Geotechnical Engineering Report

VA Domiciliary

Washington Hospital Center
NW, Washington, DC

GeoConcepts
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August 28, 2008

Mr. Rick Andrew
HDR Engineering, Inc.
1020 NE Loop 410, Suite 400
San Antonio, Texas 78209

Subject: ***Geotechnical Engineering Report, VA Domiciliary, Washington Hospital Center, NW, Washington, DC (Our 28014)***

Dear Mr. Andrew:

GeoConcepts Engineering, Inc. (GeoConcepts) is pleased to present this geotechnical engineering report for the above referenced project. These services have been performed in accordance with our proposal/agreement dated May 22, 2008.

1.0 Scope of Services

This geotechnical engineering report presents the results of the field investigation, soil laboratory testing, and engineering analysis of the geotechnical data. This report specifically addresses the following:

- An evaluation of subsurface conditions within the area of the proposed site development, including a seismic site classification per the International Building Code.
- Foundation recommendations for support of the proposed building and lower floor slab on grade.
- Lateral earth pressures for use in design of site retaining walls, including recommended backfill and subdrainage requirements.
- An assessment of subgrade conditions for support of flexible and rigid pavements, including recommended flexible and rigid pavement sections.
- Comments on utility installations for the site development.
- Earthwork recommendations for construction of loadbearing fills, including an assessment of on-site soils to be excavated for re-use as fill.

Services not specifically identified in the contract for this project are not included in the scope of services.

2.0 Site Description and Proposed Construction

The Washington Hospital Center site is developed with existing medical facilities and supporting pavement areas and utility infrastructure. The proposed VA Domiciliary building is to be located on the northeast portion of the property in a relatively flat area currently in use as a parking/staging area. A site vicinity map is presented as Figure 1 at the end of this report. We understand that the proposed building will be a 3-story modular construction with no basement levels. We also understand that the maximum column load is 130 kips.

3.0 Subsurface Conditions

Subsurface conditions were investigated by drilling a total of six test borings in the proposed site development area. Test boring logs and a boring location plan are presented in Appendix A.

3.1 Stratification

The subsurface materials encountered have been stratified for purposes of our discussions herein. These stratum designations do not imply that the materials encountered are continuous across the site. Stratum designations have been established to characterize similar subsurface conditions based on material gradations and parent geology. The subsurface materials encountered in the test borings completed at the site have been assigned to the following strata:

Stratum A (Existing Fill)	generally firm or medium stiff, clayey gravel, clayey sand, and gravelly silty clay, FILL, with glass, wood, brick, and concrete fragments, moist, dark brown to dark gray. Present to a maximum depth of 13.5 feet.
Stratum B (Pleistocene Terrace)	firm, silty SAND (SM) with gravel, clayey SAND (SC) with gravel, and POORLY GRADED GRAVEL (GP) with silt and sand, moist, brown to reddish-brown
Stratum C1 (Potomac Group)	stiff, FAT CLAY (CH), moist, brown and reddish-brown
Stratum C2 (Potomac Group)	firm, silty SAND (SM), moist, brown

Asphalt and gravel base were encountered in the test borings to depths ranging from about 0 to 8 inches below the existing ground surface. Asphalt and gravel base depths presented herein should not be considered as stripping depths, as asphalt and grave base depths may vary widely across the site.

The two letter designations included in the strata descriptions presented above and on the test boring logs represent the Unified Soil Classification System (USCS) designations for the samples based on visual classifications conducted in the field during the subsurface investigation. Visual classifications were made using the methods described in ASTM D-2488, and may not match classifications determined by laboratory testing per ASTM D-2487.

3.2 Geology

The site is located within the Coastal Plain Physiographic Province of Washington, DC. The Coastal Plain consists of a seaward thickening wedge of unconsolidated to semi-consolidated sedimentary deposits from the Cretaceous Geologic Period to the Holocene Geologic Epoch. These deposits represent marginal-marine to marine sediments consisting of interbedded sands and clays. The Coastal Plain is bordered to the east by the Atlantic Ocean and to the west by the Piedmont Physiographic Province. The dividing line between the Coastal Plain and the Piedmont is locally referred to as the "Fall Line". This name comes from the waterfalls that form as a result of the differential erosion that occurs as streams cross the Piedmont/Coastal Plain contact.

The existing fill soils of Stratum A are believed to be related to previous site grading. The natural soils assigned to Stratum B are believed to be terrace deposits associated with the nearby Potomac River. The soils assigned to Stratum C are believed to be Potomac Group sediments. The Potomac Group sediments are the oldest sedimentary deposits in the Washington, DC area. These soils are known to be highly over-consolidated as a result of the weight of a substantial thickness of overlying soils that have since been eroded away. As a result of over-consolidation, Potomac Group soils have been pre-loaded and are capable of supporting substantial loads.

Based on the results of the subsurface investigation and our knowledge of local geologic conditions, the site soils have been assigned to a site class D per the International Building Code.

3.3 Groundwater

Groundwater level observations were made in the field during drilling. Groundwater was not encountered in any of the test borings. Accordingly, groundwater should be below the finished floor level.

The groundwater observations presented herein are considered to be an indication of the groundwater levels at the dates and times indicated. Accordingly, the groundwater information presented herein should be used with caution. Also, fluctuations in groundwater levels should be expected with seasons of the year, construction activity, changes to surface grades, precipitation, or other similar factors.

3.4 Soil Laboratory Test Results

Selected soil samples obtained from the field investigation were tested for grain size distribution, Atterberg limits, California Bearing Ratio (CBR), and natural moisture contents. A summary of soil laboratory test results is presented as Appendix B. The results of natural moisture content tests are presented on the test boring logs in Appendix A.

Samples tested from Stratum A classified as gravelly silty CLAY (CL-ML), clayey GRAVEL (GC), and clayey SAND (SC) in accordance with the USCS, with about 30 to 52 percent fines passing the U.S. Standard No. 200 sieve. Liquid limits and plasticity indices ranged from 26 to 39, and 7 to 21, respectively. Natural moisture contents ranged from 7.5 to 18.4 percent. Laboratory CBR test results of the Stratum A soil materials expected at pavement subgrades indicate CBR values of 17.9% and 32.0%.

A sample tested from Stratum B classified as silty SAND (SM) in accordance with the USCS, with about 44 percent fines passing the U.S. Standard No. 200 sieve. The liquid limit and plasticity index was 15 and non-plastic, respectively. The natural moisture content was 8.3 percent.

A sample tested from Stratum C1 classified as FAT CLAY (CH) in accordance with the USCS, with about 93 percent fines passing the U.S. Standard No. 200 sieve. The liquid limit and plasticity index were 60 and 38, respectively. The natural moisture content was 22.3 percent.

A sample tested from Stratum C2 classified as silty SAND (SM) in accordance with the USCS, with about 14 percent fines passing the U.S. Standard No. 200 sieve. The liquid limit and plasticity index were non-plastic. The natural moisture content was 6.4 percent.

4.0 Engineering Analysis

Recommendations regarding foundations, lower floor slabs, lateral earth pressures, subdrainage, pavements, utility installations, and earthwork are presented herein.

4.1 Foundations

The proposed building may be supported by spread footings founded on rammed aggregate piers or on drilled piers. Details regarding these foundation options are presented below. The final selection of a foundation system should be based on an economic/construction schedule comparison of these options by the general contractor or cost estimator.

4.1.1 Spread Footings Supported by Rammed Aggregate Piers

Spread footings may be considered for support of the proposed building construction. However, due to the presence of up to 13.5 feet of uncontrolled existing fill in the building area, we recommend that the spread footings be founded on the existing fill soils improved by rammed aggregate piers. This soil improvement system is a practical refinement of the traditional over-excavation and replacement method of strengthening subsoils for settlement control and bearing capacity improvement. The pier support elements are constructed by drilling 30-inch diameter holes, approximately 8 to 12 feet depth beneath footing locations, removing a volume of compressible subsoil materials, then building a bottom bulb of clean, open-graded stone while vertically prestressing and prestraining subsoils underlying the bottom bulb. The pier shaft is built on top of the bottom bulb, using dense well-graded aggregate placed in about 12-inch thickness compacted lifts. Densification of the bottom bulb and the upper shaft lifts is accomplished by using the impact ramming action of a modified hydraulic hammer. The tamper head assists in transferring force laterally during impact densification, resulting in the pushing of aggregate against the confined walls of the cavity. The nature of the soil is to "push back", creating significant lateral soil pressure build-up in the soil matrix and lateral confinement to the pier elements. In addition to increasing the shear resistance at the pier perimeter, the increased horizontal stress in the soil matrix improves the soil matrix and makes it stiffer, which reduces total and differential settlement.

For this project, the pier elements with shaft lengths of about 8 to 12 feet can be expected to provide an allowable spread footing bearing pressure of 6,000 psf. The pier design including lengths, support capacities, spacings, and layout should be a coordinated effort between the pier designer and structural engineer.

Individual column footings and continuous wall footings should be at least 30 inches and 18 inches wide, respectively, for punching shear considerations. A maximum slope of one horizontal to one vertical (1H:1V) should be maintained between the bottom edges of adjacent footings. Settlement of spread footings should not exceed about 1-inch and differential settlement between adjacent foundation elements should not exceed about one-half this amount.

Footing subgrades should be observed and approved prior to placement of concrete, to ascertain that footings are placed on suitable bearing soils as recommended herein. Footings should be excavated and concrete placed the same day in order to avoid disturbance from water or weather. Disturbance of footing subgrades by exposure to water seepage or weather conditions should be avoided. Any existing fill, disturbed, frozen, or soft subgrade soils should be removed prior to placing footing concrete. It may be desirable to place a 3 to 4-inch thick "mud mat" of lean concrete immediately on the approved footing subgrade to avoid softening of the exposed subgrade. Forms may be used if necessary, but less subgrade disturbance is anticipated if excavations are made to the required dimensions and concrete placed against the soil. If footings are formed, the forms should be removed and the excavation backfilled as soon as possible. Water should not be allowed to pond along the outside of footings for long periods of time.

4.1.2 Drilled Piers

Drilled piers may also be considered for support of the proposed building. Drilled piers should extend through the existing fill and upper Stratum B terrace soils and bear on the Stratum C Potomac Group soils. An allowable end bearing pressure of 8,000 psf is recommended for design of drilled piers, with an estimated drilled pier length at 30 feet below the existing grades. Skin friction capacities should not be considered in the design; however, the weight of the drilled pier concrete may be neglected. Total settlement of drilled piers is not expected to exceed 1-inch.

Drilled piers should be constructed as straight shafts at least 30 inches in diameter, to facilitate cleaning of the bottoms and to facilitate observations of drilled pier end bearing materials. Prior to concrete placement, drilled pier subgrades should be observed by a representative of the geotechnical engineer in order to verify that subgrades are suitable for support of design bearing pressures, and to ensure that subgrades are free of loose or disturbed material.

Drilled piers should extend down to adequate bearing materials as described herein. Bases of drilled piers should be essentially level, although steps up to 1 foot high may be used at the drilled pier base. After the shaft is advanced to suitable bearing material, the subgrade should be hand cleaned prior to observation. Pumping of water at the bottom of the drilled pier may be required to control groundwater during construction.

Steel casings extending to the bottom of the drilled piers should be used to seal out groundwater and to aid in preventing sidewalls from caving. The casing may be extracted as the concrete is poured; however, a sufficient head of concrete should be maintained above the bottom casing during withdrawal to seal off groundwater, and to prevent infiltration of soil into the shaft.

Concrete should not be placed in standing water in excess of 2 inches in depth. The concrete should have a minimum slump of 5 inches. Concrete may be placed using the free fall method, as long as the concrete does not strike the sides of the casing or any reinforcing steel. If concrete free falls and strikes obstructions, it may segregate and result in zones of low strength concrete. Drilled piers should be concreted the same day they are drilled and should not be concreted to intermediate depths due to insufficient amounts of concrete at the site.

4.2 Lower Floor Slabs on Grade

Lower floor slab subgrades are expected to consist of existing fill or new compacted fill. These materials are generally considered suitable for support of the planned roadways and parking areas. However, where pavement subgrades consist of existing fill, we recommend a budget be established for undercutting the existing fill to a depth of at least 2 feet and backfilling with new compacted fill.

The lower floor slab may be designed based on a modulus of subgrade reaction K_{01} of 100 tons per cubic foot (tcf) based on a one-foot square plate. Caution should be used in determining the proper modulus of subgrade reaction to be input into a computerized solution to determine the thickness of the floor slab. Specifically, the modulus of subgrade reaction for the specific computer program being used should be based on the actual size of the slab's bearing/reaction area.

All debris and soft soils near the final floor slab subgrade as a result of construction operations should be stripped and removed prior to placement of underfloor stone. A 4-inch minimum thickness of washed gravel or crushed stone meeting the requirement of AASHTO No. 57 should be placed below floor slabs on-grade to serve as a capillary break. An impermeable plastic membrane should be placed on top of the crushed stone layer to assist as a moisture barrier. Special attention should be given to the surface curing of the slab in order to minimize uneven drying of the slab and associated cracking. Underfloor subdrainage should not be necessary since groundwater is expected to be below the finished floor level.

We recommend that the floor slab be isolated from the footings so differential settlement of the structure will not induce shear stresses on the floor slab. We also recommend mesh (fiber or welded wire fabric) reinforcement be included in the design of the floor slab to minimize the development of any shrinkage cracks near the surface of the slab. If welded wire fabric is used, the mesh should be located in the top half of the slab.

