



NEWSLETTER OF THE PARTNERSHIP FOR THE DELAWARE ESTUARY: A NATIONAL ESTUARY PROGRAM

Nonpoint Source Pollution: the Delaware Estuary's Biggest Water Quality Problem

By Kathy Klein, Executive Director, Partnership for the Delaware Estuary

Thanks to the passage of the Clean Water Act in 1972, water quality in our country has greatly improved over the past 33 years. The Act established the basic structure for regulating pollutant discharges into the waters of the United States. Accordingly, it gave the Environmental Protection Agency the authority to implement pollution control programs, such as setting wastewater standards for industry.

The Clean Water Act made it unlawful to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions. It also funded the construction of sewage treatment plants, which led to tremendous water quality improvements, especially in large population centers like Philadelphia, Wilmington and other cities in the Delaware Estuary.

In spite of the improvements brought about by the Clean Water Act, water quality in many places around the country is still not drinkable (without treatment), swimmable or fishable. The reasons for this are many, but one of the biggest culprits is nonpoint source pollution, also known as stormwater runoff pollution.

Nonpoint source pollution occurs when water from rain or melting snow flows over the ground, picking up debris, chemicals, dirt and other materials on its way into a storm sewer system, river, stream, lake, wetland, or coastal waterway. In urban areas, the variety and amount of pollutants transported into waterways is exacerbated by the increase of impervious surfaces, such as driveways, sidewalks, streets, and parking lots. These surfaces prevent stormwater runoff from naturally infiltrating into the ground.

In the Delaware Estuary, stormwater from many areas is washed into storm sewer systems, which drain directly into water bodies. Unlike point source pollution, instituting regulations to prevent this type of contamination is difficult because each and every one of us is the cause of the problem.

Due to the complexity of nonpoint source pollution, we are dedicating this issue of Estuary News to both its impact within the Delaware Estuary and to some of the creative strategies being used to address this problem in the region. We are also providing our readers with simple tips that can help each of us to reduce this major source of pollution. ■

In this Issue

2 Updates

New Website Goes Live!

Schuylkill the Site of Coast Day

Celebration Reaps "Bounty" of Funding

Hurricanes Ravage Barataria Terrebonne Estuary and its Children

5 Making Waves

Sharing Resources to Manage Stormwater in the Schuylkill

DogIPots Arrive in Pike Creek

7 Policy

Philly Moving Toward Better Stormwater Management

DRBC Stormwater Retrofit Project

9 Estuary Basics

Stormwater Runoff and You

10 Species Specific

The Mighty Elliptio and Stormwater Runoff

12 Teachers' Page

Students Participate in World Water Monitoring Day

Stormwater and the Schoolyard

14 Estuary Events

Highlight

Glossary of Stormwater Terms, page 15

New Website Goes Live!

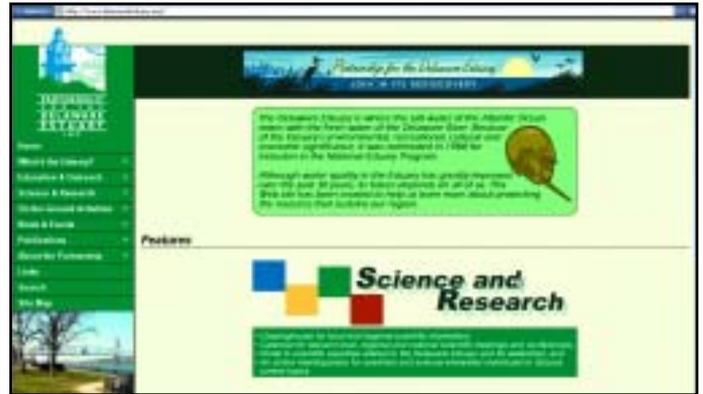
By Shaun Bailey, Marketing and Communications Specialist, Partnership for the Delaware Estuary

The Partnership for the Delaware Estuary has unveiled a revamped website, located at www.DelawareEstuary.org. From an improved home page, visitors can access a wide variety of new information, making this technological improvement a significant leap forward in serving stakeholders.

One of the many new additions to the website is a section entitled "Science & Research." Here, visitors can browse everything from scientific articles to late-breaking data sets and reports. Furthermore, scientists can access any one of eight different message boards, where featured topics include everything from general matters to water quality, emerging issues and more.

The website also includes a new section solely dedicated to "On-the-Ground Activities." Many programs with volunteer opportunities are described in this area, including the Corporate Environmental Stewardship Program, Restoration Rangers, "Sense of Place" program, and the Schuylkill Action Network.

Those working to increase Estuary awareness now have pages dedicated to them in the "Education & Outreach" section as well. For instance, teachers can now access important information on classroom presentations, drawing contests and course materials. A "Kids" page will soon offer many activities for youngsters to explore.



The new homepage of www.DelawareEstuary.org

Estuary press releases are in the new "News & Events" area, and on the "Other Events" page, eco-enthusiasts can find dozens of upcoming environmental events throughout the Estuary. Past Partnership newsletters are archived in the "Publications" section.

