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May 18, 2017

Fairfax County
Department of Housing and Community Development
3700 Pender Drive Suite 300
Fairfax, VA 22030

Attention: Tony Esse, P.E.
Associate Director, Design, Development and Construction
Phone: 703-246-5172
E-mail: Tony.Esse@fairfaxcounty.gov

Subject: Preliminary Geotechnical Exploration and Assessment Report
Proposed Residential Housing Development
SE Corner of Intersection of Oakwood Road and South Van Dorn Street
Alexandria, VA 22310
PSI Project Number: 0512784

Dear Mr. Esse:

We have completed the preliminary subsurface exploration for the above referenced project. This preliminary geotechnical report incorporates the subsurface findings and provides our opinion on the feasibility of the proposed site for the support of earthwork and foundations.

The soil samples obtained during this exploration will be retained in our laboratory for sixty days, unless otherwise advised.

Should there be any questions, please do not hesitate to contact our office. PSI would be pleased to continue providing geotechnical services throughout the implementation of the project, and we look forward to working with you and your organization on this and future projects.

Respectfully Submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.

Naveen Thakur, P.E.
Senior Geotechnical Engineer

Naseer Nayeem, P.E.
Principal Consultant

Information To Build On
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Preliminary Subsurface Exploration and Geotechnical Assessment

Proposed Residential Housing Development
SE Corner of Intersection of Oakwood Road and
South Van Dorn Street
Alexandria, Virginia

Prepared For

Fairfax County
Department of Housing and Community Development
3700 Pender Drive Suite 300
Fairfax, VA 22030

Prepared By

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PSI Project No. 0512784

May 18, 2017

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APPENDICES

1 EXECUTIVE SUMMARY

PSI has completed preliminary subsurface exploration and geotechnical assessment for the proposed Residential Housing Development Project to be located at the southeast corner of the intersection of Oakwood Road and South Van Dorn Street in Alexandria, Virginia. A total of six test borings were drilled for this project. Competent granular soils were encountered in most of the test borings. In general, based on the review of the subsurface conditions, the proposed structures at the site may be supported on shallow foundations, provided our recommendations in this preliminary report are considered.

2 PROJECT INFORMATION

2.1 PROPOSAL AND PROJECT AUTHORIZATION

This report presents the findings of preliminary subsurface explorations and provides preliminary geotechnical recommendations and geotechnical evaluation performed by Professional Service Industries, Inc. (PSI) provided these services for the Proposed Residential Housing Development Project to be located at Oakwood Road and South Van Dorn Street in Alexandria, Virginia, in general accordance with PSI's Proposal No. 0512-182249, dated September 7,2016.

2.2 PROJECT DESCRIPTION

Initial project information was provided by Mr. Esse of Fairfax County Department of Housing and Community Development on February 1, 2017. We also reviewed the provided Oakwood/Van Dorn Sketch Plan 1 dated November 2016, which was prepared by BC Consultants.

Based on the provided information, PSI understands that the Fairfax County Department of Housing and Development is interested in identifying any potential site issues which may impact the development of the approximately 6.2-acre tract of land located on the southeast corner of the intersection of Oakwood Road and South Van Dorn Street in Alexandria, Virginia. PSI understands that a new residential housing development consisting of 5 individual multi-story townhouse structures is being considered for the site. The site development would also include the construction of new paved parking lots, drive aisles and roadways, which will connect with Oakwood Road in the north and Bent Willow Drive in the south. Further, we also understand that the preliminary considerations for the site development also includes a Stormtech Subsurface stormwater facility with footprint of approximately 19,500 SQFT and is planned to be located within the southwest portion of the site.

As of this report preparation PSI was not provided with structural loads and site grading plans or finish floor information of the proposed structures, due to preliminary state of the proposed site development. However, based on our experience with similar type of projects, we anticipate maximum column load of 50 kips with wall loads around 10 kips per lineal foot.

If any of the noted information is incorrect or has changed, please inform PSI so that we may review the geotechnical data and amend the recommendations presented in this report, if appropriate.

2.3 PURPOSE AND SCOPE OF WORK

The scope of services for this study included the preliminary assessment of subsurface conditions through field exploration and laboratory testing. The study included an evaluation of the site and subsurface conditions relative to the proposed construction and the preparation of a report of findings. The preliminary subsurface exploration was developed to provide the following:

- A general assessment of the area geology based on our experience and review of available geological literature.
- A discussion of subsurface conditions encountered including pertinent soil properties and groundwater conditions.
- Evaluation of the data as it relates to the proposed development.
- Discussions concerning the geotechnical aspects of the proposed development.
- Feasibility of type of foundations based on the subsurface conditions.
- Determination of the Seismic Site Class and seismic design parameters per IBC 2015 based on SPT 'N'-values.
- Comments and recommendations relating to other observed geotechnical conditions that could impact development.

The scope of PSI's geotechnical services did not include an environmental assessment. Statements made in this report or on the boring logs regarding odors, colors, unusual or suspicious items or conditions are strictly for the information of our client.

2.4 SUBSURFACE EXPLORATION

A total of six (6) soil test borings, designated as B-1 through B-6, were drilled across the footprint of the proposed site development and within the proposed building areas. The information from these test borings is also used for proposed parking areas. These test borings were drilled to depths varying from 17.3 to 25 feet, below the existing grade.

Boring layout was based on the topographic view found in Google Earth and test borings were staked in the field, by our field engineer using standard tape measurements from the existing site features. The approximate test boring locations are shown on the attached Boring Location Plan, in **APPENDIX B**. The boring elevations shown on the individual boring logs were also estimated from the google earth.

The drilling subcontractor used an All-Terrain Vehicle (ATV) mounted drill rig which was equipped with an automatic hammer. The subcontractor used 2-7/8 in. I.D. hollow stem augers to advance the borehole and performed Standard Penetration Testing (SPT), in general accordance with ASTM D1586, at selected intervals in each of the borings. The penetration resistance, in conjunction with soil classifications, provides an indication of engineering characteristics of a soil.

Soil samples recovered during the drilling operations were transported to the PSI laboratory in Fairfax, Virginia for visual classification and further evaluation. The soil samples obtained during this exploration will be retained in our laboratory for six months, unless otherwise advised. Thereafter, the samples will be disposed. Descriptions of the soils encountered during our subsurface exploration are provided in the Boring Logs. Groundwater conditions, penetration resistances, and other pertinent information are also included in the Boring Logs. The borings were backfilled with the soil cuttings after the completion of drilling.

Drilling, and soil sampling was conducted in accordance with the procedures generally recognized and accepted as standard methods of exploration of subsurface conditions related to earthwork and foundation engineering projects at the present. The findings of the PSI borings are presented on the Test Boring Logs which are included in Appendix **C**.

2.5 LABORATORY TESTING

Our geotechnical engineering staff visually classified the recovered soil samples in the laboratory in general accordance with the Unified Soil Classification System (USCS) (ASTM D2488). Natural moisture content determinations (ASTM D2216), Atterberg limits tests (ASTM D4318) and grain size analyses (ASTM D6913) were conducted on select samples. The laboratory test results are presented in **APPENDIX D**, as well as shown on the individual boring logs.

3 SITE AND SUBSURFACE CONDITIONS

3.1 SITE LOCATION AND DESCRIPTION

The proposed residential housing development site is located at the southeast corner of the intersection of Oakwood Road and South Van Dorn Street in Alexandria, Virginia. The site is currently undeveloped. Within the central-western portion of the site, a large VDOT stormwater reservoir currently exists and is within an existing chain link fence. This reservoir appeared to be in a good condition, and appeared to be nearly completely drained at the time of our site visit dated February 3, 2017. Outside the fenced off reservoir, the northern, eastern and southern portions of the site are currently wooded and overgrown with medium to dense brush. Further, numerous small 2H:1V slopes exist across majority of the site. In general, based on the google earth, the existing grade within the limits of the proposed site development varies from EL. 222 to EL. 242 feet. The lowest EL. 222 feet is at the bottom of the existing VDOT reservoir.

3.2 AREA GEOLOGY

The site is geologically located in the Atlantic Coastal Plain Physiographic Province. A study of the area geology from the available literature shows that the site is underlain by Potomac Formation (Kp) of Cretaceous age. The Potomac Formation in general, consists of sand with varying amounts of silt and clay.