4.3 Lateral Earth Pressures and Subdrainage

Site retaining walls should be designed to withstand lateral earth pressures. An average equivalent fluid pressure of 42H (psf) is recommended for design of site retaining walls, where H refers to the height of the wall. The design should account for any surcharge loads within a 45 degree slope from the base of the wall. Retaining walls may be designed to include a passive equivalent fluid pressure of 375D (psf), where D represents the depth of wall embedment below the exposed wall face. The upper 1.5 feet of soil at the base of retaining walls should not be included in the design of passive soil resistance. A coefficient of friction of 0.35 may be used for sliding resistance at the soil/concrete interface. A recommended lateral earth pressure diagram for use in the design of site retaining walls is presented as Figure 2 at the end of this report.

Hydrostatic pressures are not included in the lateral earth pressure diagram assuming the use of relatively granular or free draining backfill, and perimeter subdrainage (weepholes) at the base of walls below grade. Recommended subdrainage for site retaining walls is presented on Figure 2 at the end of this report.

4.4 Pavements

Pavement subgrades are expected to consist of existing fill or new compacted fill. These materials are generally considered suitable for support of the planned roadways and parking areas. However, where pavement subgrades consist of existing fill, we recommend a budget be established for undercutting the existing fill to a depth of at least 2 feet and backfilling with new compacted fill.

Based on the soils encountered in the test borings at probable pavement subgrades, a preliminary design CBR value of 10 is recommended for pavement design purposes. If fill placed at the site is generated from off-site borrow areas, the actual CBR value for the pavement subgrades may be significantly different from the preliminary value presented herein. Therefore, CBR tests should be performed on the in-place subgrade after rough grading and installation of utilities within roadways. Final pavement sections should be based on CBR tests taken on subgrade soils at the time of construction. Concrete pavements should be utilized in loading dock areas and for dumpster pads. Design of concrete pavements including compressive strength, air entrainment, reinforcement, control joints, etc. should be provided by the structural engineer.

Estimated traffic loading was developed using information presented on the site plan and the current Institute of Traffic Engineers Trip Generation Manual. The recommended pavement sections presented herein are in accordance with the AASHTO Pavement Design and Analysis System. A design period of 20 years has been assumed for the pavement sections. Based on the preliminary design CBR value and traffic loading, the following pavement sections are recommended at this site:

	Light Duty	Heavy Duty	Loading Dock/Dumpster Pads
Bituminous Concrete Surface (inches)	1.5 inches	1.5 inches	---
Bituminous Concrete Base (inches)	2 inches	4.5 inches	---
Reinforced Concrete (inches)	---	---	7 inches
Aggregate Subbase (inches)	6 inches	8 inches	6 inches

The recommended pavement sections consider post-construction traffic conditions, and do not take into account construction traffic. Construction loading conditions may be more severe than post-construction conditions and typically occurs prior to placement of the total pavement sections recommended herein. Construction traffic activity on partially constructed pavement sections may result in subgrade and pavement failures due to the reduced support qualities of a partial section and the relatively heavy loads associated with construction traffic. Accordingly, consideration should be given to the construction of designated haul roads where the thickness of the granular subbase and/or asphalt base course has been increased to account for the heavier-loaded construction traffic. We suggest that placement of the asphalt surface course not occur until all the major construction has been completed for pavement areas subjected to construction traffic. To minimize damage to light duty pavement areas during and after construction, consideration should be given to restricting access by construction and any future commercial (non-passenger vehicle) traffic onto the light duty pavement areas, where possible.

The overall grading design should include suitable storm inlets, pavement underdrains and diversion structures for collecting surface runoff and to limit excessive ponding on paved surfaces. Specific surface drainage recommendations are beyond the scope of our services.

4.5 Utility Installations

We have assumed that the underground utilities will be placed up to 15 feet below proposed grades. In general, we expect that generally firm natural soils or existing fill will be encountered at utility subgrades, which should be suitable for support of utilities. Accordingly, we do not recommend that any special bedding be specified, and that construction of utility trenches be performed in accordance with the pipe type and specifications. However, where soft soils are encountered at utility invert elevations, we recommend that the pipe subgrade be undercut to a depth of 1 foot and the resulting excavation be filled with AASHTO No. 57 stone. Undercutting should extend one pipe joint beyond the soft soil area on each end.

4.6 Earthwork

Fill may be required for site grading in building and pavement areas, and as backfill against walls below grade. Unsuitable existing fill, soft or loose natural soils, organic material, and rubble should be stripped to approved subgrades as determined by the geotechnical engineer. The actual depth of stripping necessary to provide a suitable base for placement and compaction of earthwork may include topsoil and other soft surficial layers with or without organic matter. All subgrades should be proofrolled with a minimum 10 ton, loaded dump truck or suitable rubber tire construction equipment approved by the geotechnical engineer, prior to the placement of new fill.

For building areas, the new fill should extend at least 10 feet outside building lines. For parking areas, the new fill should extend at least 5 feet outside pavement edges. These recommendations are illustrated by Figure 3 at the end of this report.

Fill material should be compacted in lifts not exceeding 8 inches loose thickness, to at least 95 percent of the maximum dry density per ASTM D-698. The upper 6 inches of pavement subgrades should be compacted to at least 100 percent of the maximum dry density per the same standard. Materials used for compacted fill for support of footings, floor slabs, and pavements should consist of soils classifying SC, SM, SP, SW, GC, GM, GP, or GW per ASTM D-2487, with a maximum dry density greater than 105 pcf. Materials used for backfill against walls below grade should consist of soils classifying SM, SP, SW, GM, GP, or GW, with a liquid limit and plasticity index less than 40 and 15, respectively. Portions of the Stratum A existing fill may be suitable for re-use as new compacted fill based on classification; however, the Stratum A existing fill may be unsuitable for re-use as new fill due to deleterious man-made materials in the fill. In addition, drying of excavated soils by spreading and aerating may be necessary to obtain proper compaction. This may not be practical during the wet period of the year. Accordingly, earthwork operations should be planned for early Spring through late Fall, when drier weather conditions can be expected. Individual borrow areas, both from on-site and off-site sources, should be sampled and tested to verify classification of materials prior to their use as fill.

Fill materials should not be placed on frozen or frost-heaved soils, and/or soils that have been recently subjected to precipitation. All frozen or frost-heaved soils should be removed prior to continuation of fill operations. Borrow fill materials should not contain frozen materials at the time of placement.

Compaction equipment that is compatible with the soil type used for fill should be selected. Theoretically, any equipment type can be used as long as the required density is achieved; however, sheepsfoot roller equipment are best suited for fine-grained soils and vibratory smooth drum rollers are best suited for granular soils. Ideally, a smooth drum roller should be used for sealing the surface soils at the end of the day or prior to upcoming rain events. In addition, compaction equipment used adjacent to walls below grade should be selected so as to not impose undesirable surcharge on walls. All areas receiving fill should be graded to facilitate positive drainage of any water associated with precipitation and surface run-off.

After completion of compacted fill operations in building or pavement areas, construction of building elements or asphalt should begin immediately, or the finished subgrade should be protected from exposure to inclement weather conditions. Exposure to precipitation and freeze/thaw cycles will cause the finished subgrade to soften and become excessively disturbed. If development plans require that finished subgrades remain exposed to weather conditions after completion of fill operations, additional fill should be placed above finished grades to protect the newly placed fill. Alternatively, a budget should be established for reworking of the upper 1 to 2 feet of previously placed compacted fill.

5.0 General Limitations

Recommendations contained in this report are based upon the data obtained from the relatively limited number of test borings. This report does not reflect conditions that may occur between the points investigated, or between sampling intervals in test borings. The nature and extent of variations between test borings and sampling intervals may not become evident until the course of construction. Therefore, it is essential that on-site observations of subgrade conditions be performed during the construction period to determine if re-evaluation of the recommendations in this report must be made. It is critical to the successful completion of this project that GeoConcepts be retained during construction to observe the implementation of the recommendations provided herein.

This report has been prepared to aid in the evaluation of the site and to assist your office and the design professionals in the design of this project. It is intended for use with regard to the specific project as described herein. Changes in proposed construction, grading plans, structural loads, etc. should be brought to our attention so that we may determine any effect on the recommendations presented herein.

An allowance should be established for additional costs that may be required for foundation and earthwork construction as recommended in this report. Additional costs may be incurred for various reasons including wet fill materials, soft subgrade conditions, unexpected groundwater problems, rock excavation, etc.

This report should be made available to bidders prior to submitting their proposals to supply them with facts relative to the subsurface conditions revealed by our investigation and the results of analyses and studies that have been performed for this project. In addition, this report should be given to the successful contractor and subcontractors for their information only.

We recommend the project specifications contain the following statement: "A geotechnical engineering report has been prepared for this project by GeoConcepts Engineering, Inc. This report is for informational purposes only and should not be considered part of the contract documents. The opinions expressed in this report are those of the geotechnical engineer and represent their interpretation of the subsoil conditions, tests and results of analyses that they performed. Should the data contained in this report not be adequate for the contractor's purposes, the contractor may make their own investigations, tests and analyses prior to bidding."

This report was prepared in accordance with generally accepted geotechnical engineering practices. No warranties, expressed or implied, are made as to the professional services included in this report.

We appreciate the opportunity to be of service for this project. Please contact the undersigned if you require clarification of any aspect of this report.

Sincerely,
GEOCONCEPTS ENGINEERING, INC.

Paul L. Barnes, P.E.
Project Manager

DISTRICT OF COLUMBIA ★ PAUL E. BURKART No. 900345 REGISTERED PROFESSIONAL ENGINEER ★

Paul E. Burkart, P.E.
Principal

Figure 1: Site Vicinity Map
Figure 2: Design Earth Pressures for Site Retaining Walls
Figure 3: Compacted Structural Fill Diagram

Appendix A: Subsurface Investigation Report
Appendix B: Soil Laboratory Test Report

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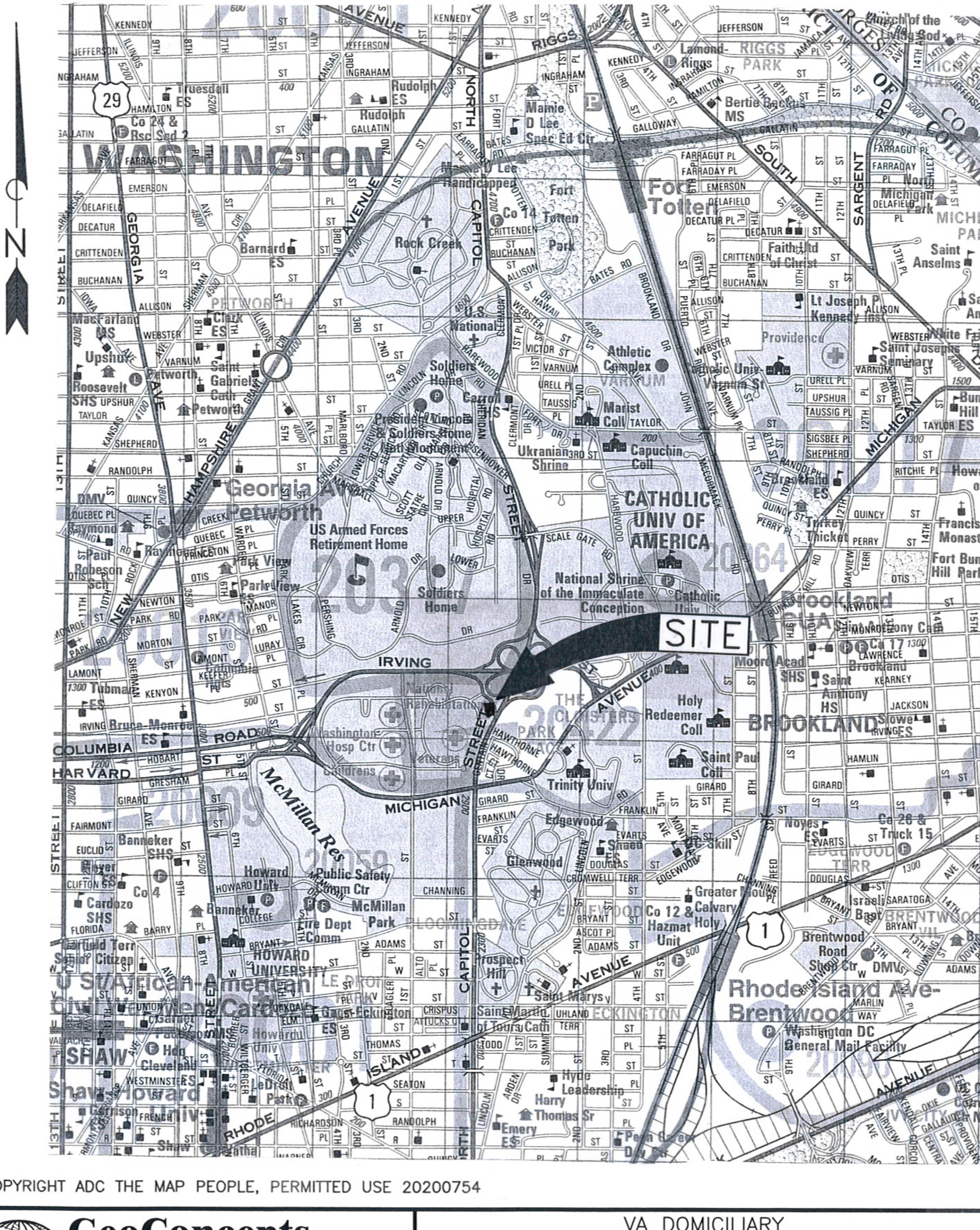

