

**Developing a Blue-Green
Infrastructure Plan for the GW
Region: Final Report**



NA10NOS4190205-Task 12.03

FY 2010



**Developing a Blue-Green Infrastructure
Plan for the GW Region**

NA10NOS4190205-Task 12.03

FY 2010

FINAL REPORT

This project was funded, in part, by the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant #NA10NOS4190205 of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, under the Coastal Zone Management Act of 1972, as amended.

The views expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Department of Commerce, NOAA, or any of its sub-agencies.

Table of Contents

Product #1: Regional Green Infrastructure Report	4
Attachment 1.1: Final Report (with Executive Summary)	4.1 - 4.118
Attachment 1.2: Digital (.shp) files of Recommended Regional Green Infrastructure Plan (on disk)	5
Product #2: Summary of Local Government and Regional Stakeholder Comments on Regional Green Infrastructure Plan	6
Attachment 2.1: Local Planning Commission meeting minutes	6
Attachment 2.2: Local Government Staff and/or NGO comments.....	9
Product #3: Summary of GWRC Action on Proposed Regional Green Infrastructure Plan	10
Attachment 3.1: Final GWRC Resolution (draft).....	10
Attachment 3.2: Adopted GWRC Resolution (final).....	11

Product #1: Regional Green Infrastructure Plan Report

Attachment 1.1

Final Report

(with Executive Summary)



2011

Regional Green Infrastructure Plan



Regional Green Infrastructure Plan

Acknowledgments

The GWRC expresses its appreciation for the professional and community interest contributions of the members of the GWRC Green Government Commission's Green Earth Sub-Committee which provided technical and community input to the development of this plan. Additional recognition is given to a team of college student interns that, over the three years of the Plan's development, contributed extensively to the development of this plan and the component mapping and other planning research and analysis tasks incorporated herein.

Steering Committee

Paula Chow, Sierra Club and City of Fredericksburg
Amber Forestier, Stafford County
Chris Folger, Spotsylvania Greenways Initiative
Patricia Kurpiel, Friends of Stafford Creeks
Michael Lott, Stafford County
David Nunnally, Caroline County
Jacob Pastwik, Spotsylvania County
Mac Saphir, Caroline County
Heather Straughan, King George County
Eric Lawrence Stott, Sierra Club and King George County
Kevin Utt, City of Fredericksburg (Chair)

Partnering Organizations

Million Mile Greenway (Atlanta, Ga)
PhotoScience, Inc.
Virginia Department of Forestry
American Forests

GWRC Staff and Intern Team:

Kevin F. Byrnes, AICP, Director of Regional Planning and Regional Demographer
Laurel Hammig, Senior Regional Planner (2007-2011)
Brittney Baker, Intern, University of Mary Washington & Duke University (2008, 2011)
Elizabeth Hudson, Intern, University of Mary Washington (2011)
Laura Wagner, Intern, University of Arizona (2011)
Ryan Flaherty, Intern, University of Mary Washington (2011)
Lynnette Humphries, Intern, University of Mary Washington (2009, 2011)
Wade Dickinson, Intern, Virginia Polytechnic University (2010)

This project was funded, in part, by the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant #NA10NOS4190205 of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, under the Coastal Zone Management Act of 1972, as amended.

The views expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Department of Commerce, NOAA, or any of its sub-agencies.

RESOLUTION NO. 12-07

ENDORING THE REGIONAL GREEN INFRASTRUCTURE PLAN

WHEREAS, the George Washington Regional Commission ("the Commission") is the Planning District Commission serving the City of Fredericksburg and Caroline, King George, Spotsylvania and Stafford counties, known together as Planning District 16, and

WHEREAS, the Commission received funding in FY 2008-2009, 2009-2010 and 2010-2011 from the Virginia Coastal Zone Management Program to develop a regional Green Infrastructure Plan, and;

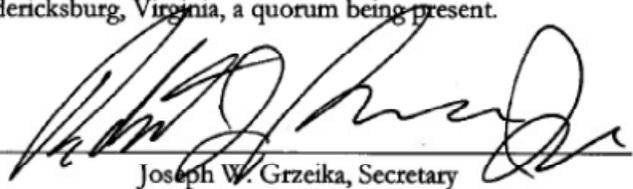
WHEREAS, the Commission staff, in consultation and collaboration with the Commission's Green Government Commission Green Earth Sub-Committee, made up of local government planners, public works personnel and representatives of other community environmental interest groups, developed the Regional Green Infrastructure Plan presented to the Commission in Executive Summary form at the Commission's September 19th meeting, and;

WHEREAS, the Regional Green Infrastructure Plan provides analytical tools and strategies to support local governments' involvement in and response to Virginia's Chesapeake Bay Watershed Implementation Plan-Phase 2 program; and,

WHEREAS, the Regional Green Infrastructure Plan is advisory in nature and respects local governments' autonomy, while identifying regional assets within each community that, with cooperation among local governments, could be preserved or enhanced to maintain the Region's high quality of life and natural areas and open space valued by the region's citizenry.

NOW, THEREFORE, BE IT RESOLVED by the George Washington Regional Commission that it hereby approves and endorses the proposed Regional Green Infrastructure Plan and directs the staff to forward this document to: a) the Virginia Coastal Zone Management Program in fulfillment of the program's grant requirements and b) to local governments and other stakeholders in Planning District 16 as a reference tool and guide to promote local consideration of green infrastructure planning as part of the local comprehensive planning and stormwater management planning process and related implementation programs.

Adopted by the George Washington Regional Commission at its duly called meeting of October 17, 2011, in the City of Fredericksburg, Virginia, a quorum being present.



Joseph W. Grzeika, Secretary

October 17, 2011

Signed by Chair in absence of Secretary



Table of Contents

List of Tables.....	5
List of Figures.....	5
I. Executive Summary.....	6
II. Green Infrastructure: Introduction.....	12
III. The Green Infrastructure Plan.....	15
IV. Goals of the Green Infrastructure Plan.....	17
V. Assessing the Regional Asset.....	19
A. Custom regional VCLNA Data Set (GWRC Eco-Cores & Corridors).....	19
B. Urban Ecosystem Analysis.....	19
C. Estimating Impervious Surface Area.....	27
D. Regional and Local Greenway Planning.....	28
E. Regional Scenario Planning Models.....	35
F. Children and Nature Network.....	42
VI. Green Infrastructure Implementation Toolkit.....	43
A. Zoning Tools.....	43
B. Design/Density Tools.....	51
C. Land Management Program Tools.....	63
D. Agricultural and Forestal Districts.....	70
E. Education.....	72
F. Mapping Tools.....	73
G. Other Tools.....	74
VII. Highlighting Local “Green Infrastructure”-Related Programs.....	77
A. Land and Open Space Conservation-Oriented Green Infrastructure Efforts.....	77
B. Park and Greenway Operation, Planning & Acquisition and Urban Reforestation Initiatives.....	83
C. Local Government Planning & Zoning Practices.....	88
D. Stormwater Management Planning and Program Implementation.....	90
Conclusion.....	95
VIII. Findings and Recommendations.....	96
A. Findings.....	96
B. Recommendations.....	97
Appendices.....	98
Sources and EndNotes.....	118

List of Tables

Table No.	Title	Page
1	GWRC Greenway Siting Model	28
2	Local Government Planning & Zoning Practices	88
3	Summary of Low Impact Development Ordinances for the City of Fredericksburg	90

List of Figures

Figure No.	Title	Page
1	Green Infrastructure Network Components	5
2	2009 Classified Land Cover, Planning District 16 (30-meter resolution)	20
3	Caroline County Green Infrastructure Network	21
4	City of Fredericksburg Green Infrastructure Network	22
5	King George County Green Infrastructure Network	23
6	Spotsylvania County Green Infrastructure Network	24
7	Stafford County Green Infrastructure Network	25
8	Changes in Hydrology from Increased Impervious Surface	26
9	Greenway Paths for Caroline County	29
10	Greenway Paths for the City of Fredericksburg	30
11	Greenway Paths for King George County	31
12	Greenway Paths for Spotsylvania County	32
13	Greenway Paths for Stafford County	33
14	GWRC Green Print Growth Scenario – General Development Map	36
15	GWRC Regional Composite Map – Green Print Layer – Contributing Factors	37
16	GWRC Regional Composite Map – Green Print Avoidance Layer	38
17	Summary Matrix (Scenario Planning)	39
18	Scenario Planning Results – Green Print Scenario	40
19	Scenario Planning Results – Compact Growth Scenario	40
20	Scenario Planning Results – Decentralized Growth Scenario	41

I. Executive Summary

The George Washington Region (Planning District 16) has experienced the most rapid population growth of any region in the Commonwealth for almost two decades. The cumulative result of hundreds of private development actions individually approved at various levels by local governments (acting in the absence of an overall regional plan to coordinate local actions) has led to a regional development pattern with unintended and unforeseen consequences, including the fragmentation and loss of valuable forest and open space.

Green infrastructure is an interconnected network of natural areas, other open spaces and management practices that conserve natural ecosystem functions, sustains clean air, promotes water quality (by mimicking natural processes to infiltrate, evapotranspire or reuse storm water or runoff), and provides a wide array of benefits to people and wildlife. Our green infrastructure resources include commercial and non-commercial forests, waterways, wildlife areas, wetlands, historic landscapes, working farms, vineyards and pasture, and public parks.

As an approach to strategic conservation of our green infrastructure assets, the GWRC undertook a series of tasks to define the region's critical green infrastructure and the pressure on this regional asset. Moreover, recent activities in the finalization of the Plan have emphasized the relevance of the Plan to local watershed implementation planning efforts to respond to TMDL goals coming from the Commonwealth of Virginia. The plan includes eight key products:

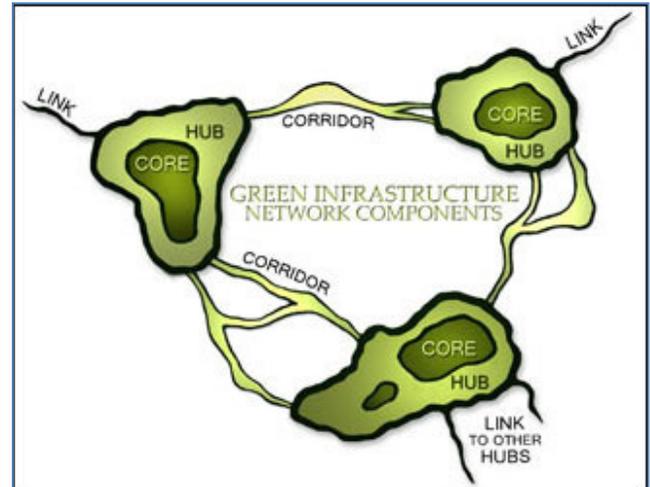


Figure 1: Green Infrastructure Network Components
Source: The Conservation Fund

Custom Regional VCLNA Data Set (i.e. Regional Eco-cores & Corridors maps)

A regional green infrastructure map will identify intact habitat areas (cores) through a network of corridors to allow people, wildlife, and plants to move across the landscape. A connected landscape makes species less susceptible to extinction while allowing for both conservation and recreation. This contributes to better land use planning, better protection of green infrastructure, and healthier communities.

The Virginia Natural Heritage Program in the Department of Conservation and Recreation developed the Virginia Conservation Lands Needs Assessment (VCLNA) dataset which is an integrated assemblage of geospatial data and conservation prioritization guidelines. The GWRC updated the VCLNA map data from 2000 to 2009 using the most recent building footprint files from local governments, demonstrating the areas of lost or disturbed natural environment resulting from post-2000 land development. These maps can be seen on pages 19-24.

Urban Ecosystem Analysis

Healthy trees provide valuable ecosystem services including reducing stormwater runoff, increasing atmospheric carbon sequestration and storage, improving air and water quality. The greater the tree cover and the less the impervious surface area in a community, the more ecosystem services are produced and the greater the community benefit from the existing tree cover.

Using imagery provided by the *National Oceanic and Atmospheric Administration's* Coastal Change Analysis Program (C-CAP), GWRC staff worked with the non-profit American Forests and their CITYgreen® spatial

analysis tool. This tool allowed the GWRC to analyze the land cover of Virginia Planning District 16 and calculate a variety of ecosystem service benefits of the Region's remaining tree canopy. The tool was used to analyze land cover in the three major watersheds in the Region, the ecological cores of the Region, locally-defined Resource Protection Areas, and the sub-watershed containing two local reservoirs (i.e. Motts Run and Rocky Pen Run). The goal of this study was to provide regional and sub-regional information on general land cover trends over a 13 year period (1996-2009) and the associated monetary value of the ecological services provided by the tree canopy within each area.

The CITYgreen® analysis examined land cover change trends over the 13 year period and found that Planning District 16 lost 4.17% of its tree canopy, while gaining 2.80% of urban bare area, 8.68% of open space, and 43.46% of impervious surface area. These changes resulted in the loss of the tree canopy's ability to naturally manage 222.98 million cubic feet of stormwater, valued at \$1.06 billion using a local average engineering cost of \$4.75¹ per cubic foot for man-made stormwater retention facilities. The Region's "green infrastructure" also lost the ability to remove approximately 2.89 million lbs. of air pollutants annually, valued at \$7.74 million per year, 1.24 million lbs. of carbon stored in trees' wood, and 9,616 lbs. of annual carbon sequestration.

Through this study, GWRC analyzed the ecosystem service benefits that the Region would derive if it pursued and achieved a goal of restoring 5 percent of the Region's tree canopy, thereby reversing the losses of the last 13+ years. If the Region increased its canopy cover by 5% overall, the ecosystem services would provide an additional \$4.61 million in annual air pollutant removal value, an additional 1,970,156 tons of stored carbon and an annual 15,338 tons of sequestered carbon, as well as potentially 589.06 million cubic feet of additional managed stormwater, valued at \$2.80 billion. Of course the Region would also realize other benefits in the form of increased property value (due to increased land valuation), increased tax revenue, reduced energy consumption, reduced carbon "footprint", etc.

Estimating Impervious Surface Area

Impervious surface areas in the George Washington Region generate stormwater runoff which, if not properly managed, can erode the landscape, contributing non-point pollution, and sediment to streams, rivers, and ultimately the Chesapeake Bay. In this project, GWRC researched and evaluated differences between readily-available modeling tools, one of which was the Impervious Surface Analysis Tool (ISAT) developed by NOAA researchers, for estimating impervious surface area for various geographies in the George Washington region.

From GWRC's research that compared the results of different models and methods, it was determined when analyzing different City of Fredericksburg imagery data (30 meter² versus 1-meter resolution) that the 30-meter resolution imagery over-estimated the City's impervious surface area by 34%, as well as under-estimated the City's tree canopy by 40%. These findings are troubling when considered in the context of the reasonableness and fairness of Total Maximum Daily Load (TMDL) allocations to communities throughout the Chesapeake Bay watershed, particularly on communities in the MS-4 program.

This study recommended that local governments collaborate in acquiring higher-resolution imagery (1-meter or less) and in applying a consistent land cover classification to this imagery to:

- a) develop a consistent dataset of land cover for the region which will support regional and local comprehensive land use and environmental planning and

¹ Local cost estimates ranged from under \$2.00 to over \$10.00 per cubic foot. \$4.75 was used as a cost average, but local stormwater program managers, in some cases, place a higher value on the cost-avoidance benefit of green infrastructure.

² 30 meter resolution imagery is the basis for EPA's estimates of land cover and land cover change across the Chesapeake Bay watershed for the Chesapeake Bay watershed implementation plan and total maximum daily load (TMDL) pollution reduction goals.

b) assist in developing local code revisions to comply with federal urban storm water management (MS4) requirements, Chesapeake Bay Preservation Act Phase III compliance, State Storm Water Management and Chesapeake Bay TMDL regulations.

Regional and Local Greenway Planning

MillionMile Greenway (MMG), an organization which aims to solve the problem of disconnected communities due to daily destruction of undeveloped land, partnered with the GWRC to create a “greenway” planning model which illustrated a set of corridors to provide citizens with natural experiences through active recreational opportunities. GWRC provided necessary spatial data as well as obtained local citizen and government staff participation to identify the necessary model inputs. MMG, through their technical partner PhotoScience, Inc., then performed a suitability analysis to determine the most suitable areas in Planning District 16 for new greenway development.

MMG then provided the GWRC with the derived data sets to use in local planning. GWRC staff collaborated with the Green Government Commission’s Green Earth Subcommittee to decide on weightings of the suitability surfaces provided by MMG. The group consensus was to display the top 50% of the calculated corridors. The resulting maps can be seen on pages 28-32.

Regional Scenario Planning Models

Scenario planning is being used in support of the regional long-range transportation planning program to identify regional goals and community values, as well as explore alternatives for growth, development, and transportation investments in the region. A preferred development scenario and supporting recommendations for Your Vision, Our Future³ will be available to local governments as they contemplate future updates to their plans and ordinances.

FAMPO and GWRC created a project steering committee to provide direct oversight and counsel in the planning process. Citizens took online surveys and the FAMPO/GWRC held focus group meetings and citizen workshops. The project team prepared four development scenarios using the general themes of volunteered information by the partnering groups. The four scenarios include Decentralized Growth, Compact Centers & Growth Corridors, Green Print Initiative, and Greater Jobs-Housing Balance.

Results of the citizens’ surveys showed that overall, residents are clear that they do not want decentralized growth which was preferred by only 5% of the respondents. Thirty-six (36) percent of respondents preferred the Greenprint scenario, 34% the Compact Centers & Growth Corridors scenario, and 25% the Greater Jobs-Housing Balance scenario. Respondents who preferred the Greenprint scenario liked it most (32%) because of the large areas of preserved open space. Fifty-two (52) percent of the respondents said they chose the Compact Centers & Growth Corridors scenario because they like having everything close by. Not surprisingly, job opportunity had the biggest influence (30%) on the selection of the Greater Jobs-Housing Balance scenario.

One of the final development scenarios to be prepared for the project will represent adopted comprehensive plans in the region (a.k.a. the “Adopted Plans Development Scenario”). It will highlight the tradeoffs (if any) associated with implementing adopted visionary plans vs. adopted zoning ordinances for promoting desirable development types, patterns, and intensities in the region. A summary of the development scenario and values for the development scenario report card will be shared with the Scenario Planning Steering Committee at the next scheduled meeting. In the meantime, the Fredericksburg Area metropolitan Planning Organization (FAMPO) will consider information generated for Your Vision, Our Future as it updates its next Long-Range Transportation Plan, now underway.

³ See: <http://www.fampo.gwregion.org/transportation-planning-documents/regional-land-use-scenario-planning/>

Children and Nature Network

GWRC collaborated with local stakeholders to explore the development of a regional Children and Nature Network (CANN) program to expand youth-oriented environmental education in the region. Inspired by Richard Louv's book, "Last Child in the Woods," this program's purpose is, by fostering this education, to encourage children and their families to become more connected with nature. This connection with nature will help to promote healthy lifestyles among families, ultimately helping to reduce the risk of child obesity, and other related health issues. Similarly, this program will help to strengthen relationships within families and will promote participation within the community.

Last year, the local CANN effort developed the "Children and Nature Guide", a web-based comprehensive inventory of local parks and recreational areas that includes park locations, hours, available amenities, and other relevant information. Currently, CANN is working on a "Passport to the Central Rappahannock", a project designed to connect different nature-based programs and recreational areas across the region and encourage families' participation and visitation. This product is available for public download from FOR's and GWRC's websites.⁴

Implementation Toolkit

The Green Infrastructure plan for the George Washington Region includes an implementation toolbox for localities. This Toolbox profiles seven types of planning and management tools; i.e. zoning, design/density, environmental programs, agricultural and forestal districts, maps, low impact development (LID) and best management practices for urban stormwater management.

Highlighting Local "Green Infrastructure"-Related Programs

The Green Infrastructure plan for the Region builds on many local programs and planning initiatives which are complementary to the goals of Green Infrastructure planning, from urban stormwater management and low-impact development initiatives to land conservation and open space protection achieved through land purchase for public parks and the acquisition of riparian and conservation easements and the promotion of working farms through aggressive farmers market promotions and innovative environmental management practices that incentivize farmers for maintaining their lands in active cultivation.

Previous planning work by GWRC to address local government progress in complying with Chesapeake Bay Preservation Act requirements identified local government interest in being included among referenced localities in the Code of Virginia (§ 15.2-961.1) which section allows localities to adopt tree conservation or preservation ordinances that provide for tree canopy coverage in the local site plan or development review process.

Findings

1. The active development of the Region over the 13 years from 1996 through 2009 contributed to a loss of 4.17% of its tree canopy, while gaining 2.80% of urban bare area, 8.68% of open space, and 43.46% of impervious surface area. The Region is still blessed with an enviable amount of tree canopy land cover, relative to other rapidly urbanizing or established urban metro areas.
2. The cumulative changes to the Region's land cover and associated losses to the Region's tree canopy resulted in the loss of the tree canopy's ability to naturally manage 222.98 million cubic feet of stormwater,

⁴ <http://www.riverfriends.org/Publications/PassporttotheCentralRappahannock/tabid/557/Default.aspx>

valued at \$1.06 billion using an assumed average cost of \$4.75⁵ per cubic foot for man-made stormwater retention facilities. As a result of these changes, the Region’s “green infrastructure” also lost the ability to remove approximately 2.89 million lbs. of air pollutants annually, valued at \$7.74 million per year, 1.24 million lbs. of carbon stored in trees’ wood, and 9,616 lbs. of annual carbon sequestration.

3. Local governments do not, generally speaking, have reliable data on the amount of impervious surface area within their jurisdiction to estimate accurately the amount of stormwater runoff by sub-watershed. These data could help localities identify priority areas for urban retrofit programs or to target reforestation efforts.
4. Active coordination between local government urban stormwater management programs and rural-oriented Soil and Water Conservation District programs is vital to achieve balanced reductions in non-point source pollution. The SWCDs will be challenged in addressing agricultural run-off issues and facilitating the development of nutrient management plans for each agricultural operation.
5. Between the urban MS4 program requirements and the Chesapeake Bay Preservation Act regulations requiring a cataloging of installed BMPs in each CBPA community, both urban and rural; all localities in the region should have a good grasp of the distribution of these facilities throughout their jurisdiction. However, the over-lapping and (at-times) seemingly contradictory stormwater regulations under various federal and state programs challenge local governments to cost-effectively manage development and associated stormwater-related water quality impacts.
6. Public opinion response to alternative regional land use scenarios demonstrated a preference for the “Greenprint” scenario, with 36 percent of respondents choosing the Greenprint scenario as the preferred option, followed by 34 percent for the “Compact Cores and Growth Corridors” scenario, and 25 percent for the “Greater Jobs-Housing Balance” scenario. Respondents who preferred the Greenprint scenario liked it most (32 percent) because of the large areas of preserved open space.
7. Many of the planning and growth management tools authorized under the Code of Virginia have been utilized by local governments to manage growth and development.
8. Green infrastructure planning practice in the Region heretofore has focused somewhat more on advancing the stormwater management practices (e.g. promoting low impact development practices as part of local governments’ response to federal and state environmental mandates). However, such notable efforts as Stafford County and the State’s acquisition of Crow’s Nest – Part 2, the adoption of a Spotsylvania County Trailways Plan, the establishment of the Mattaponi Wildlife Management Area, local designation of urban development areas, and many other initiatives demonstrates local movement toward the identification, prioritization and conservation of rural forests, working farms and other open spaces for their recognized ecological asset value.
9. There is no established locally-based, conservation-oriented land trust in Planning District 16 that can hold conservation easements. Consequently, local conservation easement negotiations must involve such out-of-region interest as the Northern Virginia Conservation Trust, the Virginia Outdoors Foundation and other entities. A local land trust may facilitate easement acquisitions.
10. Local governments have supported exploration (through the Rappahannock River Basin Commission and other initiatives) of innovative approaches to “green infrastructure” planning, such as nutrient credit

⁵ Local cost estimates ranged from under \$2.00 to over \$10.00 per cubic foot. \$4.75 was used as a regional cost average, but local stormwater program managers, in some cases, place a higher value on the cost-avoidance benefit of green infrastructure.

trading and other market-based approaches to removing pollutants from the air and water sources that pollute the Chesapeake Bay and its tributaries.

11. Local governments are interested, if designated an ozone non-attainment area, in being added to the Code of Virginia (§ 15.2-961.1) that allows referenced local governments authority to adopt a local ordinance to include in site plan review provisions for the preservation or replacement of trees on the development site.
12. Local community financial and political support will be needed to achieve continued progress in green infrastructure plan implementation.

Recommendations

1. Adopt quantitative regional goals to achieve reforestation and land conservation; including:
 - a. Increasing regional tree canopy by 5 percent (approximately 51.5 sq. miles), thereby restoring a little more than the amount of tree canopy lost in the Region in the 1996-2009 era, with priority given to infilling gaps in riparian buffers, and other areas that complement water quality protection programs implemented and expanded to respond to Chesapeake Bay watershed implementation planning goals.
 - b. Encouraging public and private landowners to increase land acreage in the Region under conservation easement by 14,300 acres, representing the Region's pro-rata share of Governor McDonnell's 400,000 acre statewide conservation easement goal for his 4-year term.
2. Continued collaboration of GWRC's ad-hoc watershed implementation plan committee with full local government technical staff participation and broad involvement of community-wide stakeholders from all sectors to develop a comprehensive, cost-effective regional responses to Chesapeake Bay Watershed Implementation Plan Phase 2 process and expansion of the installed inventory of BMPs.
3. Should a grant opportunity materialize, local governments should work through GWRC to create a 1-meter (or better) classified land cover data layer that could better define the Region's green and grey infrastructure and support comprehensive land use planning, green infrastructure planning and watershed implementation and stormwater management planning.
4. Pursue legislative support for amending the Code of Virginia (§ 15.2-961.1) to include PD 16 in the legislation so that local governments are empowered (should they be designated part of ozone non-attainment area) to require tree conservation and preservation in the site plan review process of development proposals.
5. GWRC Board endorsement of the Regional Green Infrastructure Plan and direction to staff to communicate the Plan document to local governments and other stakeholders in the Region as an advisory tool to help public and private actors incorporate green infrastructure planning into comprehensive planning and land development processes.

II. Green Infrastructure: Introduction

Green infrastructure is a term that has different meanings in different contexts. To some “green infrastructure” means: “...an interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water (quality), and provides a wide array of benefits to people and wildlife”. Within this context, green infrastructure is a strategically planned and managed network of natural lands, working landscapes, and other open spaces that conserve ecosystem values and functions and provide associated benefits to human populations.

The foundation of such green infrastructure networks are their natural elements – woodlands, wetlands,

rivers, grasslands – that work together as a whole to sustain ecological functions. Healthy functioning natural or restored ecological systems are essential to ensure the availability of the network’s ecological services.

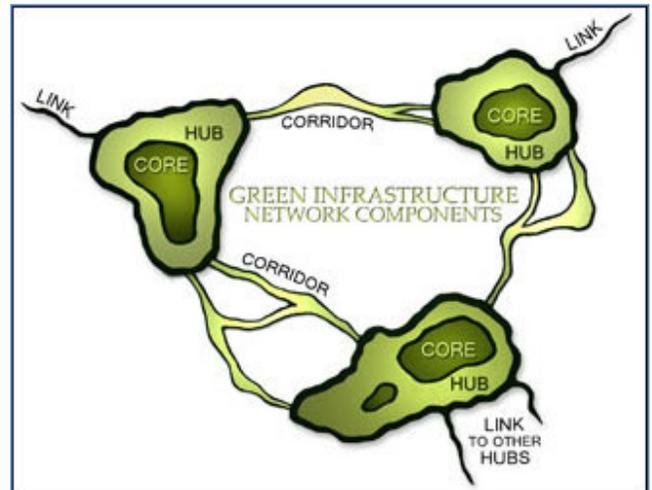
Additional elements and functions can then be added to the network, depending on the desires and needs of the designers – working lands (*e.g. working farms and grazing pasture*), trails and other recreational features, cultural and historic sites. These all can be incorporated into green infrastructure networks that contribute to the health and quality of life for America’s communities.¹

In another context, however, “green infrastructure” has been used to refer to “... systems and practices that use or mimic natural processes to infiltrate, evapo-transpirate (*i.e., the return of water to the atmosphere either through evaporation or by plants*), or reuse storm water or runoff on the site where it is generated.”ⁱⁱ This second meaning is more closely related to the application of low-impact development practices as alternative stormwater management techniques, taking on a more urban and suburban focus where urban development has greater impact on the environment.

For purposes of this regional green infrastructure plan, the project steering committee believes that a hybridization of these definitions is most appropriate for Planning District 16 with its urban, suburban and rural diversity. Moreover, these two definitions are not incompatible but, rather, have different geographic emphasis, with the first focusing somewhat more on rural and suburban natural landscape conservation and the latter focusing more on storm water management practices more applicable to an urban and suburban setting.

The proposed comprehensive definition for “Green Infrastructure” for use in this plan is:

“...an interconnected network of natural areas, other open spaces and land management practices that conserve natural ecosystem values and functions, sustains clean air, promotes water quality (by mimicking natural processes to infiltrate, evapo-transpirate or reuse storm water or runoff), and provides a wide array of benefits to people and wildlife.”



Green Infrastructure Benefits:

The implementation of a green infrastructure plan offers numerous benefits to the implementing entity as summarized below.

A. Economic / Fiscal

1. **Supports Working Farms** - The entire region benefits when a collection of local farms can provide healthy food and contribute to local tax receipts.
2. **Diversify Local Economy** – Working farms, as part of the green infrastructure network, have a significant impact on local economies by providing jobs, aiding tourism and supporting local manufacturing.
3. **Sustainable Business Sector** - Tree cover represents a source of “green” jobs, as trees require regular maintenance, inspections, pruning and periodic removal (due to storm damage or disease). Moreover, the continued supply of tree stock for reforestation efforts creates demand for commercial nurseries and tree farms that can supply tree saplings to nursery retail outlets.
4. **Enhanced Property Values** - A number of case studies suggest that green infrastructure can increase surrounding property values. Vacant land improvements.
5. **Cost-Effective Stormwater Management** – Green infrastructure has been demonstrated to offer more cost-effective storm water management than engineered solutions.
6. **Alternate Source of Rural “Development”** - Under certain air and water quality management systems, natural forests and grasslands can generate new revenue streams for the rural land owner through the inclusion of these lands in conservation-oriented nutrient trading programs.

B. Social

1. **Improved Human Health** - An increasing number of studies suggest that vegetation and green space - two key components of green infrastructure - can have a positive impact on human health. Recent research has linked the presence of trees, plants, and green space to reduced levels of inner-city crime and violence, a stronger sense of community, improved academic performance, and even reductions in the symptoms associated with attention deficit and hyperactivity disorders.
2. **Enhanced Childhood Development** - Public health improves when residents have expanded access to walking and biking trails; and access to natural areas can enhance childhood intellectual and emotional development, as well as help reduce childhood obesity and enhance the family network.
3. **Enhanced Neighborhood Quality of Life** - Reforestation and landscaping of urban areas to enhance neighborhood quality of life and urban streetscapes can stabilize and increase property values and enhance local government tax base.
4. **Reduced Energy Consumption** – Urban tree canopy and landscaping can reduce urban “heat island” effects with corresponding reductions in space cooling in residential and commercial properties shaded by tree canopy.
5. **Reduced Urban Glare** - Tree plantings and site landscaping help reduce the glare from passing cars, buildings, houses, even from the streets.
6. **Renewable Fuel Supply for Space Heating** - Trees represent a local supply of renewable fuel for space heating for families on fixed incomes that need heat during the winter months.
7. **Enhanced Recreational Opportunities** - Conservation of forested areas and open spaces preserves habitat for natural wildlife, providing recreational hunting opportunities.

C. Environmental

1. **Reduced and Delayed Stormwater Runoff Volumes** - Green infrastructure reduces stormwater runoff volumes and reduces peak flows by utilizing the natural retention and absorption capabilities of vegetation and soils. By increasing the amount of pervious ground cover, green infrastructure techniques increase stormwater infiltration rates, thereby reducing the volume of runoff entering our combined or separate sewer systems, and ultimately our lakes, rivers, and streams. Rainwater harvesting (through the use of cisterns and rain barrels) captures rainwater for non-potable beneficial uses such as toilet flushing and landscape irrigation, reducing demand on the potable water supply.
2. **Stormwater Pollutant Reductions** - Green Infrastructure techniques filter runoff close to its source and help prevent pollutants and top soil from being transported to nearby surface waters. Once runoff is absorbed into the ground, plants and microbes can naturally filter and break down many common pollutants found in stormwater which aids local farms and contributes to governmental efforts to comply with Chesapeake Bay TMDL goals through improved non-point source pollution control.
3. **Reduced Sewer Overflow Events** - Utilizing the natural retention and infiltration capabilities of plants and soils, green infrastructure limits the frequency of sewer overflow events by reducing runoff volumes and by delaying stormwater discharges.
4. **Enhanced Groundwater Recharge** - The natural infiltration capabilities of green infrastructure technologies can improve the rate at which groundwater aquifers are 'recharged' or replenished and help restore and maintain the natural hydrology in a watershed. This is significant because groundwater provides about 40% of the water needed to maintain normal base flow rates in our rivers and streams. Enhanced groundwater recharge can also boost the supply of drinking water for private and public uses and communities become both more flood- and drought- resistant.
5. **Increased Carbon Sequestration** - The plants and soils that are part of the green infrastructure approach serve as sources of carbon sequestration, where carbon dioxide is captured and removed from the atmosphere via photosynthesis and other natural processes.
6. **Urban Heat Island Mitigation and Reduced Energy Demands** - Urban heat islands form as cities replace natural land cover with dense concentrations of pavement, buildings, and other surfaces that absorb and retain heat. The displacement of trees and vegetation minimizes their natural cooling effects. Additionally, tall buildings and narrow streets trap and concentrate waste heat from vehicles, factories, and air conditioners. By providing increased amounts of urban green space and vegetation, green infrastructure can help mitigate the effects of urban heat islands and reduce energy demands. Trees, green roofs and other green infrastructure can also lower the demand for air conditioning energy, thereby decreasing emissions from power plants.
7. **Improved Air Quality** - Green infrastructure facilitates the incorporation of trees and vegetation in urban landscapes, which can contribute to improved air quality. Trees and vegetation absorb certain pollutants from the air through leaf uptake and contact removal. If widely planted throughout a community, trees and plants can even cool the air and slow the temperature-dependent reaction that forms ground-level ozone pollution (smog).
8. **Additional Wildlife Habitat and Recreational Space** - Greenways, parks, urban forests, wetlands, and vegetated swales are all forms of green infrastructure that provide increased access to recreational space and wildlife habitat.

III. The Green Infrastructure Plan

The Region's green infrastructure (GI) plan has five main components. The first component is the statement of goals and objectives for the Plan. The second component evaluates the existing green infrastructure inventory reflected in the series of land cover maps and analysis, and trends in land cover change and associated impacts (i.e., the urban ecosystem analysis phase). The third component of the plan is a toolkit for the implementation of the green infrastructure plan or plan components. The fourth component is the review of the regulatory environment and current green infrastructure planning and implementation practices in each locality of Planning District 16. The final section presents a set of findings and recommendations to advance local implementation of green infrastructure planning and programs to conserve forest (i.e. tree canopy) and open space and improve stormwater management practices to reduce non-point source surface water pollution.

Overview of Green Infrastructure Plan Development

Beginning in October 2008, the George Washington Regional Commission received a Virginia Coastal Zone Management Program Grant to focus on developing a regional green infrastructure dataset as the first stage of Plan development. GWRC staff worked with local governments and state agency personnel and staff from adjoining Planning Districts to re-evaluate the ecological value scores of State-defined ecological core areas and connecting corridors to draft a regional Eco-Core and Conservation Corridor maps. GWRC also collaborated with adjoining PDCs to help ensure consistency of methodology in developing a continuous conservation corridors across the Virginia Coastal Zone.

In Fiscal Year 2009, the GWRC acquired and applied GIS tools to quantify the amount of impervious surface and tree canopy, and the trends affecting a change in the relative amount of these dominant land cover patterns. Using these data, GWRC worked to encourage and support active local conservation efforts and the adoption of best management practices to reduce stormwater run-off and associated sedimentation and pollution of regional streams and water bodies, producing maps of the Region's designated impaired waterways, regional eco-cores and corridors, potential regional greenway routes, and assessments of the ecosystem service value of the Region's tree canopy. The results of these studies were shared with local planning departments, area environmental organizations, and other regional environmental stakeholders to support area-wide environmental educational education efforts with realistic estimates of the costs and impacts of regional development trends.

The final plan integrates research findings from the work conducted in 2008 and 2009. In the final year of the Plan's development, building on the analytical results of the first 2 years, the green infrastructure plan was "vetted" through the parallel regional land use scenario planning process to measure comparative public support for the green infrastructure scenario versus other tested future land use patterns. A series of public outreach presentations were given around the region to inform public stakeholder groups and local government Planning Commissions on trends of urbanization and loss of green infrastructure and solicit community feedback on the findings and recommendations of the regional green infrastructure planning process.

Uses of a Green Infrastructure Plan

As noted in Section II, Green Infrastructure offers numerous and diverse benefits to the community that applies green infrastructure planning principles and practices. Along with the diverse benefits, there are numerous applications of green infrastructuring planning in guiding land development and focusing conservation efforts.

- As a tool for community growth management and comprehensive planning, a GI Plan helps identify and prioritize areas to be protected and conserved through various land conservation programs.

- As a tool to guide comprehensive natural hazards mitigation planning, a GI plan defines (through floodplain mapping) areas of potential chronic property loss due to flooding that would be better suited to passive and recreational open space uses rather than experiencing repetitive property losses from natural disasters (e.g. floods).
- As a tool for guiding land conversion, a GI Plan can help communities and private property owners identify tracts of lands that are likely to experience development pressure and introduce conservation easement, purchase/transfer of development rights and other conservation programs to potentially affected property owners to maintain areas of high ecological integrity and value.
- As a tool for promoting low-impact development, a GI Plan can reinforce the need to encourage developers to apply BMPs to reduce development cost and impact on selected areas where “poorly planned” development could have unintended or undesirable consequences for areas of higher ecological benefit.
- A GI Plan provides local governments a tool to prioritize and target parkland acquisition and manage park properties to minimize adverse impact on the natural habitat. Could aid localities with property maintenance costs of owned land and target parkland acquisition.
- A GI Plan can be used as a tool for developing a strategy for environmental offsets, identifying potential sites and options for compliance planning; i.e. attainment, credit trading for regulatory compliance, mitigation sites, banking sites, in lieu of fees sites,etc.
- A GI Plan complements MS4 and other environmental permit programs designed to promote compliance with the Clean Water Act requirements.

IV. Goals of the Green Infrastructure Plan

The goal of this Green Infrastructure Plan is:

“To come to a common understanding on the value of green infrastructure, provide new and enhanced tools and information to individual property owners, development and conservation interests, local governments, and other stakeholders to use to make informed land use decision, to maintain natural landscapes that protect green infrastructure and ensure the health, safety, and welfare of the community.”

This over-arching goal can be addressed by a series of objectives and program strategies to measure progress toward achieving local fulfillment of the regional plan.

Objectives (O) and Strategy Metrics (S)

O1: Habitat protection

- 1.1. Respect private property rights in natural open and forested spaces.
- 1.2. Encourage infill development of designated urban service areas and transfer/purchase of development rights from rural areas to increase densities in designated urban service areas.
- 1.3. Preserve green infrastructure areas of high ecological value through promotion of conservation easements.

Metrics for Monitoring

- S1. Number of acres protected in high priority areas
- S2. Change in land cover in high priority areas
- S3. Growth in land acreage under conservation easements.

O2: Water Quality Protection

- 2.1 Preserve pristine and enhance water quality in the Region’s impaired rivers and streams.
- 2.2 Reduce the volume and pollution loading of non-point source storm water runoff.
- 2.3 Increase effectiveness of local stormwater management programs

Metrics for Monitoring

- S1. Reduction of impaired streams/maintenance of healthy streams
- S2. Promotion of alternative development techniques to reduce the growth in impervious surface area and promote green/open space conservation.
- S3. Growth in the number of stormwater best management practices (BMPs) installed

O3: Tree Canopy Protection

- 1.1. Preserve existing tree canopies in publicly-owned natural, undeveloped areas
- 1.2. Encourage reforestation and afforestation efforts throughout the Region.-

Metrics for Monitoring

- S1. Number of forested acres protected in conservation easements
- S2. Change in tree canopy over time
- S3. Number of trees planted through reforestation efforts.

