CHESAPEAKE
BAY JOURNAL
JULY-AUGUST 2019 VOLUME 29 NUMBER 5

Snakeheads may not be off the hook for ecological harm

≈ Though other factors may play a role, study found that some fish numbers fell when this predator invaded an area.

By Jeremy Cox

Something was pulling his fishing pole into the water — something big. So, Dustin Stem ran over and grabbed the pole just as it was about to disappear into the drainage pond's murky waters.

The 10-year-old was soon joined in the fight by his 11-year-old brother, Ryan. The final heave onto land fell to an adult who had been fishing nearby. What they discovered at the end of the line was a monster: 10.68 pounds of leopard-print scales, triangular teeth and a face only Frankenstein could love.

One northern snakehead down, countless more to go.

More than 100 fishermen participated in a snakehead "derby" in a national wildlife refuge on Maryland's Eastern Shore in June. The state's Department of Natural Resources and the U.S. Fish and Wildlife Service organized the event, hoping to enlist more anglers in the battle of attrition against the invasive species in the Chesapeake Bay region.

"It's something unique where you can go out and catch them, bring them home, eat them and feel good about it," said Joshua Newhard, a biologist with Fish and Wildlife's Annapolis office.

The species is a native of Asia and has no natural predators in the mid-Atlantic's freshwaters. Fishery managers in Virginia and Maryland have long warned that the snakehead's voracious appetite and prolific spawning ability could spell ecological disaster.

Andrew Johnson, 11, and his sister, Faith, 7, check out a snakehead caught by Rafael Ramos at the Harriet Tubman State Park in Dorchester County, MD. The fish weighed in at 8.95 pounds, garnering second place in a June snakehead "derby." (Dave Harp)

After *Channa argus* appeared in the Chesapeake watershed in 2002 and spread to most of its major rivers, little evidence emerged to support those fears. A new fish population analysis conducted in the same waters as the June fishing tournament, though, suggests that snakeheads may not be off the hook after all.

Newhard and a DNR biologist named Joseph Love surveyed the Blackwater and Little Blackwater rivers in southern Dorchester County, MD, during a three-year period that ended in 2007. Both waterways traverse Blackwater National Wildlife Refuge, a 28,000-acre expanse considered an important winter sanctuary for geese, ducks and swans.

At the time, the researchers were looking into the ecological impacts of a small dam constructed to block saltwater. A few years later,

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Some states act to treat PFAS turning up in drinking water in the watershed

≈ Contaminant was used in production of nonstick cookware, waterproof clothing, stain-resistant materials, and some cosmetics and firefighting foams.

By Timothy B. Wheeler

Not long ago, Nathan Volpi began wondering about the safety of the tap-water that he, his wife and two young children had been drinking for years.

Volpi, a lawyer, had heard worrisome stories from friends and relatives in southeastern Pennsylvania about tainted drinking water found near military bases there. The same contaminants had turned up in wells serving Harrisburg International Airport just across the Susquehanna River from his home in Newberry Township, and he knew of defense facilities in the general area.

"Seeing all these red flags," Volpi recalled, "I decided to get my water tested to see how it came out."

It cost him $350 to get a private lab to check it. A few months ago, he found out that the well water supplied to his home by a private utility contains fluorinated chemicals at levels the U.S. Environmental Protection Agency says could be harmful to human health.

Since then, Volpi said, "All of Newberry Township has been in a bit of an uproar about it."

The suburban community midway between Harrisburg and York is among the latest nationwide to discover that the water they've been drinking has been infiltrated by some widely used but poorly understood chemicals generally referred to as PFAS — short for per- and poly-fluoroalkyl substances.

PFAS are a large group of manmade chemicals that since the 1940s have been used in a host of consumer and industrial products, including nonstick

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CHESAPEAKE BAY JOURNAL

BAY JOURNAL is published by Bay Journal Media to inform the public about ecological, scientific, historic and cultural issues and events related to the Chesapeake Bay. The BAY JOURNAL, circulation 35,000, is published monthly except in midsummer and midwinter. It is distributed free of charge. Bundles are available for distribution. Material may be reproduced, with permission and attribution. Publication is made possible by grants through the U.S. Environmental Protection Agency's Chesapeake Bay Program Office, the Campbell Foundation, the National Oceanic and Atmospheric Administration's Chesapeake Bay Office, the Sumner T. McKnight Foundation, the Rauch Foundation, the Fair Play Foundation, the Shared Earth Foundation, the Virginia Environmental Endowment, anonymous donors, and by reader contributions. Views expressed in the BAY JOURNAL do not necessarily represent those of any funding agency or organization.

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Bay Journal Media is a nonprofit 501(c)(3) organization with a mission to further public education and awareness of issues affecting the Chesapeake Bay and the mid-Atlantic environment by creating and distributing journalistic products. In addition to producing the BAY JOURNAL, Bay Journal Media operates the Bay Journal News Service, which distributes BAY JOURNAL articles and original op-eds about the Chesapeake Bay or regional environmental issues to more than 400 newspapers in the region, reaching several million readers each month.

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Editor's Note

Making a world of a difference one small act at a time

On a picture perfect afternoon in mid-May on Maryland's Eastern Shore, I was reminded of the importance of what a small group of committed citizens can accomplish.

The Queen Anne Conservation Association marked its 50th anniversary, making it the oldest conservation group on the Eastern Shore. Its event drew dozens of supporters and dignitaries.

Former U.S. Rep. Wayne Gilchrest stopped by. "I'm here to tell all of you that what you're doing is important, it's vital, it makes a difference," he said.

The event took place on the lavender farm operated by the group's leader, Jay Falstad and his wife, Christa. Falstad got involved after purchasing the 14-acre farm in February 2000. Shortly thereafter, he was talking to neighbors while walking along the small lake that abuts the property.

"Hey, you heard about the landfill, right?" one of them asked.

"No" Falstad responded. He was told about plans to build a landfill along the lake. What really got his attention was being informed, "you're the first house downstream."

That started Falstad's involvement with the group, which was originally formed to battle a planned nuclear power plant. Since 2009, he's been its executive director (and staff) fighting harmful projects like the landfill.

The group has been involved in a host of activities over the years, warding off developments that would fundamentally alter Queen Anne County's character; protecting natural areas; educating the public; joining litigation when necessary; and watchdogging development — recently it's been using a drone to document violations of environmental regulations, some of which have resulted in fines.

Lately, the group's been fighting plans for a new Bay Bridge. Former Gov. Parris Glendening, who is now president of the organization Smart Growth America, cheered that effort, saying the new bridge would just lead to loss of forests, disruption of local communities — and likely even more traffic congestion over the long term.

"Sometimes people get discouraged because the decisions and problems and challenges seem so big, and you wonder if there is anything you can do," he said.

He recounted the tale of a boy who watched a man return a starfish to the water from a beach filled with stranded starfish. "What are you doing?" the boy asked. "There are so many here, you can't possibly make a difference." The man picked up another starfish and tossed it back. "It made a difference to that one," he said.

After reading all of the state watershed implementation plans aimed at achieving Bay cleanup goals, as well as many of the comments submitted about them, I'm far from convinced that the plans will be fully implemented, and almost certainly not by 2025.

But if enough people take action on their own local waterways and communities, it can make a difference for those streams and localities. At a time when movement on big issues often seems slow, it is encouraging to see the enthusiasm that can surround a small group — and the big difference it can make.

— Karl Blankenship

Correction

The caption that goes with Deborah Landau photo in the June issue should have said that the Atlantic white cedar planting took place on the Nassawango Creek Preserve in Wicomico County, MD. The Bay Journal regrets the error.

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Clockwise from far left:

A passenger enjoys a serene moment on the Nathan of Dorchester, a skipjack that offers public sails out of Cambridge, MD. See article on page 30. (Dave Harp)

This Chesapeake logperch was caught in a Lancaster County, PA, stream near the Susquehanna River. Efforts are underway to reintroduce the fish into more streams and prevent its being put on the federal Endangered Species List. See article on page 17. (Doug Fischer / Pennsylvania Fish & Boat Commission)

Dr. Ruth Patrick, an early proponent of freshwater ecology, holds stream vegetation. See profile on page 25. (Academy of Natural Sciences of Drexel University)

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A family, left, visits Trap Pond State Park in Sussex County, DE, on Oct. 6. A paddle through the large stretch of remaining swamp at Trap Pond yields views not unlike what you would have seen hundreds of years ago.
Bill Anderson, president of the Little Juniata River Association, fishes in the Little Juniata River in Blair County, PA, in 2015.
(Photos by Will Parson / Chesapeake Bay Program)

Chesapeake Week is over but simple, everyday actions are important

By Lucy Heller

During the first week of June, the Alliance for the Chesapeake Bay, along with environmental organizations, communities, businesses and local governments in the watershed, celebrated Chesapeake Bay Awareness Week.

The week was designated in 2016 by the Chesapeake Bay Commission for activities, educational programs and events to celebrate our nation's largest estuary.

For us Annapolitans, the Bay is front and center in our everyday lives. But the majority of the people that live, work and play in the region don't make the connection between their backyards and the 100,000 tributaries that flow into the Chesapeake. Every one of the 18 million residents in the watershed have an impact on the 64,000 square miles of streams, forests and wetlands of the national treasure we all call home.

There are quite a few major metropolitan communities — Washington, DC; Richmond; Lancaster, PA; and, of course, Annapolis — whose lands drain to the Chesapeake. With the increasing pressure of an urbanizing landscape, it is critical that each of us take simple (and free!) steps to reduce our impact on local waterways.

Along with celebrating the Bay during Chesapeake Bay Awareness Week, the Alliance hosted the first *Chesapeake Challenge*, which encouraged people to pledge to take different actions each day of the week that would contribute to cleaner water and a healthier watershed. The goal of the challenge was to bring awareness to people across the region about how their everyday actions, like recycling and using single use plastics, directly affect the health of their local stream.

At the Alliance, we are strong believers in the idea that every person can take simple actions for better water quality, healthier forests and an overall improved quality of life in the Chesapeake. The *Challenge* provided a platform for people to learn about everday actions they can take and the resources needed to make those changes.

Each day, we encouraged people to pledge to take a different action:

≋ Pledge to practice responsible lawn care!

≋ Pledge to cut back on my use of single-use plastics!

≋ Pledge to pick up after my pooch!

≋ Pledge to make one easy switch in my office!

≋ Pledge to learn more about my local recycling program!

≋ Pledge to eat locally sourced seafood!

≋ Pledge to get outdoors and explore the wonders of the Chesapeake!

≋ Pledge to continue the actions I committed to this week!

While the Chesapeake Challenge may be over, we encourage you to take action every single day by making small changes in your life that support a cleaner and healthier Bay watershed. Whether you are going to pledge to eliminate single-use plastics, ride your bike to work a couple of days a week, or responsibly manage your yard, the Alliance is here to help you find the right actions.

Visit our website, allianceforthebay.org, and read the "Take Action" section to learn about upcoming volunteer opportunities. Check out our do-it-yourself websites that will walk you through making some of these changes.

Lucy Heller is a Chesapeake Conservation Corps member at the Alliance for the Chesapeake Bay.

Bacterial monitoring goes mobile in and around the District

≈ Boat-based lab and swimming app let public know when it's safe to go in the water.

By Whitney Pipkin

When Potomac Riverkeeper Dean Naujoks speaks to groups about his work, he often fields a question that, until now, he hasn't been able to answer: "Is it safe to go in the river?"

"I've been very uncomfortable answering that question because we never had data," Naujoks said, looking out across the Potomac from a dock at Maryland's National Harbor. "This area had almost zero bacterial monitoring."

Now, that's beginning to change.

As of this summer, the Potomac Riverkeeper Network and Anacostia Watershed Society have each launched sizable citizen monitoring programs — one of them buoyed by a mobile, boat-based lab — focused on determining whether bacteria that can be harmful to human health are present in the rivers.

When the weather is nice, hundreds of people plunge their paddles, toes — or their entire bodies — into these waters, which run through the region's most populous areas in and around the District of Columbia. Paddleboarders are easy to spot balancing on the ripples near Georgetown's waterfront, and experienced swimmers dive headlong into the main branch of the Potomac at National Harbor during twice-weekly open-water swims.

Liz Chudoba, water quality program manager for the Alliance for the Chesapeake Bay (left), and Annie Bronez, volunteer coordinator for the Potomac Riverkeeper Network (right), show a group of volunteers how to measure the pH of a portion of the Potomac River at National Harbor during a training session on May 15. (Whitney Pipkin)

Each year after wet weather, though, these same Potomac waters receive millions of gallons of sewage and stormwater from wastewater treatment plants in the District and Alexandria, VA.

Those systems are being updated to curtail polluted overflows, which contain human waste and often high levels of fecal coliform and other bacteria. Some of those bacteria can cause stomach flu-like symptoms or severe infections, yet few people are aware of the risk. And you don't have to swallow the water to be affected; bacteria can enter the body through the ear canal and small cuts or scrapes.

Riverkeepers for the Anacostia and Potomac are in a tight spot as they work toward a goal to make these waters "swimmable and fishable" in the next decade — encouraging people to connect with the rivers, but

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recognizing that water quality is not always safe for recreation. Monitoring, they say, can help residents know when it's safe for water contact and when it is not.

"We want people to enjoy the waterways when it's safe to use them, and we want it to be increasingly safe," said Nancy Stoner, president of the Potomac Riverkeeper Network, "We also want people to know when it's unsafe — so they won't go in and also so they'll push for investments."

It is illegal to swim in District waters, a law the network would like to see replaced with water contact recommendations linked to monitoring. But recreating on vessels such as stand-up paddleboards is permitted — even though balancing on the boards often involves falling in. Swimming is permitted during special events if the water passes a half-dozen quality tests in the weeks leading up to an event. But rains and high bacteria levels have foiled the swim portion of the Nation's Triathlon more often than not the last six years.

In Maryland and Virginia, the Potomac is more often used by boaters than swimmers, but high school and college rowing crews wade in to push their vessels, and swimming is popular at a handful of locations relatively close to polluted overflows. No organized swims take place in the Anacostia, but some groups have floated the idea of suspending a swimming pool filled with clean water in the river — to ease people into the idea of future safe swimming.

The Anacostia Watershed Society gave the Anacostia its first passing grade, a D-, in 2018 in a report that stated sewage overflow improvements would help the river become ready for swimming by 2025. Bacterial monitoring for recreation began in the Anacostia that same year under a grant from the District Department of the Environment. The renewed effort should provide a baseline of how the river's water in and around the District are swimmable now while tracking progress toward future goals.

Naujok is glad to see the monitoring spread farther downriver as more funders have seen the value of recreational information. His 14-year-old daughter used to swim often in the Potomac near Alexandria's Belle Haven Marina a mile away from their home — before he found out a couple of years ago that sewage from the city's treatment plant habitually overflowed into Oronoco Bay, just upstream.

"When we first moved in, she was 11. She was just a kid jumping in the river," he said. "After a rain event, I'd say, 'Please don't go in the river,' but we had no data."

Now, Belle Haven Marina is one of nearly two-dozen sites along the Potomac and the Anacostia from which volunteers are drawing water samples every Wednesday. By Friday, the results are available in time for people to decide whether it's safe for a dip. Those results are posted to an online app, *Swim Guide,* that already covers nearly 8,000 locations around the world.

The Potomac Riverkeeper Network's new boat, the 42-foot Sea Dog, goes out for an inaugural spin from National Harbor with funders and supporters in March. A Navy admiral donated the boat to the nonprofit, which has transformed it into a mobile laboratory for water quality testing. (Dave Harp)

Anne Irving, an Alexandria resident and member of the Hunting Creek Garden Club, will be one of the volunteers collecting that data. Her club also donated $5,000 from its conservation fund to the nascent monitoring effort.

"We wanted to do it because we live in Alexandria. With all the recent information on the sewer system, this seemed like a good idea," Irving said.

Irving also had two sons who were on a local high school's rowing team, which pushes out to the Potomac from Oronoco Bay, where the outfall with the highest volume of polluted overflows also is located.

Patrick Fletcher, a volunteer with the Potomac Riverkeeper Network and a post-doctoral research fellow at The National Institutes of Health, holds a tray where water samples incubate more than 24 hours to be tested for bacteria on the nonprofit's new boat-turned-mobile-lab. (Whitney Pipkin)

"They survived, but I didn't realize it was not monitored at the time," she said.

On a mid-May morning, Irving was among more than a dozen volunteers gathered at National Harbor to learn how to collect the water samples and deliver them to a yacht-turned-mobile-lab that's the hub of the Potomac Riverkeeper Network's monitoring program. A former Navy admiral donated the 42-foot vessel, now named the "Sea Dog," last fall just as the nonprofit's new citizen monitoring program was coalescing.

Other grants have since helped to transform it into the region's first floating laboratory focused on monitoring water conditions for recreation. A stainless-steel table, mini fridge and lab equipment had recently replaced the yacht's futon mattress when the volunteers were brought on board to see what will happen with their samples.

Annie Bronez, the network's outreach and volunteer coordinator, had already explained how to take the temperature of the water and the air and measure the water's pH, a measure of acidity, in the field. Along with those written results, two bottles filled with samples of river water will be placed in a cooler and delivered to this boat within five hours, where they'll be analyzed for turbidity and bacteria levels.

"This machine is the incubator," Patrick Fletcher, a volunteer who is also a post-doctoral research fellow at The National Institutes of Health, told volunteers clustered on the boat. It takes about 24 hours to grow a culture and identify bacteria. "*E. coli* like to be at about 35 degrees Celsius, which is the temperature of the inside of your intestines that we want to mimic," he said.

He held up the results of a sample from the previous week, with liquid divided among rows of small cubes in a sealed, metallic tray. Several of the cubes glowed a fluorescent green under the black light, indicating the presence of certain bacteria.

"We count how many big squares are glowing and how many littles ones are glowing," Fletcher said, comparing those numbers to a chart, revealing that the sample from early May would not meet Virginia water quality standards.

A sample taken the week before and a few since have, however, met those standards, which means the project posted a green "meets water quality standards" emblem on the *Swim Guide* app. When quality falls close to or below those standards, the emblem is yellow or red.

"When the water is turbid like this, that's when it's more likely to be high [in bacteria], when it looks murky," said the network's Nancy Stoner. "Over time, we'll have trend data as well. This year will be the baseline.

In the future, Naujoks would like to create a larger monitoring program around the boat, one that perhaps goes on the road to popular public access points along the Potomac. In New York, he said, a similar, boat-based lab traverses the Hudson River, collecting hundreds of water quality samples from volunteers to be analyzed on board.

"We'd like to make it a port-of-call thing where we go down the river, introducing ourselves and inviting people to see the lab," Naujoks said, "anything we can do to promote this idea of a swimmable Potomac and to get people to start making connections."

Funding is largest obstacle preventing states from reaching cleanup goals

≈ Stormwater, agricultural goals proving hardest to meet.

By Karl Blankenship

The draft Bay cleanup plans drawn up by watershed states fall short of ensuring the region will finally achieve its longstanding goal of delivering a healthy Chesapeake by 2025, federal officials have concluded.

Reviews by the U.S. Environmental Protection Agency confirm that drafts submitted by two states, Pennsylvania and New York, fail to achieve nutrient reduction goals set for those jurisdictions. That would ensure the region's overall goal would be missed unless the shortfall is addressed in final plans due in August.

But even in states where plans appeared to achieve their goals on paper, the EPA said the drafts lacked details showing they had adequate funding, programs, regulations — and in some cases legislation — to ensure there would be enough on-the-ground action to reach the Bay's clean water goals.

Those concerns were echoed by a variety of stakeholder groups. The overriding concern is money — or lack of it. Most state plans did not offer detailed cost estimates for fulfilling their plans, or say where they would get needed money.

Many local governments and farm groups are worried that they could be left bearing the brunt of costs that would easily run into the billions of dollars over the next six years to curb farm runoff, control urban stormwater and complete wastewater treatment plant upgrades.

Corn irrigation on Maryland's Eastern Shore. Under the draft plans, about 85% of the reductions would now come from agriculture, a sector where progress has been difficult. (Dave Harp)

The concerns came in response to the draft watershed implementation plans submitted to the EPA in April by six states and the District of Columbia. The plans, or WIPS for short, are supposed to spell out how states would achieve by 2025 the remaining nitrogen and phosphorus reductions for each jurisdiction that were established under the Chesapeake Bay Total Maximum Daily Load, which was set by the EPA in 2010.

Although the region has made progress, it is behind schedule for controlling nitrogen, the primary nutrient responsible for algae blooms that cloud the Bay's water and fuel its oxygen-starved dead zones. The WIPs lay out actions needed to finish the job, plus the programs and funding required to get there.

The EPA released its evaluations of the plans in June while dozens of local governments, environmental groups and others also submitted comments. States must complete final plans in August.

If the EPA concludes the final plans do not provide confidence that states will reach their goals, it can take a variety of actions, including increasing oversight, extending its regulatory authority over more entities and requiring more pollution reductions from dischargers with permits, such as wastewater treatment plants.

Draft plans from Pennsylvania, which accounts for most of the region's nutrient shortfall, as well as the plan from New York failed to reach their goals by substantial margins. Two jurisdictions, the District of Columbia and West Virginia, have already met their goals.

In most of the plans, states fall short of achieving stormwater goals, which are particularly costly, and make up for that with reductions from wastewater plants or agricultural controls.

Some criticize that approach. By transferring responsibilities to others, noted Choose Clean Water, a coalition of conservation groups from around the region, states are "failing to put the programs and

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resources in place and to ask the stormwater sector to reduce its fair share."

Taken as a whole, the biggest hurdle will be ramping up programs for agriculture, the largest source of nutrients to the Bay. About 85% of the nitrogen reductions achieved since the TMDL went into place came from upgrades to wastewater plants, but that job is nearly complete.

Under the draft plans, about 85% of the reductions would now come from agriculture, a sector where progress has been difficult. State programs lack adequate funding to pay for needed conservation measures, critics say, and agencies lack enough technical staffing to assist farmers.

Financial problems are not limited to government agencies. The WIPs are coming at a time when many farmers are hard-hit financially from the impact of last year's harvest-reducing rains, tariffs and low commodity prices.

Even if state programs were staffed and funded, farmers in many cases would not have the money to implement practices that require cost-share, many said.

"The agricultural economy is at its lowest point since the agricultural depression in the early 1980s," said the Maryland Association of Soil Conservation Districts. "Conservation is not free, and even with cost-share, private farmer dollars are required to implement conservation practices."

Here are some highlights of comments on state plans:

Pennsylvania

Nitrogen

2009 Load: 112.71 million pounds
2018 Load: 107.36 million pounds
2025 Target: 73.18 million pounds

Phosphorus

2009 Load: 4.46 million pounds
2018 Load: 3.85 million pounds
2025 Target: 3.04 million pounds

The state's draft WIP achieves only 64% of its nitrogen reductions needed to meet its 2025 goal, according to the EPA's review, and 76% of its phosphorus goal — the only state to miss the mark for that nutrient.

Meeting cleanup goals would result in clearer water, helping underwater grass beds, like this widgeon grass bed in Maryland's Honga River, to thrive. (Dave Harp)

The EPA review said Pennsylvania's plan lacked details showing how it would address shortfalls in funding and staff. The federal agency also questioned the lack of timelines for making needed regulatory and legislative changes.

In some cases, the state plan calls for more than a tenfold increase in the installation of certain runoff control practices, but says little about how that would happen.

The EPA said it understood that Pennsylvania has "unique challenges." The state is the largest contributor of nutrients to the Bay, and those pollutants mostly come from small farms and small municipalities where controlling them is difficult.

The EPA and others lauded the state for striving to involve local governments and stakeholders in developing county-specific cleanup plans. But the first four completed plans fell short of their goals, the agency said, and the WIP did not show how it would make up for those shortfalls.

The EPA also faulted the sparse explanation of how the state would curtail runoff from developed lands. Pennsylvania has more stormwater than any other state in the watershed, and 75% of it comes from areas too sparsely populated to be covered by existing regulatory programs.

Pennsylvania's draft plan acknowledged an annual funding shortfall of $257 million and outlined various potential funding sources to fill that gap. But the plan didn't identify which are being pursued or pledge to establish any dedicated funding source, the EPA said.

Others also pressed for increased state funding. The Chesapeake Bay Foundation said some existing state programs "are so underfunded and understaffed that they essentially fail to function." Spending on environmental programs in Pennsylvania has been steadily declining for more than a decade, and CBF said "the trend of disinvestment in resource agencies must be reversed."

Beyond more funding, CBF said the state needs to impose new regulations and laws to limit the application of manure during the winter, exclude animals from streams and restrict lawn applications of fertilizer.

Local governments worried they would be on the hook for covering financial shortfalls, especially for stormwater.

The Pennsylvania State Association of Township Supervisors questioned "the affordability of this level of spending," and suggested the plan's completion deadlines were unrealistic.

York County, one of four that participated in developing initial cleanup plans, flatly stated that the 2025 deadline "will not be met."

None of the four pilot counties that developed plans met their goal. Even with a shortfall, York County called its plan a "stretch" and said it would require new programs, policies and funding from the state — specifics which it said were lacking in the draft WIP.

The environmental group PennFuture said it would be a "significant feat" for the remaining 39 counties to write and implement plans in the next five years. It said the WIP failed to detail how the state would address gaps in the county plans, or even ensure that they were being written or carried out.

Maryland

Nitrogen

2009 Load: 57.51 million pounds
2018 Load: 52.75 million pounds
2025 Target: 45.78 million pounds

Phosphorus

2009 Load: 4.05 million pounds
2018 Load: 3.61 million pounds
2025 Target: 3.68 million pounds

The EPA said Maryland's plan met its nutrient reduction goals but lacked important details.

In particular, the state needed to offer more information about how it would install new agricultural runoff control measures which, in many cases, must be done at significantly higher rates. The EPA said the draft is unclear whether the state has adequate funding in place to support those efforts, or to provide the necessary increased technical assistance to farmers.

The agency also said the plan lacked detail about how Maryland would accelerate stormwater controls by 2025.

Several environmental groups also described the state's plan as "vague," especially when it comes to stormwater and agriculture.

The Choose Clean Water coalition

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faulted Maryland for not including county-level detail for achieving nutrient reduction goals. It noted that nitrogen farm runoff has been increasing in several counties in recent years, but the WIP failed to explain how those trends would be reversed.

In a comment echoed by others, the Washington County Soil Conservation District said meeting goals was contingent on adequate state funding, adding that it cannot meet plan expectations "if we are not given additional manpower for the work."

Many in the agricultural community also called for greater investments in technical assistance. "Maryland must provide long-term stability of technical assistance positions — not just grant-based jobs," commented the Delmarva Poultry Industry.

The Maryland Association of Soil Conservation Districts said another 30 planners are needed statewide to write farm conservation plans — a staffing increase of more than a quarter — as well as more engineers to design manure storage and runoff control structures. In some counties, as many as half of the requests for technical positions went unfilled in 2018, it said.

The Chesapeake Bay Foundation urged the state to begin putting more emphasis on buffers, pasture management, wetland restoration and other systems that help build natural filters on the landscape. But the state's buffer goal, CBF said, is even less than that proposed by county conservation districts.

The Blue Plains Advanced Wastewater Treatment Plant in the District of Columbia is projected to exceed nutrient goals for 2025 and beyond. (Dave Harp)

Although local engagement was supposed to be an important part of WIP development, many questioned whether that took place. The Maryland Municipal Stormwater Association said many local governments likely disagree that they were actively engaged, and that the state never gave local governments the chance to comment on assumptions the state incorporated into its WIP.

Virginia

Nitrogen

2009 Load: 68.1 million pounds
2018 Load: 58.16 million pounds
2025 Target: 55.73 million pounds

Phosphorus

2009 Load: 6.99 million pounds
2018 Load: 6.16 million pounds
2025 Target: 6.19 million pounds

The EPA said the state plan achieves nutrient goals statewide as well as in its major river basins, except for on the Eastern Shore, which would not meet the nitrogen goal.

The EPA said the state should provide more details about how it would significantly increase implementation rates for many agricultural controls such as nutrient management, forest buffers and livestock exclusion. It also asked the state to provide more information about how it would greatly expand its poultry litter transport program, from 6,000 to 89,000 tons of transported litter each year.

In addition, the EPA asked for more information about how Virginia would address stormwater runoff in rural areas not covered by existing permits.

Virginia counts on achieving additional reductions from wastewater treatment plants to cover stormwater pollution, but the EPA said the state needed to provide more detail about those additional reductions and when they would be made.

A number of communities expressed concern that the state said it could seek further wastewater reductions from some plants, noting that sector had already far exceeded its goal. In a comment reflected by others, the Stafford County Board of Supervisors called the proposal "an inefficient approach that will have negative impacts on local sewer rates."

Many also said that the state needs to provide more detail, especially when it

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comes to how it would pay for ramped-up programs.

In the last 15 years, 60% of the state's Bay-related spending has gone for wastewater treatment plant upgrades, noted the Choose Clean Water coalition. With a greater proportion of future reductions expected to come from agriculture and stormwater, the state needs "adequate and consistent" funding for those sectors to be successful, the coalition said.

CBF estimated that the state's agricultural cost-share programs need about $100 million a year but typically get less than one-third of that.

"Stabilization of funding should help improve performance of all restoration programs," the environmental group said.

New York

Nitrogen
2009 Load: 14.51 million pounds
2018 Load: 14.28 million pounds
2025 Target: 11.53 million pounds
Phosphorus
2009 Load: 737,000 pounds
2018 Load: 629,000 pounds
2025 Target: 587,000 pounds

New York submitted a plan that achieved only 61% of its needed nitrogen reductions by 2025, the EPA said. Most of the shortfall comes from its agricultural sector. The state proposed to continue existing programs at current levels of funding and staffing rather than accelerate those efforts or launch new initiatives.

The EPA said the state needs to provide a more detailed strategy — and a commitment to implement it — to fill its nitrogen gap. It noted the state often has low goals for important programs. The state calls for having nutrient management plans for less than 10% of available farm acres, the EPA noted, pointing out that such plans "are typically an essential management element" for making decisions about manure application on farmland.

The state's draft plan calls for a 30–35% reduction in stormwater from developed lands, but the EPA said it provides little information about how those reductions would be achieved and whether programs have adequate staffing.

