



CHAPTER 5

Watershed Protection

Valleys Planning Council	175
Using Smart Growth, Ecology-Based Planning and Community Advocacy to Preserve a Treasured Landscape in Baltimore County, Maryland <i>By Teresa Moore</i>	
Improving Codes and Ordinances	187
Building a Cleaner James River <i>By William H. Street and Amber Foster</i>	
Earning Multiple Credits for a Forested Riparian Buffer	195
A Methodology for Reducing Pollution in Pennsylvania's Susquehanna Watershed <i>By Scott Van de Mark</i>	
Converting Poultry Manure from Waste to Resource	201
Using Manure and Paper Mill Waste to Reclaim Abandoned Mine Lands in Pennsylvania <i>By Scott Van de Mark and Dr. Richard Stehouwer</i>	
Lynnhaven River NOW	211
Improving Water Quality in the Lynnhaven River <i>By Karen W. Forget</i>	

Watershed Protection

Introduction

The Chesapeake Bay watershed is rapidly urbanizing and faces intense pressure from climate change, development, population growth, highway construction, agriculture, and water and air pollution.

The watershed includes more than 64,000 square miles of land and 100,000 miles of streams and rivers, encompassing parts of Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia, and the entire District of Columbia. A natural and non-political jurisdiction for land management, the watershed is defined by the highest edges of all the lands that eventually drain into the Chesapeake estuary. Water quality is a direct reflection of the management of human activities within the watershed and whether they are in harmony with complex ecosystem processes, particularly those involving wetland and riparian zones. Protecting and restoring the Bay begins with watershed protection in the hundreds of sub-watersheds within the Chesapeake region.

All across the watershed, pioneering efforts have been made to use new techniques involving highly sophisticated technology, planning and policies to improve water quality. Citizens, non-profit organizations, corporations, and scientists have developed creative and new ways to improve water quality. The Valley's

Planning Council used ecology-based planning and community advocacy to establish monumental achievements in conservation and growth management in Baltimore County. The James River Association has developed a system to improve development codes and ordinances that affect water quality. The Pennsylvania Environmental Council developed a market-based system to earn credits for reducing nutrients, sediment and carbon and worked with the Pennsylvania State University to reclaim abandoned mines using waste materials, which also addresses a nutrient management challenge. Lynnhaven River NOW orchestrated a series of coordinated water pollution reduction and habitat restoration initiatives with remarkable success. While human activities have degraded substantial portions of the Chesapeake's ecological resources, particularly the watershed's aquatic systems, advances in watershed protection presented in this chapter can be replicated in geographic areas across the Chesapeake region to improve water quality, restore habitat and solve resource management challenges.

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

► **Use watershed assessment tools to direct growth management policy:**

Historical settlement patterns and poor planning and development policies have left a legacy of harmful environmental impacts across the watershed. New GIS resource inventory and watershed assessment techniques bring powerful science based insights that can vastly improve government land use planning and growth management decisions —allowing us to escape, reduce or reverse the damaging effects of poor development choices.

► **Strengthen local advocacy efforts by using scientifically-based data and legal strategies:**

Even small neighborhood organizations and marginally funded environmental advocacy groups can make their voices heard and redirect ill-conceived development plans. Advocacy actions that are supported by scientific data and legal strategies provide strong credibility, improve awareness of potential environmental consequences and can broaden public support for positive change.

► **Create solutions to environmental problems using market forces:**

A nationwide trend in economic development focuses on the expansion of natural industry “clusters” that yield synergistic and competitive advantages in the global market place. Cluster industries in our watershed, such as poultry production and mining, produce “waste” products that can be converted into environmental resources to leverage rapid, positive changes and enhance the local economy.



Valleys Planning Council

Using Smart Growth, Ecology-Based Planning and Community Advocacy to Preserve a Treasured Landscape in Baltimore County, Maryland

The Valleys Planning Council served as the catalyst for the legendary 1964 ecology-based *Plan for the Valleys* by Ian McHarg—laying the groundwork for a 47-year track record of achievement in resource conservation, land preservation, and growth management in northwestern Baltimore County, Maryland.

CASE STUDY SUMMARY

People traveling through northwestern Baltimore County within the territory covered by the Valleys Planning Council (VPC) will be struck by the marked transition from urban to rural land use as they cross the county's Urban Rural Demarcation Line (URDL) (See sidebar on the following page). Within a mile of the Baltimore Beltway, drivers heading north cross the demarcation line, into that portion of the county zoned for resource conservation. The suburban surroundings quickly change into a rural environment: narrow, two-lane roads winding through rolling countryside, forested ridgelines, and lush valleys. The land uses outside the URDL are primarily large-lot residential, horse farms, forests, and crop fields. The rural area also houses a number of private institutional uses that serve as an effective transition zone from urban to rural in many locations.

The effectiveness of the growth boundary, conservation zoning, and easements is apparent to even the casual observer. Planners who marvel at the success in containing sprawl often ask how Baltimore County

established growth management tools at such an early and critical stage of the county's development. Why was Baltimore County decades ahead of other jurisdictions in its ability to envision the need and mechanisms for growth management? A significant contribution to the county's early land use vision came from a proactive and forward-thinking group of residents who cherished the valleys' landscape and realized the looming threat to it from swelling population centers on all sides and decided a regional plan was needed.

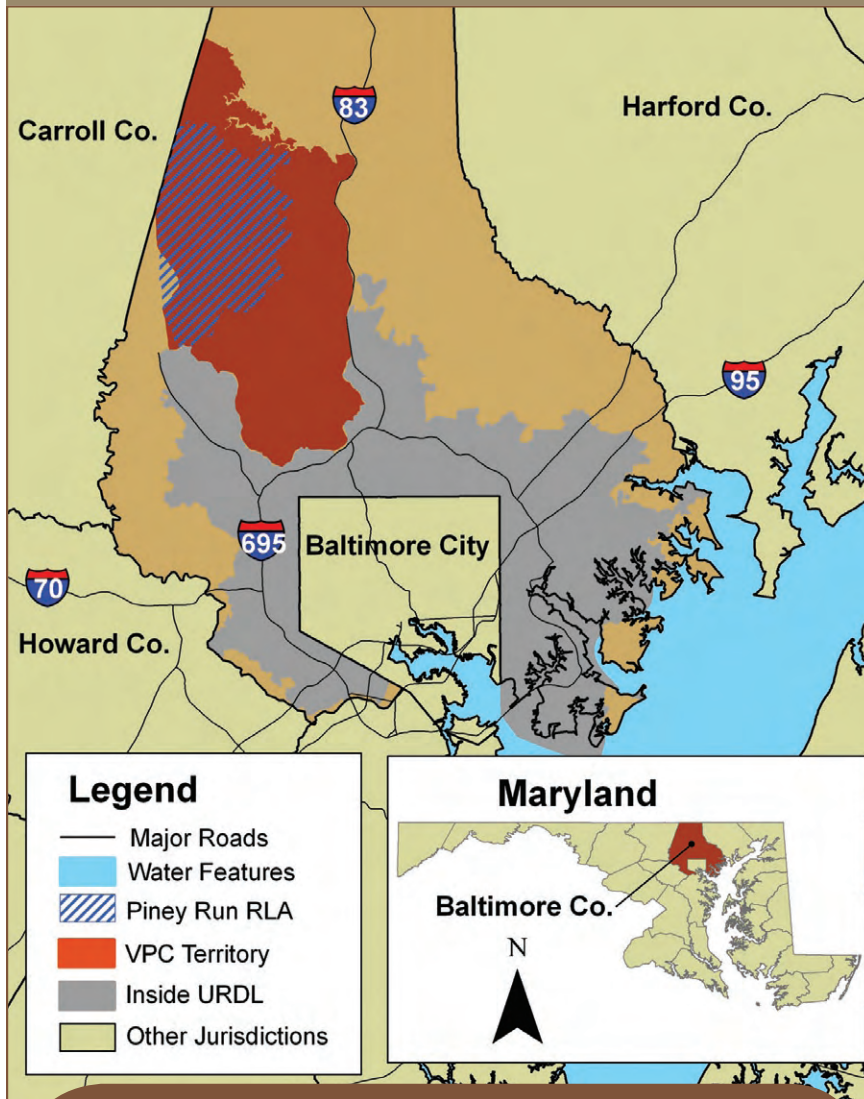
In 1962, the group formed a non-profit, and raised \$100,000 for a land use study to protect the valleys in northwestern Baltimore County and direct future growth to appropriate areas. Renowned landscape architect Ian McHarg and urban planner David Wallace were hired, and the *Plan for the Valleys* was published in 1964.¹ It was a landmark document in its day, and is still highly regarded as a breakthrough in ecology-based landscape planning. It was featured as a chapter in McHarg's 1967 acclaimed work *Design With Nature*.²

Almost 50 years later, the Valleys Planning Council is still going strong—maintaining its well-regarded role as “the eyes and ears” of the valleys. The Council's work is frequently strengthened by partnerships with land trusts and local community associations who are often aligned on issues. In 2009, the Council returned to its roots by hiring Wallace, Roberts and Todd, the current incarnation of the firm that prepared the original *Plan for the Valleys*, to assist VPC in preparing recommendations for an update of the Baltimore County Master Plan.

While it would be difficult to duplicate the entire effort forged over decades by the Valleys Planning Council, there is much that other citizen-led groups can learn from this organization's experience. Important natural and cultural landscape features, open space, streams, drinking water supplies and other shared resources can be protected with minimal funding by an engaged and dedicated set of supporters.

The widely recognized and respected organization helps shape local land use and environmental laws and

Valleys Planning Council Location Map



The Valleys Planning Council territory covers 130 square miles in the north-west quadrant of Baltimore County, MD. The VPC territory lies outside the county's Urban Rural Demarcation Line or URDL, and includes the Piney Run Rural Legacy Area.

decisions by informing and mobilizing the public, utilizing local media coverage to spotlight particular issues and actions, and maintaining regular contact with elected officials and agency staff.

RESOURCE MANAGEMENT CHALLENGE

When the *Plan for the Valleys* was initiated in the early '60s, the VPC's territory was only about half the size it is today. The area was described in the *Plan* as follows:

Its 70 square miles and almost 45,000 acres contain great sweeping valleys, wooded ridges and plateaus, an intricate pattern of streams, farms, rural roads, and copses of trees. It is a beautiful inheritance, a serious responsibility, an area threatened, a challenge and opportunity.

Today, VPC's 130-square-mile territory extends further north to the Prettyboy Reservoir and includes portions of three major watersheds: Jones Falls, Loch Raven, and Pretttboy. The Jones

THE URBAN RURAL DEMARCATION LINE

Established in 1967, Baltimore County's growth boundary is called the Urban Rural Demarcation Line. Known locally as the URDL (rhymes with "girdle"), the boundary separates urban and rural areas. Areas inside the URDL are served by public water and sewer systems and have higher-density zoning. Areas outside the URDL rely on wells and septic systems and have low-density resource conservation zoning.

Baltimore County has no municipalities. Instead, the county's urban area is inside the URDL. The entire county is governed by the Baltimore County Council. The effectiveness of the URDL and the restrictive rural zoning is evidenced by the fact that 90% of the county's population lives within the URDL on 33% of the county's land area. The remaining 10% of the population lives outside the URDL on 67% of the land.

Falls and Loch Raven watersheds contain portions inside the URDL, and much of the development in these areas predates stormwater management regulations. The Prettyboy watershed remained more rural until recent decades when subdivision activity gained momentum. About 50% of the watershed is agricultural and nearly 40% is forested. All three watersheds contain "impaired" surface waters, meaning they have stream segments that fail to meet one or more federal water quality standards.

The VPC territory contains several stream segments that today qualify as high-quality, Tier II waters (See



An aerial view of a portion of the VPC territory along the Falls Road corridor illustrates the mix of large-lot residential, agricultural, and forest cover which typify the land uses in the valleys.

Land Management Features Map). There are 85 Tier II stream segments in Maryland. These stream segments exceed federal water quality standards and fall under an “antidegradation policy” that calls for greater protection from harmful impacts. Land preservation efforts in the valleys have undoubtedly contributed to the existence of these Tier II stream segments, and adequate protection is now a requirement.

Water quality is of particular concern in the Prettyboy and Loch Raven watersheds as they contain large reservoirs that, along with Liberty reservoir, supply the drinking water for 1.8 million people in Baltimore City and five surrounding counties. About another one million residents in the metropolitan area watersheds have wells and depend on groundwater supplies. Baltimore City owns the three reservoirs and operates the central regional water system, but it owns only about six percent of the watershed. The bulk of the reservoir watershed lands are in Baltimore and Carroll counties. Water quantity and quality is a resource of critical importance to the Valleys Planning

Council and many other groups working on land use, conservation, and environmental issues. Residents are concerned about the health of streams, reservoirs, and the Chesapeake Bay.

Protection of the prolific Cockeysville Marble Aquifer was identified as an important need in both the 1964 *Plan for the Valleys* and the 1989 *Supplement to the Plan for the Valleys*.³ It remains a key concern for VPC. Should the county ever have to supply its own public system of water, this aquifer would be the source, not to mention the many wells that already draw from it.

CONSERVATION VISION

The vision that united the supporters of the Valleys Planning Council was a plan that would spare the valleys from sprawl development and preserve farming, the rural landscape, and natural resources. It set the direction for a large area, which influenced the direction of the county and led to legislation, ordinances, and a strong focus on easements for the permanent preservation of agricultural and resource lands.

The *Plan for the Valleys (Plan)* was an ecology-based study and landscape plan that contained recommendations to create growth patterns that preserve water, forests, farmland, and other natural resources. The “Basic Amenity” map in the *Plan* focused on the valley floors and valley walls (areas of steep slope) of three valleys: Worthington, Caves, and Green Spring. The floors of the valleys were deemed to be most vulnerable due to the physiography, zoning at that time (one-acre lots), and land values. The *Plan* provided the foundation for limiting sprawl and retaining much of the natural, green infrastructure that makes the area both beautiful and productive. The *Plan* linked resource preservation and intelligent use of the landscape to an enhanced quality of life. The *Plan* helped inform and motivate a large constituency that has gained considerable recognition and influence.

The VPC leadership saw the need to curb sprawl by directing growth. The idea was to achieve an optimum land use that would accommodate growth but preserve the rural character and special resources of the area.

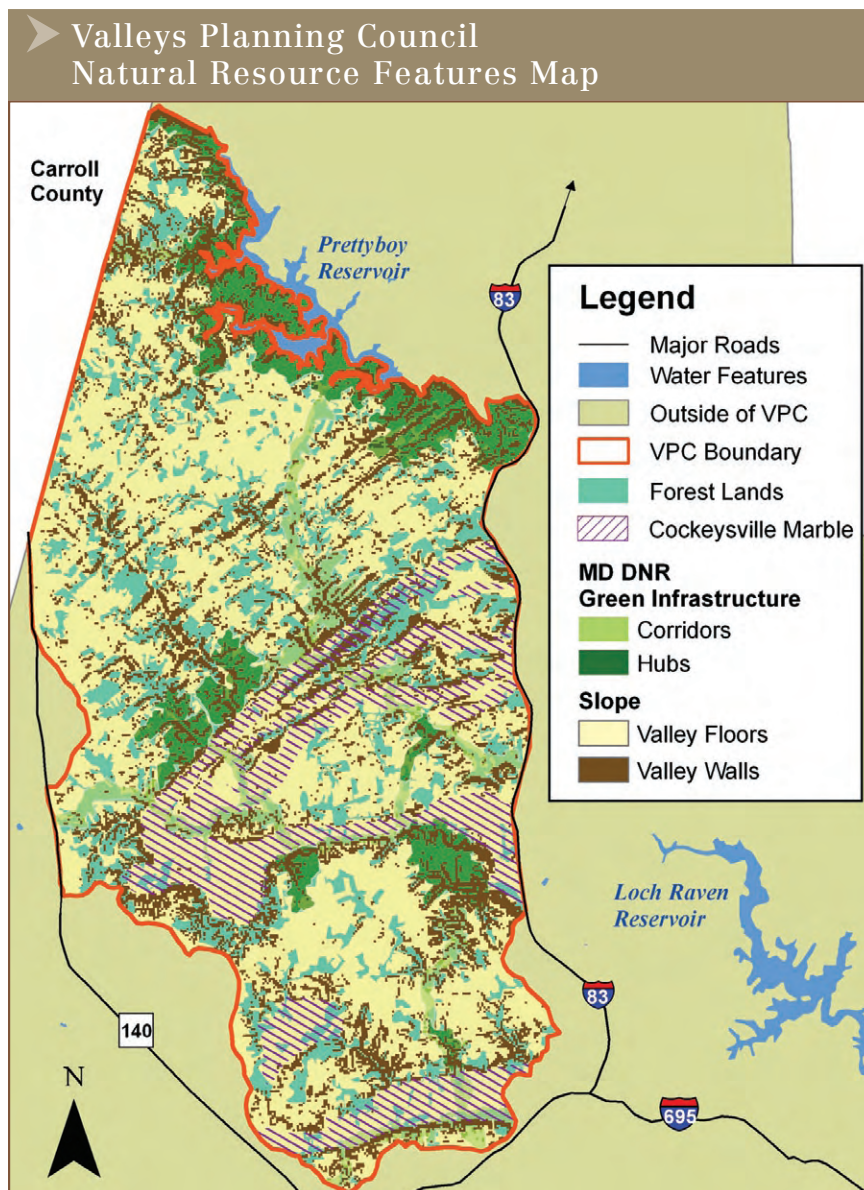


Preselecting areas to receive public water and sewer was a primary tenet of the plan. This was viewed as an effective barrier to growth. VPC also saw the need for conservation zoning that would preserve sufficient land to support farming, and VPC worked with farmers and others to get initial resource conservation zoning in place and later helped make incremental improvements. As a result, Baltimore County is among the leaders nationally in rural preservation and effective conservation zoning, and for a county in a metropolitan area, it has a high percentage of forest (34% of land cover).

