



# Delaware Water Resources Center

60<sup>th</sup> Anniversary  
Special Edition  
(1965 - 2025)

December 7, 2025

Delaware Water  
Resources Center  
University of Delaware  
Newark, Del.  
Lewes, Del.

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**Delaware Water Resources Center**  
**60<sup>th</sup> Anniversary Special Edition**  
**(1965 – 2025)**

December 7, 2025

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# Delaware Water Resources Center (DWRC)

A research unit of the *Institute for Public Administration*  
in the *Joseph R. Biden, Jr. School of Public Policy & Administration*



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## What is DWRC?

Established on campus in 1965, the University of Delaware Water Resources Center (DWRC) is one of the 54 National Institutes for Water Resources (NIWRs) at land grant universities in the 50 states, District of Columbia, and island territories of Guam, Puerto Rico, and U.S. Virgin Islands. The DWRC is supported by the U.S. Geological Survey through Section 104 of the Water Resources Research Act signed into law by Lyndon Baines Johnson in 1964. The mission of the DWRC is to: (1) support water resources research, education, and public outreach programs in Delaware and (2) sponsor training of future water scientists, engineers, managers, and policymakers in the First State.

## What is WRA?

Established in 1977 and modified in 1990 and 1997, the Water Resources Agency (WRA) is a program of the DWRC and provides regional water resources assistance to governments in Delaware and the Delaware Valley through the University of Delaware's land-grant public service, education, and research role. The WRA is supported by federal, state, and local government partners, including the State of Delaware, New Castle County, City of Newark, and City of Wilmington.

## Where is DWRC?

The DWRC is located in Newark, Delaware, on UD's main campus at 261 Academy Street in the Delaware Geological Survey (DGS) Annex, behind Penny Hall and the UD Rain Garden.

## DWRC Partners

- Artesian Water Company
- Brandywine Conservancy
- Brandywine Red Clay Alliance
- Chester County Water Resources Authority
- Christina Conservancy
- City of Wilmington
- City of Newark
- Delaware Center for Horticulture
- DE Department of Transportation
- DE Department of Natural Resources and Environmental Control
- Delaware Greenways
- Delaware River Basin Commission
- Delaware Sea Grant
- Green Building United
- National Fish and Wildlife Foundation
- National Park Service
- New Castle Conservation District
- New Castle County
- Partnership for the Delaware Estuary
- Stroud Water Research Center
- The Nature Conservancy
- U.S. Environmental Protection Agency
- U.S. Geological Survey
- Veolia Water Delaware
- William Penn Foundation

## DWRC is involved with...

- Brandywine and White Clay Flood Studies
- Christina Basin Clean Water Partnership
- City of Wilmington Green Jobs Program
- Delaware Flora Database
- Delaware Source Water Assessment and Protection Program
- Delaware Water Supply Coordinating Council
- Delaware Watersheds
- Economic Value of Watersheds
- GIS Services/Education/Outreach
- Delaware Resilient And Sustainable Communities League
- Sustainable Coastal Community Initiative
- White Clay Creek Wild and Scenic Management Committee



*Delaware Water  
Resources Center  
Newsletter  
2024-2025*

# 2025 DWRC Director's Message

December 7, 2025

Today is December 7, 2025 (Delaware Day) and it's the right day to unveil our 60<sup>th</sup> Anniversary Edition of the activities of the Delaware Water Resources Center that was formed on campus at the University of Delaware way back in 1965!

On May 16, 2025, Martha, Andrew, and I chaired the 60<sup>th</sup> meeting of the University of Delaware Water Resources Center Advisory Panel in Old College Room 202 at the University of Delaware in Newark, Delaware. It was appropriate to have this 60<sup>th</sup> annual meeting in the most historic building on campus (circa 1838) as the original building of the University of Delaware that held dormitories, a dining hall, and classes for 18 students all in one building. The UDWRC Advisory Panel heard about the research of 15 undergraduate and 4 graduate water research students who presented their work about the critical water issues in Delaware, the Delaware Valley, and the Nation concerning PFAS and lead in drinking water, coastal/riverine flooding, sea level rise, fishery and habitat, and water economics. This research was supported by the FY24 Water Resources Research Act (WRRRA) appropriation from the President and Congress through the Dept. of Interior and USGS and conforms with the 1964 law that charges the 54 water research institutes at land grant universities throughout the nation with conducting important water research by training scientists and engineers and planners for jobs after they graduate. And after hearing about the research conducted by the undergraduate and graduate students over the Fall 2024 and Winter/Spring 2025 semesters, we conclude that, in its 60<sup>th</sup> year, the UDWRC has fulfilled its water research, public service, and education mission for the good of Delaware and the Nation.

As winter approaches, we applaud the approval of the FY25 WRRRA appropriation by the Interior Department and OMB to bring the next cohort of 16 undergraduate and graduate research students to begin their research with the Fall 2025 semester. With Federal support from the Water Resources Research Act through USGS to our NIWR institute here in Delaware along with local support from our State, county, and cities, we look forward to continuing our work at the University, school, and the institute through FY26 and beyond.

We especially appreciate the scientists both on and off campus who support the students in the role of faculty advisors and by participating on the UDWC Advisory Panel. They've made a difference in scientific research and in the lives of the students who graduate go on to get good jobs in society and become the next generation of leaders in the United States.

Looking back, UD, Old College, and UDWRC were established 282, 187, and 60 years ago, respectively. That's quite a test of time!

**Gerald Joseph McAdams Kauffman, Jr.**  
Director, Delaware Water Resources Center (DWRC)  
Past - President, National Institutes for Water Resources (NIWR)



*UDWRC Advisory Panel Undergraduate Water Research Students at Old College Rm 202 (May 16, 2025)*



*UDWRC Advisory Panel Graduate Water Research Students at Old College Rm 202 (May 16, 2025)*

On September 17, 2025, Water Science and Policy (WSP) Director, Dr. Gerald Joseph McAdams Kauffman Jr., and WSP Doctoral Student, Megan Wassil, presented “The Water Science and Policy Implications of PFAS in Delaware Drinking Water Streams” at the first WSP Brown Bag Seminar held in Penny Hall. In 2021, Dr. Gerald Kauffman and Megan Wassil of the Delaware Water Resources Center completed initial sampling of Delaware drinking water streams for the presence of PFAS. Since then, the Water Resources Center has continued to sample these streams as well as investigate the impacts these compounds have on the state of Delaware and its drinking water.



*Megan Wassil presents on PFAS at the first WSP Brown Bag Seminar (Sep 17, 2025)*



*Martha (center) and Jerry (right) at the 13<sup>th</sup> Annual Delaware River Watershed Forum in Lake Hopatcong, NJ (Oct 23, 2025)*

# *Message from the NIWR President*

**May 1, 2025**

Dear NIWR:

Today is May 1, 2025 and it's 12:04 am in the East in Delaware and US Virgin Islands, 11:04 in Illinois, Minnesota and Ohio, 10:04 in Colorado and Montana, 9:04 in Washington, 8:04 in Alaska, 6:04 in Hawaii and pardon me it's already been May 1 for 14 hours in Guam! Glancing at these time charts always reminds me of the vast network of the National Institutes for Water Resources that stretches halfway across the globe from Maine to Micronesia as we are one of the few Congressionally chartered national scientific networks that has stood for 60 years now and counting.

Today Dr. Yu-Feng Forrest Lin from the University of Illinois becomes our NIWR President, Dr. Linda K. Weavers from the Ohio State University will become President-elect with a vote of nearly  $\frac{3}{4}$  of the eligible NIWR votes recorded, Dr. Jeffrey Peterson from the University of Minnesota will have served a 3 year term as President-elect, President, and Past President and I will move on in accordance with the bylaws from NIWR President to the position of Past President to support our President and President-elect and the NIWR Board in their duties.

It's been my pleasure to be the NIWR President this year and working with all 54 of you at world class universities that stretch across America. In this time I've gotten to know more about the water science and policy research that you do and how much you care about the scientific method and care about the students who you advise in their research and then go on to get good jobs in our civil society. I'm one of the ones, yes one of the NIWR directors (it's hard to believe I know!) who have actually lived much of the Water Resources Research Act when it was signed by Lyndon Baines Johnson and I can attest personally to the role that America plays in scientific research that benefits our water resources and the environment and the economy because I have actually lived and breathed it. The summers back then growing up in a rowhouse without AC in Kensington next to Fishtown were clogged with smog and gases. I remember breathing the sweet smell of benzene that would drift over from the Rohm and Haas plant in Pt. Richmond by the river and I thought that was how air actually was. The Delaware River that I used to skate on with my friends playing hockey was black and the golden carp we caught through the ice were coated with oil. And the air and water is much, much better now and that is due to our attention to water science and policy over more than half a century.

And over the 60 years our environment has gotten cleaner but it's not enough, and there is much more to do and that is where NIWR comes in. A month ago I was invited to speak at the Youth Environmental Summit (YES) to a bunch of high school kids in Wilmington along the banks of the Christina river and I actually told them that I loved going to school and a couple of the kids told me (these are the conscientious students) that no one ever told them that it was OK to like going to school. And I still feel like that now I like going to school at the University of Delaware teaching, researching, and conducting the business of the National Institutes for Water Resources. And I like working with you, being part of NIWR is all I wanted to do in my career actually and I appreciate the chance to work with you all.

I wish to extend my thanks to the NIWR Board, Jeff, Yu-Feng, Linda, Keith, Stephanie, Brian, Tao, Michael, Jon, Nicole, Karen, and John and to Leslee and Laurie and India from Van Scoyac in DC, Jennie from Southern Illinois University, and especially Bob and Christian from USGS for their sense of dedication and decency in doing their jobs.

Thank you to our past NIWR Presidents including Brian Haggard (Arkansas), Sharon Megdal (Arizona), Rick Cruse (Iowa State), Stephen Schoenholtz (Virginia Tech), Sam Fernald (New Mexico State), Daniel Devlin (Kansas State), Doug Parker (California), Kevin Wagner (Oklahoma State), Nicole Misarti (Alaska), and Jeffrey Peterson (Minnesota).

As I reported at the DC business meeting on Feb 24, 2025, NIWR is structurally and financially sound and our water research and jobs training mission is strong and consequential. India reported that 53 of the 54 NIWR institutes have paid their dues and we have a healthy cash reserve. A full 2/5 of the NIWR institutes are led by rising new Directors, Delegates, and Associate Directors and this has infused a sense of new energy, an ingredient necessary to any scientific organization. Our WRRRA appropriations have doubled over the last decade and a half and in 2024 the NIWR flyer assembled by Jennie reports that \$14.4M in Federal funds were matched by \$13.7M in local funds that supported 245 research projects and research and training of 434 students, that's good production in a Federally supported, state-based

science research enterprise! Looking ahead I recommend prioritizing the NIWR water research needs of our island territories and Alaska and Hawaii in USGS water availability reporting and in NIWR water research.

This afternoon in the newspaper I read something quite encouraging. Senator Susan Collins of Maine and Chair of the full Senate Appropriations committee decried the attack on scientific research in our Federal agencies and our institutions of higher learning and frankly I take her at her word because on Wednesday morning Feb 26, 2025, Leslee and I met with the Senate Interior Appropriations Subcommittee in the Senate Hart Office Building and I left with the same favorable feeling that USGS and WRRRA will be supported by the subcommittee chaired by AK and OR and the full committee chaired by ME and WA with the themes of drinking water, energy production, flood and drought, agriculture, outdoor recreation, and minerals being priorities. When you think about it, the 4 water states chairing these appropriations committees have their wellbeing that depend inherently on water. We left after 20 minutes in that room with a comforting feeling that the United States Senate will support water and I got the same feeling after the Senate Appropriations committee chairwoman made similar remarks today.

Last Tuesday we convened what I'll call a NIWR council of presidents with Yu-Feng, Linda, Jeff, Nicole, and me along with Leslee and Laurie from VSA to gameplan actions that we may need to take as contingencies to fulfill our NIWR WRRRA FY25 Sec. 104b and Sec 104g appropriations. The options available to us include the law (we are lawfully appropriated by Congress in FY25) and I am looking into low interest loans in Delaware's financial sector and from scientifically minded and socially liberal foundations to bridge us and I will look into that more thoroughly as Past President in case we need. And as Director of the UD Water Resource Center and professor in the Biden School, College of Engineering, and Dept of Geography I have been dealing with the intrusions in my own way with Earth Day teach ins on my own campus and stand up for science rallies and protecting international students as I imagine must be happening on your campuses.

Given that we passed the 60<sup>th</sup> anniversary of WRRRA and celebrated that at our joint AWRA/UCOWR/NIWR conference in Saint Louis, I spent a fair amount of time researching the 60 year history of the WRRRA, UCOWR, and NIWR for an upcoming perspective piece in JCWRE and discovered that our enterprise was severely tested during two periods. One was around 1980 when the role of the federal government was questioned and there is a hand drafted map published that actually marked the state water research institutes that would discontinue functioning if federal funding were withdrawn. And the second time the highest level of concern was the second term of Ronald Reagan when David Stockman the OMB director and James Watt the Secretary of Interior questioned several water programs such as the river basin commissions, the National Water Commission, and the Interior Dept Water Research Office that were authorized by Congress and Lyndon Baines Johnson in 1964 and 1965. While historically successful in knocking down the Berlin Wall eventually by embracing the altruistic foreign policies of economic investment in Eastern Europe advanced by Sen Bill Bradley while accommodating the diplomatic policies of glasnost and perestroika, they questioned these federal initiatives like everything else (such as Pell Grants, tell me about it!) under the now disproven premise of trickle down economics which I studied as a young guy in graduate school at Princeton whereby the states were supposed to take on the financial responsibilities of the federal government and their economic philosophy went off the rails with hyperinflation and 14% interest rates. In the end they vetoed everything in one fell swoop the WRRRA reauthorization and related legislation authorizing Title 1 River Basin Commissions (such as the Upper Mississippi and DOI office of water research) yet Congress overruled the veto by a supermajority that authorized and reappropriated the WRRRA and we came out even stronger than before and have had strong congressional support ever since. In 1987 at the DC water institute director meetings at the motor inn in Arlington, Va., Dr. Caulfield a political scientist from Colorado State University looked back to the 1984 WRRRA reauthorization under Ronald Reagan and recommended that the WRRRA reauthorizations should be supported without regard for political ideology as the 54 state institutes provides a widespread base for distributive politics that not all very worthwhile federal programs are fortunate enough to possess.

In a little while you will be able to read an article about the Golden Age of Water (1964-2025) published in the Journal of Contemporary Research and Education published by the Universities Council on Water Resources (UCOWR) and I do believe we will be about to enter the second golden age after all this blows over. One of the first NIWR research students supported by the WRRRA was Elinor Ostrom, a UCLA graduate student who researched regional planning and water wars in Southern California and after moving to Indiana University was one of the early scholars in game theory and was awarded the Nobel Prize in Economics. The WRRRA Program invests in water resources that support a trillion dollar

economy in the U.S. notably clean water that supports fishing (\$42 billion), hunting (\$23 billion), and bird watching (\$46 billion) and outdoor recreation totaling \$140 billion nationally for boating, paddling, and sailing. River basins feeding the Delaware River support \$22 billion in economic activity and 600,000 jobs, the Chesapeake Bay as the nation's largest estuary supports a trillion dollar tourism, fishery, and agriculture economy, and the Colorado River supports drinking water for 40 million Americans, a \$1.4 trillion economy, 16 million jobs, and 12% of U.S. GDP. The 54 WRRR program institutes at our nation's colleges with over 10 million alumni have trained and supported over 25,000 student water research projects that have paid off in protecting the health, safety, and welfare of the American public.

In closing, our 54 National Institutes for Water Resources (NIWR) are Congressionally authorized by the Water Resources Research Act of 1964 and 1984, as amended, and have been in existence for six decades and the law states: "Subject to the approval of the Secretary of the Interior...one water resources research and technology institute, center, or equivalent agency...may be established in each State (...includes the Commonwealth of Puerto Rico, District of Columbia, Virgin Islands, Guam, American Samoa, Commonwealth of the Mariana Islands and Federated States of Micronesia) at a college or university which was established in accordance with the Act approved July 2, 1862 (12 Stat. 503) [7 U.S.C. 301 et seq.] and the institute in such State... be established at the one such college or university designated by the Governor of the State..."

The 54 NIWRs at land grant schools that stretch halfway across the world exist to assist the public to address water problems as our core mission by law. It is in our nation's schools, elementary schools, junior highs, high schools, vocational, trade schools, community colleges, universities where we have opportunities to learn from science and get good jobs and earn a livelihood and provide for our families and make the nation better. This is what the WRRR and NIWR and UCOWR are all about and it's what LBJ and Congress had in mind way back in 1964. As we look back to the historic year of 1964 where civil rights and the principles of scientific water research became the law of the land, I look ahead cogently to the next 60 years of good and civil water science and policy in the United States.

So on May 1, 2025 in the East, I pass the baton to Yu-Feng to become our NIWR President and Linda to be our President-elect and I will succeed Jeff as Past President and become the NIWR Parliamentarian in accordance with our bylaws. I feel especially reassured by the rising directors and associate directors of NIWR who I've had a chance to meet over the last year from Alabama, California, Colorado, Delaware, Idaho, Indiana, Kansas, Mississippi, Missouri, Montana, Nevada, New Hampshire, New York, North Dakota, Pennsylvania, Vermont, Virginia, US Virgin Islands, and Wisconsin and I look for you all to be the face of NIWR in the coming years and decades and perhaps be on the NIWR Board and NIWR President one day, you've got it in you!

And in my first and only Executive Order as NIWR President I proclaim that all NIWR Past Presidents and NIWR retired Directors have hereby earned "emeritus" status as NIWR Past President (Emeritus) and NIWR Director (Emeritus). In other words, I hold all of you who came before us in the highest regard.

It's been a good year from the water research point of view and an unprecedentedly trying year on the political side but I happen to think we'll come out the other side even better than before because science rules and besides, I'm not ready to give up on it yet.

Warmly,

**Gerald Joseph McAdams Kauffman, Jr.**

President, National Institutes for Water Resources (NIWR)  
Director, University of Delaware Water Resources Center  
Associate Professor, Biden School of Public Policy & Administration  
Institute for Public Administration  
DGS Annex 261 Academy Street  
Newark, Del. 19716



*Gerald McAdams Kauffman completes Board Term as Past President with UCOWR President Dr. Jeffrey Peterson at Univ. of Minnesota (Jun 3, 2025)*

# *New Director of the Interdisciplinary Graduate Program in Water Science & Policy*

**March 17, 2025**

I am delighted to be appointed by the provost and the dean as the interim director of the University of Delaware Graduate College's interdisciplinary program in water science and policy. Established in 2014 by authorization of the Faculty Senate, the program began as an experiment in multidimensional thinking and is the oldest interdisciplinary degree program housed in the Graduate College. We have awarded close to four dozen doctoral and master's degrees over the last decade to students who come from all over Delaware, America and the world to study about water.

Interdisciplinary graduate programs have the benefit of flexibility by allowing the students, with their advising faculty, to design their own course curriculum and choose from the full depth and breadth of the colleges and departmental programs at our University. As the foundation of our planet's environment and economy, water is found in all strands of society and therefore it's entirely appropriate that our graduate program in water science and policy have an interdisciplinary approach to thinking and learning. Because after all, isn't this our real mission here at UD: to take a broad-based approach to critical thinking and create new knowledge? That's exactly what water science and policy students have been doing here by researching and studying and then going on to get good jobs in the public, private and nonprofit sectors.

Our graduates are working on climate science in Spain, drought in California, the Puget Sound in Seattle, drinking water in New York City, water management in West Chester, Pennsylvania, and water treatment in Wilmington, Delaware. They are doing great things for society and before long, they become our next generation of leaders, which is reassuring to me in today's world. So welcome to the interdisciplinary graduate program in water science and policy. I hope you consider joining us!

**Gerald Joseph McAdams Kauffman, Jr., Ph.D.**

Associate Professor, Biden School of Public Policy & Administration  
Director, University of Delaware Water Resources Center



*Chauncey at Mt. Ekwonok, VT (Apr 2025)*

# *UDWRC Director's Message*

**February 2025**

***Gerald Joseph McAdams Kauffman, Jr., Ph.D.***  
***Director, University of Delaware Water Resources Center***  
***Associate Professor, Biden School of Public Policy & Administration***  
***University of Delaware***  
***Newark, Del. 19716***

## ***The Golden Age of Water (1964-2024)***

The year was 1964. It was a year the United States was embroiled in Vietnam. It was the year of the British Invasion before the Beatles played at Shea Stadium. And it was the year that Lyndon Baines Johnson who embraced the civil rights policies of his predecessor John Fitzgerald Kennedy signed the Civil Rights Act on July 2, 1964 after Congress passed it by a 2 1/2 to 1 margin in the House of Representatives and 3 to 1 in the Senate that outlawed discrimination based on race, color, religion, sex, national origin, in the workplace, and in schools. And it was the year that presidential historians agreed democracy began not in 1776 but in America just 60 years ago.

It was the year in 1964 that a clean environment and science was the popular preference of Americans. It followed from the space race in 1955 when the Americans and the Soviets raced to the moon and Dwight David Eisenhower pushed for a change in the way that kids were educated in America in math and science. It followed from the quest for science and engineering when Ike in 1956 pushed to build the Interstate highway system that linked America from coast to coast and put engineers to work on building America's biggest public works project ever. And it followed from Silent Spring in 1962 when oceanographer Rachel Carson wrote the book about chemicals in society as a best seller and John Fitzgerald Kennedy read it and embraced it because he was a sailor who cared about the environment. That's how JFK became interested in cleaning up our nation's waterways and he followed up on a 1959 report from Senator Mike Mansfield from Montana that said water was the biggest problem in the American West, a 1961 report he commissioned by the National Academy of Sciences recommending more water research and jobs training by our nation's universities, and a 1963 article in the journal Science that recommended strengthening our nation's institutions of higher learning to train engineers and scientists.

Building on JFK's water initiative, on July 17, 1964 Lyndon Baines Johnson signed the Water Resources Research Act (WRRRA) passed by a healthy majority of the Congress that established a network of "water resources research and technology institutes or centers..." at the 54 land grant institutions that stretch from Maine on the Atlantic to Micronesia in the South Pacific. The 1964 WRRRA was based on the 1862 Morrill Act that established land grant colleges and the 1887 Hatch Act that established state agricultural experimental stations and was reauthorized in 1984 and reappropriated in the 2021 Bipartisan Infrastructure Law. We are authorized by Congress and have the authority of Federal laws passed during the administrations of Abraham Lincoln in 1862, Grover Cleveland in 1887, Lyndon Baines Johnson in 1964, Ronald Reagan in 1984, and Joe Biden in 2021. Our Congressionally chartered land grant institutions in the mid-Atlantic at Delaware, District of Columbia, Cornell, Penn State, Maryland, Rutgers, Virginia Tech, West Virginia, and our peer universities out West at Alaska, Colorado, Connecticut, Hawaii, Illinois, Minnesota, Ohio State, Purdue, Montana, Tennessee, and Washington State are authorized to assist the Nation and the States in augmenting their water resources science and technology as a way to: (1) conduct research into the nation's water matters and challenges and (2) train and educate future scientists, policy specialists, and engineers for careers in water resources. When LBJ signed the act into law he said that "abundant, good water is essential to continued economic growth and progress... and Congress has found that we have entered a period in which acute water shortages are hampering our industries, our agriculture, our recreation, and our individual health and happiness."

The 1964 Water Resources Research Act with an appropriation administered by the Department of Interior and U.S. Geological Survey has been successful over the last six decades. One of the first NIWR research students supported by the WRRRA was Elinor Ostrom, a UCLA graduate student who researched regional planning (not popular in LA) and

the water wars in Southern California and when she moved to Indiana University was one of the early scholars in game theory and was awarded the Nobel Prize in Economics. The WRRRA Program invests in water resources that support a trillion dollar economy in the U.S notably clean water that supports fishing (\$42 billion), hunting (\$23 billion), and bird watching (\$46 billion) and outdoor recreation totaling \$140 billion nationally for boating, paddling, and sailing. River basins feeding the Delaware River contributes \$22 billion in economic activity and 600,000 jobs, the Chesapeake Bay as the nation's largest estuary supports a trillion dollar tourism, fishery, and agriculture economy, and the Colorado River supports drinking water for 40 million Americans, a \$1.4 trillion economy, 16 million jobs, and 12% of the U.S. GDP. The 54 WRRRA program institutes at our nation's colleges with over 10 million alumni have trained and supported the research of over 25,000 student water research projects that have paid off in protecting the health, safety, and welfare of the American public.

Water research in the U.S is a national priority. The drought in the East continues after it hadn't rained in over two months, a record stretching back to the first National Weather Bureau rain gauges in 1894. Unprecedented catastrophic flooding from Hurricane Ida in September 2021 and Hurricanes Helena and Milton this year drove Americans away from their homes and jobs in Delaware, Pennsylvania, Florida and North Carolina. Out West we saw the worst drought in 400 years since the Indigenous people and then the Spanish lived on the land and then atmospheric rivers flowed from the Pacific and flooded LA, San Francisco, and Seattle and more recently NOAA reports there is a concerning snow drought in the Sierra Nevada in the water towers of the west.

In 1965 the Board of Trustees established the University of Delaware Water Resources Center on campus in accordance with the WRRRA and it was set in law by an act of the Governor and Delaware General Assembly. This year we are celebrating the 60<sup>th</sup> anniversary of the Water Resources Research Act and next year in 2025 we will commemorate the 60<sup>th</sup> anniversary of the UDWRC on campus. In Delaware, the UDWRC has offices in Newark on the main campus with origins in 1743 as the 8<sup>th</sup> oldest institution of higher learning in the U.S. and Lewes campus at the mouth of the Delaware Bay by the Atlantic Ocean. With a cost sharing approach from Federal, state, local and philanthropic sources, we support dozens of undergraduate and graduate students at Delaware, Delaware State University, and Delaware Technical and Community College in their water research concerning PFAS in drinking water, coastal and riverine flooding, harmful algal blooms in lakes and reservoirs, water based recreation such as hunting and fishing and boating, water economics, and drinking water quality which are issues of utmost importance to Delaware and surrounding states in the Delaware Valley and along the Chesapeake. And these students, many who graduated from and are excellently educated at Delaware high schools, go on to get good jobs in the public, private, and nonprofit sectors, consulting, leading, and advocating for clean and plentiful water. That is, these graduates who conduct water research supported by funding from the WRRRA and our state, county, cities, and foundations get good jobs and become the future leaders of our nation, that's what LBJ and Congress had in mind when they passed the Water Resources Research Act in 1964.

So this year as we reach the end of 2024 as we celebrate the 60<sup>th</sup> anniversary of the Water Resources Research Act and go into 2025 for the diamond anniversary of the University of Delaware Water Resources Center it's important to remember that modest investments in our youth and teaching and research about water science and policy in our nation is paying off with huge dividends in protecting our water supplies. At the UD Water Resource Center and the 54 National Institutes for Water Resources at the land grant schools that stretch halfway across the world we are here to assist the public to address and solve water problems because that is our core mission by law. It is in our nation's schools, our elementary schools, junior highs, high schools, vocational, trade schools, apprenticeships, community colleges, universities where we have opportunities to learn and get good jobs and earn a livelihood and provide for our families and make ourselves better and make the nation better. This is actually what the WRRRA and NIWR and UDWRC are all about. As we look back to 1964, we also look ahead cogently to the next 60 years of good and civil water science and policy in the United States.

Dr. Gerald Joseph McAdams Kauffman, Jr. is Director of the University of Delaware Water Resources Center in Newark, Del., Associate Professor in the Biden School of Public Policy & Administration, and the 60<sup>th</sup> President of the 54 National Institutes for Water Resources (NIWR) chartered by Congress in the 1964 Water Resources Research Act at the 54 land grant institutions in the United States, District of Columbia, and island territories of Guam/Mariana Islands/American Samoa, Puerto Rico, and U.S. Virgin Islands.



*NIWR along the Potomac in DC at VSA (Feb 25, 2025)*

# AWRA/NIWR/UCOWR 60<sup>th</sup> Anniversary Conference in St. Louis, MO

Oct 1, 2024

The AWRA/NIWR/UCOWR 60<sup>th</sup> Anniversary conference that commemorated the year 1964 when all three of our water resources organizations were founded when Lydon Baines Johnson signed the Water Resources Research Act (WRRRA) was a pretty productive affair. We did a 5 km run along the Mississippi at sunrise after our meetings with the New England and Powell Consortium and Texas regions the night before and in a few short hours we convened again at sunrise under the big arch and got to the finishing line in time for our 8 am NIWR membership meeting at breakfast then many of us gave their papers at 8:30 am in the seminar rooms, not bad, not bad at all, that's how AWRA/NIWR/UCOWR rolls! My compliments to Andrea at the Univ. of Tennessee and Lucas at Texas A&M for setting up the course and getting us out there at this hour, they can really run! In November we'll start training for the annual UCOWR/NIWR conference coming up in June 2025 in Minneapolis, I'm really looking forward to this conference in the land of 10,000 lakes!

It was so nice to be with my colleagues at the 60<sup>th</sup> Anniversary conference in St. Louis by the banks of the big river of the American Water Resources Administration (AWRA), National Institutes for Water Resources (NIWR), and Universities Council on Water Resources (UCOWR), all founded in 1964 after Lyndon Baines Johnson signed the Water Resources Research Act during the Great Society and the same year the Civil Rights Act was passed when Democracy actually began in America. From the left it's Dr. Yu-Feng Forrest Lin, (NIWR President-elect from the University of Illinois), Dr. Gerald Joseph McAdams Kauffman (NIWR President from the University of Delaware), Dr. Jeffrey Peterson (NIWR Past President from the University of Minnesota), Dr. Kevin Wagner (NIWR Past President from Oklahoma State University), Dr. Sam Fernald (NIWR Past President from New Mexico State University), my beautiful friend at Princeton and Rutgers we both studied there Dr. Sharon Megdal (NIWR Past President from the University of Arizona), and Dr. Brian Haggard (NIWR Past President from the University of Arkansas), and we just missed Dr. Nicole Misarti (NIWR Past President from the University of Alaska) who jetted down to the lower 48 just in time to be with us.

Student Perspective - Cooper Feeny, Undergraduate Research Assistant, DWRC (pictured below, right): As someone early in their professional career, I feel very grateful to attend and present at my first conference. I was selected for a topical session where I discussed my research on Wilmington, Delaware's compliance with, and the resulting costs of, the 2021 EPA Lead and Copper Rule Revision. I am grateful to my advisors and mentors at the Delaware Water Resources Center for recommending this invaluable opportunity to share my knowledge with respected researchers and professionals in the field of water resources. I look forward to being able to present further research with professionals throughout my career.

Gerald Joseph McAdams Kauffman, Jr.



AWRA NIWR UCOWR 60<sup>th</sup> Anniversary  
Conference 5k Run at the Great Arch  
(Oct 2, 2024)



NIWR Presidents at the 60<sup>th</sup> Anniversary  
AWRA UCOWR NIWR Conference in St  
Louis, MO (Sep 30, 2024)



Cooper Feeny presents at the 60<sup>th</sup> AWRA NIWR  
Conference (Oct 2, 2024)

# UDWRC 59<sup>th</sup> Annual Advisory Panel Meeting

May 9, 2024

On Thursday May 9, 2024, we held the 59<sup>th</sup> annual meeting of the UDWRC Advisory Panel at the Rust Ice Rink on the campus of the University of Delaware in Newark, Delaware where the water research students presented the results of their work that began in the fall 2023 semester and continued through the winter and spring semesters of 2024. We heard from 15 graduate and undergraduate students from the University of Delaware and Delaware State University who presented their research on the water problems of the day in Delaware and the Mid-Atlantic on topics such as lead in drinking water, PFAS in surface water, deep well injection in the Coastal Plain, wildlife research in the Inland Bays, water quality trends in our drinking water streams, hydrology/hydraulics flooding research on the Brandywine River, and Green Jobs in Wilmington. This work was presented by the students to comply with the support provided by Congress, Department of Interior, and the United States Geological Survey through the FY23 appropriation from the Water Resources Research Act of 1964 and 1984 as amended. Our advisory panel of scientists, planners, engineers, and faculty both on and off campus heard the research and made important points on implementation, for instance recommendations for the water research students to continue work on removing lead pipes in Wilmington and continued work on PFAS in drinking water. We also conveyed the selection of the next cohort of 15 water research students who will begin work with our FY24 federal appropriation from Congress on September 1, 2024 with the beginning of the fall semester and then we'll look forward to the 60<sup>th</sup> anniversary of the UDWRC research advisory panel next May so it'll be quite a year. After the business meeting concluded we adjourned for a fine lunch catered by the UD Creamery at our College of Agriculture and Natural Resources. Please see the advisory panel agenda and presentation and research posters posted on our website [wrc.udel.edu](http://wrc.udel.edu) here and I invite you to review them and provide any comments that might be helpful to us.

I hope you all have a fine Memorial Day weekend and take a moment to remember the sacrifices of the Americans who fought to keep our country free - free to express our own opinions and respect the rights and thoughts of others.

Take care,

*Gerald*

President, National Institutes for Water Resources (NIWR)  
Director, Delaware Water Resources Center (UDWRC)  
Associate Professor, Biden School of Public Policy & Administration



UDWRC Advisory Panel Meeting - Martha, Lydia, Jerry and Andrew at UD Ice Arena (May 9, 2024)

# *Gerald McAdams Kauffman begins term as 60<sup>th</sup> NIWR President*

**May 1, 2024**

It's noon in the East and that means its 1 pm in the US Virgin Islands, 11 am in Minnesota, 10 am in New Mexico, 9 am in Oregon, 7 am in Alaska, and 1 am in Guam and these time zone boundaries remind me of the vastness of our network of the 54 National Institutes for Water Resources (NIWR) at land grant universities that stretch half way across the globe from the Atlantic to the Pacific and from the Caribbean to the Arctic.

Good afternoon and good morning! Today on May 1, 2024, I am delighted to begin my one-year term representing you as the President of the National Institutes for Water Resources! I follow in the able footsteps of my predecessors Dr. Jeffrey Peterson from the University of Minnesota, Dr. Nicole Misarti from the University of Alaska, Dr. Kevin Wagner from Oklahoma State University, and Dr. Doug Parker from the University of California and we all welcome Dr. Yu-Feng Lin as incoming President-elect from the University of Illinois Champaign Urbana. My predecessors Jeff and Nicole have boosted the NIWR to be a well-funded and well-respected scientific organization supported by Congress and the Department of Interior and USGS and I hope to follow their fine example, they have taught me a lot how to be a president.

This is a good time to remember that the 54 NIWRs are authorized by the Water Resources Research Act of 1964 and 1984, as amended (42 USC 10301 et seq.) and we have been in existence for six decades and are celebrating our 60-year anniversary. The law states: "Subject to the approval of the Secretary of the Interior... **one water resources research and technology institute, center,** or equivalent agency... may be established in each State (... includes the Commonwealth of Puerto Rico, the District of Columbia, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Mariana Islands and the Federated States of Micronesia) at a college or university which was established in accordance with the Act approved July 2, 1862 (12 Stat. 503) [7 U.S.C. 301 et seq.]. In accordance with such Act of July 2, 1862, the institute in such State shall... be established at the one such college or university designated by the Governor of the State..."



*Congresswoman Melanie Stansbury (NM) with NIWR President-elect Gerald McAdams Kaufman overlooking the Capitol (Feb 2024)*

So, we are Congressionally chartered and have the authority of Federal laws signed by Abraham Lincoln in 1862, Lydon Baines Johnson in 1964, Ronald Reagan in 1984, and with the FY24 Federal Budget Appropriation Joe Biden in 2024. Our mission according to the law is to assist the Nation and the States in augmenting their water resources science and technology as a way to: (1) assure supplies of water sufficient in quantity and quality to meet the Nation's expanding needs for the production of food, materials, and energy, (2) discover practical solutions to the Nation's water and water resources related problems, particularly those problems related to impaired water quality, (3) assure the protection and enhancement of environmental and social values in connection with water resources management and utilization, (4) promote more effective coordination of the Nation's water resource, s research program, (5) promote the development of a cadre of trained research scientists, engineers, and technicians for future water resources problems; and (6) encourage long-term planning and research to meet future water management, quality, and supply challenges.

The University of Delaware Water Resources Center was established on-campus in 1965 and I have had the benefit of working with my predecessors Dr. Robert Varrin Chair of the Department of Civil and Environmental and Dr. Tom Sims the Deputy Dean of the College of Agriculture and Natural Resources, we have had just three UDWRC directors over the decades!

In parting I wish for you the water golden rule which was talked about by our US Senator and Secretary of Natural Resources and Environmental Control which is to do unto others downstream and upstream as they would do unto you. I look forward to working with you all in Delaware and throughout the nation!

Warmly,

**Gerald Joseph McAdams Kauffman, Jr,**

President, National Institutes for Water Resources (NIWR)  
Director, Delaware Water Resources Center (UDWRC)  
Associate Professor, Biden School of Public Policy & Administration  
University of Delaware  
Newark, Del. 19716

# *Happy MLK Jr. Day*

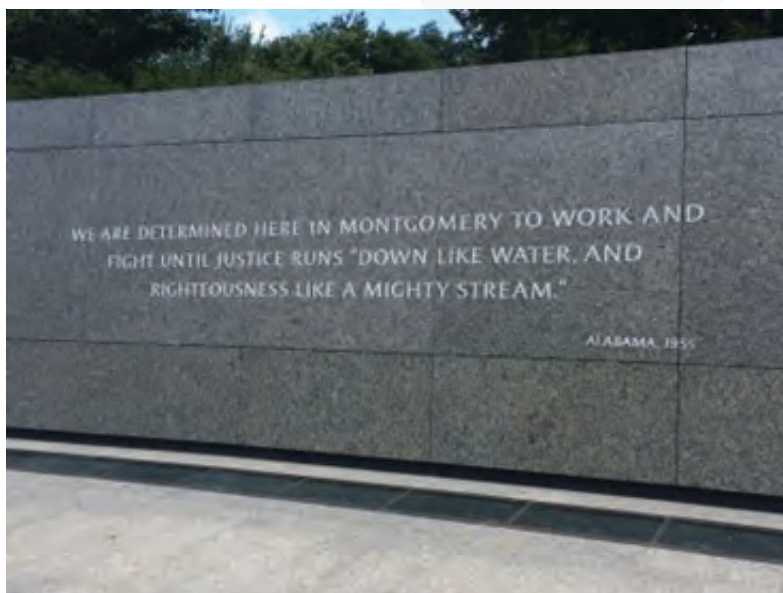
**Jan 15, 2024**

We are determined here in Montgomery to work and fight until justice runs “Down like water, and righteousness like a mighty stream.” Dr. Martin Luther King, Jr. said these words in Alabama in 1955 and they are written in Amos 5:24, beautiful words that I first read at the MLK memorial behind the Jefferson Memorial when a million of us joined the March for Science on Earth Day 2017. And today almost 70 years after the day when he first said them, I try to understand their meaning better especially in this climate emergency world that we live and work in.