O4: Recreation Protection and Enhancement

- 4.1. Encourage the establishment and maintenance of regional and local natural hiking trails, greenways and other natural corridors.
- 4.2. Promote eco-tourism to raise public awareness of the social, environmental and economic/fiscal benefits of natural areas and open spaces.

Metrics for Monitoring

- S1. Trail miles and usage
- S2. Visitation records at national, state and local parks
- S3. Eco-tourism statistics

V. Assessing the Regional Asset

A. Custom regional VCLNA Data Set (GWRC Eco-Cores & Corridors)

The Virginia Natural Heritage Program in the Department of Conservation and Recreation has developed the Virginia Conservation Lands Needs Assessment (VCLNA) which is an integrated assemblage of geospatial datasets and conservation prioritization guidelines, with the goal of implementing Green Infrastructure planning in the Virginia Coastal Zone.

The Ecological Core Model, one of models developed under the VCLNA, used the Virginia Natural Landscape Assessment (VaNLA) which is a model for identifying, prioritizing, and linking natural lands in Virginia. The base satellite imagery used to evaluate natural areas was the RESAC 2000. Natural land areas (i.e. “cores”) were assigned an Ecological Integrity Score based on statistical analyses of 53 geospatial attributes. In general, higher scores were given to areas that are more biologically diverse, part of a larger complex of natural lands, and contribute to water quality enhancement.

Another model in the VCLNA created Landscape Corridors. The corridors are a minimum of 300 meters wide (100 meters of interior cover and 100 meter buffer on either side). Landscape nodes are lower-ranked Ecological Cores and Habitat Fragments that intersect Landscape Corridors.

Updates

VCLNA Ecological Core Model ranked areas from C1 to C5, with C1 representing the areas of the very highest ecological integrity. Cores are at least 100-acres and not fragmented by roads, rail, power lines, etc. The ecological core model was created by DCR based on 2000 satellite imagery. Because the imagery input was almost a decade old, the GWRC updated the model based on the most recent building footprint file for each locality. The ecological impact a building (and its occupants) has on the environment is 100 meters (as determined by the scientists who built the first eco-core model). Based on this 100-meter buffer around the new building footprints, areas that encroached on the cores were removed from the originally-defined eco-core area. The remaining areas of the cores were recalculated and where an area lost more than 20% as a result of the disturbance buffer around new development in a defined eco-core area, the area was “downgraded 1 level on its ecological integrity score. In less than a decade, the location, extent, prevalence, and status of the cores of ecological significance have changed dramatically. Many areas were fragmented because of development.”⁶

The state created a network of corridors and nodes by connecting ecological cores in the two highest categories (C1 and C2). The model selected routes between each high priority core and were guided as much as possible through natural lands and lower-ranked eco cores. The width is at least 300 meters to create the corridors (100 meters of interior cover and 100 meters of buffer on either side). After the ecological core model was updated, the corridor and node model was overlaid on the updated model. If corridors moved through areas that lost ecological integrity, corridors were rerouted to travel through areas of highest ecological integrity.

The GWRC Eco-cores & Corridors maps (shown on pages 9-13) for each locality in the George Washington region demonstrate the distribution of natural lands of ecological integrity across the George Washington Region.

B. Urban Ecosystem Analysis

Trees are important indicators of the health of a community’s urban ecosystem. Healthy trees provide valuable environmental benefits through the biological functions performed by their roots and leaves. These functions

⁶ This methodology was jointly developed by the Richmond Regional Planning District Commission and the VCLNA project staff of the Virginia Department of Conservation and Recreation.

can be measured in terms of ecosystem services including reducing stormwater runoff, increasing atmospheric carbon sequestration and storage, improving air and water quality. The greater the tree cover and the less the impervious surface area in a community, the more ecosystem services are produced and the greater the community benefit from the existing tree cover.

The George Washington Regional Commission (GWRC) worked with American Forests, a non-profit organization, to obtain 2009 30-meter LANDSAT imagery (see Figure 2) to extend the time-series (1996, 2001, and 2006) of classified imagery available through NOAA's Coastal Change Analysis Program (C-CAP). With these data, GWRC staff used American Forest's CITYgreen® spatial analysis tool to analyze the land cover of Virginia Planning District 16, including the City of Fredericksburg and the Counties of Caroline, King George, Spotsylvania and Stafford, and to calculate a variety of ecosystem service benefits of the region's remaining tree canopy. The tool also was used to analyze land cover in the three major watersheds in the Region, the ecological cores of the Region, locally-designated Resource Protection Areas, and the sub-watershed containing two local reservoirs (i.e. Motts Run and Rocky Pen Run). The goal of the study was to provide information on general land cover trends throughout the 13 year period for the Region and the associated monetary value of the ecological services provided by the remaining tree canopy.

The resulting "Urban Ecosystem Analysis" (UEA) report of the George Washington Region was the first of its kind for the Region and was based on well-accepted environmental research sponsored by the U.S. Forest Service and the U.S. Department of Agriculture's Natural Resources Conservation Service. The study can be used to educate local government staff, planning commissioners and elected officials on the monetary value of the tree canopy and the associated indirect ecosystem costs of new development. This information can be used by community planners to help the Region grow in a more sustainable manner.

An analysis of 1996-2009 data to identify land cover change trends over the 13 year period found that the GW Region (i.e. Planning District 16) lost 4.17% of its tree canopy, while gaining 2.80% of urban bare area, 8.68% of open space, and 43.46% of impervious surface area. These changes resulted in the loss of the tree canopy's ability to naturally manage 222.98 million cubic feet of stormwater, valued at \$1.06 billion using a local engineering cost of \$4.75⁷ per cubic foot for man-made stormwater retention facilities. The Region's "green infrastructure" also lost the ability to remove approximately 2.89 million lbs. of air pollutants annually, valued at \$7.74 million per year, 1.24 million lbs. of carbon stored in trees' wood, and 9,616 lbs. of annual carbon sequestration.

With differing levels of tree canopy and urbanization among local governments, local loss of tree canopy over the 13 year period varied considerably, from a low of 2.36% in King George County to a high of 27.64% in the City of Fredericksburg. At the same time, changes in the amount of impervious surface area over this period reflected the rapid population and development pressure experienced throughout the Region, with the highest population increases in Stafford (48.93%) and Spotsylvania (46.78%) Counties, followed by King George Co. (41.91%), Caroline Co (32.85%) and the City of Fredericksburg (25.19 %).

Through this study, GWRC analyzed the ecosystem service benefits that the Region would derive if it pursued and achieved a goal of restoring 5 percent of the Region's tree canopy, thereby reversing the losses of the last 13+ years. If the Region increased its canopy cover by 5% overall, the ecosystem services would provide an additional \$4.61 million in annual air pollutant removal value, an additional 1,970,156 tons of stored carbon and an annual 15,338 tons of sequestered carbon, as well as potentially 589.06 million cubic feet of additional managed stormwater, valued at \$2.80 billion. Of course the Region would also realize other benefits in the form of increased property value, increased tax revenue, reduced energy consumption, etc. In light of the

⁷ Local cost estimates ranged from under \$2.00 to over \$10.00 per cubic foot. \$4.75 was used as a regional cost average, but local stormwater program managers, in some cases, place a higher value on the cost-avoidance benefit of green infrastructure.

compatibility of such an initiative with Chesapeake Bay Preservation Act requirements, Virginia stormwater management regulations and Watershed Implementation Planning/TMDL goals, the Green Infrastructure planning committee supports this regional goal.



**URBAN ECOSYSTEM ANALYSIS
2009 MEDIUM-
RESOLUTION
CLASSIFICATION
GEORGE WASHINGTON REGION,
VIRGINIA**

LAND COVER

Acres (Percent of Total)

	Impervious Surfaces 40,247 (4%)
	Open Space 191,554 (21%)
	Trees 659,245 (72%)
	Bare 873 (0%)
	Water 21,331 (2%)

**GEORGE
WASHINGTON**
REGIONAL COMMISSION



Figure 2: 2009 Classified Land Cover, Planning District 16 (30-meter resolution)

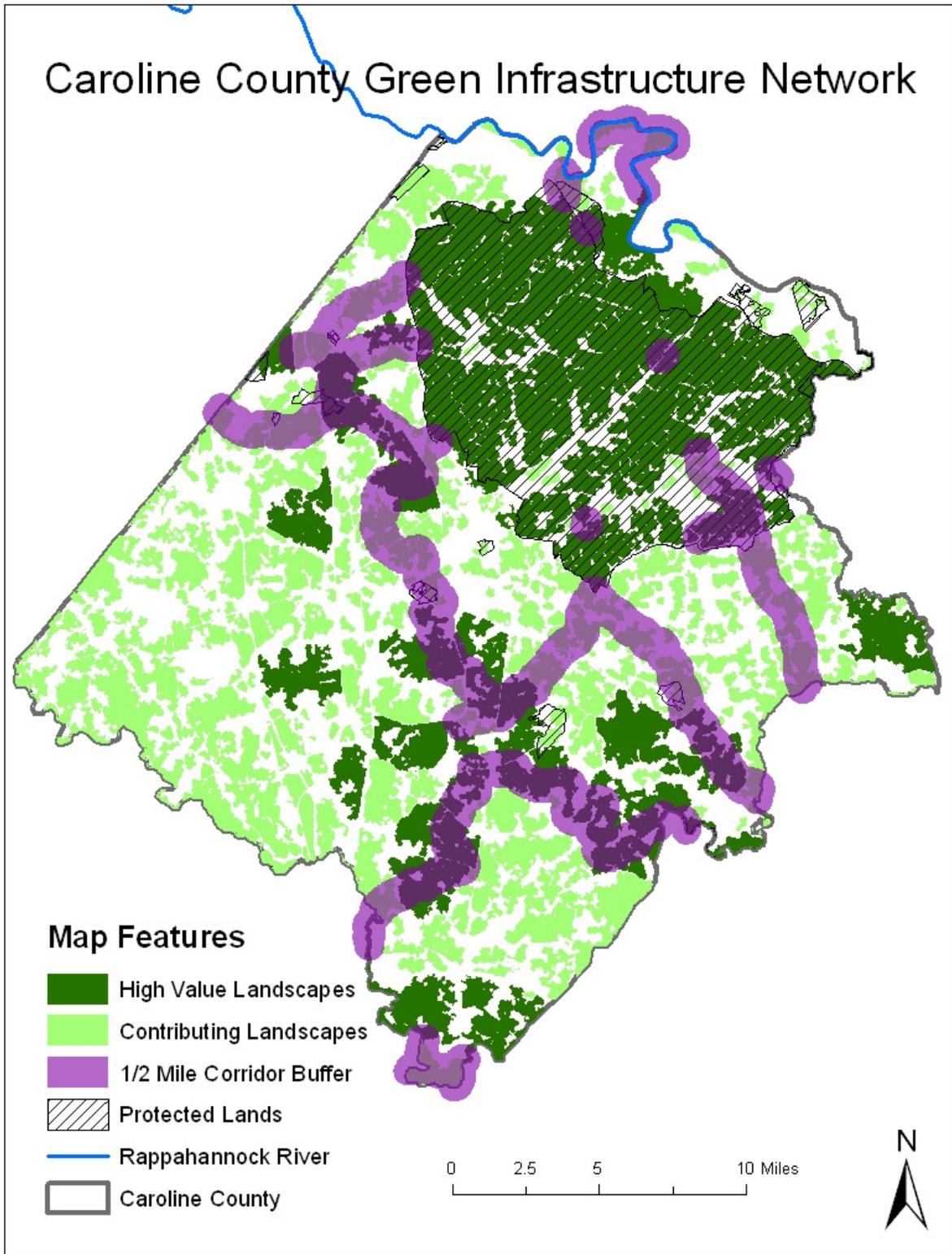


Figure 3: Caroline County Green Infrastructure Network

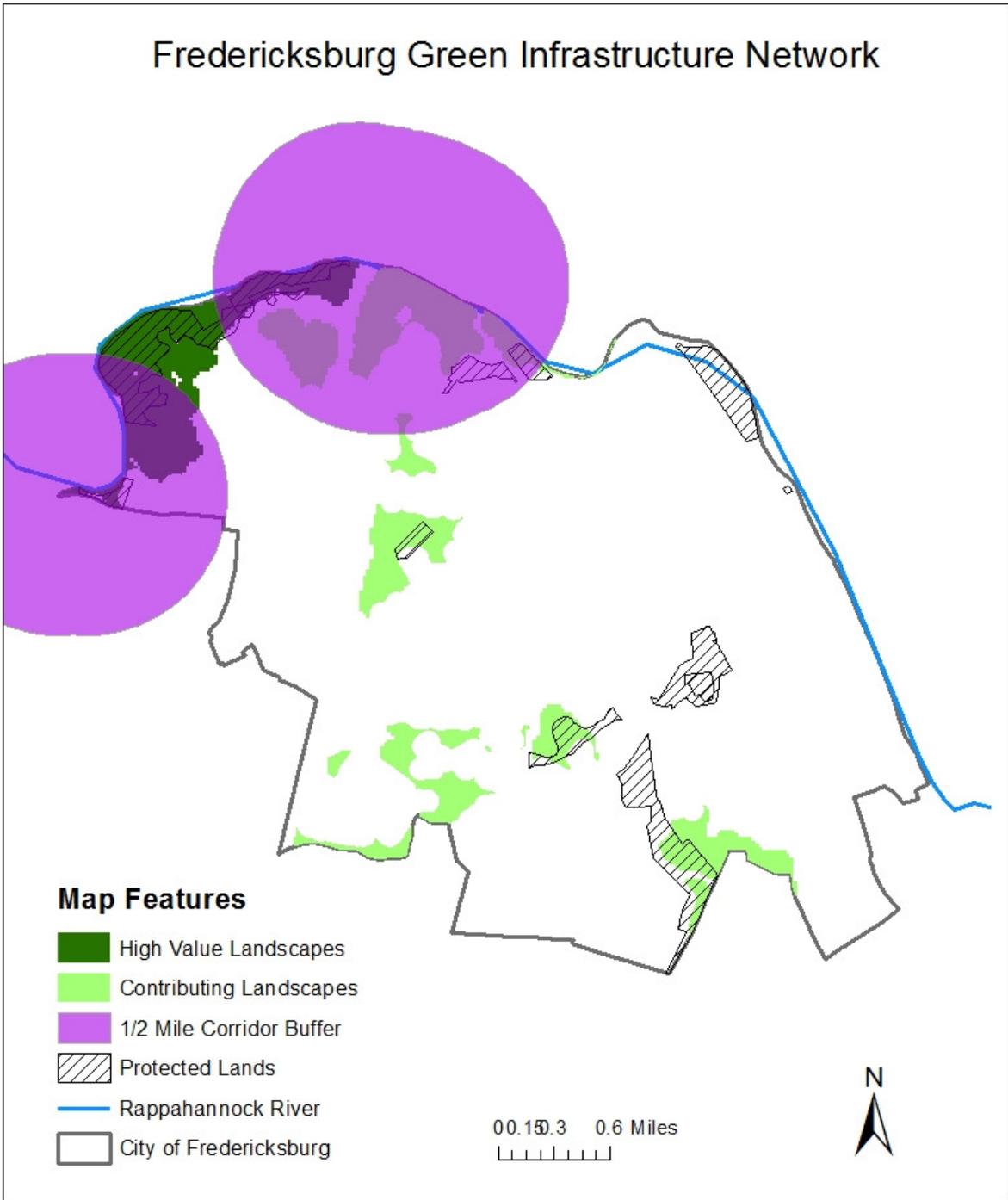


Figure 4: City of Fredericksburg Green Infrastructure Network

King George Green Infrastructure Network

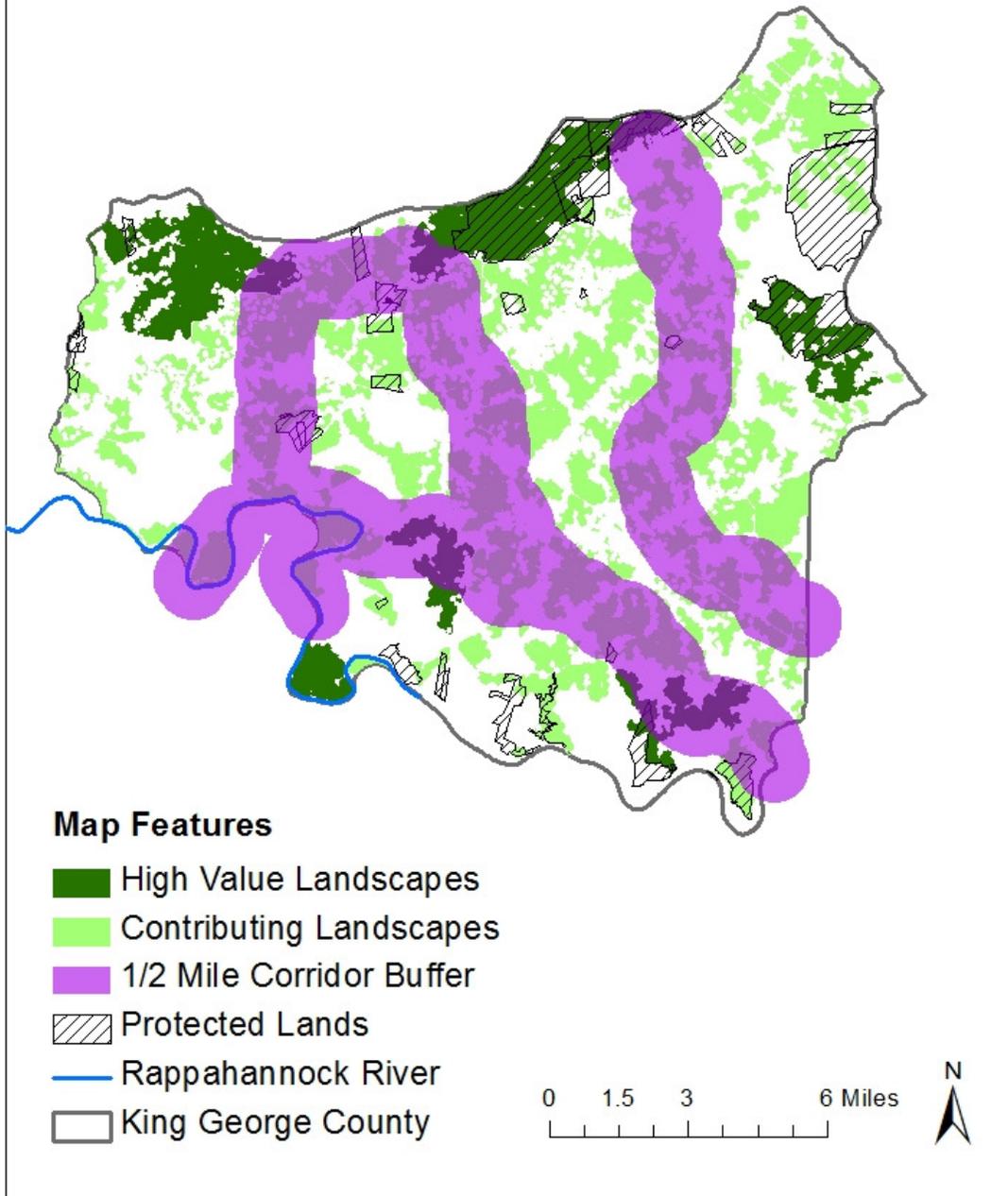


Figure 5: King George County Green Infrastructure Network

Spotsylvania County Green Infrastructure Network

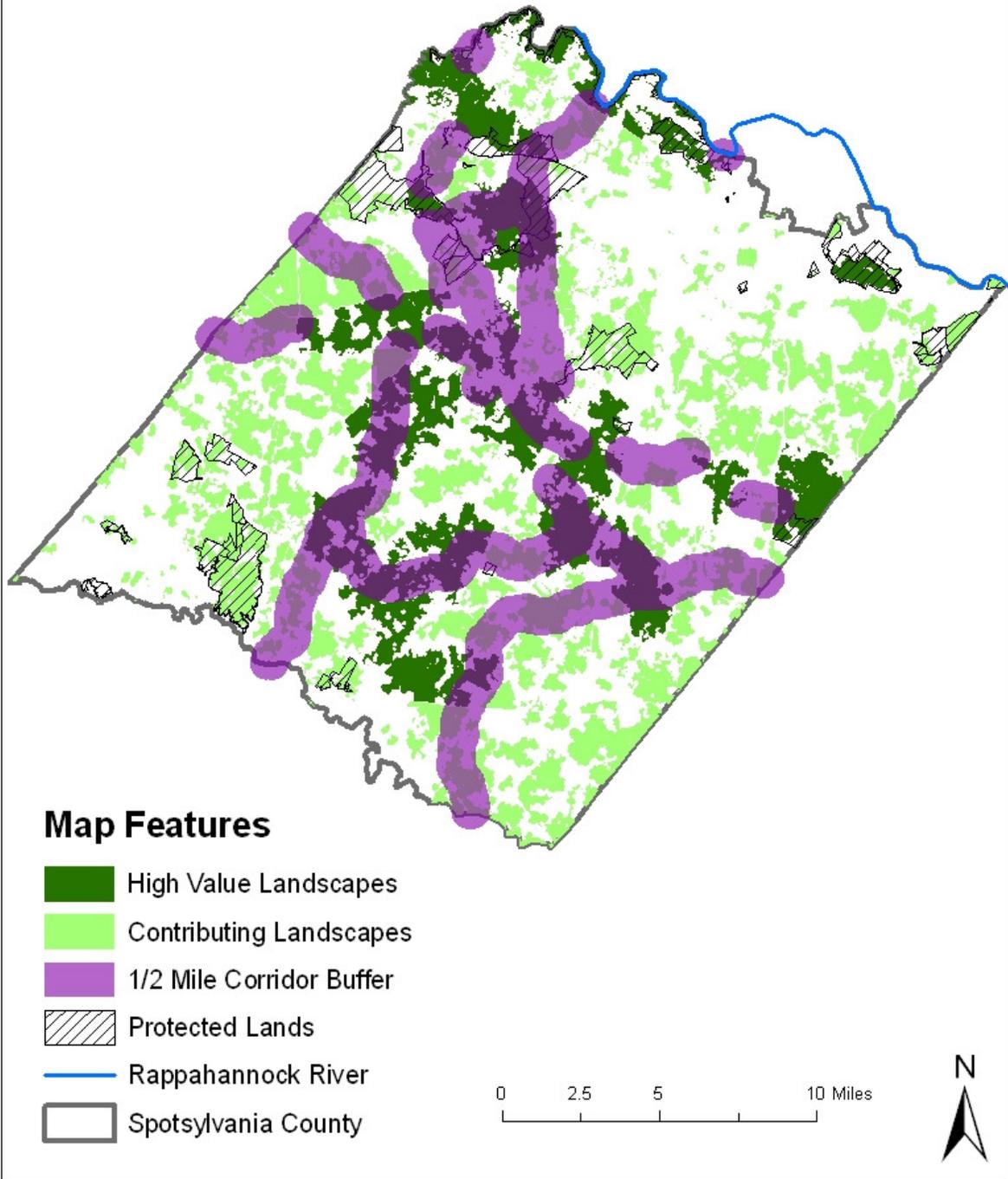


Figure 6: Spotsylvania County Green Infrastructure Network

Stafford County Green Infrastructure Network

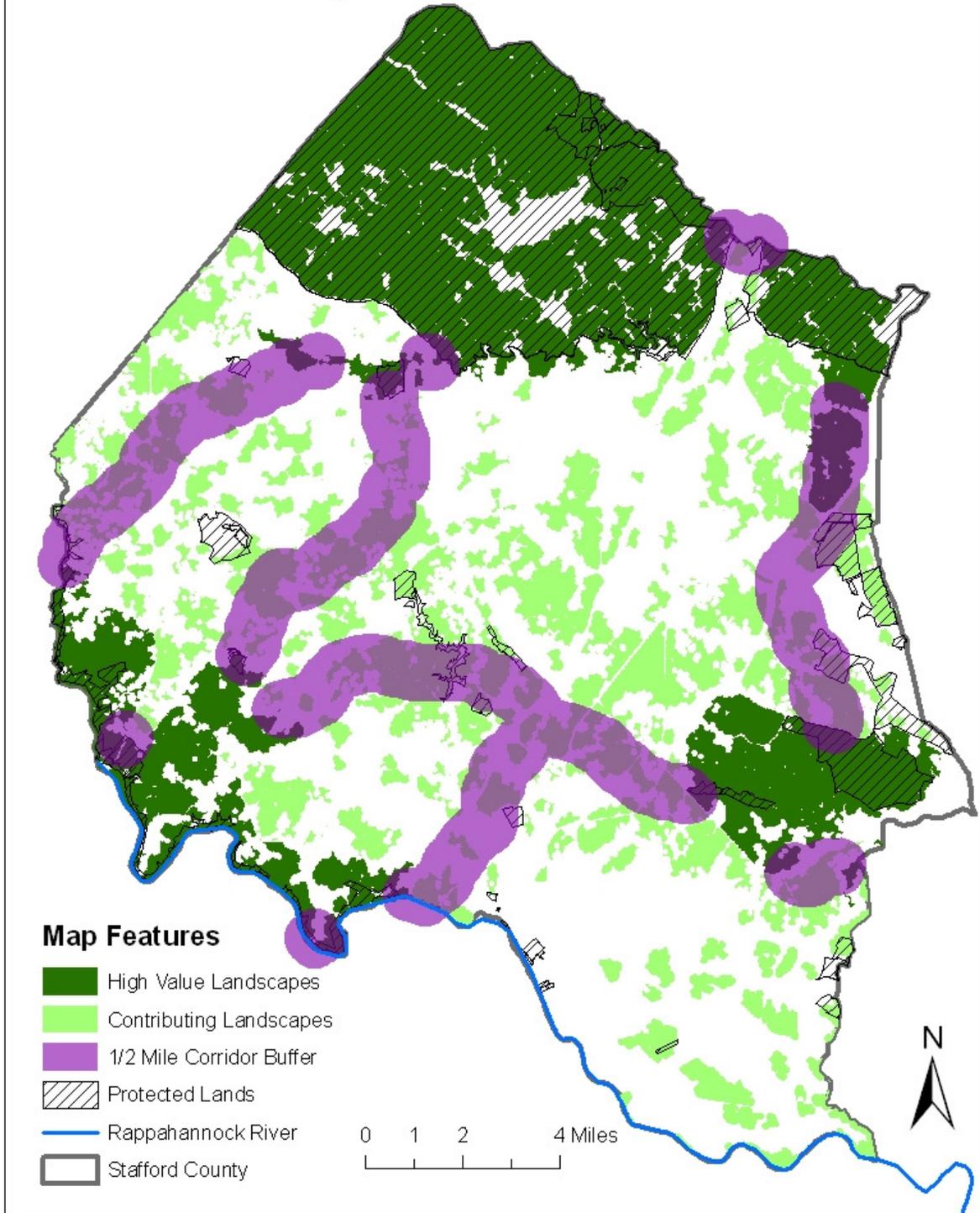


Figure 7: Stafford County Green Infrastructure Network

C. Estimating Impervious Surface Area

Impervious surface land cover in the George Washington Region generates stormwater runoff which, if not properly managed, can erode the landscape contributing non-point pollution (from urban and rural sources) and sediment to streams, rivers and ultimately the Chesapeake Bay.

Re-doubled efforts by the U.S. Environmental Protection Agency and the Virginia Departments of Environmental Quality (DEQ) and Conservation and Recreation (DCR) to improve the water quality of the Chesapeake Bay is driving, in part, recent changes to State stormwater management regulations and the development of Chesapeake Bay Total Maximum Daily Load (TMDL) nutrient and sediment reduction allocation goals for each Bay tributary and locality. These programs have raised the importance to local governments of understanding urban and rural land cover and the trends of land cover change over time.

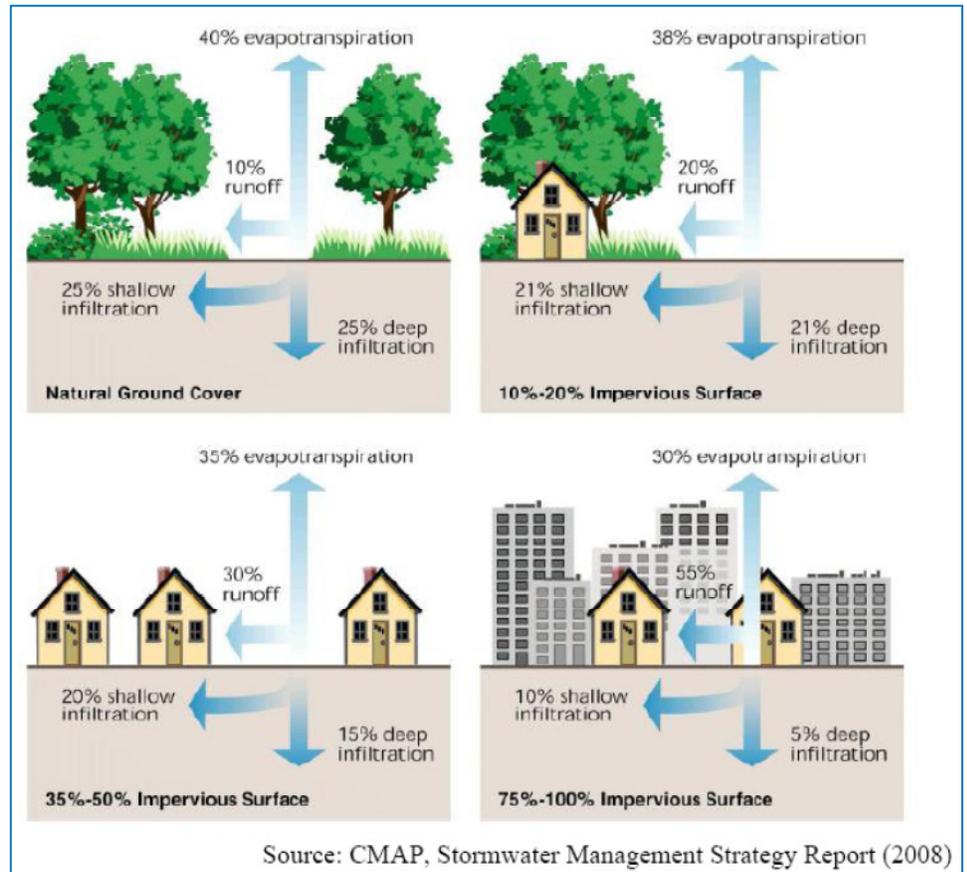


Figure 8: Changes in Hydrology from Increased Impervious Surface

Through this project, GWRC researched and evaluated differences between readily-available modeling tools for estimating impervious surface area for various geographies in the George Washington region, including the region as a whole, the three major watersheds, the five member localities, and 29 discrete local magisterial districts. Moreover, these tools were applied to medium (30-meter) and high-resolution (1-meter) classified satellite imagery to compare the differences in the detected impervious surface area and tree canopy, both of which have significant bearing on the Chesapeake Bay water quality model developed for calculating the TMDL goals for each tributary. Also, through this research, GWRC documented user tips to pass along to others interested in using the evaluated models and methods to facilitate their use.

From a review of related planning and civil engineering research literature, GWRC found that, in order of preference, planimetric data are preferred for estimating impervious surfaces, followed by estimates from high-resolution imagery using semi-automated methods to classify spectral patterns in the imagery. Two public domain programs (ISAT and ETIS) developed through NOAA-supported research at the University of Connecticut have been reported in academic research to be fairly accurate, particularly when appropriate secondary data are used to represent varying levels of development across the landscape. One of these, the Impervious Surface Analysis Tool (ISAT) was applied to various geographies in the Region. The results of the ISAT model were compared with 1-meter imagery estimates of impervious surface area in the City of

Fredericksburg, where it was found that the high-intensity development coefficients option of the ISAT model were most appropriate for indirectly estimating the City's impervious surface area.

From GWRC's research, it was determined that 30-meter resolution imagery (which is the basis for EPA's estimates of land cover and land cover change across the multi-State Chesapeake Bay watershed) as compared to higher resolution 1-meter imagery for the City of Fredericksburg over-estimated the City's impervious surface area by 34 percent and under-estimated the City's tree canopy by 40 percent. These findings are troubling in the context of evaluating the reasonableness and fairness of TMDL goals for urban, suburban and rural communities' WIP responses throughout the Chesapeake Bay watershed.

From this review of alternative imagery data sources and modeling efforts, this study recommends that local governments work together, if and when it is fiscally feasible, to collaborate in acquiring higher-resolution imagery (1-meter or less) and in applying a consistent land cover classification to this imagery to develop a consistent dataset of land cover for the region which will support regional and local comprehensive land use and environmental planning and assist in developing local code revisions to comply with federal urban storm water management (MS-4) requirements, Chesapeake Bay Preservation Act Phase III compliance, State Storm Water Management and Chesapeake Bay TMDL regulations. Emerging work through the Virginia Geographic Information Network (VGIN) point to a future opportunity for localities to partner across the State with regional and state agencies to more cost-effectively develop such a consistent and highly accurate land cover database.

D. Regional and Local Greenway Planning

The MillionMile Greenway (MMG) organization (based in Atlanta, Georgia) aims to solve the problem of disconnected communities due to daily conversion of undeveloped land. MMG believes it is possible to achieve a balance between incredible population growth and conservation of land and water resources for parks, trails, and natural spaces. Connections can be made between communities and natural spaces across town, a county, or a region.

The MMG first came to the Region in support of the Spotsylvania Greenway Initiative. GWRC staff approached MMG's President Jim Langford to see if GWRC could consult with MMG on its methodology for obtaining stakeholder input into a "greenway" planning model. Based on the model inputs, the greenway model would illustrate a set of corridors to provide natural experiences through active recreational opportunities. In contrast, the previous green infrastructure "eco-corridors", identified by GWRC in FY2009, focused on natural corridors for wildlife to travel between larger areas of natural habitat. MMG approved GWRC's application for \$4,000 of in-kind technical assistance provided through MMG's partner, PhotoScience, Inc.

GWRC staff obtained local citizen and government staff input to identify the desired model parameters through the Green Earth Sub-committee of GWRC's Green Government Commission. GWRC staff provided the necessary spatial (GIS) data required to run the suitability models. MMG, through their technical partner PhotoScience Inc., took the GWRC data and performed a suitability analysis to determine the most suitable areas within the GWRC Region for new greenway development based on the input provide by GWRC stakeholders and the data provided by GWRC. The MMG technical team reviewed the preliminary results of this analysis with GWRC staff and provided additional technical input on the interpretation of preliminary model results.

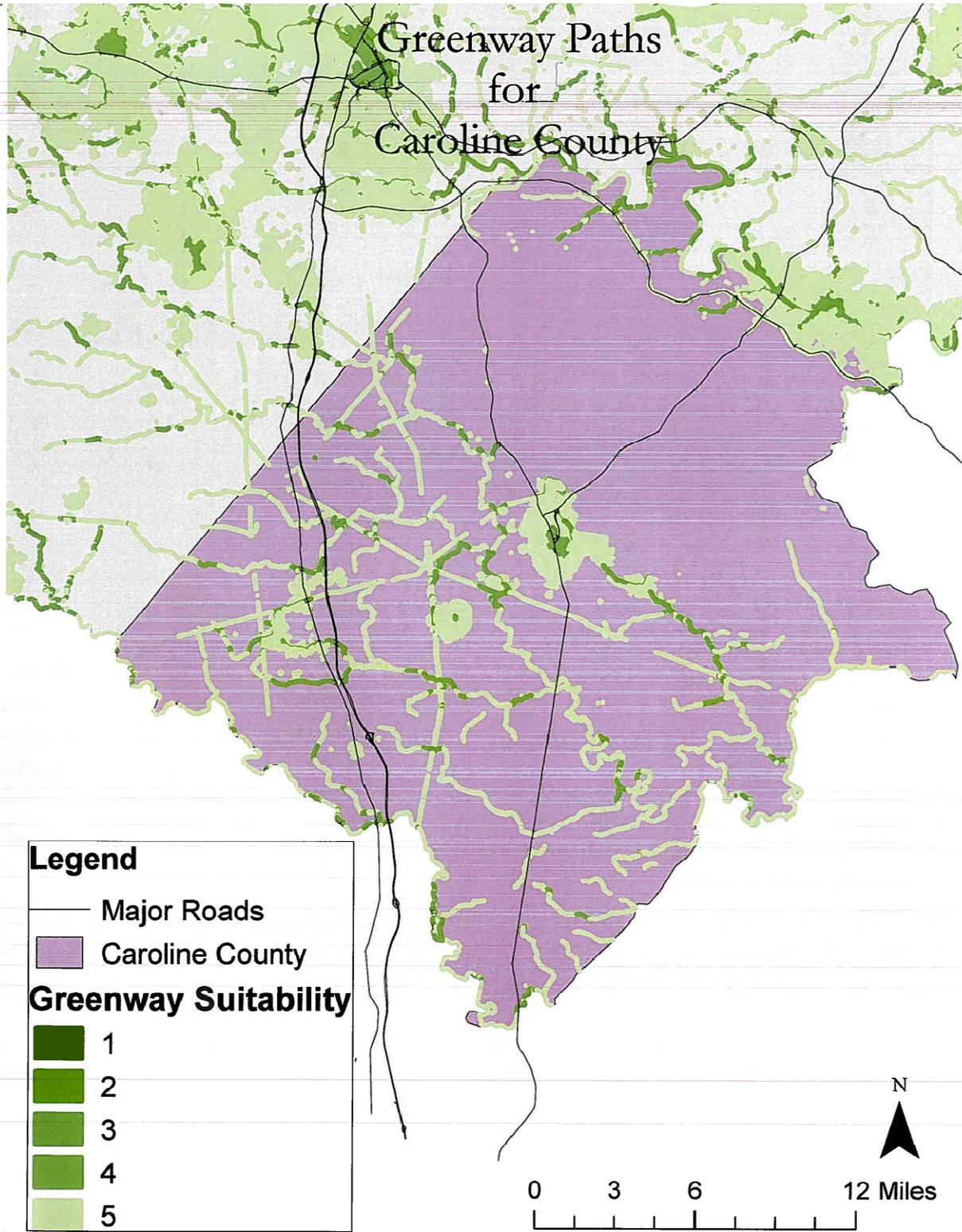
MMG then provided the derived data sets to GWRC to use in local planning. Also, MMG hosted a webinar meeting to demonstrate and present the results of the regional greenway analysis. In the future, GWRC may perform routing analysis using the suitability maps provided as a result of this project. MMG provided GWRC with step-by-step documentation to explain how to perform the routing analysis in case GWRC chooses to pursue this additional analysis. MMG also offered other technical support and assistance with questions that might arise when using or modifying this data.

GWRC Staff collaborated with the Green Earth Subcommittee of the Green Government Commission to decide on weightings of the suitability surfaces provided by MMG. On June 24, 2010, the subcommittee met for a work session to reach a consensus on the weights of the greenway modeling parameters. The Committee focused on selecting weights for factors related to three main variables (i.e. factors, features and slope) with corresponding weights shown in Table 1.

