PRELIMINARY REPORT OF

SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING ANALYSIS

DEANWOOD HILLS
5201 HAYES STREET, NE
WASHINGTON, D.C.

ECS PROJECT NO. 37:1404

FOR

PENNROSE PROPERTIES, LLC

FEBURARY 25, 2015

ECS CAPITOL SERVICES, PLLC
"Setting the Standard for Service"
Geotechnical • Construction Materials • Environmental • Facilities • Code Compliance

February 25, 2015

Ms. Ivy Dench-Carter
Vice President
Pennrose Properties, LLC
575 S. Charles Street
Suite 140
Baltimore, MD 21201

ECS Project No. 37:1404

Reference: Preliminary Report of Subsurface Exploration and Geotechnical Engineering Analysis, Deanwood Hills, 5201 Hayes Street, NE, Washington, DC

Dear Ms. Dench Carter:

As authorized by your acceptance of our Proposal No. 37:262-GP that was last revised on September 24, 2014, ECS Capitol Services, PLLC (ECS) has completed the subsurface exploration and geotechnical engineering analysis for the proposed Deanwood Hills development in northeast, Washington, DC.

A preliminary report, including the results of our subsurface exploration, boring data, laboratory testing, preliminary engineering recommendations, as well as a Boring Location Diagram is enclosed herein. These preliminary recommendations presented are intended for use by your office and for use by other professionals involved in the design and planning stages of the project described herein. These recommendations were based upon preliminary information for the project and should be confirmed when the final design loads and drawings are completed and we have a chance to review and produce a final report.

We appreciate the opportunity to be of service to Pennrose Properties, LLC on this project. If you have any questions with regard to the information and recommendations contained in this report, or if we may be of further service to you during the planning and/or construction phase of this project, please do not hesitate to contact the undersigned.

Respectfully,

ECS CAPITOL SERVICES, PLLC

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PRELIMINARY REPORT

PROJECT

Subsurface Exploration and
Geotechnical Engineering Analysis
Deanwood Hills
5201 Hayes St, NE
Washington, DC

CLIENT

Pennrose Properties, LLC
575 S. Charles Street
Suite 140
Baltimore, MD 21201

PROJECT NO. 37:1404

DATE February 25, 2015

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PROJECT OVERVIEW

Introduction

This preliminary report presents the results of our subsurface exploration and geotechnical engineering analysis performed for the proposed Deanwood Hills project located at the address of 5201 Hayes St, NE Washington, DC. This preliminary report was prepared in general accordance with ECS Proposal No. 37:262-GP most recently revised on September 24, 2014 and authorized by your office. Please note this report has been prepared using only the information provided to us and data collected from the subsurface exploration performed at the project site.

Site Location and Existing Site Conditions

Based on the information provided to us and our site observations, the project site is located at the address of 5201 Hayes St, in Northeast Washington, DC. The subject parcel is currently a vacant lot containing various concrete pads, asphalt pavement sections, and site retaining walls from previous site developments. Generally, the site is triangularly shaped and grassed covered with wooded areas located around the fence-lined perimeter. The site is bound to the north by Hayes Street, NE, to the west by 51st Street NE and existing buildings, a parking lot and existing building to the south, and a public alley to the east. Based upon topographic mapping provided, the site appears to slope from the northeast corner of the site down to the southwest. Currently Hayes Street, NE is approximately at EL. 80 feet at the east end of the site and approximately at EL. 60 feet at the west end. The south edge of the property is at approximately EL. 54 feet. The site is relatively level in the center of parcel where the site was previously developed with grades ranging from approximately EL. 62 to 57 feet.

Proposed Construction

Based on the site and architectural plans provided to us by you, we understand the proposed development will require demolition of any existing site features, significant regrading of the site including substantial fill placement (on the order of 10+ feet), construction of stormwater management facilities, and the construction of a retaining wall with a maximum expected height of 12 feet on the south edge of the site. We understand a new stick frame structure will be built on the site and will have a partial basement and 4 floors above grade. As shown on the boring location diagram, the proposed building will have 4 individual wings off of a main part of the building located south of the wings. The lowest, basement level (shaded orange on the Boring Location Diagram) will be located beneath wings 1-3 and the main part of the building having a finish floor elevation of EL. 60 feet. This level will only be partially buried on the north part of the site and will be at-grade to the south parking lot area. Wing 4 of the proposed structure (shaded blue on the Boring Location Diagram) will be cut into the hillside and have a finish floor elevation of EL. 77.67 feet. We have shown our current understanding of the building footprint and lowest finished floor elevations on the Boring Location Diagram which is included in the Appendix. From the information you have provided, we understand the maximum wall loads are on the order of 6 kips per linear foot of wall.

The description of the project site is based on the information provided by the project team, and the plans provided to us at this time. If any of this information is inaccurate, either due to our misunderstanding or design changes, we recommend we be contacted in order to provide alternative recommendations that may be warranted.

Purpose and Scope of Work

The purpose of this exploration was to perform a subsurface exploration and develop preliminary engineering recommendations to guide the design and construction budgeting of the project based on review of the exploration findings and performing an engineering analysis using the current site plan. We accomplished these purposes by performing the following scope of services:

1. Reviewing the geotechnical reports prepared for adjacent project sites by ECS,
2. Performing eighteen soil borings,
3. Performing nineteen, in-situ, infiltration tests,
4. Reviewing laboratory testing performed to determine their engineering properties,
5. Analyzing the field and laboratory data from the exploration to develop appropriate engineering recommendations, and
6. Preparing this preliminary geotechnical report of summarizing our findings and recommendations.

ECS recently performed a total of eighteen soil borings (referenced as B-1 through B-18) at the project site. Borings B-1 through B-8 were performed in close proximity to the proposed building footprint at drill rig accessible locations and extended to depths ranging from 40 feet to 60 feet below the ground surface. Borings B-9 through B-18 were performed in close proximity to the potential stormwater infiltration facilities. These borings were advanced to depths of 8 feet below the ground surface. Nineteen auger probes were also advanced at the potential stormwater infiltration facilities to allow for infiltration testing at approximately 6 feet below site grades. The subsurface exploration included split spoon sampling, Standard Penetration Tests (SPT), groundwater level observations in the boreholes, and in-situ infiltration testing. Laboratory tests were then conducted on selected soils samples to determine certain engineering properties.

Each of the borings and auger probes were located in the field by ECS personnel measuring from existing site features and by use of a portable GPS. We consider the boring locations to be accurate to within ±3 feet of the plan location shown herein. The ground surface elevations were interpolated from the topographical survey provided to ECS. We consider the boring elevations to be accurate to within ±2 feet of actual elevation. The results of the completed soil borings along with a Boring Location Diagram are included in the appendix of this report. We have also included three cross-section profiles (labeled as A-A’, B-B’, and C-C’) showing the subsurface conditions through different areas of the proposed development.

EXPLORATION PROCEDURES

Subsurface Exploration Procedures

Soil Borings

The soil borings were performed utilizing an ATV-mounted auger-drilling rig, which utilized continuous flight, hollow stem augers to advance the borehole. Because of the closed LUST case onsite, the borings were advanced assuming the site is potentially contaminated. Due to these conditions, borings that were advanced below the confining layer included the installation of casing that is installed 10 feet down into the confining unit and grouted in place. Boring advancement was then continued within the casing using mud rotary drilling methods. After completion of the borings, each was backfilled with grout in general accordance with DDOE regulations. The drilling spoils were containerized and were removed from the site.

Representative soil samples were obtained by means of the split-barrel sampling procedure in accordance with ASTM Standard D-1586. In the split-barrel sampling procedure, a 2-inch O.D., split-barrel sampler is driven into the soil a distance of 18 or 24 inches by means of a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler through the last for the 12-inch interval for 18-inch sample or the middle 12-inch interval for the 24-inch sample is termed the Standard Penetration Test (SPT) “N” value and is indicated for each sample on the boring logs. This value can be used to provide a qualitative indication of the in-place relative density of cohesionless soils.

A field log of the soils encountered in the boring was maintained by the drill crew. After recovery, each sample was removed from the sampler, visually classified, and placed in glass jars. Representative portions of each sample were (placed in the glass jars) brought to our laboratory for further visual classification and select laboratory testing.

In-Situ Infiltration Testing

At the infiltration test locations (IT-1 through IT-19), an auger probe boring (no samples taken) was advanced to the approximate infiltration test elevation provided to us by the project civil engineer and a temporary solid PVC pipe was installed and seated near the bottom of the hole to keep the bore hole from collapsing prior to infiltration testing. ECS used the Johnson Permeameter™ to perform a constant head infiltration test which is in general accordance with the publication entitled “DDOE (District Department of the Environment) Stormwater Guidebook, Appendix O.”

Each hole is prepared in general accordance with the information contained in the *Johnson Permeameter™ Instruction Manual* dated June 14, 2014. A schematic of the equipment used is included in the Appendix of this report for reference. The test is then peformed in general accordance with the same manual and the test results are recorded during testing of each location. The final design rate chosen is ultimately the discretion of the design engineer; however, is typically the average of the last three to four readings taken during the test or the last reading, as appropriate, based on the test results. The results of each infiltration test are included in the Appendix of this report for reference.

Laboratory Testing Program

Representative soil samples were selected and tested in our laboratory to check field classifications and to determine pertinent engineering properties. The laboratory testing program performed included visual classifications, moisture content tests, Atterberg Limits, grain size distribution analysis, and hydrometer analysis. The data obtained from the laboratory tests is included in the Appendix of this report.

An engineer/geologist classified each soil sample on the basis of texture and plasticity in accordance with the Unified Soil Classification System. The group symbols for each soil type are indicated in parentheses following the soil descriptions on the boring logs. A brief explanation of the Unified System is included with this report. The soil engineer grouped the various soil types into the major zones noted on the soil boring logs. The stratification lines designating the interfaces between earth materials on the soil boring logs and profiles are approximate; in situ, the transitions may be gradual, rather than distinct.

The soil samples will be retained in our laboratory for a period of 60 days, after which they will be discarded unless other instructions are required as to their disposition.

EXPLORATION RESULTS

Regional Geology

The proposed site is located in the Coastal Plain Physiographic Province of Washington, DC. The near surface soils in the Washington, D.C. area typically consist of man-placed fill soils or natural soils which have been disturbed by previous construction.

Beneath these near surface fill or disturbed soils, Pliocene and Pleistocene river terrace deposits were generally encountered. These deposits vary in their percentages of sand, silt, clay and gravel, both laterally and vertically, and contain localized areas of organics. Beneath the Coastal river terrace deposits, the area is typically underlain by lower and upper Cretaceous, or Potomac Formation soils. The Potomac formation is generally characterized by silty clay beds inter-bedded with irregular sand and gravel lenses.

Soil Conditions

During the time of our exploration, the site consisted of a vacant lot and the borings were performed throughout the site. The surface materials encountered at the site generally consisted of topsoil less than 7 inches thick with isolated areas of asphalt pavement approximately 24 inches thick. The subsurface profile can generally be subdivided into three different and distinct strata, (I) Stratum I – Existing Fill, (II) Stratum II – Alluvial Terrace Formation, and (III) Stratum III – Potomac Deposits. The following sections describe each soil strata in more detail and three cross-sections (referenced as A-A', B-B', and C-C') showing the subsurface conditions are included in the Appendix of this report.

Stratum I – Existing Fill

Fill soils were observed in borings B-4 through B-11 and B-14 through B-16 to depths ranging from 2.0± feet to 8.5± feet below existing site grades or depths explored. The fill soils typically consisted of varying mixtures of sand, silt, and clay and contained various debris such as asphalt, brick and organics. The existing fills encountered are most likely associated with the demolished structure onsite and generally appear to be located within the center and southern portions of the site. SPT N-values in the fill soils varied greatly between 4 blows per foot (bpf) to greater than 50 bpf.

Stratum II – Alluvial River Terrace Deposits (Pleistocene Deposits)

Stratum II was encountered in each of the borings directly beneath the existing fill materials of Stratum I (where encountered) or below the surface cover materials. Stratum II soils generally consisted of various amounts of silt, clay, and sand but were typically classified as Lean CLAY (CL), Sandy Silt (ML) or Silty/Clayey SAND (SM/SC). A small layer of Gravel with Sand (GP) was observed in boring B-6 at elevation EL. 33 feet. SPT N-Values with in the Stratum II soils generally ranged from 2 bpf to 26 bpf. Stratum II generally extended to approximately elevation EL. 25 feet in borings B-1 through B-8, or the depths explored.

Stratum III – Potomac Group Formation (Cretaceous Deposits)

Stratum III was generally encountered directly beneath the Stratum II in the deeper borings B-1 through B-8 that extended below elevation 25; however, was most likely not encountered in the remaining borings that were terminated at shallower depths. The Potomac deposits generally consisted of Lean Clay, (CL) with varying amounts of sands encountered. SPT N-Values with in the Stratum III soils generally ranged from 27 bpf to 48 bpf.

Groundwater Observations

During the subsurface exploration, the boreholes were observed for the presence of groundwater during drilling, before removal of the augers, and after the removal of the augers prior to grouting. In hollow-stem auger drilling operations, water is not introduced into the boreholes, and the groundwater position can often be determined by observing water flowing into or out of the boreholes; however, drilling fluid was used in borings B-1 through B-8. Visual observation of the soil samples retrieved during the auger drilling exploration can often be used in evaluating the groundwater conditions. A summary of groundwater observations is summarized in the table below; however, groundwater was not observed in borings B-1 through B-3 and boring B-10 through B-19.

Table 1: Summary of Groundwater Observations

Boring	Water Level During Drilling (Depth, ft)	Water Level During Drilling (Elevation, ft)	Water Level Before Pulling Augers (Depth, ft)	Water Level Before Pulling Augers (Elevation, ft)
B-1	Not Observed	-	Not Observed	-
B-2	Not Observed	-	Not Observed	-
B-3	Not Observed	-	Not Observed	-
B-4	28.5	32.5	32.0	29.0
B-5	18.5	44.5	-	-
B-6	28.5	31.5	-	-
B-7	13.5	43.5	-	-
B-8	33.5	24.5	19.5	38.5
B-9	4.0	57.0	-	-
B-10	Not Observed	-	Not Observed	-
B-11	Not Observed	-	Not Observed	-
B-12	Not Observed	-	Not Observed	-
B-13	Not Observed	-	Not Observed	-
B-14	Not Observed	-	Not Observed	-
B-15	Not Observed	-	Not Observed	-
B-16	Not Observed	-	Not Observed	-
B-17	Not Observed	-	Not Observed	-
B-18	Not Observed	-	Not Observed	-

Variations in the location of the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff, and other factors not immediately apparent at the time of this exploration. Free and/or “perched” water may also be encountered at the interface of fill materials and natural soils such as the water observed in boring B-9.

PRELIMINARY ANALYSIS AND DESIGN RECOMMENDATIONS

The conclusions and recommendations presented in this preliminary report should be incorporated in the design and construction of the project to minimize possible soil and/or foundation related problems during construction; however, only preliminary loading details regarding the proposed buildings were provided at this time. Once the design advances further ECS should be provided with the design documents to confirm the recommendations included herein are still applicable and/or provide alternate recommendations (if necessary).

The following sections present more specific recommendations with regard to the design of the proposed building and site improvements. These include recommendations with regard to building foundations, below-grade walls and drainage, earthwork, ground slabs, construction dewatering, pavement, retaining walls and seismic design parameters.

We recommend that ECS review the final design and specifications to check the earthwork and foundation recommendations presented in this report have been properly interpreted and implemented in the design and specifications. Depending on if a ground improvement method is utilized on the site, the grading and fill placement will be a critical component of the site development.

Foundations

General

As we understand the current design for the site is preliminary; however, the structure will be constructed using slab on grade methods. We understand the existing grading will be significantly changing (12 feet of fill will be added along the southern property line and minor fill areas on the north side of the site) to allow for building construction. In general, the majority of the building will have a finish floor elevation of EL. 66 feet; however, Wing 4 will have a finish floor elevation of EL. 77.67 feet. The Boring Location Diagram included within the appendix as well as cross sections A-A’ and B-B’ show the proposed structure including the approximate finish floor elevations with regard to the existing site conditions. This information is based upon the preliminary grading plan provided and should be confirmed upon completion of the final design.

Within the site, localized areas of existing fill extend to depths up to 8.5± feet below the existing ground surface, which often consisted of organics and construction debris/concrete. Additionally, the site is generally underlain by soft natural soils which would also need to be addressed prior to building construction or new fill placement. Considering the variability of the existing fill and the presence of the soft natural soils, the total settlement potential of the proposed structure as well as settlement of the new fill, could be problematic. Additionally, the timing of the settlement can also be variable, with some settlement occurring during grading operations and some occurring after grading/building construction.

The traditional option for providing a suitable subgrade for building and floor slab support would be to completely remove the unsuitable materials to a stable, natural subgrade and replace them with new engineered fill that is placed and compacted in accordance with the project specifications. For this site we are recommending two options for construction of the fills and structures, both designed to reduce the risk of future settlement.

Option 1: Undercut Existing Fills and Perform Settlement Monitoring

Under this scenario, we recommend undercutting the existing fills in building pad areas, and either re-using the materials (if suitable) or new fill to establish the proposed lowest level elevation.

The project site should be prepared in accordance with the Subgrade Preparation and Earthwork Operations section of this report. In order to quantify the magnitude and rate of the settlement realized during construction, we recommend that settlement platforms be installed. The settlement platforms should be installed prior to placement of engineered fill to evaluate the existing soils and additional platforms be installed within the newly placed engineered fill to evaluate settlement of the new fill. At a minimum, four settlement platforms should be installed onsite however; the ultimate locations should be determined by the GER once final site and building plans are developed. Additional information regarding the settlement platforms is included in subsequent sections of this report.

The purpose of the settlement platforms are to measure the vertical displacement of the engineered fill and natural soil. The GER will review and interpret settlement data and provide opinions on when it is appropriate to begin foundation construction. Subsequent to the completion of earthwork and grading operations onsite, we recommend the site be monitored for a minimum of two months to provide the GER with sufficient data to provide recommendations for foundation construction. Please note, additional monitoring may be required prior to the foundation construction. We also recommend the settlement monitoring be carried out during building construction.

Option 2: Ground Improvement

Alternatively, subgrade stabilization/ground improvement could be performed throughout the project site to decrease the risk of soil settlement and limit the required waiting period after earthwork operations are completed. Therefore, as an alternative, we recommend ground improvement consisting of densified aggregate piers or stone columns be considered for the subgrade stabilization within the project site. The most suitable use of ground improvement will likely be through the use of stone columns or aggregate piers installed in a grid pattern, to improve the existing unsuitable subgrade materials, prior to the placement of engineered fill. By improving the subgrade prior to new fill placement, the ground improvement method will provide adequate bearing for both the engineered fill and building pads.

For this option, the construction operations should be sequenced such that any subgrade to be improved is properly stripped and prepared prior to the installation of the aggregate piers/stone column elements. After the aggregate piers/stone columns are installed, the grading operations for the remainder of the building pad may resume. Under this option piers would only be required in deep proposed fill areas with existing fills (to be left in place) and/or soft natural soils.

Discussions of the recommended option for building pad preparation are detailed further in following sections of the report. Several additional options, including the use deep foundation support consisting of short drilled shafts or micropiles in conjunction with structural slabs, were also considered; however, we anticipate these options are not considered to be economical and are therefore not being considered at this time. Additional options/recommendations can be provided upon your request.

Option 1: Shallow Spread Footings

Where the building is founded in new engineered fill, the building may be supported on shallow foundations designed for an allowable soil bearing pressure of 3,000 psf. This bearing pressure assumes that the Subgrade Preparation and Earthwork Operations recommendations are followed as detailed in subsequent sections of the report. A bearing pressure of, 3,000 psf can also be used if natural soils are encountered at the bearing elevation. The existing fill materials onsite are not capable of supporting building foundations and should be completely removed and replaced with engineered fill. The allowable soil bearing pressure refers to the pressure which may be transmitted to the foundation bearing soils in excess of the final minimum surrounding overburden pressure. During construction, the bearing capacity at the final footing excavation should be tested in the field by an experienced soil engineer or qualified representative to document that the in-situ bearing capacity at the bottom of each footing excavation is adequate for the design loads. If unsuitable soil or rock materials are observed at the design subgrade elevation for any footing, it will be necessary to “step down” the individual footing to suitable material.

Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for too long a time. Therefore, foundation concrete should be placed the same day the footing excavations are made. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete. If the excavation must remain open overnight, or if rainfall becomes imminent while the bearing soils are exposed, we recommend a 1- to 3-inch thick "mud mat" of "lean" concrete be placed on the bearing soils before the placement of reinforcing steel.

On the basis of the design assumptions outlined in this report including the required monitoring period, settlement of the structures is expected to be within tolerance for the proposed development. Total settlement is expected to be on the order of 1 inch, with differential settlement on the order of 3/4 inch or less. These settlement values are based on our engineering experience with these soils, the anticipated structural loading, and are a guide for the structural engineer with his design.

We recommend the continuous footings have a minimum width of 18 inches and that isolated column footings have a minimum lateral dimension of 30 inches. The minimum dimensions recommended above help reduce the possibility of foundation bearing failure and excessive settlement due to local shear or "punching" action. In addition, footings should be placed at a depth to provide adequate frost cover protection. Therefore, we recommend footings in heated areas be placed at a minimum depth of 24 inches below the finished grade, and perimeter footings subject to climatic variations be located at a minimum depth of 30 inches below finished grade.

Option 2: Ground Improvement

As previsiouly mentioned, drilled aggregate piers or stone columns could be utilized as a ground improvement technique to decrease the risk of settlement and stabilize and improve the existing subgrade soils, in order for the engineered fill to be placed after stripping is complete.

Stone columns are a ground improvement technique in which a column of soil is replaced with open-graded crushed stone vibrated into place. In a similar manner, drilled aggregate piers are constructed by replacing a column of soil with well-graded aggregate, except the aggregate is compacted (not vibrated) as it is put in place. In this case, the footings within the building footprint will not bear directly on the improved subgrade and will be supported by the newly placed engineered fill which is supported by an improved subgrade. While the footings within the overhang portion of the building will be directly bearing on the aggregate piers/stone columns. The piers generally consist of 24-inch to 30-inch minimum diameter drilled excavations. The soil reinforcement occurs as a result of the excavation of soft unsuitable soils and replacement by vibrated or compacted dense granular aggregate, such as VDOT No. 57, 21A, or 21B. In addition, some limited densification of the surrounding soils is reported to occur with aggregate piers, which will provide a suitable subgrade for fill placement to commence.

As with other soil improvement techniques, the aggregate piers are designed by a design build contractor and the proposed soil improvement plan is reviewed by the GER. We anticipate the contractor will perform a grid pattern throughout the proposed site to improve the subgrade soils, but different approaches may be proposed if competitive bids are solicited. We recommend that ECS review any such submittals. The design-build contractor should design a system to limit settlement of the underlying materials to no more than ½ inch after the new fill is placed. The design-build contractor should also take into account the foundation elements of the proposed building in their subgrade improvement plan. Where the depth of new engineered fill to be placed is less than the width of the overlying footing, an increased aggregate pier/stone column density may be required at the footing location to provide adequate improvement within the footing stress zone of influence. We expect that a bearing pressure on the order of 4,000 psf to 6,000 psf may be used for preliminary design if aggregate piers are used; however, the design build contractor will include this information as part of their soil improvement plan.

This information is provided for your use in preliminary design and budgeting. The stone columns or aggregate pier system should be designed by a design-build contractor and the proposed soil improvement plan should be reviewed by the GER.

Floor Slab Design

We expect the existing subgrade soils will either be undercut and replaced or be treated with ground improvement, atop which the new engineered fills will be constructed. Therefore, the slabs can be designed as slab on-grades for this project. Depending on which foundation earthwork option is chosen, a monitoring period may be necessary following fill construction and prior to slab construction.

Prior to sub-slab stone placement for soil fill (in areas where grades need to be raised), the slab on grade subgrade should be visually observed for soft/loose and/or excessively wet soils and the subgrade should be proofrolled utilizing a fully loaded tandem axle dump truck (minimum axle weight of 10 tons). Before the proofrolling, the subgrade should be densified in place to 95% maximum dry density). The stripped area should be observed by the Geotechnical Engineer of Record (GER) or their authorized representative during the time of construction in order to aid in locating all such unsuitable materials, which should be removed. Materials placed as engineered fill below the floor slab should be placed in accordance with the recommendations provided in the Fill Placement section of this report.

At a minimum, 8 inches of granular material having a maximum aggregate size of 1.5 inches and no more than 2% soils passing the No. 200 sieve should be placed below the slab. This granular layer will facilitate the fine grading of the subgrade and help prevent the rise of water through the floor slab. Prior to placing the granular material, the floor subgrade should be free of standing water, mud, and frozen soil. Before the placement of concrete, a vapor barrier may be placed on top of the granular material to provide additional moisture protection. Weldedwire mesh reinforcement should be placed in the upper half of the ground slab and attention should be given to the surface curing of the slab in order to reduce uneven drying of the slab and associated cracking.

Underslab Drainage

We recommend the below grade areas of the proposed development be provided with an interior perimeter and underslab subdrainage system (i.e., a "drained" condition). This recommendation applies to all areas within the building footprint that are below existing or proposed site grades. A sketch titled "Below-Grade Wall Waterproofing and Underslab Drainage Details" provides a graphical summary of our recommendations and is included in the Appendix. The system may consist of perforated or porous wall, closed joint drain tiles located around the interior perimeter of the below-grade areas, as close as feasible to the exterior wall, below the finished floor level.

Lateral drain lines under the floor slab should be placed at no more than 40 to 60 feet on center. Underslab drain lines should have a minimum diameter of 4 inches, be underlain by 2 inches of free draining material and have 6 inches of cover. They should be slotted or appropriately perforated. For the filter fabric we recommend a non-woven product such as Mirafi 140N with an AOS of 70 (U.S. Sieve) be placed on the entire subgrade. An equivalent geotextile fabric can also be used if approved by the Geotechnical Engineer of Record. Clean out access should be installed at all sharp bends and at approximately every 100 feet for straight runs.

We recommend that the interior perimeter and underslab drain system for the proposed building be designed to flow to via gravity to an adjacent storm structure or day-lighted onto the south portion of the site. Should gravity not be feasible, we recommend the permanent sump(s) be designed with a full duplex capability (i.e., two pumps per pit). We recommend that each individual pump rated at no less than 25 gpm for the multi-family building. With this configuration, under emergency conditions, these individual sumps would have the capacity to pump 50 gpm for the building. The contractor should monitor the pumping rate of the construction dewatering system in order to verify that the permanent sump pump has been adequately sized. Smaller or conversely larger pumps may ultimately be needed. Once the plans are further developed, please contact ECS so that we can refine our pumping estimates. Based on the actual design below-grade and water conditions

Pavements

For the design and construction of exterior pavements, we recommend the subgrade be prepared following the recommendations included in the previous sections of this report. The stripped surface should be proofrolled and carefully observed by the GER at the time of construction in order to aid in identifying the localized soft or unsuitable materials, which would be removed. In addition, the guidelines provided in the section entitled Subgrade Preparation and Earthwork Operations should be followed. At the time of subgrade preparation, additional laboratory testing, consisting of California Bearing Ratio (CBR) and Atterberg limit tests, should be performed on representative subgrade materials in the proposed pavement areas to confirm final design of these pavements prior to installation.

CBR testing was not performed during the previous exploration; however, based on the materials encountered, and our experience with similar soils, we recommend a design CBR value of 4 to 6 be used for **preliminary** design for the near surfaced natural clay soils. We recommend CBR samples be obtained within the upper 12 inches of the subgrade soils during construction for final pavement design. The value(s) obtained during construction should be used to confirm and/or change the design of the pavements. If the results of the CBR tests performed during construction differ from that mentioned above, the pavement design should be modified as necessary. Pavements and subgrades should have a minimum cross-slope of 2% and where the pavement base course does not daylight, underdrains should be installed on the low side of pavements.

The pavement recommendations provided herein are for preliminary planning purposed only. A detailed pavement design and analysis is required to be performed by the site civil engineer prior to construction.

Retaining Walls

Site Retaining Walls

We understand the proposed site grading will require a retaining wall, with a maximum height of 12 feet, along the south property line of the site. In general, we understand the retaining wall will have a top elevation that ranges from EL. 63 to 65 feet while the toe will be at EL. 52 to 54 feet. Cross section C-C' included within the Appendix visually shows the retaining wall profile as well as the borings advanced within that area. Please note, borings advanced along the south property line were generally advanced for stormwater infiltration facilities and not the proposed retaining wall.

The design of the retaining wall will be performed by a specialty design/build contractor to determine the most economical solution; however, post and panel type wall, segmental block gravity type wall, or cast-in-place concrete walls are all feasible at the site. Please note, the existing fill soils and natural soils will likely not be acceptable backfill for a segmental block wall. When additional details for the retaining wall are known, ECS should be contacted to participate in the design/evaluation process. Since details for proposed retaining wall are unknown at this time, we are providing the following general parameters for design.

We recommend the retaining wall be designed using a linearly increasing lateral "active" earth pressure of approximately 40 psf per vertical foot of wall if free draining granular materials (SP, SW, GP, GW) are used for wall backfill. Additionally, we recommend a coefficient of friction against sliding of 0.30 for the wall foundation which will be bearing in the natural clay, silts and sands. The retaining wall should be designed so that the resultant of the overturning forces remains in the central one-third of the footing. The foundations for the proposed retaining wall should be designed for a net allowable soil bearing pressure on the order of 2,500 psf, provided that the footings are founded within firm natural soils or engineered fill placed over firm natural soils with SPT N-values greater than 6 blows per foot (bpf). Based on the soils encountered at the proposed footing elevation, undercutting should be expected. The proposed retaining wall should also be designed for any surcharge load within a 45 degree slope from the base of the wall and the sloping backfill onsite. A Lateral Earth Pressure Diagram – Site Retaining Walls, illustrating our general recommendations regarding the application of lateral earth pressure on the retaining wall is included with the Appendix of this report. At this time, the design recommendations provided are considered general and should be specifically evaluated based on the type of wall and construction processes to be used for its installation. In addition, we recommend ECS review the design documents prior to construction of the retaining wall.

The recommendations contained above assume that the backfill behind the retaining walls is properly drained through the use of a gravel chimney drain or suitable man-made drainage medium. Drainage of the backfill may be accomplished through the use of 4-inch diameter weep holes at 8 feet spacing, through the wall, immediately above proposed grade at the front of the wall. Alternatively, a longitudinal drain line could be used behind the retaining wall. The drain should consist of a 6-inch perforated pipe surrounded by a minimum of 6 inches of #57 stone and encapsulated in a geotextile fabric. The geotextile used should be reviewed and approved by the GER.

As previously mentioned, the final site layout (site retaining walls, sidewalks, etc.) and proposed grading is unknown at this time. The selected wall design engineer should take into account global stability during the design process and **additional analysis will be necessary once additional design details are known. Please contact ECS to complete this analysis once the design is finalized.**

Below-Grade Walls

We understand the building level walls will be below grade or partially buried due to grade changes on the site. Walls should be designed to withstand lateral earth pressures and surcharge loads. Where a below-grade drainage system is utilized that effectively eliminates hydrostatic pressures, we recommend the below-grade walls be designed for a linearly increasing lateral earth pressure of 60 psf per foot of wall depth. This lateral earth pressure assumes that the below grade walls are fully drained (i.e., hydrostatic pressures) and does not include any surcharge loads. Any surcharge loads imposed within a 45 degree slope of the base of the wall should be considered in the below-grade wall design. The influence of these surcharge loads on the below-grade walls should be based on an at-rest pressure coefficient, k_0, of 0.5. The below-grade walls are recommended to be fully waterproofed as well. A Lateral Earth Pressure (LEP) Diagram-Drained is included in the Appendix of this report.