Today these words mean even more to me because they apply to what’s going on over at the Brandywine. For 20 years we have been working in Delaware and with our upstream neighbors in Pennsylvania to restore the Brandywine River, the most beautiful small watershed in America. The Brandywine Christina Task Force is working to restore water quality in the sole source of drinking water for Delaware’s largest City. The Brandywine River Restoration Trust is restoring the anadromous American shad who our UD oceanographers with students at Howard High School have found to spawn in downtown Wilmington in the middle of the megalopolis under I-95 and then swim out to the ocean and live their lives as adults way up off of Labrador until they swim back to spawn back in little Delaware, these are Canadian fish! We are trying to restore the river to its historically natural condition and remove the deteriorating mill dams that extinguished the cultural food source for the Lenape people every spring until the first dams were built by the Swedes in the 17<sup>th</sup> century. We have been trying to restore the shaded, green recreation place in Brandywine Park and the zoo that served as an oasis during the Pandemic, one of the few places we could go to get fresh air and cool off. We are trying to implement solutions to the flooding caused by Hurricane Ida that damaged Rockland, Bancroft Mills, and the \$2 million Northern Delaware Greenways footbridge. With Northeast Rising in Northeast Wilmington we are working with Green Building United and the City at the very bottom of the watershed to address flooding problems in the community that receives all the water that flows down from two states.

The Brandywine River restoration effort is about real-life environmental justice and righteousness and Dr. MLK Jr. spoke about these things a long time ago. What goes on upstream in the affluent hills directly affects our neighbors who live in the long underserved Northeast neighborhoods at the bottom of the watershed. A small group does not get to use their influence and connections to take over the Brandywine and threaten to negate the 20 years of work we have been doing to restore this beautiful river. Who owns the Brandywine? We do, the people.

So in the spirit of public service and caring about our neighbors, I wish you a good MLK Jr. holiday today and thank you for everything!



*MLK Jr. speaks about justice, Washington, DC*

# *Happy 247<sup>th</sup> Anniversary of Delaware Day!*

**Dec 7, 2023**

Happy 247<sup>th</sup> Anniversary of Delaware Day, the First State to sign the Constitution! Season's Greetings and Happy Holidays from the UD Water Resources Center! In the truest meaning of the season, I wish you all peace, love, and goodwill on Earth!



*Seasons Greetings on the UD Green (Dec 7, 2023)*



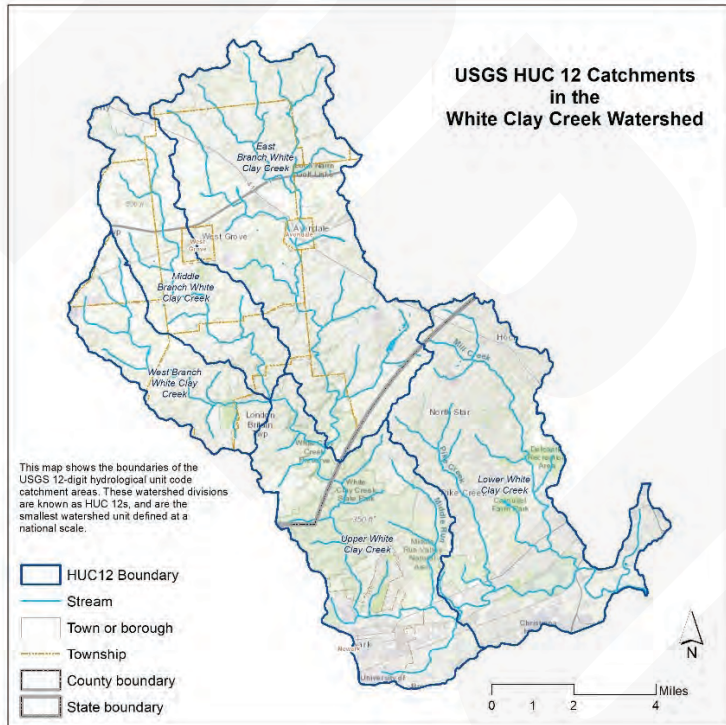
*CIEG 440 Water Resources Engineering at Newark Water Treatment Plant (Dec 7, 2023)*

*Delaware Water  
Resources Center  
Newsletter Articles  
2024-2025*

# White Clay Creek State of the Watershed

Andrew Homsey

It is said that that which is measured improves. This is true whether you are trying to control cholesterol, improve your 5K time, or encourage your kids to improve their grades. Performance metrics let you know where you stand, where you need to go, and how you are doing on that journey. It is the same with the environment—for example, measuring the health of a watershed is a key indicator of how well it supports the well-being of those organisms, from insects to humans, that live there.



The White Clay Creek (see map at left) covers 107 square miles in Delaware and SE Pennsylvania, flowing from rolling farmland in the north, through Newark, DE, finally emptying into the tidal Christina River near Newport DE. The White Clay is the home watershed of the UD WRC, and a designated Wild and Scenic River system (the first such designation on a watershed basis).

Over the years, UD WRC has performed assessments regarding the status of the overall watershed health. By measuring several key indicators and determining how each is trending, we may assign a “grade” to each to determine where we and how far we need to go.

Previous reports on the “state of the watershed” were conducted in 2008 and 2016. The most recent assessment, published in 2023, looked at five major categories of watershed health: hydrology, habitat, water quality, scenery, and recreation. This effort was undertaken in partnership with Stroud Water Research Center and the White Clay Wild & Scenic River Program. Within each broad category, several

## White Clay Creek Wild and Scenic watershed

quantitative measures, or indicators, were developed to help refine the assessment. Each of the 21 indicators was measured across 5 sub-watersheds within the White Clay Creek. A grade was assigned (where feasible) for each indicator and to each broad category, for each sub-watershed and for the watershed overall.

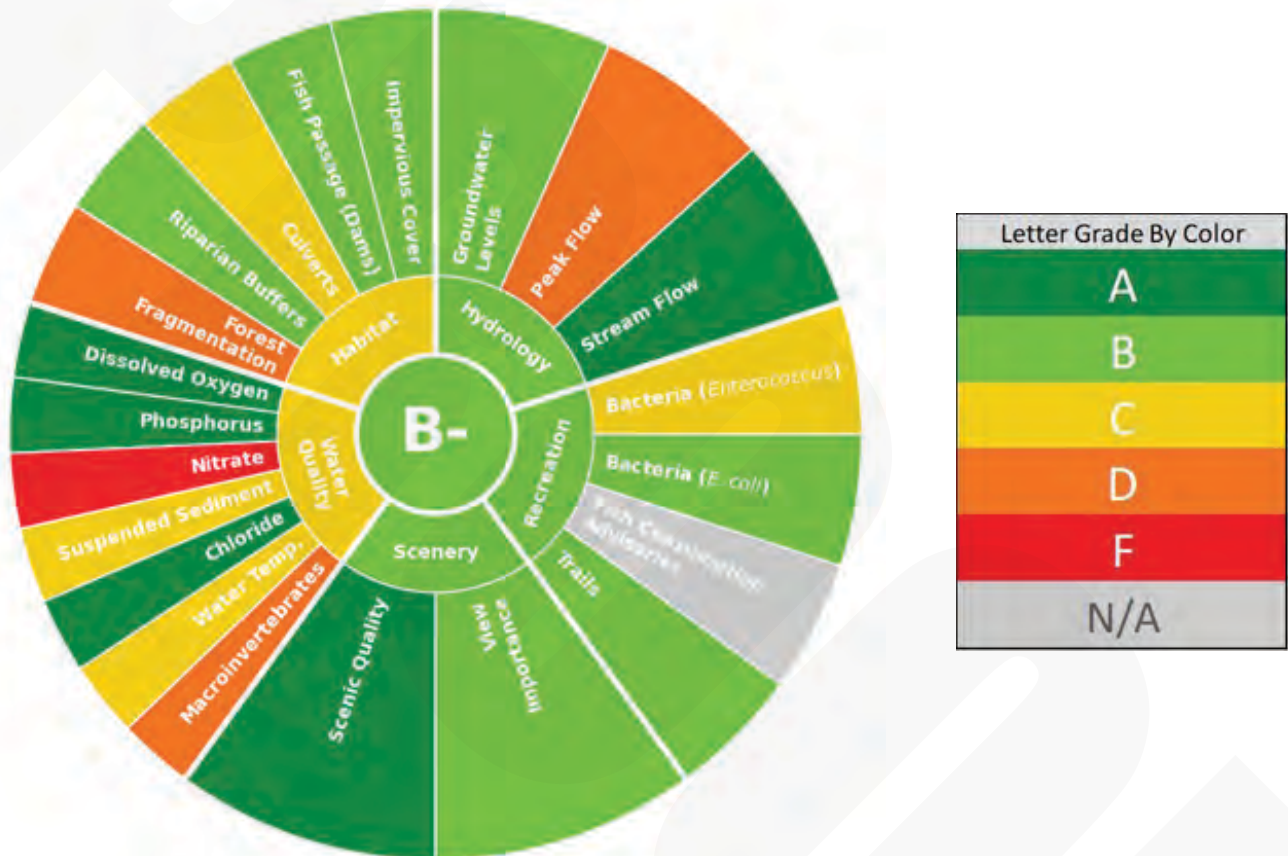
The table at right summarizes the broad categories and detailed indicators pertaining to each. Hydrology includes a measure of stream flow, groundwater levels in monitoring wells, and analysis of peak flow trends. Habitat indicators include connectivity in streams (dams and culverts), forest condition, and extent of streamside buffers. Constituents monitored to assess water quality include nutrients (phosphorous and nitrates), suspended sediment, water temperature, and macroinvertebrate (aquatic insect species). Scenery measures the visual quality at key points across the watershed, and the degree of their cultural or historic importance. Recreation is measured by the incidence of trails, the presence of bacteria in the water, and whether there are fish consumption advisories in the waterbodies.

Category	Indicator
Stream Flow	Streamflow
	Peak flow
	Flooding
Habitat	Impervious cover
	Aquatic connectivity (dams)
	Aquatic connectivity (culverts)
	Forest fragmentation
	Riparian buffers
Water Quality	Dissolved oxygen
	Phosphorus
	Nitrates
	Total suspended sediment
	Chloride/conductivity
Scenery	Water temperature
	Macroinvertebrates
Recreation	Visual quality
	Cultural importance
	Trails
	Fish consumption advisories
Bacteria ( <i>E. coli</i> )	Bacteria ( <i>E. coli</i> )
	Bacteria ( <i>Enterococcus</i> )

White Clay Creek state of the watershed categories and health indicators

## So, how did the watershed do?

Overall, the White Clay Creek gets a B-. This doesn't tell us much about what is good and what is bad, or what is improving and what is worsening. Scores vary across the sub-watersheds, allowing for more detailed grading. Hydrology is consistently good (As and Bs) throughout the watershed, except for peak flows (D+), which are trending toward more intense flooding events. Habitat is generally fair to good, except for forest fragmentation, which, compared regionally, gets a D+. Water quality is also generally good, except, notably, for nitrates and macroinvertebrates, which receive a grade of F and D-, respectively. Scenery receives generally high marks, especially in the upper main stem (where the State Park and Preserve is found). Recreation scores are also fairly high, except for Enterococcus bacteria, which gets a C+. Below are the overall grades for the watershed, by category and indicator.



Overall grades for the White Clay Creek Wild and Scenic watershed - 21 indicators in 5 categories

Assessing the health of the White Clay, can help planners, managers, regulators, and the general public understand both current conditions, past trends, and areas of concern. This study can guide policies and practices to best work toward the improvement of this unique and valuable watershed, for all who use and depend on it.

The full report may be viewed at <https://whiteclay.org/state-of-the-watershed>.

# Wilmington Lead Service Line Inventory

## Martha Narvaez

The University's Delaware Water Resources Center<sup>1</sup> (DWRC) partnered with the City of Wilmington Department of Public Works and Jacobs Inc. (the engineering lead) to help develop the City's Service Line Inventory Map<sup>2</sup>, to help ensure the City's continued compliance with the U.S. Environmental Protection Agency's revised Lead and Copper Rule, designed to protect public health by eliminating toxic metals in the nation's drinking water.

DWRC's Martha Narvaez (Associate Director) and Andrew Homsey (GIS Services Manager), supervised eight graduate and undergraduate students as they reviewed more than 70,000 work orders dating back to 1916 to create a comprehensive inventory of the City's water supply system. The information included service line data from the City's as-built plans and asset management system, as well as from its meter shop, licensing and inspection, and insurance records.

- The students who worked to review the historic and current work orders and records included:
- Lydia Franks, Master of Water Science and Policy, 2025
- Alex Makowski, Master of Public Administration, 2023
- Elizabeth Shields, Master of Public Policy, 2023
- Megan Wassil, PhD of Water Science and Policy, 2025
- Aaron Balmer, BA Wildlife Conservation and Ecology, 2025
- Cooper Feeny, BS Economics/BA Public Policy, 2025
- Dmitriy Rybin, BS Civil Engineering, 2026
- Michele Wassil, BS Environmental Science, 2027

The documents the students reviewed ranged from work orders written in cursive from the early 1900s to data gathered by today's GIS mapping and artificial intelligence systems. The students were then able to provide the City with the required inventory information, including the materials used, the sizes and locations of the lines, and their dates of installation.

Based on the inventory, the City of Wilmington was provided with the following information:

- Out of the more than 74,000 water service lines in the system, fewer than 2,000 were found to be made of lead.
- Fewer than 1,000 lines were found to be made of galvanized material. Although galvanized lines are not made of lead, the EPA requires their removal if they were previously connected to lead service lines; such a connection increases the risk of lead exposure.
- Approximately 18,000 lines were designated as "unknown" because they have not been identified yet. The EPA acknowledges in its regulations that water utilities, especially ones the size of Wilmington, would not be able to identify all water lines during this initial inventory. Wilmington will continue its inventory work until all lines are identified.



Sample Public Works work order from 1952

Following the initial inventory, each property served by a lead, galvanized, or "unknown" service line will receive a letter from the City detailing the findings, the steps the property owner can take to reduce potential lead exposure, and actions being taken by the City. It is important to note that the presence of a lead, galvanized, or "unknown" line does not mean there has been lead exposure, only that there is an increased risk. Wilmington's water treatment process significantly mitigates the risk.

The work to identify and ultimately remove lead pipes is taking place throughout the nation and the EPA's regulations provide water utilities sufficient time to identify all service lines, including the pipes on a customer's property that the homeowner is responsible for maintaining. As part of the inventory process, the City of Wilmington continues to seek customer assistance in identifying their private service lines, and encourages residents to participate in the water service line survey, which can be found here<sup>3</sup>. The DWRC will continue to work with the City of Wilmington and Jacobs to achieve inventory goals. Our partnership will serve as a State and national model for other cities and towns. Results from the inventory are available on the Wilmington Water Lead Reduction Program page<sup>4</sup>.

1. <https://www.wrc.udel.edu/>

2. <https://www.wilmingtonewater.gov/245/Service-Line-Inventory-Map>

3. <https://survey123.arcgis.com/share/c807894a91214a668b1cddb45920042e>

4. <https://www.wilmingtonewater.gov/204/Lead-Reduction-Program>

# Predictive Flood Risk Assessment for Kent County, Delaware

**Andrew Homsey**

With an average elevation of only 60 feet above sea level, Delaware is the lowest-lying state in the nation. As such, Delaware's coastal areas are particularly susceptible to flooding from coastal inundation. During storms, many parts of the

state, particularly along the eastern coastal portions may see increased flooding due to water being pushed inland by tides, wind, and increased wave action. Even during periods of calm weather, land adjacent waterbodies can experience "clear-sky" flooding with increasing frequency, due to the effects of climate-change driven sea level rise. As water levels rise globally, and as storms become more frequent and intense, we may expect the negative impacts coastal inundation due to storms such as hurricanes and nor'easters to increase.



*Flooding at South Bowers in 2016. (Doug Curran, special to the Wilmington News Journal)*

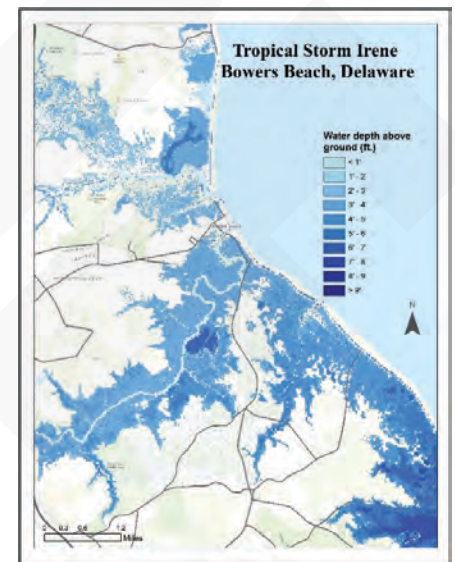
Flooding due to coastal inundation can be devastating to affected communities. Homes and business can be damaged, transportation routes disrupted, emergency services cut off, and infrastructure damaged, resulting in long-term disruptions and expense.

The Delaware Department of Transportation (DelDOT), is responsible for nearly all the roads in Delaware, and owns many facilities in and adjacent to flood-prone areas. The UD Water Resource Center has been working with DelDOT for over a decade to map, model, and help determine the effects of coastal inundation and potential "worst-case" storm scenarios on the infrastructure, livelihoods, and people of the state. Funded through DelDOT's Office of Transportation Resilience and Sustainability, in partnership with the UD Center for Environmental Modeling and Analysis (CEMA), the UD Center for Applied Demographic Survey Research (CADSR), and NOAA, the latest phase of the study focuses on the effects of coastal inundation, including potential future scenarios, on transportation networks, DelDOT facilities and assets, and the provision of emergency management in Bowers Beach and the surrounding areas of coastal Kent County.

To help understand the impacts on the study area of coastal storms, as well as possible future effects of sea level rise, UD WRC analyzed the effects of historical storms on coastal communities in and around Bowers Beach by modeling inundation depths and extent for the duration of the storms. Additionally, the maximum, "worst-case" effects of Category 1 and Category 2 hurricanes striking the Delaware coast were analyzed. The impacts of two future sea level rise (SLR) scenarios of 0.5 m and 1.0 m to these modeled storms were also considered.

## Modeling historic storms

Using tide gages maintained by USGS and NOAA, water surface levels were estimated for five historical storms—the 2008 Mother's Day Storm, Tropical Storm Irene (2011), Superstorm Sandy (2012), the storm of Sept 10<sup>th</sup>, 2018, and Tropical Storm Ophelia (2023)— for the period of each storm's duration. Using this information, water depths and inundation extent were modeled at one-hour intervals for the study area. Animated maps of each storm's impact across coastal Kent County were produced to assess the effects across time. This process enabled the identification and prioritization of affected roads, based on the degree of impact (depth and length), duration of inundation, and potential interruption of travel.



*Effects of Tropical Storm Irene (2011), Bowers Beach, Delaware*

## Modeling worst-case storms

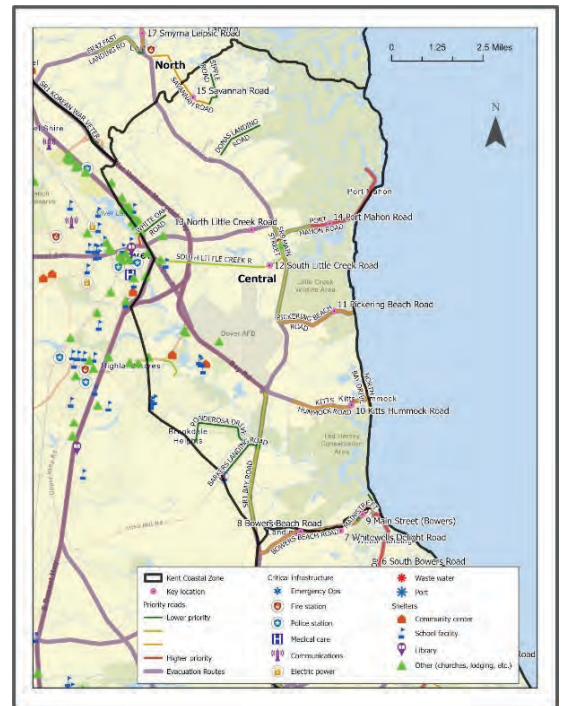
Using data for hypothetical “worst-case” storms striking the Delaware coast, the extent and depth of inundation was determined for both a Category 1 and Category 2 hurricane. The analysis determined the maximum inundation level at for every location, based on storm strength, speed, and direction.

To account for rising sea levels and their effect on Delaware during storm events, two scenarios were examined: a 0.5 m and 1.0 m rise in sea level, for each storm category. This analysis will assist DelDOT and the state in planning efforts around preparing for potential future storms.

## Other efforts

UD WRC and our project partners also produced an inventory of key institutions and infrastructure (for instance police and fire stations, schools, and emergency shelters) to assess the impacts of potential future storms on each region within the study area. By understanding where people live (particularly vulnerable populations), and where effects of real and hypothetical storms are felt, roads and facilities were prioritized for further study and consideration of the most cost-effective protective measures and possible design standard changes.

By understanding the historic impacts of storms on the Delaware coast in Kent County, and the potential future impacts of “worst-case” storms under a sea-level rise scenario, local, state, and regional managers, planners, and policymakers have additional tools to prepare for the next “big one”.



*Critical infrastructure and prioritized road segments, central Kent County.*

# City of Wilmington Green Jobs Program Impact Study

## Martha Narvaez

Since 2011, the City of Wilmington's Department of Parks and Recreation and the University of Delaware's Water Resources Center (UDWRC) have partnered to lead the City's Green Jobs Program. This Impact Study evaluated the City of Wilmington Green Jobs Program from 2011 to 2023, providing program hosts, alumni, and interested parties with the history of the program, program statistics, and a summary of the survey results. This analysis was funded by the University of Delaware's Community Engagement Initiative's Wilmington Partnership Mini-Grants. The project was led by UDWRC in partnership with the City of Wilmington Department of Parks and Recreation. The project team collected and summarized program statistics, researched comparable national and local programs, developed survey instruments, coordinated the survey administration, analyzed survey responses, and summarized the findings.



*Green Jobs participants learning to canoe on the Brandywine*

Through the City's Department of Parks and Recreation's Youth Career Development Program, the City administers the program and the UDWRC implements and oversees six weeks of programming for participants between the ages of fourteen and eighteen. Through an application and interview process, fourteen interns are selected. The program commences in late June and youth work twenty-five hours per week for six weeks, earning minimum wage. The overall goal of the program is to provide City of Wilmington youth with work experience that includes exposure to environmental resources, issues, careers and professional development.



*Sampling in the stream at First State National Historical Park*

From 2011 to 2023 the program has employed 174 interns. The youth are residents of the City of Wilmington and represent thirty-seven different public, private, and charter middle and high schools throughout the City and New Castle County. Throughout the thirteen years of programming there have been forty-one organizations and an average of sixteen program hosts each summer, with no less than nine and most recently as many as 21 hosts, representing nonprofit, academic, private, and government entities.

Two survey tools, structured and semi-structured, were designed and administered for the study. The structured survey, developed through Qualtrics, was distributed to 120 of the total 174 program alumni. The response rate ranged from sixteen to twenty-three participants in the structured survey. The structured survey results were followed up with two semi-structured interviews. The survey aimed to collect participant feedback on the following key areas: demographics,

education, occupation and outlook, program evaluation, and youth and citizen development. Due to the low survey response rate, the responses may not truly represent the impact of the Green Jobs Program but provide a starting point for future survey and research efforts.

Of the survey responses, the Green Jobs Program was evenly divided among males and females with the majority (92%) of participants identifying as black or African American. Over half of the respondents are currently in high school. The Green Jobs Program introduces many Wilmington youth into the world of work, with 83 percent indicating it was their first paid job of twenty or more hours per week. The participants' environmental responses ranked quite favorably toward the environmentally focused statements presented, such as "I would clean up green areas in my neighborhood" (50%). The Green Jobs Program participants positively ranked the program, and all survey respondents (100%) indicated they are likely to recommend the program to others. Based on the responses, the program provides job/workplace readiness and skills related to outdoor/field work. Survey respondents agreed that the program provided participants with professional development exposure to work as part of a team and exposure to varied perspectives and views. The majority of respondents did not express a targeted interest in working in an environmental field based on the responses, yet the program seems to have had a positive impact on awareness of outdoor recreation, natural areas and historic/cultural resources. Most respondents agreed that the Green Jobs Program affected their understanding of eight environmentally-related lifestyle choices listed in the survey.

Overall, the City of Wilmington Green Jobs Program is a highly performing environmentally focused youth labor program in Delaware. The survey respondents uniformly recommend the program and assimilate key messaging provided over the six-week program based on the survey responses. Potential future program enhancements include increasing funding for the program administration and program hosts; enhancing the youth workforce development benefits of the program; strengthening the Green Jobs Program Alumni relations and connection opportunities, and conducting annual and multi-year assessments.



*Green Jobs participants after a day on the water*

# Delaware Planning for Local Adaptation Needs (DE-PLANs)

Nicole Minni

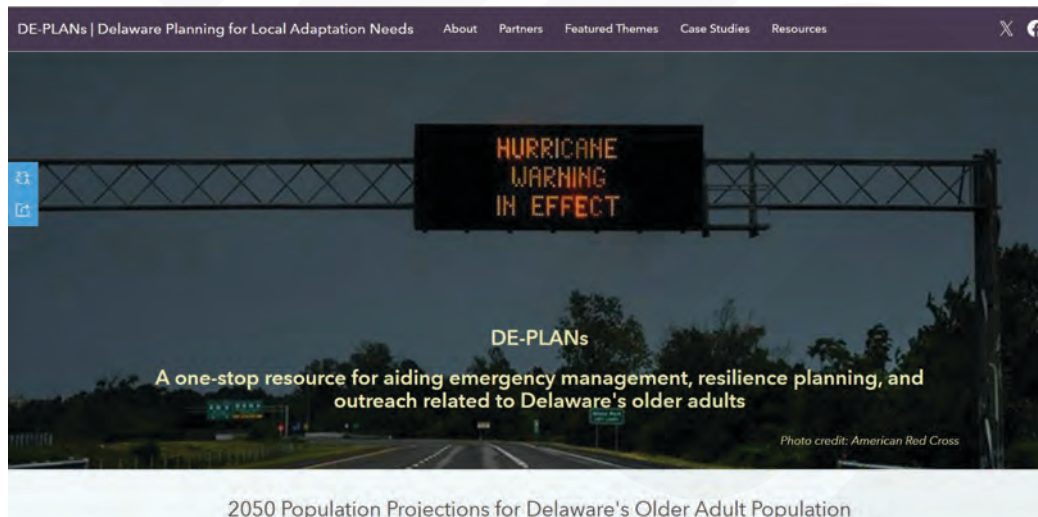
<https://de-plans-udel.hub.arcgis.com/>

Delaware is the 10<sup>th</sup> fastest-aging state in the Nation. This growth in the older adult demographic underscores the need for thoughtful planning to support older adults' ability to live comfortably and safely in their homes and communities for as long as possible, so-called "aging in place". As seen during the 2020 pandemic, older adults experience higher rates of social isolation and are less connected to the internet and technology than younger populations. Moreover, their healthcare and mobility needs, distance from close family, and tendency to live on fixed incomes make them particularly vulnerable to disasters.

Each Delawarean has unique needs and circumstances. Those who opt to remain living independently have particular need for ready access to emergency services. Therefore, emergency preparedness is a critical and integral component for planning communities where many older residents have chosen to age in place.

DE-PLANs is a suite or platform of tools (funded by the Delaware Emergency Management Agency, or DEMA) that assists residents, planners, and policy makers by combining Delaware-specific information with other tools and resources. The platform combines data from many sources (for instance US Census demographic data) with GIS tools to support state and local capacity-building for serving the needs of an aging population. The tool is designed to help shape the state's policies around seniors and their unique needs.

The DE-PLANs platform is organized by "Featured Themes," which include: Aging in Place, Hazards, and Connectivity. The site compiles social vulnerability data, social services, infrastructure, and hazard information in one place to support state, county, and local planning efforts related to emergency management preparedness with an emphasis on aging in place.



*DE-PLANs online toolkit is a web-based resource for Delaware's older population*

The online tool was developed to help inform thoughtful planning and service delivery related to several topics:

- Risk assessment and mitigation
- Emergency preparedness, response, and recovery
- Community design
- Grant writing
- Health & wellness
- Transportation planning
- Access to social services
- Community resilience

DE-PLANS defines older adults as those 65 years and older, consistent with Census definitions and academic literature. It is worth noting that the American Association of Retired Persons welcomes those aged 50 and above, and that some age-restricted communities set the bar at 55 years old. Although this site primarily focuses on individuals aged 65 and above, many datasets include information for younger age brackets. Ultimately, the needs of people in their fifties and early sixties should be factored into long-range planning, as they are transitioning into the older demographic.

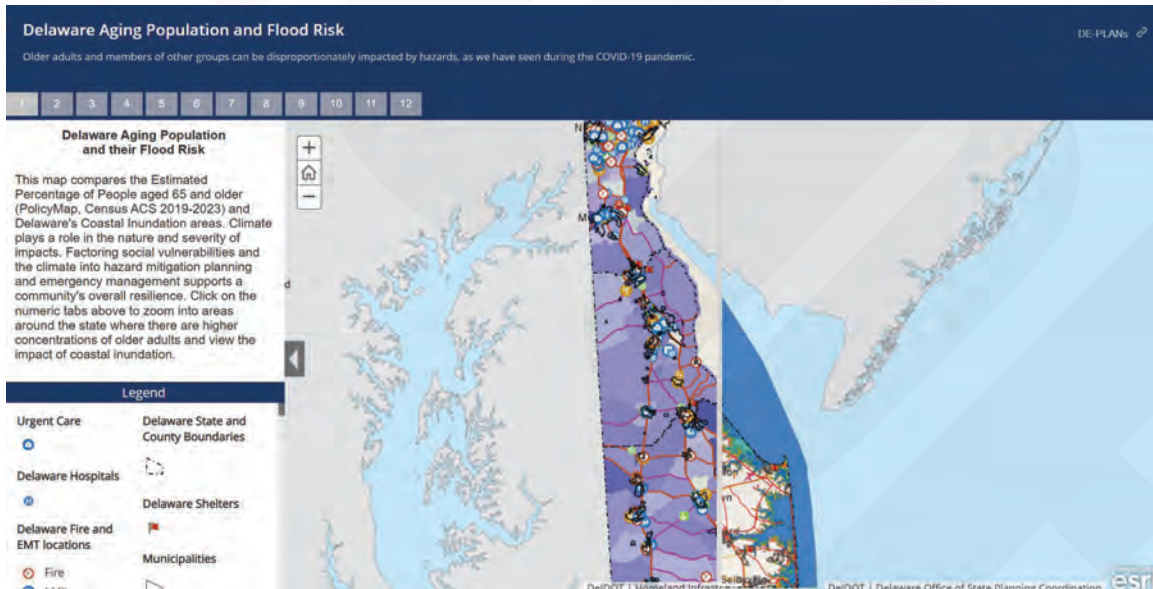
To understand each unique community, “At Risk Population Profiles” were created under “Featured Themes”<sup>1</sup> for each county and municipality in the state using Esri’s Community Analyst and American Community Survey (ACS) Census data.

Other site features include mapping applications that highlight residences with no vehicle access, people aged 65 and older in poverty, the estimated percentage of households without internet access, and more.



At Risk Population Profile for Ocean View

The “Case Studies”<sup>2</sup> section highlights specific topic areas, including Delaware’s Aging Population and Flood Risk, Delaware’s Vulnerable Populations and Health Facilities, The Ardens Case Study, Village and South Village Homebound Clients, and Delaware’s Food Resources. Lastly, the “Resources”<sup>3</sup> section includes information such as the newly released Delaware State Plan on Aging, and other resources relating to aging in place and emergency services.



Hazards such as flood risk can affect older populations disproportionately.

1. <https://de-plans-udel.hub.arcgis.com/pages/featured-themes>
2. <https://de-plans-udel.hub.arcgis.com/pages/case-studies>
3. <https://de-plans-udel.hub.arcgis.com/pages/Resources>

# *The Delmarva GIS Conference Celebrates 25 Years and Prepares for the 2026 Conference: Treasuring Our World!*

**Nicole Minni**

Wow, what a ride it has been! In May 2024, the Delmarva GIS Conference celebrated our 25<sup>th</sup> Anniversary.

Delaware hosted its first GIS Conference in 1999. I am incredibly fortunate to have been part of the conference committee since the inaugural event, along with Dr. Richard Sacher, who is now retired from the University of Delaware. Over the decades, Geographic Information Systems (GIS) have undergone significant evolution and are now employed in nearly every industry. Let's go back 25 years to see how it all began.



*Julia O'Hanlon and Nicole Minni of the UD IPA present their project: "Delaware Planning for Local Adaptation Needs (DE-PLANs)" at the 2024 conference.*

WRC has been involved in GIS nearly since its inception almost 50 years ago. Our colleague Vern Svatos worked closely with Jack Dangermond, founder of ESRI Inc. (the global leader in GIS technologies) starting in 1977, to implement a water-based GIS called the Automated Environmental Resources Information System (AERI). Originally, water data for the state was coded into raster grids (before vector data came into use) and stored in a "giant" (15 megabyte) text-based file. AERI II was a later version of the system, incorporating ESRI's new ArcInfo software, a digitizer, UNIX SPARC workstation, and electrostatic plotter. Vern was truly there from the beginning, and at each conference we honor a member of the Delmarva GIS community with a special Service Award, named in honor of Vern (who passed away in 2004).

The Water Resources Agency (WRA) for New Castle County was one of the first to use ESRI software. Miriam Pomilio, now retired from the State, used it when she worked for WRA in the 1980s. Miriam coordinated with EPA Region 3 to convert WRA's raster-based (grid) data into more advanced vector data using ESRI software. DNREC also established educational classes in partnership with ESRI to help the Delaware GIS community learn the new GIS systems and technologies.

In the 1990s Dave Racca served as GIS administrator for the WRA, working along with Andrew Homsey and me. In 1994 Dave moved on to our sister center at UD, the Center for Applied Demography and Survey Research (CADSR), and Vern once again assumed the role of GIS Manager. In 1995, a symposium was held at the University of Delaware to discuss the future of GIS. In 1998, UD's Institute for Public Administration (IPA) hosted a Policy Forum focused on GIS in Delaware. This led to the establishment of the Delaware Geographic Data Committee (DGDC). The following year, in March of 1999, the first official Delaware GIS Conference was held. In 2002, the first GIS in Education Award was awarded, and DataMIL—a geographic data digital repository--was established. In 2005, our first Delaware Geographic Community Service Award was awarded in memory of the late Vern Svatos.

Fast-forward to 2014, when the conference name was officially changed to the Delmarva GIS Conference, to recognize and include our neighbors in Maryland and Virginia. Last year, in May 2024, we celebrated 25 years of the GIS Conference and its community.

Our next Delmarva GIS Conference: "Treasuring Our World" will be held on May 13<sup>th</sup> and 14<sup>th</sup>, 2026. We are excited that this will be our first two-day event. Visit [www.degis.org](http://www.degis.org) to learn more about what the conference committee has in store!



*DWRC's Nicole Minni is recognized for her service on the conference committee since its inception*

# GIS Day Celebrates 25 Years!

Nicole Minni

GIS Day is an international celebration held on the Wednesday of Geography Awareness Week, which occurs the third week of November. According to Esri, “GIS Day is dedicated to sharing, teaching, and inspiring others with GIS.” Globally, practitioners of GIS (Geographic Information Systems) leverage the benefits of geospatial technologies across a variety of industries<sup>1</sup>. Providing students with an understanding of how this technology is applied may inspire them to discover a rewarding career path. The DGDC/GIS Day Committee in Delaware<sup>2</sup> celebrates GIS Day by hosting a field trip for 5<sup>th</sup> graders to learn about geospatial technologies and their use in everyday life.



*The UD Department of Geography showcases its “Learning with Satellites” station*



*Students sitting inside the Earth Balloon*

Our first field trip was held in 2008, and since then this annual excursion has been our signature event as we celebrate GIS Day. Check out our story map<sup>3</sup> to learn more.

The event is held at the Air Mobility Command Museum<sup>4</sup> in Dover, each year hosting approximately 300 students from all over the state. On average, each student visits seven activity stations on GIS Day. The stations include hands-on activities to engage the students in learning geospatial technologies. Examples include the Delaware Children’s Museum Earth Balloon, the MERR Institute<sup>5</sup>, a flight simulator, UD Geography

Department’s “Learning with Satellites”, and more. We rely on the volunteer services of nearly 70 GIS professionals, who act as tour guides, station chiefs, and coordinators for the students. Sponsors fund station materials, breakfast, and lunch for our station leaders.



*The MERR Institute shares information about its Marine Rescue and Rehabilitation services*

We asked the students to tell us one thing they learned from GIS Day:

“On GIS day I learned how to use coordinates to track where some animals like to stay in the water of the land you can see where they like to hang out and see differences if there is ever a problem with the animal. So, I really enjoyed GIS day and all of the people there.”

- Student attendee from Gallaher Elementary School

So don't wait for GIS Day to share this with your students; you can use GIS anytime by checking out activities on our



*Delaware Department of Technology and Information (DTI) CIO Gregory Lane, and the Dept. of Education Deputy Secretary Cora Scott honor the GIS Day Committee with a General Assembly Tribute recognizing National GIS Day, Nov. 20, 2024.*

HUB site<sup>2</sup> and Esri's GeoInquiry lessons<sup>6</sup>. What are GeoInquiries™, you may ask? Esri developed 15-20 minutes of standards-based activities for teaching map-based content in many curriculum areas. The activities can be presented quickly from a single computer or modified to enhance hands-on engagement for students, thereby enriching your curriculum throughout the year and inspiring your students.

1. <https://www.esri.com/en-us/industries/index>

2. <https://geoeducation-in-delaware-delaware.hub.arcgis.com/pages/gis-day>

3. <https://arcg.is/1aSaSq0>

4. <https://www.amcmuseum.org/>

5. <https://www.merrinstitute.org/>

6. <https://www.esri.com/en-us/industries/k-12-education/geoinquiries>

# Brandywine Flood Study

Martha Narvaez



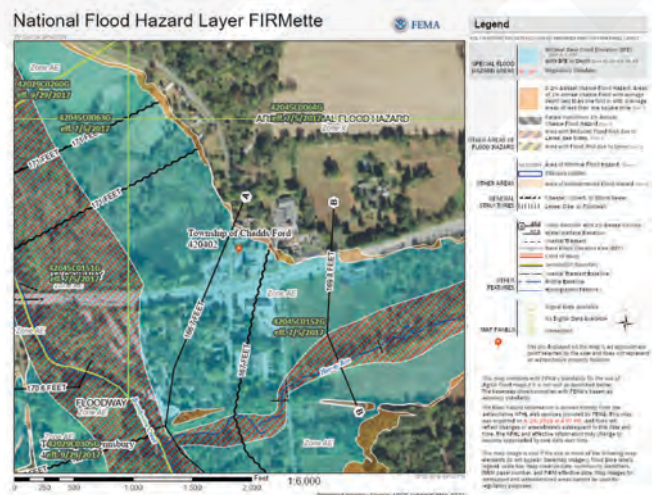
Flood hazard areas in the Brandywine watershed

Conducted in partnership with Chester County Water Resources Authority (CCWRA), the Brandywine Conservancy & Museum of Art and the Water Resources Center (UDWRC), the Brandywine Flood Study was launched in August 2023 in response to more frequent and extreme flooding events impacting communities along the Brandywine Creek in both Pennsylvania and Delaware. This coordinated effort sought to better understand where and why flooding occurs in the Brandywine watershed in order to identify the best approaches to protect communities during future severe flooding events.