The original plan called for several plateau areas to be more heavily developed and to be served by public water and sewer. This concept was later scaled back by the county's designation of the more restrictive URDL. At the time the *Plan* was developed, only three subdivisions out of a total of fifty-five were served by water and sewer, and five were served only by water. The URDL was established in time to prevent connections to outlying subdivisions, thereby limiting sprawl and encouraging development in existing service areas.

The growth boundary alone was not enough to control and direct growth.

directing growth away from prime and productive soils, steep slopes, and sensitive resource areas. A major focus of VPC's work in the early days was helping to create and apply effective resource conservation zoning. Although zoning is a temporary measure that can change over time, it is an important way to limit and direct development and has been a stable and effective tool in Baltimore County. Permanent protection through perpetual conservation easements is the best way to achieve land preservation, and VPC has worked continuously to create and support land trusts and to promote and defend easements.



IMPLEMENTATION RESOURCES

VPC currently operates on a modest annual budget of less than \$250,000. The budget covers basic operating expenses of maintaining an office and paying two full-time and one part-time staff persons. Additional funds for specific activities are raised on an as-needed basis. For example, in 2005 almost \$50,000 was raised to prepare a study and recommendations on Rural Road Design Standards. Funds were used to hire two transportation engineers to conduct the study. As a second example, between 2004 and 2009, over \$41,000 in individual contributions was raised to challenge the approval of a development plan for a major subdivision in a sensitive area.

Studies and development challenges like these are treated as "special projects" by the organization, and these funds are not included in the operating budget. Instead, funds are raised on an as-needed basis to pay for legal, stormwater, traffic, environmental and other experts who help challenge plan approvals or conduct targeted studies. Although the bulk of the funds for these actions are raised by individual contributions for a particular project, VPC occasionally



The Caves Valley is less than five miles outside the Baltimore Beltway. The valley floor overlays the Cockeysville Marble aquifer. The Caves Valley Land Trust has obtained conservation easements covering 75% of this 2,000-acre valley. In the '70s and '80s large subdivisions were proposed for this area, as well as changes to zoning that would allow greater density than RC2. The VPC successfully challenged those efforts and eventually worked out a compromise for a golf course on a portion of the valley floor. The VPC holds covenants with the golf course that restrict development and provide for monitoring of wells. In 2005, the VPC challenged another proposed development of a forested tract in the Caves Valley. VPC won that case and that property (49 acres) was put under easement in 2007, bringing the total easement acreage in the Caves Valley to 1,443.

receives grants from local foundations for this work.

VPC raises about \$200,000 each year in annual contributions from individuals. In 2008, five contributors gave at the highest level, which is \$5,000. That year, roughly 45% of the contributions to VPC's annual fund came from individual families who gave \$1,000 or more (the recommended amount for annual board member contributions). Like many non-profits, the category with the most contributors was for gifts between \$10 and \$149. The full spectrum of givers is needed to keep the organization viable.

Raising the annual operating budget is a year-round task for the staff.

VPC is fortunate to have many long-standing members who have been consistent supporters. However, there is always attrition, so new supporters are needed. Also, operating costs tend to gradually rise over the years, but contributors do not generally increase their annual giving amounts from year to year. Thus, it is not unusual for there to be a gap between operating income and operating expenses. To address this, the organization holds a special event in most years. Such events are significant time commitments for a small staff but a necessary element of solvency.

CONSERVATION STRATEGY

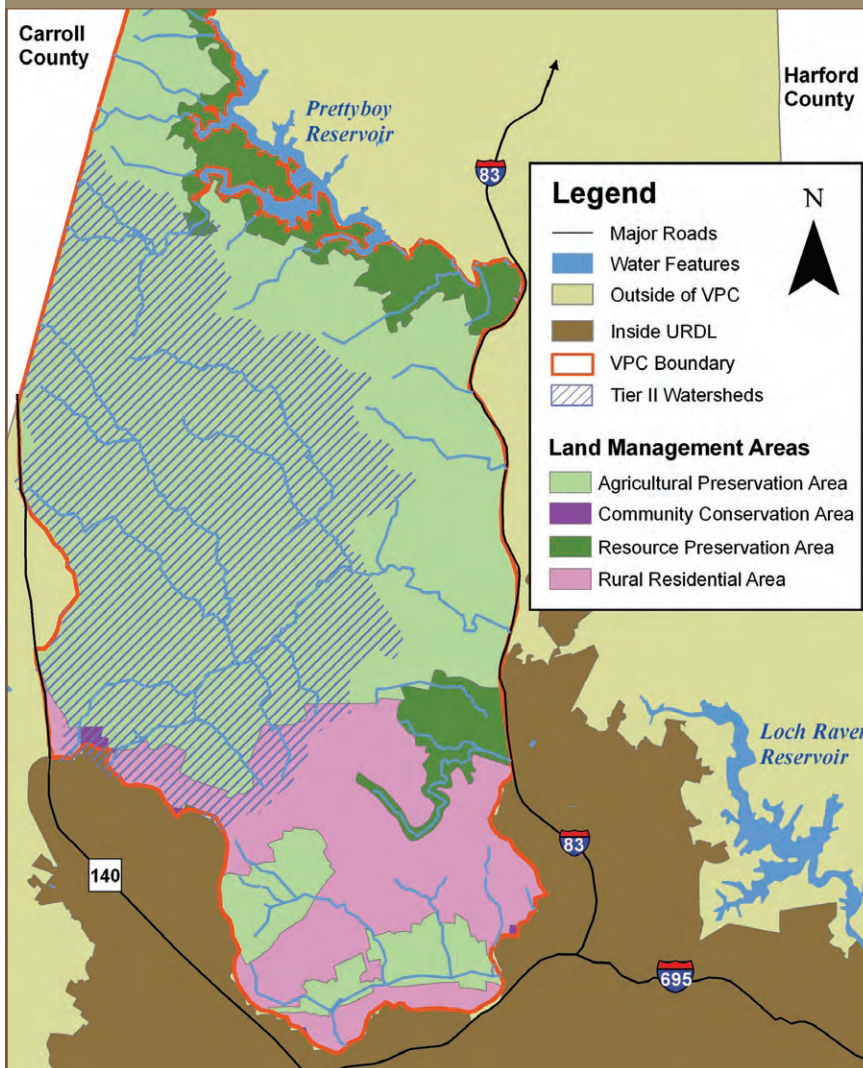
As a result of the *Plan for the Valleys* and subsequent actions by Baltimore

County and state government, many plans, policies and land use controls are now in place to ensure that basic conservation and development goals in the *Plan* are achieved or improved upon. The fundamental conservation strategy of VPC is to leverage and direct public land use and conservation policy to preserve farming and protect the resources and scenic beauty of the valleys.

Three operational principles guide the organization's day-to-day conservation strategies:

- Maintaining a group of informed and dedicated residents who use all available tools to promote resource conservation and manage growth in accordance with sound plans and policies.

Valleys Planning Council Land Management Features Map



- Monitoring and challenging inappropriate or inconsistent actions that would undermine sound land use policies and preservation programs and/or create harmful precedents.
- Initiating steps to create new or improved tools, such as zoning amendments, administrative policies, or regulations, when new threats are anticipated or a need for increased protection is realized.

The conservation and development tools available in Baltimore County may or may not be like those in other local jurisdictions in the Chesapeake region. However, it is important to realize that the strategy

of shaping these tools to meet local planning goals can be successfully implemented anywhere. These tools can generally be grouped into the following categories:

- Planning and Smart Growth
- Land Conservation
- Historic Preservation
- Zoning and Regulation
- Monitoring and Activism

The discussion below describes how the Valleys Planning Council works to promote conservation and to limit the impacts and intensity of development in the rural area.

PLANNING AND SMART GROWTH

The *Plan for the Valleys* was the study that galvanized the residents of northwest Baltimore County, gained the respect of county agencies and elected officials, and laid a foundation for moving in the direction of smart growth. It included concepts such as directing future growth to the most suitable areas (plateaus), limiting growth on valley floors, and preserving forested steep slopes. It recommended limiting growth by controlling the provision of public water and sewer. It presented the landscape as an interconnected system that is kept healthy by maintaining fully functioning ecological systems.

The cutting-edge ecological analysis and land use planning employed in the *Plan* laid the groundwork for the creation of Baltimore County's Resource Conservation zones, which the VPC vigorously supported and continues working to improve, defend, and support. The URDL was another early planning milestone instituted after the publication of the *Plan* and supported by the Council.

VPC supported the creation of the first Baltimore County Master Plan in 1972 and participates in all updates to the plan. The plan serves as the guide for development and conservation, and all county land use laws and policies must be consistent with the Master Plan. The Baltimore County Master Plan includes an acreage goal for land preservation (80,000 acres in a county that is roughly 383,000 acres in size), describes designated scenic roads and historic districts, and sets the framework for urban and rural growth, inside and outside the URDL. The Master Plan, referred to in many jurisdictions as the local comprehensive plan, can be a major asset to groups like VPC.

The State of Maryland has passed several important pieces of legislation that have helped move the counties in the direction of smart growth and resource protection. The state's growth management laws have been complemented with well-funded easement and open space programs. Concerns about the deteriorated condition of the Chesapeake Bay have led to many regulatory changes, most recently an overhaul of stormwater regulations and a new requirement for a Water Resources Element in local comprehensive plans. VPC supports state efforts like these, as they provide added tools to use at the local level and added oversight at the state level to ensure compliance.

LAND CONSERVATION

As recommended in the *Plan for the Valleys*, the VPC launched a local land trust in 1986, the Land Preservation Trust. In 1988, it helped create the Caves Valley Land Trust. Both orga-

nizations have been very successful in obtaining conservation easements. VPC does not hold any easements itself, but works closely with local land trusts and the state's Maryland Environmental Trust (MET) to help facilitate and enforce easements.

VPC takes every opportunity to support the county in its preservation activities, including encouraging continuation of state and local preservation funding programs and expansion of federal incentives for donated easements. VPC hosts informational meetings on the benefits of conservation easements for landowners, and supports a part-time staff person who assists interested residents in exploring their options. Information on easement programs and new easement properties are regularly featured in the VPC newsletter.

VPC also initiated the first Rural Legacy grant for the area and

provided the up-front administrative costs for the first several years. The Piney Run Rural Legacy Area is one of the most successful of the designated areas in Maryland and has been awarded over \$22 million since the program's inception. The Rural Legacy Program provides state funding for easements in designated large-block areas, designed to protect a critical mass of farmland.

Historic Preservation: The VPC supported the formation of several historic districts within its territory, and spearheaded the applications for the Greenspring Valley National Register Historic District in 1980 and the Caves Valley Historic District in 1988. Also, VPC is sometimes involved in promoting individual properties for the county's landmark list.

Historic designation of structures and areas can be a very useful tool. The VPC has used such designations effectively to prevent the erection

The VPC initiated the first Piney Run Rural Legacy Grant in 1998. The local Land Preservation Trust took over management of the rural legacy grants and has been successful in obtaining over \$22 million from that state program. Over 16,000 acres have been protected within the Piney Run Rural Legacy Area, a portion of which is shown in the photo below.



of unsightly cell towers, to oppose inappropriate development within a historic district, to support downzoning requests and oppose upzoning requests, and to save individual structures. Protecting a historic area or site generally protects associated land and resources that were not adequately protected by other regulations.

Zoning and Regulation: A primary tool used by the VPC and many other groups in the county is conservation zoning. Baltimore County initiated progressive changes to local zoning in 1975 when it created Resource Conservation (RC) zones. VPC's support of RC2 zoning in the early '70s was instrumental in its passage. This was perhaps the most restrictive zoning in the country at that time. Getting this conservation zoning in place for a large portion of the county allowed time for further planning, analysis, and creation of the finer-tuned tools

that followed and provided even greater protection.

The regulations for the RC2 zone evolved over time, starting out with a density of 0.2 or 20 houses per 100 acres. This was a hard-fought battle at the time, but it was soon realized that such density was not sufficient to protect farmland. The present-day RC2 allows a maximum of two lots on any parcels sized between 2 and 100 acres. As science and analysis tools progressed, more restrictive zones were created starting in 2000 with the RC6, RC7, and RC8 zones, which provide for greater protection of the most sensitive areas, also known as "green infrastructure."

An unusual aspect of Baltimore County zoning regulations is the quadrennial Comprehensive Zoning Map Process (CZMP). During the CZMP, any person or community association can request a change in zoning on

any piece of property, regardless of ownership. This process results in hundreds of requests for zoning changes in each four-year cycle. Due to proactive groups like VPC, most of the requests in the rural area of the county (which is 2/3 of the county) are for downzoning. Thousands of rural acres have been downzoned through issues raised during the CZMP cycles.

Baltimore County has many effective and progressive environmental regulations designed to protect streams, forests and other resources. The *Plan* pointed to the need to protect forests and streams and called for wide stream buffers. Today, Baltimore County has complex environmental regulations that address many of those early goals. Regulations and plans are so complex that when evaluating a proposed development plan, VPC must often hire its own expert to check calculations and measurements. VPC has won several notable development plan challenges by proving that a planned stormwater outfall was not suitable, that a planned stormwater pond was not of sufficient size, that an outfall would result in an unacceptable rise in temperature of a trout stream, or other issues related to stormwater management.

A lawyer is generally needed for such a challenge. In many cases, VPC also uses the services of the People's Counsel. This is a lawyer housed in the county Planning Office who reviews all zoning cases to ensure that the zoning code is properly upheld. Citizens and groups like VPC often work with the People's Counsel to challenge zoning decisions that appear to be flawed or based on an odd interpretation of the regulations. VPC has worked with the People's Council on numerous cases involving issues inside and outside the organization's territory, sometimes testifying on projects in other parts of the county

BALTIMORE COUNTY'S RESOURCE CONSERVATION ZONES (FOUR OF TEN RC ZONES ARE DESCRIBED.)

RC2, an agricultural protection zone, is designed to foster conditions favorable to a continued agricultural use of land with productive soils. Over 30% of the county is zoned RC2 which has a density of two lots for any parcels between 2 and 100 acres, with a minimum lot size of 1 acre.

RC6, a rural conservation and residential zone, is a relatively new and complicated zone designed to protect total ecosystem function of sensitive areas and foster creative site planning. The most sensitive portions of a given RC6 property are designated as Primary Conservancy Areas and afforded greater protection, and this area is netted out of the acreage used for the density calculation of 0.2 lots per acre (1 house per 5 acres). It also has a 10% impervious surface cap for most uses.

RC7, a resource preservation zone, was created to provide a true one lot per 50 acre zone. It has a density of 0.04 lots per acre for tracts > 50 acres. Tracts < 50 acres cannot be subdivided in this zone.

RC8, an environmental enhancement zone, is designed to protect forests, reservoir watersheds and extensive natural areas. Allowed density is 0.02 lots per acre (1 lot per 50 acres) for tracts ≥ 51 acres. One to three lots are allowed on tracts up to 50 acres in size, depending on the size of the parcel.



Baltimore County enjoys a healthy agriculture sector, in large part due to the actions that have preserved large blocks of farmland. Approximately 37 percent of the county is designated as Agricultural Preservation Area under the County's land management areas. There are over 53,000 acres of land under perpetual conservation easement. Baltimore County also has the state's largest equine population valued at over \$121 million.

that could set a bad precedent for a particular RC zone or other issue of concern countywide.

MONITORING AND ACTIVISM

VPC is known in the local community as "the eyes and ears of the valleys." VPC monitors and participates in activities affecting land use including development plans, comments on proposed changes to policies and regulations, testifies at public meetings, serves on planning committees, and stays in close touch with elected officials and county staff. Many citizens with an interest in such matters cannot keep abreast of complicated issues and often do not have the flexibility in their schedule to attend hearings or meetings. Having VPC track land use issues and provide concise updates to constituents keeps interested persons in the loop. They are also advised when direct action is needed and what kind of action is

likely to be effective. VPC provides information on signing petitions, letter-writing campaigns, attendance needed at public hearings, and sometimes suggests calls to elected officials. Sharing information has been greatly enhanced by the use of email and the website. A periodic newsletter and action alerts are also utilized.

VPC staff monitors all development proposals, development plan amendments, and water and sewer plan amendments submitted to the county and routinely comments on proposed projects within its territory. Staff also regularly attends review meetings, zoning commissioner hearings, planning board meetings, and county council sessions, expressing opinions and positions as appropriate.

SUMMARY

VPC is able to motivate citizen action through communications that describe the potential impacts to

their community, property, and future quality of life. VPC has found that local families willingly and generously support the organization knowing it is there to help sort out complex issues and provide practical solutions. Part of the continuing mission and conservation strategy of VPC is to push the county towards excellence in the areas of smart growth, land conservation, and watershed protection.

