# REPORT OF
# SUBSURFACE EXPLORATION, LABORATORY TESTING, AND GEOTECHNICAL ENGINEERING ANALYSES

**Annapolis DPW**
**Annapolis, Anne Arundel, Maryland**

**ECS Project No. 02-8325**

**Prepared For:**

**MCCRONE**
**20 RIDGELY AVENUE**
**ANNAPOLIS, MD 21401**

**February 28, 2017**

February 28, 2017

Ms. Kristin Ward
McCrone
20 Ridgely Avenue
Annapolis, MD 21401

ECS Project No. 02-8325

Reference: Report of Subsurface Exploration, Laboratory Testing, and Geotechnical Engineering Services for **Annapolis DPW,** Annapolis, Anne Arundel County, Maryland

Dear Ms. Ward:

As requested, ECS Mid-Atlantic, LLC (ECS) has completed the geotechnical engineering services for the above-referenced project. This work was performed in accordance with ECS Proposal No. 02-16805-PR, dated January 3, 2017.

It has been our pleasure to be of service to McCrone and the Design Team for this project. We would appreciate the opportunity to continue our role as Geotechnical Engineer of Record during final design and subsequent construction. If you have any questions with regard to the information contained in the enclosed report, or if we can be of further assistance to you during the planning or construction phases of the project, please contact us.

Most sincerely,

ECS Mid-Atlantic, LLC

Zachary Adcock, E.I.T.
Project Engineer

Hasan M. Aboumatar, Ph.D., P.E.
Principal Engineer

STATE OF MARYLAND
HASAN M. ABOUMATAR
No. 29553
PROFESSIONAL ENGINEER

Professional Certification I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland.

License No *29553*. Expiration Date: *12/31/2017*

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## Prepared For:

**MCCRONE**
**20 RIDGELY AVENUE**
**ANNAPOLIS, MD 21401**

**Submitted by:**

**ECS Mid-Atlantic, LLC**
**1340 Charwood Road, Suite A**
**Hanover, Maryland 21076**

**February 28, 2017**

**ANNAPOLIS DPW**

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# ANNAPOLIS DPW

## INTRODUCTION

### Project Location

The site is located at the existing Annapolis Department of Public Works (DPW) building, at approximately 937 Spa Road in the Annapolis area of Anne Arundel County, Maryland. A Site Location Diagram is provided in the Appendix.

### Project Information and Site Conditions

In preparing the subsurface exploration program for this study, ECS discussed the proposed development and proposed boring locations with you. In addition, ECS was provided with sheets SP-00.01 and SP-01.01, as prepared by McCrone and dated September 23, 2016, which indicated the existing grades, proposed grades, and proposed boring locations. ECS attended two site meetings as well to discuss the proposed development.

The site is currently developed with two (2) existing DPW buildings, as well as a trailer; with associated parking area and drive lanes. We understand that the existing buildings and trailer will be demolished to allow for the construction of the proposed DPW buildings. Existing grades at the site slope generally downward from north to south, ranging from EL 38 at the northern portion of the site, to EL 18 at the southern portion of the site. Grades within the proposed upper building footprint range from EL 35 to EL 38, and grades within the proposed lower building footprint range from EL 24 to EL 25. Information regarding the planned finished floor elevation for the new buildings was not available at the time this report was prepared; however, we anticipate the finished floor will be at or near EL 36 for the upper building and EL 24 for the lower building. Therefore, only minor cuts and fills will be required to establish final grades.

Based on the information provided to us, it is our understanding that the proposed construction is two (2) two-story buildings; one building with services bays, and offices at the mezzanine level, and the other building consisting primarily of garage space for service vehicles. We anticipate the buildings will be constructed at-grade (i.e., no basement or below-grade levels).The other site improvements include parking, retaining walls, and stormwater management (SWM). The SWM is proposed to the southeast of the lower DPW building, consisting of micro-bioretention facilities. Specific details regarding the planned SWM facilities were not provided at the time this report was prepared; however, we anticipate that facility bottoms will be less than 10 feet below existing grades, and that infiltration is desirable. The existing retaining wall adjacent to the incinerator will be reconstructed, and retaining walls are planned adjacent to Spa Road. The height of the existing retaining wall adjacent to the incinerator has an exposed height of approximately 14 feet, and the proposed retaining walls adjacent to Spa Road are planned to be 5 feet or less in exposed height.

Structural loading information was provided, and the column loads for the upper DPW building are planned to be on the order of 100 kips, and the column loads for the lower DPW building are planned to be on the order of 30 kips.

### Scope of Services

Our scope of services included drilling eleven (11) soil test borings, designated as: B-1 through B-5 to evaluate the subsurface condition for the building; P-1 through P-3 to evaluate the subsurface conditions for the pavement, RW-1 to evaluate the surface conditions behind the existing retaining wall, and SWM-1 and SWM-2 to evaluate the subsurface conditions for the SWM facilities. The approximate boring locations are presented on the Boring Location Plan in the Appendix.

All borings were drilled in general accordance with ASTM D 1586 standards. The scope of work also included visually classifying soil boring samples, performing laboratory testing on selected soil samples from the borings, performing various engineering analyses, and providing this written report of findings, evaluations and recommendations.

The report contains the following information:

a. Information regarding site conditions, including surface drainage, geology, and special site features;
b. Descriptions of the field exploration and laboratory testing procedures used;
c. Boring logs in accordance with the standard practice of geotechnical engineers, showing subsurface strata and descriptions, groundwater conditions, and results of field tests;
d. Results of laboratory tests on summary sheets and on individual test reports;
e. A Site Vicinity Map, a Boring Location Plan, and pertinent Reference Sheets;
f. A description of the general subsurface conditions at the site, along with any special subsurface conditions that would be expected to impact site development, including existing fill, or other unsuitable soils; and
g. Evaluations and recommendations for geotechnical aspects of design and construction, including general site development, foundation systems with allowable bearing pressures and estimates of total and differential settlements, frost depth considerations, lateral earth pressure for below grade walls or retaining walls, seismic site classification, SWM facilities, pavements, earthwork considerations, and other aspects of geotechnical-related design and construction.

## EXPLORATION PROCEDURES

### Subsurface Exploration Procedures

The soil borings were drilled with an ATV-mounted drill rig, using continuous-flight, hollow-stem augers to advance the boreholes. Drilling fluid was not used during advancement of the boreholes.

Representative soil samples were obtained by means of the split-barrel sampling procedure in general accordance with ASTM 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 inches by means of a 140-pound hammer falling 30 inches.

The number of hammer blows required to drive the sampler through the second and third 6-inch drive increments is termed the Standard Penetration Test (SPT) value (blow count, or N-value) and is indicated for each sample on the Boring Logs. In the borings, split-barrel sampling was performed at 2.5 ft intervals to depths of 10 ft and at 5.0 ft intervals thereafter.

N-values can be used to provide a qualitative indication of the in-place relative density of cohesionless soils. In a less reliable way, N-values also provide an indication of consistency for cohesive soils. The indications of relative density and consistency are qualitative, since many factors can significantly affect N-values and prevent direct correlations, including differences among drill crews, drill rigs, drilling procedures, and hammer-rod-sampler assemblies.

A field log of the subsurface conditions encountered in the borings was maintained by the Drill Crew during the drilling operations. Each recovered soil sample was removed from the sampler and visually classified by the Drill Crew. Representative portions of soil samples were sealed in glass jars and returned to the ECS laboratory for further visual examination and possible laboratory testing.

**Laboratory Testing Program**

The laboratory testing program included visual classification of the boring samples by an experienced Geotechnical Engineer. The classifications were based on texture and plasticity in accordance with the Unified Soil Classification System (USCS). A brief explanation of the USCS is included in the Appendix of this report. The USCS group symbol for each soil type is indicated in parentheses following the soil descriptions on the Boring Logs.

During the visual classification procedures, the Geotechnical Engineer grouped the various soil types into the major strata noted on the Boring Logs. The stratification lines designating the interfaces between various soil strata on the Boring Logs are approximate. In situ, these transitions will likely be gradual and could occur at slightly different levels from those shown on the Boring Logs.

The limited laboratory testing program included natural moisture content, percent passing the No. 200 sieve, and Atterberg Limits on selected boring samples to estimate engineering properties of the soils and to help verify the visual classifications. The results of the laboratory testing are included in the appendix of the report.

The soil samples will be retained in the ECS laboratory for a period of 60 days. After that holding period, the samples will be discarded, unless ECS receives other instructions regarding their disposition.

# EXPLORATION RESULTS

## Geologic Conditions

The project site is located within the Atlantic Coastal Plain Physiographic Province, which is characterized by marine and river sediments deposited during successive periods of fluctuating sea level and moving shorelines. Generally, the sediments thicken from west to east, towards the Atlantic Ocean. The uppermost sediments are often comprised of interbedded sands, gravels, clays, and silts.

Based on the results of the test borings and a review of the *Geologic Map of Anne Arundel County, Maryland*, dated 1968, the natural soils at the project site are generally described as the Aquia Formation (Ta) which is:

> *"Dark green to gray-green, argillaceous, highly glauconitic, well sorted fine- to medium-grained sand; locally indurated shell beds; thickness 0 to 100 feet."*

## Subsurface Conditions

In general, the subsurface conditions encountered at the ground surface in our field exploration consisted of 2 to 6 inches of asphalt overtop 4 to 7 inches of gravel parking areas, 3 inches of topsoil in the undeveloped areas, and 4 to 8 inches of concrete over 2 to 6 inches of gravel within the buildings, overlying fill, possible fill, and natural soils.

The existing/possible fill was encountered in borings B-2 through B-4, P-2, P-3, RW-1, SWM-1, and SWM-2. The existing/possible fill extended to a depths ranging from 2 feet to 15 feet below existing grades. The existing fill consisted of SAND (SP) and CLAY (CL) with significant asphalt millings, along with gravel, concrete, glass, and brick.

Natural soils were encountered below the existing/possible fill, and surficial materials. The natural soils were generally brown, brownish green, greenish brown, orange, brownish red and green in color. The natural soils consisted generally of Clayey SAND (SC), Silty SAND (SM), CLAY (CL), Sandy CLAY (CL), Clayey SILT (ML/CL), and SAND (SP) soil types. The N-values recorded in the natural granular soils ranged from 2 blows per foot (bpf) to 32 blows per foot, indicating very loose to dense relative densities. The N-values recorded in the natural cohesive soils ranged from 7 bpf to 12 blows per foot, medium stiff to stiff relative consistencies. More detailed descriptions of the encountered subsurface conditions are provided on the boring log in the Appendix.

**Water Level Observations**

Groundwater level observations were made in the borehole, generally during the drilling operations and at completion of drilling operations, both before and after removal of the drilling augers. Groundwater was encountered in borings B-1, RW-1, and SWM-1 at a depth of 19 feet (EL 16), 29 feet (EL 7), and 11 feet (EL 12). Cave-in depths for the borings also were observed after removal of the drilling augers from the boreholes and ranged from 6.0 feet to 22.0 feet below existing grades.

Observations regarding the presence and absence of groundwater levels reflect the conditions at the time of this exploration only. Fluctuations in the locations of groundwater tables or perched water levels could occur as a result of seasonal variations in evaporation, precipitation, surface water run-off, and other factors. Therefore, water levels at future times could vary from those observed at the time of the borings.

## ANALYSES AND RECOMMENDATIONS

Based on the information provided, we understand that the proposed construction consists of two (2) buildings; one building with services bays, and offices at the mezzanine level, and the other building consisting primarily of garage space for service vehicles. We anticipate the buildings will be constructed at-grade (i.e., no basement or below-grade levels). Information regarding the planned finished floor elevation for the new buildings was not available at the time this report was prepared; however, we anticipate the finished floor will be at or near EL 36 for the upper building and EL 24 for the lower building. Therefore, only minor cuts and fills will be required to establish final grades.

Existing/possible fill was encountered in Borings B-2 through B-4, extending to depths ranging from 2 to 8 feet below existing grade. The fill material consists mainly of SAND (SP) with trace amounts of brick gravel, and concrete. The existing/possible fill was encountered beneath the slab of the existing buildings. The encountered fill appears to be suitable to remain in place and support new fill and foundations. However, the existing/possible fill should be thoroughly proofrolled prior to slab placement or placement of any additional fill to verify the suitability of the existing/possible fill. The proofrolling should be observed by a qualified representative of the Geotechnical Engineer in order to make final evaluations of the suitability of the existing/possible fill to remain in place. If any existing/possible fill soils are found to be soft or contain excessive amounts of organics, this unsuitable fill should be removed and replaced.

