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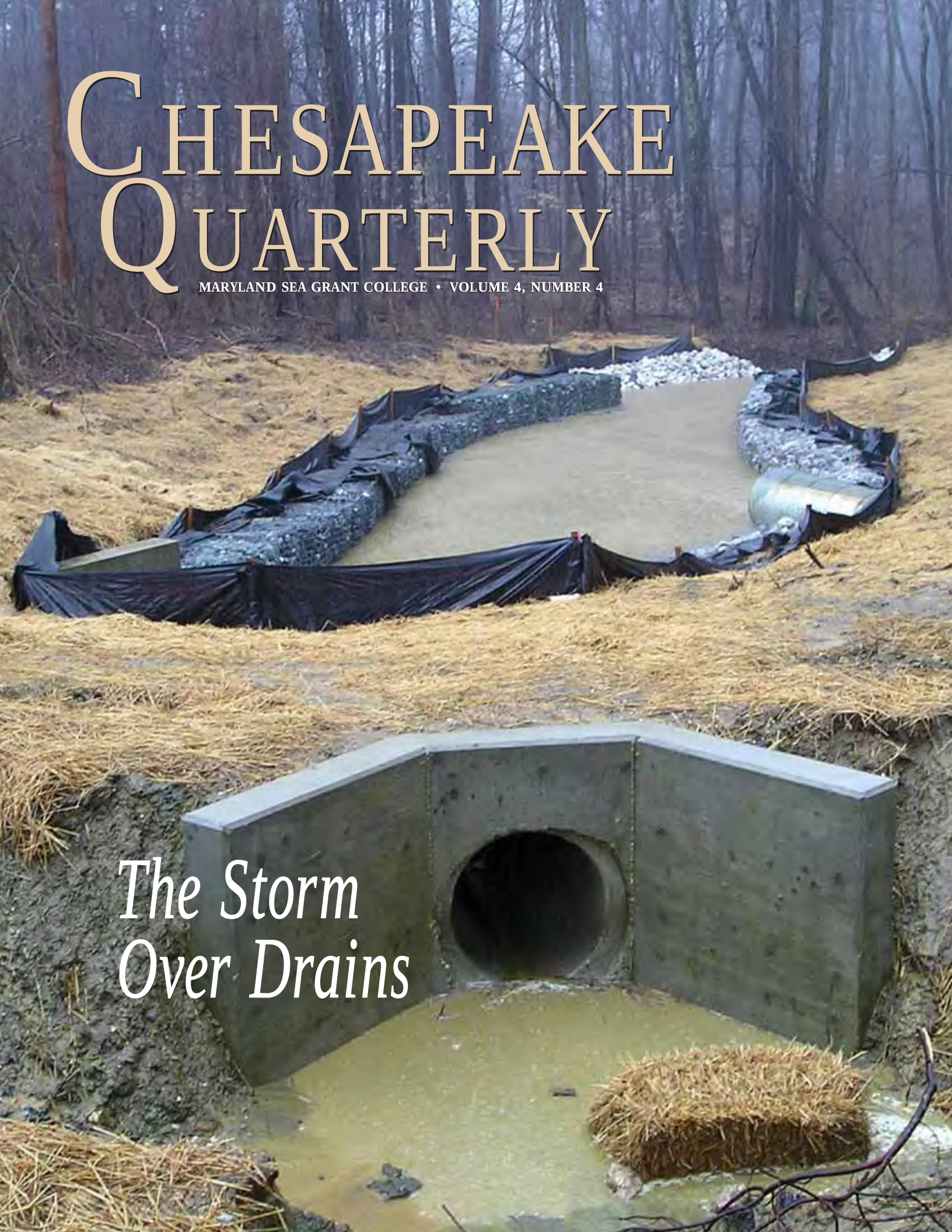

The Storm Over Drains

contents

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Cover photo: *Corralling the rain, a new storm drain sends fine silt towards Beards Creek. Construction recasts the region's natural hydrology.* PHOTOGRAPH BY JACK GREER. ***Photo on opposite page:*** *Twilight settles on Beards Creek, one of a dozen creeks that grace Maryland's South River, now threatened by development.* PHOTO BY SKIP BROWN.

Twilight

As night falls on Beards Creek, red-winged blackbirds drop out of the twilight sky like black dice thrown by an invisible hand. They don't fly as much as fall fast, then with a flutter of wings easily break their speed and settle on the tips of marsh grass. The grass blades bob with the weight of the blackbirds in graceful silence.

Silence is a rare gift as it drops over the marsh that forms the headwaters of Beards Creek. Only a decade or two ago, the silence was as deep as the silt that fills the marsh. But each year has brought more people, more cars and trucks, and more noise from two busy highways beyond the trees. There Route 214 takes traffic east and west, and nearby Route 2 takes it north and south.

When the tide is high enough, the creek can carry a canoe on its thin watery trail through the marsh grass until the ground rises into thick woods. Here the stream deepens beneath a fallen tree and continues on against a gentle flow, right into the face of the forest. If the tide is high enough, you can push your canoe over the clutter of sticks and branches the beavers have piled to stem the flow, and drift right into the shallow flats of the beaver pond.

Though these beaver-tended woods seem inviolate here, the truth is that if the narrowing stream could carry your canoe only a few hundred yards farther, you would paddle right into Route 214. There inexorable lines of cars, trucks, and motorcycles make their way from the Bay to the Washington beltway and back. In the language of the local landscape, this intersection of stream and highway is a critical one.

Here the stream shrinks to pass through a culvert pipe beneath the road. The culvert channels the stream and alters its ability to rise and spread during heavy rainfall, changing its natural flood-

for a Tributary?

plain. The road, too, can be cut off during storm events, when the creek overcomes the culvert pipe and rises across Route 214. On those days, commuters returning from Washington encounter flares burning on the blacktop and a big orange sign that says, "Road Closed." Then they have to turn right and head the long way around the creek through the woods, until they reach Route 2 and turn north to find 214 again.

Except for these flood events, most motorists probably don't think about the stream or have any idea that they are driving over Beards Creek — the same creek where they may fish or water ski or sail or swim. One of those green road signs would be good here, to let commuters know that they are driving over Beards Creek. But when asked about installing such a sign, the State Highway Administration answered no, saying that this was "nothing but a pipe crossing."

Call it the psychology of pipes. According to Dennis Whigham of the Smithsonian Environmental Research Center, creeks and streams often confront this clogging of their arteries. Pipes constrict and channelize stream flow, causing erosion, downstream siltation and habitat destruction. Much better are bridges on raised pylons that allow the water to spread over natural floodplains. A bridge like that here would not only help the stream, it would cure the flooding problem.

In so many places we are changing the way water flows to the Chesapeake Bay. As forests and fields fall to roads and parking lots, streams become ditches. Gone are trees and long meanders that slow runoff. Unimpeded, sediment rushes toward the Bay and its rivers.