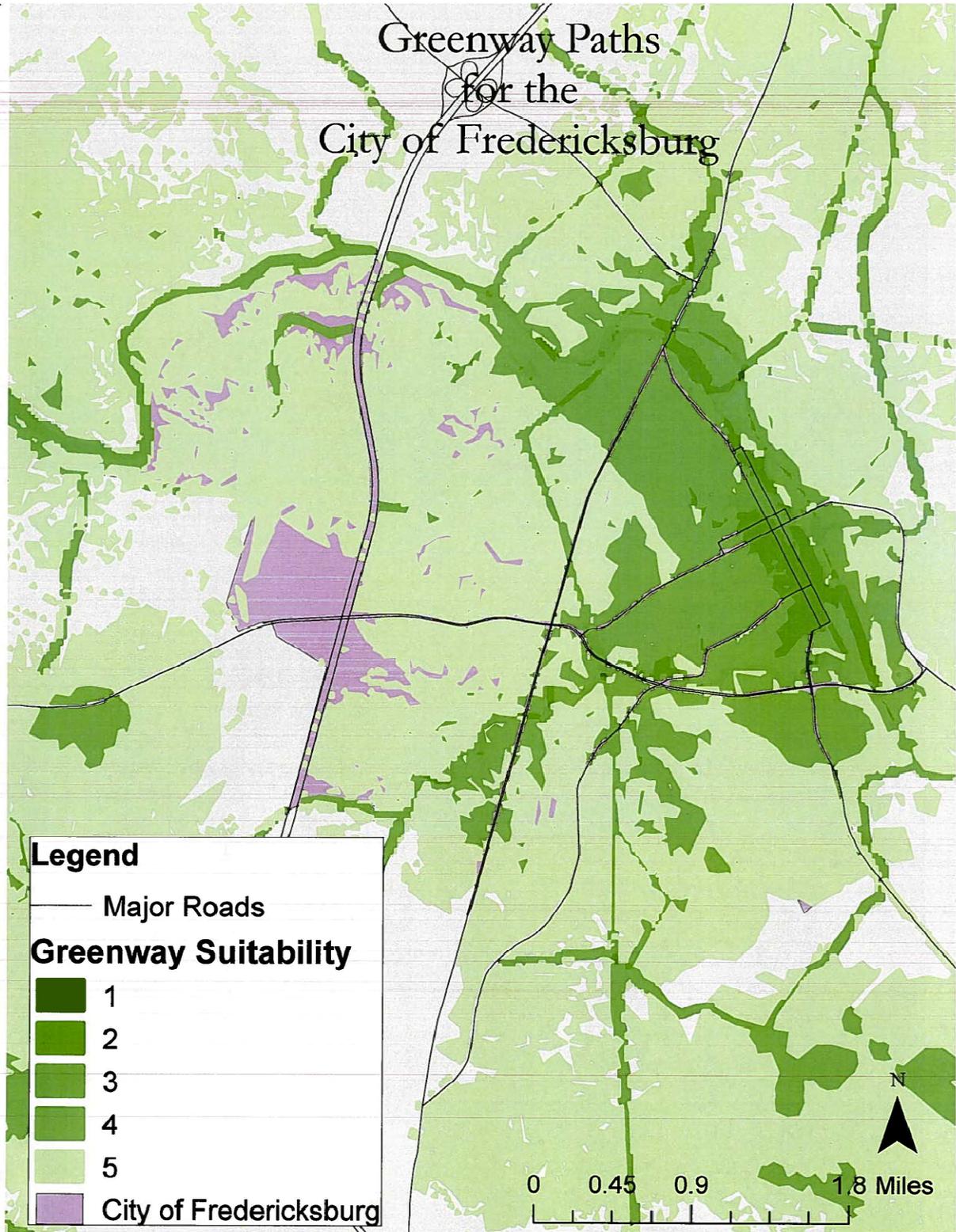
Table 1. GWRC Greenway Siting Model

Model Factors & Overall Weight	Associated Variable	Relative Weight (%)
Connectivity (45%)	Linear features (e.g. roads, trails, etc)	70
	Streams	25
	Floodplains	5
Features (45%)	Points of Interest	20
	Proximity to EcoCores, Conservation Easements & Wetlands	25
	Proximity to Public Places	15
	Proximity to Public Green Space	30
	Proximity to Lakes	10
Slope (10%)		100

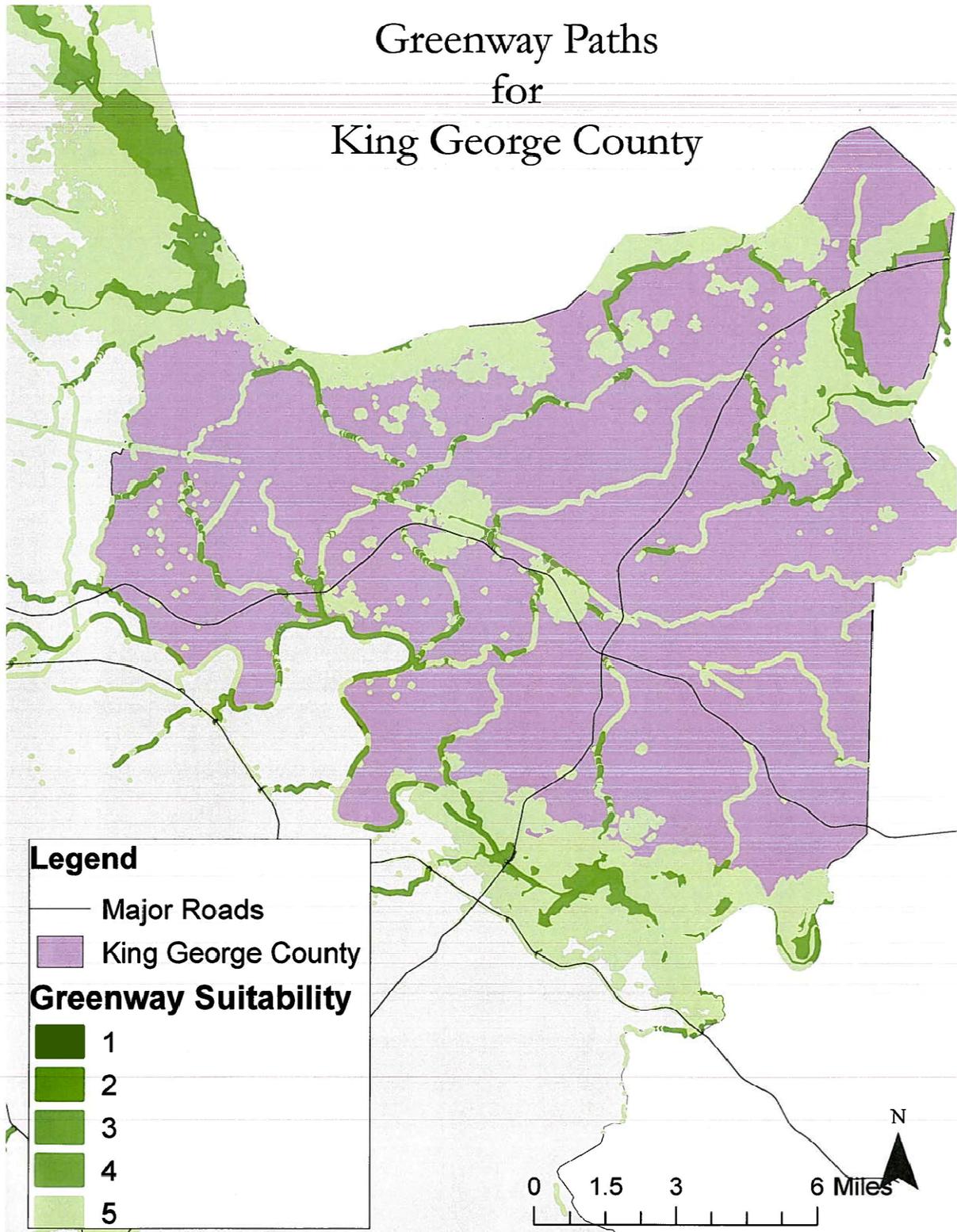
The group wanted the top 50% of the calculated corridors displayed. The resulting series of greenway suitability maps for member localities follows in Figures 9 through 13, illustrating the results of the Committee’s priority weights on greenway planning variables.



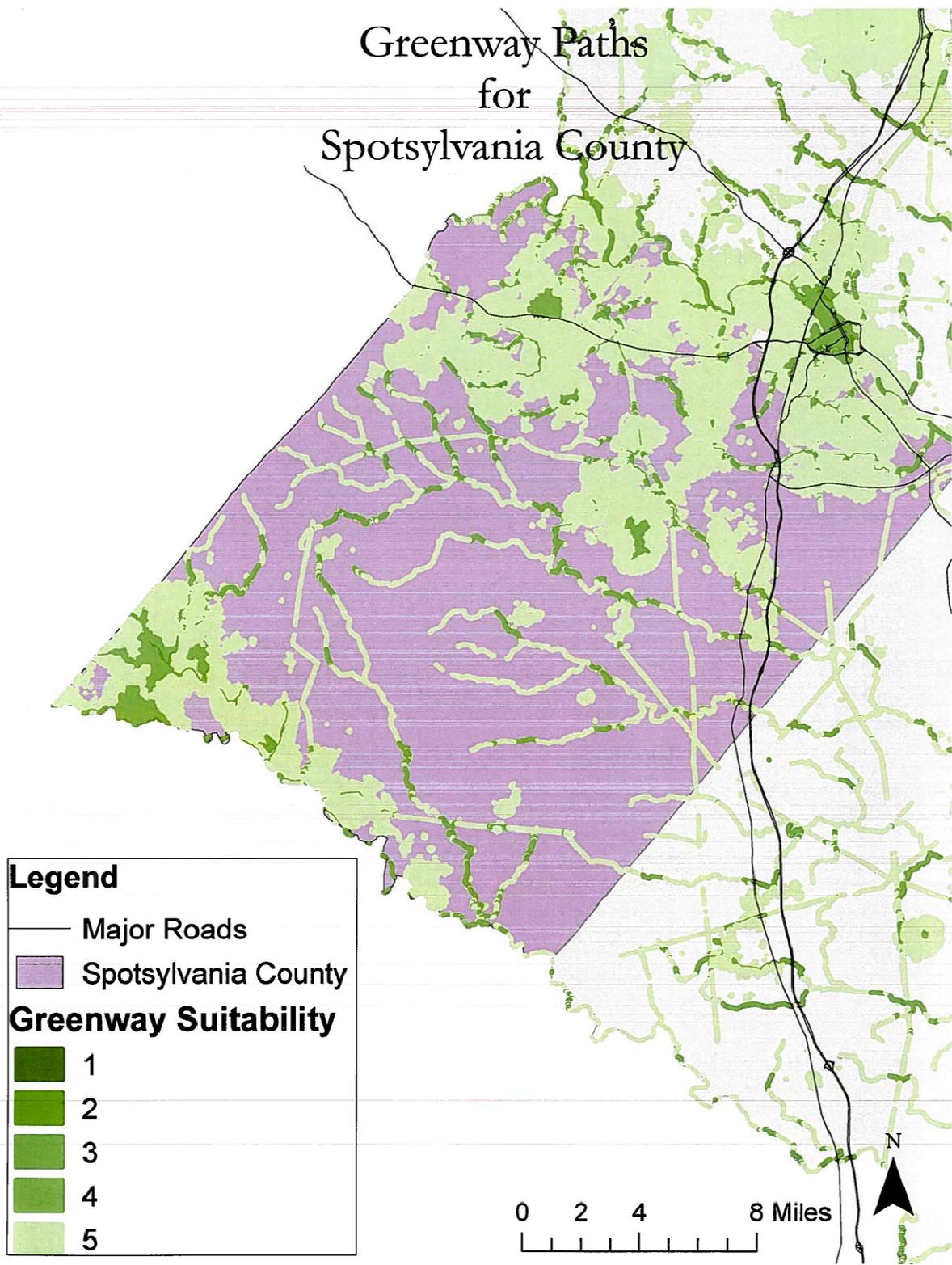
Greenway Paths for the City of Fredericksburg



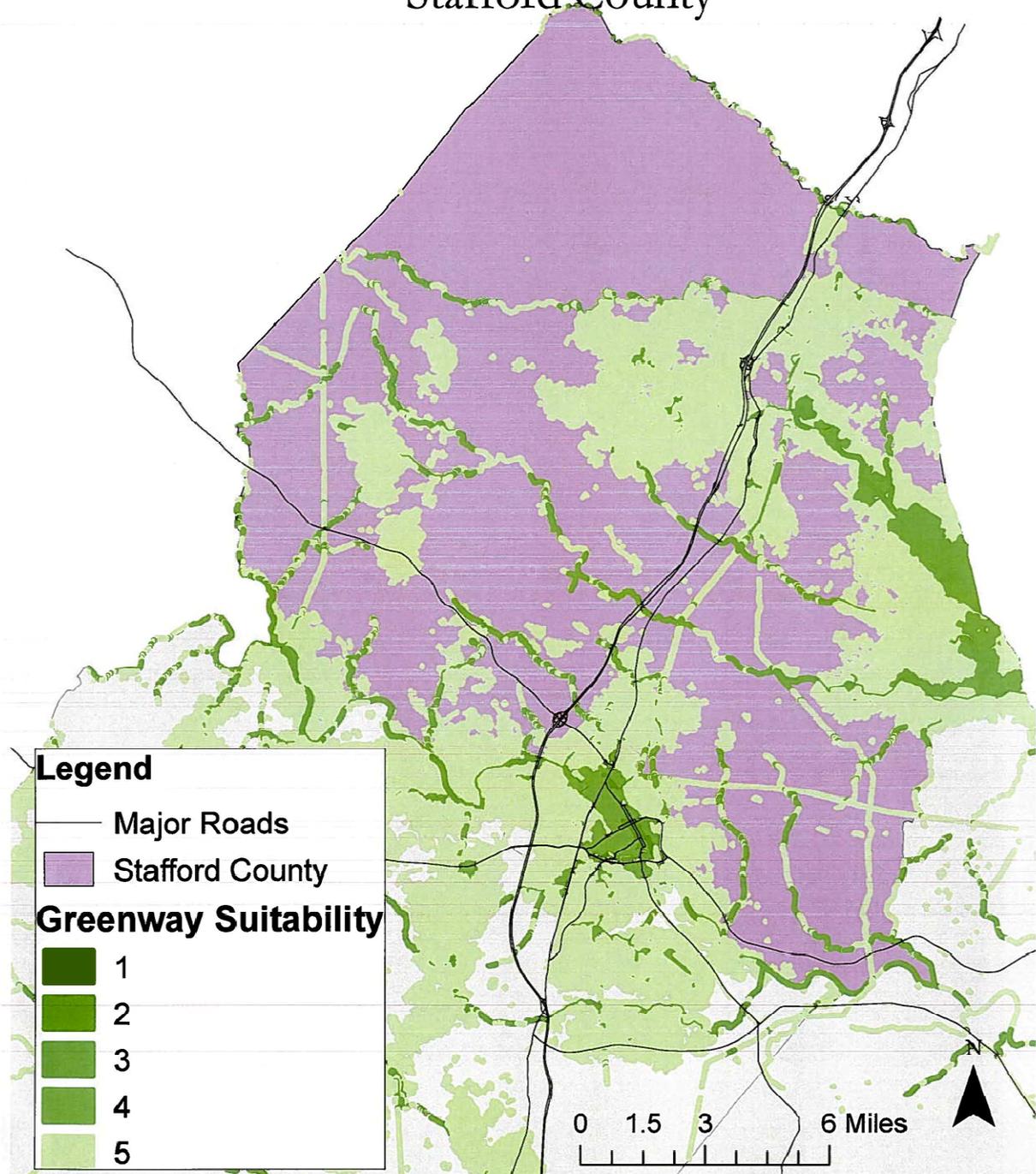
Greenway Paths for King George County



Greenway Paths for Spotsylvania County



Greenway Paths for Stafford County



E. Regional Scenario Planning Models

The evolution of a regional land use scenario planning process is an outgrowth of the current regional long range transportation planning process that produced the 2035 Constrained Long-Range Transportation Plan adopted in 2007 by FAMPO, in partnership with GWRC. The Plan, with widespread regional public support, recommended that the Region pursue stronger land use and transportation planning integration. To that end, the scenario planning effort is intended to compare and contrast alternative future land development scenarios to help generate more recognition that changing land development patterns can help make improved transportation networks viable, increasing the feasibility for alternate modes of travel to single-occupant vehicles, and reducing environmental impacts from both land and transportation system development.

The planning and development of the scenario planning process provided this CZM-funded project a chance to leverage the significant FAMPO investment (\$300,000+ over a couple years) in data collection, integration, modeling and public engagement to create a system to illustrate the build-out impacts of different land development and conservation scenarios. Through this process, local land use and land cover data which had been analyzed to produce the regional ecosystem cores and corridors, working farms and other environmental data layers; was loaded into the Community Viz GIS models developed for each of the five localities. The model results of the tested scenarios were then taken out and presented to community groups and public opinion-tested through random on-line surveys. The goal of this public outreach effort was to collect public feedback on the relative community appreciation for and willingness to support green infrastructure planning as a component of local and regional comprehensive planning. The Development Scenario Summary can be viewed through the FAMPO website and the link below⁸.

The Tested Scenarios (4)

1. Decentralized Growth

The decentralized growth scenario contemplates how the region might develop if the dispersed pattern of development occurring in some areas of the George Washington Region were to continue. New growth would take the form of single use, low-density development that is generally isolated, or not well-connected.

Common features of the scenario include: green field development patterns (i.e. conversion of working farms , wooded lots and open spaces) , outward expansion of public utilities, and transportation investments that favor convenience for automobile users. Development types and locations assigned in the scenario follow closely existing zoning maps and ordinances administered by cities, towns, and counties in the region and/or past trends to rezone rural areas in high-growth areas for new residential neighborhoods.

Anticipated growth assumed for the region recognizes the George Washington Region as a bedroom community to nearby larger metropolitan centers, namely Washington, D.C. and Richmond, VA. The scenario best represents the prevailing development patterns and intensities assumed for FAMPO's Constrained Long Range Transportation Plan for 2035.

2. Compact Centers & Growth Corridors

The compact centers and growth corridors scenario contemplates how the region might develop if new growth was focused into compact, walk-able communities with nearby opportunities to live, work, shop, and be entertained. Development in each center could vary in scale, use, and intensity; represented by rural hamlets, community centers, employment centers, or town centers. Communities would accommodate a portion of new growth in existing urban areas (i.e., infill development or redevelopment); leaving more undeveloped land for open space and agriculture uses.

⁸ <http://www.fampo.gwregion.org/regionallandusescenarioplanning.html>

Growth patterns and development intensities assigned for the scenario closely follow the adopted comprehensive plans and/or identified urban development areas pursuant to Virginia House Bill 1071 - Urban Development. Environmentally-sensitive lands identified in the GWRC's Green Infrastructure planning process and/or identified battlefield protection areas influenced the selection of designated growth centers.

Anticipated growth contemplated for the region also recognizes the George Washington Region as a bedroom community to nearby large metropolitan centers, namely Washington D.C. and Richmond, VA. Most future growth is concentrated in designated compact centers, while acknowledging some development will occur in outlying suburban or rural areas (i.e., an assumed 80/20 split for allocating new growth between compact centers and outlying areas).

3. Greater Jobs-Housing Balance

The greater jobs-housing balance scenario contemplates how the region develops if more employment is attracted to the George Washington Region. The objective would be to reduce overall commuting distance for residents because of greater proximity to local employment opportunities. Benefits may include reductions in commute time and distance, reduced traffic congestion, and reduced air emissions. Development locations, types, patterns, and intensities in the development scenario mimic closely those recommended in the compact centers and growth corridors scenario.

Anticipated growth contemplated for the region theorizes a greater balance between employment and housing in the region. Specifically, employment forecasts were increased and housing forecasts decreased compared to the socioeconomic data that supports FAMPO's 2035 LRTP.

4. GreenPrint

The GreenPrint scenario, a proxy for the Green Infrastructure Plan, contemplates how the region could develop if new growth is directed away from identified environmentally-sensitive lands and resources as a matter of high-priority public policy. Preservation of natural areas and cultural resources maximize the protection of large, contiguous forested lands and the tree bands that connect them; along with working farms and battlefield landscapes identified in potential National Register boundaries. Figures 14 – 16 illustrate the Greenprint land use scenario and its component parts.

Moreover, low-impact development principles and enhanced storm water management practices would be incorporated into future development standards for urban and suburban areas. Conservation easements, transfer of development rights or purchase of development rights may be necessary for preserving some areas in the green print area approved for development, but not yet built.

Anticipated growth contemplated for the region recognizes the George Washington Region as a bedroom community to nearby large metropolitan centers, namely Washington D.C. and Richmond, VA. Development patterns and intensities in the scenario consider the impact of new rules for the Chesapeake Bay Watershed, which link urban and suburban land cover to target pollutant loading thresholds for the Bay.

George Washington Region Scenario Planning Study

Development Scenario Map Series

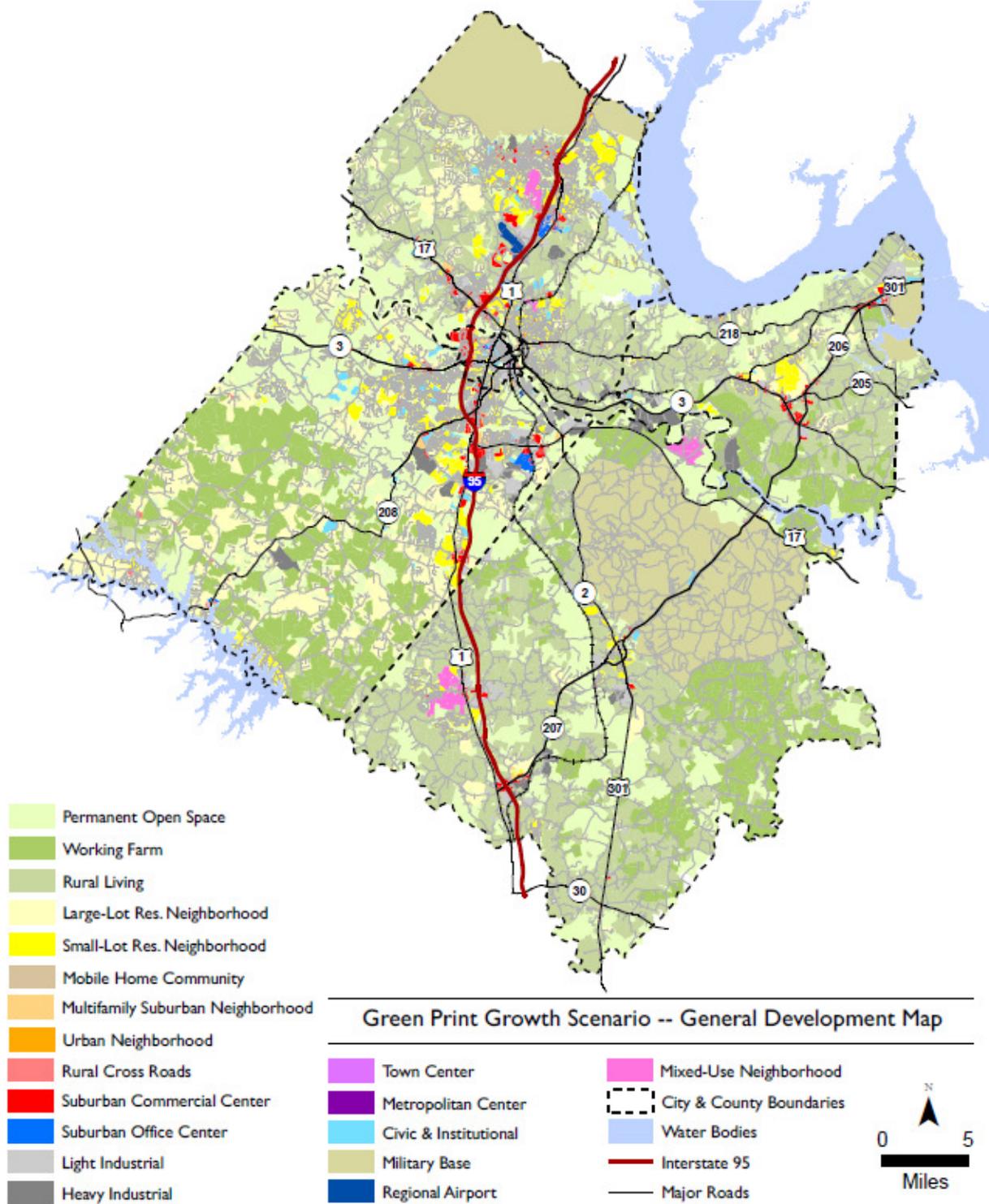


Figure 14: Green Print Growth Scenario - General Development Map

George Washington Region Scenario Planning Study

Development Scenario Map Series

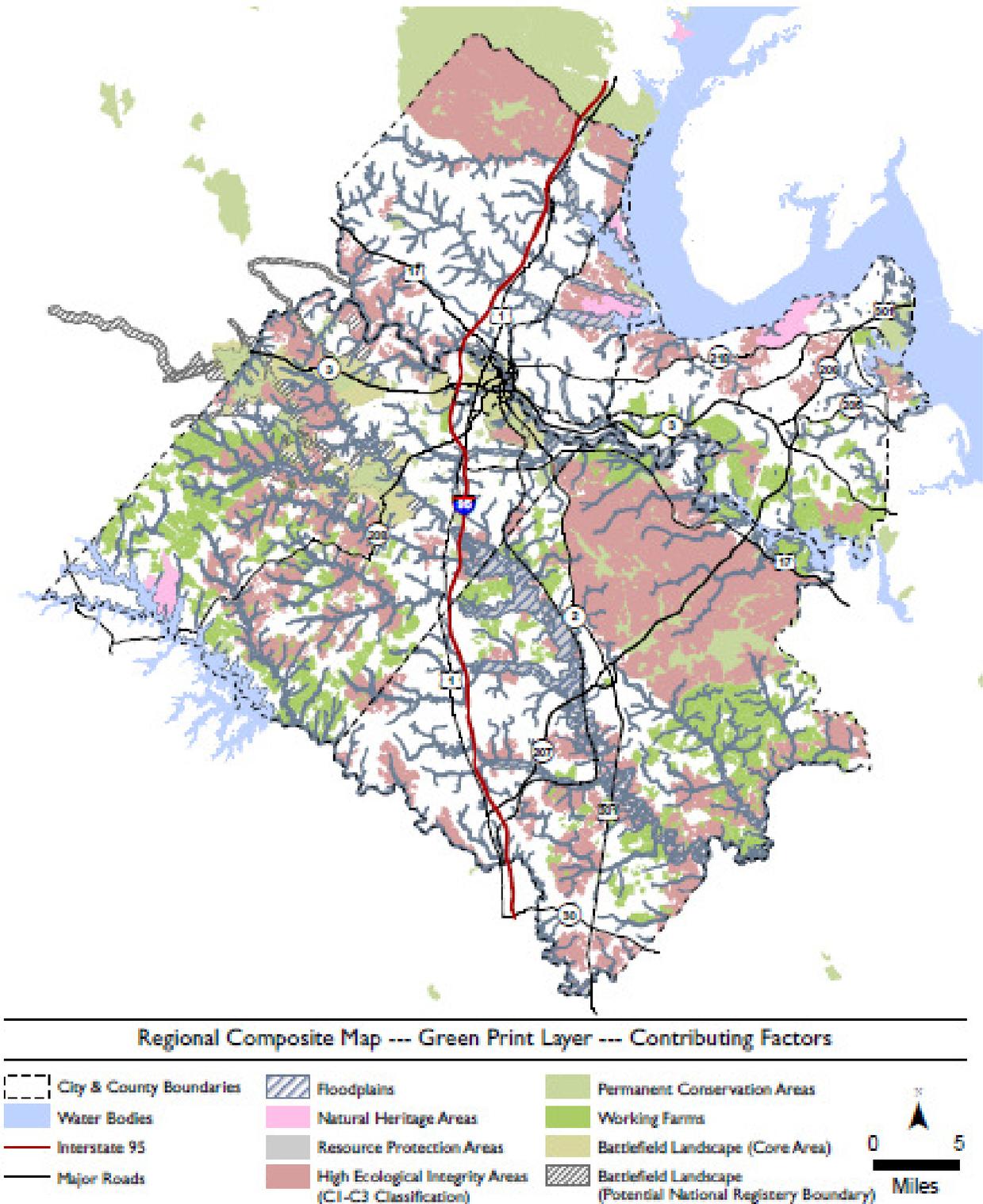


Figure 15: Regional Composite Map - Green Print Layer – Contributing Factors

George Washington Region Scenario Planning Study

Development Scenario Map Series



Regional Composite Map --- Green Print Development Scenario --- Green Print Avoidance Layer

City & County Boundaries	Regional Green Print *
Water Bodies	* = The regional green print represents cultural and environmentally-sensitive areas that should be protected from the encroachment of development.
Interstate 95	
Major Roads	

0 5
Miles

Figure 16: Regional Composite Map – Green Print Scenario Avoidance Layer

Summary Matrix

The report card’s summary matrix compares all of the performance measures for Your Vision, Our Future side-by-side to evaluate the four development scenarios. Based on information presented in the table, the Jobs-Housing Balance development

scenario best satisfies the regional growth principles stated for Your Vision, Our Future; followed in order by Compact Development, Green Print, and Decentralized Growth.

	Decentralized Growth	Green Print Initiative	Compact Development	Jobs-Housing Balance
Mobility				
Vehicle Miles Traveled per Capita	○	◐	◑	●
Vehicle Hours Traveled per Capita	○	◐	◑	●
Percent of Population Near Potential Transit Node	○	◐	●	●
Congested Corridors	○	◐	◑	●
Percent of Income Spent on Transportation	○	◑	●	●
Viable Transportation Options	○	◑	●	●
Environment				
Urban Footprint	○	●	◑	◑
Agricultural Land Consumed	○	●	◑	◑
Eco-Core Land Consumed	○	●	◑	◑
Amount of Protected Open Space	○	●	◑	◑
Genuine Communities				
Housing Mix	○	◑	●	●
Proximity to Existing Development	○	●	◑	◑
Jobs-Housing Balance	○	○	○	●
Regional Collaboration				
Consistency with Local Plans & Ordinances	●	○	◑	◑
Consistency with Regional Plans	○	◐	◑	◑
Land Use / Transportation Connection	○	◑	●	●
Maximizing Efficiencies in Public Infrastructure				
Demand for New Parks	○	◐	◐	●
Demand for New Schools	○	◐	◐	●
Demand for Water	○	◐	◐	●
Demand for Sewer	○	◐	◐	●
Quality-of-Life				
Protection of Civil War Battlefields	○	●	◐	◐
Jobs-Housing Balance	○	○	○	●
Amount of Protected Open Space	○	●	◑	◑
Maintaining Rural Character	○	●	◑	◑
Composite Grade (w/ Equal Weighting for All Variables)				
		◐	◑	●

Notes:
 ● = Most satisfies the performance measure ◐ = Somewhat satisfies the performance measure
 ◑ = Moderately satisfies the performance measure ○ = Least satisfies the performance measure

Figure 17: Summary Matrix of the Virginia Planning District 16 regional growth principles in accordance with the four proposed growth scenarios.

Scenario Planning Results

The objectives of the Regional Scenario Planning study process were to:

- 1) Assess citizens' preferences for specific land use scenarios for the George Washington Region,
- 2) Understand how each scenario resonates with citizens, and
- 3) Understand residents' rationale behind the relative appeal of the preferred scenario.

In May 2011, respondents were shown a scenario description, a map, and photos for each scenario and then asked to provide individual ratings for each scenario. After rating all scenarios, they were asked to choose their preferred scenario. A random sample of 472 residents completed surveys. (Non-random sample survey respondents answered very similarly) The following statistics are based on the random sample survey.

GreenPrint Scenario: Nearly half of the respondents (48%) found the greenprint scenario to be attractive. Two-thirds (64%) recognized that it will protect the environment, while 59% found it to be a good place to raise a family, 38% percent found it to be a good place to work, and 58% found it a good place to lives (see graph to right).

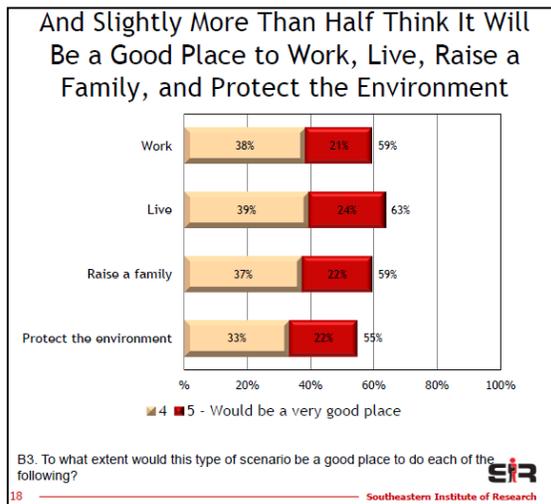


Figure 19: Regional preference for Compact Growth scenario.

Greater Jobs-Housing Balance Scenario: Six in ten participants (60%) found the jobs-housing scenario to be attractive and about three-quarters (72%) recognized that it would make the region a good place to work. Sixty-three percent of the participants found the scenario represented a good place to live, 60% found it a good place to raise a family, and 53% found it a good place to protect the environment.

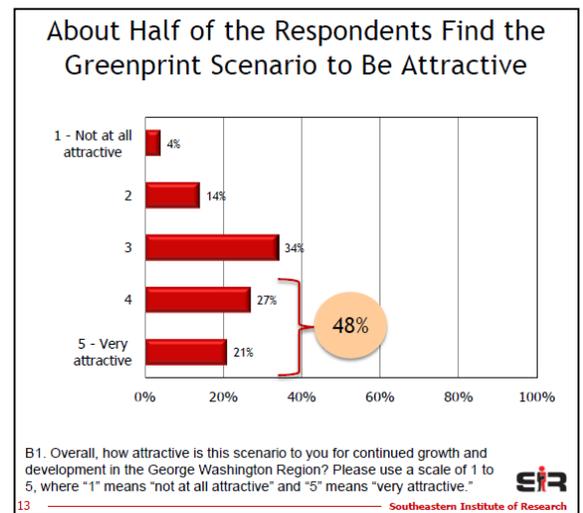


Figure 18: Regional preference for Green Print growth scenario.

Compact Growth Scenario: Slightly more than half (57%) of the respondents found the compact growth scenario to be attractive, and slightly more than half thought it would be a good place to work (59%), live (63%), raise a family (59%), and protect the environment (55%) (see graph to left).

Decentralized Growth Scenario: Only 15% found the decentralized growth scenario to be attractive. Twenty-seven percent found it a good place to work, 23% a good place to live, 25% a good place to raise a family, and 16% good place to protect the environment.

Overall, residents are clear that they do not want Decentralized Growth (see graph to right). Thirty-six percent of respondents preferred the greenprint scenario, 34 percent the compact scenario, and 25 percent the jobs-housing scenario. Respondents who preferred the greenprint scenario liked it most (32 percent) because of the large areas of preserved open space. Fifty-two percent of the respondents said they chose the compact growth scenario because they like having everything close by. Not surprisingly, job opportunity was the biggest influencer (30 percent) of selection of the jobs-housing balance scenario.

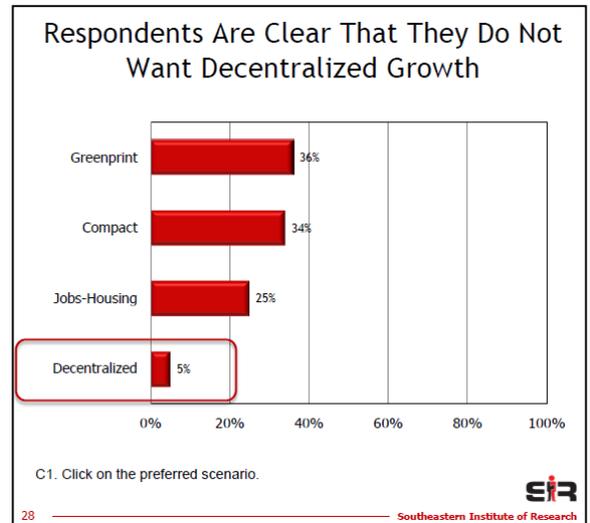


Figure 20: Regional preference for Decentralized Growth scenario.

There were only slight differences between localities and no significant differences between men and women. There were slight generational differences, as 56 percent of Generation X (those born 1982-2001) preferred the compact scenario, whereas only 22 percent of those born in 1945 or earlier did. Those living in the George Washington Region for 5-10 years were most likely to prefer the compact scenario. Differences in income were not statistically different.

F. Children and Nature Network

GWRC has collaborated with local environmental and community educator stakeholders to develop a regional Children and Nature Network (CANN) program to expand on current environmental education work performed in the region. Inspired by Richard Louv’s book, “Last Child in the Woods,” GWRC is interested in creating a program to encourage children and their families to become more connected with nature and foster local environmental education opportunities. This connection to nature will help to promote healthy lifestyles among families, ultimately helping to reduce the risk of child obesity, and other related health issues. Similarly, this program will help to strengthen relationships within families and will promote participation within the community.

Recently, CANN developed the Children and Nature Guide, a web-based comprehensive inventory of local parks and recreational areas that includes park locations, hours, available amenities, and other relevant information. CANN has completed a Passport to the Central Rappahannock, a project designed to connect different nature-based programs and recreational areas across the region and encourage families’ participation and visitation. This project is just one of the many ways the CANN is encouraging active and healthy activities for children and families to participate in. The Passport, as well as additional information, can be found on the Friends of the Rappahannock organization website under the Publications link⁹.

⁹ <http://www.riverfriends.org/Publications/PassporttotheCentralRappahannock/tabid/557/Default.aspx>

VI. Green Infrastructure Implementation Toolkit¹⁰

Green infrastructure planning and conservation efforts can be considered part of the practice of managing the impacts of land development with community sustainability and environmental protection as prominent goals served by supportive public and private actions. These actions are guided and shaped by planning and zoning processes in each community that are enabled by statutory authority given by the Virginia General Assembly to local governments. This section describes these processes and how they may be applied in Virginia to enhance and/or conserve green infrastructure.

A. Zoning Tools

1. Zoning Power

Zoning is considered the quintessential tool of comprehensive plan implementation. Zoning divides a locality into specific districts and establishes regulations concerning the use, placement, spacing and size of land and buildings within the respective districts.

This section of the report provides an overview of the zoning tool in general (Part 1), and is then followed by descriptions of a few of the major variants on zoning that are used in the commonwealth, including Agricultural or Large Lot Zoning, Cluster Zoning, Traditional Neighborhood Development, and Historic District Zoning. (Also, Conditional Zoning/Cash Proffers are discussed under financing tools rather than zoning tools). This short list does not include every variation used by Virginia localities, but does include several of the more prominent ones.

According to the Virginia Code (§ 15.2-2280) any locality may, by ordinance, classify the territory under its jurisdiction or any substantial portion thereof, into districts of such number, size and shape as deemed important to needs of the community and the purposes of zoning as defined by the code. Accordingly, zoning is a discretionary tool of plan implementation. It is not a mandated tool like the subdivision ordinance, except in Chesapeake Bay Preservation Act localities (generally those east of I-95).

Zoning is intended to avoid disruptive land use patterns by preventing activities on one property from generating external effects that are detrimental to other properties. Zoning ordinances, if drafted by the planning commission and adopted by the governing body, must feature text describing each district and the district regulations, as well as a map detailing the location and extent of each district throughout the community.

Conventional zoning is called “Euclidean”, named after the Town of Euclid, Ohio, whose zoning ordinance was upheld by the U. S. Supreme Court in a landmark case in 1926. This conventional approach divides the land within the jurisdiction into discreet geographic districts based on the general use and intensity that is permitted for land and buildings. Typical zoning districts under this approach are residential, commercial and industrial. Many variations on this approach have been devised during the past 80 years, and many of these are used in various localities in Virginia. One prominent variation is called “Planned Unit Development (PUD), in which some amount of flexibility is permitted for lot sizes and uses within the district, based upon a detailed conceptual development plan submitted by the applicant.

¹⁰ GWRC wishes to recognize the primary source for much of the narrative in this section taken, in whole or in part, from [“Managing Growth and Development in Virginia: A Review of the Tools Available to Localities”](#). The Virginia Chapter of The American Planning Association; 2010. Other supplemental sources are cited as they appear.

Authority

Standards authorizing the use of zoning in Virginia are found in § 15.2-2280 of the state code. The purposes of zoning are spelled out in § 15.2-2283 of the code, while matters that a locality shall consider when developing a zoning ordinance and when applying or using the zoning ordinance are outlined in § 15.2-2284. The 2008 General Assembly added flood inundation zones and impoundment structures as new items of consideration when developing a zoning ordinance.

Criteria governing the preparation, administration and enforcement of zoning, along with zoning standards applicable to group homes, airports, conditional uses, affordable dwelling units, historic properties and the vesting of rights are found in § 15.2-2285 through § 15.2-2307 of the code. In 2010 the General Assembly expanded the definition of a “significant affirmative governmental act” which vests a property right to included written orders, decisions or determinations of the zoning administrator regarding use or density of property.

Implementation

On its own initiative or at the direction of the governing body, the planning commission may prepare a zoning ordinance, including text and maps dividing the community into districts; detailing the regulations applicable in each district; and providing for enforcement, variances, conditional zoning, special exceptions, appeals and penalties. To date, every city in Virginia, most towns and 87 of the 95 counties have chosen to adopt zoning to regulate land use and to help manage local growth. This is a remarkable statistic considering zoning is not mandated by the state of Virginia other than those localities affected by the 1988 Chesapeake Bay Preservation Act. Generally speaking these cities, counties and towns are east of the fall line in eastern Virginia.

