DEPARTMENT OF ENERGY & ENVIRONMENT

Palisades Recreation Center

Final Report, September 2020

DPR II – Design and Build 4 LID Sites

Contract Number CW712222

Prepared By

Natural Resources Design, Inc.

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1. Executive Summary

Palisades Community Center's **Current Project Area Assessment Report (DOEE DPR II – Design and Build 4 LID Sites)** identifies existing site conditions that could influence the selected Best Management Practice (BMP) designs. There are several factors noted that could have a significant impact upon DOEE's and NRD's proposed BMP designs anticipated for this location.

Major utilities impact both DOEE and NRD's proposed bioretention area located adjacent to the parking lot, including a 78-inch diameter concrete waterline, stormwater piping, and overhead electrical lines. In addition, DDOT has a trolley trail project currently under design that indicates a future paved pathway bisecting this area. As a result, the bioretention basin has been designed to work around the existing utilities without obstructing the proposed trolley trail access.

There is an area of turf at the entrance of the park, between the parking lot and Sherier Pl NW, that was considered for managing stormwater runoff from the road. However, existing soil conditions were not conducive to infiltration and community input strongly recommended against reducing the existing turf area. For these reasons, this alternative has been eliminated from the final design.

An evaluation of the potential benefits of subsoiling/decompaction for the baseball field indicates that the benefits of this approach here may be limited due to heavily compacted subsoils (below the zone of influence for decompaction). Subsoiling/decompaction is not being performed as part of this project.

Overall, the final stormwater BMP design for this site consists of construction of a new bioretention basin to manage the parking lot runoff, along with some minor reconfiguration to improve the drainage to this basin.

2. Project Overview

This site is part of a DC Department of Energy & Environment (DOEE) funded stormwater management & nutrient reduction project that includes four DPR park sites within the District of Columbia.

The Palisades Recreation Center is a 14-acre site located in northwest DC (Figure 1). The site is located at 5200 Sherier Pl NW and is situated between Canal Road NW and MacArthur Blvd NW, with an old trolley trail along the northern boundary of the site.

The park is located in a residential neighborhood of single-family homes and includes basketball courts, a playground and splash park, community center, community garden, soccer field and baseball field (Figure 2). The site is surrounded by a dense wooded area to the southwest.

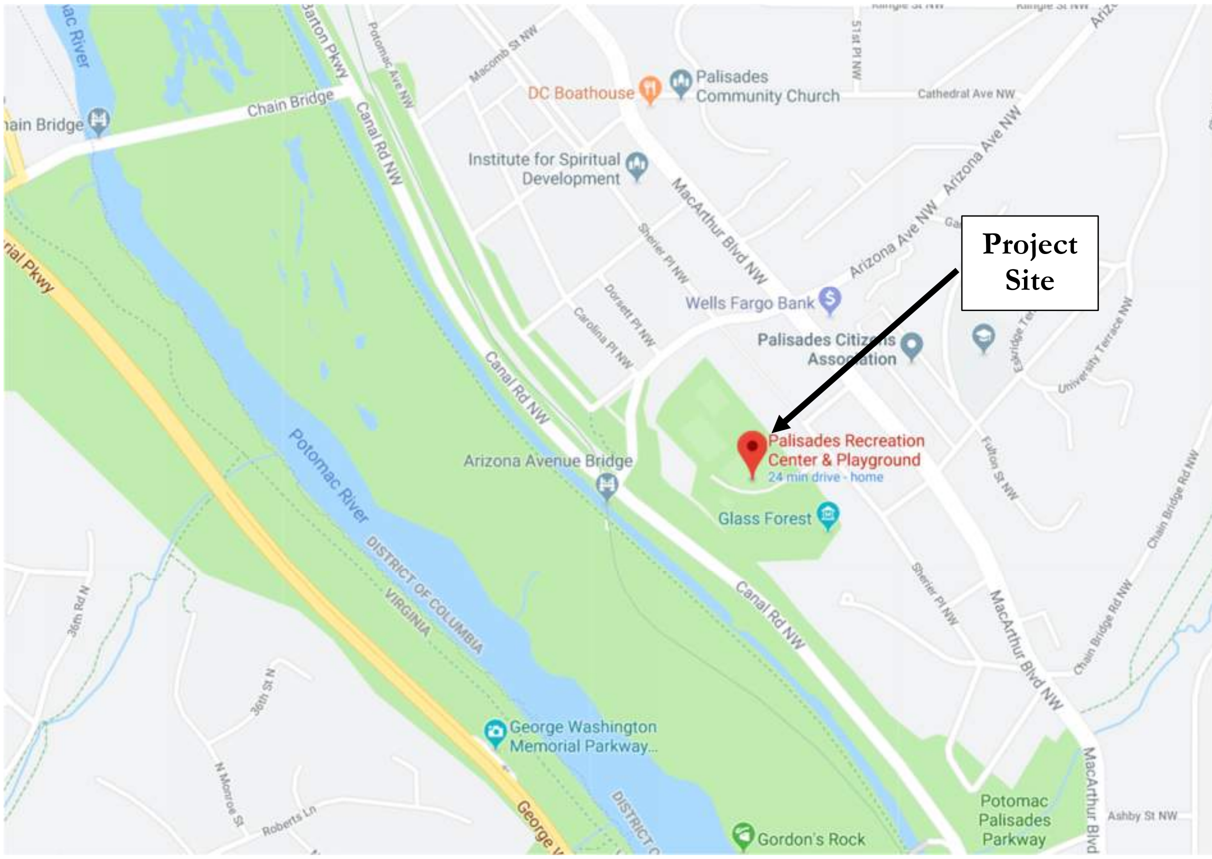


Figure 1 – Vicinity Map (© Google 2019)

Figure 2 – Project Site (outlined in red) as provided in the DPR II RFP

General objectives for this project are to design and construct stormwater improvements to reduce stormwater nutrients and volumes from the impervious areas of this site.

The specific objectives identified in the RFP for this site were as follows:

1. Design and install a bioretention system in the area adjacent to the existing parking lot to capture and treat stormwater runoff prior to releasing it to the adjacent stream, and to mitigate standing water problems in the parking lot.
2. Install a bioretention system upstream of the soccer field to capture drainage to slow and treat runoff that currently impacts the soccer field.
3. Apply subsoiling to the ~1 acre baseball field to reduce soil compaction and increase stormwater infiltration.

During the contract negotiation discussions between DOEE and Natural Resources Design (NRD) for this project, treatment of the area above the soccer field was removed as a project objective. The Department of Parks and Recreation (DPR) has indicated that there is already an active project for the replacement of the soccer field surface that addresses this area.

