

Reducing Runoff from New Development

Recommendations for Greene County



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The Environmental Law and Conservation Clinic is an academic program of the University of Virginia School of Law. The clinic and its students represent and counsel environmental nonprofits, citizen groups, and other community organizations seeking to protect and restore the environment of Virginia and other parts of the country.

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The Rivanna Conservation Society is a nonprofit organization located in Charlottesville. The mission of the RCS is to develop public support to safeguard the ecological, recreational, cultural, scenic, and historic resources of the Rivanna River Watershed.

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Acknowledgments

Sincere appreciation is extended to the Greene County Government and Planning Department personnel. Photos were taken by Rebecca Huber and Robbi Savage.

INTRODUCTION

This report – prepared by the University of Virginia Law School’s Environmental Law and Conservation Clinic on behalf of the Rivanna Conservation Society – is one in a series of reports being published to put forward recommendations to help Charlottesville, Albemarle, Greene, and Fluvanna protect the Rivanna River and its tributaries. The report identifies a number of straightforward and common sense changes Greene County can make to its ordinances, technical and guidance manuals, and other policies in order to reduce pollution from stormwater runoff.

Greene County is in a unique position to take steps now to protect the quality of its rivers and streams for future generations. And, while Greene County has grown a great deal over the past two decades, it is still largely rural in character. According to the Greene County Comprehensive Plan, the population doubled between 1981 and 2003. And, between 2000 and 2007, Greene County experienced a 17.3% population increase, faster than Albemarle County and Charlottesville City.¹

Despite this growth, its rivers and streams are still comparatively healthy. The waters located within Greene County are for the most part unimpaired, with only slightly more than six miles of river flowing within Greene County currently included on the Virginia Department of Environmental Quality’s (DEQ) list of “impaired waters.”² Greene County’s healthy waters are an important asset – for water supply, recreation, and fish and wildlife – that the County should act now to protect.

Because Greene County is at the headwaters of two rivers (the Rivanna and the Rapidan), it is effectively in complete control of the quality of its waters – since pollution flows downstream. Greene County is also in a critical position to help protect the quality of downstream waters. Because of this position, and because of growth pressures in the County, it is important that Greene County take action now to protect the water quality of the Rivanna Basin. A proactive role becomes even more important when one is aware of the fact that the Rivanna River drains into the James River Basin and then into the Chesapeake Bay. The extent and pattern of growth in Greene County will determine whether its streams maintain their current quality, or meet the same fate as many waters in more urbanized areas of Charlottesville and Albemarle. While the

causes of water pollution can vary considerably, the increasing population in Greene County suggests that efforts to mitigate stormwater runoff are a needed step to protect the County’s waters, including the headwaters of the Rivanna Basin.

Recognizing that the stormwater problem is likely to increase in magnitude as the County’s population continues to grow, Greene County officials have acknowledged the importance of protecting its waterways.



Impervious surfaces from development prevent infiltration of water into the ground and cause stormwater runoff.

1 The University of Virginia Weldon Cooper Center for Public Serve used the 2000 Census along with school records, housing stock, drivers’ licenses, and tax returns, to determine the population growth between 2000 and 2007 (<http://www.coopercenter.org/demographics/POPULATION%20ESTIMATES/>).

2 Virginia Department of Environmental Quality, Final 2006 305(b)/303(d) Water Quality Assessment Integrated Report (approved by the Environmental Protection Agency on Oct. 16, 2006) (<http://gisweb.deq.virginia.gov/FactSheets2008/FactSheets.aspx?loc=GREENE+CO.&style=1>).

Greene County's Comprehensive Plan sets a goal in 2020 of starting a program "to work with landowners who create buffers on land adjacent to important County waterways." Such buffers will "create greenways that help protect the water quality and provide wildlife corridors."³

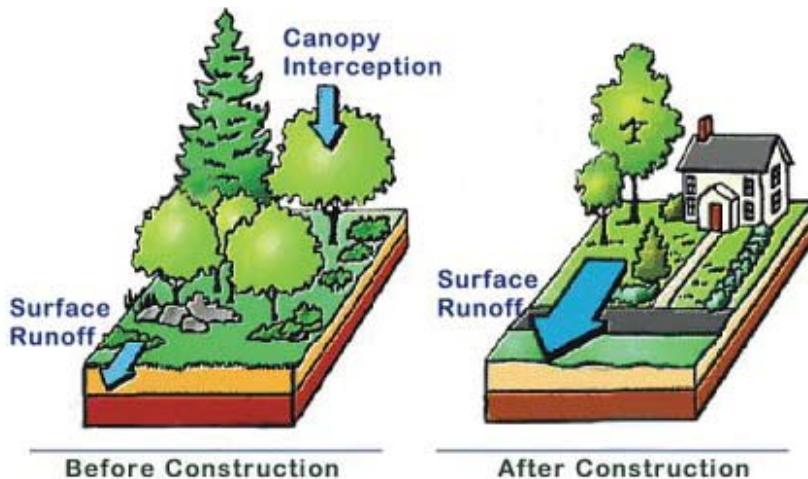
The recommendations in this report focus on simple changes that can be made to the Greene County Code, technical manuals, and other guidance documents so as to better promote development practices that will reduce stormwater pollution. These practices include 1) reducing the amount of paved and other impervious surfaces associated with new development, 2) improving certain erosion control practices during construction, and 3) protecting riparian areas around rivers and streams in the County when new development takes place. Implementation of these recommendations will not eliminate stormwater runoff in the County or completely solve the myriad of erosion and sedimentation problems it causes. This is because these recommendations focus primarily on limiting runoff from new land development. Retrofitting some existing developments with better stormwater protections and working with landowners to reduce runoff from agricultural lands are also important in protecting the future quality of Greene County's streams. In addition, this report focuses on how things are built, not where. The topics of land-use planning and zoning are very important for water quality, but beyond this report's scope. This report's recommendations, however, do represent important and incremental steps in the right direction.

In addition, a number of ongoing efforts at the state level may result in significant changes to stormwater programs in the Rivanna Basin and Virginia as a whole. The Department of Conservation and Recreation is currently considering significant changes to state stormwater regulations. More locally, the Rivanna River Basin Commission, of which Greene County is a member, is undertaking further scientific evaluation and research over the next several years, and intends to develop tools to help developers and localities reduce stormwater pollution. This work may demonstrate that a wholesale shift in the way our region approaches stormwater runoff is necessary if we are ever to solve the problem fully, and may give rise to initiatives well beyond the focus of this report.

