
GEOTECHNICAL ENGINEERING REPORT

for

Sparrow Pond Restoration Arlington, Virginia

Prepared For:

**Arlington County
Department of Environmental Services**

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1.0 INTRODUCTION

This report presents the results of our geotechnical engineering study performed for the proposed retrofit of Sparrow Pond located in Arlington, Virginia. The purposes of this study were to:

- 1) Research and review available site information;
- 2) Obtain subsurface information by conducting DCP tests, conducting hand augers, and collecting soil samples for specialty laboratory testing, and
- 3) Provide recommendations for earthwork associated with the proposed project;

Existing grades and elevations at the site are referenced from the drawing set entitled Sparrow Pond Restoration, S. Abington St & 6th Street S. prepared by Arlington County and dated 22 January 2022. No environmental testing or analysis was completed as part of our study. This study is limited to the planned earthwork for construction of the pond and does not include study or analysis of the proposed maintenance road, new utilities, or utility crossings.

2.0 PROJECT DESCRIPTION

2.1 Existing Conditions

The project is focused on Sparrow Pond which is located in Glencarlyn Park in Arlington, Virginia. The project site area included in our assessment is about 62,000 square feet in size and is bordered by wooded areas to the east, north, and west and the Washington and Old Dominion Trail (W&OD Trail) to the south; see Inset 1. The pond generally consists of low grass vegetation, sediment, and areas of standing water.



Inset 1

Existing grades at the bottom of the pond typically range from el 149 to 151 except for isolated sediment mounds that are 1 to 5 feet above the basin bottom. The inlet area, northwest of the general pond area, has grades grading from el 151 to 155 increasing to the northwest. Site grades slope up in all directions outward from the pond bottom. The paved W&OD Trail, located south of the pond, is on an embankment with surface grades ranging from el 156 to 160.

We understand that the pond was originally constructed in 2001-2002 and has filled with sediment over time. The pond was identified for restoration in a 2012-2013 Watershed Retrofit Study. We understand that the pond collects water from an approximate 80-acre area to the north that is primarily developed with single-family residences.

2.2 Proposed Construction

We understand the restoration will include construction of three water pools (Pools 1 through 3), a forebay, and a maintenance access area. The project will also include a new outlet structure and pipe connecting to Four Mile Run under the W&OD Trail.

Based on the provided 22 January 2022 grading plans prepared by Arlington County, we understand the site will require excavation as follows:

- Forebay: About 10 to 12 feet below existing site grade to a new surface elevation of 142.5
- Pool #1: About 4 feet below existing site grade to a new surface elevation of 146
- Pool #2: About 6 to 15 feet below existing site grade to a new surface elevation of 144
- Pool #3: About 3 to 4 feet below existing site grade to a new surface elevation of 146
- Maintenance Area: About 0 to 6 feet below existing site grade to a new surface elevation of 150.5

We understand a berm will be constructed between Pools #1 and #3 and have a top of berm elevation of 150.5. An aquatic bench will be provided around each of the pools. The pools will be separated with grouted rip rap.

3.0 SUBSURFACE INVESTIGATION

Our geotechnical investigation consisted of completing 10 dynamic cone penetrometer tests and hand augers within the existing pond area. Details of the subsurface investigation are given in the following sections. Permission to access the site was obtained through Arlington County prior to mobilizing to the site.

3.1 Wildcat DCPs

The dynamic cone penetrometer (DCP) tests, designated as DCP-01 through DCP-10, were performed by our field engineers on 12 and 13 April 2022 using a Wildcat DCP. Each DCP test was performed by driving a 1-inch-diameter steel rod fitted with a 1.4-inch-diameter cone tip into the subsurface using a 35-pound hammer dropped from a height of 15 inches.

The cone was advanced to depths between 4 and 13 feet below grade to either a pre-determined penetration depth or refusal of the DCP. The number of hammer blows to advance the cone for each 4-inch increment was recorded and the test results were analyzed using software developed by Triggs Technologies, Inc. The DCP data reduction methodology and the DCP test logs are given in Appendix A.

3.2 Hand Auger Boreholes

After DCP testing, a 3-inch-diameter hand auger was used to extract soil samples up to a maximum depth of 7.5 feet below the existing grade, or to refusal of the auger. Soil samples were visually examined in the field, and classifications were confirmed by re-examination in our Arlington, Virginia office. Hand auger logs are provided in Appendix A.

3.3 Laboratory Testing

Soil samples were visually examined in the field, and classifications were confirmed by re-examination in our Arlington, Virginia office. Select samples were sent to a specialty testing laboratory where the following tests were performed:

- Grain Size Analysis
- Water Content
- Atterberg Limits
- Organic Content

The laboratory testing results are discussed together with the soil strata descriptions in the following sections. The laboratory test results are given in Appendix B.

4.0 SUBSURFACE CONDITIONS

Subsurface conditions were determined based on the DCP tests and hand augers completed as part of our investigation. Additionally, we have included the results of boring B-1 completed in the pond area and included in the 12 June 2018 Sparrow Pond Stability Study prepared by Rummel, Klepper, and Kahl, LLP.

The subsurface conditions in the site area generally consist of a surficial layer of topsoil overlying successive strata of sand/clay sediment, natural sand, weathered rock, and bedrock. The following sections describe the subsurface and groundwater conditions encountered during our investigation.

4.1 Topsoil

Topsoil consisting of dark brown clay, silty clay, or sand with some clay was encountered in eight of ten test locations at the site. Where encountered, the topsoil was observed to have trace to some organics and isolated roots. Topsoil was typically measured to be 1 to 6 inches thick in the hand augers. However, thicker topsoil measuring 12 and 18 inches thick was encountered at DCP-7 (Pool #1) and DCP-9 (Pool #2), respectively.

4.2 Stratum A – Sediment and Fill

Stratum A was encountered at all test locations and the historic boring B-1. The sediment stratum is highly variable but typically consists of variable amounts of sand and clay with some to trace amounts of silt and organics and trace amounts of gravel. Plastic debris was observed in the hand auger at DCP-8 near the surface.

Many of the hand augers refused in this stratum due to localized pockets of gravel and/or roots. Therefore, we have estimated the bottom of Stratum A based on DCP test results.

Stratum A Estimated Bottom Depth & Elevation

Pond Area	DCP / Boring	Bottom of Stratum Depth (Feet)	Bottom of Stratum Elevation (Feet)
Maintenance Area	B-1	8	144.0
	DCP-1	5.2	146.8
Forebay	DCP-2	6.8	145.2
	DCP-3	6.2	146.8
Pool 1	DCP-4	6.8	144.2
	DCP-7	5.5	144.5
Pool 2	DCP-9	11.2	139.8
	DCP-10	8.5	149.5
Pool 3	DCP-5	> 9	-
	DCP-8	> 9	-
Berm Between Pool 1 & 3	DCP-6	3.8	146.2

Table 1

The consistency of Stratum A ranged from very loose/soft to medium dense/very stiff as evidenced by correlated SPT N-values ranging from 9 to greater than 25 blows/ft. We anticipate a majority of the

N-values greater than 10 blows/foot were the result of gravel and cobbles in the sediment layer as most correlated N-values ranged from 1 to 10 blows/foot.

Laboratory testing of select clay samples within Stratum A resulted in a liquid limit ranging from 30 to 36, a plastic limit ranging from 14 to 21, and a plasticity index ranging from 14 to 16. The results indicate that the clay is typically a low plasticity clay.

The Stratum A soils were measured to have water content of 12.5 to 32.1 percent indicating a high moisture content. Organic content testing of two samples indicated an organic content of 2.5 and 2.6 percent.

4.3 Stratum B – Sand

Stratum B was reported in historic boring B-1 to consist of fine to coarse sand with micaceous silt, although no recovery was reported in the split spoon samples. The hand auger at DCP-2 encountered the sand stratum and samples indicate the material consisted of gray clayey fine to medium sand. This stratum is expected to be encountered below Stratum A throughout the site; refer to Table 1 for expected interface depth and elevation.

The consistency of Stratum B ranged from loose to medium dense as evidenced by correlated SPT N-values ranging from 8 to 25 blows/ft.

4.4 Stratum C – Decomposed Rock

Decomposed rock is a material that results from the physical and chemical weathering of rock and can retain relic structure of the parent rock, such as banding. The top of Stratum C is estimated from the boring log and DCP refusal as noted in Table 2.

Stratum C Estimated Top Depth & Elevation

Pond Area	DCP / Boring	Top of Stratum Depth (Feet)	Top of Stratum Elevation (Feet)
Maintenance Area	B-1	13.5	138.5
	DCP-1	5.8	146.2
Forebay	DCP-2	7.8	144.2
	DCP-3	7.8	145.2
Pool 1	DCP-4	9	142.0
	DCP-7	> 9	-
Pool 2	DCP-9	> 12.8	-
	DCP-10	9	149.0
Pool 3	DCP-5	> 9	-
	DCP-8	> 9	-
Berm Between Pool 1 & 3	DCP-6	4	146.0

Table 2

The hand augers did not reach this stratum. This stratum is reported in historic boring B-1 to consist of fine to coarse sand with some rock fragments and trace silt. Stratum C was observed to be very dense as evidenced by SPT refusal (50 blows per 6-inch increment).

4.5 Stratum D – Bedrock

Bedrock was reported in historic boring B-1 beneath Stratum C and consisted of fine- to medium-grained mélange rock. The coring resulted in a recovery of 100 percent and rock quality designation (RQD) of 60 percent indicating fair quality bedrock.