Suitable man-made drainage materials may be used in lieu of the granular backfill, adjacent to the site retaining and/or below-grade walls. The LEP Diagram provided is applicable where drainage board is used to drain water from the wall and behind the walls. Examples of suitable materials include Enka Mat, Mira Drain, or Geotec Drains. These materials should be covered with a filter fabric having an Apparent Opening Size (AOS) consistent with the size of the soil to be retained. The material should be placed in accordance with the manufacturer’s recommendations and should be discharged to a suitable outlet.

If appropriate and where a space exists between the outside of the walls and the excavation, granular backfill may be placed in lieu of manmade drainage material. Granular fill should extend to a level of approximately two feet below the final outside grade. The remaining two feet should consist of a clayey material to reduce the amount of surface water infiltration into the granular material. The ground surface adjacent to the walls should be kept properly graded to prevent ponding of water adjacent to the walls.

Temporary and Permanent Slopes

Temporary fill slopes constructed of on site native sandy, silty or clayey soils should be limited to a maximum gradient of approximately 2H:1V. The temporary slopes should also be thoroughly vegetated to help reduce erosion of the surficial soils. Temporary excavation slopes cut in the native soils should be no steeper than 1H:1V, or as indicated by OSHA and VOSHA protocol. Permanent slopes constructed of native soils should generally be 3H:1V or flatter. Slopes steeper than 3H:1V should be designed by the GER. Gradients as steep as 2H:1V may be achieved through the use of select aggregate or engineered rock fills, as well as through the installation of geosynthetics in native soils, but again, must be designed by the GER. Small landscape berms (< 5 feet in height) may be as steep as 1H:1V but should be compacted as structural fill and thoroughly vegetated immediately upon completion.

Infiltration Test Results

The individual infiltration tests and laboratory testing results are included as an attachment to this report and are summarized in Table 2 below.

Table 2: Field Infiltration Rates

Infiltration Test Location	Depth of Infiltration Test (ft)	Soil Classification at Infiltration Soil Horizon[1] (USCS/USDA)	Measured Field Infiltration Rate (in/hr)[2]
I-1	6.0	CL	0.00
I-2	6.0	CL	0.01
I-3	6.25	CL	0.00
I-4	6.25	CL	0.52
I-5	6.25	CL	0.00
I-6	6.25	CL	0.00
I-7	6.25	CL	0.00
I-8	6.0	SM	0.00
I-9	6.0	SM	0.00
I-10	6.25	CL	0.00
I-11	6.25	CL	1.47
I-12	6.25	ML	0.00
I-13	6.25	CL	0.00
I-14	6.0	ML	0.63
I-15	6.25	CL	0.01
I-16	5.75	CL	0.00
I-17	6.25	ML	0.11
I-18	6.25	ML/Loam	0.42
I-19	5.75	ML/Loam	0.83

1. The soil classification was based upon samples collected from adjacent boring. At the direction of the project civil engineer, USDA classification was only performed on samples for I-18 and I-19.
2. Site conditions are variable and the project civil engineer should consider applying a factor of safety to these higher field infiltration rates to account for the different soil horizons encountered.

Site Seismic Considerations

The subsurface exploration completed for the proposed development included the drilling of 18 borings to depths ranging from 8.0 to 60 feet below the existing surface elevation. The International Building Code (IBC) 2012 requires site classification for seismic design based on the upper 100 feet of a soil profile. Where site specific data are not available to a depth of 100 feet, appropriate soil properties are permitted to be estimated by the registered design professional preparing the soils report based on known geologic conditions.

Three methods are utilized in classifying sites, the shear wave velocity (v_s) method; the unconfined compressive strength (s_u) method; and the Standard Penetration Resistance (N-value) method. The Standard Penetration Resistance method was used in classifying this site. Based on our interpretation of IBC 2012 and Section 1613.3.2, the project is defined as "Site Class D" for seismic design considerations. The Site Class definition should not be confused with the Seismic Design Category designation, which the Structural Engineer typically assesses.

In addition to the seismic site class noted above, ECS has determined the design spectral response acceleration parameters following the IBC 2012 methodology. The Mapped Reponses were estimated from the free Java Ground Motion Parameter Calculator available from the USGS website. The design responses for the short and 1-second period (SDS and SD1) are noted at the far right end of the Table 2.

Table 3: Ground Motion Parameters (IBC 2012 Method)

Period (sec)	**Mapped Spectral Response Accelerations (g)**		**Values of Site Coefficient for Site Class D**		**Maximum Spectral Response Acceleration Adjusted for Site Class (g)**		**Design Spectral Response Acceleration (g)**	
Reference	Figures 1613.3.1 (1) & (2)		Tables 1613.3.3 (1) & (2)		Eqs. 16-37 & 16-38		Eqs. 16-39 & 16-40	
0.2	S_S	0.118	F_a	1.6	S_{MS}	0.189	$\boldsymbol{S_{DS}}$	*0.126*
1.0	S_1	0.051	F_v	2.4	S_{M1}	0.122	$\boldsymbol{S_{D1}}$	*0.081*

PRELIMINARY PROJECT CONSTRUCTION RECOMMENDATIONS

Subgrade Preparation and Earthwork Operations

Initial preparation of the site should consist of complete removal of any existing building elements or foundations, retaining walls, pavements, sidewalks, and abandoned utilities as well as any trees, shrubs, and other deleterious organic or refuse material. Further excavation to the design subgrade level should be limited to about 1 foot above the design subgrade for the lowest level subgrade elevation. This remaining 1-foot of material should remain in place during foundation installation just until the slab or engineered fill is ready for placement. This can reduce the amount of subgrade undercutting necessary due to disturbance from construction activities.

The stripping within the proposed structural building and pavement areas should be extended at least 5 feet, where possible, beyond the planned limits of the proposed building and pavements. Stripping limits should be extended an additional 1 foot for each foot of fill required at the building's exterior edge.

After stripping to the desired grade and performing all necessary excavation (and after the installation of the aggregate piers/stone columns if used), and prior to any engineered fill placement, the exposed soils should be carefully examined to identify any localized loose, yielding or otherwise unsuitable materials by an experienced geotechnical engineer or their authorized representative. After examining the exposed soils, loose and yielding areas can be identified by proofrolling with an approved piece of equipment, such as a loaded dump truck, having an axle weight of at least 10 tons. If any soft or unsuitable materials are encountered during proofrolling, the GER should be contacted for further recommendations.

Existing fill material will be prevalent throughout the project site. Should aggregate piers be selected for subgrade ground improvement, we recommend the materials currently present be left in place provided they are stable for the support of compaction of engineered fill, followed by the pier installation. If aggregate piers are not used, the existing fill materials should be completely removed under the proposed building pad and backfilled to building bad subgrade elevation with engineered fill as outlined in the Fill Placement section herein. Existing fill materials may remain in place under the proposed pavement areas provided they are stable during proofrolling operations as noted above. However, in order to reduce the potential for future settlement and reduced life cycle costs of the proposed pavement, we recommend the existing fill material be removed to a minimum of 2 feet below all of the proposed pavement subgrade elevations. At this depth, the subgrade should be proofrolled and, provided the areas are stable, should be backfilled to pavement subgrade elevation with engineered fill as outlined in the Fill Placement section herein. However, should yielding or soft areas be encountered beneath any fill, the GER should be contacted for additional recommendations.

The preparation of any areas to receive engineered fill, as well as proposed building subgrades should be observed on a full-time basis. These observations should be performed by the GER, or their authorized representative, to document that all unsuitable materials have been removed, and that the subgrade is suitable for support of the proposed construction and/or fills.

Fill Placement

Engineered fills are anticipated for the project and all engineered fill should consist of an approved material (approved by the GER), free of organic matter and debris, cobbles greater than 4-inches, and have a Liquid Limit and Plasticity Index less than 40 and 20, respectively. Unacceptable engineered fill materials include topsoil and organic materials (OH, OL), and high plasticity silts and clays (CH, MH). Under no circumstances should high plasticity soils be used as engineered fill material. Wall (retaining walls or below-grade walls) backfill will require a maximum Liquid Limit and Plasticity Index of 40 and 15, respectively. Undercuts beneath footings should be replaced with lean concrete or approved engineered fill.

Based on the materials encountered during the subsurface exploration, a majority of the on-site soils **will not** be suitable for reuse as engineered fill or will be difficult to work with due to their moisture sensitive properties and segregate construction debris. Alternative sources for engineered fill materials may be necessary for grading of the site.

Engineered fill materials should be placed in lifts not exceeding 8-inches in loose thickness and moisture conditioned to within ±2 percentage points of the optimum moisture content. Soil bridging lifts should not be used, since excessive settlement of overlying structures will likely occur. Controlled engineered fill soils placed below the building pad should be compacted to 98% of the maximum dry density obtained in accordance with ASTM Standard D-698, Standard Proctor Method. Controlled engineered fill soils placed below the pavement areas should be compacted to a minimum of 98% of the maximum dry density obtained in accordance with ASTM Standard D-698, Standard Proctor Method. However, the upper one foot of engineered fill soils supporting pavements, sidewalks, or gutters should be compacted to a minimum of 100% of the maximum dry density obtained in accordance with ASTM Standard D-698.

To minimize excessive pressures against the below-grade walls and to reduce the settlement of the wall backfill, it is recommended the wall backfill (if required) be compacted to 95% of the maximum dry density determined in accordance with ASTM Standard D-698, Standard Proctor Method. Heavy earthwork equipment should maintain a minimum horizontal distance away from the below-grade walls of 1 foot per foot of vertical wall height. Lighter compaction equipment should be used close to the below-grade walls.

The footprint of the proposed building pad, pavement, and engineered fill areas should be well defined, including the limits of the engineered fill zones at the time of engineered fill placement. Grade control should be maintained throughout the engineered fill placement operations. All engineered fill operations should be observed on a full-time basis by the GER or their authorized representative to determine the compaction requirements specified are being met. A minimum of one compaction test per 2,500 square-foot area should be tested in each lift placed. The elevation and location of the tests should be clearly identified at the time of fill placement.

In any areas where the total depth of fill will exceed 5 feet, we recommend these fill zones be placed as early as possible in the earthwork operations phase and that the fill soils be compacted per the recommendations above. The purpose of the higher compaction criteria is to reduce differential settlement between natural cut soils and controlled fill soils and total settlement of the fill mass. Additionally, we recommend these areas are monitored using settlement platforms as described herein, if the pier option is not chosen.

Please note that although the building pad areas may be improved through the use of aggregate piers/stone columns, the engineered fill placed to achieve the final subgrade elevations will still be required to be placed and compacted in accordance with the recommendations outlined above (i.e. 98% compaction within the building pad locations and within the pavement areas).

Compaction equipment suitable to the soil type used as engineered fill should be used to compact the engineered fill material. Theoretically, any equipment type can be used as long as the required density is achieved. Ideally, a steel drum roller would be most efficient for compacting and sealing the surface soils. All areas receiving engineered fill should be graded to facilitate positive drainage from the building pad and pavement areas of any free water associated with precipitation and surface runoff.

Prior to the commencement of fill operations and/or utilization of any off-site borrow materials, the GER should be provided with representative samples to determine the material's suitability for use in a controlled compacted fill and to develop moisture-density relationships (minimum of 5-days prior to use). In order to expedite the earthwork operations, if off-site borrow materials are required for use as engineered fill, it is recommended they consist of a select granular material which will provide suitable support and be easily compacted and well drained.

Engineered fill materials should not be placed on frozen soils or frost-heaved soils and/or soils that have been recently subjected to precipitation. All frozen soils should be removed prior to continuation of fill operations. Borrow fill materials, if required, should not contain frozen materials at the time of placement. All frost-heaved soils should be removed prior to placement of controlled, compacted fill, granular subbase materials, foundation or slab concrete, and asphalt pavement materials.

Settlement Platform Recommendations

Based on the way in which the subgrade will be prepared, we recommend the use of settlement platforms if the undercut and replace option is chose during the installation of the engineered fill which will support the proposed building pad and parking lot. This work will consist of the installation of settlement platforms as specified herein. The Contractor shall furnish all necessary labor, equipment, and materials and shall perform all operations necessary and incidental to the installation of all instrumentation specified. If requested, ECS can provide the fabrication, installation, and monitoring of the settlement platforms. Instrumentation shall be performed at locations as directed by the Engineer.

Part 1 – General

1. Settlement platforms are surface displacement reference platforms placed on the prepared ground surface in locations selected by the GER. Settlement platforms shall consist of 3-foot square plates to which risers are attached. The risers are extended as the engineered fill is placed. Settlement platforms are monitored by optical survey methods to determine vertical displacements occurring during and after fill construction.

Part 2 – Submittals

1. Prior to installation, the Contractor shall submit suppliers' or manufacturer's plans (or shop drawings) to the GER for approval.

Part 3 – Materials

1. The base plate shall be made from 1/8-inch thick steel plate conforming to the requirements of ASTM A 36. The casing and inner riser pipe shall be steel pipe conforming to the requirements of ASTM A 53, welded, standard weight. The casing shall consist of 3-inch diameter pipe and the riser shall consist of 1-1/2 inch diameter pipe. Centralizing spacers shall also be provided to maintain the alignment of the exterior casing.

Part 4 – Equipment and installation Procedure

1. The GER shall be present during installation of the settlement platforms to determine the general degree of contractor compliance with the plans and specifications.

2. Settlement platforms should be constructed and installed before placement of any engineered fill material. Installed on the improved subgrade, as well as within the engineered fill. The settlement platforms shall be installed on a 4-inch thick sand base on the improved subgrade surface and engineered fill surface. The riser pipe shall be marked in 1-foot increments and labeled at 5-foot increments to indicate the distances above the platform extending up through the engineered fill.

3. The sand base shall be tamped to provide a firm, level, and unyielding bearing surface for the base plate. The original ground surface must be stripped and prepared in accordance with the previous sections of this report prior to placement of the sand base. The casing and riser pipes shall be steel pipes of Schedule 40 (ASTM A 53) with a maximum length of 6 feet. Spacers shall be provided between the riser pipe and the casing at a minimum of 3-foot intervals to ensure concentricity. A container, approximately 2.5 feet in diameter and 3 feet high, with both ends open, shall be placed around the initial length of casing pipe. This container shall be backfilled with tamped clean sand or fine gravel to support the pipe in a vertical position during fill placement until the fill is carried above the platform.

4. The casing pipe shall be marked by flags to clearly show its location and to warn equipment operators and others of its location. The Contractor shall maintain the flags during the entire length of the Contract and replace those flags that are missing. At no time shall the settlement platform risers extend higher than 5 feet above the fill surface elevation.

5. The Contractor is responsible for maintaining the settlement platforms in working order. Settlement platforms damaged by the Contractor's construction operation or the operation of subcontractors under the direction of the Contractor shall be repaired or replaced by the Contractor at his expense within three calendar days after the damage occurs.

6. The platforms shall be surveyed by the GER (vertically and horizontally) upon completion of the installation of the settlement platforms. All settlement platforms should be initially surveyed within 24 hours after installation and prior to starting engineered fill placement. During engineered fill placement and after the engineered fill has reached the subgrade elevation, the platforms shall be surveyed once per week while the engineered fill is being

placed and for a period of 15 to 60-days upon the completion of grading operations within the building limits have been completed. Building construction can begin, once the GER indicates that any settlements observed appear to have stabilized; however, we recommend settlement monitoring continue through building construction.

Construction Dewatering

As noted previously in this report, groundwater was not encountered at elevations above EL. 45 feet in the borings performed. We anticipate construction phase dewatering operations, if necessary, can be handled by the use of conventional sump pit and pump operations in conjunction with trenching. It may be necessary to use several sump pits and pumps around the site along with temporary trenches or french drains consisting of free draining granular stone wrapped in filter fabric to direct the flow of water and to remove water from the excavation. A French Drain installation detail is included in the Appendix of this report for reference. We recommend that the sump pits be established at an elevation at least 2 to 3 feet below the design footing subgrade elevation on the excavation. Perforated 55 gallon drums, or other temporary structures could be used to house the pumps. Regardless of the water control techniques ultimately selected, the soils at the design subgrade elevation will be both water and disturbance sensitive. ECS should be retained to review the final dewatering system chosen.

Closing

In addition to geotechnical engineering services, ECS Capitol Services, PLLC has the in-house capability to perform multiple additional services as this project moves forward. These services include the following:

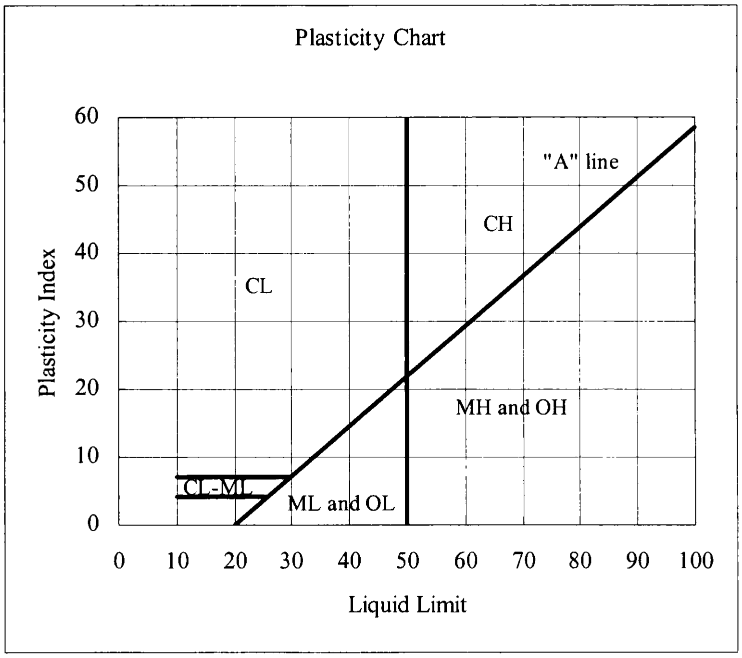
- Global Stability Analysis;
- 3-D Monitoring of the SOE and adjacent structures;
- Construction Material Testing / Special Inspections; and,
- Third Party Inspections / Code Compliance for MEP, Elevators, etc.

We would be pleased to provide these services for you. If you have any questions with regard to this information or need any further assistance during the design and construction of the project please feel free to contact us.

This report only provides preliminary recommendations for early design and early construction planning and ECS should be provided with the design documents as the project progresses to confirm the recommendations included herein are applicable. Depending on the final building layout/elevation, additional/alternate recommendations may apply.

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

Major Divisions			Group Symbols		Typical Names	Laboratory Classification Criteria		
Coarse-grained soils (More than half of material is larger than No. 200 Sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 percent GW, GP, SW, SP More than 12 percent GM, GC, SM, SC 5 to 12 percent Borderline cases requiring dual symbols[b]	$C_u = D_{60}/D_{10}$ greater than 4 $C_c = (D_{30})^2/(D_{10} x D_{60})$ between 1 and 3	
			GP		Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM[a]	d	Silty gravels, gravel-sand mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
				u				
			GC		Clayey gravels, gravel-sand-clay mixtures		Atterberg limits below "A" line or P.I. less than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines		$C_u = D_{60}/D_{10}$ greater than 6 $C_c = (D_{30})^2/(D_{10} x D_{60})$ between 1 and 3	
			SP		Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM[a]	d	Silty sands, sand-silt mixtures		Atterberg limits above "A" line or P.I. less than 4	Limits plotting in CL-ML zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
				u				
			SC		Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
Fine-grained soils (More than half material is smaller than No. 200 Sieve)	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 sandy or silty soils, elastic silts			
			CH		Inorganic clays of high plasticity, fat clays			
			OH		Organic clays of medium to high plasticity, organic silts			
	Highly Organic soils		Pt		Peat and other highly organic soils			

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[a] Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u used when L.L. is greater than 28.

[b] Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC,well-graded gravel-sand mixture with clay binder. (From Table 2.16 - Winterkorn and Fang, 1975)

REFERENCE NOTES FOR BORING LOGS

I. Drilling Sampling Symbols

SS	Split Spoon Sampler	ST	Shelby Tube Sampler
RC	Rock Core, NX, BX, AX	PM	Pressuremeter
DC	Dutch Cone Penetrometer	RD	Rock Bit Drilling
BS	Bulk Sample of Cuttings	PA	Power Auger (no sample)
HSA	Hollow Stem Auger	WS	Wash sample
REC	Rock Sample Recovery %	RQD	Rock Quality Designation %

II. Correlation of Penetration Resistances to Soil Properties

Standard Penetration (blows/ft) refers to the blows per foot of a 140 lb. hammer falling 30 inches on a 2-inch OD split-spoon sampler, as specified in ASTM D 1586. The blow count is commonly referred to as the N-value.

A. Non-Cohesive Soils (Silt, Sand, Gravel and Combinations)

Density		*Relative Properties*	
Under 4 blows/ft	Very Loose	Adjective Form	12% to 49%
5 to 10 blows/ft	Loose	With	5% to 12%
11 to 30 blows/ft	Medium Dense		
31 to 50 blows/ft	Dense		
Over 51 blows/ft	Very Dense		

Particle Size Identification		
Boulders		8 inches or larger
Cobbles		3 to 8 inches
Gravel	Coarse	1 to 3 inches
	Medium	½ to 1 inch
	Fine	¼ to ½ inch
Sand	Coarse	2.00 mm to ¼ inch (dia. of lead pencil)
	Medium	0.42 to 2.00 mm (dia. of broom straw)
	Fine	0.074 to 0.42 mm (dia. of human hair)
Silt and Clay		0.0 to 0.074 mm (particles cannot be seen)

B. Cohesive Soils (Clay, Silt, and Combinations)

Blows/ft	*Consistency*	*Unconfined Comp. Strength Q_p (tsf)*	*Degree of Plasticity*	*Plasticity Index*
Under 2	Very Soft	Under 0.25	None to slight	0 – 4
3 to 4	Soft	0.25-0.49	Slight	5 – 7
5 to 8	Medium Stiff	0.50-0.99	Medium	8 – 22
9 to 15	Stiff	1.00-1.99	High to Very High	Over 22
16 to 30	Very Stiff	2.00-3.00		
31 to 50	Hard	4.00–8.00		
Over 51	Very Hard	Over 8.00		

III. Water Level Measurement Symbols

WL	Water Level	BCR	Before Casing Removal	DCI	Dry Cave-In
WS	While Sampling	ACR	After Casing Removal	WCI	Wet Cave-In
WD	While Drilling	▽	Est. Groundwater Level	▼	Est. Seasonal High GWT

The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in a granular soil. In clay and plastic silts, the accurate determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally applied.

CLIENT
Pennrose Properties, LLC

JOB #
37:1404

BORING #
B-1

SHEET
1 OF 2

PROJECT NAME
Deanwood Hills

ARCHITECT-ENGINEER

SITE LOCATION
5201 Hayes Street, NE, Washington, District of Columbia

NORTHING

EASTING

STATION

CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

SURFACE ELEVATION 77

SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	BLOWS/6"
S-1	SS	18	18	2 5 9
S-2	SS	18	18	6 10 11
S-3	SS	18	18	3 5 6
S-4	SS	18	18	3 3 4
S-5	SS	18	18	2 2 3
S-6	SS	18	15	2 1 2
S-7	SS	18	15	2 2 5
S-8	SS	18	18	7 11 13

DEPTH (FT): 0, 5, 10, 15, 20, 25, 30

ELEVATION (FT): 75, 70, 65, 60, 55, 50

Topsoil Depth [2"]

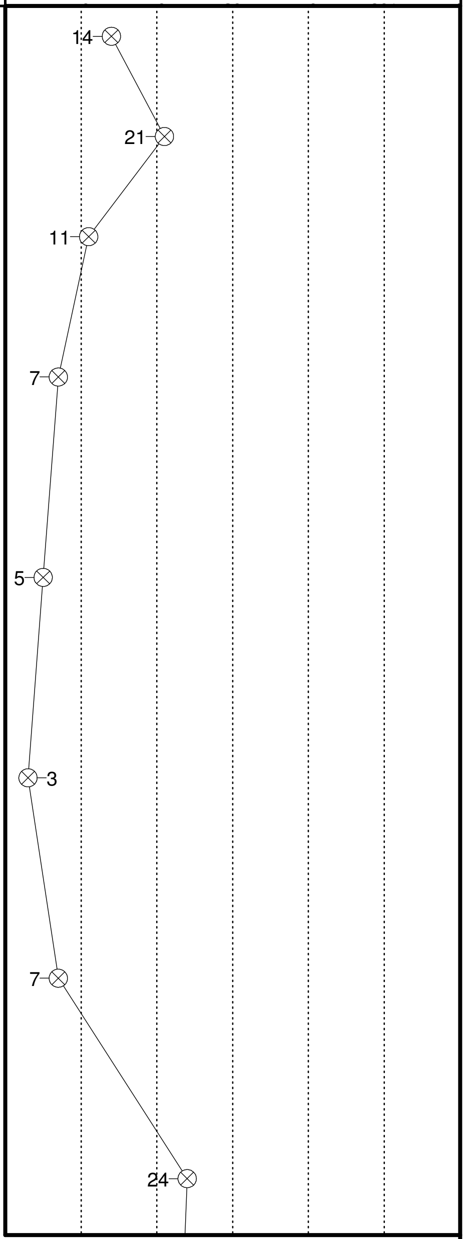
(CL) SANDY LEAN CLAY WITH GRAVEL, Light Brown, Moist, Medium Stiff to Very Stiff

(SC) CLAYEY SAND, Reddish Brown, Moist, Loose

(SM) SILTY SAND, Black, Moist, Very Loose

(SM) SILTY SAND WITH GRAVEL, Gray, Moist, Loose

(CL) SANDY Lean CLAY, Light Purple, Moist, Very Stiff to Hard



CONTINUED ON NEXT PAGE.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/A WS ☐ WD ☐
BORING STARTED 12/18/14
WL(BCR) WL(ACR)
BORING COMPLETED 12/19/14
CAVE IN DEPTH
WL
RIG 750 ATV FOREMAN Nadal
DRILLING METHOD 4.25 HSA

CLIENT: Pennrose Properties, LLC
JOB #: 37:1404
BORING #: B-1
SHEET: 2 OF 2
PROJECT NAME: Deanwood Hills
ARCHITECT-ENGINEER:
SITE LOCATION: 5201 Hayes Street, NE, Washington, District of Columbia
NORTHING:
EASTING:
STATION:

-○- CALIBRATED PENETROMETER TONS/FT^2

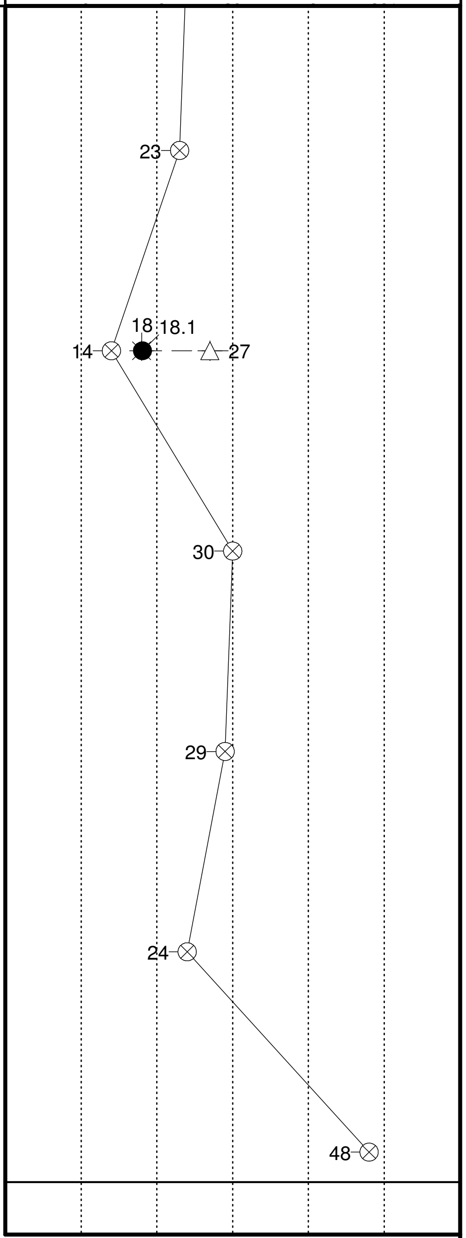
ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% ✕ — WATER CONTENT% ● — LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS
BOTTOM OF CASING ➤ LOSS OF CIRCULATION 100%
SURFACE ELEVATION 77

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					(CL) SANDY Lean CLAY, Light Purple, Moist, Stiff to Hard		45	
	S-9	SS	18	18				8 8 15
35								
							40	
	S-10	SS	18	18				6 7 7
40								
							35	
	S-11	SS	18	18				9 12 18
45								
							30	
	S-12	SS	18	18				6 13 16
50								
							25	
	S-13	SS	18	18				8 12 12
55								
							20	
	S-14	SS	18	18				13 20 28
60					END OF BORING @ 60.00'			



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/A WS ☐ WD ☐	BORING STARTED 12/18/14	
WL(BCR) WL(ACR)	BORING COMPLETED 12/19/14	CAVE IN DEPTH
WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 4.25 HSA

CLIENT	JOB #	BORING #	SHEET
Pennrose Properties, LLC	37:1404	B-2	1 OF 2

PROJECT NAME: Deanwood Hills

ARCHITECT-ENGINEER:

SITE LOCATION: 5201 Hayes Street, NE, Washington, District of Columbia

NORTHING: EASTING: STATION:

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% — — — REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

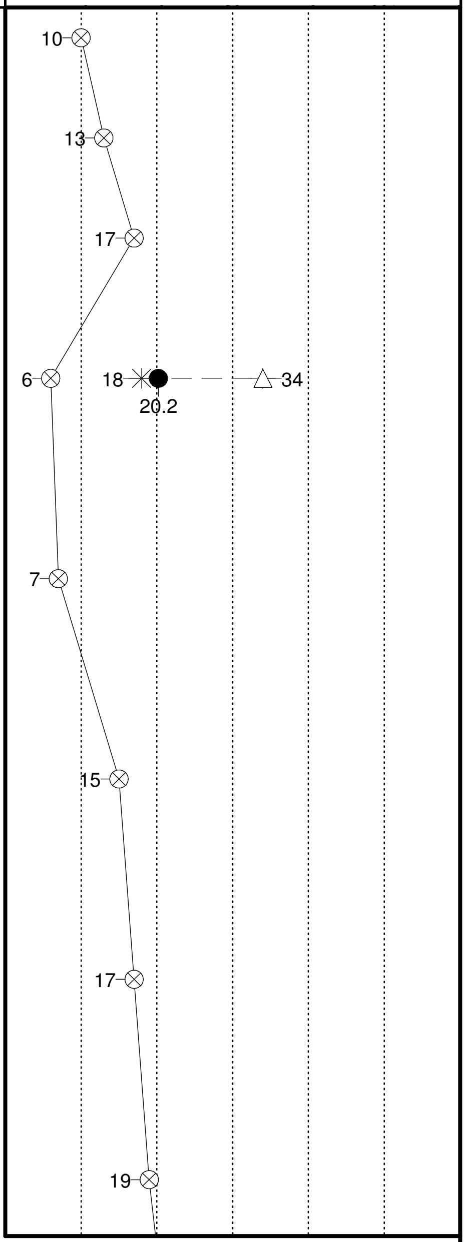
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

SURFACE ELEVATION 70

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	18	Topsoil Depth [2"] (CL) SANDY LEAN CLAY, Light Brown, Moist, Medium Stiff to Very Stiff		70	3 5 5
	S-2	SS	18	18				3 5 8
5	S-3	SS	18	18			65	6 7 10
	S-4	SS	18	15				2 2 4
10							60	
	S-5	SS	18	18				3 3 4
15							55	
					(SM) SILTY SAND WITH GRAVEL, Light Brown, Moist, Medium Dense			
	S-6	SS	18	18				2 8 7
20							50	
					(CL) SANDY LEAN CLAY, Light Brown, Moist, Very Stiff			
	S-7	SS	18	18				6 7 10
25							45	
	S-8	SS	18	15				12 10 9
30							40	



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/A WS☐ WD☐	BORING STARTED 12/22/14	
WL(BCR) WL(ACR)	BORING COMPLETED 12/22/14	CAVE IN DEPTH
WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 4.25 HSA

