# *Final Report Accomack County Sustainable Community Project*

## Virginia Coastal Zone Management Program

Accomack County Department of Planning & Community Development

NOAA Grant: NA10NOS4190205

Grant Year 2010 Task 12.01

# Accomack County Sustainable Community Project

# Final Report

*February 2013*

*Prepared For:*

**Virginia Coastal Zone Management Program**

Virginia Department of Environmental Quality

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NOAA Grant No. NA10NOS4190205
Grant Year 2010
Task 12.01

# *Acknowledgements*

The following persons provided invaluable assistance in A-NPDC's Technical Assistance Projects:

Accomack County  Staff – Rich Morrison, Tom Brockenbrough, Norman Pitt, Rob Testerman, Hollis Fate, David Fluhart, Jim McGowan

Virginia Coastal Zone Management Program – Laura McKay, and April Bahen

Green Infrastructure Center – Karen Firehock

The students of the Fall 2011 Green lands Class at the University of Virginia School of Architecture

*On the cover – Photograph of Chincoteague National Wildlife Refuge and Assateague Lighthouse from across Chincoteague Channel.*



*This project was funded 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.*

# Introduction

During 2009 and 2010 Accomack County worked with the Green Infrastructure Center (GIC) to develop the Accomack County Blue & Green Infrastructure Study. This current grant built on that earlier work to create a development guide minimizing impacts on blue and green infrastructure and web page. The guide and web page will help the development community and the public to learn about Accomack's blue and green infrastructure assets and how to protect them through improved development practices such as clustering and low impact development. Accomack County also integrated sustainable community information into a draft comprehensive plan element that is being utilized as part of the current comprehensive plan update as well as into the County's web site by preparing information on sea level rise, alternative energy, the Chesapeake Bay Preservation Act, Erosion and Sediment Control, and Stormwater Management.

As part of this grant Federal expenditures of $34,846.60 were matched with local funds totaling $35,046.55. In addition, $26,834 was leveraged from the efforts of University of Virginia students.

# Activities/Deliverables

The following sections describe the activities completed during the grant period by Accomack County.

1. **Blue & Green Infrastructure Guide** – Accomack County developed a Blue & Green Infrastructure Guide explaining the County's blue and green infrastructure, how to preserve it during the development process by using cluster development provisions of the Accomack County Zoning Ordinance, and low-impact development.
2. **Blue & Green Infrastructure Web Page** – Accomack County developed a Blue and Breen Infrastructure Web Page explaining blue and green infrastructure and how to conserve it using clustering options and implementing elements of low-impact

development. The page includes links to additional resources on blue and green infrastructure and low impact development resources.

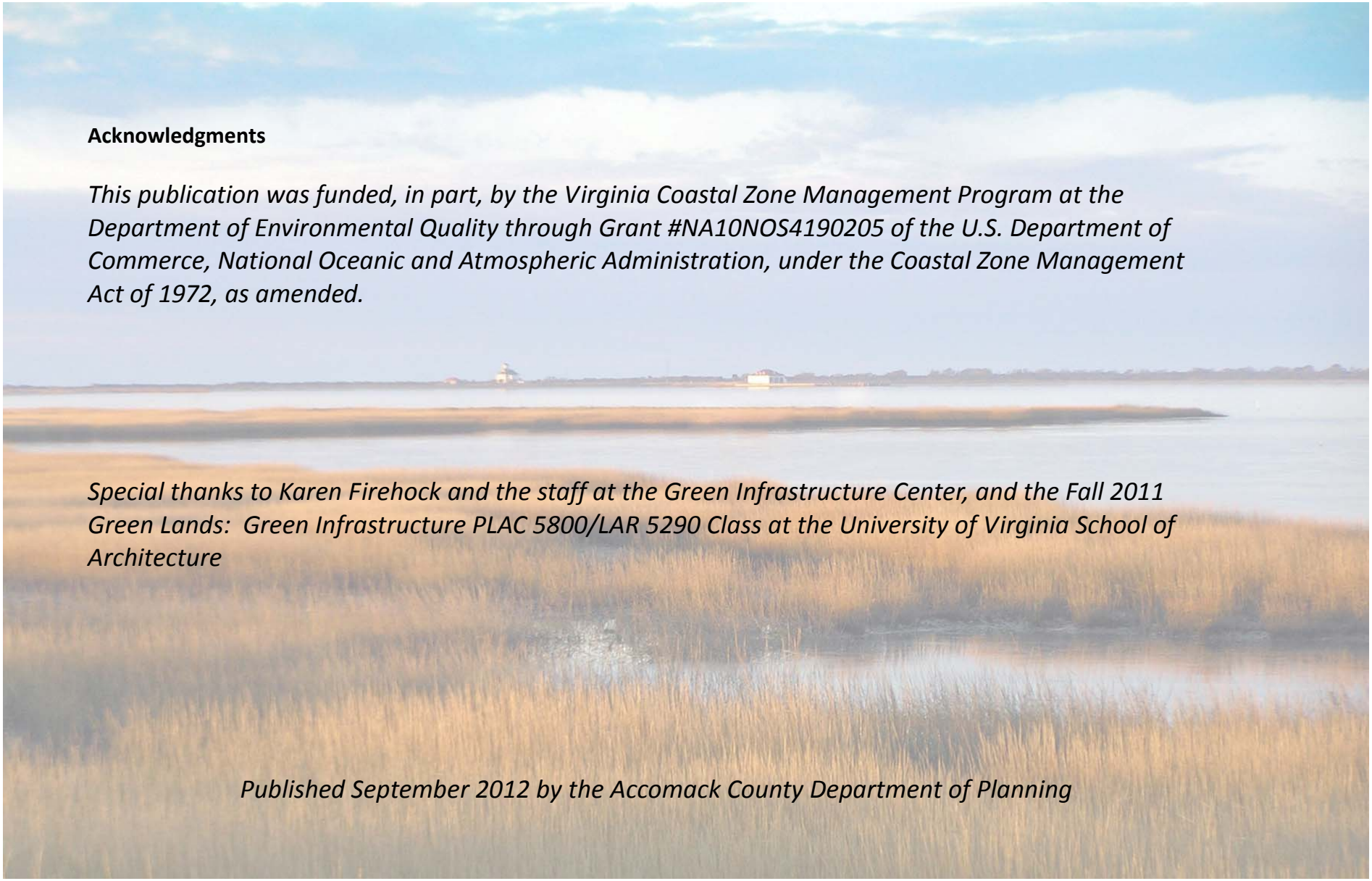
3. **Blue & Green Infrastructure Development Workshop Report** – Accomack County planned and conducted a workshop focusing on Accomack's blue and green infrastructure and how to protect it during the development process by utilizing clustering options available via the Accomack County Zoning Ordinance as well as elements of low-impact development.
4. **Sustainable Community Comprehensive Plan Element** – Accomack County staffed developed a draft Sustainable Community Comprehensive Plan Element integrating sustainable community information on Sea Level Rise, Alternative Energy, Chesapeake Bay Preservation Act, Erosion and Sediment Control, and Stormwater Management.
5. **Sustainable Community Web Pages** – Accomack County updated the Department of Planning and Community Development web pages to integrate sustainable community information on Sea Level Rise, Alternative Energy, the Chesapeake Bay Preservation Act, Erosion and Sediment control, and Stormwater Management. These pages include links to other sustainable community resources.
6. **Sustainable Community Workshop Report** – Accomack County planned and conducted a Sustainable Community Workshop which focused on sustainable community information developed to update the Comprehensive Plan and Departmental web pages on sustainable community elements.

## Deliverable 1. Blue and Green Infrastructure Guide

Item(s) included:

- Blue and Green Infrastructure in Accomack County

# BLUE AND GREEN INFRASTUCTURE IN ACCOMACK COUNTY



**Acknowledgments**

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*Special thanks to Karen Firehock and the staff at the Green Infrastructure Center, and the Fall 2011 Green Lands: Green Infrastructure PLAC 5800/LAR 5290 Class at the University of Virginia School of Architecture*

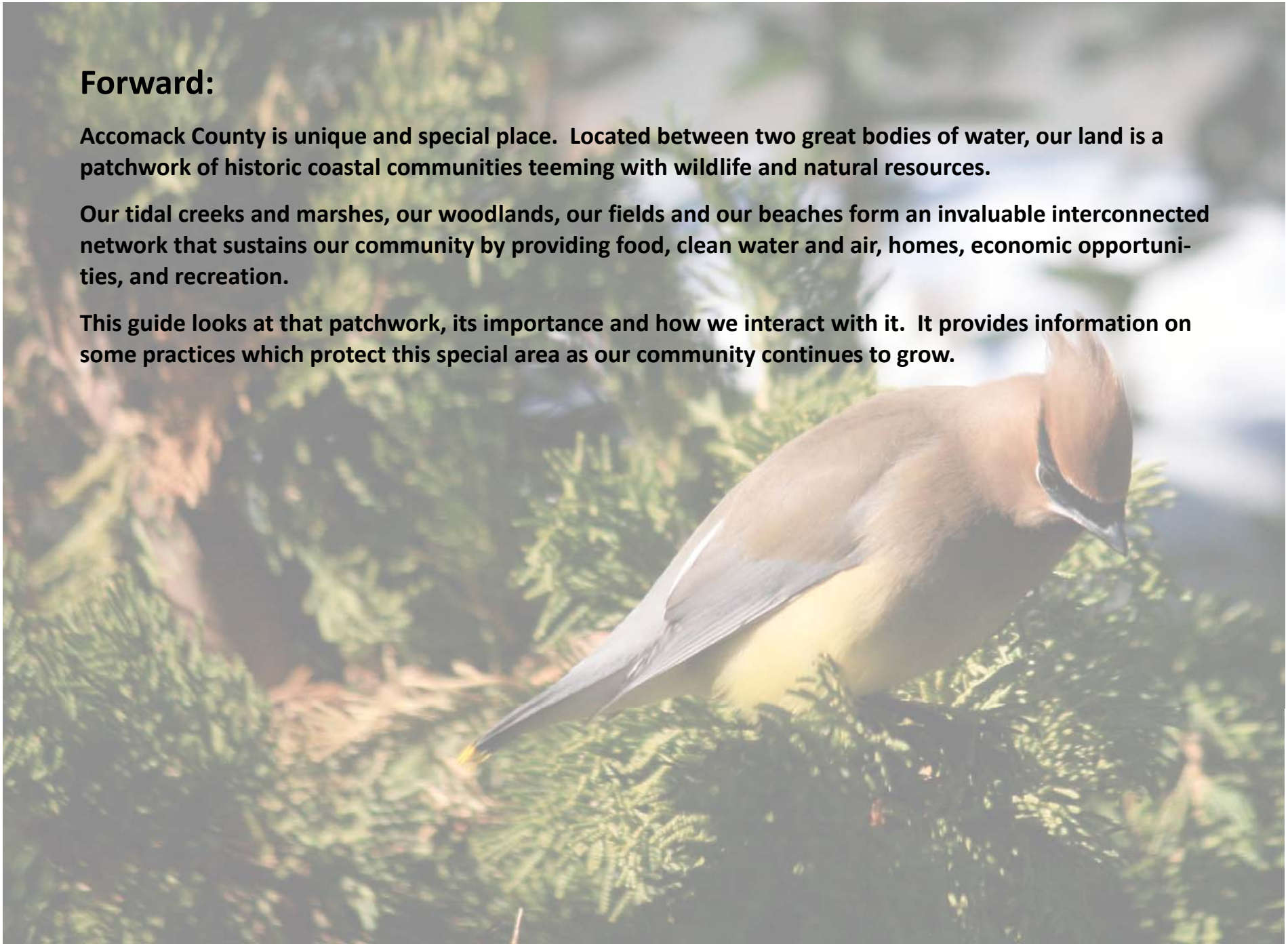
*Published September 2012 by the Accomack County Department of Planning*

Virginia Coastal Zone MANAGEMENT PROGRAM

NOAA

Green Infrastructure Center

COUNTY OF ACCOMACK VIRGINIA



## Forward:

**Accomack County is unique and special place. Located between two great bodies of water, our land is a patchwork of historic coastal communities teeming with wildlife and natural resources.**

**Our tidal creeks and marshes, our woodlands, our fields and our beaches form an invaluable interconnected network that sustains our community by providing food, clean water and air, homes, economic opportunities, and recreation.**

**This guide looks at that patchwork, its importance and how we interact with it. It provides information on some practices which protect this special area as our community continues to grow.**

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# Table of Contents

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***What is Blue and Green Infrastructure?***

When we think of infrastructure, we think of the man-made structures and items that allow us to move around goods and services and work. These can be our roads and bridges, our airports and railroads, water and sewer lines. Other assets that exist as part of our infrastructure include landfills, schools, police, fire and rescue services; all items that we need in a complex society in order to sustain and grow. Since these items are focused on the built environment, this type of infrastructure is also commonly referred to as grey infrastructure.

***Green Infrastructure*** has a wide range of definitions. Most definitions focus that green infrastructure is based on a combination of the landscape, of biodiversity, or as nature-based alternatives to gray infrastructure.

Green infrastructure takes the approach that certain lands have value that are made even greater when part of a network as defined by The Conservation Fund:

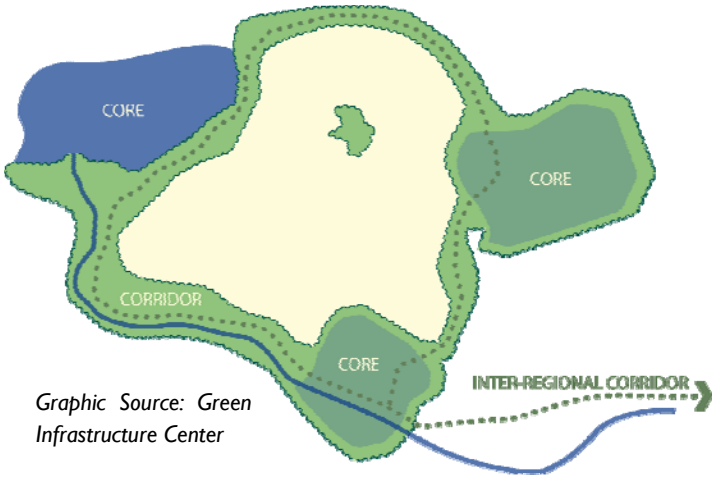
> *Strategically planned and managed networks of natural lands, working landscapes, and other open spaces that conserve ecosystem values and functions and provide associated benefits to human populations.*

The foundation of a green infrastructure network consists of the woodlands, wetlands, creeks, and pastures that work together to maintain and sustain ecological functions. It also includes agricultural working lands, trails and other recreational features, and cultural and historic sites. These areas form a connection of natural systems and ecological processes that provide critical functions such as rich soils for farming, habitat for wildlife, drinking water storage and filtration, and clean air.

While the more common term is "Green Infrastructure," we've used the terms "Blue and Green" or "Blue/Green" infrastructure interchangeably to highlight the importance of bays and oceans, tidal creeks and marshes on our local network.

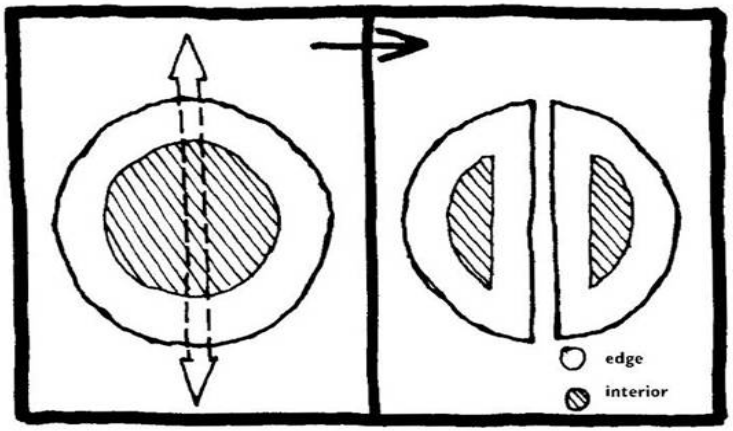
Accomack's green infrastructure links to and supports historic and cultural resources which provide opportunities for hunting, hiking, horseback riding, and bird watching. The County's blue infrastructure supports the rich fisheries economy, tourism, and aquatic recreation opportunities.

On a grand, macro scale, blue and green infrastructure planning connects intact larger natural habitats such as wetlands and forests (also known as ***hubs*** or ***cores***) through a network of ***corridors*** such as a steam corridor to allow people, wildlife, and plants to move across the landscape between cores. The system manages stormwater, reduces flooding, and improves water quality naturally instead of relying on man-made features to perform the same function at a much greater cost.




*Graphic Source: Green Infrastructure Center*

Cores need to be at least 100 acres in order for interior species to thrive. When a core is removed or a corridor is disrupted such as through roads and development, connectivity is lost resulting in fragmentation of the natural system. A connected landscape benefits natural systems by keeping habitats connected so that animals, plants, seeds, and pollinators can reach areas needed to survive and propagate. Disconnected habitats can weaken a species. If population numbers drop in one area and the species is isolated from other areas, the species can lose genetic diversity and face extinction in that area. A connected landscape provides a more resilient ecosystem and is also important for human recreational activities.




*Graphic Credit: Dramstad, Wenche E., et al. Landscape Ecology Principles in Landscape Architecture and Land Use Planning. Washington D.C., Island Press, 1996.*

*Delmarva Fox Squirrel. Image Source: Chincoteague National Wildlife Refuge*

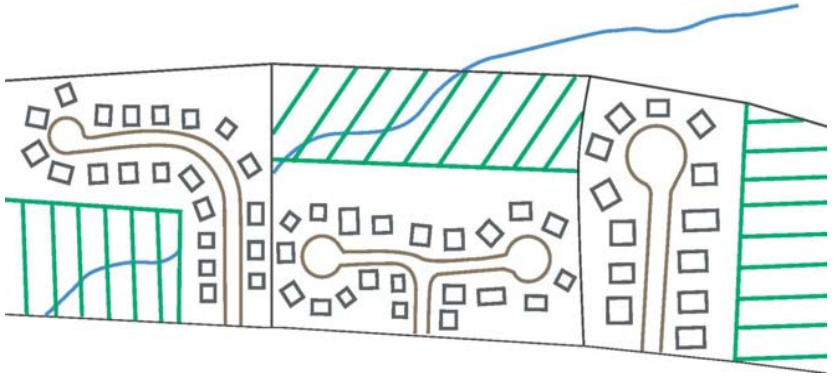
**Blue and Green Infrastructure and Development**

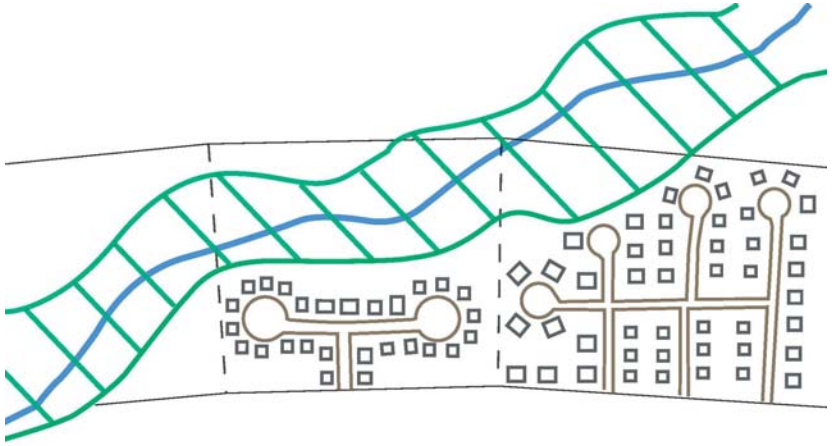
The rate at which Accomack has been developing land is faster than our population growth. The period from 2000 until 2010 saw a period when the County's population remained relatively flat while there was an huge increase in new homes and residential lots. Part of this is a result of national trends where land development is outpacing population growth due to sprawl but another part of this is due to the attractions provided by our proximity to the Atlantic Ocean and the Chesapeake Bay as well as the natural environment provided by our blue and green infrastructure.

As of 2012, one-third of all developed property in Accomack County was owned by people who resided outside of Accomack. As development continues both for current residents as well as the second home market and tourism, it is important to maintain the connection to the natural environment for the economic opportunities it provides by attracting people to the areas as well as for the natural functions it provides for the community.

Economic growth provides jobs and opportunities for Accomack County, its people, and businesses. However some aspects of growth negatively impact the natural system and its processes. The blue and green infrastructure can become further fragmented as development increases if improperly handled.

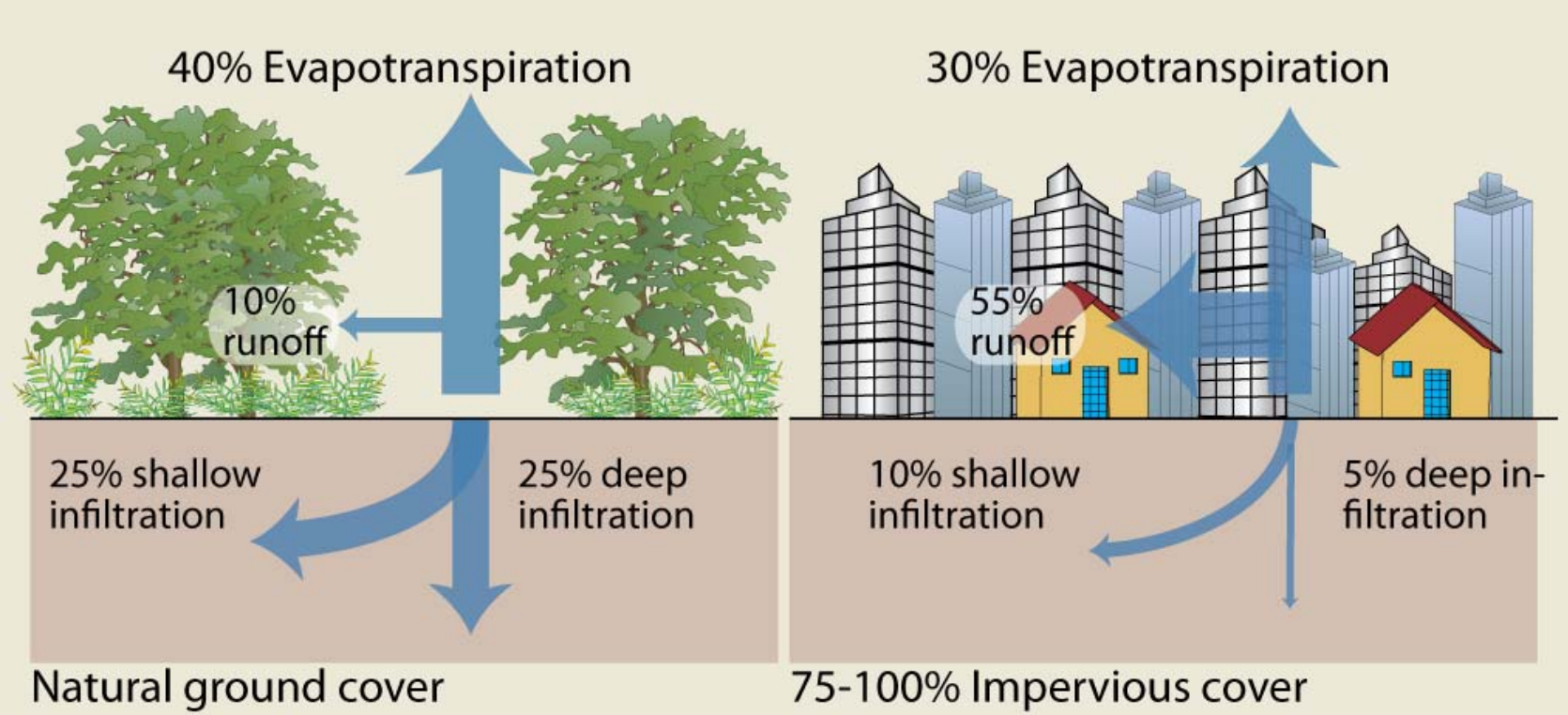
Increased development also means increased impervious surfaces as our landscape is covered with roads, buildings, and parking lots. As the surface is increasingly hardened, the ability of the surface to absorb rainfall is lessened.





*Above and Below: Examples how development can either fragment or maintain blue/green infrastructure. Graphic Source: Green Infrastructure Center*

Increased runoff from development poses several challenges. As a flat, coastal community with little in the way of fresh surface water, Accomack relies solely on groundwater for its drinking water supply. Increased runoff means that less water is available to recharge the aquifer.

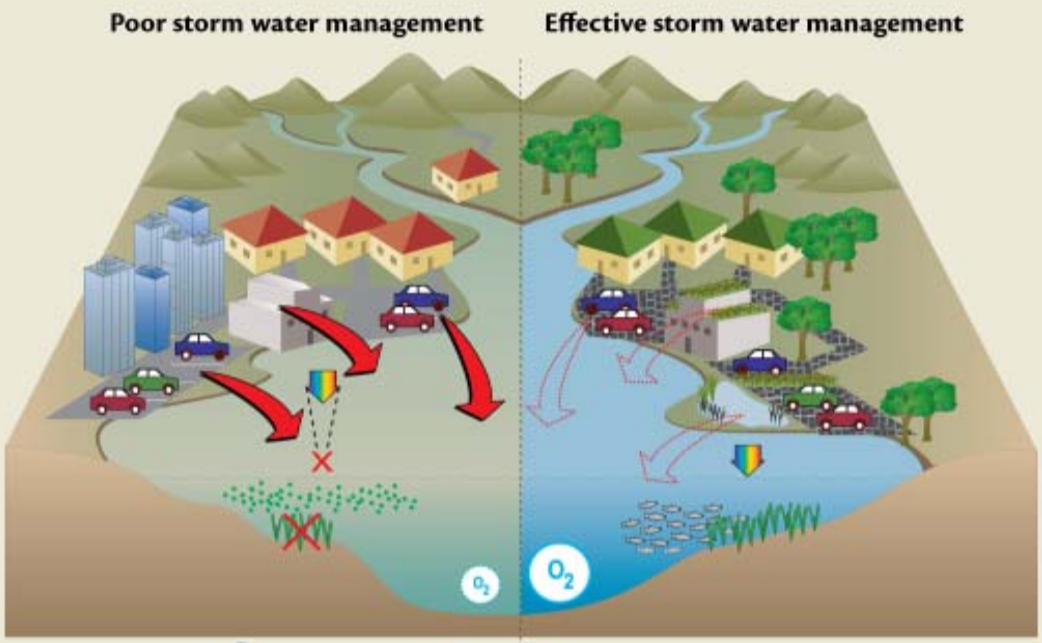



Conceptual diagram illustrating a natural verses impervious water filtration system.

Even in the absence of impervious surfaces, our brackish creeks and marshes would receive some runoff after a storm. But with increased impervious surfaces these natural systems receive increased volumes of freshwater runoff with an increased frequency, changing the salinity of the near shore creeks and marshes and causing spikes in freshwater inundation. These events can cause stress to the local habitat and reduce its ability to adapt to wildly changing water conditions as a result of runoff.

There are additional impacts that need to be mitigated with increased runoff. Runoff entering streams is coming off of a site at a faster rate than would be over vegetated areas.

The water coming off has increased volume, velocity, and is lasting for a longer period which can lead to increased flooding. Increased volumes and velocity can lead to stream bank erosion. Finally, runoff from development can carry higher levels of sediments, fertilizers, pesticides, and other items harmful to aquatic live. With increased development comes an increased need to mitigate the impacts of development.




Urban development , urban sprawl , roads and parking lots , and buildings without green roofs all increase impervious surfaces on the landscape. Impervious surfaces cause stormwater runoff and nutrients to enter waterways in large, pulsed amounts . This influx of nutrients can result in an increased incidence of algal blooms , decreased light availability , low dissolved oxygen levels , and loss of submerged aquatic vegetation .

The use of pervious pavers on roads and parking lots , rain gardens , stormwater retention ponds , and green roofs minimize impervious surfaces on the landscape. Minimizing impervious surfaces allows stormwater runoff and nutrients to enter waterways in small, diffuse amounts . This allows natural levels of light availability , dissolved oxygen $O_2$ , submerged aquatic vegetation , and other aquatic organisms to proliferate.

## Additional Resources:

- **United States Environmental Protection Agency, Green Infrastructure** http://water.epa.gov/infrastructure/greeninfrastructure/index.cfm
- **Environmental Protection Agency, Why Green Infrastructure? http://water.epa.gov/infrastructure/greeninfrastructure/gi_why.cfm#WaterQuality**
- **Virginia Coastal Zone Management Program Blue Green Infrastructure Mapping and Planning Efforts.** http://www.deq.state.va.us/Programs/CoastalZoneManagement/CZMIssuesInitiatives/BlueGreenInfrastructure.aspx
- **Virginia Department of Conservation and Recreation Video on Green Infrastructure.** http://www.youtube.com/watch?v=fb7HLYPwJ4I
- **Accomack County Blue & Green Infrastructure.** http://www.co.accomack.va.us/Planning/BlueGreen%20Infrastructure/BlueGreenInfrastructure.html
- **Green Infrastructure Center gicinc.org**
- **Maryland's Green Infrastructure**. http://www.dnr.state.md.us/greenways/gi/gi.html

**Clustering Options**

One method to preserve blue/green infrastructure in Accomack County is to utilize the clustering options of the Accomack County Zoning Ordinance in the Agricultural, Rural Residential, and Village Residential Districts.

Clustering allows the grouping homes on smaller lots in a development than would ordinarily be allowed instead of spreading units evenly across the parcel on large lots. By clustering, large areas are kept intact and it reduces the opportunity to further fragment the landscape.

Clustering can also mean more money to the developer. The land developer can potentially sell more lots using the cluster option as the Zoning Ordinance provides a bonus for clustering. The developer can maximize income by providing additional lots for development.

The developer can also save on expenses using the clustering option. By having development concentrated in one area and reducing impervious surfaces that increase the amount of stormwater runoff, costs for gray infrastructure can be lessened significantly. The property owner can maintain the benefits of preserving blue/green infrastructure by having the development clustered outside of sensitive areas. In Accomack County the cluster option is not mandatory.

The following pages show are some sample scenarios using the clustering option on a 50 acre parcel in the Agricultural, Rural Residential, and Village Residential Districts. In each case the total number of lots, the area used and the area maintained as open space are shown.

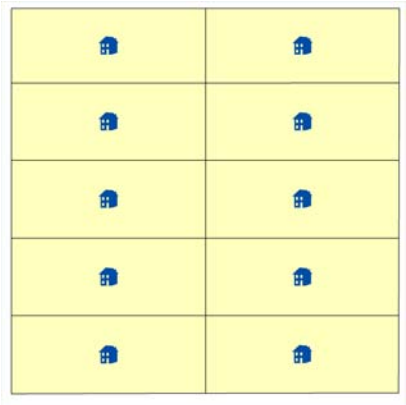
Note: The examples provided are for illustrative purposes and does not take into account land area needed for other items such as roads and stormwater management or for the presence of sensitive environmental features on the site which may impact lot placement. The applicable sections of the Accomack County Zoning Ordinance and the Accomack County Subdivision Ordinance should be consulting prior to submitting an application for development.

## Additional Resources:

- **Accomack County Zoning Ordinance, Agricultural District Clustering Provisions**. http://library.municode.com/HTML/13191/level3/CO_CH106ZO_ARTIIIAGDIA.html#CO_CH106ZO_ARTIIIAGDIA_S106-55ARDERE
- **Accomack County Zoning Ordinance, Rural Residential District Clustering Provisions**. http://library.municode.com/HTML/13191/level3/CO_CH106ZO_ARTXXRUREDIRR.html#CO_CH106ZO_ARTXXRUREDIRR_S106-505ARDERE
- **Accomack County Zoning Ordinance, Village Residential District Clustering Provisions.** http://library.municode.com/HTML/13191/level3/CO_CH106ZO_ARTXXIVIREDIVR.html#CO_CH106ZO_ARTXXIVIREDIVR_S106-535ARDERE
- **National Association of Home Builders: Mixed Use and Compact Development Introduction.** http://www.nahb.org/generic.aspx?sectionID=628&genericContentID=16945
- **Code of Virginia Section on Clustering Provisions.** http://lis.virginia.gov/cgi-bin/legp604.exe?000+coh+15.2-2286.1+500018

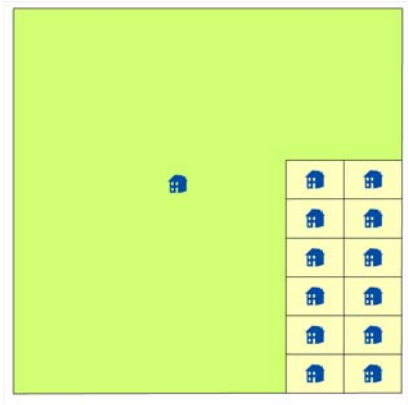
**Agricultural District**—50 Acres

Without the clustering option, the minimum lot size in the Agricultural Zoning District is 5 acres. There is no maximum lot size.. Theoretically a 50 acres parcel could potentially be divided into 10 parcels with no open space maintained.



| **No Cluster Option** | |
|---|---|
| Min /Max Lot Size Conventional | 5 Acres/None |
| Min/Max Lot Size Cluster | N/A |
| Total Conventional Lots Allowed | 10 |
| Total Cluster Lots Allowed | None |
| **Open Space Maintained/Preserved** | **N/A** |
| Conservation Lot | N/A |

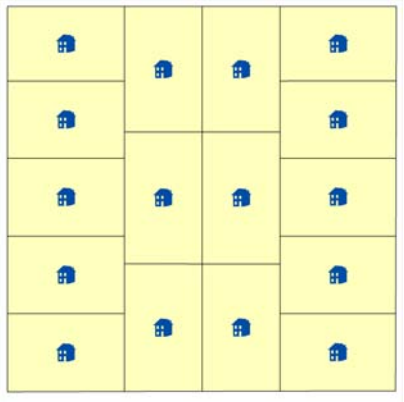
If the property is developed using the cluster option the property owner is able to cluster 12 lots on just over 8 acres, maintaining up to 83% of the 50 acres as open space.



| **Cluster Option** | |
|---|---|
| Min /Max Lot Size Conventional | 5 Acres/None |
| Min/Max Lot Size Cluster | 30,000 sq. ft./3 Acres |
| Total Conventional Lots Allowed | 1 |
| Total Cluster Lots Allowed | 12 |
| **Open Space Maintained/Preserved** | **Up to 83%** |
| Conservation Lot | N/A |

**Rural Residential District** —50 Acres

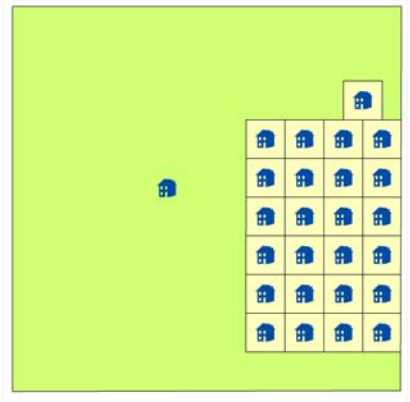
Without the clustering option, the minimum lot size in the Agricultural Zoning District is 3 acres. There is no maximum lot size.. Theoretically a 50 acres parcel could potentially be divided into 16 parcels with no open space maintained.



**No Cluster Option**

| | |
|---|---|
| Min /Max Lot Size Conventional | 3 Acres/None |
| Min/Max Lot Size Cluster | N/A |
| Total Conventional Lots Allowed | 16 |
| Total Cluster Lots Allowed | None |
| **Open Space Maintained/Preserved** | **N/A** |
| Conservation Lot | N/A |

If the property is developed using the cluster option the property owner is able to cluster 12 lots on just over 8 acres, maintaining up to 83% of the 50 acres as open space.

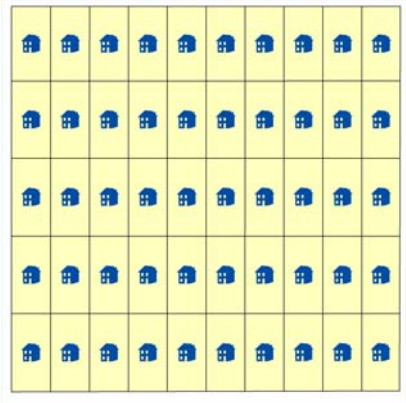


**Cluster Option**

| | |
|---|---|
| Min /Max Lot Size Conventional | 3 Acres/None |
| Min/Max Lot Size Cluster | 20,000 sq. ft./2 Acres |
| Total Conventional Lots Allowed | N/A |
| Total Cluster Lots Allowed | 25 |
| **Open Space Maintained/Preserved** | **60% Minimum** |
| Conservation Lot | Required |

**Village Residential District** —50 Acres

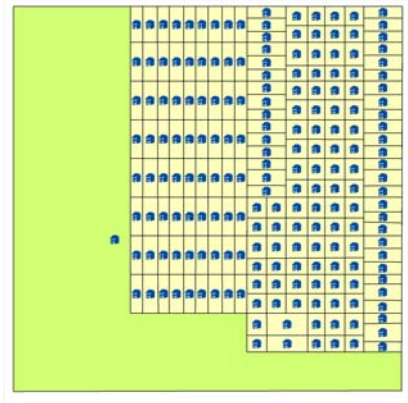
Without the clustering option, the minimum lot size in the Agricultural Zoning District is 3 acres. There is no maximum lot size.. Theoretically a 50 acres parcel could potentially be divided into 16 parcels with no open space maintained.



**No Cluster Option**

| | |
|---|---|
| Min /Max Lot Size Conventional | 1 Acre/None |
| Min/Max Lot Size Cluster | N/A |
| Total Conventional Lots Allowed | 50 |
| Total Cluster Lots Allowed | None |
| **Open Space Maintained/Preserved** | **N/A** |
| Conservation Lot | N/A |

If the property is developed using the cluster option the property owner is able to cluster 12 lots on just over 8 acres, maintaining up to 83% of the 50 acres as open space. Cluster lots would be served by water and wastewater utilities.

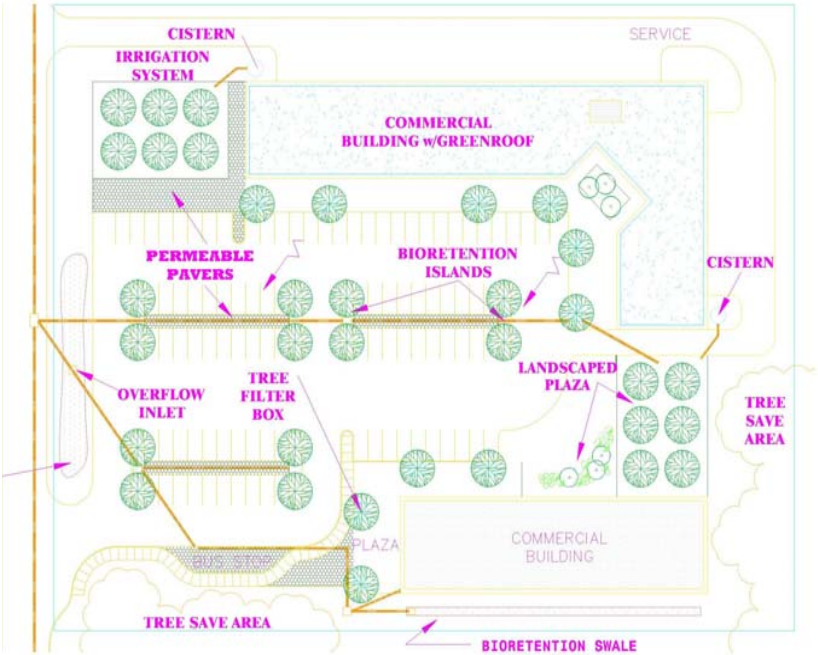


**Cluster Option**

| | |
|---|---|
| Min /Max Lot Size Conventional | N/A |
| Min/Max Lot Size Cluster | 6,000 sq ft/30,000 sq ft |
| Total Conventional Lots Allowed | None |
| Total Cluster Lots Allowed | 200 |
| **Open Space Maintained/Preserved** | **40% Minimum** |
| Conservation Lot | Required |

**Low Impact Development** concepts offer another vehicle to protect blue/green infrastructure and on a micro level are often seen as components of blue/green infrastructure.

Low impact development (LID) is an approach to stormwater management that aims to handle it as much as possible as the way it was handled prior to development. That is to utilize techniques to infiltrate, filter, store, and evaporate water at the site rather than to simply convey it offsite via a stormwater drainage system. In essence, it treats the water on a site as a resource and opportunity rather than a by-product to be disposed of as quickly as reasonable.