4.6 Groundwater

Groundwater was first encountered at the surface at test locations DCP-4 through DCP-9. Groundwater was encountered in historic boring B-1 and DCP-1 through DCP-3 at 0.3 to 3.5 deep. The only location that did not encounter groundwater was hand auger DCP-10, which was completed to a depth of 5 feet (el 153), and was terminated before the surface elevation of the other test locations due to an obstruction to the hand auger.

Based on the site usage and topography, we anticipate this water is perched groundwater based on repeated saturation of the area from storm events and runoff.

5.0 RECOMMENDATIONS

We anticipate that the primary geotechnical challenges associated with the project will be shallow perched water and relatively soft sediment soil at the existing pond surface. Our geotechnical recommendations for the project are given in the following sections.

5.1 Demolition and Site Preparation

Prior to commencement of excavation or grading, miscellaneous trash, debris, or other unsuitable materials should be removed from the site. In existing vegetated/wooded areas, clearing and grubbing of vegetation designated for removal should be performed. This should include removal of all surface vegetation and root structure. All unsuitable materials should be properly disposed off-site in accordance with Virginia, Arlington County, and local regulations.

All perimeter erosion and sediment control features should be installed prior to clearing/earthwork at the site. The contractor should refer to the soil erosion and sediment control plans for staging of site preparation operations. All soil erosion and sediment control features should be protected and maintained throughout construction. All clearing activities should be performed in strict accordance with the approved soil erosion and sediment control plan prepared for the project.

Topsoil should be stripped from the site area prior to mass grading. The topsoil should be stockpiled and protected from erosion or disposed off-site. The reuse of topsoil should be evaluated by a Landscape Architect prior to reuse at the site.

At this time, we recommend the following regarding site demolition:

- Demolition plans indicate removal of an existing 36-inch-diameter storm pipe and appurtenances near the proposed Forebay. Backfill of the excavation to remove this pipe should be completed in accordance with Section 5.7.
- Care should be taken to not excavate into the embankment supporting the W&OD Trail. The bottom of the embankment should be properly marked to avoid potential undermining of the embankment.
- Existing utilities should be located prior to the start of earthwork and marked at the surface to avoid conflicts during construction.
- Care should be taken during work near the existing Observation Deck and Sitting Area to avoid damage to these structures.
- A stormwater runoff diversion system should be implanted to prevent subgrades and slopes from being damaged during construction as discussed in Section 5.6.

5.2 Earthwork

We anticipate that a majority of the earthwork in the soil can be completed using conventional excavation equipment. Localized areas of decomposed rock may be encountered in the Forebay and northeast portion of Pool #2 that may require larger excavators to remove. Based on the depth to rock in boring B-1, we do not anticipate rock excavation will be required for the project.

Initial grading work at the start of the project is expected to occur on very wet and saturated soils. The contractor will need to consider this in their logistics and plan to use appropriate equipment with the

ability to work in these soil conditions. Additionally, the contractor may want to include an allowance for temporary cribbing for initial phases of the project to start the grading work. We recommend starting earthwork at higher elevations and working down to prevent damage to prepared subgrades.

The DCPs and hand augers indicate thick sediment deposits (Stratum A) at the site that are relatively weak. A discussion of the conditions in each area of the pond are as follows:

- Maintenance Area – We understand this area will be lowered to a subgrade at about el 150, or about 1 to 6 feet below existing grade, before placement of 6 to 9 inches of stone for a maintenance vehicle area. DCP-1 and historic B-1 were completed in this area and indicate that the subgrade is expected to consist of Stratum A soil that are loose to medium dense. We anticipate that the subgrade will be relatively wet based on the depth to groundwater and therefore recommend considering an over-excavation of about 12 inches and replacement with open-graded stone to stabilize the subgrade prior to placement of the stone course. If weak soils are encountered at the over-excavation subgrade, a layer of bi-axial or tri-axial geogrid should be placed on the over-excavation subgrade to help stabilize the soil for vehicular traffic loads.
- Forebay – We understand this area will be lowered to a subgrade elevation of about el 142.5, or about 10 to 12 feet below existing grade. DCP-2 and DCP-3 were completed in the forebay and encountered refusal on likely natural Stratum B or C soil at 7.8 feet below-grade, or about el 144 to 145. We anticipate that the subgrade within the forebay will not require over-excavation and replacement provided care is taken during construction to prevent saturation and softening of the subgrade soil.
- Pool #1 - We understand this area will be lowered to a subgrade elevation of about el 146, or about 4 to 5 feet below existing grade. DCP-4 and DCP-7 were completed in this pool and indicate that the subgrade is expected to consist of very soft clay and very loose sand with organics. The DCP tests indicate more stable soil present at about 5.5 to 6 feet below grade. Therefore, we recommend assuming that about 1.5 to 2 feet of over-excavation and replacement will be required at the subgrade to remove loose soil and allow for proper working platform.

Additionally, the slope on the north side of Pool #1 is anticipated to have a global stability factor of safety between 1.3 and 1.5 in the static case if cut into existing soil (see Section 5.3). We anticipate this is satisfactory since the slope does not support structures or infrastructure; however, if a higher factor of safety is required then the slope may need to be over-excavated and reconstructed.

- Pool #2 – We understand this area will be lowered to a subgrade elevation of 144, or about 6 to 15 feet below existing site grade. DCP-9 was completed in the existing low area of the pool and the test results indicate that existing Stratum A soil is expected to extend at least 3 feet below the bottom of the pool. The testing indicates these soils are very loose to loose. DCP-10 was completed at a higher elevation and encountered refusal on Stratum B or C soil at 9 feet below grade, or at el 149. Therefore, we recommend considering over-excavation and replacement of about 2 feet at the south half of the pool. We expect that removal of denser natural soil and potentially decomposed rock will be required at the north side of the pool where existing grades are higher.
- Pool #3 – We understand this area will be lowered to a subgrade elevation of 146, or about 3 to 4 feet below existing site grade. DCP-5 and DCP-8 were completed in this pool and indicate

relatively weak soils below the subgrade elevation. The bottom of the weak soil zone was not encountered; therefore, we do not anticipate that all weak soils can be removed in this pond and recommend using a geogrid-reinforced platform to work in this area. We initially estimate that this platform should be constructed by over-excavating at least 2 feet, placing a layer of bi-axial or tri-axial geogrid, and backfilling up to the proposed subgrade using a well-graded stone to stabilize the work area.

Care should be taken when over-excavating at the south side of Pool #3 to prevent the undermining of the existing W&OD embankment or the observation deck foundations.

- Berm Between Pools #1 and #3 – The berm located between pools #1 and #3 will require raising grades about 0.5 to 1 foot above existing grade. The near-surface soils at DCP-6 indicate soft topsoil and sandy clay present. We recommend considering up to 12 inches of over-excavation here to remove topsoil and weak soil near the surface before placement of fill.

We anticipate minimal space will be available for stockpiling of existing fill and most excavated soil will be hauled off site. If existing material is considered for reuse at the site, an experienced geotechnical representative should observe the conditions of the excavated soil to determine where the soils can be reused and if additional processing is necessary based upon the intended use of the material.

We anticipate that excavated on-site soil will be wet of optimum water content due to the shallow perched groundwater. Sufficient area will be required to store and dry the on-site soils prior to reuse as compacted fill and may limit potential options for reuse at the site.

5.3 Slope Stability

We completed a limited slope stability analyses for two of the proposed slopes where relatively weak soil was encountered in the DCP tests. Cross-sections of the slopes were developed based on the 22 January 2022 Grading Plan prepared by Arlington County indicating slopes ranging from approximately 4H:1V to 3H:1V. The locations of the slope stability cross-sections are shown in Figure 1. Cross section A-A' is located on the north side of Pool #1 and cross section B-B' is located on the east side of Pool #2.

The slopes are expected to consist of sand of Stratum A and B and localized areas of clay. Because of the limited sample data from hand augers and DCPs, we used the proposed geometry to back-calculate the required internal angle of friction required for each slope for a factor of safety of 1.3 and 1.5 in the static case (non-seismic). The results are presented in Table 3.

Required Angle of Internal Friction

Cross-Section	Required Internal Angle of Friction	
	Factor of Safety of 1.3	Factor of Safety of 1.5
A-A (Pool #1)	22 degrees	25 degrees
B-B (Pool #2)	23 degrees	26 degrees

Table 3

The DCP test results at Pool #1 (DCP-4 and DCP-7) indicate the existing soil in the upper 5 to 7 feet consist of very loose sand with correlated SPT N-values of 0 to 2 blows/foot. We anticipate these soils will have an approximate angle of internal friction angle of 24 to 25 degrees and therefore an equivalent

factor of safety between 1.3 and 1.5 for the static case. We anticipate that this slope will require over-excavation and replacement if a minimum factor of safety of 1.5 is desired. However, we anticipate that a factor of safety of 1.3 is acceptable for this slope since it does not support structures or infrastructure.

The DCP test results at Pool #2 (DCP-9 and DCP-10) indicate the existing soil in the upper 5 to 7 feet below grade consist of loose silty and clayey sand or sandy clay with correlated SPT N-values of 0 to 8 blows/foot. We anticipate these soils will have an approximate angle of internal friction angle of 26 to 28 degrees and an equivalent factor of safety of 1.5 for the static case. We anticipate that this slope will not require over-excavation and replacement.

