

2022 Annual Report

A YEAR IN REVIEW

Profiles in Stewardship

For more than 50 years, Stroud™ Water Research Center has focused on one thing: clean fresh water. Through cornerstone scientific research, environmental education, and watershed restoration, the Stroud Center is advancing knowledge and stewardship of freshwater systems in your community and around the world. Learn more and make a difference today at stroudcenter.org.

A | RESEARCH

Scientists Marc Peipoch, Ph.D., and Scott Ensign, Ph.D., discovered a new and easier way to trace the origins of algae in waterways, and in turn, sources of pollution. They published their findings in the peer-reviewed journal *Limnology and Oceanography Letters*.

B | EDUCATION

At a World Water Day event in March, the Stroud Center unveiled the Watershed Education Mobile Lab. In 2022, the fully outfitted 14-foot box trailer traveled more than 3,000 miles across four states to deliver education programs to underserved schools and communities.

Photo: Elizabeth Hedley

C | RESTORATION

To educate the public about soil health, the Pennsylvania Soil Health Coalition, the Stroud Center, and partners launched Soil Your Undies. The campaign challenges people to discover if their soils host plenty of good microbes by planting their undies in the ground and unearthing them 60 days later to examine the level of decomposition. Photos: Matt Steinruck

D | THE WATER'S EDGE

The 2022 Stroud Award for Freshwater Excellence was awarded to Michael E. Mann, Ph.D., presidential distinguished professor at the University of Pennsylvania and director of Penn Center for Science, Sustainability, and the Media. He was presented the award on November 3 at the Delaware Museum of Nature & Science in Wilmington during The Water's Edge annual gala. A scientist and author, Mann and his colleagues published research proving human-caused climate change.

E | COMMUNITY SCIENCE

Four of the Stroud Center's EnviroDIY™ Monitoring Stations contributed data to a project led by Schuylkill River Greenways to investigate public perceptions versus what science says about the health and safety of the Schuylkill River.

Tribal Chief Dennis Coker of the Lenape Indian Tribe of Delaware holds a freshwater mussel while wading in Fork Branch in the St. Jones Watershed (see p. 7).

AT A GLANCE
2022



517 active research sites visited



17 annual peer-reviewed

ARTICLES, BOOKS, AND SCIENTIFIC REPORTS PUBLISHED

53 acres

OF FORESTED STREAMSIDE BUFFERS ESTABLISHED



140 best management practices

ENABLED BY OUR WATERSHED RESTORATION PROGRAM



7,964 people

IMPACTED BY OUR EDUCATION DEPARTMENT'S PROGRAMS AND TRAININGS



5,142 people

BENEFITED FROM WATERSHED RESTORATION WORKSHOPS, TRAININGS, AND OUTREACH



MESSAGE

FROM THE EXECUTIVE DIRECTOR



As I look back at the last year and our accomplishments, I am struck by those beyond our doors who have made so much of our work possible. And perhaps this is our greatest accomplishment of all: that we have delivered our science in service of others. Together with our partners, volunteers, and supporters like you, we have fostered stewardship of clean fresh water for this generation and the ones that follow.

As we continue our scientific research on how to best protect the streams and rivers that sustain life on Earth, we invest even more in our work with the people and institutions who put our discoveries into action.

In this annual report, we honor those relationships by shining a light on just a few of our heroes.

Executive Director, President, and Research Scientist

“Let us be good stewards of the earth we inherited from our parents. And let us preserve it for our children, and their children after them.”

— KOFI ANNAN, FORMER SECRETARY-GENERAL OF THE UNITED NATIONS

what you can do

To learn about our latest work and to share it with others, sign up for our newsletter at stroudcenter.org/subscribe and follow us on social media.

RESEARCH



Stroud™ Water Research Center is helping unsung heroes and the watershed organizations through which they work by providing technical support, capacity building, and a bit of can-do spirit.



We, the Community Scientists

PEOPLE THROUGHOUT THE DELAWARE RIVER WATERSHED ARE JOINING FORCES AND COLLECTING DATA TO PROTECT THE VITAL FRESHWATER RESOURCES THAT SUSTAIN THEIR COMMUNITIES

By Diane Huskinson

Volunteers are gathering data on the health of the Delaware River watershed, helping scientists and local watershed groups understand threats to water quality and where progress can be made. Their backgrounds are varied – some are teachers, others are doctors – but they all have one ambitious goal in common: to ensure everyone has access to clean fresh water. Stroud™ Water Research Center is helping these unsung heroes and the watershed organizations through which they work by providing technical support, capacity building, and a bit of can-do spirit.

Carol Armstrong

PASSION:

Data and stream ecology



After a successful and rewarding career working in brain injury rehab and cognitive neuroscience research and healthcare, Carol Armstrong decided it was time to retire and help scientists tackle the global water crisis. She had seen the National Climate Assessment and was alarmed by the rapid change in marine and freshwater environments in response to human-caused climate change. She became a Penn State Master Watershed Steward and soon after, one of the Stroud Center's most dedicated volunteers.

First, she helped the watershed restoration team plant rain gardens, gather data in tree plots, and monitor streamside forests on farms. Later, she began troubleshooting data from about 50 EnviroDIY™ Monitoring Stations in the Delaware River watershed and maintaining three

Right: Carol Armstrong checks wire connections and performs other maintenance.



“ I KNOW HOW IMPORTANT SCIENTIFIC RESEARCH IS.

...My own research changed the way certain medical practices were done.”

Left: Volunteers Charlie Coulter, Deirdre Gordon, Lloyd Cole, and Dale Weaver joined Anna Willig and Lauren McGrath of WCT, Michelle Lampley of Upper Main Line YMCA, and Aurora Dizel of DCVA on a sunny November day to measure salt pollution in Darby Creek. Photo: Willistown Conservation Trust

of them on Pickering Creek, a tributary to the Schuylkill River. She also engages local government and land owners with that data.

Once, during a reconnaissance mission, she and a Master Watershed Steward in training tracked a tributary to the Pickering back to its source, taking stream samples along the way. “It was black and white. It was day and night,” she recalls. “When the stream went through any areas with impervious surfaces, conductivity went up. It was a great lesson that what we were taught is in fact true.” It was confirmation that land use can degrade or enhance the health of streams.

Charlie Coulter

PASSION:

Upstream impacts of Darby Creek on the watershed

Darby Creek flows into the Delaware River in Philadelphia, but its headwaters and the flooding and pollution they may bring, begin 20 or so miles to the northwest in the suburbs of Radnor, Berwyn, and Newtown Square.

Willistown Conservation Trust’s Lauren McGrath and Anna Willig are working with the Stroud Center and Aurora Dizel at the Darby Creek Valley Association (DCVA) to collect data and identify problem areas. In speaking with downstream partners and volunteers about environmental justice, McGrath says, “Conversations came to a head that people are dying because of poor watershed planning and flood issues.”

McGrath says that acceptance of the status quo in the upstream neighborhoods and a sense of powerlessness in the downstream ones present challenges to restoring the watershed.

All three women agree that by connecting people to their local watersheds, they will be more inclined to protect them.

A woman of action, Armstrong has reached out to local businesses as well as local and state agencies to address documented cases of improperly stored road salt, which can pollute nearby streams. She also convinced her township to start an environmental advisory council, offering to share the knowledge she’s gained from her community science training.

“Unfortunately, it is inherently political to talk about the environment, but I’m optimistic that there is increasing concern about water quality,” she says.



Among those forming a connection to Darby Creek is Charlie Coulter.

He became a Master Watershed Steward after retiring as an instrument technician and volunteers with DCVA to monitor the headwaters of Darby Creek. He also monitors data from 19 EnviroDIY Monitoring Stations and provides weekly reports to the station owners and managers.

While he enjoys examining the data and looking for patterns, his main concern is for his grandchildren and ensuring they have access to healthy streams. Thinking of them, he takes every opportunity to speak with friends and neighbors about watershed issues.

“I talk to everybody. I say, ‘Hey, did you ever think about where the salt goes that you throw on your driveway? It just goes down the street into that culvert over there and right into the creek. And when you wash your car, that goes right into the creek.’ They say, ‘Gee, I never really thought of it that way.’”



“THIS IS OUR STUDY STREAM.”

Photo: Berks Nature



“BY USING THE DATA, I THINK WE CAN OPEN SOME PEOPLE’S EYES TO RETHINK HOW THEY’RE DOING THINGS.”

Photo: Chris Coulter
Right: A salt pile that is stored in the open and exposed to the elements allows some of the deicing material to escape, unused, into waterways.
Photo: Carol Armstrong



Jill Kemp

PASSION:

Trout in Angelica Creek



The naturally cold waters that support trout are heating up amid climate change, the loss of tree shade, and other sources of thermal pollution. Stan and Jill Kemp, David George, and Beckey Seel hope to save Angelica Creek from such a fate.

“From headwaters to mouth, Angelica Creek, which runs through Nolde Forest, is a naturally producing trout stream,” says Stan Kemp.

The Kemps and George are volunteers with Angelica Creek Watershed Association (ACWA). Seel runs the volunteer program at Berks Nature, which oversees ACWA as one of its programs.

“By monitoring temperatures, it gives us an idea of how the stream is doing, where the stream is getting too warm, and where

we might need to do some restoration,” says Stan Kemp, who is a fish ecologist and professor at the University of Baltimore.

Jill Kemp is an environmental educator at Nolde Forest Environmental Educational Center who relies on the stream as an educational resource.

George, a retired physician and a Master Watershed Steward, maintains one of the EnviroDIY Monitoring Stations.

Together, they are petitioning the Pennsylvania Department of Environmental Protection to raise the status of Angelica Creek to Exceptional Value, which would come with additional protections, and they’re using data from EnviroDIY Monitoring Stations to support their cause.

Seel says, “The volunteers are deeply involved, and they deeply care about the watershed. Angelica Creek is used in so many different educational aspects with all ages from preschool to postgraduate, so I really feel that we’re teaching the future about water quality.”

George Seeds

PASSION:

The impact of pollution on healthy soils and stream health



George Seeds says humans need to do a better job of managing healthy soils and clean water. Retired from a career in managed healthcare, he enjoys his time gardening, visiting scenic freshwater lakes and streams, and volunteering to monitor the health of Black Horse Run and Taylor Run. He also mentors community scientists working at four other stations in West Chester, Pennsylvania.

He says, “Volunteering has taught me to see the value in collecting and tracking data. You can demonstrate what’s going on with the stream from the standpoint of pollution.”

He has learned that Goose Creek and Plum Run have chronically high conductivity and chloride levels, an indication that salt pollution has contaminated not only the streams, but the groundwater too.

“It really demonstrates the impact of stormwater and what it’s carrying into streams,” he says.

Seeds says volunteering makes him feel like part of something greater than himself: “Community science is such a powerful concept. You have this network of stations and volunteers collecting all kinds of stream data that you could never have without the volunteers. We’ve always looked at scientists doing this kind of thing, but it’s something many more people can be involved in. I hope in some small way I am contributing to that trend.”

From right: George Seeds, a Master Watershed Steward, trains Joe Debes to maintain an EnviroDIY Monitoring Station that collects continuous water quality data.