*Graphic Source: Low Impact Development Center*

LID looks at the entire site, both hardened areas and soft as an opportunity to manage the hydrologic process on site by retaining, storing, and changing the timing of, or filtering runoff. Some of the most common techniques of LID include:

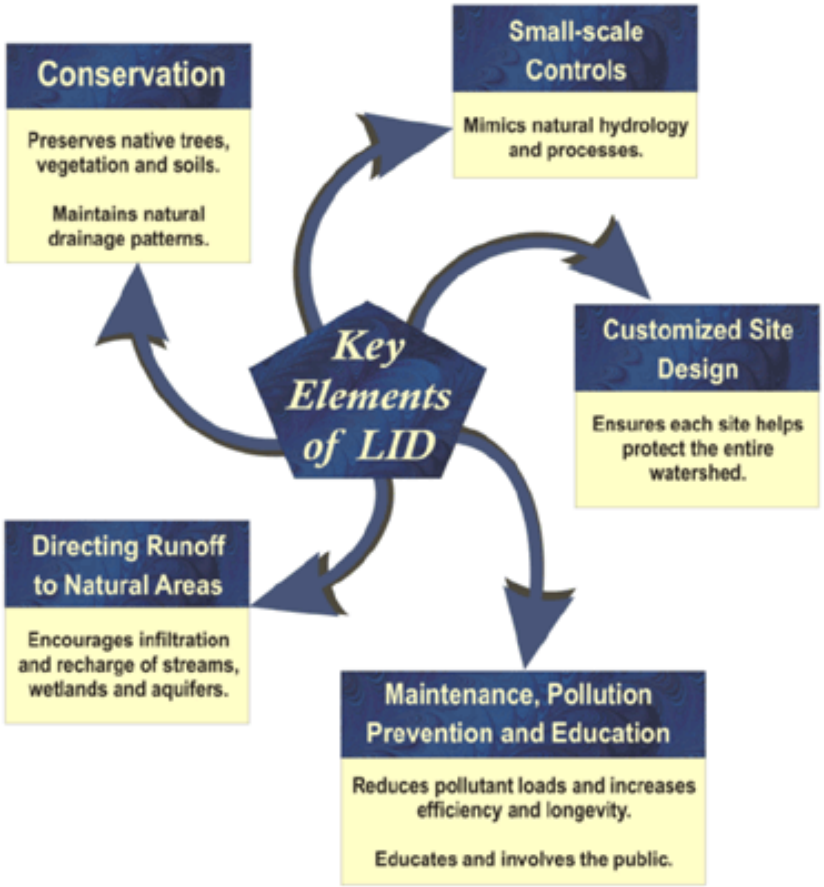
- Reducing imperviousness by using permeable paving or landscaping to break up large expanses of impervious surfaces.
- Directing runoff into or across vegetated areas to help filter runoff and encourage groundwater recharge.
- Preserving vegetated areas near parking areas, buildings, and other impervious expanses in order to slow runoff, filter out pollutants, and facilitate infiltration.
- Remove curbs and gutters parking areas and parking islands to allow storm water sheet flow into vegetated areas.
- Install green roofs.
- Use devices such as bioretention cells, vegetated swales, infiltration trenches, and dry wells to increase storage volume and facilitate infiltration.
- Grade to encourage sheet flow and lengthen flow paths to increase the runoff travel time in order to modify the peak flow rate.
- Disconnect impervious areas from the storm drain network and maintain natural drainage divides to keep flow paths dispersed.
- Disconnect roof downspouts and direct storm water into vegetated areas or into water collection devices.
- Install cisterns or sub-surface retention facilities to capture rainwater for use in irrigation and non-potable uses.

- Use native plants (or adaptable species) to establish an adaptable and low maintenance landscape that requires less irrigation and are appropriate for the climatic conditions.
- Use naturally occurring bio-chemical processes in plants located in tree box filters, swales, and planter boxes.
- Divert water away and disconnect from the storm drain or CSO using correctional drainage techniques.

Principles of LID are achieved through both structural and nonstructural practices. LID offers many benefits over traditional stormwater management such as increased groundwater recharge, less runoff, less pollution, less erosion and less damage to our coastal waters.

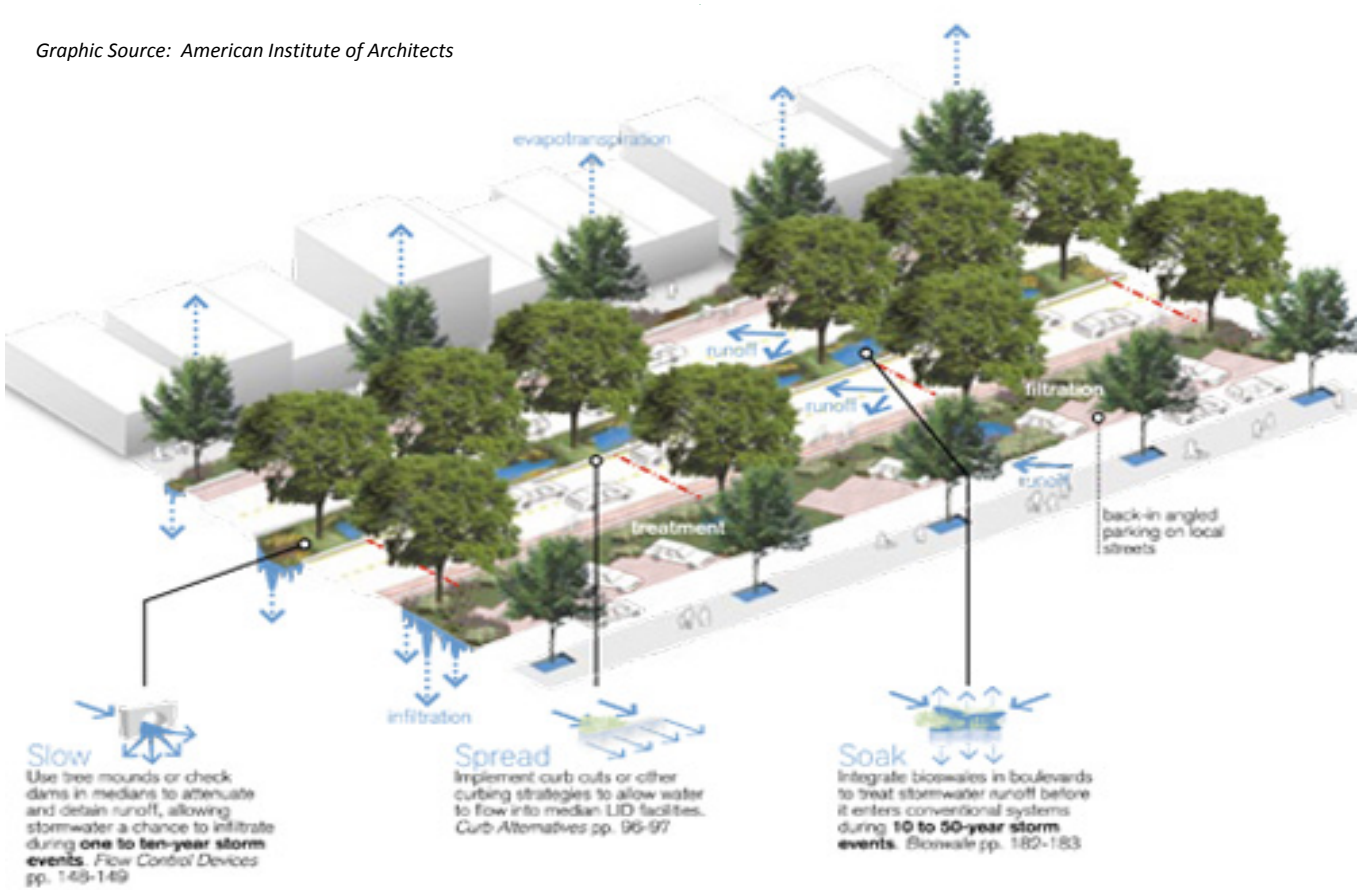
By incorporating nonstructural components into the design, LID can be a cost=effective method of handling and treating water over structural stormwater management componentsA 2007 EPA cost comparison 17 projects of conventional development costs versus using LID principles found that while one LID project did have higher costs, capital costs were reduced by 15% - 80% on the remaining sites and environmental performance was improved.

There are some important caveats to keep in mind when attempting to implement elements of low impact development on a site. First, each element must be tailored to the unique circumstances on each site. For example, many applications require quick drainage and do not work in areas with wet soils or a high water table. Also, while current Virginia regulations allow many uses of low impact development to meet criteria for reducing pollutants under stormwater regulations, they have not been incorporated within the erosion and sediment control regulations for accommodating the amount of stormwater runoff. Although some of these practices do not reduce the volume of stormwater required to be handled on site, they can provide many other benefits.




*Graphic Source: National Institute of Building Sciences*

*Graphic Source: American Institute of Architects*




On the following pages are some additional information about selected low impact development practices, both structural and nonstructural. The list is by no means comprehensive.

Information is also provided on pollutant removal efficiencies of various stormwater and low impact development practices

Based on a 1 inch rainfall event. Higher pollutant removal efficiencies may be achieved by utilizing multiple practices.

Many of these low approaches require professional design, installation, and possibly maintenance as well as approval by the Accomack County Department of Planning for compliance with Stormwater and Erosion and Sediment Control Ordinances.

Reported Pollutant Removal Efficiencies of Certain LID Practices

| PMP | TSS | Total P | Total N | Zinc | Lead | BOD | Bacteria |
|---|---|---|---|---|---|---|---|
| Bioretention | - | 81 | 43 | 99 | 99 | - | - |
| Dry Well | 80-100 | 40-60 | 40-60 | 80-100 | 80-100 | 60-80 | 60-80 |
| Infiltration Trench | 80-100 | 40-60 | 40-60 | 80-100 | 80-100 | 60-80 | 60-80 |
| Filter/Buffer Strip | 20-100 | 0-60 | 0-60 | 20-100 | 20-100 | 0-80 | - |
| Vegetated Swale | 30-65 | 10-25 | 0-15 | 20-50 | 20-50 | - | Neg. |
| Infiltration Swale | 90 | 65 | 50 | 80-90 | 80-90 | - | - |
| Wet Swale | 80 | 20 | 40 | 40-70 | 40-70 | - | - |
| Rain Barrel | NA | NA | NA | NA | NA | NA | NA |
| Cistern | NA | NA | NA | NA | NA | NA | NA |

Hydrologic Functions of Certain LID Practices

| | PMP | | | | | | |
|---|---|---|---|---|---|---|---|
| Hydrologic Functions | Bio Ret | Dry Well | Filter/ Buffer | Swale Grass | Rain Barrel | Cistern | Infilt. Trench |
| Interception | H | N | H | M | N | N | N |
| Depression Storage | H | N | H | H | N | N | M |
| Infiltration | H | H | M | M | N | N | H |
| G.W. Recharge | H | H | M | M | N | N | H |
| Runoff Volume | H | H | M | M | L | M | H |
| Peak Discharge | M | L | L | M | M | M | M |
| Runoff Frequency | H | M | M | M | M | M | M |
| Water Quality | H | H | H | H | L | L | H |
| Base Flow | M | H | H | M | M | N | L |
| Stream Quality | H | H | H | M | N | L | H |

H = High M = Moderate L = Low N = None

*Tables Source: Low-Impact Development Design Strategies: An Integrated Design Approach, Prince George's County Maryland Department of Environmental Resources*

## Additional Resources:

- **United States Environmental Protection Agency, Low Impact Development (LID) .** http://water.epa.gov/polwaste/green/index.cfm
- **Urban Design Tools Low Impact Development.** **http://www.lid-stormwater.net/**
- **Low Impact Development Center.** **http://www.lowimpactdevelopment.org/publications.htm**
- **Prince George County, Maryland, Low-Impact Development Design Strategies: An Integrated Design Approach.** http://www.lowimpactdevelopment.org/pubs/LID_National_Manual.pdf
- **Low Impact Development: A Guidebook for North Carolina.** http://www.ces.ncsu.edu/depts/agecon/WECO/lid/documents/NC_LID_Guidebook.pdf

**Bioretention (Rain Garden) -** Bioretention is a shallow densely vegetated depression that captures rainwater from impervious surfaces and allows stormwater to infiltrate through the soil media. As the water infiltrates, it provides onsite pollutant removal of the stormwater. Some of the incoming runoff is temporarily held by the bioretention area and exits the system by way of evaporation, plant uptake or infiltration

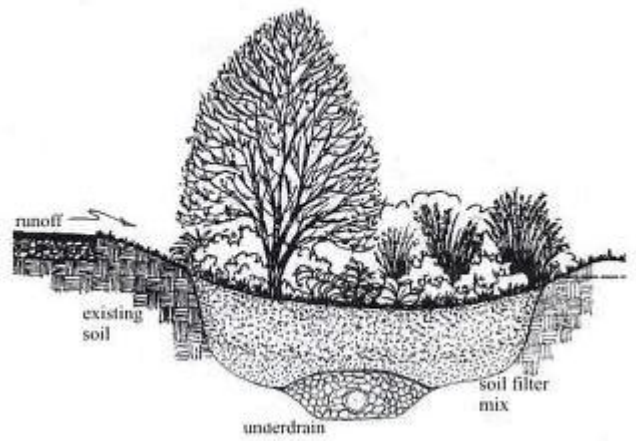
In Virginia, there are seven major components to bioretention areas including a grass buffer strip, additional plantings. ponding area, surface mulch and planting soil, optional sand bed, organic layer, plant material, and infiltration chambers.

Some bioretention facilities also incorporate underground drainage to convey excess water away from the area after being filtered through the soil medium.

Bioretention has been found to be highly effective at treating the stormwater by removing sediments, phosphorus, nitrogen, coliform and heavy metals. It can also be used to slow runoff reduce the peak runoff rate.

Common uses for bioretention have been to treat runoff from parking lost and commercial rooftops and one benefit is that they can be broken up to fit smaller areas such as between rows of parking as well as traffic islands.

Bioretention cells serve smaller areas than a stormwater management pond and, unlike a stormwater pond, it is designed to be shallower, generally holding no more than 5 –6 inches of water in the cell after a rain event. It alternates between slight ponding after a storm event with water filtering into the ground and uptake through plants and evapotranspiration within in a day.




*Graphic Source: Virginia Stormwater Management*

Since it is not permanently wet a bioretention cell can accommodate vegetation which aids in filtering pollutants as well as provides habitat for birds and butterflies.

Smaller, less complex systems serving primarily residential runoff fro m areas as residential rooftops or driveways are more commonly known as rain gardens and provide similar functions. Inflow is generally from sheet flow although concentrated flow withy energy dissipation can be found in downspouts. It is a practice individual homeowners can implement. Rain gardens can be planted with native plants that are ornamental and in many cases, the environmental functions provided is not apparent to others.

Since bioretention promotes quick groundwater recharge, it is not appropriate for areas with a high water table without underground drainage to a stormwater pond or receiving channel.

*Rain garden filtering runoff from nearby street. Image Source: City of Lincoln, NE.*

## Additional Resources:

- **Virginia Department of Conservation and Recreation, Bioretention Design Specification.** http://vwrrc.vt.edu/swc/april_22_2010_update/DCR_BMP_Spec_No_9_BIORETENTION_FinalDraft_v1-8_04132010.htm
- **United States Environmental Protection Agency, Bioretention (Rain Gardens).** http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=72
- **Chesapeake Stormwater Network, Bioretention.** http://chesapeakestormwater.net/training-library/stormwater-bmps/bioretention/
- **Urban Design Tools, Bioretention. http://chesapeakestormwater.net/training-library/stormwater-bmps/bioretention/**
- **Rain Garden Templates.** http://www.lowimpactdevelopment.org/raingarden_design/templates.htm
- **Chesapeake Bay Foundation, Build Your Own Rain Garden.** http://www.cbf.org/document.doc?id=31

**Permeable Pavement**—Permeable pavement is one of any number of terms (others include porous asphalt, open cell paving, pervious concrete, etc.) that allows water to infiltrate beneath paved services and a underlying stone reservoir rather than running off into a storm drain. It provides pollutant removal as it filters through the underlying reservoir and filter and is slowly released into the surrounding soil.

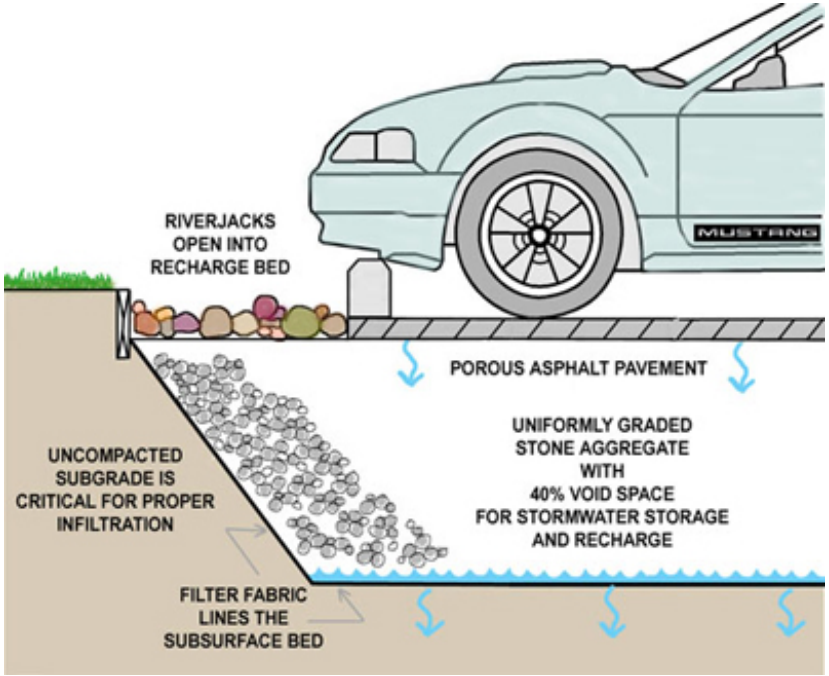
This practice is best suited to relatively flat areas of sidewalks, patios, parking or low traffic roadways. In Accomack County the water table should be at least 4 feet below the bottom of the stone reservoir. It is not appropriate for high traffic or heavy load areas.

This type of practice can be more expensive to install than traditional roadways and some parking areas but the increased costs may be offset by eliminating the need or capacity for curb and gutters, storm water inlets and conveyance systems, and smaller stormwater detention ponds.

Most of these practices require professional design and installation. Proper maintenance is also needed to prevent the surface from becoming clogged with sediments and reducing the permeability of the surface. Also, issues do arise with respect to using chemicals or plows for snow removal.

*Above: Example of water passing through permeable pavement. Image Source: Clean Rivers Campaign*

*Below: Sample design of permeable pavement system. Graphic Source: University of Maryland*



*Above: Example of rainfall simultaneously on standard pavement (background) and pervious concrete (foreground). Image Source: Environmental Protection Agency*

*Below: Examples of pervious pavers (left) and open celled pavers (right). Image Source: New York State Environmental Facilities Corporation*

Another type of practice which falls into this category are pervious pavers and open celled pavers.. These are generally precast concrete or brick. Although they are used on commercial sites, they are attractive LID feature for landowners as they are easier to install, come in a variety of colors and shapes and can be used for driveways, walkways, and patios.

Pervious pavers are laid over a drainage base and permeable joint material. Water will seep between the joints into the ground. Open celled pavers are concrete or plastic grids installed over a bed of drainage material and soil. Grass is able to grow through the voids in the pavers or they may ve filled with gravel or sand.

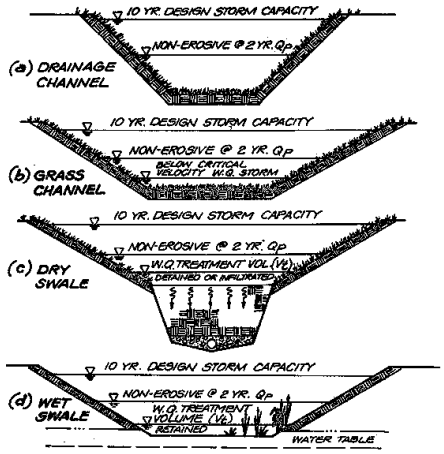
## Additional Resources:

- **Virginia Department of Conservation and Recreation, Permeable Pavement Design Specification.** http://vwrrc.vt.edu/swc/april_22_2010_update/DCR_BMP_Spec_No_7_PERMEABLE_PAVEMENT_Final_Draft_v1-7_03082010.htm
- **Perviouspavement.org.** http://perviouspavement.org/
- **Vermont Department of Environmental Conservation, Pervious Pavement.** http://www.vtwaterquality.org/stormwater/htm/sw_PerviousPavement.htm
- **North Carolina State University, Permeable Pavement: Research Update and Design Implications.** http://www.bae.ncsu.edu/stormwater/PublicationFiles/PermPave2008.pdf

**Swales –** Swales come in various forms and names performing a variety of functions. In general, a swale is a long, broad, and vegetated shallow channel which reduces the peak flow of runoff, reduces the velocity of flow and promotes the infiltration of water and removal of sediment and pollutants. They are commonly located near roadways and parking lots

**Grassed swales** are incorporated into sites where there are lesser amounts of impervious surfaces and pollutants coming off of a are not as high and the underlying soils already provide relatively quick infiltration. Rock check dams are incorporated into the design in order to promote ponding behind them which results in greater infiltration and less stormwater runoff.

A **dry swale, water quality swale,** or **bioswale** incorporates concepts of bioretention into the design of the swale with underlying drainage and soil mediums to promote infiltration and pollutant removal. Compared to grassed swales, this practice is appropriate to larger impervious areas and sites where higher pollutant removal is necessary.




Various types of swales. Graphic Source: Environmental Protection Agency

*Left: Grassed Swale*
*Image Source: Delaware Department of Transportation*

*Right: Dry Swale*
*Image Source: New York Department of Environmental Conservation*

## Additional Resources:

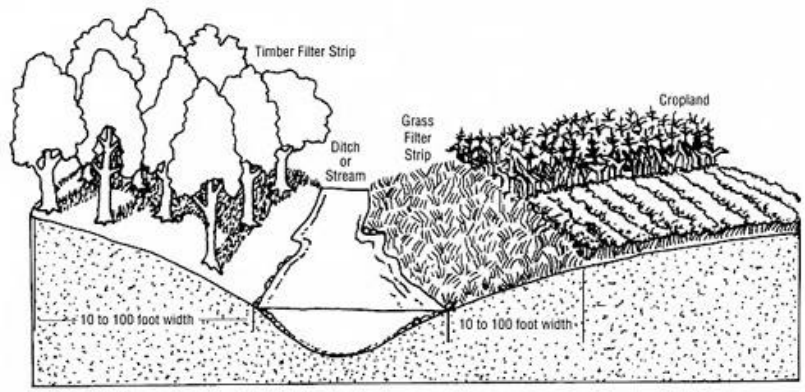
- **Virginia Department of Conservation and Recreation Design Specification, Grassed Channels.**
  http://vwrrc.vt.edu/swc/NonPBMPSpecsMarch11/DCR%20BMP%20Spec%20No%203_GRASS%20CHANNELS_Final%20Draft_v1-9_03012011.pdf

- **Virginia Department of Conservation and Recreation Design Specification, Dry Swale.**
  http://www.cwp.org/cbstp/Resources/d2s5a-dcr-bmp-dryswale.pdf

- **United States Environmental Protection Agency, Grassed Swales.**
  http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=75

**Vegetated Filter Strips** are used to treat sheet flow coming off a site. The vegetated strip slow the rate of runoff, allow pollutants and especially sediments to be filtered out and provide for some infiltration of stormwater.

Filter strips are also commonly used to address agricultural runoff and on the Eastern Shore they are used as a tool to help mitigate runoff from plasticulture.




*Vegetated Filter Strip Used in Agricultural Setting.*
*Image Source: University of Florida*

In addition to being used as an agricultural practice, vegetated strips can be effective when used as a tool of Low Impact Development by treating sheet flow coming off impervious surfaces such as parking lots or roadways. Concentrated flow must be converted to sheet flow prior to entering a filter strip.

In Accomack, filter strips generally are broad and relatively flat . A level spreader on the down slope side of a filter strip can provide an opportunity for slight ponding and additional infiltration.

Above: Flow from parking area passes through filter strip prior to entering dry swale. Image Source: Virginia Department of Conservation and Recreation

By themselves, vegetated buffer strips can only treat low intensity rainfall events. The real value of buffer strips are as a best management practice when located upstream of other practices that have higher pollutant removals. An example would be a buffer strip to accommodate sheet flow prior to water entering a bioretention facility or into a stormwater management pond. By providing sediment and other pollutant removal as well as some infiltration prior to runoff entering a bioretention site, swale, or a stormwater pond, a filter

strip can reduce the amount of maintenance required on these other more complex installations and increase both their functionality and their lifespan. With respect to agricultural filter strips, they are often combined with practices such as contour plowing, conservation tillage, and nutrient management.

Areas that have runoff that typically contains higher concentrations of pollutants compared to most other types of stormwater runoff (such as runoff from a gas station) are not good candidates for filter strips and bioretention as it provides a greater potential for groundwater contamination.

## Additional Resources:

- **Virginia Department of Conservation and Recreation. Virginia DCR Stormwater Design Specification – Sheet Flow to a Vegetated Filter Strip or Conserved Open Space.**
  http://vwrrc.vt.edu/swc/NonPBMPSpecsMarch11/DCR%20BMP%20Spec%20No%202_SHEET%20FLOW_Final%20Draft_v1-9_03012011.pdf

- **Virginia Department of Conservation and Recreation. Virginia Erosion and Sediment Control Handbook, Vegetated Filter Strip.**
  http://dcr.cache.vi.virginia.gov/stormwater_management/documents/Chapter_3-14.pdf

- **United States Environmental Protection Agency, Vegetated Filter Strip.**
  http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=76

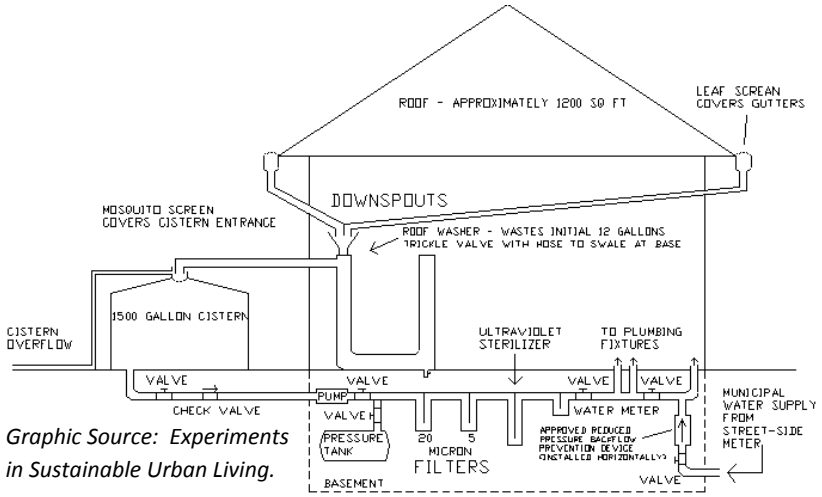
**Cisterns/Rain Barrels**

Cisterns and rain barrels collect rainwater for later use. Unlike relatively recent practices such as bioretention, they are not new technology. These practices are low cost devices that reduce runoff volume and can delay and reduce peak runoff rates. They provide a source of water for gardens and landscaping and can provide a source of water when it is needed rather than when it is collected from impervious surfaces.

Cisterns store rainwater in much larger volumes in tanks or underground storage. Sometimes rainwater collected in cisterns is also used for irrigation, water for livestock, toilet flushing, or groundwater recharge.

Rain barrels are commonly used in residential locations and are a low cost tool. Collection barrels are placed outside a building at roof downspouts to store rooftop runoff for later reuse in lawn and garden watering. Although they can be larger, most rain barrels commonly used to collect water from residential downspouts are generally less than 100 gallons each. Since cisterns and rain barrels are sources of standing water, care must be taken to ensure they do not become breeding grounds for mosquitoes.

*Image Source: Live Green Lancaster*




*Graphic Source: Experiments in Sustainable Urban Living.*

## Additional Resources:

- **Virginia Department of Conservation and Recreation. Virginia DCR Stormwater Design Specification – Rainwater Harvesting.** http://vwrrc.vt.edu/swc/april_22_2010_update/DCR_BMP_Spec_No_6_RAINWATER_HARVESTING_Final_Draft_v1-8_04132010.htm

- **Virginia Department of Health. Rainwater Harvesting & Use Guidelines.** http://www.vdh.state.va.us/EnvironmentalHealth/ONSITE/gmp/documents/2011/pdf/GMP_154.pdf

- **Chesapeake Stormwater Network, Rainwater Harvesting.** http://chesapeakestormwater.net/training-library/stormwater-bmps/rainwater-harvesting/

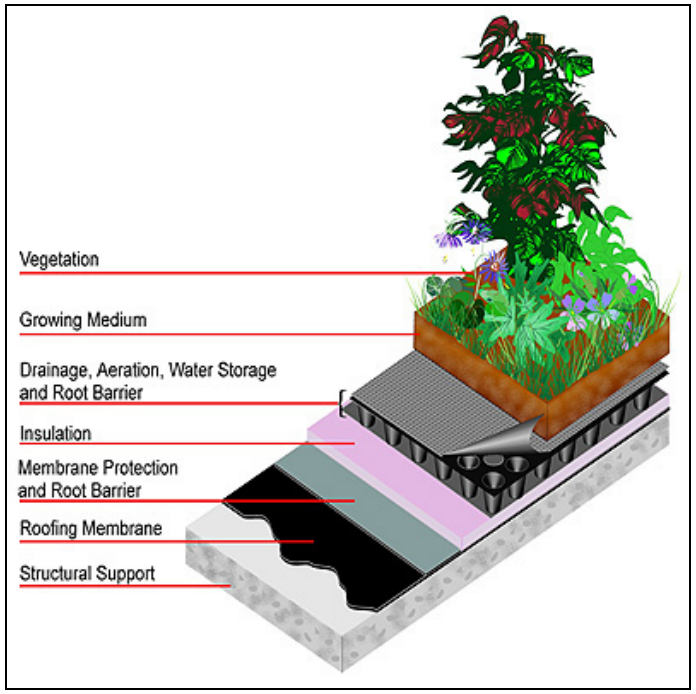
- **Urban Design Tools for Low Impact Development, Rain Barrels and Cisterns.** http://www.lid-stormwater.net/raincist_specs.htm

- **Live Strong, Ways to Keep Mosquitoes from Rain Barrels.** http://www.livestrong.com/article/272199-ways-to-keep-mosquitoes-from-rain-

**Green Roofs** – Green roofs are those that have been partially or fully covered in vegetation on top of the man-made roofing structure. The vegetation and soil are placed over a waterproofing membrane and other items such as root barriers, irrigation systems, and drainage systems may be incorporated as part of the green roof system.

Green roofs can be either ***intensive*** or ***extensive***. Extensive green roofs have a shallow growing medium, generally 2—6 inches. Intensive green roofs consist of deep growing medium greater than 6 inches that can support a full range of vegetation from groundcovers to large trees. It is intended to be self sustaining with little to no maintenance and requires less reinforcement of existing roofing when installed. The roof deck layer is the foundation of the roof and the type of roof will determine strength, load bearing capacity, and longevity of the system. Increasingly, roofs are being constructed with portable modular trays which may or may not be preplanted.

Green roofs can provide many environmental and economic benefits. Depending on rain intensity and soil depth, anywhere from 15 to 90% of runoff can be absorbed by the area it covers. This considerably reduces both the runoff and the potential pollutants from traditional building surfaces. Building energy costs can be reduced as the natural insulation property now provided by the roof leads to structures that are cooler in the summer and warmer during the winter and energy consumption is reduced. The evaporation of water held by the soil also adds in reducing roof surface temperatures.




*Above: Layers of a typical green roof. Image Source: City of Toronto, CA.*

*Below: Extensive Green Roof, Image Source: University of Connecticut*

In addition to being properly designed by a structural professional, green roofs should also incorporate a planting plan created by a landscape architect, botanist, or other profession with experience in green roofs. Plant species should be chosen based on sunlight conditions, ability to sow, water needs, plant hardiness zone and spreading rate. For a shallow green roof, the primary plants are low growing succulents such as *Sedum, Delosperma, Talinum, Semperivum* or *Hieracium*. Roofs can take at least one full growing season to become fully established.

*Above: Green roofs are not limited to flat roofs as shown in this example. Image Source University of Minnesota.*

Green roofs also insulate a building against external sound. Depending on the type of vegetation, it can provide habitat and food for birds and butterflies. A green roof also protects the existing roofing, reducing the number of roofing replacements required as well as waste from reroofing.

*Top/Middle/Bottom: Example of an existing building in Toronto being retrofitted for a green roof with a combination of both intensive and extensive plantings with preplanted modular components. Image Source: Josephine Chan, ESRI Canada*

## Additional Resources:

- **Virginia Department of Conservation and Recreation, Vegetated Roof Design Specification.** http://vwrrc.vt.edu/swc/NonPBMPSpecsMarch11/VASWMBMPSpec5VEGETATEDROOF.html
- **United States Environmental Protection Agency, Green Roofs.** http://www.epa.gov/hiri/mitigation/greenroofs.htm
- **Chesapeake Stormwater Network, Bioretention.** http://chesapeakestormwater.net/training-library/stormwater-bmps/bioretention/
- **Virginia Tech News:** ***Green roof design may help control urban runoff*****.** http://www.vtnews.vt.edu/articles/2012/07/070312-caus-greenroof.html

**Native Landscaping** – Native landscaping involves the use of trees, shrubs, and groundcover that have developed or occurred naturally in an area. They are a hardy source for plantings as they have already adapted to local growing conditions and the local area will support this type of vegetation. Native plants resist local pests and disease.

Traditional gardens and landscaping have higher costs and impacts compared to native landscaping. According to the Environmental Protection Agency, a one-acre lawn costs $400 to $700 annually to maintain. The amount of air pollution from one hour of mowing with a gas mower is equal to that from driving 20 miles in a vehicle. Homeowners use pesticides at a rate of 10 times per acre over the amount used by farming. Beneficial species are inadvertent targets of pesticides. Improperly disposed pesticides have been found in detectable limits in 5% to 10% of wells. Nitrogen and phosphorus from fertilizers are the main pollutants in the Chesapeake Bay and a high amount of nitrogen from fertilizer makes its way into surface and groundwater.

With established native plantings and landscaping, maintenance costs are reduced as less money, if any, is needed since they do not need fertilizers, herbicides, pesticides, or watering. Native landscapes do not need to be mowed as would a conventional lawn which saves time and reduces harm from runoff of herbicides and pesticides. Native plants attract a diverse variety of wildlife such as birds, butterflies and other animals, which supports biodiversity in a community.

Native plantings and landscapes are a process of selecting the right plant for the right place. It requires selecting plants that thrive in the conditions while avoiding invasive plant species. Using a diversity of plants will provide more interest from season to season and more wildlife habitat. Dense layered plantings provide better water retention, greater air quality benefits and increase cooling. Perennials or annuals that have high rates of reseeding are best.

Plant ES Natives
They're Shore Beautiful!

The Plant ES Natives campaign was initiated by the Virginia Coastal Zone Management Program and participating partners through its Virginia Seaside Heritage Program. The campaign published a guide entitled *Native Plants of Accomack and Northampton* which highlights the benefits of using native plants locally. The guide provides information on native plants including grasses, shrubs, trees, vines, forbs, and ferns as well as local demonstration sites and information on plant care and conditions.


As part of the campaign banners have been distributed to participating local garden centers which identify them as native plant providers and campaign partners. Native plants have been tagged with unique tags also highlighting the program. The guide is available from project partners, local garden centers as well as online. Local plant suppliers are also on the site.

Several demonstration sites to fit a variety of sites have been created in Accomack and Northampton Counties. In Accomack County there is a Shady ES Native Plant Demonstration along the Chincoteague Island Nature Trail along Hallie Whealton Smith Drive, a Healing Garden ES Native Plant Demonstration at the Onley Rural Health Center on Badger Lane and another demonstration site is planned for Seaside Park in Wachapreague. In Northampton County there is a Living Shoreline ES Native in Oyster near the boat ramp for kayaks and canoes, a Maritime Forest ES Native Plant Demonstration at the UVA Anheuser Busch Coastal Research Center in Oyster, a Shoreline ES Native Plant Demonstration at the observation platform in Willis Wharf, a butterfly Native Plant Demonstration at the Northampton Free Library on Seaside Road in Nassawadox, and a Pollinator native Plant Demonstration at the Eastern Shore of Virginia National Wildlife Refuge.


*Above and Below: From the Healing Garden ES Native Plant Demonstration, Onley Rural Health Center.*

## Additional Resources:

- **Virginia Coastal Zone Management Program: Native Plants of Accomack and Northampton.**
  http://www.deq.virginia.gov/Portals/0/DEQ/CoastalZoneManagement/esnativeplantguide_000.pdf

- **Virginia Department of Conservation & Recreation, Natural Heritage—Native Plants for Conservation, Restoration, and Landscaping (site includes brochures for Coastal Plain Native Plants and Riparian Native Plants)**
  http://www.dcr.virginia.gov/natural_heritage/nativeplants.shtml

- **U.S. Fish & Wildlife Service: Native Plants for Wildlife Habitat and Conservation Landscaping/Chesapeake Bay Watershed.**
  http://www.nativeplantcenter.net/guides/chesapeakenatives.pdf

- **Lady Bird Johnson Wildflower Center, Virginia Recommended.**
  http://www.wildflower.org/collections/collection.php?collection=VA

**Tree Preservation and Planting** - Trees and forests improve stream quality and watershed health primarily by decreasing the amount of stormwater runoff and pollutant. Trees and forests reduce stormwater runoff by capturing and storing rainfall in the canopy and releasing water into the atmosphere through evapotranspiration. In addition, tree roots and leaf litter create soil conditions that promote the infiltration of rainwater into the soil. This helps to replenish our groundwater supply.

The presence of trees also helps to slow down and temporarily store runoff, which further promotes infiltration, and decreases flooding and erosion downstream. Trees and forests reduce pollutants by taking up nutrients and other pollutants from soils and water through their roots, and by transforming pollutants into less harmful substances. In addition to these stormwater benefits, trees provide a host of other benefits such as improved air quality, reduced air temperatures in summer, reduced heating and cooling costs, noise and wind screening, increased property values, habitat for wildlife, and recreation and aesthetic value.

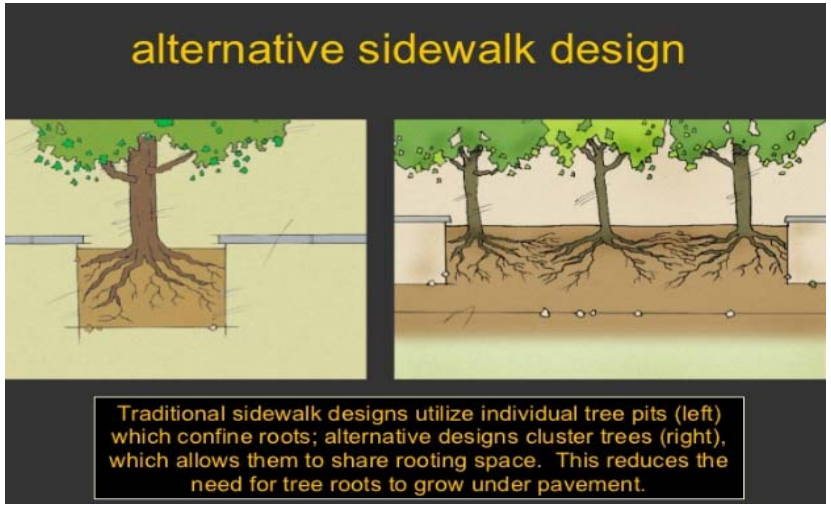
Established trees on a site when possible are normally preferable to planting new trees. The uptake of water is greater leading to reduced runoff, and the extensive roos system of established trees stabilize the soil and hold it in place. As less area is disturbed, costs for excavation and grading are reduced.

The *Virginia Erosion and Sediment Control Handbook* contains information on protecting trees during construction. Primary considerations are keeping the preserved trees protected from the trunk past the drip line of the tree. Construction activities such as fill and excavation, compacting the roots by driving heaving equipment over the root zone, and trenching through the root zone can be harmful to the tree. These activities could possibly destroy the benefits that preserving trees during construction were planned to provide.

*Improper (Above) and Proper (Below) Tree Preservation During Construction. Image Sources: National Tree Preservation and Elkhart County Soil and Water Conservation District.*

There are additional financial benefits of trees on sites. According to the U.S.D.A. Forest Service, just 20% shad on a street improves pavement conditions to increase time between required repaving. This amounts to a 60% savings in resurfacing costs over 30 years.

Along streets, tree boxes are mini bioretention filters can provide expanded space under sidewalks that with proper growing mediums would provide additional pollutant removal and infiltration.




*Graphic Source: USDA Forest Service*

## Additional Resources:

- **Virginia Department of Conservation and Recreation. Erosion and Sediment Control Handbook, Tree Preservation and Protection.** http://dcr.cache.vi.virginia.gov/stormwater_management/documents/Chapter%203%20-%203.38.pdf
- **Virginia Tech, Stormwater Management: Using Trees and Structural Soils to Improve Water Quality.** http://urbanforestry.frec.vt.edu/stormwater/
- **Trees Virginia, Planning for Tree Preservation.** http://www.treesvirginia.org/joomla/treecare/Planning%20for%20Tree%20Preservation.pdf

**Conservation Easements** – A conservation easement protects property from certain development activities. The landowner achieves this by voluntarily placing a legally binding restriction on their deed restricting or limiting future development rights. The landowner maintains ownership of the property while the development rights are sold or donated to a government entity or a qualified conservation organization.

Typically a conservation easement allows a property to continue its current use in farming, forestry, or as open space but restricts development rights. These restrictions run with the land and are binding on future landowners. Other property rights not addressed under the easement such as hunting, maintaining a residence, etc, remain as they existed prior to the easement.

Conservation easements can be beneficial to preserving blue/green infrastructure as they preserve open space, keep the landscape and animal habitat from becoming further fragmented, protecting sensitive lands and provide mitigation opportunities to reconnect blue/green infrastructure hubs and corridors that have become fragmented. While not necessarily a tool of low impact development, it does provide an opportunity for someone who is not developing their property to potentially positively impact our blue/green infrastructure.

A conservation easement is a binding agreement with legal and tax implications for the property owner. Decisions to place property in an easement should be done in consultation with a combination of the following: attorney, accountant, and/or a qualified conservation easement appraiser.

As of 2012, there were just over 200 parcels in Accomack County with recorded conservation easements. This amounts to about 24 square miles or between 6% and 6.5% of privately owned land in Accomack. In order for a conservation easement to be valid and enforceable, the property and conditions must conform with the Accomack County Comprehensive Plan at the time the easement is granted. For example a conservation easement on property shown as appropriate for residential or commercial development on the Future Land Use Map could be in conflict with the Comprehensive Plan.