The purpose of this **Final Design Report** is to summarize existing site information that may impact stormwater design approaches and scope for this property, discuss various alternatives considered, and describe the final stormwater management approaches selected.

3. Existing Site Conditions

The site information included within this assessment is compiled from several sources of information, including:

- Topographic site survey (Appendix A)
- Geotechnical Evaluation (Appendix B)
- GIS data
- Site visits and observations
- Record Drawings

In areas where discrepancies are identified, field data is given preference over general site data or historical documents, with the nature and significance of the discrepancies noted.

3.1 Topographic Survey

A topographic field survey of the anticipated BMP areas was prepared by Sustainable Land Surveys, LLC of Washington, DC. A copy of this survey is included as Appendix A. The survey includes the area from Sherier Place NW to the edge of the existing playground. This incorporates the existing parking lot, access drive and a semi-circular turf entrance area.

3.2 Site Utilities

This area of the site is heavily impacted by existing site utilities, as indicated on the survey (Appendix A). These utilities include:

<u>Stormwater</u>:

The stormwater infrastructure includes a curb inlet on Sherier Place NW and several inlets on the southeast end of the parking lot. The outfall for this system is an existing channel located in the woods behind/below the parking lot. There is an existing bioretention basin located adjacent to the parking lot. The functionality of this basin (which is one of several similar basins on the site) was not evaluated as part of this assessment but is assumed to be limited based on cursory site observations.

<u>Water</u>:

There is a water service line to the park that runs under the entry road and northern edge of the parking lot. This line does not create any potential conflict with proposed site improvements. There is also a very large (78-inch diameter) prestressed concrete pipe water line that runs under the parking lot, roughly aligned with the abandoned trolley trail. This line presents a significant limitation to construction in the area adjacent to the parking lot.

<u>Electric</u>:

Electric service to the site is provided via overhead lines located along the northern side of the entry road and parking lot. There are also overhead power lines running along the southern edge of the trolley trail area. Buried power lines run to the parking lot lighting poles.

<u>Gas</u>:

Gas service to the site is run along the northern side of the entry road and parking lot to the Community Center.

3.3 Future Site Development

The District Department of Transportation (DDOT) is currently developing plans for a paved trail system through the project site. This will consist of a paved or compacted stone trail that approximately follows along the trolley trail alignment.

3.4 Soil & Vegetation Conditions

Soil Mapping:

Based upon the USDA Websoil Survey (included as part of the geotechnical evaluation report in Appendix B), soils across the site consist of an urban land variant of the Glenelg series soil. Where undisturbed, the original base soil is a well-drained loam with good infiltration characteristics.

Geotechnical Evaluation:

A field evaluation of existing soil conditions within the existing bioretention basin and across the baseball field was performed by Natural Resources Design on July 11th and July 17th, 2019. This report is included as Appendix B.

A soil boring was performed within the semi-circular turf area along Sherier Place NW, in consideration of a potential bioretention basin within this area. This area was determined to be an old building demolition site with unconsolidated fill (riprap). The report recommends confirmation of this condition with a test pit to determine the depth and extent of the unconsolidated fill.

An evaluation of the degree of compaction across the baseball field area was performed to a depth of 24" in consideration of possible subsoiling/decompaction methods in this area. This evaluation concluded that subsoil compaction conditions across the field were very high, and that decompacting surface soils will provide little benefit or runoff reduction.

Soil Erosion:

There were no significant areas of soil erosion noted within the project area.

Existing Vegetation:

Vegetation at this site consists primarily of managed turf in good condition.

4. Existing Stormwater Management

Stormwater management within the project area includes capture of runoff from Sherier Place NW by the existing curb inlet located in front of the semi-circle, and capture of parking lot runoff by a series of drop inlets in and adjacent to the parking lot area.

The curb inlet has a Contributing Drainage Area (CDA) of approximately 3,500 sf of impervious surface and 500 sf of managed turf surface.

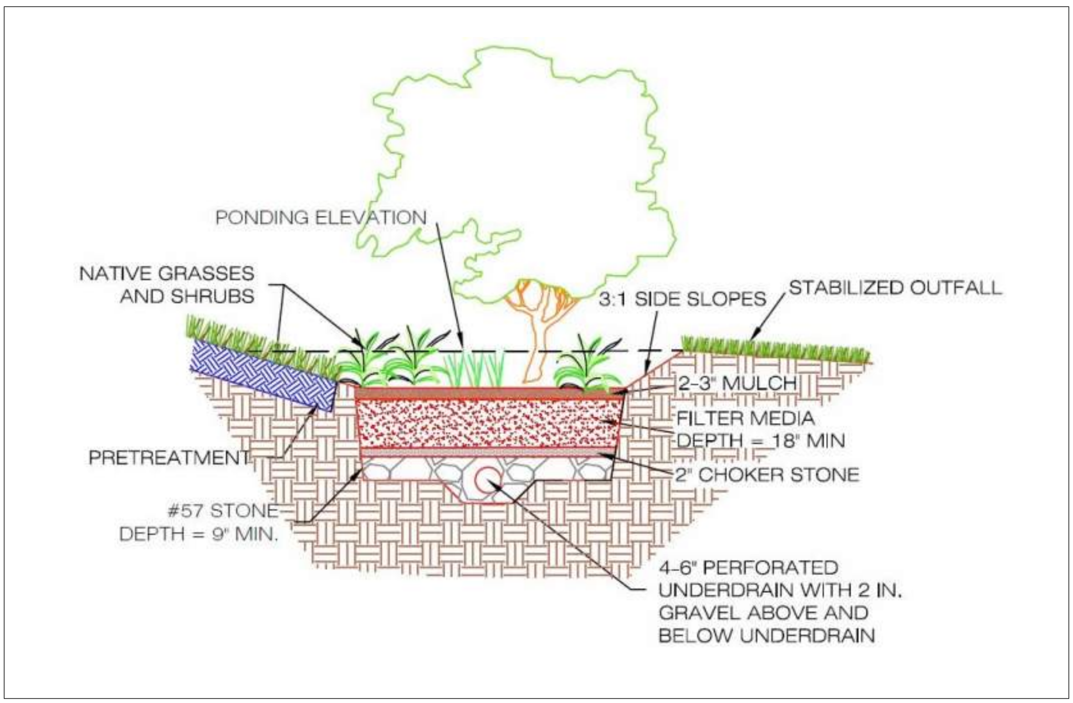
The CDA for the existing storm drain inlet at the end of the parking lot (structure 3 on the survey) is approximately 17,500 sf impervious, 6,700 sf turf. The CDA for the inlet along the southern curb of the parking lot is approximately 3,200 sf impervious. This portion of the drainage area could be added to the overall parking CDA by removing the existing drop inlet along the curb.

