



A Sustainable Chesapeake

BETTER MODELS FOR CONSERVATION

Edited by David G. Burke and Joel E. Dunn

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Green Infrastructure

Introduction

Strategic land conservation of large, ecologically intact, natural areas, working forestlands and connecting corridors is now recognized as one of the key emerging solutions to protect and restore the Chesapeake Bay.

The term green infrastructure has taken on various meanings in and outside of conservation circles. The authors and organizations involved with the green infrastructure case studies featured in this publication also think of and define green infrastructure in slightly different ways. Yet, they are consistently referring to and concerned about the conservation of a linked network of natural resource lands, particularly forestlands, wetlands, grasslands and other plant communities that perform valuable services which benefit people, wildlife and the environment. These services include, for example, removing pollutants; sequestering carbon through plant biomass production; and abating floods and storm damage. Of great significance is the protection of these natural resources within a broader network of large, contiguous and inter-connected landscapes that, from an ecological perspective, work more effectively.

The case studies in this chapter were carefully chosen to cover the breadth of actions needed to protect green

infrastructure in different settings. The Hampton Roads study shows how green infrastructure can be protected in a complex metropolitan area spanning several jurisdictions. Cacapon and Lost Rivers Land Trust prove that a small rural non-profit organization with limited resources can mobilize strong partnerships to achieve impressive land conservation results. Prince George's County highlights a well conceived process to garner citizen interest and support for green infrastructure protection using land use controls in a county with significant development pressures. Baltimore County shows how the government partnered with landowners in rural subdivisions to improve watershed health by replacing excess lawn areas with strategic forest plantings. Chino farms profiles native grasslands and forest restoration actions taken by an enlightened farm management team. A group of conservationists reveal the next generation of assessment and targeting tools that are available to minimize environmental impacts of public infrastructure. Blue Ridge

Forest Cooperative demonstrates a grass roots approach to facilitating sustainable management practices on private forestlands.

Some of the principles underlying these successful green infrastructure profiles, which are essential to attaining a sustainable Chesapeake, include:

- **Plan at multiple scales to protect the complete green infrastructure network:** Identifying the green infrastructure land network and devising protection strategies needs to occur at all geographical and jurisdictional levels and requires intergovernmental and private landowner collaboration and monitoring of progress at regular intervals.
- **Select appropriate implementation tools:** Conservation of the green infrastructure land network involves careful consideration and selection of implementation tools tailored to fit specific circumstances. The most commonly used methods are: public land acquisition; donated conservation easements; landowner best management practices; and land use controls which limit both direct and indirect impacts to a variety of green infrastructure physical and functional components.
- **Stimulate action through credible analytical techniques and public participation:** The use of thorough, defensible assessment methods and well chosen environmental indicator data have a proven track record. Simple presentation graphics communicating study results enhance citizen and decision-maker understanding of the values of and need for protection of green infrastructure networks. Providing opportunities for public participation in the decision making process increases the likelihood of acceptance and stimulates implementation actions.

Developing and Protecting Green Infrastructure

A Regional Approach to Conservation in Southeastern Virginia

A joint effort of local governments in the Hampton Roads area demonstrates how a green infrastructure plan evolved to protect valuable ecological services and open space while contributing to the region's economic vitality.

CASE STUDY SUMMARY

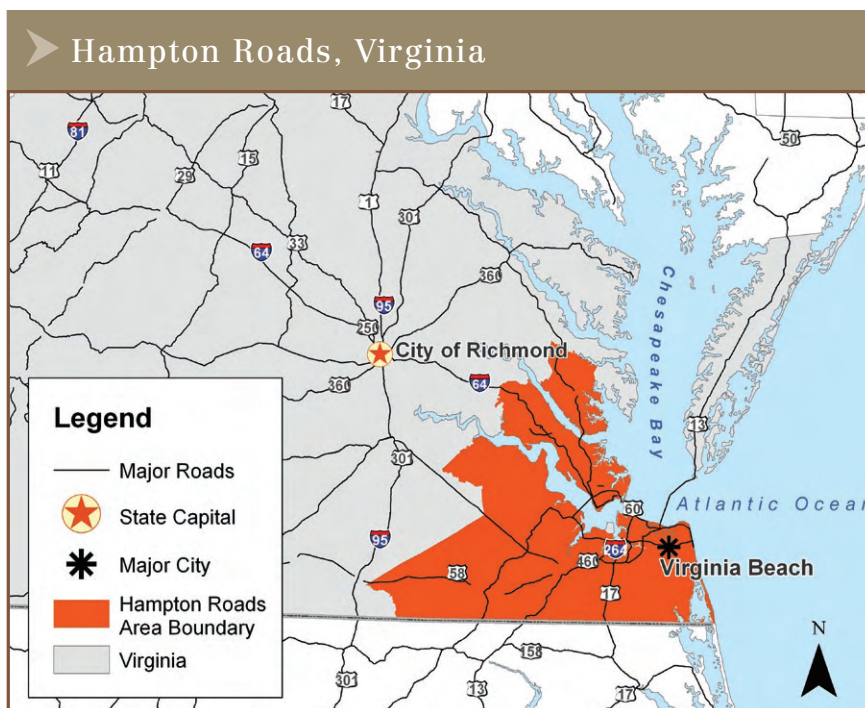
The Hampton Roads green infrastructure network is the first and most fully realized regional conservation planning effort of its kind in Virginia. The name of the region, Hampton Roads, is a reference to the harbor at the center of a highly urbanized region at the confluence of the James River and the southern terminus of the Chesapeake Bay and the Atlantic Ocean. This green infrastructure project was developed to address the need for a comprehensive regional approach to conservation planning in an area of Virginia that is both blessed with a rich array of natural resources and challenged by development pressures and use conflicts. The project is the result of a multi-year team effort among a broad range of stakeholders, including the staff and member localities of the Hampton Roads Planning District Commission, the Virginia Coastal Zone Management Program, and the Virginia Natural Heritage Program. The resulting regional network consists primarily of lands that have high intrinsic value for the protection of water quality and critical habitat.

Implementation efforts have taken many forms.

The regional green infrastructure network is used in several local comprehensive plans, parks and recreation plans, and purchase of development rights programs. The regional network has also been used to prioritize wetlands mitigation sites and to identify lands that have been purchased or placed under

conservation easements to prevent conversion to other uses. Increasingly, the network is being used in conjunction with efforts to buffer military facilities from encroachment by new development.

The Hampton Roads Planning District Commission is one of twenty-one regional planning agencies in Virginia. Its staff coordinates the regional green infrastructure project



in Hampton Roads and is responsible for the majority of the technical work associated with the effort.

RESOURCE MANAGEMENT CHALLENGE

The Hampton Roads region consists of the central cities of Chesapeake, Hampton, Newport News, Norfolk, Virginia Beach, and Portsmouth arrayed around the port of Hampton Roads. Moving out of the urban core, land use patterns become more rural and feature a mix of low-density residential uses, agriculture, and forestry operations. Population growth, redistribution of population, and the development of open space, farms, and forests is the primary challenge in maintaining the ecological vitality of southeastern Virginia.

The sprawling development pattern in the region has resulted in fragmentation of natural areas and an increase in impervious surface, resulting in impaired waters. According to the Virginia Department of Environmental Quality's 2008 Water Quality Assessment, 66% of the assessed river miles in Virginia are impaired.¹ Nearly 95% of the assessed estuary acres are impaired. Many pollution sources, including atmospheric deposition, point sources and nonpoint sources, contribute to water quality problems in the region. In addition, significant wetland acreage in Hampton Roads has been ditched and drained for agriculture or filled for development. A sophisticated green infrastructure plan was needed to prioritize land conservation activities that address regional land and water issues.

CONSERVATION VISION

The Hampton Roads green infrastructure plan identifies opportunities to protect ecological services, provide open space and recreational opportunities, and maintain economic vitality through quality community planning

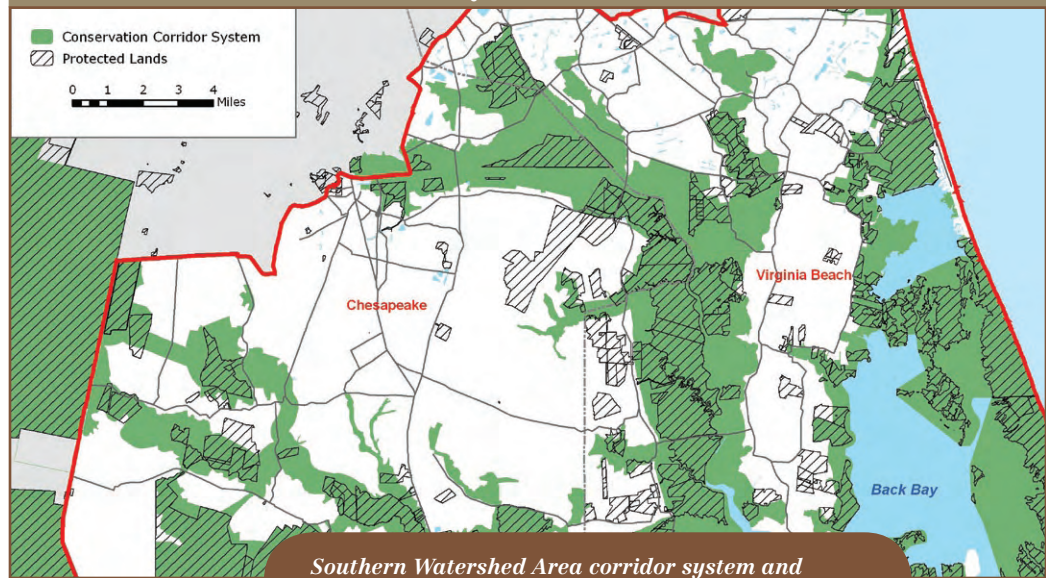
SOUTHERN WATERSHED AREA MANAGEMENT PROGRAM

The Southern Watershed Area Management Program (SWAMP), developed by the cities of Chesapeake and Virginia Beach in partnership with the Hampton Roads Planning District Commission and the Virginia Coastal Zone Management Program, is designed to protect natural resources, sensitive lands, and water supplies in the headwaters of the Albemarle-Pamlico system and to facilitate wetland mitigation.² The development of a conservation corridor system and an associated conservation plan for SWAMP was the precursor for the regional green infrastructure network.

During the time period when the corridor was under development the term "green infrastructure" was not yet in common use. The corridor system has been used in comprehensive planning efforts, the creation of a purchase of development rights program in the city of Chesapeake, and is the target area for wetlands mitigation.

The system was designed to capitalize on the existing network of protected lands and highlight opportunities for connectivity. The corridor system provides a framework for the protection of the rich set of natural heritage resources found in the Southern Watershed Area.

Southern Watershed Area Conservation Corridor System



and minimal encroachment on military facilities. The primary considerations for the regional green infrastructure design included: maintaining and improving the connectivity and viability of the remaining natural areas; watershed protection; and watershed management.

There are limited opportunities in Hampton Roads to protect large tracts of interior forest. Instead, the greatest potential for conserving and restoring green infrastructure is associated with critically important wetlands habitat and riparian areas. Riparian areas are transitional envi-



ronments found between terrestrial and aquatic ecosystems. They often have high biodiversity, a prevalence of wetlands, and offer potential for water quality enhancement, other ecological services, and recreation amenities such as greenways and trails. Urban development patterns in Hampton Roads, particularly in the older central city areas, have fragmented habitat to the extent that riparian areas now represent the best means of achieving a linked corridor system. The vision of conserving riparian corridors originated with a project called the Southern Watershed Area Management Program (SWAMP) in the cities of Chesapeake and Virginia Beach.

IMPLEMENTATION RESOURCES

The costs associated with the green infrastructure project in southeastern Virginia can be divided into two categories: planning and implementation.

Planning: The regional green infrastructure project was funded through a combination of grants from the Virginia Coastal Zone Management Program and matching funds from the Hampton Roads Planning District Commission. Total funding for the project was approximately \$70,000, with \$40,000 in grant money and \$30,000 in match. The budget also included the development of an educational video on the regional green infrastructure effort for use by the member localities. Production of the video consumed approximately 15% of the total project budget.

Implementation: There are a wide variety of state and federal conservation incentive programs and funding sources available to landowners and local governments in Virginia. This backdrop of assistance and incentives serves as the principal mechanism for conserving the green infrastructure network. In addition, the efforts of the City of Virginia Beach and the

City of Chesapeake are particularly noteworthy. Both cities have used funding from a variety of sources for land acquisition. In addition, they have implemented other incentives, such as purchase of development rights programs. The location of lands within the green infrastructure network is one of the criteria considered when candidate parcels are reviewed for potential purchase through these various programs.

CONSERVATION STRATEGY

A regional green infrastructure network for southeastern Virginia was developed based on the experience and utility of the conservation corridor system in the SWAMP. Data analysis and mapping techniques using a Geographic Information System (GIS) helped to produce a map of a green infrastructure network. A stakeholder involvement process then identified areas of emphasis. The network is meant to complement existing conservation initiatives in Hampton Roads, including compatible land use planning with military facilities—such as buffering the installations from encroachment by new development—and a wetlands mitigation agreement between the Cities of Chesapeake, Virginia Beach, and others. Subsequently, the Hampton Roads Planning District Commission conducted green infrastructure workshops and worked closely with local government staff to include the network in local planning efforts and with agencies and conservation organizations doing land acquisition. The conservation strategy moved through a stepwise process described below.

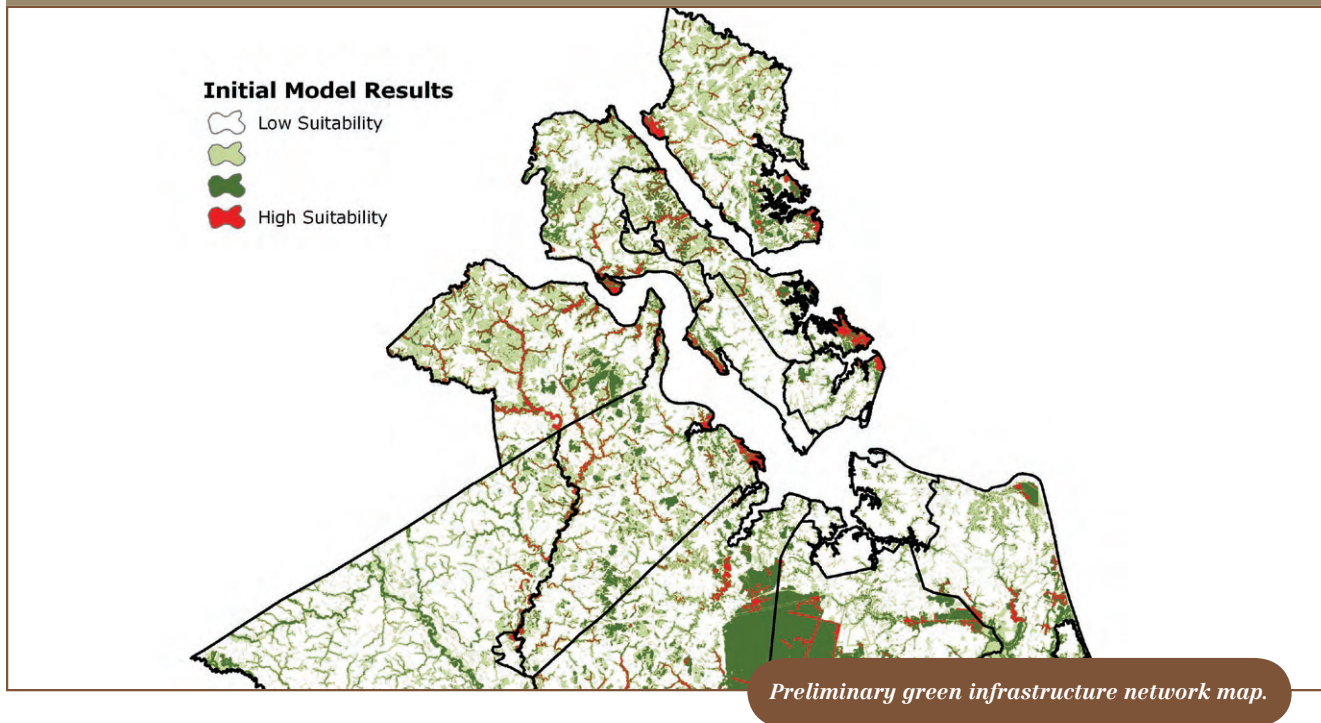
Data Acquisition and Green Infrastructure Model Development:

One of the challenges of choosing the data layers to include in the regional model was finding data that both encompassed the entire Hampton Roads region and was consistent in

quality and scale across jurisdictional boundaries. Only four datasets met these criteria and were ultimately chosen for use in the modeling effort:

1. **National Wetlands Inventory (NWI)** was chosen for this model because it is the most comprehensive wetlands data layer available for all jurisdictions in Hampton Roads. The inventory is produced by the U.S. Fish and Wildlife Service. Wetlands in this dataset were extracted from interpretation of aerial photography and classified into numerous categories. For the purposes of this project, a data layer was derived from the original that depicts simply whether an area is classified as a wetland or not.
2. **National Land Cover Dataset (NLCD)** was chosen to represent land cover in the model. It was developed by the United States Geologic Survey using Landsat Thematic Mapper satellite data. The National Land Cover Dataset uses a 21-class land cover classification scheme. The data was captured at a 30-meter resolution for the entire United States and therefore is the best land cover dataset available for working on a regional scale.
3. **Virginia Conservation Lands Needs Assessment (VCLNA)** was chosen to identify unfragmented “cores,” which are interior patches of habitat (mainly forest and wetlands) that are greater than 100 acres in area. The VCLNA is a landscape-scale GIS analysis that identifies, prioritizes, and links natural habitats in Virginia. The VCLNA is a product of the Natural Heritage Program in the Virginia Department of Conservation and Recreation. A core prioritization model was developed and used to assess the ecological significance of each core based on various factors such as rare species and habitats, species diversity, and stream quality. The cores were ranked on a scale of one to five,

► Preliminary Hampton Roads Conservation Corridor Map



with one representing “outstanding ecological significance” and five representing “general ecological significance.”

4. **Riparian Area Buffers** were developed to represent the riparian corridor system in the model. The riparian corridor data layer was derived from the hydrology dataset included in the 2002 Virginia Base Mapping Project. This dataset was created from the project’s aerial imagery and is more accurate than other available hydrology datasets. Several steps were undertaken to make the data compatible with GIS for input into the model. In summary, the hydrology features were extracted and buffers were created in GIS for 100, 200, 300, 400, and 500 feet. The 100-foot buffer directly adjacent to the shoreline was ranked highest in the modeling with the ranking decreasing with distance from the water’s edge.

A weighted overlay analysis in GIS was used to create the initial version of the corridor system for Hampton Roads. The two major steps in the

weighted overlay analysis process are ranking and weighting the data layers. For this project, the four approved datasets were incorporated into the model to produce one final suitability dataset.

Preliminary Green Infrastructure Network Map: The initial modeling effort was used to refine the green infrastructure network. A preliminary map (Preliminary Hampton Roads Conservation Corridor Map) was produced and shown to professionals in the field of natural resource conservation, planning, and government for review and comment. Issues raised included possible conflicts between the draft corridor system and future land use plans, opportunities for linkage of the corridor system across locality boundaries, and possible linkage of the corridor system with existing or planned parks and open space features. Stormwater management and Total Maximum Daily Load requirements were identified as elements to consider in the design of the regional system.

Final Green Infrastructure Network

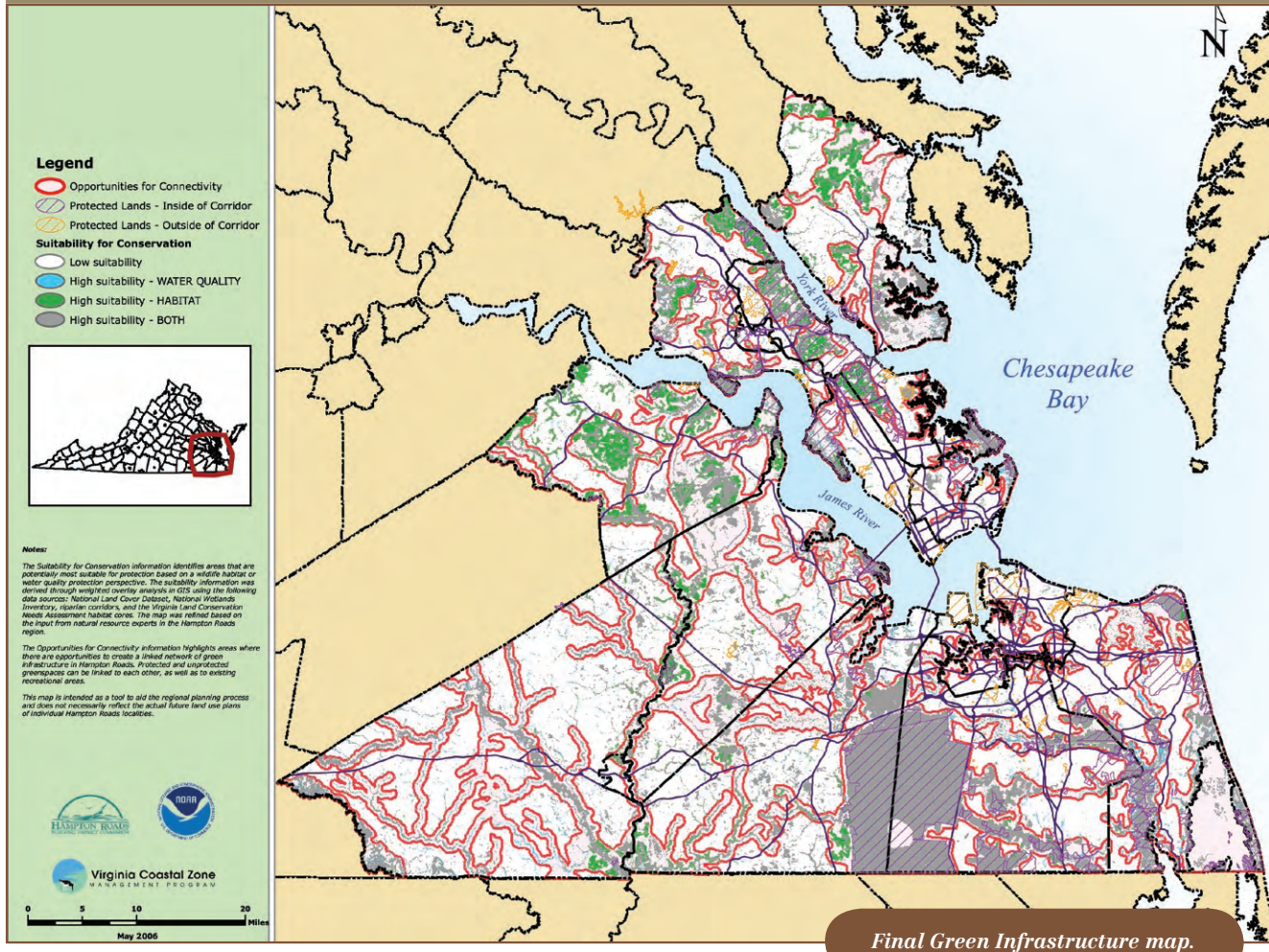
Map: The green infrastructure network map was refined based upon stakeholder input and a final map was developed (Final Hampton Roads Conservation Corridor Map). The final map depicts areas that are important for water quality protection and habitat protection, as well as places in which these two attributes overlap. It also highlights protected lands and areas where there are opportunities to create a linkage in the green infrastructure network. Since the corridor system is primarily riparian-based, most of the recommended conservation areas are connected via streams.

Green Infrastructure Workshops:

The Hampton Roads Planning District Commission organized and hosted two workshops on green infrastructure topics in 2006. The workshops were intended to:

- Provide a forum for discussion of green infrastructure topics among professionals involved in the field

► Final Hampton Roads Conservation Corridor Map



Final Green Infrastructure map.

- Provide an opportunity for education and involvement of local, regional, and state agency staff involved in land use planning and natural resource management
- Provide an opportunity for education and involvement of a broader stakeholder community including private non-profit groups and citizens
- Foster discussion on the future of green infrastructure in Hampton Roads

Green Infrastructure Video: The Hampton Roads Planning District Commission produced a video, titled *Make the Connection: Green Infrastructure for the Future of Hampton Roads*. The video provides

an introduction to basic green infrastructure concepts and discusses SWAMP and the subsequent regional green infrastructure program. The language in the video is nontechnical and accessible to a general audience. The video has been used in public meetings and on local public access cable TV stations to introduce the concept of green infrastructure. The video is currently being used as the basis for the development of a similar video for use statewide in Virginia.