Based on the boring results, building footings are anticipated to be placed on new fill, on approved existing/possible fill, or natural soils. Based on the project information, it is ECS' opinion the proposed DPW buildings can be supported on conventional shallow foundations consisting of continuous wall footings and isolated column footings.

Foundation Considerations

Footings placed on firm natural soils, approved existing/possible fill, or on new engineered fill placed on firm natural soils or existing/possible fill can be designed for net allowable bearing pressures not to exceed 2,000 pounds per square foot (psf) for isolated column footings and continuous wall footings. The net allowable soil bearing pressure refers to the pressure that can be transmitted to the foundation bearing soils in excess of the final overburden pressure at the base of a footing.

Prior to the placement of reinforcement and concrete for footings, the bases of the footing excavations should be observed, tested, and approved by a qualified representative of the Geotechnical Engineer to verify that soil conditions at each footing location are suitable for the design bearing pressure. If unsuitable soils are encountered at planned subgrade levels for any footing, the unsuitable soils should be undercut to suitable bearing materials. The footing can be directly supported on the competent soils at greater depths or, alternatively, the design footing bearing level can be restored through placement of lean concrete or select engineered fill materials.

If the design bearing level is restored using select engineered fill, then the excavation to remove the unsuitable soils should extend at least 0.5 ft laterally beyond the bottom edge of the footing for each 1 ft of vertical undercut below the footing bearing level. The select engineered fill materials should be placed and compacted as discussed in greater detail later in this report.

Settlement of the hotel foundations will be a function of the compressibility of the underlying subgrade soils, the actual applied loads, and other factors. Based on the anticipated maximum column loads provided, the anticipated total settlements of individual footings, designed and constructed as outlined in this report, will be less than 1 inch. Maximum differential settlements within the proposed building are expected to be ½ inch over a horizontal distance of 30 feet.

In order to reduce the possibility of foundation bearing failure and excessive settlement due to local shear or "punching" action, we recommend that continuous footings have a minimum width of 2 feet and that isolated column footings have a minimum lateral dimension of 4 feet. In addition, footings should be placed at a sufficient depth to provide adequate protection against frost heave. We recommend that all footings be placed at a minimum depth of 30 inches below finished grade.

All continuous load-bearing wall foundations should be suitably reinforced. To provide continuity and minimize differential movements, the longitudinal reinforcing steel should be extended into any column footing situated along the walls (exterior or interior) and the foundations constructed as a continuous unit. The reinforcing steel should also be continuous through the building corners. Where top and bottom steel is included in the continuous wall foundations, a minimum footing thickness of 12 inches should be required. Prior to placing any foundation concrete, the steel reinforcement should be examined to ensure that the bars are properly sized and positioned in accordance with the foundation plans and specifications.

**Ground Supported Floor Slabs**

Building floor slabs may be ground-supported on subgrades prepared in accordance with the recommendations in the sections titled Subgrade Preparation and Fill Placement. It is important that the slab subgrade be firm and stable before the placement of the granular subbase materials, the moisture barrier, and the concrete. Based on the test boring results and the anticipated planned finished floor elevations, the anticipated slab subgrade should generally consist of approved fill, or new engineered fill.

The existing subgrade should be thoroughly proofrolled with suitable equipment and/or probed by a qualified representative of the Geotechnical Engineer in an effort to detect unstable or otherwise unacceptable soil conditions. Soils in any excessively unstable areas should be undercut and replaced with new engineered fill. Recommendations for construction of engineered fill are presented in the Fill Placement section of this report.

It is recommended that ground-supported slabs be underlain by a minimum of 4 inches of CR-6 or GA S/B dense-graded aggregate or approved equivalents. However, for areas that are subject to heavy loading, such as the maintenance bays, a minimum of 6 inches of aggregate base should be utilized. Acceptable granular subbase materials should have no aggregate size greater than 1.5 inches, 95 to 100 percent passing the 1 inch sieve, and less than 12 percent by total weight passing the Number 200 sieve. The granular subbase materials will provide a capillary break between the subgrade and the concrete slab, a higher modulus of subgrade reaction, and more uniform support conditions.

All granular materials should be compacted; however, if the granular subbase materials have more than 5 percent fines, those materials should be compacted to a minimum of 98 percent of the maximum dry density as determined by the Standard Proctor compaction test method (ASTM D 698). For structural design purposes, a modulus of subgrade reaction (k) of 100 pounds per cubic inch (pci) may be utilized for the structural design of slabs, provided a 4-inch subbase is utilized and the subgrade has been prepared in accordance with the recommendations presented herein.

In the event there is a significant time lag between the site grading work and the fine grading of concrete slab areas prior to the placement of the subbase stone or concrete, the Geotechnical Engineer should verify the condition of the prepared subgrade. Prior to final slab construction, the subgrade may require scarification and re-compaction to provide firm and stable conditions.

Where moisture vapor seepage through concrete slab is a concern, a moisture vapor barrier, consisting of at least 8 mil polyethylene sheets, should be placed on top of the granular materials before the placement of the concrete. However, with the use of a moisture vapor barrier, special attention should be given to the surface curing of the slab in order to minimize uneven drying of the slab and any associated cracking and curling.

It is recommended that ground-supported slabs be isolated from the foundation footings so that differential movement between the footings and slab will not induce excessive shear and bending stresses in the floor slab.

Where the structural configuration prevents the use of a free floating slab, the slab should be designed with suitable reinforcement and load transfer devices to preclude overstressing of the slab. Slabs must also be provided with proper control joints to minimize the effects of concrete shrinkage and differential settlements. To minimize the widths of any shrinkage cracks that may develop near the surface of the slab, it is recommended that welded-wire mesh reinforcement be provided. The welded-wire mesh should be in located the top half of the slab to be effective.

**Lateral Earth Pressure for Below-Grade Walls and Site Retaining Walls**

Based upon our understanding of the proposed construction, the existing retaining wall adjacent to the incinerator will be reconstructed, and retaining walls are planned adjacent to Spa Road. The height of the exiting retaining wall adjacent to the incinerator has an exposed height of approximately 14 feet, and the proposed retaining walls adjacent to Spa Road are planned to be 5 feet or less in exposed height. The following recommendations are provided to guide the general design of below-grade building and site retaining walls for lateral earth pressures.

It is very important with regard to construction of below-grade building walls and site retaining walls that soils within the critical zones behind the walls meet certain criteria with regard to soil type. The critical zone can be considered as the zone between the bottom back edge of the wall footing and an imaginary line extending upward and rearward from the bottom back edge of the wall footing at a 45-degree angle.

It is recommended that all natural soils and backfill soils within the critical zones of the walls should have USCS classifications of Silty SAND (SM) or more granular. Any soils having classifications less granular than Silty SAND (SM) may need to be removed from the critical zones of the walls, as determined by the Geotechnical Engineer at the time of construction. Based upon the results of the borings, it appears that the soils at the site are suitable to remain in-place for use as wall backfill. The existing retaining wall backfill can be re-used for the reconstructed retaining wall.

Backfill materials for site retaining walls and below-grade walls should be placed and compacted in accordance with criteria outlined in the **Earthwork** section of this report. The minimum degree of compaction for backfill soils behind below-grade building walls and conventional retaining walls should be 95 percent of the Standard Proctor maximum dry density (ASTM D 698), unless otherwise approved by the Geotechnical Engineer.

It is important that below-grade building walls that generally are designed for minimal displacements at the top of the wall should not be backfilled until the walls are adequately braced by permanent structural framing. Conversely, walls that are designed for active earth pressures generally should not be braced during backfill compaction, so that the walls can yield and rotate and develop active earth pressures. For yielding walls, it generally will be best not to place steel framing, or conventional masonry or concrete walls for the buildings, until wall backfilling operations have been completed.

Below-grade building walls and other retaining walls that are rigid and not free to rotate at the top should be designed for at-rest earth pressure conditions. Walls that are flexible and free to rotate at the top can be designed for active earth pressure conditions.

Based on the typical properties for Silty SAND (SM) or more granular soil types and the SPT N-values the following parameters are recommended for design/evaluation:

- Total (wet) unit weight: 120 pcf
- Internal friction angle: 30 degrees
- At-rest earth pressure coefficient, $K_o$: 0.50
- Active earth pressure coefficient, $K_a$: 0.33
- Passive earth pressure coefficient, $K_p$: 3.0
- At-rest equivalent fluid pressure: 60H (psf)
- Active equivalent fluid pressure: 40H (psf)
- Sliding Resistance: 0.36

The value of H in the expressions above is defined as the height of the wall in units of feet against which the retained earth is placed. It should be noted that because the frictional and passive earth pressure resistances are based on limit strength conditions, appropriate factors of safety of at least 1.5 should be applied to the designs considering these resistances.

The design criteria presented above for evaluation of horizontal earth pressures on retaining walls are based on the assumption of level backfill conditions and the absence of free water within the wall backfill materials. Lateral pressures induced by sloping backfills and/or by any surcharge loadings adjacent to walls will also need to be considered in the wall designs. In addition, suitable drainage will need to be provided to intercept and to dispose of any surface infiltration and groundwater behind walls.

Additional resistance to sliding from passive earth pressure resistance also can be considered, if the earth materials considered for passive resistance will remain in place on the low side of the retaining wall. Equivalent fluid pressures for passive earth pressure resistance can be computed as 250D, in units of pounds per square foot, where D is the depth of undisturbed natural soil or engineered fill that will remain in place above the base of the wall footing. The Geotechnical Engineer can provide additional design guidance regarding these and other aspects of below-grade wall and retaining wall design upon request.

**Seismic Classification**

Section 1613.3.2 of the IBC 2012 refers to Chapter 20 of ASCE7 for seismic site classification, which is based on various criteria, one of which is the Standard Penetration Resistance, $N_{bar}$, derived from the Standard Penetration Test Procedure (ASTM D-1586). ASCE7 Table 20.3.1 provides correlations for Site Classes C, D, and E with various ranges of $N_{bar}$ to be calculated for the top 100 feet of the subsurface materials at a site in accordance with procedures described in Section 20.4.2 of ASCE7.

In addition, the table presents criteria related to various soil properties for Site Classes E and F. ECS has used Table 20.3.1 of ASCE7 and the procedures outlined in Section 20.4.2 of ASCE7 to evaluate the Site Class for this project site.

Based on our review of the soil test boring results, it appears that the average $N_{bar}$ value should be in the range between 15 bpf and 50 bpf over a depth of 100 ft. This $N_{bar}$ places the project site within the Site Classification of D, according to Table 20.3.1 of ASCE7.

**Pavement Construction**

Details regarding traffic conditions anticipated for the site were not provided. However, based on our previous experience and understanding of the proposed development, it is ECS' opinion that two pavement sections generally should be considered for use – a light-duty pavement section for areas that will be subjected primarily to automobile and light-truck traffic and a heavy-duty pavement section for areas that will be subjected to some routine heavier delivery and trash pickup truck traffic, in addition to normal automobile and light-truck traffic. The majority of the site will likely be heavy-duty pavement.

It is our judgment that traffic conditions associated with light-duty pavements can be represented by approximately 25,000 18-kip equivalent single-axle loads (ESALs) during an approximately 20-year service life, while traffic conditions associated with heavy-duty pavements can be represented by approximately 250,000 ESALs during an approximately 20-year service life.

It is ECS' opinion that use of the light-duty pavement section and the heavy-duty pavement section most likely will be sufficient for traffic conditions likely to occur at the development. However, traffic loading conditions are an extremely important parameter with regard to pavement design. Therefore, if the traffic condition estimates provided above are considered to be inappropriate for the project, please advise ECS so that revised pavement section designs can be determined for this site. Final decisions regarding pavement sections can be made as project design progresses, when further input regarding likely traffic conditions can be provided by other Design Team members.