RESULTS

After more than 45 years at the helm of planning, outreach, education and advocacy work, the VPC has a long list of individual accomplishments. The organization has been part of a collective effort by many groups and public agencies to curb sprawl, preserve sensitive and productive lands, and accommodate reasonable growth. As a result of partnerships with the VPC, land trusts, and other local groups, and by conducting and





Control of the size of local roads was identified by VPC as an unaddressed component of Smart Growth that unwittingly accommodates sprawl development. In the absence of design standards for local roads, federal highway guidelines are typically substituted, resulting in inappropriately and unnecessarily wide roadways. VPC published a study and recommended rural road design standards in 2005. A version of those standards was adopted by Baltimore County in 2008. The goal of the standards is to maintain the rural character of the roads and to complement, rather than conflict with, local land use policies and preservation programs.

sharing extensive environmental analyses and studies, Baltimore County has become a leader in environmental planning and growth management. Collectively, this work has resulted in very effective preservation of rural lands, natural resources, and rural character.

The proof of VPC's effectiveness is best observed on the ground, seeing the large expanses of forests and open space that still exist in the valleys. Highlights of successful actions

taken over the years by VPC in the effort to preserve the valleys include:

- Published the *Plan for the Valleys*, an inspired ecology-based land use plan that laid the groundwork for the county's URDL, effective rural conservation zoning, variable buffer widths, protection of steep slopes, and other environmental and land use regulations.
- Recognized that road development and expansions were generally omitted from smart growth and

conservation planning, often resulting in road improvement proposals that would be counterproductive to the county's rural land use policies and goals. To address this the VPC fought many individual battles such as an early concept for an outer beltway; numerous proposed road, bridge and intersection improvements that were either dropped or significantly scaled back; and attempts to use land under conservation easements for expanding roadways and/or bridges. Ultimately, the VPC hired

engineers to develop rural road design standards which led to the County Council adopting standards in 2008.

- ▶ Maintained the integrity of the URDL by routinely opposing requests for water and sewer extensions in the planned non-service area.
- ▶ Took actions that helped preserve farmland and maintain a viable agricultural industry.
- ▶ Contributed to successful easement efforts by helping to create two local land trusts (Caves Valley Land Trust and the Land Preservation Trust), hosting easement workshops and events, and initiating the first application for the Piney Run Rural Legacy Area.
- ▶ Supported creation of several historic districts, preparing the successful applications for two districts (Greenspring Valley National Register Historic District and Caves Valley Historic District).
- ▶ Helped downzone hundreds of acres of rural lands by initiating and/or supporting issues filed during the Comprehensive Zoning Map Process.
- ▶ Prevented development of many sensitive areas by successfully challenging residential and institutional building proposals that would have had an adverse impact on natural resources; two recent illustrative cases prevented development of houses (18 on one site and 13 on another) on sensitive parcels that were instead purchased by conservation buyers.
- ▶ Preserved the rural and historic character of the valleys by supporting only well-camouflaged, stealth cell towers and opposing proposals for towers that intrude on the scenic landscape, and by enforcing sign ordinances, limiting outdoor lighting, and insisting on the least amount of guardrail possible along roadways.

- ▶ Assisted in enforcement of environmental and zoning regulations by reporting unpermitted actions and failures to adhere to laws and court decisions. Actions such as clearing trees; illegal grading or paving; unapproved withdrawals from or discharges to streams; and uses not permitted by zoning are routinely reported and challenged as appropriate.
- ▶ Limited future development of private institutions, commercial operations, and subdivisions by entering into restrictive covenants that set student caps, designate building envelopes, limit parking, require tree planting or other buffers, and other provisions to control the scale and design of large facilities and developments in the rural area.

KEYS TO SUCCESS

- ▶ Planning at the landscape level with a bold vision for the future has been a major catalyst to achieving results and has provided a foundation for sound regulation and policies.
- ▶ Taking action to achieve broader policy and regulation solutions, rather than participating in endless project-by-project battles, is efficient and effective and has the desired long-term effect.
- ▶ Using a combination of conservation zoning and conservation easements provides the tools for effective growth management and long-term land preservation.
- ▶ Maintaining the organizational structure of VPC with professional staff, a large board, and committed membership has assured deep-rooted community involvement and steady financial support.
- ▶ Maintaining a non-partisan status keeps a strict focus on land use issues.
- ▶ Fostering relationships and frequent contact with public agency staff and elected officials is

BALTIMORE COUNTY LAND USE AND LAND MANAGEMENT RESULTS

- ▶ 90% of the county's population lives inside the URDL on 1/3 of the county's land area and is serviced by public water and sewer;
- ▶ 10% of the county's population lives outside the URDL on 2/3 of the county's land area, utilizing wells and septic systems;
- ▶ Over 50,000 acres are protected under easement throughout the entire county;
- ▶ Baltimore County adopted Rural Road Design Standards in 2008, initially prepared and recommended by the VPC;
- ▶ Baltimore County has created an effective stream buffer regulation that requires a varying width of protection based on soils and slopes, with a minimum width of 75' on each bank, but in some cases may require 100-200' or more;
- ▶ Fifty-five miles of stream in Baltimore County have Tier II status (exceptional quality waters that must receive a higher standard of protection); 62 sites have known trout populations;
- ▶ Baltimore County has established a Forest Sustainability Committee, on which VPC participates, that is supporting new initiatives to protect and restore forested areas, prevent further fragmentation, and promote better management of forests.



essential to staying informed and providing timely input/action.

- Developing a stable of reliable, credible and affordable experts to help evaluate development plans and regulations helps the staff and board understand and address complicated issues and proposals.
- Ensuring that messages of concern from VPC are leveraged through cultivation of the media, local community groups, and others who can apply pressure helps build momentum when it is needed to affect outcomes.
- Establishing a willingness to stand united behind the basic principles of the landscape plan and using well-reasoned arguments creates a solid reputation that commands respect and consistently earns a seat at the table on important issues.
- Having a full-time, qualified staff creates a professional impression and provides a steady contact for both public agency staff and contributors.



Much of the VPC's work is evidenced by what has not occurred on the landscape. Due to the combination of early regional planning and the subsequent rural conservation zoning and easement programs, much of the valley walls and floors have been spared from development and remain in agricultural or forested land uses.

PHOTOS AND FIGURES

All photos by Valleys Planning Council
All figures by Burke Environmental Associates/The Conservation Fund

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Improving Codes and Ordinances

Building a Cleaner James River

The James River Association's watershed-wide analysis of local development codes and ordinances provides an effective solution for any organization seeking improved water quality and open space protection.

CASE STUDY SUMMARY

In recent years, many techniques and practices have been identified to reduce the impact of land development on streams and rivers while still meeting other social and economic goals. These environmentally sensitive development practices include minimizing impervious surfaces (pavement, rooftops, etc.) to reduce runoff, clustering development to preserve more open space, protecting riparian areas that act as natural filters, and directing stormwater to localized infiltration areas rather than channeling it directly to storm drains. Local codes and ordinances play a major role in determining the extent to which these techniques are applied; and it is the local codes and ordinances that have been identified as the greatest impediments to environmentally sensitive development.

In 2006-2007, the James River Association (JRA) conducted the first watershed-wide analysis of local development codes and ordinances in the nation. The analysis, called "Building a Cleaner James River," examined the development codes and ordinances of the 43 major counties and cities in the James River watershed for their ability to incorporate environmentally sensitive design

practices, known collectively as Better Site Design. The project was a unique joint effort of JRA and its project partners: Virginia Polytechnical Institute and State University (Virginia Tech), University of Virginia, Virginia Commonwealth University, and the Center for Watershed Protection.

JRA and its partners used model development principles to evaluate each locality's codes and ordinances, which were then given a percentage score based on their ability to support environmentally sensitive development. The scores ranged from a low of 17% to a high of 72% out of a possible 100%. A score below 80% indicated that significant opportunities exist to improve development rules. A score of less than 60% indicated that development codes are not environmentally friendly and in need of serious reform. The average score was 42%. Subsequently, JRA has worked with targeted, rapidly urbanizing jurisdictions to improve their scores and avoid future stormwater pollution.

The James River touches the lives of more Virginians than any other feature on the landscape; one-third of all Virginians make their homes in the 39 counties and 19 cities of its watershed. Development will largely

determine the future health of the James River and its continued role as a great asset to these communities. Therefore, local codes and ordinances that shape how development occurs are among the most important tools for protecting the river. It is imperative that obstacles to environmentally friendly development practices be removed and that incentives are established to reduce impervious surfaces and the associated stormwater runoff. There is only one opportunity to truly minimize the impacts of development. Once a site is developed, it is very difficult and very expensive to correct the associated watershed and water quality problems related to a given site. These factors make this profile and JRA's subsequent work to update codes and ordinances an important example for other communities in the Bay region.

RESOURCE MANAGEMENT CHALLENGE

The James River is Virginia's largest tributary to the Chesapeake Bay and its watershed encompasses approximately 10,000 square miles. After centuries of nurturing Virginians, the James River now needs nurturing in return.

Scientific studies show that the James River and its ecosystem have been fundamentally altered by human activity. More than 1,500 miles of the James River and its tributaries are listed on the U.S. Environmental Protection Agency's "dirty waters" list.¹ The impaired river recently scored 52%—a grade of C—on JRA's State of the James River.² Pollution in the form of nitrogen, phosphorus, and sediment is the greatest current threat to the James River and to the services and amenities it provides to the region. These pollutants cloud the water, blocking sunlight from vital underwater grasses, fouling critical aquatic habitat for fish, and fueling harmful algae growth that can become toxic to aquatic life and even humans. As harmful algae blooms die, the resulting decomposition consumes vast amounts of oxygen from the water, leaving little to support aquatic life.

Landmark water quality actions recently taken or underway by the Virginia General Assembly focus primarily on addressing pollution from sewage treatment plants and other point sources and on implementing agricultural pollution reduction practices. Point sources and agriculture make up the two largest sources of current pollution in the James River. Efforts to address these pollution sources can provide the most cost-effective approach to reduce current pollution loads. However, the fastest growing source of pollution and the greatest impact to urbanizing streams and creeks stems from development and its associated stormwater runoff.³ Additional efforts are needed to ensure that stormwater pollution from future development does not negate the progress made on reducing current sources of pollution.

Stormwater pollution from development, both during and after construction, can have devastat-

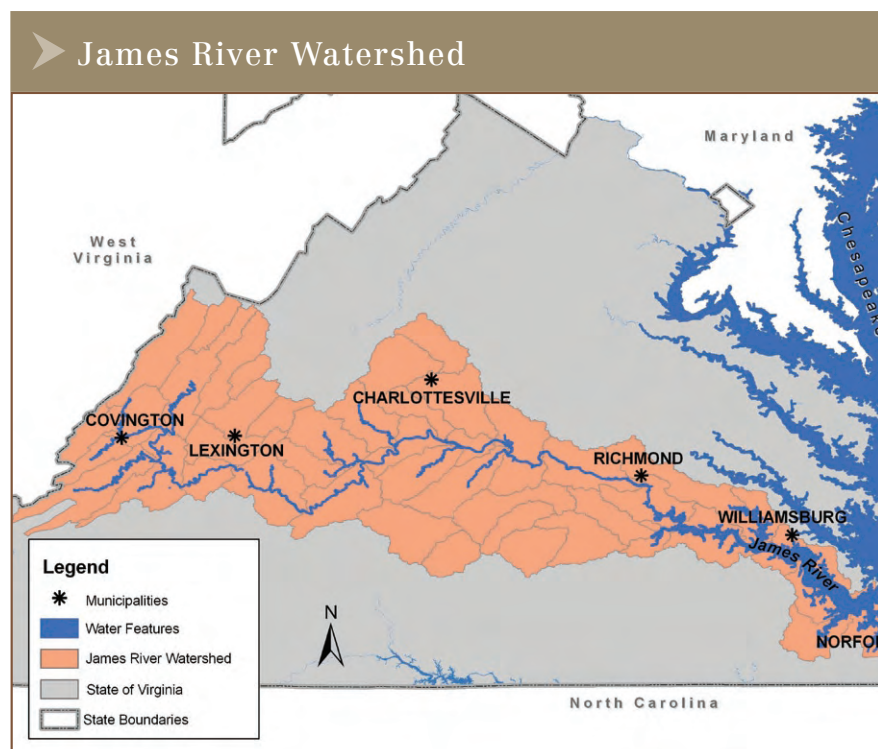
ing impacts to local streams and the James River. When land is cleared for development, increased erosion and sedimentation of downstream habitats results unless all necessary erosion and sediment control practices are installed properly and maintained vigilantly. After construction, development can continue to damage streams and the river by altering the natural hydrology to which the receiving stream is accustomed. The receiving stream's natural channel is overwhelmed by the increased volume and velocity of runoff, causing tremendous stream bank erosion and sending tons of pollution downstream. Better Site Design (BSD), including Low Impact Development (LID) practices, can protect natural areas, minimize land clearance, and maintain natural hydrology in order to protect local streams and rivers.

CONSERVATION VISION

The manner in which development occurs on the land is determined by a broad array of codes, ordinances, and regulations, most of them implement-

ed by the local government. Many of these local development rules are not specifically environmental regulations at all, but have a tremendous influence on the impact that development has on water quality. In recent years, an entire professional field has developed around the concept of LID. Local government codes and ordinances play a major role in determining the extent to which such techniques are applied (or accepted).

When local governments are not familiar with BSD or LID techniques and their codes and ordinances are antiquated, it can sometimes be more difficult to build environmentally sensitive developments. Developers who seek to implement low impact practices often find that the lack of clarity and adoption of environmentally friendly development standards results in extensive delays in project approval, thereby sending developers back to traditional, more damaging approaches that can be approved relatively quickly. Also, counties seeking to implement new environmentally sensitive ordinances may have codes



BETTER SITE DESIGN

The Center for Watershed Protection developed a process called Better Site Design (BSD), in which local governments review and modify local zoning codes and ordinances to permit new development practices that preserve more pervious areas and lessen environmental impacts. BSD incorporates the principles of Low Impact Development (LID) and Conservation Design.

BSD allows communities to continue to realize the economic benefits of new development while improving their ability to protect the local environment.⁴ At the core of the BSD process is a set of model development principles that focus on the design of streets, parking areas, and building lots in new developments. They are designed to be used as benchmarks for local government officials to investigate where existing codes and ordinances could be revised to reduce the impacts of development.

Studies in Maryland and Illinois indicate that new residential developments using BSD principles pertaining to stormwater saved \$3,500 to \$4,500 per lot when compared to new developments with conventional stormwater controls. In addition, each site discharges less stormwater runoff than conventional developments.⁵



A low impact development biofilter, built into parking lot landscape island.

that conflict with the new ordinances. The purpose of the JRA codes and ordinances analysis was to assess each locality on the degree to which local development codes protect water quality and to work with them to on possible improvements.

IMPLEMENTATION RESOURCES

Project funding totaled \$150,000 from federal, state, and private sources. These included the U.S. National Oceanic and Atmospheric Administration, Virginia Coastal Zone, Virginia Department of Conservation and Recreation,

and The Keith Campbell Foundation. An unofficial cost-effectiveness analysis was conducted for this study. To hire a consultant or firm to take on the hundreds of hours required to complete this project would have cost JRA upwards of \$500,000.

Costs associated with the project included stipends to the three universities (Virginia Tech, University of Virginia, Virginia Commonwealth University); JRA staff time and travel; planning and hosting a symposium to present the results; printing and distributing the final report; meeting with individual localities for in-depth review of codes that resulted in recommendations for new or modified code language. The majority of the research was conducted by graduate and undergraduate students at the three universities. While each school received a stipend for their time, the actual work was conducted by student volunteers and their professors. Technical assistance was also provided by the Center for Watershed Protection. Ongoing implementation of the model development principles is an essential part of JRA and its partners' continued efforts to restore the James River watershed.

CONSERVATION STRATEGY

In order to assess the degree to which BSD techniques are allowed or encouraged in local counties, JRA coordinated an analysis of the codes and ordinances for 43 cities and counties with major amounts of land within the James River watershed. This analysis was a significant first step in increasing awareness and understanding of these techniques and increasing their use. The second step was to approach the counties and suggest areas where they could make improvements to their codes and ordinances.





James Riverkeeper Chuck Frederickson explains the importance of land use decisions to Goochland County leaders.

The James River analysis represents the first comprehensive and systematic assessment conducted at a river-basin scale. Breaking ground once again, JRA tackled the project by forming a first-of-its-kind academic partnership with the University of Virginia, Virginia Commonwealth University, and Virginia Tech. Each participating university conducted one class in the 2006 spring semester that focused on analyses for approximately one-third of the 43 localities. Working with a professor or team of professors with expertise in watershed management or land use planning, each student or team of students analyzed a particular locality. To assist them in the analysis, contact was made with local planning officials to ensure the applicable codes and ordinances were identified.

Each class collected the data using worksheets provided by JRA and its partners. The worksheets included 28 BSD principles that addressed codes and ordinances, erosion control, and stormwater. The BSD principles were divided into four categories:

- 1. Residential Streets and Parking Lots** – The transportation network associated with development creates large amounts of paved, impervious surfaces that contribute to stormwater runoff and pollution. The impact of roads and parking lots on water quality can be reduced by minimizing their width and length, reducing the number of parking spaces required, avoiding curbs and gutters, and encouraging stormwater infiltration and treatment areas.
- 2. Lot Development** – The manner in which houses and buildings are

situated on lots can help reduce impervious surfaces and stormwater pollution. Clustering homes and buildings or reducing setbacks and frontages can minimize the road lengths needed to service them. Alternative designs for driveways and sidewalks can reduce impervious surfaces while still achieving pedestrian and parking needs. Stormwater runoff can also be reduced by directing rooftop runoff to landscape areas for infiltration rather than directly to storm drains.