Tonight the tide is down, and I cannot canoe past the beaver dam. The old wooden paddle drips as it rests across the gunnels, and the canoe hardly moves, waiting like a patient horse for the time to head home.

I have seen fox and deer and raccoon and possum and beaver in this marsh. I have seen a wild turkey emerge on 214, its eyes wild as it ran like a bewildered old man through the baffling traffic until it found the safety of the underbrush.

This evening, as dusk comes, a winged shadow glides to the bare top of the only large tree in the center of the marsh. Barred owls love these lowlands and marshlands at the edge of forests. Its silhouette looms in the branches, and enough light remains for me to see its tawny back. I lift the binoculars just as he swivels his head. Two severe eyes, the size of silver dollars, fix me like crosshairs. The owl needs no telescope to look right through me.

When I lower the binoculars the bird seems farther off, high in his perch, regal, as though in command. Then the huge wings spread, and like a hang glider the owl pushes from his branch and soars down toward the dim marsh. At the same moment another owl appears from the left, rising to meet him. The two owls tangle and swirl, talon-to-talon, and pirouette down and out of sight. There is no sound.

I fear for the marsh. I fear for the creek.

The water so often now exudes a tan tint, a pale and sickly brown. I have seen this leathery color of runoff before. Several summers ago I took a kayak trip with my photographer friend Skip Brown on the Anacostia River. Skip was taking photographs for an article about the Anacostia for this magazine, and we paddled among rafts of plastic bottles and debris afloat in brown water.

So far Beards Creek still shines with another color, the luminous gray-green common to the Chesapeake — and even, on bright sunny days, a brilliant blue. But more and more runoff — often from construction — makes its way through a long gauntlet of pipes and spills its dark secrets into the creek. Then a shadow of sediment falls on underwater grasses, on oyster spat, on everything.

— Jack Greer

Who'll Stop the Rain?

The Challenge of Managing Stormwater

By Jack Greer

From the waters of Beards Creek Irene Hantman pulls a dripping line tied to the end of her community dock. At the other end floats a plastic crate full of oyster shells, and on those shells lie pale white juvenile oysters (or spat), about the size and shape of a fingernail, and almost as translucent. Hantman and a neighbor examine the spat's growth, but when Hantman pokes each developing shell, none of them close. Though the weather has remained relatively mild this year, she can see that the diminutive oysters have died. All of them.

Oysters have a tough time in Beards Creek. Salinity can drop fast here, when rainfall sends fresh water pouring in from the watershed, bad news for salt-loving oysters. But they've done well in other creeks nearby, and Hantman says that she has a gut-level intuition that there's something else that's making it hard for oysters to survive in Beards Creek.

For almost five years now Hantman and her neighbors have watched the creek's waters change color, especially just after a rain. Brown plumes work their way out from storm drain outlets on both sides of their community — from a pipe right by the community pier and from a marshy outlet to the south, where stormwater finds its way from neighborhood streets and roads and, increasingly, from construction sites.

Hantman and her neighbors believe that this fine cloud of clay and silt has killed their oysters and hurt the creek — they are well aware that scientists have fingered cloudy waters as a prime suspect in the disappearance of underwater grasses. And they know that sediment can cover and smother oyster bars.

What they don't know is exactly to what degree this is happening in their creek, and to what extent the development that has exploded in their Edgewater community has caused any ecological damage. Most of all, they don't know what to do about it.

Skip Brown

Hantman and her neighbors believe that this fine cloud of clay and silt has killed their oysters and hurt the creek.

The rising tide of stormwater *(opposite page) tops the list of sources for nitrogen and phosphorus inputs in Anne Arundel County. This runoff can wash sediment directly into the Bay's waterways, threatening underwater grasses and oysters, like those grown by Irene Hantman and her neighbors (above).*

What the Rain Brings

Stormwater runoff has become a new scourge on the Chesapeake landscape. In 2001, the Chesapeake Bay Program's Executive Council, including the governors of Maryland, Virginia, and Pennsylvania, issued a directive blaming stormwater for poor water quality in over 1,570 miles of streams in the Bay's watershed. According to that directive, "the vast majority of land developed prior to the early 1980s in the Chesapeake Bay watershed has no stormwater quality controls."

As a result, stormwater from urban, suburban, commercial, and residential development carries about 15 percent of the phosphorus, 14 percent of the nitrogen, and 9 percent of the sediment that annually enters Bay waters, according to estimates from the computerized watershed model used by the Chesapeake Bay Program. While agricultural runoff brings in greater loads (more than 40 percent of nitrogen and phosphorus and more than 60 percent of sediment entering the Bay), agricultural acreage is declining, while developed acreage is growing. And in rapidly urbanizing counties like Anne Arundel, stormwater, not agriculture, has already become the dominant source of both sediment and nutrients.

In the 2001 directive the leaders of the Bay states and the federal government agreed to implement innovative stormwater controls on state and federal lands, whether developing or already developed. This voluntary effort transcends existing regulation and serves as a model for municipalities and developers throughout the watershed.

But as Hantman began to learn, a wide ditch separates policy statements and even laws on the books from what may happen on a particular construction site at a particular time. Or in a particular creek.

An Accidental Expert

Hantman is not, as they say, from around here. She grew up in the suburbs of Washington, D.C., in Montgomery County. Like so many others, she moved by the Bay to find a more pleasant life, and to be near the region's premiere natural asset.

Hantman is brown-haired, short in stature, and long on energy. With her eyeglasses and her intense intellectual curiosity, there is something almost scholarly about her, and she seems to take her nature seriously. She moved near Beards Creek in the fall of 2001. When she arrived with her husband Todd and their three-month-old daughter Fern, it never occurred to her that she would soon become a citizen expert in zoning ordinances and stormwater issues. All she knew of Beards Creek was that it lies on the southern shore of the South River and that their two-story wooden house in a modest neighborhood was only a two-block walk away from water.

Hantman has not lived in southern Anne Arundel County long enough to see the gradual changes that preceded her. The old draw bridge across the South River replaced by a fifty-three-foot-high fixed span. Bigger, more expensive waterfront homes sprouting up along the river shore. The arrival of South River Colony along Route 2, a large development bankrolled by a subsidiary of Exxon Corporation, with 900 homes and a

shopping center anchored by a K-Mart two football fields long.

Beards Creek is only one of more than a dozen deep-water creeks branching gracefully off the South River that have seen the effects of changes in the watershed. For now, its marshy headwaters remain a haven for wildlife and a buffer for nutrients while development creeps closer — including a county highway facility constructed right on the edge of the wetland. The sounds of growling motorcycles and roaring cars and trucks on routes 2 and 214 have become the creek's new anthems.

Hantman began her unexpected foray into runoff and the affairs of the creek when a wave of development broke directly on her doorstep.