The Flood Study team conducted a broad analysis of flood risk in the Brandywine watershed, assessing impacts during intense storm and flooding events—including historic flooding, projections for future floods, and potential impacts of future precipitation, storm events, and land use based on the watershed’s projected population in the year 2100. The study area encompassed the main stem of the Brandywine Creek, including key tributaries in Chester and Delaware Counties in Pennsylvania and downstream to impacted areas in Delaware. The final report, released in May 2025, includes a summary of the community outreach, data collection, and analyses conducted over the study period, along with an actionable suite of proposed flood mitigation recommendations throughout the watershed, presented in two distinct categories: structural and non-structural improvements.

Study partners are confident that implementation of the structural and non-structural recommendations laid out in this report can meaningfully reduce future flood risks to communities throughout the Brandywine watershed, and, most importantly, help prevent future loss of life and property. Of the recommendations laid out in the report, structural mitigation measures are often the most visible, like the five major flood control dams and reservoirs that were built after extreme flood events during the early- and mid-20<sup>th</sup> century, which collectively provide over six billion gallons of flood storage capacity. Study partners analyzed numerous structural project opportunities, including upgrades to existing flood control infrastructure, bridge and culvert replacements, low-head dam removal, floodplain restoration, and stormwater basin retrofits. Ultimately, of the more than 300 individual sites evaluated, 16 were prioritized for their potential to reduce regional and localized flood risks, including 10 bridge replacements, four low-head dam removals, one floodplain restoration project on the Brandywine Conservancy & Museum of Art’s campus, and upgrades to the existing Barneston Dam flood control structure in Chester County.

More than a dozen non-structural recommendations related to emergency planning, early warning systems, public education campaigns, and more extensive road closures are also included in the report. For developed areas within the 100-year floodplain, the report outlines strategies for enhanced floodplain management, flood insurance, and structural elevations, floodproofing, and voluntary buyouts. The Study also calls for increased land preservation to ensure the long-term functionality of natural floodplains and open space, which act as temporary reservoirs during flooding events.



FEMA’s flood hazard mapper, showing floodplains in Chadds Ford, PA

All of the implementation recommendations include both collaborative action and individual stakeholder projects. The Brandywine Flood Study is an important component of broader, multi-faceted efforts currently being undertaken by a variety of non-profit, government, academic, and private organizations to address flooding and its impacts on the communities in the Brandywine Creek watershed. The Brandywine Flood Study partners are committed to supporting the implementation of these strategies and to continue evaluating new opportunities to reduce localized and regional flooding in the future.

The Brandywine Flood Study was funded in part through grants from FEMA, PEMA, Chester County Government, and Delaware County Council. Multiple project partners contributed to the study, including the Stroud Water Research Center, West Chester University, and Meliora Design. In addition, a Technical Advisory Committee was convened to include additional government officials, non-profit organizations, and private entities. Robust public and stakeholder engagement was a priority of the study. This was achieved through sustained efforts to engage the public and ensure that its input informed the technical flooding analyses. There were diverse engagement options, including over 35 public meetings, listening sessions, and forums; over 1,500 public interactions; an online public survey; an interactive flood mapper; a media/communications toolkit; and a comprehensive project website.

Additional analysis of mitigation projects is currently underway throughout the watershed, including ongoing studies in the Cities of Coatesville, Downingtown, and Wilmington. These complementary efforts will likely produce additional approaches and project sites to supplement those identified in the Brandywine Flood Study. To view the Brandywine Flood Study report, visit <https://www.brandywine.org/flood-study>

# All About Stormwater

## Andrew Homsey

What is stormwater? Simply put, it's the water that runs off the land when it rains. Until relatively recently (the early 1990s) stormwater was seen only as a nuisance to be removed as quickly as possible. What happened to it after leaving a property was largely ignored. A system of inlets, pipes, and outlets was constructed in urbanized areas to expeditiously



*Rain barrels, such as this one at DWRC's Newark campus headquarters, can help control rooftop runoff*

convey the water to the nearest natural water course. Out of sight out of mind. But there were some problems with this way of thinking. First, with all the hard surfaces and concrete pipes, the volume of water produced by even small storms could easily overwhelm the conveyance system, flooding streets and structures. Once the water reached a stream or waterway, the rapid influx of such large amounts of water flooded downstream areas, causing erosion, riparian flooding, and loss of property. And not just water was being conveyed. Anything on the land that could be picked up by that water also moved downstream. Pollution such as oils, toxic materials, fertilizers, pesticides, and bulk trash was also carried along, often ultimately ending up in rivers, lakes, and bays, contaminating waters used for swimming, fishing, and for drinking supply.

In response to this situation many state and local governments, following the 1972 Clean Water Act, sought to address the problems of flooding and contamination by creating regulations on municipal, industrial and agricultural pollution, limiting the levels of contaminants that can be introduced into waterways. The need to regulate the stormwater infrastructure that municipalities used to handle their stormwater was recognized.

UD WRC supports the efforts of several local governments in the region to address issues associated with stormwater: maintenance of infrastructure, control of volume, pollution reduction, and regulatory compliance. Following is a brief overview of three of these current projects.

### New Castle County

New Castle County maintains stormwater infrastructure over a wide area. Most of the county's stormwater, in fact, other than areas under DelDOT or local jurisdiction, is controlled and maintained by New Castle County's Public Works Department. In support of their efforts to inventory and inspect all stormwater facilities, UD WRC has developed a GIS-based method for mapping and tracking these facilities regulated by the state (under DNREC). For each regulated stormwater management facility, the area of land draining to it, as well as the amount of impervious cover (pavement, roofs, sidewalks, etc.) within the drainage is derived from models or measured based on topography and aerial photographs. Currently nearly 97% of the county's facilities are accounted for. The information derived will help determine the effectiveness of pollution and volume reductions in stormwater impacting Delaware's waterways.

### University of Delaware

UD WRC has worked with the UD campus stormwater coordinator for several decades, supporting all aspects of stormwater affecting the University. Mapping, maintenance, and modeling of these facilities is crucial, as the University maintains a joint DNREC stormwater permit with the City of Newark. Students and scientists at UD WRC have worked with UD's Environmental Health and Safety (EHS) department on developing a web-based inventory and mapping tool for stormwater. This tool allows EHS to



*UD WRC's mapping app for stormwater inventory and inspection*

meet the state's regulatory requirements, and also provides a powerful way to maintain an inventory of assets and their maintenance. Students assist the EHS stormwater coordinator in performing field assessments of all UD's stormwater infrastructure, including all parking lots, inlets (catch basins, curb inlets, etc.), outfalls, and stormwater management facilities (or BMPs). Field workers can quickly inventory any issues or concerns such as clogged inlets, cracked pipes, debris build-up, etc. Additionally, the locations of assets can be verified, and elements added, moved, or deleted as appropriate. The data are quality checked by EHS and uploaded to the master database, which is maintained on UD WRC's servers.

### **Brandywine-Christina Watersheds of Chester County**

It is said that watersheds don't recognize political boundaries. It is the same with stormwater. For Delawareans, anything harmful entering waterways in our upstream Pennsylvania neighbor can have an impact on our drinking water, and on the habitats on which our health and the health of the environment rely. UD WRC is helping address this through our involvement in municipal stormwater activities in Chester County, PA. The state of Pennsylvania regulates stormwater in each municipality in the commonwealth. The Christina Watersheds Municipal Partnership<sup>1</sup> (CWMP) is a consortium of public and private organizations whose mission is to provide technical support, coordination, and planning assistance to 41 municipalities in Chester County to meet the state's stormwater requirements. CWMP provides an online clearinghouse for stormwater information, including best practices, regulatory considerations, and a forum for municipalities to learn about the state's permitting programs and state-of-the-practice for protecting surface and groundwater. These efforts help both Pennsylvania's residents and towns by reducing volume and pollution, and also benefit Delawareans who live downstream and use these waters to swim, fish, and as our drinking water supply.

1. <https://cwmp.org/>

# The Presence of PFAS in Delaware Drinking Water Streams

Megan Wassil

Per- and polyfluoroalkyl substances (PFAS), also known as “forever chemicals”, are a group of thousands of synthetic compounds. PFAS have a carbon-fluorine bond that makes them resistant to degradation in the natural environment. Regulations around PFAS are limited, which allows for their extensive production, use, and disposal. At each of those stages, PFAS may enter the environment where they can contaminate air, soil, sediment, groundwater, and surface water. PFAS in water can be a major problem, as drinking contaminated water is the most common route of exposure in humans. Once in the body, PFAS can cause a wide range of health problems, including endocrine disruption, infertility, and cancer. The U.S. Environmental Protection Agency took a significant step in regulating these compounds in drinking water in April of 2024 by releasing maximum contaminant levels (MCLs) for five compounds. By 2027 these compounds must be monitored in all public water systems. Water supplies where the MCLs are exceeded must be treated to meet the standards by 2029.

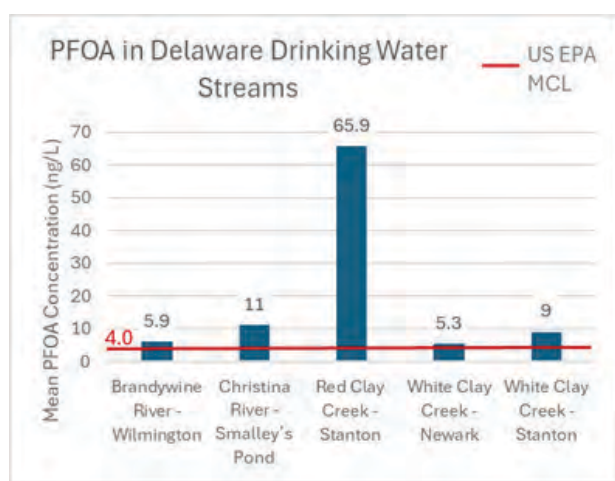
Compound	Final Maximum Contaminant Limit
PFOA	4.0 ppt
PFOS	4.0 ppt
PFHxS	10 ppt
PFNA	10 ppt
HFPO-DA	10 ppt
Mixtures containing two or more of: PFHxS, PFNA, HFPO-DA, PFBS	Hazard Index of 1.0*

ppt = parts per trillion = ng/L

$$* \text{Hazard Index} = \frac{[\text{HFPO-DA}]_{\text{ppt}}}{[10 \text{ ppt}]} + \frac{[\text{PFBS}]_{\text{ppt}}}{[2000 \text{ ppt}]} + \frac{[\text{PFNA}]_{\text{ppt}}}{[10 \text{ ppt}]} + \frac{[\text{PFHxS}]_{\text{ppt}}}{[10 \text{ ppt}]}$$

U.S. EPA MCLs for 5 compounds required to be monitored in drinking water

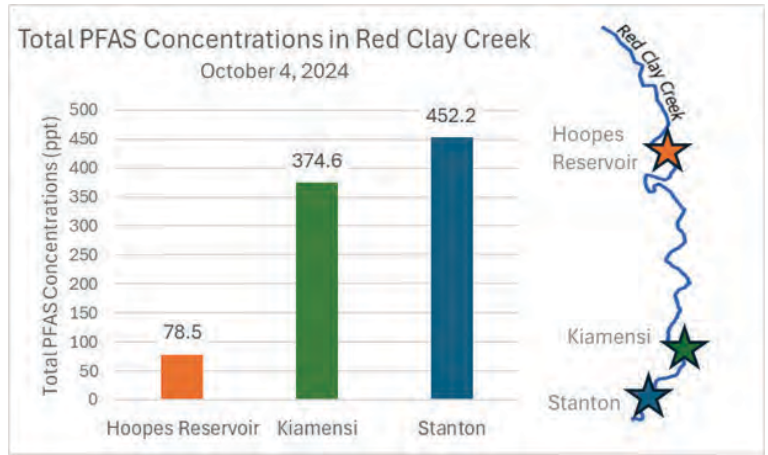
The University’s Delaware Water Resources Center (DWRC) set out to determine if these contaminants are present in Delaware’s drinking water systems. At the time of initial sampling, Delaware had four water treatment plants that drew from surface water, including: Brandywine River, Christina River, Red Clay Creek, and White Clay Creek. These streams provide the state with nearly two-thirds of its drinking water. A sampling site was selected upstream of each surface water intake to gain an understanding of influent PFAS concentrations. On three occasions, the center sampled all of Delaware’s drinking water streams. The samples were then analyzed by the firm PFAS Solutions, which analyzed for 40 different compounds using EPA Method 1633.



Results revealed the presence of PFAS compounds in all Delaware drinking water streams. Perfluorooctanoic acid (PFOA) was found in concentrations above the EPA’s maximum contaminant level in all of Delaware’s drinking water streams. While these results reveal raw water concentrations, the treated water distributed to residents may be lower, though without specialized equipment, most water treatment systems are unable to remove PFAS. Such systems are costly and may be difficult to implement. With these challenges, it is likely that PFAS concentrations in the raw and treated water are similar, suggesting that water suppliers will need to implement treatment by 2029.

PFOA in drinking water streams in Delaware

Initial results also revealed elevated concentrations of PFAS in Red Clay Creek at the first sampling site. A second sampling location upstream of the initial Red Clay site was selected to compare concentrations. This site, near Hoopes Reservoir, had much lower levels of PFAS, indicating the possibility of a point source between the two locations. A third location was selected between the upstream and initial sites, off Kiamensi Road. This location also showed elevated concentrations of PFAS, a levels similar to the initial sampling site. Investigation of superfund sites in Delaware between Hoopes Reservoir and Kiamensi Road revealed possible point sources that may be targets for mitigating PFAS contamination in the stream.



*PFAS concentrations at three sites on the Red Clay Creek*

*Delaware Water  
Resources Center  
Undergraduate  
and Graduate  
Research  
2023-2025*

# DWRC Undergraduate and Graduate Research 2025-2026

**Abigale Britz** (BENE Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

**Water Quality Spatial and Temporal Trends in the Delaware River Watershed In Delaware, New Jersey, Pennsylvania, and New York**



**Cai Foster** (BA Environmental Studies)

Advisor: Dr. Gerald McAdams Kauffman

**Groundwater Contamination Along the Atlantic Coast in Sussex County Delaware**



**Lianna Greenstein** (BENE Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

**Water Quality Spatial and Temporal Trends in the Delaware River Watershed In Delaware, New Jersey, Pennsylvania, and New York**



**Shayla Kapoor** (BS Energy and Environmental Policy)

Advisor: Dr. Gerald McAdams Kauffman

**Water Quality Trends in the Brandywine-Christina Basin and How They Impact Public Health, Delaware and Pennsylvania**



**Ryan Knott** (BENE Environmental Engineering)

Advisors: Dr. Paul Imhoff & Dr. Carolyn Voter

*Evaluating the Success of Residential Rain Gardens in Washington, D.C.*

**Joshua Koppel** (BS Energy and Environmental Policy, BA Economics and Political Science)

Advisor: Dr. A.R. Siders

*Attribution of Responsibility and Risk in Media from the July 2025 Texas Flood*



**Faith Moen** (BLA Landscape Architecture)

Advisor: Dr. Gerald McAdams Kauffman

*Northeast Wilmington Flood Resilience Park Design & 3D Modeling for Community Comprehension along the Brandywine River*



**Helena Owen** (BS Environmental Resource Economics)

Advisor: Dr. Maik Kecinski

*Economic Valuation of Oyster Reef Habitat in the Gulf of Mexico*



**Owen Rader** (BS Meteorology and Climate Science,  
Minor in Geography and Energy/Environmental Policy)

Advisor: Dr. Maik Kecinski

*Integrating Climate Projections and Event Attribution to Assess Future Flood Risk in the Brandywine Watershed*



**Dmitriy Rybin** (BCE Civil Engineering)

*Advisors: Martha Narvaez & Andrew Homsey*

***Integrating GIS Technology in Public Works and Stormwater Management***



**John Vuillemot** (BA Public Policy)

*Advisors: Dr. Gerald McAdams Kauffman & Martha Narvaez*

***Delaware's Brownfields and Water and Energy Demands for Hyperscale Data Centers in Delaware***



**Michele Wassil** (BS Environmental Science)

*Advisor: Dr. Gerald McAdams Kauffman*

***Bacteria Trend analysis: Is White Clay Creek Safe for Swimming?***



**Sienna Wong** (BS Environmental Science)

*Advisor: Dr. Gerald McAdams Kauffman*

***Effects of Wetland Flooding on Historically Underserved Communities along the Christina and Brandywine Rivers; Evaluating Modern Environmental Policy Effectiveness in Wilmington, DE***



**Megan Wassil** (PhD Water Science & Policy)

Advisor: Dr. Gerald McAdams Kauffman

**The Water Science and Policy Implications of PFAS in Delaware Drinking Water Streams**



**Olivia Francisco** (MS Environmental Science and Management)

Advisor: Dr. Shreeram Inamdar

**Water Salinity and Nitrogen Increases in the Newark-Philadelphia Area**



**Cooper Feeny** (MS Water Science & Policy)

Advisor: Dr. Gerald McAdams Kauffman

**Economic Assessment of the Value of Clean Water to the City of Philadelphia**



# DWRC Undergraduate and Graduate Research 2024-2025

**Jillian Abramson** (BS Environmental and Resource Economics)

Advisor: Dr. Gerald McAdams Kauffman

**Delaware River Basin and Economics**

**Aaron Balmer** (BS Wildlife Ecology)

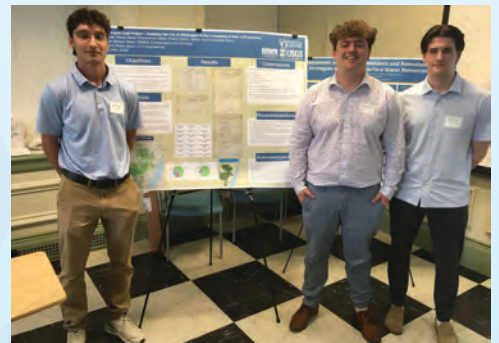
**Cooper Feeny** (BS Economics and Public Policy)

**Dmitriy Rybin** (BCE Civil Engineering)

Advisor: Martha Narvaez

**Wilmington Lead Project - Assisting the City of Wilmington in the Completion of their EPA Lead and Copper Rule Inventory**

The USEPA's recent Lead and Copper Rule Revisions required that an inventory of water line materials be comprehensively collected by October 2024. This project assisted the City of Wilmington in developing the inventory of its potable public water distribution infrastructure through an exhaustive review and digitization of historic records. The project outcome will reduce costs for the City and help protect the citizens of Wilmington.

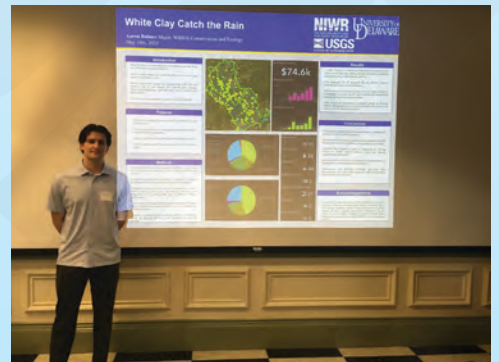


**Aaron Balmer** (BS Wildlife Ecology)

Advisor: Martha Narvaez

**White Clay Creek Wild & Scenic Catch the Rain**

Catch the Rain is a collaborative initiative between landowners and the White Clay Watershed Association (WCWA) aimed at reducing stormwater runoff into White Clay Creek through voluntary community action. This project involved the development of a dynamic, publicly accessible ArcGIS dashboard to visualize and analyze participation in the Catch the Rain program. By transforming raw data into an interactive geospatial tool, the dashboard enhances transparency, supports environmental planning, and engages the public in watershed stewardship. Ultimately, this project demonstrates the power of geospatial technology to advance environmental goals through community involvement and effective data visualization.

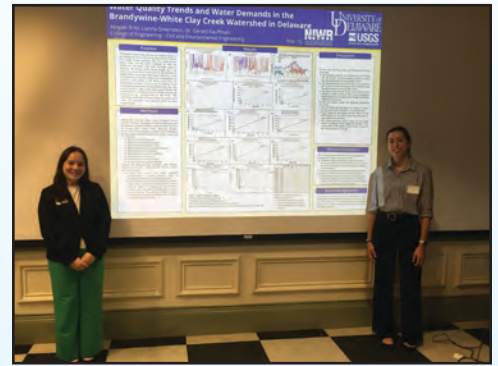


**Abigale Britz** (*BENE Environmental Engineering*)  
**Lianna Greenstein** (*BENE Environmental Engineering*)

Advisor: Dr. Gerald McAdams Kauffman

***Water Quality Trends and Water Demands in the Brandywine-White Clay Creek Watershed in Delaware***

This study monitored multiple aspects of the Brandywine-White Clay Creek Watershed in Northern New Castle County, Delaware. The New Castle County public water demands were compared to both the Brandywine and White Clay Creek discharge graphs to determine the severity of the recent drought and if the public consumption was in excess of the watershed's capacity. This information will allow officials to make announcements to the public about water consumptions and can help the public avoid exposure to harmful bacteria while providing education on the appropriate drought response.

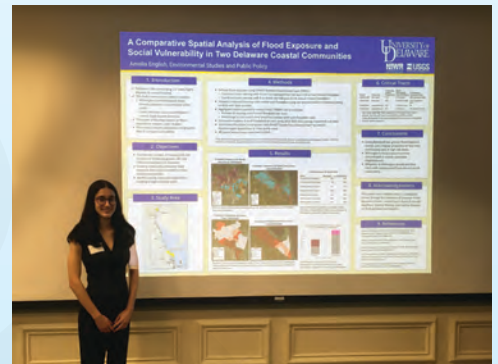


**Amelia English** (*BA Environmental Studies/Public Policy*)

Advisor: Dr. Gerald McAdams Kauffman

***A Comparative Spatial Analysis of Flood Exposure and Social Vulnerability in Two Delaware Coastal Communities***

As flood hazards become more frequent and intense with climate change, it is necessary to understand population exposure for planning and adaptation in coastal states like Delaware, which faces compounding risks from sea level rise, its low elevation, and land subsidence. This research uses GIS to assess exposure and social vulnerability to flooding in two Delaware coastal regions through a comparative analysis: the City of Wilmington and the Lewes/Rehoboth region. In identifying areas where socially vulnerable populations reside in high-risk flood zones, this research emphasizes the need for adaptation strategies that address both the physical exposure and structural inequity aspects of flood risk.

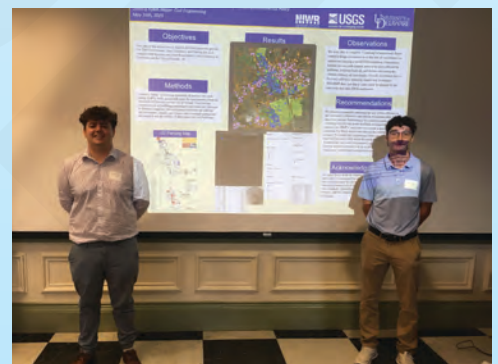


**Cooper Feeny** (*BS Economics and Public Policy*)  
**Dmitriy Rybin** (*BCE Civil Engineering*)

Advisor: Andrew Homsey

***Integrating GIS Technology in Public Works: University of Delaware MS4 Permit Compliance***

The University of Delaware MS4 Permit Compliance project seeks to digitize the current pen-and-paper inspection process for the University's Phase II Tier I Municipal Separate Stormwater Sewer System (MS4) permit. This project explores the feasibility of digitizing inspections, exploring two survey systems, Survey123 and FieldMaps to find the most effective option to record and store the data. The project successfully provided a survey tool to replace pen-and-paper inspections and work continues to establish the first annual inspection record of MS4 structures for the University of Delaware.



## **Cai Foster** (BA Environmental Studies)

*Advisor: Dr. Gerald McAdams Kauffman*

### **Wetlands, Infrastructure, and Storm Surges along the Brandywine River in Wilmington Delaware**

This study evaluates the relationship between land use, infrastructure, environmental factors, and demographic characteristics with respect to flooding events in the lower Brandywine River within the City of Wilmington, Delaware. Changes in infrastructure and building stock in the city over the previous two decades were examined to determine potential negative effects to surrounding neighborhoods of certain neglected industrial properties, in particular in relation to public health concerns following major flooding events. One potential resolution to the deleterious effects of flooding of those problematic properties is their conversion to naturalized open space.



## **Caroline Gilliard** (BENE Environmental Engineering) **Elizabeth Manning** (BENE Environmental Engineering)

*Advisor: Dr. Gerald McAdams Kauffman*

### **Flood Hydrology and Hydraulics and Hydraulics along the Brandywine River in Delaware and Pennsylvania**

In September 2021 the remnants of tropical storm Ida caused record-breaking flooding in the Brandywine Creek, leading to significant damage throughout the watershed, especially in the lower stretches in Wilmington, DE. To model this storm and its effects, the US Army Corps of Engineers (USACE) HEC-RAS model was used to simulate flooding behavior in the Brandywine, including the East Branch, West Branch, Main Stem, and several tributaries. The model determined flood elevations to ascertain impacts on floodway structures such as buildings, dams, roads, and bridges to help identify and prioritize mitigation strategies. Potential alterations to or removal of dams and bridges along the Brandywine could help lower flood elevations by up to 3.5 feet. While removal is not feasible for most bridges, the raising of bridge deck elevations or alteration of cross-sectional geometries can also help ameliorate flood levels.



## **Isabelle Kornas** (BS Energy and Environmental Policy)

*Advisor: Dr. Gerald McAdams Kauffman*

### **Economic Value of Floodplain Properties in Delaware Coastal Towns**

Delaware is extremely vulnerable to flooding and sea level rise is expected to rise .10 inches per year. This research focuses on six coastal towns in Delaware: Milton, Lewes, Henlopen Acres, Rehoboth Beach, Dewey Beach, Bethany Beach, and Fenwick Island. This research seeks to fully understand the economic value of properties is truly at risk in lower coastal Delaware by comparing properties inside and outside FEMA's floodplain. Understanding the effects of sea level rise and the economic impact of flooding on these six coastal towns, public educational outreach can be made to prevent future urban development on vulnerable areas as well as the protection and build up of natural ecosystems like salt marshes.

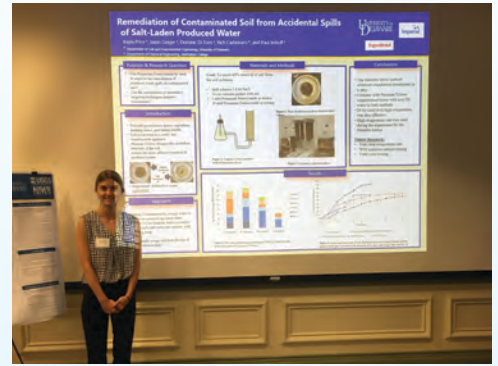


## **Kayla Price** (BENE Environmental Engineering)

Advisor: Dr. Paul Imhoff

### **Remediating Texas Soils Contaminated by Accidental Spills of Fracking Fluids and Produced Water**

This research seeks to determine if potassium ferrocyanide has potential to help remediate contaminated soil and whether the introduction of subsurface irrigation techniques improves remediation. Prussian yellow changes the crystalline structure of the salt and allows for more effective removal of produced waters. We used syringe water to replace measured evaporated water and then used a Mariotte bottle system to continuously add water into the system with a heating lamp. We manually scraped soil from the top of the columns to reach 80% removal of salt from the soil columns. We used a solution of 3.8 M NaCl, 30 cm columns packed with soil, 1 mM potassium ferrocyanide in bottles, 10 mM potassium ferrocyanide in syringe. The Mariotte bottle method achieved a remediation benchmark in 6 days. Columns with Prussian Yellow outperformed those with only DI water in both methods. DI by itself with high evaporation was also effective. A high evaporation rate was used during the experiment for Mariotte bottles. We recommend during final research to find an ideal evaporation rate, conduct well injection method testing, and then conduct field scale testing.



## **Silvie Sandeen** (BA Environmental Science)

Advisor: Martha Narvaez

### **Environmental Literacy in Career and Technical Education in Delaware**

As the impacts of climate change increase in prevalence and severity in Delaware, integrating environmental literacy into education statewide will become increasingly beneficial. This project incorporated an environmental perspective into the existing Pathways Program curriculum for Delaware public high schools through the development of frameworks that will link educators with environmental resources, with the goal of increasing awareness of green jobs and opportunities for careers in sustainability sectors. Environmental literacy is the desired outcome of environmental education and provides our future workforce with sound scientific information, critical thinking skills, and the ability to apply creative, strategic problem-solving to current and future climate challenges.



## **Helena Owen** (BS Environmental Resource Economics)

Advisor: Dr. Maik Kecinski

### **Valuation of Ecosystem Services Related to Water**

Oyster reefs in the Gulf of Mexico have declined at an accelerated rate within the past few decades due to ecosystem stressors such as hurricanes, oil spills, and extensive freshwater exposure. Oyster reefs provide a multitude of benefits such as biodiversity and secondary species effects, improve water quality, support commercial harvesting, and provide storm surge protection. This study used a Discrete Choice Experiment to understand the public valuation of oyster reef restoration in the Gulf of Mexico. This survey is intended to be distributed in the Fall of 2025 via Qualtrics, and the findings are intended to improve restoration efforts, policy making, and resource allocation.

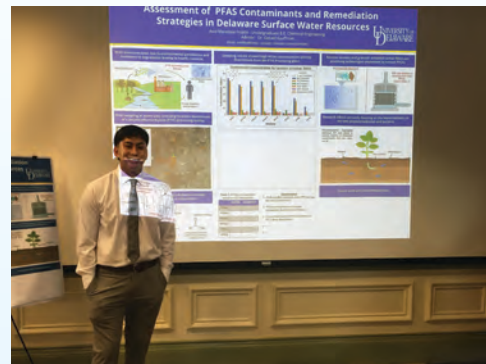


## **Avid Mendiola-Trujillo** (BCHE Chemical Engineering)

Advisor: Dr. Gerald McAdams Kauffman

### **Assessment of PFAS Contaminants and Remediation Strategies in Delaware Surface Water Resources**

Per- and polyfluoroalkyl substances (PFAS) are a group of persistent environmental contaminants of concern that have been widely used in industrial and consumer applications. This study assessed the occurrence and distribution of PFAS contaminants in the Christina River Basin, focused in the Red Clay Creek watershed downstream of the former Solvay PTFE processing facility. Surface water samples were collected during three sampling periods in 2024-2025 and analyzed for key PFAS species. Results indicated that long-chain and short-chain perfluoroalkyl carboxylic acids (PFCAs), particularly PFOA, PFNA, PFHxA, and PFHpA, were the dominant contaminants. PFOA concentrations exceeded the EPA MCL of 4 ng/L by 15–20 times at impacted sites. Spatial patterns suggest that historical industries are a key source of contamination. Sediment sampling showed minimal PFAS accumulation, with most compounds remaining dissolved in the water column. These findings highlight the need for ongoing monitoring, improved treatment technologies, and further study into the behavior of PFAS in surface water and sediments.



## **Jhaney Hamlett** (Master of Public Administration)

Advisor: Martha Narvaez

### **City of Wilmington Green Jobs Program Impact**

The Green Jobs Program is a summer internship program providing City of Wilmington youth exposure to and experiences in natural spaces in their community, environmental topics, careers in the environmental field, outdoor hands-on activities, and professional development. UD's Delaware Water Resources Center (DWRC) and the City of Wilmington Department of Parks and Recreation have partnered on the implementation of this program since 2011. Over the course of a 6-week internship, program hosts--consisting of private, governmental, and non-governmental organizations--provide programming activities for the youth participants. This project developed a survey administered to past program participants. Responses were compiled and analyzed to provide a comprehensive assessment of the program. Understanding how the program performed, it will be possible to refine, enhance, and grow its reach and effectiveness to serve future participants.

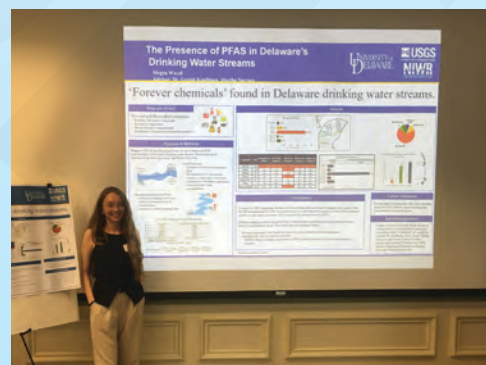


## **Megan Wassil** (MS Water Science & Policy)

Advisor: Dr. Gerald McAdams Kauffman

### **Water Science and Policy Implications of the Presence of Per- and Polyfluoroalkyl Substances in Delaware Drinking Water Streams**

From 2021 to 2025, the University of Delaware Water Resources Center has been sampling Delaware's drinking water streams for the presence of per- and poly- fluoroalkyl substances (PFAS). In April of 2024, the U.S. EPA finalized drinking water standards for six PFAS compounds. This is based on the idea that PFAS have the potential to harm human health primarily through the ingestion of contaminated drinking water. Findings show some level of PFAS in all Delaware drinking water streams near or below the EPA standards. However, Red Clay Creek was found to have levels of PFOA and PFNA over 10 times higher than the federal limits.



**Nicole Re** (*Master of Energy and Environmental Policy*)

*Advisor: Dr. Gerald McAdams Kauffman*

***Assessing the Impacts of Loper Bright on Wetlands Protections in the US***

Wetlands provide ecosystem services by filtering nutrients and sequestering carbon to maintain clean waterways and lower greenhouse gas emissions. Regulations to protect wetlands are crucial to avoid environmental degradation. The 1972 Clean Water Act (CWA) is the primary policy that regulates water throughout the United States. As a result of recent US Supreme Court (SCOTUS) decisions altering the definitions of “waters of the United States” fewer wetlands are now afforded federal protection under the CWA.

These SCOTUS decisions are examined to determine their effects on wetland policy, including from the shift from Chevron to Loper Bright, along with Skidmore Deference and Auer Deference. Even under altered definitions of the waters of the US the prevailing political atmosphere in the US will continue to be determinative of ultimate impacts.



**Catherine Gilman** (*Master of Energy and Environmental Policy*)

*Advisor: Dr. Casey Taylor*

***Evaluating the Effectiveness of Reimplementing a Bottle Bill for Cleaner Waterways in Delaware***

Management of solid waste is an important factor in the health of our waterways, since mishandled waste material can easily enter our waterways and cause pollution and habit degradation. Recycling programs have been an important policy tool to help curb the amount of waste and trash in our environment, including Delaware’s Container Deposit Law, begun 1978 and ended in 2010. While Delaware no longer has a deposit law, many other states still have theirs. This project looks at the history and efficacy of container deposit laws to determine whether this approach can be an effective mechanism to reduce waste entering our streams and water bodies, and whether Delaware should reimplement their program.



# DWRC Undergraduate and Graduate Research 2023-2024

**Aaron Balmer** (BS Wildlife Ecology)

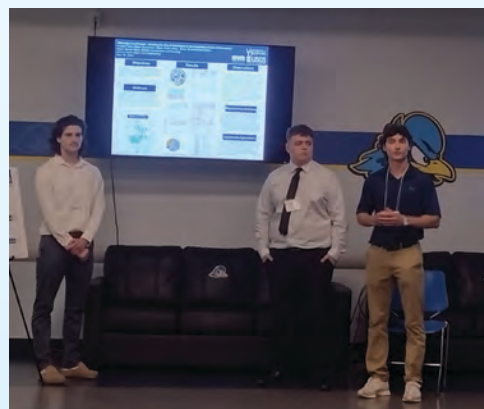
**Cooper Feeny** (BS Economics and Public Policy)

**Dmitriy Rybin** (BCE Civil Engineering)

Advisor: Martha Narvaez

## ***Wilmington Lead Project - Assisting the City of Wilmington in the Completion of their EPA Lead and Copper Rule Inventory***

The USEPA's recent Lead and Copper Rule Revisions required that an inventory of water line materials be comprehensively collected by October 2024. This project assisted the City of Wilmington in developing the inventory of its potable public water distribution infrastructure through an exhaustive review and digitization of historic records. Research interns from the UD's DWRC assisted the City and its contractor in inventorying over 100 years of records, using historic scanned documents, online GIS mapping techniques, and Artificial Intelligence technology to complete the inventory by the deadline. This effort will reduce costs for the City and help protect the health and well-being of the citizens of Wilmington.



**Ambre Crawford** (BS Marine Science)

Advisor: Martha Narvaez and Andrew Homsey

## ***GIS Use in Diamondback Terrapin Conservation in Delaware's Inland Bays***

The diamondback terrapin (*Malaclemys terrapin*) is an endangered keystone species occurring in salt marshes along the east coast, whose ability to nest in the Delaware Inland Bays is threatened by human development and disruptions to the sandy areas where they nest. This project developed on-line GIS-based survey tools to allow volunteers to accurately and efficiently perform the annual count of diamondback terrapins, both on land and in the water, in support of the efforts of the Delaware Center for the Inland Bays. The tools were designed to enhance and extend standardized data collection protocols for the protection of this species regionally.

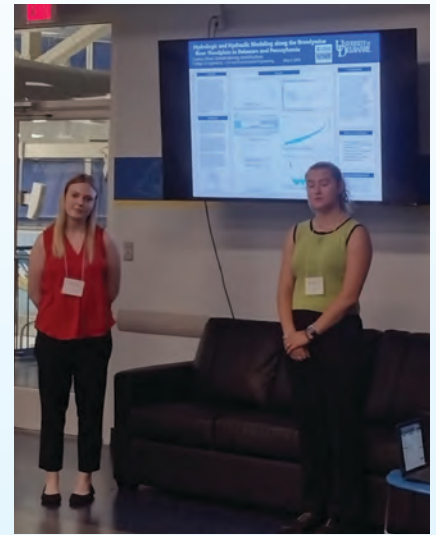


**Caroline Gilliard** (BENE Environmental Engineering)  
**Elizabeth Manning** (BENE Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

***Hydrologic and Hydraulic Modeling along the Brandywine River Floodplain in Delaware and Pennsylvania***

In September 2021 the remnants of Tropical Storm Ida caused widespread flooding in the Brandywine River valley in Pennsylvania and Delaware, when historic flood levels were recorded at gages on the Brandywine and its tributaries. Using the USDA WinTR-55 program the temporal distribution of the discharge were modeled for the period from September 1-3, 2021. HEC-RAS modeling software was also used to determine flood heights and hydraulic characteristics in the affected streams. By identifying areas where existing bridges and culverts caused negative flood impacts up- or down-stream, infrastructure impacting streamflow during flooding events could be identified and prioritized for improvement, alteration, or removal.