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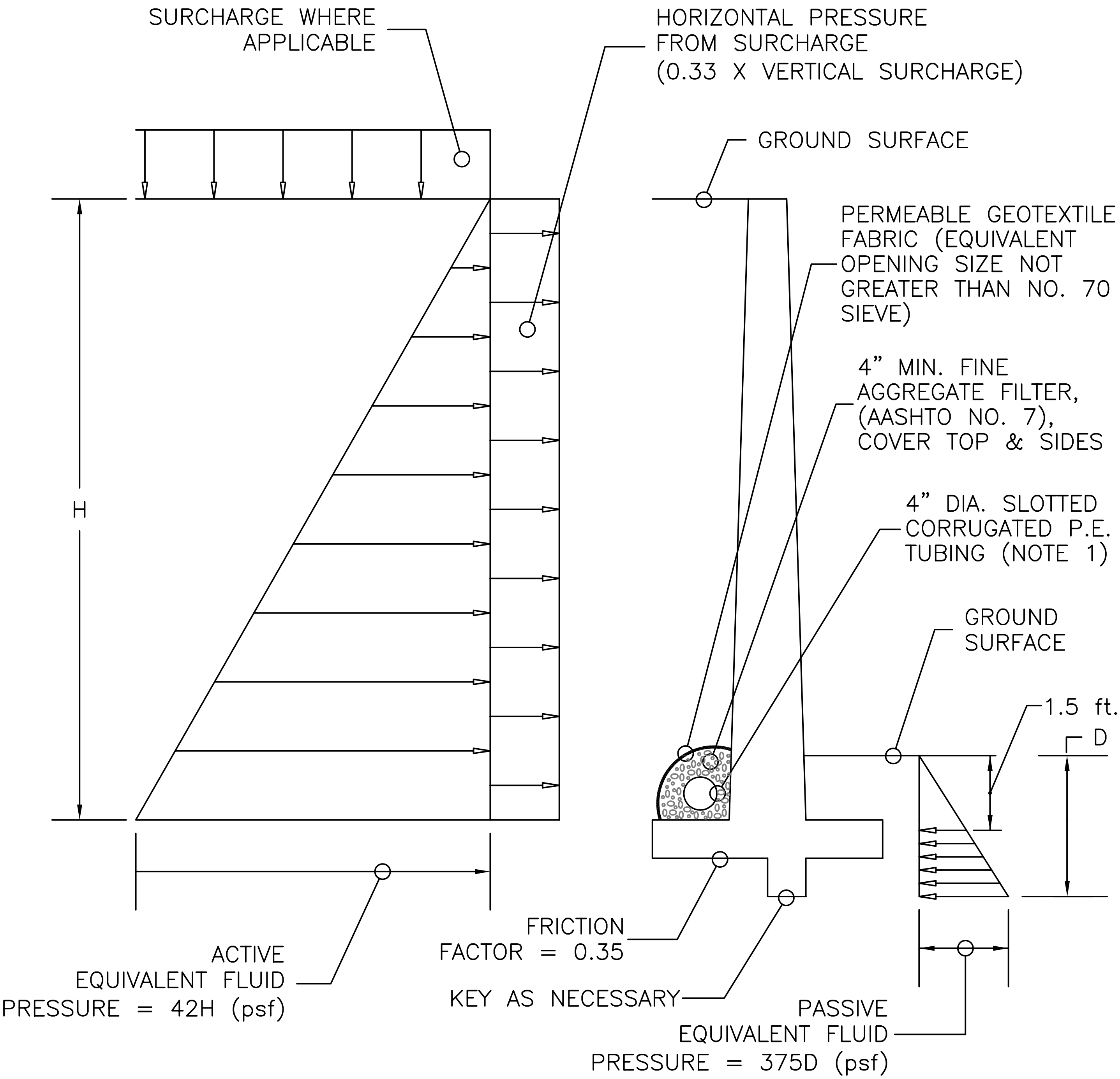
VA DOMICILIARY WASHINGTON HOSPITAL CENTER N.W., WASHINGTON, D.C.			
SITE VICINITY MAP		Scale: 1" = 2,000'	Fig. 1
Date: AUGUST 2008	Checked By: P.E.B.	Project No.: 28014	



NOTES:

1) WEEPHOLES CONSISTING OF 3-INCH DIA. PVC PIPE AT 10 FEET INTERVALS SHOULD BE SUBSTITUTED FOR SUBDRAINAGE PIPE.
2) PRESSURE DIAGRAM SHOWN ASSUMES HORIZONTAL GROUND BEHIND WALL AND FULL DRAINAGE OF HYDROSTATIC PRESSURES.
3) BACKFILL SHOULD CONSIST OF MATERIAL CLASSIFIED AS SM, SP, SW, GM, GP, OR GW PER ASTM D-2487. THE LIQUID LIMIT AND PLASTICITY INDEX OF BACKFILL MATERIAL SHOULD NOT EXCEED 40 AND 15, RESPECTIVELY.

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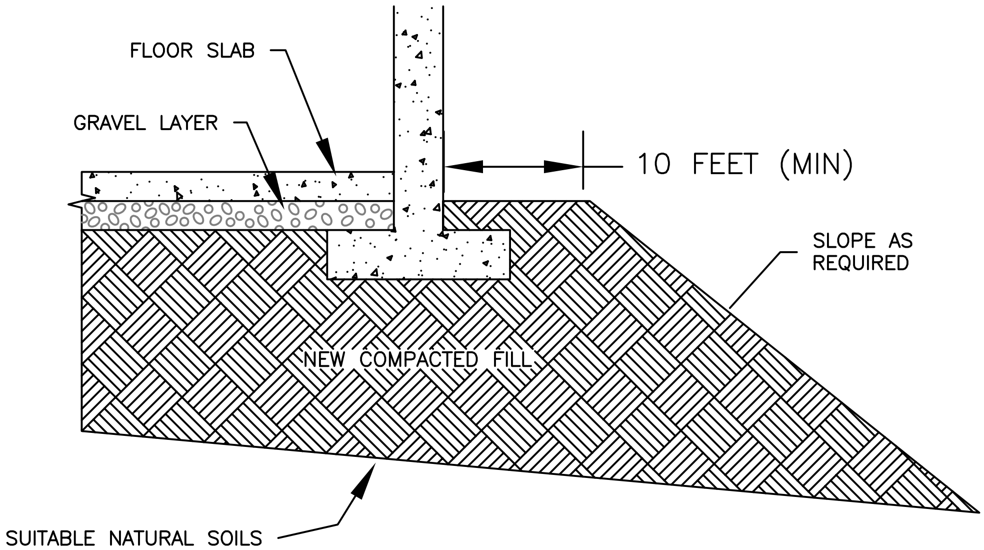
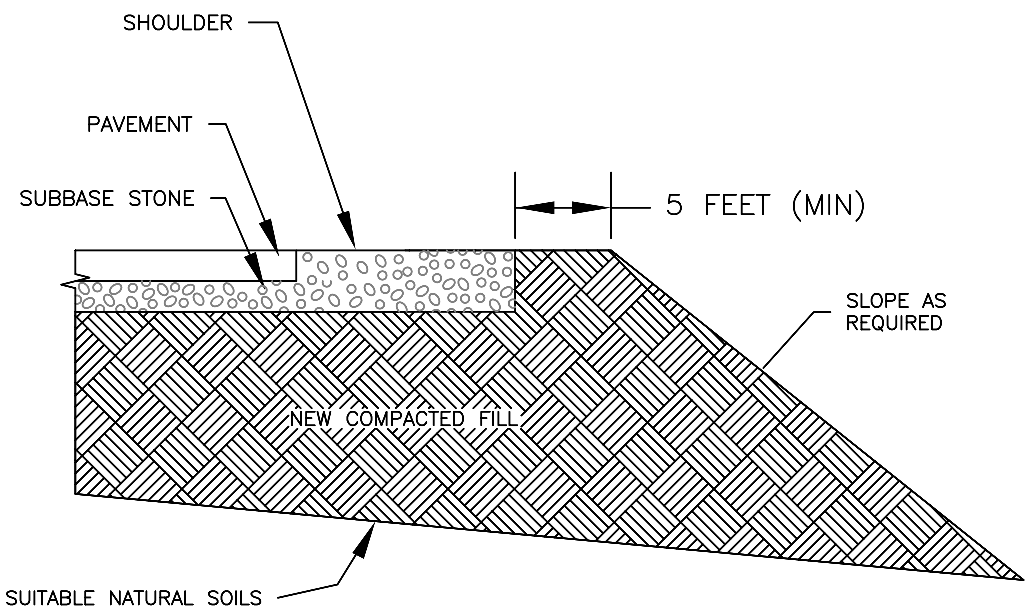
VA DOMICILIARY
WASHINGTON HOSPITAL CENTER N.W., WASHINGTON, D.C.

DESIGN EARTH PRESSURES FOR SITE RETAINING WALLS		Scale: NTS	Fig. 2
Date: AUGUST, 2008	Checked By: P.E.B.	Project No.: 28014	

FOR BUILDINGS:



FOR PAVEMENTS:



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VA DOMICILIARY WASHINGTON HOSPITAL CENTER, N.W., WASHINGTON, D.C.			
COMPACTED STRUCTURAL FILL DIAGRAM		Scale: N.T.S.	Fig. 3
Date: AUGUST, 2008	Checked By: P.E.B.	Project No.: 28014	

Subsurface Investigation Report

Subsurface Investigation Procedures (1 page)
Identification of Soil (1 page)
Test Boring Notes (1 page)
Test Boring Logs (6 pages)
Boring Location Plan, Figure 4 (1 page)

Subsurface Investigation Procedures

1. ***Test Borings – Hollow Stem Augers***

   The borings are advanced by turning an auger with a center opening of 2-¼ inches. A plug device blocks off the center opening while augers are advanced. Cuttings are brought to the surface by the auger flights. Sampling is performed through the center opening in the hollow stem auger, by standard methods, after removal of the plug. Usually, no water is introduced into the boring using this procedure.

2. ***Standard Penetration Tests***

   Standard penetration tests are performed by driving a 2 inch O.D., 1-⅜ inch I.D. sampling spoon with a 140-pound hammer falling 30 inches, according to ASTM D-1586. After an initial 6 inches penetration to assure the sampling spoon is in undisturbed material, the number of blows required to drive the sampler an additional 12 inches is generally taken as the N value. In the event 30 or more blows are required to drive the sampling spoon the initial 6 inch interval, the sampling spoon is driven to a total penetration resistance of 100 blows or 18 inches, whichever occurs first. The sampling operation is terminated after a total of 100 hammer blows and the depth of penetration is recorded.

3. ***Test Boring Stakeout***

   The test boring stakeout was provided by GeoConcepts personnel using available site plans. Ground surface elevations were estimated from topographic information contained on the site plan provided to us and should be considered approximate. If the risk related to using approximate boring locations and elevations is unacceptable, we recommend an as-drilled survey of boring locations and elevations be completed by a licensed surveyor.

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IDENTIFICATION OF SOIL

I. DEFINITION OF SOIL GROUP NAMES

		ASTM D-2487	Symbol	Group Name
Coarse-Grained Soils More than 50% retained on No. 200 sieve	**Gravels** - More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines	**GW**	WELL GRADED GRAVEL
			GP	POORLY GRADED GRAVEL
		Gravels with Fines More than 12% fines	**GM**	silty GRAVEL
			GC	clayey GRAVEL
	Sands - 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines	**SW**	WELL GRADED SAND
			SP	POORLY GRADED SAND
		Sands with fines More than 12% fines	**SM**	silty SAND
			SC	clayey SAND
Fine-Grained Soils 50% or more passes the No. 200 sieve	**Silts and Clays** - Liquid Limit less than 50	Inorganic	**CL**	LEAN CLAY
			ML	SILT
		Organic	**OL**	ORGANIC CLAY
				ORGANIC SILT
	Silts and Clays - Liquid Limit 50 or more	Inorganic	**CH**	FAT CLAY
			MH	ELASTIC SILT
		Organic	**OH**	ORGANIC CLAY
				ORGANIC SILT
Highly Organic Soils	Primarily organic matter, dark in color, and organic odor		**PT**	PEAT

II. DEFINITION OF MINOR COMPONENT PROPORTIONS

Minor Component	**Approximate Percentage of Fraction by Weight**
Adjective Form	
Gravelly, Sandy	30% or more coarse grained
With	
Sand, Gravel	15% to 29% coarse grained
Silt, Clay	5% to 12% fine grained

III. GLOSSARY OF MISCELLANEOUS TERMS

SYMBOLS - Unified Soil Classification Symbols are shown above as group symbols. Use "A" Line Chart for laboratory identification. Dual symbols are used for borderline classification.

BOULDERS & COBBLES - Boulders are considered pieces of rock larger than 12 inches, while cobbles range from 3 to 12 inches.

DISINTEGRATED ROCK - Residual rock material with a standard penetration test (SPT) resistance between 60 blows per foot and refusal.

ROCK - Rock material with a standard penetration test (SPT) resistance of 100 blows for 2 inches or 50 blows for 0 inches, or less penetration

DECOMPOSED ROCK - Residual rock material exhibiting rock-like properties that can be excavated by backhoe equipment. Similar to Disintegrated Rock, but cannot be classified as such because SPT N-Values were not obtained.

ROCK FRAGMENTS - Angular pieces of rock, distinguished from rounded transported gravel, which have separated from original vein or strata and are present in a soil matrix.

QUARTZ - A hard silicate mineral often found in residual soils. Only used when describing residual soils.

CEMENTED SAND - Usually localized rock-like deposits within a soil stratum composed of sand grains cemented by calcium carbonate, iron oxide, or other minerals. Commonly encountered in Coastal Plain sediments, primarily in the Potomac Group sands (Kps).

MICA - A plate-like phyllosilicate mineral found in many rocks, and in residual or transported soil derived therefrom.

ORGANIC MATERIALS (Excluding Peat) - Topsoil - Surface soils that support plant life and contain organic matter.
Lignite - Hard, brittle decomposed organic matter with low fixed carbon content (a low grade of coal).