The objective of this report is to highlight several near-term changes that can be made to the County's code to reduce the stormwater pollution running off the new development occurring in Greene County. Our hope is that all jurisdictions within the Rivanna Basin will implement the recommendations made in the community-specific reports, and we look forward to having these recommendations play an important role in reducing stormwater pollution from new development. By implementing them now, Greene County can take an important step towards protecting the existing quality of one of its most important natural resources – its clean rivers and streams.

³ Greene County, Va. Comprehensive Plan, A Vision of Greene for 2020 section, County Resources chapter, page 42.

THE CHALLENGES OF STORMWATER RUNOFF



By replacing natural terrain with pavement and rooftops, new land development often limits the opportunities for precipitation to be absorbed by plants or infiltrate into the ground. As a result, a much higher percentage of precipitation becomes surface runoff after land is developed, posing significant threats to nearby waterways.

The Virginia Department of Environmental Quality (DEQ) has recognized stormwater runoff as a “primary contributor” to water quality impairments throughout the state.⁴ It affects urban and rural watersheds and is primarily caused by changes made to the landscape by humans.

When land is in natural and forested conditions, much of the precipitation from rainstorms is absorbed into the ground close to where it falls, nourishing plant life and helping to recharge groundwater aquifers. Typically, any excess rainwater will flow gradually over the terrain and slowly drain into nearby streams and rivers. But as forests are replaced with pavement, buildings, and manicured lawns, less of the precipitation is able to seep back into the soil. Instead, the rainwater quickly collects on these compacted surfaces and forms sheet runoff that flows off the site at a much higher volume and speed. Stormwater runoff can cause excessive erosion and sedimentation of the waterways into which it flows. The Virginia Department of Conservation and Recreation (DCR) estimates, for example, that a one-acre parking lot creates 16 times more runoff than a meadow of the same size.⁵

Often, the accumulated runoff forms rivulets that pour directly into the nearest stream or tributary. Alternately, stormwater might first flow into a storm sewer that pipes it directly to a nearby river or stream. The result is the same in both cases: the volume of flows in the receiving waters increases significantly. As the higher flows rush through stream channels unaccustomed to such volumes and speeds of water, the water carves away a large amount of sediment from the stream banks and streambeds.⁶ The eroded sediment eventually settles to the streambed where it smothers aquatic habitat and alters the waterway’s ecology.

The second principal way in which stormwater runoff damages local waterways is by washing pollutants directly into rivers and streams. As rainfall collects upon and washes over paved surfaces, construction sites, lawns, and pastures, it picks up some of the oil, sediment, fertilizers, and bacteria present on those surfaces.⁷ When the runoff then empties into nearby waters it carries those pollutants along with it, often causing harm to aquatic life and even making rivers and streams unfit for recreation. Pollutants contained in stormwater runoff are significant contributors to water quality problems in the Chesapeake Bay.

⁴ Virginia Department of Environmental Quality, Final 2006 305(b)/303(d) Water Quality Assessment Integrated Report, p. 3.1-3 (approved by the Environmental Protection Agency on October 16, 2006).

⁵ Chesapeake Bay Foundation, A Better Way to Grow: For More Livable Communities and a Healthier Chesapeake Bay (1996), p. 4.

⁶ Virginia Department of Conservation and Recreation, Virginia Stormwater Management Program (http://www.dcr.virginia.gov/soil_&_water/stormwat.shtml).

⁷ Virginia Department of Conservation and Recreation, Virginia Stormwater Management Program (http://www.dcr.virginia.gov/soil_&_water/stormwat.shtml).

The stormwater pollution described above is caused when forests and other pervious natural landscapes are replaced by impervious surfaces, such as roads, parking lots, and roofs. These surfaces become, in effect, permanent parts of the landscape and represent a long-term pollution issue. Although the construction phase of development is more short-lived, the risk of pollution is in fact most acute during the construction phase. Typically, construction activities remove the stabilizing layer of topsoil on a site. When the underlying soil layers are exposed directly to the elements, the rate at which those soils erode accelerates dramatically. Stormwater runoff then captures the eroded sediment and conveys it directly into streams, exacerbating water quality problems both in the direct vicinity of the site and for miles downstream.

There are many strategies that can be employed by the localities and developers to significantly reduce stormwater pollution. Many of these strategies promote techniques that increase the amount of water that soaks into the ground on site (a process called infiltration) and reduce the volume and intensity of stormwater runoff. A number of aspects of Greene County's ordinances (and those of other Virginia localities) inadvertently promote site designs that increase runoff. By simply removing some unnecessary regulatory obstacles to smarter development patterns and by encouraging more responsible site design and construction practices, we can reduce the adverse water quality impacts of new development and protect Greene County's waters for the future.

BACKGROUND

The recommendations discussed below are the result of an extensive analysis of the County's development ordinances and policies conducted by the University of Virginia Law School's Environmental Law and Conservation Clinic for the Rivanna Conservation Society. The project was designed to build upon a broader review the James River Association conducted in 2006 of the forty-five major localities that make up the James River watershed, including Greene County.⁸

The Center for Watershed Protection developed a Code and Ordinance Worksheet ("Worksheet") that was used as the starting point for the analysis. The Worksheet contains a number of benchmarks against which a locality's ordinances may be compared to determine how well they promote development practices and techniques that reduce stormwater runoff.⁹ These benchmarks focus on how developers build, not where they build. The JRA report used the Worksheet to identify practices and specific provisions of the Greene County Code that unnecessarily promoted impervious surfaces or otherwise failed to take specific steps to reduce stormwater pollution from new development.

The team working on this report then conducted a more detailed analysis of the Greene County Code to identify the most likely areas for action and improvement. The team then spent several months expanding and refining those preliminary findings based on numerous discussions with County staff and others in Greene County, as well as the collective experience and knowledge of our own organizations. The recommendations outlined below are the culmination of this effort, and these recommendations represent a manageable set of practical, common-sense steps the County can take to reduce the damage that polluted stormwater runoff is causing to our local waterways.

⁸ Working in conjunction with the Center for Watershed Protection and students from the University of Virginia, Virginia Tech and Virginia Commonwealth University, the James River Association's review culminated in the publication of an informative report entitled Building a Cleaner James River: Improving Local Building Codes & Ordinances to Protect the James River & Its Tributaries (January 2007). The report can be accessed at http://www.jamesriverassociation.org/watershed_scores.html.