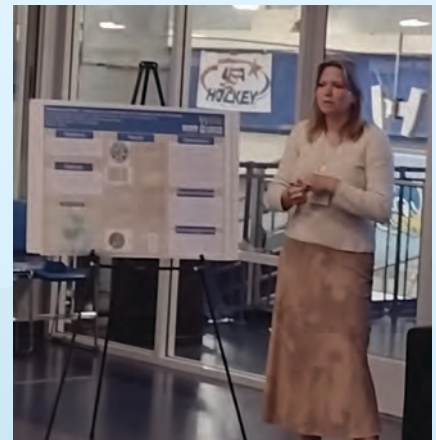


**Catherine Gilman** (BS Energy and Environmental Policy)

Advisor: Dr. Casey Taylor

***Evaluating the Effectiveness of Reimplementing a Bottle Bill for Cleaner Waterways in Delaware***

Management of solid waste is an important factor in the health of our waterways, since mishandled waste material can easily enter our waterways and cause pollution and habitat degradation. Recycling programs have been an important policy tool to help curb the amount of waste and trash in our environment, including Delaware's Container Deposit Law, begun 1978 and ended in 2010. While Delaware no longer has a deposit law, many other states still have theirs. This project looks at the history and efficacy of container deposit laws to determine whether this approach can be an effective mechanism to reduce waste entering our streams and water bodies, and whether Delaware should reimplement their program.



**Nicole Gutkowski** (BS Marine Science)  
**Megan Wassil** (MS Water Science & Policy)

Advisor: Dr. Gerald McAdams Kauffman

***PFAS Assessment of Delaware Raw and Treated Drinking Water Supplies***

Per- and polyfluoroalkyl substances (PFAS) are a contaminant of emerging concern subject to recent scrutiny and regulation by state agencies and the USEPA. Determining whether these compounds are present in the drinking water supplies in Delaware are a prime concern for water providers and public health officials. UD DWRC students sampled raw and treated water supplies for the presence of PFAS over the course of three years: 2021, 2022, and 2024 in the Brandywine River, White Clay Creek, Red Clay Creek, and Christina River, which provide water up to 64 mgd of water used by the City of Wilmington, the City of Newark, and Veolia. Finished water was also sampled from drinking water taps on the UD campus, and from the Newark Reservoir. Levels of PFAS in finished drinking water and most raw surface water were found to be below federal standards, but Red Clay Creek was found to have levels of PFOA and PFNA over 10 times higher than those limits.



## **Summer Moals** (BS Agriculture, Delaware State University)

Advisor: Dr. Ozbay Gulnihal

### **Comparing the Efficacy of Floating Wetland (*Pontederia cordata*) and Submerged Wetland (*Sagittaria subulata*) Treatments for Excess and Nitrogen and Phosphorus Removal from Aquaculture Water**

Aquaculture is an important tool to ensure food availability worldwide, but faces challenges due to nutrient pollution from organic waste and uneaten feed. Techniques such as Floating Treatment Wetlands (FTWs), employ aquatic plants to mitigate these environmental stressors. The effectiveness of two plants, pickerelweed (*Pontederia cordata*) and dwarf sagittaria (*Sagittaria subulata*) at addressing nutrient pollution was explored in 18 replicated tanks at Delaware State University's Aquaculture Research and Demonstration Facility. Pickerelweed was found to be effective at assimilating nutrients, while dwarf sagittaria was effective at stabilizing nutrient concentrations. Plant selection in FTWs was shown to be critical in determining the effectiveness of these methods at supporting aquaculture production.

## **Cole Palmer** (BS Fisheries Management)

Advisor: Dr. Christopher Heckscher

### **Consolidation of Delaware's Tier 1 Insects of Greatest Conservation Need and Associations with Non-Tidal Freshwater Wetlands**

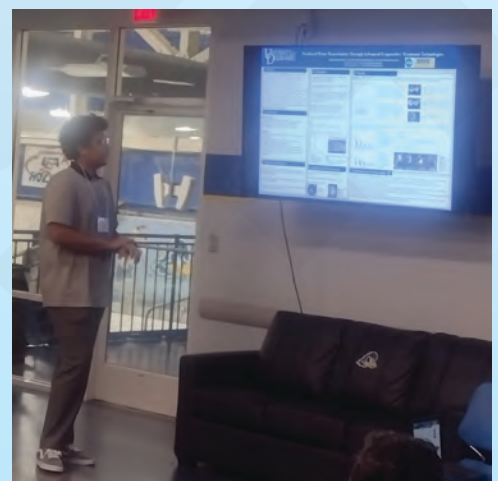
Using the Delaware Wildlife Action Plan as the primary guide, a dataset of Delaware's non-tidal wetlands and their associated Tier 1 insect species was developed. The dataset was used to create an online searchable database for easy viewing of species-habitat associations, as well as sources for each species confirming those associations. Non-tidal wetland ranges and species associations were mapped using the Northeastern Terrestrial Wildlife Habitat Classification System. The goal of the study is the protection and enhancement of Delaware's valuable non-tidal wetland habitats and the ecological communities they support.

## **Brayden Rochester** (BENE Environmental Engineering)

Advisor: Dr. Paul Imhoff

### **Produced Water Remediation Through Advance Evaporative Treatment Technologies**

Hydraulic fracking is an oil and natural gas extraction technique in which water is forced into fissures in the earth through wells. During this process leakage can occur, resulting in contaminated, high-salinity waste water adversely impacting soils, plants, groundwater, and nearby waterways. While treatment and remediation is typically expensive and ecologically harmful, this research proposes a low impact enhanced evaporative flux with the crystallization modifier ferrocyanide (Prussian Yellow) and the use of geotextile mats as a low-impact remediation technique. Under experimental conditions these approaches show promise to provide an affordable method to remove contaminants from soils surrounding fracking sites, and clean up agricultural soils affected by high levels of salinity.



## **Jordan Rosales** (*BS Geological Sciences*)

*Advisor: Dr. Robert Scarborough*

### ***Evaluating the Feasibility of Using UIC Class I Injection Wells in Delaware***

In Delaware the wastewater generated by landfills and wastewater treatment plants (WWTP) is generally disposed of through spray irrigation, rapid infiltration basins (RIBs), or river and ocean outfalls. This research examined the use of underground injection into confined rock formation as an alternative approach (Underground Injection Control Class I Injection Well, or UIC). A favorable waste disposal formation is one that has saline groundwater, is permeable, porous, and is vertically and laterally extensive to accommodate continuous injection over a period of 30 years or longer. Deep geologic resources need to be below any Underground Source of Drinking Water (USDW), with no chance of migration. Delaware has several candidate formations for this alternative to surface distribution of wastewater, including the Queen Anne, Greenville, and Bridgeville Basins of Delaware's Atlantic Coastal Plain, pending on extensive feasibility analysis.

## **Jhaney Hamlett** (*Master of Public Administration*)

*Advisor: Martha Narvaez*

### ***City of Wilmington Green Jobs Program Impact Study***

The Green Jobs Program is a summer internship program providing City of Wilmington youth exposure to and experiences in natural spaces in their community, environmental topics, careers in the environmental field, outdoor hands-on activities, and professional development. UD's Delaware Water Resources Center (DWRC) and the City of Wilmington Department of Parks and Recreation have partnered on the implementation of this program since 2011. Over the course of a 6-week internship, program hosts--consisting of private, governmental, and non-governmental organizations--provide programming activities for the youth participants. This project developed a survey administered to past program participants. Responses were compiled and analyzed to provide a comprehensive assessment of the program. Understanding how the program performed, it will be possible to refine, enhance, and grow its reach and effectiveness to serve future participants

## **Lydia Franks** (*MS Water Science & Policy*)

*Advisor: Dr. Gerald McAdams Kauffman*

### ***A Decade of Change in Shoreline Conditions along the Delaware Inland Bays***

The Delaware Center for the Inland Bays Living Shoreline Initiative focuses on protecting and restoring shoreline habitats through the statewide promotion of nature-based shoreline stabilization. Living shorelines are typically engineered using native vegetation, shellfish, sand, and other natural structures to control erosion while maintaining native habitat. In recent years extensive shoreline erosion has affected Rehoboth, Indian, and Little Assawoman Bays, constituting a need for a detailed shoreline condition inventory. In support of the Living Shoreline Initiative, this study aims to update previous shoreline condition inventories for Rehoboth Bay and Indian Bay and create a shoreline condition inventory for Little Assawoman Bay.

*Biden School of  
Public Policy &  
Administration  
Excellence in  
Water Resources  
Scholarship Medal*

***Biden School of Public Policy & Administration  
(School of Urban Affairs and Public Policy)  
Excellence in Water Resources Scholarship Medal***

The Biden School of Public Policy and Administration (School of Urban Affairs and Public Policy) Excellence in Water Resources Scholarship Award is a medal awarded to a graduate student who demonstrates superior scholarship and interest in the field of water resources planning, management or policy. Qualifications include: recipient must have a superior academic record (minimum 3.5 GPA) and demonstrated excellence and enthusiasm in the water resources field through published papers, projects, and/or presentations.

2025 .....	<i>Megan Wassil</i>
2024 .....	<i>Lydia G. Franks</i>
2023 .....	<i>Elizabeth Shields</i>
2022 .....	<i>Hayley Rost</i>
2021 .....	<i>Kelly M. Slabicki</i>
2020 .....	<i>Kelly Jacobs</i>
2019 .....	<i>Jillian Shaye Young</i>
2017 .....	<i>Briana Diacopoulos</i>
2016 .....	<i>Kristen Molfetta</i>
2015 .....	<i>Laura Askin</i>
2014 .....	<i>Joseph R. Brown</i>
2013 .....	<i>Kate Miller</i>
2011 .....	<i>Stacey Mack</i>
2010 .....	<i>Sarah Chatterson, Erin McVey</i>
2009 .....	<i>Kelly J. Wolfe</i>
2008 .....	<i>Maureen H. Seymour</i>
2007 .....	<i>Melissa Zechiel</i>
2006 .....	<i>Kevin J. Vonck</i>
2005 .....	<i>Amardeep Dhanju</i>
2003 .....	<i>Kevin J. Vonck</i>
2002 ..	<i>Justin M. Bower, Martha B. Corrozi</i>
2001 .....	<i>William J. Smith, Jr.</i>



*Excellence in Water Resources Scholarship Award plaque*



*UD Water Science and Policy Graduate Student Jillian Young receives the Biden School Excellence in Water Resources Scholarship Award, (May 15, 2019)*



*UD Water Science and Policy Graduate Student Megan Wassil receives the Biden School Excellence in Water Resources Scholarship Award, (May 16, 2025)*



*UD Water Science and Policy Graduate Student Lydia Franks receives the Biden School Excellence in Water Resources Scholarship Award, (May 9, 2024)*

*Delaware Water  
Resources Center  
Photo Gallery  
2023-2025*



*UDWRC Advisory Panel Undergraduate Water Research Students at Old College Rm 202 (May 16, 2025)*



*UDWRC Advisory Panel Graduate Water Research Students at Old College Rm 202 (May 16, 2025)*



Earth Day Indigenous Teach-In Flyer (Apr 22, 2025)



55<sup>th</sup> Anniversary of Earth Day Teach-In, UD Memorial Hall (Apr 22, 2025)



Stand Up for Science Teach-In Main St (Mar 7, 2025)



*CIEG 467 667 Streampower Field Survey  
White Clay Creek Brynes Dam No. 1 removed  
Dec 2014 (May 15, 2025)*



*CIEG 467 667 Streampower Field Survey  
Rockland Rd. Bridge on the Brandywine  
(Apr 8, 2025)*



*PFAS Sampling Along the White Clay Creek with  
Megan Wassil  
(Mar 17, 2025)*



*GJMK presents on the History of the Christina Basin Task Force  
(Jan 16, 2025)*



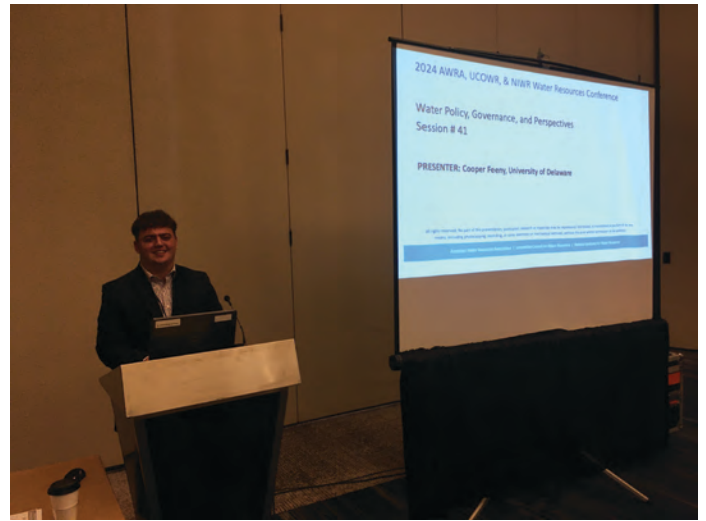
*Martha Narvaez presents at the Brandywine-Christina Watershed  
Conference, Mendenhall, PA (Jan 16, 2025)*



*CIEG 440 Water Resources Engineering, Newark Water Treatment Plant on the Last Day of Class (Dec 10, 2024)*



*UDWRC Nicole Re, Catherine Gilliard, Nicole Minni, and Andrew Homsey representing at UD Coast Day Lewes, Del. (Oct 7, 2024)*



*Cooper Feeny presents at the AWRA UCOWR NIWR 60<sup>th</sup> Conference in St. Louis, MO (Oct 1, 2024)*



*NIWR Presidents at the 60<sup>th</sup> Anniversary AWRA UCOWR NIWR Conference St Louis, MO including Lin – Univ. of Illinois, Kauffman – Univ. of Delaware, Peterson – Univ. of Minnesota, Wagner – Oklahoma State, Fernald- New Mexico State, Megdal – Univ. of Arizona, and Haggard – Univ. of Arkansas (Sep 30, 2024)*



*Delawareans representing at the AWRA/UCOWR/NIWR 60<sup>th</sup> Anniversary Conference in St. Louis (Sep 30-Oct 2, 2024): Rushabh Dohke (UD Mechanical Engineering, graduate student), Carol Collier (Drexel University), David Wunsch (Delaware State Geologist), Andrew Homsey (DWRC), Martha Narvaez (DWRC), Cooper Fenney (UD Economics and Public Policy, undergraduate student), and Gerald McAdams Kauffman (DWRC)*



*UDWRC and Vietnamese Thailand Laos Delegation at UDWRC (May 29, 2024)*



*UDWRC Advisory Panel Meeting - Nicole Gutkowski and Megan Wassil present at the UD Ice Arena (May 16, 2024)*



*GJM presents at the UDWRC Advisory Panel Meeting at UD Ice Arena (May 16, 2024)*



*Water Research Students at UDWRC Advisory Panel Meeting at the UD Ice Arena (May 16, 2024)*



*UD Bratfest – Cooper Feeny, Lydia Franks, Caroline Gilliard, Catherine Gilman and Megan Wassil (May 23, 2024)*



*UAPP 411 611 White Clay Creek Field Recon (Mar 15, 2024)*



*NIWR Annual Meeting in DC (Feb 5, 2024)*



*Rep. Melanie Stansbury (NM) and NIWR President-elect Gerald McAdams Kauffman in Washington, DC (Feb 5, 2024)*



CIEG 440 Water Resources Engineering at Newark Water Treatment Plant (Dec 7, 2023)



Seasons Greetings on the UD Green on Delaware Day (Dec 7, 2023)



Gerald McAdams Kauffman at the Brandywine River Museum of Art, Chadds Ford, PA (Aug 22, 2023)

*Delaware Water  
Resources Center  
Through History  
2000-2023*

# UDWRC Director's Message

October 2023

## *The UDWRC, Presidentially Speaking... Dr. Gerald Joseph McAdams Kauffman, Jr.*

Delaware is the First State and has had a prominent presidential role in leadership lately. After all, a Delaware resident leads the nation and indeed the free world. As one of the million residents in our small state, I am even more aware now of our standing in the nation and worldwide. You could also say that the UDWRC is “presidential” and indeed we are noted as a national leader in water resources research, education, and public service.

### **UDWRC is a Congressionally chartered water research**

**institute:** Established on-campus in 1965 in the year after Lyndon Baines Johnson signed the Water Resources Research Act (WRRRA) of 1964, the UDWRC is one of the 54 Congressionally chartered National Institutes for Water

Resources (NIWR) supported by the Department of Interior and U.S Geological Survey at land grant universities in the 50 states, D.C., and three island territories of Guam, Puerto Rico, and U.S. Virgin Islands.

**UDWRC top ranked in the nation by USGS:** The UDWRC is recognized as “exceptional” in support of our students at Delaware universities. Per the Water Resources Research Act of 1984, the Secretary of Interior and Director of the U.S. Geological Survey informed the President of the University of Delaware by letter that the UDWRC is “unique nationally” and its collaborations are “impressive” amounting to a “high” rating and top 12 ranking nationwide among the 54 land grant universities. The five-year evaluation of the 54 National Institutes for Water Resources (NIWR) at land grant universities that stretch from Maine to Micronesia noted that our institute: (1) Engages with universities/colleges around the state, (2) Has strong leadership on the part of the Institute Director, and (3) Facilitates research and information transfer closely tied to the water resources needs/issues of Delaware.

**UD AWRA voted national student chapter of the year:** Our national prominence in water is further cemented with news that the University of Delaware student section of the American Water Resources Association (UDAWRA) was voted for the 4<sup>th</sup> time as the national chapter of the year, a feat matched only by the University of Wisconsin and the University of Florida. Martha C. Narvaez is the faculty advisor of the nationally prominent UD student section of the AWRA.

**American Water Resources Association (AWRA) 51<sup>st</sup> President:** In 2015, Martha C. Narvaez was elected as the 51<sup>st</sup> President of the American Water Resources Association (AWRA). The AWRA was established in 1964 and with 25,000 members is the world's largest water resources professional organization.

**Brandywine Red Clay Alliance (BRC) 77<sup>th</sup> President:** In 2021, Andrew R. Homsey was elected as the 77<sup>th</sup> President of the Brandywine Red Clay Alliance of West Chester, Pennsylvania which was established in 1945 as the oldest small watershed association in the United States.

**Universities Council on Water Resources (UCOWR) 59<sup>th</sup> President:** In June 2023 at the national conference at Colorado State University, DWRC director Gerald McAdams Kauffman was elected as the 59<sup>th</sup> President of the Universities Council on Water Resources (UCOWR) which represents the 80 water resources research and degree-granting institutions of higher learning in America. Established in 1964, the UCOWR board is composed of faculty from the University of Delaware, Texas A&M, Minnesota, Oklahoma State, Mississippi State, Penn State, Purdue, Virginia Tech, Kansas State, University of Hawaii, University of California Berkeley, Washington State, and Southern Illinois University.



*Gerald McAdams Kauffman at UCOWR Annual Conference  
(Jun 14, 2023, Colorado State Univ., Ft. Collins, CO)*

## ***About the UDWRC***

**Mission:** Established in 1965 as one of the 54 National Institutes for Water Resources<sup>1</sup> (NIWR) at land grant universities in the 50 states, the District of Columbia, and three island territories of Guam, Puerto Rico, and the U.S. Virgin Islands. The UDWRC is Congressionally-mandated by Section 104 of the Water Resources Research Act of 1984 and 1964 administered by the U.S. Department of the Interior and U.S. Geological Survey. As part of the NIWR network, the mission of the UDWRC is to: (1) Support research, education, and public outreach programs that focus on water supply, water management, and water quality—issues important to Delaware citizens and (2) Foster/support training and education programs for future water scientists, engineers, managers, and policy-makers who will lead the water resources research, planning, and management efforts in our state.

**Staffing:** The UDWRC hosts the following faculty, scientists, and students to fulfill our mission:

Gerald McAdams Kauffman - Director/Associate Professor  
Martha C. Narvaez - Policy Scientist/Associate Director  
Nicole M. Minni - Associate Policy Scientist/GIS Laboratory, Lewes Campus  
Andrew R. Homsey - Policy Scientist/GIS Manager  
Marta Driscoll - Grant Analyst  
Liz Shields - Post-Graduate Research Fellow (Master of Public Policy)  
Lydia Franks - Graduate Research Fellow (Master of Water Science & Policy)  
Jhaney Hamlett - Graduate Research Fellow (Master of Public Administration)  
Alex Makowski - Graduate Research Fellow (Master of Public Administration)  
Megan Wassil - Graduate Research Fellow (Master of Water Science & Policy)  
Cooper Feeny - Graduate Research Fellow (Master of Water Science & Policy)

### **UDWRC Advisory Panel**

Stefanie Baxter - *Delaware Geological Survey*, University of Delaware, Newark, DE  
Dr. Asia Downtin - *Department of Forestry*, Michigan State University, East Lansing, MI  
Dr. Dewayne Fox - *College of Agriculture and Related Sciences*, Delaware State University, Dover, DE  
Christian Hauser - *Delaware Sea Grant*, Newark, DE  
Dr. Mi-ling Li - *School of Marine Science & Policy*, University of Delaware, Newark, DE  
Stacy McNatt - *Department of Special Services*, New Castle County, New Castle, DE  
Shane Morgan - *White Clay Creek Wild and Scenic Management Program*, Landenberg, PA  
Chris Oh - *Department of Public Works*, City of Wilmington, Wilmington, DE  
Erica Rossetti - *Partnership for the Delaware Estuary*, Wilmington, DE  
Betzaida (Betzy) Reyes - *U.S. Geological Survey*, Dover, DE  
Ethan Robinson - *Department of Public Works*, City of Newark, Newark, DE  
Kash Srinivasan - *Kash Srinivasan Group*, Wilmington, DE  
Kristen Travers - *Delaware Nature Society*, Hockessin, DE  
Dr. Carolyn Voter - *Civil and Environmental Engineering*, University of Delaware, Newark, DE  
Steve Williams - *DE DNREC, Division of Watershed Stewardship*, Dover, DE

[1 https://water.usgs.gov/wrri/index.php](https://water.usgs.gov/wrri/index.php)

## ***Meet the 2023-2024 UDWRC Graduate Research Fellows***

### ***Lydia Franks***



Lydia is a second-year Master's student in the Water Science and Policy Program and Co-Chair for the University of Delaware Student Chapter of the American Water Resources Association (AWRA). She is from Northeast Ohio and completed her Bachelor's degree in Environmental Science at the University of Akron. Prior to joining the University of Delaware community, Lydia worked in county parks systems and environmental consulting. Currently, at the Water Resources Center, she conducts water quality monitoring for the White Clay Creek National Wild and Scenic River Program, works with the City of Wilmington to locate and inventory water service lines according to the EPA's Lead and Copper Rule, assists with GIS projects on shoreline conditions and stormwater management, and is assisting with an economic valuation report of the upper Delaware River watershed in New Jersey. Lydia's primary research interests include human impacts on water quality and watershed restoration.

### ***Jhaney Hamlett***



Jhaney is a 2019 graduate of Delaware State University where she received her Bachelor's degree in Mass Communications with a specialization in Public Relations. After graduation, Jhaney's background of connecting with communities and personal affinity for protecting the environment led her to work at Delaware Nature Society as a Communications and Outreach Coordinator. In this position, Jhaney found an appreciation for nonprofit work to service and improve the community. Jhaney's work experience, mentorship, and encouragement from colleagues have brought her to the University of Delaware to continue her studies at the Biden School's Institute for Public Administration to pursue a Master of Public Administration (MPA) degree, where she will specialize in Nonprofit Management. During Jhaney's time in the MPA program, she will be working as a fellow with the University of Delaware's Water Resources Center. Jhaney hopes that specializing in nonprofit work will give her the skills to be an advocate and do work that can bring social justice.

### ***Elizabeth Shields***



Liz is a Delaware native and recent graduate of the Biden School's Master of Public Policy program where she concentrated in environmental policy and climate change studies. She also earned her Bachelor's degree in Environmental Studies from the University of Delaware's College of Earth, Ocean, and Environment in 2020. Her research involves various activities throughout the Delaware River Watershed and projects related to community engagement around water, climate, and Environmental Justice topics. Liz volunteers on the Executive Committee of the Delaware Chapter for the Sierra Club where she is Co-Chair of the Climate & Energy Committee. She currently lives in Pike Creek with her family and dog, Myla.

### ***Megan Wassil***



Megan is a first-year Master's student in the Water Science and Policy program. She is from Lincoln University, Pennsylvania, and received her Bachelor's degree from the University of Delaware in Environmental Engineering. Megan has worked on various projects with the Delaware Water Resources Center in her undergraduate career which included water quality testing of the White Clay Creek, sampling of the tidal Christina River, and PFAS testing in various locations. This past summer Megan reviewed work orders of public water lines in the City of Wilmington to track lead pipes in Wilmington's drinking water system.

***Master of Public Policy Grad Liz Shields  
Awarded 2023 UDWRC Excellence in Water Resources Scholarship Medal***

On May 27, 2023, Elizabeth Shields graduated from the University of Delaware with a Master's degree in Public Policy. During the spring semester, Shields was also awarded the 2023 Biden School of Public Policy and Administration Excellence in Water Resources Scholarship Award for her dedication and innovation. Shields began working at the University of Delaware's Water Resources Center (UDWRC) in August 2021. A few of her most notable research projects include the (1) Reconnaissance Study of Potentially Eligible National Wild and Scenic Rivers in Delaware, (2) Study of The Economic Value of the Tributaries of The Upper Delaware River, and (3) Administration and Oversight of the City of Wilmington Green Jobs Program. Shields has also shown interest in learning more about the multitude of ongoing projects at UDWRC and has taken on extra work to further her knowledge of the water resources field in areas such as field work, advocacy and education, and outreach.



*Elizabeth Shields (center) receives the 2023 UDWRC Excellence in Water Resources Scholarship Medal with Jerry Kauffman, Jerome Lewis, Liz Shields, Martha Narvaez, and Andrew Homsey*

## ***UD Water Resources Center Represents at the 2023 UCOWR/NIWR Annual Water Resources Conference at Colorado State University in Fort Collins, CO***



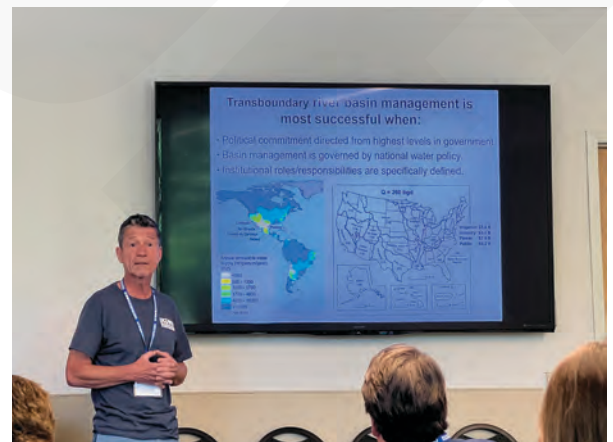
*UDWRC Director Gerald McAdams Kauffman accepting the gavel from outgoing UCOWR Board President Dr. Bridgette Guerrero (Texas A&M) at the UCOWR Annual Conference Awards Luncheon on June 14, 2023 at Colorado State University in Ft. Collins, CO*

The UD Water Resources Center was well represented among the 360 attendees from water research universities throughout North America at the 2023 UCOWR/NIWR Annual Water Resources Conference on June 13-15, 2023, at Colorado State University in Ft. Collins, Colorado. UDWRC staff and students presented the following water resources research in Delaware and the region.

- East is East and West is West: Interstate River Basin Governance of Drought and Flood in the USA.
  - Dr. Gerald McAdams Kauffman, Director, Delaware Water Resources Center, University of Delaware, Newark, Del.
  - Dr. Sharon Megdal, Director, Arizona Water Resources Research Center, Univ. of Arizona, Tucson, AZ
  - Dr. John Tracy, Director, Colorado Water Center, Colorado State University, Ft. Collins, CO
- City of Wilmington Green Jobs Program, Martha Narvaez, UDWRC Associate Director and Policy Scientist
- The Watersheds and Landscapes of the Delaware Basin and Estuary: 2023 Status and Trends, Andrew Homsey, Policy Scientist
- Indigenous and European Place Names Along Streams and Waterways in Delaware (Lenapehocking), Elizabeth Shields, Master of Public Policy.
- Economic Value of New Jersey Tributaries to the Delaware River, Lydia Franks, MS Water Science & Policy)



*UDWRC represents at UCOWR/NIWR Annual Conference at Colorado State Univ. (Ft. Collins, CO, Jun 14, 2023)*



*Gerald McAdams Kauffman presents at UCOWR/NIWR Annual Conference at Colorado State Univ. (Ft. Collins, CO, Jun 14, 2023)*



*Jerry Kauffman speaks at Brandywine Flood Study Press Event at Brandywine Conservancy (Aug 2023)*



*DWRC graduate student Lydia Franks conducts water quality sampling field work in the Wild & Scenic White Clay Creek*



*Lydia Franks, Liz Shields, and Jerry Kauffman (left to right) participate in outreach at the White Clay Creek Fest (May 2023)*



*City of Wilmington Mayor Purzycki, Deputy Director City of Wilmington Parks and Rec Department, DWRC's Martha Narvaez and City of Wilmington Green Jobs Program interns at closing ceremony (Aug 4, 2023)*



*IPA Director, Jerome Lewis, and DWRC staff and graduate and undergraduate research interns gather at the DWRC Advisory Panel meeting (May 11, 2023)*



*DWRC's annual Bratfest cookout brought out both students and other faithful friends (May 17, 2023)*



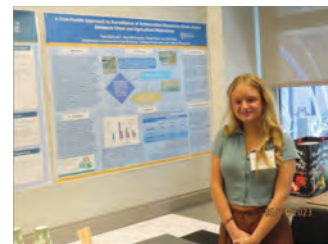
*Wilmington watershed bike tour at the Coalition for the Delaware River Watershed Conference (Oct 2023)*

## 2022 - 2023 Undergraduate Water Research Students

**Theodora Bertneski** (Food Science)

Advisor: Dr. Kali Kniel

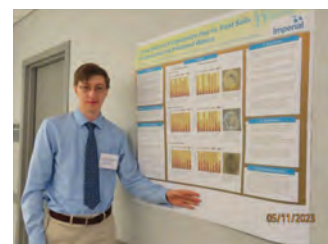
*AMR Detection and Analysis of Spread Through Delaware Watersheds*



**Andrew Blackburn** (Chemical Engineering)

Advisor: Dr. Paul Imhoff

*Use of Precipitation and Evaporative Flux on Treating Soils with High Salt Concentrations*

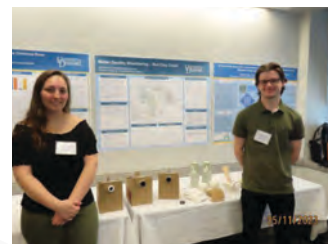


**Francesca Discenza** (Environmental Engineering)

**Jake Marren** (Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

*Water Quality Trends Along the White Clay Creek National Wild and Scenic River in Creek National Wild & Scenic River in Delaware and Pennsylvania*



**Owen Donnelly** (Biology)

Advisor: Dr. Eric Wommack

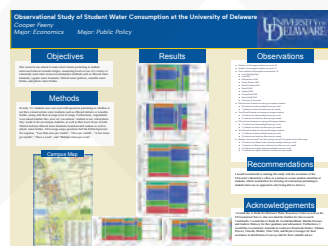
*COVID19 Detection and Surveillance in Wastewater in the White Clay Creek Watershed in New Castle County, Delaware*



**Cooper Feeny** (Economics and Public Policy)

Advisor: Dr. Gerald McAdams Kauffman

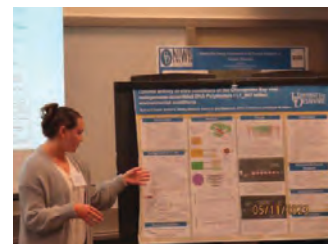
*Taste, Odor, Water Quality and Public Perception of Drinking Water Supplies in Delaware*



**Sydney Iredell** (Biology)

Advisor: Dr. Eric Wommack

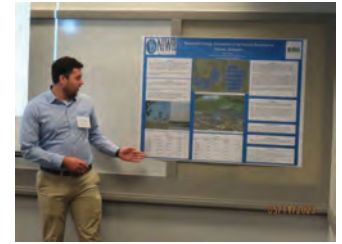
*COVID19 Detection and Surveillance in Wastewater in the White Clay Creek Watershed in New Castle County, Delaware*



**Brian Kennedy** (Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

**Water Quality Monitoring of the Newark Surface Water Supply System Along the White Clay Creek in Delaware**



**Nathaniel Levia** (Insect Ecology and Conservation)

Advisor: Dr. Shreeram Inamdar

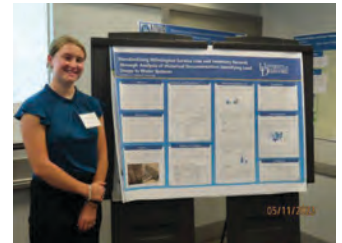
**The Effects Mill Dams Have on Insects and Spiders in Aquatic and Riparian Ecosystems**



**Elizabeth Manning** (Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

**Watershed Characterization of the Tributaries Along the Red Clay Creek**



**Kylee McGinness** (Biology)

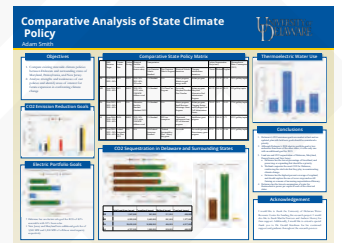
Advisor: Dr. Eric Wommack

**COVID19 Detection and Surveillance in Wastewater in the White Clay Creek Watershed in New Castle County, Delaware**

**Adam Smith** (Political Science and Criminal Justice)

Advisor: Dr. Gerald McAdams Kauffman

**Comparative Analysis of State Climate Policy**



**Sophia Talley** (Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

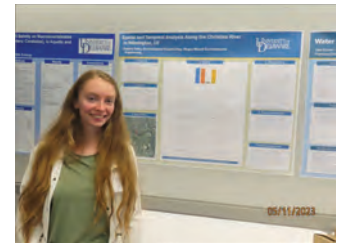
**Temporal and Spatial Analysis of the Christina River in Wilmington Delaware**



**Megan Wassil** (Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

**Temporal and Spatial Analysis of the Christina River in Wilmington, Delaware**



**Alyssa Wentzel** (Energy and Environmental Policy)

Advisor: Dr. Gerald McAdams Kauffman

**Microplastics and Delaware Waterways**

## 2022-2023 Water Resources Center Graduate Assistants

**Lydia Franks** (M.S. Water Science & Policy)

Advisor: Dr. Gerald McAdams Kauffman

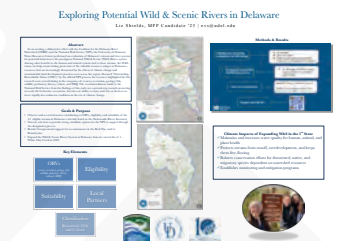
**Surface Water Quality Patterns of White Clay Creek Subwatersheds in Delaware and Pennsylvania**



**Elizabeth Shields** (Master of Public Policy)

Advisor: Dr. Gerald McAdams Kauffman

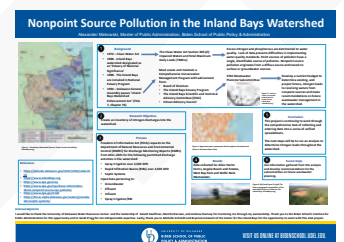
**Reconnaissance Study of Potentially Eligible National Wild & Scenic Rivers in Delaware**



**Alex Makowski** (Master of Public Administration)

Advisor: Martha Narvaez

**Nonpoint Source Pollution in the Inland Bays Watershed**



# *UDWRC Director's Message*

**June 2022**

***Drought is Drought and Flood is Flood, And Never the Twain Shall Meet***

***Dr. Gerald Joseph McAdams Kauffman, Jr., Director  
University of Delaware, Water Resources Center***



*Jerry Kauffman in a blizzard at Mt Greylock (Mar 2022)*

“Oh, East is East, and West is West, and never the twain shall meet.” Rudyard Kipling wrote this about colonialism and the state of world affairs in 1889, and one could apply it to the Russian invasion of Ukraine now. But in this case, we may apply it to the affairs of climate and water. While the West bakes in the worst drought in a millennium, the East has been deluged by the floods of Ida, the worst in two centuries along the Brandywine in Delaware and Pennsylvania. While drought and flood are at opposite extremes of the hydrologic cycle, they share the common causes of atmospheric warming and climate change. With Joe Biden (UD '65) now in the White House as the 46<sup>th</sup> President of the United States of America, I want to share with you my views on a national approach to these global challenges because at the UDWRC we employ the “Delaware Model” to address climate and water problems.

In Barcelona during the November 2009 negotiations for the Copenhagen climate conference, the executive director of the Stockholm International Water Institute precisely said that “climate change is water change.” This is explained in thermodynamics by the Clausius-Clapeyron relationship that for every 2 degrees Fahrenheit rise in temperature the atmosphere can hold 7 percent more water vapor. That is, global warming causes more evaporation, higher humidity, and increased water saturation in the atmosphere resulting in more wildfires, damaging storms and floods, searing drought, burying blizzards, and melting of the glaciers leading to dwindling water supplies and sea-level rise. With the inauguration of President Joe Biden on January 20, 2021, and the 117<sup>th</sup> Congress, climate change is once again a top priority of the federal government, and we are seeing a brand new age—the 4<sup>th</sup> era of environmentalism—in the United States. The actions and deliberations on climate change ought to be apolitical and nonpartisan because after all to adapt an adage from my colleague at the University of Minnesota Water Resources Center, “clean water (and air) is neither red or blue, it is clear.”

In these new “Roaring Twenties” the four great challenges of the day are: (1) Fight the pandemic, (2) Revive the economy, (3) Combat climate change, and (4) Achieve racial justice. All four of these issues are intertwined in the disciplines of sustainable water and environmental policy. Clean water provides necessary hygiene to control the spread of the coronavirus. Clean water programs stimulate the economy and support high-paying green jobs. Finance of clean low-carbon energy combats climate change. Investment in polluted neighborhoods provides environmental justice to fight racism and provides good jobs for people of all races, creeds, and colors.

On March 22, 2016, President Obama invited 200 scientists to the White House Water Summit in Washington, D.C. On UN World Water Day, the White House hosted this first-ever national water summit to shine a spotlight on cross-cutting, creative solutions to solving the water problems of the day. Six years later, we're looking forward to the next White House summit that could be a "Bretton Woods" of water and climate modeled on the 1944 economic summit where the 75 allied nations assembled in the White Mountains of New Hampshire to plan a new world order. Constitutionally, Delaware is the First State, and so it is in water. Sitting on the Delmarva Peninsula and surrounded on three sides by water, it is one of just three peninsular states, and with the C&D Canal, many consider it technically to be an island. At a mean elevation of only sixty feet above sea level, Delaware is also the lowest state in the United States with one-fifth of its landmass in the floodplain and a beautiful and bounteous 130-mile coastline with the cleanest ocean beaches in the nation. But this profile leaves the state vulnerable to worsening coastal storms and accelerating sea-level rise, perhaps more than other states. The Diamond State is fortuitously situated by geography and hydrology between two great estuary systems in America, the Chesapeake and the Delaware, that support abundant ecology and a \$16 billion water economy.