FILL - Man made deposit containing soil, rock, and other foreign matter.

PROBABLE FILL - Soils which contain no visually detected foreign matter but which are suspect with regard to origin.

LAYERS - ½ to 12 inch seam of minor soil component.

COLOR - Two most predominant colors present should be described.

MOISTURE CONDITIONS - Wet, moist, or dry to indicate visual appearance of specimen.

Test Boring Notes

1. Classification of soil is by visual inspection and is in accordance with the Unified Soil Classification System.

2. Estimated groundwater levels are indicated on the logs. These are only estimates from available data and may vary with precipitation, porosity of soil, site topography, etc.

3. Sampling data presents standard penetrations for 6 inch intervals or as indicated with graphic representations adjacent to the sampling data. Where undisturbed tube samples are taken, they are designated "Shelby Tube" on the soil test boring log. The length of insertion and recovery for tube samples in inches are also provided on the soil test boring log.

4. The logs and related information depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at the test locations. Also, the passage of time may result in a change in the subsurface conditions at the test locations.

5. The stratification lines represent the approximate boundary between soil types as determined in the sampling operation. Some variation may be expected vertically between samples taken. The soil profile, groundwater level observations and penetration resistances presented on the logs have been made with reasonable care and accuracy and must be considered only an approximate representation of subsurface conditions to be encountered at the particular location.

6. Disintegrated rock is defined as residual earth material with a penetration resistance between 60 blows per foot and refusal. Spoon refusal at the surface of rock, boulders, or obstructions is defined as a penetration resistance of 100 blows for 2 inches penetration or less. Auger refusal is taken as the depth at which further penetration of the auger is not possible without risking significant damage to the drilling equipment.

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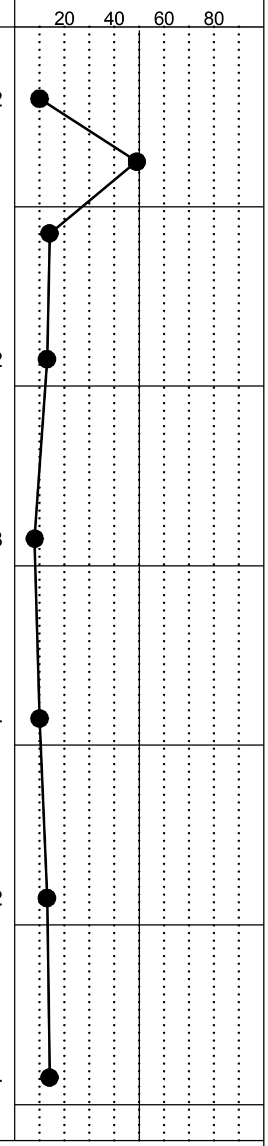
Ashburn, Virginia 20147 (703) 726-8032 fax

PROJECT: VA Domiciliary	LOGGED BY: T. Nguyen	BORING NUMBER: **B-1**
LOCATION: Washington Hospital Center, N.W. Washington, D.C.	DRILLING CONTRACTOR: Connelly and Associates, Inc.	SHEET 1 OF 1
OWNER/CLIENT: HDR Engineering, Inc.	DRILLER: D. Pao	DATE STARTED: 7/25/08
PROJECT NUMBER: 28014 / GROUND SURFACE ELEVATION (ft): 206.0 ±	DRILLING METHOD: 2.25" I.D. HSA	DATE COMPLETED: 7/25/08

ELEV. (ft)	DEPTH (ft)	STRATUM	MATERIAL DESCRIPTION	MC (%)	SAMPLE TYPE	SPT BLOW COUNTS	RECOVERY (in)
205.7			Asphalt = 4 inches				
205.3			Gravel base = 4 inches				
		A	lean clay FILL, with sand, gravel, and wood chips, moist, dark gray		Split Spoon	4+5+5+6	22
			with concrete fragments between 3.0 and 4.5 ft.		Split Spoon	23+41+8	8
	5			15.2	Split Spoon	4+7+7	6
197.5		C1	FAT CLAY (CH), moist, brown	22.3	Split Spoon	4+5+8	12
	10						
192.5		C2	silty SAND (SM), moist, brown		Split Spoon	3+3+5	18
	15						
				6.4	Split Spoon	5+4+6	14
	20						
					Split Spoon	5+7+6	12
	25						
177.5			clayey SAND (SC), with gravel, moist, brown		Split Spoon	5+6+8	14
176.0	30		Bottom of Boring at 30.0 ft				

STANDARD PENETRATION TEST RESISTANCE (BLOWS/FOOT)



GROUND WATER LEVELS:

ENCOUNTERED: None

UPON COMPLETION: Dry

CAVED: 16.0 ft ELEV. 190.0

SAMPLE TYPES: Split Spoon

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

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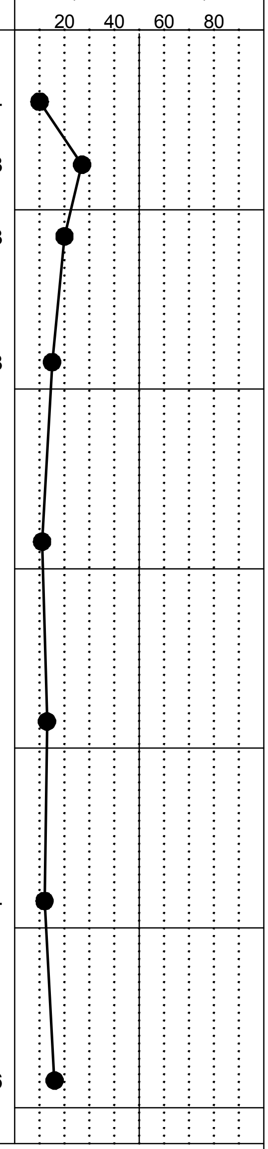
Ashburn, Virginia 20147 (703) 726-8032 fax

PROJECT:	LOGGED BY:	BORING NUMBER:
VA Domiciliary	T. Nguyen	**B-2**
LOCATION: Washington Hospital Center, N.W. Washington, D.C.	DRILLING CONTRACTOR: Connelly and Associates, Inc.	SHEET 1 OF 1
OWNER/CLIENT: HDR Engineering, Inc.	DRILLER: D. Pao	DATE STARTED: 7/25/08
PROJECT NUMBER: 28014 / GROUND SURFACE ELEVATION (ft): 206.0 ±	DRILLING METHOD: 2.25" I.D. HSA	DATE COMPLETED: 7/25/08

ELEV. (ft)	DEPTH (ft)	STRATUM	MATERIAL DESCRIPTION	MC (%)	SAMPLE TYPE	SPT BLOW COUNTS	RECOVERY (in)
205.7			Asphalt = 4 inches				
205.3			Gravel base = 4 inches				
203.5		A	sandy lean clay FILL, with gravel, moist, brown		Split Spoon	4+5+5+8	24
		B	clayey SAND (SC), with gravel, moist, brown	8.9	Split Spoon	9+12+15	18
	5			9.6	Split Spoon	10+13+7	18
				8.2	Split Spoon	6+8+7	18
	10						
	15				Split Spoon	5+6+5	1
187.5			POORLY GRADED GRAVEL (GP), with silt and sand, moist, brown		Split Spoon	15+8+5	6
	20						
182.5		C2	silty SAND (SM), moist, brown		Split Spoon	4+7+5	14
	25						
176.0	30				Split Spoon	4+8+8	16
			Bottom of Boring at 30.0 ft				

STANDARD PENETRATION TEST RESISTANCE (BLOWS/FOOT)



GROUND WATER LEVELS:

ENCOUNTERED: None

UPON COMPLETION: Dry CAVED: 16.0 ft ELEV. 190.0

SAMPLE TYPES: Split Spoon

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

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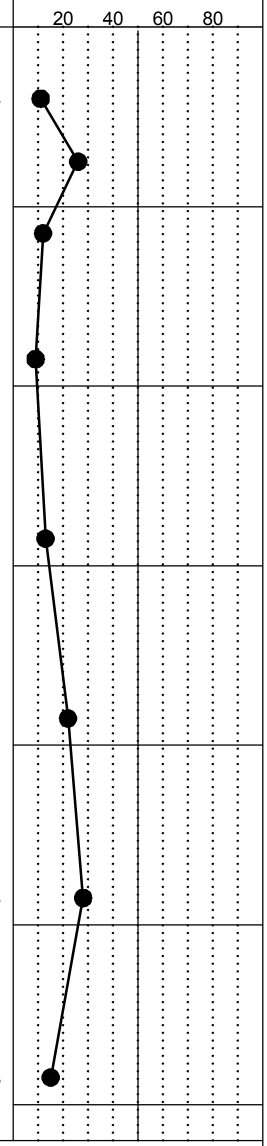
Ashburn, Virginia 20147 (703) 726-8032 fax

PROJECT: VA Domiciliary	LOGGED BY: T. Nguyen	BORING NUMBER: **B-3**
LOCATION: Washington Hospital Center, N.W. Washington, D.C.	DRILLING CONTRACTOR: Connelly and Associates, Inc.	SHEET 1 OF 1
OWNER/CLIENT: HDR Engineering, Inc.	DRILLER: D. Pao	DATE STARTED: 7/25/08
PROJECT NUMBER: 28014 / GROUND SURFACE ELEVATION (ft): 208.0 ±	DRILLING METHOD: 2.25" I.D. HSA	DATE COMPLETED: 7/25/08

ELEV. (ft)	DEPTH (ft)	STRATUM	MATERIAL DESCRIPTION	MC (%)	SAMPLE TYPE	SPT BLOW COUNTS	RECOVERY (in)
207.8			Asphalt = 3 inches				
207.6			Gravel base = 2 inches				
		A	lean clay FILL, with sand, gravel, and brick fragments, moist, brown		X	3+3+8+8	14
				12.0	X	10+17+9	7
203.0	5		clayey sand FILL, with gravel and brick fragments, moist, brown	10.4	X	10+7+5	6
					X	3+3+6	0
	10						
194.5		B	clayey SAND (SC), moist, brown		X	7+6+7	6
	15						
			with gravel, reddish-brown below 18.5 ft.	6.0	X	10+13+9	8
	20						
184.5		C2	silty SAND (SM), moist, brown	11.2	X	8+16+12	14
	25						
					X	7+9+6	18
178.0	30		Bottom of Boring at 30.0 ft				

STANDARD PENETRATION TEST RESISTANCE (BLOWS/FOOT)



GROUND WATER LEVELS:

ENCOUNTERED: None

UPON COMPLETION: Dry CAVED: 11.0 ft ELEV. 197.0

SAMPLE TYPES:

☒ Split Spoon

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

BOREHOLE/TEST PIT 28014, VA DOMICILIARY.GPJ GEOCONCEPTS.GDT 8/28/08

GeoConcepts Engineering, Inc.

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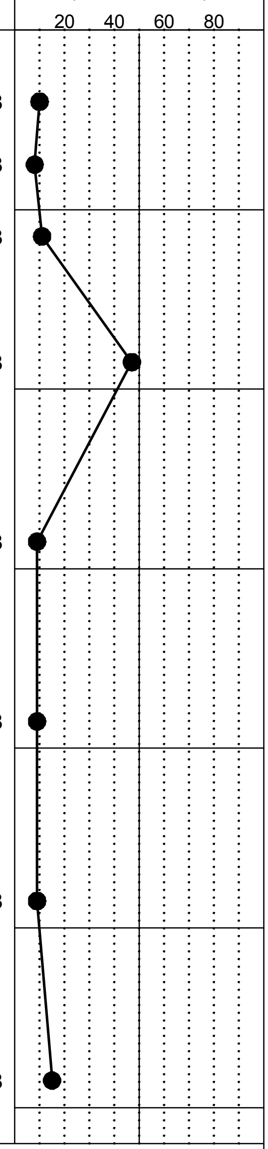
Ashburn, Virginia 20147 (703) 726-8032 fax

PROJECT: VA Domiciliary	LOGGED BY: T. Nguyen	BORING NUMBER: **B-4** SHEET 1 OF 1
LOCATION: Washington Hospital Center, N.W. Washington, D.C.	DRILLING CONTRACTOR: Connelly and Associates, Inc.	
OWNER/CLIENT: HDR Engineering, Inc.	DRILLER: D. Pao	DATE STARTED: 7/25/08
PROJECT NUMBER: 28014 / GROUND SURFACE ELEVATION (ft): 208.0 ±	DRILLING METHOD: 2.25" I.D. HSA	DATE COMPLETED: 7/25/08

ELEV. (ft)	DEPTH (ft)	STRATUM	MATERIAL DESCRIPTION	MC (%)	SAMPLE TYPE	SPT BLOW COUNTS	RECOVERY (in)
207.7			Asphalt = 4 inches				
207.4			Gravel base = 3 inches				
		A	clayey sand FILL, with gravel and glass, moist, dark gray brown below 2.5 ft.		Split Spoon	5+5+5+4	18
				18.4	Split Spoon	3+3+5	18
	5				Split Spoon	4+5+6	18
199.5		B	silty SAND (SM), with gravel, moist, brown	8.3	Split Spoon	18+24+23	18
	10						
194.5		C1	FAT CLAY (CH), moist, brown		Split Spoon	3+4+5	18
	15						
189.5		C2	silty SAND (SM), moist, brown		Split Spoon	2+4+5	18
	20						
					Split Spoon	7+5+4	18
	25						
					Split Spoon	5+7+8	18
178.0	30		Bottom of Boring at 30.0 ft				

STANDARD PENETRATION TEST RESISTANCE (BLOWS/FOOT)



GROUND WATER LEVELS:

ENCOUNTERED: None

UPON COMPLETION: Dry

SAMPLE TYPES: ☒ Split Spoon

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

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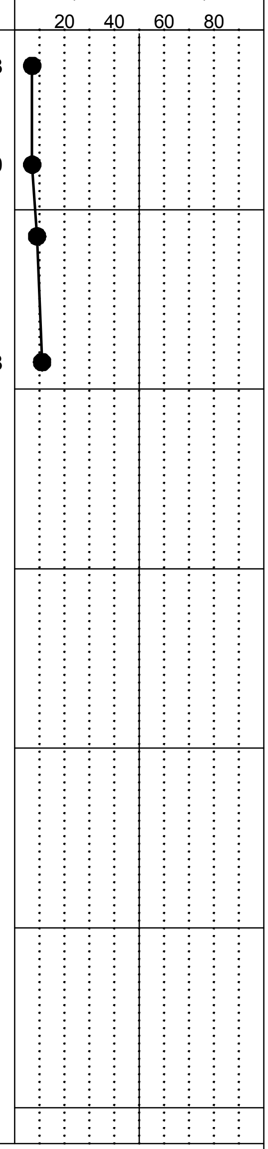
PROJECT:	LOGGED BY:	BORING NUMBER:
VA Domiciliary	T. Nguyen	**B-5**
LOCATION: Washington Hospital Center, N.W. Washington, D.C.	DRILLING CONTRACTOR: Connelly and Associates, Inc.	SHEET 1 OF 1

OWNER/CLIENT:	DRILLER:	DATE STARTED:
HDR Engineering, Inc.	D. Pao	7/25/08

PROJECT NUMBER:	GROUND SURFACE ELEVATION (ft):	DRILLING METHOD:	DATE COMPLETED:
28014	205.0 ±	2.25" I.D. HSA	7/25/08

ELEV. (ft)	DEPTH (ft)	STRATUM	MATERIAL DESCRIPTION	MC (%)	SAMPLE TYPE	SPT BLOW COUNTS	RECOVERY (in)
204.8			Gravel base = 2 inches				
		A	clayey gravel FILL, with sand and brick fragments, moist, dark brown		Split Spoon	4+3+4+4	18
					Split Spoon	3+3+4	10
	5				Split Spoon	3+4+5	3
196.5		C1	FAT CLAY (CH), moist, reddish-brown		Split Spoon	4+5+6	18
195.0	10		Bottom of Boring at 10.0 ft				
	15						
	20						
	25						
	30						

STANDARD PENETRATION TEST RESISTANCE (BLOWS/FOOT)



GROUND WATER LEVELS:

ENCOUNTERED: None

UPON COMPLETION: Dry

CAVED: 6.5 ft ELEV. 198.5

SAMPLE TYPES:

☒ Split Spoon

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

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Ashburn, Virginia 20147 (703) 726-8032 fax

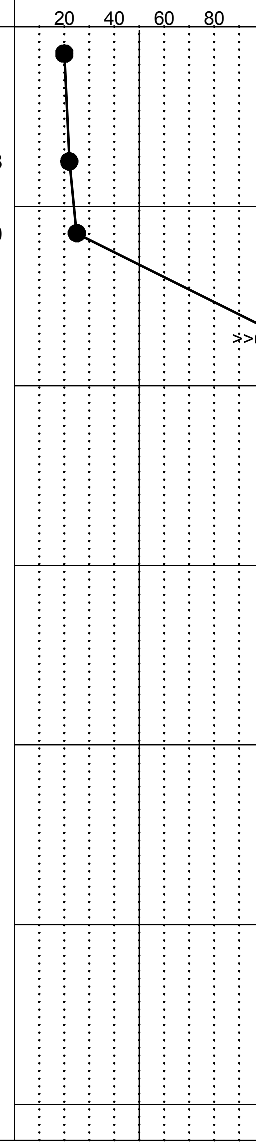
PROJECT:	LOGGED BY:	BORING NUMBER:
VA Domiciliary	T. Nguyen	**B-6**
LOCATION: Washington Hospital Center, N.W. Washington, D.C.	DRILLING CONTRACTOR: Connelly and Associates, Inc.	SHEET 1 OF 1

OWNER/CLIENT:	DRILLER:	DATE STARTED:
HDR Engineering, Inc.	D. Pao	7/25/08

PROJECT NUMBER:	GROUND SURFACE ELEVATION (ft):	DRILLING METHOD:	DATE COMPLETED:
28014	205.0 ±	2.25" I.D. HSA	7/25/08

ELEV. (ft)	DEPTH (ft)	STRATUM	MATERIAL DESCRIPTION	MC (%)	SAMPLE TYPE	SPT BLOW COUNTS	RECOVERY (in)
		A	clayey gravel FILL, with sand, moist, brown		Split Spoon	7+10+10	11
					Split Spoon	9+13+9	18
	5				Split Spoon	7+12+13	10
					Split Spoon	100/5	5
195.0	10		Bottom of Boring at 10.0 ft				
	15						
	20						
	25						
	30						

STANDARD PENETRATION TEST RESISTANCE (BLOWS/FOOT)



GROUND WATER LEVELS:

ENCOUNTERED: None

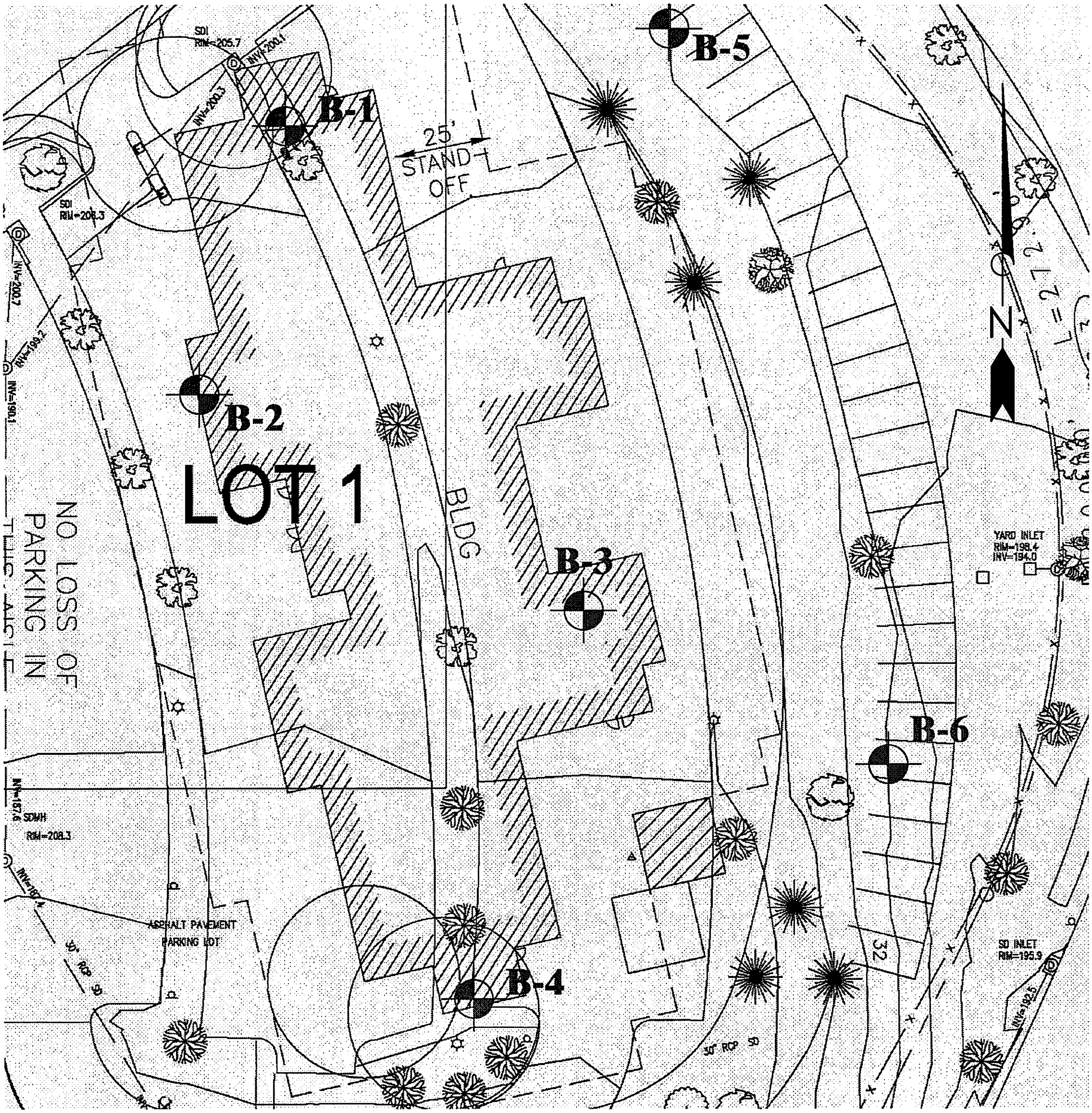
UPON COMPLETION: Dry   CAVED: 7.0 ft   ELEV. 198.0

SAMPLE TYPES:

Split Spoon

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.



L E G E N D

B-1 BORING LOCATION

N:\PROJECTS\28014\Final\BLP.dwg

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Ashburn, Virginia 20147 (703) 726-8032 fax

VA DOMICILIARY WASHINGTON HOSPITAL CENTER, N.W., WASHINGTON, D.C.			
BORING LOCATION PLAN		Scale: 1" = 40'	Fig. 4
Date: AUGUST 2008	Checked By: P.E.B.	Project No.: 28014	

Soil Laboratory Test Report

Summary of Soil Laboratory Test Results (1 page)
Gradation Curves (7 pages)
Moisture Density Relation Curves (2 pages)
CBR Test Curves (2 pages)

Summary of Soil Laboratory Test Results

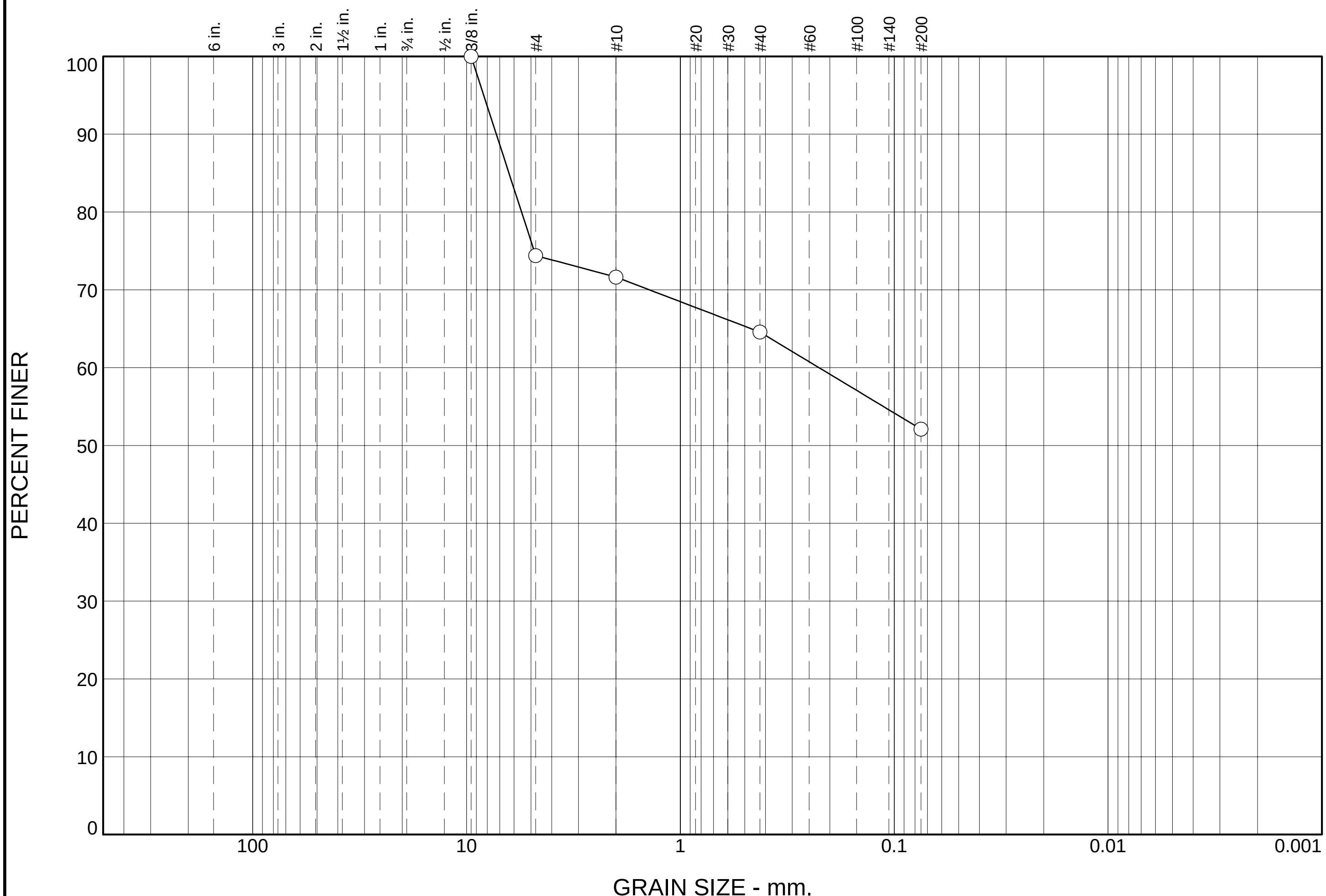
Project: VA Domiciliary **Contract No.: 28014**