## Additional Resources:

- **Virginia Department of Conservation and Recreation Office of Land Conservation.** http://www.dcr.virginia.gov/land_conservation/index.shtml
- **Virginia Department of Forestry Forest Legacy Program.** http://www.dof.virginia.gov/mgt/index-flp.htm
- **Virginia Outdoors Foundation.** http://www.virginiaoutdoorsfoundation.org/
- **Virginia Eastern Shore Land Trust.** http://www.veslt.org/
- **Code of Virginia Sections on Conservation Easements §10-1-1009 through 16.** http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+10.1-1009

# Appendices

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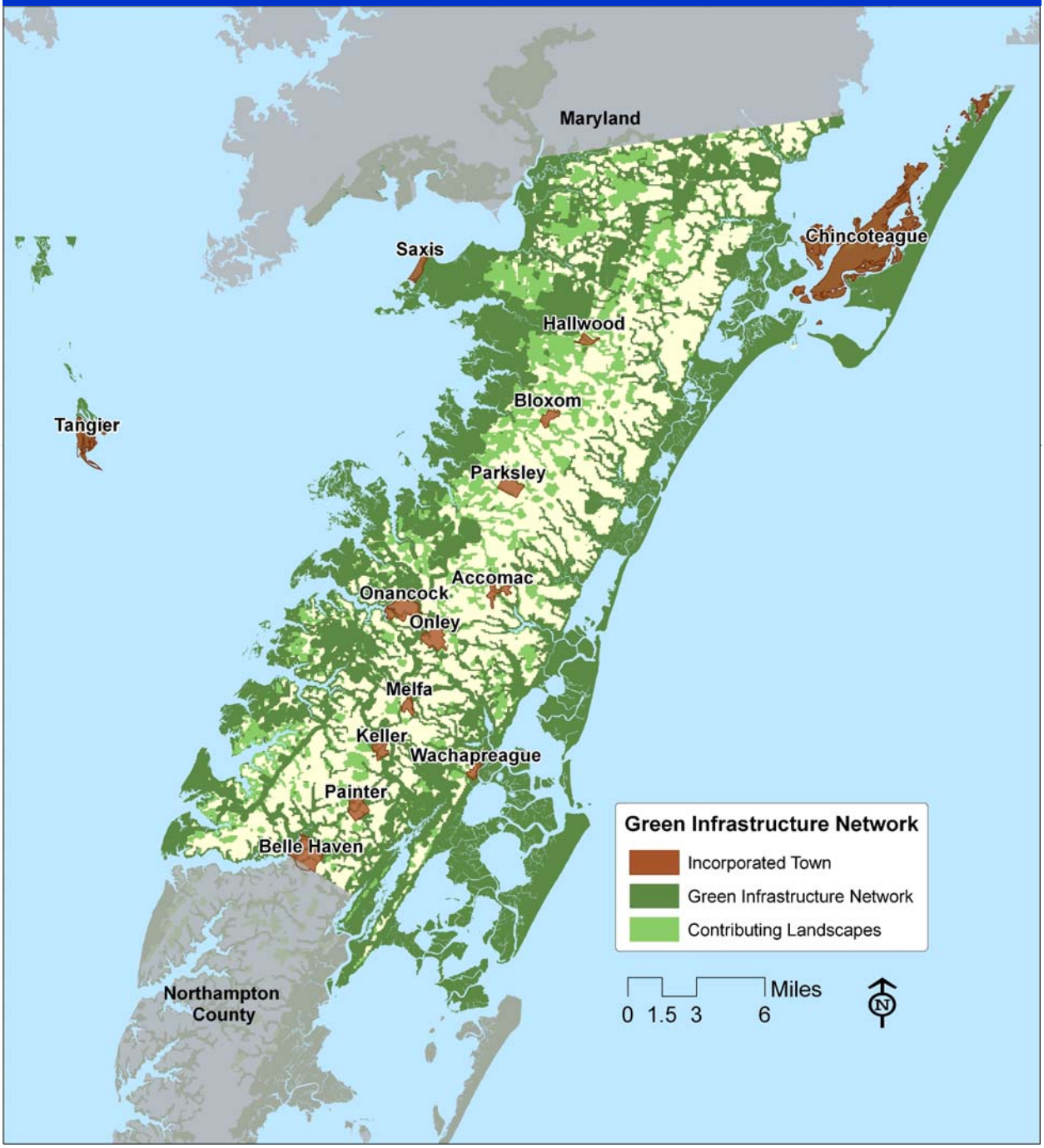
# Accomack County

# Blue and Green Infrastructure



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The following chart, prepared by the Center for Neighborhood Technology and American Rivers provides a quick reference on some different types of low impact development practices and the resulting benefits each may provide. *Source: [The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental and Social Benefits.] Center for Neighborhood Technology, 2010.*

| Benefit | Reduces Stormwater Runoff | | | | Increases Available Water Supply | Increases Groundwater Recharge | Reduces Salt Use | Reduces Energy Use | Improves Air Quality | Reduces Atmospheric $CO_2$ | Reduces Urban Heat Island | Improves Community Livability | | | | | Improves Habitat | Cultivates Public Education Opportunities |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Reduces Water Treatment Needs | Improves Water Quality | Reduces Grey Infrastructure Needs | Reduces Flooding | | | | | | | | Improves Aesthetics | Increases Recreational Opportunity | Reduces Noise Pollution | Improves Community Cohesion | Urban Agriculture | | |
| Practice | | | | | | | | | | $CO_2$ | | | | | | | | |
| Green Roofs | ● | ● | ● | ● | ○ | ○ | ○ | ● | ● | ● | ● | ● | ◒ | ● | ◒ | ◒ | ● | ● |
| Tree Planting | ● | ● | ● | ● | ○ | ◒ | ○ | ● | ● | ● | ● | ● | ● | ● | ● | ◒ | ● | ● |
| Bioretention & Infiltration | ● | ● | ● | ● | ◒ | ◒ | ○ | ○ | ● | ● | ● | ● | ● | ◒ | ◒ | ○ | ● | ● |
| Permeable Pavement | ● | ● | ● | ● | ○ | ◒ | ● | ◒ | ● | ● | ● | ○ | ○ | ● | ○ | ○ | ○ | ● |
| Water Harvesting | ● | ● | ● | ● | ● | ◒ | ○ | ◒ | ◒ | ◒ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ● |

● Yes ◒ Maybe ○ No

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COUNTY OF ACCOMACK
VIRGINIA

## Deliverable 2. Blue and Green Infrastructure Development Workshop

Item(s) included:

- Accomack Blue and Green Infrastructure Workshop Report
- Workshop Press Release
- Accomack County Blue & Green Development Workshop Agenda
- Accomack County Blue & Green Development Workshop PowerPoint Presentation
- Handout – Builder's Guide to Low Impact Development
- Handout – Municipal Guide to Low Impact Development
- Display – Native Plants for Conservation, Restoration & Landscaping (Riparian Buffer Zones)
- Display - Native Plants for Conservation, Restoration & Landscaping (Virginia Coastal Plain)
- Accomack County Map for Drainage Discussion
- Map of Accomack County Potential Growth Areas

## Accomack Blue and Green Infrastructure Workshop Report:

The Accomack County Blue and Green Infrastructure Workshop was held during the afternoon of Friday, September 28, 2012 in the Accomack County Administration Building. The Workshop focused on the County's Blue and Green Infrastructure and How to develop it during the development process.

A press release (attached) was created and sent to local media and was also email and mailed to interested parties. The release was printed in the Eastern Shore News and was heard on WESR, a local radio station.

The workshop agenda and presentation (both attached) were developed and presented by the Land Use Planner, the Environmental Planner and the GIS Coordinator and focused on Accomack's Blue and Green Infrastructure and how to preserve it using elements of Low Impact Design (LID) and using the clustering options of the Accomack County Zoning Ordinance. A handout developed by the Low Impact Development Center was provided and is included along with smaller versions of posters printed for the workshop involving information on native plants and areas used to show development pressure in the County.

There were 9 attendees and were primarily from the public as well as someone interested in developing property in Accomack. Most of the comments focused on a recent Planned Unit Development considered by the Accomack County Planning Commission and the Board of Supervisors. In addition it was noted that some of the recent ordinance changes have had confusing when it comes to implementation by the Building & Zoning Department and the Planning Department needs to develop implementation procedures to clear up questions with respect to new ordinances when those changes are drafted.

This workshop and report were 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.

Virginia Coastal Zone
MANAGEMENT PROGRAM

Contact: Tom Brockenbrough
Telephone: 757-787-5726
Email: tbrockenbrough@co.accomack.va.us

FOR IMMEDIATE RELEASE

# Accomack County to Hold Sustainable Community and Blue & Green Infrastructure Workshops

Accomack County will be holding two workshops on Friday, September 28, 2012. The morning workshop will start at 9:30am. This workshop will focus on sustainable community information that will aide in updating the Comprehensive Plan and Department of Planning web pages. The workshop will include information on sea level rise, alternative energy, the Chesapeake Atlantic Preservation Act, erosion and sediment control, and stormwater management.

The second workshop will begin at 1:30pm. This workshop will focus on blue & green infrastructure and how to conserve during development process by using amended Agricultural, Rural Residential and Village residential Zoning districts.

Developers, engineers, designers, citizens, and local government representatives are encouraged to attend both workshops to give input and feedback on the issues.

The workshops will be held in the Board Chambers, room 104 of the Accomack County Administration Building, 23296 Courthouse Avenue, Accomac

These workshops are 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.

# Accomack County Blue & Green Development Workshop

Friday, September 28, 2012
Accomack County Administration Building
23296 Courthouse Avenue, Accomac VA 23301
Room 104

## Agenda

1:30 PM – Welcome and Introductions

1:45 PM – What Is Blue & Green Infrastructure?

2:30 PM – Cluster Zoning Options in Accomack County

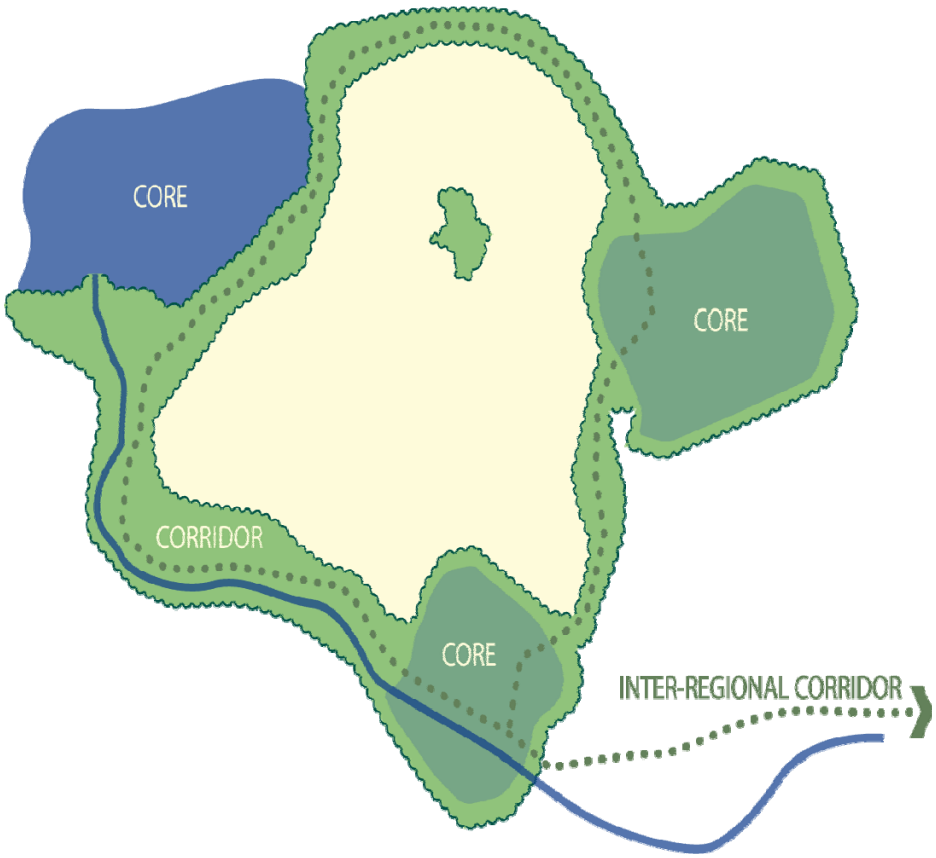
3:00 PM – LID Development

4:00 PM – Adjourn


# Blue & Green Infrastructure

Cluster Zoning in Agricultural, Rural Residential, and Village Residential Zoning Districts

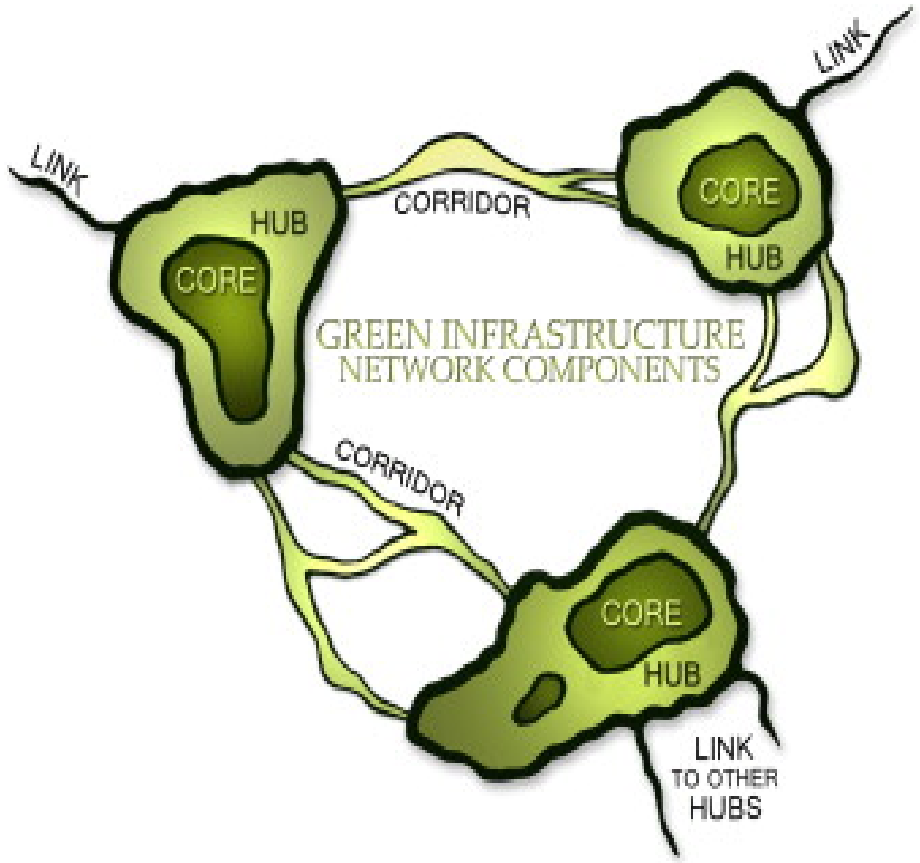
# What is Blue & Green Infrastructure?



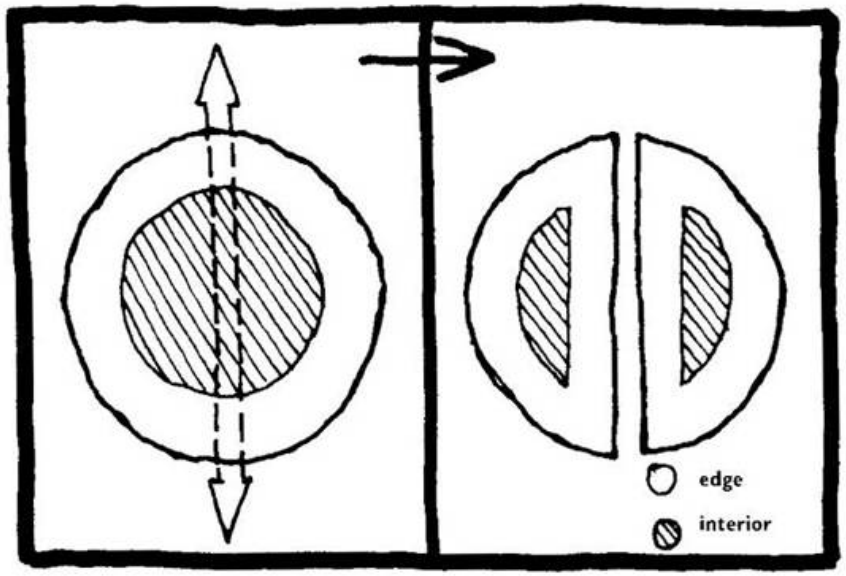

- "Strategically planned and managed networks of natural lands, working landscapes and other open spaces that conserve ecosystem values and functions and provide associated benefits to human populations"

# Components

- Larger natural habitat areas (wetlands and forests) – **hubs** and **cores.**
- Undeveloped linkages between hubs and cores known as **corridors.**



# Blue & Green Infrastructure




- When a corridor is disrupted, connectivity is lost resulting in fragmentation of the natural system.
- A connected landscape benefits natural systems.

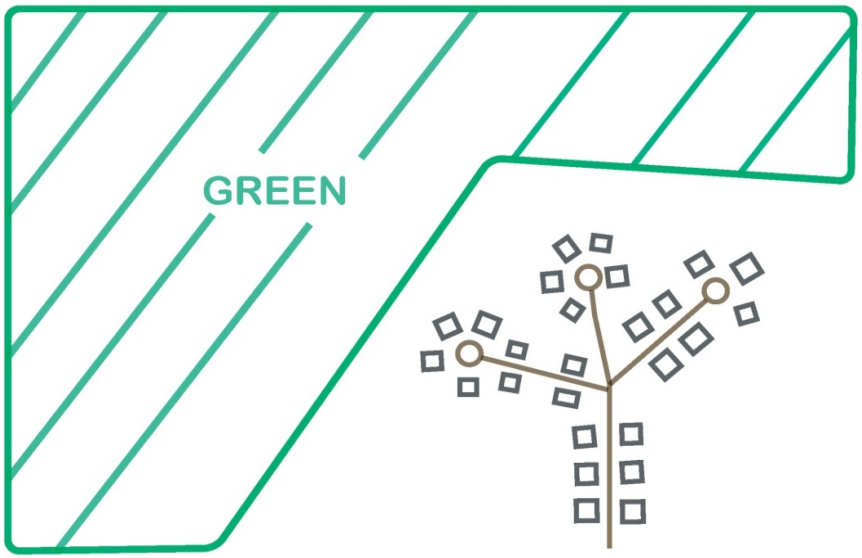
# Blue & Green Infrastructure and Accomack Zoning

- One means of minimizing disruption of the corridors and networks is by utilizing Accomack County's clustering options when developing residential subdivisions.
- In addition to minimizing disruption, clustering may also save the developer money during the development stages, and earn them more money in extra lots.

# Clustering Options

- Allows grouping of homes on smaller individual lots, rather than spreading units evenly across the parcel on large lots.
- Large areas are kept intact and reduces fragmentation of the landscape.
- Accomack zoning provides density bonuses for clustering, allowing more lots than would typically be allowed on a given parcel, potentially earning the developer a higher income on the lots.
- Clustering the lots also means there is less materials needed for roadways and utilities, saving the developer money.

# Traditional Development vs. Cluster Development

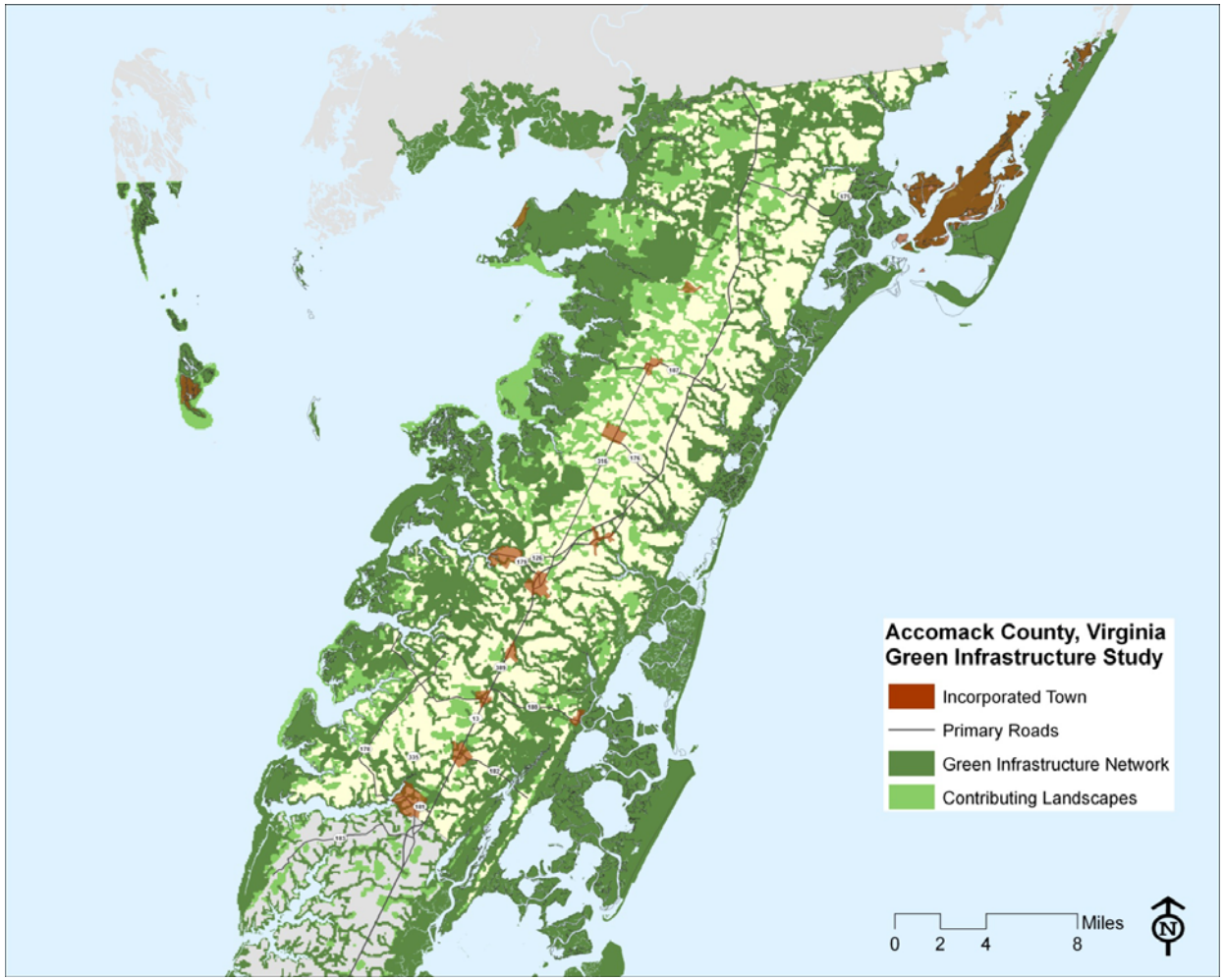


# Cluster Developments

# Benefits of Blue & Green Infrastructure Planning

- Conserving working lands such as farms and forests, that contribute to the economy.
- Protecting and preserving water quality and supply.
- Providing cost-effective stormwater management and hazard mitigation.
- Preserving biodiversity and wildlife habitat.
- Improving public health, quality of life and recreation networks.

# Accomack County Green Infrastructure Study

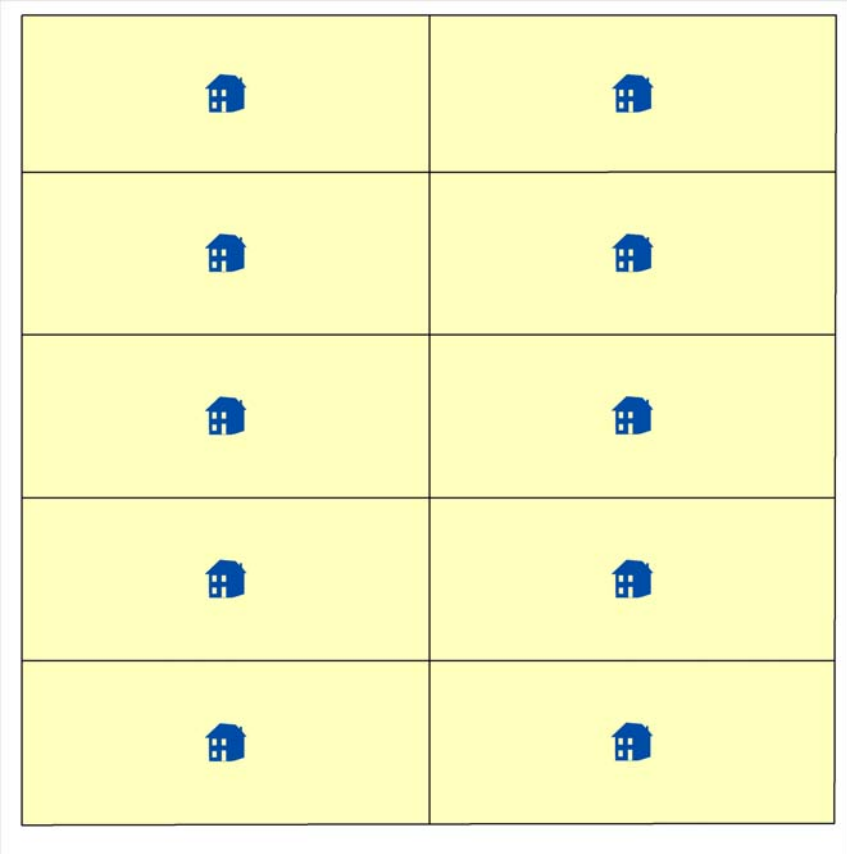


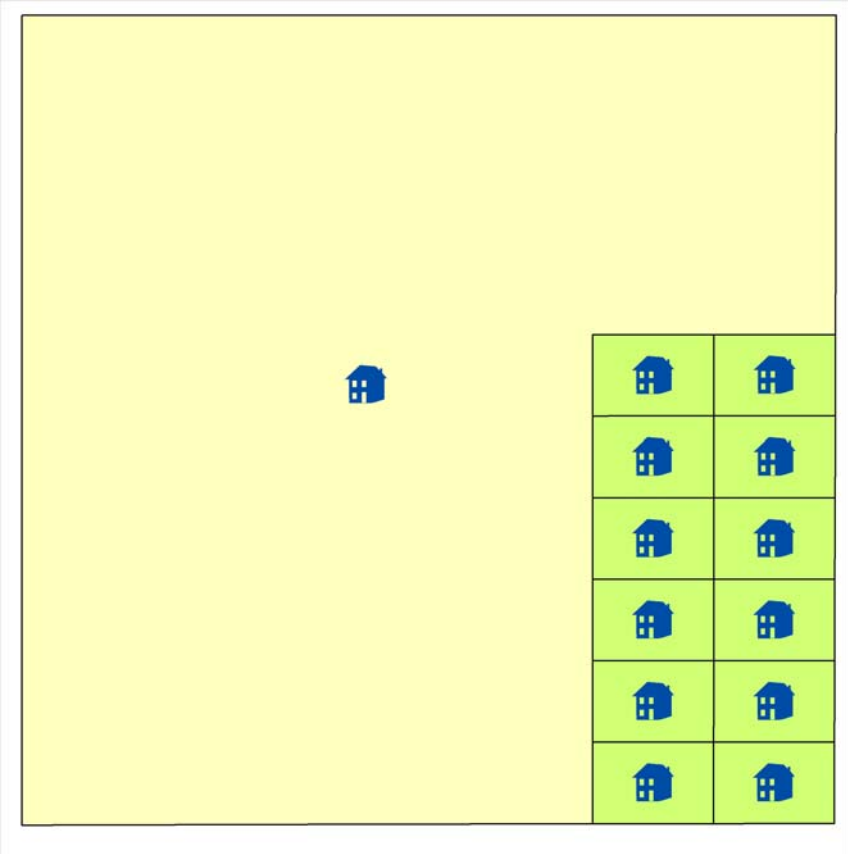
# Agricultural Zone
# Clustering vs. No Clustering

- **Without Clustering**
- Minimum Lot Size:
  5 acres
- Maximum Lot Size:
  None
- Maximum Number of Lots:
  10
- Open Space Preserved:
  None

- **With Clustering**
- Minimum Lot Size:
  30,000 sq. ft.
- Maximum Lot Size:
  3 acres
- Maximum Number of Lots:
  12
- Open Space Preserved: Up to 83%

# Agricultural Zone
# Clustering vs. No Clustering



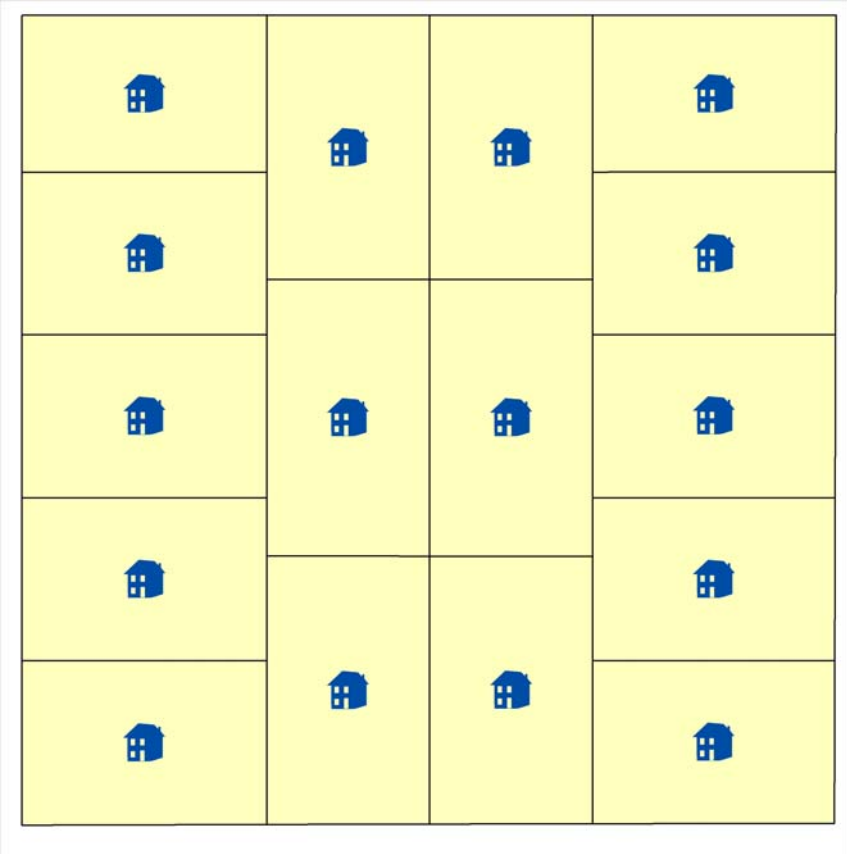


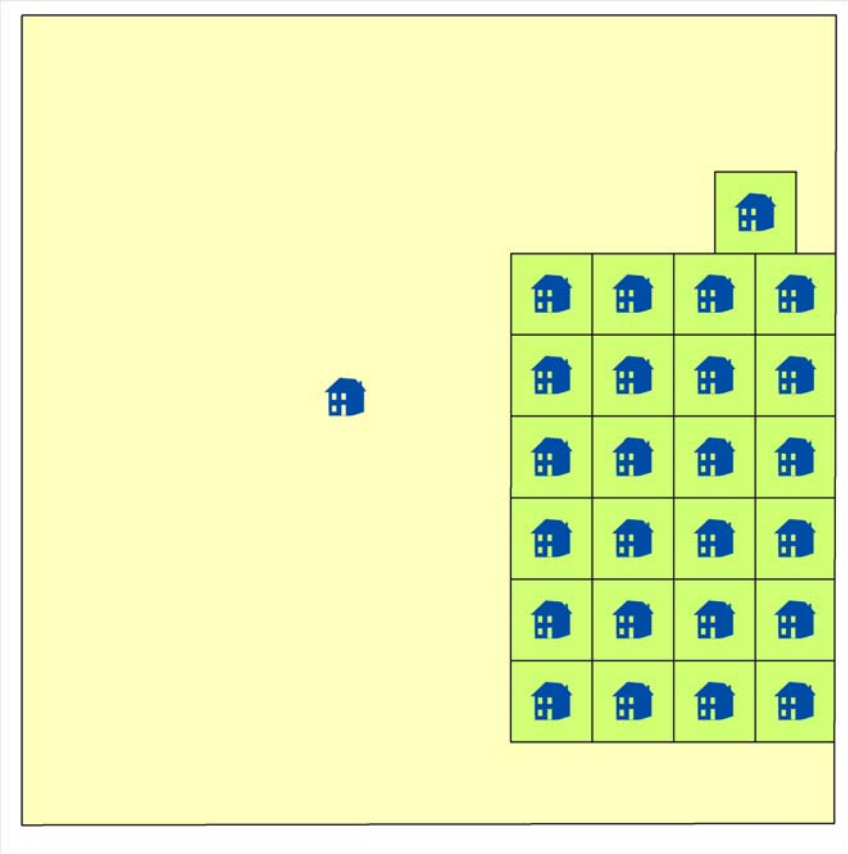
# Rural Residential Zone
# Clustering vs. No Clustering

- **Without Clustering**
- Minimum Lot Size:
  3 acres
- Maximum Lot Size:
  None
- Maximum Number of Lots:
  16
- Open Space Preserved:
  None

- **With Clustering**
- Minimum Lot Size:
  20,000 sq. ft.
- Maximum Lot Size:
  2 acres
- Maximum Number of Lots:
  25
- Open Space Preserved @ Max Buildout: Up to 77% (60% minimum)

# Rural Residential Zone
# Clustering vs. No Clustering



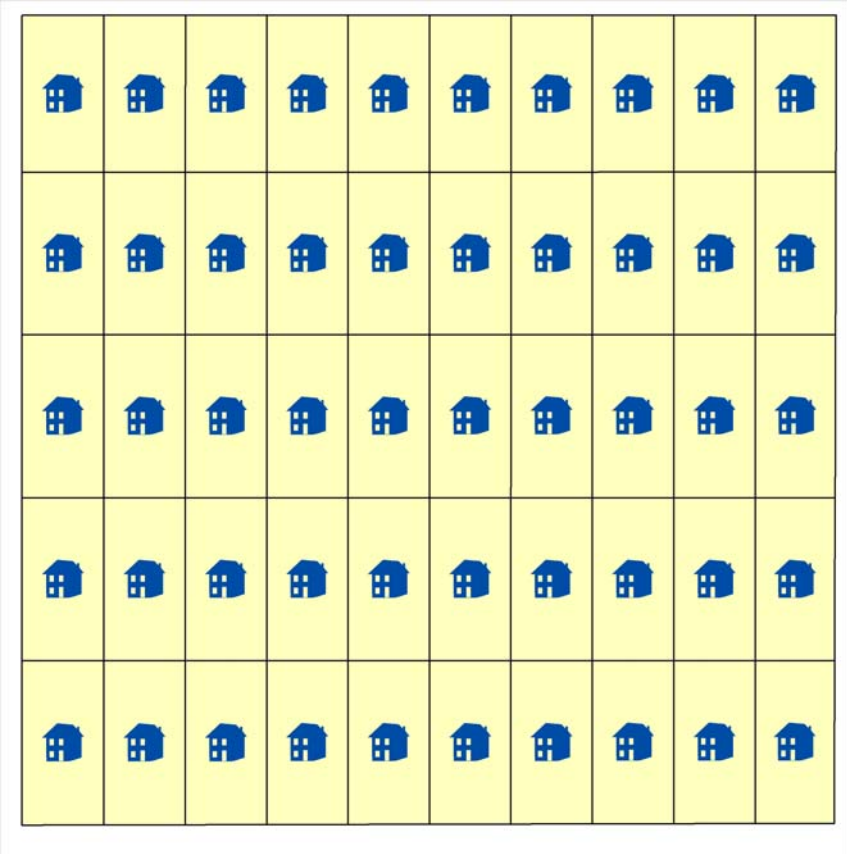


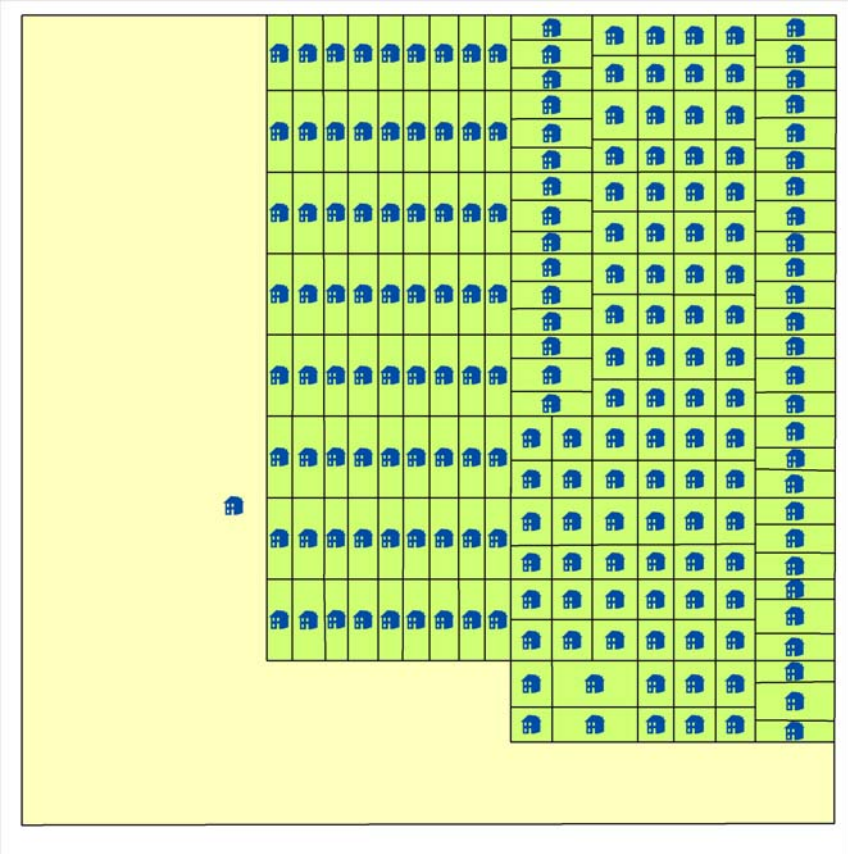
# Village Residential Zone
# Clustering vs. No Clustering

- **Without Clustering**
- Minimum Lot Size:
  1 acre
- Maximum Lot Size:
  None
- Maximum Number of Lots:
  50
- Open Space Preserved:
  None

- **With Clustering**
- Minimum Lot Size:
  6,000 sq. ft.
- Maximum Lot Size:
  30,000 sq. ft.
- Maximum Number of Lots:
  200
- Open Space Preserved:
  Minimum of 40%

# Village Residential Zone
# Clustering vs. No Clustering





Virginia Coastal Zone
MANAGEMENT PROGRAM

*This workshop 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.*

# What is Low Impact Development (LID)?

Ever wish you could simultaneously lower your site infrastructure costs, protect the environment, and increase your project's marketability? With LID techniques, you can. LID is an ecologically friendly approach to site development and storm water management that aims to mitigate development impacts to land, water, and air. The approach emphasizes the integration of site design and planning techniques that conserve the natural systems and hydrologic functions of a site.

Source: Prince George's County DER

**Residential Lot with Bioretention**

Somerset Development
Prince George's County, MD

## LID Benefits

In addition to the practice just making good sense, LID techniques can offer many benefits to a variety of stakeholders.

Developers

- Reduce land clearing and grading costs
- Potentially reduce infrastructure costs (streets, curbs, gutters, sidewalks)
- Reduce storm water management costs
- Potentially reduce impact fees and increase lot yield
- Increase lot and community marketability

Municipalities

- Protect regional flora and fauna
- Balance growth needs with environmental protection
- Reduces municipal infrastructure and utility maintenance costs (streets, curbs, gutters, sidewalks, storm sewer)
- Increase collaborative public/private partnerships

Environment

- Preserve integrity of ecological and biological systems
- Protect site and regional water quality by reducing sediment, nutrient, and toxic loads to water bodies
- Reduce impacts to local terrestrial and aquatic plants and animals
- Preserve trees and natural vegetation

Cover Photo: R. Arendt

# Case Study

Kensington Estates is a conventional development on 24 acres consisting of 103 single-family homes in Pierce County, WA. A study was conducted to redesign the site using a new state storm water model and to illustrate the full range of LID practices and technologies available to developers.

Overall, the redesigned LID site could have:

- Resulted in construction cost savings of over 20%;
- Preserved 62% of the site in open space;
- Maintained the project density of 103 lots;
- Reduced the size of storm pond structures and eliminated catchments and piped storm conveyances; and
- Achieved "zero" effective impervious surfaces.


**Cost Comparison: LID vs. Conventional Development**

# For More Information

- Low Impact Development Center
  http://www.lowimpactdevelopment.org
- Prince George's County, Maryland
  http://www.goprincegeorgescounty.com
- NAHB Research Center Toolbase Services
  http://www.toolbase.org
- U.S. EPA
  http://www.epa.gov/owow/nps/urban.html

NAHB RESEARCH CENTER

*Assumes paving costs of $15/sq. yd.

Printed on recycled paper with soy ink

# Builder's Guide to Low Impact Development

Would you be interested in saving upwards of $70,000* per mile in street infrastructure costs by eliminating one lane of on-street parking on residential streets?

Did you know that communities designed to maximize open space and preserve mature vegetation are highly marketable and command higher lot prices?

Are you aware that most homeowners perceive Low Impact Development practices, such as bioretention, as favorable since such practices are viewed as additional builder landscaping?

Did you know that by reducing impervious surfaces, disconnecting runoff pathways, and using on-site infiltration techniques, you can reduce or eliminate the need for costly storm water ponds?

# LID Site Planning and Design Concepts

Successful LID projects simultaneously reduce land development and infrastructure costs while protecting a property's natural resources and functions. During the development process, the designer, developer, and reviewing agency should work together to identify solutions that integrate the following concepts:

- Preserve Open Space and Minimize Land Disturbance;
- Protect and Incorporate Natural Systems (wetlands, stream/wildlife corridors, mature forests) as Design Elements;
- Utilize Neo-Traditional Street and Lot Layouts and Designs; and
- Decentralize and Micromanage Storm Water at its Source Using LID Storm Water Management Practices.

## LID and Storm Water Management

LID aims to mimic natural hydrology and processes by using small-scale, decentralized practices that infiltrate, evaporate, and transpire rainwater. Specifically, LID aims to:

- Minimize impervious surfaces;
- Disconnect hydrologic elements (roofs, downspouts, parking areas);
- Maintain/increase flow paths and times; and
- Utilize decentralized treatment practices.

Bioretention Areas
Storm water directed to these shallow topographic depressions in the landscape is filtered, stored, and infiltrated into the ground using specialized vegetation and engineered soils.

Grassed Swales
Water moving through these systems is slowed, filtered, and percolated into the ground. These systems can act as low cost alternatives to curbs, gutters, and pipes.