The angry phone calls and e-mails came in the spring of 2002, not long after she agreed to serve as secretary of her community association. An ugly brown plume had poured into the creek, something unusual for this quiet tributary, and neighbors were upset.

As a recent transplant to the region, Hantman was initially caught off-guard by her neighbors' emotional response. "It took about five e-mails before I finally began to get it," Hantman says.

The plume came from a construction site for Johnson's Lumber, a long-time Annapolis business recently relocated in Edgewater not far from Hantman's house. In an effort to be a good neighbor, the lumber company entered into a set of formal agreements, or covenants, with the community association, promising to minimize the impact of lighting, noise, and commercial access to neighborhood roads. But on the Friday evening of Memorial Day weekend, according to Hantman, contractors decided to empty a temporary stormwater pond used during construction. A filter was supposed to keep sediment from escaping, but fine silt washed directly down the community's storm system and into the creek.

The brown plume, the first of many to arrive from a number of different construction sites, drew Hantman into the world of sediment control and the bureaucratic labyrinths of stormwater management.

Hantman's first inquiries brought her to the Anne Arundel County Department of Inspections and Permits, the office in charge of permitting construction sites. They told her that in the case of Johnson's Lumber everything was being done according to county regulations. They would later tell her the same about other construction projects. And yet ugly plumes continued to darken the creek.

Some runoff during construction was inevitable, they said. Besides, she was told, there were several different issues here: one was the construction permit, another was the issue of sediment control, and yet another was the condition of the community's own stormwater system.

Hantman just wanted to stop the flow of silt into the creek, but she found no one at the county level who seemed to share her concern. "I was incredibly frustrated with the county," Hantman says.

Her association board asked Bea Poulin, a county-appointed community liaison, to attend one of their meetings. Poulin suggested that Hantman and her neighbors contact the county's Public Works Department to find out just what to do about their stormwater problem.

Hantman and other members headed to the Public Works office with a raft of questions. She had heard that new construction was supposed to maintain "predevelopment" runoff levels, but who determines exactly what "predevelopment" means? Who inspects the site before, during, and after construction? What role, if any, do local communities and homeowner associations have? Who would really be there when it started to rain?

The Next Turn

Chris Phipps, chief engineer for the Public Works Department, had heard such questions and complaints before. He told Hantman and her neighbors that Anne Arundel County has a backlog of some $400 million dollars worth of repair work — to fix the pipes, ponds, and other devices that make up the area's stormwater infrastructure. He listened carefully and then suggested that while the county had no budget to undertake extensive repairs at present, he could support a study of their community's stormwater system. Hantman's felt encouraged. It seemed like a place to start.

She next contacted her county council representative to see if he could help — to support funding, for example, to actually repair the stormwater system. She also testified at council hearings, trying to draw more attention to the impact on her community and Beards Creek caused by development projects fringing her neighborhood.

Meanwhile development continued to arrive in a big way. For many years, a lone Giant food store marked the gateway to the neighborhood on the north side of Southdown Road, the main street leading into the neighborhood. A small bank stood on the other side, and south of the bank remained a stand of trees two blocks long. To the north, lay the last remaining farm fields in this area. Now their time had run out.

First one stand of trees fell to make way for a WaWa convenience store with gas pumps. Since construction plans called for runoff from the store and its parking lot to drain into the neighborhood's stormwater system, Hantman's community voiced its concern at a hearing before the county board of appeals. In the end, Hantman and her neighbors saw that the scale of the project remained essentially unchanged and felt their efforts had proven futile.

When the county finished its independent study of Hantman's community stormwater system in 2003, they reported that much of that system was failing. This confirmed Hantman's fear that new construction along Route 2 fed into a system already inadequate to keep stormwater from damaging the creek.

Hantman took this information to a county permit hearing, and questioned how new development could be allowed to tie into a stormwater system that the

See Stormwater, page 8

A Stormwater Primer

Regulations

Erosion and sediment control. The Maryland Department of the Environment has authority over sediment control statewide, but it also delegates authority to counties and municipalities to administer and enforce their own sediment control programs.

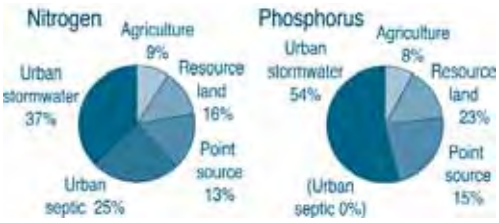
A developer must submit a comprehensive erosion and sediment control plan to comply with both Maryland and federal regulations. Maryland's sediment control regulations are more rigorous than those set forth in the federal Clean Water Act — though violators can face federal as well as state penalties.

According to the Maryland Department of the Environment, the state's sediment and control laws face several limitations. They call for general construction requirements, but do not contain specific standards for pollution prevention or removal. They are designed to handle runoff from smaller storms. According to MDE, "A site that meets all ESC [erosion and sediment control] standards may still contribute a significant amount of sediment to the Bay and its tributaries," especially during larger storm events.

Stormwater regulations. Stormwater controls go beyond controlling erosion and focus on controlling the flow of water from developed lands. Maryland has statewide stormwater requirements in the Code of Maryland Regulations, and in 2000, the state adopted a new Stormwater Design Manual. All counties and municipalities must incorporate the new state requirements into local ordinances.

Maryland's stormwater manual includes guidelines for managing flow during small to large storm events. The manual emphasizes the need to maintain as much as possible flow rates similar to those preceding development. The entire manual in two volumes is available from the Maryland Department of the Environment (on the web at www.mde.state.md.us).

Nutrient Sources
Anne Arundel County Waters, 2002



Chesapeake Bay Program

Stormwater dwarfs agriculture *as the major source of nutrients in developing areas like Anne Arundel County, Maryland. Increasing levels of stormwater will require enforcement of current regulations and more funding, probably through new fees.*

Paying for Stormwater

According to Dan Nees, director of the University of Maryland Environmental Finance Center, stormwater is about two things: "Fixing the sins of the past, and preventing future sins."

The sins of the past include everything from poorly planned parking lots to large ultra-urban environments, such as Washington and Baltimore. The Chesapeake Bay Blue Ribbon Finance Panel, chaired by former Virginia governor Gerald L. Baliles, determined that it would cost about $15 billion to address stormwater problems throughout the watershed. About 60 percent of that figure, or $9 billion, would go to retrofitting stormwater management facilities in already developed areas.

A special problem in older cities is combined sewer overflow, where sewerage headed for a treatment plant mixes with stormwater in a system of shared pipes. Estimates for repairing this problem in Washington and Baltimore approach $1 billion for each city.

While the EPA has listed urban stormwater as one of the top degraders of the nation's estuaries, the problem may not rise to the top of a municipality's priority list. For this reason Nees says that we should focus on increasing the capacity of local communities. "We shouldn't just think of this as a Bay problem. We should think of it as a community problem," he says.