- 3. Conservation of Natural Areas** – Retaining forests and meadows, particularly along streams and other water bodies, can reduce stormwater runoff and help filter out pollutants before they enter the waterbody.
- 4. Stormwater and Erosion Control** – In Virginia, local governments play an important role in prevent-

LOCALITY CLASSIFICATION

Urban Impacted localities show a decrease in population but still maintain a significant amount of existing or new development; in some cases, typically in cities, the locality is largely built-out.

Urbanizing Rapidly localities were the top population gainers between 2000 and 2004 with increases in population greater than 10% and/or they grew faster during the timeframe of 2000 to 2004 than 1990 to 2000.

Urbanizing localities exhibit a moderate level of existing development, but a relatively high level of development pressure.

Rural Unprotected localities typically have an agricultural economy and modest median income. They have experienced low to moderate development pressure to date and the land within the county is generally unprotected. Existing zoning often promotes sprawling development and in many cases there is potential development pressure from nearby metropolitan areas.

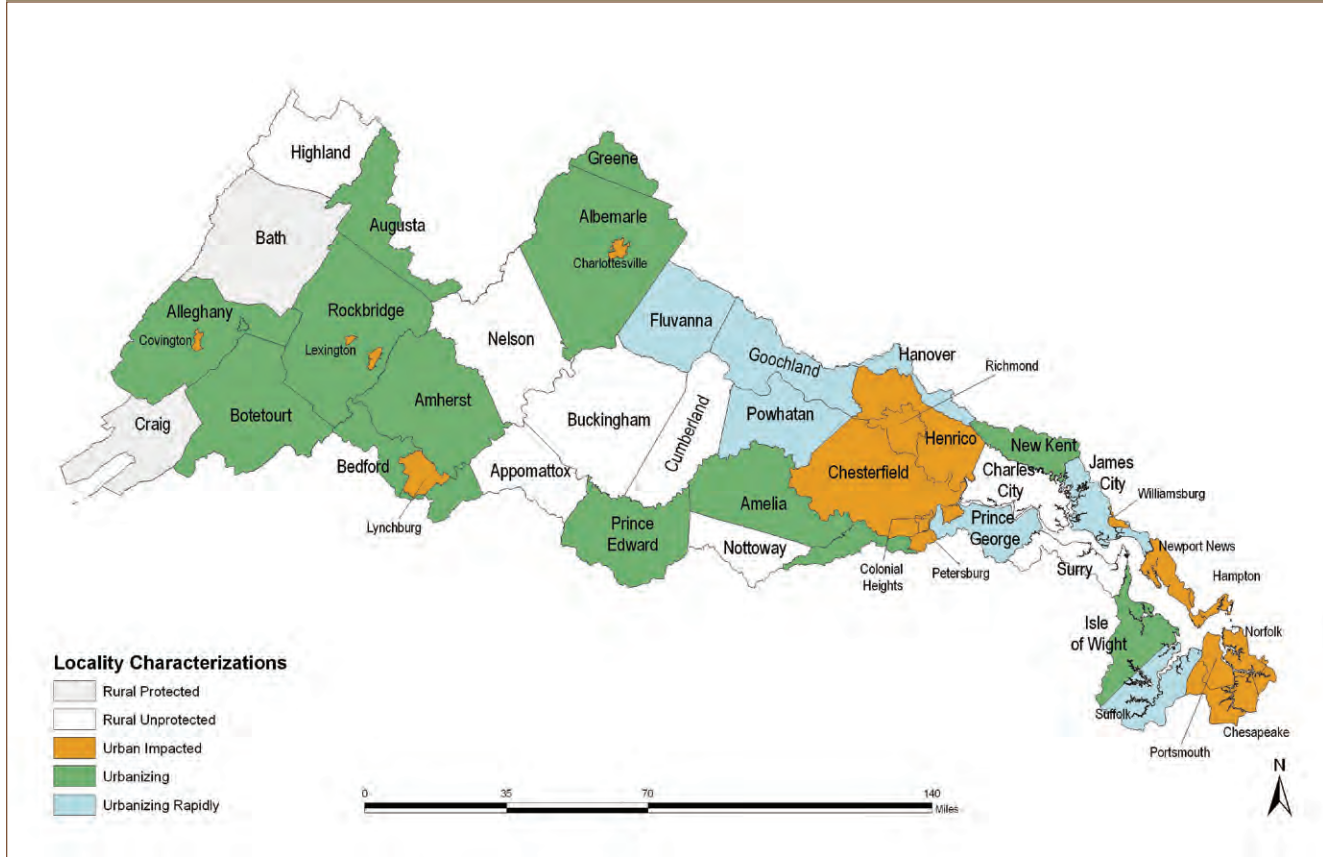
Rural Protected localities have relatively low development pressure and very limited local government resources to handle development issues. Population growth is projected to be minimal and a significant amount of acreage is already under some form of local, state, or federal protection.

ing pollution through stormwater management programs, erosion and sediment control, and septic regulation. Local governments also need to address sewage leaks and spills and ensure that development programs meet state and federal permit requirements for wetland and stream protection.

Each principle was scored and points were awarded on the worksheet. The overall score provides a general indication of the locality's ability to support environmentally sensitive development. The overall score is based on 120 possible points. The final score for each locality is generally based on the total points earned divided by the total points possible and multiplied by 100 to obtain a percentage. The overall scores can be seen below, under "Results."

Because the watershed localities are so varied in terms of need and

James River Watershed Locality Characterizations



Building a Cleaner James River Locality Scores		
Jurisdiction	Final Score	Category
Albermarle	65%	Urbanizing
Alleghany	42%	Urbanizing
Amelia	57%	Urbanizing
Amherst	38%	Urbanizing
Appomattox	19%	Rural Unprotected
Augusta	36%	Urbanizing
Bath	18%	Rural Protected
Bedford	24%	Urbanizing
Botetourt	41%	Urbanizing
Buckingham	15%	Rural Unprotected
Campbell	19%	Urbanizing
Charles City	60%	Rural Unprotected
Charlottesville	50%	Urban Impacted
Chesapeake	53%	Urban Impacted
Chesterfield	61%	Urban Impacted
Colonial Heights	43%	Urban Impacted
Craig	14%	Rural Protected
Cumberland	14%	Rural Unprotected
Fluvanna	40%	Urbanizing Rapidly
Goochland	44%	Urbanizing Rapidly
Greene	36%	Urbanizing
Hampton	60%	Urban Impacted
Hanover	60%	Urbanizing
Henrico	68%	Urban Impacted
Highland	28%	Rural Unprotected
Isle of Wight	63%	Urbanizing
James City	54%	Urbanizing Rapidly
Lexington	48%	Urban Impacted
Lynchburg	38%	Urban Impacted
Nelson	36%	Rural Unprotected
New Kent	36%	Urbanizing
Newport News	50%	Urban Impacted
Norfolk	67%	Urban Impacted
Nottoway	15%	Rural Unprotected
Petersburg	26%	Urban Impacted
Portsmouth	50%	Urban Impacted
Powhatan	31%	Urbanizing Rapidly
Prince Edward	18%	Urbanizing
Prince George	38%	Urbanizing Rapidly
Richmond	67%	Urban Impacted
Rockbridge	26%	Urbanizing
Suffolk	42%	Urbanizing Rapidly
Williamsburg	53%	Urban Impacted

capacity building, JRA separated the localities into categories to help with the analysis. These categories take into consideration population, growth pressure, land use, and potential or existing conservation lands. The five classifications derived from various data sources include: Urban Impacted, Urbanizing Rapidly, Urbanizing, Rural Unprotected, and Rural Protected.

Following the initial assessment and report of local codes and ordinances, JRA worked to improve development policies in targeted jurisdictions and collaborated with conservation partners to make policy improvements in additional jurisdictions.

JRA targeted the six “Urbanizing Rapidly” jurisdictions in the watershed. Of the five categories, JRA determined that these localities are at a critical stage of development. They have a history of low development pressure and, as a result, typically do not have codes in place to curb or prevent unnecessary impervious surfaces or promote BSD principles. Each Urbanizing Rapidly locality is under development pressure from adjacent urban areas. As the population and development demands increase, these local governments need to be ready to protect the watershed for both economic and environmental viability.

RESULTS

Study Results: The results for the 43 localities of the James River watershed are presented in the table at left.⁶ Key findings include the following:

- Scores ranged from 14% to 72%.
- Average watershed score was 42%.

Twenty-three of the 28 BSD principles were met by at least one locality.

- Incorporating the best codes from all of the localities would achieve a score of 95%.



View of the James River in Virginia.

- Rural localities generally scored lower because they have not had the need to address many of the principles; thus, they do not have certain codes in place.
- Changes to Virginia Department of Transportation standards can improve scores of every locality.

Staff and elected officials from each of the localities were provided with the results, which spurred a lot of discussion among and between local government officials as well as state, federal, and non-government organizations.

Policy Changes: With the implementation of the model development

principles, communities can see improvements in local conditions. Potential benefits to the natural environment, the economy, and the community at large include:

- Protection of water quality of local streams, lakes, and estuaries
- Reduced pollutant loads in stormwater
- Reduced erosion during construction
- Reduced development costs
- Increased property values
- Creation of more pedestrian-friendly neighborhoods

- Provision of open space for recreation
- Allowance for more sensible locations for stormwater facilities
- Protection of sensitive forests, wetlands, and habitats from clearing
- Increased local property tax revenues

In an effort to incorporate BSD principles into county codes and ordinances, JRA first worked with Goochland County. Goochland is a largely rural county that is on the western fringe of the Richmond metropolitan area. JRA and the county convened a roundtable with representatives from developers, architects, soil and water conservation districts, county planning commissions, and interested citizens. The roundtable reviewed the findings of the study and developed recommendations for improving county policies to encourage BSD principles and achieve at least 80% in the Building a Cleaner James River score. The county adopted the recommendations in the 2008 update of its comprehensive plan and is finalizing an associated riparian buffer ordinance.

JRA has initiated similar work with Powhatan County and Fluvanna County. In Fluvanna County, JRA has partnered with the Rivanna Conservation Society, which has a goal of

JRA's Bill Street facilitating a discussion at the Building a Cleaner James Symposium.





improving its five adjoining jurisdictions' environmental performance to a score of 90% or better. The Rivanna Conservation Society has worked with the Southern Environmental Law Center and the University of Virginia Environmental Law Clinic to formulate and introduce policy recommendations for the City of Charlottesville and Albermarle County. The Potomac Conservancy also has used the Building a Cleaner James River model to begin a strategic approach to improve development policies in the Potomac River basin.

To help localities that would like to improve their environmental performance and encourage conservation, JRA has assembled a Low Impact Development Policy Manual⁷ that provides examples of codes and ordinances, mostly from Virginia

jurisdictions, that meet the principles and criteria of the Building a Cleaner James River analysis. JRA has also used its experience and findings to help the Virginia Department of Conservation and Recreation to develop a similar scoring method for the Chesapeake Bay Preservation Act. Through this process, the Department will review the codes and ordinances of the 84 Virginia jurisdictions that are subject to the Preservation Act and ensure that performance standards are met.

PHOTOS AND FIGURES

All photos and figures by James River Association

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Earning Multiple Credits for a Forested Riparian Buffer

A Methodology for Reducing Pollution in Pennsylvania's Susquehanna Watershed

The Pennsylvania Environmental Council's process for capturing multiple credits for the reduction of nutrients, sediment, and carbon can be followed by private landowners and corporations to further conservation efforts and receive compensation through ecosystem services markets.

CASE STUDY SUMMARY

The Pennsylvania Environmental Council conducted this project to demonstrate the ways in which a landowner can receive credits and financial compensation for the multiple environmental services that can result from a single conservation practice. Environmental services are functions of the natural landscape that deliver benefits to humans and/or wildlife. They include ecosystem functions that clean the air and the water, reduce greenhouse gases, and provide wildlife habitat. Emerging markets allow landowners to receive credit for environmental services performed by their land; those credits can then be exchanged in the markets for financial compensation.

In this case, the Pennsylvania Environmental Council entered into a layered partnership to reforest a riparian buffer on agricultural land in the lower Susquehanna watershed. The planting, sponsored by Exelon Corporation, created a 1,100-foot forested buffer on farmland owned

by Lancaster General Health along an unnamed tributary to Little Conestoga Creek. The buffer is now under a 25-year conservation easement, and a series of private contracts ensures that any nutrient reduction or carbon sequestration credit resulting from the buffer is conveyed from Lancaster General Health to the Pennsylvania Environmental Council and in turn to the project's sponsor, Exelon Corporation, for the term of the easement. By quantifying the pollution reduction services provided by this new buffer, the landowner already qualifies for carbon sequestration credits with the U.S. Department of Energy; it was also designed to qualify for Pennsylvania's nutrient trading program in the future.

RESOURCE MANAGEMENT CHALLENGE

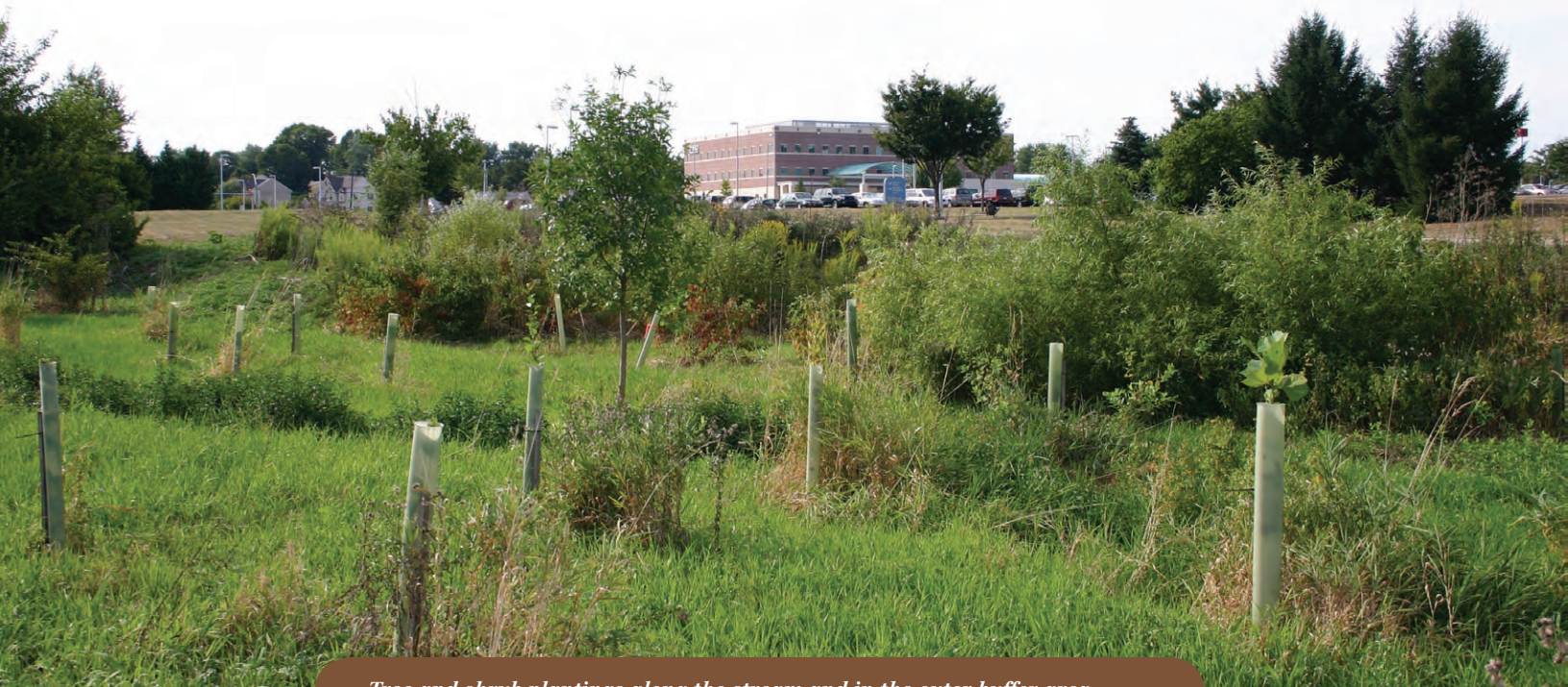
The lower Susquehanna sub-basin of the Chesapeake Bay watershed is one of the most intensively farmed regions of the United States. It is home to millions of livestock, hogs, chickens, and dairy cattle that gener-

ate a major portion of the nutrient load that flows from Pennsylvania into the Chesapeake Bay. This sub-basin contributes approximately 25% of all the nitrogen, phosphorous, and sediment delivered to the Bay, but only represents approximately 10% of the entire Bay watershed in Pennsylvania.

