Chesapeake Bay Preservation Plan

2023

ARLINGTON
VIRGINIA

ARLINGTON COUNTY CHESAPEAKE BAY PRESERVATION PLAN

Section 1: Introduction

This update to the Chesapeake Bay Preservation Plan highlights the County's programs and policies that protect water resources. These programs include the County's Chesapeake Bay Preservation program, which is focused on the implementation of the Chesapeake Bay Preservation Ordinance and the Chesapeake Bay Preservation Act. The Chesapeake Bay Preservation Program is an important component of the County's overall stormwater management program, which seeks to address the stormwater impacts from existing developed lands as well as new development activities. This plan update provides an opportunity to inform the community about the strength and breadth of Arlington County's Chesapeake Bay Preservation program, and the CBPP relates to other stormwater program activities and environmental protection efforts within the County to protect water quality now and in the future.

1.1 Regulatory Overview of Chesapeake Bay Preservation Program

In 1988, the Commonwealth of Virginia enacted the Chesapeake Bay Preservation Act (Bay Act), which required 84 localities in Virginia to institute water quality protection measures to improve the declining health of the Chesapeake Bay and its tributaries.

Under the Bay Act framework, the Chesapeake Bay Preservation Area Designation and Management Regulations (Regulations) were adopted by the Commonwealth of Virginia in 1989, and amended in 1991, 2001, 2012 and in 2021.

The Bay Act and Regulations provide the required elements and criteria that local governments must adopt and implement in their local Chesapeake Bay Preservation programs. They comprehensively address the effects of land use planning and development on water quality. They recognize also that local governments have the primary

responsibility for land use decisions and expand local authority to manage water quality and establish a direct relationship between water quality protection and local land use decision-making.

Specifically, the Bay Act and associated Regulations require localities to:

1. Establish Chesapeake Bay Preservation Areas, a land use overlay that designates sensitive areas for protection from water quality impacts during development;
2. Establish a local Ordinance that codifies the water quality protection requirements authorized via the Bay Act and Regulations and provides for regulatory review (Learn more about Arlington's Chesapeake Bay Preservation Ordinance in section 3.1); and
3. Integrate Chesapeake Bay Preservation Area water quality protection into their comprehensive plans.

1.2 Overview of the Chesapeake Bay Preservation Plan

In 2001, the County adopted the first Chesapeake Bay Preservation Plan (CBPP) as part of the Arlington County Comprehensive Plan. The Preservation Plan:

- Identifies and characterizes the County's water resources and examines the extent to which they have been affected by urban land activities.
- Develops the actions that Arlington County can take to help preserve and restore local streams, the Potomac River, and the Chesapeake Bay.
- Meets the Comprehensive Plan requirements of the Chesapeake Bay Preservation Area Designation and Management Regulations.

The CBPP provides a comprehensive background on natural constraints to development, sensitive natural resources, and existing and potential sources of pollution.

CHESAPEAKE BAY PRESERVATION PLAN

The Bay Act and Regulations require that localities maintain a current Chesapeake Bay comprehensive plan element. Arlington's Preservation Plan has not been updated since it was adopted in 2001. In the last 20 years, the County's stormwater management program has evolved and grown. With this CBPP update, the County will ensure relevant sections of the stormwater management program are identified in addition to the Chesapeake Bay Preservation program components for continued compliance with Virginia's Chesapeake Bay Preservation Act.

The required CBPP components and updates can be found in the table below. Several components have been included and updated in plans adopted between 2001 and 2022 (see Section 1.3). Updates to most components, including the required maps, are incorporated in this document.

Comprehensive Plan Information	Update Provided
Physical Constraints to Development	Yes (Section 3)
Shoreline and Streambank Erosion Problems	Yes (Sections 2,3)
Public and Private Waterfront Access	Yes (Section 2)
Location and extent of Chesapeake Bay Preservation Areas	Yes (Section 3, Appendix B)
Existing and Potential Water Pollution Sources	Yes (Section 2)
Existing and Proposed Land Use	Yes (Sections 1, 2)
Commercial and Recreation Fisheries	No official fishery programs
Maps	Yes (Appendix B)

1.3 Planning and Policy Framework

Arlington County has developed several plans and studies to address environmental resource management which overlap with the Chesapeake Bay Preservation Plan. The following plans and programs will be referenced due to their relevance:

The Stormwater Master Plan evaluates the current state of stormwater management and the condition of streams, watersheds and storm sewers in Arlington County. It charts a path to a more sustainable community by providing a

comprehensive framework for managing stormwater, streams, and watersheds for the next 20 years.

The Public Spaces Master Plan (PSMP) envisions a network of publicly- and privately-owned public spaces that connect the County's established neighborhoods and growing corridors to natural areas, protect valuable natural resources, provide opportunities for structured and casual recreation, and ensure access to the Potomac River, Four Mile Run, and their tributaries.

The Forestry and Natural Resources Plan (FNRP) is Arlington's plan to protect and improve natural resources. The FNRP is an update to the 2004 Urban Forest Master Plan and the 2010 Natural Resources Management Plan. The FNRP, when adopted, will collectively address the conservation, planting, and management of trees and unique ecosystems in Arlington County. This plan aims to increase and protect tree canopy and natural areas, and improve biophilic features within the County, as well as allocate resources for climate adaptation and resilience activities. The strategic directions outlined in the FNRP complements the CBPP and provide an overall direction to manage natural resources effectively.

The General Land Use Plan (GLUP) is the primary land use policy guide for future development in the County. The GLUP establishes the overall character, extent and location of various land uses. The changing needs and perspectives of the community are reflected in the GLUP.

Land use plans and studies are supporting documents to the Comprehensive Plan and define special planning areas that are guided by place-specific studies. These include sector plans, revitalization plans, and small area plans. For example, the Four Mile Run design guidelines were jointly adopted by the City of Alexandria and Arlington County for the Four Mile Run corridor for the Four Mile Run Restoration Master Plan. More information about sector plans can be found at Land Use Plans and Studies.

Overall, the GLUP, the Public Spaces Master Plan, and the pending Forestry and Natural Resources Plan, intersect with this plan in their mutual goals to conserve or enhance stream buffers and water resources and encourage public access to the Potomac River, Four Mile Run and their tributaries.

1.4 Future Updates to the Preservation Plan

Arlington consistently strives to ensure best practices are implemented to meet Chesapeake Bay Preservation Program goals and requirements, which includes periodic updates to policy and practice along with ordinance changes where necessary. Where practical, these updates will be summarized on the Chesapeake Bay Preservation program website. Future updates to this Comprehensive Plan element may be incorporated and integrated into other master planning efforts to maximize efficiency across the Stormwater Program.

Section 2: Arlington's Water Environment

Arlington County is 26 square miles, home to 236,000 residents, and part of the larger 14,700 square mile Potomac River and 64,000 square mile Chesapeake Bay watersheds. Arlington's watersheds, streams, and other water features are shown on the Water Resources map in the appendices and discussed in detail in the Stormwater Master Plan.

2.1 Arlington's Streams

Arlington's urban character and development history has significantly impacted its stream valleys. During the population boom of the 1930s through the 1960s, many of Arlington's streams were buried in underground pipes. At that time, there were no environmental regulations to protect streams or require stormwater management for building projects.

There are now roughly 32 stream miles remaining, an estimated one-third of the original network, and more than 400 miles of stormwater pipes. There are also numerous wetlands and seeps and springs within the County, also shown on the Water Resources map in Appendix B.

An estimated 43% of Arlington's land is now covered in roads, roofs and other hard (impervious) surfaces. Even Arlington's less dense neighborhoods are 30% impervious, fundamentally changing how the landscape absorbs rainfall and generates runoff. When it rains heavily, water runs off roofs, roads, and parking lots, rushes into storm drains, and surges through underground pipes, overwhelming the streams.

The increased runoff from the initial wave of development began decades of stream bank erosion that continues today. Arlington streams responded to the larger flows by cutting down (incising) and widening. In heavy storms, rushing water carved away at streams' sides, or banks.

Steep banks continued to erode down and out, sending large volumes of sediment downstream, undercutting trees and trails, and exposing sanitary sewer lines and other infrastructure, all increasing the risks and costs of inaction.

Example of a steep, eroding stream bank in Arlington

The County completed a stream assessment from 2011-2012 to determine stream condition and to develop a prioritized list of stream projects to address severe erosion and risks to co-located infrastructure as part of the Stormwater Master Plan. The Stream Assessment maps and reports are available by watershed. See section 3.5 for more information about stream resilience projects in Arlington.

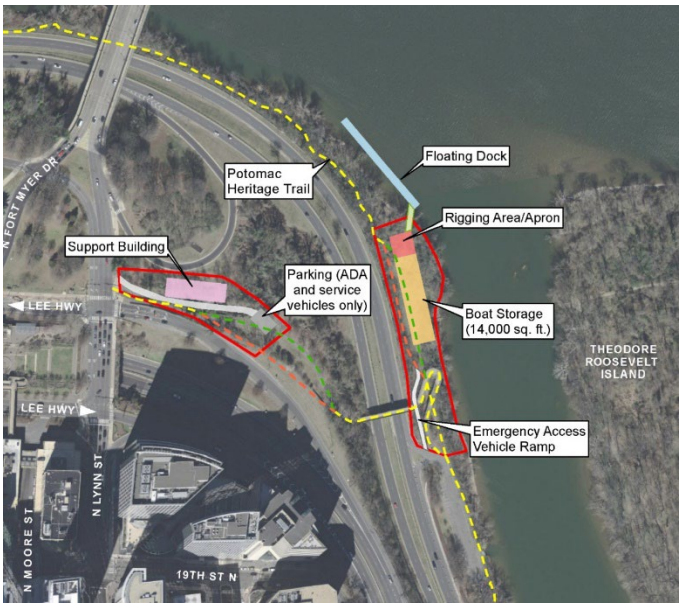
A segment of the 2011 Stream Assessment map, with colors indicating severity of erosion.

2.2 Public and Private Waterfront Access

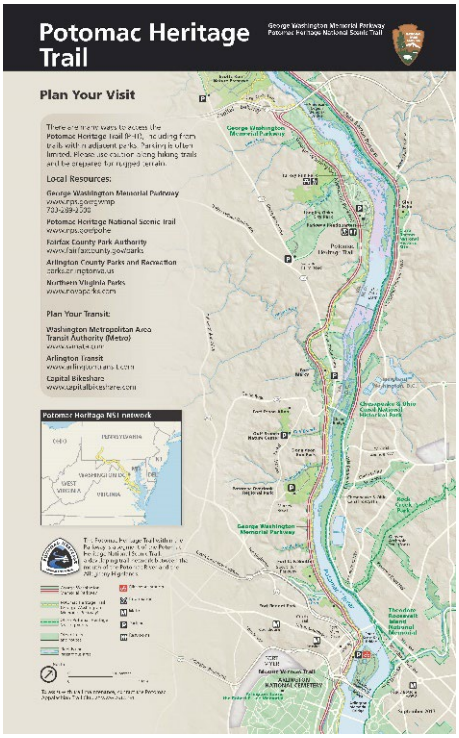
Arlington residents and visitors access streams and the Potomac River primarily through parks and trails. The Public Spaces Master Plan (PSMP) shows a network of publicly and privately-owned public spaces connecting the County's established neighborhoods and high-density corridors to natural areas. Many miles of public trails along streams and stream valleys are owned and managed by Arlington County as well as Northern Virginia Parking Authority and the National Park Service.

Primary Multi-Use Trails, from the Arlington County Public Spaces Master Plan

Much of the access to the Potomac River in Arlington is on National Park Service property. Future waterfront access is planned in Lower Rosslyn both on Arlington County and National Park Service land via a new public boathouse facility. The boathouse will increase access along the Virginia shoreline for nonmotorized water-based recreational activities on the Potomac River and alleviate pressure on other area boathouses, which are currently at maximum capacity.



Location of the new public boathouse facility in Rosslyn, from the National Park Service



To learn more about how to access the Potomac River in Arlington,
see the National Park Service's Potomac Heritage trail maps.

2.3 Existing and Proposed Land Use

Land use planning is an important tool to protect water resources in Arlington. In the 1930s-1950s, Arlington County was the fastest growing County in the nation, and very few regulations regarding development existed. Over 66 percent of streams were encased in stormwater pipes because there were no regulations protecting streams or floodplains at this time. Starting in the 1950s, to avoid future flooding around remaining streams, the County began targeting stream corridors for land acquisition.

The County Board adopted the first General Land Use Plan (GLUP) in 1961 (see Planning and Policy Framework in section 1.3). The public land corridors surrounding Arlington's remaining above ground streams are clearly visible in the 1961 map. Most of Arlington's existing streams currently flow through public parkland or areas of low-density land use. In the 1970s, land use planning shifted to targeting future high-density development around Metrorail transit corridors; this planning focus is reflected in updates to the GLUP which have continued to present day.

The current GLUP Map illustrates these forward-thinking efforts, depicting both the targeted development corridors and public/lower intensity use land along stream valleys. However, recent intense storms have resulted in serious flooding along buried stream corridors, demonstrating that Arlington's rapid development in the first half of the 20th century has current ramifications that are difficult to address.