Local Government Planning: A key goal of the regional green infrastructure project has been the development of a set of tools that is useful and applicable at the local government level. The regional

network was developed with the input of local government staff to enhance compatibility between the regional network and future local land use plans. All of the GIS products and associated technical reports were delivered to the Hampton Roads Planning District Commission's member localities.

RESULTS

Plan Implementation at the Local Level: The green infrastructure network is used in local planning programs in the Southern Watershed Area and in buffering military facilities.

- The City of Chesapeake included the green infrastructure network in its most recent comprehensive plan and on its future land use map.



| Conservation Lands | | | | |
|---------------------------|-------|------------------------|------------------|------|
| Property | Acres | Buyer | Price (millions) | Year |
| Stumpy Lake Area | | | | |
| Stumpy Lake Property | 970 | City of Virginia Beach | \$13.0 | 2001 |
| Graves Property | 47 | City of Virginia Beach | \$1.17 | 2007 |
| Wilson Property | 140 | City of Chesapeake | \$14.0 | 2007 |
| Sawyer Property | 314 | City of Chesapeake | \$0.5 | 2008 |
| Additional Properties | 105 | City of Virginia Beach | \$3.40 | 2008 |
| Knight and Tye Properties | | | | |
| Knight easement | 62.5 | City of Chesapeake | \$0 | 2007 |
| Tye easement | 35 | City of Chesapeake | \$0 | 2008 |

- The City of Virginia Beach included the Southern Watershed Area conservation corridor system in its comprehensive plan by reference.
- The regional green infrastructure network was recently used in the development of a Parks and Recreation Plan for Southampton County.
- The Cities of Chesapeake and Virginia Beach, in conjunction with the U.S. Department of Defense, are using the green infrastructure network as an element in the selection of lands to buffer Oceana Naval Air Station, Naval Auxiliary Landing Field Fentress, and the Northwest Annex in Chesapeake and Virginia Beach from encroachment.

Land Conservation: The most significant result associated with the regional green infrastructure network program has been the fee-simple purchase and acquisition of development rights on lands within the green infrastructure network (see Conservation Lands table). Several entities have been involved in the purchase of land and development rights, including The Conservation Fund, The Nature Conservancy, Department of Defense, Virginia Department of Conservation and Recreation, U.S. Fish and Wildlife Service, and the Cities of Chesapeake and Virginia Beach. These purchases, totaling tens of millions of dollars

and involving thousands of acres, are intended to accomplish a variety of goals, including protecting water quality and habitat, buffering of military facilities from encroachment by development, and providing open space and recreational opportunities for localities. The degree to which the green infrastructure network drives the decision to purchase these parcels varies from case to case.

- **Southern Watershed Area:** This area's green infrastructure network was initially developed in 2000, so there has been considerably greater time and effort expended on implementation in this part of the region. As a result, the percentage of protected land within the network is higher in the Southern Watershed than the network as a whole. Approximately 50% of the land in the corridor system in the Southern Watershed is protected from development. The corridor system is 94,901 acres in size and 45,729 acres are protected from development. A significant portion of the protected land has been purchased by The Nature Conservancy and the Cities of Chesapeake and Virginia Beach since the establishment of the corridor system.
- **Regional Green Infrastructure Network:** The green infrastructure network was expanded to cover the entire Hampton Roads region in 2006. Mostly as a result of previous

conservation efforts, approximately 25% of the land within the regional network is protected. The regional network is 860,212 acres in size and 212,344 acres are protected from development.

While it is not possible to provide a complete account of all of the land purchases associated with the green infrastructure network in this publication, the following examples demonstrate the type of work that is underway. Both cities have purchased land or easements in the green infrastructure network to meet a variety of planning goals, including the protection of critical habitat areas and provision of passive and active recreation opportunities. Three focal areas are summarized below.

Stumpy Lake Area: The area surrounding Stumpy Lake is on the boarder of the Cities of Chesapeake and Virginia Beach and in is the green infrastructure network. It also happens be in the Interfacility Traffic Area between the Naval Air Station Oceana and Naval Auxiliary Landing Field Fentress. Both cities have purchased land in this area to meet a variety of planning goals, including the provision of passive and active recreation opportunities and protection of critical habitat areas. This entire area was identified as a part of the initial

conservation corridor system designated under the SWAMP program and was ranked as a high priority for protection and proper management (Stumpy Lake Area Conservation Corridor System).

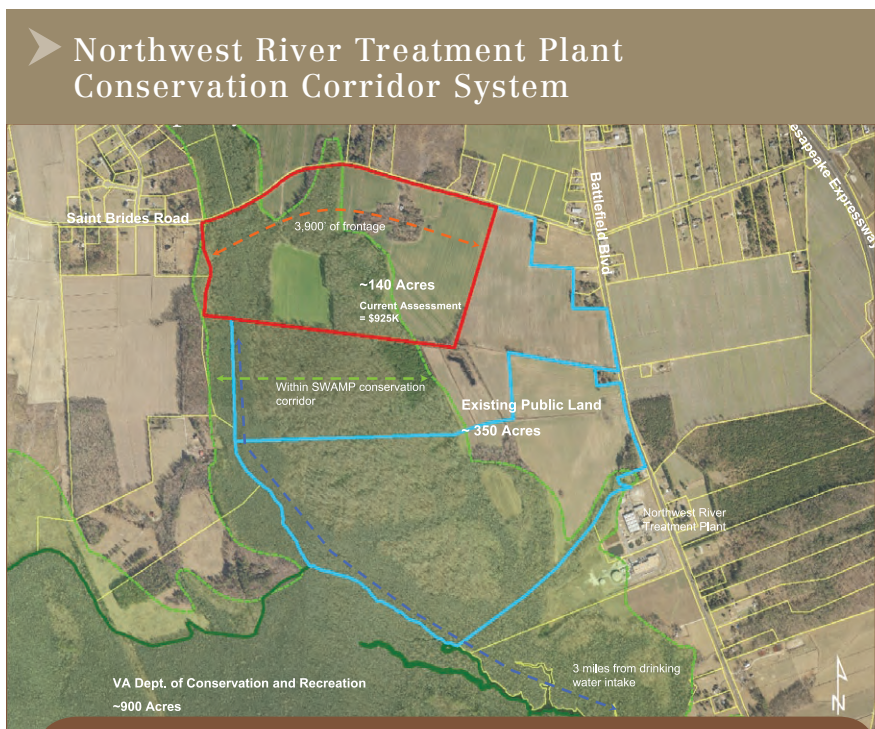
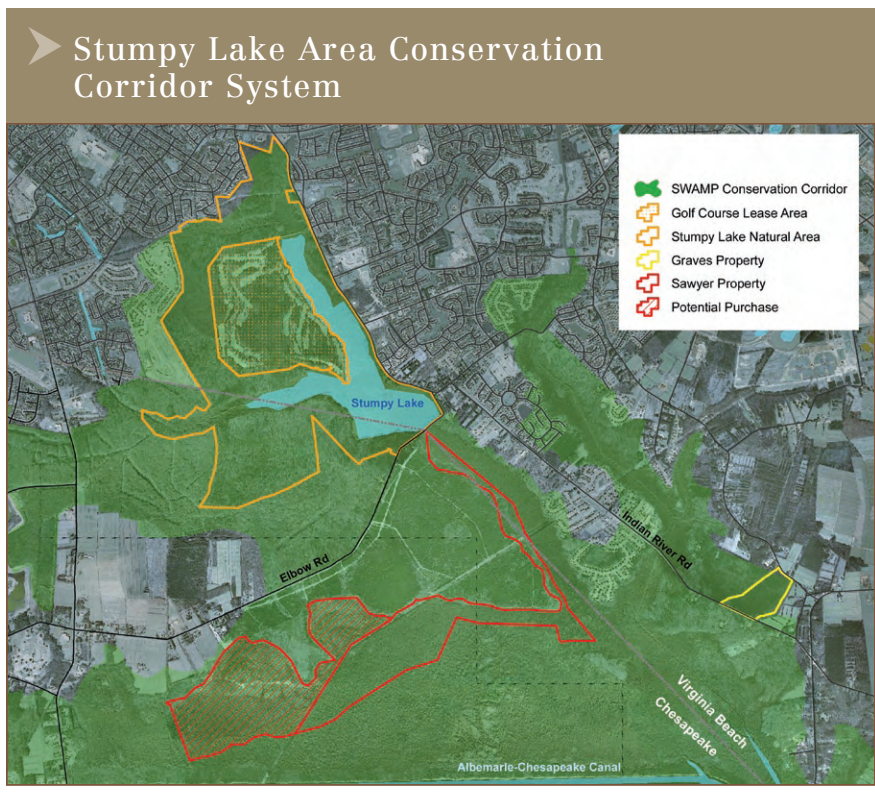
Northwest River Treatment Plant: The area to the north of the Northwest River Treatment Plant is a valuable addition to the green infrastructure network in that it will both protect a critical habitat area

and help to limit development in close proximity to the City of Chesapeake's drinking water intake on the Northwest River. The Wilson Tract is 140 acres in size and was purchased in December of 2007 by the City of Chesapeake for approximately \$14 million (Northwest River Treatment Plant Conservation Corridor System).

Knight and Tye Properties: In addition to land purchases, the City of Chesapeake is accepting donated easements on lands within the green infrastructure network. The Knight easement (62.5 acres in 2007) and the Tye easement (35 acres in 2008) allow continued agricultural and forestry use of the land while extinguishing the development rights associated with these properties. In exchange the land owners benefit from a state tax credit and federal tax deduction.

KEYS TO SUCCESS

- ▶ **Partnerships and Teamwork:** The regional green infrastructure project is based on solid partnerships with stakeholders at the local, regional, state, and federal levels.
- ▶ **Longevity:** The initial conservation corridor work associated with the SWAMP began in 1999 and the work on the regional green infrastructure network began in 2005. It is essential that this type of regional planning effort be maintained over a number of years to allow sufficient time for refinement and integration with local planning efforts.
- ▶ **Science-Based Analysis:** The regional green infrastructure network is based on landscape ecology principles and uses a combination of satellite imagery and field work to identify critical features for habitat and water quality protection. This science-based approach has been critically important in the acceptance of the project.



Land conservation adjacent to the Northwest River Treatment Plant.



- ▶ **Multiple-Benefits Approach:** The identification of opportunities for the achievement of multiple benefits through strategic conservation planning continues to be an important factor in implementation of the regional green infrastructure network.
- ▶ **Regional Vision for Open Space Protection and Restoration:** The articulation of a vision of a regional open space network for Hampton Roads was essential. Prior to this effort local governments in Hampton Roads had little in the way of a blueprint for a regional system of open space.
- ▶ **Technical Assistance and Project Support:** A broad range of stakeholders provided GIS analysis and data, analysis of local development controls, and critique of the regional green infrastructure network. The broad range of expertise of participants from state and local government and academia helped to insure that the regional program is well balanced and structured to address the wide range of planning and natural resource management concerns present in Hampton Roads.

All figures by Hampton Roads Planning District Commission; except page 73, Burke Environmental Associates/The Conservation Fund

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²Hampton Roads Planning District Commission. 2005. A Partnership to Protect the Southern Watershed. Environmental Planning Special Report. Hampton Roads Planning District Commission, Chesapeake, Virginia. Available online at: <http://www.hrpdcva.gov/Documents/Phys%20Planning/Special%20Reports/EPSR%20swamp2005.pdf>.

The following individuals have contributed significantly to this project:

Hampton Roads Planning District Commission: John Carlock, Claire Jones, Sara Kidd and Eric Walberg.

City of Virginia Beach: Clay Bernick

City of Chesapeake: Brian Ballard and Jaleh Shea.

Virginia Department of Conservation and Recreation: Joseph Weber.

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PHOTOS AND FIGURES

All photos by Chris Bonney, Lynnhaven River NOW



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Further Reading:

A web page with information on the regional green infrastructure program is located at http://www.hrpdc.org/PEP/PEP_Green_Infras_Plan.asp.

A summary report on the regional green infrastructure project is available for downloading:
Walberg, E. 2007. *Green Infrastructure in Hampton Roads*. Hampton Roads Planning District Commission, Chesapeake, VA. Available online at: http://www.hrpdc.org/Documents/Phys%20Planning/Green_Infrastructure_in_HR.pdf

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Carlock, J., C. Jones, S. Kidd and E. Walberg. 2006. *The Hampton Roads Conservation Corridor Study*. Hampton Roads Planning District Commission, Chesapeake, VA. http://www.hrpdc.org/Documents/Phys%20Planning/HRCCS/HRCCS_web.pdf

A Rapid Green Infrastructure Assessment for the Cacapon and Lost Rivers Watershed

Planning and Implementation Results by a West Virginia Land Trust

The Cacapon and Lost Rivers Land Trust used a rapid land prioritization process and a practical approach of engaging private landowners to protect over 9,000 acres of vital green infrastructure lands in their region.

CASE STUDY SUMMARY

The Cacapon and Lost Rivers, major tributaries of the Potomac River, flow northeastward for 112 miles as they drain 896 square miles of northeastern West Virginia. The watershed includes portions of Morgan, Hampshire, and Hardy counties. The upper third of the waterway is called the Lost River because at low flows it sinks into subterranean channels, and resurfaces downstream where it is called the Cacapon River. Lying in the path of suburban sprawl, the large forest and farmland parcels of this rural, montane watershed are being sold and subdivided. Because development is proceeding without watershed-scale planning and ecosystem functions are being degraded, the Cacapon and Lost Rivers Land Trust, Inc. (Land Trust) developed a green infrastructure assessment that identifies the highest conservation priorities in the watershed and has subsequently been working to protect these areas.

Founded in 1995, the Land Trust has protected 35 parcels totaling 10,121 acres, making it the largest land trust

in West Virginia. Their mission is to assist landowners and their communities in maintaining healthy rivers, protecting forests and farmland, and in preserving rural heritage for the enjoyment and wellbeing of present and future generations. The organization's daily work has been guided by a belief in permanent land protection, formation of enduring friendships with landowners, promotion of a land stewardship ethic, and organizational and personal integrity.¹

In 2002, in response to the growing

threat of development and habitat loss, the Land Trust convened the Healing Waters Retreat to produce a rapid green infrastructure assessment





An aerial view, above Lost River State Park in West Virginia, looking eastward toward the Town of Basore and a section of George Washington National Forest.

to prioritize lands for protection.² Retreat participants were asked to rank conservation criteria. These prioritized criteria were then coupled with GIS spatial data of watershed resources. The resulting green infrastructure assessment provides a guiding framework for the Land Trust and has significantly influenced their work in the watershed. Importantly, the development of the assessment also helped to form some lasting partnerships with citizens in the community and provided a scientific basis for their work, both of which improved the credibility of the organization within the community and throughout the state of West Virginia.

RESOURCE MANAGEMENT CHALLENGE

Until the 1970s the watershed's location, sandwiched between eastern cities and coal fields to the west,

provided serendipitous protection for its maturing deciduous forest, fish and wildlife resources, and rural life style. In the last 40 years, though, the basin has seen swift subdivision of large land parcels for the construction of second homes, high voltage powerlines and a 4-lane highway called Corridor H. These land-use changes have been fueled by the watershed's proximity to eastern cities, minimal land-use planning, and the draw of low real property taxes. Further complicating matters, there is little zoning in the three counties of the watershed and a large percentage of the population does not vote in the region because their primary residences are elsewhere.

Hampshire County presents a good example of the watershed's resource management challenges. Between November 1998 and August 2009,

the average development rate was 2,463 acres per year. Over this 11-year period, 27,100 acres of the county's 410,701 acres (6.6%) were subdivided from larger land parcels, which supported mainly forest and farm uses, to smaller lots with the potential of full build-out residential density.³ Environmental consequences have included habitat loss, forest fragmentation, and excess siltation of the Cacapon and Lost Rivers and some of their tributaries. Social consequences have included losses of rural cultural heritage, defined as those parts of the environment that characterize one's place. Examples of these changes include more light pollution, loss of farm lands, and fewer boating, hunting, and fishing opportunities. In 2000, a timber company sold a 3,200-acre holding, which was subdivided into 20+ acre lots and sold out within a year. This galvanized



LEFT: A new powerline (left of the existing powerline) being installed directly through the Fallen Springs Hunt Club.
RIGHT: The Cacapon River, a tributary of the Potomac River.

the landowner community to support land conservation and highlighted the need for an assessment that identifies conservation priorities.

CONSERVATION VISION

The Land Trust's overall goals are to assist landowners and communities in maintaining healthy rivers, protect forests and farmland, and preserve rural heritage for the enjoyment and well being of present and future generations. Given the advances in Geographic Information Systems (GIS) and conservation planning optimization techniques, the Land Trust identified the need and desire to produce a land prioritization assessment for the watershed (a.k.a. a green infrastructure assessment).

In June of 2002, the Land Trust convened the Healing Waters Retreat, where participants worked with scientists to prioritize land within the watershed for protection, explored funding opportunities, and formed new partnerships. The 31 attendees included technical experts from federal and state government agencies; and national, regional and state conservation groups. Participants also included 12 watershed landowners including three farmers. The retreat featured facilitation and GIS mapping

CRITERIA FOR PRIORITY LANDS

Forest land:

- Large interior forest tracts*
- Adjacent forest blocks*
- Forest biodiversity and condition*
- Forested riparian areas*
- Threat of forest conversion*
- Private lands
- Forest economic viability & sustainability

Farmland:

- Threatened by development*
- Within viewshed
- Nearness to river
- In floodplain
- On prime soils
- With unique features – springs, mature forests
- Size
- Next to other farms
- Working family farm
- Economically sustainable
- Use of BMP's
- Use of sustainable agriculture practices

Water quality:

- Forested riparian buffers*
- Large undeveloped tracts
- Lands in proximity to protected lands/areas
- High quality wetlands, streams
- Groundwater recharge areas
- Grassy riparian buffers
- Headwater streams

Rural Heritage:

- Wild lands*
- Valuable farmlands
- Sustainable timberlands
- Significant plant & animal habitats
- Scenic viewsheds
- Historic, pre-historic sites
- Stewardship example
- Culturally significant land
- High quality streams
- Scenic
- Recreational land

**identified as most important*

by the Canaan Valley Institute, GIS support from the Division of Forestry of West Virginia University, and conservation information from the Rivers and Trails Conservation Assistance Program of the National Park Service.

Using the GIS tools and expertise available to them, retreat participants assessed the watershed's resources, such as soil types, contiguous forests, surface waters, and other natural and cultural assets. These spatial data were integrated with consensus conservation criteria derived by the participants, creating a new optimization technique. The resulting Healing Waters Land Prioritization Plan details consensus recommendations on green infrastructure priorities.⁴ The plan has been providing the Land Trust's board and staff with clear direction and is raising the group's credibility with landowners, project partners, and funders.

IMPLEMENTATION RESOURCES

The Land Trust received a \$45,000 grant from the National Fish and Wildlife Foundation to conduct the retreat and produce the Healing Waters Land Prioritization Plan. This funding paid for the venue, meals, travel, office operations, and three

years of the Executive Director's salary. The Canaan Valley Institute and West Virginia University were core partners in producing the assessment, and provided staff time and materials valued at \$100,000.

Since the retreat, the Land Trust has raised \$2.2 million and \$365,000 in bridge loans from multiple funding sources to buy conservation easements in the green infrastructure network. They also raised additional funds for other conservation projects in the watershed, including: \$650,000 for stream restoration and \$100,000 per year for general operations. These figures are significant considering that the state of West Virginia provides few incentive-based conservation tools for private land protection, such as a land conservation fund, state tax credit or deduction, or transfer of development rights program.

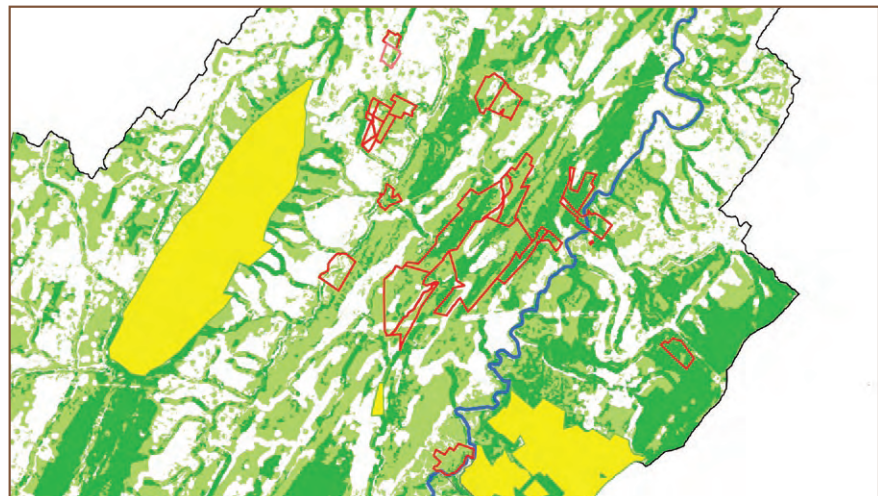
CONSERVATION STRATEGY

From its inception in 1995 until 2002, the Land Trust approached conservation in an unstructured, opportunistic manner, acquiring the lands that were donated or seemed important. With growing analytical capability through the use of GIS they were determined

to get better information, so they could be more proactive and make informed decisions.⁵

The Healing Waters Retreat was conducted to define criteria for priority lands, rank the criteria, acquire the needed data, and display the results in GIS. Primary criteria and sub-criteria were identified by the group using an open discussion brainstorming technique. These categories included: water quality, forest land, farmland, and rural heritage (see text box). Integrating the criteria in order of importance required the use of multi-criteria decision making processes.⁶

Retreat participants identified 37 sub-criteria and then filled out an abbreviated pairwise comparison test, which identified individual preference for each criterion (equal, somewhat prefer, critically better, and absolutely better). The highest rated criteria were dominated by those favoring forests, including: riparian forest buffers for forests, adjacent/connected forest, forest biodiversity, large tracts of undeveloped land and threatened forest lands. The highest rated agricultural criterion was farms threatened with development. The



LEFT: Map showing the high priority green infrastructure (darkest green) in the Cacapon and Lost Rivers watershed. RIGHT: Map of the Hampshire County Hub, showing the relationship among public lands (yellow) and the private parcels (red) protected by the Land Trust.



FUNDING SOURCES FOR CONSERVATION EASEMENTS

Federal Programs:

- US Department of Agriculture's Farm and Ranch Land Protection Program, US Fish and Wildlife Service's State Wildlife Grants Program

State Programs:

- West Virginia Department of Transportation's Transportation Enhancement Program and highway mitigation funds
- West Virginia Division of Natural Resources' State Wildlife Grants Program

County Program:

- Hampshire County Farmland Protection Board

Private Foundations:

- National Fish and Wildlife Foundation, Norcross Wildlife Foundation, anonymous foundation

Private Entities:

- Columbia Gas mitigation funds, individual donors

FUNDING SOURCES FOR OTHER CONSERVATION WORK

Federal Programs:

- US Department of Agriculture, US Forest Service, Environmental Protection Agency

State Programs:

- West Virginia Department of Environmental Protection's Stream Partners Program

Private Foundations:

- National Fish and Wildlife Foundation, Carlson Family, MARPAT, Vos Family

Private Entities:

- Canaan Valley Institute
- 500 individual benefactors

highest rated water quality criterion was forested riparian areas for water quality. The highest rated rural heritage criterion was wild lands.⁷ The pairwise comparison results were averaged to create aggregate results, which were then used to rank and weight the criteria.

Using the available data, a GIS additive model was developed to identify high priority land for

conservation. The additive model was simply a linear weighted model, which multiplies all of the criteria with available GIS data by the weight that retreat participants gave it and adds up the values to highlight priorities. The additive model appeared to work better at identifying the highest valued lands than a maximization model, which used only the highest rated criteria and weight combina-

tion regardless of overlapping data.^{8,9}

After the Healing Waters Retreat, the Land Trust used the rapid green infrastructure assessment to identify the larger critical parcels on the landscape that served to connect protected lands. The next step involved a review of the parcel data within this area and identification of landowners that could be approached regarding conservation options. A crucial part of the Land Trust's conservation strategy is becoming friends with landowners—by working “in the dirt” with them—as a way to understand their needs. This personal touch has built trust with landowners, which in turn has attracted partners and funders to participate in conservation projects. In addition, the organization's staff facilitates small neighborhood coffee table gatherings where neighbors talk to neighbors about conservation options.

The Land Trust also formed project-specific partnerships for baseline, legal, and funding needs enabling them to negotiate permanent conservation easements. They also became very adept at splicing together project-specific funding from disparate funding sources. Finally, they annually monitor each eased parcel for compliance with easement criteria, ensuring conservation on the ground.

