG0177

HOLE NO.
BH10-05



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

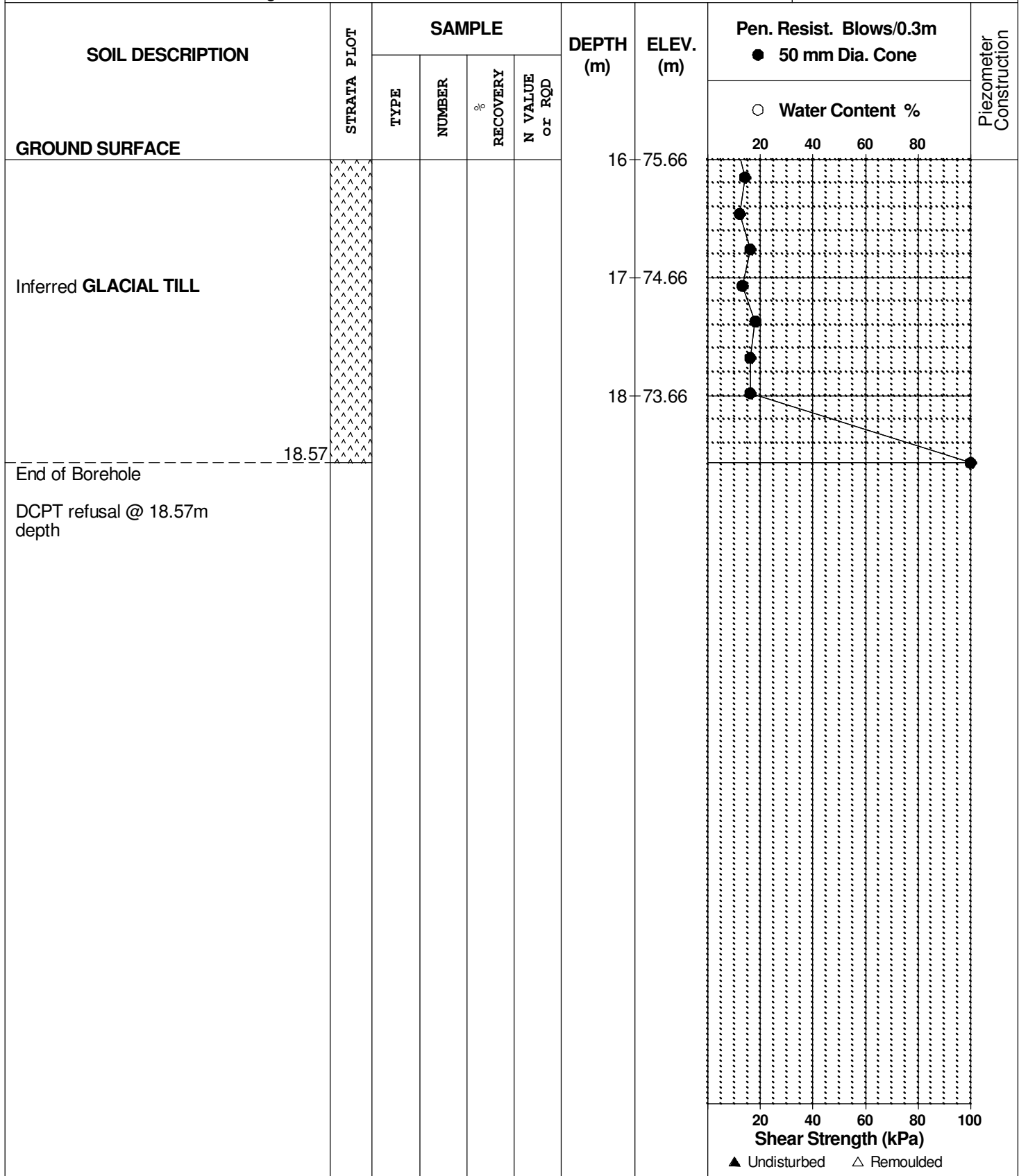
REMARKS

BORINGS BY CME 55 Power Auger

DATE 28 June 2005

FILE NO.
PG0177

HOLE NO.
BH10-05



DATUM Ground surface elevations provided by J.D. Barnes Limited.

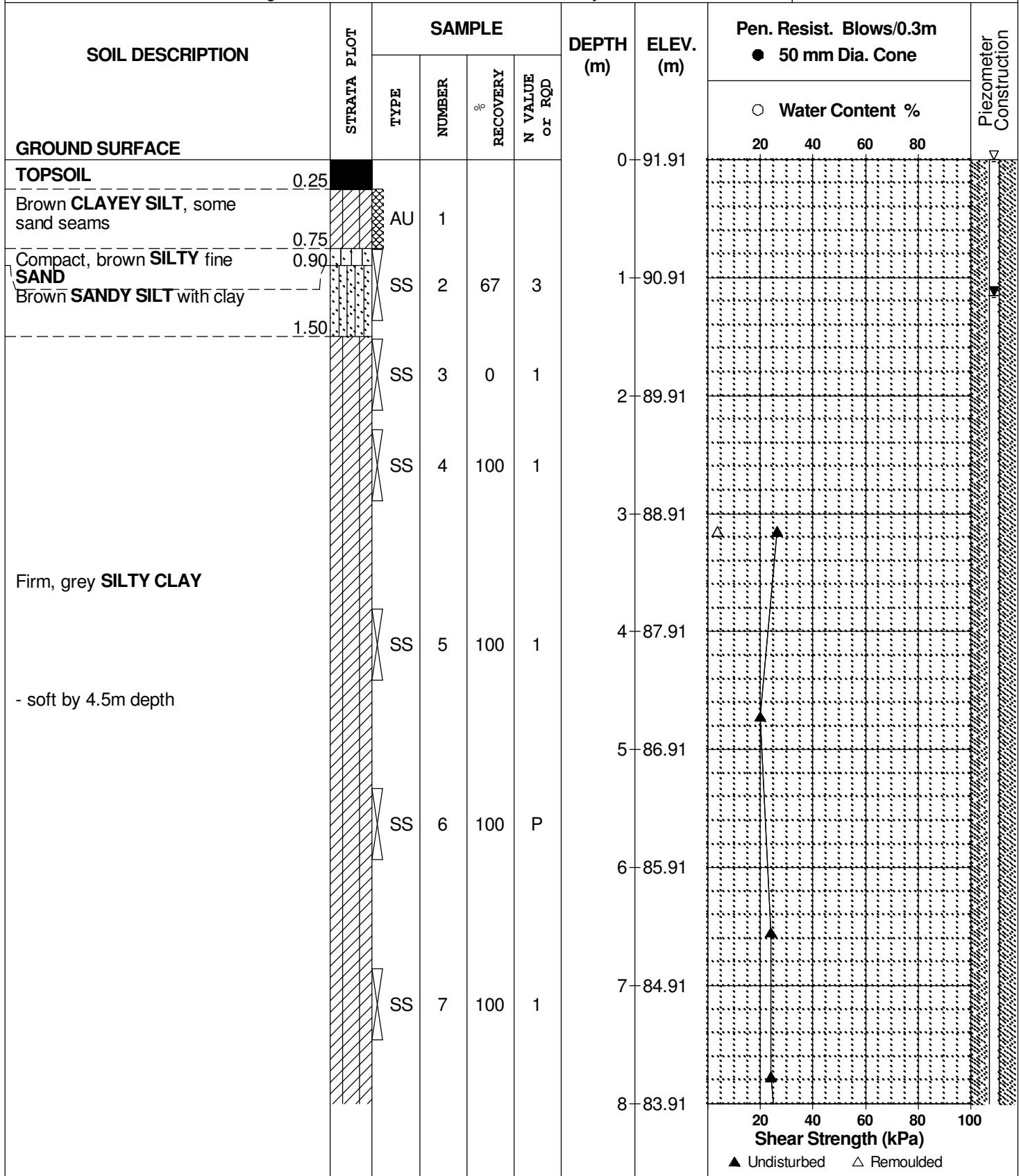
REMARKS

BORINGS BY CME 55 Power Auger

DATE 4 July 2005

FILE NO.
PG0177

HOLE NO.
BH11-05



DATUM Ground surface elevations provided by J.D. Barnes Limited.

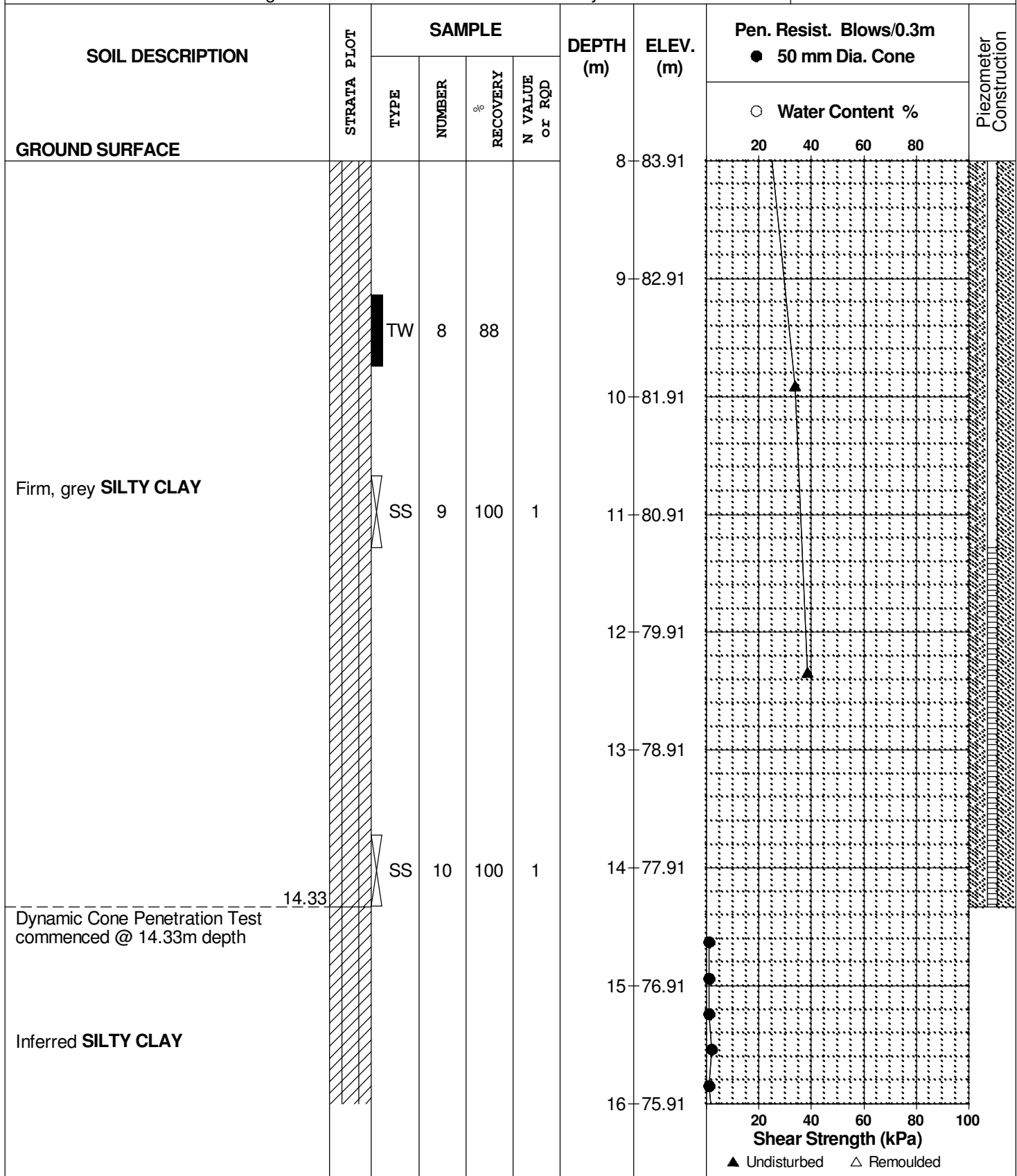
REMARKS

BORINGS BY CME 55 Power Auger

DATE 4 July 2005

FILE NO. PG0177

HOLE NO. BH11-05



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

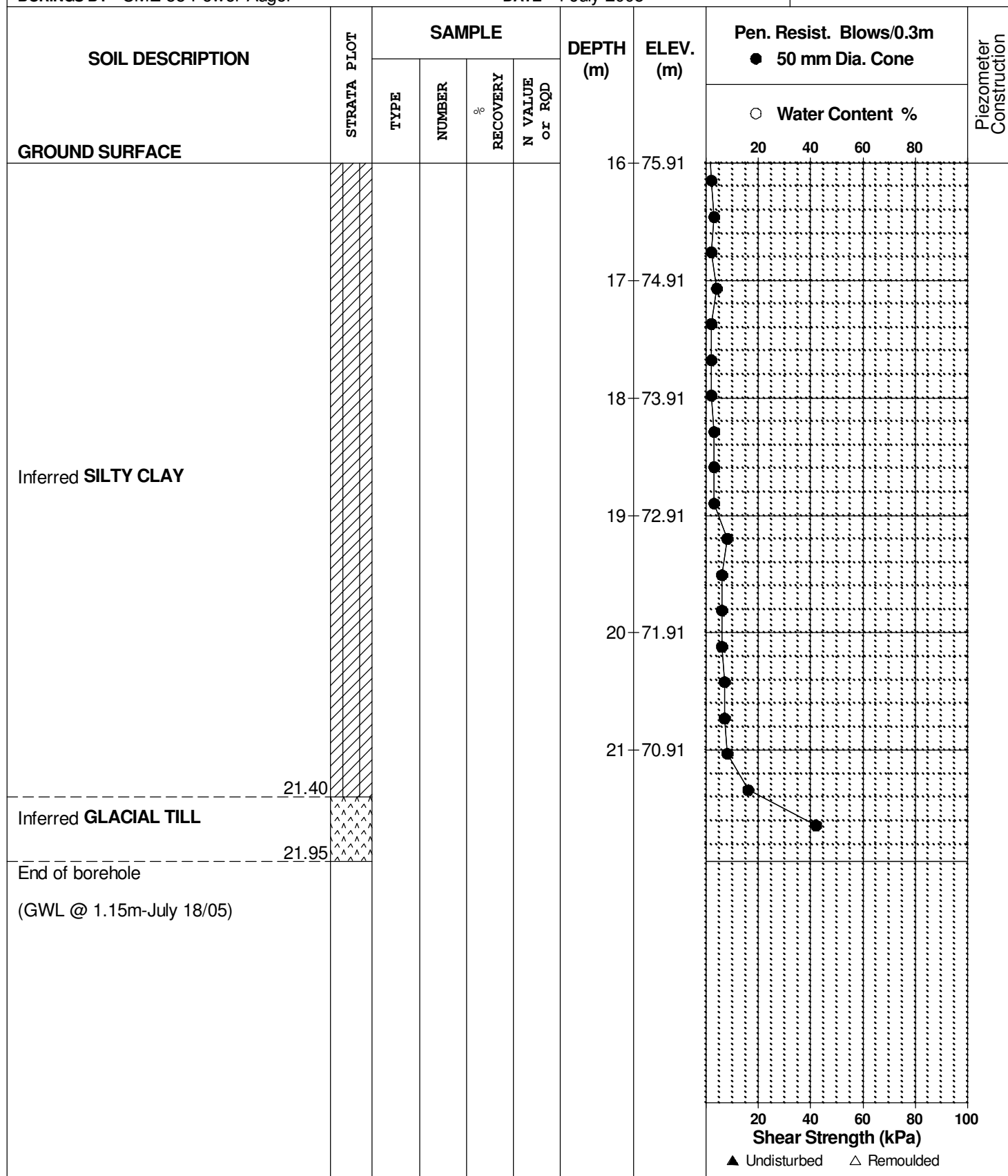
FILE NO.
PG0177

REMARKS

HOLE NO.
BH11-05

BORINGS BY CME 55 Power Auger

DATE 4 July 2005



DATUM Ground surface elevations provided by J.D. Barnes Limited.

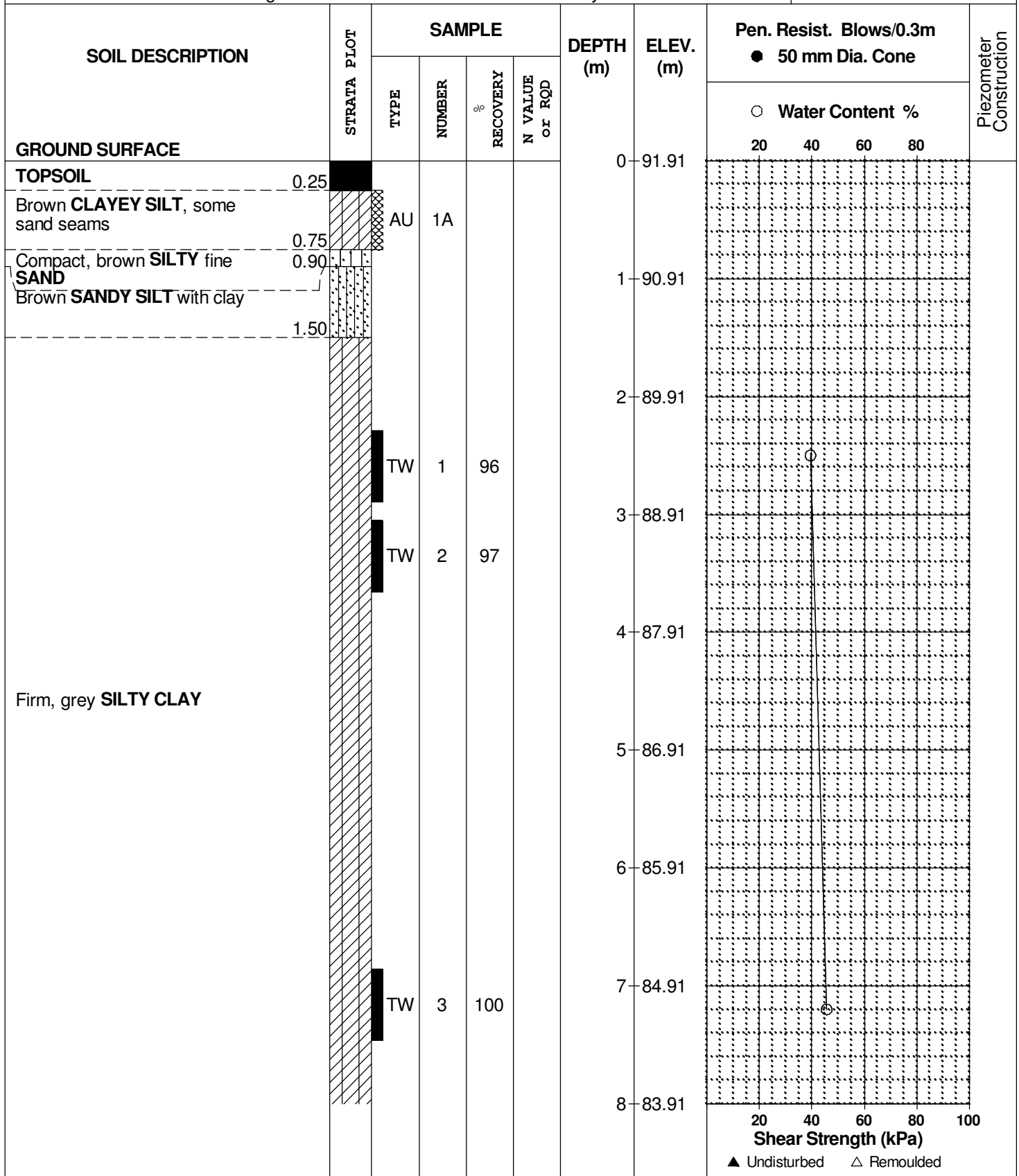
REMARKS

BORINGS BY CME 55 Power Auger

DATE 7 July 2005

FILE NO.
PG0177

HOLE NO.
BH11A-05



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.





REMARKS

BORINGS BY CME 55 Power Auger

DATE 7 July 2005

FILE NO.
PG0177

HOLE NO.
BH11A-05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %				
								20	40	60	80	
GROUND SURFACE						8	83.91					
Firm, grey SILTY CLAY			TW	4	100	9	82.91					
			TW	5	96	11	80.91					
			TW	6		12	79.91					
		End of Borehole					12.95					
								20 40 60 80 100				
								Shear Strength (kPa)				
								▲ Undisturbed △ Remoulded				

SOIL PROFILE AND TEST DATA

Geotechnical Investigation

Proposed Residential Development-Half Moon Bay Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

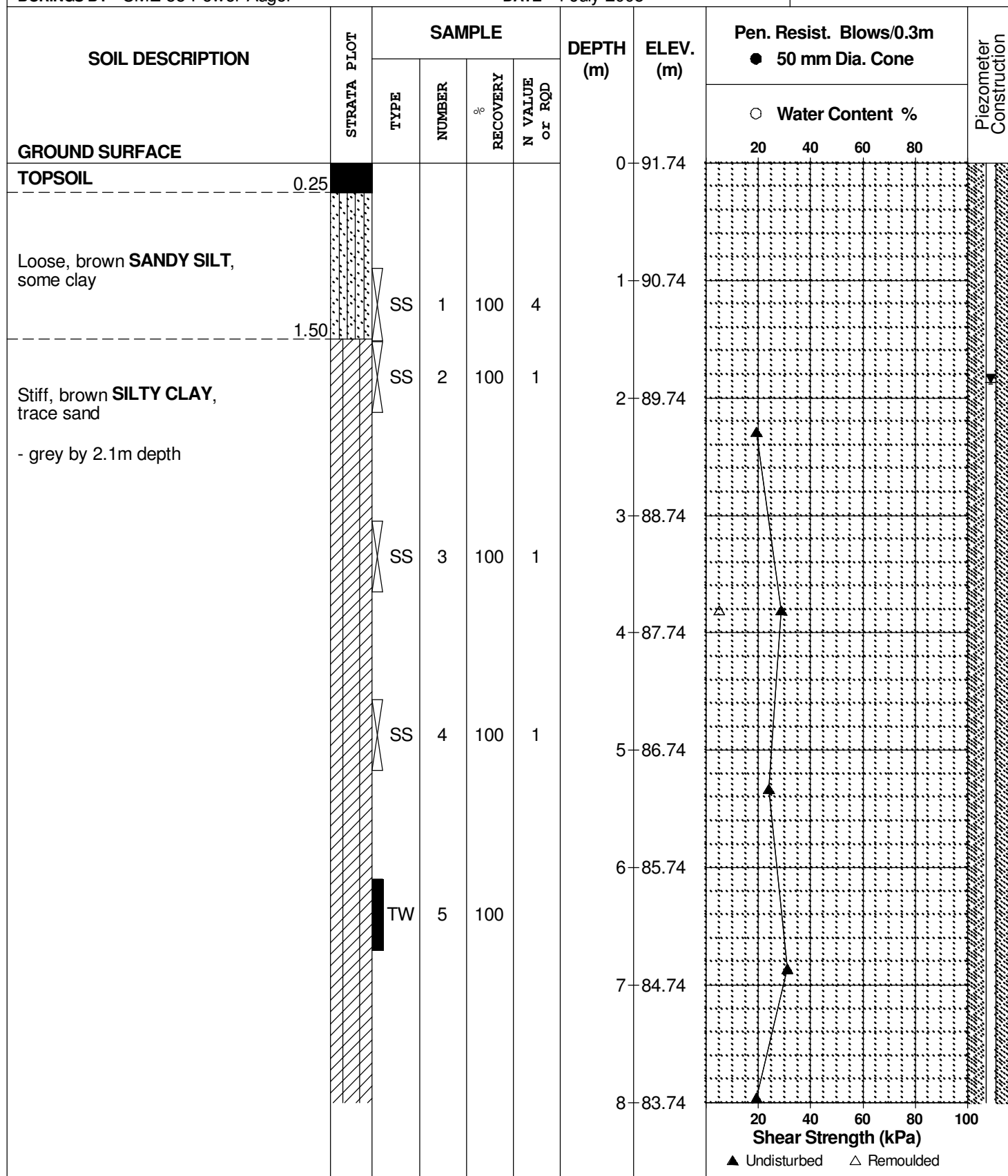
FILE NO. PG0177

REMARKS

HOLE NO. **BH12-05**

BORINGS BY CME 55 Power Auger

DATE 4 July 2005



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

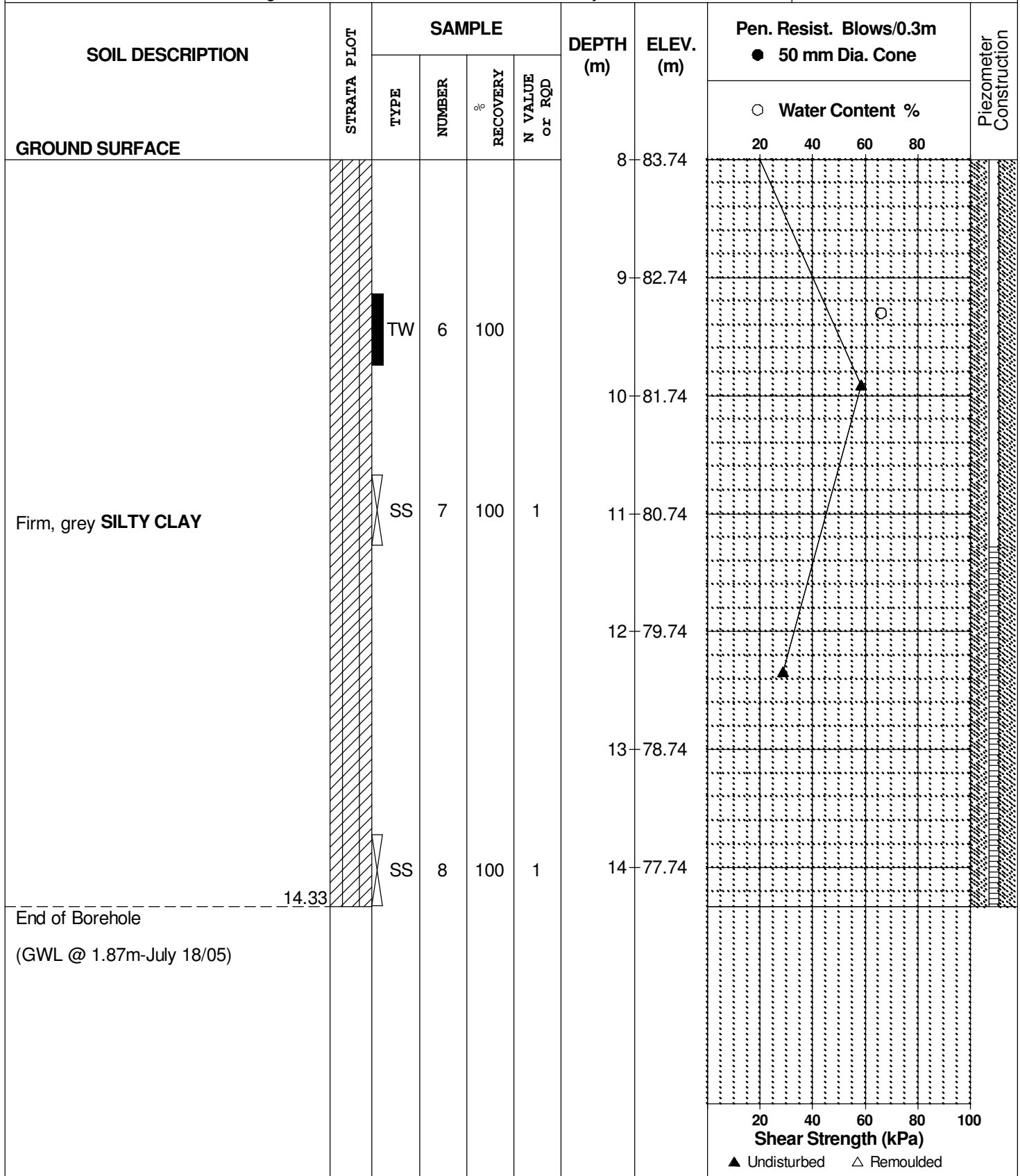
REMARKS

BORINGS BY CME 55 Power Auger

DATE 4 July 2005

FILE NO. PG0177

HOLE NO. BH12-05



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 6 October 2005

FILE NO.
PG0177

HOLE NO.
BH14-05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %				
GROUND SURFACE						0	92.50	20	40	60	80	
TOPSOIL	0.28											
Stiff SILTY CLAY/CLAYEY SILT	1.50					1	91.50					▽
End of Borehole												
(Open hole WL @ 0.95m depth)												
								20 40 60 80 100				
								Shear Strength (kPa)				
								▲ Undisturbed △ Remoulded				

DATUM Ground surface elevations provided by J.D. Barnes Limited.

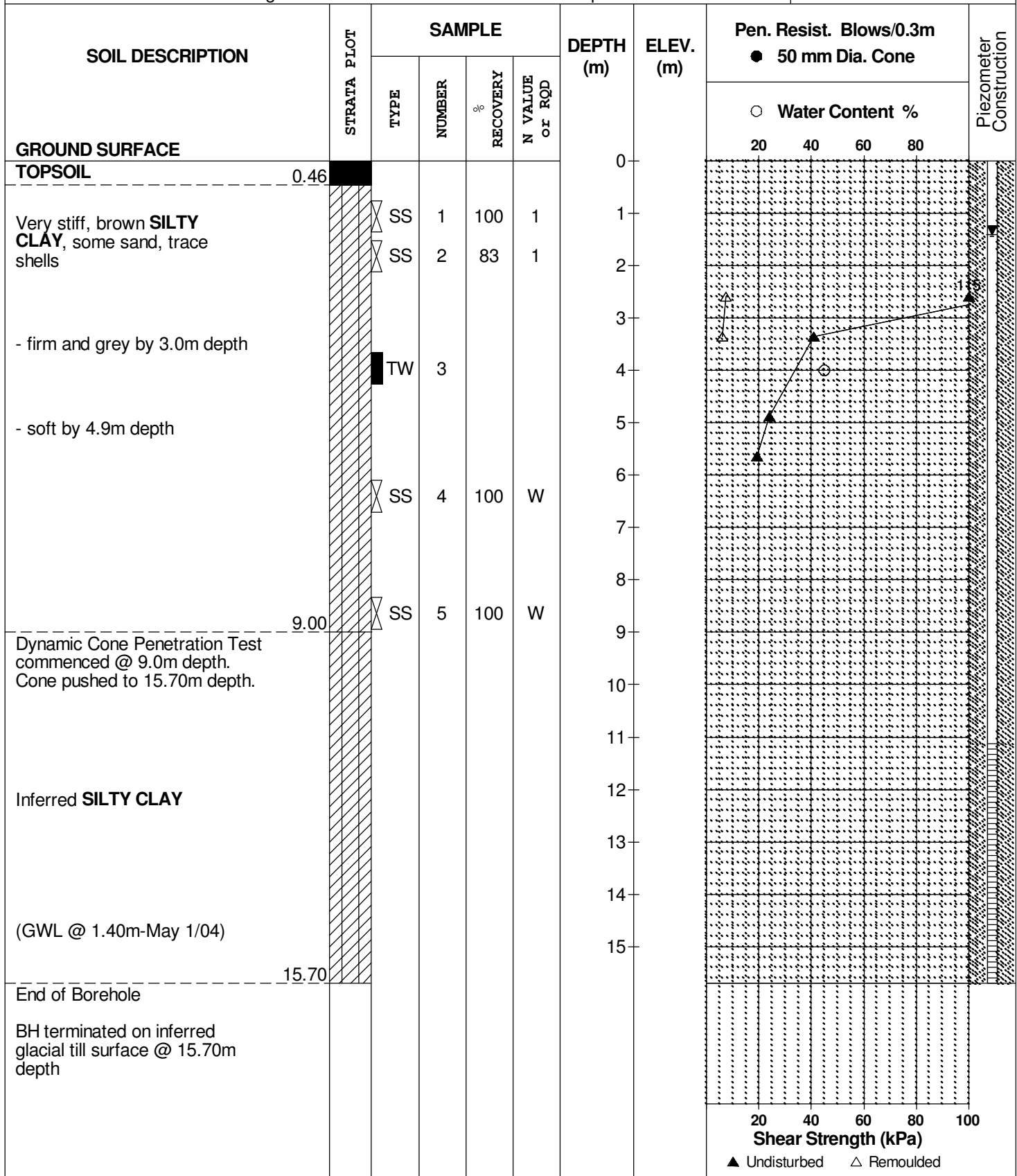
REMARKS

BORINGS BY CME 75 Power Auger

DATE 15 April 2004

FILE NO.
PG0177

HOLE NO.
BH 2A



SOIL PROFILE AND TEST DATA

Geotechnical Investigation

Proposed Residential Development-Half Moon Bay Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

FILE NO. PG0177

REMARKS

HOLE NO. **BH 2B**

BORINGS BY CME 75 Power Auger

DATE 20 April 2004

[illegible]

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation Nepean South Lands, South of Jock River Ottawa (Nepean), Ontario

DATUM

REMARKS

BORINGS BY CME 45 Power Auger

DATE 26 November 2003

FILE NO.

G9132

HOLE NO.

BH 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %				
								20	40	60	80	
GROUND SURFACE						0						
Remoulded SILTY CLAY with organic matter	0.76					1						
Firm, brown SILTY CLAY						2						
- soft and grey by 2.2m depth						3						
						4						
						5						
- firm by 5.6m depth						6						
- soil running up the augers upon removing auger plug starting @ 6.1m depth						7						
- soft by 7.0m depth						8						
						9						
						10						
- firm by 10.0m depth						11						
						12						
						13						
						14						
	15.24					15						
Dynamic Cone Penetration Test commenced @ 15.24m depth						16						
Inferred SILTY CLAY						17						
	17.53											
End of Borehole												
Cone refusal @ 17.53m depth												
(GWL @ 1.43m-Dec. 11/03)												

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation Nepean South Lands, South of Jock River Ottawa (Nepean), Ontario

DATUM

REMARKS

BORINGS BY CME 45 Power Auger

DATE 27 November 2003

FILE NO.

G9132

HOLE NO.

BH 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %				
								20	40	60	80	
GROUND SURFACE						0						
Frozen remoulded SILTY CLAY with organic matter	0.76					1						
Stiff, brown SILTY CLAY						2						
- organic matter in upper 750mm						3						
- firm and grey by 2.2m depth						4						
- firm by 4.9m depth						5						
- soil running up the augers upon removing the auger plug starting at 6.1m depth	6.10					6						
Dynamic Cone Penetration Test commenced @ 6.10m depth. Cone pushed to 14.94m depth.						7						
						8						
						9						
						10						
						11						
Inferred SILTY CLAY						12						
						13						
						14						
						15						
	15.80					16						
Inferred GLACIAL TILL						17						
	17.32											
End of Borehole												
Cone refusal @ 17.32m depth												
(GWL @ 1.11m-Dec. 11/03)												

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Nepean South Lands, South of Jock River
Ottawa (Nepean), Ontario

DATUM

REMARKS

BORINGS BY CME 45 Power Auger

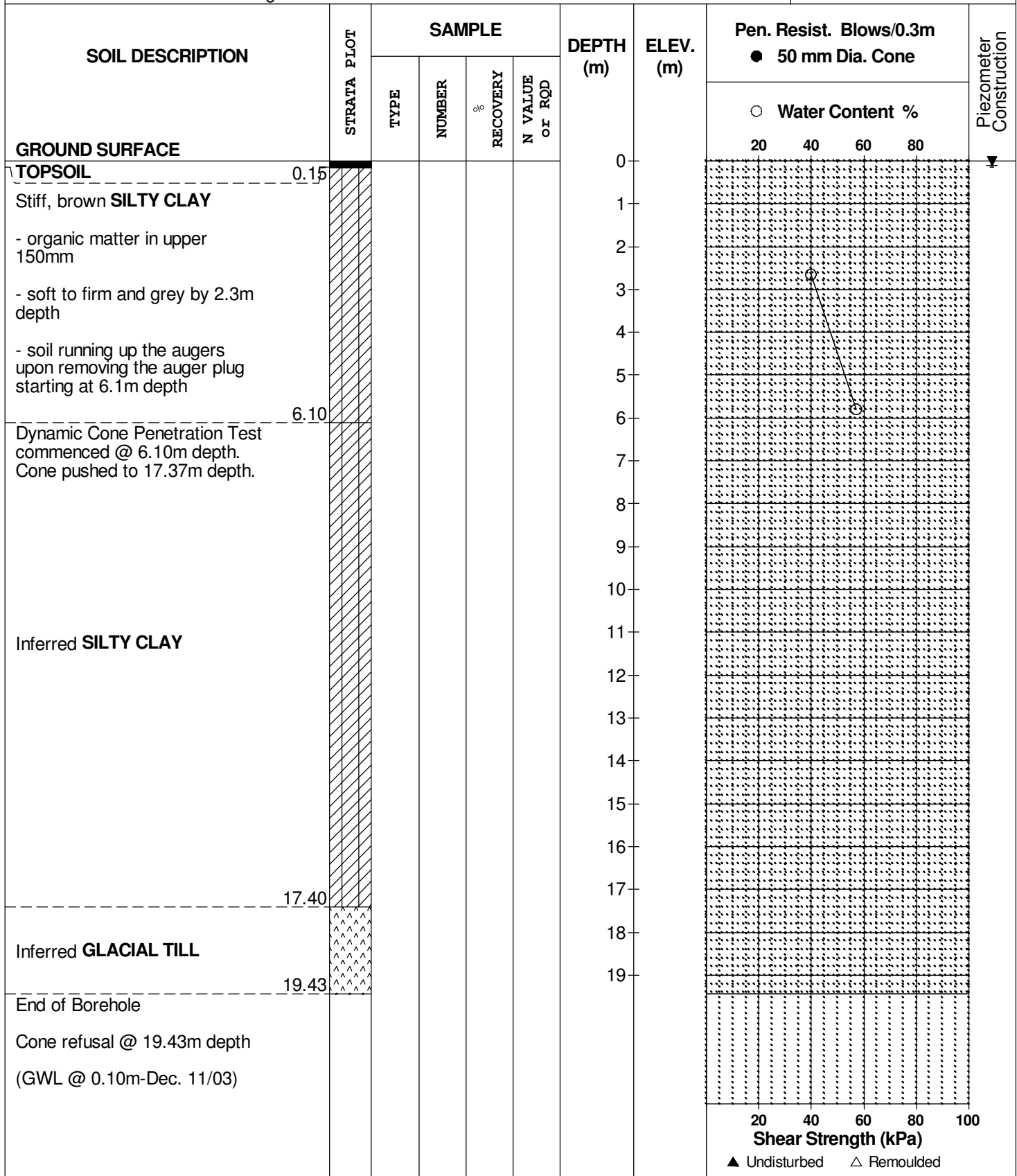
DATE 27 November 2003

FILE NO.

G9132

HOLE NO.