The GLUP is reviewed through the County's small area, corridor, and sector plan planning studies as well as through countywide land use studies and site specific Special General Land Use Plan Studies. These planning processes include consideration of the diverse range of Comprehensive Plan goals including goals expressed in the CBPP and other Plan elements that intersect with Chesapeake Bay Preservation policies. Recommendations from these planning studies may result in amendments to

the General Land Use Plan, including the adoption of special area specific planning districts and site-specific amendments that occur through subsequent private development plans responsive to plan recommendations.

The Arlington County Zoning Ordinance (ACZO) defines legal rights and constraints regarding land use. The Zoning Ordinance consists of a text and a map and classifies all land according to districts, with general correspondence to the GLUP land use designations. Each district permits a certain type and level of development "by right." The Zoning Ordinance regulates use; size and coverage of lots; height, bulk and siting of buildings; parking requirements; and density of development for each parcel of land.

Currently, the proactive GLUP review policy, in combination with zoning standards that reinforce Chesapeake Bay program goals, support the County's ability to limit water quality impacts from land development.

2.4 Point Source Pollution

Point source pollution is defined under the Federal Clean Water Act as follows:

The term "point source" means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture.

Arlington County's regulated point source dischargers are shown in the appendices. These include the County's Water Pollution Control Facility and Municipal Separate Storm Sewer System (MS4), the Pentagon, Reagan National Airport, the WMATA bus maintenance facility, the National Foreign Affairs Training Center, Virginia Concrete, and the Nature Conservancy, which has an on-site groundwater treatment system.

Since 2001, the County Board authorized up to $568 million to help protect, restore and safeguard state waters as part its wastewater treatment plant operations. In 2003, Arlington County pursued limit-of-technology standards concerning nutrient removal set by the Virginia Department of Environmental Quality (DEQ). Since completion of the comprehensive facility upgrade, the Plant has led the State in reducing nitrogen pollution to the Bay, discharging well below the State's limit of 3 milligrams per liter. Learn more about the high levels of performance of Arlington's Water Pollution Control Plant.

For more information about point source pollution permitting in Arlington, see the Virginia Department of Environmental Quality's Surface Water Pollution Discharge Elimination System.

Onsite Septic Systems and Abandoned Wells

Onsite Septic systems can be a source of pollution if they are improperly sited, installed or maintained or if they fail to function. Abandoned wells can serve as direct conduits for pollution to enter groundwater if they are not properly capped and sealed. Both are regulated under the Chesapeake Bay Preservation Ordinance. Arlington County's Department of Human Services, Public Health Division, Environmental Health program works with residents and partners to ensure that onsite sewage (septic systems) are appropriately operated and maintained and abandoned wells are properly closed or converted to geothermal systems. The County's Chesapeake Bay Ordinance requires onsite septic systems to be pumped out every five years.

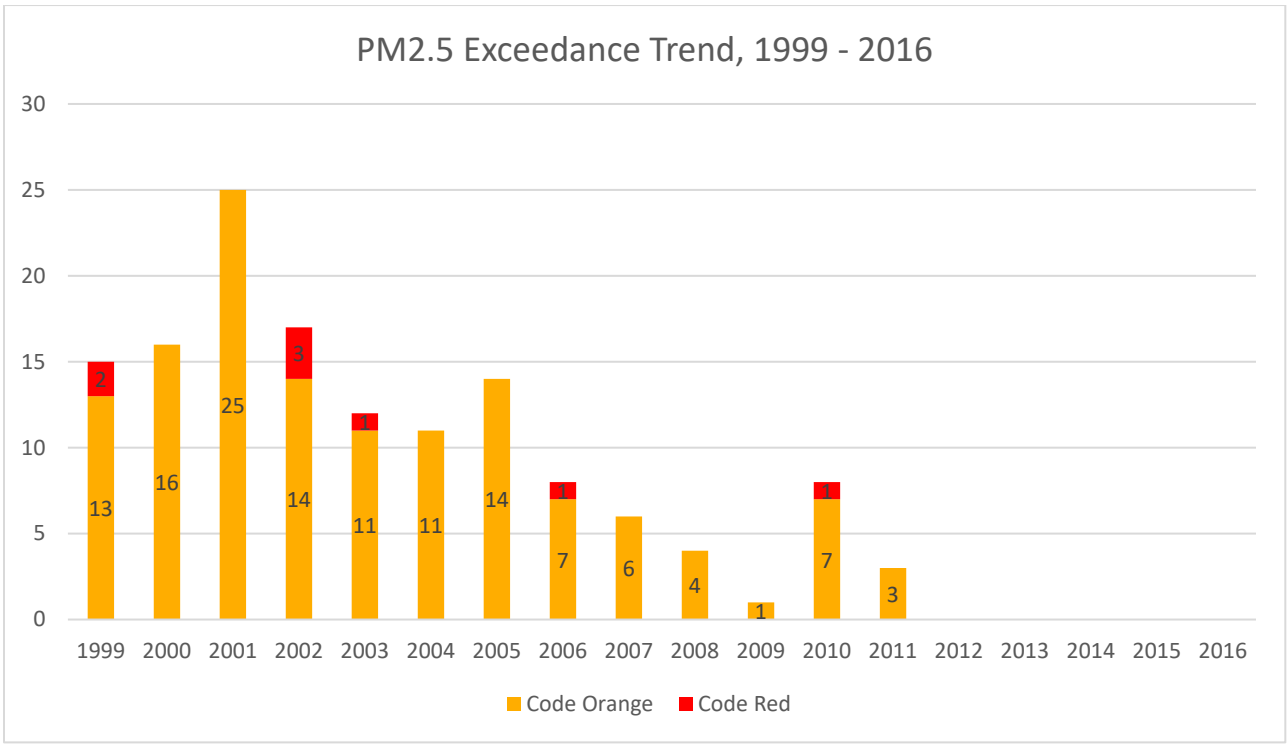
Arlington County does not prohibit the installation and use of onsite septic systems but does encourage homeowners connect to public sewer whenever possible. The few areas of the County not served by public sewer are areas where connecting is cost prohibitive or logistically challenging (e.g. the need for agreement among neighbors for public hook-up.)

2.5 Air Pollution Sources

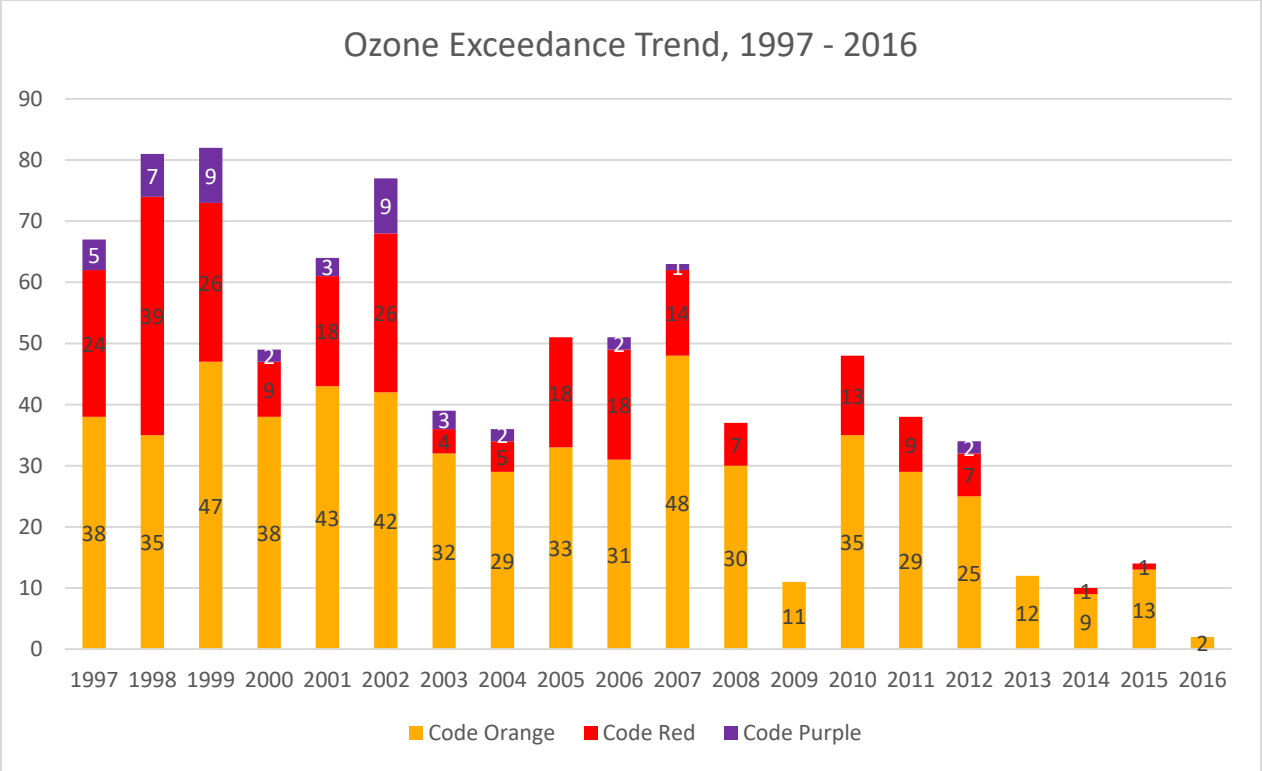
In addition to water pollution sources, the Chesapeake Bay Preservation Act also requires that this plan discuss air pollution sources and air quality.

Air quality in the District of Columbia, the State of Maryland, and the Commonwealth of Virginia (Washington DC-MD-VA) has improved significantly in recent years, with both particulate matter (PM) and ground-level ozone (O_3) declining. Federal, state and local programs are responsible for this progress, including the Acid Rain Program, vehicle emission rules, inspection and maintenance programs, renewable energy development, energy efficiency programs, idling reductions, and other measures.

Arlington continues to participate in the Metropolitan Washington Council of Governments' Air Quality initiatives. Additionally, Arlington's Rethink Energy program works to improve air quality while reducing carbon emissions in the County.



PM2.5 Exceedance Trend: Number of Exceedance Days – 2006 24-Hour PM2.5 Standard (35 µg/m³). Breakdown of Code Orange, Red & Purple Days, 1999 – 2016. Based on 2016 data from Metropolitan Washington Council of Governments.



Ozone Exceedance Trend. Number of Exceedance Days – 2015 Ozone Standard (70 ppb). Breakdown of Code Orange, Red and Purple Days, 1997-2016. Based on 2016 data from the Metropolitan Washington Council of Governments.

Section 3: Arlington's Comprehensive Chesapeake Bay and Stormwater Program

Arlington County is committed to helping restore the Chesapeake Bay by improving the health of local streams; which are important natural resources that enhance the quality of life for County residents. The County has adopted several local ordinances to reduce the effects of land development activities on its water resources and has gone even further by making capital investments in green stormwater infrastructure and stream resiliency projects that mitigate the impacts of existing developments already in place.

3.1 Chesapeake Bay Preservation Ordinance and Resource Protection Areas

In accordance with the Bay Act and Regulations, Arlington County adopted a Chesapeake Bay Preservation Ordinance in 1992 (with revisions in 2003, 2011, and 2014) to protect local streams and the downstream Potomac River and Chesapeake Bay from pollution due to land use and development.

To protect these waterways, sensitive areas along streams and other water bodies throughout Arlington are designated by the Chesapeake Bay Preservation Ordinance as **Resource Protection Areas (RPAs)**. In Arlington, RPAs exceed minimum State requirements and include:

- Natural stream channels (ephemeral, intermittent and perennial);
- Man-made open stream channels;
- Tidal wetlands and shores;
- Non-tidal wetlands contiguous to tidal wetlands or waterbodies with perennial flow;
- A minimum 100-foot buffer adjacent to these water bodies;
- Steep slopes greater than or equal to 25 percent contiguous to the 100-foot buffer;

- Contiguous steep slopes greater than or equal to 15 percent which are in the Potomac Palisades area of the County from Chain Bridge to the County boundary; and,
- When necessary to protect the integrity of the RPA buffer, contiguous slopes greater than or equal to fifteen percent contiguous to the RPA buffer may also be designated by the County Board.

The County's adopted Chesapeake Bay Preservation Areas Map (January 2018) serves as a guide to help property owners determine if an RPA exists on their property.

Resource Management Areas (RMAs) includes the entire County outside of areas designated as RPA. The RMA designation acknowledges that any activities in Arlington County have the potential to cause significant water quality degradation or damage to the RPA. The CBPO and stormwater requirements focus on minimizing impervious cover, limiting disturbance, and maximizing protection of vegetation, including minimum tree canopy requirements.

Projects within Resource Protection Areas (RPAs) are regulated under the Chesapeake Bay Preservation Ordinance and the policy set in the Stormwater Guidance Manual. New projects such as a home addition or building a new home on properties adjacent to a stream or wetland must obtain permits and may require mitigation for potential water quality impacts. Land disturbance activity within the RPA is reviewed regardless of the level of land disturbance. All tree removal in the RPA is reviewed and tree conservation is prioritized. Tree replacements are required in cases where trees are approved for removal. Residents planning any land disturbing activities in the RPA should contact the County prior to the commencement of any proposed work.

All public projects in RPAs are also reviewed for compliance with the Ordinance, including park, school and linear transportation and utility projects to maximize protection of streams and minimize water quality impacts both during and following construction.

3.2 Constraints for Development in Arlington

In addition to Resource Protection Areas along streams, physical constraints to development in Arlington also include wetlands, steep slopes, highly erodible soils, floodplains, and storm sewer capacity. Some of these constraints are regulated directly. For example, wetlands connected to perennial streams, steep slopes adjacent to RPAs, and floodplains are included in Resource Protection Areas. Others, such as steep slopes outside of RPAs and internal flooding of storm sewers, are addressed through plan review and other approaches, as outlined below.