Subgrade support conditions are the other major parameter of importance to pavement design and performance. It is anticipated that the subgrade soil conditions which will be exposed at final subgrade levels when the project site is graded prior to pavement construction will consist of Clayey SAND (SC) or SAND Fill (SP FILL), or new engineered fill. Based on the borings, the existing pavement subgrade has a significant amount of fill which may need to be overexcavated, or recompacted in-place. The fill should be evaluated by proofrolling the exposed subgrade. The undercuts can be limited to 18 inches. We recommend conducting California Bearing Ratio tests on planned subbase material once the subgrade for the planned parking areas and drive lanes are established.

Based upon our previous experience with similar projects and site conditions, it is our judgment that the typical pavement subgrade soils such as the soils encountered at the site could exhibit a minimum California Bearing Ratio (CBR) value of 3 when compacted to at least 95 percent of the maximum dry density, as determined by the Standard Proctor test (ASTM D 698). Therefore, for pavement design a CBR value of 3 is considered. If material having a CBR value of less than 3 is encountered at pavement subgrades, it is recommended to undercut the top 18 inches of this material at the pavement subgrade and replace it with approved fill material.

The pavement sections provided in this report have been designed based on methodology from the American Association of State Highway and Transportation Officials' (AASHTO) *Guide for Design of Pavement Structures*, 1993. Summarized below are the subgrade strength parameters, the traffic conditions, and other design parameters and criteria considered in these analyses.

| | |
|---|---|
| CBR value: | 3 |
| Traffic for Light-Duty Pavement: | 25,000 ESALs |
| Traffic for Heavy-Duty Pavement: | 250,000 ESALs |
| Reliability: | 85 percent |
| Overall Variance: | 0.45 |
| Initial Serviceability: | 4.2 |
| Terminal Serviceability: | 2.0 |

| **Pavement Material** | **Compacted Material Thicknesses (Inches)*** | |
|---|---|---|
| | **Standard-Duty (25,000 ESALs)** | **Heavy-Duty (250,000 ESALs)** |
| **Surface Course Asphalt**<br>HMA Superpave - 9.5 mm ** | 1.5 | 1.5 |
| **Base Course Asphalt**<br>HMA Superpave –19.0 mm ** | 2.5 | 4.5 |
| **Graded Aggregate Base**<br>GAB | 4.0 | 8.0 |
| **Total Pavement Thickness** | 8.0 | 14.0 |
| * Compaction: Level 1 (50 Gyrations)<br>** Binder Type: PG64-22 | | |

Our design analyses were based on methodology from the American Association of State Highway and Transportation Officials' (AASHTO) *Guide for Design of Pavement Structures*, 1993. Based on the assumptions and methodologies presented above, we recommend the pavement sections indicated in the table below be utilized for preliminary design and planning purposes.

Final determinations of pavement section to be used at the site may not be possible until the time of actual construction, when the subgrade soil conditions become exposed in the various site areas and design CBR values have been determined for these specific soil types. Adjustments to the pavement sections indicated in the table above may be necessary at that time. For planning and pricing considerations, however, it is anticipated that the pavement section shown for a CBR value of 3 should provide a reasonable estimate of the average pavement sections that will be needed for the site.

We recommend that rigid Portland cement concrete pavement sections should be provided for any dumpster storage areas and for any unloading zones for deliveries. The Portland cement concrete pavement section should be at least 6 inches thick and should consist of air-entrained Portland cement concrete having a minimum 28-day compressive strength of 4,000 pounds per square inch (psi). A minimum of 6 inches of compacted dense-graded aggregate subbase (CR-6 or GASB) should be placed beneath all rigid concrete pavements. For any dumpster storage areas, the Portland cement concrete slab area should be large enough to support the dumpster and at least the front wheels of the truck used to unload the dumpster.

The State of Maryland is using pavement materials whose characteristics are based on the Superpave material specifications. We have provided specifications for Superpave materials in the tables above. Please note that it is important to specify the Compaction Level and the Binder Type for Superpave materials.

All pavement materials and construction should be in accordance with the most current version of the *Standard Specifications for Construction and Materials* of the Maryland Department of Transportation, State Highway Administration (SHA), and any applicable Anne Arundel County standards.

The pavement sections provided in the table above were developed for the indicated in-service traffic conditions only and do not provide an allowance for construction traffic conditions. Therefore, if pavements will be constructed early during site development to accommodate construction traffic, consideration must be given to the construction of heavier pavement sections, capable of accommodating the much heavier loads normally associated with construction traffic, as well as the future in-service traffic. ECS can provide additional design assistance with regard to pavements upon request.

**Stormwater Management**

Based on the provided information, the proposed SWM is located to the southeast of the lower DPW building, and consists of micro-bioretention facilities. Specific details regarding the planned SWM facilities were not provided at the time this report was prepared; however, we anticipate that facility bottoms will be less than 10 feet below existing grades, and that infiltration is desirable. The subsurface conditions for the SWM facilities were evaluated with Borings SWM-1 and SWM-2. The details about the soil strata for each boring can be seen on the soil boring logs in the Appendix.

Based on the boring results, existing fill was encountered in both borings SWM-1 and SWM-2. The existing fill extended to a depth of 12 feet (EL 11) below existing grades in Boring SWM-1, and 15 feet (EL 7) in Boring SWM-2. The fill consisted of SAND (SP), Clayey SAND (SC), and Silty CLAY (CL/ML) with gravel, brick, shells, and glass.

Field infiltration testing, and laboratory testing consisting of USDA classifications were not performed. Fill was encountered in Borings SWM-1 and SWM-2 to a depth of 12 feet and 15 feet, respectively. Additionally, groundwater was encountered at a depth of 11 feet in Boring SWM-1, within the fill materials. The MDE does not permit infiltration in fill soils, and therefore, infiltration is not feasible at the locations represented by SWM-1 and SWM-2. Based on the boring results, SWM utilizing infiltration should not be considered. A summary of soil boring results are shown in the following table.

| **Boring Results for SWM Facilities** | | | | |
|---|---|---|---|---|
| Boring # | Existing Grade (EL) | Depth of Fill | Groundwater Depth (EL) | Infiltration Feasibility |
| SWM-1 | 23 | 12 Feet | 11 Feet (EL 12) | **N** |
| SWM-2 | 22 | 15 Feet | Not Encountered | **N** |

**Earthwork Operations**

The following paragraphs detail our recommendations regarding subgrade preparation and compaction requirements.

Subgrade Preparation

Subgrade preparation should generally include the stripping of any unsuitable surface materials from the planned structure areas. It is recommended that the stripping of unsuitable surficial materials should extend to a minimum of 10 feet beyond the structure area limits, where feasible.

Subsequent to stripping operations, the exposed subgrade soils in the planned building areas should be examined by a qualified representative of the Geotechnical Engineer. The exposed soils should be thoroughly proofrolled by a vehicle having an axle weight of at least 20 tons, such as a fully-loaded tandem-axle dump truck. This procedure is intended to assist in identifying any localized loose or yielding materials. In the event that any yielding materials are encountered during the proofrolling operations, those subgrade soils should either be thoroughly densified in-place, or undercut to firm ground and replaced with controlled, compacted fill to final subgrade elevations.

Fill Placement

Prior to placement of compacted fill, representative bulk samples (about 50 pounds) should be taken of the proposed fill soils and laboratory tests should be conducted to determine Atterberg limits, natural moisture content, grain-size distribution, and moisture-density relationships for compaction. These test results will be necessary for proper control of construction for new engineered fill.

Upon achieving competent subgrade conditions, the Contractor can place and compact engineered fill to reach final subgrade levels. In general, any materials to be used as structural fill should consist of soil types classified as GC, GM, SP, SM, SC, ML and CL, in accordance with ASTM D 2487, and should have a Liquid Limit less than 40 and a Plasticity Index less than 20. However, materials used as backfill behind below-grade walls or retaining walls should have classifications of SM, or more granular, in accordance with ASTM D 2487, and should have no more than 30 percent by weight of soil particles finer than the No. 200 sieve. Based on the boring results, the on-site material is may be used as structural fill; however, the fill should be evaluated and have any debris and trash removed prior to placement.

Finer-grained, more plastic, and organic soil types (MH, CH, OL, OH, Pt), if encountered at the site, may be used as fill materials in landscape areas. Any such materials encountered during grading operations should be either stockpiled for later use in landscape fills, or should be placed in approved disposal areas either on-site or off-site.

Prior to the utilization of any on-site or off-site borrow materials, the Geotechnical Engineer should be provided with representative samples in order to determine the suitability of the materials for use as a controlled compacted fill and to develop moisture-density relationships. In order to expedite the earthwork operations, it is recommended that any off-site borrow materials generally should be comprised of SM or more granular soil types.

All structural fill should be placed in loose lifts, which do not exceed 8 inches in thickness, and should be compacted to at least 95 percent of the maximum dry density, as determined by the Standard Proctor Compaction Test (ASTM D 698). Generally, the moisture content of the fill material should be maintained within $\pm$2 percentage points of the optimum moisture content for the fill material, as determined by ASTM D 698. Fill materials in the upper 1 foot of slab and pavement subgrades should be compacted to at least 98 percent of the Standard Proctor maximum dry density. Fill placed in non-structural areas should be compacted to at least 90 percent of the Standard Proctor maximum dry density in order to avoid significant subsidence.

Due to the textural variations of the on-site soils, variations in moisture-density relationships should be anticipated. Such variations must be determined in the field by a qualified representative of the Geotechnical Engineer at the time of construction, so that any necessary changes to fill placement and compaction procedures can be implemented.

The footprint of the proposed building area should be well defined, including the limits of the fill zones at the time of fill placement. Grade controls should be maintained throughout the filling operations.

All filling operations should be observed on a full-time basis by a qualified representative of the Geotechnical Engineer to determine that minimum compaction requirements are being achieved. A minimum of one compaction test per lift should be made per 2,500 square feet of fill lift area, but not fewer than two tests per lift should be made for any lift. The elevations and locations of the field density tests should be clearly identified at the time of fill placement and compaction.

Compaction equipment suitable for the soil types being used as fill should be selected to compact the fill. Theoretically, any equipment type can be used, so long as the required density is achieved. Ideally, a steel drum roller generally will be the most efficient for compaction of granular soil types and for sealing the surface soils, while a sheepsfoot roller or pneumatic-tire roller generally will be most efficient for compaction of cohesive soil types. All fill areas should be graded to facilitate surface drainage of any surface runoff associated with precipitation, and should be sealed by use of a smooth-drum roller to limit infiltration of surface water at the end of each work day. During placement and compaction of new fill at the beginning of each workday, the Contractor should scarify existing subgrade soils so that a weak plane will not be formed between the new fill and the existing subgrade soils. We recommend that subgrade soils should be scarified to depths of about 4 inches prior to placement of new fill.

Fill materials should not be placed on frozen soils, frost-heaved soils, and/or excessively wet soils. All frozen, frost-heaved, or excessively wet soils should be removed prior to continuation of fill operations. Borrow fill materials should not contain frozen materials at the time of placement. All frozen, frost-heaved, or excavated wet soils should be removed prior to placement of controlled, compacted fill. Moisture contents for excessively wet soils will need to be lowered to the range limits previously discussed.

If any problems are encountered during the earthwork operations, or if site conditions deviate from those indicated by the borings, the Geotechnical Engineer should be notified immediately.

## Construction Considerations

The on-site soils contain silt and clay fines that will be sensitive to moisture increases and to construction disturbance. Construction activities in the presence of excessive moisture can lead to softening of the subgrade soils and loss of bearing capacity. Therefore, it will be prudent to schedule earthwork operations during the warmer and drier seasons that generally occur from late spring to early fall. Measures should also be taken to limit site disturbance, especially from rubber-tired heavy construction equipment, and to provide for drainage of surface water from areas being developed.

A firm working surface for the placement of engineered fill should be established prior to construction of new fills. The moisture content of the fill soils at the time of placement should be carefully controlled to ensure that the required compaction effort can be achieved without excessive pumping or movement of the fill mass. In the event that the earthwork operations are accomplished during the cooler and wetter periods of the year, delays and additional costs should be anticipated.

At these times, reduction of soil moisture may need to be accomplished by a combination of mechanical manipulation and the use of chemical additives, such as lime or cement, in order to lower moisture contents to levels appropriate for compaction.