BH 3



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

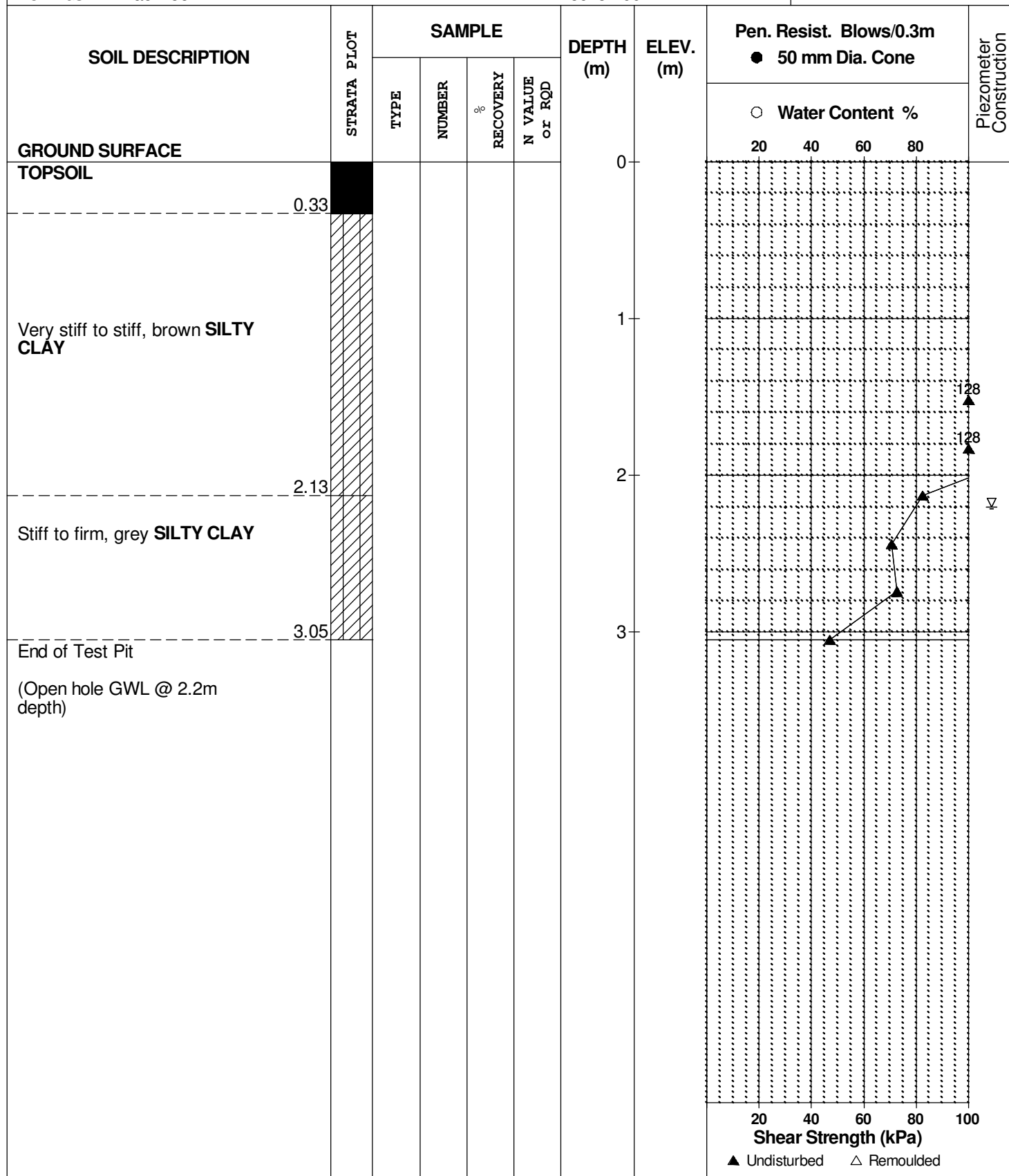
FILE NO.
PG0177

REMARKS

HOLE NO.
TP 6-07

BORINGS BY Backhoe

DATE 1 June 2007



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

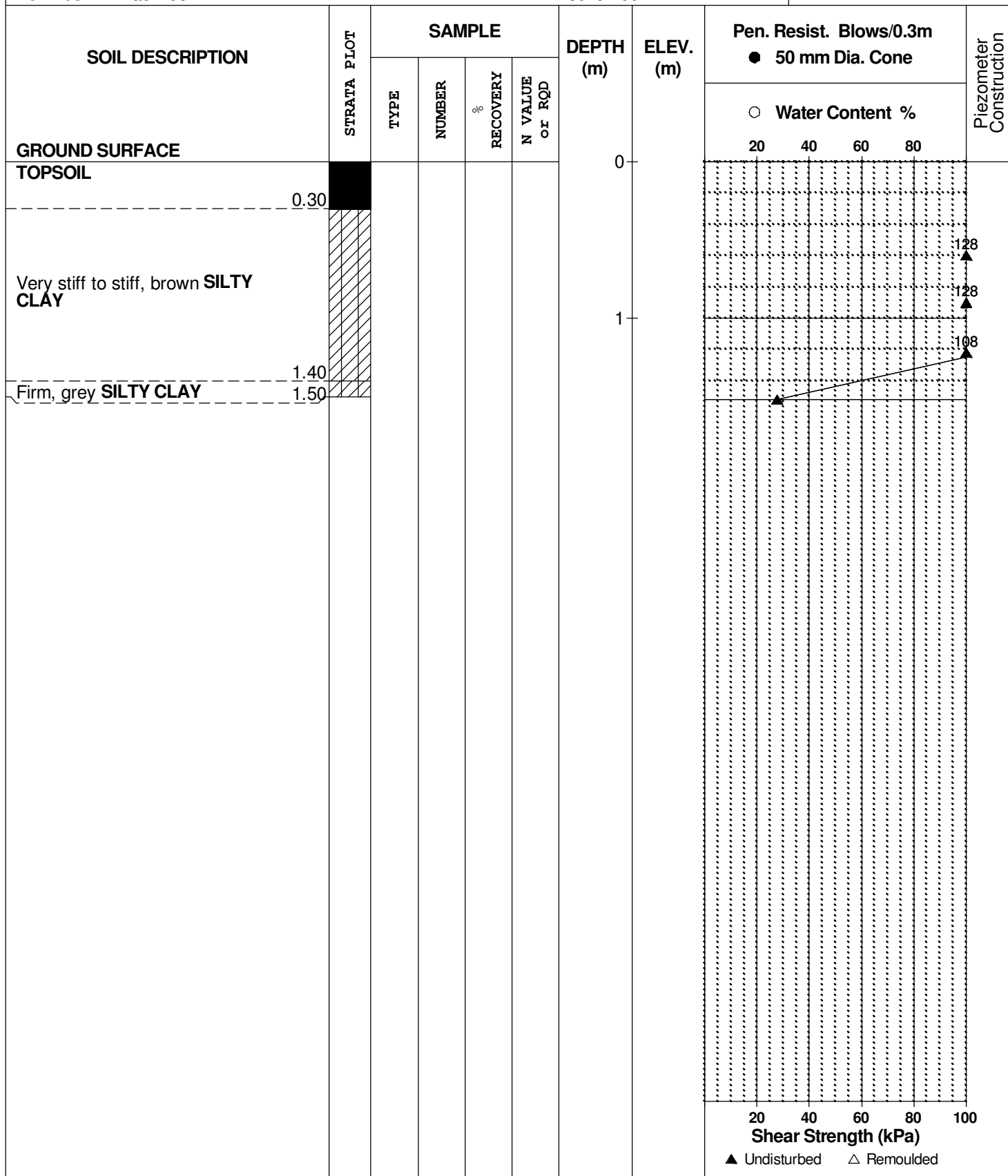
REMARKS

BORINGS BY Backhoe

DATE 4 June 2007

FILE NO.
PG0177

HOLE NO.
TP18-07



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

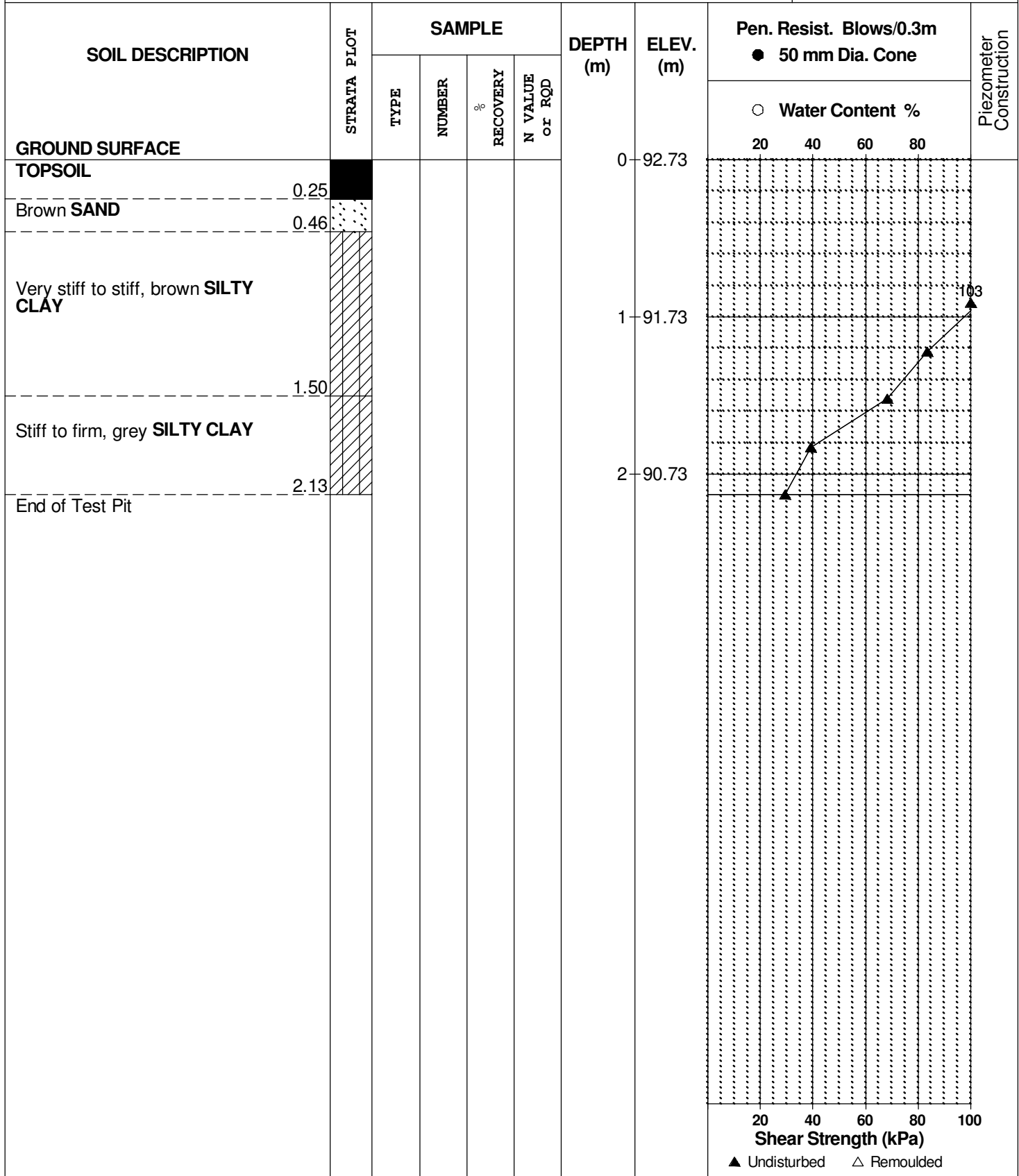
REMARKS

BORINGS BY Backhoe

DATE 4 June 2007

FILE NO. PG0177

HOLE NO. TP22-07



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

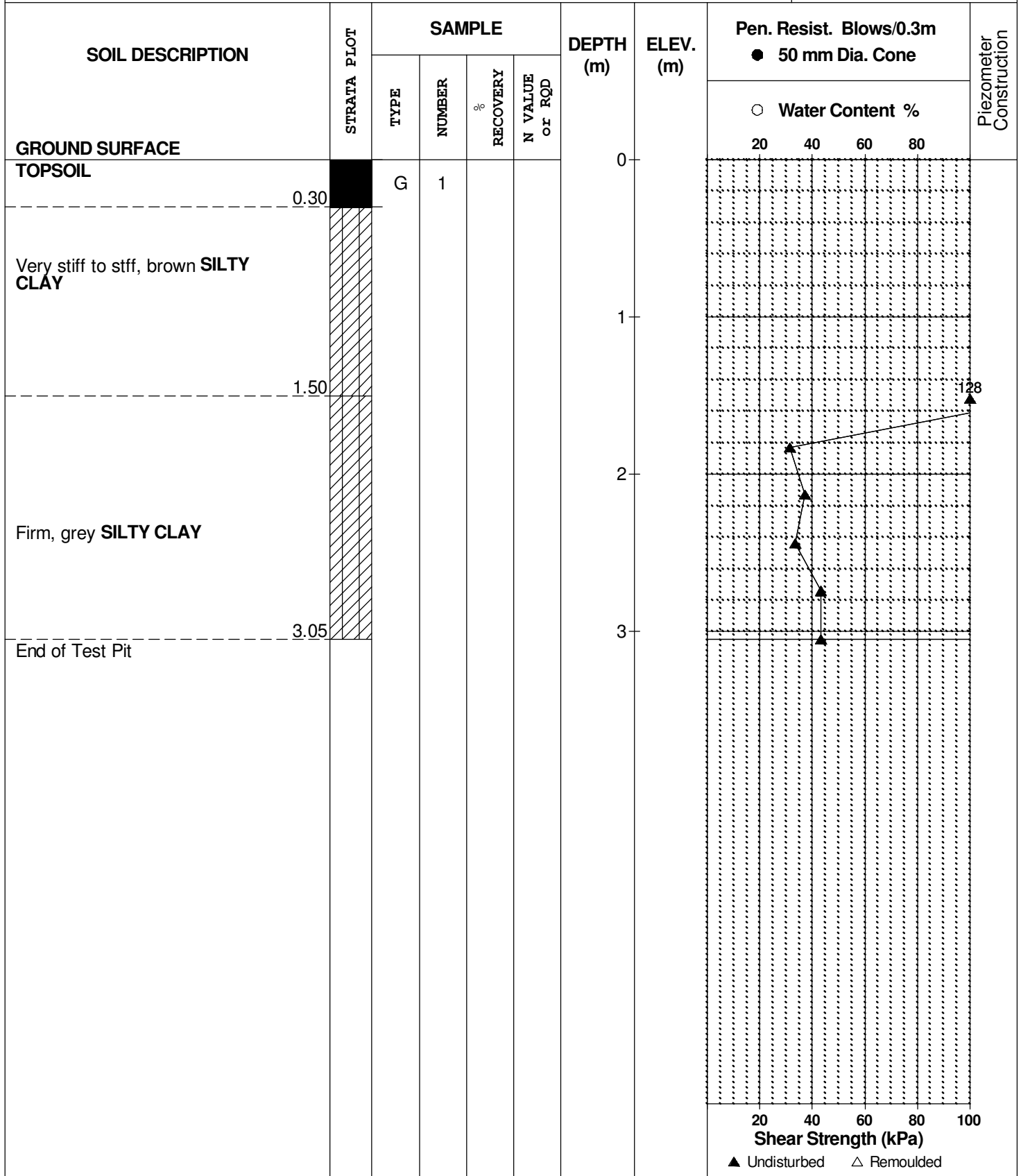
REMARKS

BORINGS BY Backhoe

DATE 1 June 2007

FILE NO. PG0177

HOLE NO. TP23-07



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

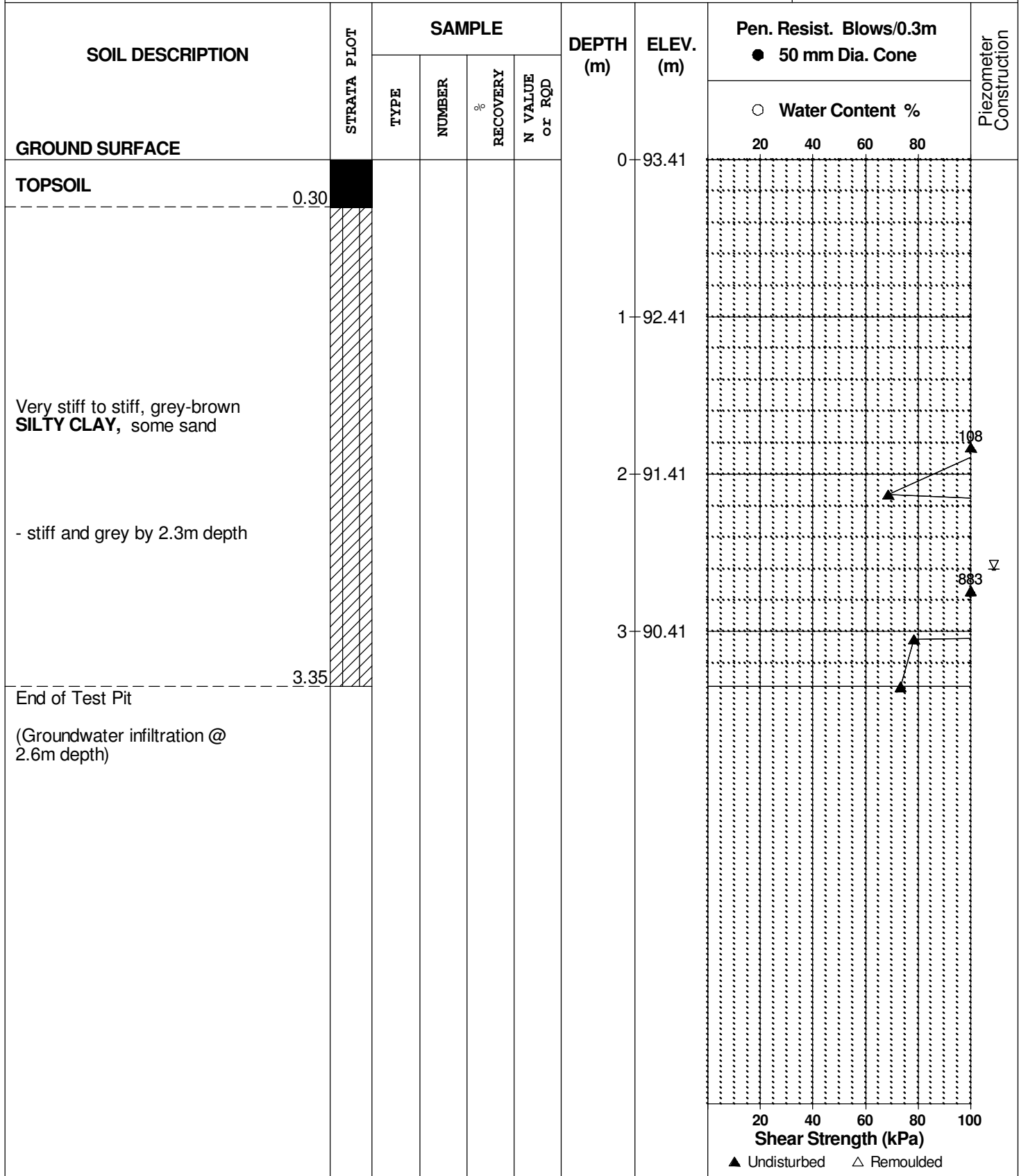
REMARKS

BORINGS BY Backhoe

DATE 1 June 2007

FILE NO. PG0177

HOLE NO. TP26-07



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

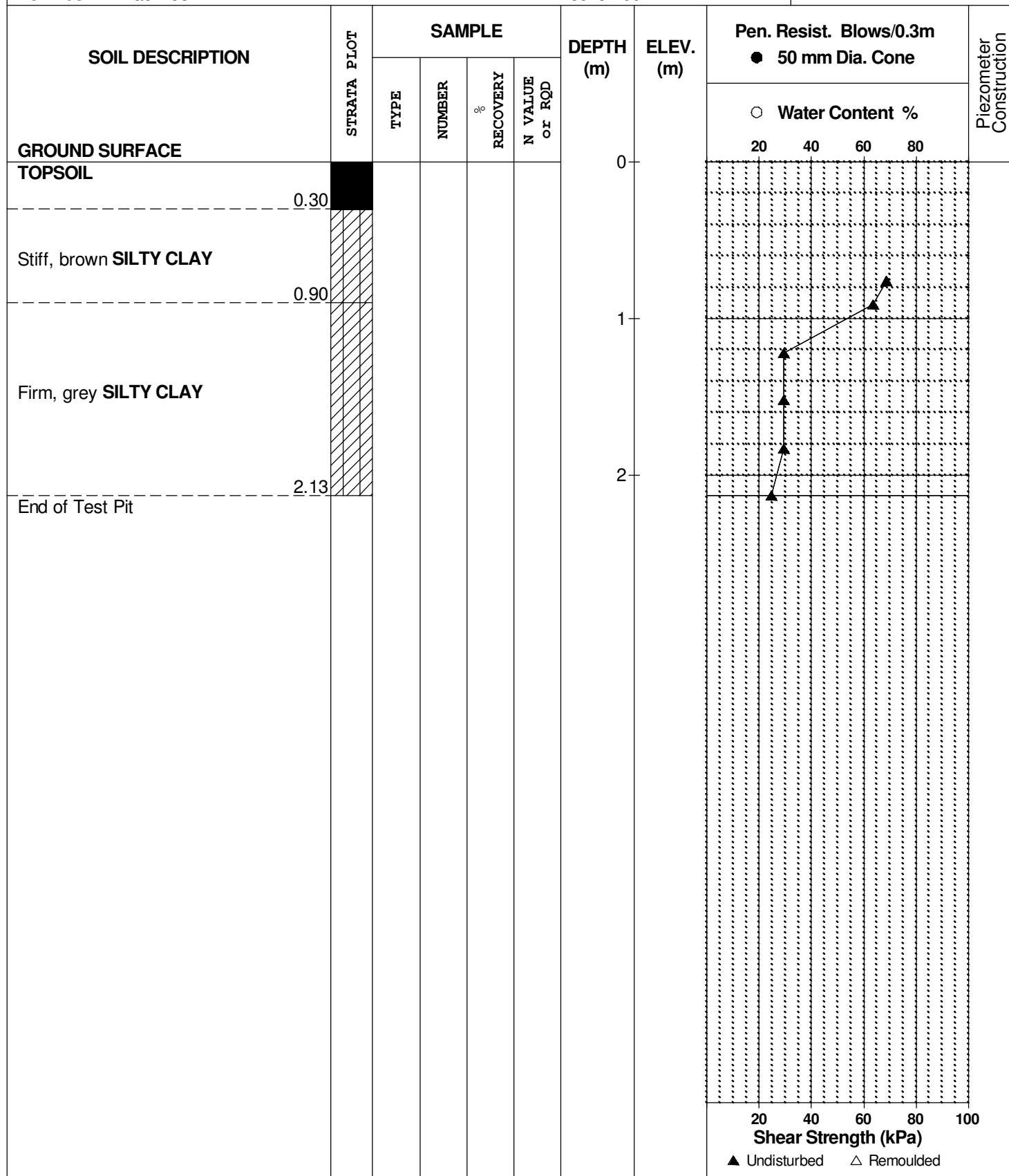
FILE NO.
PG0177

REMARKS

HOLE NO.
TP27-07

BORINGS BY Backhoe

DATE 4 June 2007



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

REMARKS

BORINGS BY Backhoe

DATE 14 June 2007

FILE NO.
PG0177

HOLE NO.
TP50-07

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction				
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %								
								20	40	60	80					
GROUND SURFACE						0	92.32					▽				
TOPSOIL	0.30					1	91.32									
Stiff, grey-brown, dessicated CLAYEY SILT, some shells	1.80					2	90.32									
Firm to soft, grey SILTY CLAY	4.30					3	89.32									
End of Test Pit						4	88.32									
(Open hole GWL @ 2.2m depth)																
							Shear Strength (kPa)									
							20						40	60	80	100
							▲ Undisturbed △ Remoulded									

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

REMARKS

BORINGS BY Backhoe

DATE 14 June 2007

FILE NO. PG0177

HOLE NO. TP51-07

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %				
								20	40	60	80	
GROUND SURFACE						0	92.29					
TOPSOIL	0.25											
Brown CLAYEY SILT , trace silt in upper 300mm												
- some shells by 1.0m depth	1.20					1	91.29					
Stiff to firm, brown SILTY CLAY	1.80											
						2	90.29					
						3	89.29					
Firm to soft, grey SILTY CLAY						4	88.29					
						5	87.29					
End of Test Pit	5.00											
(Open hole GWL @ 1.8m depth)												
							</					

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation Nepean South Lands, South of Jock River Ottawa (Nepean), Ontario

DATUM

REMARKS

BORINGS BY Backhoe

DATE 1 December 2003

FILE NO.

G9132

HOLE NO.

TP13

[illegible]

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation Nepean South Lands, South of Jock River Ottawa (Nepean), Ontario

DATUM

REMARKS

BORINGS BY Backhoe

DATE 1 December 2003

FILE NO.

G9132

HOLE NO.

TP14

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %				
GROUND SURFACE								20	40	60	80	
TOPSOIL						0						
- - - - - 0.40												
Stiff, brown SILTY CLAY						1						
- firm and grey by 1.8m depth						2						
- - - - - 3.00						3						
End of Test Pit												
(Open hole GWL @ 1.0m depth)												

▲ Undisturbed △ Remoulded

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Nepean South Lands, South of Jock River
Ottawa (Nepean), Ontario

DATUM

REMARKS

BORINGS BY Backhoe

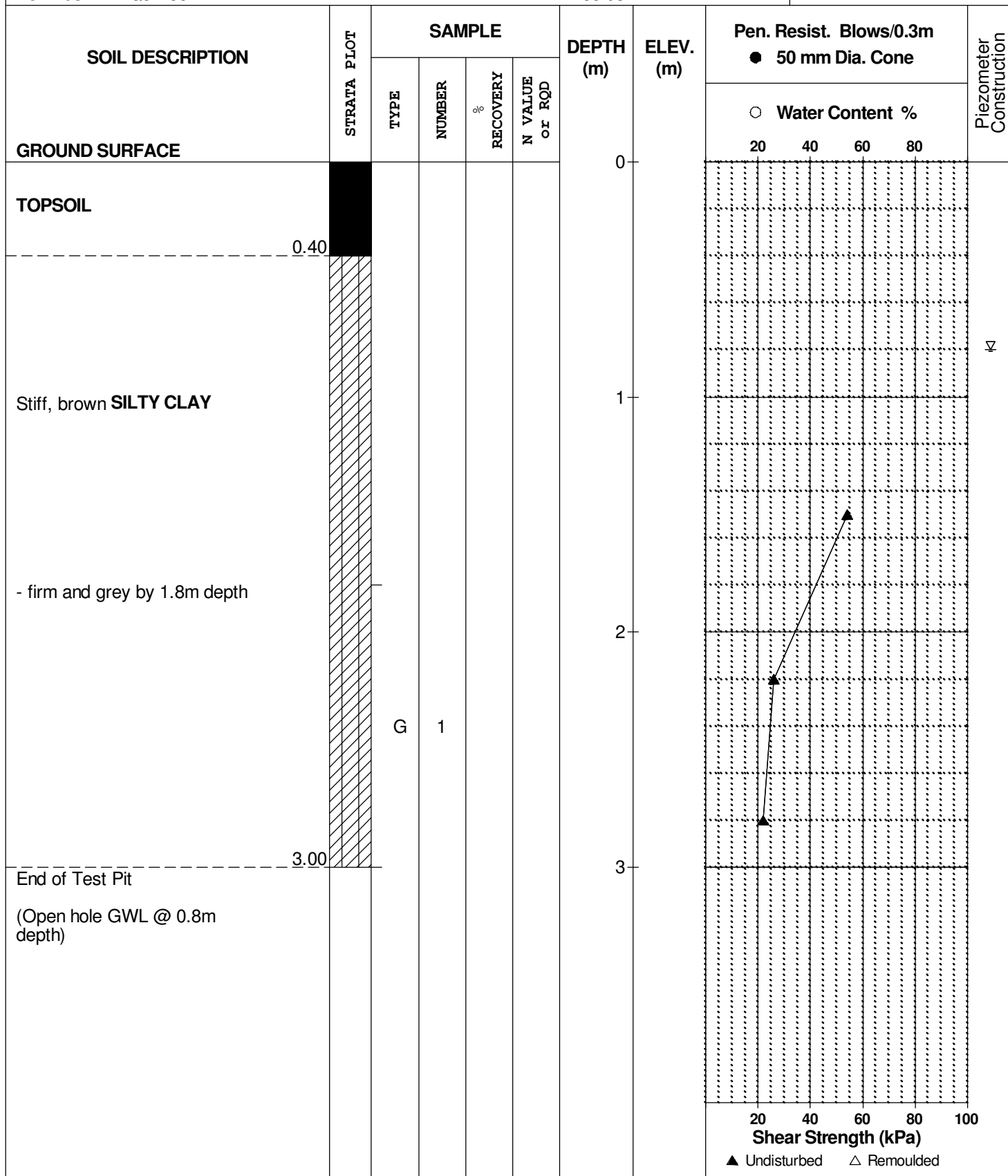
DATE 1 Dec 03

FILE NO.

G9132

HOLE NO.

TP15



SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

Relative Density	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NXL size core. However, it can be used on smaller core sizes, such as BX, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	ROCK QUALITY
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC%	-	Natural moisture content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic limit, % (water content above which soil behaves plastically)
PI	-	Plasticity index, % (difference between LL and PL)
Dxx	-	Grain size which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D_{30})^2 / (D_{10} \times D_{60})$
Cu	-	Uniformity coefficient = D_{60} / D_{10}

Cc and Cu are used to assess the grading of sands and gravels:

Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$

Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$

Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.

Cc and Cu are not applicable for the description of soils with more than 10% silt and clay
(more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidation ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.
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SYMBOLS AND TERMS (continued)

STRATA PLOT



Topsoil



Asphalt



Fill



Peat



Sand



Silty Sand



Silt



Sandy Silt



Clay



Silty Clay



Clayey Silty Sand



Glacial Till



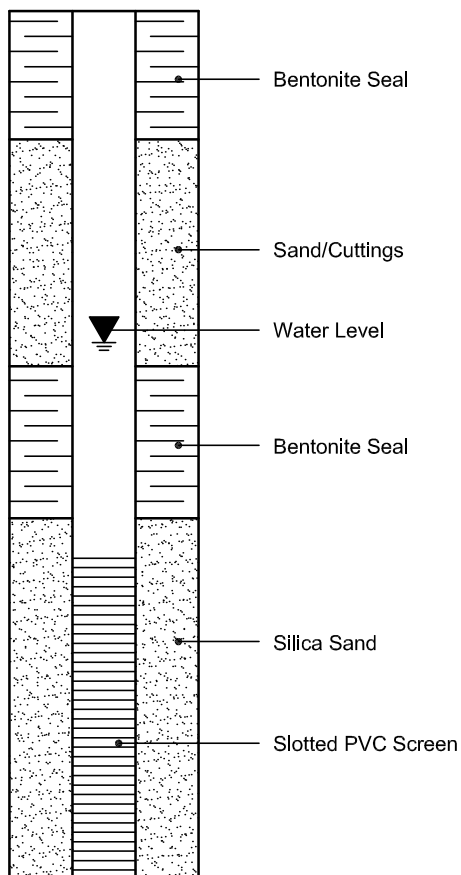
Shale



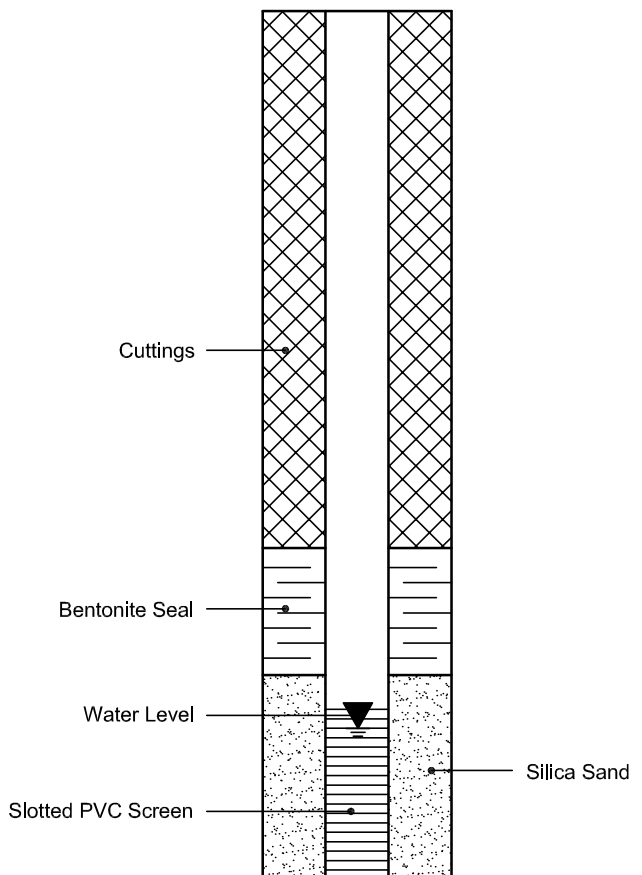
Bedrock

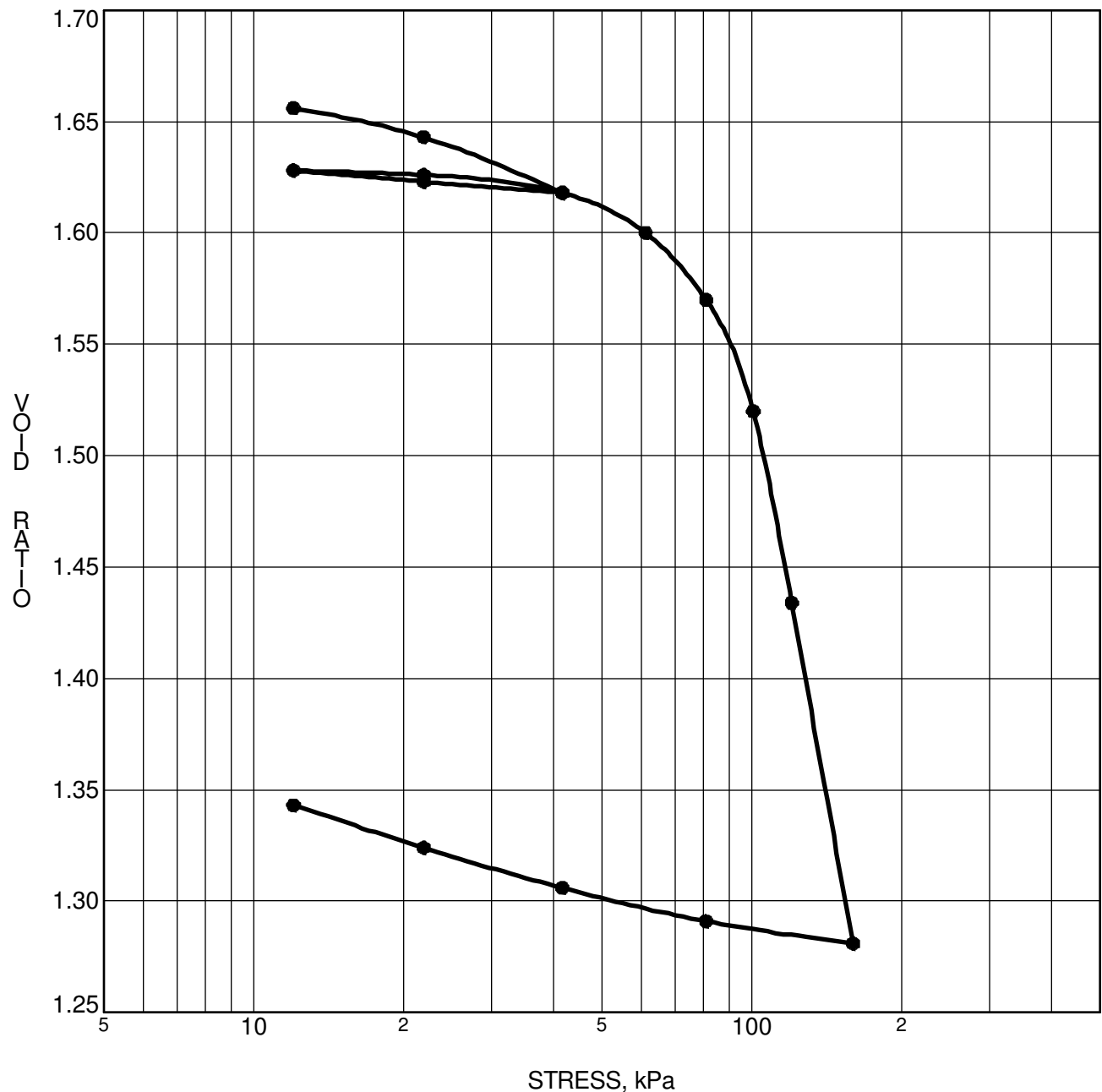
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION





CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 1-10	p'_o	58.3 kPa	C_{cr}	0.019
Sample No.	TW 7	p'_c	93 kPa	C_c	1.228
Sample Depth	9.45 m	OC Ratio	1.6	W_o	60.8 %
Sample Elev.	84.54 m	Void Ratio	1.673	Unit Wt.	16.1 kN/m³