RESULTS

The Land Trust's process of creating a rapid green infrastructure assessment is unique in the Chesapeake Bay Watershed. In a three-day-long workshop, they produced a scientifically rigorous green infrastructure



The Cheves Farm, foreground shows a 2.3 acre wetland mitigation site, background shows the 286 acre conservation easement.

assessment to guide their work. They subsequently protected a substantial amount of land within the identified green infrastructure network.

In general terms, the Land Trust has raised local acceptance of land protection as a valid landowner goal. They have grown a forested green infrastructure hub and its connecting corridors in two counties and started them in a third. They have permanently protected land and its associated fish and wildlife habitats and helped maintain ecological functions, like the water quality in the Cacapon and Lost Rivers. Finally, the Land Trust has helped to maintain the watershed's rural cultural heritage.

At the time of this writing, the retreat was convened at the organization's half-life. After the retreat, the Land Trust experienced a dramatic increase in the amount of parcels and land protected. A direct contrast of pre- and post-retreat results shows,

respectively, seven vs. 26 parcels and 1,375 vs. 8,309 acres protected.

The projects highlighted below represent a sample of numerous successful conservation easements by the Land Trust in the high priority green infrastructure areas of the watershed.

The Cheves Farm
Year Completed: 2006
Acres: 286 acres

The protection of the Cheves Farm began with a discussion regarding a wetland mitigation project. To mitigate habitat degradation caused by one of its construction projects, Columbia Gas and Hardy Storage worked with the Land Trust to create a 2.3 acre wetland mitigation site on Bob Cheves' 286-acre farm. In return for wetland mitigation, Columbia Gas and Hardy Storage agreed to provide partial funding for the bargain sale purchase of a conservation easement

on the property. Remaining funds were provided by USDA Farmland Protection Program and by tax transfer income provided by the Hampshire County Farmland Protection Board.

Primary easement restrictions for the Cheves Farm prevents any development unless it is agricultural related and requires a 100-foot riparian corridor along streams on the property. Currently, the farm has nutrient and forest management plans and it is being managed in an effort to permanently protect its soils for agricultural use.

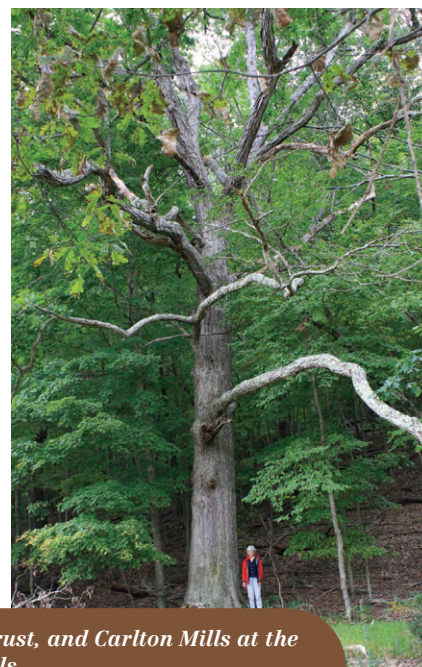
The Fallen Springs Hunt Club
Year completed: 2004
Acres: 1,000

The Fallen Springs Hunt Club, owned by Carlton Mills, is an important part of the watershed's protected green infrastructure network. Years earlier, his mother's farm was sold



LEFT: Nancy Ailes, Executive Director of the Cacapon and Lost Rivers Land Trust, and Carlton Mills at the Fallen Springs Hunt Club, a 1,000-acre conservation easement donated by Mills.

RIGHT: The Rudolph Old-Growth Forest, a 500-acre conservation easement purchased by CLR Land Trust.



and subdivided for development in order to pay taxes upon her death, so he was determined to ensure that the Club land was perpetually protected. At the advice of his attorney, Mills reached out to the Land Trust about a conservation easement agreement for his land.

The Land Trust informed him that a conservation easement would perpetually protect the Club's land, and significantly reduce the inheritance taxes for his daughter. In July, 2004, Mills donated his conservation easement with the Land Trust providing permanent protection from development and subdivision while allowing timber harvest, hunting, and the expansion of his part-time residence and hunting lodge.

Today, the Club is a piece of a much larger network of protected land known as the Cacapon Legacy Project Area. Being an avid outdoorsman, Mr. Mills knew that protecting contiguous parcels was important for maintaining healthy wildlife populations, so he started knocking on neighbors' doors. Just five months later, the Land Trust

protected a 1,657-acre parcel adjacent to the Club. Soon after that, they protected an additional 1,682 acres in two adjacent parcels. The Land Trust hopes to eventually connect the project area to the 8,200-acre Short Mountain Wildlife Management Area managed by the WV Division of Natural Resources lying to the North, and to the even larger George Washington National Forest to the south.

The Trust has exported its "Carlton lesson" to other parts of the watershed. For example, in Morgan County several landowners and hunt clubs have protected over 1,000 acres adjacent to Cacapon State Park.

The Rudolph Old-Growth Forest

Year Completed: 2007

Acres: 500

For four generations, the Rudolph family forest of Yellow Spring, West Virginia, has served as the focus of the family's annual deer hunt in November. When the Healing Waters Land Prioritization Plan identified this parcel as a high priority within the Hampshire County green infrastruc-

ture network, the Land Trust started working with the family to protect the property.

After reaching consensus with the family on a bargain sale for the conservation easement, the Land Trust received a \$250,000 one-year, no-interest loan from the Norcross Wildlife Foundation to secure the easement while funds were being raised. They subsequently received grants to pay for the easement from the U.S. Fish and Wildlife State Wildlife Grant Program (the first in West Virginia history), the National Fish and Wildlife Foundation, and a sympathetic private donor.

Primary easement restrictions for the Rudolph family forest include: a Habitat Management Plan through the West Virginia Department of Natural Resources; stream bank fencing; restrictions on timber harvesting; and development restricted to one subdivision and two minimal building zones. The family is currently managing the land for invasive species reduction and stream bank protection from livestock.





A typical view of the picturesque Cacapon and Lost Rivers watershed.

KEYS TO SUCCESS

- ▶ **Identify conservation criteria** and its relative importance with a group of informed citizens and professionals.
- ▶ **Use resulting information and GIS** to identify high priority focal areas for conservation.
- ▶ **Establish on-the-ground, get-dirt-on-your-hands friendships with landowners**, with the intent of understanding their problems and joys and to develop mutual respect. Then work to address their issues.
- ▶ **Organize a coffee table party** where neighbors talk to neighbors, develop credibility with landowners and the community, and use neighbor to neighbor networks to maximize success.
- ▶ **Develop partnerships** with government, non-profits, funders and private citizens to advance the vision of the green infrastructure assessment.

- ▶ **Promote landowner leadership**, such as that shown by Carlton Mills and his effort to protect lands adjacent to the Fallen Springs Hunt Club.

PHOTOS AND FIGURES

All photos by Joel Dunn
 Page 81: Figure, Burke Environmental Associates/The Conservation Fund
 Page 82: Image, Google Earth
 Page 84: Figures, Dr. Michael Strager

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⁹Strager, M. P., and R. S. Rosenberger. 2006. Incorporating stakeholder preferences for land conservation: weights and measures in spatial MCA. *Ecological Economics*. 57: 627-639.



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A Green Infrastructure Functional Master Plan

Countywide Green Infrastructure Planning and Implementation in Prince George's County, Maryland

Prince George's County adopted a Green Infrastructure Plan that guides development through the development review process, which protects the integrity of ecological features of countywide significance.

CASE STUDY SUMMARY

The Prince George's County Green Infrastructure Plan is the first of its kind in the Chesapeake Bay watershed. Prepared as a "functional master plan," it is a guide to county government and decision makers for future comprehensive planning, land acquisition and development decisions. Since the plan was adopted, numerous important green infrastructure resources have been protected or enhanced. The plan has helped to reduce woodland fragmentation, preserve wildlife habitat and improve water quality.

It is now standard practice for the county to prepare functional master plans for vital topic areas in the jurisdiction, such as transportation, public safety, and historic sites and districts. The Green Infrastructure Plan is the county's first environmentally focused master plan and was approved by the County Council in 2005.

Green infrastructure is the county's natural life-support system, which is composed of an interconnected network of natural areas and other

open spaces that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife.¹ The plan identifies sensitive ecological resources across the county in an effort to ensure their protection, restoration and enhancement. It also helps direct growth to existing communities,

which reduces impacts to forestlands and other sensitive natural resource areas and reduces "gray" infrastructure costs. Gray infrastructure is composed of man-made systems that support communities, such as roads and utilities.

Like most of the county's master plans, the Green Infrastructure Plan contains goals, measurable



objectives, policies and strategies. What makes it unique is that the strategy statements are action oriented and lay out a work program for implementation. By wording the strategies in this manner, the plan is not static and implementation began the day of approval. By creating and implementing a green infrastructure plan, Prince George's County has shown its resolve to preserve important ecological features determined to be of countywide significance.

RESOURCE MANAGEMENT CHALLENGE

Prince George's County covers approximately 500 square miles in Maryland and has a population of over 800,000 people. The county is located within the coastal plain physiographic region and is characterized by a diverse array of plant species, wide floodplains, and extensive wetlands and woodlands. From 1990 to 2000, construction and land development within the county substantially expanded, which resulted in fragmented forests, destruction of sensitive ecological habitats, reduction in wildlife and degradation of water quality. Development pressure has always been strong due to the county's close proximity to Washington, D.C., and demographic projections indicate total population will continue to grow in the coming decades.

The county has lost a substantial amount of freshwater wetlands and their associated uplands, which negatively impacts water quality and wildlife. The U.S. Fish and Wildlife Service's National Wetlands Inventory of 1988-89 identified 19,470 acres of wetlands representing 6.2% of the county. Palustrine forested wetlands were the dominant type. Between 1981 and 1989 the county lost about 229 acres of vegetated wetland, with roughly 123 acres converted

to upland. The principal causes of wetland conversions were road and highway construction, commercial and industrial development and sand and gravel pit operation.² Although the Green Infrastructure Plan does not directly address wetland loss, it does provide implementation strategies aimed at expanding minimum stream buffer widths to protect more wetlands and their associated drainage areas.

Construction and development has fragmented the forest in the county into noncontiguous patches of various sizes, in some instances with great distance between patches. County staff recently assessed existing woodland cover and projected losses by comparing aerial photos from 1938, 1965 and 2000. In 1938, the county contained nearly the same amount of woodland cover that existed in 2000. The big difference was the size and contiguity of the wooded areas. In 1938, the county had large tracts of woodlands and connecting corridors that facilitated wildlife movement. In 2000, the woodlands were extremely fragmented and confined mainly to public lands and private lands zoned for low density residential uses. The findings raised concerns that further efforts would be needed to maintain sustainable and livable communities for future generations.

Pollution from stormwater runoff and the loss of forest buffers and wetlands resulted in low water quality in some areas of the county. A recent water quality analysis, conducted by the county's Department of Environmental Resources, measured two broadly accepted water quality measures: the quality of stream buffer habitat and the presence of benthic invertebrates.³ County watersheds were rated on a scale that used ratings of very good, good, fair, poor and very poor (see Habitat Water Quality

of Major Watersheds 1999-2003 Biological Assessments). None of the county's watersheds received a "good" or "very good" rating. Of the 42 watersheds surveyed, four received a "fair" rating for benthic invertebrates and seven received a "fair" rating for habitat. The remaining watersheds were rated "poor" or "very poor." With the county aware of these conservation challenges they set forth a bold vision for conservation planning.

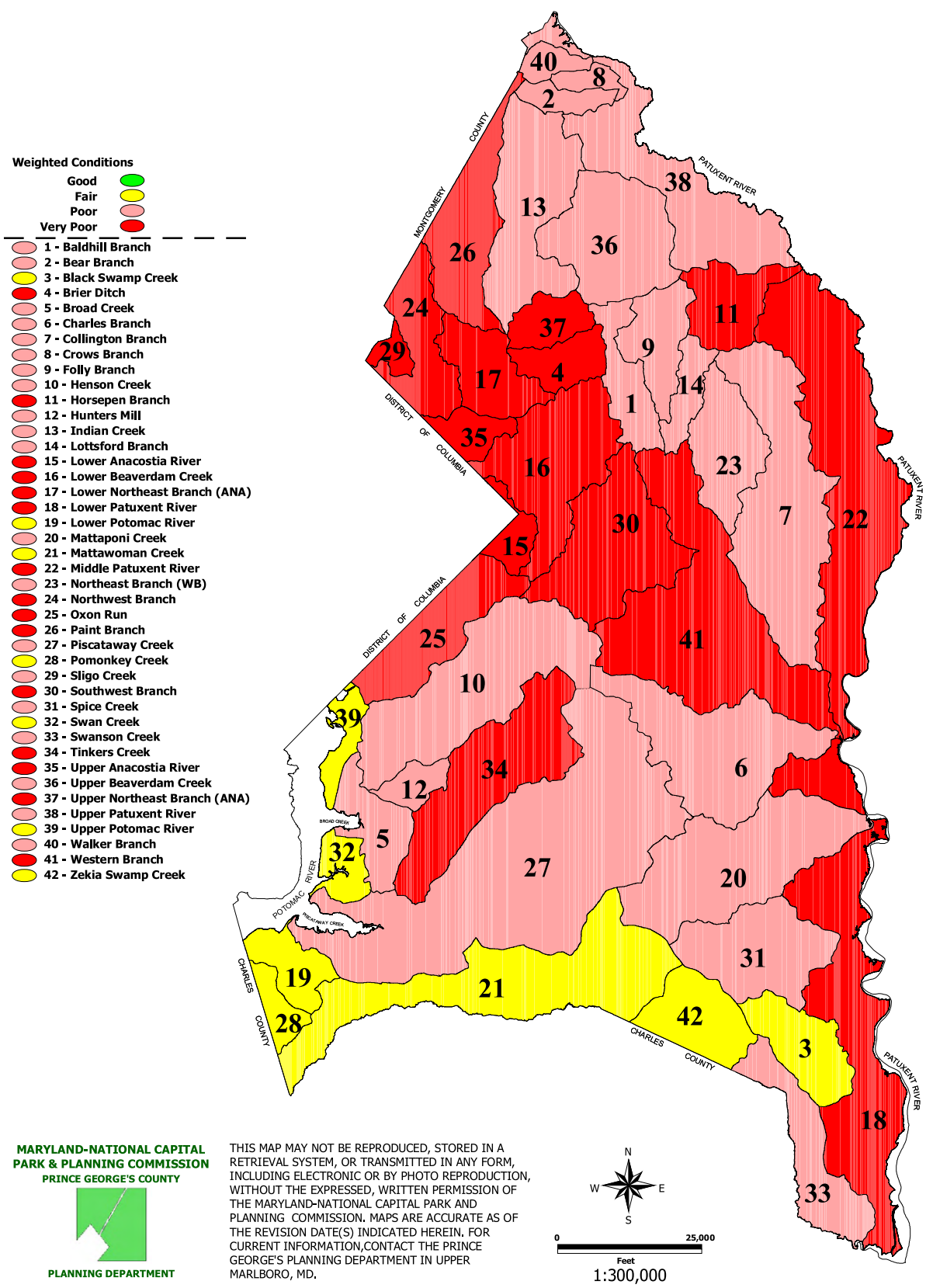
CONSERVATION VISION

The county's 2002 "General Plan" for development included an environmental goal to preserve, enhance, and restore the natural environment and its ecological functions as the basic component of a sustainable development pattern.⁴ It also contained measureable environmental objectives that address the preservation, enhancement and/or restoration of a designated green infrastructure network; the improvement of water quality; the attainment of long-term tree canopy goals; and the promotion of environmental education and stewardship. Most importantly, the General Plan provided the county staff with a formal mandate to prepare a Green Infrastructure Plan based on functional master planning—a well understood and established process in the county.

The county staff established guiding principles for the preparation of a Green Infrastructure Plan, including:

- Identify a contiguous network of environmentally important areas
- Recommend strategies to preserve, protect, enhance, and restore the network
- Support the desired development pattern of the General Plan
- Recommend effective implementation mechanisms

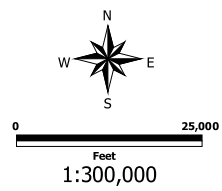
Habitat Water Quality of Major Watersheds 1999 - 2003 Biological Assessments



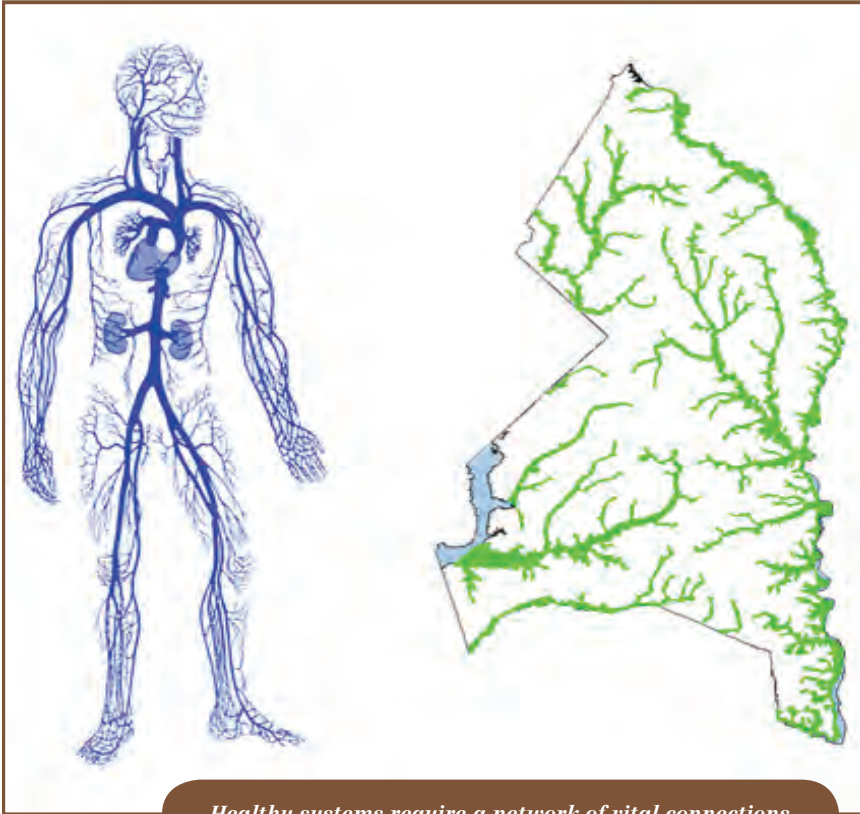
MARYLAND-NATIONAL CAPITAL PARK & PLANNING COMMISSION
PRINCE GEORGE'S COUNTY

PLANNING DEPARTMENT

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► Vital Connections



Healthy systems require a network of vital connections.

- Support the county's Livable Communities Initiative
- Ensure meaningful public participation

To better communicate the conservation vision and need for an inter-connected green infrastructure system that performs vital natural functions, county staff equated this need with highway network planning and human biological systems. All three systems rely on interconnected networks that must function together properly to produce the desired results (see Vital Connections graphic).

IMPLEMENTATION RESOURCES

The green infrastructure planning effort was led by The Maryland-National Capital Park and Planning Commission's (M-NCPPC or the Commission) Prince George's

County Planning Department. The Department was assisted by an interdisciplinary team which included representatives from the Department of Parks and Recreation within the Commission; the county Department of Public Works and Transportation; the county Department of Environmental Resources; and the bi-county Washington Suburban Sanitary Commission. M-NCPPC is a bi-county agency, created by the General Assembly of Maryland in 1927. The Commission's geographic authority extends to the majority of Montgomery and Prince George's Counties in Maryland and was created to provide planning, parks and recreation functions for the two counties located next to Washington, D.C. The Green Infrastructure planning effort took a little over two years to complete with one project planner full-time and one project manager part-time. For a

period of approximately six months, a GIS Technician worked on the project almost full-time.

CONSERVATION STRATEGY

Three elements were required to produce a plan to identify and protect the county's green infrastructure network. The first was an on-going public outreach element; the second focused on green infrastructure network development driven by GIS analysis, scenario building and by determinations of "countywide significance"; and the third addressed implementation mechanisms needed to protect the network.

Public Outreach: The county made a significant effort to involve the public in the green infrastructure planning process. They believed that a plan developed in concert with the public would be more accurate and receive stronger support from citizens, elected officials and non-profit partners. Their outreach efforts included citizen focus groups to provide input before the plan was developed, a citizen review group to review a draft plan, and a formal public hearing and testimony on the final plan. The county also produced a website where meeting locations, dates and results were posted along with public presentation materials.

Focus groups: Focus groups were established for several interest groups, including: municipalities and large civic associations; agriculture and forestry; citizens and environmental advocacy; business and industry; and interagency groups and neighboring jurisdictions. Each focus group was provided a separate forum to voice their concerns before the plan preparation stage began. Providing separate meetings was purposeful to allow the parties to voice opinions in an open and unbridled way so that the input was as uncensored as



In many instances, the Prince George's County green infrastructure network enhances stream and riparian corridor protection. This stream is buffered by a mature beech forest in Rosaryville State Park.

possible. The input received from the focus groups was posted on the project website.

Citizen review group: The second major component of the public input portion of the project was a citizen group meeting to review several possible scenarios for the green infrastructure plan. All of the participants of the focus groups were invited as well as any other interested parties. The attendees were purposefully divided into specific breakout groups so that the various interests were represented on each breakout group. During the breakout sessions, each group was asked to come to consensus on what was to be “in” the plan and what was to be “out.” There was healthy debate and eventual ownership of the results.

Overall there was general consensus to include more, not less, in the network, include some specific areas of concern, and ensure that the final network is science-based. Interestingly, there was no consensus on whether or not the approved subdivisions should be deleted from the network. Using this feedback, the team prepared a preliminary version of the plan for public comment.

Green infrastructure Network Development:

GIS analysis: To develop the final designated network (see Green Infrastructure Network - Interim Map),

all relevant GIS layers available for both Prince George's and adjacent counties were used. The focus of the GIS analysis was on several environmental factors, including: streams and wetlands and their associated buffers; 100-year floodplains; topography; and state information regarding rare, threatened and endangered species habitat. There were many other layers that were used for the analysis; an entire list is provided in the plan.⁵

Scenarios: After the input was received from the focus groups, county staff used GIS to prepare six scenarios to illustrate various options for the designation of the green infrastructure network. The scenarios started with a baseline of only the existing regulated areas which include:

- perennial and intermittent streams and a minimum 50-foot buffer on each side;
- the 100-year floodplain;
- wetlands and a minimum 25 foot buffer on all sides;
- Wetlands of Special State Concern and a 100 foot buffer on all sides and slopes 25% or greater adjacent to these features.

It should be noted that slopes from 15 to 25% on highly erodible soils are also regulated. However, because a soils layer was not available in GIS, these slopes were not included in

the analysis. When the soils layer becomes available, the network will be updated.

The criteria for “countywide significance” was applied to the baseline scenario, which was then modified to create scenarios with other land-based features added such as land within the state green infrastructure assessment and known sensitive habitat areas. Other scenarios were developed that added these features but subtracted areas of approved subdivisions that had not yet been built. This subtraction reduced the amount of land within the network as an acknowledgement that at least some portions of these subdivisions had been approved for clearing. The six scenarios were then printed on large boards and 11 x 17 inch maps for use in the citizen review group meeting process. Using this method, participants could see the results of a series of possible decisions and provide feedback regarding whether or not they agreed with the decisions proposed.

Countywide significance criteria:

In order for land features to remain within the network, three criteria for countywide significance must be met:

1. **Remaining woodlands** - In developing and rural growth areas, the land must contain woodlands at least 200 feet wide to be considered of countywide significance. The 200

PRINCE GEORGE'S COUNTY CITIZENS SUPPORT CONSERVATION

A one-page survey was prepared by Prince George's County staff to gauge interest in the planning process and preservation of natural resources. Over 100 surveys were returned and the results were compiled. Two of the key findings were:

- 94% indicated that natural areas are important and/or very important to them.
- 93% indicated that all communities should include natural areas.

foot width is based on wildlife requirements for interior forest. This measure also relates to ensuring that if a stream is part of a corridor that the stream itself is shaded. Within the designated "developed areas," forest of any width qualified as significant as did any regulated area.

- 2. Connectivity** - In an effort to prioritize areas of woodlands that were more closely connected, woodland patches with a gap of more than 600 feet from another patch were deleted from the network. This criterion is based on wildlife and insect movement data that shows that gaps larger than 600 feet are difficult barriers for movement.
- 3. Contiguity** - In order to remain in the network, areas needed to be connected to downstream corridors, open bodies of water or designated network or open space areas of adjacent jurisdictions.

Implementation Mechanisms:

The Green Infrastructure Plan is implemented through a variety of mechanisms.