5. Stormwater Management Opportunities

In general, the purpose of Best Management Practices (BMPs) used to manage stormwater is to reduce pollutants and runoff volumes before the stormwater flows off the site. Of the various BMPs available to achieve these goals, bioretention is the BMP best suited to provide stormwater management for this site. This practice is described as follows (excerpted from the DOEE 2020 Stormwater Guidebook):

Definition. *Practices that capture and store stormwater runoff and pass it through a filter bed of engineered filter media composed of sand, soil, and organic matter. Filtered runoff may be collected and returned to the conveyance system or allowed to infiltrate into the soil.*

Bioretention systems are typically not designed to provide stormwater detention of larger storms (e.g., 2-year, 15-year), but they may be in some circumstances. Bioretention practices shall generally be combined with a separate facility to provide those controls.



Example of standard bioretention design.

The specific opportunities identified for consideration at the Palisades site include:

Bioretention Basin at Entrance – A small bioretention basin was considered for construction in the semi-circular turf area by the park entrance. The small CDA for this site would allow for capture of the maximum design storm (1.7 inch). Stormwater flow to this basin would be provided by a scupper-style curb inlet located just upstream of the existing inlet in the street. This system would be designed to bypass larger storms to the existing drainage infrastructure. Concerns were raised during the public review of this option that use of this area for bioretention would adversely impact current usage of this turf area. These concerns, coupled with a high cost-per-area-treated resulted in elimination of this alternative from the final design.

Bioretention Basin by Parking Lot – Construction of this BMP to capture and treat the runoff from the parking lot area has been selected as the basis for the final design and construction at this site. Portions of the existing stormwater infrastructure will be used as part of this system. Due to tight site constraints, the lower portion of the basin will be wrapped with a low section of retaining wall.

Baseball Field Subsoiling – Subsoiling/decompacting of the existing outfield area was considered to reduce the runoff from this large area of managed turf. Based upon the geotechnical evaluation, which indicated heavily compacted fill soils, the potential benefits of this practice at the Palisades site were expected to be minimal, and this alternative was eliminated from final design.

<u>Stormwater Quality Volumes</u>:

Based upon the site survey and proposed site improvements, NRD has delineated the anticipated drainage area to the proposed bioretention basin to calculate the required Stormwater Retention Volume (SWRv).

The required SWRv for the proposed BMP was calculated in accordance with the DOEE Stormwater Management Guidebook (July 2013). Based upon the project location, this proposed retrofit project uses a 1.2-inch design storm for calculating the SWRv, using Equation 2.1 from the guidebook. Table 1 below shows the drainage area characteristics and SWRv.

Table 1: SWRv Calculations

		Contributing Drainage Area (CDA)					Stormwater Retention Volume
		Paved	Compacted	Natural	Total	P	(SWRv)
CDA	Description	sf	sf	sf	sf	in	cf
1	Bioretention Basin – Parking Lot Area	20,700	6,700	0	27,400	1.2	2,134

6. Maintenance Requirements

As with any landscape-intensive site area, bioretention basins require regular maintenance to provide effective ongoing stormwater treatment while providing an aesthetically pleasing site impact.

Maintenance of bioretention areas should be integrated into routine landscape maintenance tasks. If landscaping contractors will be expected to perform maintenance, their contracts should contain specifics on unique bioretention landscaping needs, such as maintaining elevation differences needed for ponding, proper mulching, sediment and trash removal, and limited use of fertilizers and pesticides. A summary of common maintenance tasks and their frequency is provided in the following table:

Maintenance Tasks for Palisades Bioretention Basin

Frequency	Maintenance Tasks
Upon establishment	▪ For the first 6 months following construction, the practice and CDA should be inspected at least twice after storm events that exceed 0.5 inch of rainfall. Conduct any needed repairs or stabilization. ▪ Inspectors should look for bare or eroding areas in the CDA or around the bioretention area and make sure they are immediately stabilized with grass cover. ▪ One-time, spot fertilization may be needed for initial plantings. ▪ Watering is needed once a week during the first 2 months, and then as needed during first growing season (April through October), depending on rainfall. ▪ Remove and replace dead plants. Up to 10% of the plant stock may die off in the first year, so construction contracts should include a care and replacement warranty to ensure that vegetation is properly established and survives during the first growing season following construction.
At least 4 times per year	▪ Check inlet structure for accumulated grit, leaves, and debris that may block inflow. Remove these materials and dispose of as solid waste.
Twice during growing season	▪ Spot weed, remove trash, and rake the mulch
Annually	▪ Conduct a maintenance inspection ▪ Supplement mulch in devoid areas to maintain a 3-inch layer ▪ Prune trees and shrubs ▪ Remove sediment at inflow area
Once every 2–3 years	▪ Remove and replace the mulch layer if necessary. (Note that mulch replacement/replenishment is not necessary if the basin surface is fully vegetated)
As needed	▪ Add reinforcement planting to maintain desired vegetation density ▪ Remove invasive plants using recommended control methods ▪ Remove any dead or diseased plants ▪ Stabilize the CDA to prevent erosion

Standing water is the most common problem outside of routine maintenance. If water remains on the surface for more than 72 hours after a storm, adjustments to the grading may be needed or underdrain repairs may be needed. The surface of the filter bed should also be checked for accumulated sediment or a fine crust that builds up after the first several storm events. There are several methods that can be used to rehabilitate the filter. These are listed below, starting with the simplest approach and ranging to more involved procedures (i.e., if the simpler actions do not solve the problem):

- Open the underdrain observation well or cleanout and pour in water to verify that the underdrains are functioning and not clogged or otherwise in need of repair. The purpose of this check is to see if there is standing water all the way down through the soil. If there is standing water on top, but not in the underdrain, then there is a clogged soil layer. If the underdrain and stand pipe indicates standing water, then the underdrain must be clogged and will need to be cleaned out.
- Remove accumulated sediment and till 2 to 3 inches of sand into the upper 6 to 12 inches of soil.
- Install sand wicks from 3 inches below the surface to the underdrain layer. This reduces the average concentration of fines in the media bed and promotes quicker drawdown times. Sand wicks can be installed by excavating or auguring (i.e., using a tree auger or similar tool) down to the top of the underdrain layer to create vertical columns that are then filled with a clean open-graded coarse sand material (e.g., ASTM C-33, Standard Specification for Concrete Aggregates, concrete sand or similar approved sand mix for bioretention media). A sufficient number of wick drains of sufficient dimension should be installed to meet the design dewatering time for the facility.
- Remove and replace some or all of the filter media.