The agency also said the state should consider making further nutrient reductions at its wastewater treatment plants to compensate for the lack of adequate progress in its agricultural sector.

The Choose Clean Water coalition faulted the state for its disregard of the 2025 goal. While meeting the agricultural goals would require a "massive increase in capital, technical staff capacity and landowner participation," the coalition added that "we argue that there needs to be a discussion on how these barriers could be overcome."

Although pollution from stormwater is increasing, most states plan to meet their stormwater goals at least in part with additional reductions from wastewater treatment plants or agriculture. (Dave Harp)

Delaware

Nitrogen
2009 Load: 7.25 million pounds
2018 Load: 6.66 million pounds
2025 Target: 4.55 million pounds
Phosphorus
2009 Load: 140,000 pounds
2018 Load: 118,000 pounds
2025 Target: 108,000 pounds

The EPA's review found that the state's plan would achieve the nutrient and sediment reduction goals but cautioned that the plan often lacked needed detail to assure those goals could be reached.

For instance, the state plan calls for "enrolling every eligible acre" in cover crop programs but failed to demonstrate that it had funding to achieve such a goal. The EPA review noted that the plan calls for planting more grass and forest buffers. But the state did not explain how that would happen, and the state historically has been largely ineffective in getting farmers to plant buffers.

The state also needs to include a strategy and timeline to address the backlog of cost-share applications for animal waste management systems, the EPA said.

It also said the state needed a long-term strategy to address its small wastewater plants, which will be challenged by increased growth in Delaware's part of the watershed.

The Choose Clean Water coalition said that the state needs to establish a dedicated source of funding to support water quality improvements. "State agencies charged with implementing the WIP are understaffed and underfunded," it said. "Similarly, local county agencies need additional staff and resources dedicated to WIP implementation."

West Virginia

Nitrogen
2009 Load: 8.06 million pounds
2018 Load: 7.72 million pounds
2025 Target: 8.22 million pounds
Phosphorus
2009 Load: 624,000 pounds
2018 Load: 429,000 pounds
2025 Target: 432,000 pounds

The state has achieved its overall 2025 goals, and its plan will continue to meet the state's nutrient reduction goals for the Potomac River, but the EPA's review said it falls short of the goals for the small portion of the state that falls in the James River basin.

To ensure the state maintains its progress, the EPA called on it to provide more details about how it would accelerate nitrogen reductions in its agricultural sector, including new programs, incentives and funding to increase implementation of high-priority practices such as prescribed grazing, conservation tillage and the development of soil conservation plans.

The agency noted that the plan calls for increasing stream fencing and forest buffer installation 40% by 2025, even though implementation has been essentially steady in recent years. It did not explain how this increase will happen.

District of Columbia

Nitrogen
2009 Load: 2.76 million pounds
2018 Load: 1.62 million pounds
2025 Target: 2.42 million pounds
Phosphorus
2009 Load: 72,272 pounds
2018 Load: 58,000 pounds
2025 Target: 130,000 pounds

The District has achieved its goals, and its draft plan would continue to meet them through 2025.

The EPA had relatively few comments on DC's plans, noting that the Blue Plains Advanced Wastewater Treatment Plant is projected to exceed nutrient goals for 2025 and beyond. Meanwhile, the replumbing of the district's combined sewage overflow system will treat 96 % of that.

But a third of the district's land is owned by various federal agencies, and the EPA said the district needed to better coordinate with those agencies to report on runoff control practices on those lands.

Scientists predict severe dead zone, but are hopeful about Bay grass beds

≈ 2018's high river flows have continued into this year with mixed impacts on the Bay and its resources.

By Karl Blankenship

The downpours that soaked 2018 have spilled into this year, with three of the first five months reporting higher-than-normal freshwater flows into the Chesapeake.

That will likely mean worse-than-normal oxygen conditions in the Bay. Scientists are predicting the fourth largest summertime dead zone in the last two decades.

Still, the often record-setting rains that commenced a year ago have not been a total washout for the estuary.

Underwater grass beds — a closely watched indicator of Bay health — appear to have survived last year's influx of muddy water. Field reports from this spring made scientists cautiously optimistic that the beds may not suffer the extensive dieback they had feared.

But scientists say this spring's high flows may have hurt the spawning run of shad in many places — it was the worst-ever on the Susquehanna. And biologists say the freshwater has allowed invasive blue catfish and snakeheads to turn up in places they haven't been seen before.

Many species, though, will find much of the Bay off-limits this year because of poor oxygen conditions, according to scientists.

"The forecast this year reflects the high levels of precipitation that have been observed across the Bay's watershed," said Jeremy Testa, of the University of Maryland Center for Environmental Science, which makes the annual Chesapeake dead zone prediction in conjunction with scientists from the University of Michigan.

"The high flows observed this spring, in combination with very high flows late last fall, are expected to result in large volumes of hypoxic and anoxic water," Testa added.

Heavy rains wash large amounts of nutrients off the watershed and ultimately into the Bay, where they spur large algae blooms. When the algae die, they sink to the bottom and are decomposed by bacteria in a process that removes oxygen from the water, resulting in so-called dead zones in deep areas of the Bay.

Spring rains this year washed an estimated 102.6 million pounds of nitrogen from the Susquehanna River into the Bay, far more than the springtime average of 80.6 million pounds, according to the U.S. Geological Survey. The Potomac River contributed another 47.7 million pounds, compared with the normal flow of 31.8 million.

Scientists predict that big influx of nutrients will produce about 2.1 cubic miles of hypoxic water — water with too little oxygen to support most Bay species — or about one-sixth of the Chesapeake. Between 0.49 and 0.63 cubic miles, or about 4 percent of the Bay, will be anoxic, meaning water in that area will have essentially no oxygen.

Water flows over the weir at the USGS gaging station on the upper Choptank River at Red Bridges. This photo was taken at 10 a.m. on June 19, when the flow was approximately 130 cubic feet per second after two days of thunderstorms. (Dave Harp)

"The forecast is not surprising considering the near-record high flows in 2018 that have continued into 2019," said Bruce Michael, director of the Resource Assessment Service of the Maryland Department of Natural Resources. He added, though, that the long-term trend has been toward a slight improvement in oxygen conditions.

USGS figures show that, except for March and April, river flows into the Chesapeake Bay have been higher than normal every month starting last July, one of the longest periods of sustained high river flows on record.

Because persistent high flows drive bloom-feeding nutrients and cloud the water with sediment, they are generally considered bad news for underwater grasses, which depend on clear water to get the sunlight they need to survive.

After measuring a record 104,843 acres of grasses in the Bay in 2017, scientists were braced for a significant retreat. But it appears the decline last year may be limited, though the results won't be known until surveys are completed later this year.

Bob Orth, the Virginia Institute of Marine Science researcher who oversees the annual underwater grass survey, described his outlook as "cautious optimism."

Much of last year's survey was completed before consistently heavy rainfalls began last July. At that point, about 80 percent of the Bay had been surveyed, and results showed it was likely en route to another record-setting year with grass beds being found in some places they had not previously been seen, said Dave Wilcox, a VIMS scientists who works on the survey.

But the persistent high flows and muddy water prevented the survey from being completed.

Scientists say some of the beds died back amidst the high flows, especially in the Upper Bay and upper parts of several tidal tributaries where conditions were the worst.

But scattered satellite imagery and field observations made last year indicate that many beds in hard-hit areas appear to have survived. That includes the bed in Susquehanna Flats which, despite bearing the brunt of high flows from the Bay's largest tributary, appeared largely intact.

Biologists caution that it is possible that the stress caused by poor water quality could still result in diebacks that will not be evident until this year. While they expect declines, scientists are optimistic it won't be as catastrophic as they had feared.

This spring, scientists reported seeing apparently healthy beds when they've been out on the water, and citizens have reported robust beds in areas such as the Severn River in Maryland.

Brooke Landry, a biologist with the Maryland DNR, said citizens trained to survey underwater grass beds have reported large areas of horned pondweed this spring, one of the earliest underwater plants to emerge in Maryland.

"That is really good news," she said. "In areas where there may have been a little horned pondweed here and there in earlier years, there's a lot of it out there now."

Grasses are considered one of the most important indictors of Bay health because they require clear water to survive. They are also important habitats for many types of fish, juvenile blue crabs, and waterfowl.

But the high flows have been a mixed bag for other Bay species. This spring was the worst year on record for fish passage at the Conowingo Dam on the Susquehanna, where just 4,787 migrating fish were lifted over the 94-foot-high structure.

More than 190,000 have been lifted over the dam by multimillion-dollar elevators in some years. Biologists said high flows in May contributed to this year's poor performance.

In Virginia, biologists also blamed high flows for contributing to poorer-than-average American shad runs on the James, York and Rappahannock rivers. On the James, the annual VIMS survey of shad and river herring saw just nine American shad this spring, said Pat McGrath, the biologist who oversees the effort.

The good news, he said, is that years with high flows often result in the good survival of young from those fish that do spawn. Last year's juvenile fish surveys showed better-than-average survival for several anadromous fish — those that live in the ocean but return to rivers to spawn — including shad and striped bass.

"Hopefully, all this water translates to a good 'year class' with juvenile shad," McGrath said.

One species that clearly seemed to benefit, he said, was blue catfish — a fish introduced in the 1970s, whose population has dramatically expanded in the last two decades.

The invasive species is confined to fresh and brackish water, but McGrath said there was so much freshwater in the James this spring that their survey was netting hundreds near the James River Bridge by Newport News, which is normally well beyond the range of blue catfish.

Biologists around the Bay say reduced salinities over the last year have allowed both blue catfish and snakeheads, another invasive species, to expand their range.

Ellicott City unveils flood plan to weather increasingly severe storms

≈ Stormwater tunnel, upstream retention ponds, razing and modifying some buildings could cost up to $140 million.

By Timothy B. Wheeler

Ravaged twice in two years by killer flash floods, Ellicott City, MD, is embarking on an ambitious and costly race against time to shield the historic mill town from severe storms that appear to be striking with increasing frequency.

Howard County Executive Calvin Ball unveiled a flood mitigation plan in May that aims to keep Ellicott City "safe and sound." It proposes boring a tunnel to siphon floodwaters away from the quaint shops and restaurants lining Main Street and building or expanding stormwater retention ponds and culverts farther up the watershed.

Ball's plan would also demolish four of the historic buildings on lower Main and modify up to six more.

"When you look at the reality of it, there are some buildings that just have to come down in order to ensure the highest level of public safety possible," Ball said in an interview.

The floods that devastated old Ellicott City on July 30, 2016, and on May 27, 2018, were generated by "1,000-year storms," with rains so intense that meteorologists consider them exceptionally rare and put the probability of their occurring in any year at 1 in 1,000.

However, extreme rainfall events have become much more frequent across the Northeast since the 1950s, a trend scientists say is likely to keep happening as the global climate continues to change in the coming decades.

Ellicott City has been flood-prone since its founding as a grain mill community in 1772. It was built in a steep, rocky valley where four streams come together before flowing into the Patapsco River. Some of the buildings actually sit atop culverted stream channels.

Over the years, Main Street has been inundated dozens of times, but there have been three major floods in the last seven years, including Tropical Storm Lee in 2011. In the past, flooding came from the Patapsco rising out of its banks, but the two most recent floods were "top-down," meaning that rain falling in the 11-square mile Tiber-Hudson watershed burst from the channels of the streams that would normally carry it to the larger river.

The first flood claimed two lives, damaged 90 businesses, displaced nearly 100 residents and put hundreds out of work. But the community cleaned up, repaired and returned.

The 2018 flood killed one person and washed out many of the same businesses and residents. The county has repaired the damage to public infrastructure, including one road closed for months after it washed out. But a number of businesses and residents have opted not to come back.

Howard EcoWorks Executive Director Lori Lilly, during a tour of Ellicott City's historic downtown in May, glances up at a sign directing people to higher ground in the event of flooding. (Jeremy Cox)

Sandbags are piled by one resident's home as an extra precaution to keep floodwaters from storms away from the door. (Timothy B. Wheeler)

Flood mitigation projects planned after the 2016 storm were still mostly on the drawing board when last year's flood hit. Ball's predecessor as county executive, Allan Kittleman, responded with a proposal to buy and take down 10 buildings on lower Main Street to turn that flood-prone area into a waterfront park.

Ball, a County Council member who defeated Kittleman in last year's election, opposed that plan, saying he thought a better balance could be struck between safety and retaining historic structures. His plan has a target completion date of 2024, the same as Kittleman's, but it would cost significantly more; estimates range from $113.5 million to $140.5 million, compared with $85 million for the previous plan.

"I wanted to ensure that we had a plan that kept more water off of Main Street and away from the west end [of town]," Ball said. "And I recognize that in this changing climate, where we have more frequent and intense storms, the nation and the world are watching how we deal with these issues. I want us to be an example for resiliency, and how we respect and preserve the nature and character of a city while also putting public safety first."

The county budgeted about $17 million in each of the last two years to work on projects intended to ease flooding in Ellicott City. Where the rest will come from is an open question.

"It's an aggressive plan," said James Irvin, the county's public works director. "If everything falls into place, it's doable." But, he said, much depends on raising enough funds to pay for the rest. The county is hoping for significant help from the state to relieve the burden on local taxpayers.

Even if fully funded and carried out, the plan doesn't claim to eliminate the threat of flooding, just reduce the depth and velocity of the rushing water. Once all the work is completed, officials say floodwaters that measured 5.5 feet deep at the foot of Main Street during the 2016 storm should be no deeper than 3 feet. And in less severe storms, they say, the water should be less than a foot deep.

But some worry the county seems fixated on plans designed in response to the 2016 flood when storms can vary. Streamflows and floodwaters were actually higher in the 2018 flood, according to the U.S. Geological Survey. And the surge was nearly twice as great down one tributary, New Cut Branch, which comes in on the opposite side of Main Street from the planned flood tunnel.

"If the storm concentrates in a different area, the tunnel wouldn't do any good," said Lori Lilly, executive director of the nonprofit Howard EcoWorks, which is working to get area homeowners to replace grass lawns with more rain-absorbing vegetation.

"Every storm is different," said Mark DeLuca, deputy county public works director. The county's plan is focused, he explained, on reducing flooding where it's the worst, at the base of Main Street. Even so, the runoff retention projects in the works should ease flooding everywhere, officials say.

Historic preservation advocates, who had opposed Kittleman's plan, praise the new blueprint's proposal to retain more of the existing structures.

"In a situation like this, there's no perfect outcome," said Nicholas Redding, executive director of Preservation Maryland. But he called Ball's plan a "win" for historic preservation, while also improving safety.

Redding said he sees Ellicott City as a test case for how historic communities can survive floods and other weather-related calamities in an increasingly volatile climate. But he said it's also a teachable moment for coming to terms with the costs of improvident development.

Many residents are convinced the flooding has worsened because of continued development of the heights above town. Roughly two-thirds of the land in the 11-square-mile watershed is developed, and more than 20% is covered by hard surfaces such as pavement and rooftops.

Much of that development occurred decades ago, before there were any stormwater management requirements. The county has tightened its regulations in more recent years, but residents contend the county was still too willing to waive the rules.

"Ellicott City is not the only place in the state that's suffering from these mistakes," Redding said. But the consequences are most acutely felt there, because the terrain makes the community especially vulnerable to flash flooding.

After the 2018 flood, the County Council imposed a building moratorium in the watershed and then extended it until the end of October to consider whether stormwater requirements should be tightened still more to deal with flash flood conditions.

The county has asked the U.S. Army Corps of Engineers and other flood experts to review its plan, which they hope will build public confidence that the proposed mitigation projects will work as designed. Meanwhile, county officials are

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forging ahead, striking deals for eight of the 10 properties it wants to acquire.

One business that came back now finds itself forced to get out. The Phoenix Emporium, a pub that's been a fixture at the foot of Main Street for four decades, occupies one of the buildings the county intends to knock down.

"Of course, I'd love to be able to stay in this location, but that's not possible," pub owner Mark Hemmis said. He added that he recognizes the county had to do something after the back-to-back disasters. "I'm no expert," he said, "but changing climates and developmental issues all need to be addressed."

While the brick-and-mortar projects take time, county officials say they are doing what they can now to enhance safety. They've instituted a more aggressive regimen for clearing debris out of stream channels after heavy rains. Tree limbs, furniture and even rocks washed downstream can worsen flooding by constricting or even blocking culverts.

The county also has installed a public-alert system that emits beeping tones if officials believe a flash flood is imminent or likely. Signs also are being posted pointing people toward high ground.

Beth Woodruff, who lives in the west end of town, said she and her neighbors aren't relying solely on the county's alarm. They formed their own flood-warning network, sending out text alerts and sounding air horns outside if they see rising water.

Some buildings have yet to be repaired from the May 2018 flood. This building and several others were built over the Tiber-Hudson channel. (Timothy B. Wheeler)

In both floods, the rampaging water gouged sedan-sized craters in Woodruff's front yard, washed out her driveway and nearly invaded her home — missing by only an inch last year. Since 2016, she's kept a "go" bag with essentials to grab if she and her family need to flee another deluge. Last year, she said, she and her son and dog escaped to higher ground just 20 minutes before the road became impassable. Her home sits at a spot where the Hudson Branch, no more than a concrete chute at that point, flows through a culvert under Main Street. Woodruff calls it a "poorly designed funnel" that causes the stream to jump out of its channel and rush down the road.

The county informed her in May that it wanted to buy her house — one of 10 additional properties it wants to acquire this year in the west end and Valley Meade, another flood-prone neighborhood even farther out. Plans are to use her land to install an overflow pond when the stream threatens to surge out of its chute.

"I told them that because I realized something has to be done with that culvert that we would be willing to go if it was necessary," Woodruff said. She'd like to find a new home in the same school district for her son's sake, but it likely won't be in the same neighborhood.

"Ellicott City is where my heart is," she said, "I care about these people, I care about the town." But the homes there in less vulnerable areas are too expensive, she explained, "and the places I could afford are too dangerous."

Even so, Woodruff said, she's relieved that the county is taking action.

"I'm glad to see that a lot of the major pinch points and major issues are being addressed," she said. But she added that she's worried about whether five years is soon enough to get the work done.

"No matter what administration is in power," she said, "they're fighting against time. … We never know when the next flood is coming. It really could be tomorrow. How quickly real change can be made is of the utmost importance."

Elizabeth River chemical cleanup continues to make progress

≈ Military and wood processor to reimburse EPA and VA almost $64 million in costs associated with remediating contaminated soils.

By Sarah Vogelsong

Sediments contained at the Atlantic Wood Industries Superfund site, left, in Portsmouth, VA, will eventually be spread and compacted over the site. (Sarah Vogelsong)

For almost 70 years, the Elizabeth River in Portsmouth, VA, was the final destination for multiple streams of the oily, tarlike liquid known as creosote. A key ingredient used in wood preservation, the toxic chemical was as much a part of life in Norfolk as the industry that once relied on it to function: shipbuilding.

And nowhere was it found in greater concentrations than at the former Atlantic Wood Industries site, an old wood-processing center that began operating in 1926 and backed directly up to the river's southern branch.

In certain areas, "if you stepped in the sediments, you would coat your leg with creosote," recalled Randy Sturgeon, who has overseen the U.S. Environmental Protection Agency's efforts to clean up the site under its Superfund program since 2004. "In some places it was 25 feet deep."

Michael Unger, a professor at the Virginia Institute of Marine Science who has been studying the effects of the Elizabeth River contamination since the 1980s, remembered that "you could take a grab sample of the sediments and see the liquid creosote. You could see it and you could smell it."

Today, much of that contamination is gone. Atlantic Wood, now operating as Atlantic Metrocast, is no longer in the wood business, having pivoted to the manufacture of precast concrete. The U.S. Navy, which over the years had used the site to dispose of waste, has ceased to do so and halted sludge flows into nearby wetlands. Polluted soils from the river bottom have been dredged and either contained behind an offshore wall or landfilled on Atlantic's property, the latter an ongoing process.

The work isn't done, but in an important step forward this March, the U.S. Department of Defense, U.S. Navy and Atlantic Wood agreed to reimburse the EPA and the commonwealth of Virginia almost $64 million in costs associated with remediating the contaminated soils and waters. Of that, $55.3 million will be paid by the Department of Defense and the Navy to the EPA, and $8.5 million will go to the state.

Atlantic Wood, which the settlement decree found "has limited ability to pay for response costs," will reimburse Virginia and the EPA a total of $250,000 plus interest.

According to the most recent estimates, the cleanup will ultimately cost more than $126 million.

The agreement, filed in the U.S. District Court for the Eastern District of Virginia, was hailed by Virginia Secretary of Natural Resources Matthew Strickler as "a critical milestone in addressing historic contamination in the Elizabeth River."

Part of the James River watershed, the Elizabeth is a three-branched river whose shores have been heavily industrialized for more than 200 years. In November 1993, the Chesapeake Executive Council declared the river one of three regions of concern (alongside Baltimore Harbor and the Anacostia River) for its "known toxic problems" and "significant potential … for toxic impacts on living resources and habitats."

Some of these toxic impacts came from the chemicals found in creosote: benzene, toluene, ethylbenzene, xylenes and polycyclic aromatic hydrocarbons, or PAHs. Unger said that during the 1980s, VIMS tests in the Elizabeth "measured some of the highest concentrations that you could find anywhere in the world of PAHs."

Other substances of concern included dioxin derived from pentachlorophenol (PCP), another wood-treatment chemical previously used by Atlantic Wood. Heavy metals such as lead, copper, arsenic and zinc also appeared, left over from the Navy's sandblasting of ships during and after World War II, as did calcium hydroxide, a byproduct of the production of acetylene, a gas used for fuel, at the adjacent Norfolk Naval Shipyard.

Since cleanup efforts began, the researchers have seen cancer prevalence among mummichog decline, and the number of species observed in the waters has risen from 4 to 26

A 1983 report by the EPA found that sediments in the Elizabeth (along with those in the Patapsco River in Maryland) had the highest concentrations of heavy metals found anywhere in the Bay watershed, "100 times greater than natural background levels." Upstream of Atlantic Wood, the nonprofit Elizabeth River Project in 2005 found that 35 acres of the river off Money Point, where another wood-treatment operation had once stood, was a "biological dead zone."

Besides the ecological impacts of the contamination, much of the alarm that surrounded it concerned its possible links with cancer. It was to look for that link — "to try to find a canary in that particular coalmine," he said — that Wolfgang Vogelbein came to VIMS in 1989 and began working with Unger.

What they found was disturbing. The pair chose to focus on the mummichog, a small nonmigratory fish resembling a minnow, which is found in tidal waters and eaten by many larger fish. Because this species remains in its immediate environment year-round, it was a prime test case for examining the impacts of the contamination. Particularly at the Atlantic Wood site, Vogelbein said, "I was seeing a liver cancer prevalence higher than 30%, and over 90% of those animals had what we call precancerous conditions."

Interestingly, although many of its oldest members showed the highest prevalences of cancer, the mummichog population was thriving in terms of numbers.

"They are a prime example of evolution in action. They've developed a resistance to the acute toxicity," Vogelbein said. "It's fascinating from a scientific standpoint."

It was also a red flag. As Unger pointed out, "If we're exposing and changing the genetic composition of a population … who's to know what else is happening to the ecological

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environment where these high-contamination events are taking place that we aren't aware of?"

Since cleanup efforts began, the researchers have seen cancer prevalence among mummichog decline, particularly in recent years. Up at Money Point (where a different approach to remediation has been taken), Elizabeth River Project Deputy Director Joe Rieger reported that the prevalence of cancerous and pre-cancerous lesions among mummichog has dropped, and the number of species observed in the waters has risen from 4 to 26.

"We have otters at the site now," Rieger marveled.

In an odd twist, however, cancer prevalence rates among mummichog have proven difficult to test in the waters off the Atlantic Wood site — because much of this area no longer exists.

After years of study, the EPA determined that the best way to remediate the Atlantic Wood site was to build a sheet pile wall off the banks of the Elizabeth just east of the shore. Of the 360,000 cubic yards of sediment dredged from the waters as part of remediation, just less than half was placed behind a 12-foot-wide wall with an expected 100-year lifespan and capped in place. What had once been river was now land, and under the March settlement agreement, it belongs to the commonwealth.

The remaining contaminated sediments — about 200,000 cubic yards — are being systematically spread over the Atlantic Wood site and also capped in place with 12 inches of permeable stone topped with an additional 4-inch barrier to keep rainwater from infiltrating and allowing the contamination to seep back into the river.

"We looked at shipping this stuff offsite, but it would probably be two to three times more expensive," Sturgeon said.

The containment strategy might be cheaper, but it's accompanied by its own complications. The biggest, Sturgeon said, "is that we have a manufacturing facility that we're trying to clean up while they're still producing product." What that means is that as the EPA spreads and compacts the contaminated soils in one area, Atlantic Metrocast goes about its business elsewhere on the site. Once the EPA needs to focus on a new area, the concrete operation must up sticks and shift as well.

The Elizabeth River flows by the Atlantic Wood Industries Superfund site in Portsmouth VA. The structure is a containment wall for contaminated sediments dredged from the river constructed by the EPA as part of remediation. (Sarah Vogelsong)

The process may be cumbersome, but it's also in line with the EPA's goal of ensuring that Superfund and brownfield sites be put back to productive use, Sturgeon said.

"EPA goes to a lot of effort to work with developers and landowners to make sure land can be reused in a way that's safe," he said.

In the case of the Atlantic Wood site, all of the possible reuses are industrial: the March agreement stipulates that the property can "not be used for residential or other non-industrial purposes (such as a day care center or agricultural development) that may present an unacceptable risk to human health from contamination remaining on-site after the cleanup is complete." Furthermore, no groundwater can be used as a source of potable water.

"Creosote doesn't disappear," Sturgeon said.

Exposure to creosote vapors can irritate peoples' lungs, and skin contact with the chemicals can cause blistering and peeling or eye damage, according to the U.S. Centers for Disease Control. Regular skin contact over time can result in skin cancers, according to the Agency for Toxic Substances and Disease Registry

The EPA's approach to handling the contamination isn't the only possible one. Upstream at Money Point, the Elizabeth River Project has spearheaded a cleanup effort that takes a different approach. Rather than containing contaminated sediments behind a wall and losing additional habitat in a river that has become narrower and deeper, the group has focused on removing the impacted sediments and restoring the wetlands they once polluted.

"Ultimately, we are glad that the [Atlantic Wood] site was cleaned up," Rieger said. "We envisioned a different process of how to address the contamination. … There's no silver bullet for sediment cleanup."

The EPA is about halfway through with the onsite capping, Sturgeon said, and expects to complete the job by fall 2019 — assuming that rainfall doesn't slow the compaction process, as it did last summer.

At the Virginia Institute of Marine Science, Unger and Vogelbein are preparing for another round of monitoring to track the progress of the cleanup's effects on fish and sediments — what Unger called "a physical on the river."

The last comprehensive tests were conducted in 2016. During the fall of 2018, the researchers collected 850 fish, whose livers are preserved in test tubes waiting for analysis, as well as sediment samples from 14 sites on the Elizabeth. Analysis is slated to begin in July.

Both cautioned, that while progress has been made, the Elizabeth is still not what it was before industrialization.

"There are places that have not yet been remediated that there is still liquid creosote at the bottom of the river," Unger said. "It's better than it was, but we're not to goals yet."

Low-salinity water from rivers stunting oyster growth at hatcheries

≈ If trend of wetter winters and springs persists, aquaculture industry will have to adapt.

By Jeremy Cox

Horn Point Lab's oyster hatchery manager Stephanie Tobash Alexander adds salt to a mass larvae tank at the Cambridge, MD, facility. Water from the nearby Choptank River is filtered and pumped into the tanks but lower salinity has caused problems with oyster reproduction recently. (Dave Harp)

Producing billions of baby oysters is technical stuff. At the Horn Point Lab oyster hatchery, it takes thousands of parent oysters, massive water tanks, an algae greenhouse, computer-controlled feeding equipment and a brigade of interns.

By February of this year, everything was in place for another fruitful spawning season. Everything, that is, except for one of the most basic ingredients: salt.

Oysters require a bit of brine — about 10 parts per thousand will do — to survive and reproduce.

Since 1973, when it was founded, the University of Maryland Center for Environmental Science facility had always gotten all of the salt it needed from the Choptank River, which flows right outside its door. But last year's record-breaking rainfall flushed away virtually any hint of salt from the Eastern Shore river.

Up and down the Chesapeake Bay, oyster hatcheries like Horn Point near Cambridge have been hit with severely reduced salinity concentrations. Hatcheries are the reproductive engines for public oyster restoration efforts and private oyster farming.

About 65% of the young oysters produced at Horn Point are destined for sites where officials are trying to rebuild the population.

"We've had low salinity in the past, but we've always had an uptick in the fall and the winter," said Stephanie Tobash Alexander, who manages the Horn Point hatchery. "This is the longest low-salinity period that we've encountered."

The problem delayed the production of baby oysters by a month or longer. While the problem isn't expected to dent this year's oyster market, it could lead to a drop-off in the number of oysters available to consumers in two or three years, when the current class of baby oysters reaches maturity, industry members say.

The issue is more pressing for oyster restoration projects. Those, too, have been put on hold until the young oysters, known as spat on shell, are ready to plant. Unless hatcheries can somehow make up for lost time, there won't be as much spat to go around this year, said Chris Judy, head of the Maryland Department of Natural Resource's shellfish division.

This year's salinity squeeze also could be a sign of things to come. As climate change unleashes wetter winters and springs in the region, the aquaculture industry may have to adapt to survive, Alexander said.

"I would like to think this [year] is a blip, but I don't know," she added.

In 2017, Maryland's aquaculture industry harvested 74,000 bushels of oysters, a 13% increase over the previous year. The wild harvest topped 213,000 bushels that year.

At the Little Wicomico Oyster Company in Heathsville, VA, owner Myles Cockrell said his oyster-farming operations are "a little behind" because of the delay in getting young oysters. He buys from several of the region's hatcheries — wherever he can find them.

"From what I've heard it's been a slow start for everybody," Cockrell said. "That's going to be a little bit of a challenge later on."