To be effective, zoning ordinances need to reflect the views of how land within a jurisdiction can, or should, be used at the present time, as well as in the future. These views should be reflected in the community’s comprehensive plan. Thus, when a property owner petitions a locality for a rezoning (zoning map amendment), the planning staff, planning commission and the local governing body must refer to the comprehensive plan to determine if the rezoning request comports with the plan’s goals, objectives, policies and vision. Indeed, the planning commission and the governing body must each hold public hearings before acting on any rezoning proposal. In addition to hearing the public’s perspective regarding the proposed rezoning, the commission and governing body alike must identify and share the facts and findings each body used in deciding to support or reject the proposed rezoning. Action taken by a governing body is final unless parties file an appeal with the local circuit court. In contrast to subdivision approvals, which are ministerial, zoning actions are legislative acts. Localities enjoy the “presumption of validity” under the law when approving or denying zoning amendments.

Localities have devised many and various ways to craft and implement the broad tool called zoning. Several of the major variations are described in the following pages of this report, although this is by no means intended to be an exhaustive catalogue of every variation to be found throughout the commonwealth. However, the General Assembly has placed some limitations on local authority including, among other things, prohibiting the ability to deny placement of or require use permits for manufactured housing, group homes and assisted-living facilities, family day care, medical cottages and small scale biomass energy production if these use meet certain state code defined criteria. This list grows longer with each Session of the General Assembly.

Limitations

Throughout most of the 20th century, zoning was used to prevent incompatible land uses from locating close to one another. While not inherently wrong, this rather narrow perspective thwarted zoning’s use as a proactive or anticipatory tool of planning. Further, this absolute separation of land uses (especially various types of residential from each other and from commercial uses) has to a great extent led to an automobile-centric development pattern.

Another limitation centers on stale or old zoning. Unlike the comprehensive plan, there is no mandate that a zoning ordinance be reviewed on a periodic basis. It is not uncommon to discover localities using zoning ordinances first developed 30 and 40 years ago to implement current comprehensive plans. Not surprisingly, problems can and do result when this situation occurs.

Another limitation long associated with zoning practices in Virginia involves the mindset that downzoning, i.e., diminishing the number of development rights permitted by right in a district or zone, is illegal. This perspective (which is unfounded) is a major reason localities cite for not rewriting or modifying, in a substantial manner, their zoning ordinances. This erroneous view must be corrected. However, it must be noted that the public notice requirements contained in the Code of Virginia with respect to residential downzoning are onerous and very costly.

Enhancements

Zoning regulations, in both theory and practice, should be consistent with the local comprehensive plan. Indeed, this is a mandate in nearly half of the states nationwide. Better decisions and better communities, arguably, would be the byproduct of enhanced plan and ordinance consistency. This does not necessarily mean that a locality should zone to the plan by rezoning property on their own motion to conform to the planned future land use map. Rather, it means that the development standards pertaining to various districts and land uses should reflect the goals and policies set forth in the comprehensive plan.

However, localities must carefully consider rezoning properties for which the range of by-right uses directly conflict with the Comprehensive Plan. For example in areas where industrial uses are planned, leaving such land zoned for agricultural uses where residential development is permitted as a matter of right could too easily interfere with the plan's vision.

The mandate to review local zoning ordinances on a periodic basis is worthy of consideration as is the admonition that every locality be required to adopt zoning.

Lastly, by separating structures and land uses, conventional zoning regulations tend to reinforce dispersed settlement patterns, which many localities are finding to be less than desirable when compared to compact, pedestrian-friendly historic areas. By softening zoning's hard edge, by creating situation-based development standards, and by encouraging localities to adopt flexible techniques such as traditional standards modeled after historic neighborhoods, zoning may become truly a 21st century tool for planning.

2. Subdivision and Site Plan Regulations

Subdivision regulations are also one of the four primary tools of implementing the comprehensive plan. Each local government in Virginia is required to adopt a subdivision ordinance to assure that land development occurs in an orderly and safe manner. The subdivision ordinance establishes the procedures, platting and design requirements, as well as surety guarantees for public infrastructure improvements, associated with the subdivision of land into parcels or lots of development.

A subdivision according to the Code of Virginia means the division of a parcel of land into either three or more lots or into parcels of less than five acres each for the purpose of transfer of ownership or building development. Many Virginia localities have three types of subdivisions: minor, major, and family. The Code of Virginia defines a site plan as the "proposal for a development or a subdivision, including all covenants, grants or easements and other conditions relating to use, location and bulk of buildings, density of development, common open space, public facilities and such other information as required by the subdivision ordinance to which the proposed development or subdivision is subject."

Authority

Land subdivision and development standards are contained in § 15.2-2240 through § 15.2-2279 of the Virginia Code. As prescribed, a subdivision ordinance will specify administrative procedures to be followed in the division of land; design standards for subdivisions; and the identification of improvements (e.g., streets, utilities) to be installed.

Implementation

Every local government in Virginia has adopted a subdivision ordinance to promote the safe, functional, and proper development of property. The subdivision ordinance provides details for plats and plat approval, a coordinated network of streets; provisions for public facilities; drainage and flood control; fees and enforcement; and in selected localities family subdivisions. The subdivision of land is generally viewed as a ministerial act. This means the local governing body does not have to review and approve the proposed subdivision. Typically, only the staff, and/or planning commission will review proposed subdivisions to assure conformity with the subdivision and related ordinances. For plat features requiring state agency approval the agency has 45 days to complete their review. Staff and/or the Planning Commission has 60 days to complete the review of a subdivision submission or re-submission.

Most subdivisions create new roads or are along existing public roads. In counties, the various design standards of the Virginia Department of Transportation (Access Management, Secondary Street Acceptance Requirements, etc.) are a significant design consideration in subdivisions. Increasingly, counties require that new private roads also meet current VDOT road design standards.

Limitations

Because the subdivision of land is considered a by-right activity, the landowner's only obligation is to meet the applicable subdivision (and zoning) regulations before subdividing. This guarantee can become a liability if the subdivision regulations are out of date or the underlying zoning of the property does not reflect the intent of the community's comprehensive plan. When this happens the subdivision, regardless of the concern expressed by citizens, the planning staff, the planning commission or the governing body, must be approved. Accordingly, it is essential that subdivision ordinances be reviewed and updated on a regular basis.

Family subdivision (see §15.2-2244) provisions are required to be a part of subdivision ordinances in counties. While these provisions can be tailored somewhat to local needs, they can represent a substantial loophole in a county's ability to affect the type of growth and development envisioned in the local comprehensive plan.

Enhancements

Committing to a periodic review and update of the subdivision ordinance should become standard operating procedure statewide. In addition, correlating the goals and objectives of the comprehensive plan, the zoning ordinance and the subdivision ordinance should be considered an essential land use requirement for every locality.

3. Form Based Codes

Form-based codes are a basic zoning mechanism for directing development toward meeting specific goals, and are the primary tools used to implement Traditional Neighborhood Development (TND) and New Urbanism development form concepts, which are discussed as community design policy tools in Section E.5.

A few definitions of form-based Codes are offered:

“Form-based codes are a method of regulating development to achieve a specific urban form. Form-Based Codes create a predictable public realm by controlling

physical form, primarily with a lesser focus on land use, through city or county regulations.”

-- Form-Based Code Institute

“Form-based codes add the details of relationship between buildings and the public realm of the street, the form and massing of buildings in relation to one another, and the scale and types of streets and blocks.”

-- Paul Crawford, AICP

Form-based codes in particular differ from conventional codes in that they make greater use of graphics to reinforce the text of the regulations, and they emphasize the *form* of development, especially the relationship of building mass and openings to the public street, rather than the *use* and *density* of development.

Authority

Same as for conventional zoning techniques (§ 15.2-2280, et seq.)

Implementation

The preparation of a form-based code typically includes the following steps:

- Existing conditions analysis and inventory
- Public visioning/charette
- Determine appropriate spatial basis for regulation
- Determine standards
- Illustrate standards

The typical components of a form-based code include:

- Regulating plan
- Building form standards
- Public space standards
- Architectural standards
- Streets standards
- Definitions
- Administration

Zoning regulations that implement TND and New Urbanism principles differ from conventional zoning regulations in that the standards do not require that structures and uses be separated and dispersed. Instead, they promote a more compact, pedestrian-oriented streetscape with a mixture of residential and commercial land uses.

Arlington County has a true form-based code for the Columbia Pike corridor district. Arlington’s form-based code is implemented through an optional overlay district that offers development incentives, including density bonuses and an expedited site plan review process.

Limitations

In Virginia, form-based codes should not regulate architectural design, per se (unless they also use the provisions of the code for conditional zoning or historic district zoning in §15.2-2306), but should adhere to the normal topics of zoning regulations such as bulk, height, and use of structures. Because form-based codes govern very specific aspects of how buildings and parking areas are located on a site, it is important that they be based upon a detailed comprehensive plan element for the area covered by the district.

Enhancements

Form-based codes should be based upon detailed comprehensive plans for the areas to which they pertain. This approach should encourage localities to prepare plans that show specific concepts for street networks, relationships of buildings and parking areas to streets, and provisions for pedestrian and bicycle circulation as

well as for motor vehicles. Goals and objectives within comprehensive plans should include language that promotes a desirable development form, thus establishing an appropriate nexus for the development of an implementation device (i.e. zoning ordinance, form-based code). The benefits of outlining community transects in Comprehensive Plans to help direct the type of desired development form the locality is seeking in a particular location. Other broad public health and safety items, such as transportation, open space or civic areas (parks, community buildings, etc.) are community forms that should also be considered as subjects in form-based codes.

4. Cluster Subdivision/Zoning¹¹

Under cluster subdivision/zoning provisions, when a residential subdivision is created, it is designed so that the dwelling units are clustered together on smaller than average lots on only a portion of the tract, leaving the remainder available for open space or similar uses. Clustering may be used in either urban or rural areas. However, the term “cluster zoning” is usually associated with rural land use issues.

Depending on the provisions of the specific cluster ordinance, the remaining open space within a cluster development may be held in common and/or be strictly an agricultural or environmental area with no “development rights” remaining on it; or, the open space parcel(s) may be allowed to have a dwelling unit with a permanent easement that prohibits further subdivision or additional dwellings.

In urban areas, cluster provisions are typically used for preserving sensitive environmental features and/or for encouraging a compact development pattern that makes efficient use of grey/man-made infrastructure. In rural areas, cluster provisions are typically aimed at agricultural and forest conservation.

Cluster provisions can be voluntary options within a zoning district, or they can be mandatory. Per §15.2-2286.1, a rezoning, use permit or special exception may not be required in order to create a cluster development, unless there is a density increase involved in the request.

One of the key advantages of rural cluster techniques is that the tool can help to preserve rural land resources while still meeting the desires of rural landowners to obtain a relatively high development value for their property. Typically, rural cluster provisions allow roads and dwellings to be sited with less disruption to views from the public road right-of-way and/or with greater buffer distances between neighboring properties. Thus, cluster provisions can protect “rural character” as viewed from the road and in some localities also allow for some continued agricultural use of the remaining land, but because the development still occurs in the rural part of the locality, cluster provisions do not completely protect rural land from the effects of sprawl.

There are many variations on the rural cluster technique, including the following:

- *Percent of Land Developed.* One variation on rural clustering is to specify a maximum percentage of the parent parcel or tract that can be converted to non-agricultural or non-open space uses. Such a provision can be relatively simple and may permit a great deal of flexibility to the developer in terms of lot size and unit type on that portion of the land that is permitted to be converted.
- *Lot Size Averaging.* Another variation on rural clustering is to specify the average minimum lot size for a rural subdivision, but permit the developer to achieve that average by creating some lots that are larger and some smaller. Again, the advantage of this variant is to provide more design flexibility in order to respond to unique site conditions and to the local market demand.

¹¹ Source: Arendt, Randall. (1996) Conservation Design for Subdivisions: A Practical Guide to Creating Open Space Networks. Island Press, Washington, DC.

- *Maximum Size of Building Lots.* Another variation is to set a *maximum* rather than *minimum* lot size for rural subdivisions, thereby forcing a clustered layout. The percentage of open space remaining will be determined by the actual maximum lot size required in relation to the maximum overall site density required.

Authority

Same as for all zoning techniques (§ 15.2-2280, et seq.). In 2006 the General Assembly added § 15.2-2286.1 which mandates clustering in certain high growth localities (discussed further on page 26).

Implementation

Some examples of rural cluster provisions in Virginia:

- *Loudoun County.* Voluntary rural cluster. In the AR-1 District, a minimum lot size of 20 acres is required, unless lots are clustered. In this case a lot yield of one lot per 5 acres is allowed, with cluster lots at least 20,000 square feet and not more than four acres in size, with at least one lot of at least 15 acres, and at least 70% of the land in the cluster subdivision in common open space. In the AR-2 District, a minimum lot size of 40 acres is required, unless lots are clustered. In this case a lot yield of one lot per 15 acres is allowed, with cluster lots at least 20,000 square feet and not more than four acres in size, with at least one lot of at least 25 acres, and at least 70% of the land in the cluster subdivision in common open space.
- *Hanover County.* Mandatory rural cluster to obtain maximum permitted density. Sixteen clustered lots are permitted per each 100 acres with a minimum of 70% open space required (slightly more than six acres per lot on average). If cluster is not used, minimum lot size/density is 10 acres per dwelling in the agricultural zone.
- *Isle of Wight County.* Voluntary rural cluster with density incentives. In order to get a higher density than the restrictive agricultural zone allows (about 40 acres per lot), the owner may cluster the subdivision lots and achieve a density of 1 per 10 acres if 50% of the tract is preserved in open space, 1 per 8 acres if 60% is preserved, and 1 per 5 acres if 70% is preserved.
- *Accomack County.* Voluntary rural cluster with density incentives. Cluster lots of 30,000 square feet up to one acre in size are allowed with two bonus lots per parent tract in addition to the base density of one dwelling per five acres.

Limitations

Clustering is a middle ground between full preservation and full development, and thus doesn't completely "solve the problem" of preserving agriculture or rural character while allowing land development to occur. Also, additional design effort is usually required to create a cluster subdivision compared to a conventional, large lot subdivision. Yet, cluster zoning is becoming more widespread as localities seek to deal with the conflicting pressures for development and preservation.

§ 15.2-2286.1 requires that, effective July 1, 2007, most high-growth localities (10 year growth rate over 10%) must provide cluster regulations applicable to at least 40% of the unimproved land in residential and agricultural zoning districts. Such cluster developments must be permitted by right under the local subdivision ordinance, without a public hearing or any kind of special use permit.

Enhancements

Localities should be given the maximum possible discretion and flexibility in crafting cluster zoning regulations that fit the particular needs and circumstances of each locality. As noted above, cluster zoning can be particularly effective when used in combination with other rural preservation tools.

5. Zoning Ordinances

Once a locality has drafted a green infrastructure plan and it has been reviewed by the public and ideally incorporated into the locality's Comprehensive Plan, the next step is to determine whether the plan can be actualized through land use codes. Zoning laws can be written to establish parameters that would allow a green infrastructure network to emerge (or conversely, be preserved from conversion by development). Zoning regulations themselves cannot simply mandate certain nodes and corridors as fully protected natural areas, but they can restrict the type and intensity of use allowed by landowners in specific areas.

The Code of Virginia lists several valid objectives for zoning that are relevant to green infrastructure:

- Improving the health, safety, convenience and welfare of its citizens.
- Recognizing the need for mineral resources and the needs of agriculture, industry and business in future growth.
- Providing residential areas with healthy surroundings for family life.
- Preserving agricultural and forest land.
- Assuring that the growth of the community is consonant with the efficient and economical use of public funds.

6. Rezoning Proffers

When developers request a Special Use Permit to vary from by-right allowable uses in an area, the planning commission and Board of Supervisors have a certain degree of latitude in determining the benefits to the community of permitting the requested site plan. Developers may choose voluntarily to offer proffers, which are legally-binding commitments from the developer to provide an amenity to the community for the purpose of mitigating the impact of development. It is important to note that proffers are distinct from impact fees, insofar as they are made by developers on a voluntary basis and accepted by a planning commission, as well, on a voluntary basis. Moreover, the voluntary nature of proffers is understood to distinguish their offering and acceptance as a legal transaction that does not constitute an illegal "contract" rezoning. Proffers must be reasonably linked to the nature of the impact from the development in question.

Green infrastructure, because of its proven ability to enhance property values in proximity to the improvements, is an especially viable option for proffers. Developers have often proffered a certain level of open space on the site, an easement for a trail or system of trails on site, bio-retention facilities for stormwater management, retention of mature trees, or funds to be used for the acquisition of parkland or greenways. Often site plans will include a combination of proffers. Although proffers are less useful of a tool for the placement of green infrastructure in rural areas where there is less development occurring, they can be among the most valuable means of doing so in more urbanized areas.

7. Zoning Maps

Communities that choose to adopt land use regulations should use their future land use map to inform a zoning map, which includes legal regulations. The zoning map references land use codes, either codes focusing on allowable uses or on identifiable features of urban form, and applies them to specific areas indicated on the map. A review of the zoning map will help determine the degree to which the introduction of green infrastructure will conform with existing regulations.

There are always measures for altering or even rewriting the zoning code, but it may be more advantageous to work within the current model before considering alterations. However, it's also important to recognize that the green infrastructure plan itself may inform a future zoning map. The existing map, by revealing the restrictions residents have already opted to place upon themselves, can be used to gain a valuable insight into the ideals and goals of a given community.

B. Design/Density Tools

1. Urban Growth Boundaries (*Land Use and Infrastructure Coordination*)

Extensions of infrastructure, particularly water and sewer lines and major streets, significantly affect the timing and density of development. The comprehensive plan can designate areas which are planned for immediate or long-term utility service, thereby coordinating development approvals (rezonings) and utility extensions to achieve an orderly and compact development pattern adjacent to existing settlements. Urban Growth Boundaries in Virginia are not zoning designations per se, but rather policy designations established in the comprehensive plan so as to guide decisions about rezoning applications and public infrastructure investments.

Authority

Virginia Code § 15.2-2223, § 15.2-2223.1, § 15.2-2232 and § 15.2-2283(vi).

Implementation

Examples include:

- *Chesterfield County:*
 - Planned Growth Area
 - Public water and sewer is required for development in the planned growth area.
 - Public sewer is required in areas planned for nonresidential and higher density residential development. Septic tanks are required in designated areas for residential lots of 2 acres or more.
 - Deferred Growth Area
 - No planned water and sewer extensions in this area where [urban] development is deferred.
- *Hanover County:*
 - Planned growth areas require public water and sewer.
 - Timing of [urban] development depends on planned extension of public water and sewer trunk lines.

The advent of the Urban Development Area mandate in certain localities and available for use in all localities has strengthened the ability of localities to establish infrastructure extension boundaries and limits.

Limitations

Urban Growth Boundaries are an important tool for focusing growth in places where infrastructure exists or can be efficiently provided. Care must be taken, however, to ensure that an adequate supply of developable land is provided within the UGB in order to ensure enough choice in available land for the land market to function and to provide enough users of the utilities to create an adequate revenue stream to support the utility systems.

Example

A planning commission may reject a rezoning application and/or a requested sewer line extension if it is not located within a designated area as set forth in the comprehensive plan because it would not be in substantial accord with the comprehensive plan as per Virginia Code § 15.2-2232.

2. Density Incentives

A zoning ordinance is a principal planning tool used by localities to achieve their development objectives. Historically, zoning ordinances were purely regulatory tools that established minimum standards for new development. However, because “minimum standards” many times become “maximum performance”, zoning ordinances have evolved to include incentive-based approaches to community development objectives.

Although different types of incentives can be incorporated into a zoning ordinance (fast track plan reviews, reduced application fees, etc.), the most positive incentive to developers is often increased density.

Incentives may be considered and applied through the rezoning process and/or directly through provisions of the zoning ordinance text. In the rezoning process, a locality's comprehensive plan provides recommended density ranges for areas planned for residential use and intensity ranges (i.e., ranges of building square footage, floor area ratios) for nonresidential use areas. Establishing density as part of a rezoning approval is a matter of the extent to which the objectives as specified in the comprehensive plan are met by the rezoning proposal.

Incentives may also be directly incorporated into a locality's zoning ordinance text, and be available to anyone who meets the standards established in the zoning ordinance. Incentives may be structured to foster an assortment of community objectives including, but not limited to affordable housing, dedication of land for highway improvements, reservation of land for open space, enhanced landscaping or signage design, or dedication of land for public uses.

Authority

Existing planning and zoning enabling legislation contained in Title 15.2 Chapter 22 of the Code of Virginia, sets forth broad purposes and objectives which allow localities to establish density ranges and the criteria to be satisfied in order to develop at certain densities. In the legislative act of rezoning, there is opportunity and the discretion to achieve local objectives of the comprehensive plan.

Implementation

When applying density credits, the extent to which density may be awarded will reflect the priorities of the community as may be set forth in the comprehensive plan. Purposes are therefore varied and should be left to the discretion of the local governing body (ex: open space, preservation of environmentally sensitive lands, land area for public facilities, land for public roads, affordable housing, etc.).

3. Community Design Concepts: Traditional Neighborhood Development and New Urbanism

Traditional Neighborhood Development (TND) and New Urbanism are forms of development that reflect the principles of New Urbanism, which is aimed at achieving a "human-scale" built environment of mixed uses and interconnected streets that is conducive to pedestrian movements, as well as to motor vehicle movements.

New Urbanism is a planning concept that includes, or is otherwise known as neo-traditional design, transit-oriented development, and traditional neighborhood development. It has blossomed into a widespread planning movement during the past two decades, largely as a reaction to some of the deficiencies and unintended consequences of conventional suburban development patterns. The "Smart Growth" movement has adopted New Urbanism and TND as a part of its toolbox of solutions.

It is based upon principles of community development that have been used successfully for centuries, but which have been largely neglected during the advent of the motor vehicle in the post-World War II 20th century. Indeed, much of New Urbanism is a reflection of the sort of organic growth that occurred in towns and villages prior to the widespread use of zoning. It seeks to combine classic principles with the best features of modern urban design to create walkable, human-scale communities that have the timeless quality of historic settlements while also meeting the needs of modern society.

New Urbanism is aimed at creating new communities that have the civic features that people have long enjoyed, including "human-scale" streetscapes that are comfortable for pedestrians, a "fine-grain" of mixed-uses, usable public spaces, prominent civic buildings, and strong neighborhood identity. These are provided in ways that still accommodate motor vehicles, modern commercial markets, and consumer preferences.

New Urbanism is based on principles of urban design rather than architectural design. Whereas architecture is concerned with style and materials, urban design is concerned with the relationship of buildings to the street, the real and perceived scale of buildings, public space design, site access, and street networks. For example, New Urbanism will typically provide for parking to be at the side or rear of buildings, and will locate buildings fairly close to the street so as to provide spatial definition to the public right-of-way. Wide sidewalks, street trees, on-street parking, and other pedestrian amenities are common features as well. These elements will produce the benefits of New Urbanism regardless of the architectural style of the buildings.

One fundamental difference between conventional suburban development patterns and New Urbanism is the street network. Conventional suburban areas typically feature “spine” roads and cul-de-sacs. New Urbanism instead uses an interconnected street network to distribute traffic, much like the street grid in many historic cities and towns. However, whereas historic street grids were often very rigid, New Urbanism typically allows the grid to “flex” as needed to accommodate topography, natural features and modern buildings. New Urbanism streets are designed to naturally limit speeds and be inviting to use by pedestrians and bicyclists while in many 20th Century suburbs, traffic calming devices are commonly being demanded by residents to slow the speed of vehicles on residential streets and increase the safety for non-motorized transportation modes. Thus, comprehensive plans that incorporate New Urbanism principles will typically include a detailed conceptual plan for the future street network, rather than just showing “blobs” of land use connected only by arterial highways. Plans may also provide guidance for land use intensity across the locality, from the least dense rural areas, to the most dense urban cores, on a gradient known as the “transect.”

New Urbanism can occur as infill projects, as transit-oriented developments, or as suburban planned communities as extensions of urban areas, or on “greenfield” sites. Hundreds of new urbanism projects have been built or planned across the U.S. Many localities have adopted zoning regulations that permit, encourage, or even require New Urbanist elements.

At the heart of the New Urbanism concept is the design of neighborhoods, and there is no clearer description than the 13 points developed by town planners Andres Duany and Elizabeth Plater-Zyberk. An authentic neighborhood contains most of these elements:

- The neighborhood has a discernible center. This is often a square of a green, and sometimes a busy or memorable street corner. A transit stop would be located at this center.
- Most of the dwellings are within a five-minute walk of the center, an average of roughly 2,000 feet.
- There is a variety of dwelling types -- usually houses, rowhouses and apartments -- so that younger and older people, singles and families, the poor and the wealthy may find places to live.
- There are shops and offices at the edge of the neighborhood, of sufficiently varied types to supply the weekly needs of a household.
- A small ancillary building is permitted within the backyard of each house. It may be used as a rental unit or place to work (e.g. office or craft workshop).
- An elementary school is close enough so that most children can walk from their homes.
- There are small playgrounds near every dwelling -- not more than a tenth of a mile away.
- The streets within the neighborhood are a connected network, providing a variety of pedestrian and vehicular routes to any destination, which disperses traffic.
- The streets are relatively narrow and shaded by rows of trees. This slows traffic, creating an environment suitable for pedestrians and bicycles.
- Buildings in the neighborhood center are placed close to the street, creating a strong sense of place.
- Parking lots and garage doors rarely front the street. Parking is relegated to the rear of buildings, usually accessed by alleys.

- Certain prominent sites at the termination of street vistas or in the neighborhood center are reserved for civic buildings. These provide sites for community meetings, education, religion or cultural activities.
- The neighborhood is organized to be self-governing. A formal association debates and decides matters of maintenance, security and physical change. Taxation is the responsibility of the larger community.

Authority

In order to adequately plan for communities with New Urbanism characteristics, a Virginia locality can take its authority from §15.2-2200, which:

“...is intended to encourage localities to improve the public health, safety, convenience and welfare of its citizens and to plan for the future development of communities to the end that transportation systems be carefully planned; that new community centers be developed with adequate highway, utility, health, educational, and recreational facilities; that the need for mineral resources and the needs of agriculture, industry and business be recognized in future growth; that residential areas be provided with healthy surroundings for family life; that agricultural and forest land be preserved; and that the growth of the community be consonant with the efficient and economical use of public funds.”

Further, §15.2-2283 calls for Zoning ordinances to be for the general purpose of promoting the health, safety or general welfare of the public and of further accomplishing the objectives of § 15.2-2200. Many of the purposes cited in § 15.2-2283 are consistent with the features of New Urbanism. Also, definitions for mixed use and planned unit development expressed by § 15.2-2201 help define a mix of land uses typically found in a community demonstrating New Urbanism principles.

In sweeping land use and transportation legislation enacted during the 2007 General Assembly Session (and amended in 2009 and 2010), TND and New Urbanism became formally recognized as a development form in the Code of Virginia and indeed its use is required in those localities in which UDAs are required. As part of HB3202, the comprehensive planning enabling authority section of the Code was revised with the following title and language inserted:

*15.2-2223.1. Comprehensive plan to include urban development areas.
B. 6. The comprehensive plan shall incorporate principles of traditional neighborhood design in the urban development area, which may include but need not be limited to (i) pedestrian-friendly road design, (ii) interconnection of new local streets with existing local streets and roads, (iii) connectivity of road and pedestrian networks, (iv) preservation of natural areas, (v) mixed-use neighborhoods, including mixed housing types, with affordable housing to meet the projected family income distributions of future residential growth, (vi) reduction of front and side yard building setbacks, and (vii) reduction of subdivision street widths and turning radii at subdivision street intersections.*

Furthermore, the VDOT Secondary Street Acceptance Requirements that became effective in 2009 effectively mandate the use of a TND street pattern in “compact” development areas.

Implementation

TND and New Urbanism development concepts should be implemented through both comprehensive plan policies and zoning regulations.

Many localities in Virginia have policies in their comprehensive plans that promote elements of New Urbanism, including, among many others, Albemarle County, Loudoun County, Fauquier County, the City of Suffolk, the City of Lynchburg, the City of Chesapeake, and the Town of Warrenton.

Many localities also implement the principles of New Urbanism by using what are called “Form-Based Codes”; refer also to Section D.2., “Form-Based Codes.” Although New Urbanism can be implemented through text-only standards, form-based codes can be more effective because they provide a means of better addressing the three-dimensional nature of New Urbanism by using diagrams to illustrate the rules.

Zoning regulations that implement New Urbanism principles differ from conventional zoning regulations in that the standards do not require that structures and uses be separated and dispersed. Instead, they promote a more compact, pedestrian-oriented streetscape with a mixture of residential and commercial land uses.

Implementing New Urbanism through zoning typically involves creating one or more districts that are a variation of “planned” districts, or “planned unit development” districts. These TND districts typically allow (or require) a variety of dwelling types, relatively narrow streets that form a connected network, a variety of permitted uses, location of parking at the rear of lots, and the use of alleys for motor vehicle access.

Several localities in Virginia have TND districts that do not actually use form-based provisions per se, including the City of Lynchburg, the Town of Stephens City, Loudoun County, and Botetourt County. The Town of Leesburg received a Charter Amendment (Senate Bill 1246) in 2007 granting the authority to designate Architectural Control Districts (ACD) on the basis of protecting the general welfare and to prevent deterioration of the appearance of the town. The Town Council may establish, enlarge, contract, or alter ACD’s anywhere within the Town. The compliance of the ACD’s may be determined either by a form-based code through an administrative process, or a design guideline, the compliance of which is determined by a Board of Architectural Review. Leesburg’s Charter Amendment also allows the Town to review architectural design. The City of Suffolk’s “Unified Development Ordinance” adopted in the year 1999 expresses many New Urbanism principles.

Enhancement

Localities should be encouraged to pursue New Urbanism in areas where such patterns are appropriate. State agencies such as VDOT should be encouraged to cooperate with such localities so as to ensure that appropriate road infrastructure can be created that achieves the important goals of New Urbanism, which seeks to balance the needs of motor vehicle movement with pedestrian and bicycle movement. The concept of the “transect” which establishes a continuum of densities and land use mixes from very urban to very rural, is an appropriate policy framework for comprehensive plans. It provides a framework for implementing New Urbanism through a variety of tools, including form-based codes as discussed earlier in Section D.2.

4. Design Review Boards

Certain districts, usually with some level of historical significance, can be designated in land use regulations as requiring review by a committee before building, demolishing, or adapting. Historic preservationists, in recent years, have become more aware of the value of preserving the context of historic buildings, beyond just the structures themselves. The Design Review Board may express the wish to see elements of green infrastructure in proposals before permitting them, especially if the preservation of natural resources is inherent to the mission of the board. Like proffers, this tool is typically most effective for more urbanized areas.

5. Site Sensitive and Low Impact Development

At the individual site level, there are many design strategies that developers can use to draw out the natural features inherent to the landscape. This approach requires a more careful survey of existing conditions and the creation of site-specific plans, but developments that take these steps are often financially successful. A

comparative study of real estate values in Concord, Massachusetts found a \$17,100 difference per property between conventional subdivisions and developments that have clustered and protected open space. The related concept of Low-Impact Development is generally used to describe development that incorporates stormwater management techniques to mimic hydrologic activity, yet there is certainly a significant overlap with green infrastructure. A green infrastructure plan, with a broader scope, could assist developers of individual sites in their efforts to create places where people want to live, work, or shop that may be tied together by non-vehicular greenways and trails. Localities may choose to offer incentives to landowners and developers to undertake design strategies that would minimize impact on the environment.

6. Stormwater Management

The Virginia Stormwater Management Program, administered by the Virginia Department of Conservation and Recreation, includes both erosion and sediment control as well as stormwater management. It was developed to protect citizens, property and natural resources from unmanaged stormwater runoff. During construction, a permit may be required for [erosion and sediment control](#). These land disturbance permits are issued by localities as part of their erosion and sediment control program. DCR also conducts reviews of [local erosion and sediment control programs](#).

A stormwater permit may be required to discharge stormwater from a construction activity. Such a permit may also be required to discharge stormwater through a stormwater conveyance system owned or operated by a government entity. DCR administers these [stormwater permits](#) under [Virginia Stormwater Management Program \(VSMP\) Permit Regulations](#) (PDF), authorized by the [Virginia Stormwater Management Act](#) (PDF). As mandated by the Clean Water Act and the Code of Federal Regulations, federal permitting requirements have been incorporated into the VSMP permit regulations.

The Virginia stormwater act and VSMP permit regulations provide the ability to manage the quantity and quality of stormwater runoff on a construction site as well as on a regional or watershed basis.

General Stormwater Information

In a natural Virginia woodland or meadow, very little rainfall runs off. During development, natural vegetation is usually removed and replaced with hard surfaces such as roads, buildings and parking areas. This land surface change decreases infiltration, groundwater recharge and evapotranspiration, and it increases runoff.

Stormwater runoff is water flowing overland into surface waters or that which is channeled into natural or man-made conveyance systems during and after rainfall or during snowmelt. Unmanaged stormwater can cause erosion and flooding. It can also carry excess nutrients, sediment and other contaminants into our waters. Properly managed stormwater protects our lands from erosion, properties from flooding, waters from pollutants, and ensures our general health, safety and welfare.

Program Overview

The Virginia Stormwater Management Program includes both erosion and sediment control as well as stormwater management. It was developed to protect citizens, property and natural resources from unmanaged stormwater runoff.

During construction, a permit may be required for [erosion and sediment control](#). These land disturbance permits are issued by localities as part of their erosion and sediment control program. DCR also conducts reviews of [local erosion and sediment control programs](#).

A stormwater permit may be required to discharge stormwater from a construction activity. Such a permit may also be required to discharge stormwater through a stormwater conveyance system owned or operated by a government entity. DCR administers these [stormwater permits](#) under [Virginia Stormwater Management Program \(VSMP\) Permit Regulations](#) (PDF), authorized by the [Virginia Stormwater Management Act](#) (PDF). As mandated by the Clean Water Act and the Code of Federal Regulations, federal permitting requirements have been incorporated into the VSMP permit regulations.

The Virginia stormwater act and VSMP permit regulations provide the ability to manage the quantity and quality of stormwater runoff on a construction site as well as on a regional or watershed basis.

Quantity of Stormwater Runoff – Compared with impervious surfaces, such as pavement or rooftops, pervious surfaces, such as meadows and woodlands, absorb and filter rainfall and reduce runoff. When meadows and woodlands are developed, the increase in impervious surfaces increases the amount of runoff that occurs when it rains. This increase in runoff can overwhelm waterways, causing erosion, localized flooding and property damage.

Quality of Stormwater Runoff - Pervious and impervious surfaces in urban areas collect pollutants, such as automobile oil, grease, sediment, bacteria from animal waste, excess nutrients and pesticides, and deposits from airborne pollutants. Stormwater runoff with high concentrations of these pollutants may enter nearby drinking water supplies and waterways when it rains.

DCR is responsible for the issuance, denial, revocation, termination and enforcement of individual and general VSMP permits for the control of stormwater discharges from MS4s and construction activities. DCR administers these program through [Virginia Stormwater Management Program \(VSMP\) Permit Regulations](#) (PDF), authorized by the [Virginia Stormwater Management Act](#)

Many diffuse sources contribute the pollutants found in stormwater runoff. These pollutants include: excess fertilizers, herbicides and insecticides from residential areas; oil, grease and toxic chemicals from roadways and parking lots; sediment from improperly managed construction sites; bacteria and nutrients from pet waste, failing sanitary sewers and faulty septic systems; and carelessly discarded trash, such as cigarette butts, paper wrappers and plastic bottles. When they enter nearby waterways, these pollutants can impair them, discouraging recreational use of the resource, contaminating drinking water supplies, and interfering with habitat for fish, other aquatic organisms and wildlife.

Often polluted stormwater runoff is collected and discharged through municipal separate storm sewer systems (MS4s). MS4s are conveyances, including road drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels and storm drains designed to collect and convey stormwater, which are owned or operated by a federal, state or local government entity. MS4s are not systems that are part of a "publicly owned treatment works system" (sewage collection, transportation and treatment) or part of a combined sewer (a system designed to carry both sanitary wastes and stormwater to the sanitary sewer treatment plant). Privately owned and operated drainage systems also are not considered MS4s.

Discharges from MS4s are regulated under the Virginia Stormwater Management Act and the Clean Water Act as point source discharges. MS4 regulations were developed and implemented in two phases. Implementation of the first phase began in the early 1990s and required that operators of MS4s serving populations of greater than 100,000 people (per the 1990 census) apply for and obtain a permit to discharge stormwater from their outfalls.

Stormwater discharges from Phase I municipal separate storm sewer systems are authorized under individual VSMP permits. Under these permits, the MS4 owner/operator must implement a collective series of programs to reduce the discharge of pollutants from the given storm sewer system to the maximum extent practicable in a manner that protects the water quality of nearby streams, rivers, wetlands and bays.

The programs must include elements to:

- Operate and maintain structural stormwater controls.
- Control discharges from areas of development and significant redevelopment.
- Operate and maintain public streets, roads and highways.

- Identify, monitor and control discharges from municipal waste treatment, storage or disposal facilities.
- Control pollutants related to application of pesticides, herbicides and fertilizers.
- Implement an inspection program to enforce ordinances, which prohibit illicit connections and illegal dumping into the MS4.
- Screen the MS4 for illicit connections and illegal dumping.
- Implement standard investigative procedures to identify and terminate sources of illicit connections or discharges.
- Prevent, contain and respond to spills that may discharge into the MS4.
- Limit the infiltration of sanitary seepage into the MS4.
- Identify, monitor and control discharges from municipal landfills; hazardous waste treatment, storage, disposal and recovery facilities; facilities subject to EPCRA Title III, Section 313; and any other industrial or commercial discharge the permittee determines to be contributing a substantial pollutant loading to the MS4.
- Control pollutants in construction site runoff.
- Conduct public education on stormwater.

The second phase of MS4 regulations became effective March 23, 2003, and requires that operators of small MS4s in "urbanized areas" (as defined by the U.S. Census Bureau's latest decennial census) obtain permit coverage for stormwater discharges. Small MS4s include storm sewer systems operated by cities, counties, towns, federal facilities such as military bases, Veteran's Affairs hospitals and research facilities, Department of Defense facilities and parkways, and state facilities such as VDOT, community colleges and public universities. Discharges from small MS4s are regulated under the [General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems](#) (PDF).

Under that permit, small MS4s must develop, implement and enforce a program that includes the following "six minimum control measures":

- Public education and outreach on stormwater impacts.
- Public involvement and participation.
- Illicit discharge detection and elimination.
- Construction site stormwater runoff control.
- Post-construction stormwater management in new development and redevelopment.
- Pollution prevention/good housekeeping for municipal operations.

Similar to the Phase 1 programs, small MS4 programs must be designed and implemented to control the discharge of pollutants from their storm sewer system to the maximum extent practicable in a manner that protects the water quality in nearby streams, rivers, wetlands and bays.

Given the wide variability of the amount of pollutants in stormwater at any given time and the difficulty in determining their actual impacts on water quality, MS4 permits are based on an iterative Best Management Practice (BMP) strategy. This strategy, which is consistent with EPA's Interim Permitting Approach for Water Quality-Based Effluent Limitations in Storm Water Permits, takes an iterative approach to reducing pollutants in stormwater. For MS4s, the operator selects and implements BMPs to reduce the pollutant load in the stormwater. These BMPs can be programmatic, such as ordinances, inspections, and educational activities, or project-oriented, such as detention ponds, retention ponds and constructed wetlands.

Once implemented, BMPs are evaluated by the MS4 permittee for effectiveness and efficiency in reducing pollutants in stormwater as well as appropriateness for the specific MS4 area. When necessary, refinements or modifications are made to how the BMP is implemented. There are many parameters that an MS4 operator can

use to evaluate a particular BMP. Since the MS4 regulations are water-quality based regulations, the effectiveness of the BMP to reduce pollutants in the stormwater discharge must be included.