CLIENT	JOB #	BORING #	SHEET
Pennrose Properties, LLC	37:1404	B-2	2 OF 2

PROJECT NAME	ARCHITECT-ENGINEER
Deanwood Hills	

SITE LOCATION
5201 Hayes Street, NE, Washington, District of Columbia

NORTHING	EASTING	STATION

-○- CALIBRATED PENETROMETER TONS/FT^2

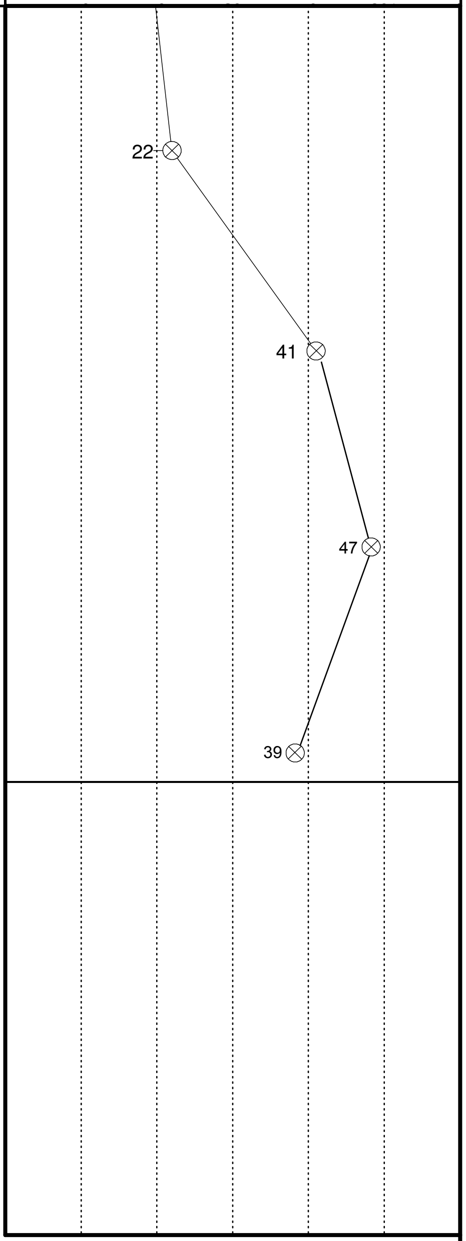
ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% × WATER CONTENT% ● LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS
BOTTOM OF CASING — LOSS OF CIRCULATION
SURFACE ELEVATION 70

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					(CL) SANDY LEAN CLAY, Light Brown, Moist, Very Stiff			
					(CL) SANDY Lean CLAY, Light Purple, Moist, Very Stiff to Hard			
	S-9	SS	18	18				6 11 11
35							35	
	S-10	SS	18	18				22 18 23
40							30	
	S-11	SS	18	18				15 19 28
45							25	
	S-12	SS	18	18				16 21 18
50					END OF BORING @ 50.00'		20	
55							15	
60							10	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/A WS☐ WD☐	BORING STARTED 12/22/14	
WL(BCR) WL(ACR)	BORING COMPLETED 12/22/14	CAVE IN DEPTH
WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 4.25 HSA

CLIENT	JOB #	BORING #	SHEET
Pennrose Properties, LLC	37:1404	B-3	1 OF 2

PROJECT NAME: Deanwood Hills

ARCHITECT-ENGINEER:

SITE LOCATION: 5201 Hayes Street, NE, Washington, District of Columbia

NORTHING:
EASTING:
STATION:

—○— CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

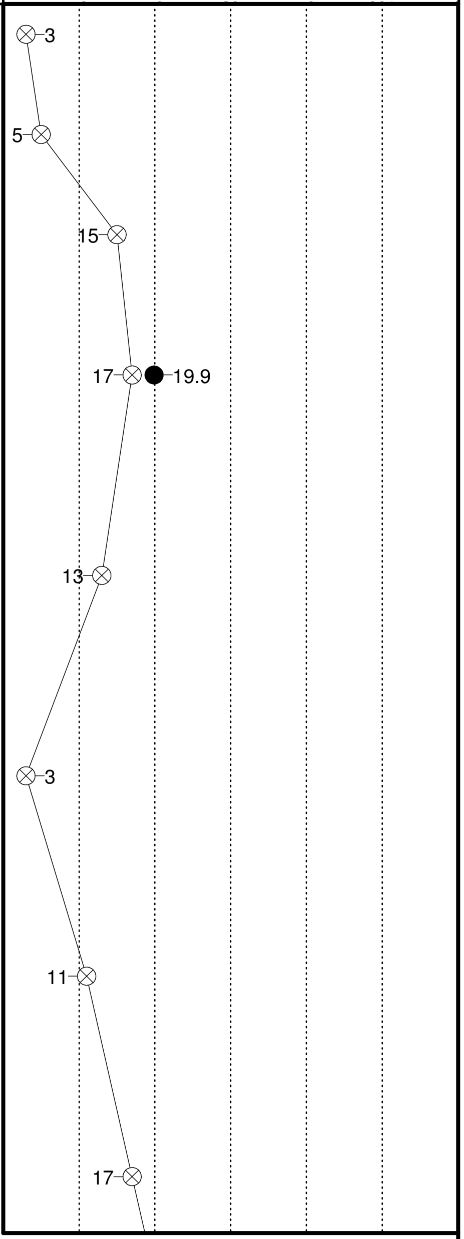
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➤ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 64

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	18	Topsoil Depth [1"] (CL) SANDY LEAN CLAY, Light Brown, Moist, Soft to Very Stiff			2 2 1
	S-2	SS	18	15				2 3 2
							60	
5	S-3	SS	18	18				5 7 8
	S-4	SS	18	18			55	4 7 10
10								
	S-5	SS	18	18			50	3 5 8
15								
	S-6	SS	18	10			45	1 1 2
20								
	S-7	SS	18	18			40	3 5 6
25								
					(CL) SANDY Lean CLAY, Light Purple, Moist, Very Stiff to Hard			
	S-8	SS	18	18			35	6 7 10
30								



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/A WS ☐ WD ☐	BORING STARTED 12/26/14	
WL(BCR) WL(ACR)	BORING COMPLETED 12/26/14	CAVE IN DEPTH
WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 4.25 HSA

CLIENT Pennrose Properties, LLC	JOB # 37:1404	BORING # B-3	SHEET 2 OF 2
PROJECT NAME Deanwood Hills	ARCHITECT-ENGINEER		
SITE LOCATION 5201 Hayes Street, NE, Washington, District of Columbia			
NORTHING	EASTING	STATION	

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — –   REC% ———

PLASTIC LIMIT% × —— WATER CONTENT% ● —— LIQUID LIMIT% △

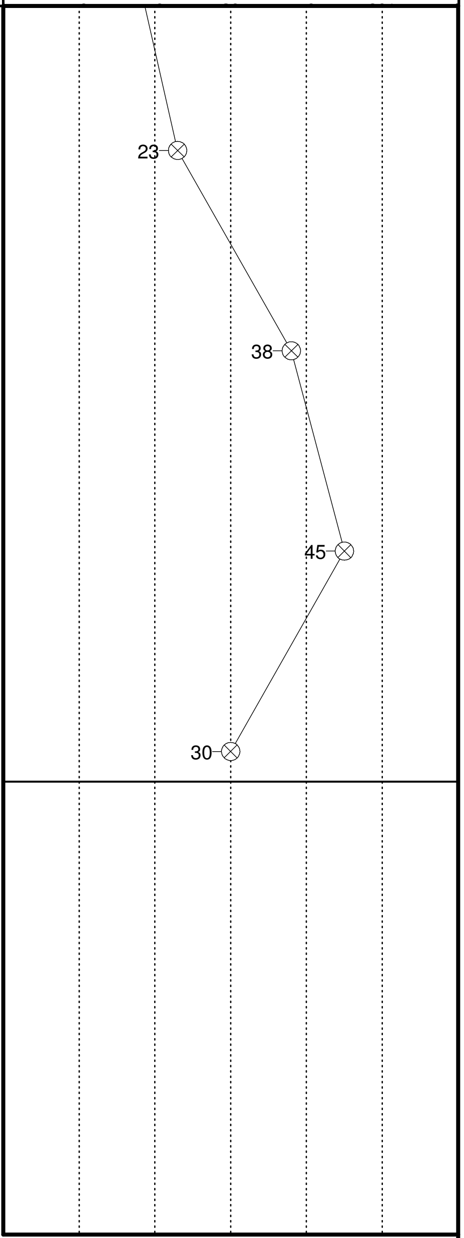
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL   ENGLISH UNITS

BOTTOM OF CASING   LOSS OF CIRCULATION

SURFACE ELEVATION 64

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					(CL) SANDY Lean CLAY, Light Purple, Moist, Very Stiff to Hard			
35	S-9	SS	18	18			30	8 10 13
40	S-10	SS	18	18			25	15 17 21
45	S-11	SS	18	18			20	18 20 25
50	S-12	SS	18	18			15	8 11 19
					END OF BORING @ 50.00'			
55							10	
60							5	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/A WS ☐ WD ☐	BORING STARTED 12/26/14	
WL(BCR) WL(ACR)	BORING COMPLETED 12/26/14	CAVE IN DEPTH
WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 4.25 HSA

CLIENT	JOB #	BORING #	SHEET
Pennrose Properties, LLC	37:1404	B-4	1 OF 2

PROJECT NAME Deanwood Hills

ARCHITECT-ENGINEER

SITE LOCATION 5201 Hayes Street, NE, Washington, District of Columbia

NORTHING

EASTING

STATION

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY

RQD% – — – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

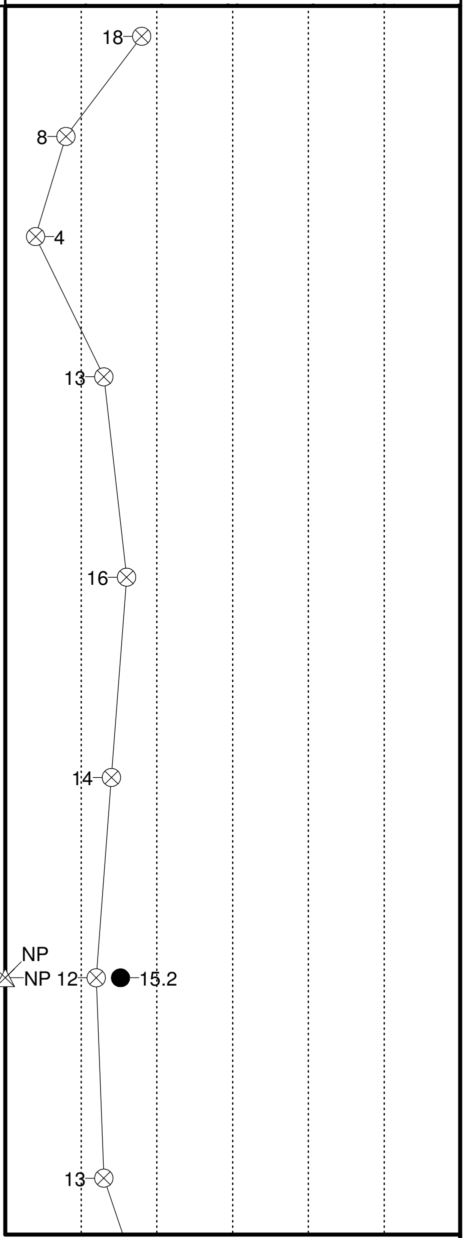
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING LOSS OF CIRCULATION

SURFACE ELEVATION 61

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	18	Topsoil Depth [1"] (SM FILL) SILTY SAND WITH GRAVEL, Contains Asphalt and Organics, Light Brown and Black, Moist, Loose to Medium Dense		60	5 12 6
	S-2	SS	18	5				4 4 4
5	S-3	SS	18	18	(CL) SANDY LEAN CLAY, Light Brown and Gray, Moist, Soft to Very Stiff		55	2 2 2
10	S-4	SS	18	18			50	3 4 9
15	S-5	SS	18	15			45	5 6 10
20	S-6	SS	18	18			40	3 5 9
					(SM) SILTY SAND, Light Brown, Moist, Medium Dense			
25	S-7	SS	18	18			35	2 5 7
30	S-8	SS	18	18		▽		3 5 8



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL 28.50 WS ☐ WD ☐	BORING STARTED 12/26/14	
▽ WL(BCR) 32.00 ▼ WL(ACR)	BORING COMPLETED 12/26/14	CAVE IN DEPTH
▽ WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 4.25 HSA

CLIENT	JOB #	BORING #	SHEET
Pennrose Properties, LLC	37:1404	B-4	2 OF 2

PROJECT NAME	ARCHITECT-ENGINEER
Deanwood Hills	

SITE LOCATION

5201 Hayes Street, NE, Washington, District of Columbia

NORTHING	EASTING	STATION

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY

RQD% – — – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

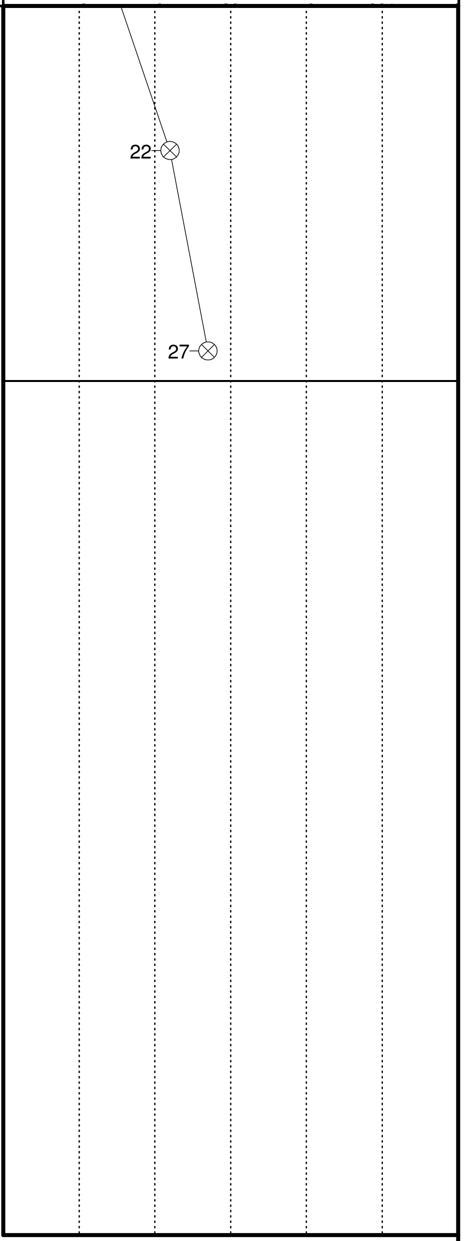
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING LOSS OF CIRCULATION

SURFACE ELEVATION 61

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					(SM) SILTY SAND, Light Brown, Moist, Medium Dense		30	
					(CL) SANDY LEAN CLAY WITH GRAVEL, Light Brown, Moist, Very Stiff	▽		
	S-9	SS	18	10				9 9 13
35							25	
	S-10	SS	18	8				10 12 15
40					END OF BORING @ 40.00'			
							20	
45							15	
50							10	
55							5	
60							0	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL 28.50 WS ☐ WD ☐	BORING STARTED 12/26/14	
▽ WL(BCR) 32.00 ▼ WL(ACR)	BORING COMPLETED 12/26/14	CAVE IN DEPTH
▽ WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 4.25 HSA

CLIENT	JOB #	BORING #	SHEET
Pennrose Properties, LLC	37:1404	B-5	1 OF 2

PROJECT NAME: Deanwood Hills

ARCHITECT-ENGINEER:

SITE LOCATION: 5201 Hayes Street, NE, Washington, District of Columbia

NORTHING: EASTING: STATION:

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➧ LOSS OF CIRCULATION

SURFACE ELEVATION 63

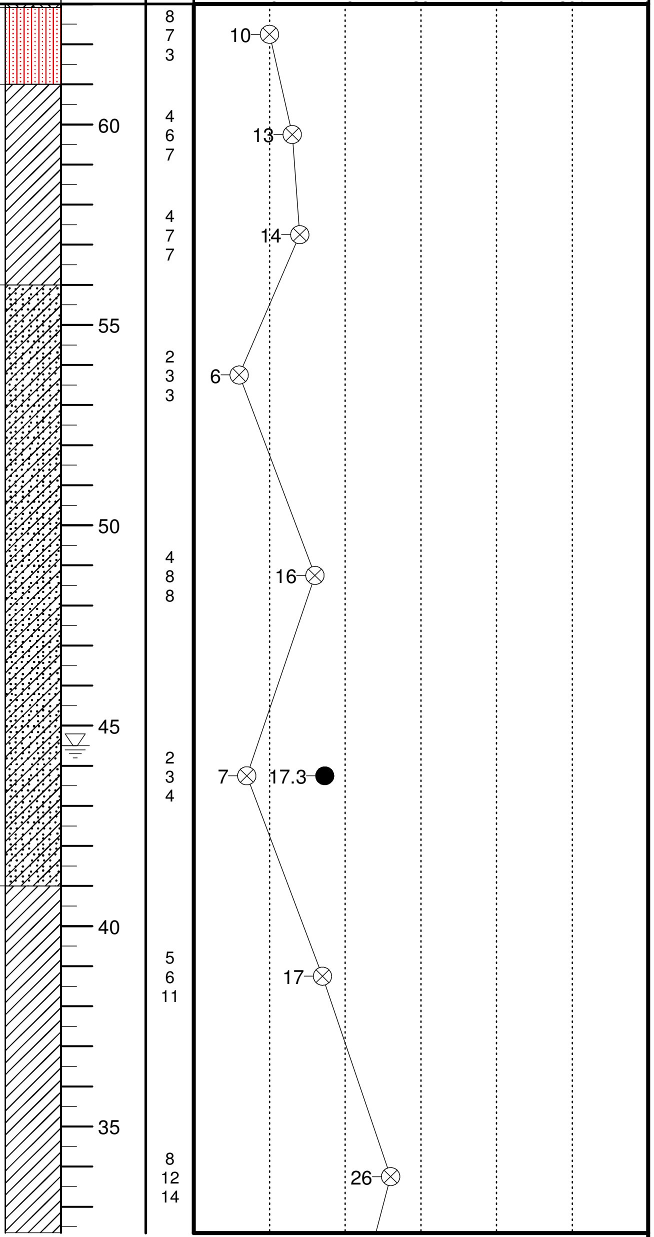
-○- CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – – – REC% ———

PLASTIC LIMIT% ✕ — WATER CONTENT% ● — LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"	STANDARD PENETRATION BLOWS/FT
0	S-1	SS	18	10	Topsoil Depth [1"] (SM FILL) SILTY SAND WITH GRAVEL, Contains Brick and Asphalt, Black, Moist, Loose			8 7 3	10
	S-2	SS	18	18	(CL) SANDY LEAN CLAY, Light Brown, Moist, Stiff		60	4 6 7	13
5	S-3	SS	18	18				4 7 7	14
					(SC) CLAYEY SAND, Light Brown, Moist, Loose to Medium Dense		55		
10	S-4	SS	18	18				2 3 3	6
							50		
15	S-5	SS	18	18				4 8 8	16
						▽	45		
20	S-6	SS	18	18				2 3 4	7 (water content 17.3)
					(CL) SANDY Lean CLAY, Light Purple, Moist, Very Stiff		40		
25	S-7	SS	18	18				5 6 11	17
							35		
30	S-8	SS	18	18				8 12 14	26



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL 18.50 WS ☐ WD ☐	BORING STARTED 12/18/14	
▽ WL(BCR) ▼ WL(ACR)	BORING COMPLETED 12/18/14	CAVE IN DEPTH
▽ WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 4.25 HSA

CLIENT
Pennrose Properties, LLC

JOB #
37:1404

BORING #
B-5

SHEET
2 OF 2

PROJECT NAME
Deanwood Hills

ARCHITECT-ENGINEER

SITE LOCATION
5201 Hayes Street, NE, Washington, District of Columbia

NORTHING

EASTING

STATION

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — –   REC% ———

PLASTIC LIMIT% × —— WATER CONTENT% ● —— LIQUID LIMIT% △

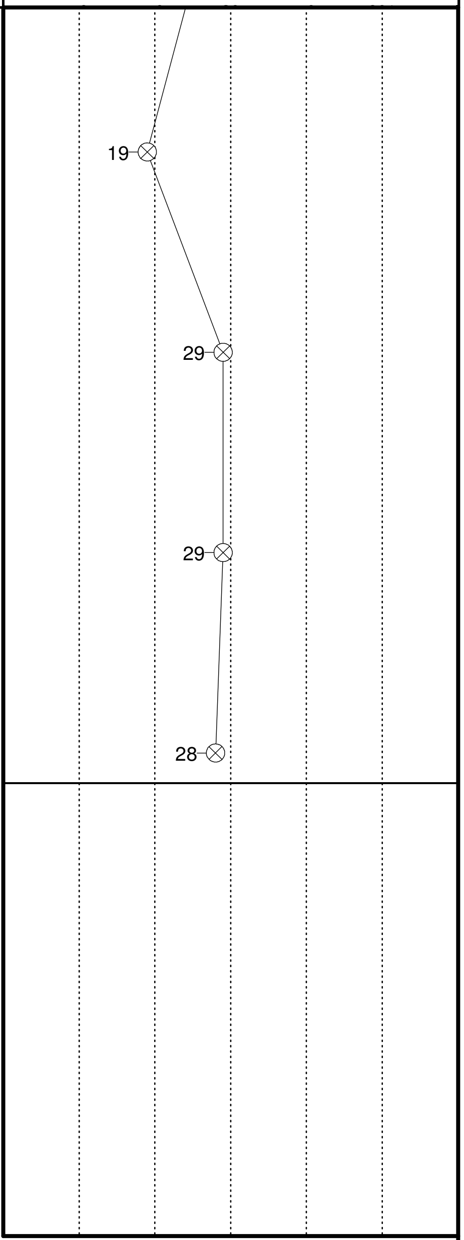
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➤ — LOSS OF CIRCULATION

SURFACE ELEVATION 63

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					(CL) SANDY Lean CLAY, Light Purple, Moist, Very Stiff			
							30	
	S-9	SS	18	18				5 8 11
35								
							25	
	S-10	SS	18	18				7 13 16
40								
							20	
	S-11	SS	18	18				6 10 19
45								
							15	
	S-12	SS	18	18				8 16 12
50					END OF BORING @ 50.00'			
							10	
55								
							5	
60								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 18.50 WS ☐ WD ☐	BORING STARTED 12/18/14	
WL(BCR) WL(ACR)	BORING COMPLETED 12/18/14	CAVE IN DEPTH
WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 4.25 HSA

CLIENT	JOB #	BORING #	SHEET
Pennrose Properties, LLC	37:1404	B-6	1 OF 2

PROJECT NAME: Deanwood Hills

ARCHITECT-ENGINEER:

SITE LOCATION: 5201 Hayes Street, NE, Washington, District of Columbia

NORTHING: EASTING: STATION:

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – – – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

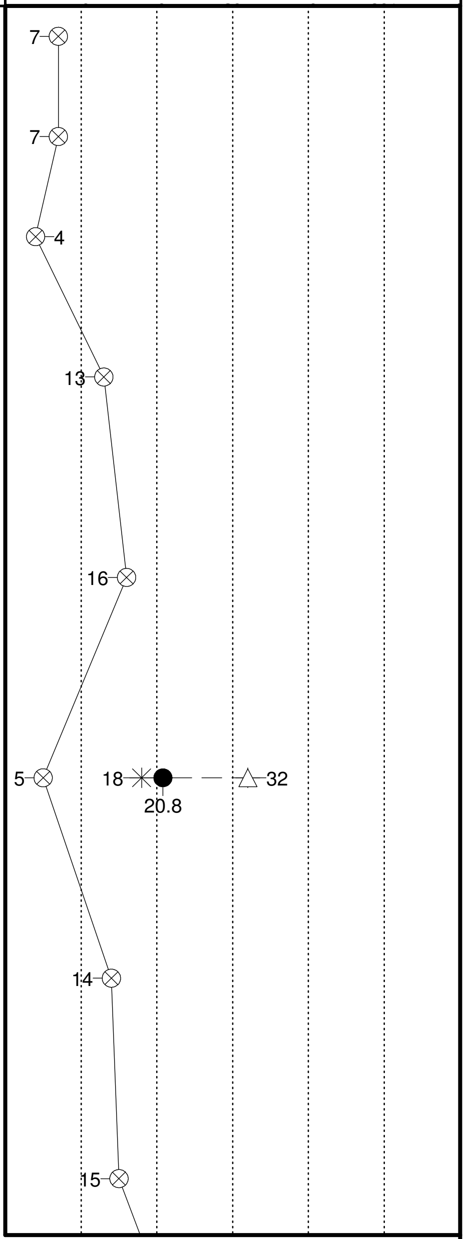
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ➤ LOSS OF CIRCULATION

SURFACE ELEVATION 60

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	15	Topsoil Depth [1"] (CL FILL) SANDY LEAN CLAY, Contains Organics and Concrete, Light Brown, Moist, Soft to Medium Stiff	60	2 4 3
	S-2	SS	18	18			6 4 3
5	S-3	SS	18	18		55	3 2 2
	S-4	SS	18	10	(CL) SANDY LEAN CLAY, Contains Organics, Light Brown and Gray, Moist, Stiff to Very Stiff		5 5 8
10						50	
	S-5	SS	18	15			8 10 6
15						45	
					(CL) SANDY LEAN CLAY, Light Brown, Moist, Medium Stiff to Stiff		
	S-6	SS	18	18			2 2 3
20						40	
	S-7	SS	18	18			2 7 7
25						35	
					(GP) GRAVEL WITH SAND, Brown, Moist, Medium Dense		
	S-8	SS	18	15			7 10 5
30						30	



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL 28.50 WS ☐ WD ☐	BORING STARTED 12/19/14	
WL(BCR) WL(ACR)	BORING COMPLETED 12/19/14	CAVE IN DEPTH
▽ WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 4.25 HSA

CLIENT	JOB #	BORING #	SHEET
Pennrose Properties, LLC	37:1404	B-6	2 OF 2

PROJECT NAME: Deanwood Hills

ARCHITECT-ENGINEER:

SITE LOCATION: 5201 Hayes Street, NE, Washington, District of Columbia

NORTHING: EASTING: STATION:

-○- CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% × WATER CONTENT% ● LIQUID LIMIT% △

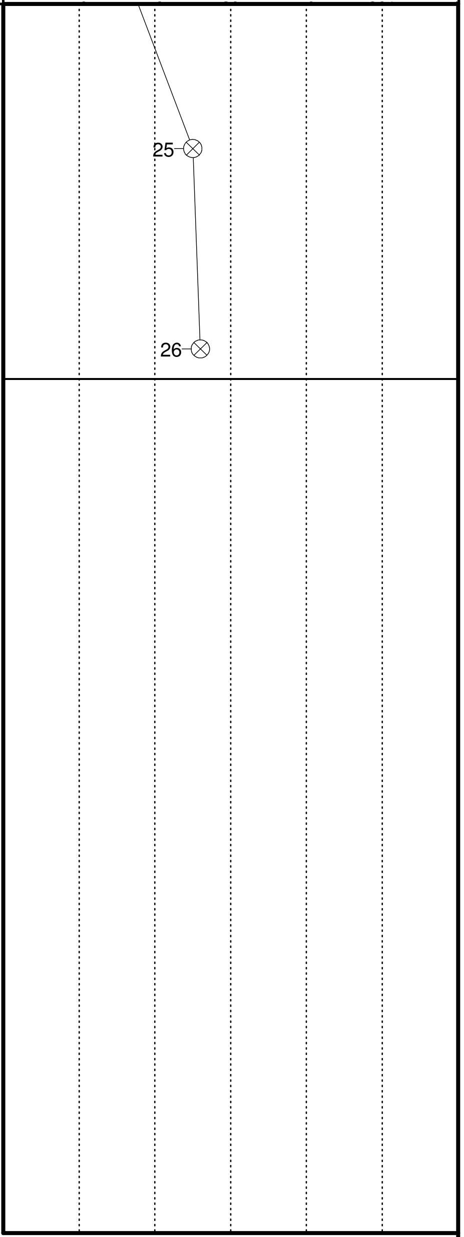
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING LOSS OF CIRCULATION

SURFACE ELEVATION 60

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"	STANDARD PENETRATION BLOWS/FT
					(GP) GRAVEL WITH SAND, Brown, Moist, Medium Dense				
					(CL) SANDY Lean CLAY, Light Purple, Moist, Very Stiff				
	S-9	SS	18	18				8 10 15	25
35							25		
	S-10	SS	18	15				8 12 14	26
40					END OF BORING @ 40.00'		20		
45							15		
50							10		
55							5		
60							0		



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 28.50 WS ☐ WD ☐	BORING STARTED 12/19/14	
WL(BCR) WL(ACR)	BORING COMPLETED 12/19/14	CAVE IN DEPTH
WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 4.25 HSA

CLIENT	JOB #	BORING #	SHEET
Pennrose Properties, LLC	37:1404	B-7	1 OF 2

PROJECT NAME: Deanwood Hills

ARCHITECT-ENGINEER:

SITE LOCATION: 5201 Hayes Street, NE, Washington, District of Columbia

NORTHING:
EASTING:
STATION:

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION 100%

SURFACE ELEVATION 57

-○- CALIBRATED PENETROMETER TONS/FT^2

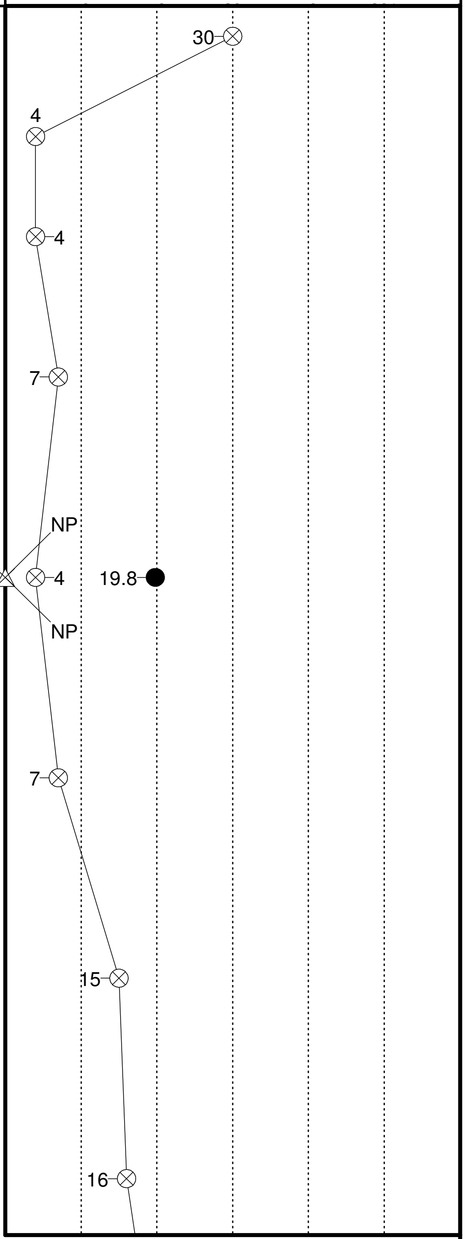
ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — –   REC% ———

PLASTIC LIMIT% ✕ — WATER CONTENT% ● — LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	BLOWS/6"
0	S-1	SS	18	15	(SM FILL) SILTY SAND WITH GRAVEL, Contains Concrete, Brick, and Asphalt, Brown, Moist, Loose to Dense	12 13 17
	S-2	SS	18	10		2 2 2
5	S-3	SS	18	18	(CL) SANDY LEAN CLAY, Light Brown, Moist, Soft to Medium Stiff	1 2 2
10	S-4	SS	18	18		1 3 4
15	S-5	SS	18	18	(SM) SILTY SAND WITH GRAVEL, Light Brown and Gray, Moist, Very Loose to Medium Dense	1 2 2
20	S-6	SS	18	18		2 3 4
25	S-7	SS	18	15		3 8 7
30	S-8	SS	18	18	(ML) SANDY SILT, Light Brown, Moist, Medium Dense to Dense	5 8 8