Visitors are advised to return to the website often, as new content will be posted on a frequent basis. For more information, or to have your environmental organization's event posted to the "Other Events" page, please contact Shaun Bailey at (800) 445-4935, extension 113. ■

MEETINGS CONTACT LIST

The meetings of the Estuary Program's Implementation Teams and Advisory Committees occur on a regular basis and are open to the public. For meeting dates and times, please contact the individuals listed below:

Estuary Implementation Committee

Kathy Klein, Executive Director (Chair)
(800) 445-4935, ext. 102
kklein@delawareestuary.org

Monitoring Advisory Committee

Edward Santoro, Monitoring Coordinator
(609) 883-9500, ext. 268
edward.santoro@drbc.state.nj.us

Toxic Advisory Committee

Thomas Fikslin, Branch Head
(609) 883-9500, ext. 253
thomas.fikslin@drbc.state.nj.us

Polychlorinated Biphenyls Implementation Advisory Committee

Pamela Bush, esq.
(609) 883-9500, ext. 203
pamela.bush@drbc.state.nj.us

Fish Consumption Advisory Team

Thomas Fikslin, Branch Head
(609) 883-9500, ext. 253
thomas.fikslin@drbc.state.nj.us

Science Coordination

Danielle Kreeger, Estuary Science Coordinator

(800) 445-4935, ext. 104
dkreeger@delawareestuary.org

Habitat Restoration Coordination

Kellie Westervelt, Restoration Director
(800) 445-4935, ext. 111
kwestervelt@delawareestuary.org

Delaware Estuary Education Network

Lisa Wool, Program Director
(800) 445-4935, ext. 105
lwool@delawareestuary.org

Schuylkill the Site of Coast Day

On September 25, the Partnership for the Delaware Estuary, in collaboration with the Philadelphia Water Department, held the 4th Annual Southeastern Pennsylvania Coast Day at the historic Fairmount Water Works, on the banks on the Schuylkill River.

Thousands of people spent their Sunday visiting exhibits by environmental organizations from throughout the Delaware Estuary, and learning ways they can help protect and enhance water resources. Children especially enjoyed the festival-like atmosphere thanks to many activities, such as an inflatable slide, arts and crafts, face painting, music, food, and more.

One of the attractions was the Fairmount Water Works Interpretive Center, where free tours were conducted throughout the day. Also popular was the Water Department's "Fun Philly Fishing Fest." At this event, citizens of all ages enjoyed the fun of "catch and release" fishing, and many received awards for their skills as anglers.

Sponsors for this year's event included the Philadelphia Water Department, Pennsylvania Coastal Zone Management Program,

TOP PHOTO: Estuary residents big and small learned about water conservation at Coast Day in Philadelphia. **AT RIGHT:** People of all ages enjoyed the many activities at Southeastern Pennsylvania Coast Day, including face painting.



Pennsylvania Department of Environmental Protection, the National Oceanic and Atmospheric Administration, and the Fairmount Park Commission.

For more information on this and future Southeast Pennsylvania Coast Day events, please call (800) 445-4935, extension 106, or visit www.DelawareEstuary.org. ■

PARTNERSHIP FOR THE DELAWARE ESTUARY

Hurricanes Ravage Barataria Terrebonne Estuary and its Children

In the aftermath of Hurricanes Katrina and Rita, the Barataria Terrebonne National Estuary Program (BTNEP) has continued to work with local, parish, state and federal agencies, and the business community, to help the thou-

sands of school students who were evacuated. However, needs continue to far outweigh resources. As a result, the BTNEP and its related Barataria Terrebonne Foundation (BTF) have launched "Operation A.B.C.: All Barataria's Children." This

fundraising drive is outfitting displaced students throughout the Estuary with the supplies they so desperately need.

For more information on the BTNEP, and Operation A.B.C.: All Barataria's Children, please visit www.btne.org. ■



Celebration Reaps 'Bounty' of Support

On October 6, the Partnership for the Delaware Estuary held the 7th Annual "Experience the Estuary Celebration" at the Figure 8 Barn in Bellevue State Park. "Bounty of the Bay" was this year's theme and over 250 guests attended the annual fundraiser.

Partygoers were treated to a newly featured raw bar of oysters from the Delaware Bay and fine cuisine representative of the region's bountiful resources. Entertainment throughout the evening included reggae music, silent



Volunteers, Eric Lienhard and Shannon O'Neill auctioned off numerous items at the Partnership's fundraiser.

PARTNERSHIP FOR THE DELAWARE ESTUARY



PARTNERSHIP FOR THE DELAWARE ESTUARY

Board Member, Judi Jeffers, and Executive Director, Kathy Klein, welcome guests to Bounty of the Bay.

and live auctions featuring more than 100 items, and more. When the evening was over, attendees left for home with a free boater's duffle bag filled with garden-fresh produce that was either grown in the Estuary or transported on the Delaware River.

Thanks to the generosity of both donors and bidders, Bounty of the Bay was the most successful fundraiser ever for the Partnership. Proceeds will be used to further the non-profit's mission.

The Experience the Estuary Celebration would not have been possible without the help of many volunteers, board members and local businesses. The Partnership thanks these people for their guidance, donations and assistance.

For more information on this event and future fundraisers, please call Program Specialist, Dee Ross, at (800) 445-4935, extension 106, or visit www.DelawareEstuary.org. ■

SHARING RESOURCES TO MANAGE STORMWATER IN THE SCHUYLKILL



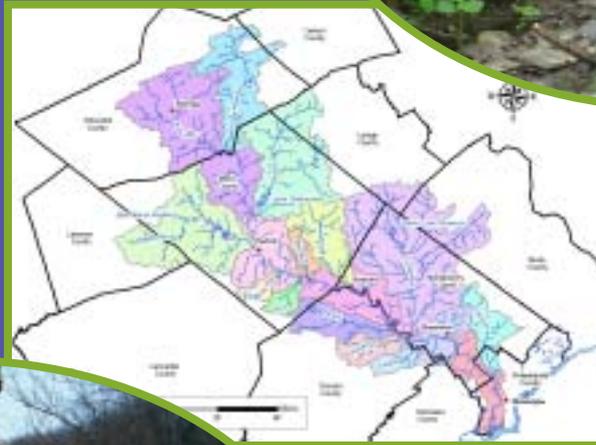
By Jennifer Adkins

Schuylkill Watershed Initiative Grant Coordinator, Partnership for the Delaware Estuary
and Paula Conolly

Watershed Specialist, Philadelphia Water Department

Every year billions of gallons of stormwater flow into the Schuylkill River, draining an area nearly 2,000 square miles in size: the Schuylkill Watershed. This is the largest, most diverse and most heavily developed region in the Delaware Estuary, and it provides drinking water to more than 1.5 million people. The stormwater that drains from these lands carries with it pollutants from lawns, homes, roads, businesses and industry. Largely unimpeded by vegetation, this water also causes flooding and erosion because of its swift movement, in large volumes, across the landscape.

