

**GEOTECHNICAL ENGINEERING STUDY
VAMC – MARTINSBURG
COMMUNITY LIVING CENTER EXPANSION
MARTINSBURG, WEST VIRGINIA
HCEA PROJECT NO.: H10090**

Prepared for:
District Veterans Contracting, Inc.
3172 – B Bladensburg Road, NE
Washington, DC 20018

Prepared By:
Hillis-Carnes Engineering Associates, Inc.
10228 Governor Lane Boulevard, Suite 3007
Hagerstown, Maryland 21795

October 28, 2010

HILLIS-CARNES ENGINEERING ASSOCIATES, INC.

HILLIS-CARNES

ENGINEERING ASSOCIATES, INC.

10228 Governor Lane Boulevard

Suite 3007

Williamsport, MD 21795

Main 301-582-4662

Fax 301-582-4614

www.hcea.com

October 28, 2010

District Veterans Contracting, Inc.
3172 – B Bladensburg Road, NE
Washington, DC 20018

Attention: Mr. Frank Dunbar

Re: Geotechnical Engineering Study
VAMC – Martinsburg
Community Living Center Expansion
Martinsburg, West Virginia
HCEA Project No.: H10090

Dear Mr. Dunbar:

Hillis-Carnes Engineering Associates, Inc. (HCEA) has completed the geotechnical engineering study for the above-referenced project. The project site is located on the grounds of the Veterans Administration Medical Center in Martinsburg, West Virginia. This report has been prepared for the new construction for the expansion to the Community Living Center Complex. Proposed for this phase of construction is an addition to the southwestern portion of the existing Community Living Center with an associated retaining wall.

As per your request for proposal, the exploration consisted of drilling a total of nine (9) Standard Penetration Test (SPT) borings within portions of the site, performing engineering analyses, and preparing this written report of our findings and conclusions.


We recommend that construction-monitoring services be performed by HCEA. This will help verify that the project design and construction are consistent with the assumptions made in the analyses and conclusions contained in this report.

Boring samples will be stored at our Hagerstown, Maryland office for a maximum period of 30 days from the date of this letter. Should you wish the samples to be stored for a longer period of time or to be delivered to you or another party, please advise us.

Should you have any questions or require additional information, please contact us.

Sincerely,

Hillis-Carnes Engineering Associates, Inc.



Cindy S. Shepeck
Senior Project Manager



William M. Carnes, P.E.
Principal Engineer

Corporate Headquarters – Annapolis Junction, MD

Frederick, MD • Hagerstown, MD • Salisbury, MD • Waldorf, MD • Hollywood, MD • Owings Mills, MD • State College, PA

Chantilly, VA • Dover, DE • New Castle, DE • Barbados, West Indies

TABLE OF CONTENTS

LETTER OF TRANSMITTAL.....	i
1.0 PURPOSE AND SCOPE	1
2.0 PROJECT CHARACTERISTICS	1
3.0 FIELD EXPLORATION	2
4.0 SUBSURFACE CONDITIONS.....	2
4.1 General Site Geology	3
4.2 Surficial Materials	4
4.3 Man-Placed Fill Materials	4
4.4 Natural Materials	5
4.5 Groundwater Conditions.....	6
4.6 Site Seismicity	6
5.0 EVALUATIONS AND RECOMMENDATIONS.....	7
5.1 General Site Preparation.....	7
5.2 Fill Selection, Placement and Compaction.....	9
5.3 Sinkholes and Karst Topography	10
5.4 Foundations.....	12
5.5 Ground-Supported Slabs.....	13
5.6 Groundwater and Drainage	14
5.7 Below-Grade Walls and Retaining Walls.....	14
6.0 RECOMMENDED ADDITIONAL SERVICES	15
7.0 REMARKS.....	16

APPENDIX

Figure 1: *Project Location Map*

Figure 2: *Boring Location Plan*

Figure 3: *Sinkhole Remediation Detail*

Particle Size Distribution Report (1 page)

Moisture/Density Relationship Test Report (1 page)

Records of Soil Exploration (Boring Logs; 11 pages)

Field Classification Sheet

GEOTECHNICAL ENGINEERING STUDY
VAMC – MARTINSBURG
COMMUNITY LIVING CENTER EXPANSION
MARTINSBURG, WEST VIRGINIA
HCEA PROJECT NO.: H10090

1.0 PURPOSE AND SCOPE

The purpose of this study was to determine the general subsurface conditions at the boring locations and make corresponding evaluations for the proposed site development. Evaluations were made with respect to the concept and design of foundation systems, floor slabs and site work.

Based on an analysis of project characteristics and subsurface observations, evaluations and recommendations were made for this report. The stratification lines and transitions thereof, marked on boring log data should be considered approximate boundaries. However, transitions in reality may be gradual, not clear and distinct. Strata are best evaluated during construction. Observations at that time can be used to make any necessary design changes.

Also, included in this report, potential problems and recommendations dealing with the earthwork and inspection during construction have been evaluated and suggested. In order to verify site conditions and soils related activities, construction inspection performed by HCEA is considered necessary. The Appendix contains a summary of the field and laboratory work on which this report is based.

2.0 PROJECT CHARACTERISTICS

The project site is located on the grounds of the Veterans Administration Medical Center located along the northeastern side of West Virginia Route 9 in Martinsburg, Berkeley County, West Virginia. A map of the location is included and found on Figure 1 of the Appendix.

It is our understanding that an addition to the southwestern portion of the Community Living Center complex with an associated retaining wall is to be constructed at the site.

General site information for the project site was obtained from your office and August 31, 2010 drawings prepared by the civil engineer All Land Services, Inc.

3.0 FIELD EXPLORATION

Nine (9) Standard Penetration Test (SPT) soil borings were drilled within portions of the site. Specifically, five (5) test borings (B-1 thru B-5) were drilled within the proposed building expansion, three (3) within the proposed retaining wall (W-1 thru W-3) and one (1) within the proposed courtyard area (CY-1). The approximate boring locations are shown on Figure 2 (Boring Location Plan) in the Appendix.

The borings were advanced with hollow-stem augers and the subsurface soils were sampled at 2.5 ft and 5.0 ft intervals. Samples were taken by driving a 1-3/8 inch I.D. (2-inch O.D.) split-spoon sampler in accordance with ASTM D-1586 specifications. The sampler was first seated 6 inches to penetrate any loose cuttings and then was driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot is designated as the "Penetration Resistance" or "N" value. The penetration resistance, when properly evaluated, is an index of the soil strength and compression characteristics.

Representative portions of each soil sample were placed in glass jars and transported to Hillis-Carnes' laboratory. In the laboratory, the samples were visually examined by the Geotechnical Engineer to verify the driller's field classifications. The samples were classified in accordance with the Unified Soil Classification System and the field classifications were revised where necessary. The Unified Soil Classification Symbols appear on the Boring Logs and the system nomenclature is briefly described in the Appendix.

4.0 SUBSURFACE CONDITIONS

Details of the subsurface conditions encountered at the site are shown on the Records of Soil Exploration (Boring Logs). A brief description of the subsurface conditions and pertinent engineering characteristics of the soils are given below.

Strata divisions shown on the Boring Logs have been estimated based on visual examinations of the recovered boring samples. In the field, strata changes could occur gradually and/or at slightly different levels than indicated. Also, groundwater conditions indicated on the Boring Logs are those observed during the period of the subsurface exploration. Fluctuations in groundwater levels could occur seasonally and might also be influenced by changes in grading, runoff and infiltration rates, and other influencing factors.

Generalized subsurface conditions based on the results of the borings are discussed in detail in the following report sections. For more specific information on soil and groundwater conditions, please refer to the individual boring logs in the Appendix.

4.1 General Site Geology

The geology underlying the project site appears to belong to the Great Limestone Valley Physiographic Province of Berkeley County, West Virginia. According to the Geology Map of the Hedgesville, Keedysville, Martinsburg, Shepherdstown and Williamsport Quadrangles, Berkeley and Jefferson Counties, West Virginia, dated 1987; the site is located within either the Chambersburg Limestone and/or Martinsburg Formations. The Chambersburg Limestone is typically composed of gray, aphanitic limestone with argillaceous bands gives weathered rock a cobbly appearance; fossiliferous. The Martinsburg Formation typically consists of brown to black shale that weathers into a light brown spheroidal weathering common; well-developed cleavage that masks bedding; sparsely fossiliferous.

According to the County Reports by the West Virginia Geological Survey, the rock strike in this area of Berkeley County is oriented relatively flat on an plunging anticline and dipping a few degrees east to up to 38 to 50 east and west. The significance of the geometry of the site is that the Contractor will likely encounter rock at these shallow depths when excavating along the regional rock strike (i.e., in an N-S direction). When excavating across the rock strike (i.e., perpendicular to the regional rock strike) the excavation work will encounter both shallow rock and relatively deep soils zones. This is typical of “cutter” (deep soil zones) and “pinnacle” (shallow rock) geology. Consequently, the amount of rock and soil excavation required for floor slabs, wall and column footings, and utility trench excavations may be difficult to quantify due to the type of geologic features in which this site is located. The site is located in an area characterized by Karst topography, a landscape that is described below.

Karst Topography

Portions of Berkeley County such as the location of the site are underlain by a multifarious assortment of limestone substrata. The calcareous nature of this substrata and its variable decomposition lead to a somewhat irregular landscape. As stated above, more resistant materials form pinnacles of rock near or at the surface, while less resistant materials have parented deeper pockets of soil materials and forms a type of geologic subsurface topography known as “cutter and pinnacle geology”.

Fractures due to tectonic shifting have allowed access to, the dissolution of, and removal of more soluble substrata materials beneath more resistant ones. This removal can produce voids that may become unstable if the overburden becomes too great. At this point a failure will occur and collapse is probable. Historical collapses can be disguised by the forces of time and climatic forces. This fact makes subsurface exploration and evaluation imperative. It is also the reason that subgrade materials are to be inspected prior to any construction operations involving the use of natural soils on Karst topography.

4.2 Surficial Materials

The soil test borings indicate that the site surface is primarily covered by a surficial layer of organic topsoil and man-placed fill materials. The layer of organic topsoil was encountered near the surface in all of the borings and typically had an approximate thickness ranging between of 3 to 5 inches. The depths of these materials encountered at each specific boring location are indicated on the Boring Logs in the Appendix.

4.3 Man-Placed Fill Materials

Man-placed materials were observed near the surface during our exploration in all of the test boring locations. Generally these materials were encountered beneath the surficial layer of topsoil and typically extended to approximate depths ranging from 2.5 to 12 feet below existing grades. The depths of these materials encountered at each specific boring location are indicated on the Boring Logs in the Appendix.

