60th Annual Meeting of the Delaware Water Resources Center Advisory Panel

Old College Rm 202
University of Delaware

Newark, Del.
May 16, 2025

Gerald Joseph McAdams Kauffman, Jr.
Director and Associate Professor
University of Delaware
Water Resources Center

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University of Delaware
Water Resources Center

NIWR
THE NATIONAL INSTITUTES FOR WATER RESOURCES

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UNIVERSITY OF DELAWARE WATER RESOURCES CENTER
60TH ANNUAL ADVISORY PANEL MEETING

AGENDA

OLD COLLEGE
ROOM 202
18 E. MAIN STREET
UNIVERSITY OF DELAWARE
NEWARK, DE

1.	Introductions	10:00 am
2.	UDWRC Special Report from DC	10:10 am
3.	DOI/USGS WRRA FY26 Budget Request	10:30 am
4.	FY25 Undergraduate/Graduate Research Presentations	10:40 am
5.	FY26 Undergraduate Water Resources Center Internship Proposals	11:40 am
6.	UDWRC Advisory Panel Membership	11:55 am
7.	Fluctuating Federal/State Fiscal Landscape in Water	12:10 pm
8.	Lunch to Follow at Deer Park Tavern (108 W. Main Street, next door)	12:30 pm

Introductions

Old College

If these walls could talk, they'd tell of joy, struggle, innovation—even murder.

Old College isn't merely the oldest or most recognizable building on the University of Delaware campus. And it isn't merely a pretty landmark (although that columned entryway has provided the backdrop to many a campus selfie). Old College is an icon, an architectural lodestar with a history as twisty as the balusters of a colonial stairwell (look for those next time you find yourself inside the building).

Alumni wax nostalgic about the space. Faculty speak about her with deference and gratitude. Most recently, 65 Blue Hens across 10 units came together to celebrate Old College's 290-year history in the "Colors of Old College" exhibition, happening inside the landmark now through May 18.

So why, exactly, does the Old College love run so deep?

According to Nicholas Fandaros, AS23, 24M, who spent a portion of his undergraduate degree studying the architectural evolution of the building, the answer is simple:

"This is the heart of UD."

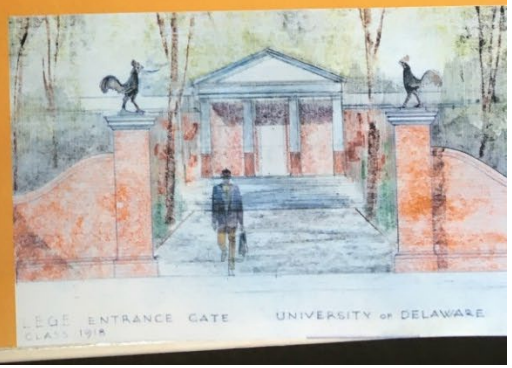
EARLY DAYS

At the turn of the 19th century, the University did not yet exist. Rather, the city was home to the Academy of Newark, a preparatory school for teenage boys. The board members there very much wanted to launch a college and, after years of pleading their case, state officials agreed to charter one. In short order, a new board came together and purchased an empty plot of land at the edge of town, now the west end of Main Street. Charles Bullfinch, architect of the U.S. Capitol, submitted a building design, but it proved cost prohibitive for the fledgling institution. So a prolific lighthouse designer by the name of Winslow Lewis stepped in. He conceived of a Greek temple-esque structure that forever altered a countryside landscape. In 1834, Newark College—precursor to UD—was born.

This building, known today as Old College, initially housed everything: classrooms, offices, dining hall and dormitories. While early cohorts were small—the first group of graduates comprised only four young men—they embodied all the academic ambition and youthful moxie of modern-day classes.

"Faculty reports reveal that 18-year-olds are 18-year-olds," says Lisa Gensel, University archivist. "You'll read things like: 'The boys need to not imbibe spirituous liquors,' and: 'The boys must stop bringing swords to their rooms—I do not care if they want to decorate with them.'"

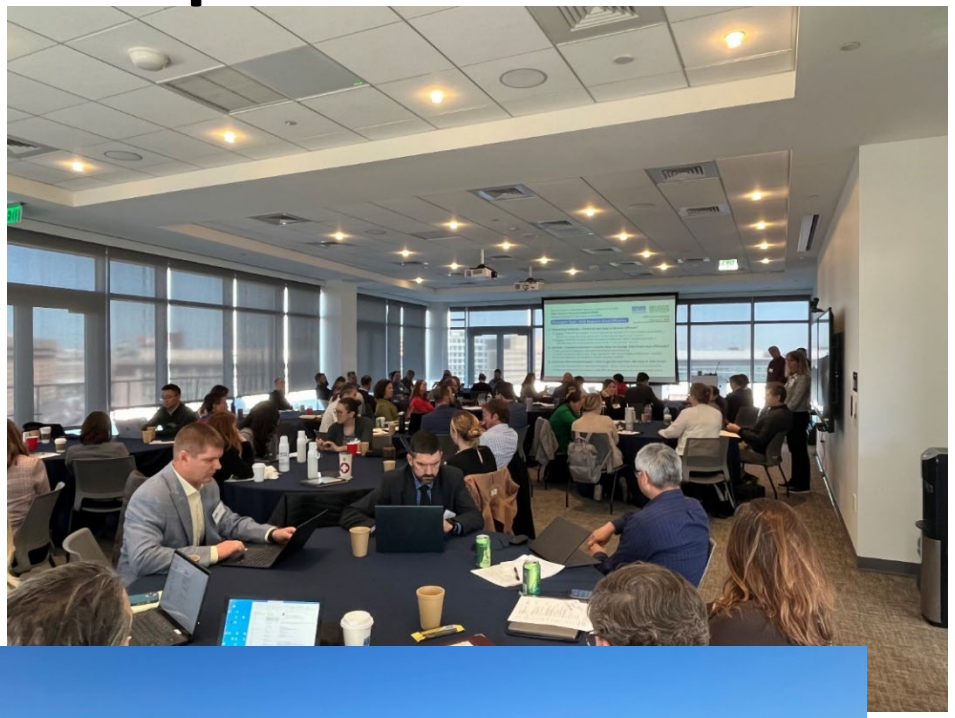
But these early Blue Hens also faced uniquely 19th century



UD Old College (circa 1834)

UDWRC Special Report from DC

Rep. Melanie Stansbury (NM), NIWR Annual meeting, Washington, DC (Feb 25, 2024)



NIWR Annual meeting in Washington, DC (Feb 25, 2025)

NIWR


The Network of Water Resources Research Institutes
Univ. of Alaska
Washington State Univ.
Oregon State Univ.
Univ. of Idaho
Montana State Univ.
North Dakota State Univ.
South Dakota State Univ.
Univ. of Minnesota
Univ. of Wisconsin
Michigan State Univ.
Univ. of Maine
Univ. of Vermont
Univ. of New Hampshire
Univ. of Massachusetts
Cornell Univ.
Univ. of Connecticut
Univ. of Rhode Island
Pennsylvania State Univ.
Rutgers Univ.
Univ. of Delaware
Univ. of Maryland
Univ. of the District of Columbia
Va. Polytechnic Institute & State Univ.
West Virginia Univ.
Ohio State Univ.
Purdue Univ.
Univ. of Illinois
Iowa State Univ.
Univ. of Nebraska
Kansas State Univ.
Univ. of Missouri
Univ. of Kentucky
Univ. of Tennessee
North Carolina State Univ.
Clemson Univ.
Georgia Institute of Technology
Auburn Univ.
Mississippi State Univ.
Louisiana State Univ.
Univ. of Arkansas
Oklahoma State Univ.
Texas A & M Univ.
University of Florida
Univ. of Arizona
New Mexico State Univ.
Colorado State Univ.
Univ. of Wyoming
Utah State Univ.
Desert Research Institute
Univ. of California
Univ. of Hawai'i
Univ. of Guam
Univ. of the Virgin Islands
Univ. of Puerto Rico

NIWR
THE NATIONAL INSTITUTES FOR WATER RESOURCES

2025 Annual NIWR Meeting
February 23-26, 2025

All events take place at 800 Maine Avenue, Southwest in Washington, D.C, penthouse floor, unless otherwise noted

SUNDAY, February 23, 2025

4:00 pm	Board Meeting	800 Maine Ave., Suite 800 Washington Conf. Room
6:00 pm	Board Meeting Adjourns	
6:30 pm	Dinner for Board Only	Kirwan's on the Wharf 749 Wharf Street NW

MONDAY, February 24, 2025

8:00 am	Registration Desk Open Coffee, beverages, and light snacks available	Penthouse lobby
	New Director's Coffee Host: NIWR President Gerald Kauffman (DE)	8th Floor Washington Conf. Room
8:45 am	Welcome, Meeting Overview, and Introductions NIWR President-elect Yu-Feng Forrest Lin (IL)	
9:00 am	NIWR Update NIWR President Gerald Kauffman (DE)	
9:30 am	Legislative Updates and Guidance for Hill Visits Leslee Gilbert (VSC)	
10:00 am	Coffee Break	Penthouse Lobby
10:15 am	U.S. Geological Survey Update Water Resources Research Act Program: Christian Schmidt (Program Coordinator) National Water Availability Assessment: Robert (Bob) Joseph (Senior Advisor) Water Mission Area: William (Bill) Werkheiser (Associate Director)	
12:00 pm	Lunch on your own (Financial review meeting: Executive Committee and India Allen)	
1:30 pm	How to be a NIWR Center Director 10 table topics	
2:15 pm	How to be a NEW NIWR Center Director: The stories that you won't usually hear (Gerald Kauffman (DE), Brian Rahm (NY), and more)	
3:00 pm	Coffee Break	Penthouse Lobby
3:15 pm	Communications NIWR Staff Network UCOWR Update Student Travel Scholarships	Jeff Peterson (MN) & Jennie Snyder (UCOWER) Amy Weckle (IL), Danielle Kalisek (TX) Jeff Peterson (MN) Karen Schlatter (CO), Michael Dietz (CT)
4:45 pm	Wrap-up and Adjourn	
6:00 pm	Evening Reception Hors d'oeuvres and beverages provided	800 Maine Ave. SW, 8th Floor (202) 638-1950
7:30 pm	Reception Ends	

TUESDAY, February 25, 2025

8:00 am	Registration Desk Open Coffee, beverages, and light snacks available	Penthouse lobby
8:30 am	NIWR Development: Communication Jeff Peterson (MN) & Jennie Snyder (UCOWER)	
9:15 am	NIWR New Topics Perry Oddo (NASA) and AI-Water-Energy Nexus by Yu-Feng Lin (IL)	
10:00 am	Coffee Break	Penthouse Lobby
10:15 am	Congressional Speaker	
11:00 am	NIWR Discussion: Best Practices and Messaging for Capitol Hill Visit Linda Weavers (OH)	
11:45 am	NIWR Regional Meetings (Buffet lunch)	Penthouse Lobby
1:15 pm	Reports from Regional Meetings (NIWR Board)	
1:45 pm	Expanding Water Workforce and Dialogues: Examples from NIWR Institutes Karen Schlatter (CO) and Erik Porse (CA)	
2:30 pm	60 Years of WRRA History and Current Executive Orders Gerald Kauffman (DE) and Leslee Gilbert (VSC)	
3:30 pm	Coffee Break	Penthouse Lobby
3:45 pm	NIWR Business Meeting by Gerald Kauffman (DE)	
4:15 pm	NIWR Proposed Budget for 2025 by India Allen (VSC)	
4:45 pm	Annual Meeting Wrap-up and Adjourns	
5:30 pm	Board Meeting and Dinner	Washington Conf. Room

WEDNESDAY, February 26, 2025 **Capitol Hill Visits (Scheduled individually)**

8:00 am – 12:00 pm	Penthouse Floor Meeting room available for workspace or meetings

2024-25 NIWR Board of Directors

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Nicole Misarti
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Montana
Great Plains Rep.

Delegates and Alternate Delegates of the National Institutes for Water Resources			
Member	**Location**	**Delegate**	**Alternate Delegate**
Water and Environmental Research Center, Univ. of Alaska Fairbanks	AK	Nicole Misarti	
Auburn University Water Resources Center	AL	Mona Dominguez	Carolina Ruiz
Water Resources Research Center, University of Arizona	AZ	Sharon Megdal	Jamie McEvoy
Arkansas Water Resources Center	AR	Brian Haggard	Erin Grantz
California Institute for Water Resources	CA	Erik Porse	Rachel Shellabarger
Colorado Water Center	CO	Karen Schlatter	Jessica Thrasher
Connecticut Institute of Water Resources	CT	Michael Dietz	
Water Resources Center, University of Delaware	DE	Gerald Kauffman	Martha Narvaez
Water Resources Research Institute, Univ. of the District of Columbia	DC	Tolessa Deksissa	
Florida Water Resources Research Center	FL	Antarpreet Jutlan	Mark Newman
Georgia Water Resources Institute	GA	Aris P. Georgakakos	Husayn El Sharif
Water and Evironmental Research Institute of the Western Pacific	GU	Yuming Wen	Nathan Habana
Water Resources Research Center, University of Hawaii	HI	Tao Yan	
Idaho Water Resources Research Institute	ID	Kendra Kaiser	Margaret (Meg) Wolf
Illinois Water Resources Center	IL	Yu-Feng Forrest Lin	Amy L. Weckle
Indiana Water Resources Research Center	IN	Keith Cherkauer	
Iowa Water Center	IA	Rick Cruse	Laura Frescoln
Kansas Water Resources Institute	KS	Susan Metzger	Jonathan Aguilar
Kentucky Water Resources Institute	KY	Jason Unrine	Steven Evans
Louisiana Water Resources Research Institute	LA	Frank Tsai	
Maine Water Resources Research Institute	ME	David Hart	
Maryland Water Resources Research Center	MD	Kaye Brubaker	
Massachusetts Water Resources Research Center	MA	Timothy Randhir	Olga Tsvetkova
Institute of Water Research, Michigan State University	MI	Pouyan Nejadhashem	Jeremiah Asher
Water Resources Center, University of Minnesota	MN	Jeffrey Peterson	Joel Larson
Mississippi Water Resources Research Institute	MS	Jason Barrett	
Missouri Water Center	MO	Baolin Deng	Karen Turner
Montana Water Center	MT	Stephanie Ewing	Whitney Lonsdale
Nebraska Water Center	NE	Chittaranjan Ray	Karina Schoengold
Nevada Water Resources Research Institute	NV	Sean McKenna	Matt Bromley
New Hampshire Water Resources Research Center	NH	Adam S. Wymore	Michelle Shattuck
New Jersey Water Resources Research Institute	NJ	Christopher C. Obrop	Lisa Galloway Evrard
New Mexico Water Resources Research Institute	NM	Sam Fernald	Bob Sabie
New York State Water Resources Institute	NY	Brian Rahm	Kristen Hychka
North Carolina Water Resources Research Institute	NC	Susan White	John Fear
North Dakota Water Resources Research Institute	ND	Xinhua Jia	
Ohio Water Resources Center	OH	Linda Weavers	John Lenhart
Oklahoma Water Resources Center	OK	Kevin Wagner	
Institute for Water & Watersheds, Oregon State University	OR	Todd Jarvis	Lisa Gaines
Pennsylvania Water Resources Research Center	PA	Jonathan Duncan	
Puerto Rico Water Resources and Environmental Research Institute	PR	Walter F. Silva	
Rhode Island Water Resources Center	RI	Vinka Craver	
South Carolina Water Resources Center	SC	Charles Privette	Thomas Walker
South Dakota Water Resources Institute	SD	Kasiviswanathan Mut	John Maursetter
Tennessee Water Resources Research Center	TN	John Schwartz	Tim Gangaware
Texas Water Resources Institute	TX	Giovanni Piccinni	Allen Berthold
Utah Center For Water Resources Research	UT	David Tarboton	
Vermont Water Resources and Lake Studies Center	VT	Anne Jefferson	Gretchen Nareff
Virginia Water Resources Research Center	VA	Kevin McGuire	Daniel McLaughlin
Virgin Islands Water Resources Research Institute	VI	Kristin Grimes	
State of Washington Water Research Center	WA	Jonathan Yoder	
West Virginia Water Research Institute	WV	Paul Ziemkiewicz	Melissa O'Neal
Wisconsin Water Resources Institute	WI	Christina Remucal	Jennifer Hauxwell
Office of Water Programs, University of Wyoming	WY	Greg Kerr	
April 16, 2025			

2024-25 NIWR Board Members

Name	Email	Affiliation/Institute	Board Position	Term	Regional Association
Gerald Kauffman	jerryk@udel.edu	Delaware	President	2023-26	
Jeff Peterson	jmpeter@umn.edu	Minnesota	Past President	2022-25	
Yu-Feng Lin	yflin@illinois.edu	Illinois	President-Elect	2024-27	
Vacant			Treasurer		
Linda Weavers	weavers.1@osu.edu	Ohio	At-Large Representative	2023-26	
Keith Cherkauer	cherkaue@purdue.edu	Indiana	Regional Representative	2024-27	Great Lakes
Stephanie Ewing	stephanie.ewing@montana.edu	Montana	Regional Representative	2023-26	Great Plains
Brian Rahm	bgr4@cornell.edu	New York	Regional Representative	2024-27	Mid-Atlantic
Tao Yan	taoyan@hawaii.edu	Hawaii	Regional Representative	2024-26	Oceania and Islands
Michael Dietz	michael.dietz@uconn.edu	Connecticut	Regional Representative	2023-26	New England
Jon Yoder/Nicole Misar	yoder@wsu.edu / nmisarti@alaska.edu	Washington / Alaska	Regional Representative	2024-27	Pacific Northwest
Karen Schlatter	karen.schlatter@colostate.edu	Colorado	Regional Representative	2023-26	Powell Consortium
John Schwartz	jschwart@utk.edu>	Mississippi	Regional Representative	2024-26	South Atlantic-Gulf

Regular Guests to NIWR Board Meetings

Name	Email	Affiliation	Role
Leslee Gilbert	lgilbert@vsadc.com	Van Scoyoc Associates	Lobbyist
Laurie Katz	lkatz@vsadc.com	Van Scoyoc Associates	Lobbyist
Christian Schmidt	cgschmidt@usgs.gov	USGS	WRRA Program
Robert Joseph	rljoseph@usgs.gov	USGS	WRRA Program

Happy 60th WRRA, 1964-2024!

Fig. 1. 60th Anniversary AWRA/UCOWR/NIWR Conference, St. Louis, Oct 1, 2024. NIWR President-elect Yu-Feng Lin (IL), President Gerald McAdams Kauffman (DE), Past-President Jeffrey Peterson (MN), NIWR Presidents Kevin Wagner (OK), Sam Fernald (NM), Sharon Megdal (AZ), Brian Haggard (AS).

THE NATIONAL INSTITUTES FOR WATER RESOURCES

NIWR NEWS

December 2024

President's Message

The Golden Age of Water (1964-2024)

Gerald Joseph McAdams Kauffman, Jr,

University of Delaware

Water Resources Center

Newark, Del.

The year was 1964. It was a year the United States was embroiled in Vietnam. It was the year of the British Invasion when 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 banned discrimination based on race, creed, color, national origin, and gender. And it was the year that presidential historians agreed democracy began not in 1776 but in America just 60 years ago.

Table 1. 60-year History of UCOWR and NIWR and WRRA

Year	Milestone
1862	Abraham Lincoln signed the Morrill Act that created the land grant college system to study mechanical arts.
1887	Grover Cleveland signs the Hatch Act of 1887 forms agricultural experiment stations/University coop. extension programs.
1961	President Eisenhower's Bureau of Budget sends bill to Congress to establish Federal River basin planning commissions.
1961	JFK asks National Academy of Sciences review Federal programs to strengthen water resources research capabilities.
1962	Prof. D. Todd (UC-Berkeley) and Warren Hall (UCLA) hosted an intercollegiate hydrology symposium on Aug 7-9, 1962 at Lake Arrowhead, CA.
1963	"Science" reports shortage qualified water research scientists, Congress should pass law, strengthen university water research.
1964	LBJ signs the Water Resources Research Act on July 17, 1964 authorizes funding for water research institutes in each state land grant college.
1965	Board of Trustees est. University of Delaware Water Resources Center in Newark, Del. by act of Governor/General Assembly.
1971	Interior Task Force on Water Resources: "interregional institutional research will strengthen overall water research effort."
1984	Congress reauthorizes Water Resources Research Act over Ronald Reagan's veto. Sen. Abdnor and Rep. McNulty leadership vital.
1984	Interior Sec. J. Watt, OMB Dir. D. Stockman question 1978 Water Research & Development Act, abolish Water Resources Council & OWRT.
1987	Dr. Caulfield (Col. State U.): 54 state water institutes, widespread base for distributive politics, not all federal programs as fortunate.
1989	Drs. P. Godfrey (MA), P. Sonic (MN), P. Zelinsky (Clemson) incorporate National Association of Water Institute Directors, Inc. in Mass.
1996	Resources for the Future deems WRRA of 1964 as most important water research and education legislation ever enacted.
1999	Federal WRRA appropriation to 54 NIWR institutes $4 million, institutes leveraged local funds $71 million, 38:1 local match.
2004	George W. Bush reauthorizes Water Resources Research Act in 2004.
2009	USGS: challenges of climate change facing Nation's water managers will affect fundamental drivers of the hydrological cycle.
2014	50th Anniversary of WRRA Conference sponsored by UCOWR/NIWR/CUAHSI on Jun 18, 2014 at Tufts University, Medford, MA.
2019	NOAA Sea Grant College Programs & USGS Water Resources Research Institutes held Mid-Atlantic joint meeting Feb 27. 2019 in Washington, DC.
2021	President Biden signs Bipartisan Infrastructure Law with WRRA reauthorization passed by House (228 Yea) & Senate 69 Yea).
2024	NIWR President Dr. Gerald Joseph McAdams Kauffman (University of Delaware)
2024	60th Anniversary of AWRA/UCOWR/NIWR water resources conference in St. Louis, MO.
2024	FY2025, Appropriations Committee recommends $18,000,000 for USGS WRRA, $14,500,00 104b base grants, $3,500,000 104g nat'l. grants.
2024	NIWR commemorates the 60th Anniversary of the Water Resources Research Act at the Feb 2024 Annual meetings in Washington, DC.
2025	UCOWR/NIWR Annual Conference scheduled for Jun 3. 2025 at University of Minnesota in Minneapolis-St. Paul, MN.

22 November 1963, Volume 142, Number 3595 SCIENCE

Water-Resources Research in the Federal Government

Physical, biological, engineering, and social sciences can help solve a problem of growing dimensions.

Roger Revelle

Water is the most abundant substance in the part of our planet that is accessible to man. Nearly all our planet's water is salty, and this is perfectly satisfactory for the creatures that live in the sea. But land plants and animals must have fresh water. They can live only because the sun continually distills pure water from the ocean and some of this distillate is carried in the air as vapor until it condenses and drops on the land. The flux of water from the ocean into the air, onto the land, and back to the sea, is called the hydrologic cycle.