Small MS4s include storm sewer systems operated by cities, counties, towns, federal facilities such as military bases, Veteran's Affairs hospitals and research facilities, Department of Defense facilities and parkways, and state facilities such as VDOT, community colleges and public universities. This permitting program includes the federal MS-4 permit¹² process which has developed an on-line catalog¹³ of best management practices in six areas related to stormwater management, namely:

- a. [Public Education](#) - BMPs for MS4 permitted communities to inform individuals and households about ways to reduce stormwater pollution.
 - i. **Developing Municipal Outreach Programs**
 - [Developing an Outreach Strategy](#)
 - ii. **Promoting the Stormwater Message**
 - [Classroom Education on Stormwater](#)
 - [Stormwater Outreach for Commercial Businesses](#)
 - [Tailoring Outreach Programs to Minority and Disadvantaged Communities and Children](#)
 - [Using the Media](#)
 - iii. **Stormwater Outreach Materials**
 - [Educational Displays, Pamphlets, Booklets, and Bill Inserts](#)
 - [Promotional Giveaways](#)
 - [Stormwater Outreach Materials](#)
 - iv) **Education for Homeowners**
 - [Alternatives to Toxic Substances](#)
 - [Chlorinated Water Discharge Options](#)
 - [Landscaping and Lawn Care](#)
 - [Pest Control](#)
 - [Pet Waste Management](#)
 - [Proper Disposal of Household Hazardous Wastes](#)
 - [Residential Car Washing](#)
 - [Trash and Debris Management](#)
 - [Water Conservation Practices for Homeowners](#)
 - v) **Education for Businesses**
 - [Automobile Maintenance](#)
 - [Pollution Prevention for Businesses](#)
 - [Promoting Low Impact Development](#)

¹² Phase 2 MS4 permittees in Planning District 16, include the City of Fredericksburg, Spotsylvania and Stafford Counties, the University of Mary Washington, the Virginia Department of Transportation, Marine Corps Base-Quantico, Naval Surface Warfare Center-Dahlgren and Fort A. P. Hill.

¹³ See: <http://cfpub.epa.gov/npdes/stormwater/menuofbmps/>

b. [Public Involvement](#) - BMPs for MS4 permitted communities to involve the public in the development, implementation, and review of an MS4's stormwater management program.

i. Stormwater-Related Activities

- [Adopt-A-Stream Programs](#)
- [Reforestation Programs](#)
- [Storm Drain Marking](#)
- [Stream Cleanup and Monitoring](#)
- [Volunteer Monitoring](#)
- [Wetland Plantings](#)

ii. Soliciting Public Opinion

- [Attitude Surveys](#)
- [Stakeholder Meetings](#)
- [Watershed Organizations](#)

c. [Illicit Discharge Detection & Elimination](#) - BMPs for MS4 permitted communities for identifying and eliminating illicit discharges and spills to storm drain systems.

i. Developing an IDDE Program

- [Illicit Discharge Detection and Elimination Program Development](#)
- [Reducing the Occurrence of SSOs](#)

ii. Trash and Illegal Dumping

- [Developing a Used Oil Recycling Program](#)
- [Illegal Dumping Control](#)
- [Trash and Debris Management](#)

iii. Decentralized Wastewater

- [Preventing Septic System Failure](#)
- [Sewage from Recreational Activities](#)

iv. Public Reporting

- [Community Hotlines](#)

d. [Construction](#) - BMPs for MS4 permitted communities and construction site operators to address stormwater runoff from active construction sites.

i. Municipal Program Oversight

- [Construction Phase Plan Review](#)
- [Contractor Training and Certification](#)
- [Local Ordinances for Construction Site Runoff Control](#)
- [Municipal Construction Inspection Program](#)

ii. Construction Site Planning and Management

- [Construction Sequencing](#)

- [Construction Site Operator BMP Inspection and Maintenance](#)
 - [Land Grading](#)
 - [Preserving Natural Vegetation](#)
- iii. Erosion Control**
- [Chemical Stabilization](#)
 - [Compost Blankets](#)
 - [Dust Control](#)
 - [Geotextiles](#)
 - [Gradient Terraces](#)
 - [Mulching](#)
 - [Riprap](#)
 - [Seeding](#)
 - [Sodding](#)
 - [Soil Retention](#)
 - [Soil Roughening](#)
 - [Temporary Slope Drain](#)
 - [Temporary Stream Crossings](#)
 - [Wind Fences and Sand Fences](#)
- iv. Runoff Control**
- [Check Dams](#)
 - [Grass-Lined Channels](#)
 - [Permanent Slope Diversions](#)
 - [Temporary Diversion Dikes](#)
- v. Sediment Control**
- [Brush Barrier](#)
 - [Compost Filter Berms](#)
 - [Compost Filter Socks](#)
 - [Construction Entrances](#)
 - [Fiber Rolls](#)
 - [Filter Berms](#)
 - [Sediment Basins and Rock Dams](#)
 - [Sediment Filters and Sediment Chambers](#)
 - [Sediment Traps](#)
 - [Silt Fences](#)
 - [Storm Drain Inlet Protection](#)
 - [Straw or Hay Bales](#)

- [Vegetated Buffers](#)
- vi. Good Housekeeping/Materials Management**
- [Concrete Washout](#)
 - [General Construction Site Waste Management](#)
 - [Spill Prevention and Control Plan](#)
 - [Vehicle Maintenance and Washing Areas at Construction Sites](#)
- e. [Post-construction](#)** - BMPs for MS4 permitted communities, developers, and property owners to address stormwater runoff after construction activities have completed.
- i. Municipal Program Elements**
- [BMP Inspection and Maintenance](#)
 - [Ordinances for Post-construction Runoff](#)
 - [Post-construction Plan Review](#)
 - [Zoning](#)
- ii. Innovative BMPs for Site Plans**
- [Alternative Turnarounds](#)
 - [Conservation Easements](#)
 - [Development Districts](#)
 - [Eliminating Curbs and Gutters](#)
 - [Green Parking](#)
 - [Green Roofs](#)
 - [Infrastructure Planning](#)
 - [Low Impact Development \(LID\) and Other Green Design Strategies](#)
 - [Narrower Residential Streets](#)
 - [Open Space Design](#)
 - [Protection of Natural Features](#)
 - [Redevelopment](#)
 - [Riparian/Forested Buffer](#)
 - [Street Design and Patterns](#)
 - [Urban Forestry](#)
- iii. Infiltration**
- [Grassed Swales](#)
 - [Infiltration Basin](#)
 - [Infiltration Trench](#)
 - [Permeable Interlocking Concrete Pavement](#)
 - [Pervious Concrete Pavement](#)
 - [Porous Asphalt Pavement](#)

iv. Filtration

- [Bioretention \(Rain Gardens\)](#)
- [Catch Basin Inserts](#)
- [Sand and Organic Filters](#)
- [Vegetated Filter Strip](#)

v. Retention/Detention

- [Dry Detention Ponds](#)
- [In-Line Storage](#)
- [On-Lot Treatment](#)
- [Stormwater Wetland](#)
- [Wet Ponds](#)

vi. Other

- [Alum Injection](#)
- [Manufactured Products for Stormwater Inlets](#)

f. BMPs for MS4 permitted communities to address stormwater runoff from their own facilities and activities.

i. Education

- [Municipal Employee Training and Education](#)

ii. Municipal Activities

- [Municipal Landscaping](#)
- [Municipal Vehicle Fueling](#)
- [Municipal Vehicle and Equipment Maintenance](#)
- [Municipal Vehicle and Equipment Washing](#)
- [Parking Lot and Street Cleaning](#)
- [Road Salt Application and Storage](#)
- [Roadway and Bridge Maintenance](#)
- [Storm Drain System Cleaning](#)

iii. Municipal Facilities

- [Hazardous Materials Storage](#)
- [Materials Management](#)
- [Municipal Facilities Management](#)
- [Spill Response and Prevention](#)

C. Land Management Program Tools

1. Transferable Development Rights (TDR)

TDR, or transfer of development rights, is a concept in which some or all of the rights to develop a parcel of land in one district (the sending district) can be transferred to a parcel of land in a different district (the receiving district). TDR is a tool used to preserve open space, farmland, water resources and other resources in areas where a locality wishes to limit or curtail development.

In a classic TDR system, one or more sending districts are identified as well as one or more receiving districts. "Development rights" are assigned to landowners in the sending district, typically on the basis of a certain number of permitted dwellings per acre. Owners of land in the sending district instead of developing at the full level of their development rights, may sell their development rights to owners of land in the receiving district, who may then use the newly-acquired development rights to build at higher densities than normally allowed by existing zoning (without further legislative approval). TDR systems are intended to maintain designated land in open or non-developed uses and to compensate owners of the preserved land for the loss of their right to develop it.

Authority

In 2006, the Virginia General Assembly authorized any Virginia locality to provide for transfer of development rights (§ 15.2-2316.1 and 2316.2). The Virginia statute, as crafted, contains many of the characteristics associated with TDR provisions used elsewhere in the country. For example, when development rights are transferred from a sending parcel, a permanent conservation easement must be placed on the land. In addition, the decision to use TDR is voluntary. The Virginia statute does not mandate its use. In 2009 the General Assembly accepted the recommendations of a 2-year study committee and enacted extensive enhancements to the statutes with the goal of making the program more useable. The amendments make clear that development rights may be severed but not immediately affixed to a receiving property. Other changes state that a locality may provide in its ordinance for (i) the owner of such development rights to make application to the locality for a real estate tax abatement for a period up to 25 years, to compensate the owner of such development rights for the fair market value of all or part of the development rights, (ii) the owner of a property to request designation by the locality of the owner's property as a "sending property" or a "receiving property," and (iii) the receiving areas to include such urban development areas in the locality established. Also, any proposed severance or transfer of development rights shall only be initiated upon application by the property owners of the sending properties, development rights, or receiving properties and a locality may not require property owners to sever or transfer development rights as a condition of the development of any property. In 2010 the General Assembly further refined 15.2-2316.2 by making it clear that a density bonus can be included as part of a local TDR program.

Implementation

The original Virginia TDR statute took effect in 2006. A 2007 amendment allowed the transfers across the boundaries of two adjacent jurisdictions. After the 2009 General Assembly session a working group was formed to develop a "model local ordinance." The group, with broad stakeholder participation, completed work on the model ordinance in 2010. Frederick County adopted a TDR program in 2010 joining Arlington County in having adopted TDR programs. Albemarle, James City and New Kent counties among others are developing TDR ordinances and maps.

Limitations

TDR programs are technically complicated and will require a significant investment of time and local government resources to implement. Key questions for a locality include:

- Which areas should be protected?
- How should development rights be allocated?
- To where should development be transferred and at what densities?
- What mix of incentives should a locality use to encourage landowners to use TDR?

A major challenge associated with TDR involves predicting the likely supply of and demand for development rights in the real estate market. Indeed, the pace of transactions will depend on the private market for development rights.

Enhancements

As a core group of localities move toward implementation, it is likely that other potential enhancements will be identified. APA Virginia will continue to monitor this process to develop recommendations for improving the current statutes.

2. Use Value Assessment and Taxation (“Land Use”)

The Use Value Assessment and Taxation Program uses discounts in property tax assessments to promote and preserve agricultural, forestal, and open space lands.

Use Value Assessment (also commonly known as “land use” or “land use assessment”) is a state guided program available to localities in which the locality can tax farmland and open space land at its “use” value rather than its fair market value. In most rapidly growing jurisdictions, this typically reduces the real estate tax on the land by a significant amount, thus making it easier to continue a farming business. The program is voluntary to the landowner and requires only five acres to qualify under agricultural or open space classification or 20 acres under the forest use classification (areas as small as one quarter acre may qualify if adjacent to a scenic river or scenic highway or other specific instances provided by the code). Rollback taxes must be paid when the property is removed from the program.

Authority

Virginia Code, § 58.1-3231 through § 58.1-3244 allows any locality, which has adopted a land-use plan, to adopt an ordinance to provide for use value assessment and taxation in certain districts.

Implementation

Use Value Assessment is used in nearly every state and in many counties and cities in Virginia. According to a the 2009 Weldon Cooper Center local tax report 118 localities (75 counties, 19 cities and 24 towns) have some form of land taxation based on use value.

The program’s purpose is to:

- Ensure a readily available source of agricultural, horticultural, and forestal products;
- Conserve natural resources, preventing erosion and protecting water supplies;
- Preserve scenic natural beauty and open spaces;
- Promote proper land-use planning and the orderly development of real estate for the accommodation of an expanding population; and
- Promote a balanced economy.

Use Value Assessment does not stop the pressure to convert farmland to urban development, but does appear to temporarily reduce some of the pressure on landowners in areas where urban development pressures are causing tax burdens to rise.

Limitations

Many jurisdictions have the personnel to process the applications but often lack of the resources to verify the information provided by the property owner. Consequently, the honor system is often used. More importantly, owing to the temporary nature of the program, it tends to function as a stop-gap measure against pressures for farmland conversion, as well as a method of allocating the local tax burden in accord with the actual use of land. State aid to localities for K-12 education is calculated on a formula, called the Local Composite Index that

uses the full value of real estate to determine a locality's ability to pay. If a locality adopts Land Use Assessment, the Composite Index does not adjust for the reduction in the local ability to raise revenue. This limitation discourages the use of this land preservation tool and has been identified as conflicting with the Commonwealth's farmland preservation goals.

3. Conservation Easements (including Purchase of Development Rights)

Conservation easements are legally enforceable land preservation agreements, usually made in perpetuity, placed on a parcel for the purposes of conservation. Lands can be designated for agricultural or forestal use, recreational use with public access, or solely for the purposes of conservation. The Virginia Outdoors Foundation (VOF) is the primary holder of easements in the area, although non-profit organizations may fill this role as well. Easements can also be written for preservation of historical resources or for trail or multiuse path rights-of-way.

Easements, because of their permanent nature, can create the foundational building blocks of green infrastructure. Because of the tax incentives involved, VOF will often have to be selective in the parcel chosen for protection. They have developed selection criteria that include large chunks of adjunct parcels, areas of particular ecological concern, and areas that are most susceptible to development. A green infrastructure plan can help provide substance and direction to the easement selection criteria and vice versa, ensuring that the state agency and local governments are collaborating with common objectives.

A conservation easement (also known as an Open Space or Scenic Easement) is a legal agreement between a landowner and a land trust or government agency that limits the use of the land by recording deed restrictions that prohibit or severely restrict further development in order to protect the conservation value of the property, such as farmland, watersheds, wildlife habitat, forests, and/or historical lands. Each easement is unique in terms of acreage, description, use restrictions, and duration. These details are negotiated between the property owner granting the easement, and the organization that will be holding the easement.

Conservation easements are typically established in perpetuity, but may be established for shorter periods. The easement allows a property owner to continue to own any underlying interest in the land that is not specifically limited by the easement, to use the land within the terms and restrictions of the easement, and to sell the land or pass it on to heirs (with the easement restrictions conveying with the land). Conservation easements do not permit public access unless specifically provided.

Conservation easements may be established through *purchase*, *lease* (short term), or through *donation*. In all of these easement programs, the easement is established through the voluntary cooperation or initiative of the landowner.

Purchase (PDR). When conservation easements are purchased as part of a broad government program, it is typically called "Purchase of Development Rights" or PDR. In some other parts of the country it is also known as PACE or Purchase of Agricultural Conservation Easements. Purchasing "development rights" is the same as purchasing conservation easements or that portion of the "bundle of rights" that allows landowners to construct dwellings or non-farm commercial structures on the property. Thus, when a locality purchases a conservation easement from a landowner, it essentially "buys" the right to develop the land and "retires" that right by placing a permanent conservation easement on the property that restricts or prohibits further non-farm development. Typically, these easement restrictions run in perpetuity.

Lease. When conservation easements are acquired for short periods, they are called easement leases, term easements or the leasing of development rights (LDR).

Lease of Development Rights (LDR) is the same as Purchase of Development Rights except that the term of the easement can be as short as five years, under amendments to Virginia's Open Space Land Act made in 1981. To

date, no Virginia locality has enacted an LDR program, but the concept has the potential to be a good alternative to Use Value Assessment, because the locality can set the terms of eligibility, easement duration, restrictions, and compensation; whereas under the Use Value program, the state sets most of the rules. However, like Use Value Assessment, an LDR program is a temporary solution to the problem of farmland and open space conversion.

Donation. When conservation easements are accepted as donations from landowners, the donor property owner qualifies for certain tax incentives at the state and federal levels, instead of receiving payment from the locality. For landowners in the upper tax brackets, these provisions can be quite lucrative. Localities may accept donations of conservation easements, and many private or semi-private institutions also accept easement donations. Easement donations can also be promoted by localities in conjunction with a PDR program.

The Internal Revenue Service (IRS) code allows two principal forms of tax benefit - a federal income tax deduction and an estate tax exclusion. The amount of the deduction or exclusion is determined by an appraiser who calculates the diminution in value resulting from the permanent restriction on the use of the land resulting from the placement of the easement on the land. Only easements granted in perpetuity are eligible for the tax benefit. The donation must be made to a qualified organization exclusively for "conservation purposes."

In Virginia, the charitable gift deduction taken for a conservation easement on the federal tax return results in the same diminution in taxable income for state income tax purposes as it does for federal income purposes. Virginia Code Sec. 58.1-510 through 513 allows a tax credit of an amount equal to 40 percent of the value of a gift of easement up to \$100,000. As with the federal tax benefits, the unused portion of the credit may be carried forward for a maximum of five consecutive tax years. This limit has been temporarily reduced from \$100,000 to \$50,000 for tax years 2009, 2010 and 2011 but the carry forward was extended to a maximum of 13 years.

Authority

Virginia Code, §10.1-1009 et seq. allows any locality or land trust (defined in §§ 10.1- 1700-5) to purchase or accept as a donation, and hold a conservation easement for periods of as little as five years, and for as long as perpetuity. In addition, §§ 10.1-1801.1, enacted in 1997, created a fund to assist landowners with the costs of preparing and conveying conservation easements.

Virginia localities are authorized within their general powers (§15.2-1800) to acquire property to initiate a purchase of development rights program (PDR); however, funding such a program may be limited, as in the case of counties, by constitutional authorities to incur debt.

Implementation

Purchase (PDR). Several jurisdictions in Virginia have established Purchase of Development Rights (PDR) programs, including Albemarle County, Clarke County, James City County, Loudoun County (2000 to 2004), and the City of Virginia Beach.

Virginia Beach was the first to fully adopt and fund a PDR program. The City enacted its Agricultural Reserve Program (ARP) in 1995 as a non-development option for property owners located in the City's designated rural area. The property owner voluntarily nominates his property for inclusion in the program. A commission reviews the applications and rank them based on (1) the quality of the farmland, (2) circumstances supporting agriculture, (3) likelihood of conversion to non-farm use, (4) environmental quality, and (5) historic or scenic value. Once eligible properties are determined, the City Council approves the purchase of development rights and directs the City Manager to proceed with negotiations with the landowner. Once the development rights are purchased, the property cannot be developed for non-farm purposes for a pre-determined period of time. After this period, the property owner may request the local government to repurchase the development rights.

The Program has several dedicated funding sources: a dedicated \$0.015 property tax; partial revenues of a local cellular phone tax; and payment in lieu of taxes from the U.S. Fish and Wildlife Service. These three sources provide approximately \$ 3.5 million in annual funding. Landowners participating in the program are paid through installment purchase agreements of twenty-five years maturity.

Some other states have been more active in promoting easement acquisition than Virginia. Suffolk County, New York, on the eastern end of Long Island, pioneered the PDR concept in the mid 1970s. Soon after, Maryland, Massachusetts, Connecticut and New Hampshire authorized such programs at the state level. Since then, several other states have authorized such programs at the local level, and/or funded PDR programs at the state level. Collectively, state and local PDR programs have preserved nearly a half million acres of farmland in the United States, most of this in the mid-Atlantic and northeast regions.

Lease. No broad conservation easement leasing programs appear to be active in Virginia. Short-term easements would seem to offer great prospects as a tool for growth management, as a supplement or alternative to Use Value Assessment, for example. The General Assembly amended the Code of Virginia in 1981 specifically to provide the option of short-term easements, but localities have not availed themselves of it to any substantial degree.

Donation. Primary holders of donated easements in Virginia include the Virginia Outdoors Foundation (VOF), the Virginia Department of Historic Resources, Soil and Water Conservation Districts, and local organizations and land trusts such as the Piedmont Environmental Council, the Valley Conservation Council, the Williamsburg Land Conservancy, the Land Trust of Virginia, and the James River Association. The VOF currently holds (as of September, 2010) over 3,050 conservation easements on over 590,000 acres in 105 jurisdictions throughout the Commonwealth.

Limitations

In general, conservation easements provide for a great deal of flexibility in implementation. Conservation easements feature:

- Placing land under easement does not make it open to the public unless specifically provided.
- The property is maintained in private ownership.
- Segments or whole parcels may be placed under easement.
- Some or all of the property rights may be deed restricted.
- The easement may be held in perpetuity or for a set number of years.
- The financial benefits of conservation easements can be substantial in reduced real estate taxes and inheritance taxes if the conservation is donated.

Purchase of Development Rights (PDR) programs require a dedicated source of stable revenues in order to be most effective. Most local governments simply do not have the funds required for such a program and counties are further restricted in that they cannot incur debt.

Albemarle County is considering a lease purchase program that would depend on an annual appropriation by their Board of Supervisors in order to implement this program within their constitutional limitations.

Enhancements

Providing additional funding or funding incentives at the state level would enhance the attractiveness and effectiveness of PDR programs, and of conservation easement leasing programs.

4. Purchase or Transfer of Development Rights

The Commonwealth of Virginia allows localities to adopt Purchase of Development Rights (PDR) Programs. A PDR program enables a locality to preserve working lands such as farms and working forest lands, as well as open space and natural areas by restricting future development of the land while permitting landowners to continue to use their land as they had been. Conservation easements are the legal tool used in securing the development rights. A Transfer of Development Rights (TDR) system follows the same legal apparatus as PDR, but the development rights are instead traded between private landowners on an open market. The local government creates a “sending area,” where development rights are sold from, and a “receiving area,” where the rights can then be purchased and used to develop in some way otherwise prohibited by law. The government also writes the terms and proportions of the trades, and sometimes maintains a public TDR bank to facilitate market activity. The Virginia General Assembly passed enabling legislation for TDR in 2008, but no Virginia localities have yet established a system. However, there are several examples of successful TDR programs currently in use around the country.

These are both powerful tools for implementing green infrastructure in rural areas. PDR programs give the locality more precise control to target conservation efforts, yet the program can also be quite expensive to operate. The State had initially offered some “seed” funding to help create PDR programs, but now localities need to provide all of their own resources. For TDR systems, green infrastructure can help inform the boundaries of sending and receiving areas, yet there is less control over the exact parcels being traded.

5. Parkland Acquisition

The Virginia Outdoors Plan recommends a minimal amount of land be set aside for local public parks: 4 acres per 1000 citizens for District Parks, 4 acres per 1000 citizens for smaller Community Parks, and 3 acres per 1000 citizens for Neighborhood Parks within walking distance of most residents. Access to parkland creates a number of benefits for people in all walks and stages of life, from providing venues for public gatherings to giving healthy outlets for sports and recreation. Greenways are public parks with a focus on facilitating alternative modes of transportation and recreational travel. Parks can be important hubs and greenways can be important links in green infrastructure. As areas grow, the locality may consider acquiring more land for parks to meet the needs of their citizens. Although proximity to residents who will use the facility is an important concern in parkland siting, a green infrastructure plan could help inform the precise locations chosen and connect parks into the broader system of preserved lands.

6. Nutrient Trading

Article 4.02 of the Code of Virginia established the Chesapeake Bay Watershed Nutrient Credit Exchange Program. The final regulation was approved by the State Water Control Board at its September 6, 2006 meeting. The type of trading considered by some to offer the greatest relevance to the Chesapeake Bay is a voluntary market-driven mechanism that has the potential to promote cost-effective approaches to meeting environmental outcomes (e.g., Total Maximum Daily Loads). A nutrient trading market allows sources that reduce their nutrient loadings below target levels to sell their surplus reductions or “credits” to other sources that cannot meet their target levels. In some cases, this approach can allow nutrient sources that can reduce nutrients at relatively low cost (e.g., agriculture) to sell credits to those facing higher-cost nutrient reduction options (e.g., small development sites).¹⁴ The types of trading, explanations of each and examples are shown in the following table.

¹⁴ Source: <http://www.dcr.virginia.gov/documents/IrNutrientTradingInTheStateOfVirginia.pdf>

Descriptions of Different Types of Trading/Offsite Compliance Programs		
Type	Description	Example
Point source to nonpoint source	Point sources, such as wastewater treatment plants, pay a nonpoint source, such as a farmer, to account for discharges that exceed load caps in permits. The farmer may implement approved practices (e.g., no-till, land conversion) to reduce the load increase in a more cost-effective manner.	Chesapeake Bay Watershed Nutrient Credit Exchange Program in Virginia (VADEQ, 2009): http://www.deq.state.va.us/vpdes/nutrienttrade.html
Nonpoint to nonpoint	A class of nonpoint source with a load reduction requirement pays another site or facility to achieve some or all of the load reduction. For instance, a developer that cannot meet all load reduction requirements on the site may pay a farmer to implement land conversion (e.g., crop to forest) or another urban landowner to implement stormwater retrofits.	Virginia Soil and Water Conservation Board Guidance Document on Stormwater Nonpoint Nutrient Offsets (VADCR, 2009): http://www.dcr.virginia.gov/lr6.shtml
Urban to agricultural	This can be either point to nonpoint OR nonpoint to nonpoint. However, it connotes that an urban source (e.g., wastewater plant or developer) is trading to an agricultural operation to accomplish unmet load reductions at the urban source.	See 2 examples above.
Urban to urban	This type of “offsetting” has not been as well-defined programmatically, except by certain local governments. It connotes that unmet nutrient reductions from an urban source (e.g., developer) are offset by another urban site, operator, or facility. The reductions can be accomplished through stormwater retrofits, urban stream restoration, implementing BMPs for uncontrolled areas, or other practices.	Henrico County Watershed Management Program (Henrico, 2010): http://www.co.henrico.va.us/works/engineering-environmental-services/stream-assmt--watershed-program/stream-assessment.html

Source: <http://www.dcr.virginia.gov/documents/lrNutrientTradingInTheStateOfVirginia.pdf>

One response to this new approach has been the formation, by various operators of wastewater treatment and industrial plants and other interested parties, of the Virginia Nutrient Credit Exchange Association (a voluntary association of owners of 105 regulated municipal wastewater treatment plants and industrial facilities discharging nitrogen and phosphorus within the Chesapeake Bay watershed). The purpose of the Exchange is to coordinate and facilitate nutrient credit trading among its members with the goal of improving water quality in the Chesapeake Bay watershed efficiently and cost-effectively.

As an extension of this markets-based approach to nutrient and pollution management, the Rappahannock River Basin Commission endorsed the exploration and development of other markets-based approaches to nutrient reduction to help localities in the Basin respond to anticipated TMDL goals that would be financially-challenging to meet through conventional governmental actions.

D. Agricultural and Forestal Districts

1. Agricultural and Forestal Districts (AFD)

The Virginia Code provides for the voluntary creation of Agricultural and Forestal Districts (AFDs) in order to “provide a means for a mutual undertaking by landowners and localities to protect and enhance agricultural and forestal land as a viable segment of the Commonwealth’s economy and as an economic and environmental resource of major importance.”

Agricultural and/or Forestal Districts are established by local ordinance to run for a set number of years (from 4 to 10), during which the property owner continues to hold fee simple title to the land, and enjoy various

benefits provided by the code for such districts. The local ordinances usually include provisions that permit the landowner to withdraw from the program under certain defined circumstances.

AFDs are established at the request of landowners, who must assemble at least 200 acres of contiguous land and be approved for a district by the local governing body. Districts last from 4 to 10 years and can be renewed. Being in a district ensures a landowner that his land will continue to be eligible for Use Value Assessment, even if the program is otherwise rescinded by the locality. The AFD also provides some extra protection against certain public infrastructure improvements. In and of itself, an AFD does not change the zoning within its borders.

However, an AFD can be a factor in the locality's zoning decisions and planning policies. Further, in adopting an AFD, the governing body may require, as a condition to creation of the district, that any parcel in the district shall not, without the prior approval of the governing body, be developed to any more intensive use or to certain more intensive uses (other than uses resulting in more intensive agricultural or forestal production), during the period which the parcel remains within the district.

Other protections for landowners in AFDs include:

- The local governing body may adopt programs offering incentives to landowners to impose land use and conservation restrictions on their land within the district.
- Local ordinances, comprehensive plans, land use planning decisions, administrative decisions and procedures affecting parcels of land adjacent to any district must take into account the existence and purposes of the district.
- No special district for sewer, water or electricity or for non-farm or non-forest drainage may impose benefit assessments or special tax levies on the basis of frontage, acreage or value on land used for primarily agricultural or forestal production within a district, except a lot not exceeding one-half acre surrounding any dwelling or nonfarm structure located on such land.
- Any agency of the Commonwealth or any political subdivision which intends to acquire land in an AFD must provide individual notice to landowners in the AFD. The local governing body then holds a public hearing on the proposal. If the local governing body determines that the proposed action is not necessary to provide service to the public in the most economic and practical manner and will have an unreasonably adverse effect upon state or local policy, it is to issue an order prohibiting the proposed action.

Authority

Virginia Code, §§ 15.2-4300 et seq. allows any locality to adopt Agricultural and Forestal Districts. Land lying within a district and used in agricultural or forestal production is automatically qualified for a land use assessment pursuant to Article 4 of Chapter 32 of Title 58.1 regardless if a local ordinance pursuant to § 58.1-3231 has been adopted. (See the discussion on Use Value Assessment and Taxation).

Section 15.2-4400 allows for certain localities to create —Local Agricultural and Forestal Districts² for periods of eight years. These can be as little as twenty acres in size and have similar provisions as regular AFDs.

Implementation

Approximately 700,000 acres of land in twenty-six localities in Virginia is in Agricultural and Forestal Districts. Farmers and farmland owners typically seek these districts in order to protect their farms from non-farm development, ensure their qualification for use value assessment, and protect against nuisance regulations. These districts can also be used for the purpose of minimizing the impact of incompatible development in agricultural areas and can be made more effective by incorporating a PDR program.

An added benefit for using Agricultural and Forestal Districts as a conservation tool is that it promotes communication and collaboration between local government, farmers, foresters and landowners regarding long-term farmland protection.

Limitations

No local ordinances may be applied to an Agricultural and Forestal District that would unreasonably restrict or regulate farming practices, other than to provide for the health and safety of the public. The process by which AFDs are established, expanded and renewed can be cumbersome and consideration should be given to streamlining.

The Code of Virginia allows localities to adopt specific Agricultural and Forestal Districts within their boundaries, and each member of the TJPDC has opted to do so. These are allocations of land, 200 acres or more per district, voluntarily submitted by landowners to the local governing body. The primary purpose of the districts is to help determine eligibility for land use taxation and protect farmers from nuisance laws that would inhibit standard farming practices. Once rural areas have been identified for inclusion in the green infrastructure plan, landowners of related parcels could be encouraged to consider adopting this designation. The use of Agricultural and Forestal Districts may be the best option for landowners who are not currently able to commit to the full protection of an easement, yet want to move forward in efforts to voluntarily preserve their land.

2. Agricultural and Forestal Districts Maps

A map of Agricultural and Forestal Districts will help determine where land is less likely to be developed in the near future, due to voluntary preservation commitments. See the section on “Other Tools” for more on Agricultural and Forestal Districts.

E. Education

1. Education

Education is not only important for building political support for policy changes, but it also helps orient the community toward collective voluntary action on behalf of the environmental resources surrounding it. Many of the existing tools, such as conservation easements and water quality management practices, are often initiated by individuals. In order to act upon their personal values, citizens need to be made aware of these tools and whatever support they can obtain for making use of them.

Educational campaigns may take several forms. First, a green infrastructure plan itself may help educate the public about its merits, especially if it has gone through an extensive period of public review and media exposure. If the plan is written in an accessible and engaging style and freely made available online and in hard copy, it is more likely to receive wider exposure to the general public. Second, some localities may choose to conduct marketing campaigns or hold public workshops on the subject of green infrastructure. In cases where the information is targeted to a particular subset of the population, it may be beneficial to directly contact the individuals who would be most interested. Third, the public school system or institutions of higher learning could explain green infrastructure in more detail and walk students through the rationale and process of implementing it. Education should not be overlooked as an important tool, working in conjunction with each of the other tools presented here.

2. Public Advocacy

While it is incumbent upon government agencies to educate the public of the benefits of green infrastructure, many of the necessary legislative changes are the result of advocacy from organizations and individual citizens. Residents may petition local governments to preserve land around their property, or they may seek to influence policies at the state or federal level designed to aid green infrastructure planning. As with many other

aspects of governance, the creation and implementation of a green infrastructure plan can be greatly shaped by an active and engaged citizenry.

F. Mapping Tools

1. Parcel Maps

Parcel maps for any community are available from the local planning department or tax assessor's office. Parcel maps will give a conceptual shape for the preexisting boundaries of ownership, which may inform the content of a realistic green infrastructure plan. Parcels will also give a reasonable indication of where subdivisions or commercial developments currently exist, even if they are more difficult to perceive with aerial photographs. The maps will also help locate landowners of properties under consideration for green infrastructure, which is a crucial piece of information, since most of the available tools are used on a parcel by parcel basis in negotiation with individual landowners. Parcel maps are also essential for identifying future subdivisions that are already platted. This will help determine the level of risk involved in selecting certain areas of land as components of the plan.

2. Future Land Use Maps

Most communities have a Future Land Use Map of some type, which sheds light on the vision already adopted for the extent and shape of their own growth. The maps can be used as stand-alone documents, but, in most cases, a land use chapter of the Comprehensive Plan will explain the meaning of terms used on the map and provide much more detail for how the map will be used in the planning process.

It is important for the green infrastructure network to be consistent with other visions for land use accepted by the community. For example, conservation easements and cluster development are useful tools for preserving land in areas set aside for agriculture or low-density residential use, while in areas slated for more density it may be more appropriate to acquire smaller neighborhood parks and greenways with public access. Both are perfectly fine strategies for developing a green infrastructure network, and the future land use map will help determine where each is the more appropriate tool.

3. Transportation Plans

Transportation plans adopted by a local government can offer a number of important insights into a community's vision. First, allocations of future transportation infrastructure will corroborate the land use map and help determine more precisely where future growth may be concentrated. Second, if there are specific roads, paths, or railways set to be constructed in the near future, it will be important to know the exact sites so as to avoid conflicts down the road. Third, there may already be plans for a greenway transportation corridor for cyclists and pedestrians that would serve as a component of green infrastructure in its own right. These elements of the transportation plan can certainly overlap with green infrastructure.

4. Floodplain Maps

The Federal Emergency Management Agency (FEMA) collects and regularly updates a national database of Flood Insurance Rate Maps (FIRM). For each community, a FIRM will identify areas of special hazard to flooding, as well as areas that have a higher risk premium. These maps could prove helpful for implementing green infrastructure, because they identify areas where development potential is already limited and the water quality impacts of development may be accentuated.

The Flood Insurance and Mitigation Administration (FIMA), a component of the Federal Emergency Management Agency (FEMA), manages [the National Flood Insurance Program \(NFIP\)](#). The three components of the NFIP are:

[Flood Insurance](#), [Floodplain Management](#), [Flood Hazard Mapping](#)

Nearly 20,000 communities across the United States and its territories (including all localities of PD 16) participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes Federally backed flood insurance available to homeowners, renters, and business owners in these communities. Community participation in the NFIP is voluntary.

Flood insurance is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods. Flood damage is reduced by nearly \$1 billion a year through communities implementing sound floodplain management requirements and property owners purchasing of flood insurance. Additionally, buildings constructed in compliance with NFIP building standards suffer approximately 80 percent less damage annually than those not built in compliance.

In addition to providing flood insurance and reducing flood damages through floodplain management regulations, the NFIP identifies and maps the Nation's floodplains. Mapping flood hazards creates broad-based awareness of the flood hazards and provides the data needed for floodplain management programs and to actuarially rate new construction for flood insurance.

- The [NFIP Program Description](#) offers a more detailed overview and history of the program.
- Buying [flood insurance](#) is the best thing you can do to protect your home, your business, family, and financial security.

5. Gray Infrastructure Maps

Gray infrastructure refers to the physical components of the built landscape necessary to provide services to residents. It includes not only the transportation infrastructure, but water and sewer service, the electric grid, broadband networks, communications towers, gas pipelines, and the footprints of structures. Maps of each of these ought to be available from the service providers or the local planning staff.

Water and sewer maps are helpful because they give a further indication of where future growth is likely to occur. They may also reveal areas where green infrastructure may be especially fitting, for example around an existing or planned reservoir or in an area very sensitive for the local drinking water supply. Power or communications infrastructure, whether overhead or buried, create either challenges or opportunities for green infrastructure. On the one hand, certain species may be either threatened or endangered by their proximity, and they may reduce the aesthetic value of the land for recreational use. On the other hand, lands used for these purposes may already be protected to some degree, making them less costly additions to a green infrastructure network. Buried pipelines are often particularly feasible corridors to preserve, with the one drawback being that they may need to be serviced on occasion. A careful analysis of these maps will help inform the siting of green infrastructure.

G. Other Tools

1. Comprehensive Plans

The Code of Virginia requires several elements in local Comprehensive Plans that dovetail well with green infrastructure. Comprehensive plans must designate areas for the implementation of reasonable ground water protection measures. All communities meeting a certain size or growth threshold are required to create Urban Development Areas, wherein growth is concentrated and organized according to urban design principles. Green infrastructure may help inform the selection of these areas, and likewise areas designated for growth may call for a different type of green infrastructure than would be used in rural areas. Local planners are also required to survey and study a variety of natural features of the area before writing the plan. Of course, many localities choose to exceed the required minimums by including a broad inventory of natural resources and ecosystem services, as well as identifying priorities and potential methods for their preservation or enhancement. Localities in Virginia, both urban and rural, have incorporated green infrastructure plans directly into their

Comprehensive Plans, or otherwise used green infrastructure prescriptions to inform a chapter on Environment and Natural Resources.

2. Shoreline Management Plan

As a result of the enactment of SB 964 in the 2011 Virginia General Assembly session, the localities in Tidewater Virginia (inclusive of Planning District 16) must comply with [§15.2-2223.2](#), beginning in 2013. This section provides that the local comprehensive plan...

“... shall incorporate the guidance developed by the Virginia Institute of Marine Science pursuant to subdivision 9 of § [28.2-1100](#) into the next scheduled review of its comprehensive plan. The Department of Conservation and Recreation, Virginia Marine Resources Commission, and the Virginia Institute of Marine Science shall provide technical assistance to any such locality upon request.”

The Code further elaborates that the “living shoreline” guidance will relate to shoreline management practices that provide erosion control and water quality benefits; protects, restores or enhances natural shoreline habitat; and maintains coastal processes through the strategic placement of plants, stone, sand fill, and other structural and organic materials. In support of this initiative the Virginia Institute of Marine Sciences is directed by the same statute to:

“Develop comprehensive coastal resource management guidance for local governments to foster the sustainability of shoreline resources by December 30, 2012. The guidance shall identify preferred options for shoreline management and taking into consideration the resource condition, priority planning, and forecasting of the condition of the Commonwealth’s shoreline with respect to projected sea-level rise.”

3. Other Land Use Ordinances

Land use ordinances may apply uniformly across the entire locality or state, rather than reference a specific zone. For example, a Water Protection Ordinance may require 100 foot stream buffers on both sides of streams in the rural areas. Development and grading may be restricted within the buffers. These kinds of buffers, known as riparian buffers, not only protect water quality and manage stormwater, but can be essential elements of a green infrastructure network. They make an ideal corridor for wildlife, which are often predisposed to follow water sources.

Localities within the Chesapeake Bay watershed are now required to plan for stormwater management, and the requirements from the [Virginia Department of Conservation and Recreation](#) (DCR) may grow in magnitude and scope in the future. Stormwater management offers significant opportunities for overlap with green infrastructure. Open spaces can be an efficient and cost-effective way to collect and filter runoff from impervious surfaces. Stormwater management requirements are often simplest to meet in rural areas, because of the large amounts of space available for filtration. However, innovative approaches are being developed to manage runoff in urban areas as well, through such strategies as green roofs, rain gardens, and vegetative swales. These stormwater management Best Management Practices, many of which are cataloged into a BMP clearinghouse by DCR, can be critical features of green infrastructure implementation.

The Commonwealth of Virginia must adopt enabling legislation for any tools to be used by a locality (i.e. “the Dillon Rule”). Discussion is currently underway at the state level over “Adequate Public Facilities Ordinances”, which would allow localities to restrict development to public facilities service areas, and impact fees for new development. These and other code tools may become available in the future.

4. Historic Districts

Historic District designation is often a prerequisite for guidance by a Design Review Board. There are more legal rights for protection afforded to areas that are deemed to be of national or statewide historic significance. In the Piedmont Virginia area, civil war battlefields are important historic resources that are

often required to be maintained in a natural state and are open for recreational use. The Journey through Hallowed Ground is a National Heritage Area, extending from Gettysburg, Pennsylvania to Charlottesville, Virginia. It includes more than 10,000 listings on the National Register of Historic Places. Many of these places can function as green infrastructure hubs.