ELEVATION (FT): 55, 50, 45, 40, 35, 30



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 13.50 WS ☐ WD ☐	BORING STARTED 12/22/14	
WL(BCR) WL(ACR)	BORING COMPLETED 12/22/14	CAVE IN DEPTH
WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 4.25 HSA

CLIENT
Pennrose Properties, LLC

JOB #
37:1404

BORING #
B-7

SHEET
2 OF 2

PROJECT NAME
Deanwood Hills

ARCHITECT-ENGINEER

SITE LOCATION
5201 Hayes Street, NE, Washington, District of Columbia

NORTHING

EASTING

STATION

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

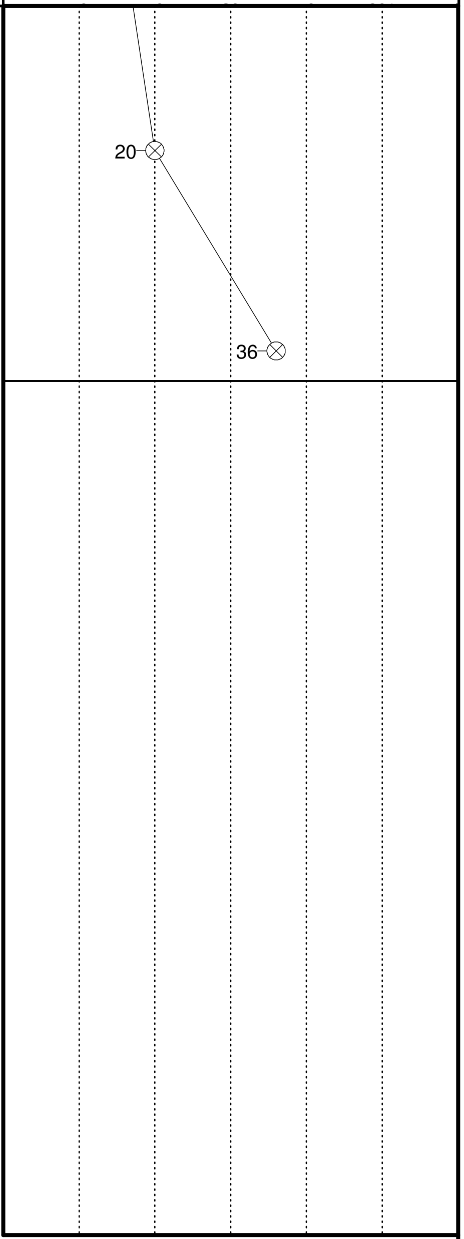
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING LOSS OF CIRCULATION 100%

SURFACE ELEVATION 57

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					(ML) SANDY SILT, Light Brown, Moist, Medium Dense to Dense		25	
	S-9	SS	18	18				6 10 10
35								
							20	
	S-10	SS	18	18				14 17 19
40					END OF BORING @ 40.00'			
							15	
45								
							10	
50								
							5	
55								
							0	
60								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 13.50 WS ☐ WD ☐

WL(BCR) WL(ACR)

WL

BORING STARTED 12/22/14

BORING COMPLETED 12/22/14

CAVE IN DEPTH

RIG 750 ATV FOREMAN Nadal

DRILLING METHOD 4.25 HSA

CLIENT
Pennrose Properties, LLC

JOB #
37:1404

BORING #
B-8

SHEET
1 OF 2

PROJECT NAME
Deanwood Hills

ARCHITECT-ENGINEER

SITE LOCATION
5201 Hayes Street, NE, Washington, District of Columbia

NORTHING

EASTING

STATION

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➤ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 58

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – – – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT

SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	BLOWS/6"
S-1	SS	18	18	2 2 3
S-2	SS	18	18	5 7 7
S-3	SS	18	18	10 12 19
S-4	SS	18	15	3 2 1
S-5	SS	18	18	3 5 6
S-6	SS	18	15	3 3 3
S-7	SS	18	10	3 6 6
S-8	SS	18	16	5 6 6

DEPTH (FT): 0, 5, 10, 15, 20, 25, 30

ELEVATION (FT): 55, 50, 45, 40, 35, 30

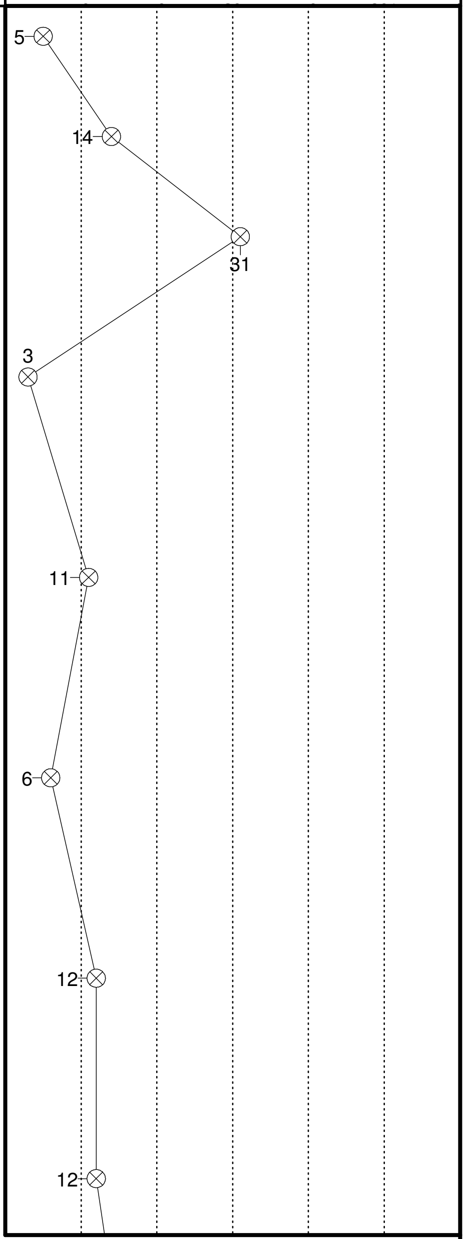
Topsoil Depth [2"]

(CL FILL) SANDY LEAN CLAY, Contains Brick, Brown, Moist, Medium Stiff to Stiff

(SM FILL) SILTY SAND, Contains Asphalt, Brown and Black, Moist, Dense

(CL) SANDY LEAN CLAY, Light Brown, Moist, Soft to Stiff

(SM) SILTY SAND WITH GRAVEL, Brown, Wet, Medium Dense



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 33.50 WS ☐ WD ☐

BORING STARTED 12/26/14

WL(BCR) 19.50 WL(ACR)

BORING COMPLETED 12/26/14

CAVE IN DEPTH

WL

RIG 750 ATV FOREMAN Nadal

DRILLING METHOD 4.25 HSA

CLIENT Pennrose Properties, LLC	JOB # 37:1404	BORING # B-8	SHEET 2 OF 2
PROJECT NAME Deanwood Hills	ARCHITECT-ENGINEER		
SITE LOCATION 5201 Hayes Street, NE, Washington, District of Columbia			
NORTHING	EASTING	STATION	

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

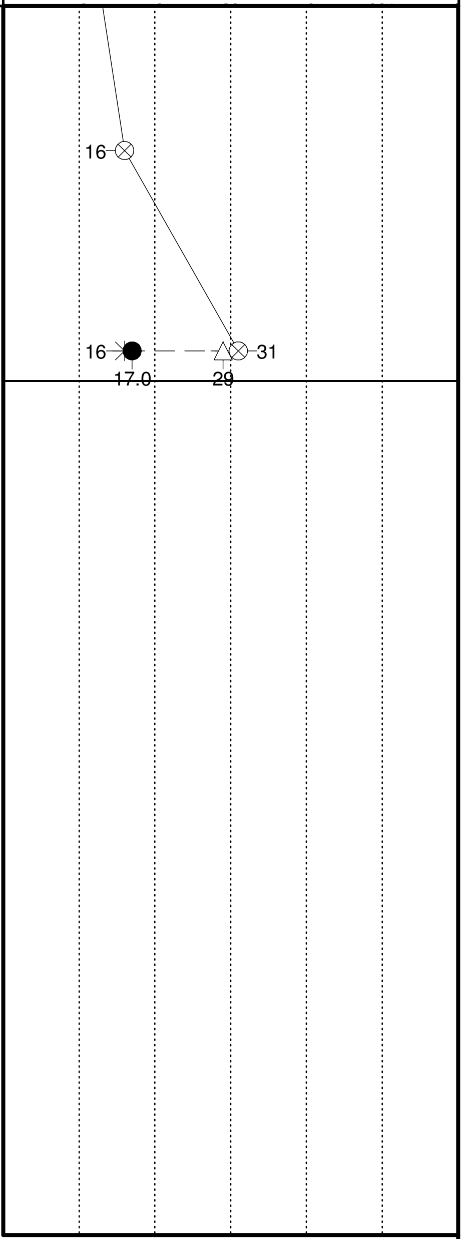
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING LOSS OF CIRCULATION

SURFACE ELEVATION 58

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					(SM) SILTY SAND WITH GRAVEL, Brown, Wet, Medium Dense			
					(CL) SANDY Lean CLAY, Light Purple, Moist, Very Stiff to Hard		25	
						▽		
	S-9	SS	18	18				5 6 10
35								
							20	
	S-10	SS	18	18				12 14 17
40					END OF BORING @ 40.00'			
							15	
45								
							10	
50								
							5	
55								
							0	
60								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL 33.50 WS ☐ WD ☐	BORING STARTED 12/26/14	
▽ WL(BCR) 19.50 ▼ WL(ACR)	BORING COMPLETED 12/26/14	CAVE IN DEPTH
▽ WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 4.25 HSA

CLIENT	JOB #	BORING #	SHEET
Pennrose Properties, LLC	37:1404	B-9	1 OF 1

PROJECT NAME: Deanwood Hills

ARCHITECT-ENGINEER:

SITE LOCATION: 5201 Hayes Street, NE, Washington, District of Columbia

NORTHING: EASTING: STATION:

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY

RQD% – — – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

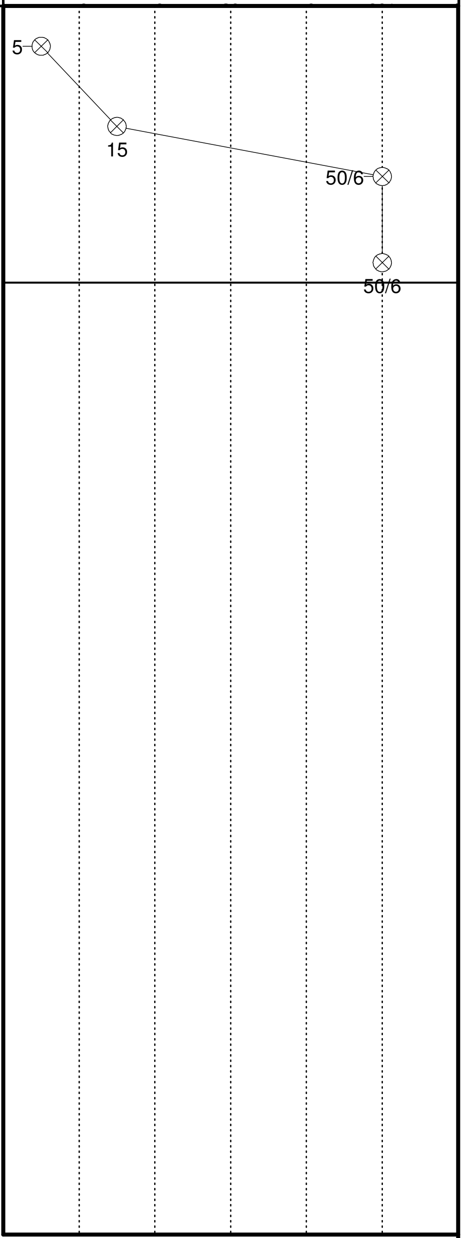
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ➤ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 61

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	2	Topsoil Depth [1"] (CL FILL) SANDY LEAN CLAY WITH GRAVEL, Contains Concrete and Asphalt, Light Brown, Moist, Medium Stiff to Stiff		60	1 2 3 9
	S-2	SS	24	15		▽		13 10 5 8
	S-3	SS	6	6	(ML) SANDY SILT WITH GRAVEL, Brown, Moist, Very Dense			50/6
5					(SM) SILTY SAND, Brown, Moist, Very Dense		55	
	S-4	SS	12	1				13 50/6
					END OF BORING @ 6.9'			
10							50	
15							45	
20							40	
25							35	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL 4.00 WS ☐ WD ☐	BORING STARTED 12/18/14	
▽ WL(BCR) ▼ WL(ACR)	BORING COMPLETED 12/18/14	CAVE IN DEPTH
▽ WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 2.25 HSA

CLIENT Pennrose Properties, LLC
JOB # 37:1404
BORING # B-10
SHEET 1 OF 1
PROJECT NAME Deanwood Hills
ARCHITECT-ENGINEER
SITE LOCATION 5201 Hayes Street, NE, Washington, District of Columbia
NORTHING
EASTING
STATION

-○- CALIBRATED PENETROMETER TONS/FT^2

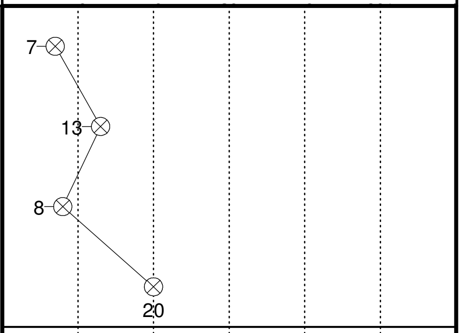
ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% × WATER CONTENT% ● LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL ENGLISH UNITS
BOTTOM OF CASING LOSS OF CIRCULATION
SURFACE ELEVATION 58

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	18	Topsoil Depth [2"] (CL FILL) LEAN CLAY WITH SAND, Brown, Moist, Medium Stiff to Stiff			1 2 5 6
	S-2	SS	24	24			55	4 6 7 7
5	S-3	SS	24	24	(CL FILL) SANDY LEAN CLAY, Brown Light Brown and Gray, Moist, Medium Stiff to Very Stiff			3 4 4 7
	S-4	SS	24	24				9 11 9 9
					END OF BORING @ 8.00'		50	
10							45	
15							40	
20							35	
25							30	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/A WS ☐ WD ☐	BORING STARTED 12/18/14	
WL(BCR) WL(ACR)	BORING COMPLETED 12/18/14	CAVE IN DEPTH
WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 2.25 HSA

CLIENT	JOB #	BORING #	SHEET
Pennrose Properties, LLC	37:1404	B-11	1 OF 1

PROJECT NAME: Deanwood Hills

ARCHITECT-ENGINEER:

SITE LOCATION: 5201 Hayes Street, NE, Washington, District of Columbia

NORTHING: EASTING: STATION:

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – – – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

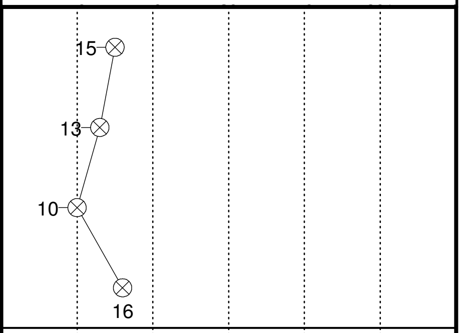
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➤ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 58

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [1"]			
	S-1	SS	24	20	(SC FILL) CLAYEY SAND WITH GRAVEL, Gray, Moist, Medium Dense			3 7 8 8
	S-2	SS	24	1			55	5 6 7 8
5	S-3	SS	24	24	(CL) SANDY LEAN CLAY, Light Brown and Gray, Moist, Stiff to Very Stiff			4 4 6 6
	S-4	SS	24	24				6 7 9 10
					END OF BORING @ 8.00'		50	
10								
							45	
15								
							40	
20								
							35	
25								
							30	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/A WS ☐ WD ☐	BORING STARTED 12/16/14	
WL(BCR) WL(ACR)	BORING COMPLETED 12/16/14	CAVE IN DEPTH
WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 2.25 HSA

CLIENT
Pennrose Properties, LLC

JOB #
37:1404

BORING #
B-12

SHEET
1 OF 1

PROJECT NAME
Deanwood Hills

ARCHITECT-ENGINEER

SITE LOCATION
5201 Hayes Street, NE, Washington, District of Columbia

NORTHING

EASTING

STATION

—○— CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

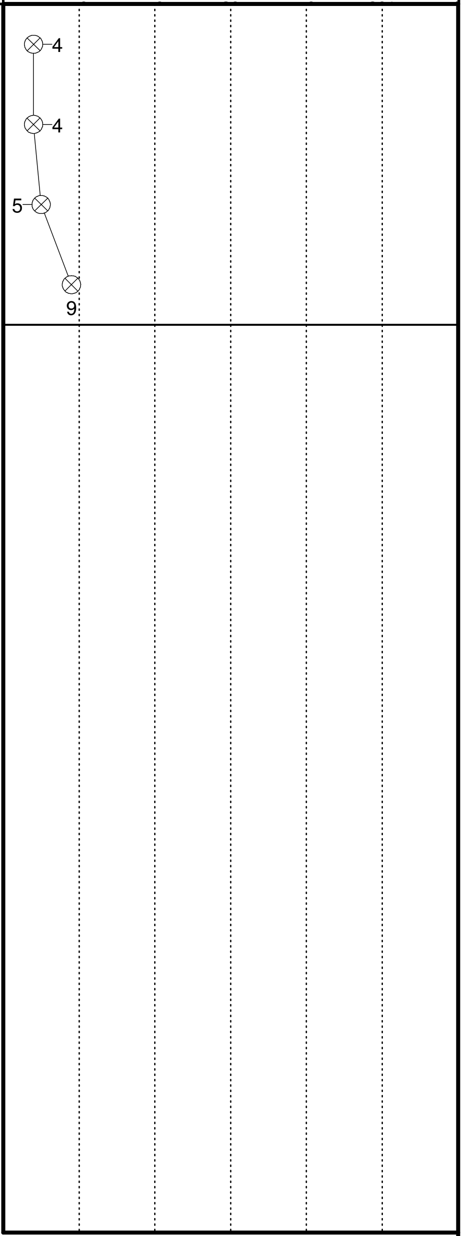
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➡ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 60

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [1"]		60	
	S-1	SS	24	18	(CL) LEAN CLAY WITH SAND, Light Brown, Moist, Soft			2 2 2 2
	S-2	SS	24	24	(SM) SILTY SAND, Brown, Moist, Very Loose			2 2 2 2
5	S-3	SS	24	20	(CL) SANDY LEAN CLAY, Light Brown and Gray, Moist, Medium Stiff		55	2 2 3 3
	S-4	SS	24	18	(ML) SANDY SILT, Light Brown, Moist, Loose			5 4 5 4
					END OF BORING @ 8.00'			
10							50	
15							45	
20							40	
25							35	
30							30	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/A WS ☐ WD ☐

BORING STARTED 12/17/14

WL(BCR) WL(ACR)

BORING COMPLETED 12/17/14

CAVE IN DEPTH

WL

RIG 750 ATV FOREMAN Nadal

DRILLING METHOD 2.25 HSA

CLIENT
Pennrose Properties, LLC

JOB #
37:1404

BORING #
B-13

SHEET
1 OF 1

PROJECT NAME
Deanwood Hills

ARCHITECT-ENGINEER

SITE LOCATION
5201 Hayes Street, NE, Washington, District of Columbia

NORTHING

EASTING

STATION

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

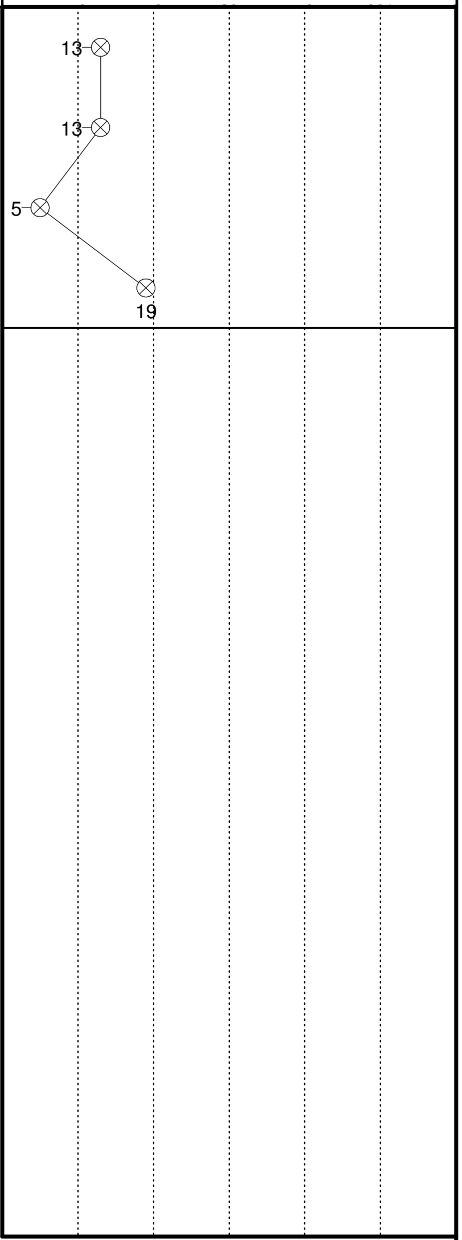
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➤ LOSS OF CIRCULATION

SURFACE ELEVATION 61

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [1"]			
	S-1	SS	24	24	(CL) SANDY LEAN CLAY, Light Brown, Moist, Medium Stiff to Very Stiff		60	4 8 5 5
	S-2	SS	24	18				6 6 7 7
5	S-3	SS	24	24				2 2 3 4
							55	
	S-4	SS	24	24				6 8 11 11
					END OF BORING @ 8.00'			
10							50	
15							45	
20							40	
25							35	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/A WS ☐ WD ☐

BORING STARTED 12/17/14

WL(BCR) WL(ACR)

BORING COMPLETED 12/17/14

CAVE IN DEPTH

WL

RIG 750 ATV FOREMAN Nadal

DRILLING METHOD 2.25 HSA

CLIENT Pennrose Properties, LLC	JOB # 37:1404	BORING # B-14	SHEET 1 OF 1
PROJECT NAME Deanwood Hills	ARCHITECT-ENGINEER		

SITE LOCATION
5201 Hayes Street, NE, Washington, District of Columbia

NORTHING
EASTING
STATION

DESCRIPTION OF MATERIAL ENGLISH UNITS
BOTTOM OF CASING ➤ LOSS OF CIRCULATION
SURFACE ELEVATION 61

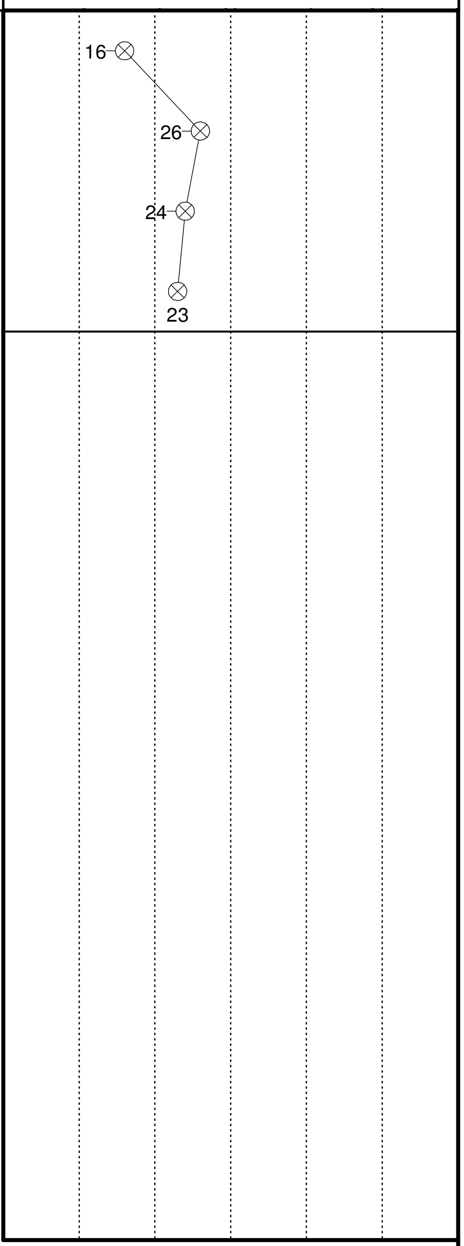
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	24	18	Topsoil Depth [1"], Asphalt Depth [24"]	60	2 2 14 16
	S-2	SS	24	18	(DEBRIS FILL), Contains Brick, Organics, and Asphalt		11 10 16 12
5	S-3	SS	24	15			9 12 12 14
	S-4	SS	24	20	(ML) SANDY SILT, Gray, Moist, Medium Dense	55	9 11 12 10
					END OF BORING @ 8.00'		
10						50	
15						45	
20						40	
25						35	
30							

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – – – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/A WS ☐ WD ☐	BORING STARTED 12/17/14	
WL(BCR) WL(ACR)	BORING COMPLETED 12/17/14	CAVE IN DEPTH
WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 2.25 HSA

CLIENT	JOB #	BORING #	SHEET
Pennrose Properties, LLC	37:1404	B-15	1 OF 1

PROJECT NAME: Deanwood Hills

ARCHITECT-ENGINEER:

SITE LOCATION: 5201 Hayes Street, NE, Washington, District of Columbia

NORTHING:

EASTING:

STATION:

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — –   REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

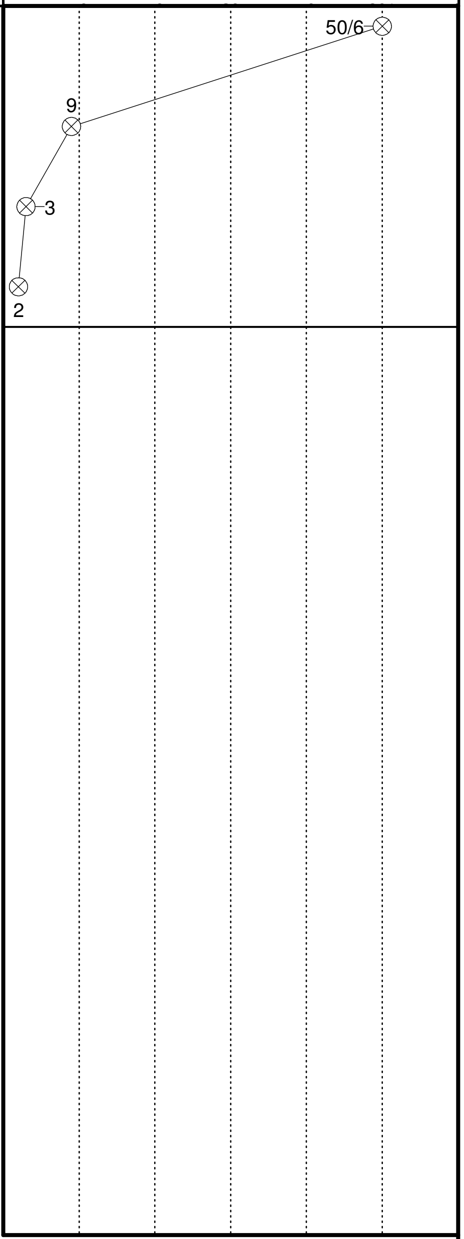
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➤   LOSS OF CIRCULATION

SURFACE ELEVATION 59

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	12	8	Topsoil Depth [1"] (ML FILL) SANDY SILT, Contains Slight Organics, Brown and Black, Moist, Very Dense			2 50/6
	S-2	SS	24	24	(ML) SANDY SILT, Contains Slight Organics, Light Brown, Moist, Loose			7 5 4 4
5	S-3	SS	24	24	(ML) SANDY SILT, Light Brown, Moist, Very Loose		55	1 1 2 2
	S-4	SS	24	24	(CL) SANDY LEAN CLAY, Light Brown, Moist, Very Soft			1 1 1 2
					END OF BORING @ 8.00'		50	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/A WS ☐ WD ☐	BORING STARTED 12/17/14	
WL(BCR) WL(ACR)	BORING COMPLETED 12/17/14	CAVE IN DEPTH
WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 2.25 HSA

CLIENT
Pennrose Properties, LLC

JOB #
37:1404

BORING #
B-16

SHEET
1 OF 1

PROJECT NAME
Deanwood Hills

ARCHITECT-ENGINEER

SITE LOCATION
5201 Hayes Street, NE, Washington, District of Columbia

NORTHING

EASTING

STATION

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — –   REC% ———

PLASTIC LIMIT% ✕ —— WATER CONTENT% ● —— LIQUID LIMIT% △

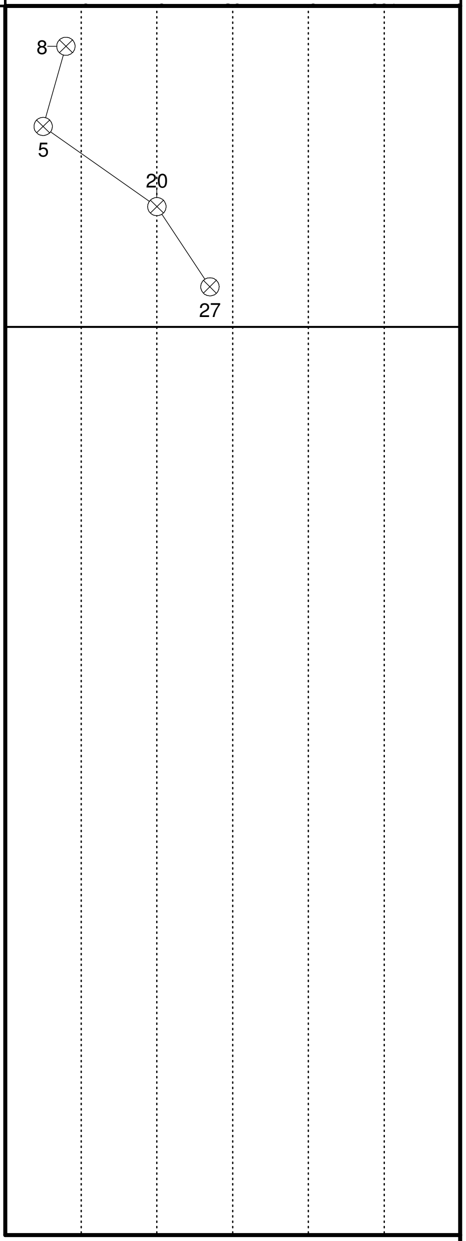
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL   ENGLISH UNITS

BOTTOM OF CASING ➡   LOSS OF CIRCULATION

SURFACE ELEVATION 61

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [1"]			
	S-1	SS	24	15	(CL FILL) SANDY LEAN CLAY WITH GRAVEL, Contains Concrete, Brick, and Asphalt, Brown and Black, Moist, Medium Stiff to Very Stiff		60	2 4 4 4
	S-2	SS	24	10				2 2 3 3
5	S-3	SS	24	20				6 8 12 18
	S-4	SS	24	18			55	14 17 10 9
					END OF BORING @ 8.00'			
10							50	
15							45	
20							40	
25							35	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/A   WS ☐   WD ☐

BORING STARTED 12/17/14

WL(BCR)   WL(ACR)

