Hydrologic & Hydraulic Analysis for the Takoma park Public Library

TAKOMA PARK , MD

PRELIMINARY REPORT
August 2018

Prepared for:
The City of Takoma Park
Montgomery County, MD

And

ADTEK Engineers

And
Department of Permitting Services
Montgomery County, MD

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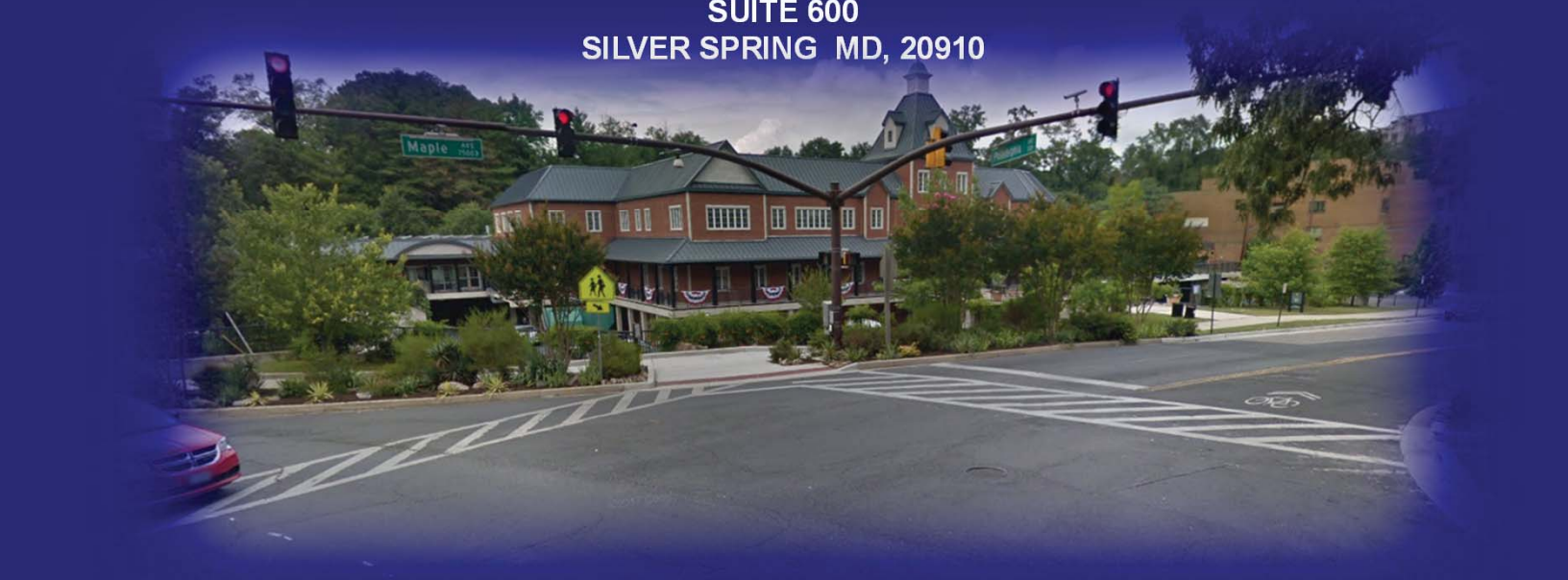

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Section 1. INTRODUCTION

It is our understanding that this project is to perform a flood plain study in support of a building addition at the Takoma Park Library. The proposed additions will be situated within the currently approved floodplain. The site at present has a flood wall protecting the building and an automatically engaging flood gate at the entrance to parking area to the adjoining police station.

The area in question is not in a FEMA designated 100 year flood plain, The closest stream with FEMA designated floodplain is Sligo Creek, based on our review of the floodplain maps there is no impact of Sligo Creek's flood plain on the project area, therefore, as has also been communicated by Montgomery County Department of Permitting Service (DPS), there will be no backwater impact of Sligo Creek's Flood plain on the project site.

It is also our understanding the flood plain study will begin at Lee Avenue as the downstream end and move up stream to logical point indicated by a defined channel shape.

A project map is given in Figure 1.