According to Pennsylvania's Chesapeake Bay Tributary Strategy, the eastern portion of the lower Susquehanna sub-basin delivered 19,260,000 pounds of nitrogen, 711,000 pounds of phosphorus, and 278,000 tons of sediment to the Bay watershed in 2002.¹ In order to meet the Chesapeake 2000 agreement goals by 2010, the area needs to reduce its total load of nitrogen, phosphorus, and sediment delivered to the Bay by approximately half of its 2002 load levels. This represents an enormous challenge that requires multiple actions to address point and nonpoint sources of nutrients and sediment.

The Pennsylvania Department of Environmental Protection developed





Tree and shrub plantings along the stream and in the outer buffer area.

its nutrient trading program as one of the key elements in the Tributary Strategy to help meet Bay Program goals. Since its inception in 2006, the program has resulted in five executed trades; trading may increase in the next few years as more municipalities become subject to strict nitrogen and phosphorus discharge limits and seek nutrient reduction credits to satisfy their permit requirements for the National Pollutant Discharge Elimination System.

Even with a robust nutrient trading program and significant expansion of cost-share programs for agricultural best management practices, regional leaders have publicly stated that Pennsylvania and other state partners in the Chesapeake Bay Program will not reach the goals of the Chesapeake 2000 agreement by 2010.² One way to further progress toward nitrogen-reduction goals is to encourage conservation practices on farms by helping landowners to take advantage of other environmental credits, such as those for carbon sequestration, that are generated coincidentally with standard agricultural conservation

practices like no-till farming and forested riparian buffers.

CONSERVATION VISION

For many years, conservation groups and economists have been exploring ways to develop markets for environmental services. The markets provide a framework for placing financial value on the environmental services provided by a given conservation practice; the landowner can then receive credits for the environmental services provided by his or her land, and trade those credits for financial compensation. The credits or payment might be offered as incentive for participating in a government conservation program, or they might be part of a trading program through which a business entity offsets the impact of its pollution with financial support for conservation practices at another location.

Several successful and liquid individual credit markets have developed over the last twenty years. The Acid Rain Program, administered by the U.S. Environmental Protection

Agency, uses a cap-and-trade system to reduce emissions of nitrogen and sulfur oxides from coal-fired power plants in the eastern United States. Across the nation, nutrient trading programs like the one in Pennsylvania encourage practices that reduce nutrient runoff from farms and other nonpoint sources.

Should the nutrient reduction and carbon sequestration credit markets evolve into lucrative and liquid markets, the conservation implications for agriculture in Pennsylvania's portion of the Bay watershed may be profound. The additional income that can be generated by implementing conservation practices on farms may significantly add to the landowner's bottom line while also improving air and water quality and promoting the continued viability of agriculture.

The aim of this particular project was to model the process in which landowners can capture multiple credits from these emerging markets by implementing a single conservation practice—the planting of a forested riparian buffer in an



agricultural setting. The Conestoga River Nutrient Trading Pilot Project and the Conestoga Multi-Credit Trading Framework Project helped inform the project design. While the planting of forested riparian buffers is an approved best management practice under the Pennsylvania nutrient trading program that can also generate carbon sequestration credits, there are unique challenges in the certification, verification, registration, and contractual transfer of those credits.

IMPLEMENTATION RESOURCES

The Pennsylvania Environmental Council received a \$61,800 grant from Exelon Corporation in 2006 to develop the methodology and implement a demonstration project in Lancaster County, Pennsylvania. Exelon Corporation sponsored the project because they were interested in learning how to participate in emerging nutrient and carbon credit markets within the Bay watershed. Representatives of the Little Conestoga Watershed Alliance helped find a suitable site for the demonstration project in the East Hempfield Township. The buffer was initially planted on September 22, 2007, with the support of more than 70 volunteers organized by the Little Conestoga Watershed Alliance. The volunteer planting crew included representatives of the following organizations: Exelon Corporation; Lancaster Country Day School; Lancaster General Health; Little Conestoga Watershed Alliance; local Cub Scout and Boy Scout troops; and Millersville University.

CONSERVATION STRATEGY

Site Search: In 2006, the Pennsylvania Environmental Council began working with Exelon Corporation to find a suitable project site in East Hempfield Township. They needed an on-the-ground project to formally develop and test a replicable methodology

CONESTOGA RIVER NUTRIENT TRADING PILOT PROJECT

The Pennsylvania Environmental Council launched the Conestoga River Nutrient Trading Pilot Project in 2000, with support from The Conservation Fund, the Chesapeake Bay Foundation CH2M HILL, Environmental Defense Fund, Lancaster County Conservation District, and Pennsylvania Department of Environmental Protection. The project proceeded on three fronts:

1. Statewide nutrient trading policy development;
2. Nutrient trading education and outreach in the Conestoga watershed; and
3. Execution of a demonstration nutrient trade resulting from a natural stream and floodplain restoration project.

This pilot project played a central role in the development of Pennsylvania's nutrient trading program. Project partners envisioned nutrient trading as a significant tool for reducing Pennsylvania's net loading of nutrients to impaired waters like the Conestoga River and the Chesapeake Bay.

The project also highlighted the additional conservation benefits that could arise from rewarding participants for practices that generate multiple environmental services, including improved water quality, groundwater recharge, flood control, carbon sequestration, wetland creation, and endangered species habitat restoration.

In 2003, Enterprising Environmental Solutions, Inc., a supporting organization of the Pennsylvania Environmental Council, worked with CH2M HILL to complete a multi-credit trading evaluation of the Conestoga River watershed in conjunction with the ongoing Conestoga River Nutrient Trading Pilot Project. Multi-credit trading involves trading pollution reduction credits across multiple environmental media, using watersheds as a basis for trade. This approach recognizes the ecosystem values of the watershed and provides multiple incentives for restoration and improvement of ecosystem functions.

for planting trees in a riparian area, calculating carbon and nutrient benefits, and transferring the credits between entities.

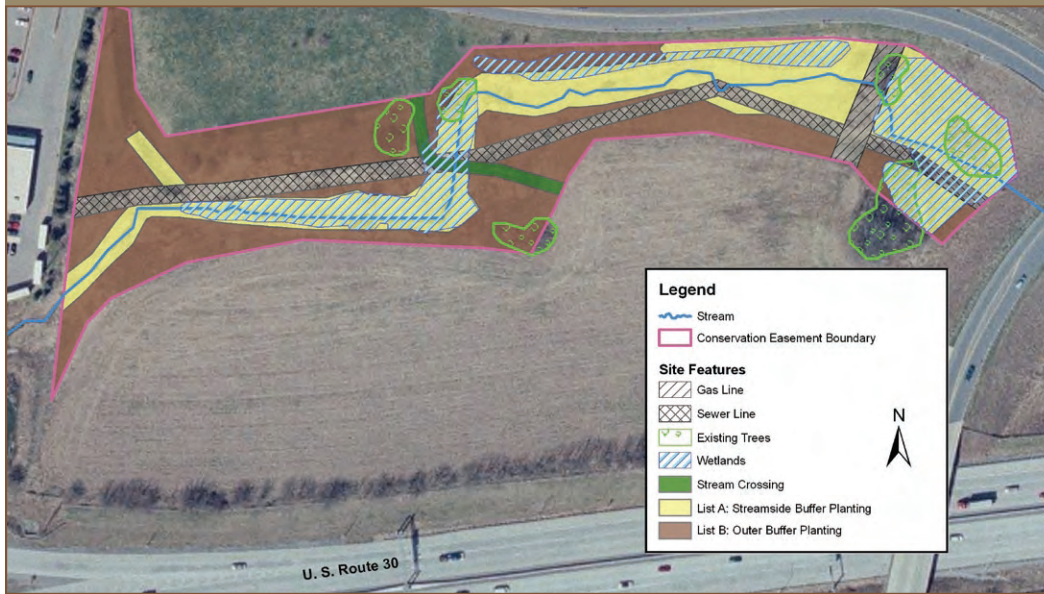
The partners began the search by contacting the Lancaster County Conservation District and local watershed groups. They were specifically looking for a site located directly adjacent to a stream and an agricultural field that had been deforested many years ago, so the buffer would filter nutrients running off the farm and sequester new carbon in the trees at the same time.

In the spring of 2007, representatives of the Little Conestoga Watershed

Alliance recommended a segment of an unnamed tributary of the Little Conestoga Creek, owned by Lancaster General Health, as the project site for the buffer installation and multi-credit trade. The southern border of the stream and the buffer site itself is adjacent to a six-acre field that is currently leased to a farmer and cultivated for soybeans during the crop year October 2007 to September 2008. The northern side of the stream consists of mixed shrubs, herbs, and grasses. The site also builds upon a forested buffer installed just upstream of the site in 2007.

Site Planting: In the fall of 2009, a team of 70 volunteers led by the

Lancaster General Health Campus Conservation and Nutrient Credit Easement



Pennsylvania Environmental Council, Exelon Corporation, Lancaster General Health, Little Conestoga Watershed Alliance, and Rettew Associates installed a forested riparian buffer at the Lancaster General site. Rettew Associates provided buffer design and surveying services for the project. The volunteers planted a diverse mix of 517 native trees and shrubs in a buffer measuring 1,100 feet long and 120 feet wide. Plants suitable for drier soils were selected for the outer buffer planting area. The Pennsylvania Environmental Council and Lancaster General Health reached a “Water Quality Trading and Carbon Sequestration Agreement,” which details watering and maintenance requirements to be followed by Lancaster General Health.

Project partners and a team of volunteers conducted a re-planting effort at the site in October 2008. Reforestation projects often require a re-planting effort due to natural environmental factors that kill plants, such as drought or disease. A subsequent inventory of the surviving trees and shrubs was conducted by Rettew Associates. The inventory data

was used for the carbon sequestration evaluation completed in December 2008.

The Pennsylvania Environmental Council hired expert consultants to help with the carbon and nutrient credit calculations and worked with the staff of the various partners involved to craft the credit agreement and easement language.

RESULTS

Multi-Credit Partner Agreements:

A private contract was developed in which the Pennsylvania Environmental Council receives credits for the annual nutrient and sediment reduction and carbon sequestration from the property owner, Lancaster General Health, for a duration of 25 years. A separate private contract was developed and signed, in which the Pennsylvania Environmental Council transferred title to those same credits to the project sponsor, Exelon Corporation. The buffer was also placed under a protection easement, in order to ensure its long-term survival and maintenance. Title to the buffer will be held for the 25-year term by the Lancaster County Conservancy, which

will also provide annual monitoring and enforcement services for the easement.

Carbon Sequestration Credits:

Environmental Resources Trust, a program of Winrock International (ERT-Winrock), estimated that the buffer will sequester approximately 8.84 metric tons of carbon per acre per year, or a total of 221 metric tons, for the first 25 years

after its installation—if growth occurs as expected. These estimates were based on the October 24, 2008, survey of surviving trees and shrubs and in accordance with the forest ecosystem carbon tables published by the U.S. Department of Energy’s 1605(b) program.³

The restored buffer area totaled 3.22 acres, with trees planted at approximately 15-foot intervals. The plantings were classified into three species groups: shrub, maple-beech-birch, and oak-hickory. Based on the species survey, an estimated 52.8% of the project area is expected to be occupied by trees in 2032, and the remainder is expected to be occupied by shrubs. Approximately 77.8% of the tree cover is expected to be maple-beech-birch, and 22.2% of the tree cover is expected to be oak-hickory. The Pennsylvania Environmental Council and ERT-Winrock used Department of Energy guidelines and field surveys to determine the carbon stock gain in metric tons of carbon dioxide equivalent per acre for each tree class. As a part of its “2020 Low Carbon Roadmap,”⁴ Exelon Corporation will register the



Expected Biomass Carbon Gain by Age 25

Class	Species	Metric Tons CO ₂ e/Acre	Source
Shrubs	Anything less than 20' tall at maturity	31.5	1605 (b) Forestry Table B2
Oak-hickory	Oak and ash trees	34.2	1605 (b) Forestry Table B3
Maple-beech-birch	Maple, shadbush, birch, hackberry, sweetgum, tulip poplar, sycamore, arrowwood, white pine, and blackhaw.	13.6	G. Smith field survey and calculation

*There is no reference carbon table for white pine for the northeast states; thus it is included in the maple class because it has low density wood similar to some of the species in that classification. **Calculations assume that shrubs achieve 1" diameter at 4.5' above the ground and a density of one stem per 2.25 square feet and a height of 10'.

carbon sequestration credits resulting from the buffer project on the Department of Energy's 1605(b) registry.

Nutrient and Sediment Reduction Credits:

The Pennsylvania Environmental Council and the World Resources Institute calculated nutrient and sediment reduction credits for the six-acre field after the installation of the adjoining 3.22 acre forest buffer and as a result of the no-till practices at the field. The farmer provided detailed information necessary for calculating nitrogen, phosphorus, and sediment reduction credits. Standardized Excel credit calculation spreadsheets, which are used by the Pennsylvania nutrient trading program⁵ and in accordance with the Pennsylvania State University Agronomy Guide,⁶ were used for the

calculation. Nutrient credit calculations are based on the crop in current production. The table presented here details the various factors involved in these calculations.

The Pennsylvania Environmental Council has determined that the project is not expected to generate significant nutrient or sediment credits this year because the farmer applied more nitrogen fertilizer than the Pennsylvania nutrient trading program recommends. Importantly, the field retains approximately 50 pounds of nitrogen per acre as a result of the soybean (legume) crop in the prior year, which the credit calculation spreadsheets take into account. In the spring of 2008, the farmer applied 160 pounds of nitrogen fertilizer per

acre. Exelon and the Pennsylvania Environmental Council are examining how future nutrient and sediment credits resulting from the project can be registered on the Pennsylvania nutrient trading system.

ADDENDUM: LESSONS LEARNED

In August of 2009, the authors were informed that the Lancaster County Commissioners had decided to build a new 10,000 square foot county morgue and crime laboratory on two acres of the six acre field owned by Lancaster General Health.⁷ The site was determined to be centrally located, easily accessible and is not near any residential areas. This information came as a surprise to the Pennsylvania Environmental Council. In their efforts to create a multi-credit forest riparian buffer methodology, the Pennsylvania Environmental Council was unable to secure an easement on the agricultural field that is designated for nutrient and sediment credits. The crime lab and morgue is expected to be developed by 2011 or 2012.

Pennsylvania Environmental Council, Lancaster County Conservancy, Little Conestoga Watershed Alliance and the Lancaster County Conservation District are working with the County and Lancaster General Health to encourage good watershed stewardship moving forward. They have asked Lancaster General Health to abide

Nutrient Credit Calculation Factors for the Six-Acre Farm

Credit Calculation Factor	Data Input
Primary crop/crop rotation used	Soybeans
Yield for soybeans crop	40-50 bu/ac
Total acreage of cropping field	6+ ac
Average Mehlich-3 P test results for cropping field	45 ppm
RUSLE 2 soil loss value for soybean field	1 ton/ac/yr
Current tillage method	No-Till
Planned N applied from commercial fertilizer	160 lbs/ac/yr
PSU Agronomy Guide recommended rate	150 lbs/acre/yr
Residual nitrogen from soybean crop harvested in 2007	50 lbs/acre
Frequency of previous manure application	Assumed none in last decade
Planned P applied from commercial fertilizer	20 lbs/ac/yr

by the easement provisions for the planted buffer and replace any trees lost due to the development of the right-of-way to the property. They are also encouraging the County and Lancaster General Health to use Low Impact Development techniques to ensure a zero net discharge of storm-water runoff from the development.

KEYS TO SUCCESS

- **Leadership:** The vision and leadership of all of the project partners was vital to developing the methodology, which can now be used in future projects.
- **Funding:** The project was made possible by generous financial support of Exelon Corporation and by volunteer assistance with the planting and re-planting efforts led by the Little Conestoga Watershed Alliance.
- **Permanent Conservation Easements:** The project's major achilles heel was its failure to put a permanent conservation easement on the farm field that was supposed to generate the nutrient and sediment credits. Future projects should ensure that vital lands associated with the multi-credit framework are protected from development.
- **Partners:** The partners brought a wide spectrum of expertise essential to the success of the project. The Little Conestoga Watershed Alliance assisted with the selection of the site as well as the organizing of volunteers for two buffer plantings. ERT-Winrock and the World Resources Institute, experts in

carbon sequestration measurement and nutrient trading policy and metrics respectively, determined the value of the environmental credits. ERT-Winrock also provided design services for the riparian restoration project. The Lancaster County Conservancy played a key role by holding title to the riparian forest buffer protection easement and providing annual easement monitoring and enforcement services.

- **Communication:** Exelon and the Pennsylvania Environmental Council coordinated a communications strategy that included press releases issued by the respective organizations and outreach to local and state media outlets. The Little Conestoga Watershed Alliance contacted a broad network of watershed volunteers to staff the original planting and the secondary re-planting efforts.
- **Volunteers:** The buffer planting and re-planting efforts would not have been possible without the 70-plus volunteers organized by the Little Conestoga Watershed Alliance.

PHOTO AND FIGURE CREDITS

Page 195: Photo, David Burke

Page 196: Photo, Pennsylvania Environmental Council

Page 198: Figure, Burke Environmental Associates/The Conservation Fund, using Google Earth image

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Converting Poultry Manure from Waste to Resource

Using Manure and Paper Mill Waste to Reclaim Abandoned Mine Lands in Pennsylvania

Scientists and conservationists worked together to develop an abandoned mine land reclamation methodology that simultaneously uses waste materials to revitalize the soil, produce biomass, and solve nutrient management challenges.