5.4 Subgrade Preparation

After performing the aforementioned site preparation work and prior to constructing the maintenance area surface or new slopes, soil subgrades, including over-excavation subgrades, should be proofrolled/compacted using a ride-on or double-drum walk-behind roller. All proofroll activities should be inspected and approved by a qualified geotechnical representative. Additional proofrolling coverages should be performed in any areas deemed necessary based on observations made by the geotechnical representative. Soft areas identified during proofrolling should be undercut and replaced with approved fill.

The clay liner subgrade should be cleared of all debris and gravel larger than 3 inches to prevent intrusions into the clay liner.

5.5 Temporary Excavations

We anticipate that excavations at the site will have sufficient space for open cuts. Temporary excavation support for the culvert installation was beyond the scope of this report. Temporary and permanent surcharge loading due to traffic loads, equipment, soil stockpiles, and roads should be considered while designing excavation slopes.

Where sufficient space exists at the site to allow for open cuts, temporary construction slopes can be used. We recommend that temporary construction slope excavations be preliminarily no steeper than the OSHA "Type C" slopes (1.5H:1V). Because of the soft nature of the soil and perched water, we recommend considering even gentler temporary slopes (2H:1V) for the area of Pool #1 where very loose or very soft soils were encountered.

If temporary slopes are left open for extended periods of time, exposure to weather will have detrimental effects such as sloughing and erosion. Construction slopes should be excavated in accordance with all applicable OSHA regulations and any state of Virginia safety requirements including but not limited to proper sloping and/or shoring.

5.6 Groundwater and Runoff Management During Construction

Groundwater was encountered near the surface of the existing pond or within 3 feet below grade in most test locations. Additionally, the site is an existing pond that receives stormwater runoff for a large tributary area to the north.

We recommend that a stormwater diversion system be installed at the start of construction to limit disturbance of subgrades and slopes. We recommend this diversion system capture the concentrated runoff at the northwest side of the site and route it to the existing (or new) culvert below the W&OD

trail during construction. The diversion system should also consider the use of a temporary diversion trench along the north side of the pond to capture runoff and divert it from the work area.

We anticipate that a localized dewatering system will be required to manage perched water during construction. Assuming that stormwater runoff is properly re-routed, we anticipate that traditional sumps and gravel-filled trenches can be used to dewater the site. These sumps and trenches should be installed as early as possible to help remove the perched water prior to start of work in specific areas of the site and prevent softening of subgrades and slopes. We recommend sumps extend at least 3 feet below the anticipated subgrade elevations to lower water below the working subgrade and anticipated over-excavations discussed in Section 5.2.

The pumping, handling, and discharge of all dewatering effluent should be handled in accordance with all Virginia, Arlington County, and Federal regulations.

5.7 Engineered Fill

5.7.1 Fill Designation

Structural fill should be used to raise grades and fill over-excavations in areas of the new maintenance area. Structural fill is recommended to consist of soils classified as GW, GP, GM, SW, SP, SM, or a combination of these soils in accordance with the USCS classification system. Structural fill soils are recommended to have a maximum fines content of 30 percent, a liquid limit not exceeding 35, and a plasticity index not more than 12. Structural fill soils should have a maximum particle size of 3 inches.

Any fill placed for the construction of basin embankments (outside of required liners) should include low-plasticity soils (liquid limit less than 50) having a minimum of 40 percent passing the No. 200 sieve. Ideally these materials will be classified as GC, SC, or CL in accordance with USCS.

Non-structural fill should be used in all other areas of the site and should not have particles exceeding 3 inches within the uppermost foot of final grade and 6 inches below. Soils classified as CH, MH, OL, and PT in accordance with USCS should not be used at the site as backfill.

All fill materials should be free of trash, debris, roots, vegetation, or other deleterious materials and should be approved by the geotechnical engineer of record prior to placement.

5.7.2 Pond Liner

A pond liner can be used to create a wet pond condition. In accordance with VDEQ, the liner should consist of either a 30-mil poly-liner, bentonite clay, or soil meeting the following requirements:

- A permeability less than 10^{-6} cm/sec (3.94×10^{-7} in/sec)
- Plasticity index of at least 15
- Liquid limit of at least 30
- Minimum clay content of 30 percent

The soil liner should be at least 12 inches thick and an additional 8 inches of cover soil should be placed to protect the liner from desiccation soon after it has been completed. The cover soil should consist of a relatively fine-grained soil or topsoil. A geosynthetic filter fabric should be placed between the clay liner and the underlying existing soil to prevent the migration of the fines from the clay liner into the underlying soils.

5.7.3 Clay Core at Outlet Pipe

A clay core material should be used to backfill around the outlet pipe in accordance with VDOT and VDEQ design guidelines. This material should consist of materials classified as GC, SC, or CL in accordance with USCS classification and a liquid limit no more than 50.

We recommend that the core be installed to a minimum of 4 feet below and a minimum of 4 feet to each side of the outlet pipe. We recommend the core material extend up to the 10-year storm water elevation above the pipe, or to about el 152.2. The bottom and top of the core should be sloped at 1H:1V.

The length of the core (e.g. along the alignment of the pipe) should be a minimum of 12 feet and the ends should be sloped at 1H:1V resulting in a flat bottom length of 4 feet assuming a depth below the pipe of 4 feet as previously noted.

5.7.4 Reuse of Existing On-site Soils

We anticipate that granular (sand and gravel) portions of the on-site soils slated for excavation can be reused as structural fill at the site. Portions of Stratum A denoted as clay should not be used as structural fill but are expected to be able to be reused as embankment fill. However, portions of the sand and clay with high organic content should not be reused at the site.

Almost all soil to be excavated at the site is expected to be above the optimum moisture content due to the shallow perched water at the site. The reuse of on-site soil will require proper drying prior to reuse which may be problematic with the limited work area and schedule. This may necessitate the import of soil to complete new embankments.

The Contractor's ability to work with the site soils and seasonal weather conditions during the site preparation and filling phases of construction will have a significant impact on timely project completion. Care should be taken to prevent disturbance of proofrolled areas and softening of materials prior to finished construction.

5.7.5 Imported Fill

Any approved imported fill should be "certified clean fill" free of all hazardous substances and meeting all Virginia, Arlington County, and local regulations. The Contractor should provide documentation of compliance to the project geotechnical engineer of record prior to delivery of any fill to the site. Grain size distribution, maximum dry density, and optimum water content determinations should be made based on representative samples of the backfill and fill materials proposed by the Contractor.

5.7.6 Fill Placement and Compaction

We recommend that fill be placed in the following lift sizes and compaction criteria:

- Structural Fill (maintenance area) – Maximum 10-inch-thick lifts and compacted to 98 percent of the material's maximum dry density (ASTM D698). The water content at the time of compaction should be within 3 percentage points of the optimum.
- Embankment Fill – Maximum 8-inch-thick lifts and compacted to 98 percent of the material's maximum dry density (ASTM D698). The water content at the time of compaction should be within 2 percentage points of the optimum.

- Clay Liner – Maximum 6-inch-thick lifts and compacted to 98 percent of the material’s maximum dry density (ASTM D698). The water content at the time of compaction should be within 2 percentage points of the optimum.
- Clay Core - Maximum 4-inch-thick lifts and compacted to 98 percent of the material’s maximum dry density (ASTM D698). The water content at the time of compaction should be within 2 percentage points of the optimum.
- Exterior Landscaped Areas – Maximum 12-inch-thick lifts and compacted to 90 percent of the material’s maximum dry density (ASTM D698). The water content at the time of compaction should be within 3 percentage points of the optimum.

Typically, sand and silt soils should be compacted with a smooth drum roller and clay soils should be compacted using a sheeps-foot roller. Fill placement for slopes and embankments should be placed in horizontal lifts beyond the design grade and then cut back to the design slope. New fill placed immediately adjacent to existing rising slopes should be keyed into the slope by cutting a bench.

Embankment fill and the clay liner should be compacted using a sheeps-foot roller or the top of each lift should be scarified before placement of the subsequent lift to prevent the formation of seepage paths.

All fill placement should be subject to inspection and testing by a qualified geotechnical representative. Nuclear density tests (or other approved methods) should be performed on every lift of soil that is placed. Density tests should be performed at a minimum for every 3,000 square feet of embankment and maintenance area and every 5,000 square feet of each lift within landscaped areas not part of slopes/embankments.

During periods of wet weather, the Contractor should make provisions to dry portions of the excavated soils to an acceptable moisture content prior to compaction by methods such as discing/air drying.

Fill material should not be placed in areas of standing water, on snow-covered subgrades, on frozen subgrades, or on surfaces not approved by geotechnical testing.

5.8 Protection of Existing Structures and Utilities

All construction work should be performed so as not to adversely impact or cause loss of support to adjacent structures, pavements, and utilities that are to remain.

5.8.1 Pre-Excavation Survey

We recommend performing a comprehensive preconstruction-conditions survey of adjacent structures (observation deck and seating area) and the W&OD trail surface within 100 feet of the site limits before any construction activities. At a minimum, these surveys should include a video survey and photographs of the inspected areas. The survey would serve as a qualitative document of the conditions of the structures and adjacent areas prior to the start of work.