Although the hydrologic cycle is exceedingly complex in detail, in general we can think of the water particles as following one of three paths. (i) The larger part of the water that falls on the land surface passes back to the air, either directly by evaporation or through the bodies of plants in transpiration. It may recondense and fall again on the land, or it may fall in the ocean. (ii) A smaller part of the water that reaches the land surface remains in liquid form and either sinks into the ground or stays on the surface. This liquid water runs downhill or flows underground until it is gathered by rivers that carry it back to the sea. (iii) A very small fraction is taken up in the bodies of plants and animals. Some of this fraction is broken down by plants, which use its hydrogen in forming their tissues. The hydrogen is later recombined with oxygen in animal and plant respiration, and the water thus produced is returned to the air.

The time required for water particles to travel through the hydrologic cycle varies widely. A particle evaporated from the ocean near shore may fall as rain in a coastal region, evaporate again almost immediately, and return to the ocean as rain within a few hours. Water falling as snow in the mountains may remain for months (or, in glaciers, for centuries) before it melts and runs off. Water that sinks into the ground may remain there a few years or many millennia before reappearing on the surface to complete its journey to the sea. Thus, enormous quantities of fresh water are stored underground. In the United States the volume of underground fresh water is probably at least 10 times the average annual precipitation of 30 inches.

The author is university dean of research at the University of California, Berkeley, and director of the university's Scripps Institution of Oceanography, La Jolla. This article is an abbreviated version of a report of the Task Group on Coordinated Water-Resources Research of the Federal Council for Science and Technology. The members of the task group were Roger Revelle, then Science Adviser to the Secretary of the Interior, *chairman*; John A. Baker, Assistant Secretary of Agriculture; Francis W. Reichelderfer, Chief of the Weather Bureau, Department of Commerce; Donald P. Martineau, Department of Defense; James M. Quigley, Assistant Secretary of Health, Education and Welfare; Eugene D. Eaton, Department of the Interior; and Richard G. Ray, National Science Foundation.

The amount of water evaporated each year from the oceans would be sufficient, if it were carried to the continents and uniformly distributed, to cover all the land with more than 100 inches of rain and snow. This is three times the potential annual evaporation from land surfaces. The fact is, however, that the average depth of rainfall over the oceans is much greater than the average over the continents. On about a third of the land areas of the earth the annual precipitation is less than the potential evaporation. Life is possible in these arid regions only because water is carried to them from nearby mountains, where rain and snow exceed evaporation, and because precipitation in the arid lands occurs sporadically, so that some of the water can be caught and stored by plants, or in the ground, before it can evaporate. Even in humid regions the hydrologic cycle slows down and speeds up from time to time, causing periods of drought to alternate with floods. If we can think of the hydrologic cycle as nature's plumbing system, it must be admitted that from man's point of view the pipes are erratically arranged and the valves capriciously managed. Man is slowly becoming more skillful at forecasting fluctuations in this system; someday he may be able to improve the arrangements.

Water Supply of the United States

The United States, exclusive of Alaska and Hawaii, has a surface area of about 2 billion acres. On the average, nearly 5 billion acre-feet of water per year falls on this area (*1*). Seventy-one percent of this water evaporates or is transpired back to the air near the place where it falls. The remaining 29 percent runs off or sinks into the ground and is eventually gathered by streams. A quantity equivalent to about one-fourth the streamflow (345 million acre-feet, 7 percent of the total annual precipitation) is diverted from rivers or pumped from wells for human use. Something less than half the water with-

The development of economical methods of reducing erosion in small upstream watersheds must be based on research into the relationships of precipitation, topography, kinds of soil, plant cover, and runoff, and on the mechanisms of suspension and transport of soil particles by running water. Similarly, the lives of storage reservoirs could be lengthened, and the number of unwanted changes in river channels reduced, if we had greater understanding of sediment transport in rivers. Comparative studies of river ecology and of the sequence of biological changes produced by different pollutants are needed to establish realistic standards for pollution control and to lessen pollution damage.

Role of the Federal Government

Under the Constitution, by tradition, and because of the national interest, the federal government has certain special responsibility for water resources. As manager of the national forests and all other federal and Indian lands, it conserves and develops the water resources of these lands for livestock grazing, timber production, outdoor recreation, fish and wildlife conservation, hydroelectric power, and irrigation agriculture, and maintains them as the principal watersheds for adjoining regions. It protects these lands, which cover about a quarter of the entire area of the country, from erosion, floods, and other water damage.

The federal government has responsibility for the coastal and inland waters, including related nonnavigable river reaches and tributaries. It has joint control, through treaties with Canada and Mexico, over the development and use of international streams. Public works for the development of these waters are large items in the federal budget. They include projects for flood control, navigational improvements in rivers and coastal waterways, and watershed and shoreline protection, as well as hydroelectric power, drainage, conservation storage of industrial and domestic water supplies, pollution abatement, maintenance of recreation areas, and other aspects of river-basin development.

The government delivers much of the water for irrigation agriculture in the 17 western states. Federal water investments in this largely arid region include projects for storage, transportation, distribution, and drainage of agricultural waters, for hydroelectric power generation, for flood control, and for other purposes.

Because many river basins cross state lines, the government has had to assume growing responsibility, as water supplies have become scarcer, for participation in river-basin planning. The pollution of interstate river waters is becoming increasingly serious in many regions, and the government has begun to take vigorous control measures.

In cooperation with the states, the federal government surveys the nation's water resources, including the water carried in rivers and available from underground. It measures and forecasts precipitation, snowmelt, evaporation, runoff, river flows, floods, and storm surges.

To conserve and augment the nation's fish and wildlife population the government acquires wetlands, establishes refuges, maintains hatcheries, and constructs waterways for fish migration. It attempts to keep the effects of water pollutants on fishes, birds, and mammals to a minimum.

The government is virtually the sole producer of one of the most potentially dangerous of water pollutants—radioactive wastes—and it maintains a careful surveillance over the behavior of these materials in rivers, aquifers, and coastal waters.

To carry out these responsibilities efficiently and economically, the federal government must undertake a wide range of investigations and research. Nearly all aspects of [illegible] research activity [illegible] responsibility for conducting [illegible] capacity throughout the country. Consequently, the government has long supported and conducted water-resources investigations for the benefit of all levels of government, and of private industry in many sectors of the economy. A Task Group on Coordinated Water-Resources Research was established in 1962 by the Federal Council for Science and Technology, to find ways of improving this research program (*6*). The following is a condensation of its conclusions and recommendations.

Task Group Conclusions and Recommendations

In the short period of its existence, the task group was not able to develop a satisfactory basis for evaluating or comparing research projects in different fields, or even in the same field. For the present, we must depend on the judgment of the responsible agencies. With adequate staff resources, a future water-resources research coordinating committee should, in time, be able to develop criteria for evaluating the components of the national program.

The task group did arrive at general conclusions in four areas: program deficiencies and opportunities; manpower needs; coordinating mechanisms; and legislation.

Program deficiencies and opportunities. Deficiencies in intramural and extramural education and training, in research on ground water (including the infiltration processes and soil-plant-water relationships), and in socioeconomic research are so evident that we can immediately recognize the need for increased effort in these fields. Similarly, the opportunities for water-quality research are great, and the present [illegible] research [illegible] that the level of sustained effort should be sharply raised.

Manpower needs. Shortages of qualified personnel now exist in many areas of water-resources research. Steps will have to be taken to increase the number of people qualified to carry on the research programs. The scientific fields involved are much broader than physical hydrology and include many of the physical and biological sciences as well as social sciences and engineering. The universities need help in attracting graduate students to research and training bearing on water resources. To meet [illegible] this, the federal agencies should make grants to, or contracts with, universities so that they can strengthen their graduate research and training programs. The following steps should be taken.

1) The federal agencies engaged in water-resources research should be authorized and given funds to use a variety of educational-assistance measures to strengthen the training and research capabilities of the universities in the disciplines bearing on water resources, and to attract increasing numbers of graduate students. Such measures to promote training at the graduate level include training grants, facilities grants, research fellowships, and institutional grants. For example, the Department of Agriculture does not have specific statutory authority to award fellowships, training grants, or grants for educational facilities, except

1964

USGS science for a changing world

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Water Resources Research Act Program

HOME

CURRENT BUDGET JUSTIFICATION

PRIOR BUDGET

Authorizations

Water Resources Research Act Program (WRRA) activities are conducted under the authority of various pieces of authorizing legislation. Many of the primary authorizations that allow the USGS and WRRA to serve the American people are listed below, along with descriptions of either how the authorization relates to USGS or what WRRA activities are performed under a particular authorization.

1964 - Water resources research and technology institutes

CHAPTER 109—WATER RESOURCES RESEARCH

Sec.
10301. Congressional findings and declarations.
10302. Congressional declaration of purpose.
10303. Water resources research and technology institutes.
10304. Research concerning water resource-related problems deemed to be in national interest.
10305. Development of water-related technology.
10306. Administrative costs.
10307. Types of research and development.
10308. Patent policy.
10309. New spending authority; amounts provided in advance.

§ 10301. Congressional findings and declarations

The Congress finds and declares that—

(1) the existence of an adequate supply of water of good quality for the production of materials and energy for the Nation's needs and for the efficient use of the Nation's energy and water resources is essential to national economic stability and growth and to the well-being of its people;

(2) the management of water resources is closely related to maintaining environmental quality, productivity of natural resources and agricultural systems, and social well-being;

(3) there is an increasing threat of impairment to the quantity and quality of surface and groundwater resources;

(4) the Nation's capabilities for technological assessment and planning and for policy formulation for water resources must be strengthened at the Federal, State, and local governmental levels;

(5) there should be a continuing national investment in water and related research and technology commensurate with growing national needs;

(6) it is necessary to provide for the research and development of technology for the conversion of saline and other impaired waters to a quality suitable for municipal, industrial, agricultural, recreational, and other beneficial uses;

(7) the Nation must provide programs to strengthen research and associated graduate education because the pool of scientists, engineers, and technicians trained in fields related to water resources constitutes an invaluable natural resource which should be increased, fully utilized, and regularly replenished; and[1]

(8) long-term planning and policy development are essential to ensure the availability

of product water, considering the amortization of all components of the demonstration plant and ancillary facilities. Such report shall be accompanied by a proposed contract (or cooperative agreement) between the Secretary and a duly authorized non-Federal entity, in which such entity shall agree to provide not less than 15 per centum and not more than 35 per centum of the total cost of the demonstration; such cost to include, without being limited to, necessary water rights, water supplies, rights-of-way, power source interconnections, brine disposal facilities, land, construction, ancillary facilities, and the operation and maintenance costs for a period of four years following final acceptance of the construction of the plant from the plant contractor. The contributions of the non-Federal entity under such proposed contract may be in-kind. During the participation by the Secretary in the construction and the operation and maintenance of such demonstration, access to the demonstration and its operating data will not be denied to the Secretary or his representatives. The period of participation by the Secretary in the operation and maintenance of any such demonstration shall be four years. The Secretary is authorized to include in the proposed contract a provision for conveying, as appropriate, and in such amounts as are appropriate, rights, title, and interest of the Federal Government in the demonstration project to the non-Federal public entity.

"(c) There is authorized to be appropriated, to remain available until expended, for the fiscal year ending September 30, 19[illegible] dollars to carry out the purposes of this section. The Federal cost of the demonstration plants authorized by this section, such cost to include, without being limited to, necessary water rights, water supplies, rights-of-way, power source interconnections, brine disposal facilities, land, construction, ancillary facilities, and the operation and maintenance costs for the four-year period of Federal participation in such costs.

"(d) When appropriations have been made for the commencement or continuation of design, construction, or operation and maintenance of any demonstration plant authorized under this Act [this note], the Secretary may, in connection with such design, construction, or operation and maintenance, enter into contracts and cooperative agreements for miscellaneous services, for materials and supplies, as well as for construction, which may cover such periods of time as the Secretary may consider necessary but in which the liability of the United States shall be contingent upon appropriations being made therefor."

[For termination of Trust Territory of the Pacific Islands, see note set out preceding section 1681 of Title 48, Territories and Insular Possessions.]

§ 10302. Congressional declaration of purpose

It is the purpose of this chapter 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 the interest of State and local governments as well as private industry in research and the development of technology that will reclaim waste water and to convert saline and other impaired waters to water suitable for municipal, industrial, agricultural, recreational, and other beneficial uses;

(5) promote more effective coordination of the Nation's water resources research program;

(6) promote the development of a cadre of trained research scientists, engineers, and technicians for future water resources problems; and

(7) encourage long-term planning and research to meet future water management, quality, and supply challenges.

(Pub. L. 98–242, title I, §103, Mar. 22, 1984, 98 Stat. 97; Pub. L. 101–397, §1(a), Sept. 28, 1990, 104 Stat. 852; Pub. L. 104–147, §2, May 24, 1996, 110 Stat. 1375.)

REFERENCES IN TEXT

This chapter, referred to in text, was in the original "this Act", meaning Pub. L. 98–242, Mar. 22, 1984, 98 Stat. 97, known as the Water Resources Research Act of 1984. For complete classification of this Act to the Code, see Short Title note set out under section 10301 of this title and Tables.

AMENDMENTS

1996—Par. (6). Pub. L. 104–147, §2([illegible] struck out "to" [illegible] and [illegible] Par. (7). Pub. L. 104–147, §2(3), added par. (7).

1990—Par. (5). Pub. L. 101–397 substituted "to promote more effective coordination of" for "coordinate more effectively".

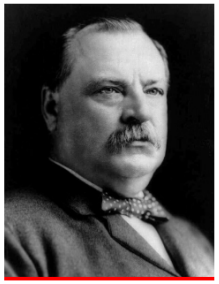
§ 10303. Water resources research and technology [illegible]

(a) Establishment; designation of site by State legislature or Governor

Subject to the approval of the Secretary of the Interior (hereafter in this chapter referred to as the "Secretary") under this section, one water resources research and technology institute, center, or equivalent agency (hereafter in this chapter referred to as the "institute") may be established in each State (as used in this chapter, the term "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.], or at some other institution designated by act of the legislature of the State concerned. If there is more than one such college or university in a State established in accordance with such Act of July 2, 1862, the institute in such State shall, in the absence of a designation to the contrary by act of the legislature of the State, be established at the one such college or university designated by the Governor of the State. Two or more States may cooperate in the establishment of a single institute or regional institute, in which event the sums otherwise allocated to institutes in each of the cooperating States shall be paid to such single or regional institute.

(b) Scope of research; other activities; cooperation and coordination

Each institute shall—



Grover Cleveland

Dates In Office: March 04, 1885 to March 04, 1889
Age in Office: 47
Birth - Death: March 18, 1837 to June 24, 1908
Party: Democratic
Location Born: New Jersey
Office: Governor of New York
Religion: Presbyterian

Grover Cleveland

Grover Cleveland signs 1887 Hatch Act

JFK signs 1961 DRBC Compact

Lyndon B. Johnson

XXXVI *President of the United States: 1963-1969*

461 - Statement by the President Upon Signing the Water Resources Research Act.

July 17, 1964

Like 9.6k Tweet 0 +1

THE Water Resources Research Act of 1964, which I have approved today, fills a vital need.

Abundant, good water is essential to continued economic growth and progress. The 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.

Assuming a continuation of current practices, by the year 2000 there will not be enough usable water to meet the water requirements of parts of the States of Arizona, California, Colorado, Delaware, Idaho, Illinois, Indiana, Iowa, Kansas, Louisiana, Michigan, Minnesota, Montana, Nebraska, Nevada, New Jersey, New Mexico, New York, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, South Dakota, Texas, Utah, Wisconsin, and Wyoming.

This legislation will help us solve this problem. It will create local centers of water research. It will enlist the intellectual power of universities and research institutes in a nationwide effort to conserve and utilize our water resources for the common benefit. The new centers will be concerned with municipal and regional, as well as with national water problems. Their ready accessibility to State and local officials will permit each problem to be attacked on an individual basis, the only way in which the complex characteristics of each water deficiency can be resolved. The bill contemplates a high degree of interstate cooperation, and I urge that this be encouraged.

In large measure, this legislation is a tribute to the vision and wisdom of Senator Clinton P. Anderson of New Mexico. He has long recognized the problems. He developed the program. He guided it through Congress. He has been in the forefront of the effort to see that adequate supplies of water are available in all parts of the Nation.

COLLECTION: *Public Papers of the Presidents*

Lyndon B. Johnson 1963-64: Book II

Font Size: A A A A

LBJ signs 1964 Water Resources Research Act

Ronald Reagan vetos 1984 WRRA Amendments

The University of Delaware Water Resources Center, est. on campus in 1965 at the 8th oldest institution of higher learning in the nation (est. 1743), is a research center in the IPA within the Joseph R. Biden School of Public Policy & Administration.

NIWR
THE NATIONAL INSTITUTES FOR WATER RESOURCES

2024 Highlights

NIWR by the Numbers
FY 2024

$14.41M
in federal funds
(**104b:** 8.33M | **104g:** 6.09M)

$13.7M
in matching funds
(**104b:** 7.6M | **104g:** 6.1M)

245
sponsored research projects
(**104b:** 223 | **104g:** 22)

434
students supported
(**104b:** 399 | **104g:** 35)

Idaho Water Resources Research Institute
Addressing Irrigation Effeciency

Success from the Ground Up in Water-Related Practices and Policies

The **National Institutes for Water Resources (NIWR)** play a major role in addressing water-related concerns by providing a platform for research, training, and collaboration at the state and regional levels.

Housed in the nation's land-grant universities, the 54 NIWR member institutes leverage university expertise in research, education, and outreach to find solutions to the water management challenges we face.

With our funding and educational services, water-related professionals and researchers receive support for the creation of local tools and policies to better manage our water. These local successes magnify the strength of the network, benefiting communities across the entire United States.

California Institute for Water Resources:
On-Farm Workshop

Research for Resilience

Enabling Innovative Ideas

University of California Agriculture and Natural Resources
California Institute for Water Resources

Urban and Agricultural Water Use

- Provided technical assistance for **500 successful applications in irrigation efficiency and healthy soils for California growers**, resulting in $45 million of investments.
- Partnered with the California Department of Food and Agriculture to provide extension programs for nitrogen and irrigation efficiency on farms, including more than 300 on-farm consultations, 160 workshops, and 40 farm trials.
- Published resource kits and fact sheets with crop-specific tips for growers to manage severe drought.
- **Increased drought resilience** through research on water use efficiency in cities, which will promote investments in new appliances, climate-friendly landscaping, and leak loss reductions in pipes.

University of Idaho
Idaho Water Resources Research Institute

Addressing Irrigation Efficiency

- Professors and their students examined changes in crop water use across southern Idaho over the past 30 years.
- Their research explored how variations in wet and

Algal Bloom Action Team of the North Central States

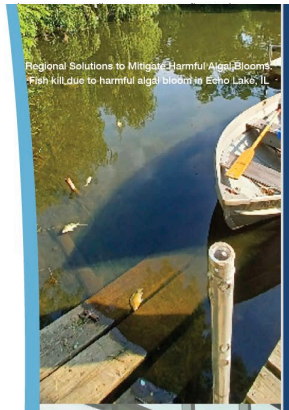
Regional Solutions to Mitigate Harmful Algal Blooms

- Some blue-green algae can form harmful blooms that contain cyanobacteria that can harm swimmers, pets, livestock, or wildlife coming into contact with infected waters.
- Established in 2019, the Algal Bloom Action Team is a 12-state team that partners Water Resource Research Institutes with Cooperative Extensions at each of the states' land-grant institutions.
- The team hosts bimonthly webinars and an annual virtual research symposium. These efforts bring together researchers, state and federal agencies, nonprofits, and students, allowing for the **transfer of knowledge** and technological developments to improve actions by affected communities to mitigate these toxin-producing bacteria that thrive under the increasingly warmer, wetter climates.

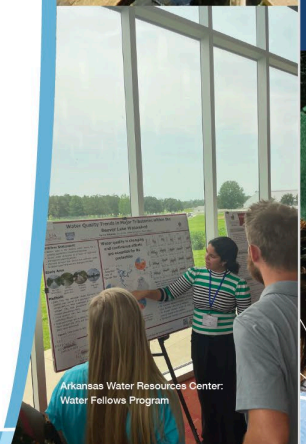
University of Arkansas
Arkansas Water Resources Center

Water Fellows Program

- In 2024, the AWRC began the Water Center Fellows Program, which aligns with the Center's core mission area of **workforce development** in water resources fields.
- The Center funded undergraduate fellowships during the summer of 2024. The Fellows worked in water-related areas that address the state's emerging research, education, or communication needs.
- Their projects contributed meaningful insights into Arkansas's water resources, particularly in water quality, conservation, and resource management.
- The program ended with the Fellows presenting their work at the annual Agriculture, Forestry, and Water Conference at the University of Arkansas.



Regional Solutions to Mitigate Harmful Algal Blooms:
Fish kill due to harmful algal bloom in Echo Lake, IL



Arkansas Water Resources Center:
Water Fellows Program

2024

People, communities, and organizations benefit from the expertise and resources of our institutes to enhance their resilience to water challenges in their regions.

Availability of and access to safe, adequate water supplies are critical to our nation's prosperity and quality of life. NIWR is ready to meet the challenges of water resource management today and in the future.

For more than 60 years, the Water Resources Research Act (WRRA) Program has invested in local, state, and regionally focused water-related research; information and technology transfer; and workforce development through student training and professional internships.

A true federal–state partnership, the WRRA Program is administered by the Office of Planning and Programming in the USGS Water Resources Mission Area.

In FY 2024, the **Water Resources Research Act (WRRA)** provided $14.41 million in funding toward cutting-edge research on the nation's most pressing water issues. This funding was met by a 1:1 match from local public and private sector entities, doubling the funding the WRRA provides.

Annual Base Grants

104b grants are awarded annually to NIWR member institutes to plan and conduct applied and peer-reviewed research, education, and outreach activities on water. In FY2024 $8.33 million was awarded in 104b.

National Competitive Grants

The 104g National Competitive Grants program funds research in water issues that are of a regional or interstate nature. In FY 2024 more than $6 million was awarded for grants on multiple water topics.

All images were provided by and are used with permission of the institutes.

NIWR
THE NATIONAL INSTITUTES FOR WATER RESOURCES

USGS says... A- … not bad!

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

13 March 2024

Dr. Gerald J. Kauffman, Director
Water Resources Center
University of Delaware
DGS Annex-261 Academy Street
Newark, Delaware 19716
jerryk@udel.edu

Dear Dr. Kauffman:

The Water Resources Center at the University of Delaware receives an annual matching grant from the Water Resources Research Act Program administered by the U.S. Geological Survey (USGS) under the provisions of section 104 of the Water Resources Research Act of 1984, as amended. The Act requires that the Center be evaluated periodically to determine its eligibility for continued support under the Act. The determination is based on its effectiveness in the use of its Federal grant and required matching funds in meeting the mandates of the Act.

I am pleased to inform you that the Delaware Water Resources Center demonstrated acceptable performance during 2016 – 2020 with respect to the criteria set forth by the Act. This decision is based on a recent evaluation report and recommendation by a panel convened in February 2024 to evaluate the activities of the 54 Institutes/Centers authorized by the Act during Fiscal Years 2016 – 2020.