CASE STUDY SUMMARY

The Pennsylvania Environmental Council and Pennsylvania State University have developed an innovative watershed protection methodology that uses poultry manure and paper mill sludge to amend the soil of abandoned mine lands and then cultivates biomass on those lands for the production of renewable energy. As a result, nutrient pollution is reduced from poultry operations and unproductive mined lands are converted into productive working lands that support the nation's need for green energy.

Laboratory and greenhouse-scale research on the reclamation methodology was initiated in 2004. Field-scale research and test plots were planted in Schuylkill County, Pennsylvania, in 2006 and are ongoing. Two larger demonstration projects of 13 and 7 acres were planted in Clearfield County in September 2008, and an additional 10-acre demonstration area was planted in the spring of 2009.

The reclamation methodology can be applied to any coal mining

region in the eastern United States located near significant sources of excess poultry manure. Other animal manures and high-carbon, low-nitrogen waste streams such as yard waste, sawdust, and agricultural residues can be used as substitute soil amendments for mine reclamation.

RESOURCE MANAGEMENT CHALLENGE

This methodology offers a new environmental and watershed management tool that addresses three critical conservation problems: the reduction of nutrient pollution from livestock operations, the reclamation of nutrient-deficient lands degraded by historic and current mining activities, and the reduction of greenhouse gases from fossil fuel combustion.

Pennsylvania faces several environmental challenges related to intensive livestock agriculture. Foremost among them is the overloading of nutrient runoff (nitrogen and phosphorous) from livestock operations in the rich agricultural regions located in the Chesapeake Bay watershed. Consequently, many of the streams in

Pennsylvania are on the Environmental Protection Agency's 303(d) list as impaired by nutrients and sediment. The Susquehanna River basin, much of which is located in Pennsylvania, is also the largest source of nutrients for the Chesapeake Bay. Pennsylvania's 2004 Chesapeake Bay Tributary Strategy calls for reductions of 37 million pounds of nitrogen per year and 1.1 million pounds of phosphorous per year from its portion of the Bay watershed.¹ This will require a reduction in the application of manures to Pennsylvania farmland.

Pennsylvania also has approximately 180,000 acres of abandoned mine land (AML) that affect water quality by generating acid runoff and discharges.² AML is located primarily in the western bituminous region of Pennsylvania, and a lesser amount is found in the anthracite region in central eastern Pennsylvania. Approximately 4,600 stream miles in Pennsylvania are impacted by acid mine drainage,³ and many of those streams are listed as impaired by low pH and metals due to acid mine drainage and runoff.



A Schuylkill County, Pennsylvania, reclamation site showing an abandoned mine area (above), and a reclaimed segment (next page).

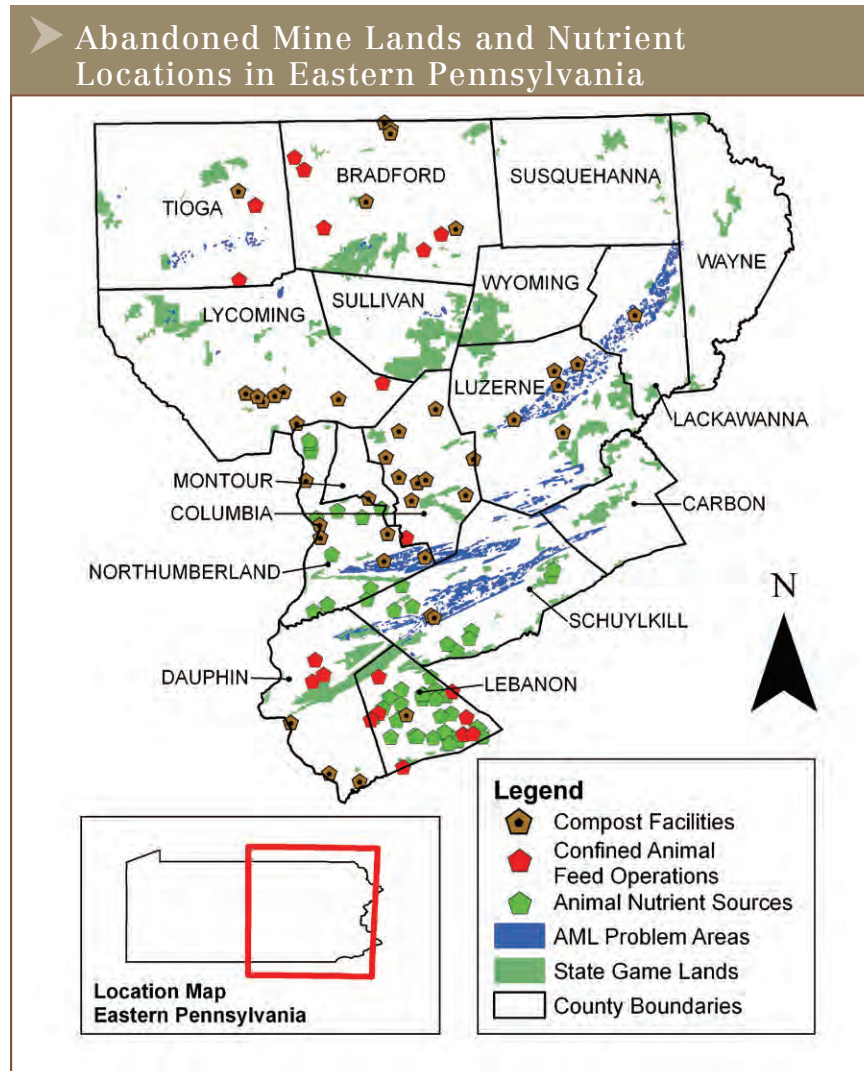
Reclamation of these 180,000 acres is needed to reduce the sources of acid mine drainage impairing Pennsylvania waters. Pennsylvania has received \$1.4 billion in federal funding for AML restoration, but some officials estimate the problem will cost \$10 to \$15 billion to address.⁴

Restoring healthy productive soils to abandoned surface mines can play an important role in this effort by effectively reducing acidic surface and subsurface runoff and drainage

from those reclaimed mines—the methodology outlined in this case study not only achieves this goal, but can be used at operating surface coal mines as well. At an application rate of 35 tons per acre, the potential for exporting manure from nutrient-impaired regions represents a significant watershed management tool for relieving stressed watersheds of their excessive nutrient load and putting those nutrients to work in locations when they are needed.

According to the U.S. Department of Energy, Pennsylvania ranks third in the United States for greenhouse gas emissions and contributes approximately 1% of total global greenhouse gas emissions.⁵ Pennsylvania’s government recently passed legislation to develop a climate change action plan, and the state is actively promoting the development of domestic renewable sources of energy to displace the use of fossil fuels for heat, power, and transportation. Pennsylvania forests, mine lands, and farms can provide a significant source of renewable biomass energy for the production of heat, power, and liquid transportation fuels. All energy generated from renewable biomass is considered to have a carbon-neutral effect, provided that all harvested biomass is regenerated on the same acreage that was originally harvested. If cultivated on a wide scale, biomass can significantly reduce the state’s carbon footprint.

Paper mill waste, typically disposed in landfills, is an underused resource. Scientists have demonstrated that the organic carbon content of such waste can have a beneficial effect on soil properties and thus on crop production.^{6,7} Numerous studies have found that mill waste has the capability to increase the carbon content of soils, improve the structural stability of soils and their water-holding capacity, and potentially increase the productivity of farmland.^{8,9,10,11} The main components of this waste sludge are short fiber cellulose (which is unsuitable for paper manufacture), along with clay and lime. The region’s paper mills usually dispose of their waste sludge in a landfill, paying both the cost of





transportation to the landfill and a disposal or tipping fee. Converting the sludge into a useful by-product is an attractive alternative.

CONSERVATION VISION

The widespread application of this reclamation methodology can benefit both the sending and receiving watersheds. Transporting manure out of nutrient-dense watersheds will improve both soil and water resources by reducing application of excess nutrients to farmland. In the receiving watersheds, the use and sequestration of the nutrients for mine reclamation will improve water resources by stabilizing soil, reducing erosion, and potentially reducing acid mine drainage. Overall soil quality and productivity of mined lands will be improved and returned to productive use. This project also turns paper mill waste into a useful by-product and enhances atmospheric resources by increasing carbon sequestration in mine spoils and by producing crops for bioenergy.

Initial laboratory and greenhouse-scale investigations determined that poultry manure is a highly effective nutrient source for soil augmentation of AML sites and that paper mill sludge provides organic carbon needed to sequester manure nutrients in the minesoil. These studies, combined with field-scale research, have focused on developing the ideal mixture, application, and cultivation of soil amendments and mine spoil material to maximize biomass production and plant nutrient uptake and to minimize nutrient runoff and leachate.

In 2006, a field-scale research project was launched in Schuylkill

County to refine the methodology. In the summer of 2008, a 20-acre demonstration project was launched at two active mining sites in Clearfield County, and an additional 10 acres was reclaimed in the spring of 2009. The Clearfield demonstration project will provide an opportunity to further evaluate the economics and commercial viability of the reclamation and biomass production methodology.

Working in conjunction with the Pennsylvania State University, Eastern Pennsylvania Coalition for the Reclamation of Abandoned Mines, Pennsylvania Foundation for Watersheds, Chesapeake Bay Foundation Capital Area Resource, Conservation and Development Program, and other partners, the Pennsylvania Environmental Council determined that there are a large number of agricultural operations in a sixteen-county region of central Pennsylvania within close proximity to abandoned mine lands in need of soil augmentation. This indicates at least one geographic area that could significantly benefit from the proposed methodology.

IMPLEMENTATION RESOURCES

In 2004, the Pennsylvania Environmental Council received funding from the Pennsylvania Department of Agriculture to investigate the use of composted poultry manure and mill sludge waste for soil augmentation on AML. Subsequent grants were provided by the U.S. Department of Agriculture, Pennsylvania Conservation Commission, Pennsylvania Department of Agriculture, and Foundation for Pennsylvania Watersheds.

Most of the initial costs of developing the methodology have been associated with primary scientific research

on the methodology for applying raw manure mixed with paper mill sludge and composted manure as soil amendments for the production of switchgrass. Other major costs have been project management and administration, grass seed, transportation, materials, and site reclamation activities (mixing, spreading, and seeding).

The Pennsylvania State University's Department of Crop and Soil Science played the lead role in developing and refining the reclamation methodology. The Eastern Pennsylvania Coalition for Abandoned Mine Reclamation provided assistance by developing GIS layers of abandoned mine lands and large sources of poultry manure in a 16-county region of central Pennsylvania.

The Coalition and the Pennsylvania Department of Environmental Protection Office of Surface Mining also helped to identify candidate sites for the demonstration projects in Clearfield County. The Chesapeake Bay Foundation coordinated and funded the delivery of 1,100 tons of composted manure to mine sites in Clearfield County.

CONSERVATION STRATEGY

The Pennsylvania Environmental Council's overall strategy for this project was to 1) conduct the necessary research, 2) demonstrate the environmental benefits, and 3) set new empirical standards that will allow its widespread use in the economy. The following narrative describes these strategies and the various agronomic and environmental issues associated with the techniques developed through this project.

A Schuylkill County, Pennsylvania, reclamation site showing a reclaimed segment (above), and reclamation in process (next page).

Methodology Development Costs						
Grass Seed						
Seed Type	Lb./Acre					
Switchgrass	8					
Big bluestem	8					
Atlantic coastal panic grass	8					
Birdsfoot trefoil	8					
Showy tick trefoil	8					
Transportation						
Material	\$/Ton	Distance Hauled	\$/Ton/Mile	Coal Backhaul	Appl. Rate: Tons/Acre	\$/Trailer Load
Raw manure	\$35	150 mi.	\$0.23	Yes	35	\$427 (12.2 tons/load)
Paper mill sludge*		30 mi.			108	
Composted manure**	\$31.67	190 mi.	\$0.17	No	65	\$875 (28 tons/load)
Materials						
Material	\$/Ton				Appl. Rate: Tons/Acre	Cost Per Acre
Composted manure	\$24				65	\$1,560**
Paper mill sludge	\$0*				108	\$0
Raw manure	\$0				35	\$64
Reclamation						
Task		Tons/Acre			\$/Ton	\$/Acre
Raw manure mixing and spreading		35			\$22	\$770
Paper mill sludge mixing and spreading*		108			0	0
Composted manure mixing and spreading		65			\$15	\$975
Seeding		8 lbs.			\$4.75 - \$36	\$150

* Paper mill sludge delivery, mixing and spreading costs paid for by mine operator.

** Composted manure delivered and provided at no charge to project.

Strategy 1 - Conduct research required to determine AML reclamation standards:

Research has demonstrated that organic amendments such as sewage sludge, paper mill sludge, and compost are highly effective for re-vegetation of mine spoil materials, due mainly to the addition of organic carbon.^{12,13,14,15,16} But a problem with the use of

sewage sludge or manure is that these materials have low carbon-to-nitrogen (C:N) ratios (often below 10:1). Thus, application rates intended to achieve desired levels of organic C input result in N application well in excess of the amount that the newly established vegetation can take up and also in excess of the amount that can be retained in the developing

soil organic matter. This can lead to significant N loss, primarily due to nitrate leaching.^{17,18} Stehouwer et al. (2006) measured nutrient concentrations in percolate water collected at a one-meter depth for two years following the application of biosolids for mine reclamation and found that more than 40% of the total N applied in biosolids was lost by leaching—

Critical Elements and Compounds at Work in the Reclamation Methodology

Nitrogen (N)	A critical element for plant growth. Plants can utilize nitrogen when it is in the form of ammonium or nitrate. Almost all nitrogen in soils is organic nitrogen and is part of the soil organic matter. Before plants can utilize this nitrogen, microbes in the soil must convert it into ammonium and nitrate.
Nitrate (NO ₃ -)	A form of nitrogen that plants can use for growth. Bacteria in soils convert ammonium to nitrate. Its negative charge means that it is very weakly retained in soils and can easily be transported to waterways.
Ammonium (NH ₄ +)	A form of nitrogen that plants can use for growth. It is not a gas, nor is it volatile. Its positive charge means that it is held in soils and not easily transported to nearby waterways.
Ammonia (NH ₃)	A volatile gas at normal atmospheric pressure and temperature. Some manure contains a significant amount of ammonia which can escape to the atmosphere if the manure is left on the soil surface. However ammonia is very soluble in water and in the soil environment, and it is rapidly converted to NH ₄ + (ammonium).
Carbon (C)	An essential element for life. In photosynthesis, plants convert carbon dioxide in the atmosphere into organic carbon compounds that build the plant and provide energy for organisms (animals and humans) that consume the plant material. This organic carbon also provides energy to soil microbes that decompose plant residues, recycle the nutrients, and build soil organic matter.

mostly of nitrate (NO₃-) and some of ammonium (NH₄+).¹⁹ Nitrate leaching would also be expected with direct application of manure for mine reclamation.

Composting presents a solution to this problem by combining manures with materials that have a high C:N ratio. This increases the overall C:N ratio, stabilizing the organic fraction and reducing mineralization rates.^{20,21} Stehouwer and Macneal (2002) utilized compost for remediation of incinerated soil at a field rate equivalent of 100 tons/acre.²² Initial leachate NO₃- reached 80 mg N/L but decreased to less than 1 mg N/L in subsequent leachings. In a greenhouse experiment, composting poultry layer manure was found to effectively eliminate N loss by leaching²³ while significantly increasing switchgrass growth on minespoil material.

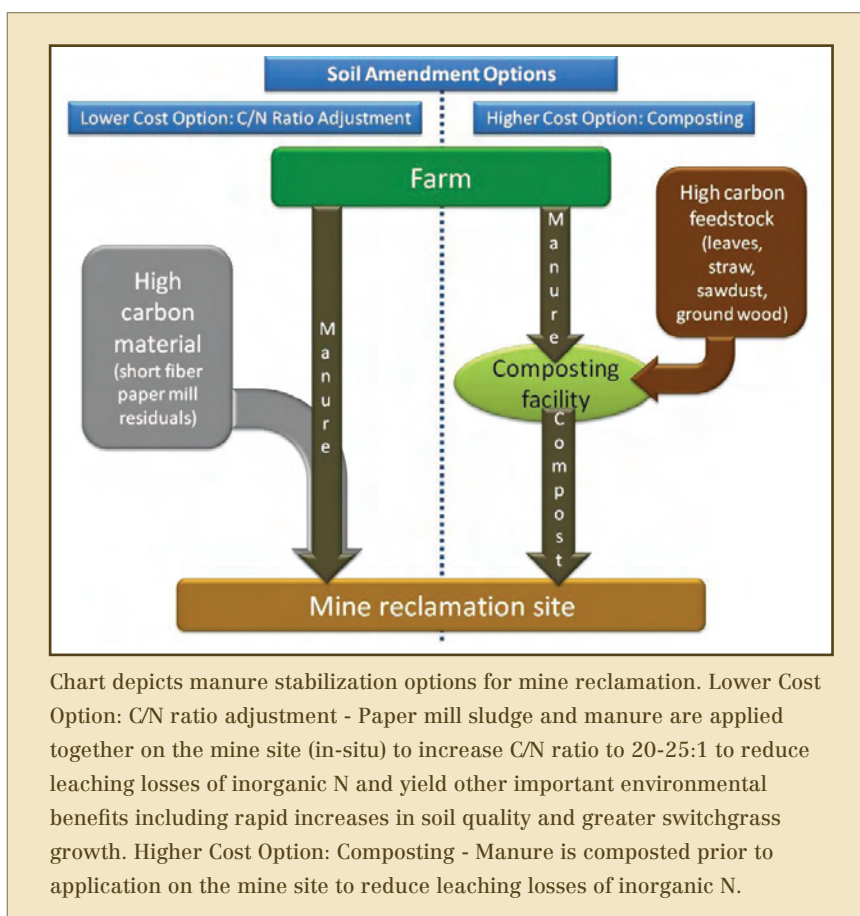


Chart depicts manure stabilization options for mine reclamation. Lower Cost Option: C/N ratio adjustment - Paper mill sludge and manure are applied together on the mine site (in-situ) to increase C/N ratio to 20-25:1 to reduce leaching losses of inorganic N and yield other important environmental benefits including rapid increases in soil quality and greater switchgrass growth. Higher Cost Option: Composting - Manure is composted prior to application on the mine site to reduce leaching losses of inorganic N.