Wetlands

The adopted Natural Resources Management Plan (2010) identified and mapped wetland features across the County. Wetlands with a connection to a perennial stream(s) are designated within Resource Protection Areas and included on the RPA map. Additional isolated wetlands are also mapped in the County's GIS system and in the Water Resources map in the appendices.

Steep Slopes

Arlington County has expanded the minimum 100-foot RPA buffer to include areas with steep slopes including:

- Contiguous steep slopes greater than or equal to 25 percent,
- Contiguous steep slopes greater than or equal to 15 percent which are in the Potomac Palisades area of the County from Chain Bridge to the County boundary, and
- Contiguous slopes greater than or equal to 15 percent where necessary to protect the integrity of the RPA buffer.

Development on steep slopes located outside the RPA buffer, while not restricted directly by code, is reviewed closely under the Land Disturbing Activities permitting program, with particular attention to managing runoff and stabilizing soils at outflow points from the property. The Land Disturbance Activity (LDA) 2.0 program, launched in

September 2021, includes increased performance requirements for single family homes, with an emphasis on managing more water onsite and protecting downhill properties from increased volumes and rates of runoff (see section 3.2). A map of steep slopes is included in the appendices.

Soil Erosivity

Arlington soils are mapped and classified by erosivity and other key characteristics in the Arlington soil survey map. Highly erodible soils are taken into consideration during site plan review, inspection, and erosion and sediment control plans and practices. Arlington County Soil Survey is included in the appendix.

Floodplains

A floodplain is any area of land that is susceptible to being inundated by unusual and rapid accumulation of water from any source. The Floodplain Ordinance in Chapter 48 of the Arlington County Code regulates development in flood zones. Floodplain areas often overlap with RPA areas. Development in floodplain areas requires review at the local level and is governed by the Federal Emergency Management Agency (FEMA).

The Floodplain Management Ordinance, first adopted in 1977 and revised several times since then, regulates how development can occur in federally regulated floodplains adjacent to streams. The adoption of a Floodplain Management Ordinance is required to participate in the National Flood Insurance Program, which is a federal program enabling property owners in participating communities to purchase affordable insurance protection against losses from flooding. In general, designated floodplains include the area of land inundated during a 100-year flood. These flood hazard areas are designated by FEMA on Flood Insurance Rate Maps. The County's Flood Insurance Rate Maps are currently being updated by FEMA with final maps expected in 2023-4 with an update to the Floodplain Ordinance expected subsequently. A map of

currently effective floodplain areas map is available in the appendices.

Storm Sewer Capacity

As part of the 2014 Stormwater Master Plan, a storm sewer system study was conducted to identify areas that need to be enlarged or modified to address localized flooding issues. In recent years, increased storm intensity and flooding has proven the urgency of addressing storm sewer capacity and its importance as a constraint for development.

In November 2020, Arlington County voters approved a stormwater bond referendum to help fund watershed-scale projects and local capacity improvements and expansions to mitigate high-risk flood areas, as part of a path toward a Flood Resilient Arlington.

The investment is based on current needs including certain projects previously identified in 2014 Stormwater Master Plan and repetitive flooding areas experiencing significant economic losses, damage to infrastructure, and threats to public health and safety. It includes solutions, such as capacity improvement projects, stormwater detention vaults, stormwater pumping stations, land acquisition and small drainage improvements.

Work is also underway on a Risk Assessment and Management Plan (RAMP) to inform the Flood Resilient Arlington program. Arlington is working toward flooding resilience through defining balance between private and public responsibility, scaling levels of flood protection and mitigation, and needs based investment. The RAMP as outlined will:

- Create mid and long-term climate mitigation and adaptation plans and actions.
- Inform current and future CIP planning.
- Provide certain project cost-benefit analyses.
- Perform pre-disaster mitigation planning (with the Department of Public Safety Communications and Emergency Management).
- Explore potential grant and alternative funding efforts.

- Use data to support relevant future code and ordinance updates.

3.3 Land Disturbing Activity – Stormwater Permit

Arlington County has a robust land development review process with the goal of reducing stormwater impacts from new development.

Before 2014, all countywide stormwater requirements for development were administered through the Chesapeake Bay Preservation Ordinance. In 2013, the Virginia Department of Environmental Quality enacted new stringent stormwater regulations, which Arlington adopted as a separate Stormwater Management Ordinance in 2014.

Together, these ordinances regulate both construction and post-construction stormwater and tree impacts and require mitigation practices. In addition, the Floodplain Management Ordinance (Chapter 48) governs land development activities proposed within designated flood zones.

Land Disturbing Activity Permit

A Land Disturbing Activity/Stormwater (LDA) Permit is required for any activities that disturb equal to or greater than 2,500 square feet of land, as required by the:

- Erosion and Sediment Control Ordinance,
- Stormwater Management Ordinance,
- Chesapeake Bay Preservation Ordinance.

In Arlington, construction is subject to regulation when an area greater than 2,500 square feet is disturbed during the development or redevelopment process.

LDA 2.0: Updating the Land Disturbing Activities Permit Requirements

In 2021, the County launched the LDA 2.0 program, named for the Land Disturbing Activities permit, for new single-family homes to control more stormwater on-site. The program is especially focused on managing heavy rainfall and protecting downhill properties while continuing to make investments in water quality.

LDA 2.0 adds State water quantity requirements for single family homes but also offers a simpler, more feasible, and

more effective alternative compliance option. This option includes a requirement to store and release up to three (3) inches of rainfall from increased impervious surfaces and incorporates a new gravity-release detention tank tool for improved performance and reliability. LDA 2.0 also requires soil profile rebuilding to de-compact and amend disturbed and damaged soils and provides additional incentives for maintaining and adding tree cover.

At the lot scale, LDA 2.0 complements the significant public investments being made at the stormwater system scale to increase flood resiliency. While single-family homes are being replaced at a strong pace of approximately 8% every decade, roughly 75% of Arlington's single-family housing stock was built before 1960. Much more redevelopment is yet to come. The new program is today's opportunity to change the trajectory towards stronger mitigation of impacts from tomorrow's single-family infill redevelopment—at the source.

Top: Aboveground tanks will capture rainfall. Below: A backhoe operator uses the soil profile rebuilding method to de-compact soil and improve porosity and soil health. Both tanks and soil amendment will be required under the new LDA 2.0 permit.

3.4 Tree Conservation

A 2016 report found that Arlington has over 755,000 trees, with approximately 45 trees per acre. Arlington's trees remove pollution, store and sequester carbon, prevent emissions, save energy, and capture runoff. Approximately 41% of Arlington is covered in trees (not counting Department of Defense and National Airport land). The County uses incentives as well as its regulatory authority to conserve and increase tree canopy. For example, the County undertakes planting campaigns to plant trees on public and private property, through internal programs and partnerships with organizations such as EcoAction Arlington, and the Virginia Department of Forestry.

Much of Arlington County's regulatory authority for tree conservation derives from the Chesapeake Bay Preservation Ordinance. This authority extends to County-wide to all Chesapeake Bay Preservation Areas, Resource Management Area as well as Resource Protection Area, and both private and public property.

Tree Conservation in Chesapeake Bay Preservation Areas

The Chesapeake Bay Preservation Ordinance identifies general performance standards that apply to all development in Chesapeake Bay Preservation Areas. In accordance with the Chesapeake Bay Preservation Ordinance (Section 61-10), all development activities must conserve trees to the maximum extent practicable. The limit of disturbance, inclusive of the construction footprint and all utilities and stormwater infrastructure, must be minimized to maximize conserved tree canopy. The plan of development process, outlined in the Chesapeake Bay Preservation Ordinance and implemented through the County's Land Disturbing Activity permit, requires County review and approval of a landscape plan prepared by a certified arborist or landscape architect for all development activities to ensure that trees are conserved and protected during development.

Tree conservation is achieved by taking the actions outlined in the Stormwater Management Guidance Manual. The Guidance Manual identifies the County's requirements for the landscape plan and for tree protection during construction. For example, a required element of the landscape plan is the tree protection plan. The tree protection plan identifies all existing trees and other woody vegetation on the site of three (3) inches or greater with each tree's condition as well as the tree protection that must be employed during construction to limit unintended tree impacts and to protect conserved trees.

Additionally, the Chesapeake Bay Preservation Ordinance has a tree canopy requirement. Tree canopy cover can be met through conservation and/or planting to meet 20-year

tree canopy targets of 10-20%, depending on the site's permitted density. Arlington County has worked towards ensuring trees are conserved during construction by adopting bonus tree canopy credit for conservation of trees. The County extends two times the standard tree canopy credit for conservation of medium to large native trees that are conserved on a site.

Tree Conservation in Resource Protection Areas

Trees and other native vegetation in Resource Protection Areas must be conserved during routine property management, as well as during redevelopment. RPA tree conservation requirements are communicated to property owners through educational mailings.

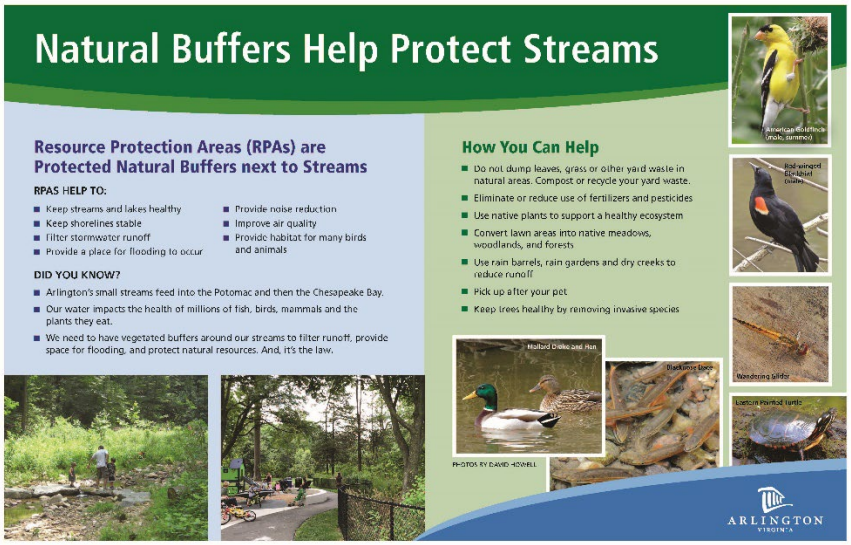
However, there are cases where property owners need to remove or prune trees in the RPA. In such cases, the county works with homeowners to assess tree removal requests, and the replacement value of RPA trees to be removed. In limited circumstances, tree removal is allowable under the Chesapeake Bay Preservation Ordinance with prior review and approval (Section 61.7.B) Dead, diseased, or dying trees with a diameter three inches or more may be removed. However, the trees are required to be replaced within the RPA at 1:1 (1 tree replacement for each tree removed). Property owners are required to provide supplementary information on trees such as location, condition, and reason for removal. Minor trimming and clearing of vegetation for reasonable sight lines and vistas and the creation of access paths up to 4 feet in width may also result in allowable RPA tree removal with a county permit.

RPA development pre-dating the 1989 adoption of the Chesapeake Bay Act is "grandfathered," and redevelopment can occur with a permit provided that impervious surface does not increase and the distance from the primary structure (typically a single-family home) to the stream does not decrease (Section 61-7). This redevelopment can, however, result in tree impacts. In such cases, tree removal is limited to that necessary for the redevelopment and

associated utilities. Permit submissions must identify steps taken to protect existing RPA trees and justify requests for removal. Replacement tree planting must be provided, quantified in accordance with the County's Tree Replacement Guidelines.

Finally, while removal of vegetation is warranted in some cases, vegetation that is removed must be replaced with other vegetation equally effective at limiting runoff and preventing erosion. Increases in impervious cover in the Resource Protection Area or decreases in the distance of a development to the stream require an exception to the Chesapeake Bay Preservation Ordnance to be granted. In such cases, tree or other native vegetation planting, or removal of non-native species in the RPA is frequently required mitigation to offset water quality impacts. Overall buffer improvement is an expected outcome of redevelopment in the RPA.

For more information, see: Tree Protection Regulations



3.4 Resource Protection Area Education and Outreach

Arlington County also conducts targeted outreach directly to the homeowners with properties on lots with RPA to inform them about regulatory changes such as map updates and permitting requirements. Information and brochures addressing programs and permits for protection and development are mailed to residents and posted on the County website. Arlington County uses its Chesapeake Bay Preservation Ordinance website to post resources such as Frequently Asked Questions for homeowners on permitting requirements for projects in the RPA, and tree protection and resources for planting.

Arlington staff conduct outreach to community volunteer groups and property owners via presentations, online articles, and onsite meetings to help protect streams through invasive plant removal, tree planting and stream monitoring. A significant community engagement effort is also included as part of all stormwater management and stream restoration capital projects in Arlington.

Stream monitor volunteers learn about aquatic life and the importance of protecting stream habitat.

Additional stream and stormwater education and outreach are conducted in support of the County's MS4 permit requirements. These include stormwater and watershed

management issues, including illicit discharges and pollution prevention, household hazardous waste, litter, recycling, stream buffer and stream restoration, and water quality monitoring. Additional details are available in the Stormwater Master Plan Outreach and Civic Engagement section.