Boring	Depth (ft.)	Sample Type	Stratum	Description of Soil Specimen	Sieve Results		Atterberg Limits			Natural Moisture Content (%)	Remarks
					Percent Retained # 4 Sieve	Percent Passing # 200 Sieve	LL	PL	PI		
B-1	5.0-6.5	Jar	A	gravelly silty CLAY (CL-ML), with sand	25.6	52.1	26	19	7	15.2	--
B-1	8.5-10.0	Jar	C1	FAT CLAY (CH)	0.0	92.8	60	22	38	22.3	--
B-1	18.5-20.0	Jar	C2	silty SAND (SM)	0.0	14.0	NP	NP	NP	6.4	--
B-4	2.5-4.0	Jar	A	clayey SAND (SC), with gravel	28.4	41.9	38	17	21	18.4	--
B-4	8.5-10.0	Jar	B	silty SAND (SM)	6.1	44.3	15	NP	NP	8.3	--
B-5	0-5.0	Bag	A	clayey GRAVEL (GC), with sand	36.6	31.2	39	19	20	9.1	CBR = 17.9%
B-6	0-5.0	Bag	A	clayey GRAVEL (GC), with sand	18.0	30.4	36	19	17	7.5	CBR = 32.0%

Notes:

1. Soil tests are in accordance with applicable ASTM standards.
2. Soil classification symbols are in accordance with Unified Soil Classification System.
3. Visual identification of samples is in accordance with ASTM D-2488.
4. Key to abbreviations: LL= Liquid Limit; PL= Plastic Limit; PI= Plasticity Index; NP= Nonplastic; N/T = Not Tested

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	25.6	2.8	7.0	12.5	52.1	

	Colloids	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○		26	19	6.3359	0.2250						

Material Description	USCS	AASHTO
○ Gravelly silty clay with sand	CL-ML	A-4(1)

Project No. 28014 **Client:**

Project: VA Domiciliary

○ **Source of Sample:** B-1 **Depth:** 5.0-6.5' **Sample Number:** S-3

Date: ○

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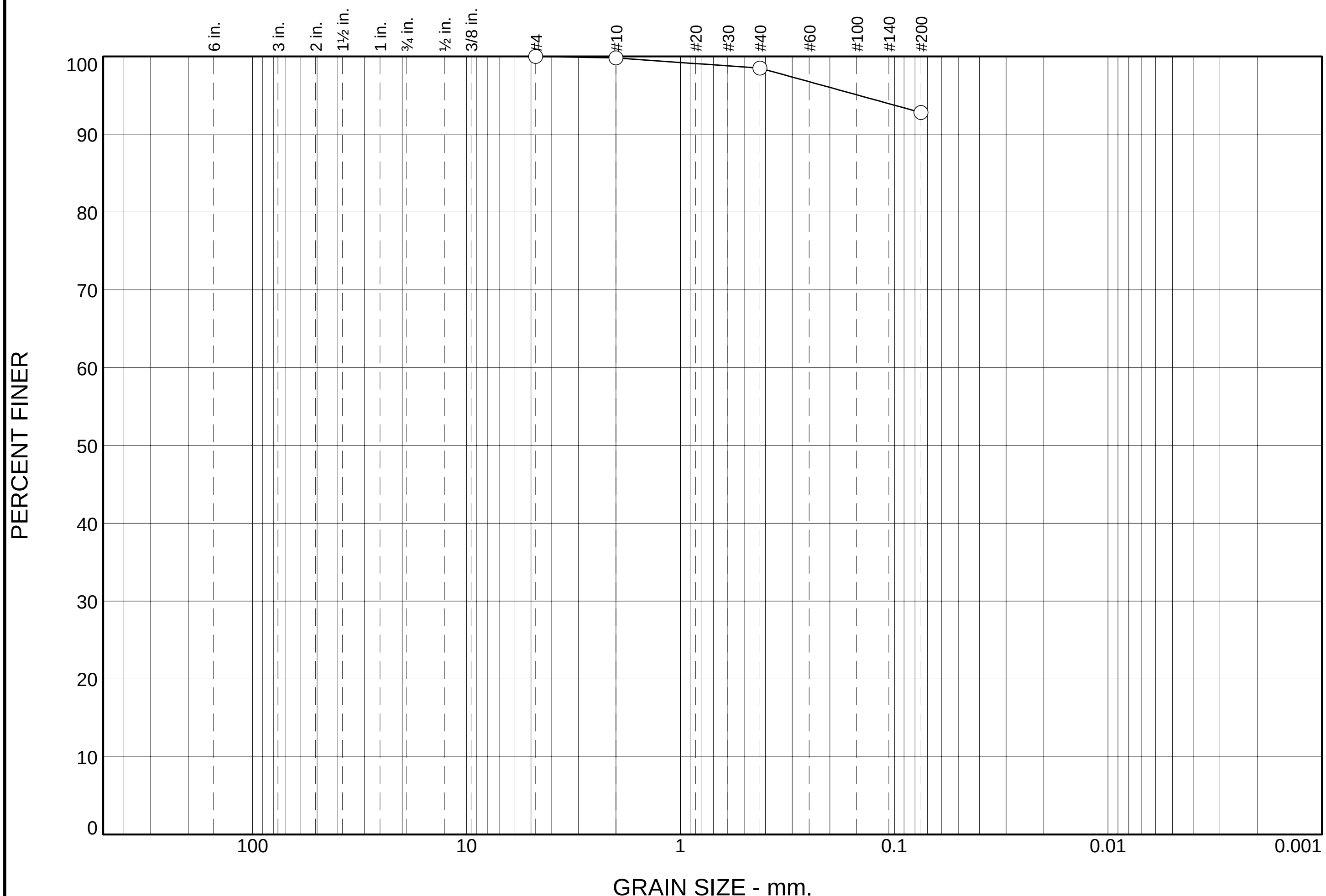
Ashburn, VA 20147

Remarks:
○ Natural Moisture: 15.2%

Figure

Tested By: NA **Checked By:** JA

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.2	1.3	5.7	92.8	

	Colloids	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○		60	22								

Material Description	USCS	AASHTO
○ Fat clay	CH	A-7-6(39)

Project No. 28014 **Client:**

Project: VA Domiciliary

○ **Source of Sample:** B-1 **Depth:** 8.5-10.0' **Sample Number:** S-4

Date: ○

Remarks:
○ Natural Moisture: 22.3%

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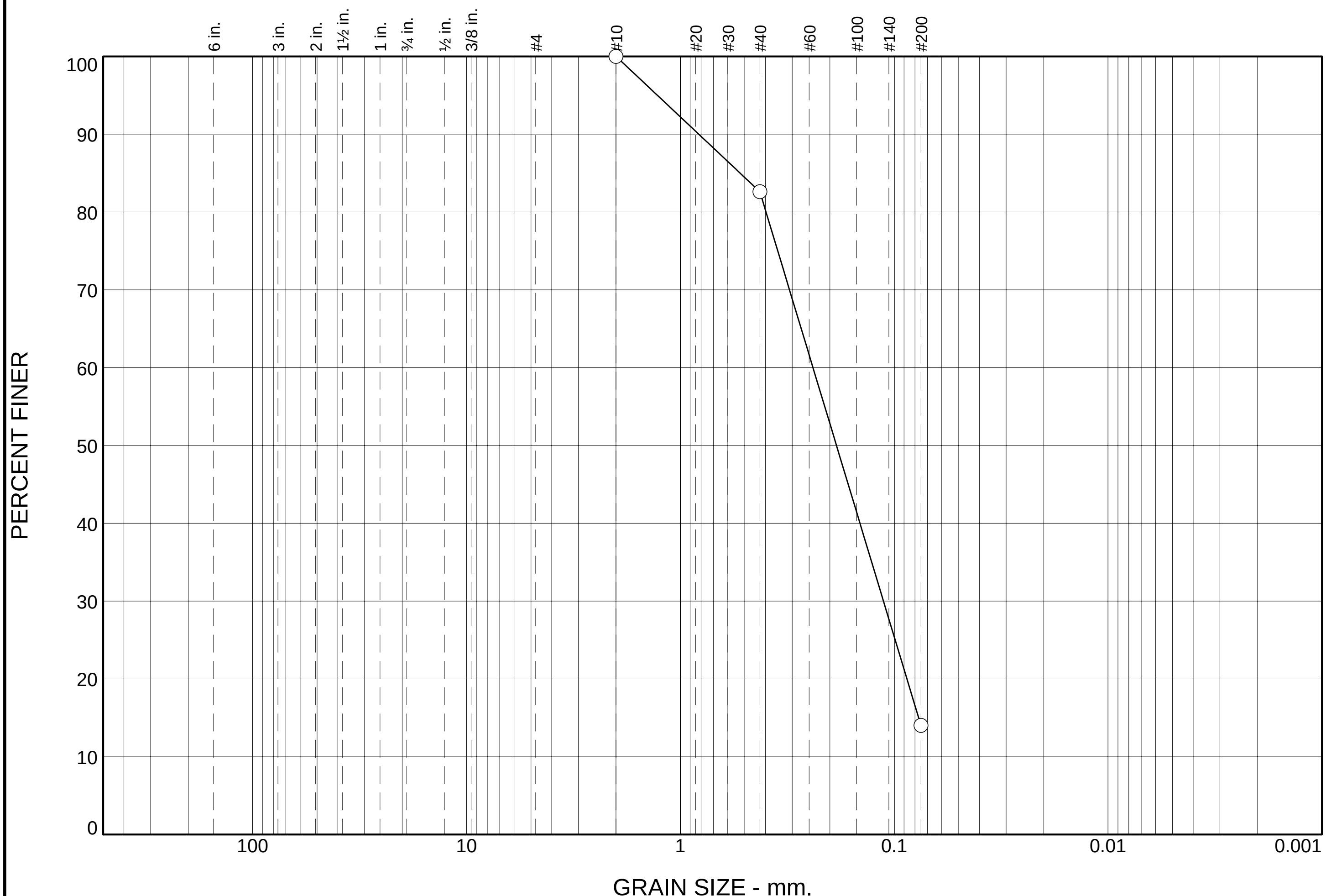
Ashburn, VA 20147

Figure

Tested By: NA **Checked By:** JA

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	17.4	68.6	14.0	

	Colloids	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○		NV	NP	0.5259	0.2399	0.1863	0.1123	0.0769			

Material Description	USCS	AASHTO
○ Silty sand	SM	A-2-4(0)

Project No. 28014 **Client:**

Project: VA Domiciliary

○ **Source of Sample:** B-1 **Depth:** 18.5-20.0' **Sample Number:** S-6

Date: ○

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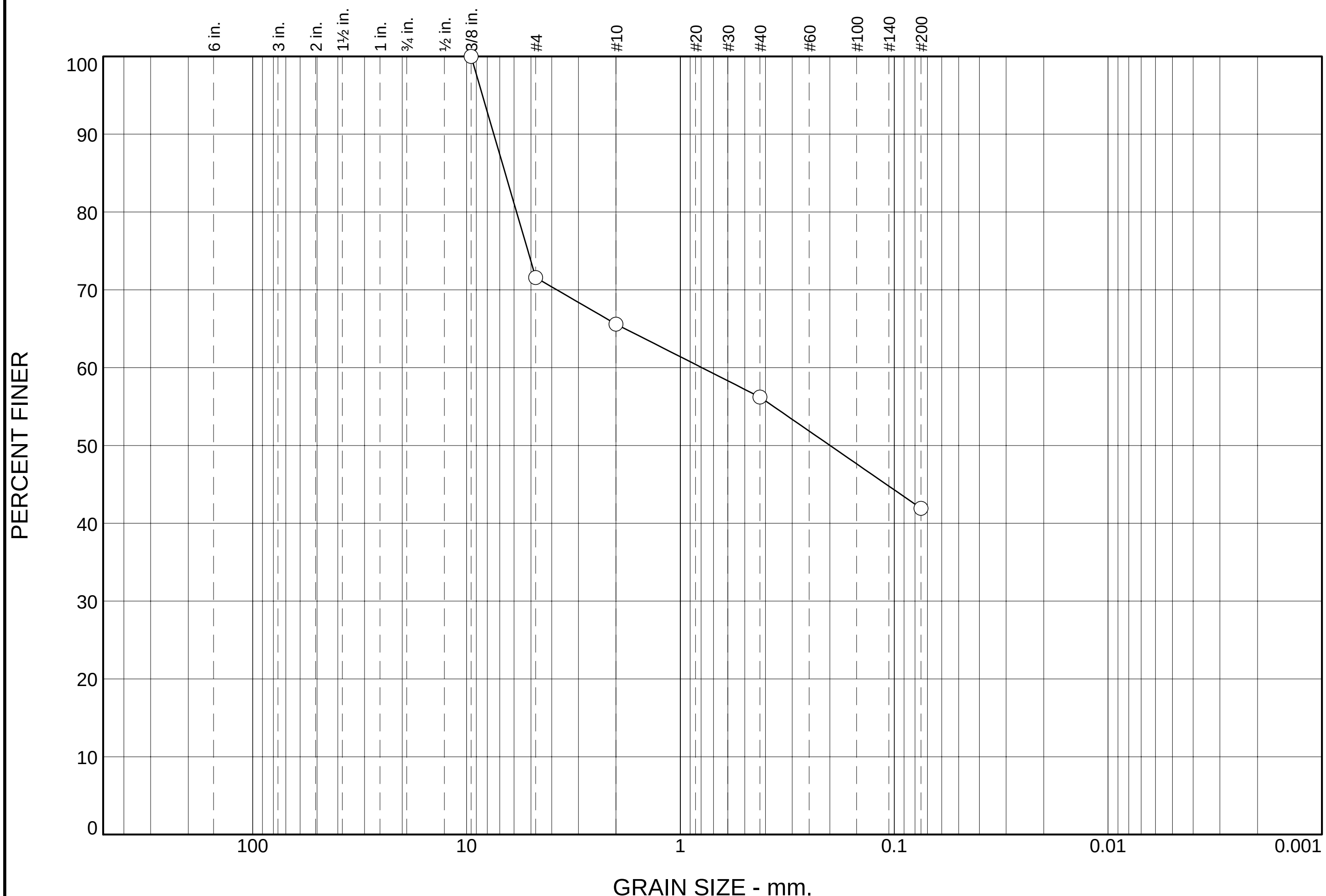
Ashburn, VA 20147