In 2003, a source water assessment conducted by the Philadelphia Water Department (PWD) concluded that stormwater runoff poses



ABOVE: The damage caused by stormwater runoff can clearly be seen along the banks of the Scioto Creek in the Perkiomen Sub-Watershed. LEFT: Billions of gallons of stormwater from the Schuylkill Watershed flow into the Schuylkill River every year.

a major threat to water supplied from the Schuylkill. Thereafter it became clear that a group effort was needed to protect this critical resource. The Schuylkill Action Network (SAN) was born from this need, and today its purpose is to address the major threats to drinking water from the Schuylkill, including pollutants from agriculture, abandoned mines and sewer systems.

Projects that the SAN is working on have been made possible by a \$1.15 million Environmental Protection Agency (EPA) "Targeted Watershed Initiative Grant," which was given to the PWD and the Partnership for the Delaware Estuary to collaborate on the project. The award, referred to as the Schuylkill Watershed Initiative Grant (SWIG), was one of only 13 given by the EPA in 2004. This grant, combined with other funding, provides a total of \$2.2 million for the SAN.



Large amounts of rain and melting snow can carry contaminants into waterways like the Scioto Creek in Montgomery County, Pennsylvania.

continued on page 6



SHARING RESOURCES cont'd. from page 5

Over time, the SAN has grown to approximately 80 partner members who are working together on over 40 priority projects. They represent a variety of government agencies, water suppliers, non-profit organizations, corporations, citizens, universities and donors. This network of stakeholders strives to use the unique skills and experiences of each of its partners to help further its mission.

The SAN has established a number of workgroups to address each of the major threats identified by the source water assessment. The Stormwater Workgroup looks specifically at how to restore the more than 30 percent of streams in the Schuylkill Watershed that are impaired due to stormwater. Accordingly, the Workgroup is identifying and working with the owners of large land areas, such as schools and golf courses, to slow and reduce stormwater.

"By focusing on public lands, we get additional benefits beyond the improvements themselves," explained Susan Greth of the Montgomery County Conservation District (MCCD). "We get owners with the ability to do long-term maintenance, and the opportunity for a lot of people to see the effects."

Nowhere is this more important than in the Perkiomen Sub-Watershed, which is the largest in the Schuylkill and a microcosm of the watershed itself. As a manager of seven SAN projects, the Perkiomen Watershed Conservancy is obtaining necessary permits, developing plans and carrying out plantings with the help of volunteers. Plantings such as these have been shown to stabilize streamside areas so they can better absorb runoff, filter pollutants, slow the flow of water from storms, and prevent erosion.

Another example of a SAN project is at Spring Ford High School, where the MCCD is working to "naturalize" a massive stormwater detention basin. This basin is a manmade, earthen bowl designed to catch stormwater from the school's campus. This way it can be slowed and filtered before it drains into a stream. Creating wetland "pockets" and adding native vegetation to the basin will increase its capacity to absorb runoff and filter out pollutants. It will also create new habitats for plants and animals, decrease the need for mowing, and create new educational opportunities for the school's science classes.

"Managing stormwater is a challenge for everyone in the region," said Kathy Klein, executive director of the Partnership, "but the Schuylkill is fortunate to have a diverse and dedicated group of organizations, and agencies, working together to address that challenge."

For more information about the SAN, contact Jennifer Adkins, SWIG coordinator for the Partnership, at (800) 445-4935, extension 112. ■

DogiPots Arrive in Pike Creek

*By Dee Ross, Program Specialist,
Partnership for the Delaware Estuary*

Cleaning up after "man's best friend" just got a lot easier in Pike Creek, a small watershed with a large human and canine population near Wilmington, Delaware. In a collaborative program, the Department of Natural Resources and Environmental Control (DNREC), the Delaware Department of Transportation (DelDOT), and the Partnership for the Delaware Estuary have joined efforts to provide free dispensers of pet waste bags to neighborhoods and county parks throughout the Pike Creek Watershed. These "DogiPot" units supply dog walkers with waste collection bags when and where they need them most.

State law requires that dog owners clean up after their pets, and for good reason. Besides being a public nuisance, pet waste is a measurable source of pollution in the water supply. Along with other contaminants on lawns, sidewalks, and roadways, pet waste that is left on the ground washes into storm sewers with rainwater and melting snow.

Last year, DNREC performed pollution source tracking through DNA in the waters surrounding Pike Creek. It demonstrated that dog waste contributed as much as 12 percent of the total bacteria in some areas. In addition to contaminating water sources with disease-causing bacteria, animal waste nutrients promote algae blooms and other excessive plant growth that chokes waterways, and robs the water of vital oxygen

once plant materials begin to decay. In the future, DNREC will conduct additional water testing to measure the effectiveness of the pilot DogiPot program.

The DogiPot initiative fits nicely into the U.S. Environmental Protection Agency's (EPA) current Phase II implementation of the National Pollutant Discharge

Elimination System (NPDES). This stormwater management program requires suburban and rural municipalities to satisfy water quality requirements of the Clean Water Act. It also fits well with DelDOT's NPDES Program,

which is a comprehensive effort to improve the quality of stormwater runoff from DelDOT-owned streets and facilities. This effort includes improvements in the operation and maintenance of storm drain systems, spill prevention and response, public education and training, and the overall discharge of pollution.

Nonetheless, because of the challenges being presented by the NPDES, the Pike Creek Watershed could soon be in violation of Total Maximum Daily Load (TMDL) regulations for bacteria and nutrients (see "Stormwater Glossary" p. 15 for definition). Thus, building partnerships such as this one, and encouraging community involvement, is becoming critical among municipalities as they work to develop and implement stormwater programs.