Composting, however, increases costs due to additional materials handling and operational expenses. A much lower cost alternative is direct application of the composting feedstocks (manure and high organic C material) to the mine spoil, so that decomposition and mineralization occur in the mine spoil rather than a compost pile. The research team called this process *in-situ* “composting.” In addition to economic benefits, such *in-situ* composting has potential ecological and environmental benefits. Slower fungal-based decomposition in the field may retain more added C in the soil and lead to more rapid increases in soil quality than application of pre-composted material.²⁴ However, *in-situ* composting requires finding the right balance between N and C mineralization and N immobilization, such that the potential NO₃ leaching loss is limited, yet sufficient inorganic N is available for vegetative growth. In the preliminary greenhouse experiment cited above, the research team found that adding raw manure to mine spoil together with short fiber paper mill sludge to increase the C:N ratio from 7:1 (raw manure) to 30:1 resulted in a 6.7-fold reduction in leaching losses of inorganic N.²⁵ Switchgrass growth was also doubled compared to composted manure amendment.

Strategy 2 - Demonstrate the environmental benefits: Schuylkill County Field Research Project: The ongoing field research experiment in Schuylkill County investigates the use of manure, paper mill sludge, and composted manure as soil amendments for mine reclamation and switchgrass production. Normal mine reclamation practices in Pennsylvania will apply inorganic N fertilizer at about 100 lbs. N/acre. Researchers compared this N rate with much larger N application from composted layer manure and layer manure mixed with paper mill

sludge. The application rates and quantities are given in the Schuylkill Project table.

The researchers collected leachate water from these amendments for three growing seasons and measured nutrient loss via leaching. Switchgrass was established one year after amendments were applied.

The results and data obtained during the second year of research (summer 2007) were used to establish the manure reclamation approach for the full-scale reclamation demonstration project (composting approach and application rate) in Clearfield County.

Clearfield County Demonstration Project: A full-scale mine reclamation demonstration project using poultry layer manure was launched in 2008 near Morrisdale in Clearfield County. The 30-acre demonstration project is the largest and most advanced experimental use of this reclamation methodology. The ongoing field-scale research is continuing to provide results that inform the development and refinement of the techniques.

The project initially reclaimed 20 acres at two mines. Thirteen acres were reclaimed with approximately 450 tons of raw poultry manure mixed with paper mill sludge at two

sites. Seven acres were reclaimed with approximately 455 tons of composted manure at one of the sites. Both sites were seeded with oats to establish green cover, and they were reseeded with switchgrass and a mix of warm season grasses in June 2009. The project team reclaimed an additional 10 acres utilizing 650 tons of composted layer manure in June 2009. Approximately half of the total 30 reclaimed acres were seeded with switchgrass and the remaining acreage was seeded with a mix of warm season grasses in June 2009. Long-term research conducted on degraded lands in Minnesota has shown that such stands can be established on degraded lands, that they are sustainable, that they produce more biomass fuel per acre than monocultures of corn or switchgrass, and that they sequester more soil carbon than monocultures.²⁶ High diversity stands also have greater potential than monocultures to serve as wildlife habitat, if managed appropriately.

A local paper mill paid for the transportation and application of 1,405 tons of paper mill sludge that was applied to approximately 13 acres at an application rate of 108 tons per acre. The paper mill sludge was mixed with raw poultry manure and residual top soil and spread over the land prior

Schuylkill Project: Application Rates and Quantities	
Reclamation Soil Amendment (T/A: tons/acre)	Quantity of Total N Added (Lbs. N/acre)
Lime (6 T/A) and fertilizer	100
Composted poultry manure (35 T/A dry weight)	1,890
Composted poultry manure (70 T/A dry weight)	3,780
Poultry manure (22 T/A dry weight) mixed with paper mill sludge (46 T/A) to achieve C:N ratio of 20:1	1,890
Poultry manure (22 T/A dry weight) mixed with paper mill sludge (82 T/A) to achieve C:N ratio of 30:1	1,890



Extensive soil amendments are necessary to reclaim abandoned mine lands. In this photo the reader can see composted manure (dark brown) and raw manure covered with paper mill sludge (very light grey material) along with one pass of the chisel plow behind the tractor.

to seeding. The local paper mill paid for the delivery and spreading of the paper mill sludge at a cost that was competitive with the conventional delivery and disposal of the material at the landfill. The application of the sludge is acceptable to the mine operator because the alkaline nature of the sludge makes it a good substitute for lime, which would have been used in a conventional reclamation process in combination with commercial nitrogen fertilizer. The paper mill sludge also helps retain soil moisture and adds carbon to the soil.

The Clearfield site will be monitored to ensure that nutrient and carbon flux, and switchgrass and native grass production is similar to results obtained in the field experiment. This will be done by periodic collection and analysis of soil samples, measurement of harvest yield, and tissue analysis.

This project will include an evaluation of the commercial potential of the

reclamation methodology on both operating and abandoned coal mine lands. The evaluation for operating coal mines, scheduled for completion in 2010, will compare conventional reclamation techniques to the poultry manure technique. It will also examine the revenue potential from both environmental credit markets (carbon sequestration and water quality trading) and sales of biomass for energy production. The evaluation of the project for AML reclamation will include an assessment of state and federal funding sources for reclamation projects.

Strategy 3 - Set new empirical standards: Composting poultry manure is a highly effective way to stabilize the added nitrogen and sequester it in the soil. Leachate analysis over three growing seasons showed that less than 1% of N added as compost was lost via leaching during this period, even with the application of 3,780 lbs. N per acre. Adding fresh poultry

manure mixed with paper mill sludge was less effective than composting at retaining the added N. Most of the loss was due to nitrate leaching in the late fall of each year. Nitrate leaching was greatest in the first year, much smaller in the second year and almost zero in the third growing season.

Although significant N leaching occurred with the combined manure and paper mill sludge amendment, the amount of N lost over two growing seasons with the 20:1 ratio treatment is comparable to N leaching losses from two seasons of conventionally produced corn on agricultural fields. And while leaching loss has essentially ceased after two years, it is an annual event in production agriculture fields. The manure and paper mill sludge amendment was also very effective at sequestering added N. The 20:1 treatment lost only 8% via leaching, and soil analysis confirmed that most of the added N was still present in the soil.





The Schuylkill County AML site prior to reclamation in April 2006.

Both composting and the combination of manure and paper mill sludge were very effective at sequestering added phosphorus (P). Leaching loss of P was very small and over two growing seasons amounted to less than 2% of the added P. Both of the organic amendments produced excellent vegetative growth during all three growing seasons. Switchgrass was established in the second growing season (2007). Both compost and the combination of manure and paper mill sludge produced much larger yields than the conventional reclamation practice of lime and inorganic fertilizer. These two-year stands of switchgrass are comparable to two-year stands on high quality agricultural soils.

Based on these results, the research team decided to decrease the manure application rate to 14.3 tons per acre (T/A) dry weight (approximately 30 T/A wet weight) for a total N application of 1000 lbs. per acre. The manure was combined with paper mill sludge applied at a rate of 42 T/A dry weight (approximately 114 T/A wet weight). This application will produce an overall C:N ratio of approximately 20:1 in the applied material. The researchers believe the 35% reduction

in the total amount of N applied will further decrease the potential for nitrate leaching while still maintaining adequate nutrient and carbon addition for good biomass production.

RESULTS

The experimental results and new empirical standards determined through research and demonstration projects will facilitate the implementation of this methodology across Pennsylvania, benefitting both AML reclamation statewide and management efforts in nutrient-impaired watersheds. While only 30 acres have been restored through this project, the Pennsylvania Environmental Council and Pennsylvania State University have laid the foundation for future efforts to turn harmful pollutants from the livestock and paper industries into the essential nutrients needed to restore mine land. Approximately 1,100 tons of composted manure and 455 tons of raw poultry manure were imported and applied at the three mine sites. The switchgrass and warm season grasses that are grown on the sites may be used in biomass-ready boilers for heat and power production and potentially as a feedstock for cellulosic ethanol. The

next step is to facilitate larger-scale implementation for AML and conventional surface coal mine reclamation in both the anthracite and bituminous coal regions of Pennsylvania.

KEYS TO SUCCESS

- **Leadership:** Throughout its 40-year history, the Pennsylvania Environmental Council has demonstrated leadership by convening key stakeholders from academia, state and local agencies, and the business community to develop innovative policies and projects to address Pennsylvania's leading environmental challenges.
- **Funding:** Project partners succeeded in obtaining state and federal grants to support the research and demonstration components of the project, with matching cash and in-kind contributions from private foundations, conservation organizations, and the private sector.
- **Partners:** Project success is a direct result of working with key partners in the agricultural community; the mining industry; local, state and federal agencies; the state university; and private conservation organizations.
- **Communication:** Using poultry manure to reclaim AML and



The Schuylkill County AML site after reclamation in October 2009. Photo shows vigorous switchgrass growth resulting from manure and paper mill sludge applied together (in situ) to increase C/N ratio to 20:1.

produce renewable energy represents a win-win-win solution that resonates as an economic development and environmental restoration story.

PHOTOS AND FIGURES

Page 201, 207-209: Photos, Dr. Richard Stehouwer

Page 202-205: Photos, Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR)

Page 202: Figure, Burke Environmental Associates/The Conservation Fund, adapted from EPCAMR

Page 205: Figure, Dr. Richard Stehouwer

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Lynnhaven River NOW

Improving Water Quality in the Lynnhaven River

The Lynnhaven River NOW organization has achieved remarkable success with a well orchestrated campaign to bring back healthy oyster populations through innovative watershed pollution reduction and habitat restoration initiatives.

CASE STUDY SUMMARY

The Lynnhaven River watershed covers 64 square miles of the City of Virginia Beach. Watershed development is largely residential with approximately 225,000 people, or roughly one-half of Virginia Beach's population, living in one-fifth of the city's total land area. Water quality in the Lynnhaven is currently degraded due to high levels of pollutants entering the river and decreased acreage of beneficial habitats that filter pollut-

ants from the water. The Lynnhaven River oyster used to be a delicacy locally and around the world, until eating the oysters became a health hazard due to pollution.

Lynnhaven River NOW (LRNow) was founded in 2002 with the mission to substantially improve water quality in the Lynnhaven River. The group chose the oyster as its symbol and set the tangible goal of eating an oyster from the river by 2007. To reach their goal, they began working to:

1. Identify and reduce sources of nutrients, sediment, bacteria, and chemicals running off of lawns, parking lots, roadways, and out of septic systems in the Lynnhaven watershed
2. Restore vital habitats such as oyster reefs, salt marshes, and riparian buffers that filter polluted runoff and improve water quality for the river and its marine life
3. Educate and engage the community and partner organizations in the restoration effort

LRNow and the partnerships they have created have been remarkably successful at improving water quality and gaining public support for their initiatives in a short period of time. When they were established, most of the river did not meet the Virginia Department of Health standards for safe shellfish harvest, an indicator of river health. In 2006, thanks to LRNow's leadership, 7% (365 acres) of the river was opened to shellfish harvest. In 2007, almost 29% (1,462 acres) of the river met the standard and was opened for harvest. In 2008, almost 31% (1,574 acres) of the river met this standard and were opened. Some of the newly opened areas have been closed since 1930. The ongoing success of LRNow demonstrates a



Long Creek, a tributary of the Lynnhaven River. The creek and entire river are now a "no discharge zone," which means vessels cannot discharge sewage into the water.



A bushel of Lynnhaven River oysters. LRNow and its partners embarked on an ambitious effort to increase the population of native oysters in the Lynnhaven River.

model for the restoration of water quality through leadership, partnerships, and volunteerism.

RESOURCE MANAGEMENT CHALLENGE

Like many tidal waters of the Chesapeake Bay and its tributaries, portions of the Lynnhaven River are severely polluted and have been identified in Virginia state water quality reports as having impaired (Category 5) surface waters needing Total Maximum Daily Loads (TMDLs). TMDLs establish the maximum amounts of an impairing substance or stressor that a water body can assimilate and still meet water quality standards; they also allocate that load among pollution contributors.

Pollution in the Lynnhaven River has caused many problems. Both the main stem of the Lynnhaven and the Eastern and Western Branch of the upper river are impaired due to low levels of dissolved oxygen—which affects a wide variety of aquatic life. Recreational use of the Eastern and Western Branch is impaired due to *Enterococcus* criteria violations. Most of these branches were closed to shellfish harvesting. The water is

contaminated with enteric bacteria from human, pet, and wildlife fecal matter. Fish consumption is limited by the advisory for PCBs issued by the Virginia Department of Health in 2004. Water clarity is severely diminished by toxic algae blooms and high concentrations of suspended sediments.

Stormwater runoff is the main source of pollution that enters into the river, but other contributing sources are boats that discharge their sewage, poor pet waste management, sanitary sewer overflows, and old leaky septic systems. Most of the watershed was developed before there were any environmental regulations and retrofitting is difficult and expensive. The landscape is very flat and poses challenges to flood control and nutrient and runoff management. Lastly, it is difficult to change the behavior of 225,000 people who are accustomed to conveniences that harm the river.

CONSERVATION VISION

The recovery of the Lynnhaven River began with a unifying, non-threatening vision created by individuals from Virginia Beach, particularly Harry Lester, Andy Fine, and Bob

Stanton. The principal founders have a strong connection with the area, a love of the water, and shared a dream of a cleaner river. They started Lynnhaven River 2007 (later changed to Lynnhaven River NOW), with the expressed mission to clean up the river enough so that they could eat the Lynnhaven oysters in 2007 on the 400th anniversary of the exploration of the river by the English.

LRNow set out to be the model for community-based water quality improvement. Previous conservation and restoration initiatives in the watershed failed to have a collective effect. LRNow felt that the general concept of water quality improvement was difficult for most people to understand and embrace. In addition, the community lacked a clear vision for a clean and healthy river. To create and enunciate that vision, the group chose the oyster as its symbol.

The oyster is a tangible and powerful symbol that people in Virginia Beach could easily rally around, understand, and measure. The Lynnhaven River oyster, known for its large size and salty flavor, was a delicacy in Paris, New York, and the local region in the early 20th century, but had not been eaten for years due to pollution and disease. The oysters used to be so famous that Sinclair Lewis wrote about them in *Babbitt and Main Street*. The oyster is a keystone species in the river because it filters sediment and algae from tremendous volumes of water, and oyster reefs provide critical habitat and food for animals in the river. It also revived proven memories of the way the river used to be, with oystermen shacks and oysters the size of dinner plates. Best of all, if restoration efforts were successful, people could eat the oysters once again.

The organization raised funds, hired excellent staff, and built successful

partnerships that leveraged others' expertise and resources. The partners include the City of Virginia Beach, the National Oceanic and Atmospheric Administration, U.S. Army Corps of Engineers, Virginia Institute of Marine Sciences, Chesapeake Bay Foundation, and others.

LRNow focused their efforts on **pollution control** measures that treat or reduce the sources of sediment, nutrients, and bacteria before the pollutants reach the river. They also focused on the **protection of natural habitats** that improve water quality by filtering out pollutants and providing homes for the river's marine life, and specifically on the **restoration of oyster reef habitat**. Lastly, they made every effort to **raise awareness in the watershed** because they felt that community education is one of the only strategies for reducing pollution from private residential properties in the Lynnhaven watershed. This culminates every year with their State of the River Report, which provides statistics and grades regarding river health.

IMPLEMENTATION RESOURCES

The organization's principal founders had extensive contacts and experience in Virginia Beach, which they called upon to develop a small capital campaign for LRNow. They built a board of directors with broad backgrounds and wrote letters to people asking for donations. They wanted 70 individuals to become founding members, which would require a commitment of \$1,000 each year for a total of three years. The board met monthly in the mornings and set specific goals: improve water quality; create oyster reefs; manage stormwater; control pollutants; engage partner organizations; and educate the community.

The City of Virginia Beach has provided resources and contracts to LRNow to enhance the collective effort to improve water quality. The city realized that LRNow could do things beyond the government's capability and could help them accomplish their mandates, particularly as it related to education. In all, the city has contributed \$150,000 to LRNow since 2002. LRNow also received a grant from the National Fish and Wildlife Foundation for \$30,000 to launch an important part of their program.