Interested in monitoring water quality in your local area? [Email us at communitysci@stroudcenter.org](mailto:communitysci@stroudcenter.org) to become a community scientist today.

EDUCATION



“In our culture, we look at water as a living being, and we’re taught to respect it as if it’s a human. It’s the lifeblood of Mother Earth. Water gives all life.... Without water, there’s no life.”

— AUTUMN PELTIER, CHIEF WATER COMMISSIONER FOR THE ANISHINABEK NATION



Right: Territory called the Lënapehòkink and the Delaware River Basin

- Delaware River Basin
- Lënapehòkink



Nurturing the Good Mind

TRADITIONAL ECOLOGICAL KNOWLEDGE MEETS MODERN WATER SCIENCE

By Jacqueline Wolf Tice

When you picture this area of Chester County, the Christina River watershed, White Clay Creek, a thousand years ago before the English, French, and Dutch found the Chesapeake Bay, it was teeming with Indigenous tribes all within a territory called the Lënapehòkink.*

Stroud Water Research Center sits in the southern tier of the Lënapehòkink, the traditional name of the ancestral lands of the Lenape (also called Delaware) people, whose presence here is archaeologically documented for 12,000 years. They lived near the water, harvested from the water, were nurtured by the water, and communed with the water.

Although overt evidence of Indigenous communities has been sparse here in the last 250 years, there are pockets of thriving Native communities who descend from the Delaware River Basin, inclusive of southern New York, Pennsylvania, New Jersey, and Delaware. By name, they are the Delaware Nation, Delaware Tribe of Indians, and Stockbridge-Munsee Band of Mohicans, Nanticoke Lenape Nation of New Jersey, Powhatan Renape Tribe, Ramapough Lunaape Nation of New Jersey, Nanticoke Tribe of Delaware, and the Lenape Indian Tribe of Delaware.

“In the past two years, the Stroud Center has initiated a dedicated purpose of building bonds with Indigenous communities to assist them with freshwater science and education and to learn from Indigenous communities how we can all better connect and become responsible stewards of water and the earth.”

— STEVE KERLIN, STROUD CENTER DIRECTOR OF EDUCATION

Native communities who descend from the Delaware River Basin



DELAWARE NATION



DELAWARE TRIBE OF INDIANS



STOCKBRIDGE-MUNSEE BAND OF MOHICANS



NANTICOKE LENAPE NATION OF NEW JERSEY



POWHATAN RENAPE TRIBE



RAMAPOUGH LUNAAPE NATION OF NEW JERSEY



NANTICOKE TRIBE OF DELAWARE



LENAPE INDIAN TRIBE OF DELAWARE

* Also called the Lenapehokink.



“WE ARE UNALACHTIGO – PEOPLE NEXT TO THE BIG WATER. THIS PROJECT IS ABOUT HELPING US TO RECONNECT TO WATER AS OUR EXISTENCE. ONGOING WATER SCIENCE SUPPORT IS PART OF THE STROUD CENTER’S IMPORTANT ROLE IN THAT GOAL.”

— Tribal Chief Dennis Coker, Lenape Indian Tribe of Delaware

Unalachtigo – People Next to the Big Water



In the St. Jones watershed, a young bald eagle flies over a grove along Fork Branch near Cheswold, Delaware. She circles four times above our gathering of six volunteers and then flies off to the south. It was a good

sign and inspiring to behold while visiting the Lenape Indian Tribe of Delaware to discover more about their watershed restoration project with the Stroud Center, and other efforts to reclaim and honor the sacred lands and waters of their ancestors.

Since gaining recognition as a tribal government from the state of Delaware in 2016, they have actively engaged with universities and organizations on water and forest conservation projects that blend traditional ecological knowledge – that is, Indigenous knowledge gained over hundreds or thousands of years about local resources – with modern scientific methods of environmental assessment, water research, and land management.

At the edge of the Little Union Cemetery is a half-acre plot of wooded freshwater wetlands. The land was donated to the tribe in the 1990s, and after three years of steady work by tribal youth and community volunteers, it includes a walking path,

talking circle, and native plant species like sassafras and mountain mint.

Tribal Chief Dennis Coker says this

land is intended to be an edible forest garden for the Lenape community. “Originally,” Coker explains, “this area had agricultural mismanagement, with collector streams edging

farm fields that contained fertilizer” doing damage to stream ecosystems. The waters of this region would have once supported a Lenape food culture that included freshwater mussels. Today, mussels are one of the most imperiled freshwater faunal groups in the world, and their status in the tributaries of the St. Jones and Leipsic watersheds was unknown until recently.

Assistant Director of Education Tara Muenz has been collaborating with tribal members to look for mussels in both of these watersheds. The effort is part of the Stroud Center’s initiatives activating science-based monitoring to support Indigenous communities’ values and water stewardship. Initial surveys from this project showed that the eastern elliptio mussel (*Elliptio complanata*) is present in small populations within Fork Branch.

For Chief Coker, part of his purpose as a tribal leader is, he says, “to keep people cognizant of who they are and how unique they are.” He continues, “We are Unalachtigo – People Next to the Big Water. This project is about helping us to reconnect to water as our existence.” Ongoing water science support is part of the Stroud Center’s important role in that goal.

Clockwise: A youth camper and Mike Gates enjoy learning about their local waterways; Tribal member J.T. Johnson is one of the dedicated volunteers stewarding the teachings of the ancestors by attending workdays on the land that are organized with youth coordinator Simon Purchase James, who recently joined the education team at the Stroud Center.

The eastern elliptio mussel (*Elliptio complanata*), one of the historically known species in the Delaware River Basin, has been detected in Fork Branch.



Seneca Nation of Indians — Beginning the Day With Ganö:nyög

A similar sentiment exists among the Seneca Nation of Indians on the Allegany and Cattaraugus territories in western New York. The Stroud Center began working with the Allegany community in 2022. Seneca members Chelce Finch and Liz Smith, the respective director and assistant director of the Seneca Arts and Learning Center, introduce themselves by their clans as is traditional in their tribal community. The learning center serves as an infant-to-preschool-age daycare, Head Start, and essential after-school facility for approximately 60 children, mostly from the Seneca Nation. It is a place that integrates Seneca culture and language in all lesson plans, even in lunch menus!

Mike Gates, director of emergency management for the tribal nation, was researching water management equipment for the Seneca when the Stroud Center's work came to his attention. He was especially attracted to the Stroud Center's youth outreach programs. For the Seneca, Gates explains, a youth program makes sense, as "the planet is left in their care, the children will bring the water teachings into the future." Through a Bureau of Indian Affairs grant, Gates says he created the Water Protectors program to get Seneca children "out of the classroom and into the water."

By pairing scientific methodology and meaningful watershed education with cultural teachings, the initiative augments traditional ecological knowledge with modern water science.

Along the Allegheny River, the day starts with the Ganö:nyög, the Thanksgiving Prayer of the Seneca, which addresses and acknowledges 22 elements in the world — gifts of the Sky-world to this Earth, to teach a way of seeking the unity of all things — the good mind. Water is one of the special elements acknowledged ceremonially each day. Muenz and Gates' connection was so immediate and "heartfelt," says Muenz, that she and her education colleagues from the Stroud Center were invited to take part in this daily cultural remembering. It was an honor and source



of internal meaning for Muenz. "Water is my family," says the aquatic biologist; "sharing this

deeper ceremonial connection allowed me to feel and express my deep connection and appreciation of water in community with the Seneca." Integrating with the cultural aspects of the Seneca created a meaningful experience for the tribal community members who participated in the Stroud Center's various activities at the river.



Seneca Arts and Learning Center staff engage in watershed activities along the Allegheny River. Photo: Seneca Media & Communications Center

Ganö:nyög

The Thanksgiving Prayer of the Seneca, which addresses and acknowledges 22 elements in the world



Water

is one of the special elements acknowledged ceremonially each day.

The Stroud Center's participation in the Allegany Territory of the Seneca Nation has been in and at the river, according to Smith and Finch, who both acknowledged that the Stroud Center showed them how to make each activity developmentally appropriate for each age.

The professional development training offered by the Stroud Center introduced 40 teachers and 10 outside participants to an array of water engagement and learning tools through the nationally recognized "Getting Little Feet Wet" curriculum of the Project WET Foundation. According to Smith, prior to this training, the

learning center "used water strictly for sensory play. This training demonstrated other domains as well: fine motor, gross motor, cognitive, and socio-emotional skills. It allowed us to see how this beautiful natural resource can be brought into the classroom and used to expand these other areas." At the end of the last session of the year, the Stroud Center provided each classroom with a toolkit of instructional supplies to deliver and enhance the practice skills learned through the curriculum.

Learning about water through scientific methods and connecting to water as a source of ancestral significance has strengthened a throughline of cultural continuity for the Seneca Nation and the Lenape Indian Tribe of Delaware. Reiterating the words of Autumn Peltier, for Indigenous cultures, "water is a living being." By conducting these trainings, demonstrating respect for specific cultural values, and taking the lead from the tribal communities themselves, the Stroud Center has established a bond with these communities in what is just the beginning of a long road together nurturing the good mind.



The Stroud Center offers a variety of education programs. To find one that's right for you, go to our website. [Visit **stroudcenter.org/education** for more information.](https://www.stroudcenter.org/education)

WATERSHED RESTORATION



“I want to be the best I can be at what I do. I want to surround myself with experts and use resources available to me to protect and improve the soil I’m using in my lifetime — making it better than when I started farming with hopes to pass it on to the next generation.” — JAMIE HICKS, FARMER OF THE YEAR



Bringing Eastern Brook Trout Back to Red Clay Creek

IN PENNSYLVANIA, PROPERTY OWNERS AND FARMERS ARE TRANSFORMING THEIR LANDS TO RESTORE A STREAM'S HEALTH AND ITS NATIVE FISH

By David Wise

Might brook trout one day swim again in Red Clay Creek? If and when they do, it will be a sign that watershed restoration efforts are working in the stream that runs through southeastern Pennsylvania and northeastern Delaware.

The eastern brook trout (*Salvelinus fontinalis*) is the only trout native to streams of the eastern United States. It is widely regarded as one of the most visually striking American freshwater fish.

Sometimes called brookies, these fish once thrived in the streams of eastern forests and formerly occupied nearly 95% of Pennsylvania's 1,313 watersheds, according to Eastern Brook Trout Joint Venture. Pre-Colonial forests provided the cool, clean water that brookies require.

But with the clearing of forests for timber and farming, and later mining, water quality suffered, and with it, brook trout. Today, just 1.2% of Pennsylvania's watersheds have vibrant brookie populations. Almost 80% have few or none at all. Their decline reflects watersheds that suffer the stresses of pollution, climate change, and changes in land use.

But hope bubbles up. In the West Branch of Red Clay Creek, local residents are partnering with Stroud™ Water Research Center to restore the watershed to good health for all life that depends on clean water – from bugs to humans to brook trout.

Brookies in Decline

Eastern brook trout (*Salvelinus fontinalis*), sometimes called brookies, are the only trout native to streams of the eastern United States. These fish once thrived in the streams of eastern forests.

THEN

Brookies once occupied nearly 95% of Pennsylvania's 1,313 watersheds.