BORING COMPLETED 12/17/14

CAVE IN DEPTH

WL

RIG 750 ATV   FOREMAN Nadal

DRILLING METHOD 2.25 HSA

CLIENT
Pennrose Properties, LLC

JOB #
37:1404

BORING #
B-17

SHEET
1 OF 1

PROJECT NAME
Deanwood Hills

ARCHITECT-ENGINEER

SITE LOCATION
5201 Hayes Street, NE, Washington, District of Columbia

NORTHING

EASTING

STATION

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — –   REC% ———

PLASTIC LIMIT% × —— WATER CONTENT% ● —— LIQUID LIMIT% △

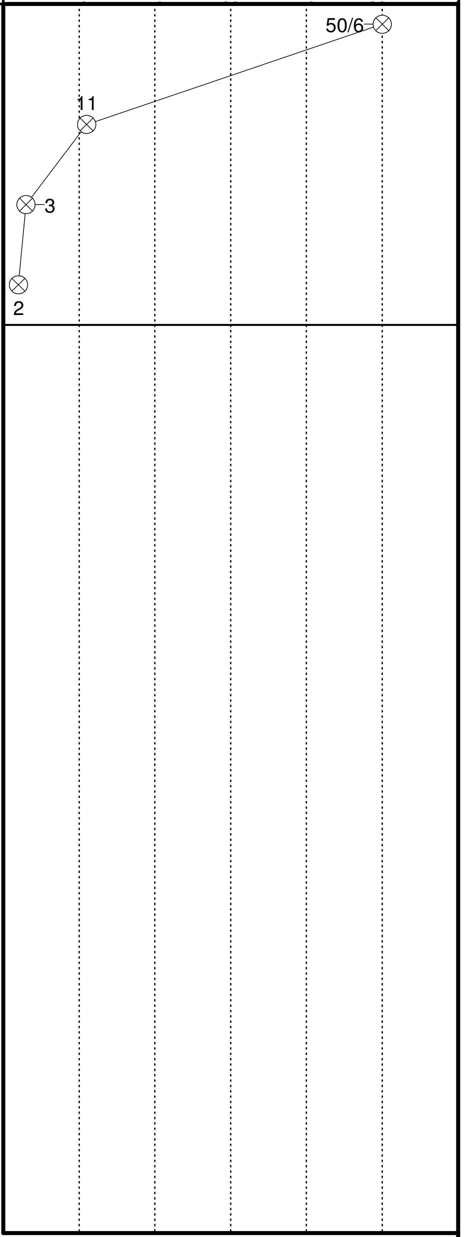
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL   ENGLISH UNITS

BOTTOM OF CASING   LOSS OF CIRCULATION

SURFACE ELEVATION 58

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	12	8	Asphalt Depth [24"]			9 50/6
	S-2	SS	24	18	(ML) SANDY SILT, Contains Organics, Light Brown, Moist, Hard to Stiff		55	14 7 4 4
5	S-3	SS	24	18	(ML) SANDY SILT, Light Brown, Moist, Very Loose			3 2 1 1
	S-4	SS	24	18				1 1 1 2
					END OF BORING @ 8.00'		50	
10								
							45	
15								
							40	
20								
							35	
25								
							30	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/A   WS ☐   WD ☐

BORING STARTED 12/17/14

WL(BCR)   WL(ACR)

BORING COMPLETED 12/17/14

CAVE IN DEPTH

WL

RIG 750 ATV   FOREMAN Nadal

DRILLING METHOD 2.25 HSA

CLIENT	JOB #	BORING #	SHEET
Pennrose Properties, LLC	37:1404	B-18	1 OF 1

PROJECT NAME: Deanwood Hills

ARCHITECT-ENGINEER:

SITE LOCATION: 5201 Hayes Street, NE, Washington, District of Columbia

NORTHING: EASTING: STATION:

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➤ LOSS OF CIRCULATION

SURFACE ELEVATION 57

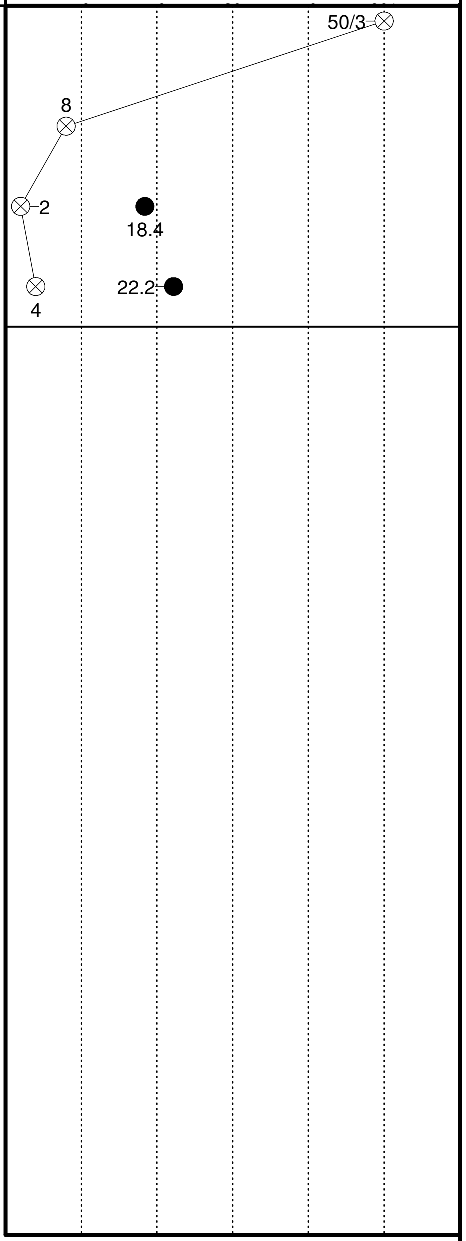
-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% × WATER CONTENT% ● LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	9	8	Topsoil Depth [7"], Asphalt Depth [16"]			15 50/3
	S-2	SS	24	24	(ML) SANDY SILT, Light Brown, Moist, Loose		55	4 4 4 3
5	S-3	SS	24	24	(ML) SANDY SILT, Light Brown, Moist, Very Loose			1 1 1 1
	S-4	SS	24	24			50	1 2 2 3
					END OF BORING @ 8.00'			
10								
							45	
15								
							40	
20								
							35	
25								
							30	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/A WS ☐ WD ☐	BORING STARTED 12/17/14	
WL(BCR) WL(ACR)	BORING COMPLETED 12/17/14	CAVE IN DEPTH
WL	RIG 750 ATV FOREMAN Nadal	DRILLING METHOD 2.25 HSA

Laboratory Testing Summary

Page 1 of 1

Sample Source	Sample Number	Depth (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Percent Passing No. 200 Sieve[4]	Moisture - Density (Corr.)[5]		CBR Value[6]	Other
					LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
B-1												
	S-10	38.50 - 40.00	18.1	CL	27	18	9	73.4				
B-2												
	S-4	8.50 - 10.00	20.2	CL	34	18	16	66.4				
B-3												
	S-4	8.50 - 10.00	19.9									
B-4												
	S-7	23.50 - 25.00	15.2	SM	NP	NP	NP	49.9				
B-5												
	S-6	18.50 - 20.00	17.3									
B-6												
	S-6	18.50 - 20.00	20.8	CL	32	18	14	60.0				
B-7												
	S-5	13.50 - 15.00	19.8	SM	NP	NP	NP	37.7				
B-8												
	S-10	38.50 - 40.00	17.0	CL	29	16	13	71.5				
B-18												
	S-3	4.00 - 6.00	18.4	ML				62.8				
	S-4	6.00 - 8.00	22.2	ML				70.2				

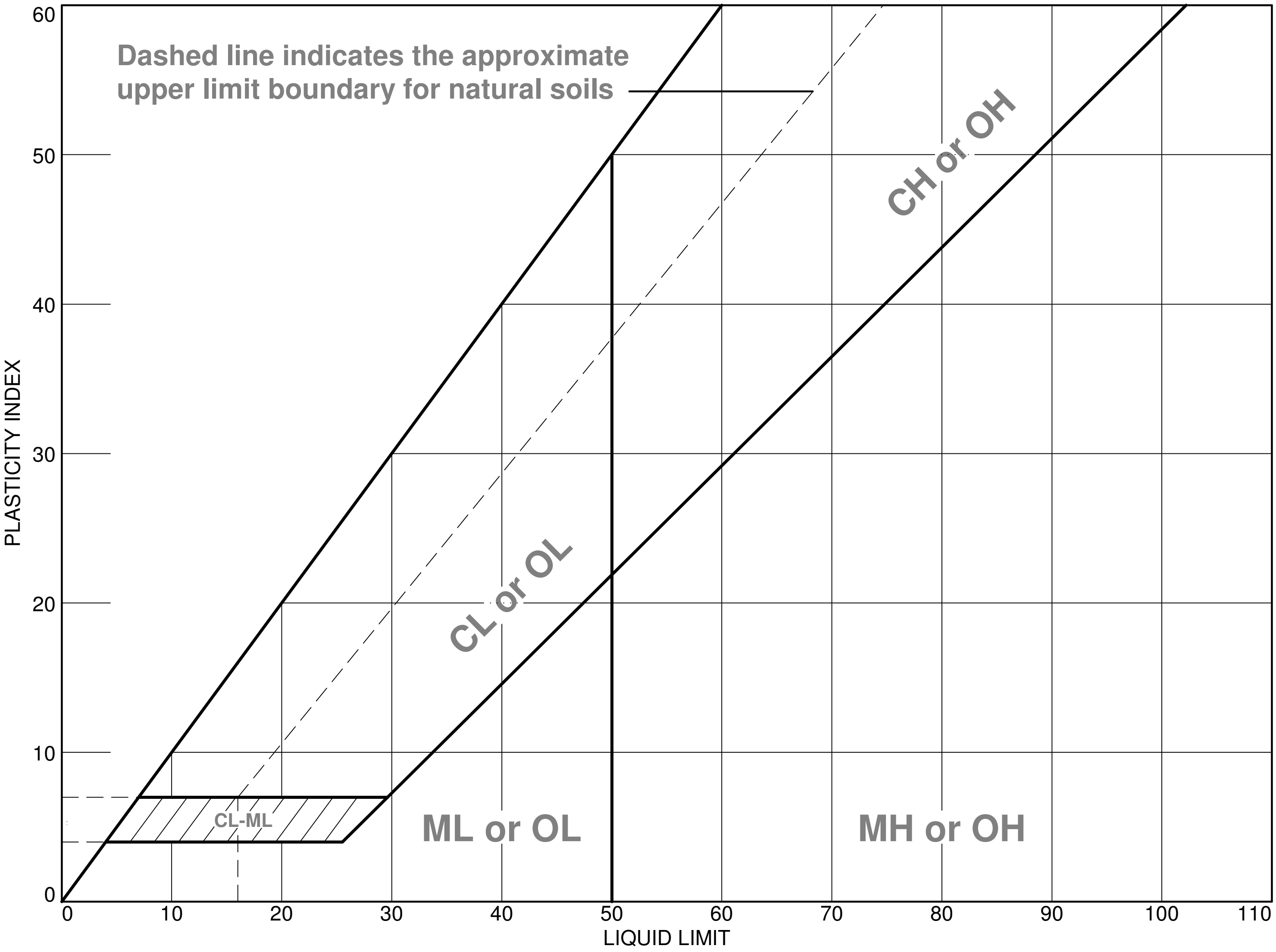
Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content (ASTM D 2974)

Project No. 37:1404
Project Name: Deanwood Hills
PM: Dan Spielvogel
PE: Stephen F. Patt
Printed On: Friday, February 13, 2015

ECS MID-ATLANTIC, LLC
14026 Thunderbolt Place, Suite 100
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sandy Silt Light Brown (ML)				91.1	62.8	ML
■	Silt with Sand Light Brown (ML)				93.7	70.2	ML

Project No. 37:1404 **Client:** Pennrose Properties, LLC

Project: Deanwood Hills

● **Source of Sample:** B-18 **Depth:** 4.00-6.00 **Sample Number:** S-3

■ **Source of Sample:** B-18 **Depth:** 6.00-8.00 **Sample Number:** S-4

Remarks:

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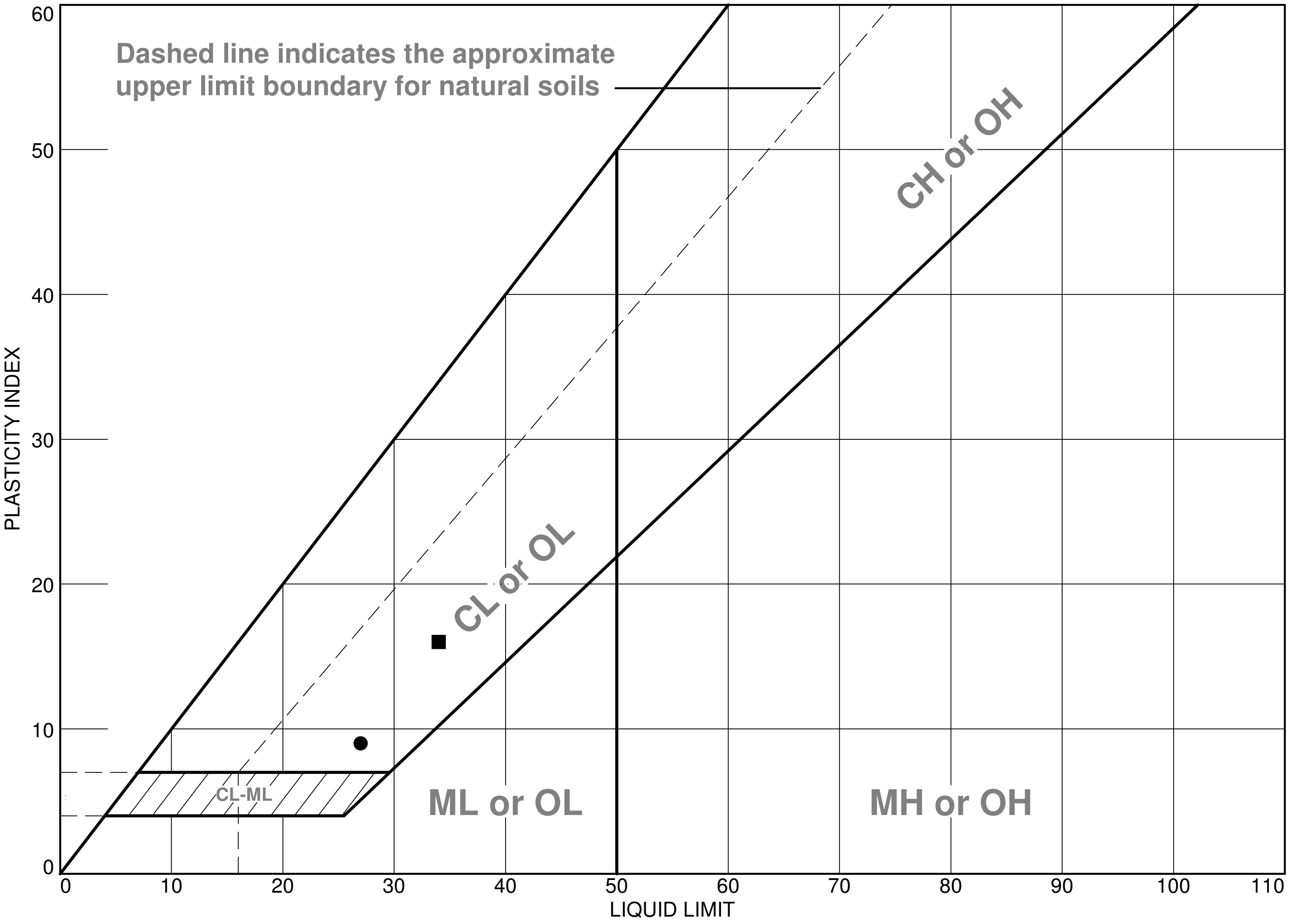
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean Clay with Sand Trace Mica Reddish Brown (CL)	27	18	9	99.9	73.4	CL
■	Sandy Lean Clay Strong Brown (CL)	34	18	16	92.8	66.4	CL
▲	Silty Sand Yellowiah Brown (SM)	NP	NP	NP	93.4	49.9	SM

Project No. 37:1404 **Client:** Pennrose Properties, LLC

Project: Deanwood Hills

● **Source of Sample:** B-1 **Depth:** 38.50-40.00 **Sample Number:** S-10

■ **Source of Sample:** B-2 **Depth:** 8.50-10.00 **Sample Number:** S-4

▲ **Source of Sample:** B-4 **Depth:** 23.50-25.00 **Sample Number:** S-7

Remarks:

● Data Entered: 2/5/15

■ Data Entered: 2/5/15

▲ Data Entered: 2/5/15

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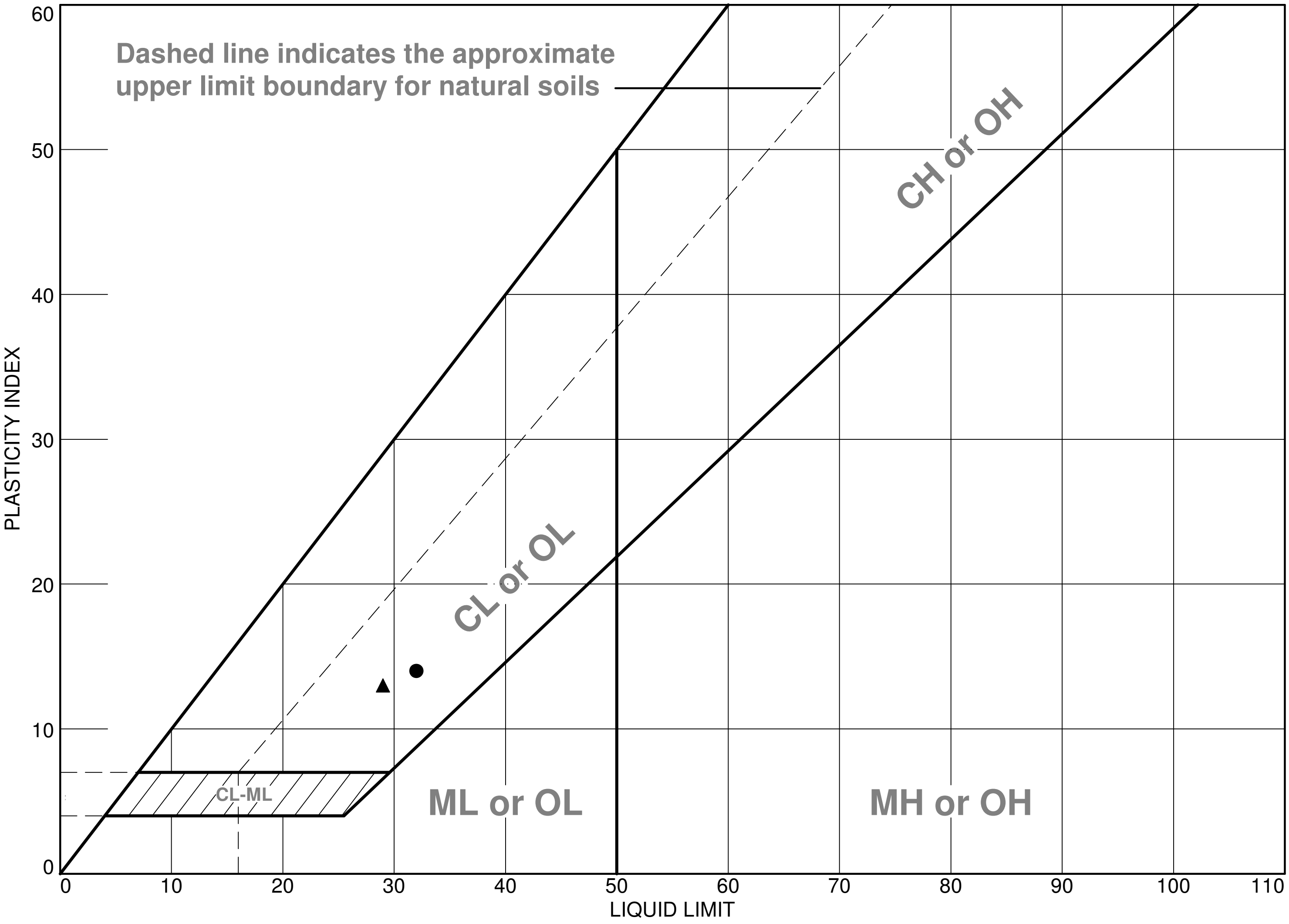
Figure

Tested By: HTN1 **Checked By:** DVT

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sandy Lean Clay Yellowish Brown (CL)	32	18	14	92.6	60.0	CL
■	Silty Sand Grayish Brown (SM)	NP	NP	NP	82.6	37.7	SM
▲	Lean Clay with Sand Trace Mica Reddish Brown (CL)	29	16	13	100.0	71.5	CL

Project No. 37:1404 **Client:** Pennrose Properties, LLC

Project: Deanwood Hills

● **Source of Sample:** B-6 **Depth:** 18.50-20.00 **Sample Number:** S-6
■ **Source of Sample:** B-7 **Depth:** 13.50-15.00 **Sample Number:** S-5
▲ **Source of Sample:** B-8 **Depth:** 38.50-40.00 **Sample Number:** S-10

Remarks:

● Data Entered: 2/5/15
■ Data Entered: 2/5/15
▲ Data Entered: 2/5/15

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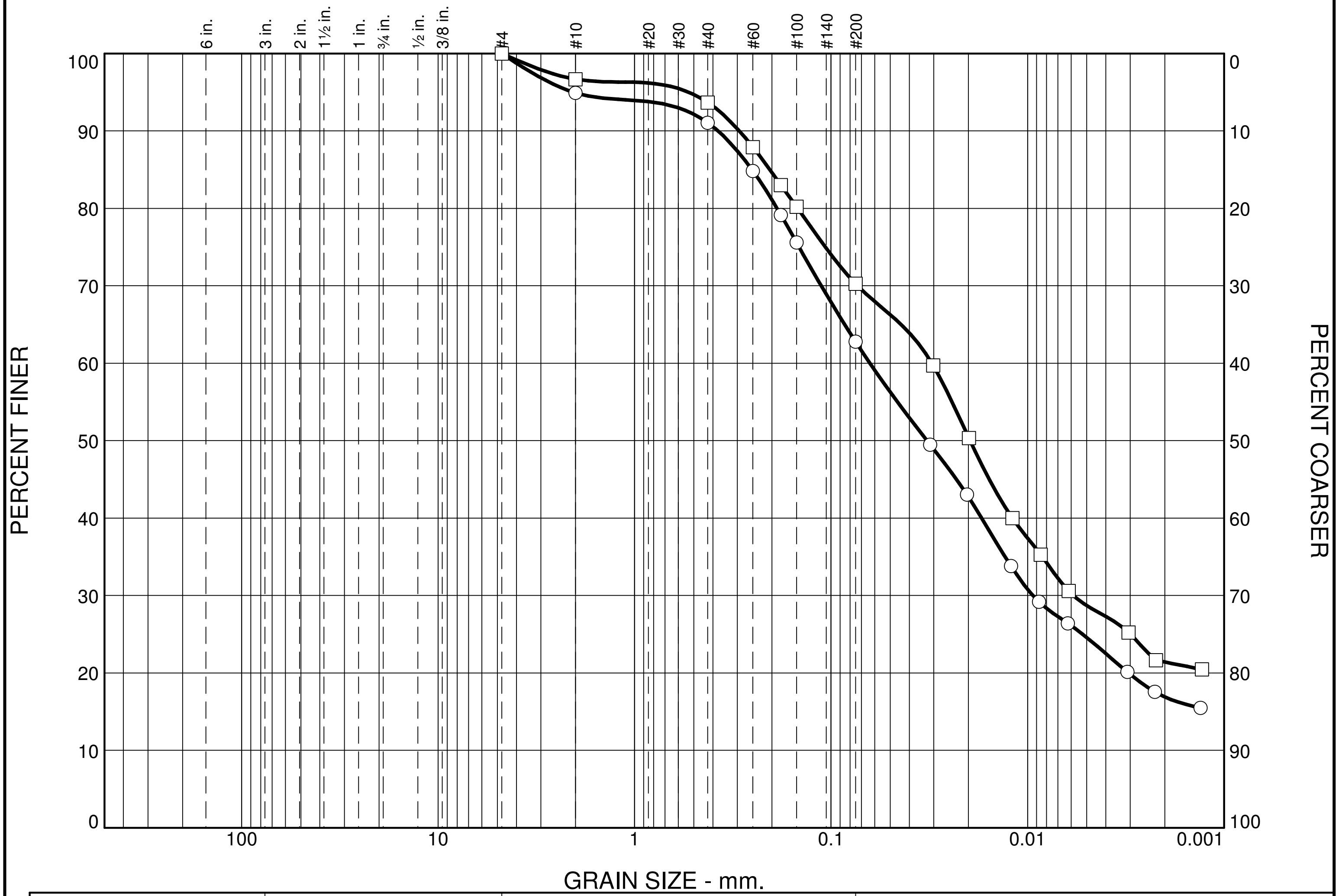
Figure

Tested By: ● HTN1 ■ HNT1 ▲ HNT1 **Checked By:** DVT

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	5.1	3.8	28.3	38.2	24.6
☐	0.0	0.0	0.0	3.3	3.0	23.5	41.5	28.7

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.2526	0.0634	0.0325	0.0094				
☐			0.2053	0.0307	0.0196	0.0058				

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ Sandy Silt Light Brown (ML)		ML	18.4
☐ Silt with Sand Light Brown (ML)		ML	22.2

Project No. 37:1404 **Client:** Pennrose Properties, LLC

Project: Deanwood Hills

○ **Source of Sample:** B-18 **Depth:** 4.00-6.00 **Sample Number:** S-3

☐ **Source of Sample:** B-18 **Depth:** 6.00-8.00 **Sample Number:** S-4

Remarks:

○Data Entered: 2/6/15
Minimum Infiltration rate: 0.52

☐Data Entered: 2/6/15
Minimum Infiltration rate: 0.52

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Figure

Tested By: KV **Checked By:** DVT

Particle Size Distribution Report

	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.1	26.5	73.4	
□	0.0	0.0	0.6	0.6	6.0	26.4	66.4	
△	0.0	0.0	0.0	0.1	6.5	43.5	49.9	

╳	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	27	18	0.0949							
□	34	18	0.2205							
△	NP	NP	0.2643	0.1072	0.0752					

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ Lean Clay with Sand Trace Mica Reddish Brown (CL)		CL	18.1
□ Sandy Lean Clay Strong Brown (CL)		CL	20.2
△ Silty Sand Yellowiah Brown (SM)		SM	15.2

Project No. 37:1404 **Client:** Pennrose Properties, LLC

Project: Deanwood Hills

○ **Source of Sample:** B-1 **Depth:** 38.50-40.00 **Sample Number:** S-10
□ **Source of Sample:** B-2 **Depth:** 8.50-10.00 **Sample Number:** S-4
△ **Source of Sample:** B-4 **Depth:** 23.50-25.00 **Sample Number:** S-7

Remarks:

○Data Entered: 2/5/15
□Data Entered: 2/5/15
△Data Entered: 2/5/15

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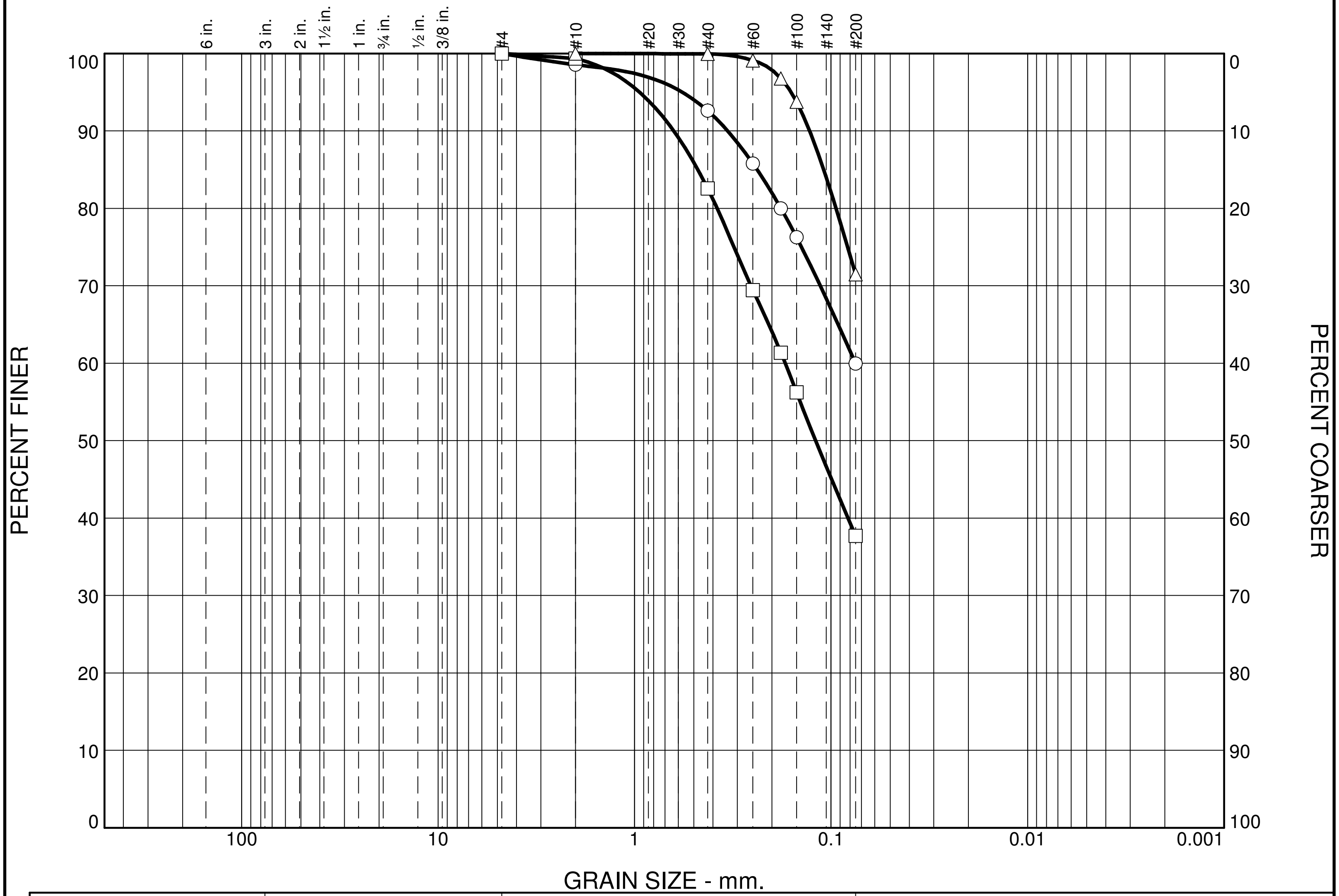
Figure

Tested By: KV **Checked By:** DVT

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	1.4	6.0	32.6	60.0	
□	0.0	0.0	0.0	0.6	16.8	44.9	37.7	
△	0.0	0.0	0.0	0.0	0.0	28.5	71.5	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	32	18	0.2380	0.0751						
□	NP	NP	0.4767	0.1713	0.1198					
△	29	16	0.1090							

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ Sandy Lean Clay Yellowish Brown (CL)		CL	20.8
□ Silty Sand Grayish Brown (SM)		SM	19.8
△ Lean Clay with Sand Trace Mica Reddish Brown (CL)		CL	17.0

Project No. 37:1404 **Client:** Pennrose Properties, LLC

Project: Deanwood Hills

○ **Source of Sample:** B-6 **Depth:** 18.50-20.00 **Sample Number:** S-6
□ **Source of Sample:** B-7 **Depth:** 13.50-15.00 **Sample Number:** S-5
△ **Source of Sample:** B-8 **Depth:** 38.50-40.00 **Sample Number:** S-10

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Remarks:
○Data Entered: 2/5/15
□Data Entered: 2/5/15
△Data Entered: 2/5/15

Figure

Tested By: KV **Checked By:** DVT

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........:	Deanwood Hills	**Boring No...........:**	IT-1 (B-9)	**Solution and Terminology (R. E. Glover Solution)***
Project No.............:	37:1404	**Investigators......:**	RPH	Ksat = Q[$\sinh^{-1}$(H/r) - (r^2/H^2+1)$^{.5}$ + r/H]/(2πH^2) [Basic Glover Solution]
Project Location...:	5201 Hayes St, NE	**Date...................:**	12/17/2014	Ksat$_B$= QV[$\sinh^{-1}$(H/r) - (r^2/H^2+1)$^{.5}$ + r/H]/(2πH^2) [Temperature-corrected]
Boring Depth.........:	6 ft **(m, cm, ft, in)**	**WCU Base Ht. h:**	10.0 **cm*****	Ksat$_B$: (Coefficient of Permeability, K) @ Base Tmp. T$_B$ °C: 20
Boring Diameter...:	11.4 **cm**	**WCU Susp. Ht. S:**	0.0 **cm**	Q: Rate of flow of water from the borehole
Boring Radius r.....:	5.72 **cm**	**Const. Wtr. Ht. H:**	10.0 **cm**	H: Constant height of water in the borehole
Soil/Water Tmp. T:	12 **°C**	**H/r**..................:**	1.7	r: Radius of the cylindrical borehole
Dyn. Visc. @ T......:	0.001236 **kg/m·s**	**Dyn. Visc. @ T$_B$.:**	0.001003 **kg/m·s**	V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T$_B$ °C