⁹ Further information on the Code and Ordinance Worksheet, the model development principles on which it is based, and the process used to develop those principles and the worksheet may be found in The Center for Watershed Protection, Site Planning and Model Development Principles (www.cwp.org/22_principles.htm).

RECOMMENDATIONS

The recommendations are grouped into five broad categories:

1. Promote better design and layout of new development sites.
2. Actively encourage low-impact development techniques.
3. Limit sediment-laden runoff from construction sites.
4. Promote riparian protection on pasture land.
5. Increase protection of buffers.

I. Promote Better Design and Layout of New Development Sites

As described above, the amount of stormwater runoff a parcel of land generates can increase considerably when its trees and meadows are replaced with buildings and pavement. In recent years, however, innovative approaches to the design and layout of new development sites have emerged that seek to minimize this effect. These approaches focus on two goals: (1) avoiding the construction of excessive impervious surface; and (2) using natural landscape features to absorb and treat much of the site runoff. These natural techniques are commonly referred to as “low-impact development” or LID. The first section of this report offers ways in which different Greene County Code provisions can be improved, and the County’s development policies refined, to better promote these practices.

A. Parking Lots

Large surface parking lots can generate massive volumes of stormwater runoff. A one-acre paved parking lot (43,560 square feet) will produce over 27,000 gallons of runoff during a one-inch rain.¹⁰ As a local example, over 10 acres of parking lot will be built during the construction of the Gateway Center at the intersection of routes 33 and 29 in Ruckersville. During a one-inch rainstorm, a parking lot that size will generate over a quarter of a million gallons of runoff – enough to fill a swimming pool the size of the basketball court in the John Paul Jones Arena to an Olympic regulation depth of 6.56 feet and have 50,696.69 gallons leftover. Such runoff also carries with it many of the various pollutants that accumulate on the parking lot surface and can transport these pollutants into local waterways.

The recommendations in this subsection focus on reducing the stormwater impact of new parking lots by giving developers the option of reducing lot size and incorporating LID features into parking lot design.



Parking lots are one of the most significant sources of concentrated stormwater runoff.

¹⁰ Calculation available at North Carolina Clean Water Education Partnership website at (<http://www.nccwep.org/involvement/kids/slobber.php>).

i. **Require that 20% of spaces within larger parking lots be designed to “compact car” dimensions (8’ X 16’).**

The amount of land that gets paved to build a new surface parking lot is a product of several factors. Two of those factors are the number of spaces in the lot and the size of each space. Parking lots are often configured so that every parking space can accommodate the largest class of automobile, even when roughly 20% of the automobiles on the road today are smaller “compact” cars.¹¹

A requirement that an appropriate percentage of the parking spaces within large parking lots be designed to “compact” dimensions can reduce the size of the parking lot while accommodating the same number of vehicles. It can also increase the space available within the lot for LID stormwater management practices.

Greene County requirements are silent with regard to designated compact car spaces, and the County should consider adding compact car language in §16.8 of the zoning ordinance.

We recommend that the County amend section 16.8 of the zoning ordinance to require that 20% of the parking spaces within parking lots of 10 or more spaces be designed to a “compact car” set of dimensions (8’X 16’), and be marked for use by compact cars only.

ii. **Lower minimum parking space requirement for professional office buildings and retail buildings.**

Another major factor in the size of a surface parking lot is the overall number of parking spaces. Often, local ordinances specify a minimum number of parking spaces that must be built for various types of land uses, such as professional offices and retail space. When these minimum parking requirements exceed what a particular development is likely to require, it may in fact require the installation of unnecessary asphalt. These minimums may force a developer to build a larger lot than he or she wants or needs. Not only does this increase the amount of stormwater the site generates, but it can also increase construction costs for the developer. To help localities avoid these results, the Center for Watershed Protection (CWP) has developed a recommended minimum number of parking spaces for major uses such as professional office buildings and shopping centers.

Greene County’s minimum parking space requirements are contained in sections 16-8-3, 16-8-7, and 16-8-9 of the County Code. While the requirement for single-family homes falls within the CWP’s recommendations for those classes of uses, the County’s parking requirement for professional office buildings and retail buildings exceeds the mark. The CWP recommends a minimum of 3 spaces per 1,000 square feet of gross floor area of office space or retail space. Greene requires 5 parking spaces per 1,000 square feet of gross floor area.

Reducing the minimum parking space requirements for office space and retail buildings is an easy way for the County to give developers flexibility to reduce unnecessary impervious surface in new commercial developments without jumping through extra hoops. Notably, this change would not require developers of office space or retail buildings to build fewer parking spaces; it would simply allow them to do so by decreasing the mandatory minimum size of a parking lot. This will, in many cases, save developers unnecessary and unwanted costs when the size of the parking lot required by ordinance is larger than what the developer actually deems necessary.

We recommend that sections 16-8-7 and 16-8-9 of the zoning ordinance be amended to reduce the minimum parking ratio for professional office space and retail buildings to 3 spaces per 1,000 square feet of gross floor area (or, using net office floor area, 3.75 parking spaces for every 1,000 square feet of net office floor area).

¹¹ Mary Smith, Vehicle Sizes Inch Down . . . Literally!, Walker Parking Consultants (2007) (copy available from author).

iii. Implement a maximum limit on parking spaces and require mitigation measures when the maximum is exceeded.

In addition to requiring a minimum number of parking spaces for various uses, the County should also limit the maximum number of spaces that may be built to accommodate each use to ensure that developers do not create unneeded amounts of impervious surface. Under section 16-8 of the zoning ordinance, language should be added to state that the number of parking spaces built for a particular use may not exceed the required minimum number of spaces for that use by more than 40%. Setting a reasonable maximum limit helps ensure that lots are not built to sizes that greatly exceed the anticipated demand for parking.

Local ordinances that contain parking maximums will also normally include a provision allowing County staff to increase or simply waive the limit at a developer's request. We recommend that any Code amendment creating a parking maximum include such flexibility, but also that the Code provide standards for the justification for such a request. The County could require developers to submit with their site plan an official parking study demonstrating the need for the additional spaces. Beyond simply requiring justification, the County should also direct developers to install enhanced stormwater protections in return for permission to exceed the maximum parking requirements. For example, in order to be eligible to exceed the parking space limit, the County could require developers to retain the runoff from all of the parking spaces exceeding the maximum or to use pervious material for all spaces over the maximum. Requiring that a parking study be submitted before parking maximums may be exceeded would give the County the information needed to determine whether additional spaces are in fact necessary, and it would give the County the ability to incorporate more progressive stormwater mitigation practices into parking lot design.

