

IN ETNA,

when it rains, it pours. And therein lies a \$2 billion problem. • The tattered square-mile borough sits at the foot of Pine Creek, which courses through affluent hilltop suburbs before reaching the northern shore of the Allegheny River at the town's floodplain. • Rainfall that drops gently into golf courses and manicured lawns at higher elevations sloshes when it arrives in Etna. Gathering velocity as it pours off highways, parking lots and mall roofs, it dumps a dirty, turbulent vortex into sewers that pour into the river when it rains even a tenth of an inch. • When Hurricane Ivan dumped eight inches of rain in 24 hours on September 17, 2004, sewers burst. Etna was inundated—another disaster for an aging town whose population had plummeted in the post-steel era.

But nine years later, the town of 3,900 has undertaken a crash course on how to control its destiny, working with upstream neighbors and rebuilding its streets and parks to soak up rainfall with plants, trees and ingenuity. Instead of being a gray filter, Etna aspires to become a green sponge.

Borough Manager Mary Ellen Ramage has seen Etna residents slowly rebuild homes and businesses that were decimated by the storm. The tax increases that Etna had to impose after Ivan wiped out its savings were another blow. Now the municipality is struggling to raise its share of funds for improvements to the Pine Creek interceptor system, which collects flow from multiple trunk sewers in six municipalities. The \$11 million price tag is more than triple Etna's annual budget.

Still, Ramage is optimistic. She believes that green infrastructure, a combination of natural and passive systems to control stormwater before it hits the sewer system, offers

a facelift for the old river town, as well as protection from future floods.

"It's really exciting to see people believing that there is a way we can control some of this—that's the good part of this," she says cheerfully.

Ramage's enthusiasm has been slow to spread. But 83 local municipalities and ALCOSAN, the Allegheny County Sanitary Authority, are running ahead of some big regulatory sticks. Federal and state consent orders signed in the past decade require them to meet tough new clean water standards for local rivers. That means controlling stormwater surging out of municipal and ALCOSAN systems.

The overall cost: a staggering \$2 billion.

That amount includes \$1.5 billion from ALCOSAN and \$530 million from participating municipalities. As Allegheny County embarks on the biggest public works project in its history, residents are realizing that they have a say in how it's designed. Green infrastructure projects like those planned for

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In the magazine's special issue on urban public education, published earlier this year, Christine's essay on the outlook for urban public education highlighted challenges and reasons for optimism, while her interviews with Pittsburgh high school students revealed their insights about the educational process.



WET WEATHER

WITH DEADLINES LOOMING TO MEET FEDERAL CLEAN WATER STANDARDS FOR PITTSBURGH RIVERS, THE ALLEGHENY COUNTY SANITARY AUTHORITY AND LOCAL MUNICIPALITIES ARE WORKING TOGETHER, WITH PHILANTHROPIC SUPPORT, TO DEVELOP AN INFRASTRUCTURE PLAN THAT IS "GREENER" AS WELL AS CLEANER THAN TRADITIONAL CONCRETE AND METAL PIPELINES. BY CHRISTINE H. O'TOOLE

Etna may offer a carrot: a way to control costs while upgrading public space and conserving energy and water. And local philanthropies are supporting efforts to nudge government officials in this direction.

Etna may be the poster child for stormwater challenges unique to the region: steep hills, too much concrete and aging pipes. The combination of befouled overflow and malfunctioning septic systems has resulted in Pittsburgh's sewage overflow problem being among the worst in the country. Pennsylvania is the worst offender for combined sewage overflows in the United States.

Most of ALCOSAN's 320,000 customers would agree that this has to change. They'd probably say they're all for clean water, in both local rivers and their own homes. They might also agree that federal clean water rules have made the region healthier and more livable. But when they open their sewage treatment bill for the proposed upgrade, which includes 10 miles of new underground concrete tunnels, there will be some predictable howls.

"When people understand how much it's going to cost, there will be questions," predicts Jennifer Rafanan Kennedy, campaign director for Clean Water Action, an advocacy group. "They'll look for a choice: burying money in tunnels under a river, or building green facilities in their neighborhoods."