To raise additional funding for the organization, LRNow hosts an annual oyster roast. This cultural event is usually held at a volunteer's home, includes a band, and features the newly restored Lynnhaven River oysters. A monumental moment came in 2007 when LRNow was able to



Shucking a Lynnhaven River oyster. The oyster is a tangible and powerful symbol for LRNow's conservation and restoration efforts.

serve Lynnhaven oysters for the first time. The oyster roast typically raises approximately \$25,000 to \$30,000 a year. It also gives LRNow a chance to celebrate its successes and galvanize its supporters for the long road yet to come.

The LRNow budget can be viewed in thirds: approximately one-third from individual donations, one-third from foundation and government grants; and one-third from contracts with the city government. LRNow also intends to set up a long-term endowment.

In 2003, a committed group of local citizens came together to foster partnerships that would apply public and private resources to the challenge of reducing pollution in the Lynnhaven River. That core group formed the nucleus of what has grown into an award-winning river restoration project with more than 3,000 members called Lynnhaven River NOW.

Their goal is a clean and healthy Lynnhaven River and their objectives are to:

1. Identify and reduce sources of contamination in the river; reduce nutrients, sediments, and chemicals running off of our lawns, parking lots, roadways, and out of septic systems
2. Restore lost habitats such as oyster reefs, salt marshes, and other buffers that help to filter polluted runoff and protect the river and its marine life
3. Educate and engage the community and partner organizations in restoring and protecting the Lynnhaven River

CONSERVATION STRATEGY

One of the most important things that LRNow did was to inspire the Virginia Beach city government to become a leader and strong partner in the restoration effort. Their participation led to new sewers and new laws that reduced pollution. A key early strategy was for LRNow to hire Barry Frankenfield, a Virginia Beach city employee, two days a week. By hiring from within the city, LRNow was able to pick up Barry's knowledge, experience, and connections, and hit the ground running.

LRNow then took excellent steps to engage citizen leaders within the city by setting up subcommittees to deal with specific projects, including the following: Landscape Practices, Clean Boating and Marinas, Education, Oyster Restoration, Public Relations & Marketing, Stewardship and Access, Public Policy, and Water Quality. Thanks to the city's adoption of Lynnhaven's vision, city employees

were encouraged to attend meetings and were paid for their time. The subcommittees currently hold regular meetings and are a very effective way to involve volunteers, so that their goals are measurable, tangible, and clearly understood, and that the results of their efforts provide a sense of gratification.

In 2005, LRNow hired a full time education director who developed and implemented a comprehensive community education program, which continues to expand every year. LRNow's education program has been the key to turning the tide and facilitating the various water quality improvement initiatives. LRNow's education efforts include working with the public school system to offer training for teachers and direct support of environmental education programs in all of the schools in Virginia Beach.

LRNow's partnership with Dave Iwans and Associates provides them with

excellent materials, including a quarterly newsletter, which advanced their mission and membership. LRNow set a goal of obtaining membership and involvement from 5% of the watershed population, which they surpassed. In 2008, they had obtained membership and involvement from 10% of the watershed. In 2009, they raised their goal to 15%. That same year, they revised their website and began a semi-monthly newsletter.

LRNow PROJECTS

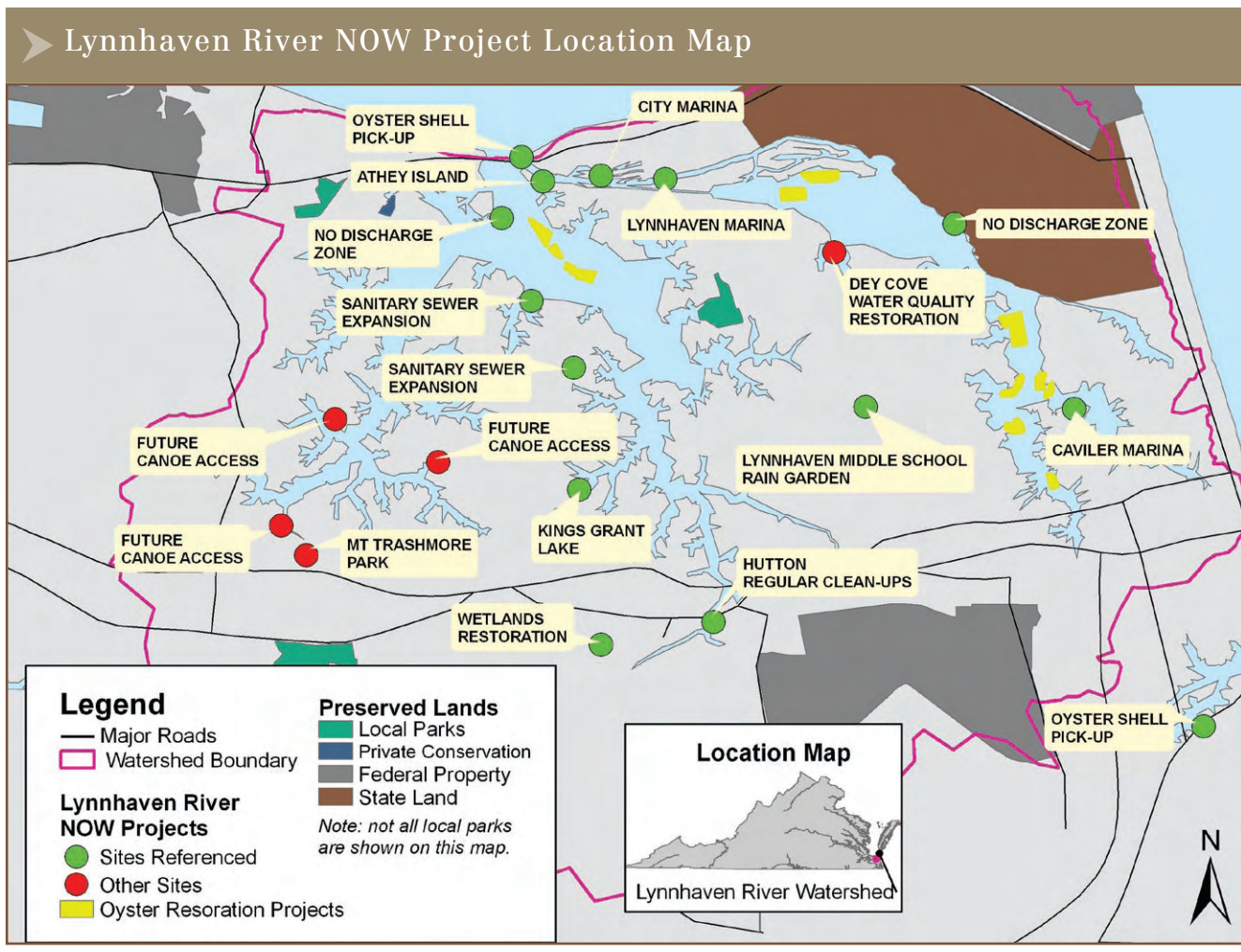
LRNow launched a series of projects to increase pollution control, with the following goals: 1) reduce bacteria, 2) eliminate the "dead zone" (covering approximately 90% of the river) by reducing additions of nitrogen and phosphorus, and 3) improve water clarity for underwater grasses.

Clean Marinas: LRNow encouraged certification of "clean marinas" that provide vessel pump-out facilities and lessons in "clean boating" practices. Their first success was the city-owned marina. Next they moved to private marinas. There are currently four clean marinas, and all have appropriate policies and procedures in place as well as an on-going monitoring program.

No Discharge Zone: LRNow took the impressive step of working with the City Council, the Virginia Department of Environmental Quality, and the U.S. Environmental Protection Agency to designate the entire river a "no discharge zone," which prohibits the discharge of sewage (treated or untreated) from all vessels. The Lynnhaven was the first tidal river in Virginia to receive this designation. After final approval, the City Council passed an enforcement ordinance that requires all boat owners to lock their sewer valves and place dye tablets in their holding tanks. Through a cooperative program with Hampton



Virginia Beach Mayor Oberndorf, LRNow staff, and others install a stormwater treatment system at Mt. Trashmore Park. This system will reduce bacteria and pollutants from runoff entering the Lynnhaven River.



Roads Sanitation District, LRNow has also been able to offer one free pump-out each season to boaters. The Hampton Roads Sanitation District brings the equipment to boater's dock and pumps out their boat.

Sanitary Sewer Expansion: To reduce the sources of human waste, LRNow convinced the City of Virginia Beach to reduce the number of sanitary sewer leaks and overflows into the river, and aggressively pursue the elimination of septic tanks within the watershed. Since 2003, the Public Utilities Department has completed 42 projects in the Lynnhaven River watershed including the largest project, the extension of sanitary sewer lines on the Little Neck peninsula. There is an on-going effort to routinely test the lines and keep them in good maintenance to avoid leaks.

In addition, there have been several pump station upgrades, reducing the chances of an overflow in a storm. These projects represent an investment of more than \$45,000,000 in improved infrastructure.

Solar Aerators in Kings Grant Lake: Most of the lakes in the watershed are surrounded by residential properties and have poor water quality with high bacteria levels, high nutrient levels, and low dissolved oxygen levels. LRNow worked with the Public Utilities Department to install solar-powered aerators in two of the lakes as a pilot project to determine their effectiveness in improving water quality. The data from the test lakes is positive, showing lower levels of bacteria and nutrients and higher levels oxygen levels. LRNow plans to work with the Department of Public



A sign defining the Lynnhaven River as a "no discharge zone."



From LRNow and the SPCA's "scoop the poop" campaign.



LEFT: *An LRNow intertidal reef at Athey Island.*
RIGHT: *A LRNow intern delivering oyster shell from participating restaurants.*

Works to expand this program and install aerators in more lakes in the Lynnhaven system.

Water Quality Infrastructure: LRNow aggressively pursued the development of water quality infrastructure, such as retention lakes and ponds, which filter pollutants from the water before they reach the river. With more than 1,000 untreated stormwater outfalls in the watershed, LRNow lobbied the City Council to allocate \$2.05 million and earmark the 2006 capital improvement budget to “retrofit” some of these outfalls with devices that intercept and reduce pollutants. LRNow consistently asks citizens not to pour grease down the drain, which can block pipes and cause wastewater to overflow and release bacteria and other contaminants into the river.

Reduce Pet Waste: One-third of the fecal coliform pollution in the Lynnhaven River is from dog waste. To reduce the sources of pet waste, LRNow worked with the SPCA to develop “Scoop the Poop” programs, which encourage pet owners to clean

up after their animals before the waste is washed into the river.

Broad Bay and Linkhorn Bay Oyster Reef Construction: LRNow worked with the U.S. Army Corp of Engineers to complete Phases I and II of a three-phase oyster reef restoration project in the Lynnhaven River. Sanctuary reef construction is the premier strategy for revitalizing the devastated oyster population, which has declined by 99% since 1607. Together they created 35 acres of oyster reef in 2007 and 22 acres in 2008. These acres are low profile reef on the river bottom, located primarily in Broad Bay and Linkhorn Bay. The Virginia Institute of Marine Sciences identified these areas using hydrodynamic models and historical records of productive oyster grounds as the best location for reefs to supply spat to the entire river system. LRNow also teamed with up the Chesapeake Bay Foundation and the Oyster Reefkeepers of Virginia to encourage citizens and schools to purchase oyster gardening equipment and grow oysters, which are then rounded up and deposited on the sanctuary reefs.

Athey Island Oyster Reef Construction:

LRNow also worked with the City of Virginia Beach, Fish America Foundation, and Virginia Marine Resources Commission to create an intertidal reef at Athey Island. This modest reef is a half acre in size and located at the confluence of the Long Creek and the main stem of the river. It is visible from local restaurants and shops across the creek and is in a great location to receive natural spat set.

Save Oyster Shell:

During the summer months 2006, LRNow developed and ran a Save Oyster Shell pilot program with eight restaurants and two public drop-off sites. Funding for the pilot project was provided by the Chesapeake Bay Restoration Fund. The success of the pilot program convinced the City of Virginia Beach to provide funding through their Oyster Heritage Fund to run the program year-round. There are now fourteen restaurants participating, with two public drop-off sites, and LRNow picks up shell from private oyster roasts. During the summer months, LRNow is averaging 25 bushels of



LEFT: LRNow volunteers help plant a buffer garden. This buffer will slow the flow of stormwater runoff and capture pollutants.
RIGHT: Children at one of LRNow's pearl schools. This program recognizes schools that teach environmental responsibility.



shell per week; in the winter months it drops to about 10 bushels per week. The shell is cured and then used for oyster reef restoration. Shell from the pilot project was used in the construction of the Athey Island Reef.

Green Ribbon Committee: Because of LRNow's urging, the City Council formed a Green Ribbon Committee to provide advice and assistance on water quality matters. The committee has made 56 specific recommendations to the City Council on changes to building codes and ordinances that will reduce the impact and extent of impervious cover; preserve and enhance existing natural resources; integrate stormwater management to maximize efficiency and effectiveness of the overall system; and utilize other means that are effective and practicable to improve water quality. The Green Ribbon Implementation Committee is currently working through directives, policy changes, and code and ordinance revisions.

Open Space Protection:

Ninety percent of the Lynnhaven River's watershed is developed with

residences, roads, and buildings. The remaining open space is crucial for the protection of water quality and wildlife habitat. LRNow has been a strong advocate with both city and state governments to protect 100 acres of undeveloped land in the watershed, especially within the Conservation Corridor System identified by the Hampton Road Planning District Commission.

Rain Garden Construction: Inspired by an LRNow teacher workshop on rain gardens, two middle school science teachers at Lynnhaven Middle School developed a two-year project called the Lynnhaven Legacy that has transformed the school grounds and provides a model for other schools. LRNow worked closely with the school to construct a 900 square-foot rain garden, create an outdoor classroom, build a butterfly garden, install eight rain barrels and "scoop the poop" boxes, and restore a wetland area. All the classes in the school played a role in the planning and execution of the project including the math, science, social studies, and

English classes; the art students; the technology students; and the special education classes. The funding came from a variety of sources, including three grants and funds from the City of Virginia Beach and the school's PTA.

Community Education Programs:

LRNow put a great deal of emphasis on raising public awareness because they felt that community education is one of the only strategies for reducing pollution from private residential properties in the watershed. LRNow programs include four public meetings per year, seminars and lectures on various topics, a bi-annual river symposium, community workshops, presentations to civic leagues and other community groups, and a teacher education program. In 2008 alone, LRNow provided 107 educational programs, including eight workshops for teachers. Two years ago, LRNow launched the "Pearl School" program to recognize, encourage, and support the efforts of teachers and schools that are developing an ethic of environmental



responsibility and stewardship among students. LRNow has also completed a wetland restoration project called “Growing Wetlands in the Classroom,” through which plants are grown by students and transplanted to restoration sites.

Events and Opportunities for

Participation: Throughout the year, LRNow engages citizens by leading clean-ups in various locations around the watershed. LRNow and Wild River Outfitters also host an annual “Paddle for the River”—a seven-mile race or three-mile fun paddle, with proceeds benefitting LRNow. LRNow also hosts an annual photography contest; the winning photo is published in the LRNow calendar. LRNow holds an annual volunteer appreciation picnic and officially recognizes a volunteer of the year, which provides a member of the community with a prestigious award.

RESULTS

Bacterial levels: In 2008, shellfish were safely consumable from 31% of the Lynnhaven River, up from 29% in 2007 and 7% in 2006.

Pollution Control: The “no discharge zone,” established in 2007, was the first for an estuary in Virginia and the second in the whole state. In 2008, the City of Virginia Beach allocated another \$3.8 million to retrofit more of the untreated stormwater outfalls.

Sewer System Improvement: The City of Virginia Beach spent \$45 mil-

lion to reduce the number of sanitary sewer leaks and overflows into the river, and they have aggressively pursued the elimination of septic tanks within the watershed. Only 276 septic tanks remain in the watershed and city officials estimate that they will reduce that number to 125 by 2010.

Protection of Natural Habitats: As of 2007, 62 acres have been protected. LRNow has also strongly advocated for the stringent enforcement of the “no net loss” policy in place to protect wetlands from destruction.

Oyster Reef Restoration: Nearly 60 acres of oyster reef habitat have been created and seeded with wild stock oyster spat.

Raise Awareness: In 2008, LRNow provided 107 educational programs, including several workshops, 6 clean-ups, and 27 presentations to community groups. In addition, in 2008, LRNow accounted for 30 newspaper articles focusing on Lynnhaven River water quality, and ran 4 television advertisements about pet waste and fertilizer. They published an oyster restoration publication, a landscaping guide, and a 2009 calendar.

KEYS TO SUCCESS

► **Leadership:** The principle founders of LRNow took the initiative to start the organization and chose to surround themselves with environmental and community leaders that shared their vision.

► **Funding:** The principle founders were able to recruit approximately 70 individuals who committed to funding the first three years of the organization. This provided enough funding to hire staff, who in turn applied for grants from foundations and developed government service contracts.

► **Partners:** LRNow was effective because their partnership with the city enabled them to more effectively implement restoration measures and appropriate regulations. In addition, LRNow became the coordinating entity for others working on restoring the river.

► **Communication:** LRNow had a clear vision with a tangible core element of opening up the shellfish beds. They communicated it to the public efficiently and effectively. A good idea that is well expressed can quickly grow into a movement.

► **Volunteers:** LRNow was able to accumulate an impressive group of volunteers to achieve the organization mission. The committees give ownership and responsibility to participants.

PHOTOS AND FIGURES

All photos by Lynnhaven River NOW
Figure by Burke Environmental Associates/The Conservation Fund



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