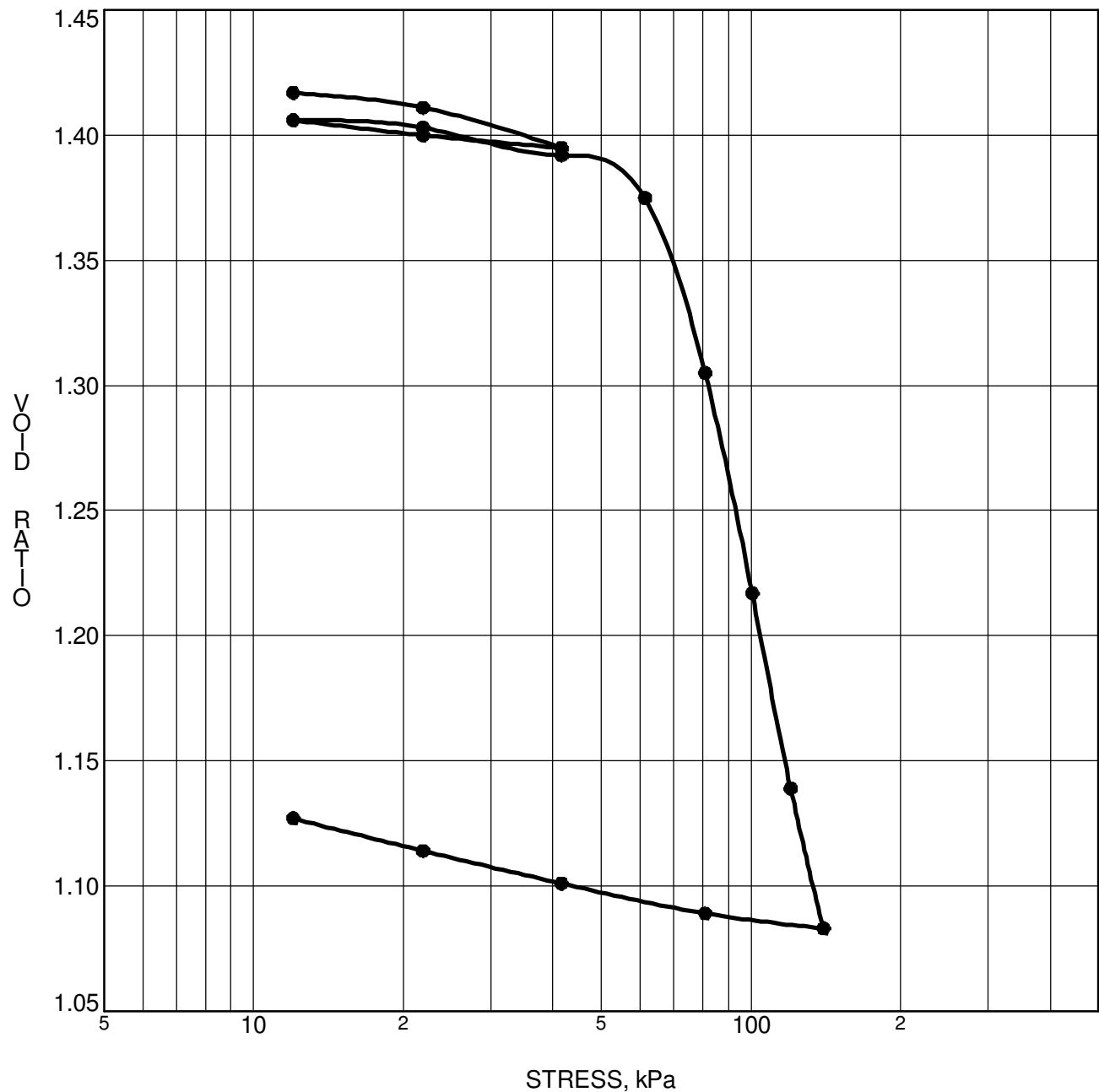
Note: Overburden stress calculated from original ground surface (92.30m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Half-Moon Bay West -**
Cambrian Road

FILE NO. **PG2246**
 DATE **11/03/2010**

patersongroup Consulting Engineers
 154 Colonnade Road South, Ottawa, Ontario K2E 7J5

**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 2-10	p'_o	36 kPa	C_{cr}	0.023
Sample No.	TW 4	p'_c	67.7 kPa	C_c	1.024
Sample Depth	2.64 m	OC Ratio	1.9	W_o	51.9 %
Sample Elev.	89.13 m	Void Ratio	1.428	Unit Wt.	17.0 kN/m³

Note: Overburden stress calculated from original ground surface (91.77m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Half-Moon Bay West -**
Cambrian Road

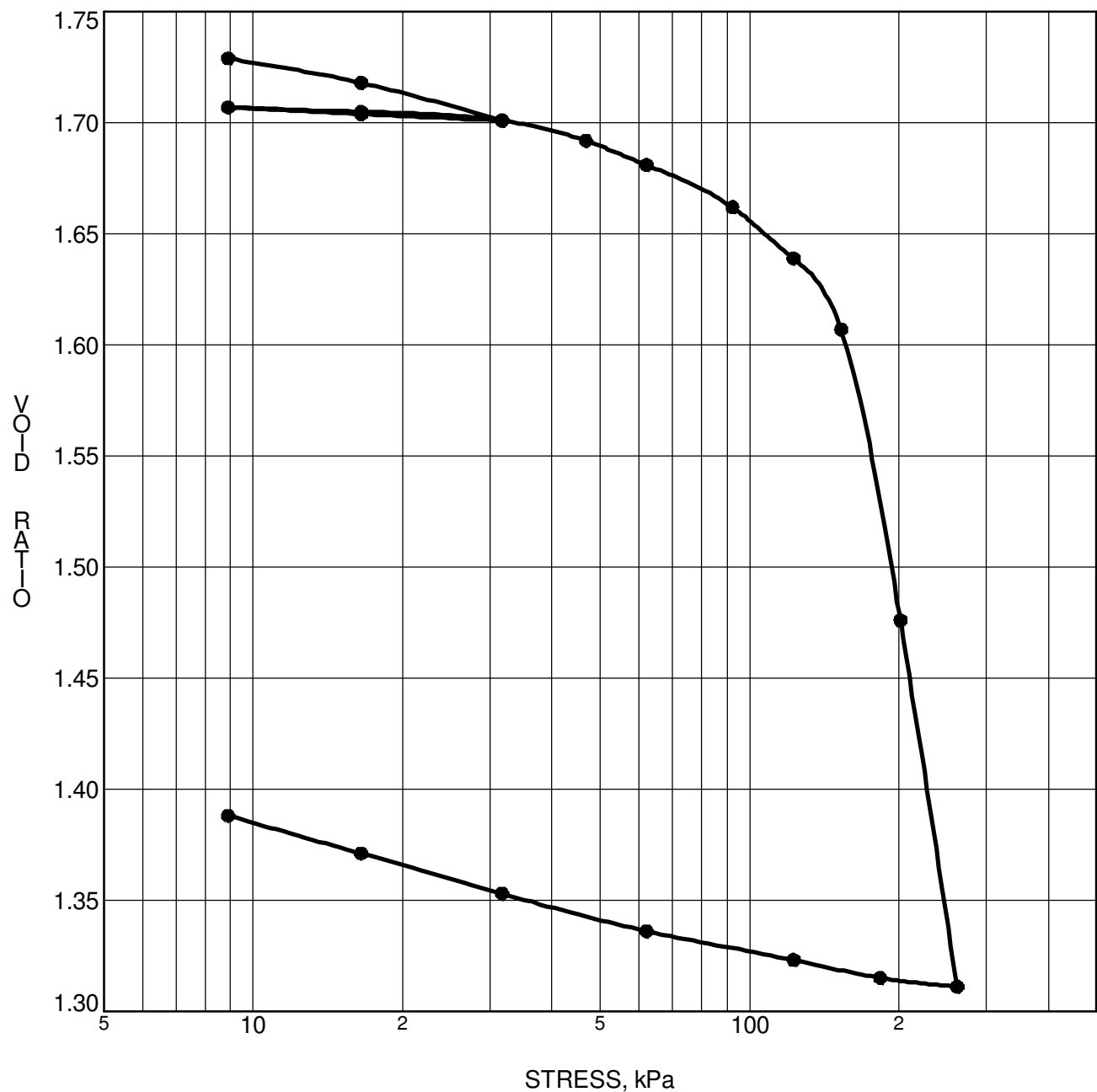
FILE NO. **PG2246**
 DATE **11/04/2010**

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Engineers

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 3-10	p'_o	116 kPa	C_{cr}	0.012
Sample No.	TW 7	p'_c	153.1 kPa	C_c	1.208
Sample Depth	15.67 m	OC Ratio	1.3	W_o	63.6 %
Sample Elev.	76.39 m	Void Ratio	1.749	Unit Wt.	16.3 kN/m³

Note: Overburden stress calculated from original ground surface (92.00m)

CLIENT Mattamy Homes
 PROJECT Geotechnical Investigation - Half-Moon Bay West -
Cambrian Road

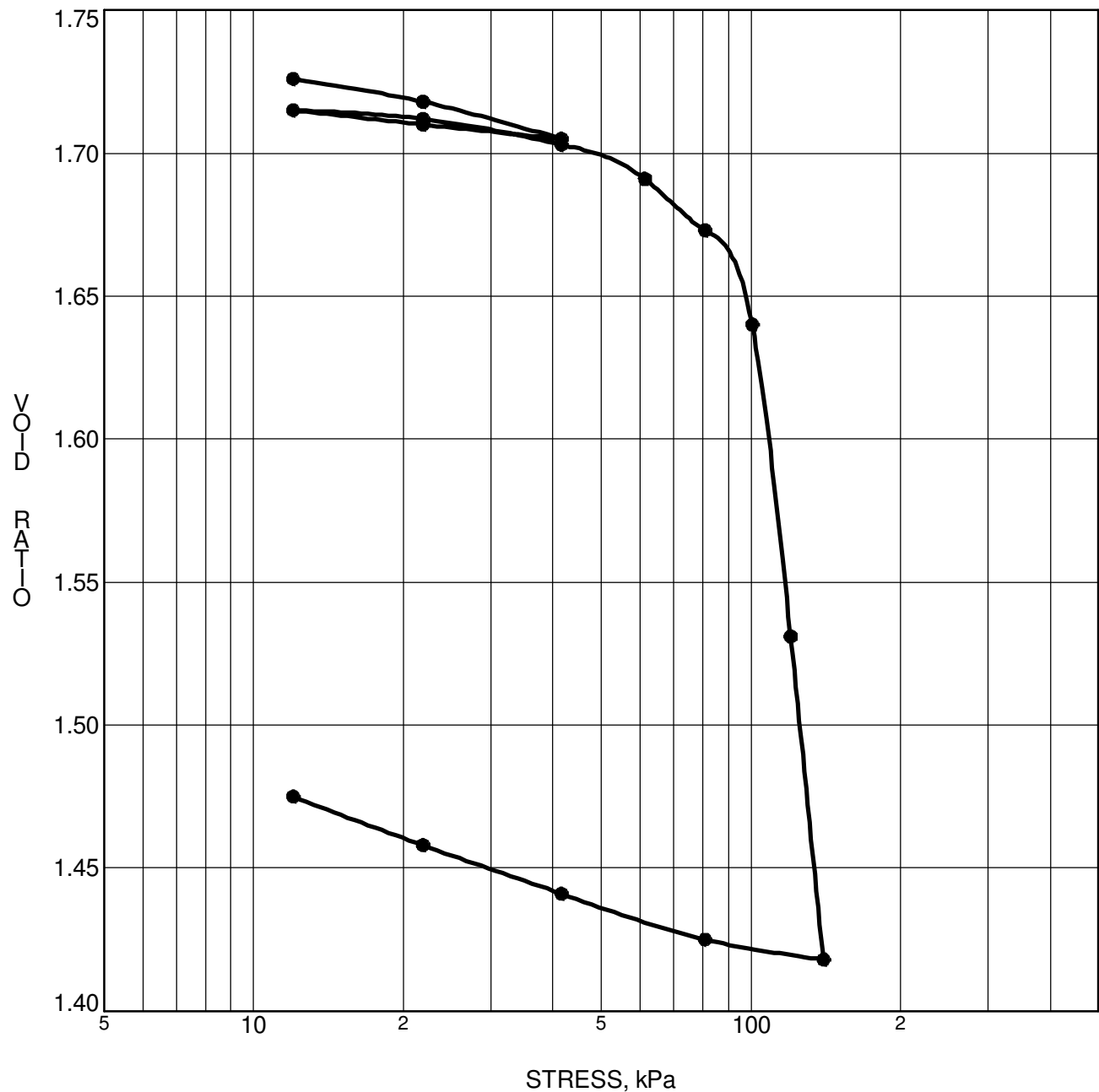
FILE NO. PG2246
 DATE 11/08/2010

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Engineers

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 4-10	p'_o	49.6 kPa	C_{cr}	0.020
Sample No.	TW 8	p'_c	100 kPa	C_c	1.585
Sample Depth	7.13 m	OC Ratio	2.0	W_o	63.2 %
Sample Elev.	86.66 m	Void Ratio	1.738	Unit Wt.	16.2 kN/m³

Note: Overburden stress calculated from original ground surface (92.50m)

CLIENT Mattamy Homes
 PROJECT Geotechnical Investigation - Half-Moon Bay West -
Cambrian Road

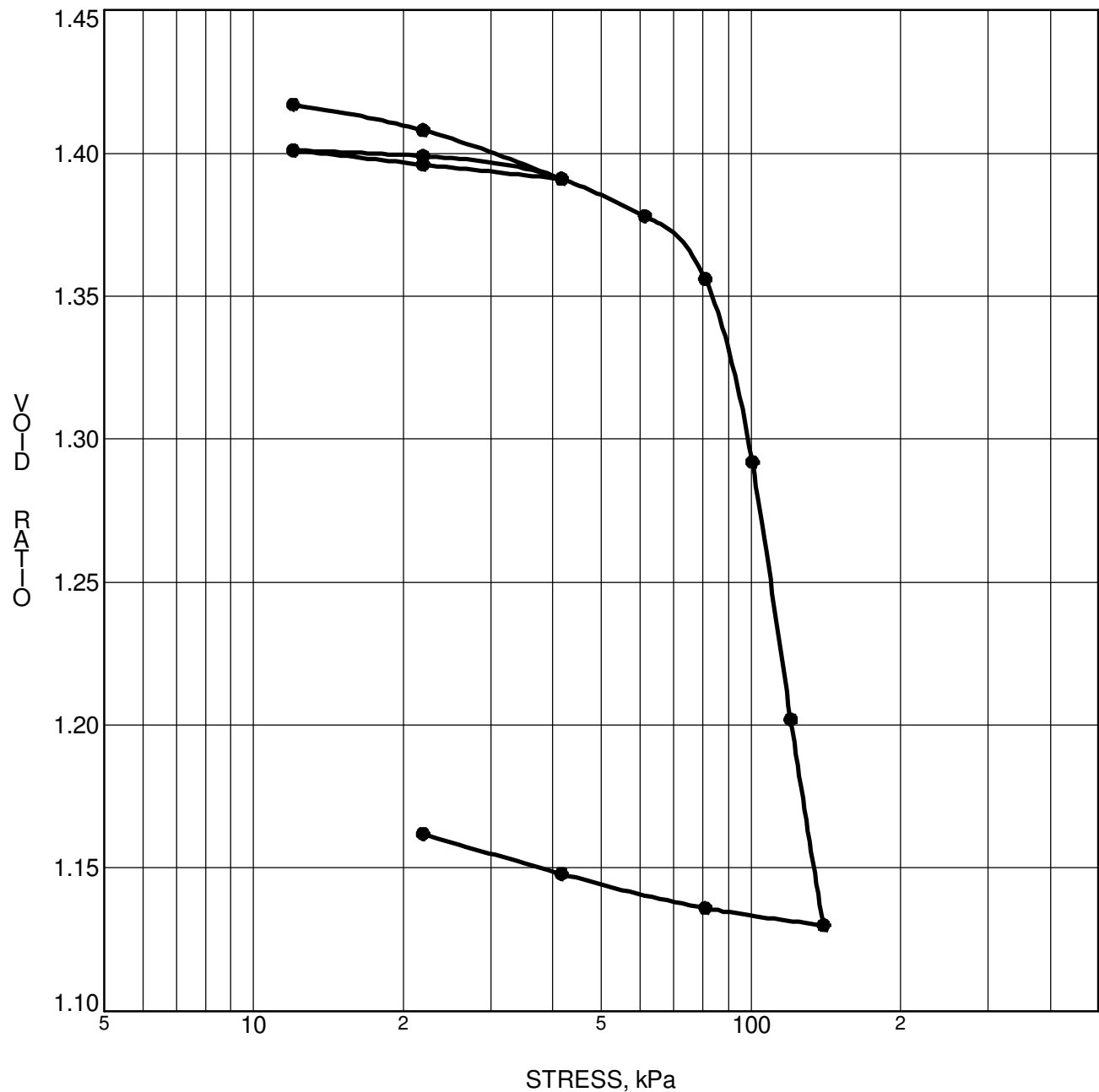
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Engineers

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 5-10	p'_o	41 kPa	C_{cr}	0.019
Sample No.	TW 5	p'_c	87.17 kPa	C_c	1.186
Sample Depth	4.24 m	OC Ratio	2.1	W_o	52.0 %
Sample Elev.	88.27 m	Void Ratio	1.43	Unit Wt.	16.9 kN/m³

Note: Overburden stress calculated from original ground surface (92.26m)

CLIENT Mattamy Homes
 PROJECT Geotechnical Investigation - Half-Moon Bay West -
Cambrian Road

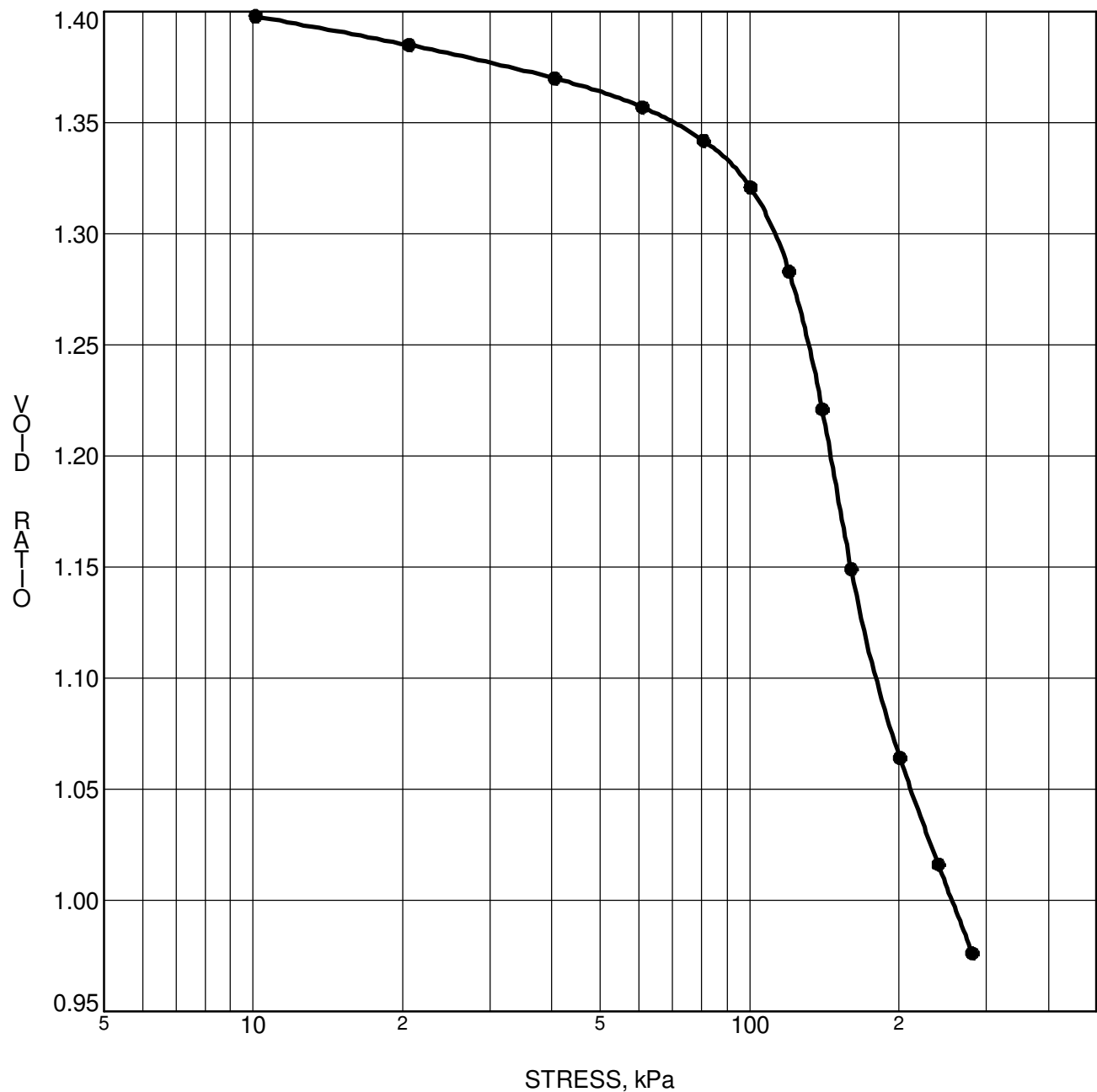
FILE NO. PG2246
 DATE 11/08/2010

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Engineers

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 5-10	p'_o	74.4 kPa	Ccr	
Sample No.	TW 7	p'_c	118.66 kPa	Cc	1.114
Sample Depth	9.64 m	OC Ratio	1.6	Wo	51.5 %
Sample Elev.	82.87 m	Void Ratio	1.417	Unit Wt.	17.2 kN/m ³

Note: Overburden stress calculated from original ground surface (92.26m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Half-Moon Bay West -**
Cambrian Road

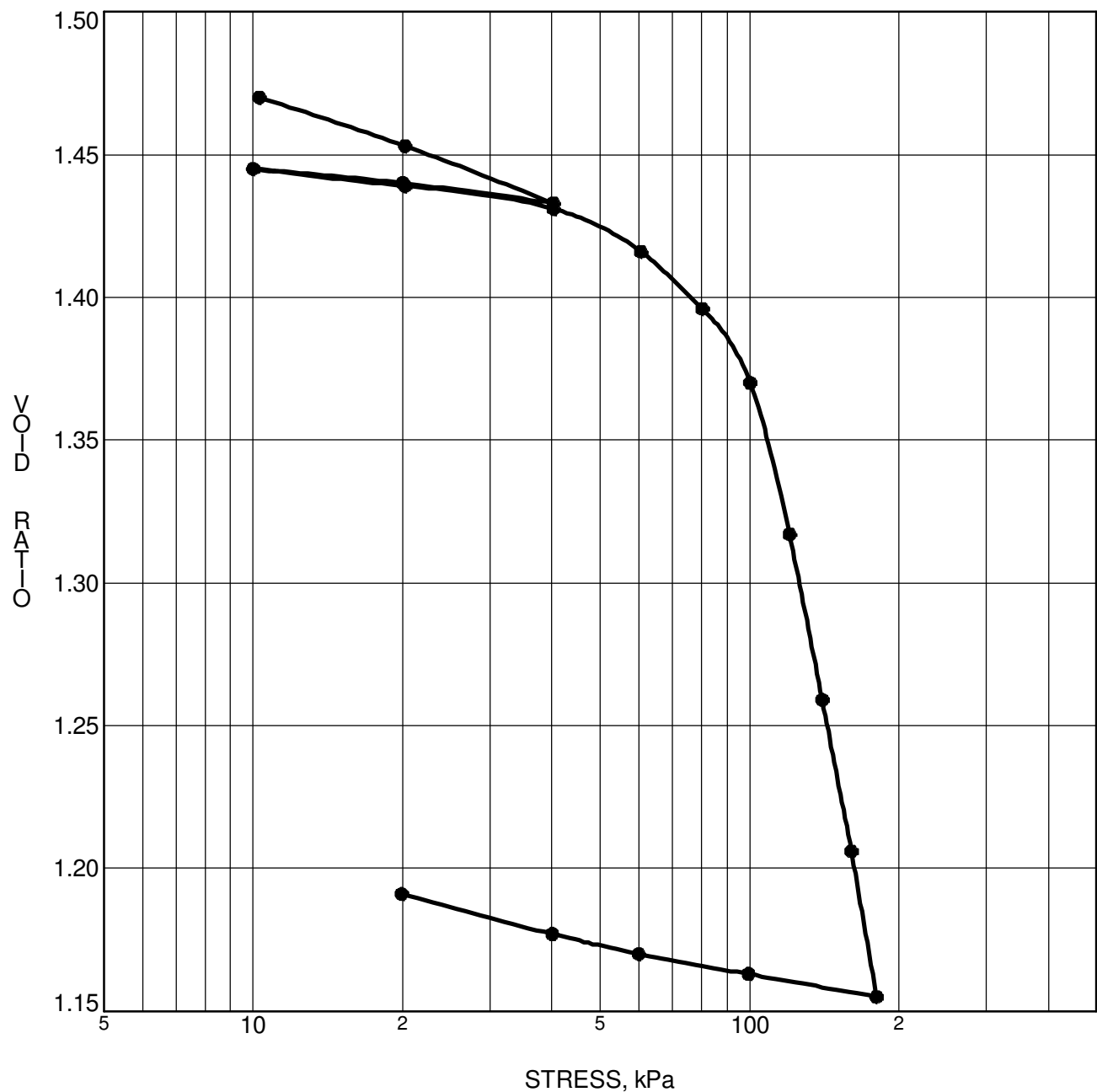
FILE NO. **PG2246**
 DATE **11/08/2010**

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Engineers

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 7-10	p'_o	41.2 kPa	C_{cr}	0.022
Sample No.	TW 3	p'_c	101 kPa	C_c	0.927
Sample Depth	2.74 m	OC Ratio	2.5	W_o	54.3 %
Sample Elev.	88.67 m	Void Ratio	1.493	Unit Wt.	16.9 kN/m³

Note: Overburden stress calculated from original ground surface (92.10m)

CLIENT Mattamy Homes
 PROJECT Geotechnical Investigation - Half-Moon Bay West -
Cambrian Road

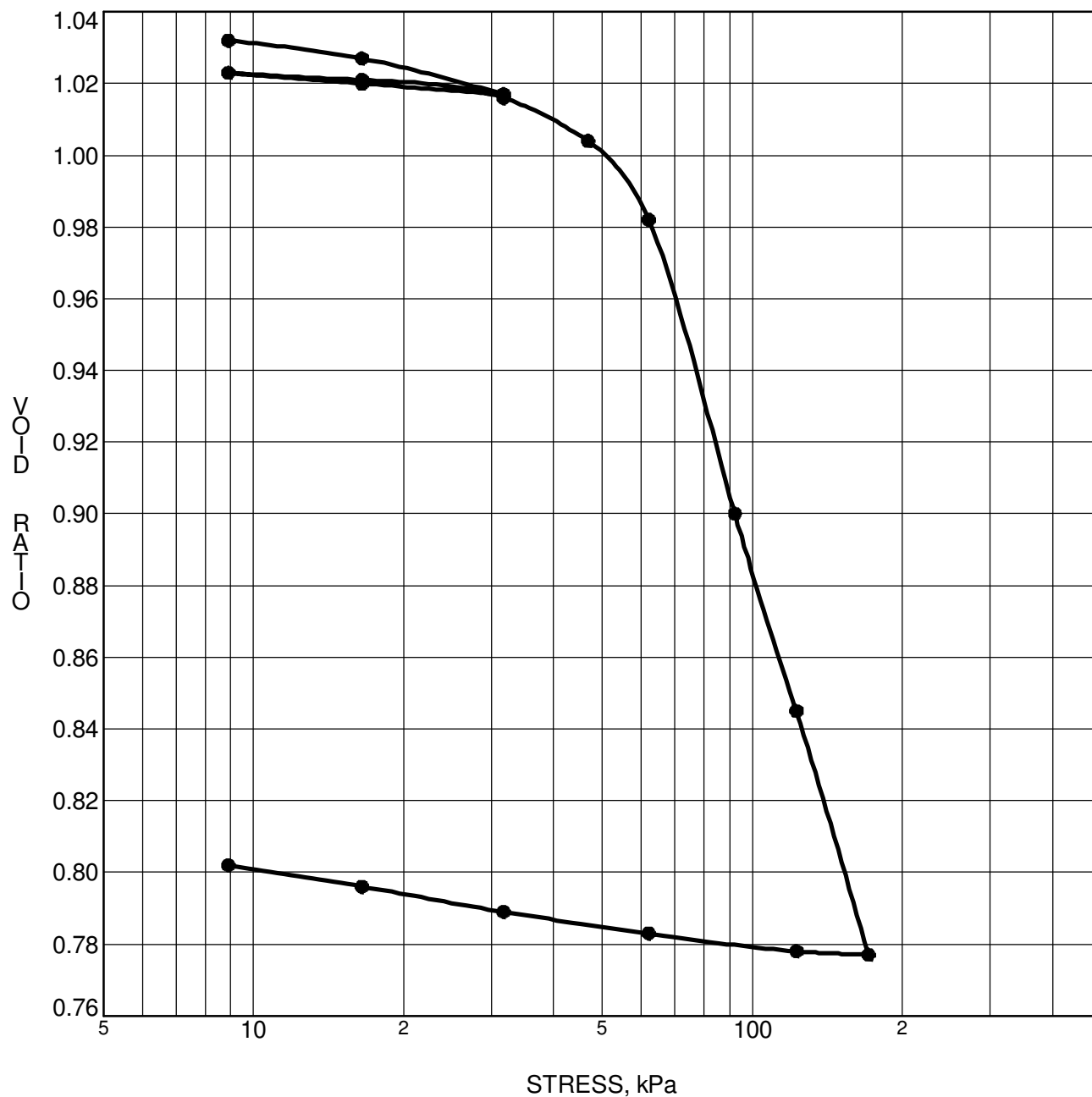
FILE NO. PG2246
 DATE 02/22/2011

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Engineers

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH10-10	p'_o	29.1 kPa	C_{cr}	0.012
Sample No.	TW 3	p'_c	55.46 kPa	C_c	0.472
Sample Depth	3.48 m	OC Ratio	1.9	W_o	37.8 %
Sample Elev.	90.37 m	Void Ratio	1.039	Unit Wt.	18.2 kN/m³

Note: Overburden stress calculated from original ground surface (92.90m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Half-Moon Bay West -**
Cambrian Road

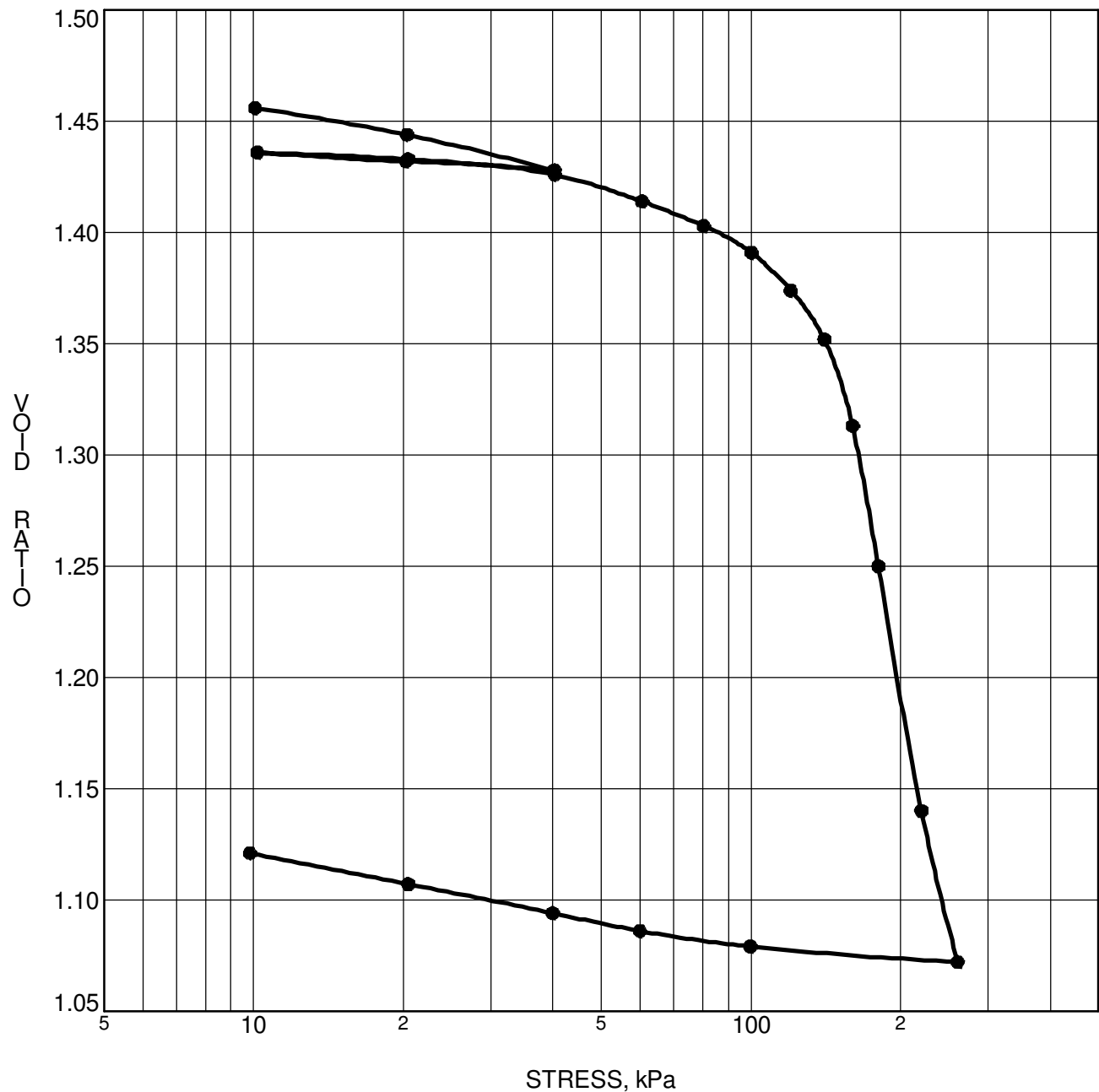
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 DATE **11/30/2010**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH11-10	p'_o	85 kPa	C_{cr}	0.014
Sample No.	TW 6	p'_c	141 kPa	C_c	1.259
Sample Depth	12.72 m	OC Ratio	1.7	W_o	53.8 %
Sample Elev.	80.97 m	Void Ratio	1.48	Unit Wt.	17.1 kN/m³

Note: Overburden stress calculated from original ground surface (92.70m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Half-Moon Bay West -**
Cambrian Road

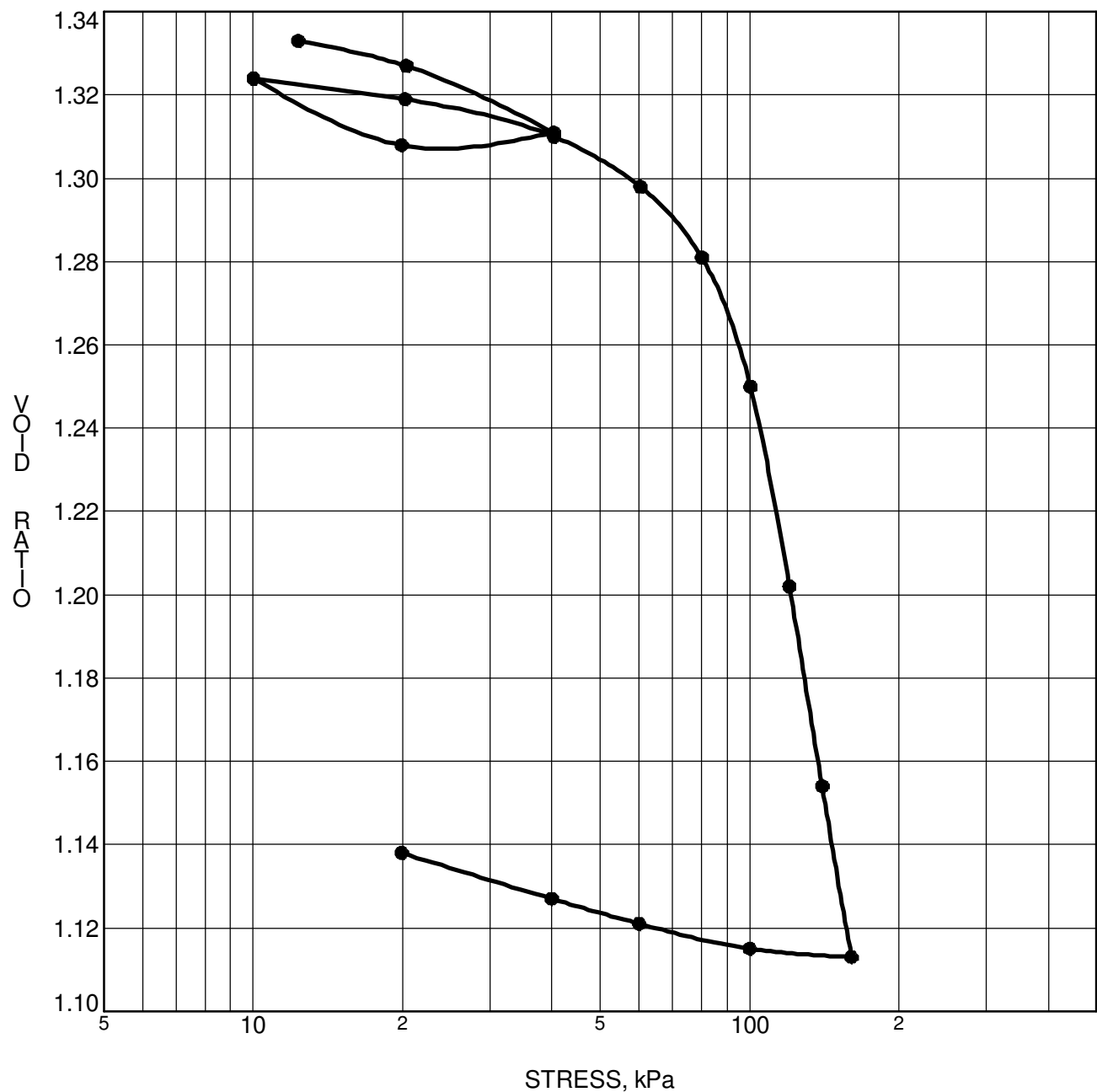
FILE NO. **PG2246**
 DATE **02/10/2011**

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Engineers

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH12-10	p'_o	39.8 kPa	C_{cr}	0.022
Sample No.	TW 3	p'_c	92 kPa	C_c	0.721
Sample Depth	5.66 m	OC Ratio	2.3	W_o	49.2 %
Sample Elev.	89.09 m	Void Ratio	1.353	Unit Wt.	17.4 kN/m³

Note: Overburden stress calculated from original ground surface (93.00m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Half-Moon Bay West -**
Cambrian Road