5.8.2 Monitoring During Construction

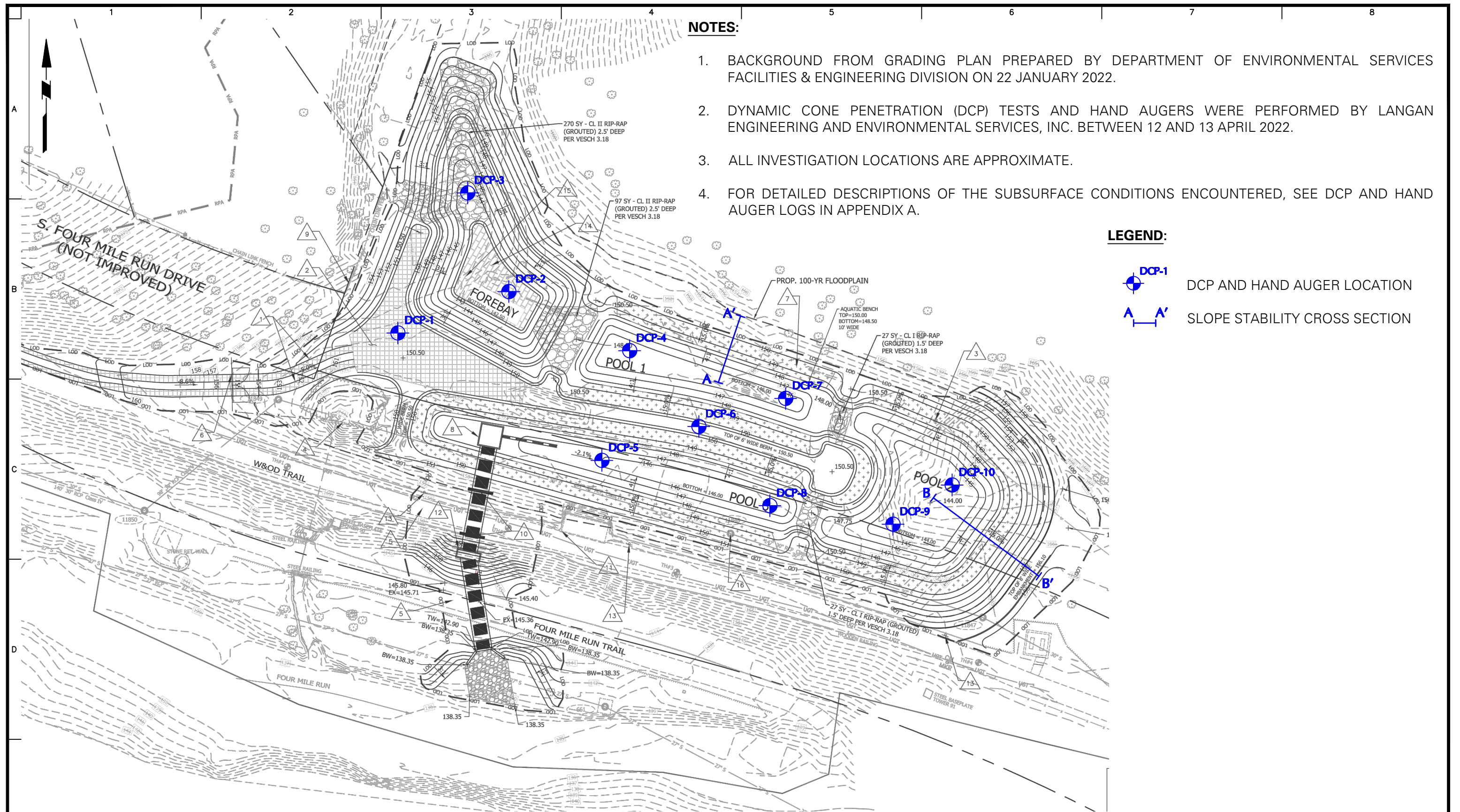
We recommend that the north embankment slope of the W&OD trail be monitored during construction to verify detrimental movements do not occur. We recommend that surface settlement points be installed at the toe and top of the slope within 50 feet of the excavation of Pool #3. Surface settlement points should be monitored on a weekly basis. We recommend a preliminary threshold value of 1 inch be used to alert the design and construction team.

6.0 CLOSURE/LIMITATIONS

This report presents our recommendations regarding the geotechnical earthwork aspects for the proposed restoration of Sparrow Pond in Arlington, Virginia. These recommendations are based on our site subsurface investigation, information and drawings provided by Arlington County, and review of available information. Recommendations given are contingent upon one another and no recommendation should be followed independent of the others. Final drawings should be provided to our office to confirm our recommendations. Langan Engineering and Environmental Services, Inc. cannot assume responsibility for the use of this report to generate recommendations for other than the specific site and structures addressed in this report.

FIGURES



Figure 1 – Investigation Location Plan

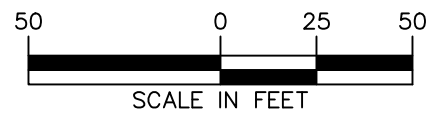


NOTES:

1. BACKGROUND FROM GRADING PLAN PREPARED BY DEPARTMENT OF ENVIRONMENTAL SERVICES FACILITIES & ENGINEERING DIVISION ON 22 JANUARY 2022.
2. DYNAMIC CONE PENETRATION (DCP) TESTS AND HAND AUGERS WERE PERFORMED BY LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES, INC. BETWEEN 12 AND 13 APRIL 2022.
3. ALL INVESTIGATION LOCATIONS ARE APPROXIMATE.
4. FOR DETAILED DESCRIPTIONS OF THE SUBSURFACE CONDITIONS ENCOUNTERED, SEE DCP AND HAND AUGER LOGS IN APPENDIX A.

LEGEND:

-  DCP-1 DCP AND HAND AUGER LOCATION
-  A-A' SLOPE STABILITY CROSS SECTION



LANGAN Langan Engineering and Environmental Services, Inc. 1300 Wilson Boulevard, Suite 450 Arlington, VA 22209 T: 571.366.6800 F: 571.366.6801 www.langan.com	Project SPARROW POND RESTORATION ARLINGTON COUNTY VIRGINIA	Drawing Title INVESTIGATION LOCATION PLAN	Project No. 270060008	Drawing No. 1
			Date 5/17/2022	Sheet 1 of 1
			Drawn By ANG	
			Checked By RTM	

Appendix A

DCP Test & Hand Auger Logs

WILDCAT ADHESION CONE LOG

Lanagan
 1300 Wilson Boulevard, Suite 450
 Arlington, VA, 22209

PROJECT NUMBER: 270060009
 DATE STARTED: 04-12-2022
 DATE COMPLETED: 04-12-2022

HOLE #: DCP-1
 CREW: Amber Ganapathy, Jane Le
 PROJECT: Sparrow Pond
 ADDRESS: Glencarlyn Park
 LOCATION: Arlington, VA

SURFACE ELEVATION: 152
 WATER ON COMPLETION: NR
 HAMMER WEIGHT: 35 lbs.
 CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	SLEEVE TORQUE ft.-lbs.	ADHESION Kg/cm ²	CONE RESISTANCE Kg/cm ²	ADHESION RATIO %	GRAPH OF CONE RESISTANCE				N'	INFERRED SOIL DESCRIPTION	
						0	50	100	150			200
-	6			26.64		.....					5	
-	4			17.76		....					3	
- 1 ft	3			13.32		....					2	
-	44			195.36		.....	.....	.....	.....	.....	25+	
-	33			146.52		.....	.....	.....	.....	.....	25+	
- 2 ft	17			75.48		.....	.....	.....	.....	.....	14	
-	9			39.96		.....	.....	.....	.....	.....	7	
-	6			26.64		.....	.....	.....	.....	.....	5	
- 3 ft	11			48.84		.....	.....	.....	.....	.....	9	
- 1 m	22			97.68		.....	.....	.....	.....	.....	18	
-	34			131.24		.....	.....	.....	.....	.....	24	
- 4 ft	21			81.06		.....	.....	.....	.....	.....	15	
-	6			23.16		.....	.....	.....	.....	.....	4	
-	5			19.30		.....	.....	.....	.....	.....	3	
- 5 ft	9			34.74		.....	.....	.....	.....	.....	6	
-	36			138.96		.....	.....	.....	.....	.....	25+	
-	50			193.00		.....	.....	.....	.....	.....	25+	
- 6 ft												
- 2 m												
- 7 ft												
-												
- 8 ft												
-												
- 9 ft												
- 3 m	10 ft											
-												
- 11 ft												
-												
- 12 ft												
- 4 m	13 ft											

LOG OF TEST PIT DCP-01

PROJECT NAME Sparrow Pond	PROJECT NUMBER 270060009	DATE 04/14/2022
LOCATION Arlington, VA	ELEVATION Approx. el 152 (NAVD88)	
EXCAVATION CONTRACTOR Langan	DEPTH 1.3 ft	WATER LEVEL - First 1 ft
EQUIPMENT Hand Auger	FOREMAN -	WATER LEVEL - Completion -
		LANGAN PERSONNEL Amber Ganapathy / Jane Le

Symbol	ELEV (feet)	DESCRIPTION	Depth Scale	SAMPLE		REMARKS
				Number	Type	
	+152.0	Dark brown Silty CLAY, trace f-c sand, trace organics (moist)	0			Began augering at 10:40.
	+151.8	[TOPSOIL] Brown Sandy CLAY, trace silt (moist)				
	+151.3	Reddish brown SILT, trace f-c sand, trace clay, trace mica, trace fine gravel (wet)	1	S-1	HA	Refusal on gravel at 6 in; offset by 1 ft.
	+150.9	Brown Sandy f-c GRAVEL (wet)				
	+150.7	End of Hand Auger at 1.3 ft				Refusal at 1.1 ft; offset by 2 ft. Refusal at offset on gravel at 1.3 ft. Completed at 11:10.
			2			
			3			
			4			
			5			
			6			
			7			
			8			