We recommend that section 16-8 of the zoning ordinance be amended to implement maximum parking requirements and outline requirements for when they may be exceeded. We further recommend that a parking study be required as part of the site plan, and that the County require enhanced LID stormwater protections on the site as a necessary condition for exceeding the maximum parking lot size.



Some water draining off of the parking lot at the Gateway Development in Ruckersville can flow directly into bioswales that absorb some of the runoff and can help filter pollution.

iv. Increase landscaping in new parking lots, and require the landscaped areas be designed to collect and filter runoff.



Raised islands such as this provide landscaping, but relatively little stormwater treatment.

It is fairly common for local ordinances to require that some small percentage of the total area of a new surface parking lot be set aside for trees and shrubs. Greene County has already incorporated this requirement in its zoning ordinance: for parking lots of five or more spaces, an area equal to five percent of the total paved area must be set aside and landscaped with plants.¹²

Although parking lot landscaping requirements have traditionally been

based on the desire to provide safe pedestrian havens as well as shade, the planted landscape areas also pose significant potential for treating stormwater. Currently, plants in parking lots are often contained in islands that are raised above adjacent portions of the parking lot and bordered by impenetrable curbs. Because runoff from the paved portion of the parking lot is unable to infiltrate the landscaped areas, the stormwater benefit they provide is limited to the rain that falls directly on top of them.

More effective design techniques are available and are already being used throughout the region. For example, if landscaped areas are built at a slightly lower grade than the adjacent portions of the parking lot and are not surrounded by curbs, or are surrounded by curbs with “cuts,” some runoff from the paved portion of the lot will drain into them. The landscaped areas can then provide the additional benefit of filtering and even absorbing some of the runoff generated by the parking lot. Incorporating “back-up” drainage systems into the landscaped areas, as set forth in the photographed examples below, can address overflow and help ensure that the plants are not flooded during heavy rainstorms. Greene County’s Code could do more to provide developers with the flexibility of adopting these design measures.

In particular, the Code could increase the percentage of parking lots devoted to landscaping, and make clear that stormwater practices that encourage infiltration can be used to satisfy these landscaping requirements. Specifically, we recommend that the Code increase the minimum landscaping requirement to 10 percent, make clear that this requirement can be satisfied by practices that promote the onsite retention and infiltration of stormwater, and allow such practices to count double towards the minimum landscaping requirement. This would provide additional flexibility to developers to integrate LID stormwater practices into their parking lot landscaping, and it would give them some additional incentive to do so.

We recommend that section 19-6-4 of the zoning ordinance be amended to increase the parking lot landscaping requirement to 10%, and to allow the landscaping requirement to be met by features designed to filter a portion of the runoff from the paved parking surface.

12 Greene County Zoning Ordinance § 19-6-4.

B. Streets and Driveways

Streets and driveways are both major contributors to the impervious surfaces generated by residential development. Streets are often the largest single component of pavement in a residential subdivision, accounting for roughly half of the impervious cover in the overall road network of traditional neighborhoods.¹³ Driveways are usually responsible for another twenty to thirty percent of the impervious cover, and cul-de-sacs and other turn-arounds represent approximately seven percent.¹⁴ Because these features can be such major sources of impervious surface, it is important to encourage developers to build street networks that do not have an unnecessarily large footprint and that do incorporate LID measures into their design.

Most counties in Virginia, including Greene, have fairly limited discretion over the design of streets in new developments if they want the Virginia Department of Transportation (VDOT) to bear the expense of road maintenance. This is because the state has prescribed a set of design standards that new streets must meet before VDOT can agree to maintain them. However, VDOT has recently updated these “secondary street acceptance requirements” to include “provisions to minimize stormwater runoff” from the secondary streets.¹⁵

The new regulations grant localities increased flexibility to promote new street designs that incorporate LID measures into the right-of-way and within cul-de-sacs. Developers may be given the flexibility to build narrower streets and smaller cul-de-sacs, where appropriate. We recommend that the County evaluate the new regulations and determine whether it needs to amend its subdivision ordinance or guidance to more actively promote such roadway designs.



To reduce rainwater runoff this Greene County development installed single sided walkways. Traditional curb and gutter systems do not facilitate on-site infiltration of stormwater.

13 Thomas R. Schueler, Headwater Streets (Ch. 6), Site Planning for Urban Stream Protection (1995) (<http://www.cwp.org/SPSP/TOC.htm>).

14 Thomas R. Schueler, Headwater Streets (Ch. 6), Site Planning for Urban Stream Protection (1995) (<http://www.cwp.org/SPSP/TOC.htm>).

15 24 VAC 24-92-10.

- i. Explicitly allow perforated curbs along roadsides in the designated growth areas, and publish guidance documents demonstrating acceptable designs.



Periodic curb cuts allow some street runoff to drain into planting areas like the ones pictured in the example above.
Photo Credit: Lower Columbia River Estuary Partnership.

in the curb allow some runoff from the road to spill into planted areas or other landscaping adjacent to the road (if appropriate) and would offer a natural opportunity for slowing, filtering and absorbing some of the runoff from the roadway. As with landscaped areas in parking lots, “back-up” drainage features can be used to address potential overflow in the planting areas during heavy rainstorms.

In step with the adoption of the new secondary street acceptance requirements, the County should add a sentence to its subdivision street ordinance to make clear that properly-designed perforated curb systems that allow runoff to drain into adjacent planting strips or other areas of natural terrain are acceptable along new streets in the designated growth areas. To further encourage the practice, the County should publish a guidance document demonstrating acceptable designs.

We recommend that the subdivision ordinance be amended to expressly allow perforated curb designs for both public and private streets, and that the County publish a guidance document demonstrating acceptable designs.

- ii. Explicitly allow landscaped islands in the middle of cul-de-sacs, and publish guidance demonstrating how the islands can be outfitted with LID stormwater treatments.