A limited number of DogiPot units are still available, free of charge, to Pike Creek Watershed communities. Please call (800) 445-4935, extension 106, for more information. ■



Philly Moving Toward Better Stormwater Management

Revitalization projects in Philadelphia neighborhoods are transforming once unwanted eyesores into community amenities and highly desirable housing. In fact, areas previously perceived to be unsuitable for businesses and housing are seeing an unprecedented boom in redevelopment. As part of this favorable transformation, the City of Philadelphia has taken on its own revitalization project: overhauling its outdated stormwater management policy.

By Christine Marjoram, Water Resources Engineer for the Stormwater Management Program, Philadelphia Water Department

A simple walk along some of the city's stream banks reveals the obvious need: exposed tree roots, pipes, down cutting channels and excessive erosion are everywhere. Stream life is reduced to only the few species able to cope with large variations in flow and water quality. Being that all of the city's drinking water comes from the Schuylkill and Delaware Rivers, stormwater entering these waterways should be as clean as possible.

Current stormwater regulations address key issues such as managing large storms and capturing the "first flush" of rainfall. Evidence suggests, however, that such requirements are no longer working. Of the 72 stream miles within Philadelphia, 71 are impaired

due to pollutant-rich, urban stormwater runoff.

This is why Philadelphia, for the past two years, has collaborated with Montgomery, Delaware and Chester Counties during the planning process for the implementation of Federal Act 167 in the Darby and Cobbs Creek Watersheds. Act 167 requires that stormwater management plans be developed at a watershed level and become implemented by municipalities within the watershed. Throughout this process, a set of stormwater management standards has been developed based upon the actual conditions in the watershed. Once the Department of Environmental Protection approves this plan, the standards will then be implemented by municipalities through the adoption of local ordinances.

The city has taken a major step forward in updating its stormwater management policy by adopting the ordinances developed for the Darby and Cobbs Creek Watersheds. This ordinance is also ready for integration into the six remaining Philadelphia watersheds' Act 167 stormwater management plans. Its key components include:

- **Optimizing site design while minimizing disturbances**
- **Infiltrating the first inch of rainfall from hard surfaces and cleaning stormwater from the first inch that cannot be infiltrated (i.e., through sediment removal, sand filters or allowing it to flow over land)**

- **Slowly releasing stormwater flow into streams to prevent erosion and bank destabilization**
- **Controlling stormwater flows from large storms based upon the site-specific flood management district**

Perhaps the most innovative approach of this new policy is recognizing the importance of maintaining and increasing porous cover throughout the city. This goal is being achieved through tree plantings, green roof installations, the disconnection of roof leaders and more. In addition, redevelopment projects that reduce on-site hard surfaces by at least 20 percent will have the incentive of not being required to meet chan-

continued on page 14



DRBC Stormwater Retrofit Project

By Kenneth F. Najjar, Ph.D., P.E., Branch Head, Planning & Implementation, Delaware River Basin Commission

To serve as a working example of good stormwater management, the Delaware River Basin Commission (DRBC) is currently retrofitting its headquarters in West Trenton, New Jersey. The office building and site are representative of 1970's land development practices, which essentially use no stormwater management. Hence, the facility, like many others from the time, has diverted its runoff to offsite areas through pipes or over paved surfaces.

Once retrofitted, the DRBC's headquarters will serve as a model facility, both for using innovative methods and materials, and for using runoff as a resource. It will prove that recharge and the maintenance of water quality can be achieved in a built environ-

ment interpretive displays.

The retrofitting project has several goals:

- Increase and restore 100 percent of the site's groundwater recharge capabilities prior to development
- Reduce the discharge of nonpoint source pollutants from the site, and, in the process, return the total suspended solids to 80 percent and nutrients to the maximum possible
- Reduce the volume of stormwater runoff in accordance with two-year, 10-year and 100-year storm events
- Install as many non-structural measures (i.e., landscaping



In the future, stormwater running across the site's parking lot will be managed more efficiently.

The Delaware River Basin Commission is currently working to make its headquarters a model facility for stormwater management.



DELAWARE RIVER BASIN COMMISSION

ment within Piedmont soils and geology. Furthermore, the retrofitting will demonstrate the overall value of stormwater management practices.

"The DRBC's mission is to manage the water resources of the Delaware River Basin, and it must lead by doing," said Executive Director, Carol R. Collier. "One of the best things the DRBC can do is to provide tangible examples of innovative stormwater management options for older, developed sites, in order to protect the quality and quantity of our waters."

Thanks to a grant from the New Jersey Department of Environmental Protection, the five-acre site will be redesigned to demonstrate the implementation of New Jersey's stormwater regulations. In addition, enhancements to the building's courtyard and lobby are planned, along with landscaping and water man-

and drainage alterations, and water quality improvement devices) as funds will allow, so the site can serve as a water management education center

- Improve on-site management practices such as fertilization, pesticide use and deicing

In mid-2005, the DRBC contracted with Princeton Hydro, LLC to prepare a master stormwater retrofit plan and to design the first phase of work, which will likely be completed by mid-2006. In the meantime, additional funds are currently being sought to help implement subsequent phases of this project.

For more information, please contact the DRBC at (609) 883-9500, or visit the organization's website at www.state.nj.us/drbc/drbc.htm. ■

Stormwater Runoff and You

By Martha Maxwell-Doyle, Deputy Director, Partnership for the Delaware Estuary

Stormwater runoff occurs when water from rain or melted snow flows over impermeable surfaces such as driveways, sidewalks and streets. Rather than naturally soaking into the ground, this stormwater picks up debris, chemicals, dirt, and other pollutants on its way into sewers. It is then discharged as untreated runoff into the water bodies we use for swimming, fishing, drinking water and more.