5. Scenic Byways and Rivers

There are more than 2,500 miles designated as scenic byways in Virginia. The Virginia Department of Transportation (VDOT) maintains an official list of [Scenic Byways in Virginia](#), and the federal [National Scenic Byways Program](#) selects routes of national significance. The purpose of the Scenic Byways program is to draw attention to travel routes that offer a unique scenic value and experience, whether natural or historical, in order to encourage tourism and economic development. The designation does not carry any regulatory weight, but may inform local land use controls or sign ordinances.



The [Virginia Scenic Rivers Program](#), operated out of DCR, has a similar mission. The Virginia Scenic Rivers Program's intent is to identify, designate and help protect rivers and streams that possess outstanding scenic, recreational, historic and natural characteristics of statewide significance for future generations. The Rappahannock River (from its headwaters to Ferry Farm in Stafford Co) has been designated a scenic river and the Mattaponi River in Caroline County has been pre-qualified as a potential scenic river segment in PD 16.

Scenic Byway and River designations give an extra impetus to green infrastructure plans and reinforce the crucial connection between land preservation and economic development. The use of green infrastructure in conjunction with scenic byways and rivers will help showcase the natural beauty of the region to outsiders and help residents identify with their natural landscape as they travel through it.

VII. Highlighting Local “Green Infrastructure”-Related Programs

The Green Infrastructure plan for the Region builds on many local programs and planning initiatives which are complementary to the goals of Green Infrastructure planning. These include urban stormwater management and low-impact development initiatives, land conservation and open space protection achieved through land purchase for public parks and the acquisition of riparian and conservation easements and the promotion of working farms through aggressive farmers market promotions and the creation of agricultural and forestall districts. Local governments in PD 16 have a substantial number of “green infrastructure”-related programs in place by virtue of their compliance with various federal and state regulatory programs. In this section, we highlight the major initiatives which are already helping local governments conserve natural lands and maintain open space, reduce stormwater run-off, improve water quality and promote working farms.

A. Land and Open Space Conservation-Oriented Green Infrastructure Efforts

1. City of Fredericksburg

a. Acquisition and Management of Rappahannock River Riparian Easements

The City of Fredericksburg owns approximately 4,800 acres of forested riparian lands along the Rappahannock and Rapidan Rivers. These holdings extend upriver from the City itself, into five upriver counties through Spotsylvania, Stafford, Orange, Culpeper and Fauquier Counties. The bulk of these lands is located to the west of Interstate-95, reaching toward Kelly’s Ford (Route 620) on the Rappahannock and Germanna Ford (Route 3) on the Rapidan. The integrity of these resources is high and the prospect for long term preservation is outstanding. A portion of this acreage accommodates public drinking water impoundments on tributary streams, related raw water intakes, and water treatment facilities. Most of these City lands also remain in their natural state, to protect this critical source of drinking water as much as possible. As an added benefit, the natural integrity of this corridor provides exceptional recreational opportunities.

In 2006, the City placed 4,232 acres of this ecologically significant land into a Conservation Easement. This Conservation Easement provides total protection from development, vegetation removal, and any alterations. Still, there are numerous land management issues that have a significant bearing on how the Conservation Easement is administered, including access management, trails management, and consideration of new recreational uses. To address these issues, in 2011 the City developed and adopted the Fredericksburg Watershed Property Management Plan and established the position of River Steward, a uniformed police officer to patrol and enforce the City’s easements.

2. Stafford County

a. Public Acquisition of “Crow’s Nest – Phase 2” Area

The Phase 2 acquisition consists of 1,100 acres of the ecologically rare and historically valuable Crow’s Nest Peninsula in Stafford County, Virginia and will be added to the 1,770 acres (known as Phase 1) acquired by the Commonwealth and Stafford County in 2008.

The Crow’s Nest Peninsula is a 4,000 acre wilderness jutting out into the Potomac River approximately 40 miles south of Washington, DC and a little over a mile from a commuter rail station. Conservationists have long identified Crow’s Nest as one of the Chesapeake Bay watershed’s most important and imperiled natural areas. The Virginia Department of Conservation and Recreation has assigned the Crow’s Nest Peninsula a designated biodiversity rank of B-2 (“Very High Significance”) and Crow’s Nest contains two plant communities which are ranked globally imperiled (G2) by The Nature Conservancy (6 to 20 occurrences worldwide).

In addition, Crow's Nest lies within the view shed of the Captain John Smith Chesapeake National Historic Trail and preservation will keep the land looking as it did when Pocahontas was abducted off the shores of Crow's Nest by Samuel Argall in 1613. The area is also chock-full of historic resources (47 archeological sites and 56 isolated finds have already been identified) including Native American encampments, domestic farmsteads, gravesites, and Civil War encampment areas. In 2006, the Washington Smart Growth Alliance designated the Crow's Nest Peninsula as one of the Washington, DC region's Top Six Conservation Priorities.

b. Adoption of Urban Development Area Designations

In 2010, the General Assembly, through House Bill 1071, amended the UDA provisions, found in Section 15.2-2223.1 of the State Code, to require that any locality with growth rates of at least 5% and populations between 20,000 and 130,000 shall create the UDAs with residential densities of 12.0 condominiums or apartments, 6.0 townhouses, or 4.0 single family homes per acre and commercial densities of 0.4 FAR. The deadline for compliance is July 1, 2011.

The proposed Plan considered by the Board on December 14th included eight UDAs. The Stafford Board of Supervisors adopted six of the eight UDAs on December 14, 2010. They are:

- Courthouse UDA
- Southern Gateway UDA
- George Washington Village UDA
- Eskimo Hill UDA
- Centerport UDA
- Leeland Station UDA

When the Board adopted the Comprehensive Plan on December 14, 2010, Supervisors established a joint committee of the Board of Supervisors and the Planning Commission to develop and recommend Comprehensive Plan amendments necessary to redistribute the 4,000 dwelling units included in the formerly proposed Stafford Station and Brooke Station Urban Development Areas, which were recommended by the Planning Commission on November 17, 2010, but not adopted by the Board. The Board directed that the 4,000 dwelling units that had been proposed for the Stafford Station and Brooke Station UDAs be distributed in one of the six UDAs adopted on December 14, or in one or more new UDAs to be proposed by the joint committee.

c. Transfer of Development Rights (TDR) Program

On September 6, 2011, Stafford County supervisors took the first official step toward a transfer of development rights program by sending a potential TDR ordinance to the Planning Commission for public hearing and review. Proponents hope it will be a useful tool to combat suburban sprawl in the county as well as help preserve rural open space. A TDR program allows developers to buy potential development lots in a rural "sending" area and transfer them to a more urban "receiving" area. The rural property owner gets cash for the development rights, while the developer gets to increase the residential density of the receiving area. Once the transfer is made, an easement is placed on the rural property and it cannot be developed.

The Board of Supervisors will probably not revisit the TDR ordinance until early next year, when it could hold another public hearing and possibly implement the program. Some supervisors had concerns about how the TDR program would function. Since the development rights transferred are by-right units, the entire process would be by-right. That means there would be no public review process to approve the transfer.

The proposed ordinance does not create a countywide TDR program, but rather a pilot program that focuses exclusively on the Brooke UDA area. The proposed sending area encompasses the area east of

Brooke between Aquia and Potomac creeks. The receiving areas are the Brooke Station and Courthouse urban development areas--zones the county has decided are prime high-density growth areas.

d. Purchase of Development Rights (PDR) Bond Referendum and Program

The Purchase Development Rights (PDR) Committee of the Friends of Stafford Creeks association asked the Board of Supervisors to consider a bond referendum for the purchase of development rights. If approved, this would have allowed Stafford County to purchase by-right development rights from property owners in the agricultural area of the County. The proposal would have provided the lot's owner to be paid a fixed payment and in addition be eligible for State and Federal tax benefits. Land owners place a permanent conservation easement on the land in exchange for the payment and tax benefits. Advocates asserted that approving this plan would mean saving taxpayer dollars in the long run by reducing demand for future public services from the low-density development allowed for under existing zoning. On June 16, 2009, the Board of Supervisors voted NOT to allow a PDR referendum on the November 2009 ballot.

However, Stafford already has a purchase of development rights program that uses local, state and federal money to purchase the development right for a piece of property. The government buys the development right and the property owner keeps the land, although the property is devalued and must remain in its rural, undeveloped state forever. Essentially the property owner is paid for legally ensuring the land is never developed. That program is limited by money--something that is in very short supply these days--and Stafford has purchased the development rights on only 98 acres since the program started in 2009. The other option is TDR, which requires no money yet achieves a similar goal of retaining rural open space.

3. Spotsylvania County

a. Adoption of Urban Development Area Designations

Three areas were approved by The County Board of Supervisors as the County's "urban development areas", including:

- the area around Four-mile Fork (U.S.1 and Lafayette),
- the area around the courthouse, and
- the Massaponax area between I-95 and U.S. 2 along Highway 17/Mills Road.

The area around Four-mile Fork is a redevelopment area, and the area around the courthouse will include the existing mixed-use Spotsylvania Courthouse Village. The area along U.S. 17 includes the proposed Jackson Gateway exit for I-95, which is just south of the hospital, and the area along Highway 17 to the west side of Jim Morris Road on the north and just east of the new VRE train station on the south. The main change made, other than semantics, to the existing proposed land map was designating one section of land mixed use that was previously designated an employment center. This was the area east of the proposed Jackson Gateway interchange.

b. Comprehensive Plan Implementation Strategies

The Implementation Strategies section of the County's current Comprehensive Plan includes the following green infrastructure-related recommendations.

- **Introduce a Traditional Neighborhood Development (TND) zoning district.**
This also would allow Spotsylvania to meet the requirements of Virginia State Law (House Bill 3202) which require development within Urban Development Areas to follow Traditional Neighborhood Development guidelines.

- **Introduce a Transfer of Development Rights (TDR) ordinance.**
This would enhance Spotsylvania County’s attempts to preserve open space within the rural areas of the County and concentrate development within the Primary Development Boundary.
- **Introduce an Ordinance Amendment to allow for the conservation of land and for flexible site design.**
The purpose of this amendment would be to change the pattern of residential development within the rural parts of the County by placing a premium on the preservation of open space and emphasizing unique designs based upon the characteristics of individual sites.
- **Identify and inventory potential locations for Purchase of Development Rights & Transfer of Development Rights with the primary focus being upon agricultural, historical and natural resource preservation.**
This would provide the County with an integrated approach towards the preservation of land within the County creating connected areas of natural, undeveloped open space.
- **Introduce a Comprehensive Plan Element dedicated to the preservation of open space within the County.**
This element would help ensure the preservation of Spotsylvania’s valuable open space for the utilization and enjoyment of the citizens of the County.
- **Introduce a Trailways Plan for the County.**
The purpose of a Trailways Plan would be the provision of a connected set of trails that could be used for recreation by the citizens of the County.
- **Inventory and create a voluntary registry of historic sites within Spotsylvania County.**
This will allow opportunities for the preservation of historic resources by having a public record of sites that are historically significant.
- **Inventory archaeological resources as well as develop plans and an interpretation priority schedule.**
In a similar manner to the registry of historic sites, this will help to ensure the preservation and discovery of significant archaeological resources.
- **Inventory significant viewsheds within the County.**
The purpose of this strategy would be to identify and then preserve significant viewsheds within the County for future generations of Spotsylvania residents to be able to enjoy.
- **Introduce a tree preservation ordinance.**
The purpose of this ordinance would be to preserve specimen trees and to utilize them as design features in development proposals.
- **Introduce an air quality control ordinance.**
This ordinance is increasingly important to ensure the health and safety of County residents as air quality deteriorates from continued development and growth.

4. Caroline County

a. Mattaponi Wildlife Management Area

This 2,500 acre project (see Figure 21) is a partnership between Fort A. P. Hill, The Nature Conservancy and the Virginia Department of Game and Inland Fisheries (DGIF). The Mattaponi Wildlife Management Area (WMA) is the newest VDGIF land acquisition and latest addition into VDGIF's WMA system and opened for public use on Wednesday, March 30. The WMA is open for hunting, fishing, wildlife watching and the other wildlife-oriented recreational activities that are allowed on all of our WMAs. Horseback riding is prohibited.



Figure 21. Mattaponi Wildlife Management Area (in Caroline County)

b. Proposed 400 Acre Wetland Mitigation Bank (upstream from Mattaponi WMA)

A private landowner that has granted a 1,400 acre conservation easement to the Virginia Outdoors Foundation (VOF) is exploring the possible use of 400 acres of the easement as a wetland mitigation bank. This proposal may require some form of special use permit from the County.

c. Partnership with City of Fredericksburg in Nutrient Trading Program

The County and City of Fredericksburg are working with consultants to the Rappahannock River Basin Commission to explore the establishment of nutrient credit trading relationship, involving

the cultivation of grass cultivation (for bio-fuel production) on farmland along the Rappahannock River, with nutrient credit off-set payments from the City to supplement farming operators' revenue from bio-fuel grass production.

d. "Bowling Green Farm" Historic and Conservation Easement

A private land owner in the Town of Bowling Green has placed historic and conservation easements on a 125 acre tract of land in the southern area of the Town near Rt 301.

e. Caroline Co. Conservation Easement Near Meadowview Biological Research Station

The Caroline County Board of Supervisors recently agreed to hold conservation easement on a 17 acre tract adjacent to Meadowview Biological Research Station located along Rt 2, northwest of the Town of Bowling Green. Meadowview is a non-profit 501(c)(3) organization dedicated to preserving and restoring rare wetland plants, habitats and associated ecosystems on the coastal plain of Maryland and Virginia. Meadowview specializes on an endangered habitat known as pitcher plant bogs or seepage wetlands. Bogs are acidic, nutrient poor wetlands which are characterized by a unique assemblage of plants and animals. Many bogs have been lost in Maryland and Virginia through drainage, development or neglect and most of the plants found in these sites are threatened with extinction.



5. King George County

King George has adopted a residential cluster zoning component in the County Zoning Ordinance (Article 11) and a companion provision in the Subdivision Ordinance (Article 5). The County has three approved and partially-developed cluster subdivisions (i.e. Hopyard, Caledon Crossing, Serria Ridge) and another (Lake Caledon) approved, but not yet recorded.

The County also promotes LID design through its subdivision ordinance (Section 8.3.9) by allowing the elimination of curb and gutter street design when LID is employed within the subdivision. The County has approved one subdivision that incorporated LID design (Potomac Landing Section III) which is currently being developed.

A number of conservation easements exist in the County which have been reflected in the mapping of the County's Green Infrastructure assets (see Figure 5) and the regional "Greenprint" scenario maps (Figures 14-16).

B. Park and Greenway Operation, Planning & Acquisition and Urban Reforestation Initiatives

1. City of Fredericksburg

a. City Parks and Trails

- **River and Canal Trail**

This paved pathway is 1.8 miles long and winds along the canal from Fall Hill Ave. to Princess Anne St. Understandably popular with area joggers, this paved, level out-and-back traces an important remnant of Fredericksburg’s commercial past. Wetland parcels en route, home to swans and herons, are a welcome counterbalance to the concrete underbelly of US 1. Constructed over two decades, the Rappahannock River canal system once stretched 50 miles upstream to Fauquier County. The notion of using canals to promote trade and industry along the river was first endorsed by Virginia legislators in 1811. In fact the conduit is often referred to as the VEPCO Canal, after the acronym for Virginia Electric and Power Company, which maintained the 1910 Embry Dam on the canal’s west end and Embry Power Plant on its east end through the 1960s. Embry Dam was demolished by 2006, and the City plans to extend the trail along the canal northwest of Fall Hill Avenue to the Rappahannock River.

- **Other Nature & Historic Trails**

Several trail projects, summarized below, are actively being planned in Fredericksburg. summarized below.

Trail	Route	Length
Hazel Run Trail	Rappahannock River to Interstate-95	4.6 miles
Smith Run Trail	Existing trail end into future Smith Run Battlefield Park	1.2 miles
Fall Hill Greenway Trail	Canal Park Trail to Snowden Park	1.0 miles
Dixon Park Trail	Caroline Street to Dixon Park	0.6 miles
Rappahannock River Trails	Along riverbank in various locations	11-40 miles

- **Alum Springs Park**

This wooded park is located at the end of Greenbrier Drive extended. It is equipped with a renovated picnic shelter, picnic tables, restrooms, grills, play equipment, walking paths, and a fitness trail. Picnicking, exercise trails and hiking with scenic views. This wooded park is a great place for children to play; even during the warmest days of summer the shade trees keep it cool.

- **City Dock**

This historic dock dates back to George Washington's day. Public fishing is permitted. Located near the end of Sophia Street, just past the railroad tracks.

- **Duff McDuff Green Memorial Park**

Duff McDuff Park overlooks the Rappahannock River and is a wonderful picnic spot. Small picnic shelters are available for rent. Park includes several two lighted soccer / football fields, baseball diamonds, playground, and a paved trail to the river overlook dock.

- **Dixon Park**

The City's newest outdoor facility is 46 acres and features athletic fields, outdoor swimming pool, playground equipment, 1.5 miles of trails, restrooms, and nature preserve areas. Future

expansion plans include a new Community Center. The Jogging/ Walking Trail is a paved pathway that begins at the kiosk, and is marked to help you track your distance. Click here to view the sign that is posted at the trail's starting line. Dixon Park is located at 1300 Dixon Street, which is on Rt. 2 & 17 across from Mayfield subdivision.

- **Hurkamp Park**

A historic downtown park with a fountain, brick sidewalks and benches. Local farmers sell produce on Saturdays and some weekday mornings. Also the site of concerts, craft shows and occasional festivals and events. The park is located at William and Prince Edward Streets, right in the heart of Old Town Fredericksburg.

- **Old Mill Park**

Located on Caroline Street. This park features soccer fields, picnic shelters, restrooms and river front views.

- **Memorial Recreation Park**

Memorial Recreation Park (also known as Kenmore) is located on the corner of Kenmore Ave. and Mary Ball St. The park is equipped with 2 unlighted tennis courts and 6 tennis courts that are lighted from dusk - 10 pm throughout the year, as well as a tennis practice wall, basketball court, youth soccer field, children's play equipment, and a toddler play area.

- **Riverfront Park**

The newest of the City's parks, located along Sofia St, adjacent to the commercial downtown district.

- **St. Clair Brooks Memorial Park**

St. Clair Brooks Park boasts 80 acres of wooded parkland. Amenities include picnic pavilions, grills, a skate park, basketball courts, a sand volleyball court, horseshoe pit, skate park, two baseball fields, football field, nature trails, playground equipment and restrooms. It is located on Butler Road (Route 212) between Route 1 and the YMCA.

- **Virginia Outdoor Center**

Canoeing, kayaking, rock climbing, backpacking, fly-fishing, ropes course. Instruction, rentals and guiding. Co-located with the offices of the Friends of the Rappahannock, a non-profit environmental education, planning and advocacy organization.

b. City Reforestation Efforts

- **Tree Fredericksburg and City Clean and Green Commission**

Tree Fredericksburg is a private, non-profit organization established with the mission to restore and maintain a vibrant urban forest in the City of Fredericksburg. The City of Fredericksburg, Fredericksburg Clean & Green Commission, and Tree Fredericksburg work cooperatively for planting trees within the City rights of ways.

In spite of recent storms in 2011 that have ravaged mature trees in many parts of urban Virginia, and even in Fredericksburg, Dave King, the City's Arborist, notes that:

"...Collectively (City staff, Tree committee, and Tree Fredericksburg) have come to recognize the potential

"...my perception (is) that the majority of our city residents and elected officials value the existence of our urban forest and the benefits it provides, over the concerns for potential damage to property."

Dave King, City Arborist
City of Fredericksburg

threat that extremely large mature trees such as pin oaks can present to property when planted in the wrong place, such as very tight utility strips in front of homes, and we therefore plant smaller, more appropriate trees in such locations now days.”

2. Stafford County

a. Park Acquisition, Expansion and Operation

• Crow’s Nest – Phase 2 Acquisition

Officials from Stafford County, the Virginia Department of Conservation and Recreation, local residents and representatives from local, state and national conservation groups celebrated the acquisition of 1,100 acres of the Crow’s Nest peninsula in eastern Stafford County. This second acquisition brings the total of acres protected at Crow’s Nest to 2,870. The property is recognized as one of the most significant natural areas remaining on the East Coast.

• Parks and Recreation Bond Referendum

In November 2009, Stafford County citizens voted to approve a \$20 million Parks and Recreation Bond Referendum that will develop, improve or and renovate various parks. The \$29 million bond will pay for:

- Development of Chichester Park at 75 Stafford Indians Lane for park, baseball complex, and related facilities
- Development of the Belmont-Ferry Farm Trail, the Dominion Virginia Power Easement Trail and the Belmont to Cannon Ridge Trail
- Development of Musselman Park at 750 Truslow Rd. for baseball fields, rectangular fields, trails, playground, picnic shelter, restrooms, parking and related facilities
- Development of rectangular athletic field complex
- Improvements to existing parks, including renovations to play grounds, picnic shelters, trails, courts, handicapped accessibility and signage
- Land acquisition
- Renovation or reconstruction of Curtis Park Pool
- Development of Phase II of Duff McDuff Green Park

• Government Island

Government Island is an historic 18th century quarry site that provided Aquia sandstone for the construction of the White House and the U.S. Capitol building. During George Washington's Presidency, Government Island was purchased by Pierre L'Enfant on behalf of the federal government in 1791 to provide stone to build the nation's new capital city - Washington, D.C. Now a natural park preserve and archaeological site, Government Island contains a trail and interpretive signs to help depict its rich, nationally significant history. The total length of the trail is approximately 1.5 miles (from the parking lot, to and around the island, and back). Government Island is an ideal location to observe aquatic and native plants, as well as birds and other wildlife.

• John Lee Pratt Park

John Lee Pratt Park is a spacious community park that boasts many amenities: Picnic shelters, grills, tennis and basketball courts, 10 soccer fields, a baseball field, Frisbee disc golf course, horseshoe pit, playground areas, restrooms, nature trails, one-mile gravel track, and one-mile paved hike/bike trail.

• Curtis Memorial County Park

Curtis Memorial is a beautiful wooded park with nature trails, picnic shelters (by reservation), a baseball diamond, a playground, a skateboard park, sand volleyball courts, tennis courts, an Olympic-size swimming pool with diving area (\$ fee), a zero-depth entry wading pool with water umbrella for children (\$ fee), a 91-acre fishing lake and an 18-hole public golf course.

- **Smith Lake Park**

This 17-acre site located on Doc Stone Road in Northern Stafford features three baseball diamonds (all lighted and irrigated) and two synthetic turf rectangular athletic fields (with lights). Other amenities include one large and one small picnic shelter, paved trails, a playground, and a restroom/storage building

- **Willowmere Park**

Willowmere Park has a walking trail, three lighted baseball diamonds, one baseball field, three soccer fields, picnic shelters, a concession stand, and a playground.

3. Spotsylvania County

a. Parks Operation and Planning

- **Patriot Park**

Patriot Park, located at the west end of Smith Station Road (near Parkside Elementary School and the YMCA) and Massaponax Church Road, opened on Saturday, October 27, 2007. The soggy conditions were not ideal for the planned celebration as the youth football games were rained out; however, the weather did provide an appropriate environment in which to talk about the "green" aspects of the park.



The 134-acre facility features two basketball courts, 12 baseball, softball and multipurpose fields, and 3.11 miles of walking trails. Three restroom facilities, and an amphitheater in a beautiful, natural setting, will be completed soon. There are 586 parking spaces built into the design.

Patriot Park incorporates the use of pervious concrete paving (an EPA-rated Best Management Practice (BMP)) to capture stormwater. The Park utilizes pervious concrete around the restroom facility at the baseball complex and in the amphitheater seating area. The design captures water around the perimeters for runoff into storm drains and into a stormwater pond, for future irrigation needs. A biomix under the mulch around the baseball field backstops assists in conserving this runoff flow. There are also green boxes located near the baseball fields, and by the fire hydrant, that can be tapped into for irrigation if needed. However, irrigation pipes with stainless steel heads are built into the fields.

Bio-filters or LIDs (Low Impact Development) treat the runoff from one of the smaller parking lots and four of the multipurpose fields. The runoff flows to these small basins containing a mix of sand, topsoil and compost. The water then seeps through this filtering mix and exits via drain pipes throughout 17 acres of the Park. Stormwater runoff will be used for irrigation beginning next year. This runoff recycling reduces or eliminates the amount of nutrients leaving the site and will dramatically reduce future irrigation costs.

Patriot Park Trail

All of the clearing debris from the 67.8 improved acres was recycled and used for perimeter erosion and sediment control, slope stabilization and construction of over three miles of walking trails through the undisturbed forest portion of the Park. Over 4,000 cubic yards of mulch was produced by the predominately cedar trees once covering what are now the ballfields and parking lots.

- **Motts Run Reservoir Recreation Area**

This 860-acre natural area including the 160-acre reservoir, is a haven for fishing, boating canoeing, hiking and picnicking. It also serves the residents of the City of Fredericksburg and parts of Spotsylvania County with drinking water. Personal boats (ELECTRIC MOTORS ONLY) can be launched on the lake, and fishing from the banks is allowed. A fee is charged for fishing and boat launching. No swimming, horseback riding,

biking of any kind, or all-terrain vehicles is permitted. The park has jon boats and canoes available for rental, picnic grills and tables, and over 4 miles of hiking trails.

- **Arritt Park**

Picnic shelter, playground and hiking trails; ball fields all on 26.5 acres.

- **Loriella Park**

Swimming pool, four tennis courts, soccer and baseball fields, picnic area and hiking trail.

b. Greenway & Trailway Initiatives

- **Spotsylvania Trailways Master Plan**

Adopted in 2010, the purpose of the plan is to provide a framework around which a comprehensive system of trailways can evolve, both now and in the future. The overall goal is to encourage the development of a system for non-motorized travel that will link neighborhoods, parks, schools, businesses and public facilities, as well as link and protect important natural, historic and cultural resources. Development of a Comprehensive Spotsylvania County Trailways Master Plan is an implementation item of the *Comprehensive Plan*, adopted in 2008.

The plan addresses trailways on public and private land where the trails are open to the public. This plan identifies a number of goals, objectives, and implementation strategies that Spotsylvania County can use in the development of an integrated system of trailways. An integrated system would link the existing trailway segments within the County into a larger common network of trailways that access residential areas, state, county, and national parks, forests and wildlife management areas, significant viewsheds, entertainment, water related resources, cultural and historic resources, schools, retail outlets, commercial services, mixed-use areas, employment centers, and transportation nodes. On a larger scale they can be incorporated into a regional system of trailways, effectively allowing for inter- and intra-jurisdictional infrastructure, regional tourism, and promoting regional alternative transportation possibilities.

- **Spotsylvania Greenway Initiative**

The *Spotsylvania Greenways Initiative* (SGI) was founded by local citizens, with the generous support of Luck Development Partners and MillionMile Greenway, to locate, preserve and create greenways in Spotsylvania County. Spotsylvania's rich history and our unique landscape can be connected through greenways that provide lessons in history, allow people to be part of nature, and offer recreational activities through extended hiking and biking trails – all while linking to other communities throughout our region.

4. Caroline County

Caroline County does not own or operate any public park sites. In light of the pre-qualification by the Virginia Department of Conservation and Recreation of the Mattaponi River (from Milford to Walkerton, in King William Co), as a possible "Virginia Scenic River", there has been active discussion by County staff of efforts to coordinate various conservation and recreation activity opportunities along the Mattaponi River corridor.

The Town of Bowling Green is actively planning a small (2 acre) public park to be located near the County courthouse complex and Town Hall, east of Main St.

5. King George County

a. Wayside Park

Wayside Park is a 10 acre park site on the Potomac River located on Route301 at the Harry G. Nice Memorial Bridge. Amenities include several picnic tables, two grills and approximately 100 yards of

beach. Parking is limited on-site; however, there is additional parking located at the commuter parking lot adjoining the Welcome Center and at Barnesfield (a short 5 minute stroll).

b. Barnesfield Park

Barnesfield Park is located on Route 301 approximately one mile south of the Harry G. Nice Memorial Bridge. This 150 acre park has 2 picnic shelters, 3 baseball/softball fields, 1 Little League size field, 2 multipurpose fields, outdoor basketball courts and fitness loop.

c. Wilmont Landing

This landing provides public boat access to the Rappahannock River. This site has very limited parking available. Wilmont Landing is located on Wilmont Road off of Rollins Fork Road (Rt. 681).

C. Local Government Planning & Zoning Practices

Table 2 (see next page) summarizes the diversity of planning and zoning tools adopted and applied by local governments in Planning District 16.

Tools	Caroline County	Town of Bowling Green	Town of Port Royal	King George County	City of Fredericksburg	Spotsylvania County	Stafford County
1. Zoning							
a. Subdivision and Site Plan Regulations	2	2	3	2	2	2	1
b. Zoning Tools	2	2	2	2	2	1	2
c. Form Based Codes	2	4	4	4	3	3	1
d. Cluster Subdivision/Zoning	3	2	3	2	2	1	1
e. Zoning Ordinances	2	2	2	2	2	2	2
f. Rezonings and Proffers	2	2	4	2	2	2	2
g. Zoning Maps	2	2	2	2	2	2	2
2. Design/Density							
a. Urban growth boundaries & service areas	1	4	4	4	4	1	1
b. Density Incentives	1	4	4	3	3	2	2
c. Community Design Concepts: Traditional Neighborhood Development and New Urbanism	4	2	4	4	4	1	1
d. Design Review Boards	4	4	2	2	1	1	1
e. Site Sensitive and Low Impact Development	2	2	2	2	1	1	1
3. Programs							
a. Transferable Development Rights (TDR)	3	4	4	4	4	2	3
b. Use Value Assessment & Taxation ("Land Use")	2	4	4	2	2	2	2
c. Conservation Easements	2	2	3	2	1	2	1
d. Purchase or Transfer of Development Rights	4	4	4	4	4	2	2
f. Parkland acquisition	4	4	4	2	1	1	1
4. Agricultural and Forestal Districts							
a. Agricultural and Forestal Districts (AFD)	2	N/A	4	4	N/A	1	1
b. Agricultural and Forestal Districts Maps	2	4	4	4	4	1	2
5. Public Outreach							
a. Education	2	4	4	4	1	1	1
b. Public Advocacy	2	4	4	4	1	4	4
6. Maps							
a. Parcel Maps	1	1	1	1	1	1	1
b. Future Land Use Maps	2	2	2	2	1	1	2
c. Transportation Plans	2	2	2	2	1	2	2
d. Floodplain Maps	2	2	2	2	1	2	2
7. Other							
a. Comprehensive Plans	1	1	1	1	1	1	1
b. Other Land Use Ordinances	2	2	2	3	2	2	2
c. Gray Infrastructure Maps	?	?	?	?	?	?	?
d. Historic Districts	2	2	2	2	1	1	1
e. Scenic Byways and Rivers	3	3	4	4	1	2	4

Table 2: Local Government Planning & Zoning Practices

Symbol	Status
1	Adopted, being implemented
2	Adopted, implementation by voluntary private action
3	Under Consideration
4	Not Yet Considered/Implemented

D. Stormwater Management Planning and Program Implementation

1. City of Fredericksburg

a. MS4 Program

The City's MS4 permit program, operates under the Building and Development Services Department (B&DS). For new development or redevelopment or significant site or building modifications, City requirements are addressed through the site plan review process. A site plan is a detailed engineering drawing depicting the overall development scheme and proposed improvements to a particular tract of land. Information provided on a typical site plan includes, but is not limited to, existing and proposed elevations, erosion and sediment control measures, stormwater management facilities, vehicular and pedestrian access and circulation plans, parking lot layout, water and sewer facilities, and landscaping. The purpose of the site plan is to facilitate utilization of the most advantageous techniques in the development of land and to promote high standards and innovations in the layout, design, landscaping and implementation of development. Site plans are generally required for all new buildings, large additions to existing buildings, and changes in use of existing buildings. Site plans are submitted to B&DS for review and then forwarded to the Planning Commission for approval. The site plan review process typically requires approximately 60-90 days to complete.

If Stormwater Management is performed on-site, the owner is required to provide a Best Management Practice (BMP) Agreement, which must be submitted for review and approval. Once signed off by City officials, the agreement must be recorded and provide the City with a copy of the recorded agreement along with a copy of the receipt. The Stormwater Management facility must be maintained in accordance with the agreement.

b. Chesapeake Bay Preservation Act Compliance

Compliance with the Chesapeake Bay Preservation Act is achieved through the City's administration of Division 26 of the City Code of Ordinances, which establishes that:

"(a) The Chesapeake Bay preservation overlay district (CBPO district) is created for the purpose of protecting sensitive environmental lands within the city, safeguarding the quality of state waters, including the Chesapeake Bay and the Rappahannock River, reducing existing pollution of state waters, and promoting water resource conservation for the health, safety, and welfare of all present and future citizens of the City.

(b) The CBPO district shall be in addition to and shall overlay all other zoning districts where it is applied, so that any parcel of land lying in whole or in part within the CBPO district shall also lie within one more zoning district established by this chapter. The effect shall be to create new districts that have the characteristics and limitations of the underlying districts, together with the characteristics and limitations of the overlying districts.

(c) The continued pollution of the Chesapeake Bay and its tributaries, including the Rappahannock River, and the adoption of the Chesapeake Bay Preservation Act, Code of Virginia, § 10.1-2100 et seq., requiring the City's passage of the ordinance from which this division is derived, constitute a change in circumstances substantially affecting the public health, safety, and welfare of the citizens of the City. This division shall therefore apply to all property rezoned by the city prior to the effective date of the ordinance from which this division is derived. "

c. LID Ordinance

The City worked with the Friends of the Rappahannock, the Fredericksburg Area Builders Association, and other stakeholders to develop new criteria for managing stormwater runoff and, in 2009, adopted amendments to the site plan review requirements for stormwater management. The new provisions are:

“(20) The city requirement for stormwater management shall be to limit the rate of stormwater runoff from a developed area to that which existed before development occurred. The policies for attaining this requirement are more specifically addressed in the city’s comprehensive stormwater facilities plan. The basic design criteria for stormwater management facilities employ the ten-year frequency, two-hour duration storm to determine pre-development and post-development flows. Required storage shall be computed using unit hydrograph methods. Emergency spillways shall be designed to pass the 100-year frequency, two-hour storm, hydrographs, spillway design, embankment design and flow computations shall be submitted with the site plan.

(21) Within the Hazel Run, Rappahannock Canal, Kenmore Flume and Deep Run watersheds (the "volume control area"), for new development or redevelopment, the first one-half inch of runoff from all new impervious surfaces shall be removed from the runoff flow as defined in [section 78-1](#). A one-year 24-hour extended detention may be used to satisfy up to 70 percent of this volume. The remaining 30 percent shall be removed from runoff flow. At least 50 percent of the parking lot surface shall drain to a filtration practice. The table below summarizes this requirement.

(22) For new or re-developed parking lots outside the Hazel Run, Rappahannock Canal, Kenmore Flume and Deep Run watersheds, volume control of stormwater is not required. However, at least 50 percent of the parking lot surface (or in the case of redevelopment, at least 50 percent of the additional parking lot area) shall drain to a filtration practice that is sized to treat the first one half inch of runoff. The table below summarizes this requirement. “

Table 3: Summary of Low Impact Development Ordinances for the City of Fredericksburg

Development Type	Location	Volume Control Requirement	Volume Control Method
New development	Within the volume control area	½" from all impervious surface	Infiltration, evaporation, or reuse. Alternatively, up to 70 percent of required volume may be satisfied via 1-year extended detention
	Outside the volume control area	None	N/A
Redevelopment	Within the volume control area	½" from new impervious area	Infiltration, evaporation, or reuse. Alternatively, up to 70 percent of required volume may be satisfied via 1-year extended detention
	Outside the volume control area	None	N/A

Notes:

1. At least 50 percent of new parking lot surface area shall drain to a filtration practice.
2. The volume controls and filtration practices required by subsections (21) and (22) can be utilized to satisfy the stormwater management quantity and quality control requirements for the site.

(23) If, after implementing on-site volume controls to the maximum extent practicable, the stormwater volume reductions required by subsections (21) or (22) cannot be fully achieved on-site, the remainder may be achieved through retrofit of off-site impervious areas within the same watershed. In the alternative, compliance may be achieved through the payment to the city of an in-lieu fee per cubic foot of volume reduction not attained. The city shall apply all funds so collected to stormwater control projects.

(24) Recorded stormwater management and nonpoint source pollution control facilities maintenance agreements and deeds of easement shall be provided. Such documents shall include a drawing or plat showing the facilities, the metes and bounds of the easement, a maintenance agreement obligating the owner to provide and maintain appropriate landscaping and to provide regular or periodic maintenance of the facilities and the best management practices used therein,

and such other provisions as the director of building development services may deem necessary to meet the requirements of this division and to ensure the public health and safety.

(25) Floodplain studies shall be prepared for drainage areas exceeding 100 acres. The 100-year rainfall curve shall be used, with a two-freeboard easement added to the computed water level. Floodplain computations shall be performed using the standard-step method or an equivalent method to achieve a balance of energy. Cross sections, stream profiles and support calculations shall be submitted with the site plan.

d. Other City Environmental Programs

A host of other environmental programs are managed and coordinated by the Building and Development Services Department, including: Dam Safety, the City Floodplain Ordinance, the National Flood Insurance Program, and the City's Wetland Ordinance, to name a few.

2. Stafford County

a. MS4 Program

The stormwater management provisions of the Stafford County Code were adopted to establish requirements for the management and control of stormwater runoff from developed properties in the County during and after construction. The County Board of Supervisors has approved a Stormwater Management Design Manual to provide guidance for designers to assist in meeting those requirements. The manual serves as a supplement to State and Federal design manuals that govern stormwater management design.

Stafford County requires the use of low-impact development (LID) techniques to the maximum extent practicable. Low-impact development stormwater management design approaches are fundamentally different from conventional design approaches and challenge traditional thinking regarding development standards, watershed protection, and public participation. LID combines fundamental hydrologic concepts with many of today's common stormwater strategies, practices and techniques to reshape development patterns in a way that maintains natural watershed hydrologic functions.

All stormwater management facilities in Stafford County need to be secured with a maintenance agreement prior to the plan being approved.

Effective May 1, 1011, Stafford County entered the Community Rating system (CRS) with a Class 8 rating, a rating achieved by only fourteen other communities within the Commonwealth. This qualifies each eligible National Flood Insurance Policy (NFIP) policyholder for a 10% savings in their flood insurance premium. Overall, the County's CRS accomplishment has resulted in a total annual savings of \$15,000.

LID Program: Low Impact Development (LID) is an innovative stormwater management approach with a basic principle that is modeled after nature: manage rainfall at the source using site design techniques that store, infiltrate, filter, evaporate, and detain runoff. LID's goal is to mimic a site's pre-development hydrology by using nature's design techniques. A goal of LID is to use site and subdivision design techniques in coordination with stormwater management engineering to mimic the hydrologic conditions associated with an undeveloped site.

Improvements

In 2003, Stafford County updated its stormwater management ordinance to include LID as an option for complying with the water quality, stream channel erosion, and flooding technical criteria of the county stormwater ordinance. The county also refined some of its requirements in the zoning and subdivision ordinances to provide some incentives to utilize LID practices.

In 2004, the county went a step further and required the use of LID on new development projects to the maximum extent practicable. To lead by example and to provide a demonstration project to show developers and engineers some LID facilities, the county in conjunction with friends of the Rappahannock constructed an LID demonstration project in the County Administration Center parking lot.

b. Chesapeake Bay Preservation Act Compliance

Stafford County adopted the Chesapeake Bay Preservation Act into County Code in 1994 through the adoption of Section 28-62 of the Zoning Ordinance – Chesapeake Bay Preservation Area Overlay District. The ordinance was modified in December of 2003 to require perennial flow studies on any streams associated with a development proposal. The Overlay District applies to the entire County, ensuring that all development meets the general performance criteria requirements in the Bay Act.

Stafford County ensures that all development plans are reviewed for compliance with the Chesapeake Bay, erosion and sediment control, storm water management and wetlands regulations. The County has a program which ensures that all septic systems in the County are required to be pumped-out every five years.

The County's program has been found compliant with the Phase I (2004) and Phase II (2002) requirements of the Bay Act and was found to have adequate provisions to meet State requirements during an advisory Phase III review, conducted in 2009.

3. Spotsylvania County

The Chesapeake Bay Division of the Department of Code Compliance is responsible for the review and approvals of all Stormwater Management, Erosion & Sediment control plans as well as RPA determinations, waivers and requests. This office also reviews all engineering and support data related to any stormwater runoff-related studies which include but are not limited to Flood Zone studies, Stream bed and bank restoration.