The Panel's specific findings follow:

- The research program is relevant and addresses unique Delaware research priorities as a State located entirely on a peninsula and having >33% wetlands cover. Research priorities are focused on associated challenges: climate change and sea-level rise and associated extreme coastal flooding responses, and fresh water and saltwater wetlands and their ecosystems. The Institute has at least 3 doi-journal publications and at least 12 Institute Reports focusing on accomplishments for the above topics and overall water quality assessment.

- A diverse state-wide research advisory committee ensures the program is addressing water issues of the State. Large numbers of awards from small communities are noted along with 2 large grant awards illustrating the relevance of the Institute. The program has excellent ties to USGS through the internship program.

- Supporting data indicates 70 data releases, which makes the program seem fairly data-collection oriented. An increase in peer reviewed publications is recommended, and this might be more easily achieved with a broader number of PI's (only 2), and perhaps with input from other academic institutions, even if from adjoining States and also from the Delaware Sea Grant Program.

- There is strong support for students with direct funding by the Institute and student fellowships used to increase student support on numerous 104b base grant projects. There are moderate numbers of graduate students but considerable numbers of undergrad students (60), but lesser graduate students (Ph.D., 4; MSc, 8; non-federal, 21). There are 4 completed MSc or Ph.D. theses.

- There is strong host institution support for this program.

- Public outreach is focused on attendance at large events and festivals and K-12 school children. The annual local conference is organized in coordination with the Delaware Sea Grant Program. However, outreach seems undersold given all the student and intern involvement. Is a stronger social media and public outreach presence than is reported?

Please share these results with your staff and other interested individuals at your University. The USGS and Water Resources Research Act Program looks forward to an active and mutually beneficial partnership with the Delaware Water Resources Center in the future.

Sincerely yours,

GREGORY WETHERBEE Digitally signed by GREGORY WETHERBEE
Date: 2024.03.13 11:28:20 -06'00'

Gregory A. Wetherbee
Water Resources Research Act Program Manager, Acting

Happy 60th UDWRC, 1965-2025!

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.

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.

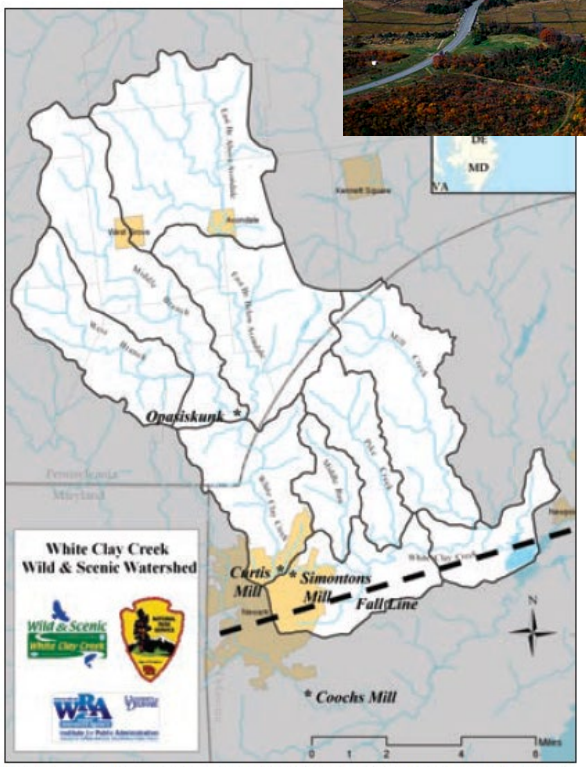


Figure 1. Map of Newark and environs (source: Water Resources Agency, Institute for Public Administration, University of Delaware, 2008)*

The University of Delaware is fortuitously situated on campuses ideally suited by hydrology and geography to study water resources.

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Marta Driscoll
Senior Budget Analyst
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The Delaware Water Resources Center (DWRC) is a unit of th Institute for Public Administration (IPA), a research center within the Biden School of Public Policy & Administration at the University of Delaware.

Directions

DWRC has two Delaware offices its main office on the University of Delaware's Newark campus, between Penny Hall and the Perkins Student Center, and on the Hugh R. Sharp campus of the University of Delaware in Lewes. Detailed directions for both locations are at www.wrc.udel.edu.

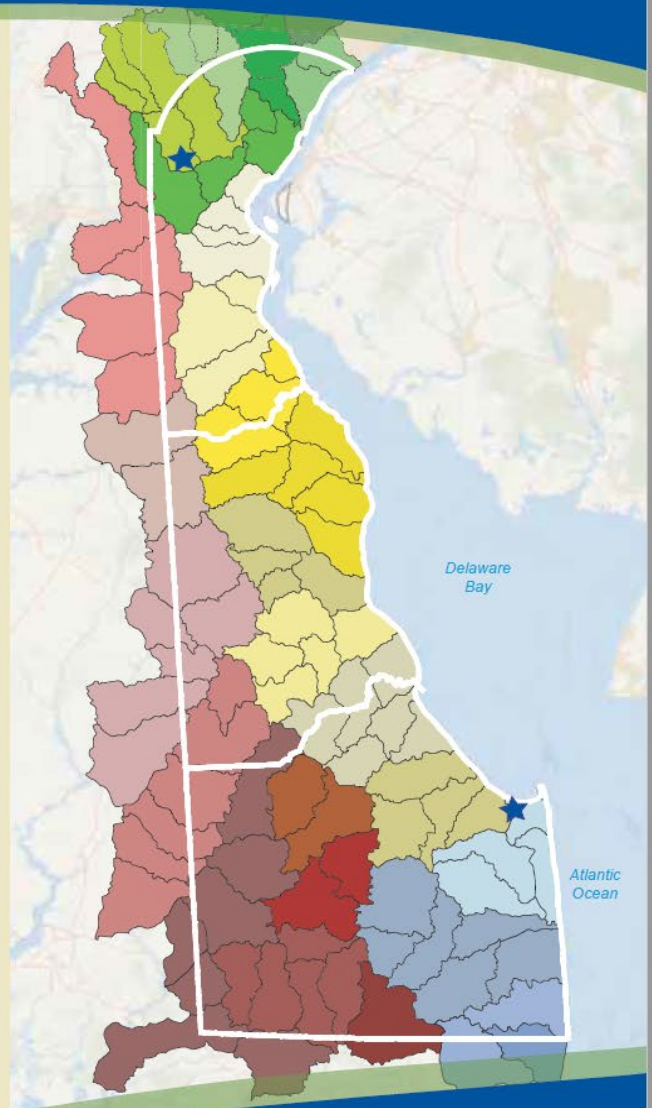
DWRC Newark Office
DGS Annex
261 Academy Street
University of Delaware
Newark, Delaware 19716

DWRC Lewes Office
805 Pilottown Road
Pollution Ecology Lab, Room 109
Lewes, Delaware 19958

NIWR
THE NATIONAL INSTITUTES FOR WATER RESOURCES

Where to find us

Water Resources Center



UNIVERSITY OF DELAWARE

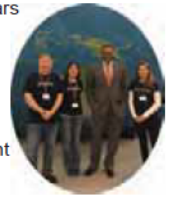
Mission

The University of Delaware Water Resources Center (DWRC), established in 1965, 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 receives funding through Section 104 of the Water Resources Research Act of 1984, which was originally signed into law by Lyndon Baines Johnson in 1964. The U.S. Geological Survey administers the provisions of the Act and provides oversight of the nation's Water Resources Centers through the National Institute of Water Resources (NIWR).

As a member of the NIWR, the DWRC has two key missions related to Delaware's water resources – our precious groundwater aquifers and our streams, ponds, lakes, and coastal waters to: (1) support research, education, and public outreach programs that focus on water management issues of importance to Delaware citizens and (2) to foster and support training and education programs for the future water scientists, engineers, managers, and policy-makers.

Education

DWRC provides an important role in water resources education at the University of Delaware and to the greater public. The DWRC carries out its education role through participating in outreach activities; offering courses, seminars and forums with a water resources focus; and advising undergraduate and graduate students through funded assistantships.



Courses Offered

- UAPP 611: Regional Watershed Management
- GEOG 432: Environmental Hydrology
- CIEG 440: Water Resources Engineering
- UAPP 667: GIS Applications in Public / Nonprofit Sectors
- UAPP 652: GIS in Public Policy

Conferences

- Water Policy Forum
- Delmarva GIS Conference

Community Events

- Delaware Clean Water Rally
- Delaware GIS Day
- University of Delaware Ag Day
- University of Delaware Coast Day

Public Service

DWRC provides water policy assistance to governments in Delaware and the surrounding region. This public service role is significant to the mission of the College of Arts & Sciences and the School of Public Policy & Administration (SPPA). DWRC takes a regional, intergovernmental approach to water management since watersheds and aquifers cross many political jurisdictions.

The Water Resources Agency, a project of the DWRC, receives support from Delaware, New Castle County, and the cities of Wilmington and Newark to provide water resources assistance to the public with regard to water supply, water quality, and watershed planning and management.

Water Supply

- Delaware's Water Supply Coordinating Council
- Office of the State Water Coordinator
- New Castle County Water Resource Protection Areas, Technical Advisory Committee
- Delaware Source Water Assessment and Protection Program

Watershed Management and Planning

- Christina Basin Clean Water Partnership
- White Clay Creek Wild and Scenic Management Committee
- Nonpoint Education for Municipal Officials (NEMO)
- Floodplain/Stormwater Management

Mapping and Data Services

- Comprehensive Plan Mapping
- Mapping Applications
- Public and Private Education (K-12) Assistance
- Regional Watershed Mapping, Data Creation, and Analysis

Research

DWRC seeks opportunities to collaborate with University faculty, scientists, and students to fund, conduct, and publish water-resources research.

University of Delaware Experimental Watershed

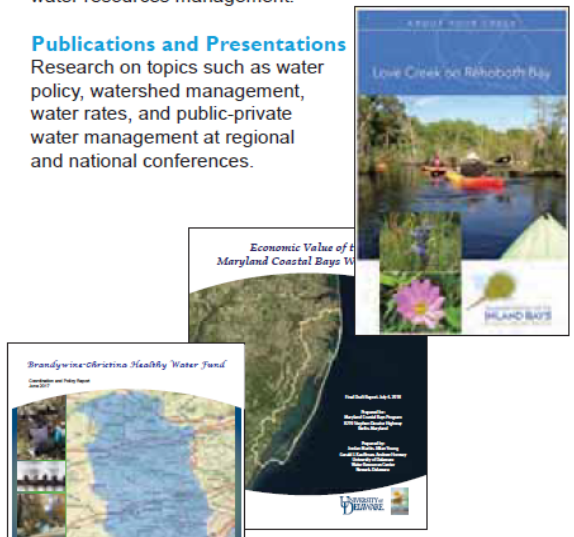
Development of an experimental watershed as an on-campus education and research laboratory.

Geospatial Analysis and Information Management

Repository of core DWRC data and information collaboration in water research with other groups on campus and beyond. Advancement of GIS and remote-sensing technologies for water resources management.

Publications and Presentations

Research on topics such as water policy, watershed management, water rates, and public-private water management at regional and national conferences.



Delaware Water Resources Center (UDWRC)

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

UNIVERSITY OF DELAWARE

UDWRC Faculty/ Scientists/Students

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Director/Associate Professor

Andrew R. Homsey
Policy Scientist
(GIS Services Manager)

Nicole M. Minni
Associate Policy Scientist
(GIS Laboratory/Lewes Office)

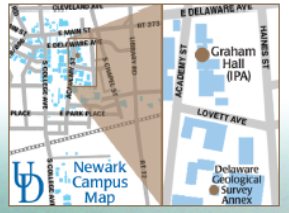
Martha C. Narvaez
Associate Director/Policy Scientist

Marta Driscoll
Senior Budget Officer

Jhaney Hamlett
Master of Public Admin. (MPA)

Megan Wassil
M.S. Water Science & Policy (WSP)

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



What is UDWRC?

Established on campus in 1965, the University of Delaware Water Resources Center (UDWRC) is one of the 54 National Institutes for Water Resources (NIWR) at land grant universities in the 50 states, District of Columbia, and island territories of Guam, Puerto Rico, and U.S. Virgin Islands. The UDWRC 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 UDWRC 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 UDWRC?

The UDWRC 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.

UDWRC Partners

- Brandywine Conservancy
- Brandywine Valley Association
- City of Wilmington
- City of Newark
- Delaware Nature Society
- Delaware Center for Horticulture
- Delaware Greenways
- Delaware Department of Transportation
- Delaware River Basin Commission
- Delaware Department of Natural Resources and Environmental Control
- FishAmerica Foundation
- New Castle Conservation District
- New Castle County
- National Oceanic and Atmospheric Administration
- National Park Service
- Partnership for the Delaware Estuary
- Veolia Water Delaware
- The Nature Conservancy (Delaware)
- DE Sea Grant
- U.S. Environmental Protection Agency
- U.S. Geological Survey
- William Penn Foundation

UDWRC is involved with...

- 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
- Sussex Economic Development Action Committee
- Sustainable Coastal Community Initiative
- White Clay Creek Wild and Scenic Management Committee

www.wrc.udel.edu


2024 AWRA, UCOWR, & NIWR Water Resources Conference
Water Policy, Governance, and Perspectives
Session # 41
PRESENTER: Cooper Feeny, University of Delaware


The Delaware River Basin
50th Anniversary of the
Delaware River Basin Commission
Oct 19, 2011
Shawnee Inn, Penna.
Gerald Kauffman
University of Delaware
Newark, Del.

Earth Day Indigenous Teach-In

Celebrate the 55th Anniversary of Earth Day!
April 22, 1970 - 2025

- **Tuesday, April 22, 2025**
  1 - 4 pm walk out of your lab, classroom, or office.
- Earth Day is for Everyone!
- Gather on the North Green in front of the Memorial Hall.
- Learn about Earth Day history, Indigenous values, science, poetry, policy, and social justice for all!

Tue Apr 22, 2025
1-4 pm UD North Gr

Sponsored by the American Indian & Indigenous Relations Committee of the University of Delaware Antiracism Initiative (U

DOI/USGS WRRA FY25 Budget Request

WATER RESEARCH GRANTS

The state water resources research institutes authorized by section 104 of the Water Resources Research Act of 1984 are organized as the National Institutes for Water Resources. The NIWR cooperates with the U.S. Geological Survey to support, coordinate and facilitate research through the Annual Base Grants, National Competitive Grants, Coordination Grants, and in operating the NIWR-USGS Student Internship Program. The Annual Base Grants, 104(b), and National Competitive Grants, 104(g), make up the backbone of the USGS 104 program. Below is a brief explanation of these two similar, but different grants.

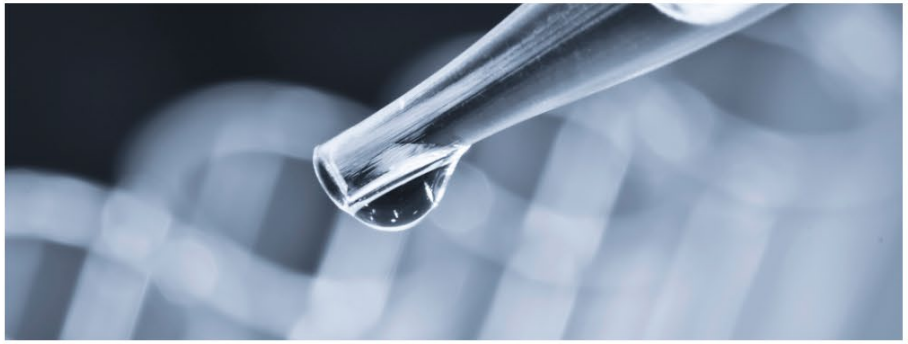
State Water Research Grants - USGS 104(b) Program

These grants provide competitive seed grant funding opportunities for faculty members or affiliates at institutions of higher education. Applications must be submitted through your State Water Research Institute or Center. The Institutes or Centers may only consider project proposals from faculty members or affiliates at institutions of higher education in its State. To find out where your state's Institute or Center is located visit the Institutes webpage here and click on your state.

Unique characteristics of this program include:

- Research priorities are set by each institute in consultation with its state advisory board.
- Research focuses on state and regional water resources problems that can be addressed by researchers at academic institutions in states with common problems.
- All federal funds must be matched by at least two non-federal dollars for each federal dollar.

For more information on the USGS 104 program visit the USGS Water Resources Research Institutes website here.



National Water Research Grants - USGS 104(g) Program

The goals of the National Competitive Grants program are to promote collaboration between the USGS and university scientists in research on significant national and regional water resources issues; promote the dissemination and results of the research funded under this program; and to assist in the training of scientists in water resources. The USGS 104(g) Program provides the major mechanism to meet the growing needs not filled by state or federal research programs.

Unique characteristics of this program include:

- Research priorities are set jointly by the National Institutes for Water Resources and the U.S. Geological Survey.
- The program focuses on regional and interstate water resources problems beyond those of concern only to a single state.
- All federal funds must be matched by at least one non-federal dollar for each federal dollar.

For more information on the USGS 104 program visit the USGS Water Resources Research Institutes website here.

United States Geological Survey

WATER RESOURCES RESEARCH ACT PROGRAM ANNUAL BASE GRANTS FI
YEAR 2024

https://water.usgs.gov/wrri/

Notice of Funding Opportunity - Fiscal Year 2024
Funding Opportunity Number (FON) G24AS00537

Closing Date: 05/22/2024

(3) "cooperate closely with other institutes and other organizations in the region to increase the effectiveness of the institutes and for the purpose of promoting regional coordination."

Applications submitted under this Announcement are to be in furtherance of these objectives and promote the national mission and objectives of the U.S. Geological Survey which are focused on providing water-quality and -quantity information, understanding water availability, addressing the influence of climate on water resources, and responding to water-related emerging needs. Specific areas of emphasis are at the discretion of the individual Institute or Center Directors.

Funding Opportunity Goals
Research for water resources in each State or Territory served by the Water Resources Research Institutes under the Water Resources Research Act.

B. Federal Award Information

B1. Total Funding

Estimated Total Funding
$8,373,000

B2. Award Amount

Maximum Award
$440,685

Minimum Award
$146,895

The amount available to each Institute or Center in FY 2024 will be $146,895. A total of $440,685 will be available to the regional Institute in Guam, which serves Guam, the Federated States of Micronesia and the Commonwealth of the Northern Mariana Islands. A total of $293,790 will be available to the regional Institute in Hawaii, which serves Hawaii and American Samoa. The Government's obligation under this program is contingent upon the availability of appropriated funds.

B3. Anticipated Award Funding and Dates

Anticipated Award Date
September 01, 2024

B4. Number of Awards

Expected Number of Awards

Fluctuating Federal/State Fiscal Landscape in Water

FY 2025 Funding Goal for the Water Resources Research Act Program

Program:	Water Resources Research Act Program
Subcommittee:	Interior and the Environment Appropriations
Account:	Surveys, Investigations, and Research - Water Resources
Agency:	U.S. Geological Survey
FY2024 Funding Level:	Pending- $16 million in both House and Senate FY24 Interior Appropriations bills
Program Authorization:	The Water Resources Research Act, 42 USC Sec. 1030 3 WRRA was reauthorized through 2025, as included in the 2022 Bipartisan Infrastructure Law
FY2025 Funding Request	$18,000,000
	Report Language: *Water Resources Research Act—the Committee provides $18,000,000 for the Water Resources Research Act program at USGS and directs that at least $14,500,000 fund the 104b annual base grants and the remaining funds to support 104g national grants, including special research topics such as AIS and PFAS.*
Budget Offset, if asked	U.S. Department of Interior, Working Capital Fund

Justification: The water resources research institutes provide vital support to stakeholders, states and federal agencies for long-term water planning, policy development, and resource management. This support takes the forms of research, education, and outreach. In partnership with the U.S. Geological Survey, the water institutes have a 60-year history of rendering assistance to all members of the water- user communities in their states in an efficient and non-duplicative manner. The FY 2025 funding goal for the water resources research institutes program in the U.S. Geological Survey budget is $18,000,000.

Funding Rationale: As the nation's water challenges increase, the institutes are poised to grow their partnership with USGS to tackle key problems related to water-related hazards, water quality, and water availability. This funding level ensures that institutes can attract water scientists, develop the USGS-related workforce and expand regional partnerships to leverage multiple stakeholders to address these national water concerns.

1/3/2024

Cost Category	Federal	Non-Federal	Grand Total
Total Salaries and Wages for:	**$110,719.00**	**$52,092.00**	**$162,811.00**
Principal Investigator	$14,000.00	$21,092.00	$35,092.00
Regular Investigators	$15,519.00	$19,000.00	$34,519.00
Post Docs	$0.00	$0.00	$0.00
Graduate Students	$45,200.00	$0.00	$45,200.00
Undergrad Students	$36,000.00	$12,000.00	$48,000.00
Director	$0.00	$0.00	$0.00
Admin Assistants	$0.00	$0.00	$0.00
Total Fringe Benefits for:	**$17,463.00**	**$15,676.00**	**$33,139.00**
Principal Investigator	$5,474.00	$8,247.00	$13,721.00
Regular Investigators	$2,737.00	$2,737.00	$5,474.00
Post Docs	$0.00	$0.00	$0.00
Graduate Students	$5,921.00	$0.00	$5,921.00
Undergrad Students	$0.00	$0.00	$0.00
Director	$3,331.00	$4,692.00	$8,023.00
Admin Assistants	$0.00	$0.00	$0.00
Tuition for:	**$14,098.00**	**$0.00**	**$14,098.00**
Graduate Students	$14,098.00	$0.00	$14,098.00
Undergrad Students	$0.00	$0.00	$0.00
Supplies	$1,560.00		$1,560.00
Equipment			$0.00
Services or Consultants			$0.00
Travel	$1,500.00		$1,500.00
Other Direct Costs	$1,500.00	$1,500.00	$3,000.00
Total Direct Costs:	**$146,840.00**	**$69,268.00**	**$216,108.00**
Indirect Costs Federal	XXXX	$50,973.00	$50,973.00
Indirect Costs Non-Federal	XXXX	$26,599.00	$26,599.00
Amount Proposed at Institute University	**$146,840.00**	**$146,840.00**	**$293,680.00**
Amount Proposed at Other University	**$0.00**	**$0.00**	**$0.00**
Total Amount Proposed	**$146,840.00**	**$146,840.00**	**$293,680.00**

184 Graham Hall
Newark, DE 19716-7380
Phone: 302-831-1687
Email: bidenschool@udel.edu

April 30, 2025

Congresswoman Sarah McBride
105 North Market St. Suite 400
Wilmington, Del. 19801

Re: Water Resources Research Act
Fiscal Year 2026 Interior, Environment, and Related Agencies Appropriations Bill

Dear Congresswoman McBride:

As President of the National Institutes for Water Resources (NIWR) and Director of the University of Delaware Water Resources Center (UDWRC), we respectfully request your support of the House Subcommittee to provide $18 million for the Water Resources Research Act program in the Fiscal Year 2026 Interior, Environment, and Related Agencies Appropriations bill.