NOW

Just 1.2% of PA's watersheds have vibrant brookie populations. Almost 80% have few or none at all.



Photo, top right: Ryan Hagerty, U.S. Fish and Wildlife Service

The loss of brookies is tied to human activities that degrade freshwater habitats.



Peter Welling
LOCAL RESIDENT

Like Peter Welling, most of the Stroud Center’s landowner partners along the West Branch of Red Clay Creek have planted a minimum of 100 feet of forest buffers on each side of the stream, which is the gold standard for protecting water quality.



Local residents like Peter Welling have embraced the challenge to reforest their stream. Welling is one of 12 landowners on the West Branch who have partnered with the Stroud Center to restore more than 100 acres of streamside forest. In total, the new trees and shrubs cover nearly half of the watershed’s deforested stream miles, and more plantings are in the works.

Welling grew up in the 18th century farmhouse at Scarlet Thicket Farm next to the West Branch and still lives there today. He says the property has been farmed since at least 1671 and that prior to European settlement, it was the winter campground of the Lenape people.

Welling says, “I’d often wondered what had happened to the stream I had fished, trapped, and waded 70 years ago. I’d wondered why thriving populations of aquatic reptiles, crayfish, sculpins, mussels, swarms of mayflies and caddisflies had all but vanished. Even the odd brook trout had disappeared. I wondered what had happened to the muskrats, pollinators, ground nesters, and upland game birds along the hedgerows and in the pasture grass.”

In 2000 he fenced out livestock, reforested 35 acres along the creek corridor, and took some acres out of production to plant them with warm season grasses. Then, a few years ago, with guidance and support from the Stroud Center, he doubled the forest acres, planted an additional 10,000 deciduous trees, and created a plan to mitigate erosion and runoff from crop fields.

“Along the way, I chided and encouraged my upstream neighbors to do the same thing, and in partnership with Stroud, they are,” says Welling.

His property, and much of the agricultural land along the West Branch, is farmed by Jamie Hicks. As the owner of a crop-farming business, he leases more than 5,000 acres in Chester County and the surrounding region. He also integrates stewardship into every facet of his farming operation and helps his landowners improve their land and water in the process.

Recently, Hicks treated more than 600 acres of land with next-level actions for soil health and nutrient management on the West Branch. Cover crops and no-till farming are among them and have proven benefits for stream health. Soils managed with long-term no-till and cover crops can absorb rainfall at two to four times the rate of conventionally farmed soils, thereby reducing how much soil, manure, nutrients, agricultural chemicals, and pathogens reach streams.

When asked what motivates his tireless efforts, he says, “I want to be the best I can be at what I do. I want to surround myself with experts and use resources available to me to protect and improve the soil I’m using in my lifetime — making it better than when I started farming with hopes to pass it on to the next generation.”



Jamie Hicks
LOCAL FARMER

Jamie Hicks, an innovative farmer dedicated to stewardship of land and water, partners with the Stroud Center to implement conservation projects on land he farms and encourages others to do the same.



The Chester County Commissioners and the Chester County Agricultural Development Council named him the 2022 Farmer of the Year.

Photo: Chester County Ag Council

Forested buffers and soil health practices are especially valuable because when it comes to improving watershed health, they have a high return on investment compared to structural agricultural enhancements, which are expensive but still necessary to address specific water quality concerns, often related to livestock.

“This is not just a restoration project but also an important scientific study,” says John Jackson, Ph.D., senior research scientist and principal investigator of the Entomology Group. “We know to some degree how and how much these conservation practices can improve water quality based on

DID YOU KNOW?

FORESTED STREAMS SUPPORT

3 to 5x more

TOTAL AQUATIC LIFE AND REMOVE

2 to 9x more

POLLUTANTS

A Better Chance for Fish and Wildlife

The level of landowner participation in the restoration of the West Branch is among the highest of any watershed in Stroud Center history. Nearly two-thirds of the watershed's cropland has improved soil health practices. A similar portion of stream miles has been planted with forest buffers, or may be soon. The range of further agricultural improvements is extensive, including everything from manure management to stabilized stream crossings to grassed waterways. With such a high concentration of stream-friendly practices, native wildlife like brookies have a better chance of survival.

small, short-term studies. By studying the restoration of this watershed, we'll better understand what's possible in the long term when you have such a diversity of conservation practices and high percentage of landowner participation. Our scientists will be able to model scenarios, monitor progress, and evaluate success, and our findings will inform both policy and practice going forward."

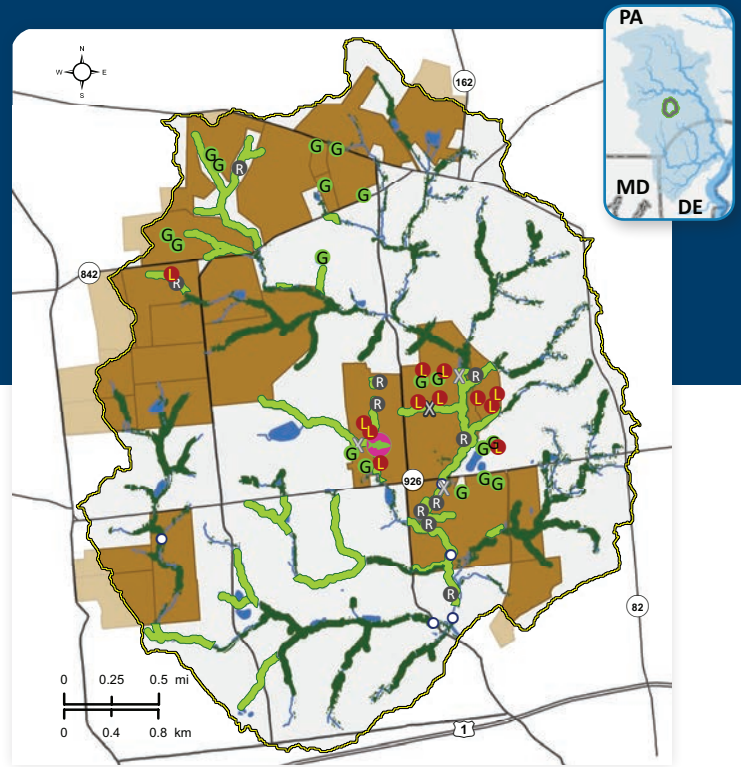
In the West Branch, the Stroud Center has helped seven landowners implement dozens of practices that protect water quality – work that is funded through a variety of federal, state, and private sources such as the William Penn Foundation. The restoration of the West Branch is funded in part through the Delaware River Watershed Initiative, which seeks to conserve and restore the watershed that provides drinking water to more than 15 million people across four states.

As part of the initiative, the Stroud Center is focusing on restoration in headwater streams and their watersheds, which can also improve downstream water quality and freshwater habitat.

However, neither the initiative's goals nor the return of brookies would be possible without farmers like Hicks and landowners like Welling.

Lizzie and Burley Vannote have also embraced the vision to restore the West Branch. They are working with the Stroud Center to plant forest buffers and install structures that keep manure and sediment out of the stream that runs through their property, a horse farm that hosts world-class competition hopefuls. The conservation practices will improve conditions for the horses while protecting headwaters of Red Clay Creek.

In the early planning for the Vannotes' project, Burley Vannote's father, Robin, joined a small group walking the stream and dreaming of what the stream could once again be. As the group walked, Vannote, Ph.D., the Stroud Center's first director



Forested Buffer Status

- Recent, planned, under discussion
- Existing trees

Agricultural Best Management Practices (BMP)

- Grassed waterway & similar BMP
- Livestock BMP
- Stabilized stream crossing
- Improved soil health practice properties

Other Info

- Brook Trout reported
- Reforestation research plots
- Water quality monitoring sites
- West Br. RCC watershed

and a former resident on the property, noted that brook trout were present in this small tributary in the past and likely still are today. With robust actions by many landowners helping to improve the conditions on the main stem, this remnant population in the Vannotes' small tributary holds potential to repopulate the whole watershed. When that happens, it will be a milestone not only for an iconic fish, but for all life that depends on clean water and healthy streams.



Lizzie and Burley Vannote

LOCAL RESIDENTS

Lizzie and Burley Vannote installed 16 structural best management practices – from roof gutters to grass waterways – and planted trees along the stream that runs through their property.



learn more

To partner with the Stroud Center and get help caring for your land and local stream, please contact us. [Email buffers@stroudcenter.org](mailto:Email_buffers@stroudcenter.org) to discuss your project.



Kristen McCarthy, Jacquie Carroll, Cooper Reilly, Stephanie Bernasconi, Laura Zgleszewski, and Courtland Hess take in a view of the Potomac River at Great Falls Park. Stroud Center scientists are working with the National Capital Region Network to monitor fish populations and stream habitat for the National Park Service.

Research Projects

Note: Research, education, and watershed restoration projects listed were active in 2022. Stroud Water Research Center scientists and staff are indicated in bold.

Assessment of Environmental Conditions in Bennett’s Run at Kendal-Crosslands

Funded by: Phoebe A. Driscoll and the Phoebe Internship Fund

Bennett’s Run is a small tributary to Brandywine Creek in southern Chester County, Pa., where a watershed conservation plan is being developed. To inform this plan, this study is measuring water chemistry, temperature, aquatic macroinvertebrates, and fish to quantify the condition of Bennett’s Run between Longwood Gardens and Kendal-Crosslands Communities, and again downstream from Kendal-Crosslands.

Principal Investigators: **John K. Jackson** and **Bernard W. Sweeney**

Biological Nitrogen Removal in Sediment Plumes: A Critical but Missing Component of Watershed Models

Funded by: U.S. Department of Agriculture

Nutrient export from rivers is closely tied to sediment plumes that form during storms. By using experiments and methods to peer inside these sediment plumes, this project will discover how biological processes change nutrients concentrations while sediment plumes move downstream. The results will lead to more accurate watershed management models and better decisions on where best management practices can be most effective in agricultural watersheds.

Principal Investigators: **Marc Peipoch** and **Jinjun Kan**

Collaborator: Shreeram Inamdar (University of Delaware)

Brandywine Stream Stewards: Community Action in Support of Healthy Waters

Funded by: William Penn Foundation

The Stream Stewards Program engages adults and youth from Wilmington, Del., to monitor water resources in the 1,100 acres of open space in the First State National Historical Park. This educational program and community science effort galvanizes people around watershed protection and leads to conservation and improved management of land and water resources.

Principal Investigators: The Nature Conservancy – Pennsylvania/Delaware Chapter; **John K. Jackson** and **Matthew J. Ehrhart**

Collaborators: **Jinjun Kan**, **Melinda D. Daniels**, and **David B. Arscott**

DRWI Phase II+ Monitoring, Evaluation, Scientific Support, and Capacity Building for Watershed Protection and Restoration Projects

Funded by: William Penn Foundation

This project, part of the Delaware River Watershed Initiative, provides technical background and assistance to grantees of the William Penn Foundation and the National Fish and Wildlife Foundation to develop, implement, monitor, and communicate watershed restoration efforts in the initiative’s clusters. This includes technical support via a circuit rider, working with farmers of the Pa. Association for Sustainable Agriculture, contributing to technical reports, engaging watershed residents in the documentation of conditions across the focus areas of the initiative, collecting and interpreting data on macroinvertebrates and physicochemical parameters from stream sites to provide a baseline to evaluate goals for restoration and protection projects, and contributing to Coordinating and Advisory Committees for the Delaware River Watershed Initiative.