Maintenance Inspections. It is recommended that a qualified professional conduct a spring maintenance inspection and cleanup at the bioretention area. Maintenance inspections should include information about the inlets, the actual bioretention facility (sediment buildup, outlet conditions, etc.), and the state of vegetation (water stressed, dead, etc.) and are intended to highlight any issues that need or may need attention to maintain stormwater management functionality.

DOEE's maintenance inspection checklists for bioretention areas and the Maintenance Service Completion Inspection form can be found in Appendix M - Maintenance Inspection Checklists of the January 2020 Stormwater Guidebook.

7. Conclusions

Development of a suitable BMP at the Palisades Recreation Center site was significantly impacted by the existing soil conditions at the site, as well as the community usage and concerns. The resulting BMP to be constructed at the site will provide stormwater treatment for the paved parking lot area without hampering access to the trolley trail or adversely impacting existing activity spaces.

8. BMP Scorecard

	CDA (sf)				SWRv	Volume	Runoff Depth Captured	Pollutant Removal Rates		
BMP Description	Impervious	Turf	BMP	Total	Required (cf)	Provided (cf)	per Imperv Acre	P	N	TSS
BMP-1 Standard Bioretention Basin	8,280	4,360	550	13,190	950	950	1.3	74%	63%	79%

9. Appendices

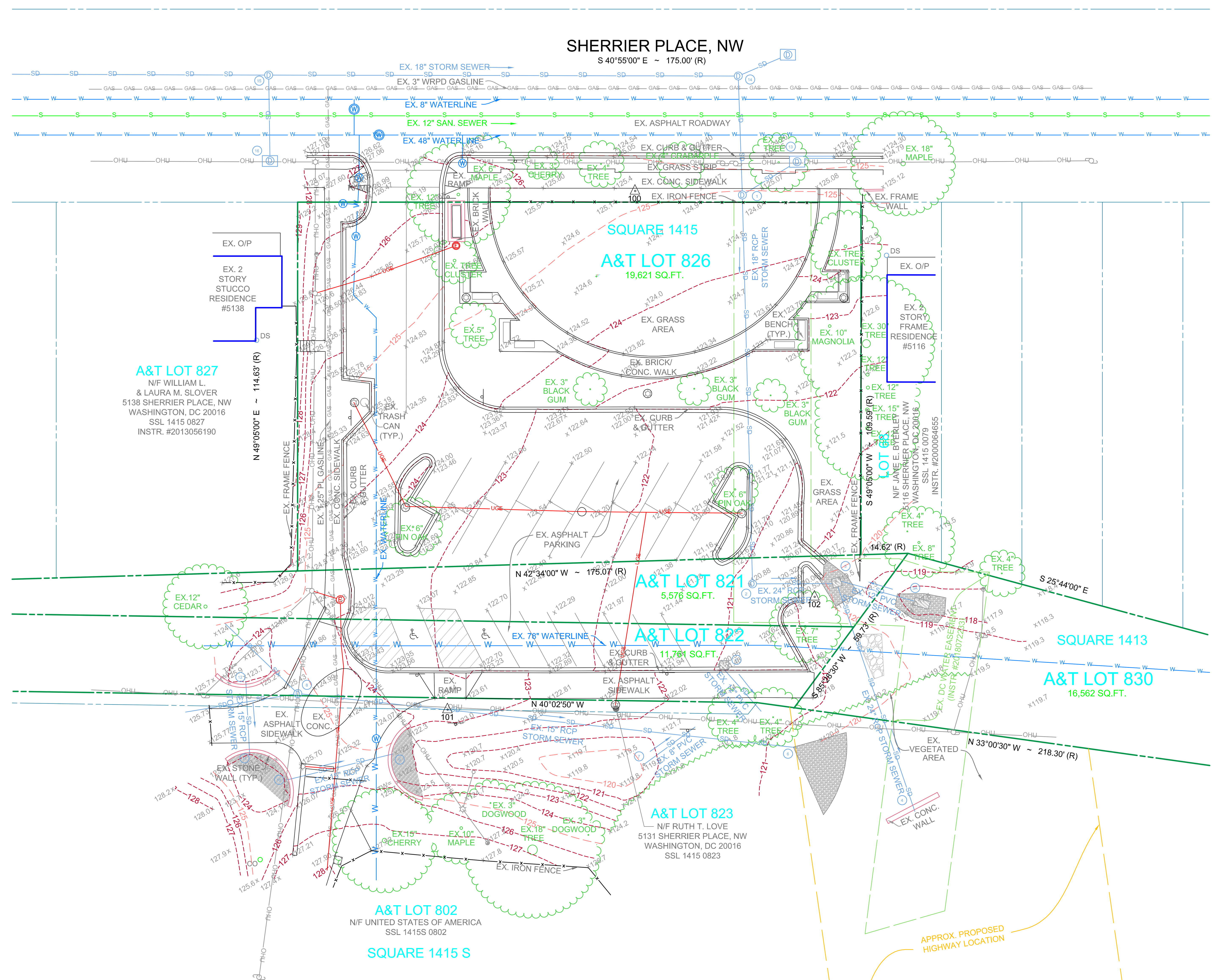
Appendix A: Survey

(See insert on following page)

NOTES:

1. OWNER: UNITED STATES OF AMERICA (LOT 826, SQUARE 1415)
DISTRICT OF COLUMBIA (LOTS 821 & 822, SQUARE 1415 & LOT 830, SQUARE 1413)

2. SSL #: 1415 0821, 1415 0822, 1415 0826 & 1413 0830 3. ZONE: R-1-B
4. NO TITLE REPORT FURNISHED, THUS EASEMENTS AND OTHER RESTRICTIONS ON TITLE MAY NOT BE SHOWN HEREON.
5. THE PROPERTY SHOWN HEREON IS SUBJECT TO RESTRICTIONS AND EASEMENTS OF RECORD.
6. ANY UNDERGROUND UTILITY LOCATIONS SHOWN HEREON ARE TAKEN FROM AVAILABLE RECORDS AND ARE APPROXIMATE. MISS UTILITY MUST BE NOTIFIED PRIOR TO COMMENCEMENT OF ANY EXCAVATION ACTIVITY AND A THIRD-PARTY UTILITY MARKOUT AND/OR TEST HOLES MAY BE REQUIRED TO ASCERTAIN ACCURATE LOCATIONS/DEPTHS.
7. THE PROPERTY SHOWN HEREON IS LOCATED IN FLOOD ZONE "X" (AREAS OF MINIMAL FLOOD HAZARD) PER FIRM MAP PANEL 1100010011C, REVISED 9/27/2010.
8. TOPOGRAPHIC SURVEY WAS FIELD RUN BY THIS FIRM. VERTICAL DATUM = NAVD '88 PER FIELD GPS STATIC DATA POST-PROCESSED THROUGH NGS OPUS PROGRAM. BEARINGS ARE REFERENCED TO DISTRICT OF COLUMBIA NORTH, AND COORDINATES ARE REFERENCED TO MARYLAND STATE PLANE (MSP) 1983 PER GPS STATIC DATA ALSO POST-PROCESSED THROUGH NGS OPUS PROGRAM.
9. RECORD LOT AREA = 53,520 SQUARE FEET OR 1.2287 ACRES.
10. TREE SPECIES/SIZES ARE APPROXIMATE AND A THIRD-PARTY ARBORIST REPORT MAY BE REQUIRED TO OBTAIN ACCURATE TREE DATA.