Cul-de-sacs generally constitute large circles of pavement at the end of a residential road. Their use within residential road networks has been increasingly discouraged in recent years by the state because they limit connectivity between different developments and thereby increase congestion on larger connector roads. Where they must be used, however, cul-de-sacs can be designed in ways that help mitigate their stormwater impact. Fortunately, this appears to be another area in which the revised version of the secondary street regulations grants localities increased flexibility.

For example, creating landscaped islands in the middle of cul-de-sacs, rather than paving the entire surface, can help cut down on pavement. A 40-foot diameter island in the middle of an 80-foot diameter cul-de-sac will reduce the impervious surface of the cul-de-sac by 25%. Further, if the island is built at a lower elevation than the surrounding roadway and surrounded by a perforated curb rather than an impenetrable one, it can capture and treat runoff from the adjacent roadway. Installing other LID stormwater features in the island can increase the amount of runoff that can be efficiently treated without overflow. Such practices are explicitly contemplated by VDOT’s new regulations.¹⁶

Conventional curb and gutter systems simply collect all the stormwater runoff from the roadbed and channel it directly to the storm sewer system. This approach is often used in areas of dense development because there is typically less natural terrain on adjacent lots to help absorb the runoff. However, a few minor design changes to the traditional roadside curb and gutter system can allow for the on-site treatment and infiltration of some of the stormwater the street generates.

Specifically, instead of being designed as one long, uninterrupted channel, roadside curbs can be “perforated” with periodic curb cuts. These breaks

Greene County currently requires a fully paved turnaround. The ordinance could be changed to allow landscaped islands, which would give developers the option of reducing the amount of impervious surfaces associated with cul-de-sacs.

We recommend that the subdivision ordinance be amended to expressly allow landscaped islands in the middle of cul-de-sacs, and that the County publish a guidance document demonstrating how LID stormwater features can be incorporated within the islands.

C. Site Layout

Our recommendations to this point have focused on standards and designs that mitigate the stormwater impact of two major sources of pavement in new developments: roads and parking lots. Runoff can also be reduced by promoting a more thoughtful layout of the development on the overall site that minimizes destruction of natural resources and limits disturbance to soils. This is the focus of the recommendations outlined below.

i. Explore developer incentives to preserve existing trees on new development sites.

Trees provide a variety of aesthetic, economic and air quality benefits to a development site; they also can help protect nearby waterways. Specifically, a leafy tree canopy provides an initial barrier to rainfall, reducing the erosive force with which raindrops hit the earth. The leaves and the roots of trees also absorb and filter some of the rainwater that falls on and around them, decreasing the amount of rainfall that becomes stormwater runoff. These effects of trees to slow rainfall and reduce runoff are especially valuable during the critical stages of high erosion that occur during and after construction. A common development practice is to completely clear the development site of trees, and then plant the site with new trees when landscaping is completed. This practice deprives such development sites of the benefit of the canopy provided by mature trees. It can be many years until new trees grow to provide similar benefits.

At present, Greene County has no canopy provision in its zoning ordinance to ensure that new development has an adequate tree canopy and to maximize incentives to protect existing mature trees. In its 2008 session, the Virginia General Assembly passed Code of Virginia § 15.2-961.1. This statute enables localities to adopt a tree canopy requirement, and explicitly mentions efforts to protect existing trees.¹⁷ We recommend that Greene County adopt a canopy requirement for new development and include requirements to preserve existing trees, in accordance with § 15.2-961.1. In order to encourage developers to preserve existing trees, we recommend that the County allow mature trees that are preserved on a site throughout the construction process to count “extra” toward the canopy requirements. Additional incentives for preserving existing trees on development sites can



A common development practice is to entirely clear a site of trees before grading and building.

¹⁷ Frank Mustac. “Virginia Bill Looks to Save Trees.” February 28, 2008, The Fairfax County Times.

also be explored, and we recommend that these incentives include measures that ensure that the designated trees are adequately protected during the entire construction process.

We recommend that the County explore adopting a canopy requirement and related incentives to preserve existing trees on new development sites.

ii. **Adopt a tree conservation ordinance and designate specific trees for protection.**

Another option for preserving existing trees on development sites is to adopt a tree conservation ordinance pursuant to the enabling authority provided in the Virginia Code.¹⁸ Greene County currently has no firm requirement that assures the protection of exceptional trees or wooded areas on development sites. As discussed in the previous recommendation, entire sites can be razed with no mature trees left standing to help slow and filter runoff during and after construction.

One problem with having just a tree canopy ordinance without a tree protection program is that developers can clear the land of many existing trees – large and small – and then meet the canopy requirement by planting new trees which are younger and smaller. Such practices may meet the letter of the law, but it takes decades for these trees to grow to the size of the cleared trees. Greene County is encouraged to adopt a tree protection program that would require the establishment of tree protection zones for all areas not required to be cleared for development.

An example that Greene County could use is that of nearby Fluvanna County. Among the many goals of Fluvanna County's tree protection ordinance is the need to encourage the recharge of groundwater by providing pervious area and to preserve the rural character of the County.¹⁹ Fluvanna County does not explicitly require the preservation of existing trees in new developments. Instead, the Fluvanna Code requires all development projects over one half acre to create a Tree Protection Plan.

The Tree Protection Plan must be prepared by a certified specialist such as an arborist or horticulturist as deemed qualified by the Director of Planning. This program requires the establishment of tree protection zones and provides guidelines indicating that within these zones, existing stands of trees or individual specimen trees whose removal is not necessary for the development of the site should be protected. The guidelines also encourage the use of existing trees to comply with the Landscaping Plan.

Finally, Greene County should consider adopting an ordinance that would allow the County and landowners to work together to provide long term protection for certain trees that are remarkable for their age, history, beauty, or other properties. Other Virginia localities, including Fairfax City²⁰ and Arlington County,²¹ have adopted tree conservation ordinances to protect the trees those localities have deemed worthy of protection.

A tree protection ordinance would help ensure that the stormwater benefit provided by the County's most outstanding trees would be insulated against future development activity.

We recommend the County adopt a tree protection ordinance and designate specific trees deemed worthy of preservation.

¹⁸ Specifically, § 10.1-1127.1 of the Virginia Code gives localities the authority to adopt tree conservation ordinances.

¹⁹ Fluvanna County Code, Article 24. Tree Protection § 22-24-1.

²⁰ City of Fairfax, Va., Code § 110-257 (2007).

²¹ Arlington County, Va., Code § 67-3 (2007).

iii. Improve open space requirements.