Land development application process: Some categories of development applications, such as subdivisions, must conform to the Green Infrastructure Plan in order to gain approval. As a result, applicants are aware of the plan and the designated green infrastructure network influences the size and shape

of development proposals. To date, only one application has been disapproved for lack of conformance with the plan. For applications outside the network, more flexibility is provided to maximize densities as an incentive to develop outside the designated network.

Land conservation incentives: County approval of legislation allowing the use of conservation subdivision techniques provided an incentive for preservation by allowing smaller lots without rezoning the property and requiring minimum percentages of open space preservation. In addition, the plan proposes that regulations be strengthened where environmental conditions warrant and provide greater flexibility where development is targeted. This policy seeks to provide incentives to build in areas where gray infrastructure already exists and provides a disincentive to build within the green infrastructure network.

Purchase of development rights: In 2008, a purchase of development rights (PDR) program was approved and funded in the county. Funds from this program can be used to purchase perpetual conservation easements.

Legislative proposals: The plan recommends a variety of legislative changes to better protect the designated resources. These include widening minimum stream buffers,

reducing forest fragmentation, and prioritizing the resources within the network for preservation and restoration.

Use of public funds: The plan proposes that public infrastructure expenditures be strategically planned to help concentrate growth outside the green infrastructure network and that public funds for land acquisition for preservation be focused inside the network.

Local green infrastructure network refinement: As more detailed land use plans are prepared for segments of the county, called master plans or sector plans, the network is refined to include areas of local significance. This process allows stakeholders to shape the countywide network based on more detailed local information.

Monitoring of plan objectives: The county established eight clearly defined and measurable plan objectives. They include measures of how much of the network continues to meet the criteria for countywide significance (i.e. 75% by 2025); measures of net losses of woodland cover within the network (i.e. less than 25%) and several measures related to water quality and mitigation for impacts to regulated areas. These objectives will be evaluated every five years to determine if course corrections are needed. Because the plan was approved in 2005, the first five-year analysis is due in 2010.

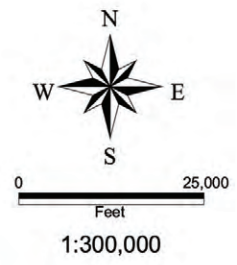
RESULTS

Land Development: Since the approval of the plan in June of 2005, there have been dozens of development proposals approved that contain some portion of the designated network. For each application, the regulated areas were refined with field delineations and the evaluation areas of the network were analyzed for environmental features in need of

Green Infrastructure Network (Interim Map)

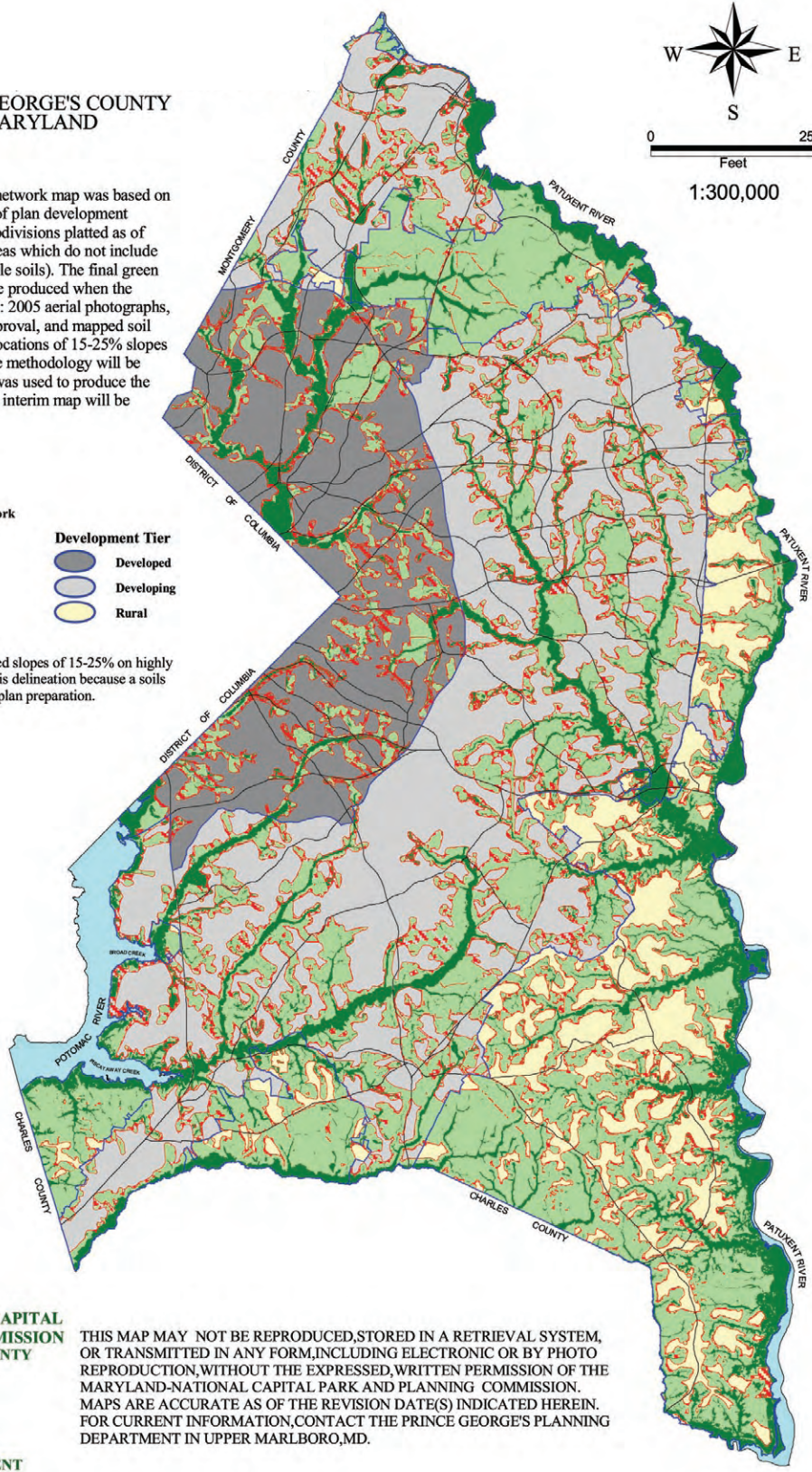
PRINCE GEORGE'S COUNTY MARYLAND

This interim green infrastructure network map was based on information available at the time of plan development (i.e., 2000 aerial photography, subdivisions platted as of March 31, 2004, and regulated areas which do not include 15%-25% slopes on highly erodible soils). The final green infrastructure network map will be produced when the following information is available: 2005 aerial photographs, platted subdivisions as of plan approval, and mapped soil series to determine approximate locations of 15-25% slopes on highly erodible soils. The same methodology will be used to produce the final map as was used to produce the interim map. In the meantime, the interim map will be used for implementation.



- Green Infrastructure Network
- Green Infrastructure Plan**
 - Regulated Area *
 - Evaluation Area
 - Gap
- Development Tier**
 - Developed
 - Developing
 - Rural

*Information regarding the regulated slopes of 15-25% on highly erodible soils is not included in this delineation because a soils layer was not available at time of plan preparation.



MARYLAND-NATIONAL CAPITAL PARK & PLANNING COMMISSION
PRINCE GEORGE'S COUNTY



PLANNING DEPARTMENT

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► Subdivision Approval Process and Green Infrastructure Conservation



1

2



3



The sequence above graphically illustrates how resources within the green infrastructure network are conserved during a typical subdivision review process. Number 1 depicts the subdivision parcel in relation to Prince George's County's mapped green infrastructure network and stream and floodplain features to the left. Number 2 represents the proposed subdivision and number 3 shows the approved subdivision. The proposed subdivision had 22 lots, and conserved only 0.48 acres of land within the green infrastructure network (required floodplain conservation acreage not included). The subdivision review process took into account detailed information derived from on-site surveys and reduced the number of lots in the final plan to 18 while conserving 1.81 acres of land within the green infrastructure network - a three-fold increase compared to the original proposed plan.



conservation. The applications were then shaped to ensure the maximum preservation of the resources while allowing the development of the properties within the requirements of the existing zoning (see Subdivision Approval Process and Green Infrastructure Conservation).

Land Conservation: In addition to influencing new developments to conserve land within the green infrastructure network, the plan has facilitated the acquisition of land for conservation purposes. A recent example is the preservation of 43 acres in the ecologically significant transition zone between the coastal plain and Piedmont physiographic province. The protection of this land and 50+ acres of adjacent land in Montgomery County to the west contain forest cover types not found elsewhere in either county. The designation of the area as being of countywide significance in the green infrastructure network provided significant support to the acquisition of this land in Prince George's County.

KEYS TO SUCCESS

- **Guiding principles:** Before the public input process started, the team developed a set of guiding principles to direct the work on the plan. In the public forums, buy-in was requested and received. This resulted in an agreement among the team and stakeholders regarding the direction of the plan and helped people see common ground.
- **Best available information technology:** County staff use of GIS allowed participants to make decisions regarding what should be in and out of the network, and see the results of their decisions on various scenarios. As a result, participants felt more connected to the resulting network map. This method also provided a defensible network because it was based

➤ Green Infrastructure Photo Collage



- solely on GIS parameters, making it objective instead of subjective.
- **Connections to water quality:** One of the driving forces behind the preparation and approval of the Green Infrastructure Plan was the need to address water quality concerns. Much of the western portions of the county were developed without the benefit of stormwater management. This has resulted in reduced water quality in these areas. The water quality maps illustrated the need for better protection in a simple, easily interpreted format.
- **Champion:** A former elected official was a champion for the concept of green infrastructure planning through the General Plan process and the green infrastructure preparation and approval process. He understood the issues of green infrastructure planning and could communicate the process and potential outcomes to others.
- **Leadership:** All elected and appointed officials provided leadership in support of the planning process and subsequent green infrastructure plan. The Prince George's County Planning Board took a leadership role in the project by supporting this effort with financing and enthusiastic input. The County Executive had been recently elected on a platform emphasizing "Livable Communities," so green infrastructure planning and preservation meshed well with his subsequent initiatives. The County Council received multiple briefings during the preparation of the plan and were engaged and supportive throughout.
- **Accessibility:** Through the use of some simple graphics, the plan became more comprehensible to the average citizen. The Green Infrastructure Photo Collage (above) became almost iconic throughout the process and assisted people in recognizing the

project amid many other planning efforts underway at the time.

PHOTOS AND FIGURES

All figures by Prince George's County; except page 89, Burke Environmental Associates/The Conservation Fund
Page 89: Photo, David W. Krankowski
Page 93: Photo, Ted Weber

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Restoring Green Infrastructure

Rural Reforestation and Forest Stewardship Initiatives in Baltimore County

These model programs have planted nearly 40 acres of forest on privately owned, suburban land, increasing the stewardship practices of the landowners and reducing the amount of sediment and nutrients that enter local waterways and the Chesapeake Bay.

CASE STUDY SUMMARY

The Department of Environmental Protection and Resource Management (DEPRM) in Baltimore County, Maryland, developed and implemented two versions of a rural reforestation initiative to meet its resource management challenges and help landowners become better forest and watershed stewards.

The first project, the Rural Residential Stewardship Initiative in 2005 and 2006, involved working with landowners in rural residential sub-

divisions with lots of three or more acres. The landowners converted mowed, “excess” lawn and fields to forest cover, expanding riparian buffers and contiguous forest patches. The second project, the Valleys Reforestation Initiative in 2008 and 2009, involved reforestation of larger rural properties. Reforestation was targeted to riparian buffers and areas adjacent to existing forest patches in the Loch Raven and Prettyboy Reservoir watersheds, which are part of the Gunpowder River basin of the Chesapeake Bay watershed.

DEPRM worked to reduce rural landowners’ perceived barriers to beneficial stewardship practices, including costs, technical knowledge of reforestation, and legal consequences of required easements for reforestation areas. DEPRM’s experience with these projects supports the conclusion that using education, reducing barriers, and providing technical and financial incentives is just as necessary to achieve successful stewardship for rural residential landowners as it is for farmers.

In all, the two projects resulted in a total of 38.7 acres of reforestation on lands owned by 19 different landowners. Three different conservation organizations were also involved in the projects. Both projects were supported by the Chesapeake Bay Small Watershed Grants Program, administered by the National Fish and Wildlife Foundation.

RESOURCE MANAGEMENT CHALLENGE

The Rural Residential Stewardship Initiative and Valleys Reforestation Initiative addressed two major resource management challenges: (1) the loss of and need to replace critical forest resources for watershed health, and (2) the need to engage



Baltimore County targeted the watersheds of Loch Raven Reservoir (above) and Prettyboy Reservoir for reforestation efforts.



rural landowners, who own about 75% of the forests in Baltimore County, as forest resource managers. The premise of both projects was that forests are the most effective land cover for protecting water quality and that under-utilized lands can be converted to forest cover.

By reducing nutrient and sediment loads and improving habitat, these projects also directly addressed goals established by the Chesapeake Bay Program, including the restoration of 10,000 miles of stream buffers by 2010 and covering at least 70% of riparian areas with forest buffers. Recently, the need for accelerated progress toward these and other restoration goals has been widely acknowledged. Environmental indicators tracked by government and leading non-profit organizations demonstrate that the largely voluntary efforts undertaken since 1983 have not achieved established restoration targets.

Baltimore County's reforestation projects focused on the interface of land management for water quality and the special character of rural

land ownership patterns. Baltimore County's rural landscape is a mosaic of active farms, forests, and large-lot, low-density residential uses. DEPRM used Maryland nutrient load data from the Chesapeake Bay Program to illustrate the functional benefits of converting what were essentially agricultural lands to forest cover. Over the long-term, each acre of land returned to forest reduces pollutants that degrade water quality, including approximately 12.7 pounds of nitrogen, 1.06 pounds of phosphorus, and 0.42 tons of sediment each year. Because many local jurisdictions use large-lot, low-density zoning as a tool for protecting rural lands and managing growth, rural reforestation projects have wide applicability for improving water quality.

CONSERVATION VISION

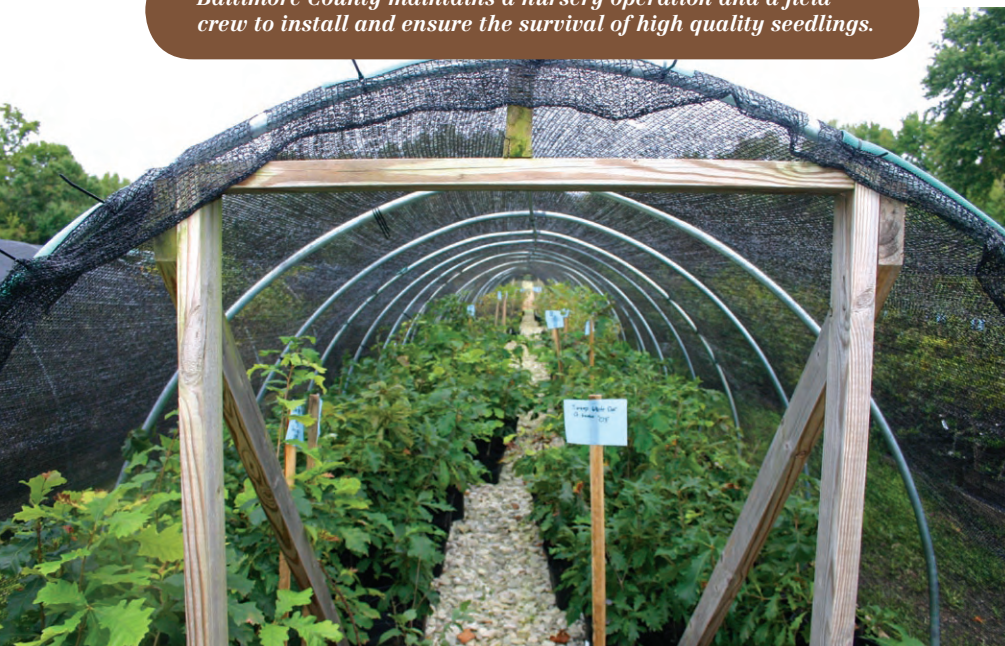
Baltimore County's rural reforestation initiatives arose from a long-standing awareness of the multiple benefits of forests, as well as a specific challenge from a conservation organization.

On one hand, the county was rather progressive in developing an environmental program for stream and forest

protection. Forest buffer regulations for new development evolved from non-tidal wetland protection efforts in the mid-1980's, and the *Regulations for the Protection of Water Quality, Streams, Wetlands, and Floodplains* (forest buffers) were enacted in 1989. The county also adopted the Maryland Forest Conservation Act of 1991, as required, which remains the only state-wide development regulation of its type. The county worked with the Maryland Department of Natural Resources in the mid-1990's to develop a GIS-based method for identifying a green infrastructure network of the most ecologically-valuable forests and wetlands. And in 2001, the county was one of three counties in the United States that were invited to participate in the *Linking Communities to the Montreal Process Criteria and Indicators* (MPCI) project. This project was sponsored by the Communities Committee of the Seventh American Forest Congress following adoption by the United States and 11 other nations of the MPCI, which measure the ecological and economic sustainability of forests. Through this project, the county began to compile data about forest distribution and health, and it worked with a stakeholder steering committee to prepare and implement a Forest Sustainability Strategy for the county in 2005. As issues were identified, DEPRM developed programs to improve forest management, including the two rural reforestation projects.

Baltimore County also contributed to technical review of The Conservation Fund's *The State of Chesapeake Forests*¹, which summarized the scientific information regarding the functional benefits of riparian buffers and forests for protecting water quality. The report cites that riparian buffers and forest canopy over streams are associated with wider, shallower stream

Baltimore County maintains a nursery operation and a field crew to install and ensure the survival of high quality seedlings.





Rural Baltimore County—a mosaic of farms, forestlands, and low-density subdivisions.

channels compared to open grass/agricultural lands, thereby increasing the water surface area and permitting a 10 to 40-fold increase in biological processing of nutrients. The report further noted that 100 acres of forest in the Bay watershed are converted to non-forest uses each day, and a third or more of the remaining forests are vulnerable to conversion due to local zoning.

The second impetus for the rural reforestation initiatives came from concern about thresholds for impervious surfaces in sensitive trout streams in the protected rural portions of the county. The northern two-thirds of the county are located outside of the Urban-Rural Demarcation Line, which was established in 1967 and subsequently has become an urban growth boundary. Resource Conservation Zones have been in place in these areas since 1975, protecting more than 92% of the reservoir watersheds that cover 182,650 acres or 47% of the

county. However, DEPRM's analysis revealed that forest cover in rural watersheds with agricultural uses and large-lot, low-density development was typically less than 50%. It was also highly fragmented and parceled. While the prevailing programs for agricultural best management practices included efforts to re-establish riparian buffers on farmland, there was no service agency for the rural residential landowners.

Overall, tens of thousands of acres of rural land in Baltimore County are residential; they are not owned by farmers who work the land for a living. Many of these rural residential lots, by the nature of the zones that created them, abut or include significant parts of large forest patches that primarily exist along the major stream systems.

Based on information from the Maryland Department of Natural Resources on the threatened health

of sensitive trout populations, the Greater Baltimore Group of the Sierra Club asked DEPRM to help identify the degree to which these threatened systems can be better protected during future development, through measures such as impervious surface limits. GIS analysis revealed that many of these areas have essentially been built out, or that future development potential is far less than the cumulative development to date. In addition, some of the Resource Conservation Zones already had impervious surface restrictions, and the densities were as low as one dwelling unit per fifty acres. The challenge, then, was to assure continued protection of water quality in areas with multiple ownerships of moderate-sized forests greater than 100 acres and to expand forest cover.

IMPLEMENTATION RESOURCES

The Rural Residential Stewardship Initiative (RRSI) was funded



by a \$27,200 grant from the U.S. Environmental Protection Agency's Chesapeake Bay Small Watershed Grants Program, administered by the National Fish and Wildlife Foundation. The Valleys Reforestation Initiative was funded by a \$50,000 grant from the U.S. Department of Agriculture Forest Service through the same program. These grants provided funds for materials, including tree seedlings and associated planting supplies (such as tree shelters with bird nets, stakes, root dip, and rodenticide pellets), and labor. For the RRSI project, a small amount of grant funds also reimbursed the Sierra Club for printing costs and the Gunpowder Valley Conservancy for staff time

devoted to outreach. The match from DEPRM totaled \$10,800 and \$ 15,700, respectively.

Labor for both projects was provided by DEPRM's in-house Community Reforestation Program, which uses fees in lieu of mitigation from developers with reforestation obligations. After implementing the reforestation program for several years through private contractors and an AmeriCorp-affiliated youth service organization, a full-time, year-round crew of four was hired to plant, monitor, and maintain reforestation projects using the fees-in-lieu payments from developers. For these two reforestation projects, the county used its crew for labor and charged

the costs to the reforestation grants instead of the mitigation fund. The project therefore benefited from a highly experienced team that has to date planted more than 170 acres, and from the use of its reforestation equipment, including a truck, tractor and trailer, and hardwood seedling planter, all of which were provided as match for the grants. DEPRM staff also provided an in-kind match for grant management and GIS/GPS functions.

Labor costs (salary and benefits) for the Valleys Reforestation Initiative averaged \$600 per day for a crew of four, including a field supervisor. DEPRM costs included preparation of planting plans, site preparation



A reforestation project in Bernouddy Farms subdivision—trees were planted to expand a narrow riparian buffer (above). This tract is located in the upper right hand corner of the Bernouddy Farms stewardship plan (see right).

► A Cluster of Properties Within the Bernoundy Farms Stewardship Plan



The Bernoundy Farms stewardship plan shows actual locations where reforestation took place in one large lot subdivision located on former agricultural lands in northern Baltimore County.

(mowing) where necessary, and planting. The crew was able to plant an average of one acre per day (including installation of tree shelters) at an average density of about 200 trees per acre. The lower planting density was possible due to the high quality and survival rate of the seedlings, with the benefit of reducing both labor and tree costs compared to planting 300 to 400 seedlings per acre. A “tree unit” (seedling, tree shelter with stake, root

dip treatment, and rodenticide) cost about \$3.50 each. DEPRM equipment for each project was valued at about \$5,000, including \$36 per day for a truck and trailer, \$250 for the tractor, and \$20 for the seedling planter. Tree seedlings included two-year bare root seedlings and 12 to 18 inch seedlings grown out in DEPRM’s tree nursery for one year. The stock originated from bare-root seedlings purchased from the state nursery at about \$0.50 each. DEPRM has found that the extra

year of growth results in a superior seedling that can still be planted using a mechanical planter. Survival rates were in excess of 90%.

An important goal of these projects was to engage landowners as stewards of forests and other rural resources. In order to accomplish this and also to provide additional match for the grants, landowners agreed to provide monitoring and maintenance for the projects after the DEPRM reforestation crew installed the seedlings. DEPRM met with landowners and provided practical guidance about maintenance options.

CONSERVATION STRATEGY

Both the Rural Residential Stewardship Initiative and Valleys Reforestation Initiative used partner organizations for outreach and communication with landowners during the initial stages of each project. This was done to overcome any of the traditional biases that are commonly associated with government programs. For the Stewardship Initiative, the Gunpowder Valley Conservancy sent an introductory letter to residents in a targeted thirty-lot subdivision that solicited their interest in meeting with them and DEPRM to discuss details about the reforestation. For another five-lot subdivision, a landowner coincidentally contacted DEPRM directly asking about reforestation opportunities. For the Valleys Reforestation Initiative, the Valleys Planning Council sent a letter prepared by DEPRM that announced the opportunity for reforestation to its entire membership, over an area that covers about 21% of the northwestern portion of the county.

DEPRM staff worked closely with all of the participating landowners because increasing awareness and stewardship were important objectives of both projects. Especially for the single-lot



residential homeowners, DEPRM's initial assumption was that these owners were not very connected to the trees and forests on their lots or the adjacent stream systems. This was confirmed by one landowner who simply stated that "we didn't want all of this land, it just came with the house." DEPRM initially asked for a landowner in each subdivision to volunteer to host a meeting at their house for just their neighbors. DEPRM staff then presented an overview of the local watershed, showing maps of all forested areas, streams, hypothetical 100-foot buffers, and all property boundaries. This clarified the watershed context and resource management needs and emphasized the role that each landowner potentially plays in resource management. After the introductory meeting, DEPRM arranged for a separate "walk and talk" session with each landowner to map and design the reforestation on their lot and, where possible, to blend it into the reforestation area on adjacent lots. Lot owners seemed to trust the DEPRM staff and were eager to ask questions about other trees on their lot.