Even at the state level, agencies often lack the capacity to handle and inspect all the permits called for by the federal Clean Water Act and its National Pollutant Discharge Elimination System (see Glossary).

The laws are essentially there, Nees says, but we lack the capacity to enforce them.

One solution, he says, is to create a reliable source of funds at the local level, a dedicated fund set aside specifically for stormwater that cannot be raided for other uses. One model established by a number of municipalities, including Virginia Beach, Virginia, and Montgomery County, Maryland, is to set up a stormwater utility. This approach calls for citizens to pay a stormwater bill, just as they would any other utility, though it is usually modest — for example $5 a month in Virginia Beach. The proceeds are then placed in a dedicated fund and used to implement stormwater management efforts on the ground.

Nees says that the best approach is for communities to focus on not creating stormwater problems to begin with, and to develop the right best management practices (BMPs) such as low impact development (LID) and the right financial tools (e.g., a stormwater utility).

"It is much cheaper to prevent problems than to have to fix them," he says.

For more information about financing watershed protection visit the Environmental Finance Center at www.efc.umd.edu.

— J.G.

Glossary

Bioretention. This method uses carefully selected plants, substrate, and design to slow stormwater and take up nutrients. According to the Nationwide Pollutant Removal Performance Database for Stormwater Treatment Practices, a conventional shallow detention pond or wetland removes 39 percent of phosphorus while bioretention removes 65 percent. Bioretention can also sequester heavy metals and other toxic compounds.

Erosion and sediment control. In 1970 Maryland was one of the first in the country to pass a sediment control law. This law requires a permit from the soil conservation district before construction, and focuses on preventing the runoff of soil and sediment. The law is fairly general, however, and specific implementation occurs at the local level.

Combined sewer systems. Often found in older urban areas like Baltimore and Washington and known as combined sewer overflow (CSO), these combined systems send stormwater and municipal sewage to a waste treatment plant through a network of shared pipes. Rain events can quickly increase volume and challenge a plant's treatment capacity.

Separate stormwater systems. These systems handle stormwater and sewerage in two separate systems. The shorthand term for these municipal separate storm sewer systems (MSSSS) is MS4. These separate storm sewer systems are permitted differently from combined sewer systems.

NPDES. The National Pollutant Discharge Elimination System was established in 1972 under the authority of the federal Clean Water Act. In terms of stormwater controls, NPDES permits took effect in two phases, referred to as Phase I and Phase II.

Phase I. The first phase of NPDES, established in 1990, requires stormwater permits for municipalities with populations of 100,000 or more.

Phase II. The second phase of NPDES, established in 1999, extends permit requirements to smaller municipalities (generally with populations of 10,000 or more) with separate stormwater systems (MS4s) and smaller construction sites (e.g., one acre or more).


Jack Greer


Jack Greer


Jack Greer


Skip Brown

A patch of woods *starts to fall in the Beards Creek watershed (above). Heavy equipment moves in, taking down trees and reshaping the natural hydrology. Large drains and pipes will now tie into the community stormwater system and send rainwater toward the creek. Dying oysters, plumes of brown sediment, and scum on the water drove Irene Hantman (bottom photo, above, and opposite page) to become a citizen activist, an accidental expert on stormwater.*

Stormwater, *from page 6*

county itself labeled as failing. The answer confused her. County officials told her that projects like the new WaWa actually surpassed county requirements for stormwater management — they were, in fact, "overmanaging." Hantman asked exactly what that "overmanaging" meant, and was told that the convenience store would have large underground tanks that would catch the first flush of rainwater. But once the tanks filled, she understood, the stormwater would then empty into the community system.

No one seemed able to answer her question about how that would affect the community's stormwater system or the creek's water quality.

Then in 2004 a developer cleared land for a new subdivision adjacent to nearby Lee airport, and more silt found its way to the creek, more brown plumes wafted into the water. Soon after, another developer cleared what remained of the two-block stand of trees along the neighborhood's eastern edge to make way for a four-story apartment building. Change had clearly come to Hantman's little piece of Bay country.

Coming Full Circle

Hantman trudged through the mud of the apartment construction site, along with two other representatives from her community. They followed the site manager as he pointed out stormwater devices and described their environmental protection measures. Although the company diligently graded the lot and installed silt fences, rainfall soon sent another brown plume down storm drains and into Beards Creek.

Something seemed wrong, and Hantman still questioned how permits could allow construction projects to tie into failing systems.

She decided to take her question to the next level, to the agency charged with keeping pollution out of the state's waterways, the Maryland Department of the Environment (MDE). There she found some very helpful information, and another twist in the bureaucratic maze.

Ken Pensyl, the administrator of MDE's Sediment, Stormwater and Dam Safety Program, like Hantman, takes the environment very seriously. Pensyl informed her that Maryland has a comprehensive stormwater management manual, and tries to maintain "as near as possible" the same runoff characteristics as before land is developed. He assured her that state stormwater rules are in place to reduce stream channel erosion, pollution, sedimentation, and local flooding. The state, he says, also requires local governments to include inspection and maintenance of stormwater practices, which can include specific maintenance agreements, with homeowners associations, for example. Hantman said that she had heard from a number of experts that Maryland's stormwater provisions serve as something of a model for the nation.

But what Pensyl told her next plumbed the heart of the matter. He said that actual decisions on the ground occur at the county level, through local zoning and permitting, and through local enforcement of construction practices.

Hantman found herself right back where she started — at the county level. Like someone lost in the woods who begins to recognize the same trees, she felt that she had come full circle.

Undeterred, she ratcheted the process up a notch, writing a formal complaint to the U.S. Environmental Protection Agency (EPA), and copying both of Maryland's U.S. senators and the Chesapeake Bay Foundation. She did this in her capacity as community association secretary — and because there must be, she felt, some way to step out of this endless cycle. It was now 2005, four years after her move to Beards Creek.

The EPA is the agency charged with enforcing the federal Clean Water Act, first passed by Congress in 1972. That law calls for the nation's waters to become fishable and swimmable, depending on their designated uses. A primary role of the EPA is to enforce limits on contaminants, including sediment and nutrients,

that flow into the nation's waterways, so-called total maximum daily loads (TMDLs). The EPA keeps watch over stormwater management and can penalize states for not meeting the requirements of the Clean Water Act, but Hantman learned that the states have considerable latitude in precisely how they decide to manage stormwater.

The federal government depends on the states. The states depend on the counties. The counties depend on local input. Hantman saw that she would have to become part of that local input.

At hearings and in discussions with government agencies and even developers, Hantman met a barrage of technical information. Runoff coefficients. Sheet flow. Predevelopment rates. If she were going to speak this language she needed to climb the learning curve. She signed up for an urban runoff symposium organized by Allen Davis, director of the University of Maryland Water Resources Research Center. An engineer, Davis is a leading researcher in the relatively new field of bioretention — designing ways to restore natural buffering capacity to highly developed landscapes. (See "Bend in the River," page 13.)