Source: Low Impact Development Center

**LID Lot Level Source Controls**

## Preserve Open Space and Minimize Land Disturbance

Source: Bielinski Homes

**Community Open Space**

Bielinski Homes
Waukesha, WI

## Decentralize and Micromanage Storm Water at its Source using LID Storm Water Management Practices

Source: Low Impact Development Center

**Grassed Swales**

Somerset Development
Prince George's County, MD

From Conservation Design for Subdivisions: A Practical Guide to Creating Open Space Networks, by Randall G. Arendt. Copyright (©) 1996 by Island Press. Reprinted by permission of Island Press, Washington, D.C. and Covelo, CA.

## Protect and Incorporate Natural Systems as Design Elements

Source: Applied Ecological Services, Inc.

**Wetland System**

Prairie Crossing
Grayslake, IL

## Utilize Neo-Traditional Street and Lot Layouts and Designs

Source: DPZ & Co.

**Bowman Park**

Vermillion Community
Vermillion, NC

# What is Low Impact Development (LID)?

LID is an ecologically friendly approach to site development and storm water management that aims to mitigate development impacts to land, water, and air. The approach emphasizes the integration of site design and planning techniques that conserve natural systems and hydrologic functions on a site. The practice has been successfully integrated into many municipal development codes and storm water management ordinances throughout the United States. Specifically, LID aims to:

- Preserve Open Space and Minimize Land Disturbance;
- Protect Natural Systems and Processes (drainage ways, vegetation, soils, sensitive areas);
- Reexamine the Use and Sizing of Traditional Site Infrastructure (lots, streets, curbs, gutters, sidewalks) and Customize Site Design to Each Site;
- Incorporate Natural Site Elements (wetlands, stream corridors, mature forests) as Design Elements; and
- Decentralize and Micromanage Storm Water at its Source.

Source: City of Portland, BES

**Courtyard with Bioretention Areas**

Buckman Heights Community
Portland, OR

Cover Photo: R. Arendt

# Questions and Answers

Information on the most frequently asked low impact development questions.

Public Safety

Q. I am aware that in some instances, LID advocates the reduction of street widths and the reduced use of sidewalks to decrease impervious surfaces. Isn't this a threat to public safety?

A. No. Studies have shown that reduced street widths still provide all the functions of access, parking, and circulation for residents and emergency vehicles alike. Depending on density, minimizing the use of sidewalks may help to reduce development costs, increase housing affordability, and reduce impervious surfaces.

Q. Don't LID storm water management practices increase the likelihood of flooding?

A. No. LID designs provide adequate conveyance of storm water by using designs that maintain predevelopment volumes and rates of runoff. Since bioretention areas are designed to completely drain within a specified period of time, they do not provide breeding grounds for mosquitos. Overflow controls within bioretention areas control the risk of flooding.

Public Perception

Q. Aren't homeowners concerned about maintaining storm water controls on their properties?

A. Environmental stewardship is everyone's responsibility. Most homeowners view these systems as additional landscaping and once they are aware of the benefits that these systems provide to local hydrology, few remain opposed.

Maintenance

Q. LID practices sound great, but who maintains all of the open space and various storm water controls?

A. Communities designed using LID practices often rely on a combination of homeowner stewardship and maintenance agreements. When designed correctly, most homeowners perceive these systems as value-added builder amenities and actively provide for their maintenance.

# For More Information

- Low Impact Development Center
  http://www.lowimpactdevelopment.org
- Prince George's County, Maryland
  http://www.goprincegeorgescounty.com
- NAHB Research Center Toolbase Services
  http://www.toolbase.org
- U.S. EPA
  http://www.epa.gov/owow/nps/urban.html

NAHB RESEARCH CENTER

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# Municipal Guide to Low Impact Development

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Are you aware that most homeowners perceive Low Impact Development practices, such as bioretention, as favorable since such practices are viewed as additional builder landscaping?

Did you know that by reducing impervious surfaces, disconnecting runoff pathways, and using on-site infiltration techniques, you can reduce or eliminate the need for costly storm water ponds?

Source: Low Impact Development Center

**Grassed Swale and Narrow Street**

Montgomery County, MD

Source: Applied Ecological Services, Inc.

**Bioretention with Native Vegetation**

Prairie Crossing
Grayslake, IL

# LID Benefits

In addition to the practice just making good sense, low impact development techniques can offer many benefits to a variety of stakeholders.

Municipalities

- Protect regional flora and fauna
- Balance growth needs with environmental protection
- Reduce municipal infrastructure and utility maintenance costs (streets, curbs, gutters, sidewalks, storm sewer)
- Increase collaborative public/private partnerships

Developers

- Reduce land clearing and grading costs
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- Increase lot and community marketability

Environment

- Preserve integrity of ecological and biological systems
- Protect site and regional water quality by reducing sediment, nutrient, and toxic loads to water bodies
- Reduce impacts to local terrestrial and aquatic plants and animals
- Preserve trees and natural vegetation

# Case Study

Somerset is an 80-acre development in Prince George's County, Maryland consisting of 199 homes on 10,000-square-foot lots. During its creation, the developer used LID practices to reduce the storm water management burden. By using LID, the developer:

- Eliminated the need for storm water ponds by using bioretention techniques saving approximately $300,000;
- Gained six additional lots and their associated revenues; and
- Reduced finished lot cost by approximately $4,000.

**Lot with Bioretention**

**Grassed Swale and Street without Curb and Gutter**

**Bioretention Area and Open Space**

Photos: Low Impact Development Center

| Description | Conventional Design | Bioretention System |
|---|---|---|
| Engineering Redesign | 0 | $110,000 |
| Land Reclamation (6 lots x $40,000 Net) | 0 | <$240,000> |
| Total Costs | $2,457,843 | $1,541,461 |
| Total Costs (-Land Reclamation + Redesign Costs) | $2,457,843 | $1,671,461 |
| Total Cost Savings = $916,382 | | |
| Cost Savings Per Lot = $4,604 | | |

**Cost Comparison: Conventional Design vs. Bioretention**


**Aerial View of Somerset Development Site Plan, Prince George's County, MD**

## Hydrologic Comparison between Conventional Storm Water Management and LID

Hydrologic alterations within the landscape occur whenever land is developed. Conventional development approaches to storm water management have used practices to quickly and efficiently convey water away from developed areas. Usually these practices are designed to control the peak runoff rate for predetermined storm events, usually the 2- and 10-year storms. While these systems have worked to some degree, they still have not accounted for the increased runoff rates and volumes from smaller, more frequent storms, nor have they addressed the larger watershed functions of storage, filtration, and infiltration.

In contrast, LID utilizes a system of source controls and small-scale, decentralized treatment practices to help maintain a hydrologically functional landscape. The conservation of open space, the reduction of impervious surfaces, and the use of small-scale storm water controls, such as bioretention, are just a few of the LID practices that can help maintain predevelopment hydrological conditions.

## ABOUT THE NATIVE PLANTS FOR CONSERVATION, RESTORATION AND LANDSCAPING PROJECT

This project is a collaboration between the Virginia Department of Conservation and Recreation and the Virginia Native Plant Society. VNPS chapters across the state helped to fund the 2011 update to this brochure.

The following partners have provided valuable assistance throughout the life of this project:

*The Nature Conservancy – Virginia Chapter • Virginia Tech Department of Horticulture • Virginia Department of Agriculture and Consumer Services • Virginia Department of Environmental Quality, Coastal Zone Management Program • Virginia Department of Forestry • Virginia Department of Game and Inland Fisheries • Virginia Department of Transportation*

## FOR MORE INFORMATION

Virginia Department of Conservation and Recreation
Natural Heritage Program
804-786-7951
www.dcr.virginia.gov/natural_heritage/nativeplants.shtml

## FOR A LIST OF NURSERIES THAT PROPAGATE NATIVE SPECIES, CONTACT:

Virginia Native Plant Society
400 Blandy Farm Lane, Unit 2
Boyce, VA 22620
540-837-1600 | vnpsofc@shentel.net
www.vnps.org

## FOR A LIST OF NURSERIES IN A PARTICULAR REGION OF VIRGINIA, CONTACT:

The Virginia Nursery and Landscape Association
383 Coal Hollow Road
Christiansburg, VA 24073
540-382-0943 | vnla@verizon.net
To search for species in VNLA member catalogs, visit:
www.vnla.org/search.asp

## ILLUSTRATIONS COURTESY OF THE FLORA OF VIRGINIA PROJECT.

Illustrators: Lara Gastinger, Roy Fuller and Michael Terry. To learn more, visit:
www.floraofvirginia.org

DCR Virginia Department of Conservation & Recreation

9/2011

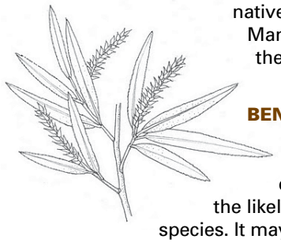
# Native Plants

## for Conservation, Restoration & Landscaping

Virginia Riparian Buffer Zones

## WHAT ARE NATIVES?

Native species evolved within specific regions and dispersed throughout their range without known human involvement. They form the primary component of the living landscape and provide food and shelter for native animal species. Native plants co-evolved with native animals over many thousands to millions of years and have formed complex and interdependent relationships. Our native fauna depend on native flora to provide food and cover. Many animals require specific plants for their survival.



## BENEFITS OF NATIVE PLANTS

Using native species in landscaping reduces the expense of maintaining cultivated landscapes and minimizes the likelihood of introducing new invasive species. It may provide a few unexpected benefits as well.

Native plants often require less water, fertilizer and pesticide, thus adding fewer chemicals to the landscape and maintaining water quality in nearby rivers and streams. Fewer inputs mean time and money saved for the gardener.

Native plants increase the presence of desirable wildlife, such as birds and butterflies, and provide sanctuaries for these animals as they journey between summer and winter habitats. The natural habitat you create with native plants can become an outdoor classroom for children, or a place for you to find peace and quiet after a busy day.

Native plants evoke a strong sense of place and regional character. For example, live oak and magnolia trees are strongly associated with the Deep South. Redwood trees characterize the Pacific Northwest. Saguaro cacti call to mind the deserts of the Southwest.

## BUYING AND GROWING NATIVE PLANTS

More gardeners today are discovering the benefits of native plants and requesting them at their local garden centers. Because of this increased demand, retailers are offering an ever-widening selection of vigorous, nursery-propagated natives.

Once you've found a good vendor for native plants, the next step is choosing appropriate plants for a project. One of the greatest benefits of designing with native plants is their adaptation to local conditions. However, it is important to select plants with growth requirements that best match conditions in the area to be planted.

If you're planning a project using native plant species, use the list in this brochure to learn which plants grow in your region of Virginia. Next, study the minimum light and moisture requirements for each species, noting that some plants grow well under a variety of conditions. Many of the recommended species are well-suited to more than one of these categories.

For more information, refer to field guides and publications on local natural history for color, shape, height, bloom times and specific wildlife value of the plants that grow in your region. Visit a nearby park, natural area preserve, forest or wildlife management area to learn about common plant associations, spatial groupings and habitat conditions.

For specific recommendations and advice about project design, consult a landscape or garden design specialist with experience in native plants.

## WHAT ARE NON-NATIVE PLANTS?

Sometimes referred to as "exotic," "alien," or "non-indigenous," non-native plants are species introduced, intentionally or accidentally, into a new region by humans. Over time, many plants and animals have expanded their ranges slowly and without human assistance. As people began cultivating plants, they brought beneficial and favored species along when they moved into new regions or traded with people in distant lands. Humans thus became a new pathway, enabling many species to move into new locations.

## WHAT ARE INVASIVE PLANTS?

Invasive plants are introduced species that cause health, economic or ecological damage in their new range. More than 30,000 species of plants have been introduced to the United States since the time of Columbus. Most were introduced intentionally, and many provide great benefits to society as agricultural crops and landscape ornamentals. Some were introduced accidentally, for example, in ship ballast, in packing material and as seed contaminants. Of these introduced species, fewer than 3,000 have naturalized and become established in the United States outside cultivation. Of the 3,500 plant species in Virginia, more than 800 have been introduced since the founding of Jamestown. The Virginia Department of Conservation and Recreation currently lists more than 100 of these species as invasive.

In the United States, invasive species cause an estimated $120 billion in annual economic losses, including costs to manage their effects. Annual costs and damages arising from invasive plants alone are estimated at $34 billion.

## NATIVE PLANTS VS. INVASIVE PLANTS

Invasive plants have competitive advantages that allow them to disrupt native plant communities and the wildlife dependent on them. For example, kudzu (*Pueraria montana*) grows very rapidly and overtops forest canopy, thus shading other plant species from the sunlight necessary for their survival. A tall invasive wetland grass, common reed (*Phragmites australis ssp. australis*), invades and dominates marshes, reducing native plant diversity and sometimes eliminating virtually all other species.

Invasive species can marginalize or even cause the loss of native species. With their natural host plants gone, many insects disappear. And since insects are an essential part of the diet of many birds, the effects on the food web become far reaching. Habitats with a high occurrence of invasive plants become a kind of "green desert." Although green and healthy in appearance, far fewer native species of plants and animals are found in such radically altered places.

# Virginia Riparian Buffer Zones

Riparian forest buffers are areas of trees, shrubs and other vegetation found next to stream channels and other waterways. The removal of these buffers has contributed to ecological problems in our waterways and the Chesapeake Bay. Problems include sedimentation, nutrient and toxic chemical pollution, and reduction of fish habitat.

Riparian forest buffers are natural communities such as bottomland hardwood forest, coastal scrub and upland oak-hickory-pine forests. They support a variety of plants and animals, particularly plants that are adapted to periodic flooding or saturated soils. Because of the presence of moving water, more materials are deposited in, and pass through, riparian forests than any other wetland ecosystem.

**Riparian forest buffers provide important ecosystem services.**

- Vegetation, leaf litter and porous soil slow the flow of water. This helps control the rate and volume of water in streams and rivers, greatly influencing flood levels.
- Leaf litter filters sediment from upland runoff, as well as phosphorus, nitrogen and other nutrients that may be bonded to sediment particles. Leaf litter intercepts and stores these polluting nutrients before they can cloud waterways.
- Leaf litter captures and converts pesticides to nontoxic compounds by various chemical and microbial activities within the forest buffer. This protects fish and amphibians, which are threatened by pesticide pollution.
- Soils store water, and plants in the forest buffer take up that water and release it into the atmosphere.
- The canopy created by riparian forests provides shade and controls water temperature, which is essential for instream organisms and the invertebrate food sources on which they depend. Instream, leaf litter and woody debris create food and habitat vital to the aquatic food web.
- Riparian forests provide food and habitat for a variety of terrestrial wildlife species and serve as safe corridors for movement between habitats. Habitat conversion and fragmentation have reduced wildlife habitat and limited the ability of animals to move between existing habitats.
- Riparian forest buffers offer recreation to fishermen, hunters, birders, hikers, canoeists and picnickers. People enjoy these areas in many different ways because of the diversity of life and scenic beauty they provide.

Drier upland forests adjacent to waterways provide many of the same ecosystem values. These ecological functions combine to make riparian forest buffers critical to ecological and human health. Recognizing this, staff at the Chesapeake Bay Program has set a goal to replant riparian buffers along 70 percent of stream miles in the bay watershed.

## RIPARIAN VEGETATION ZONES

Riparian forest buffers consist of four vegetation zones. Zone 1, the emergent vegetation zone, is permanently to semipermanently flooded and often dominated by grasses, sedges, rushes and other herbaceous plants. Zone 2, the riverside thicket, may be seasonally to temporarily flooded and is often characterized by emergent aquatic species, shrubs and a few tree species. Zone 3, the saturated forest, has soils that are saturated to poorly drained. Zone 4, the well-drained forest, is also known as upland forest and has dry soil. Zones 3 and 4 are dominated by trees but also contain shrub and herb layers in the understory.

### Recommended Uses
**W** = Wildlife
**H** = Horticulture & landscaping
**C** = Conservation & restoration
**D** = Domestic livestock forage

### Region
**M** = Mountain
**P** = Piedmont
**C** = Coastal Plain

### Minimum Light Requirements
**S** = Shade
**P** = Partial sun
**F** = Full sun

### Moisture Requirements
**L** = Low moisture
**M** = Moderate moisture
**H** = High moisture

### Riparian Buffer Zones
**1** = Emergent
**2** = Riverside thicket
**3** = Saturated forest
**4** = Well-drained forest

Some species are marked with the following footnote symbols:

\+ May be aggressive in a garden setting

* Due to the rarity and sensitivity of habitat in Virginia, these species are recommended for horticultural use only. Planting these species in natural areas could be detrimental to the survival of native populations.

| *Scientific Name* | *Common Name* | Uses W | H | C | D | Region M | P | C | Light S | P | F | Moisture L | M | H | Riparian Zone 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Herbs** | | | | | | | | | | | | | | | | | | |
| Amsonia tabernaemontana | blue star | | • | | | | • | • | • | • | | | • | • | | | • | • |
| Arisaema triphyllum | Jack-in-the-pulpit | | • | | | • | • | • | • | | | | • | | | | • | • |
| Asarum canadense+ | wild ginger | | • | • | | • | • | • | • | | | | • | | | | | • |
| Asclepias incarnata | swamp milkweed | • | • | • | | • | • | • | | • | • | | | • | • | • | | |
| Bidens cernua+ | nodding beggar-ticks | | • | • | • | • | • | • | | • | • | • | • | • | • | • | | |
| Boltonia asteroides* | aster-like boltonia | | • | | | | | • | | • | | • | | • | • | • | • | |
| Caltha palustris | marsh marigold | | | • | • | | • | | | • | • | | | • | | | • | |
| Chamaecrista fasciculata+ | partridge pea | | | • | | • | • | • | | | • | • | • | | | | | • |
| Chelone glabra | white turtlehead | | • | • | | • | • | • | • | • | | | | • | | • | • | |
| Chrysogonum virginianum | green and gold | | • | • | | • | • | • | • | | | | • | | | | | • |
| Conoclinium coelestinum | blue mistflower | • | • | • | | • | • | • | | • | • | | • | | | | • | • |
| Coreopsis tripteris | tall coreopsis | | • | • | | • | • | • | | • | • | | • | | | • | • | • |
| Delphinium tricorne | dwarf larkspur | | • | | | • | • | | • | • | | | • | | | | | • |
| Dicentra cucullaria | Dutchman's breeches | | • | | | • | • | | • | | | | • | | | | | • |
| Doellingeria umbellata | flat-top white aster | | • | • | | • | • | | | • | • | | • | • | | | • | |
| Equisetum hyemale | horsetail | | | • | | • | • | • | • | • | • | | • | • | | | • | • |
| Eupatoriadelphus fistulosus | Joe-pye weed | • | • | • | | • | • | • | | • | • | | • | • | | | • | • |
| Eupatorium perfoliatum | common boneset | | | • | | • | • | • | | • | • | | • | • | • | • | • | |
| Helenium autumnale | sneezeweed | • | • | • | | • | • | • | | • | • | | • | | • | • | • | |
| Helianthus decapetalus | ten-petaled sunflower | • | • | • | | • | • | • | | • | • | | • | | | | • | • |
| Helianthus divaricatus | woodland sunflower | • | • | • | | • | • | • | | • | | • | | | | | | • |
| Hibiscus moscheutos | Eastern rosemallow | • | • | • | | • | • | • | | | • | | • | • | • | | | |
| Iris virginica | Virginia blue flag | | • | • | | | • | • | | • | • | | • | • | | | | |
| Kosteletskya virginica | seashore mallow | • | | • | | | | • | | | • | | • | • | | | | |
| Lilium superbum | Turk's cap lily | | • | | | • | • | • | | • | • | | • | • | | | • | • |
| Lobelia cardinalis | cardinal flower | • | • | • | | • | • | • | | • | • | | | • | • | • | • | |
| Lobelia siphilitica | great blue lobelia | • | • | • | | • | • | • | • | • | | | • | | | | • | • |
| Maianthemum racemosum | false Solomon's seal | | • | • | | • | • | • | • | • | | | • | | | | • | • |
| Mertensia virginica | Virginia bluebells | | • | • | | • | • | • | | • | • | | • | • | | | • | • |
| Mimulus ringens | monkeyflower | | • | • | | • | • | • | | | • | | | • | • | • | • | |
| Monarda didyma | bee balm | • | • | • | | • | | • | | • | • | | • | | | | • | • |
| Nymphaea odorata | American water lily | • | • | • | | • | • | • | | | • | | • | • | | | | |
| Oenothera fruticosa | sundrops | • | • | • | | • | • | • | | | • | | • | • | | | | • |
| Packera aurea+ | golden ragwort | • | | • | | • | • | • | • | • | | | • | • | | | • | • |
| Peltandra virginica | arrow arum | • | • | • | | | • | • | | • | • | | | • | • | • | | |
| Phlox divaricata | woodland phlox | | • | • | | • | • | | | • | | • | • | | | | • | • |
| Phlox paniculata | summer phlox | | • | • | | • | • | • | | • | • | | • | | | | • | • |
| Podophyllum peltatum+ | mayapple | • | • | • | | • | • | • | | • | • | | • | | | | | • |
| Polemonium reptans | Jacob's ladder | | • | | | • | • | • | • | • | | | • | | | | | • |
| Pontederia cordata | pickerel weed | • | • | • | | | • | • | | | • | | | • | • | | | |
| Rhexia virginica | Virginia meadow-beauty | • | | • | | • | • | • | | | • | | | • | | | • | |
| Rudbeckia laciniata | cut-leaved coneflower | • | • | • | | • | • | • | | • | • | | • | | | | • | • |
| Sagittaria latifolia | broadleaf arrowhead | • | • | • | | • | • | • | | | • | | | • | • | • | | |
| Saururus cernuus | lizard's tail | | • | • | | • | • | • | | • | • | | | • | • | • | | |
| Solidago rugosa+ | rough-stemmed goldenrod | | • | | | • | • | • | | • | • | | • | | | | • | • |
| Symphyotrichum novae-angliae | New England aster | | • | • | | • | | | | • | • | • | • | | | | • | |
| Symphyotrichum novi-belgii | New York aster | • | • | • | | | • | | | • | • | | • | | • | • | | |
| Verbena hastata | blue vervain | | • | • | | • | • | | | • | • | | • | • | | • | • | |
| Vernonia noveboracensis | New York ironweed | • | • | • | | • | • | • | | • | • | | | • | | | • | • |
| Viola cucullata | marsh blue violet | • | • | • | | • | • | • | | • | • | | | • | | | • | |
| Viola pubescens | yellow violet | • | • | • | | • | • | | • | • | | | • | | | | | • |
| Zephyranthes atamasco | Atamasco lily | | • | • | | | • | | | • | • | | • | • | | | • | • |
| **Ferns & Fern Allies** | | | | | | | | | | | | | | | | | | |
| Athyrium asplenioides | Southern ladyfern | | • | • | | • | • | • | • | | | | • | • | | | • | • |
| Botrychium virginianum | rattlesnake fern | | • | | | • | • | • | • | • | | • | • | | | | | • |
| Onoclea sensibilis+ | sensitive fern | | • | • | | • | • | • | | • | • | | • | • | | | • | • |
| Osmunda cinnamomea | cinnamon fern | | • | • | | • | • | • | • | • | | | • | • | | • | • | |
| Osmunda regalis | royal fern | | • | • | | • | • | • | | • | | | • | • | | • | • | |
| Polystichum acrostichoides | Christmas fern | | • | • | | • | • | • | • | | | | • | | | | | • |
| Thelypteris palustris | marsh fern | | • | | | • | • | • | | • | • | | • | • | • | • | • | |
| Woodwardia virginica+ | Virginia chain fern | | • | • | | | • | | • | • | • | | • | • | • | • | | |
| **Grasses, Sedges & Rushes** | | | | | | | | | | | | | | | | | | |
| Agrostis perennans | autumn bentgrass | | | • | | • | • | • | • | • | • | • | • | • | | • | • | |
| Andropogon gerardii | big bluestem | • | • | • | • | • | • | | | • | • | • | • | | | • | • | |
| Andropogon glomeratus | bushy bluestem | | • | • | | • | • | • | | • | • | | • | • | | | • | |
| Arundinaria gigantea | wild cane | • | | • | | • | | | • | • | • | | • | • | | • | • | • |
| Arundinaria tecta | switch cane | • | | • | | | • | • | • | • | • | | • | • | • | • | • | |
| Carex crinita | long hair sedge | • | • | • | | • | • | • | | • | • | | • | • | • | • | • | |
| Carex lurida | sallow sedge | • | | • | | • | • | • | | • | • | | • | • | • | • | • | |
| Carex stricta | tussock sedge | • | | • | | • | • | • | | • | • | | • | • | • | • | • | |
| Chasmanthium latifolium+ | river oats, spanglegrass | | • | • | | • | • | • | • | • | • | | • | | | • | • | • |
| Dichanthelium clandestinum | deer-tongue | • | | • | • | • | • | • | | • | • | • | • | • | | • | • | |
| Dichanthelium commutatum | variable panicgrass | • | • | • | | • | • | • | • | • | | • | • | | | | | • |
| Dulichium arundinaceum | dwarf bamboo | • | | • | • | • | • | • | | • | • | | • | • | • | • | • | |
| Elymus hystrix | bottlebrush grass | • | • | | | • | • | • | • | • | • | • | • | | | | | • |
| Elymus virginicus | Virginia wild rye | • | | • | | • | • | • | • | • | | • | • | | | • | • | • |

| *Scientific Name* | *Common Name* | Uses W | H | C | D | Region M | P | C | Light S | P | F | Moisture L | M | H | Riparian Zone 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Juncus canadensis | Canada rush | • | • | | | | • | • | | • | • | | • | • | • | • | • | |
| Juncus effusus | soft rush | • | • | | | • | • | • | | • | • | | • | • | • | • | • | |
| Leersia oryzoides | rice cutgrass | • | • | | | • | • | • | | • | • | | • | • | • | • | • | |
| Panicum virgatum | switch grass | • | • | • | | • | • | • | | • | • | • | • | • | • | • | • | |
| Saccharum giganteum | giant plumegrass | • | • | • | | | • | • | | • | • | | • | • | • | • | • | |
| Scirpus cyperinus | woolgrass bulrush | • | • | • | | • | • | • | | • | • | | • | • | • | • | • | |
| Sparganium americanum | American bur-reed | • | • | | | • | • | • | | • | • | | | • | • | | | |
| Tripsacum dactyloides | gama grass | • | • | • | • | • | • | • | | • | • | | • | • | • | • | • | |
| Typha latifolia | broad-leaved cattail | • | • | | | • | • | • | | | • | | • | • | • | | | |
| Zizania aquatica | wild rice | • | • | • | | | | • | | | • | | | • | • | | | |
| **Vines** | | | | | | | | | | | | | | | | | | |
| Bignonia capreolata | crossvine | • | • | | | • | • | • | • | • | | | • | • | | | • | • |
| Celastrus scandens | climbing bittersweet | • | • | | | • | • | • | • | • | • | | • | | | | | • |
| Clematis virginiana | virgin's bower | | • | | | • | • | • | | • | • | | • | | | | • | • |
| Parthenocissus quinquefolia | Virginia creeper | • | • | • | | • | • | • | | • | • | | • | | | | • | • |
| **Shrubs & Small Trees** | | | | | | | | | | | | | | | | | | |
| Alnus serrulata | hazel alder | • | • | • | | • | • | • | • | • | • | | | • | • | • | • | |
| Aronia arbutifolia | red chokeberry | | • | • | | • | • | • | | • | • | | • | • | | | • | • |
| Aronia melanocarpa | black chokeberry | | • | • | | • | • | • | | • | • | • | • | • | | | • | • |
| Baccharis halimifolia | high tide bush | | • | • | | | • | | | • | • | • | • | • | | | • | • |
| Callicarpa americana | American beautyberry | • | • | | | | • | • | • | • | | | • | | | | • | • |
| Cephalanthus occidentalis | buttonbush | | • | • | | • | • | • | | • | • | | | • | • | • | | |
| Clethra alnifolia | sweet pepper-bush | • | • | • | | | • | • | • | • | | | • | • | | | • | |
| Cornus amomum | silky dogwood | • | | • | | • | • | • | • | • | | | • | • | | | • | • |
| Eubotrys racemosa | fetterbush | | • | • | | • | • | • | | • | • | | • | | • | • | | |
| Hydrangea arborescens | wild hydrangea | | • | | | • | • | • | • | • | | | • | | | | | • |
| Ilex decidua | deciduous holly | • | • | • | | | • | • | • | • | | | • | | | | • | • |
| Ilex verticillata | winterberry | • | • | • | | • | • | • | | • | • | | • | • | | | • | • |
| Itea virginica | Virginia willow | • | • | • | | | • | • | • | • | | | | • | | | • | • |
| Leucothoe axillaris | coastal dog-hobble | | • | | | | • | | • | | | | • | | | | • | • |
| Lindera benzoin | spicebush | • | • | • | | • | • | • | | • | | | • | | | | | • |
| Myrica cerifera | Southern wax myrtle | • | • | • | | | • | • | • | • | | | • | • | • | • | • | • |
| Rhododendron viscosum | swamp azalea | | • | • | | • | • | • | | • | | | • | • | • | | | |
| Rubus allegheniensis | Alleghany blackberry | • | • | • | | • | • | | | • | • | | | | | | • | • |
| Salix sericea | silky willow | | • | • | | • | • | • | | • | • | | • | | | | • | • |
| Sambucus canadensis | common elderberry | • | • | • | | • | • | • | | | • | | • | • | | | • | • |
| Spiraea alba | narrow-leaved meadowsweet | • | • | • | | • | | | | • | | | • | | | | • | • |
| Spiraea latifolia | broad-leaved meadowsweet | • | • | • | | • | | | | • | | | • | | | | • | • |
| Vaccinium corymbosum | highbush blueberry | • | • | • | | • | • | • | • | • | • | • | • | • | | | • | • |
| Viburnum dentatum | Southern arrow-wood viburnum | • | • | • | | • | • | • | | • | • | • | • | | | | • | • |
| Viburnum prunifolium | black-haw viburnum | • | • | • | | • | • | • | | • | • | | • | | | | | • |
| **Medium Trees** | | | | | | | | | | | | | | | | | | |
| Amelanchier arborea | downy serviceberry | • | • | • | | • | • | • | | • | • | | • | | | | | • |
| Amelanchier canadensis | Canada serviceberry | • | • | • | | • | • | • | | | • | | • | • | | | • | • |
| Amelanchier laevis | smooth serviceberry | • | • | • | | • | | | | • | • | • | • | | | | | • |
| Asimina triloba | paw paw | • | • | • | | • | • | • | • | • | | | • | | | | • | • |
| Cornus alternifolia | alternate-leaf dogwood | • | • | • | | • | • | • | | • | • | • | • | | | | | • |
| Crataegus viridis | green hawthorn | • | • | • | | • | • | • | | • | • | | • | • | | | • | • |
| Morus rubra | red mulberry | • | • | • | | • | • | • | • | • | | | • | | | | • | • |
| Ostrya virginiana | Eastern hop-hornbeam | | • | | | • | • | • | • | • | | | • | | | | | • |
| Persea borbonia | redbay | | • | • | | | • | • | • | • | | | • | • | | | • | |
| Rhus glabra | smooth sumac | • | • | • | | • | • | • | | • | • | | • | • | | | • | • |
| Salix nigra | black willow | | | • | | • | • | • | | • | • | | • | • | • | • | • | |
| **Large Trees** | | | | | | | | | | | | | | | | | | |
| Acer rubrum | red maple | | • | • | | • | • | • | | | • | | • | • | • | • | • | • |
| Betula lenta | sweet birch | • | • | • | | • | • | | | • | • | | • | | | | • | • |
| Betula nigra | river birch | • | • | • | | • | • | • | | | • | | • | • | • | • | | |
| Diospyros virginiana | persimmon | • | • | • | | • | • | • | • | • | • | • | • | | | | • | • |
| Fraxinus americana | white ash | • | • | | | • | • | • | | • | • | | • | | | | • | • |
| Fraxinus pensylvanica | green ash | • | • | • | | • | • | • | | • | • | | • | | | | • | • |
| Juglans nigra | black walnut | • | | • | | • | • | • | | • | • | | • | | | | • | • |
| Liquidambar styraciflua | sweetgum | | • | • | | • | • | • | • | • | | | • | • | | | • | • |
| Liriodendron tulipifera | tulip poplar | • | • | • | | • | • | • | | | • | | • | | | | | • |
| Nyssa aquatica | water tupelo | • | • | • | | | | • | | • | • | | | • | • | | | |
| Nyssa sylvatica | black gum | • | • | • | | • | • | • | | • | • | | • | | | | • | • |
| Oxydendrum arboreum | sourwood | | • | | | • | • | • | | • | | | • | | | | • | • |
| Pinus taeda | loblolly pine | • | • | • | | | • | • | | | • | • | • | • | | | • | • |
| Platanus occidentalis | sycamore | | | • | | • | • | • | | • | • | | • | • | | | • | • |
| Quercus bicolor | swamp white oak | • | | • | | • | • | • | • | • | | | | • | | | • | • |
| Quercus laurifolia | swamp laurel oak | • | • | | | | • | • | | • | • | | • | • | | | • | • |
| Quercus michauxii | swamp chestnut oak | • | • | | | | • | • | | • | • | | | • | | | • | • |
| Quercus nigra | water oak | • | • | | | | • | • | • | • | | • | • | | | | • | • |
| Quercus palustris | pin oak | • | • | • | | • | • | • | • | • | | | • | • | | | • | • |
| Quercus phellos | willow oak | • | • | • | | | • | • | | • | • | | • | • | | | • | • |
| Taxodium distichum | bald cypress | | • | • | | | • | | | • | | | • | | • | | | |

## ABOUT THE NATIVE PLANTS FOR CONSERVATION, RESTORATION AND LANDSCAPING PROJECT

This project is a collaboration between the Virginia Department of Conservation and Recreation and the Virginia Native Plant Society. VNPS chapters across the state helped to fund the 2011 update to this brochure.

The following partners have provided valuable assistance throughout the life of this project:

*The Nature Conservancy – Virginia Chapter • Virginia Tech Department of Horticulture • Virginia Department of Agriculture and Consumer Services • Virginia Department of Environmental Quality, Coastal Zone Management Program • Virginia Department of Forestry • Virginia Department of Game and Inland Fisheries • Virginia Department of Transportation*

## FOR MORE INFORMATION

Virginia Department of Conservation and Recreation
Natural Heritage Program
804-786-7951
www.dcr.virginia.gov/natural_heritage/nativeplants.shtml

## FOR A LIST OF NURSERIES THAT PROPAGATE NATIVE SPECIES, CONTACT:

Virginia Native Plant Society
400 Blandy Farm Lane, Unit 2
Boyce, VA 22620
540-837-1600 | vnpsofc@shentel.net
www.vnps.org

## FOR A LIST OF NURSERIES IN A PARTICULAR REGION OF VIRGINIA, CONTACT:

The Virginia Nursery and Landscape Association
383 Coal Hollow Road
Christiansburg, VA 24073
540-382-0943 | vnla@verizon.net
To search for species in VNLA member catalogs, visit:
www.vnla.org/search.asp

## ILLUSTRATIONS COURTESY OF THE FLORA OF VIRGINIA PROJECT.

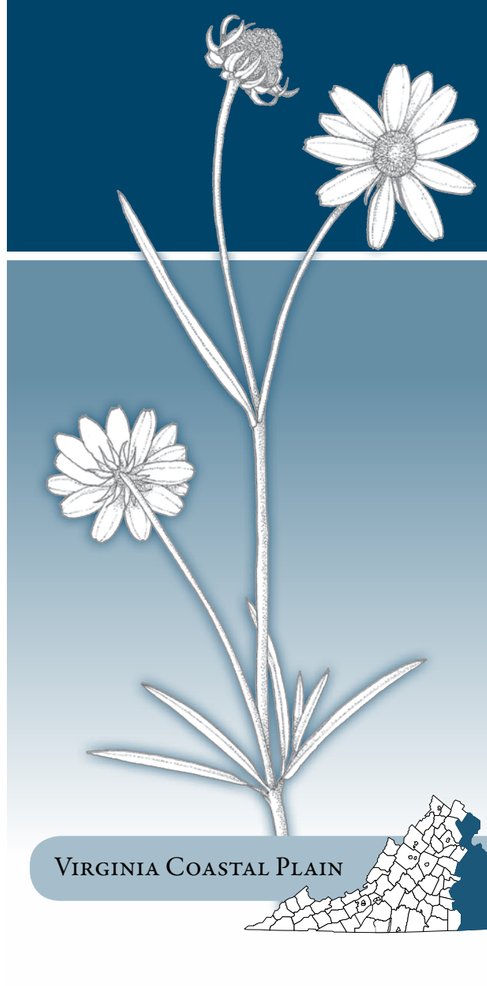
Illustrators: Lara Gastinger, Roy Fuller and Michael Terry. To learn more, visit:
www.floraofvirginia.org

DCR Virginia Department of Conservation & Recreation

9/2011

# Native Plants

## for Conservation, Restoration & Landscaping



Virginia Coastal Plain

## WHAT ARE NATIVES?

Native species evolved within specific regions and dispersed throughout their range without known human involvement. They form the primary component of the living landscape and provide food and shelter for native animal species. Native plants co-evolved with native animals over many thousands to millions of years and have formed complex and interdependent relationships. Our native fauna depend on native flora to provide food and cover. Many animals require specific plants for their survival.

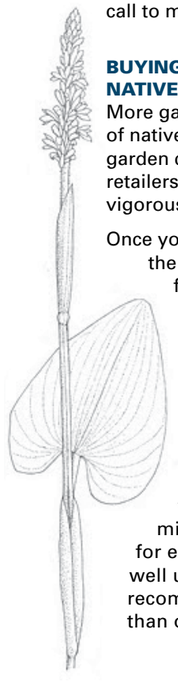
## BENEFITS OF NATIVE PLANTS

Using native species in landscaping reduces the expense of maintaining cultivated landscapes and minimizes the likelihood of introducing new invasive species. It may provide a few unexpected benefits as well.

Native plants often require less water, fertilizer and pesticide, thus adding fewer chemicals to the landscape and maintaining water quality in nearby rivers and streams. Fewer inputs mean time and money saved for the gardener.

Native plants increase the presence of desirable wildlife, such as birds and butterflies, and provide sanctuaries for these animals as they journey between summer and winter habitats. The natural habitat you create with native plants can become an outdoor classroom for children, or a place for you to find peace and quiet after a busy day.

Native plants evoke a strong sense of place and regional character. For example, live oak and magnolia trees are strongly associated with the Deep South. Redwood trees characterize the Pacific Northwest. Saguaro cacti call to mind the deserts of the Southwest.



## BUYING AND GROWING NATIVE PLANTS

More gardeners today are discovering the benefits of native plants and requesting them at their local garden centers. Because of this increased demand, retailers are offering an ever-widening selection of vigorous, nursery-propagated natives.

Once you've found a good vendor for native plants, the next step is choosing appropriate plants for a project. One of the greatest benefits of designing with native plants is their adaptation to local conditions. However, it is important to select plants with growth requirements that best match conditions in the area to be planted.

If you're planning a project using native plant species, use the list in this brochure to learn which plants grow in your region of Virginia. Next, study the minimum light and moisture requirements for each species, noting that some plants grow well under a variety of conditions. Many of the recommended species are well-suited to more than one of these categories.

For more information, refer to field guides and publications on local natural history for color, shape, height, bloom times and specific wildlife value of the plants that grow in your region. Visit a nearby park, natural area preserve, forest or wildlife management area to learn about common plant associations, spatial groupings and habitat conditions. For specific recommendations and advice about project design, consult a landscape or garden design specialist with experience in native plants.

## WHAT ARE NON-NATIVE PLANTS?

Sometimes referred to as "exotic," "alien," or "non-indigenous," non-native plants are species introduced, intentionally or accidentally, into a new region by humans. Over time, many plants and animals have expanded their ranges slowly and without human assistance. As people began cultivating plants, they brought beneficial and favored species along when they moved into new regions or traded with people in distant lands. Humans thus became a new pathway, enabling many species to move into new locations.

## WHAT ARE INVASIVE PLANTS?

Invasive plants are introduced species that cause health, economic or ecological damage in their new range. More than 30,000 species of plants have been introduced to the United States since the time of Columbus. Most were introduced intentionally, and many provide great benefits to society as agricultural crops and landscape ornamentals. Some were introduced accidentally, for example, in ship ballast, in packing material and as seed contaminants. Of these introduced species, fewer than 3,000 have naturalized and become established in the United States outside cultivation. Of the 3,500 plant species in Virginia, more than 800 have been introduced since the founding of Jamestown. The Virginia Department of Conservation and Recreation currently lists more than 100 of these species as invasive.

In the United States, invasive species cause an estimated $120 billion in annual economic losses, including costs to manage their effects. Annual costs and damages arising from invasive plants alone are estimated at $34 billion.

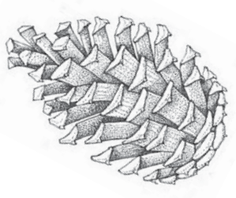
## NATIVE PLANTS VS. INVASIVE PLANTS

Invasive plants have competitive advantages that allow them to disrupt native plant communities and the wildlife dependent on them. For example, kudzu (*Pueraria montana*) grows very rapidly and overtops forest canopy, thus shading other plant species from the sunlight necessary for their survival. A tall invasive wetland grass, common reed (*Phragmites australis ssp. australis*), invades and dominates marshes, reducing native plant diversity and sometimes eliminating virtually all other species.

Invasive species can marginalize or even cause the loss of native species. With their natural host plants gone, many insects disappear. And since insects are an essential part of the diet of many birds, the effects on the food web become far reaching. Habitats with a high occurrence of invasive plants become a kind of "green desert." Although green and healthy in appearance, far fewer native species of plants and animals are found in such radically altered places.