Open space requirements are designed to promote development that clusters houses together on the site and preserves larger contiguous tracts as open space. Cluster development provides for more housing units with decreased demand for highly developed land. By having smaller lot sizes, and more housing units, the remaining land is set aside as open space. Cluster development can reduce impervious surfaces by as much as thirty-five percent,²² along with reducing the cost to develop the subdivision.

Although Greene County has a subdivision ordinance to promote such developments, several opportunities exist to improve the ordinance. For example, for the R-1 and R-2 districts, Greene County provides open space requirements that are set as maximums rather than minimums.²³ The rationale behind this is to encourage the maximum use of land in the growth areas for actual building. The zoning ordinance does provide for minimum open space requirements in those areas outside the growth area. For the PUD district, the zoning ordinance requires a minimum of 25 % open space, but gives the Board of Supervisors authority to approve a lesser amount of open space. The County should examine the types of open space being created in its subdivisions and the role of that open space in preventing stormwater pollution. Based on this analysis, the County should consider adopting minimum, rather than maximum, open-space requirements.

In addition, the zoning ordinance language with respect to permissible uses of open space is fairly broad. As a result, a subdivision can use recreational facilities to meet the open space requirements in the County, and the code places no restrictions as to what forms of recreation are allowed to qualify for this provision. For example, in Greene County, subdivisions may build a pool or clubhouse as recreational space and use this to satisfy the open space requirement. A pool or clubhouse increases the amount of impervious surface, creating the opposite effect that open space is designed to achieve as it relates to water quality. In an effort to correct this loophole, the County should develop a list of appropriate recreation activities that would qualify as open space. This list should include activities such as nature trails, picnic areas, natural areas, and sports fields that do not increase impervious surfaces.

We recommend a clarification of County policy that encourages the use of pervious natural areas for the recreational spaces that may be used to meet the open space requirement, especially within the County's designated growth areas. The County should also evaluate whether its cap on open spaces in the R-1 and R-2 districts is achieving its objective.

II. Actively Encourage Low-Impact Development Stormwater Management Techniques

As discussed throughout this report, a new approach to stormwater management has emerged in recent years. It uses a set of techniques collectively known as “low impact development” (LID) to manage rainwater closer to where it falls. The LID approach incorporates small-scale natural landscape features into the designs for new development sites. These features emulate the way the site naturally absorbs and filters runoff in its pre-development state. This is in contrast to traditional stormwater strategies that convey runoff away from the site and into the storm sewer system or local waterways as quickly as possible. Because LID practices use natural systems to filter out pollutants and allow runoff to infiltrate into the ground, they can reduce both the amount of pollutants as well as the overall volume of runoff that flow off a development site. These techniques have some application everywhere, but would be particularly beneficial for development in the County’s growth areas, where denser development has the potential to create more intense local runoff.

²² Lincoln, Nebraska Public Works. “Floodplain Management: Cluster (Open Space) Development” (<http://www.lincoln.ne.gov/city/pworks/watrshed/mfptf/meetings/2002/111902/factsht/pdf/cluster.pdf>).

²³ Greene County Zoning Ordinance §§ 5-10-1 and 6-6-1.

The Rivanna River Basin Commission (RRBC) is currently engaged in a multi-year effort to assist localities in the Basin with reducing stormwater pollution. Part of this program will involve providing materials and technical assistance to help localities and developers in using LID and other stormwater mitigation techniques.

i. Offer incentives to utilize low-impact development features.

Recent research demonstrates that incorporating LID practices can reduce the overall cost of a development project while increasing environmental performance.²⁴ Even still, concerns persist about the amount of time it could take to get these features approved, as well as the potential for higher costs incurred in installing and maintaining them; these concerns appear to be limiting their use.

The County can help address these barriers by offering incentives to incorporate certain LID features into new and existing developments. For example, inducements to developers such as height or density bonuses and reduced or waived application fees could provide the necessary enticement to build green roofs. In addition, the Charlottesville City Council has recently adopted a real estate tax reduction for owners of energy efficient homes and businesses; Greene County should pursue enabling authority to create similar incentives for homeowners and developers who incorporate LID features such as rainwater harvesting systems. Also, as the RRBC's work in this area progresses, it may identify additional options for promoting use of LID throughout the Basin.

We recommend the County explore incentives to utilize green roofs, rainwater harvesting systems, and other low-impact development practices.

ii. Develop and publish guidance on low-impact development options.

While some landowners and developers might be waiting for the type of short-term economic incentive discussed in the above recommendation before they consider installing LID features, others likely have the desire already and simply lack the requisite knowledge. It is therefore important to have written guidance available explaining when certain LID practices may be appropriate, as well as instructions on how to design and implement those practices. It is also very helpful to make clear to developers how they can meet existing regulatory requirements when they use LID practices.

A plethora of stormwater practices are detailed in the Virginia Stormwater Management Handbook and associated technical bulletins. We encourage the County to supplement these materials by publishing its own guidance materials that detail some of the specific LID practices we discuss in this report and that are most appropriate for the kind of development that occurs in Greene County. These materials could be appended to the County's design standards manual or could form the basis of the County's own stormwater guidance document, which could be made readily available to interested landowners and developers. In addition, if the RRBC develops technical assistance documents or provides expertise to Rivanna Basin localities, Greene County should take advantage of these resources. By providing such creative LID information to the County staff members responsible for putting the guidance documents together (as well as members of the citizenry), this effort would help move Greene County to the forefront of innovation in stormwater management.

We recommend that the County make guidance available that describes the acceptable design and installation of some of the LID stormwater management practices we recommend in this report as well as other such practices.

²⁴ For example, a recent U.S. Environmental Protection Agency report analyzes seventeen case studies of developments and compares the costs of applying LID stormwater controls to the costs of traditional stormwater controls on the same developments. The report concludes that in the vast majority of cases, significant savings were realized and environmental performance was improved when LID methods were used. U.S. Environmental Protection Agency, Reducing Stormwater Costs through Low Impact Development Strategies and Practices, Publication Number EPA 841-F-07-006 (December 2007) (<http://www.epa.gov/owow/nps/lid/costs07/>).

III. Limit Sediment Pollution from Construction Sites



Denuded construction sites are especially vulnerable to stormwater sediment pollution.