Please note that test borings are not a definitive method of evaluating the presence and composition of existing fill materials because of the limited hole diameters and the very limited sample sizes obtained in comparison to the areal extent of the site. Also, the fill materials may be similar in composition to the on-site natural soils and therefore would be difficult to distinguish in the relatively small boring samples obtained. It should be anticipated that man-placed fill materials may be encountered at other locations and to different depths due to the construction that has previously occurred at the site. It should be noted that the proper assessment of subsurface conditions and the suitability of soil materials for various construction purposes can best be made during excavation by a Geotechnical Engineer or an experienced Soils Inspector.

The fill materials were generally composed of sandy SILTS (ML) and silty or sandy CLAYS (CL) with varying amounts of clay, silt, sand and organics depending on the boring location in which they were encountered.

4.4 Natural Materials

The natural soils encountered include clayey SANDS (SC) and cohesive CLAYS (CL) with various amounts of sand and silt. The granular soils typically had relative densities ranging from loose to very dense with N-values ranging from 8 blows/foot to 50 blows/1". The cohesive soils typically had consistencies ranging from stiff to hard with N-values ranging from 11 blows/foot to 50 blows/3". These materials were typically intercepted beneath the man-placed fill materials at depths ranging from 2.5 to 11.0 feet below existing grades. These materials typically extended to depths ranging from 6 to 23 feet within the test borings where they terminated at rock.

Rock: For this report, rock is defined as fractured and unfractured rock materials that cannot be penetrated with the auger. Materials classified as rock were encountered within the depths explored in all of the test soil borings. Rock was encountered at depths ranging from 6.0 to 23.0 feet below existing grades. For more specific information, refer to the Records of Soil Exploration in the Appendix.

Boring information and measurements are summarized in Table 1 below (and may also be found in the attached boring logs):

Table 1
Summary of Test Borings

Boring Number	Approximate Surface Elevation (Feet)	Depth of Man-Placed Materials Depth/Elevation	Rock Depth/Elevation (Feet)	Cave-In Depth/Elevation (Feet)
B-1	504.5	8.0/496.5	15.0/489.5	9.5/495
B-2	502.5	2.5/500	12.0/490.5	6/496.5
B-3	506	8.0/498	23.5/482.5	17/489
B-4	504	11.0/493	18.0/486	12/492
B-5	505.5	12.0/493.5	18.5/487	13.5/492
CY-1	506.5	12.0/494.5	23/485.5	15/491.5
W-1	503.8	3.5/500.3	11/492.8	4.5/499.3
W-2	500	4.0/496	6.0/494	3/497
W-3	500	2.5/497.5	7.5/492.5	3/497

4.5 Groundwater Conditions

Groundwater observations were made during the drilling of the soil borings. Water was not encountered within the depths explored during the drilling of the test borings. It should be noted that variations in the presence of, and the depth to, groundwater should be expected to occur due to seasonal fluctuations, surface runoff, evaporation, construction activity, etc.

A more accurate determination of the hydrostatic water table would require the installation of perforated pipes or piezometers that could be monitored over an extended period of time. The actual level of the hydrostatic water table and the amount and level of perched water should be anticipated to fluctuate throughout the year, depending on variations in precipitation, surface run-off, infiltration, site topography, and drainage.

4.6 Site Seismicity/Liquefaction Potential

Seismic hazard evaluations were carried out using the United States Geological Survey (USGS) earthquake hazards modeling program 2008. Based on the modeling conducted for the project site, it appears that the site indicates a moderately high to high seismic hazard. Our interpretation of the subsurface conditions based on SPT drilling data indicates that the site belongs to **Site Class B** as per the seismic characteristics based on the International Building Code 2006. This recommendation is based upon shallow depth to rock and/or auger refusal at the project site. The mapped spectral acceleration for short period (S_a -0.2 second spectral acceleration with 2% probability of exceedance in 50 years) is observed to be 13.07, while that for the 1-second period (S_1) is observed to be 4.38. The peak ground acceleration with a 2% probability of exceedance in 50 years was observed to be 6.275%g, which is less than the 10%g limit stipulated by typical state requirements for seismic design. The site coefficients, F_a (a function of site class and mapped spectral response acceleration at 0.2 second period) and F_v (a function of site class B and mapped spectral response acceleration at 1-second period) are both 1.0. The location of the project site within a moderately high to high seismicity zone will require the incorporation of seismic design for any foundation.

Liquefaction analysis of the project site was carried out using the Chinese criteria. Owing to the fact that the project site is located within an area of moderately high to high seismic hazard, the soils in the subsurface are of an unsaturated nature, and were encountered at shallow depths, the Chinese criterion indicates that the site has moderate potential for liquefaction and surface rupturing by lateral spreading. Although the site indicates seismic parameters below the 10%g limit stipulated by the

typical seismic guidelines. The Peak Ground acceleration values themselves are significantly high enough to predict a major earthquake of magnitude that would cause soil liquefaction at the project site. However, care must be taken for foundation stability in the event of an earthquake in case the subsurface has significant karst activity. It has been recorded historically that areas of active and significant karst have been known to fail in the likelihood of a moderate earthquake, depending on the extent and nature of karst features in the shallow subsurface.

The potential for a combination of a significant earthquake and subsidence of the ground due to failing Karst geologic features may be small but it should not be disregarded. While not precluding construction of the project, it may be prudent to incorporate seismic design criteria into the building addition design.

5.0 EVALUATIONS AND RECOMMENDATIONS

Our findings indicate that the site can be developed for the proposed structure utilizing spread footing foundation support. However, the presence of existing man-placed fill materials will have a significant impact on the proposed development. Additional measures and monitoring will be required during construction to reduce the potential detrimental effects of total and differential settlements. In constructing over man-placed fill materials, the owner must realize that there is risk involved and that future maintenance and/or repair of the structure may be required. It will be necessary to completely remove and replace all existing fill materials in order to reduce this type of risk entirely. Special consideration should be given to the proper monitoring of fill operations, footing excavations, and concrete placement in all structural areas.

The following recommendations have been developed on the basis of the previously described project characteristics and subsurface conditions. If there are any changes to the project characteristics or if different subsurface conditions are encountered during construction, HCEA should be consulted so that the recommendations of this report can be reviewed and revised, if necessary.

5.1 General Site Preparation

Any existing below ground structures within the area to be developed should be removed prior to the initiation of new construction. We suggest that all available information regarding the existing utilities at the site be reviewed prior to construction.

Removal should include all underground pipes, utilities, and underground structures that might interfere with the new construction. If abandoned underground utilities are to be removed prior to the initiation of construction, provisions should be made in the construction specifications and budget to restore the subgrade to stable condition. Restoration should include backfilling and compaction of the excavation areas.

Removal should also include topsoil and unapproved man-placed materials; frozen, wet, soft or very loose soils; and any other deleterious materials. These operations should be performed in a manner consistent with good erosion and sediment control practices.

After the initial stripping process is completed, areas of the site to receive fill, or areas of the site at-grade where structures will be located, should be proofrolled. The proofrolling operations should be performed using a 20-ton, fully-loaded dump truck or another pneumatic-tire vehicle of similar size and weight. The purpose of the proofrolling will be to provide surficial densification and to locate any near-surface pockets of soft or loose soils requiring undercutting. A Geotechnical Engineer or experienced Soils Inspector should witness the proofrolling operations and determine whether any areas require undercutting and/or stabilization.

Materials specifically identified as man-placed fill materials were encountered in all of the boring locations to depths of 2.5 to 12 feet below existing site grades. In general the FILL was composed of brown, loose to dense sandy SILT with various amounts of clay and rock fragments with organics or silty or sandy CLAY with various amounts of sand and rock fragments.

However, it should be anticipated that man-placed fill materials may be encountered to varying depths at other locations of the site due to the nature of the site history. There are two options for subgrade remediation, either a partial undercut and removal of the old fill materials or complete removal of the old fill materials can be considered as the project approach. If partial undercut option for the entire building pad is selected, we recommend that a minimum of 5 feet of the old fill materials be removed beneath either the proposed bottom of footing elevation or deepest site utility. At which time a geotechnical engineer from our office should witness the relative suitability of the exposed subgrades. Localized additional undercutting should be anticipated. Although, the partial subgrade improvement will give more uniform support, the old fill materials may yield additional settlements that may require future maintenance or repair.

After the removal of the surficial topsoil and complete/partial removal of the old fill materials, the exposed subgrade soils should be inspected by the geotechnical engineer. The exposed subgrades should be proofrolled with a fully loaded (10 ton payload) dump truck. The purpose of the proofrolling would be to provide surficial densification and to locate any isolated areas of soft, loose soils requiring undercutting or additional undercutting.

If the partial undercut option is selected, prior to the placement of compacted fill, a geogrid such as Tensar 3000 BX or equivalent should be placed on the approved subgrade. The grid should be overlapped a minimum of 2 feet on all perimeters and should be connected by ties.

5.2 Fill Selection, Placement and Compaction

All material to be used as fill or backfill should be inspected, tested and approved by the Geotechnical Engineer. In general, the on-site soils which are free from organic and other deleterious components can be re-used as general site fill. Materials suitable for various construction purposes can be identified by an experienced Soils Inspector during grading operations. However, we do not recommend that highly plastic materials (LL greater than 50) be utilized for structural fill, particularly for backfill materials adjacent to foundation walls or below slabs, should such materials be encountered at the site.

Moisture conditioning (that is, wetting or drying) of the soils should be anticipated to achieve proper compaction, particularly if earthwork is performed other than in the summer months. The moisture contents of the soils should be controlled properly to avoid extensive construction delays. If imported fill material is required, those materials should have Unified Soil Classifications of SM or better.

All fill should be placed in relatively horizontal 8-inch (maximum) loose lifts and should be compacted to a minimum of 95 percent of the Standard Proctor (ASTM D-698) maximum dry density. Fill materials in landscape and other non-structural areas should be compacted to at least 90 percent of the Standard Proctor maximum dry density if significant subsidence of the fill under its own weight is to be avoided. Field moisture contents should be maintained within 2 percentage points of the optimum moisture content in order to provide adequate compaction.

Structural fill should extend a minimum of ten feet beyond structural fill pads. Fill slopes no steeper than 2(H):1(V), or flatter, should be used. New fill materials should be properly benched into any existing slopes. A sufficient number of in-place density tests should be performed by an experienced

Engineering Technician on a full-time basis to verify that the proper degree of compaction is being obtained.

5.3 Sinkholes and Karst Topography

Portions of Berkeley County, WV and surrounding areas are underlain by a multifarious assortment of both calcareous and non-calcareous substrata. The calcareous portion of the underlying substrata and its variable weatherability lead to a somewhat irregular landscape. Fractures due to tectonic shifting have allowed access to, the dissolution of, and removal of more weatherable substrata materials beneath less weatherable ones. This removal can produce voids that may become unstable if the overburden becomes too great. At this point a failure will occur and collapse is probable. Historical collapses can be disguised by the forces of time and climatic forces. This fact makes subsurface exploration and evaluation imperative. It is also the reason subgrades are to be inspected prior to any construction operations involving the use of natural soils on Karst topography.