VOLUME (ml)	**Volume Out (ml)**	**TIME (h:mm:ss A/P)**	**Interval Elapsed Time (hr:min:sec)**	**(min)**	**Flow Rate Q (ml/min)**	**-------------------- Ksat$_B$ Equivalent Values -------------------------** (µm/sec)	**(cm/sec)**	**(cm/day)**	**(in/hr)**	**(ft/day)**
2,000		4:05:00 PM								
1,990	10	4:25:00 PM	0:20:00	20.00	0.50	0.1	1.22E-05	1.1	0.02	0.03
1,990	0	4:45:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
1,990	0	5:05:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
1,990	0	5:25:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00

Natural Moisture.........:		**Consistency...............:**	Very Dense	**Total Time (min)**	**Enter Ksat$_B$ Value:**	0.0	0.00E+00	0.0	0.00	0.00
USDA Txt./USCS Class.:	SM	**Water Table Depth...:**	N/A			Notes: Ksat$_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.				
Struct./% Pass. #200...:		**Init. Saturation Time.:**		80.00						

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........: Deanwood Hills
Project No.............: 37:1404
Project Location...: 5201 Hayes St, NE

Boring No...........: IT-2 (B-10)
Investigators......: RPH
Date...................: 12/17/2014

Boring Depth.........: 6 ft **(m, cm, ft, in)**
Boring Diameter...: 11.4 **cm**
Boring Radius r.....: 5.72 **cm**
Soil/Water Tmp. T: 12 **°C**
Dyn. Visc. @ T......: 0.001236 **kg/m·s**

WCU Base Ht. h: 10.0 **cm*****
WCU Susp. Ht. S: 0.0 **cm**
Const. Wtr. Ht. H: 10.0 **cm**
H/r..................:** 1.7
Dyn. Visc. @ T_B.: 0.001003 **kg/m·s**

Solution and Terminology (R. E. Glover Solution)*

$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]

$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]

$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C: 20
Q: Rate of flow of water from the borehole
H: Constant height of water in the borehole
r: Radius of the cylindrical borehole
V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C

VOLUME (ml)	**Volume Out (ml)**	**TIME (h:mm:ss A/P)**	**Interval Elapsed Time**		**Flow Rate Q (ml/min)**	**$Ksat_B$ Equivalent Values**				
			(hr:min:sec)	**(min)**		**(µm/sec)**	**(cm/sec)**	**(cm/day)**	**(in/hr)**	**(ft/day)**
3,200		3:19:00 PM								
3,060	140	3:39:00 PM	0:20:00	20.00	7.00	1.7	1.71E-04	14.7	0.24	0.48
3,000	60	3:59:00 PM	0:20:00	20.00	3.00	0.7	7.31E-05	6.3	0.10	0.21
2,990	10	4:19:00 PM	0:20:00	20.00	0.50	0.1	1.22E-05	1.1	0.02	0.03
2,990	0	4:39:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
2,990	0	4:59:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
2,985	5	5:19:00 PM	0:20:00	20.00	0.25	0.1	6.09E-06	0.5	0.01	0.02

Natural Moisture.........:
USDA Txt./USCS Class.: CL
Struct./% Pass. #200...:

Consistency...............: Very Stiff
Water Table Depth...: N/A
Init. Saturation Time.:

Total Time (min) 120.00

Enter $Ksat_B$ Value: 0.0 | 4.57E-06 | 0.4 | 0.01 | 0.01

Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........: Deanwood Hills
Project No.............: 37:1404
Project Location...: 5201 Hayes St, NE
Boring Depth.........: 6.25 ft **(m, cm, ft, in)**
Boring Diameter...: 11.4 **cm**
Boring Radius r.....: 5.72 **cm**
Soil/Water Tmp. T: 6 **°C**
Dyn. Visc. @ T......: 0.001473 **kg/m·s**

Boring No...........: IT-3 (B-11)
Investigators......: RPH
Date...................: 12/16/2014
WCU Base Ht. h: 10.0 **cm*****
WCU Susp. Ht. S: 0.0 **cm**
Const. Wtr. Ht. H: 10.0 **cm**
H/r..................:** 1.7
Dyn. Visc. @ T_B.: 0.001003 **kg/m·s**

Solution and Terminology (R. E. Glover Solution)*

$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]

$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]

$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C: 20
Q: Rate of flow of water from the borehole
H: Constant height of water in the borehole
r: Radius of the cylindrical borehole
V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C

VOLUME (ml)	**Volume Out (ml)**	**TIME (h:mm:ss A/P)**	**Interval Elapsed Time**		**Flow Rate Q (ml/min)**	**-------------------- $Ksat_B$ Equivalent Values -------------------------**				
			(hr:min:sec)	**(min)**		**(µm/sec)**	**(cm/sec)**	**(cm/day)**	**(in/hr)**	**(ft/day)**
3,200		9:15:00 AM								
3,110	90	9:35:00 AM	0:20:00	20.00	4.50	1.3	1.31E-04	11.3	0.19	0.37
3,100	10	9:55:00 AM	0:20:00	20.00	0.50	0.1	1.45E-05	1.3	0.02	0.04
3,100	0	10:15:00 AM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
3,100	0	10:35:00 AM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
3,095	5	10:55:00 AM	0:20:00	20.00	0.25	0.1	7.26E-06	0.6	0.01	0.02

Natural Moisture.........:
USDA Txt./USCS Class.: CL
Struct./% Pass. #200...:

Consistency...............: Stiff
Water Table Depth...: N/A
Init. Saturation Time.:

Total Time (min) 100.00

Enter $Ksat_B$ Value: 0.0 2.42E-06 0.2 0.00 0.01

Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........:	Deanwood Hills	**Boring No...........:**	IT-4 (B-12)
Project No.............:	37:1404	**Investigators......:**	RPH
Project Location...:	5201 Hayes St, NE	**Date...................:**	12/18/2014
Boring Depth.........:	6.25 ft **(m, cm, ft, in)**	**WCU Base Ht. h:**	10.0 **cm*** **
Boring Diameter...:	11.4 **cm**	**WCU Susp. Ht. S:**	0.0 **cm**
Boring Radius r.....:	5.72 **cm**	**Const. Wtr. Ht. H:**	10.0 **cm**
Soil/Water Tmp. T:	5 **°C**	**H/r**..................:**	1.7
Dyn. Visc. @ T......:	0.001520 **kg/m·s**	**Dyn. Visc. @ T_B.:**	0.001003 **kg/m·s**

Solution and Terminology (R. E. Glover Solution)*

Ksat = $Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]

$Ksat_B$= $QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]

$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C: 20

Q: Rate of flow of water from the borehole

H: Constant height of water in the borehole

r: Radius of the cylindrical borehole

V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	(min)	Flow Rate Q (ml/min)	-------------------- $Ksat_B$ Equivalent Values ------------------------- (µm/sec)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
3,200		10:00:00 AM								
2,880	320	10:20:00 AM	0:20:00	20.00	16.00	4.8	4.79E-04	41.4	0.68	1.36
2,560	320	10:40:00 AM	0:20:00	20.00	16.00	4.8	4.79E-04	41.4	0.68	1.36
2,260	300	11:00:00 AM	0:20:00	20.00	15.00	4.5	4.50E-04	38.8	0.64	1.27
2,010	250	11:20:00 AM	0:20:00	20.00	12.50	3.7	3.75E-04	32.4	0.53	1.06
1,790	220	11:40:00 AM	0:20:00	20.00	11.00	3.3	3.30E-04	28.5	0.47	0.93
1,590	200	12:00:00 PM	0:20:00	20.00	10.00	3.0	3.00E-04	25.9	0.42	0.85
1,390	200	12:20:00 PM	0:20:00	20.00	10.00	3.0	3.00E-04	25.9	0.42	0.85
1,180	210	12:40:00 PM	0:20:00	20.00	10.50	3.1	3.15E-04	27.2	0.45	0.89
980	200	1:00:00 PM	0:20:00	20.00	10.00	3.0	3.00E-04	25.9	0.42	0.85

Natural Moisture.........:		**Consistency...............:**	Loose	**Total Time (min)**	**Enter $Ksat_B$ Value:** 3.6 | 3.63E-04 | 31.4 | 0.52 | 1.03
USDA Txt./USCS Class.:	ML	**Water Table Depth...:**	N/A		Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.
Struct./% Pass. #200...:		**Init. Saturation Time.:**		180.00	

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........:	Deanwood Hills	**Boring No...........:**	IT-5 (B-12)	**Solution and Terminology (R. E. Glover Solution)***
Project No.............:	37:1404	**Investigators......:**	RPH	Ksat = $Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]
Project Location...:	5201 Hayes St, NE	**Date..................:**	12/18/2014	$Ksat_B$= $QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]
Boring Depth.........:	6.25 ft **(m, cm, ft, in)**	**WCU Base Ht. h:**	10.0 **cm*** **	$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C: 20
Boring Diameter...:	11.4 **cm**	**WCU Susp. Ht. S:**	0.0 **cm**	Q: Rate of flow of water from the borehole
Boring Radius r.....:	5.72 **cm**	**Const. Wtr. Ht. H:**	10.0 **cm**	H: Constant height of water in the borehole
Soil/Water Tmp. T:	5 **°C**	**H/r**..................:**	1.7	r: Radius of the cylindrical borehole
Dyn. Visc. @ T......:	0.001520 **kg/m·s**	**Dyn. Visc. @ T_B.:**	0.001003 **kg/m·s**	V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C

VOLUME (ml)	**Volume Out (ml)**	**TIME (h:mm:ss A/P)**	**Interval Elapsed Time**		**Flow Rate Q (ml/min)**	**-------------------- $Ksat_B$ Equivalent Values -------------------------**				
			(hr:min:sec)	**(min)**		**(µm/sec)**	**(cm/sec)**	**(cm/day)**	**(in/hr)**	**(ft/day)**
3,200		10:01:00 AM								
3,170	30	10:21:00 AM	0:20:00	20.00	1.50	0.4	4.50E-05	3.9	0.06	0.13
3,170	0	10:41:00 AM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
3,170	0	11:01:00 AM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
3,170	0	11:21:00 AM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00

Natural Moisture.........:		**Consistency...............:**	Loose	**Total Time**	**Enter $Ksat_B$ Value:**	**0.0**	**0.00E+00**	**0.0**	**0.00**	**0.00**
USDA Txt./USCS Class.:	ML	**Water Table Depth...:**	N/A	**(min)**		Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.				
Struct./% Pass. #200...:		**Init. Saturation Time.:**		80.00						

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........: Deanwood Hills
Project No.............: 37:1404
Project Location...: 5201 Hayes St, NE

Boring No...........: IT-6 (B-5)
Investigators......: RPH
Date...................: 12/16/2014

Solution and Terminology (R. E. Glover Solution)*

$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]

$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]

$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C: 20

Q: Rate of flow of water from the borehole

H: Constant height of water in the borehole

r: Radius of the cylindrical borehole

V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C

Boring Depth.........: 6.25 ft **(m, cm, ft, in)**
Boring Diameter...: 11.4 **cm**
Boring Radius r.....: 5.72 **cm**
Soil/Water Tmp. T: 12 **°C**
Dyn. Visc. @ T......: 0.001236 **kg/m·s**

WCU Base Ht. h: 10.0 **cm*****
WCU Susp. Ht. S: 0.0 **cm**
Const. Wtr. Ht. H: 10.0 **cm**
H/r.................:** 1.7
Dyn. Visc. @ T_B.: 0.001003 **kg/m·s**

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time		Flow Rate Q (ml/min)	-------------------- $Ksat_B$ Equivalent Values -------------------------				
			(hr:min:sec)	(min)		(µm/sec)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
2,000		2:15:00 PM								
1,995	5	2:41:00 PM	0:26:00	26.00	0.19	0.0	4.69E-06	0.4	0.01	0.01
1,995	0	3:01:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
1,995	0	3:21:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
1,995	0	3:41:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
1,995	0	4:01:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00

Natural Moisture.........:
USDA Txt./USCS Class.: CL
Struct./% Pass. #200...:

Consistency...............: Stiff
Water Table Depth...: N/A
Init. Saturation Time.:

Total Time (min) 106.00

Enter $Ksat_B$ Value: 0.0 | 0.00E+00 | 0.0 | 0.00 | 0.00

Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........: Deanwood Hills
Project No.............: 37:1404
Project Location...: 5201 Hayes St, NE
Boring Depth.........: 6.25 ft **(m, cm, ft, in)**
Boring Diameter...: 11.4 **cm**
Boring Radius r.....: 5.72 **cm**
Soil/Water Tmp. T: 12 **°C**
Dyn. Visc. @ T......: 0.001236 **kg/m·s**

Boring No...........: IT-7 (B-13)
Investigators......: RPH
Date...................: 12/17/2014
WCU Base Ht. h: 10.0 **cm*****
WCU Susp. Ht. S: 0.0 **cm**
Const. Wtr. Ht. H: 10.0 **cm**
H/r..................:** 1.7
Dyn. Visc. @ T_B.: 0.001003 **kg/m·s**

Solution and Terminology (R. E. Glover Solution)*

$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]

$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]

$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C: 20
Q: Rate of flow of water from the borehole
H: Constant height of water in the borehole
r: Radius of the cylindrical borehole
V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	(min)	Flow Rate Q (ml/min)	-------------------- $Ksat_B$ Equivalent Values ------------------------- (µm/sec)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
3,200		3:32:00 PM								
3,060	140	3:52:00 PM	0:20:00	20.00	7.00	1.7	1.71E-04	14.7	0.24	0.48
3,050	10	4:12:00 PM	0:20:00	20.00	0.50	0.1	1.22E-05	1.1	0.02	0.03
3,050	0	4:32:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
3,050	0	4:52:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00

Natural Moisture.........:
USDA Txt./USCS Class.: CL
Struct./% Pass. #200...:

Consistency...............: Very Stiff
Water Table Depth...: N/A
Init. Saturation Time.:

Total Time (min) 80.00

Enter $Ksat_B$ Value: 0.0 | 0.00E+00 | 0.0 | 0.00 | 0.00

Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........: Deanwood Hills
Project No.............: 37:1404
Project Location...: 5201 Hayes St, NE

Boring No...........: IT-8 (B-13)
Investigators......: RPH
Date...................: 12/17/2014

Solution and Terminology (R. E. Glover Solution)*

$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]

$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]

$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C: 20
Q: Rate of flow of water from the borehole
H: Constant height of water in the borehole
r: Radius of the cylindrical borehole
V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C

Boring Depth.........: 6 ft **(m, cm, ft, in)**
Boring Diameter...: 11.4 **cm**
Boring Radius r.....: 5.72 **cm**
Soil/Water Tmp. T: 12 **°C**
Dyn. Visc. @ T......: 0.001236 **kg/m·s**

WCU Base Ht. h: 10.0 **cm*****
WCU Susp. Ht. S: 0.0 **cm**
Const. Wtr. Ht. H: 10.0 **cm**
H/r..................:** 1.7
Dyn. Visc. @ T_B.: 0.001003 **kg/m·s**

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time		Flow Rate Q (ml/min)	-------------------- $Ksat_B$ Equivalent Values -------------------------				
			(hr:min:sec)	(min)		(µm/sec)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
2,000		11:51:00 AM								
1,997	3	12:11:00 PM	0:20:00	20.00	0.15	0.0	3.66E-06	0.3	0.01	0.01
1,995	2	12:31:00 PM	0:20:00	20.00	0.10	0.0	2.44E-06	0.2	0.00	0.01
1,995	0	12:51:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
1,995	0	1:11:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00

Natural Moisture.........:
USDA Txt./USCS Class.: CL
Struct./% Pass. #200...:

Consistency...............: Very Stiff
Water Table Depth...: N/A
Init. Saturation Time.:

Total Time (min) 80.00

Enter $Ksat_B$ Value: 0.0 | 0.00E+00 | 0.0 | 0.00 | 0.00

Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........: Deanwood Hills
Project No.............: 37:1404
Project Location...: 5201 Hayes St, NE

Boring No...........: IT-9 (B-14)
Investigators......: RPH
Date...................: 12/17/2014

Solution and Terminology (R. E. Glover Solution)*

Ksat = Q[sinh^{-1}(H/r) - (r^2/H^2+1)$^{.5}$ + r/H]/(2πH^2) [Basic Glover Solution]
Ksat$_B$= QV[sinh^{-1}(H/r) - (r^2/H^2+1)$^{.5}$ + r/H]/(2πH^2) [Temperature-corrected]

Boring Depth.........: 6 ft **(m, cm, ft, in)**
Boring Diameter...: 11.4 **cm**
Boring Radius r.....: 5.72 **cm**
Soil/Water Tmp. T: 12 **°C**
Dyn. Visc. @ T......: 0.001236 **kg/m·s**

WCU Base Ht. h: 10.0 **cm*****
WCU Susp. Ht. S: 0.0 **cm**
Const. Wtr. Ht. H: 10.0 **cm**
H/r..................:** 1.7
Dyn. Visc. @ T$_B$.: 0.001003 **kg/m·s**

Ksat$_B$: (Coefficient of Permeability, K) @ Base Tmp. T$_B$ °C: 20
Q: Rate of flow of water from the borehole
H: Constant height of water in the borehole
r: Radius of the cylindrical borehole
V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T$_B$ °C

VOLUME (ml)	**Volume Out (ml)**	**TIME (h:mm:ss A/P)**	**Interval Elapsed Time**		**Flow Rate Q (ml/min)**	**-------------------- Ksat$_B$ Equivalent Values -------------------------**				
			(hr:min:sec)	**(min)**		**(µm/sec)**	**(cm/sec)**	**(cm/day)**	**(in/hr)**	**(ft/day)**
3,200		11:54:00 AM								
3,055	145	12:14:00 PM	0:20:00	20.00	7.25	1.8	1.77E-04	15.3	0.25	0.50
3,050	5	12:34:00 PM	0:20:00	20.00	0.25	0.1	6.09E-06	0.5	0.01	0.02
3,050	0	12:54:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
3,050	0	1:14:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00

Natural Moisture.........:
USDA Txt./USCS Class.: ML
Struct./% Pass. #200...:

Consistency...............: Medium Dense
Water Table Depth...: N/A
Init. Saturation Time.:

Total Time (min) 80.00

Enter Ksat$_B$ Value: 0.0 | 0.00E+00 | 0.0 | 0.00 | 0.00

Notes: Ksat$_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........: Deanwood Hills
Project No.............: 37:1404
Project Location...: 5201 Hayes St, NE

Boring No...........: IT-10 (B-14)
Investigators......: RPH
Date...................: 12/16/2014

Solution and Terminology (R. E. Glover Solution)*

$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]

$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]

Boring Depth.........:	6.25 ft	**(m, cm, ft, in)**	**WCU Base Ht. h:**	10.0	**cm*****
Boring Diameter...:	11.4	**cm**	**WCU Susp. Ht. S:**	0.0	**cm**
Boring Radius r.....:	5.72	**cm**	**Const. Wtr. Ht. H:**	10.0	**cm**
Soil/Water Tmp. T:	6	**°C**	**H/r**.................:**	1.7	
Dyn. Visc. @ T......:	0.001473	**kg/m·s**	**Dyn. Visc. @ T_B.:**	0.001003	**kg/m·s**

$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C: 20
Q: Rate of flow of water from the borehole
H: Constant height of water in the borehole
r: Radius of the cylindrical borehole
V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	(min)	Flow Rate Q (ml/min)	-------------------- $Ksat_B$ Equivalent Values ------------------------- (µm/sec)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
3,200		12:13:00 PM								
3,180	20	12:33:00 PM	0:20:00	20.00	1.00	0.3	2.90E-05	2.5	0.04	0.08
3,170	10	12:53:00 PM	0:20:00	20.00	0.50	0.1	1.45E-05	1.3	0.02	0.04
3,170	0	1:13:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
3,170	0	1:33:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
3,170	0	1:53:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00

Natural Moisture........:
USDA Txt./USCS Class.: ML
Struct./% Pass. #200...:

Consistency...............: Medium Dense
Water Table Depth...: N/A
Init. Saturation Time.:

Total Time (min) 100.00

Enter $Ksat_B$ Value: 0.0 | 0.00E+00 | 0.0 | 0.00 | 0.00

Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........: Deanwood Hills
Project No.............: 37:1404
Project Location...: 5201 Hayes St, NE

Boring No...........: IT-11 (B-15)
Investigators......: RPH
Date...................: 12/17/2014

Boring Depth.........: 6.25 ft **(m, cm, ft, in)**
Boring Diameter...: 11.4 **cm**
Boring Radius r.....: 5.72 **cm**
Soil/Water Tmp. T: 12 **°C**
Dyn. Visc. @ T......: 0.001236 **kg/m·s**

WCU Base Ht. h: 10.0 **cm*****
WCU Susp. Ht. S: 0.0 **cm**
Const. Wtr. Ht. H: 10.0 **cm**
H/r..................:** 1.7
Dyn. Visc. @ T_B.: 0.001003 **kg/m·s**

Solution and Terminology (R. E. Glover Solution)*

$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]

$Ksat_B= QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]

$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C: 20

Q: Rate of flow of water from the borehole

H: Constant height of water in the borehole

r: Radius of the cylindrical borehole

V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (µm/sec)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
3,200		11:52:00 AM								
2,520	680	12:12:00 PM	0:20:00	20.00	34.00	8.3	8.29E-04	71.6	1.17	2.35
1,685	835	12:32:00 PM	0:20:00	20.00	41.75	10.2	1.02E-03	87.9	1.44	2.88
840	845	12:52:00 PM	0:20:00	20.00	42.25	10.3	1.03E-03	89.0	1.46	2.92
3,200		12:52:00 PM								
2,340	860	1:12:00 PM	0:20:00	20.00	43.00	10.5	1.05E-03	90.5	1.49	2.97
1,485	855	1:32:00 PM	0:20:00	20.00	42.75	10.4	1.04E-03	90.0	1.48	2.95
645	840	1:52:00 PM	0:20:00	20.00	42.00	10.2	1.02E-03	88.4	1.45	2.90

Natural Moisture.........:
USDA Txt./USCS Class.: CL
Struct./% Pass. #200...:

Consistency...............: Very Soft
Water Table Depth...: N/A
Init. Saturation Time.:

Total Time (min) 120.00

Enter $Ksat_B$ Value: 10.4 | 1.04E-03 | 89.7 | 1.47 | 2.94

Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........: Deanwood Hills
Project No.............: 37:1404
Project Location...: 5201 Hayes St, NE

Boring No...........: IT-12 (B-15)
Investigators......: RPH
Date....................: 12/18/2014

Boring Depth.........: 6.25 ft **(m, cm, ft, in)**
Boring Diameter...: 11.4 **cm**
Boring Radius r.....: 5.72 **cm**
Soil/Water Tmp. T: 5 **°C**
Dyn. Visc. @ T......: 0.001520 **kg/m·s**

WCU Base Ht. h: 10.0 **cm*****
WCU Susp. Ht. S: 0.0 **cm**
Const. Wtr. Ht. H: 10.0 **cm**
H/r..................:** 1.7
Dyn. Visc. @ T_B.: 0.001003 **kg/m·s**

Solution and Terminology (R. E. Glover Solution)*

$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]

$Ksat_B= QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]

$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C: 20

Q: Rate of flow of water from the borehole

H: Constant height of water in the borehole

r: Radius of the cylindrical borehole

V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	(min)	Flow Rate Q (ml/min)	-------------------- $Ksat_B$ Equivalent Values ------------------------- (µm/sec)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
3,200		8:16:00 AM								
3,195	5	8:36:00 AM	0:20:00	20.00	0.25	0.1	7.49E-06	0.6	0.01	0.02
3,195	0	8:56:00 AM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
3,195	0	9:16:00 AM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00

Natural Moisture.........:
USDA Txt./USCS Class.: CL
Struct./% Pass. #200...:

Consistency...............: Very Soft
Water Table Depth...: N/A
Init. Saturation Time.:

Total Time (min) 60.00

Enter $Ksat_B$ Value:	**0.0**	**0.00E+00**	**0.0**	**0.00**	**0.00**

Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........:	Deanwood Hills	**Boring No...........:**	IT-13 (B-16)	
Project No.............:	37:1404	**Investigators......:**	RPH	
Project Location...:	5201 Hayes St, NE	**Date...................:**	12/18/2014	
Boring Depth.........:	6.25 ft **(m, cm, ft, in)**	**WCU Base Ht. h:**	10.0	**cm*****
Boring Diameter...:	11.4 **cm**	**WCU Susp. Ht. S:**	0.0	**cm**
Boring Radius r.....:	5.72 **cm**	**Const. Wtr. Ht. H:**	10.0	**cm**
Soil/Water Tmp. T:	5 **°C**	**H/r**..................:**	1.7	
Dyn. Visc. @ T......:	0.001520 **kg/m·s**	**Dyn. Visc. @ T_B.:**	0.001003	**kg/m·s**

Solution and Terminology (R. E. Glover Solution)*

Ksat = $Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]

$Ksat_B$= $QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]

$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C: 20

Q: Rate of flow of water from the borehole

H: Constant height of water in the borehole

r: Radius of the cylindrical borehole

V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C

VOLUME (ml)	**Volume Out (ml)**	**TIME (h:mm:ss A/P)**	**Interval Elapsed Time (hr:min:sec)**	**(min)**	**Flow Rate Q (ml/min)**	**-------------------- $Ksat_B$ Equivalent Values ------------------------- (µm/sec)**	**(cm/sec)**	**(cm/day)**	**(in/hr)**	**(ft/day)**
3,200		8:17:00 AM								
3,200	0	8:37:00 AM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
3,200	0	8:57:00 AM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
3,200	0	9:17:00 AM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00

Natural Moisture.........:		**Consistency...............:**	Very Stiff	**Total Time (min)**	**Enter $Ksat_B$ Value:**	0.0	0.00E+00	0.0	0.00	0.00
USDA Txt./USCS Class.:	CL	**Water Table Depth...:**	N/A							
Struct./% Pass. #200...:		**Init. Saturation Time.:**		60.00						

Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........:	Deanwood Hills		**Boring No...........:**	IT-14 (B-16)		**Solution and Terminology (R. E. Glover Solution)***
Project No.............:	37:1404		**Investigators......:**	RPH		Ksat = $Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]
Project Location...:	5201 Hayes St, NE		**Date....................:**	12/16/2014		$Ksat_B$= $QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]
Boring Depth.........:	6 ft	**(m, cm, ft, in)**	**WCU Base Ht. h:**	10.0	**cm*** **	$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C: 20
Boring Diameter...:	11.4	**cm**	**WCU Susp. Ht. S:**	0.0	**cm**	Q: Rate of flow of water from the borehole
Boring Radius r.....:	5.72	**cm**	**Const. Wtr. Ht. H:**	10.0	**cm**	H: Constant height of water in the borehole
Soil/Water Tmp. T:	6	**°C**	**H/r**..................:**	1.7		r: Radius of the cylindrical borehole
Dyn. Visc. @ T......:	0.001473	**kg/m·s**	**Dyn. Visc. @ T_B.:**	0.001003	**kg/m·s**	V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C

VOLUME	**Volume Out**	**TIME**	**Interval Elapsed Time**		**Flow Rate Q**	**-------------------- $Ksat_B$ Equivalent Values -------------------------**				
(ml)	**(ml)**	**(h:mm:ss A/P)**	**(hr:min:sec)**	**(min)**	**(ml/min)**	**(µm/sec)**	**(cm/sec)**	**(cm/day)**	**(in/hr)**	**(ft/day)**
2,010		12:05:00 PM								
1,635	375	12:25:00 PM	0:20:00	20.00	18.75	5.4	5.45E-04	47.0	0.77	1.54
1,260	375	12:45:00 PM	0:20:00	20.00	18.75	5.4	5.45E-04	47.0	0.77	1.54
940	320	1:06:00 PM	0:21:00	21.00	15.24	4.4	4.43E-04	38.2	0.63	1.25
630	310	1:26:00 PM	0:20:00	20.00	15.50	4.5	4.50E-04	38.9	0.64	1.28
330	300	1:46:00 PM	0:20:00	20.00	15.00	4.4	4.36E-04	37.6	0.62	1.23
2,000		1:46:00 PM								
1,700	300	2:06:00 PM	0:20:00	20.00	15.00	4.4	4.36E-04	37.6	0.62	1.23

Natural Moisture.........:		**Consistency...............:**	Very Stiff	**Total Time**	**Enter $Ksat_B$ Value:**	**4.4**	**4.43E-04**	**38.3**	**0.63**	**1.26**
USDA Txt./USCS Class.:	CL	**Water Table Depth...:**	N/A	**(min)**		Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.				
Struct./% Pass. #200...:		**Init. Saturation Time.:**		121.00						

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........:	Deanwood Hills	**Boring No...........:**	IT-15 (B-17)	**Solution and Terminology (R. E. Glover Solution)***
Project No.............:	37:1404	**Investigators......:**	RPH	$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]
Project Location...:	5201 Hayes St, NE	**Date..................:**	12/18/2014	$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]
Boring Depth.........:	6.25 ft. **(m, cm, ft, in)**	**WCU Base Ht. h:**	10.0 **cm*** **	$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C: 20
Boring Diameter...:	11.4 **cm**	**WCU Susp. Ht. S:**	0.0 **cm**	Q: Rate of flow of water from the borehole
Boring Radius r.....:	5.72 **cm**	**Const. Wtr. Ht. H:**	10.0 **cm**	H: Constant height of water in the borehole
Soil/Water Tmp. T:	6 **°C**	**H/r**..................:**	1.7	r: Radius of the cylindrical borehole
Dyn. Visc. @ T......:	0.001473 **kg/m·s**	**Dyn. Visc. @ T_B.:**	0.001003 **kg/m·s**	V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C

VOLUME	**Volume Out**	**TIME**	**Interval Elapsed Time**		**Flow Rate Q**	**-------------------- $Ksat_B$ Equivalent Values -------------------------**				
(ml)	**(ml)**	**(h:mm:ss A/P)**	**(hr:min:sec)**	**(min)**	**(ml/min)**	**(µm/sec)**	**(cm/sec)**	**(cm/day)**	**(in/hr)**	**(ft/day)**
3,200		12:55:00 PM								
3,120	80	1:15:00 PM	0:20:00	20.00	4.00	1.2	1.16E-04	10.0	0.16	0.33
3,080	40	1:35:00 PM	0:20:00	20.00	2.00	0.6	5.81E-05	5.0	0.08	0.16
3,070	10	1:55:00 PM	0:20:00	20.00	0.50	0.1	1.45E-05	1.3	0.02	0.04
3,070	0	2:15:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
3,070	0	2:35:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
3,070	0	2:55:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00

Natural Moisture.........:		**Consistency...............:**	Very Loose	**Total Time**	**Enter $Ksat_B$ Value:**	**0.0**	**3.63E-06**	**0.3**	**0.01** / **0.01**
USDA Txt./USCS Class.:	ML	**Water Table Depth...:**	N/A	**(min)**		Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.			
Struct./% Pass. #200...:		**Init. Saturation Time.:**		120.00					

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........: Deanwood Hills
Project No.............: 37:1404
Project Location...: 5201 Hayes St, NE

Boring No...........: IT-16 (B-17)
Investigators......: RPH
Date..................: 12/18/2014

Solution and Terminology (R. E. Glover Solution)*

$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]

$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]

$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C: 20
Q: Rate of flow of water from the borehole
H: Constant height of water in the borehole
r: Radius of the cylindrical borehole
V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C