When clearing, grading and other construction activities expose bare earth and soil to the elements, the rate at which the soil erodes increases dramatically. According to the Virginia Department of Conservation and Recreation, erosion associated with construction activities can be 200 times greater than that from cropland and 2,000 times greater than that naturally occurring in woodlands.²⁵

Similarly, a guidance

document published by the United States Environmental Protection Agency notes that erosion rates from natural areas such as undisturbed forested lands are typically less than one ton per acre per year, whereas erosion rates from construction sites range from seven to 500 tons per acre per year.²⁶

Stormwater runoff can sweep eroded sediment from construction sites into nearby waterways. For example, in just one week in 2002, monitoring stations showed that rainfall washed 1.4 million pounds (or 700 tons) of sediment off of construction sites for Route 288 into the Swift Creek Reservoir, a primary drinking water source for Chesterfield County.²⁷

The primary regulatory mechanism in Virginia for dealing with this problem is the Erosion and Sediment Control Program (“E & S program”). The E & S program requires developers to submit and implement a plan (“E & S plan”) containing the sediment-reduction measures they will undertake on a construction site. At the heart of the E & S program regulations are nineteen guidelines – the state law refers to them as “minimum standards” – which all E & S plans must meet.²⁸ As their name implies, the state’s minimum standards act only as a baseline set of protections. A significant amount of sediment-laden runoff can still escape a construction site even when an E & S plan fully complies with the state’s standards and is properly implemented by the contractors on the site. Further, some of the minimum standards are vaguely worded and contain loopholes that can be easily exploited, minimizing what protection they were meant to offer.

Local governments have the explicit authority to require stronger erosion protections than those contained in

25 Virginia Department of Conservation and Recreation, Virginia’s Erosion and Sediment Control Program (http://www.dcr.virginia.gov/soil_&_water/e&s.shtml).

26 U.S. Environmental Protection Agency, National Management Measures to Control Nonpoint Source Pollution from Urban Areas, Management Measure 8: Construction Site Erosion, Sediment, and Chemical Control, Publication Number EPA 841-B-05-004 (Nov. 2005) (available for download at <http://www.epa.gov/owow/nps.urbanmm>).

27 Tom Pakurar, Hands Across the Lake, Impact of Runoff Pollution 8/25/02-9/2/02 on Swift Creek Reservoir, November 12, 2002.

28 4 VAC 50-30-40.

the minimum standards.²⁹ We have identified several upgrades Greene County could make to its local erosion control program to limit the amount of sediment that gets washed from construction sites into local waterways. These measures have also been recommended in the reports done for the other Rivanna Basin jurisdictions.

i. **Require all erosion and sediment control plans to include a time limit by which all denuded terrain must be permanently re-vegetated.**

Erosion occurs much less rapidly when soil is protected by a permanent vegetative cover than when it is left bare and exposed to the elements. As a result, a key factor in reducing the amount of sediment that gets washed from a development site into nearby waterways is limiting the amount of time that the site is denuded (barren, without any vegetation).

Although Virginia regulations require that denuded terrain at construction sites be re-vegetated once grading is complete or if grading will not occur for a specified amount of time,³⁰ those regulations have a built-in loophole: by simply doing some marginal grading work on the site whenever the deadline for re-vegetation approaches, developers are able to “restart the clock” and leave large portions of construction sites in a denuded condition almost indefinitely. The most noticeable manifestations of this regulatory loophole in our area are the muddy moonscapes that sometimes persist for years at a time along the Route 29 corridor.

In a few recent re-zonings, Albemarle County has begun accepting a proffer from developers that reduces the potential for this type of abuse.³¹ The proffer requires that permanent vegetation must be in place on all denuded areas of a construction site within a certain number of months after grading begins (except for any areas of the site where construction of roads or structures is already underway at that time). The requirement provides needed clarity in determining the deadline for re-vegetation of a construction site.

This approach to stabilization could be incorporated into a locality’s set of ordinances that are related to erosion and sediment control. This would not solve all problems with delayed stabilization, but would provide a time limit for permanent stabilization and would encourage phased development. Greene County should adopt a similar standard and codify the requirement into its erosion and sediment control ordinance so that it applies to all new construction activities covered by the County’s E & S program. This change would help limit one way the County’s erosion protections can be abused.

We recommend the County amend its erosion and sediment control ordinance to require that all erosion and sediment control plans include a time limit by which all denuded terrain must be permanently re-vegetated.

ii. **Expand the list of erosion control measures explicitly referenced in the form contract the County uses for agreements-in-lieu-of-a-plan.**

When a land-disturbing activity results from the construction of a single-family residence, Virginia law and the County’s E & S ordinance allow the property owner to enter into an “agreement-in-lieu-of-a-plan” rather than submit a full erosion and sediment control plan.³² In contrast to a detailed, site-specific E & S plan, an agreement-in-lieu-of-a-plan is usually just a short form contract in which the landowner pledges to comply with any applicable erosion control requirements. This option is meant to streamline the construction planning and

29 Va. Code Ann. § 10.1-570 (2008).

30 4 VAC 50-30-40.

31 For example, the developers of the Biscuit Run project recently proffered the following as part of the rezoning for that project: “Within nine (9) months after the start of grading under any erosion and sediment control permit, permanent vegetation shall be installed on all denuded areas, except for areas the Program Authority determines are otherwise permanently stabilized or are under construction with an approved building permit. A three (3) month extension for installation of permanent vegetation may be granted by the Program Authority due to special circumstances including but not limited to weather conditions.”

32 Va. Code Ann. § 10.1-563 (2008); Greene County, Code § 38-74(b) (2003).

permitting process for landowners or developers proposing only to build a single-family home (as opposed to the larger disturbance necessary for a new subdivision or shopping center).

Because the agreements are broadly worded and often lack detail, their effectiveness can be limited and it can be difficult to enforce them. Some localities, however, append to the agreements a list of specific erosion protections that must be undertaken on any site covered by an agreement-in-lieu-of-a-plan. By way of example, the City of Norfolk expressly incorporates twelve conditions into its agreements. These conditions include, but are not limited to, a requirement to stabilize all stockpiles of soil on the site during construction and a reminder that the contractor must inspect all erosion control measures after rainstorms to make sure they are working properly.³³ By explicitly articulating the most critical requirements, Norfolk can ensure that property owners and contractors are more familiar with the required practices for limiting erosion. This, in turn, can lead to more consistent compliance with the requirements. In the Rivanna Basin, Albemarle County has recently undertaken to revise its agreement to include those additional details.