3.3 SUBSURFACE CONDITIONS

Surface Cover: From the ground surface, test borings encountered 8 to 14 inches of topsoil. The approximate thickness of surface cover at each of the test boring location is indicated on the attached Test Boring Logs and may be greater or less between the exploration locations.

Native Granular Soils: Below the surface cover materials, native granular soils, described as clayey sand (SC), silty clayey sand (SC-SM), silty sand (SM), poorly graded sand with silt and gravel (SP-SM), silty gravel (GM), well graded sand with silt and gravel (SW-SM) were encountered to depths varying from 13.5 to 25 feet, below the existing grade. Most of the test borings, except B-3 and B-6, were terminated in this stratum. Within the granular deposits, cohesive soils, described as lean clay (CL) with varying amounts of sand were also encountered in test borings B-1 and B-4. In general, the relative density of the near surface granular soils is loose, while the relative density of the deeper granular deposits range from medium dense to dense. Further, the consistency of the cohesive soils varies from stiff to very stiff. The SPT N-values of the native soils varied from 7 to 50 blows per foot (bpf). The natural moisture content values of these soils varied from 6 to 23 percent.

Atterberg limits and sieve analysis tests were performed within these native soils. Based on the Index testing, the soil samples were classified as sandy lean clay, clayey sand, silty clayey sand, silty sand with gravel and lean clay as per USCS soil classification. The liquid limit values of these soils ranged from 16 to 55, while plasticity index values varied from 1 to 32. In the tested soil samples, the approximate percent of the fines ranged from 12 to 75 percent

Highly Weathered Rock: In test borings B-3 and B-6, highly weathered rock, described as very dense silty sand was encountered to the auger refusal depths, which varied from 22.4 to 22.5 feet, below the existing grade. The SPT N-values of this weathered rock stratum varied from 65 blows per foot to 50 blows for 1-inch of penetration, with natural moisture content values ranging from 4 to 9 percent.

Detailed descriptions of the subsurface conditions are presented on the soil boring logs included as **APPENDIX C,** and the laboratory test results located in **APPENDIX D**.

The above subsurface description is generalized to highlight the major soil strata encountered. The boring logs included in the appendices should be reviewed for specific information as to individual test boring locations. The stratification lines shown on the test boring logs represent the conditions only at the actual test boring locations. Variations may occur and should be expected across the site. The stratification lines represent the approximate boundaries between subsurface materials and the actual transition may be gradual.

3.4 GROUNDWATER CONDITIONS

During drilling, no groundwater was encountered and test borings remained dry, upon completion of drilling operations.

The groundwater observations presented in this report and the attached boring logs reflect those observed at the time of our field activities. Fluctuation in groundwater levels should be anticipated. We recommend that the Contractor should determine the actual groundwater levels at the time of construction to determine the groundwater impact on the proposed construction.

4 GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

This report is preliminary and no site grading plans, specific building loads or the finish floor elevation for the proposed buildings are available. The existing grade within the limits of the proposed site development varies from EL. 222 to EL. 242 feet. The lowest elevation of 222 feet is within the bottom of the existing VDOT reservoir. As part of the construction of the buildings, we anticipate that the existing VDOT reservoir will be backfilled with compacted structural fill.

Based on the review of test borings, the site in general is feasible for the support of the shallow foundations. Since no site grading information is available, for the purposes of this report, we have assumed two possible cases for the support of the proposed townhome buildings.

Case 1 - Proposed Townhome Buildings without Basement Level:

Case 1 involves the construction of the proposed buildings without a basement level and with finish floor assumed to be at or near EL. 230 ft. As such, to match this assumed finish floor elevation, approximately 12 feet of cut and 8 feet of new fill will be required. The floor slabs and parking areas are also assumed to be graded at or near this elevation (230 ft.). The native soils and/or compacted structural fill at or below EL. 230 ft. are suitable for the support of the floor slabs, parking areas and shallow foundations. Shallow foundations may be proportioned using a net allowable soil bearing pressure of **2,000 pounds per square foot (psf).** Since the shallow foundations will be bearing on dissimilar materials, we have provided this low bearing pressure to minimize the differential settlements.

Case 2 - Proposed Townhome Buildings with Basement Level:

Case 2 involves the construction of the proposed buildings with a basement level and finish floor assumed to be at or near the EL. 220 ft. As such, to match this assumed basement level elevation, approximately 2 to 22 feet of cut will be required within the limits of the proposed buildings. In this case, the shallow foundations and the basement slabs will be bearing on the competent native soils. Shallow foundations can be proportioned using a net allowable soil bearing pressure of **2,000 pounds per square foot (psf).** Higher allowable soil bearing pressure is feasible in this case and can be provided or modified upon request.

Based on the test borings, we did not encounter any groundwater. However, perched or trapped water within the granular deposits may be encountered during the construction of the buildings and parking areas. Further, groundwater infiltration may also occur due to precipitation. In general, sump pumps can be used for temporary dewatering.

Based on the review of the soils information from the Fairfax County Soil Maps and from the test borings, the site does not appear to have the potential for the marine clay soils. Although, site grading information is not available at this time, we anticipate that site retaining walls will be needed. As part of the final grading and design, PSI recommends that slope stability analysis be evaluated for the retaining walls and for any permanent slopes steeper than 3:1 (H:V) slope configuration.

4.1 SITE PREPARATION AND EARTHWORK

PSI anticipates significant cut and fill activities at this site. The following recommendations are general and are intended to attain the planned grades within the footprint area of the proposed buildings and parking areas.

- The undercutting activities should be performed during a period of dry weather. Any underground utilities encountered within the proposed construction limits shall be removed or rerouted. We further recommend that abandoned utilities left in place be permanently grouted solid to fill voids and to prevent the inadvertent introduction of fluids into the construction area.

- Areas to support slabs and parking should be stripped of all surface debris, fill, litter and any organic topsoil. The Geotechnical Engineer or qualified representative should observe the site for proper stripping, excavation and preparation.

- Once stripping, excavation to grade in cut areas, and undercutting of unsuitable materials is complete and prior to beginning fill placement activities, we recommend that all exposed surface areas be evaluated by proof rolling the exposed grade.

- The subgrade should be proof rolled in the presence of the Geotechnical Engineer of Record or qualified representative with at least two passes of a fully loaded dump truck weighing at least 20 tons or similar equipment to identify any soft/loose pockets.

- Soils that are observed to rut or deflect excessively under the moving load should be undercut and replaced with properly compacted fill soils satisfying the structural fill requirements detailed later in this report.

- If soils are wet of optimum, lowering the moisture content by scarifying and aeration (discing and exposure to sun and wind) may be required. However, this method may not be feasible if construction occurs during wet seasonal conditions. Very moist to wet soils will "pump" under the operation of heavy equipment, resulting in deep rutting and perhaps rendering the operation of grading and paving equipment difficult or impossible.

  Therefore, other methods of subgrade modification may be required in areas of any high moisture content. Modification may also be achieved by undercutting and replacement with granular subbase (possibly in combination with a geotextile separation layer or geogrid reinforcement), mixing stone into the subgrade, or treating the subgrade with hydrated lime. The appropriate method of subgrade modification should be determined by the Geotechnical Engineer (PSI) or his site representative at the time of construction.

- Material satisfactory for structural fill may include clean soil or bank run sand and gravel (SW, SP, SM, and GM). CL, ML, GC, and SC material can be used in engineered fills, subject to the following limitations, however, fill placed below foundations must consist of granular fill classified as SW, SP, SM, GM or a combination of these:

Maximum Dry Density (per ASTM D698)	$\geq$ 105 pcf
Liquid Limit	$\leq$ 40
Plasticity Index	$\leq$ 20

  Organic soils and high plasticity clays and silts (CH, MH, OL, OH, PT) should not be used as engineered fill. The fill materials should be free from topsoil and debris, have less than 2 percent organics and should not contain rock fragments having a major dimension greater than 3 inches. The use of the excavated fill soils for controlled structural fill will be subject to approval of the Geotechnical Engineer of Record and moisture adjustments at the time of construction, and the plasticity and maximum dry density requirement specified in this section.

- Fill placement should be in loose horizontal lifts no greater than 8 inches thick compacted uniformly with the proper equipment.

- Fill required to support the footings, slab-on-grade and the pavements should be compacted to at least 95 percent of the maximum dry density as per ASTM D1557 (Modified Proctor) test method. The moisture content of the fill should be within plus or minus two (±2) percentage points of the optimum moisture content.