Boring Depth.........: 5.75 ft **(m, cm, ft, in)**
Boring Diameter...: 11.4 **cm**
Boring Radius r.....: 5.72 **cm**
Soil/Water Tmp. T: 6 **°C**
Dyn. Visc. @ T......: 0.001473 **kg/m·s**

WCU Base Ht. h: 10.0 **cm*****
WCU Susp. Ht. S: 0.0 **cm**
Const. Wtr. Ht. H: 10.0 **cm**
H/r..................:** 1.7
Dyn. Visc. @ T_B.: 0.001003 **kg/m·s**

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	(min)	Flow Rate Q (ml/min)	-------------------- $Ksat_B$ Equivalent Values ------------------------- (µm/sec)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
3,030		12:05:00 PM								
3,020	10	12:25:00 PM	0:20:00	20.00	0.50	0.1	1.45E-05	1.3	0.02	0.04
3,015	5	12:45:00 PM	0:20:00	20.00	0.25	0.1	7.26E-06	0.6	0.01	0.02
3,015	0	1:05:00 PM	0:20:00	20.00	0.00	0.0	0.00E+00	0.0	0.00	0.00
3,010	5	1:45:00 PM	0:40:00	40.00	0.13	0.0	3.63E-06	0.3	0.01	0.01
3,010	0	2:25:00 PM	0:40:00	40.00	0.00	0.0	0.00E+00	0.0	0.00	0.00

Natural Moisture.........:
USDA Txt./USCS Class.: ML
Struct./% Pass. #200...:

Consistency...............: Very Loose
Water Table Depth...: N/A
Init. Saturation Time.:

Total Time (min) 140.00

Enter $Ksat_B$ Value: 0.0 | 1.21E-06 | 0.1 | 0.00 | 0.00

Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........: Deanwood Hills
Project No.............: 37:1404
Project Location...: 5201 Hayes St, NE

Boring No...........: IT-17 (B-17)
Investigators......: RPH
Date...................: 12/18/2014

Solution and Terminology (R. E. Glover Solution)*

$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]

$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]

Boring Depth.........: 6.25 ft **(m, cm, ft, in)**
Boring Diameter...: 11.4 **cm**
Boring Radius r.....: 5.72 **cm**
Soil/Water Tmp. T: 6 **°C**
Dyn. Visc. @ T......: 0.001473 **kg/m·s**

WCU Base Ht. h: 10.0 **cm*****
WCU Susp. Ht. S: 0.0 **cm**
Const. Wtr. Ht. H: 10.0 **cm**
H/r..................:** 1.7
Dyn. Visc. @ T_B.: 0.001003 **kg/m·s**

$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C: 20
Q: Rate of flow of water from the borehole
H: Constant height of water in the borehole
r: Radius of the cylindrical borehole
V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C

VOLUME (ml)	**Volume Out (ml)**	**TIME (h:mm:ss A/P)**	**Interval Elapsed Time (hr:min:sec)**	**(min)**	**Flow Rate Q (ml/min)**	**-------------------- $Ksat_B$ Equivalent Values ------------------------- (µm/sec)**	**(cm/sec)**	**(cm/day)**	**(in/hr)**	**(ft/day)**
3,230		10:41:00 AM								
3,180	50	11:01:00 AM	0:20:00	20.00	2.50	0.7	7.26E-05	6.3	0.10	0.21
3,160	20	11:11:00 AM	0:10:00	10.00	2.00	0.6	5.81E-05	5.0	0.08	0.16
3,110	50	11:31:00 AM	0:20:00	20.00	2.50	0.7	7.26E-05	6.3	0.10	0.21
3,050	60	11:51:00 AM	0:20:00	20.00	3.00	0.9	8.71E-05	7.5	0.12	0.25
3,000	50	12:11:00 PM	0:20:00	20.00	2.50	0.7	7.26E-05	6.3	0.10	0.21
2,950	50	12:31:00 PM	0:20:00	20.00	2.50	0.7	7.26E-05	6.3	0.10	0.21
2,910	40	12:51:00 PM	0:20:00	20.00	2.00	0.6	5.81E-05	5.0	0.08	0.16
2,850	60	1:11:00 PM	0:20:00	20.00	3.00	0.9	8.71E-05	7.5	0.12	0.25

Natural Moisture.........:
USDA Txt./USCS Class.: ML
Struct./% Pass. #200...:

Consistency...............: Very Loose
Water Table Depth...: N/A
Init. Saturation Time.:

Total Time (min) 150.00

Enter $Ksat_B$ Value: 0.8 | 7.62E-05 | 6.6 | 0.11 | 0.22

Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........:	Deanwood Hills	**Boring No...........:**	IT-18 (B-18)
Project No.............:	37:1404	**Investigators......:**	RPH
Project Location...:	5201 Hayes St, NE	**Date...................:**	12/18/2014
Boring Depth.........:	6.25 ft **(m, cm, ft, in)**	**WCU Base Ht. h:**	10.0 **cm*****
Boring Diameter...:	11.4 **cm**	**WCU Susp. Ht. S:**	0.0 **cm**
Boring Radius r.....:	5.72 **cm**	**Const. Wtr. Ht. H:**	10.0 **cm**
Soil/Water Tmp. T:	5 **°C**	**H/r**..................:**	1.7
Dyn. Visc. @ T......:	0.001520 **kg/m·s**	**Dyn. Visc. @ T_B.:**	0.001003 **kg/m·s**

Solution and Terminology (R. E. Glover Solution)*

$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]

$Ksat_B= QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]

$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C: 20

Q: Rate of flow of water from the borehole

H: Constant height of water in the borehole

r: Radius of the cylindrical borehole

V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (µm/sec)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
3,200		8:19:00 AM								
2,750	450	8:39:00 AM	0:20:00	20.00	22.50	6.7	6.74E-04	58.3	0.96	1.91
2,330	420	8:59:00 AM	0:20:00	20.00	21.00	6.3	6.29E-04	54.4	0.89	1.78
2,110	220	9:19:00 AM	0:20:00	20.00	11.00	3.3	3.30E-04	28.5	0.47	0.93
1,900	210	9:39:00 AM	0:20:00	20.00	10.50	3.1	3.15E-04	27.2	0.45	0.89
1,710	190	9:59:00 AM	0:20:00	20.00	9.50	2.8	2.85E-04	24.6	0.40	0.81
1,540	170	10:19:00 AM	0:20:00	20.00	8.50	2.5	2.55E-04	22.0	0.36	0.72
1,350	190	10:39:00 AM	0:20:00	20.00	9.50	2.8	2.85E-04	24.6	0.40	0.81
1,165	185	10:59:00 AM	0:20:00	20.00	9.25	2.8	2.77E-04	24.0	0.39	0.79
970	195	11:19:00 AM	0:20:00	20.00	9.75	2.9	2.92E-04	25.2	0.41	0.83

Natural Moisture.........:	22.2	**Consistency...............:**	Very Loose	**Total Time (min)**	**Enter $Ksat_B$ Value:**	3.0	2.96E-04	25.6	0.42	0.84
USDA Txt./USCS Class.:	Loam/ML	**Water Table Depth...:**	N/A							
Struct./% Pass. #200...:	70.2 %	**Init. Saturation Time.:**		180.00						

Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name.....: GloverRE-deep-WT

Project Name........: Deanwood Hills
Project No.............: 37:1404
Project Location...: 5201 Hayes St, NE

Boring No...........: IT-19 (B-18)
Investigators......: RPH
Date...................: 12/18/2014

Boring Depth.........: 5.75 ft **(m, cm, ft, in)**
Boring Diameter...: 11.4 **cm**
Boring Radius r.....: 5.72 **cm**
Soil/Water Tmp. T: 6 **°C**
Dyn. Visc. @ T......: 0.001473 **kg/m·s**

WCU Base Ht. h: 10.0 **cm*****
WCU Susp. Ht. S: 0.0 **cm**
Const. Wtr. Ht. H: 10.0 **cm**
H/r..................:** 1.7
Dyn. Visc. @ T_B.: 0.001003 **kg/m·s**

Solution and Terminology (R. E. Glover Solution)*

$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]

$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]

$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C: 20
Q: Rate of flow of water from the borehole
H: Constant height of water in the borehole
r: Radius of the cylindrical borehole
V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C

VOLUME (ml)	**Volume Out (ml)**	**TIME (h:mm:ss A/P)**	**Interval Elapsed Time**		**Flow Rate Q (ml/min)**	**-------------------- $Ksat_B$ Equivalent Values -------------------------**				
			(hr:min:sec)	**(min)**		**(µm/sec)**	**(cm/sec)**	**(cm/day)**	**(in/hr)**	**(ft/day)**
3,200		10:04:00 AM								
2,580	620	10:24:00 AM	0:20:00	20.00	31.00	9.0	9.00E-04	77.8	1.28	2.55
2,100	480	10:44:00 AM	0:20:00	20.00	24.00	7.0	6.97E-04	60.2	0.99	1.98
1,900	200	10:54:00 AM	0:10:00	10.00	20.00	5.8	5.81E-04	50.2	0.82	1.65
1,490	410	11:14:00 AM	0:20:00	20.00	20.50	6.0	5.95E-04	51.4	0.84	1.69
1,290	200	11:24:00 AM	0:10:00	10.00	20.00	5.8	5.81E-04	50.2	0.82	1.65

Natural Moisture.........: 18.4%
USDA Txt./USCS Class.: Loam/ML
Struct./% Pass. #200...: 62.8%

Consistency...............: Very Loose
Water Table Depth...: N/A
Init. Saturation Time.:

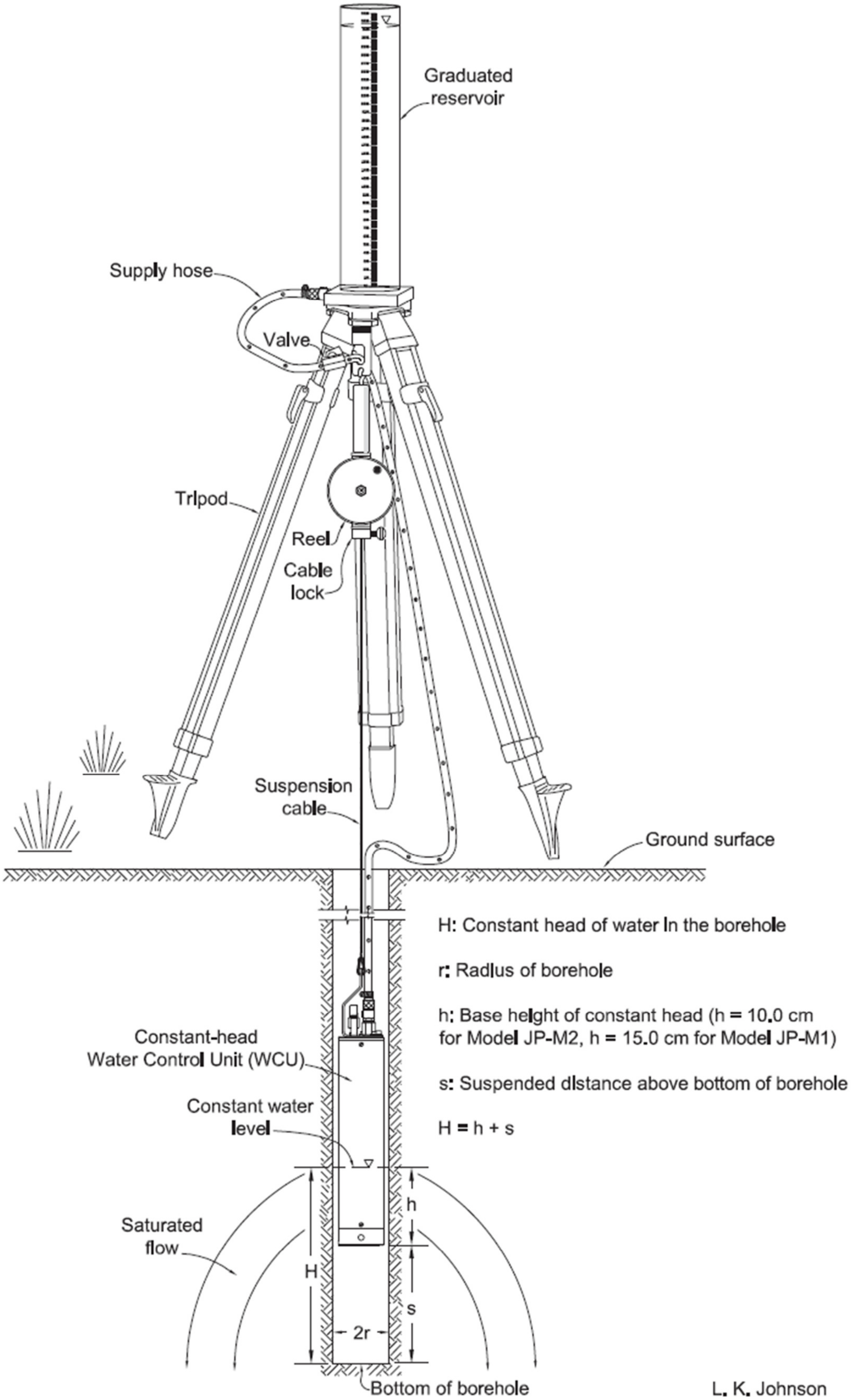
Total Time (min) 80.00

Enter $Ksat_B$ Value:	5.9	5.86E-04	50.6	0.83	1.66

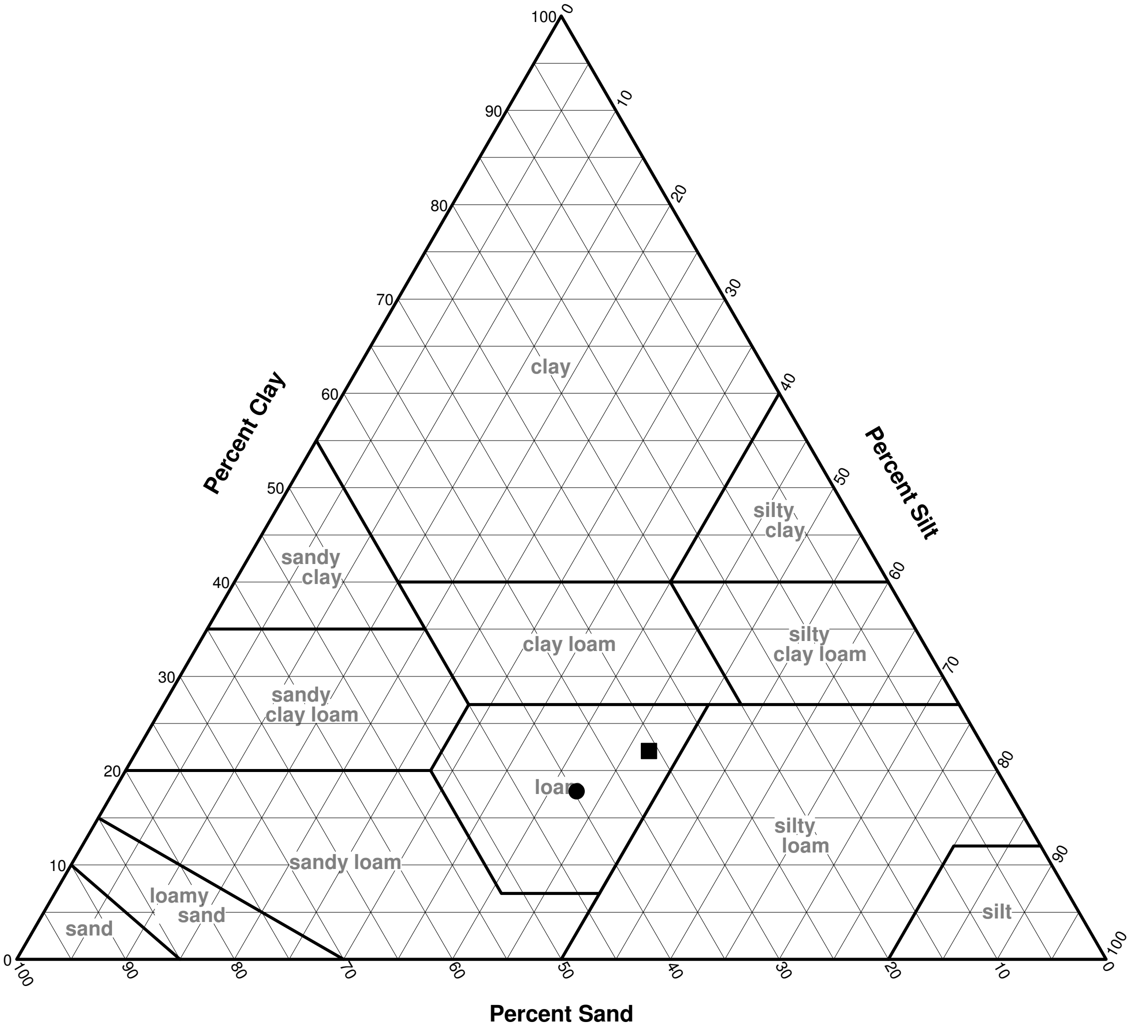
Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

JOHNSON PERMEAMETER



USDA Soil Classification



SOIL DATA

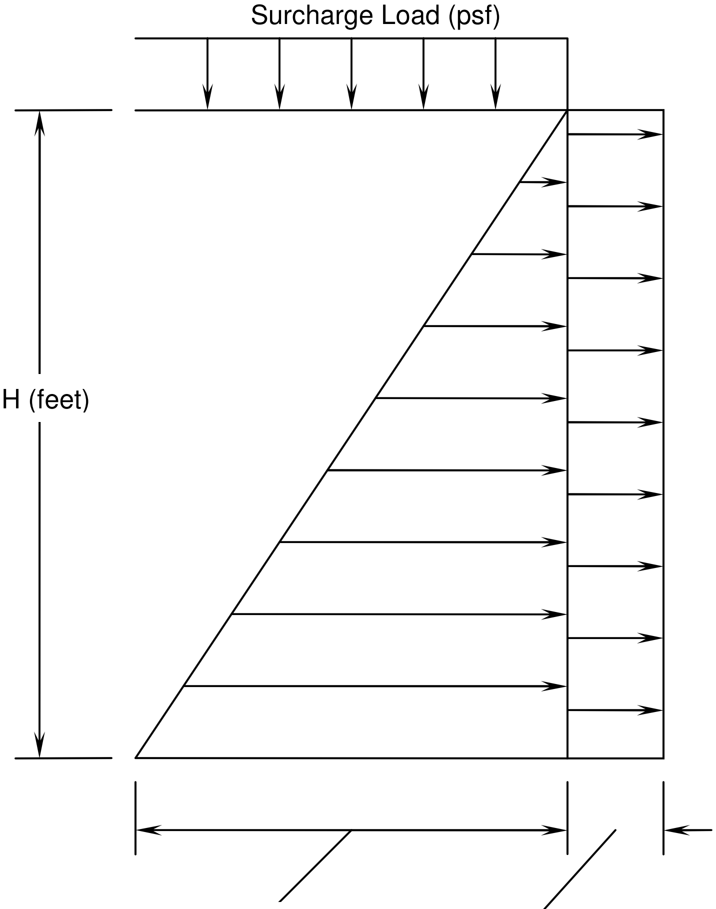
	Source	Sample No.	Depth	Percentages From Material Passing a #10 Sieve			Classification
				Sand	Silt	Clay	
●	B-18	S-3	4.00-6.00	39.7	42.5	17.8	Loam
■	B-18	S-4	6.00-8.00	30.9	46.9	22.1	Loam

ECS MID-ATLANTIC, LLC
14026 Thunderbolt Place, Suite 100
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

Client: Pennrose Properties, LLC
Project: Deanwood Hills

Project No.: 37:1404 **Figure**

LATERAL EARTH PRESSURE DIAGRAM - DRAINED RETAINING WALLS

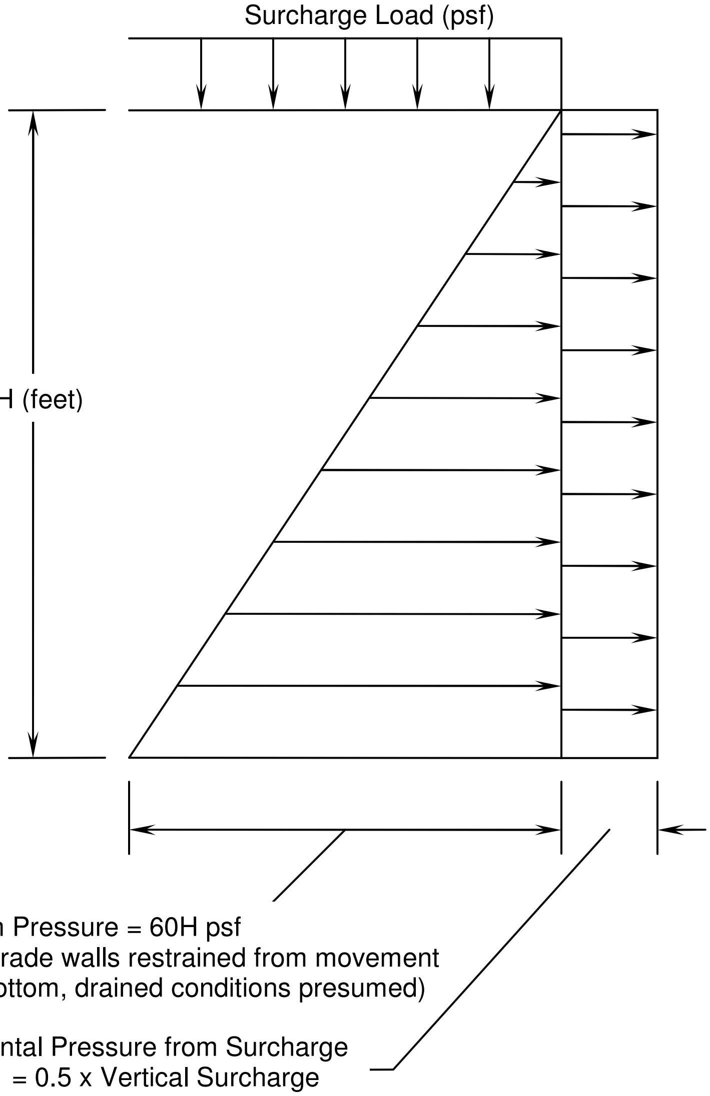


Lateral Earth Pressure = 40H psf
(For site retaining walls assuming drained conditions
and free to rotate at the top)

Horizontal Pressure from Surcharge
= 0.5 x Vertical Surcharge

This diagram is not suitable for the design of Support of Excavation or temporary shoring systems.

LATERAL EARTH PRESSURE DIAGRAM - DRAINED BELOW GRADE BUILDING WALLS



Lateral Earth Pressure = 60H psf
(For below grade walls restrained from movement
at top and bottom, drained conditions presumed)

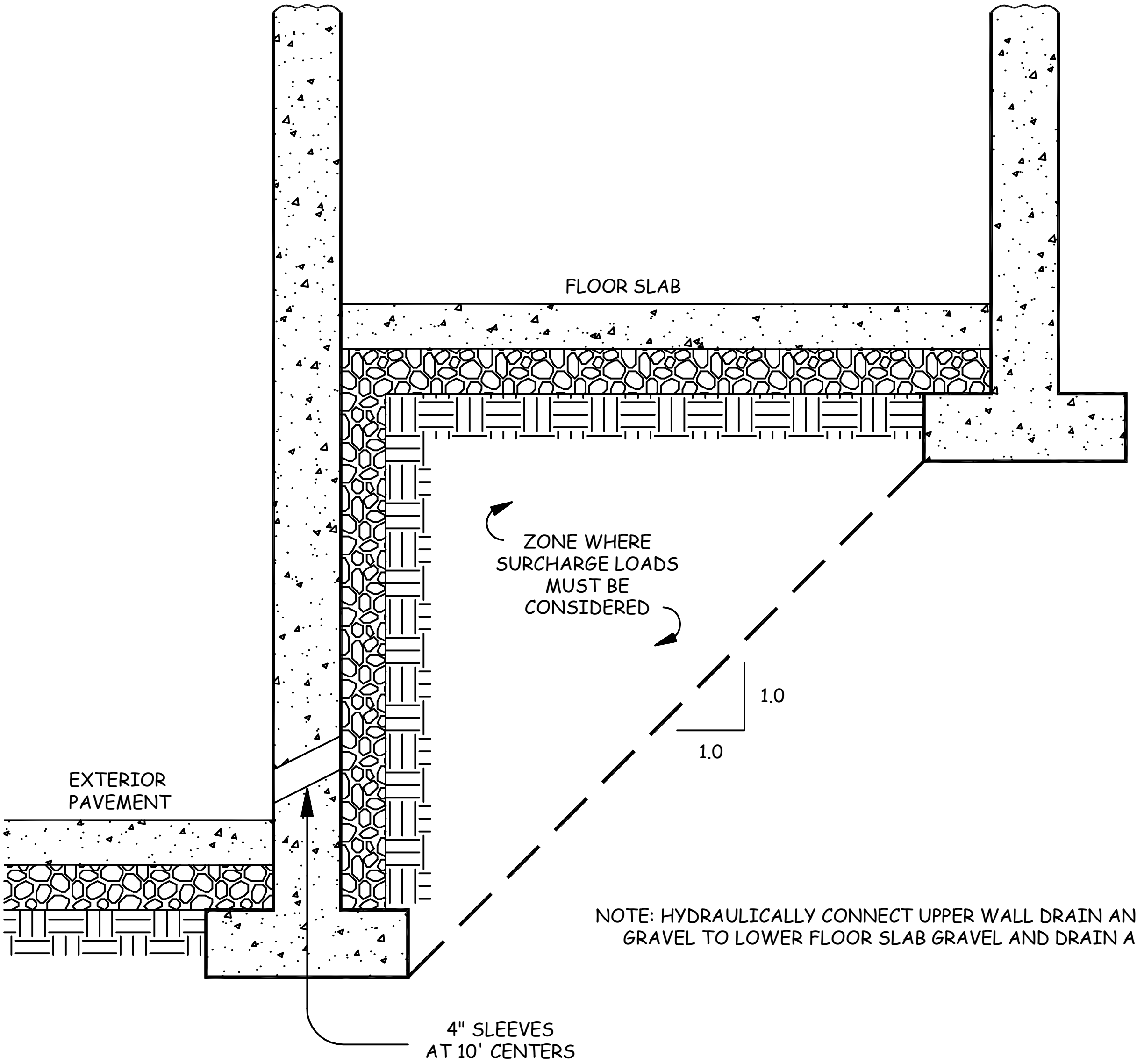
Horizontal Pressure from Surcharge
= 0.5 x Vertical Surcharge

This diagram is not suitable for the design of Support of Excavation or temporary shoring systems.

ZONE OF INFLUENCE DIAGRAM

(EXTERIOR WALLS)

NOT TO SCALE

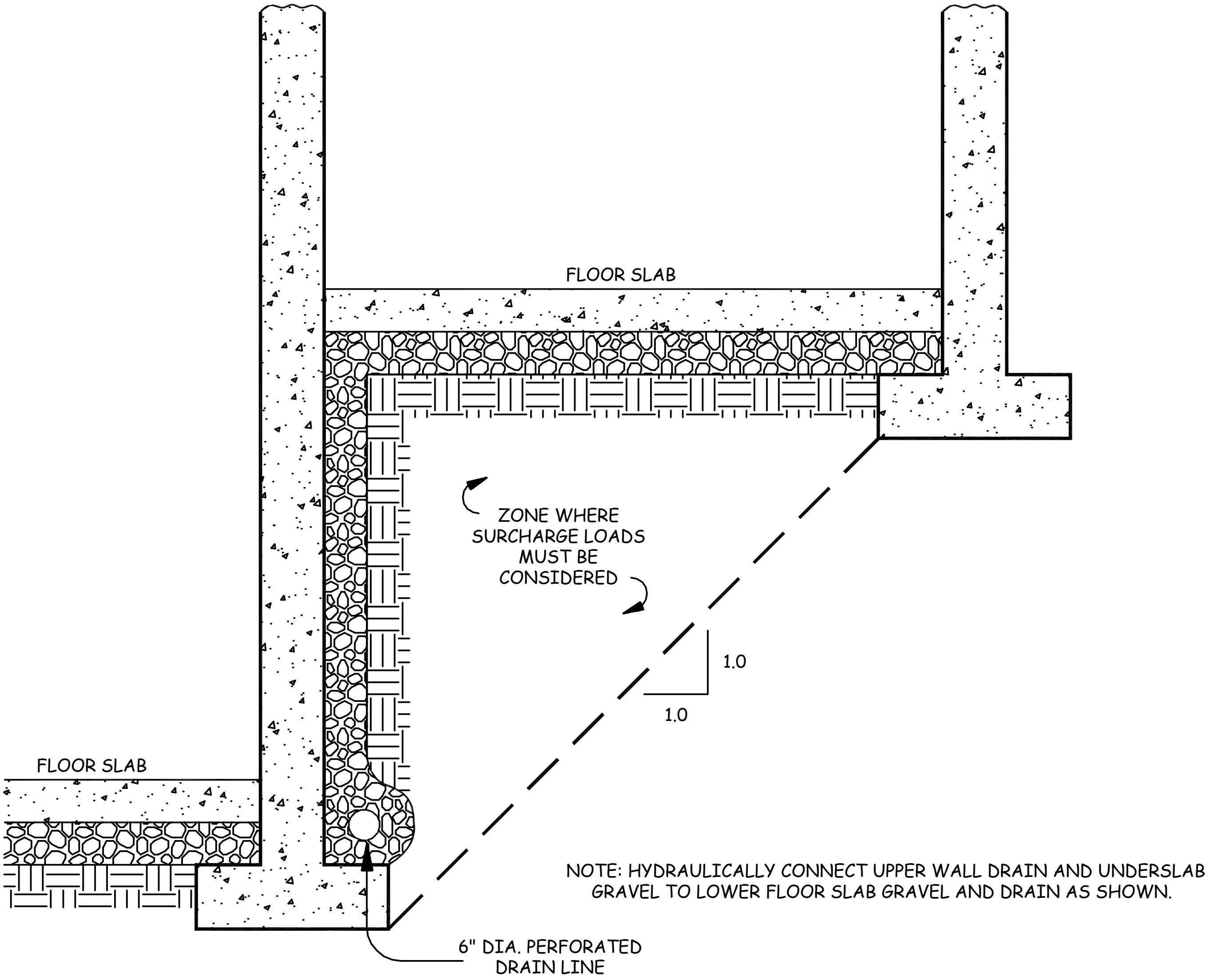


NOTE: HYDRAULICALLY CONNECT UPPER WALL DRAIN AND UNDERSLAB GRAVEL TO LOWER FLOOR SLAB GRAVEL AND DRAIN AS SHOWN.

ZONE OF INFLUENCE DIAGRAM

(INTERIOR WALLS)

NOT TO SCALE

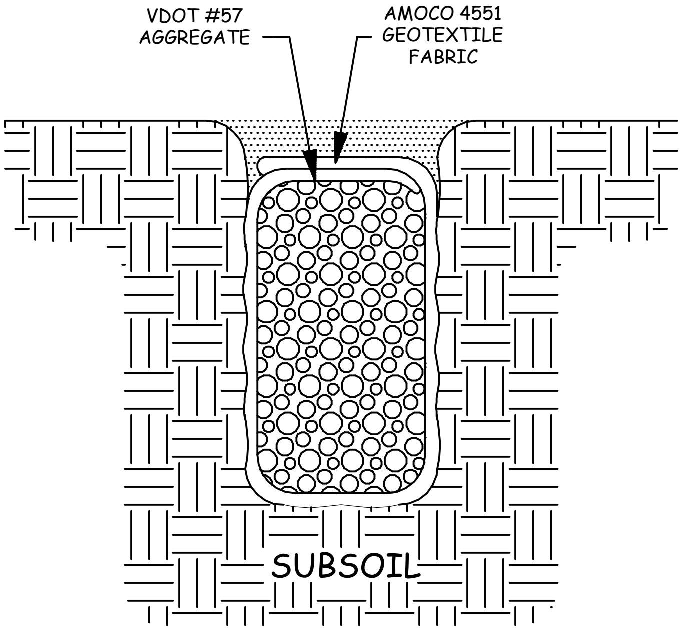


NOTE: HYDRAULICALLY CONNECT UPPER WALL DRAIN AND UNDERSLAB GRAVEL TO LOWER FLOOR SLAB GRAVEL AND DRAIN AS SHOWN.