Fortunately, there are a variety of measures that individual citizens like you can take to combat the effects of stormwater runoff. These measures include:

Residential Stormwater Management

- Recycle or properly dispose of household products that contain chemicals, and never pour these products onto the ground or into storm drains.
- Do not over water your lawn, and use a soaker hose instead of a sprinkler.
- Use pesticides and fertilizers sparingly. When use of

these products is necessary, apply them only in recommended amounts.

- Use organic mulch or non-toxic pest control methods whenever possible.
- Compost or mulch debris from your yard. Never leave debris in the street or sweep it into a storm drain where nutrients and organic matter can collect.
- Cover piles of dirt or mulch so the wind does not blow them away.

Septic System Management

- Inspect your septic system and pump your tank every three to five years. Doing so prevents nutrients, bacteria and viruses from entering nearby waterways.
- Do not dispose of household hazardous waste in sinks or toilets.

Automobile Care

- Use a commercial car wash that treats or recycles its wastewater, or wash your car on grass so water infiltrates into the ground.
- Repair leaks and dispose of used automotive fluids, batteries and degreasers at designated drop-off points or recycling centers.

continued on page 15



PARTNERSHIP FOR THE DELAWARE ESTUARY

Stormwater BMPs can be implemented by anyone, including homeowners, businesses and municipalities, the latter of which can be seen here.



Excessive pesticides and fertilizers can be washed into nearby waterways, leading to oxygen-depleting algal growth.





The

Mighty Elliptio

Freshwater mussels are greatly affected by stormwater runoff and yet, they offer promise as biological filters to combat such pollution. The “mighty elliptio,” or the mussel *Elliptio complanata*, is one such hardy species that lives throughout the Atlantic drainage of North America. Mussels like this can be abundant in the bottom sediment of lakes, ponds, streams, rivers and tidal freshwater estuaries.

To the untrained eye, these mussels may resemble rocks, but these “rocks” contain giant gills and powerful muscles that work to cleanse water. In most streams and rivers of the Delaware Estuary, healthy populations of native mussels are hard to find. However, where dense beds still occur, they offer a glimpse into the past.

It is believed that freshwater mussels were once much more common in the streams and rivers of the United States. In the lower Brandywine River, I have found areas with up to 70 mussels per square meter. Nationally, however, there are reports of 300 to 500 mussels per square meter in certain niche habitats. While some may see this as significant, we

believe that these densities were once much more widespread and abundant during pre-settlement times.

Associated with their growing rarity, freshwater mussels are the most imperiled fauna in North America, which is home to the greatest diversity of mussels in the world. More than three-quarters of our 300 native species are classified as “species of special concern,” and many of these have been assigned either endangered or threatened status.

Why are freshwater mussels no longer so abundant? One reason is their lifestyle. Freshwater mussels belong to the same class of mollusks as marine oysters, clams, mussels and scallops, but they differ radically in several life history traits. For example, marine bivalves are “broadcast spawners,” which produce lots of free-living offspring that have rather short lives of five to 10 years. In contrast, freshwater mussels can live for 80 to 100 years and they do not begin to reproduce until about the age of eight. The adults care for their young by brooding them until they attach to a passing fish as parasitic larvae. After

they undergo metamorphosis into juvenile form, they drop to the bottom where they begin to live as adults.

Since the parasitic larval stage is mandatory, the life cycle of freshwater mussels often gets short-circuited whenever something happens to their host fish due to pollution or habitat alteration. Combined with the many years required to reach maturity, this means that freshwater mussels rebound slowly, if at all, once impaired. This interruption can occur whenever stormwater runoff is a problem.

The eastern elliptio, or *Elliptio complanata*, is the

most common species of freshwater mussel in the Delaware Estuary’s watershed. For example, in the lower Brandywine River, I estimated that more than half a million mussels live within a six-mile reach, where they appear to outweigh all other animals combined. However, the common elliptio was the only species found despite historical accounts indicating that as many as seven species may have once lived there. Since only older animals were found, the remaining population does not appear to be as healthy as it once was.

What does stormwater pollution mean for mussels in the Estuary? As suspension-feed-



ABOVE: In an effort to further study them, researchers tagged freshwater mussels for relocation in the Brandywine River. **TOP LEFT:** The eastern elliptio, or *Elliptio complanata*.

PARTNERSHIP FOR THE DELAWARE ESTUARY





Stormwater Runoff

By Danielle Kreeger, Science Coordinator,
Partnership for the Delaware Estuary

ers, mussels process large volumes of water over soft body parts, making them especially prone to the contaminants and poor water quality caused by stormwater runoff. They also feed on a microscopic diet that is itself efficient at taking up contaminants. Besides their high exposure to pollutants, stormwater can also harm mussels by altering their habitat through erosion and physical changes. Stormwater can therefore impact mussels in many ways.

Why are mussels, in turn, important for stormwater management? As a mussel eats suspended particles—a rich soup of microorganisms and dead and decaying material—it filters more than a liter of water per hour, removing not just nutritious matter but contaminants as well. They not only cleanse stormwater through this process, but they also help to stabilize and diversify the physical structure of the bottom, thereby improving habitat conditions for other animals and plants.