- Fill placement on sloping ground should be benched into the existing slope and bear on natural materials.

- Some of the onsite excavated soils can be reused as structural fill, provided it satisfies the Structural Fill" requirements as indicated above.

For proper site preparation, the earthwork should be performed under the observation of and to the satisfaction of the Geotechnical Engineer of Record or his authorized representative.

4.2 FOUNDATION DISCUSSION

As indicated earlier in the "Geotechnical Evaluation" section, the proposed townhome buildings in both the cases (Case 1 and Case 2) can be supported on shallow foundations bearing on underlying competent native soils and/or compacted structural fill. Shallow foundations can be proportioned using a net allowable soil bearing pressure value of **2,000 pounds per square foot (psf).**

General Shallow Foundation Recommendations

Isolated column footings should have a minimum width of 36 inches and continuous wall foundations should have a minimum width of 24 inches. The bottom of the exterior foundations should be at or below the frost depth.

Because of possible variations in subsurface conditions and related bearing capacity, all footing excavations and trenches should be observed and approved by the Geotechnical Engineer of Record or his qualified representative. Water and possibly some loose soil may collect in the footing excavations as a result of surface precipitation and near ground surface seepage. Therefore:

- Water, loose soil and soil softened by water should be removed from the bottom of the footing excavations before placing concrete.

- We recommend that foundations be cast the same day the excavations are made. If this is not possible, then the contractor must protect the foundation subgrade from becoming disturbed.

Where unsuitable bearing conditions are encountered as determined by the PSI Geotechnical Engineer or designated representative, these soils should be undercut and replaced with controlled structural fill. If backfilled up to the design bearing elevation, the over-excavation should extend laterally from all foundation edges a minimum of one half the depth of the undercut. The backfill should consist of the materials described earlier in this section. If the overexcavation is filled with concrete or flowable fill, the widening of the excavation will not be required.

Backfill around and above the footing should satisfy the controlled fill requirements described in Section 4.1 'Site Preparation and Earthwork'.

Wall footings should be provided with continuous, longitudinal steel reinforcement for greater bending strength so they can span across small areas of loose or soft soils that may go undetected during construction.

4.3 SEISMIC CONSIDERATIONS

The project site is located within a municipality that employs the International Building Code (IBC), 2015 edition. As part of this code, the design of structures must consider dynamic forces resulting from seismic events. These forces are dependent upon the magnitude of the earthquake event as well as the properties of the soils that underlie the site.

Part of the IBC code procedure to evaluate seismic forces requires the evaluation of the Seismic Site Class, which categorizes the site based upon the characteristics of the subsurface profile within the upper 100 feet of the ground surface.

To define the Seismic Site Class for this project, and in accordance with your requested level of assessment, we have interpreted the results of our soil test borings drilled within the project site per Section 1613.3 of the code. The estimated soil properties are based upon data available in published geologic reports as well as our experience with subsurface conditions in the general site area.

Based upon our assessment, it is our opinion that the subsurface conditions within the areas of the site planned for building construction are consistent with the characteristics of **Site Class D** as defined in the building code.

The associated IBC 2015 probabilistic ground acceleration values for latitude 38.79127º and longitude -77.13621º obtained from the U.S. Seismic Design Maps Web Application web page (http://geohazards.usgs.gov/designmaps/us/application.php) are as follows:

Seismic Design Parameters*								
Period (seconds)	**Mapped MCE Spectral Response Acceleration** (g)**		**Site Coefficients**		**Adjusted MCE Spectral Response Acceleration (g)**		**Design Spectral Response Acceleration (g)**	
0.2	S_S	0.119	F_a	1.6	SM_S	0.191	SD_S	0.127
1.0	S_1	0.051	F_v	2.4	SM_1	0.123	SD_1	0.082
* 2% Probability of exceedance in 50 years. ** At B-C interface (i.e. top of bedrock). MCE= Maximum Considered Earthquake								

The Site Coefficients, F_a and F_v presented in the above table were also obtained from the same USGS application but can be interpolated from IBC Tables 1613.3.1(1) and 1613.3.1(2) as a function of the site classification and mapped spectral response acceleration at the short (S_S) and 1 second (S_1) periods.

For buildings with a Seismic Design Category of C, D, E, or F the code requires an assessment of slope stability, liquefaction potential, and surface rupture due to faulting or lateral spreading. Detailed assessments of these factors were beyond the scope of this study. However, the following presents a qualitative assessment of these issues considering the site class, the subsurface soil properties, the groundwater elevation, and probabilistic ground motions:

Seismic Hazards		
Hazard	**Relative Risk**	**Comments**
Liquefaction	Low	The soil types present are not susceptible to liquefaction, and the seismic hazard at the site is relatively low
Slope Stability	Low	The seismicity at this site is low and the on-site materials are expected to be stable when cut or compacted as fill slopes.
Surface Rupture	Low	The site is not underlain by a mapped Holocene-aged fault

5 REPORT LIMITATIONS

The preliminary recommendations submitted are based on the available subsurface information obtained by PSI and design details furnished by **Fairfax County Department of Housing & Community Development** and their consultants for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be notified immediately to determine if changes in the foundation recommendations are required. If PSI is not retained to perform these functions, we will not be responsible for the impact of those conditions on the geotechnical recommendations for the project.

PSI did not provide, nor was it requested to provide, any service to investigate or detect the presence of moisture, mold or other biological contaminants in or around any structure, or any service that was designed or intended to prevent or lower the risk of the occurrence of the amplification of the same. Client acknowledges that mold is ubiquitous to the environment with mold amplification occurring when building materials are impacted by moisture. Client further acknowledges that site conditions are outside of PSI's control, and that mold amplification will likely occur, or continue to occur, in the presence of moisture. As such, PSI cannot and shall not be held responsible for the occurrence or recurrence of mold amplification.

The client must also acknowledge that some project sites may have impacted soil or groundwater associated with a known or unknown hazardous material release. Also, at sites that have been previously graded, it is possible that buried debris, organics, or other deleterious materials may be present on the site. Impacted soil and groundwater as well as buried degradable materials may produce vapor intrusions into new and existing buildings, which could compromise the indoor air quality of the structure(s). The geotechnical scope of services did not include an assessment of these potential conditions at this site. Vapor intrusion is a non-scope consideration that PSI would be pleased to help you assess at your request.

PSI warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area at the date of this report. No other warranties are implied or expressed.

This preliminary report has been prepared for the exclusive use of **Fairfax County Department of Housing & Community Development** and its consultants for the specific application to the proposed **Residential Housing Development Project,** located at southeast corner of the intersection of Oakwood Road and South Van Dorn Street in Alexandria, Virginia.

APPENDIX A: IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL REPORT

Important Information about Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE
THE BEST PEOPLE ON EARTH