Toward the end of last year, it often seemed like the rain wouldn't let up. Nearly 72 inches of rain pummeled Baltimore in 2018, crushing the previous single-year record of 62 inches set in 2003. The 63 inches that fell on Richmond marked the second-wettest year in that city's history.

That glut of freshwater poured into the Bay's rivers and streams. The high flows kept the influence of salty ocean water at bay. As recently as the end of May, the salinity concentration at Horn Point's lab was still a notch below 6 parts per thousand.

Typically, the lab dredges oysters from nearby sanctuaries to use as brood stock. But the oysters in the Tred Avon, Choptank and Nanticoke rivers were in no shape to start spawning earlier this spring because they were under stress from the ultra-low salinity conditions.

"Having a long-term low salinity has our oysters in this lower state of reproductive readiness," said Mike Roman, the lab's director. So, the hatchery's staff had to travel farther south to the Manokin River to find enough healthy oysters.

Horn Point and some other hatcheries, particularly in the more freshwater area of the Mid Bay, were forced to postpone shipments of young bivalves by as much as a month into mid-June. Many had no choice but to purchase tons of salt to add to their water tanks, an unprecedented step for most.

Such was the case nearly as far south as the mouth of the Bay, where the water is normally almost as salty as the open ocean. But at Ward Oyster Company on Mobjack Bay on Virginia's western shore, hatchery managers had to shake some salt into their water for the first time this year as salinity levels tumbled from 18–21 ppt to 10–12 ppt.

The first batch of young oysters still fared poorly, owner John Vigliotta said. The cause remains mysterious.

"We'd spawn them and they'd look OK, and they'd just fizzle out," he said.

Hoopers Island Oyster Company, a private hatchery not far from Horn Point, was at least a month behind schedule this year, with no shipments expected until around the end of June. To combat low salinity, the facility was adding some salt but mostly relying on drawing in water during high tides and periods of minimal wind, when salt concentrations are at their zenith.

Will hatcheries be able to offset impacts from the delay? "I think that depends on how willing you are to slam on the gas pedal," said Natalie Ruark, Hoopers' hatchery manager.

It's unclear whether Horn Point will be able to make up for lost time this year, but, Roman said, his staff will try. Last year, the facility churned out nearly 1.3 billion oyster larvae.

Logperch eagerly help scientists in effort to avoid federal listing

≈ Scientists propagate fish to reintroduce them to PA streams where they once lived.

By Ad Crable

In a mad dash to keep the Chesapeake logperch from being placed on the federal endangered species list, the tiny fish is certainly doing its part.

In an underwater roundup of sorts, 28 logperch were netted in late March from three tributaries to the Susquehanna River in Lancaster County, PA, just north of the Maryland line. In an experiment with plenty of doubts, those 28 have multiplied to about 1,500 in propagation fish tanks in Tennessee and at Penn State University.

The plan is to reintroduce logperch into one southern Pennsylvania stream this fall, with later stockings possible into up to seven lower Susquehanna tributaries in Pennsylvania from the Holtwood Dam to Harrisburg. That's an area where the fish were once native but have disappeared.

It's a rare experiment. The relatively recent discovery of the fish as a distinct species caused fisheries agencies in both Pennsylvania and Maryland to reassess its status. Both declared it threatened in their states.

Chesapeake logperch peer out from their shelter in rearing tanks where they were raised in Tennessee. This fall, the tiny fish, threatened in Pennsylvania and Maryland, are scheduled to be reintroduced to a tributary to the Susquehanna River in Pennsylvania where they were once found. (Conservation Fisheries, Inc.)

"There has been quite a lot of work done in the last 10 years or so trying to restore fishes to their habitats, but there are not many restoration projects of this magnitude with a species that has not been federally listed," said Jay Stauffer, a distinguished professor of ichthyology at Penn State. "To try to prevent a species from being federally listed is pretty unique,"

But first, a seed stock was needed. To make the captured fish feel right at home, researchers scooped gravel and sand from the streams where they were found. They even collected rocks that the members of the darter family flip

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LOGPERCH FROM PAGE 17

over with their piglike snouts to look for aquatic insects. They are known for flipping rocks. The elements from their home stream were combined in the propagation tanks, where pumps replicated the current.

Apparently, the fish indeed felt right at home. They reproduced so fast that their fecundity had to be cut off after three weeks for fear they would overwhelm their tanks. The fish were divided between Penn State and rearing facilities in Tennessee run by the nonprofit aquaculture group Conservation Fisheries, Inc. so that an unforeseen accident or disease wouldn't wipe out the entire population.

Ripe with that success, the next phase of the four-year plan has been expedited. This summer, teams will snorkel and scuba dive in candidate streams, checking stream-bottom habitat, flow and water temperatures in search of ideal homes for the juveniles. The effort will be aided by an underwater drone attached to a 300-foot tether that will send back a deepwater video of the terrain.

They'll also study the logperch themselves, because so little is known about the 4-inch fish that were only identified as a separate species in 2008.

"It's never been studied," remarked Doug Fischer, an ichthyologist and nongame fisheries biologist with the Pennsylvania Fish and Boat Commission, which is spearheading the effort. "We don't know for sure what they eat, how old they get, when they spawn and at what water temperatures, where they spawn or how many eggs they release. This year, to increase the odds, we're going to study what the fish does to live."

Still, Fischer is "cautiously optimistic" logperch can be reinserted in the streams they once roamed and escape inclusion on the federal endangered species list

As far back as 1842, one man knew the Chesapeake logperch roamed the lower Susquehanna and its feeder streams. He was Samuel S. Haldeman, a naturalist from Lancaster County, who caught and described the fish with its zebralike dark bars to the scientific community.

But the fish was promptly lumped in with other known and similar-looking logperch darters and forgotten. Then, in 2008, DNA testing proved the fish was a separate species. It was named *Percina bimaculata Haldeman* and given the common name of Chesapeake logperch because it was found only in streams that drain into the Chesapeake Bay.

Historically, the fish was found in the main stem and tributaries of the Lower Susquehanna in Pennsylvania and Maryland, and several streams that drain into the Upper Bay at the Susquehanna Flats. In the Susquehanna, the fish are found in the river and streams between the Conowingo and Holtwood dams. They have not been found above the Holtwood Dam, including where Haldeman discovered them. They are gone from about half of their native range in Pennsylvania.

A rearing tank in the Tennessee lab of Conservation Fisheries, Inc. Twenty-eight Chesapeake logperch caught from Pennsylvania streams swelled to 1,500 in a matter of weeks, surprising and delighting scientists who want to reintroduce them to their native streams in the lower Susquehanna River. (Conservation Fisheries, Inc.)

They also were found in the lower and middle sections of the Potomac River basin but not have not been seen since 1938.

Matters escalated in 2017, when the Center for Biological Diversity, a nonprofit that seeks to protect endangered species, sued the U.S. Fish and Wildlife Service for not taking enough action to protect threatened species. The Chesapeake logperch was one of them.

Fish and Wildlife contacted Maryland and Pennsylvania and to learn about the potential for restoration.

"We fleshed out a dream project for the species," Fischer said. The Fish and Boat Commission secured $500,000 from Fish and Wildlife for the four-year restoration plan. Funds also came from Penn State and the state. Partners with the Pennsylvania Fish and Boat Commission include Penn State, Pennsylvania Biological Survey, Maryland Department of Natural Resources, Susquehanna River Basin Commission and Conservation Fisheries, Inc.

Although Maryland is participating in the plan, there are no plans to begin stocking the fish in that state's streams. A conservation plan for the fish in Maryland will be prepared, though.

Living in waterways vulnerable to agricultural runoff is a continued threat to the logperch. The fish spawn over sand, and large rain events could smother fragile eggs with silt. Once researchers learn more about the life history of the logperch and what they need, future stream restoration projects could include creating specific habitat for them.

A more recent threat to logperch is the arrival of invasive fish such as snakeheads and the blue and flathead catfish.

The stocking of about 1,200 logperch this fall will be in a tributary, not the main stem of the Susquehanna. Researchers believe the fish will be more likely to find each other that way. If reproduction is successful, they figure the larvae will reach the river anyway, bolstering the population there as well.

Fischer is buoyed by the initial success of the reproduction and thinks the Chesapeake logperch can escape the sad denouement of a federal listing or even extinction. Fish and Wildlife is holding off until the project is finished before determining whether it needs federal protection in 2023.

"Nobody wants to list anything [on the endangered species list]," he said. "That means something has happened. This is a novelty because we are repatriating fish. Our goal is to increase distribution to the point they are technically secure. We want to put them back to where Haldeman would have found them."

Brown trout's survival in Anacostia tributary an upstream struggle

≈ As development, severe storms have increased, numbers of fish have all but disappeared.

By Whitney Pipkin

As the story goes, the first person to spot a trout rising in Paint Branch in the 1970s — a Maryland stream that already passed under a half-dozen highway ramps on its way to the Anacostia River — could hardly believe it. And despite increased development in the surrounding landscape since then, the trout have continued to persevere and reproduce in a Paint Branch tributary called Good Hope.

But they may soon be little more than urban legend.

For 40 years and counting, Maryland's Department of Natural Resources has documented the little-known presence of wild brown trout in the relatively cool waters of the Good Hope. For half of those decades, every November, biologists could walk to a particular spot along the stream and see spawning beds, where trout had fertilized and covered eggs for protection through the winter. And every spring and summer, for just as long, biologists could find the fish returning to feed and shelter beneath tree roots hugging the shore.

"You could set your watch by it," said Mark Staley, a DNR biologist who's been participating in the annual counts since the late '80s. "It's remarkable that this stream was here and that it maintained the quality that it had for so very long."

When the counts began in 1979, electrofishing surfaced nearly 40 brown trout in the Good Hope, a tributary to Paint Branch that serves as the trout's central spawning grounds. There were trout of various sizes and newly hatched juveniles. Those numbers peaked at just more than 50 in the mid-1990s, but have been declining steadily since 1999.

Last year, officials counted just five adult trout in the Good Hope, all around the same age, which indicates that recent spawns have not been successful. When they look again later this summer, Staley hopes they'll find at least one.

"I'm sure they're still attempting to spawn, but either the substrate's not conducive or the winter floods mess up the nests, or other factors don't allow the reproduction that's taking place to be successful," Staley said. "There's no smoking gun. There are multiple tipping points."

Brown trout are not native to the United States but were introduced from Europe as a popular sporting fish. Officials think they came to Paint Branch waters in the 1930s.

"Brownies," as well as the more sensitive native brook trout, are good indicators of stream health because they need cool, clean water to reproduce. They disappear when those conditions aren't met.

Mark Staley, a fisheries biologist with Maryland's Department of Natural Resources, holds up the smaller pebbles that have long been conducive to brown trout spawning in this stretch of the Good Hope, which eventually flows to the Anacostia River. Much of that substrate, however, has been covered with larger cobble in recent years as development, extreme weather and other factors have slowly changed the stream. (Dave Harp)

Less than 10% of Maryland streams can host trout, which cannot typically withstand water temperatures above 68 degrees. That leaves trout relegated mostly to rural headwaters, away from developed land that warms the water and buries spawning grounds in sediment.

The landscape around Paint Branch has become increasingly urbanized during the brown trout's 80-year presence there. Yet, somehow, the trout have survived, even as they have shrunk back to their spawning grounds in the Good Hope. Staley said abundant and cool groundwater fuels trout-worthy temperatures, and shade helps keep them cool.

The trout population and requisite water quality are a rarity in the area, and advocates have rallied to protect the watershed from development.

"I spent a good portion of my life fighting for this," said David Dunmire, a member of the Eyes of Paint Branch. "And they're still there."

Dunmire, who lives in the Good Hope's watershed in Silver Spring, MD, said the tributary and Paint Branch have been "hallowed ground" for as long as he can remember, and not just because of the trout. The conditions that have allowed the trout to survive — perfectly sized pebbles in a shaded, meandering streambed — are unique in the otherwise crowded suburbs of the District of Columbia.

Dunmire said the Eyes of Paint Branch went from six to 60 members almost overnight in the mid-1990s, when officials first floated ideas for a new six-lane freeway across the watershed. Their attempt to stop the project ultimately failed, and the Intercounty Connector now crosses Paint Branch three times.

Still, the group's work set a series of initiatives into motion that would — at least on paper — limit new development in the watershed, transfer a chunk of the headwaters into county parklands and create an environmental "special protection area" for the high-quality stream, the first of its kind in Montgomery County.

On a morning in early June, verdant ferns unfurled along each side of the Good Hope and an unnamed tributary that feeds it, lit by sunlight filtered through a diverse forest canopy. Nearby homes were invisible from the stream, which benefits from thick foliage and a 1,000-acre stream valley park, set aside years ago with the help of advocates like Dunmire.

Greg Smith, who led an effort to oppose the Intercounty Connector, said the project's eventual approval was so devastating that it took him years to visit the area again. He still thinks of it as "one of the most destructive projects" in the Atlantic region at the time. He was surprised to hear of the trout surviving as long as they have.

"It's unlikely that throwing 10 lanes of pavement across the heart of a forested stream valley did the trout a lot of good," he said, adding the freeway's shoulders to the lane count.

Staley, who continued monitoring the trout population during and after the freeway's construction, said costly and innovative techniques to control sediment and erosion went far to minimize impacts to the stream, but it might have been too late. By the time it was built, the acreage of impervious surface in the county already had risen from less than 8% to more than 10%. The trout population had already begun its decline.

Other factors contributed, too. In 2003, Hurricane Isabel washed a fresh layer of sediment into the system, covering some of the substrate that had been suitable for spawning. More frequent and heavier rains, especially in the winter months, also are thought to have gradually covered thumb-sized pebbles, which an 8-inch trout might move to cover a nest, with larger cobble.

"It's been death by a thousand cuts," Staley said as he stood near a bend in the Good Hope where he would almost always find trout in years past.

To the naked eye, the clear water, cool to the touch, still looks ideal, particularly for waters so near a neighborhood.

"This is not a bad stream," he added. "It's in good shape compared to many urban streams. It's just not good enough for trout any longer."

Mark Taylor, a spokesman for Trout Unlimited, said his organization sees similar combinations of habitat changes leading to the end of trout runs in other suburban areas. He's witnessed it near his home in Roanoke, VA, where brown trout eventually disappeared from a spring-fed stream running through the city. He said increases in extreme weather, especially heavy rains or flooding in the winter months, can be the last straw for streams that have become less resilient to such changes.

Winter flooding "happens in nature, too. But when it happens three years in a row, then you've created a system that can sometimes push the trout past the point of no return," Taylor said.

But, for the trout in the Good Hope, Dunmire and others still have a little optimism left. As long as they are there, even a few of them, "nature has not upended," he said.

"The jury is still out," Dunmire added. "We still have a lot of natural diversity here. We're hoping the trout can hang on, too."

Septic system failures expected to increase in coastal VA

≈ Storms, rising sea level raise risks to human health and water quality.

By Sarah Vogelsong

As sea level rise accelerates along the Chesapeake coast, an old threat to Virginia's water quality may be rearing its head.

Failing septic systems have been a perennial problem in the commonwealth — one that led a soil scientist working on the Middle Peninsula to once christen Virginia the "septic repair capital of the East Coast."

And when septic systems fail, pollution follows. Leaks can send sewage into groundwater and surface water, creating risks for human health and pollution in the Bay and its rivers.

Now, with sea level rising and land continuing to subside, the historical threat has taken on new urgency, particularly in the Middle Peninsula, Northern Neck and Eastern Shore of Virginia. Largely rural and separated by both land and water from the state's metropolises, all of these regions rely heavily on septic systems to meet their residents' sewage disposal needs — and they will be some of the first to see the impacts of rising waters.

"These systems were not built to be able to withstand flooding," said Del. Keith Hodges, R-98, who since 2012 has represented much of the Middle Peninsula in the General Assembly. "It will increase the number of failures that are out there, or it decreases the life expectancy of the system."

Hodges' belief is backed up by both research institutions and state agencies. The Virginia Coastal Policy Center found that because septic systems become less efficient in water-saturated soils, failures "will only increase as Virginia confronts imminent sea level rise," and flooding may "compound the issues that already exist." And at the Virginia Department of Health, the state's primary septic regulator, the issue is being discussed by an internal Climate Change Committee formed this January.

"We are expecting [sea level rise] to cause greater failures," said VDH legal affairs and environmental health coordinator Karri Atwood. "Systems will be inundated with water. When they're inundated, they're going to fail."

Failing septic systems pose multiple threats to communities. When released into soils and water bodies, bacteria and parasites from human waste can lead to dysentery, hepatitis, typhoid and hookworm. (After nearly being eradicated in prior decades, hookworm has reappeared in some poor areas of the South with widespread septic failures.)

Like many places in the Chesapeake region, coastal areas of Virginia are experiencing wetter weather and increased flooding, as well as rising sea levels. Saturated soils can compromise the operation of septic systems and increase the chance of pollution in nearby waterways. Here, waters rise from the York River at Gloucester Point, VA. (P. Lynch/Virginia Institute of Marine Science)

Human waste also carries nitrogen, the primary pollutant in the Chesapeake Bay, which causes algae blooms and an oxygen-deprived dead zone. VDH has estimated that onsite sewage systems contribute about 4% of the nitrogen that flows into the Bay annually, with more than half a million systems in Virginia contributing 2.9 million pounds of nitrogen to the Bay every year.

These impacts bleed into other areas of life, too. Polluted waters do more than inhibit recreation; they can also lead to closures of areas used for commercial fishing and the harvesting of shellfish, an important part of coastal Virginia's economy and culture.

Coastal Virginia will not, of course, be the only region affected by septic failures. Increased precipitation will likely cause effects across the state, soaking soils and hobbling technology not designed to withstand such large volumes of water. But coastal communities will likely be the hardest hit because they are expected to bear additional impacts from sea level rise, severe storm events and erosion.

To Lewis Lawrence, executive director of the Middle Peninsula Planning District Commission, which in 1997 founded Virginia's first public septic repair program to help struggling homeowners, the evidence of the problem is already apparent.

"If you go into these low-lying coastal areas, the land is not drying. It's just not," he said. "The whole system is completely collapsing under the weight of too much water everywhere."

"Vast under-reporting"

While Virginia recognizes the growing problem that septic failures pose for human and environmental health, its efforts to address the issue have been hampered by three key problems: The state has insufficient data on existing septic systems, its regulatory framework relies on individuals to bear the financial burden of repairs, and the gap between state regulation and local enforcement has produced laws that lack teeth.

Of these, perhaps the most pressing concern is the lack of complete data.

In a number of cases, "we don't even know exactly where [a] system is located," said Carl Hershner, director of the Center for Coastal Resources Management at the Virginia Institute for Marine Science.

For the last year, a team led by Hershner has been working with the state Health Department to predict where septic failures will most likely occur. Work has been slow because of struggles to centralize basic information. Virginia's first septic regulations weren't adopted until 1980, and they are largely enforced locally — meaning that many records are held by local health departments and frequently exist only on paper.

"VDH has hundreds of thousands of hard copy, onsite sewage system records on file that predate our statewide database," Lance Gregory, director of the VDH Division of Onsite Sewage and Water Services, Environmental Engineering, and Marina Programs, wrote in an email. The department has been working to gather all of that information into a centralized database, he said, but "local health department resources dictate how quickly that can be accomplished."

According to Gregory, VDH has "pretty good data" on systems installed after 2003, when the state established its first septic database, but has a "data gap" for the years 1990–2003. (The U.S. Census Bureau used to collect information on septic usage but stopped after 1990.)

Overall, VDH estimates that Virginia is home to about 1.1 million septic systems — many of which were installed prior to 2003. And on the Middle Peninsula, Lawrence said, "we're already seeing the first batch of systems that we put in in 2000 [get] worn out."

Lawrence sees 2000 as a turning point that triggered the installation of hundreds of new septic systems on the peninsula. That year, changes in Virginia's sewage handling and disposal regulations allowed homeowners to install "alternative" systems, which use technology to filter and treat waste before discharging it to a surrounding area. In contrast, conventional systems largely rely on the soil of a drainfield to naturally filter waste.

While conventional systems tend to be simpler and cheaper than alternative systems, their reliance on gravity-driven percolation means that they can't be installed everywhere. Poor soils that can't adequately filter nutrients or a lack of low-lying land that prevents downward percolation

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can make conventional systems either unworkable or a threat to water quality.

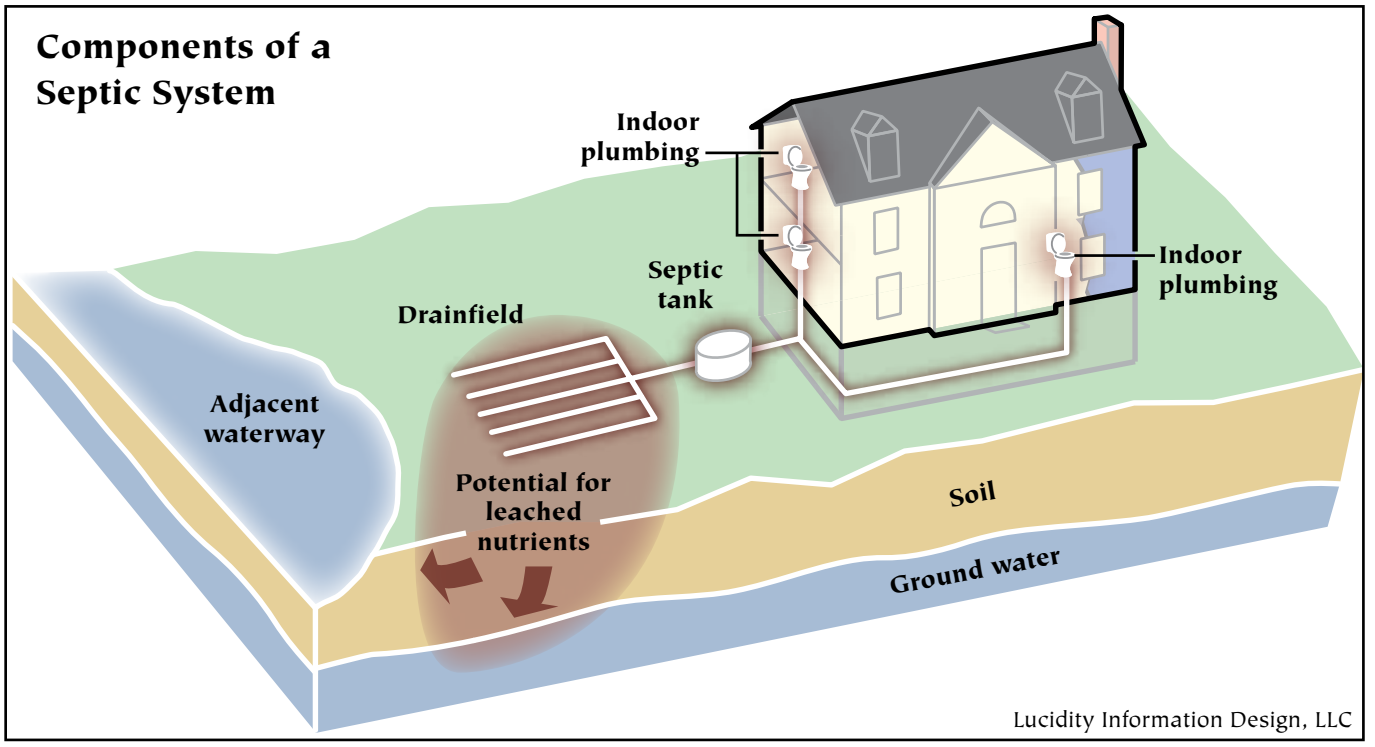
Alternative systems have made it possible to construct homes with septic systems in areas once not considered viable. On the Middle Peninsula, the number of alternative systems spiked 40% between 2000 and 2008.

The status of many of these alternative systems remains murky. Owners with property in the Chesapeake Bay Preservation Area (which largely lies east of Interstate 95) are required to submit an operations and maintenance report to their local health department annually, but many do not. According to a December 2016 VDH report, the department had no operations or maintenance record for 58% of the alternative systems in its database. (The remaining 42% had at least one, but not necessarily a report for every year they had been operating.) Since then, Gregory said, VDH outreach has lowered that number to 50%.

As Virginia began drafting its most recent plan to meet water quality goals for the Chesapeake Bay, several planning districts aired concerns about these gaps.

"There is vast underreporting of conventional systems, pump-outs, sewer connections, and alternative … systems from localities to VDH, and VDH to the [Virginia Department of Environmental Quality]," noted the Hampton Roads Planning District Commission in December. Most significantly, the commission argued that the Bay Program had undercounted the district's septic systems by more than 8,000.

For the Accomack-Northampton Planning District Commission, which oversees Virginia's portion of the Eastern Shore, the big question is how many residences lack any indoor plumbing. That commission estimated that about 200 homes on the Shore are forced to rely on privies or portable toilets, but, as a 2015 study noted, "the full extent of the problem has not been documented."



Septic systems have the potential to leach nutrients into waterways if the system is not operating properly or if compromised by continually saturated soils.

Wastewater islands

Despite the lack of complete information, Hershner's team at the Center for Coastal Research Management is striving to develop a predictive model of where septic systems might be most likely to fail. Pilot work is focusing on Lancaster, Northampton, Accomack, Gloucester and Isle of Wight counties, all of which lie in coastal regions.

"A lot of that information, we may never be able to get a handle on," said Julie Herman, a senior GIS analyst on the team. Besides age and the exact location of a system, soil composition, depth of the water table, repair history and a host of other factors can play important roles in determining what fails and what doesn't.

Still, Hershner said, the research has "started to lead us in certain directions. Not unexpectedly, low-lying areas tend to have more of a problem."

Other less immediately apparent factors may also play a role. In Virginia, areas with a high degree of reliance on onsite septic systems frequently coincide with low-income and historically disenfranchised communities, such as those with high numbers of African American residents. Known as "wastewater islands," these areas have no access to centralized public sewer systems and typically have poor soils that don't support conventional septic systems well.

The reasons behind this phenomenon are complex and, to some degree, not fully understood. One hypothesis, offered by Gregory and former VDH training coordinator Danna Revis in an influential 2015 paper, contends that its origins lie in the post-Civil War allocation of land.

"Disenfranchised people in Virginia were historically given the least productive agricultural lands and … there is a correlation between poor soils for agricultural purposes and poor soils for onsite wastewater disposal," they noted. "These 'poor lands' were passed on to future generations, so the future generations inherited the inequities, creating a cycle of poverty."

Both Virginia and the federal government offer a range of grants and loans to help homeowners repair or replace failing systems. On a broader scale, localities can apply for funding from sources such as the Virginia Clean Water Revolving Loan Fund and Community Development Block Grant program.

Most recently, thanks to mitigation payments by Dominion Energy connected to its construction of a major transmission line across the James River, VDH received $500,000 to help repair failing septic systems and replace pipes that discharge untreated waste directly into waterways in the James River watershed.

These funding sources have been "very effective" over the last 20 years in addressing septic failures, said David Fridley, a manager for the Three Rivers Health District, which encompasses both the Middle Peninsula and Northern Neck. As a consequence, "the volume and number of cases has decreased over time."

But others have criticized the fragmentation of funding sources on the grounds that many people facing failures don't know they exist. Gregory and Revis noted in their 2015 paper that government programs are geared more toward assisting sewer plants than private residents. Similarly, the Virginia Coastal Policy Center's 2018 report noted that "despite this being a communitywide threat," septic system costs "usually [are] borne by individual property owners."

At VDH, Atwood called the need to help people who can't afford to repair a failing system "a constant source of frustration." And Lawrence pointed out that some funding sources, like the Virginia Clean Water Revolving Loan program, can be tapped out.

"This winter was so wet that the number of applicants that we had calling asking for financial assistance to repair their septic systems went through the roof," he said.

The state can fine or prosecute homeowners who fail to maintain their septic systems, but rarely does, particularly because the violation of septic laws is a criminal offense in most rural parts of Virginia. Even when penalties are imposed, the Virginia Coastal Policy Center has argued that they are often "counterproductive." Ordering people who can't afford to repair or replace their system to pay a fine, after all, only reduces the money they have available to remedy the problem.

Del. Hodges put it more bluntly: "Commonwealth's Attorneys … are not going to take Granny to jail or to court to pump out their system."

A solution may be on the horizon: During its last session, the General Assembly passed a law, sponsored by Hodges, ordering that VDH study the possibility of assuming the oversight of septic pump-outs on the Middle Peninsula, Northern Neck and Eastern Shore. The study has also been included as a priority in the state's most recent plan for meeting Bay cleanup goals.

Until change occurs, however, Lawrence expressed skepticism about how localities can meet the state's most recent goal to pump out 20% of all septic systems in the Bay watershed every year — helping to forestall or prevent failures.

"How do you expect to reach this goal when there's no enforcement mechanism at the local rural level, and the judges and commonwealth's attorneys have said, 'Don't bring these septic issues to court?' " he asked. "There's no hammer. And so if there's no hammer, we're at a standstill."

Funding concerns table annual $25 million for DE water projects

≈ Backers hopeful that dedicated money to fight pollution will pass in 2020.

By Jeremy Cox

A bill that would dedicate $25 million a year toward tackling Delaware's growing backlog of water-cleanup and drainage projects has been tabled amid concerns over how it is funded.

But backers remain optimistic of its passage when the legislature reconvenes in January 2020 for the second year of its two-year session.

The measure passed out of the House's Natural Resource's committee on June 5. But it stalled in the chamber's appropriations committee.

Supporters say they hope to couple the dedicated funding with bonds to raise the annual total to $50 million. The state faces a $100 million annual shortfall in funding water quality programs aimed at reducing pollution to waterways, managing flooding and updating water infrastructure, according to a state task force report.

Last year, the legislature set aside $10 million for water-cleanup efforts, the largest sum in decades.

"This legislation this year makes clear that we prioritize clean water," state Sen. Bryan Townsend told about 125 cheering bill supporters during a rally on the Capitol's steps before the committee hearing. "This legislation is so key because it says we are going to guarantee, not subject to the annual whims, a guarantee of funding."

That guarantee, though, could lead to the bill's demise. A key state lawmaker and members of Gov. John Carney's administration objected to earmarking general spending funds in a manner they warned could tie their hands in future budgets.