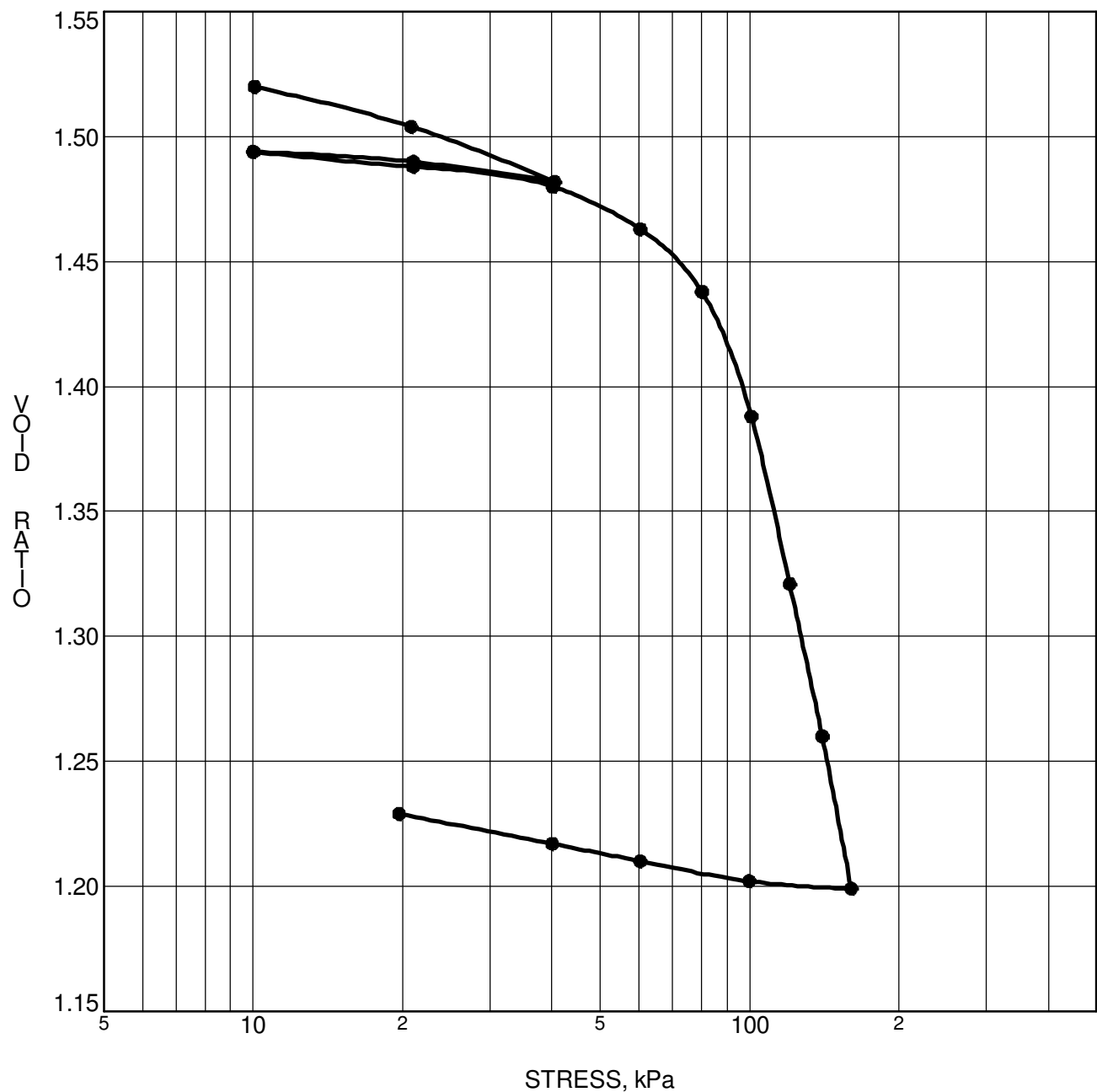
FILE NO. **PG2246**
 DATE **02/10/2011**

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28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH14-10	p'_o	67.7 kPa	C_{cr}	0.021
Sample No.	TW 7	p'_c	90 kPa	C_c	0.961
Sample Depth	9.55 m	OC Ratio	1.3	W_o	56.3 %
Sample Elev.	83.25 m	Void Ratio	1.548	Unit Wt.	16.9 kN/m³

Note: Overburden stress calculated from original ground surface (92.00m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Half-Moon Bay West -**
Cambrian Road

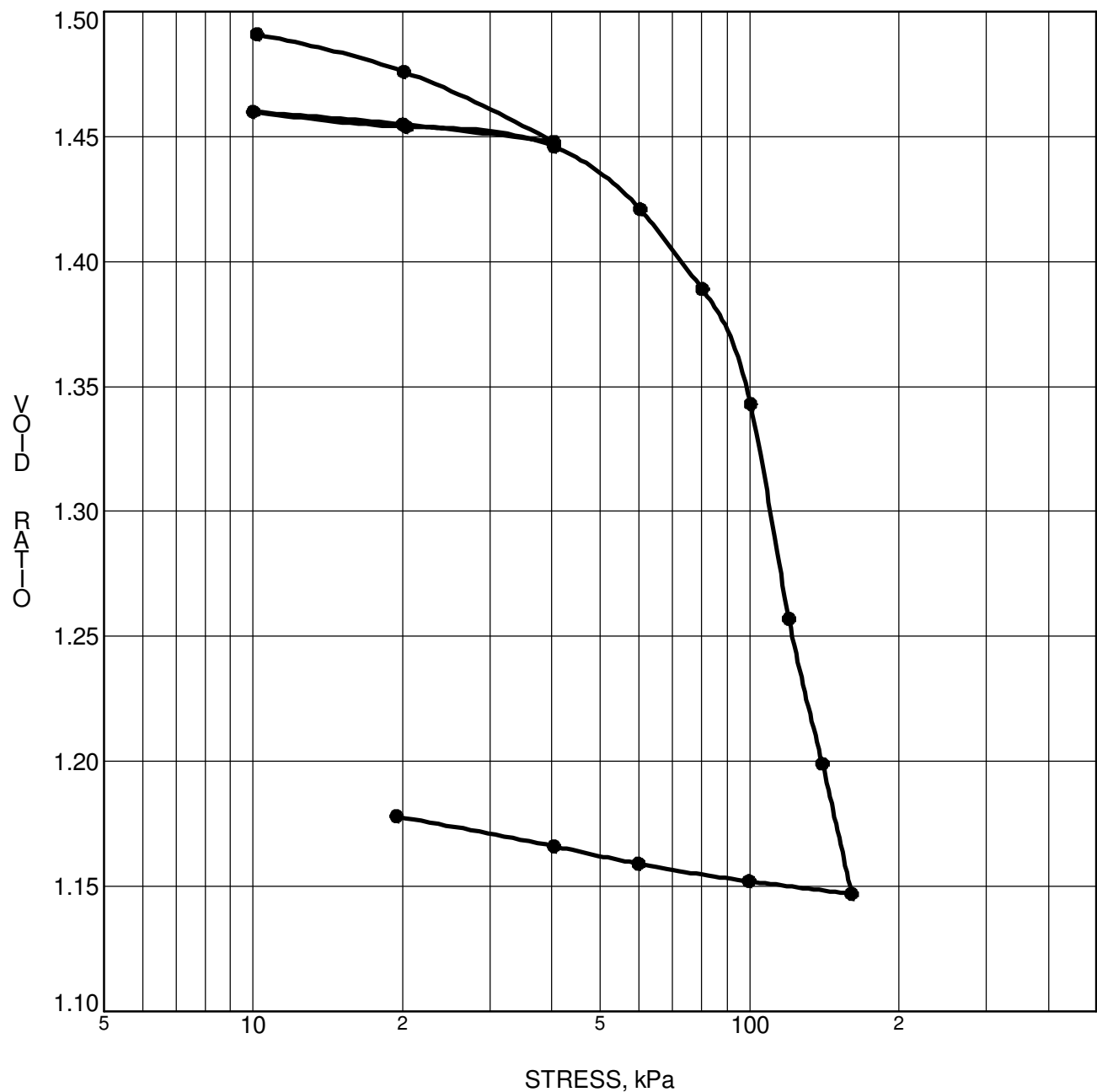
FILE NO. **PG2246**
 DATE **02/22/2011**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH15-10	p'_o	55.2 kPa	C_{cr}	0.021
Sample No.	TW 4	p'_c	87 kPa	C_c	1.133
Sample Depth	6.50 m	OC Ratio	1.6	W_o	54.9 %
Sample Elev.	86.11 m	Void Ratio	1.508	Unit Wt.	16.9 kN/m³

Note: Overburden stress calculated from original ground surface (91.80m)

CLIENT Mattamy Homes
 PROJECT Geotechnical Investigation - Half-Moon Bay West -
Cambrian Road

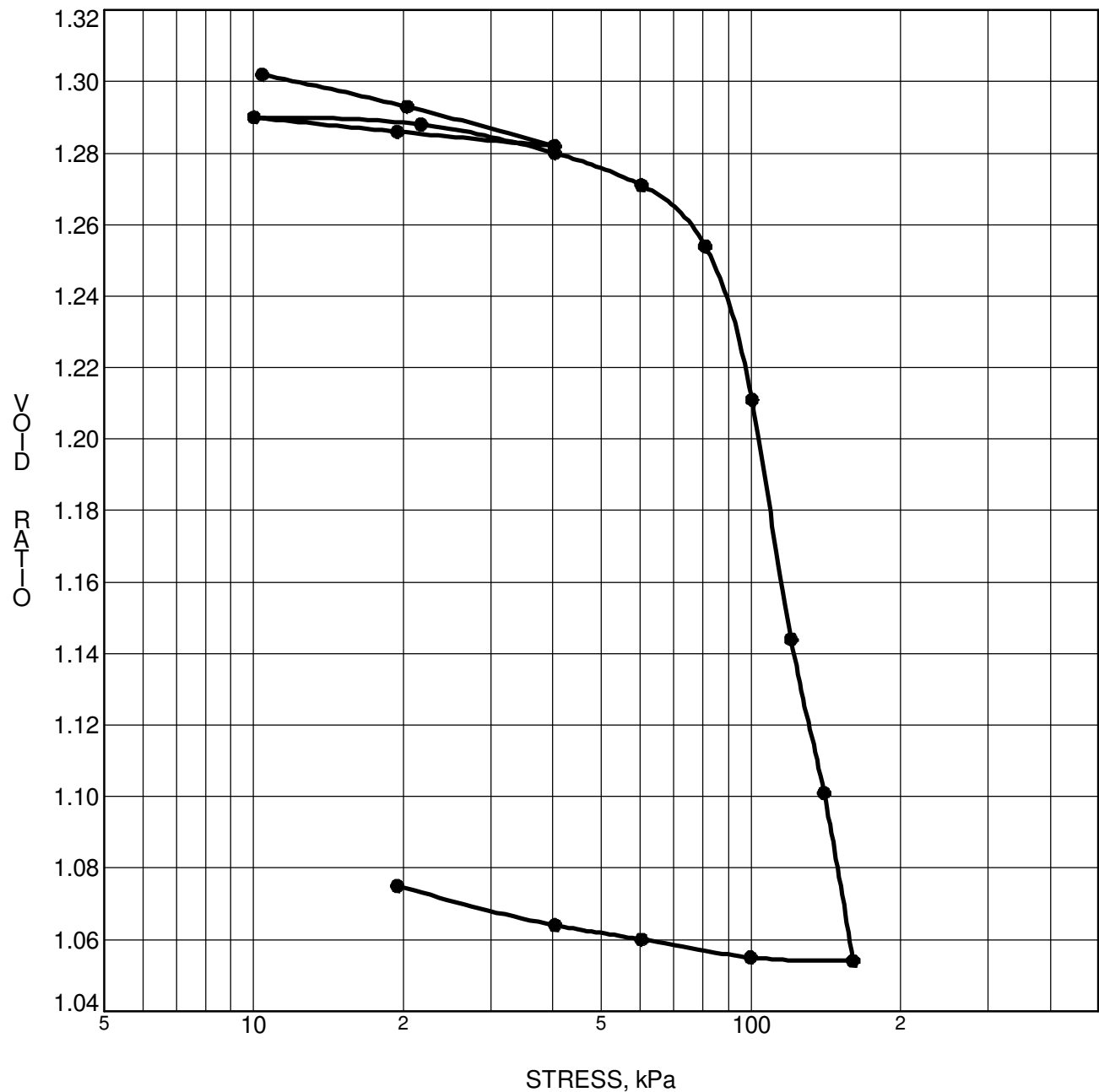
FILE NO. PG2246
 DATE 02/22/2011

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH15-10	p'_o	54.3 kPa	C_{cr}	0.015
Sample No.	TW 4	p'_c	87.9 kPa	C_c	0.778
Sample Depth	6.60 m	OC Ratio	1.6	W_o	47.7 %
Sample Elev.	86.01 m	Void Ratio	1.313	Unit Wt.	17.4 kN/m³

Note: Overburden stress calculated from original ground surface (91.80m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Half-Moon Bay West -**
Cambrian Road

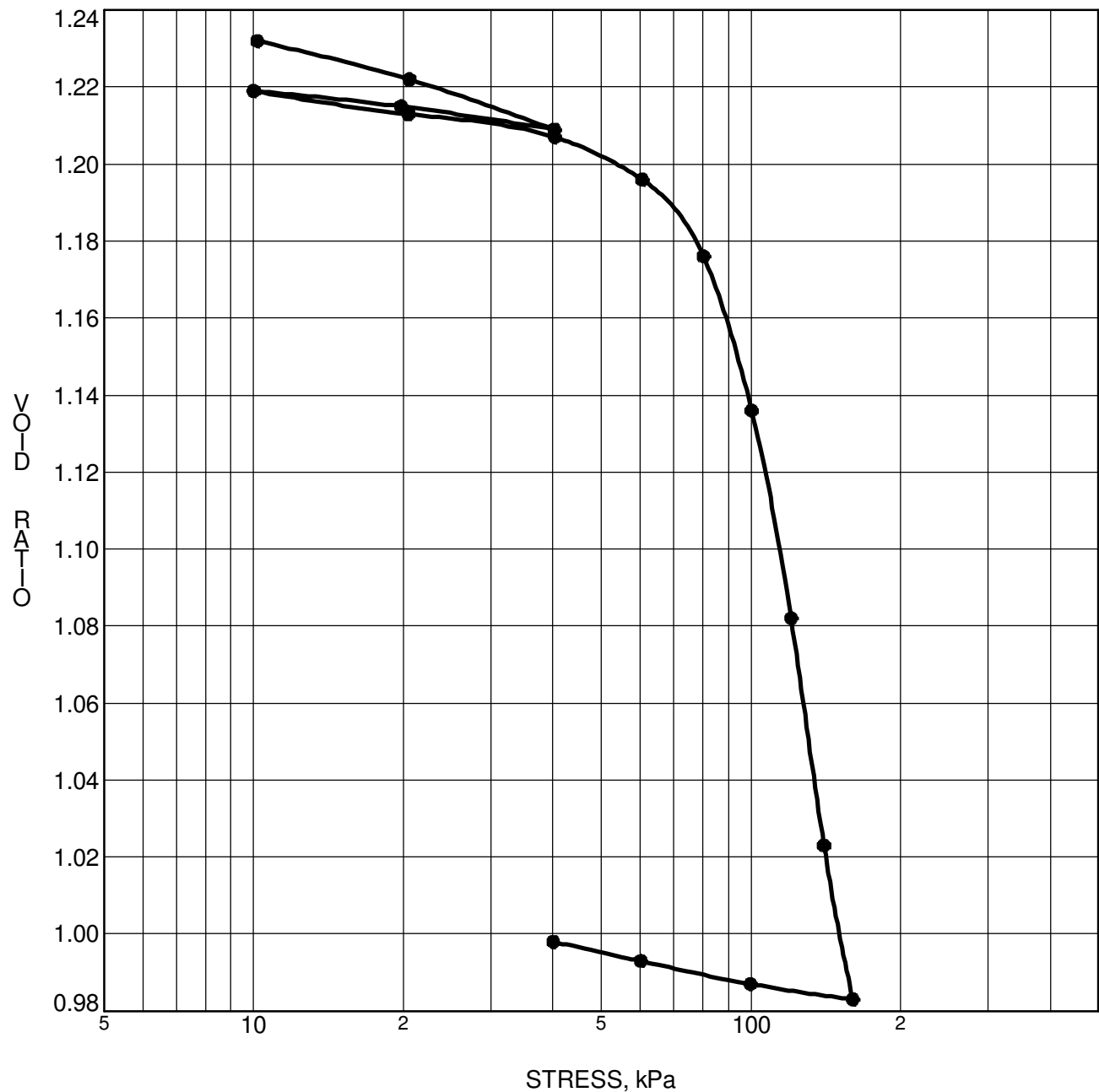
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 DATE **02/10/2011**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH20-10	p'_o	38 kPa	C_{cr}	0.019
Sample No.	TW 7	p'_c	90 kPa	C_c	0.763
Sample Depth	5.80 m	OC Ratio	2.4	W_o	45.3 %
Sample Elev.	88.78 m	Void Ratio	1.244	Unit Wt.	17.6 kN/m³

Note: Overburden stress calculated from original ground surface (92.20m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Half-Moon Bay West -**
Cambrian Road

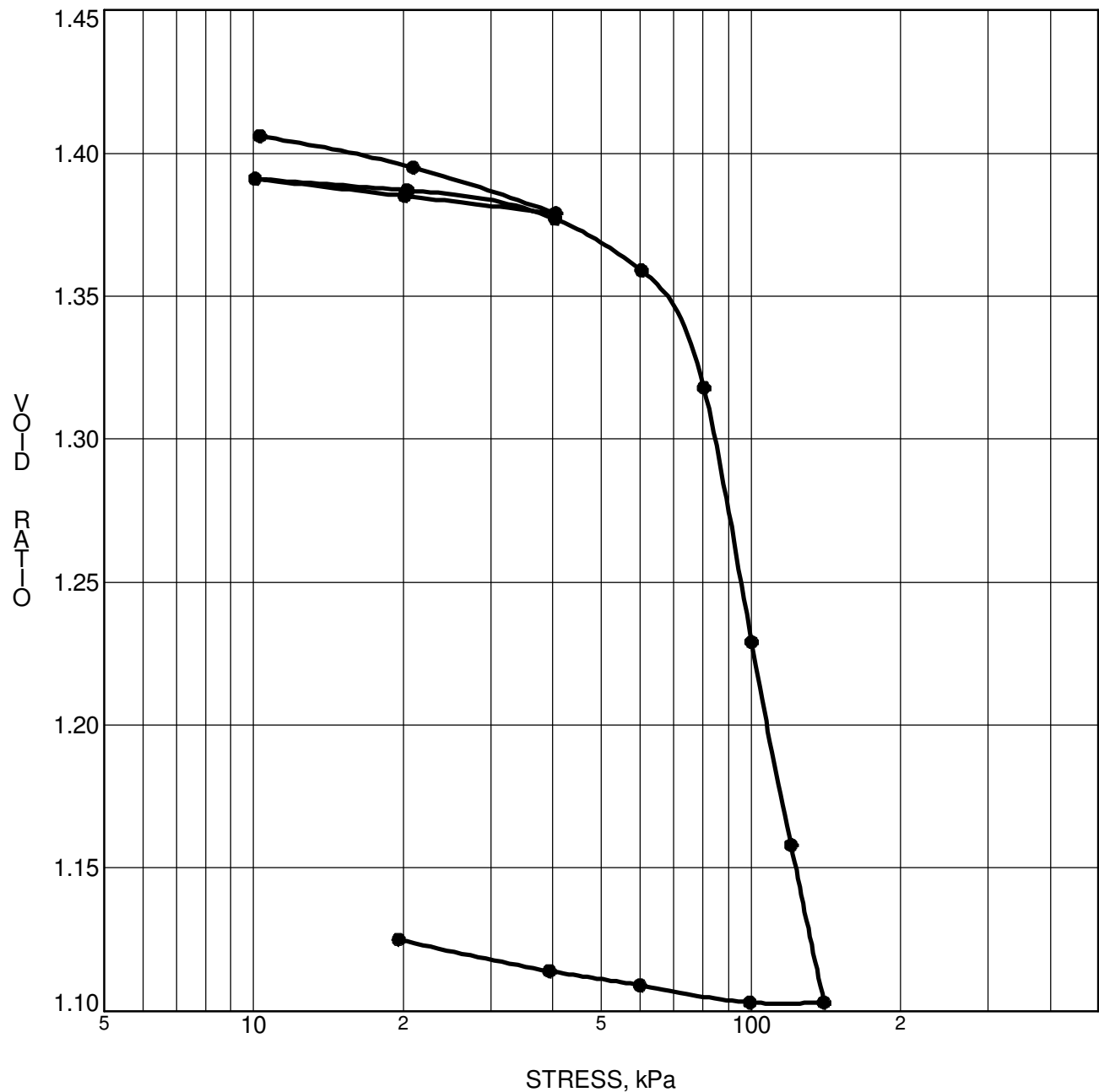
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 DATE **03/01/2011**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH23-10	p'_o	35.8 kPa	C_{cr}	0.022
Sample No.	TW 6	p'_c	74 kPa	C_c	0.903
Sample Depth	3.50 m	OC Ratio	2.1	W_o	51.7 %
Sample Elev.	89.66 m	Void Ratio	1.422	Unit Wt.	17.2 kN/m³

Note: Overburden stress calculated from original ground surface (93.10m)

CLIENT Mattamy Homes
 PROJECT Geotechnical Investigation - Half-Moon Bay West -
Cambrian Road

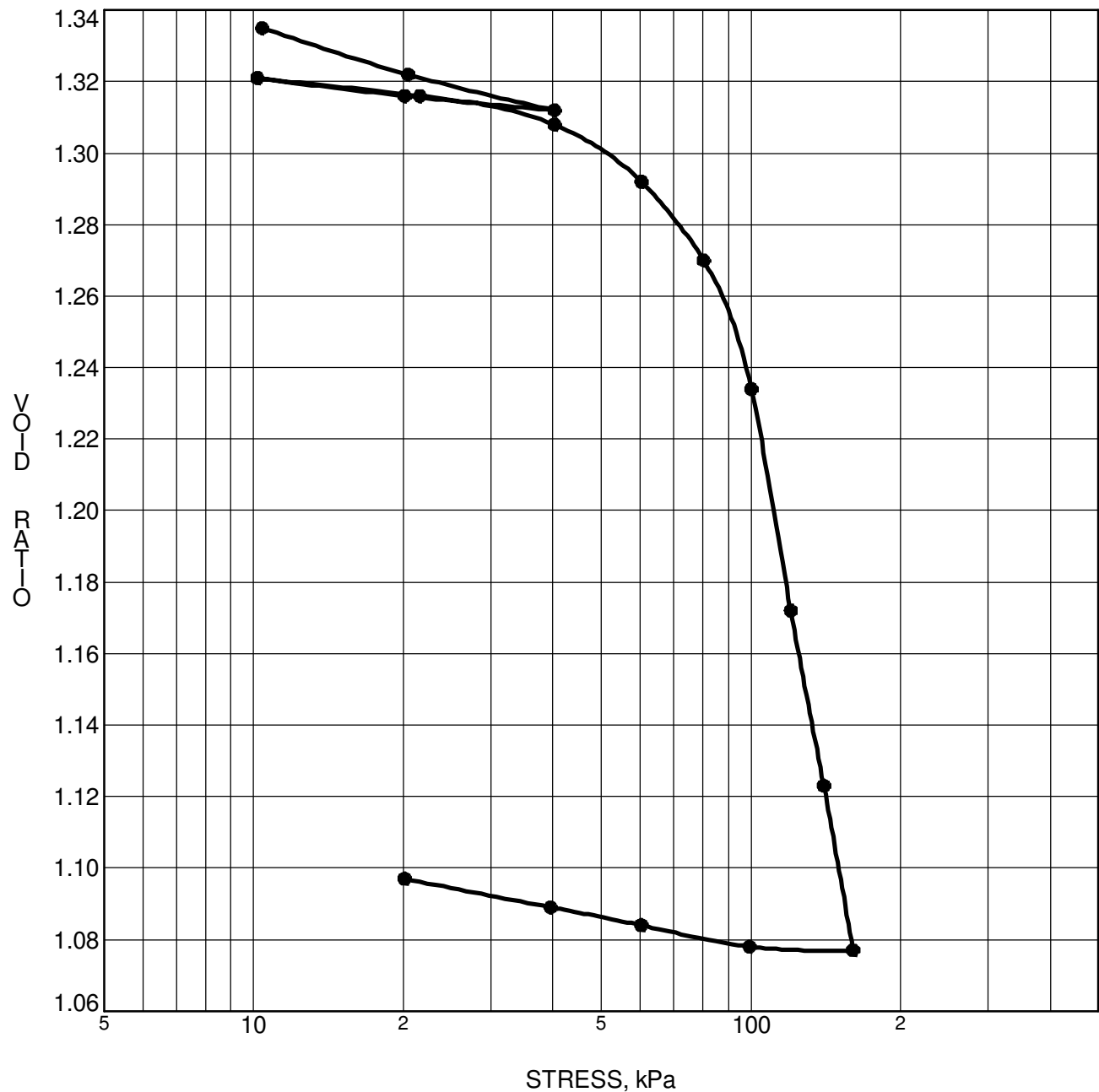
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 DATE 03/01/2011

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH24-10	p'_o	55.3 kPa	C_{cr}	0.017
Sample No.	TW 4	p'_c	90 kPa	C_c	0.784
Sample Depth	6.56 m	OC Ratio	1.6	W_o	49.3 %
Sample Elev.	86.52 m	Void Ratio	1.356	Unit Wt.	17.4 kN/m³

Note: Overburden stress calculated from original ground surface (93.10m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Half-Moon Bay West -**
Cambrian Road

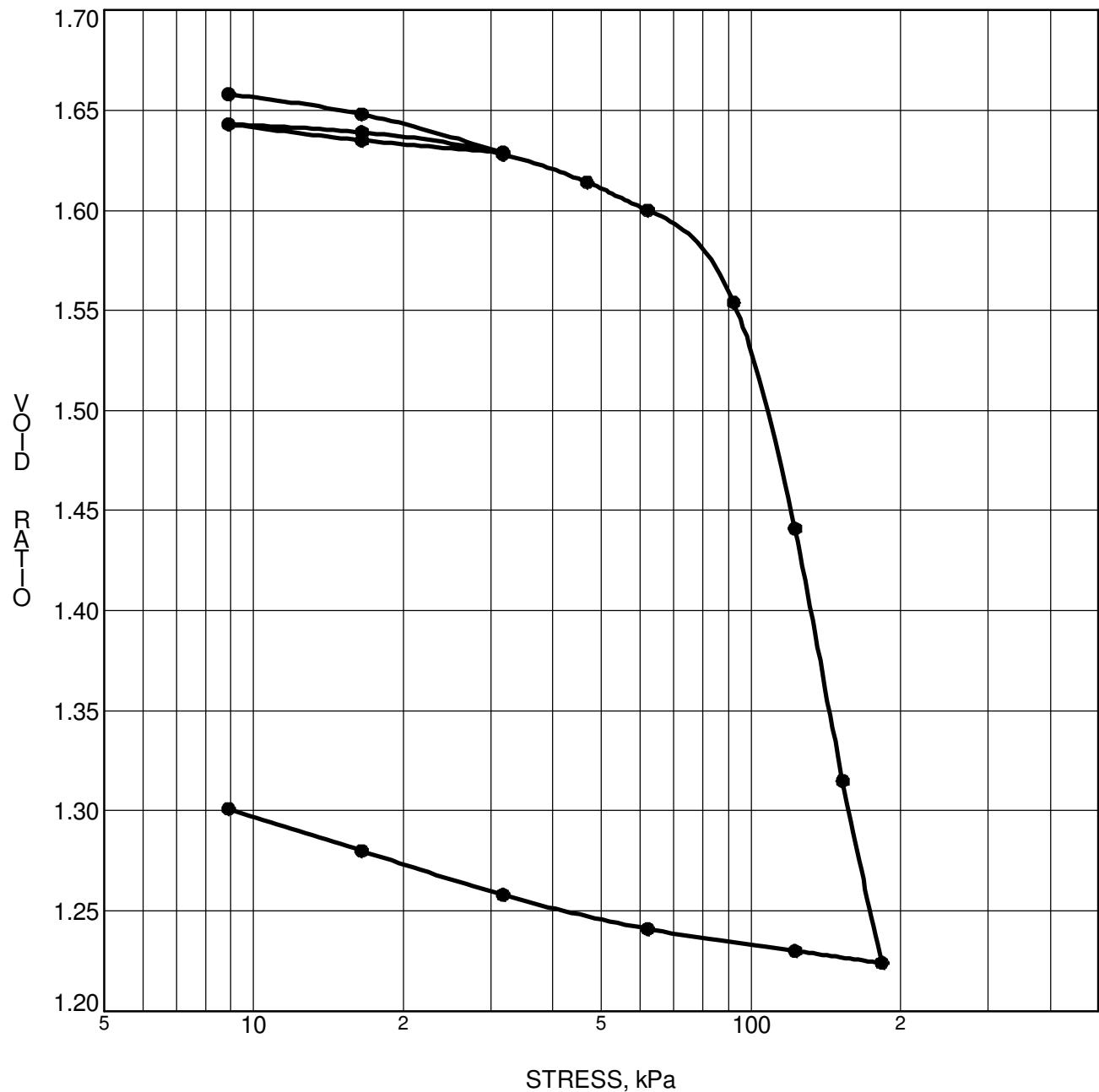
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 DATE **03/01/2011**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH14-08	p'_o	44.5 kPa	C_{cr}	0.016
Sample No.	TW 6	p'_c	92 kPa	C_c	1.214
Sample Depth	8.02 m	OC Ratio	2.1	W_o	60.6 %
Sample Elev.	87.85 m	Void Ratio	1.667	Unit Wt.	16.3 kN/m³

Note: Overburden stress calculated from original ground surface (92.2m)

CLIENT Mattamy Homes

PROJECT Geotechnical Investigation - Proposed Residential

Development-Half Moon Bay

FILE NO. PG1618

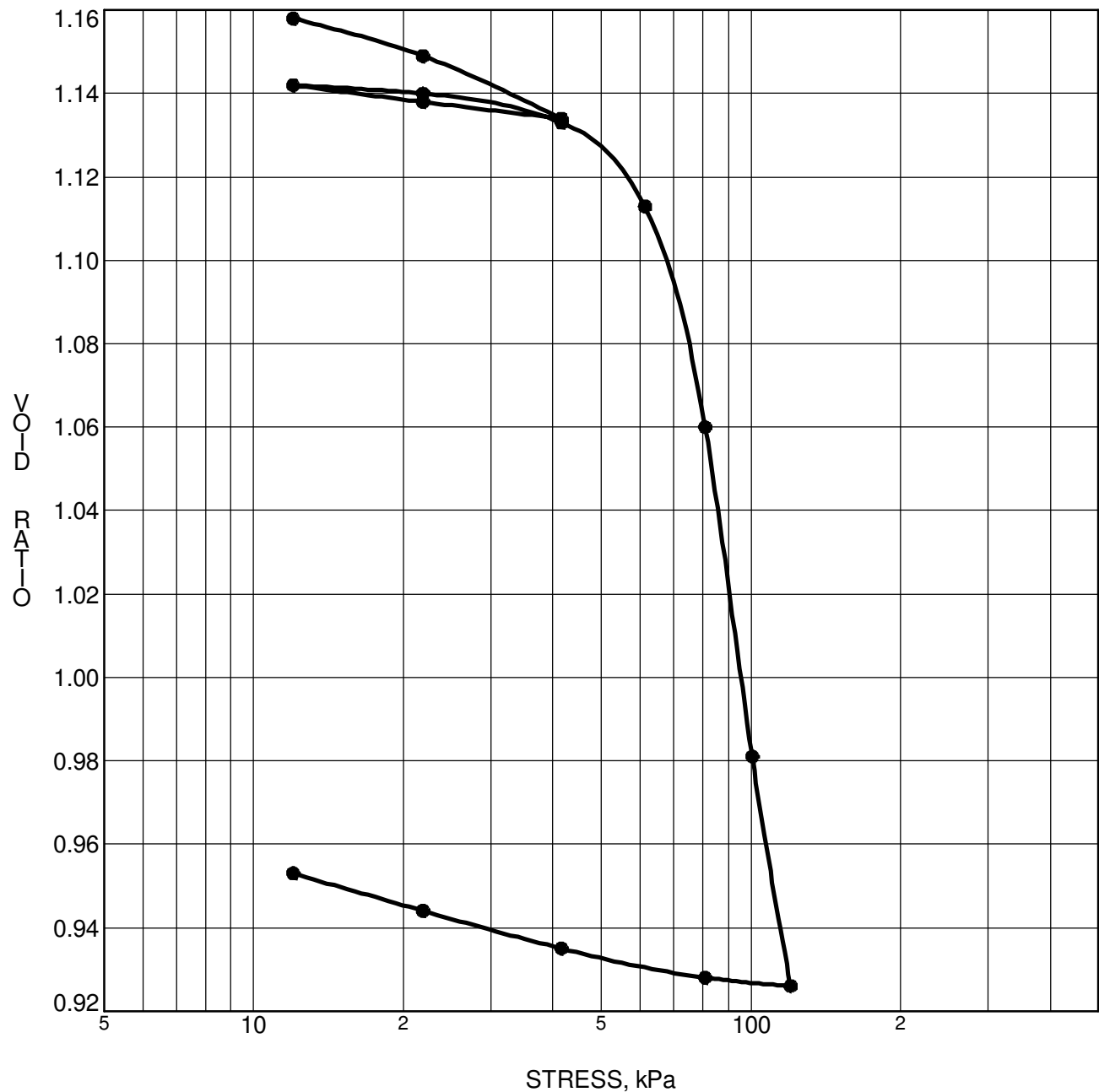
DATE Apr 7/08

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH15-08	p'_o	30.5 kPa	C_{cr}	0.011
Sample No.	TW 5	p'_c	69 kPa	C_c	0.761
Sample Depth	4.28 m	OC Ratio	2.3	W_o	42.5 %
Sample Elev.	89.00 m	Void Ratio	1.168	Unit Wt.	17.8 kN/m³

Note: Overburden stress calculated from original ground surface (92.40m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

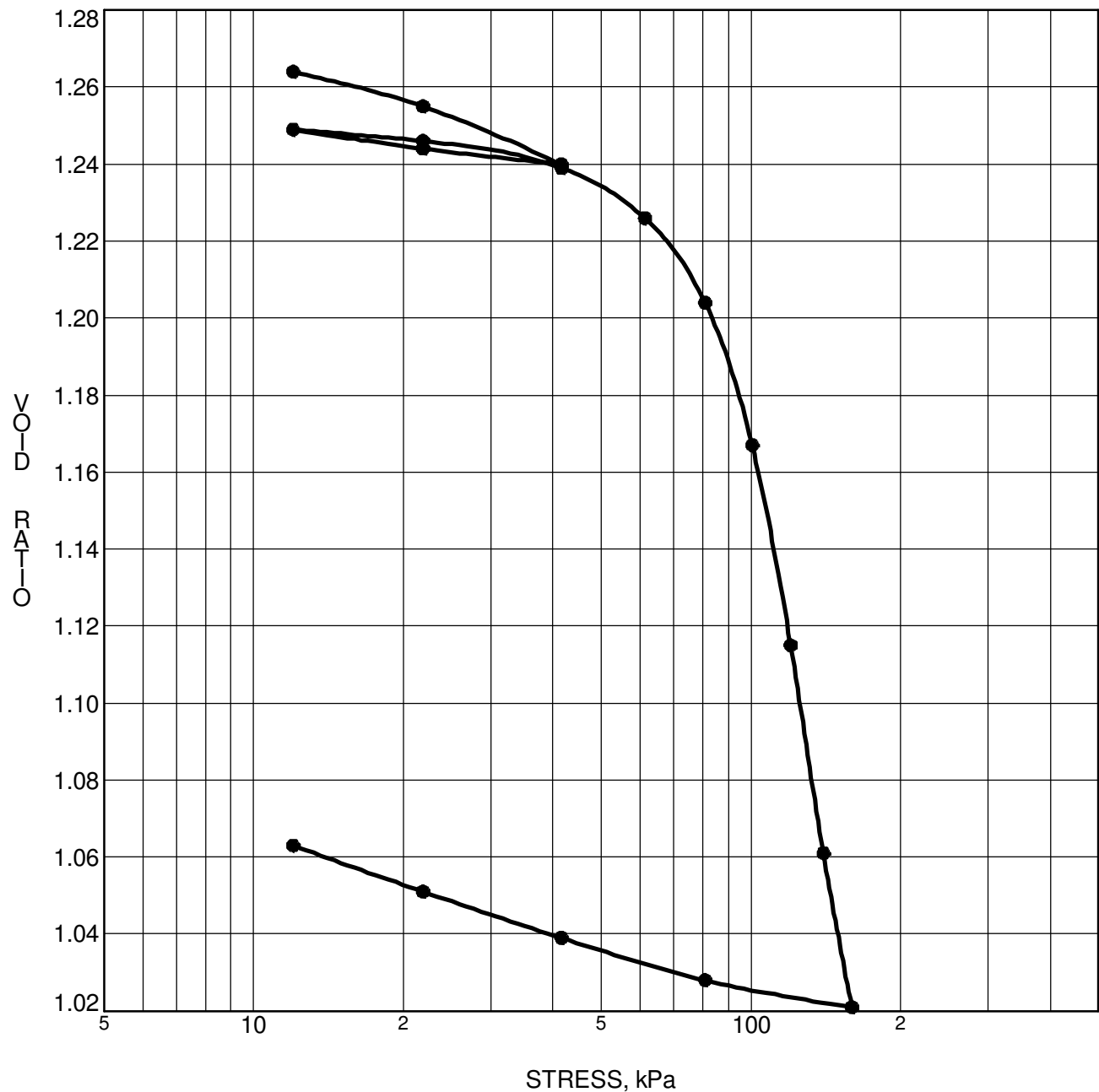
FILE NO. **PG1618**
 DATE **April 27/08**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH20-08	p'_o	42.2 kPa	C_{cr}	0.015
Sample No.	TW 6	p'_c	88 kPa	C_c	0.763
Sample Depth	5.79 m	OC Ratio	2.1	W_o	46.5 %
Sample Elev.	88.26 m	Void Ratio	1.278	Unit Wt.	17.3 kN/m³

Note: Overburden stress calculated from original ground surface (92.20m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