Any sinkholes encountered during construction should be remediated on a case-by-case basis. The geotechnical engineer should be contacted for site-specific recommendations when any sinkholes are observed. Any sinkholes that are encountered during site development should be remediated by constructing an inverted rock filter as described on the Sinkhole Remediation Detail (Figure 3 in the Appendix) and below.

An inverted rock filter is a method to remediate sinkholes by excavating the hole down to rock, placing large rock in the bottom of the hole, and filling the excavation with successively smaller rock. The method is presented below.

- 1) Remove and properly dispose of materials dumped in and around the sinkhole.
- 2) Excavate loose material from sinkhole and try to expose the solution void(s) in the bottom. Enlarge the sinkhole, as necessary, to allow for installation of filter materials (Figure 3).
- 3) Select a field stone that is about 1.5 times larger than the solution void(s). Place the stone(s) in the void(s) forming a secure "bridge". A geotextile may be needed to "lock" the stone "bridge" in place, as determined by the geotechnical engineer.

- 4) Place a layer of filter material over the "bridge" at a minimum thickness of 18 inches. About 30 percent of the material should be larger than the openings between the bridge and the void(s). (A well placed "bridge" should not have large openings around it.) In most cases this material could be Rip Rap.
- 5) Place a layer of smaller size filter material over the previous layer at a minimum thickness of 9 inches. The size should be 1/4 to 1/2 the size of the pervious layer. In most cases this material could be No. 57 stone.
- 6) Place a layer of sand size filter material over the previous layer at a minimum thickness of 9 inches. The sand has to be compatible in size with the previous layer to prevent piping. In most cases this material could be C-33 sand or equivalent.
- 7) Backfill over the last filter layer (or filter cloth) with soil material to the surface. The reuse of any soil material excavated from sinkhole should be considered. The fill materials should be compacted to a minimum of 95% of the Standard Proctor (AASHTO T-99).

A non-woven filter cloth with burst strength between 100 to 200 psi can be substituted for the stone and sand filter materials discussed in steps 5 and 6 above. Additionally, stone used for the "bridge" and the filters should have a rock strength at least equal to moderately hard (that is, resistant to abrasion or cutting by knife blade but can be easily dent or broken with light blows of hammer). Shale or similar soft and non-durable rock is not acceptable.

All work should be monitored by a geotechnical engineer on a case-by-case basis to refine the recommendations as warranted by the site conditions.

To reduce the risk of sinkhole development, it is considered essential that adequate site drainage is provided at all times to minimize any increases in the moisture contents of the subsurface materials and to avoid aggravating incipient solution activity.

Site grades should be sloped to prevent ponding of water adjacent to the proposed buildings or structures. Final designs should incorporate measures that will reduce water infiltration, including the following:

- edge drains that flow directly to the storm drain system.
- water tight storm drains.
- swales adjacent to roadways should be lined with concrete, asphalt or soil/cement to prevent infiltration. Unlined swales are a very common cause of sinkhole development.

Utilities should be placed on well compacted firm soil to reduce possible settlement and leaks. Open graded stone should not be placed below the utility lines, as the stone easily transports water. Additionally, water lines should be periodically tested for leaks. Backfill around structures and above utilities should be well compacted to reduce surface depressions which could collect water.

There is always some risk associated with developing new structures in limestone (Karst) terrain, regardless of the extent of the exploration and/or design precautions. The probability of sinkhole development can be reduced by taking the precautions included herein.

5.4 Foundations

Due to the potential for differential settlements in portions of the foundation subsoil materials when developing within a Karst area, it is recommended that foundations be designed to span an unsupported length of 5 feet. Reinforcement of foundations will minimize the risk of structural failures and property damage.

Based on our experience with similar projects and the general soil conditions that were encountered, it is our judgment that an allowable soil bearing pressure of 2000 lbs/sq ft can be used for foundations to be supported on natural materials or on new structural fill placed over firm natural materials. Footings should not be placed on or over any existing fill materials unless they are specifically observed, tested and approved by the Geotechnical Engineer or his designated representative in the filed during construction. As stated previously, the owner must realize that detrimental settlements are still possible when constructing over existing fill materials. However, if the loads differ from what we have assumed, then this office should be contacted for further recommendations.

However, in order to provide adequate bearing capacity, all wall footings should be at least 16 inches wide, and all column footings should be at least 24 inches square. Longitudinal reinforcement should be provided in all wall footings. A maximum slope of 1H:1V should be maintained

between the bottoms of footings where foundations are at different levels. Exterior footings should be located at depths of at least 2.5 feet below the final exterior grades for frost protection. If proposed construction or the construction schedule results in the exposure of interior footings to freezing temperatures, then those footings should be provided with suitable frost protection as well. Otherwise, interior footings can be supported at nominal depths below finished floor grades.

We consider it imperative that all footing excavations be inspected, tested and approved by the geotechnical engineer directly prior to the placement of concrete. The purpose of the inspection would be to verify that the exposed materials are capable of supporting the design bearing pressure. If soft or loose pockets are encountered in the footing excavations, the unsuitable material should be removed and replaced with compacted fill or lean (2000 psi) concrete.

Soils exposed at the bases of all approved foundation excavations should be protected against disturbances from the effects of groundwater, rain and freezing temperatures. Surface runoff and other water should be drained away from the excavations and not be allowed to pond on the subgrade soils. If possible, all footing concrete should be placed during the same day that the excavation is made and approved. If this is not practical, then the footing excavations should be adequately protected. Any subgrade soils which are disturbed, wet, loose or frozen should be removed prior to placement of reinforcing steel or concrete.

5.5 Ground-Supported Slabs

Floor slabs should be supported on approved, firm natural soils, or on newly compacted fill. The slab subgrade should be prepared in accordance with the procedures outlined in Sections 5.1 and 5.2 of this report. In particular, the slab subgrade should be heavily proofrolled to delineate any soft or loose areas requiring undercutting and/or stabilization. As stated previously, the owner must realize that detrimental settlements are still possible when constructing over existing fill materials.

It is recommended that slabs be directly supported on a minimum 4-inch layer of clean granular materials such as washed sand, clean sand and gravel, or screened, crushed stone. These materials will require acquisition from an off-site source. A suitable moisture/vapor barrier (that is, polyethylene sheeting) should also be provided. These procedures will provide a moisture break that will help to prevent capillary rise, dampness of the floor slabs and also help to cure the slab concrete. It is also recommended that the floor slab be designed as a structural slab and connected to the wall footings. Additionally, both the structural slab and wall footings shall be supported on reinforced structural fill.

All floor slab areas should be inspected by a geotechnical engineer prior to placing the gravel below the slabs. Some disturbance of the subgrade soils is expected from weather and construction traffic, and soft subgrades should be removed and replaced with compacted fill. On most projects, there is a significant time lag between initial grading and a point when the contractor is ready to pour the slabs-on-grade. Exposure to the elements and construction traffic often disturb the subgrade soils. Provisions should be made in the construction specifications for the restoration of the subgrade soils to a stable condition prior to the placement of the concrete for the floor slab.

5.6 Groundwater and Drainage

Any water infiltration resulting from a shallow interception of the groundwater table, precipitation, surface run-off, or perched water should be able to be controlled by means of sump pits and pumps, or by gravity ditching procedures. If any conditions are encountered which cannot be handled in such a manner, this office should be consulted.

Adequate drainage should be provided at the site to minimize any increases in the moisture contents of the foundation soils. All pavement or parking areas should be sloped away from the structures to prevent the ponding of water. The site drainage should also be such that run-off onto adjacent properties is controlled properly. In pavement/parking lot areas, it may be necessary to locally provide finger drains where it is not possible to properly slope pavement subgrades to catch basins or other outlets.

5.7 Below-Grade Walls and Retaining Walls

The magnitude of lateral earth pressure against subsurface walls is dependent on the type of backfill soil, drainage provisions, and whether the walls are permitted to yield during and/or after placement of the backfill. If the walls are designed as free-standing walls with unrestricted rotation at the top, then an equivalent fluid pressure distribution considering an equivalent fluid weight of 45 lbs/ft can be used for design purposes. For walls that are designed such that movement of the top of the wall is prohibited, an equivalent fluid pressure distribution considering an equivalent fluid weight of 60 lbs/ft should be used for design purposes. Any surcharge loadings must also be considered in the wall designs.

Generally, backfill materials behind the walls should consist of granular soils having classifications of SM or better. Because of a potential for swelling and poor drainage, cohesive materials, such as soil materials classified as lean silty CLAYS (CL) and clayey SANDS (SC), should not be used as wall backfill except, perhaps, in the upper most 1 ft where a relatively impermeable layer will be desirable in order to minimize the infiltration of the subsurface drainage into the granular backfill behind the wall. It is

considered essential that all backfill materials be inspected and approved by the Geotechnical Engineer prior to their use.

Wall backfill materials should be compacted to dry densities on the order of 95 percent or greater of the Standard Proctor maximum dry density and in accordance with recommendations provided in Section 5.2 of this report. We wish to point out that it may be necessary to use smaller walk-behind compaction equipment near the walls to attain the proper compaction but to avoid damaging the walls. Compaction equipment exceeding 3000 pounds should not be used within an imaginary line of 1 (horizontal) to 1 (vertical) as projected upward from the outer edge of the footings of the walls to avoid overloading the walls. Additionally, all walls should be properly cured and braced during backfilling.

An adequate drainage system should be provided behind walls such that any surface infiltration or groundwater is intercepted and disposed. Otherwise, hydrostatic pressures should also be considered in the wall design.

6.0 RECOMMENDED ADDITIONAL SERVICES

Additional soil and foundation engineering, testing, and consulting services recommended for this project are summarized below:

Site Preparation and Proofrolling: A Geotechnical Engineer or experienced Soils Inspector should inspect the site after it has been stripped and excavated. The inspector should determine if any additional undercutting or in-place densification is necessary to prepare pavement or building subgrades for fill placement or for slab support and to observe for signs of potential Karst activity.

Fill Placement and Compaction: A Geotechnical Engineer or experienced Soils Inspector should witness any required filling operations and should take sufficient in-place density tests to verify that the specified degree of fill compaction is achieved. He should observe and approve borrow materials used and should determine if their existing moisture contents are suitable. Additionally, the Geotechnical Engineer should verify that the proper grid is being utilized and properly placed.

Footing Excavation Inspections: A Geotechnical Engineer or experienced Soils Inspector should inspect the footing excavations for the building foundations. He should verify that the design bearing pressure is available and that no loose pockets exist beneath the bearing surfaces of the footing excavations. Based on the inspection, the Inspector would either approve the bearing surfaces or recommend that loose or soft soils be undercut to expose satisfactory bearing materials.

7.0 REMARKS

This report has been prepared for the exclusive use of District Veterans Contracting, Inc. and in accordance with generally accepted geotechnical engineering practice. No other warranty, either expressed or implied, is made.