As noted in the **Water Level Observations** section of this report, groundwater was encountered in borings B-1, RW-1, and SWM-1 at a depth of 19 feet (EL 16), 29 feet (EL 7), and 11 feet (EL 12). However, groundwater is not anticipated to have a significant effect on construction. Any groundwater encountered during the construction of the structure should be the results of perched water and should be readily managed by interceptor trenches and localized systems of sumps and pumps. Deeper excavation for utilities may encounter ground water and provision for handling water in excavations should be anticipated.

All foundation excavations must be protected to prevent the disturbance of the subgrade materials and to minimize any potential loss of support capacity. Foundation concrete generally should be placed for foundations during the same day that the foundation excavations are made and approved. Should excavating and placing the foundation concrete the same day not be practical, we recommend that a concrete mud mat, 2 to 3 inches thick, be placed to protect the subgrade soils from moisture changes and disturbance. If protection of the soils is not provided, then undercutting of softened or loosened soils may be necessary prior to the placement of reinforcing steel and foundation concrete.

Prior to the placement of any foundation concrete or mud mat, the subgrade soils must be carefully examined and tested by a qualified representative of the Geotechnical Engineer to confirm the availability of the design soil bearing capacity. To minimize disturbance to the subgrade soils during excavation, we recommend that a bucket without scarifying teeth, in addition to hand excavation methods, be used during the final phases of the excavation for the foundations.

Any cuts or excavations associated with building and utility excavations may require forming or bracing, slope flattening, or other physical measures to control sloughing and/or to prevent slope failures. An examination of the applicable OSHA codes and requirements should be made by the appropriate Contractor to ensure that adequate protection of the excavations and trench walls is provided.

The surface soils contain some silt and fine sands and are considered erodible. The Contractor should provide and maintain good site drainage during earthwork operations to help to maintain the integrity of the surface soils. All erosion and sedimentation shall be controlled in accordance with sound engineering practice and current local requirements. Surface water should be directed away from the construction area, and the site should be sloped at gradients of 1 to 2 percent to reduce the potential for ponding water and the subsequent saturation of the surface soils.

## CLOSING

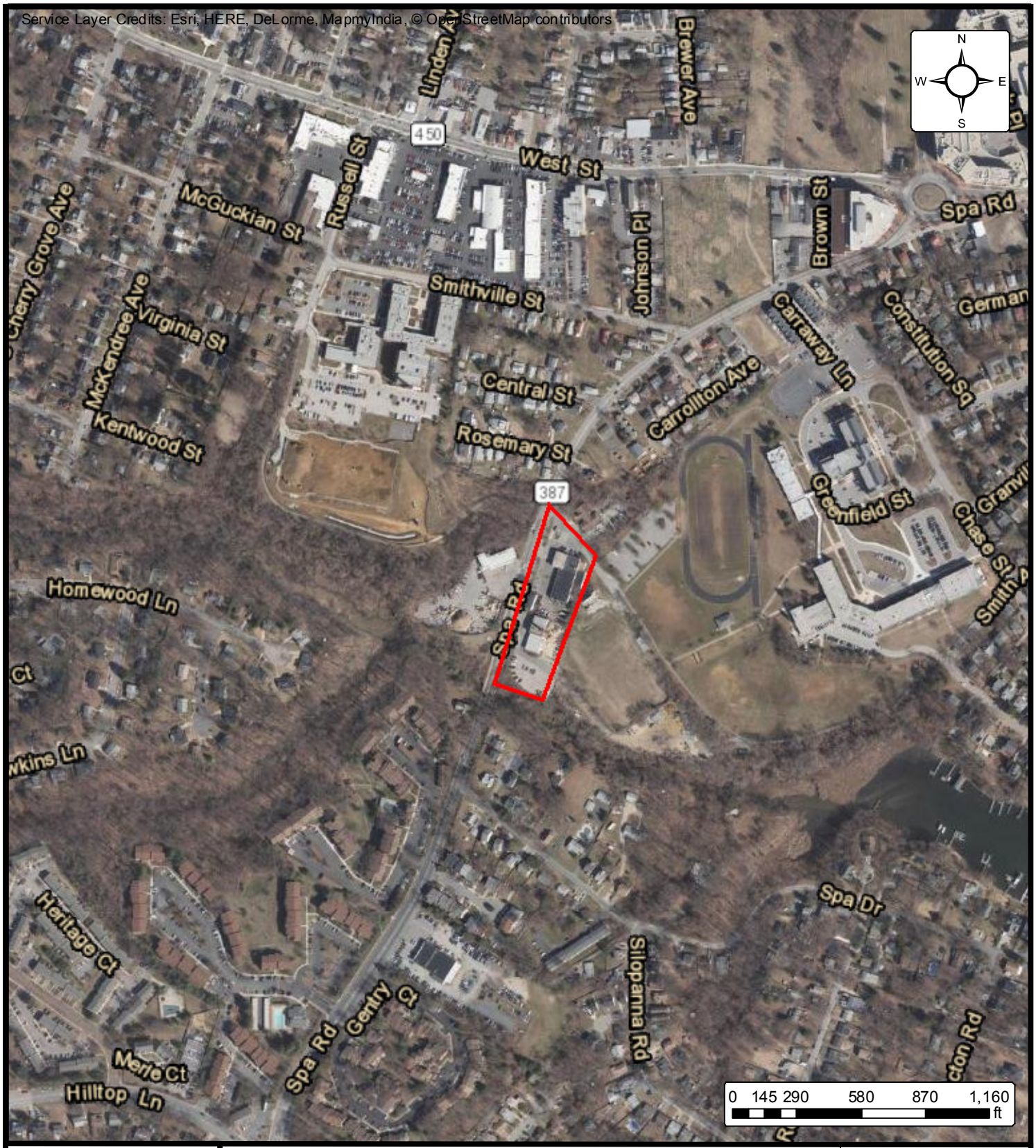
This report has been prepared to provide the Owner and the Design Team with subsurface information and evaluations and recommendations to guide geotechnical-related design and construction for development of the proposed Annapolis DPW buildings in Annapolis, Maryland. Additional Geotechnical Consulting may be needed as planning and design for the project progress.

The evaluations and recommendations presented in this report are, of necessity, based on the information made available to us at the time of the actual writing of the report and the site conditions, surface and subsurface, that existed at the time the exploratory borings were drilled. Further assumption has been made that the limited exploratory borings, in relation both to the aerial extent of the site and to depth, are representative of general subsurface conditions across the site. If subsurface conditions are encountered that differ significantly from those reported herein, the Geotechnical Engineer should be notified immediately so that the analyses and recommendations presented in this report can be reviewed for validity.

If there are significant changes to the proposed construction from those previously discussed, ECS may need to review the changes to determine whether the evaluations and recommendations of this report will remain valid. ECS should be provided with appropriate plans and other information as project design progresses, so that we can review the information and provide additional geotechnical guidance, as needed. ECS recommends further subsurface investigation at the site prior to final design so that the presence of existing/possible fill materials at the site can be more fully investigated. The Geotechnical Engineer should be retained to prepare, or at least to review, any earthwork specifications to assure that the recommendations of this report have been properly interpreted and included in the construction documents.

# APPENDIX

- **Site Location Diagram**
- **Laboratory Test Results**
- **Reference Notes for Boring Logs**
- **Boring Logs**
- **Generalized Building Subsurface Profile**
- **Boring Location Plan**




# SITE LOCATION DIAGRAM

# CITY OF ANNAPOLIS DPW

**MCCRONE**
**ANNAPOLIS MD**

| | |
|---|---|
| ENGINEER | ZLA |
| SCALE | 1 " = 600 ' |
| PROJECT NO. | 02:8325 |
| SHEET | 1 OF 1 |
| DATE | 2/15/2017 |

# REFERENCE NOTES FOR BORING LOGS

| MATERIAL[1,2] | | |
|---|---|---|
| | ASPHALT | |
| | CONCRETE | |
| | GRAVEL | |
| | TOPSOIL | |
| | VOID | |
| | BRICK | |
| | AGGREGATE BASE COURSE | |
| | FILL[3] | MAN-PLACED SOILS |
| GW | WELL-GRADED GRAVEL | gravel-sand mixtures, little or no fines |
| GP | POORLY-GRADED GRAVEL | gravel-sand mixtures, little or no fines |
| GM | SILTY GRAVEL | gravel-sand-silt mixtures |
| GC | CLAYEY GRAVEL | gravel-sand-clay mixtures |
| SW | WELL-GRADED SAND | gravelly sand, little or no fines |
| SP | POORLY-GRADED SAND | gravelly sand, little or no fines |
| SM | SILTY SAND | sand-silt mixtures |
| SC | CLAYEY SAND | sand-clay mixtures |
| ML | SILT | non-plastic to medium plasticity |
| MH | ELASTIC SILT | high plasticity |
| CL | LEAN CLAY | low to medium plasticity |
| CH | FAT CLAY | high plasticity |
| OL | ORGANIC SILT or CLAY | non-plastic to low plasticity |
| OH | ORGANIC SILT or CLAY | high plasticity |
| PT | PEAT | highly organic soils |

**DRILLING SAMPLING SYMBOLS & ABBREVIATIONS**

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

**PARTICLE SIZE IDENTIFICATION**

| DESIGNATION | | PARTICLE SIZES |
|---|---|---|
| Boulders | | 12 inches (300 mm) or larger |
| Cobbles | | 3 inches to 12 inches (75 mm to 300 mm) |
| Gravel: | Coarse | ¾ inch to 3 inches (19 mm to 75 mm) |
| | Fine | 4.75 mm to 19 mm (No. 4 sieve to ¾ inch) |
| Sand: | Coarse | 2.00 mm to 4.75 mm (No. 10 to No. 4 sieve) |
| | Medium | 0.425 mm to 2.00 mm (No. 40 to No. 10 sieve) |
| | Fine | 0.074 mm to 0.425 mm (No. 200 to No. 40 sieve) |
| Silt & Clay ("Fines") | | <0.074 mm (smaller than a No. 200 sieve) |

**COHESIVE SILTS & CLAYS**

| UNCONFINED COMPRESSIVE STRENGTH, $Q_P$[4] | SPT[5] (BPF) | CONSISTENCY[7] (COHESIVE) |
|---|---|---|
| <0.25 | <3 | Very Soft |
| 0.25 - <0.50 | 3 - 4 | Soft |
| 0.50 - <1.00 | 5 - 8 | Medium Stiff |
| 1.00 - <2.00 | 9 - 15 | Stiff |
| 2.00 - <4.00 | 16 - 30 | Very Stiff |
| 4.00 - 8.00 | 31 - 50 | Hard |
| >8.00 | >50 | Very Hard |

| RELATIVE AMOUNT[7] | COARSE GRAINED (%) | FINE GRAINED (%) |
|---|---|---|
| Trace | <5 | <5 |
| Dual Symbol *(ex: SW-SM)* | 10 | 10 |
| With | 15 - 20 | 15-25 |
| Adjective *(ex: "Silty")* | 25 - <50 | 30 - <50 |

**GRAVELS, SANDS & NON-COHESIVE SILTS**

| SPT[5] | DENSITY |
|---|---|
| <5 | Very Loose |
| 5 - 10 | Loose |
| 11 - 30 | Medium Dense |
| 31 - 50 | Dense |
| >50 | Very Dense |

**WATER LEVELS[6]**

| | |
|---|---|
| WL | Water Level (WS)(WD) |
| | (WS) While Sampling |
| | (WD) While Drilling |
| SHW | Seasonal High WT |
| ACR | After Casing Removal |
| SWT | Stabilized Water Table |
| DCI | Dry Cave-In |
| WCI | Wet Cave-In |

[1] *Classifications and symbols per ASTM D 2488-09 (Visual-Manual Procedure) unless noted otherwise.*

[2] *To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.*

[3] *Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-**FILL**)].*

[4] *Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).*

[5] *Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf).*

[6] *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 granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.*