Now celebrating our 60th anniversary, the Water Resources Research Act, signed by Lyndon Baines Johnson in 1964, established the National Institutes for Water Resources (NIWR) at 54 land grant universities (such as the University of Delaware) in the 50 states, Washington D.C., and three island territories of Guam/Northern Mariana Islands/American Samoa, Puerto Rico, and Virgin Islands. Through the U.S. Geological Survey in the Department of Interior, these institutes provide a Federally supported and state-based network dedicated to solving problems of water supply and quality in partnership with universities, local governments, water industry, and the public. Each state contributes a minimum of a 1:1 match, thus ensuring that we address local, state, and regional water priorities, and maximize the impact of the federal dollar. Last year we supported 245 water research projects that benefit the citizens of nation, and our institutions have trained over 10 million alumni for the workforce. The University of Delaware Water Resources Center was established on campus in 1965 and since then we have supported the education, training, and research of thousands of students (many from Delaware high schools) who have focused on solving the significant water resources issues of the day in Delaware, the Delaware Valley, and tl

Please don't hesitate to co
have any questions about t
resources.

Respectfully,

Gerald J. Kau

Gerald Joseph McAdams K
University of Delaware
Water Resources Center
Newark, DE 19716

JOSEPH R. BIDEN,
www.bidenschool.udel.edu

184 Graham Hall
Newark, DE 19716-7380
Phone: 302-831-1687
Email: bidenschool@udel.edu

April 30, 2025

Senator Chris Coons
1105 N. Market Street Suite 100
Wilmington, Del. 19801

Re: Water Resources Research Act
Fiscal Year 2026 Interior, Environment, and Related Agencies Appropriations Bill

Dear Senator Coons:

As President of the National Institutes for Water Resources (NIWR) and Director of the University of Delaware Water Resources Center (UDWRC), we respectfully request your support of the House Subcommittee to provide $18 million for the Water Resources Research Act program in the Fiscal Year 2026 Interior, Environment, and Related Agencies Appropriations bill.

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Please don't hesitate to contact us at mcorrozi@udel.edu or jerryk@udel.edu or 302-893-1571 if you have any questions about this important appropriation concerning our state and national water

184 Graham Hall
Newark, DE 19716-7380
Phone: 302-831-1687
Email: bidenschool@udel.edu

April 30, 2025

Senator Lisa Blunt Rochester
105 North Market St. Suite 400
Wilmington, Del. 19801

Re: Water Resources Research Act
Fiscal Year 2026 Interior, Environment, and Related Agencies Appropriations Bill

Dear Senator Blunt Rochester:

As President of the National Institutes for Water Resources (NIWR) and Director of the University of Delaware Water Resources Center (UDWRC), we respectfully request your support of the House Subcommittee to provide $18 million for the Water Resources Research Act program in the Fiscal Year 2026 Interior, Environment, and Related Agencies Appropriations bill.

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:du or jerryk@udel.edu or 302-893-1571 if you
concerning our state and national water

Martha B. Narvaez

Martha B. Narvaez, Associate Director
University of Delaware
Water Resources Center
Newark, DE 19716

JBLIC POLICY & ADMINISTRATION

184 Graham Hall
Newark, DE 19716-7380
Phone: 302-831-1687
Email: bidenschool@udel.edu

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IR. SCHO

April 30, 2025

Hon. Mike Simpson, Chairman
Interior, Environment, & Related Agencies Subcommittee
House Committee on Appropriations
U.S. House of Representatives
1016 Longworth House Office Building
Washington, DC 20515

Hon. Chellie Pingree, Ranking Member
Interior, Environment, & Related Agencies Subcommittee
House Committee on Appropriations
U.S. House of Representatives
2007 Rayburn House Office Building
Washington, DC 20515

Dear Chairman Simpson and Ranking Member Pingree:

As President of the National Institutes for Water Resources (NIWR) and Director of the University of Delaware Water Resources Center (UDWRC), we respectfully request your support of the House Subcommittee to provide $18 million for the Water Resources Research Act program in the Fiscal Year 2026 Interior and Environment Appropriations bill. The WRRA is a proven and effective program since 1964 and is a vital resource for many constituencies, regional water managers, and local business leaders. The WRRA (32 USC 109 et seq.) established National Institutes for Water Resources (NIWR) at 54 land grant universities in the 50 states, District of Columbia, and island territories of Guam, Puerto Rico, and Virgin Islands to research water-related phenomena, aid the entry of new research scientists into water resources fields, train future water scientists and engineers, and distribute the results of sponsored research to water managers and the public.

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We appreciate the Subcommittee's support for the Water Resources Research Act and request that you continue funding this program in the FY26 Interior and Environment Appropriations bill.

Respectfully,

Gerald J. Kauffman

Gerald Joseph McAdams Kauffman, Jr., Director
University of Delaware
Water Resources Center
Newark, DE 19716

Martha B. Narvaez

Martha B. Narvaez, Associate Director
University of Delaware
Water Resources Center
Newark, DE 19716

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Phone: 302-831-1687
Email: bidenschool@udel.edu

April 30, 2025

Senator Lisa Murkowski, Chair
Interior and Environment Subcommittee
Appropriations Committee
SD-131 Dirksen Senate Office Building
Washington, DC 20510

Senator Jeff Merkley, Ranking Member
Interior and Environment Subcommittee
Appropriations Committee
SH-125 Hart Senate Office Building
Washington, DC 20510

Dear Senators Murkowski and Merkley:

As President of the National Institutes for Water Resources (NIWR) and Director of the University of Delaware Water Resources Center (UDWRC), we respectfully request your support of the House Subcommittee to provide $18 million for the Water Resources Research Act program in the Fiscal Year 2026 Interior and Environment Appropriations bill. The WRRA is a proven and effective program since 1964 and is a vital resource for many constituencies, regional water managers, and local business leaders. The WRRA (32 USC 109 et seq.) established National Institutes for Water Resources (NIWR) at 54 land grant universities in the 50 states, District of Columbia, and island territories of Guam, Puerto Rico, and Virgin Islands to research water-related phenomena, aid the entry of new research scientists into water resources fields, train future water scientists and engineers, and distribute the results of sponsored research to water managers and the public.

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Respectfully,

Gerald J. Kauffman

Gerald Joseph McAdams Kauffman, Jr., Director
University of Delaware
Water Resources Center
Newark, DE 19716

Martha B. Narvaez

Martha B. Narvaez, Associate Director
University of Delaware
Water Resources Center
Newark, DE 19716

UDWRC Advisory Panel
Water Resources Research and Education Priorities

- Water quality (nutrients, pathogens, public health), harmful algal blooms, PFOA contamination
- Storm water runoff (management and control)
- Water supply, demand, and conservation (infrastructure/technology)
- Water policy (governance and economics)
- Climate change, sea level rise, riverine/coastal flooding
- Groundwater (remediation and treatment)
- Watershed management
- Wetlands (protection and restoration)
- Wastewater management (treatment and reuse)
- Water, food, and energy nexus

Chauncey says study and be nice!

2024-2025 Undergraduate and Graduate Research Projects

Name	School	Major	Research Advisor	Research Project
Undergraduate Research				
Jillian Abramson	UD	Environmental and Resource Economics	Dr. Gerald Kauffman	Delaware River Basin and Economics
Aaron Balmer	UD	Wildlife Ecology	Martha Narvaez	Wilmington Lead Project and White Clay Catch the Rain
Abigale Britz	UD	Environmental Engineering	Dr. Gerald Kauffman	Water Quality Trends and Water Demands in the Brandywine White Clay Creek Watershed in Delaware
Amelia English	UD	Environmental Studies/Public Policy	Dr. Gerald Kauffman	A Comparative Spatial Analysis of Flood Exposure and Social Vulnerability in Two Delaware Coastal Communities
Cooper Feeny	UD	Economics and Public Policy	Martha Narvaez/Andrew Homsey	Wilmington Lead Project and UD MS4 Permit Compliance
Cai Foster	UD	Environmental Studies	Dr. Gerald Kauffman	Wetlands, Infrastructure, and Storm Surges along the Brandywine River in Wilmington Delaware
Caroline Gilliard	UD	Environmental Engineering	Dr. Gerald Kauffman	Flood Hydrology and Hydraulics Along the Brandywine River in Delaware and Pennsylvania
Lianna Greenstein	UD	Environmental Engineering	Dr. Gerald Kauffman	Water Quality Trends and Water Demands in the Brandywine White Clay Creek Watershed in Delaware
Isabelle Kornas	UD	Energy and Environmental Policy	Dr. Gerald Kauffman	Economic Value of Floodplain Properties in Delaware Coastal Towns
Elizabeth Manning	UD	Environmental Engineering	Dr. Gerald Kauffman	Flood Hydrology and Hydraulics Along the Brandywine River in Delaware and Pennsylvania
Avid Mendiola-Trujillo	UD	Chemical Engineering	Dr. Gerald Kauffman	Assessment of PFAS Contaminants and Remediation Strategies in Delaware Surface Water Resources
Helena Owen	UD	Environmental Resource Economics	Dr. Maik Kecinski	Oyster Valuation in the Gulf of Mexico
Kayla Price	UD	Environmental Engineering	Dr. Paul Imhoff	Remediation of Contaminated Soil from Accidental Spills of Salt-Laden Produced Water
Dmitriy Rybin	UD	Civil Engineering	Martha Narvaez/Andrew Homsey	Wilmington Lead Project and UD MS4 Permit Compliance
Silvie Sandeen	UD	Environmental Science	Martha Narvaez	Integrating Environmental Literacy into DE Public High Schools CTE Pathways Program
Graduate Research				
Catherine Gilman	UD	Energy and Environmental Policy	Dr. Gerald Kauffman	Delaware's Bottle Bill Repeal in Context: Drivers, Challenges, and Comparisons with Other States
Jhaney Hamlett	UD	Masters of Public Administration	Martha Narvaez	City of Wilmington Green Jobs Program Impact Study
Nicole Re	UD	Master of Energy and Environmental Policy	Dr. Gerald Kauffman	Assessing the Impacts of Loper Bright on Wetlands Protections in the US
Megan Wassil	UD	MS Water Science & Policy	Dr. Gerald Kauffman	The Presence of PFAS in Delaware's Drinking Water Streams

Wilmington Lead Project – Assisting the City of Wilmington in the Completion of their LCR Inventory.

Cooper Feeny *Major: Economics Major: Public Policy Minor: Environmental Policy*
Aaron Balmer *Major: Wildlife Conservation and Ecology*
Dmitriy Rybin *Major: Civil Engineering*
May 16th, 2025

Objectives

- Identify and map the presence of lead and other materials (copper, galvanized, etc.) in Wilmington's service lines using over 70,000 historical work orders.
- Utilize GIS to spatially track the location and material composition of service lines across the city.
- Integrate AI models to streamline classification of work orders, reducing manual sorting workload.
- Develop a publicly accessible database and interactive map to allow Wilmington residents to view the known or estimated pipe materials serving their property or neighborhood.
- Support the City of Wilmington's compliance with the 2021 EPA Lead and Copper Rule Revisions by informing replacement planning and funding strategies.

Methods

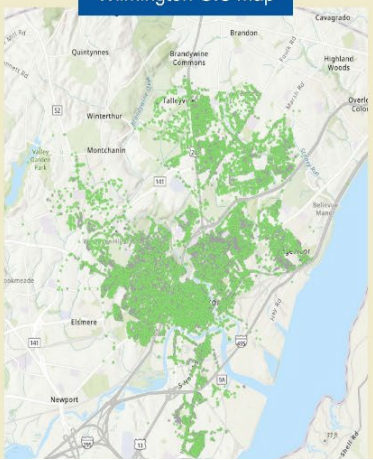
Work Order Review:
Over 70,000 work orders—some dating back to the early 20th century—were scanned, digitized, and reviewed. These documents included critical details such as service line material (e.g., lead, copper, galvanized, cast iron), location, pipe diameter, and installation date. The bulk of usable records came from the mid-20th century onward.

AI-Assisted Classification:
In 2023–2024, Large Language Models (LLMs) were introduced to assist in distinguishing between relevant and irrelevant work orders (e.g., separating service line replacements from unrelated tasks like hydrant or meter maintenance). This reduced the manual sorting workload by approximately 42%, accelerating inventory completion and improving accuracy.

Material Tagging and Categorization:
Service lines were categorized by material type: lead, copper, galvanized, ductile iron, cast iron, and unknown. Ambiguous records were flagged for field verification or future excavation. Material frequency distributions were created to estimate lead prevalence within the city's infrastructure.

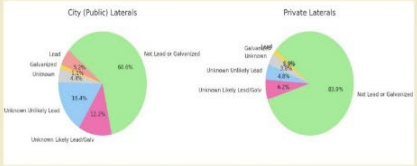
GIS Integration:
All reviewed and classified service lines were geolocated and uploaded to an ArcGIS database, enabling spatial analysis and mapping. This allowed the team to visualize lead prevalence by neighborhood and supported the development of a public-facing database for residents to view pipe materials in their area.

Wilmington GIS Map



Results

City Lateral	Private Lateral	Total Laterals
36,442	36,313	72,765
City Lateral - Lead	Private Lateral - Lead	Total - Lead
1,912	11	1,923
City Lateral - Galvanized	Private Lateral - Galvanized	Total Galvanized
399	469	868
22,069	30,773	Not Lead or Galvanized 55,161
City Lateral - Unknown	Private Lateral - Unknown	Total Unknown
1,618	1,384	3,004
5,991	1,771	Unknown Unlikely Lead 7,762
4,453	2,270	Unknown - Likely Lead /Galv 6,837



Observations

Material Breakdown of Reviewed Data:

- Lead: ~12.4%
- Copper: 60%
- Galvanized: 1%
- Other metals (ductile, cast iron): 3%
- Unknown: ~30%

Initial cost estimates suggest:

- Lower Bound: $40.68 million (4,068 lines × $10,000)
- Upper Bound: $52.46 million (4,372 lines × $12,000)

Pie chart comparison of Public vs. Private Laterals shows big unknowns and non-lead materials, but public lines have more relative lead presence.

Recommendations

- Prioritize the replacement of lead service lines in vulnerable communities, such as schools and low-income neighborhoods.
- Launch targeted public health outreach campaigns to raise awareness of lead risks and communicate replacement timelines.
- Continue efforts to secure funding from federal, state, and local agencies, especially given Wilmington's limited municipal budget and current receipt of only ~0.35% of pledged EPA funds.
- Future Research (2025–2026): Conduct an economic analysis of the impact of lead prevalence on property values in Wilmington by comparing housing prices of homes with and without lead service lines. This will help quantify the economic burden on affected homeowners and support further policy and funding decisions.

Acknowledgements

We would like to thank the Delaware Water Resources Center as well as the US Geological Survey who provided the funding for this research through the US Dept. of Interior by the Water Resources Research Act of 1964 and 1984. Continually, we would like to thank Dr. Gerald Kauffman, Martha Narvaez, and Andrew Homsey for their guidance and advisement. Furthermore, we would like to extends our gratitude to Jacobs, as well as Cheryl Townsend-Braun for allowing us the opportunity to participate in this effort that has proven to offer us a genuine insight into important local and federal policy implementation.

White Clay Catch the Rain

Aaron Balmer Major: Wildlife Conservation and Ecology
May 16th, 2025

Introduction

•Catch the Rain is a partnership between landowners and the White Clay Watershed Association (WCWA).

•Aims to reduce stormwater runoff into White Clay Creek through voluntary community action.

•Offers homeowners rebates for implementing Catch the Rain practices such as rain barrels, rain gardens, tree plantings, conservation landscaping, permeable paver retrofit, depaving, and adding buffers.

•Create an ArcGIS dashboard to visualize Catch the Rain data.

Purpose

•Develop a sustainable, interactive ArcGIS dashboard for Catch the Rain data.

•Create a geospatial layer to map program participants, projects, and total costs by municipality.

•Ensure long-term usability through training and documentation.

•Improve data accessibility and transparency for WCWA and the public.

Methods

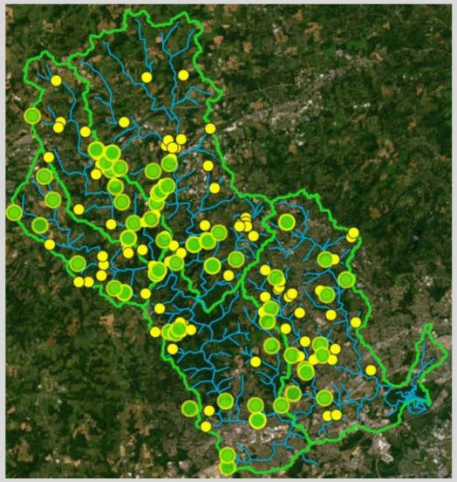
•Data Preparation: The project began by organizing existing Catch the Rain data from Google Sheets into a format compatible with ArcGIS.

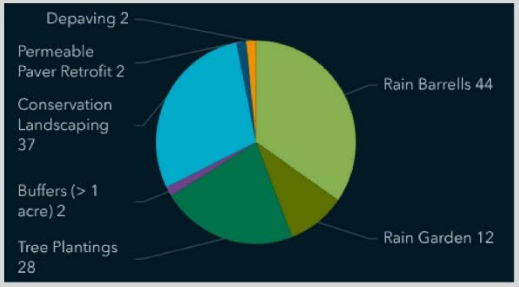
•Geospatial Integration: Using ArcGIS, a spatial layer was created to map applicants and project locations within the watershed.

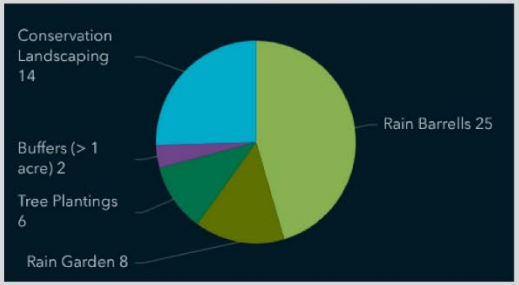
•Dashboard Development: An interactive dashboard was built in ArcGIS, featuring charts, maps, and filters to show the yearly progression of the project based on the Program Director's specifications.

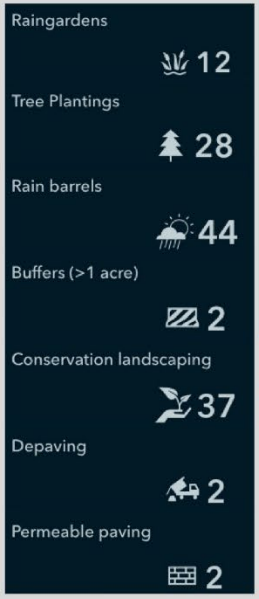
•Documentation: Implement before and after photographs of project sites to provide further applicants with clear visual examples and inspire participation.

•Training: A demonstration and training session was provided to ensure the Program Director could confidently manage the platform.









Results

• A fully functional ArcGIS-based dashboard now visualizes real-time Catch the Rain data, offering insights into project distribution, participation rates, and the funding involved.

•The dashboard will be integrated into the WCWA's website, enabling public access and transparency.

•The interactive ArcGIS map allows users to filter projects by municipality to provide specific data including the implemented practices, total costs, and awarded rebates.

•Each green point representing a completed project on the map displays photographs as well as the individual total costs of the project as well as the awarded rebates.

Conclusions

•The project successfully transformed raw data into an interactive, publicly accessible ArcGIS dashboard.

•Enhanced WCWA's ability to communicate the impact of Catch the Rain through visual tools, including photographs and cost details.

•Improved data transparency and user engagement by allowing viewers to explore project locations, types, and financial breakdowns by municipality.

•Provided WCWA with long-term resources and documentation, to independently manage and update the dashboard.

•Demonstrated how geospatial technology and clear visual communication can support and expand the reach of community-based environmental programs.

Acknowledgements

I would like to thank the Delaware Water Resources Center who provided the funding to complete this project. I would also like to thank Gerrald Kauffman, Martha Narvaez, and especially Andrew Homsey for their continued guidance and advisement on this project. I would also like to extend my gratitude towards Shane Morgan the program director at the WCWA for her support and feedback.

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

Abigale Britz, Lianna Greenstein, Dr. Gerald Kauffman
College of Engineering - Civil and Environmental Engineering

May 16, 2025

NIWR THE NATIONAL INSTITUTES FOR WATER RESOURCES

UNIVERSITY OF DELAWARE

USGS science for a changing world

Purpose

The purpose of this study is to monitor 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 was consuming too much water for the watershed to support. This information would allow officials to make announcements to the public about water consumptions. To determine water quality in the White Clay Creek and Brandywine watershed, *Enterococcus sp.* bacterial levels were measured during the warmer months of the year, May through October. These values were graphed along with rainfall to find a correlation between rainfall amounts and *Enterococcus sp.* concentrations in the water. This information would allow officials to make statements on the safety of recreational water activities based on these bacterial levels.

Methods

Obtain data from the United States Geological Survey (USGS), Delaware Department of Natural Resources and Environmental Control (DNREC), Artesian Water Co., City of Newark, New Castle County Municipal Services Commission, Veolia Delaware, and the City of Wilmington for monitoring stations throughout New Castle County and it's waterways:

- White Clay Creek at Newark
- Brandywine Creek at Wilmington
- Brandywine River at Breck's Mill
- Brandywine Creek at Experimental Station
- Brandywine Creek at Northeast
- Brandywine Creek at Smith's Bridge
- Christina River at 7th Street
- Christina River at Kalmar Nyckel
- Brandywine River at Smith's Bridge

Compile the following data: discharge, water demand, enterococcus bacteria, 24-hour rainfall, 48-hour rainfall, and weekly rainfall.

- Arrange the dataset and create graphical representations to display temporal trends in parameter variations at each sampling location.
- Analyze the trend of enterococcus bacteria in relation to the amount of rainfall to identify possible concerns with the safety of swimming in the waterways studied. Asses the pattern of discharge at the two selected stations to determine drought behavior. Evaluate the progression of water demands in relation to current drought conditions.