3.5 Green Stormwater Infrastructure

To control stormwater impacts from developed land, the County has implemented pond and wetland restoration, green streets projects to capture and absorb runoff, and stream resiliency projects. Together, these green stormwater infrastructure projects rely on vegetation and soil to reduce runoff and pollution, with a growing emphasis on creating resiliency to climate change. These projects also complement the benefits of other forms of green infrastructure, including urban tree canopy and natural open spaces.

To inform the 2014 Stormwater Master Plan, all County watersheds were studied to identify potential spaces on County land and right-of-way where green stormwater infrastructure could be added. The Arlington Green Streets program has completed dozens of projects in the public right of way to date, many in collaboration with streetscape improvement and traffic calming projects initiated by the Transportation Planning Bureau and Arlington Neighborhood Program (formerly Neighborhood Conservation Program).

In addition, the program has targeted the few large scale pond and wetland restoration opportunities in the County with the Ballston Pond and Sparrow Pond projects.

The Capital Improvement Plan (CIP) includes programmatic funding to sustain progress for implementing more green stormwater infrastructure systems, including the few remaining (and smaller) pond systems. Learn more about stormwater and green infrastructure projects.

3.6 Stream Resiliency

Over time, increased development throughout the County has caused the streams to erode and degrade. This degradation impacts not only the environmental health of the stream and adjacent riparian corridor, but also nearby utilities and other infrastructure. Planning for resilience in Arlington's stream corridors takes into consideration current conditions and future impacts in changing climate conditions.

When assessing the need for stream resiliency projects, there are many factors considered. Projects are strategically identified to align with infrastructure protection and integrity needs and address related public safety issues resulting from failed slopes, eroded trails, exposed and broken sanitary sewer lines and collapsed outfalls.

As outlined in Section 2, a County-wide stream inventory was conducted to inform the 2014 Stormwater Master Plan to assess stream conditions and prioritize stream resiliency projects. Arlington stream project goals focus on four areas: infrastructure protection, environmental improvements, resilience in future climate and land use conditions, and reductions to excess sediment and nutrient loads transported downstream to help protect local streams and the Chesapeake Bay and meet regulatory requirements.

Stream resiliency projects reduce bank erosion and downstream sedimentation to help provide stream habitat for aquatic organisms. These projects also protect infrastructure in a way that is more sustainable than hardening utilities in streams or using other pipe protection methods. Based on the priorities identified in the assessment, stream resiliency practices have been implemented to date in Windy Run, Donaldson Run, and Four Mile Run.

For these projects, Arlington has used natural channel design techniques to create a new stream channel in balance with the runoff it receives from the surrounding land. The watershed characteristics, such as the amount of

runoff generated during rain events and the stream's slope, guide the stream design.

Natural channel design techniques often raise stream beds to reconnect with a floodplain area. During higher flows, the stream can flow onto the floodplain and the water will slow down and reduce its energy. In addition, stone structures are often added to help manage the energy of the stream. The approach emulates the function of natural, stable riparian systems.

Over time, natural channel design has incorporated elements of other approaches: focusing on the plant communities in the adjacent riparian areas, using wood for habitat and stabilization, and reducing impacts on the stream valley.

The County will continue to explore new and evolving stream project approaches, that might allow for stream stabilization in appropriate settings. Success of these approaches will rely on upstream sediment load, stream width, shape of stream valleys, and site access. The applicability of these practices for Arlington stream sections will be evaluated on a case-by-case basis.

See the stream bank erosion map for Arlington County and learn more about stream assessment.

Windy Run before and after the 2018 stream resiliency project. Before: Broken stormwater infrastructure, erosion undermining the trail, vulnerable sanitary sewer pipe. After: Stable, wide channel and gently sloping banks. Stone structures protect infrastructure and prevent future erosion.

3.7 Water Quality Regulations

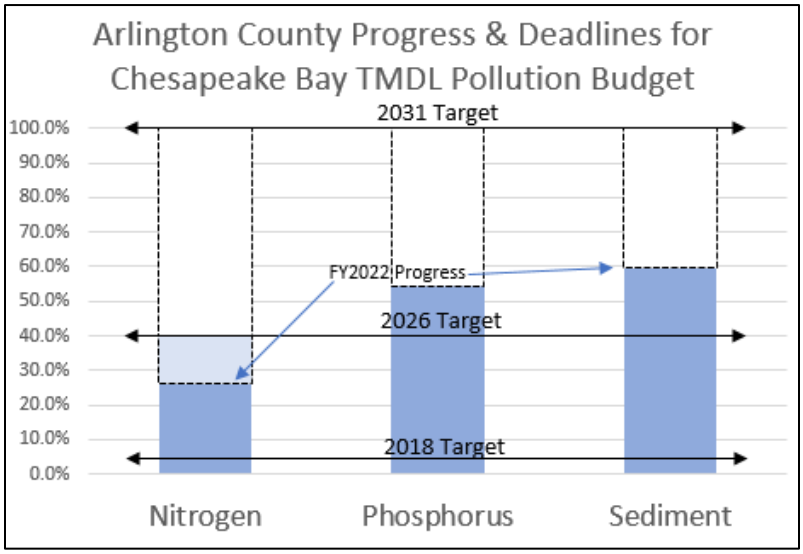
The Virginia Department of Environmental Quality (DEQ) issues permits for the discharge of stormwater into waterways like Four Mile Run and the Potomac River. These permits, called municipal separate storm sewer system (MS4) permits, are good for five years. Arlington's current MS4 permit was issued on July 1, 2021. The MS4 Program Plan illustrates how the County will meet its permit requirements.

Arlington was the first municipality in Virginia to receive an MS4 permit that included quantitative pollution reduction requirements to clean up the Chesapeake Bay. The Chesapeake Bay Total Maximum Daily Load (TMDL) or pollution diet requires significant reductions in nutrient and sediment pollution across the Chesapeake Bay watershed.

This permit took effect in mid-2013 and, by the end of the five-year permit cycle, required 5% progress towards the nutrient and sediment load reductions allocated to the

County for the TMDL. The Commonwealth of Virginia established an accelerating compliance schedule for Virginia MS4 permittees: 5% during the first permit cycle, 40% by the end of the second permit cycle, and full 100% compliance by the end of the third permit cycle. The tools for achieving credit are set forth through Virginia's TMDL action plan guidance document, with guidance and crediting changing over time. Most of the crediting options ultimately derive from the Environmental Protection Agency approval through the Chesapeake Bay Program.

DEQ's accelerating schedule for TMDL compliance required an implementation trajectory that ramped up quickly. The planning and prioritization efforts of the 2014 Stormwater Master Plan helped identify high priority stream resilience and watershed retrofit projects, which were incorporated into Arlington's TMDL Action Plan. The first permit cycle required at least seven watershed retrofit projects be constructed. Arlington met these requirements and exceeded the 5% target as shown below.



The program has increased forward progress during the 2nd permit cycle (which began in FY22) to exceed the 40% target, which will help keep pace with the steepening compliance curve to the 100% target.

The program's challenges to accelerate further to reach the 100% target include:

- Several larger projects with higher nutrient and sediment reductions have been completed,
- Limits on funding and project implementation capacity.

There are, however, continued opportunities, especially with stream projects in areas with significant ongoing erosion. Also, investments at the County's Water Pollution Control Plant allow the stormwater program to 'borrow' TMDL nutrient credits if needed to allow for additional time to meet the TMDL targets. It is expected that credits for nitrogen, which is the most difficult to remove from urban stormwater, will be applied for this purpose.

In addition to responding specifically to the Bay TMDL nutrient and sediment reduction requirements, Arlington County's projects and programs reflect the goals and objectives of Arlington's adopted Stormwater Master Plan – which emphasizes local water quality, stream corridors, and mitigating development impacts – alongside a growing emphasis on creating resiliency to flooding and climate change.

Section 4: Looking Forward

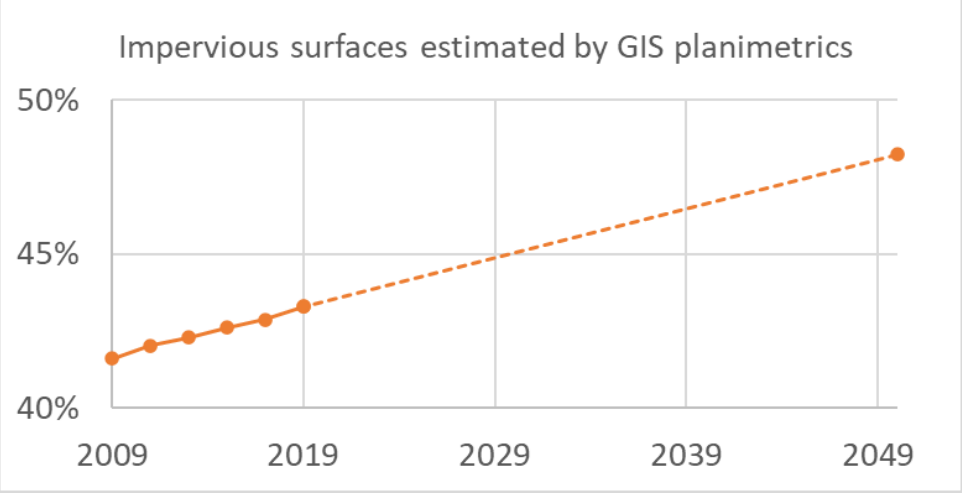
Arlington is a dynamic county that will continue to face new challenges and look ahead to opportunities on the horizon. Several challenges and opportunities that relate to the Chesapeake Bay Preservation Plan include:

- Increasing impervious cover,
- New planning efforts,
- A potential transition in funding mechanism to a Stormwater Utility Fee, and
- Chesapeake Bay Preservation Act amendments.

4.1 Land Use Changes: Increasing Impervious Cover

The growth of impervious surfaces, particularly roofs, driveways, walkways, and patios, is an ongoing challenge for Arlington's stormwater program and adds other harmful consequences, including contributing to the urban heat island effect.

From today's estimate of 43% impervious cover County-wide, the projected trend forward based on the rate of growth to date suggests approximately 48% impervious cover by 2050.



Increasing impervious surfaces over time. Note that GIS planimetric data captures most but not all impervious surfaces. The data includes buildings, roads, sidewalks, driveways, parking lots, and alleys. Patios and residential walkways are not included. While some of the GIS estimated increase can be attributed to increased mapping resolution over time, this is considered a relatively minor factor.

While most of today's impacts across the stormwater spectrum (from water quality to stream erosion and extreme flooding) derive from the development already in place, the incrementally growing challenges to manage and mitigate stormwater impacts from increasing impervious surfaces are expected to be amplified by increasing storm intensities and heavy rainfall frequencies from climate change.

The LDA program, including the new LDA 2.0 initiative, is a primary tool to mitigate the stormwater quality and quantity impacts from the development activities it regulates. However, it cannot eliminate all environmental impacts. Further, projects that disturb less than 2,500 square feet are not required to add stormwater management facilities but still contribute to increasing impervious cover.

With LDA 2.0, the stormwater program took one important step within its control to help address unmitigated increases in impervious surfaces. The maintenance agreement required for all LDA projects requires a plan revision for new impervious surfaces added after project completion that exceed the lesser of 10 percent of the site impervious area managed by stormwater facilities or 300 square feet of impervious area.

Further steps to consider with future Zoning Ordinance revisions, also recommended in the FNRP, include:

- Revising the definition of lot coverage to further emphasize lot size and provide more permeable space; and,
- Consider establishing caps on impervious surfaces that are not already counted as lot coverage under the Zoning Ordinance. These surfaces are primarily any paved or concrete surface less than 8 inches in height where vehicles are not parked. Over time, these additional, unregulated surfaces add stormwater and other ecological impacts and remove and/or prevent the installation of natural infrastructure.

4.2 Future-Focused Planning

Starting in FY22 and continuing through FY23 and into FY24, Arlington will be working on several strategic planning efforts, including:

- **Risk Assessment and Management Plan** (RAMP) described earlier in this document. The RAMP will include climate projections, inundation maps, risk and vulnerability analyses, estimated costs of inaction, and mitigation and adaptation strategies. Alongside the RAMP, Arlington will also be developing a Flood Resilient Design Guidelines Manual to facilitate more flood resilient redevelopment for properties subject to higher risk of flooding. The RAMP may be ready for public distribution in 1Q CY 2023. Learn more about Arlington's efforts to improve stormwater capacity.
- **MS4 Permit compliance planning to** optimize cost-effective compliance with the pollution reduction requirements of the Chesapeake Bay TMDL alongside maximizing benefits for the Arlington community for the environment, public safety and infrastructure protection, and climate resiliency.
- **Forestry and Natural Resources Plan** is built around four Strategic Directions which, together, embody actions that protect ecosystems, preserve Arlington's natural capital, and ensure that the benefits of nature are well-understood and available for current and future generations of residents and visitors. The key strategic directions which are relevant to the CBPP include allocating resources to climate vulnerable hot spots, maximize climate protection capacity of trees and green space and restore and manage water resources in a holistic and ecologically-sound way. The FNRP also recommends standards for development that optimize retention or replacement of tree canopy, natural vegetation, permeable surfaces, and biophilic elements through state legislation, changes to the zoning ordinance, and additional permits for

increased lot imperviousness. Overall, the key findings and goals of the FNRP are in alignment with the CBPP. Learn more about the FNRP.