Figure 1 – Location Map (Not to Scale)

Section 2. SCOPE OF SERVICES

1. Perform an Aerial Survey of the project site supplemented by field run survey to include cross sections at locations identified to be critical to the study including at change in slope width or at structural crossing at buildings and structures.

2. Obtain and review existing storm drain records from Montgomery County and/or the City of Takoma Park.

3. Delineate drainage area to the study point (Lee Avenue) and sub drainage areas contributing to major storm sewer systems and points of interest and tributary points.

4. Perform storm sewer capacity calculations based on the receiving drainage areas, to determine if there is storage capacity within the system during a 100 year storm event.

5. Perform hydrologic analysis using TR-55 for ultimate development condition>

6. Develop a HEC-RAS model based on the cross section data, roughness coefficient and the hydrologic and Hydraulic analysis date. The model will be run on an urban channel beginning on the downstream end at Lee Avenue and upstream to Birch Avenue.

Section 3. SOURCES OF INFORMATION

In order to carry out the present study, the following data were provided:

1. Montgomery County GIS topography (2-foot contour intervals).
2. Aerial topographic plan prepared by Potomac Aerial Survey and supplemented by field run cross sections by Aultec. Inc.
3. Storm drain information obtained from the City of Takoma Park in GIS format.

In addition, reference was made to the following manuals in the report:

1. U.S. Army Corps of Engineers, Hydrologic Engineering Center, River Analysis System (HEC-RAS) Manual, Version 5.0, February 2016.
2. United States Department of Agriculture, Natural Resources Conservation Service (NRCS) Technical Release 55 (TR-55) Urban Hydrology for Small Watersheds, April 2002.

Section 4. METHODOLOGY

4.1 Drainage Area Maps

Drainage area maps for the project were developed using 2-foot contour intervals extracted from the Montgomery County GIS topography. The Drainage area map is included in Appendix A.

4.2 Hydrology

4.2.1 Soils Information

The hydrologic soil information for the project was obtained from USDA Natural Resources Conservation Service, National Cooperative Soil Survey for Montgomery County, MD, (Refer to Appendix A).

4.2.2 Land Use

Land uses were obtained from Montgomery County GIS (MC Atlas) for the ultimate zoning condition

4.2.3 Runoff Curve Numbers

Runoff curve numbers were developed using TR-55 Urban Hydrology for Small Watersheds by the USDA Natural Resources Conservation Service (NRCS). HydroCADD software was used to perform the calculations. Drainage areas, soil types and land uses were used to generate the existing and ultimate runoff curve numbers for the various drainage areas.

4.2.4 Time of Concentration Flow Paths

Time of concentration flow paths were determined using the 2-foot contour intervals GIS plans as well as the storm drain information obtained from the City of Takoma Park. Sheet flow, shallow concentrated flow, open channel flow and pipe flow were the flow types used to calculate the time of concentration for each drainage area. For computing times of concentration, stream velocities for channel flow and pipe flow were based on average channel slopes. Drainage Area maps showing drainage boundaries, flow paths, land use and hydrologic soil groups for both existing and ultimate conditions are given in Appendix B.

4.2.5 Rainfall Depths

The rainfall depths were obtained from the Maryland Department of Transportation State Highway Administration, Highway Drainage Manual, Chapter 2, and Charts SHA-61.1-403.4 to SHA-61.1-403.9. The rainfall depths for the 24 hour duration storms model are listed below in Table 1. A Type II rainfall distribution was applied to the 24-hour duration storms.

Table 1– Rainfall Depths

Return Period (years)	Duration (hours)	Rainfall Depth (inches)
2	24	3.2
10	24	5.1
100	24	7.2

4.2.5 Peak Discharge Rates

Peak discharges were calculated for the 2-year, 10-year and 100-year, 24-hour storm events using TR-55 input data [Drainage Areas (DA), Runoff Curve Numbers (RCN) and Time of Concentration (Tc). Three drainage areas were identified contributing runoff at three points along the stream.

The hydrologic computations for both existing and ultimate conditions are given in Appendix B.