Twenty years ago, at the turn of the century, Delaware took action to address the critical water issues of the day in a collaborative manner of getting along known as the "Delaware Model." In 2000, the Governor and General Assembly appointed the Water Supply Coordinating Council and a State Water Master that transformed water supply management in Delaware after the crippling drought of 1995–2002. The same year a state law was passed creating the Delaware Nutrient Management Commission a voluntary program that allows farmers to modernize farms and reduce nutrient loads to the Delaware, Chesapeake, and Inland bays without overbearing regulation. Also in 2000, Bill Clinton signed the White Clay Creek National Wild and Scenic River Act advanced by Senator Joe Biden (D-DE) and Congressman Joe Pitts (R-PA) as a bipartisan interstate approach to preserve the watershed in Delaware and Pennsylvania that supplies drinking water to 200,000 people or a full one-fifth of the population of the First State. Since then, Delaware has created a Division of Climate Change and Energy in the Department of Natural Resources and Environmental Control (one of the first in the nation) with a focus on climate change, sea-level rise, and clean energy. Delaware enacted these water and climate programs a generation ago and this cooperative way of cleaning up the environment is a model available to the greater United States.



*UD MPA Grad Hayley Rost Awarded 2022 Biden School of Public Policy & Administration Excellence in Water Resources Scholarship Medal (May 2022)*

## Ratledge Family Award for Delaware Public Service

*Dr. Gerald McAdams Kauffman*

The 2021 recipient of the Ratledge Family Award for Delaware Public Service included Gerald Joseph McAdams Kauffman, Jr., director of the UD Water Resources Center (UDWRC) in the Institute for Public Administration (IPA) and associate professor in the Biden School of Public Policy and Administration. “It gives me great pleasure to recognize the outstanding recipients of the 2021 and 2020 Ratledge Family Award,” said Maria Aristigueta, dean of the Biden School and the Charles P. Messick Chair in Public Administration. “As the director of the UDWRC, Jerry defined two key missions related to Delaware’s water resources—our precious groundwater aquifers and our streams, ponds, lakes, and coastal waters,” said Jerome R. Lewis, director of IPA in the Biden School. “The first is to support research, education, and public outreach programs that focus on water supply, water management, and water quality—issues of considerable importance to Delaware citizens who are concerned about the future of our water resources. The second mission is to foster and support training and education programs for the future water scientists, engineers, managers, and policymakers who will lead the water resources research, planning, and management efforts in our state in the future.”

“For me, Delaware provides one of the very finest settings in the nation to conduct public service through our institute, school, and University,” Kauffman said. “Our land grant mission at the University of Delaware is a three-legged stool of public service, education, and research based on the Delaware model. Our small yet progressive state provides us the ability to translate new knowledge from research in the laboratory and education in the classroom out to our citizens and governments by public service in a way that few states and universities can match. I am very proud to be a part of it all and quite glad to receive the Ratledge Family Award this year.”

## Red Flag Alert! Bratfest 2022

On April 28, 2022, for the first time in three years, we celebrated the reemergence from the pandemic and 20 years of the annual Wisconsin-style Bratfest at the offices of the UDWRC in Newark, Delaware. Brought east by University of Wisconsin graduate, President of the Madison student body, and UD urban affairs and public policy doctoral student Kevin Vonck, this annual lunch celebrates the beauty of the brat boiled in beer and onions and then grilled to a delicious char with sauerkraut and onions on a fresh Philly style roll. But this year an unprecedented Arizona-style Red Flag Alert by the National Weather Service with less than 10 percent humidity and over 20-mph winds shut down the grills at the office grounds. With contingency plans in effect, 100 vegan and 200 regular brats were safely cooked by the chefs at the offices of the Fairfield Watershed Association in Newark, Delaware and delivered at noon on the appointed day.



*Sophie, Liz, and Martha at Bratfest '22*



*Undergrads at Bratfest '22*



*Kristie and Jerry at Bratfest '22*



*Dr. Jerome Lewis (left) and Dr. Gerald McAdams Kauffman (right) accepting the Ratledge award*

## Platinum Anniversary of the Delaware Water Supply Coordinating Council

On January 1, 2000, the Delaware Water Supply Coordinating Council (WSCC) was established by Governor Tom Carper and a unanimous vote by the Delaware General Assembly to transform water supply and management in the First State in the aftereffects of the drought emergencies of 1995 and 1999. The Water Supply Coordinating Council was appointed by Executive Order No. 74 on December 30, 1999. The Secretary of DNREC was appointed by the Governor as chair. The Delaware Geological Survey and DNREC were appointed as water advisory agencies. The Governor's Executive Order No. 74 also appointed the Water Resources Agency at the University of Delaware as the State's Temporary Water Coordinator for a period that expired on December 31, 2000. The responsibility of the Water Coordinator is to work cooperatively with the public and private water purveyors to ensure that additional water supplies are developed within an agreed-upon schedule without slippage. HB No. 549 was later passed unanimously by Governor Ruth Ann Minner and the General Assembly that would appoint the WSCC and the Water Coordinator through December 31, 2003, when the options for expanded water supplies identified in the Task Force report were scheduled to be completed. This foresight to give us just three years to build a million gallons of reserve water supply storage in northern Delaware was cogent as the drought emergency reoccurred in 2002 and the WSCC later built 2 million gallons of reserve storage, double the goal, to meet the demands during the next drought. Over the 22 years since the Delaware Water Supply Coordinating Council was established, there have been five DNREC secretaries, four governors, three state geologists, two state climatologists, and one temporary water coordinator. After 22 years and 31 days, the responsibility of the Temporary Watershed Coordinator for New Castle County has been fulfilled with the sunset of the WSCC on Jan 31, 2022.



*Newark Reservoir filling 2005*



*GIS Conference committee members Miriam Pomilio, Nicole Minni and Laurel Sullivan (May 2022)*



*GIS Conference attendees (May 2022)*



Attendees gathered at the 57<sup>th</sup> Annual meeting of the UDWRC Advisory Panel last month at Hillside Park in Newark (May 2022)



UDWRC Graduate fellows outside the office: Hayley (left), Sophie (middle), and Liz (right) graduated in May 2022



UD undergraduate students get prepped for the Northbrook tour via kayak (May 2022)



UDWRC Graduate Research Assistants Sophie Phillips and Liz Shields, enjoying UDWRC Bratfest (May 2022)



UDWRC Graduate Research Assistant & Miss Delaware Sophie Phillips with Senator Chris Coons on the Brandywine River for the Shad 2020 Meeting at Dam 2

## 2021 - 2022 Undergraduate Water Research Students

**Andrew Blackburn** (Chemical Engineering)

Advisor: Dr. Paul Imhoff

*Physical and Chemical Effects of Biochar on Soil*



**Nicole Gutkowski** (Marine Science -Oceanography)

Advisor: Dr. Mi-Ling Li

*Investigating the Utility of Bivalves as Biomonitors of Heavy Metal Contamination in the Delaware Bay*



**Megan Jarocki** (Environmental Engineering)

**Megan Wassil** (Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

*PFAS Analysis Along the Four Drinking Water Streams in New Castle County, Delaware*



**Brian Kennedy** (Energy and Environmental Policy)

**Erik Rodriguez** (Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

*Water Quality Analysis of the Water Supply System in and Around Newark, Delaware*



**Nathaniel Levia** (Insect Ecology and Conservation)

Advisor: Dr. Shreeram Inamdar

*How Mill Dams Affect Insects and Spiders in Aquatic and Riparian Ecosystems*

**Andreanna Roros** (Geological Sciences)

Advisors: Rachel McQuiggan, Dr. Changming He, Dr. Scott Andres

*Impact of Stormwater Infiltration on Groundwater Radium Levels in Delaware*



**Sophia Talley** (*Environmental Engineering*)

*Advisor: Dr. Gerald McAdams Kauffman*

***PFAS Analysis Along the Four Drinking Water Streams in New Castle County, Delaware***



## **2021-2022 Water Resources Center Graduate Assistants**

**Sophie Phillips** (*Master of Energy and Environmental Policy*)

*Advisor: Dr. Chris Williams*

***Diversity in National Parks: How Understanding our Past Can Help Us Create an Inclusive Experience***



**Hayley Rost** (*Master of Public Administration*)

*Advisor: Andrew Homsey*

***Water Quality Monitoring in the White Clay Creek National Wild & Scenic River***



**Elizabeth Shields** (*Master of Public Policy*)

*Advisor: Dr. Gerald McAdams Kauffman*

***Indigenous and European Place Names Along Stream and Waterways in Delaware (Lenapehocking)***



# *UDWRC Director's Message*

**April 2021**

***Everyone is Equal on this Blue Earth***

***Dr. Gerald Joseph McAdams Kauffman, Jr., Director  
University of Delaware, Water Resources Center***

Back during the pandemic summer, Martha, Nicole, Andrew, and I crafted a FY21 work plan to direct our efforts at maximum efficiency in this time of great challenges during the global pandemic and at long last our racial awakening. I am writing here from the Biden School, a place of great hope and feeling that if we stick together and learn about the social and physical sciences and treat people with decency, civility, and diversity in background and opinion that this world will be alright again.

As school resumed last fall, the health of everyone we work with is of paramount importance as we fight this pandemic. Our fieldwork along the White Clay Creek National Wild and Scenic River near Newark and Brandywine River in Wilmington has been safely conducted by our research students distancing and with masks. With support from Sec 104b of the Water Resources Research Act of 1984 and the appropriation by Congress this fiscal year through the U.S. Department of the Interior and U.S. Geological Survey we can provide for the funded water resources research of 17 undergraduate and graduate students to examine the critical water issues of the day in Delaware and the mid-Atlantic region. In Delaware and on campus we receive excellent guidance from the offices of the Governor and UD President about safe practices to stay healthy and we are committed to following these practices and most importantly wear masks when inside and out. Now the UD nursing school is conducting vaccinations on campus looks like there is light at the end of our watershed that is the home of Jennersville, Pennsylvania after the young physician from Oxford who developed the smallpox inoculation in 1776 and saved the world!

With regard to our racial awakening and indeed my own personal reckoning, I have thought about this every day and looked into the mirror and we need to do better – much, much better. The scales are off my eyes now and at long last the stage is set for true racial equality where indeed all of humanity is created equal with certain unalienable rights endowed by our creator under the laws of nature. The UDWRC will become more diverse, we will bring on more scientists and students of every color from Delaware and America and from every corner of the globe.

Four years ago, I requested that our homepage fly the message from Amos 5:24 and MLK, Jr. that reminds us to “let justice roll on like a river, righteousness like almighty stream” and these are the words that we live by and will continue to live by. I was taught to fight racism wherever it reared its ugly head up but it’s not enough.

And so now I look back on my life almost a half century ago when as a young guy learned about true courage from the amazing Olympians of Mexico City 1968. During the summer of 1977 my track coach was Larry James (the Mighty Burner) who ran at Villanova and was the AD at Stockton State down near Atlantic City and in the 1968 Mexico City Olympics he ran 43.97 and won the silver in the 400m and gold in the world record 4x400 relay and his teammates were three amazing men, Lee Evans, John Carlos, and Tommie Smith. I met them one day at a training camp in the Pine Barrens and they told me how they were ostracized and banned from their sport after raising their fists on the medal stand in 1968 and I was in awe of the world class athletes sitting with me but the beautiful thing is that they took this young white guy in and tried to tell me how it felt to be black and speak their minds while paying the ultimate price and banned from doing what they loved which was to run. These good men were a half century ahead of their time and their story is beautiful and right and true. I have their photo in my office at UD from 50 years ago with the Australian silver medalist Peter Norman who stood on that stand with them and opposed racism and supported his competitors and friends the black Americans and he too was ostracized when he went back to his country and never ran in the Olympics again. These young men black and white stood up to end racism and the old men took away the gift that God gave them, the ability to run fast! So, I never fully appreciated the lessons of warmth and inclusion and forgiveness that Larry, Lee, John, and Tommie taught me during that brief time in the summer at the turn of the 80s but I look back to that lesson to help me understand now.

What is clear to me is that everyone is equal on this blue Earth and that the only way forward is to stick together and choose love over hate. Our office at UD stands as a welcoming place of peace and tolerance and safety and I ache for my Black countrymen and those of all races who suffer from racism and bigotry in ways that I cannot begin to understand. I wish you all peace, health, and love.



*Joseph R. Biden, Jr. School of Public Policy & Administration (May 2018)*

## 2020 - 2021 Undergraduate Water Research Students

### **Sitlaly Avelino** (Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

**Watershed Characterization of First Order Tributaries along the Brandywine River in Delaware**



### **Brendan Benson** (Environmental Engineering)

Advisor: Dr. Paul Imhoff

**The Effect of Biochar on Infiltration Rate and Soil Aggregation in Both the Field and Lab**



### **Brielle Bianchini** (Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

**Water Quality Trends in White Clay Creek National & Wild Scenic River, Delaware and Pennsylvania**

### **Tommy Breedveld** (Environmental Engineering)

### **Lily Peterson** (Environmental Engineering)

Advisors: Dr. Gerald McAdams Kauffman & Dr. Julia Maresca

**Stream Habitat Sampling along Tributaries of the Red Clay Creek in Delaware**



### **Shannon Bushinsky** (Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

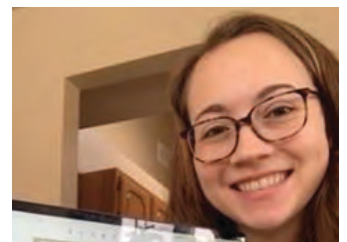
**Intergovernmental River Basin Management, the International Joint Commission Model**



### **Alexis Cervantes** (Environmental Science)

Advisor: Dr. James Pizzuto

**Historic Significance of the Brandywine River as Drinking Water Supply in Wilmington, Delaware**



**Elizabeth De Sonier** (Environmental Science)

Advisor: Dr. James Pizzuto

**Stratigraphy of Valley Fill Deposits Upstream of a Small Colonial-Age Mill Dam, White Clay Creek, Pennsylvania**



**Delaney Doran** (Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

**Watershed Characterization of First Order Tributaries along the Brandywine River in Delaware**



**Grace Hussar** (Environmental Studies)

Advisor: Dr. McKay Jenkins

**The Effects of Reforestation and Invasive Species Removal on Stormwater Flooding Events in Baltimore**



**Emily Jimenez** (Environmental Engineering)

Advisors: Dr. Gerald McAdams Kauffman & Dr. Julia Maresca

**Frequency of Peak Flood and High Tide Events in Delaware with Climate Change and Sea Level Rise**



**Bridgette Kegelman** (Geography/Greek Roman Studies)

Advisor: Andrew Homsey

**Updating Land Use and Impervious Cover Change for the State of the Bays Report**



**Patrick McGay** (Environmental Engineering)

Advisor: Dr. Anastasia Chirnside

**White Rot Fungi with Solid State Bioreactors to Reduce Pathogens in Dairy Manure Runoff**



**Karmyn Pasquariello** (*Environmental Engineering*)

*Advisors: Dr. Gerald McAdams Kauffman & Sarah Palmer*

***Economic Value of Properties in the Coastal/Riverine Floodplain in Delaware with Sea Level Rise***



**Jady Perez** (*Environmental Engineering*)

*Advisor: Dr. Gerald McAdams Kauffman*

***Forest Hydrology and Stream Health in the Hickory Run Watershed at Mt. Cuba Center***



**Anna Singer** (*Environmental. Studies/Public Policy*)

*Advisor: Martha Narvaez*

***Water Quality Trends in White Clay Creek National Wild & Scenic River, Delaware and Pennsylvania***



## **2020-2021 Water Resources Center Graduate Assistants**

**Sophie Phillips** (*Master of Energy and Environmental Policy*)

*Advisor: Dr. Chris Williams*

***Diversity in National Parks: How Understanding our Past Can Help Us Create an Inclusive Experience***



**Kelly Slabicki** (*M.S. Water Science & Policy*)

*Advisor: Dr. Gerald McAdams Kauffman*

***Seasonal Variations of the Brandywine River, Total Organic Carbon Removal and Disinfection Byproduct Presence in the City of Wilmington's Drinking Water***

**Hayley Rost** (*Master of Public Administration*)

*Advisor: Andrew Homsey*

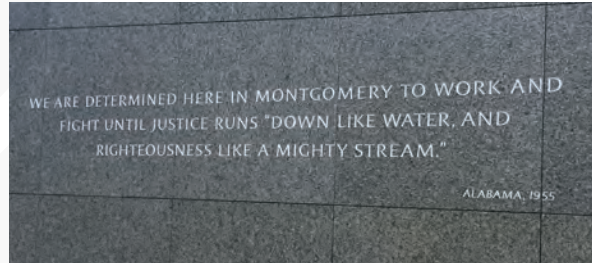
***Water Quality Monitoring in the White Clay Creek National Wild & Scenic River***

# *UDWRC Director's Message*

**October 11, 2020**

***Everyone is Equal on this Blue Earth***

***Dr. Gerald Joseph McAdams Kauffman, Jr., Director  
University of Delaware, Water Resources Center***



*MLK Jr. speaks about justice, Washington, DC*

Dear Friends and Colleagues:

I wish to refer to you the enclosed UDWRC FY21 work plan that Martha, Nicole, Andrew, and I have crafted to direct our efforts at maximum efficiency in this time of great challenges during the global pandemic and at long last our racial awakening. I am writing here from the Biden School, a place of great hope and feeling that if we stick together and learn about the social and physical sciences and treat people with decency, civility, and diversity in background and opinion that this world will be alright again and it shall be again – by next January.

As school resumed this fall, the health of everyone we work with is of paramount importance as we fight this pandemic.

We think our fieldwork in the fall along the White Clay Creek National Wild and Scenic River near Newark and Brandywine River in Wilmington can be safely conducted by our research students distancing and with masks and we have submitted our research plan to the University for approval.

With support from Sec 104b of the Water Resources Research Act of 1988 and the appropriation by Congress this fiscal year through the U.S. Department of the Interior and U.S. Geological Survey we can provide for the funded water resources research of 17 undergraduate and graduate students to examine the critical water issues of the day in Delaware and the mid-Atlantic region. So, we are forging on. In Delaware and on campus we receive excellent guidance from the offices of the Governor and UD President about safe practices to stay healthy and we are committed to following these practices and most importantly wear masks when inside and out. I am tracking the science journals that indicate there are 126 different research initiatives around the world to develop a COVID19 vaccine and my bet is on the impressive young scientist at Oxford, entirely appropriate to follow in the footsteps of Edward Jenner!

I have been too reticent about this but with my heart breaking with the shootings in Kenosha, Wisconsin, a place I used to work as a municipal engineer 30 years ago I just cannot be silent no more, so I wish to speak. With regard to our racial awakening and indeed my own personal reckoning, I have thought about this every day and looked into the mirror and we need to do better – much, much better – Black Lives Matter! The scales are off my eyes now and at long last the stage is set for true racial equality where indeed all of humanity is created equal with certain unalienable rights endowed by our creator under the laws of nature. It's time to amend the Declaration of Independence. I have long believed that and was taught that in my family by my aunt Sister Anne Virginia who taught me selfless love and lovingly brought me books to read as a 5-year old in Kensington in Philadelphia and at St. Cecilia's and Bishop Eustace Prep. in Pennsauken, NJ but until now have not fully understood it because how could I, I am white and descended from Irish, Scot, and Welsh tribes with some Alsace thrown in and I am learning from my DNA that my Irish ancestors from Philadelphia fought and died to end slavery during the Civil War but they probably didn't fully know what they were fighting for then. But now I am

beginning to grasp it, and it is time to do something about it. The UDWRC will become more diverse, we will bring on more scientists and students of every color from Delaware and America and from every corner of the globe. When I pass the baton, my successor will be a woman and our ranks will be more representative of society in creed, race, and color. This is our mission.

Three years ago, I requested that our homepage fly the message from Amos 5:24 and MLK, Jr. that reminds us to “let justice roll on like a river, righteousness like a mighty stream” and these are the words that we live by and will continue to live by. I grew up in Pennsauken, NJ just a block from the border of Camden on the Delaware and remember the riots of 1969 just a couple blocks from my school yard at St. Cecilia’s and my mother’s and father’s pain that they tried to hide from me the year before when Dr. King and RFK were shot. I recoiled at the white supremacist march on Charlottesville, and I swear that it will not happen here in Newark. I was taught to fight racism wherever it raised its ugly head up but it’s not enough and so now I look back on my life almost a half century ago when as a young guy learned about true courage from the amazing Olympians of Mexico City 1968.

How do we achieve true racial equality? I don’t know if I was looking for answers like that as a teenager the year before going up to Rutgers and perhaps didn’t even know how to ask the question then. During the summer before my freshman year my track coach was Larry James (the Mighty Burner) who ran at Villanova and was the AD at Stockton State down near Atlantic City and in the 1968 Mexico City Olympics he ran 43.97 and won the silver in the 400m and gold in the world record 4x400 relay and his teammates were three amazing men, Lee Evans, John Carlos, and Tommie Smith. I met them one day at a training camp in the Pine Barrens and they told me how they were ostracized and banned from their sport after raising their fists on the medal stand in 1968 and I was in awe of the world class athletes sitting with me but the beautiful thing is that they took this young white guy in and tried to tell me how it felt to be black and speak their minds while paying the ultimate price and banned from doing what they loved which was to run. But I could not understand it back then but the shootings in Minnesota and Wisconsin are flashbacks in my mind back to then and the images are searing it into my senses now. These good men were a half century ahead of their time and their story is beautiful and right and true. I have their photo in my office at UD from 50 years ago with the Australian silver medalist Peter Norman who stood on that stand with them and opposed racism and supported his competitors and friends the Black Americans and he too was ostracized when he went back to his country and never ran in the Olympics again. These young men black and white stood up to end racism and the old men took away the gift that God gave them, the ability to run fast! So I never fully appreciated the lessons of warmth and inclusion and forgiveness that Larry, Lee, John, and Tommie taught me during that brief time in the summer at the turn of the 80s but I look back to that lesson to help me understand now.



200M Medal Stand at the 1968 Mexico City Olympics

What is clear to me is that everyone is equal on this blue Earth, that Black lives matter, and that the only way forward is to stick together and choose love over hate. And I just want to let you know that my office at UD stands as a welcoming place of peace and tolerance and safety and I ache for my Black countrymen and those of all races who suffer from racism and bigotry in ways that I cannot begin to understand. I ask you please, help me to understand.

I wish you all peace, health, and love.

Warmly,

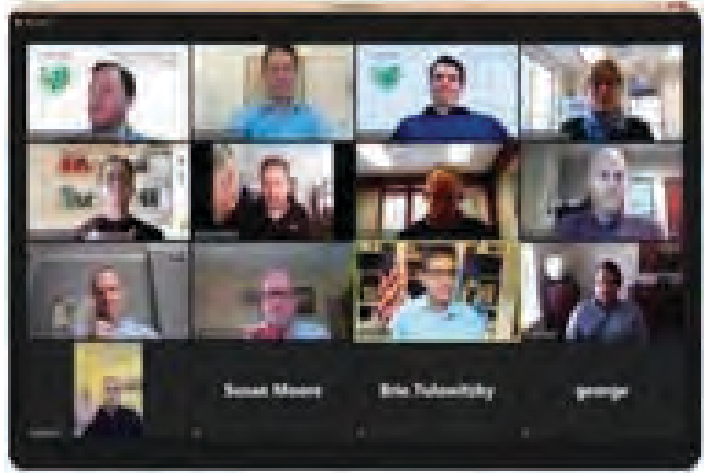
Gerald McAdams Kauffman



UDWRC Director Dr. Gerald McAdams Kauffman was elected to the Board of the Universities Council on Water Resources (UCOWR) at the annual meeting in Little Cottonwood Canyon, Utah in June 2019



*UDWRC Director Dr. Gerald McAdams Kauffman was elected to the National Institutes for Water Resources (NIWR) Board to represent the mid-Atlantic Region joining water institute directors from the universities of California, Alaska, Rhode Island, Wisconsin, New Mexico, Texas A & M, and Hawaii (Feb 2021)*



*Andrew Homsey appointed by County Executive Matt Myers to the New Castle County Resource Protection Area Technical Advisory Committee*



*Andrew Homsey elected as the 75<sup>th</sup> President of the Board of the Brandywine Red Clay Alliance (Est. 1945) as the oldest small watershed association in the nation*



*Matt and Kelly meet with Delaware Representative Lisa Blunt Rochester with members of the Coalition for the Delaware River Watershed (Mar 11, 2020)*



*Kelly Jacobs (MS Energy & Environmental Policy) receives UD Biden School Excellence in Water Resources Scholarship Medal (May 2020)*



*GEOG 453/653 Environmental Hydrology Field Survey of Fairfield Run in White Clay Creek Valley (Oct 2020)*

## 2019 - 2020 Undergraduate Water Research Students

**Sicily Bordrick** (Environmental Engineering)

**Zach Burcham** (Environmental Engineering)

Advisor: Dr. Anastasia Chirnside

**Optimization of HPLC Analysis of Ergosterol to Quantify Fungal Biomass within Bioreactors**

**Savanah Love** (Environmental Engineering, Wesley College)

Advisor: Dr. Stephanie Stotts

**Interactive Art Exhibit Focused on Salinification of Wetlands**

**Justin Leary** (Environmental Engineering)

Advisor: Dr. Stephanie Stotts

**Hercules Red Clay Creek Watershed Monitoring Plan**

**Mary Kegelman** (Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

**Water Quality Trends in New Castle County (Delaware) Streams, 2000-2020**

**Polly Ni** (Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

**Brandywine Piedmont Field Monitoring Plan**

**Aaron Nolan** (Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

**Duck Pond Creek Watershed Plan at Winterthur Gardens, Wilmington, Del.**

**Emily Symes** (Geological Sciences)

Advisor: Dr. James Pizzuto

**Sediment Fingerprint Red Clay Creek Watershed**

**Ji Zhendong** (Environmental Science)

Advisor: Dr. James Pizzuto

**Discriminating between Mill Dam and Flood Deposits along White Clay Creek**



Undergraduate water research students (left to right) Polly Ni, Aaron Nolan and Mary Kegelman

## **2019-2020 Water Resources Center Graduate Assistants**

**Kelly Jacobs** (M.S. Energy and Environmental Policy)

Advisor: Martha Narvaez

**Effect of Macellus Shale Gas Drilling on the Delaware River Watershed**

**Matt Kirchoff** (M.S. Energy and Environmental Policy)

Advisor: Andrew Homsey

**White Clay Creek Source Water Plan, White Clay Creek Wild & Scenic River**

**Kelly Slabicki** (M.S. Water Science and Policy)

Advisor: Dr. Gerald McAdams Kauffman

**Seasonal Variations of the Brandywine River, Total Organic Carbon Removal and Disinfection Byproduct Presence in the City of Wilmington's Drinking Water**

# *UDWRC Director's Message*

## *Delaware, the First State in Water*

**January 2020**

***Dr. Gerald McAdams Kauffman, Director  
University of Delaware Water Resources Center***

This has been a very good year in 2019 at the University of Delaware Water Resources Center (UDWRC) as I am pleased to report to you that the UDWRC has been recognized as “exceptional” in support of our students at Delaware universities. In accordance with the Water Resources Research Act of 1984, the U.S. Geological Survey informed the University of Delaware by letter that the UDWRC is “unique nationally” and its collaborations are “impressive,” a high rating granted by the US Department of Interior. The five-year evaluation of the 54 National Institutes for Water Resources (NIWR) at land grant universities that stretch from Maine to Micronesia noted that our institute: (1) Engages with universities/colleges around the state, (2) Has strong leadership on the part of the Institute Director, and (3) Facilitates research and information transfer closely tied to the water resources needs/issues of Delaware.

Our very good grade on the USGS report card is due to our sterling water faculty and scientists who have advised over 250 students in research and on-the-job training for careers that address the critical water issues of the day in Delaware such as coastal flooding, water pollution, and climate change. Our national prominence in water was further cemented this year with the news that the University of Delaware student section of the American Water Resources Association was voted for the 4<sup>th</sup> time as the national chapter of the year, a feat only surpassed by the University of Wisconsin and University of Florida.

I am also grateful to have been elected in June 2019 to a three-year term to the Board of Directors of the Universities Council on Water Resources (UCOWR) at the annual meeting along Little Cottonwood Creek, Utah. My fellow UCOWR board members include faculty from Oklahoma State, Mississippi State, Penn State, Purdue, Virginia Tech, Kansas State, Delaware, Hawaii, Cal Berkeley, Washington State, and Southern Illinois. What a great group of water scientists and even better people too!

Established on-campus in 1965, the UDWRC is one of the 54 Congressionally-mandated National Institutes for Water Resources (NIWR) supported by the Department of Interior and US Geological Survey at land grant universities throughout the US by the Water Resources Research Act of 1984.

Delaware was the first state to sign the Constitution in 1787 and now as we enter our 55<sup>th</sup> year on campus in 2020, we are a “First State” in water as well.



*UDWRC Director Gerald McAdams Kauffman installed to the Board at UCOWR conference in Snowbird, Utah (Jun 2019)*



*Andrew Homsey, Martha Narvaez, and Gerald McAdams Kauffman with graduate research assistant Jillian Young receiving the Biden School Excellence in Water Resources Award at Honor's Day (May 2019)*

### ***Meet the UDWRC Graduate Research Fellows***



*Kelly Jacobs*



*Matt Kirchoff*

Kelly is a second-year Master's student in the Energy and Environmental Policy program. She is from Dallas, Pennsylvania and received her Bachelor's degree from Lebanon Valley College in Economics. Kelly has worked on various projects for UDWRC including the City of Wilmington's Green Jobs program, field work for White Clay Wild and Scenic, and an economic valuation report for the Nanticoke River watershed in southern Delaware. Kelly is writing her Master's thesis on Marcellus Shale fracking documentaries and how they have influenced public perception and policy in Pennsylvania.

Matt is a second-year Master's student in the Energy and Environmental Policy program. He is from Laytonsville, Maryland and received his Bachelor's degree from the University of Delaware in Environmental Science. Since Matt is working towards his GIS certificate, most of his work for UDWRC involves mapping and data analysis. He is currently working on a solar aeration project for the City of Newark and updating a web-based, interactive map of the White Clay Creek watershed. Matt's research interests include national seashore feasibility and equity issues related to water resources.

## USGS Recognizes UDWRC as “Unique Nationally” and “Impressive”

A 5-year evaluation conducted by the U.S. Geological Survey by provisions of Section 104 of the Water Resources Research Act of 1984 finds among the 54 National Institutes for Water Resources at land grant universities throughout the U.S., the UDWRC is “unique nationally” and its collaborations are “impressive.” By letter from USGS to the University of Delaware, the USGS evaluation panel found that:

- The University of Delaware Water Resources Center is unique nationally in that it follows a model that is highly supportive of students. This exceptional support of students is to be commended.
- The extensive collaboration with state and federal agencies, universities, and other entities due to the use of student internships and fellowships was impressive.

UDWRC Director Dr. Gerald McAdams Kauffman thanks the Administration, Congress, and the USGS for its support of the research, education, and work force training of over 250 student water resources researchers from the University of Delaware, Delaware State University, and Wesley College since 2002. We are especially grateful to our Delaware Congressional Delegation (Senator Tom Carper, Senator Chris Coons, and Congresswoman Lisa Blunt Rochester) for their support of the appropriations in the Water Resources Research Act in the Department of Interior budget.

This recognition could not have happened without the leadership from the first two directors since the UDWRC was established on campus in 1965 (Dr. Robert Varrin, Professor of Civil and Environmental Engineering and Dr. Tom Sims, Deputy Dean of Agriculture and Natural Resources) and Bernard Dworsky, first director of the UD Water Resources Agency. Dr. Jerome Lewis (Director) and Lisa Allred (Policy Scientist) of the Institute for Public Administration are instrumental in hosting the UDWRC and bringing the research students on-board for their graduate assistantships and undergraduate internships.

This is good news as we enter the 55<sup>th</sup> year of the University of Delaware Water Resources Center!



*UDWRC Graduate Research Students Jillian Young (MS Water Science & Policy) and Kelly Jacobs (MS Energy & Environmental Policy) prepare for fieldwork along the White Clay Creek National Wild and Scenic River, May 2019*

UDWRC Graduate Research Students Jillian Young (MS Water Science & Policy) and Kelly Jacobs (MS Energy & Environmental Policy) prepare for fieldwork along the White Clay Creek National Wild and Scenic River, May 2019

## The UD Water Resources Center and Delaware Sea Grant College Program, from Watershed to the Sea

Two thousand and nineteen was the year that the University of Delaware Water Resources Center (a program of the U.S. Department of Interior in USGS) and Delaware College Sea Grant Program (a program of the U.S. Department of Commerce in NOAA) integrated their research programs from freshwater in the watersheds to saltwater in the bay and the ocean. The UDWRC is one of the 54 National Institutes for Water Resources (NIWR) supported by the USGS at land grant universities throughout the US that traditionally focuses on research in the upland or freshwater regions in Delaware. Delaware Sea Grant (DSG) is one of the 33 sea grant programs along the Atlantic and Pacific and Great Lakes that focuses research on the coastal tidewater and saltwater regions of the First State. Due to our flat coastal geography

and status as the lowest lying state in the nation, no area in Delaware is more than 10 miles from sea level. Therefore, it makes sense for the UDWRC and DSG to coordinate our research programs. In February 2019, the USGS Water Research Institutes and NOAA Sea Grant Programs from the Atlantic met in Washington, DC to coordinate our water research programs at Rutgers, Cornell, Penn State, Delaware, Maryland, and Virginia Tech. As part of the integration UDWRC Associate Director Martha Narvaez has been appointed to the Delaware Sea Grant Advisory Council and DSG Associate Director Christian Hauser was appointed to the Delaware Water Resources Center Advisory Panel.



*UDWRC Director, Dr. Gerald McAdams Kauffman, presents at the Joint Atlantic Regional Meeting of the NOAA Sea Grant College Program and USGS Water Research Institutes in Washington, D.C. (Feb 28, 2019)*

### **54<sup>th</sup> UDWRC Advisory Panel Meets at the Biden Institute**

On May 16, 2019, the Advisory Panel of the UDWRC met for the 54<sup>th</sup> annual meeting at the Biden Institute, located at 44 Kent Way. UDWRC interns had the opportunity to present their research projects and receive feedback from panel members. Project topics ranged from regenerative agriculture practices at the Coverdale Farm Preserve to addressing perfluoroalkyl chemical contamination in Delaware. UDWRC interns spend 10 hours a week from September to May working on their research projects, which often includes fieldwork and collaboration with professors from various departments. Advisory panel members also discussed new business, including FY 2019/20 research projects, research priorities for the upcoming year, joint ventures with Delaware Sea Grant, and the UDWRC becoming part of the newly established Biden School of Public Policy and Administration.

### **Coast Day 2019**

On October 6<sup>th</sup>, the annual Coast Day event was held at the University of Delaware's Hugh R. Sharp campus in Lewes. The College of Earth, Ocean, and Environment (CEOE) and Delaware Sea Grant organized the event. This year's theme was "A Ripple Through Time" to emphasize the importance of scientists studying how our environment changes over time and how we can work to improve our future. UD faculty and various environmental groups presented their research through hands-on displays, poster presentations, and demonstrations in labs and outdoor tents. Other events included a crab cake cook-off, seafood chowder challenge, chemical magic show, watershed dance, and multiple seafood cooking demonstrations.



*UDWRC graduate research assistant, Matt Kirchoff, prepares materials to create water-related crafts (Oct 6, 2019)*

## UD AWRA Student Chapter, Four-Time Winner!

On Wednesday, November 6<sup>th</sup>, the American Water Resources Association (AWRA) presented the University of Delaware Student Chapter (UDAWRA) with the AWRA Outstanding Student Chapter for 2019. This award is presented to the AWRA Student Chapter that has been most active in advancing water resources knowledge and carrying out the association's mission. This is the third consecutive year UDAWRA won the award and the fourth overall win. UDAWRA also won in 2015, 2017, and 2018. UDAWRA is officially the second winningest school in AWRA history; the only other Student Chapter with more wins than UDAWRA is the University of Wisconsin-Stevens Point. Jillian Young, the former UDAWRA Student Chapter Vice President and UDWRC graduate fellow, accepted the award during the awards luncheon on the final day of the conference in Salt Lake City, Utah. Members of the Executive Board for the 2018-19 school year included Maggie Capooeci (President), Jillian Young (Vice President), Lauren Mosesso (Secretary), and Nate Sienkiewicz (Treasurer).



*Jillian Young (left) and Martha Narvaez, UD Student Chapter advisor at awards luncheon in Salt Lake City, Utah (Nov 6, 2019)*

## Delaware GIS Day 2019

On Monday, November 18<sup>th</sup> at the Air Command Mobility Museum in Dover the GIS Day Committee held its 12<sup>th</sup> Annual GIS Day field trip. GIS day is an International Event which falls during Geography Awareness Week. The GIS Day Committee, a subcommittee of the Delaware Geographic Data Committee, is made up of nine GIS professionals ranging from the federal, state, and county government; higher education; and utility industries.