DEPRM's reforestation designs involve building stands of native species, which are matched to the hydrologic gradients of sites (floodplains to dry ridges), with a limited number of flowering and other accent trees added to high-visibility edges. Seventeen species were planted for the RRSI, favoring oak communities whose long-term dominance in the Maryland Piedmont is threatened. Five species accounted for 77.8% of trees planted, including red oak, green ash, chestnut oak, pin oak, and black oak. All bare-root seedlings were treated with a mycorrhizae dip, and all trees planted were protected by four-foot tree shelters with bird netting. The addition of forest to riparian buffers and existing forest patches will benefit numerous species of terrestrial and aquatic wildlife, as well as the quality of life of the landowners in these developments.

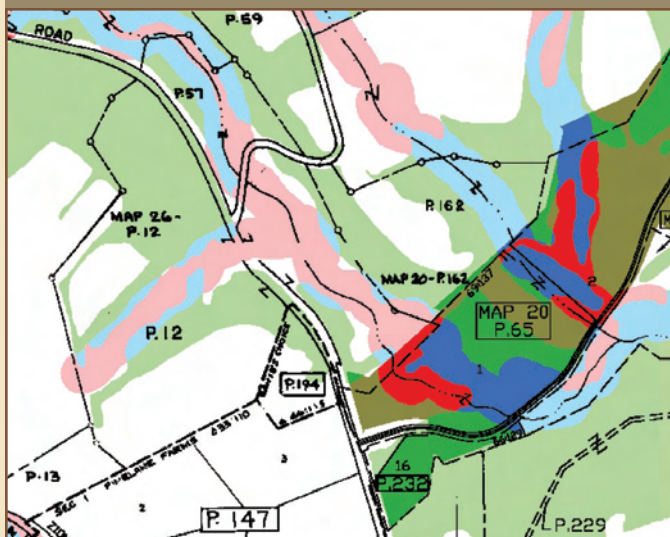
In addition to engaging the individual lot owners, the Greater Baltimore Group of the Sierra Club developed two special newsletters about the benefits and functions of riparian buffers and some background infor-

mation on forest management issues. These were distributed across the region's membership to an estimated 1,850 addresses.

For the Valleys Reforestation Initiative, DEPRM performed a GIS-analysis of reforestation opportunities for the entire project area, which covers 83,159 acres or 21% of the county. Summary information about the status of forest and buffers in the area was incorporated in the introductory letter that was sent by the Valleys Planning Council to its 600 member families. The analysis indicated that active agriculture is the predominant land cover, with forest cover at only 38.5%. Most land (64.4%) in this area is unprotected, with only 7.7% of lands in public ownership and 27.9% of lands preserved through land conservation programs. Fortunately, most of this area has low-density zoning.

More than 13,300 acres of forested land, or 41.6% of total forested land and 16.0% of total land in the project area, have the highest level of protection through either public ownership or inclusion in a land preservation

➤ Reforestation Opportunities in the Valley Planning Council Region



Baltimore County conducted a parcel level GIS-analysis of reforestation opportunities in the 130 square-mile Valleys Planning Council region. Among other informational features shown on this graphic are areas along streams (pink and red) where reforestation efforts are possible. This analysis pin-points specific properties where green infrastructure can be restored to improve water quality and wildlife habitat.

| | | Unforested | Forested |
|---------------------|----------------|------------|----------|
| 100' Stream Buffers | Unencumbered | | |
| | Publicly Owned | | |
| | Preserved | | |
| Non-Buffer Lands | Unencumbered | | |
| | Publicly Owned | | |
| | Preserved | | |



program. Hypothetical 100-foot stream buffers comprise more than 14,000 acres or about 17% of the area. More than 6,400 acres or 45.6% of stream buffers are un-forested. More than 2,300 acres or 53.6% of buffers on preserved land in the area are un-forested. Outside of stream buffers, more than 13,200 acres or 69.8% of preserved land is un-forested.

An important part of the conservation strategy for the reforestation projects focused on reducing barriers, such as cost, to landowner participation in watershed restoration projects. Prior to these projects, DEPRM was aware that landowners are often advised by attorneys to not participate in environmental restoration programs that place permanent easements and restrictions on their deeds and incur costs for legal review and recordation. Without an agreement that prevents landowners from cutting, most government programs will not support reforestation efforts on private lands.

DEPRM approached these reforestation projects with the idea that working closely with landowners and increasing awareness and commitment to stewardship would help reduce the likelihood of future loss of forests. Most of the subject subdivision lots have no further development potential, and buffer areas are protected from disturbance in any event. Even if forest harvesting were to occur, decades would elapse before trees were mature and, in the meantime, sustainable forest management practices would assure that the area remained a forest and not be converted. The county's interest in improving water quality for reservoir protection and meeting Total Maximum Daily Loads under the Clean Water Act argued for assuming that the risk of forest loss was reasonably balanced.

RESULTS

For the Rural Residential Stewardship Initiative, a total of 17 acres of forest was established on 12 residential lots in two subdivisions in 2005 and 2006. Forest cover increased 76.2%, from 17.8% to 49.1% for the eight lots in one of the subdivisions. One landowner, with a 12-acre lot and enough existing and reforested land to meet the five-acre eligibility, entered the state's Woodland Assessment Program in 2009, which provides a property tax reduction for forested lands under management. The tax reduction was sufficient to cover the cost of having a Forest Stewardship Plan prepared by a licensed forester to guide future forest management activities. Each participant received a copy of *Caring for Your Reforestation*,² a landowners booklet developed by DEPRM that explains the details of the reforestation project and that provides guidance for monitoring and maintaining the reforested areas. Each participant also received a copy of the subdivision's "reforestation plan." DEPRM shared the project concept as a case study in the USDA National Agroforestry Center's newsletter, *Inside Agroforestry*.³

The 2009 Valleys Reforestation Initiative resulted in the planting of 21.7 acres of forest on land held by seven different landowners. More than 4,250 trees were planted. Due to mostly mechanical planting and larger planting sites, the project was more cost efficient than the Stewardship Initiative, which used mechanical and manual planting on smaller lots. The total project cost came to \$35,000, compared to \$50,000 for the Stewardship Initiative. DEPRM used Maryland-specific pollution load reduction data (2002) from the Chesapeake Bay Water Quality Model to estimate that the project will ultimately reduce about 275 pounds of nitrogen, 23 pounds of phosphorus,

and 9 tons of sediment per year. Pollutant loads are 12, 60, and 13 times greater, respectively, for farm versus forest cover.

While the full potential for water quality protection will only be realized once the reforestation areas mature, forests are nevertheless the most cost-effective best management practice and provide increasing and continuing benefits over time.

KEYS TO SUCCESS

Don Outen, DEPRM's Natural Resource Manager for forest sustainability, offered the following recommendations for promoting rural residential stewardship through reforestation:

- ▶ Partner with local citizen organizations, including watershed associations that are known to citizens in the project area, to assist with identifying candidate properties.
- ▶ Do not underestimate the extent of assistance needed to successfully enlist the participation of rural residential landowners, even for a project designed to reduce barriers.
- ▶ Do not underestimate the potential for rural residential landowners to become better stewards or the potential acreage that can be reforested—even in priority areas such as riparian buffers. Unlike farmers who use most of their land, the majority of rural residential landowners appear to actively use only about 1.0 to 1.5 acres of land.
- ▶ Rural residential landowners often mow un-used, "excess" areas of their lots because they have been told that they must control invasive weeds. Outreach efforts are essential—landowners know of no alternatives to mowing, and there are virtually no assistance programs to achieve alternative outcomes.
- ▶ In some areas, residents may be concerned about the aesthetics

of tree shelters. Black open-mesh shelters may help address this concern. A broad multi-party education effort may also be needed regarding sustainability.

- Contact all property owners if working on a subdivision basis. Do not assume that a local contact or coordinator is actually contacting and coordinating with all landowners, especially non-participants. All landowners who live in the development and who can see a project are potentially affected by it.
- Provide detailed information for landowners about the reforestation process on their land and recommended monitoring and maintenance practices.
- Follow-up with landowners on the progress of the reforestation and

continue a dialogue about resource stewardship. Leave landowners with the feeling that they can make a difference.

PHOTOS AND FIGURES

Pages 99, 100, 102: Photos, David Burke

Page 101: Photo, Don Outen

Pages 103, 104: Figures, adapted from Baltimore County Department of Environmental Protection and Resource Management

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Green Infrastructure and Organic Farming

Managing a Sustainable Enterprise on Chino Farms in Queen Anne's County, Maryland

A farm owner with extensive land holdings on Maryland's Eastern Shore has pioneered new approaches to land conservation, grasslands management and green infrastructure restoration, which have created a vision and body of knowledge for others to follow.

CASE STUDY SUMMARY

Chino Farms offers a private landowner conservation model of regional and national significance. Dr. Henry Sears, with the help of his able farm manager Evan Miles and a team of researchers, volunteers and government specialists, has created a remarkable 5,200 acre matrix of native grasslands and forest and wildlife habitats along side of a working organic farm operation. Chino farms produces corn, soybeans, hay, wheat, organic peas and corn.

Dr. Sears is inherently curious about the ecological processes at work on the farm and the relationships between plant communities and wildlife. He is also eager to demonstrate how good conservation practices coupled with market driven, innovative economic incentives can help farm owners incorporate green infrastructure concepts, manage their lands sustainably and prevent loss of farmland to development. A prevailing philosophy Sears supports recognizes the need for the standard corn, soybean and wheat rotation operations prevalent on the Eastern

Shore to gradually evolve. He foresees opportunities for more profitable niche markets; locally generated renewable energy sources from the sale of agricultural and forest products; and collaborative efforts among farm owners to develop viable alternative markets.

Arguably, one of the greatest achievements highlighted in this case study is the protection of the fast disappearing Eastern Shore agricultural landscape. To help improve water quality, preserve forestland and stabilize this and nearby farms, Dr. Sears worked closely with many partners to conserve Chino Farms and initiate a state Rural Legacy Area that has secured thousands of farmland acres.

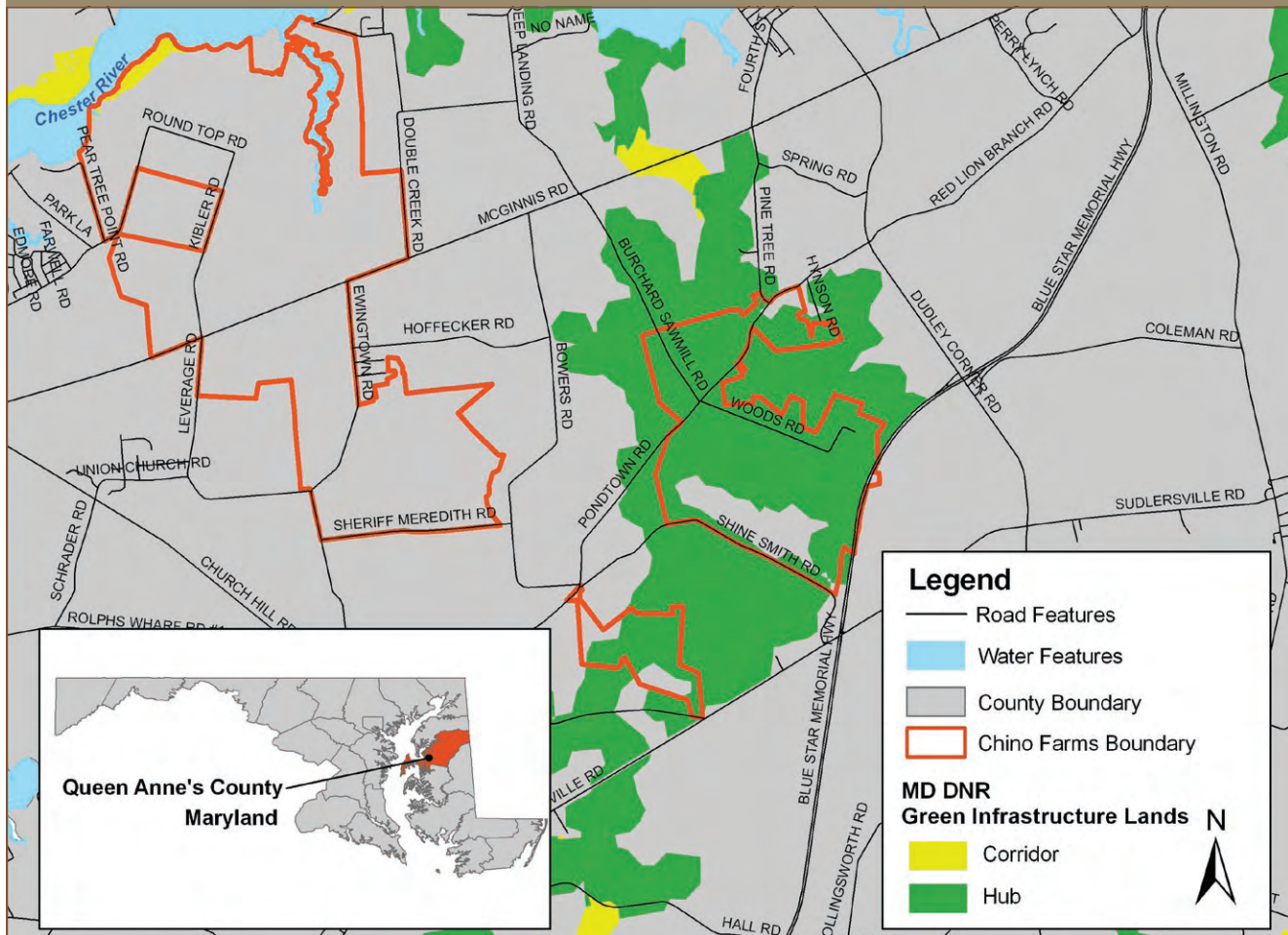
RESOURCE MANAGEMENT CHALLENGE

Chino Farms is three miles from historic Chestertown in an area that has seen an increasing number of scattered rural home subdivisions. Dr. Sears sees the subdivisions as a threat to both the rural character of the area as well as the productive agricultural lands in and around Fore-

man Branch Rural Legacy Area. Chino Farms was first acquired by the family in 1939. Back then it was less than one-tenth the size it is today. At that time, Henry's father used the farm as a gathering place for his friends from New York who made the journey to the Eastern Shore to enjoy the challenge of hunting the once plentiful and diverse array of waterfowl species found along the Chester River fringe marshes, including redheads (*Aythya americana*), canvasbacks (*Aythya valisineria*) lesser scaup (*Aythya affinis*) and greater scaup (*Aythya marila*).

According to most wildlife biologists, the decline of waterfowl in the Chester River coincided with the disappearance of submerged aquatic vegetation (SAV) which was once plentiful along Chesapeake Bay tributaries in the 1950's and 1960's. Like many areas around the Chesapeake Bay, the Chester River has lost SAV stands due to poor water clarity resulting from excess nutrients that cause algal growth, suspended sediment in the water column and other factors. In part, this was fueled by the

► Chino Farms Green Infrastructure Lands



change from small animal husbandry farms to very large row crop farms.

Starting in the late 1960's and '70's, local farming practices included liberal use of pesticides and herbicides. In 2000, the Environmental Protection Agency's Chesapeake Bay Program characterized the Chester River as an Area of Emphasis¹ for toxic pollution because available water and sediment toxicity data and the elevated levels of a few pesticides and metals in some areas of the river indicated the potential for adverse effects on living resources. Two banned pesticides, dieldrin and dichlorodiphenyltrichloroethane (DDT), were found in portions of the Upper Chester River sediments and may have contributed to some of the adverse biological effects observed by researchers.

An additional resource management challenge in Queen Anne's county is maintenance and improvement of forest and non-tidal wetland resources. Only 15% of the land in Queen Anne's county is forested - the smallest in the state of Maryland - and from 1986-1999 forest cover in the county declined by 34.2%.² Delmarva Bays, unique non-tidal wetland ecosystems designated a State Special Concern, are found in relative abundance in Queen Anne's county, yet many of these 16,000 to 21,000 year old interdunal wetland systems have been drained, cleared or contoured for agricultural purposes.³ Dr. Sears reports that several Delmarva Bays at Chino Farms had been farmed historically, however they are no longer used for agricultural production and are

currently protected through natural vegetated buffers.

Dr. Sears also worries that increasing habitat loss and harassment from encroaching human populations will put significant pressures on bald eagles (*Haliaeetus leucocephalus*). Bald eagles are making a comeback on Chino Farms with nesting pairs frequently sighted in various locations on or near the farm. In an effort to rescue declining bald eagle populations stressed by hunting, habitat loss and DDT, the Federal government placed the eagles on the endangered species list and banned DDT in 1972. As their populations recovered, the government first lowered their status to threatened. Then, in June of 2007, bald eagles were removed from the list. Now, development around nest



Chino Farms grasslands plantation looking north toward the Chester River.

sites may proceed without contacting the U.S. Fish and Wildlife Service—although projects must conform with published guidelines.⁴ The bald eagle is still afforded protection under the Bald and Golden Eagle Protection Act and the Migratory Bird Protection Act.

Prior to European settlement, native grasslands were part of the landscape, but they have been nearly eliminated from much of North America. Dr. Sears points out that pre-colonial Native Americans were instrumental in maintaining grasslands for hunting and that these habitats were believed to be more abundant in the mid-Atlantic. Due to fire suppression, widespread agricultural operations and other factors, few native grasslands now exist in the Chesapeake region. Sears stated there are no remaining examples of Eastern grassland coastal savanna and prairie communities and grassland dependent bird and wildlife species have been greatly diminished. Native grasslands are also referred to as warm season grasses, prairie or “bunch” grasses. They have deep root systems, grow in clumps and are an important habitat type for a variety of wildlife including birds, mammals, amphibians and reptiles. They grow best and are the greenest in appearance when temperatures are high.

Cool season grasses were introduced to North America because they were easily established and managed, provided good early season forage for domestic livestock and could be closely grazed. Cool season grasses, like Kentucky bluegrass (*Poa pratensis*) and tall fescue (*Lolium pratense*), have limited wildlife value and are the greenest and grow best in spring and fall temperatures.

CONSERVATION VISION

Given the number of resource management challenges in and around Chino Farms, the farm management team is interested in contributing ideas and solutions that improve the environment and help area farmers stay in business. The management team’s conservation vision is broad but centered on:

- maintaining a model, certified organic farm operation that will eventually target the production of more specialized, locally consumed niche crops with higher commercial value;
- taking advantage of market based opportunities to convert untapped agricultural and forest products to cash crops for local energy production;
- providing a diverse array of habitat types to support resident wildlife populations and exploring

management techniques that facilitate the return of former plant and wildlife species once abundant in the area; and

- strategically restoring important forest patches and corridors that reconnect fragmented stands and link them to major contiguous forestlands within and beyond Chino Farms.

Dr. Sears is a businessman who supports holistic thinking about sustainable land management with a “triple bottom line” approach that yields ecological, economic and social benefits. He is actively seeking practical solutions to creating low cost, low impact energy sources that use materials available on his and other farms like wood, agricultural waste, and switchgrass – which are grown in abundance at Chino Farms. Under the right circumstances, Henry envisions a small renewable energy facility on his farm that produces power for the local community from agricultural and forest products.

IMPLEMENTATION RESOURCES

Returns generated from ongoing farm operations have produced the funds needed to maintain and expand the organic agriculture side of the business and conduct the bulk of the habitat restoration and enhancement projects. The US Department of



Agriculture's (USDA) Conservation Reserve Program and Conservation Reserve Enhancement Program has provided funding for reforestation and grassland restoration. An additional sum of several million dollars was assembled through a variety of partners (see details below—Farm Preservation and Smart Growth) to enable permanent protection of the farm.

Chino Farms has become the host of several academic and government research and management projects that greatly informed and benefited the conservation approaches used on the farm. Extensive studies are being conducted by the University of Maryland and Washington College, including: research on grasslands and their associated management regimens; seed bank productivity on grasslands and other selected plots; the ecology and behavior of the grasshopper sparrow (*Ammodramus saviannarum*) and northern bobwhite (*Colinus virginianus*) both at-risk grassland bird species; and, soil organic and chemical properties analysis on uncultivated areas to contrast soil fertility and seed bank contents with agriculturally managed areas. Dr. Sears is quick to cite the

contribution of Dr. Douglas Gill, University of Maryland, Department of Biology – who initiated interest in the now on-going suite of research projects centered on the restored grasslands habitat. An important technical assistance effort was also directed towards restoration of green infrastructure forest components on agricultural lands.

CONSERVATION STRATEGY

The farm management team pursued a multi-tiered approach to conservation at Chino Farms. The four major elements of their conservation strategy include:

- maintaining an on-going, certified organic farming operation
- preserving the farm in perpetuity and advocating smart growth
- using managed grasslands to promote wildlife and plant diversity
- restoring forest and wetland green infrastructure

Organic Farming: The move toward organic farming at Chino farms was a perfect fit for a progressive management team that understood the complementarity between sustainable agriculture practices and good natural resource management.

Key motivations guiding the organic farming operation include:

- growing safer, healthier crops
- protecting bird, fish and wildlife habitats and aquatic resources on the farm and in the adjacent Chester River riparian ecosystem
- reducing the level of nutrient and pesticide loadings affecting ground and surface waters

The first decision made by management was to start organic farming practices on a small portion of Chino farms to gain experience and confidence. Among other requirements, the move to organic farming involves managing the land and soil for three years using only accepted inputs and practices before it can be certified organic. In 2003, the management team began this 3-year transition process on a 24 acre field that was initially planted with red and white clover to smother weeds, retain more carbon in the soil profile, and to build residual soil nitrogen for future crop production.

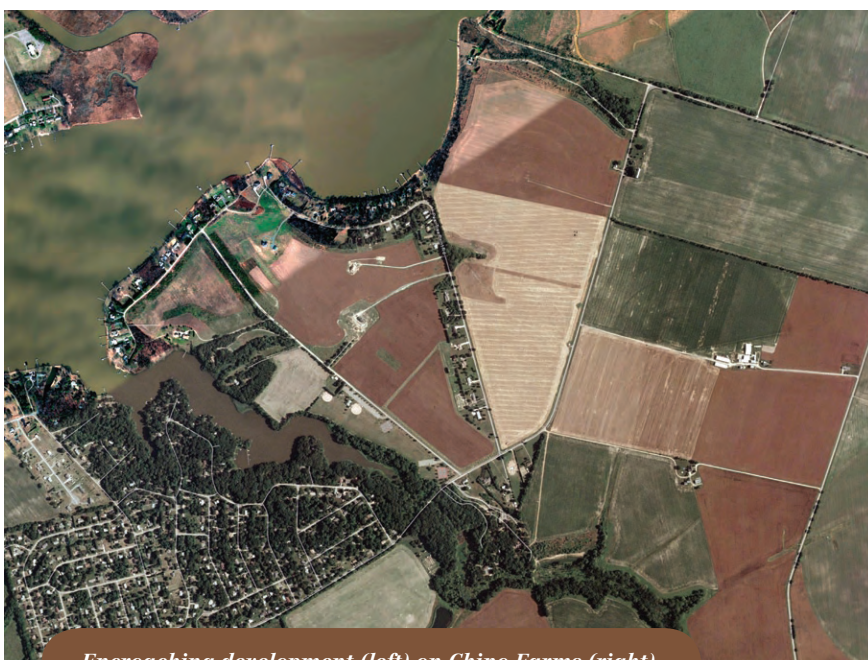
Next, management systematically positioned organic farm fields adjacent to major water bodies of the farm to reduce potential pollutant loads. Finally, operations were expanded to include production of organic green peas for the frozen food market and organic corn and soybeans for grain. At present, 60 acres of the farm are certified organic by the Maryland Department of Agriculture and another 56 acres are in the second transitional year of alfalfa production.

Farm Preservation and Smart

Growth: Expansion of the farm to its present size occurred gradually over decades during which both economic and conservation issues were paramount. Dr. Sears, a lifelong conservationist, wished to conserve the farm in perpetuity. In 2001,



The northern portion of Chino Farms borders the scenic Chester River a short distance upstream from historic Chestertown, Maryland.



Encroaching development (left) on Chino Farms (right).

he was able to buy out the other ownership interest in Chino, with funding obtained through the sale of a 5,031 acre conservation easement now held by the State of Maryland. At that time, the easement was the largest in Maryland's history. A plan which included this sale and other transactions was developed by The Conservation Fund in collaboration with the North American Wetlands Conservation Council, Maryland Department of Natural Resources and Queen Anne's County. The easement, a transaction in excess of \$8 million dollars, was the cornerstone to establishing what was then called Chino Farms Rural Legacy Area - now known as Foreman Branch Rural Legacy Area. The Rural Legacy Program was created in 1997 to protect large, contiguous tracts of Maryland's most precious cultural and natural resource lands through grants made to local applicants and cooperative partnerships between the state, local governments and land trusts.