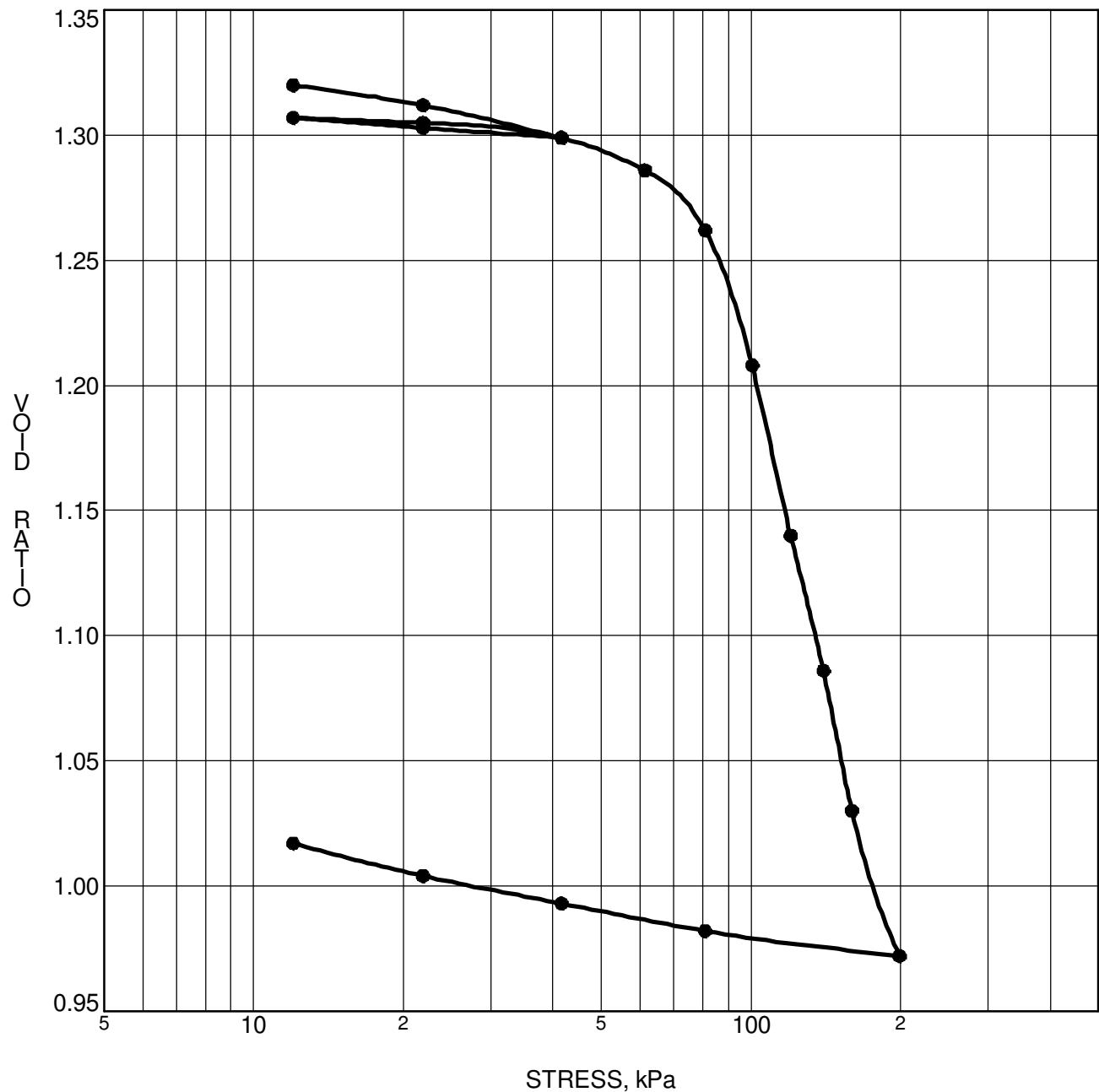
FILE NO. **PG1618**
 DATE **April 3/08**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH22-08	p'_o	45.5 kPa	C_{cr}	0.010
Sample No.	TW 4	p'_c	85 kPa	C_c	0.902
Sample Depth	4.27 m	OC Ratio	1.9	W_o	48.4 %
Sample Elev.	87.99 m	Void Ratio	1.33	Unit Wt.	17.1 kN/m³

Note: Overburden stress calculated from original ground surface (92.80m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

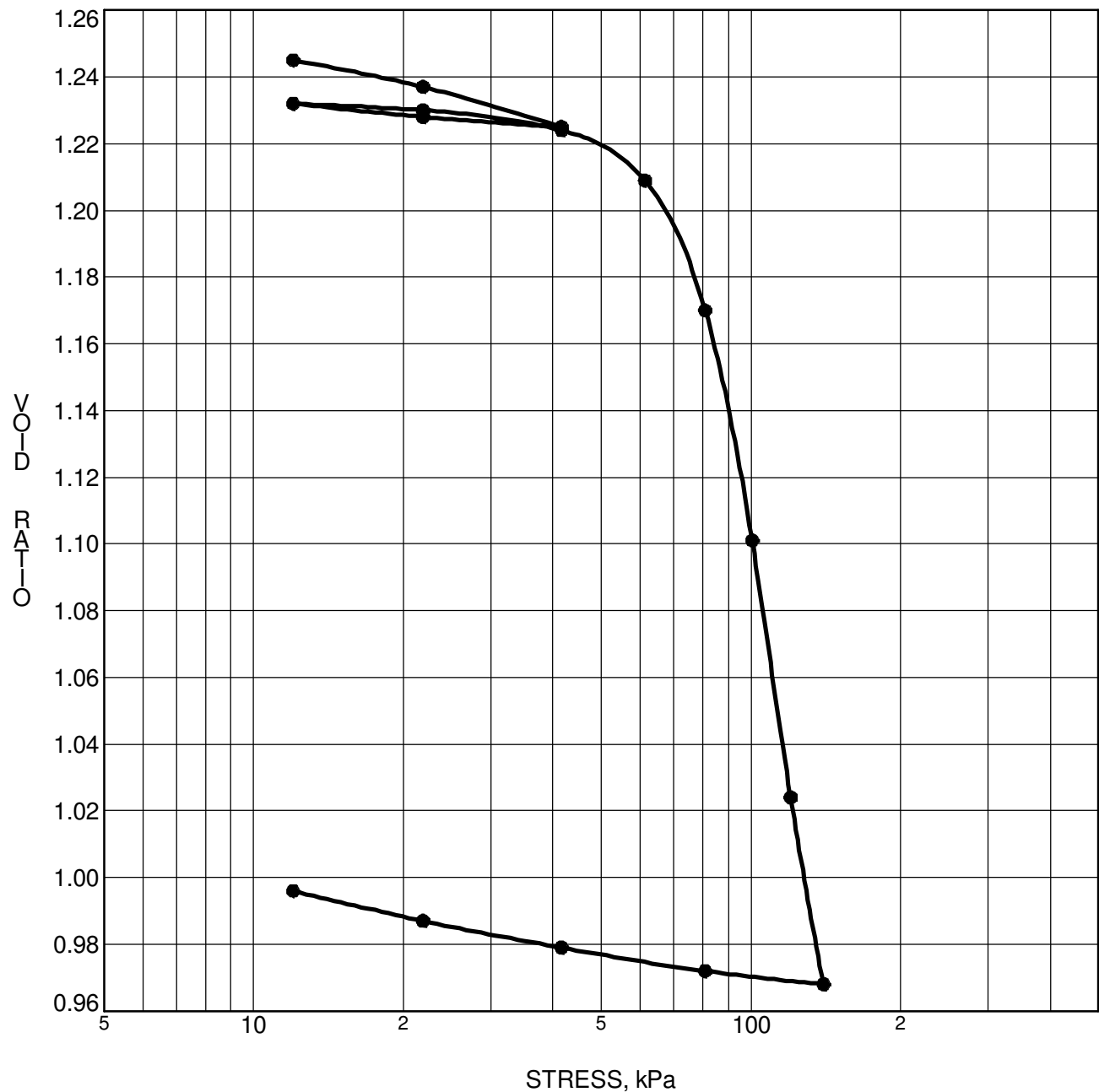
FILE NO. **PG1618**
 DATE **Mar 31/08**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH29-08	p'_o	48.3 kPa	C_{cr}	0.014
Sample No.	TW 5	p'_c	78 kPa	C_c	0.905
Sample Depth	7.20 m	OC Ratio	1.6	W_o	45.6 %
Sample Elev.	84.79 m	Void Ratio	1.254	Unit Wt.	17.4 kN/m³

Note: Overburden stress calculated from original ground surface (91.90m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

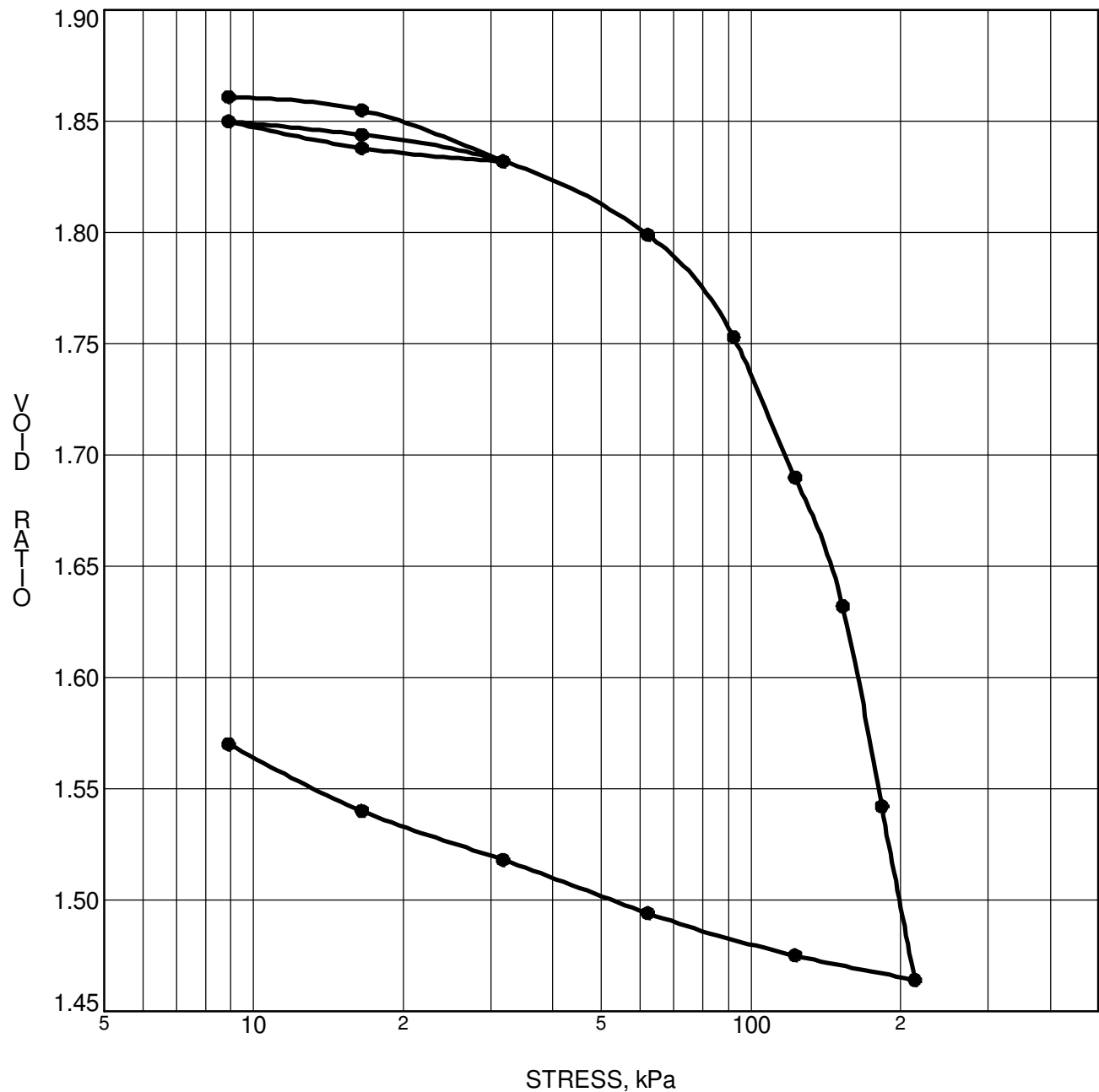
FILE NO. **PG1618**
 DATE **April 28/2008**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 1-07	p'_o	58 kPa	C_{cr}	0.033
Sample No.	TW 3	p'_c	108 kPa	C_c	1.165
Sample Depth	3.25 m	OC Ratio	1.9	W_o	67.7 %
Sample Elev.	89.01 m	Void Ratio	1.862	Unit Wt.	15.8 kN/m³

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

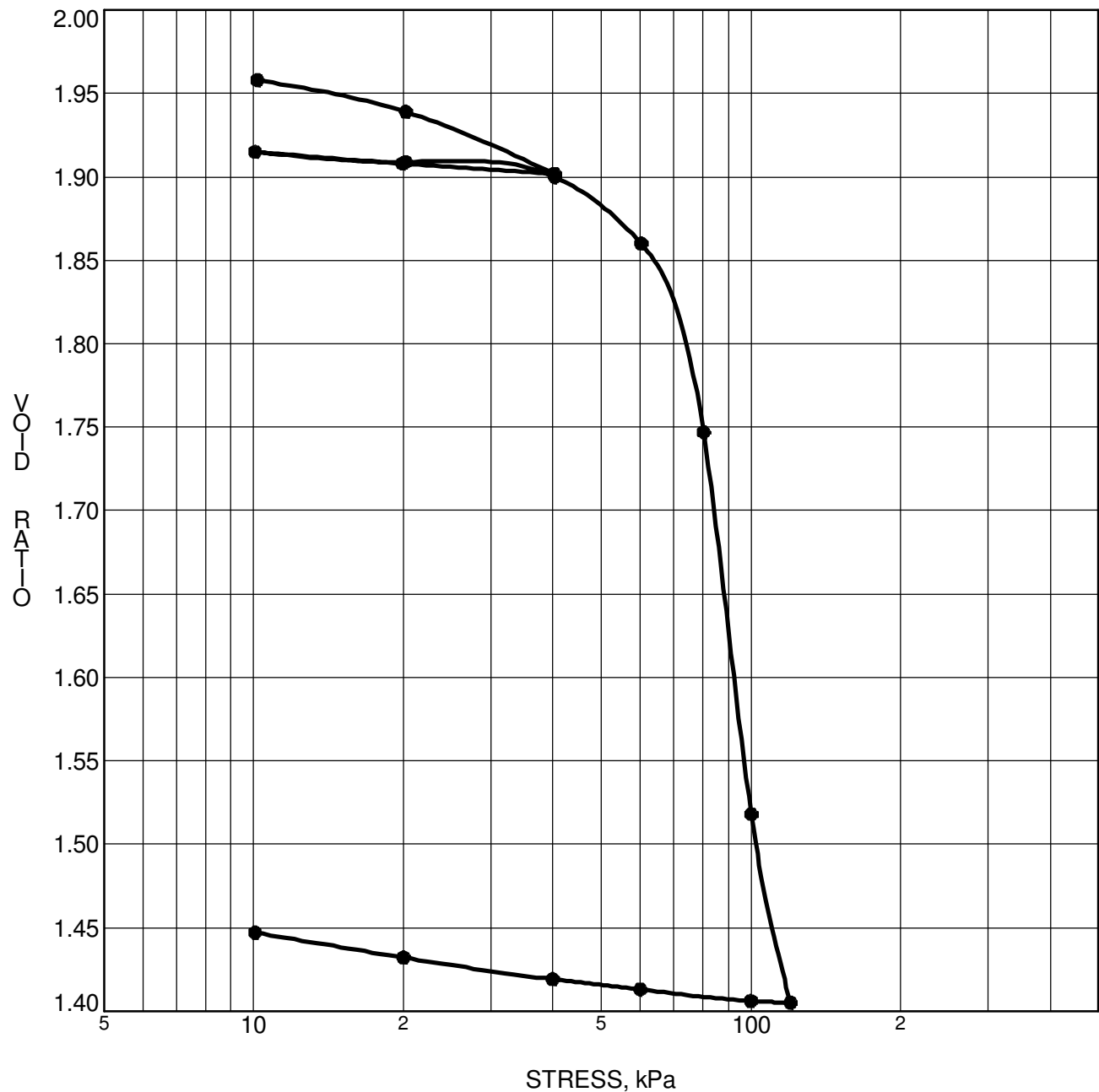
FILE NO. **PG0177**
 DATE **07/23/2007**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 1-07	p'_o	59 kPa	C_{cr}	0.024
Sample No.	TW 4	p'_c	71 kPa	C_c	2.352
Sample Depth	5.54 m	OC Ratio	1.2	W_o	71.9 %
Sample Elev.	86.72 m	Void Ratio	1.978	Unit Wt.	15.6 kN/m³

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential**
Development-Half Moon Bay

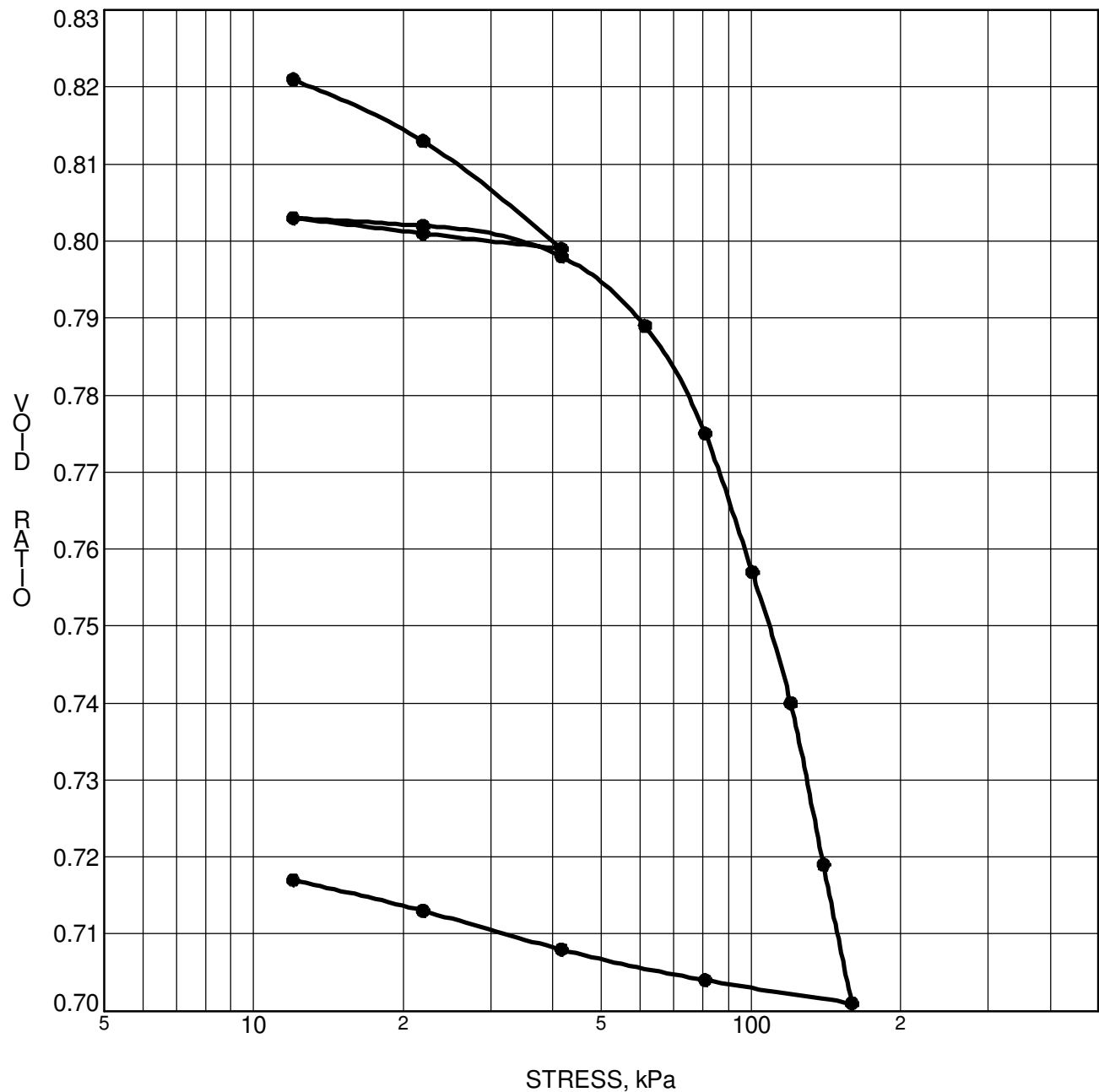
FILE NO. **PG0177**
 DATE **07/27/2007**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 2-07	p'_o	53 kPa	C_{cr}	0.009
Sample No.	TW 4	p'_c	87 kPa	C_c	0.324
Sample Depth	4.95 m	OC Ratio	1.6	W_o	30.2 %
Sample Elev.	87.62 m	Void Ratio	0.829	Unit Wt.	19.2 kN/m³

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

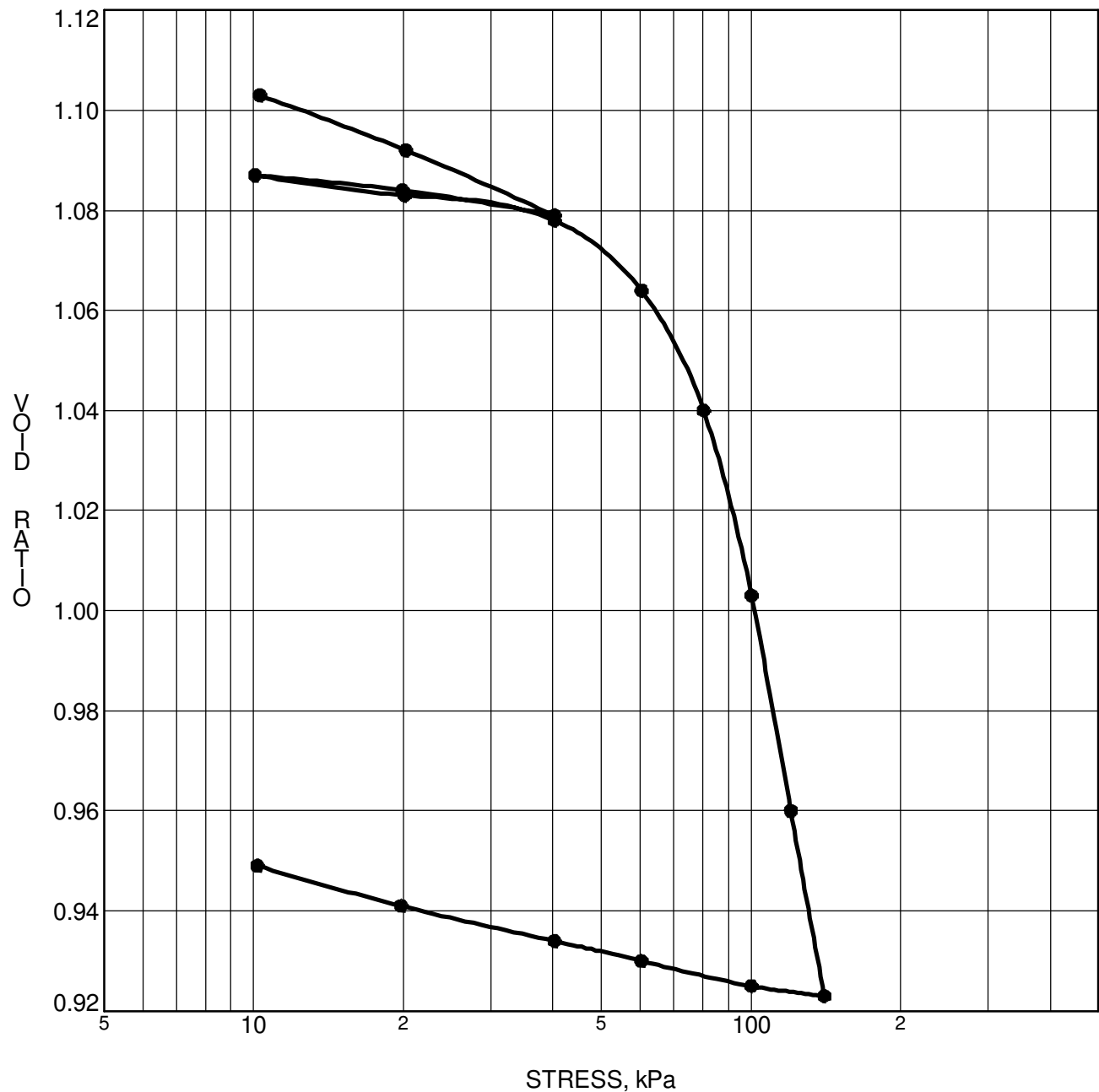
FILE NO. **PG0177**
 DATE **07/23/2007**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 3-07	p'_o	34 kPa	C_{cr}	0.014
Sample No.	TW 3	p'_c	81 kPa	C_c	0.550
Sample Depth	2.54 m	OC Ratio	2.4	W_o	40.6 %
Sample Elev.	90.13 m	Void Ratio	1.115	Unit Wt.	17.9 kN/m³

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential**
Development-Half Moon Bay

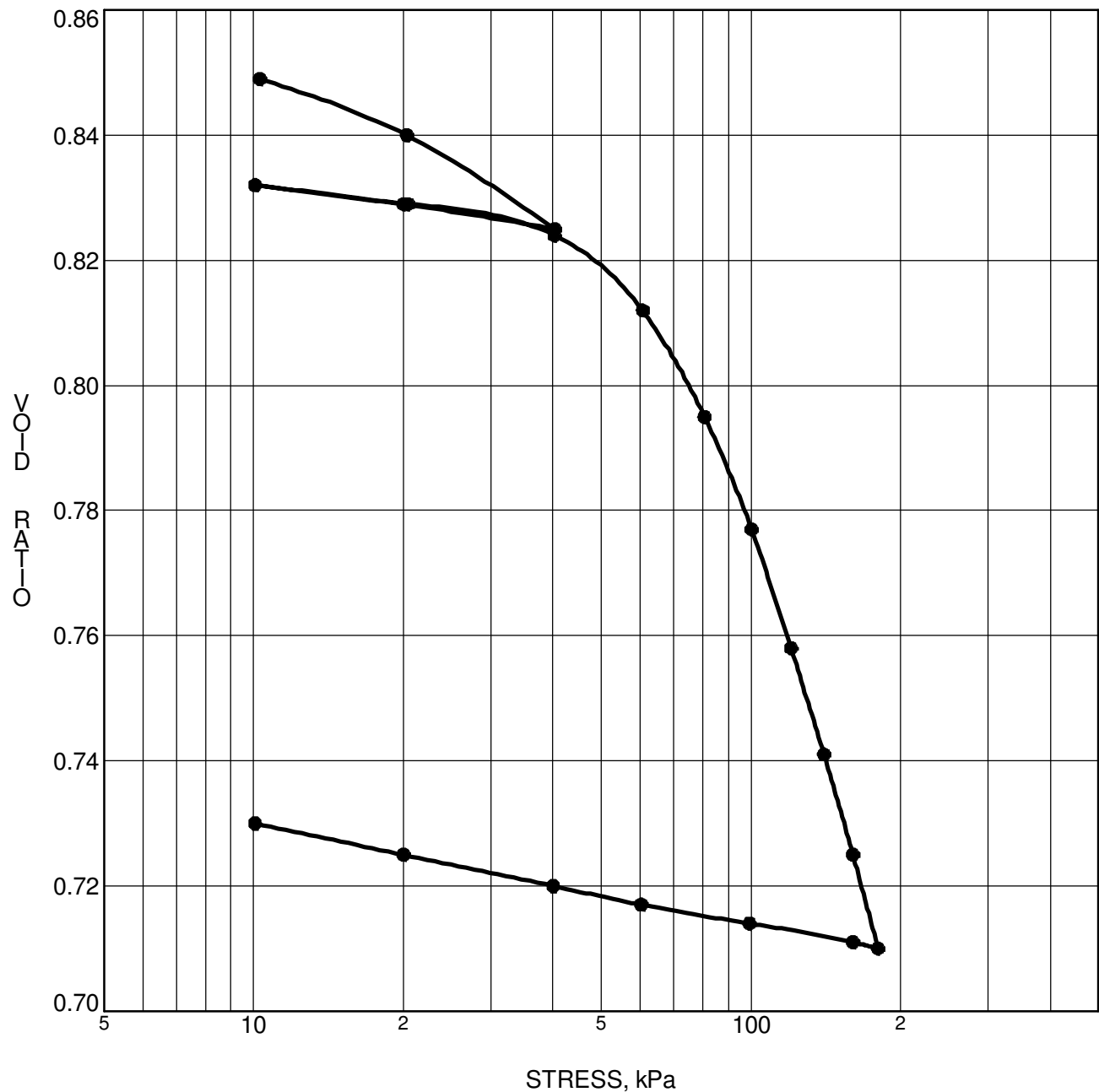
FILE NO. **PG0177**
 DATE **07/31/2007**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 3-07	p'_o	45 kPa	C_{cr}	0.013
Sample No.	TW 4	p'_c	71 kPa	C_c	0.253
Sample Depth	4.19 m	OC Ratio	1.6	W_o	31.5 %
Sample Elev.	88.48 m	Void Ratio	0.866	Unit Wt.	19.0 kN/m³

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

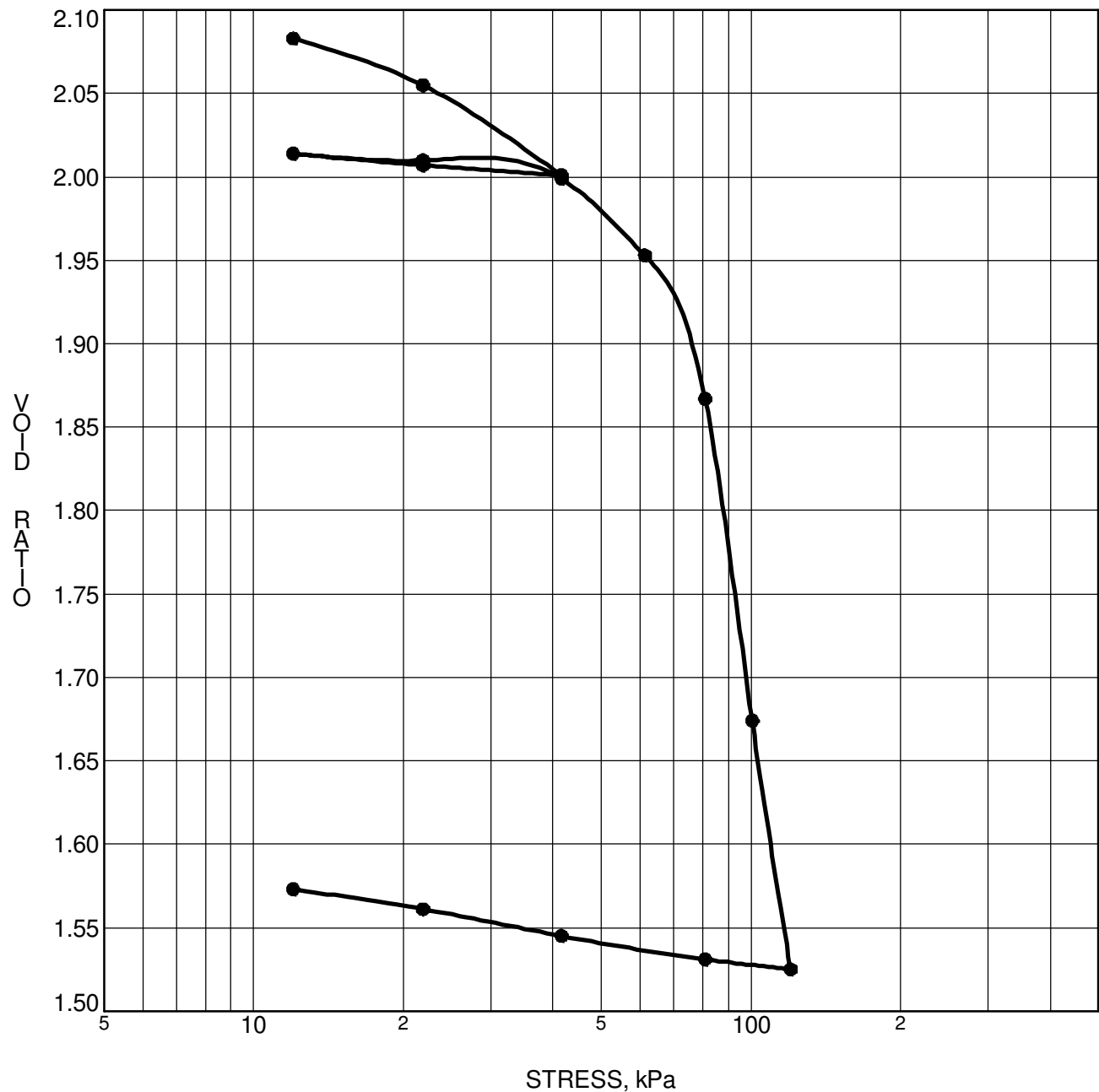
FILE NO. **PG0177**
 DATE **07/27/2007**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 3-06	p'_o	47 kPa	C_{cr}	0.027
Sample No.	TW 4	p'_c	72 kPa	C_c	2.044
Sample Depth	4.85 m	OC Ratio	1.5	W_o	76.6 %
Sample Elev.	87.15 m	Void Ratio	2.106	Unit Wt.	15.3 kN/m³

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

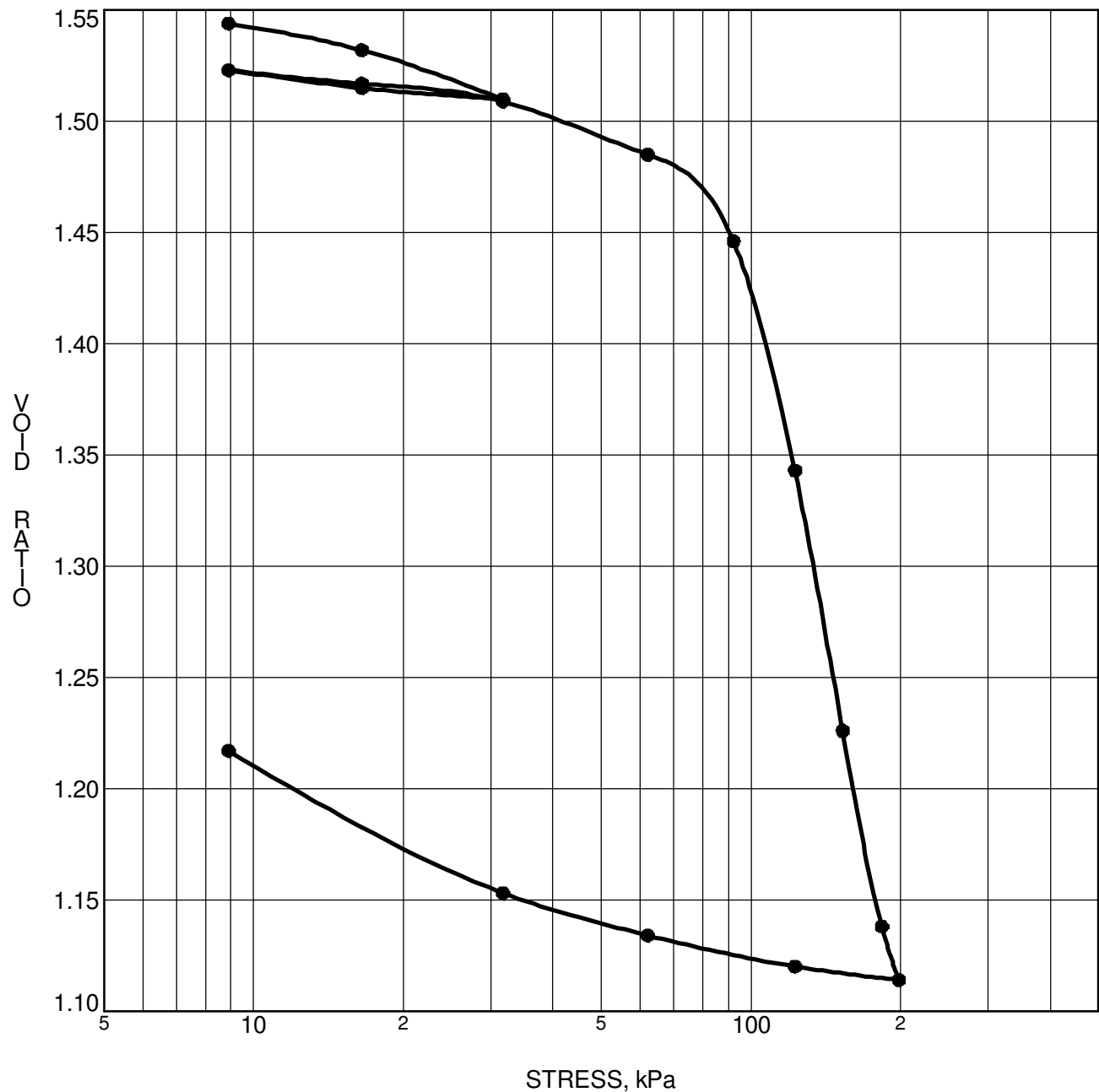
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 DATE **02/19/2017**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 5-06	p'_o	38.5 kPa	C_{cr}	0.026
Sample No.	TW 2	p'_c	96 kPa	C_c	1.185
Sample Depth	4.37 m	OC Ratio	2.5	W_o	56.4 %
Sample Elev.	88.24 m	Void Ratio	1.55	Unit Wt.	16.5 kN/m³

Note: Overburden stress calculated from original ground surface (92.61m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

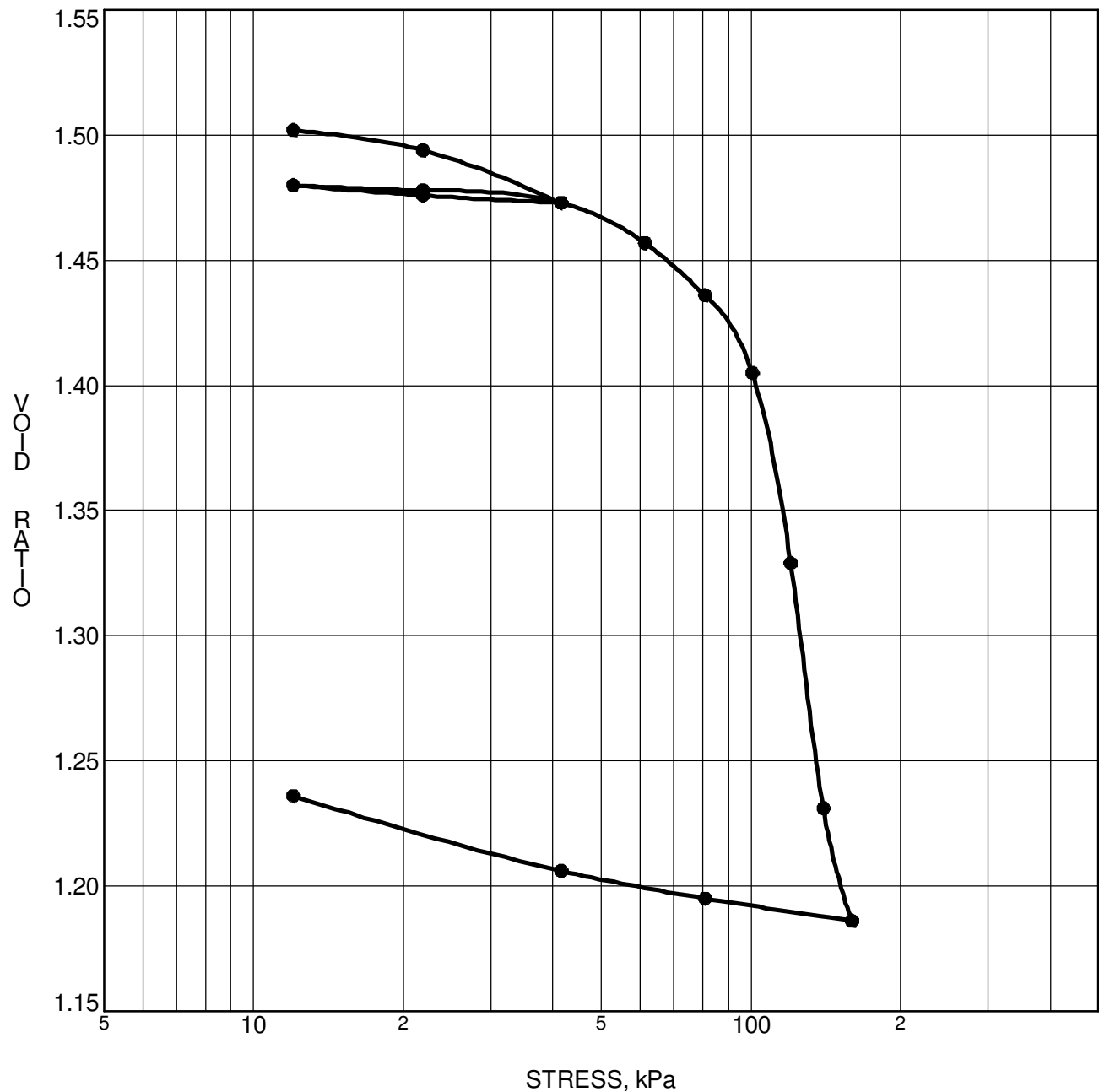
FILE NO. **PG0177**
 DATE **02/16/2007**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 6B-06	p'_o	32 kPa	C_{cr}	0.014
Sample No.	TW 1	p'_c	101 kPa	C_c	1.527
Sample Depth	2.67 m	OC Ratio	3.2	W_o	54.9 %
Sample Elev.	89.98 m	Void Ratio	1.51	Unit Wt.	16.6 kN/m³