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WILDCAT ADHESION CONE LOG

Lanagan
 1300 Wilson Boulevard, Suite 450
 Arlington, VA, 22209

PROJECT NUMBER: 270060009
 DATE STARTED: 04-12-2022
 DATE COMPLETED: 04-12-2022
 SURFACE ELEVATION: 152
 WATER ON COMPLETION: NR
 HAMMER WEIGHT: 35 lbs.
 CONE AREA: 10 sq. cm

HOLE #: DCP-2
 CREW: Amber Ganapathy, Jane Le
 PROJECT: Sparrow Pond
 ADDRESS: Glencarlyn Park
 LOCATION: Arlington, VA

DEPTH	BLOWS PER 10 cm	SLEEVE TORQUE ft.-lbs.	ADHESION Kg/cm ²	CONE RESISTANCE Kg/cm ²	ADHESION RATIO %	GRAPH OF CONE RESISTANCE					N'	INFERRED SOIL DESCRIPTION
						0	50	100	150	200		
-	8			35.52		.....					6	
	9			39.96		.....					7	
1 ft	10			44.40		.....					8	
	11			48.84		.....					9	
	10			44.40		.....					8	
2 ft	5			22.20		.....					4	
	12			53.28		.....					10	
	12			53.28		.....					10	
3 ft	4			17.76		.....					3	
- 1 m	2			8.88		..					1	
	8			30.88		.....					5	
4 ft	14			54.04		.....					10	
	5			19.30		.....					3	
	3			11.58		..					2	
5 ft	3			11.58		..					2	
	2			7.72		..					1	
	2			7.72		..					1	
6 ft	4			15.44		.....					2	
	6			23.16		.....					4	
- 2 m	6			23.16		.....					4	
	23			78.66		.....					14	
7 ft	46			157.32		.....					25+	
	50			171.00		.....					25+	
8 ft												
- 3 m	10 ft											
- 4 m	13 ft											

LOG OF TEST PIT DCP-02

PROJECT NAME Sparrow Pond		PROJECT NUMBER 270060009	DATE 04/14/2022
LOCATION Arlington, VA		ELEVATION Approx. el 152 (NAVD88)	
EXCAVATION CONTRACTOR Langan		DEPTH 7 ft	WATER LEVEL - First 3.5 ft ▽
EQUIPMENT Hand Auger		FOREMAN -	WATER LEVEL - Completion - ▼
		LANGAN PERSONNEL Amber Ganapathy / Jane Le	

Symbol	ELEV (feet)	DESCRIPTION	Depth Scale	SAMPLE		REMARKS
				Number	Type	
	+152.0	Brown f-c SAND, some clay, trace organics, trace silt, trace fine gravel (moist)	0			Began augering at 08:40.
			1	S-1	HA	
	+150.5	Dark brown Silty CLAY, trace f-c sand, trace organics (moist)	2			Refusal on gravel or root at 1.5 ft; offset by 2 ft.
			3	S-2	HA	
	+149.2	Dark gray f-c SAND, trace silt, trace organics (moist)	4			
			5	S-3	HA	
	+147.6	Dark brown CLAY, some f-c sand (wet)	6			
			7	S-4	HA	
	+146.2	Gray Clayey f-m SAND (wet)	8			
			9			
	+145.0	End of Hand Auger at 7 ft	10			Sidewalls collapsing after auger removal; borehole filling with water and sand. Completed at 10:05.

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WILDCAT ADHESION CONE LOG

Lanagan
 1300 Wilson Boulevard, Suite 450
 Arlington, VA, 22209

PROJECT NUMBER: 270060009
 DATE STARTED: 04-12-2022
 DATE COMPLETED: 04-12-2022

HOLE #: DCP-3
 CREW: Amber Ganapathy, Jane Le
 PROJECT: Sparrow Pond
 ADDRESS: Glencarlyn Park
 LOCATION: Arlington, VA

SURFACE ELEVATION: 153
 WATER ON COMPLETION: NR
 HAMMER WEIGHT: 35 lbs.
 CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	SLEEVE TORQUE ft.-lbs.	ADHESION Kg/cm ²	CONE RESISTANCE Kg/cm ²	ADHESION RATIO %	GRAPH OF CONE RESISTANCE				N'	INFERRED SOIL DESCRIPTION	
						0	50	100	150			200
-	5			22.20		.....					4	
	5			22.20		.....					4	
1 ft	12			53.28		.....					10	
	7			31.08		.....					5	
	4			17.76		.....					3	
2 ft	2			8.88		..					1	
	1			4.44		.					0	
	1			4.44		.					0	
3 ft	2			8.88		..					1	
- 1 m	3			13.32		.....					2	
	2			7.72		..					1	
4 ft	2			7.72		..					1	
	2			7.72		..					1	
5 ft	2			7.72		..					1	
	3			11.58		...					2	
	9			34.74		.....					6	
6 ft	11			42.46		.....					7	
	30			115.80		.....					21	
- 2 m	20			77.20		.....					14	
7 ft	8			27.36		.....					5	
	39			133.38		.....					25	
	50			171.00		.....					25+	
8 ft												
9 ft												
- 3 m	10 ft											
	11 ft											
	12 ft											
- 4 m	13 ft											

LOG OF TEST PIT DCP-03

PROJECT NAME Sparrow Pond	PROJECT NUMBER 270060009	DATE 04/14/2022
LOCATION Arlington, VA	ELEVATION Approx. el 153 (NAVD88)	
EXCAVATION CONTRACTOR Langan	DEPTH 6.33 ft	WATER LEVEL - First 1.8 ft ▽
EQUIPMENT Hand Auger	FOREMAN -	WATER LEVEL - Completion - ▼
LANGAN PERSONNEL Amber Ganapathy / Jane Le		

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Symbol	ELEV (feet)	DESCRIPTION	Depth Scale	SAMPLE		REMARKS
				Number	Type	
	+153.0	Brown f-c SAND, trace clay, trace fine gravel, trace roots, trace organics (moist)	0			Began augering at 10:10.
	+152.0	Brown Silty CLAY, trace f-c sand, trace organics, trace mica (moist)	1			
	+151.2	Reddish brown f-c SAND, trace clay, trace silt (wet)	2	S-1	HA	
	+150.0	Brown f-c SAND, some clay, trace silt (wet)	3			
	+149.0	Brown CLAY, some silt, trace f-c sand (wet)	4	S-2	HA	
	+148.0	Brown CLAY, some f-c sand, trace silt (wet)	5			
	+146.7	End of Hand Auger at 6.33 ft	6			
			7			Completed at 10:35.
			8			

WILDCAT ADHESION CONE LOG

Lanagan
 1300 Wilson Boulevard, Suite 450
 Arlington, VA, 22209

PROJECT NUMBER: 270060009
 DATE STARTED: 04-12-2022
 DATE COMPLETED: 04-12-2022
 SURFACE ELEVATION: 151
 WATER ON COMPLETION: NR
 HAMMER WEIGHT: 35 lbs.
 CONE AREA: 10 sq. cm

HOLE #: DCP-4
 CREW: Amber Ganapathy, Jane Le
 PROJECT: Sparrow Pond
 ADDRESS: Glencarlyn Park
 LOCATION: Arlington, VA

DEPTH	BLOWS PER 10 cm	SLEEVE TORQUE ft.-lbs.	ADHESION Kg/cm ²	CONE RESISTANCE Kg/cm ²	ADHESION RATIO %	GRAPH OF CONE RESISTANCE					N'	INFERRED SOIL DESCRIPTION
						0	50	100	150	200		
-	2			8.88		••					1	
	1			4.44		•					0	
1 ft	1			4.44		•					0	
	2			8.88		••					1	
	1			4.44		•					0	
2 ft	0			0.00							0	
	0			0.00							0	
	1			4.44		•					0	
3 ft	0			0.00							0	
- 1 m	0			0.00							0	
	1			3.86		•					0	
4 ft	2			7.72		••					1	
	2			7.72		••					1	
	2			7.72		••					1	
5 ft	2			7.72		••					1	
	3			11.58		•••					2	
	4			15.44		••••					2	
6 ft	9			34.74		••••••••					6	
	8			30.88		••••••					5	
- 2 m	8			30.88		••••••					5	
7 ft	19			64.98		••••••••••••••					12	
	28			95.76		••••••••••••••••					18	
	30			102.60		•••••••••••••••••					19	
8 ft	39			133.38		••••••••••••••••••••					25	
	42			143.64		••••••~					25+	
	48			164.16		••••~					25+	
9 ft	50			171.00		••••~					25+	
- 3 m	10 ft											
	11 ft											
	12 ft											
- 4 m	13 ft											

LOG OF TEST PIT DCP-04

PROJECT NAME Sparrow Pond	PROJECT NUMBER 270060009	DATE 04/14/2022
LOCATION Arlington, VA	ELEVATION Approx. el 151 (NAVD88)	
EXCAVATION CONTRACTOR Langan	DEPTH 7.5 ft	WATER LEVEL - First 0 ft ▽
EQUIPMENT Hand Auger	FOREMAN -	WATER LEVEL - Completion 0 ft ▽
		LANGAN PERSONNEL Amber Ganapathy / Jane Le

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Symbol	ELEV (feet)	DESCRIPTION	Depth Scale	SAMPLE		REMARKS
				Number	Type	
▼	+151.0	Dark brown f-c SAND, some clay, trace silt, trace organics (wet) [TOPSOIL]	0			Began augering at 07:35.
	+150.8	Gray f-c SAND, trace silt (wet)				
		Dark brown f-c SAND, some organics, trace silt (wet)	1	S-1	HA	
			2			
			3			
	+147.5	Dark brown CLAY, trace silt, trace f-c sand, trace organics (wet)	4			
	+146.0	Dark gray CLAY, some f-c sand, trace silt (wet)	5	S-2	HA	
	+145.5	Dark gray f-m SAND, trace clay, trace silt (wet)	6	S-3	HA	
	+145.0	Dark gray Clayey f-m SAND, trace silt (wet)	7			
		Reddish brown f-c SAND, some clay, trace silt, trace mica (wet)	7	S-4	HA	
	+143.5	End of Hand Auger at 7.5 ft	8			Refusal due to dense soils at 7.5 ft. Completed at 08:35.