House Speaker Pete Schwartzkopf said he backed last year's version of the bill, in part, because it raised most of its funding through a new fee attached to income tax filings and business licensing. That bill failed to make it out of committee.

Because the new bill taps into existing revenues, it would potentially sap funding from other pressing initiatives, Schwartzkopf said. And if the state uses that money to obtain bonds, lenders will likely require that funding to be locked into place for years to come.

"The funding process is not what we do," the Rehoboth Beach Democrat told the Natural Resources committee. "It's not how we fund projects in this state."

Finance Secretary Rick Geisenberger and Department of Natural Resources and Environmental Control Secretary Shawn Garvin also questioned the funding method. When the state has dedicated funds in the past, it has been for "narrow" purposes, such as using highway toll revenues for road maintenance, Geisenberger said.

About 125 advocates called on lawmakers to pass a clean water bill June 5 on the steps of Delaware's Capitol building in Dover. The bill would set aside $25 million a year for water-cleanup and drainage projects. (Jeremy Cox) Watch the video at BayJournal.com.

Before the Natural Resources vote, House Majority Leader Valeria Longhurst, the bill's lead sponsor, told a cheering group of bill supporters that she believes it is "at the end of our marathon." But she also referred to the legislation as a "work in progress" and vowed to work with the Carney administration and skeptical lawmakers to iron out their revenue concerns.

The bill is backed by a broad coalition of more than 50 environmental groups, civic organizations and trade groups known as the Clean Water Alliance. A dedicated funding source is needed, they say, to clean up the 90 percent of state waterways that are listed as impaired and the 100 miles of waters under fish-consumption advisories.

"Historically, the state of Delaware has funded water as needed, which runs anywhere from a half-million dollars to last year [when] we were successful in getting $10 million," said Brenna Goggin, advocacy director for the Delaware Nature Society, one of the alliance's steering committee members. "We have been successful in moving the needle, but we still have a long way to go."

Delaware is one of six states, along with the District of Columbia, that have signed on with the U.S. Environmental Protection Agency to implement Chesapeake Bay cleanup goals by 2025. Just a little more than one-third of the state's land area — mostly its rural western portion — drains into a creek or river that feeds into the Chesapeake.

The state represents only about 1% of the Chesapeake's total drainage area. That's not much. But its $800,000 contribution toward the restoration in 2018 accounted for an even smaller share of the total spent by the watershed states — about .05%. The state is also off track toward meeting its Bay nutrient reduction obligations.

The creation of a dedicated water fee that would raise its own revenue has gained little traction over the years in the First State, though. A $30 million annual fee proposed by then-Gov. Jack Markell in 2014 never even made it into bill form. An ill-fated bill sponsored the following year would have charged homeowners fees starting at $45 a year.

The political tide may be shifting, though. Thirty-four lawmakers have signed up to co-sponsor the latest bill, including 22 of the House's 41 members. That level of support drew a "wow" from Rep. Debra Heffernan, who chairs the Natural Resources Committee.

The bill draws funding from portions of existing revenue sources: income tax revenue, business revenue taxes, taxes on real estate sales and corporate income taxes. The funds would be managed by a newly created Clean Water Trust to be overseen by four cabinet secretaries as well as an expert in public-private finance.

The money would be set aside for increasing flood resiliency, repairing failing sewage pipes, improving drinking water, cleaning up nutrient and sediment pollution in waterways and offering cost-share funding for conservation practices on farms.

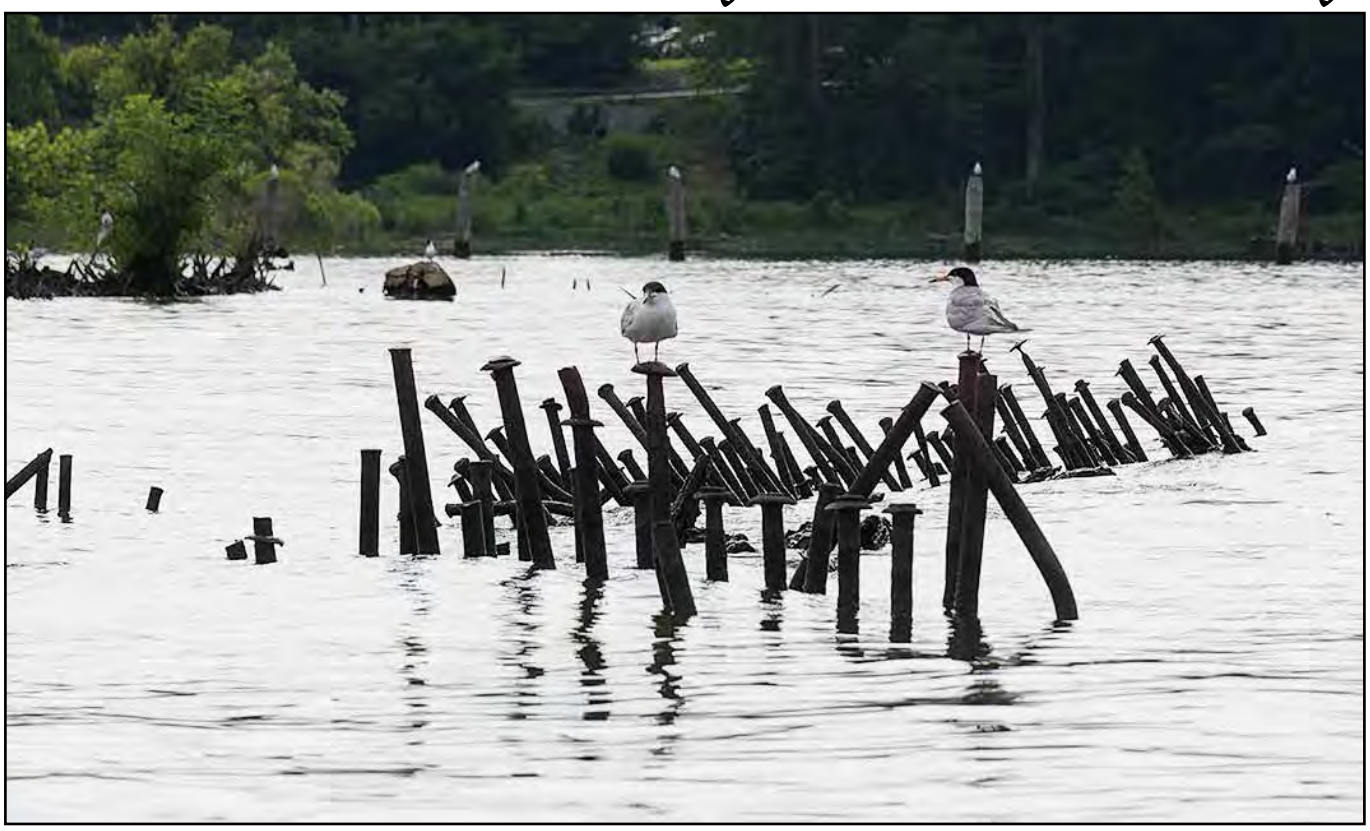
Nan Zamorski, a resident of Seaford, called the bill "Delaware's Clean Water Act" during her turn at the lectern at the June 5 committee hearing. "We need to take this path as Delawareans for our quality of life," she said.

The legislative session was scheduled to end June 30. If the bill doesn't pass, lawmakers can pick up where they left off in January during the second year of the two-year session.

Accord reached to make Mallows Bay marine sanctuary

≈ MD gets up to 10 years to seek reconsideration.

By Timothy B. Wheeler



Sea gulls perch on the remnants of a vessel in Mallows Bay. The designation of the Potomac River ship graveyard as a national marine sanctuary may be finalized by the end of 2019. It would be the first in the Chesapeake Bay watershed. (Dave Harp)

The proposal to make Maryland's Mallows Bay a national marine sanctuary cleared a major hurdle, as Gov. Larry Hogan in late May declared he'd reached a "responsible agreement" with federal and local officials to ensure the move doesn't harm fishing.

The National Oceanic and Atmospheric Administration posted a notice May 31 in the *Federal Register* indicating its intent to move ahead with a marine sanctuary designation for the 18-square mile portion of the Potomac River to protect the historic shipwreck remains found there.

If finalized as expected by year's end, Mallows Bay, about 30 miles south of Washington, DC, would be the first new national marine sanctuary in nearly two decades. It would also be the first in the Chesapeake Bay watershed.

Often described as the largest ship graveyard in the Western Hemisphere, the small bay on the Maryland shore of the Potomac holds the sunken remains of nearly 200 known vessels dating to the Civil War, though some artifacts found there go back 12,000 years. It's best known as the watery crypt for more than 100 wooden steamships built to support the U.S. engagement in World War I. Finished too late to be used, they were deemed obsolete, towed to Mallows for salvage and subsequently burned to the waterline.

Joel Dunn, president and CEO of the Chesapeake Conservancy, one of many groups pushing for the designation, said he was "thrilled" that the sanctuary designation is finally moving ahead.

"Mallows Bay is one of the Chesapeake's great treasures, a place steeped in our nation's history, a thriving ecological habitat and just a short drive from the capital of the United States," he said. "It's a place to visit that deserves national and international attention, on par with the likes of Everglades National Park or the Golden Gate National Recreation Area."

The designation, first proposed by Maryland nearly five years ago, had been stalled for more than a year, with the Hogan administration pressing for the right to have the sanctuary designation revoked in the future it were to interfere with the livelihoods of watermen in the area.

Fishermen in both Maryland and Virginia spoke out vehemently against the proposal starting in 2017 after NOAA released its draft environmental impact statement describing the agency's "preferred alternative" for setting aside 52 square miles of the Potomac, far beyond Mallows Bay. They noted that other marine sanctuaries prohibit fishing, and they complained loudly that NOAA had misled them about the size of the proposed sanctuary in Maryland.

NOAA agreed to scale back the proposed sanctuary to the boundaries listed in 2015 under the National Register of Historic Places, which encompass most but not all of the historic shipwrecks and artifacts. But the watermen remained opposed and suspicious of NOAA's insistence that it only intends to protect the ship remains from disturbance and has no plans to limit or regulate fishing in the sanctuary. There are other marine sanctuaries set up solely for the purpose of protecting historic wrecks.

NOAA officials and Hogan's legal counsel, Robert Scholz, began negotiations in early 2018 to resolve the issue. Scholz insisted on Maryland having the right to revoke Mallows Bay's sanctuary status at the state's request for up to 15 years after its designation.

Two decades ago, NOAA did agree to include an opt-out clause in its designation of another marine sanctuary, on the Michigan shore of Lake Huron. It was also created to protect shipwrecks, but commercial fishermen, charter boat captains and scuba divers feared it would restrict their activities there. The clause was never invoked, and at least some of those who'd feared the sanctuary have since become its champions.

Advocates for Mallows Bay had expressed reservations about such an opt-out clause, particularly one that could be invoked repeatedly when the sanctuary management plan comes up for review at five-year intervals.

Around the time in April that the *Bay Journal* and other media reported the hitch in the designation process, Maryland's congressional delegation expressed its concern in a meeting with Hogan and urged the parties to resolve the problem.

Sens. Ben Cardin and Chris Van Hollen, Maryland's U.S. senators, and Rep. Steny Hoyer, whose district includes Mallows Bay, all applauded the move Friday, issuing a statement saying sanctuary status "will help protect Mallows Bay for future generations, spur tourism, and support local jobs and the economy."

Under terms of the agreement, NOAA would reconsider Mallows Bay's sanctuary designation for up to 10 years, but only if the state presents documented evidence that it has somehow hurt commercial or recreational fishing and that NOAA has failed to address concerns about it raised over time by the state.

"This continues our commitment to skilled stewardship and puts us on a path to make this national treasure a marine sanctuary this fall," Hogan said in a statement issued by his office. He thanked NOAA and Charles County for "working with us to craft a responsible agreement to protect our history, and boating and fishing opportunities."

Kris Sarri, president and CEO of the National Marine Sanctuary Foundation, said her group saw no reason for an opt-out provisions, because the state will jointly manage the sanctuary with NOAA. But she indicated that the terms were acceptable in order to get the designation moving.

"Nobody ever gets completely what they want," she said, but added that she was "very excited" to see the designation move forward, and she credited the strong support for it voiced by a broad array of groups.

Robert T. Brown Sr., president of the Maryland Watermen's Association, said he'd been briefed verbally on the deal but wanted to withhold judgment about whether it protected his members' interests adequately until he'd had a chance to review the memorandum of agreement between the state and NOAA. "I'm cautious at this time, very cautious," he said.

The final environmental impact statement and joint management agreement are available for review at mallowsbaypotomacrivernmsdesignationfeisfmp_small.pdf.

Manure injection passes the smell test as a best management practice

≈ Method reduces nutrient runoff and increases crop growth while disposing of animal waste.

By Ad Crable

For centuries across the Chesapeake Bay region, farmers have spread manure on their fields to boost crop growth and dispose of animal waste.

But stormwater runoff can send those manure-based nutrients into local streams and eventually the Bay. Reducing runoff from farmland is one of the biggest challenges remaining in cleaning up the Bay.

Now, after decades of experimentation and false starts, injecting liquid manure into the ground, rather than on top of it, is gaining traction among mainstream farmers. The method can prevent runoff, make crops grow better and spare neighbors from unpleasant odors.

"It's ready for prime time, baby!" is the rallying cry of Kristen Hughes Evans, executive director of Sustainable Chesapeake, a group that secured grants to pay for more than 150 farmers in Pennsylvania and Maryland to try manure injection on more than 9,000 acres in 2018.

Her optimism is buttressed by farmer-friendly improvements in injection equipment, more governmental endorsement of the practice and increasing pressure for farmers to control odors as development closes in on their farms. Among the recent changes:

≈ The state-federal Chesapeake Bay Program has officially added manure injection as a recognized best management practice, and farmers who use it are eligible to make money by selling nutrient trading credits to offset the impact of pollution in other places. The recognition also means that states can compute the amount of nutrient reductions from manure injection and apply it toward meeting their commitments to the Bay cleanup.

≈ In Pennsylvania, the use of manure injectors that only slightly disturb the soil earns farmers state tax credits.

≈ A recent four-year study by researchers at Penn State University and the U.S. Department of Agriculture concluded that manure placed in disced slits 4 inches below fields vastly reduced runoff and increased levels of nutrients taken up by plants to help them grow better. That means any added costs of manure injection can be offset by savings on commercial fertilizers that are often spread after crops emerge.

Just as importantly, the study found that a low-disturbance method of injection was compatible with no-till farming and maintaining soil health, long a concern.

The study suggested that large-scale use of manure injection could help Pennsylvania come closer to meeting its nutrient-reduction goals. The state's progress is lagging badly and suffers, in part, from being underfunded.

A tractor with an injector fitted with a pipe to pump liquid manure from the farm's storage facility injects that manure below the surface on a farm in southcentral Pennsylvania. (Penn State Extension)

Indeed, Pennsylvania regulators with the state Department of Environmental Protection have recently gotten so many comments advocating for manure injection that they are considering adding it to the state's formal Bay cleanup strategy, known as a watershed implementation plan.

Maryland and Virginia already have done that. Maryland's WIP calls for 7,226 acres to be treated with manure injection; Virginia wants to have 10,501 acres undergoing manure injection, both by 2025.

Though Pennsylvania does not yet include manure injection in its WIP, its most agriculture-dominated county, Lancaster, calls for 10,000 acres to be treated by 2025 in its own localized plan.

The Lancaster County Conservation District is trying to deploy a demonstration project to introduce the technique to its many Plain Sect farmers. The farmers would have to hire others to do the work because manure injectors are too heavy to be pulled by teams of horses or mules. The idea is to get grant funding so there would be no cost to farmers who participate in the pilot project.

The Penn State study said that governments and conservation groups would have to pony up more cost-sharing money for the practice to make a big dent in Bay states. That is starting to happen. Maryland has a cost-share program for farmers using manure injection. Virginia, in the next fiscal year, will offer cost-share money too.

Another influential study, conducted by Virginia Tech researchers and published in the scientific journal *Soil Science*, found that manure injection reduced evaporation releases of ammonia (a constituent of soot and a threat to water quality) 87–98%, depending on the soil type. It also cut nitrogen runoff from rain or snowmelt 13–26%.

Why are farmers showing more interest now, after nearly two decades of trying to get manure injection to take root?

Smell is one big answer.

"Increasing development in rural areas and an ability to apply manure that doesn't cause nuisance calls" is a growing factor, said Mark Dubin, agricultural technical coordinator for the Bay Program.

"We're working with a lot of farmers that want to do a good job and be progressive. They want the odor to be out of sight, out of mind," agreed Jeff Zimmerman, owner of Agri-Applicators, a custom manure applicator based in Lebanon County, PA, that spreads manure for farmers.

"They want to be good neighbors. We probably didn't understand how important that is on some farms," said Hughes Evans, whose Sustainable Chesapeake group and partners have been busy holding field days to introduce farmers in Pennsylvania and Maryland to the possibilities of manure injection and the costs and benefits of having their fields injected by hired commercial firms or buying equipment to do it themselves.

Technological advances have also helped to move manure injection beyond an intriguing idea toward a workable money-saving choice for farmers.

Early prototypes of machinery that injected manure into fields were clunky, were undersized, couldn't handle bedrock and rocky soils, and required many refill trips back to manure storage facilities, compacting the soil each time.

Now, a new "drag-line" system comes with up to 2 miles of hose that pumps manure continuously from storage tanks into the injectors mounted on the tractor. That means spreading manure by injection now takes no more time than conventional surface spreading, according to Hughes Evans. New blades inject manure in rocky fields.

"The technology has definitely advanced and made it more feasible in different geographic areas of the [Bay] watershed," Dubin said.

"I'm a very calculated-risk type of person," seconded Zimmerman, the commercial applicator. "I've been in the hauling business since 2000. I was watching the stuff that didn't work and now I feel like they've finally gotten something that works."

Convincing farmers that manure injection saves money will likely be the biggest driver for widespread use, experts said.

With more nutrients staying in the shallow ground where crop roots can find them, farmers are finding they no longer need a second shot of commercial fertilizer after crops start growing.

Those on some larger farms already are convinced and are buying their own systems. But most farmers hire companies to apply their manure, and the next leap forward will be to persuade those businesses to invest in manure injectors.

Zimmerman, for one, thinks the demand is on the upswing — enough so that his company has just purchased four manure injectors. And, banking on more large farms wanting to own their own equipment, Agri-Applicators has become a dealership for one brand of injectors.

There are still lingering concerns about manure injection. It doesn't work well on odd-shaped fields or contoured fields. Prototypes still need perfecting in order to use thicker liquid poultry manure without clogging.

In some areas, there are concerns that injected manure could pollute shallow groundwater, though a Bay Program workgroup found no danger of leaching if recommended application rates are observed.

Studies on how injecting nutrients affects soil health and microbes are conflicting. One found that disturbing microbes in the soil by manure injection caused a slow release of nitrous oxides, a small but potent greenhouse gas.

But backers of manure injection brim with confidence these days.

Said Hughes Evans, "I think we're beyond the hump of whether this technology is unproven."

Ruth Patrick's stream research broke ground – and a glass ceiling or two

≈ Algae expert pioneered method to evaluate a creek's health based on its denizens.

By Ad Crable

In World War II, the U.S. Navy captured a German submarine off the East Coast. But where in the world was the sub base that posed such an alarming threat to the country?

Military officials didn't have a clue, but they scraped the crusted gunk off the bottom of the vessel and took it to the Academy of Natural Sciences in Philadelphia, which had an extensive collection of microscopic organisms that live in water. Was there an expert on staff who could take a look?

Ruth Patrick became the first female CEO of the Academy of Natural Sciences, which had refused to pay her earlier in her career because she was a woman. (Academy of Natural Sciences of Drexel University)

Yes, there was. Dr. Ruth Patrick, an algae scientist who had excelled in obscurity at the illustrious academy for eight years, was working as a volunteer because no one hired female scientists at the time. She was advised not to wear lipstick to work.

Patrick, who was the world's foremost expert on microscopic single-celled algae, recognized a particular diatom in the scrapings that lived in the West Indies. Armed with the intel, the military found and destroyed the sub base.

It was a coming out party, of sorts, for the woman who would go on to pioneer the concept that the health of freshwater streams and rivers could be determined by the type and number of organisms living in them. It was a revolutionary idea at the time.

Patrick died in a retirement community near Philadelphia in 2013, not long before her 106th birthday and only a few years after stopping work.

She proved her iconoclastic ecosystem approach to evaluating stream health, now known as the "Patrick Principle," by spending the summer of 1948 with a team of hand-picked scientists wading into the Conestoga River — then known as Conestoga Creek — in Lancaster County in southeastern Pennsylvania.

It was a time when testing for chemicals was the standard way to search for industrial or sewage pollution in a waterway. But those chemicals may not have been there the day before and could be gone by the next day. Patrick knew of dumping that went on at night so the evidence would be swept away by day.

She was sure of her more reliable approach, so she proved it by taking her team into the water at 150 spots on the Conestoga and its tributaries. They looked for leeches, fish, underwater insects, microscopic protozoa, algae, bacteria, nutrients, pH — all things that Patrick believed tell the true tale of stream health.

In 1949, when she published her study, she gave the scientific community a new litmus test for gauging water quality.

"It is a tome. It is amazing. Today, it would be a huge study. In 1948, it was just unprecedented," recalled Dr. Bern Sweeney, a friend and colleague of Patrick who gave a heartfelt tribute to her in Lancaster in June as part of Lancaster Water Week. "This is the system we're using today with a few twists. She got it right."

Ruth Patrick established the concept of using organisms found in a stream or river to determine water quality. (Academy of Natural Sciences of Drexel University)

Patrick's curiosity in nature was sparked at an early age by her father, an attorney and amateur naturalist who dragged her into the woods each Sunday with a basket that his daughter used to collect anything from the natural world that caught her eye. Back home, Patrick would sit on her father's lap and peer into a microscope to examine organisms that lived in the creek, invisible to the naked eye. She earned a doctorate in botany from the University of Virginia in 1934.

After the World War II sub discovery, which made headlines, Patrick was finally offered a paying job at the academy. But that same year, in 1945, industrial giants Atlantic Richfield and DuPont approached the academy about using Patrick's ecosystem approach to look into industrial pollution they had been accused of. Sure, we can do that, but Patrick won't be leading the project because women can't manage big projects and big budgets, the executives were told. The executives insisted she would.

She'd do the tests, she told the officials, but the results would be published regardless of what they revealed. If

Dr. Ruth Patrick, fourth from left, poses with her hand-picked team of scientists who conducted the pioneering study on ecosystem ecology on the Conestoga River in Pennsylvania in 1948. (Academy of Natural Sciences of Drexel University)

Patrick continues on page 26

PATRICK FROM PAGE 25

the companies were indeed harming waterways, the public would know.

When she was asked by fellow scientists why she would cooperate with big industry, she would reply, "They need our help."

Her status growing, Patrick was contacted by the state of Pennsylvania in 1948 to use her system on a stream somewhere in the state to prove that environmental degradation in a stream or river could indeed be ferreted out by looking at its denizens.

Patrick chose the Conestoga and its tributaries because they had a wide range of water quality and could be waded easily for sampling. It wasn't always clear cut. Some organisms actually thrived in pollution. But Patrick found that a healthy stream had a balance of many organisms with none dominating.

Her team of scientists from many disciplines raised eyebrows both among the local populace and the scientific community as they probed the water. Always at the helm was a woman in printed blouses and a sun hat. Newspaper headlines were along the lines of "Female scientist heads big project."

"What she included in that study back then is unheard of today," Sweeney recalled. "We don't include that many parameters today. You can't afford to. But she didn't know what she would get into."

Patrick became an environmental groundbreaker on a par with Rachel Carson, helping to write the Clean Water Act and winning major environmental awards. She advised President Lyndon B. Johnson on water pollution and President Ronald Reagan on acid rain. In 1996, when she was almost 90, President Bill Clinton presented her with the National Medal of Science, the nation's highest honor for a scientist. She was one of the first to sound the alarm about global warming.

She also created the Stroud Water Research Center in Pennsylvania, which Sweeney would head for many years. The center conducts freshwater stream research that provides information for Chesapeake Bay restoration efforts. She also created an estuary research lab on the Bay.

After facing years of discrimination for her temerity in a man's scientific world, she became the first female CEO of the Academy of Natural Sciences that had earlier refused to pay her. She also was the first woman board member and environmental scientist to sit on the board of the DuPont Company.

She continued on at the academy in Philadelphia for nearly 80 years as chair of its limnology department, now named in her honor. She hired a lot of women and was hard on them. At the same time, she taught botany and limnology classes at the University of Pennsylvania for 35 years. Students flocked to be taught by Patrick, even though she was a demanding professor and held mandatory field labs on Sundays.

And she kept expanding the field of freshwater ecology, writing an expansive series of books on the rivers of the United States. Sweeney recalled a field trip Patrick led for a group of industry executives on the Savannah River. Patrick was in her 90s. The executives were gasping. Sweeney flashed a photo of Patrick, wading a stream for analysis at the spry age of 100. She worked five days a week at the academy until she turned 97.

"Ruth paved the way to enable women to excel in science, business and society in general," Sweeney said. "She had the most difficult road to hoe to become a successful scientist but she became an extremely huge success. She did it through hard work. She was relentless."

Patrick remained curious until the end. Of anyone she met during a day she would ask what they had learned new in the last 24 hours. Blank stares invited the gentle rebuke, "Then what have you been doing?"

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snakeheads found their way into the rivers. The two men realized they had a unique opportunity to see how life changed in the waters after the invaders' introduction.

Their latest sampling, conducted from June 2018 to May 2019, provides the strongest argument yet that snakeheads can upend a Chesapeake ecosystem. And the effects might not just be limited to two rivers on the Eastern Shore, the researchers said.

At the Blackwater refuge, Newhard and Love used baited, fish-trapping nets to catch more than 45,000 fish the first time around. Using the same methods more than a decade later, they only counted a little more than 7,600, a decline of more than 80%.

Where did all those fish go? It's possible many were eaten or muscled out of their territory by snakeheads, Newhard said.

"I like to say there's only so much energy to go around," he said.

Snakeheads registered eighth in abundance in the latest survey, but that figure likely obscures the species' influence on the ecosystem, Newhard said. The study didn't involve weighing the fish, but if it had, snakeheads "would easily be in the top five," he added.

Newhard doesn't want to put all the blame on snakeheads, though. Last year's record-shattering rainfall led to low dissolved oxygen levels in the water. That would cause many fish to flee — but not snakeheads, which can tolerate meager amounts of oxygen and even breathe out of water for short durations, he said.

The toothy snakehead, an invasive species from Asia, is as ugly as it is tasty. (Photos / Dave Harp)

"I've had them sit in a refrigerator for three days and still be alive," Love said. "They're not your typical fish."

Another finding points more emphatically at snakeheads as the cause: There were stark declines in the types of species snakeheads prefer to eat. White perch were once the most dominant species by far, accounting for nearly 40% of all those netted. By 2018–2019, barely 10% were white perch. The abundance of sunfish, another snakehead staple, also dimmed in parts of the system.

Meanwhile, two species not typically found on the snakehead's menu — common carp and gizzard shad — emerged as the top two most common fish.

The results are particularly concerning because of the study's location, Newhard said. The Blackwater area is one of the few freshwater marshes in the Chesapeake region and historically has served as an important nursery for perch species and other fish.

The two researchers don't expect to finish analyzing their results until the end of the year. But they say the early findings make a case that snakeheads are making their presence felt.

"I think Blackwater as a nursery has changed and is degraded," Love said. "We cannot determine if snakeheads actually caused the changes or if some other effect we did not measure did, but in light of the science done on the species to date, we will have a justifiably strong argument."

Newhard and Love may struggle to lure fishermen and other scientists to their way of thinking.

John Odenkirk, one of the region's top snakehead experts, questions whether snakeheads caused the fish population changes documented at Blackwater. Any time a study involves measurements collected more than a decade apart, there are bound to be many changes triggered by a variety of factors, such as fishing pressure and

SNAKEHEAD CONTINUES ON PAGE 27

Snakehead from page 26

weather, he said.

In the Potomac River and the creeks on the Virginia side of the waterway, "we've yet to document any sort of ecological shifts," said Odenkirk, a Virginia Department of Game and Inland Fisheries biologist. "Ill effects are really hard to come by, and I would argue that we haven't really come across any ill effects so far."

The snakehead's numbers have exploded on both sides of the Bay since it was first found in a pond in Crofton, MD, in 2002. The so-called "frankenfish" made it to the Delmarva Peninsula by 2010. Wherever it has turned up in the Chesapeake or its adjoining waters, the snakehead's abundance has typically tripled within the first few years.

It has now colonized most major Bay tributaries, but densities vary from region to region, scientists say. "Hot spots" include the Gunpowder, Potomac and Patuxent rivers, Love said. At its current rate of expansion, the snakehead will be found throughout the entire Chesapeake watershed in about a half-century, Neward and Love predicted in a 2018 paper.

Odenkirk, though, has documented a healthy leap in largemouth bass numbers and a stabilization, if not a drop, in the snakehead population's growth. He suspects that in the wake of its initial population boom, snakeheads outpaced the carrying capacity of local waterways. Now, things are trending toward equilibrium, Odenkirk said.

"They're definitely here to stay," he added. "We're not getting rid of them. They're not doing the catastrophic damage we predicted. But it may still happen."

The snakehead has now colonized most major Chesapeake tributaries. "Hot spots" include the Gunpowder, Potomac and Patuxent rivers. A 2018 paper predicted that at its current rate of expansion, the fish will be found throughout the watershed in about a half-century.

Fishermen also deserve some credit for heeding calls to catch and kill as many snakeheads as possible, Odenkirk said. They didn't need much persuading, though.

When hooked, snakeheads put up a satisfying fight, fishermen say. When cooked, the meat is white and mild.

On a Saturday morning in June, many fishermen drove two hours or more from the suburbs of Baltimore and DC to participate in the Blackwater snakehead derby. Love and Newhard opened the tournament by discussing its higher purpose: getting rid of as many snakeheads as possible.

"There aren't really any bad areas around here in Blackwater" to find the fish, Newhard told the group.