Beyond the preservation of Chino Farms, Dr. Sears is a strong advocate for smart growth and the maintenance of rural character of

Maryland's Eastern Shore towns and farmlands. Dr. Sears is concerned that sprawling developments outside of nearby Chestertown are threatening both sensitive wildlife species, like the bald eagle, and local farm operations. Taking a stand against encroaching developments bordering Chino Farms, Grassland Plantation, Inc. (an academic research partnership of Chino Farms and an entity Sears is a part of) took legal action against the proposed subdivision of an adjacent 270± acre farm into 51 residential lots. The defendant party's subdivision initially called for 120 units on 267 acres of prime farm land directly adjacent to a tributary stream running within a half-mile of the Chester River. The subdivision was also next to a wood lot on Chino Farms that had been preserved because it contained a bald eagle's nest and Delmarva fox squirrels (*Sciurus niger cinereus*) tagged by Maryland Department of Natural Resources. A unanimous, favorable ruling of Maryland's Court of Appeals required the Queen Anne's County's Board of Appeals to determine whether the increased density of the proposed development was greater

than it should otherwise be under the county's Comprehensive plan. The Maryland Court of Appeals ruling reversed three preceding adjudications and ordered the County Board of Appeals to consider all of the issues raised by Grasslands Plantation, Inc. To date, the developer has taken no further action and has not requested a hearing before the Board of Appeals. There are a number of obstacles that would make further development unlikely or difficult.

Managed Grasslands: Establishing and managing warm-season grasslands to increase wildlife and plant diversity are core elements of the Chester River Field Research Center, Grassland Plantation, Inc., Dr. Gill and James Gruber, principal of the Foreman's Branch Bird Observatory. This innovative partnership ensures that effective conservation ideas are put into practice.

In 1997, Chino Farms and Dr. Gill convened a conference of regional wildlife management specialists from both the government and private sectors to explore what was known about grassland research under the new U.S. Department of Agriculture conservation programs such as the Conservation Reserve Program. Recognizing then that grassland species were in steep decline, attendees discussed, among other topics, how to replicate a grassland that would function in a biologically similar manner to Eastern grasslands that existed prior to colonial settlement.

As a result of the conference, in the spring of 1998, Dr. Sears participated in and financially contributed to a long term study, now in its eleventh year, of native warm season grasses at the farm. In his role as Scientific Director of the newly created Chester River Field Research Center, Dr. Gill was the lead researcher and designed the study to:

► Chino Farms Grasslands Field Plots



- observe how well grassland plants, birds and wildlife responded to different grassland vegetative communities and management practices
- develop practical methods for grassland restoration and management in the Eastern United States

The research team lead by Gill used the grasshopper sparrow, a grassland dependant bird species, as one of the biological indicators for the comparison of various grassland management practices. A 228 acre native grassland restoration site was established in 1998 with 12 different fields designated for varying grass plant communities and management techniques such as prescribed burning, herbicide applications for noxious weed control, and replanting different plant species assemblages.

The initial mix of grasses included eight warm season grasses including: big bluestem (*Andropogon gerardii*), sideoats grama (*Bouteloua curtipendula*), deertongue (*Dichanthelium clandestinum*), switchgrass (*Panicum virgatum*), little bluestem (*Schizachyrium scoparium*), indian grass (*Ischaemum indicum*), eastern gamagrass (*Tripsacum dactyloides*),

broomsedge (*Andropogon virginicus*), coastal panicgrass (*Panicum amarum*) and two cool season grasses—red fescue (*Festuca rubra*) and tall meadow fescue (*Lolium pretense*).

All ten of the planted grass species were readily established and began seed production by the close of the second growing season. Switchgrass aggressively reproduced and was rapidly crowding out other grassland species. The researchers concluded that switchgrass should be eliminated from or greatly reduced in native grassland seeding mixtures. Many other valuable lessons learned and detailed scientific results are discussed in a peer reviewed paper published by Gill and his colleagues in the Wildlife Society bulletin.⁵

Forest Restoration: In order to reduce nutrients and sediment entering the Chesapeake Bay and its tributaries, the State of Maryland established ten Tributary Strategy Teams comprised of governor-appointed representatives from the business community, farmers, foresters, watermen, non-governmental and governmental organizations. One of these teams, the Upper

Eastern Shore Tributary Team, wanted to create a restoration demonstration project that would provide water quality and habitat benefits; and show how multiple partners can work together.

The Tributary Team used Maryland's Green Infrastructure Assessment as the basis for identifying candidate restoration sites. This team identified several potential locations where restoration efforts would yield multiple ecological benefits due to their strategic location within the

forested green infrastructure network. To enhance the ecological functions and value of the existing forest, a wetland and terrestrial planting plan was formulated which reduced the amount of forest edge area, increased interior forest area and formed a connection between some of the largest remaining contiguous forest tracts in the Upper Eastern Shore.

Several landowners were contacted to gauge their interest in having restoration on their properties. Fortunately, Chino Farms was the site that promised the greatest ecological benefit from restoration and Henry Sears was more than willing to collaborate. Dr. Sears first heard of the green infrastructure concept through his colleague Patrick Noonan, founder and Chairman Emeritus of The Conservation Fund and former president of The Nature Conservancy. Noonan told Sears that "the green infrastructure conservation concept would be a driving force for land protection in the 21st century." Maryland Department of Natural Resources helped the Tributary Team, Dr. Sears, Queen Anne's County, and a local consulting firm to implement reforestation and wetland restoration on 52 acres.

DNR provided a \$12,000 habitat restoration grant and Queen Anne's County donated matching funds from their "fee in lieu" program, which collects payments used to replant cleared forestlands when losses can't be replanted by developers. The Chino Farms project represents a rare example where a private landowner has participated in a restoration effort specifically designed to reconnect a regionally significant forest landscape.

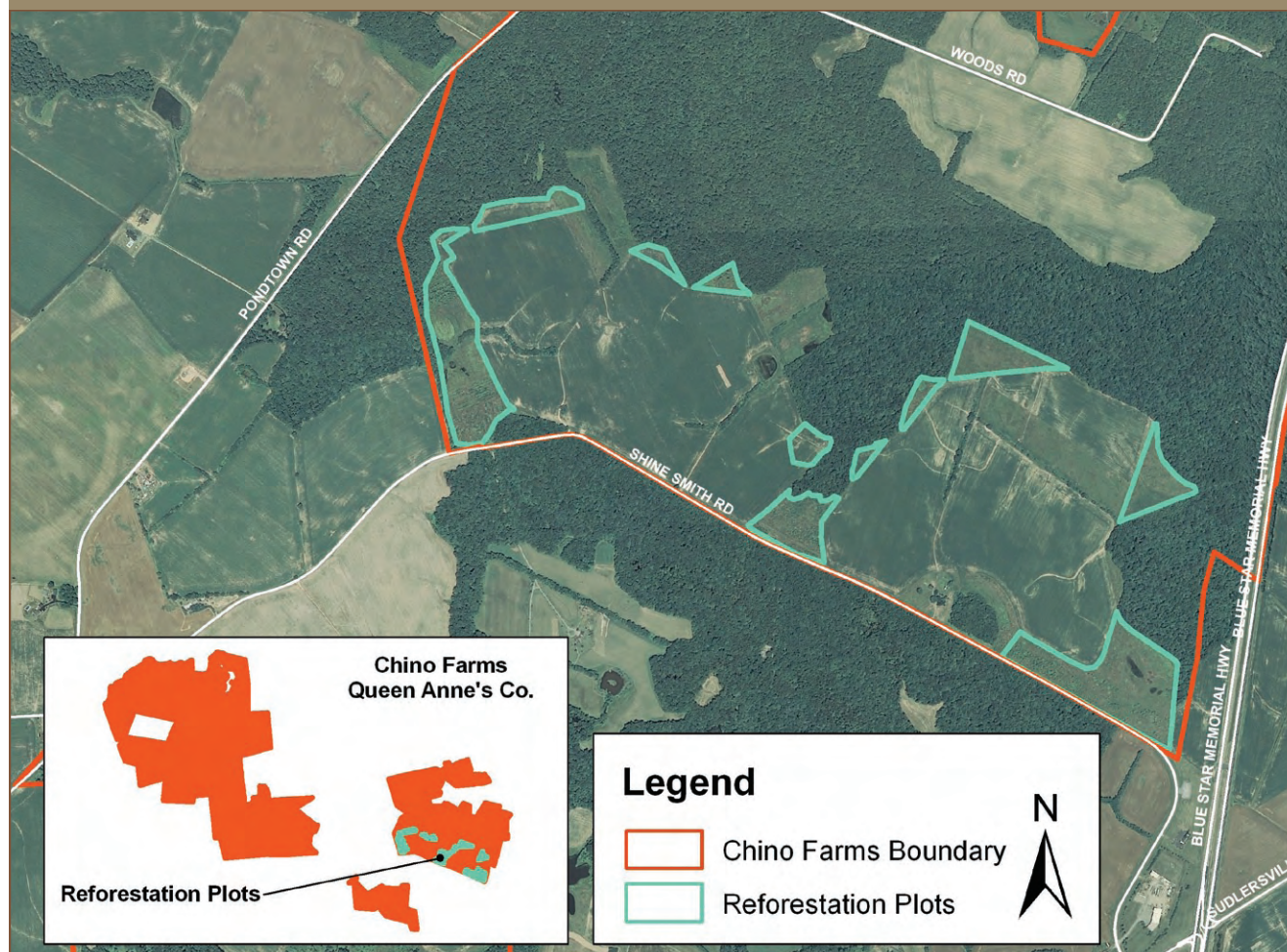
RESULTS

Anyone who has toured Chino Farms immediately recognizes this is no ordinary farm. The picturesque setting and great variety of forests, wetlands, grasslands, expansive organic corn and soybean fields and waterfront shoreline make a memorable impres-

sion. Notable results achieved by the Chino Farms management team and their partners include:

- Establishment of the Chino Farms easement which ensured the protection of more than eight square miles of critical riparian habitat including 100 acres of unique Delmarva Bays, nearly 4 miles of historic Chester River shoreline, a 90-acre waterfowl sanctuary, and important habitat for bald eagle and endangered fox squirrel.
- Reconstruction of an extremely rare, 228 acre mid-Atlantic native grassland habitat, which has been effectively stabilized through a variety of management practices. This habitat hosts extensive grassland-nesting bird species populations, particularly the grasshopper sparrow, which returns to the site year after year.
- Documentation of the most cost-effective and successful grassland management protocols that help government resource management agencies, researchers and habitat creation specialists replicate the core design, creation and management practices landowners can use to restore productive grassland landscapes across the mid-Atlantic. This activity is an on-going, work in progress which addresses new issues as they come into focus.
- Prevention of an attempt to develop 275 acres of farmland adjacent to Chino Farms, setting a legal precedent that will likely benefit future farmland conservation efforts in the area.

➤ Chino Farms Restoration Plots



- ▶ Planting of 36,000 trees on 65 acres of restored forestlands that now connect and enhance some of the largest forestland systems in the area—enhancing water quality and wildlife habitat.
- ▶ Achieving Certified Organic farm status on 60 acres of land for corn production through the Maryland Department of Agriculture.

KEYS TO SUCCESS

The various successes at Chino Farms can be attributed to several factors, including:

Strong farm management: Farm manager Evan Miles oversees the day-to-day operations at Chino Farms with the continuing goal of balancing the efficiency and effectiveness of the farm while protecting natural resources.

Access to scientific research: Dr. Gill and his research team have posed critically important research questions regarding native grasslands, which have led to successful approaches for the design, creation and management of grasslands at the farm and elsewhere in the region. In addition, the strong association with the Maryland Department of Natural Resources and the Upper Eastern Shore Tributary Team produced a one-of-a-kind green infrastructure forest restoration plan.

Profit motive not paramount: The farm business must maintain a profit margin that carries the basic costs of the operation, but it is not the fundamental driver of decision-making. Maintaining the long term sustainability of Chino Farms is an overriding concern that motivates Dr. Sears and his management team. An equally compelling theme that makes the farm successful is the long term mutual support the Chino Farms team has in their respect for one another and concern over the stewardship of the farm.

Curiosity and love of learning: At several points in time, Dr. Sears has redirected his energies into new exploratory pursuits that promote conservation. A current topic of interest is the potential designation of the Chester River as a connector trail of the John Smith Chesapeake National Historic Trail. Sears believes the trail will foster greater appreciation for the need to protect and better manage lands bordering the trail.

PHOTOS AND FIGURES

All photos by David Burke
 Page 108: Figure, Burke Environmental Associates/The Conservation Fund
 Page 111: Image, Google Earth
 Pages 112, 113: Figures, Burke Environmental Associates/The Conservation Fund, using Google Earth images

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Visit www.chesterriverfieldresearchcenter.org to find academic papers produced by researchers investigating Chino farms.



Green Infrastructure Design and Benefit-Cost Optimization in Transportation Planning

Maximizing Conservation and Restoration Opportunities in Four Southern Maryland Watersheds

A team of natural resource and conservation experts has developed a powerful set of analytical tools that represent the next generation of green infrastructure planning for transportation applications and beyond.

CASE STUDY SUMMARY

Population growth along the US Highway 301 corridor near the town of Waldorf, Maryland, has created worsening traffic headaches, particularly for those commuting from bedroom communities in Charles County to employment centers in the Washington, D.C. area. The Maryland State Highway Administration (SHA) has been exploring transportation improvement options for US 301 in the Waldorf area including construction of a bypass or upgrading the existing road. SHA is also evaluating natural resources in four watersheds in Charles and Prince George's counties that could potentially be impacted by construction. The watersheds include: Piscataway Creek, Mattawoman Creek, Port Tobacco Creek, and Zekiah Swamp, as shown in the map of US 301 study area watersheds.

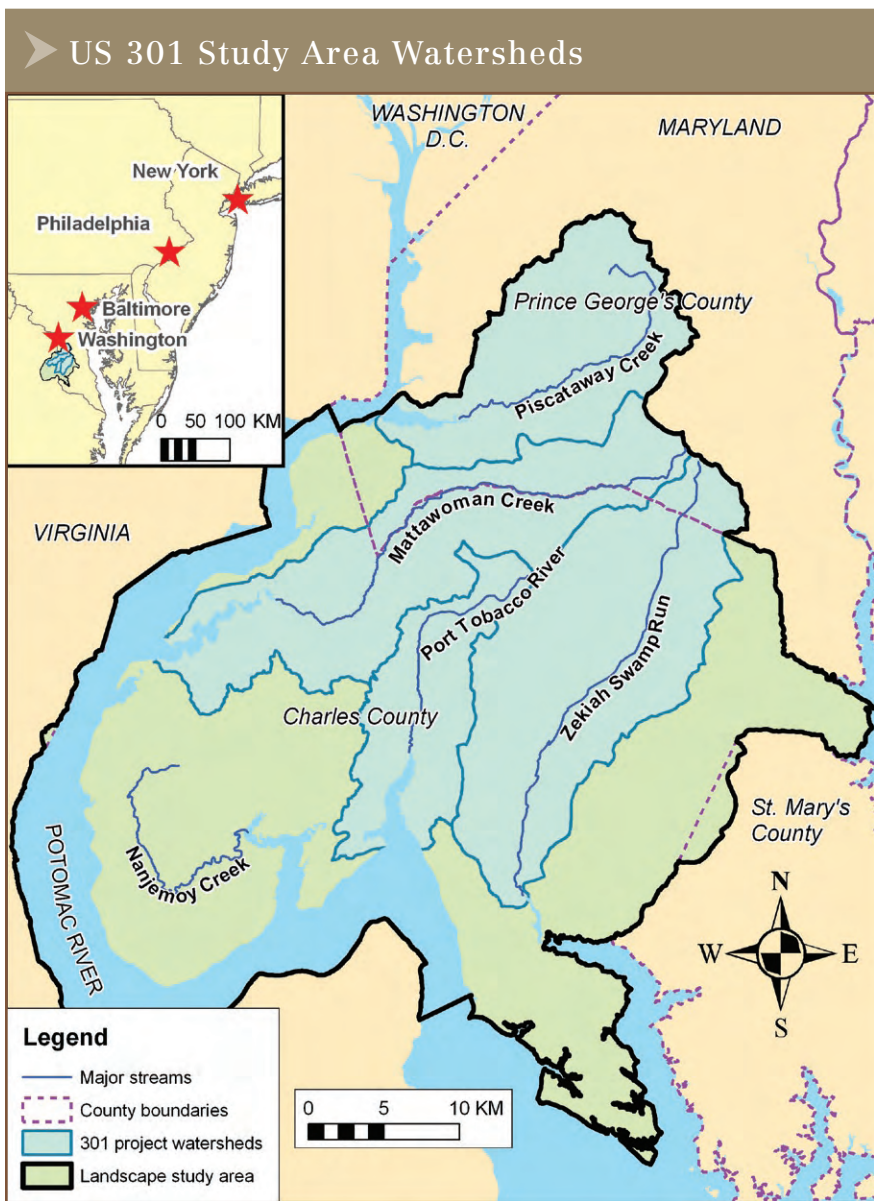
The State Highway Administration adopted environmental stewardship in its US 301 transportation planning process, with the goal of creating a

net benefit to the environment. This approach is innovative among transportation agencies because it goes above and beyond compensatory mitigation required by the National Environmental Policy Act (NEPA) to offset impacts from construction and related activities. In 2007 SHA asked The Conservation Fund, the Maryland Department of Natural Resources (DNR), and the U.S. Fish and Wildlife Service (FWS) to convene a Natural Resources Work Group (NRWG) to objectively identify and evaluate environmental stewardship needs and opportunities.

Recognizing the importance of landscape and watershed contexts, the NRWG followed a green infrastructure approach to identify and prioritize natural resources in the assessment area. Additionally, the NRWG designed a benefit-cost optimization tool to help SHA identify the set of stewardship projects that will maximize natural resource benefits within given budget constraints. The combined use of green infrastructure network design and benefit-cost

optimization constitutes the first known use of this powerful analytical approach in a real world application for development of grey infrastructure and conservation of natural resources. This new approach may well become the standard for future conservation planning—ensuring maximum ecosystem benefits for every dollar spent on conservation or restoration actions. A widely accepted definition of green infrastructure is strategically planned and managed networks of natural lands, working landscapes, and other open spaces that conserve ecosystem functions and provide associated benefits to human populations.¹

Webster's New World Dictionary defines infrastructure as "the substructure or underlying foundation, especially the basic installations and facilities on which the continuance and growth of a community or state depends."² Just as "grey infrastructure" – built structures like roads, water mains, and power lines – is needed by society, green infrastructure provides essential services like clean air, clean water, stormwater



RESOURCE MANAGEMENT CHALLENGE

The four watersheds examined by NRW for conservation and stewardship opportunities contain some of the state’s most important natural resources, including high-quality forests, wetlands, streams, and biological communities. Mattawoman Creek and its wetlands are among the most productive finfish spawning and nursery streams in the entire Chesapeake Bay watershed.³ Mattawoman Creek is recognized as “an exceptional anadromous fish spawning and nursery ground that presently exhibits one of the highest densities of anadromous juveniles and the healthiest trophic fish assemblages in the Chesapeake system.”⁴ In a study of eight tidal Chesapeake tributaries, scientists reported that anadromous juveniles in Mattawoman Creek were 40 times more abundant per unit effort than the other seven combined. They also found that Mattawoman Creek “represents as near to ideal conditions as can be found in the northern Chesapeake Bay, perhaps unattainable in the other systems, and should be protected from overdevelopment.”⁵

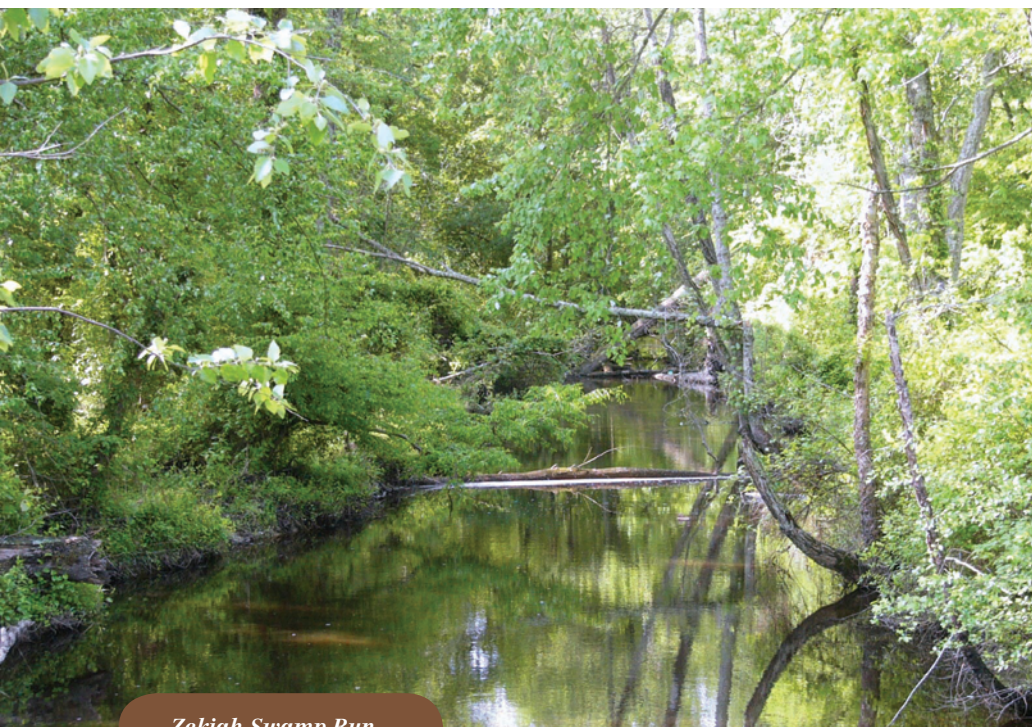
The Smithsonian Institution described Zekiah Swamp as “the largest natural hardwood swamp in Maryland and one of the most important remaining ecological areas on the East Coast.”⁶ Zekiah Swamp is the highest ranking watershed in Maryland for freshwater stream and riverine biodiversity,⁷ and is designated a Wetland of Special State Concern, a Natural Heritage Area, a Rural Legacy Area, and part of a State Scenic River. This watershed contains high quality wetlands, forests, and streams in both the swamp and many of its tributaries.

Piscataway Creek falls into the top tier of Maryland’s watersheds for aquatic biodiversity and is a stronghold

control, food and fiber, and recreation opportunities. Protecting and restoring our natural life-support system is a necessity, not an amenity. Green infrastructure provides a systematic and strategic framework for conservation, restoration, land use planning, and sustainable management practices.

To identify environmental stewardship needs, the NRW reviewed pertinent studies, analyzed existing natural resource conditions, convened community focus group sessions, and delineated a green infrastructure network. Within the green infrastructure network, the NRW identified top priorities for conservation and

restoration. The NRW developed technical field protocols and assessed priority areas on the ground, assigning resource values and estimating the costs of land protection and restoration, if needed. SHA’s proactive environmental stewardship, the green infrastructure approach and analyses, and the use of benefit-cost optimization are all concepts that can be adapted and improved in future efforts to identify natural resource priorities, minimize impacts of transportation improvement projects, and select projects that provide the greatest environmental benefits under a given budget.



Zekiah Swamp Run.