Table 2 - Summary of TR-55 Inputs for Existing and Ultimate Conditions

Sub-Area	Ultimate		
	Drainage Area (Ac)	Runoff Curve Number	Time of Concentration (hrs)
DA-1	151.4	86	0.48
DA-2	159.7	85	0.48
DA-3	36.0	86	0.32

The hydrologic computations for both existing and ultimate conditions are given in Appendix B.

4.3 Hydraulics

The site is an urban site without a defined stream channel. The reach modeled is the gutter line of Philadelphia Avenue and Maple Avenue. The reach was modeled utilizing the HEC-RAS River Analysis System software (V 5.05.1.0, January 2016). Elevation data was collected and cross sections were developed based on the 1-foot contour survey data provided by AULtec, as well as an aerial topographic survey performed by Potomac Aerial Survey. In addition drainage area maps were developed using the 2-foot contours extracted from the Montgomery County GIS topography. Steady flow data was entered for the 100-year, 24-hour storm events based on computations performed as described in section 4.2.5 above. The Manning's n was approximated based on field verification and the existing culvert information was based on the survey.

The reach is an urban street with a network of storm sewer system designed to convey the 10 year storm out to the receiving water body, which is Sligo Creek. Therefore the assumption is any storm over the 10 year storm is conveyed overland via the streets and overland swales and channels, therefore the peak discharge used to model the 100 year flood plain in HEC-RAS is the difference between the 10 year and 100 year peak discharge. The peak discharges that are conveyed overland are therefore as shown on

Stream cross sections and results of the HEC-RAS analysis are given in Appendix D.

Section 5. FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) FLOODZONE

The flood zones for Montgomery County, Maryland and incorporated areas are outlined in the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM), dated September, 2006. The project will take place in Community Panel 24031C04600D. See FIRMette included in Appendix C. According to the map, the project site is not located in any special flood hazard areas.

Section 6. HYDROLOGIC ANALYSIS

The total drainage area draining to the point of analysis, which is at the intersection of Lee Avenue and Maple Avenue is 0.54 square miles (347.1 Acres). This area is divided into three based on where it enters the reach. The entire drainage area is assumed to be at an ultimate condition development. Per Montgomery County Atlas the predominant zoning within the drainage area is R-60 which is approximately and eighth of an acre single family residential development, within the area there are some areas that are less dense and some more. Per SCS TR-55 manual the average percent impervious is 65%.

The distribution of Hydrologic Soil Group (HSG) includes HSG A, B, C and D. The soil types were considered in developing the composite Run off Curve Number (RCN).

The data for each of the drainage areas was entered into the TR-55 model and the appropriate Runoff Curve Numbers (RCN) were calculated for each area. In addition, methods outlined in the TR-55 were used to calculate the Time of Concentration (T_c) for each basin. Existing topographic / contour mapping as well as inlet / pipe / culvert / ditch data from Montgomery County was used to determine flow paths and hydraulic characteristics of the flow paths. The TR-55 analyses were carried out to determine the RCN and T_c for each basin for both existing and ultimate land uses. Tables 3 show the TR-55 inputs for the existing conditions for the north and south streams. Table 4 summarize the peak discharges for the north and south streams.

Table 3 - Summary of TR-55 Inputs for Existing and Ultimate Conditions

Sub-Area	Existing			Ultimate		
	Drainage Area (Ac)	Runoff Curve Number	Time of Concentration (hrs)	Drainage Area (Ac)	Runoff Curve Number	Time of Concentration (hrs)
DA-1	123.07	78	0.362	123.09	74	0.362
DA-2	49.78	77	0.248	49.77	79	0.248

Table 4 - Summary of Results of Peak Discharges for Existing and Ultimate Conditions

	Peak Discharges (CFS)		
	DA-1 (Sta-10+54)	DA-2 (Sta-6+89)	DA-3 (Sta-0+00)
2-YR	186	187	53.95
10-YR	346	351	99
100-YR	673	697	193

The hydrologic computations for both existing and ultimate conditions are given in Appendix B.