But no green solutions were included in the draft compliance plan submitted for federal approval last July—only "gray" ones prescribing more concrete. Now, with a deadline extension, advocates are scrambling to shoehorn green infrastructure solutions into the plan. They argue that catching rainfall before it hits the system can lower sewer costs while providing other advantages.

"There are two issues," says Caren Glotfelty, former senior director of The Heinz Endowments' Environment Program. "One is, it's quite likely that at least in some subwatersheds, it will be substantially cheaper to use green infrastructure to solve the problem. The other issue is really important and hasn't been understood. We know there are multiple benefits that accrue—whether it's actual green, like trees and rain gardens, or artful curb designs. Those are amenities that enhance neighborhoods—they beautify and even reduce energy costs. You get those free when you pay for the stormwater [improvements]."

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Jennifer Rafanan Kennedy, campaign director, Clean Water Action

Without a stack of data on proven local results, however, municipalities have been slow to adopt the new solutions. Accustomed to calculating pipe diameters and rate-per-second flow, their engineers dismiss plants, porous parking lots, green roofs and backyard rain barrels as the impractical dream of the hemp-and-granola crowd.

"My biggest frustration has been the inability to get people to the table," says ALCOSAN Executive Director Arletta Scott Williams. Between now and June 2014, when a revised plan is submitted, the "Greens" and the "Grays" are racing to find common ground.

For too long, however, southwestern Pennsylvania relied on rivers as a dumping ground for sewage. "Rivers are the natural and logical drains and are formed for the purpose of carrying the wastes to the seas," declaimed N.S. Sprague, superintendent of the Pittsburgh Bureau of Construction in 1912. Open sewage drains ran down the center of many neighborhood streets. In 1907, the city opened its first water filtration plant and began a sewer building binge. Like most other large American cities, it chose a combined system to carry sanitary waste and stormwater—the cheapest and easiest solution, used by nearly 95 percent of cities with populations of more than 300,000. Systems overflowed to the rivers.

Today, those old Midwestern and Northeastern cities face similar consequences: an overloaded hodgepodge of systems patched together, poorly maintained, and prone to dumping sewage into streams when overwhelmed by storms. Most are scrambling to comply with the Environmental Protection



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WATER, WATER EVERYWHERE

Many people don't think about the Pittsburgh region's aging infrastructure until stormwater overwhelms sewer systems, leading to flooding that damages property and roads, and can be life-threatening. In the top photo, stormwater runoff and overflowing water from a nearby creek inundate a Pittsburgh street during a July 11 storm. On the same day, water pours off a parking lot at a greenhouse, above, in the suburb of Baldwin Borough. Below, water gushes out of a storm drain.



Agency's demands to limit combined sewer overflow (CSO) as well as sanitary sewer overflow (SSO). In 2008, ALCOSAN agreed to find a way to eliminate all SSOs and greatly reduce CSOs into the three rivers.

From tiny Etna to the city of Pittsburgh, no government wants to increase taxes. But the failures of the current system can no longer be ignored. "We've had 149 years of deferred maintenance," says John Schombert, executive director of 3 Rivers Wet Weather, a nonprofit addressing the problem. "I use an automotive analogy: If you don't change the oil, it's cheap—until you get a \$3,000 bill. We're beyond oil changes now."

ALCOSAN has grappled with how to comply with EPA regulations since at least 2008, when it signed a consent order to develop a plan to keep sewage out of the rivers. The \$2 billion version announced in July 2012 would capture not all, but 79 percent of combined sewer overflows, with special attention to recreation areas. It would build vast underground tunnels for storing and conveying sewage, and expand ALCOSAN's wastewater treatment plant on the Ohio River to 480 million gallons a day for primary treatment, which allows solid material to settle from the liquid, and 295 million for secondary treatment, the biological process to remove organic material.

Fulfilling all aspects of the EPA mandate would have cost the region \$3.6 billion. Deeming that unaffordable, ALCOSAN made a series of careful compromises to reduce costs—but ignored green infrastructure solutions to capture water before it enters the system.

"In our planning process, our individual basin planners were tasked with looking at potential green applications," explains ALCOSAN's Williams. The process identified seven regional watersheds, asking municipalities to coordinate across their boundaries. "We didn't have a high response. Municipalities weren't interested. Now, we're going to go back. There is more regional interest in looking at green. The county executive [Rich Fitzgerald] is leading the effort. [Mayor Luke Ravenstahl] redirected the Pittsburgh Water and Sewer Authority to incorporate green approaches to the extent feasible. The municipalities will come to the table with different energy."