A Day with the Pros

On a brisk November day as 2005 nears its end, Hantman finds her way onto the sprawling College Park campus of the University of Maryland, itself very much a part of the region's urbanized environment. Even finding a place to park can prove a challenge on the 35,000-student campus. She negotiates heavy traffic and a crowded parking deck to arrive at the Adele Stamp Student Union, three stories high and a city-block long, replete with movie theater, bowling alley, food court, and meeting rooms. She gets directions to a conference room on the second floor and arrives to find it packed. Government officials, resource managers, engineers, and others have all come to hear about stormwater and the effect of urbanization on Maryland's streams.

Hantman, it becomes clear, is not alone.

Skip Brown

Bend in the River: Engineering Takes a Turn

Modern development continues to reshape much of the Chesapeake watershed. Bulldozers level once variable landscapes, and construction covers the earth with miles of asphalt and concrete. To move water from this hardened landscape, engineers design pipes and drains, gutters and culverts — stormwater systems that carry water away from our homes and highways. Now growing torrents of diverted stormwater have damaged local streams and creeks, and engineers are taking on another challenge — restoring the landscape's natural hydrology.

Michael W. Fincham

Allen Davis

A rain garden, *such as the one shown above, says Allen Davis (above left), is one of the methods that can lessen the effects of stormwater on the environment. It redirects runoff from impervious surfaces to green areas that keep water onsite. With its thin layer of mulch densely planted with grasses, shrubs, and small trees covering an underlayment of porous soil, it can be designed to mimic natural hydrologic processes to absorb and filter water through uptake by plants, evaporation, and soil filtering mechanisms.*

In Prince George's County, Maryland, stormwater experts led by Larry Coffman began to experiment with new techniques aimed at reducing the flow of damaging stormwater in the Anacostia watershed. They called these methods low impact development or LID. Their approaches were blazing a new path in stormwater management, but what they didn't have was compelling scientific evidence that their techniques were working.

In 1991, Coffman came to the University of Maryland looking for help. There he found a willing cooperator in engineering professor Allen Davis.

Davis did not start out working on stormwater. When Coffman first appeared, Davis was focusing on aquatic chemistry, but was intrigued that there was "virtually no research" on the effectiveness of new stormwater techniques like bioretention.

Davis took on the challenge, and now works at the forefront of civil engineering's new bent, the field of environmental engineering.

Seated in his office in the Department of Civil and Environmental Engineering and surrounded by stacks of journal articles, papers, and reports, Davis says that stormwater is finally getting some of the attention it deserves. The stormwater symposium held in November 2005, the one attended by citizen activist Irene Hantman, drew the biggest turnout they've ever had for one of their meetings.

He has become a firm believer in the art of nature-based treatments, which can take the form of grassy swales, rain gardens, or other terraced and vegetated areas.

These devices work, Davis says. They can change the way runoff moves across the urbanized landscape, and prevent the kind of blowout of streams so common in developed

At the front of the room Davis and other experts describe what we know about stormwater impacts, and what we don't know. Hantman jots down notes and struggles to take it all in.

Davis presents data from his studies of bioretention, where he employs topography, substrate, and carefully selected vegetation to slow runoff and take up nutrients. His work includes four years of data on gutter filters along Route 1 in Prince Georges Country. He shows graphs that document how these filters not only slow the flow but at times absorb virtually all the load. The data also show a reduction of suspended solids, which means that less sediment is washing downstream.

Hantman learns that researchers like Davis are studying ways to degrade hydrocarbons like motor oil and nutrients like nitrate that find their way into stormwater. Microbes are key in both cases, explains Davis, who explores methods for boosting the degrading work that microbes do. For example, he has found that shredded newspaper provides a pretty good carbon source to nurture the right kind of bacteria to convert nitrates to nitrogen gas through the process of denitrification.

From other speakers Hantman learns that stormwater and its effects on streams and hydrology plague many developed areas throughout the Chesapeake Bay's 64,000-square-mile watershed. Margaret Palmer, director of the Chesapeake Biological Laboratory, one of three labs that comprise the University of Maryland Center for Environment Science, tells the audience that even when we work to restore streams, very little monitoring follows. This leaves citizens, scientists, and funding agencies largely in the dark about whether the methods we use to repair insults to the natural hydrology are working. Or not.

Other speakers detail how population has migrated to coastal areas, not only in the Chesapeake region, but in many parts of the United States and beyond. Gerrit Knaap, executive director of the National Smart Growth Center at the University of Maryland, describes the rise of "megacities" and the environmental impacts that follow when developed areas reach farther into farm and forestlands. The trends are disturbing.

For now, Davis and others argue, the key is to promote low impact development (LID) to reduce the amount of runoff — and whatever it carries — at or near the source. This means urging and requiring developers to install retention areas and other features as they build, and not waiting until development is already in place. The most cost-effective thing we can do, Davis says, is to construct these devices upfront, a golden opportunity in areas where development is just taking hold, an opportunity we don't want to lose.

Hantman packs up her notepad. She

areas. That means that they can help slow the rapid erosion that not only wrecks streams and their food webs, but that also sends tons of sediment downstream into rivers like the Anacostia and the Potomac. And into small tributaries like Beards Creek.

By now Davis has worked not only with Prince Georges County but also with Montgomery County, Washington, D.C., and the Maryland State Highway Administration. He has not yet worked with Anne Arundel County, where Irene Hantman and her neighbors struggle to change old ways of thinking about stormwater before the damage is done.

There are barriers, he says. These range from cost, to inexperienced administrators and contractors, to just plain inertia. (See "How to Slow the Flow," p. 12.)

Fifteen years after he first took it on, stormwater has become his passion. "Ninety-five percent of my work is now stormwater and LID [low impact development]," he says.

"In many ways it's overwhelming," he adds. "There's just so much to do." Davis points out that he's a faculty researcher, a teacher. He has his research lab to keep going and six graduate students to support, in addition to teaching classes in environmental engineering and water chemistry. He regularly fields phone calls and e-mails from across the country from those who want to know more about bioretention. "There is enough research in this area to keep me busy the rest of my career," he says. "It consumes my life."

— J.G.

is bolstered by the knowledge that she is not alone in facing the stormwater issue, which represents a nationwide, even a global, challenge. But the talks also make clear the large gap between what is possible — what developers and others could be doing — and what is actually happening on the ground. She lingers to speak to some of the experts before she retrieves her car from the parking deck and returns to the complexities of her own community's struggle to slow the ravages of stormwater.

Changing Waters, Changing Lives

Do the personal energies that Hantman and other private citizens expend on the region's stormwater troubles make any difference? Can they bridge the gap between theory and practice, between regulation and reality?