WILDCAT ADHESION CONE LOG

Lanagan
1300 Wilson Boulevard, Suite 450
Arlington, VA, 22209

PROJECT NUMBER: 270060009
DATE STARTED: 04-12-2022
DATE COMPLETED: 04-12-2022

HOLE #: DCP-5
CREW: Amber Ganapathy, Jane Le
PROJECT: Sparrow Pond
ADDRESS: Glencarlyn Park
LOCATION: Arlington, VA

SURFACE ELEVATION: 149
WATER ON COMPLETION: NR
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	SLEEVE TORQUE ft.-lbs.	ADHESION Kg/cm ²	CONE RESISTANCE Kg/cm ²	ADHESION RATIO %	GRAPH OF CONE RESISTANCE				N'	INFERRED SOIL DESCRIPTION
						0	50	100	150		
-	1			4.44		.				0	
-	2			8.88		..				1	
-	1 ft 2			8.88		..				1	
-	3			13.32		....				2	
-	3			13.32		....				2	
-	2 ft 3			13.32		....				2	
-	3			13.32		....				2	
-	2			8.88		..				1	
-	3 ft 3			13.32		....				2	
-	1 m 2			8.88		..				1	
-	2			7.72		..				1	
-	4 ft 3			11.58		...				2	
-	2			7.72		..				1	
-	3			11.58		...				2	
-	5 ft 3			11.58		...				2	
-	4			15.44		....				2	
-	4			15.44		....				2	
-	6 ft 4			15.44		....				2	
-	4			15.44		....				2	
-	2 m 3			11.58		...				2	
-	7 ft 5			17.10		.....				3	
-	4			13.68		....				2	
-	6			20.52		.....				3	
-	8 ft 6			20.52		.....				3	
-	8			27.36		.....				5	
-	8			27.36		.....				5	
-	9 ft 9			30.78		.....				5	
-	3 m 10 ft										
-	11 ft										
-	12 ft										
-	4 m 13 ft										

LOG OF TEST PIT DCP-05

PROJECT NAME Sparrow Pond		PROJECT NUMBER 270060009	DATE 04/13/2022
LOCATION Arlington, VA		ELEVATION Approx. el 149 (NAVD88)	
EXCAVATION CONTRACTOR Langan		DEPTH 1.5 ft	WATER LEVEL - First 0 ft ▼
EQUIPMENT Hand Auger		FOREMAN -	WATER LEVEL - Completion 0 ft ▼
		LANGAN PERSONNEL Amber Ganapathy / Jane Le	

Symbol	ELEV (feet)	DESCRIPTION	Depth Scale	SAMPLE		REMARKS
				Number	Type	
	+149.0	Dark brown Clayey f-m SAND, trace silt, trace organics (wet) [TOPSOIL]	0			Began augering at 12:45.
	+148.7	Dark brown and gray f-m SAND, some clay, trace mica (wet)				
	+148.2	Dark gray Silty CLAY, trace f-c sand, trace organics (wet)	1	S-1	HA	
	+148.0	Dark brown f-c SAND, some clay, trace fine gravel, trace silt, trace organics (wet)				
	+147.5	End of Hand Auger at 1.5 ft				
			2			Refusal at 1.5 ft; offset by 2 ft. Refusal at 1.5 ft in offset. Completed at 13:20.
			3			
			4			
			5			
			6			
			7			
			8			

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WILDCAT ADHESION CONE LOG

Lanagan
1300 Wilson Boulevard, Suite 450
Arlington, VA, 22209

PROJECT NUMBER: 270060009
DATE STARTED: 04-12-2022
DATE COMPLETED: 04-12-2022

HOLE #: DCP-6
CREW: Amber Ganapathy, Jane Le
PROJECT: Sparrow Pond
ADDRESS: Glencarlyn Park
LOCATION: Arlington, VA

SURFACE ELEVATION: 150
WATER ON COMPLETION: NR
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	SLEEVE TORQUE ft.-lbs.	ADHESION Kg/cm ²	CONE RESISTANCE Kg/cm ²	ADHESION RATIO %	GRAPH OF CONE RESISTANCE				N'	INFERRED SOIL DESCRIPTION
						0	50	100	150			200
-	2			8.88		..				1	
	2			8.88		..				1	
1 ft	3			13.32		....				2	
	7			31.08		.....				5	
	10			44.40		.....				8	
2 ft	11			48.84		.....				9	
	8			35.52		.....				6	
	6			26.64		.....				5	
3 ft	3			13.32		....				2	
- 1 m	3			13.32		....				2	
	6			23.16		.....				4	
4 ft	50			193.00		.....				25+	
5 ft											
6 ft											
- 2 m											
7 ft											
8 ft											
9 ft											
- 3 m	10 ft										
11 ft											
12 ft											
- 4 m	13 ft										

LOG OF TEST PIT DCP-06

PROJECT NAME Sparrow Pond		PROJECT NUMBER 270060009	DATE 04/13/2022
LOCATION Arlington, VA		ELEVATION Approx. el 150 (NAVD88)	
EXCAVATION CONTRACTOR Langan		DEPTH 2 ft	WATER LEVEL - First 0 ft ▽
EQUIPMENT Hand Auger		FOREMAN -	WATER LEVEL - Completion 0 ft ▽
		LANGAN PERSONNEL Amber Ganapathy / Jane Le	

Symbol	ELEV (feet)	DESCRIPTION	Depth Scale	SAMPLE		REMARKS
				Number	Type	
▼	+150.0	Dark brown CLAY, some organics, trace silt, trace f-c sand (wet) [TOPSOIL]	0			Began augering at 12:00. Refusal on root or rock at 4 in; offset by 1 ft. Refusal on root or rock at 6 in; offset by 1 ft. Refusal on root or rock at 1 ft; offset by 2 ft.
▨	+149.5	Dark brown Sandy CLAY, trace silt, trace organics (wet)				
▧	+149.0	Light brown Silty CLAY, trace fine gravel, trace f-c sand (wet)	1	S-1	HA	
▩	+148.7	Brown SILT, some f-c sand, trace clay, trace mica, trace fine gravel (wet)				
	+148.0	End of Hand Auger at 2 ft	2	S-2	HA	Refusal at 2 ft. Completed at 12:40.
			3			
			4			
			5			
			6			
			7			
			8			
			8			

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WILDCAT ADHESION CONE LOG

Lanagan
1300 Wilson Boulevard, Suite 450
Arlington, VA, 22209

PROJECT NUMBER: 270060009
DATE STARTED: 04-13-2022
DATE COMPLETED: 04-13-2022

HOLE #: DCP-7
CREW: Jane Le, Fahim Shahi
PROJECT: Sparrow Pond
ADDRESS: Glencarlyn Park
LOCATION: Arlington, VA

SURFACE ELEVATION: 150
WATER ON COMPLETION: NR
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	SLEEVE TORQUE ft.-lbs.	ADHESION Kg/cm ²	CONE RESISTANCE Kg/cm ²	ADHESION RATIO %	GRAPH OF CONE RESISTANCE				N'	INFERRED SOIL DESCRIPTION
						0	50	100	150		
-	0			0.00						0	
-	1			4.44		.				0	
-	1 ft			4.44		.				0	
-	1			4.44		.				0	
-	1			4.44		.				0	
-	3			13.32		...				2	
-	2 ft			8.88		..				1	
-	1			4.44		.				0	
-	3			13.32		...				2	
-	3 ft			4.44		.				0	
-	0			0.00						0	
-	0			0.00						0	
-	4 ft			0.00						0	
-	1			3.86		.				0	
-	1			3.86		.				0	
-	5 ft			11.58		...				2	
-	2			7.72		..				1	
-	15			57.90		.....				10	
-	6 ft			111.94		.....				21	
-	14			54.04		.....				10	
-	2 m			34.74		.....				6	
-	7 ft			37.62		.....				7	
-	14			47.88		.....				9	
-	16			54.72		.....				10	
-	8 ft			82.08		.....				15	
-	19			64.98		.....				12	
-	20			68.40		.....				12	
-	9 ft			51.30		.....				9	
-	3 m										
-	10 ft										
-	11 ft										
-	12 ft										
-	4 m										
-	13 ft										