Section 7. HYDRAULIC ANALYSIS

The site is an urban site where stormwater is conveyed via underground storm drain systems and overland flow via streets and swales, Therefore there is defined stream or river channel. The reach is identified based on the path a storm runoff would take in the event that the underground system has reached its capacity, for this site it is basically the l gutter of Philadelphia Street and Maple Avenue. Once the reach was identified cross sections were cut along the reach at appropriate locations, between the library and lee road.

Models for reach were modeled in HEC-RAS, and were based on existing topography, under the ultimate hydrologic conditions. The models were used to find the water surface elevations for the 100-year flood events. Based on 100-yr water surface elevations, the boundary of the 100-yr floodplain was delineated.

The cross sections were based on field survey performed by AULTEC Inc. . The “n” values for the channels consisted of the following: 0.030 for grassy areas and any impervious areas of concrete or asphalt used a value of 0.013.

A subcritical flow regime for a steady flow condition was run, with the critical depth as the boundary condition.

Summary tables of the 100 year water surface elevation at different reach stations is shown in Table 5 below.

Table 5– 100 Year Water Surface Elevations

River Station	Profile	WSE - Existing (ft)
1054	100-YR	210.03
887	100-YR	210.03
689	100-YR	209.53
463	100-YR	205.84
203	100-YR	198.60
000	100-YR	193.80

Section 8. CONCLUSIONS AND RECOMMENDATIONS

The analysis determines that there will be significant flooding between maple Avenue and cedar Avenue for the 100 year storm. The terrain of this triangular area to the south of the city hall is basically a low area without and overland flow relief. The water does not have a way out until the water surface reaches elevation of 209.2. It is then conveyed via Maple Avenue downstream towards the receiving water body. It appears that the natural flow regime has been altered in this area due to the construction of the street and buildings creating a sump situation.

This study is to set the result of the flood plain delineation as the existing condition 100 year flood plain elevation and the design of the future library addition will performed to avoid any impact to these elevations,

APPENDIX A – DRAINAGE AREA AND SOIL MAP

Soil Map—District of Columbia, Montgomery County, Maryland, and Prince George's County, Maryland
(TAKOMA PARK LIBRARY ADDITION DA STUDY)

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 scales ranging from 1:12,000 to 1:15,800.

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 11, Oct 2, 2017

Soil Survey Area: Montgomery County, Maryland
Survey Area Data: Version 13, Sep 18, 2017

Soil Survey Area: Prince George's County, Maryland
Survey Area Data: Version 15, Sep 19, 2017