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

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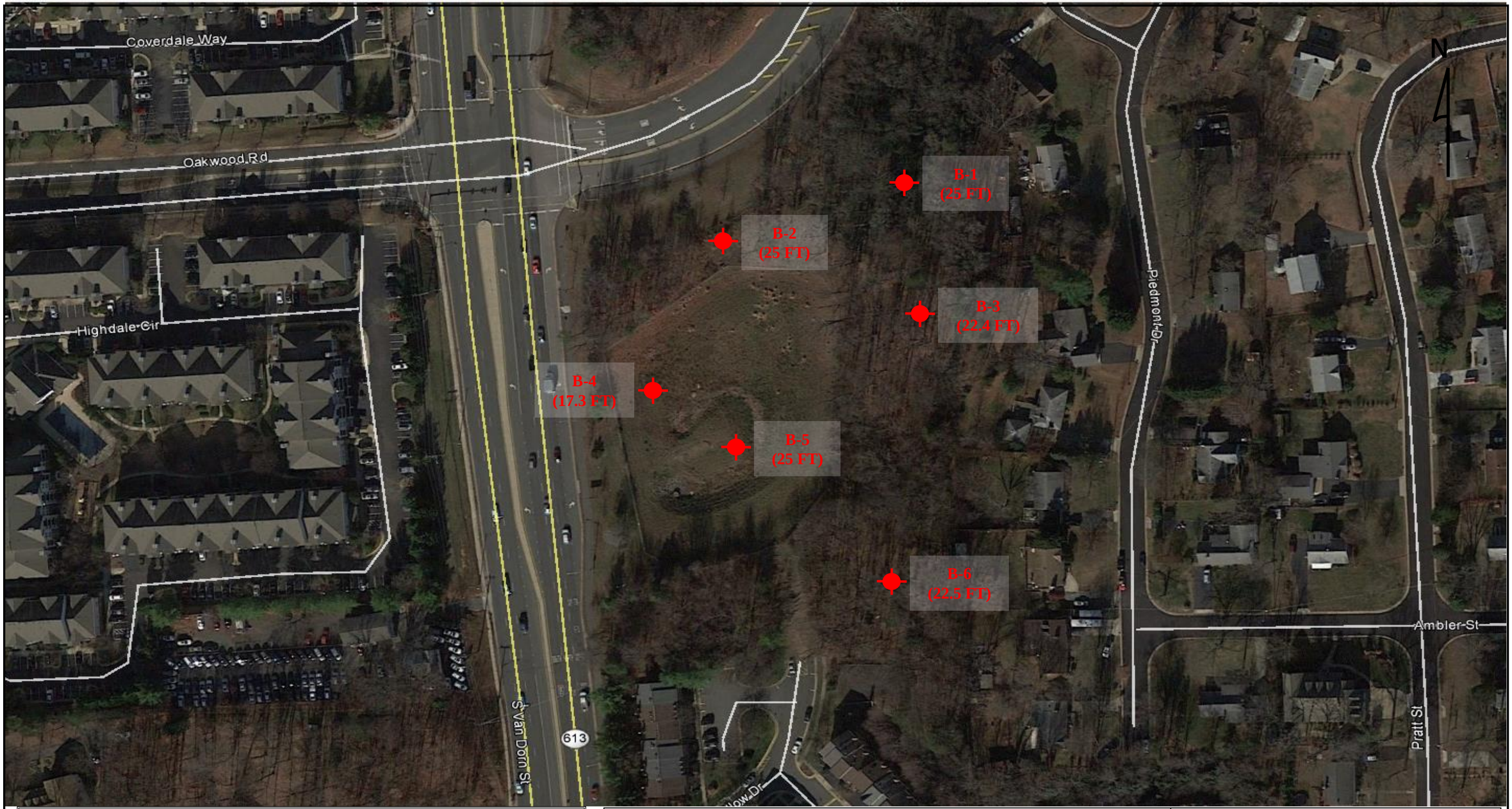
APPENDIX B: BORING LOCATION PLAN AND SOIL PROFILE



LEGEND:

B-1 (10 FT) - PROPOSED BORING

- BORING DEPTH

NOTES:

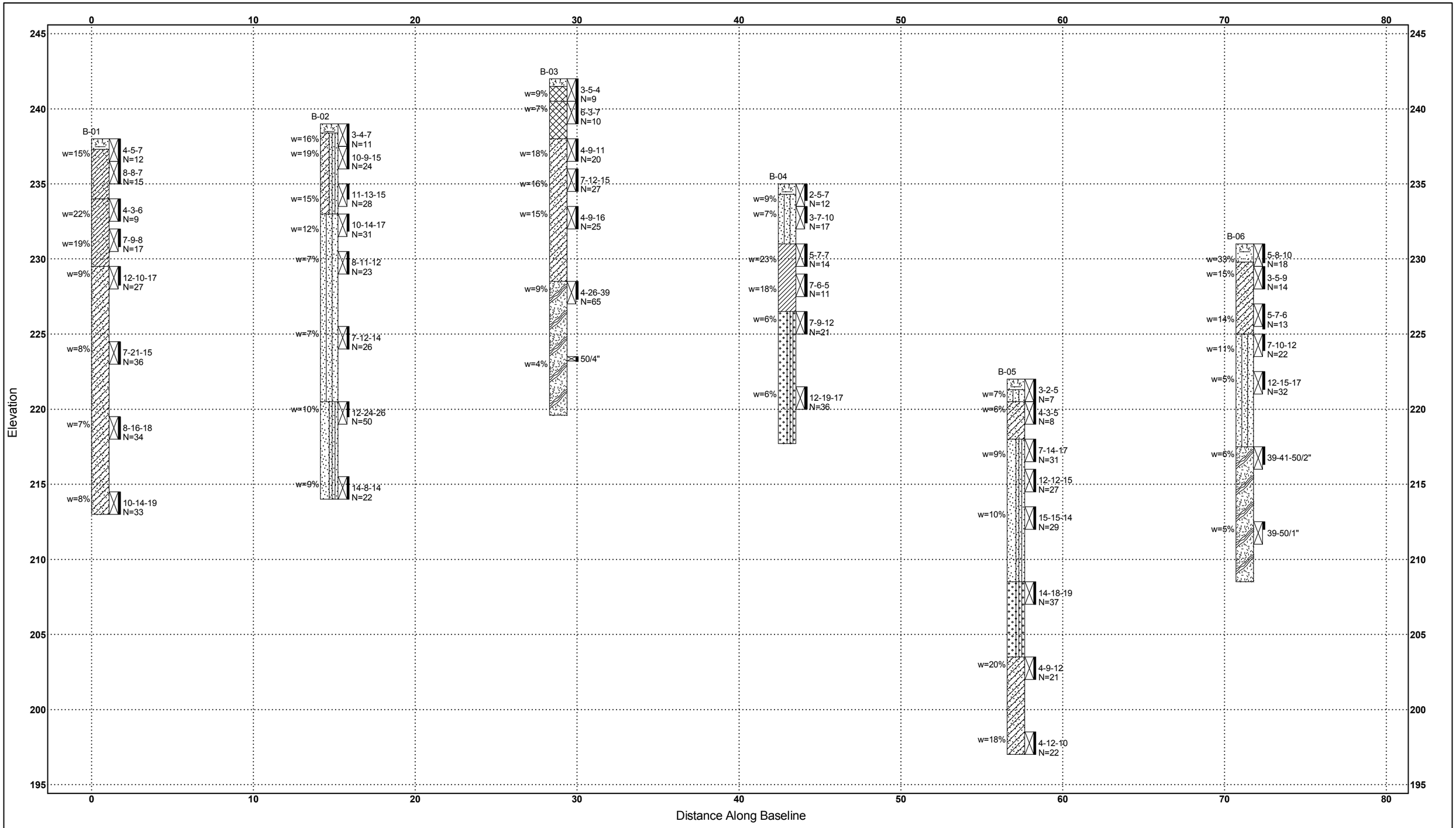
1. ALL BORINGS WILL BE ADVANCED WITH HOLLOW-STEM AUGERS.
2. SPT SAMPLING WILL BE PERFORMED IN ALL BORINGS.
3. BORING DEPTHS ARE AS SHOWN
4. BORING SPOILS WILL USED TO BACKFILL THE BORE HOLES.

psi Information To Build On
Engineering • Consulting • Testing

REVISIONS

BORING LOCATION PLAN
OAKWOOD/ VAN DORN PROJECT

Alexandria, VA		05/15/2017
INITIALS	N. Thakur	0512-784



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Fairfax, VA 22031

Profile

Oakwood/Van Dorn Project
PSI Project Number: 0512784-1

Oakwood Rd and South Van Dorn St
Alexandria, VA

APPENDIX C: BORING LOGS

BORING B-01

DATE STARTED:	4/7/17	**DRILL COMPANY:**	HSA, Inc.
DATE COMPLETED:	4/7/17	**DRILLER:** J. Warren	**LOGGED BY:** E. Segismundo
COMPLETION DEPTH	25.0 ft	**DRILL RIG:**	CME-55 Track
BENCHMARK:	N/A	**DRILLING METHOD:**	3 1/4" Hollow Stem Auger
ELEVATION:	238 ft	**SAMPLING METHOD:**	SSStandard
LATITUDE:	38.79177°	**HAMMER TYPE:**	Automatic
LONGITUDE:	-77.13545°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	N. Thakur

REMARKS: Boring ground elevation, latitude and longitude were obtained from Google Earth and Site Plan.