DNA tests revealed that the snakeheads found on the Eastern Shore likely didn't swim across the Bay from the Potomac but rather were brought in by humans from a population in Delaware, Love said. He believes much of the snakehead's expansion was caused by fishermen introducing it in waters closer to home, so they don't have to travel as far to find them.

After their discovery, Maryland and Virginia quickly banned possession of live snakeheads to prevent people from moving them around. They must be killed immediately or released directly back in the waters where they were caught.

Snakeheads have been an economic boon in the out-of-the-way corners of Dorchester County. Before the species reared its ugly head, a fisherman was an uncommon sight on either the Blackwater or Little Blackwater, Newhard said. During their sampling over the last year, they spotted fishermen on kayaks at least once per outing.

"The word is out," Newhard said.

Charles "Caz" Kenny is helping to spread that word. In March 2018, he launched a Facebook page called SnakeheadLife.com to give the growing fishing community a digital gathering place. As of late June, it had garnered more than 4,300 members.

Kenny makes a living as a fishing guide in Dorchester's backwaters, where snakeheads are a favorite catch. He also sells whole snakeheads to restaurants across the Bay and to a local market. He came to the Blackwater fishing tournament to share his tricks for landing a big one.

Despite how good the fish has been for his wallet, Kenny has mixed feelings about the phenomenon.

"There ain't nothing for the better," he said. "What I see right now is no juvenile [largemouth] bass. I don't see bass under 12 inches anywhere. These areas where you see people on the bridges catching 100–150 snakeheads and putting them on Facebook used to be bass nurseries."

Ten-year-old Dustin Stem worked with his brother Ryan to land this 10.68 lb. snakehead, the tournament winner. The boys and their father traveled from Bel Air, MD, for the tournament. (Dave Harp)

It's difficult to tell whether snakeheads are affecting the bass population, Love said. There aren't enough snakeheads to have depleted the bass' food sources, nor are bass commonly eaten by snakeheads. Greater threats loom for bass, such as overfishing and loss of underwater habitat, he said.

That could change, though. The toothy predator has been shown to spread a potentially deadly virus to bass.

It could take years until the impact of snakeheads becomes apparent, Love said.

"Some invasive species can take decades before the science fully describes consequences of their introduction," he said. "For some reason, expectations with this species were set really high in the early 2000s, and when that bar wasn't achieved within 10 years, some people shrugged and said, 'Eh, so what?'

"Who knows? Maybe they'll be right, and in 100 years, snakeheads will be as American as apple pie. But I'd just caution everyone that the story with snakeheads hasn't been fully written yet, and it's dangerous to pretend that it has."

In the meantime, fishery managers would like to see more fishermen join the battle. In Maryland, snakehead tournaments have taken place on the Potomac, and officials hosted tournaments in 2016 and 2017 along the Chesapeake and Ohio Canal. This year's derby at Blackwater was the first of its kind on the Eastern Shore.

Over five hours, fishermen caught and killed 25 snakeheads, according to Love's tally. The biggest catch of the day belonged to the young Stem brothers with their 10-plus pound haul.

"Our hope is to grow this fishery at a rate that outpaces the population growth of snakehead," Love said. "Unfortunately, we haven't seen that yet."

PFAS FROM PAGE 1

cookware, waterproof clothing, stain-resistant fabrics and carpets, some cosmetics and some firefighting foams.

They're practically everywhere — including in the blood of virtually every person in the United States.

PFAS have been found in water supplies or groundwater in more than 600 places in 43 states, according to data mapped by the nonprofit Environmental Working Group and Northeastern University.

Many of the contaminated sites are military bases and airports that used fire-fighting foam containing PFAS, while others are factories where the chemicals were made or used in making other products.

In the six-state Chesapeake Bay watershed, there are at least 18 sites where PFAS have been detected. That could mean that relatively few industrial facilities in the region have made or used PFAS — or it may mean that no one's looked very hard.

That's about to change in Pennsylvania. With 23 sites already under investigation there, including four in the Bay watershed, the Wolf administration has made PFAS a priority. In June, the Department of Environmental Protection began sampling about 360 drinking-water systems believed to be at risk.

"We needed to start getting our arms around just how prevalent this was in the commonwealth," DEP Secretary Patrick McDonnell said in an interview.

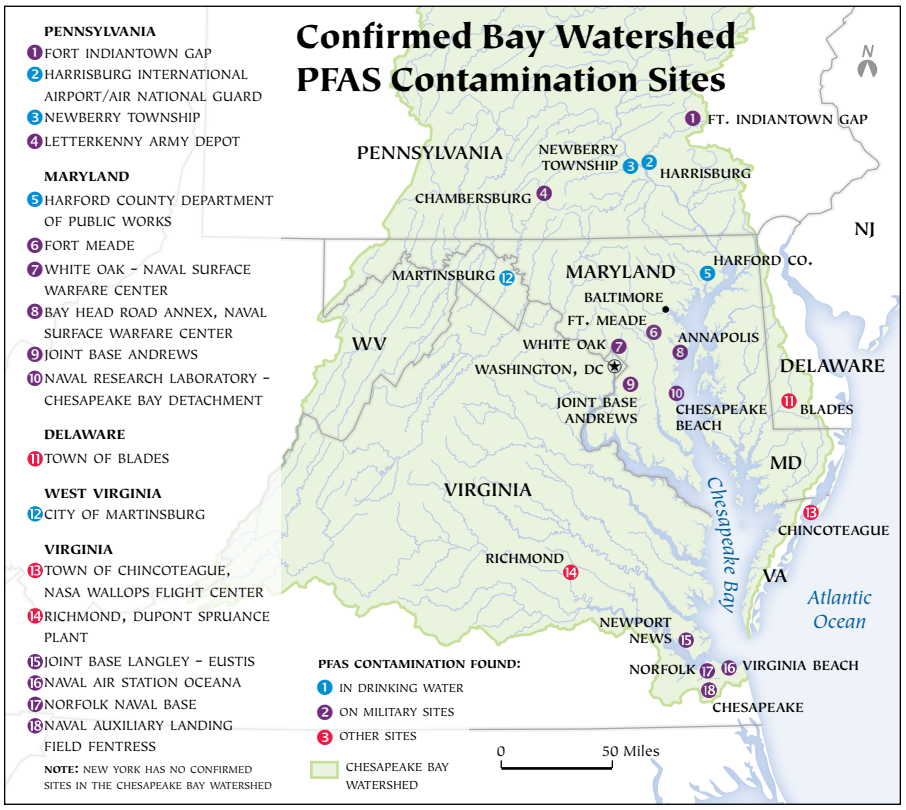
By some estimates, there are nearly 5,000 types of PFAS. All include carbon and fluorine atoms in a chemical bond that scientists say is very hard to break. The durability that makes them attractive commercially is a concern to environmental specialists. The compounds persist long after they've been produced, leading some scientists to dub them "forever chemicals."

Some PFAS compounds can travel through groundwater or surface water. They also can move through air. And, they tend to bioaccumulate, or build up, in the bodies of animals and people who ingest them. A check of blood drawn nearly two decades ago for a nationwide health survey found PFAS in more than 98% of the samples.

That worries some scientists, who say that some PFAS display all of the problematic traits seen in contaminants like mercury and PCBs, or polychlorinated biphenyls. Those two toxic substances are the top causes of fish consumption advisories in the Chesapeake Bay watershed.

"It's just a very complex group of chemicals that do not break down easily in the environment, but have the potential to be as widespread and persistent as PCBs," said Michelle Lorah, a research hydrologist with the U.S. Geological Survey, who briefed the Chesapeake Bay Program's toxics workgroup on PFAS late last year.

"And right now," Lorah added, "there is a lack of information on them in the environment and on their toxicity. The science is trying to catch up."



One Maryland site, the Naval Air Station Patuxent River, was inadvertently omitted from the map and list. Also, one Virginia site shown, Chincoteague, is not in the Chesapeake Bay watershed. (Lucidity Information Design, LLC)

Some studies, according to the U.S. Agency for Toxic Substances and Disease Registry, have shown that exposure to some PFAS may affect fetal and child development, including changes in growth, learning and behavior. They may also lower fertility and interfere with natural hormones, raise cholesterol, affect the immune system and even increase cancer risk. Unlike PCBs, PFAS do not concentrate in fat, but in blood. Yet they can remain in the body for years after ingestion.

While concerns have been mounting for decades, the EPA has been slow to regulate PFAS. In the early 2000s, the agency persuaded industry to voluntarily phase out two of the most produced compounds. Among other things, PFOA, or perfluorooctanoic acid, and PFOS, or perfluorooctane sulfonate, were used to make nonstick cookware, waterproof and stain-resistant fabrics and some fire-fighting foams. Years later, they are still the most commonly found PFAS in drinking water and blood samples.

In 2016, the EPA set a lifetime health advisory for PFOA and PFOS in drinking water of 70 parts per trillion. (One part per trillion is equivalent to one drop in a pool of water covering a football field to a depth of 43 feet.)

That level may seem inconsequential. But Linda Birnbaum, director of the National Institute of Environmental Health Sciences, explained in a press briefing that PFAS can bioaccumulate in people's bloodstreams to 100 or 200 times the level consumed in drinking water..

The EPA directed the nation's large public water systems several years ago to check for PFOA, PFOS and a handful of other compounds. About 1 percent of the 5,000 systems reported detecting the contaminants at levels higher than the agency's health advisory.

Under pressure to do more, the EPA announced in February that it is working on setting a maximum contaminant level in drinking water for PFOA and PFOS. It also said it was gathering information and seeking comment on whether to regulate a broader class of PFAS.

The Fluoro Council, an industry association representing PFAS manufacturers, says manufacturers have replaced PFOA and PFOS with other fluorinated compounds that are less likely to build up in the blood. Meanwhile, the U.S. Centers for Disease Control and Prevention reported that levels of PFOA and PFOS found in blood have declined greatly in the last two decades.

Birnbaum, head of the national environmental health lab, said some of the replacement compounds appear to be less toxic because they don't bioaccumulate. But she noted that may be offset if people are ingesting them daily in drinking water.

"My question," Birnbaum said, "would be 'why are we making chemicals that never go away?'"

Given the mobility and persistence of PFAS, drinking water is just one path of exposure. The Environmental Working Group reported recently that the U.S. Food and Drug Administration found substantial PFAS levels in some grocery store meats and seafood and in off-the-shelf chocolate cake in the mid-Atlantic region.

FDA officials confirmed the unpublished findings but stressed that PFAS were not detected in most of the foods and said that the levels detected likely don't represent a health concern. Several items had concentrations that exceeded the EPA advisory level for drinking water — the cake by 250 times — but there is no federal safety standard for PFAS in foods.

Some studies also suggest that at least some PFAS can make their way into aquatic life. Researchers in 2002 reported finding PFOS in oysters collected from the Gulf of Mexico and Chesapeake Bay. The levels in Chesapeake oysters were very low, except at Hog Point, at the mouth of the Patuxent River in Maryland, right by a naval air base. That oyster contained the second highest concentration of PFOS of all the bivalves analyzed.

A handful of states, including Pennsylvania, have decided to set their own limits. Most other Bay watershed states say they're relying on the EPA to set nationwide standards for PFAS but some are looking at steps they can take to gauge the extent of the problem in their jurisdictions.

Back in Pennsylvania's Newberry Township, Nathan Volpi is waiting for another test of his family's drinking water. Even with Suez, the company filtering the tainted wells before supplying the water, Volpi decided to pay more than $2,000 to put in a whole-house carbon filtration system. The family is still using bottled water until new tests show the tapwater is PFAS-free.

"I figure, hey, it's got to run through two of them," Volpi said. "I hope it's enough."

Here are details on how each state in the watershed is moving on this issue:

Pennsylvania

Last September, Pennsylvania Gov. Tom Wolf announced that "in the absence of federal action, Pennsylvania will move forward aggressively to ensure Pennsylvania residents are protected."

Pennsylvania has never set a drinking-water standard before, and so the state is in the process of hiring or contracting for toxicologists to help parse the science and come up with a defensible limit designed to protect people's health.

The water system sampling begun in June will help reveal the extent of the contamination and its impacts, explained Lisa Daniels, DEP's Safe Drinking Water Program director.

The DEP also has beefed up its environmental testing laboratory to extract minute amounts of PFAS from water samples and then identify the compounds and their concentrations.

"It's pretty challenging to be asked

PFAS CONTINUES ON PAGE 29

PFAS from page 29

to analyze down to the parts-per-trillion range," said June Black, organic chemistry section chief for DEP's Bureau of Laboratories.

The state expects to spend $500,000 on the sampling, which could take close to a year to complete, and another $1 million in the analysis and preparation of its drinking water standards, the DEP's Daniels said.

In Newberry Township, the DEP responded promptly once Nathan Volpi shared his water test results. Officials urged Suez, the company supplying the water, to confirm Volpi's findings with its own tests. But the company chose not to wait, quickly installing granular activated carbon filtration systems on four of its 10 wells serving the township.

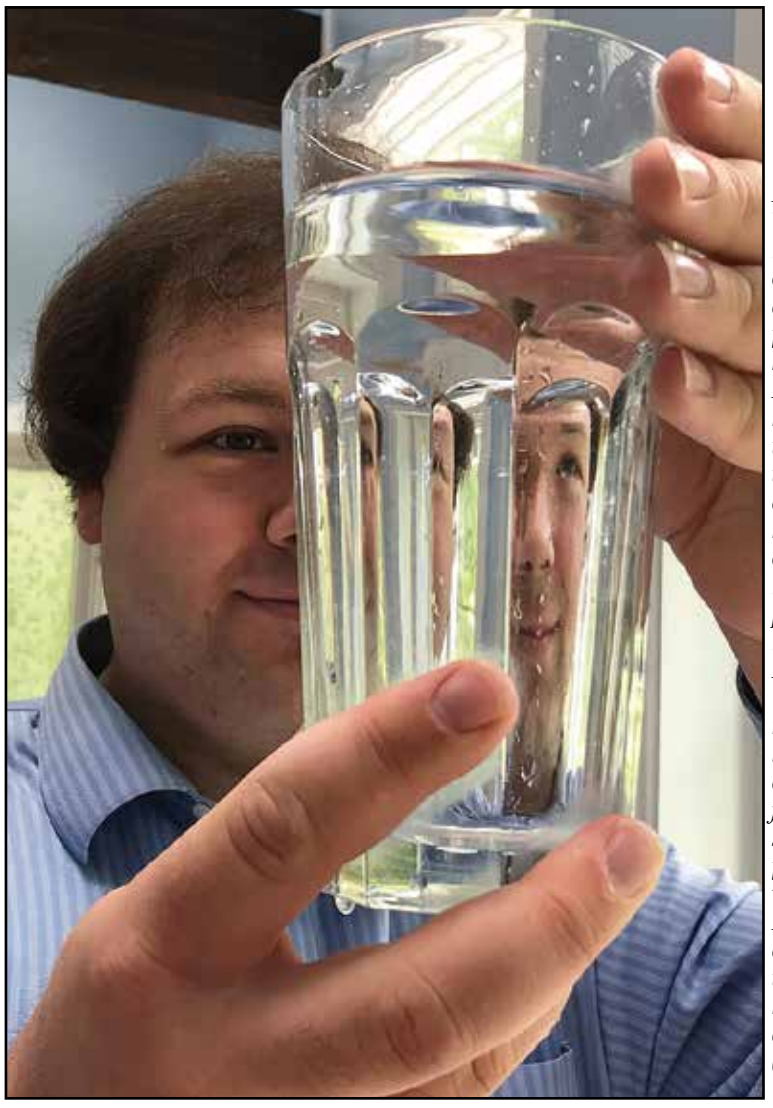
"In our mind it was paramount to get out there and zero it out," said Richard Henning, the company's senior vice president. The carbon filters have reduced PFAS to undetectable levels in the four treated wells, he said. In the other six, concentrations are below the EPA lifetime health advisory, the company reported.

At a public meeting June 13 in Newberry Township, a DEP official said an electronics factory and former scrapyard might be sources of PFAS.

Residents at the meeting expressed appreciation for the state's response, but still had questions.

"I feel like the ball is rolling in the right direction," said Deb Smith, who works at a school in the area, but she was "not reassured that everything's OK." After all, she noted, her son had attended elementary school not far from the contaminated wells and drank the water there.

State regulators said they plan to begin testing 35 private wells there in late July to see if they have any contamination.



Nathan Volpi examines a glass of water drawn from his kitchen tap. He paid to have his tap-water tested and discovered high levels of PFAS in it. The private utility serving Newberry Township responded by placing carbon filtration systems on four of 10 wells where PFAS levels exceeded the EPA health advisory. (Timothy B. Wheeler)

Maryland

There are seven current or former military installations and one municipal water supply in Maryland where contamination has been detected, according to state officials and public records.

Ben Grumbles, secretary of the Maryland Department of the Environment, said in an interview that assessments are under way at Aberdeen Proving Ground in Harford County, Joint Base Andrews, an Air Force base in Prince George's County, the Naval Research Laboratory in Chesapeake Beach and at Fort Meade and the Bay Head Annex, both in Anne Arundel County.

Aberdeen Proving Ground was implicated when Harford County discovered PFAS in its nearby Perryman wellfield, which furnishes water to about 30% of the utility's 40,000 customers, according to Bill Bettin, deputy public works director. The level detected was below the EPA advisory limit, but the county already had a carbon filtration system on the wellfield to deal with another carcinogenic contaminant, the solvent trichloroethylene.

Grumbles did not mention two other military sites with documented contamination: Naval Air Station Patuxent River in St. Mary's County and the former White Oak Naval Surface Warfare Center in Silver Spring.

At the sprawling Patuxent River air base, PFAS at levels up to 16 times the EPA health advisory were detected in shallow groundwater in 2017, according to a May 2018 consultant's report. The facility includes headquarters for the Naval Air Systems Command and a test range for aircraft and pilots.

The contaminants were found in at least eight of 11 monitoring wells in a 20-acre area on the southern end of the base. Some buried plastic containers, including one with a label for fire-fighting foam, had been dug up there in the 1990s, the consultant said. Metal drums and other contaminants were also found there and removed, but testing for PFAS didn't occur until two years ago, the report says. The Navy plans to further investigate that area and other sites on the base, according to base spokesman Patrick Gordon, who noted that 2014 testing of the base's deep drinking-water wells found no PFAS.

PFAS levels higher than the EPA health advisory also were detected in groundwater at the White Oak site, according to a Department of Defense report last year to Congress.

Grumbles said the EPA and the Pentagon are handling military site investigations, but state regulators are looking to check for contamination elsewhere.

Grumbles, a former EPA official, said Maryland would work with the EPA on setting a PFAS drinking water limit.

"I think the real question is whether or not they're moving fast enough," he said.

Virginia

Virginia is also "following the federal lead" on dealing with PFAS contamination, said Ann Regn, spokeswoman for the state Department of Environmental Quality.

Regn said state regulators are aware of four federal facilities with PFAS issues, two of which are on the fringe of the Bay watershed — Naval Air Station Oceana in Virginia Beach and Naval Auxiliary Landing Field Fentress in the City of Chesapeake.

The Navy has tested for PFAS in dozens of private wells neighboring Oceana and Fentress and is supplying bottled water to eight households with levels higher than the EPA advisory limit, according to Oceana spokeswoman Jennifer Christine Hayes. The Navy expects to contract with Chesapeake, VA, to extend municipal water to the well owners near Fentress, she said.

In addition, the Norfolk Naval Base and Joint Base Langley-Eustis both have PFAS higher than the recommended limit in groundwater, but none off base, according to the DOD report.

And in Richmond, PFOA was among several toxic chemicals found in groundwater at DuPont's Spruance manufacturing plant. According to an EPA website, the company installed a groundwater extraction and treatment system last year.

Delaware

Delaware has three contaminated sites, but only one in the Chesapeake watershed. Elevated PFAS levels found in three wells furnishing drinking water to the town of Blades prompted authorities in early 2018 to warn residents not to drink or cook with it.

Shawn Garvin, secretary of the Department of Natural Resources and Environmental Conservation, said his staff was working with the EPA to investigate possible contamination from a pair of chrome-plating facilities in town when they discovered the problem.

"We had a hot minute to figure out how we'd deal with this," Garvin recalled. The state promptly furnished bottled water to the 1,300 residents served by the town wells. It then paid $225,000 to install a treatment system.

A DNREC spokesman said the state has also provided home filtration equipment to nine households on private wells on the town's outskirts

Meanwhile, Delaware regulators are reviewing records to see if they can identify other facilities that may have used PFAS, Garvin said.

"Much like the rest of the country, we're still trying to figure a way through all of this," he said.

West Virginia

Of five drinking-water systems with known PFAS contamination, only one is in the Bay watershed. The city of Martinsburg took one of its two water filtration plants offline in 2016 after learning it had levels higher than the EPA's health advisory. The city ultimately installed a carbon filtration system. The suspected source is a nearby Air National Guard base.

New York

New York has about three dozen PFAS detections, but none in the Susquehanna River watershed. The state is surveying more than 2,500 locations for potential contamination, including 100 groundwater public water supplies, a Department of Environmental Conservation spokesman said.

An advisory council last year recommended that New York set a drinking-water limit of 10 parts per trillion for PFOA and PFOS, far below the EPA's lifetime health advisory.

Eastern Shore skipjack dredges up maritime past

Veena Yarlagadda of Ashburn, VA, was one of the first passengers on the skipjack Nathan to try her hand at the wheel.

By Jeremy Cox
Photos by Dave Harp

A skipjack tacked up and down the Choptank River in Maryland for two hours on an azure afternoon in late spring. One of the last of its kind still cruising the Chesapeake Bay's waters, the Nathan of Dorchester returned to its slip with a brimming haul.

Not of oysters, mind you. That's so 19th century.

This boat was built in 1994 with a different purpose in mind. On this trip, it carried 19 people — not counting its captain and six crewmembers — out for an exploration of a heritage that is disappearing and this particular skipjack's place in it.

"They said there were so many skipjacks in here you could walk from one side of the creek to the other without getting wet," Charlie Rouse told the passengers as the Nathan eased into the mouth of Cambridge Creek at the outset of the journey.

Skipjacks were once the workhorse of the Bay's oyster industry. After its introduction to the Chesapeake in the 1880s, skipjacks numbered as many as 1,000 at their height around 1900; today, only about 20 remain. The Nathan has the distinction of being the youngest — and perhaps last — member of that iconic armada.

To spend a pair of brief hours aboard the vessel, with a salt-tinged breeze teasing its two sails, is to peek into a past that continues to shape life in and around the modern Chesapeake Bay.

July marks the 25th anniversary of the Nathan's launch. The nonprofit that runs the commercial charter service offers two-hour sails on most Saturdays from May to October and one-hour trips on one Sunday per month. It is also available for special events and private outings.

After paying the captain's wages, all proceeds go toward the maintenance and operation of the 60-foot vessel. (The Dorchester Skipjack Committee reported about $30,000 in receipts in 2017.) The crew consists entirely of volunteers.

There's also a docent on board. On this particular Saturday, that duty fell to Rouse, an amiable former drug and alcohol counselor from Baltimore. Smitten with James Michener's 1978 tome, *Chesapeake,* he retired to the Eastern Shore community of Cambridge, one of the principal inspirations for the book's fictional setting.

His audience consisted of one sprawling family group and a smattering of couples. Once the boat was under way, so was Rouse, giving a lively recap of the Nathan's origin story intertwined with snippets of local maritime history.

The skipjack's home port is Cambridge's Long Wharf, a marina on the Choptank just a few hundred yards downstream from the Route 50 bridge. If there ever was a capital of Maryland's seafood industry, this town certainly would have been a candidate. Nearly half of all the 2,000 skipjacks that ever sailed the Chesapeake were built right here, Rouse pointed out.

Skipjacks are the last sail-powered commercial boats still active in U.S. waters. Their continued existence owes less to romanticism than to a quirky conservation law. To keep oyster beds from getting overfished, 1800s-era lawmakers in Maryland restricted dredging to vessels powered only by sail. That law was later amended to allow a skipjack to get a motorized assist two days a week from a "push" or "yawl" boat mounted to its rear.

Power dredgers vastly outnumber their wind-powered counterparts these days, but state regulations continue to cast favor on the historic fleet. Commercial skipjacks may harvest up to 150 bushels a day; a power dredger can only keep 24.

"Comin' about! Ease the jib," Doug Macnair, the skipjack's captain, called out to his crew several times during the trip.

If the wind changes direction, so too must the sail attached to the skipjack's single mast. Hand over hand, crewmembers worked quickly to pull ropes and swing the boom in a long arc across the deck.

In the distant past, Rouse noted with a faint smile, skipjack captains would accomplish this maneuver for a more-sinister purpose. Some captains would "shanghai" a crewmember or two in Baltimore. At the end of the oyster season, those unfortunate souls would receive their "payment": a smartly placed blow from a boom, blasting them into the Bay's shallows.

Volunteer Charlie Rouse shares the story of the skipjack Nathan and maritime history on the Chesapeake Bay.

Above, passengers watch as the crew of the Nathan catches oysters with a cage-like hand scrape from the bottom of the river. In the past, skipjacks were the power behind oyster harvesting in the Chesapeake, using mechanically operated dredges on both sides of the hulls. At right, the Nathan's mainsail catches the wind near Cambrige, MD, on a quiet day.

Traditionally, skipjacks catch oysters using two mechanically operated dredges draped off either side of their hulls. The Nathan works on a smaller scale. At the appointed time, when the boat is directly above an oyster bed, the crew eases a cage-like hand scrape onto the river bottom.

It bounces across the bottom at a jogger's pace, snagging oysters and whatever else might be lurking below. Afterward, it takes four crew to lift it on deck by hand. In his experience, Macnair said, this method has brought up as many as 150 oysters. This trip's yield was 63.

All were returned to the water. The Nathan's state permit doesn't allow the crew to keep what they catch. But they are careful to count the catch and report the figures to the state.

The idea for a tourism-centered skipjack in Cambridge came from a group of civic boosters known as the Committee of 100, who in 1990 proposed a handful of initiatives aimed at raising the community's profile. At first, organizers cast about for an existing skipjack to rehabilitate. But all were either too far gone or too expensive to purchase, Rouse said.

Instead, they decided to build one from scratch. But who would build it? It had been about four decades since a working skipjack had been constructed on the Eastern Shore. The fledgling skipjack group that grew out of the Committee of 100 turned to Harold Ruark, a Shore native who had spent his life designing and building boats. His boat models could also be found in museums across the country, including the Smithsonian.

The project's funding came from the Nathan Foundation, which was started by a prominent local family that ran a chain of furniture stores. The gift stipulated that the name "Nathan" had to appear in the vessel's title. Although virtually all skipjacks bear female names — usually in honor of the captain's mother — Nathan it would be for the new boat.

The number of skipjacks declined in lockstep with the deterioration of the Bay's oyster fishery. Overfishing, disease and poor water quality conspired to eat away at the bivalve's population year after year. From a height of nearly 17 million bushels in 1880, the annual harvest plummeted to a bottom-scraping 50,000 bushels in 2004. Last season's harvest hit 180,000 bushels.

Still, the culture that the skipjack embodies continues to reverberate across Dorchester County. The visitors center at Sailwinds Park — another brainchild of the Committee of 100 — is topped by a sail-like structure that evokes the shape of a skipjack. The slogan of the county's tourism campaign is "Water Moves Us."

For its part, the Nathan is still creating moving experiences of its own. As the boat headed downwind toward the Chesapeake, Macnair turned the wheel over to the Nathan's guests. Ananya Yarlagadda, a 13-year-old from Ashburn, VA, was one of the first to take up the offer.

She quickly got a lesson in a navigational trick as old-fashioned as the skipjack itself: dead-reckoning.

"What you do is pick your favorite tree out there and keep your eye on it," Macnair told her.

More than a century has passed since the skipjack was the boat of choice for the Chesapeake Bay's watermen. But on the Choptank, with the help of a steady wind and a seasoned storyteller, no other vessel will do.

Sail away on the Nathan of Dorchester… or a skipjack of your choosing

The Nathan sails out of Long Wharf, which lies at the end of Mill Street in Cambridge, MD. Public sails occur May–October. The cost is $35 for adults, $10 for ages 6–12 and free for younger ones. For information, visit skipjack-nathan.org or call 410-228-7141.

For public skipjack cruises at other locations, try these (fees vary):

- The Rebecca T. Ruark in Tilghman, MD: www.skipjack.org, 410-829-3976
- Herman M. Krentz in St. Michaels, MD: oystercatcher.com, 410-745-6080
- Dee of St. Marys in Solomons, MD: skipjacktours.com, 410-326-2042 x41
- Martha Lewis in Havre de Grace, MD: chesapeake-heritage.org/skipjack-martha-lewis, 410-939-4078
- Claud M. Somers in Reedville, VA: rfmuseum.org, 804-453-6529, office@rfmuseum.org.
- The Stanley Norman, sailing from Annapolis and Baltimore: cbf.org/events/bay-discovery-trips, 410-268-8816

Water/Ways exhibit brings impact of local rivers to light

The Phoenix Dam and reservoir was a popular bathing spot in Baltimore County, MD, before it was submerged under water with construction of the expanded Loch Raven Reservoir in 1914. (Historical Society of Baltimore County)

By Ad Crable

When the Smithsonian Institution looked for a first stop in Maryland for its traveling exhibit *Water/Ways*, it wisely chose Baltimore County.

From the very beginning, water has shaped the area's economy, transportation network and culture. And it still does — the Loch Raven, Prettyboy and Liberty reservoirs in the county provide drinking water to millions. Dam tailwaters are a mecca for trout fly fishers and whitewater tubers and paddlers. There are more than 100 roads in the county with "mill" in their names. The county has both freshwater and saltwater within its borders.

"Everyone in the county lives close to water and it's part of their lives, whether they realize it or not," said Tom Graf of the Historical Society of Baltimore County.

The *Water/Ways* exhibit is traveling to 30 states as part of the Smithsonian Institution's Museum on Main Street program. Its aim is to raise awareness of water as a finite resource and as an element in U.S. culture. At each stop, the Smithsonian partners with local organizations to extend the exhibit in ways that tell the local story.