Results

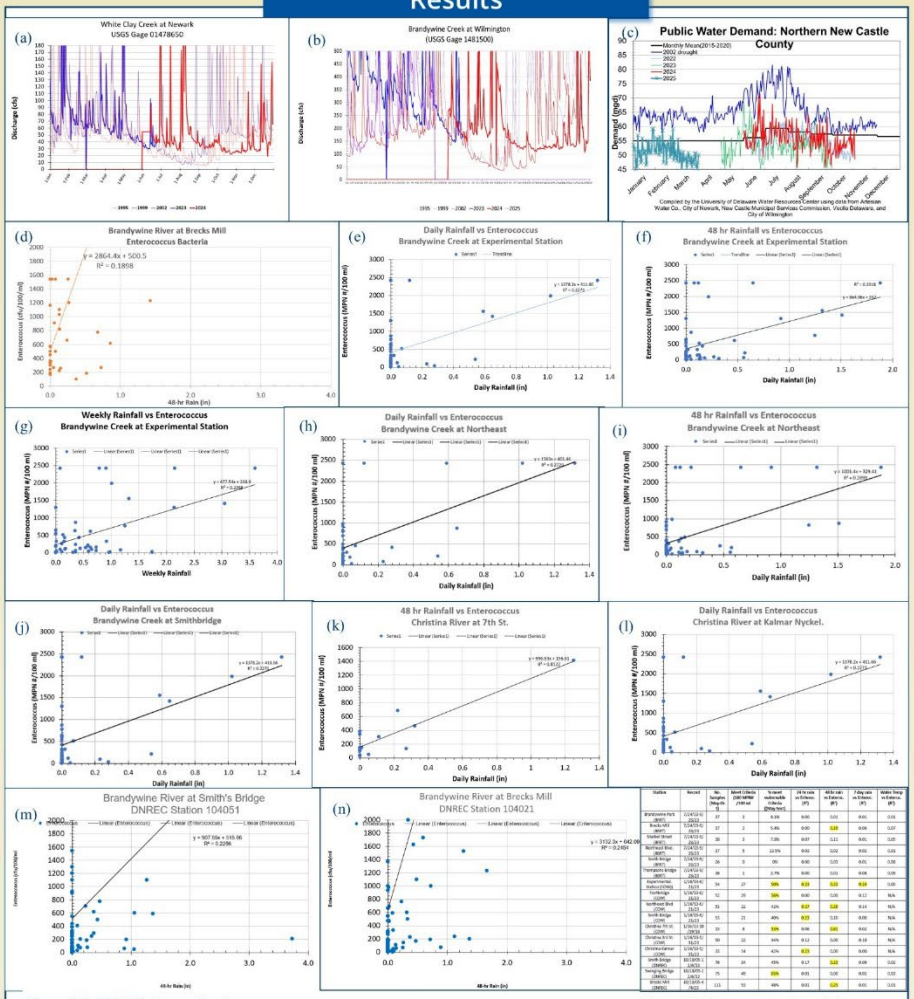


Figure 1 (a&b): Discharge Graphs
(a)White Clay Creek at Newark, DE
(b)Brandywine Creek at Wilmington, DE
Figure 1 (c): Water Demand of New Castle County, DE
Figure 1 (d-n): Site Enterococcus Levels vs Rainfall Intervals, New Castle County, DE

Figure 2: Enterococcus Levels in Relation to Site Data:

- Highlighted values have met the criteria for hazardous conditions when determining the swimmable standard.

Discussion

For the water demands results, the following conclusions were made:

- The discharge graph for the Brandywine Creek during the fall of 2024 and the beginning of 2025 was lower than the 2002 drought for some periods of time
- The discharge graph for the White Clay Creek during the fall of 2024 and the beginning of 2025 was lower than the 2002 drought for some periods of time
- The public water demands for the end of 2024 and the beginning of 2025 were lower than normal, meaning the public has been conscientious of the drought and mindful about their water usage

For the water quality results, the following conclusions were made:

- If the R^2 values for each graph were equal to or above 0.2, the water quality conditions were deemed unsafe
- If the samples of each station met the criteria of (180 MPN/100mL) for over 50% of the recorded values, it was considered safe to swim.
- The criteria percentage and R^2 values for each graph should be compared when making the decision if the water quality of the specific station is safe to swim in after certain durations of rainfall.

Recommendations

The following recommendations about water demands in northern New Castle County can be made:

- The public should continue to be mindful about their water consumption, as we are still trying to recover from the current drought and recharge the local watersheds as much as possible

The following recommendations about water quality in the Brandywine-White Clay Creek watershed can be made:

- The public should avoid swimming in these watersheds when the R^2 values are above or equal to 0.2 and fi the criteria is below 50%, to avoid possible health risks from the amount of enterococcus bacteria present.

Acknowledgements

This project was funded by the USGS from the U.S. Department of Interior by the Water resources Act of 1964 and 1984. Thank you to Gerald Kauffman and Martha Narvaez for the support and guidance you have provided throughout this project.

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

Amelia English, Environmental Studies and Public Policy

1. Introduction

- Delaware is the lowest-lying U.S. state, highly exposed to coastal flooding.
- This study examines two distinct locations:
  - Wilmington (north/Delaware River): densely populated, industrialized urban center
  - Lewes/Rehoboth area (south/Atlantic): coastal, large tourism economy
- The extent of flooding impacts on these populations remains under-studied.
- This project analyzes population and property data to compare vulnerability.

2. Objectives

- Estimate the number of housing units and residents in FEMA-designated 100- and 500-year flood zones in Delaware.
- Examine relationships between flood exposure and social vulnerability in two coastal communities.
- Identify socially vulnerable populations residing in high-risk flood zones.

3. Study Area

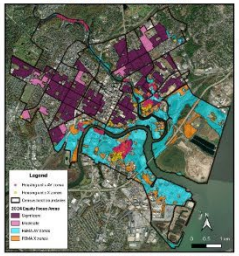
4. Methods

- Defined flood exposure using FEMA's National Flood Hazard Layer (NFHL):
  - Combined zones starting with A and V to represent the 100-year (1% annual chance) floodplain
  - Combined zones starting with X to define the 500-year (0.2% annual chance) floodplain
- Mapped residential housing units within each floodplain using the National Address Database (NAD), verified with land use data
- Aggregated address points to census tracts (TIGER/Line) to calculate:
  - Number of housing units in each floodplain per tract
  - Percentage of each tract's land area that overlaps with each floodplain type
- Estimated residents in each floodplain by tract using 2019-2023 ACS average household size data
- Intersected floodplain housing data with DelDOT Equity Focus Areas (EFAs)* to identify disadvantaged populations in flood-prone areas
- All spatial analysis was conducted in QGIS

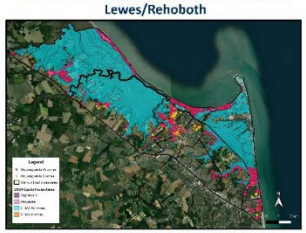
*EFAs identify block groups with elevated social vulnerability based on poverty, income, race/ethnicity, and language isolation. EFAs are classified as Moderate or Significant based on how multiple indicators compare to state-level thresholds.

5. Results

Floodplain Exposure and Equity Focus Areas: Wilmington



Floodplain Exposure and Equity Focus Areas: Lewes/Rehoboth



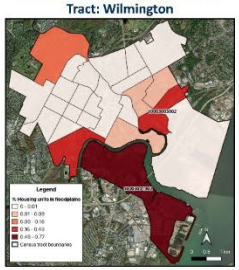
FEMA-designated flood zones, housing units at risk, and Equity Focus Areas in Wilmington and Lewes/Rehoboth.

Flood Exposure by Study Area

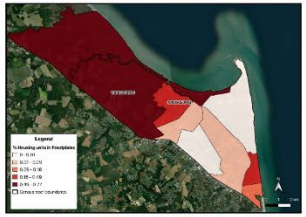
Metric	Wilmington	Lewes/Rehoboth
% Land Area in Floodplains	29%	64%
% Housing Units in AV Zones	5%	23%
% Housing Units in X Zones	1%	2%
Housing Units in AV Zones	1876	3545
Housing Units in X Zones	507	358
Total Population in AV Zones	4067	6965
Total Population in X Zones	1161	655

Lewes/Rehoboth has a higher percentage of land, housing, and population in flood zones compared to Wilmington, especially in high-risk AV zones.

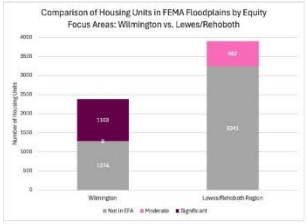
Housing in Floodplains by Census Tract: Wilmington



Housing in Floodplains by Census Tract: Lewes/Rehoboth



Percent of housing units in floodplains (both AV and X zones) by census tract in Wilmington and Lewes/Rehoboth. Maps show spatial variation in residential flood exposure within and between study areas.



In Wilmington, nearly half of all housing in floodplains is located in Significant Equity Focus Areas (EFAs), compared to none in Lewes/Rehoboth.

6. Critical Tracts

Tract ID	Study Area	% Housing Units in Flood Zones	Social Vulnerability Index (SVI) Score	% Floodplain Housing in EFAs
10003001902	Wilmington	77%	0.745 (High)	58% (Significant EFA)
10003003002	Wilmington	43%	0.933 (Very High)	100% (Significant EFA)
10005050903	Lewes/Rehoboth	49%	0.129 (Very Low)	0%
10005050905	Lewes/Rehoboth	63%	0.329 (Low)	32% (Moderate EFA)

Key tracts with high flood exposure. Wilmington tracts have greater overlap with social vulnerability and EFAs, while Lewes/Rehoboth tracts have significantly lower social vulnerability despite similar exposure.

7. Conclusions

- Lewes/Rehoboth has greater flood exposure overall, with a higher proportion of land area and housing units in high-risk zones.
- Wilmington's flood exposure is more concentrated in socially vulnerable neighborhoods.
- Mitigation in Wilmington should prioritize tracts with compounded flood risk and social vulnerability.

8. Acknowledgements

This project was funded by the U.S. Geological Survey through the University of Delaware Water Resources Center. I would like to thank Dr. Gerald Kauffman, Andrew Homsey, and Martha Narvaez for their guidance and support.

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UD MS4 Permit Compliance Assistance.

Cooper Feeny *Major: Economics Major: Public Policy Minor: Environmental Policy*
Dmitriy Rybin *Major: Civil Engineering*
May 16th, 2025

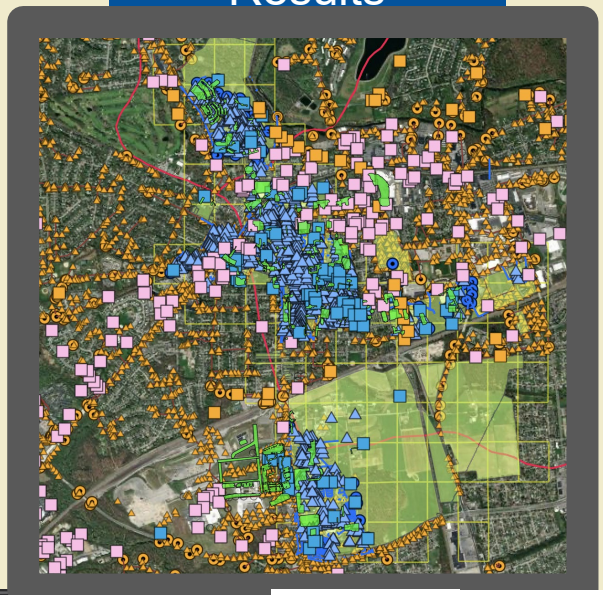
Objectives

Our aim in this project was to digitize the field inspection process for Udel Catch basins, Inlets, Outflows, and Parking lots as to comply with the phase two MS4 Permit held by the University of Delaware and the CIty of Newark, DE.

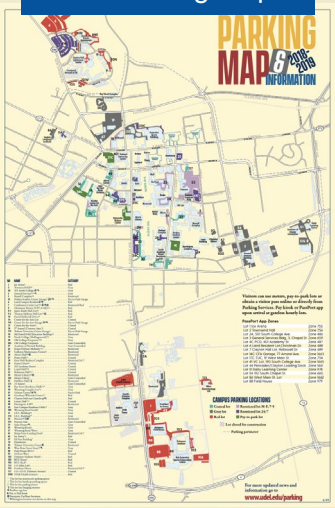
Methods

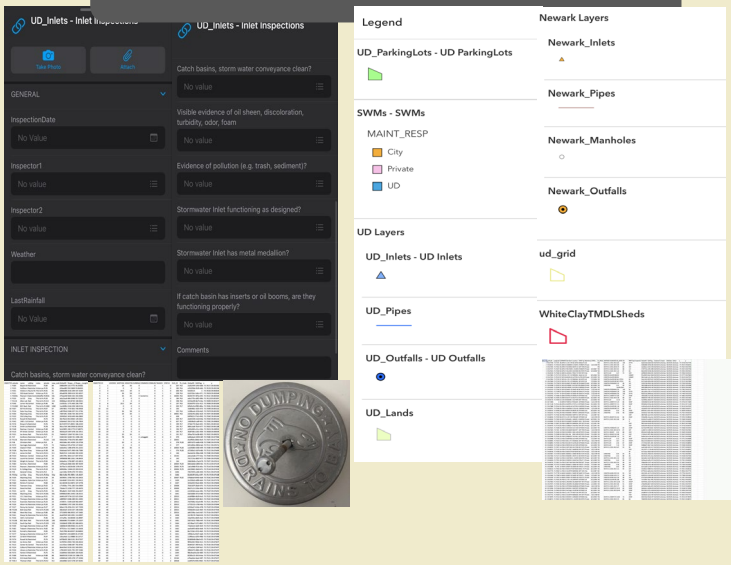
Created a "living" ArcGis map containing all parking lots, catch basins, BMP's, Inlets, and outfalls under the management of both the University of Delaware and the City of Newark. From here we created surveys in FieldMaps pertaining to each particular University of Delaware datapoint. After integrating the mobile app with the ArcGIS website,, Dmitriy and Cooper went to multiple parking lots on campus to test the viability of these inspections via FieldMaps.

Results



UD Parking Map





Observations

We were able to complete 15 parking lot inspections. Some common things we noticed were that lots of catch basins on campus are missing a metal UDel medallion. Furthermore, parking lots on north campus seem to be more affected by pollution, sediment build up, and factors concerning the viability/efficacy of catch basins. Overall, we believe this to be a very effective, relatively simple way to manage MS4/BMP data, and that it could easily be adopted by the university and other SWM institutions.

Recommendations

We would recommend continuing the use of this software in the University's efforts to take data as to maintain their MS4 phase two permit. Furthermore, we would recommend creating a step by step guide on filling out inspections for parking lots, BMP's, and inlets as to create a smoother transition for future interns that take on the continuance of this project. We would also recommend, after continued testing, that the University fully adopt this method of data keeping. Furthermore, we would recommend continuing inspections into the summer and next year as to get a full picture of the University's stormwater management practices and needs.

Acknowledgements

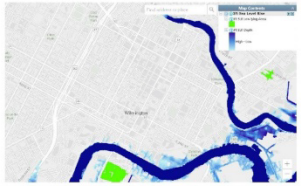
We would like to thank the Delaware Water Resources Center as well as the US Geological Survey who provided the funding for this research through the US Dept. of Interior by the Water Resources Research Act of 1964 and 1984. Continually, we would like to thank Dr. Gerald Kauffman, Martha Narvaez, and Andrew Homsey , and Mrs. Stephanie Briggs for their guidance and advisement.

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

Cai Foster, College of Earth, Ocean, and the Environment, Environmental Studies Major
Peace and Justice Studies Minor, Environmental Planning and Design Concentration

Introduction

The Brandywine River has continuously been experiencing changes from the effects of flooding and storm surges. The surrounding infrastructure and constant land changes has impacted how outstanding communities are affected by these floods and storm surges. In particular Hurricane Ida has made a huge impact on the land, infrastructure, and environmental conditions. Below is my study area in the 100 year floodplain at 1 meter (3 ft) of flooding.



Background

The surrounding land in the Brandywine River in Wilmington Delaware has experienced major changes throughout the past 2 decades. These changes include numerous land and infrastructure adjustments which have changed the severity of the environmental status in this area. While some positive implementations have been put in place such as solar panels, buildings are breaking down, buildings are being created, and empty patches of land are being replaced with lots.

Objectives

(1) Demolish the decaying factory along the river.

(2) Replace the area where the factory lays with wetlands.

(3) Add wetlands to the empty plots of land along the river.

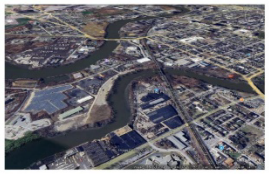
(4) Turn the new wetland over to the National Wildlife Refuge.

(5) End the severe flooding in surrounding populated areas of land, with the implementation of a wildlife refuge wetland.

Changes in Surrounding Land

According to overhead perspectives from Google Maps ranging from 1997-2024, numerous changes can be seen from human interactions, and non human interactions. In particular numerous areas of lost vegetation along the Brandywine can be seen in maps from 2024, and 2010. In addition, property damage, likely from the effects of Hurricane Ida, can be seen in the factory along the River in the 2024 map view.

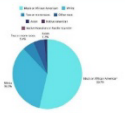
Brandywine River, Wilmington Delaware 1997



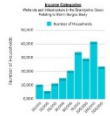
Brandywine River, Wilmington Delaware 2024

Brandywine Demographics

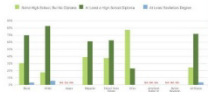
Demographic Index In Wilmington Delaware from percentile to percentage.



Low income in Wilmington Delaware from percentile to income categories annually.



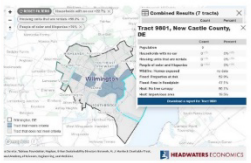
Less than high school education from percentile to percentage.



Lead paint in percentile to superfund proximity in percentile (indicates pollution).

Soil Survey and Headwater Economics Maps

- Othello-Fallsington-Urban soil
  - High moisture capacity
  - Poorly drained
- I recommend using oaks, sweetgum, blackgum, swamp maple, and holly wetland forests for this soil type.



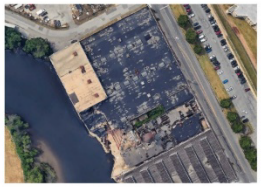
- Headwaters Economics
  - Tract 9801, New Castle county, DE
  - Flood: properties at risk- 52.9%
  - Flood: area in floodplain- 47.1%
  - Heat: no tree canopy- 90.1%
  - Heat: Impervious area- 19.5%

Possible Implementations in the Brandywine River

Destruction of Decomposing Factory- Taking down this building is essential as it is actively decomposing in the Brandywine, and will only continue to do so as flooding and storm surges continue.

Wetland Implementation Replacing Decomposing Factory- An implementation of wetlands in areas such as where the decomposing factory is currently sitting is necessary to help with the reduction of CO2 in the air.

Wetland Implementation Along the Brandywine River- An implementation of wetlands along the brandywine where vegetation used to sit would also be ideal, and helpful.



The decomposing factory from Google Maps in March of 2025

Conclusions

1. This factory began decomposing after Hurricane Ida, as presumed through map changes. Since then water and air pollution levels have risen to severely dangerous levels.
2. Wetlands instead of infrastructure replacing the factory would also help to prevent water pollution as harmful chemicals and other debris would no longer be entering the river from this area of land, even in the event of a storm.
3. Numerous areas surrounding the river previously had been filled with trees and other greenery which would have helped with flooding as well as air pollution. With the absence of this vegetation, diseases like asthma and cancer are at dangerously high levels.

Recommendations

1. Speak to Delaware Elected officials and practitioners at the Resilient and Sustainable Communities League, who I have been interning with, to push forward the removal of the decomposing factory.
   a. RASCL Mission Statement: "RASCL is a collaborative network of state agencies, non-profit organizations, and academic institutions that convenes partners, leverages limited resources, and coordinates efforts to build a more resilient and sustainable Delaware"
2. Restore this area of land back to a wetland forest with oaks, sweetgum, blackgum, swamp maple, and holly.
3. Turn the new wetland over to the US National Wildlife Refuge System in the US Fish and Wildlife Service to take it over and manage, naming it a national wildlife refuge.

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

Caroline Gilliard, Elizabeth Manning, Gerald Kauffman

University of Delaware

Abstract

Hurricane Ida in September 2021 caused record-breaking flows in the Brandywine Creek leading to significant damage throughout the watershed, especially in the lower branch in Wilmington, DE. To simulate flooding behavior for large storms in the Brandywine, we used a HEC-RAS model provided by the US Army Corps of Engineers. This includes detailed information from FEMA for the East, West, Lower Branch, and various tributaries. This study focuses specifically on the flood elevations and how the numerous structures along the channel impact them. The model shows where water is overtopping bridges, dams, and roadways, indicating where mitigation strategies are necessary. To alleviate these risks, we explored modifications to the geometries of multiple bridges. A successful mitigation strategy would reduce the flood elevation by 3.5 feet. Since less water is backing up on the upstream side of the structure, there is less volume spilling into the floodplains. In addition to modifying the existing model, we extended the lower reach to include the dam, bridge, and railroad in Rockland, DE. Field survey data and the USGS Streamstats program's profile elevation tool allowed us to add multiple cross sections onto the FEMA profile to continue our hydraulic analysis. Overall, for many of the bridges, the only successful mitigation strategy was completely removing the bridge, which may or may not be feasible. Some bridges we looked at were close to being successful when the elevation of the bottom of the deck was raised, indicating a possibility for mitigation with future geometric analysis.

Figure 1: Aerial image of Rockland Rd. Structures

Purpose & Research Question

- Utilize a HEC-RAS model of the Brandywine River to simulate flood scenarios for various amounts of rainfall
- Evaluate feasibility of bridge removal or modification to reduce flood elevations in Wilmington, DE.
- Create additional cross-sections upstream of existing Brandywine HEC-RAS model.

Methods & Analysis, Results

•The HEC-RAS model was run without altering stream geometry or existing structures

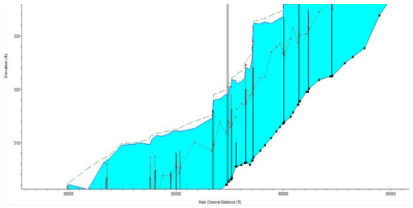

Figure 2. Existing HEC-RAS profile, West Branch Brandywine River

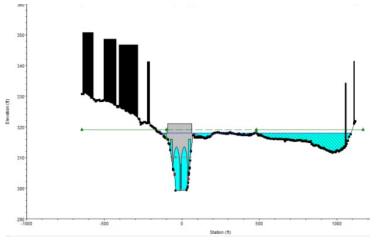

Figure 3: Existing US Route 30/ Lincoln Hwy Cross Section, Upstream

•Change geometry for each bridge of potential interest using best engineering judgement

- This includes raising low chord, reducing width into floodplain
- Assume piers are removed

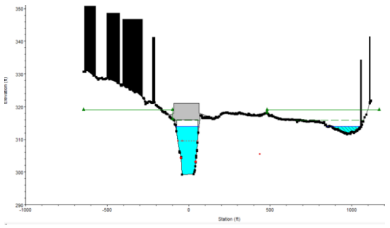

Figure 4: Proposed US Route 30 Bridge Modification, Upstream Cross-Section

•If this didn't reduce overtopping by 3.5 feet we recommend complete removal of the bridge, if feasible

Methods & Results, continued

- Used USGS Streamstats profile elevation tool and field survey data to model the Rockland dam and road bridge

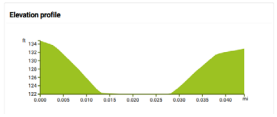

Figure 5: Streamstats profile elevation output for Rockland Rd.

•The Rockland region's profile was added upstream of existing Brandywine River geometry in the HEC-RAS model

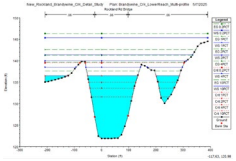

Figure 6: Streamstats and field survey of Rockland Rd. channel

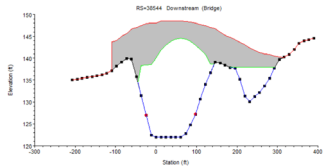

Figure 7: Rockland Road Bridge Cross-Section

- Data from existing Brandywine geometry is compared with potential removal measurements
- Total flood elevation difference counts are shown below for all Brandywine River structures

Table 1. Bridge Count for Flood Elevation Differences with Structure Removal

Flood Elevation Difference (>=), ft	Bridge Count
1	136
2	74
3.5	34
5	19
8	7
10	2

Conclusions

Renovation or removal of bridges of interest will reduce peak flood heights along the Brandywine River.