According to Hantman, the answer is a qualified yes. Until recently, she explains, county regulations gave contractors two weeks to stabilize disturbed sites — two weeks when heavy rains might flush clay and silt from land scraped raw. They now have 48 hours. Hantman credits this change to the hard work of the South River Federation and other activists. Though there are still holes in the sediment control requirements, she says, this represents a real, tangible improvement.

And now inspectors show up more often. That is what Osprey Development and Harkins Builders, the developer and construction firm putting up that apartment building, have told her. "We have never seen an inspector so often," they said. The site manager believes that the county has been "sensitized" to Hantman's concerns. She and her colleagues have evidently been heard.

"Some days it seems that people are really beginning to understand how our behavior affects the Bay. I'm amazed at people in my community who 'want to do something.' But they need to know what little things they can do. Otherwise," she says, "the news can sound pretty hopeless."

She still believes that "every shoreline project, every oyster garden can make a difference." She is also a big believer in low impact development techniques, and hopes to win grant funds so her community can undertake stormwater abatement efforts beyond what the Department of Public Works can afford.

Her community's focus on low impact techniques should help, according to engineer Allen Davis. "People worry about what percentage of a watershed is covered by impervious surface," he says, "but that's not the whole picture." While impervious surface can clearly degrade a watershed, Davis points out that size and location make a difference. Is the impervious surface in huge areas, like giant parking lots (bad); or is it broken up into smaller pieces (better)? Is it downstream or upstream? Are there best management practices that could slow runoff coming from those impervious surfaces, such as rain gardens, sunken medians, or terraces?

"All watersheds," he says, "are not created equal."

There are signs of hope in Hantman's community. Gas stations and car dealerships with deep grassy swales instead of straight gutters. Parking lots with sunken medians, and roofs planted with vegetation to absorb rainwater.

But the biggest challenge, she feels, is a lack of funds and a lack of leadership. "The inspectors I speak to are sympathetic," she says. "They do what they can for tighter controls on construction projects. But they just cannot inspect all the sites. The county code calls for inspecting every two weeks, which is not really enough, and they can't even do that," she says. "They just don't have the manpower. I feel an incredible sense of frustration about that."

"We need the infrastructure to catch up with the advocates," Hantman says, adding that this may mean no new development in some areas. "Some people seem to think that 'all development is good.' We need to be thoughtful about where we live and where we work." She says that development invariably means more impervious surface, which means more runoff — especially without aggressive bioretention efforts to help gather and slow the flow.

Hantman has not yet heard about her complaint to the EPA and says that she still hasn't gotten good answers to many of her questions. How can permits allow new projects to feed into a stormwater system that the county itself says is failing? How will the county handle that $400 million backlog of stormwater infrastructure projects? Who will pay? Who will make sure it happens?

For the past six months Hantman's been working to promote the idea of a Watershed Restoration Fund for Anne Arundel County, built on the concept of a stormwater utility. The utility calls for county residents to pay a small fee, perhaps five dollars a month, to support stormwater upgrades, maintenance, and repairs. This would provide a strategy for chipping away at that $400 million backlog, but so far the plan lacks political momentum.

In many ways, stormwater has changed Hantman's life, something she did not expect when she first moved near Beards Creek with her infant daughter. "I wasn't really 'Bay aware' until I moved down to the South River," she says. Largely she knew what she read in the newspapers. "I knew there was a 'dead zone,' but I didn't understand the scope of the problem."

Now Fern is almost five, and the demands on Hantman's time and energy have only grown. Hantman estimates that she has worked 10 to 20 hours a week for the last two years — for free of course. "It's been a real experience," she says.

She thinks about changing careers. "I might want to do this full time," she says. She's thought about a career in environmental policy work, and perhaps a degree in environmental law.

"It all started with the stormwater work," she says. Others have enlisted Hantman's help as well. She now serves on the Western Shore Tributary Team, used by the Maryland Department of Natural Resources to guide the state's Chesapeake Bay initiatives.

Hantman has connected with others who have taken similar journeys. She has strengthened ties with a network of activists in the Chesapeake Bay Foundation, the local Watershed Alliance, and the South River Federation. She has come to rely especially on Drew Koslow, the South River's full-time riverkeeper. A paid citizen watchdog, Koslow travels the length of the South River in his skiff, *Remedy*, and keeps track of trends and changes, and follows up on complaints. With all the development in the South River watershed, stormwater has risen to the top of his list of concerns. (See "The River's Keeper," p. 13.)

Will the determined intervention of activists and new techniques from engineers finally slow stormwater's destructive tide?

Hantman says that her concerns leave her somewhere between hope and despair. She sees hope in new construction techniques and in stricter adherence to both the letter and the spirit of stormwater regulations. But at times she feels despair watching a development boom that appears to have no end, and that threatens to overwhelm even our best-laid plans. Most of all, she says she wonders whether they will ever be able to raise oysters at the end of the dock, and if it will ever be safe for her daughter to swim in Beards Creek.

How to Slow the Flow?


Jack Greer

Slowing the flow of stormwater is everybody's business. On the front line are contractors and the developers and property owners who retain them. The best time to install stormwater devices is during construction. It's easier and costs a lot less.

Homeowners and businesses must also help to slow the flow. Here are some suggestions:

Rain barrels. Placed at the base of downspouts, they catch runoff from the roof and disperse it slowly, e.g., through a soak hose.

Green roofs. Using carefully designed substrate and plantings, these roof gardens absorb water and provide shade and other benefits.

Infiltration terraces. Rather than forcing water to flow away, these terraces let water seep into the ground.

Permeable pavers and pavements. Unlike conventional asphalt or concrete, these permeable surfaces let water percolate through, reducing runoff.

Grassy swales. Used instead of concrete culverts, these depressions allow water to infiltrate, helping to capture nutrients as well.

Rain gardens (bioretention areas). A form of "vegetated soil media," rain gardens capture runoff and use infiltration and evaporation to slowly disperse moisture, while taking up nutrients.

Sunken medians. Unlike raised medians that drive water away, these depressions gather water and may function like grassy swales or rain gardens.

Barriers That Remain

According to stormwater expert Allen Davis, a number of barriers stymie efforts to reduce runoff.

Lack of understanding. Many local government officials, contractors, or financial officers in charge of letting out bids still do not understand the nature, purpose, or standards for bioretention devices and other progressive stormwater practices.

Lack of information. Good data on how specific stormwater devices perform over time in varying areas are still lacking.

Expense. Stormwater fixes often carry a big cost, especially when old systems must be "retrofit" with newer, more environmentally friendly devices.

Regulatory hurdles. Though Maryland is known for its comprehensive stormwater manual, regulations can still sometimes hinder rather than help.

Inexperience. Contractors and others on the ground often lack experience with new techniques, and may stick with what they know.

Inertia. All these taken together, along with human nature, can lead to a ponderous inertia, with the result that little may change without some countervailing force.

— J.G.