Principal Investigators: **Matthew J. Ehrhart**, **John K. Jackson**, and **David B. Arscott**

Collaborators: **David Bressler**, **Jinjun Kan**, **Melinda D. Daniels**, and **Steven C. Kerlin**; Roland Wall, Stefanie A. Kroll, Richard J. Horwitz, Marie J. Kurz, David Keller, Lin Perez, and Timothy Maguire (Academy of Natural Sciences of Drexel University)

DRWI Phase II+ Monitoring, Evaluation, and Scientific Support for Protecting and Restoring Places of Ecological Significance (Brandywine-Christina, Middle Schuylkill, Schuylkill Highlands Clusters) as part of the Delaware River Watershed Initiative

Funded by: William Penn Foundation

This funding supports the Stroud Center’s research and restoration teams to participate in the Delaware River Watershed Initiative’s focus areas within the Brandywine-Christina, Middle Schuylkill, and Schuylkill Highlands watersheds where restoration and land preservation efforts are underway in highly targeted locations. Professional and volunteer monitoring plans for chemistry, macroinvertebrates, and fish, as well as evaluation and communication plans, were developed and implemented as part of restoration and protection plans. These efforts represent invaluable (and often neglected) tools to evaluate and communicate short- and long-term progress toward conservation priorities and goals.

Principal Investigators: **John K. Jackson** and **Matthew J. Ehrhart**

Collaborators: Audubon Pennsylvania; Berks Nature; Brandywine Conservancy; Brandywine Red Clay Alliance; French and Pickering Creeks Conservation Trust; Green Valleys Watershed Association; Natural Lands; Partnership for the Delaware Estuary; The Nature Conservancy of Delaware; University of Delaware

DRWI Pollution Assessment: Stage 2

Funded by: William Penn Foundation

The Delaware River Watershed Initiative pollution assessment will refine and estimate progress to protect and restore water quality in targeted geographies. In this study, researchers utilize water quality modeling tools to estimate the impact of strategies to reduce water pollution and provide forest protection and then relate these outcomes to broader estimates of total water pollution in the watershed.

Principal Investigator: David B. Arscott

Collaborators: Anthony Aufdenkampe (LimnoTech); Lin Perez, Barry Evans, and Michael Campagna (Academy of Natural Sciences of Drexel University)

Dynamics of Phytoplankton Growth and Transport in River Networks From Local to Continental Scales

Funded by: National Science Foundation

The project proposes a transformative approach using real-time monitoring of algae concentrations during storm events to evaluate the effects of excessive nutrients on entire watersheds. The project includes a regional assessment of the Delaware River and a continental approach using data collected by the National Ecological Observatory Network.

Principal Investigators: Marc Peipoch, Scott H. Ensign, and Melinda D. Daniels

Ecotoxicity Study for Mayflies Exposed to Elevated Concentrations of Chloride at Different Temperatures

Funded by: Pa. Department of Environmental Protection and Stroud Water Research Center

Chloride concentrations in surface waters have been increasing over the last several decades across the United States and at times may reach levels that threaten aquatic organisms. To test this, laboratory experiments are performed with four mayfly species exposed to elevated chloride concentrations and temperatures ranging from 5–25 degrees Celsius.

Principal Investigators: John K. Jackson and David H. Funk

Evaluating How Conventional, Conservation, and Organic Farming Management Practices Enhance Soil Health and Improve Water Quality

Funded by: William Penn Foundation

This project investigates how different agricultural management practices influence water quality and soil health. Using Rodale Institute's 37-year old Farming Systems Trial and a recent transition to organic farming at the Stroud Preserve, it examines the effect of farming techniques on water infiltration, runoff, and nutrient, contaminant, and sediment export. Results will inform practices that can reduce contamination and flooding in the Delaware River watershed.

Principal Investigators: Jinjun Kan, Melinda D. Daniels, Diana Oviedo Vargas, Marc Peipoch, David B. Arscott, Matthew J. Ehrhart, and Bernard W. Sweeney

Collaborators: Jeff Moyer, Andrew Smith, Gladis Zinati, Yichao Rui, and Kirsten Pearsons (Rodale Institute); Raven Bier (Savannah River Ecology Lab, University of Georgia); Kurt Williamson (William & Mary)

Evaluating NCRN Data Quality, Revising and Updating Protocols, and Analyzing Long-Term Data

Funded by: National Park Service

The National Park Service National Capital Region Inventory and Monitoring Network (NCRN) has monitored stream water quality and quantity for more than 15 years in shallow streams located in 10 national parks in and around Washington, D.C. The main goal of this project is to analyze this complex dataset to document spatiotemporal trends and assess watershed health in NCRN streams.

Principal Investigators: Diana Oviedo Vargas, Marc Peipoch, Melinda D. Daniels, Jinjun Kan, and Scott H. Ensign

Evaluating the Effects of Watershed-Scale Agricultural Best Management Practices on Water Quality

Funded by: Pa. Department of Agriculture

In early 2020, streambank fencing, forested buffers, and barnyard improvements were installed on Amish farms in Lancaster County, Pa. This project is monitoring stream nutrient and sediment loads and macroinvertebrates before, during, and after the implementation of the best management practices to detect changes in water quality due to these efforts.

Principal Investigators: Diana Oviedo Vargas, Jinjun Kan, Marc Peipoch, and John K. Jackson

Collaborator: Lamonte Garber

Evaluating the Risk for PFAS Contamination of Surface and Groundwater Through Application of Biosolids in Agroecosystems

Funded by: Foundation for Food and Agricultural Research

Per- and polyfluoroalkyl substances (PFASs) are a group of thousands of chemicals that are used in a wide range of industrial applications and represent a risk to human health. They can end up on farm fields through the application of contaminated biosolids. This occurs when biosolids are sourced from a wastewater treatment facility that receives water contaminated with PFASs. Scientists are investigating whether biosolid application on Pennsylvania farms represents a significant source of PFASs in soils and water.

Principal Investigators: Diana Oviedo Vargas and Matthew J. Ehrhart

Collaborators: Seetha Coleman-Kammula and Charles Powley (STRIDE)

Exploring the Link Between Soil and Human Health: Protein, Protein Quality, and the Nutraceutical Amino Acid Ergothioneine

Funded by: Foundation for Food and Agriculture Research

Ergothioneine, an amino acid that has scientifically proven benefits to human health, is exclusively biosynthesized by fungi and certain bacteria in soils. With coupled field testing and lab incubation experiments, this project is investigating how soil microbes synthesize and transform ergothioneine from soil to products under different farming practices.

Principal Investigator: Jinjun Kan

Collaborators: Andrew Smith (Rodale Institute); Harsh Bais (University of Delaware); Wade Heller (USDA)

Impact of Land Management on Winter Squash Yield and Post-Harvest Nutrient Density

Funded by: Pa. Department of Agriculture

By examining the bacteria, Archaea, and fungi living in soils, this project will provide insights on how farming practices and land management affect the microbes that make soils healthy. This information will help improve guidelines for growing squash and managing nutrients on farm fields.

Principal Investigator: Jinjun Kan

Collaborators: Gladis Zinati (Rodale Institute); Lavanya Reddivari (Purdue University)

Impact of Pesticides on Soil and Vegetables Grown in Organic and Conventional Systems in a Long-Term Vegetable System Trial

Funded by: Pa. Department of Agriculture

This project characterizes microbial soil health through detailed community structure of bacteria and fungi and determines the relationship of microbial structure with application of pesticides under conventional and organic cropping systems in the Vegetable Systems Trial.

Principal Investigator: Jinjun Kan

Collaborators: Gladis Zinati (Rodale Institute); John Fagan (Penn State University)

Land Protection Impact Assessment in Support of Delaware River Watershed Initiative

Funded by: Open Space Institute and William Penn Foundation

This project evaluates the hypothesis that protection and/or maintenance of natural land maintains ecological stream quality by limiting, preventing, or redirecting changes to land cover and use away from headwaters, stream buffers, and wetlands.

Principal Investigators: John K. Jackson, Charles L. Dow, and David B. Arscott

Collaborators: Stefanie A. Kroll, Marie J. Kurz, David Keller, Lin Perez, Barry Evans, and Timothy Maguire (Academy of Natural Sciences of Drexel University); Claire Jantz (Center for Land Use and Sustainability, Shippensburg University)

Long-Term Research in Environmental Biology: River Ecosystem Responses to Floodplain Restoration

Funded by: National Science Foundation

After 25 years of litigation, a massive ecological restoration is under way in the Upper Clark Fork River, Mont. Metal-laden floodplain soils are being removed, floodplains are being reconnected with river floods, and over 70 kilometers of floodplains are being restored. This project uses long-term monitoring data to discover how river ecosystem structure and function respond to changing nutrient concentrations and large-scale floodplain restoration. By testing fundamental theories and frameworks of ecology, these discoveries will guide future river restorations.

Principal Investigator: Marc Peipoch

Collaborators: Maurice Valett and Michael DeGrandpre (University of Montana); Rob Payn and Juliana D'Andrilli (Montana State University)

Long-Term Research in Environmental Biology: Trajectory for the Recovery of Stream Ecosystem Structure and Function During Reforestation

Funded by: National Science Foundation

Stream restoration in the United States is a multibillion-dollar industry, yet long-term monitoring of its effectiveness is virtually nonexistent. To fill this gap, the Stroud Center restored a portion of White Clay Creek by reforesting meadows and pastures with native deciduous trees and removing invasive plant species. Decadal changes in the aquatic biological communities and how they function are being monitored as this forest matures. This project is producing discoveries and insights that will guide future restoration techniques and train teachers to use long-term environmental data to enhance math skills, analytical abilities, and environmental knowledge of students and teachers.

Principal Investigators: John K. Jackson, Jinjun Kan, Melinda D. Daniels, Diana Oviedo Vargas, and Marc Peipoch

Collaborators: J. Denis Newbold, David B. Arscott, Charles L. Dow, Steven C. Kerlin, Tara K. Muenz, Louis A. Kaplan, and Bernard W. Sweeney

Low-Head Milldams as Hotspots for Denitrification and Nitrogen Consumption: Hydrologic and Biogeochemical Controls

Funded by: National Science Foundation

As dam removal has increased in recent years in an effort to improve fish habitat and reduce financial liability, few studies have addressed the consequences of these removals for water quality and regulatory compliance. This project investigates the role of low-head milldams on nitrogen and sediment transport in stream ecosystems.

Principal Investigator: Marc Peipoch

Collaborators: Shreeram Inamdar (University of Delaware); Art Gold (University of Rhode Island)

Macroinvertebrate Monitoring at Sites in White Clay Creek, Pa., Flint River, Ga., Susquehanna River, Pa., and Delaware River, Pa.

Funded by: Various public and private sources

These projects use aquatic macroinvertebrates such as mayflies, stoneflies, and caddisflies to provide assessments of current water quality in these streams and rivers. Where long-term data are available, the most recent conditions are compared to historical conditions.