LOG OF TEST PIT DCP-07

PROJECT NAME Sparrow Pond	PROJECT NUMBER 270060009	DATE 04/13/2022
LOCATION Arlington, VA	ELEVATION Approx. el 150 (NAVD88)	
EXCAVATION CONTRACTOR Langan	DEPTH 4.5 ft	WATER LEVEL - First 0 ft ▽
EQUIPMENT Hand Auger	FOREMAN -	WATER LEVEL - Completion 0 ft ▽
		LANGAN PERSONNEL Amber Ganapathy / Jane Le

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Symbol	ELEV (feet)	DESCRIPTION	Depth Scale	SAMPLE		REMARKS
				Number	Type	
▼	+150.0	Dark brown f-c SAND, some clay, trace silt, trace organics (wet) [TOPSOIL]	0			Began augering at 10:00.
	+149.0	Brown f-c SAND, trace silt, trace clay, trace fine gravel (wet)	1	S-1	HA	
		Gray f-c SAND (wet)	2			
		Dark brown f-c SAND, some organics, trace clay, trace plastic, trace wood chips (wet)	3	S-2	HA	
			4			
	+145.5	End of Hand Auger at 4.5 ft	5			Sidewalls collapsing after auger removal; filling with water and sand. Completed at 10:35.
			6			
			7			
			8			

WILDCAT ADHESION CONE LOG

Lanagan
 1300 Wilson Boulevard, Suite 450
 Arlington, VA, 22209

PROJECT NUMBER: 270060009
 DATE STARTED: 04-13-2022
 DATE COMPLETED: 04-13-2022

HOLE #: DCP-8
 CREW: Jane Le, Fahim Shahi
 PROJECT: Sparrow Pond
 ADDRESS: Glencarlyn Park
 LOCATION: Arlington, VA

SURFACE ELEVATION: 149
 WATER ON COMPLETION: NR
 HAMMER WEIGHT: 35 lbs.
 CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	SLEEVE TORQUE ft.-lbs.	ADHESION Kg/cm ²	CONE RESISTANCE Kg/cm ²	ADHESION RATIO %	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	INFERRED SOIL DESCRIPTION
-	1			4.44		•	0	
-	3			13.32		••••	2	
1 ft	3			13.32		••••	2	
-	3			13.32		••••	2	
-	3			13.32		••••	2	
2 ft	7			31.08		••••••••	5	
-	3			13.32		••••	2	
-	9			39.96		••••••••	7	
3 ft	13			57.72		••••••••••	10	
- 1 m	9			39.96		••••••••	7	
-	6			23.16		••••••	4	
4 ft	12			46.32		••••••••	8	
-	7			27.02		••••••	5	
-	7			27.02		••••••	5	
5 ft	6			23.16		••••••	4	
-	6			23.16		••••••	4	
-	5			19.30		••••••	3	
6 ft	4			15.44		••••	2	
-	5			19.30		••••••	3	
- 2 m	19			73.34		••••••••••••••	13	
7 ft	23			78.66		••••••••••••••	14	
-	9			30.78		••••••••	5	
-	8			27.36		••••••	5	
8 ft	8			27.36		••••••	5	
-	9			30.78		••••••	5	
-	8			27.36		••••••	5	
9 ft	7			23.94		••••••	4	
- 3 m	10 ft							
-	11 ft							
-	12 ft							
- 4 m	13 ft							

LOG OF TEST PIT DCP-08

PROJECT NAME Sparrow Pond	PROJECT NUMBER 270060009	DATE 04/13/2022
LOCATION Arlington, VA	ELEVATION Approx. el 149 (NAVD88)	
EXCAVATION CONTRACTOR Langan	DEPTH 4.3 ft	WATER LEVEL - First 0 ft ▽
EQUIPMENT Hand Auger	FOREMAN -	WATER LEVEL - Completion 0 ft ▽
		LANGAN PERSONNEL Amber Ganapathy / Jane Le

Symbol	ELEV (feet)	DESCRIPTION	Depth Scale	SAMPLE		REMARKS
				Number	Type	
	+149.0	Dark brown CLAY, some silt, some organics (wet) [TOPSOIL]	0			Began augering at 10:45.
		Light brown Clayey SILT, trace mica, trace f-c sand, trace fine gravel, trace organics, trace plastic (wet)	1	S-1	HA	
				2		
	+146.0	Dark brown Sandy CLAY, trace silt, trace fine gravel (wet)	3	S-2	HA	Refusal on root or rock at 3 ft; offset boring by 2 ft.
			4			
	+144.7	End of Hand Auger at 4.3 ft	5			Refusal at 4.3 ft. Completed at 11:50.
			6			
			7			
			8			

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WILDCAT ADHESION CONE LOG

Lanagan
 1300 Wilson Boulevard, Suite 450
 Arlington, VA, 22209

PROJECT NUMBER: 270060009
 DATE STARTED: 04-13-2022
 DATE COMPLETED: 04-13-2022

HOLE #: DCP-9
 CREW: Jane Le, Fahim Shahi
 PROJECT: Sparrow Pond
 ADDRESS: Glencarlyn Park
 LOCATION: Arlington, VA

SURFACE ELEVATION: 151
 WATER ON COMPLETION: NR
 HAMMER WEIGHT: 35 lbs.
 CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	SLEEVE TORQUE ft.-lbs.	ADHESION Kg/cm ²	CONE RESISTANCE Kg/cm ²	ADHESION RATIO %	GRAPH OF CONE RESISTANCE				N'	INFERRED SOIL DESCRIPTION
						0	50	100	150		
-	1			4.44		.				0	
-	2			8.88		..				1	
-	1 ft 2			8.88		..				1	
-	2			8.88		..				1	
-	2			8.88		..				1	
-	2			8.88		..				1	
-	2 ft 4			17.76		....				3	
-	4			17.76		....				3	
-	4			17.76		....				3	
-	3 ft 3			13.32		...				2	
-	1 m 2			8.88		..				1	
-	4			15.44		....				2	
-	4 ft 12			46.32		.....				8	
-	8			30.88		.....				5	
-	8			30.88		.....				5	
-	5 ft 8			30.88		.....				5	
-	7			27.02		.....				5	
-	6			23.16		.....				4	
-	6 ft 6			23.16		.....				4	
-	8			30.88		.....				5	
-	2 m 12			46.32		.....				8	
-	7 ft 12			41.04		.....				7	
-	13			44.46		.....				8	
-	12			41.04		.....				7	
-	8 ft 10			34.20		.....				6	
-	8			27.36		.....				5	
-	7			23.94		.....				4	
-	9 ft 7			23.94		.....				4	
-	6			20.52		.....				3	
-	3 m 10 ft 4			13.68		...				2	
-	7			17.10		....				3	
-	10			21.42		.....				4	
-	10			30.60		.....				5	
-	14			42.84		.....				8	
-	11 ft 17			52.02		.....				9	
-	29			88.74		.....				16	
-	33			100.98		.....				18	
-	12 ft 31			94.86		.....				17	
-	24			73.44		.....				13	
-	4 m 13 ft 23			70.38		.....				13	

LOG OF TEST PIT DCP-09

PROJECT NAME Sparrow Pond	PROJECT NUMBER 270060009	DATE 04/13/2022
LOCATION Arlington, VA	ELEVATION Approx. el 151 (NAVD88)	
EXCAVATION CONTRACTOR Langan	DEPTH 6.5 ft	WATER LEVEL - First 0 ft ▼
EQUIPMENT Hand Auger	FOREMAN -	WATER LEVEL - Completion 0 ft ▼
		LANGAN PERSONNEL Amber Ganapathy / Jane Le

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Symbol	ELEV (feet)	DESCRIPTION	Depth Scale	SAMPLE		REMARKS
				Number	Type	
▼	+151.0	Dark brown CLAY, trace f-m sand, trace organics (wet) [TOPSOIL]	0			Began augering at 09:25.
			1	S-1	HA	
	+149.5	Brown Clayey SILT, trace f-c sand, trace mica (wet)		S-2	HA	
	+149.2	Brown Sandy CLAY, trace silt, trace fine gravel (wet)	2	S-3	HA	
	+148.5	Brown CLAY, some f-c sand, some f-c gravel (wet)	3	S-4	HA	Refusal at 2.5 ft; offset by 3 ft at 11:25 on 04/14/2022. Augered to 2.5 ft.
			4			
			5			
			6			
	+144.5	End of Hand Auger at 6.5 ft	7			Refusal on gravel at 6.5 ft. Completed at 12:00.
			8			



WILDCAT ADHESION CONE LOG

Lanagan
1300 Wilson Boulevard, Suite 450
Arlington, VA, 22209

PROJECT NUMBER: 270060009
DATE STARTED: 04-13-2022
DATE COMPLETED: 04-13-2022

HOLE #: DCP-10
CREW: Jane Le, Fahim Shahi, Amber Ganapathy
PROJECT: Sparrow Pond
ADDRESS: Glencarlyn Park
LOCATION: Arlington, VA