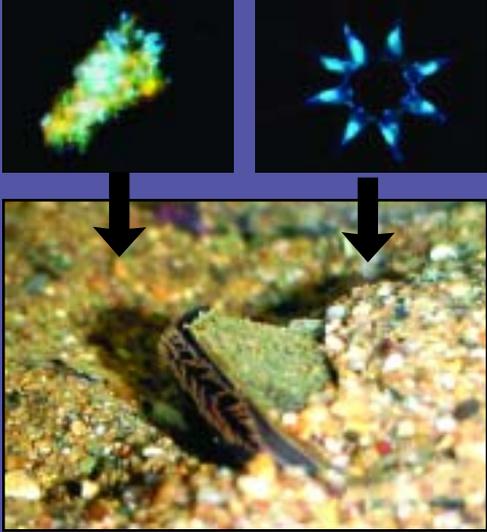
The lower Brandywine's population of mussels demonstrates these benefits. Despite being a remnant of its past glory, this bed still acts like a giant conveyor belt that traps fine particles and moves them to the bot-

Ecological Structure

- ▲ Habitat Complexity
- ▲ Binding of Bottom
- ▲ Bottom Turbulence

Ecological Function

- ▲ Material Processing Rate
- ▼ Suspended Particulates
- ▼ Particulate N, P
- ▲ Light
- ▲ Sediment Enrichment
- ▲ Dissolved Nutrients



Ecological services provided by suspension-feeding bivalves are listed on the left. The freshwater mussel can be found living mostly buried, with its mantle tissue extended for feeding. Mussels graze on microscopic particles, including detritus and bacteria (upper left), and microalgae such as diatoms (upper right).

tom. As much as 26 metric tons of dry, suspended matter is estimated to be filtered per year by these animals, which represent a substantial portion of fine particles being carried downstream. In addition, these mussels were found to enrich the sediments with organic material and nutrients, benefiting other organisms.

Awareness of the critical role freshwater mussels play in the ecosystem is increasing,

especially in the streams and rivers in which they are abundant, or were once abundant. With this, evidence is also mounting that the conservation and restoration of freshwater mussels can provide a new tool to help remediate water quality and act as a buffer against stormwater pollution.

We may never be able to fully restore the population sizes and biodiversity of mussels that existed in the Delaware

Estuary during pre-settlement times. However, "ecosystem management" could combine mussel bed restoration with other initiatives that enhance and restore buffer habitats (e.g., riparian areas and wetlands). Attention to our native mussel populations offers promise as another tool to improve the overall health of the Delaware Estuary, and the "mighty elliptio" can figure prominently into this effort. ■





Students Participate in World Water Monitoring Day

By Stephen Platt, U.S. Environmental Protection Agency, Region 3

On Wednesday, September 28, Jill Platt's fourth and fifth grade classes at Evergreen Elementary School participated in World Water Monitoring Day. For the third year in a row, students from the school in Woodbury, New Jersey, conducted water quality samplings at nearby Stewart Lake, with the help of Stephen Platt, a national groundwater expert with the Region 3 Office of the U.S. Environmental Protection Agency.

Stewart Lake drains into Woodbury Creek, which eventually discharges into the Delaware River. Thus, maintaining good water quality in the lake contributes to the protection of the entire Delaware Estuary. Unfortunately, however, it receives stormwater runoff from both a park and an urban

environment, and dams prevent the flow of tidal water in the Delaware River from reaching the inland lake.

This year, the students' results indicated that the water quality in Stewart Lake is good and, as they discovered, the lake can support many forms of wildlife. In fact, while collecting water samples and learning about protecting water

resources from pollution, they saw a family of ducks and many turtles. Their sampling results from 2005 also compared favorably with previous years, providing evidence that the lake's water quality has not changed.

World Water Monitoring Day was celebrated worldwide from September 18 to October 18, 2005. It is estimated that 60 countries from across the globe participated in the col-

lection of water samples from lakes, streams, and rivers in order to assess the overall quality of the world's water. All of the data collected from these samples is stored on an international database and will be used to determine where improvements in water quality need to be made.

For more information on World Water Monitoring Day, please call America's Clean Water Foundation at (202) 898-0908 or visit www.worldwatermonitoringday.org. ■

Test samples collected by students for World Water Monitoring Day showed the water quality of Stewart Lake has not changed.



Stormwater and the Schoolyard

*By Shaun Bailey,
Marketing and Communications Specialist
and Jennifer Adkins
Schuylkill Watershed Initiative Grant Coordinator,
Partnership for the Delaware Estuary*

Abraham Lincoln once said, "The philosophy of the schoolroom in one generation will be the philosophy of government in the next." It is this reasoning that has guided both Sulzberger Middle School and Penn Alexander School of West Philadelphia to include stormwater pollution in their curriculum. By implementing best management practices (BMPs) on schoolyard properties, these and other schools are providing new learning experiences for both students and the community, while at the same time helping to develop future stewards of the Schuylkill Watershed.

"Returning something as simple as stormwater infiltration to a school site offers a lot of curriculum opportunities to an urban school such as Penn Alexander," said Howard Neukrug, director of the Philadelphia Water Department's Office of Watersheds. "You can use the site to demonstrate all the elements of stormwater pollution."

The value of implementing BMPs is evident at both schools. For example, students and parents alike have

earned volumes about stormwater pollution since the construction of Sulzberger Middle School's Outdoor Classroom and Community Park in 2001. Here, visitors can learn about BMPs such as rain barrels, check dams, trench drains, vegetated swales and more, all of which are complemented by a student-designed mural featuring illustrations of the water cycle.

BMPs can also be incorporated into school construction from the very beginning, as was the case with Penn Alexander School in 2001. Although BMPs such as a rain garden, infiltration field and porous pavement were built long before the arrival of current students, they benefit and learn from them daily nonetheless.

"The work at Penn Alexander was one of the first innovative stormwater management efforts in the Philadelphia area," Neukrug added. "It offers a lot to the school district and other landowners on what is possible...and it shows that it can be done for not a lot of money."

Implementing stormwater BMPs can also be as simple as not mowing lawns. Norristown

Area High School in Pennsylvania has recently stopped mowing a portion of its property in an effort to increase biofiltration and enhance habitat. This approach, which is the first of many at the school, can prove quite effective in reducing stormwater runoff, as well as lawn care expenses.

"It has definitely generated some questions in the community," said Norristown Area Schools District Director of Building Services, Robert Malkowski. "It reminds us that we need to communicate why we are doing this, and what the benefits are going to be."

The Norristown Area High School project is one of about 40 ventures funded under the Schuylkill Watershed Initiative Grant. For more information on this program, please see "Sharing Resources to Manage Stormwater in the Schuylkill" on page five of this newsletter.