Principal Investigator: John K. Jackson

Microbial Population Dynamics of Periphyton Biofilms in White Clay Creek

Funded by: Stroud Water Research Center

Using glass microscope slides as tiny gardens to grow microbial biofilms, this project explores differences in microorganisms between three reaches of White Clay Creek with different streamside vegetation. Molecular DNA fingerprints of biofilms on glass slides differed in the three reaches, as did the biofilms on natural underwater surfaces. This revealed how subtle differences in surfaces and surroundings affect microbial communities and their distribution.

Principal Investigator: Jinjun Kan

Mitigating Agricultural Pollution of Fresh Water and Combating Climate Change by Restoring Soil Health

Funded by: Prince Albert II of Monaco Foundation

Plowing, disking, synthetic fertilizers, and pesticides have damaged the health of agricultural soils, resulting in reduced rainfall infiltration and storage, increased stormwater and pollutant runoff, degraded streams, and contaminated groundwater. This project measures how no-till seeding, multispecies cover cropping, and elimination of synthetic fertilizers and pesticides (in particular, neonicotinoids) can rejuvenate agricultural soils and protect water quality.

Principal Investigators: Melinda D. Daniels, Jinjun Kan, Diana Oviedo Vargas, and Marc Peipoch

Model My Watershed

Funded by: Stroud Water Research Center, William Penn Foundation, and Pa. Department of Environmental Protection

Stroud Water Research Center continues to maintain and update the Model My Watershed® web application.

Principal Investigators: David B. Arscott and Steven C. Kerlin

Collaborators: Anthony Aufdenkampe (LimnoTech); Lin Perez, Barry Evans, and Michael Campagna (Academy of Natural Sciences of Drexel University); Robert Cheatham (Azavea, Inc.)

Molecular Ecology of Archaea in Aquatic and Terrestrial Environments

Funded by: Southern University of Science and Technology (SUSTech), China

Less is known about Archaea than the other two domains of life on Earth (Bacteria and Eukarya), particularly the role they play in ecosystem functions and nutrient cycling (e.g., ammonia oxidation). Applying cutting-edge molecular approaches, this project is characterizing community composition and spatiotemporal distribution of Archaea in White Clay Creek, Costa Rica, Chesapeake Bay, and terrestrial environments.

Principal Investigator: Jinjun Kan

Collaborator: Chuanlun Zhang (SUSTech)

Monitoring Fish Populations and Stream Habitat Quality for the National Park Service

Funded by: National Park Service

This project monitors biological conditions, water quality, habitat integrity, and fish at 37 sites in 10 national parks in the National Capital Region

Network around Washington, D.C. The findings of this project are used by the National Park Service to make conservation and management decisions.

Principal Investigators: Marc Peipoch, Melinda D. Daniels, Diana Oviedo Vargas, John K. Jackson, Jinjun Kan, and Scott H. Ensign

North American Macroinvertebrate Taxonomic Certification Program

Funded by: Society for Freshwater Science

This program coordinates and executes the taxonomic certification program for the Society for Freshwater Science, conducting family- and genus-level tests throughout the year.

Principal Investigators: John K. Jackson and Bernard W. Sweeney

Collaborator: Michael C. Broomall

Recovery of Nutrient Processes and Microbial Communities in Relict Hydric Soils Following Restoration

Funded by: U.S. Department of Agriculture

This research explores how microbes and biogeochemical processes in buried relict soils evolve after restoration and how these organisms and processes can be harnessed to remove nitrogen before it pollutes streams. This will help practitioners design restoration projects with conditions that fast-track microbial recovery and nitrogen processing.

Principal Investigators: Jinjun Kan and Marc Peipoch

Collaborator: Shreeram Inamdar (University of Delaware)

Restoration Project Impact Assessment in Support of the DRWI

Funded by: National Fish and Wildlife Foundation and William Penn Foundation

This project quantifies the positive impacts of restoration projects on water quality and soil health associated with the Delaware River Watershed Initiative.

Principal Investigators: John K. Jackson, Diana Oviedo Vargas, Matthew J. Ehrhart, Melinda D. Daniels, Jinjun Kan, and Marc Peipoch

Collaborators: Stefanie A. Kroll, Marie J. Kurz, David Keller, Lin Perez, and Timothy Maguire (Academy of Natural Sciences of Drexel University); Green Valleys Watershed Association; French and Pickering Creeks Conservation Trust; Berks Nature; Musconetcong Watershed Association; The Nature Conservancy - New Jersey; North Jersey Resource Conservation & Development Council; Trout Unlimited; South Jersey Land and Water Conservancy; Rutgers University; New Jersey Audubon

Saturated, Suffocated, and Salty: Hotspots of Dissimilatory Nitrate Reduction in Anoxic Riparian Soils

Funded by: National Science Foundation

Riparian soils above low-head dams (milldams) usually contain large amounts of bioavailable nitrogen that could impair the adjacent streams if it becomes mobilized. This project investigates the origin of the nitrogen stored in the riparian soils above milldams, the dominant processes controlling its transformation, and its risk of being released into the stream.

Principal Investigators: Marc Peipoch and Jinjun Kan

Collaborators: Dipankar Dwivedi (Berkeley National Laboratory); Shreeram Inamdar (University of Delaware)

Soil Microbes and Bean Nutrients in Organic and Conventional Systems

Funded by: Pa. Department of Agriculture

Little is known regarding soil microbes and nutrition levels in vegetables under different farming practices. We are connecting soil microbial community structure, extracellular enzyme activity, and nutrient density in green/black beans under conventional vs. organic farmings.

Principal Investigators: Jinjun Kan and Diana Oviedo Vargas

Collaborators: Gladis Zinati (Rodale Institute); Lavanya Reddivari (Purdue University)

Source Tracking and Spatial/Temporal Dynamics of Bacterial Contaminants in Red Clay Creek

Funded by: Starrett Foundation

Scientists monitor fecal indicator bacteria and water chemistry on a monthly basis in the East and West branches of the Red Clay Creek watershed.

Principal Investigators: Jinjun Kan, Jacob Price, and David B. Arscott

Tidal Rivers Biofingerprinting Sediment: Resolving Sediment Connectivity Between Rivers and Estuaries by Tracking Particles With Their Microbial Genetic Signature

Funded by: National Science Foundation

Sediment flowing from rivers to estuaries is a double-edged sword: too much sediment can harm oyster beds but not enough sediment can starve tidal marshes. Measuring whether a river is providing too much or not enough sediment requires knowing exactly where that sediment comes from and when. This project uses molecular characterization of attached microbes on sediment particles to detect where sediment comes from during different periods of river flow.

Principal Investigators: Scott H. Ensign and Jinjun Kan

Collaborators: Steven C. Kerlin and Tara K. Muenz

Using Microbial Source Tracking to Identify Potential Bacterial Sources in White Clay Creek

Funded by: White Clay Watershed Association and White Clay Creek Wild and Scenic River Program

Scientists monitored fecal indicator bacteria in White Clay Creek during summer and identified potential bacterial contamination by molecular microbial source tracking with the goal of targeting best management practices and implementation strategies.

Principal Investigators: Jinjun Kan and Jacob Price

Collaborator: Shane Morgan (White Clay Creek Wild and Scenic River Program)

Water Quality Modeling to Support Source Water and Aquatic Life Protection in Octoraro Creek Watershed

Funded by: Environmental Protection Agency

This project supports water quality monitoring and development of a water quality model to guide an alternative restoration plan for the Octoraro Creek watershed. The data, model, and plan will guide the Pa. Department of Environmental Protection in implementing nutrient reduction strategies that restore designated uses of Octoraro Creek.

Principal Investigator: Marc Peipoch



A friendly salamander greets Laura Zgleszewski during fieldwork.



An education program participant makes a great catch.

Education Projects

Advancing Education and Community Outreach — Oxford Area

Funded by: Oxford Area Foundation

Continued support enables the expansion of education and outreach in southeastern Pennsylvania, including K–12 school programs, out-of-school youth programs, educator professional development trainings, and community science projects.

Project Lead: Steven C. Kerlin

Collaborators: Tara K. Muenz, Mandy Nix, and David Kline

Bringing the Amazon Rainforest Home

Funded by: The Longwood Foundation

Fifteen teachers from New Castle, Sussex, and Kent counties in Delaware worked with partners to develop curricula that not only meets the robust Next Generation Science Standards of the U.S. Educational System but also fosters mutual understanding between cultures and allows schools to engage directly with a network of professionals in the Amazon rainforest.

Project Lead: Jon Cox (Amazon Center for Environmental Education Research Foundation)

Collaborator: Tara K. Muenz

Building District Capacity for Environmental Literacy and MWEEs in Delaware

Funded by: Del. Sea Grant and NOAA

This project strengthens state and school district capacity to integrate environmental literacy (E-LIT) and Meaningful Watershed Educational Experiences (MWEEs) into learning for Delaware students. Collaborators will create a Delaware MWEE Facilitator Guide and work directly with Caesar Rodney and Appoquinimink school districts and Sussex Montessori Charter School in Delaware to expand environmental education and develop E-LIT plans that serve as models for other districts.

Project Lead: David Christopher (Del. Sea Grant)

Collaborators: Steven C. Kerlin and David Kline; Tonyea Mead (Del. Department of Education); David Pragoff (Del. Nature Society); Ashley Melvin (Del. Association for Environmental Education)

Capacity Building for Girls-in-STEM Watershed Education

Funded by: Pa. Department of Environmental Protection (DEP)

This project expanded meaningful and inclusive education in water-focused environmental STEM for regional K–12 girl audiences, including pilot programs for high-needs and marginalized youth in DEP environmental justice areas. Girl audiences may include cis and trans girls, nonbinary youth, gender-nonconforming youth, and/or youth who identify with the experience of girlhood as part of their unique journeys.

Project Leads: Mandy Nix and Steven C. Kerlin

Collaborator: Tara K. Muenz

Consortium for Scientific Assistance to Watersheds

Funded by: Pa. Department of Environmental Protection’s Growing Greener Program

Education, research, and watershed restoration staff provided technical assistance to statewide conservation groups in effective watershed assessment, monitoring, and restoration.

Project Leads: Scott H. Ensign, David B. Arscott, Steven C. Kerlin, and Tara K. Muenz

Collaborators: Alliance for Aquatic Resource Monitoring at Dickinson College; Conemaugh Valley Conservancy; Del. Riverkeeper Network; Pa. Lake Management Society; U.S. Geological Survey; Pocono Northeast Resource Conservation and Development Council

Delivering Meaningful, Safe, and Accessible Watershed Education

Funded by: Pa. Department of Environmental Protection and CCRES Educational and Behavioral Services

This project expands meaningful and inclusive environmental STEM programs, including online stream study lessons for fourth-grade and middle school students and a Watershed Education Mobile Lab for outreach to environmental justice communities.

Project Lead: Tara K. Muenz

Collaborators: Steven C. Kerlin and Mandy Nix

Effectively Engaging Audiences with Aquatic Macroinvertebrates Through Innovative Traveling Touch Tanks

Funded by: Pa. Department of Environmental Protection

Educators designed and created aquatic macroinvertebrate touch tanks to create effective, culturally responsive, and inclusive learning environments for all audiences. This project supported using the newly created touch tanks during community and festival events.