[7] *Minor deviation from ASTM D 2488-09.*



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# Laboratory Testing Summary



| 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-2 | 2.50 - 4.00 | 23.2 | | | | | | | | | |
| | S-3 | 5.00 - 6.50 | 15.1 | | | | | | | | | |
| | S-4 | 8.50 - 10.00 | 22.1 | | | | | | | | | |
| | S-5 | 13.50 - 15.00 | 22.9 | | | | | | | | | |
| B-2 | | | | | | | | | | | | |
| | S-2 | 2.50 - 4.00 | 27.5 | CL | 42 | 18 | 24 | 68.9 | | | | |
| B-3 | | | | | | | | | | | | |
| | S-2 | 2.50 - 4.00 | 17.0 | | | | | | | | | |
| | S-3 | 5.00 - 6.50 | 20.3 | | | | | | | | | |
| | S-4 | 8.50 - 10.00 | 25.4 | | | | | | | | | |
| | S-5 | 13.50 - 15.00 | 13.3 | | | | | | | | | |
| B-5 | | | | | | | | | | | | |
| | S-2 | 2.50 - 4.00 | 14.4 | | | | | | | | | |
| | S-3 | 5.00 - 6.50 | 12.5 | | | | | | | | | |
| P-3 | | | | | | | | | | | | |
| | S-2 | 2.50 - 4.00 | 24.7 | SM | NP | NP | NP | 16.9 | | | | |
| RW-1 | | | | | | | | | | | | |
| | S-4 | 8.50 - 10.00 | | SC | 28 | 11 | 17 | 35.1 | | | | |
| | S-5 | 13.50 - 15.00 | 6.0 | | | | | | | | | |

**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.** 8325
**Project Name:** City of Annapolis DPW
**PM:** Zachary L Adcock
**PE:** Hasan M. Aboumatar
**Printed On:** Tuesday, February 28, 2017

ECS MID-ATLANTIC, LLC
1340 Charwood Road, Suite A
Hanover, MD 21076
Phone: (410) 859-4300
Fax: (410) 859-4324

| CLIENT | JOB # | BORING # | SHEET |
|---|---|---|---|
| McCrone, Inc. | 8325 | B-1 | 1 OF 1 |

| PROJECT NAME | ARCHITECT-ENGINEER |
|---|---|
| City of Annapolis DPW | McCrone, Inc. |

SITE LOCATION: 937 Spa Road, Annapolis, Anne Arundel County, MD

| NORTHING | EASTING | STATION |
|---|---|---|
| | | |

CALIBRATED PENETROMETER TONS/FT$^2$

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

PLASTIC LIMIT% — WATER CONTENT% — LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

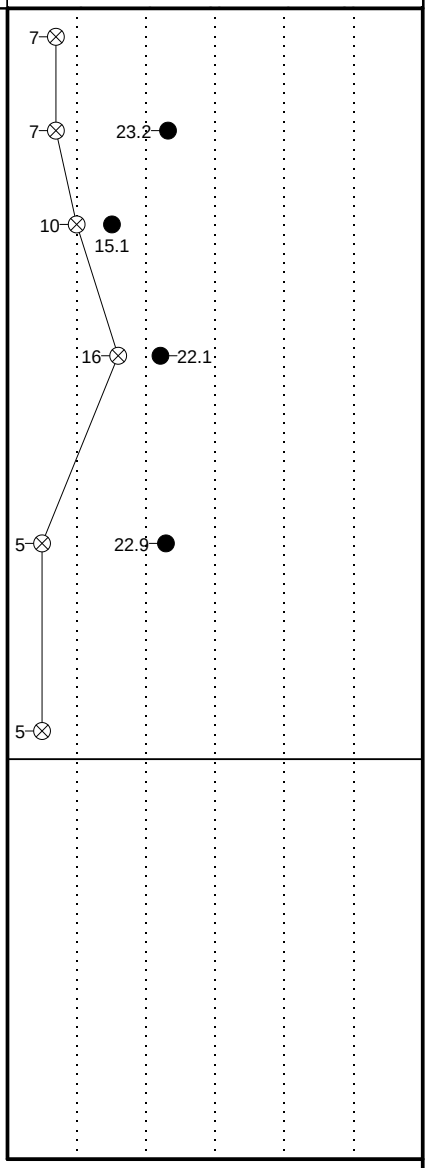
DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

SURFACE ELEVATION 35

| DEPTH (FT) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DIST. (IN) | RECOVERY (IN) | BLOWS/6" | ELEVATION (FT) |
|---|---|---|---|---|---|---|
| 0 | S-1 | SS | 18 | 18 | 7 4 3 | 35 |
| | S-2 | SS | 18 | 18 | 2 3 4 | |
| 5 | S-3 | SS | 18 | 12 | 3 5 5 | 30 |
| | S-4 | SS | 18 | 15 | 5 7 9 | |
| 10 | | | | | | 25 |
| | S-5 | SS | 18 | 18 | 3 2 3 | |
| 15 | | | | | | 20 |
| | S-6 | SS | 18 | 10 | 1 2 3 | |
| 20 | | | | | | 15 |
| 25 | | | | | | 10 |
| 30 | | | | | | 5 |

Asphalt Depth [6.00"]
Gravel Depth [7.00"]
(SC) CLAYEY SAND, Greenish Brown, Moist, Loose
(CL) SANDY LEAN CLAY, Greenish Brown, Moist, Medium Stiff
(SC) CLAYEY SAND, Brown and Brownish Green, Moist, Medium Dense to Loose
END OF BORING @ 20.0'




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

| | | |
|---|---|---|
| WL 19.0' WS ☐ WD ☒ | BORING STARTED 01/12/17 | CAVE IN DEPTH 11.0' @ EOD |
| WL(SHW) WL(ACR) | BORING COMPLETED 01/12/17 | HAMMER TYPE Auto |
| WL | RIG Low Clearance FOREMAN B. MULLENDORE | DRILLING METHOD HSA |

| CLIENT | JOB # | BORING # | SHEET |
|---|---|---|---|
| McCrone, Inc. | 8325 | B-2 | 1 OF 1 |

| PROJECT NAME | ARCHITECT-ENGINEER |
|---|---|
| City of Annapolis DPW | McCrone, Inc. |

SITE LOCATION: 937 Spa Road, Annapolis, Anne Arundel County, MD

| NORTHING | EASTING | STATION |
|---|---|---|
| | | |

CALIBRATED PENETROMETER TONS/FT$^2$

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

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

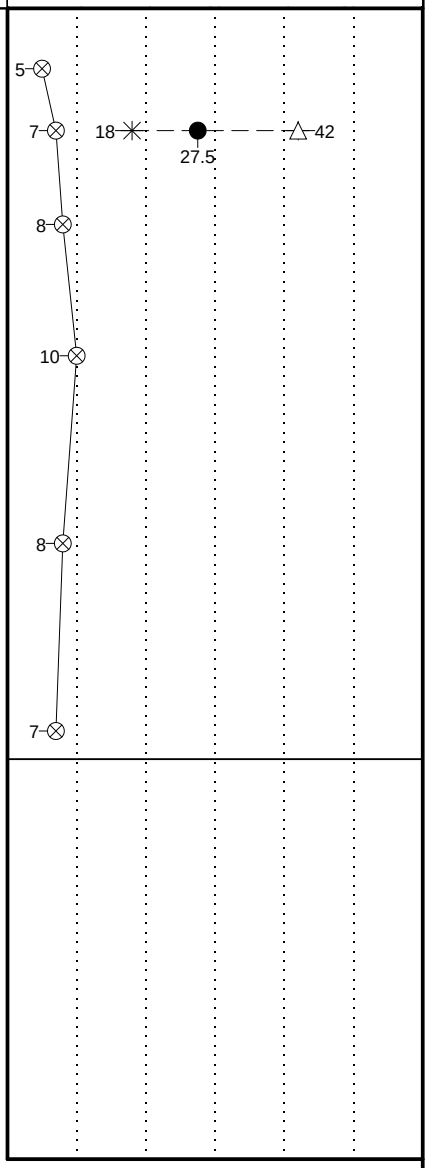
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

SURFACE ELEVATION 35

| DEPTH (FT) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DIST. (IN) | RECOVERY (IN) | DESCRIPTION OF MATERIAL | ELEVATION (FT) | BLOWS/6" |
|---|---|---|---|---|---|---|---|
| 0 | | | | | Concrete Depth [8.00"] | 35 | |
| | | | | | Gravel Depth [2.00"] | | |
| | S-1 | SS | 18 | 4 | (CL POSSIBLE FILL) SANDY LEAN CLAY, Brown, Moist, Medium Stiff | | 4 3 2 |
| | S-2 | SS | 18 | 18 | (CL) LEAN CLAY, Trace Silt, Brown, Moist, Medium Stiff to Stiff | | 2 3 4 |
| 5 | | | | | | 30 | |
| | S-3 | SS | 18 | 13 | | | 2 3 5 |
| | S-4 | SS | 18 | 18 | | | 3 4 6 |
| 10 | | | | | | 25 | |
| | | | | | (SM) SILTY SAND, Dark Green, Moist, Loose | | |
| | S-5 | SS | 18 | 14 | | | 1 3 5 |
| 15 | | | | | | 20 | |
| | S-6 | SS | 18 | 18 | | | 2 3 4 |
| 20 | | | | | END OF BORING @ 20.0' | 15 | |
| 25 | | | | | | 10 | |
| 30 | | | | | | 5 | |




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

| | | |
|---|---|---|
| WL DRY WS ☐ WD ☒ | BORING STARTED 01/12/17 | CAVE IN DEPTH 16.0' @ EOD |
| WL(SHW) WL(ACR) | BORING COMPLETED 01/12/17 | HAMMER TYPE Auto |
| WL | RIG Low Clearance FOREMAN B. MULLENDORE | DRILLING METHOD HSA |

| CLIENT | JOB # | BORING # | SHEET |
|---|---|---|---|
| McCrone, Inc. | 8325 | B-3 | 1 OF 1 |

| PROJECT NAME | ARCHITECT-ENGINEER |
|---|---|
| City of Annapolis DPW | McCrone, Inc. |

SITE LOCATION: 937 Spa Road, Annapolis, Anne Arundel County, MD

| 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 35

| DEPTH (FT) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DIST. (IN) | RECOVERY (IN) | DESCRIPTION OF MATERIAL | ELEVATION (FT) | BLOWS/6" | STANDARD PENETRATION BLOWS/FT | CALIBRATED PENETROMETER TONS/FT$^2$ |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | Concrete Depth [6.00"] | 35 | | | |
| | | | | | Gravel Depth [6.00"] | | | | |
| | S-1 | SS | 18 | 8 | (SP POSSIBLE FILL) SAND WITH GRAVEL, Brown, Moist, Medium Dense | | 2 4 5 | 9 | |
| | S-2 | SS | 18 | 11 | (CL/ML POSSIBLE FILL) SILTY CLAY, Dark Green, Moist, Stiff, Trace Organics | | 2 4 5 | 9 | 17.0 |
| 5 | S-3 | SS | 18 | 15 | (CL) SANDY LEAN CLAY, Brown, Moist, Stiff | 30 | 5 5 5 | 10 | 20.3 |
| | S-4 | SS | 18 | 18 | (ML/CL) CLAYEY SILT, Brown and Orange, Moist, Stiff | | 4 5 6 | 11 | 25.4 |
| 10 | | | | | | 25 | | | |
| | | | | | (SC) CLAYEY SAND, Brownish Green, Moist, Loose | | | | |
| | S-5 | SS | 18 | 18 | | | 2 3 5 | 8 | 13.3 |
| 15 | | | | | | 20 | | | |
| | S-6 | SS | 18 | 16 | | | 3 4 6 | 10 | |
| 20 | | | | | END OF BORING @ 20.0' | 15 | | | |
| 25 | | | | | | 10 | | | |
| 30 | | | | | | 5 | | | |

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

| | | |
|---|---|---|
| WL DRY WS ☐ WD ☒ | BORING STARTED 01/12/17 | CAVE IN DEPTH 12.0' @ EOD |
| WL(SHW) WL(ACR) | BORING COMPLETED 01/12/17 | HAMMER TYPE Auto |
| WL | RIG Low Clearance FOREMAN B. MULLENDORE | DRILLING METHOD HSA |

| CLIENT | JOB # | BORING # | SHEET |
|---|---|---|---|
| McCrone, Inc. | 8325 | B-4 | 1 OF 1 |

| PROJECT NAME | ARCHITECT-ENGINEER |
|---|---|
| City of Annapolis DPW | McCrone, Inc. |