*2019 DE GIS Committee (Nov 18, 2019)*

## 2018 - 2019 Undergraduate Water Research Students

**Michaella Becker** (Environmental Engineering)

Advisor: Dr. Paul Imhoff

**Impact on New Castle County Roadway Soils Amended with Biochar**

**Nicolette Bugar** (Environmental Engineering)

Advisor: Dr. Gerald McAdams Kauffman

**Monitoring/Mitigation of Perfluoroalkyl Substances (PFAs) in Delaware Aquifers**

**Chelsea Caplinger** (Political Science)

Advisor: Dr. Gretchen Bauer

**Policy Governance of Interstate Watershed Management**

**Alyssa Cortese** (Environmental Science)

Advisor: Dr. Gerald McAdams Kauffman

**Restoration of the Brandywine River in Wilmington, Delaware**

**Monica Crosby** (Environmental Studies)

Advisor: Dr. Paul Jackson

**Water Policy and Wetland Ecology**

**Andrew Dorazio** (Mechanical Engineering)

Advisor: Dr. Gerald McAdams Kauffman

**Watershed Plan for the White Clay Creek National Wild and Scenic River**

**Veronica Hill** (Resource Economics)

Advisor: Dr. Leah Palm-Forster

**Combat Increasing Sea Level Rise in Delaware**

**Allison Kaltenbach** (Environmental Engineering)

Advisors: Martha Narvaez & Kristen Travers

**Effects of Tidal Flood Inundation in Delaware**

**Mia Kane** (*Environmental Science*)

*Advisor: Dr. Anastasia Chirnside*

***Regenerative Agriculture with the Delaware Nature Society***



**Thomas McLaughlin** (*Business*)

*Advisor: Dr. Joshua Duke*

***Cost-Benefit of Agriculture Conservation in the Delaware Coastal Plain***

**Rebecca Steiner** (*Public Policy & Environmental Studies*)

*Advisor: Dr. Gerald McAdams Kauffman*

***Local Plans/Ordinances and Growth Management & Water Quality Protection***

**Liam Warren** (*Energy and Environmental Policy*)

*Advisor: Dr. Philip Barnes*

***Stormwater Utility Fees in Municipalities in Delaware***

**Natalie Zimmerman** (*Geology*)

*Advisor: Dr. Gerald McAdams Kauffman*

***Sediment Finger Printing in the White Clay Creek Watershed***

## 2018 - 2019 Water Resources Center Graduate Assistants

**Kelly Jacobs** (M.S. Energy and Environmental Policy)

Advisor: Martha Narvaez

*Effect of Macellus Shale Gas Drilling on the Delaware River Watershed*



**Matt Kirchoff** (M.S. Energy and Environmental Policy)

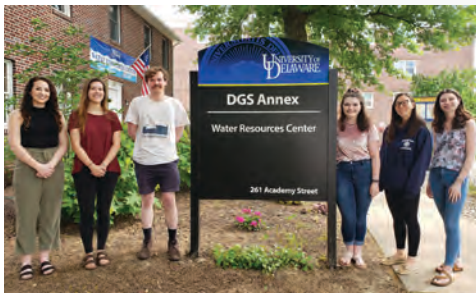
Advisor: Andrew Homsey

*White Clay Creek Source Water Plan, White Clay Creek Wild & Scenic River*

**Jillian Young** (M.S. Water Science and Policy)

Advisor: Andrew Homsey

*GIS Stormwater Management in the White Clay Creek*



UDWRC Interns and Presenters (left to right): Michaella Backer (Environmental Engineering), Alyssa Cortese (Environmental Science), Liam Warren (Engineering and Environmental Policy), Chelsea Caplinger (Political Science), Rebecca Steiner (Public Policy) and Natalie Zimmerman (Geology)

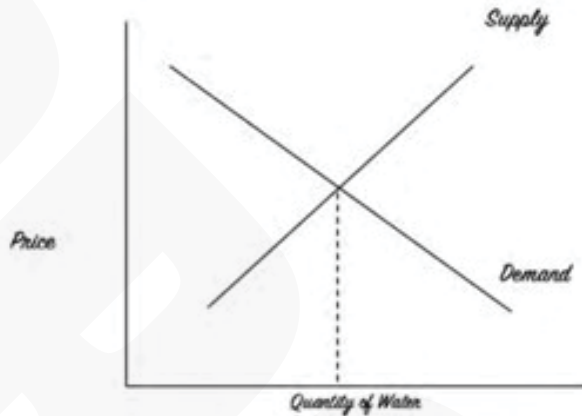


UDWRC Interns and Presenters (left to right): Veronica Hill (Resource Economics) Natalie Zimmerman (Geology), Alyssa Cortese (Environmental Science), and Mia Kane (Environmental Science)

# Why Study Water?

December 2018

**Dr. Gerald Joseph McAdams Kauffman, Jr., Director,  
University of Delaware, Water Resources Center**



*The old supply and demand curves don't quite capture the true value of data and knowledge developed by NIWR universities*

Why study water? Because it's not just good for our ecology, it's also the foundation of our economy. Established on campus in 1965 after Lyndon Baines Johnson signed the Water Resources Research Act (WRRRA) during the golden era of water resources in the United States, the University of Delaware Water Resources Center (DWRC) is one of 54 National Institutes for Water Resources (NIWR) situated at land grant universities stretching across the Atlantic and Pacific from Maine to Micronesia. The 54 NIWR institutions of higher learning have graduated over 25 million alumni, many who hold jobs in the sciences, engineering, arts and humanities (STEAM) that support our national economy. We're finding that the byproducts of our NIWR universities – data and knowledge – are priced differently and worth much more now in the new economy and the old supply and demand curves just don't quite capture the true economic value of water.

The WRRRA/NIWR research program invests in water resources that support a hundred-billion-dollar economy in the United States. The American Water Works Association (AWWA) calculated the U.S. gains \$220 billion in economic activity and generates 1.3 million jobs by investing in water and wastewater infrastructure. Every new water sector job adds an additional 3.7 jobs to the U.S. economy and every dollar invested in infrastructure generates \$6.00 in returns. In 2005, surface waters gaged by the USGS totaled 260 billion gallons per day for irrigation, industry, thermoelectric power, and drinking water uses with an instream value estimated by the University of Delaware of \$21 billion. Ecosystem services and wetland habitat in National Wildlife Refuges maintained by the U.S. Fish and Wildlife Service totaled \$27 billion in 2008 dollars. The U.S. Fish and Wildlife Service estimates clean water habitat supports \$157 billion in annual expenditures including \$46 billion for fishing, \$35 billion for hunting, and \$76 billion for bird/wildlife watching.

The Outdoor Industry Association estimates the outdoor recreation economy totals \$140 billion nationally for water sports such as boating, paddling, and sailing. The University of Delaware found the Delaware River in Delaware, New Jersey, New York, and Pennsylvania supports \$22 billion in annual economic activity and 600,000 direct/indirect jobs. The University of Maryland estimated the nation's largest estuary, the Chesapeake, supports a trillion-dollar economy. The Nature Conservancy concluded the Colorado River drives a \$1.4 trillion economy and 16 million jobs in California, Arizona, Nevada, Utah, Colorado, New Mexico and Wyoming or 10% of the U.S. GDP. Investments in NIWR universities such as the University of Delaware by federal, state, and local governments are paying off handsomely in terms of jobs, careers, and GDP.



*DWRC Director Gerald McAdams Kauffman with Assoc. Director David Shields (Brandywine Conservancy), President & CEO Collin O'Mara (National Wildlife Federation), and Exec. Director Jim Jordan (Brandywine Red Clay Alliance) at the Bi-State Solution: Clean Water in the Brandywine-Christina Watershed conference, Mendenhall, PA (May 3, 2018)*

### **UD Water Resources Center now part of the Biden School of Public Policy and Administration**

We are proud and pleased to announce that the University of Delaware Water Resources Center is now a research unit of the Joseph R. Biden, Jr. School of Public Policy and Administration! Joe Biden is the 47<sup>th</sup> Vice President of the United States, elected at 29 to become a six-term U.S. Senator, and UD alumnus (class of '65). In 2000 Senator Biden co-sponsored legislation in Congress and signed by Bill Clinton that designated over 190 miles of the White Clay Creek and tributaries in Delaware and Pennsylvania as the first-ever national wild and scenic river system protected on a watershed-basis. With this action by the Board of Trustees, the Delaware Water Resources Center in the Biden School joins our colleagues in the National Institutes for Water Resources (NIWR) based in the Senator George Mitchell Center for Sustainability (Maine), Humphrey School of Public Affairs (Minnesota), and Strom Thurman Institute (Clemson/South Carolina).



*UD Water Resources Center now part of the Biden School of Public Policy and Administration (May 2018)*



*UDAWRA receives national student chapter of the year! (Nov 2018)*

## Martin W. Wollaston, Policy Scientist (1983-retired 2018)

Water Resources Agency for New Castle County  
University of Delaware Water Resources Agency

Martin Wollaston retired in 2018 after 35 years with the Water Resources Agency and the UD Water Resources Agency. Wollaston received his Master of Public Administration (MPA) in 1983 at the University of Delaware and was in the first class of the Institute for Public Administration's Legislative Fellows Program. He spent decades of his career working at the University of Delaware's Water Resources Agency, formerly part of New Castle County, where he was involved with all aspects of water supply, water quality and source water protection. Wollaston was a policy scientist with the Institute for Public Administration (IPA) and led IPA's planning services group for more than a decade. As the planning services group manager, Wollaston worked with the Delaware Office of State Planning Coordination, state and local government leaders, IPA staff and students to provide technical assistance, training, and comprehensive planning services to Delaware local governments.



*Water Resources Agency Colleagues: Jerry Kauffman (left), Andrew Homsey (middle) and Martin Wollaston (right) (Jun 13, 2008)*

## 2017 - 2018 Undergraduate Water Research Students

### **Samuel Furio** (Economics)

Advisor: Dr. Kent Messer

***Understanding the Social Behavior within a Competitive Environmental: An Experimental Investigation of Agri-Environmental Policies***

### **Lauren Glinko** (Geography)

Advisors: Dr. Afton Clarke-Sather & Dr. Tracy Deliberty

***Causes of Change of Irrigation in the Eastern United States***

### **Margaret Krauthauser** (Geology)

Advisor: Dr. James Pizzuto

***Quantifying Floodplain Sediment Storage Rates and Identifying Rate-Changing Characteristics in the White Clay Creek Watershed, Pennsylvania***

### **Jack Protokowicz** (Biochemistry)

Advisor: Dr. Shreeran Inamdar

***Nuclear Magnetic Resonance Assessment of Organic Matter Sources in a Small Forested Waersged***

### **Michael Rechsteiner** (Environmental Engineering)

Advisor: Dr. Paul Imhoff

***Reducing Stormwater Runoff & Pollutant Loading with Biochar Addition to Highway Greenways***

### **Nicholas Tobia** (Geology)

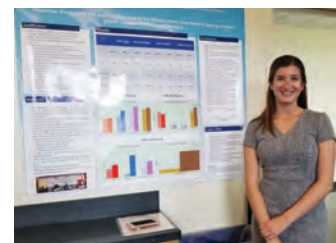
Advisor: Dr. Paul Imhoff

***Reducing Stormwater Runoff & Pollutant Loading with Biochar Addition to Highway Greenways***

### **Christina Valenti** (Environmental Engineering)

Advisor: Dr. Anastasia Chirnside

***Assessment of the Leaching Potential of Fibrous Plastic Inert Support Material from a Fungal Biocell Reactor***



**Reid Williams** (*Environmental Engineering*)

*Advisor: Dr. Paul Imhoff*

*Effectiveness of Bio-Char to Reduce Nitrate Concentration in Storm Water Runoff*

## **2017 - 2018 Water Resources Center Graduate Assistants**

**Jillian Young** (*M.S. Water Science and Policy*)

*Advisor: Andrew Homsey*

*GIS Stormwater Management in the White Clay Creek*



# DWRC Director's Message

June 2017

**Dr. Gerald Joseph McAdams Kauffman, Jr., Director,  
University of Delaware, Water Resources Center**



These are the scientific equations that guide the movement of dihydrogen monoxide on Earth. Water is the most valuable chemical in society, and it is one of the few compounds in nature that exists in the three forms of matter: solid, liquid, and gas. It's been said that water always flows downhill by gravity, yet it flows uphill toward money. My professor at Rutgers taught us that science is rational, linear, and logical yet policy (or politics) can be irrational, nonlinear, and chaotic. Maybe this explains what is going on these days.

In the week after the November 2016 election, I drove north from sea level in Delaware through the Schuylkill Valley and up and over the ridge through the Appalachian coal fields on the way to the Bucknell symposium on the Susquehanna River. And in towns like Frackville and Minersville, there was the election, downtowns tilted away from the past with economies shackled by the future. And after descending through the valley to the campus by the river on the other side, I realized that the quest for knowledge is an undeniable truth. Science and the classroom have always brought hope for a brighter future to towns just like these throughout America. So for the first time in 30 years, I went to a protest and took the train down from UD to DC to the March for Science on Earth Day on April 22, 2017. Emerging from Union Station I was proud to see on the right the Delaware flag, representing the First State in the Union. It was raining, with lots of water vapor, a perfect day for science. I rode the Citibike over to briefings at the American Association for the Advancement of Science (AAAS) and American Geophysical Union (AGU). A million scientists marched from the Washington Monument, past the White House, and up Constitution Avenue by the Smithsonian museums on the National Mall then over to the Capitol. I never saw science so strong. We marched with kids cured of cancer, biology teachers, physicians, nurses, teachers, a 95-year-old astrophysicist, mobilized citizen scientists. You couldn't help getting the feeling that there will be more scientists in D.C. by 2018.

At UD we are fortunate to be one of the 54 National Institutes for Water Resources in a science network that stretches from Maine to Micronesia at land grant universities in the 50 states, D.C., and the three island territories of Guam, Puerto Rico, and U.S. Virgin Islands. The 54 NIWR colleges educate over a million students annually and have over 10 million alumni from throughout the U.S. and the world. Over the last 15 years, the DWRC has supported the water research of over 250 young scientists and engineers who have gone on to productive careers in society. With the start of the fall 2017 semester in September, we are excited to be part of the Biden School of Public Policy and Administration and look forward to working with Professor Biden on the cross-cutting environmental sustainability issues of the day.

These are turbulent times. Environmental budgets are being cut. Science funding is under scrutiny. Natural-born rights are being challenged. Yet with all this uncertainty, it's reassuring to know that water always obeys the universal laws of nature. And with science as our foundation, at the University of Delaware Water Resources Center we search for new knowledge and train future scientists in an unfettered way with openness to the policies and viewpoints of all. As I tweeted before, I embrace all on Earth who seek peace and love in this nation of inalienable rights that each are born with, and no government may take away.

And as they say in the NIWR, water is clear--it is neither red or blue.



*Gerald Kauffman attends World Water Day Reception after the White House Water Summit near the Lincoln Memorial and the U.S. Institute for Peace at the George P. Schultz Great Hall (Mar 22, 2016)*

## DWRC 2016-17 Annual Update

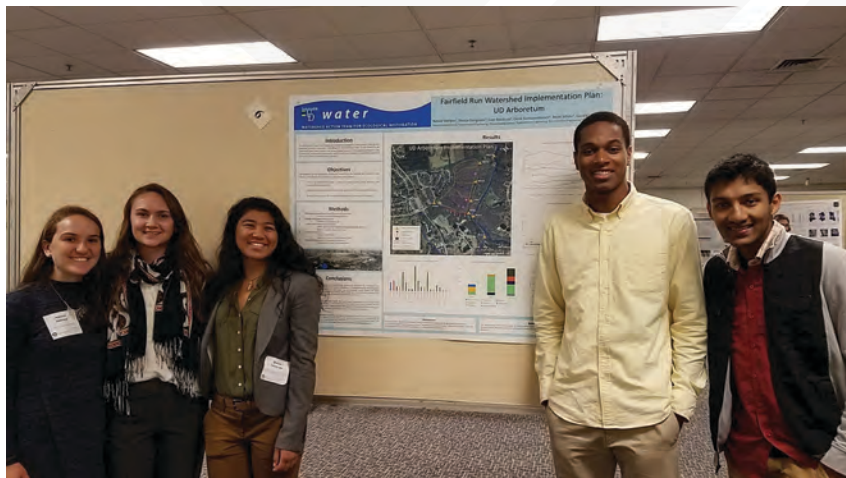
The past year (2016-2017) has been another productive year for the Delaware Water Resources Center. During the summer of 2016, thirteen DWRC undergraduate water resources interns began work on their research with faculty advisors. In August 2016, our two U.S. Senators, Tom Carper and Chris Coons, visited the offices of the DWRC in Newark, Delaware to discuss water science and policy issues critical to the First State such as coastal flooding, drinking water quality, and water quality impacts on coastal tourism. In November 2016, DWRC Director Gerald McAdams Kauffman was invited to present plenary remarks at the 11th Annual Susquehanna River Symposium hosted by the Bucknell University Watershed Sciences and Engineering Program in Lewisburg, Pennsylvania. Also in November, DWRC Policy Scientist Martha Narvaez handed over the gavel and completed her term as the 51<sup>st</sup> President of the American Water Resources Association (AWRA).

During the fall of 2016, Andrew Homsey was elected to the Board of Directors at the Brandywine Red Clay Alliance, an organization formed in 1946, and the oldest small watershed organization on the U.S. In February 2017, DWRC Director Gerald McAdams Kauffman met with institute directors from throughout the United States at the annual National Institutes for Water Resources (NIWR) meeting in Washington, DC to discuss the changing water resources landscape and meeting with our congressional delegation to support the Water Resources Research Act appropriation. On April 28, 2017, the Advisory Panel met for the 52<sup>nd</sup> annual meeting of the DWRC at the University of Delaware campus in Lewes, Delaware and selected new water resources interns who will start their research during the summer and fall of 2017. On May 5, 2017, the DWRC research interns presented the results of their water resources research at the University of Delaware undergraduate research poster session at the Perkins Student Center on the Newark campus.

It is a new world in water with changes in the White House and statehouse, but the Delaware Water Resources Center is poised now more than ever to train and educate our students to meet the water science and policy challenges of the future.

### 2016-2017 DWRC Research Interns Present at UD Engaged Scholarship Day

On May 5, 2017, thirteen DWRC students presented research posters at the Celebration of Undergraduate Engaged Scholarship at the University of Delaware Perkins Student



*Shailja Gangrade (Environmental Engineering), Natale Depase (Environmental Science), Catherine Medlock (Environmental Science), Advisor: Andrew Homsey, Gerald Kauffman (UD Water Resources Center), Restoration of the Fairfield Run Watershed at the UD Arboretum (May 5, 2017)*

## UD Welcomes the Biden Institute

The DWRC looks forward to working with the Biden Institute, part of the Biden School of Public Policy and Administration (SPPA) in the fall 2017 semester. On February 7, 2017 UD President Dennis Assanis announced a new partnership with Joe Biden and the School of Public Policy and Administration. Joe Biden, US Senator from Delaware for 36 years, 47<sup>th</sup> Vice President of the United States and UD alumnus (class of 1965), will serve as the founding chair of the UD Biden Institute.



*Martha Narvaez attends the SPPA launch of the Biden Institute at UD (Mar 2017)*

## University of Delaware AWRA, Repeat National Champions!

The American Water Resources Association (AWRA) Board of Directors selected the University of Delaware Student Chapter as the AWRA Outstanding Student Section for 2017. The UD AWRA also won the national award in 2015. Past award winners include: Univ of Florida (2016), University of Delaware (2015), Texas A&M (2014), Oregon State (2013), Oregon State (2012)



*Chelsea Krieg (DEAWRA Vice President), Amanda Doremus (President), Erin Johnson (Secretary) and Briana Diacopoulos (Treasurer) attend 2016 AWRA Mid Atlantic Conference (Sep 2016)*



*Jerry Kauffman speaks at the 11th Annual Susquehanna River Symposium, sponsored by the Watershed Sciences and Engineering Program at Bucknell University (Nov 12, 2016)*

## City of Wilmington Green Jobs Program

July 2017 will kick-off the 7<sup>th</sup> year of the City of Wilmington Green Jobs Program. The program, coordinated by DWRC's Martha Narvaez and the City of Wilmington's Department of Parks and Recreation, is a six-week employment program for City-residents that provides participants with hands-on outdoor environmental work, career exploration, exposure to environmental issues, and a mentoring component. This summer the program will kick-off on July 5<sup>th</sup> with DSU Andrew Wetherill, College of Agriculture, Extension Educator introducing the youth to interactive agriculture series.



*City of Wilmington Green Jobs Program with the Delaware Nature Society's Jim White (2017)*



*DWRC's Jerry Kauffman and Martha Narvaez awarded Laura Askin and Briana Diacopoulos the School of Public Policy and Administration Excellence in Water Resources Scholarship Award (May 18, 2017)*



*Third Annual Clean Water Rally- a huge success led by the Delaware Nature Society, close to 200 people attended, including 40 that met with Governor Carney (Jun 6, 2016)*



*UAPP 411/611 Regional Watershed Management students survey remnants of Dam No. 1 (circa 1777) along the White Clay Creek National Wild and Scenic River (Apr 2017)*

## 2016-2017 Undergraduate Water Research Students

**Natalie Criscenzo** (*Energy and Environmental Policy*)

Advisor: Dr. Philip Barnes

**Overcoming Policy and Planning Barriers to Resilient and Sustainable Communities in Delaware**



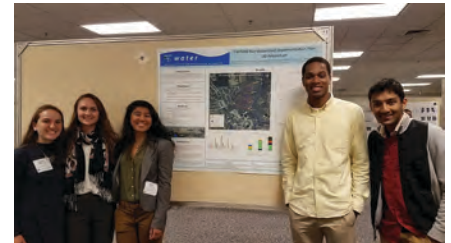
**Natale Depase** (*Environmental Science*)

**Shailja Gangrade** (*Environmental Engineering*)

**Catherine Medlock** (*Environmental Science*)

Advisors: Andrew Homsey & Dr. Gerald McAdams Kauffman

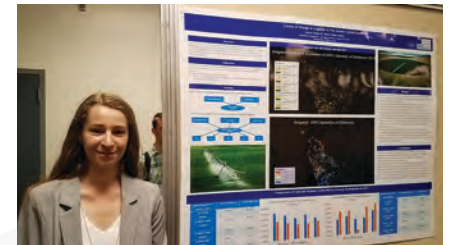
**Restoration of the Fairfield Run Watershed**



**Lauren Glinko** (*Geography*)

Advisor: Dr. Afton Clarke-Sather

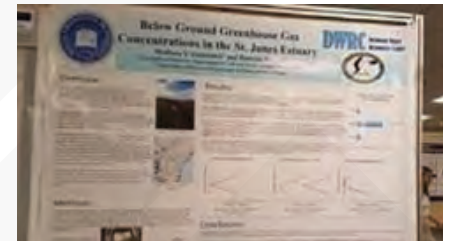
**Causes of Change of Irrigation in the Eastern United States**



**Madison Gutekunst** (*Environmental Engineering*)

Advisor: Dr. Rodrigo Vargas

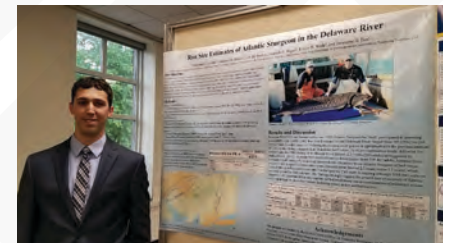
**Linking Below Ground Greenhouse Gas Concentrations with Water Chemistry in the St. Jones Estuary**



**Benjamin Jenkins** (*Natural Resources - Fisheries Management, Delaware State Univ*)

Advisor: Dr. Dewayne Fox

**Estimating the Spawn Population of Atlantic Sturgeon (*Acipenser oxyrinchus*) in the Delaware River**

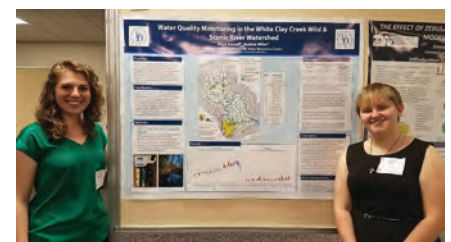


**Maya Kassoff** (*Environmental Science*)

**Andrea Miller** (*Environmental Studies*)

Advisor: Dr. Gerald McAdams Kauffman

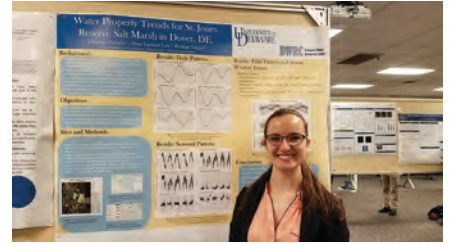
**Water Quality Monitoring in the White Clay Creek National Wild & Scenic River**



**Courtney Rempfer** (Environmental Science)

Advisor: Dr. Rodrigo Vargas

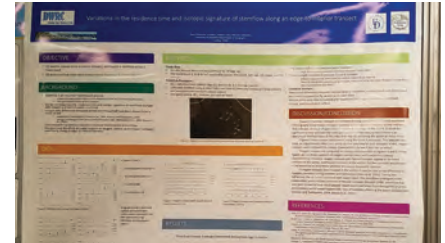
**Designing an Automated System to Monitor O<sub>2</sub>, CO<sub>2</sub>, and CH<sub>4</sub> from Sediments in a Salt Marsh**



**Ilana Schnauffer** (Chemistry & Environmental Science)

Advisor: Dr. Delphis Levia

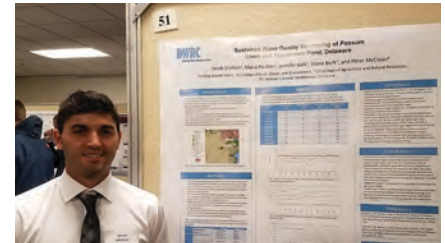
**Variations in the Residence Time and Isotopic Signature of Stemflow along an Edge-to-Interior Transect**



**Jacob Shelton** (Environmental Studies)

Advisor: Ms. Maria Pautler

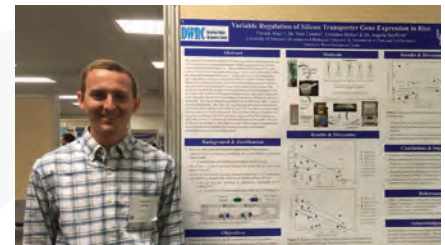
**Sustained Water Quality Monitoring of Possum Creek and Noxontown Pond, Delaware**



**Patrick Wise** (Biological Sciences & History)

Advisor: Dr. Angelia Seyffreth

**Variable Regulation of Silicon Transporter Gene Expression in Rice**



**2016-2017 Water Resources Center Graduate Assistants**

**Lauren Lechner** (M.S. Civil and Environmental Engineering)

Advisor: Dr. Pei Chiu

**Nutrient Removal from Stormwater, Wastewater, and Agricultural Runoff Using Scrap Iron and Biochar**

**Daniel Sanchez-Carretero** (Ph.D. Civil and Environmental Engineering)

Advisor: Dr. C.P. Huang

**Electrochemical Reduction of Dissolved Carbon Dioxide in Water to Hydrocarbons**

# UDWRC =UDWRA

October 2016

***Dr. Gerald Joseph McAdams Kauffman, Jr., Director  
University of Delaware, Water Resources Center***

During the century-ending drought of 1999, the State Geologist once informed the Governor's Drought Advisory Committee that "a drought always ends when it rains." While no one can predict the future and our warming atmosphere makes it harder to forecast the weather, this adage is always true. This summer we sweated through the hottest August on record in Delaware in 122 years dating to 1895 and our drinking water streams such as the Brandywine have declined to the lowest levels since the record drought of 2002. The Delaware Water Supply Coordinating Council is watching this closely and a drought watch may be in the offing unless we receive tropical moisture in the name of Matthew, Nicole, or Otto.

Delaware relies on concordant relationships with our Federal water agencies and neighboring states as a full two thirds of the First State's drinking water flows from four streams that roll down from the Piedmont foothills in Pennsylvania and Maryland across William Penn's 1682 arc into the Coastal Plain of Delaware. Since the UD campus lies by the banks of one of these streams, the White Clay Creek National Wild and Scenic River, our Delaware Water Resources Center (DWRC) students have an ideal outdoor living laboratory at their doorsteps to carry out their research on droughts and floods. On a drought-like August day, our senior Senator Tom Carper, a ranking member of the Senate Public Works and Environment Committee, stopped by the DWRC offices to discuss these critical water resource issues with our water science and policy and environmental studies students. As we enter the 2017 Water Year on October 1<sup>st</sup>, we reflect on our strategic thinking about how to provide more cohesive research opportunities for budding water scientists and students here in Delaware.

Therefore, for the first time in 40 years, we are pleased to announce the merger of the Delaware Water Resources Center (est. 1965) with the Water Resources Agency (est. 1977). You can read more about the fluidity of this synchronization at our new website. Do you remember Adam Smith who discussed the invisible hand of economics? Well back in 1776 he also wrote about the diamond-water paradox. Water (and the people who study it) are precious resources, that's always been true too!



*Senator Carper visits the UDWRC with Matt Ludington (Water Science & Policy), Laura Askin (Public Administration), Gerald Kauffman (UDWRC), Sandra Petrakis (Water Science & Policy), Andrea Miller (Environmental Studies), and Larry Windley (Senate Staff)(UDWRC), Sandra Petrakis (Water Science & Policy), Andrea Miller (Environmental Studies), and Larry Windley (Senate Staff) (Aug 2016)*



*DWRC faculty, scientists and students gather with Senator Tom Carper outside the Water Resources Center (Aug 2016)*

## **DWRC Selects Cohort of Undergraduate and Graduate Research Students from UD and DSU for 2016 -2017**

At the 51<sup>st</sup> Annual meeting of the DWRC Advisory Panel in April 2016 at the Trabant Student Center in Newark, Del, Dr. Gerald J. Kauffman was pleased to announce the UDWRC Advisory Panel has selected students in five colleges at the University of Delaware and Delaware State University for the undergraduate and graduate research program during 2016-2017 supported by the Department of Interior (USGS) through the Water Resources Research Act (WRRRA) signed by Lyndon Baines Johnson in 1964.

## DWRC to go Down Under to New Zealand in 2017

DWRC Director Gerald Kauffman has been invited to New Zealand over November 19-24, 2017 as the keynote speaker at the 5<sup>th</sup> biennial symposium of the International Society for River Science on the banks of the Waikato River, Hamilton, New Zealand. Sponsored by the University of Waikato, New Zealand Dairy, the Waikato River Commission and the New Zealand Freshwater Sciences Society (NZFSS), Dr. Kauffman will discuss the economics of investing in coastal watersheds, a topic that Delaware as a small peninsular state and New Zealand as a small island country, have much in common.



*Gerald looks at New Zealand on the Globe (Nov 2017)*

## DEAWRA Hosts Mid-Atlantic AWRA Conference

On September 15<sup>th</sup> and 16<sup>th</sup>, the Delaware Section of the American Water Resources Association (DEAWRA) in conjunction with the National Capital Region Section, New Jersey State Section, Pennsylvania State Section, and Philadelphia Metropolitan Area Section hosted the 2016 Mid- Atlantic Conference (MAC) of the American Water Resources Association (AWRA) in Wilmington, Delaware with over 200 attendees, one of the highest attended MAC conferences.



*2016 MAC Conference Committee (Sep 16, 2016)*



*UD Undergraduate Student Life President Natalie Criscenzo*

# *Celebrating Our 50<sup>th</sup> Year!*

**March 2016**

## ***Delaware: The First (Water) State in the Union***

***Dr. Gerald Joseph McAdams Kauffman, Jr., Director  
University of Delaware - Water Resources Center***

Twitter, CSPAN, the New York Times... water is increasingly in the news these days. From the California drought to blizzards and coastal flooding in Delaware, not to mention the Flint River crisis, water issues are impossible to avoid. Through all the noise of the election, the economy, and even March Madness, water is “bubbling up to the top” for the public as well as top officials from governors to the President.

I saw this first-hand when invited to represent the University of Delaware and the state at the White House Water Summit on March 22, 2016, which coincided with World Water Day. These national water issues were also the focus of the National Institutes for Water Resources (NIWR) meeting this past February in Washington, DC, which Martha Narvaez and I attended with our colleagues and the directors of water resources institutes at 48 other land grant universities stretching from Maine to Alaska to Guam and the U.S. Virgin Islands. We spent much of our time discussing these national water issues with scientists from NOAA, USDA, Department of the Interior, EPA and the US Army Corps of Engineers. It is clear that it is indeed in the national interest to address these water crises through the research and education programs supported through the USGS and the National Water Resources Research Program created by LBJ and Congress in 1964.

At the DWRC, I am glad to report that we are doing our best to train the next generation to address these profound water resources issues that have great impact on the economy and ecology of the United States. At our February 29, 2016 special Leap Day meeting of the DWRC Advisory Panel, we heard presentations on the work of our graduate research assistants and undergraduate interns supported by DWRC, who put on display a very impressive body of research. Over the last year we have sponsored the research of 20 students who joined with faculty and scientist advisors across four colleges of the University to work on addressing the water resources problems of tomorrow. I am happy to report that the future of water resources is in good hands with this cohort of budding water scientists, and that the DWRC is poised to address the water challenges in Delaware, the Delmarva, and indeed nationally and globally. Although Delaware may be small, we are always the First State for water resources.

### **DWRC Advisory Panel Meets on Leap Day**



*DWRC Director Gerald Kauffman invited to White House Water Summit on World Water Day at 1600 Pennsylvania Avenue in Washington, D.C. (Mar 22, 2016)*

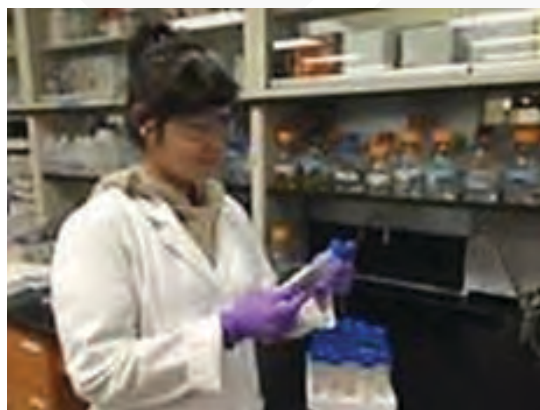


*Meeting Gregory McAdams Kauffman, MD, from the American College of Cardiologists at World Water Day reception (Mar 22, 2016)*

On February 29, 2016, the DWRC Advisory Panel utilized the extra day authorized by the Julian Calendar in 46 BC and met on Leap Day at the University of Delaware on the Newark Campus. The DWRC Advisory Panel continued funding for graduate students Lauren Lechner and Daniel Sanchez-Carretero. Graduate student Alex Soroka completed USGS-supported research and will graduate.



*Students present research findings at the Annual DWRC Advisory Panel meeting, Leap Day, 2016 at Trabant Student Center, Newark, Del.*



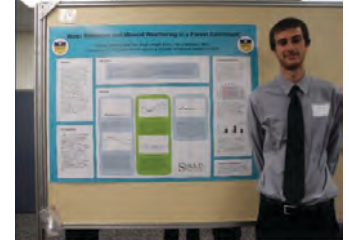
*Ph.D. Student Ha Vu (Chemistry and Biochemistry), application of  $^{31}\text{P}$ -NMR spectroscopy to understand Phosphorus speciation in wastewater*

## 2015-2016 Undergraduate Water Research Students

**Samuel Dever** (Environmental Engineering)

Advisor: Dr. Paul Imhoff

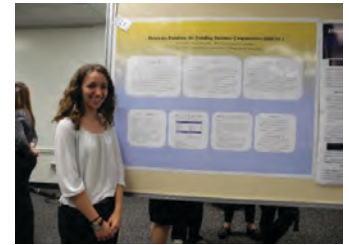
*Effect of Organic Matter on Mineral Weathering*



**Nicole Golomb** (Energy and Environmental Policy)

Advisor: Dr. Philip Barnes

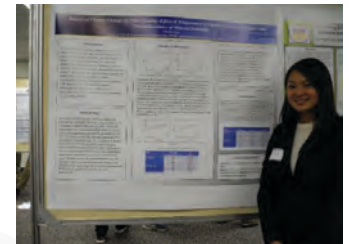
*Developing a Resource Guide for Funding Community Resilience in Delaware*



**Xiaolun Guo** (Environmental Engineering)

Advisor: Dr. C.P. Huang

*Effect of Temperature on the Kinetics and Thermodynamics of Mineral Solubility*



**Ryan Hall** (Environmental Engineering)

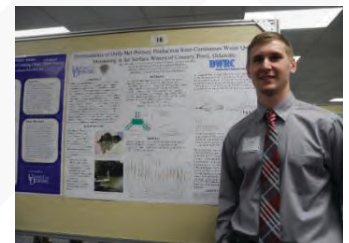
Advisor: Dr. Paul Imhoff

*Integrating Biochar Amendments in Green Stormwater Management Systems for Enhanced Nitrogen Treatment of Stormwater Runoff*

**James Hanes** (Environmental Science)

Advisor: Mr. A. Scott Andres

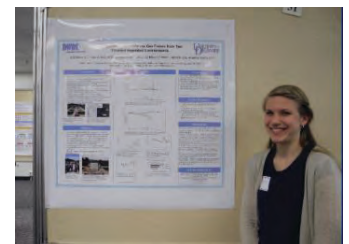
*Determination of Daily Net Primary Production in Coursey Pond, Delaware*



**Kelli Kearns** (Environmental Engineering)

Advisor: Dr. Angelia Seyfferth

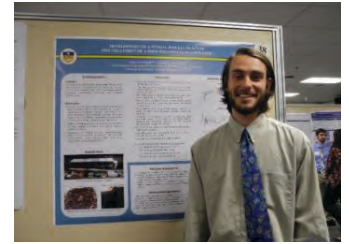
*Biogeochemical Controls on Metal and Nutrient Fluxes in a Protected Estuary in Delaware*



**Andres Kwart** (Environmental Engineering)

Advisor: Dr. Anastasia Chirnside

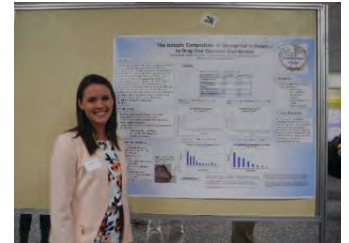
**Development of a Fungal Biocell Reactor for Treatment of a Food Processing Wastewater**



**Alyssa Lutgen** (Environmental Science)

Advisor: Dr. Delphis Levia

**The Isotopic Composition of Throughfall in Relation to Drop Size Diameter Distribution**



**Jillian Matz** (Environmental Science)

Advisor: Dr. Shreeram Inamdar

**Pulse of the Watershed: Studying Rapid (Sub-hourly) Changes in Stream Water Quality Using High-frequency, In-situ Sensors**

**Marcos Miranda** (Environmental Science)

Advisor: Dr. Daniel Cha

**Breathable Membrane Enclosures for Fecal Sludge Stabilization: Application in Eco-vapor Toilets**

**Adam Nesbitt** (Energy and Environmental Policy & Economics)

Advisor: Dr. Lawrence Agbemabiese

**Application of the DESEU to Water Resources**



**Margaret Orr** (Environmental Science)

Advisor: Dr. Shreeram Inamdar

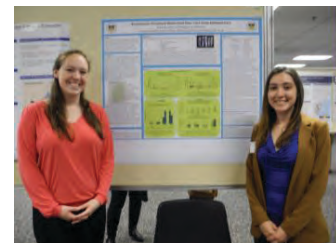
**Assessing the Impact of Severe Storm Events on Exported Sediment, Particulate Organic Matter, and Nutrients and Stream Water Quality**



**Erica Rossetti** (Natural Resources Management)  
**Samantha Serratore** (Environmental Engineering)

Advisor: Dr. Gerald Kauffman

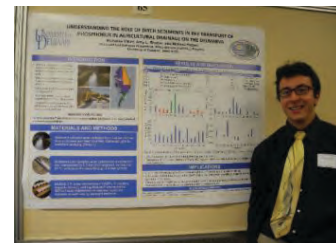
**Brandywine-Piedmont Watershed Plan**



**Nicholas Villari** (Plant Science)

Advisor: Dr. Amy Shober

**Understanding the Role of Ditch Sediments in the Transport of Phosphorus in Agricultural Drainage on the Delmarva**



## 2015-2016 Water Resources Center Graduate Assistants

**Lauren Lechner** (M.S. Civil and Environmental Engineering)

Advisor: Dr. Pei Chiu

**Nutrient Removal from Stormwater, Wastewater, and Agricultural Runoff Using Scrap Iron and Biochar**

**Daniel Sanchez-Carretero** (Ph.D. Civil and Environmental Engineering)

Advisor: Dr. C.P. Huang

**Electrochemical Reduction of Dissolved Carbon Dioxide in Water to Hydrocarbons**

**Alex Soroka** (M.S. Water Science and Policy)

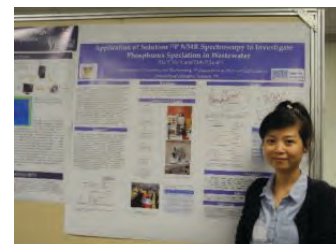
Advisor: Dr. Amy Shober

**Maximizing Yield and Nitrogen Use Efficiency in Delaware's Irrigated Corn**

**Ha Vu** (Ph.D. Chemistry and Biochemistry)

Advisor: Dr. Deb Jaisi

**Remineralization of Organic Matter and Chesapeake Bay Hypoxia**



# *Happy 50<sup>th</sup> Anniversary of the UDWRC (1965-2015)*

**Nov 2015**

***Dr. Gerald Joseph McAdams Kauffman, Jr., Director  
University of Delaware, Water Resources Center***

Twenty fifteen has indeed been a watershed year for water resources in the Diamond State. The Delaware Water Resources Center is celebrating the Golden Anniversary of our founding in 1965, just a year after Lyndon Baines Johnson worked with Congress and signed the Water Resources Research Act that formed the 54 National Institutes for Water Resources (NIWR) at land grant universities in the 50 states, D.C. and the three island territories of Guam, Puerto Rico, and U.S. Virgin Islands. The DWRC Advisory Panel has recommended water resources research funding from the USGS that supports 18 undergraduate internships and 3 graduate assistantships to study with faculty and scientists from five colleges at the University of Delaware. In September, the University of Delaware was chosen to host the 3<sup>rd</sup> Annual Delaware River Forum sponsored by the Coalition for the Delaware River Watershed that highlighted over \$35 million in investments by the William Penn Foundation to 40 nonprofits and universities to protect and restore the watershed that provides drinking water to 5% of the population of the United States. Accepting the gavel from our NIWR colleague and outgoing President Dr. John Tracy (Director of the University of Idaho Water Resources Research Center), the University of Delaware Water Resources Center's Martha Narvaez was inducted on November 18, 2015 as the 51<sup>st</sup> President of the American Water Resources Association at the AWRA annual conference in Denver, Colorado. Completing the flow of good news, past president and geography doctoral candidate Asia Dowtin and current president and Water Science and Policy graduate student Sandra Petrakis accepted the award in Denver on November 15, 2015 as the University of Delaware was recognized as 2015 outstanding AWRA student chapter at the annual AWRA conference in Denver, Colorado. National champs! I wonder what the next ten years will bring for us here at the DWRC. Diamonds anyone?