For more information on the projects described in this story, please call (800) 445-4935, extension 112. Also, consider visiting [www.Stormwater Authority.org](http://www.StormwaterAuthority.org) for information and ideas relating to stormwater BMPs. ■

Stormwater Education Resources

Information for teaching students about stormwater runoff may be found at the following websites:

Academy of Natural Sciences:
www.acnatsci.org

Center for Watershed Protection:
www.cwp.org

Clean Water Clear Choice:
www.cleanwaterclearchoice.org

Delaware Department of Natural Resources and Environmental Control:
www.dnrec.state.de.us/DNREC2000/Divisions/Soil/Stormwater/StormWater.htm

Schuylkill Action Network:
www.schuylkillactionnetwork.org

Stormwater Management Academy:
www.stormwater.ucf.edu

Stroud Water Research Center:
www.stroudcenter.org

U.S. Environmental Protection Agency – Nonpoint Source Pollution:
www.epa.gov/owow/nps/kids

U.S. Environmental Protection Agency – Ground & Drinking Water:
www.epa.gov/safewater/kids

Utah State University Extension:
extension.usu.edu/cooperative/waterquality/index.cfm/cid.815



ESTUARY EVENTS



Knee-High Naturalists
Wednesday,
December 14,
2005,
10:00 to
11:30 a.m.

Woodford
 Cedar Run
 Wildlife Refuge,
 Medford, New
 Jersey

Here is a special time for you and your three- to five-year-old to discover the Delaware Estuary through age-appropriate games, stories, crafts and hikes. Enroll by calling (856) 983-3329, extension one. The cost is \$8 per child/adult and major credit cards are accepted. Visit www.cedarrun.org for details.



Annual Storytelling Event
Tuesday,
December 27,
2005,
7:00 p.m.

Rutgers Haskin
 Shellfish
 Research Lab
 Bivalve, New Jersey

The Haskin Shellfish

Research Lab of Rutgers University will be rounding out the year with its free annual storytelling event, this time focusing on the shellfish industry. For more information, please call (856) 785-2060, ext.101.



Winter Walks
Throughout the
winter season

John Heinz
 National
 Wildlife
 Refuge at
 Tinicum,
 Philadelphia,
 Pennsylvania

Choose from
 dozens of guided
 walks this winter at the

John Heinz National Wildlife Refuge at Tinicum. Participants should wear appropriate clothing and good walking shoes, and bring both binoculars and field guides where desired. All walks and programs are one to three hours in length. For further information, please call (215) 365-3118 or visit the Refuge's website at heinz.fws.gov.

10th Annual "Kids Can!" Expo
Sunday, February 26, 2006
10:00 a.m. to 4:00 p.m.

New Jersey Audubon Society's Nature
 Center of Cape May
 Cape May, New Jersey

Visit the New Jersey Audubon Society's Nature Center of Cape May for a day of family fun and excitement. A wide variety of environmental and historical organiza-



tions will be on hand to offer children's programs, which include hands-on science activities, nature crafts, beach discovery walks, and more. Music, games, live animals and dancers will also

entertain visitors

throughout the day. Please call (609) 898-8848 for more details, or visit www.njaudubon.org.

Environmental Awards Banquet
Thursday, March 23, 2006,
6:00 to 9:00 p.m.

Perkiomen Watershed Conservancy
 Schwenksville, Pennsylvania

The Perkiomen Watershed Conservancy is honoring projects, people and organizations who have worked to protect and improve the Perkiomen Watershed.

Guests will enjoy a casual evening with a light buffet dinner and friendly competition as they bid on silent auction items.

The cost per person is \$40. For reservations and information, please call (610) 287-9383.



For more event information,
please visit the "Other
Events" page at
www.DelawareEstuary.org

Stormwater Management

continued from page 7

nel protection and flood control requirements.

A side benefit of this new ordinance is that it helps to bring the city into compliance with the requirements of the National Pollution Discharge Elimination System (NPDES), which is designed to protect streams from pollutants that enter the water through municipal separate storm sewer systems (MS4s). The MS4 program requires each regulated municipality to develop and implement a stormwater management program that addresses:

- **Public education**
- **Public participation**
- **Illicit discharge detection and elimination**
- **Construction site stormwater management**
- **Post-construction stormwater management**
- **Pollution prevention and good housekeeping at municipal facilities**

The City of Philadelphia anticipates some exciting changes in the way stormwater is managed when these new regulations go into effect in 2006. The new policy will have an important role in ensuring a greener city with public access to water, cleaner and healthier streams where a variety of aquatic populations can thrive, and better drinking water for citizens.

For additional information on Philadelphia's stormwater management program, please visit www.PhillyRiverInfo.org or contact Christine Marjoram at (215) 685-4949. ■

Glossary of Stormwater Terms

Biofilter: Dense vegetation designed to filter stormwater runoff as it passes through.

Best Management Practices (BMPs): Activities or structural improvements that help to reduce the quantity and improve the quality of stormwater runoff. BMPs include treatment requirements, operating procedures and practices that together control site runoff, spillage and leaks, sludge or waste disposal, and drainage from raw material storage.

Combined Sewer Overflow (CSO): A pipe that, during storms, discharges untreated wastewater from a sewer system that carries both sanitary wastewater and stormwater. The overflow occurs because the system does not have the capacity to transport and treat the increased flow caused by stormwater runoff.

Detention: A stormwater system that delays the downstream progress of stormwater runoff in a controlled manner, typically by using temporary storage areas and a metered outlet device.

Erosion: Removal of soil particles by wind and water. Often the eroded debris (silt or sediment) becomes a pollutant via stormwater runoff. Erosion occurs naturally but can be intensified by human activities such as farming, development and timber harvesting.

Holding pond: A pond or reservoir, usually made of earth, built to store polluted runoff for a limited time.