Water		
	While Drilling	Dry
	Upon Completion	Dry
	Cave-In	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			Approximately 8" of **Topsoil**				
		1	20	Stiff, moist, dark brown to yellowish brown, **sandy lean CLAY (USCS: CL)**, trace roots		4-5-7 N=12	15	
235		2	18		CL	8-8-7 N=15		
	5	3	18	Stiff to very stiff, moist, dark brown to reddish brown, **sandy lean CLAY (USCS: CL)**, trace roots		4-3-6 N=9	22	
		4	14		CL	7-9-8 N=17	19	LL = 31 PL = 17 Fines=64.1%
230		5	15	Medium dense to dense, moist, reddish to yellowish brown, **clayey SAND (USCS: SC)**, with to trace gravel		12-10-17 N=27	9	
	10							
225								
	15	6	18			7-21-15 N=36	8	
					SC			
220								
		7	18			8-16-18 N=34	7	LL = 23 PL = 15 Fines=21.0%
	20							
215								
		8	18			10-14-19 N=33	8	
	25			Boring terminated at approximately 25 feet (Bottom of Boring)				

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0

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Telephone: (703) 698-9300

PROJECT NO.: 0512784-1
PROJECT: Oakwood/Van Dorn Project
LOCATION: Oakwood Rd and South Van Dorn St
Alexandria, VA

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-02

DATE STARTED:	4/7/17	**DRILL COMPANY:**	HSA, Inc.
DATE COMPLETED:	4/7/17	**DRILLER:** J. Warren	**LOGGED BY:** E. Segismundo
COMPLETION DEPTH	25.0 ft	**DRILL RIG:**	CME-55 Track
BENCHMARK:	N/A	**DRILLING METHOD:**	3 1/4" Hollow Stem Auger
ELEVATION:	239 ft	**SAMPLING METHOD:**	SSStandard
LATITUDE:	38.7916°	**HAMMER TYPE:**	Automatic
LONGITUDE:	-77.13612°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	N. Thakur

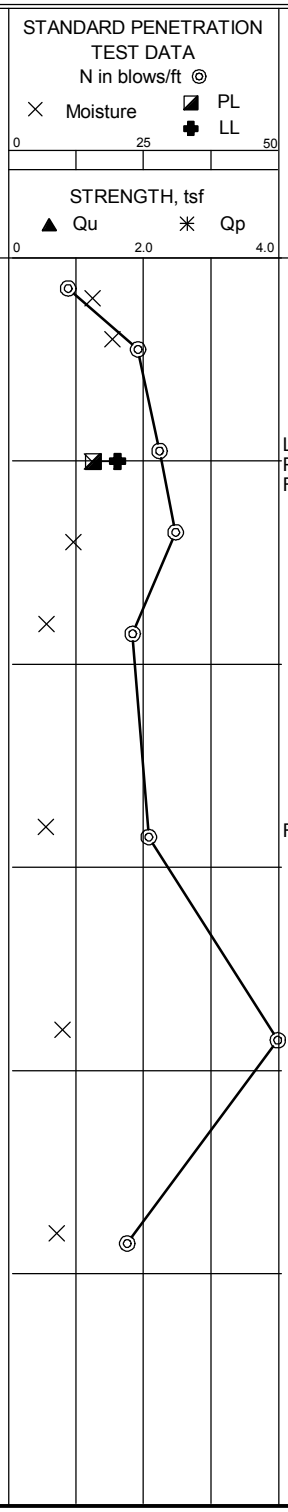
Water

While Drilling	Dry
Upon Completion	Dry
Cave-In	N/A

BORING LOCATION:

REMARKS: Boring ground elevation, latitude and longitude were obtained from Google Earth and Site Plan.

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			Approximately 7" of **Topsoil**				
		1	18	Medium dense, moist, reddish brown, **silty clayey SAND (USCS: SC-SM)**, trace roots		3-4-7 N=11	16	
		2	18		SC-SM	10-9-15 N=24	19	
235	5	3	12			11-13-15 N=28	15	LL = 20 PL = 16 Fines=45.2%
		4	14	Dense to medium dense, moist, reddish to yellowish brown, **silty SAND (USCS: SM)**, trace to with gravel		10-14-17 N=31	12	
230	10	5	18			8-11-12 N=23	7	
					SM			
225	15	6	18			7-12-14 N=26	7	Fines=12.7%
220	20	7	12	Dense to medium dense, reddish brown, **poorly graded SAND (USCS: SP-SM)**, with silt, trace to with gravel		12-24-26 N=50	10	
					SP-SM			
215	25	8	18			14-8-14 N=22	9	
				Boring terminated at approximately 25 feet (Bottom of Boring)				



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PROJECT NO.: 0512784-1
PROJECT: Oakwood/Van Dorn Project
LOCATION: Oakwood Rd and South Van Dorn St
Alexandria, VA

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-03

DATE STARTED:	4/11/17	**DRILL COMPANY:**	HSA, Inc.
DATE COMPLETED:	4/11/17	**DRILLER:** J. Warren	**LOGGED BY:** E. Segismundo
COMPLETION DEPTH	22.4 ft	**DRILL RIG:**	CME-55 Track
BENCHMARK:	N/A	**DRILLING METHOD:**	3 1/4" Hollow Stem Auger
ELEVATION:	242 ft	**SAMPLING METHOD:**	SSStandard
LATITUDE:	38.79133°	**HAMMER TYPE:**	Automatic
LONGITUDE:	-77.1354°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	N. Thakur

Water

While Drilling	Dry
Upon Completion	Dry
Cave-In	N/A

BORING LOCATION:

REMARKS: Boring ground elevation, latitude and longitude were obtained from Google Earth and Site Plan.

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			Approximately 6" of **Topsoil**				
		1	18	Loose, moist, brown, **silty SAND (USCS: SM)**, with gravel	SM	3-5-4 N=9	9	
240		2	18	Loose, moist, brown, **silty GRAVEL (USCS: GM)**, trace sand	GM	6-3-7 N=10	7	LL = 16 PL = 15 Fines=24.8%
	5	3	18	Medium dense, moist, brown to yellowish brown, **clayey SAND (USCS: SC)**		4-9-11 N=20	18	
235		4	18			7-12-15 N=27	16	LL = 37 PL = 22 Fines=37.8%
		5	18		SC	4-9-16 N=25	15	
230	10							
	15	6	14	Very dense, moist, brown to light brown, **silty SAND (USCS: SM)** (Highly Weathered Rock)		4-26-39 N=65	9	>>
225					SM			
		7	4			50/4"	4	>>
	20							
220				Boring terminated at approximately 22.4 feet due to Auger Refusal				

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0

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Alexandria, VA

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BORING B-04

DATE STARTED:	4/11/17	**DRILL COMPANY:**	HSA, Inc.
DATE COMPLETED:	4/11/17	**DRILLER:** J. Warren	**LOGGED BY:** E. Segismundo
COMPLETION DEPTH	17.3 ft	**DRILL RIG:**	CME-55 Track
BENCHMARK:	N/A	**DRILLING METHOD:**	3 1/4" Hollow Stem Auger
ELEVATION:	235 ft	**SAMPLING METHOD:**	SSStandard
LATITUDE:	38.79113°	**HAMMER TYPE:**	Automatic
LONGITUDE:	-77.13636°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	N. Thakur

REMARKS: Boring ground elevation, latitude and longitude were obtained from Google Earth and Site Plan.

Water		
	While Drilling	Dry
	Upon Completion	Dry
	Cave-In	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
	0					Approximately 8" of **Topsoil**					
				1	13	Medium dense. moist, dark brown, **silty SAND (USCS: SM)**, trace gravel		2-5-7 N=12	9		
				2	13		SM	3-7-10 N=17	7		
230	5			3	18	Stiff, moist, brown, **lean CLAY (USCS: CL)**, with sand, trace gravel		5-7-7 N=14	23		LL = 47 PL = 23 Fines=74.6%
				4	18		CL	7-6-5 N=11	18		
225	10			5	18	Medium dense to dense, moist, light brown, **well-graded SAND (USCS: SW-SM)**, with silt, with gravel		7-9-12 N=21	6		
							SW-SM				
220	15			6	18			12-19-17 N=36	6		Fines=7.0%
						Boring terminated at approximately 17.3 feet due to Auger Refusal					

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Alexandria, VA

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BORING B-05

DATE STARTED:	4/11/17	**DRILL COMPANY:**	HSA, Inc.
DATE COMPLETED:	4/11/17	**DRILLER:** J. Warren	**LOGGED BY:** E. Segismundo
COMPLETION DEPTH	25.0 ft	**DRILL RIG:**	CME-55 Track
BENCHMARK:	N/A	**DRILLING METHOD:**	3 1/4" Hollow Stem Auger
ELEVATION:	222 ft	**SAMPLING METHOD:**	SSStandard
LATITUDE:	38.79092°	**HAMMER TYPE:**	Automatic
LONGITUDE:	-77.13606°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	N. Thakur

Water

While Drilling	Dry
Upon Completion	Dry
Cave-In	N/A

BORING LOCATION:

REMARKS: Boring ground elevation, latitude and longitude were obtained from Google Earth and Site Plan.