STORM TABLE

1	EX. STORM MH TOP = 124.84 INV.IN = 120.04 Fr. 13 INV.IN=116.14 Fr. 14 INV.OUT = 116.14 To 2
2	EX. STORM MH TOP = 120.88 INV.IN=114.88 Fr. 1 INV.OUT = 114.53 To 3
3	EX. STORM GRATE TOP = 119.53 INV.IN=112.33 Fr. 2 INV.IN=111.53 Fr. 3A INV.OUT = 109.23 To 4
3A	EX. STORM GRATE TOP = 117.48 INV.OUT = 112.48 To 3
4	EX. ENDWALL INV.OUT = 104.52
5	EX. STORM GRATE TOP = 120.93 INV.OUT = 118.03 To SOUTH
6	EX. ENDWALL INV.OUT = 116.99
7	EX. RISER GRATE TOP = 120.79 INV.OUT = 119.09 To EAST
8	EX. STORM MH TOP = 125.55 INV.IN=121.00 Fr. NW INV.IN=121.00 Fr. NORTH INV.OUT = 120.95 To 6
9	EX. ENDWALL INV.OUT = 122.52
10	EX. HEADWALL INV.OUT = 123.23
11	EX. ENDWALL INV.OUT = 123.30
12	EX. HEADWALL INV.OUT = 123.70
13	EX. CURB INLET TOP = 124.88 FLOOR =119.48 (PIPES NOT VISIBLE)
14	EX. STORM MH TOP = 124.71 INV.IN=116.81 Fr. 15 INV.OUT = 116.81 To 1
15	EX. STORM MH TOP = 128.12 INV.IN=121.72 Fr. 16 INV.IN=119.62 Fr. NW INV.OUT = 119.52 To 14
16	EX. CURB INLET TOP = 128.29 FLOOR =123.59 (PIPES NOT VISIBLE)

SEWER TABLE

A	EX. SAN. MH TOP = 127.70 INV.IN = 118.10 Fr. B INV.OUT = 118.00 To SE
B	EX. SAN. MH TOP = 133.46 INV.OUT = 122.66 To A

CITY NORTH

KEY

CONC.	CONCRETE
EX.	EXISTING
O/P	OPEN PORCH
PVC	POLYVINYL CHLORIDE PIPE
RCP	REINFORCED CONCRETE PIPE
SQ.FT.	SQUARE FEET
TYP.	TYPICAL
	SIGN POST
	LIGHT POLE
	UTILITY POLE
	GUY WIRE
	ELECTRIC METER
	ELECTRIC MANHOLE
	SANITARY MAN HOLE
CO	CLEAN OUT
	STORM MANHOLE
DS	DOWNSPOUT
	FIRE HYDRANT
	WATER MANHOLE
	WATER METER

DC BOUNDARY NOTE

THIS IS NOT A BOUNDARY SURVEY AND SHOULD NOT BE USED FOR CONSTRUCTION LAYOUT OR FOR PROPERTY LINE DETERMINATION/STAKING.

BOUNDARY INFORMATION SHOWN HEREON WAS OBTAINED FROM THE DISTRICT OF COLUMBIA SURVEYOR'S OFFICE. PROPERTY LINE DIMENSIONS FROM OFFICIAL RECORDS (R) MAY NOT NECESSARILY AGREE WITH ACTUAL MEASURED (M) DIMENSIONS, AND A "SURVEY TO MARK" PREPARED BY A DISTRICT OF COLUMBIA REGISTERED LAND SURVEYOR AND VERIFIED BY THE OFFICE OF THE SURVEYOR MAY BE REQUIRED TO ESTABLISH THE FINAL BOUNDARY LOCATION OF THIS PROPERTY.

RECORD BOUNDARY DATA FOR RECORD LOTS IS TAKEN FROM RECORDED SUBDIVISION PLATS. RECORD BOUNDARY DATA FOR ASSESSMENT & TAXATION (A&T) LOTS IS TAKEN FROM OFFICE OF TAXATION AND REVENUE RECORDS.

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 20 ft.

DISTRICT OF COLUMBIA
TIMOTHY GREENWOOD
LS907754
6/24/2019
LICENSED LAND SURVEYOR

PLAT SHOWING
TOPOGRAPHIC SURVEY
ON A PORTION OF
PALISADES RECREATION CENTER
(COUNTY BOOK 8, PAGE 19
& INSTRUMENT #2018072233)
DISTRICT OF COLUMBIA
JUNE 24th, 2019 JOB #: 19-044 PALISADES
SCALE: 1"=20' SHEET : 1 OF 1

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Appendix B: Geotechnical Report

(See insert on following page)

Report of
Subsurface Exploration, Soil Testing, and
Geotechnical Engineering Evaluation

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5200 Sherier Place NW
Washington DC

Natural
Resources
Design
an ecologically focused design firm
Washington DC

DISTRICT OF COLUMBIA
CHRISTOPHER E. SONNE
PE906009
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PROFESSIONAL ENGINEER

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July 19, 2019

Amended November 14, 2019

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Websoil Survey

1.0 INTRODUCTION

1.1 Project Information

This site is part of a DC Department of Energy & Environment (DOEE) funded stormwater management & nutrient reduction project that includes four park sites within the District of Columbia. The Palisades Recreation Center consists of tennis and basketball courts, a playground and splash park, community center, community garden, a baseball field and a soccer field. Project objectives are to design and construct stormwater improvements to reduce stormwater nutrients and volumes from the impervious areas of this site. The purpose of this geotechnical evaluation is to provide site soils information for use as part of the Best Management Practice (BMP) stormwater design process.

1.2 Scope of Services

The purposes of our involvement on this project were as follows: 1) provide general descriptions of the subsurface soil conditions encountered at the boring location, 2) identify subsurface water levels (if any), and 3) provide geotechnical parameters and recommendations for stormwater infiltration and general construction. To accomplish the above objectives, we undertook the following scope of services:

1) Visited the site to observe existing surface conditions and features;
2) Coordinated with Miss Utility services for utility clearance;
3) Reviewed readily available geologic and subsurface information relative to the project site;
4) Executed a geotechnical subsurface exploration program consisting of two (2) hand-augered borings drilled to the depths indicated in the Boring Logs shown in Appendix B.
5) Performed field testing on recovered soil samples to ascertain characteristic soil properties;

6) Prepared this written report summarizing our geotechnical engineering work on the project, providing descriptions of the subsurface conditions encountered, and discussing geotechnical related aspects of the proposed construction.