FRENCH DRAIN
INSTALLATION PROCEDURE

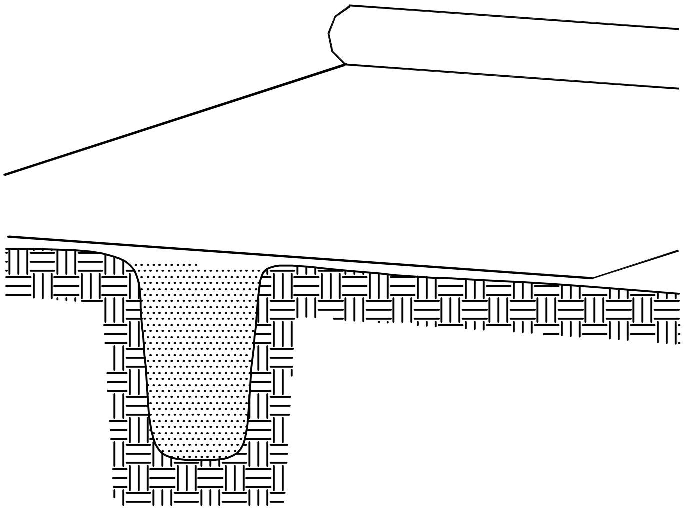
NOT TO SCALE

FINAL CONFIGURATION



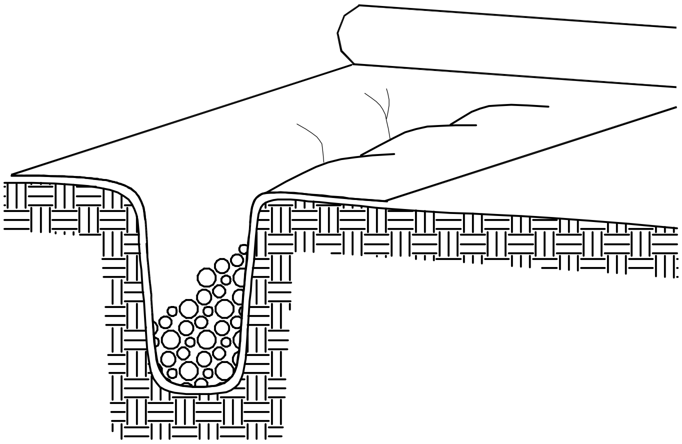
SUBDRAIN USING FILTER FABRIC

STEP 1



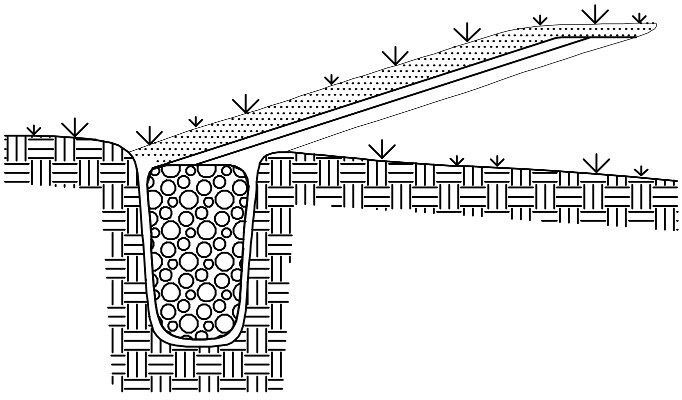
FABRIC IS UNROLLED DIRECTLY OVER TRENCH

STEP 2

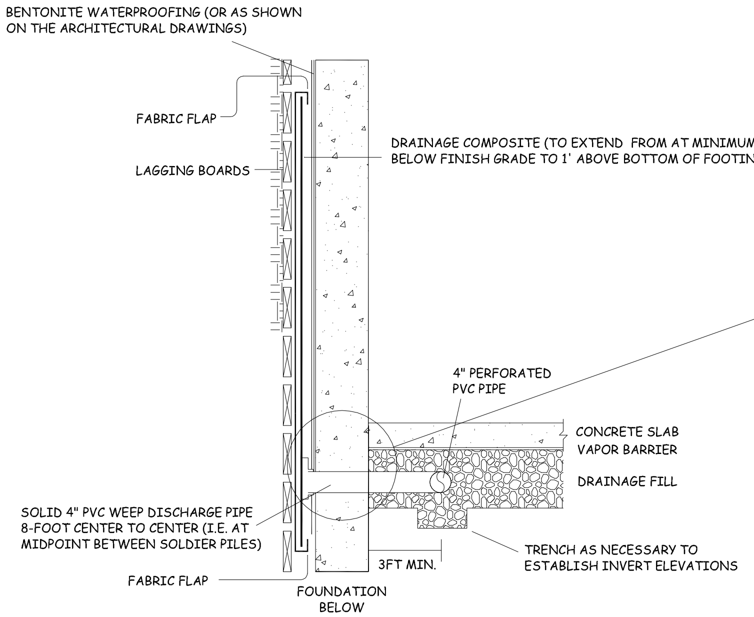


THE TRENCH IS FILLED WITH AGGREGATE

STEP 3

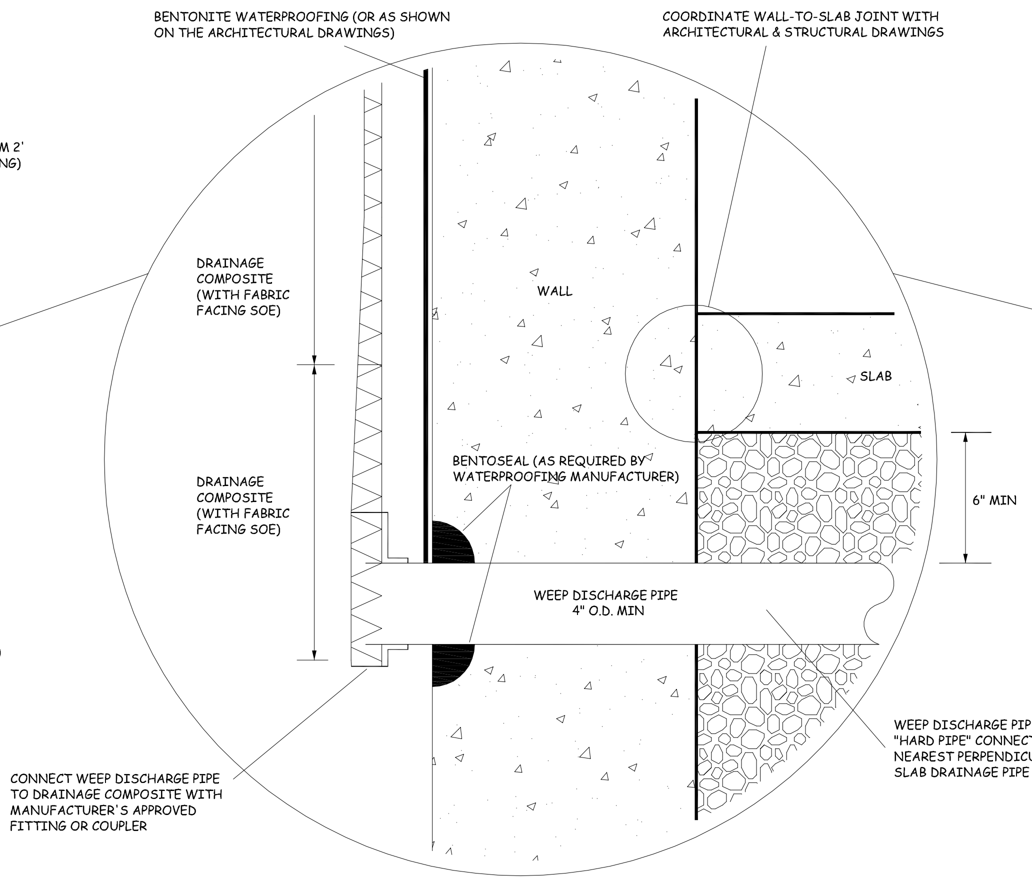


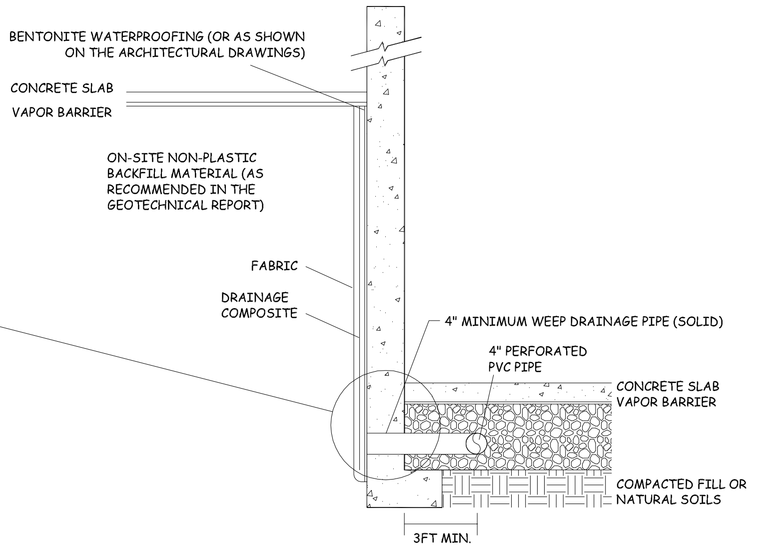
THE FABRIC IS LAPPED CLOSED AND
COVERED WITH BASE STONE



EXTERIOR WALL DRAIN DETAIL (TYPICAL) - DRAINED CONDITION (1.0)

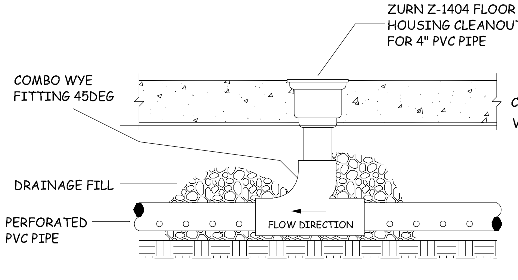
(NTS)





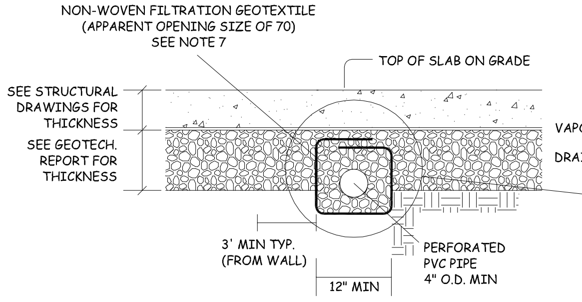
INTERIOR BELOW GRADE WALL DETAIL (2.0)

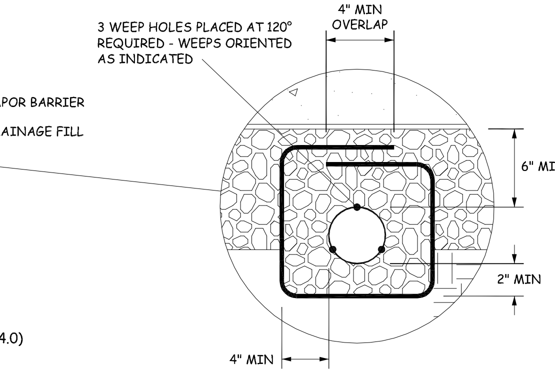
(NTS)



CLEANOUT DETAIL (TYPICAL) - PERFORATED PIPE (3.0)

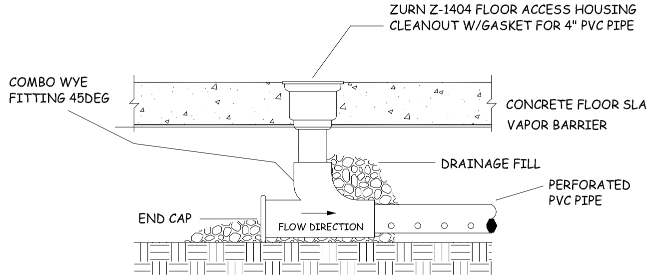
(NTS)





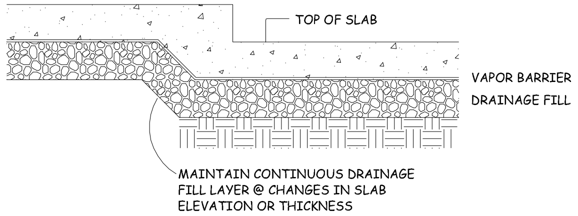
UNDERSLAB DRAIN DETAIL (TYP) (4.0)

(NTS)



CLEANOUT DETAIL W/END CAP - PERFORATED PIPE (5.0)

(NTS)



DRAINAGE LAYER STEP DETAIL (TYP) (6.0)

(NTS)

NOTES:

1) PRODUCTS SPECIFIED MAY BE SUBSTITUTED WITH AN EQUIVALENT PRODUCT, UPON REVIEW AND APPROVAL OF ECS.

2) GEOTEXTILE FILTER FABRIC TO CONTACT LAGGING OR SOIL, NOT THE CONCRETE WALL.

3) A GEOTEXTILE WRAPPED ADS DRAIN LINE MAY NOT BE SUBSTITUTED IN LIEU OF DETAIL 4.0.

4) 4" MINIMUM DIAMETER WEEP HOLES (SOLID PVC) TO BE LOCATED AT 8 FOOT CENTER TO CENTER (I.E. AT MIDPOINT BETWEEN SOLDIER PILES, ADJUSTED IN THE FIELD AS REQUIRED). THESE WEEPS SHOULD BE "HARD PIPE" CONNECTED TO THE NEAREST PERPINDICULAR UNDERSLAB DRAIN PIPE.

5) DRAINAGE & WATERPROOFING COMPOSITE ON EXTERIOR OF BELOW GRADE WALLS TO BE CONTINUOUS AROUND WALLS AND ALL SIDES OF EXCAVATION.

6) SEE MANUFACTURER'S DETAIL FOR CONNECTION BETWEEN DRAINAGE PANELS.

7) A NON-WOVEN FILTRATION GEOTEXTILE (MIRAFI 140N OR EQUIVALENT) SHOULD BE PLACED ON THE ENTIRE BUILDING SUBGRADE, PRIOR TO THE PLACEMENT OF THE UNDERSLAB DRAINAGE SYSTEM STONE IF INDICATED IN GEOTECHNICAL REPORT. THE GEOTEXTILE SHOULD HAVE AN APPARENT OPENING SIZE OF 70 AND SHOULD BE PLACED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS. THE FABRIC SHOULD OVERLAP THE PERIMETER PILE CAPS/FOOTINGS BY A MINIMUM OF 6 INCHES AT THE WALLS, AND SHOULD GO VERTICAL AND OVERLAP THE WALL BY 6 INCHES WHERE NO PILE CAP/FOOTING OR GRADE BEAM IS PRESENT. A MINIMUM OF 6 INCHES OVERLAP SHOULD ALSO BE MAINTAINED AT COLUMNS WHERE FABRIC MUST BE CUT.

8) MINIMUM 6-INCH GRAVEL COVER REQUIRED BETWEEN BOTTOM OF SLAB AND TOP OF PVC DRAIN PIPE.

9) 2-INCHES OF GRAVEL MUST LIE BELOW THE INVERT OF ALL DRAIN PIPES, UNLESS NOTED OTHERWISE.

10) BENTONITE WATERPROOFING (OR AS SHOWN ON THE ARCHITECTURAL DRAWINGS) TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

11) MAINTENANCE OF THE UNDERSLAB DRAINAGE SYSTEM WILL BE REQUIRED. THE BUILDING ENGINEER WILL NEED TO DERIVE A SCHEDULE OF MAINTENANCE. ECS RECOMMENDS A MINIMUM OF MONTHLY INSPECTIONS OF THE SYSTEM DURING CONSTRUCTION, QUARTERLY INSPECTIONS POST-CONSTRUCTION FOR A PERIOD OF TWO YEARS, AND ANNUALLY THEREAFTER. SHOULD EXCESSIVE ACCUMULATION OF GRIT, IRON OCHRE, OR OTHER MATERIALS BE IDENTIFIED, MORE FREQUENT MAINTANANCE MAY BE REQUIRED.

12) THE PERFORATED PVC DRAINS MUST BE SLOPED MINIMUM 0.5% TO APPROPRIATE DRAINAGE COLLECTION POINT.

13) THE GROUNDWATER CONDITIONS DURING THE EXCAVATION PROCESS SHOULD BE EVALUATED TO DETERMINE IF ADDITIONAL MEASURES ARE REQUIRED TO HANDLE ANY IRON OCHRE INTRUSION INTO THE UNDERSLAB DRAINAGE SYSTEM. SUCH MEASURES MAY INCLUDE BUT ARE NOT LIMITED TO REDUCED WEEP HOLE SPACING, ADDITIONAL CLEANOUTS, FREQUENT FLUSHING & CLEANING, ENLARGED PERFORATED PVC DRAIN LINES, ETC.

14) WATERSTOPS (IF REQUIRED BASED ON THE ARCHITECTURAL & STRUCTURAL DRAWINGS) SHALL BE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS.

15) CONTRACTOR TO COORDINATE CLEANOUT LOCATIONS WITH WALLS PER ARCHITECTURAL PLANS. COORDINATE WITH THE ENGINEER WHERE CONFLICTS OCCUR.

16) SOILD PIPE ONLY TO BE USED AT WEEP LOCATIONS TO CONNECT WEEP TO PERFORATED UNDERSLAB PIPE.

17) EACH SUMP PIT SHALL BE EQUIPPED WITH TWO PUMPS, EACH RATED AS INDICATED IN THE GEOTECHNICAL REPORT. CONSTRUCTION DEWATERING FLOWS SHOULD BE OBSERVED DURING CONSTRUCTION DEWATERING TO DETERMINE IF PUMP CAPACITY REVISIONS ARE NECESSARY.

18) INSTALL GRIT COLLECTION CHAMBER UPSTREAM AND ADJACENT TO SUMP PUMPS.

BELOW-GRADE WALL AND UNDERSLAB DRAINAGE DIAGRAM

ECS™

C:\data\dwg\dtls\UNDERSLAB_DTL_NEW.dwg, 1/29/2015 3:20:36 PM, ECS Mid-Atlantic, LLC Chantilly, VA

I:\Geotechnical\(eProjects)\23600-23699\23658\23658_BLD.dwg, 2/17/2015 10:37:11 AM, ECS Mid-Atlantic, LLC Chantilly, VA

LEGEND

● APPROX. INFILTRATION TEST LOCATION

⊕ APPROX. BORING LOCATION

APPROX. CROSS SECTION LOCATION

🟦 FINISH FLOOR ELEVATION = 77.67'

🟧 FINISH FLOOR ELEVATION = 66.00'

DEANWOOD HILLS
5201 HAYES STREET, NE
WASHINGTON, DC

ECS

BORING LOCATION DIAGRAM

ECS REVISIONS

ENGINEER	DRAFTING
DJS	RAC

SCALE 1"=50'

PROJECT NO. 37:1404

SHEET 1 OF 4

DATE 12-15-14

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SOIL CLASSIFICATION LEGEND

ST - SHELBY TUBE
RC - ROCK CORE
PM - PRESSURE METER

- GW - WELL GRADED GRAVEL
- GM - SILTY GRAVEL
- GP - POORLY GRADED GRAVEL
- GC - CLAYEY GRAVEL
- SW - WELL GRADED SAND
- ML - LOW PLASTICITY SILT
- CL - LOW PLASTICITY CLAY
- MH - HIGH PLASTICITY SILT
- SM - SILTY SAND
- SP - POORLY GRADED SAND
- SC - CLAYEY SAND
- CH - HIGH PLASTICITY CLAY
- OH - HIGH PLASTICITY ORGANIC SILTS AND CLAYS
- OL - LOW PLASTICITY ORGANIC SILTS AND CLAY
- PT - PEAT
- 🟧 FILL OF ALL TYPES.
- 🟩 WEATHERED ROCK
- 🟪 PROBABLE FILL OF ALL TYPES.
- 🟪 POSSIBLE FILL OF ALL TYPES.

SURFACE MATERIALS

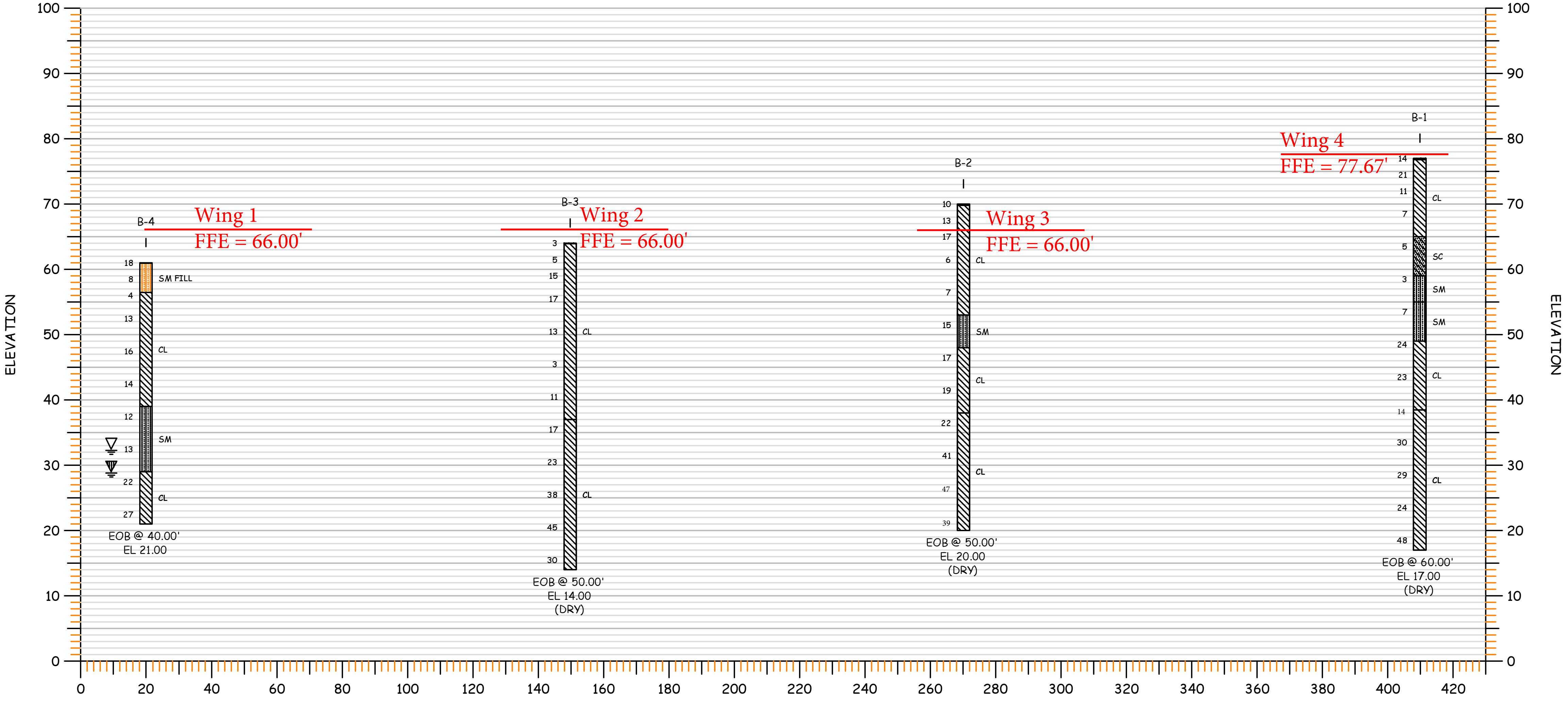
- TOPSOIL
- ASPHALT
- GRAVEL
- CONCRETE
- VOID

ROCK TYPES

- IGNEOUS
- METAMORPHIC
- SEDIMENTARY

SYMBOL LEGEND

- ▽ WATER LEVEL - DURING DRILLING/SAMPLING
- ▽ WATER LEVEL - BEFORE CASING REMOVAL
- ▼ WATER LEVEL - AFTER CASING REMOVAL
- ▽ WATER LEVEL - AFTER 24 HOURS



SCALE
VERTICAL SCALE 1"=20'
HORIZONTAL SCALE 1"=40'

DEANWOOD HILLS
5201 HAYES STREET, NE
WASHINGTON, DC

CROSS SECTION
A-A

ECS REVISIONS

ENGINEER	DRAFTING
DJS	RAC

SCALE AS NOTED

PROJECT NO. 37:1404

SHEET 2 OF 4

DATE 02-17-15

SOIL CLASSIFICATION LEGEND

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WATER LEVEL - AFTER CASING REMOVAL
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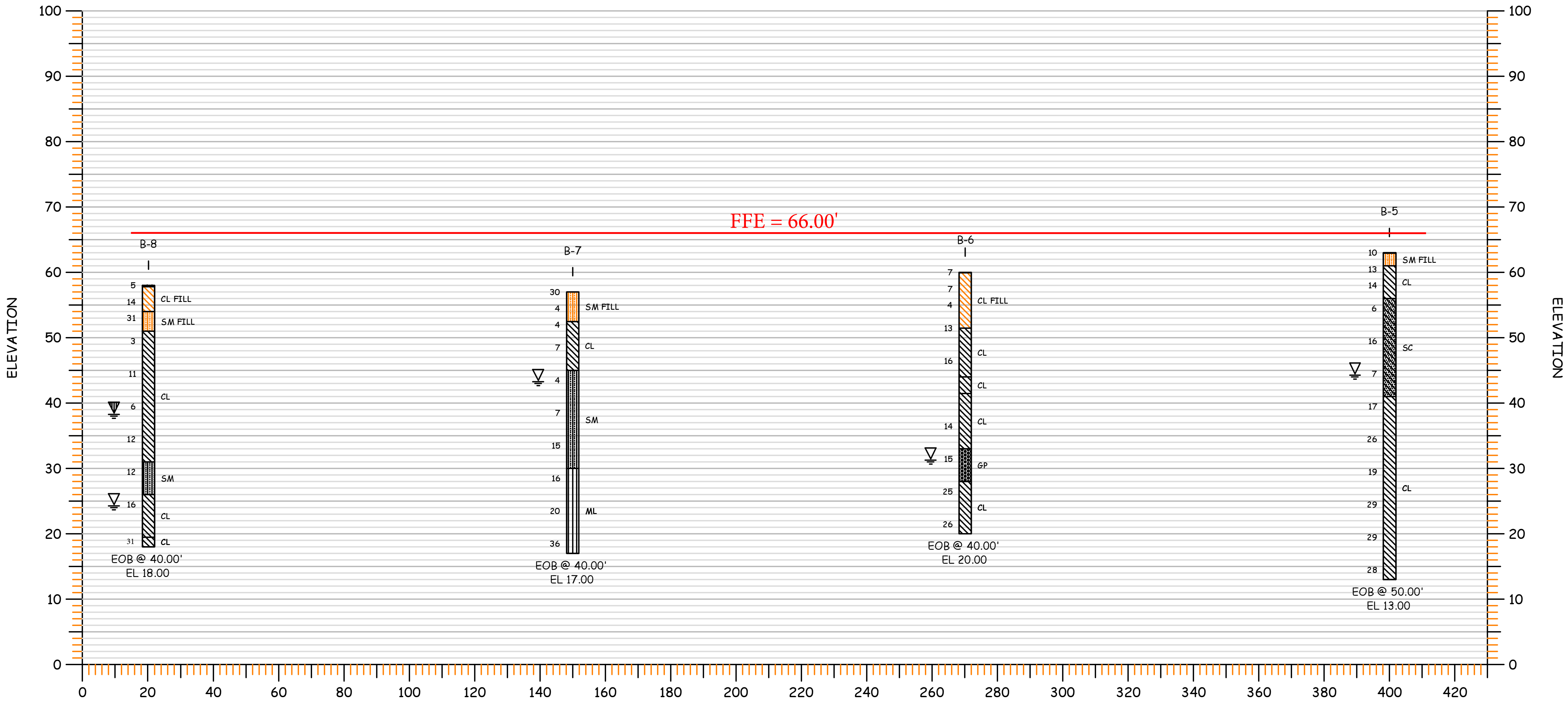

SCALE
VERTICAL SCALE 1"=20'
HORIZONTAL SCALE 1"=40'

DEANWOOD HILLS
5201 HAYES STREET, NE
WASHINGTON, DC

CROSS SECTION
B-B

ECS REVISIONS

ENGINEER DJS	DRAFTING RAC
SCALE	AS NOTED
PROJECT NO.	37:1404
SHEET	3 OF 4
DATE	02-17-15

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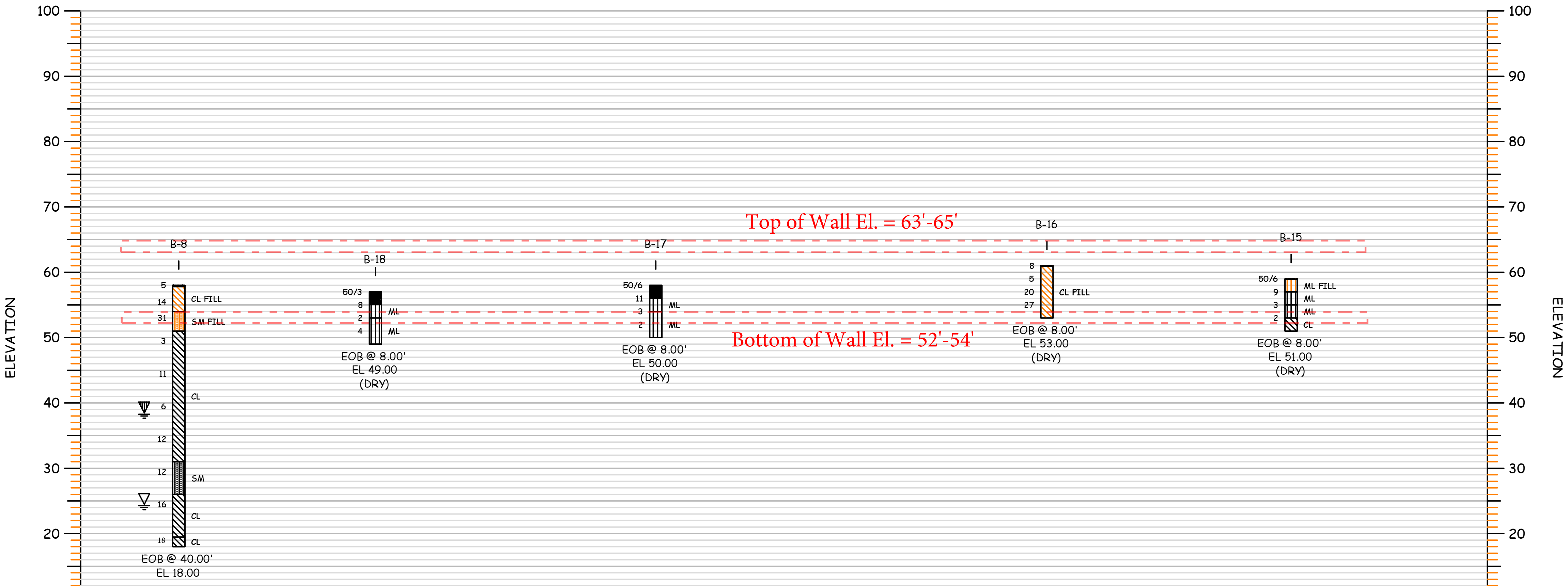

SCALE
VERTICAL SCALE 1"=20'
HORIZONTAL SCALE 1"=40'

DEANWOOD HILLS
5201 HAYES STREET, NE
WASHINGTON, DC

ECS

CROSS SECTION
C-C

ECS REVISIONS

ENGINEER	DRAFTING
DJS	RAC

SCALE
AS NOTED

PROJECT NO.
37:1404

SHEET
4 OF 4

DATE
02-17-15

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