For More Information

University of Maryland Department of Engineering (Bioretention)
www.ence.umd.edu/~apdavis/Bioret.htm

Maryland Water Resources Research Center
www.waterresources.umd.edu/

Maryland Cooperative Extension
www.agnr.umd.edu/MCE/Category.cfm?ID=10

Maryland Environmental Finance Center
www.efc.umd.edu

National Center for Smart Growth Research and Education
www.smartgrowth.umd.edu

Center for Watershed Protection
www.cwp.org

Chesapeake Bay Foundation
www.cbf.org

Chesapeake Bay Program
www.chesapeakebay.net/stormwater.htm

Low Impact Development Center
www.lowimpactdevelopment.org

Maryland Department of Natural Resources
www.dnr.state.md.us/streams/

U.S. Environmental Protection Agency
www.epa.gov/owow/nps/urbanmm/

Maryland Department of the Environment
www.mde.state.md.us

Profile

The River's Keeper

By Jack Greer

All photographs by Jack Greer

The good, the bad, and the ugly. *Riverkeeper Drew Koslow stands near a stormwater pipe responsible for blowing out tons of sediment (above, top). Two approaches to handling such sediment: an expensive creek restoration (right) and a cheaper method that Koslow calls "old school," simply emptying a pipe into a pool surrounded by rip-rap (above, bottom).*

Drew Koslow shouts from the center of a deep ditch, the sides of which rise well above his head. "We call this 'Gingerville Gorge,' " he yells. The ditch was once a small streambed, but water erupting through a large culvert pipe has eroded a deep gully, with banks some 10 feet high. Where has all the dirt gone that used to be here? Into Gingerville Creek, says Koslow, and then the South River, just south of Annapolis.

Koslow is the riverkeeper for the South River, the first in its history, and one of his jobs is keeping sediment from clouding the water and killing underwater grasses. His other jobs include looking for pollution coming into the river, tracking down the culprits, and calling for enforcement of current laws and enactment of new laws where needed. In short, he's responsible for keeping watch over and speaking out for the South River.

Koslow is one of a small but growing army of riverkeepers around the country. The first riverkeepers were fishermen along the Hudson River who created an organization called the Hudson River Fisherman's Association to speak out for their endangered river back in 1966. Robert Boyle, a well-known writer with *Sports Illustrated* and one of the founders of the Hudson River group, discovered a legal hammer in the largely overlooked 1888 Refuse in Harbors Act. That law allowed citizen organizations to sue polluters and offered a way to clean up the river. Boyle and his fishermen friends hired lawyers, sued bad actors, and later found a new name for their organization based on the 1980 book, *Death of a Riverkeeper*, by famed fly fisherman Ernie Schwiebert.

A movement was born, and a new militancy entered American environmentalism. John Cronin, commercial fisherman turned activist, signed on as the first riverkeeper for the Hudson River. Then came the Waterkeeper Alliance, with riverkeepers, baykeepers, and others forming a network of environmental activists nationwide. Riverkeepers often place themselves on the frontlines of environmental protection and environmental

debate. Their best-known advocate and leader (with whom Boyle split in 2000) is one of the nation's most famous sons, Robert F. Kennedy, Jr.

The Waterkeeper Alliance licenses the official use of names like waterkeeper, riverkeeper, and baykeeper. To launch a riverkeeper requires an organization stable enough and well-funded enough to support the effort. In Koslow's case, the organization is the South River Federation, a citizen group created in 1999. Other Bay river associations have hired riverkeepers, including the West and Rhode, the Chester, the Severn, and the Patuxent.

Riverkeepers usually come to their jobs with a background in law or science and a love for the water. Now 43, Koslow first came to the Bay as a boy, back when the bluefish were running and you could "catch 'em with a bare hook."

Though born in Washington, D.C. and raised in Northern Virginia, Koslow had uncles in Annapolis and early on developed a fondness for Bay country. He went on to study environmental science at the University of Virginia and was awarded a fellowship from the Virginia Sea Grant Program.

Koslow considered a number of career paths, working two and a half years for the U.S. Fish and Wildlife Service and then five years for the Maryland Department of Natural Resources. But the grassroots level "is where the action is right now," he says. Koslow helped to launch the South River Federation when he served as president from 1999 to 2002. As riverkeeper he now has an office in the Chesapeake Bay Foundation's striking new "green building" on the shores of the Bay. He says that he loves the energy there.

If you can't find him in his new office, you may find him out on the river or down in a ditch like the Gingerville Gorge. Koslow travels the South River in his fiberglass skiff, *Remedy*, but some days he has to head upstream where his skiff can't reach. On this somber winter day, upstream means the leafless woods behind an office complex on Riva Road,

Jack Greer

Rebuilding what we've lost, *restoring a stream requires a new kind of engineering, with careful attention to soil chemistry as well as water flow.*

in the western suburbs of Annapolis. From his vantage point in the ditch below he explains how this site was developed in the 1990s — from the looks of the huge pipe going straight into the stream, the stormwater controls seem virtually nonexistent.

"I think that in Anne Arundel County we're even worse off than normal, because of the kind of soils we have here." This area has highly erodable soils, he says, easily washed away and very difficult for stormwater managers to control.

Koslow points to models that show that as little as 10 percent impervious surface in a watershed can begin to impair a stream's biology. Those impacts show up clearly in measurements of small organisms — what he calls macroinvertebrates — and in the diversity of fish and other species.

While Maryland and Anne Arundel County have strong stormwater codes — codes that call for "mimicking" undeveloped conditions — these are not always achieved or enforced, he says.

As an example he refers to the construction of a new Safeway on Route 214, where the runoff ends up in Scotts Cove, an arm of Beards Creek. He saw a fallen silt fence there, with the creek turning chocolate brown. "That's 30-year old technology," he says of the stacks of wire and rip-rap placed at the end of a pipe to guide flow of stormwater. "Strictly old school."

Old school is how he might describe the ditch where he now stands. Like the muzzle of an artillery piece, the gaping pipe looks as if it has literally blown away tons of earth.

There are places where stormwater experts have done better.

Only ten minutes away, on the east side of Maryland Route 2, Koslow climbs down into a much healthier looking ravine. Near the community of Wilelinor, not far from the busy Annapolis Harbor Center shopping area, the county and some very creative engineers have worked together to literally reconstruct a tiny tributary. Unlike Gingerville Gorge, here there is a large pond and a newly reconfigured stream with bends and meanders. Environmental engineers made certain that the stream would meander by carving new channels and placing rocks at regular intervals to force a curve in the flow.

There's an art to reconfiguring a stream like this, Koslow says. "They had to dance machinery through a flowing creek."

Outlets along the stream allow water to seep into a restored bog. The whole design aims to slow the flow of water coming from Route 2 and the development there, and to allow sediment to settle and plants to absorb nutrients. Chest-high cedar trees line the entire quarter-mile length of this restored stream — Atlantic white cedars, according to Koslow.