Our geotechnical scope of services did not include foundation or pavement design or recommendations, a survey of boring locations and elevations, quantity estimates, preparation of plans or specifications, or the identification and evaluation of wetland and/or other environmental aspects of the project site.

2.0 SUBSURFACE EXPLORATION PROCEDURES

Our geotechnical subsurface exploration program consisted of two (2) test borings designated B-1 and B-2, as well as a surface compaction evaluation at the existing baseball field area.

The exploration was performed on July 11th and July 17th, 2019 at the approximate locations shown on the attached Boring Location Plan (Appendix B). In consideration of the methods used in their determination, the boring locations shown on the attached Boring Location Plan should be considered approximate. The test borings were performed using a hand auger with a 3-1/4" diameter chuck. A vacuum auger with a 6" chuck was also used for boring B-1.

Boring B-1, located in semi-circular turf area between Sherier Place NW and the parking lot, was advanced through the soil overburden to a depth of 32 inches below the existing site grade. Large gravel was encountered at 4 inches deep. This transitioned to large (8 inches) riprap at 32 inches, at which point the boring was terminated. Voids and unconsolidated soils were observed between the riprap, indicating this area was filled. Discussions with local resident indicated this is the past site of a single family residence which was razed when the park was first developed. No indications of seasonally high groundwater were observed.

Boring B-2 was performed in the outfield of the baseball field at the approximate location indicated on the boring map. This boring was performed as part of the surface compaction evaluation for the field (to determine the suitability of subsoiling/decompaction practices).

Boring B-3 was initiated at the proposed bioretention basin adjacent to the parking area. This boring was advanced to a depth of 22 inches prior to termination due to cobbles. Construction debris was noted in this boring. Further investigation indicated that the entire area would be part of the backfill for the 78-inch diameter water line that runs under this area. This boring was abandoned and backfilled without further investigation.

Upon completion of the field testing, all boreholes were backfilled.

Representative soil samples were visually classified on the basis of texture and plasticity in general accordance with the Unified Soil Classification System (USCS) (ASTM D2487) and/or the Visual-Manual Procedure (ASTM D 2488). The group symbol for each soil type, based on the USCS, is indicated in the parentheses following the soil description on the boring logs. The engineer grouped the various soil types into zones noted on the boring log. The stratification lines designating the interfaces between earth materials on the boring log are approximate; in situ, the transitions may be gradual. Copies of our boring logs (soil profiles) are provided in Appendix B.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Description

The site areas investigated all consist of highly manipulated fill material (old home site, cut/fill sports field, and water main backfill). All three sites are covered with turf. Borings B-1 and B-2 are located on flat area (slopes less than 2%). The slope at abandoned boring B-3 is approximately 5%.

3.2 Regional Geology

Based upon the USGS soils mapping for the project site, the underlying site soil in the areas of exploration is as follows:

Glenelg variant-Urban land complex – This soil complex consists of 40% urban soils, 40% Glenelg and similar soils, and 20% minor component soils. The Glenelg component consists of moderately well drained loams with moderately high to high Ksat values (0.20 – 1.98 inches/hour). Hydrologic Soil Group B/D. Typical groundwater depths present at 6 to 36 inches.

The Websoil Survey report for the project area is attached as Appendix C.

3.2.1 General

The subsurface conditions discussed in the following paragraphs and those shown on the attached boring logs represent an estimate of the subsurface conditions based on interpretation of the boring data using normally accepted geotechnical engineering judgments. Transitions between different soil strata are usually less distinct than those shown on the boring logs. Sometimes the relatively small sample obtained in the field is insufficient to definitely describe the origin of the subsurface material. In these cases, we qualify our origin descriptions with “possible” before the word describing the material’s origin (i.e. possible fill, possible residuum, etc.). Although individual test borings are representative of the subsurface conditions at the boring locations on the dates shown, they are not necessarily indicative of subsurface conditions at other locations or at other times. Data from the specific test borings are shown on the attached boring logs in Appendix B.

3.2.2 Fill/Possible Fill Soils

Fill/Possible Fill may be any material that has been transported and deposited by man. Materials described as fill/possible fill were encountered at B-1 and B-2. The fill materials at B-1 consist of riprap with voids and unconsolidated soils. The fill materials at B-2 appeared to be well consolidated and stable.

4.0 SOILS INFILTRATION

4.1 Methodology

Due to the unconsolidated fill materials encountered at boring B-1, no infiltration testing was performed at this location. If further investigation, such as a test pit at this location indicates consolidated soil conditions below this riprap fill, infiltration testing could be performed on the underlying subsoils.

5.0 SUBSOILING EVALUATION

5.1 Methodology

Part of the project scope at this site is the evaluation of soil subsoiling/decompaction to improve the stormwater function (reduce runoff) of the existing baseball outfield area (turf). The approach taken to evaluate the potential benefits of subsoiling at this site was as follows:

A boring (B-2) was performed in the central area of the field to evaluate the existing degree of soil compaction from the surface down to a total depth of 22 inches. Compaction was measured using manual penetrometer (Dickey-John Soil Compaction Tester), calibrated to read soil compaction in lbs/sq. inch (PSI) up to 400 psi. Soils with compaction levels greater than 200 psi are considered compacted and soils with compaction levels greater than 300 psi are considered severely compacted.

The compaction levels encountered within the boring were consistently at or above 300 psi through the entire soil boring depth. Soil moisture levels during testing were good, and the existing turf was well established and healthy.

The soils across the field were then mapped out on a 20-foot grid to evaluate the consistence of compaction across the field. Compaction of the upper 4″ to 6″ layer of soil was compared to soils in the lower 6″ to 18″. This comparison was made to determine if decompaction of the surface soils is likely to allow surface waters to penetrated into a less compacted subsoil. The results of this evaluation, which involved a total of 136 test points, were as follows:

- Surface Compaction between 200 psi and 300 psi: 29%
- Subsurface Compaction between 200 psi and 300 psi: 4%
- Surface Compaction above 400 psi (no penetration): 7%

The remainder of the tests results indicated compaction values between 300 and 400 psi (highly compacted).

5.0 RECOMMENDATIONS

Based upon the observed site conditions at boring location B-1, any infiltration-based practices in this area would require a synthetic liner due to the unconsolidated fill conditions. This recommendation could be altered if a test pit indicates more suitable conditions exist at a reasonable depth below the fill area.