Project Lead: Tara K. Muenz

Expanding and Creating Sustainability for Environmental Literacy and Meaningful Watershed Educational Experience (MWEE) Implementation Capacity Across Pa.

Funded by: National Oceanic and Atmospheric Administration and Pa. Department of Education (PDE)

This 2020–2022 statewide project builds capacity for environmental literacy and stewardship of the Chesapeake Bay and other watersheds in Pennsylvania by expanding the inclusion and implementation of environmental education (EE), particularly MWEEs, in schools. PDE supported initial planning of the PA Gateway to Green website to further support EE providers like classroom teachers, nonformal educators, and guardians/caregivers.

Project Leads: Steven C. Kerlin; Tamara Pepper (Pa. Department of Education); Michelle Niedermeier (Pa. Sea Grant Program)

Collaborators: Mandy Nix and Steve Mohapp; Bert Myers and Juan Serrat (Pa. Department of Environmental Protection); Jessica Kester and Matt Marsden (Pa. Association of Environmental Educators); Carissa Longo (Pa. Bureau of State Parks); Nanette Marcum-Dietrich (Millersville University); Jenn Fetter (Penn State Extension); Paul Joyce (West Chester Area School)

District); Erin McCool (Riverbend Environmental Center); Lauren Beal (Lancaster-Lebanon IU); Ellen Schults (Fairmount Water Works); Kelly Byrne (Downingtown School District); Carrie Lankford (Red Lion School District); Tarrea Potter (Chesapeake Bay Foundation); Kevin Willis (Carmichaels School District); Camila Rivera-Tinsley (Women and Girls Foundation of Southwestern Pa.); Alexandra Konsur-Grushinski and Stephanie Williams (NEPA STEM Ecosystem); Rebecca Gibbone (BLAST IU); Hannah Evans (IU 5); Demetrius Roberts (Pa. Dept. of Education); Kammars Kersch (Chester County IU); Stephon Fitzpatrick (Pa. Department of Agriculture); **Heather Brooks**

Girl Scouts of the USA and Boy Scouts of America

Funded by: Nick Kerlin and Donna Queeney, Kimberton Whole Foods, Inc., and The RJM Foundation

Educators engage and empower K–12 youth involved in scouting activities, badges, awards, service projects, and other advancements.

Project Leads: Steven C. Kerlin, David Kline, Mandy Nix, Tara K. Muenz, Kathryn Metzker, and Steve Mohapp

Collaborator: Chester County Council, BSA

GIS-Based Professional Development: Helping K–12 Teachers Overcome Obstacles Due to COVID-19

Funded by: Pa. Sea Grant and National Oceanic and Atmospheric Administration

This project builds capacity and advances environmental literacy efforts that integrate geospatial technology use among educators in the Lake Erie, Susquehanna River, and Delaware Estuary watersheds. Partners are developing, implementing, and researching a professional development module that encourages the use of GIS to support watershed-based inquiry practices in times of physical distancing and limited mobility.

Project Leads: Tamara Pepper (Pa. Department of Education); **Steven C. Kerlin**

Collaborators: Michelle Niedermeier (Pa. Sea Grant); **David Kline**

Habitat Restoration and Outdoor Education in the Caesar Rodney School District

Funded by: National Fish and Wildlife Foundation

This project restores underutilized space on 10 public school campuses within the Caesar Rodney School District in Delaware, providing benefits to wildlife and water quality, as well as meaningful outdoor learning opportunities for teachers and their pre-K–12 and special needs students.

Project Lead: Caesar Rodney School District

Collaborators: Steven C. Kerlin, Tara K. Muenz, and David Kline;

Del. Nature Society; U.S. Fish and Wildlife Service

HerStory in STREAM

Funded by: The Fund for Women and Girls of Chester County

This project engages girls and girl identifying individuals in a set of four programs providing experiences in watershed STEM careers and outdoor education.

Project Lead: Kathryn Metzker

Collaborator: Tara K. Muenz

Hidden Gems of the Delaware and Susquehanna River Basins: Increasing Accessibility and Capacity of Boating and Fishing

Funded by: Pa. Fish and Boat Commission and Cabela's Outdoor Fund

This project serves Scout, school, and public audiences with on-the-water education through fishing and canoeing programs to improve equitable access to safe outdoor aquatic recreation, raise awareness of related careers, and foster environmental awareness throughout these watersheds.

Project Leads: Tara K. Muenz and Mandy Nix

Collaborators: Steven C. Kerlin, David Kline, and Steve Mohapp

Improving Schoolyards and the Stroud Center for Outdoor Environmental Education and Stewardship Across Southeast Pa.

Funded by: Pa. Department of Environmental Protection and E. Kneale Dockstader Foundation

Educators collaborated with local schools and school districts to design and construct outdoor learning spaces on school grounds. Educators are working with teachers to create lessons tailored to each outdoor learning space. With the help of Stroud Center research staff, educators are designing and creating outdoor stream tables to aid student discovery of stream and hydrology concepts. Educators will develop student-driven curriculum centered around the interactive stream tables.

Project Leads: Steven C. Kerlin and Tara K. Muenz

Collaborators: Melinda D. Daniels and Scott H. Ensign

Increasing Accessibility to Watershed-Based Climate Change Education Through Youth and Teacher Education in the White Clay Creek Watershed

Funded by: National Park Trust

With a theme of climate change literacy within the White Clay Creek watershed, this project delivers a series of canoeing, angling, and Watershed Education Mobile Lab programs to engage marginalized youth, their families, and educators in recreation and stewardship in watershed STEM.

Project Leads: Steven C. Kerlin and Tara K. Muenz

Collaborator: Shane Morgan (White Clay Creek Wild and Scenic River Program)

Independent K–12 Student Research Projects

Funded by: Auman Family

The establishment of this fund makes staff support available to assist K–12 students interested in conducting independent scientific research in freshwater ecology.

Project Lead: Tara K. Muenz

Collaborator: David Kline

Lancaster Area Outdoor Learning Network Initiative

Funded by: Chesapeake Bay Trust

Educators planned and delivered teacher professional development in watershed education content and skills for Conestoga Valley, Ephrata, and Columbia school districts in Pennsylvania.

Project Lead: Sallie Gregory (Lancaster County Conservation District)

Collaborators: Steven C. Kerlin and Tara K. Muenz; Dan Daneker (Conestoga Valley School District)

Lawrenceville School Partnership for Student Water Quality Monitoring of Shipetaukin Creek

Funded by: Fair Play Foundation

Educators are partnering with The Lawrenceville School to create and implement opportunities for students to study water quality impacts on the school campus using EnviroDIY™ Monitoring Stations.

Project Leads: Steven C. Kerlin and Tara K. Muenz; Stephen Laubach (The Lawrenceville School)

Collaborator: David Bressler

Leaf Pack Stream Ecology Kit and International Network

Funded by: Stroud Center education product development and Anonymous

This international program, which is bilingual in English and Spanish, engages students, teachers, families, and the public in water quality monitoring through the lens of aquatic macroinvertebrates.

Project Lead: Tara K. Muenz

Collaborator: Steven C. Kerlin

Learning to See, Seeing to Learn

Funded by: National Science Foundation

This project continued to enhance the Macroinvertebrates.org site in addition to creating aquatic macroinvertebrate identification resources for learners, teachers, and trainers.

Project Lead: Marti Louw (Carnegie Mellon University)

Collaborators: Tara K. Muenz, Mandy Nix, Steven C. Kerlin, John K. Jackson, and Michael C. Broomall; John Morse (Clemson University); John Wenzel (Carnegie Museum of Natural History)

Professional Development for School District of Philadelphia (SDP) Teachers Leading After School Enrichment (ASE) Programs

Funded by: School District of Philadelphia

This project assists SDP teachers leading outdoor and environmental ASE programs by providing ongoing professional development, support, and resources. The Stroud Center and four partnering organizations provide programming at each participating school to engage students and model activities.

Project Lead: Steven C. Kerlin

Collaborators: Kathryn Metzker and Steve Mohapp; Keisha Scovens (Let's Go Outdoors); Scott Quitel (LandHealth Institute); Michelle Niedermeier (Pa. Sea Grant); Suzanne Safran (Riverbend Environmental Education Center); Tamara Peffer (Pa. Department of Education)

Programs for Underserved Audiences

Funded by: Anonymous, Nick Kerlin and Donna Queeney, and Blue Yak Foundation

Educators engage and empower K–12 youth involved in BSA in environmental badges, awards, service projects, and other advancements. These funds also support ongoing education with underserved populations in environmental STEM. Audiences include marginalized communities of color; socioeconomically disadvantaged populations; women and girls; English language learners; and other communities disproportionately harmed by environmental injustice. An integral partner in this project, the Harambee Institute of Science and Technology Charter School in Philadelphia offers community-driven education focused on the origins, status, and future of the African world.

Project Leads: Steven C. Kerlin, David Kline, Mandy Nix, Tara K. Muenz, and Kathryn Metzker

Collaborators: The Garage; Mighty Writers El Futuro

Scouts BSA Fish and Wildlife Merit Badge with New Online Learning Hybrid Format

Funded by: Pa. Department of Environmental Protection



An electrofishing demonstration station at the Stroud Center's World Water Day celebration gives visitors a chance to see and touch live fish.

Educators develop and implement new hybrid merit badge programming with online and in-person portions, including an online learning portal for remote education to limit face-to-face contact and reduce virus transmission.

Project Leads: Steven C. Kerlin, David Kline, and Tara K. Muenz

Collaborators: Department of Conservation and Natural Resources; Pa. Fish and Boat Commission; Heather Brooks

Seneca Nation Water Protectors

Funded by: Bureau of Indian Affairs

Educators engaged with and empowered youth to become Water Protectors in the Allegany and Cattaraugus territories. Educators provided professional development in watershed education for early childhood center staff members.

Project Leads: Mike Gates (Seneca Nation Department of Emergency Management); Tara K. Muenz

Collaborators: Kathryn Metzker, Steve Mohapp, and Mary Paxton-Boeni

Source to Sea Explorer Curriculum

Funded by: Anonymous and Stroud Water Research Center

Stroud Center educators are collaborating with Connect Ocean to create a Source to Sea curriculum that will be distributed internationally to schools and scuba diving centers.

Project Leads: Ernst van der Poll (Connect Ocean); David B. Arcsott and Steven C. Kerlin

Collaborators: Tara K. Muenz; Kathryn Metzker, and Mary Paxton-Boeni

Watershed Awareness Using Technology and Environmental Research for Sustainability (WATERS)

Funded by: National Science Foundation

Educators developed and piloted a new national curriculum and extensive learning resources using principles of universal design for learning in California, Pennsylvania, and Virginia, with special attention to students who are English language learners.