# Virginia Coastal Plain

Virginia's Coastal Plain extends from the sands of Virginia Beach west to the fall line. Formed by marine sediments eroded from the Appalachian Highlands, the Coastal Plain varies in topography from north to south. In the north, the Northern Neck is somewhat hilly and well-drained. On the Middle Peninsula and Lower Peninsula, hills are less steep. South of the James River, the landscape levels off to about a 1-degree slope toward the ocean. In places, streams cut easily through the sands, gravels and clays to form well-developed ravine systems, and tidal rivers widen as the topography flattens. The Eastern Shore, separated from the mainland by the Chesapeake Bay, exhibits relatively little topography across the uplands extending from the Atlantic on the east to the bay on the west. From white sand beaches of the barrier islands, to tidal freshwater marshes, to blackwater swamps, to upland mixed hardwood and pine forests, the Coastal Plain has a diverse array of habitats for many native plant species.



**Recommended Uses**
**W** = Wildlife
**H** = Horticulture & landscaping
**C** = Conservation & restoration
**D** = Domestic livestock forage

**Minimum Light Requirements**
**S** = Shade
**P** = Partial sun
**F** = Full sun

**Moisture Requirements**
**L** = Low moisture
**M** = Moderate moisture
**H** = High moisture

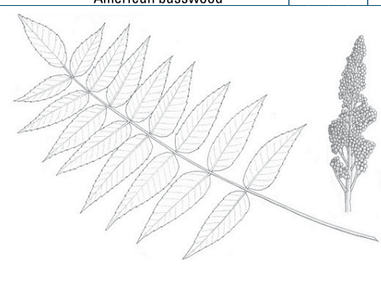
Some species are marked with the following footnote symbols:

\+ May be aggressive in a garden setting

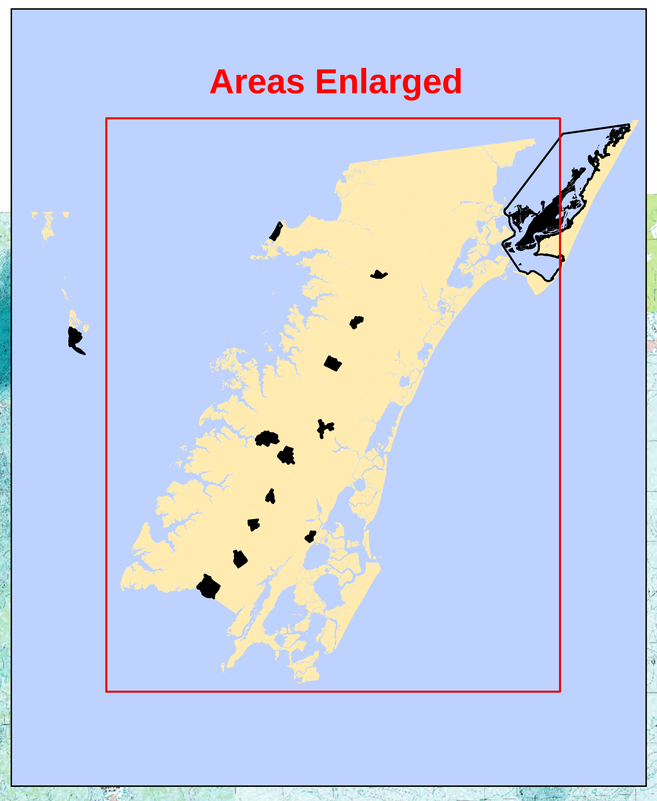
* Due to the rarity and sensitivity of habitat in Virginia, these species are recommended for horticultural use only. Planting these species in natural areas could be detrimental to the survival of native populations.

| Scientific Name | Common Name | Uses | | | | Light | | | Moisture | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | W | H | C | D | S | P | F | L | M | H |
| **Herbs** | | | | | | | | | | | |
| Achillea millefolium | common yarrow | | • | | | | • | • | • | | |
| Ageratina altissima | white snakeroot | • | | | | • | • | | | • | |
| Amsonia tabernaemontana | blue star | | • | | | | • | • | | | • |
| Anemone quinquefolia | wood anemone | | • | | | | • | • | | • | |
| Anemonella thalictroides | rue anemone | | • | | | | • | | | • | |
| Aquilegia canadensis | wild columbine | • | • | | | | • | • | • | • | |
| Arisaema triphyllum | Jack-in-the-pulpit | | • | | | | • | | | • | |
| Aruncus dioicus | goatsbeard | | • | | | | • | • | | • | |
| Asarum canadense+ | wild ginger | | • | • | | | • | | | • | |
| Asclepias incarnata | swamp milkweed | • | • | • | | | • | • | | | • |
| Asclepias syriaca+ | common milkweed | | • | • | | | | • | • | | |
| Asclepias tuberosa | butterfly weed | • | • | • | | | | • | • | | |
| Baptisia tinctoria | yellow wild-indigo | | • | • | | | • | • | • | | |
| Bidens cernua+ | nodding beggar-ticks | • | • | • | | | • | • | • | • | • |
| Boltonia asteroides* | aster-like boltonia | | • | | | | | • | | • | |
| Caltha palustris | marsh marigold | | • | • | | | • | • | | | • |
| Chamaecrista fasciculata+ | partridge pea | | | • | | | | • | • | • | |
| Chelone glabra | white turtlehead | | • | • | | • | • | | | | • |
| Chrysogonum virginianum | green and gold | | • | • | | | • | | | • | |
| Chrysopsis mariana | Maryland golden aster | • | • | • | | | • | • | • | | |
| Cimicifuga racemosa | black cohosh | | • | | | • | • | | | • | |
| Clitoria mariana | Maryland butterfly pea | | • | • | | • | • | | • | | |
| Conoclinium coelestinum | blue mistflower | • | • | • | | | • | • | | • | |
| Coreopsis lanceolata | longstalk coreopsis | • | • | | | | | | • | | |
| Coreopsis tinctoria | golden tickseed | • | • | | | | • | • | | • | |
| Coreopsis tripteris | tall coreopsis | | • | • | | | • | • | | • | |
| Coreopsis verticillata | threadleaf coreopsis | | • | • | | | • | • | • | | |
| Desmodium paniculatum | narrow-leaf tick trefoil | • | | • | | • | | | • | | |
| Equisetum hyemale | horsetail | | | • | | • | • | • | | • | • |
| Eupatoriadelphus fistulosus | Joe-pye weed | • | • | • | | | • | • | | • | • |
| Eupatorium perfoliatum | common boneset | | | • | | | • | • | | • | • |
| Helenium autumnale | sneezeweed | • | • | • | | | • | • | | • | |
| Helianthus angustifolius | narrow-leaf sunflower | • | • | • | | | • | • | | • | • |
| Helianthus decapetalus | ten-petaled sunflower | • | • | • | | | • | • | | • | |
| Helianthus divaricatus | woodland sunflower | • | • | • | | | • | | • | | |
| Heliopsis helianthoides | oxeye sunflower | • | • | • | | | • | • | • | • | |
| Hepatica nobilis var. obtusa | round-lobed hepatica | | • | | | • | | | • | • | |
| Heuchera americana | alumroot | | • | | | • | | | • | | |
| Hibiscus moscheutos | Eastern rosemallow | • | • | • | | | | • | | | • |
| Iris prismatica | slender blueflag | | • | | | | • | • | | • | • |
| Iris virginica | Virginia blue flag | | • | • | | | • | • | | | • |
| Kosteletskya virginica | seashore mallow | • | | • | | | | • | | | • |
| Lespedeza capitata | round-head bush clover | | • | | | | | • | • | | |
| Liatris pilosa var. pilosa | grass-leaf blazing star | • | • | • | | | • | • | • | • | |
| Lilium superbum | Turk's cap lily | | • | | | | • | • | | • | • |
| Lobelia cardinalis | cardinal flower | • | • | • | | | • | • | | | • |
| Lobelia siphilitica | great blue lobelia | • | • | • | | • | • | | | | • |
| Lupinus perennis | lupine | | • | | | | • | • | • | | |
| Maianthemum racemosum | false Solomon's seal | | • | • | | • | • | | | • | |
| Mimulus ringens | monkeyflower | | • | • | | | | • | | | • |
| Monarda fistulosa | wild bergamot | • | • | • | | | • | • | • | • | |
| Monarda punctata | Horse-mint | • | • | | | | | • | • | | |
| Nymphaea odorata | American water lily | • | • | • | | | | • | | | • |
| Oenothera fruticosa | sundrops | • | • | • | | | | • | | • | • |
| Opuntia humifusa | Eastern prickly-pear | • | • | • | | | | • | • | | |
| Packera aurea+ | golden ragwort | • | | • | | • | • | | | • | • |
| Peltandra virginica | arrow arum | • | • | • | | | • | • | | | • |
| Penstemon laevigatus | smooth beardtongue | | • | | | • | • | • | | • | |
| Phlox paniculata | summer phlox | | • | • | | | • | • | | • | |
| Podophyllum peltatum+ | mayapple | • | • | • | | | • | • | | • | |
| Polemonium reptans | Jacob's ladder | | • | | | • | • | | | • | |
| Polygonatum biflorum | Solomon's seal | | • | | | • | • | | • | • | |
| Pontederia cordata | pickerel weed | • | • | • | | | | • | | | • |
| Pycnanthemum incanum | hoary mountain mint | • | | • | | • | | | • | | |
| Pycnanthemum tenuifolium | narrow-leaved mountain mint | • | • | • | | | • | • | • | • | |
| Rhexia virginica | Virginia meadow-beauty | • | | • | | | | • | | | • |
| Rudbeckia hirta | black eyed Susan | | • | • | | | • | • | • | • | |
| Rudbeckia laciniata | cut-leaved coneflower | • | • | • | | | • | • | | • | |
| Rudbeckia triloba | three-lobed coneflower | • | • | • | | | • | • | | • | |
| Sagittaria latifolia | broadleaf arrowhead | • | • | • | | | | • | | | • |
| Salvia lyrata+ | lyre-leaf sage | | | • | | | • | • | • | | |
| Sanguinaria canadensis | bloodroot | | • | | | • | | | | • | |
| Saururus cernuus | lizard's tail | | • | • | | | • | • | | | • |
| Saxifraga virginiensis | early saxifrage | | • | | | • | • | • | • | • | |
| Sedum ternatum | wild stonecrop | | • | | | • | • | | | • | |
| Senna marilandica | Maryland wild senna | | • | • | | | • | | • | • | |
| Solidago caesia | bluestem goldenrod | • | • | • | | • | • | | | • | |
| Solidago odora | sweet goldenrod | • | • | • | | | • | • | • | | |
| Solidago pinetorum+ | pineywoods goldenrod | | • | | • | | • | • | • | | |
| Solidago puberula | downy goldenrod | • | • | • | | | | • | • | | |
| Solidago rugosa+ | rough-stemmed goldenrod | • | | • | | | • | • | | • | |
| Solidago sempervirens | seaside goldenrod | • | • | • | | | • | • | | • | |
| Symphyotrichum concolor | Eastern silvery aster | • | • | • | | | | • | • | | |
| Symphyotrichum cordifolium | heart-leaved aster | | • | • | | | • | • | | • | |
| Symphyotrichum novi-belgii | New York aster | • | • | • | | | • | • | | • | |
| Symphyotrichum pilosum | frost aster | • | • | • | | | | • | • | | |
| Tradescantia virginiana+ | Virginia spiderwort | | • | • | | • | • | • | | • | |
| Vernonia noveboracensis | New York ironweed | • | • | • | | | • | • | | | • |
| Viola cucullata | marsh blue violet | • | • | • | | | • | • | | | • |
| Viola pedata | bird's foot violet | • | | | | | • | • | • | | |
| Yucca filamentosa | common yucca | • | • | | | | | • | • | | |
| Zephyranthes atamasco | Atamasco lily | | • | • | | | • | • | | • | • |
| **Ferns & Fern Allies** | | | | | | | | | | | |
| Adiantum pedatum | maidenhair fern | | • | • | | | • | | | • | |
| Asplenium platyneuron | ebony spleenwort | | • | | | • | • | | | • | |
| Athyrium asplenioides | Southern ladyfern | | • | • | | | • | | | • | • |
| Botrychium virginianum | rattlesnake fern | | • | | | | • | • | • | • | |
| Dennstaedtia punctilobula+ | hay-scented fern | | | • | | | • | • | • | • | |
| Dryopteris intermedia | evergreen wood-fern | | • | • | | | • | • | | • | • |
| Onoclea sensibilis+ | sensitive fern | | • | • | | | • | • | | • | • |
| Osmunda cinnamomea | cinnamon fern | | • | • | | | • | • | | • | • |
| Osmunda regalis | royal fern | | • | • | | | • | | | • | • |
| Polystichum acrostichoides | Christmas fern | | • | • | | | • | | | • | |
| Thelypteris palustris | marsh fern | | • | | | | • | • | | • | • |
| Woodwardia virginica+ | Virginia chain fern | | • | • | | | • | • | | • | • |
| **Grasses, Sedges & Rushes** | | | | | | | | | | | |
| Agrostis perennans | autumn bentgrass | | | • | | | • | • | • | • | • |
| Andropogon glomeratus | bushy bluestem | | • | • | | | • | • | | • | • |
| Andropogon virginicus | broomsedge | | • | • | | | • | • | • | • | • |
| Arundinaria tecta | switch cane | • | | • | | | • | • | | • | • |
| Carex crinita | long hair sedge | • | • | • | | | • | | | • | • |
| Carex lurida | sallow sedge | • | | • | | | • | • | | • | • |
| Carex pensylvanica | Pennsylvania sedge | | • | • | | | • | • | • | • | |
| Carex stricta | tussock sedge | • | | • | | | • | • | | • | • |
| Chasmanthium latifolium+ | river oats, spanglegrass | | • | • | | | • | • | | • | |
| Danthonia sericea | silky oatgrass | • | | • | | | • | • | • | • | |
| Danthonia spicata | poverty oatgrass | | • | | | | • | • | • | • | |
| Dichanthelium clandestinum | deer-tongue | • | | • | • | | • | • | • | • | • |
| Dichanthelium commutatum | variable panicgrass | • | • | • | | | • | • | | • | |
| Dulichium arundinaceum | dwarf bamboo | • | | • | • | | • | • | | | • |
| Elymus hystrix | bottlebrush grass | • | • | | | | • | • | • | • | |
| Elymus virginicus | Virginia wild rye | • | | • | | | • | • | | • | • |
| Juncus canadensis | Canada rush | • | | • | | | • | • | | • | • |
| Juncus effusus | soft rush | • | | • | | | • | • | | • | • |
| Leersia oryzoides | rice cutgrass | • | | • | | | • | • | | • | • |
| Panicum amarum | coastal panic grass | • | • | • | | | | • | • | | |
| Panicum virgatum | switch grass | • | • | • | | | • | • | • | • | • |
| Saccharum giganteum | giant plumegrass | • | • | • | | | • | • | | • | • |
| Schizachyrium scoparium | little bluestem | • | • | • | • | | • | • | • | • | |
| Scirpus cyperinus | woolgrass bulrush | • | • | • | | | • | • | | • | • |
| Sorghastrum nutans | Indian grass | • | • | • | • | | • | • | • | • | |
| Sparganium americanum | American bur-reed | • | | • | | | • | • | | | • |
| Tridens flavus | redtop | • | • | • | • | | • | • | • | • | |
| Tripsacum dactyloides | gama grass | • | • | • | • | | • | • | | • | • |
| Typha latifolia | broad-leaved cattail | • | | • | | | | • | | • | • |
| Zizania aquatica | wild rice | • | • | • | | | | • | | | • |

| Scientific Name | Common Name | Uses | | | | Light | | | Moisture | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | W | H | C | D | S | P | F | L | M | H |
| **Vines** | | | | | | | | | | | |
| Bignonia capreolata | crossvine | • | • | | | • | • | | | • | • |
| Campsis radicans | trumpet creeper | • | • | | | | • | • | • | • | |
| Celastrus scandens | climbing bittersweet | • | • | | | • | • | • | | • | |
| Clematis virginiana | virgin's bower | | • | | | | • | • | | • | |
| Decumaria barbara | climbing hydrangea | | • | • | | • | • | | | • | • |
| Gelsemium sempervirens | Carolina jasmine | • | • | | | • | • | • | • | • | • |
| Lonicera sempervirens | trumpet honeysuckle | | • | • | | | • | | | • | |
| Parthenocissus quinquefolia | Virginia creeper | • | • | • | | | • | • | | • | |
| Passiflora incarnata | Purple passionflower | • | • | | | | • | • | • | • | |
| Wisteria frutescens | Atlantic wisteria | | • | | | | • | • | | • | • |
| **Shrub & Small Trees** | | | | | | | | | | | |
| Alnus serrulata | hazel alder | | • | • | • | | • | • | | | • |
| Aronia arbutifolia | red chokeberry | | • | • | | • | • | | | • | • |
| Aronia melanocarpa | black chokeberry | | • | • | | | • | • | • | • | • |
| Baccharis halimifolia | high tide bush | | • | • | | | • | • | • | • | • |
| Callicarpa americana | American beautyberry | • | • | | | • | • | | | • | |
| Castanea pumila | Allegheny chinkapin | • | • | • | | • | • | • | • | | |
| Ceanothus americanus | New Jersey tea | • | • | • | | | • | • | • | | |
| Cephalanthus occidentalis | buttonbush | | • | • | | | • | | | | • |
| Clethra alnifolia | sweet pepper-bush | • | • | • | | • | • | | | • | • |
| Cornus amomum | silky dogwood | • | | • | | • | • | | | • | • |
| Crataegus crus-galli | cockspur hawthorn | • | • | • | | | • | • | • | • | |
| Eubotrys racemosa | fetterbush | | • | • | | | • | • | | • | |
| Euonymus americanus | American strawberry-bush | • | • | | | | • | | | • | |
| Gaultheria procumbens | wintergreen | • | • | | | • | • | | • | • | |
| Gaylussacia baccata | black huckleberry | • | • | • | | | • | • | • | • | |
| Gaylussacia frondosa | dangleberry | • | • | • | | | • | • | • | | |
| Hamamelis virginiana | witch hazel | | • | • | | | • | • | | • | • |
| Hydrangea arborescens | wild hydrangea | | | • | | | • | • | | • | |
| Ilex decidua | deciduous holly | • | • | • | | | • | • | | | • |
| Ilex glabra | inkberry | • | • | • | | | • | • | • | • | |
| Ilex verticillata | winterberry | • | • | • | | | • | • | | • | • |
| Ilex vomitoria | yaupon holly | • | • | • | | • | • | • | • | | |
| Itea virginica | Virginia willow | • | • | • | | | • | • | | | • |
| Iva frutescens | marsh elder | | • | • | | | | • | • | • | |
| Kalmia latifolia | mountain laurel | • | • | • | | | • | • | | • | |
| Leucothoe axillaris | coastal dog-hobble | | • | | | | • | | | • | |
| Lindera benzoin | spicebush | • | • | • | | | • | | | • | |
| Lyonia lucida | shining fetterbush | | • | • | | | • | • | | • | |
| Morella caroliniensis | Southern bayberry | • | • | • | | | • | • | | • | • |
| Morella pensylvanica | Northern bayberry | • | • | • | | | | • | • | • | • |
| Myrica cerifera | Southern wax myrtle | • | • | • | | | • | • | | • | • |
| Rhododendron atlanticum | dwarf azalea | • | • | | | | • | | | • | |
| Rhododendron periclymenoides | pinxter flower | | • | • | | | • | • | | • | • |
| Rhododendron viscosum | swamp azalea | | • | • | | | • | • | | • | • |
| Rhus copallinum | winged sumac | | • | • | | | • | • | • | | |
| Rosa carolina | pasture rose | • | | • | | | • | • | • | • | |
| Salix humilis | prairie willow | | • | • | | | | • | • | | |
| Salix sericea | silky willow | | • | • | | | • | • | | • | |
| Sambucus canadensis | common elderberry | • | • | • | | | | • | | • | • |
| Stewartia malacodendron* | silky camelia | | • | | | • | • | | | • | |
| Vaccinium corymbosum | highbush blueberry | • | • | • | | • | • | • | • | • | • |
| Vaccinium stamineum | deerberry | • | | | | | • | | • | • | |
| Viburnum dentatum | Southern arrow-wood viburnum | • | • | • | | | • | • | • | • | |
| Viburnum nudum | possum-haw viburnum | | • | • | | • | • | | | | • |
| Viburnum prunifolium | black-haw viburnum | • | • | • | | | • | • | | • | |
| **Medium Trees** | | | | | | | | | | | |
| Amelanchier arborea | downy serviceberry | • | • | • | | | • | • | | • | |
| Amelanchier canadensis | Canada serviceberry | • | • | • | | | | • | | • | • |
| Aralia spinosa | devil's walkingstick | • | • | | | | • | | | • | |
| Asimina triloba | paw paw | • | • | • | | • | • | | | • | |
| Carpinus caroliniana | American hornbeam | • | • | | | | • | • | | • | |
| Cercis canadensis | Eastern redbud | | • | • | | • | • | | | • | |
| Chionanthus virginicus | fringetree | | • | | | | • | • | | • | |
| Cornus florida | flowering dogwood | • | • | • | | • | • | | • | • | |
| Crataegus viridis | green hawthorn | • | • | • | | | • | • | | • | • |
| Ilex opaca | American holly | • | • | • | | • | | | | • | |
| Magnolia virginiana | sweetbay magnolia | | • | • | | • | • | | | • | • |
| Morus rubra | red mulberry | • | • | • | | • | • | | | • | |
| Ostrya virginiana | Eastern hop-hornbeam | | • | | | • | • | | | • | |
| Persea borbonia | redbay | | • | • | | • | • | | | • | • |
| Prunus americana | American wild plum | | • | • | | | • | | | • | |
| Rhus glabra | smooth sumac | • | • | • | | | | • | • | • | |
| Rhus typhina | staghorn sumac | • | • | • | | | | • | • | | |
| Salix nigra | black willow | | | • | | | • | • | | • | • |
| Viburnum rufidulum | rusty blackhaw | • | • | | | | • | | | • | |
| **Large Trees** | | | | | | | | | | | |
| Acer negundo | ash-leaf maple | • | • | | | | | • | | • | |
| Acer rubrum | red maple | | • | • | | | | • | | | • |
| Betula nigra | river birch | • | • | • | | | | • | | • | • |
| Carya cordiformis | bitternut hickory | • | | | | • | • | • | | • | • |
| Carya glabra | pignut hickory | • | • | • | | | • | • | • | | |
| Carya ovata | shagbark hickory | | | • | | | • | • | | • | |
| Carya tomentosa | mockernut hickory | | | • | | | • | • | | • | |
| Chamaecyparis thyoides* | Atlantic white cedar | • | • | | | | • | • | | | • |
| Diospyros virginiana | persimmon | • | • | • | | • | • | • | • | • | |
| Fagus grandifolia | American beech | • | • | | | • | • | • | | • | |
| Fraxinus americana | white ash | • | • | | | | • | • | | • | |
| Fraxinus pensylvanica | green ash | • | • | • | | | • | • | | • | |
| Juglans nigra | black walnut | • | | • | | | • | • | | • | |
| Juniperus virginiana | Eastern red cedar | • | • | | | | • | • | • | • | |
| Liquidambar styraciflua | sweetgum | | • | • | | • | • | • | | • | • |
| Liriodendron tulipifera | tulip poplar | • | • | • | | | | • | | • | |
| Nyssa aquatica | water tupelo | • | • | • | | | • | • | | | • |
| Nyssa sylvatica | black gum | • | • | • | | | • | • | | • | |
| Oxydendrum arboreum | sourwood | | • | | | | • | | | • | |
| Pinus echinata | shortleaf pine | | • | | | | • | • | • | | |
| Pinus serotina | pond pine | • | • | • | | | | • | | • | • |
| Pinus strobus | white pine | | • | • | | | | • | • | • | |
| Pinus taeda | loblolly pine | • | • | • | | | | • | • | | • |
| Pinus virginiana | Virginia pine | | | • | | | | • | • | • | |
| Platanus occidentalis | sycamore | | | • | | | • | • | | • | • |
| Prunus serotina | wild black cherry | • | | • | | | • | • | | | |
| Quercus alba | white oak | • | • | • | | | • | • | | | |
| Quercus bicolor | swamp white oak | • | | • | | • | • | | | | • |
| Quercus coccinea | scarlet oak | • | • | | | | • | • | • | | |
| Quercus falcata | Southern red oak | • | • | • | | • | | | • | • | |
| Quercus laurifolia | swamp laurel oak | • | | • | | | • | • | | | • |
| Quercus michauxii | swamp chestnut oak | • | • | | | | • | • | | | • |
| Quercus muehlenbergii | chinkapin oak | • | | | | | • | • | • | | |
| Quercus nigra | water oak | • | | • | | | • | • | | • | • |
| Quercus palustris | pin oak | • | • | • | | | • | • | | | • |
| Quercus phellos | willow oak | • | • | • | | | • | • | | | • |
| Quercus prinus | chestnut oak | • | | • | | • | • | | • | | |
| Quercus rubra | Northern red oak | • | • | • | | | • | • | • | • | |
| Quercus stellata | post oak | • | • | • | | | | • | • | | |
| Quercus velutina | black oak | • | • | • | | • | • | | | | • |
| Quercus virginiana | live oak | • | • | | | | • | • | | • | |
| Robinia pseudoacacia | black locust | | | • | | | • | • | | • | |
| Sassafras albidum | sassafras | | | • | | | • | • | • | • | |
| Taxodium distichum | bald cypress | | • | • | | | | • | | | • |
| Tilia americana | American basswood | | | • | | | • | | | • | |



# Accomack County Drainage

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Miles

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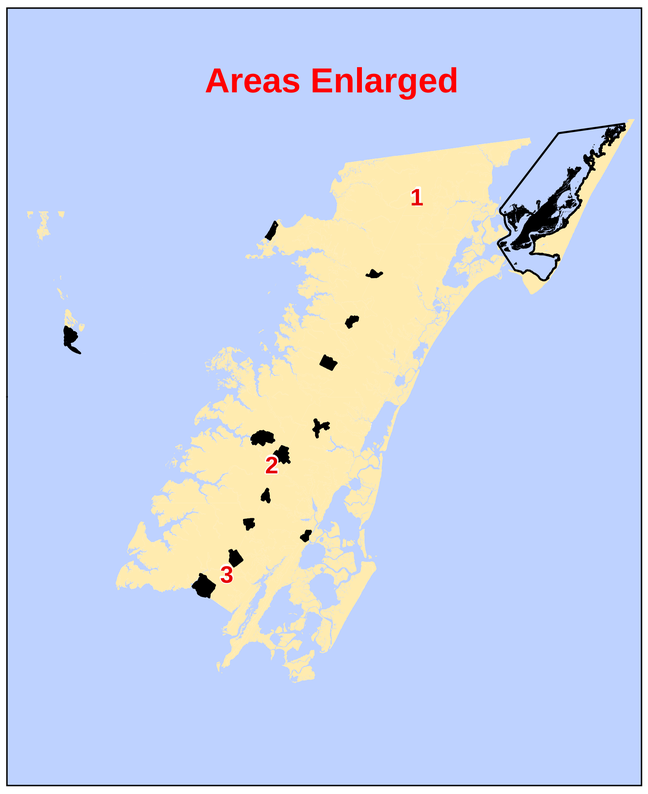
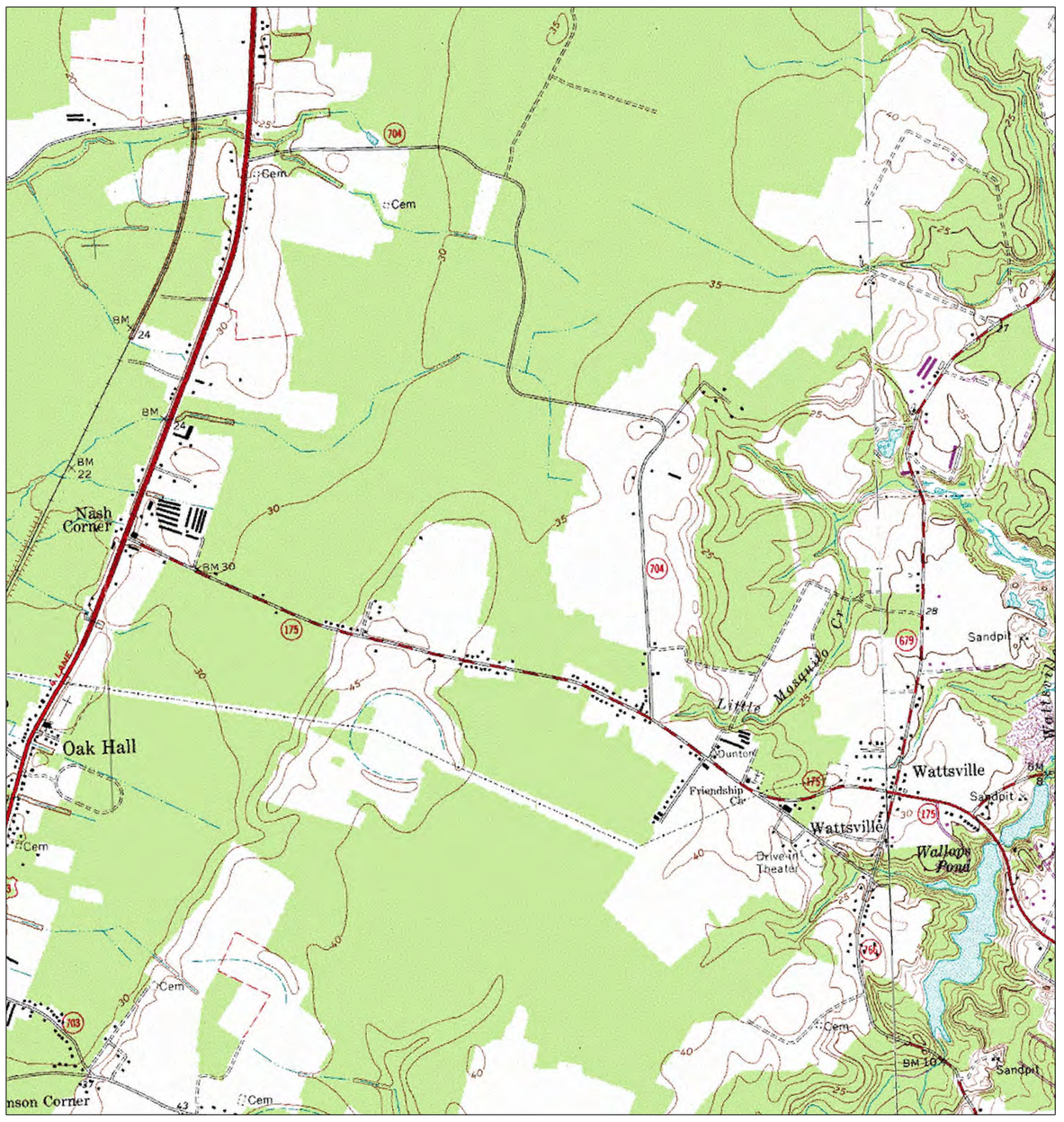
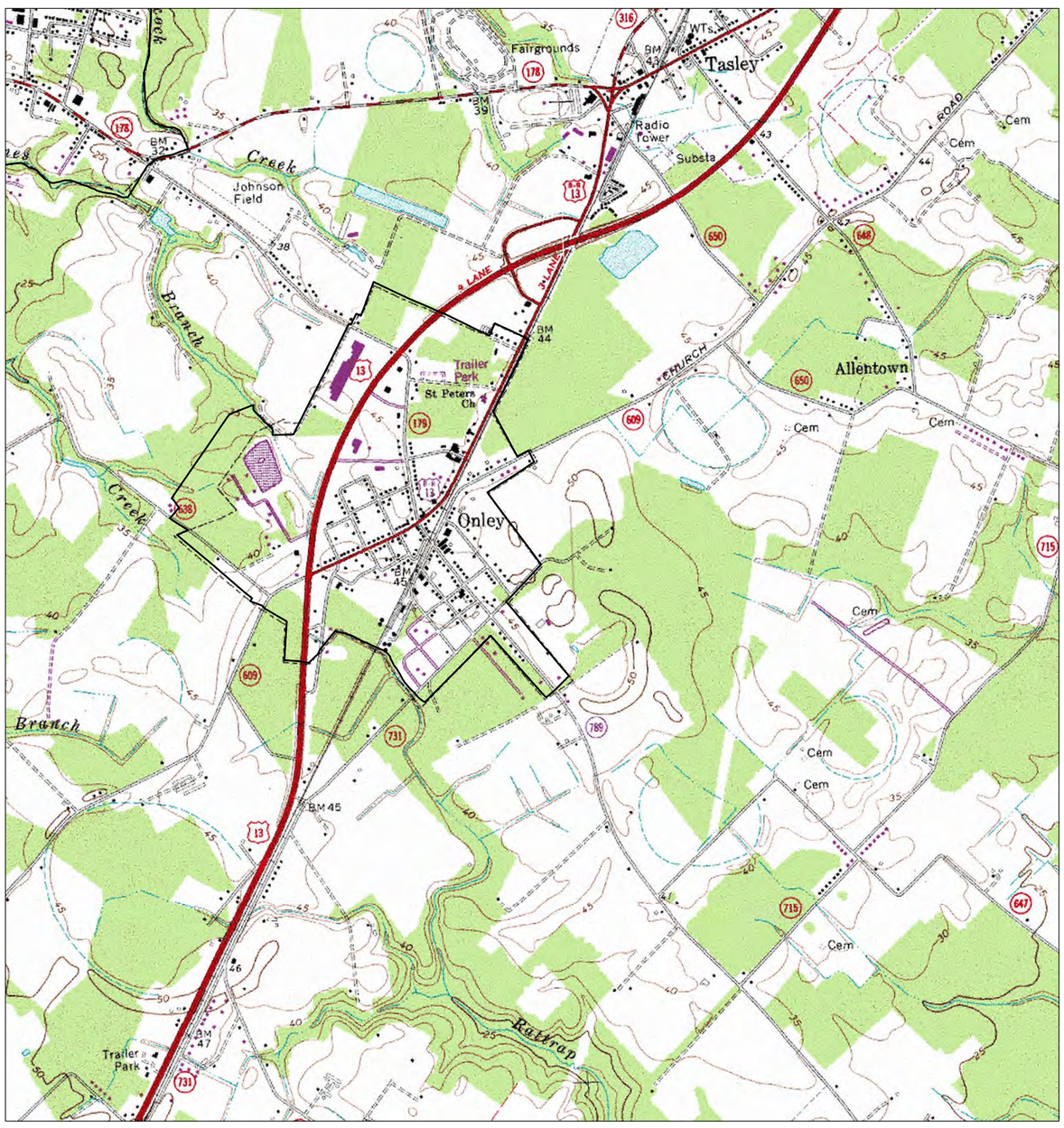
**September 24, 2012**

# Accomack County Potential Growth Areas

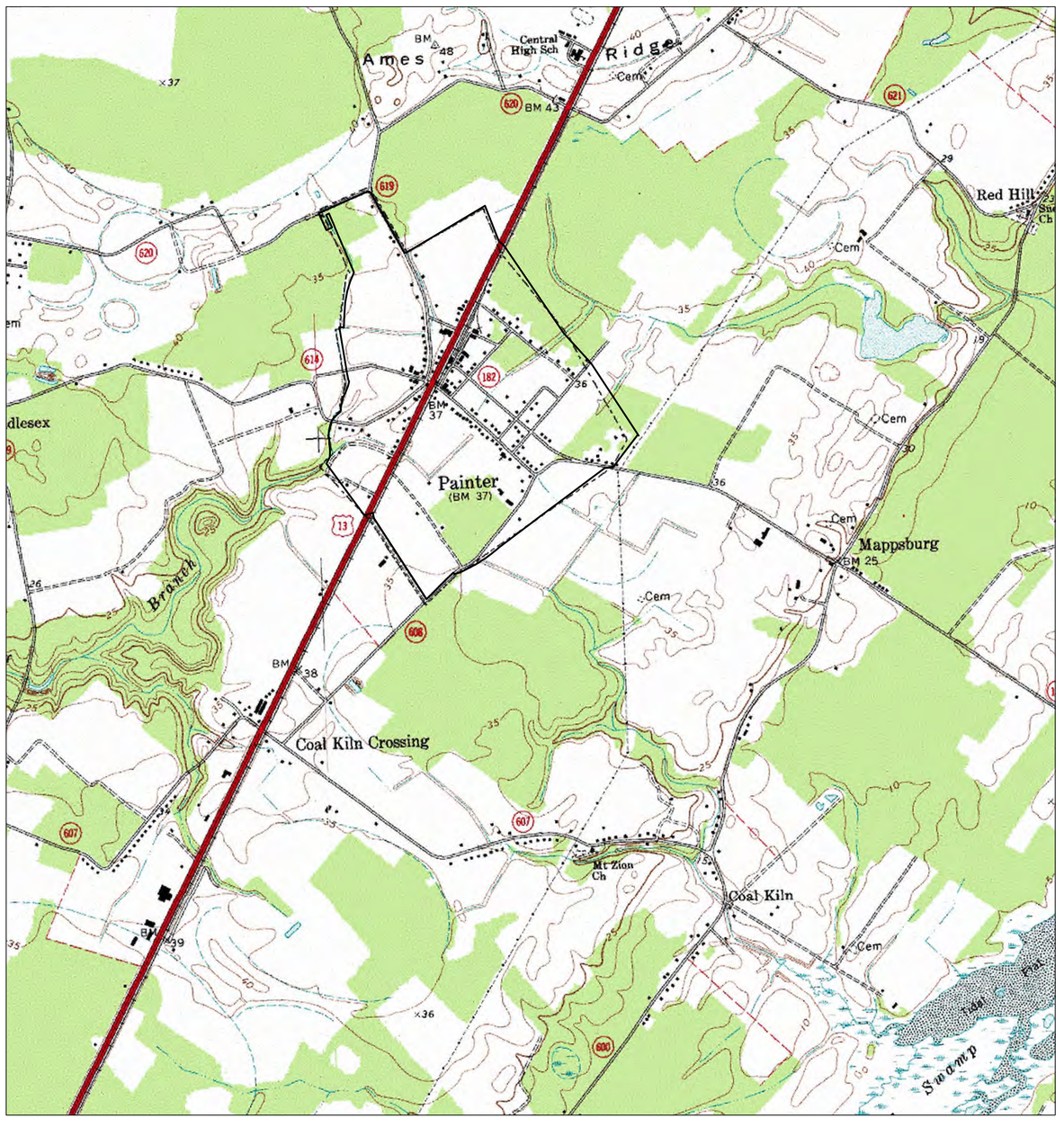



1




2




3


1,000 0 1,000 2,000 3,000

Feet

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## Deliverable 3. Blue and Green Infrastructure Web Page

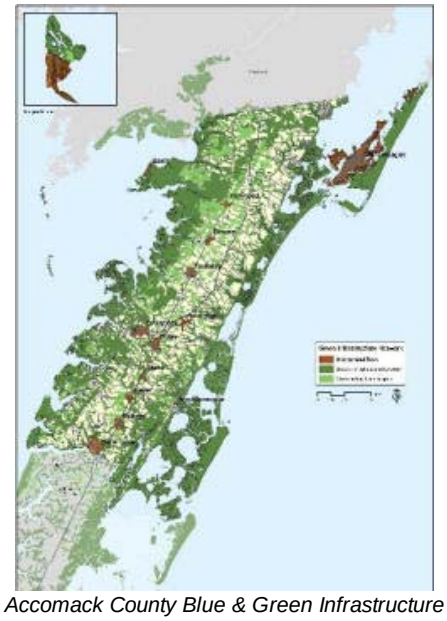
Item(s) included:

- Blue and Green Infrastructure Web Page (also available online at http://www.co.accomack.va.us/Planning/BlueGreen%20Infrastructure/BlueGreenInfrastructure.html)

*Official Website of*
**Accomack County**
**Eastern Shore of Virginia**

## Blue & Green Infrastructure

***What is Blue & Green Infrastructure?***
Green Infrastructure consists of the network of waterways, wetlands, woodlands, habitats and other natural and manmade features that support native species, clean water. Taken together these strategically planned and managed
of natural resources and working lands provide Accomack's
er and air, ensure our quality of life, and other benefits to the
hile the more common term used is Green Infrastructure, due to
l nature of Accomack County, the dominant presence of creeks,
ches, and marshes, we have used the term Blue/Green
ure to highlight the dependence on water (Blue) resources as



*Accomack County Blue & Green Infrastructure*
*Click to Enlarge*

Accomack County Calendar of Events

Click here for the calendar.

**Contact Information**

Department of Planning
Accomack County
23282 Courthouse Ave.
P.O. Box 686
Accomac, Virginia 23301

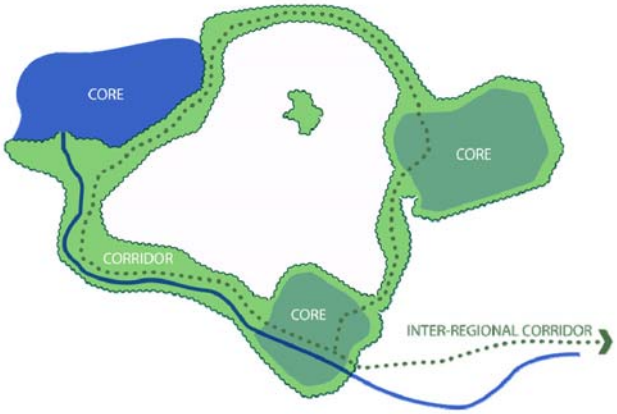
**Director:**
Rich Morrison
planning@co.accomack.va.us

8:30 AM to 5:00 PM
Monday through Friday

(757) 787-5726
(757) 824-5324

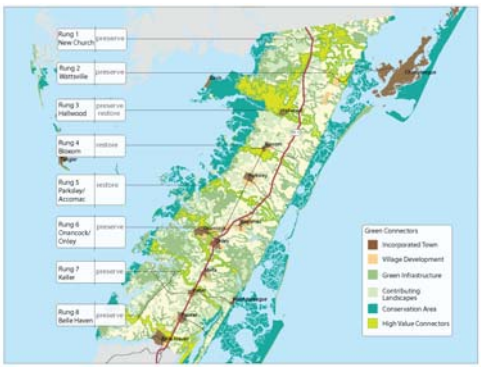
If you would like to work in this department, please click here to learn if there are Employment Opportunities.