This office conducts these reviews using the current versions of the State's Erosion & Sediment Control handbook, Stormwater Management handbooks, VDOT drainage manual, FHWA HEC 22 manuals as well as the County ordinances Chapter 6A Chesapeake Bay, 19A Stormwater Management and reference the Chapters 20 Subdivision & 23 Zoning ordinances for all reviews and approvals.

The Chesapeake Bay Division also promotes Low Impact Development practices and conducts LID reviews to meet the current understanding and definition for Low Impact Development which is; "*The ability to infiltrate or re-infiltrate the water as it had been doing before any form of land disturbance activity had occurred.*" This definition was first expressed by Thomas Jefferson and is the basis for Spotsylvania's attitude towards a greener design using Low Impact Development.

a. MS4 Program

The County program recognizes that MS4s are conveyances, including road drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels and storm drains designed to collect and convey stormwater, which are owned or operated by a federal, state or local government entity. MS4s are not systems that are part of a "publicly owned treatment works system" (sewage collection, transportation and treatment) or part of a combined sewer (a system designed to carry both sanitary wastes and stormwater to the sanitary sewer treatment plant). Privately owned and operated drainage systems also are not considered MS4s.

b. Chesapeake Bay Preservation Act Compliance

The Environmental Engineering Office of Spotsylvania County regulates and monitors land disturbing activities equal to, or greater than, 2,500 square feet through the permitting process of construction and related activities by means of the Erosion and Sediment Control Ordinance. In addition, this office also regulates and monitors the [Flood Plain Ordinance](#). The [Erosion and Sediment Control Ordinance](#) is a County-wide program for the control of construction site sediments and the protection of public safety, properties, and waters of the Commonwealth of Virginia and the United States.

4. Caroline County

The County Department of Planning and Community Development is responsible for enforcing the County's Chesapeake Bay Preservation Act-related ordinances, including the land disturbance permitting program, the Soil Erosion and Sediment Control ordinance and stormwater management agreements required in the site plan

review process. Caroline County was found in compliance with Chesapeake Bay Preservation Act requirements in its last compliance review.

5. King George County

The County Department of Community Development is responsible for enforcing the County's Chesapeake Bay Preservation Act-related ordinances, including the land disturbance permitting program, the Soil Erosion and Sediment Control ordinance and stormwater management agreements required in the site plan review process. King George County was found in compliance with Chesapeake Bay Preservation Act requirements in its last compliance review.

6. Rappahannock River Basin Commission (RRBC)

a. Coordination of Federal and State Stormwater Management Programs

The RRBC at its September 2011 meeting had a major presentation on the impact of stormwater and related regulations on local governments in the Rappahannock River Basin and across the Commonwealth. This presentation by three local government staff members from PD 16 noted the challenge and the complexity of coordinating and applying multiple federal and state stormwater programs at the local level.

b. Innovative Market-Based Approaches to Water Quality Improvement

RRBC has four demonstration projects under development that promote green infrastructure efforts in the middle basin (PD 16) area as well as the upper (PD 9) and lower (parts of PDCs 17 & 18) basin.

i. Fredericksburg-Caroline Co. -Ft. A.P. Hill Optimum Energy & Environmental Efficiency Project

This project will create and implement a financial mechanism that links the City, County, and A.P. Hill by providing each entity cost-effective pollution reduction and energy supply.

Partners: RRBC, City of Fredericksburg, Caroline County, Ft. A.P. Hill, Public Policy of Virginia, The Nature Conservancy, Hanover-Caroline Soil and Water Conservation District, Conserv

ii. The Nutrient Neutral Highway

Using the proposed George Washington Toll Road, this project will develop and design a pollution reduction offset program and payment program that funds and neutralizes highway impact on the Bay.

Potential Partners: RRBC, City of Fredericksburg, FAMPO, George Washington Toll Road Authority (GWTRA), Transportation Engineering Consultant, Conserv

iii. The Bay Friendly Yard

This project will test the financial and environmental efficiencies of the retrofit of existing lawn to "Bay Friendly Yard" in Fredericksburg.

Potential Partners: RRBC, City of Fredericksburg, National Wildlife Federation, Friends of the Rappahannock, Gentle Gardener Green Design, Landscape Designers, Landscape Architects, George Mason University, Virginia Tech University, Conserv

iv. Testing of Market Infrastructure for Trust for Clean Water Economy

The purpose of this proposed initiative is to test and evaluate the architecture of a private sub-watershed based ecosystem services management entity - the Trust for a Clean Water Economy (The Trust). The Trust primarily would act as a nutrient bank to incentivize ecosystem services restoration. The initiative is also envisioned to be a USDA demonstration project that will enhance efforts to find other revenue sources to aid farmers with conservation practice implementation.

Partners/Cooperators:

Rappahannock River Basin Commission
Virginia Dept. of Forestry
Virginia Dept of Environmental Quality
Water Stewardship, Inc.
Virginia Tech University
Resources for the Future

Working Lands Investment Partners, LLC
Eco Assets Markets, Inc.
Public Policy of Virginia
Kathy Harrigan (consultant)
World Resources Institute
Conserv

Conclusion

Taken together, this set of planning studies and projects presents a comprehensive approach to greater green infrastructure appreciation and protection in the George Washington Region (Planning District 16). Given recent trends in land use/cover change and local governments' involvement in the State's commitment to improve water quality in the Chesapeake Bay and its tributaries, the recommendations in this plan (and tangible implementation actions) are offered to help local governments comply with various environmental mandates that collectively press on all of them. The GWRC identified some opportunities for action in key locations where green infrastructure investments can quickly achieve significant benefits. The illustration of these opportunities provides a useful framework to undertake a comprehensive green infrastructure conservation and enhancement program using the full array of tools available in the Implementation Toolkit. Investing in these assets now will help ensure the protection of green infrastructure, water and air quality, and the associated benefits of nature to PD 16 residents for current and future generations.

VIII. Findings and Recommendations

A. Findings

1. The active development of the Region over the 13 year period from 1996 through 2009 contributed to a loss of 4.17% of its tree canopy, while gaining 2.80% of urban bare area, 8.68% of open space, and 43.46% of impervious surface area. The Region is still blessed with an enviable amount of tree canopy land cover, relative to other rapidly urbanizing or established urban metro areas.
2. The cumulative changes to the Region's land cover and associated losses to the Region's tree canopy resulted in the loss of the tree canopy's ability to naturally manage 222.98 million cubic feet of stormwater, valued at \$1.06 billion using the average cost assumption of \$4.75¹⁵ per cubic foot for man-made stormwater retention facilities. The Region's "green infrastructure" also lost the ability to remove approximately 2.89 million lbs. of air pollutants annually, valued at \$7.74 million per year, 1.24 million lbs. of carbon stored in trees' wood, and 9,616 lbs. of annual carbon sequestration.
3. Local governments in the region do not, generally speaking, have reliable data on the amount of impervious surface area within their jurisdiction to estimate stormwater runoff by sub-watershed or to use to identify priority areas for urban retrofit programs or to target reforestation efforts.
4. Active coordination between local government urban stormwater management programs and rural-oriented Soil and Water Conservation District programs is vital to achieve balanced reductions in non-point source pollution. The SWCDs will be challenged in addressing agricultural run-off issues and facilitating the development of nutrient management plans for each agricultural operation.
5. Between the urban MS4 program requirements and the Chesapeake Bay Preservation Act regulations requiring a cataloging of installed BMPs in each CBPA community, both urban and rural; all localities in the region should have a good grasp of the distribution of these facilities throughout their jurisdiction. However, the over-lapping and (at-times) seemingly contradictory stormwater regulations under various federal and state programs challenge local governments to cost-effectively manage development and associated stormwater-related water quality impacts.
6. Public opinion response to alternative regional land use scenarios demonstrated a preference for the "greenprint" scenario, with 36 percent of respondents choosing the greenprint scenario as the preferred option, followed by 34 percent for the compact scenario, and 25 percent for the jobs-housing scenario. Respondents who preferred the greenprint scenario liked it most (32 percent) because of the large areas of preserved open space.
7. Many of the planning tools authorized under the Code of Virginia have been utilized by local governments in PD 16 to manage growth and development and promote, directly or indirectly, the enhancement of the Region's green infrastructure.
8. Green infrastructure planning practice in the Region heretofore has focused somewhat more on advancing the stormwater management practices (as part of local governments' response to federal and state environmental mandates). However, such notable efforts as the acquisition of Crow's Nest – Part 2, the adoption of a Spotsylvania County Trailways Plan and local designation of urban development areas demonstrates local movement toward the identification, prioritization and

¹⁵ Local cost estimates ranged from under \$2.00 to over \$10.00 per cubic foot. \$4.75 was used as a regional cost average, but local stormwater program managers, in some cases, place a higher value on the cost-avoidance benefit of green infrastructure.

conservation of rural forests, working farms and other open spaces for their recognized ecological asset value.

9. Local governments have supported exploration (through Rappahannock River Basin Commission and other initiatives) of innovative approaches to “green infrastructure” planning, such as the development of a regional nutrient credit trading program and other market-based approaches to removing pollutants from the air and water sources that pollute the Chesapeake Bay and its tributaries.
10. There is no established locally-based, conservation-oriented land trust in Planning District 16 that can hold conservation easements. Consequently, local conservation easement negotiations must involve such out-of-region interest as the Northern Virginia Conservation Trust, the Virginia Outdoors Foundation and other entities.
11. Local governments are interested, if designated an ozone non-attainment area, in being added to the Code of Virginia (§ 15.2-961.1) that allows referenced local governments authority to adopt a local ordinance to include in site plan review provisions for the preservation or replacement of trees on the development site.
12. Local community financial and political support will be needed to achieve continued progress in green infrastructure plan implementation.

B. Recommendations

1. Adopt quantitative regional goals to achieve reforestation and land conservation outcomes; including:
 - a. Increasing regional tree canopy by 5 percent (approximately 51.5 sq. miles), thereby restoring a little more than the amount of tree canopy lost in the Region in the 1996-2009 era, with priority given to infilling gaps in riparian buffers, and other areas that complement water quality protection programs implemented and expanded to respond to Chesapeake Bay watershed implementation planning goals.
 - b. Encouraging public and private landowners to increase land acreage in the Region under conservation easement by 14,300 acres, representing the Region’s pro-rata share of Governor McDonnell’s 400,000 acre statewide conservation easement goal for his 4-year term.
2. Continued collaboration of GWRC’s ad-hoc watershed implementation plan committee with full local government technical staff participation and broad involvement of community-wide stakeholders from all sectors to develop a comprehensive, cost-effective regional responses to Chesapeake Bay Watershed Implementation Plan Phase 2 process and expansion of the installed inventory of BMPs.
3. Should a grant opportunity materialize, local governments should work through GWRC to create a 1-meter (or better) classified land cover data layer that could better define the Region’s green and grey infrastructure and support comprehensive land use planning, green infrastructure planning and watershed implementation and stormwater management planning.
4. Pursue legislative support for amending the Code of Virginia (§ 15.2-961.1) to include PD 16 in the legislation so that local governments are empowered (should they be designated part of ozone non-attainment area) to require tree conservation and preservation in the site plan review process of development proposals.
5. GWRC Board endorsement of the Regional Green Infrastructure Plan and direction to staff to communicate the Plan document to local governments and other stakeholders in the Region as an advisory tool to help public and private actors incorporate green infrastructure planning into public and private comprehensive planning and land development processes.

APPENDICES

Appendix 1: Glossary¹⁶

Afforestation: is the establishment of a forest or stand of trees in an area where there was no forest previously.

Agricultural and Forestal District: District formed to maintain and conserve the rural character of farm and forest lands. Land uses which conflict with farming and forestry activities will be minimized. No public services or infrastructure should be provided which might encourage residential or other nonagricultural development (Spotsylvania Co. Comprehensive Plan).

Attenuation: Reduction in magnitude, as in the lowering of peak runoff discharge rates, in the case of dry ponds; or the reduction of contaminant concentrations, as in the action of biodegradation in wetlands or bioretention facilities.

Baffle: Any deflector device used to change the direction or the flow of water.

Base Flow: The flow in a stream between storm events. This flow is supplied by groundwater.

Benches: Surface configurations added to stormwater basins that create flat edges, usually installed for safety and to minimize erosion.

Benthic: Pertaining to occurrence on or in the bottom sediment of wetland and aquatic ecosystems, including wetlands.

Berm: A mound of earth formed to control the flow of surface water.

Biodiversity: Biodiversity refers to the number of species of plants and animals in a defined area. Biodiversity is measured by a variety of indices that consider the number of species and, in some cases, the distribution of individuals among species.

Bioretention: A water quality practice that utilizes landscaping and soils to treat stormwater runoff by collecting it in shallow depressions and then filtering it through a planting soil media.

BMP (or Best Management Practice): A state-of-the-art method for achieving a desired benefit, such as infiltration or improved water quality.

Buffer: A vegetated strip immediately adjacent to a water body. The primary function of buffers is to protect the receiving water from sediment and pollutants derived from upstream areas. Ancillary benefits may include infiltration of rainfall and habitat enhancement. Forested riparian buffers are one example of a best management practice related to the use of buffers.

Channelization: The creation of a channel or channels resulting in faster water flow, a reduction in hydraulic residence time, and less contact between water and solid surfaces in the water body.

Contour: A line on a topographical map connecting points of like elevation.

Cluster Development: A development approach that preserves ecologically valuable open space and other lands by grouping buildings and other built infrastructure in less environmentally sensitive areas; a site-planning technique in which lot sizes, setbacks, and frontage distances are minimized to allow for open space; also called conservation design, conservation development, or open space development.

¹⁶ Author Note: Terms do vary in meaning based on the context of their usage.

Comprehensive Plan: A plan that includes the guidelines, principles, and standards for an area's orderly, coordinated, and balanced future economic, social, physical, environmental, and fiscal development; also called a general plan or master plan.

Connectivity: The creation of functionally contiguous blocks of land or water through linkage of similar ecosystems or native landscapes; the linking of trails, communities, and other human features.

Conservation corridor: A linear feature that serves as an ecological connector that facilitates the movement of animals, plants, and their genes into other populations. They are primarily managed for the conservation of biological diversity, renewable resources, water flow, and water quality protection.

Core area: A large area within a reserve network that is managed solely or primarily as an ecological reserve for the conservation of biological diversity; such areas will often be the central units within the network- they may include several ecosystems.

Corridor: A narrow or linear segment of land that differs from the matrix on each side; they may serve as biological and/or hydrological connecting corridors and/or provide outdoor, resource-based recreational opportunities.

Denitrification: The anaerobic microbial conversion of nitrogen to nitrogen gas.

Detritus: Dead plant material that is in the process of decomposition.

Easement: A grant of one or more of the property rights by the property owner to and/or for the use by the public, a corporation or another person or entity. A legal restriction contained within a deed that prohibits certain land uses in perpetuity; landowners voluntarily place a conservation easement on their property to protect natural resources, such as water quality, wildlife habitat, or scenery, or to protect the land for a certain type of use, such as farming; the landowners retain rights to use the land for any purpose that is not prohibited by the terms of the easement.

Ecological degradation: The interruption of ecological functions and processes and/or loss of ecological structure necessary to maintain the integrity and adaptive nature of native landscapes and ecosystems.

Ecological network: A network of lands that is designed to conserve native ecosystems and landscapes, restore connectivity among native ecological systems and processes, and maintain the ability of native ecosystems and landscapes to function as dynamic systems and to allow biota to adapt to future environmental changes.

Ecosystem integrity: The ability of an ecosystem to maintain essential ecological processes, functions, and structures and to adapt to spatial and temporal changes.

Embankment: An elevated man-made or natural deposit of soil, rock or other materials

Emergent plant: A plant with stems and leaves that grows in periodically or permanently flooded areas. Parts of the plant extend through and above the water.

Evapotranspiration: The combined processes of evaporation from the water or soil surface and transpiration of water by plants.

Exotic species: A plant or animal species that has been intentionally or accidentally introduced and that does not naturally occur in a region.

Extended detention: A function provided by BMPs which incorporate a water quality storage. BMPs with extended detention, intercept runoff and then release it over an extended period of time.

Extended Detention (ED) Pond: Temporarily detains part of stormwater runoff for up to 24 hours after a storm by using a fixed orifice. ED ponds normally are "dry" between storm events and do not have permanent standing water. An enhanced

ED pond is designed to prevent clogging and resuspension. It provides flexibility in achieving target detention times. It may be equipped with plunge pools near the inlet, a micropool at the outlet, and may have an adjustable reverse-sloped pipe at the ED control device.

Extended Detention Control Device: A pipe or series of pipes that extend from the riser of the stormwater pond that are used to gradually release stormwater from the pond over a 12- to 48-hour interval.

Fascine: Bundled willow cuttings used to stabilize stream banks. Bundling allows otherwise weak green twigs to reinforce each other and resist the forces of stream currents.

Filter Strip: A vegetated boundary characterized by uniform mild slopes. Filter strips may be provided downgradient of developed tracts to trap sediment and sediment-borne pollutants and to reduce imperviousness. Filter strips may be forested or vegetated turf. Filter strips located adjacent to waterbodies are called buffers.

Flood Fringe: The flood fringe occupies the distal parts of the floodplain, outside of the floodway. Complete obstruction of the flood fringe will not significantly increase flood levels. The flood fringe boundary is typically based on an increase in flood level of one foot during the 100-year return frequency flooding event.

Floodplain: Area that is in the path of water as it flows naturally from higher to lower elevations during periods of heavy rain. Areas that are flooded periodically (usually annually) by the lateral overflow of rivers. In hydrology, the entire area that is flooded at a recurrence interval of 100 years.

Floodway: Part of the floodplain, centered on the stream, that will convey most of the flow during overbank flooding events.

Forebay: Stormwater design feature that uses a small basin to settle out incoming sediment before it is delivered to a stormwater BMP.

Gabion: Wire cage used to contain rip rap and stone. Gabions are used to increase the resistance of rip rap to movement caused by flowing water.

Geotextile: A fabric manufactured from synthetic fiber that is designed to achieve specific engineering objectives, including seepage control, media separation (e.g., between sand and soil), filtration, or the protection of other construction elements such as geo-membranes.

Gray infrastructure: Man-made systems that support communities, including roads and other transportation systems, stormwater management systems, and utilities.

Green Infrastructure:

1. Green Infrastructure is an “interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains air and water, and provides a wide array of benefits to people and wildlife.” (The Conservation Fund)
2. Green infrastructure is management approaches and technologies that utilize, enhance and/or mimic the natural hydrologic cycle processes of infiltration, evapotranspiration and reuse. When used as components of a stormwater management system, Green Infrastructure practices such as green roofs, porous pavement, rain gardens, and vegetated swales can produce a variety of environmental benefits. In addition to effectively retaining and infiltrating rainfall, these technologies can simultaneously help filter air pollutants, reduce energy demands, mitigate urban heat islands, and sequester carbon while also providing communities with aesthetic and natural resource benefits. (US EPA).

Green Infrastructure Network: A physical network that links conservation areas and other types of open spaces to maximize the natural functions of the landscape and protect the species that live there; often, green infrastructure networks also provide diverse benefits and services to people and communities.

Green Infrastructure Plan:

1. Green Infrastructure Planning involves strategically planned and managed networks of natural lands, working landscapes and other open spaces that conserve natural ecosystem values and functions and provide associated benefits to human populations. The network consists of core habitats connected by corridors that help animals, seeds, and people move across the landscape. (Source: Green Infrastructure Center, Charlottesville, VA)
2. Green Infrastructure Planning involves the integration of landscape architecture design principles with stormwater management BMPs to achieve reduced off-site runoff of stormwater volume and increased evapotranspiration, infiltration and reuse of stormwater to limit the conveyance of pollutants to other water bodies downstream. (GWRC staff)

Green Space: Natural areas, parks, trails, greenways, and other types of open space that are not developed; green space can preserve natural ecological values and functions and provide places for resource-based recreation and other forms of human enjoyment.

Greenway:

1. A strip or belt of vegetated land that typically includes both upland and riparian areas. Greenways are often used for recreation, or to provide as a land use buffer, or to provide a corridor and habitat for wildlife.
2. A linear open space established along either a natural corridor, such as a riverfront, stream valley, or ridgeline, or over land along a railroad right-of-way converted to recreational uses, canals, scenic roads, or other routes; any natural or landscaped course for walking, biking, and other recreation use that links parks, nature reserved, cultural features, and/or historic sites with each other and with populated areas; locally, a strip of land or linear park designated as a parkway or greenbelt.

Groundwater Recharge: Increasing the amount of groundwater in storage via percolating rainwater.

Habitat:

1. The natural environment of an organism; contains the elements of a landscape that the plant or animal needs for survival.
2. The environment occupied by individuals of a particular species, population, or community.

Habitat fragmentation: Human activity such as agriculture, road building, and land development that results in the creation of small, isolated areas poorly suited to maintaining ecological features and supporting smaller populations of remaining species; there are two components of habitat fragmentation: 1) reduction in total habitat area, which affects population size and increases extinction rate; and 2) redistribution of the remaining area into disjointed fragments, which affects dispersal and decreases immigration rates.

Headwall: A wall of stone, metal, concrete, or wood at the end of a culvert or drain to protect fill from scour or undermining, increase hydraulic efficiency of conduit, divert flow, retard disjuncting of short sectional pipe, or serve as a retaining wall.

Herbaceous: Plant parts that contain chlorophyll and are non-woody.

Hydric Soil: A soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions. Hydric soil that is in areas having indicators of hydrophytic vegetation and wetland hydrology is wetland soil.

Hydrologic Soil Group: A designation developed by the NRCS which describes the infiltration capacity of soil. Soil associations are categorized in decreasing infiltration capacity from A to D.

Impervious surface: Those surfaces in the landscape that can not infiltrate rainfall, such as rooftops, pavement, sidewalks, driveways and compacted earth.

Infiltration: The downward movement of water from the surface of the land to subsoil.

Invasive Plant: A plant that becomes established and spreads aggressively into new areas and environments, often with detrimental effects on native plant species.

Land trust: A privately supported, nonprofit land conservation organization whose purpose is to protect human and natural resources including productive farmland and forests.

Landscape: A mosaic of ecosystems or land uses that possess common attributes that are repeated across a large area.

Low Flow Channel: An incised or paved channel from inlet to outlet in a dry basin which is designed to carry low runoff flows directly to the outlet without detention.

Low Impact Development (LID) : A comprehensive stormwater management and site-design technique. Within the LID framework, the goal of any construction project is to design a hydrologically functional site that mimics predevelopment conditions. This is achieved by using design techniques that infiltrate, filter, evaporate, and store runoff close to its source. Rather than rely on costly large-scale conveyance and treatment systems, LID addresses stormwater through a variety of small, cost-effective landscape features located on-site. LID is a versatile approach that can be applied to new development, urban retrofits, and revitalization projects. This design approach incorporates strategic planning with micro-management techniques to achieve environmental protection goals while still allowing for development or infrastructure rehabilitation to occur.

Marsh: A wetland dominated by herbaceous emergent plants.

Mitigation: The replacement of functional values lost when an ecosystem is altered. Mitigation can include replacement, restoration, and enhancement of functional values.

Mitigation banking: Preserving and/or restoring large natural systems or areas for the purpose of mitigation in advance the adverse effects of development or other land alteration activities; mitigation banks allow developers and landowners with eligible sites to transfer mitigation responsibility to multi-acre 'bank' sites of degraded lands that bank operators enhance or restore to carry out their clients' mitigation responsibilities.

Native Plant: A plant that naturally occurred in an area before disturbance by humans.

Non-native Plant: Also called "introduced", this vegetation has been brought to an area by humans and becomes established. These plants are native to other regions. Some non-native plants become invasive.

Ordinance: A publically adopted law or regulation by a local governmental body.

Palustrine Wetland: All nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens; and all such tidal wetlands in areas where salinity from ocean-derived salts is below 0.5 parts per thousand.

Peak Rate (of Runoff): The maximum instantaneous rate at which runoff is discharged from a site as the result of a precipitation event, usually measured in cubic feet per second.

Percolation Rate: The downward movement under the influence of gravity movement of water under hydrostatic pressure through the interstices of the rock or soil.

Perennial: Persisting for more than one year. Perennial plant species persist as woody vegetation from year to year or resprout from their rootstock annually.

Photic Zone: The area of a water body receiving sunlight.

Plant Community: All of the plant species and individuals occurring in a shared habitat or environment.

Plunge Pool: A small permanent pool at either the inlet to a BMP or at the outfall from a BMP. The primary purpose of the pool is to dissipate the velocity of stormwater runoff, but it also can provide some pretreatment.

Pore Space: Open space in rock or granular material; also known as interstices.

Purchase of development rights: A method by which landowners place a deed restriction on their land in exchange for payment.

Open Space: Undeveloped lands suitable for passive recreation or conservation uses.

Receiving Water: A water body into which wastewater or treated effluent is discharged.

Reforestation: is the reestablishment of forest cover, either naturally (by natural seeding, coppice, or root suckers) or artificially (by direct seeding or planting).

Retrofit: To install a new BMP or improve an existing BMP in a previously developed area.

Return Frequency Storm (rainfall event): The average period of time that an observer must wait between the occurrence of an event of a particular statistic probability of a storm of equal magnitude, or larger magnitude occurring. For example, when the interval between observations is a year, a return frequency period of 100 years means that, on the average, an event of this magnitude or greater is expected to occur not more often than once in 100 years.

Riparian:

1. Pertaining to a stream or river. Also, Plant communities occurring in association with any spring, lake, river, stream, or creek through which waters flow at least periodically.
2. Living or located on the bank of the natural watercourse; a riparian corridor is a corridor adjacent to and/or including the banks of a body of water functioning to protect water resources and environmental integrity.

Riparian Corridor: Narrow strip of land, centered on a stream, that includes the floodplain as well as related riparian habitats adjacent to the floodplain.

Riparian Trail: A linear corridor on land or water that provides public access for recreation or authorized alternative modes of transportation.

Riverine Wetlands: Wetlands associated with rivers.

Runoff: That part of the precipitation that appears in surface water bodies after traveling across land.

Saturated Soil: Soil in which the pore space is completely filled with water.

Seed Bank: The accumulation of viable plant seeds occurring in soil and available for germination under favorable environmental conditions.

Setback: A distance from the edge of a water body within which intensive development is restricted. Setbacks are established by local regulation for the purpose of maintaining open space next to streams, lakes, and other water bodies. The area within setbacks is frequently used for flood control, recreation, preservation of drinking water supply, and wildlife habitat enhancement.

Sheet Flow: Water flow with a relatively thin and uniform depth.

“Smart Growth”: A range of development and conservation strategies intended to protect our natural environment while simultaneously making our communities more attractive, economically stronger, and more socially diverse. Smart Growth encourages development that serves the economy, the community, and the environment. In direct response to the effects of urban sprawl, towns and cities across the country are using creative strategies to develop in ways that preserve natural lands and critical environmental areas, protect water and air quality, and reuse already-developed land. Smart Growth communities conserve resources by reinvesting in existing infrastructure, reclaiming historic buildings, and by designing neighborhoods that have shops, offices, schools, churches, parks, and other amenities within walking or biking-distance of residential areas. Green Infrastructure practices can play a role in Smart Growth development by providing communities with a variety of environmental and aesthetic benefits that are in line with Smart Growth principals.

Streambank Erosion: Removal of soil particles from a bank slope primarily due to water action. Changes in land use, climatic conditions, ice and debris and chemical reactions can also lead to streambank erosion.

Storm Sewer System: Pipes, swales natural features and man-made improvements designed to carry runoff.

Substrate: Substances used by organisms for growth in a liquid medium. Surface area of solids or soils used by organisms to attach.

Succession: The temporal changes of plant and animal populations and species in an area that has been disturbed.

Sustainable Infrastructure : A set of policies, approaches and planned expenditures that provide for consistently effective water infrastructure systems over the long term. 'Water infrastructure' generally refers to the pumps, plants, pipes and other physical assets that make up our systems, including those for drinking water, wastewater and stormwater. It may also include more innovative 'soft path' approaches or 'green infrastructure' techniques, and is not limited to traditional systems of conveyance and collection. This infrastructure is truly 'sustainable' when there is a long term plan for replacing the components of the system as they age and wear out - as well as having adequate, dependable revenue streams to support capital needs, operation and maintenance.

Terrestrial: Living or growing on land that is not normally flooded or saturated.

Transition Zone: The area between habitats or ecosystems. Frequently, transition zone is used to refer to the area between uplands and wetlands. In other cases, wetlands are referred to as transitional areas between uplands and aquatic ecosystems.

Transpiration: The transport of water vapor from the soil to the atmosphere through growing plants.

Transfer of development rights-A tool for preserving rural or undeveloped land while allowing landowners to reap the full value for their property by allowing landowners to sell assigned rights to developers at a mutually agreed upon price for use to increase development densities in other areas.

Upland: An area that is not an aquatic, wetland, or riparian habitat. An area that does not have the hydrologic regime necessary to support hydrophytic vegetation.

Watershed-A topographically discrete unit or stream basin, including the headwaters, main channel, slopes leading from the channel, tributaries, and mouth area, all defined by a common drainage pattern.

Wattles: Fence or barrier constructed of interwoven twigs and branches used to stabilize soil from erosive forces.

Weir: A device used to control and measure water flow.

Wetlands:

1. Swamps, marshes, fens, and bogs.
2. An area that is inundated or saturated by surface water or groundwater at a frequency, duration, and depth sufficient to support a predominance of emergent plant species adapted to growth in saturated soil conditions.

Wildlife corridor: Stretches of land that connect otherwise disconnected wildlife habitat; contribute to greater biodiversity and increased long-term genetic viability and are needed by some species to survive.

Working lands: Land that has been modified by humans to produce food, fiber, or other materials; include lands used for agricultural protection, forestry, ranching, and mining, also called working landscapes.

Zonation: The development of a visible progression of plant or animal communities in response to a gradient of water depth or some other environmental factor.

Appendix 2: Working Farms and Green Infrastructure in the George Washington Region

Contents

Introduction	106
Analysis	106
Maps	107
Tables	113
Comparison to Urban Ecosystem Analysis.....	115
The Census of Agriculture & Economic Value.....	115
Ecosystem Services	116
Conclusion.....	116

Introduction

Working farms make up about a quarter of the area in the George Washington region. Working farms are a valuable part of the region's green infrastructure. Working farms in the region preserve open space. The Conservation Fund defines green infrastructure as "a network of natural areas and open spaces—woodlands, wetlands, trails and parks—that conserves ecosystems, helps sustain clean air and water and provides many other benefits to people and wildlife."¹⁷ Because working farms provide open space in the region, working farms should be included in the region's green infrastructure. The acreage of working farms in the five localities of the region can be studied in the context of other green infrastructure components to determine how the addition of working farms affects the region's green infrastructure.

Analysis

The purpose of this analysis was to determine the effect of adding working farms to the green infrastructure network in the George Washington region.

First, the acreage of working farms in the region was calculated in ArcMap, a GIS software, using a working farms shapefile. The shapefile shows the geographic distribution and boundaries of working farms. The acreage was calculated for each locality (Fredericksburg City, and Caroline, King George, Spotsylvania, and Stafford Counties) and for the region as a whole. This information was used to calculate the percent working farms area in each locality.

Next, the working farms shapefile was analyzed with different green infrastructure components: high value cores, medium value cores, and corridors. These green infrastructure eco cores were derived from the Virginia Natural Heritage Program's Ecological Core Model. The natural areas in the region were assigned Ecological Integrity scores based on 53 geospatial attributes.¹⁸ The high value cores had Ecological Integrity scores of Outstanding, Very High, and High. The medium value cores had Ecological Integrity scores of Moderate and General. The corridors were created by connecting ecological cores in the two highest categories: Outstanding and Very High. The corridor routes were modeled in such a way that high value cores were connected and the corridor passed through cores of lower Ecological Integrity scores. For a more detailed explanation of these Green Infrastructure components, please reference the *2009 Green Infrastructure and Conservation Corridors Maps* Commission document.

The working farms shapefile was dissolved with the different green infrastructure components described above. Dissolving is a process in ArcMap that creates a single shapefile from the input shapefiles. This removes the possibility of double counting acreage if the working farms area already overlapped with any of the other green infrastructure components. The dissolve function was used to create the following combinations of green infrastructure: high value eco cores, medium value eco cores, corridors, and working farms; high value eco cores and corridors; and high value eco cores, corridors and working farms. Maps were created to demonstrate the spatial distribution of the different combinations of green infrastructure. The percent area of green infrastructure was calculated for each locality and the region as a whole.

Finally, the acreage of working farms was compared to the tree canopy and impervious surface acreage that was calculated as a part of the *Urban Ecosystem Analysis for the George Washington Region (PD 16)* report.¹⁹

¹⁷ The Conservation Fund (2011). *Green Infrastructure*. Retrieved June 2011, from The Conservation Fund: http://www.conservationfund.org/green_infrastructure

¹⁸ The George Washington Regional Commission (2009). *2009 Green Infrastructure and Conservation Corridors Maps*.

¹⁹ The George Washington Regional Commission (2010). *Urban Ecosystem Analysis for the George Washington Region (PD 16)*.

Maps

This section includes maps that show the spatial distribution of working farms in the region. The maps also show the spatial distribution of working farms in the context of other green infrastructure components.

The maps show the following progression:

Map 1: Working Farms in the George Washington Region

This map shows the spatial distribution of working farms throughout the George Washington region.

Map 2: Eco Cores & Corridors in the George Washington Region

This map shows the spatial distribution of the high value eco cores, medium value eco cores and the green infrastructure corridors that connect these cores in the region.

Map 3: Eco Cores, Corridors and Working Farms in the George Washington Region

This map shows the components of Map 2, with the addition of working farms. This map shows where working farms make an addition to the region's green infrastructure.

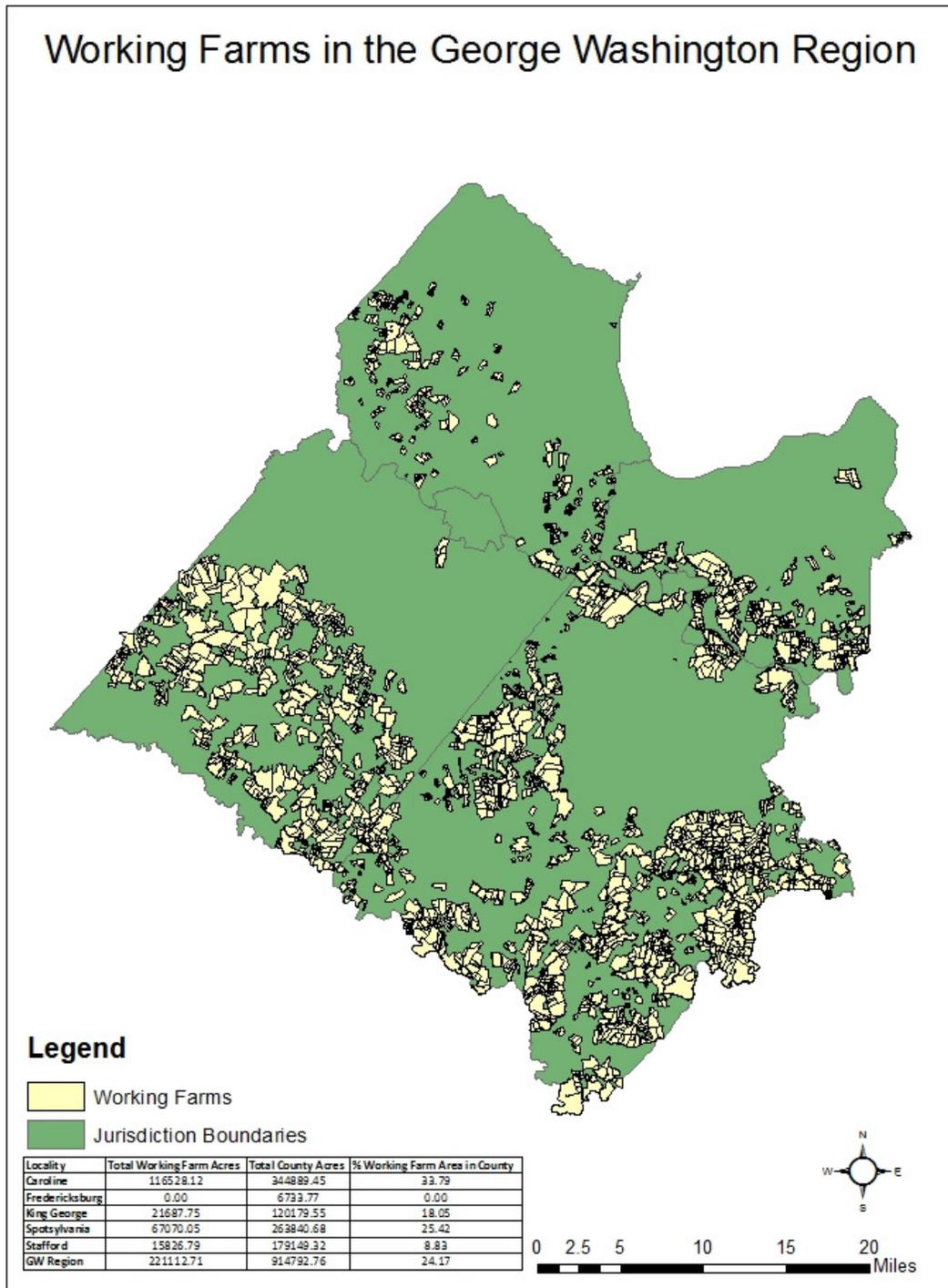
Map 4: High Value Eco Cores and Corridors in the George Washington Region

This map shows the spatial distribution of high value eco cores and corridors throughout the region.

Map 5: High Value Eco Cores, Corridors and Working Farms in the George Washington Region

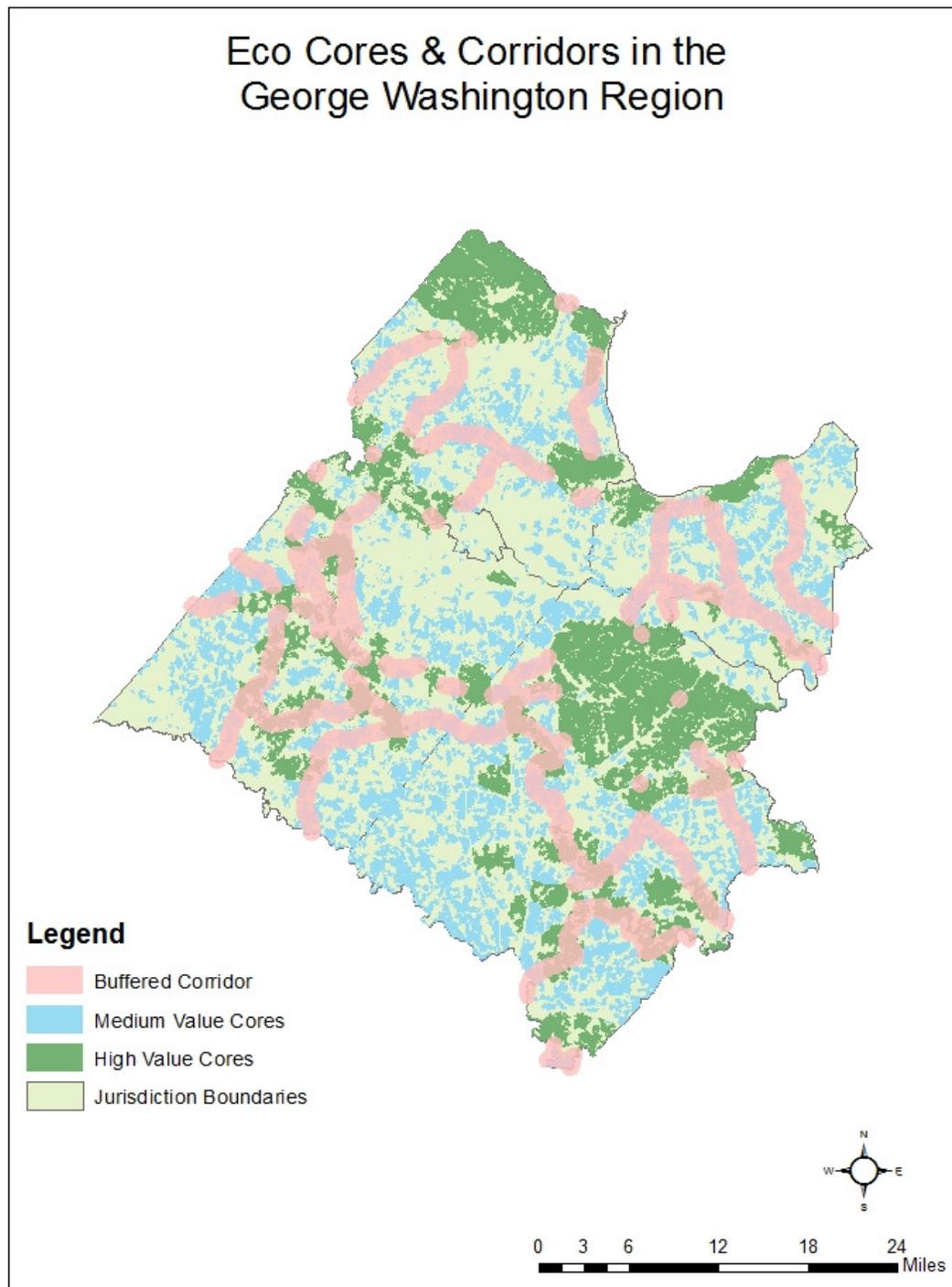
This map shows the same components of Map 4, with the addition of working farms. This map shows where working farm acreage adds to the region's high value green infrastructure.