- **Green stormwater infrastructure planning** to evaluate and develop cost-effective strategies to deliver green stormwater infrastructure including green streets and other projects to mitigate stormwater runoff and water quality impacts and support climate resiliency.
- **Resilient streams planning** that will include a field assessment to evaluate the physical condition of stream channels and banks as well as the condition of and risks to in-stream and near stream utilities, amenities, and other infrastructure from stream erosion. The information obtained during this assessment will be used to identify and prioritize capital investments in stream repair and resiliency projects. Stream repair and resiliency work supports multiple objectives, including mitigation of erosion and downstream sedimentation, infrastructure repair and protection, regulatory water quality credits, public safety and recreational access, and establishment of stream forest areas not compromised by continued erosion.
- **Master Transportation Plan (MTP) Update.** The current MTP has six overarching goals laid out in the Goals and Policies Document including Provide High-Quality Transportation Services Move More People Without More Traffic, Promote Safety, Establish Equity, Manage Effectively and Efficiently, and Advance Environmental Sustainability. This document is supplemented by the Transportation Plan Map and six modal elements — Bicycle, Demand and System Management, Parking and Curb Space Management, Pedestrian, Streets, and Transit. For more information on the current MTP, go to the Master Transportation Plan.
- **Biophilic City Network.** In March 2020, Arlington joined the Biophilic City Network. Biophilic design incorporates nature into urban and built

environments. It recognizes that exposure to nature and natural elements can reduce stress, aid recovery from illness, enhance cognitive skills, improve academic performance, and aid in combating childhood and adult illnesses. Biophilic principles value conservation of natural resources, the presence of nature in buildings and public spaces, urban nature, and equitable access to green spaces, parks, and other natural elements. Arlington will track its progress in meeting biophilic goals. As Arlington incorporates biophilic principles into design and planning, there is considerable overlap with its water quality goals. Learn more about Arlington's Biophilic Goals.

4.3 Stormwater Funding

Arlington's stormwater program is currently funded through a Sanitary District Tax mechanism, based on property value. For CY21, the Sanitary District Tax of $0.017 per $100 of assessed real property value increased by $0.004 from CY 20, and generated an estimated $13,746,952 in revenue, of which $2,495,591 will go towards executing the capital program and $661,564 will go towards debt service. Recognizing the significance of the stormwater investment that is needed for the program, Arlington voters approved a November 2020 bond referendum for stormwater and watershed infrastructure. For more information, see the FY21 adopted budget for the Stormwater Fund.

Funding for public infrastructure projects is allocated through the Capital Improvement Plan (CIP). The CIP includes funding for stream repair, outfall repair, and green streets to benefit local streams and contribute to improving the Chesapeake Bay.

The County has conducted a feasibility study to change the stormwater funding mechanism to a stormwater utility. Currently, the stormwater program is funded through the Sanitary District Tax based on a property's real estate assessment. A stormwater utility, however, is calculated

based on the amount of impervious surface on a parcel (hard surfaces like roofs and driveways that do not let rain runoff soak into the ground). Properties with more hard surfaces contribute more stormwater runoff to the system and would pay a higher rate. It is a more equitable way to pay for stormwater based on usage of the system, as opposed to the property assessment. It also allows localities to offer credits to customers who reduce their properties' runoff to the stormwater system. The stormwater utility is planned to take effect in FY 2024. Learn more about the proposed Stormwater Utility.

4.4 Chesapeake Bay Preservation Act Amendments

Two new amendments of the Chesapeake Bay Preservation Act became effective September 29, 2021. These amendments encourage and promote the conservation and planting of trees, as well as adaptation to sea-level rise and climate change impacts. Once the amendments are adopted by the County,

> (1) The County shall assess the impacts of climate change and sea level rise on any proposed land development within the resource protection area (RPA) during the plan of development or project review process, and "shall, as necessary and appropriate, require conditions, alterations, or the installation of adaptation measures as part of the proposed land development" consistent with the State Code and regulations.
>
> (2) Requirements for the conservation of mature trees or the planting of trees as a water protection tool and as a means of providing other natural resource benefits. These changes will apply to all Chesapeake Bay Preservation Areas both RMA and RPA. For example, proposed changes would require that mature trees "shall only be removed where necessary, including to provide for the proposed use or development." Other changes would require tree planting in buffer areas if it must be reestablished

"as appropriate to site conditions and in such a manner to maximize the buffer function."

Additionally,

- Localities have three (3) years to implement regulations by updating the local ordinance (by September 2023). Arlington County will propose ordinance changes for public comment and conduct outreach prior to implementation of the changes.
- Additional details of the amendments will be provided in upcoming guidance documents under development by DEQ. DEQ will provide model ordinances and training and education for local jurisdiction staff.
- The time between the issuance of the amendment and the effective date allow for guidance development for local government.

Read the Amendment to incorporate Coastal resilience and adaptation to Climate Change.

Read the Amendment to incorporate additional requirements related to preservation of mature trees

4.5 Upcoming Initiatives

Arlington has the following actions under consideration to improve the administration of the Chesapeake Bay Preservation Ordinance.

- Explore maintaining an internal Resource Protection Area map that incorporates site-specific RPA delineation or other RPA boundary adjustments. A full-scale RPA map update subject to approval by the County Board is not currently planned.
- Continue to review and update guidance to streamline compliance with the Chesapeake Bay Preservation Ordinance and conduct outreach and education.
- Support local and regional efforts to train professionals in sustainable and ecologically based landscaping – in collaboration with the Chesapeake

Bay Landscape Professionals and Plant Northern Virginia Natives (Plant NOVA Natives).

- Invest in stream assessment and planning (Resilient Streams Plan) to identify the stream and outfalls most in need of repair and that provide the best benefits to water quality and climate resiliency. Move forward with the planned project in Gulf Branch. For more information, see the Capital Improvement Plan.
- Continue to recruit qualified members of the community onto the Chesapeake Bay Ordinance Review Committee.
- Continue to work cooperatively across all County departments to ensure ordinances and plans address mutual areas of concern regarding land use planning and water quality protection.

Arlington's robust and innovative programs define appropriate land use, implement constraints on development to minimize its impacts, address stream bank erosion problems, provide access to streams and waterfronts, clearly depict Chesapeake Bay Preservation Areas, track water pollution sources, and provide detailed maps that support County initiatives. This Chesapeake Bay Preservation Plan documents the extraordinary growth and increasing breadth and depth of the County's stormwater and water quality programs from 2001 to the present.

Appendix A: Glossary and List of Acronyms

Biophilia: The innate connection of humans to the natural world. (Adapted from E.O. Wilson) (Public Spaces Master Plan)

Bioretention: A shallow, planted depression designed to retain or detain stormwater before it infiltrates into the ground or is discharged downstream.

Infiltration Trench: gravel-filled areas that store rainwater underground, allowing for more storage and infiltration of runoff than the original soil allowed.

CBPA: Chesapeake Bay Preservation Act, originally enacted by the Virginia General Assembly in 1988 to protect and improve water quality in the Chesapeake Bay through land use management.

CBPO: Chesapeake Bay Preservation Ordinance, a County ordinance adopted by Arlington to comply with the CBPA.

CBPP: Chesapeake Bay Preservation Plan (this document), a Comprehensive Plan element adopted by Arlington to comply with the CBPA.

Chesapeake Bay Total Maximum Daily Load (TMDL). A pollution 'budget' for the Chesapeake Bay that sets the maximum amount of the phosphorous, nitrogen and sediment the Bay can receive and still meet water quality standards. Each MS4 permit in Virginia prorates a portion of this budget to the regulated localities.

Green Stormwater Infrastructure: A subset of green infrastructure that includes engineered systems to manage stormwater runoff while providing other co-benefits. Includes but is not limited to rain gardens, vegetated roofs, blue roofs, rainwater capture, and permeable paving

LDA 2.0 Initiative: Increased stormwater management requirements for single family homes to control more

stormwater on-site. The program is especially focused on managing heavy rainfall and protecting downhill properties while continuing to make investments in water quality. Arlington County Department of Environmental Services. September 2021.

Municipal Separate Storm Sewer System (MS4): A system of publicly owned stormwater conveyances (street curbs, storm drains, etc.) that conveys stormwater and discharges it to waters of the United States. Arlington's MS4 Permit (also known as the Stormwater Permit) allows the County to discharge stormwater to local streams and requires the County to meet the requirements of the permit.

Permeable Pavement: Permeable pavements are alternative paving surfaces that allow stormwater runoff to filter through voids in the pavement surface into an underlying stone reservoir, where it is temporarily stored and/or infiltrated

Resource Protection Area: Land adjacent to streams, lakes, bays, wetlands, or other water bodies that has an intrinsic water quality value because of the ecological and biological processes it performs or because it is sensitive to impacts that may significantly degrade the quality of state waters. Resource Protection Areas are typically 100 feet wide but can be wider in some situations.

Watershed: An area of land that drains to a water body, such as a river or lake.

List of Acronyms

BMPs - Best Management Practices

CIP - Capital Improvement Plan

DES - Department of Environmental Services

DPR - Department of Parks and Recreation

FNRP - Forestry and Natural Resources Plan

VA DEQ - Virginia Department of Environmental Quality

Appendix B: Maps

This Chesapeake Bay Preservation Plan update also includes a variety of related maps on the pages that follow.

ARLINGTON COUNTY, VIRGINIA

Adopted Resource Protection Area: Streams & Watersheds

Note: All areas outside of mapped RPA's are Resource Management Areas (RMA)

Pimmit Run

Stohman's Run

Little Pimmit Run, Mainstem

Gulf Branch

Pimmit Run Tributary

Little Pimmit Run, W. Branch

Little Pimmit Run, E. Branch

Donaldson Run

Rixey Branch

Windy Run

Palisades

Rosslyn

Colonial Village Branch

Crossman Run

Westover Branch

Torreyson Run

Spout Run

Rocky Run

Four Mile Run, Upper Mainstem 1

Lubber Run

Cemetery/Pentagon

POTOMAC RIVER

Four Mile Run, Upper Mainstem 2

Arlington Forest Branch

Lower Long Branch

Doctor's Branch

Roaches Run

Upper Long Branch

Arlington Branch

Bailey's Branch

Nauck Branch

Virginia Highlands

National Airport

Four Mile Run, Middle Mainstem

Four Mile Run, Lower Mainstem

Lucky Run

Fairlington/Bradlee

Legend

Watershed Boundaries

Resource Protection Area

Streams

County Boundary

Map prepared by GIS Mapping Center
2100 Clarendon Boulevard
Arlington, VA 22201
Email: GISMC@arlingtonva.us
Maps are available for sale at the above location, Suite 1000.

Spatial reference: Virginia State Plane North, NAD 1983.
Base map updated from March 2021 digital aerial photography.
Potomac River from USGS 1:24,000 DLG files.
Maps shall not be construed as legal documents.

Printed: July 2022

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ARLINGTON VIRGINIA

Adopted Resource Protection Area: Streams & Watersheds

ARLINGTON COUNTY, VIRGINIA
Water Resources

Pimmit Run
Stohlman's Run
Little Pimmit Run, Mainstem
Gulf Branch
Pimmit Run Tributary
Little Pimmit Run, W. Branch
Little Pimmit Run, E. Branch
Donaldson Run
Rixey Branch
Palisades
Windy Run
Colonial Village Branch
Rosslyn
Crossman Run
Westover Branch
Torreyson Run
Spout Run
Rocky Run
Four Mile Run, Upper Mainstem 1
Lubber Run
Cemetery/Pentagon
POTOMAC RIVER
Four Mile Run, Upper Mainstem 2
Arlington Forest Branch
Doctor's Branch
Lower Long Branch
Upper Long Branch
Four Mile Run, Middle Mainstem
Arlington Branch
Roaches Run
Bailey's Branch
Nauck Branch
Virginia Highlands
National Airport
Four Mile Run, Lower Mainstem
Lucky Run
Fairlington/Bradlee

Legend

- Streams
- Ponds
- Wetlands
- Seep/Spring
- Resource Protection Area
- Watersheds
- Potomac River
- County Line

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ARLINGTON VIRGINIA
Water Resources

ARLINGTON COUNTY, VIRGINIA

Stream Condition Assessment (2011)

Pimmit Run

Stohman's Run

Little Pimmit Run, Mainstem

Gulf Branch

Pimmit Run Tributary

Donaldson Run

Rixey Branch

Palisades

Little Pimmit Run, E. Branch

Little Pimmit Run, W. Branch

Windy Run

Rosslyn

Colonial Village Branch

Crossman Run

Westover Branch

Torreyson Run

Spout Run

Rocky Run

Four Mile Run, Upper Mainstem 1

Lubber Run

Four Mile Run, Upper Mainstem 2

Lower Long Branch

Cemetery/Pentagon

Arlington Forest Branch

Doctor's Branch

Upper Long Branch

Roaches Run

Arlington Branch

Nauck Branch

Virginia Highlands

National Airport

Bailey's Branch

Four Mile Run, Middle Mainstem

Four Mile Run, Lower Mainstem

Lucky Run

Fairlington/Bradlee

Stormwater Outfall Condition	Stream Condition
Very Good	Stable
Good	Partially Stable
Fair	Widening
Poor	Downcutting
Very Poor	Unassessed Stream
Other Utilities Condition	Partially armored
Very Good	Fully armored
Good	Watersheds
Fair	County Line
Poor	
Very Poor	

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Spatial reference: Virginia State Plane North, NAD 1983.
Base map updated from March 2021 digital aerial photography.
Potomac River from USGS 1:24,000 DLG files.
Stream assessment conducted by VHB, Inc., 2011
Cadastral and political data layers are maintained on an on-going basis.
Maps shall not be construed as legal documents.