Project Leads: Steven C. Kerlin; Nanette Marcum-Dietrich (Millersville University); Carolyn Staudt (Concord Consortium)

Collaborators: Melinda D. Daniels, Diana Oviedo Vargas, David Kline, Tara K. Muenz, and Mandy Nix

Watershed Education Mobile Lab

Funded by: E. Kneale Dockstader Foundation, Pa. American Water, Pa. Department of Environmental Protection, CCRES Educational and Behavioral Services, Pa. Fish and Boat Commission, National Park Trust, Burkholder Manufacturing, Pengara Design and Production, Full Throttle Wraps and Graphics, and Bass Pro Shops, Cabela's Outdoor Fund, and Seneca Nation Tribes

The new lab is a fully outfitted 14-foot box trailer ready to travel to and deliver education programs to underserved schools and communities unable to visit the Stroud Center. It also expands public engagement at parks and festivals.

Project Leads: Tara K. Muenz and Steven C. Kerlin

Collaborators: Mandy Nix, David Kline, and Kathryn Metzker

Watershed Education Programs While Canoeing

Funded by: Education program fees, National Park Trust, and Pa. Educational Improvement Tax Credit Program

Stroud Center educators provided watershed education experiences while canoeing on local streams, lakes, and reservoirs for schools, Scouts, community groups, and audiences of all ages.

Project Leads: Steven C. Kerlin and Tara K. Muenz

Collaborators: Mandy Nix, David Kline, Kathryn Metzker, and Steve Mohapp

Watershed STEM Meaningful Watershed Educational Experience (MWEE) After-School Programming

Funded by: North American Association for Environmental Education, National Oceanic and Atmospheric Administration

Thanks to a generous eeBLUE grant program, educators engaged high-needs students from four 21st Century Community Learning Center (CCLC) sites in MWEs and watershed-focused STEM.

Project Lead: David Kline

Collaborators: Mandy Nix, Steven C. Kerlin, and Tara K. Muenz; 21st CCLC sites in Coatesville Area, Oxford Area, and Avon Grove school districts

Water Quality Mobile App

Funded by: Stroud Center education product development and National Science Foundation

The Water Quality App for Apple and Android mobile devices received updates to its macroinvertebrate digital field guide, pollution tolerance index, and water chemistry parameters.

Project Leads: Steven C. Kerlin and Tara K. Muenz

Collaborators: Heather Mayfield (Foundation for Ohio River Education); Miriam Steinitz-Kannan (Northern Kentucky University)

Watershed Restoration Projects

Agricultural Best Management Practices and Forested Buffers for Chester County Focus Areas

Funded by: Pa. Department of Environmental Protection

This project implements agricultural conservation practices on three Plain community farms in the Honey Brook, Pa., area.

Project Lead: Matthew J. Ehrhart

Collaborators: Brandywine Conservancy; Brandywine Red Clay Alliance; Mowery Environmental, LLC

Agricultural Best Management Practices and Forested Buffers for Lancaster Focus Areas

Funded by: Pa. Department of Environmental Protection

This project implements whole-farm conservation on all four farms in the catchment of a very small unnamed tributary to Pequea Creek in Lancaster County, Pa. The farmers are undertaking comprehensive conservation planning and implementation to address major water quality issues from their dairy operations. Coordination with Stroud Center science staff is underway to document response to restoration efforts.

Project Lead: Matthew J. Ehrhart

Collaborator: TeamAg, Inc.

Agricultural Best Management Practices and Buffers for Middle Schuylkill Focus Area

Funded by: National Fish and Wildlife Foundation

Farmers receive assistance to plan and implement at least 80 agricultural best management practices on the condition that they also install forested buffers on their streams.

Project Lead: Matthew J. Ehrhart

Collaborators: Berks County Conservation District; Cover Crop Coaching, LLC (Steve Groff); Pa. No-Till Alliance; Red Barn Consulting, Inc.; TeamAg, Inc.

Agricultural Best Management Practices and Forested Buffers in Brandywine-Christina Focus Areas

Funded by: National Fish and Wildlife Foundation

The project increases capacity for and accelerates the rate of installing state-of-the-art forested buffers as part of locally led clean water plans for Lancaster and Chester counties. The project will result in more than 40 acres and nearly 10 miles of riparian forest buffers.



Stroud Center educators lead a day on the water with participants in STREAM Girls, a national Trout Unlimited program that combines STEM with art and recreation to connect girls to two fields historically underrepresented by women: STEM and fisheries.

Project Lead: Matthew J. Ehrhart

Collaborator: Mowery Environmental, LLC

Ag BMPs and Forested Buffers for Red Clay Creek 2022

Funded by: Pennsylvania Department of Environmental Protection

This project implements best management practices on three equine operations to improve water quality and stream health of the West Branch of Red Clay Creek.

Project Lead: Matthew J. Ehrhart

Collaborator: Mowery Environmental, LLC

Collaboration With Pa. DCNR for Riparian Forest Buffers

Funded by: Pennsylvania Department of Conservation and Natural Resources

This project installs riparian forested buffers for water quality and stream health improvements. Locations include but are not limited to target areas in Chester and Lancaster Counties.

Project Lead: Matthew J. Ehrhart

Collaborators: Alliance for Chesapeake Bay; Mowery Environmental, LLC

Comprehensive Nutrient Management Planning for Lancaster County Farms

Funded by: National Fish and Wildlife Foundation

This project will accelerate implementation of agricultural water quality improvements in Lancaster County through development and implementation of comprehensive nutrient management plans. Project will result in more than 1,100 acres under plans and more than four miles of forested buffer restoration with livestock exclusion to protect streams.

Project Lead: Matthew J. Ehrhart

Collaborators: TeamAg, Inc.; Mowery Environmental, LLC

Forest Buffer Tree Seedling Care Initiative 2020

Funded by: Marshall Reynolds Foundation

This project includes site visits to check the status of recently planted buffers, replanting of any mortality, and providing feedback to landowners on status and success of their buffer plantings.

Project Lead: Matthew J. Ehrhart



Lisa Blazure talks about ways to improve soil health with agriculture industry professionals at Penn State's Ag Progress Days.

Forested Buffers for Farms in the Chesapeake Bay Watershed

Funded by: Pa. Department of Conservation and Natural Resources

This project provides funding for five farms in Lancaster and Chester counties in Pennsylvania to install forested buffers and any needed infrastructure to protect streams from livestock.

Project Lead: Matthew J. Ehrhart

Collaborators: Alliance for the Chesapeake Bay; Mowery Environmental, LLC; Salisbury Township; TeamAg, Inc.

"Healthy Soils, Healthy Streams" Training and Technical Assistance

Funded by: Pa. Department of Environmental Protection and National Fish and Wildlife Foundation

This project will conduct trainings on soil health and stream health for nearly 6,000 farmers, conservation professionals, and others. The Pa. No-Till Alliance will offer technical assistance on cover crops and no-till farming to at least 24 farmers. The potential for synergy between the alliance and the Stroud Center is promising. The same biological principles – nurturing microbes and other organisms that do the real work – apply to achieving both healthy soils and healthy streams.

Project Lead: Matthew J. Ehrhart

Collaborators: Pa. No-Till Alliance; Cover Crop Coaching, LLC

Improving Success and Cutting Costs on Riparian Buffers

Funded by: Chesapeake Bay Foundation

Chesapeake Bay Foundation's Keystone 10 Million Trees Partnership contracts with the Stroud Center to test tree planting and maintenance-related materials. The goal is to demonstrate methods that maintain high levels of forested buffer success while reducing herbicide use and total costs. This work is occurring in the West Branch of Red Clay Creek.

Project Lead: Matthew J. Ehrhart

Meeting Lancaster County's Clean Water Goals through Riparian Forest Buffers

Funded by: National Fish and Wildlife Foundation

The project increases capacity for and accelerates the rate of installing state-of-the-art forested buffers towards locally led clean water plans for Lancaster and Chester County. The project will result in more than 40 acres and nearly 10 miles of riparian forest buffers.

Project Lead: Matthew J. Ehrhart

Collaborators: TeamAg, Inc.; Mowery Environmental, LLC

Outreach and Installation of Agricultural Best Management Practices in Brandywine-Christina

Funded by: National Fish and Wildlife Foundation

This project installs conservation practices on farms to improve watershed health. It provides outreach, technical assistance, and financial assistance to farmers to plan and implement whole-farm conservation.

Project Lead: Matthew J. Ehrhart

Collaborators: Brandywine Conservancy; Brandywine Red Clay Alliance; Chester County Conservation District; Mowery Environmental, Inc.; Red Barn Consulting, Inc.; TeamAg, Inc.

Promoting Soil Health and Riparian Buffers to Support Aquatic Diversity in Northwest Pennsylvania

Funded by: National Fish and Wildlife Foundation

This project restores stream health by addressing excessive sedimentation in the French Creek and Shenango River waterways that threatens freshwater species. Project creates a multi-county no-till drill rental program to increase implementation of cover crops and no-till crop establishment and provides funding to establish streamside buffers for sediment control and overall stream health functions.

Project Lead: Matthew J. Ehrhart

Collaborator: Crawford County Conservation District

South Central Pa. Conservation Partnerships

Funded by: National Fish and Wildlife Foundation

This project helps about two dozen farms in Lancaster and Chester counties to install nearly 200 agricultural best management practices, including nine miles of forested buffers and nearly 21,000 acres of cover crops. It also provides outreach and training to more than 11,000 farmers and conservation professionals.

Project Lead: Matthew J. Ehrhart

Collaborators: Alliance for the Chesapeake Bay; Chesapeake Bay Foundation; Chester County Conservation District; Crow and Berry Land Management; Lancaster County Conservation District; Mowery Environmental, LLC; Penn State Agriculture and Environment Center; Red Barn Consulting, Inc.; TeamAg, Inc.

Stroud Center–Alliance for Chesapeake Bay Partnership

Funded by: Alliance for the Chesapeake Bay

This project supports installation and care of about 25 acres of forested buffers after they are planted in the West Branch of Red Clay Creek.

Project Lead: Matthew J. Ehrhart

Stroud Center–Pa. Department of Conservation and Natural Resources Buffer Collaborative

Funded by: Pa. Department of Conservation and Natural Resources

This project installs nearly 80 acres of forested buffers and demonstrates the income potential from buffers for fruits, nuts, and salable horticultural materials.

Project Lead: Matthew J. Ehrhart

Collaborators: Brandywine Conservancy; Berks County Conservation District; Chester County Conservation District; Crow and Berry Land Management; Mowery Environmental, LLC; Red Barn Consulting, Inc.; TeamAg, Inc.

Stroud Center–Pa. Department of Conservation and Natural Resources Forested Buffer Partnership 2020

Funded by: Pa. Department of Conservation and Natural Resources

This project restores 30 acres of forested buffer in the West Branch of Red Clay Creek and includes care after planting. The buffers are part of whole-farm work on a former dairy farm in the headwaters of the watershed.

Project Lead: Matthew J. Ehrhart

Collaborator: Hicks Brothers, LLC

Support for a Coalition on Soil Health in Pennsylvania

Funded by: National Fish and Wildlife Foundation

This project establishes the Pennsylvania Soil Health Coalition to improve communication and coordination among numerous organizations involved with soil health education, implementation, and research. Coalition member organizations will conduct educational programming on soil health, collect soil health samples for analysis, and implement no-till, cover crops, or rotational grazing on 12,600 acres.