- Bridges of interest should include all bridges that have a 100-yr flood elevation difference of over 1 ft
- A total of 136 bridges within the Brandywine River Main Stem should be categorized in this way

34 bridges of interest have 100-yr flood elevation differences of over 3.5 feet. These bridges should be evaluated for potential removal, if feasible.

Combining field survey data and USGS elevation data helped add the existing Rockland Road Bridge which can be analyzed further for future mitigation strategies.

Directions for Future Research

- For bridges of interest, raise high chord and low chord to overall lift the bridge structure.
- Look into different changes to bridge geometry, beyond low chord openings.
- Research ways to potentially alter the stream channel or floodplain. This could reduce flooding upstream of structures to avoid taking the bridges out entirely.
- Collect more field data for the Rockland railroad bridge, there is limited elevation data available
- Continue mapping upstream cross sections and overall geometry for the Brandywine River to analyze additional solutions for flood mitigations.

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USGS science for a changing world

Economic Value of Floodplain Properties in Delaware Coastal Towns

Belle Kornas, UDWRC Undergraduate Research Assistant
Energy and Environmental Policy Major

Background

1) This research focuses on six towns in Sussex County Delaware: Milton, Lewes, Henlopen Acres, Rehoboth Beach, Dewey Beach, Bethany Beach, and Fenwick Island.

1) Delaware is a low lying state and extremely vulnerable to flooding caused by sea level rise.

1) These towns are highly susceptible to flooding and have extreme property value.

1) Flooding impacts infrastructure, alters habitats, excellerates coastal erosion, and causes saltwater intrusion.

1) These six coastal towns are a catalyst for tourism revenue and supporting Delaware's economy. However, due to their geography, they are at the most risk to flooding.

Objectives

This research seeks to...

1) Understand the effects of sea level rise and flooding on the six coastal towns in Sussex County, Delaware.

1) Quantify the economic value of properties within FEMAs coastal floodplain inside and outside Delaware coastal towns.

1) Analyze the economic risk of properties and people within the floodplain of the coastal towns.

Study Area

North of Inlet

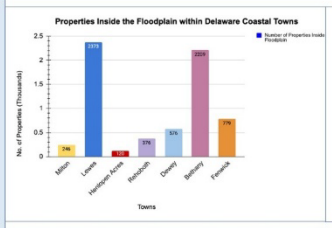
South of Inlet

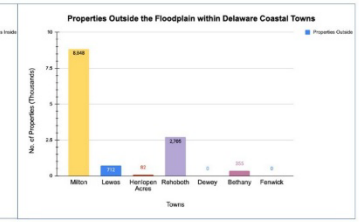
Key: Blue areas are within FEMAs 100 year floodplain

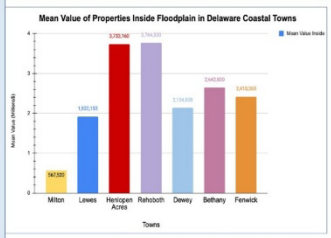
Methods

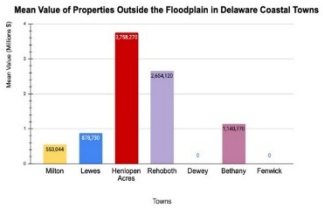
1) **Literature Review:** Review peer reviewed literature of Delaware's geography, sea level rise, property value, infrastructure, climate change, and future predictions. These sources covered Delaware and surrounding states as well as the Atlantic Ocean and Delaware Bay.
2) **Mapping:** Analyzed mapping figures of the coastal towns. Utilizing government agency websites and online databases, properties were deemed to be considered inside or outside the floodplain.
3) **Gather Data on Demographics:** Online databases such as Delaware Sea Grant and First Step, report demographics of each coastal town report average income, home value under $100,000, age, and race.
4) **Gather Data on Economic Value:** Established the maximum and minimum property value outside and inside FEMAs coastal floodplain in Sussex County, Delaware.
5) **Graphing/Analysis:** Bar charts show the number of properties, mean value, and total economic value inside and outside FEMAs floodplain.
6) **Conclusions/Recommendations:** Prepare study summarizing literature review, mapping, demographics, floodplains, and economic data and recommend policy actions.

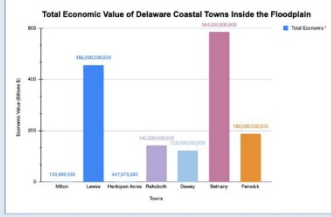
Results

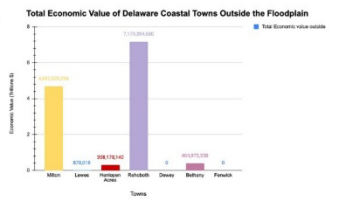












Of the six coastal towns, Lewes and Bethany have the most floodplain properties (80% to 86%) with more than 2,200. Fenwick Island and Dewey have 100% of the properties in the floodplain. In Milton, just 3% of the 9,094 properties lie in the floodplain.

In Henlopen Acres and in Rehoboth Beach, floodplain properties have a mean value of $3.7 M and outside $6.4M. In Bethany, Fenwick, Dewey, and Lewes properties inside and outside the floodplain have a mean value of $2 M. In Milton, properties inside and outside the coastal floodplain have a mean value of $0.5M.

The total economic value of floodplain properties in the six coastal towns is $1.5 T.

In Henlopen Acres and in Rehoboth Beach, properties have a total economic value of $598 B. In Bethany, Fenwick, Dewey, and Lewes floodplain properties have a total value of $1.4T .In Milton, total value outside the coastal floodplain is $4.7B.

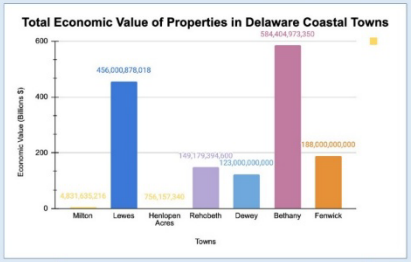
Conclusions

1) Delaware coastal towns are extremely vulnerable to flooding. With Lewes having 2,373 floodplain properties and Bethany having 2,209 floodplain properties; the most out of the six towns.

1) Based on the results, in the six coastal towns (except Milton) there is a strong directly proportional relationship between having a high economic valued property and a vulnerability to flooding caused by sea level rise.

1) Fenwick Island and Dewey Beach have 100% of properties within FEMAs floodplain and have high economic value.

1) The total economic value of the six Delaware coastal towns at risk of flooding $ 1.5 T. In Bethany Beach and Lewes, $584 B and $456 B in property value, respectively, are at risk to flooding. Lewes ($456 B), Bethany Beach($584 B), and Fenwick Island ($189 B) have the most money at risk inside the floodplain.



Future Work

1) Operation of buying and protecting open land on the coast to create State Parks.

1) Infrastructure and ecological climate mitigation plans are necessary at combating sea level rise; beach nourishment, elevation of homes, building sand dunes, restoring salt marshes.

1) Plan for future population growth in the coastal towns by instilling policy and implementing incentives to reduce travel.

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Palevich, Jack, et al. "The Impact of Sea Level Rise on Roadway Design and Evacuation Routes in Delaware." *SCIRP*, Scientific Research Publishing, 7 Feb. 2024, www.scirp.org/journal/paperinformation?paperid=132271

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

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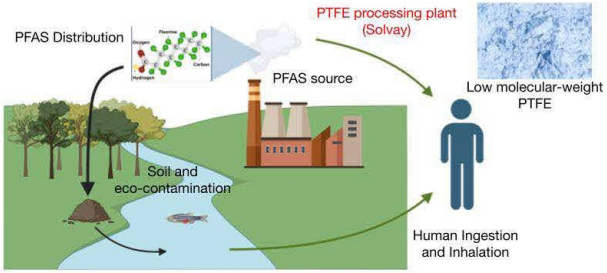
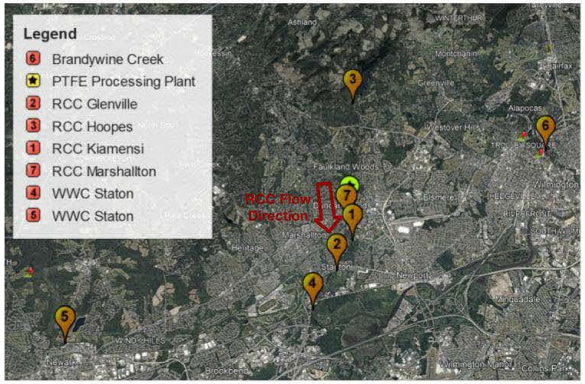
UNIVERSITY OF DELAWARE

PFAS bioaccumulates due to environmental persistence and resistance to degradation leading to health concerns.

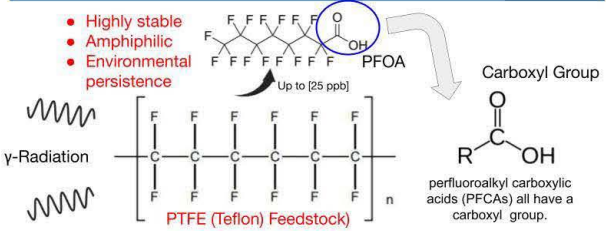


PFAS sampling at seven sites, including locations downstream of a polytetrafluoroethylene (PTFE) processing facility.



PTFE micropowder is produced by γ-Radiation-initiated degradation, PFOA produced as a by-product.

- Highly stable
- Amphiphilic
- Environmental persistence



Sampling results showed high PFCAs concentrations directly downstream from the PTFE Processing plant.

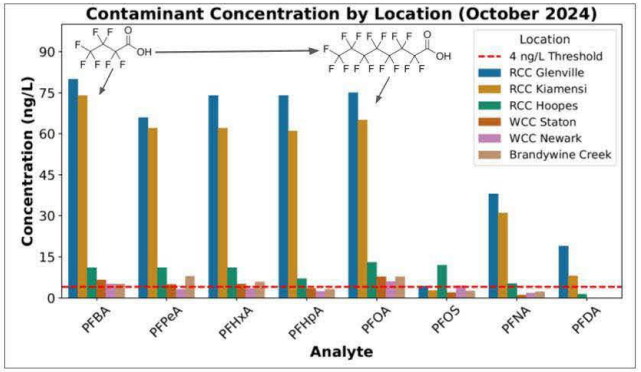


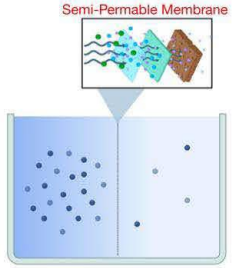
Table 1; PFCAs concentration results in RCC Marshallton

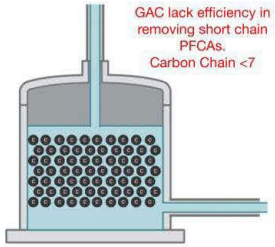
	WATER	SEDIMENT
PFBA	-	-
PFPeA	-	-
PFHxA	-	-
PFPpA	-	-
PFOA	-	-
PFOS	-	-

Observations

- Perfluoroalkyl carboxylic acids (PFCAs) are the main contaminant.
- PFCAs concentrations increase dramatically downstream of Solvay
- Contaminant concentration increases as RCC flows downstream.
- ——
- -

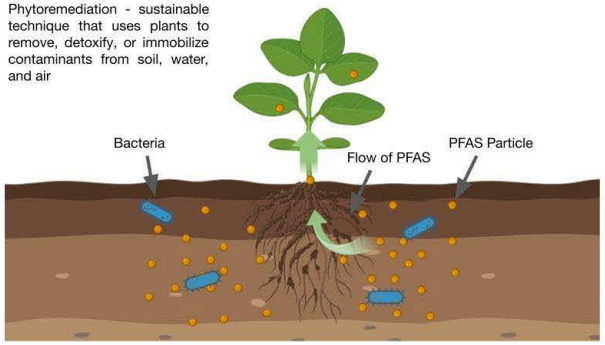
Reverse osmosis and granular activated carbon filters are promising technologies implement to remove PFCAs





Research efforts currently focusing on the bioremediation of soil with phytoremediation and bacteria.

Phytoremediation - sustainable technique that uses plants to remove, detoxify, or immobilize contaminants from soil, water, and air



Future work and acknowledgements.

Oyster Valuation in the Gulf of Mexico

by Helena Owen

Department of Applied Economics and Statistics

UNIVERSITY OF DELAWARE
AGRICULTURE & NATURAL RESOURCES

Introduction

- The Bonnet Carre Spillway diverts flood waters from the Mississippi River to protect the city of New Orleans
- The spillway has been opened more frequently than intended over the past few decades inundating oyster habitat with freshwater.
- In 2019 it was open for four months

Excessive amounts of fresh water negatively impacted Oyster reefs and led to the destruction of oyster ecosystems in the Mississippi Sound

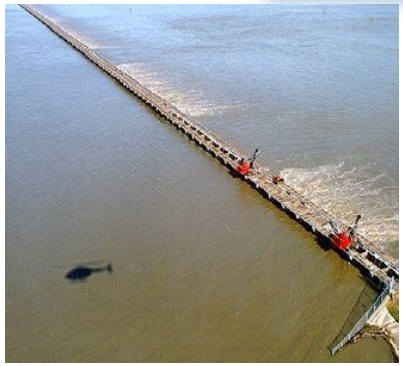
Oysters provide many ecosystem goods and services, such as water filtration, storm surge protection, and secondary biodiversity effects

Purpose & Research Question

- Little is known about the value people place on the ecosystem services provided by oysters

We will use a discrete choice experiment to better understand individuals' willingness to pay (WTP) for oyster reef restoration

Subjects, Methods & Analysis



Our Discrete Choice Experiment Methods

Sample:
The survey will be distributed to a representative sample in the states that border the Gulf of Mexico: Florida, Texas, Louisiana, Mississippi, Alabama. The survey will be a subset of a national survey

Payment Vehicle:
To ensure the realism of the survey, a non-hypothetical payment vehicle must be established.

→ **Income Tax:** The payment a one-time payment that would be collected in subjects 2026 state income tax returns. For the states that do not have income tax, the one-time upfront payment would be attributed to a different tax scheme.

Option 1	Option 2	Option 3
This reef will result in an increase in Blue Crab and Gulf Sturgeon population.	This reef will result in an increase in Blue Crab population.	I am not willing to pay for oyster reef restoration in the Gulf.
This reef will result in an increase of X pounds of commercial oyster harvest per year.	This reef will result in an increase of Y pounds of commercial oyster harvest per year.	
This reef will result in a decrease of X pounds of nitrogen and phosphorus in the Gulf.	This reef will result in a decrease of Y pounds of nitrogen and phosphorus in the Gulf.	
This reef will contribute to a reduction in erosion and help protect X acres of marsh habitat.	This reef will contribute to a reduction in erosion and help protect Y acres of marsh habitat.	
This reef will cause visual interference during low tide.	This reef will not cause visual or recreational interference at all.	
Cost to you = $	Cost to you = $$$	Cost to you = $0

Attribute

- The attributes included in the survey are the ecosystem goods and services associated with oyster reefs.
- Each attribute will have multiple levels that individuals will value.

1. **Biodiversity and Secondary Species Effects:** Oyster reefs are known to positively impact Blue Crabs, Stone Crab, Gulf Sturgeon, Gobies, and Silversides. These species will be shared along with their benefit received from oyster reefs.
2. **Commercial Harvesting:** Oysters are sold and harvested, providing market value through the purchase of oysters for food in addition to providing jobs for individuals who do the harvesting.
3. **Water Filtration for Improved Quality:** Oysters filter the water specifically for nutrients such as phosphorus and nitrogen. They additionally improve water quality by keeping sediment in place
4. **Storm Surge Protection:** Oyster reefs decrease wave energy, increasing storm surge protection and reducing erosion
5. **Recreational/Visual Disamenities:** In certain areas, oyster reefs are seen as visual disamenities as they can hinder the visual aesthetics and recreational abilities of those finishing and on boats.

Next Steps

- Finalize the presentation of the survey instrument.
- The discrete choice experiment will allow us to estimate an individual's willingness to pay for each individual attribute included in the survey.
- The survey instrument is expected to be sent to respondents in the Gulf states in the Fall of 2025.
- Once data is collected, it will be analyzed and put into a manuscript to be submitted for peer-review.

Remediation of Contaminated Soil from Accidental Spills of Salt-Laden Produced Water

Kayla Price [a], Jason Geiger [a], Dominic Di Toro [a], Rich Carbonaro [b], and Paul Imhoff [a]

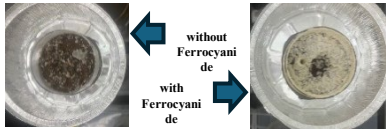
[a] Department of Civil and Environmental Engineering, University of Delaware
[b] Department of Chemical Engineering, Manhattan College

Purpose & Research Question

- Can Potassium Ferrocyanide be used to improve the remediation of produced water spills in contaminated soil?
- Can the introduction of subsurface irrigation techniques improve remediation?

Introduction

- Polluted groundwater harms vegetation, drinking water, and human health
- Full excavation is a costly and unsustainable approach
- Prussian Yellow changes the crystalline structure of the salt
- Allows for more effective removal of produced waters



- Experiment: Subsurface water application

Approach

Method 1) Intermittently syringe water to replace measured evaporated water
Method 2) Use Mariotte bottle system to continuously add water into system, with a heating lamp

- Manually scrape soil from the top of the columns daily

Materials and Methods

Goal: To reach 80% removal of salt from the soil columns

- Spill solution 3.8 M NaCl
- 30 cm columns packed with soil
- 1 mM Potassium Ferrocyanide in bottles
- 10 mM Potassium Ferrocyanide in syringe

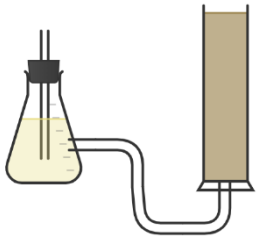


Figure 1. Diagram of Mariotte bottle method experiment set-up.

Figure 2. Photo of efflorescence from Mariotte bottle system

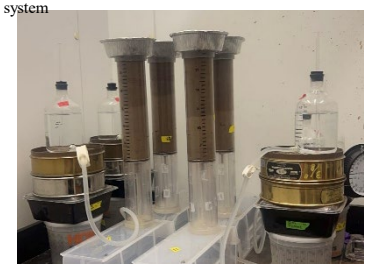


Figure 3. Laboratory experiment photo.

Conclusions

- The Mariotte bottle method achieved 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
- High evaporation rate was used during the experiment for the Mariotte bottles

Future Research:

- Find ideal evaporation rate
- Well injection method testing
- Field scale testing

Results

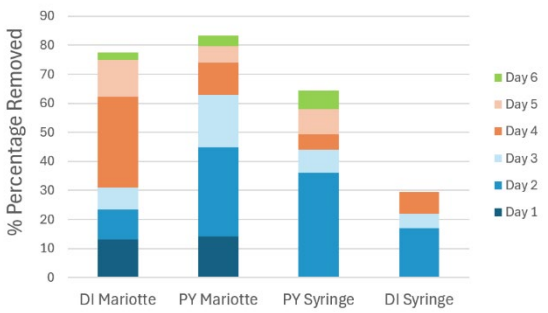


Figure 4. Bar chart representing percentage of NaCl (g) removed daily from each system for a period of 6 days.

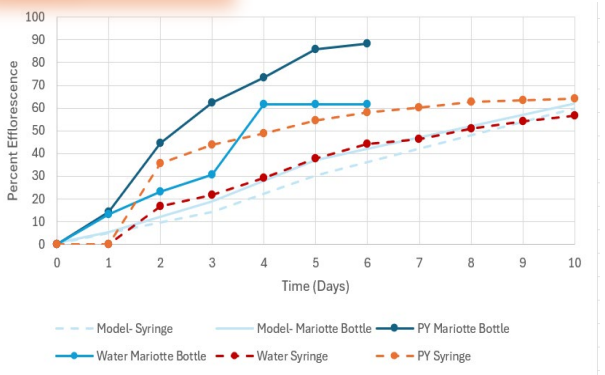


Figure 5. Scatter-plot line chart of both Mariotte bottle and syringe systems plotted against model data. Mariotte bottle data runs for 6 days and syringe data runs for 10 days.

Integrating Environmental Literacy into DE Public High Schools CTE Pathways Program

Silvie Sandeen, B.S. Environmental Science
Advisor: Martha Narvaez, Dr. Gerald Kauffman

Introduction and Purpose

Purpose: As the impacts of climate change increase in prevalence and severity in Delaware, integrating environmental literacy into education statewide has become necessary. This project aims to incorporate an environmental perspective into the existing Pathways Program curriculum through the development of frameworks that will link educators with environmental resources. The goal is to increase awareness of green jobs and opportunities for sustainability for students preparing to enter these careers.

Environmental Literacy is the desired outcome of environmental education and provides our future workforce with sound scientific information, as well as skills for critical thinking and creative, strategic problem-solving for current environmental sustainability innovation and future cumulative climate challenges.

The Delaware Public High School Pathways Program connects education and workforce development to give youth meaningful work experience aligned to their career goals through quality programs that lead to postsecondary education and careers.

Acknowledgements

The Delaware Water Resources Center partnered with Lisa Torbert (Advance CTE), who facilitated and directed the project. The overall project is led by Advance CTE and the Delaware Department of Education, funded through the NOAA B-Wet program.

Methods

Evaluation: Resources were evaluated and added to the framework through ten assessment criteria (shown in the table below).

Each framework aimed to educate students on the environmental impacts of existing practices and expose them to various advancements and alternative practices that are creating 'green' jobs and opportunities in the growing career field of environmental sustainability.