***What are some of the benefits of Blue & Green Infrastructure and Planning for Blue & Green Infrastructure?***



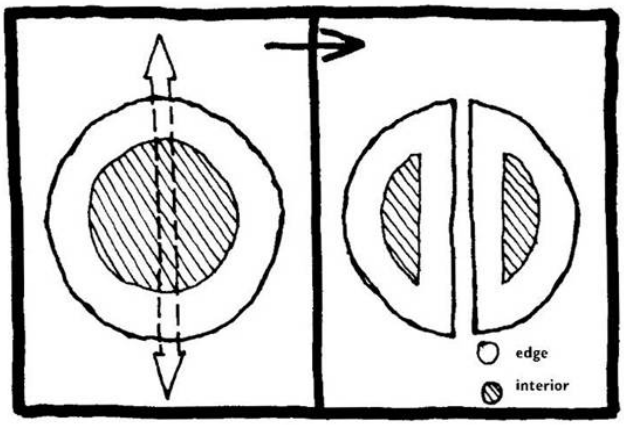

Blue/Green Infrastructure, in a multitude of ways, benefits all the residents of Accomack County. The natural environment of Chincoteague National Wildlife Refuge and Assateague Island National Seashore supports a large tourism industry that caters to outdoor recreation. For teachers, it is an educational opportunity. For farmers and those living near farms, it can protect their properties from erosion. For working watermen and those who sell and harvest timber, it provides a livelihood. Some additional benefits include:

- Protects environment
- Conserves working lands such as farms and forests that contribute to the economy
- Filter and cleans runoff before it is treated
- Protects and preserves water quality and supply
- Preserves viewsheds
- Absorbs air pollution and reduces temperatures in urban centers
- Attractive to businesses
- Preserves biodiversity and wildlife habitat
- Homes near parks and recreation areas can have higher property values
- Supports local businesses and tourism
- Increased physical activity, quality of life and recreation networks
- Can reduce costs for stormwater management and reduces need for increased built infrastructure



*Accomack County Green Connectors*
*Click to Enlarge*

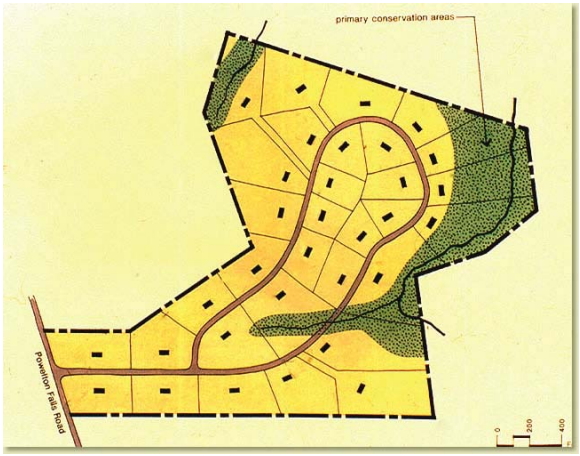
***How Can Blue & Green Infrastructure Be Protected?***




Clustering development to preserve Blue and Green Infrastructure is one method as it reduces or prevents the existing blue and green infrastructure from being further fragmented or reduced in size so that it no longer is adequate for protecting resources. Dividing a large patch into two smaller patches removes interior habitat, reduces interior species population as well as reduces the diversity of interior species.

*Illustration Credit: Dramstad, Wenche E., et al. Landscape Ecology Principles in Landscape Architecture and Land Use Planning. Washington D.C., Island Press, 1996.*

In addition to protecting sensitive lands and open spaces it can be economical, too. The examples below are from The Belle Hall Study which evaluated the economic and environmental costs of two different residential subdivision plans in coastal South Carolina. Both plans accommodated the same number of homes. The study concluded that a conservation-oriented design (right) that maintained half of the area as green space had substantially less environmental impact and cost half as much to build.



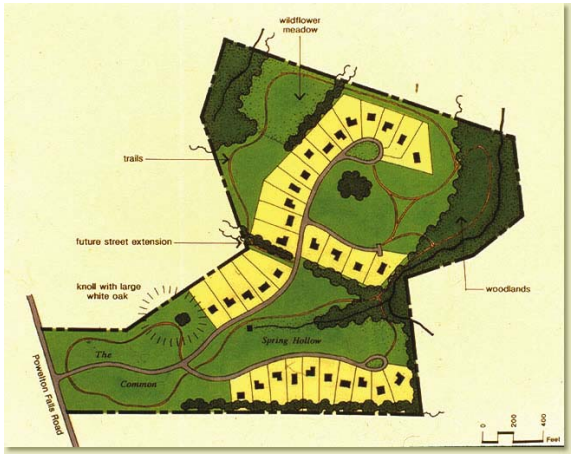



*Illustration Credit: Conservation Design for Subdivisions: A Practical Guide to Creating Open Space Networks. Randall J. Arendt (Washington, SC: Island Press, 1996)*

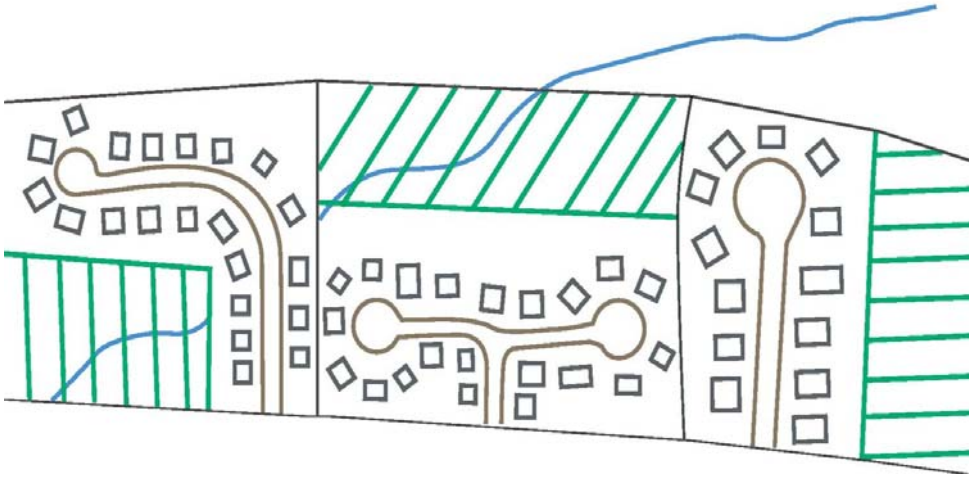
In this second example, an 85 acre site of mixed woodlands, fields, and meadows is located along a stream. Under a conventional subdivision design, this site would have been divided into 34 lots of 80,000 square feet, taking up all but unbuildable areas. Clustering the lots yielded the same number of home sites but on 36,000 square feet provided the ability to preserve almost two thirds of the site as permanently protected open space, protected water quality of the adjoining stream and prevented further fragmentation of the blue and green infrastructure already in place.



*Illustration Credit: Growing Greener: Putting Conservation into Local Plans and Codes, Randall Arendt (Island Press, 1999)*

When looking to preserve Blue and Green Infrastructure as part of the

development process, it is important not to just preserve open space on the site, but to preserve corridors coming from offsite, extending onto the parcel and beyond. In the example shown below, each of the sites are developed in a manner which preserves open space yet the blue and green corridor is still fractured:



By adopting a more comprehensive approach that looks at the entire corridor rather than individual parcels, a better option to preserve the infrastructure may be found.

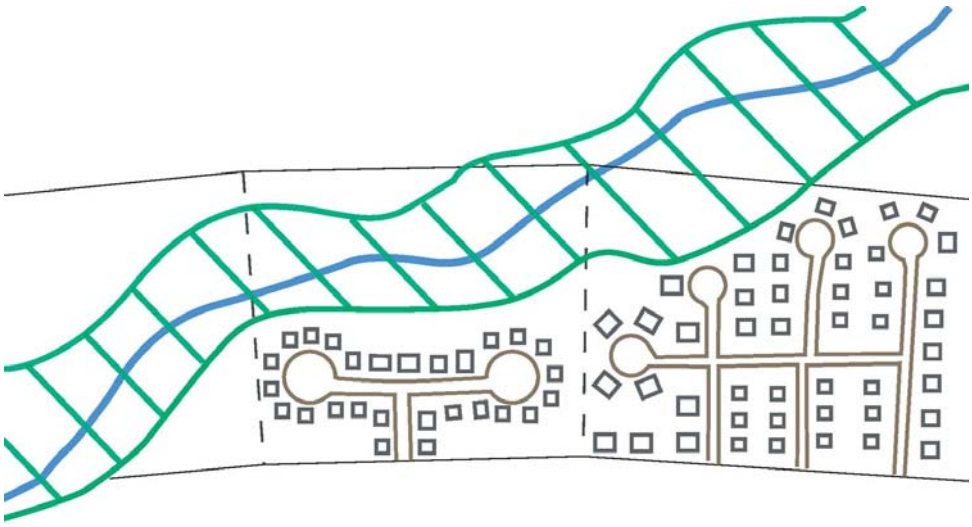
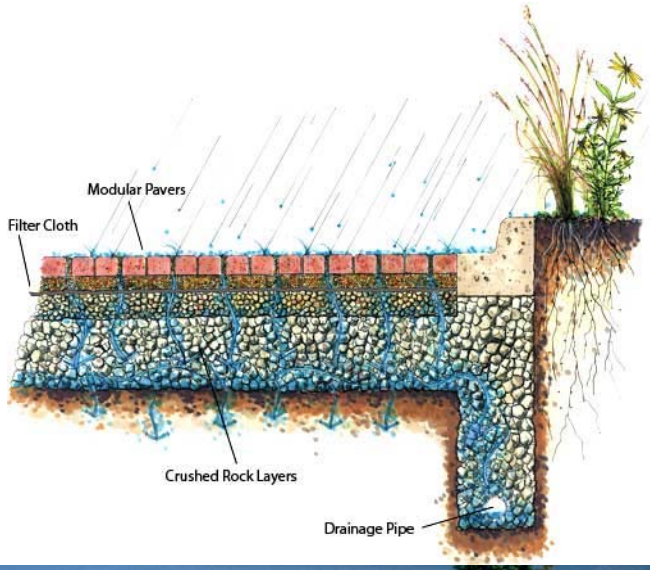


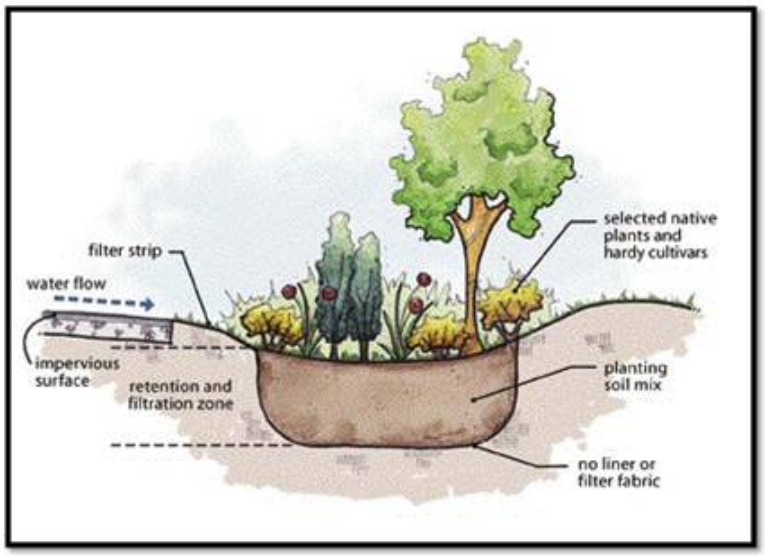
*Illustration Credits : Green Infrastructure Center*

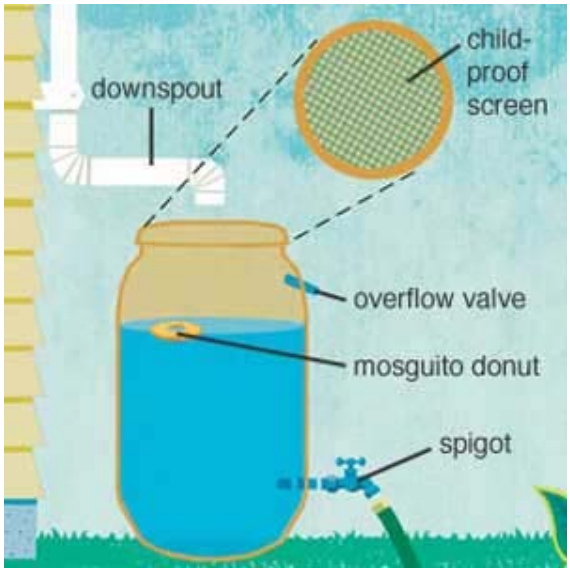
Yet another method to protect blue/green infrastructure is to incorporate elements of Low Impact Development into development plans. Low Impact Development (LID) looks to mitigate development impacts to the natural environment by conserving natural systems and runoff functions on a site. Successfully incorporating LID can reduce development and infrastructure costs while protecting resources and its associated functions. Principles of LID projects preserve open space and minimize land disturbance; protect and incorporate natural features such as drainage ways, and vegetation into the design of the site as well as

reducing concentrations of stormwater on a site. By reducing stormwater runoff, more water is kept for needs on the site as well as to water available for groundwater recharge instead of surface water runoff.




The examples shown above include porous pavement and pervious pavement which allow water to permeate to recharge the water table instead and reduce the amount of surface water runoff. Below are further examples of capturing water which would ordinarily take the form of surface water runoff and convert it to groundwater recharge or provide it for other uses.

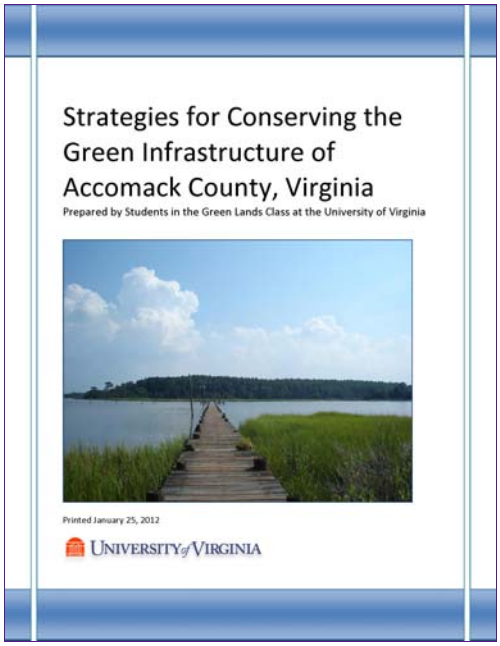


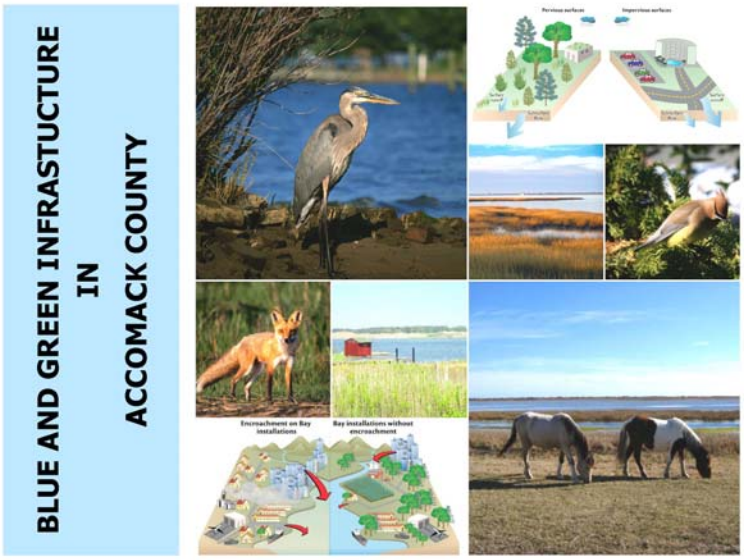




***What has happened concerning Blue & Green Infrastructure in Accomack County?***

In 2010, the nonprofit Green Infrastructure Center (GIC), located in Charlottesville, completed a study of Accomack County's Blue and Green Infrastructure Resources. During the fall of 2011 students of the Green Lands Class developed strategies for conserving green infrastructure in Accomack. Also, Accomack has prepared a guide to Blue & Green Infrastructure and ways to preserve it while developing property. Click on the report covers below to obtain these studies *(note: files are large)*


ACCOMACK COUNTY
BLUE / GREEN INFRASTRUCTURE STUDY
PLANNING FOR THE FUTURE
May 2010


Strategies for Conserving the Green Infrastructure of Accomack County, Virginia
Prepared by Students in the Green Lands Class at the University of Virginia
Printed January 25, 2012
UNIVERSITY of VIRGINIA




***Where can I find out more about Blue & Green Infrastructure?***

Links to Previous Evaluations on Blue and Green Infrastructure in Accomack County:

- Accomack County Blue/Green Infrastructure Study (May 2010 - 50Mb)
- Strategies for Conserving the Green Infrastructure of Accomack County, Virginia. Prepared by Students in the Green Lands Class at the University of Virginia (January 2012 - 7Mb)
- Blue and Green Infrastructure in Accomack County (September 2012 - 4Mb)

Additional Resources on Blue/Green Infrastructure and Low Impact Design:

- Virginia Department of Conservation and Recreation Video on Green Infrastructure
- Virginia Coastal Zone Management Program Blue Green Infrastructure Efforts
- Virginia Conservation Lands Needs Assessment
- Regional Blue-Green Infrastructure Project of the Richmond Regional Planning District Commission and the Crater Planning District Commission
- The Conservation Fund's Green Infrastructure Leadership Program
- Maryland's Green Infrastructure Assessment
- Maryland GreenPrint
- Center for Green Infrastructure
- Low Impact Development Center
- American Society of Landscape Architects

Virginia Coastal Zone
MANAGEMENT PROGRAM

*This page 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.*

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## Deliverable 4. Sustainable Community Comprehensive Plan Element

Item(s) included:

- Sustainable Accomack Comprehensive Plan Element (draft)

# Sustainable Accomack
# Comprehensive Plan Element (Draft)


COUNTY OF ACCOMACK
VIRGINIA

# Sustainable Accomack

# Comprehensive Plan Element

***(Draft November 2012)***

**Prepared by the**
**Accomack County Planning Department**
**P.O. Box 686**
**23296 Courthouse Avenue**
**Accomac, VA 23301**
**757.787.5726**
**757.824.5324**
**planning@co.accomack.va.us**
**http://www.co.accomack.va.us/planning_home.html**

Virginia Coastal Zone
MANAGEMENT PROGRAM

*This project was funded in part, by the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant FY10 #NA107NOS4190205 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 subagencies.*

# Sustainability

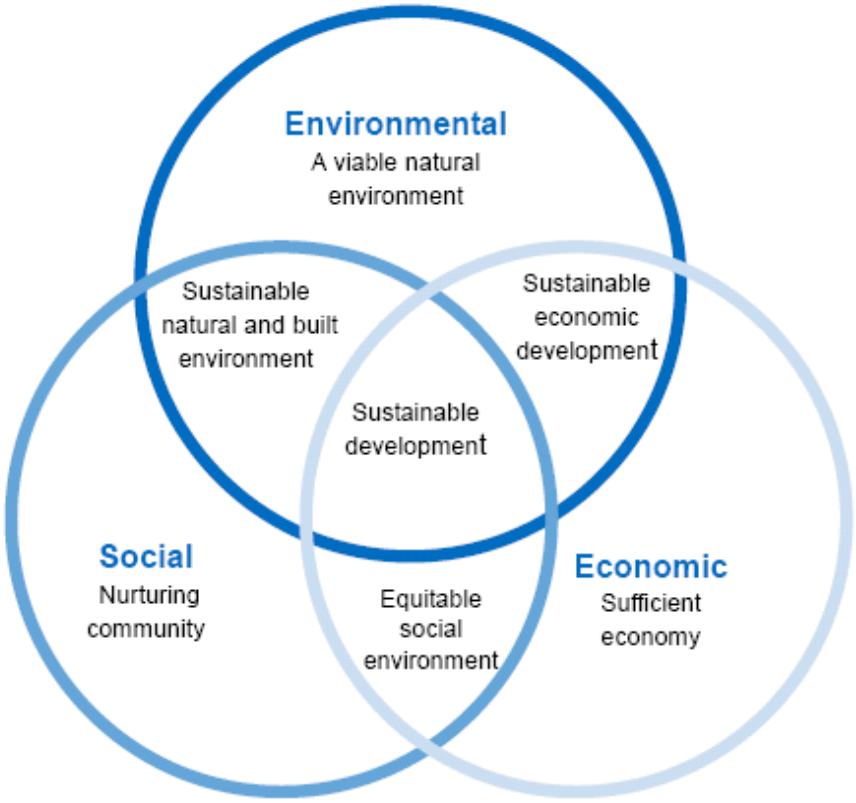
There are many definitions for “sustainability,” “sustainable development,” and “green.” Often times you will hear these words used interchangeably, however sustainability is much broader than the environment. The most common definition of sustainability is:

“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” *Our Common Future: the Report of the World Commission on Environment and Development (also known as the Brundtland Report)*

The concept of sustainability centers on a balance of our society, economy and environment for current and future health. A sustainable system does not break down over time. Resources that are consumed are replenished.

Sustainability links the issues of environment, economy and social equity together. An action or decision in one of these areas will likely have consequences in the other whether intended or not.

Graphic I



Environmental sustainability consists of preserving the functions and components of the ecosystem in a sustainable manner. It is also the capacity that the natural environment has to maintain living conditions for humans and other living beings, taking into account the inhabitability and beauty of the environment and its role as a source of renewable energies.

Economic sustainability, framed within the scope of sustainable development, refers to a series of measures and policies which contemplate the incorporation of environmental and social concerns and concepts.

Environmental and social parameters are added to the traditional concepts of economic advantage, thereby creating an interconnection between the various dimensions. As part of this, profit is not only measured in financial terms, but also in environmental and social terms. Thus, it is necessary to incorporate within the business activity more efficient management of natural resources, whether they be minerals or biological or energy raw materials.

The main aim is to guarantee sustainable exploitation of resources, without placing them at risk of running out, via the introduction of elements in their management such as the optimal level of pollution or environmental externalities, thereby adding economic value to the environmental component.

Social sustainability is based on social balance in terms of social and socio-economic development, which is expressed as a means of humanizing the economy, by developing the social fabric in its humanistic and cultural components.

This Comprehensive Plan Element addresses is designed to complement the existing 2008 Accomack County Comprehensive Plan and provide a template for future updates by evaluating three main subject areas:

- Sea Level Rise
- Alternative Energy
- Surface Water Quality (focusing on provisions of the Chesapeake/Atlantic Preservation Area requirements of the Accomack County Zoning Ordinance, Stormwater Management, and Soil and Erosion Control). Many of these components were addressed in the 2008 Comprehensive Plan and this section will highlight changes since then.

## Sea Level Rise

Accomack County faces challenges with needing to adapt to sea level rise and management of its coastal resources.

Sea level rise (SLR) refers to both eustatic and relative sea level rise. Eustatic SLR is the change in the global average sea level brought about by an increase in the level of the ocean relative to the land. Relative SLR is more localized and is the increase of the ocean relative to both the ocean rise and/or local land level subsidence.

According to a 2008 National Wildlife Federation report, during the 20th Century many places along the Chesapeake Bay saw a one-foot increase in relative sea level rise and there are significant potential impacts for the Eastern Shore.

The historical SLR rate is accelerating. According to a 2012 U.S. Geological Survey report, rates of sea level rise are increasing three-to-four times faster along portions of the U.S. Atlantic Coast than globally.in relative SLR Since about 1990, sea-level rise in the 600-mile stretch of coastal zone from Cape Hatteras, N.C. to north of Boston, Mass. – coined a "hotspot" by scientists – has increased 2 – 3.7 millimeters per year (0.08 – 0.14 inch); the global increase over the same period was 0.6 – 1.0 millimeter per year (0.2 – 0.4 inch) Based on data and analyses included in the report rates of sea level rise in this area are expected to continue to increase. By 2100, the hotspot area is expected to experience an increase in sea level of 8 to 11.4 inches on top of the global rate.

Being between the Atlantic Ocean and the Chesapeake Bay with a relatively low and flat topography, Accomack County is particularly vulnerable to increases in the sea level. Already certain areas of the County are flooding more frequently both from lesser intensity storms as well as from tidal cycles. According to the USGS study accelerated sea level rise in the hotspot will make coastal cities and surrounding areas increasingly vulnerable to flooding by adding to the height that storm surge and breaking waves reach on the coast. The Commonwealth of Virginia is currently conducting a study on areas which experience repetitive flooding either as a result of storms or tides.

This change poses problems such as wetlands retreat and loss, saltwater intrusion and inundation, shoreline erosion, loss of islands which provide important functions during storms by absorbing energy.

Sea level rise will have major impacts of concern to sustainability and comprehensive planning. These include:

- Inundation and inland shoreline migration making larger areas subject to periodic flooding and permanent inundation.
- Increased flooding from even severe weather events as the flood zones are increased in size and wetlands and barrier islands which absorb wave energy and impacts are reduced in size or disappear altogether

- Elevated water tables and saltwater contamination of ground water and surface water supplies.
- Transformation of ecosystem habitats and life as habitats are squeezed out between rising sea levels and fixed hard defenses such as bulkheads. Wetlands may disappear.

Accomack County is fortunate to have an increasing ability to measure potential impacts with the recent acquisition of LIDAR (Light Detection and Ranging) data for the area. This data was funded by the U.S. Geological Survey, the University of Virginia's Long-Term Ecological Research project, and the Nature Conservancy. LIDAR data provides many uses, one being highly accurate elevation data and the ability to use it to model various scenarios. Some information from the LIDAR data, such as Map I, have been incorporated into this Comprehensive Plan element, additional information, such as new and more accurate flood zones will be coming out in the future and will provide additional opportunities.

Changes in sea level threatens Map I shows areas possibly inundated as a result of different levels of sea level rise in Accomack County. Since the County is relatively low and flat between two large bodies of water, a large portion of the County is at risk. Homes, farms, roads, businesses are all placed at long term risk by inundation. The Chincoteague National Wildlife Refuge and Assateague Island National Seashore, a major economic engine for Accomack, is at risk.

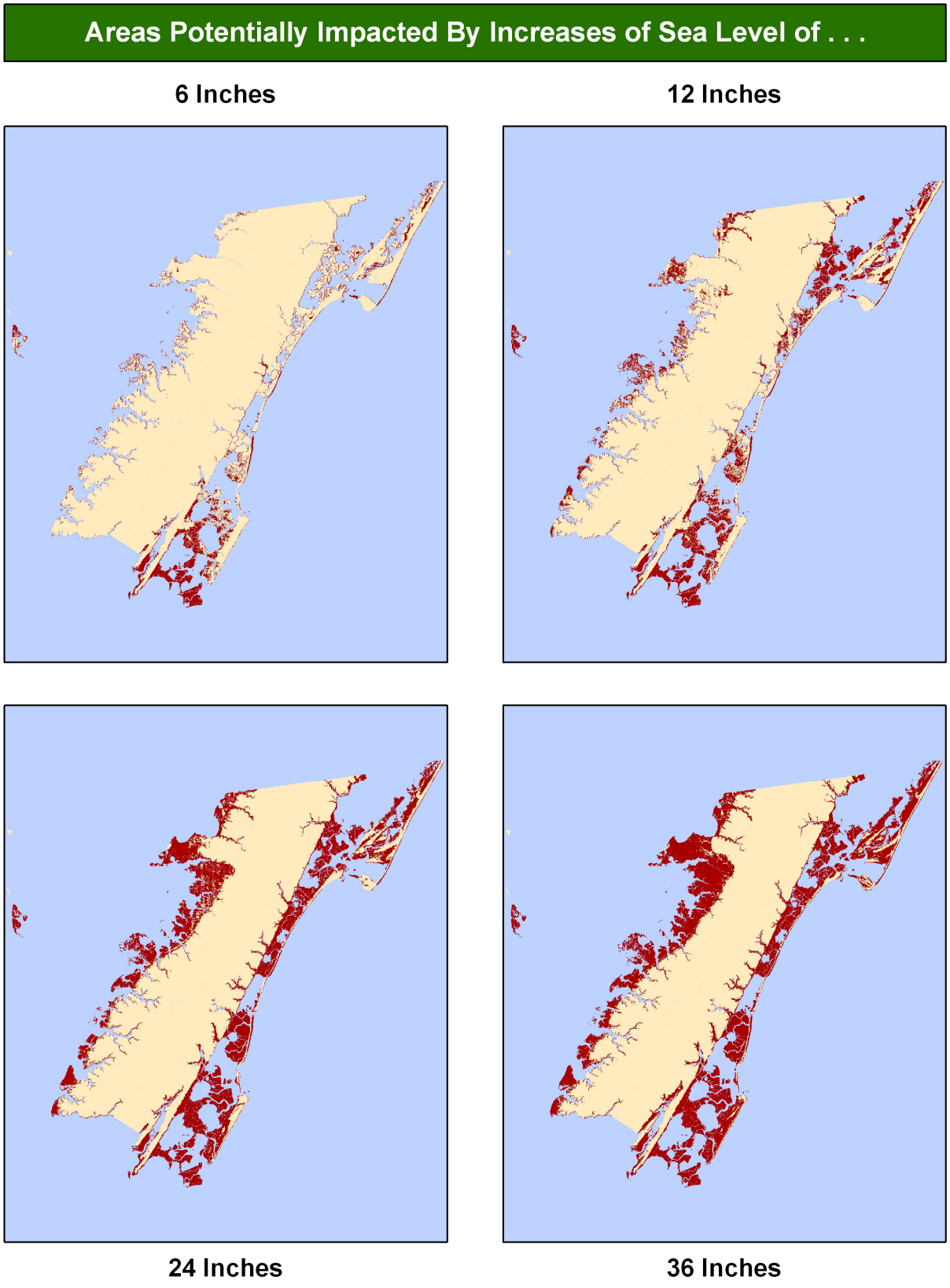
Private development as well as public facilities and infrastructure can be at risk by SLR as a result of inundation or by increased vulnerability from storm surge flooding.

Map II uses the LIDAR data to show similar changes on a more localized level with current topography in the Greenbackville area as well as a projection of how the area would look with an 18 inch rise in sea level.

FEMA is using the LIDAR data to generate new flood zones for Accomack County and is it hoped that information will be released in 2013 or 2014. Accomack County's Flood Program is currently administered by the Accomack County Building Department for the unincorporated portions of the County. Currently the Flood Hazard Overlay District requires within the Special Flood Hazard Area that the lowest floor of new construction or substantial improvements to existing structures to be constructed a minimum of one foot above the base flood elevation required by FEMA. This current requirement will accommodate changes in SLR in the near future on new construction but not in the long term as the SLR is projected to accelerate. It also does not offer any protection to older homes constructed prior to the flood program or those constructed prior to the additional one foot requirement.

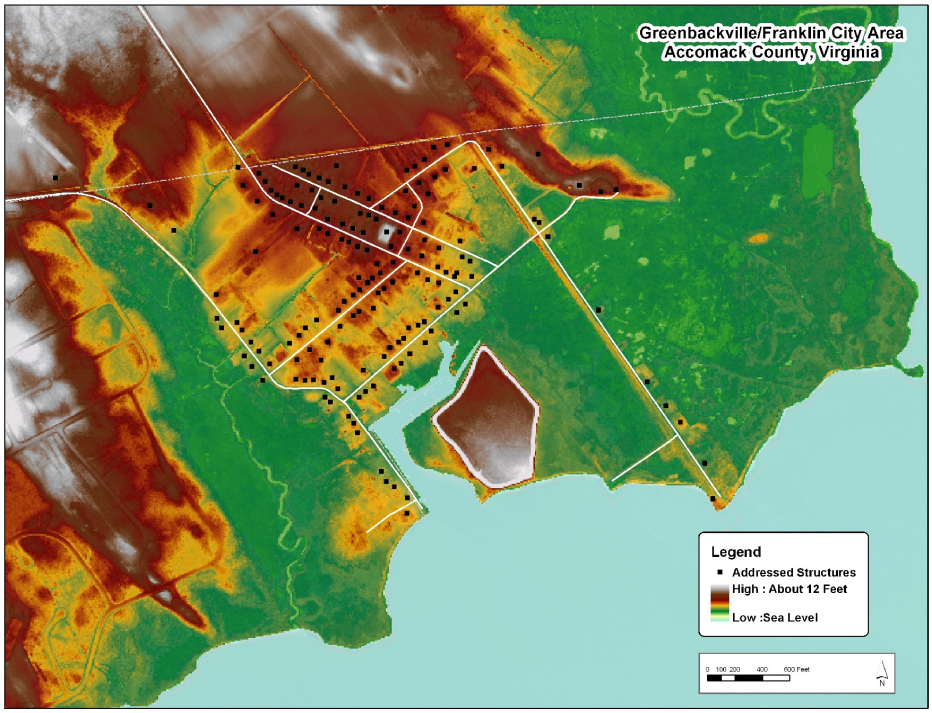
Map III shows projected impacts of various category hurricanes on Accomack County. These impact areas can potentially expand in the future as a result of SLR.

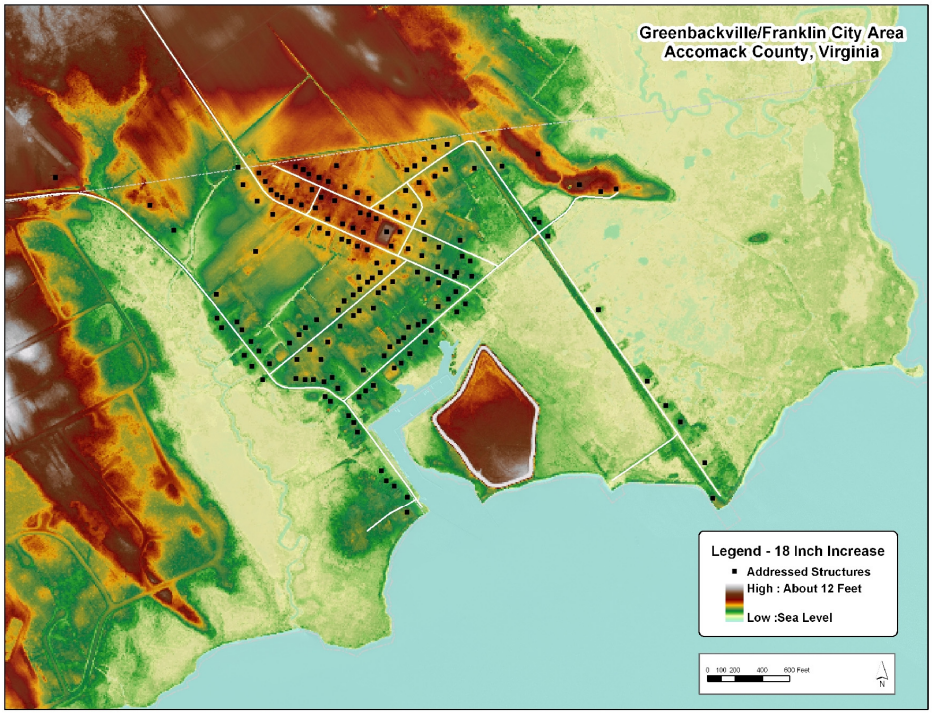
Map I


Areas Potentially Impacted By Increases of Sea Level of . . .
6 Inches
12 Inches
24 Inches
36 Inches

Map II

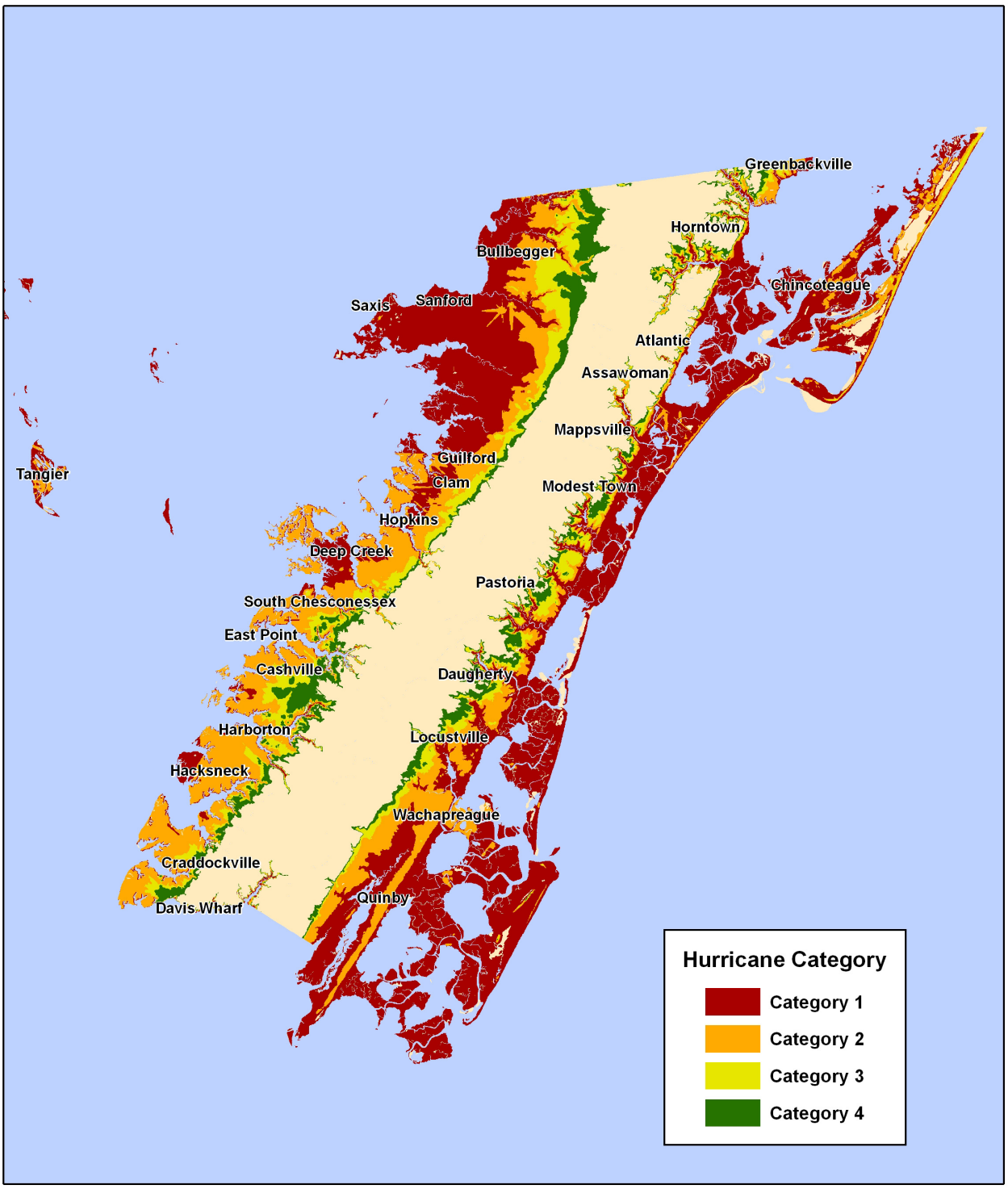
## Impact of 18 Inch Rise in Sea Level - Greenbackville Area



Map III

## Potential Areas Impacted by Hurricane Storm Surges (2010)



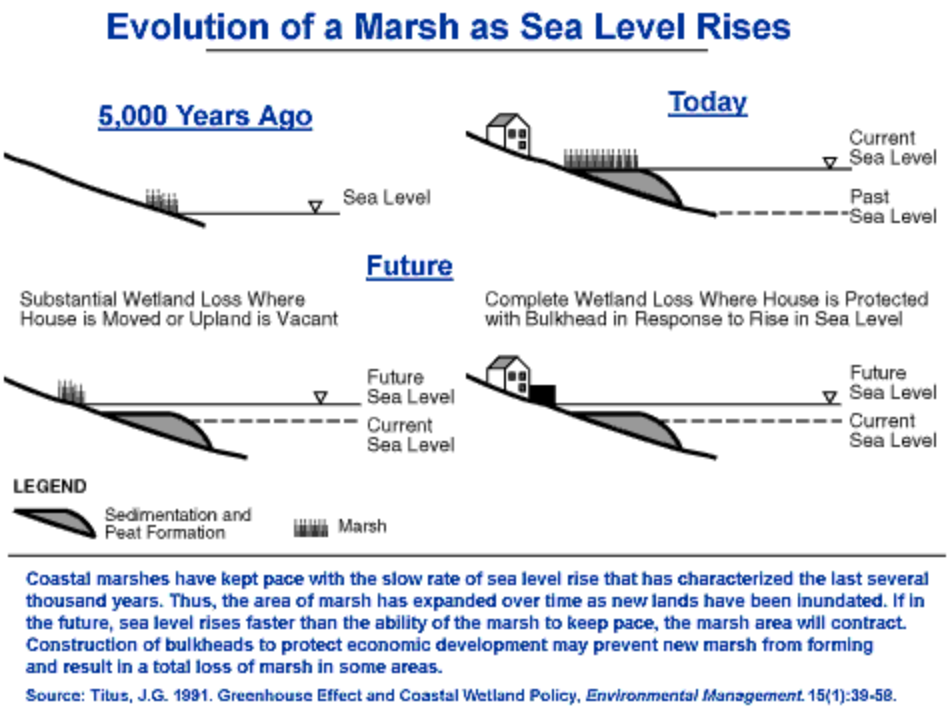
While SLR increases stress on the built environment, SLR impacts on Accomack's coastal ecosystem could be difficult could be severe based on the rate of increase as well as manmade barriers to natural adaptation. The primary impacts of sea level rise on shoreline erosion and barrier island changes, the drowning of extensive wetlands and saltwater intrusion into freshwater habitats.

Wetlands are a source of basic ecological "services," providing wildlife habitat, food chain support, floodwater storage, erosion control, groundwater recharge, nutrient cycling, nutrient storage, and pollutant removal. They are critical to the tourism and commercial fishing industries as well as to the general environmental integrity of the county. Wetlands have historically been lost to development, although federal and state laws have slowed these losses. Increased stress and potential for massive wetland losses will result from sea level rise, and tidal wetlands will be inundated from sea level rise. With sea level rise scenarios that project a gradual inundation, wetlands may have the ability to migrate landward as water levels rise, depending on the slope, sediment availability and the presence of inland barriers to migration. If this occurs, some undeveloped coastal uplands will be converted to wetlands, high marsh will become low marsh, and tidal flats will be converted to open water.