SURFACE ELEVATION: 158
WATER ON COMPLETION: NR
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	SLEEVE TORQUE ft.-lbs.	ADHESION Kg/cm ²	CONE RESISTANCE Kg/cm ²	ADHESION RATIO %	GRAPH OF CONE RESISTANCE					N'	INFERRED SOIL DESCRIPTION
						0	50	100	150	200		
	2			8.88		..					1	
	4			17.76		.....					3	
1 ft	6			26.64		.....					5	
	8			35.52		.....					6	
	6			26.64		.....					5	
2 ft	5			22.20		.....					4	
	3			13.32		....					2	
	4			17.76		.....					3	
3 ft	4			17.76		.....					3	
1 m	4			17.76		.....					3	
	3			11.58		...					2	
4 ft	1			3.86		.					0	
	1			3.86		.					0	
	3			11.58		...					2	
5 ft	5			19.30		.....					3	
	5			19.30		.....					3	
	6			23.16		.....					4	
6 ft	4			15.44		.....					2	
	4			15.44		.....					2	
2 m	3			11.58		...					2	
7 ft	6			20.52		.....					3	
	5			17.10		.....					3	
	5			17.10		.....					3	
8 ft	5			17.10		.....					3	
	5			17.10		.....					3	
	30			102.60		.....					19	
9 ft	50			171.00		.....					25+	
3 m	10 ft											
	11 ft											
	12 ft											
4 m	13 ft											

LOG OF TEST PIT DCP-10

PROJECT NAME Sparrow Pond	PROJECT NUMBER 270060009	DATE 04/13/2022
LOCATION Arlington, VA	ELEVATION Approx. el 158 (NAVD88)	
EXCAVATION CONTRACTOR Langan	DEPTH 5 ft	WATER LEVEL - First NE
EQUIPMENT Hand Auger	FOREMAN -	WATER LEVEL - Completion -
LANGAN PERSONNEL Amber Ganapathy / Jane Le		

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Symbol	ELEV (feet)	DESCRIPTION	Depth Scale	SAMPLE		REMARKS	
				Number	Type		
	+158.0	Dark brown Silty CLAY, trace wood, trace roots (moist) [TOPSOIL]	0	S-1	HA	Began augering at 08:25.	
	+157.5	Light tannish brown SILT, some clay, trace fine sand, trace organics (moist)					
		Light orange-brown Silty f-m SAND, trace clay (moist)		S-2	HA		
	+157.0	Light orange-brown Clayey f-m SAND, trace silt (moist)	1				
				S-3	HA		
	+156.0	Light orange-brown Silty f-m SAND, trace clay (moist) - Tan SILT lense at 3 ft (2 inches thick)	2				
				S-4	HA		
	+154.0	Light orange-brown and tan mottled SILT, trace f-m sand, trace clay (moist)	4				
	+153.0	End of Hand Auger at 5 ft	5				Refusal at 5 ft. Completed at 09:15.
			6				
			7				
			8				

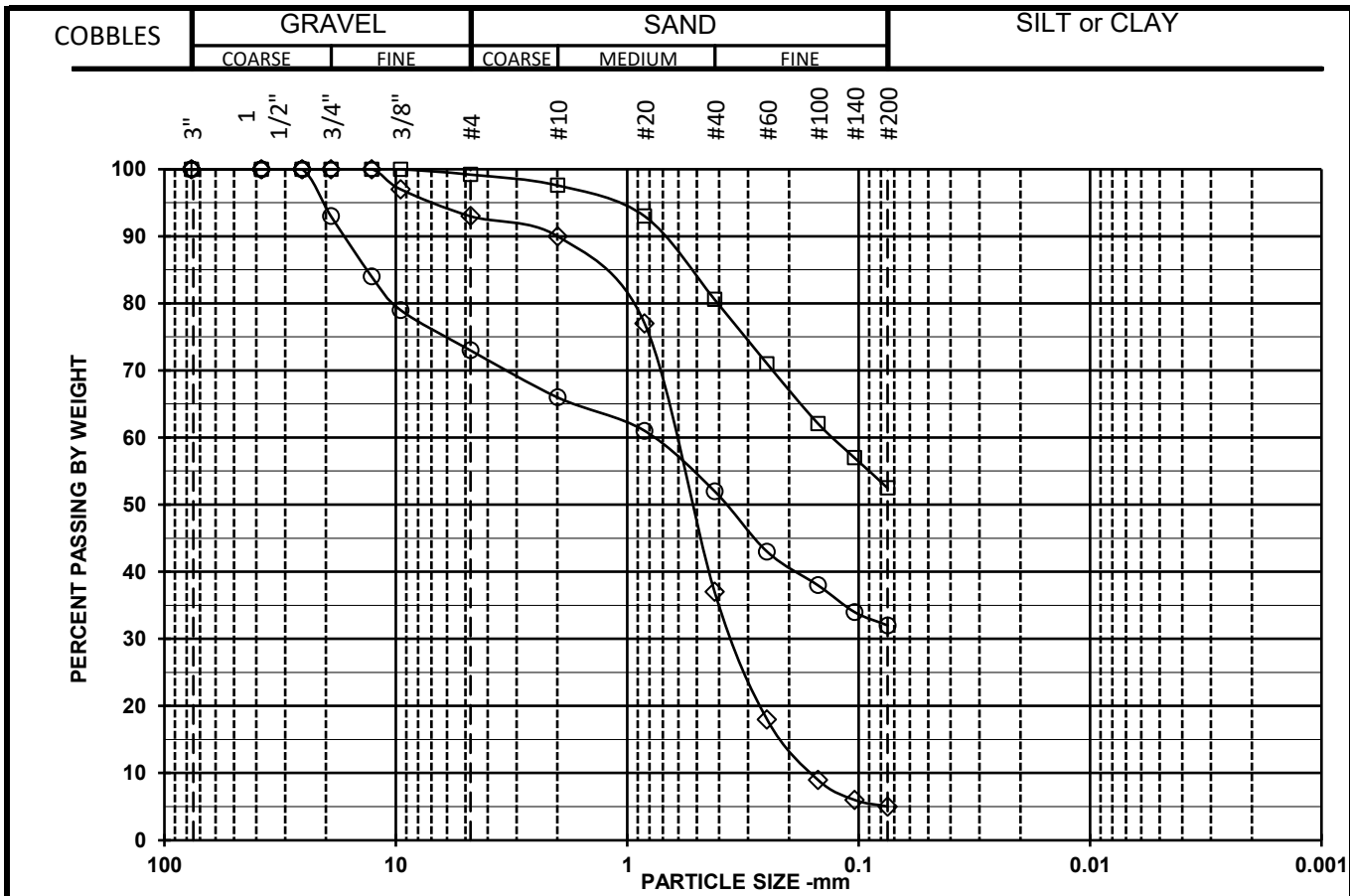
Appendix B

Laboratory Test Results

Langan Engineering #270060009
Sparrow Pond
LABORATORY TESTING DATA SUMMARY

BORING NO.	SAMPLE NO.	DEPTH (ft)	IDENTIFICATION TESTS							REMARKS
			WATER CONTENT (%)	LIQUID LIMIT (-)	PLASTIC LIMIT (-)	PLAS. INDEX (-)	USCS SYMB. (1)	SIEVE MINUS NO. 200 (%)	ORGANIC CONTENT (burnoff) (%)	
DCP-2	S-4	4.5-5	25.5	36	21	15	CL		2.5	
DCP-4	S-2	5-5.5	26.6	35	21	14	CL	52.5		
DCP-7	S-2	2.5-3	31.2				SP-SM	5		
DCP-8	S-2	3-3.5	12.5	30	14	16	SC	32		
DCP-9	S-1	0.5-1	32.1						2.6	

Note: (1) USCS symbol based on visual observation and Sieve and Atterberg limits reported.



Open Symbols: Sieve analysis by ASTM D6913
 Filled symbols: Hydrometer analysis by ASTM D7928 corrected for complete sample

Symbol	□	◇	○
Boring	DCP-4	DCP-7	DCP-8
Sample	S-2	S-2	S-2
Depth	5-5.5	2.5-3	3-3.5
% +3"	0	0	0
% Gravel	0.8	7	27
% SAND	46.7	88	41
%C SAND	1.6	3	7
%M SAND	17	53	14
%F SAND	28.1	32	20
% FINES	52.5	5	32
D ₁₀₀ (mm)	9.53	12.7	25.4
D ₆₀ (mm)	0.129	0.625	0.778
D ₃₀ (mm)		0.35	
D ₁₀ (mm)		0.16	
Cc		1.2	
Cu		3.9	

Sieve	Percent Finer Data		
Size/ID #	Sample 1 (□)	Sample 2 (◇)	Sample 3 (○)
6"	100.0	100.0	100
4"	100.0	100.0	100
3"	100.0	100.0	100
1 1/2"	100.0	100.0	100
1"	100.0	100.0	100
3/4"	100.0	100.0	93
1/2"	100.0	100.0	84
3/8"	100.0	97.0	79
#4	99.2	93.0	73
#10	97.6	90.0	66
#20	93.0	77.0	61
#40	80.6	37.0	52
#60	71.0	18.0	43
#100	62.1	9.0	38
#140	57.0	6.0	34
#200	52.5	5.0	32
5μ m			
2μ m			
1μ m			

SYMBOL	w (%)	LL	PL	PI	USCS	AASHTO	USCS DESCRIPTION AND REMARKS	DATE
□	26.6	35	21	14	CL		Brownish gray, Sandy lean clay	04/29/22
◇	31.2				SP-SM		Brownish gray, Poorly graded sand with silt	04/29/22
○	12.5	30	14	16	SC		Brown, Clayey sand with gravel, Insufficient sample size	04/29/22

Langan Engineering	#270060009	Sparrow Pond
TerraSense	#22004132A	

PARTICLE SIZE DISTRIBUTION
ASTM D6913 & ASTM D7928