SITE LOCATION: 937 Spa Road, Annapolis, Anne Arundel County, MD

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 24

| 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 | | | | | Concrete Depth [4.00"] | | | | |
| | S-1 | SS | 18 | 6 | Gravel Depth [2.00"] (SP FILL) SAND, Trace Gravel, Brown, Moist, Medium Dense, Contains Brick | | | 3 6 8 | 14 |
| | S-2 | SS | 18 | 6 | (CL FILL) SANDY LEAN CLAY, Dark Brown, Moist, Stiff to Very Stiff, Concrete At 4' | | 20 | 4 5 5 | 10 |
| 5 | S-3 | SS | 18 | 6 | | | | 3 1 1 | 2 |
| | S-4 | SS | 18 | 12 | (CL) SANDY LEAN CLAY, Brownish Red, Moist, Stiff | | 15 | 3 5 7 | 12 |
| 10 | | | | | (SC) CLAYEY SAND, Brownish Green, Moist, Medium Dense to Dense | | | | |
| | S-5 | SS | 18 | 18 | | | 10 | 10 13 15 | 28 |
| 15 | | | | | | | | | |
| | S-6 | SS | 18 | 18 | | | 5 | 11 15 17 | 32 |
| 20 | | | | | END OF BORING @ 20.0' | | | | |
| | | | | | | | 0 | | |
| 25 | | | | | | | | | |
| | | | | | | | -5 | | |
| 30 | | | | | | | | | |

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

| | | |
|---|---|---|
| WL DRY WS ☐ WD ☒ | BORING STARTED 01/13/17 | CAVE IN DEPTH 12.5' @ EOD |
| WL(SHW) WL(ACR) | BORING COMPLETED 01/13/17 | HAMMER TYPE Auto |
| WL | RIG Low Clearance FOREMAN B. MULLENDORE | DRILLING METHOD HSA |

| CLIENT | JOB # | BORING # | SHEET |
|---|---|---|---|
| McCrone, Inc. | 8325 | B-5 | 1 OF 1 |

| PROJECT NAME | ARCHITECT-ENGINEER |
|---|---|
| City of Annapolis DPW | McCrone, Inc. |

SITE LOCATION: 937 Spa Road, Annapolis, Anne Arundel County, MD

| NORTHING | EASTING | STATION |
|---|---|---|
| | | |

CALIBRATED PENETROMETER TONS/FT$^2$

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

PLASTIC LIMIT% — WATER CONTENT% — LIQUID LIMIT%

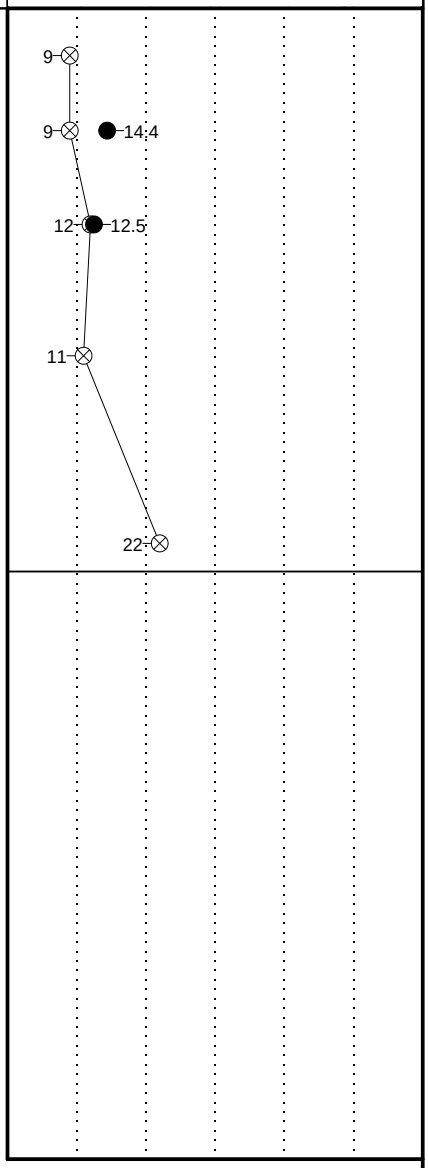
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

SURFACE ELEVATION 24

| DEPTH (FT) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DIST. (IN) | RECOVERY (IN) | DESCRIPTION OF MATERIAL | WATER LEVELS | ELEVATION (FT) | BLOWS/6" |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | Concrete Depth [6.00"] | | | |
| | S-1 | SS | 18 | 18 | (SC) CLAYEY SAND, Green, Moist, Loose | | | 5 4 5 |
| | S-2 | SS | 18 | 18 | (SP) SAND, Greenish Brown, Moist, Loose to Medium Dense | | 20 | 6 5 4 |
| 5 | S-3 | SS | 18 | 18 | | | | 4 6 6 |
| | S-4 | SS | 18 | 18 | (SP-SC) SAND WITH CLAY, Brownish Green, Moist, Medium Dense | | 15 | 3 5 6 |
| 10 | S-5 | SS | 18 | 18 | | | 10 | 8 12 10 |
| 15 | | | | | END OF BORING @ 15.0' | | 5 | |
| 20 | | | | | | | 0 | |
| 25 | | | | | | | -5 | |
| 30 | | | | | | | | |




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

| | | |
|---|---|---|
| WL DRY WS ☐ WD ☒ | BORING STARTED 01/13/17 | CAVE IN DEPTH 8.5' @ EOD |
| WL(SHW) WL(ACR) | BORING COMPLETED 01/13/17 | HAMMER TYPE Auto |
| WL | RIG Low Clearance FOREMAN B. MULLENDORE | DRILLING METHOD HSA |

| CLIENT | JOB # | BORING # | SHEET |
|---|---|---|---|
| McCrone, Inc. | 8325 | P-1 | 1 OF 1 |

| PROJECT NAME | ARCHITECT-ENGINEER |
|---|---|
| City of Annapolis DPW | McCrone, Inc. |

SITE LOCATION: 937 Spa Road, Annapolis, Anne Arundel County, MD

| 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 25

| DEPTH (FT) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DIST. (IN) | RECOVERY (IN) | DESCRIPTION OF MATERIAL | ELEVATION (FT) | BLOWS/6" | STANDARD PENETRATION BLOWS/FT |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | Asphalt Depth [2.00"] | 25 | | |
| | | | | | Concrete Depth [4.00"] | | | |
| | S-1 | SS | 18 | 18 | Gravel Depth [6.00"] | | 2 3 4 | 7 |
| | S-2 | SS | 18 | 18 | (SC) CLAYEY SAND, Brown and Greenish Brown, Moist, Loose | | 3 3 4 | 7 |
| 5 | | | | | | 20 | | |
| | S-3 | SS | 18 | 18 | (SP) SAND, Brownish Green, Moist, Loose | | 2 3 3 | 6 |
| | S-4 | SS | 18 | 18 | (SC) CLAYEY SAND, Green, Moist, Loose | | 2 2 3 | 5 |
| 10 | | | | | END OF BORING @ 10.0' | 15 | | |
| 15 | | | | | | 10 | | |
| 20 | | | | | | 5 | | |
| 25 | | | | | | 0 | | |
| 30 | | | | | | -5 | | |

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

| | | |
|---|---|---|
| WL DRY WS ☐ WD ☒ | BORING STARTED 01/13/17 | CAVE IN DEPTH 6.5' @ EOD |
| WL(SHW) WL(ACR) | BORING COMPLETED 01/13/17 | HAMMER TYPE Auto |
| WL | RIG Low Clearance FOREMAN B. MULLENDORE | DRILLING METHOD HSA |

| CLIENT | JOB # | BORING # | SHEET |
|---|---|---|---|
| McCrone, Inc. | 8325 | P-2 | 1 OF 1 |

| PROJECT NAME | ARCHITECT-ENGINEER |
|---|---|
| City of Annapolis DPW | McCrone, Inc. |

SITE LOCATION: 937 Spa Road, Annapolis, Anne Arundel County, MD

| NORTHING | EASTING | STATION |
|---|---|---|
| | | |

CALIBRATED PENETROMETER TONS/FT$^2$

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

PLASTIC LIMIT% — WATER CONTENT% — LIQUID LIMIT%

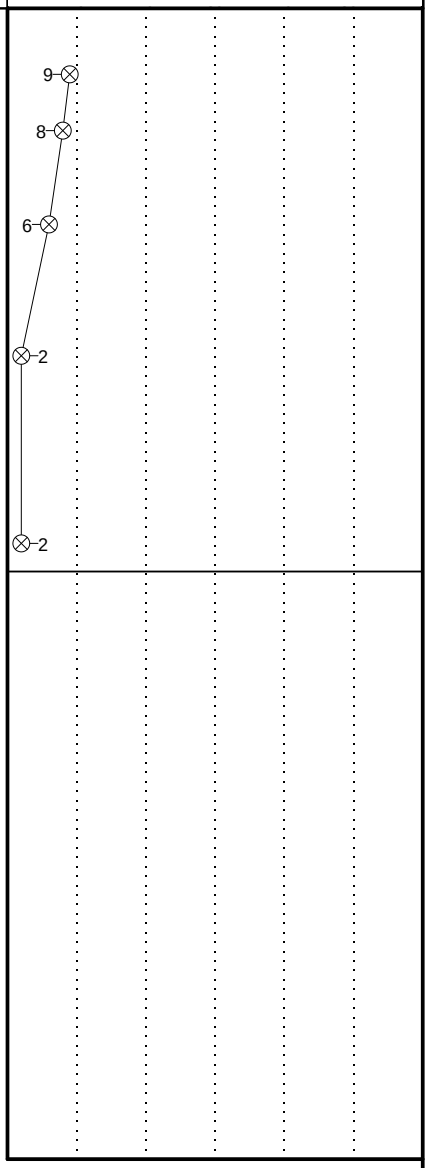
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

SURFACE ELEVATION 20

| DEPTH (FT) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DIST. (IN) | RECOVERY (IN) | DESCRIPTION OF MATERIAL | ELEVATION (FT) | BLOWS/6" |
|---|---|---|---|---|---|---|---|
| 0 | | | | | Asphalt Depth [6.00"] | 20 | |
| | | | | | Gravel Depth [6.00"] | | |
| | S-1 | SS | 18 | 12 | (SP FILL) SAND, Trace Gravel, Dark Brown and Black, Moist, Loose | | 9 5 4 |
| | S-2 | SS | 18 | 18 | | | 4 4 4 |
| 5 | | | | | | 15 | |
| | S-3 | SS | 18 | 18 | | | 2 3 3 |
| | S-4 | SS | 18 | 6 | (SC FILL) CLAYEY SAND, Trace Gravel, Brown, Moist, Very Loose, Contains Trace Amounts Of Glass, Shells | | 2 1 1 |
| 10 | | | | | | 10 | |
| | S-5 | SS | 18 | 18 | | | 1 1 1 |
| 15 | | | | | END OF BORING @ 15.0' | 5 | |
| 20 | | | | | | 0 | |
| 25 | | | | | | -5 | |
| 30 | | | | | | -10 | |




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

| | | |
|---|---|---|
| WL DRY WS ☐ WD ☒ | BORING STARTED 01/13/17 | CAVE IN DEPTH 10.5' @ EOD |
| WL(SHW) WL(ACR) | BORING COMPLETED 01/13/17 | HAMMER TYPE Auto |
| WL | RIG Low Clearance FOREMAN B. MULLENDORE | DRILLING METHOD HSA |

| CLIENT | JOB # | BORING # | SHEET |
|---|---|---|---|
| McCrone, Inc. | 8325 | P-3 | 1 OF 1 |

| PROJECT NAME | ARCHITECT-ENGINEER |
|---|---|
| City of Annapolis DPW | McCrone, Inc. |

SITE LOCATION: 937 Spa Road, Annapolis, Anne Arundel County, MD

| 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 20

| DEPTH (FT) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DIST. (IN) | RECOVERY (IN) | DESCRIPTION OF MATERIAL | ELEVATION (FT) | BLOWS/6" | STANDARD PENETRATION BLOWS/FT |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | Asphalt Depth [2.00"] | 20 | | |
| | S-1 | SS | 18 | 18 | Gravel Depth [4.00"] (SC FILL) CLAYEY SAND, Trace Gravel, Black, Moist, Loose, Contains Trace Glass | | 8 4 3 | 7 |
| | S-2 | SS | 18 | 10 | (SP FILL) SAND, Trace Gravel, Dark Brown, Moist, Very Loose, Contains Trace Brick And Glass | | 2 1 1 | 2 NP NP 24.7 |
| 5 | S-3 | SS | 18 | 6 | | 15 | 2 2 1 | 3 |
| | S-4 | SS | 18 | 12 | | | 2 1 1 | 2 |
| 10 | | | | | END OF BORING @ 10.0' | 10 | | |
| 15 | | | | | | 5 | | |
| 20 | | | | | | 0 | | |
| 25 | | | | | | -5 | | |
| 30 | | | | | | -10 | | |