Ten frameworks were created for the following 12 CTEs, some pathways were grouped due to the sectors being connected:

1) Agriculture, Food & Natural Resources (AgriScience)
2) Architecture & Construction
3) Arts, A/V Technology & Communications
4) Business Management & Administration
5) Education & Training
6) Finance Careers
7) Health Sciences
8) Hospitality & Tourism
9) Information Technology
10) Marketing
11) Science, Technology, Engineering & Mathematics (STEM)
12) Transportation, Distribution & Logistics

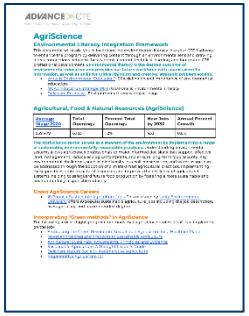
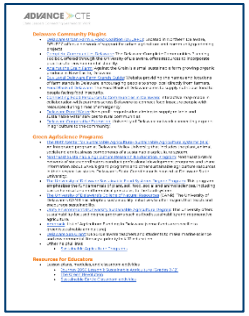
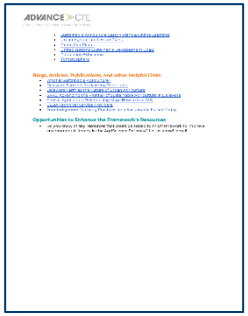
Criteria for Assessing Environmental Literacy Framework Resources

Criteria	Excellent (4)	Good (3)	Fair (2)	Poor (1)
Content Accuracy	All information is accurate and up to date.	Mostly accurate with minor errors.	Some inaccuracies are present.	Significant inaccuracies.
Relevance to Curriculum	Fully aligns with curriculum standards and objectives.	Aligns with most curriculum standards and objectives.	Partially aligns with curriculum standards.	Does not align with curriculum standards.
Clarity and Organization	Well-organized, clear, and easy to follow.	Generally clear and organized with minor issues.	Some parts are unclear or poorly organized.	Unclear and poorly organized.
Engagement and Interactivity	Highly engaging and interactive for students.	Moderately engaging and interactive.	Some engagement and interactivity.	Little to no engagement or interactivity.
Accessibility	Fully accessible to all learners, including those with disabilities.	Mostly accessible with minor issues.	Some accessibility features are missing.	Not accessible to students with disabilities.
Differentiation	Provides resources for different learning styles and needs.	Some differentiation provided.	Limited differentiation.	No differentiation provided.
Assessment Tools	Includes comprehensive assessment tools and rubrics.	Includes some assessment tools.	Limited assessment tools.	No assessment tools included.
Technical Quality	High-quality visuals, audio, and text.	Good quality with minor technical issues.	Some technical issues affect usability.	Poor technical quality.
Cultural Inclusivity	Includes a diverse range of perspectives and communities.	Generally inclusive with minor gaps.	Some perspectives are underrepresented.	Not inclusive of diverse cultures and perspectives.
Cost-effectiveness	Highly valuable for cost.	Good value for cost.	Some aspects are not cost-effective.	Not cost-effective.

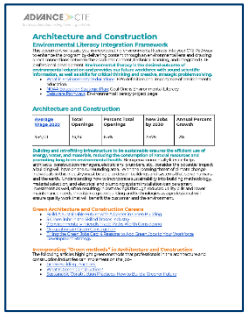
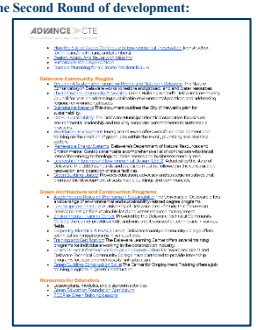
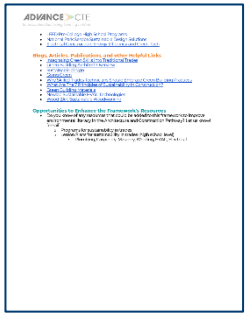
Results

The following are three of the ten environmental literacy frameworks created. Each is from a different round of development, which occurred over a 9-month period. These frameworks showcase how sufficient frameworks should look; other frameworks are less developed and contain bullets under the "Opportunities to Enhance the Framework's Resources" section detailing what is needed to complete the framework.

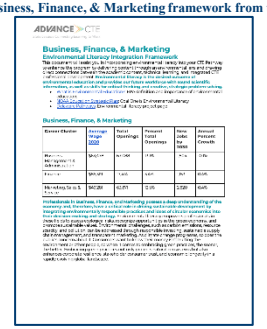
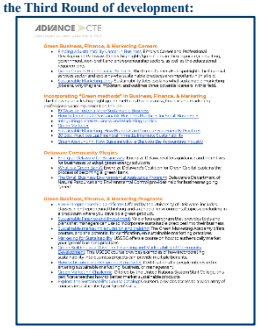
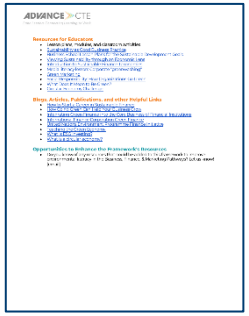
AgriScience framework from the First Round of development:

Architecture and Construction framework from the Second Round of development:

Business, Finance, & Marketing framework from the Third Round of development:

Frameworks Explanation

The lists below explain the importance of each framework component, separated into original CTE elements and new components added during this project's development.

Original Framework Components:

1. Job Prospects Table: Advertise sector growth
2. Green Careers: Opportunities in the green workforce
3. Green Methods: Sustainable practices that can be implemented to address environmental challenges within the sector
4. Delaware Community Plugins: Initiatives currently happening within the state to inspire students
5. Green Programs: Courses, training, certificates, Bachelor's and Master's programs offered either online or within Delaware to provide students with professional training in green practices.
6. Resources for Educators: Lesson plans, modules, and classroom activities for teachers to use to educate students on green practices
7. Additional helpful links: Articles and tools for additional context

Components Added to the Original Framework:

1. Environmental Literacy Integration Framework background with links: Explains the purpose of the framework, as well as the concept and importance of teaching environmental literacy
2. Connection paragraph for every pathway program: Specifically calls out the importance of environmental literacy in the sector(s)
3. Opportunities to Enhance: Advise educators of gaps in the framework and solicit their input

Conclusions

The development of these frameworks highlighted the need for more resources connecting environmental issues to different sectors of industry. Many frameworks currently lack sufficient resources due to the unavailability of in-depth, trustworthy, or US-based resources.

Additionally, resources that would have been beneficial, due to the timing and current political climate, were removed from public access.

Sufficient Data and Resources:

- AgriScience
- Business, Finance, & Marketing
- Architecture & Construction
- Education & Training

Insufficient Data and Resources:

- Transportation, Distribution, & Logistics
- STEM
- Information Technology
- Hospitality & Tourism

Directions for Future Research

The continued development and expansion of Environmental Literacy Resources is imperative to successfully educate youth statewide.

Future work should include:

- **Further vetting of frameworks by**
  - Delaware educators and teachers of the respective Pathway Programs
  - Environmental experts in Delaware
- **Identification of additional resources**
  - Continue to look for new trustworthy, US-based resources as they become publicly available
  - Conduct outreach to teachers and the community for resources they might know of
  - Gain access to important removed or relocated government resources

Delaware's Bottle Bill Repeal in Context: Drivers, Challenges, and Comparisons with Other States

Catherine Gilman, Energy and Environmental Policy

Advised by Dr. Casey Taylor, Joseph R. Biden School of Public Policy & Administration

Purpose and Research Question

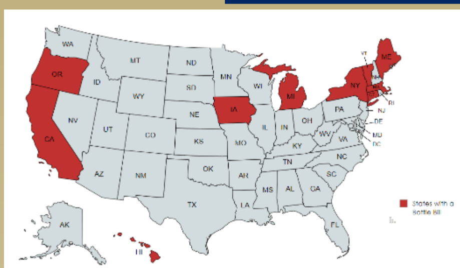
- Background: In the year 2010, the state of Delaware removed its Container Deposit Program.
- Purpose: Understand changes in Delaware's recycling policy and how that affected recycling rates and waste along coastlines in the state.
- Research Question: What factors contributed to Delaware's decision to remove its bottle bill, and how do these factors compare to the motivations behind Maryland and New Jersey's current efforts to implement a bottle bill?
- Methods: Literature review, interviews, analysis, conclusions and policy rec

State	Beverage Container Litter Reduction	Total Litter Reduction
Hawaii	38-53%	N/A
Iowa	76%	39%
Maine	68-77%	34-64%
Michigan	84%	41%
Massachusetts	N/A	30-35%
New York	70-80%	30%
Oregon	83%	47%
Vermont	76%	35%

(Container Recycling Institute, 2024)

Why Study This?

- Incentivize recycling
- Litter reduction
- Better regrind material
- Cleaner coastlines
- Delaware is a unique state



What is a Bottle Bill?

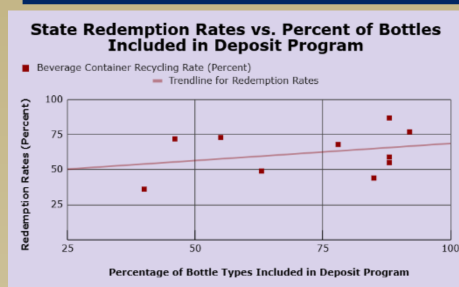
- Used to curb mismanaged waste and debris, especially concerning waste in waterways.
- A 2-15-cent deposit is placed on glass, aluminum, and plastic beverage bottles sold at the retail level.
- When a retailer buys a beverage from a distributor, a deposit is made to the distributor for each container purchased.
- Retailers and redemption centers are reimbursed by the distributor and are also paid a handling fee for their services (typically 20% of refund value).
- Unredeemed deposits are returned to the states.

Delaware's Recycling History

- The bottle bill program was created in Delaware in 1978 to incentivize manufacturers, distributors, dealers, and consumers to reuse or recycle their beverage containers to reduce the increasing costs of litter collection and disposal in the state.
- There was much support for the expansion of the CDL program rather than its removal, yet these concerns were overpowered by those who advocated for its removal.
- The Universal Recycling Law removed the CDL program and replaced it with curbside recycling for all residents in Delaware in 2010. They replaced the CDL program with a temporary 4-cent tax on all beverages until they were able to pay for the curbside recycling program.

Failures of Delaware's CDL

- Seen as a tax to many Delaware residents if they did not participate in the redemption of their bottles.
- No requirement for grocery stores to recycle
- Many thought single-stream curbside recycling replaced the need for a CDL.
- They did not include aluminum cans in their program, a significantly recyclable and valuable material.
- No support from grocery stores.
- Not a very well-known program.



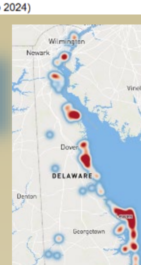
Source: (Eunomia 2023) and (Reloop 2024)

Comparison to Other States with CDLs

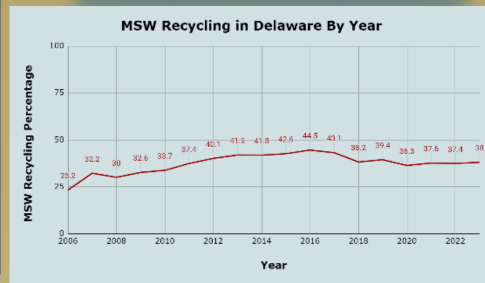
Comparison of States with Container Deposit Laws, Peer States, and Delaware

	Delaware	California	Connecticut	Hawaii	Iowa	Maine	Massachusetts	Michigan	New York	Oregon	Vermont	Maryland	New Jersey
Bottle Bill Now?	NO	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NO	NO
Timeline for Bottle Bill	1979-2010	1986 - now	1978 - now	2002 - now	1978 - now	1976 - now	1976 - now	1976 - now	1982 - now	1971 - now	1972 - now	N/A	N/A
Deposit $ Amount	5 cents	5 and 10 cents	5 cents	5 cents	5 cents	5 and 15 cents	5 cents	10 cents	5 cents	2 and 10 cents	5 and 15 cents	N/A	N/A
Redemption Rate	N/A	59%	44%	55%	49%	77%	36%	73%	68%	87%	72%	N/A	N/A
Recycling Rate (without FFP)	26%	41%	39%	22%	45%	65%	48%	40%	44%	45%	51%	33%	39%

Sources: (State Beverage Container Deposit Laws, 2020) and (Eunomia, 2023) and (Reloop, 2024)

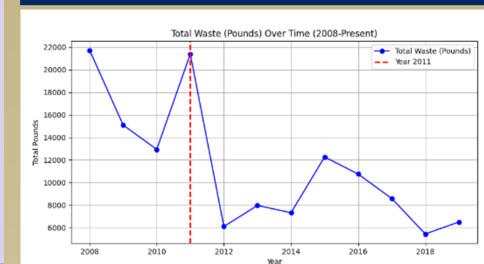


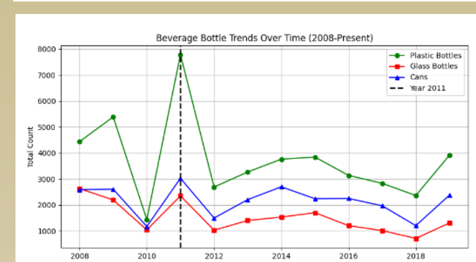
Delaware Recycling Rates



Litter Study for Delaware Coastline

- Coded with Python and utilized Delaware Coastal Cleanup Results which started in 2008 and was last collected in 2019.
- Possible relationship between decreased total waste over time and the introduction of statewide curbside recycling.
- Beverage bottle trends over time had little change after the introduction of statewide curbside recycling. This may suggest that people had an incentive to properly dispose of or clean up bottles from the Delaware coastline before curbside recycling as well, potentially due to the Container Deposit Law.
- More data is needed to make definitive conclusions.

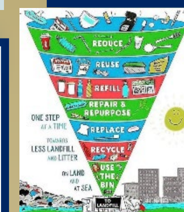




New Jersey and Maryland

- New Jersey has strong institutional opposition from the recycling industry. This is motivated by the recycling industry's fear of losing revenue, especially from high-value materials like aluminum. Existing curbside programs are considered sufficient, and creating a parallel container deposit system is seen as redundant and costly.
- Maryland has more public and organizational support for a CDL program, however the bottle bill has died in the past without a vote due to competing priorities, like budget and EPR legislation that have more traction. Some organized opposition exists, but overall it is less than in New Jersey.

Other Policies Recommended



- There are other pushes besides a CDL that also have attention
- Extended producer responsibility to hold the producers accountable, change from the top
- Putting deposits on other items that cannot be recycled in the typical curbside recycling program.

Conclusions

- The repeal of the CDL program in favor of universal single-stream curbside recycling was intended to simplify waste management and reduce litter, but the long-term results have been mixed.
- There is no way in this analysis to predict whether recycling rates would have increased if Delaware kept its CDL program and also implemented single-stream curbside recycling statewide, but it has been shown that states with a combination of both programs have some of the highest recycling rates across the country.
- Delaware's recycling rates have recently been plateauing, so there may be a push for a change to the current recycling program to incentivize recycling. One policy approach would be to incorporate the CDL back into Delaware's recycling program by expanding the role of existing redemption centers to accept and redeem bottles.
- Delaware's experience with repealing its CDL offers cautionary lessons for both New Jersey and Maryland as they consider implementing similar programs.

Resources

Litter studies in bottle bill states. (2024, January 16). Bottle Bill Resource Guide Container Recycling Institute. https://www.bottlebill.org/index.php/benefits-of-bottle-bills/litter-studies-in-bottle-bill-states

Eunomia. (2023). *The 50 States of Recycling: A State-by-State Assessment of US Packaging Recycling Rates* (The 50 States of Recycling: A State-by-State Assessment of US Packaging Recycling Rates). Ball Corporation.

Global Deposit Book 2024. (2025). Reloop. https://www.reloopplatform.org/global-deposit-book-2024/

State Beverage Container Deposit Laws. (2020, March 13). National Conference of State Legislatures. https://www.ncsl.org/environment-and-natural-resources/state-beverage-container-deposit-laws#:~:text=How%20Do%20Bottle%20Bills%20Work,supermarket%20or%20other%20redemption%20center.

Department of Natural Resources and Environmental Control. (2022, October 6). *Delaware Coastal Cleanup Results*. Delaware Open Data. https://data.delaware.gov/Energy-and-Environment/Delaware-Coastal-Cleanup-Results/jumg-zbb3/about_data

State Beverage Container Deposit Laws. (2020, March 13). National Conference of State Legislatures. https://www.ncsl.org/environment-and-natural-resources/state-beverage-container-deposit-laws#:~:text=How%20Do%20Bottle%20Bills%20Work,supermarket%20or%20other%20redemption%20center.

CITY OF WILMINGTON GREEN JOBS PROGRAM IMPACT STUDY

Martha Narvaez (Associate Director) and Jhaney Hamlett (Graduate Fellow, MPA Program),
University of Delaware Water Resources Center,
Institute for Public Administration, Biden School of Public Policy & Administration

May 16, 2025

PROJECT DESCRIPTION

The City of Wilmington Green Jobs Program is a summer internship program that provides 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. The University of Delaware Water Resources Center (DWRC) and the City of Wilmington Department of Parks and Recreation have partnered on the implementation of this program since its inception in 2011. The program is a true partnership between the City of Wilmington and DWRC as well as the numerous organizations that host the youth throughout the six-week program.

This project, led by DWRC, in partnership with the City of Wilmington Department of Parks and Recreation, will provide the City, DWRC and program host organizations feedback on the program's impact. This project employs a theoretical and methodological approach to collect data from Green Jobs Program Alumni and provides an overall assessment of the program. Program partners have requested program alumni feedback for several years and the feedback collected in this project will be valuable to the program's growth, development and potential program refinement. This project is funded by the Wilmington Partnership Mini-Grants in the University of Delaware Community Engagement Initiative.

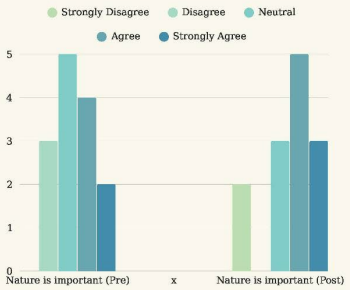
GREEN JOBS PROGRAM

The Green Jobs Program is a paid six-week internship that serves City of Wilmington youth that are 14-18 years old. The key components of this program include environmental education, natural spaces in the City and State of Delaware, hands-on field work, and professional development. DWRC and the City of Wilmington Department of Parks and Recreation have partnered on the implementation of this program since its inception in 2011 and will be employing the 15th year of the program in 2025. The program is a true partnership between the City and DWRC as well as over 25 organizations that have hosted the youth throughout the 14 years of programming (this summer will be our 15th year!).

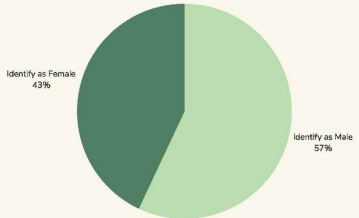
PROGRAM HOSTS & COMMUNITY PARTNERS

- Brandywine Red Clay Alliance
- City of Wilmington, Departments of Parks and Recreation and Public Works
- Delaware Center for Horticulture
- Delaware Department of Technology & Information
- Delaware Nature Society
- Delaware Sea Grant
- Delaware Solid Waste Authority
- Delaware State Cooperative Extension
- Delaware State University
- Eco Plastics Products of Delaware
- Food Bank of Delaware
- Junior Achievement of Delaware
- Lincoln University
- Partnership for the Delaware Estuary
- Straughan Environmental
- Stroud Water Research Center
- The Nature Conservancy, DE/PA
- The Village Tree, Inc.
- UD Water Resources Center
- UD Botanic Gardens
- UD Cooperative Extension

AWARENESS IMPROVEMENT



DEMOGRAPHIC DATA (GENDER)



Our 2024 Green Jobs cohort was a bit uneven compared to last year, though it was mostly split between boys and girls, this show that the Green Jobs Program is a good program for all genders

Methods

Data Collection Tools:
- Structured Online Surveys:
- Survey distributed to participants before and after the program.

Topics Covered:
- Participant demographics
- Career readiness and professional skill development
- Environmental awareness and connection to nature
- Program satisfaction and overall experience
- Long-term career aspirations

Impact on Student Perspectives and Skills

- Career Awareness: More detailed understanding of environmental jobs.
- Technical Skills: Increased awareness of technical skills needed for conservation.
- Environmental Awareness: Greater appreciation for "keeping the environment clean" and "protecting the planet"
- Climate Change Awareness: Some responses indicated a better understanding of the importance of conservation in the context of climate change and environmental health.
- Personal Connection to Nature: More responses emphasizing a deeper, personal connection to the natural world, including the role of humans in preserving it.
- Career Aspirations: Some students expressed new interest in environmental studies as a potential college major or career path.
- Personal Responsibility: Increased recognition of the individual's role in conservation and environmental advocacy.

Green Jobs Impact Study Goals:

- Capture Participant Voices: Gather richer, qualitative insights into the experiences and impacts of the City of Wilmington Green Jobs internship program.
- Contextualize Data: Put structured survey findings in a broader context, connecting quantitative results to real-world outcomes.
- Refine Program Analysis: Use qualitative responses to deepen the understanding of program strengths and areas for improvement.
- Assess Long-Term Impact: Gain a clearer picture of how the Green Jobs program influences career readiness, professional development, and environmental awareness over time.

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

By: Nicole Re
University of Delaware Water Resources Center

Background

Wetlands and their Value

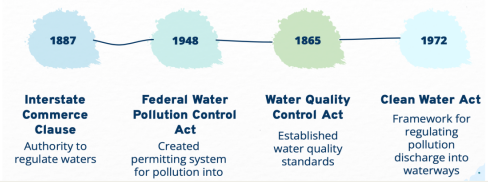
- Benefits :
  - Natural carbon sinks
  - Prevent flooding
  - Water quality
  - Reduce erosion
  - Filtering water
  - Food and fiber
  - Aquatic species

Wetlands Degradation

"Wetland degradation is happening at a more rapid scale then any other ecosystem"

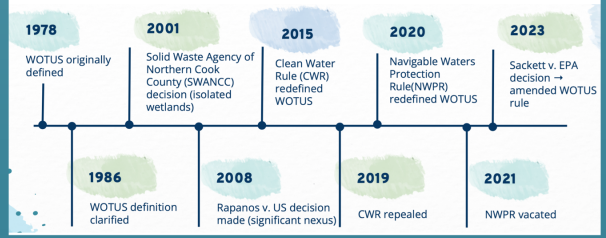
- anthropogenic sources: direct or indirect

Federal Wetlands Protection



Clean Water Act

- *Interstate Commerce Clause* gives authority to regulate United States water that impacts foreign and interstate trade
  - *National Pollution Discharge Elimination System (NPDES)*
  - *Water Quality Standards (WQS)*
    - Fishable and swimmable standards
    - *Total Maximum Daily Loads (TMDLs)* - Section 303(d)
      - *Natural Resources Defense Council (NRDC) v. EPA*
      - Best Management Practices (BMPs)
      - Federal vs. State Waters
        - Private vs. Public Property
        - *Sackett v. EPA (2023)*



Analysis/Discussion

Overview

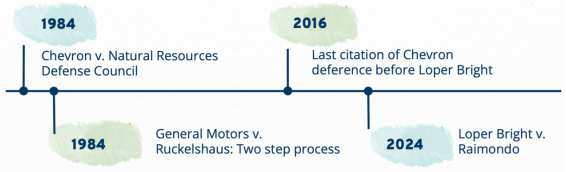
- *Chevron v. NRDC (1984)*
  - Clean Air Act disagreement over definition of stationary source
  - Bubble concept or looking at each individual smokestack
- *Loper Bright v. Raimondo (2024)*
  - Herring fisherman dispute, paying for federal monitor on board, Gina Raimondo Secretary of Commerce, NOAA

Administrative Discretion

- Congress gives agencies administration discretion to define WOTUS
- Keeping language broad can help help Congress pass legislation

Chevron Doctrine

- *Stare decisis* applying past court decisions in new cases
  - Overturning stare decisis *Brown v. Board of Education* and *Dobbs v. Jackson Women's Health Organization*



Loper Bright and Chevron

- Chevron was overturned by the citing of *Marbury v. Madison*
  - judicial branches job to interpret Congressional decisions
- *Section 706 Administrative Procedure Act*
  - Courts must decide all relevant questions of law, interpret constitutional and statutory provisions, and determine the meaning or applicability of the terms of an agency action

Property Rights

- When wetlands are not navigable it leads to property rights issues
  - In *Sackett v. EPA* this was the case
- *Fifth Amendment Taking Clause*, Eminent domain has potential to play a role in the future
- Time and money needed for property owner to develop on land
  - uncertainty about needing a permit can lead to confusion

Loper Bright and WOTUS

- *National Marine Fisheries Service (NMFS)* believed paying monitors was allowed under the *Magnuson-Stevens Fishery Conservation Act (MSA)*
  - Supreme Court not up to fisheries to pay
- Pushback from environmental organizations as many believe less environment will be negatively impacted
  - *Administrative Procedure Act* - created process for judicial review of agency action
  - *Skidmore Deference* - uses agency statement, opinion letters, and agency manuals and applies them
    - requires persuasion, only used on case by case basis
  - *Auer Deference* - allows agencies to refer to their own ambiguous relations
    - potential for restrictions of Auer after Loper Bright
  - Judicial Process - existing checks and balances in place will help keep the separation of powers aligned

Wetland Protection

- Due to the Sackett decision US is estimated to lose 380,000 acres of wetlands and deep water habitats annually
- Potential for increased litigation - stricter interpretations of policy → less wetland protection

Conclusion

- Policy shifts have great potential to harm wetlands
- Post-Sackett wetlands must be continuous to follow CWA
- Sticker policy frameworks by Congress have potential to improve outcomes in wetland policy
- EPA expected to clarify jurisdiction ditches and continuous surface water connections soon
- Skidmore and Auer deference step up to fill voids

Acknowledgements

I would like to thank the University of Delaware Water Resource Center who provided funding to make this project possible. Continually, I would like to thank Martha Narvaez, Dr. Gerald Kauffman, and Andrew Homsey for their support and guidance.