A different energy pervaded the David L. Lawrence Convention Center on Feb. 15, when shirt-sleeved engineers and backpacking green geeks came together at the first of three community meetings on "greening" the wet weather scheme.

GREEN INFRASTRUCTURE

With quality-of-life issues as a priority, The Heinz Endowments has promoted sustainable design as an essential strategy. A decade ago, it began a partnership with 3 Rivers Wet Weather to create public understanding and policymaking on the connected issues of water quality and stormwater reduction. The Endowments has provided \$3 million in support through next year, and 3 Rivers Wet Weather has become an influential player in the regional wet weather plan. The organization supports stormwater demonstration projects and has created online mapping and engineering tools that quantify green infrastructure approaches.

The Endowments also was a major funder of the decade-long rehabilitation of Nine Mile Run, a polluted city creek. The \$7.7 million effort, including \$1.6 million from the Endowments, is the largest stream restoration project ever undertaken by the U. S. Army Corps of Engineers. The project to restore more natural stream flows and improve water quality included stormwater management. Today, many homes near the newly inviting stream sport rain barrels, the result of a public education program on green solutions to keep sewage out of streams.

Rain barrels are “a great way to get people thinking and involved and willing to support other public policy initiatives,” says Brenda Smith, executive director of the Nine Mile Run Watershed Association. “But if you really want to have an impact, one green roof on a commercial building equals [the source water reduction] of dozens of rain barrels. One permeable parking lot is dozens of barrels.”

Green roofs, like the one installed at the Allegheny County Office Building in 2011, have been monitored for performance. Pittsburgh’s new zoning code requires that new developments capture at least one inch of rainfall, making green roofs a viable solution. The county project captures 60 to 100 percent of rainfall, has helped reduce electricity and steam usage for the building, and mitigates extreme heat.

Rainwater gardens are landscaping features, usually placed within parking lot islands or pockets of residential land, that are designed to capture and treat stormwater. Roof or surface runoff is directed into the gardens, increasing stormwater storage, filtration and pollutant reduction.



Photo: 3RWW



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Sixteen times more stormwater runoff is produced by a one-acre parking lot compared to a one-acre meadow.



Permeable parking lots, made of permeable paving stones, concrete or asphalt, allow water to drain through and be absorbed into the ground. As an alternative to conventional concrete or asphalt, permeable pavement reduces stormwater runoff volume, rate and pollutants.



Bioswales are shallow, open channels of vegetation and soil that reduce runoff by collecting, absorbing and filtering rainwater from streets and houses before it goes into storm drains. They also trap trash and remove pollutants, such as some chemicals.

Photo: David G. Himes of The Penn State Center

Photo: 3RWW



Green roofs, with their moisture-absorbing plant cover, can reduce stormwater runoff from commercial, industrial and residential buildings. In contrast to traditional asphalt or metal roofing, green roofs absorb, store and later enable precipitation to evaporate, serving as a stormwater management system.

50%

The EPA's extensive study of roofs found green roofs retained an average of 50 percent of rainfall (and up to 90 percent during summer weather).