Remarks:
○ Natural Moisture: 6.4%

Figure

Tested By: NA **Checked By:** JA

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	28.4	6.0	9.4	14.3	41.9	

	Colloids	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○		38	17	6.5975	0.7937	0.1997					

Material Description	USCS	AASHTO
○ Clayey sand with gravel	SC	A-6(4)

Project No. 28014 **Client:**

Project: VA Domiciliary

○ **Source of Sample:** B-4 **Depth:** 2.5-4.0' **Sample Number:** S-2

Date: ○

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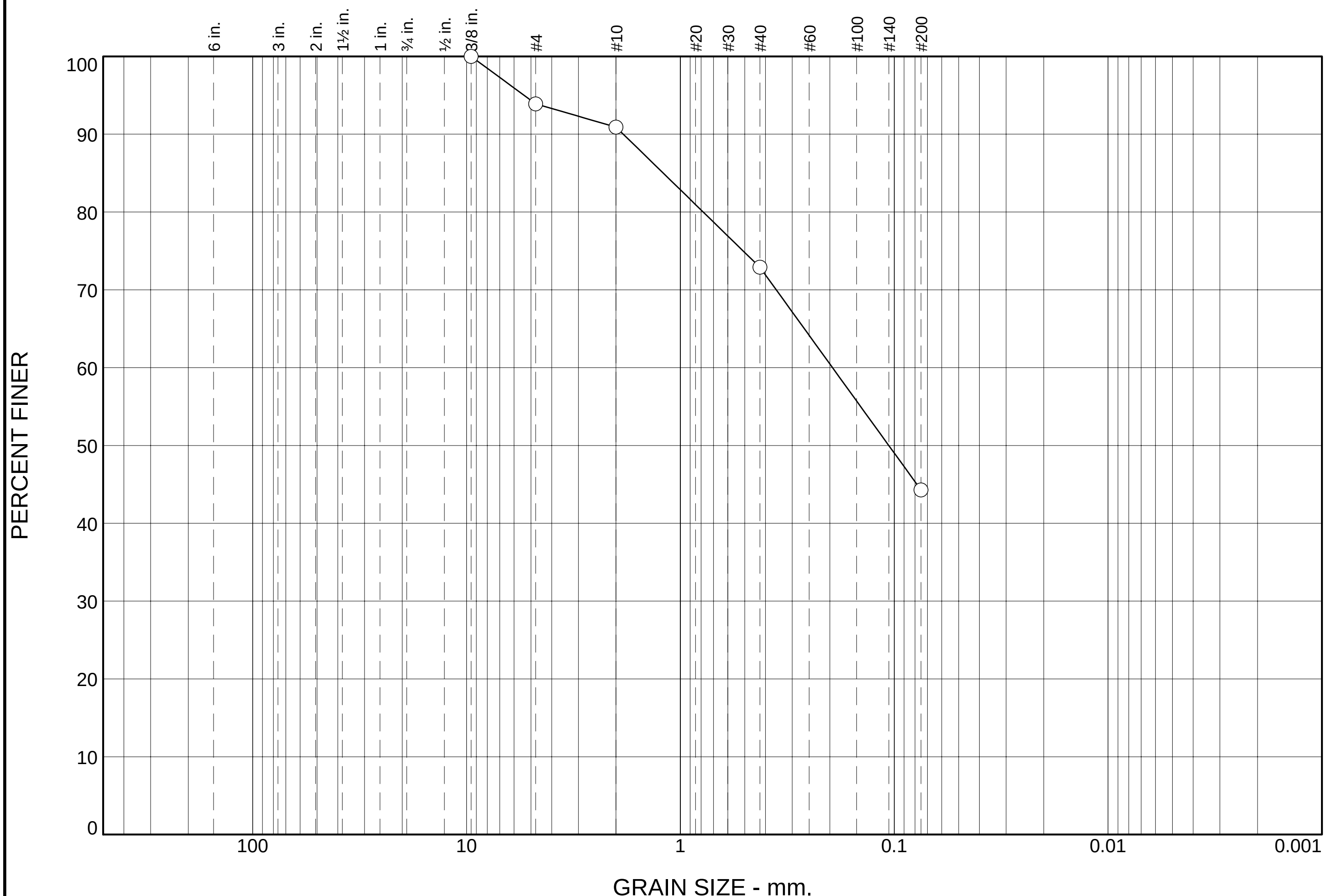
19955 Highland Vista Drive, Suite 170
Ashburn, VA 20147

Remarks:
○ Natural Moisture: 18.4%

Figure

Tested By: NA **Checked By:** JA

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	6.1	3.0	18.0	28.6	44.3	

	Colloids	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○		15	NP	1.2030	0.1945	0.1061					

Material Description	USCS	AASHTO
○ Silty sand	SM	A-4(0)

Project No. 28014 **Client:**

Project: VA Domiciliary

○ **Source of Sample:** B-4 **Depth:** 8.5-10.0' **Sample Number:** S-4

Date: ○

Remarks:

○ Natural Moisture: 8.3%

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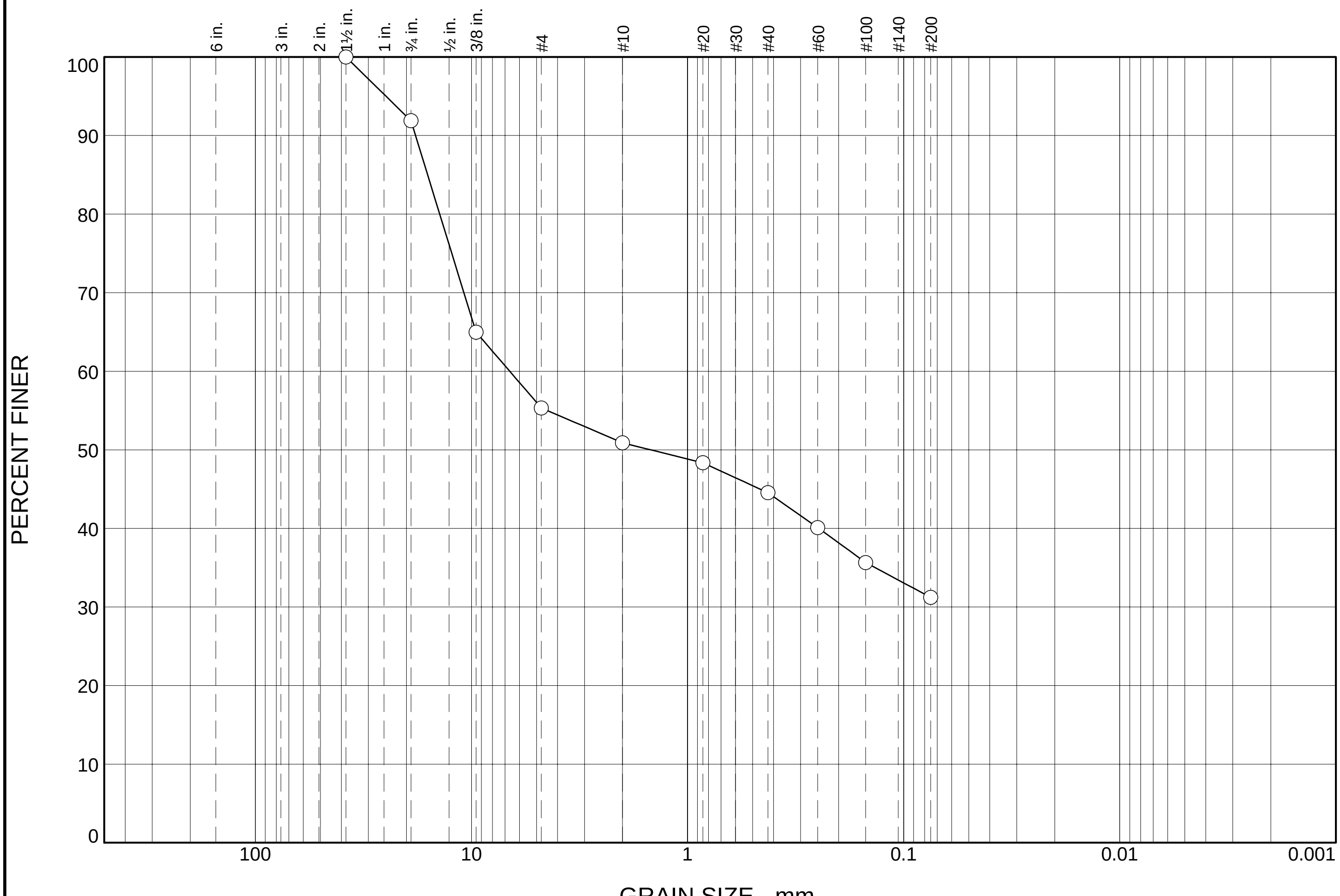
Ashburn, VA 20147

Figure

Tested By: NA **Checked By:** JA

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	8.1	36.6	4.4	6.4	13.3	31.2	

	Colloids	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○		39	19	15.9563	6.6529	1.4824					

Material Description	USCS	AASHTO
○ Clayey gravel with sand	GC	A-2-6(2)

Project No. 28014 **Client:**

Project: VA Domiciliary

○ **Source of Sample:** B-5 **Depth:** 0-5.0'

Date: ○

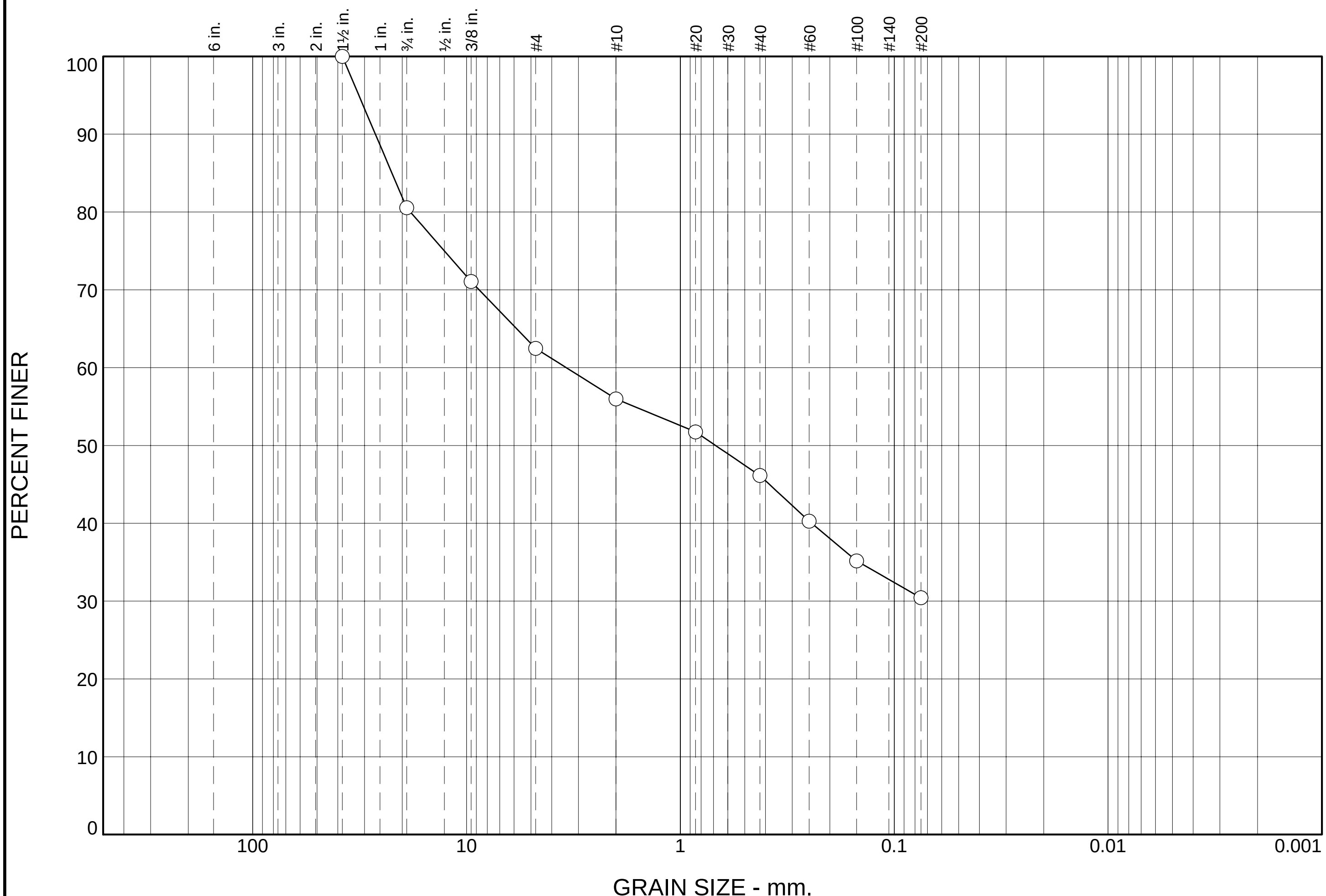
GeoConcepts Engineering, Inc.
19955 Highland Vista Drive, Suite 170
Ashburn, VA 20147

Remarks:
○ Natural Moisture: 9.1%

Figure

Tested By: NA **Checked By:** JA

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	19.5	18.0	6.5	9.9	15.7	30.4	

	Colloids	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○		36	19	22.3246	3.4171	0.6851					

Material Description	USCS	AASHTO
○ Clayey gravel with sand	GC	A-2-6(1)

Project No. 28014 **Client:**

Project: VA Domiciliary

○ **Source of Sample:** B-6 **Depth:** 0-5.0'