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0	1	18	Approximately 8" of **Topsoil**				
				Loose, moist, dark brown, **silty SAND (USCS: SM)**, trace gravel	SM	3-2-5 N=7	7	
220		2	18	Loose, moist, light brown, **clayey SAND (USCS: SC)**, trace to with gravel	SC	4-3-5 N=8	6	
	5	3	18	Dense to medium dense, moist, light brown, **poorly graded SAND (USCS: SP-SM)**, with gravel, with silt		7-14-17 N=31	9	LL = 25 PL = 17 Fines=20.1%
215		4	18			12-12-15 N=27		
		5	18		SP-SM	15-15-14 N=29	10	
210	10							
	15	6	18	Dense, moist, light brown, **well-graded SAND (USCS: SW-SM)**, with silt	SW-SM	14-18-19 N=37		
205								
	20	7	18	Medium dense, moist, light brown, **clayey SAND (USCS: SC)**	SC	4-9-12 N=21	20	LL = 55 PL = 23 Fines=30.9%
200								
	25	8	18			4-12-10 N=22	18	
				Boring terminated at approximately 25 feet (Bottom of Boring)				

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
Moisture, PL, LL
0 25 50

STRENGTH, tsf
Qu, Qp
0 2.0 4.0

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Alexandria, VA

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BORING B-06

DATE STARTED:	4/7/17	**DRILL COMPANY:**	HSA, Inc.
DATE COMPLETED:	4/7/17	**DRILLER:** J. Warren	**LOGGED BY:** E. Segismundo
COMPLETION DEPTH	22.5 ft	**DRILL RIG:**	CME-55 Track
BENCHMARK:	N/A	**DRILLING METHOD:**	3 1/4" Hollow Stem Auger
ELEVATION:	231 ft	**SAMPLING METHOD:**	SSStandard
LATITUDE:	38.7905°	**HAMMER TYPE:**	Automatic
LONGITUDE:	-77.1355°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	N. Thakur

REMARKS: Boring ground elevation, latitude and longitude were obtained from Google Earth and Site Plan.

Water		
	While Drilling	Dry
	Upon Completion	Dry
	Cave-In	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
230	0			1	15	Approximately 14" of **Topsoil**		5-8-10 N=18	33		
				2	18	Medium dense, moist, brown to reddish brown, **clayey SAND (USCS: SC)**, trace gravel, trace roots	SC	3-5-9 N=14	15		
225	5			3	20			5-7-6 N=13	14		LL = 37 PL = 20 Fines=31.9%
				4	13	Medium dense to dense, moist, reddish brown to brown, **silty SAND (USCS:SM)**, trace to with gravel		7-10-12 N=22	11		
220	10			5	14		SM	12-15-17 N=32	5		LL = 18 PL = 17 Fines=12.4%
215	15			6	14	Very dense, moist, brown to light brown, **silty SAND (USCS: SM)** (Highly Weathered Rock)		39-41-50/2"	6		
210	20			7	6		SM	39-50/1"	5	>>◎	
						Boring terminated at approximately 22.5 feet due to Auger Refusal					

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Alexandria, VA

The stratification lines represent approximate boundaries. The transition may be gradual.

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.
HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry
R.C.: Diamond Bit Core Sampler
H.A.: Hand Auger
P.A.: Power Auger - Handheld motorized auger

SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
RC: Rock Core
TC: Texas Cone
BS: Bulk Sample
PM: Pressuremeter
CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
N_{60}: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
Q_u: Unconfined compressive strength, TSF
Q_p: Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL),%
DD: Dry unit weight, pcf
▼,▽,▼ Apparent groundwater level at time noted

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Relative Density	N - Blows/foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50 - 80
Extremely Dense	80+

ANGULARITY OF COARSE-GRAINED PARTICLES

Description	Criteria
Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular:	Particles are similar to angular description, but have rounded edges
Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded:	Particles have smoothly curved sides and no edges

GRAIN-SIZE TERMINOLOGY

Component	Size Range
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.005 mm to 0.075 mm
Clay:	<0.005 mm

PARTICLE SHAPE

Description	Criteria
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

RELATIVE PROPORTIONS OF FINES

Descriptive Term	% Dry Weight
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%

GENERAL NOTES

(Continued)

CONSISTENCY OF FINE-GRAINED SOILS

Q_U - TSF	N - Blows/foot	Consistency
0 - 0.25	0 - 2	Very Soft
0.25 - 0.50	2 - 4	Soft
0.50 - 1.00	4 - 8	Firm (Medium Stiff)
1.00 - 2.00	8 - 15	Stiff
2.00 - 4.00	15 - 30	Very Stiff
4.00 - 8.00	30 - 50	Hard
8.00+	50+	Very Hard

MOISTURE CONDITION DESCRIPTION

Description	Criteria
Dry:	Absence of moisture, dusty, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water, usually soil is below water table

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term	% Dry Weight
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

STRUCTURE DESCRIPTION

Description	Criteria
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided:	Fracture planes appear polished or glossy, sometimes striated
Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed:	Inclusion of small pockets of different soils
Layer:	Inclusion greater than 3 inches thick (75 mm)
Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
Parting:	Inclusion less than 1/8-inch (3 mm) thick

SCALE OF RELATIVE ROCK HARDNESS

Q_U - TSF	Consistency
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

ROCK BEDDING THICKNESSES

Description	Criteria
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

ROCK VOIDS

Voids	Void Diameter
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)

Component	Size Range
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

ROCK QUALITY DESCRIPTION

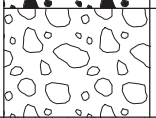
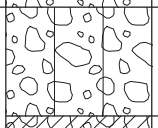
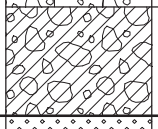
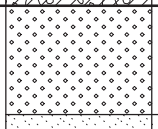
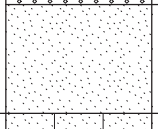
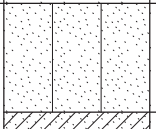
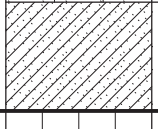
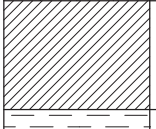
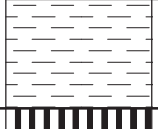
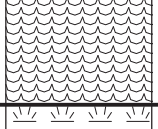
Rock Mass Description	RQD Value
Excellent	90 -100
Good	75 - 90
Fair	50 - 75
Poor	25 -50
Very Poor	Less than 25

DEGREE OF WEATHERING

Slightly Weathered:	Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.
Weathered:	Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.
Highly Weathered:	Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS: GRAPH	SYMBOLS: LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