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

| | | |
|---|---|---|
| WL DRY WS ☐ WD ☒ | BORING STARTED 01/13/17 | CAVE IN DEPTH 6.0' @ EOD |
| WL(SHW) WL(ACR) | BORING COMPLETED 01/13/17 | HAMMER TYPE Auto |
| WL | RIG Low Clearance FOREMAN B. MULLENDORE | DRILLING METHOD HSA |

| CLIENT | JOB # | BORING # | SHEET |
|---|---|---|---|
| McCrone, Inc. | 8325 | RW-1 | 1 OF 1 |

| PROJECT NAME | ARCHITECT-ENGINEER |
|---|---|
| City of Annapolis DPW | McCrone, Inc. |

SITE LOCATION: 937 Spa Road, Annapolis, Anne Arundel County, MD

| NORTHING | EASTING | STATION |
|---|---|---|
| | | |

CALIBRATED PENETROMETER TONS/FT$^2$

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

PLASTIC LIMIT% — WATER CONTENT% — LIQUID LIMIT%

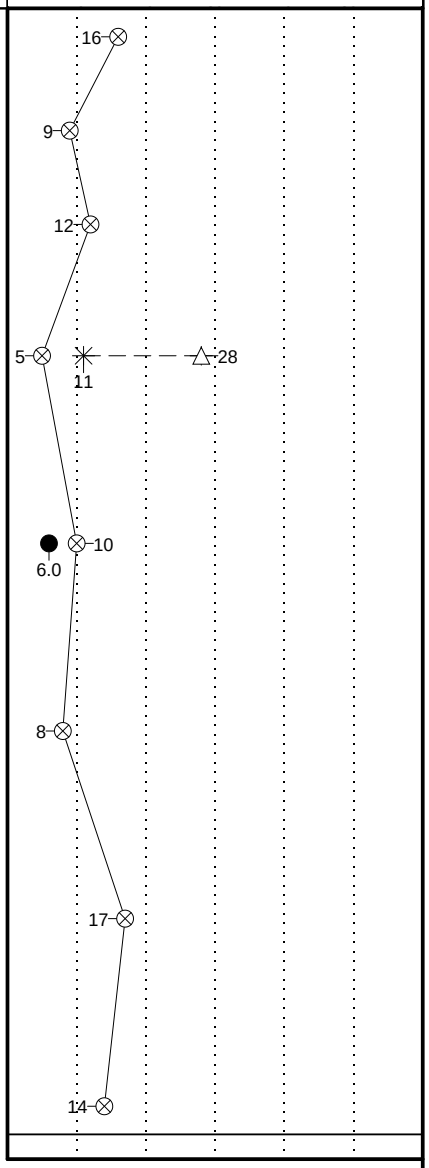
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

SURFACE ELEVATION 36

| DEPTH (FT) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DIST. (IN) | RECOVERY (IN) | DESCRIPTION OF MATERIAL | ELEVATION (FT) | BLOWS/6" |
|---|---|---|---|---|---|---|---|
| 0 | S-1 | SS | 18 | 10 | Asphalt Depth [6.00"]<br>Gravel Depth [2.00"]<br>(SP FILL) SAND WITH GRAVEL, Light Brown, Moist, Medium Dense | 35 | 5 9 7 |
| | S-2 | SS | 18 | 18 | (SM FILL) SILTY SAND, Brown, Moist, Loose to Medium Dense | | 3 4 5 |
| 5 | S-3 | SS | 18 | 12 | | 30 | 4 6 6 |
| | S-4 | SS | 18 | 6 | (SC FILL) CLAYEY SAND, Dark Brown, Moist, Loose | | 3 3 2 |
| 10 | | | | | | 25 | |
| | | | | | (SP-SC) SAND WITH CLAY, Green, Moist, Loose | | |
| | S-5 | SS | 18 | 16 | | | 3 5 5 |
| 15 | | | | | | 20 | |
| | | | | | (SC) CLAYEY SAND, Greenish Brown and Dark Red, Moist, Loose to Medium Dense | | |
| | S-6 | SS | 18 | 18 | | | 3 4 4 |
| 20 | | | | | | 15 | |
| | S-7 | SS | 18 | 17 | | | 2 6 11 |
| 25 | | | | | | 10 | |
| | S-8 | SS | 18 | 18 | | | 3 7 7 |
| 30 | | | | | END OF BORING @ 30.0' | | |




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

| | | |
|---|---|---|
| WL 29.0' WS ☐ WD ☒ | BORING STARTED 01/12/17 | CAVE IN DEPTH 22.0' @ EOD |
| WL(SHW) WL(ACR) | BORING COMPLETED 01/12/17 | HAMMER TYPE Auto |
| WL | RIG Low Clearance FOREMAN B. MULLENDORE | DRILLING METHOD HSA |

| CLIENT | JOB # | BORING # | SHEET |
|---|---|---|---|
| McCrone, Inc. | 8325 | SWM-1 | 1 OF 1 |

| PROJECT NAME | ARCHITECT-ENGINEER |
|---|---|
| City of Annapolis DPW | McCrone, Inc. |

SITE LOCATION: 937 Spa Road, Annapolis, Anne Arundel County, MD

| 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 23

| DEPTH (FT) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DIST. (IN) | RECOVERY (IN) | DESCRIPTION OF MATERIAL | ELEVATION (FT) | BLOWS/6" | STANDARD PENETRATION BLOWS/FT |
|---|---|---|---|---|---|---|---|---|
| 0 | | | | | Asphalt Depth [2.00"] | | | |
| | | | | | Gravel Depth [4.00"] | | | |
| | S-1 | SS | 18 | 12 | (CL/ML FILL) SILTY CLAY, Trace Gravel, Black, Moist, Stiff, Contains Trace Amount Of Shells | | 9 7 2 | 9 |
| | S-2 | SS | 18 | 18 | (SC FILL) CLAYEY SAND FILL, Trace Gravel, Dark Brown and Black, Moist, Loose to Very Loose, Contains Trace Amount Of Brick And Glass | 20 | 4 3 3 | 6 |
| 5 | S-3 | SS | 18 | 6 | | | 2 1 1 | 2 |
| | | | | | | 15 | | |
| | S-4 | SS | 18 | 12 | | | 1 1 1 | 2 |
| 10 | S-5 | SS | 18 | 12 | | | 1 1 1 | 2 |
| | | | | | (SC) CLAYEY SAND, Green, Moist, Very Loose | 10 | | |
| | S-6 | SS | 18 | 18 | | | WOH WOH 2 | 2 |
| 15 | | | | | END OF BORING @ 15.0' | | | |
| | | | | | | 5 | | |
| 20 | | | | | | | | |
| | | | | | | 0 | | |
| 25 | | | | | | | | |
| | | | | | | -5 | | |
| 30 | | | | | | | | |

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

| | | |
|---|---|---|
| WL 11.0' WS ☐ WD ☒ | BORING STARTED 01/13/17 | CAVE IN DEPTH 7.0' @ EOD |
| WL(SHW) WL(ACR) | BORING COMPLETED 01/13/17 | HAMMER TYPE Auto |
| WL | RIG Low Clearance FOREMAN B. MULLENDORE | DRILLING METHOD HSA |

| CLIENT | JOB # | BORING # | SHEET |
|---|---|---|---|
| McCrone, Inc. | 8325 | SWM-2 | 1 OF 1 |

| PROJECT NAME | ARCHITECT-ENGINEER |
|---|---|
| City of Annapolis DPW | McCrone, Inc. |

SITE LOCATION: 937 Spa Road, Annapolis, Anne Arundel County, MD

| 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 22

| 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 | 18 | Topsoil Depth [3.00"] (SP FILL) SAND, Trace Gravel, Gray and Black, Moist, Loose to Very Loose, Contains Trace Amount Of Brick, Glass And Shell | | 20 | 6 5 5 | 10 |
| | S-2 | SS | 18 | 18 | | | | 4 3 3 | 6 |
| 5 | S-3 | SS | 18 | 18 | | | 15 | 3 2 2 | 4 |
| | S-4 | SS | 18 | 6 | | | | 2 2 1 | 3 |
| 10 | S-5 | SS | 18 | 6 | | | 10 | 2 2 2 | 4 |
| | S-6 | SS | 18 | 6 | | | | 2 2 2 | 4 |
| 15 | | | | | END OF BORING @ 15.0' | | 5 | | |
| 20 | | | | | | | 0 | | |
| 25 | | | | | | | -5 | | |
| 30 | | | | | | | | | |

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

| | | |
|---|---|---|
| WL DRY WS ☐ WD ☒ | BORING STARTED 01/13/17 | CAVE IN DEPTH 8.5' @ EOD |
| WL(SHW) WL(ACR) | BORING COMPLETED 01/13/17 | HAMMER TYPE Auto |
| WL | RIG Low Clearance FOREMAN B. MULLENDORE | DRILLING METHOD HSA |

## SOIL CLASSIFICATION LEGEND

- GW - WELL GRADED GRAVEL
- GM - SILTY GRAVEL
- GP - POORLY GRADED GRAVEL
- GC - CLAYEY GRAVEL
- SW - WELL GRADED SAND
- ML - LOW PLASTICITY SILT
- ST - SHELBY TUBE
- CL - LOW PLASTICITY CLAY
- MH - HIGH PLASTICITY SILT
- SM - SILTY SAND
- RC - ROCK CORE
- SP - POORLY GRADED SAND
- SC - CLAYEY SAND
- CH - HIGH PLASTICITY CLAY
- PM - PRESSURE METER
- OH - HIGH PLASTICITY ORGANIC SILTS AND CLAYS
- OL - LOW PLASTICITY ORGANIC SILTS AND CLAY
- PT - PEAT
- FILL
- POSSIBLE FILL
- PROBABLE FILL
- WR - WEATHERED ROCK
- PWR - PARTIALLY WEATHERED ROCK
- HWR - HIGHLY WEATHERED ROCK
- DR - DECOMPOSED ROCK

## SURFACE MATERIALS

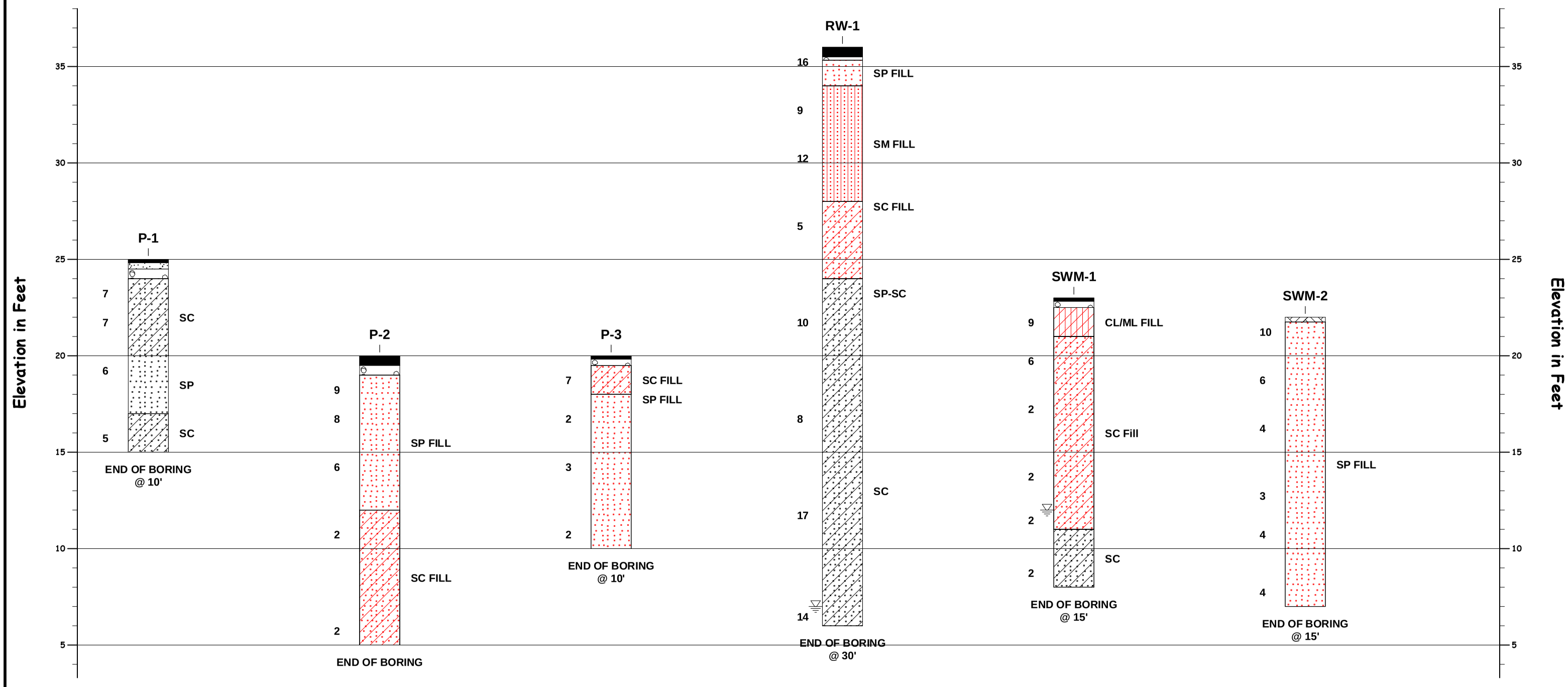
- TOPSOIL
- ASPHALT
- GRAVEL
- CONCRETE
- VOID