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ARLINGTON COUNTY, VIRGINIA

Resource Protection Areas

With Slope 25 % or Greater

Legend

- Resource Protection Buffer
- Steep Slope in RPA
- Steep Slope Outside RPA
- Streams
- County Line

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Base map updated from April 2019 digital aerial photography.
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ARLINGTON VIRGINIA

Resource Protection Areas

With Slope 25% or Greater

ARLINGTON COUNTY, VIRGINIA

Impervious Surfaces

POTOMAC RIVER

County Line
Impervious Surface
Parks
Potomac River

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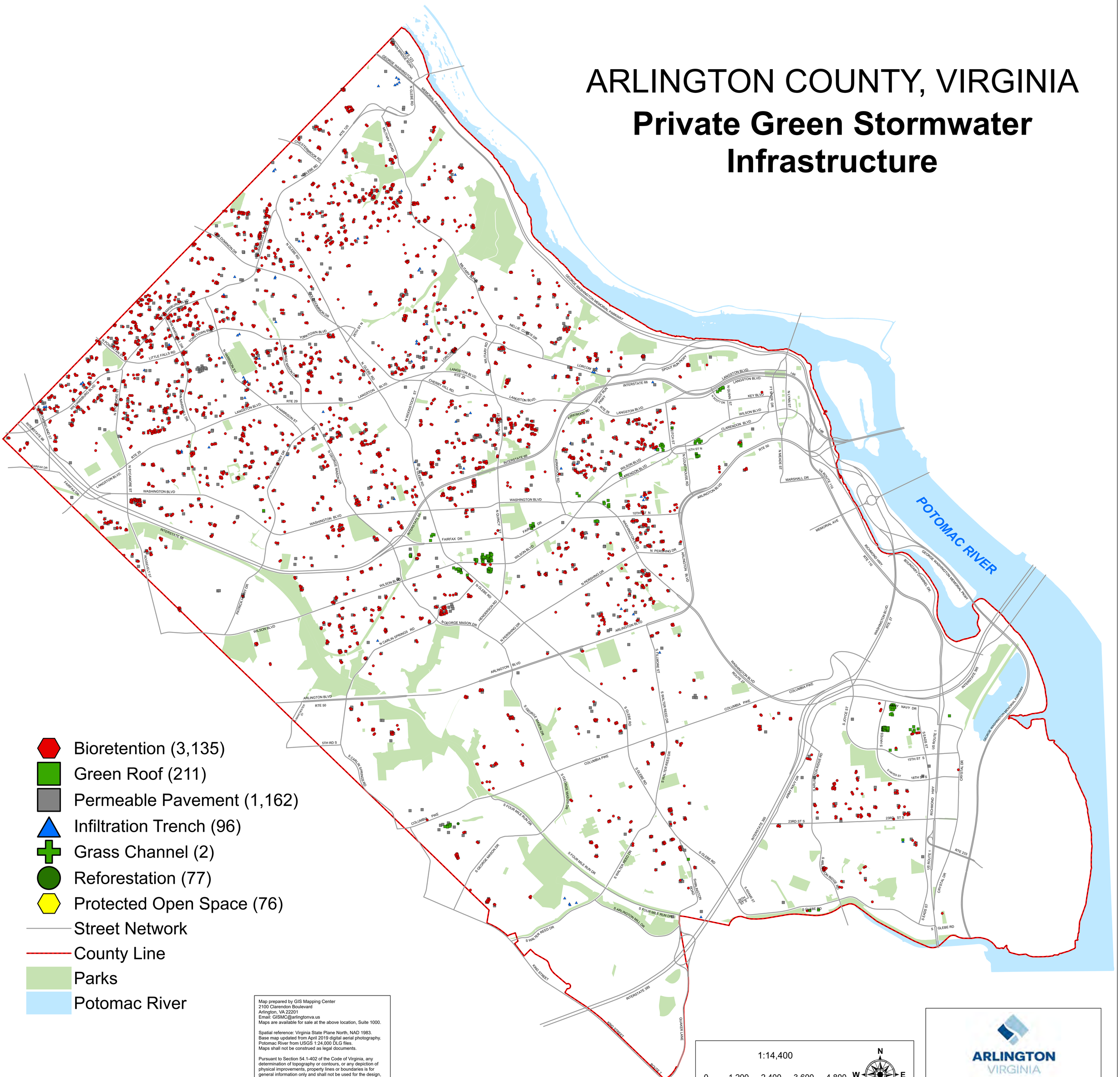
VIRGINIA

Impervious Surfaces

ARLINGTON COUNTY, VIRGINIA

Private Green Stormwater Infrastructure



- Bioretention (3,135)
- Green Roof (211)
- Permeable Pavement (1,162)
- Infiltration Trench (96)
- Grass Channel (2)
- Reforestation (77)
- Protected Open Space (76)
- Street Network
- County Line
- Parks
- Potomac River

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ARLINGTON VIRGINIA

Private Green Stormwater Infrastructure

ARLINGTON COUNTY, VIRGINIA

Public Green Stormwater Infrastructure

- Bioretention (65)
- Green Roof (3)
- Permeable Pavement (28)
- Infiltration Trench (2)
- Rainwater Harvesting (1)
- Sheet Flow to Conservation Area (1)
- Reforestation (2)
- Street Network
- County Line
- Parks
- Potomac River

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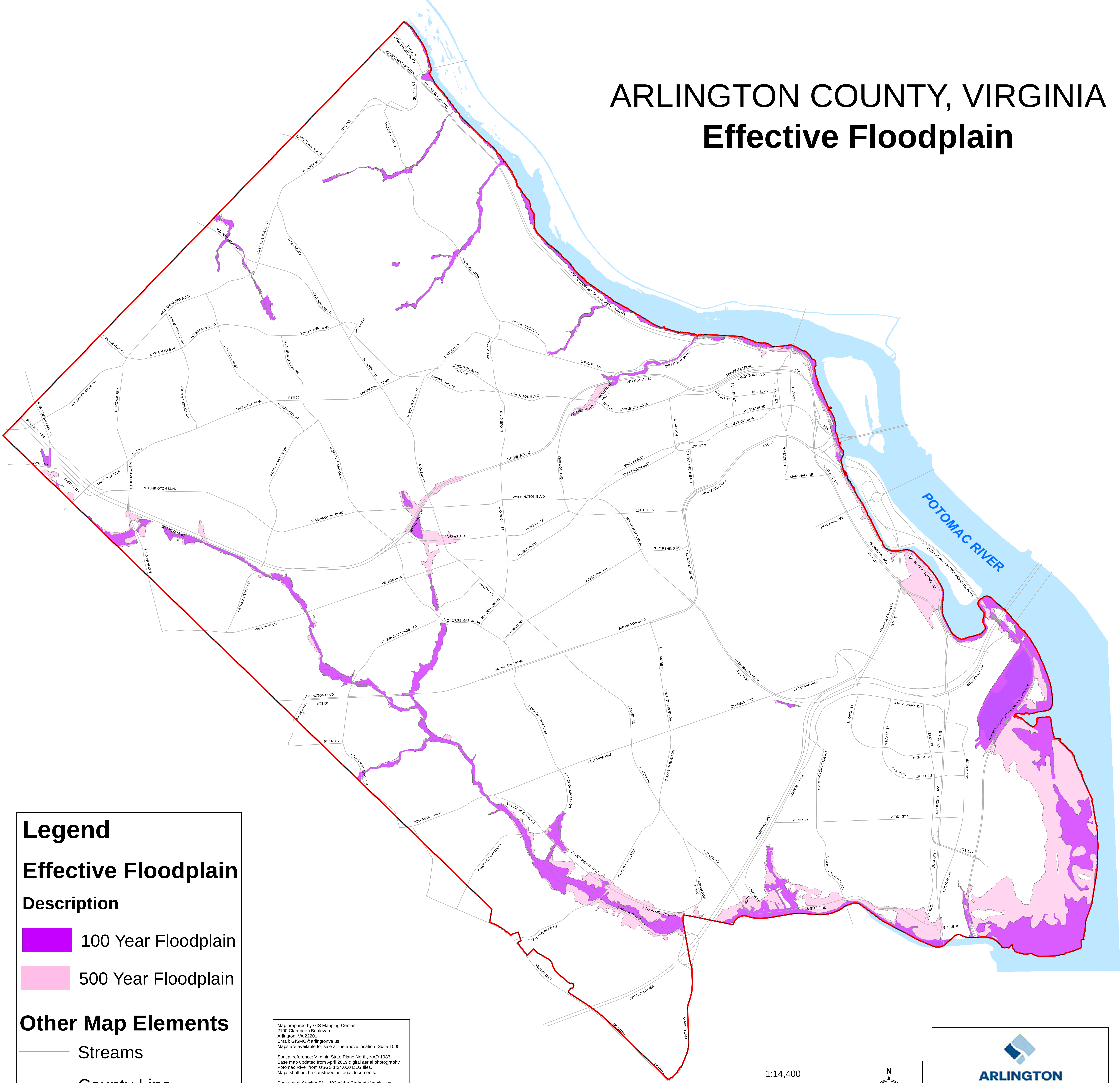
ARLINGTON VIRGINIA

Public Green Stormwater Infrastructure

ARLINGTON COUNTY, VIRGINIA
Effective Floodplain



Legend

Effective Floodplain

Description

100 Year Floodplain

500 Year Floodplain

Other Map Elements

Streams

County Line

Potomac River

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Maps are available for sale at the above location, Suite 1000.

Spatial reference: Virginia State Plane North, NAD 1983.
Base map updated from April 2019 digital aerial photography.
Potomac River from USGS 1:24,000 DLG files.
Maps shall not be construed as legal documents.

Pursuant to Section 54.1-402 of the Code of Virginia, any determination of topography or contours, or any depiction of physical improvements, property lines or boundaries is for general information only and shall not be used for the design, modification, or construction of improvements to real property or for flood plain determination.