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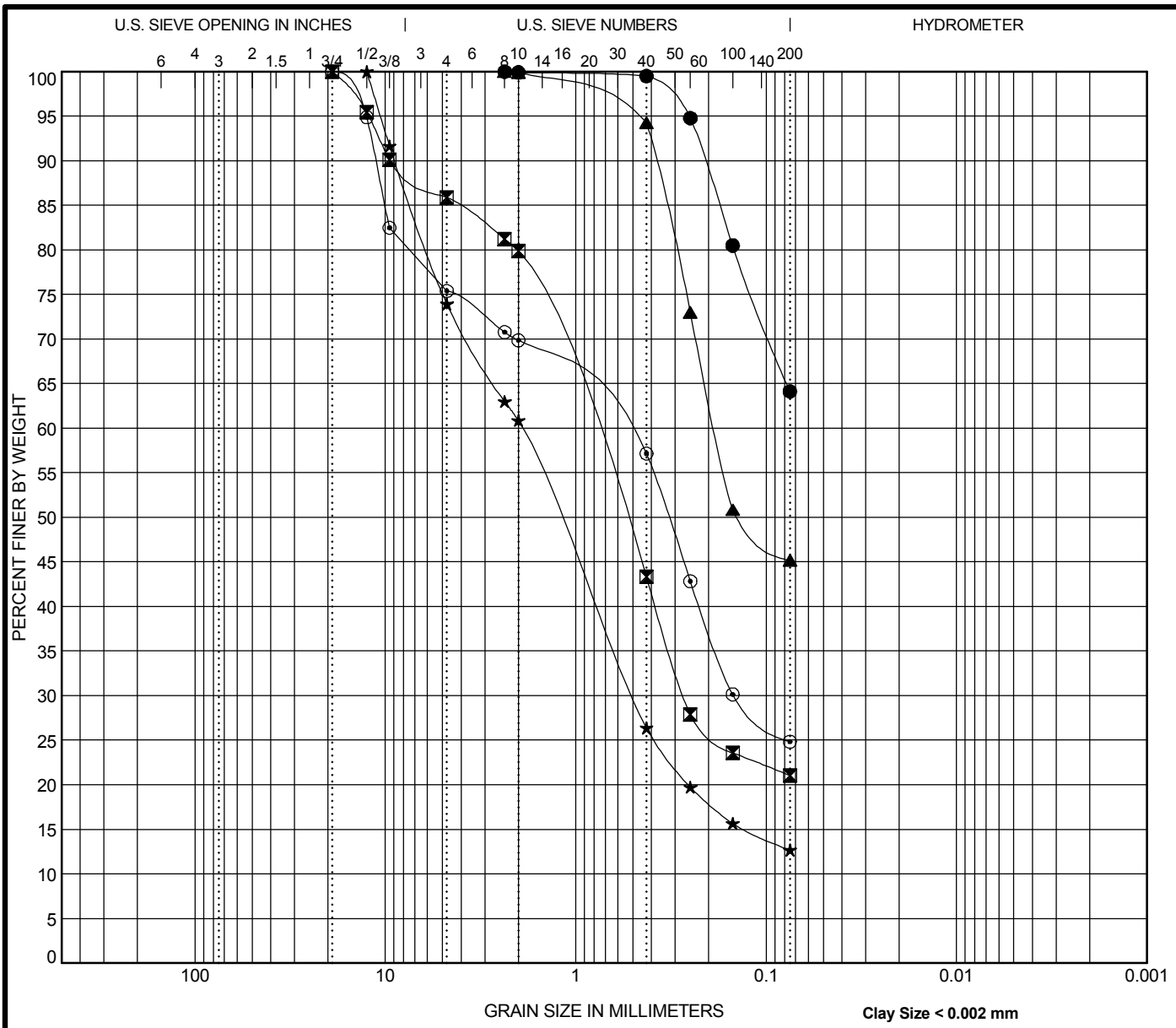
APPENDIX D: LABORATORY TESTING RESULTS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B-01	7.0	sandy lean CLAY	31	17	14		
⊠	B-01	19.0	clayey SAND, trace gravel	23	15	8		
▲	B-02	5.0	silty clayey SAND	20	16	4		
★	B-02	14.0	silty SAND, with gravel					
⊙	B-03	2.0	silty SAND, with gravel	16	15	1		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-01	7.0	2.36				0.0	35.9	64.1	
⊠	B-01	19.0	19	0.861	0.269		14.1	64.8	21.0	
▲	B-02	5.0	2.36	0.185			0.0	54.8	45.2	
★	B-02	14.0	12.5	1.923	0.5		26.1	61.3	12.7	
⊙	B-03	2.0	19	0.601	0.147		24.6	50.6	24.8	

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GRAIN SIZE DISTRIBUTION

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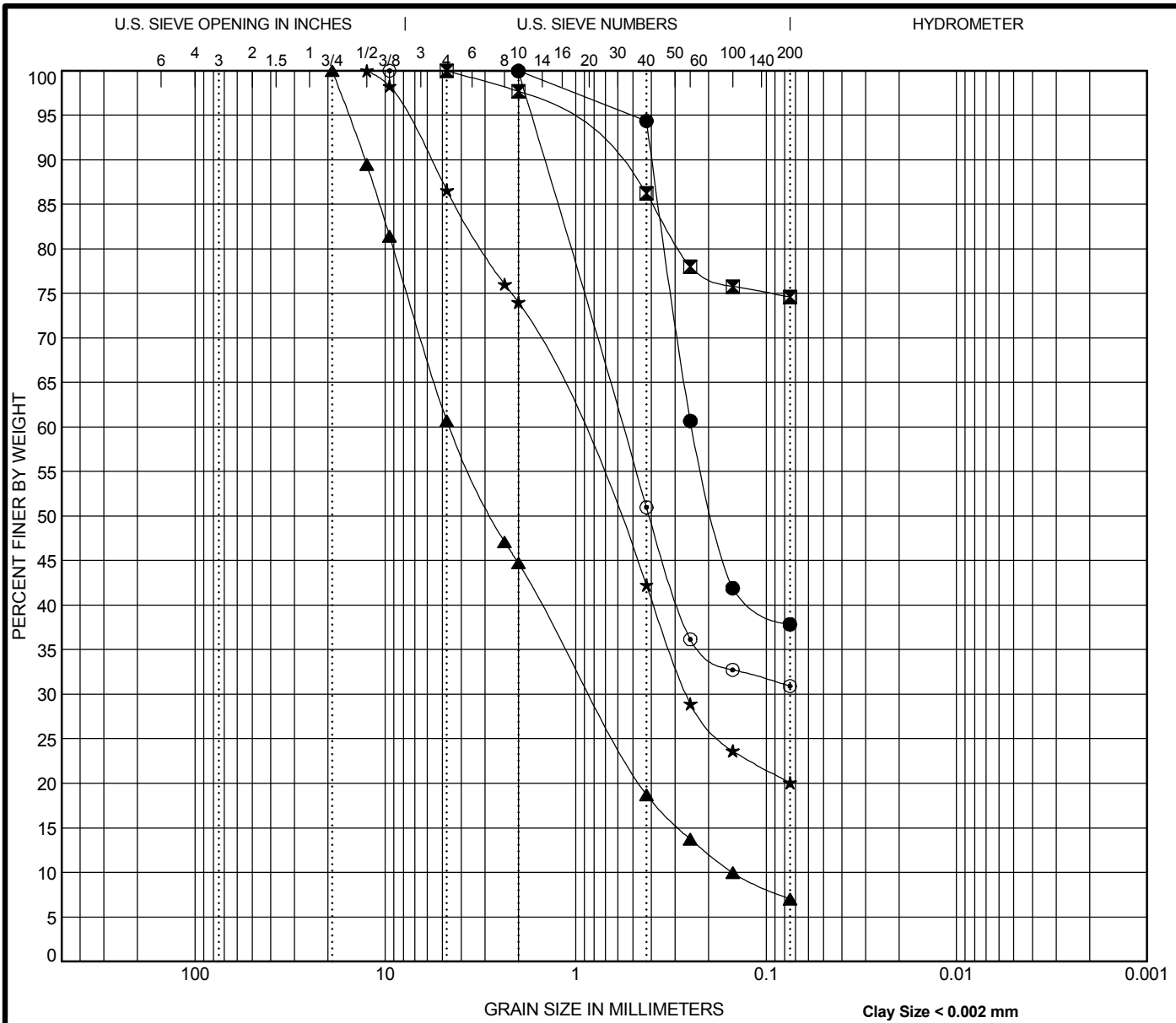
PSI Job No.: 0512784-1
Location: Oakwood Rd and South Van Dorn St
Alexandria, VA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B-03	7.0	clayey SAND	37	22	15		
⊠	B-04	5.0	lean CLAY, with sand	47	23	24		
▲	B-04	14.0	well-graded SAND, with silt, with gravel				1.00	30.39
★	B-05	5.0	clayey SAND, trace gravel	25	17	8		
⊙	B-05	19.0	clayey SAND	55	23	32		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-03	7.0	2	0.245			0.0	62.2	37.8	
⊠	B-04	5.0	4.75				0.0	25.4	74.6	
▲	B-04	14.0	19	4.582	0.833	0.151	39.3	53.7	7.0	
★	B-05	5.0	12.5	1.01	0.261		13.4	66.5	20.1	
⊙	B-05	19.0	9.5	0.565			0.0	69.1	30.9	