*Gerald up at the Newark Reservoir*

## **Three 2015 -16 UD WATER Interns Named**

The UD WATER Project (Watershed Action Team for Ecological Restoration) was formed in 2008 to minimize the environmental impacts of stormwater runoff from the University of Delaware campus. The 2015-16 UD WATER interns are Environmental Engineering major Norma Brasure, Environmental Science major Clare Sevcik, and Environmental Science major Gemma Antoniewicz.



*UD WATER interns (left to right) Norma Brasure, Clare Sevcik, and Gemma Antoniewicz*

### **3<sup>rd</sup> Annual Delaware River Watershed Forum**

The 3<sup>rd</sup> Annual Delaware River Watershed Forum was held at the UDWRC on Oct 5-6, 2015 following the first symposium at the Academy of Natural Sciences at Drexel Univ. in 2013 and in Bethlehem near Lehigh Univ. in 2014. Green infrastructure bike tour through the UD campus and City of Newark, DE at the top of Newark Reservoir.



*Green infrastructure bike tour through the University of Delaware campus and City of Newark, DE, led by DWRC Director, Jerry Kauffman. Photo taken at the top of the Newark Reservoir*

### **National Champs! UDAWRA recognized as 2015 Outstanding Student Chapter of the AWRA.**

On November 15, 2015, the University of Delaware was honored with the award for 2015 Outstanding Student Chapter by the American Water Resources Association (AWRA) at the annual conference in Denver, Colorado. Past recipients of the Outstanding Student Chapter award include Penn State, Florida, Washington, Wisconsin, and Oregon State. The UD Student AWRA Chapter was founded in 2005 and is advised by Martha Narvaez from the UDWRC.



*Amanda Doremus, Samantha Brucker, Matt Luddington, Laura Askin, Kelsey Moxey, Kristen Molfetta, Sandra Petrakis, Asia Downtin and John Tracy (AWRA President) (left to right)*

### **UD's Martha Narvaez inaugurated as the 51<sup>st</sup> President of the American Water Resources Association.**

On November 18, 2015, the University of Delaware's Martha Narvaez was inducted as the 51<sup>st</sup> President of the American Water Resources Association at the AWRA annual conference in Denver, Colorado. Martha accepted the gavel from outgoing President John C. Tracy who is the Director of the University of Idaho Water Resources Research Institute in Boise, Idaho.



*Martha Narvaez inaugurated as 51<sup>st</sup> President of AWRA (Denver, CO, Nov 2015)*

# *UDWRC Director's Message*

**August 2015**

With the retirement of Dr. Tom Sims, Deputy Dean of the University of Delaware's College of Agriculture and Natural Resources, I am pleased to be appointed the third Director of the Delaware Water Resources Center (DWRC). Dr. Sims skillfully served as the DWRC director for a decade and a half and made a real and substantial difference in the careers and lives of hundreds if not thousands of students, faculty, and staff who conducted research in water science and policy here at the University of Delaware. The DWRC is one of the 54 National Institutes for Water Resources (NIWR) supported by the U.S. Geological Survey at land grant universities in the 50 states, District of Columbia, and three island territories. The DWRC celebrates our 50<sup>th</sup> anniversary of the center's designation at the University of Delaware in 1965, one year after Lyndon Baines Johnson signed the Water Resources Research Act (WRRRA) on July 17, 1964. The DWRC belongs to the mid-Atlantic NIWR region that includes our colleagues at Cornell, District of Columbia, Penn State, Rutgers, Maryland, Virginia Tech, and West Virginia.

By its favorable geography and hydrology, the University of Delaware is fortuitously situated for water resources research. The Newark campus along the fall line between the Appalachian Piedmont and Atlantic Coastal Plain, and the coastal Lewes campus along the Atlantic Ocean sit amidst two great estuary systems – the Delaware and Chesapeake. These mid-Atlantic basins contribute drinking water to a full one-tenth of the nation's population and the first (New York City), fourth (Baltimore/DC), and seventh (Philadelphia) largest metropolitan economies in the United States. The White Clay Creek National Wild and Scenic River flows through the University of Delaware here in Newark as an ideal experimental watershed for on-campus water resources research by students and faculty/staff. One of our objectives is to increase the amount of federal, state, local, and foundation support for internships and research assistantships for students and faculty to conduct water resources research here in Delaware, the Delaware Valley, and throughout America. If you are on campus, please feel free to drop by our offices at the DGS Annex, 261 Academy Street in Newark or contact me at 302-831-4929, [jerryk@udel.edu](mailto:jerryk@udel.edu) or follow me on twitter @JerryUDwater.

Warmly,  
Gerald J. Kauffman, Ph.D.  
Director, Delaware Water Resources Center



*Jerry Kauffman named third director of the DWRC*

## **DWRC Celebrates 50 Years!**

The DWRC's 50<sup>th</sup> Anniversary was celebrated at the University of Delaware on April 17, 2015! The DWRC is one of the 54 National Institutes for Water Resources (NIWR) funded by the U.S. Geological Survey at land grant universities in the 50 states, District of Columbia, and the three island territories of Guam, Puerto Rico, and US Virgin Islands. This year the DWRC celebrated our 50<sup>th</sup> anniversary of the center's designation at the University of Delaware in 1965, one year after Lyndon Baines Johnson signed the Water Resources Research Act (WRRRA) that established the NIWR program on July 17, 1964. At the annual April meeting of the DWRC Advisory Panel at the Trabant Student Center in Newark, Del, DWRC Director Jerry Kauffman leads DWRC graduate and undergraduate students in a celebratory cake-cutting. The DWRC belongs to the mid-Atlantic NIWR region that includes our colleagues at Cornell, Penn State, Rutgers, Maryland, Virginia Tech, West Virginia and the University of District of Columbia.



*At the annual April luncheon in the UD Perkins Student Center, DWRC celebrates our 50th Anniversary in Newark, Delaware (Apr 17, 2015)*

The DWRC Advisory Panel (2015) was appointed by the Director for a three-year term and includes:

- Jayme Arthurs, USDA Natural Resources Conservation Service
- Chris Bason, Center for the Inland Bays
- Luc Claessens, Department of Geography
- Tom Coleman, City of Newark Water Department
- Jeff Downing, Mt. Cuba Center
- Asia Dowtin, UD student section of the American Water Resources Association
- Mingxin Guo, Department of Agriculture and Natural Resources, Delaware State University
- LeeAnn Haaf, Partnership for the Delaware Estuary
- Stephen Hokuf, New Castle County Department of Planning
- Paul Imhoff, Department of Civil and Environmental Engineering
- Shreeram Inamdar, Department of Plant and Soil Sciences
- Janet Johnson, Department of Political Science and International Relations
- Richie Jones, The Nature Conservancy
- Thomas McKenna, Delaware Geological Survey
- Matt Miller, City of Wilmington Department of Public Works
- Martha Narvaez, UD Water Resources Agency
- Ginger North, Delaware Nature Society
- Betzaida Reyes, U.S. Geological Survey
- Kash Srinivasan, Kash LLC
- Bob Struble, Brandywine Valley Association
- Jennifer Volk, Kent County Cooperative Extension, Department of Plant and Soil Sciences
- Jennifer Walls, Delaware DNREC, Division of Watershed Stewardship

The DEAWRA Student Chapter at the University of Delaware was selected as the 2015 American Water Resources Association Outstanding Student Chapter award presented to President Asia Dowtin in November at the 2015 AWRA Annual Conference in Denver, CO. Past winners include the University of Florida, University of Wisconsin and Oregon State University.



*UDAWRA river clean up event in spring 2015*

## Narvaez Receives WRADRB Achievement Award On April 22, 2015

AWRA President-elect Martha Corrozi Narvaez received the Achievement Award from the Water Resources Association of the Delaware River Basin at the WRADRB 33<sup>rd</sup> Annual Recognition Dinner at the Downtown Club in Philadelphia, PA for leadership in advancing practices of conservation and sound management of water in the Delaware River Basin.



*Left to right, Jerry Kauffman, Dennis Palmer (WRADRB Chairman), Martha Narvaez and Kathy Klein (President, WRADRB) at the WRADRB awards dinner in April 2015*



*Maria Pautler: Research Associate III (DWRC Program Coordinator 2000-2017)*

## 2014-2015 Undergraduate Water Research Students

**Katelyn Csatari** (Environmental Engineering)

Advisor: Dr. Rodrigo Vargas

*Greenhouse Gas Emissions from Sediments in Floodplains of the Delaware Piedmont, Christina River Basin*

**Sandra Demberger** (Environmental Science)

Advisor: Dr. Luc Claessens

*Mushroom Farming and Its Effect on Nitrogen Loading in the Brandywine-Christina River Basin*

**Amanda Doremus** (Environmental Science)

Advisor: Dr. Carmine Balascio

*Water Quality Performance for Paired Bioretention Basins*

**Jessica Fedetz** (Environmental Engineering)

Advisors: Ms. Jennifer Volk & Ms. Marcia Fox

*Fine-scale Temporal Dynamics of Estuarine Viroplankton and Bacterioplankton Populations*

**Amelia Harrison** (Ecology & Marine Science)

Advisor: Dr. K. Eric Wommack

*Fine-scale Temporal Dynamics of Estuarine Viroplankton and Bacterioplankton Populations*

**Sarah Hartman** (Environmental Science & Environmental Engineering)

Advisor: Dr. Angelia Seyfferth

*Understanding Greenhouse Gas Fluxes in Estuaries*

**Danielle Notvest** (Environmental Engineering)

Advisor: Dr. Gerald Kauffman

*Wetland Restoration and Mitigation Banking along the Cool Run Watershed at the UD Farm*

**Gregory Robinson** (Economics)

Advisor: Dr. Joshua Duke

*Procuring Abatement: Cover Crop Cost Heterogeneity and Optimal Policy Design in Delaware*

**Radhika Samant** (*Economics & Environmental and Resource Economics*)

*Advisor: Dr. Gerald Kauffman*

**Wetland Restoration and Mitigation Banking along the Cool Run Watershed at the UD Farm**

**Christopher Youngquist** (*Environmental Engineering and Economics*)

*Advisor: Dr. Paul Imhoff*

**Integrating Biochar Amendments in Green Stormwater Management Systems for Enhanced Nutrient Treatment of Stormwater Runoff**

## **2014-2015 Water Resources Center Graduate Assistants**

**Lauren Lechner** (*M.S. Civil and Environmental Engineering*)

*Advisor: Dr. Pei Chiu*

**Nutrient Removal from Stormwater, Wastewater, and Agricultural Runoff Using Scrap Iron and Biochar**

**Daniel Sanchez-Carretero** (*Ph.D. Civil and Environmental Engineering*)

*Advisor: Dr. C.P. Huang*

**Electrochemical Reduction of Dissolved Carbon Dioxide in Water to Hydrocarbons**

**Alex Soroka** (*M.S. Water Science and Policy*)

*Advisor: Dr. Amy Shober*

**Maximizing Yield and Nitrogen Use Efficiency in Delaware's Irrigated Corn**

**Eric Sakowski** (*Ph.D. Molecular Biology and Genetics*)

*Advisor: Dr. Eric Wommack*

**Microbiome of the Eastern Oyster, *Crassostrea***



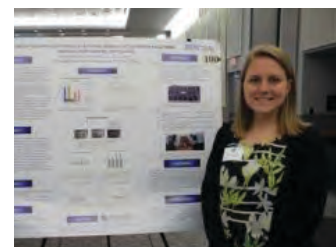
*Thomas Santangelo, Sandra Demberger, Kelcey Moxie, Luc Claussens, and Jerry Kauffman along White Clay Creek National Wild & Scenic River (Mar 2015)*

## 2013-2014 Undergraduate Water Research Students

**Anna Brady** (*Wildlife Ecology*)

Advisor: Dr. Anastasia Chirnside

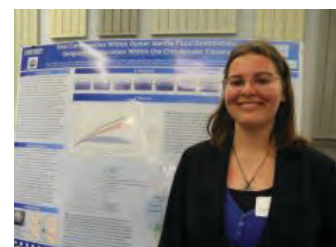
***Use of the White Rot Fungus as a Fungal Bioreactor to Remove E. coli from Aqueous Dairy Manure Wastewater***



**Alessandra Ceretto** (*Biological Science*)

Advisor: Dr. Eric Wommack

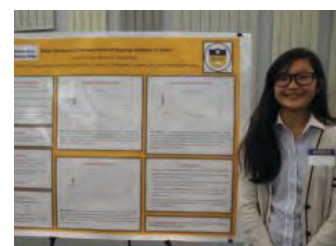
***A Biogeographic Investigation of Viral Diversity within the Eastern Oyster, Crassostrea virginica***



**Naomi Chang** (*Environmental Engineering*)

Advisor: Dr. Paul Imhoff

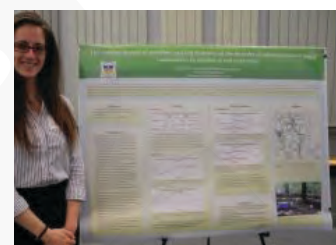
***Exploring the Viability of Biochar to Treat Stormwater***



**Katherine Junghenn** (*Environmental Science*)

Advisor: Dr. Delphis Levia

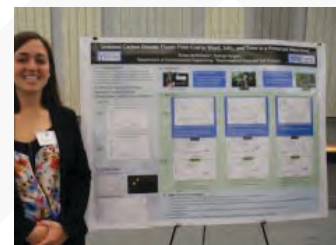
***The Varying Impact of Stemflow and Soil Moisture on the Diversity of Soil Bacterial and Fungal Communities in Relation to Soil Respiration***



**Kelsey McWilliams** (*Environmental Engineering*)

Advisor: Dr. Rodrigo Vargas

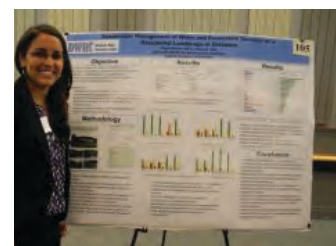
***Methane and Carbon Dioxide Fluxes in a Watershed***



**Megan Murray** (*Economics*)

Advisor: Dr. Joshua Duke

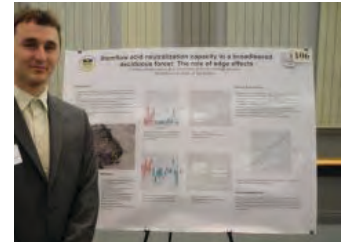
***Sustainable Management of Water and Ecosystem Services on a Residential Landscape in Delaware***



**Alexey Shiklomanov** (*Chemistry & Environmental Science*)

*Advisor: Dr. Delphis Levia*

***Acid Neutralization of Stemflow in a Deciduous Forest: The Role of Edge Effects***



## **2013-2014 Water Resources Center Graduate Assistants**

**Alex Soroka** (*M.S. Water Science and Policy*)

*Advisor: Dr. Amy Shoher*

***Maximizing Yield and Nitrogen Use Efficiency in Delaware's Irrigated Corn***

**Eric Sakowski** (*Ph.D. Molecular Biology and Genetics*)

*Advisor: Dr. Eric Wommack*

***Microbiome of the Eastern Oyster, Crassostrea***

## 2012-2013 Undergraduate Water Research Students

**Lindsey Cook** (Natural Resources Management)

Advisor: Dr. Kalmia Kniel

*Developing Scientifically-Based Food Safety Metrics for Water Management and Irrigation Methods*

**Julia Hagemeyer** (Marine Science)

Advisor: Dr. K. Eric Wommack

*Characterization of Viral Diversity within the Mantel Fluid of the Eastern Oyster, Crassostrea virginica*

**Kayla Iuliano** (Environmental Science)

Advisor: Dr. Shreeram Inamdar

*Water Quality Impacts of Landscape Best Management Practices that Enhance Vegetation*

**Daniel Kardashian** (Environmental Science)

Advisor: Dr. Tom Sims & Mr. James Adkins

*Improving Irrigation Management through Soil Moisture Monitoring and Automated Control of Sprinkler and Sub-Surface Drip Irrigation*

**Tyler Monteith** (Natural Resources Management and Policy)

Advisor: Dr. Joshua Duke

*The Returns to Best Management Practices: Evidence from Early Proposals for Nutrient Trading in the Chesapeake Bay Watershed*

**Timothy Schofield** (Landscape Horticulture and Design & Food and Agribusiness Marketing and Management)

Advisor: Dr. Susan Barton & Dr. Jules Bruck

*Water Quality Management in Urban Ecosystems*

**Wendi Xu** (Environmental Engineering)

Advisor: Dr. Pei Chiu

*Preventing Formation of Toxic Chlorination Byproducts in Water Using Zerovalent Iron*

## **2012-2013 Water Resources Center Graduate Assistants**

**Alex Soroka** (*M.S. Water Science and Policy*)

*Advisor: Dr. Amy Shober*

***Maximizing Yield and Nitrogen Use Efficiency in Delaware's Irrigated Corn***

**Eric Sakowski** (*Ph.D. Molecular Biology and Genetics*)

*Advisor: Dr. Eric Wommack*

***Microbiome of the Eastern Oyster, Crassostrea***

## 2011-2012

At the UD Trabant University Center, 2011-2012 DWRC interns, graduate fellows, advisors, and DWRC Advisory Panel members enjoyed lunch and learned about research projects and interests. Poster Session – April 20, 2012



*2012 DWRC Advisory Panel Discussion*



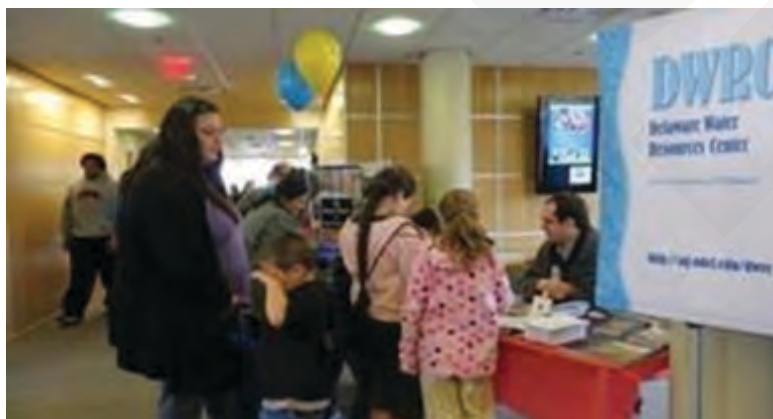
*2012 DWRC Advisory Panel Lunch*



*2012 DWRC Advisory Panel Lunch*



*Dr. Tom Sims at the 2012 DWRC Annual Panel*



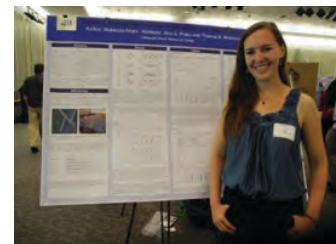
*UD graduate students Shannon Carter and Matt Siebecker engage visitors at the DWRC booth at the UD College of Agriculture and Natural Resources' annual Ag Day in April 2012*

## 2011-2012 Undergraduate Water Research Students

**Rebecca Aiken** (Civil Engineering)

Advisor: Dr. Jack Puleo

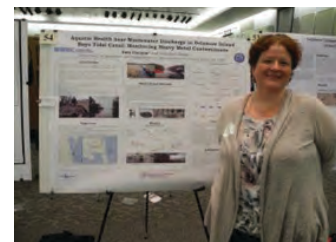
**Spatio-Temporal Hydrodynamic Variability in a Small Tidal Creek: DNERR St. Jones Reserve**



**Amy Cannon** (Environmental Science, Delaware State Univ.)

Advisor: Dr. Gulnihal Ozbay

**Aquatic Health near Wastewater Discharge in Delaware Inland Bays Tidal Canal: Monitoring Heavy Metal Contaminants**



**Stephen Gonski** (Environmental Chemistry)

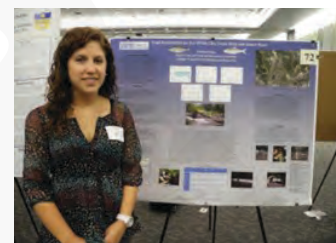
Advisor: Mr. Scott Andres

**Characterization of Submarine Groundwater Discharge Sites in a Coastal Lagoon**

**Chelsea Halley** (Natural Resource Management, Agriculture and Natural Resources & Resource Economics)

Advisor: Dr. Gerald Kauffman

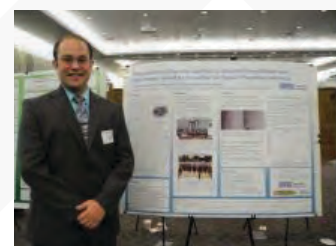
**White Clay Creek Wild and Scenic Shad Restoration Project**



**John Paul Harris** (Plant Sciences)

Advisor: Dr. Anastasia Chirnside

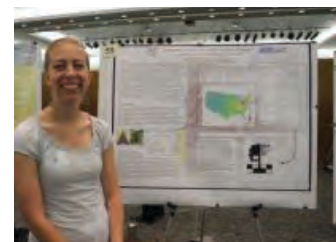
**Predation of Bacteria by the White Rot Fungi, *Pleurotus ostreatus***



**Carrie Scheick** (Environmental Science)

Advisor: Dr. Delphis Levia

**Is Atmospheric Deposition and Washoff of Aluminum in Stemflow a Significant Source of Aluminum to Forest Soils?**



**Nicholas Spalt** (Geology)

Advisor: Mr. Scott Andres

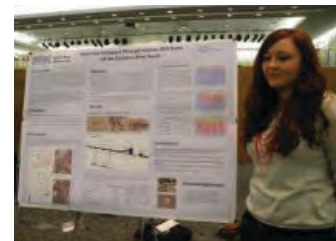
**Hydraulic Properties of the Columbia Aquifer**



**Kimberly Teoli** (Environmental Engineering)

Advisor: Dr. James Pizzuto

**Sediment Transport through Historic Mill Dams of the Christina River Basin**



**Katie Yost** (Biological Sciences)

Advisor: Dr. Doug Tallamy

**The Effect of Wetland Restoration on Arthropod Communities**

### **2011-2012 Water Resources Center Graduate Assistants**

**Maryam Akhavan** (Ph.D. Civil and Environmental Engineering)

Advisor: Dr. Paul Imhoff

**Modeling Hydrologic and Geochemical Effects of Rapid Infiltration Basin Systems**

**Gurbir Dhillon** (M.S. Plant and Soil Sciences)

Advisor: Dr. Shreeram Inamdar

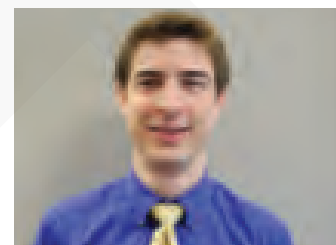
**Comparison of Particulate and Dissolved Organic Carbon Exports from Forested Piedmont Catchments**



**Eric Sakowski** (Ph.D. Molecular Biology and Genetics)

Advisor: Dr. Shreeram Inamdar

**Comparison of Particulate and Dissolved Organic Carbon Exports from Forested Piedmont Catchments**



**Claudia (Velez) Zullo** (Ph.D. Geology)

Advisor: Dr. Susan McGeary

**Seismic Imaging and Hydrogeologic Characterization of the Potomac Formation in Northern New Castle County, Delaware**

## 2010-2011

The UD WATER Project (Watershed Action Team for Ecological Restoration) was formed in 2008 as a collaborative initiative with the long-term goal of merging and facilitating university-wide efforts to minimize the environmental impacts of stormwater runoff from the University of Delaware campus in the White Clay Creek watershed. The UD WATER Team includes:

- Tom Sims (Delaware Water Resources Center)
- Jerry Kauffman (UD Water Resources Agency)
- Carmine Balascio (UD Department of Bioresources Engineering)
- Stacey Chirnside (UD Department of Bioresources Engineering)
- Kelley Dinsmore (City of Newark)
- Andrew Homsey (UDWRA)
- Dan Leathers (UD Department of Geography/DEOS)
- Mike Loftus (UD Facilities)
- Jenny McDermott (UD CANR)
- Tom McKenna (DGS)
- Martha Narvaez (UDWRA)
- Mike Sistik (City of Newark)
- Jennifer Pyle (UD Occupational Health and Safety)



2010-2011 UD WATER interns (left to right) Melanie Allen (Wildlife Conservation), Rina Binder-Macleod (Environmental Engineering), Dakota Laidman (Environmental Engineering), Melissa Luxemberg (Natural Resources Management), Kimberly Teoli (Environmental Engineering)

Delaware Water Resources Center Advisory Panel (2010):

- Steven Abbott, (USDA Natural Resources Conservation Service)
- Scott Andres, (Delaware Geological Survey)
- Katherine Bunting-Howarth (DNREC Division of Water Resources)
- Martha Narvaez (UDWRA)
- Judith Denver (USGS)
- Mingxin Guo (Delaware State University)
- Paul Imhoff (UD Civil & Environmental Engineering)
- David Legates (UD Geography)
- Edward Lewandowski (Center for the Inland Bays)
- Andrew Manus (The Nature Conservancy)
- Denise Seliskar, (UD College of Earth, Ocean, and Environment)



*Maria Pautler receives input at 4-H Science Leadership Academy in Chevy Chase, Md. (Dec 2010)*



*DWRC Annual Luncheon and Poster Session April 22, 2011, UD Trabant University Center, 2010-11 DWRC interns*



*Interns Kate (left) and Aiden (right) at DWRC Advisory Panel Meeting with DWRC faculty advisor Dr. Janet Johnson (Political Science and International Relations) (middle)*



*Ag Day - April 2011 UD graduate student Camille Jones helps a young visitor examine aquatic macroinvertebrates collected in UD's Cool Run watershed*

## 2010-2011 Undergraduate Water Research Students

**Melanie Allen** (*Wildlife Conservation*)

*Advisors: Dr. Gerald Kauffman & Dr. Judith Hough-Goldstein*

*UD Watershed Action Team for Ecological Restoration*



**Kristin Berry** (*Communication*)

*Advisor: Ms. Katy O'Connell*

*Education and Outreach for the Delaware Wetlands*



**Rina Binder-Macleod** (*Civil and Environmental Engineering*)

*Advisor: Dr. Gerald Kauffman*

*UD Watershed Action Team for Ecological Restoration*

**Aidan Galasso** (*History*)

*Advisor: Dr. Janet Johnson*

*An Analysis of the Impact of Marcellus Shale Development on Water Resources in Pennsylvania*



**Stephanie Hahn** (*Bioresources Engineering*)

*Advisor: Dr. Anastasia Chirnside*

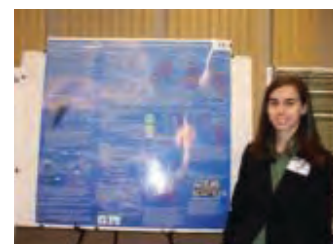
*The Use of Recycled Water for Irrigation of Turf and Landscape Plants*



**Mara Hyatt** (*Biotechnology, Delaware Technical Community College*)

*Advisor: Dr. K. Eric Wommack*

*The Prevalence of Pathogenic Bacteria in Delmarva Waters from a Virus Point of View*



**Dakota Laidman** (Civil and Environmental Engineering)

Advisor: Dr. Gerald Kauffman

**UD Watershed Action Team for Ecological Restoration**



**Michelle Lepori-Bui** (Geography)

Advisor: Dr. Delphis Levia

**A Watershed Scale Forest Inventory of the Fair Hill Natural Resources Management Area**



**Melissa Luxemberg** (Natural Resources Management)

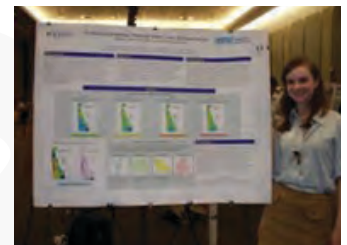
Advisors: Dr. Gerald Kauffman & Dr. John Mackenzie

**UD Watershed Action Team for Ecological Restoration**

**Kate Miller** (Environmental Studies)

Advisor: Dr. Janet Johnson

**The Impacts of Redefining Navigable Waters under the Clean Water Act**



**Kevin Myers** (Environmental Science)

Advisor: Mr. Scott Andres

**Characterization of Submarine Groundwater Discharge Sites in a Coastal Lagoon**



**Jasmine Porter** (Agriculture & Natural Resources,  
Delaware State University)

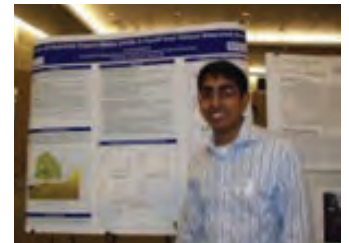
Advisor: Dr. Gulnihal Ozbay

**Oyster Restoration Efforts at Delaware Inland Bays: Utilizing RIP-RAP as a Substrate for Oysters**

**Suneil Seetharam** (*Bioresources Engineering*)

*Advisor: Dr. Shreeram Inamdar*

***Quality of Dissolved Organic Matter in Runoff from Various Watershed Sources***



**Courtney Simmons** (*Resource Economics*)

*Advisor: Dr. Steven Hastings*

***The History and Effectiveness of Wetland Mitigation***

**Hannah Starke** (*Plant Science & Landscape Horticulture/Design*)

*Advisor: Dr. Chad Nelson*

***Resurfacing Silver Brook Stream and Comparison to Connected Water Bodies***



**Kimberly Teoli** (*Civil and Environmental Engineering*)

*Advisor: Dr. Gerald Kauffman*

***UD Watershed Action Team for Ecological Restoration***



**Katie Yost** (*Biological Sciences*)

*Advisor: Dr. Doug Tallamy*

***Assessment of Changes in Invertebrate Populations Resulting from Wetland Restoration***

## **2010-2011 Water Resources Center Graduate Assistants**

**Maryam Akhavan** (Ph.D. Civil and Environmental Engineering)

Advisor: Dr. Paul Imhoff

**Modeling Hydrologic and Geochemical Effects of Rapid Infiltration Basin Systems**

**Gurbir Dhillon** (M.S. Plant and Soil Sciences)

Advisor: Dr. Shreeram Inamdar

**Comparison of Particulate and Dissolved Organic Carbon Exports from Forested Piedmont Catchments**

**Eric Sakowski** (Ph.D. Molecular Biology and Genetics)

Advisor: Dr. Eric Wommack

**Microbiome of the Eastern Oyster, Crassostrea**

**Claudia (Velez) Zullo** (Ph.D. Geology)

Advisor: Dr. Susan McGeary

**Seismic Imaging and Hydrogeologic Characterization of the Potomac Formation in Northern New Castle County, Delaware**

2009-2010



*DWRC Advisory Panel Meeting 2010*



*DWRC Advisory Panel Meeting 2010*



*DWRC Advisory Panel Meeting 2010*



*DWRC Advisory Panel Meeting 2010*



*DWRC Advisory Panel Meeting 2010*

## 2009-2010 Undergraduate Water Research Students

**Anna Bevan** (Geography)

Advisor: Dr. Delphis Levia

*Evolution of Dissolved Organic Nitrogen (DON) from the Headwaters to the Catchment Outlet: Sources, Variation with Scale, and Differences with DOC*



**Victoria Bryan** (Civil and Environmental Engineering)

Advisor: Dr. Steven Dentel

*Direct Contact Membrane Distillation for Production of Potable Water from Deep Saline Aquifers*

**Megan Furman** (Plant and Soil Science)

Advisor: Dr. K. Eric Wommack

*Microbiome of the Eastern Oyster, Crassostrea virginica*



**Aaron Hallett** (Landscape Horticulture and Design)

Advisor: Dr. Chad Nelson

*Newly Constructed Wetland Management: Year One*



**Brian Jayne** (Bioresources Engineering)

Advisor: Dr. Anastasia Chirnside

*Development of an Assay to Monitor the Activity of Fungal Enzymes in Soil*



**Kelsey Lanan** (Geology)

Advisor: Dr. Tom McKenna

*Hydrology of Freshwater Marsh Nature Preserve, New Castle County, Delaware*



**Emily Olson** (*Marine Science*)

*Advisor: Dr. Clara Chan*

***Investigation of Source and Dynamics of Bacterial Contamination in a Coastal Lagoon***



**Jennalee Rufft** (*Environmental Engineering*)

*Advisor: Mr. Scott Andres*

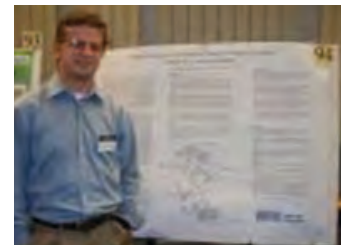
***Physical Characterization of Infiltration Facilities Used for Disposal of Wastewater and Stormwater***



**Michael Ruppel** (*Resource Economics*)

*Advisor: Dr. Joshua Duke*

***Endangered Species on the Delaware River: Ecological, Economic and Institutional Concerns***



**Suneil Seetharam** (*Bioresources Engineering*)

*Advisor: Dr. Shreeram Inamdar*

***Characterizing the Chemistry of Dissolved Organic Matter (DOM) in Watershed Runoff Using Innovative Techniques***



## **2009-2010 Water Resources Center Graduate Assistants**

**Maryam Akhavan** (*Ph.D. Civil and Environmental Engineering*)

*Advisor: Dr. Paul Imhoff*

***Modeling Hydrologic and Geochemical Effects of Rapid Infiltration Basin Systems***

**Jennifer Seiter** (*Ph.D. Plant and Soil Sciences*)

*Advisor: Dr. Donald Sparks*

***The Fate and Speciation of Arsenic in Soils and Poultry Production Systems***

**Claudia (Velez) Zullo** (*Ph.D. Geology*)

*Advisor: Dr. Susan McGeary*

***Seismic Imaging and Hydrogeologic Characterization of the Potomac Formation in Northern New Castle County, Delaware***

## 2008-2009 Undergraduate Water Research Students

**Alexandra Barnard** (*Animal Science*)

Advisor: Dr. William Saylor

**Assessing the Presence of Natural Hormones in Litter and Excreta from Broiler Chickens**

**Christen Dillard** (*Agriculture & Veterinarian Studies, Delaware State University*)

Advisor: Dr. Gulnihal Ozbay

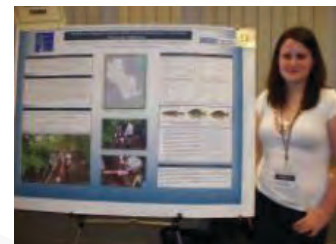
**Water Quality and Bacterial Monitoring at Delaware Inland Bays Oyster Gardening Sites, Delaware**



**Erin Dilworth** (*Natural Resources Management & Wildlife Conservation*)

Advisor: Dr. Chris Williams

**The Effect of Riparian Forested Corridors on Fish Biodiversity in Suburban and Agricultural Landscapes**



**Nicole Dobbs** (*Natural Resources Management*)

Advisor: Dr. Anastasia Chirnside

**UD Watershed Action Team for Ecological Restoration**

**Erik Eggleston** (*Civil and Environmental Engineering*)

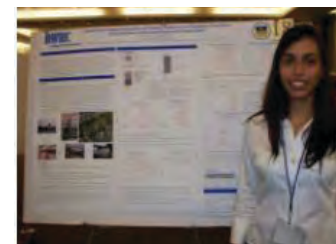
Advisor: Dr. Gerald Kauffman

**UD Watershed Action Team for Ecological Restoration**

**Cristina Fernandez** (*Geology*)

Advisor: Dr. Kyugnssoo Yoo

**Spatial and Temporal Integration of Pollution History in the Christina River Basin Using Sediment Cores from Bread and Cheese Island**



**Aaron Gibson** (Agriculture & Natural Resources,  
Delaware State University)

Advisor: Dr. Gulnihal Ozbay

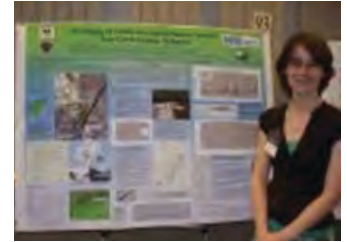
**Effects of Water Quality on Oyster Growth (*Crassostrea virginica*) in the Floating Oyster Aquaculture Gear in Delaware's Inland Bays**



**Kelsey Lanan** (Geology)

Advisor: Dr. Gerald Kauffman

**UD Watershed Action Team for Ecological Restoration**



**Samantha Loprinzo** (Civil and Environmental Engineering)

Advisor: Dr. Gerald Kauffman

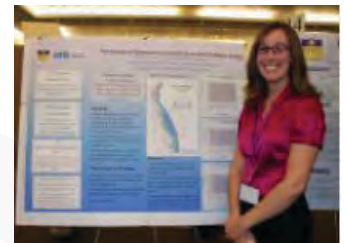
**UD Watershed Action Team for Ecological Restoration**