The analysis and recommendations contained in this report are based on the data obtained from limited observation and testing of the subsurface materials. The test borings indicate soil conditions only at specific locations and times, and only to the depths excavated. They do not necessarily reflect strata variations that may exist between the test boring locations. Consequently, the analysis and recommendations must be considered preliminary until the subsurface conditions can be verified by direct observation at the time of construction. If variations in subsurface conditions from those described are noted during construction, recommendations in this report may need to be re-evaluated.

It should be stressed that in developing the project site there will always be some risk of future solution activity occurring. Specifically, assessment methods and inspection services cannot account for all incipient sinkhole areas. However, by taking precautions during design and construction, the probability of sinkhole development can be reduced.

In the event that any changes in the nature, design, or location of the facilities are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and conclusions of this report are verified in writing. Hillis-Carnes Engineering Associates of Hagerstown, Inc. is not responsible for any claims, damages, or liability associated with interpretation of subsurface data or reuse of the subsurface data or engineering analysis without the express written authorization of HCEA.

Additional funds should be established to account for the possibility of additional construction costs, which may result from removing unsuitable soils, utilizing geo-grid systems, rock excavation, lowering footing excavations, drying fill soils, repair of disturbed subgrades, etc.

In accordance with the guidelines of ASFE/The Association of Engineering firms Practicing in the Geosciences, it is recommended that HCEA be retained to provide continuous soils engineering services for this project. Participation of HCEA will facilitate compliance with HCEA's recommendations, and allow changes to be made in these recommendations, in the event that subsurface conditions are found to vary from those anticipated prior to the start of construction.

This report and the appended materials are instruments of service. If certain conditions or items are noted during our exploration, HCEA may be required by prevailing statutes to notify and provide information to regulatory or enforcement agencies. HCEA will notify our Client should a required disclosure condition exist.

This report has been prepared to assist the design team during the design and preparation of project specifications and plans. This report should be made available to prospective bidders for informational purposes only. Use and/or interpretations of this report by any other person or persons is at the sole risk of the user. Should the bidder require additional information than provided in this report, the bidder may conduct an independent site assessment and/or investigation, if allowed by the architect.

APPENDIX

Figure 1: *Project Location Map*

Figure 2: *Boring Location Plan*

Figure 3: *Sinkhole Remediation Detail*

Particle Size Distribution Report (1 page)

Moisture/Density Relationship Test Report (1 page)

Records of Soil Exploration (Boring Logs; 11 pages)

Figure 1. Site Location Plan: VAMC Community Living Center Expansion

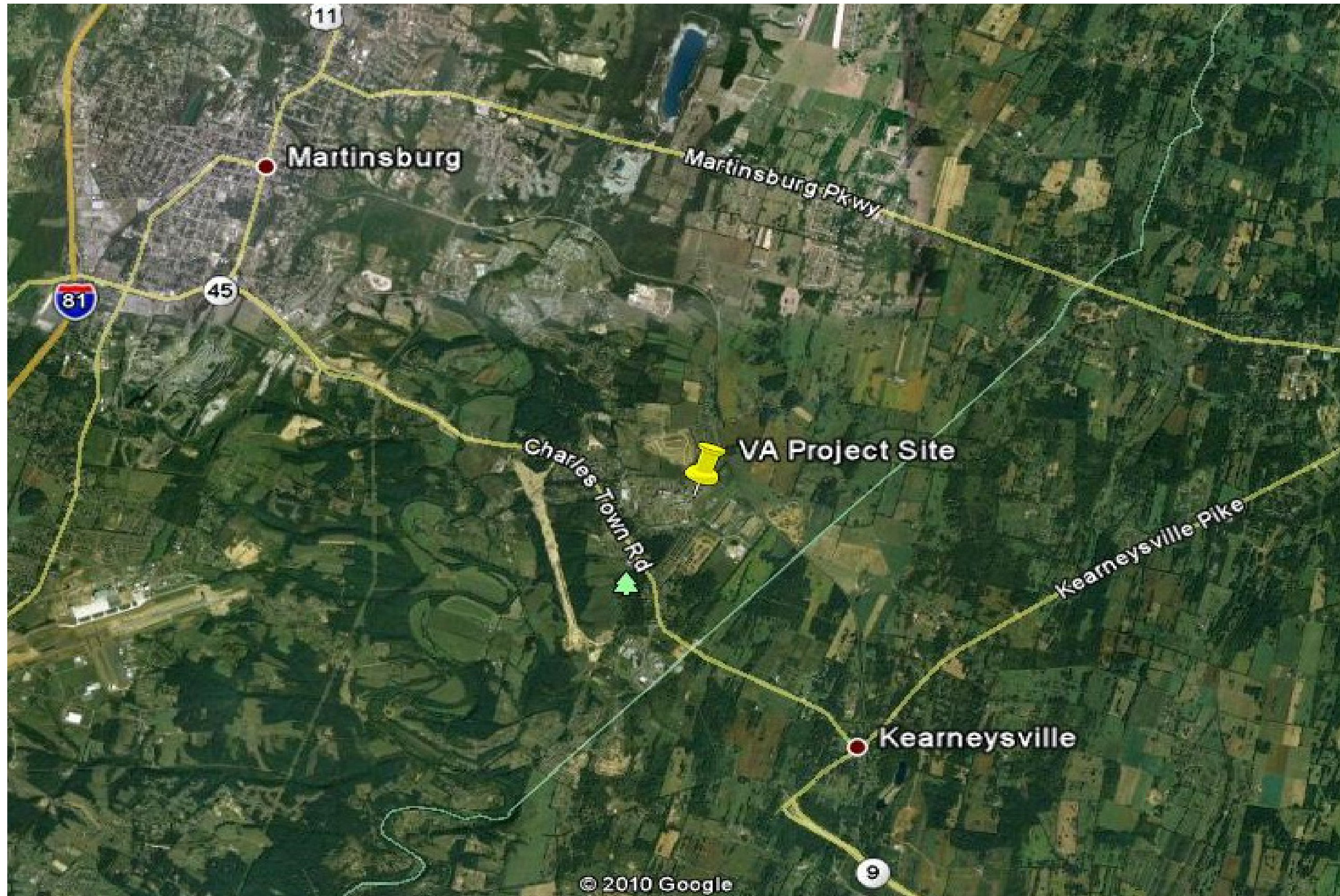


Figure 2. Boring Location Plan: VAMC Community Living Center Expansion

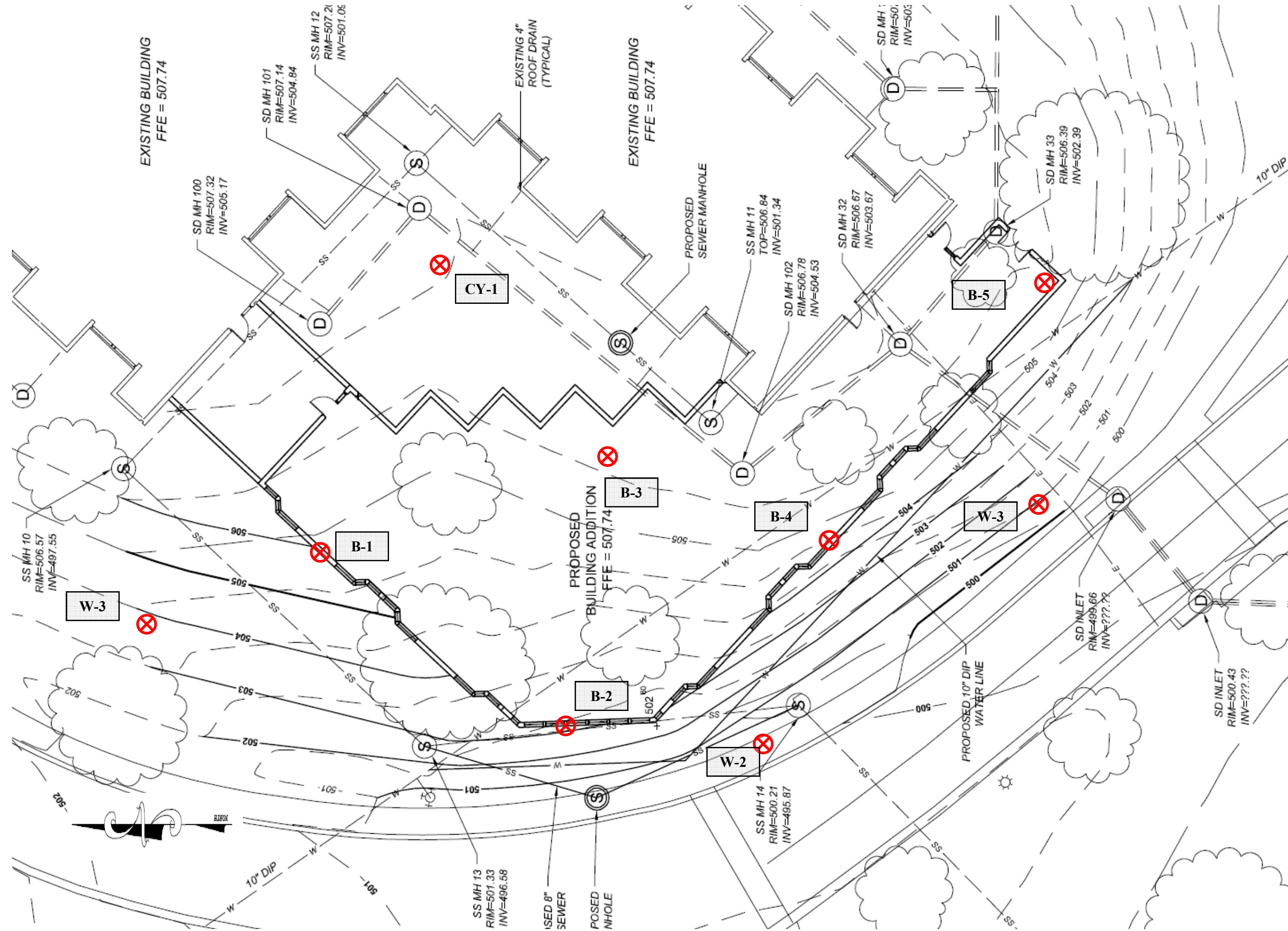
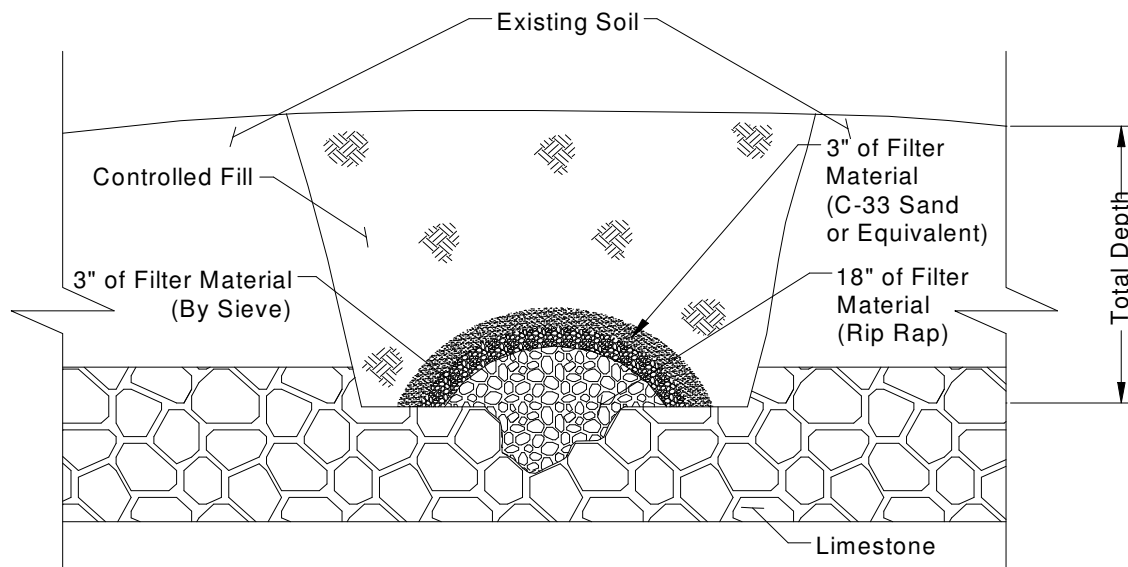


Figure 2. Boring Location Plan: VAMC Community Living Center Expansion
Martinsburg, WV
HCEA Project No.: H10090



Sinkhole Treatment
Inverted Filter 1

Figure 1

Notes:

Inverted Filter 1

Procedure for installing inverted filter to treat sinkholes.