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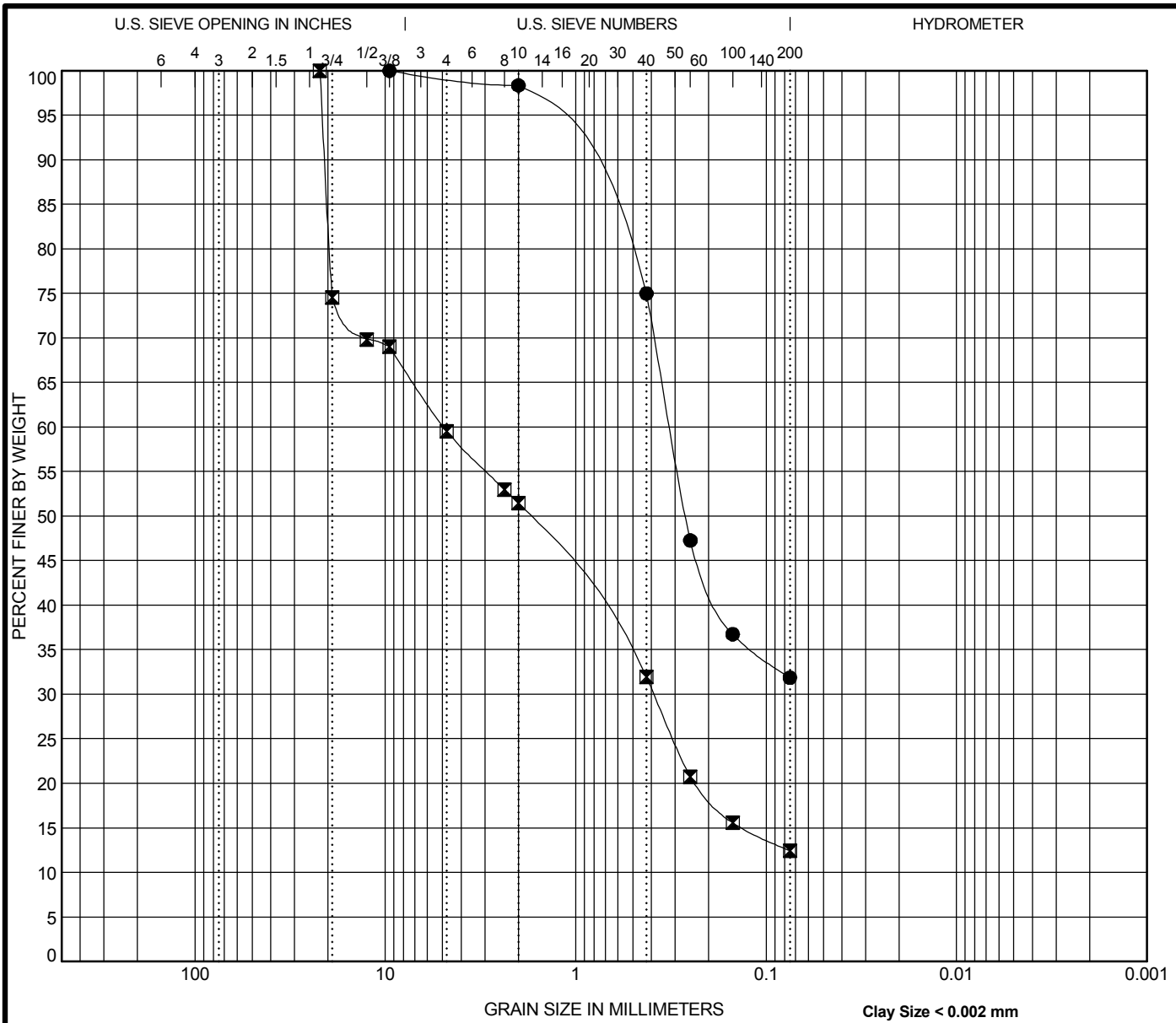

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B-06	5.0	clayey SAND, trace gravel	37	20	17		
⊠	B-06	9.0	silty SAND, with gravel	18	17	1	0.69	111.66

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-06	5.0	9.5	0.319			0.7	67.4	31.9	
⊠	B-06	9.0	22	4.916	0.388		40.5	47.1	12.4	

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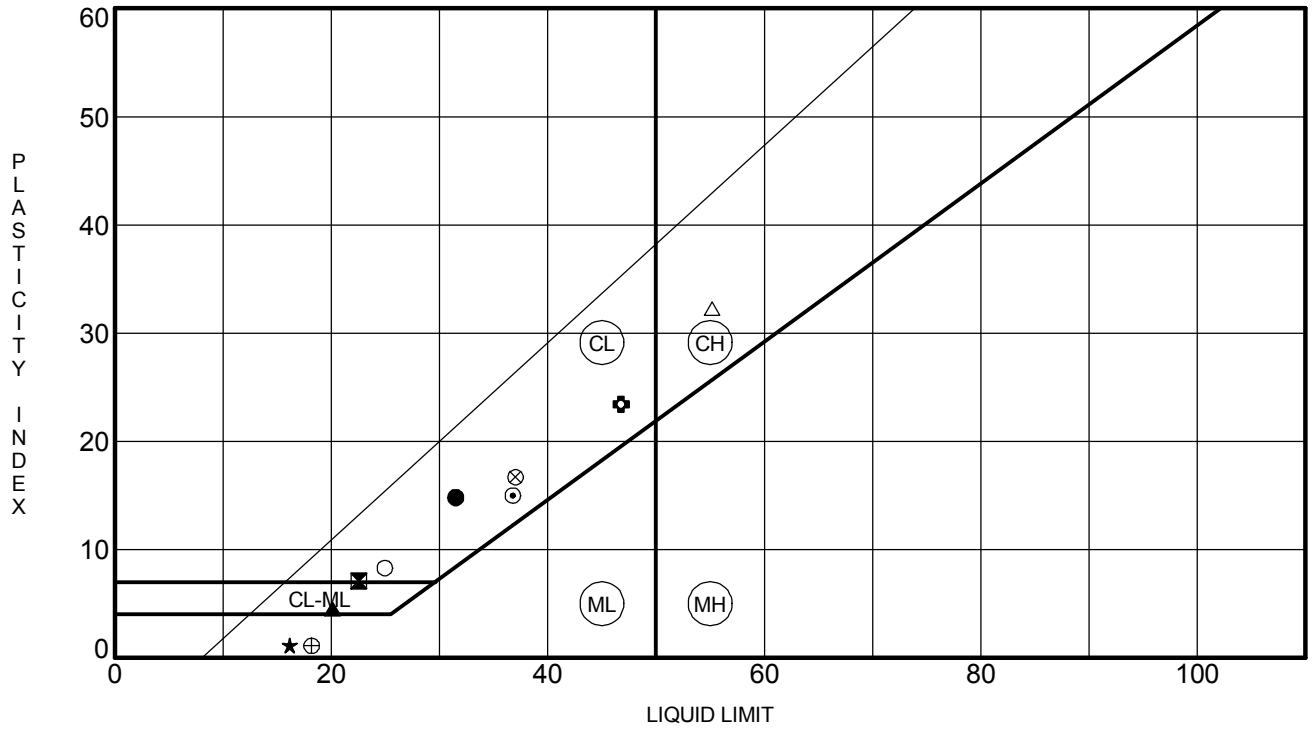

	Boring	Depth (ft)	LL	PL	PI	Fines	Classification (*Visual)
●	**B-01**	**7.0**	**31**	**17**	**14**	**64.1**	sandy lean CLAY
⊠	**B-01**	**19.0**	**23**	**15**	**8**	**21.0**	clayey SAND, trace gravel
▲	**B-02**	**5.0**	**20**	**16**	**4**	**45.2**	silty clayey SAND
★	**B-03**	**2.0**	**16**	**15**	**1**	**24.8**	silty SAND, with gravel
⊙	**B-03**	**7.0**	**37**	**22**	**15**	**37.8**	clayey SAND
✿	**B-04**	**5.0**	**47**	**23**	**24**	**74.6**	lean CLAY, with sand
○	**B-05**	**5.0**	**25**	**17**	**8**	**20.1**	clayey SAND, trace gravel
△	**B-05**	**19.0**	**55**	**23**	**32**	**30.9**	clayey SAND
⊗	**B-06**	**5.0**	**37**	**20**	**17**	**31.9**	clayey SAND, trace gravel
⊕	**B-06**	**9.0**	**18**	**17**	**1**	**12.4**	silty SAND, with gravel

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ATTERBERG LIMIT RESULTS

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