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

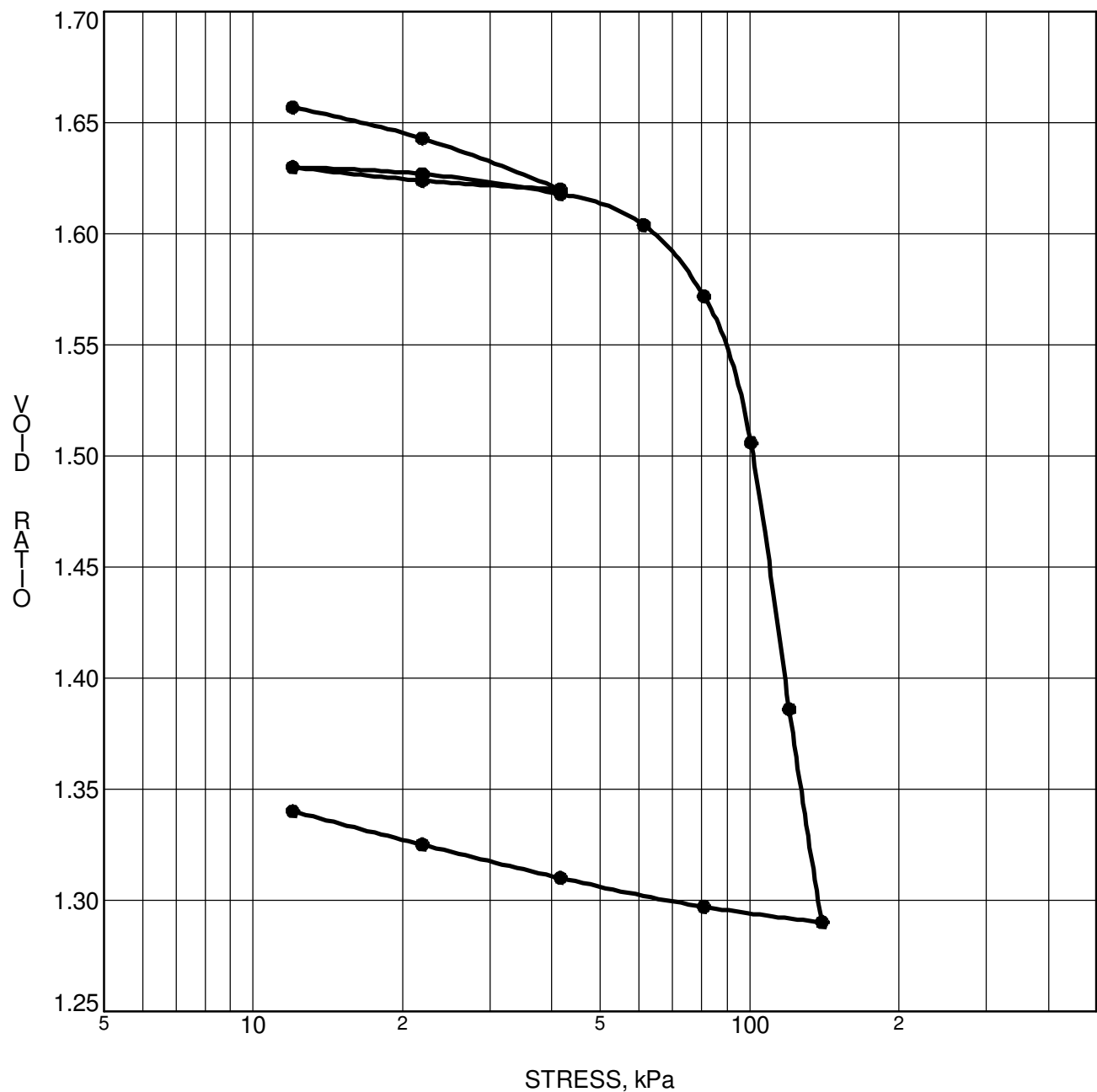
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 DATE **02/20/2007**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH16-06	p'_o	64.8 kPa	C_{cr}	0.022
Sample No.	TW 6	p'_c	89 kPa	C_c	1.483
Sample Depth	7.19 m	OC Ratio	1.4	W_o	60.8 %
Sample Elev.	84.74 m	Void Ratio	1.672	Unit Wt.	16.2 kN/m³

Note: Overburden stress calculated from original ground surface (91.93m)

CLIENT Mattamy Homes
 PROJECT Geotechnical Investigation - Proposed Residential Development-Half Moon Bay

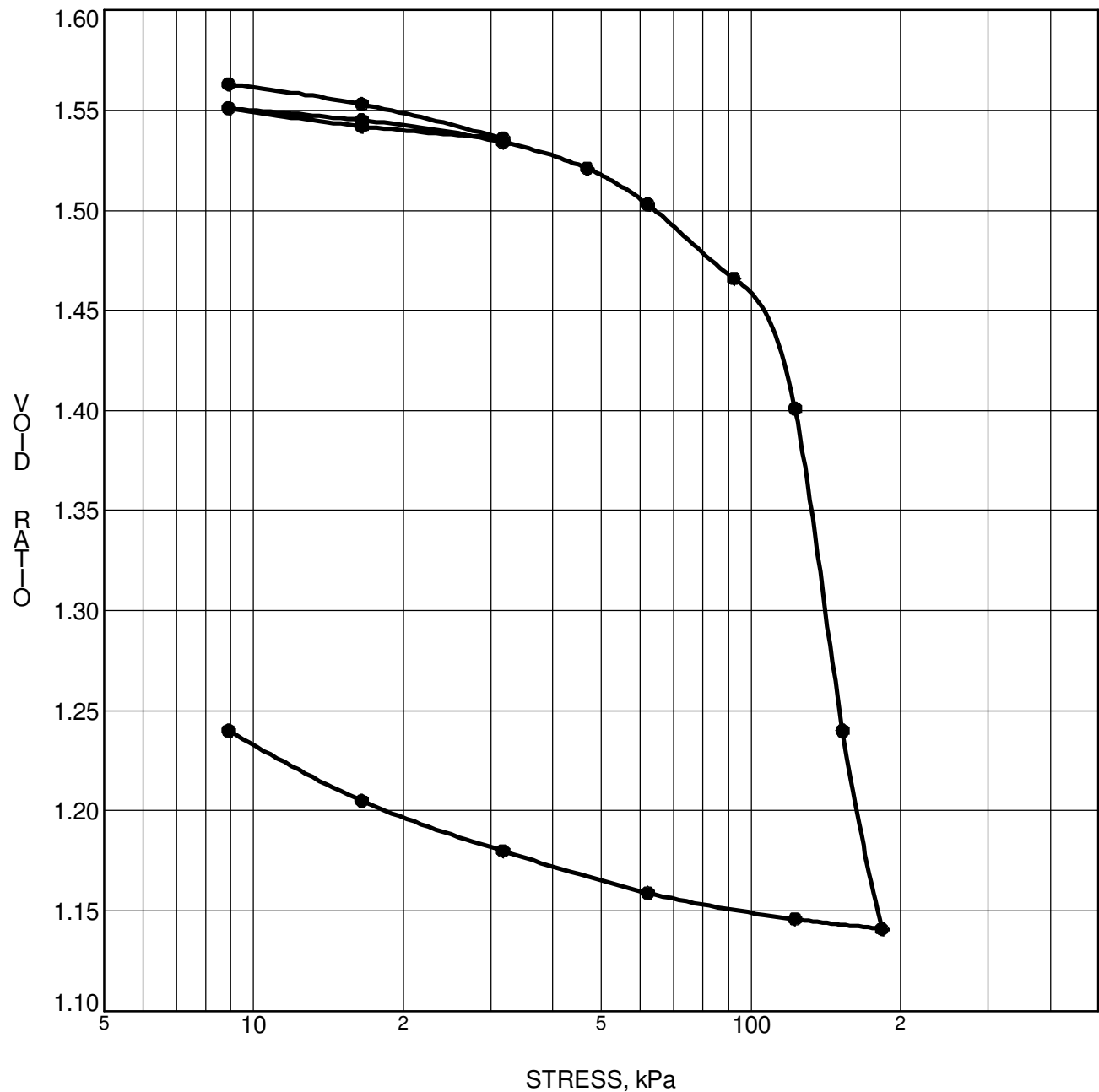
FILE NO. PG0177
 DATE 02/27/2007

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH17-06	p'_o	72.9 kPa	C_{cr}	0.310
Sample No.	TW 5	p'_c	106 kPa	C_c	1.671
Sample Depth	9.53 m	OC Ratio	1.5	W_o	57.0 %
Sample Elev.	82.71 m	Void Ratio	1.568	Unit Wt.	16.5 kN/m³

Note: Overburden stress calculated from original ground surface (92.24m)

CLIENT Mattamy Homes
 PROJECT Geotechnical Investigation - Proposed Residential
 Development-Half Moon Bay

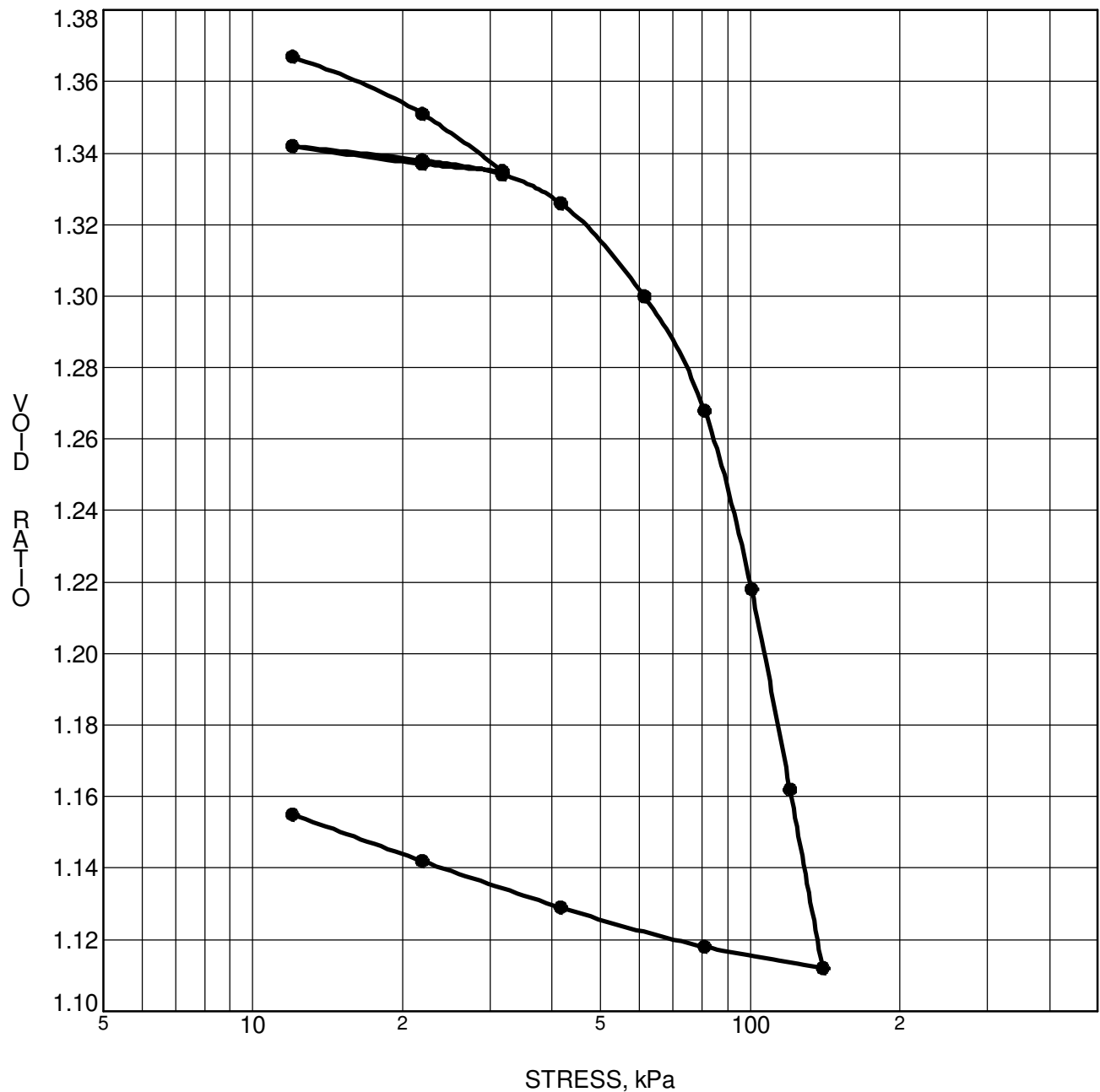
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 DATE 02/27/2007

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH18A-06	p'_o	44.8 kPa	C_{cr}	0.017
Sample No.	TW 5	p'_c	75 kPa	C_c	0.606
Sample Depth	4.92 m	OC Ratio	1.7	W_o	50.4 %
Sample Elev.	87.73 m	Void Ratio	1.386	Unit Wt.	17.0 kN/m³

Note: Overburden stress calculated from original ground surface (92.35m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

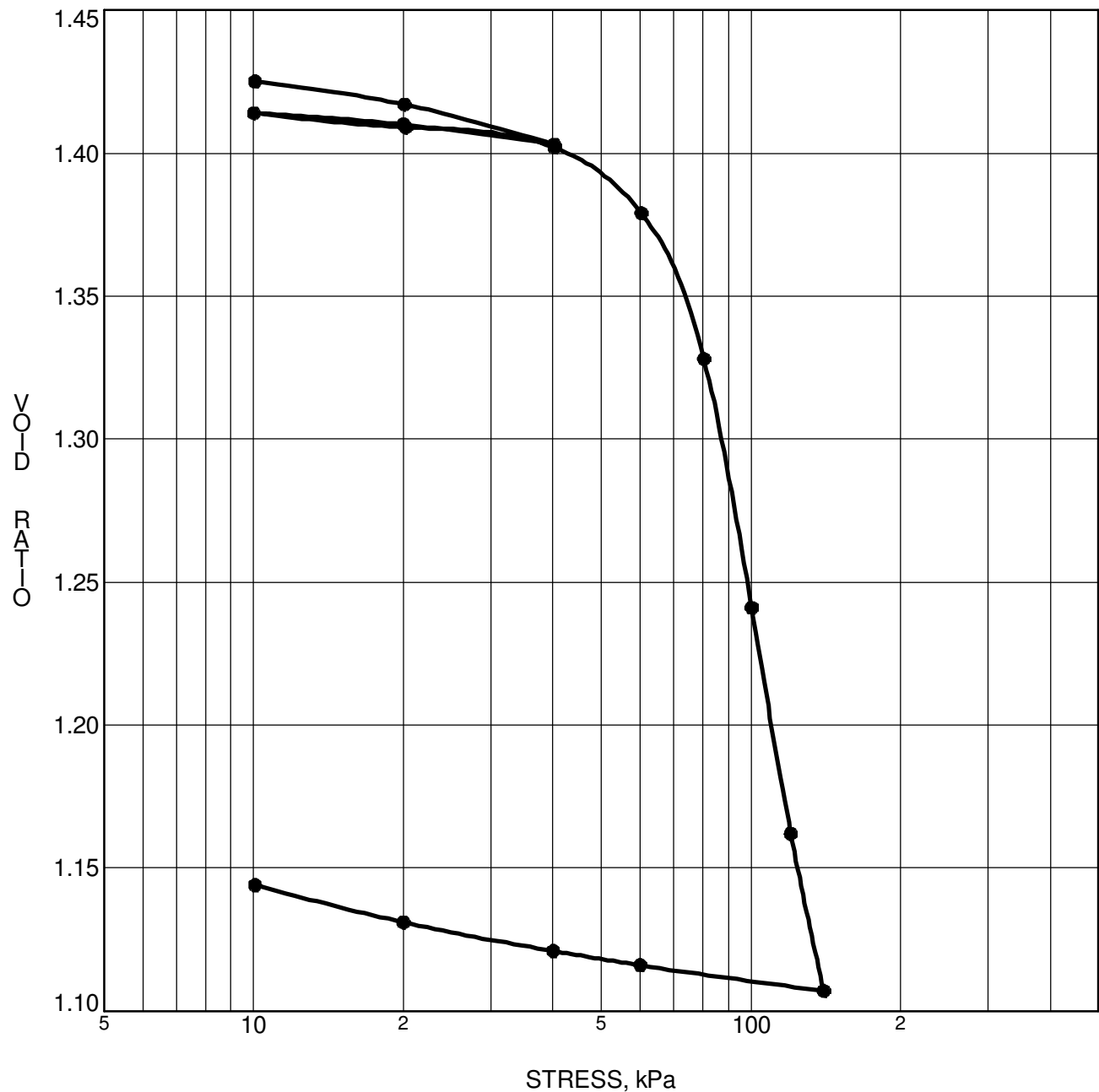
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 DATE **02/27/2007**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH20-06	p'_o	49 kPa	C_{cr}	0.020
Sample No.	TW 4	p'_c	71 kPa	C_c	0.943
Sample Depth	6.40 m	OC Ratio	1.4	W_o	52.2 %
Sample Elev.	85.65 m	Void Ratio	1.436	Unit Wt.	16.8 kN/m³

Note: Overburden stress calculated from original ground surface (92.05m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

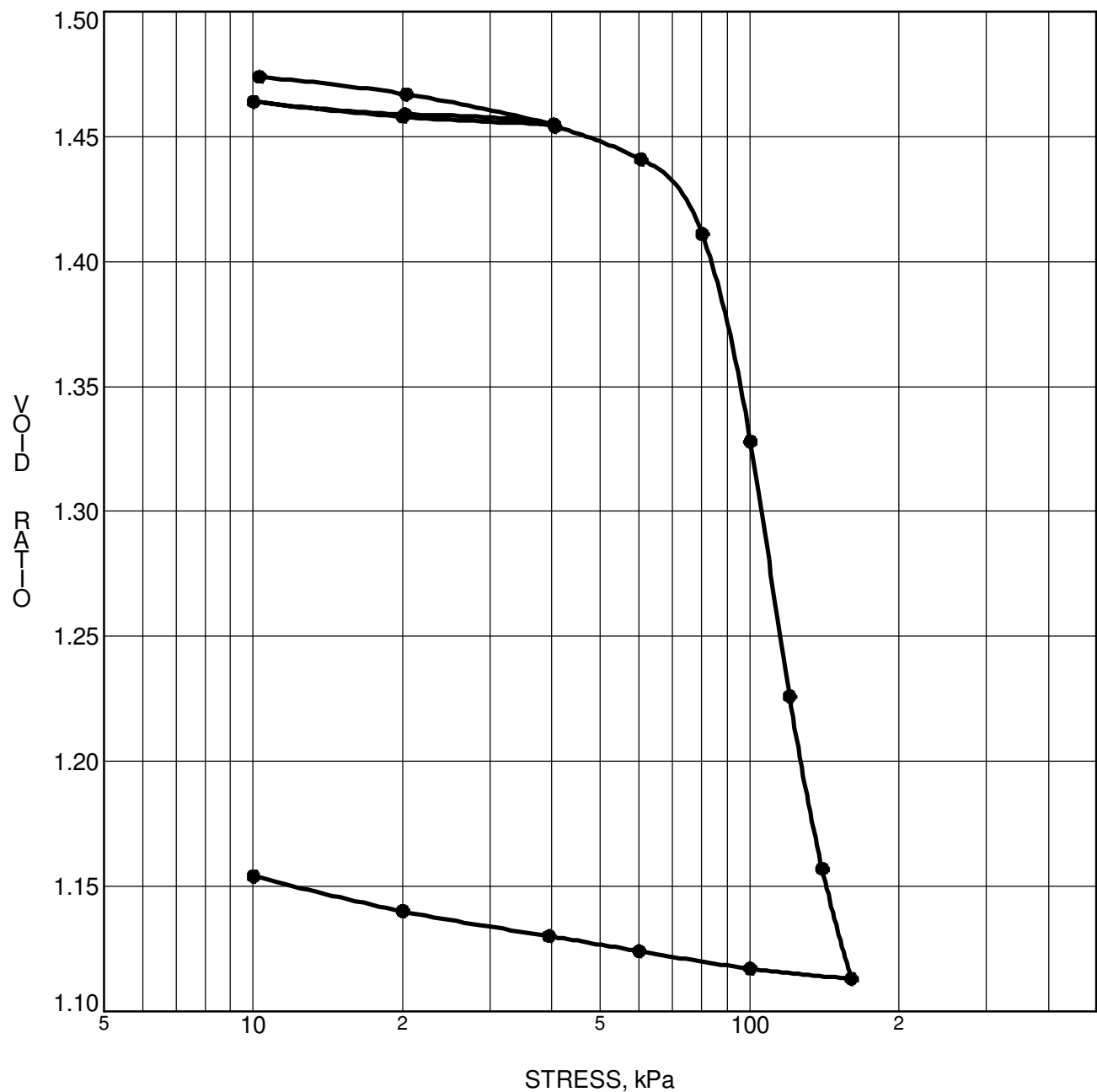
FILE NO. **PG0177**
 DATE **03/10/2007**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH24-06	p'_o	54.9 kPa	C_{cr}	0.018
Sample No.	TW 3	p'_c	84 kPa	C_c	1.309
Sample Depth	6.55 m	OC Ratio	1.5	W_o	54.0 %
Sample Elev.	86.53 m	Void Ratio	1.486	Unit Wt.	16.7 kN/m³

Note: Overburden stress calculated from original ground surface (93.08m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

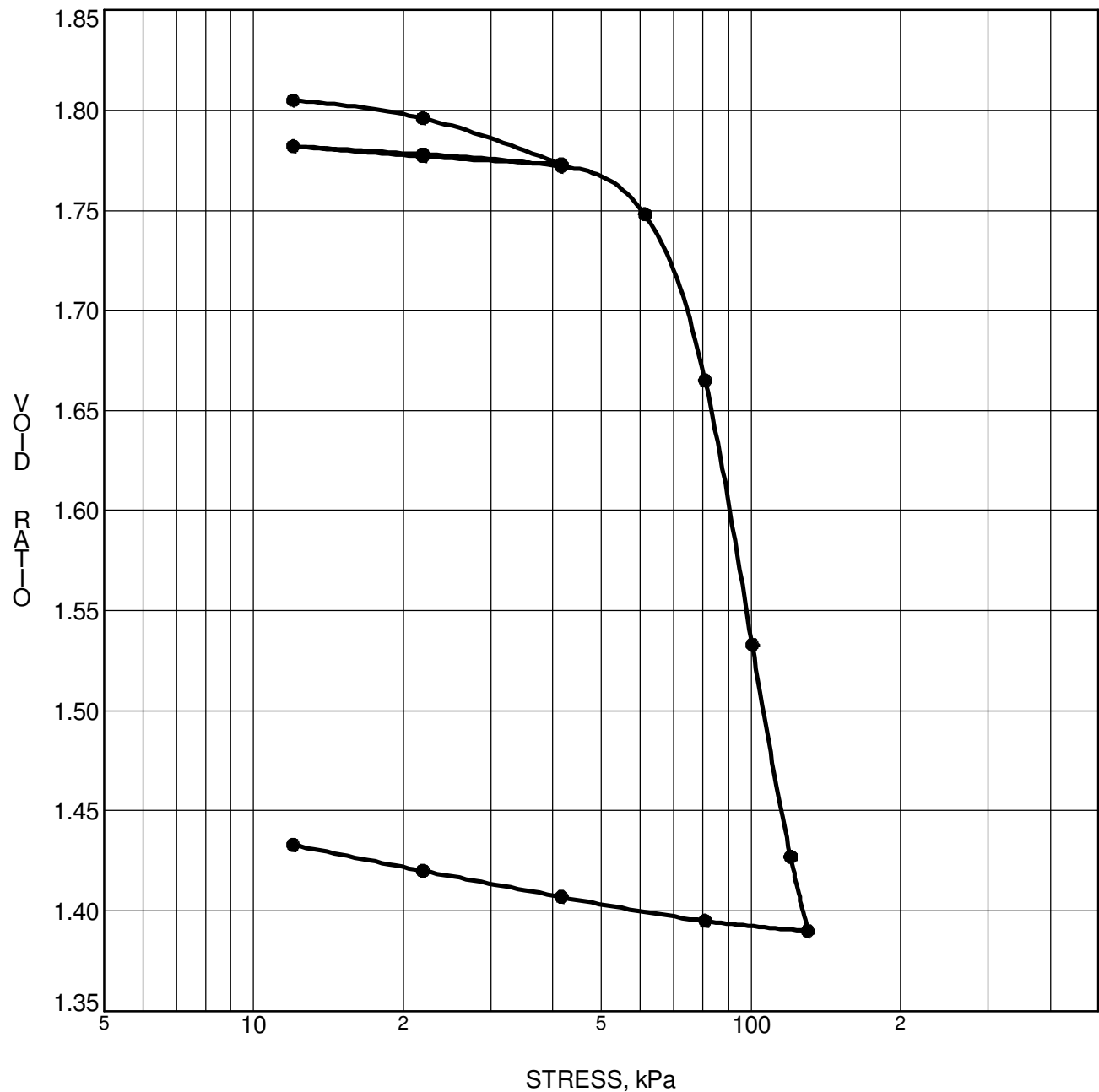
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 DATE **03/10/2007**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 2-05	p'_o	50 kPa	C_{cr}	0.016
Sample No.	TW 4	p'_c	70 kPa	C_c	1.380
Sample Depth	4.70 m	OC Ratio	1.4	W_o	66.0 %
Sample Elev.	87.80 m	Void Ratio	1.81	Unit Wt.	15.9 kN/m³

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

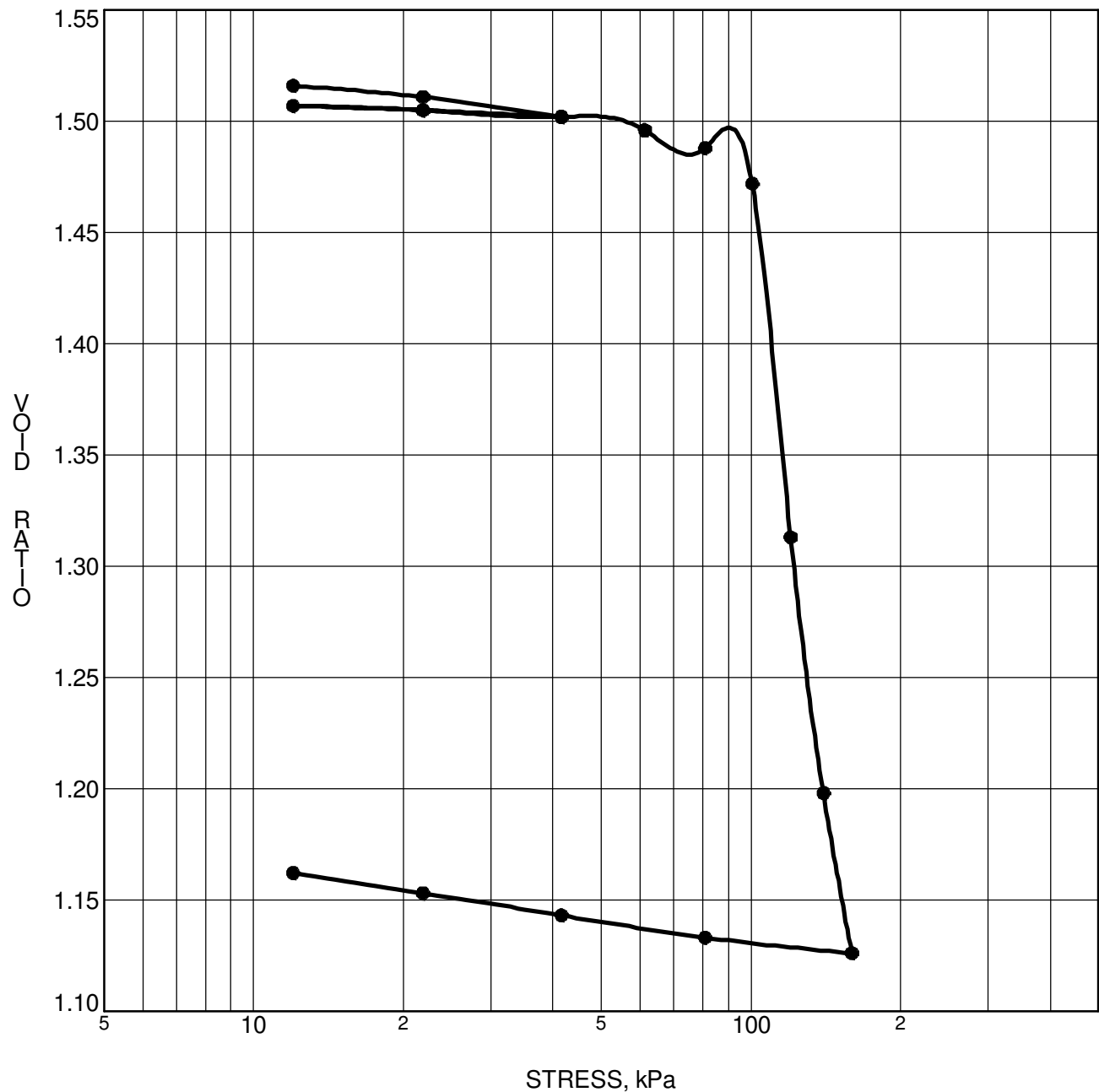
FILE NO. **PG0177**
 DATE **07/24/2005**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 3-05	p'_o	42 kPa	C_{cr}	0.010
Sample No.	TW 3	p'_c	99 kPa	C_c	1.709
Sample Depth	3.50 m	OC Ratio	2.4	W_o	55.3 %
Sample Elev.	88.96 m	Void Ratio	1.52	Unit Wt.	16.6 kN/m³

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential**
Development-Half Moon Bay

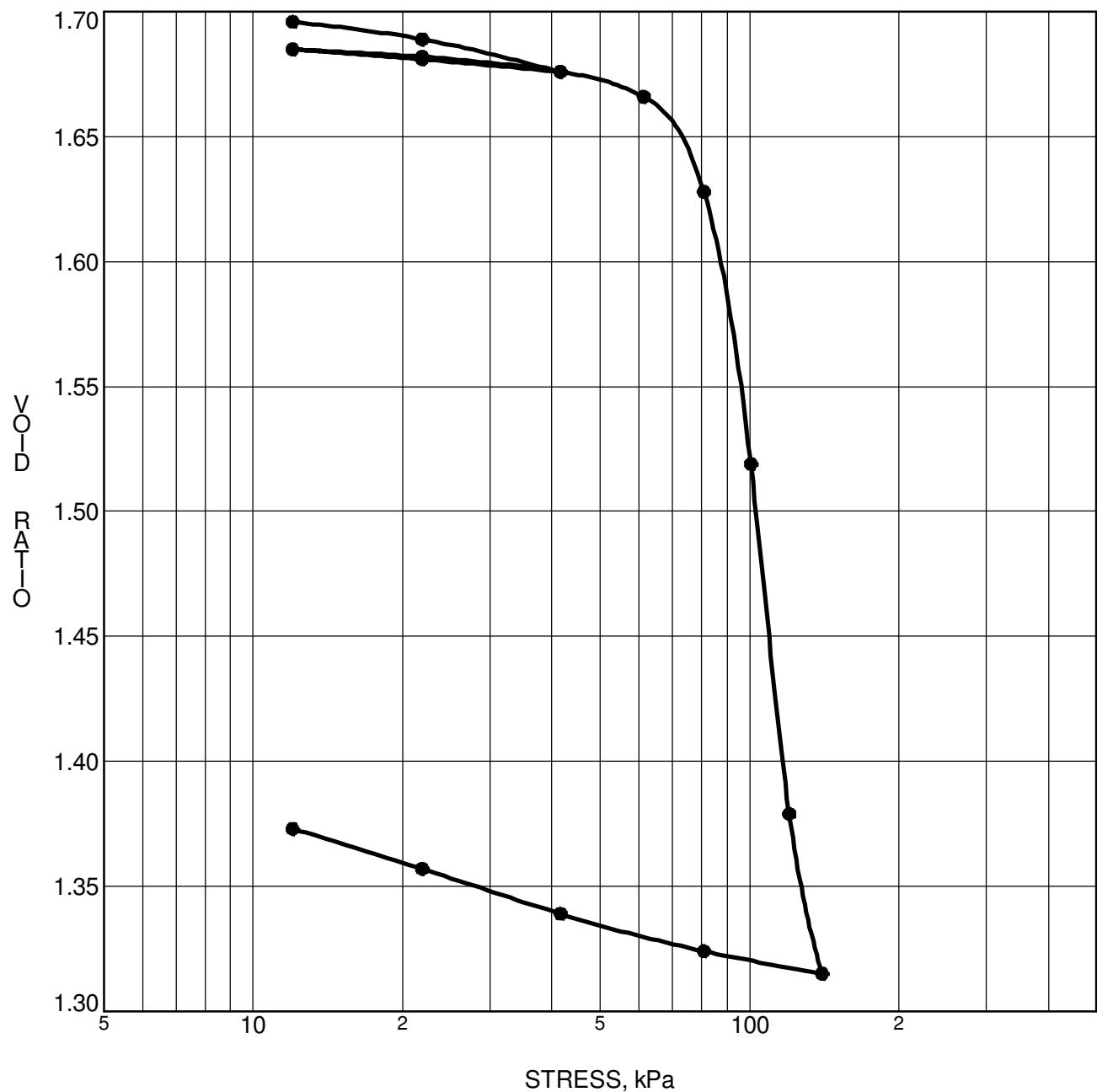
FILE NO. **PG0177**
 DATE **07/25/2005**

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Engineers

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH10-05	p'_o	48.2 kPa	C_{cr}	0.017
Sample No.	TW 5	p'_c	82 kPa	C_c	1.460
Sample Depth	4.70 m	OC Ratio	1.7	W_o	62.0 %
Sample Elev.	86.96 m	Void Ratio	1.71	Unit Wt.	16.1 kN/m³

Note: Overburden stress calculated from original ground surface (91.76m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

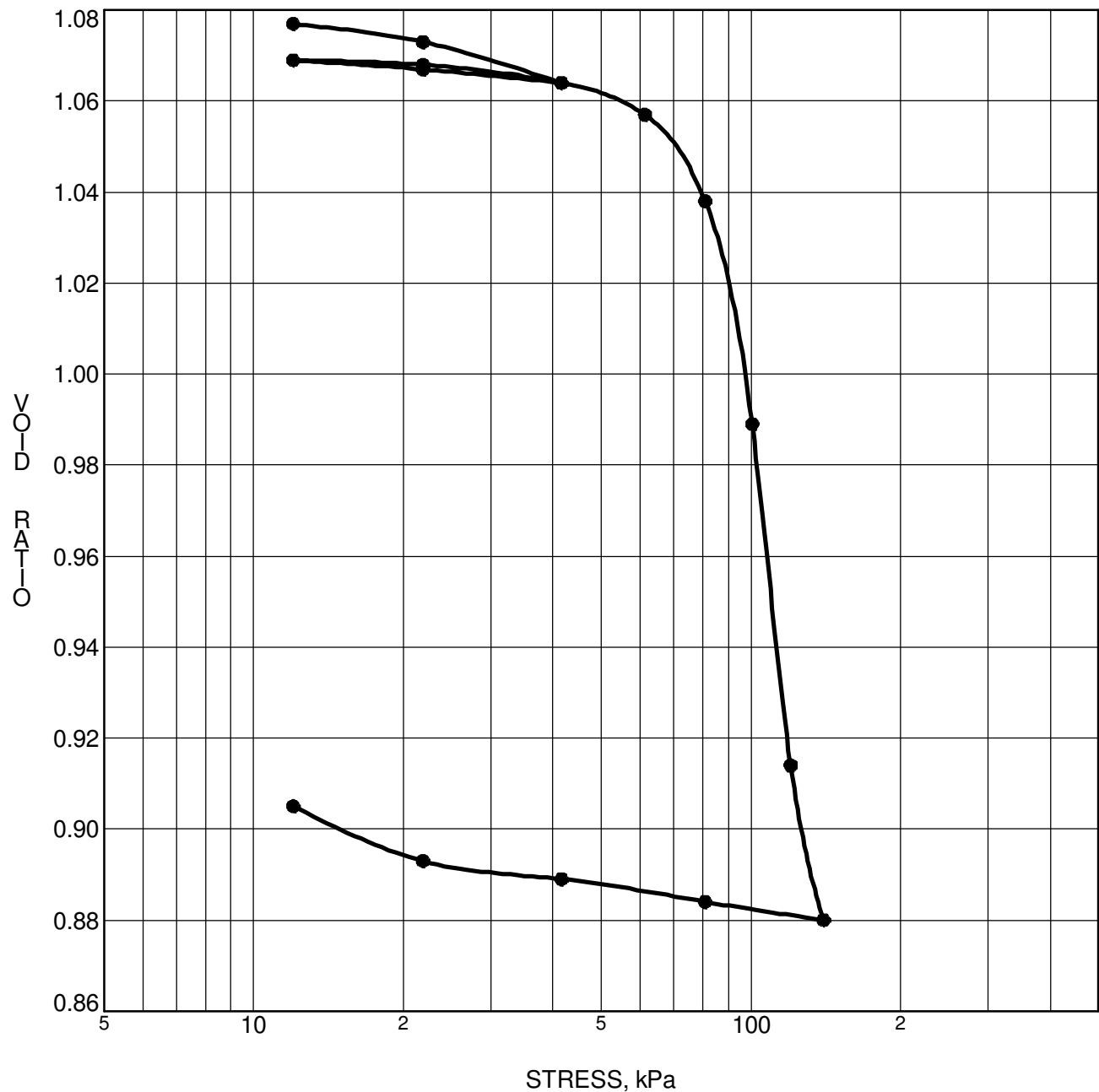
FILE NO. **PG0177**
 DATE **07/15/2005**