Photo: 3RWW

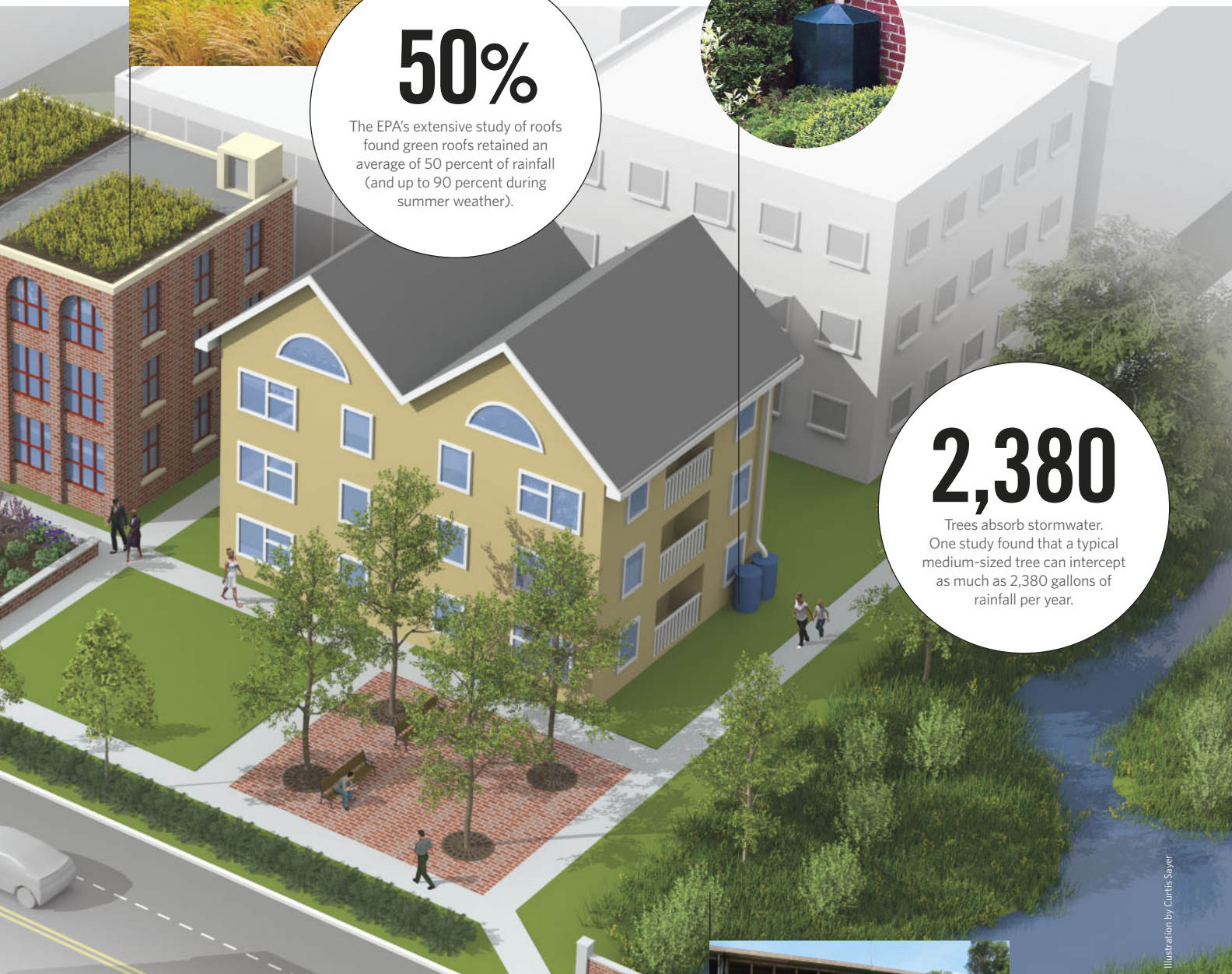


Rain barrels collect and store rooftop runoff from downspouts for later use. By holding and diverting runoff without using salts or sediments, they reduce flooding and erosion, provide chemical-free water for gardens and lawns, lower water bills, and conserve municipal water supplies.

2,380

Trees absorb stormwater. One study found that a typical medium-sized tree can intercept as much as 2,380 gallons of rainfall per year.

Illustration by Curtis Sayer



Stream buffer restoration involves improving the environmental health of a river or stream and returning it to its natural condition and function. Goals include improved habitat for aquatic life and wildlife, biodiversity maintenance, sustainable recreation, landscape development and flood management.