The exhibit wraps up its Baltimore County stay on July 6 and moves on to The Oxford Museum, in the town of Oxford on Maryland's Eastern Shore, July 13 to Aug. 4. There, too, the exhibit will be supplemented by local exhibits and programs for the public. Project partners intend to use the Smithsonian's in-depth exploration of water as a springboard to explore two important issues: protecting the drinking water supply and dealing with rising tides.

The ambitious exploration of the history and influence of water on Baltimore County, prepared by the society, attracted support from more than 30 groups that offered around 75 hands-on, water-themed events for the public. Participants went on a search for salamanders, helped clean up a stream, paddled at sunset, visited historic sites in the county, learned how to build a rain barrel, became a caretaker of a stream and participated in an interfaith spiritual nature walk.

Graf, a society board member and program manager of the Baltimore County effort, thought the widespread involvement of so many groups and people in celebrating and making efforts to protect water in their midst spoke to a new determination to protect the resource.

"There's not plenty of it. I'd like to think that it's starting to sink in in our generation and certainly the next generation coming up to recognize that, too. There is hope for the future," he said.

Native Americans were the first to use Baltimore County's waterways. And when settlers moved in, water became their first power source.

To drive the agricultural community, mills sprung up along any stream that could be dammed. Mills that produced iron, flour, textiles, gunpowder and paper flourished. Towns grew up beside them. Many of them were destroyed by a devastating flood in 1868.

The Back and Middle rivers became the first versions of highways and allowed tobacco farmers to sell their crops domestically and even overseas. At the time, the Gunpowder River was navigable to the Chesapeake Bay.

Other streams and rivers in the county powered iron forges and furnaces, including one that produced guns during the American Revolution. Bloede's Dam housed the nation's first hydro-electric plant inside the shell of the dam.

It wasn't long before the wholesale clearing of trees and vegetation, the dumping of sewage, garbage and manufacturing waste into the nearest stream brought home the consequences of poor land management.

Damming streams and channeling currents to power mills changed the ecology of the waterways. By the late 1800s, Baltimore City was complaining about unrestricted development upstream causing flooding in the city.

The growing city needed a reliable source of water. The first reservoir in Baltimore County was built in 1807 but quickly proved inadequate. Lake Roland was erected along the Jones Falls in 1858 but it was clogged within two years by sediment from upstream erosion. Later, Joppa Town,

Water/Ways continues on page 33

Charlie Conklin, left, of the Gunpowder Valley Conservancy and Tom Graf of the Historical Society of Baltimore County stand next to a replica of the old Jerusalem Mill as part of an exhibit on the history of water use in Baltimore County, MD. (Ad Crable)

Snorkel, paddle or fish at RiverPalooza summer events

By Whitney Pipkin

Taking a bridge across the Potomac River on the way to work isn't the same as plunging a paddle into the water, seeing its beauty and benefits up close. But only a fraction of the more than 6 million people living in the District of Columbia's metro area get onto the water each year.

That's why the Potomac Riverkeeper Network, with the help of partners like the National Park Service and the U.S. Forest Service, started hosting RiverPalooza, an annual series of events spanning the summer that prioritize paddling, rafting, snorkeling and learning about the so-called Nation's River and its tributaries, including the more rural Shenandoah River.

"We really try to get as many folks [as possible] out on the river that have never been before," said Shenandoah Riverkeeper Mark Frondorf, one of three riverkeepers in the network. "This is designed for people who are interested in doing something on the water but don't know where to go or what to do."

The bulk of events take place in July and are evenly spread among locations in Virginia and Maryland, with one in the District. A final gathering to close out the festival on Aug. 24 takes place at the confluence of the powerful Shenandoah and Potomac rivers at Harpers Ferry, WV, where a historic outpost affords breathtaking views of raft-worthy white waters below. Here is a selection of events.

✦ **July 11 – Monuments Paddle** (Washington, DC). Potomac commuters can take a break from weekday traffic to see some of the city's most iconic memorials from the water. The three-hour kayak trip is led by Potomac Riverkeeper Dean Naujoks and begins at 3:30 p.m. at the Columbia Island Marina on the Arlington side of the Potomac. Space is limited; register online to ensure a spot. Cost is $65, and includes a single kayak rental.

✦ **July 19 – Snorkeling on the Shenandoah** (Bentonville, VA). This all-day Friday event offers a unique vantage point of the river's resources with a short paddle to a lazy section of the river's South Fork for snorkeling. The event at Shenandoah River State Park begins at Downriver Canoe Co. Cost ranges from $35 for bring-your-own-boat to $75 for a two-person canoe rental; snorkel gear is included. Register online by July 17.

✦ **July 21 – RioPalooza!** (Elkton, VA). This dual-language Sunday afternoon event was such a success last year that it is returning to the lineup at a new location: Stonewall Riverside Park outside Harrisonburg. Named after the Spanish word for river, RioPalooza offers snorkeling, tubing, canoeing (with a chance to win a canoe) and a concert appearance by Latin Grammy Award-winning artist, Mister G. Educational booths and displays will be offered in both Spanish and English with traditional Latino dishes available from noon to 6 p.m. Register online by July 17. Suggested donation is $20 per family of four.

Rafters make their way downstream at one of the many events that take place during the annual, summer-long RiverPalooza, organized by the Potomac Riverkeeper Network. (Alan Lehman)

Other events in Maryland and West Virginia:

✦ **July 13-14 – Paw Paw Bends Overnight** (Little Orleans, MD)

✦ **July 17 – Ghost Fleet, Mallows Bay** (Nanjemoy, MD)

✦ **July 20 – American Indian Piscataway Kanoi Tribe Paddle** (Indian Head, MD)

✦ **Aug. 24 – Good-Bye Summer Blowout** (Harpers Ferry, WV)

A full schedule of events and registration are found at PotomacRiverkeeperNetwork.org/RiverPalooza-2019.

Water/Ways from page 32

a major port on the Chesapeake Bay, would be rendered useless because of the same problem.

As the exhibit noted, "Our region's centuries-old history is also the history of our water pollution."

In 1881, the larger Loch Raven Reservoir was built and expanded in 1914, drowning the old mill town of Warren that was once home to 800 people. Still, the city needed more water. Pretty Boy Reservoir was completed in 1931. Liberty Reservoir, formed by damming the North Branch of the Patapsco River, completed the trifecta in 1956. Another mill town, Oakland Mill, was buried and the city purchased and closed the Melville Woolen Mills, idling workers.

Before reservoirs created drinking water, springs provided sustenance. Water from the Chattolanee Springs in the Green Spring Valley area of the county was bottled and dispersed by train and wagon, delivered to doorsteps just as milk later would be.

The Patapsco River's mouth became the anchor for Bay Shore amusement park, the largest beach on the Chesapeake Bay. It operated from 1906 to 1947 and is now part of North Point State Park.

All this checkered use and history of water in Baltimore County surprised and enlightened Susan Graeber of Woodbrook, MD, who visited the exhibit on a recent Sunday.

"I've been a lifelong resident of Maryland for five generations, but I didn't realize the importance of water," she said. "You just turn on your faucet and drink water. I just never thought about it."

Thinking about it was precisely one of the goals of the exhibit, said Charlie Conklin, vice president of operations for the Gunpowder Valley Conservancy. "The whole thing is to engage the community to participate in best-management practices to reduce their water footprint."

Added Graf, "We basically dominated the landscape and turned it into something that we wanted, and developed it and engineered the water. We reached the 20th century and kind of looked around and saw some of the damage to the landscape and to the environment."

"I'd like to think that we've reached the era now where we can find a balance between our needs and commitments and the natural resources," he said, "and find some long-term sustainable approach so that our children and grandchildren and future generations here in the county can find that same kind of joy with water."

In partnership with Maryland Humanities, the Smithsonian Institution's *Water/Ways* exhibit is making five more stops in Maryland communities to highlight the local and global importance of water. They are:

- July 13-Aug. 4, The Oxford Museum, Oxford, Talbot County
- Aug. 31-Oct. 12, Washington County Historical Society, Hagerstown
- Oct. 19-Nov. 30, Cambridge Main Street, Cambridge, Dorchester County
- Dec. 7-Jan. 18, 2020, Crisfield Heritage Foundation, Crisfield, Somerset County
- Jan. 25, 2020-March 7, 2020, Calvert Library, Prince Frederick, Calvert County

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Great blue herons look out from their loblolly pine home in a Wye River rookery in Maryland. (Dave Harp)

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It's hard to tell the clouds from their reflections in this photo taken in the Blackwater National Wildlife Refuge near Cambridge, on Maryland's Eastern Shore. (Dave Harp)

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A kayaker heads out on the fog-shrouded Honga River on the eastern side of the Bay near Dorchester County, MD. The Hoopers Island bridge is in the background. (Dave Harp)

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Heather Chen
Columbia, MD

L. Crane
Severna Park, MD

Jack A. Cranford
Melfa, VA

James Cumbee
Gloucester Point, VA

Ed Dembeck
Annapolis, MD

John Frisk
Towson, MD

Fog envelops the marsh and farmland along the Nanticoke River on the Delmarva Peninsula. (Dave Harp)

Dorothy Hall
Odenton, MD

Edward Hutcherson
Glen Allen, VA

Gary & Margaret Kaline
Pasadena, MD

John R. Kenny, Jr.
Annapolis, MD

D. Kinna
Clarksville, VA

Jay Knight
Smyrna, DE

Michael & Susan Madden
Timonium, MD

James J. McCann
Crownsville, MD

Edmund McConnell
Altoona, PA

Linda Miller
Baltimore, MD

Steve Morley
Port Haywood, VA

Kenneth Murdock
Potomac Falls, VA

Bob Murphy
Yorktown, VA

Jeff Penrod
Johnstown, PA

Mary L. Pipkin
Parkville, MD

Melvin Poling
Winchester, VA

Marty Reefe
Libertytown, MD

John Rossheim
Harrisonburg, VA

Joanne Rudy
Dauphin, PA

Dan Russell
Mathews, VA

Heather Schwartz
Clarksville, MD

Olivia Su
Wilmington, DE

Norma Swope
Williamsburg, VA

Cindy Tworek
Gaithersburg, MD

Jeanne Weiss
Jarrettsville, MD

Fritz Wildt
Haynesville, VA

Guy Wilkerson
Sterling, VA

Norm Wurbach
Brogue, PA

Rebecca S. Ebaugh
Baltimore, MD

William Gardiner
Montross, VA

Beverly Roane
Dutton, VA

Cynthia Touchet
Camp Hill, PA

Ray Grieve
Hampton, VA

Betty Gordon
Martinsville, VA

Lester Riegel
Friedensburg, PA

Bernice Colvard
Annandale, VA

John Fusek
Newport News, VA

Charlie Bucy
Solomons, MD

John Burfeind
St. Michaels, MD

Dorothy Jones
West Lafayette, IN

Mrs. Robert Mosher
Charlton, NY

Richard Rock
Alexandria, VA

John Beckner
Colonial Beach, VA

Brent Heath
Gloucester, VA

David Bell
Glenside, PA

Andy Carroll
Washington, DC

Tony Decint
Baltimore, MD

Albert B. Gipe
Preston, MD

Holly Meyer
Silver Spring, MD

Price Shuler
Denton, MD

William Abbott
Gambrills, MD

Norman Abrahams
Port Deposit, MD

Nancy Adams
Sterling, VA

Cindy Cancilla
Felton, PA

Cecil Soil Conservation District
Elkton, MD

Madison Chase
Myersville, MD

Carroll H. Clatterbuck
Beltsville, MD

Richard P. Crane
Worton, MD

Bill Dowell
Hydes, MD

Janet Eddy
Ashland, VA

Eloise G. Hendrixson
Odenton, MD

Melvyn L. Kay
Reston, VA

John Kraft
Baltimore, MD

Tim Lang
Queenstown, MD

Ron Louzon
Woodstock, MD

Charles R. McClain
Severna Park, MD

Wayne & Elizabeth Meisner
Yorktown, VA

Scott Rhodes
Norfolk, VA

Leo & Anne Roseman
Newport News, VA

Marilyn E. Sadowski
Rochelle Park, NJ

Renate & Eckart Schutz
Blacksburg, VA

Ms. Dale-Serafin
San Marcos, CA

Ken & Sue Shumaker
Warwick, MD

Caroline Skinner
Portland, OR

Katherine Soltysiak
Bel Air, MD

Jeanette Willenbrink
Virginia Beach, VA

Cliff Gessner
Washington, DC

David Haller
Hagerstown, MD

Richard Kurtz
Ithaca, NY

Daniel Miller
Shady Side, MD

Vincent Phillips
Mechanicsburg, PA

Richard Rowan
Chambersburg, PA

Edgar Shaw
East Berlin, PA

Janice Ward
Snow Hill, MD

Kris Weaver
Peebles, OH

Paul P. Abrahams
Green Bay, WI

Caroline Cardullo
Rockville, MD

In memory
Hudson Cattell
from Maria Cattell
Millersville, PA

Chris Merryman
Whiteford, MD

Amy Parker
Laurel, MD

Charles & Margaret Schenk
Ulysses, PA

Richard B. Simmons
Silver Spring, MD

Patrick McKenna
Laurel, MD

Gil Freedman
Mechanicsburg, PA

Thomas W. Harant
Perry Hall, MD

Susan Mills
Glen Allen, VA

Edwards Seafood
Onley, VA

Richard W. Gilpin
Baltimore, MD

Anonymous

Forum

Commentary • Letters • Perspectives

Time's running out to meet Bay cleanup goals, especially in PA

By William Baker

It is a critical time for the Chesapeake Bay.

The historic federal-state partnership working to clean up the Bay's pollution is entering the final phase of restoration. By 2025, the six Bay states and the District of Columbia must have all of the pieces in place to meet science-based pollution reduction targets. If they succeed, we will all have clean water.

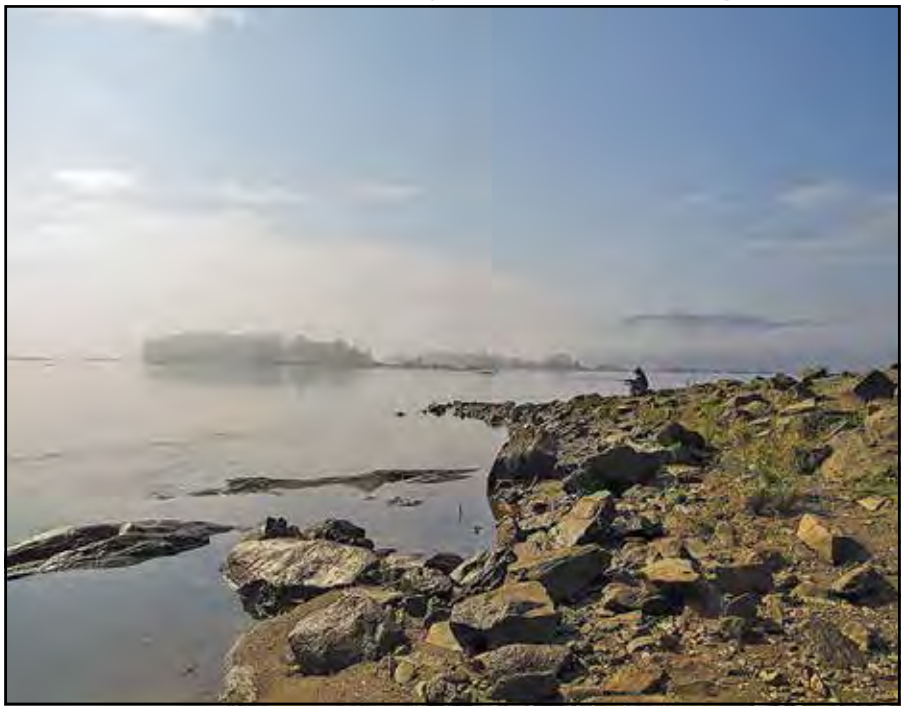
The restoration effort is unprecedented in scale and scope. Fully realizing its goals will result in the largest environmental success story in history. A saved Chesapeake Bay will provide an estimated $130 billion annually in natural resource benefits to the Bay region, home to more than 18 million people and our nation's capital. It will also provide a model for environmental restoration across the country and around the world.

Success demands two things: Each of the Bay states and the District of Columbia must do their part to reduce pollution. If they don't, the EPA must step in.

The agency has a critical opportunity over the next few months to hold up its end of the deal. It is currently reviewing the final plans drafted by the Bay jurisdictions to meet their 2025 restoration goals. It is imperative for these plans to be sufficient to get the job done.

Pennsylvania's draft plan contains many notable improvements over previous ones. But it falls short. It achieves only 67 percent of the pollution reduction needed, and will require significantly more investment than the commonwealth has provided to date.

In fact, by consistently underfunding clean water efforts since the federal-state partnership was launched in 2009, Pennsylvania's legislators have failed to uphold their promise to sufficiently reduce pollution to its surface water and groundwater.



A fisherman tries his luck below Safe Harbor Dam on the Susquehanna River. (Dave Harp)

The consequences are wide-reaching. Clean and abundant water is critical to Pennsylvania's economy, the health of its citizens, its outdoor heritage and quality of life. But according to the commonwealth's latest assessment of its waterways, approximately 40 percent of its rivers and streams violate water quality standards.

Fortunately, there are many boots on the ground working hard to reduce pollution in Pennsylvania. State and local agency leaders, farmers, sportsmen and women, conservation leaders and local communities want to do more to protect Pennsylvania's streams and rivers. We must support them.

This is a regional problem. Together, Pennsylvania, Maryland and Virginia account for 90 percent of the pollution fouling the Bay and its rivers and streams. None of these states are perfect, but because of early successes in reducing pollution from sewage treatment plants, Maryland and Virginia are on track to meet their goals.

But Pennsylvania's success will be rooted in investing in the more than 33,000 farms and 1,000 local governments. Continued failure means failure for the entire regional partnership. So, unless Pennsylvania's legislature acts now and substantially invests in these efforts, the EPA must impose penalties.

The EPA has the authority to increase regulations; review state-issued permits to make sure they adequately address polluted runoff from cities; and withhold or place conditions on grant funding. It is hard to overstate the importance of the EPA's enforcement role. Pennsylvania's elected officials should do all they can to avoid this outcome.

For decades, efforts to restore the Bay came up short. But in the last decade, progress has been made and science says the Bay is improving. Science also makes it clear that the recovery is fragile.

The Chesapeake is not alone. The same challenges plague waters across the country. From the Gulf of Mexico to the Great Lakes, algal blooms and dead zones caused by pollution have persisted and intensified.

In 2010, we did something different in the Chesapeake. The EPA set science-based targets to reduce pollution from all of the sources that contribute to the Bay's unhealthy water. All of the Bay jurisdictions committed to have practices in place to meet those targets by 2025. And the EPA agreed to hold them accountable. A blueprint to clean up the Bay was set in place.

It is working. Bay grasses are recovering, blue crab populations are rebounding, and the dead zone is shrinking. Communities throughout the Bay region are benefiting from cleaner streams, greener urban landscapes and more resilience to extreme weather — all of which improve local economies.

That's not to say the road to finishing the job is easy. The challenges are substantial and varied. We must confront climate change. We must fight regulatory rollbacks that jeopardize clean water and air. We must clean up legacy pollution from the Conowingo Dam.

But we know what we need to do. The science is clear. There is a plan. What is needed is the political will and leadership to implement it.

The entire federal-state partnership wants Pennsylvania to succeed. We need the state to succeed. Today, Pennsylvania has the opportunity to be the Bay's hero. With a science-based plan — and resources to implement it — Pennsylvania will help the region make history.

William C. Baker is president of the Chesapeake Bay Foundation.

Chesapeake Challenge

Answers to **Pursue your passion on the Chesapeake this summer!** on page 46.

Wildlife Watching: 1. life lists 2. binoculars 3. keep a safe distance 4. wildlife refuges 5. field guides 6. Important Bird areas 7. trail map 8. spotting scope

Fishing: 1. rod and reel 2. angling 3. hooking the big one 4. fishing license 5. fly-tying 6. tournament 7. nets 8. trotline

Paddling: 1. canoe 2. access site 3. rivers and streams 4. kayak 5. whitewater 6. oars 7. life preserver 8. John Smith Trail

Bay Buddies

Answers to Summer Safety! on page 46.

1. life jacket 2. bug spray 3. first aid kit 4. sunscreen 5. compass 6. helmet 7. whistle Don't leave home without it: water bottle

Forum

Commentary • Letters • Perspectives

Here's a word to the wise on Chesapeake Bay: Full

In the beginning was the Word …. and the word was Full.

By Tom Horton

The pool above Conowingo Dam, foreground, looking downstream toward Susquehanna Flats and the Bay. The buildup of sediment behind the dam is one example of a vastly larger environmental problem with growing full. (Dave Harp)

So, I didn't invent the foregoing writing technique; but sometimes it's best to just begin at the beginning: Distill your focus to a word and probe the implications of that word.

Take "estuary," meaning an embayment in a coastline — like our Chesapeake, where rivers draining 64,000 square miles collide and struggle for supremacy with the sea.

The Latin verb *aestuare* means to heave, boil, surge, be in commotion, a perfect warning that this place, where 40-odd tributaries war with ocean tides, is a most dynamic place — freshwater and saltwater, flood and drought, ebb and flow, and all manner of critters moving in and out, Sargasso to Susquehanna, Norfolk to Nova Scotia. It's an enormously challenging environment to predict and manage.

But today's word for thinking about the Bay (and beyond) is even more basic than "estuary," Today's word is "full." Its variants occupy a full page in my big unabridged Webster's, from full moon to full nelson, from full house to full-court press.

Fulminate and fuliginous notwithstanding, "full" on the whole implies something better than "empty." And for much of my environmental reporting career we were more concerned about empty: running out of oil, depleting topsoil, losing open space, keeping pace with world food demand.

All of these remain worrisome. But the filling of earth's sinks, its repositories for absorbing, buffering, cleansing, sequestering pollution may, in fact, be a tougher challenge than resource depletion.

Take, for instance, the headline *Conowingo Dam is Full*. Variations of it have appeared in newspapers throughout the Chesapeake since a very wet 2018 sent historic volumes of water and trash hurtling down the Susquehanna, from Pennsylvania and New York, across the 94-foot high dam near the river's entry to the Chesapeake.

Conowingo, which came online nearly 90 years ago, accounts for 55% of Maryland's renewable energy. It has trapped so much sediment behind its massive concrete face in that time that it is now full, passing on excessive quantities of dirt and attached phosphorus fertilizers to the

Chesapeake Born

Chesapeake, forcing us to re-examine how to reach already lagging cleanup goals.

The dam is the tiniest example of a vastly larger problem with growing full.

The oceans are full of plastics, which may outweigh the biomass of fish by 2050, according to some scientific estimates. Microplastics plague the Chesapeake, and we're trying to understand the implications.

Much better understood is an atmosphere full of CO_2, peaking at 37.1 billion tons last year. The resulting global warming drives sea level rise and worsening erosion in the Chesapeake, promising huge losses of wetlands, coastal forests and property values. Restoration of eelgrass, a vital lower Bay habitat, has become futile because the species cannot handle Bay waters that could grow as warm as South Florida's by 2100.

Very recent evidence shows another formerly reliable "sink" for CO_2 is filling up — as waters warm, phytyoplankton in the world's oceans are able to take less and less carbon out of circulation.

Also "full" are agricultural soils throughout intensive animal farming regions of Maryland, Virginia and Pennsylvania. Decades of overapplying manure, a cheap fertilizer, have saturated the soil with phosphorus, adding to the excessive nutrients that cause the loss of oxygen and declines of sea grasses in the estuary.

Similarly, the shallow groundwater across much of the Bay's watershed is full of polluting nitrate, the result of millions of acres of intensive row-cropping that "leak" excess soluble nitrogen into the Bay through subsurface flows.

There is no quick reversal for the aforementioned fillings-up of air, oceans, soils, dams and groundwater; we can only reduce or stop the sources of pollution and warming and wait decades to centuries for balance to be restored.

"The world is full," says Virginian Herman Daly, an internationally regarded economist. He explains that for most of humankind's time on earth, the amount of fish we could catch, wood we could harvest, crops we could irrigate, was limited by the amount of nets and boats, as well the technology to saw down trees and pump water.

Now it is limited by the diminishing numbers of fish and suitable timber and the flow of water down rivers. But our modern economy has not made the transition, and keeps pushing and investing to exploit nature harder, when it should be pivoting toward nature's restoration and maintenance.

We should tax the pollution and overconsumption that is filling the world, Daly says, and use the proceeds to restore natural resilience.

His notions, propounded in books you can find under "ecological economics," are eminently sensible — also radical, even threatening to the status quo. That's because they imply that the ecosystem of the planet sets limits on the human economy; imply that an end to growth might be necessary and desirable.

Conventional economics and politics don't like limits, unless it's maybe limits on limits (aka regulations). But look at Conowingo Dam, look at our air and oceans and soils and groundwater — all increasingly, blaringly, full.

Tom Horton has written about the Chesapeake Bay for more than 40 years, including eight books. He lives in Salisbury, where he is also a professor of Environmental Studies at Salisbury University.

FORUM

COMMENTARY • LETTERS • PERSPECTIVES

Come on in, the water's fun! And new access sites make it even easier

By Rachel Felver

The long, hot, lazy days of summer are here, and being on or near the water is the perfect way to spend them. Whether you feel like taking a dip, launching your boat — be it a kayak or pontoon — or simply taking a walk, there are new places throughout the Chesapeake Bay watershed for you to explore each year.

When we signed the Chesapeake Bay Watershed Agreement in 2014, our partnership not only committed to meet several goals to restore and clean up the Bay, but also to increase access to the water for the people who live, work and recreate throughout the region. Specifically, we agreed to create 300 new sites by 2025 where the public can either get on, in or near the water.

Creating a new site for the public to access the water is the very definition of the role the Bay Program plays in watershed restoration and protection. Like the makeup of the Bay Program, public access sites are created and maintained by a variety of partners, including local, state and federal agencies, as well as nongovernmental organizations. That's why it is vital to establish strong partnerships and initiatives among all partners to provide more opportunities for water access.

These partnerships are thriving, and since 2014, we have opened 176 new sites across the Chesapeake watershed for boating, fishing, swimming and other recreational activities. As you are making your plans to get out on the water this summer, check out the new sites that opened in 2018:

Unicorn Lake Fisheries Management Area in Crumpton, MD, above, has a fishing platform accessible by an American Disabilities Act-compliant ramp. (Will Parson/Chesapeake Bay Program) Visitors, right, trave; along the Waterwalk at Central Park above Newmarket Creek during a grand opening event for the 2.25-mile linear park in Hampton, VA, on May 12, 2018. (City of Hampton)

Maryland

Discovery Village, Anne Arundel County: There is one more boat ramp for the public to launch from in Anne Arundel County. Motorized boats, canoes and kayaks can access Parrish Creek, a tributary of the South River, from this site.

Downs Park, Anne Arundel County: A soft launch area has been added to Locust Cove for kayakers, canoeists and paddleboarders to access the Magothy River. Beware: This area is heavily impacted by the tides — so there may or may not be the same amount of water on the launch when you return.

Riverside Park in Mapleton, PA, received a non-motorized boat launch, primitive camping, restroom, parking, rustic shelters and an ADA-accessible fishing pier. The park also has a motorized boat launch. (Will Parson/Chesapeake Bay Program)

Hallowing Point, Calvert County: A soft launch access point has been added to accompany an existing paved ramp for boaters, canoeists and kayakers to enter the Patuxent River. Hallowing Point is a site along the Patuxent River Water Trail, which spans multiple counties as it connects boaters to different points of interest.

Unicorn Lake Fisheries Management Area, Queen Anne's County: With the addition of a new Americans with Disabilities Act (ADA)-approved fishing pier, anyone can fish for largemouth bass and bluegill on Unicorn Lake, a tributary of the Chester River. While there, be sure to check out the manmade structures built from discarded Christmas trees to attract fish, as well as the fish ladder that allows migratory fish to pass upstream.

Wye Island Natural Resources Management Area, Queen Anne's County: Launching kayaks, canoes and paddleboards onto the Wye East River just got a whole lot easier with the addition of a new access area that includes a slide. This valuable ecological site is prized habitat for wintering waterfowl on the Eastern Shore.

Newtowne Neck State Park, St. Mary's County: Take in views of Breton Bay, St. Clements Bay and the Potomac River when you try out the expanded paddle-in camping sites along this peninsula. These sites are more on the primitive side but offer miles of sandy beaches and hiking trails through the park's forests and meadows. Newtowne Neck is on the National Register of Historic Places as it was once home to the Piscataway Tribe and the site of the first European settlement in Maryland.

Point Lookout State Park, St. Mary's County: Improvements were made to 15 existing campsites at the park, which included an infrastructure upgrade and the addition of some amenities. These upgraded campsites can be reached by land or water and have access to launch kayaks, canoes or paddleboards onto Lake Conoy near floating docks.

Snow Hill Farm Park, St. Mary's County: In addition to an unsupervised public beach area, kayakers, canoeists and paddleboarders now have a soft access point in which to launch onto the Patuxent River.

Pennsylvania

Fifth Street Boat Launch, Clinton County: A paved launch has been added in Renovo Borough for all types of boaters to access the West Branch of the Susquehanna River. This rural borough was recently designated a Susquehanna Greenway River Town — a systemwide network of vibrant towns along the Susquehanna River actively connected to the water and each other.

Mapleton Riverside Memorial Park, Huntington County: Visitors have a whole host of new recreation options. Fishing is now available to all through an ADA-accessible pier, non-motorized boats can be launched from a floating dock, campers can take advantage of new tent

ACCESS CONTINUES ON PAGE 41

Forum

Commentary • Letters • Perspectives

Children's Outdoor Bill of Rights will grow a healthier, happier generation

By Chris Ryer & Reginald Moore

Baltimore Mayor Bernard C. "Jack" Young recently introduced the Children's Outdoor Bill of Rights, a positive and unifying vision of what childhood in Baltimore can and should be. Led by the City of Baltimore Department of Recreation and Parks, city agencies and many partners have been working with youth, residents and other stakeholders to develop a declaration of the rights of Baltimore children to access healthy outdoor time.