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28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH11A-05	p'_o	25.8 kPa	C_{cr}	0.020
Sample No.	TW 1	p'_c	83 kPa	C_c	0.737
Sample Depth	2.50 m	OC Ratio	3.2	W_o	39.4 %
Sample Elev.	89.41 m	Void Ratio	1.08	Unit Wt.	17.9 kN/m³

Note: Overburden stress calculated from original ground surface (91.91m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

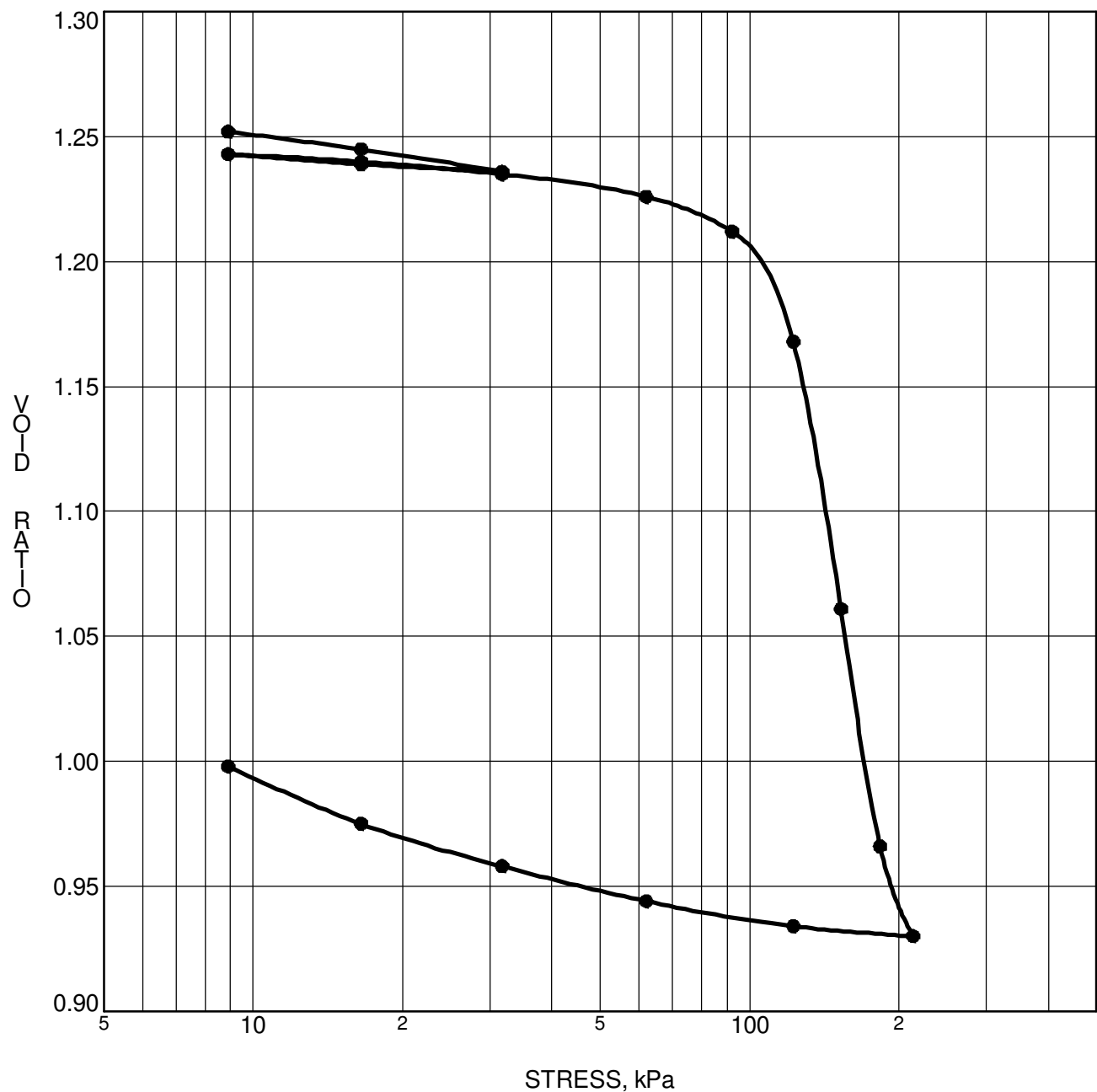
FILE NO. **PG0177**
 DATE **07/15/2005**

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Engineers

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH11A-05	p'_o	54.9 kPa	C_{cr}	0.014
Sample No.	TW 3	p'_c	110 kPa	C_c	0.942
Sample Depth	7.20 m	OC Ratio	2.0	W_o	45.6 %
Sample Elev.	84.71 m	Void Ratio	1.25	Unit Wt.	17.4 kN/m³

Note: Overburden stress calculated from original ground surface (91.10m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

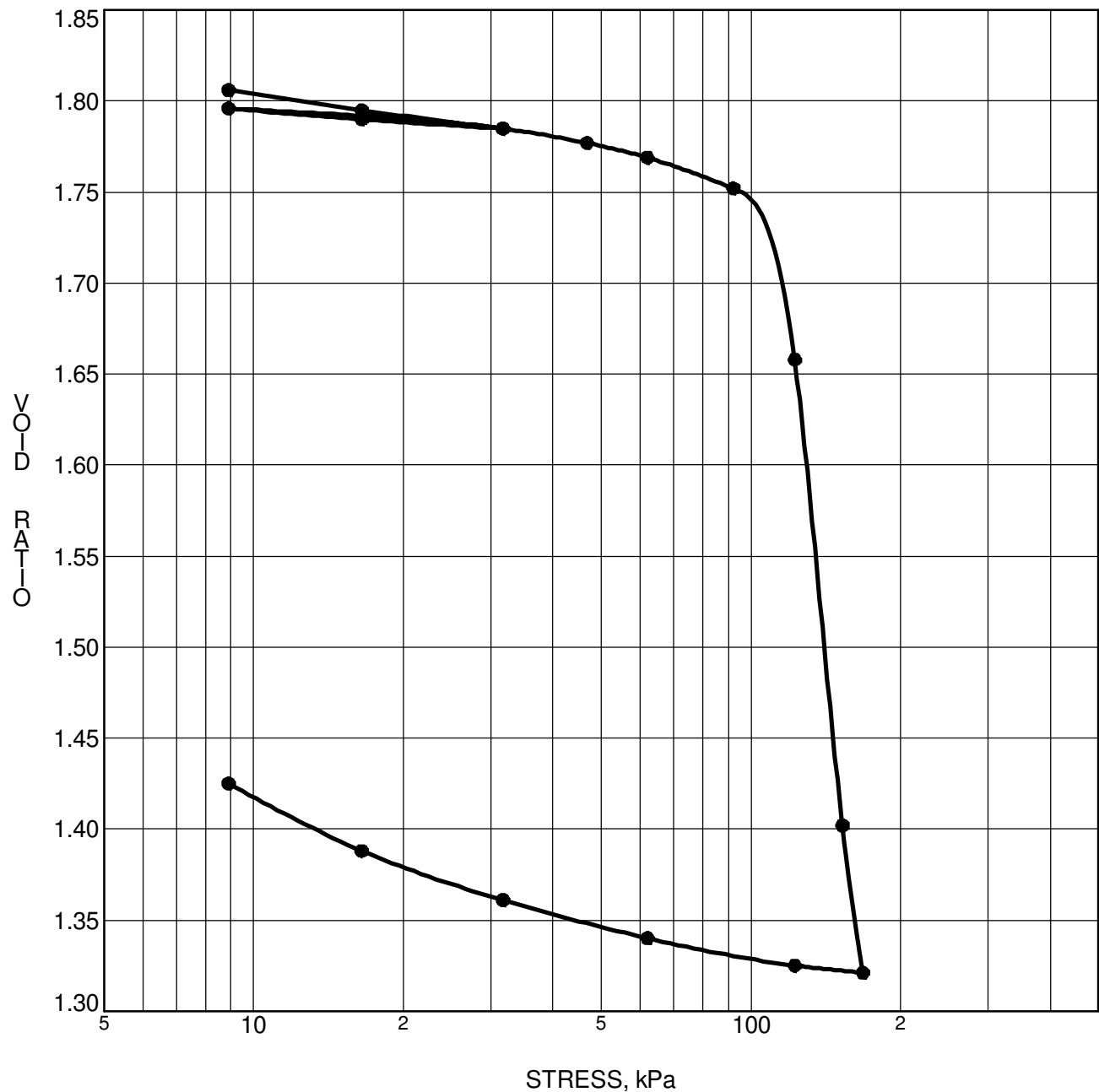
FILE NO. **PG0177**
 DATE **07/15/2005**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH12-05	p'_o	75.8 kPa	C_{cr}	0.020
Sample No.	TW 6	p'_c	115 kPa	C_c	2.510
Sample Depth	9.30 m	OC Ratio	1.5	W_o	66.1 %
Sample Elev.	82.44 m	Void Ratio	1.82	Unit Wt.	16.2 kN/m³

Note: Overburden stress calculated from original ground surface (91.74m)

CLIENT Mattamy Homes
 PROJECT Geotechnical Investigation - Proposed Residential
Development-Half Moon Bay

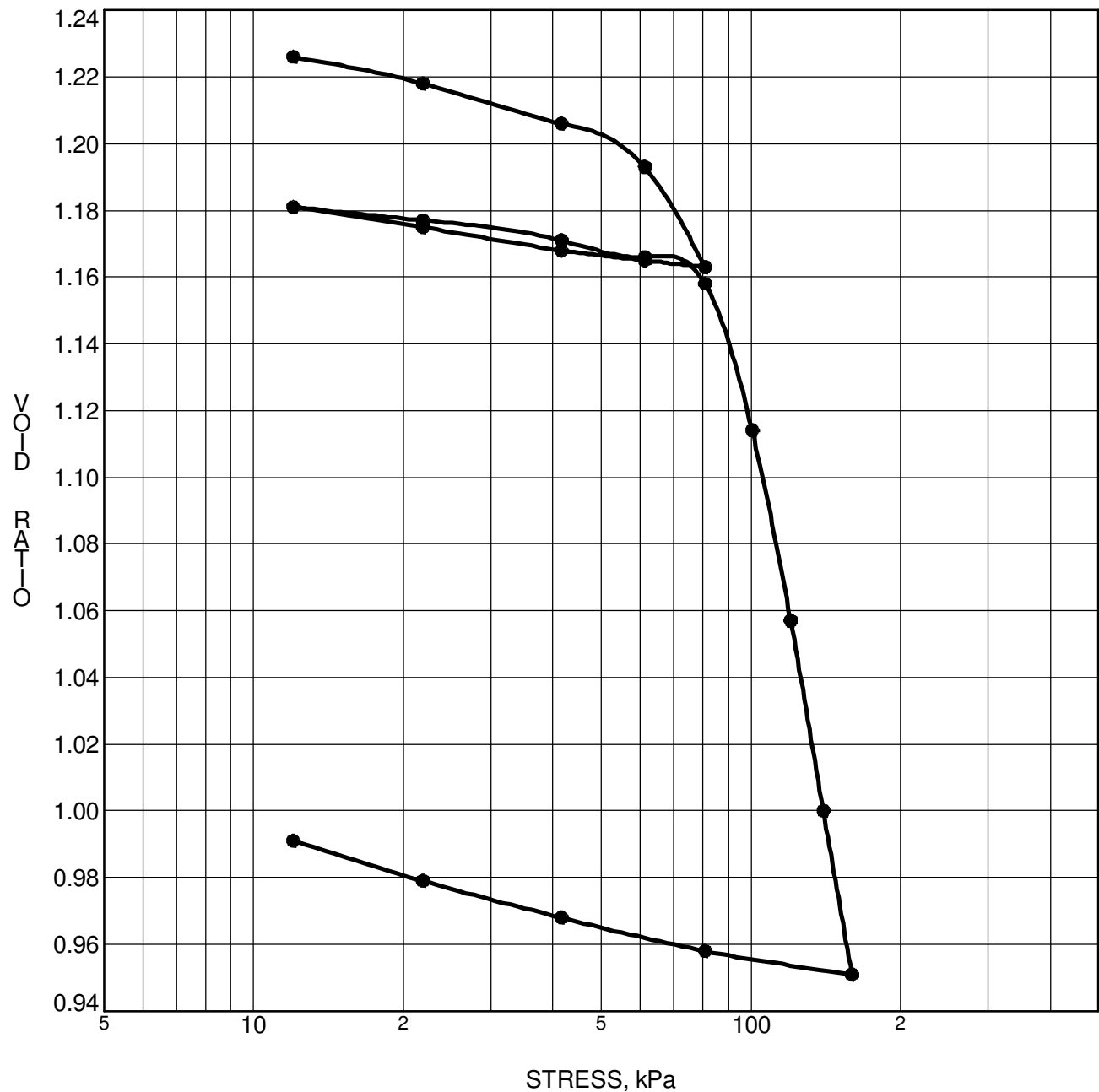
FILE NO. PG0177
 DATE 07/19/2005

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 2A	p'_o	52.9 kPa	C_{cr}	0.022
Sample No.	TW 3	p'_c	88 kPa	C_c	0.850
Sample Depth	4.00 m	OC Ratio	1.7	W_o	45.0 %
Sample Elev.	m	Void Ratio	1.24	Unit Wt.	17.5 kN/m³

Note: Overburden stress calculated from original ground surface (92.60m)

CLIENT Mattamy Homes
 PROJECT Geotechnical Investigation - Proposed Residential Development-Half Moon Bay

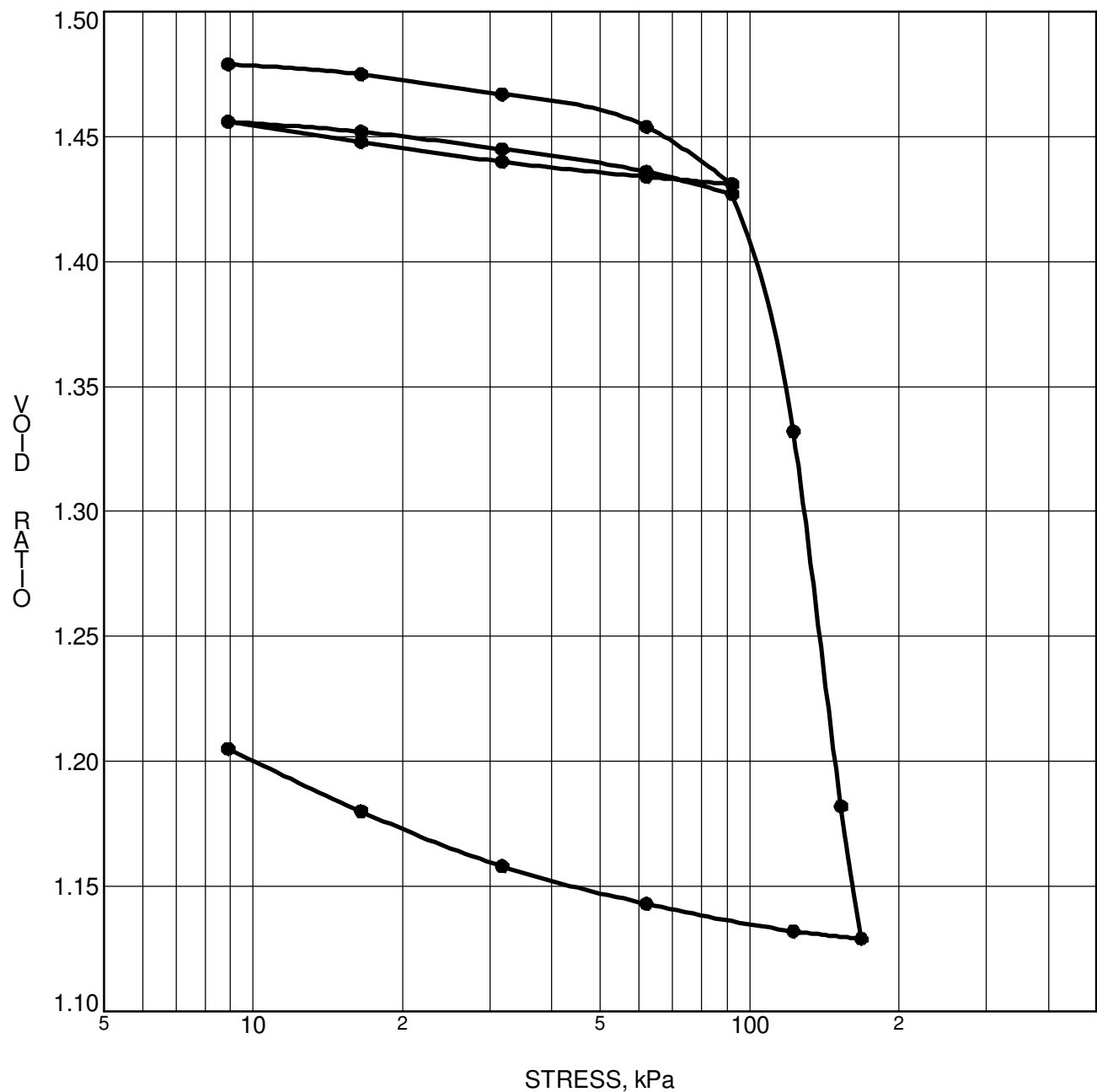
FILE NO. PG0177
 DATE 04/22/2004

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 2B	p'_o	71 kPa	C_{cr}	0.026
Sample No.	TW 1	p'_c	107 kPa	C_c	1.420
Sample Depth	8.00 m	OC Ratio	1.5	W_o	53.9 %
Sample Elev.	m	Void Ratio	1.48	Unit Wt.	16.7 kN/m³

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

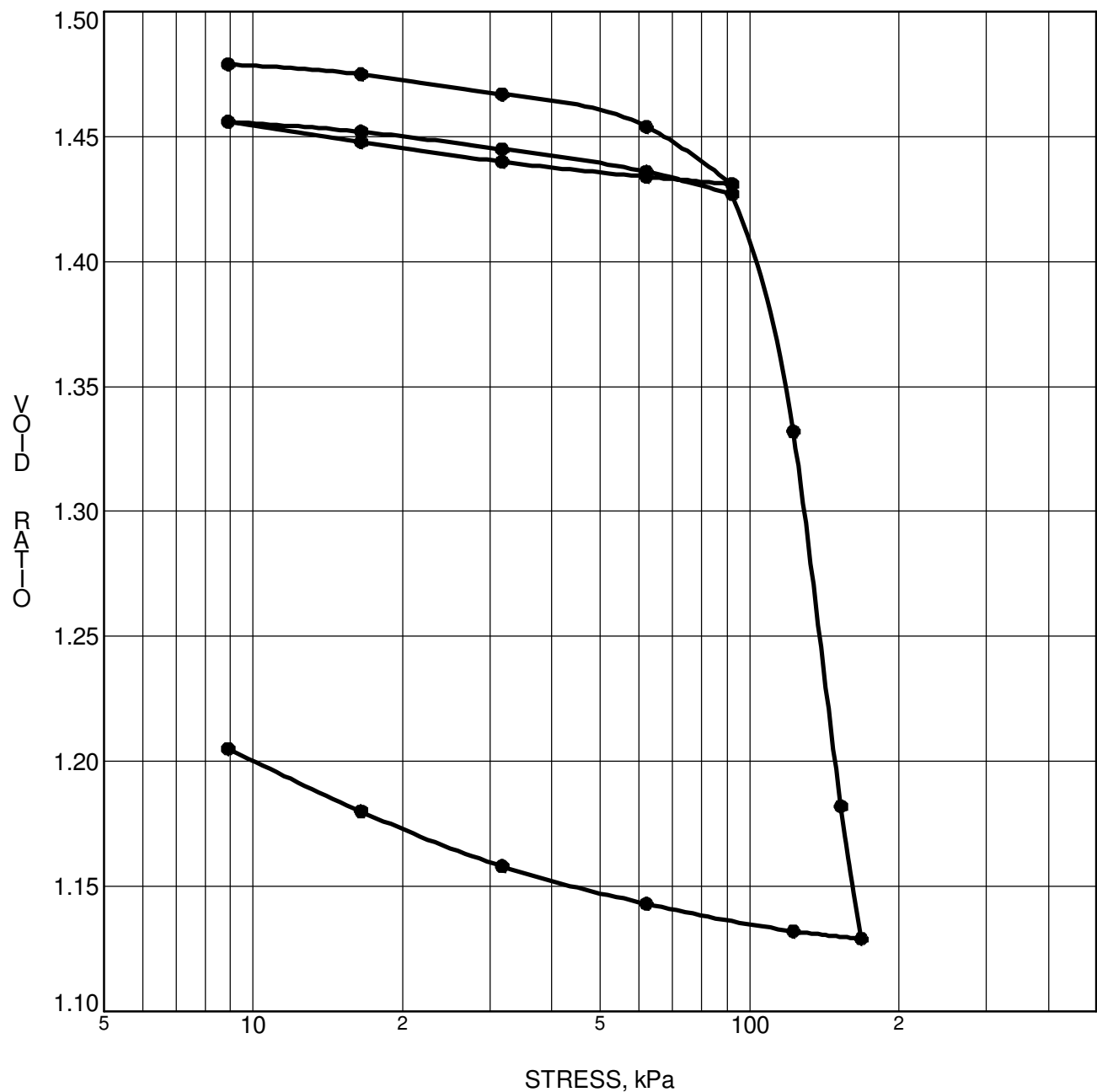
FILE NO. **PG0177**
 DATE **04/22/2004**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 2B	p'_o	77.7 kPa	C_{cr}	0.026
Sample No.	TW 1	p'_c	107 kPa	C_c	1.420
Sample Depth	8.00 m	OC Ratio	1.4	W_o	53.9 %
Sample Elev.	m	Void Ratio	1.48	Unit Wt.	16.7 kN/m³

Note: Overburden stress calculated from original ground surface (92.60m)

CLIENT **Mattamy Homes**
 PROJECT **Geotechnical Investigation - Proposed Residential Development-Half Moon Bay**

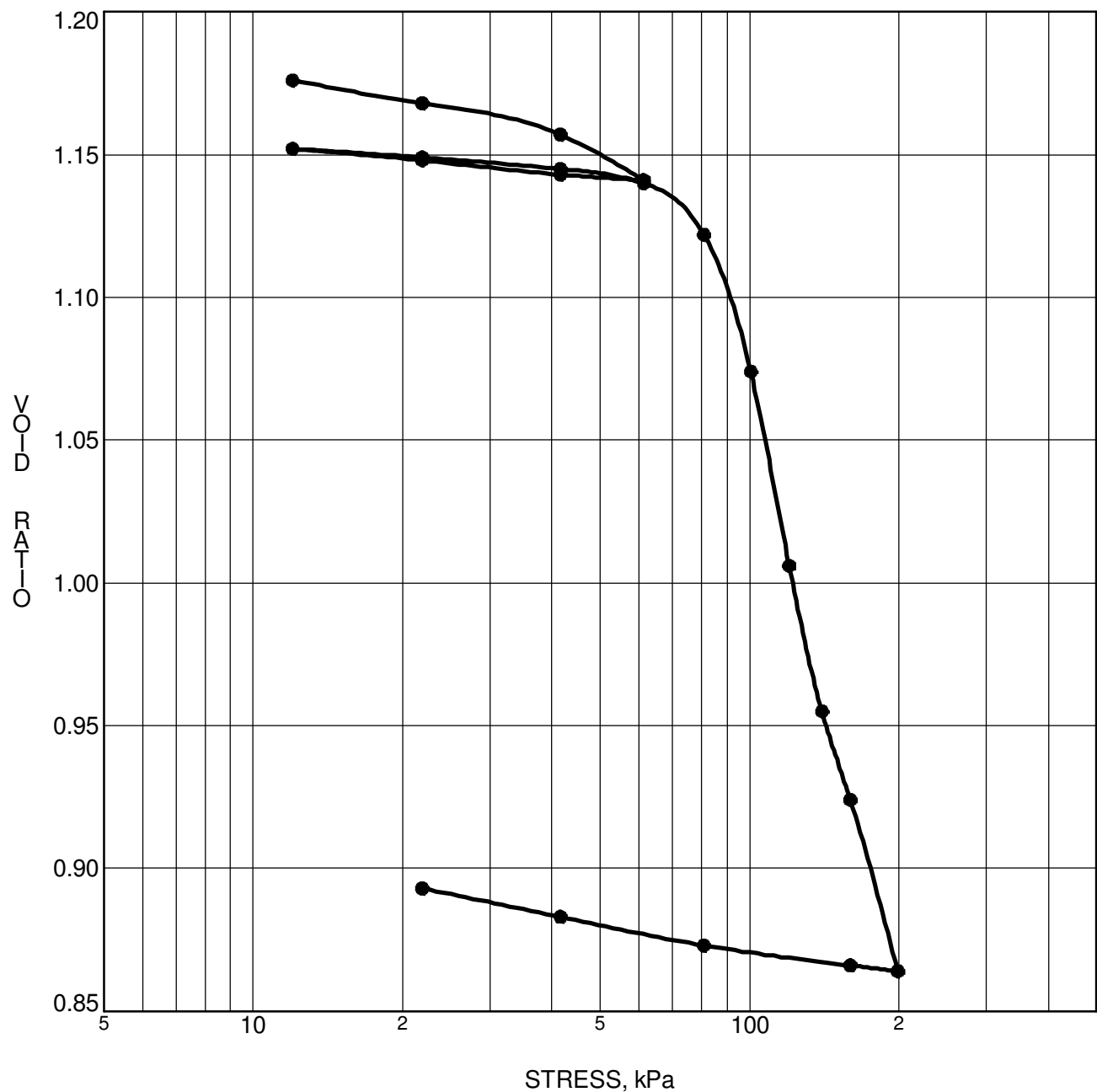
FILE NO. **PG0177**
 DATE **04/22/2004**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 1	p'_o	36.2 kPa	C_{cr}	0.018
Sample No.	TW 4	p'_c	82 kPa	C_c	0.702
Sample Depth	2.80 m	OC Ratio	2.3	W_o	43.0 %
Sample Elev.	m	Void Ratio	1.18	Unit Wt.	17.7 kN/m³

Note: Overburden stress calculated from original ground surface (92.20m)

CLIENT Brickland Timberlay
 PROJECT Preliminary Geotechnical Investigation - Nepean
 South Lands, South of Jock River

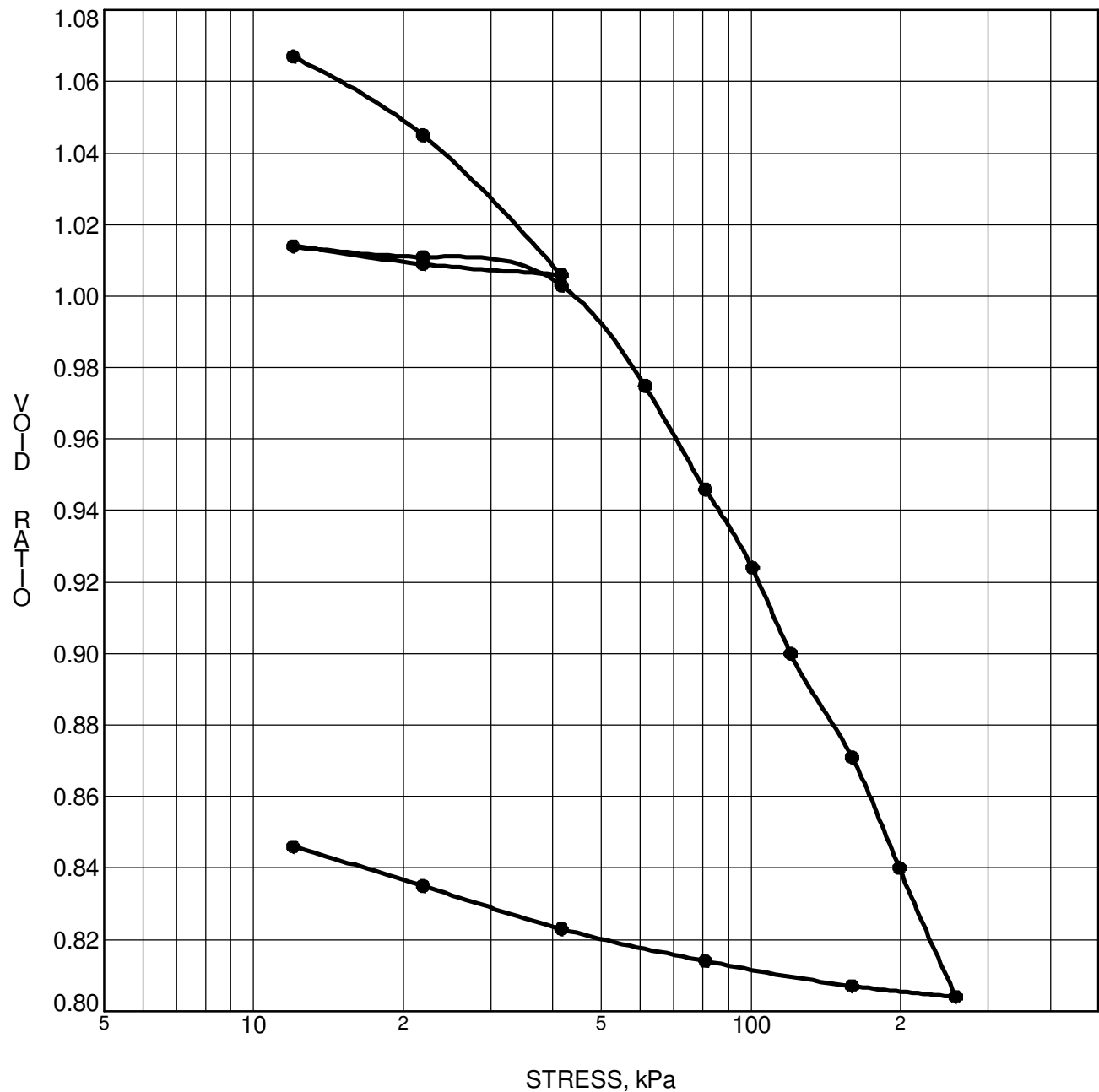
FILE NO. G9132
 DATE 12/06/2003

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 3	p'_o	31.7 kPa	C_{cr}	0.019
Sample No.	TW 3	p'_c	50 kPa	C_c	0.252
Sample Depth	2.65 m	OC Ratio	1.6	W_o	39.8 %
Sample Elev.	m	Void Ratio	1.09	Unit Wt.	18.1 kN/m³

Note: Overburden stress calculated from original ground surface (92.60m)

CLIENT **Brickland Timberlay**
 PROJECT **Preliminary Geotechnical Investigation - Nepean**
South Lands, South of Jock River

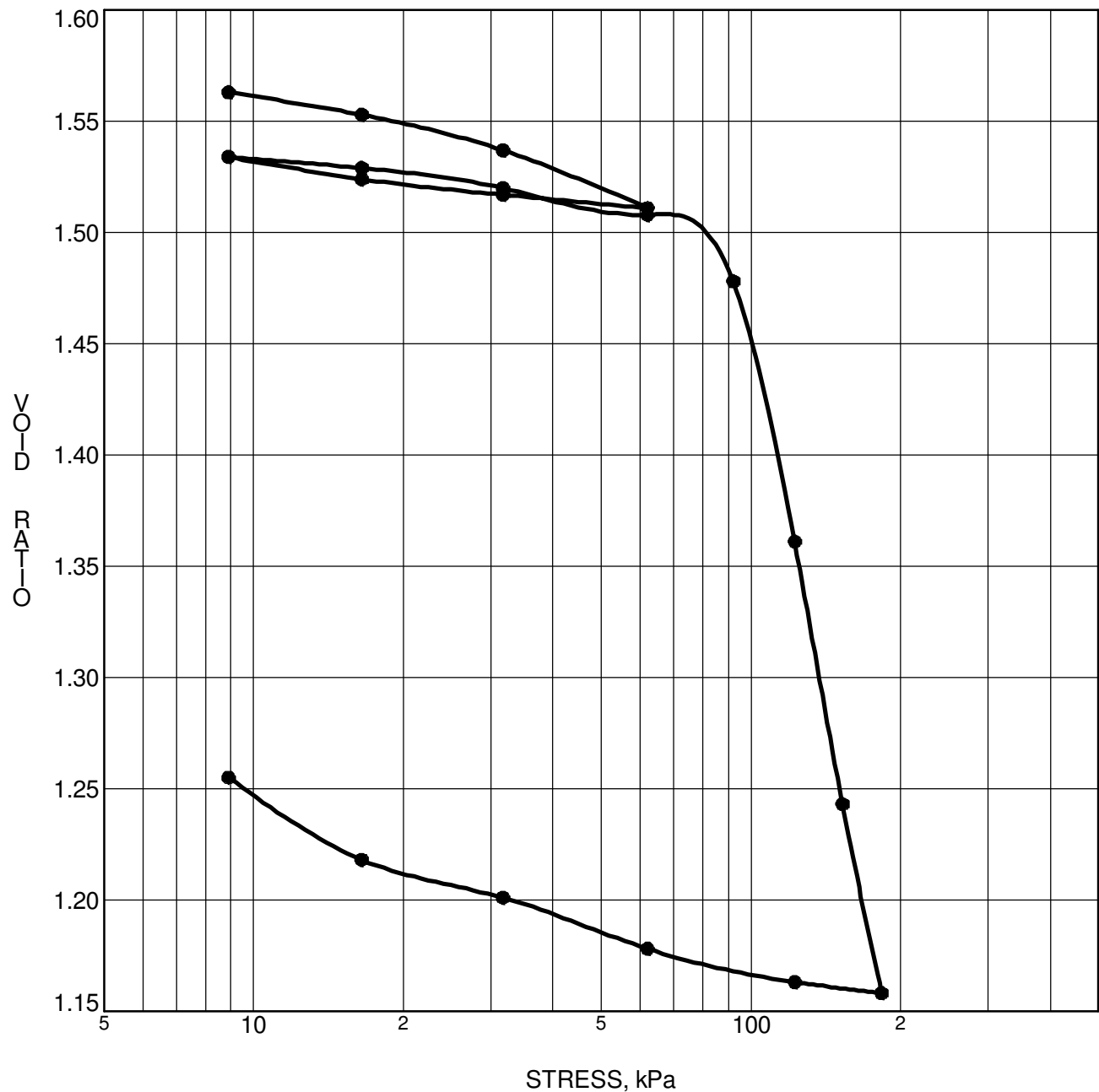
FILE NO. **G9132**
 DATE **12/15/2003**

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**CONSOLIDATION
TEST**



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 3	p'_o	51.2 kPa	C_{cr}	0.029
Sample No.	TW 5	p'_c	90 kPa	C_c	1.090
Sample Depth	5.80 m	OC Ratio	1.8	W_o	57.1 %
Sample Elev.	m	Void Ratio	1.57	Unit Wt.	16.5 kN/m³

Note: Overburden stress calculated from original ground surface (92.60m)

CLIENT **Brickland Timberlay**
 PROJECT **Preliminary Geotechnical Investigation - Nepean**
South Lands, South of Jock River

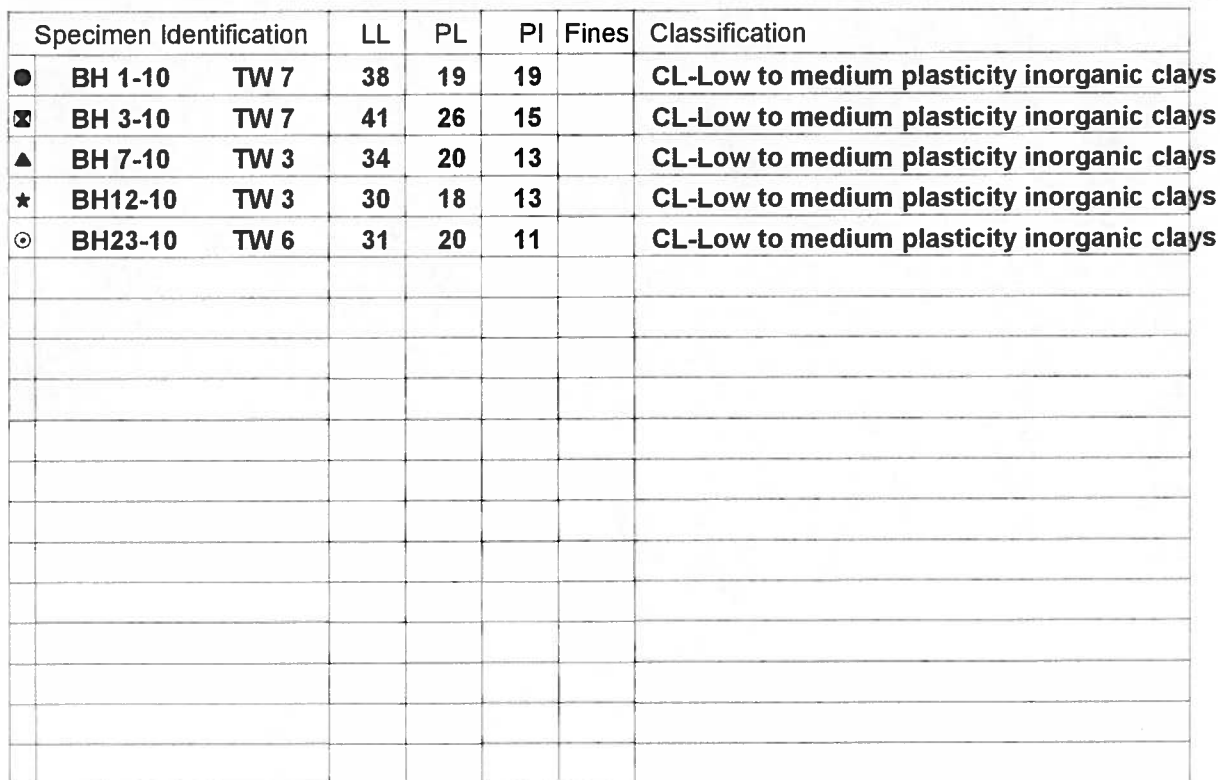
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 DATE **12/15/2003**