- 1) Remove and properly dispose of materials dumped in and around the sinkhole.
- 2) Excavate loose material from sinkhole and try to expose the solution void(s) in the bottom. Enlarge the sinkhole, as necessary, to allow for installation of filter materials (Figure 1).
- 3) Select a field stone that is about 1.5 times larger than the solution void(s). Place the stone(s) in the void(s) forming a secure "bridge". A geotextile may be needed to "lock" the stone "bridge" in place, as determined by the geotechnical engineer.
- 4) Place a layer of filter material over the "bridge" at a minimum thickness of 18 inches. About 30 percent of the material should be larger than the openings between the bridge and the void(s). (A well placed "bridge" should not have large openings around it.) In most cases this material could be Rip Rap.
- 5) Place a layer of smaller size filter material over the previous layer at a minimum thickness of 9 inches. The size should be 1/4 to 1/2 the size of the pervious layer. In most cases this material could be 57 stone.
- 6) Place a layer of sand size filter material over the previous layer at a minimum thickness of 9 inches. The sand has to be compatible in size with the previous layer to prevent piping. In most cases this material could be C-33 sand or equivalent.
- 7) (A non-woven filter cloth with a burst strength between 100 to 200 psi can be substituted for the stone and sand filter materials discussed in 5 and 6.)
- 8) Backfill over the last filter layer (or filter cloth) with soil material to the surface. The reuse of any soil material excavated from sinkhole should be considered. Overfill by about 5 percent to allow for settlement. The material should be soil with at least 50% clay materials and a minimum of 3 feet thick. The fill materials should be compacted to a minimum of 95% of the standard proctor (AASHTO T-99). Any available topsoil should be placed on the surface.
- 9) Stone used for the "bridge" and the filters should have a rock strength at least equal to moderately hard (i.e. resistant to abrasion or cutting by knife blade but can be easily dent or broken with light blows of hammer). Shale or similar soft and non-durable rock is not acceptable.

HILLIS-CARNES
ENGINEERING ASSOCIATES, Inc.

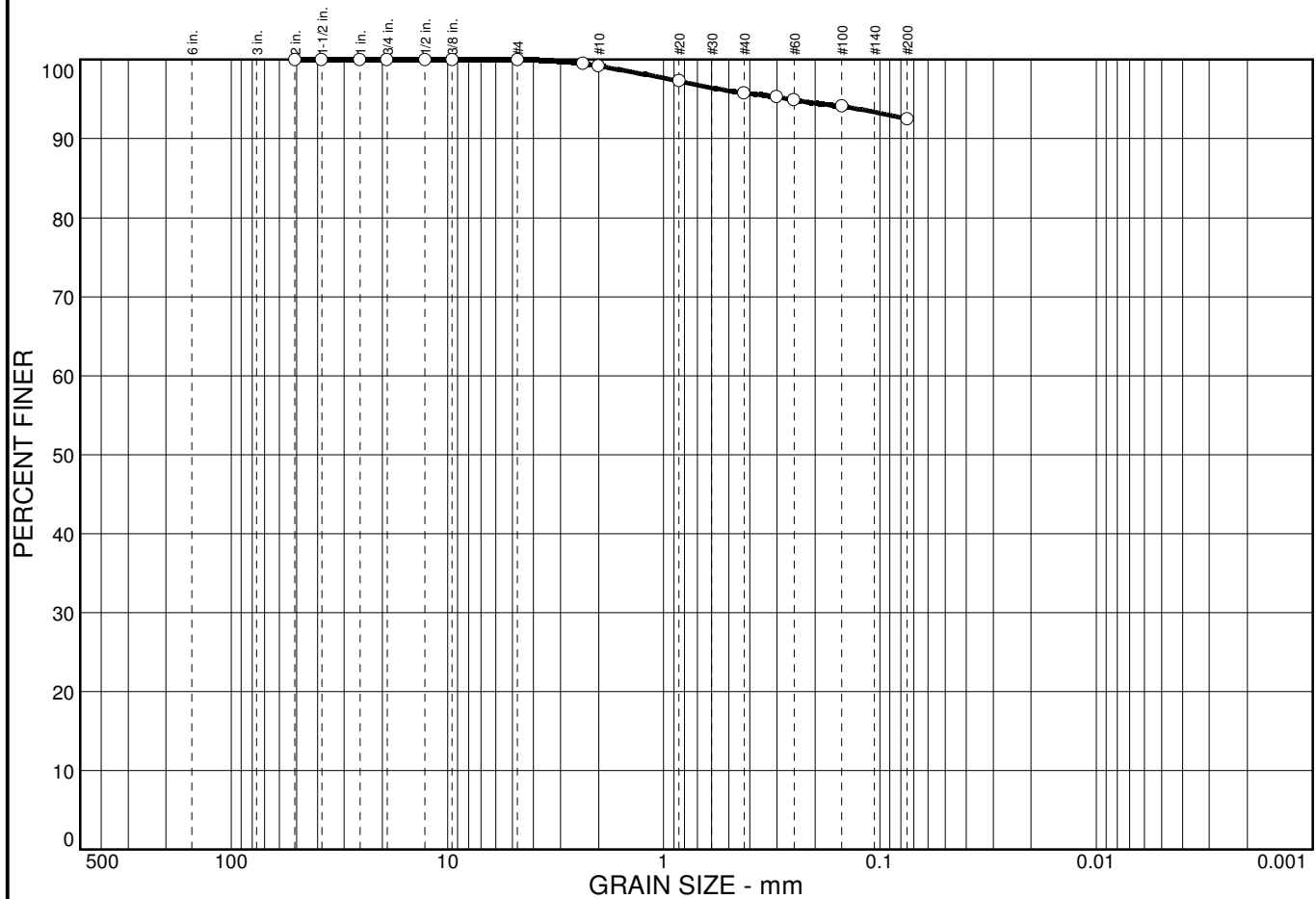
10228 Governor Lane Blvd., Williamsport, Maryland 21795
Phone: (301)582-4662 Fax: (301)582-4614

Sinkhole Remediation Detail

VAMC Community Living Center Expansion
Martinsburg, West Virginia
Job# H10090

Figure No. : 3

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	7.5	92.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2 in.	100.0		
1.5 in.	100.0		
1 in.	100.0		
.75 in.	100.0		
.5 in.	100.0		
0.375 in.	100.0		
#4	100.0		
#8	99.5		
#10	99.2		
#20	97.3		
#40	95.8		
#50	95.3		
#60	94.9		
#100	94.1		
#200	92.5		

* (no specification provided)

Soil Description
Light brown Lean clay

Atterberg Limits
PL= 13 LL= 48 PI= 35

Coefficients
D₈₅= D₆₀= D₅₀=
D₃₀= D₁₅= D₁₀=
C_u= C_c=

Classification
USCS= CL AASHTO= A-7-6(33)

Remarks

Sample No.: L10064
Location: SB-4

Source of Sample:

Date: 10-20-10
Elev./Depth:

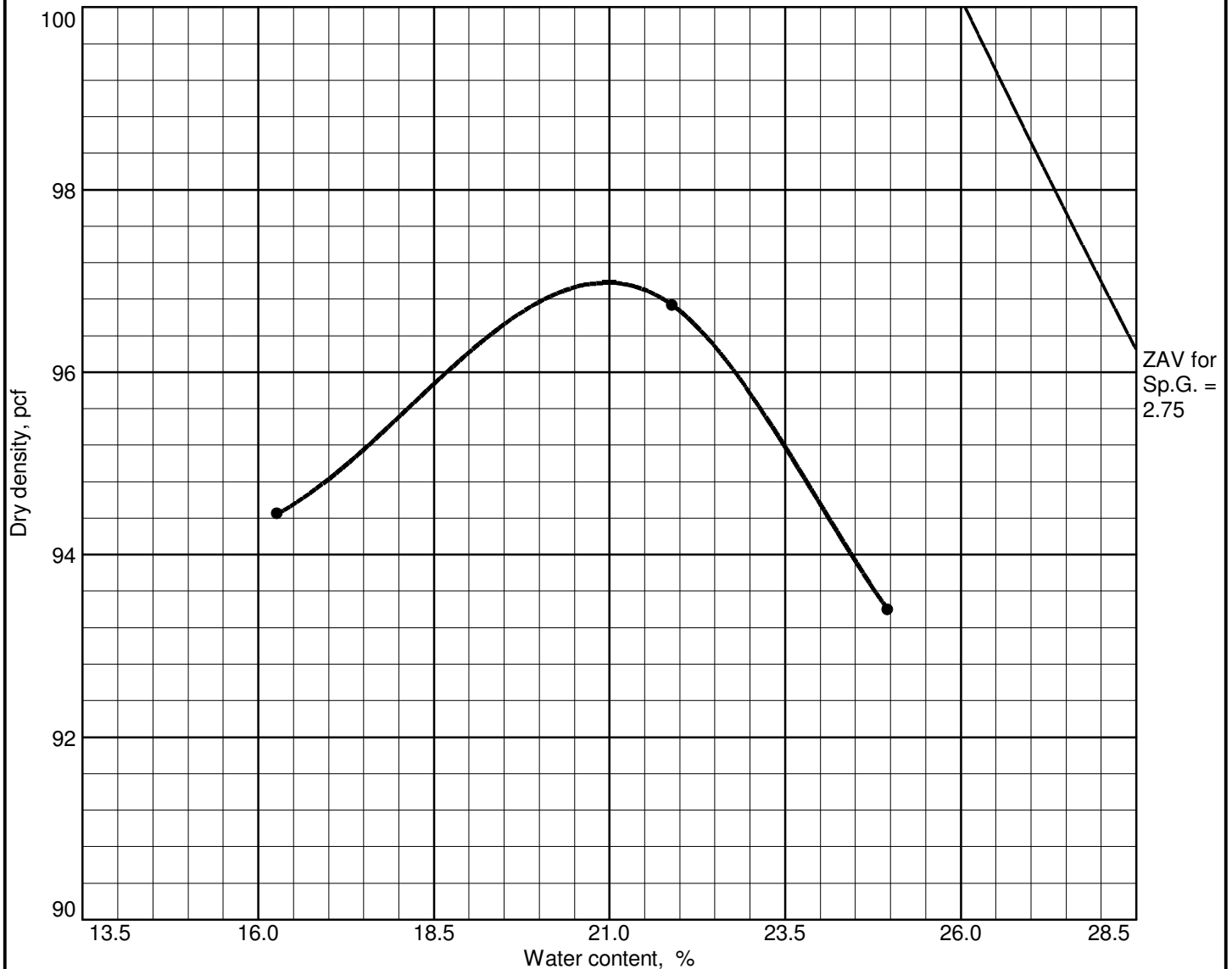
HILLIS-CARNES
ENGINEERING ASSOCIATES, INC.