The Children's Outdoor Bill of Rights states that children in Baltimore have the right to:

- Breathe fresh air
- Splash in clean streams, ponds, rivers and the Chesapeake Bay
- Explore safe and inviting forests and wild spaces
- Grow a garden and eat fresh fruits and vegetables
- Play in vibrant neighborhoods, schoolyards and parks
- Understand and feel connected to their city's unique ecosystem
- Develop confidence in outdoor skills and recreation
- Work with neighborhood mentors in nature
- Have space for agency and action

Research shows that children who learn and play in nature are healthier and happier and more likely to thrive in school and their communities. People in communities with access to nature also tend to have increased resilience to trauma and stress and live longer, healthier lives.

In addition, they are more likely to have better attention spans and quality of sleep. According to the National Wildlife Federation, spending time outside raises levels of vitamin D, which helps to protect children from future bone problems, heart disease, diabetes and other health issues. Being outside even improves distance vision.

Baltimore Mayor Bernard C. "Jack" Young (center in white shirt) is surrounded by Baltimore City students after signing the Children's Outdoor Bill of Rights on May 11 at Middle Branch Park during Baltimore Wildlife Week. (Delaney McPherson / National Wildlife Federation)

The Children's Outdoor Bill of Rights was introduced in conjunction with Baltimore Wildlife Week in May. During the week, many children took part in the wide array of festivities, illustrating the idea that being close to nature and the outdoors brings positive health benefits, as well as fun and inspiration. Some of the child-friendly events included wildlife-themed dance parties, nature walks, science shows and environmental art pop-ups.

Celebrations like Baltimore Wildlife Week are a great way to start introducing children to the outdoors and the wildlife that share their backyard.

Baltimore residents are no strangers to the array of wildlife that call the area home. The city is known for the Baltimore oriole — the state bird of Maryland, with its distinctive black, white and orange plumage. A few years ago, volunteers planted a 10,000-square-foot oriole habitat next to Camden Yards.

Baltimore is also home to diamondback terrapins, peregrine falcons, checkerspot butterflies, blue crabs, oysters and cownose rays, just to name a few of our more iconic neighbors. Gwynns Falls Urban Forest, the second largest urban forest in the country, offers more than 1,000 acres of prime wildlife habitat, as well as hiking/biking trails, a nature center, an Outward Bound facility, pavilions, historic structures and many other amenities.

Access to clean and welcoming parks, pools, schoolyards and trails supports civic pride. Children who are able and willing to embrace an outdoor lifestyle develop a positive relationship with nature and are more likely to become environmental and community stewards.

Giving children access to the wonders of nature grows their love for wildlife and inspires them to protect wildlife and natural resources. We feel strongly that *all* children have a right to be proud of where they live.The Children's Outdoor Bill is the first step of a larger effort to connect children to nature. Baltimore is one of 18 cities participating in the Cities Connecting Children to Nature Initiative, generously supported by the National League of Cities and the Children & Nature Network.The introduction of the Children's Outdoor Bill of Rights would not have been possible without the support of the Baltimore Office of Sustainability (housed within the City of Baltimore's Department of Planning), the City of Baltimore's Department of Recreation and Parks, and the Greater Baltimore Wilderness Coalition.

City agencies and our partners are committed to continuing to work toward a city that is equitable, safe and nature-centric for all children and families — it's a critical part of how we can continue to build a city that is successful for everyone.

Chris Ryer is the city of Baltimore's planning director. Reginald Moore is director of the City of Baltimore Department of Recreation and Parks

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sites and the park offers rustic pavilions and restrooms. This area along the Juniata River is one bookend to Jack's Narrows, the deepest gorge in Pennsylvania at nearly one-third of a mile deep.

- *Mount Union Riverside Park, Huntington County:* Visitors can now get on the water, in addition to just viewing it from the trails running alongside, using new motorized and unmotorized boat launches. The park added tent sites for those traveling along the Juniata River Water Trail. Mount Union Riverside Park is the other bookend to Jack's Narrows.

Virginia

- *Dutch Gap Relic River Trail, Chesterfield County:* In 2017, a floating boardwalk and viewing platform opened to allow visitors access to the James River, and this last year, an ADA-accessible platform was added to allow paddleboarders, kayakers and canoeists to launch into the water. Paddlers can take advantage of the 2.5-mile Lagoon Water Trail, which passes by a blue heron rookery and a "graveyard" of submerged barges.
- *Waterwalk at Central Park, Hampton:* A new boardwalk allows visitors access to a quiet observation deck to soak up the sights of Back River. Lucky people may spy herons, egrets, red-winged blackbirds and different crab species.
- *Thalia Creek Kayak Launch, Virginia Beach:* Virginia Beach has actively been working for several years to create a greenway around Thalia Creek, a tributary of the Lynnhaven River in proximity to the Town Center. Ample pedestrian trails have been added to access the water. Now, visitors can launch their canoes, kayaks or paddleboards as well.
- *Mason Neck State Park, Prince William County:* Mason Neck State Park has long been a respite for those living in the Washington, DC, metro area. Now with the addition of a new canoe, kayak and paddleboard launch, water enthusiasts can access Belmont Bay. Rangers provide several guided programs and tours. Be sure to keep your eyes open for bald eagles!
- *Lake Anna State Park, Spotsylvania County:* Long one of Virginia's most popular vacation destinations, Lake Anna has even more canoe, kayak and paddleboard launches to help you get onto the water.
- *Wide Water State Park, Stafford County:* Wide Water, which opened in 2018, is Virginia's newest state park and offers access for canoeists, kayakers and paddleboarders to the point at which Aquia Creek and the Potomac River meet. The park also offers paddle-in campsites. Check out one of the many ranger-led programs or try your hand at fishing — this area is known for its largemouth bass.

Increasing public access to open space and waterways creates a shared sense of responsibility to protect these important natural environments. Through the Chesapeake Bay Watershed Agreement, Chesapeake Bay Program partners have committed to increasing public access as part of a larger effort to engage communities in our conservation work.

Rachel Felver is communications director for the Chesapeake Bay Program.

VOLUNTEER OPPORTUNITIES

Marine mammals, sea turtles

The Maryland Department of Natural Resources asks anyone who has seen a marine mammal or sea turtle in Maryland waters to report it to the state Marine Mammal and Sea Turtle Stranding program at 1-800-628-9944. Anyone who finds a stranded marine mammal, alive or dead, should follow these steps: Do not touch the animal; record the location using latitude/longitude, street address, and/or description with landmarks; estimate and record the length, size, color, noticeable body parts, and movements (if alive); take photos; keep a safe distance until stranding staff arrive. Marine mammals are protected by the federal Marine Mammal Protection Act. In addition, sea turtles and whales are protected under the 1973 Endangered Species Act. It is illegal to harass, capture or collect these marine species, alive or dead, including bones or body parts.

Paradise Creek Nature Park

Paradise Creek Nature Park in Portsmouth, VA, needs volunteers for workdays 9–11 a.m. July 13 & 27 and Aug. 10 & 31. Registration is required. Info: paradisecreek.elizabethriver.org.

Gunpowder Valley Conservancy

The Gunpowder Valley Conservancy in Baltimore County needs volunteers, ages 13 & older, for *Tree Maintenance Workdays* 10 a.m.–1 p.m. July 13, 20 & 27 at the Loch Raven Skeet & Trap Center in Phoenix. Help to remove invasive plants and make sure newly planted trees are growing properly. Bring a water bottle. Registration required. Info: gunpowdervalleyconservancy.org/calendar.

Central Rappahannock Master Naturalist

The *Central Rappahannock Chapter/ Virginia Master Naturalists* is accepting applications for the 2019 Basic Training Course starting Aug. 5. Virginia Master Naturalists are trained and certified volunteers, ages 18 & older (14 & older w/parent) who participate in education, outreach, stewardship and citizen science. Classes take place in Fredericksburg. Applications must be received by July 22. Fee of $175 includes all training and course materials. Info: masternaturalistcrc@gmail.com.

MD Volunteer Angler Survey

Anglers of all ages can become citizen scientists by helping the Maryland Department of Natural Resources collect scientific data through the Volunteer Angler Survey. Anglers record basic information from their catch such as species, location and size directly to the survey on their smartphone. Biologists use this data to develop, plan and implement management strategies. The artificial reef initiative, blue crab, freshwater fisheries, muskie, shad and striped bass programs have upgraded to mobile-friendly methods. Participants are eligible to win quarterly prizes. Info: dnr.maryland.gov/Fisheries/Pages/survey/index.aspx.

Severn River Association

The Severn River Association in Annapolis needs volunteers to join a team of citizen scientists monitoring water quality on the Severn and its creeks. Weekly tours take place Wednesday and Thursday mornings and last roughly four hours. The season goes to October. Volunteers can sign up for as many tours as they'd like. Info: TAGuay@severnriver.org, 443-569-3556, info@severnriver.org

Anita Leight Estuary Center

Anita C. Leight Estuary Center in Abingdon, MD, needs volunteers for:

≋ *Juvenile Fish Survey:* 6–8 p.m. July 12 & 27. Ages 16+ Help collect fish population data used by the Otter Point Creek Alliance to determine the status of tidal freshwater fish in the upper Bush River. No experience required. All training, equipment provided.

≋ *Invasinators Workday:* 9–11 a.m. July 28. Ages 14+ Remove invasive species, install native plants. Learn removal & restoration strategies, how to identify problem plants. Wear sturdy shoes, long sleeves, work gloves for field work, weather permitting.

Registration is required for all workdays. Info: 410-612-1688, 410-879-2000 x1688, otterpointcreek.org.

Thomas Point Shoal Lighthouse

The National Historic Landmark, Thomas Point Shoal Lighthouse, restored by the U.S. Lighthouse Society, which operates tours in partnership with the Annapolis Maritime Museum, needs volunteers. Info: volunteer@amaritime.org.

Volunteer at the CBEC

The Chesapeake Bay Environmental Center in Grasonville, MD, has a variety of volunteer openings for those who only want to drop in a few times a month to assist with a project or event, or help out on a more regular basis. Openings include: helping with educational programs; guiding kayak trips or hikes; staffing the front desk; maintaining trails, landscapes and the Pollinator Garden; feeding or handling captive birds of prey; maintaining birds' living quarters; and participating in the CBEC's team of wood duck box monitors or other wildlife initiatives. Other opportunities include participating in fundraising events and behind-the-scenes operations, website development, writing for newsletters and events, developing photo archives and supporting office staff. Volunteers donating more than 100 hours of service per year receive a complimentary one-year family membership to the CBEC. Info: volunteercoordinator@bayrestoration.org.

Cromwell Valley Park

Cromwell Valley Park in Parkville, MD, needs volunteers of all ages (12 & younger w/adult) for its *Habitat Restoration Team / Weed Warrior Days* 10 a.m.–12 p.m. July 13, 17 & 27. Help remove invasive species, install native ones and maintain habitat. Service hours are available. Meet at Sherwood House parking lot. Registration required. Info: Ltmitchell4@comcast.net.

CBL Visitor Center

Volunteers, ages 16 & older, are needed at the Chesapeake Biological Laboratory's Visitor Center on Solomons Island, MD. Volunteers must commit to a minimum of two, 3– to 4-hour shifts each month in the spring, summer and fall. Training sessions are required. Info: brzezins@umces.edu.

Little Paint Branch Park

Help the Maryland-National Capital Park and Planning Commission remove invasive species 11 a.m. to 3 p.m. the last Saturday in July, August and September at Little Paint Branch Park in Beltsville. Learn about native plants. Sign in for a safety orientation. Gloves and tools are provided. Info: 301-442-5657, Marc.Imlay@pgparks.com.

Magruder Woods

Help Friends of Magruder Woods 9 a.m. to 1 p.m. the third Saturday in July, August and September remove invasive plants in the forested swamp in Hyattsville, MD. Meet at farthest end of parking lot. Info: 301-283-0808, Marc.Imlay@pgparks.com, (301-442-5657 the day of event); or Colleen Aistis at 301-985-5057.

Become a VA Master Naturalist

Virginia Master Naturalists are a corps of volunteers that help manage and protect natural areas through plant and animal surveys, stream monitoring, trail rehabilitation and teaching in nature centers. Basic training covers ecology, geology, soils, native flora and fauna, and habitat management. Info: virginiamasternaturalist.org.

Adopt-a-Stream program

The Prince William Soil & Water Conservation District in Manassas, VA, wants to ensure that stream cleanup volunteers have all of the support and supplies they need for trash removal projects. Participating groups receive an Adopt-A-Stream sign in recognition of their efforts. To learn more, adopt a stream or get a proposed site, visit waterquality@pwswcd.org. Groups can register their events at trashnetwork.fergusonfoundation.org.

American Chestnut Land Trust

The American Chestnut Land Trust in Prince Frederick, MD, needs volunteers for invasive plant removal workdays 9–11 a.m. Thursdays and 10 a.m. to 12 p.m. Wednesdays. All ages (16 & younger w/adult) are welcome. Training, tools and water are provided. Registration is required. Info: 410-414-3400, acltweb.org, landmanager@acltweb.org.

Ruth Swann Park

Help the Maryland Native Plant Society, Sierra Club and Chapman Forest Foundation 10 a.m. to 4 p.m. the second Saturday in July, August and September remove invasive plants at Ruth Swann Park in Bryans Road. Meet at Ruth Swann Park-Potomac Branch Library parking lot. Bring lunch. Info: ialm@erols.com, 301-283-0808, (301-442-5657 day of event). Carpoolers meet at the Sierra Club MD Chapter office at 9 a.m. and return at 5 p.m. Carpool contact: 301-277-7111.

Creek Critters app

Audubon Naturalist's *Creek Critters* app lets people check their local streams' health through finding and identifying small organisms that live in freshwater, then generating health reports based on what they find. The free app can be downloaded from the App Store and Google Play. Info: anshome.org/creek-critters. To learn about partnerships or host a Creek Critters event: cleanstreams@anshome.org.

Irvine Nature Center

Volunteer opportunities at Irvine Nature Center in Owings Mills, MD, include:

≋ *Weekend Weed Warriors:* 11 a.m.–4 p.m. July 13 & 27 and Aug. 10 & 24 and Sept. 7 & 21. Ages 14+ Remove oriental bittersweet, multiflora rose. Training, tools provided. Wear sturdy shoes that can get wet/muddy; bring water, nonrefrigerated snacks/lunch. Meet at main entrance. Registration required: 443-738-9230, fertigb@explorenature.org.

≋ *Fall Naturalist Training:* Four-session course meets 9:30 a.m.–12:30 p.m. Sept. 10 & 12 (snacks provided); 9:30 a.m.–12:30 p.m. Sept. 16; 9:30 a.m.–1:30 p.m. Sept. 18 (lunch provided). Learn how to lead field

WORKDAY WISDOM

Make sure that when you participate in cleanup or invasive plant removal workdays to protect the Chesapeake Bay watershed and its resources that you also protect yourself. Organizers of almost every workday strongly urge their volunteers to wear long pants, long-sleeved shirts, socks and closed-toe shoes (hiking or waterproof). This helps to minimize skin exposure to poison ivy and ticks, which might be found at the site. Light-colored clothing also makes it easier to spot ticks. Hats are strongly recommended. Although some events provide work gloves, not all do; ask when registering. Events near water require closed-toe shoes and clothing that can get wet or muddy. **Always bring water.** Sunscreen and an insect repellent designed to repel both deer ticks and mosquitoes help.

Lastly, most organizers ask that volunteers register ahead of time. Knowing how many people are going to show up ensures that they will have enough tools and supervisors. They can also give directions to the site or offer any suggestions for apparel or gear not mentioned here.

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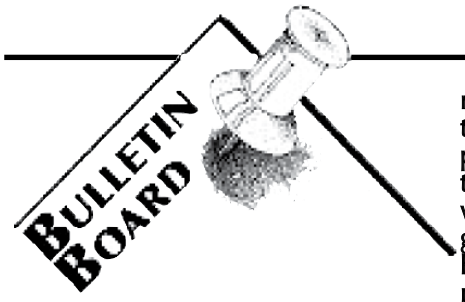

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trips for school groups. Natural history, trail activities, teaching techniques covered. No experience necessary. The training is free, but participants are expected to lead field trips during the fall semester. Registration required; explorenature.org, 443-738-9200.

Resources

The General Forestry Course

The University of Maryland Extension is offering both a paper and online *General Forestry Course* Sept. 1 to Dec. 15. There are no formal classes in this non-credit course. Students learn how to protect trees from insects, diseases and fire as step-by-step procedures walk them through a forest inventory and stand analysis. Details of the forestry business are presented, including tax nuances and the sale and harvest of forest products. The $150 fee includes copies of supplemental readings. A certificate of completion is awarded when assignments are completed. Info: http://extension.umd.edu/forestry-course: Nancy Stewart at 410-827-8056 x107 or nstewar1@umd.edu.

Stormwater class

The Alliance for the Chesapeake Bay has released the online *Municipal Online Stormwater Training Center's Dig Once Course.* Developed by the Local Government Programs staff and the University of Maryland's Environmental Finance Center, the course offers local leaders ways to integrate green infrastructure into community capital projects such as road construction and school and park improvements. Interactive lessons, videos, and knowledge checks in a user-friendly format provide communities with tools to better communicate about, build and enhance local stormwater programs. Info: mostcenter.org.

Wetlands Work website

The Chesapeake Bay Program's website, *Wetlands Work,* wetlandswork.org, was developed by the Wetlands Workgroup to connect agricultural landowners with people and programs that can support wetland development and restoration on their land.

Learn if your yard is Bay-Wise

Master Gardeners in Prince George's County (MD) takes part in *Bay-Wise*, a program that offers free consultations on sound environmental practices to help county residents' landscapes be certified as Bay-Wise. The Master Gardeners look for healthy lawn maintenance, efficient watering and pest control, and native trees and plants that provide shelter and habitat for wildlife. They also suggest approaches to reduce pollution. Bay-Wise signs are given to homeowners who demonstrate these practices. Homeowners can also evaluate their property online using the MD Yardstick, which tallies their pollution-reducing gardening and landscaping practices. To have a yard certified, though, homeowners need to have the Master Gardeners visit and evaluate their landscape. Info: Esther Mitchell: estherm@umd.edu, or visit extension.umd.edu/baywise/program-certification. Click on "download the yardstick" to evaluate a landscape and/or vegetable garden.

Turf / lawn programs

For information on the Prince William (County, VA) Soil & Water Conservation District's *12 Steps to a Greener Lawn / Building Environmental Sustainable Turf BEST Lawns* programs, low-cost, research-based programs for lawn education, contact: 703-792-4037, bestlawns@pwcgov.org.

Floatable monitoring program

The Prince William Soil & Water Conservation District in Manassas, VA, needs volunteers to help assess and trace trash in streams as part of an effort to reduce nonpoint source pollutants in urbanized and industrialized areas in relation to the County's Municipal Separate Storm Sewers (MS4) permit. Cleanup supplies are provided. Info: waterquality@pwswcd.org.

5 MD libraries offer fishing gear

The Maryland Department of Natural Resources' Aquatic Resources Education Program is providing rods and reels, tackle and fishing books geared toward children to the Eastport-Annapolis Neck Community and Mountain Road Community libraries in Anne Arundel County; Westminster Branch Library in Carroll County; Brunswick Branch Library in Frederick County; and Joppa Branch Library in Harford County. The goal is to foster the next generation of anglers by cultivating a passion for outdoor recreation and nature. The libraries, which are close to public fishing areas, have partnered with local fishing clubs to ensure inventory levels and maintenance of the equipment.

Baltimore biodiversity toolkit

There is a well-known need for high-quality and accessible green space in Baltimore, not only for native plants and animals, but for residents as well. The *Baltimore Biodiversity Toolkit* helps communities accomplish this by identifying ambassador animals that represent habitat types within, and historic to, this area; sharing resources for supporting specific wildlife needs; and monitoring and encouraging the collection of citizen science data; and developing a culture of conservation and stewardship of community land. The toolkit contains 20 ambassador wildlife species representing four habitats. These animals represent a variety of conditions that are present in high-quality environments for human, plant and animal health. The multi-platform toolkit will help partners prioritize community greening projects based on representative species, citizen science data and spatial analysis that includes social, economic and ecological indicators. Info: fws.gov.

Submission Guidelines

The *Bay Journal* regrets it is not always able to print every notice it receives because of space limitations. Priority is given to events or programs that most closely relate to the preservation and appreciation of the Bay, its watershed and resources. Items published in *Bulletin Board* are posted on the online calendar; unpublished items are posted online if staffing permits. Guidelines:

- **Send notices to kgaskell@bayjournal.com.** Items sent to other addresses are not always forwarded before the deadline.
- *Bulletin Board* contains events that take place (or have registration deadlines) on or after the 11th of the month in which the item is published through the 11th of the next month. Deadlines run at least two months in advance. See below.
- Submissions to *Bulletin Board* must be sent either as a Word or Pages document, or as simple text in the body of an e-mail. PDFs, newsletters or other formats may be considered if there is space and if information can be easily extracted.
- Programs must contain all of the following information: a phone number (include the area code) or e-mail address of a contact person; the title, time (online calendar requires an end time as well as a start time), date and place of the event or program. Submissions must state if the program is free, requires a fee, has age requirements, has a registration deadline or welcomes drop-ins.
- **September issue: August 11**
- **October issue: September 11**

Park passes for 4th-graders

The Maryland Department of Natural Resources and the U.S. Department of the Interior's *Every Kid in a Park* program provides fourth-grade students and their families free admission to national public lands and state parks. The Maryland Park Service will honor the federal passes, valid through Aug. 31, 2019, at all 75 state parks. The passes are also valid at 16 national parks, six national natural landmarks, five national wildlife refuges and two federal heritage areas in the state. The program's goal is to increase access to public lands and facilities for children to ignite their interest in the outdoors. It also offers teachers resources for planning field trips, including free access for classes and eligibility for federal transportation funding. The pass covers admission, but does not cover amenities and services, such as boat rentals, camping or staff-led tours. For details or to print a pass for this year, search engine *Every Kid in a Park* and follow the directions on the website.

Events / Programs

Corsica River Day

Learn about the efforts to preserve rivers at Corsica River Day, 12–4 p.m. Sept. 15 at the Corsica River Yacht Club in Centreville, MD. This free event includes family entertainment; water and environmental activities and exhibits; the Fishmobile; pony rides; petting zoo; Scales & Tails; and crafts for children. Food and beverages will be sold. Info: Queen Anne's County Office of Tourism at 410-604-2100, corsicariverconservancy.org.

Taste of the Chesapeake

The Alliance for the Chesapeake Bay's annual gala, *Taste of the Chesapeake,* takes place 6–9 p.m. Sept. 26 at the Crowne Plaza in Annapolis. During the event, the Alliance recognizes its environmental leadership award winners and showcases the Bay's restoration. The evening includes Chesapeake-inspired food and drink, live music, raffles and a silent auction. Tickets are $110 through Aug. 1 and $125 after. Proceeds from the fundraiser support the Alliance's work across the watershed. Info, including sponsorship opportunities: allianceforthebay.org.

Savory science with Horn Point Lab

The University of Maryland Center for Environmental Science Horn Point Laboratory invites the public to its latest *Science Bytes* event in which participants savor wine, beer,and antipasto 6–7:30 p.m. July 18 at Piazza Italian Market in Easton while the lab's Victoria Coles shares her research on the physical and ecological impacts of changes in extreme events in the Chesapeake. She will take attendees back in time over the last century using local weather stations to show how weather has been changing — and what models predict for the future. Questions are encouraged. Tickets are $25. Info: umces.edu/events/science-bytes-july, or contact Carin Starr at cstarr@umces.edu, 410-221-8408.

CASA garden tool workshop

Future Harvest Chesapeake Alliance for Sustainable Agriculture is presenting *Cultivate Baltimore: Small Farm Equipment: Hand Tools*, 5–7 p.m. Aug. 15 at Strength to Love II Farm in Baltimore. Participants can try out hand tools and learn the pros and cons of electric and gas-powered garden tools to see what works best for them. Fee: $10, scholarships available (email futureharvestcasa.org). Info: 410-549-7878, futureharvestcasa@gmail.com.

Paradise Creek Nature Park

Upcoming events at Paradise Creek Nature Park in Portsmouth, VA include:

- *Family Nature Walk:* 12–1 p.m. July 13 & 27 and Aug. 10 & 13. Free. No registration.
- *River Start Homes Workshop / Butterfly Society:* 10 a.m.–12 p.m. Aug. 24. Free. Info/registration for this event: Barbara Gavin at bgavin@elizabethriver.org,

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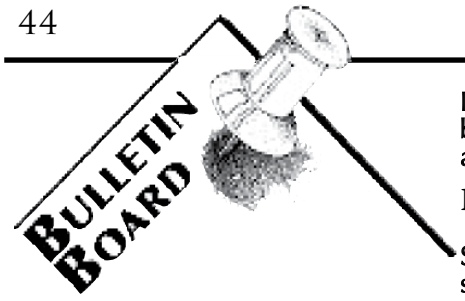

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757-392-7135.

≋ *Kayak Paddle:* 9–11 a.m. July 20 & Aug. 3. Paddle Paradise Creek & restored wetland. Learn about their wildlife, how nature and industry can coexist. Bring hats, sunscreen, plenty of water. Fee: $40.

Except where noted, online registration is required for each event: paradisecreek.elizabethriver.org.

Horticultural twilight tour

The 2019 *Horticultural Twilight Meeting and Tour* of the Western Maryland Research and Education Center in Keedysville takes place 5–8 p.m. Aug. 15. Examine projects at the research facility and interact with researchers and other specialists. Topics covered during the tour include: tree fruit diseases, bee monitoring, pumpkin disease & insects; spotted wing drosophila & disease management in brambles; seed management; Maryland apple tree selections project; trellis apples; and hops trial show & tell. The event is free but registration is required by Aug. 9: wmrectwilight.eventbrite.com or Susan Barnes at sbarnes6@umd.edu, 301-432-2767 x301. Those needing special assistance must call 301-432-2767 x301 by Aug. 9. Info on content: Bryan Butler at bbutlers@umd.edu.

Sharks at VA Living Museum

The Virginia Living Museum in Newport News invites the public to its summer exhibit, *SHARK ZONE*, which runs 9 a.m. to 5 p.m. daily through Sept. 2. As part of this exhibit, the museum is offering special presentations on the baby catsharks that are bred and raised at the museum at 11:30 a.m.–12 p.m. Aug. 3 & 31. The show highlights the shark's stages of development as well as how they thrive. Museum admission is $20/adults; $15/ages 3-12. Info: thevlm.org, 757-595-1900.

Kent Island youth fishing derby

The Kent Island Fishermen and Kent Island Estates Community Association invite youth from throughout the region to the *14th Annual Youth Fishing Derby* Aug. 10 at Romancoke Pier on Kent Island, MD. The derby is free and open to boys and girls in three age categories: 3–5, 6–10 and 11–16. Participants bring their own rods (a small number of loaner rods are available). Bait is provided. Wristbands are required for fishing and lunch admittance. Prizes are awarded for the largest fish, smallest fish, most unique fish and most fish caught in each age group. Winners must be present to claim prize; no one is awarded more than one trophy. Registration begins at 8 a.m.; the children fish 9–11 a.m. and refreshments and prizes are given out 11:30 a.m.–1 p.m. at the Kent Island American Legion. All participants must be accompanied by an adult. Info: Lou Wade at wotwater@atlanticbb.net.

Dee of St. Mary's public sails

The Calvert Marine Museum in Solomons, MD, is offering two-hour public sails on the Patuxent River aboard the historic skipjack Dee of St. Mary's, departing from the museum dock at 2:30 p.m. July 27, Aug. 11 & 24 and Sept. 15. Tickets are $25/ages 13+; $15/ages 5–12. Ages 4 & younger are not permitted. Advance reservations are taken by noon the Friday prior to the sail: visit bit.ly/ Patuxent RiverDeeOfStMarysCruises. Remaining tickets may be bought at the admissions desk the day of the sail. Info: Melissa McCormick at melissa.McCormick@calvertcountymd.gov, 410-326-2042 x41,

Ladew Topiary Gardens

Upcoming programs at Ladew Topiary Gardens in Monkton, MD, include:

≋ *Guided Hike / Nature Walk:* 9:30–11 a.m. July 17 & 1:30–3 p.m. Aug. 24. Ages 13+ Experience various wildlife habitats along the 1-mile trail and short boardwalk through wetland forest, freshwater marsh. Fee: $18. Registration, prepayment required. Info: Rachelle Rogers at 410-557-9570 x225, rrogers@LadewGardens.com.

≋ *Monarch Butterfly Workshop:* 8:30 a.m.–4 p.m. Aug. 6 & 7 (Must attend both days). Learn how to raise monarchs, create an interdisciplinary learning experience. Earn 1 MSDE credit. Fee: $120. Search engine: Ladew Garden butterfly workshop. Info: Sheryl Pedrick: 410-557-9570 x226; spedrick@ladewgardens.com.

Edna E. Lockwood heritage tour

Edna E. Lockwood, the last historic sailing bugeye in the world, has embarked on a heritage tour, traveling to ports around the Bay through September. Each stop features free, experiential programming and interpretation of traditional Chesapeake boat-building techniques and the oystering industry. Upcoming stops include July 19–21, Phillips Wharf Environmental Center, Tilghman, MD; July 25–28, Chesapeake Bay Maritime Museum, St. Michaels, MD; Aug. 2–4, Chesapeake Bay Buyboat Reunion, Cambridge, MD; Aug. 10, Annapolis Maritime Museum; Aug. 24, Saturday Bay Stroll, Crisfield, MD; Aug. 31–Sept. 2, Deal Island (MD) Skipjack Race & Festival; Sept. 6–8, Classic Reedville (VA) Weekend; and Sept. 13–14, Oyster Roast, Yorktown (VA) Watermen's Museum. All ports of call are weather dependent. Info: cbmmshipyard.org/ednalockwood.

Boating safety classes

U.S. Coast Guard Auxiliary Flotilla 25-08 is offering a *Boating Safety Class* 7:30 a.m.–5 p.m. July 20 at the Washington Farm United Methodist Church in Alexandria, VA. Learn about boat handling and regulations, nautical "rules of the road," trailering and required gear. Virginia, Maryland and the District of Columbia have varying requirements for boaters before they may legally operate certain motorized vessels on their respective waters including a safe boating class. Preregistration is required. Info: jdburt@verizon.net, 703-307-6482. The auxiliary's website, wow.uscgaux.info/content.php?unit=B-DEPT, also features boating safety tools, materials.