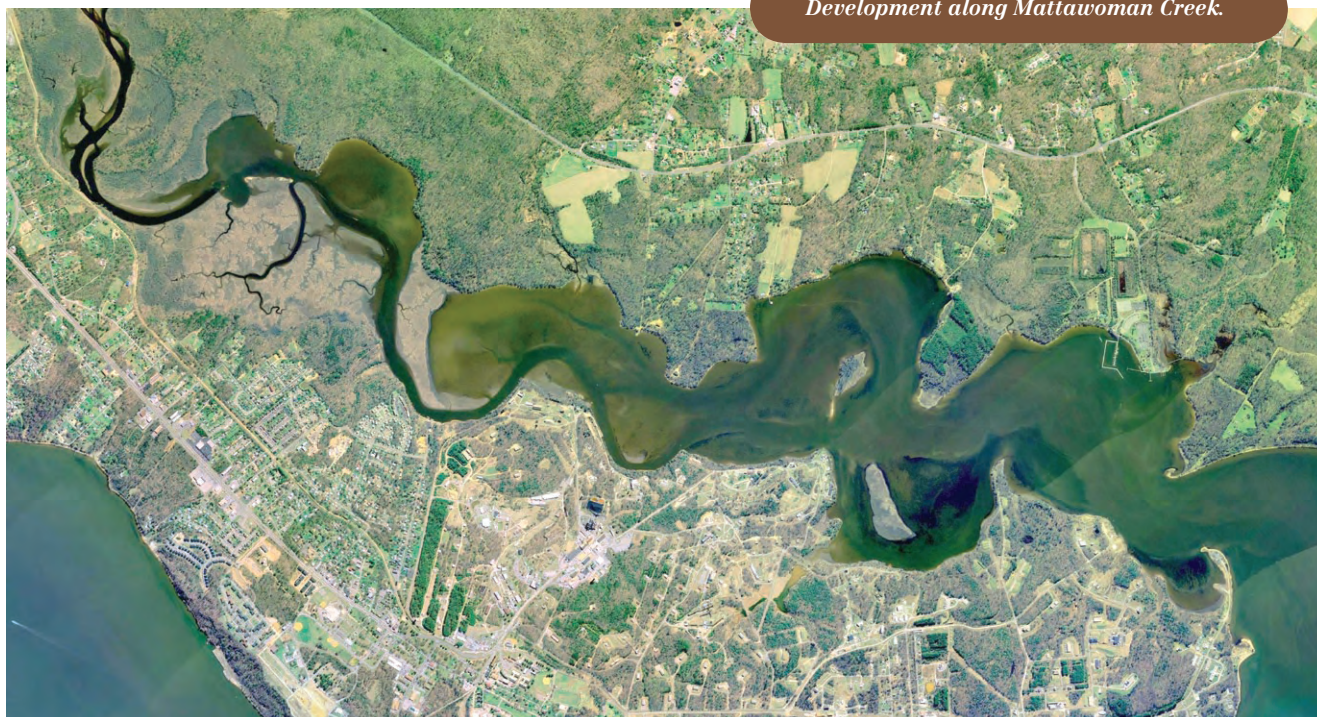
watershed for two species of greatest conservation need. The Port Tobacco watershed contains Hoghole Run, one of the Maryland Biological Stream Survey's sentinel sites, containing a reference-quality biological community and rare species.⁸ Brentland Woods, in the Port Tobacco water-

shed, is a large contiguous tract of forest that provides excellent habitat for forest interior birds and other wildlife.⁹

All four watersheds, especially Mattawoman Creek, which is in Charles County's development district, are

threatened by ongoing conversion of forests and farmland to low and medium density housing and other development. Over 10,000 acres of forest, over 2,000 acres of croplands, and almost all existing pasture are expected to be lost between 2000 and 2020 in the Mattawoman Creek watershed.¹⁰

The increase in development in these watersheds is affecting air quality, water quality and fish and wildlife habitat. Land use change due to human activity "is perhaps the single greatest factor affecting ecological resources."¹¹ When natural areas are converted to intensive human use, the population of species dependent on that habitat may decrease below the threshold needed for long-term persistence.¹² Fragmentation of formerly continuous habitat, especially by barriers like roads and buildings, reduces patch sizes, increases the edge to interior ratio, and restricts wildlife movement.¹³ Exotic plants invade fragmented forests and wetlands, and displace native species. As species are lost from an ecosystem,



Development along Mattawoman Creek.



those that depend on them for food, pollination, or other needs, also begin to disappear.¹⁴

All four watersheds in the study area contain tributaries with impaired biological communities and eroding stream banks. Stream condition is partly a legacy of past land use. The clearing of forests and poor agricultural practices eroded the sandy soils of southern Maryland, which accumulated in stream and river channels and valleys enough to impair navigation and cause the closure of ports on Mattawoman Creek, Port Tobacco River, the Patuxent River, and elsewhere.^{15,16} Further, many streams and wetlands were ditched or dammed to control flooding or drain areas for farming, and beavers were extirpated. Many streams are now incising through legacy sediments, and exporting these materials downstream.

Current land use practices, including agricultural and urban runoff, continue to impact the area's streams. Impervious surfaces (buildings, parking lots, roads, etc.) associated with development have adverse effects on streams and water quality. Studies in Maryland show that when a watershed exceeds 5-15% imperviousness, there is a rapid degradation of stream stability and aquatic habitat quality.^{17,18} Piscataway Creek, draining the most urbanized of the four watersheds, is deeply incised and has unstable banks. Another consequence of impervious surfaces is that as water is moved more quickly off the land, less of it percolates into aquifers.¹⁹ A study of watersheds in Charles County found that conversion of forests to development increases the discharges of water, nitrogen, phosphorus, and organic carbon, while conversion of forests to cropland increases the discharges of nitrate.²⁰ Stream Corridor Assessment surveys identified 218 potential environmental problem



Mature oak stand (unusually old for Southern Maryland) in a Prince George's County forest plot.

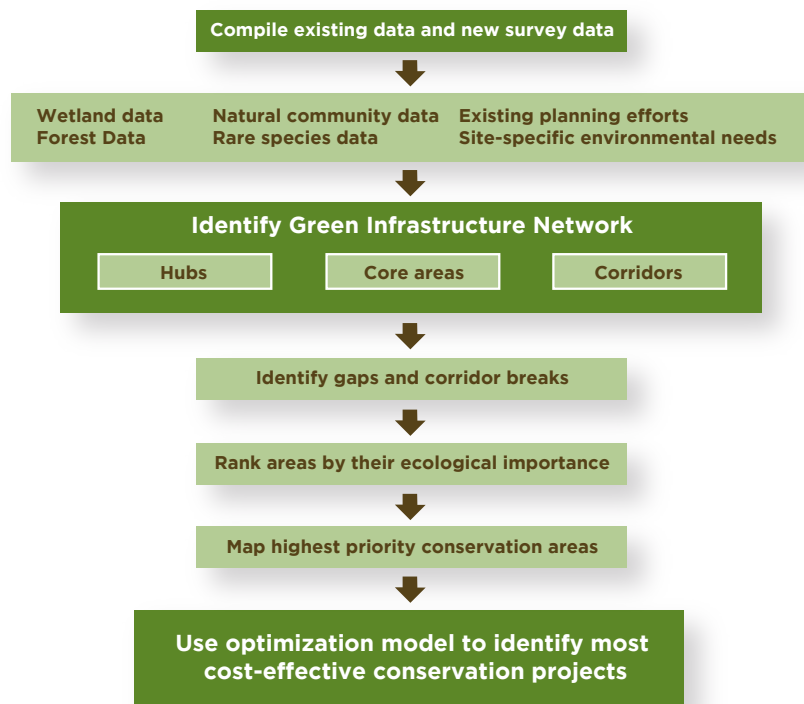
sites in the Port Tobacco watershed. The Maryland Department of the Environment also identified numerous wetland restoration opportunities throughout the study area.²¹

CONSERVATION VISION

While local governments ultimately control the area's development pattern, pace, and design, SHA was in a position to quantify its own impacts from the bypass and upgrade options it was analyzing and then go "above and beyond" that impact to

implement an ethic of stewardship in an environmentally sensitive area of the State. SHA also was intrigued by pioneering work undertaken by Dr. Kent Messer, a resource economist at the University of Delaware, and The Conservation Fund in applying the concept of optimization for conservation project selection.^{22,23} Optimization tools had been successfully designed and utilized in Baltimore County, Maryland, for agricultural land preservation, so SHA was well positioned to be good finan-

Green Infrastructure Planning Process



cial stewards by utilizing benefit-cost optimization to ensure they would get the most “bang for their buck.”

The Conservation Fund, DNR, and FWS hoped to provide a model for green infrastructure planning that strategically targets the best locations for environmental stewardship and ensures the best possible conservation outcomes from a transportation project that impacts the environment. In addition, they hoped the delineated green infrastructure network and associated data would provide valuable planning tools to county governments and state and federal agencies.

IMPLEMENTATION RESOURCES

The State Highway Administration provided funding from 2007-2009 for the NWRG’s work within the planning budget of the US 301 Waldorf Transportation Improvements Project. This was the first instance in the country of transportation planning funds being utilized directly for green infrastructure network design and

benefit-cost optimization. SHA also provided staff and consultants to assist field reconnaissance and data collection. DNR led the assessment of wetland condition, rare species and natural community analyses and collection of associated data. Coastal Resources, Inc. helped collect forest and stream data. The University of Delaware developed the benefit-cost optimization algorithms and software. DNR, SHA, Charles County, and Prince George’s County provided GIS data. Landowners granted permission for all field work. NWRG also successfully leveraged earlier green infrastructure planning efforts by DNR and The Conservation Fund by refining the methods from Maryland’s first statewide green infrastructure assessment²⁴ and recent planning work by The Conservation Fund in Baltimore, Cecil, and Talbot Counties, Maryland²⁵, and Kent County, Delaware.²⁶ FWS contributed essential expertise on characterizing stream stability, while the Fund and DNR contributed expertise in wetlands, forests, and natural

GREEN INFRASTRUCTURE NETWORK IDENTIFICATION PRINCIPLES

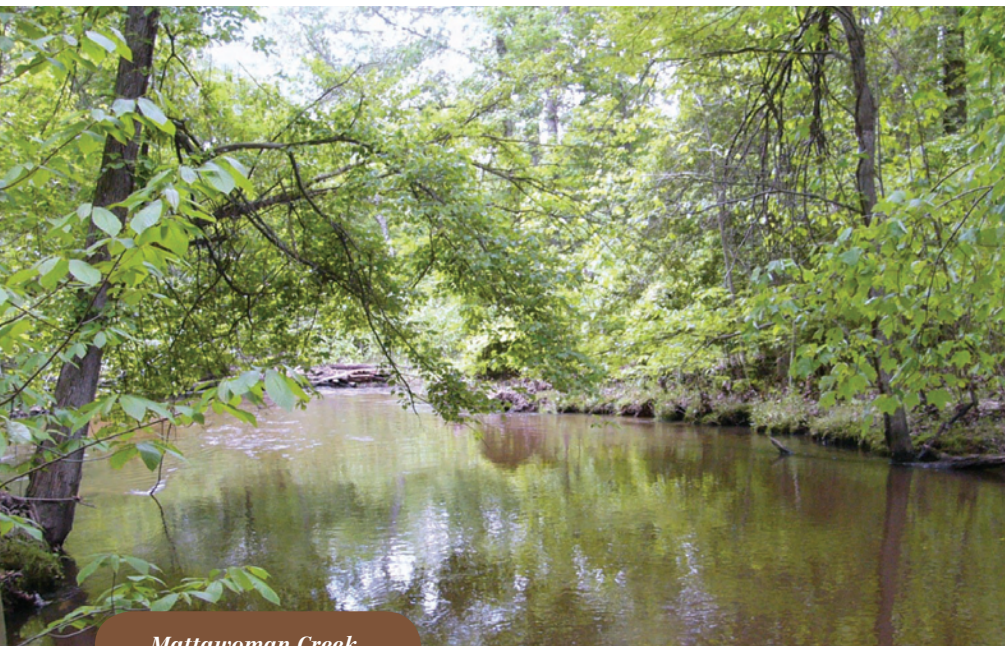
According to conservation biologists,^{26,27} a green infrastructure network should:

- ▶ Contain the best remaining examples of all native ecosystem types and the full suite of native biodiversity.
- ▶ Maintain viable populations of all native species in natural patterns of abundance and distribution.
- ▶ Maintain ecological and evolutionary processes, such as disturbance regimes, hydrological processes, nutrient cycles, and biotic interactions.
- ▶ Contain large blocks of contiguous habitat, with large populations of a species, rather than small fragmented habitat.
- ▶ Maintain connections between large blocks of habitat for gene flow and migration.
- ▶ Include habitat blocks with compatible buffers opposed to abrupt boundaries with development.
- ▶ Accommodate human activities compatible with goals of resource protection.

heritage resources. The Conservation Fund’s Conservation Leadership Network provided expertise in convening focus groups and soliciting stakeholder feedback.

CONSERVATION STRATEGY

Community Needs: Soon after beginning the project, The Conservation Fund facilitated four focus group sessions. Sixty four individuals, representing federal and state government agencies, local elected officials and staff, and various non-governmental organizations, participated in the four



Mattawoman Creek.

focus group sessions. Participants first discussed types of environmental stewardship activities most needed in the project area as well as the priority natural resources. The facilitators then provided a form to each participant, and asked them to allocate 100 points among four categories of stewardship activities and 100 points among eight categories of natural resources. Next, participants reviewed a list of available data and literature, and were asked to recommend additions. Finally, participants were asked to recommend specific projects or resource needs, writing a description, and marking their location on a map. The focus groups identified site-specific environmental needs in the study area. The input from these focus group sessions helped guide where field reconnaissance work took place for the existing conditions and green infrastructure network design and provided a preliminary look at potential environmental stewardship opportunities. The input also provided information to SHA that could be used in the prioritization of conservation projects through identification of priority natural resources and stewardship activities.

Resource Conditions: A key element of the conservation strategy involved the NRWG's survey efforts. FWS surveyed streams throughout the project area, assigning a rating of stable, unstable, or recovering. FWS and The Conservation Fund compared observed stream stability to their geomorphic setting and catchment conditions, finding that stable streams generally had low gradients and were in catchments with low imperviousness and high percentages of mature forest, or were artificially controlled by beaver dams or human engineering. FWS extrapolated these relationships to assign stability ratings to all the streams in the project area, which were used to identify potential locations for restoration activities. In addition, stable streams were considered "core" streams and therefore conservation priorities if they also provided high-quality fish habitat.

DNR and The Conservation Fund collected wetland data from each of the four watersheds, and used this to predict presence of high-quality wetlands. DNR also performed rapid assessment surveys to characterize nontidal wetlands for conservation

potential and the amount of effort and resources required for restoration.

The Conservation Fund collected forest plot data throughout the project area, and used this to identify and calibrate parameters modeling high-quality forest. They also compared the forest plot data to LIDAR (light detection and ranging) canopy height data processed in Charles County, historic aerial photos in Prince George's County, and other data such as land cover, slope, stream proximity, wetlands, and floodplains, and developed a predictive model of forest age. This analysis helped identify core forest areas in the green infrastructure network.

The Department of Natural Resources' Natural Heritage Program performed surveys of rare species and natural communities, updating their existing inventory. DNR identified and characterized Ecologically Significant Areas that contained rare species habitat, and grouped ecological communities according to species similarities. This information helped delineate and prioritize the green infrastructure network and environmental stewardship opportunities.

Green Infrastructure Network Design:

The next step in developing the conservation strategy was to identify the green infrastructure network. The basic building blocks of a green infrastructure network are core areas, hubs and corridors. Core areas contain naturally functioning ecosystems and provide high-quality habitat for native plants and animals. These are the nucleus of the ecological network. Hubs are slightly fragmented aggregations of core areas, plus contiguous natural cover. Hubs are intended to be large enough to support populations of native species, and serve as sources for emigration into the surrounding landscape, as well as providing other ecosystem services

like clean water, flood control, carbon sequestration, and recreation opportunities. Corridors link core areas together, allowing wildlife movement and seed and pollen transfer between them, and thereby promote genetic exchange.

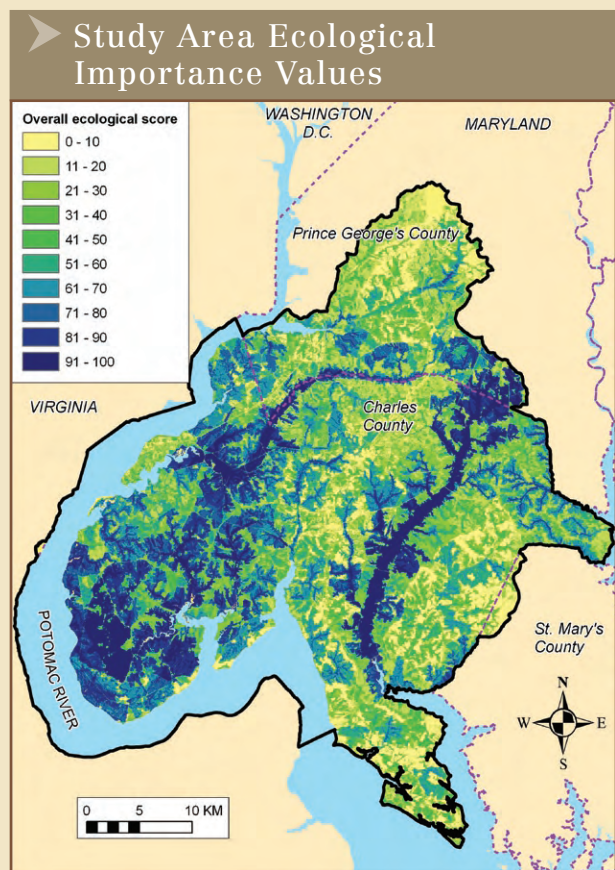
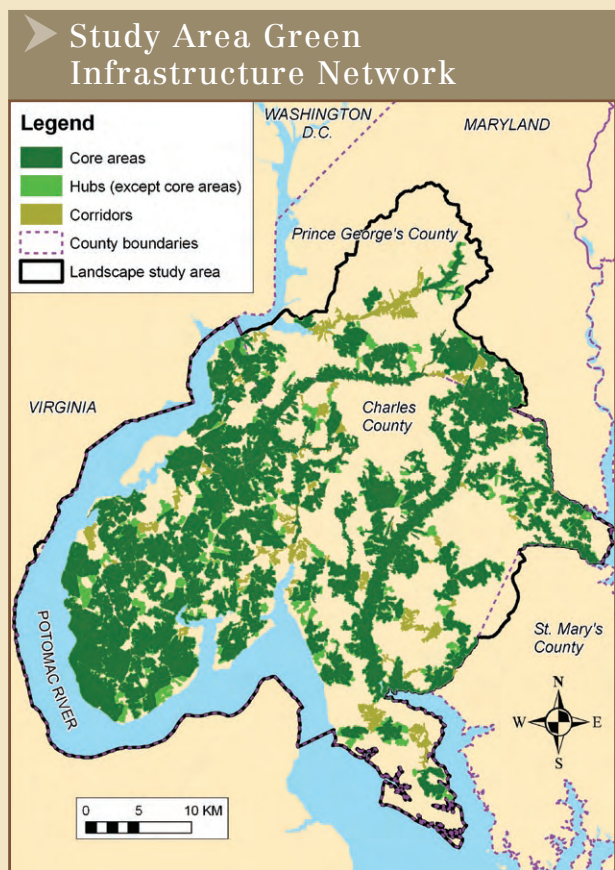
The types of landscapes and ecosystems incorporated into a green infrastructure network depend on the region's topography, climate, geology, historic and current species composition, present configuration, and other factors. The first step in developing a green infrastructure network is to identify species and natural communities occurring in the study area, and then identify their habitat preferences and requirements, home range sizes, dispersal abilities, suitable landscape features for dispersal, barriers to dispersal (e.g., highways or development), and the species role in ecosystem function. "Umbrella"

and "keystone" species native to the area are used to determine size, connectivity, and other thresholds in the green infrastructure network design. Umbrella species are a species or group of species whose habitat needs overlap those of other animals and plants. For example, the habitat needs of forest interior breeding birds overlap those of many other plant and animal species, including large mammals, many wildflowers, wood frogs, and wild turkeys. When sufficient habitat is protected to sustain a diverse assemblage of forest birds, important components and microhabitats of the forest will also be encompassed and be protected.²⁹ Keystone species are those with an important role in ecosystem function, such as pollinators, seed dispersers, hydraulic engineers (beavers), and top carnivores. Habitat preferences of umbrella and keystone species

help identify core areas and hubs. Connectivity requirements of less mobile species (e.g., amphibians and small mammals) are used to model corridors.

The Conservation Fund reviewed available literature concerning the project area and native wildlife species. Wildlife habitat requirements and movement obstacles helped parameterize green infrastructure core areas, hubs, and corridors.

For analysis purposes, NRWG divided ecosystems into three broad types: forests, wetlands, and aquatic systems. NRWG did not include grasslands (before European colonization, a rare and ephemeral ecosystem in the project area) because surveys showed that available remotely sensed data could not accurately identify grassland habitat.



CORE AREA CRITERIA

Core Forest: Blocks of forest containing at least 250 acres of mature interior (at least 100 meters from the nearest edge) deciduous or mixed forest. Criteria were derived from habitat requirements of forest interior breeding birds.

Core Wetlands: Relatively unimpaired wetlands with adjacent forest or water. These included large blocks (at least 250 acres) of interior broadleaf forest along natural perennial streams, large blocks of mature interior swamp or floodplain forest with standing water, unpolluted wetlands (at least seasonally flooded) and vernal pools with at least 215 meters of surrounding forest, and unimpaired and well-buffered marsh at least 12 acres in size. Criteria were derived from habitat requirements of several species of birds, amphibians, and reptiles.

Core Streams: Stable perennial streams with continuous riparian vegetation and not impounded or channelized. Core aquatic areas included adjacent forests and wetlands. Criteria derived from habitat requirements of native fish and mussels.

ECOLOGICAL RANKING FACTORS

- Rare species presence, viability, and habitat extent
- Aquatic biological condition and importance
- Forest maturity and extent
- Wetland and stream condition and context
- Distance from roads and development
- Proximity to other core areas or hubs
- Connectivity potential and importance in the overall network
- Type of neighboring land uses

NRWG defined core areas using criteria derived from the habitat requirements of keystone animal species in the three focal ecosystem types (see text box).

NRWG defined hubs as aggregations of core areas, other habitat, and other natural land, divided by major roads or gaps greater than 328 feet (100 meters) and at least 250 acres in size. Not all core areas, other habitat, or other ecological features fell within hubs, if they were isolated and below the size threshold. The Conservation

Fund used least cost path analysis to identify optimal linkages between core areas, and added adjacent suitable land to delineate corridors.

Finally, the NRWG identified potential buffers around core areas, hubs, and corridors. These buffers – natural land, pine plantations, fallow fields, or agriculture – could protect the green infrastructure from high-intensity disturbances associated with urban development.

NRWG then evaluated and ranked areas within and outside the green

infrastructure, using a set of factors at multiple scales, to help distinguish their relative ecological rank (see text box). NRWG used the resulting relative ecological rankings to identify the highest priorities for conservation efforts, shown here in the map of ecological importance values. These included the highest ranking unprotected forests, wetlands, and streams in the green infrastructure network that were adjacent to existing protected land, and were developable. NRWG considered the Zekiah Swamp mainstem and Mattawoman Creek floodplain too wet to develop, and subject to regulatory protections. All other privately owned land without conservation easements were considered at-risk for development or sand and gravel mining, although the immediate risk varied.

The State Highway Administration mailed letters to all landowners with at least 20 acres in these priority areas. Where permission is granted, work group and SHA will assess the conservation values of key properties, as well as restoration needs and costs. NRWG developed standardized methods for evaluating potential conservation and restoration projects in the field.

Restoration Targeting: Restoration includes a wide variety of activities to improve ecological functions, such as reforestation, wetland creation or restoration, stream restoration or stabilization, invasive species removal, stormwater management, construction of fish passages, ditch removal, road underpasses, and abandoned road or railroad removal. “Gaps” are areas within the green infrastructure that do not currently have natural vegetation, such as agricultural, barren, or lawn areas. Revegetation of these areas with natural land cover would strengthen the integrity of hubs and corridors, decrease negative edge effects, ease wildlife movement,



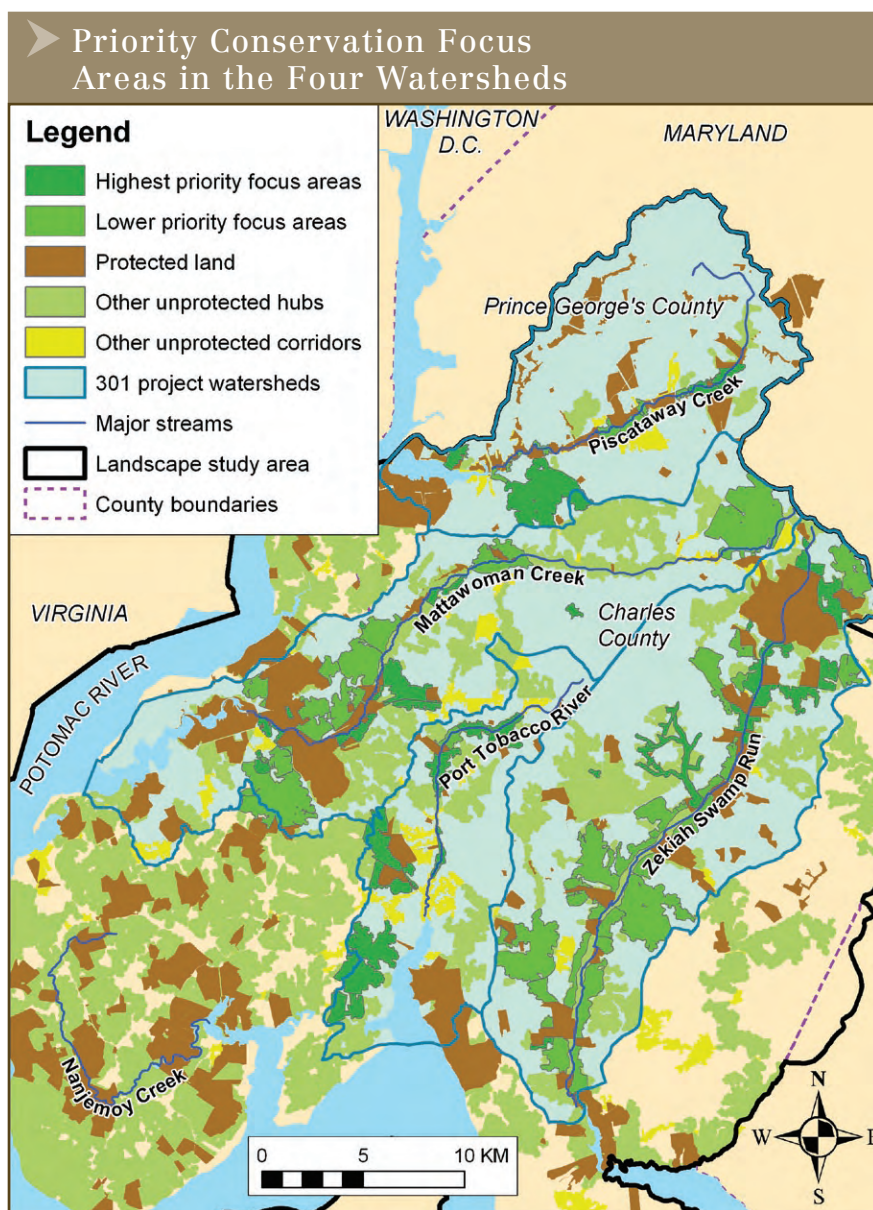
and decrease opportunities for invasive plants. The NRWG identified gaps within hubs and corridors that could be restored to natural cover by planting native species and, if needed, restoring soils or hydrology. NRWG identified corridor breaks and stream buffer gaps as high priorities. Internal gaps (entirely within a hub or corridor) were deemed higher priorities than gaps on the periphery of the network. The NRWG also identified unbuffered stream reaches outside the green infrastructure, but upstream of core aquatic areas.