The contract Greene County uses for agreements-in-lieu-of-a-plan lists only four specific conditions. At a minimum, the other erosion control requirements that Norfolk spells out could be added to the County's form contract. Further, the overall time limit by which all denuded areas of construction sites must be permanently re-vegetated, as recommended above, should also be added to the list.

We recommend that the County expand the list of erosion control measures explicitly referenced in the form contract it uses for agreements-in-lieu-of-a-plan. We further recommend that one of the measures referenced be the overarching time limit for permanent re-vegetation discussed in our previous recommendation.

IV. Increase Protection of Riparian Buffers

The health of riparian areas (the land immediately surrounding streams and other water bodies) plays a critical role in water quality. A healthy, vegetated riparian area stabilizes stream banks, limits erosion, and filters pollution. A disturbed riparian area can be a chronic source of sediment and other pollution. A vegetated buffer near a stream or river mimics the natural functions of the environment. As runoff occurs, especially on steeper slopes, the buffer slows the water down, providing time for capturing pollutants and infiltration. Beyond controlling volume, a buffer also traps sediment and can therefore reduce siltation of the water body. Additional benefits of a riparian buffer are nutrient removal, habitat protection, and tree canopies for shade. Many species of wildlife require specific temperatures, dissolved oxygen levels, pH, and water quality, all of which are parameters protected by healthy riparian zones.

A number of state policies promote riparian buffers. The state's Chesapeake Bay Tributary Strategy sets a goal of conserving and restoring forests along at least seventy percent of all streams and shoreline in the watershed. In addition, the Chesapeake Bay Preservation Act regulations require counties located within the Chesapeake Bay protection area to adopt a buffers ordinance. Counties within the Chesapeake Bay protection area are required to have a 100-foot buffer in resource protection areas, with a goal to reduce sediment pollution by seventy-five percent and nutrient pollution by forty percent – both of which are major pollution problems in the Bay.³⁴

Counties outside the Bay Act protection areas are increasingly adopting buffers ordinances in an effort to protect water quality and their own water supplies. In some cases, these counties use the Chesapeake Bay protection area requirements for their buffers ordinances. Albemarle County is a good example of a locality outside the Bay Act area with a comprehensive buffers ordinance. Albemarle County's Water Protection

³³ A copy of Norfolk's agreement-in-lieu-of-a-plan is available at http://norfolk.gov/Planning/Applications/Erosion_Sediment.pdf.

³⁴ See 9 VAC 10-20-80.

Ordinance requires that buffers be preserved or established along certain water resources and limits the activities that can occur within those buffers. Generally, a buffer width of 100 feet is required adjacent to streams, ponds and wetlands. Within the majority of the County (rural areas and areas draining to drinking water supplies), buffers must extend 100 feet from both sides of all streams, regardless of whether they flow all year (perennial) or just flow part of the year (intermittent). Buffers must also extend 100 feet from ponds and wetlands associated with those streams. In the remainder of the County, buffers must extend 100 feet from both sides of only perennial streams and the ponds and wetlands associated with those streams. Around each public water supply reservoir, buffers must extend 200 feet from the 100-year floodplain.

In addition to Albemarle County, several other counties outside the Chesapeake Bay Protection Area have adopted buffers ordinances. Within Goochland County's rural preservation districts (RP), "conservation areas" must constitute at least fifty percent of the net acreage of the RP. The remainder of such districts is reserved as "development areas" for single-family residential developments. The ordinance requires that 100 foot (for perennial streams) or fifty foot (for intermittent streams) buffers be included "where practicable" and may be used for calculation of the "conservation area" requirement of a development. Goochland County applies its buffers ordinance on developments as part of the site plan requirements.³⁵ Nelson County simply requires a fifty-foot buffer around "any stream" within specified zoning districts.³⁶ Amherst has created a Watershed District overlay, and the buffer requirements are tied to the overlay. The two watershed districts created are the Primary Water Supply District and the Secondary Water Supply District, and the map outlining these districts is superimposed over the traditional zoning map. The Primary Water Supply District has a buffer requirement of seventy-five feet, and the Secondary Water Supply District requires fifty feet. The use of an overlay substitutes for a traditional buffers ordinance, and applies to all development, regardless whether it needs a site plan or a stormwater management plan.³⁷

Several different regulatory approval requirements can trigger the applicability of the buffers ordinance, including land disturbance permits, site plans, erosion and sediment control plans, or stormwater management plans. Many buffers ordinances in Virginia, like those in localities within the Chesapeake Bay Protection Area, are applicable with the submission of a site plan. A site plan is generally required for all construction or other development activities in all zoning districts. Each county may provide for different exceptions to the site plan requirements, such as agricultural uses and single-family homes on a small plots.

Greene County has no buffers ordinance and would benefit greatly from a provision requiring the protection of riparian buffers in connection with new construction in the growth areas as well as the agricultural district. We recommend that Greene County begin an effort to identify where such an ordinance should apply, what the triggering mechanism should be, and how large the protected area should be. We also recommend the adoption of a 100-foot buffer around perennial streams and a 50-foot buffer around intermittent and ephemeral streams, and that all developments needing a site plan be subject to the ordinance. There are numerous ordinances from other counties around the state that Greene County could use as models for its ordinance.

We recommend the County implement a comprehensive buffers ordinance to protect water quality and the water supply.

³⁵ Goochland County, Va., Code Ch. 5, Art. 7 § 3 (2009).

³⁶ Nelson County, Va., Code § 4-3(A) (2010).

³⁷ Amherst County, Va., Code § 710 (2009).

CONCLUSION

Greene County is in an excellent position to protect its future water quality. Although it has grown rapidly in recent years, its rivers and streams have not yet suffered the effects of stormwater pollution from large-scale development. In contrast, large portions of the Rivanna River system in more urbanized Albemarle County and Charlottesville are impaired by stormwater runoff. If Greene County implements these common-sense approaches now it can protect its waters from future harm that might otherwise accompany its ongoing growth.

This report highlights a number of ways in which the County's ordinances and policies can be refined to foster management and development decisions that go further in protecting local waterways. By removing unnecessary regulatory obstacles to smarter development patterns, strengthening water protections where there are currently loopholes, and providing stronger incentives for more sensitive land stewardship, we can ensure cleaner and healthier rivers and streams throughout the County and make needed progress in combating the growing stormwater threat.

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