A NOAA study using a projected 27.2 inch rise in sea level by 2100 would lead to a loss on the Virginia portion of the Eastern Shore of 13,800 acres (-18%) of undeveloped land, 440 acres (-20%) of tidal swamps, 19,300 acres (-95%) of brackish marsh, 7,890 acres (-47%) of tidal flats, 23,800 acres (-93%) of estuarine beaches, 970 acres (-82%) of ocean beaches and 13,900 acres (-87%) of salt marsh. There would be an increase of 2,810 acres (+158%) in transitional salt marsh and 69,300 acres (+54%) of estuarine open water. According to the NWF studyby 2025, estuarine beach is projected to decline by 52 percent and ocean beach by 26 percent. By 2100, more than 80 percent of these beaches could disappear and be converted to open water. Like other regions around the Bay, the Eastern Shore is projected to lose more than half of its brackish marsh by 2050, with a nearly complete loss by 2100. Several types for habitats such as the sea-level fens, are at risk. Many of these impacts will greatly impact Accomack's tourism industry, which employs a significant amount of the labor force. Graphic I shows how marshes may migrate or be lost as the water level increases

The Accomack County Shoreline Situation Report published by the Comprehensive Coastal Inventory Program at the Virginia Institute of Marine Science in 2002 evaluated over 770 miles of shoreline in Accomack County. Of that amount, 98.8%, the shoreline was less than 5 feet. Almost 13 miles of shoreline along tidal creeks were found to suffering from high erosion. Compared to the vast amount of shoreline, little of it actually were armored with 1.2% of the total was bulkheaded and 0.4% having riprap. With the exception of portions of Greenbackville, Saxis, and Chincoteague, most of these were on tidal creeks as well.

Graphic II




The Nature Conservancy conducted a Climate Change Adaptation Strategies Workshop for the Eastern Shore of Virginia. The 2011 Report highlighted participant concerns about SLR:

- Vulnerable island communities: Tangier, Saxis and Chincoteague.
- Reduced tax base, property values and jobs.
- Loss of traditional development patterns, villages, hamlets, waterfront communities.
- Loss of family farms.
- Loss of important cultural/historical sites near coastline such as old homes and cemeteries.
- Loss of productive, agricultural land due to inundation.
- Reduction of forested area due to inundation.
- Inundation and flooding of residential property in low-lying areas.
- Inundation of emergency shelters, such as schools and fire stations, in low-lying areas.
- Damage to bridges that span necks.
- Damage to transportation infrastructure in general, especially Chincoteague Causeway.
- Shrinking aquifer lens and recharge areas leading to decrease in groundwater supply.
- Diminishing drinking water supply and degraded drinking water quality.
- Failing private septic systems.

- Saltwater intrusion into shallow water wells.
- Challenge of maintaining National Wildlife Refuge freshwater impoundments in order to protect migratory waterfowl.
- Storm damage to NASA Wallops Flight Facility infrastructure.
- Disproportionate burden on poor who can only afford to live in vulnerable low-lying areas.
- Loss of tourism on Assateague and Chincoteague due to less beach access.
- Loss of jobs should NASA Wallops have to relocate flight facility.

The report also focused on five priority actions for climate change adaptations:

- Review comprehensive plans and hazard mitigation plans to incorporated predicted effects of SLR and coastal flooding.
- Develop shoreline management plans for all stream reaches and promote new general permit for living shorelines.
- Work with public and private partners to enhance expansion and restoration of protected lands to provide connected transition zones from sub-tidal coastal bays to upland forests.
- Enhance and maintain groundwater recharge zone
- Provide education and outreach.

One method highlighted by the workshop report to accommodate wetlands loss as a result of SLR is the concept of a living shoreline. A living shoreline is a way of managing coastal areas to protect, restore, or enhance the habitat. This is done through the placement of plants, stone, sand, and other materials. Living shorelines do not interrupt natural relationships between land, wetlands, and bodies of water.

When people develop coastlines, they often protect the shoreline and their property by constructing rock, wood, or plastic seawalls or bulkheads. A bulkhead is a large, sturdy structure built to prevent erosion and damage from current and wave energy.

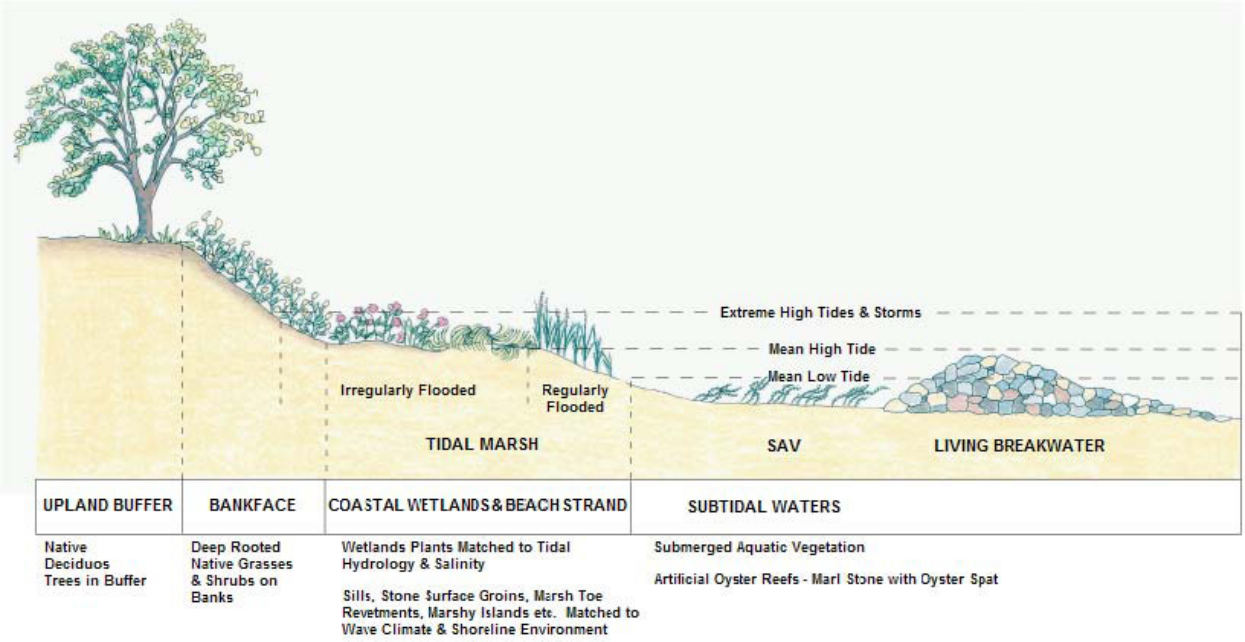
Constructing a bulkhead creates a barrier that near shore vegetation cannot move beyond. Without these plants, the biodiversity of the region shrinks. Insects no longer have a reliable source of food. Birds and fish that prey on the insects migrate elsewhere.

Living shorelines protect against erosion without removing vegetation or damaging coastal ecosystems. Unlike bulkheads, living shorelines can adjust their height and width to the season or weather. They can expand during wet seasons and reduce their fertility during dry seasons.

Living shorelines provide valuable ecological services such as water quality improvement, aquatic habitat, flood and erosion protection, tidal water exchange, sediment movement, plant community transitions, and improved groundwater flow. Some treatments preserve wetlands by allowing their gradual landward retreat as sea

levels rise. Living shoreline treatments maintain natural processes and connections between riparian, intertidal and aquatic areas.

Graphic III




Living shorelines are naturally adaptive to sea level rise, as long as it has space to migrate landward and are sufficiently supplied with sediment to be able to keep up with sea level rise. Reserving a buffer or setback area in which wetlands can form and migrate between developed places and today's shoreline could be a very cost-effective flood protection strategy. Important challenges for Accomack will be determining how much flooding new tidal marshes could attenuate, restoring them in appropriate places, and conducting restoration at a faster rate than we would without the looming threat of rising waters. Graphic II shows an example of a living shoreline.

Under legislation passed in 2011, Accomack County will need to work with the Virginia Institute of Marine Science, the Department of Conservation and Recreation, as well as the Virginia Marine Resources to incorporate Coastal Resource Management Guidance into the full review of the Comprehensive Plan. This guidance will 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.

It will not be feasible or sustainable to protect all of Accomack County from SLR but the guidance will need to indentify areas where the County will attempt to protect developed areas from sea level rise, areas where nature will be allowed to advance by a managed retreat from these areas, as well as areas transitional areas where both may be happening in the near term with a long term goal of accommodating the increase in sea level.

The goal of managed retreat is to preserve the shoreline through landward relocation of existing or future shoreline development. This strategy allows allow the shoreline to naturally migrate landward unimpeded by removing existing or future structures and infrastructure in areas vulnerable to sea-level rise inundation and flooding.

There are several advantages to managed retreat strategy. It minimizes threats to humans by essentially shifting development, including residential dwellings, away from vulnerable areas. Retreat may also be financially sustainable in the long-term; although it may be potentially expensive for significantly developed areas. It also would allow for living shorelines, which provides not only do living shorelines help to minimize coastal erosion, but they also act as a buffer for flooding and storm surge as well as provide species habitat.

# Alternative Energy

Alternative energy generally refers to energy sources other than fossil fuels. Renewable energy sources are generated from natural resources such as sun, wind, rain, tides, and geothermal heat which are naturally replenished.

Most of these types of energy are also cleaner than oil or coal. They also promote sustainability since they are naturally replenished, keep more money and jobs in local hands, and reduce reliance on foreign sources for fossil fuels. Reducing reliance on fossil fuels also reduces impacts of market volatility and supply shortages.

Increasing the share of energy produced through alternative renewable technologies will reduce greenhouse gas emissions, improve air quality, and enhance energy and national security. Renewable energy can also reduce strain on the existing energy grid and infrastructure, because it can often be generated and distributed on a local, decentralized basis. Available technologies are diverse and developing quickly.

Some renewable energy technologies are currently competitive on the market. Others, however, are not yet cost competitive. Local governments have an important role to play in promoting renewable energy. Many larger cities have been at the forefront of many efforts to expand renewable energy. These efforts include comprehensive energy planning, incentives, demonstration projects, education, and national and international alliances. Individual solar system and wind energy systems can take advantage of Virginia's net metering laws to sell excess power back to utilities.

Nationally, renewable energy accounts for 8% of energy generation. In Virginia, it is a much lower 2.8%. Most of this comes from hydro, biomass, waster to energy, and landfill gas. There is only a minimal amount currently produced from solar and wind power which are clean, emissions free, and naturally replenishing.

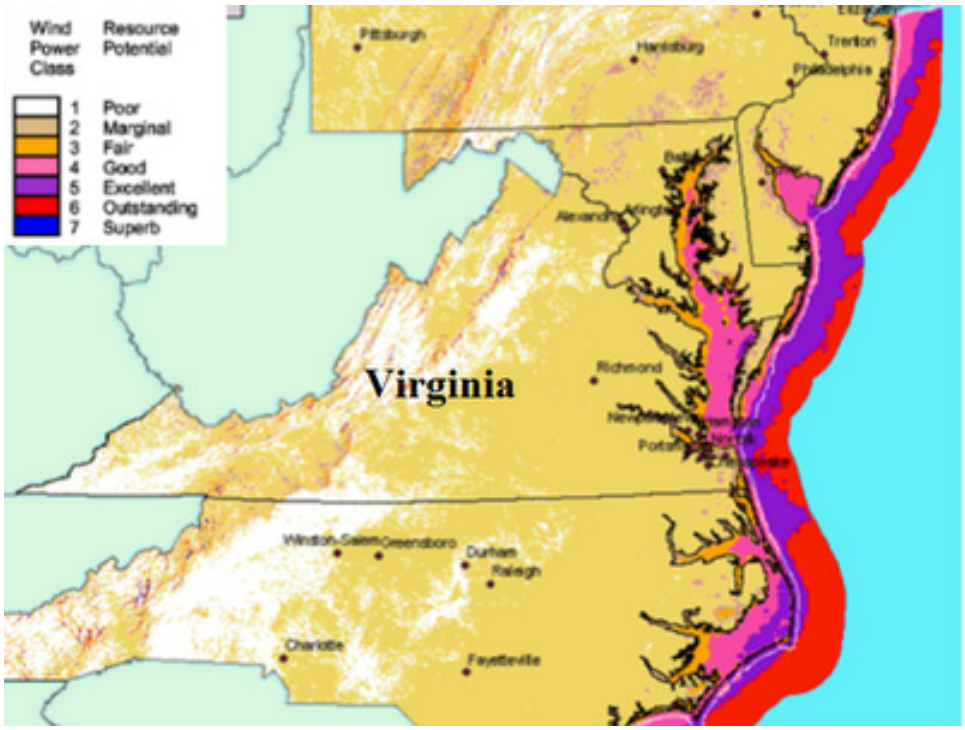
Wind power is growing as a source of electricity. The Department of Energy predicts wind power will provide 20% of the nation's electricity by 2030. With lots of sunlight and wind, Accomack County is well poised to generate larger amounts of its power from these sources.

While solar use has been in limited use for a while and wind energy has been growing, these projects, until recently, have been limited to small individual systems. That may be changing. During 2011 Accomack County granted approval for the operation of a

commercial solar farm after the Zoning Ordinance was amended to allow larger solar and wind energy systems.

Several companies have expressed interest in developing wind farms off the coast of Virginia. Graphic IV shows that near shore and offshore in the Chesapeake Bay and Atlantic Ocean are some of the prime candidates for commercial wind energy supply in Virginia. All the areas offshore of the Eastern Shore have a wind power classification of either good, excellent, or outstanding.

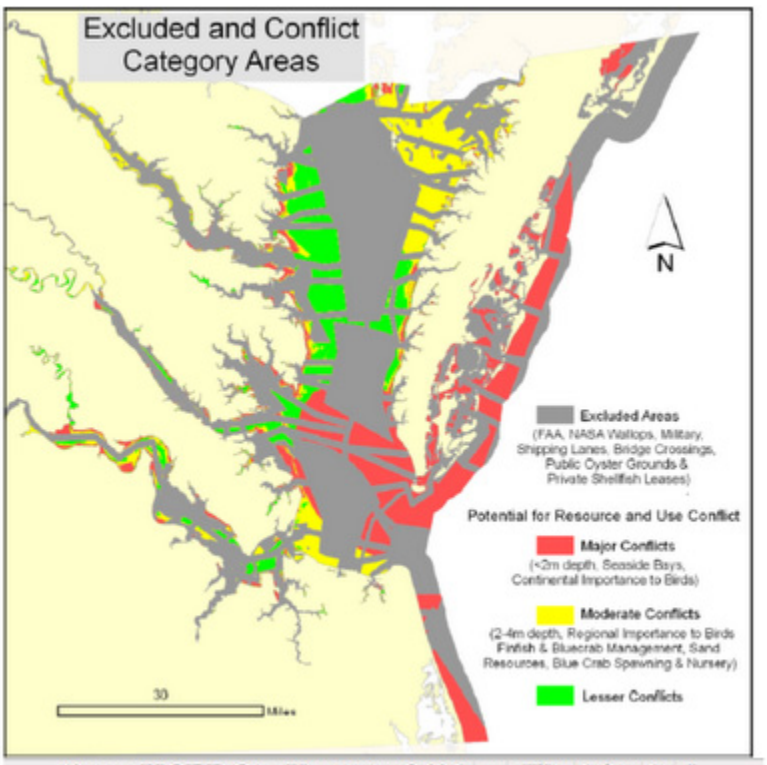
Graphic IV




The Accomack County Zoning Ordinance currently allows for individual wind energy systems by right in the Industrial, Agricultural, Rural Residential, and Village Residential Districts by right as long as certain conditions are met. The ordinance allows for both commercial systems as well as systems to serve individual homes and businesses. It does not provide for community systems and there has been some interest in that regard.

While there are significant opportunities for wind and solar energy, there are constraints as well. There may be public resistance to these types of activities on the landscape. Offshore wind energy may have conflict with other uses from NASA or military flight training. The Delmarva Peninsula is an important flyway for birds. Graphic V shows areas where areas of potential conflicts to the development of offshore wind energy.

Graphic V

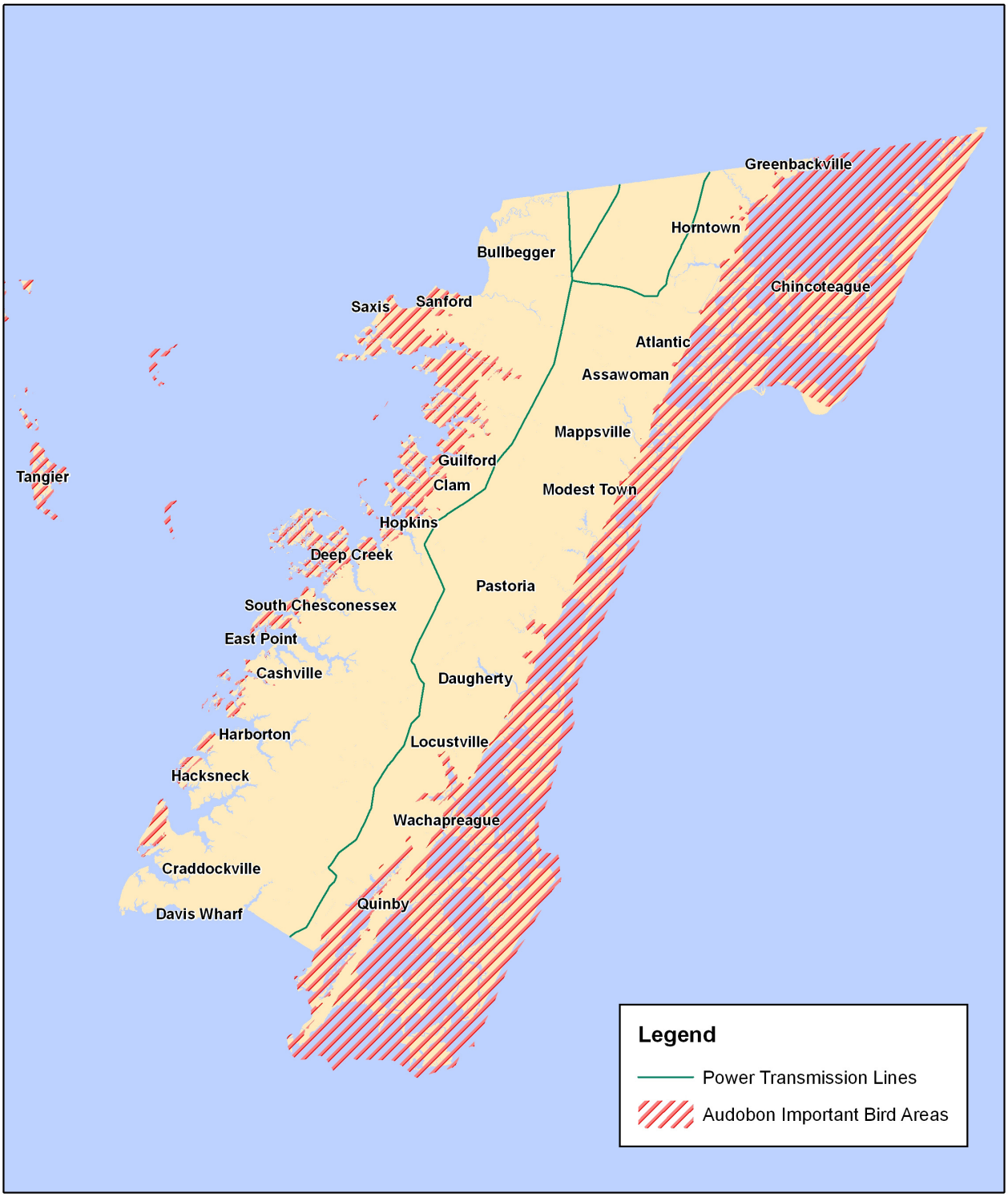



**(from VCERC's *Virginia Offshore Wind Studies*)**

A final constraint for commercial production of energy involves the location and the capacity of existing power grid. The current capacity is not sufficient to support more than a few commercial energy generating facilities. There are plans to upgrade the existing infrastructure and additional producers may be able to operate in the future. The location of power transmission lines are down the center of the Eastern Shore. This location is sufficient fine for the siting of solar power generating facilities but with current technology winds are not sufficient to support the types of installations other than those serving on site usage. Map IV shows the location of the existing power transmission lines as well as important bird habitat areas.

Map IV

## Alternative Energy - Transmission Lines, Important Bird Areas



Another source of alternative energy which has potential in Accomack County is the conversion of poultry litter to energy. An Accomack County poultry farmer has received finding to convert chicken manure into electricity. The project, serving an individual farm would be capable of converting 2,200 tons of poultry litter each year into energy.

Poultry litter is currently disposed of as fertilizer on farm fields which increases the possibility of runoff into local waters. If successful, this type of energy could be a good way to dispose of nutrient rich waste instead of fertilizer and could possibly be expanded in the area..

## Surface Water

Water is what defines Accomack County. Of the approximately 1,300 square miles that fall within its borders, almost 2/3 of it is water.

For centuries the Atlantic Ocean, the Chesapeake Bay, the coastal bays, creeks and wetlands have provided food, recreation, employment. Before the automobile took over as the preferred transportation method, it was our transportation network. The wharves along our creeks established our settlement patterns.

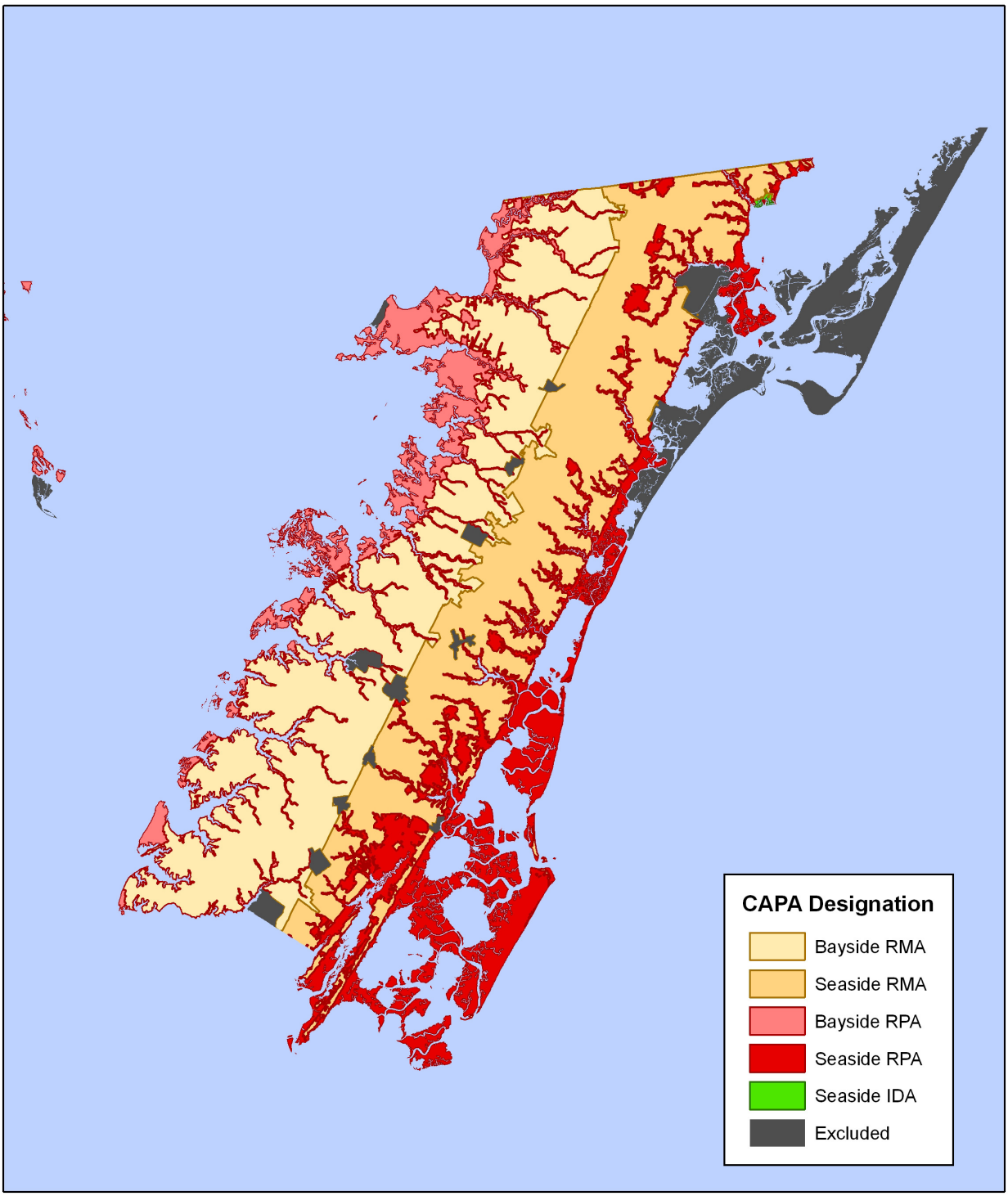
The Virginia Erosion and Sediment Control Program became law in 1973. Fifteen years later the Chesapeake Bay Preservation Act was passed by the legislature. Taken together, these two programs mark the first major efforts to bring environmental sustainability to many communities in the Commonwealth. Subsequent changes involve stormwater management and the inclusion of provisions to address the quality of stormwater runoff in addition to the volume of runoff.

The County now has almost 40 years of experience in Erosion and Sediment Control and 20 years of implementing the Chesapeake Bay Act. In 2009 the County implemented elements of the 2008 Comprehensive Plan to extend provisions of the Chesapeake Bay Preservation Area Overlay District (CBPA) to the portion of the County which drains directly to the Atlantic Ocean. The rechristened Chesapeake/Atlantic Preservation Area Overlay District (CAPA) introduces most of the original water quality protection provisions to the seaside. Map V shows the reconfigured Chesapeake/Atlantic Preservation Area.

During 2009 and 2010 the County worked with the Green Infrastructure Center to complete a Blue/Green Infrastructure Study for Accomack. Blue/Green infrastructure comprises 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 study compiled an extensive inventory and highlighted cores to preserve and areas to reestablish disconnected connected corridors. The County now has the data to incorporate blue/green infrastructure into site plan review and rezoning requests and those concepts should be incorporated into ordinances. The concepts of blue/green infrastructure, taken together with the mostly countywide CAPA provisions, serve to increase local sustainability efforts. Map VI shows the existing blue and green infrastructure in Accomack County.

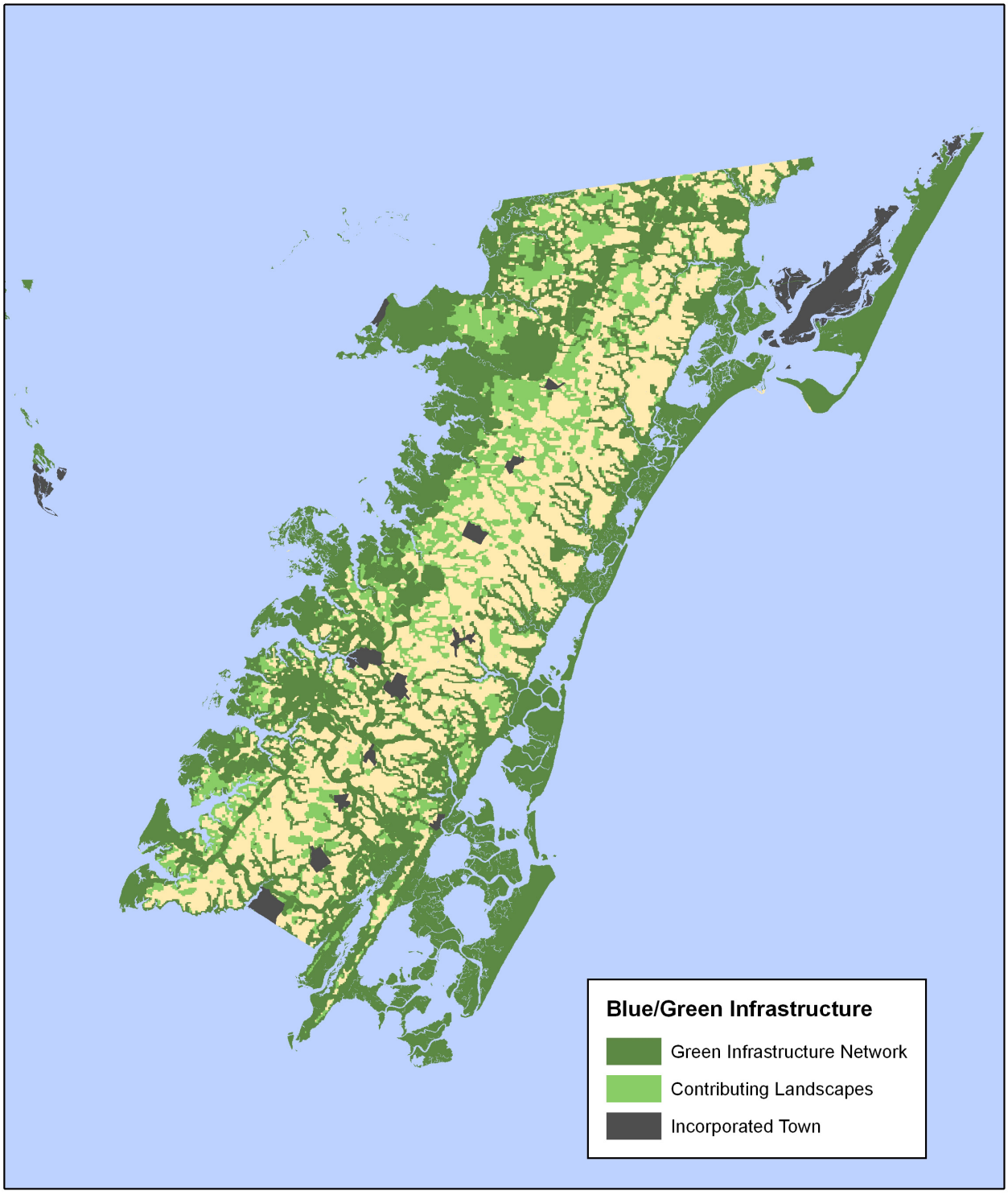
Map V

## Chesapeake/Atlantic Preservation Area (CAPA)



## Map VI

# Blue/Green Infrastructure Network



Changes in stormwater regulations and an increased emphasis on Low Impact Development offer increased opportunities to provide additional protection to stormwater, surface runoff, and erosion and sediment control.

Low impact development (LID) is an approach to stormwater management that aims to handle it as much as possible as the way it was handled prior to development. That is to utilize techniques to infiltrate, filter, store, and evaporate water at the site rather than to simply convey it offsite via a stormwater drainage system. In essence, it treats the water on a site as a resource and opportunity rather than a by-product to be disposed of as quickly as reasonable.

LID looks at the entire site, both hardened areas and soft as an opportunity to manage the hydrologic process on site by retaining, storing, and changing the timing of, or filtering runoff.

Some of the most common techniques of LID include:

- Reducing imperviousness by using permeable paving or landscaping to break up large expanses of impervious surfaces.

- Directing runoff into or across vegetated areas to help filter runoff and encourage groundwater recharge.

- Preserving vegetated areas near parking areas, buildings, and other impervious expanses in order to slow runoff, filter out pollutants, and facilitate infiltration.

Conventional Pavement – Asphalt (Background)
**Pervious Concrete** (Foreground) - Raining

- Remove curbs and gutters parking areas and parking islands to allow storm water sheet flow into vegetated areas.

- Use devices such as bioretention cells, vegetated swales, infiltration trenches, and dry wells to increase storage volume and facilitate infiltration.

- Grade sites to encourage sheet flow and lengthen flow paths to increase the runoff travel time in order to modify the peak flow rate.

- Disconnect impervious areas from the storm drain network and maintain natural drainage divides to keep flow paths dispersed.

- Install cisterns or sub-surface retention facilities to capture rainwater for use in irrigation and non-potable uses.


- Use native plants (or adaptable species) to establish an adaptable and low maintenance landscape that requires less irrigation and are appropriate for the climatic conditions.

- Use naturally occurring bio-chemical processes in plants located in tree box filters, swales, and planter boxes.

- Divert water away and disconnect from the storm drain using correctional drainage techniques.

Principles of LID are achieved through both structural and nonstructural practices. LID offers many benefits over traditional stormwater management such as increased groundwater recharge, less runoff, less pollution, less erosion and less damage to our coastal waters. Not all LID practices are applicable in every situation. Many practices promote quicker infiltration and recharge to the groundwater table. Runoff containing certain types of pollutants are not good candidates for these practices, especially in areas with a high groundwater or over the groundwater the recharge spine. Practices should be evaluated on a site by site basis. Map VII shows the location of the groundwater recharge spine in Accomack County.

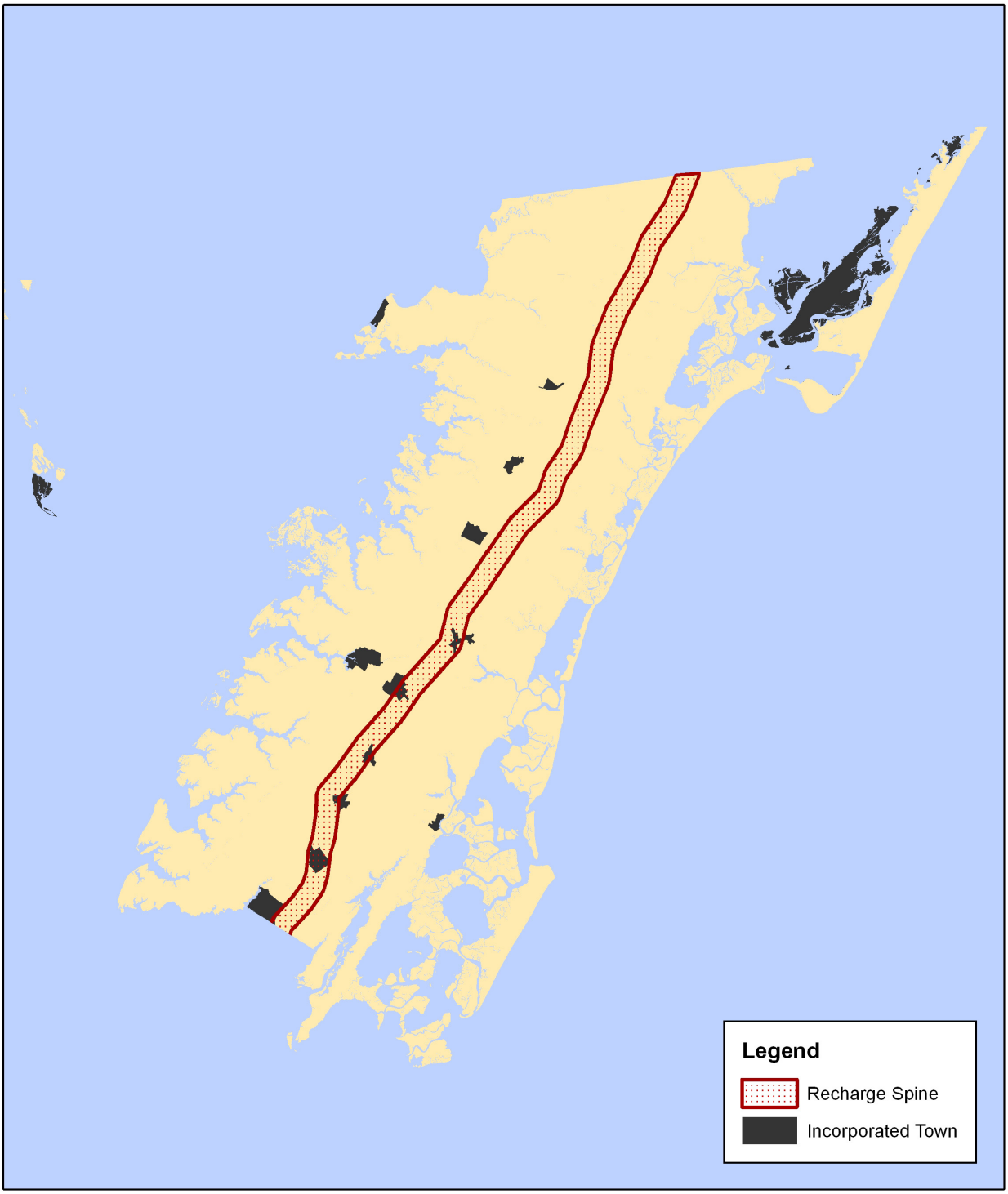
By incorporating nonstructural components into the design, LID can be a cost-effective method of handling and treating water over structural stormwater management components. A 2007 EPA cost comparison 17 projects of conventional development costs versus using LID principles found that while one LID project did have higher costs, capital costs were reduced by 15% - 80% on the remaining sites and environmental performance was improved.

There are extensive problems with stormwater and drainage in some portions of Accomack County. The Accomack County Department of Public Works maintains proper drainage of certain outfall ditches that are not the responsibility of other federal, state or private entities. Map VIII shows the existing hrydrologlic units in Accomack County. More detailed information on drainage patterns and subdrainage areas is needed to adequately plan maintenance. Drainage maintenance plans should be updated to incorporate more detailed subdrainage areas and patterns. The recent LIDAR data acquisition may derive some products that would help with this effort that would assist in developing regional stormwater solutions.

Many stormwater ponds in the County were created long ago prior to the County requiring maintenance agreements. No inspections or maintenance has been performed unless required by additional new development. These facilities should be inventoried to determine if they are properly functioning or if they need repairs should an opportunity arise.

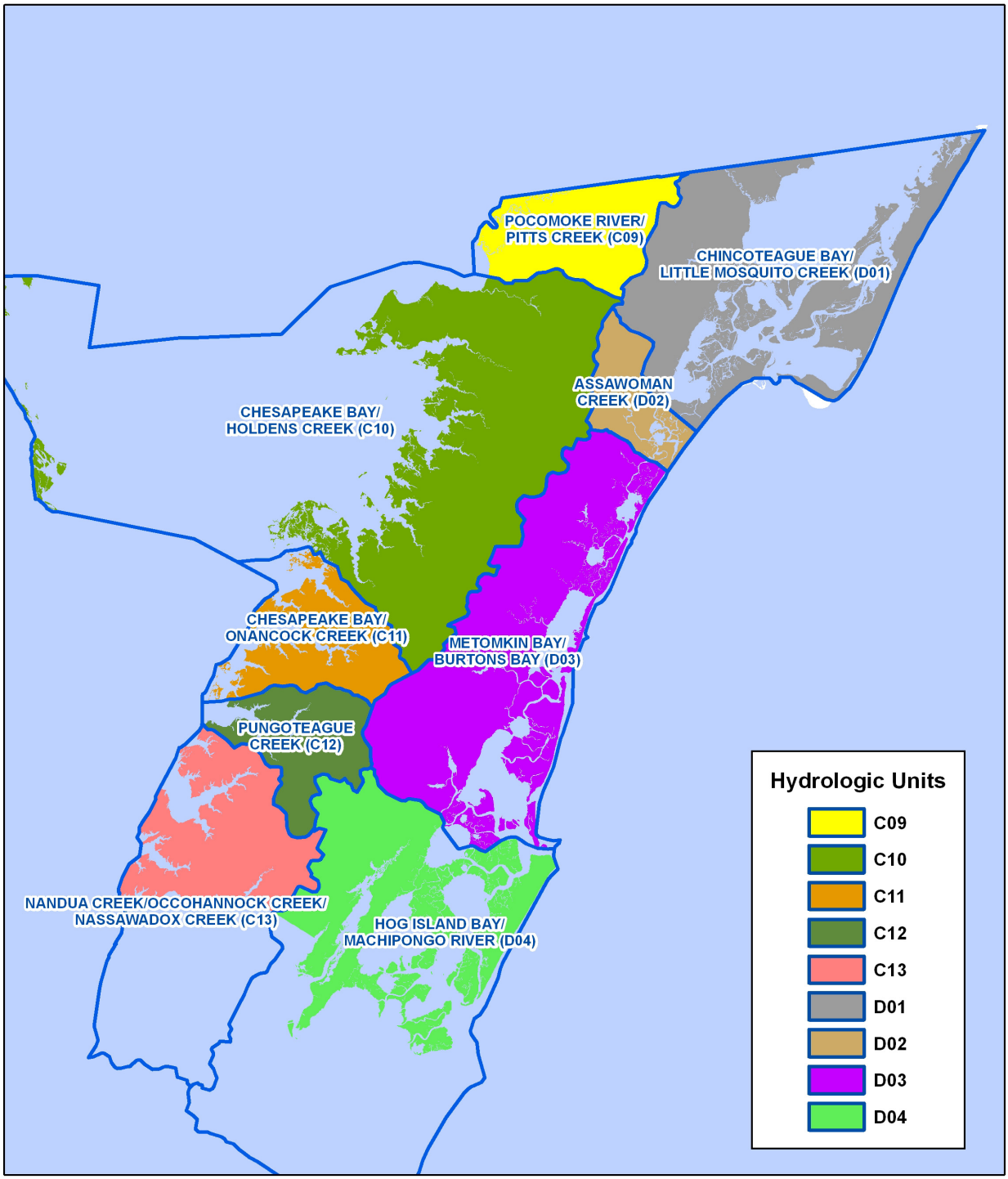
Map VII

## Groundwater Recharge Spine



Map VIII

## Hydrologic Units



Another area to be evaluated with respect to water quality involves the disposal of household wastewater. A conventional septic system is composed of three main parts. The septic tank separates solids from the wastewater, store and partially decompose as much solid material as possible, while allowing the liquid (or effluent) to go to a drainfield. After solids settle in the septic tank, the liquid wastewater (or effluent) is discharged to the drainfield, also known as an absorption or leach field. The soil below the drainfield provides the final treatment and disposal of the septic tank effluent. After the wastewater has passed into the soil, organisms in the soil treat the effluent before it percolates downward and outward.

In recent years the use of alternative septic disposal systems has increased. Alternative systems have been approved for installation where soil or groundwater conditions would not provide sufficient opportunity for the soil to treat effluent before it percolates from the system. Alternative systems provide pretreatment to remove most of the pollutants before it is discharged into the soil.