Printed: April 2022

1:14,400

0 1,200 2,400 3,600 4,800

Feet

N E S W

ARLINGTON VIRGINIA

Effective Floodplain

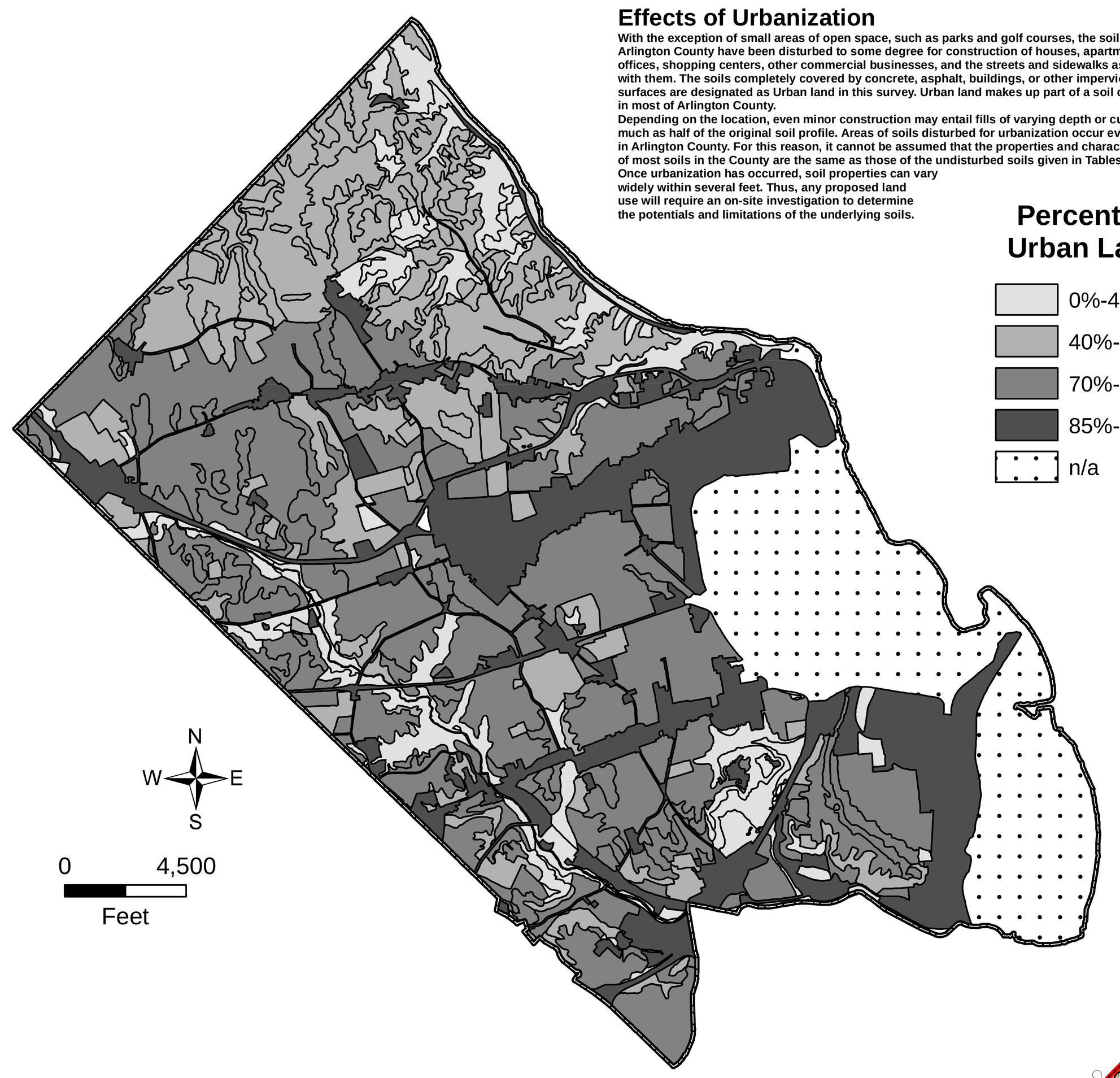
ARLINGTON COUNTY, VIRGINIA

Soil Survey

Effects of Urbanization

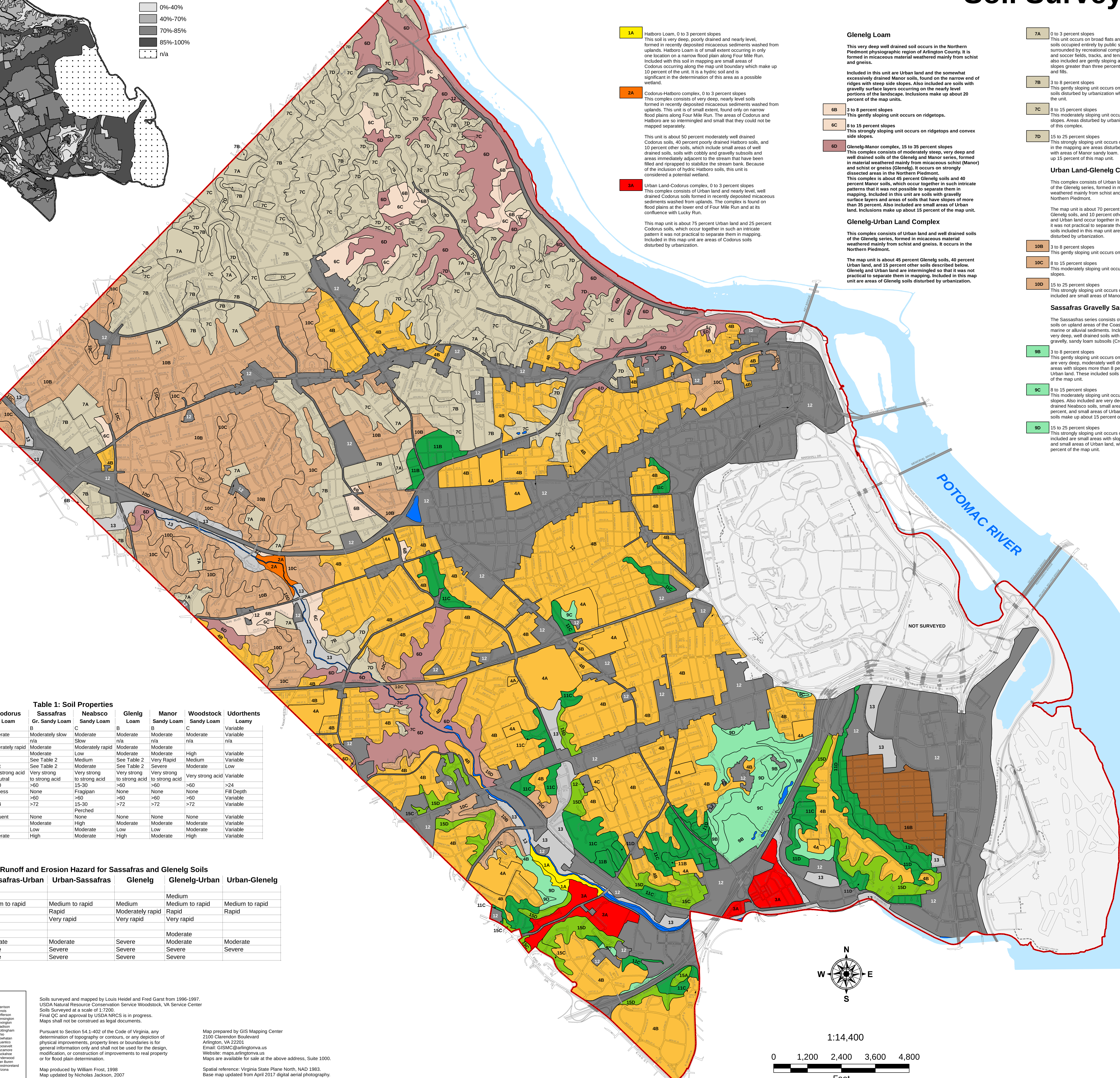
With the exception of small areas of open space, such as parks and golf courses, the soils of Arlington County have been disturbed to some degree for construction of houses, apartments, offices, shopping centers, other commercial businesses, and the streets and sidewalks associated with them. The soils completely covered by concrete, asphalt, buildings, or other impervious surfaces are designated as Urban land in this survey. Urban land makes up part of a soil complex in most of Arlington County.

Depending on the location, even minor construction may entail fills of varying depth or cuts of as much as half of the original soil profile. Areas of soils disturbed for urbanization occur everywhere in Arlington County. For this reason, it cannot be assumed that the properties and characteristics of most soils in the County are the same as those of the undisturbed soils given in Tables 1 and 2. Once urbanization has occurred, soil properties can vary widely within several feet. Thus, any proposed land use will require an on-site investigation to determine the potentials and limitations of the underlying soils.



Percent of Urban Land

- 0%-40%
- 40%-70%
- 70%-85%
- 85%-100%
- n/a



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0 1,200 2,400 3,600 4,800

Feet

1A Hatboro Loam, 0 to 3 percent slopes
This soil is very deep, poorly drained and nearly level, formed in recently deposited micaceous sediments washed from uplands. Hatboro Loam is of small extent occurring in only one location on a narrow flood plain along Four Mile Run. Included with this soil in mapping are small areas of Codorus occurring along the map unit boundary which make up 10 percent of the unit. It is a hydric soil and is significant in the determination of this area as a possible wetland.

2A Codorus-Hatboro complex, 0 to 3 percent slopes
This complex consists of very deep, nearly level soils formed in recently deposited micaceous sediments washed from uplands. This unit is of small extent, found only on narrow flood plains along Four Mile Run. The areas of Codorus and Hatboro are so intermingled and small that they could not be mapped separately.

This unit is about 50 percent moderately well drained Codorus soils, 40 percent poorly drained Hatboro soils, and 10 percent other soils, which include small areas of well drained soils, soils with cobbly and gravelly subsoils and areas immediately adjacent to the stream that have been filled and riprapped to stabilize the stream bank. Because of the inclusion of hydric Hatboro soils, this unit is considered a potential wetland.

3A Urban Land-Codorus complex, 0 to 3 percent slopes
This complex consists of Urban land and nearly level, well drained Codorus soils formed in recently deposited micaceous sediments washed from uplands. The complex is found on flood plains at the lower end of Four Mile Run and at its confluence with Lucky Run.

This map unit is about 75 percent Urban land and 25 percent Codorus soils, which occur together in such an intricate pattern it was not practical to separate them in mapping. Included in this map unit are areas of Codorus soils disturbed by urbanization.

Glenelg Loam

This very deep well drained soil occurs in the Northern Piedmont physiographic region of Arlington County. It is formed in micaceous material weathered mainly from schist and gneiss.

Included in this unit are Urban land and the somewhat excessively drained Manor soils, found on the narrow end of ridges with steep side slopes. Also included are soils with gravelly surface layers occurring on the nearly level portions of the landscape. Inclusions make up about 20 percent of the map units.

6B **3 to 8 percent slopes**
This gently sloping unit occurs on ridgetops.

6C **8 to 15 percent slopes**
This strongly sloping unit occurs on ridgetops and convex side slopes.

6D **Glenelg-Manor complex, 15 to 35 percent slopes**
This complex consists of moderately steep, very deep and well drained soils of the Glenelg and Manor series, formed in material weathered mainly from micaceous schist (Manor) and schist or gneiss (Glenelg). It occurs on strongly dissected areas in the Northern Piedmont.
This complex is about 45 percent Glenelg soils and 40 percent Manor soils, which occur together in such intricate patterns that it was not possible to separate them in mapping. Included in this unit are soils with gravelly surface layers and areas of soils that have slopes of more than 35 percent. Also included are small areas of Urban land. Inclusions make up about 15 percent of the map unit.

Glenelg-Urban Land Complex

This complex consists of Urban land and well drained soils of the Glenelg series, formed in micaceous material weathered mainly from schist and gneiss. It occurs in the Northern Piedmont.

The map unit is about 45 percent Glenelg soils, 40 percent Urban land, and 15 percent other soils described below. Glenelg and Urban land are intermingled so that it was not practical to separate them in mapping. Included in this map unit are areas of Glenelg soils disturbed by urbanization.

7A 0 to 3 percent slopes
This unit occurs on broad flats and consists of nearly level soils occupied entirely by public schools or libraries surrounded by recreational complexes consisting of baseball and soccer fields, tracks, and tennis courts. Other soils also included are gently sloping and distrubed areas with slopes greater than three percent occurring along the cuts and fills.

7B 3 to 8 percent slopes
This gently sloping unit occurs on ridgetops. It includes soils disturbed by urbanization which make up 15 percent of the unit.

7C 8 to 15 percent slopes
This moderately sloping unit occurs on ridgetops and side slopes. Areas disturbed by urbanization make up 15 percent of this complex.

7D 15 to 25 percent slopes
This strongly sloping unit occurs on side slopes. Included in the mapping are areas disturbed by urbanization, along with areas of Manor sandy loam. These included areas make up 15 percent of this map unit.

Urban Land-Glenelg Complex

This complex consists of Urban land and well drained soils of the Glenelg series, formed in micaceous material weathered mainly from schist and gneiss. It is found in the Northern Piedmont.

The map unit is about 70 percent Urban land, 20 percent Glenelg soils, and 10 percent other soils. Glenelg soils and Urban land occur together in such an intricate pattern it was not practical to separate them in mapping. The other soils included in this map unit are areas of Glenelg soils disturbed by urbanization.

10B 3 to 8 percent slopes
This gently sloping unit occurs on ridgetops.

10C 8 to 15 percent slopes
This moderately sloping unit occurs on ridgetops and side slopes.

10D 15 to 25 percent slopes
This strongly sloping unit occurs on side slopes. Also included are small areas of Manor sandy loam.

Sassafras Gravelly Sandy Loam

The Sassasfras series consists of very deep, well-drained soils on upland areas of the Coastal Plain, derived from marine or alluvial sediments. Included in this unit are very deep, well drained soils with strong brown, very gravelly, sandy loam subsoils (Croom).

9B 3 to 8 percent slopes
This gently sloping unit occurs on ridgetops. Also included are very deep, moderately well drained Neabsco soils, small areas with slopes more than 8 percent, and small areas of Urban land. These included soils make up about 15 percent of the map unit.

9C 8 to 15 percent slopes
This moderately sloping unit occurs on ridgetops and side slopes. Also included are very deep, moderately well drained Neabsco soils, small areas with slopes more than 15 percent, and small areas of Urban land. These included soils make up about 15 percent of the map unit.

9D 15 to 25 percent slopes
This strongly sloping unit occurs on side slopes. Also included are small areas with slopes more than 25 percent, and small areas of Urban land, which make up about 15 percent of the map unit.

Sassafras-Urban Land Complex

This complex consists of well drained soils of the Sassafras series derived from marine, alluvial, or fluvial sediments and Urban land. It occurs in upland areas of the Coastal Plain.

The map unit is about 45 percent Sassafras soils and 40 percent Urban land, which occur together in an intricate pattern so that it was not practical to separate them in mapping.

15B 3 to 8 percent slopes
This unit is gently sloping. It includes areas of Neabsco sandy loam and areas disturbed by urbanization, which together make up 15 percent of the complex.

15C 8 to 15 percent slopes
This is a moderately sloping unit. Included within the map unit are areas Neabsco sandy loam, very deep soils with very gravelly sandy loam subsoils, and areas disturbed by urbanization. These areas combine to make up 15 percent of the map unit.

15D 15 to 25 percent slopes
This complex is strongly sloping. Included within the map unit are areas of very deep soils with very gravelly sandy loam subsoils, and areas disturbed by urbanization. These areas combine to make up 15 percent of the map unit.

Urban Land-Sassafras Complex

This complex consists of Urban land and well drained soils of the Sassafras series derived from marine, alluvial, or fluvial sediments of the Coastal Plain. It occurs in upland areas of the Coastal Plain physiographic region.

The map unit is about 70 percent Urban land and 20 to 25 percent Sassafras soils, which intermingle together so that it was impractical to separate them in mapping.

11B 3 to 8 percent slopes
This unit is gently sloping. It includes areas of Neabsco sandy loam and areas disturbed by urbanization, which together make up 5 percent of the complex.

11C 8 to 15 percent slopes
This is a moderately sloping unit. Included within the map unit are areas of very deep soils with very gravelly sandy loam subsoils, and areas disturbed by urbanization. These areas combine to make up 10 percent of the map unit.

11D 15 to 25 percent slopes
This complex is strongly sloping. Included within the map unit are areas of very deep soils with very gravelly sandy loam subsoils, and areas disturbed by urbanization. These areas combine to make up 10 percent of the map unit.