School kids grew these seedlings at nearby Arlington Echo, the county's outdoor environmental education center, says Koslow. When the trees mature, the area will resemble the cedar bogs that some naturalists believe once covered parts of this coastal plain. For now the small trees are each surrounded by a round cage of wire fencing — except for one, which is little more than a splintered stump. "A lot

of deer in here," Koslow says, including a large buck carrying a big rack, that he saw here one evening. "Maybe he's the one that got that tree," he says.

Reconstruction projects like these take a lot of design, a lot of work, and a lot of money. "The county [Anne Arundel] paid for everything," Koslow says.

A housing development is going in next to this creek, and Koslow makes the point that stormwater controls of all kinds are best installed at the time of construction. Otherwise, he says, "it's a missed opportunity." He has seen a lot of missed opportunities.

Koslow points to projects in other parts of the country, including one in the Seattle area called SEA Streets. That project found that aesthetically pleasing stormwater controls — areas with highly adaptive flood-tolerant plants — not only perform an environmental function but also look decorative and, according to one study, actually added to property values.

"Added to property values," Koslow repeats. "That's something every politician will understand."

Koslow admits that there is a long way to go. "The Bay is dying a death by a thousand cuts," he says. He still can't understand how some projects can get permits, when the Clean Water Act prohibits adding pollutants to waterways already listed as impaired. "We need a commitment from government and from citizens," he says.

Not everyone understands this riverkeeper it seems. Koslow has had to take some tough stands, and people have gotten angry — whether lawyers representing developers or private citizens caught breaking an environmental law. "Some people have a personal vendetta against me," he says. At the same time, he refuses to go easy on those who don't obey the rules. Budget cuts and reduced staff at state agencies have unintentionally eased the burden on the development community, he says.

"That's what I like about being the riverkeeper," he says, "keeping them accountable."

Knauss Fellows for 2006

Three University of Maryland graduate students in the Marine-Estuarine-Environmental Science (MEES) program received Knauss Marine Policy Fellowships for 2006. Established in 1979 and coordinated by the National Oceanic and Atmospheric Administration (NOAA) National Sea Grant Office, the fellowship was named for former NOAA administrator John A. Knauss. The program provides graduate students across the country with an opportunity to spend a year working with policy and science experts in Washington, D.C.

Laurie Bauer is spending her fellowship year in NOAA's National Ocean Service Biogeography program. Her work will focus on the assessment of habitat and organisms in the National Marine Sanctuaries.

Bauer received a B.A. in biology from Wittenberg University in Springfield, Ohio in 2001. Following graduation, she spent a year as a volunteer with the Student Conservation Association/Americorps, working at the U.S. Department of Agriculture Invasive Plant Research Lab in Ft. Lauderdale, Florida. She began her M.S. degree in the MEES program at the University of Maryland in 2002 with the support of a Maryland Sea Grant Research Fellowship. Her research, conducted at the Chesapeake Biological Lab under the supervision of biologist Thomas Miller, focuses on the overwintering mortality of blue crabs in the Chesapeake Bay. She plans to graduate in May 2006.

Sheridan MacAuley is working for NASA's Science Mission Directorate. Her work will focus on supporting NASA's involvement in the Ocean Action Plan. She will also assist in developing a plan for NASA's ongoing role in the National Oceanographic Partnership Program.

MacAuley completed her B.S. in biology/biotechnology at George Mason University in 2000. During and after completing her undergraduate degree, she worked for the U.S. Geological Survey in Reston, Virginia, researching microbial nutrient cycling and bioremediation in aquatic habitats. She joined the MEES program in 2002 and conducted her research under the supervision of microbiologist Kevin Sowers at the University of Maryland Center of Marine Biotechnology. Her research focused on microbial fermentation and the production of recombinant proteins by methane-producing marine microorganisms. MacAuley graduated with an M.S. degree in December 2005.

Adrienne Sutton will be spending 2006 in NOAA's Office of Legislative Affairs where she will work with Congressional affairs specialists on policy issues throughout the agency. This will be an opportunity to expand her background beyond research to include an understanding of the role of marine science in the legislative process. Sutton graduated in 2000 from the University of North Carolina at Wilmington where she majored in biology with a chemistry minor. In 2000 she entered the MEES program and in January 2006 successfully defended her dissertation on agricultural nutrient reduction in restored riparian buffers in the Chesapeake Bay watershed.

See Fellowships, page 16

Fellowships, *from page 15*

Both Sutton's research and environmental policy interests center on anthropogenic effects on the health of coastal ecosystems.

Knauss Fellowships run from February 1 to January 31 and pay a stipend of $33,000 plus $7000 for health insurance, tuition, moving, and travel. They are awarded through Sea Grant programs across the nation. For more information about Knauss fellowships, visit the Maryland Sea Grant's fellowship web site, www.mdsg.umd.edu/Policy/knauss.html, and the National Sea Grant office, www.seagrant.noaa.gov/knauss/knauss.html. Those interested in applying for the fellowship should contact the Maryland Sea Grant office, 4321 Hartwick Road, Suite 300, College Park, Maryland 20740, phone 301.405.7500.

Susan Leet Moves On

Some life changes start with large moments, some with small irritations. An earthquake helped bring Susan Leet to Maryland Sea Grant back in 1991. Love of science, education, and students kept her working there as assistant to the director until she retired at the end of March 2006.

Back on October 17, 1989, Leet was working at Stanford University, sitting in a courtyard conducting an interview when the rumbling and shaking began. The quake would kill 69 people in the San Francisco Bay area, leave 12,000 homeless, and disrupt the first and only Bay-area World Series. At 6.9 on the Richter scale, the quake ranked as the second-largest in California history and the scariest in Leet's memory. "It was terrifying," says Leet, terrifying enough to inspire a new life plan.

A year later the Maryland native moved home. It was, she admits, both family and fear of earthquakes that brought her back. A year after the move, she came to work at Maryland Sea Grant.

Working under two directors, Leet was a key player on the Sea Grant management team, serving as coordinator for dozens of different jobs, the invisible administrative jobs that, well done, are seldom noticed. She was always noticed, however, for her patience and persistence — and for her love of political gossip, offbeat films, and weekends in New York.

The Sea Grant job she liked best was working with students, both graduates and undergraduates. Every year she helped graduate students find their way through the interviews and paper trails that led (for many) to a Knauss Marine Policy Fellowship.

The job she liked least was dealing with the endless paperwork that seems endemic to all grant-driven programs. "I will not miss the paperwork and grants.gov," she says. "You can quote me on that."

A Yankee fan, Leet leaves Oriole country with a new life plan. She wants to travel more widely and then relocate somewhere rural, somewhere far from government paperwork and earthquake fault zones.

Send us your comments — visit *Chesapeake Quarterly Online* at www.mdsg.umd.edu/CQ

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