The presence of alternative septic systems can indicate more marginal areas for development. The County should keep a GIS inventory of failing and alternative septic systems. Also, since these systems have high pollutant removal efficiencies, they should be evaluated for use within certain distances of shoreline to provide the benefit of pollutant removal via pretreatment, and additional pollutant removal as after discharge into the soil.

Wetlands provide many benefits with respect to protecting and enhancing water quality. The County has begun to receive applications to create wetlands mitigation banks to create or restore wetlands habitats to offset adverse impacts elsewhere. Properly sited, a wetlands mitigation bank can offer an excellent opportunity reconnect disconnected natural systems.

# Goals, Objectives, Policies, and Recommended Actions

# Goals, Objectives, Policies, and Recommended Actions

This section spells out long term goals for the policy areas for the Sustainable Accomack Comprehensive Plan Element, the objectives that should be pursued in striving to reach those goals, and policies and actions that should be carried out in order to achieve those goals and objectives.

## Sea Level Rise

**GOAL**:

**Accommodate challenges posed by rising sea level with minimal losses to developed areas and accommodate needs of habitats to migrate to new areas.**

**OBJECTIVES, POLICIES, AND RECOMMENDED ACTIONS**

**Objective 1:**

*Develop information to begin planning for adaptation for SLR in Accomack County.*

**Policies:**

*1-1 Use recently acquired LIDAR data to identify areas that are vulnerable to SLR. The vulnerable areas represent the cumulative reach of all sea level rise impacts for a determined area as well as adaptation strategies.*

*1-2 Incorporate SLR information and adaptation into most planning purposes.*

*1-3 Evaluate whether existing and planned infrastructure within areas vulnerable to SLR are ready for increases in sea level.*

*1-4 Develop Coastal Resource Management Guidance.*

**Recommended Actions:**

*1-a Identify areas not currently identified as flood hazard areas (i.e. identifying a future floodplain) and create an extended coastal flood hazard overlay to account for future flooding.*

*1-b Use the coastal flood hazard overlay district can be further delineated with Protection, and Shoreline Retreat Zones.*

*1-c Identify areas where conventional septic systems will be vulnerable to higher groundwater as a result of SLR.*

*1-d Use a 50 year planning horizon when considering adoption of protection,*

*accommodation such as site plan review, rezoning, conditional use permits, future land use map changes, and public infrastructure.*

*1-e Conduct an inventory all existing and planned infrastructure and land development within the vulnerable area for its capacity to accommodate projected sea-level rise over the life expectancy of the infrastructure and development.*

*1-f No capital improvements within the vulnerable area shall be financed or constructed without having first been reviewed to determine the extent to which the proposed improvement is sea-level rise-ready, taking into account the sea-level rise adaptation zone in which it is located, and whether it will contribute to additional development within the vulnerable area.*

**Objective 2**:

*Ensure adequate protection of the build environment through soft and hard shoreline stabilization that seeks to maintain a static shoreline position within Accomack County.*

**Policies:**

*2-1 Complete a Shoreline Management Plan to identify areas of the built environment vulnerable to sea level rise where shoreline stabilization strategies will be appropriate.*

*2-2 Compensate for the loss of ecosystem services resulting from hard shoreline stabilization in Accomack County.*

**Recommended Actions:**

*2-a Obtain and maintain a thorough inventory of existing shoreline stabilization of practices in Accomack County and determine their capacity to maintain functionality during the 50 year planning horizon.*

*2-b Develop a comprehensive shoreline stabilization strategy to address protection of the built environment with an emphasis on living shorelines where possible.*

*2-c Inventory all public buildings and infrastructure that are vulnerable to sea level rise within the 50 year horizon and determine whether such buildings and structures should be protected through shoreline stabilization.*

*2-d Require adequate mitigation for shoreline stabilization through the construction of living shorelines in front of hard shoreline stabilization structures where it is feasible do so.*

*2-e Develop living shoreline criteria for Wetlands Board for use in evaluating permit*

*applications.*

*2-f Provide public education on benefits of using living shorelines.*

**Objective 3:**

*Accommodate increasing sea levels and the additional flooding that will result by adapting the built environment and enhancing the ability of the natural environment to adapt to changes where economically and e*cologically practicable.

**Policies**:

*3-1 Ensure that all aspects of the built environment within the accommodation zone can withstand additional permanent or periodic inundation based on sea level rise projections through structural and non-structural solutions.*

*3-2 Ensure the built environment within impacted area can withstand additional permanent or periodic inundation as a result of SLR based on the 50 year horizon.*

*3-3 Discourage higher densities within the accommodation zone landward of unprotected shoreline.*

*3-4 Facilitate coastal ecosystem migration through the maintenance and restoration of adequate open space within the zone of accommodation*.

**Recommended Actions:**

*3-a Conduct public education within impacted areas on need of not only to address current flood hazards within the FEMA Special Flood Hazard Area, but to also plan for future flood hazards based on projected SLR.*

*3-b Within the existing Special Flood Hazard area require all new construction be an additional foot above the current one foot above base flood elevation.*

*3-c Within impacted area not currently within the Special Flood Hazard area require new construction to be an additional one boot about current natural grade of the area.*

*3-d Show unprotected flood prone areas as less dense categories on the future land use map.*

*3-e Downzone unprotected flood prone areas for land uses compatible with periodic inundation.*

*3-f Establish buffers that reflect projected rates of sea level rise within the 50 year*

*horizon for all tidally influenced water bodies. Such buffers shall be designed to allow the conversion of adjacent uplands to wetlands while retaining transitional zones where ecologically feasible.*

*3-g Develop priority areas for ecosystem migration areas. Some areas may require acquisition or conservation easements based on their strategic capacity to absorb floodwaters and support coastal ecosystem migration. Potential lands suitable for priority areas may include existing conservation lands, lands in conservation easements, lands in Land Use Taxation, as well as lands in Agricultural and Forestal Districts.*

**Objective 4**:

*Reduce vulnerability in the built environment and preserve coastal ecosystems through changes in land use and the orderly abandonment and /or landward relocation of structures and associated infrastructure.*

**Policies**:

*4-1 Reduce densities of future development along unprotected shorelines within managed relocation zones.*

*4-2 Preserve coastal ecosystems by ensuring that natural shoreline migration processes may continue unimpeded.*

**Recommended Actions:**

*4-a Eliminate new investment in public infrastructure within the managed relocation zone likely to be subject to the impacts of sea level rise within the 50 year horizon.*

*4-b Show unprotected flood prone areas as less dense categories on the future land use map.*

*4-c Downzone unprotected flood prone areas for land uses compatible with periodic inundation.*

*4-d Prohibit hard shoreline stabilization techniques in the managed Relocation Zone.*

*4-e Establish an erosion-based minimum setback for shoreline development within the managed relocation zone based upon the annual coastal erosion rate times a representing the economic lifetime of the coastal structure.*

*4-f Permits for new development within the shoreline retreat zone should include, as a condition of development approval, a requirement for removal of structures and fixtures once they are inundated for a specified period or are no longer habitable as determined by the Building Department or Health Department.*

# Alternative Energy

**GOAL**:

**Move toward a more sustainable energy future that increases alternative energy production and use and lessens local dependence on non-renewable sources.**

**OBJECTIVES, POLICIES, AND RECOMMENDED ACTIONS**

**Objective 5:**

*Promote opportunities for increased alternative energy use and generation.*

**Policy:**

*5-1 Promote renewable energy both for energy production and for individual sites.*

*5-2 Consider other sustainable means supplying energy locally.*

*5-3 Set an example by using renewable energy sources in County facilities.*

**Recommended Actions:**

*5-a Locate solar or wind energy generation equipment at County facilities when cost effective.*

*5-b Continue to explore the use of alternative energy technologies as new technologies become available and advances are made on existing technologies.*

*5-c Inventory poultry litter operations as a possible source for conversion to energy.*

*5-d Keep a database on alternative energy production and use to monitor progress.*

*5-e Support the upgrade of existing power transmission system to allow additional alternative energy production facilities to locate in Accomack County.*

*5-f Seek out business to locate or expand in the area that desire a portion of their energy needs to come from alternative sources.*

**Objective 6:**

*Where possible, remove constraints to alternative energy.*

**Policy:**

*6-1 Identified areas of the County having a high energy potential, such as for wind or solar that do not conflict with nearby used or other constraints will be appropriately designated for potential future use.*

**Recommended Actions:**

*6-a Revise zoning code to permit the use of on-site renewable energy facilities that includes community/neighborhood renewable energy systems.*

*6-b Modify the zoning ordinance to include solar and wind overlay zones that are near sources of energy as well as connections to the existing power grid..*

*6-c Encourage and support site plan orientations that maximize solar orientation and develop standards for the use of renewable energy resources in the layout and construction of new development.*

# Surface Water Quality

**GOAL**:

**Achieve and maintain a high water quality for aquatic life, food, and recreation.**

**OBJECTIVES, POLICIES, AND RECOMMENDED ACTIONS**

**Objective 7:**

*Minimize impact of development on natural resources.*

**Policies:**

*7-1 Maintain and preserve Blue/Green Infrastructure.*

*7-2 Encourage greater groundwater recharge and reduced runoff.*

**Recommended Actions:**

*7-a Incorporate blue/green infrastructure preservation into plan of development review.*

*7-b Encourage less impervious surfaces and more permeable surfaces through incorporating Low Impact Development as a part of project review.*

*7-c Evaluate parking requirements of the Accomack County Zoning Department to see determine if reductions in parking area are possible.*

*7-d Encourage elements of Low Impact Development (LID) and bioretention that work in areas of high seasonal water tables.*

*7-e Designate areas where certain LID practices are not appropriate due to the location of the groundwater recharge spine.*

*7-f Develop policies to encourage onsite reuse of runoff for uses such as irrigation or fire suppression instead of runoff to surface waters as part of development review.*

*7-g Encourage and protect BMPS for all land uses*

*7-h Require pretreatment of on-site waste disposal systems within a minimum distance of shorelines.*

*7-i Inventory locations of failed septic systems and create database of alternative septic systems.*

*7-j Incorporate implementation programs as part of any regulation changes*

**Objective 8:**

*Enhance and repair the existing systems.*

***Policies:***

*8-1 Utilize GIS and existing studies to identify enhancements that will improve surface water systems.*

*8-2 Encourage property owners to make water quality improvement practices on their own properties*

***Recommended Actions:***

*8-a Provide educational opportunities on how landowners can take individual action to improve water quality.*

*8-b Better delineate drainage areas from available LIDAR data.*

*8-c Use LIDAR data as a tool in to update County Drainage Maintenance Plans.*

*8-d Use GIS and Blue/Green Infrastructure Report to identify areas for possible streamside restoration.*

*8-e Use GIS and Blue/Green Infrastructure Report to identify areas where wetlands mitigation banks may reestablish disconnected ecosystems.*

*8-f Use GIS and Blue/Green Infrastructure Report to highlight areas desirable as conservation easements.*

*8-g Inventory existing stormwater ponds and encourage enhancements where necessary.*

## Deliverable 5. Sustainable Community Comprehensive Plan Workshop

Item(s) included:

- Accomack Sustainable Community Workshop Report
- Workshop Press Release
- Accomack Sustainable Community Workshop Agenda
- Accomack Sustainable Community Workshop PowerPoint Presentation

## Accomack Sustainable Community Workshop Report:

The Accomack County Community Development Workshop was held during the morning of Friday, September 28, 2012 in the Accomack County Administration Building for the purpose of soliciting input for the Sustainable Community Comprehensive Plan Element as well as the Sustainable Community Web Page Updates.

A press release (attached) was created and sent to local media and was also email and mailed to interested parties. The release was printed in the Eastern Shore News and was heard on WESR, a local radio station.

The workshop agenda and presentations (both attached) were developed and presented by the Land Use Planner, the Environmental Planner and the GIS Coordinator and focused on Sea Level Rise, Alternative Energy, the Chesapeake/Atlantic Preservation Area provisions of the Accomack County Zoning Ordinance, Erosion and Sediment Control, and Stormwater Management.

There were 9 attendees and were primarily from local engineering and development firms and the comments tended not to focus on the comprehensive plan or the web pages but questions about new stormwater regulations coming from the State that localities will have to implement.

This workshop and report were 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.

Contact: Tom Brockenbrough
Telephone: 757-787-5726
Email: tbrockenbrough@co.accomack.va.us

FOR IMMEDIATE RELEASE

# Accomack County to Hold Sustainable Community and Blue & Green Infrastructure Workshops

Accomack County will be holding two workshops on Friday, September 28, 2012. The morning workshop will start at 9:30am. This workshop will focus on sustainable community information that will aide in updating the Comprehensive Plan and Department of Planning web pages. The workshop will include information on sea level rise, alternative energy, the Chesapeake Atlantic Preservation Act, erosion and sediment control, and stormwater management.

The second workshop will begin at 1:30pm. This workshop will focus on blue & green infrastructure and how to conserve during development process by using amended Agricultural, Rural Residential and Village residential Zoning districts.

Developers, engineers, designers, citizens, and local government representatives are encouraged to attend both workshops to give input and feedback on the issues.

The workshops will be held in the Board Chambers, room 104 of the Accomack County Administration Building, 23296 Courthouse Avenue, Accomac

These workshops are 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.

# Accomack County Sustainable Community Workshop

Friday, September 28, 2012
Accomack County Administration Building
23296 Courthouse Avenue, Accomac VA 23301
Room 104

## Agenda

9:30 AM – Welcome and Introductions

9:45 AM – Sea Level Rise

10:00 AM – Alternative Energy

10:15 AM – Chesapeake Atlantic Preservation Act

10:45 AM – Erosion and Sediment Control

11:15 AM – Stormwater Management

12:00 PM – Adjourn

Virginia Coastal Zone
MANAGEMENT PROGRAM

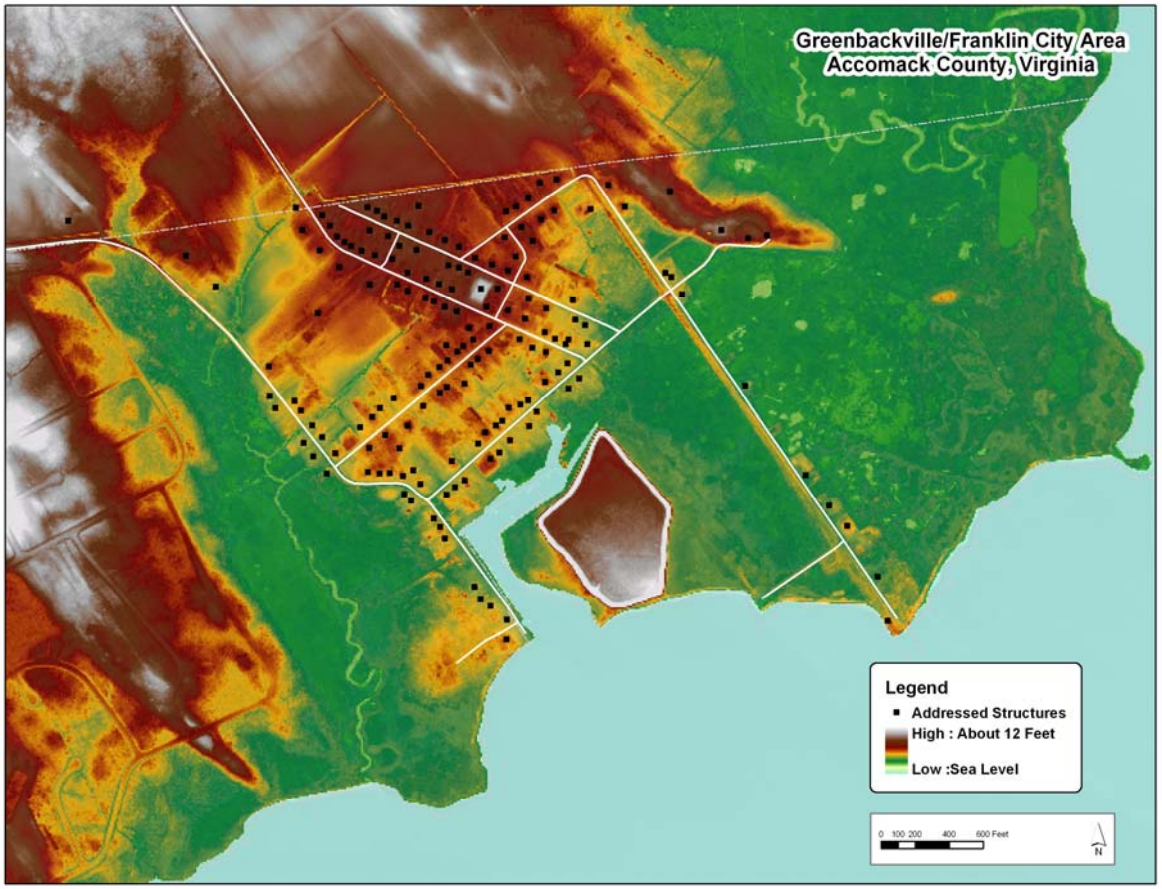
NOAA

# Sea Level Rise

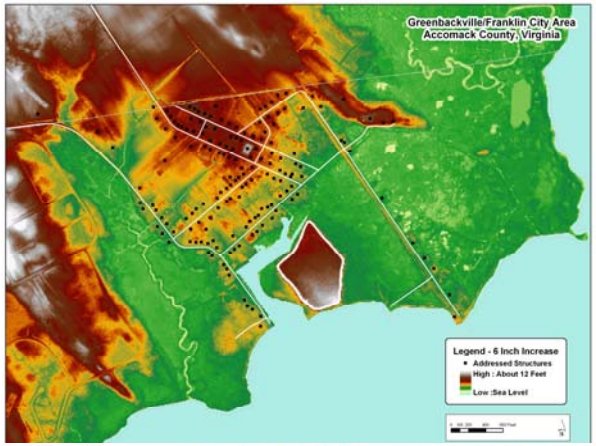
# Sea Level Rise

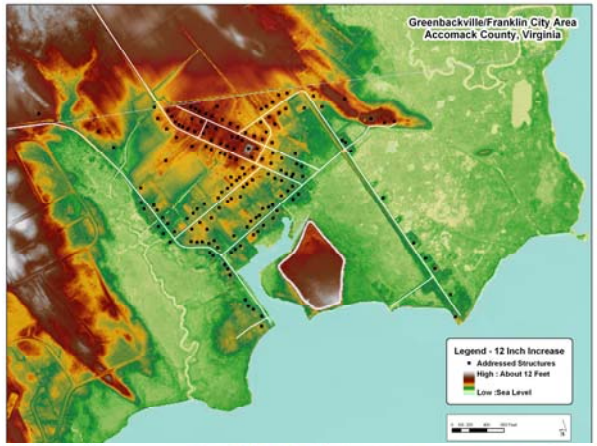
- Historic rates of sea level rise historically estimated at one foot per century.
- Modern rates of sea level rise are estimated to be 1.5 to 3 times the historic rate.
- During the 20$^{th}$ century, global sea level rose by roughly seven inches.
- Climate change models project that global sea level rise will accelerate in the 21$^{st}$ century.

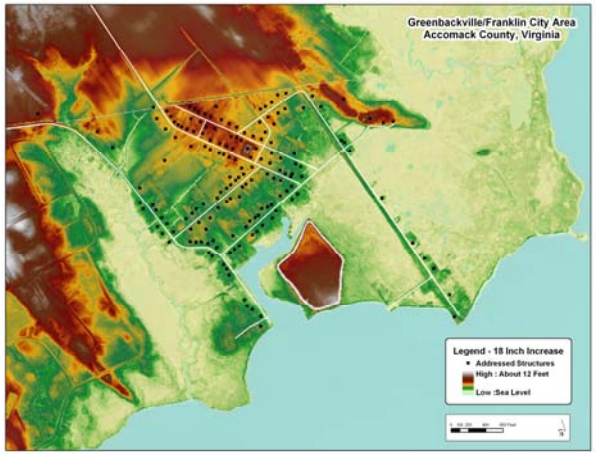
# Current Sea Levels

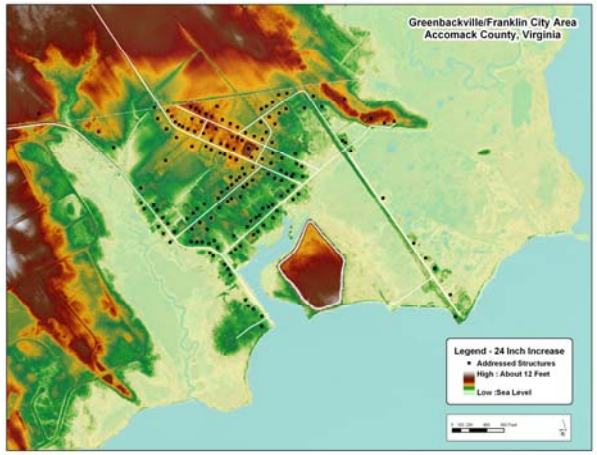


# 6, 12, 18, and 24 Inches of Sea Level Rise



# Sea Level Rise

- Development can change the amount of sediment delivered to coastal areas, worsen erosion and remove or damage wetlands.
- Rising sea levels could also increase the salinity of groundwater

# Sea Level Rise

- Accomack County Flood Hazard Districts
- AE – coastal floodplain areas
- VE – coastal high hazard areas
- Base Flood/100-Year Flood- a flood that has a 1% chance of occuring each year.

# Alternative Energy

# Alternative Energy

- Accomack County Zoning Ordinance allows for alternative energy development
- Depending on the zoning district, wind and solar energy systems of varying sizes can be developed

# Wind Energy Systems

- Three sizes allowed in Accomack County
- Small- private system with a maximum power of not more than 50 kW.
- Large- system rated capacity of not more than 999 kW
- Utility Scale- system with a rated capacity of one MW or greater.

# Solar Energy Systems

- Also broken into three sizes
- Small- private system with a maximum power of not more than 15 kW.
- Large- system that has a maximum power of not more than 999 kW.
- Utility Scale- system which has a rated capacity of one MW or greater.

Virginia Coastal Zone
MANAGEMENT PROGRAM

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## Deliverable 6. Sustainable Community Web Page Updates

Item(s) included:

- Accomack Sustainable Community Web Page (also available online at http://www.co.accomack.va.us/Planning/Sustainability/Sustainability.html)
- Sea Level Rise Web Page (also available online at http://www.co.accomack.va.us/Planning/Sustainability/SeaLevelRise.html)
- Alternative Energy Web Page (also available online at http://www.co.accomack.va.us/Planning/Sustainability/AlternativeEnergy.html)
- Chesapeake/Atlantic Preservation Area Web Page (also available online at http://www.co.accomack.va.us/Planning/CAPA/CAPA.html)
- Erosion and Sediment Control & Stormwater Management Web Page (also available online at http://www.co.accomack.va.us/Planning/ErosionSedimentControl/erosion_sediment_control.html)

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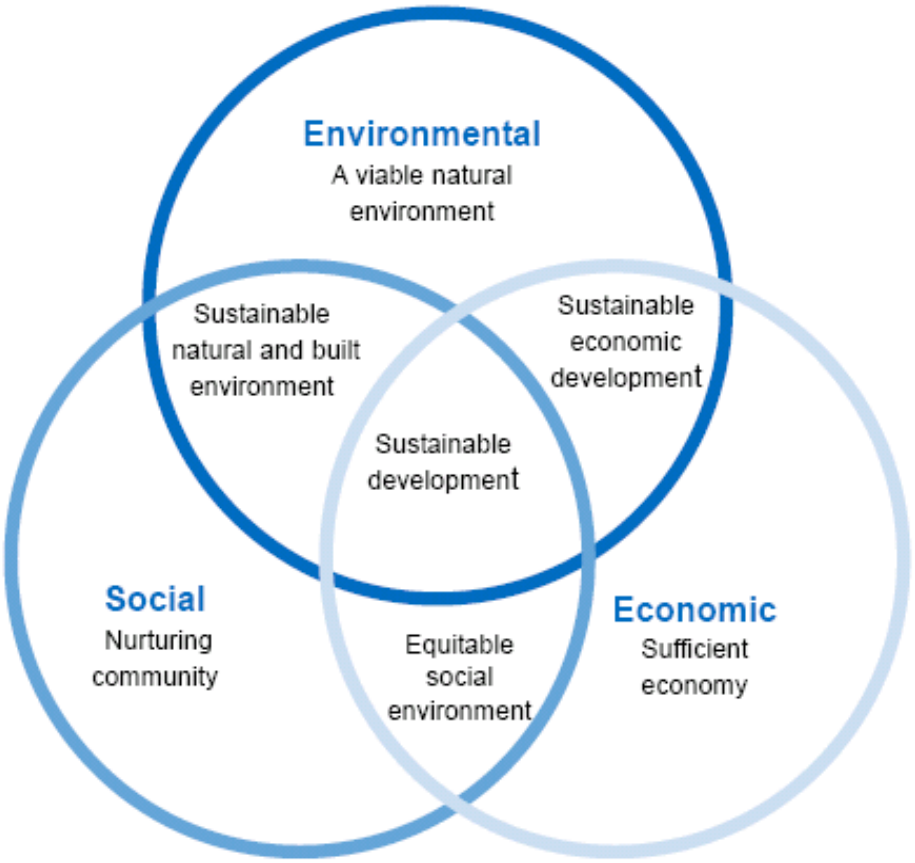
## Accomack Sustainable Community

### *What is Sustainability?*

Sustainability is broadly defined as meeting the needs of the present generation without compromising the ability of future generations to meet their own needs. A sustainable system does not break down over time. Resources that are consumed are replenished.

Sustainability links the issues of environment, economy and social equity together. An action or decision in one of these areas will likely have consequences in the other whether intended or not. The intersection of social, economic, and environmental systems represents where sustainable development would be in a balanced system.




On the following pages is additional information on sustainability as it impacts development in Accomack County:

- Sea Level Rise
- Alternative Energy
- Chesapeake/Atlantic Preservation Area
- Erosion and Sediment Control & Stormwater Management

**Where can I find out more about Sustainability?**

- Environmental Protection Agency Page on Sustainability
- American Planning Association Guide to Planning for Sustainability


*This page and subsequent pages were 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.*

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## Sea Level Rise

Whether it is called "Sea Level Rise", "Global Warming", "Land Subsidence", "Climate Change" or "Repetitive Flooding", the water levels are changing in relationship to the land in Accomack.

In 2012 the U.S. Geological Survey found that globally since 1950 the sea level has risen by an average of 0.6 to 1 millimeter annually (2.4 -3.9 inches over 100 years). Relative sea level rise in Virginia has been much higher. In the last century the tide gauge at Sewells Point rose by 1.45 feet with projections in the Bay region (Pyke et al. 2008) to range between 2.3 feet and 5.2 feet in the next century. Part of the reason for the rate in this area being higher is due to land subsidence in the Bay area.

Being between the Atlantic Ocean and the Chesapeake Bay with a relatively low and flat topography, Accomack County is particularly vulnerable to increases in the sea level. Already certain areas of the County are flooding more frequently both from lesser intensity storms as well as from tidal cycles. This change poses problems such as wetlands retreat and loss, saltwater intrusion and inundation, shoreline erosion, loss of islands which provide important functions during storms by absorbing energy.

The Eastern Shore of Virginia benefitted from the recent acquisition of LIDAR data which will benefit us in better determining the areas affected by sea level rise and potential impacts such as storms, tidal inundation and flooding, and wetlands migration and loss. The data is still being evaluated and additional information should be developed in the future. Below are maps of Accomack County showing areas in red that have the potential to become inundated as a result of sea level rise. As is evident, sea level rise and storm surge pose a severe threat to homes, businesses, natural and cultural landscapes.

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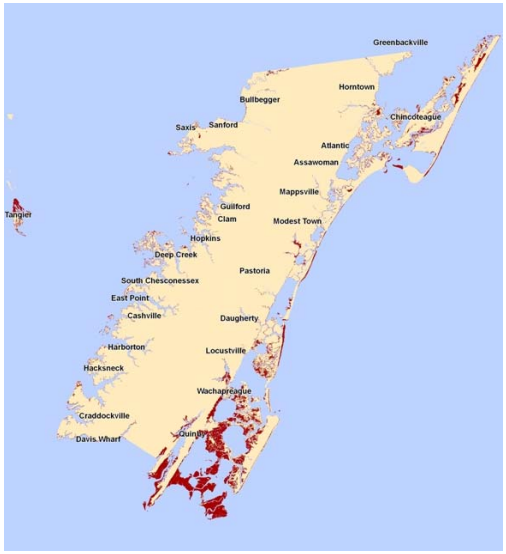
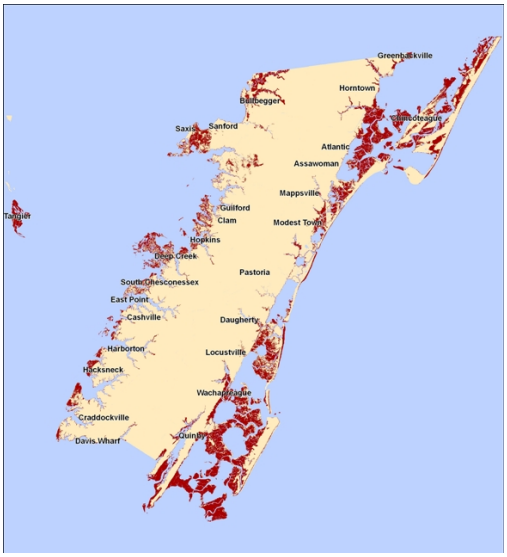
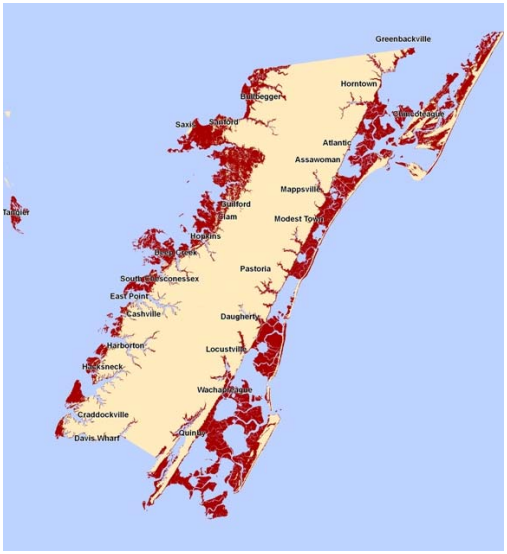



**6 Inch Rise in Sea Level**




**12 Inch Rise in Sea Level**




**24 Inch Rise in Sea Level**


**36 Inch Rise in Sea Level**


Higher water levels mean higher storm surges and flood waters. The area in green in the map at right shows the potential area impacted by storm surge from a Category 1 Hurricane. Should the water level rise, then additional areas will be at risk.

Several actions can be undertake to mitigate the impacts of sea level rise. Homes can be built higher or raised to be further out of an increasing flood zone.


Living shoreline stabilization measures can be utilized to preserve the natural environment which allow wetlands to migrate rather than shoreline hardening. Additional public lands can be obtained along the shoreline to act as a buffer. We can also encourage building further back from the shoreline.


Graphic courtesy Burke Environmental Associates

| | | |
|---|---|---|
| Riparian Vegetation Management | Tidal Marsh Enhancement | Living Breakwater |
| Bank Grading | Tidal Marsh Creation | Offshore Breakwater System |
| Fiber Logs | Beach Nourishment & Dune Restoration | Oyster Reefs |
| | Marsh Toe Revetment | |
| | Marsh Sill | |
| | Marsh with Groins | |

**Where can I find out more about Sea Level Rise?**

- The Eastern Shore of Virginia: Strategies for Adapting to Climate Change
- Virginia Sea Level Rise Maps
- Potential Response To Sea Level Rise By Virginia Coastal Localities
- Chesapeake Bay: The Increasing Effects of Sea-Level Rise and Storm Surge - National Geographic

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## Alternative Energy

Alternative energy generally refers to energy sources other than fossil fuels. Renewable energy sources are generated from natural resources such as sun, wind, rain, tides, and geothermal heat which are naturally replenished. Most of these types of energy are also cleaner than oil or coal.

In Accomack County, solar energy and wind energy are the predominant forms of alternative energy. Our coastal environment provides both a lot of sun and wind as sustainable energy sources.

While solar use has been in limited use for a while and wind energy has been growing, these projects, until recently, have been limited to small individual systems. That may be changing. During 2011 Accomack County granted approval for the operation of a commercial solar farm after the Zoning Ordinance was amended to allow larger solar and wind energy systems. Several companies have expressed interest in developing wind farms off the coast of Virginia.

The Accomack County Zoning Ordinance currently allows for individual wind energy systems by right in the Industrial, Agricultural, Rural Residential, and Village Residential Districts by right as long as certain conditions are met.

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Another source of alternative energy which has potential in Accomack County is the conversion of poultry litter to energy. An Accomack County poultry farmer has received finding to convert chicken manure into electricity. The project, serving an individual farm would be capable of converting 2,200 tons of poultry litter each year into energy. Poultry litter is currently disposed of as fertilizer on farm fields which increases the possibility of runoff into local waters. If successful, this type of energy could be a good way to dispose of nutrient rich waste instead of fertilizer.

**Where can I find out more about alternative energy?**

- Wind Power - Virginia Department of Mines, Minerals, & Energy
- Small Wind Electric Systems - U.S. Department of Energy
- Small Wind Guide for Virginia
- Virginia Center for Wind Energy - James Madison University
- Solar Energy - National Renewable Energy Laboratory
- US Department of Energy Solar Energy Page
- National Association of RC&D Councils Article on Poultry Litter to Energy Conversion

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## Chesapeake/Atlantic Preservation Area

The Chesapeake / Atlantic Preservation Area (CAPA) applies to the all of Accomack County, except for incorporated towns and Federal lands. Areas shown on the CAPA Map are subject to the requirements of the CAPA Ordinance. When reviewing development applications, Department of Planning staff conducts site visits to delineate or confirm the 100-foot vegetative buffer, prepares water quality impact assessments, considers buffer exceptions, and investigates buffer violations. The Department of Planning also maintains a Storm Water Management best management practices structure (BMP) database and administers the septic system pump-out notification program.

The Chesapeake/Atlantic Preservation Area (CAPA) provisions of the Accomack County Zoning Ordinance first came into being in Accomack County in 1990, following state legislation enacted in 1988. The ordinance imposes development standards that limit impervious cover in favor of trees and woody vegetation that protect Chesapeake Bay water quality. Originally the provisions applied to just the portion of the County in the Chesapeake Bay watershed. In 2009 most of the provisions were extended to include the portion of the County which also drain into the Atlantic Ocean.

Accomack County Calendar of Events

Click here for the calendar.

**Contact Information**

Department of Planning
Accomack County
23282 Courthouse Ave.
P.O. Box 686
Accomac, Virginia 23301

**Director:**
Rich Morrison
planning@co.accomack.va.

8:30 AM to 5:00 PM
Monday through Friday

(757) 787-5726
(757) 824-5324

If you would like to work in this department, please click here to learn if there are Employment Opportunities.

Trees and vegetation intercept rainfall, absorb and filter pollutants, provide shade, offer wildlife habitat, and provide erosion control. Impervious cover creates a hard surface that prevents natural infiltration and increases the rate of stormwater runoff, thereby speeding the rate of delivery of nutrients (fertilizers), sediments, and other pollutants into the watershed and ultimately into the Chesapeake Bay. The CAPA Ordinance attempts to balance the competing needs for environmental protection and development by promoting best practices in preservation and use of native vegetation, while setting limits on development to preserve the natural environment to the maximum extent possible.

In general the CAPA Ordinance regulates development by limiting impervious cover preserving native vegetation to the maximum extent possible requiring erosion and sedimentation controls for any land disturbing greater than 2,500 square feet, requiring septic tank pump-outs at least once every five years, requiring a Plan of Development for any land disturbance greater than 2,500 square feet, controlling stormwater runoff with Best Management Practices (BMPs), and strictly limiting development in the RPA buffer.

One of the main CAPA Ordinance tools is the Resource Protection Area (RPA), which consists of a 100-foot-wide vegetated buffer area that starts at the edge of water (or wetlands or mean high water) and continues landward for 100 feet. The RPA serves as a buffer between activities on the land and the water. Buffer functions include minimizing soil erosion, intercepting and taking up nutrients, intercepting rainfall, slowing stormwater runoff, providing habitat and shade, and serving as a protective barrier for the waterways that drain into the Bay.

The RPA is comprised of lands adjacent to water bodies with perennial flow that have an intrinsic water quality value due to the ecological and biological processes they perform or are

sensitive to impacts which may result in significant degradation to the quality of state waters."

Another feature of the CAPA Ordinance is the Resource Management Area (RMA), which is that part of the Chesapeake Bay Preservation Area that is not classified as an RPA with the exception of a small area of Captain's Cove development classified as an Intensely Developed Area (IDA).

Another component of the CAPA Ordinance is the Water Quality Impact Assessment (WQIA), a special environmental study that identifies and addresses environmental impacts for projects that will disturb any part of the 100-foot-wide RPA buffer, contain 10 acres or more for any use other than development of single-family detached residential lots, contain 25 acres or more for the development of single-family detached residential lots, or have unique characteristics.

The goal of the CAPA provisions is to protect and improve surface water quality and protect the living resources of our waters, ensuring their sustainability. These waters form part of Accomack's Blue/Green Infrastructure.

Property owners and developers can take many steps to protect these sensitive waters through simple means such as planting vegetative buffers, using rain barrels, or implementing concepts of low impact development on a site.

Additional links to sustainability and protecting our coastal waters may be found below:

- *A Sustainable Chesapeake: Better Models for Conservation*, The Conservation Fund
- Environmental Law Institute - Sustainable Use of Land in the Chesapeake Bay Region

- The UVA Bay Game - A watershed sustainability simulation
- Chesapeake Bay Journal
- Tips on Keeping Your Lawn Green and the Chesapeake Bay Clean
- Low-Impact Development Design Strategies: An Integrated Design Approach
- Blue and Green Infrastructure in Accomack County

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*Official Website of*

**Accomack County**
**Eastern Shore of Virginia**

**Planning**

## Erosion and Sediment Control and Stormwater Management

### Erosion and Sediment Control

- Minimum Erosion and Sediment Control Standards and Virginia Regulations
- Virginia Erosion and Sediment Control Handbook
  The Virginia Department of Conservation and Recreation offers this free, downloadable handbook on erosion and sediment control.
- Erosion and Sediment Control Minimum Standard Checklist
- Instructions for Submitting Your Land Disturbing Permit Application and Plan
  - Erosion and Sediment Control Plan Review Application
  - Erosion and Sediment Control Plan Review Fees

A **Land Disturbing Permit** is required for any land disturbance of:

- any project within a subdivision
- any new home site in the Chesapeake/Atlantic Preservation Area Resource Management Area (RMA) needs an E&S Agreement (home + driveway + septic + well)
- over 2,500 square feet on the bayside of the Chesapeake/Atlantic Preservation Area Resource Management Area (RMA)
- over 3,500 square feet on the seaside of the Chesapeake/Atlantic Preservation Area Resource Management Area (RMA)

Accomack County Calendar of Events

Click here for the calendar.

**Contact Information**

Department of Planning
Accomack County
23282 Courthouse Ave.
P.O. Box 686
Accomac, Virginia 23301

**Director:**
Rich Morrison
planning@co.accomack.va.us

8:30 AM to 5:00 PM
Monday through Friday

(757) 787-5726
(757) 824-5324

If you would like to work in this department, please click here to learn if there are Employment Opportunities.

- any project which encroaches into the Chesapeake Bay Resource Protection Area (RPA)100-foot waterfront buffer needs an E&S Agreement or Administrative Exemption.

**...except for the following exemptions:**

- Minor land-disturbing activities and individual home landscaping, repairs and maintenance work;
- Individual service connections;
- Installation, maintenance or repair of underground public utility lines when such activity is confined to an existing hard surfaced road, street or sidewalk;
- Septic tank lines or drainage fields unless included in an overall plan for land-disturbing activity relating to construction of the building to be served by the septic tank system;
- Surface or deep mining;
- Exploration or drilling for oil and gas including the well site, roads, feeder lines and off-site disposal areas;
- Tilling, planting or harvesting of agricultural, horticultural or forest crops, or livestock feedlot operations; including a specific list of engineering operations;
- Repair or rebuilding of the tracks, right-of-way, bridges, communication facilities and other related structures, and facilities of a railroad company;
- Agricultural engineering operations including but not limited to the construction of terraces, terrace outlets, check dams, desilting basins, dikes, ponds not required to comply with the provisions of the Virginia Dam Safety Act, ditches, strip-cropping, lister furrowing, contour cultivating, contour furrowing, land drainage and land irrigation. Farm buildings are not exempt;
- Installation of fence, sign, telephone, electric, or other kinds of posts or poles;
- Shore erosion control projects on tidal waters when the projects are

approved by local wetlands boards, the Marine Resources Commission or the U. S. Army Corps of Engineers; and
- Emergency work to protect life, limb or property, and emergency repairs.

**If you are not sure** if a Land Disturbing Permit is required for your proposed project, please contact the Department Planning for more information (contact information is in the right column).

**Small projects and single family residential home** development may be permitted with an **"Agreement in Lieu of a Plan"** rather than requiring a full Erosion and Sediment Control Plan.

## Stormwater Management

The Commonwealth of Virginia has a new requirement requiring all localities to adopt Stormwater Management regulations. The Accomack Ordinance is under development and will be forthcoming. Below are links to the Virginia requirements:

- Virginia Stormwater Management Program
- Virginia Stormwater Act
- Virginia Stormwater Management Handbook
- Stormwater BMP Checklist

Low Impact Development Strategies in development plans for Erosion and Sediment Control are important sustainability concepts in protecting surface waters. These can be done primarily through implementing aspects of Low Impact Development (LID)

LID mimics nature and treats stormwater as a resource, rather than simply something to be conveyed offsite and into surface waters. LID controls stormwater at the source and keeps much of it on site for use or groundwater infiltration. Additional information on LID and sustainability can be found at the following locations.

- Low-Impact Development Design Strategies:  An Integrated Design Approach
- Blue and Green Infrastructure in Accomack County
- Sustainable Stormwater Management
- Better Site Design Publications from the Center for Watershed Protection (requires free registration to download documents)

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