Urban Land-Sassafras-Neabsco Complex

This complex consists of well and moderately well drained soils of the Sassafras and Neabsco series, derived from marine, alluvial, or fluvial sediments deposited on uplands of the Coastal Plain.

Sassafras, Neabsco, and Urban land are closely intermingled and impractical to separate in mapping. Included in this map unit are areas of Sassafras and Neabsco soils disturbed during urbanization.

4A 0 to 3 percent slopes
This map unit is nearly level and is occupied entirely by public shools or libraries which are surrounded by recreational complexes consisting of baseball and soccer fields, tracks, and tennis courts. It is made up of about 40 percent Sassafras soils, 35 percent Urban land, and 15 percent Neabsco soils. Also included are areas with slopes greater than three percent occurring along the cuts and fills. These gently sloping and disturbed areas make up 10 percent of this complex.

4B 3 to 8 percent slopes
This unit is gently sloping and consists of about 70 percent Urban land, 15 percent Sassafras, and 10 percent Neabsco soils. Areas disturbed by cutting and grading make up 5 percent of this unit.

4C 8 to 15 percent slopes
This unit is strongly sloping and consists of about 70 percent Urban land, 15 percent Sassafras, and 10 percent Neabsco soils. Areas disturbed by cutting and grading make up 5 percent of this unit.

16B Urban Land-Woodstown Complex, 3 to 8 percent slopes
This complex consists of Urban land and gently sloping, moderately well drained soils of the Woodstown series, formed from marine, alluvial, or fluvial sediments. It occurs on nearly level terraces and uplands in the Coastal Plain and is found in the Virginia Highlands area of Arlington County.

The map unit is about 70 percent Urban land and 20 percent Woodstown soils, and 10 percent other soils, which are made up of Sassafras soils and areas covered by fill material. Urban land, Woodstown, and other soils occur together in such an intricate pattern that it was impractical to separate them in mapping.

13 Udorthents, loamy
These soils are in areas that have been reworked by machinery and consist of mostly loamy materials placed over various drainage classes on terraces and floodplains occurring along perennial streams in the Piedmont and Coastal Plain. Slope varies but is generally less than 10 percent.

The source of fill material in this unit is variable, consisting of sandy, gravelly, clayey, silty,and micaceous soil material. These reworked areas were created to provide sites for buildings, roads, recreational facilities and flood control. The thickness of the fill is quite variable, but is generally more than 2 feet.

Included with these soils in mapping are soils that are often shaped to some extent but otherwise resemble undisturbed soils surrounding the unit. Also included are some filled areas that have non-soil materials such as concrete rubble in addition to the soil material.

Permeabiliby and available water capacity are quite variable. Internal drainage is highly variable and the probability of ponding and excessive runoff is possible after heavy rainfall.

Most areas have been stabilized and are used for building sites, roads, and recreational development. Some areas are completely covered with buildings and other impervious surfaces. Remaining open areas are generally used for ornamental planting and recreational fields.

12 Urban land-Udorthents complex, 2 to 15 percent slopes
This mapping unit consists of areas where more than 85 percent of the surface is Urban land, covered by buildings, asphalt, concrete, or other impervious materials. The other 15 percent consists of areas of deep to very deep, nearly level to moderately sloping, well and moderately well drained soils. The Urban land and Udorthents are so intermingled it was not practical to map them separately. This complex occurs throughout the survey area but is largely located in the Rosslyn-Ballston and Crystal City areas. This unit is about 85 percent Urban land, 10 percent Udorthents, and 5 percent other soils.

The Udorthents consist of material that has been graded, cut, filled, or otherwise disturbed during urbanization. The disturbed material is loamy and generally reflects the soils in the adjacent area.

Included in this mapping unit are small areas of soils that have not been disturbed. Also included are moderately steep and steep slopes.

It is not pratical to examine nor attempt to identify the soil or soil-like material of this unit.

Table 1: Soil Properties

Series	Hatboro	Codorus	Sassafras	Neabsco	Glenlg	Manor	Woodstock	Udorthents
Texture	Loam	Loam	Gr. Sandy Loam	Sandy Loam	Loam	Sandy Loam	Sandy Loam	Loamy
Hydrological Soil Group	D	C	B	C	B	B	C	Variable
Permeability-Subsoil	Moderate	Moderate	Moderately slow	Moderate	Moderate	Moderate	Moderate	Variable
Fragipan	n/a	n/a	n/a	Slow	n/a	n/a	n/a	n/a
Substratum	Moderately rapid	Moderately rapid	Moderate	Moderately rapid	Moderate	Moderate		
Available Water Capacity	Moderate	High	Moderate	Low	Moderate	Moderate	High	Variable
Surface Runoff	Slow	Slow	See Table 2	Medium	See Table 2	Very Rapid	Medium	Variable
Erosion Hazard	Slight	Slight	See Table 2	Moderate	See Table 2	Severe	Moderate	Low
Soil Reaction	Very strong acid to neutral	Very strong acid to neutral	Very strong to strong acid	Very strong to strong acid	Very strong to strong acid	Very strong to strong acid	Very strong acid	Variable
Root Zone Depth (in)	10-20	10-20	>60	15-30	>60	>60	>60	>24
Root Zone Restriction	Wetness	Wetness	None	Fragipan	None	None	None	Fill Depth
Depth of Bedrock (in)	>60	>60	>60	>60	>60	>60	>60	Variable
Depth to Water Table (in)	0-6	12-24	>72	15-30	>72	>72	>72	Variable
Type of Water Table	Apparent			Perched				
Flooding Potential	Frequent	Frequent	None	None	None	None	None	Variable
Potential Frost Action	High	High	Moderate	High	Moderate	Moderate	Moderate	Variable
Corrosivity - Steel	High	High	Low	Moderate	Low	Low	Moderate	Variable
Concrete	Moderate	Moderate	High	Moderate	High	Moderate	High	Variable

Table 2: Surface Runoff and Erosion Hazard for Sassafras and Glenelg Soils

Series	Sassafras	Sassafras-Urban	Urban-Sassafras	Glenelg	Glenelg-Urban	Urban-Glenelg
Surface Runoff						
0-3 percent slopes					Medium	
3-8 percent slopes	Slow	Medium to rapid	Medium to rapid	Medium	Medium to rapid	Medium to rapid
8-15 percent slopes	Medium	Rapid	Rapid	Moderately rapid	Rapid	Rapid
15-25 percent slopes	Rapid	Rapid	Very rapid	Very rapid	Very rapid	
Erosion Hazard						
0-3 percent slopes					Moderate	
3-8 percent slopes	Moderate	Moderate	Moderate	Severe	Moderate	Moderate
8-15 percent slopes	Moderate	Severe	Severe	Severe	Severe	Severe
15-25 percent slopes	Severe	Severe	Severe	Severe	Severe	

Block Numbers on Numbered Streets

200	Ball	2000	Taft	3700	Nelson	5400	Harrison
300	Clark	2100	Uhle	3800	Oakland	5500	Illinois
400	Dale	2200	Veitch	3900	Pollard	5600	Jefferson
500	Eads	2300	Wayne	4000	Quincy	5700	Kensington
600	Fern	2400	Adams	4100	Randolph	5800	Lexington
700	Grant	2500	Barton	4200	Stafford	5900	Madison
800	Hayes	2600	Cleveland	4300	Taylor	6000	Nottingham
900	Ives	2700	Danville	4400	Utah	6100	Ohio
1000	Joyce	2800	Edgewood	4500	Vermont	6200	Powhatan
1100	Kent	2900	Fillmore	4600	Wakefield	6300	Quantico
1200	Lynn	3000	Garfield	4700	Abingdon	6400	Roosevelt
1300	Meade	3100	Highland	4800	Buchanan	6500	Sycamore
1400	Nash	3200	Irving	4900	Columbus	6600	Tuckahoe
1500	Oak	3300	Jackson	5000	Dinwiddie	6700	Underwood
1600	Pierce	3400	Kenmore	5100	Edison	6800	Van Buren
1700	Queen	3500	Lincoln	5200	Frederick	6900	Westmoreland
1800	Rolfe	3600	Monroe	5300	Greenbrier	7000	Arizona
1900	Scott						

South and West Sides are Even Address Numbers

Soils surveyed and mapped by Louis Heidel and Fred Garst from 1996-1997.
USDA Natural Resource Conservation Service Woodstock, VA Service Center
Soils Surveyed at a scale of 1:7200.
Final QC and approval by USDA NRCS is in progress.
Maps shall not be construed as legal documents.

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Map produced by William Frost, 1998
Map updated by Nicholas Jackson, 2007

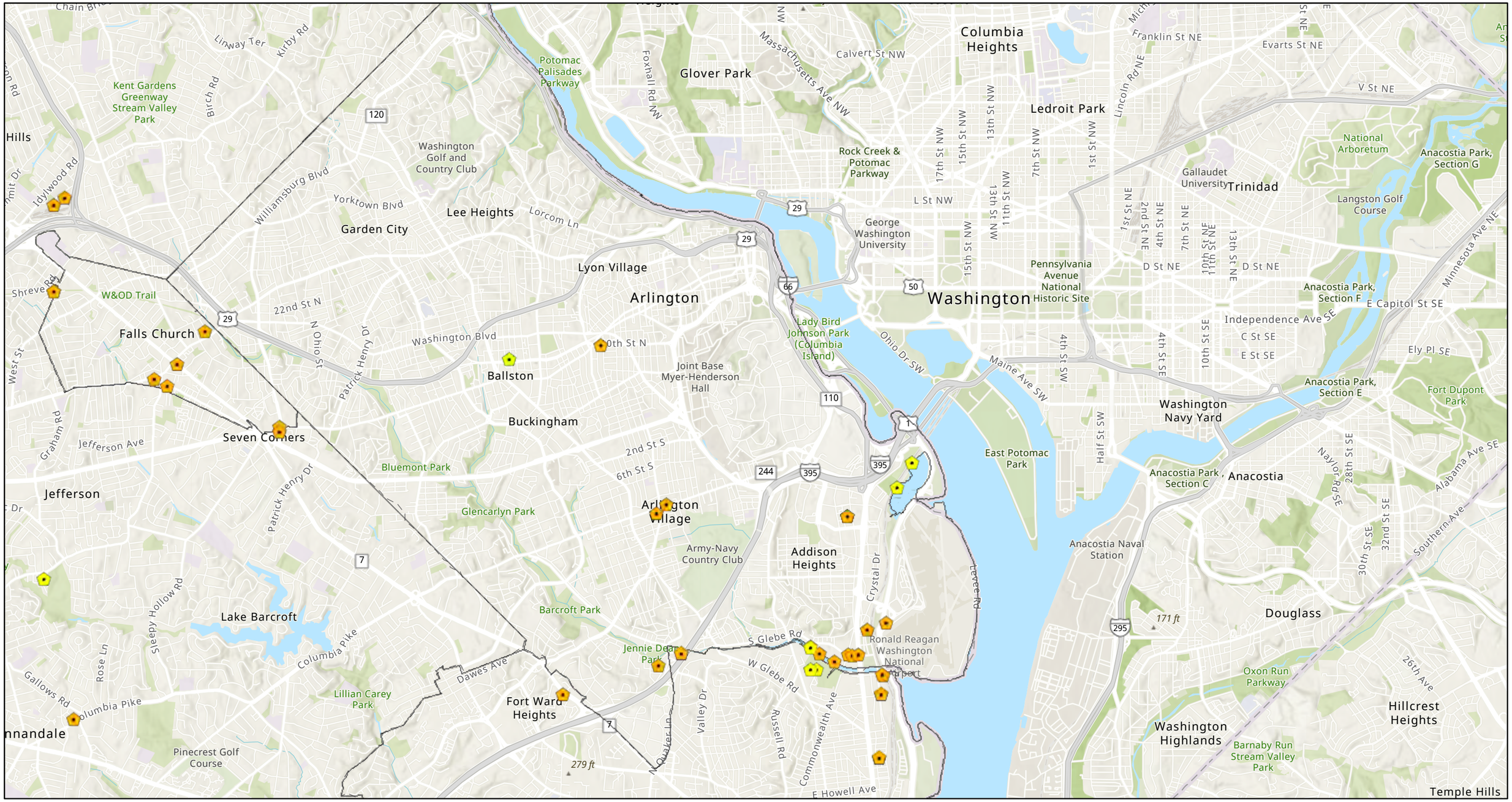
Map prepared by GIS Mapping Center
2100 Clarendon Boulevard
Arlington, VA 22201
Email: GISMC@arlingtonva.us
Website: maps.arlingtonva.us
Maps are available for sale at the above address, Suite 1000.

Spatial reference: Virginia State Plane North, NAD 1983.
Base map updated from April 2017 digital aerial photography.
Potomac River from USGS 1:24,000 DLG files.
Cadastral and political data layers are maintained on an on-going basis.

ARLINGTON
VIRGINIA

Soil Survey

Environmental Data Mapper Web Map



8/29/2022, 1:37:34 PM

VPDES Outfalls (Daily)

- General Permits
- Individual Permits
- Virginia County Boundaries
- DEQ Offices (2020)

1:72,224

0 0.5 1 2 mi

0 1 2 4 km

Virginia Department of Environmental Quality, Esri, NASA, NGA, USGS, FEMA, This EPA Geospatial data set is generated from the following national environmental programs: Superfund National Priorities

Provided by Virginia Department of Environmental Quality

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