**Erin McVey** (Natural Resource Management)

Advisor: Dr. Steven Hastings

**Delaware Coastal Zone Act's Impact on Water Quality**



**Stacy Redis** (Civil and Environmental Engineering)

Advisor: Dr. Gerald Kauffman

**UD Watershed Action Team for Ecological Restoration**



**Rachael Vaicunas** (Environmental Engineering)

Advisor: Dr. Pei Chiu

**Exploring Direct Contact Membrane Distillation (DCMD) as for Water Purification**



**Caitlin Wilson** (Environmental Engineering)

Advisor: Dr. Steven Dentel

**Exploring Direct Contact Membrane Distillation (DCMD) as for Water Purification**



**Edwin Wong** (*Environmental Engineering & Economics*)

*Advisor: Dr. Steven Dentel*

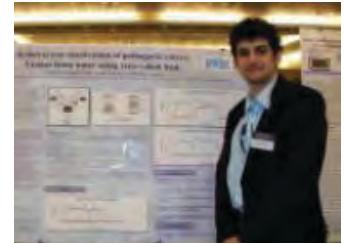
***Direct Contact Membrane Distillation of Brackish and Contaminated Water Sources for Sourcing Potable Water***



**Adam Yoskowitz** (*Animal Science*)

*Advisor: Dr. Kalmia Kneil*

***Removal and Inactivation of Pathogenic Enteric Viruses and Parasites from Water Using Zero-valent Iron***



### **2008-2009 Water Resources Center Graduate Assistants**

**Maryam Akhavan** (*Ph.D. Civil and Environmental Engineering*)

*Advisor: Dr. Paul Imhoff*

***Modeling Hydrologic and Geochemical Effects of Rapid Infiltration Basin Systems***

**Jennifer Seiter** (*Ph.D. Plant and Soil Sciences*)

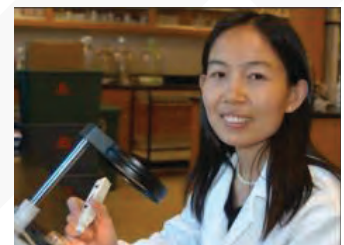
*Advisor: Dr. Donald Sparks*

***The Fate and Speciation of Arsenic in Soils and Poultry Production Systems***

**Liping Zhang** (*M.S. Plant and Soil Sciences*)

*Advisor: Dr. Yan Jin*

***Removal and Inactivation of Waterborne Viruses Using Zerovalent Iron***



**Claudia (Velez) Zullo** (*Ph.D. Geology*)

*Advisor: Dr. Susan McGeary*

***Seismic Imaging and Hydrogeologic Characterization of the Potomac Formation in Northern New Castle County, Delaware***

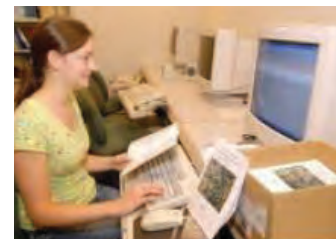


## 2007-2008 Undergraduate Water Research Students

**Sarah Chatterson** (*Food and Resource Economics*)

Advisor: Dr. Joshua Duke

**Willingness to Pay for Sustainable Agricultural Practices in the Urbanizing Region**



**Samantha-Jo Ebert** (*Pre-Veterinarian Science, Delaware State University*)

Advisor: Dr. Dennis McIntosh

**Can a Parabolic Screen Filter Improve the Quality of Water in a Recirculating Aquaculture System?**



**Adrienne George** (*Natural Resources & Environmental Science, Delaware State University*)

Advisor: Dr. Dennis McIntosh

**Determining the Effect of Various Water Conditioners on Holding Success of Mummichog (*Fundulus heteroclitus*) in Simulated Commercial Holding Tanks**

**Jennifer Handlin** (*Environmental Soil Science*)

Advisor: Dr. Yan Jin

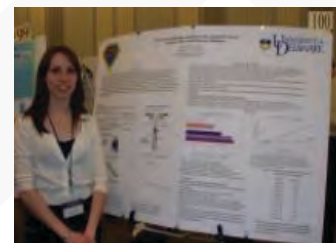
**Evaluating the Use of Zerovalent Iron to Remove Pathogens from Water**



**Janine Howard** (*Geology*)

Advisor: Mr. Scott Andres

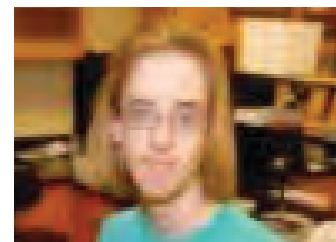
**Effects of Wastewater Disposal on Groundwater Flow in Southern New Castle County**



**Nathan Kiracofe** (*Environmental Engineering*)

Advisor: Dr. Shreeram Inamdar

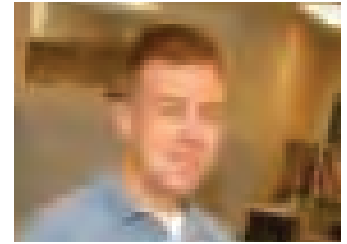
**Assessment of Baseline Water Quality and Influent Pollutant Source Identification in the Noxontown Pond Watershed, Middletown, DE**



**Stephen Mayer** (*Resource Economics*)

*Advisor: Dr. Joshua Duke*

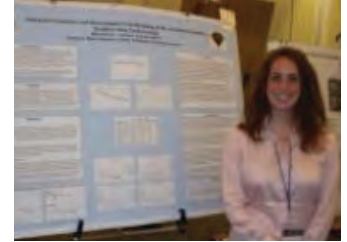
***Benefit-Cost Analysis of Pelletized Broiler Litter in Agronomic Crop Production and Turf Grass Management***



**Marie Rivers** (*Environmental Engineering*)

*Advisor: Mr. Scott Andres*

***Hydraulic Properties and Groundwater Flow Modeling of the Unconfined Aquifer in Southern New Castle County***



**Oluchi Okaegbu** (*Natural Resources, Delaware State Univ.*)

*Advisor: Dr. Gulnihal Ozbay*

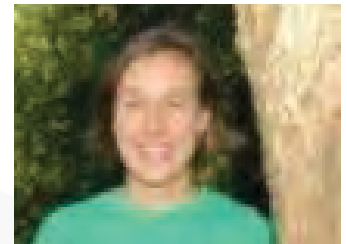
***Viability of Freshwater Mussel (*Elliptio complanata*) as a Biological Filter for Aquaculture Pond Water Quality***



**Laura Yayac** (*Agriculture and Natural Resources Management*)

*Advisor: Dr. Gerald Kauffman*

***Stream Restoration of a Piedmont Headwater Stream in the White Clay Creek Wild and Scenic Watershed***



### ***2007-2008 Water Resources Center Graduate Assistants***

**Babak Shafei** (*Ph.D. Civil and Environmental Engineering*)

*Advisor: Dr. Paul Imhoff*

***Modeling Hydrologic and Geochemical Effects of Land-based Wastewater Disposal***

**Jennifer Seiter** (*Ph.D. Plant and Soil Sciences*)

*Advisor: Dr. Donald Sparks*

***The Fate and Speciation of Arsenic in Soils and Poultry Production Systems***

**Claudia (Velez) Zullo** (*Ph.D. Geology*)

*Advisor: Dr. Susan McGeary*

***Seismic Imaging and Hydrogeologic Characterization of the Potomac Formation in Northern New Castle County, Delaware***

## 2006-2007 Undergraduate Water Research Students

**Jennifer Boutin** (*Environmental Science & International Relations*)

Advisor: Dr. David Legates

*The Effect of Proposed Climatic Warming on the Hydrological Cycle*

**Belinda Gao** (*Chemical Engineering*)

Advisor: Dr. Steven Dentel

*Enhanced Pollutant Biodegradation by Electrode Use*



**Jason Graham** (*Entomology & Wildlife Conservation*)

Advisor: Dr. Judith Hough-Goldstein

*Predators of Galerucella Beetles, Biocontrol Agents of Purple Loosestrife*

**Garrett Peters** (*Civil Engineering*)

Advisor: Dr. William Ullman Douglas Miller

*Groundwater Seepage at Roosevelt Inlet, Delaware*

**Samantha Smith** (*Biology*)

Advisor: Dr. Diane Herson

*Detection of Salmonella in Biosolids Using PCR*

**Le'Sasha Stewart** (*Biology, Delaware State University*)

Advisor: Dr. Gulnihal Ozbay

*Assessment of Sediment Macro-infaunal Communities Associated with Eastern Oyster (*Crassostrea virginica*) in Delaware Indian River Bay*

**Sarah Sturtz** (Biology)

Advisor: Dr. Jack Gingrich

**Sustainable Mosquito Control for Stormwater Ponds**



**Jarvon Tobias** (Animal Science)

Advisor: Dr. William Saylor

**The Effect of Dietary Level and Source of Copper on Chemically-defined Fractions of Copper in Broiler Excreta**



**Elizabeth Wolff** (Environmental Science)

Advisor: Mr. Scott Andres

**Hydraulic Properties of the Unconfined Aquifer in Southern New Castle County**



## **2006-2007 Water Resources Center Graduate Assistants**

**Jennifer Seiter** (Ph.D. Plant and Soil Sciences)

Advisor: Dr. Donald Sparks

**The Fate and Speciation of Arsenic in Soils and Poultry Production Systems**

**Claudia (Velez) Zullo** (Ph.D. Geology)

Advisor: Dr. Susan McGeary

**Seismic Imaging and Hydrogeologic Characterization of the Potomac Formation in Northern New Castle County, Delaware**

## 2005-2006 Undergraduate Water Research Students

**Leslie Carter** (*Landscape Horticulture & Wildlife Conservation*)

Advisor: Dr. Bruce Vasilas

*Rain Gardens*



**Christi DeSisto** (*Civil Engineering*)

Advisor: Dr. Gerald Kauffman

*Delaware River State of the Basin Report 2006: Development of Environmental Indicators*



**Bailey Dugan** (*Environmental Science & Geology*)

Advisor: Mr. Scott Andres

*Hydrogeology of the Near-surface Aquifers in Sussex County*



**Jason Graham** (*Entomology & Wildlife Conservation*)

Advisor: Dr. Judith Hough-Goldstein

*The Impact of Predation on the Galerucella Beetle, a Purple Loosestrife Biocontrol Agent*



**Leslie Howe** (*Pre-Veterinarian Science, Delaware State University*)

Advisor: Dr. Mingxin Guo

*Nutrient Release from Mineralization of Poultry Litter under Simulated Field Conditions*

**Lydia Leclair** (*Environmental Science*)

Advisor: Dr. Delphis Levia

*Winter Needle Conductance Rates of Pinus strobus L. (Eastern White Pine): Meteorological Conditions and Intraspecific Variability*



**Matthew Lee** (*Agriculture & Natural Resources*)

*Advisors: Dr. Joshua Duke & Dr. Rhonda Aull Hyde*

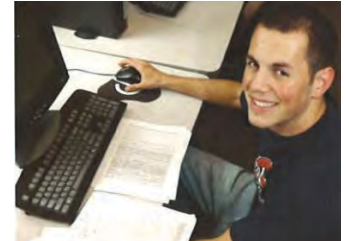
***Landowner Perceptions of the Stringency of Water Quality Regulations in Delaware***



**Matthew Loiacono** (*Natural Resource Management*)

*Advisors: Dr. Joshua Duke & Dr. Steven Hastings*

***The Impact of the Solid Waste Decision on Isolated Wetlands***



**Jimit Modi** (*Chemistry & Environmental Engineering*)

*Advisor: Dr. Herbert Allen*

***Kinetics Model for Soil***



**Jamie Pool** (*Wildlife Conservation*)

*Advisor: Dr. Judith Hough-Goldstein*

***Biological Control of Purple Loosestrife: Preventing Wetlands Degradation by an Invasive Plant***



**Brian Rosen** (*Chemical Engineering*)

*Advisor: Dr. Donald Sparks*

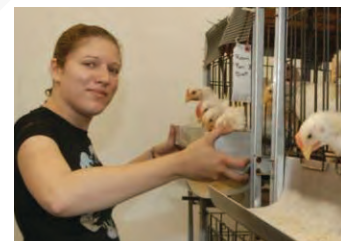
***Nickel Sorption Kinetics at the Geothite/Water Interface: Effects of Ionic Strength and 2-[N-Morpholino]-ethanesul-fonic Acid (MES)***



**Carolyn Schnek** (*Animal Science*)

*Advisor: Dr. William Saylor*

***The Effect of Dietary Level and Source of Copper (Cu) on Broiler Cu Excretion and Movement of Cu through Broiler Excreta Amended Soils***



**Nancy Scott** (Environmental Science)

Advisor: Dr. Jack Gingrich

**Sustainable, Low-impact Methods for Managing Mosquitoes in Storm Water Ponds**



**Samantha Smith** (Biology)

Advisor: Dr. Diane Herson

**Detection of Salmonella in Biosolids Using a Combination of Cultural, Molecular, and Immunological Methods**

**Maia Tatinclaux** (Natural Resource Management)

Advisor: Dr. John Gallagher

**Location and Evaluation of Coastal and Inland Brackish Aquifers for the Support of Halophyte (*Kosteletzkya*) Oil Production for Biodiesel Fuel Conversion**



**Katherine Tigani** (Plant Science)

Advisor: Dr. John Gallagher

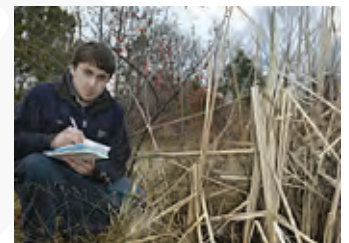
**Restoring Coastal Bay Water Quality via Native Eelgrass Micropropagation**



**Michael Zuk** (Plant Science)

Advisor: Dr. John Frett

**Diversity, Function, and Benefits of Plants Adapted to Flood-prone and Poorly Drained Environments**



## **2005-2006 Water Resources Center Graduate Assistants**

**Jennifer Seiter** (Ph.D. Plant and Soil Sciences)

Advisor: Dr. Donald Sparks

**The Fate and Speciation of Arsenic in Soils and Poultry Production Systems**

**Claudia (Velez) Zullo** (Ph.D. Geology)

Advisor: Dr. Susan McGeary

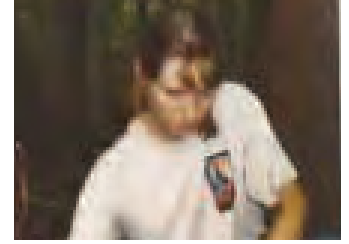
**Seismic Imaging and Hydrogeologic Characterization of the Potomac Formation in Northern New Castle County, Delaware**

## 2004-2005 Undergraduate Water Research Students

**Carol Carlson** (Plant Science)

Advisor: Dr. Bruce Vasilas

**Monitoring and Assessing the Nutrient Status and Overall Health of Freshwater Wetlands**



**Matthew DeSanctis** (Geography & Political Science)

Advisor: Dr. Janet Johnson

**An Evaluation of Water Supply Security in the State of Delaware After September 11, 2001**

**Steven Ernst** (Resource Economics)

Advisor: Dr. Steven Hastings

**An Analysis of Transboundary Resource**



**Jason Graham** (Entomology & Wildlife Conservation)

**Jamie Pool** (Wildlife Conservation)

Advisor: Dr. Judith Hough-Goldstein

**Biological Control of Purple Loosestrife at Flat Pond: Reclaiming a Freshwater Pond near the C&D Canal**



**Matthew King** (Mechanical Engineering)

Advisor: Dr. James Glancey

**Design and Field Testing of Advanced Surveillance Systems for Delaware's Shallow Depth Estuaries**

**David Kleinot** (Geology)

Advisors: Ms. Judith Denver & Mr. Mark Nardi

**Potomac River Basin/Delmarva Peninsula Data Retrieval Program (USGS National Water-Quality Assessment Program)**

**Trevor Knight** (*Fisheries Management, Delaware State University*)

*Advisor: Dr. Dewayne Fox*

***Assessing the Feasibility of Using Fish Assemblages as Indicators of Water Quality in Delaware Streams***



**Alicia Revis** (*Environmental Science, Delaware State University*)

*Advisor: Dr. Dennis McIntosh*

***Design and Field Testing of Advanced Surveillance Systems for Delaware's Shallow Depth Estuaries***



**Erin Zimich** (*Bioresources Engineering*)

*Advisor: Dr. William Ritter*

***Land Application of Wastewater in the Chesapeake Bay***



### ***2004-2005 Water Resources Center Graduate Assistants***

**Jennifer Seiter** (*Ph.D. Plant and Soil Sciences*)

*Advisor: Dr. Donald Sparks*

***The Fate and Speciation of Arsenic in Soils and Poultry Production Systems***

## 2003-2004 Undergraduate Water Research Students

**Megan Bielawa** (*Biology*)

*Advisor: Dr. Jack Gingrich*

***Breeding of Potential West Nile Virus Vectors in Stormwater Ponds and Constructed Wetlands***



**Kathleen Cormier** (*Natural Resources Management*)

*Advisor: Mr. Martin Wollaston*

***Field Measurements of Nonpoint Source Pollutant Removal Efficiencies of Stormwater BMPs at the UD Experimental Watershed***



**Justin Glier** (*Environmental Soil Science*)

*Advisor: Dr. Steven Dentel*

***Enhanced Degradation of Benzoate by Electrode- utilizing Microorganisms***

**Andrew Joslyn** (*Environmental Engineering*)

*Advisor: Dr. Steven Dentel*

***Enhanced Degradation of Benzoate by Electrode- utilizing Microorganisms***



**Eric Lang** (*Geology*)

*Advisor: Dr. Judith Denver*

***Mapping the Base of Kent County's Unconfined Surface Aquifer***

**Alice McDermott** (*Bio-resources Engineering*)

*Advisor: Dr. Anastasia Chirnside*

***Biological and Enzymatic Treatment of a Food Processing Wastewater***

**Mark Neimeister** (Geology)

Advisor: Mr. Scott Andres

**Nanticoke River Watershed: Total Maximum Daily Loads (TMDL) Program**

**Kate Schutte** (Environmental Engineering)

Advisor: Dr. Steven Dentel

**Enhanced Pollutant Biodegradation by Electrode Use**

**Kristen Sentoff** (Natural Resources Management)

Advisor: Dr. Gerald Kauffman

**Fairfield Run: An Evaluation of Stream Habitat Restoration at the UD Experimental Watershed**



**Matt Simon** (Biology)

Advisor: Dr. Eric Wommack

**Enumeration of Aquatic RNA Viruses from a Mixed Viral Sample**



**Judith Walker** (Natural Resources Management)

Advisor: Dr. Gerald Kauffman

**Blue Hen Creek: An Evaluation of Stream Habitat Restoration at the UD Experimental Watershed**



## **2003-2004 Water Resources Center Graduate Assistants**

**Jennifer Seiter** (Ph.D. Plant and Soil Sciences)

Advisor: Dr. Donald Sparks

**The Fate and Speciation of Arsenic in Soils and Poultry Production Systems**



## 2002-2003 Undergraduate Water Research Students

**Laura Boyer** (Environmental Science)

Advisor: Dr. Tom Sims

*The Chemistry of Phosphorus in the Erodible Fraction of Delaware Soils*

**Alexander DeWire** (Natural Resource Management)

Advisor: Dr. Janet Johnson

*Riparian Buffering Program Implementation Analysis for the Mid-Atlantic Region*



**Michael League** (Biology & Education)

Advisor: Dr. John Gallagher

*Understanding the Mechanisms of the Spread of Phragmites australis: For Better or for Worse*



**Kristen Sentoff** (Natural Resource Management)

Advisor: Dr. Joshua Duke

*Regulating Wetlands in Delaware in a Changing Legal Environment*



**Aditya Sharma** (Biochemistry)

**Bret Strogon** (Environmental Engineering)vv

Advisors: Dr. Steven Dentel & Dr. Pei Chiu

*Accelerated Bioremediation of Wastewater Using Electrode-reducing Microorganisms*



**Kerrie Smith** (Mechanical Engineering)

Advisor: Dr. James Glancey

*An Autonomous Full Water Column Environmental Monitoring System with Telemetry*

## 2002-2003 Water Resources Center Graduate Assistants

**Stefan Hunger** (*Ph.D. Plant and Soil Sciences*)

*Advisor: Dr. Donald Sparks*

***Mechanisms of Phosphorus Stabilization in the Soil Environment: A Molecular Scale Evaluation***

**Jennifer (Jennings) Volk** (*M.S. Marine Science and Policy*)

*Advisor: Dr. William Ullman*

***The Role of Land Use and Land Cover in the Delivery of Nutrients to Delaware's Inland Bays***

**Lynnette Ward** (*Ph.D. Bioresources Engineering*)

*Advisor: Dr. William Ritter*

***Environmental Policies for a Sustainable Poultry Industry in Sussex County, Delaware***



## 2001-2002 Undergraduate Water Research Students

### **Christina Eckstrand** (*Animal Science*)

Advisor: Dr. William Saylor

***Fate of Microbial Phytase in the Gastrointestinal Tract of Chicks, and Effects on Phosphorus Solubility***



### **Tara Harrell** (*Natural Resources Management*)

Advisor: Dr. Gerald Kauffman

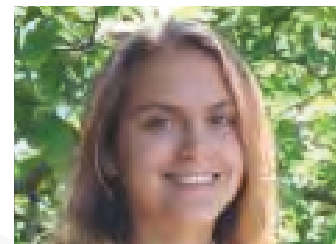
***Links between Land Use and Stream Health in the University of Delaware Experimental Watershed***



### **Katie Lemon** (*Natural Resources Management*)

Advisor: Dr. Joshua Duke

***An Analysis of Delaware's Groundwater Allocation Laws: Proposing a Plan***



### **Kirsten Lloyd** (*Environmental Soil Science*)

Advisor: Dr. Bruce Vasilas

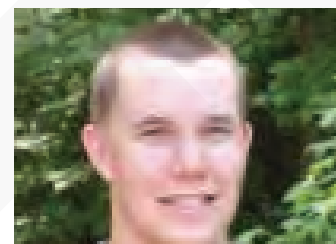
***Functional Assessment of Wetlands for Mitigation Purposes***



### **John Place** (*General Agriculture*)

Advisor: Ms. Susan Truehat Garey

***A Nutrient Management Program for Delaware Youth***



### **Lindsay Scanlon** (*Marine Studies*)

Advisor: Dr. Ronald Martin

***Stratigraphic Analysis of the St. Jones Estuary***

**Kristin Staats** (*Environmental Soil Science*)

*Advisor: Dr. Bruce Vasilas*

***Ectomycorrhizal Mantles as Indicators of Historic Hydric Soils***

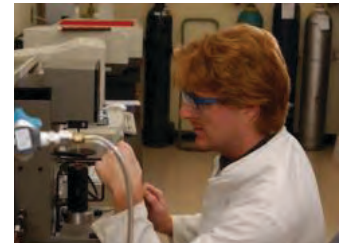


## **2001-2002 Water Resources Center Graduate Assistants**

**Stefan Hunger** (*Ph.D. Plant and Soil Sciences*)

*Advisor: Dr. Donald Sparks*

***Mechanisms of Phosphorus Stabilization in the Soil Environment: A Molecular Scale Evaluation***



**Jennifer (Jennings) Volk** (*M.S. Marine Science and Policy*)

*Advisor: Dr. William Ullman*

***The Role of Land Use and Land Cover in the Delivery of Nutrients to Delaware's Inland Bays***



**Lynnette Ward** (*Ph.D. Bioresources Engineering*)

*Advisor: Dr. William Ritter*

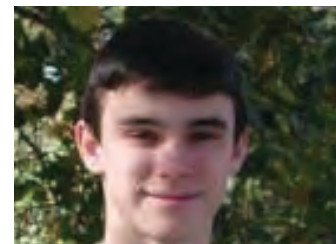
***Environmental Policies for a Sustainable Poultry Industry in Sussex County, Delaware***

## 2000-2001 Undergraduate Water Research Students

**Gregory Buckmaster** (Biochemistry)

Advisor: Dr. Jeffry Fuhrmann

*The Impact of Alum on Pathogen Survival in Poultry*



**Jennifer Campagnini** (Natural Resources Management)

Advisor: Dr. Gerald Kauffman

*The University of Delaware Experimental Watershed Project*



**Maeve Desmond** (Plant Science)

Advisor: Dr. Bruce Vasilas

*Functional Assessment of Wetlands Using a Hydrogeomorphic Model*



**Robert Ehemann** (Natural Resources Management)

Advisor: Dr. Joshua Duke

*A Spatial Analysis of the Distributional Effects of Water Quantity Management*



**Emily Gonce** (Leadership and Consumer Economics)

Advisors: Dr. James Morrison & Dr. Hye-Shin Kim

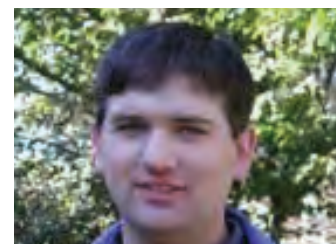
*Attitudes of Consumers Towards Bottled Water*



**Jason Hetrick** (Environmental Engineering)

Advisor: Dr. Anastasia Chirnside

*Feasibility of Using a Fungal Bioreactor In Treating Industrial Wastewater*



**Leigh Johnson** (Environmental Engineering)

Advisor: Dr. William Ritter

**Feasibility of Composting Poultry Litter and Food Residuals for Use as a Soil Amendment and Potting Medium**



**Anna Palermo** (Environmental Soil Science)

Advisor: Dr. Bruce Vasilas

**Use of Ectomycorrhiza as a Soil Hydrology Indicator for Wetland Assessments**



**Melissa Weitz** (Animal Science)

Advisor: Dr. Mark Radosevich

**Biodiversity of the Atrazine Chlorohydrolase (atzA) Gene in Soil Microbial Communities as a Function of Triazine Treatment History**



## **2000-2001 Water Resources Center Graduate Assistants**

**Stefan Hunger** (Ph.D. Plant and Soil Sciences)

Advisor: Dr. Donald Sparks

**Mechanisms of Phosphorus Stabilization in the Soil Environment: A Molecular Scale Evaluation**

**Jennifer (Jennings) Volk** (M.S. Marine Science and Policy)

Advisor: Dr. Donald Sparks

**The Role of Land Use and Land Cover in the Delivery of Nutrients to Delaware's Inland Bays**

**Lynnette Ward** (Ph.D. Bioresources Engineering)

Advisor: Dr. William Ritter

**Environmental Policies for a Sustainable Poultry Industry in Sussex County, Delaware**

*Delaware Water  
Resources Center/  
Water Resources  
Agency Students  
2000-2025*

2025

Jhaney Hamlett . . . . . *Master of Public Administration* . . . . .  
 Megan Wassil . . . . . *M.S. Water Science & Policy* . . . . .  
 Catherine Gilman . . . . . *M.S. Energy & Environmental Policy* . . . . .  
 Nicole Re . . . . . *M.S. Energy & Environmental Policy* . . . . .

2024

Jhaney Hamlett . . . . . *Master of Public Administration* . . . . .  
 Megan Wassil . . . . . *M.S. Water Science & Policy* . . . . .  
 Lydia Franks . . . . . *M.S. Water Science & Policy* . . . . .

2023

Elizabeth Shields . . . . . *Master of Public Policy* . . . . .  
 Megan Wassil . . . . . *M.S. Water Science & Policy* . . . . .  
 Lydia Franks . . . . . *M.S. Water Science & Policy* . . . . .

2022

Hayley Rost . . . . . *Master of Public Administration* . . . . .  
 Elizabeth Shields . . . . . *Master of Public Policy* . . . . .  
 Megan Wassil . . . . . *Civil and Environmental Engineering* . . . . .  
 Lydia Franks . . . . . *M.S. Water Science & Policy* . . . . .

2021

Hayley Rost . . . . . *Master of Public Administration* . . . . .  
 Sophie Phillips . . . . . *M.S. Energy and Environmental Policy* . . . . .  
 Elizabeth Shields . . . . . *Master of Public Policy* . . . . .  
 Megan Wassil . . . . . *Civil and Environmental Engineering* . . . . .  
 Sophia Talley . . . . . *Civil and Environmental Engineering* . . . . .  
 Megan Jarocki . . . . . *Civil and Environmental Engineering* . . . . .

2020

Hayley Rost . . . . . *Master of Public Administration, MPA* . . . . .  
 Sophie Phillips . . . . . *M.S. Energy and Environmental Policy, MEEP* . . . . .  
 Shannon Bushinsky . . . . . *Civil and Environmental Engineering* . . . . .  
 Patrick McGay . . . . . *Civil and Environmental Engineering* . . . . .  
 Karmyn Pasquariello . . . . . *Civil and Environmental Engineering* . . . . .

2019

Kelly Jacobs . . . . . *M.S. Energy and Environmental Policy* . . . . .  
 Matt Kirchoff . . . . . *M.S. Energy and Environmental Policy* . . . . .  
 Polly Ni . . . . . *Civil and Environmental Engineering* . . . . .  
 Justin Leary . . . . . *Civil and Environmental Engineering* . . . . .  
 Mary Kegelmann . . . . . *Civil and Environmental Engineering* . . . . .

2018

Jillian Young . . . . . *M.S. Water Science and Policy* . . . . .  
 Kelly Jacobs . . . . . *M.S. Energy and Environmental Policy* . . . . .  
 Karice Redhead . . . . . *M.S. Energy and Environmental Policy* . . . . .  
 Alyssa Cortese . . . . . *Environmental Science* . . . . .  
 Natalie Zimmerman . . . . . *Geological Sciences* . . . . .

2017

Jillian Young . . . . . *M.S. Water Science and Policy* . . . . .  
 Briana Diacopoulos . . . . . *M.S. Water Science and Policy* . . . . .  
 Jordan Martin . . . . . *M.S. Water Resources Engineering* . . . . .

2016

Chelsi Cambell . . . . . *Civil and Environmental Engineering* . . . . .

2016 continued

Matthew Ludington . . . . . M.S. Water Science and Policy . . . . .  
Andrea Miller . . . . . Environmental Studies . . . . .  
Maya Kassoff . . . . . Environmental Science . . . . .

2015

Laura Askin . . . . . Master of Public Administration . . . . .  
Samantha Brucker . . . . . M.A. Urban Affairs and Public Policy. . . . .  
Kristen Molfetta . . . . . M.S. Water Science and Policy. . . . .  
Matthew Ludington . . . . . M.S. Water Science and Policy . . . . .

2014

Jillian Allen . . . . . Civil and Environmental Engineering . . . . .  
Matt Bachman . . . . . M.S. Water Science and Policy. . . . .  
Hannah Diehl . . . . . Civil and Environmental Engineering . . . . .  
Asia Dowtin . . . . . M.S. Geography. . . . .  
Andrew Colletti . . . . . Civil and Environmental Engineering . . . . .  
Tobias Muller . . . . . Civil and Environmental Engineering . . . . .  
Danielle Notvest . . . . . Civil and Environmental Engineering. . . . .  
Kelli Platt . . . . . Civil and Environmental Engineering . . . . .  
Radhika Samant . . . . . Civil and Environmental Engineering. . . . .  
Julie Swanson . . . . . Civil and Environmental Engineering . . . . .  
Sara Veale . . . . . Civil and Environmental Engineering . . . . .

2013

Kevin Archibald . . . . . Biology. . . . .  
Emily Baumbach . . . . . Natural Resources Management. . . . .  
Joe Brown . . . . . M.A. Urban and Regional Planning . . . . .  
Asia Dowtin . . . . . M.S. Geography. . . . .  
Caren Fitzgerald . . . . . English and B.S. Environmental Studies. . . . .  
Kate Miller . . . . . M.S. Water Science and Policy . . . . .  
Thomas Santangelo . . . . . M.S. Water Science and Policy. . . . .  
Kelsey Wentling . . . . . Environmental Studies . . . . .

2012

Devika Banerjee . . . . . Environmental Studies. . . . .  
Catherine Cruz-Ortiz . . . . . Master of Energy and Environmental Policy . . . . .  
Kaitlyn Cyr . . . . . Environmental Studies . . . . .  
Jordan Deshon . . . . . Civil and Environmental Engineering . . . . .  
Ian Kaliaken . . . . . Civil and Environmental Engineering . . . . .  
Seth Olsen . . . . . B.S. Natural Resources Management . . . . .

2011

Erica Addonizio . . . . . Chemical Engineering. . . . .  
Dustin Briggs . . . . . Civil and Environmental Engineering . . . . .  
Sarah Chatterson . . . . . M.A. Urban Affairs and Public Policy. . . . .  
Chelsea Halley . . . . . Natural Resources Management. . . . .  
Lawrence Latour . . . . . Civil and Environmental Engineering. . . . .  
Stacy Mack . . . . . M.A. Urban Affairs and Public Policy . . . . .  
Erin McVey . . . . . M.A. Urban Affairs and Public Policy . . . . .  
David Specht . . . . . Civil and Environmental Engineering . . . . .

2010

Kayla Iuliano . . . . . Geography . . . . .

2010 continued

Audrey Yorke . . . . .		Civil and Environmental Engineering . . . . .
	2009	
Kaci Angeline . . . . .		B.S. Geography . . . . .
Erika Farris . . . . .		M.A. Urban Affairs and Public Policy. . . . .
Maureen Seymour . . . . .		M.A. Urban Affairs and Public Policy . . . . .
Kelly Wolfe . . . . .		M.A. Urban Affairs and Public Policy . . . . .
	2008	
Jonathan Barton . . . . .		Electrical and Computer Engineering. . . . .
Kyle Campbell . . . . .		Civil and Environmental Engineering . . . . .
Christi DeSisto . . . . .		Civil and Environmental Engineering . . . . .
Erin Dilworth . . . . .		Natural Resources Management. . . . .
Kiersten Joesten . . . . .		Natural Resources Management . . . . .
Angelina Micheva . . . . .		M.A. Urban Affairs and Public Policy . . . . .
Mary Kate O'Brien . . . . .		Natural Resources Management. . . . .
Julie Trick . . . . .		Civil and Environmental Engineering . . . . .
Laura Yayak . . . . .		Natural Resources Management. . . . .
	2007	
Andrew Belden . . . . .		Master of Energy and Environmental Policy . . . . .
Priscilla Cole . . . . .		Master of Energy and Environmental Policy . . . . .
Jyoti Karkhi . . . . .		Master of Energy and Environmental Policy. . . . .
	2006	
Molly Hesson . . . . .		Master of Energy and Environmental Policy . . . . .
Kevin Vonck . . . . .		Ph.D. Urban Affairs and Public Policy. . . . .
Melissa Zechiel . . . . .		M.A. Urban Affairs and Public Policy . . . . .
	2005	
Steven Ernst . . . . .		Natural Resources Management . . . . .
Elaine Grehl . . . . .		M.A. Horticulture Administration, Longwood Graduate Program
Andrew Kauffman . . . . .		Civil and Environmental Engineering . . . . .
Laura Robinson . . . . .		Civil and Environmental Engineering . . . . .
Lori Schnick . . . . .		Geology. . . . .
	2004	
Amy Dolan . . . . .		Master of Energy and Environmental Policy . . . . .
Sarah Wozniak . . . . .		Master of Energy and Environmental Policy. . . . .
	2002	
Justin Bower . . . . .		M.A. Urban Affairs and Public Administration. . . . .
Martha Corrozi . . . . .		Master of Public Administration . . . . .
Jarod Doucette . . . . .		Electrical Engineering . . . . .
Tara Harrell . . . . .		Natural Resources Management. . . . .
	2001	
Jennifer Campagnini . . . . .		Natural Resources Management. . . . .
	2000	
Nigel Bradley . . . . .		M.S. Marine Policy . . . . .
Anne Kitchell . . . . .		M.S. Marine Policy . . . . .

*Delaware Water  
Resources Center  
Directors  
1965-2025*



*Dr. Gerald Joseph McAdams Kauffman, Jr.  
DWRC Director (2015 – present)*

*Director, Interdisciplinary Graduate Program in Water Science & Policy  
Associate Professor, Biden School of Public Policy & Administration  
University of Delaware*



*Dr. J. Thomas Sims  
DWRC Director (2000-2015)*

*Deputy Dean, College of Agriculture & Natural Resources  
T.A. Baker Professor of Soil and Environmental Chemistry  
University of Delaware*



*Dr. Robert D. Varrin  
DWRC Director (1965-1999)*

*Professor and Chair, Department of Civil & Environmental Engineering  
University of Delaware*

*Delaware Water  
Resources Center  
Remembrances*

## Bernard L. Dworsky, WRA Director from 1977-2003

May 29, 1941 - January 30, 2025

Water Resources Agency for New Castle County  
University of Delaware Water Resources Agency

February 14, 2025

Bernie was the formative Director of the Water Resources Agency for New Castle County and he did so much fighting literally and figuratively for clean and safe water in Delaware from forming a cooperative WRA Policy Board between the Governor, County Executive and Mayors of Newark and Wilmington in 1977 that still stands today, to building relationships with our upstream neighbors in our drinking water watersheds in Pennsylvania, to fighting for the water supplies that became the Newark Reservoir. Bernie is Newark, he's Delaware, and he's a true blue University of Delaware Blue Hen and I'm glad that I worked with him through it all. We are both Catholics and we believe in the same things, Bernie, and we'll see you looking down from up there. I'll always remember you Bernie, every Autumn Friday in the office, how are the Blue Hens gonna do this Saturday? 41-14 always! Now about that golf game!

Take care and God Bless You!

Jerry K.

Gerald Joseph McAdams Kauffman, Jr.



*Bernie Dworsky (far right) and colleagues at James Farm along the Delaware Inland Bays (Jan 2000)*

## Vern C. Svatos, GIS Coordinator from 1994-2004

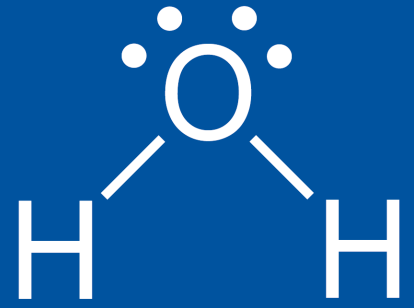
June 15, 1941 - July 3, 2004

Water Resources Agency for New Castle County  
University of Delaware Water Resources Agency

Vern Svatos served in the U.S. Army, and then went on to earn a BA and MA in English/Linguistics. He continued his study of English at the University of Delaware before embarking on a career in Geographical Information Systems (GIS). Vern later worked in computer information systems in the private sector, but returned to GIS, joining the Water Resources Agency (WRA) in 1994. Vern held the position of GIS Coordinator, WRA, Institute for Public Administration, University of Delaware. He developed a wide range of systems and projects used for environmental analyses. The university, community, and local and state governments valued him as a GIS educator and expert resource. Vern was passionate about his work and even more passionate about developing the potential in his students and interns. Vern was an ardent baseball player and fan.



*Ty Fitzpatrick, Katie Clift, and Alison Rogozenski – some of Vern's former students currently working at ESRI in CA. Also shown are Katie's husband Andy Clift and Ty Fitzpatrick's wife*



UDWRC (1965 - 2025)

University of Delaware  
Water Resources Center

DGS Annex  
261 Academy Street  
Newark, Del. 19716

Pollution Ecology Laboratory  
805 Pilottown Road  
Lewes, Del. 19958