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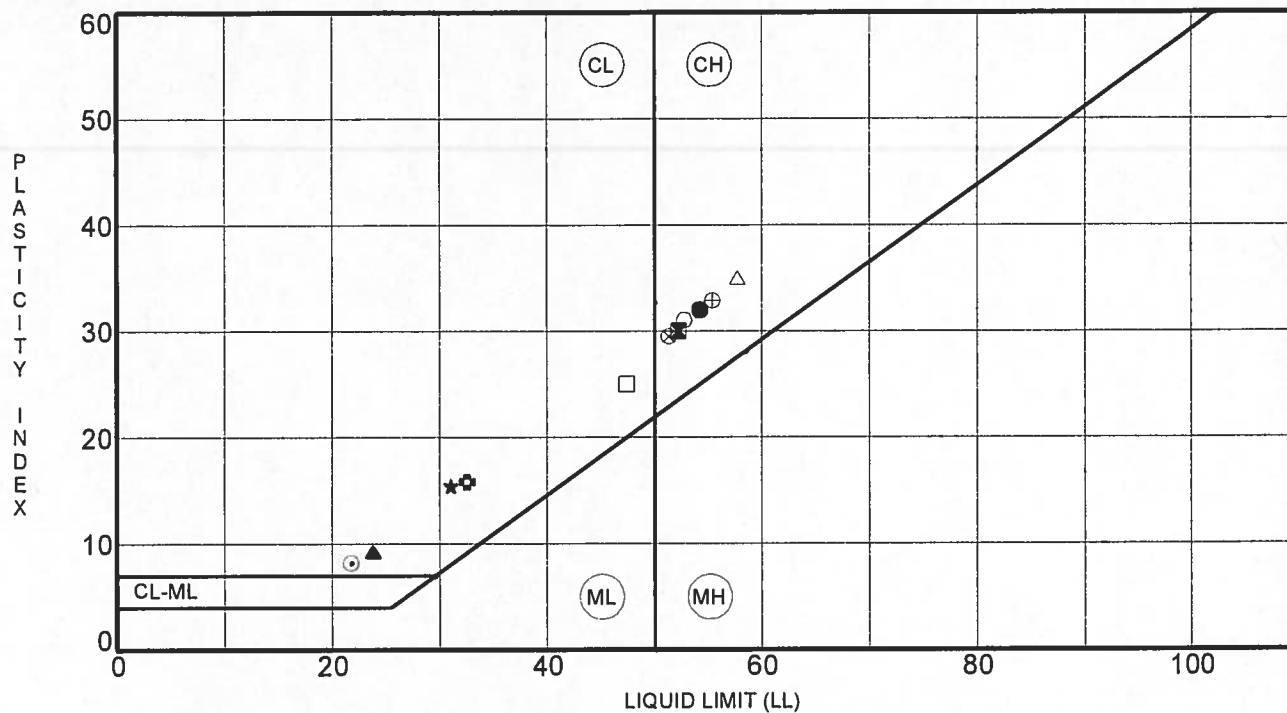
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**CONSOLIDATION
TEST**



ATTERBERG LIMITS'



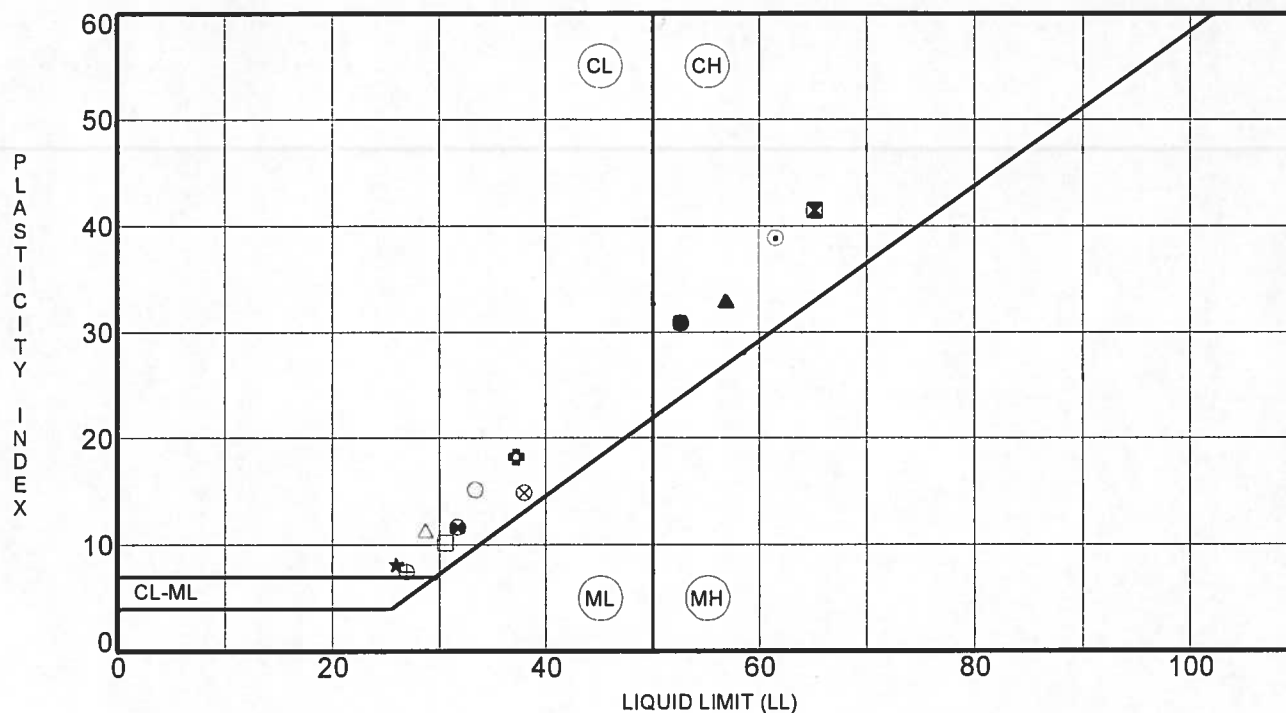
Specimen Identification	LL	PL	PI	Fines	Classification
● BH 1-07 TW 3	54	22	32		CH - Clays with high plasticity
⊗ BH 1-07 TW 4	52	22	30		CH - Clays with high plasticity
▲ BH 2-07 TW 4	24	14	9		CL - Clays with low plasticity
★ BH 3-07 TW 3	31	16	16		CL - Clays with low plasticity
⊙ BH 3-07 TW 4	22	14	8		CL - Clays with low plasticity
⊕ BH 4-07 TW 4	33	17	16		CL - Clays with low plasticity
○ BH 5-07 TW 4	53	22	31		CH - Clays with high plasticity
△ BH 6A-07 TW 1	58	23	35		CH - Clays with high plasticity
⊗ BH 7-07 TW 4	51	22	29		CH - Clays with high plasticity
⊕ BH10-07 TW 5	55	23	33		CH - Clays with high plasticity
□ BH11-07 TW 7	47	22	25		CL - Clays with low plasticity

CLIENT Mattamy Homes
 PROJECT Geotechnical Investigation - Proposed
Residential Development-Half Moon Bay

FILE NO. PG0177
 DATE 7 Dec 07

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 28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

**ATTERBERG LIMITS'
 RESULTS**



	Specimen Identification		LL	PL	PI	Fines	Classification
●	BH 2-05	TW 4	53	22	31		CH - Clays with high plasticity
⊗	BH 3-05	TW 3	65	24	41		CH - Clays with high plasticity
▲	BH 3-06	TW 4	57	24	33		CH - Clays with high plasticity
★	BH 5-06	TW 2	26	18	8		CL - Clays with low plasticity
⊙	BH 6B-06	TW 1	62	23	39		CH - Clays with high plasticity
⊕	BH10-05	TW 5	37	19	18		CL - Clays with low plasticity
○	BH11A-05	TW 1	33	18	15		CL - Clays with low plasticity
△	BH11A-05	TW 3	29	17	11		CL - Clays with low plasticity
⊗	BH12-05	TW 6	38	23	15		CL - Clays with low plasticity
⊕	BH16-06	TW 6	27	19	8		CL - Clays with low plasticity
□	BH17-06	TW 5	31	20	10		CL - Clays with low plasticity
⊕	BH18A-06	TW 5	32	20	12		CL - Clays with low plasticity

CLIENT Mattamy Homes

PROJECT Geotechnical Investigation - Proposed

Residential Development-Half Moon Bay

FILE NO. PG0177

DATE 18 Dec 06

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28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

ATTERBERG LIMITS' RESULTS

Certificate of Analysis

Client: **Paterson Group Consulting Engineers**

Report Date: 23-Mar-2011

Order Date: 17-Mar-2011

Client PO: 10293

Project Description: PG2246

Client ID:	BH 15-10 SS2	BH 9-10 SS4	BH 23-10 SS5	-
Sample Date:	17-Mar-11	17-Mar-11	17-Mar-11	-
Sample ID:	1112209-01	1112209-02	1112209-03	-
MDL/Units	Soil	Soil	Soil	-

Physical Characteristics

% Solids	0.1 % by Wt.	80.3	81.0	77.9	-
----------	--------------	------	------	------	---

General Inorganics

pH	0.05 pH Units	7.44	7.52	7.47	-
Resistivity	0.10 Ohm.m	54.1	46.3	10.7	-

Anions

Chloride	5 ug/g dry	13	16	7	-
Sulphate	5 ug/g dry	55	134	548	-

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURES 2A and 2B - TEST FILL PILE SETTLEMENT MONITORING PROGRAM

FIGURE 3 - TEST FILL PILE (2007 TO 2011) SETTLEMENT MONITORING PROGRAM

FIGURE 4 - SETTLEMENT SURCHARGE MONITORING PROGRAM

DRAWING PG2246-4 - TEST HOLE LOCATION PLAN

DRAWING PG2246-5 - PERMISSIBLE GRADE RAISE PLAN - HOUSING

DRAWING PG2246-6 - PERMISSIBLE GRADE RAISE PLAN - ROADWAYS



FIGURE 1
KEY PLAN

Figure 2A - Test Fill Pile Settlement Monitoring Program
Half Moon Bay West - Cambrian Road

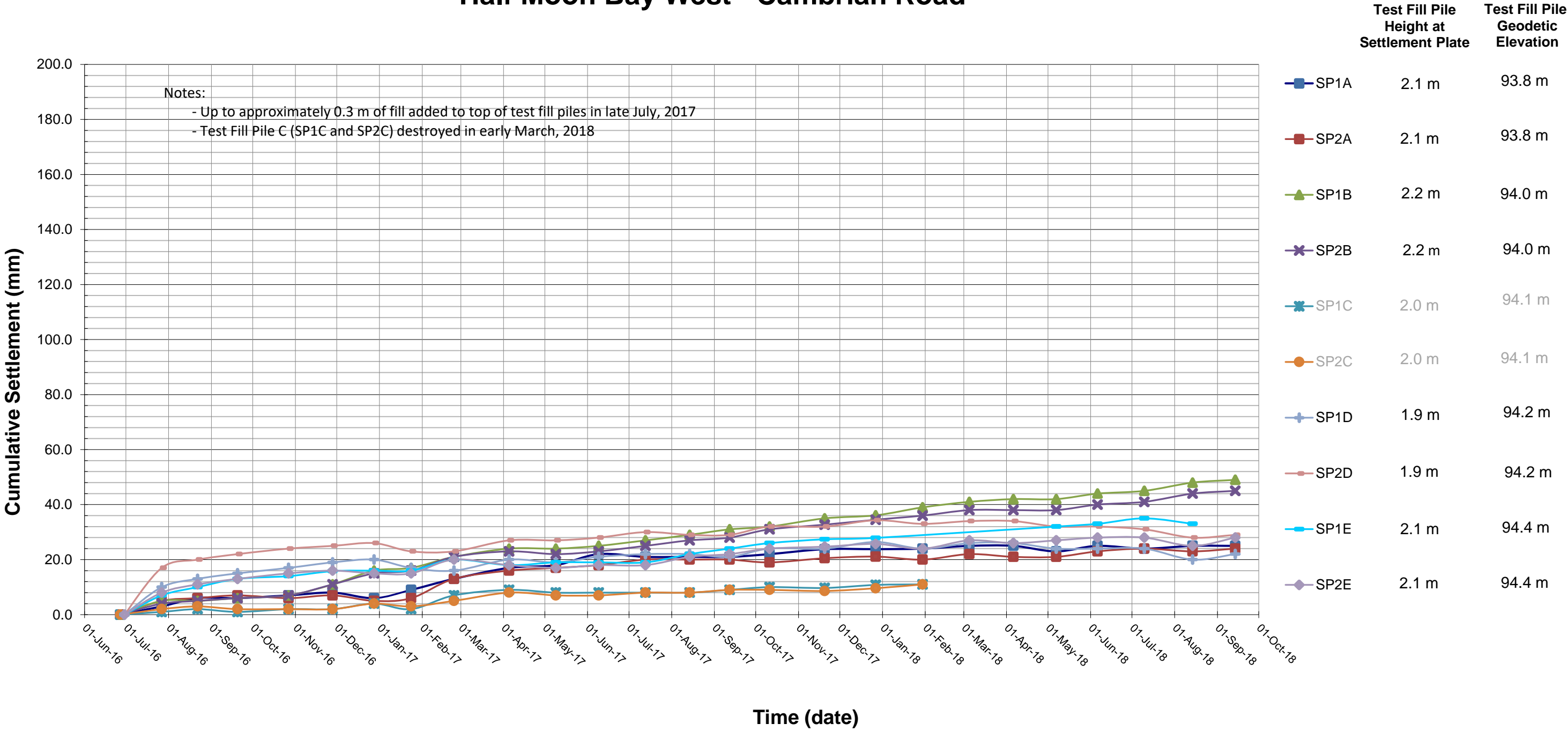
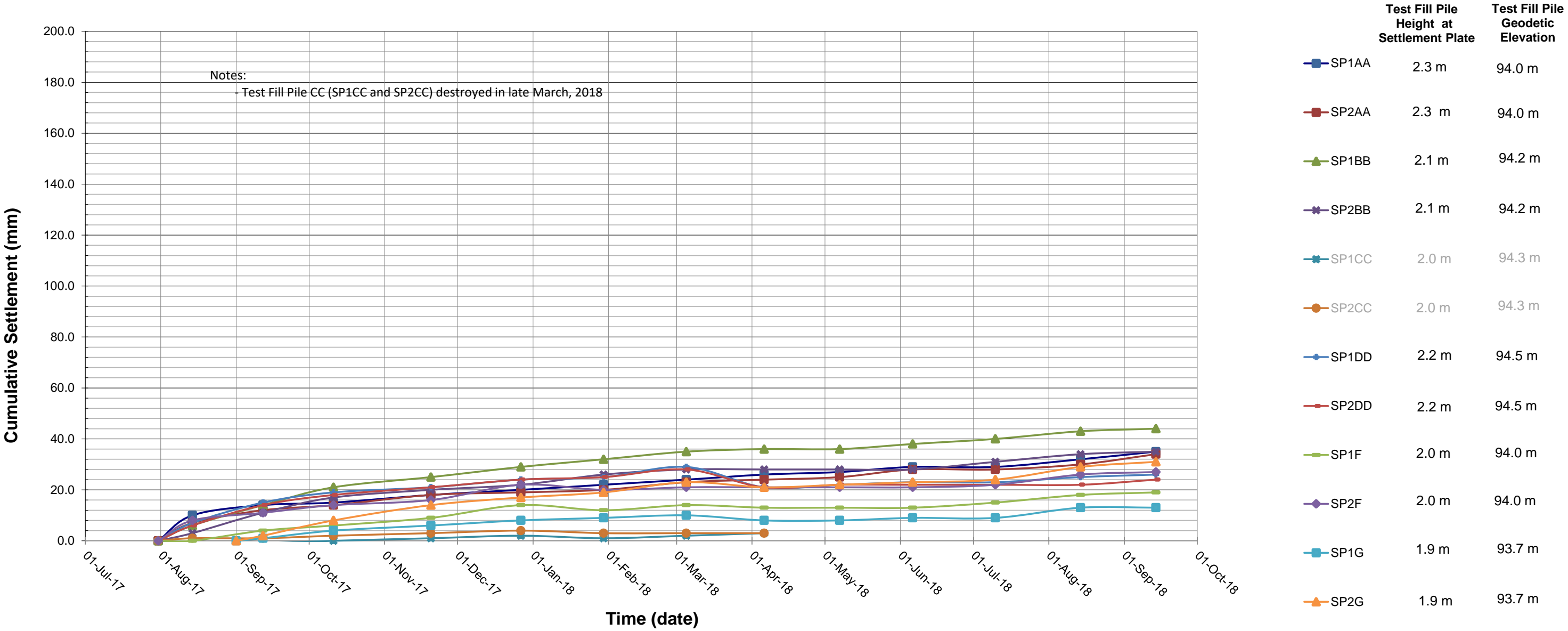
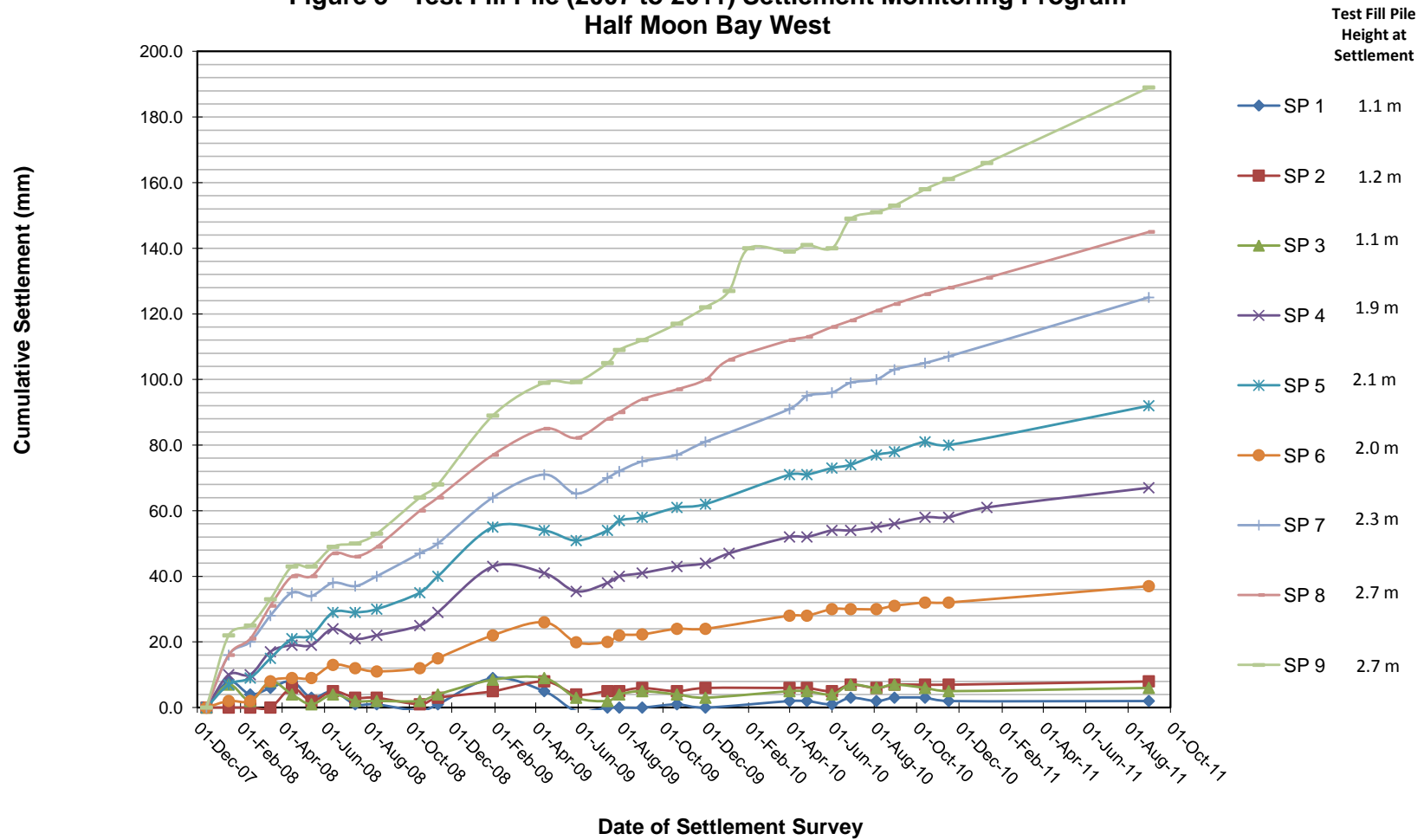


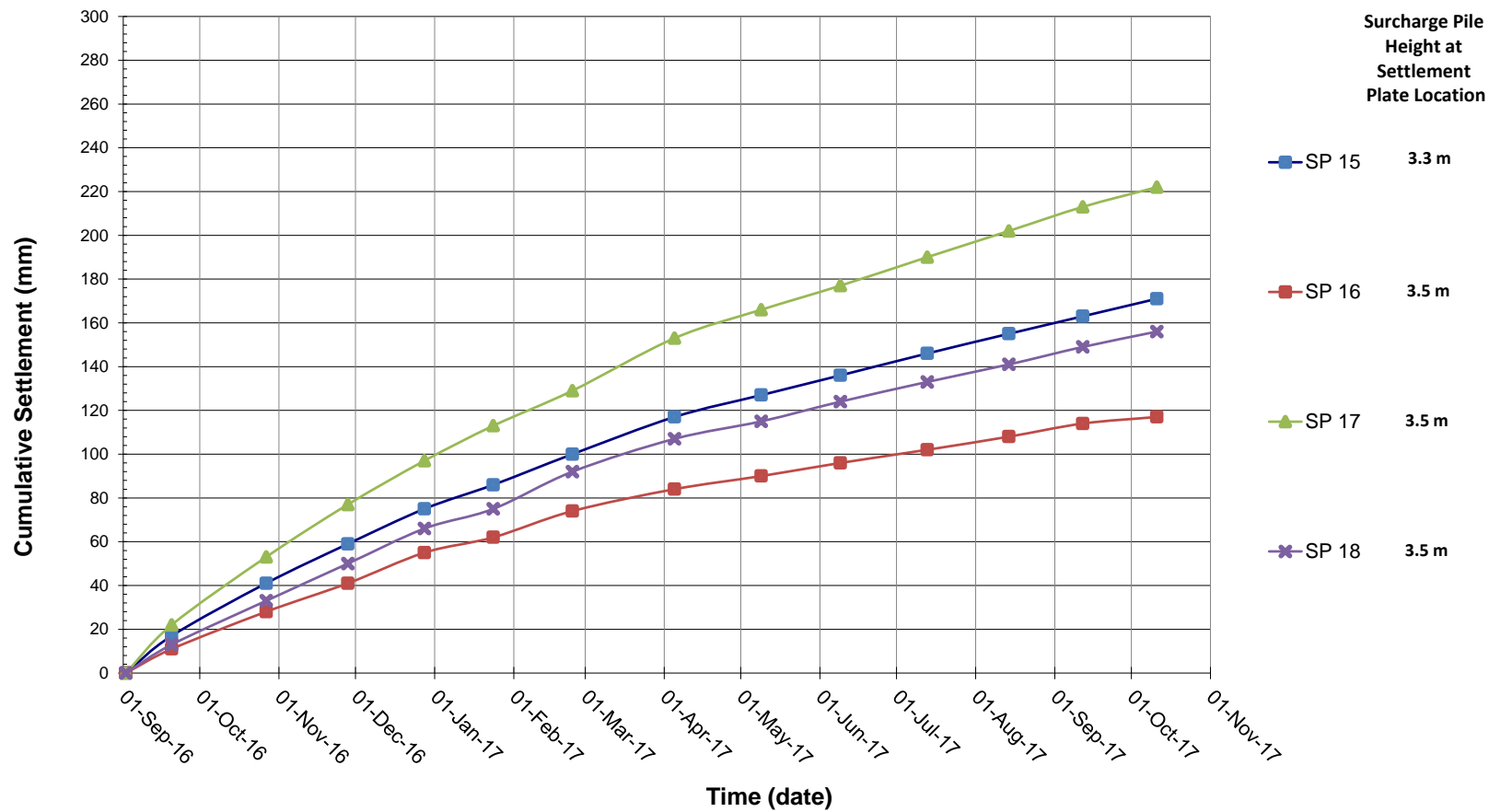
Figure 2B - Test Fill Pile Settlement Monitoring Program
Half Moon Bay West - Cambrian Road

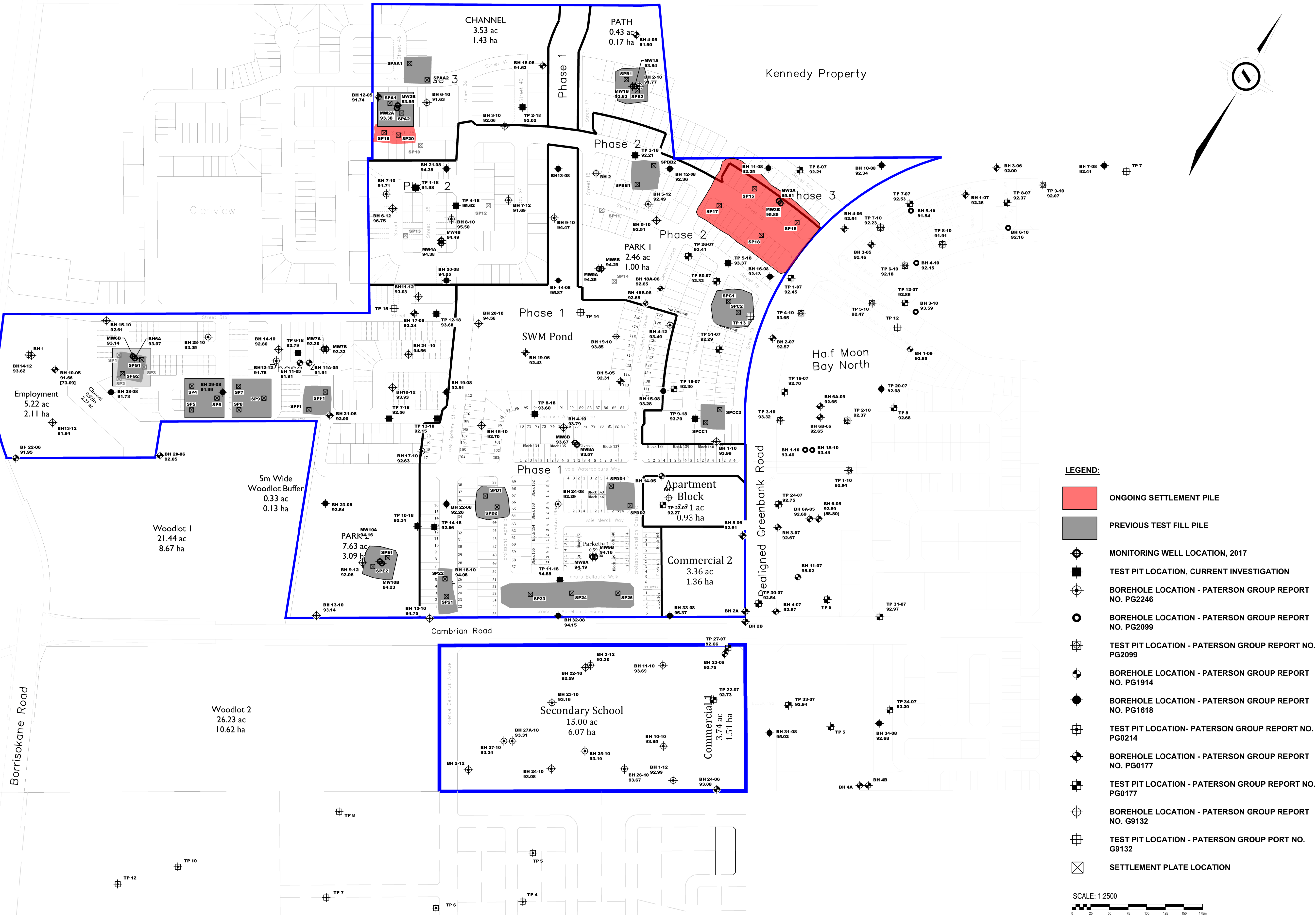


**Figure 3 - Test Fill Pile (2007 to 2011) Settlement Monitoring Program
Half Moon Bay West**



**Figure 4 - Settlement Surcharge Monitoring Program
Half Moon Bay West - River Run Avenue**





NO.	REVISIONS	DATE	INITIAL
5	UPDATED BASE PLAN	06/03/2019	RG
4	UPDATED SETTLEMENT PILES	29/01/2019	RG
3	NEW SETTLEMENT PLATES ADDED	19/06/2018	RG
2	SETTLEMENT PLATES SP19 TO SP25 ADDED	21/05/2018	RG
1	BASE PLAN UPDATED & 2018 TEST PITS ADDED	12/03/2018	RG

Title:

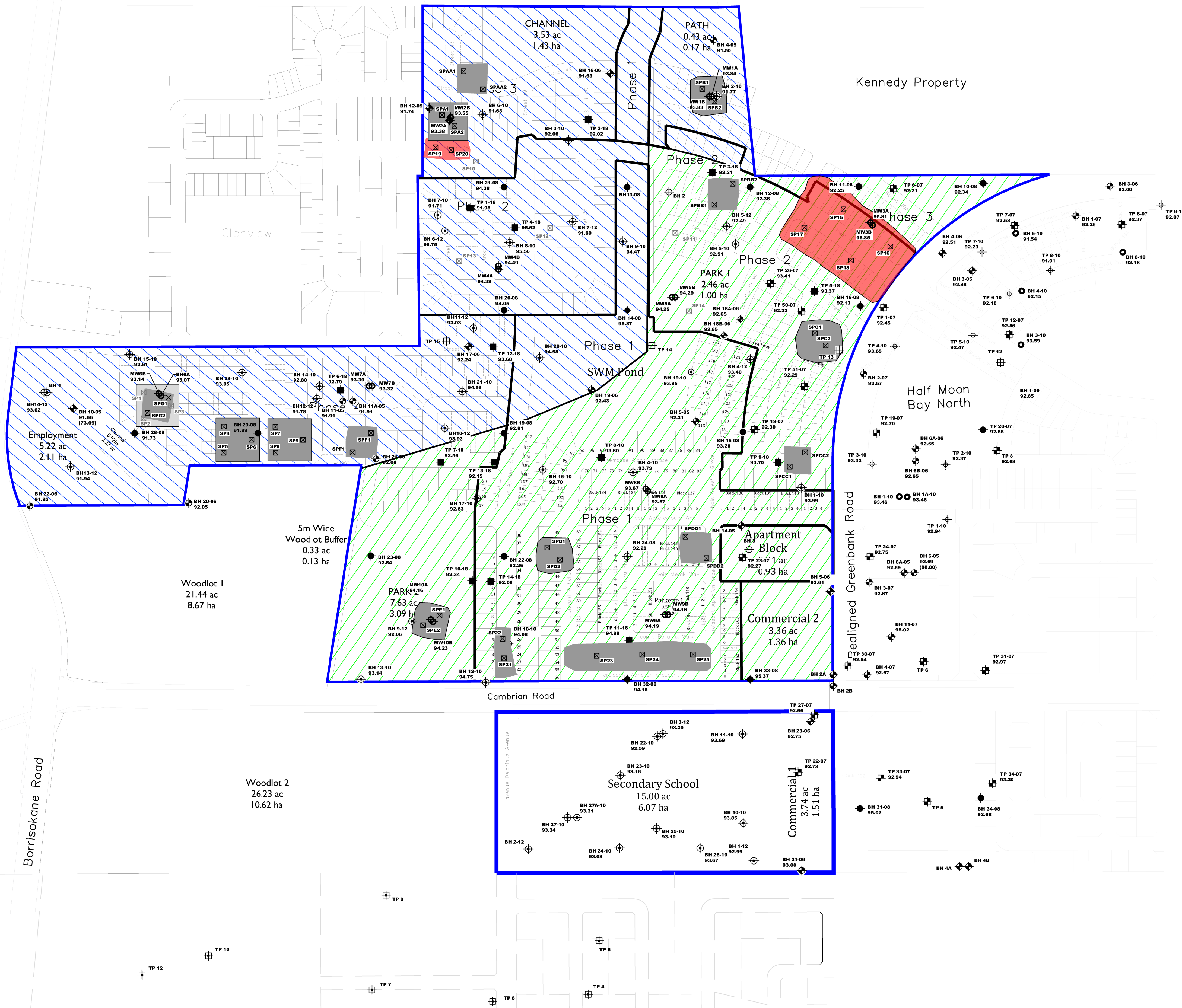
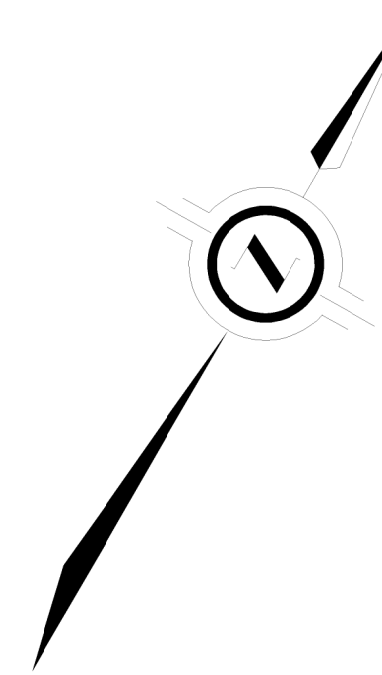
MATTAMY HOMES
GEOTECHNICAL INVESTIGATION
HALF MOON BAY WEST - CAMBRIAN ROAD
OTTAWA, ONTARIO

TEST HOLE LOCATION PLAN

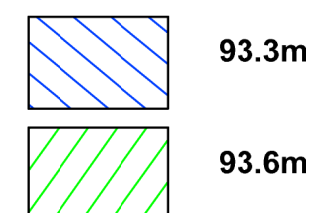
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Scale:	1:2500
Drawn by:	RCG
Checked by:	RG
Approved by:	DJG
Date:	03/2018

Report No.:	PG2246
Drawing No.:	PG2246-4
Revision No.:	5

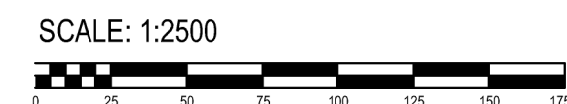


PERMISSIBLE HOUSING GRADE RAISE ELEVATIONS:



LEGEND:

- ONGOING SETTLEMENT PILE
- PREVIOUS TEST FILL PILE
- MONITORING WELL LOCATION, 2017
- TEST PIT LOCATION, CURRENT INVESTIGATION
- BOREHOLE LOCATION - PATERSON GROUP REPORT NO. PG2246
- BOREHOLE LOCATION - PATERSON GROUP REPORT NO. PG2099
- TEST PIT LOCATION - PATERSON GROUP REPORT NO. PG2099
- BOREHOLE LOCATION - PATERSON GROUP REPORT NO. PG1914
- BOREHOLE LOCATION - PATERSON GROUP REPORT NO. PG1618
- TEST PIT LOCATION - PATERSON GROUP REPORT NO. PG0214
- BOREHOLE LOCATION - PATERSON GROUP REPORT NO. PG0177
- TEST PIT LOCATION - PATERSON GROUP REPORT NO. PG0177
- BOREHOLE LOCATION - PATERSON GROUP REPORT NO. G9132
- TEST PIT LOCATION - PATERSON GROUP PORT NO. G9132
- SETTLEMENT PLATE LOCATION



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consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
5	UPDATED BASE PLAN	06/03/2019	RG
4	UPDATED SETTLEMENT PILES	29/01/2019	RG
3	NEW SETTLEMENT PLATES ADDED	19/06/2018	RG
2	SETTLEMENT PLATES SP19 TO SP25 ADDED	21/05/2018	RG
1	BASE PLAN UPDATED & 2018 TEST PITS ADDED	12/03/2018	RG

Title:

HOUSING PERMISSIBLE GRADE RAISE PLAN

MATTAMY HOMES
GEOTECHNICAL INVESTIGATION
HALF MOON BAY WEST - CAMBRIAN ROAD
OTTAWA, ONTARIO

Stamp:

Scale:
1:2500
Drawn by:
RCG
Checked by:
RG
Approved by:
DJG
Date:
03/2018

Report No.:
PG2246
Drawing No.:
PG2246-5
Revision No.:
5

Jock River

Kennedy Property

Glenview

Half Moon Bay North

Cambrian Road

Borrisakane Road

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154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
5	UPDATED BASE PLAN	06/03/2019	RG
4	UPDATED SETTLEMENT PILES	29/01/2019	RG
3	NEW SETTLEMENT PLATES ADDED	19/06/2018	RG
2	SETTLEMENT PLATES SP19 TO SP25 ADDED	21/05/2018	RG
1	BASE PLAN UPDATED & 2018 TEST PITS ADDED	12/03/2018	RG

Title:

ROAD PERMISSIBLE GRADE RAISE PLAN

MATTAMY HOMES

GEOTECHNICAL INVESTIGATION
HALF MOON BAY WEST - CAMBRIAN ROAD
OTTAWA, ONTARIO

Stamp:

Scale:
1:2500
Drawn by:
RCG
Checked by:
RG
Approved by:
DJG
Date:
03/2018

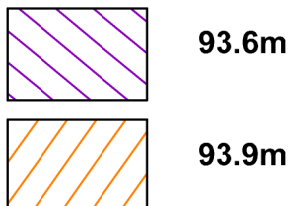
Report No.:
PG2246

Drawing No.:

PG2246-5

Revision No.:
5

PERMISSIBLE ROAD GRADE RAISE ELEVATIONS:



LEGEND:

- ONGOING SETTLEMENT PILE
- PREVIOUS TEST FILL PILE
- MONITORING WELL LOCATION, 2017
- TEST PIT LOCATION, CURRENT INVESTIGATION
- BOREHOLE LOCATION - PATERSON GROUP REPORT NO. PG2246
- BOREHOLE LOCATION - PATERSON GROUP REPORT NO. PG2099
- TEST PIT LOCATION - PATERSON GROUP REPORT NO. PG2099
- BOREHOLE LOCATION - PATERSON GROUP REPORT NO. PG1914
- BOREHOLE LOCATION - PATERSON GROUP REPORT NO. PG1618
- TEST PIT LOCATION - PATERSON GROUP REPORT NO. PG0214
- BOREHOLE LOCATION - PATERSON GROUP REPORT NO. PG0177
- TEST PIT LOCATION - PATERSON GROUP REPORT NO. PG0177
- BOREHOLE LOCATION - PATERSON GROUP REPORT NO. G9132
- TEST PIT LOCATION - PATERSON GROUP PORT NO. G9132
- SETTLEMENT PLATE LOCATION

SCALE: 1:2500