In addition to reforestation, the NRWG examined opportunities for stream stabilization, wetland restoration, and invasive species control. Because restoration projects would require permanent protection from land conversion, the highest priorities were within priority conservation areas. Further, restoration projects within the green infrastructure would benefit the network as a whole, and the restoration project would be more likely to succeed over the long term. For example, wetland restoration within a green infrastructure hub, especially near existing core wetlands, could benefit from nearby sources of

native species and a relatively natural hydrology. Restoration projects in urban or agricultural areas, although they may provide benefits like stormwater retention and flood attenuation, often become dominated by exotic species and may be subject to hydrologic impairments and influxes of pollutants. Similarly, stream restoration in a hub, especially where the watershed is mostly forested, may benefit from a more stable baseflow and storm flow, and may be linked to more diverse populations of fish and benthic organisms.

Optimization: Effective conservation and mitigation require both sound science and sound economics, yet the most common technique used to select conservation projects can be quite inefficient. This selection technique, a “rank-based model,” selects the projects with the highest benefit scores with little consideration of the relative project costs. In situations where numerous high quality projects go unfunded due to budget constraints, the rank-based approach ensures only that the available resources are spent on the highest ranked projects; however, the model frequently misses opportunities to spend the money in a cost-effective way by funding low-cost, high-benefit alternatives that would maximize overall conservation benefits.

In contrast, an “optimization model” uses a mathematical technique called binary linear programming to identify the set of cost-effective projects that maximizes aggregate benefits. The optimization model uses data describing the resource benefits of the potential projects and relative priority weights that an organization assigns to each benefit measure, as well as estimated costs of each project and overall budget constraints. The optimization model evaluates each of the possible sets of available projects and selects the set that maximizes the



aggregate conservation benefits given a specified budget. The optimization model can help distinguish between the high-cost “Cadillac” projects, which can rapidly deplete available funds while making relatively small contributions to overall conservation goals, and the “best buy” projects, which individually may not appear as valuable, but when combined, provide significantly greater aggregate benefits. An alternative approach is known as Cost-Effective Analysis, which ranks benefit-cost ratios for each project from highest to lowest and then selects the highest ranked benefit-cost ratio until the budget is exhausted. Identifying the cost efficient set of projects generated not only helps organizations maximize their financial resources, but can also provide a science-based, economic rationale for identifying and prioritizing projects.

RESULTS

Inventory: The work group performed an extensive natural resource inventory for the project. They conducted a literature review of local environmental conditions, wildlife habitat requirements, the natural history of the area, and existing planning efforts; surveyed stability conditions at 163 stream reaches; collected forest data at 62 randomly selected plots; collected data at 27 wetlands; identified 30 locations of seven rare plant species; and collected data on 89 natural communities. In addition, stakeholders in the focus groups identified 328 site-specific environmental needs.

Development of new landscape characterization methodology:

To help characterize ecosystem condition, wildlife habitat, and help prioritize conservation decisions in the study area, two members of the work group created a new spatial model that uses remotely sensed data to estimate forest maturity.³⁰

This new methodology used LIDAR (light detection and ranging) data and innovative techniques to calculate tree canopy height and thus estimate forest age. After verifying their results with sample plots on the ground, the information was used to construct a spatial model to classify the forest in the four focal watersheds of the 301 project area into three age categories: young (<30 years old), intermediate (30–70 years old), and mature (>70 years old). Of all the GIS variables used to identify conservation priority, modeled forest age was the best predictor of highly valued conservation areas. The work group used the data from this ground-breaking model extensively to help develop the conservation network.

Green Infrastructure Network Design:

The study area encompassed 439,452 acres and the resulting hub-corridor network totaled 185,862 acres (42% of the area). The work group identified 141,362 acres of core areas, 172,289 acres of hubs (30,927 acres of this external to core areas) and 13,573 acres of corridors. They also identified gaps and corridor breaks, where restoration would improve network integrity. They ranked areas by their ecological importance and developed methods to evaluate conservation and restoration projects. Finally, they mapped priority conservation focus areas.

Optimization Study: By the end of 2009, the work group will provide a list of potential environmental stewardship projects, with estimated benefits and costs, for use in the selection of opportunities based on different road alignments and budget scenarios. The US 301 project serves as a model for holistically identifying natural resource needs and priorities, minimizing the impacts of transportation projects, providing a framework for strategic mitigation and a process

for project selection that addresses benefits and costs.

In a hypothetical modeling scenario involving a \$15 million budget and a maximum of 30 conservation projects (to simulate limited staff available for implementation), optimization outperformed rank-based selection by selecting projects with 7% higher aggregate ecological value and 15% more green infrastructure acreage for \$2 million less. The additional \$2 million could have been spent to protect even more land if there was additional transaction capacity. Comparable scenarios occur with other combinations of budget and transaction capacity and illustrate that ecological value, green infrastructure acreage, and other benefit measures can be maximized using an optimization decision support tool.

Citizen Involvement: The work group’s process included substantial public input because they assumed that public assessment of needs and priorities should be key factors in decision making and resource allocation. They also felt that it would bring major benefits to the process and lead to better decision outcomes that were supported by the public.

KEYS TO SUCCESS

The Conservation Fund offers the following recommendations on how best to integrate green infrastructure and benefit-cost optimization for conservation planning:

- **Establish a collaborative green infrastructure working group** with a clear work plan, quality control procedures, and regular communication.
- **Educate transportation proponents and resource agency staff** on green infrastructure principles to ensure all parties understand the concept and the vocabulary.



- **Convene meetings with the local community early** in the process to ensure that the full range of potential resources are identified and evaluated.
- **Design the network for multiple purposes.** While a green infrastructure network may be developed for a particular purpose (e.g. a transportation improvement project), the network can be designed so that it is useful for other purposes (e.g., municipal and county land use planning and decision making).
- **Design the network to facilitate restoration targeting** so that mitigation projects are more likely to be successful and provide tangible ecological benefits.
- **Develop methods, protocols, and evaluation systems that are replicable and transparent.**
- **Develop message points for each constituency that may potentially be involved in implementation of the network design** – remembering that the network design will cross public, private and non-governmental organization owned land.
- **Actively communicate that smart mitigation using a green infrastructure approach provides positive benefits to both green and grey infrastructure** – a win-win. If planned properly, green infrastructure and grey infrastructure should be viewed as complementary systems rather than competing systems.
- **Ensure all green infrastructure plans are provided to the State Department of Transportation (DOT)** as these plans will serve as valuable data layers in DOT planning processes.

PHOTOS AND FIGURES

All photos and figures by The Conservation Fund
 Page 117: Image, Google Earth
 Page 119: Figure, Joel Dunn



Box turtle (Terrapene carolina) in Charles County, a species that relies on connectivity between wetlands and forest, and is impacted by roads and development.

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Forest Landcare in the Chesapeake Headwaters

Improving Forest Management, Markets, and Ecosystems in Virginia's Blue Ridge Forest

The Blue Ridge Forest Cooperative represents a new grass roots approach to sustainably managing non-industrial private forestlands in a cost effective manner that benefits landowners and improves ecosystem health in the Chesapeake Bay watershed.

CASE STUDY SUMMARY

The headwaters of the Chesapeake Bay are primarily forestland. The ways in which people take care of that forest impacts the quality of the Bay.

The Blue Ridge Forest Cooperative is one example of people working together to improve the watershed. The Cooperative is a for-profit landcare business owned and operated by family forest owners in Virginia's headwaters of the Chesapeake Bay. It was organized in 2004 by landowners seeking to improve the health and productivity of their forests through positive-impact, sustainable management.

The Blue Ridge Forest is a globally significant ecosystem that is controlled by thousands of public and private landowners. A prominent motto of the Blue Ridge Forest Cooperative is "One Forest, Many Owners." With 15 members that own approximately 2,500 acres of forestland, the Cooperative aims to create economies of scale that allow for cost-effective member services

and the sale of certified sustainable forest products to local and regional markets.

The Cooperative applies the Forest Landcare model, which is useful for forested regions of the Bay watershed where landowners are interested in cooperating to achieve landscape sustainability, ecosystem services, and green infrastructure objectives. This approach to sustainability represents a model that could help improve ecosystem health throughout the Chesapeake watershed.

RESOURCE MANAGEMENT CHALLENGE

Non-industrial private forestland owners possess 262 million acres of the nation's forest.¹ In recent years, private forests have increasingly split into smaller units. Referred to as parcelization, this phenomenon is significantly impacting areas in the east, where 83% of forestland is privately owned. The result is that average acreage owned is decreasing, while the number of forestland owners is growing by about 150,000 each

year.² Five million acres of forestland are predicted to be subdivided in the next several years.³ In the near future, the size of an average private forest parcel is expected to be around 17 acres.⁴ Virginia is not immune. Seventy percent of the forestland is privately owned in the state, and development and parcelization pressures are significant.⁵

Parcelization is impacting the health and productivity of private forests in the United States.⁶ As parcel size decreases, owners will increasingly face challenges in terms of the economies of scale associated with traditional harvesting systems.⁷ Forest fragmentation and conversion of forests for urban development are expected to increase as a result.⁸ Moreover, as populations continue to grow in the east, associated urban sprawl will enhance rural residential development pressures and further decrease economies of scale.⁹ Virginia reflects these trends and could benefit significantly from new management models for achieving forest conservation.¹⁰

Parcel size, however, is not the only change underway. The nation's largest intergenerational transfer of forestland is ongoing. Younger forest owners will be more likely to reside in urban and suburban areas, pursue different lifestyles than previous owners, and may be less apt to use traditional forest management practices because they view them as incompatible with their objectives.¹¹ Offering forest management opportunities that align with the objectives of new owners is needed to help maintain sustainable and profitable forests.

These changes require new approaches for forest conservation. Forest Landcare is one approach that offers a solution. It simultaneously promotes working forests that provide much needed wood products while also ensuring healthy and productive forests that can sustain a wide variety of amenity and commodity objectives. It helps to combine timber harvesting and other economic uses with residential values. Private

landowners are able to manage their forests in a way that enhances sustainability and, if desired, profitability—all while preserving the real estate value of their land.

Using Forest Landcare to manage multiple parcels of forest could help improve the overall health and productivity of a variety of forested ecosystems in the Chesapeake Bay watershed. The ecosystem services associated with vibrant working forests include things such as increased habitat and biodiversity, soil and water conservation, and improvements in air and visual quality. Forest Landcare could help ensure that the watershed and its landowners are able to realize a full suite of environmental, social, and economic benefits.

CONSERVATION VISION

The Blue Ridge Forest Cooperative originated because owners saw a need for forest management services that appeal to owners with smaller parcel sizes and changing objectives.

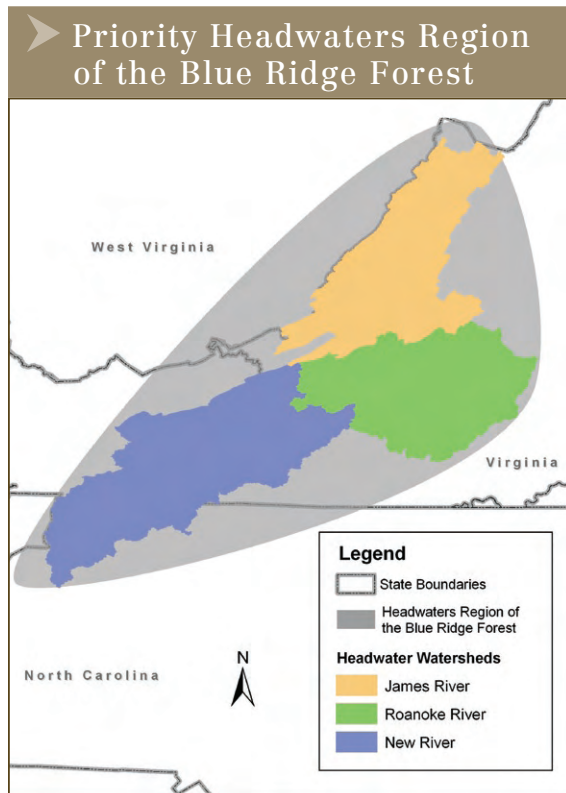
In particular, the Blue Ridge Forest Cooperative conducts low-impact practices that maintain continuous canopy conditions. One member demonstrates the appeal of this approach when describing the reason for their participation: "I kept looking at some of the practices among the logging crews around here and was very unhappy with what I saw. It almost looked like it was some type of devastation coming through the area and I just didn't appreciate the appearance that they left, or the problems that they consequently caused after that."

WHAT IS LANDCARE?

Landcare is sustainable land management—including agriculture, forestry, landscaping, and related practices—that integrates conservation and development goals. Landcare improves a broad range of economic, social, and environmental conditions (the triple bottom line or "3BL") for landowners, local communities, and global society. Successful landcare, with large-scale and long-term outcomes, requires that landowners and land managers work with their neighbors and strategic partners to achieve objectives that cannot be accomplished individually. Forest Landcare is a specific approach to landcare that provides forestland owners and managers with the tools (including knowledge, networks, and services) needed to sustainably manage forestland. For more information on landcare, please visit the Landcare Central website at www.landcarecentral.org.

Another member echoed similar sentiments and added that "I saw the co-op as a way to make it possible for landowners to sell timber and do it in a reasonably good fashion, not have their property torn up."

Harry Groot, chief executive officer of the Blue Ridge Forest Cooperative, envisioned a new way of doing things that would accomplish the goals of likeminded forest owners while achieving Forest Landcare's triple bottom line: "People [have a] desire to know more and be able to control... what happens on their land with their forest... and knowing more is also having access to more stuff to achieve





these goals.” Before beginning the cooperative, Groot and other initial members researched existing and former cooperatives in order to fully understand their accomplishments and shortcomings. His aim was to ensure Blue Ridge Forest Cooperative permanence. To scale up, Groot teamed with other visionaries to help realize the dream of a profitable Forest Landcare business in southwestern Virginia.

The Blue Ridge Forest Cooperative is truly a team effort—a member-owned business that allows its members to have a voice in its direction. Members have a unique opportunity to share their opinions and be part of the decision making process. The Cooperative has a board of directors made up of members and expert partners, and it hosts annual membership meetings. Its business structure allows members to work as a team rather than tackle forest management as individuals. One member said that “joining the cooperative and working together with other people... gives all of the individuals a voice. I mean, just individuals by themselves cannot be as effective and cannot make the

A GLANCE AT PARCELIZATION IN THE CHESAPEAKE BAY WATERSHED¹²

- ▶ How much of the watershed is affected? Approximately 60% of forests are fragmented, and 40% are influenced by development.
- ▶ How does this development look? Much of this development is termed “leapfrog” fragmentation, where larger, intact forests have holes in the center containing the development.
- ▶ What are the trends involving family forest owners? The watershed has seen a 25% increase in the total number of family forest owners, with 70% of owners having property sizes of less than 10 acres of land.

things happen that a group of people together can accomplish.”

All members recognize that another crucial reason for their cooperation is to overcome issues of scale. It is much harder for owners of a smaller forest parcel to profitably and sustainably manage their forests. By pooling resources in a cooperative, owners are able to share knowledge, equipment, and services and improve opportunities for economically managing forests of varying sizes to achieve a mix of landscape conservation and development goals.

IMPLEMENTATION RESOURCES

The Blue Ridge Forest Cooperative chose to use private investors, rather than grants, as their primary funding source in order to test whether or not economic viability is possible with limited public assistance.¹³ Therefore, the Cooperative obtained start-up funding from private investors. The Community Forestry Resource Center and the Appalachian Forest Resource Center also provided financial assistance,¹⁴ and the Southern States Cooperative Foundation helped draft a business plan to comply with state law.¹⁵ Virginia Tech, Virginia Cooperative Extension, Virginia Department of Forestry, National Network of Forest

Practitioners, and other strategic partners have provided technical assistance.

Cooperative costs include equipment costs, staff salaries, business operating space, and third party certification. An advisory board continually consults with agency and industry sources in order to improve the business’s infrastructure and operations.

To join the Cooperative, forest owners must own a parcel within its operating region, which presently encompasses southwestern Virginia but may include parts of North Carolina in the future. They must also purchase \$500 of stock in the Cooperative, cover the costs of oversight services during harvests, and pay for a forest management plan certified by the Forest Stewardship Council (FSC).¹⁶ At annual meetings, each member has one vote regarding policies and decisions. By joining, members afford the Cooperative the right of first refusal for the harvest and sale of timber from their forests. In return, members receive profits that are proportional to sales from the timber harvested from their property. Members are also required to work with a forester to develop an FSC management plan for their property. The Cooperative hopes to offer group FSC certification in the

TYPES OF COOPERATIVES

- ▶ Landowner services cooperatives
- ▶ Value-added manufacturing cooperatives
- ▶ Marketing and distribution cooperatives
- ▶ Learning and networking cooperatives

For more information on forest landowner cooperatives, visit the website for the National Network of Forest Practitioners at <http://www.nnfp.org/Resources/Cooperatives.htm>.



On-site processing of a timber stand improvement harvest sponsored by the Blue Ridge Forest Cooperative at a family-owned forest in Montgomery County, Virginia.

future as a way to reduce certification costs for individual owners.

CONSERVATION STRATEGY

Ultimately, the Blue Ridge Forest Cooperative hopes to cater to a niche market by producing a unique local brand of value-added wood products that are FSC certified.¹⁷ The Cooperative sorts, selects, and manufactures logs to create value-added products such as flooring, trim and casing, crown molding, wood paneling, and cabinetry. Available markets for these certified sustainable products include local “green” architecture firms, construction companies, and other niche buyers in local, regional, national, and international timber markets.

In order to promote forest health and help reverse the regional trend of exploitive harvesting, the Blue Ridge Forest Cooperative espouses a “worst-first” management strategy. This plan involves removing unhealthy and poorly formed trees and leaving stronger, healthier trees behind. The Cooperative sees this as a major part of its mission to help restore the productivity of degraded forests across

the region, which in turn will increase overall ecosystem health and allow for greater watershed protection.

Aside from forest health and economic benefits, membership affords other important opportunities and experience. As one member put it, “We aren’t that concerned about money, so to speak. I mean, it’s nice, it is valuable, but we’d like [the forest] to be managed, and we don’t know anything about [forestry].” The Blue Ridge Forest Cooperative provides options and educational opportunities beyond forest operations for its members. Professional advice and education are an important aspect of its conservation strategy, and members learn a great deal in the process of developing an FSC certified management plan. One member explains, “To engage people in creating the certified management plan, getting them to understand what goes on and become responsible for it, is I think the unique thing about the co-op that makes so much sense to me.”

Forest owners who are too busy to put extensive time and effort into managing their forests view the

Cooperative as a vehicle for expert advice about pest management options, species selection, and thinning. Additionally, educational programs helped spark the decision to join among some forest owners. “I think those educational opportunities are part of what brings new people in,” one member commented. “And, you know, they can hear about something so they come out and they participate, and can get interested that way.”

RESULTS

Although the Blue Ridge Forest Cooperative is still a relatively new business, there have been several important accomplishments to date. On the ground activities have focused on timber stand improvement operations. Four management prescriptions have been performed, which has produced 50,000 board feet of lumber. This lumber is being converted into value-added products, such as flooring, trim, paneling, and decking. The total costs of the salvaged logs were around \$500 per thousand board feet, which includes transportation, salvage, and equipment costs.



LEARNING FROM THE PAST: WHAT MAKES A COOPERATIVE SUCCESSFUL?

- ▶ Provide membership benefits that outweigh membership costs.
- ▶ Create a proper management infrastructure that has a business plan and an appropriate business model.¹⁸
- ▶ Develop adequate capital, cash flow, and markets for its products—becoming and staying profitable is a must!
- ▶ Establish trust between the cooperative and its members, keeping management in tune with their individual needs.¹⁹
- ▶ Provide motivated, capable leaders who can not only resolve conflicts, but also track inventory, sales, and expenses, and attract investors.²⁰
- ▶ Maintain clear communication between the management and the members—keep members informed and get feedback.²¹
- ▶ Find a way to be relevant in the local context, and be sure to differentiate the benefits of the cooperative from other options available to the landowners.²²
- ▶ Establish a clear reason to cooperate.²³

Producing these value-added products will help the cooperative to maximize profit in order to help offset the costs of “worst-first” management. This is the fundamental strategy of the business model to which the cooperative adheres.

Though positive strides have been made, the Blue Ridge Forest Cooperative faces the ongoing financial challenges involved with starting up

a vertically integrated forest products system. Becoming established in a market takes time; success will require sufficient inventory to respond to orders in a timely and efficient manner. The Cooperative is continuously adjusting its management operations in relation to cash flows and market dynamics. As the Cooperative establishes itself in the market and continues to grow, its financial success will grow as well.

Success, however, is not just measured by the number of board feet sold. Because this cooperative focuses on landowner services, other factors will contribute to its success. The Blue Ridge Forest Cooperative has been especially successful at education and outreach. It has administered more than 20 landowner education events, including tours of the harvested sites, field days, and workshops. Nearly 200 people have benefited from these efforts. The feedback from those visiting the sites has been very positive; landowners praised the aesthetics of the operation, potential of the land for future productivity, and low-impact nature of these operations. Additionally, Virginia Tech and other strategic partners have opened the door for assistance with research, marketing, and development. The promotion of Forest Landcare principles, educational events, and outreach will help community members in the Cooperative’s operating region better understand and embrace its goals. This in turn could lead to a greater demand for the value-added FSC certified products, as well as an increase in membership.

KEYS TO SUCCESS

Continued success depends on many internal and external factors. Expanding membership is critical for matching supply with demand and for generating sufficient funds

to cover start-up costs. Potential members will need the Cooperative’s operations clearly outlined for them in forms such as economic fact sheets and on-site field demonstrations. Leadership must continue to respond to landowner needs, adjust to their objectives, and offer opportunities for members to remain engaged in cooperative processes. Appropriate markets for certified products will need to be established and secured.

The success of the Blue Ridge Forest Cooperative and the advent of additional forestry cooperatives in the Chesapeake Bay watershed could help enhance the health and productivity of forest systems and their myriad benefits throughout the region. Forestry cooperatives offer opportunities for owners of smaller parcels with various objectives to realize sustainable and profitable forest management, but they are also an important vehicle for learning and adaptation. As one member stated, “if you know where you’re headed and get people to agree that this is where we’re going, then [it is just] a process of self-discovery and group discovery getting there.”

According to Groot, anyone who is thinking about starting a cooperative should keep the following things in mind:

- ▶ Start with a well crafted business plan.
- ▶ Expect changing conditions and be flexible!
- ▶ Be responsive to customers and their changing needs.
- ▶ Have enough cash flow on hand to provide the flexibility needed to respond to changes.
- ▶ Produce quality products.

PHOTOS AND FIGURES

All photos by Blue Ridge Forest Cooperative

All figures by Burke Environmental Associates/The Conservation Fund

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