Impervious surface: Hard ground cover that prevents or retards the entry of water into the soil and increases runoff, such as asphalt, concrete and rooftops.

Nonpoint-source pollutants: Pollutants

from many diffuse sources that are caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters and even underground sources of drinking water.

Point-source pollutants: Pollutants from a single, identifiable source such as a factory or refinery.

Riparian buffer: Narrow strips of land running along the banks of a river or stream that act as a biofilter for stormwater before it enters an aquatic ecosystem.

Sediment: Soil, sand and minerals washed from the land into water, usually after rain. Sediment can destroy fish-nesting areas, clog animal habitats and cloud waters so that sunlight does not reach aquatic plants.

Storm surge: An increase in water level above that which is normal on the open coast due to the action of wind stress and atmospheric pressure on the sea surface.

Stormwater runoff: The portion of rainfall that moves over the ground toward a lower elevation and does not infiltrate the soil.

Total Maximum Daily Load (TMDL): The maximum allowable loading of a pollutant that a designated water body can absorb and still meet water quality standards according to the Clean Water Act of 1972.

Watershed: A geographic area in which water, sediments and dissolved materials drain to a common water body. ■

Stormwater Run-off and You continued from page 9

Pet Waste Disposal

- When walking your pet, pick up its waste. Flushing pet waste is the most effective method of disposal. Leaving it on the ground increases public health risks by allowing harmful bacteria and nutrients to wash into storm drains, and eventually into local bodies of water.

Landscaping Practices

When landscaping your property, consider using environment-friendly methods, such as:

- Permeable Pavement: Traditional concrete and asphalt do not allow water to soak into the ground. Permeable pavement, on the other hand, allows stormwater to soak through, decreasing quantities of runoff.
- Rain Barrels: Use mosquito-proof containers to collect rainwater from rooftops for use on your lawn or garden areas.
- Rain Gardens and Grassy Swales: Specially designed areas filled with native vegetation can provide natural places for rainwater to collect and soak into the ground. Rain from rooftops or paved surfaces can also be diverted to these spots rather than into storm drains.
- Vegetated Filter Strips: Filter strips are areas of native grass or plants created along roadways and streams. They trap the pollutants that runoff carries as it flows across driveways and streets.

For more information, please consult the Environmental Protection Agency at www.epa.gov/npdes/stormwater or www.epa.gov/nps. ■





Partnership for the Delaware Estuary
 One Riverwalk Plaza
 110 S. Poplar Street, Suite 202
 Wilmington, DE 19801
 ADDRESS SERVICE REQUESTED

US POSTAGE
 Non-Profit Org
 PAID
 Wilmington, DE
 Permit #1885

Delaware Estuary Program

Partnership for the Delaware Estuary, Inc.

Kathy Klein, Executive Director
 Tel: (800) 445-4935 ext. 102 / Fax: (302) 655-4991
 E-mail: kklein@delawareestuary.org

Environmental Protection Agency

Irene Purdy, EPA Region II
 Tel: (212) 637-3845 / Fax (212) 637-3889
 E-mail: purdy.irene@epa.gov

Amie Howell, EPA, Region III
 Tel: (215) 814-5722 / Fax: (215) 814-2301
 E-mail: howell.amie@epa.gov

Pennsylvania

Andrew Zemba
 Department of Environmental Protection
 Tel: (717) 772-5633 / Fax: (717) 783-4690
 E-mail: azemba@state.pa.us

Delaware

John Kennel
 Department of Natural Resources and Environmental Control
 Tel: (302) 739-5726 ext. 109 / Fax: (302) 739-3491
 E-mail: john.kennel@state.de.us

New Jersey

Kerry Kirk Pflugh
 Department of Environmental Protection
 Tel: (609) 663-7242 / Fax (609) 777-1282
 E-mail: kerry.pflugh@dep.state.nj.us

Delaware River Basin Commission

Bob Tudor
 Tel: (609) 883-9500 ext. 208 / Fax (609) 883-9522
 E-mail: robert.tudor@drbc.state.nj.us

Philadelphia Water Department

Howard Neukrug
 Tel: (215) 685-6319 / Fax: (215) 685-6207
 E-mail: howard.neukrug@phila.gov

Editor

Shaun Bailey, Marketing and Communications Specialist
 Partnership for the Delaware Estuary

Layout & Design

Janet Andrews, LookSmartCreative

The Estuary News encourages reprinting of its articles in other publications. Estuary News is published quarterly by the Partnership for the Delaware Estuary, Inc., under an assistance agreement (CE-993985-08-0) with the U.S. Environmental Protection Agency (EPA). The purpose of this newsletter is to provide an open, informative dialogue on issues related to the Delaware Estuary Program. The viewpoints expressed here do not necessarily represent the views of the Partnership or EPA, nor does mention of names, commercial products or causes constitute endorsement or recommendation for use. For information about the Delaware Estuary Program, call 1-800-445-4935.

PRINTED ON RECYCLED PAPER

Partnership for the Delaware Estuary: a National Estuary Program

The Partnership for the Delaware Estuary, Inc., is a private, nonprofit organization established in 1996. The Partnership leads collaborative and creative efforts to protect and enhance the Delaware Estuary and its tributaries for current and future generations. The Partnership is the home of the Delaware Estuary Program, one of 28 National Estuary Programs. To find out how you can become one of our partners, call the Partnership at 1-800-445-4935 or visit our website at www.DelawareEstuary.org.



Send a Free Gift Subscription

Give a friend a subscription to Estuary News

Name _____

Affiliation _____

Address _____

City, State, Zip _____

Telephone _____ E-mail _____

I no longer wish to receive Estuary News Send me Estuary News via E-mail

Send to: Partnership for the Delaware Estuary
 One Riverwalk Plaza, 110 S. Poplar St. Suite 202, Wilmington, DE 19801

You can also notify us by sending your request to bhaas@delawareestuary.org