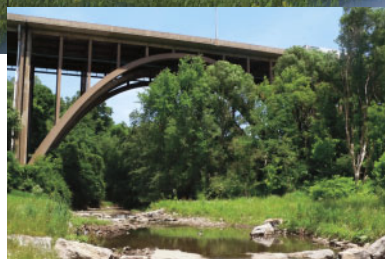
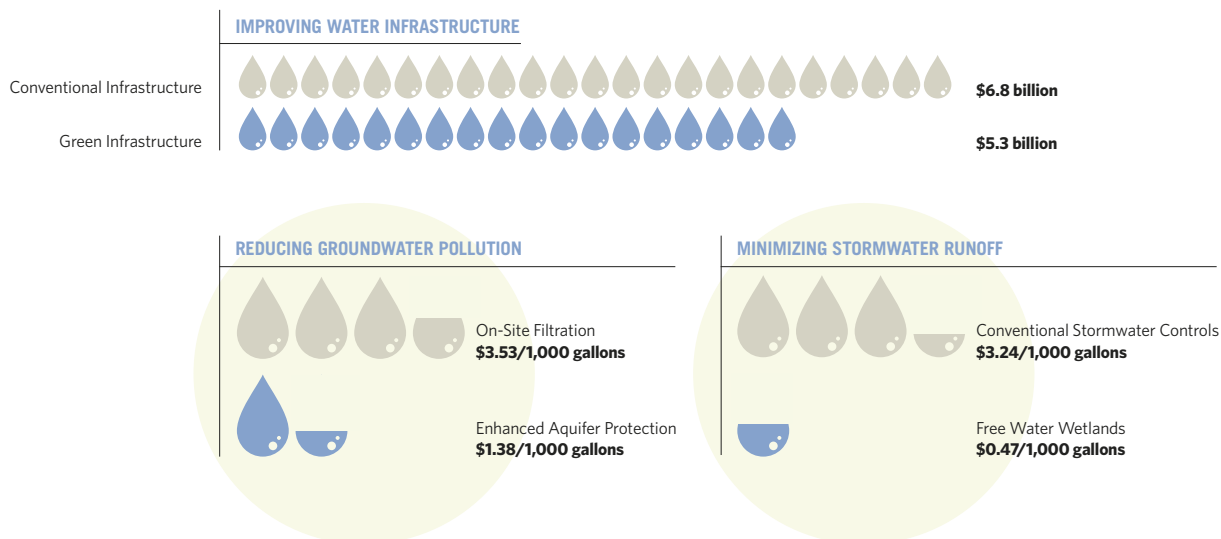


Photo: Nine Mile Run/John Moyer



SAVING GREEN

Cost analyses that compare green infrastructure to gray are convincing international cities to change their plans, according to a 2013 study by the World Resources Institute.

New York City evaluated two schemes to manage its stormwater flows. One was a green infrastructure plan that emphasized stream buffer restoration; green roofs; and bioswales, which are landscape elements designed to remove silt and pollution from surface runoff water. The other was a gray infrastructure plan involving tunnels and storm drains. The green infrastructure option, illustrated in the graphic above, presents an overall cost savings of more than \$1.5 billion. Decision-makers in Idaho and North Carolina found similar cost savings through green infrastructure.

In particular, green infrastructure methods were better and more cost-effective solutions for reducing groundwater pollution and minimizing stormwater runoff.

Foundations that had been supporters of previous wet weather pilots—including the Endowments and the Richard King Mellon, Pittsburgh and Colcom foundations—funded the series organized by the Pittsburgh Water and Sewer Authority, which serves many communities outside city limits. The groups sat down at tables draped in data: large paper maps detailing regional sewer lines, city-owned land and sewer outfalls along the rivers. Pittsburgh Mayor Luke Ravenstahl picked up the meeting's theme in a welcoming speech.

"This isn't the sexiest stuff to deal with, but it is perhaps more important than anything else we'll do in the next 10 years in this region. We need to consider good, solid investment in green infrastructure. Consider me an ally," he told the group.

Kari Mackenbach, an expert on green infrastructure practice across the country, led a breakneck review of cities meeting consent orders with green projects. Louisville, San Francisco, Kansas City and Columbus have found quantifiable benefits in controlling stormwater through permeable pavement, replanted rights of way on streets, and other green solutions, she noted.

The results from peer cities showed promise. "What we saw at the [meeting] was lots of data in places not dissimilar to Pittsburgh," argues Glotfelty. "There are viable options, and lots of data we can apply to see how far we can get."

In July, the Pittsburgh authority submitted a feasibility study to the state Department of Environmental Protection and the Allegheny County Health Department that included \$10 million over the next four years to test and implement green infrastructure solutions such as permeable asphalt, rain gardens and landscaped swales. Along with conventional infrastructure upgrades, such as the construction of a water tower and widening of pipes, the estimated cost of implementing the plan is \$165 million.