The Presence of PFAS in Delaware's Drinking Water Streams

Megan Wassil
Advisor: Dr. Gerald Kauffman, Martha Narvaez

'Forever chemicals' found in Delaware drinking water streams.

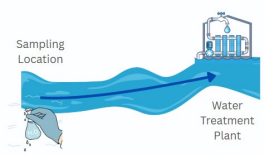
What are PFAS?

Per- and polyfluoroalkyl substances

- Synthetic, fluorinated compounds
- Resistant to degradation
- May be harmful to human health
- In hundreds of household and industrial products

Purpose & Methods

Purpose: UD's Water Resources Center set out to determine PFAS concentrations in Delaware's drinking water streams: Brandywine River, Christina River, Red Clay Creek, and White Clay Creek



Initial Sampling:

- Upstream of each water treatment plant
- EPA Method 1633: 40 analytes
- Location: surface and 1 foot below
- Comparison with federal regulations
- Estimate treated water concentrations

Investigating sources of PFAS:

- Additional sampling sites were added to determine areas of contamination
- Upstream of initial sampling sites

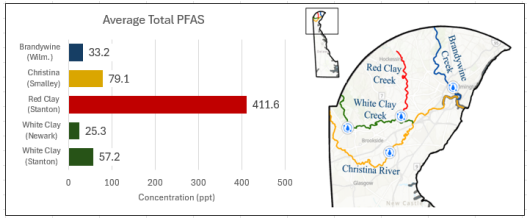
U.S. EPA Drinking Water Regulations

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*

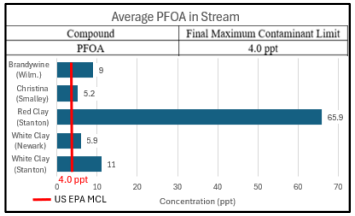
ppt = parts per trillion = ng/L

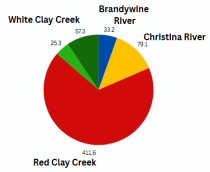
$$* \textit{Hazard Index} = \frac{[HFPO-DA_{ppt}]}{[10\ ppt]} + \frac{[PFBS_{ppt}]}{[2000\ ppt]} + \frac{[PFNA_{ppt}]}{[10\ ppt]} + \frac{[PFHxS_{ppt}]}{[10\ ppt]}$$

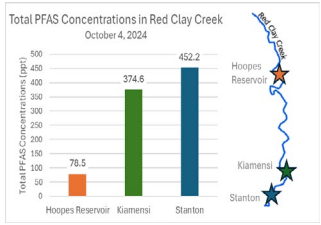
Results



Compound	MCL	Brandywine (Wilm.)	Christina (Smalley)	Red Clay (Stanton)	White Clay (Stanton)	White Clay (Newark)
PFOA	4.0	5.9	11	65.9	5.3	9
PFOS	4.0	2.4	3.5	4.2	2.5	2.9
PFHxS	10	1.3	3.1	1.9	0.8	1.4
PFNA	10	1.7	1.7	35.9	0	3.5
HFPO-DA	10	0	0	0	0	0
PFBS		2.8	6.5	3.8	2.3	3.2
Hazard Index	1.0	0.3	0.5	3.8	0.1	0.5







Conclusions

To meet U.S. EPA regulations, all three active (excluding Christina Water Treatment) will need to **treat for PFAS compounds** by 2029. Expected increase in water rates for customers. Veolia's PFAS treatment system to come online in summer 2025 is expected to increase rates over 40%.

Multiple sampling locations along Red Clay Creek revealed a possible point source between Hoopes Reservoir and Kiamensi Road. This could help with mitigation efforts.

- Detected compounds were almost all carboxylic acids, indicative of plastic treatment.
- Superfund and case records were searched
  - DNREC found a company responsible for PFOA release into Red Clay Creek. Remediation is required.

Graphics created in Canva

Further Research

Soil sampling in conjunction with water sampling along Red Clay Creek to determine compound concentrations in separate media.

Acknowledgements

Thank you to the University Water Resources Center which provided funding to make this research possible. Continually, we would like to thank Dr. Kauffman, Jessica Anton, Martha Narvaez, and Andrew Homsey for their support and guidance. Thank you to USGS and the Department of Interior for funding under the Water Resources Act

Delaware Water Resources Center
at the University of Delaware

DWRC

Undergraduate Internships In Water Resources 2015

University of Delaware | College of Agriculture & Natural Resources

Delaware Water Resources Center (DWRC) Undergraduate Internships in Water Resources provide a unique opportunity for undergraduate students and faculty to become directly involved in research and education projects addressing water resource related issues of critical importance to Delaware and the Mid-Atlantic region.

Eligibility

All undergraduate students enrolled at an institution of higher learning in Delaware may apply, except for those graduating at the end of the spring semester. All students must have the active support of a faculty advisor and a minimum GPA of 3.0. (If a student applies for any other UD-sponsored summer research experience s/he must indicate this on the ***DWRC*** application. The ***DWRC*** intends to award internships to only those students who have not been awarded another internship within a calendar year.)

Program Details and Deadline

The ***DWRC*** provides $3500 in financial support for each undergraduate internship. Students typically work ten weeks full-time during the summer and additional hours during the fall and winter. Interns must submit a written report on their project and participate in a poster session at the UD spring undergraduate research conference. The application deadline for 2015 ***DWRC*** internships is March 27, 2015. See second page for more information. For details on past projects, current faculty advisors, application materials to submit, and requirements for reports and posters, visit the ***DWRC*** website:
http://ag.udel.edu/dwrc/

Delaware Water Resources Center (DWRC) interns

experience a complete research or education project. Students, in cooperation with faculty advisors, identify a topic of interest, develop

The DWRC Internship Program

All DWRC interns conduct a project consistent with the ***DWRC***'s research and educational interests (listed below in the green box) with the support of a faculty advisor from one of our **co-sponsor organizations.** Internships may be available in sponsorship with the following:

University of Delaware (UD) Water Resources Agency (http://www.ipa.udel.edu/wra/): Internships are supported which focus on water resource policy and management.

UD College of Agriculture and Natural Resources (http://canr.udel.edu): Projects are supported to work with faculty in the departments of *Animal and Food Sciences, Entomology and Wildlife Ecology, Applied Economics and Statistics*, or *Plant and Soil Sciences*. For example, an internship in the *Department of Plant and Soil Sciences* could relate soils, plants, and land management to water use and quality.

UD College of Arts and Sciences (http://www.cas.udel.edu/): Students can conduct internship projects in *Biological Sciences, Chemistry, Political Science, Public Policy*, or other subjects closely related to water resources.

UD College of Earth, Ocean, and Environment (http://www.ceoe.udel.edu/): Internships are supported in the areas of *Geography, Geology, Marine Biology and Biochemistry, Marine Policy, Oceanography*, or *Physical Ocean Science and Engineering*.

UD College of Engineering (http://www.engr.udel.edu/): Projects can be developed in areas such as *Chemical Engineering, Civil and Environmental Engineering*, or *Mechanical Engineering*.

Delaware Geological Survey (http://www.dgs.udel.edu/): Researchers offer internships focusing on hydrogeology, ground water supply, and water quality.

Delaware State University (http://cars.desu.edu/): Faculty support internships in the areas of agriculture, natural resources, aquaculture, and aquatic ecology.

Delaware Department of Natural Resources and Environmental Control (http://www.dnrec.delaware.gov/): Staff in DNREC offices related to water resources occasionally offer internships on topics such as soil and water conservation, water quality, and climate change.

Topics in water resources research and education of interest to the DWRC:

- Water pollutants - their sources, fate, cycling, and transport
- Water supply, demand, and conservation
- Groundwater identification and protection
- Nutrient management and water quality
- Management and control of storm water runoff

How to Apply for a DWRC Internship

Select your topic: ***DWRC*** internships are for students from a wide variety of backgrounds and research interests. Titles of past projects can be found at http://ag.udel.edu/dwrc/interns.html and http://ag.udel.edu/dwrc/publications/DWRCInternshipSpotlight2009.pdf and include: *White Clay Creek Shad Restoration Project* **(Water Resources Agency)**; *Developing Scientifically-Based Food Safety Metrics for Water Management and Irrigation Methods* **(Animal and Food Sciences)**; *The Returns to Best Management Practices: Evidence from Early Proposals for Nutrient Trading in the Chesapeake Bay Watershed* **(Applied Economics and Statistics)**; *Water Quality Management in Urban Ecosystems* **(Plant and Soil Sciences)**; *The Impacts of Redefining Navigable Waters under the Clean Water Act* **(Political Science)**; *Sediment Transport through Historic Mill Dams of the Christina River Basin* **(Geology)**; *Characterization of Viral Diversity within the Mantel Fluid of the Eastern Oyster, Crassostrea virginica* **(Marine Biology)**; *Preventing Formation of Toxic Chlorination Byproducts in Water Using Zerovalent Iron* **(Civil and Environmental Engineering)**; *Hydraulic Properties of the Columbia Aquifer* **(Delaware Geological Survey)**; and *Aquatic Health near Wastewater Discharge in Delaware Inland Bays Tidal Canal* **(Delaware State University).**

Find a Faculty Advisor and Apply to the DWRC: Faculty contacts and their research interests are listed on the ***DWRC*** website, under "Faculty and Staff". Contact the ***DWRC*** program coordinator, Maria Pautler (mpautler@udel.edu; 302-831-0847), to say that you are interested. Students should contact potential faculty advisors to discuss and identify a project topic of mutual interest and then submit their application to the ***DWRC*** by the deadline **(March 27, 2015)**. Faculty may not advise more than two interns concurrently and must provide matching funds consistent with ***DWRC*** guidelines, usually by committing a percentage of their time to the intern's project.

Delaware Water Resources Center

Gerald J. Kauffman, Ph.D., Director
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Newark, DE 19716
Phone: 302-831-4929
E-mail: jerryk@udel.edu

...os by Danielle Quigley

50 Years of Water Research

NIWR & USGS A Model Partnership

NIWR THE NATIONAL INSTITUTES FOR WATER RESOURCES

USGS science for a changing world

PARTNERSHIP WITH USGS

- The National Institutes for Water Resources (NIWR) partners with the U.S. Geological Survey (USGS) through the provisions of the Water Resources Research Act (WRRA) to address water-related concerns by providing a national platform for research, training and collaboration.
- USGS provides each institute with a grant to target local priorities, recruit researchers and leverage federal funds with state money and private funding.
- 54 NIWR member institutes are housed in the country's land-grant universities in all 50 states, three U.S. territories and the District of Columbia.
- NIWR is the only federally mandated research program that focuses on applied water resource research, education, training and outreach.

Housed in the nation's leading research universities, NIWR

MAXIMIZING FEDERAL IMPACT

NIWR's ability to attract and match non-federal funds to USGS grant-sponsored research multiplies the federal investment in local water projects. The NIWR-USGS partnership also strengthens USGS's own funding model, as NIWR institutes often allow funds to pass through the institutes to USGS State Water Science Centers. The NIWR institutes open doors for the USGS at the state-level to other funding sources that may require non-federal matching funds. In recent years, the USGS State Water Science Centers have benefitted from funds that have flowed through NIWR institutes from external sources for technical assistance and scientific expertise on large-scale, multi-partner projects that address emerging water research needs.

WANTED: INTERNS

The USGS is encouraging NIWR institutes to take advantage of its nationwide internship program, details of which follow:

- The interns are hired by the NIWR institute but work with USGS Water Science Center researchers.

IMPACT & COLLABORATION

- NIWR member institutes assist public and private sector groups in their mission to protect human health, environmental resources and economic sustainability.
- Last year, NIWR member institutes sponsored more than 1,200 groundbreaking research projects.
- Grants from USGS and other sponsors are awarded through a competitive, peer-reviewed process.
- NIWR member institutes collaborated on projects with over 200 universities, 150 state agencies, 180 federal agencies, departments and divisions, and more than 165 local and municipal offices.

2025-2026 Undergraduate and Graduate Research Projects

Name	Major	Research Advisor	Proposed Research
Undergraduate Research			
Cai Foster	Environmental Studies	Dr. Gerald Kauffman/Martha Narvaez	Groundwater Nitrate Levels in Sussex County, DE/RASCL
Joshua Koppel	Energy and Enviornmental Policy (BS), Economics and Political Science (BA)	Dr. A.R. Siders	American Media Sources and Responsibility for Preventing and Responding to Flooding Events
Faith Moen	Landscape Architecture	Dr. Gerald Kauffman	3D Modeling in an Urban Flood Prone Environment
John Vuillemot	Public Policy	Dr. Taylor/UDWRC	Economic Viability of a Tidal Energy Project in Delaware Bay
Michele Wassil	Environmental Science	Dr. Gerald Kauffman	White Clay Wild & Scenic Watershed
Sienna Wong	Environmental Science	Dr. Gerald Kauffman	Ecology, Environmental Justice, Policy
Graduate Research			
Olivia Francisco	Masters Environmental Science & Management	Dr. Gerald Kauffman	
Megan Wassil	PhD Water Science & Policy	Dr. Gerald Kauffman	The Presence of PFAS in Delaware's Drinking Water Streams
Cooper Feeny	Masters Water Science & Policy	Dr. Gerald Kauffman	
Lucia Yah Paye-Layleh	Environmental Science and Management	Dr. Gerald Kauffman	

2024-2025 DWRC Advisory Panel

Ms. Jessica Anton Head of Lab Operations and Solutions PFAS Solutions	**Ms. Stacy McNatt** Chief of Construction Support Department of Special Services New Castle County	**Mr. John Harrod** Engagement Director Partnership for the Delaware Estuary
Ms. Stefanie Baxter Associate Scientist Delaware Geological Survey University of Delaware	**Ms. Shane Morgan** Management Plan Coordinator White Clay Creek Wild and Scenic River Program	**Mr. Kash Srinivasan** Principal KS Group, LLC
Mr. Michael Bard External Communications Manager American Water	**Dr. Mi-Ling Li** Assistant Professor School of Marine Science & Policy University of Delaware	**Ms. Kristen Travers** Director of Conservation Delaware Nature Society
Dr. Asia Dowtin Assistant Professor Department of Forestry Michigan State University	**Ms. Chris Oh** Water Division Director Department of Public Works City of Wilmington	**Dr. Carolyn Voter** Assistant Professor Civil and Environmental Engineering University of Delaware
Dr. Dewayne Fox Professor College of Agriculture and Related Sciences Delaware State University	**Ms. Betzaida (Betzy) Reyes** Physical Scientist U.S. Geological Survey	**Mr. Steve Williams** Environmental Program Administrator Division of Watershed Stewardship Delaware DNREC
Mr. Christian Hauser Associate Director Delaware Sea Grant Program University of Delaware	**Mr. Ethan Robinson** Deputy Director Department of Public Works & Water Resources City of Newark	

184 Graham Hall
Newark, DE 19716-7380
Phone: 302-831-1687
Email: bidenschool@udel.edu

Dr. Asia Dowtin
Department of Forestry, Natural Resources Building
Michigan State University
480 Wilson Rd.East Lansing, MI 48824

February 22, 2023

Dear Asia:

As Director and Associate Director of the University of Delaware Water Resources Center, we are pleased to invite you to serve on the UDWRC Advisory Panel for a two-year term through January 1 2025 based on your expertise in water issues of importance to Delaware and the Mid-Atlantic region. Established on campus in 1965, the UDWRC 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 of Guam, Puerto Rico, and U.S. Virgin Islands. Responsibilities of the UDWRC in the NIWR include: (1) innovative research that fosters entry of new research scientists into water resources fields, training of future water scientists and engineers, exploration of new ideas that address water issues, dissemination of research to water managers and the public and (2) cooperate with other colleges to develop a statewide program designed to resolve state/regional water problems.

We are proud of the water research program begun by our predecessor Deputy Dean Dr. Tom Sims that has supported over 350 undergraduate interns and graduate research fellowships since 2000. In accordance with the Water Resources Research Act of 1964 and as amended in 1984, the UDWRC Director appoints an advisory panel to assist in the review and ranking of research projects and establish priorities for center activities. We meet annually in May where our research students present the results of their research projects. In your role as an advisory panel member, you would have responsibilities to: (1) provide input to the Director regarding the successful mission of the UDWRC, (2) assist in review of UDWRC graduate fellowship and undergraduate internship applications, and (3) help promote interaction of the UDWRC with other organizations in the state, region, and nation.

Please let us know if you wish to serve on the UDWRC Advisory Panel and don't hesitate to contact us at 302-893-1571 or at jerryk@udel.edu and mcorrozi@udel.edu. Thank you for considering.

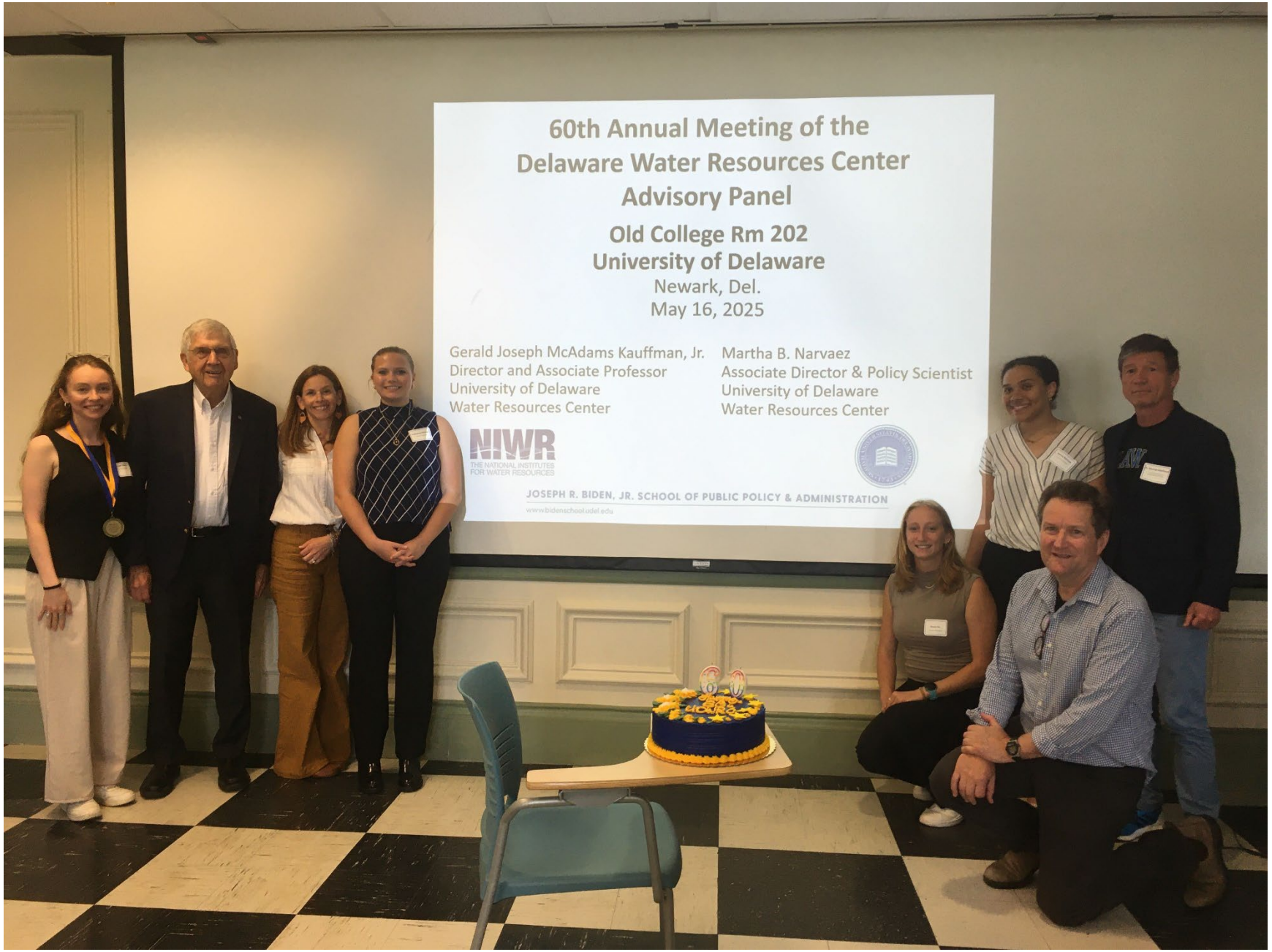
Warmly,

Gerald J. Kauffman, Director
University of Delaware
Water Resources Center
Newark, DE 19716

Martha B. Narvaez, Associate Director
University of Delaware
Water Resources Center
Newark, DE 19716

University of Delaware Excellence in Water Resources Scholarship Medal (2025)

Water Science & Policy doctoral student Megan Wassil receives UD Excellence in Water Resources Scholarship Medal (May 16, 2025)



UDWRC graduate water research students Megan Wassil (PhD WSP), Catherine Gilman (MEEP), Nicole Re (MEEP), and Jhaney Hamlett (MPA) on May 16, 2025

UDWRC undergraduate water research students Cooper Feeney (Public Policy), Dmitriy Rybin (Civil Eng'g.), Caroline Gilliard (Env. Eng'g.), Elizabeth Manning (Env. Eng'g.), Isabelle Kornas (ENEP), Silvie Sandeen (Env. Science), Amelia English (Public Policy), Caitlyn Foster (Env. Studies), Lianna Greenstein (Env. Eng'g.), and Abigale Britz (Env. Eng'g.) on May 16, 2025

Future University of Delaware Water Resources Center Building

Happy Diamond Anniversary UDWRC!

Luncheon is served