Project Lead: Matthew J. Ehrhart

Collaborators: Pa. No-Till Alliance; Pasa Sustainable Agriculture; Capital RC&D; The Nature Conservancy

Targeted Agricultural Best Management Practices and Forested Buffers for Chester County Focus Areas

Funded by: National Fish and Wildlife Foundation

This project implements agricultural best management practices and

forested buffers on farms, which includes stormwater-runoff controls for barnyards and mushroom compost processing areas, new and seasonally earlier cover crops, improved no-till practices, riparian forest buffers and related infrastructure, and more.

Project Lead: Matthew J. Ehrhart

Collaborators: Hicks Brothers, LLC; Mowery Environmental, LLC

Targeted Agricultural Best Management Practices and Forested Buffers for Lancaster County Focus Areas

Funded by: National Fish and Wildlife Foundation

In targeted portions of the Chesapeake Bay watershed in Lancaster and Chester counties, Pa., the project implements whole-farm systems of best management practices on about two dozen farms, restores about 50 acres of forested buffers, and prepares Comprehensive Nutrient Management Plans.

Project Lead: Matthew J. Ehrhart

Collaborator: TeamAg, Inc.

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(A) From left: Clay and Jill Moorhead and John Spence enjoy the cocktail reception at the Delaware Museum of Nature & Science during The Water's Edge gala. (B) Allison Patni and Anne Stroud look forward to hearing the 2022 Stroud Award for Freshwater Excellence recipient at The Water's Edge. Photos: Elizabeth Hedley

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We gratefully acknowledge the following 409 donors who generously contributed \$600,810 to the 2022 Annual Fund. These vital funds cover expenses associated with all the research, environmental education, and watershed restoration you make possible in support of clean fresh water. *Thank you* for making a difference!

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Dick Hayne and Meredith Boice wear their glad rags at the Roaring Twenties Soiree for Rivers. Photo: Jana Bannan Photography



“The rigor of the Stroud Center’s scientific work, the reliability of their findings, and their outstanding efforts to communicate this information through published papers, workshops, trainings, and the like make Stroud the go-to source for the most accurate information about watershed restoration, tree plantings, water sampling, macroinvertebrate research, and so much more.” — GEOFFREY SELLING



Geoffrey Selling, a Master Watershed Steward, and Sarah Thorne-Locke, a Master Naturalist, clear invasive plants at the Curtis Arboretum.

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From left: Sally Reed, Colleen Mooney, Julia Manahan, and Dori Graham-Vannais mingle during a cocktail reception in advance of hearing remarks by Michael E. Mann, Ph.D., the 2022 SAFE Award recipient. Photo: Elizabeth Hedley

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Care has been taken to ensure the accuracy of this listing. We regret any omission and ask that you bring any corrections to our attention.

*Stroud Center staff

“Stroud has a broad range of approaches to water education and stewardship that ticks the boxes of social and environmental justice in the frame of science. ... Their work with Indigenous communities is particularly sensitive to sovereignty and self-determination while filling a gap in the direct fieldwork education and follow-up that is so deeply needed in marginalized communities.”

— JACQLINE WOLF TICE

Jacqueline Wolf Tice, an Indigenous legal scholar and a community scientist, interviews Tribal Chief Dennis Coker for an article on the Stroud Center’s work with Indigenous communities (see page 7).



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Ed and Diane Herr are all smiles at The Water’s Edge. Photo: Elizabeth Hedley

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Empower renowned scientists to further their work and recommend ways to deliver fresh, healthy water around the world for generations to come.

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Enable educators to utilize technology to enhance and expand education beyond the classroom.

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Implement collaborations and partnerships necessary to achieve the highest level of freshwater conservation and restoration.

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Honor the legacy of Bern Sweeney's 40+ year career and provide critical funds for centerwide initiatives.

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Phoebe Driscoll and Phoebe Fisher look forward to an evening celebrating fresh water at The Water's Edge. Photo: Elizabeth Hedley



(A) Guests Farnaz Dar, Susan Mitchell (C) David Gordon, and Beth Huxster along with (B) competitors Chef Reuben Asaram and Jamie, “The Philly Sports Guy,” Pagliei enjoy their time at the Roaring Twenties Soiree for Rivers, a Gatsby-themed event with a dash of Eagles cheer. Photos by Jana Bannan Photography



“Stroud delivers wonderful, relevant, in-depth content to students and teachers. All of this is provided by top-notch professionals that always exceed my expectations. I am proud to know the remarkable individuals at Stroud and thank them for their expertise, efforts, and caring.”

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Carol E. Ware, Ph.D. – Research and Restoration in the Chesapeake and Delaware Bay Watersheds

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The Education Department gratefully acknowledges these businesses for their support through Pennsylvania’s EITC program. These dollars are used specifically to subsidize costs associated with field trips from Pennsylvania public schools.

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Learn how your business can support our freshwater education programs at www.stroudcenter.org/eitc

Financials

OPERATING STATEMENT

for the year ended December 31, 2022

REVENUES AND SUPPORT

Watershed Restoration Program	\$ 2,951,488
Research Programs (Grants and Contracts)	2,581,757
Endowment	2,371,526
Education/Public Programs	661,119
Annual Fund	600,810
Other Contributions and Income	357,682
Total Revenues and Support	\$9,524,382

EXPENDITURES

Research	\$ 3,135,402
Watershed Restoration Program	2,664,369
Facilities	1,253,159
Finance and Administrative	778,467
Education	642,558
Development/Outreach	500,856
Information Services	460,048
Communications	79,772
Other	9,751

Total Expenditures **\$9,524,382**

Financial Information

Stroud™ Water Research Center is a 501(c)(3) nonprofit organization registered with the Pennsylvania Bureau of Charitable Organizations. Gifts to Stroud Water Research Center are tax deductible on a U.S. return as allowed by law. The Stroud Water Research Center Employer Identification Number (EIN) is 52-2081073. The fiscal year is January 1 to December 31. The annual audit is performed by Belfint, Lyons & Shuman P.A. Investment assets are managed by New Providence Asset Management, Passive Capital Management, and Brown Advisory. The Stroud Center is also the beneficiary of the Morris W. Stroud 3rd Pennswood No. 2 Trust managed by the Glenmede Trust Company.

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Your continued generosity through annual, endowed, and planned gifts is vital to our research, education, and watershed restoration programs. Below is a brief list of ways you can make a tax-deductible gift:



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Visit www.stroudcenter.org/donate



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Please mail donations to: Stroud Water Research Center, 970 Spencer Road, Avondale, PA 19311



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Gifts of appreciated securities are an outstanding way to avoid 15% capital gains tax. Your broker can use this information: Charles Schwab & Co.; DTC Clearing Number: 0164 – Code 40 Account name: Stroud Water Research Center; Account number: 1749-3778. Prior to transferring assets, please alert development@stroudcenter.org, since no name will be attached to the deposit of funds.



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Funds may be wired directly to Stroud Water Research Center's financial institution. Please contact development@stroudcenter.org for instructions.



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A planned gift can meet your short-term or long-term charitable and financial goals. Planned gifts include, but are not limited to, bequest intentions, charitable gift annuities, IRA payments, retirement plan assets, insurance policies, and other various trusts to fit your needs.



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Please visit our website: www.stroudcenter.org or contact the Development Department at 610-910-0049 or development@stroudcenter.org to learn about special giving opportunities.



get involved

To learn how you can get involved, go to www.stroudcenter.org/volunteer

“Stroud Water Research Center is doing an amazing job to improve/maintain the water quality in Pennsylvania, as well as many other areas. Their approach includes education at all levels and ages, awareness, and hands-on projects that involve large numbers of volunteers. I have volunteered for a number of projects with Stroud and have enjoyed working alongside others.”

— JANET FASSBENDER



Cheerful volunteers from the community help with forest buffer maintenance on Earth Day. In addition to community volunteers, we are grateful for volunteers from Belfint, Lyons & Shuman P.A.; Resolution Life; USI Insurance Services; and Vanguard for helping us at various maintenance days throughout the year.

Sponsors and Volunteers

We gratefully acknowledge and appreciate all of our sponsors and volunteers, as well as our staff members who volunteer on top of their other responsibilities. By generously donating time, talents, or treasures, this dedicated group directly benefits our research, education, and watershed restoration programs. *Thank you!*

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**Wild & Scenic
Film Festival**

Hosted by Trail Creek Outfitters
*We are grateful to the many sponsors,
volunteers, and attendees who make
this event so successful.*



A young volunteer makes an unexpected friend on Earth Day.



A.



B.



C.



D.



E.



F.



G.



H.

**join
us!**

We hope you'll join us for fabulous events, either virtually or in person, this year. Go to www.stroudcenter.org/events to learn more.

(A) Judges and contestants of The Bee's Knees Culinary Competition strike a pose. (B) From left: Nicole Wickenhauser and Franny Abbott celebrate an elegant and entertaining evening at The Water's Edge among supporters of the Stroud Center. (C) Constellation Energy golfers tee off Fore Fresh Water. (D) Guests enjoy a beautiful sunset during the Trail Creek Outfitters Wild & Scenic Film Festival. (E) Jana Bannan and Steven Siepser at the Roaring Twenties Soiree for Rivers. (F) Contestants Chef Jeff Newman and Cheryl "Cappuchino" Hayden prepare their meal during competition. (G) Nancy and Crosby Wood at The Water's Edge gala. (H) Doug Tallamy, Ph.D., signs copies of his book at the Stroud Center after giving a presentation on how everyone can help plant landscapes that enhance local ecosystems. Photos A, E, and F by Jana Bannan Photography. Photos B and G by Elizabeth Hedley.

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(A) Courtland Hess and (J) Mike Broomall size up some brown trout. (B) Tara Muenz, Mary Paxton-Boeni, Steve Mohapp, and Kathryn Metzker stop by an alpaca farm in New York after visiting the Seneca Nation of Indians for an education program. (C) Rachel Johnson conducts maintenance on an EnviroDIY Monitoring Station. (D) Steve Mohapp, Kathryn Metzker, Steve Kerlin, and David Kline cross the Abbey Road of stream crossings. (E) Rebecca Duczowski huddles with Jessica Provinski and her daughter. (F) Many hands and a beautiful view make light work for Sylvie Randall and Jacquie Carroll. (G) David Wise, Matt Ehrhart, Lisa Blazure, Calen Wylie, Wills Curley, and Lamonte Garber are the friendliest bunch of watershed restoration professionals you'll ever meet. (H) Myriah Wadley enjoys a day of fieldwork. (I) Marc Peipoch takes his sons, Liam and Aniol, for a ride. (K) Dan Myers plays a friendly game with fellow staff after work.

Stroud Water Research Center gratefully acknowledges Caroline Chen of Chengraphix for designing this publication.

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The Stroud Center gratefully acknowledges the many years of dedicated service of Frances Moran Abbott, who reached her term limit for board service on December 3, 2021.

**The Stroud Center gratefully acknowledges the many years of dedicated service of Susan Packard LeGros, Esq., who retired on December 2, 2022.*



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Stroud™ Water Research Center seeks to advance knowledge and stewardship of freshwater systems through global research, education, and watershed restoration.