Client: District Veterans Contracting
Project: VAMC Community Living Center

Project No: H10090

Figure

COMPACTION TEST REPORT



Test specification: AASHTO T 99 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CL	A-7-6(33)		2.75	48	35	0.0	92.5

TEST RESULTS		MATERIAL DESCRIPTION	
Maximum dry density = 97.0 pcf Optimum moisture = 21.0 %		Light brown Lean clay	
Project No. H10090 Client: District Veterans Contracting Project: VAMC Community Living Center Date: ● Location: SB-4		Remarks: <	

Figure

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.
RECORD OF SOIL EXPLORATION

Community Living Center Expansion

Location Martinsburg, West Virginia
 Job Number H10090
 Boring Number B-1

Datum MSL Hammer Wt. 140 Lbs. Hole Diameter 2.25" Foreman J. Hersl
 Surf. Elev. * 504.5 Hammer Drop 30 Inches Rock Core Dia. Inspector Cindy Shepeck
 Date Started 10/1/2010 Pipe Size Inches OD Boring Method SPT Completed 10/1/2010

ELEV.	SOIL DESCRIPTION Color,Moisture,Density,Size,Proportion	STRA. DEPTH	DEPTH SCALE	CON	SAMPLE BLOWS 6"	NO.	REC.	BORING & SAMPLING NOTES
504.5	SURFACE		0.0					
	Light brown, moist, loose to medium dense sandy SILT with rock fragments and organics (ML)		2.5	I/D	2-3-4	S-1	13"	4" " Topsoil " Asphalt " Base % M = 40.1
	OLD FILL MATERIALS		5.0	I/D	13-13-13	S-2	2"	% M = 16.0
499.0		5.5						
	Light brown, moist, dense sandy SILT with rock fragments (SM/ML)		7.5	I/D	13-18-22	S-3	7"	% M = 29.1
496.5	POSSIBLE OLD FILL MATERIALS	8.0						
	Brown, moist, hard sandy CLAY AND ROCK FRAGMENTS (CL/SC)		10.0	I/D	11-17-27	S-4	18"	
			12.5					
489.5		15.0	15.0	I/D	22-35-50/3"	S-4	15"	
	Auger refusal at 15.0'							
	Bottom of Hole at 15.0'		17.5					
			20.0					Backfilled: at completion

* Surface elevation estimated off of the site drawings

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS
 OTHERWISE NOTED.
 PT-PRESSED SHELBY TUBE
 CA-CONTINUOUS FLIGHT AUGER
 RC-ROCK CORE

SAMPLE CONDITIONS
 D-DISINTEGRATED
 I-INTACT
 U-UNDISTURBED
 L-LOST

BORING METHOD
 HSA-HOLLOW STEM AUGERS
 CFA-CONT. FLIGHT AUGERS
 DC-DRIVING CASING
 MD-MUD DRILLING

Groundwater Readings				
	Time	Date	Depth	Cave-In
Encountered	—	10/1/2010	dry	—
At Completion	—	10/1/2010	dry	—
After Auger Removal	—	10/1/2010	dry	9.5'
After 24 hours	—	—	—	—

STANDARD PENETRATION TEST-DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30":COUNT MADE AT 6" INTERVALS

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.
RECORD OF SOIL EXPLORATION

Community Living Center Expansion

Location Martinsburg, West Virginia
Job Number H10090
Boring Number B-2

Datum MSL Hammer Wt. 140 Lbs. Hole Diameter 2.25" Foreman J. Hersl
Surf. Elev. * 502.5 Hammer Drop 30 Inches Rock Core Dia. Inspector Cindy Shepeck
Date Started 10/5/2010 Pipe Size Inches OD Boring Method SPT Completed 10/5/2010

ELEV.	SOIL DESCRIPTION Color,Moisture,Density,Size,Proportion	STRA. DEPTH	DEPTH SCALE	CON	SAMPLE BLOWS 6"	NO.	REC.	BORING & SAMPLING NOTES
502.5	SURFACE		0.0					
	Light brown, moist, medium dense sandy SILT, trace clay and rock fragments (ML)			I/D	2-4-8	S-1	15"	5" " Topsoil
	POSSIBLE OLD FILL MATERIALS							" Asphalt
500.0		2.5	2.5					" Base
								% M = 31.4
				I/D	22-28-27	S-2	18"	% M = 36.3
			5.0					
	Brown, moist, very dense clayey SAND and ROCK FRAGMENTS (SC)			I/D	26-50/5"	S-3	11"	% M = 27.3
			7.5					
				I/D	39-50/4"	S-4	10"	
			10.0					
490.5		12.0						
	Auger refusal at 12.0'		12.5					
	Bottom of Hole at 12.0'							
			15.0					
			17.5					
			20.0					
								Backfilled: at completion

* Surface elevation estimated off of the site drawings

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS
OTHERWISE NOTED.
PT-PRESSED SHELBY TUBE
CA-CONTINUOUS FLIGHT AUGER
RC-ROCK CORE

SAMPLE CONDITIONS
D-DISINTEGRATED
I-INTACT
U-UNDISTURBED
L-LOST

BORING METHOD
HSA-HOLLOW STEM AUGERS
CFA-CONT. FLIGHT AUGERS
DC-DRIVING CASING
MD-MUD DRILLING

Groundwater Readings				
	Time	Date	Depth	Cave-In
Encountered	—	10/1/2010	dry	—
At Completion	—	10/1/2010	dry	—
After Auger Removal	—	10/1/2010	dry	6'
After 24 hours	—	—	—	—

STANDARD PENETRATION TEST-DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30":COUNT MADE AT 6" INTERVALS

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.
RECORD OF SOIL EXPLORATION

Community Living Center Expansion

Location Martinsburg, West Virginia

Job Number H10090

Boring Number B-3 (page 1 of 2)

Datum	MSL	Hammer Wt.	140 Lbs.	Hole Diameter	2.25"	Foreman	J. Hersl
Surf. Elev. *	506.0	Hammer Drop	30 Inches	Rock Core Dia.		Inspector	Cindy Shepeck
Date Started	10/1/2010	Pipe Size		Boring Method	SPT	Completed	10/1/2010

ELEV.	SOIL DESCRIPTION Color,Moisture,Density,Size,Proportion	STRA. DEPTH	DEPTH SCALE	CON	SAMPLE BLOWS 6"	NO.	REC.	BORING & SAMPLING NOTES
506.0	SURFACE		0.0					
	Light brown, moist, loose to medium dense sandy SILT with rock fragments (ML)			I/D	2-4-4	S-1	11"	3" " Topsoil " Asphalt " Base
503.5	OLD FILL MATERIALS	2.5	2.5					% M = 24.6
	Brown, moist, medium dense sandy SILT some rock fragments (SM/ML)		5.0	I/D	11-11-11	S-2	17"	% M = 35.1
	POSSIBLE OLD FILL MATERIALS		7.5	I/D	7-12-10	S-3	18"	% M = 39.3
498.0		8.0						
	Brown to gray brown, moist, medium dense clayey SAND some silt (SC)		10.0	I	7-9-9	S-4	18"	
			12.5					
			15.0	I	4-7-9	S-5	18"	
		17.0						
	Brown to gray brown, moist, loose to very dense clayey SAND, some silt (SC)		17.5					
	Continued on next page		20.0	I	2-3-5	S-6	18"	Backfilled: at completion

* Surface elevation estimated off of the site drawings

SAMPLER TYPE	SAMPLE CONDITIONS	BORING METHOD
DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED.	D-DISINTEGRATED	HSA-HOLLOW STEM AUGERS
PT-PRESSED SHELBY TUBE	I-INTACT	CFA-CONT. FLIGHT AUGERS
CA-CONTINUOUS FLIGHT AUGER	U-UNDISTURBED	DC-DRIVING CASING
RC-ROCK CORE	L-LOST	MD-MUD DRILLING

Groundwater Readings				
	Time	Date	Depth	Cave-In
Encountered		10/1/2010		
At Completion		10/1/2010		
After Auger Removal		10/1/2010		
After 24 hours				

STANDARD PENETRATION TEST-DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30":COUNT MADE AT 6" INTERVALS

Community Living Center Expansion

Location Martinsburg, West Virginia

Job Number H10090

Boring Number B-3 (page 2 of 2)

		SAMPLER			
Datum	<u>MSL</u>	Hammer Wt.	<u>140</u> Lbs.	Hole Diameter	<u>2.25"</u>
Surf. Elev. *	<u>506.0</u>	Hammer Drop	<u>30</u> Inches	Rock Core Dia.	<u>—</u>
Date Started	<u>10/1/2010</u>	Pipe Size	<u> </u> Inches OD	Boring Method	<u>SPT</u>
				Foreman	<u>J. Hersl</u>
				Inspector	<u>Cindy Shepeck</u>
				Completed	<u>10/1/2010</u>

ELEV.	SOIL DESCRIPTION Color,Moisture,Density,Size,Proportion	STRA. DEPTH	DEPTH SCALE	SAMPLE		REC.	BORING & SAMPLING NOTES
				CON	BLOWS 6"		
506.0	SURFACE		0.0				
	Brown to gray brown, moist, loose to very dense clayey SAND, some silt (SC)		22.5				
482.5		23.5		D	50/1"	S-7	1"
	Auger refusal at 23.5'		25.0				
	Bottom of Hole at 23.5'		27.5				
			30.0				
			32.5				
			35.0				
			37.5				
			40.0				
							Backfilled: at completion