Supplanting gray infrastructure with green requires flexibility, says Chris Crocker, deputy director of the Philadelphia Water Department. That city's \$1.2 billion plan relies primarily on green infrastructure to meet EPA requirements, with the federal agency's blessing (see sidebar on page 31). "It's covering the same [tasks] with lots of little steps along the way, lots of little lifts."

For Etna, even little steps are big. "We've already spent \$1 million in compliance up till now, ranging from engineering studies to televising our sewer system," says Borough Manager Ramage. With an annual budget of \$3.9 million, she has scrounged grants and partnerships to add green projects.

The borough will break ground on a new renovation of the Butler Street business district before the end of the year. The community also recently received \$50,000 in EPA funding for the design of another block of Butler. The green streetscape will

PHILADELPHIA FORGES AHEAD

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include a handful of innovations to soak up rainwater: a portion of the sidewalks, street curbing and three parking lots will be repaved with permeable concrete. Tree trenches surrounded by decorative grates will catch more water.

The town's recreation center will add oversized rain barrels to catch roof runoff. A rain garden alongside the town swimming pool will be maintained by the local garden club, which will use the rain barrels to water community garden plots. Taken together, the efforts will allow the area to capture 1.25 inches of rainfall, in excess of current municipal standards. The EPA is providing \$375,000 for the project through the state's Growing Greener program, and Etna will contribute \$25,000 in matching funds.

And the borough is going even further. Engineers are now pinpointing what Ramage calls "hot spots"—areas that contribute the most overflow to the system—and has offered incentives for homeowners to disconnect their roof downspouts from sewers. It's working closely with its uphill neighbor, Shaler Township, to design a retention pond renovation that would recharge groundwater and wetlands.

Publicly owned land offers opportunities to demonstrate how municipalities can tackle sustainable stormwater management. "This is a local land use issue, and few municipal engineers have experience" in green technologies, says 3 Rivers' Schombert. "Between our slopes and soils, there's an urban legend that green infrastructure won't work. The reality is, it can be made to work. We can direct water toward green infrastructure."

Still, Ramage and others know that green can't solve all the region's wet weather issues.

"We could never install enough green infrastructure to solve all our issues—both flooding and the consent order," says Ramage.

Schombert agrees that pipes and tanks remain the backbone of the regional system. "We won't control big storms with green approaches alone. The volume is so enormous. The gray facilities are there to handle peak flow."

But Ramage believes that collaborations and new ideas are more welcome as the region re-attacks its wet weather plan. "Maybe this is the consent order's silver lining," she muses. "Now, doing things on a regional basis is becoming more palatable to communities. It's kind of cool. We're in a position to start from ground zero." *h*



While most Northeastern metro areas struggle to add green projects to gray infrastructure, Philadelphia's wet weather plan relies on sustainable projects to lead the way.

With the theme "Soak It Up, Philly!" the effort endorsed by the Environmental Protection Agency deploys \$1.2 billion in permeable pavement, stormwater planters, rain gardens and green roofs. The Navy Yard in Philadelphia is a 1,200-acre former naval base that is being redeveloped into a vibrant business campus along the Delaware River. Plans for it include the creation of Central Green Park and the installation of reflecting pools and stormwater canals that will purify stormwater while beautifying new residential and mixed-use neighborhoods. Already completed are League Island Park and a new recreation trail.

"We're leading with green and leveraging the gray we have in place," explains Chris Crocker, deputy director of the Philadelphia Water Department. "Tunnels don't work for us—we'd spend \$8 billion or \$9 billion, versus \$1.2 billion over the same period of time."

Crocker says the city is committed to a triple-bottom-line approach to capital projects, meaning that they must meet social, environmental and financial performance. "The rough number we have is that spending \$1 on combined sewer outflows with green methods yields \$1 of improvement for the public, in property values, heating and cooling, and jobs."

The city offers stormwater bill credits to developers who meet new standards. Crocker says 350 have already applied for the incentive.

Because Philadelphia is both a city and a county, it has bypassed the turf issues that complicate municipal consent agreements in southwestern Pennsylvania. John Schombert of 3 Rivers Wet Weather says that's not the sole reason complicating the ALCOSAN negotiations.

"Philadelphia has done well. They are seeing this as an opportunity for redevelopment," he notes.