Date: ○

GeoConcepts Engineering, Inc.
19955 Highland Vista Drive, Suite 170
Ashburn, VA 20147

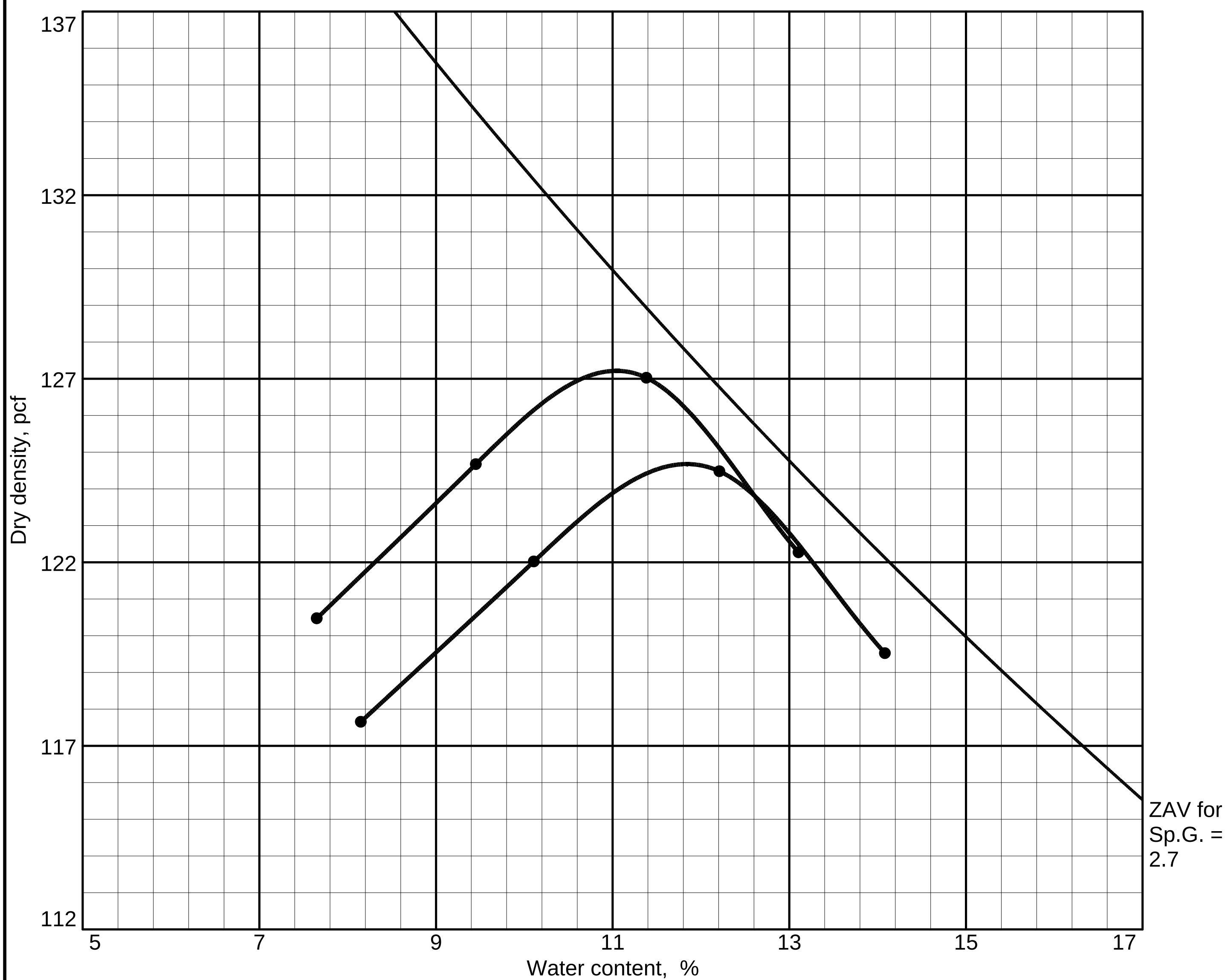
Remarks:

○ Natural Moisture: 7.5%

Figure

Tested By: NA **Checked By:** JA

COMPACTION TEST REPORT



Test specification: ASTM D 698-91 Procedure C Standard
Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
0-5.0'	GC	A-2-6(2)	9.1%	2.65	39	20	8.1	31.2

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 127.2 pcf	124.7 pcf	Clayey gravel with sand
Optimum moisture = 11.0 %	11.8 %	

Project No. 28014 **Client:**
Project: VA Domiciliary

● **Source:** B-5 **Elev./Depth:** 0-5.0'

Remarks:

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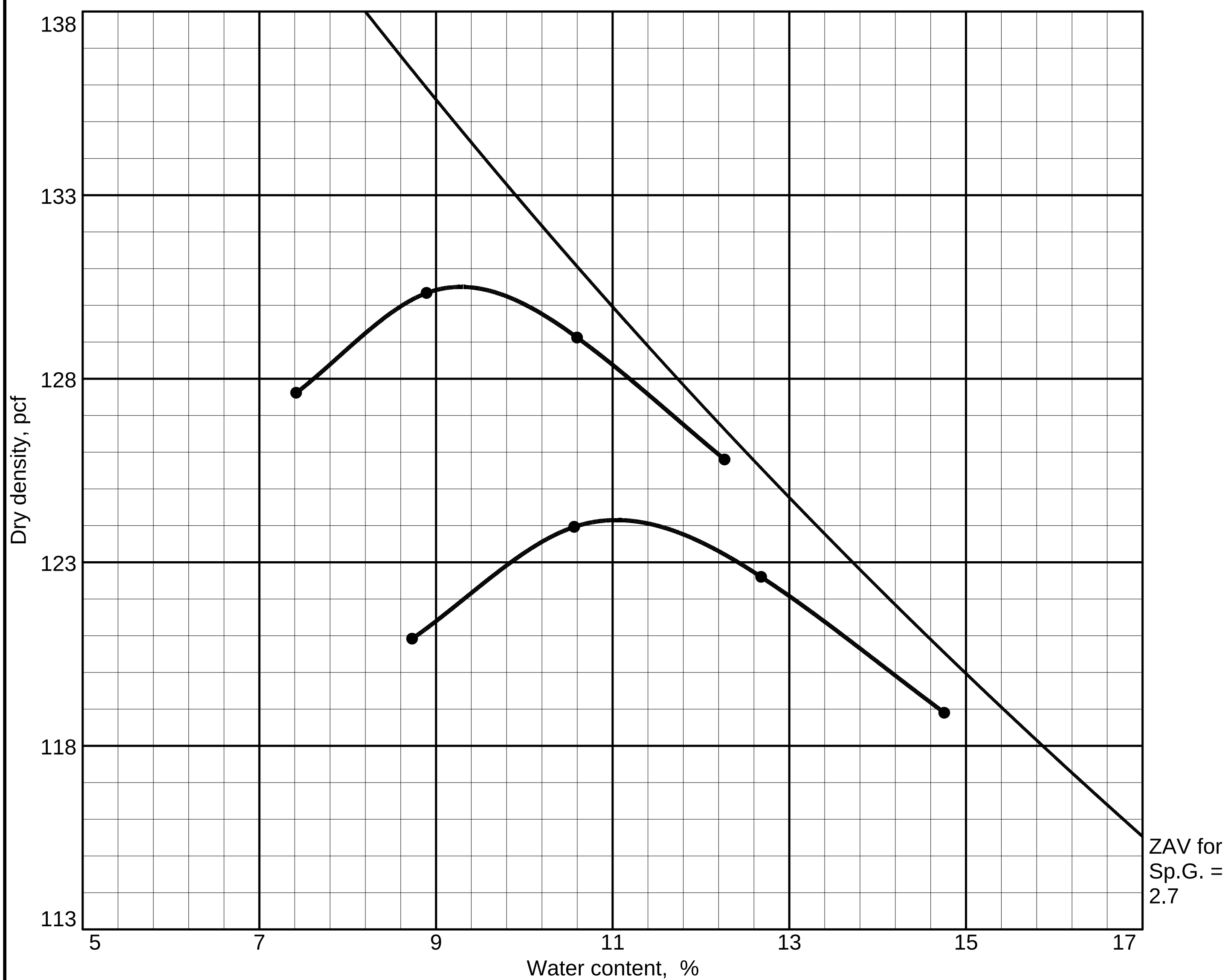
Ashburn, VA 20147

Figure

COMPACTION TEST REPORT



Test specification: ASTM D 698-91 Procedure C Standard
Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
0-5.0'	GC	A-2-6(1)		2.65	36	17	19.5	30.4

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 130.5 pcf	124.1 pcf	Clayey gravel with sand
Optimum moisture = 9.3 %	11.0 %	

Project No. 28014 **Client:**

Project: VA Domiciliary

● **Source:** B-6 **Elev./Depth:** 0-5.0'

Remarks:

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Figure

BEARING RATIO TESTING RESULTS
(VTM-008)

Date:
Project No.: 28014
Project: VA Domiciliary
Location: B-5
Depth: 0-5.0'
Material Description: Clayey gravel with sand
USCS Classification: GC
Liquid Limit: 39 **Plasticity Index:** 20

Test Description:
Maximum Dry Density, pcf : 127.2 **Optimum Moisture Content, %:** 11.0
Testing Remarks:

Sample 1 (56 Blows; Surcharge: 10 lbs.)

Water Content

Wt. Wet Soil+Tare, gms. 265.77 Wt. Soil+Tare, gms. 239.55 Wt. Tare, gms. 8.27 Moisture, % 11.3

Unit Weight

Wt. Mold+Soil, gms. 8976.7 Wt. Mold, gms. 4219.8 Ht. Soil, in. 4.6 Density, pcf 125.1

Swell Data

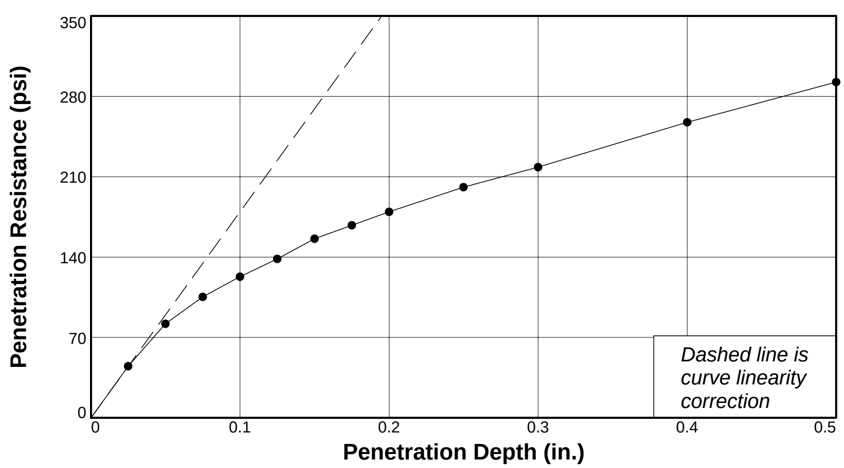
Elapsed Time, hrs.	Dial Reading in. x 1,000	Swell %
0	182	0.0
96	245	1.4

Final Water Content

	Wt. Wet Soil+Tare, gms.	Dry Soil+Tare	Tare	Moisture, %
Top	246.3	211.89	8.38	16.9
Middle	209.82	188.67	8.53	11.7
Bottom	226.28	198.38	9.03	14.7

Penetration Test Data

Pen. in.	Dial Reading	Stress psi	CBR %
0.0	0	0.0	
0.025	11.5	44.8	4.5
0.05	21	81.9	8.2
0.075	27	105.3	10.5
0.1	31.5	122.8	12.3
0.125	35.5	138.4	13.8
0.15	40	156.0	15.6
0.175	43	167.7	16.8
0.2	46	179.4	17.9
0.25	51.5	200.9	20.1
0.3	56	218.4	21.8
0.4	66	257.4	25.7
0.5	75	292.5	29.3



BEARING RATIO TESTING RESULTS
(VTM-008)

Date:
Project No.: 28014
Project: VA Domiciliary
Location: B-6
Depth: 0-5.0'
Material Description: Clayey gravel with sand
USCS Classification: GC
Liquid Limit: 36 **Plasticity Index:** 17

Test Description:
Maximum Dry Density, pcf : 130.5 **Optimum Moisture Content, %:** 9.3
Testing Remarks:

Sample 1 (56 Blows; Surcharge: 10 lbs.)

Water Content

Wt. Wet Soil+Tare, gms. 219.75 Wt. Soil+Tare, gms. 200.79 Wt. Tare, gms. 8.27 Moisture, % 9.8

Unit Weight

Wt. Mold+Soil, gms. 8983.8 Wt. Mold, gms. 4218.2 Ht. Soil, in. 4.6 Density, pcf 127.1

Swell Data

Elapsed Time, hrs.	Dial Reading in. x 1,000	Swell %
0	80	0.0
96	110	0.7

Final Water Content

	Wt. Wet Soil+Tare, gms.	Dry Soil+Tare	Tare	Moisture, %
Top	233.58	205.9	8.3	14.0
Middle	209.7	191.54	8.3	9.9
Bottom	202.78	178.31	8.27	14.4

Penetration Test Data

Pen. in.	Dial Reading	Stress psi	CBR %
0.0	0	0.0	
0.025	16.5	64.4	6.4
0.05	32	124.8	12.5
0.075	45	175.5	17.5
0.1	55	214.5	21.5
0.125	63	245.7	24.6
0.15	72	280.8	28.1
0.175	78	304.2	30.4
0.2	82	319.8	32.0
0.25	91.5	356.8	35.7
0.3	99.5	388.0	38.8
0.4	116	452.4	45.2
0.5	134.5	524.5	52.5