* Surface elevation estimated off of the site drawings

SAMPLER TYPE	SAMPLE CONDITIONS	BORING METHOD
DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED.	D-DISINTEGRATED	HSA-HOLLOW STEM AUGERS
	I-INTACT	CFA-CONT. FLIGHT AUGERS
PT-PRESSED SHELBY TUBE	U-UNDISTURBED	DC-DRIVING CASING
CA-CONTINUOUS FLIGHT AUGER	L-LOST	MD-MUD DRILLING
RC-ROCK CORE		

Groundwater Readings				
	Time	Date	Depth	Cave-In
Encountered	_____	10/1/2010	dry	_____
At Completion	_____	10/1/2010	dry	_____
After Auger Removal	_____	10/1/2010	dry	17'
After 24 hours	_____	_____	_____	_____

STANDARD PENETRATION TEST-DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30":COUNT MADE AT 6" INTERVALS

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.
RECORD OF SOIL EXPLORATION

Community Living Center Expansion

Location Martinsburg, West Virginia

Job Number H10090

Boring Number B-4

Datum	MSL	Hammer Wt.	140 Lbs.	Hole Diameter	2.25"	Foreman	J. Hersl
Surf. Elev. *	504.0	Hammer Drop	30 Inches	Rock Core Dia.		Inspector	Cindy Shepeck
Date Started	10/5/2010	Pipe Size		Boring Method	SPT	Completed	10/5/2010

ELEV.	SOIL DESCRIPTION Color,Moisture,Density,Size,Proportion	STRA. DEPTH	DEPTH SCALE	CON	SAMPLE BLOWS 6"	NO.	REC.	BORING & SAMPLING NOTES
504.0	SURFACE		0.0					
	Light brown, moist, loose sandy SILT, trace clay and rock fragments (ML)			I/D	1-3-4	S-1	12"	5" " Topsoil
	OLD FILL MATERIALS							" Asphalt
501.5		2.5	2.5					" Base
								% M = 36.0
	Light brown, moist, medium dense sandy SILT little rock fragments (ML)			I/D	7-9-11	S-2	12"	% M = 35.0
498.5	POSSIBLE OLD FILL MATERIALS	5.5	5.0					
	Light brown, moist, medium dense silty CLAY some rock fragments (ML/CL)			I/D	12-15-12	S-3	13"	% M = 42.9
	POSSIBLE OLD FILL MATERIALS							
493.0		11.0	7.5	I/D	7-11-18	S-4	11"	
			10.0					
	Brown to gray brown, moist, medium dense to very dense clayey SAND, some silt (SC)			I	4-7-10	S-5	15"	
486.0		18.0	12.5					
			15.0					
			17.5					
	Auger refusal at 18.0'			D	50/1"	S-6	0"	
	Bottom of Hole at 18.0'		20.0					Backfilled: at completion

* Surface elevation estimated off of the site drawings

SAMPLER TYPE	SAMPLE CONDITIONS	BORING METHOD
DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED.	D-DISINTEGRATED	HSA-HOLLOW STEM AUGERS
PT-PRESSED SHELBY TUBE	I-INTACT	CFA-CONT. FLIGHT AUGERS
CA-CONTINUOUS FLIGHT AUGER	U-UNDISTURBED	DC-DRIVING CASING
RC-ROCK CORE	L-LOST	MD-MUD DRILLING

Groundwater Readings				
	Time	Date	Depth	Cave-In
Encountered		10/1/2010	dry	
At Completion		10/1/2010	dry	
After Auger Removal		10/1/2010	dry	12'
After 24 hours				

STANDARD PENETRATION TEST-DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30":COUNT MADE AT 6" INTERVALS

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.
RECORD OF SOIL EXPLORATION

Community Living Center Expansion

Location Martinsburg, West Virginia
 Job Number H10090
 Boring Number B-5

Datum MSL Hammer Wt. 140 Lbs. Hole Diameter 2.25" Foreman J. Hersl
 Surf. Elev. * 505.5 Hammer Drop 30 Inches Rock Core Dia. Inspector Cindy Shepeck
 Date Started 10/5/2010 Pipe Size Inches OD Boring Method SPT Completed 10/5/2010

ELEV.	SOIL DESCRIPTION Color,Moisture,Density,Size,Proportion	STRA. DEPTH	DEPTH SCALE	CON	SAMPLE BLOWS 6"	NO.	REC.	BORING & SAMPLING NOTES
505.5	SURFACE		0.0					
	Light brown, moist, loose sandy SILT trace clay, organics and rock fragments (ML)			I/D	2-3-4	S-1	11"	5" " Topsoil
	OLD FILL MATERIALS							" Asphalt
503.0		2.5	2.5					" Base
								% M = 39.3
				I/D	6-13-16	S-2	14"	% M = 60.7
	Light brown, moist, very stiff to hard sandy CLAY some silt and rock fragments (CL/SC)			I/D	7-12-16	S-3	15"	% M = 33.3
	POSSIBLE OLD FILL MATERIALS			I/D	4-7-26	S-4	15"	
493.5		12.0	12.5					
	Brown to gray brown, moist, medium dense to very dense clayey SAND, some silt (SC)			I	5-7-9	S-5	12"	
487.0		18.5	17.5					
	Auger refusal at 18.5' Bottom of Hole at 18.5'		20.0	D	50/1"	S-6	1"	
								Backfilled: at completion

* Surface elevation estimated off of the site drawings

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS
 OTHERWISE NOTED.
 PT-PRESSED SHELBY TUBE
 CA-CONTINUOUS FLIGHT AUGER
 RC-ROCK CORE

SAMPLE CONDITIONS
 D-DISINTEGRATED
 I-INTACT
 U-UNDISTURBED
 L-LOST

BORING METHOD
 HSA-HOLLOW STEM AUGERS
 CFA-CONT. FLIGHT AUGERS
 DC-DRIVING CASING
 MD-MUD DRILLING

Groundwater Readings				
	Time	Date	Depth	Cave-In
Encountered	—	10/1/2010	dry	—
At Completion	—	10/1/2010	dry	—
After Auger Removal	—	10/1/2010	dry	13.5'
After 24 hours	—	—	—	—

STANDARD PENETRATION TEST-DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30":COUNT MADE AT 6" INTERVALS

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.
RECORD OF SOIL EXPLORATION

Community Living Center Expansion

Location Martinsburg, West Virginia
Job Number H10090
Boring Number W-1

Datum MSL Hammer Wt. 140 Lbs. Hole Diameter 2.25" Foreman J. Hersl
Surf. Elev. * 503.8 Hammer Drop 30 Inches Rock Core Dia. Inspector Cindy Shepeck
Date Started 10/1/2010 Pipe Size Inches OD Boring Method SPT Completed 10/1/2010

ELEV.	SOIL DESCRIPTION Color,Moisture,Density,Size,Proportion	STRA. DEPTH	DEPTH SCALE	CON	SAMPLE BLOWS 6"	NO.	REC.	BORING & SAMPLING NOTES
503.8	SURFACE		0.0					
	Light brown, moist, loose to medium dense sandy SILT, some clay and rock fragments (ML)			I/D	3-2-5	S-1	14"	4" " Topsoil " Asphalt " Base
	OLD FILL MATERIALS		2.5					% M = 17.6 Offset 5' towards B-2 due to utilities
500.3		3.5						
	Light brown to gray brown, moist, very dense clayey SAND, with rock fragments (SC/CL)		5.0	I/D	17-28-35	S-2	14"	% M = 34.0
				I/D	31-37-43	S-3	15"	% M = 26.2
495.8		8.0	7.5					
	Brown, moist, very dense clayey SAND AND ROCK FRAGMENTS (SC)		10.0	I/D	37-50/5"	S-4	10"	
492.8		11.0						
	Auger refusal at 11.0'		12.5					
	Auger refusal at 11.0'		15.0					
			17.5					
			20.0					
								Backfilled: at completion

* Surface elevation estimated off of the site drawings

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS
OTHERWISE NOTED.
PT-PRESSED SHELBY TUBE
CA-CONTINUOUS FLIGHT AUGER
RC-ROCK CORE

SAMPLE CONDITIONS
D-DISINTEGRATED
I-INTACT
U-UNDISTURBED
L-LOST

BORING METHOD
HSA-HOLLOW STEM AUGERS
CFA-CONT. FLIGHT AUGERS
DC-DRIVING CASING
MD-MUD DRILLING

Groundwater Readings				
	Time	Date	Depth	Cave-In
Encountered	—	10/1/2010	dry	—
At Completion	—	10/1/2010	dry	—
After Auger Removal	—	10/1/2010	dry	4.5'
After 24 hours	—	—	—	—

STANDARD PENETRATION TEST-DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30":COUNT MADE AT 6" INTERVALS

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.
RECORD OF SOIL EXPLORATION

Community Living Center Expansior

Location Martinsburg, West Virginia
Job Number H10090
Boring Number W-2

Datum MSL Hammer Wt. 140 Lbs. Hole Diameter 2.25" Foreman J. Hersl
Surf. Elev. * 500.0 Hammer Drop 30 Inches Rock Core Dia. Inspector Cindy Shepeck
Date Started 10/5/2010 Pipe Size Inches OD Boring Method SPT Completed 10/5/2010

ELEV.	SOIL DESCRIPTION Color,Moisture,Density,Size,Proportion	STRA. DEPTH	DEPTH SCALE	CON	SAMPLE BLOWS 6"	NO.	REC.	BORING & SAMPLING NOTES
500.0	SURFACE		0.0					
	Light brown, moist, medium dense sandy SILT with clay (ML)			I/D	2-4-7	S-1	12"	4" " Topsoil " Asphalt " Base
	POSSIBLE OLD FILL MATERIALS		2.5					% M = 43.8
496.0		4.0		I/D	8-20-15	S-2	13"	Offset 5' towards B-2 due to utilities
	Brown, moist, dense to very dense clayey SAND with rock fragments (SC)		5.0					% M = 36.6
494.0		6.0		D	50/1"	S-3	1"	
	Auger refusal at 6.0'		7.5					% M = 6.4
	Auger refusal at 6.0'							
			10.0					
			12.5					
			15.0					
			17.5					
			20.0					
								Backfilled: at completion

* Surface elevation estimated off of the site drawings

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS
OTHERWISE NOTED.
PT-PRESSED SHELBY TUBE
CA-CONTINUOUS FLIGHT AUGER
RC-ROCK CORE

SAMPLE CONDITIONS
D-DISINTEGRATED
I-INTACT
U-UNDISTURBED
L-LOST

BORING METHOD
HSA-HOLLOW STEM AUGERS
CFA-CONT. FLIGHT AUGERS
DC-DRIVING CASING
MD-MUD DRILLING

Groundwater Readings				
	Time	Date	Depth	Cave-In
Encountered	—	10/1/2010	dry	—
At Completion	—	10/1/2010	dry	—
After Auger Removal	—	10/1/2010	dry	3'
After 24 hours	—	—	—	—

STANDARD PENETRATION TEST-DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30".COUNT MADE AT 6" INTERVALS

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.
RECORD OF SOIL EXPLORATION