Subsoiling/decompaction of the baseball field area may provide some benefits and stormwater reductions, but the extent of these improvements is difficult to determine due to the highly compacted subsurface conditions. There does not appear to be compacted surface conditions that are acting as a restrictive soil layer.

6.0 LIMITATIONS

This report has been prepared in accordance with generally accepted engineering practices. No other warranty, express or implied, is made. Our findings and considerations are based on site observations. The findings and considerations do not reflect variations in subsurface conditions which could exist intermediate of the boring locations or in unexplored areas of the site. Should such variations become apparent during construction, it will be necessary to re-evaluate our recommendations based upon on-site observations of the conditions.

Regardless of the thoroughness of a subsurface exploration, there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. Therefore, experienced geotechnical engineers should evaluate earthwork and any pavement construction to verify that the conditions anticipated in design actually exist. Otherwise, we assume no responsibility for construction compliance with the design concepts, specifications, or recommendations.

APPENDIX A

FIGURE 1 – VICINITY MAP

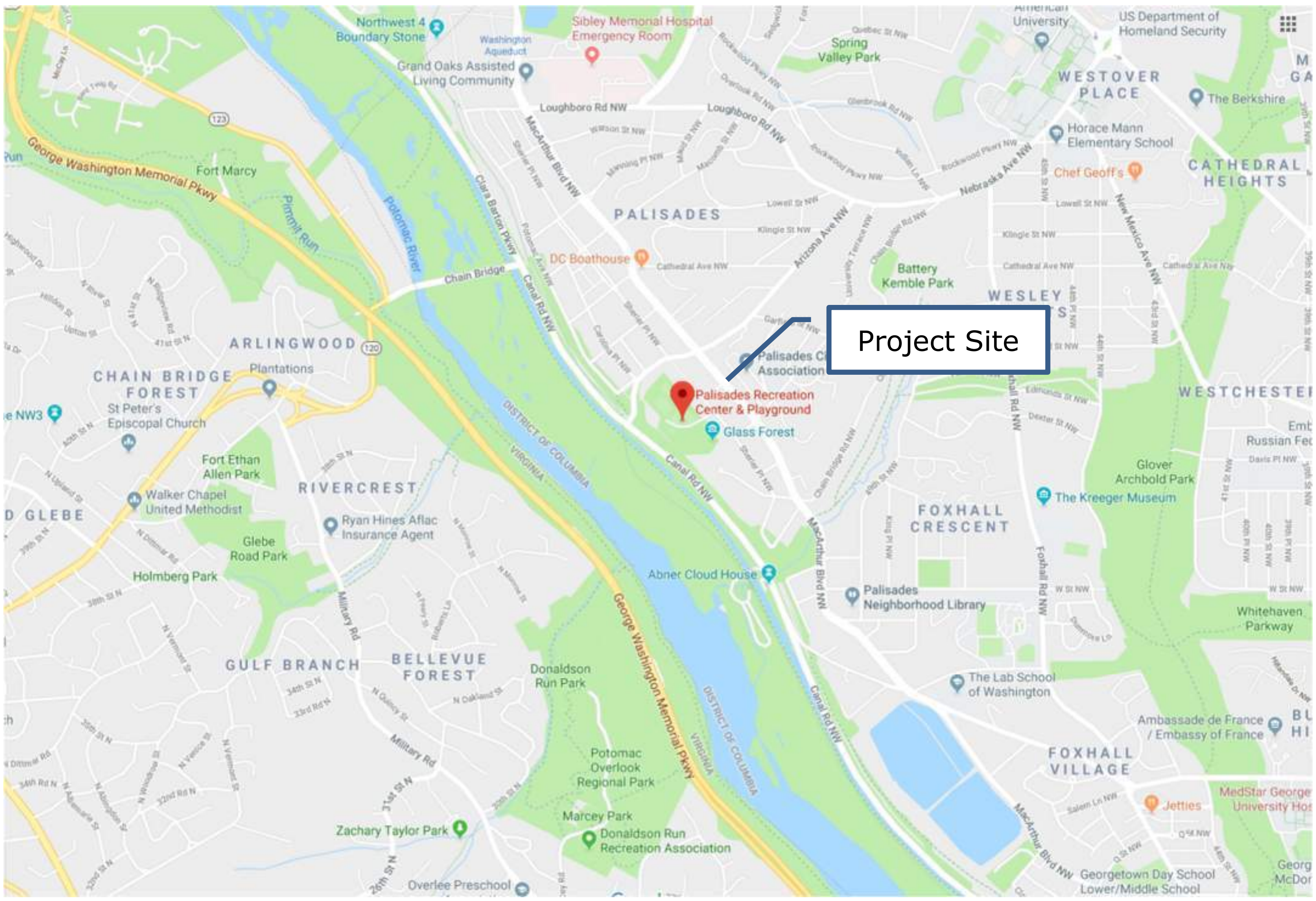


Figure 1 - Vicinity Map **2019©Google**

APPENDIX B

SOILS BORING MAP

Figure 2 – Soil Boring Locations

APPENDIX C

WEBSOIL SURVEY REPORT

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

District of Columbia

July 9, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

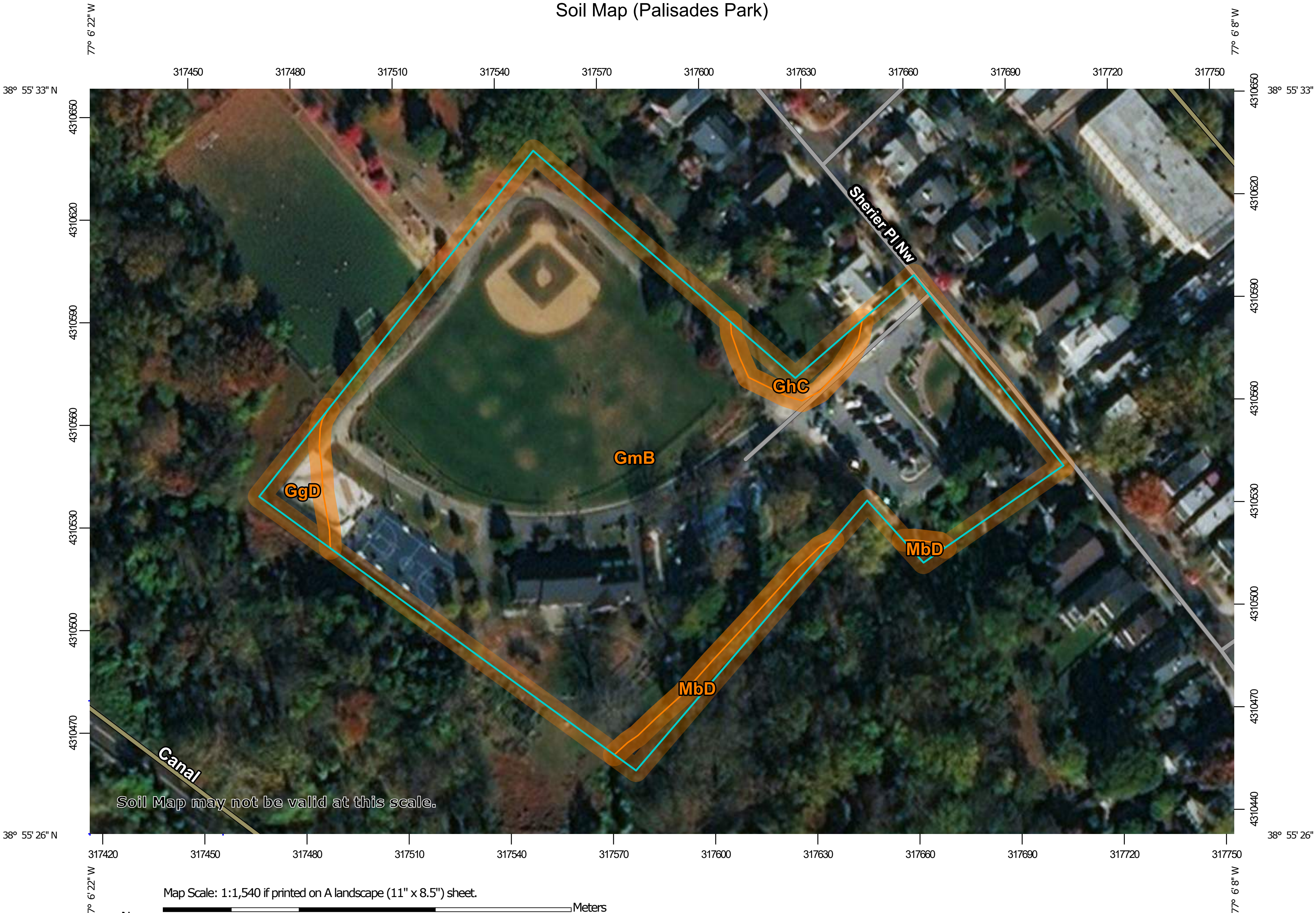
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

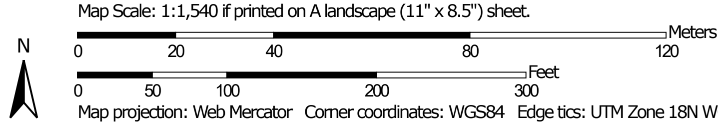
Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map (Palisades Park)



Map Scale: 1:1,540 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: District of Columbia
Survey Area Data: Version 12, Sep 10, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 3, 2015—Feb 22, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend (Palisades Park)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
GgD	Glenelg loam, 15 to 25 percent slopes	0.1	1.8%
GhC	Glenelg-Urban land complex, 8 to 15 percent slopes	0.1	1.6%
GmB	Glenelg variant-Urban land complex, 0 to 8 percent slopes	4.7	94.7%
MbD	Manor loam, 15 to 40 percent slopes	0.1	1.9%
Totals for Area of Interest		**5.0**	**100.0%**

Map Unit Descriptions (Palisades Park)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

District of Columbia

GgD—Glenelg loam, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 2w06c
Elevation: 300 to 690 feet
Mean annual precipitation: 40 to 55 inches
Mean annual air temperature: 43 to 57 degrees F
Frost-free period: 150 to 192 days
Farmland classification: Not prime farmland

Map Unit Composition

Glenelg and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Glenelg

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from mica schist

Typical profile

Ap1 - 0 to 6 inches: loam
Ap2 - 6 to 10 inches: clay loam
Bt1 - 10 to 18 inches: clay loam
Bt2 - 18 to 25 inches: clay loam
Bt3 - 25 to 30 inches: clay loam