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

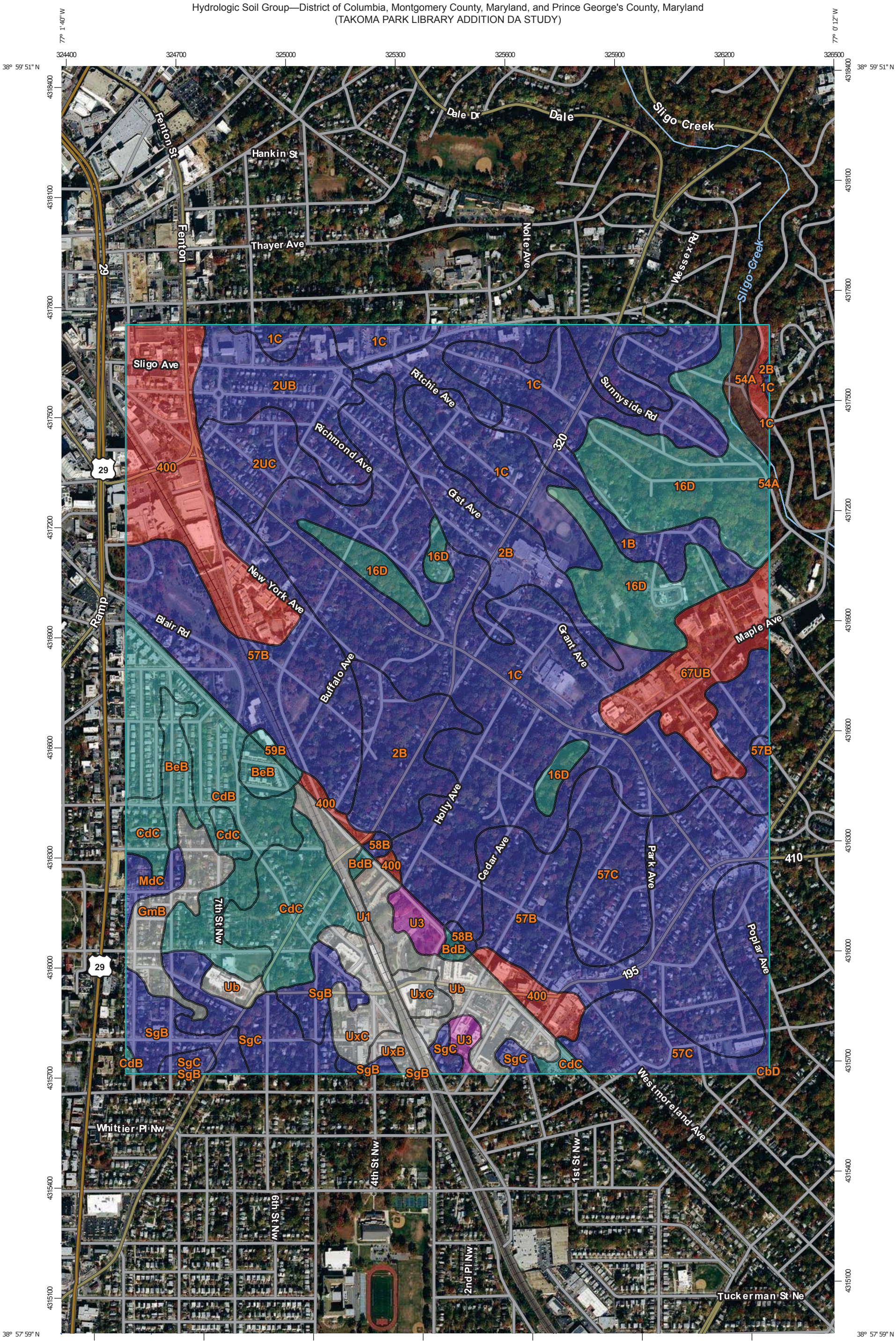
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BdB	Beltsville silt loam, 0 to 8 percent slopes	1.8	0.2%
BeB	Beltsville-Urban land complex, 0 to 8 percent slopes	11.1	1.3%
CdB	Chillum-Urban land complex, 0 to 8 percent slopes	41.6	4.7%
CdC	Chillum-Urban land complex, 8 to 15 percent slopes	31.0	3.5%
GmB	Glenelg variant-Urban land complex, 0 to 8 percent slopes	12.8	1.4%
MdC	Manor-Urban land complex, 8 to 15 percent slopes	4.1	0.5%
SgB	Sassafras-Urban land complex, 0 to 8 percent slopes	19.2	2.2%
SgC	Sassafras-Urban land complex, 8 to 15 percent slopes	22.3	2.5%
U1	Udorthents	9.3	1.0%
U3	Udorthents, sandy	6.5	0.7%
Ub	Urban land	23.0	2.6%
UxB	Urban land-Sassafras complex, 0 to 8 percent slopes	2.2	0.2%
UxC	Urban land-Sassafras complex, 8 to 15 percent slopes	14.3	1.6%
Subtotals for Soil Survey Area		**199.2**	**22.4%**
Totals for Area of Interest		**890.8**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1B	Gaila silt loam, 3 to 8 percent slopes	14.4	1.6%
1C	Gaila silt loam, 8 to 15 percent slopes	220.8	24.8%
2B	Glenelg silt loam, 3 to 8 percent slopes	69.8	7.8%
2UB	Glenelg-Urban land complex, 0 to 8 percent slopes	28.3	3.2%
2UC	Glenelg-Urban land complex, 8 to 15 percent slopes	17.4	1.9%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
16D	Brinklow-Blocktown channery silt loams, 15 to 25 percent slopes	71.6	8.0%
54A	Hatboro silt loam, 0 to 3 percent slopes, frequently flooded	5.4	0.6%
57B	Chillum silt loam, 3 to 8 percent slopes	124.8	14.0%
57C	Chillum silt loam, 8 to 15 percent slopes	53.9	6.0%
58B	Sassafras loam, 2 to 5 percent slopes	1.7	0.2%
59B	Beltsville silt loam, 3 to 8 percent slopes	1.4	0.2%
67UB	Urban land-Wheaton complex, 0 to 8 percent slopes	27.0	3.0%
116E	Blocktown channery silt loam, 25 to 45 percent slopes, very rocky	2.3	0.3%
400	Urban land	52.8	5.9%
Subtotals for Soil Survey Area		**691.6**	**77.6%**
Totals for Area of Interest		**890.8**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CbD	Chillum-Urban land complex, 5 to 15 percent slopes	0.0	0.0%
Subtotals for Soil Survey Area		**0.0**	**0.0%**
Totals for Area of Interest		**890.8**	**100.0%**