Community Living Center Expansion

Location Martinsburg, West Virginia
 Job Number H10090
 Boring Number W-3

Datum MSL Hammer Wt. 140 Lbs. Hole Diameter 2.25" Foreman J. Hersl
 Surf. Elev. * 500.0 Hammer Drop 30 Inches Rock Core Dia. _____ Inspector Cindy Shepeck
 Date Started 10/5/2010 Pipe Size _____ Inches OD Boring Method SPT Completed 10/5/2010

ELEV.	SOIL DESCRIPTION Color,Moisture,Density,Size,Proportion	STRA. DEPTH	DEPTH SCALE	CON	SAMPLE BLOWS 6"	NO.	REC.	BORING & SAMPLING NOTES
500.0	SURFACE		0.0					
	Light brown, moist, medium dense sandy SILT with clay (ML)			I/D	3-3-6	S-1	14"	3" " Topsoil " Asphalt " Base
497.5	OLD FILL MATERIALS	2.5	2.5					% M = 25.0 Offset 5' towards B-2 due to utilities
	Brown, moist, stiff sandy CLAY with silt and rock fragments (SC)		5.0	I	4-4-7	S-2	11"	% M = 23.5
493.5		6.5						
492.5	Limestone Rock Fragments	7.5	7.5	I/D	3-15-50/3"	S-3	9"	% M = 25.4
	Auger refusal at 7.5'							
	Auger refusal at 7.5'		10.0					
			12.5					
			15.0					
			17.5					
			20.0					Backfilled: at completion

* Surface elevation estimated off of the site drawings

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS
 OTHERWISE NOTED.
 PT-PRESSED SHELBY TUBE
 CA-CONTINUOUS FLIGHT AUGER
 RC-ROCK CORE

SAMPLE CONDITIONS
 D-DISINTEGRATED
 I-INTACT
 U-UNDISTURBED
 L-LOST

BORING METHOD
 HSA-HOLLOW STEM AUGERS
 CFA-CONT. FLIGHT AUGERS
 DC-DRIVING CASING
 MD-MUD DRILLING

Groundwater Readings				
	Time	Date	Depth	Cave-In
Encountered	_____	10/1/2010	dry	_____
At Completion	_____	10/1/2010	dry	_____
After Auger Removal	_____	10/1/2010	dry	3'
After 24 hours	_____	_____	_____	_____

STANDARD PENETRATION TEST-DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30":COUNT MADE AT 6" INTERVALS

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.
RECORD OF SOIL EXPLORATION

Community Living Center Expansion

Location Martinsburg, West Virginia
Job Number H10090
Boring Number CY-1 (page 1 of 2)

Datum MSL Hammer Wt. 140 Lbs. Hole Diameter 2.25" Foreman J. Hersl
Surf. Elev. * 506.5 Hammer Drop 30 Inches Rock Core Dia. Inspector Cindy Shepeck
Date Started 10/1/2010 Pipe Size Inches OD Boring Method SPT Completed 10/1/2010

ELEV.	SOIL DESCRIPTION Color,Moisture,Density,Size,Proportion	STRA. DEPTH	DEPTH SCALE	CON	SAMPLE BLOWS 6"	NO.	REC.	BORING & SAMPLING NOTES
506.5	SURFACE		0.0					
	Light brown, moist, loose sandy SILT some clay and organics (ML)			I/D	2-2-4	S-1	12"	3" " Topsoil " Asphalt " Base
504.0	OLD FILL MATERIALS	2.5	2.5					% M = 39.9
	Brown, moist, medium dense sandy SILT some rock fragments, trace clay (SM/ML)		5.0	I/D	2-6-9	S-2	16"	% M = 44.0
	POSSIBLE OLD FILL MATERIALS		7.5	I/D	5-6-8	S-3	17"	% M = 24.7
498.5		8.0						
	Brown to gray brown, moist, medium dense sandy SILT some clay (ML)		10.0	I	9-11-14	S-4	18"	
494.5	POSSIBLE OLD FILL MATERIALS	12.0	12.5					
	Brown to gray brown, moist, medium dense clayey SAND, some silt (SC)		15.0	I	6-8-11	S-5	18"	
			17.5					
487.5		19.0						
	Continued on next page		20.0	I	6-8-19	S-6	18"	Backfilled: at completion

* Surface elevation estimated off of the site drawings

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS
OTHERWISE NOTED.
PT-PRESSED SHELBY TUBE
CA-CONTINUOUS FLIGHT AUGER
RC-ROCK CORE

SAMPLE CONDITIONS
D-DISINTEGRATED
I-INTACT
U-UNDISTURBED
L-LOST

BORING METHOD
HSA-HOLLOW STEM AUGERS
CFA-CONT. FLIGHT AUGERS
DC-DRIVING CASING
MD-MUD DRILLING

Groundwater Readings				
	Time	Date	Depth	Cave-In
Encountered	—	10/1/2010	—	—
At Completion	—	10/1/2010	—	—
After Auger Removal	—	10/1/2010	—	—
After 24 hours	—	—	—	—

STANDARD PENETRATION TEST-DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30":COUNT MADE AT 6" INTERVALS

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.
RECORD OF SOIL EXPLORATION

Community Living Center Expansior

Location Easton, Pennsylvania

Job Number H10090

Boring Number CY-1 (page 2 of 2)

Datum <u>MSL</u>	Hammer Wt. <u>140</u> Lbs.	Hole Diameter <u>2.25"</u>	Foreman <u>J. Hersl</u>
Surf. Elev. * <u>506.5</u>	Hammer Drop <u>30</u> Inches	Rock Core Dia. <u> </u>	Inspector <u>Cindy Shepeck</u>
Date Started <u>10/1/2010</u>	Pipe Size <u> </u> Inches OD	Boring Method <u>SPT</u>	Completed <u>10/1/2010</u>

ELEV.	SOIL DESCRIPTION Color,Moisture,Density,Size,Proportion	STRA. DEPTH	DEPTH SCALE	CON	SAMPLE BLOWS 6"	NO.	REC.	BORING & SAMPLING NOTES
506.5	SURFACE		0.0					
483.5	Brown to gray brown, moist, medium dense clayey SAND, some silt (SC)	23.0	22.5					
	Auger refusal at 23.0'		25.0					
	Bottom of Hole at 23.0'		27.5					
			30.0					
			32.5					
			35.0					
			37.5					
			40.0					
								Backfilled: at completion

* Surface elevation estimated off of the site drawings

SAMPLER TYPE	SAMPLE CONDITIONS	BORING METHOD
DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED.	D-DISINTEGRATED	HSA-HOLLOW STEM AUGERS
PT-PRESSED SHELBY TUBE	I-INTACT	CFA-CONT. FLIGHT AUGERS
CA-CONTINUOUS FLIGHT AUGER	U-UNDISTURBED	DC-DRIVING CASING
RC-ROCK CORE	L-LOST	MD-MUD DRILLING

Groundwater Readings				
	Time	Date	Depth	Cave-In
Encountered	—	10/1/2010	dry	—
At Completion	—	10/1/2010	dry	—
After Auger Removal	—	10/1/2010	dry	15'
After 24 hours	—	—	—	—

STANDARD PENETRATION TEST-DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30":COUNT MADE AT 6" INTERVALS

HILLIS-CARNES ENGINEERING ASSOCIATES, Inc.

10228 Governor Lane Blvd., Williamsport, Maryland 21795

Phone: (301)582-4662 • Fax: (301)582-4614

Description of Soils – per ASTM D2487

Major Component	Component Type	Component Description	Symbol	Group Name
Coarse-Grained Soils, More than 50% is retained on the No. 200 sieve	Gravels – More than 50% of the coarse fraction is retained on the No. 4 sieve. Coarse = 1" to 3" Medium = ½" to 1" Fine = ¼" to ½"	Clean Gravels <5% Passing No. 200 sieve	GW	Well Graded Gravel
			GP	Poorly Graded Gravel
		Gravels with fines, >12% Passing the No. 200 sieve	GM	Silty Gravel
			GC	Clayey Gravel
	Sands – More than 50% of the coarse fraction passes the No. 4 sieve. Coarse = No.10 to No.4 Medium = No. 10 to No. 40 Fine = No. 40 to No. 200	Clean Sands <5% Passing No. 200 sieve	SW	Well Graded Sand
			SP	Poorly Graded Sand
		Sands with fines, >12% Passing the No. 200 sieve	SM	Silty Sand
			SC	Clayey Sand
Fine Grained Soils, More than 50% passes the No. 200 sieve	Silts and Clays Liquid Limit is less than 50 Low to medium plasticity	Inorganic	ML	Silt
			CL	Lean Clay
		Organic	OL	Organic silt Organic Clay
	Silts and Clays Liquid Limit of 50 or greater Medium to high plasticity	Inorganic	MH	Elastic Silt
			CH	Fat Clay
		Organic	OH	Organic Silt Organic Clay
Highly Organic Soils	Primarily Organic matter, dark color, organic odor		PT	Peat

Proportions of Soil Components

Component Form	Description	Approximate percent by weight
Noun	Sand, Gravel, Silt, Clay, etc.	50% or more
Adjective	Sandy, silty, clayey, etc.	35% to 49%
Some	Some sand, some silt, etc.	12% to 34%
Trace	Trace sand, trace mica, etc.	1% to 11%
With	With sand, with mica, etc.	Presence only

Particle Size Identification

Particle Size	Particle dimension
Boulder	12" diameter or more
Cobble	3" to 12" diameter
Gravel	¼" to 3" diameter
Sand	0.005" to ¼" diameter
Silt/Clay (fines)	Cannot see particle

Cohesive Soils

Field Description	Consistency
Easily Molded in Hands	Very Soft
Easily penetrated several inches by thumb	Soft
Penetrated by thumb with moderate effort	Medium
Penetrated by thumb with great effort	Stiff
Indented by thumb only with great effort	Hard

Granular Soils

No. of SPT Blows/ft	Relative Density
0 – 4	Very Loose
5 – 10	Loose
11 – 30	Medium Dense
31 – 50	Dense
Greater than 50	Very Dense

Other Definitions:

- **Fill:** Encountered soils that were placed by man. Fill soils may be controlled (engineered structural fill) or uncontrolled fills that may contain rubble and/or debris.
- **Saprolite:** Soil material derived from the in-place chemical and physical weathering of the parent rock material. May contain relic structure. Also called residual soils. Occurs in Piedmont soils, found west of the fall line.
- **Disintegrated Rock:** Residual soil material with rock-like properties, very dense, N = 60 to 51/0".
- **Karst:** Descriptive term which denotes the potential for solutioning of the limestone rock and the development of sinkholes.
- **Alluvium:** Recently deposited soils placed by water action, typically stream or river floodplain soils.
- **Groundwater Level:** Depth within borehole where water is encountered either during drilling, or after a set period of time to allow groundwater conditions to reach equilibrium.
- **Caved Depth:** Depth at which borehole collapsed after removal of augers/casing. Indicative of loose soils and/or groundwater conditions.