BCt - 30 to 42 inches: loam
CBt - 42 to 54 inches: loam
C - 54 to 76 inches: channery fine sandy loam

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Gaila

Percent of map unit: 10 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Manor

Percent of map unit: 10 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

GhC—Glenelg-Urban land complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 49tp
Elevation: 250 to 1,050 feet
Mean annual precipitation: 35 to 55 inches
Mean annual air temperature: 48 to 57 degrees F
Frost-free period: 110 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Glenelg and similar soils: 40 percent
Urban land: 40 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Glenelg

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Nose slope, interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy residuum weathered from phyllite

Typical profile

Ap - 0 to 10 inches: loam
Bt1,Bt2,BCt1 - 10 to 30 inches: clay loam
BCt2, CBt - 30 to 54 inches: loam

C - 54 to 76 inches: very channery sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Urban Land

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 10 inches to
Runoff class: Very high

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Minor Components

Unnamed soils

Percent of map unit: 10 percent
Hydric soil rating: No

Manor

Percent of map unit: 5 percent
Hydric soil rating: No

Brandywine

Percent of map unit: 5 percent
Hydric soil rating: No

GmB—Glenelg variant-Urban land complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 49ts
Elevation: 200 to 2,000 feet

Mean annual precipitation: 35 to 55 inches
Mean annual air temperature: 45 to 61 degrees F
Frost-free period: 110 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 40 percent
Glenelg and similar soils: 40 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 10 inches to
Runoff class: Very high

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Description of Glenelg

Typical profile

Ap - 0 to 10 inches: silt loam
Bt1,Bt2,BCt1 - 10 to 30 inches: clay loam
BCt2, CBt - 30 to 54 inches: loam
C - 54 to 76 inches: very channery sandy loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 60 to 99 inches to
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: About 6 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B/D
Hydric soil rating: No

Minor Components

Unnamed soils

Percent of map unit: 10 percent
Hydric soil rating: No

Brandywine

Percent of map unit: 5 percent
Hydric soil rating: No

Glenelg

Percent of map unit: 5 percent
Hydric soil rating: No

MbD—Manor loam, 15 to 40 percent slopes

Map Unit Setting

National map unit symbol: 49v9
Elevation: 250 to 1,000 feet
Mean annual precipitation: 35 to 50 inches
Mean annual air temperature: 48 to 57 degrees F
Frost-free period: 150 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Manor and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Manor

Typical profile

A1, A2 - 0 to 6 inches: loam
Bw1, Bw2 - 6 to 22 inches: sandy loam
C1,C2,C3,C4 - 22 to 72 inches: channery sandy loam

Properties and qualities

Slope: 15 to 40 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Hydric soil rating: No

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