Map 1.



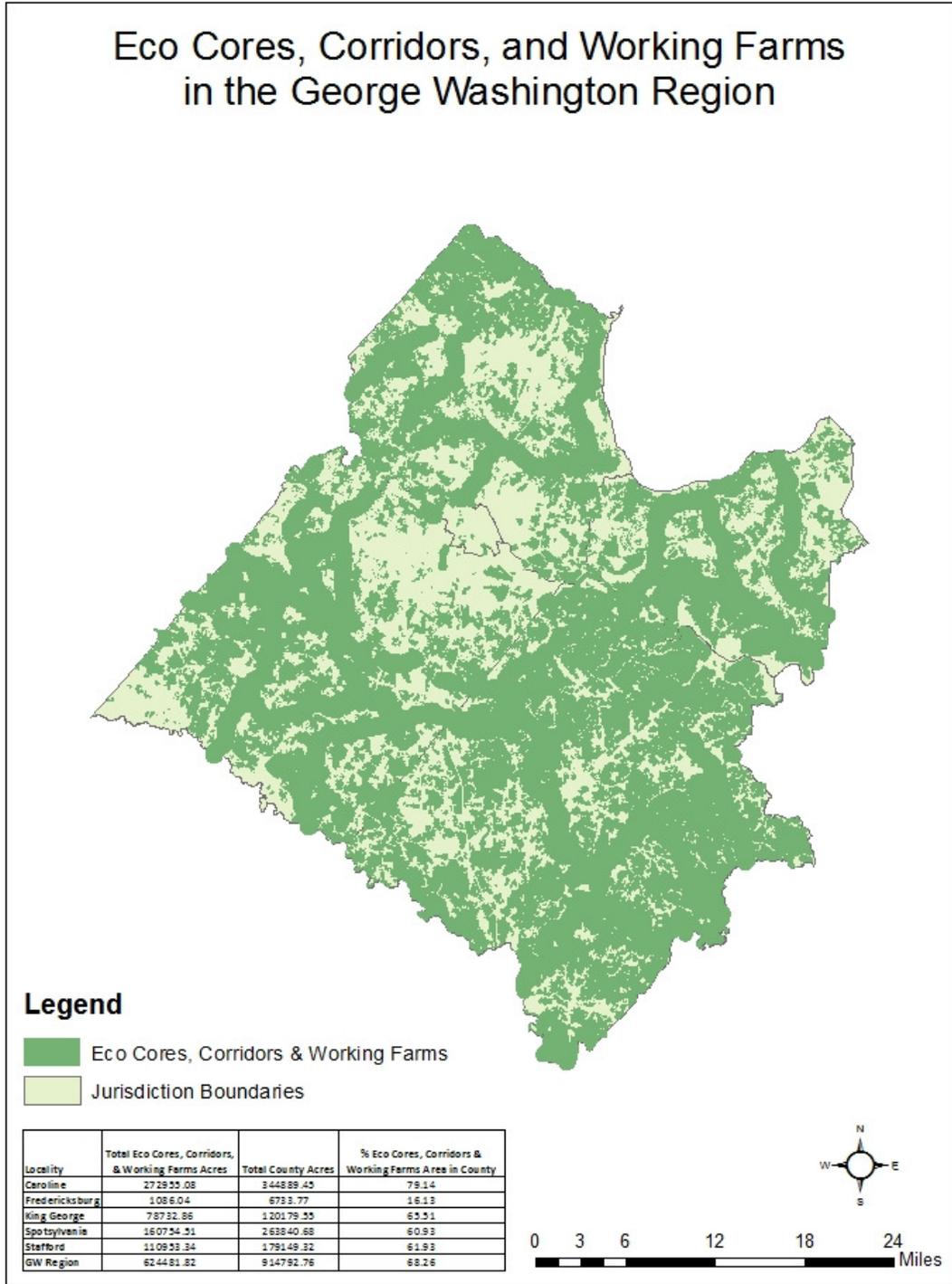
Working farms in the region do not exist as isolated entities. Most of the working farms are spatially connected to other working farms. This connection increases the area of contiguous open space, which is an important element of green infrastructure.

Map 2.



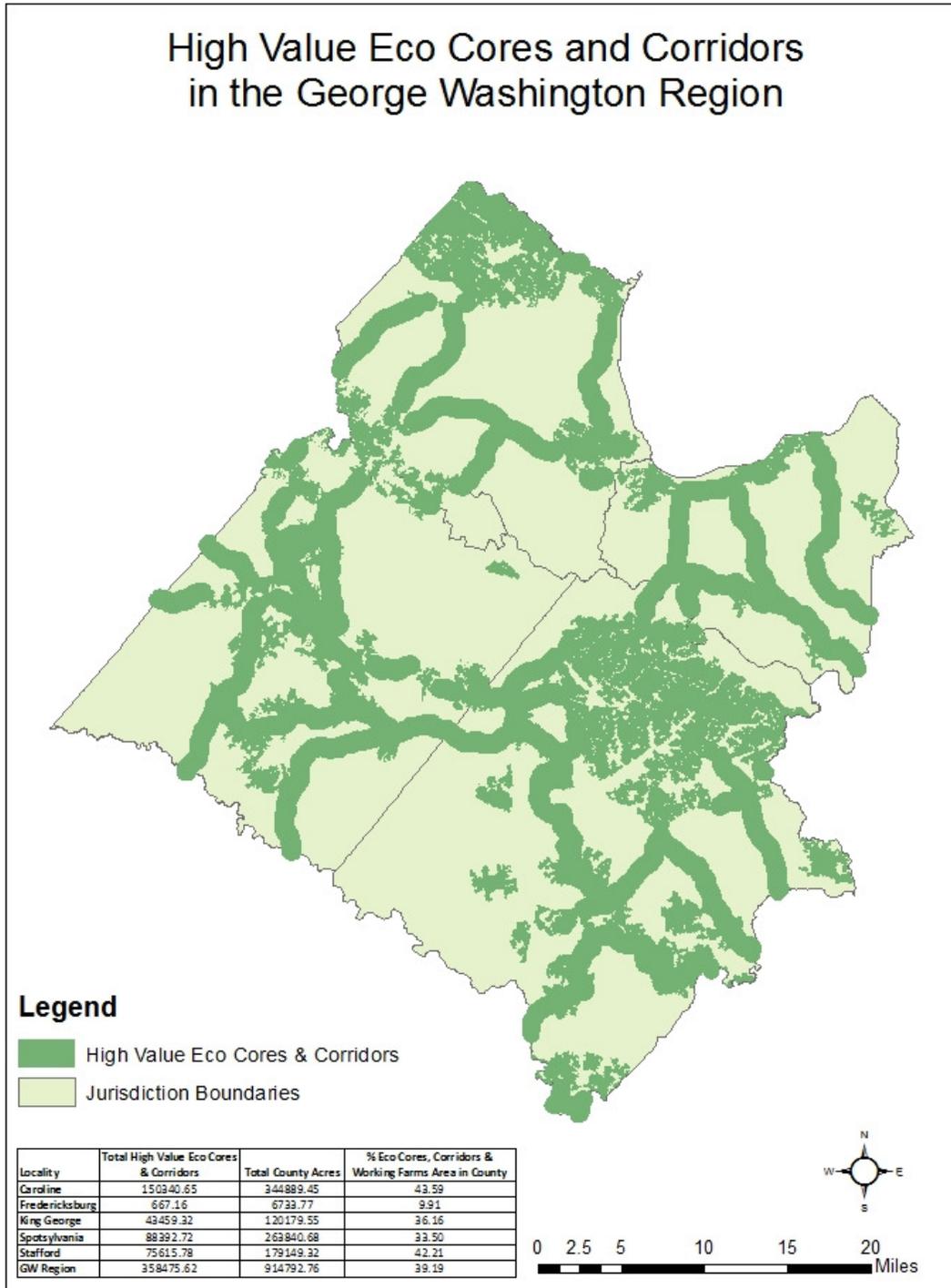
Green infrastructure components cover most of the region. The area of medium value cores is much larger than the area of the high value cores throughout the region. However, high value cores provide larger contiguous areas of green infrastructure when compared to the medium value cores.

Map 3.



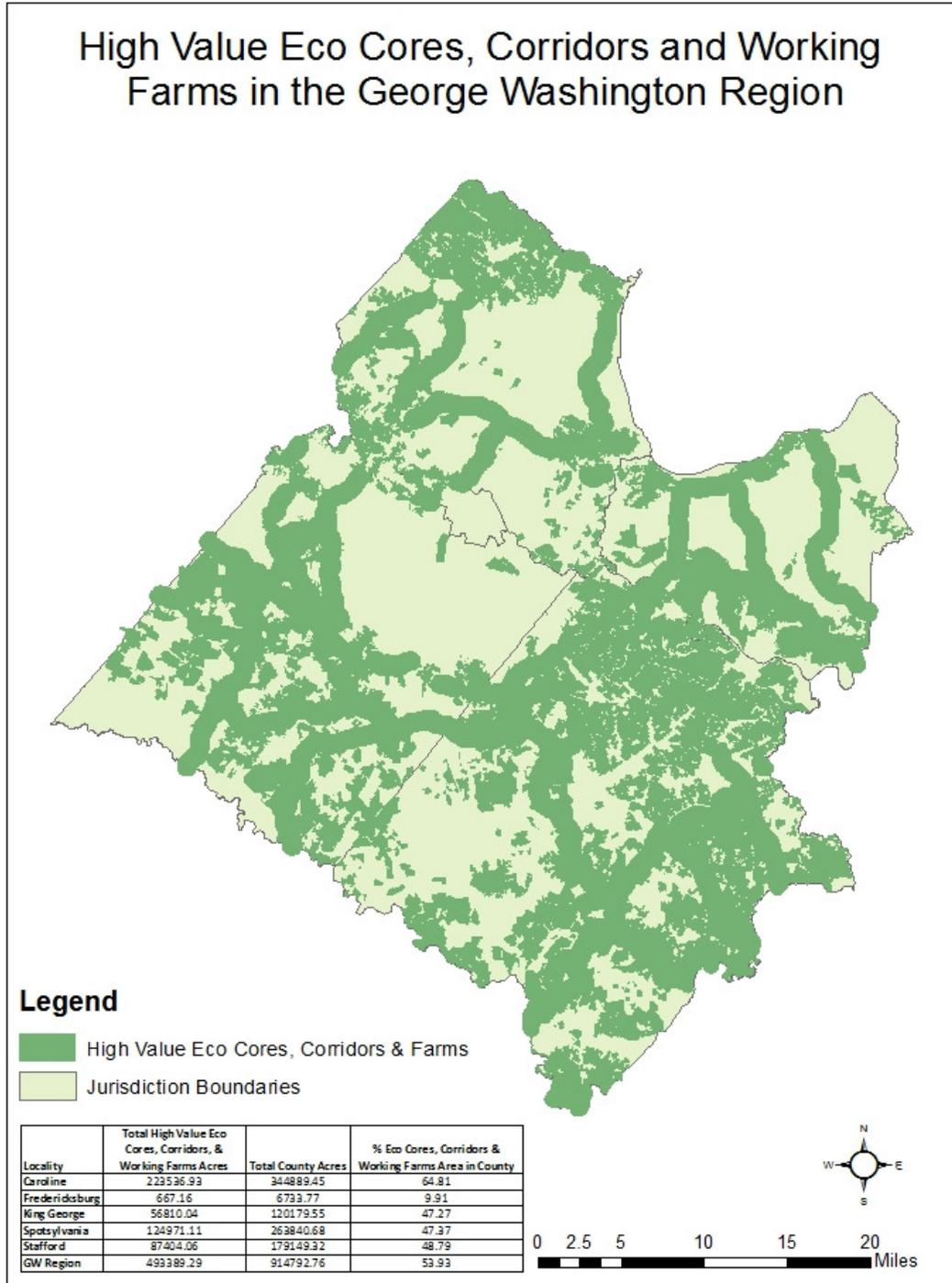
Nearly 70% of the region is covered by green infrastructure components when working farms are added to the green infrastructure footprint. The addition of working farms increases the contiguous areas of open space.

Map 4.



The high value cores and corridors represent the most important components of green infrastructure. The high value cores have high ecological integrity and the corridors allow for the transport of people, pollen and animals between the areas of high ecological integrity. About 40% of the region is covered by these critical components.

Map 5.



Adding working farms to the high value eco cores and corridors increases the area of green infrastructure in the region. The largest additions are in Caroline and Spotsylvania County. Adding working farms to the high value eco cores and corridors increases the green infrastructure area by 15% across the region.

Tables

This section includes tables that show the acreage and percent area of green infrastructure in each locality and in the region as a whole.

Table 1. Working Farms in the George Washington Region

Locality	Total Working Farms Acreage	Total Local Acreage	Percent of Local Area in Working Farms
Caroline	116,528.12	344,889.45	33.79
Fredericksburg	0.00	6,733.77	0.00
King George	21,687.75	120,179.55	18.05
Spotsylvania	67,070.05	263,840.68	25.42
Stafford	15,826.79	179,149.32	8.83
George Washington Region	221,112.71	914,792.76	24.17

Caroline County possesses the largest area of working farms in the region. Caroline County also has the highest percent area of working farms in a single locality, with a third of the county being comprised of working farms. Working farms are an important component for green infrastructure in Caroline County. In addition to preserving the rural character of the county, working farms contribute to the acreage of open space.

Fredericksburg City does not have any working farms in its jurisdiction; consequently, working farms are not a component of Fredericksburg City's green infrastructure.

Nearly a fifth of the area in King George County is in working farms. This acreage of working farms is not the main component of green infrastructure in the county, but it adds a noteworthy amount of area to the County's green infrastructure asset.

A quarter of the area of Spotsylvania County is in working farms. Spotsylvania is the second largest jurisdiction, in terms of total land area, and has the second highest amount of acreage in working farms compared to the other localities in the region. Working farms in Spotsylvania make an important contribution to the County's green infrastructure asset.

Less than 10% of the area of Stafford County is in working farms. Stafford County, like Fredericksburg City, is more urbanized and includes less acreage of working farms as compared to the other localities in the region.

Table 2. Eco Cores, Corridors and Working Farms in the George Washington Region.

Locality	Total Eco Cores (high & medium value), Corridors, & Working Farms Acres	Total Jurisdictional Acreage	Percent Eco Cores (high and medium value), Corridors & Working Farms Area in Locality
Caroline	272,955.08	344,889.45	79.14
Fredericksburg	1,086.04	6,733.77	16.13
King George	78,732.86	120,179.55	65.51
Spotsylvania	160,754.51	263,840.68	60.93
Stafford	110,953.34	179,149.32	61.93
George Washington Region	624,481.82	914,792.76	68.26

This table adds the high and medium value eco cores and corridor areas to the working farms areas that were totaled in Table 1.

Nearly eighty percent of the area in Caroline county is covered with green infrastructure, which includes the acreage of high and medium value cores, corridors, and working farms. Caroline County has the highest percent area of green infrastructure components compared with the other localities in the region.

Fredericksburg city does not have any area of working farms in the locality, so the total acreage of green infrastructure components in Table 2 indicate just the eco cores and corridors. Less than 20% of the City has green infrastructure components.

Over 60% of the area in King George, Spotsylvania, and Stafford Counties is covered with green infrastructure. Less than 20% of the area of King George and Stafford Counties is covered with working farms. These two counties have significant areas of other green infrastructure components.

Table 3. High Value Eco Cores and Corridors in the George Washington Region

Locality	Total High Value Eco Cores & Corridors	Total Jurisdictional Acreage	Percent Eco Cores & Corridors Area in Locality
Caroline	150,340.65	344,889.45	43.59
Fredericksburg	667.16	6,733.77	9.91
King George	43,459.32	120,179.55	36.16
Spotsylvania	88,392.72	263,840.68	33.50
Stafford	75,615.78	179,149.32	42.21
George Washington Region	358,475.62	914,792.76	39.19

Table 3 shows the high value green infrastructure in the region. Nearly 40% of the region is covered with high value green infrastructure.

Fredericksburg City has the lowest percent area of high value green infrastructure, with less than 10% of the locality area. The other localities in the region have at least 30% of the locality area comprised of high value green infrastructure.

Table 4. High Value Eco Cores, Corridors and Working Farms in the George Washington Region

Locality	Total High Value Eco Cores, Corridors, & Working Farms Acres	Total Jurisdictional Acreage	Percent Eco Cores, Corridors & Working Farms Area in Locality
Caroline	223,536.93	344,889.45	64.81
Fredericksburg	667.16	6,733.77	9.91
King George	56,810.04	120,179.55	47.27
Spotsylvania	124,971.11	263,840.68	47.37
Stafford	87,404.06	179,149.32	48.79
George Washington Region	493,389.29	914,792.76	53.93

When working farm area is added to the high value green infrastructure components, the green infrastructure of the region increases (from about 40% to about 54%). This increase demonstrates how the acreage and spatial distribution of working farms can help the region enhance its green infrastructure “footprint”.

More than half of the region is covered with high value green infrastructure and working farms.

Comparison to Urban Ecosystem Analysis

The *Urban Ecosystem Analysis for the George Washington Region (PD16)* document details the area in acres of tree canopy for each of the five localities. In addition, the report emphasizes the economic value of the tree canopy cover associated with the removal of air pollutants, stormwater control, and carbon storage/sequestration. By comparing the acreage of canopy area and impervious surface area to the working farms acreage, the benefit of working farms in the region can be realized.

In all of the localities, the canopy area is larger than the area of working farms. Together, these land covers contribute to the pervious land in the region. Impervious surfaces increase the amount and speed of water runoff after precipitation events. This water flows into storm drains and local streams carrying pollutants such as nitrogen and phosphorus. Pervious surfaces, such as land covered with trees (canopy area) and working farms, allow precipitation to infiltrate and replenish the groundwater supply.

Table 5. Canopy Area, Impervious Surfaces, and Working Farms Acreage in the George Washington Region

Locality	2009 Acres				2009 Population ¹
	Total Acres	Canopy Area (Acreage)	Impervious Surfaces (Acreage)	Working Farms (Acreage)	
Caroline	344,889.45	269,203.60	4,680.60	116,528.12	28,245
Fredericksburg	6,733.77	2,113.60	3,203.70	0.00	22,902
King George	120,179.55	80,402.20	3,660.90	21,687.75	23,891
Spotsylvania	263,840.68	186,014.20	13,025.00	67,070.05	121,809
Stafford	179,149.32	121,619.40	15,736.10	15,826.79	125,892
George Washington Region	914,792.76	659,245.40	40,336.50	221,112.71	322,739

¹University of Virginia, Weldon Cooper Center for Public Service, *Local Population Estimates*, 2009.

In all localities that have working farms, the working farms acreage is larger than the impervious surface acreage. Working farms provide open pervious spaces that enhance the infiltration of precipitation and runoff water in the region. When studying the impervious surfaces of the region, it is important to look at the areas that allow water to infiltrate. The canopy area represents forested land areas. The canopy area does not represent all of the pervious land areas. Working farms provide over 200,000 acres of additional pervious surface in the region.

The Census of Agriculture & Economic Value

The Census of Agriculture is conducted every five years by the United States Department of Agriculture (USDA) to account for all of the U.S. farms and ranches. The Census is conducted by mailing report forms to farm and ranch operators. The 2007 Census of Agriculture defines a farm as “any place from which \$1,000 or more of agricultural products were produced or sold, or normally would have been sold, during the Census year”.²⁰

²⁰ United States Department of Agriculture (2011). *2007 Census Publications: Getting Started*. Retrieved July 2011, from The Census of Agriculture: http://www.agcensus.usda.gov/Publications/2007/Getting_Started/index.asp

Farms in the George Washington region have real economic value. The Census of Agriculture 2007 report for each locality indicates the Market Value of Products Sold during that year.²¹ These values are shown below in Table 7. Fredericksburg City did not have any farms reported in the 2007 Census and does not have an associated report.

Table 7. Economic Value of Farms

Locality	Total Local Acreage	2007 Agriculture Census Farm Acreage	Market Value of Products Sold (2007)
Caroline	344,889.45	55,544.00	\$10,760,000
King George	120,179.55	36,723.00	\$4,461,000
Spotsylvania	263,840.68	52,230.00	\$8,218,000
Stafford	179,149.32	19,816.00	\$2,798,000
George Washington Region	914,792.76	164,313.00	\$26,237,000

In 2007, more than twenty-six million dollars of agricultural products were produced in the George Washington Region. Caroline County had the largest area of farms in 2007 and had the highest market value of products sold in that same year. As the acreage decreases in the other localities, the market value of products sold also decreases.

In addition to contributing to open space in the region, farmland adds to the local economy.

Ecosystem Services

Ecosystem services are the benefits people derive from ecosystems. Farms are a type of ecosystem that can provide benefits to people. Ecosystem services provided by farms can be profitable to agricultural producers when an environmental market exists.

The American Farmland Trust published a report, *Guide to Environmental Markets for Farmers and Ranchers*, which details how agricultural producers can benefit from the growing environmental marketplace.²² The report details the current status of several environmental markets including: greenhouse gas markets, wetland, habitat and biodiversity markets, water quality markets, water quantity markets and renewable energy markets. Agricultural producers have an opportunity to profit from the ecosystem services that their land provides.

Ecosystem services markets may be a key component in preserving farm acreage in the region. These markets will increase the value of farmland and allow farms to remain profitable. Maintaining the acreage of farmland is important for the region's green infrastructure.

Conclusion

The addition of working farms substantially increases the acreage of green infrastructure in the Region. Working farms are a valuable asset because they contribute open space. It is important that the George Washington region include the consideration and inclusion of working farms as part of its green infrastructure planning. Because nearly a quarter of the region is covered in working farms, working farms are important to the regional and local economies and efforts to reduce development pressure on working farms should be

²¹ United States Department of Agriculture (2011). *2007 Census Publications*. Retrieved July 2011, from The Census of Agriculture: http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/County_Profiles/Virginia/index.asp

²² Stuart, Don, Canty D., Killebrew, K. (2010). *Guide to Environmental Markets for Farmers and Ranchers*. Accessed electronically: <http://www.farmland.org/documents/GuidetoEnvironmentalMarketsforFarmersandRanchers.pdf>.

encouraged. Loss of the area of working farms in the region would cause significant reductions in the green infrastructure asset of the region.

Working farms are most important in Caroline, King George and Spotsylvania Counties because they add at least 10% green infrastructure to the high value green infrastructure (high value cores and corridors) in each locality respectively. These localities should consider focusing resources to protect these areas to ensure that they can continue to benefit from the ecological and economic functions of working farms in the future. Caroline County has already adopted one such measure by creating an Agricultural Preservation District as part of their Zoning Ordinance. The district is “intended to encourage economic development and to preserve farmland by providing for the viability of the County’s agricultural sector by encouraging the orderly and responsible growth of its livestock, dairy and poultry industry.”²³ Ordinances such as these ensure the preservation of farmland, and therefore open space.

Fredericksburg City does not have any working farms. Stafford County has less acreage and percent area working farms compared to the other localities. While working farms are not as important in these localities, the open space that they provide is a community asset that could be encouraged and preserved to avoid either community become more “urban” in character and retain some “rural” open space characteristics.

²³ County of Caroline (1995, March 28). *Article 5 Agricultural Preservation District (AP)*. Retrieved June 28, 2011, from Caroline County Zoning Ordinance: <http://www.co.caroline.va.us/zarticle5.pdf>

Sources and EndNotes:

American Planning Association, Virginia Chapter. "[Managing Growth and Development in Virginia: A Review of the Tools Available to Localities](#)". 2010, at:

Arendt, Randall. [Conservation Design for Subdivisions: A Practical Guide to Creating Open Space Networks](#). Island Press, Washington, DC., 1996.

ⁱBenedict, Mark A. and Edward T. McMahon. [Green Infrastructure: Linking Landscapes and Communities](#). 2006. The Conservation Fund.

Fredericksburg Area Metropolitan Planning Organization (FAMPO), [Your Vision, Our Future: Regional Land Use Scenario Study](#), 2009 – 2011, at: (<http://www.fampo.gwregion.org/transportation-planning-documents/regional-land-use-scenario-planning/>)

Friends of the Rappahannock, [Children and Nature Guide](#) and [Passport to the Central Rappahannock](#), found at: <http://www.riverfriends.org/Publications/PassporttotheCentralRappahannock/tabid/557/Default.aspx>

GWRC, [2009 Green Infrastructure and Conservation Corridors Maps](#), 2009.

GWRC, [Urban Ecosystem Analysis for the George Washington Region \(PD 16\), Calculating the Value of Nature](#), 2010.

GWRC, [Estimating Impervious Surface Area: A Comparative Assessment of CITYgreen and NOAA's Impervious Surface Analysis Tool \(ISAT\) Methodologies](#), 2010.

GWRC Member Local Government [Websites](#) and local governments' [Code of Ordinances](#).

Perkiomen Watershed Conservancy, [Stormwater Glossary](#), <http://www.greenworks.tv/stormwater/glossary.htm>

Rappahannock River Basin Commission. [Local Perspectives on Stormwater Management](#), Presentation to RRBC, September 14, 2011.

Virginia Department of Conservation and Recreation website, specifically:

- http://www.dcr.virginia.gov/stormwater_management/index.shtml
- <http://www.dcr.virginia.gov/documents/lrNutrientTradingInTheStateOfVirginia.pdf>
- http://www.dcr.virginia.gov/recreational_planning/srmain.shtml

Virginia Department of Transportation website, specifically: <http://www.virginiadot.org/programs/prog-byways.asp>

U.S. EPA, [Managing Wet Weather with Green Infrastructure: Action Strategy, 2008](#) found at: <http://nepis.epa.gov/EPA/html/DLwait.htm?url=/Adobe/PDF/P1008SI8.PDF>

U.S. EPA, [Menu of Stormwater Management Best Management Practices](#) (BMPs), found at: <http://cfpub.epa.gov/npdes/stormwater/menuofbmps/>

**Digital Files (.shp format) of Recommended Regional Green Infrastructure Plan
(on enclosed disk)**

Product #2: Summary of Local Government and Regional Stakeholder Comments on Regional Green Infrastructure Plan

Attachment 2.1

Local Planning Commission meeting minutes

A. Excerpt of Spotsylvania Co. Planning Commission Minutes, March 16, 2011

Presentation by George Washington Regional Commission Staff on the GWRC Regional Green Infrastructure Plan

Ms. Laurel Hammig, Senior Regional Planner with GWRC presented the plan. She stated that the George Washington Region has experienced the most rapid population growth of any region in the Commonwealth for two decades.

She explained that Green Infrastructure is an interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains air and water, and provides a wide array of benefits to people and wildlife.

Ms. Hammig stated that the Regional Green Infrastructure Plan has the following goals:

- To come to a common understanding on green infrastructure's value.
- To provide new and enhanced tools and information to individual property owners, development and conservation interests, local governments' jurisdictions, and other stakeholders to use to make land decisions.
- To maintain natural landscapes that protect green infrastructure, ensure the health, safety, and welfare of the community, and save money.

She explained that Green Infrastructure provides the following economic benefits:

- Provide healthy food
- Provide jobs
- Support Tourism
- Support local manufacturing
- Increase surrounding property values
- Manage Stormwater cost-effectively when compared to engineered solutions.

Ms. Hammig stated that Green Infrastructure provides the following social benefits:

- Improves public health
- Enhances childhood intellectual and emotional development
- Reduces childhood obesity
- Improves fitness by access to recreation
- Stronger family network

Ms. Hammig stated that Green Infrastructure provides the following environmental benefits:

- Natural storm water retention
- Reduce the erosion of precious top soil
- Absorb pollutants in surface storm water
- Provide recreational hunting opportunities
- Positive impact on regional air quality

She stated that Spotsylvania County has 263,971 acres and that there are 168,014 acres of tree

canopy. The total percent of land area with tree canopy is 70.5%. Ms. Hammig displayed several slides showing the trends from 1996-2009.

She stated that the benefits and uses of a Green Infrastructure Plan are the following:

- A tool for community growth management, comprehensive planning, land conversion planning, hazard mitigation planning
- Aid localities with target parkland acquisition
- Aid in analyzing potential PDR and TDR sites, Urban Development Areas, and conservation easements
- Used for meeting water quality goals
- Supports other regulatory programs such as EPA TMDLs and the Chesapeake Bay Preservation Act

Ms. Hammig stated that the next steps are the following:

- Work with steering committee to review and synthesize local planning commission reaction
- Draft Regional Green Infrastructure Plan document
- Presentations to local interest groups
- Final presentations to local Planning Commissions
- Revisions as necessary
- Final presentation to the Green Government Commission and the George Washington Regional Commission (September 2011)

Mr. Vaughan stated that he would like for the County to work with developers on how to preserve and maintain as much green space as possible.

Ms. Hammig stated that there is software that can be used to quantify, but really only works on large parcels.

Mr. Vaughan stated that this should really be used during the planning process.

B. Excerpt of King George Co. Planning Commission Meeting Minutes, April 12, 2011

Green Infrastructure Planning Presentation

Kevin F. Byrnes, GWRC Director of Regional Planning, presented the Green Infrastructure Planning Presentation.

Mr. Cox asked if they have any statistics of the percentage of land area used and Mr. Byrnes replied that they do have rough estimates for farm areas.

Mr. Kendrick asked if the end product of this would be a regional plan or would they try to adopt it as a county plan. Mr. Byrnes replied that it would be a regional plan. Mr. Kendrick also asked if they had any ideas or suggestions and Mr. Byrnes replied that they saw many opportunities for green infrastructure.

Mr. Colwell asked if they were using modeled numbers. Mr. Byrnes replied yes and that the numbers were collaborated and tested with the GIS system.

Mr. Fulcher asked if by green, did they mean only trees? Mr. Byrnes said green could also mean open fields, farms, managed space or undeveloped space.

Mr. Eschmann asked if erosion would have an impact on the green infrastructure and Mr. Byrnes said they would want to put buffers on the shorelines to compliment the infrastructure.

Ms. Frank asked for one or two examples of how green infrastructure would provide jobs. Mr. Byrnes said that it would encourage the preservation of farm jobs and other jobs that are supported and sustained by farming.

Ms. Herrink stated that the numbers did not go together and asked what exactly the numbers mean. Mr. Byrnes said he could send a report to Jack (Planning Director Jack Green) to better explain what the numbers mean.

Mr. Fulcher stated that the economic costs seems very high based on the numbers given. Mr. Byrnes said he could get them more background for the concept of green infrastructure.

C. Excerpt of City of Fredericksburg Planning Commission Meeting Minutes, April 13, 2011

PRESENTATION: A presentation was provided by Laurel Hammig, George Washington Regional Commission regarding green infrastructure.

D. Spotsylvania Co. Committee of 500 Meeting: June 5, 2011

Program Theme: What Kind of Community Do We Want? Where Do We Invest?

- Green Infrastructure: Kevin Byrnes, Director of Regional Planning, GWRC (George Washington Regional Commission), [*The Uses and Benefits of Green Infrastructure Planning*](#)

Committee of 500 Report from Political Forums to Board of Supervisors, RE: Environment and Recreation

“...Another big issue for participants was the “greening” of Spotsylvania. Many expressed support for “Green Infrastructure Planning,” which a speaker from the George Washington Regional Commission (GWRC) had addressed. The GWRC is currently devising such a plan, which would provide for “an interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions.” Citizens saw many benefits in Green Infrastructure Planning, including improved air quality, tree protection, increased recreation in the form of hiking and biking trails, and a generally better environment. Some said that the GWRC should solicit input from landowners.

Citizens want environmental considerations to play a bigger role in how the county manages growth. Some believe that the county is allowing too much clustered development without proportionate green space and that developer proffers should include dedicating green space and preserving trees. In addition, green technology should be incorporated into new buildings and rehabs.

Regarding recreation, we need to improve facilities in order to reach the next level. The citizens’ wish list includes more sports fields, playgrounds, dog parks, camping and picnicking facilities, as well as general recreation facilities in rural areas. There is strong support for the Spotsylvania Greenways Initiative’s project to create a county-wide trail network.

People thought that the developer’s role in recreation should include providing both recreation facilities in new projects and trails connecting neighborhoods.”

Local Government Staff and/or NGO comments

1. King George County Community Development Director Jack Green (E-Mail 10/5/11)

“Good start. Would like more time to review; but, can offer the following.

Would like to see:

- Analysis of impervious area similar to what you did with Fredericksburg for King George – we (have) aerial photo at 4 foot contours.
- Example zoning/subdivision ordinance language for creation of green infrastructure corridors recommended in the plan. – you provide authority but not example language.

Seem to miss the fact that King George has adopted a residential cluster zoning component to county zoning ordinance (article 11 and a companion provision to the subdivision ordinance (Article 5). The County has three cluster subdivisions (Hopyard, Caledon Crossing, Serria Ridge) on the books and one other (Lake Caledon) approved but not yet recorded. (GWRC Note: Content added in final)

The County also promotes LID design within our subdivision ordinance (Section 8.3.9) by allowing the elimination of curb and gutter street design when LID is employed within the subdivision. The County has approved one subdivision that incorporated LID design (Potomac Landing Section III) which is currently being developed. (GWRC Note: Content added in final)

If you contact Kyle he can provide with a map and list of properties with conservation easements in the County – you may to include this information on one of your maps. (GWRC Note: Easements already included in VCLNA datasets from Virginia DCR-Natural Heritage Program and Greenprint scenario.)”

2. Stafford County Environmental Planner, Amber Forestier E-Mail (9/19/2011)

“Hi Kevin,

Steve Hubble gave me the final review draft last week and I re-wrote the entire Chesapeake Bay Preservation Act Compliance part for Stafford (on page 82) and I wasn’t sure who to forward it to....In the table on page 79, #2.c. about TNDs should be a triangle for Stafford as we have a TND ordinance.

“Stafford County adopted the Chesapeake Bay Preservation Act into County Code in 1994 through the adoption of Section 28-62 of the Zoning Ordinance – Chesapeake Bay Preservation Area Overlay District. The ordinance was modified in December of 2003 to require perennial flow studies on any streams associated with a development proposal. The Overlay District applies to the entire County, ensuring that all development meets the general performance criteria requirements in the Bay Act.

Stafford County ensures that all development plans are reviewed for compliance with the Chesapeake Bay, erosion and sediment control, storm water management and wetlands regulations. The County has a program which ensures that all septic systems in the County are required to be pumped-out every five years.

The County’s program has been found compliant with the Phase I (2004) and Phase II (2002) requirements of the Bay Act and was found to have adequate provisions to meet State requirements during an advisory Phase III review, conducted in 2009.”

Thanks,

Amber Forestier, Environmental Planner
Stafford County Planning & Zoning (540) 658-8668

Product #3: Summary of GWRC Action on Proposed Regional Green Infrastructure Plan

Attachment 3.1

Proposed GWRC Resolution



George Washington Regional Commission
406 Princess Anne Street
Fredericksburg, Virginia 22401
(540) 373-2890
Fax (540) 899-4808
www.gwregion.org

Bobby P. Popowicz
Chairman

Eldon James
Interim Executive Director

RESOLUTION NO. 12-07 ENDORING THE REGIONAL GREEN INFRASTRUCTURE PLAN

WHEREAS, the George Washington Regional Commission (“the Commission”) is the Planning District Commission serving the City of Fredericksburg and Caroline, King George, Spotsylvania and Stafford counties, known together as Planning District 16, and

WHEREAS, the Commission received funding in FY 2008-2009, 2009-2010 and 2010-2011 from the Virginia Coastal Zone Management Program to develop a regional Green Infrastructure Plan, and;

WHEREAS, the Commission staff, in consultation and collaboration with the Commission’s Green Government Commission Green Earth Sub-Committee, made up of local government planners, public works personnel and representatives of other community environmental interest groups, developed the Regional Green Infrastructure Plan presented to the Commission in Executive Summary form at the Commission’s September 19th meeting, and;

WHEREAS, the Regional Green Infrastructure Plan provides analytical tools and strategies to support local governments’ involvement in and response to Virginia’s Chesapeake Bay Watershed Implementation Plan-Phase 2 program; and,

WHEREAS, the Regional Green Infrastructure Plan is advisory in nature and respects local governments’ autonomy, while identifying regional assets within each community that, with cooperation among local governments, could be preserved or enhanced to maintain the Region’s high quality of life and natural areas and open space valued by the region’s citizenry.

NOW, THEREFORE, BE IT RESOLVED by the George Washington Regional Commission that it hereby approves and endorses the proposed Regional Green Infrastructure Plan and directs the staff to forward this document to: a) the Virginia Coastal Zone Management Program in fulfillment of the program’s grant requirements and b) to local governments and other stakeholders in Planning District 16 as a reference tool and guide to promote local consideration of green infrastructure planning as part of the local comprehensive planning and stormwater management planning process and related implementation programs.

Adopted by the George Washington Regional Commission at its duly called meeting of October 17, 2011, in the City of Fredericksburg, Virginia, a quorum being present.

October 17, 2011

Joseph W. Grzeika, Secretary



CAROLINE COUNTY

CITY OF FREDERICKSBURG

KING GEORGE COUNTY

SPOTSYLVANIA COUNTY

STAFFORD COUNTY

Adopted GWRC Resolution



George Washington Regional Commission
406 Princess Anne Street
Fredericksburg, Virginia 22401
(540) 373-2890
Fax (540) 899-4808
www.gwregion.org

Bobby P. Popowicz
Chairman

Eldon James
Interim Executive Director

RESOLUTION NO. 12-07

ENDORISING THE REGIONAL GREEN INFRASTRUCTURE PLAN

WHEREAS, the George Washington Regional Commission ("the Commission") is the Planning District Commission serving the City of Fredericksburg and Caroline, King George, Spotsylvania and Stafford counties, known together as Planning District 16, and

WHEREAS, the Commission received funding in FY 2008-2009, 2009-2010 and 2010-2011 from the Virginia Coastal Zone Management Program to develop a regional Green Infrastructure Plan, and;

WHEREAS, the Commission staff, in consultation and collaboration with the Commission's Green Government Commission Green Earth Sub-Committee, made up of local government planners, public works personnel and representatives of other community environmental interest groups, developed the Regional Green Infrastructure Plan presented to the Commission in Executive Summary form at the Commission's September 19th meeting, and;

WHEREAS, the Regional Green Infrastructure Plan provides analytical tools and strategies to support local governments' involvement in and response to Virginia's Chesapeake Bay Watershed Implementation Plan-Phase 2 program; and,

WHEREAS, the Regional Green Infrastructure Plan is advisory in nature and respects local governments' autonomy, while identifying regional assets within each community that, with cooperation among local governments, could be preserved or enhanced to maintain the Region's high quality of life and natural areas and open space valued by the region's citizenry.

NOW, THEREFORE, BE IT RESOLVED by the George Washington Regional Commission that it hereby approves and endorses the proposed Regional Green Infrastructure Plan and directs the staff to forward this document to: a) the Virginia Coastal Zone Management Program in fulfillment of the program's grant requirements and b) to local governments and other stakeholders in Planning District 16 as a reference tool and guide to promote local consideration of green infrastructure planning as part of the local comprehensive planning and stormwater management planning process and related implementation programs.

Adopted by the George Washington Regional Commission at its duly called meeting of October 17, 2011, in the City of Fredericksburg, Virginia, a quorum being present.

Handwritten signature of Joseph W. Grzeika, Secretary

October 17, 2011

Signed by Chair in absence of Secretary