Hydrologic Soil Group—District of Columbia, Montgomery County, Maryland, and Prince George's County, Maryland
(TAKOMA PARK LIBRARY ADDITION DA STUDY)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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 scales ranging from 1:12,000 to 1:15,800.

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Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BdB	Beltsville silt loam, 0 to 8 percent slopes	C	1.8	0.2%
BeB	Beltsville-Urban land complex, 0 to 8 percent slopes	C	11.1	1.3%
CdB	Chillum-Urban land complex, 0 to 8 percent slopes	C	41.6	4.7%
CdC	Chillum-Urban land complex, 8 to 15 percent slopes	C	31.0	3.5%
GmB	Glenelg variant-Urban land complex, 0 to 8 percent slopes		12.8	1.4%
MdC	Manor-Urban land complex, 8 to 15 percent slopes	B	4.1	0.5%
SgB	Sassafras-Urban land complex, 0 to 8 percent slopes	B	19.2	2.2%
SgC	Sassafras-Urban land complex, 8 to 15 percent slopes	B	22.3	2.5%
U1	Udorthents		9.3	1.0%
U3	Udorthents, sandy	A	6.5	0.7%
Ub	Urban land		23.0	2.6%
UxB	Urban land-Sassafras complex, 0 to 8 percent slopes		2.2	0.2%
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Subtotals for Soil Survey Area			**199.2**	**22.4%**
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2UC	Glenelg-Urban land complex, 8 to 15 percent slopes	B	17.4	1.9%
16D	Brinklow-Blocktown channery silt loams, 15 to 25 percent slopes	C	71.6	8.0%
54A	Hatboro silt loam, 0 to 3 percent slopes, frequently flooded	B/D	5.4	0.6%
57B	Chillum silt loam, 3 to 8 percent slopes	B	124.8	14.0%
57C	Chillum silt loam, 8 to 15 percent slopes	B	53.9	6.0%
58B	Sassafras loam, 2 to 5 percent slopes	B	1.7	0.2%
59B	Beltsville silt loam, 3 to 8 percent slopes	C	1.4	0.2%
67UB	Urban land-Wheaton complex, 0 to 8 percent slopes	D	27.0	3.0%
116E	Blocktown channery silt loam, 25 to 45 percent slopes, very rocky	D	2.3	0.3%
400	Urban land	D	52.8	5.9%
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Totals for Area of Interest			**890.8**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CbD	Chillum-Urban land complex, 5 to 15 percent slopes	C	0.0	0.0%
Subtotals for Soil Survey Area			**0.0**	**0.0%**
Totals for Area of Interest			**890.8**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

LEGEND
- CITY LIMITS
- SITE DRAINAGE AREA
- SUB-DRAINAGE AREAS
- LONGEST PATH OF TRAVEL

STUDY POINT Q3

PATH TO Q3 OUTFALL POINT

STUDY POINT Q2

PATH TO Q1 OUTFALL POINT

STUDY POINT Q1

PATH TO Q2 OUTFALL POINT

① ② ③

GRAPHIC SCALE

250 125 0 125 250 500 750

(IN FEET)
1 inch = 500feet

EXISTING CONDITIONS

Delon Hampton & ASSOCIATES CHARTERED