Anita Leight Estuary Center

Upcoming programs at the Anita C. Leight Estuary Center in Abingdon, MD, include:

≋ *Pond Exploration:* 1–2:30 p.m. July 14. Ages 5+ Use dip nets to bring amphibians, fish and insects up close for observation. Fee: $3.

≋ *Kayak Cruising on the Creek:* 10 a.m.–12:30 p.m. July 18. Adults. Explore Otter Point Creek, upper Bush River. Fee: $12.

≋ *Critter Dinner Time:* 10:30 a.m. July 20. All ages. Learn about turtles, fish, snakes while watching them eat. Free. No registration.

≋ *Meet a Critter:* 2 p.m. July 21. All ages. Get close to, learn about an animal.

≋ *Beautiful Bosely Conservancy Kayak Trip:* 2:30–5 p.m. July 27. Meet at Bosely Conservancy. Ages 8+ Learn about the conservancy's history, ecology. Fee: $12.

Ages 12 & younger must be accompanied by an adult for all programs. Events meet at the center and require registration unless otherwise noted. Payment is due at time of registration. Info: 410-612-1688, 410-879-2000 x1688, otterpointcreek.org.

Eden Mill Nature Center

Upcoming programs at Eden Mill Nature Center in Pylesville, MD, include:

≋ *Child & Adult Paint Evening / Red-eyed Tree Frog:* 6-8 p.m. July 19. Ages 5–10 w/ adult. Child & adult each complete a 14"x 18" acrylic painting on canvas. Instruction provided. Fee: $50 per pair per session.

≋ *Extended Summer Nature Storybook Art Program:* 10 a.m.–2 p.m. July 22–26 . Ages 5–10. Participants learn about book illustration by creating art projects using various techniques such as drawing, painting, collage, and crafting/constructing. Fee: $71.

≋ *Goodbye to Summer Weeklong Adventure:* 9 a.m.–3 p.m. Aug. 26–30. Ages 6–11. Participants explore trails, participate in experiments, make crafts, play games, paddle Deer Creek. Fee: $175/week.

≋ *Sunrise/Sunset Canoe Trips:* 5:45–8:15 p.m. Tuesdays & Thursdays in June, September & October through Oct. 13 and 9–11:30 a.m. Saturdays in July & August. 5:45–8:15 p.m. Thursdays, in July & August. Fee of $8 includes all equipment.

Registration is required for all programs and closes 24 hours in advance of each program. Weekend program registration closes at noon on the prior Friday. Info: 410-836-3050, edenmill.org, edenmillnaturecenter@gmail.com.

Cromwell Valley Park

Upcoming programs at Cromwell Valley Park's Willow Grove Nature Center in Parkville, MD, include:

≋ *Fooling the Fish:* 11 a.m.–1:30 p.m. July 14. Ages 18+ Learn how to tie simple flies for fishing. Fly-casting demonstration. Fee: $6.

≋ *Full Thunder Moon Night Hike:* 8–9:30 p.m. July 19. Ages 5+ Listen for owls, eat s'mores around a campfire. Fee: $5.

≋ *Girl Scout Day:* 1–3 p.m. July 20. (Daisies, Brownies & Juniors) w/adult. Meet native Maryland animals, explore their summer habitat. Participants receive a Cromwell Valley Park logo patch. *NO siblings*. Fee: $5 per Scout.

≋ *Hike to the Marble Springs / Frog Roundup:* 1–3 p.m. July 21. Ages 5+ Observe, identify, release frogs. Nets supplied. Shoes will get wet. Free.

≋ *Butterflies Like It HOT!* 11 a.m.–12:30 p.m. July 27. Ages 8+ Learn to identify, observe butterflies using binoculars as well as why they prefer hot days. Free.

≋ *Discovering Dragonflies:* 1–2:30 p.m. Aug. 3. Ages 5+ Help to catch this insect at the pond. Shoes will get wet. Fee: $4.

≋ *Animal Adaptations for Summer:* 11 a.m.–12 p.m. Aug. 11. All ages. Discover how animals cope with the heat. Free.

≋ *Owl Prowl:* 8–9:30 p.m. Aug. 16. Ages 5+ A naturalist will call in a great horned owl. Wear dark clothing, sturdy shoes. Fee: $4.

≋ *Native Shelters:* 10 a.m.–12 p.m. Aug. 17. Meet at Primitive Technology Laboratory. Ages 8+ Tipis are warm in winter, cool in summer, impervious to wind, rain. Learn how to set one up. Free.

≋ *Lunch for the Animal Bunch!* 1–2 p.m. Aug. 18. All ages. Bring a small bagged salad, grapes and/or tomatoes to help prepare lunch for the park's animals. Free.

≋ *Turtle-y Awesome!* 1–3 p.m. Aug. 24. Ages 2–10 w/adult. Meet resident turtles, make a turtle craft. Fee: $4.

≋ *Not All Classrooms Have Four Walls:* 1–2 p.m. Aug. 25. Ages 2–10 w/adult. Short hike, stories. Free.

≋ *Wingin' It - Maryland's Migrating Monarchs:* 1–3 p.m. Aug. 31. All ages. Learn how long it takes monarchs to fly to Mexico. Help to tag, record them. Fee: $5.

Ages 12 & younger must be accompanied by an adult. Except where noted, registration is required for all programs. Info: cromwellvalleypark.campbrainregistration.com, 410-887-2503, info@cromwellvalleypark.org, cromwellvalleypark.org. For disability-related accommodations, call 410-887-5370 or 410-887-5319 (TTY), giving as much notice as possible.

Native plant seminar & sale

The *28th annual Native Plant Seminar & Sale* at Irvine Nature Center in Owings Mills, MD, takes place 7:30 a.m. to 3:30 p.m. Aug. 24. Attendees will learn about native vegetation, sustainable practices and the conservation of native landscapes. Seminar registrants can start purchasing native plants from regional nurseries at 7:30 a.m. (90 minutes before the sale opens to the public, 9 a.m.–3 p.m.). Free "plant-sitting" is provided for seminar participants. Topics include *From the Mountains to the Sea* (Maryland's Natural Areas); *Why We Should Care: Invasive Species; A Threat to Maryland's Forests; Covering Your Tracks: Native Groundcovers;* and *Native Orchids & the Pink Lady Slipper.* Afternoon workshops to choose from are *Butterflies, Moths & Native Plants*; and *Tree Care & Maintenance*;

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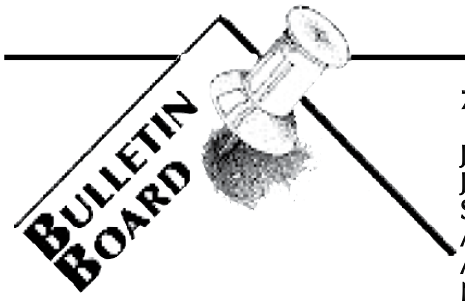

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Milkweeds & their Communities. The fee for morning sessions, which includes lunch, drinks and snacks is $65. The extra fee for an afternoon workshop (space is limited) is $25. Registration: Search engine Irvine Nature Center Native Plant Seminar. Info: Tara Lilley at LilleyT@ExploreNature.Org.

Thomas Point Shoal Lighthouse

The Annapolis Maritime Museum is offering tours of the Thomas Point Shoal Lighthouse 9–11 a.m. & 12–2 p.m. July 27, Aug. 3, 17 & 31 and Sept. 7. The tour includes 30-minute boat rides to and from the lighthouse, with chances to photograph it from many angles, and a one-hour interior tour, where visitors, who must be 12 & older, learn about the light's history, the life of a keeper and role of the U.S. Coast Guard. Tours require some physical exertion. Tickets are $80 and help fund the lighthouse's restoration. Info: amaritime.org, uslhs.org.

York County (PA) parks

Upcoming programs offered by York County (PA) Department of Park & Recreation include:

Stream Study: 2:30–4 p.m. July 21. Ages 7+ Investigate rarely seen stream animals. Bring extra water shoes/rain boots. People may not disturb the stream or pond outside of a naturalist-led program. Free. Preregistration required: 717-428-1961.

Wading Birds: 1-3 p.m. July 28. (drop-In program) Kain Park, Iron Stone Hill Parking Lot, York. Ages 8+ Use binoculars, scopes to spot herons, egrets, other waterbirds. Learn why they hang out in the shallow waters near the boardwalk. No registration.

Bats Demystified: 2:30–4 p.m. Aug. 4. Learn why bats are beneficial and not to be feared.

Outdoor Nature Watercolor Class: 9:30–11:30 a.m. Aug. 8. Ages 10+ Beginner's watercolor class takes place outside in the shade. All materials provided. Fee: $10. Registration required: 717-428-1961.

Caterpillars: 2–4 p.m. Aug. 11. (drop-in program) Meet live caterpillars, learn about their habits, habitats.

Hunter Safety Course: 6–9:30 p.m. Aug. 15 & 8 a.m.–12 p.m. Aug. 17. PA Game Commission instructors teach this new required hunter course. Sign up with the commission: pgc.state.pa.us.

Flintknapping: 2:30–4 p.m. Aug. 18. Hands-on demonstration of making tools from rock. Practice using stone axes, throwing sticks, bow & arrows, atlatl.

Survival 101: 2:30-4 p.m. Aug. 25. Stroll around Nixon Park to learn what native plants are edible, which to stay away from. Registration required: 717-428-1961.

Sunset Scramble Bike Rides: 6:30 p.m. July 16 - Rudy Park near Rail Trail entrance; July 2, - Brillhart Station; July 30 - Glatfelter Station; Aug. 6 - Seven Valleys Parking Lot; Aug. 13 - Hanover Junction Train Station; Aug. 20 - Railroad Parking Lot; Aug. 27 - New Freedom Train Station. Ride 13–15 miles (round trip) on Heritage Rail Trail. Helmet, light, water required. Bring money for snack (optional).

Moonlight Bike Ride: 8:30 p.m. Aug. 17. Meet at Seven Valleys Parking Lot for 9-mile ride north on the Heritage Rail Trail. Bike, light, helmet required.

Except where noted, events take place at Nixon Park in Jacobus, are free and do not require preregistration.

Oregon Ridge Nature Center

Upcoming programs at Oregon Ridge Nature Center in Cockeysville, MD, include:

Shoots & Letters: 10–11 a.m. July 18 *Hiking*; July 25 *Camping*; Aug. 1 *Tracking Animals*; Aug. 8 *Snails*; Aug. 15 *Insects*; Aug. 22 *Birds*; Aug. 29 *Mammals*. Ages 3+ Activities, outdoor adventures. Fee: $2. No registration.

Tubing on Little Falls: 9 a.m.–1 p.m. July 28 & Aug. 11. Ages 8+ Meet offsite for shuttle. Participants must be able to paddle tube around obstacles during this strenuous trip. Fee: $15.

Bookworm Story Time: 11–11:45 a.m. Aug. 2. Toddlers to age 6. Nature story & activity. Brief outdoor experience. Free; donations welcome. No registration.

Hey! What's that Sound? 10–11:30 a.m. Aug. 3. Ages 4+ Participants will learn sources of summer sounds. Wear closed-toe shoes, bring a water bottle, binoculars or borrow a pair from the park. Fee: $3.

Basic Paddling on the Lake: 10 a.m.–12 p.m. Aug. 4. Ages 8+ Learn basic flatwater paddling techniques, practice on the lake w/American Canoe Association certified instructor. Fee: $10.

Bird Walk: 8–9:30 a.m. Aug. 9. Adults. Bring binoculars, wear hiking shoes. Free, donations welcome.

A Morning in Mining History: 10–11:30 a.m. Aug. 10. Ages 5+ Explore park's historical sites, learn how miners lived in the 1800s. Fee: $4.

Water, Water Everywhere! 1–3 p.m. Aug. 17 & 18. Ages 6+ Activities explore the water cycle. Fee: $4.

End of Summer Campout: 6 p.m. Aug. 17 to 9 a.m. Aug. 18. All ages. Bring a tent, camping gear, picnic dinner. S'mores, light breakfast provided. A limited number of tents available for rent at $10. Fee: $10/person; $30/family up to 5 people.

Backyard Butterflies: 1–2:30 p.m. Aug. 24 & 25. Ages 5+ Learn about butterflies' life cycles. Use a butterfly net to explore, test ID skills. Fee: $4.

Children 15 & younger must be accompanied by an adult. Except where noted, registration is required for all programs and payment must be made within a week of registration. All programs are rain or shine. Programs are designed for individuals and families, not groups. To arrange a program for a group, contact the park office. Info: 410-887-1815, info@OregonRidgeNatureCenter.org. For disability-related accommodations, call 410-887-5370 or 410-887-5319 (TTD), giving as much notice as possible.

Chesapeake Bay Maritime Museum

Upcoming events at Chesapeake Bay Maritime Museum in St. Michaels, MD, include:

Apprentice for a Day Shipyard Program: Demonstrations, workshops with visiting master craftsmen, on-the-water experiences, customized programming take place on weekends and select weekdays, and include a variety of programs for every interest, age. Info: cbmm.org/shipyardprograms.

Sea Squirts Summer Camp: 9 a.m.–12 p.m. July 15–19 *Walk on the Wild Side*; July 22 *Bay Explorers*; and Aug. 12 *Play All Day!* Ages 4–6. Fee: $150/week. Scholarships are available for campers with financial need. Info: cbmm.org/summercamps.

Ecology Cruise / Winnie Estelle: 1–2:30 p.m. July 16 & 10–11:30 a.m. Aug. 14. Participants learn how to monitor the river's water quality, perform water testing, discover creatures on an oyster reef. The route goes near Long Point Island, known for eagle, osprey populations and heron rookery. Fee: $20. Registration required: cbmm.org/onthewater.

Build it. Boat it. Summer Camp/ Canoeing: 9 a.m.–3 p.m. July 22–26. Students entering grades 6–9 spend part of the day working on a project in the shipyard, then head out for a paddling adventure. Fee: $300/week. Scholarships are available for campers with financial need. Info: cbmm.org/summercamps.

Herons Summer Camp: 9 a.m.–3 p.m. July 29–Aug. 2 *Mysteries of the Bay* and Aug. 12–16 *Play All Day!* Students entering grades 4–6. Fee: $300/week. Scholarships are available for campers with financial need. Info: cbmm.org/summercamps.

Terrapins Summer Camp/ Mysteries of the Bay: 9 a.m.–3 p.m. July 29–Aug. 2. Students entering grades 1–3. Fee: $300.

Guided Paddle & Tasting: 9 a.m.–1 p.m. Aug. 24. Beginner, intermediate paddlers. Launch from Bellevue Landing, near the Oxford-Bellevue Ferry, for paddle along the Tred Avon River to watch sailing log canoe races, eat ice cream from Scottish Highland Creamery. Wear sunscreen; bring water, snacks. The fee, which includes the tastings, is $35 for those with their own kayak & gear or $65 for those renting from CBMM. Registration required: cbmm.org/paddles. The paddle is weather-dependent; participants will be notified in case of cancelation.

MD Agricultural Resource Center

Upcoming children's programs offered by the Maryland Agricultural Resource Center at the Baltimore County Agriculture Center in Cockeysville, include:

Farm Camp: 9 a.m.–3 p.m. July 22-26. Ages 8-12. Campers will take care of farm animals, learn about different ag topics, explore nature through hiking and stream activities, make crafts, plant seeds, participate in fun team challenges. Fee of $260/first child, $230/each additional child includes T-shirt, snacks, all materials. It does not include lunch, which participants must bring. Registration required: marylandagriculture.org/summer-camp.

Farm Sprouts: Participants must choose between two sessions: 9:45–10:45 a.m. or 11:30 a.m. to 12:30 p.m., July 19 *Bees & Butterflies*; July 26 *Chickens & Ducks*; Aug. 23: *Sunflowers*; Aug. 30 *Ponies*; and Sept. 13: *Grains*. Ages 5 & younger w/ parents. Each class features movement, stories, arts & crafts. The fee for ages 9 months and older is $8 per workshop. Parents are free. (If financial constraints prevent someone from attending, contact MARC to see if arrangements can be made.) Registration is required; no walk-ins. Info: info@marylandagriculture.org. Info: marylandagriculture.org/summer-camp, 410-887-8973.

Kayaking at CBEC

The Chesapeake Bay Environmental Center in Grasonville, MD, is offering kayak tours and classes to increase the appreciation, knowledge and stewardship of the Chesapeake ecosystem:

Guided Kayak Tours: 5:30–7:30 p.m. Aug. 29 & Sept. 12 and 10 a.m.–12 p.m. July 21 & Aug. 11. Beginner to intermediate kayakers. Look for wildlife while exploring Marshy Creek with a self-provided snack break at the halfway point. Instruction on equipment, paddling/safety techniques, loading & unloading vessels included. Fee of $20 includes kayaks, equipment. Registration required: bayrestoration.org/guided-kayak-tours.

ACA Level 2 – Flatwater Safety & Rescue Course: 10 a.m.–5 p.m. Aug. 25 or Sept. 15. Course includes pre-paddling preparation, safety & rescue equipment overview, self and assisted rescue maneuvers. Participants will experience full in-water self-immersion on calm, flatwater. Course fee: $80; kayak & equipment rental fee: $20. Info: bayrestoration.org/kayaking

Irvine Nature Center

Upcoming programs at Irvine Nature Center in Owings Mills, MD, include:

Tales & Tails: 10–11 a.m. Fridays. All ages. Story, songs, puppet show, meet an animal. Free.

Stream Searchin': 12–2 p.m. July 20 & July 28 and 10 a.m.–12 p.m. Aug. 10. Ages 5+ Hike to stream to look for aquatic creatures. Fee: $10.

Falconry - Hunters in the Sky: 10–11 a.m. Aug. 3. All ages. Learn what it takes to become a falconer, how to train a bird of prey. Fee: $10.

Summer Scavenger Hunt: 9 a.m. –5 p.m. Aug. 31 & Sept. 1. Families, all ages. Self-led activity. Free.

Butterfly Week: Sept. 7–15 All ages. Extended hours in the butterfly house. Free.

Registration is required for all events. Info: explorenature.org, 443-738-9200.

Chase your passion on the Chesapeake this summer!

It's summer! Celebrate the Chesapeake in any number of adventures. Get out on the water! Explore the watershed's woods! Here are words, in code, related to three outdoor activities. Once you have figured out one of the words in a list, use its letters to help crack the code in the other communities within that list. Each list has its own code. Answers are on page 38.

— Kathleen A. Gaskell

Wildlife Watching

1. F N O G   F N B H B
2. V N X Z R W F E S B
3. I G G K   E   B E O G   A N B H E X R G
4. T N F A F N O G   S G O W U G B
5. O N G F A   U W N A G B
6. N Q K Z S H E X H   V N S A   E S G E B
7. H S E N F   Q E K
8. B K Z H H N X U   B R Z K G

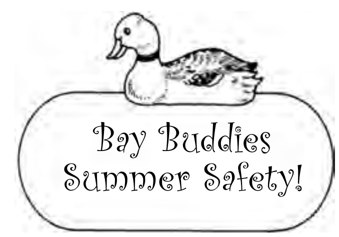
Fishing

1. D H L   J E L   D X X G
2. J E F G Y E F
3. S H H B Y E F   C S X   R Y F   H E X
4. I Y Z S Y E F   G Y P X E Z X
5. I G Q - C Q Y E F
6. C H Z D E J W X E C
7. E X C Z
8. C D H C G Y E X

This kayaker is equipped with more than one answer on this page. (Dave Harp)

Paddling

1. A S K G P
2. S A A P O O   O R W P
3. A R J P A O   S K X   O W A P S C O
4. D S Q S D
5. B L R W P B S W P A
6. G S A O
7. E R H P   Z A P O P A J P A
8. Y G L K   O C R W L   W A S R E



It's summer and the choice of outdoor activities is endless: Hiking, paddling, swimming, watching wildlife, bicycling… Here are the scrambled names of essential gear that will help to keep you safe when exploring the Chesapeake watershed. Unscramble the words and put them in the spaces. Some of the letters will have a number below them. Place the letter in the space above the matching number in the blanks at the end of the puzzle. When you are finished, the blanks will spell out an item that is essential no matter what your activity is.

Answers are on page 38.

1. F I L E   T J C A K E   __ __ __ __   __ __ __ __ __(11) __
   This will keep you high (but not dry) if you have a mishap during paddling.
2. U G B   R A S P Y   __(6) __ __   __ __ __ __ __
   Take that! You mosquitoes, ticks and chiggers!
3. S I R F T   D I A   T I K   __ __ __(5) __ __   __ __ __   __ __ __(8)
   If you get into a scrape, this will come in handy.
4. S E R C U N E S   __ __ __ __ __ __ __ __(4) __
   Feel the burn and you will learn to use this the next time.
5. S C A M P O S   __ __(7) __ __ __(2) __ __
   Always follow directions!
6. T H E E L M   __ __ __(10) __ __ __(3)
   If you use your head, you'll save your brain.
7. H E L W I T S   __(1) __ __ __ __(9) __ __
   If you forget Number 5, you might need this.

__ __ __ __ __   __ __ __ __ __ __
1 2 3 4 5   6 7 8 9 10 11

— Kathleen A. Gaskell

Common gallinule uncommonly delightful in any landscape

By Mike Burke

The common gallinule comes to the Chesapeake region every spring. It is usually found in areas with significant stands of emergent grasses along various waterways, such as the Delmarva Peninsula and the Upper Susquehanna watershed in Pennsylvania and into New York. (U.S. Fish and Wildlife Service)

The bald eagles were everywhere we looked, soaring through the summer sky and perching on top of a half-dozen loblolly pines. There were mature adults and several younger birds, and all of it was exhilarating.

My wife, Pat, had entered the Blackwater National Wildlife Refuge minutes earlier. Just past the Marsh Edge Trail, we drove down Observation Access Road to the overlook. After a few minutes to unload my scooter, we headed up the ramp to put ourselves in the center of the eagles.

Barn swallows swirled acrobatically, and red-winged blackbirds complained loudly about our presence. The regal eagles ignored us. Once again, this extraordinary place was working its magic. We were totally enthralled.

Pat and I had counted 11 bald eagles of various ages when a piercing squawk from the marsh below us finally diverted our attention. The bird squawked again and again and seemed to be under the ramp, but we couldn't see it immediately. It was hidden among the marsh grasses.

Pat inched quietly down the ramp to get a better look. She stopped, turned to me with a big smile and said, "Common gallinule!"

The unlikely looking bird peeked out from the grasses a second later, and I could see it, too.

The common gallinule (*Gallinula galeata*) is a rail that looks like a big black chicken with ridiculously long toes and a red face plate. The plate blends seamlessly into its bill, which ends in a bright yellow tip.

This was the first gallinule we'd seen during our many trips to Blackwater, located just south of Cambridge, MD. It squawked a few more times to make sure we noted its presence before silently disappearing again into the tall grass.

Gallinules are slightly smaller than American coots, which they superficially resemble. Both are big, roundish dark birds that frequent lakes, ponds, marshes and the like. The gallinule is typically close to shore, moving between wetland vegetation and small breaks of open water. The coot favors broader expanses of open water.

At first glance, the gallinule's body appears all dark gray except for a white side stripe and white feathers on either side of the tail (technically, the "outer tail coverts"). Upon closer inspection, the shoulders, wings and rump are dark brown, not gray.

The bird has rather thick, greenish-yellow legs leading into those comically large toes. The feet are an adaptation to help the bird walk on mudflats and atop vegetative mats. The gallinule eats plants and the macroinvertebrates in the surrounding marsh.

Overall, it's a foot long and weighs about 13 ounces. The sexes are similar, although females tend to be smaller.

Even though it was our first sighting of the gallinule in Blackwater, the bird is fairly common in the Eastern United States and some areas in the West.

Known as a short-distance migrant, the common gallinule comes into the Chesapeake every spring. It can't be found in the mountains, but areas with significant stands of emergent grasses along various waterways might be home to these birds. The Delmarva Peninsula and the Upper Susquehanna watershed in Pennsylvania and into New York are the most common sites in the Chesapeake region to host these birds.

These gallinules are widespread in the Americas. Permanent populations can be found in Florida and Louisiana, the Caribbean, Central America and South America down into Chile. And that's not all. The common gallinule is also found in Europe, Africa, Asia and Australia. There is even an endemic subpopulation in Hawaii.

Folklore in Hawaii tells the story of the gallinule bringing fire to humans for the first time. According to lore, the scarlet face plate is the permanent scar resulting from that first fire.

The common gallinule was given that name in 1957 by the American Ornithological Union, the official authority on species' names in the United States. The bird closely resembles the common moorhen of Europe, and in 1983, the organization changed the name to coincide with its European counterpart: common moorhen.

By 2011, evidence was mounting that the decision to share its name with the European bird was a bad idea. Key differences in morphology, behavior and mitochondrial DNA were enough to split them back into two species. And so, the bird's official name reverted to common gallinule. Much confusion in birders' life lists ensued.

There is no confusing the common gallinule in the field, however. Nothing else looks quite like it in the United States. Only its sister species, the purple gallinule, has that remarkable red face plate. But as its name suggests, the related bird is purple, not gray.

Birding in Blackwater is always a joy. As the seasons change, the cast of avian characters changes, too. Equally impressive is the refuge's stunning landscape. Marsh grasses, interspersed with stands of stately loblolly pines and tidal waters, stretch out in subtle hues that change with the time of day as well as the seasons.

That evening, I added another name to my list of Blackwater birds. Once again, the marshes had surprised and delighted me with their endless variety and beauty. The common gallinule, that unlikely looking bird, gave me one more reason to love this special place.

Mike Burke, an amateur naturalist, lives in Cheverly, MD.

JULY-AUGUST / 2019 VOLUME 29 NUMBER 5

CHESAPEAKE BAY JOURNAL

The BAY JOURNAL is printed on 100% recyclable/recycled paper using vegetable-based inks.

www.bayjournal.com

THE BAY JOURNAL
P.O. Box 222
Jacobus, PA 17407-0222

NONPROFIT ORG.
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PERMIT # 234

In a flash, nature's night lights add sparkle to summer nights

BY KATHY RESHETILOFF

Every summer, as the Earth enters a region of space containing high concentrations of solar debris, nighttime skywatchers are rewarded with a wonderful light display: the Perseid meteor shower. The annual Perseids occur when the Earth passes through a stream of dust from the Comet Swift-Tuttle, although a close to full moon may make this year's meteor shower a little less intensive than last year's, you are still likely to see 10–15 Perseids per hour during the peak night of Aug. 12–13.

To get the best view, go to the darkest possible location and observe as much sky as possible directly above you. The rate of the meteor showers increases from around 10 p.m. through dawn, so the later you can look the better.

But you don't have to be an astronomer to see summer light shows produced by nature. Some animals produce light from within their bodies. This phenomenon, bioluminescence, gives these creatures a visual aura.

Phosphorus was once thought to be the source of light in living creatures, but researchers now know that bioluminescence is accomplished through oxidation (adding of oxygen) to a protein in the animal known as luciferin. When oxygen, either in a gaseous form or mixed in a liquid, combines with the chemical luciferin in the presence of luciferase, a bioluminescent enzyme, a new "excited" compound is produced and gives off light. Unlike fuel combustion, there is no heat associated with luminescence.

The most familiar of the light producers is the firefly or lightning bug. During June and July, after spending most of the year underground, fireflies emerge to attract a mate. Light, produced in the firefly's abdomen section, flashes on and off in a specific pattern or code. There are more than 2,000 species of fireflies and each species has its own light code.

In most firefly species, the males fly about while flashing their code. Females, usually on the ground, will flash the same code back. The male joins the female on the ground, where they mate. But trusting in this

Moon jellyfish are limited in their ability to move. They move with the current, even while swimming. (Katie Wincek CC BY-NC-ND 2.0)

The firefly is the state insect of Pennsylvania. (Fiskadoro / CC BY-NC-ND 2.0)

communication has its dangers. Some female fireflies are excellent mimics, flashing back the signal of another species. The enamored male, believing he has found his mate flies down, only to be devoured by an imposter.

Our aquatic environments supports the greatest amount of bioluminescent animals. The Chesapeake Bay, especially its southern waters, supports its share of living lights. Many microscopic bacteria and plankton can produce light.

Noctiluca, about 0.0625 of an inch, belongs to a group of plankton known as dinoflagellates. Its name literally means night light. *Noctiluca* lights up in response to physical disturbances in the water. The light from one *Noctiluca* is tiny and brief. But many individuals gathered together create an eerie greenish glow in the water. Another dinoflagellate, *Ceratium*, has a three-pointed, anchor-shaped body that produces a twinkling light effect.

Other larger light creatures include the moon jellyfish and some species of comb jellies. The moon jelly sports four pink, horseshoe-shaped gonads atop its 10-12 inch "head." Its tentacles are marginal and very short. The light from a moon jelly appears bluish.

Comb jellies are similar to other jellyfish, like sea nettles, in their gelatinous appearance, minus the stinging tentacles. Instead, eight rows of fringed plates, called combs, propel them through the water.

One comb jelly common in the Bay is the sea walnut, named for its oval shape. When disturbed, the sea walnut flashes a green light along its combs. Although only 4 inches, the effect created by hundreds of congregating sea walnuts can be quite startling.

In deep ocean waters, up to 80 percent of all jellyfish, squid, shrimp and fish are luminescent. In the pitch blackness of ocean depths, it seems logical that so many animals can produce their own light.

In shallower water like the Chesapeake Bay, bioluminescence is a response to an outside stimulus. Touch, wind, rain or extremely choppy water may cause a creature to light.

Researchers also believe that bioluminescence is used by some animals to startle or confuse a predator, or disguise the prey's true size and form. Flashes and patterns of light may be a form of communication for attracting a mate, as with the fire fly, or as a warning to others of its kind.

Natural light shows are everywhere, from backyards to the Chesapeake Bay. So if you miss the Perseid shower, take a walk near a dark field and watch the firefly display. Lie on a dock after a rain and peer into the murky water. If you are lucky, the usually dark waters may provide a glimpse of fantastic creatures creating their own light.

Kathy Reshetiloff is with the U.S. Fish and Wildlife Service's Chesapeake Bay Field Office in Annapolis.