## ROCK TYPES

- IGNEOUS
- METAMORPHIC
- SEDIMENTARY

## SYMBOL LEGEND

- WATER LEVEL - DURING DRILLING/SAMPLING
- WATER LEVEL - SEASONAL, HIGH WATER
- WATER LEVEL - AFTER CASING REMOVAL
- WATER LEVEL - AFTER 24 HOURS




NOTES:
1 SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL REPORT FOR ADDITIONAL INFORMATION.
2 PENETRATION TEST RESISTANCE IN BLOWS PER FOOT (ASTM D1586).
3 HORIZONTAL DISTANCES ARE NOT TO SCALE.

# GENERALIZED SUBSURFACE SOIL PROFILE

City of Annapolis DPW
McCrone, Inc.
937 Spa Road, Annapolis, Anne Arundel County, MD

PROJECT NO.: 8325 | DATE: 2/28/2017 | VERTICAL SCALE: 1"=5'

## SOIL CLASSIFICATION LEGEND

GW - WELL GRADED GRAVEL
GM - SILTY GRAVEL
GP - POORLY GRADED GRAVEL
GC - CLAYEY GRAVEL
SW - WELL GRADED SAND
ML - LOW PLASTICITY SILT
ST - SHELBY TUBE
CL - LOW PLASTICITY CLAY
MH - HIGH PLASTICITY SILT
SM - SILTY SAND
RC - ROCK CORE
SP - POORLY GRADED SAND
SC - CLAYEY SAND
CH - HIGH PLASTICITY CLAY
PM - PRESSURE METER
OH - HIGH PLASTICITY ORGANIC SILTS AND CLAYS
OL - LOW PLASTICITY ORGANIC SILTS AND CLAY
PT - PEAT
- FILL
WR - WEATHERED ROCK
PWR - PARTIALLY WEATHERED ROCK
HWR - HIGHLY WEATHERED ROCK
- POSSIBLE FILL
DR - DECOMPOSED ROCK
- PROBABLE FILL

## SURFACE MATERIALS

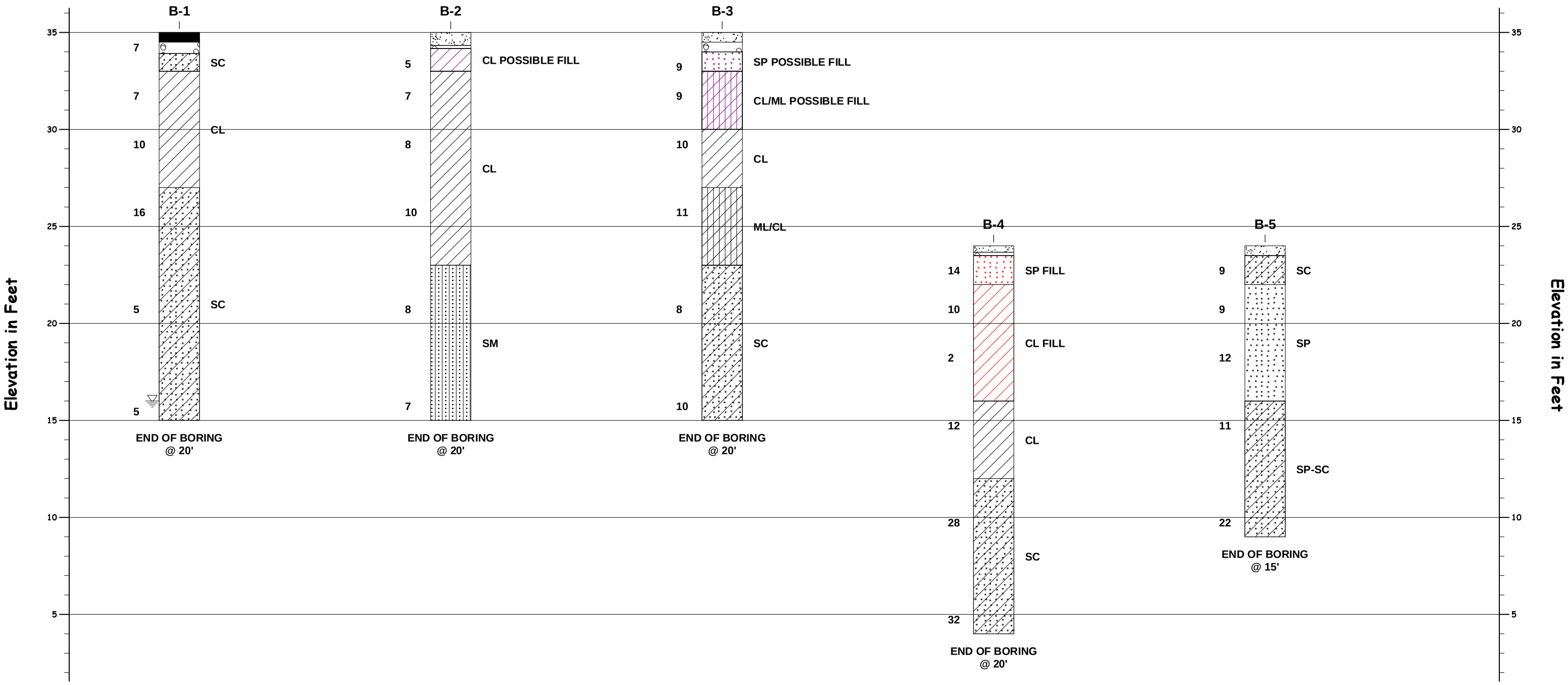
TOPSOIL
ASPHALT
GRAVEL
CONCRETE
VOID

## ROCK TYPES

IGNEOUS
METAMORPHIC
SEDIMENTARY

## SYMBOL LEGEND

WATER LEVEL - DURING DRILLING/SAMPLING
WATER LEVEL - SEASONAL, HIGH WATER
WATER LEVEL - AFTER CASING REMOVAL
WATER LEVEL - AFTER 24 HOURS



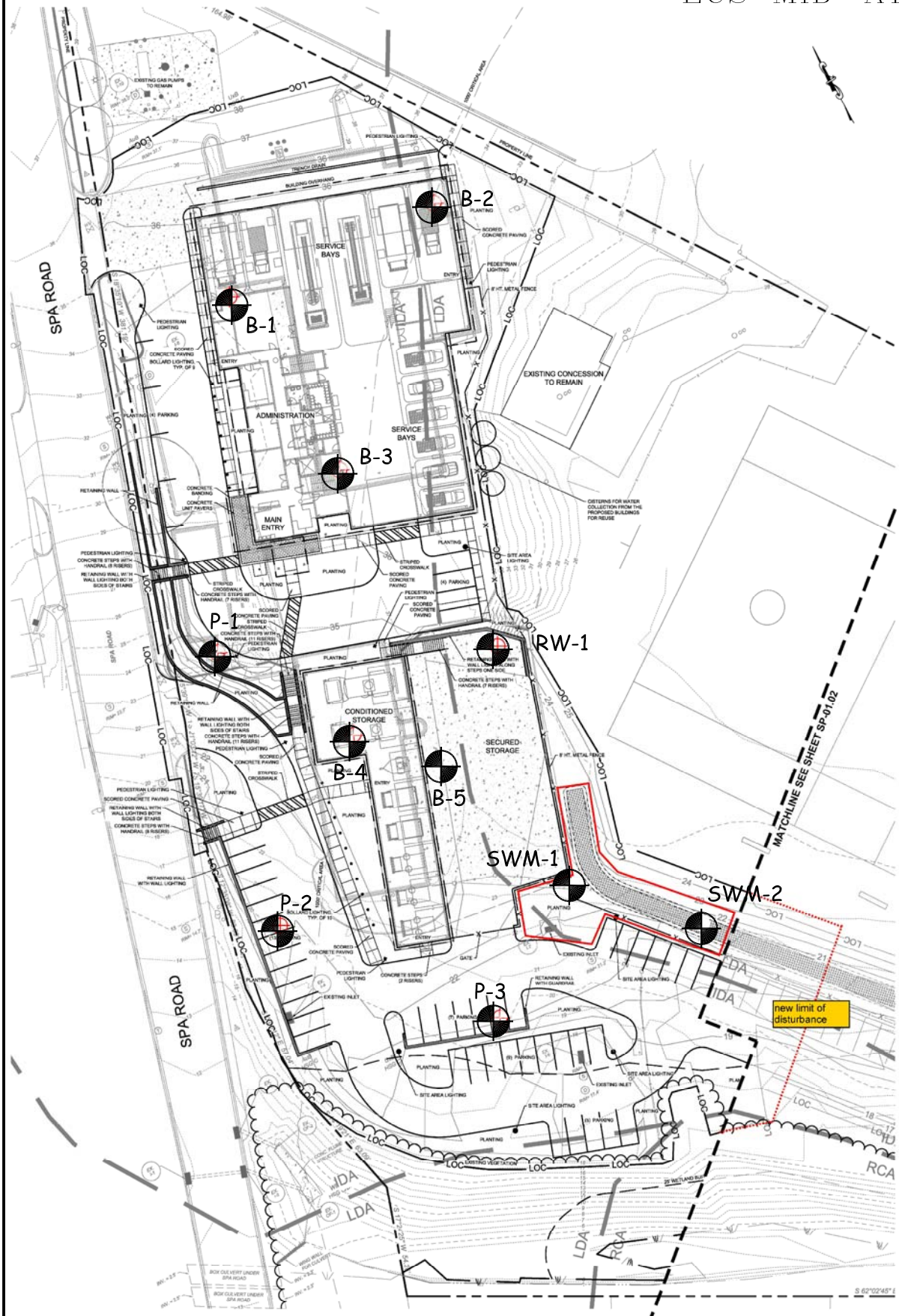

NOTES:
1 SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL REPORT FOR ADDITIONAL INFORMATION.
2 PENETRATION TEST RESISTANCE IN BLOWS PER FOOT (ASTM D1586).
3 HORIZONTAL DISTANCES ARE NOT TO SCALE.

# GENERALIZED SUBSURFACE SOIL PROFILE

City of Annapolis DPW
McCrone, Inc.
937 Spa Road, Annapolis, Anne Arundel County, MD

PROJECT NO.: 02:8325 | DATE: 2/8/2017 | VERTICAL SCALE: 1"=5'

ECS MID-ATLANTIC, LLC




LANDSCAPE PLAN - MATERIALS

GRAPHIC SCALE

LEGEND

Boring Location

| REVISIONS |
|---|
| |
| |
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| |
| |
| |

# Boring Location Plan

City Of Annapolis DPW Design Build

McCrone

| KH | ZLA | 28/02/2017 | 1"=70' | 8325 | 1 OF 1 |
|---|---|---|---|---|---|