

**CFAES**

# **IMPROVING WATER QUALITY**

## THROUGHOUT OHIO

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**THE OHIO STATE UNIVERSITY**

COLLEGE OF FOOD, AGRICULTURAL,  
AND ENVIRONMENTAL SCIENCES

## A LEADER IN APPLIED WORK ON WATER QUALITY

CFAES faculty and staff help address water quality challenges through four core activities:

**SCIENCE** Understanding Drivers and Processes of Water Quality Problems

**INNOVATION** Creating Applied Solutions

**COLLABORATION AND EXTENSION** Partnering for Impact

**EDUCATION** Training the Future Workforce

## WHAT DO WE MEAN BY WATER QUALITY?

Water quality is dynamic and complex. It includes the chemical, biological, and physical characteristics of water and water bodies. We recognize that water quality challenges in Ohio are significant, and include nutrient enrichment, siltation, habitat modification, and flow alteration. Threats to water quality come from both rural and urban areas; are influenced by both human activities and changes in weather and climate; and impact groundwater, wetlands, small headwater creeks and streams, major rivers, and lakes and reservoirs. CFAES faculty work on many different types of water quality topics. Here, we highlight the breadth and depth of our recent efforts.

## AGRICULTURE

*Agriculture is the dominant land use in Ohio and is one of our state's leading industries. Water quality impacts associated with farming activities have therefore received a lot of attention. CFAES faculty are working hard to understand how to control nonpoint source pollution—pollution that comes from many diffuse sources—and help farmers enhance sustainability, improving their environmental footprint while remaining productive and profitable.*

### Science

- **Fertilizer Application Rates:** Steve Culman, School of Environment and Natural Resources (SENR), Laura Lindsey and Peter Thomison, Department of Horticulture and Crop Science, and Anne Dorrance, Department of Plant Pathology, have coordinated a series of research projects to document how modern crop varieties respond to different levels of fertilizer application. This work is being used to update the 25-year-old Tri-State Fertilizer Recommendations, which will allow farmers to apply appropriate amounts of fertilizer for maximum yield response, potentially saving on cost while reducing the chances of runoff to local waterways.
- **Edge-of-Field Studies:** Libby Dayton, SENR, worked with U.S. Department of Agriculture-Agricultural Research Service (USDA-ARS) colleagues to measure the nutrients leaving farm fields through surface and subsurface pathways. These data help identify which management approaches can make the most improvements in water quality.
- **Livestock Diets:** Chanhee Lee, Department of Animal Sciences, works with livestock systems and has documented ways to manipulate diets fed to ruminant livestock to reduce nutrient losses in their manure.
- **Farmer Behaviors:** Robyn Wilson, SENR, studies the factors that shape farmers' ability to adopt conservation practices designed to improve water quality.
- **Cost-Benefit Studies:** Brent Sohngen, Department of Agricultural, Environmental, and Development Economics (AEDE), has studied and identified the least-cost solutions to reducing nutrient loads from agricultural sources.
- **Use of Biosolids on Ag Lands:** Nick Basta, SENR, is studying the long-term effects of applying municipal biosolids to farm fields in Ohio.



### Innovation

- **Precision Farming:** John Fulton, Scott Shearer, and Sami Khanal, all in the Department of Food, Agricultural and Biological Engineering (FABE), work to improve remote sensing and precision-agriculture technologies to allow farmers to map variation in soil qualities and crop yields across their fields and to customize nutrient application rates to individual areas.
- **Manure Management:** Glen Arnold, Ohio State University Extension, and Harold Keener, FABE, are developing 21st century technologies to better utilize manure as a source of nutrients by crop farms in Ohio, thus reducing the need to import commercial fertilizers into stressed watersheds.
- **Drainage Water Management:** Jon Witter, FABE and Ohio State ATI, and Larry Brown, FABE, are developing innovative approaches to managing drainage water—including water-control structures, constructed wetlands, and innovative ditch design—to improve both crop productivity and water quality.

# URBAN AND INDUSTRIAL WATER SYSTEMS

Urban areas also create water quality challenges. A number of CFAES faculty and staff focus their efforts on understanding and reducing impacts from stormwater runoff, aging water system infrastructure in urban areas, and wastewater streams from food processing and manufacturing.



## Collaboration and Extension

- E-Fields:** Elizabeth Hawkins, OSU Extension, and Shearer have worked in collaboration with county OSU Extension faculty and working farmers to study the effectiveness of alternative fertilizer application methods. They digitally publish an annual “E-Fields” report that makes the results of on-farm trials more rapidly available to farmers, scientists, and policymakers.
- On-Farm Research and Demonstrations:** Sam Custer, Greg LaBarge, Arnold and Harold Watters, all in OSU Extension, helped lead OSU Extension’s Nutrient Stewardship Program, which has partnered with farmers to conduct 209 on-farm research studies to explore the impacts of various nutrient management practices ([agcrops.osu.edu/on-farm-research](http://agcrops.osu.edu/on-farm-research)). The program has trained over 17,000 farmers on “4R” nutrient stewardship. The four Rs stand for right source, right rate, right time, and right place.
- Nutrient Management Planning:** County educators with OSU Extension provide independent advice and support to farmers working to develop and implement nutrient management plans.

## Science

- Urban Hydrology:** Rachel Gabor, SENR, explores the complex dynamics of urban hydrologic systems to document how the built environment and the design of stormwater systems impact groundwater and surface water bodies.
- Manufacturing Wastewater:** Dennis Heldman and David Phinney, both in the Department of Food Science and Technology (FST), help improve management of wastewater from food manufacturing operations with the goal of reducing the overall volume and increasing the recovery of components that could be harmful to the environment.
- Septic Systems:** Brian Slater, SENR, and Karen Mancl, FAGE, have documented the distribution and functional status of private septic systems across Ohio. Their work helps identify factors behind failing systems that contribute to water quality impairments.
- Stormwater Microbiome:** Jiyoun Lee, FST, Jay Martin and Ryan Winston, FAGE, will be the first to define the “microbiome of stormwater” and determine the ability of green infrastructure to reduce associated threats to public health.



## Innovation

- Stormwater Management:** Winston and Jay Dorsey, FAGE, study the effectiveness of alternative urban stormwater controls to balance flood control and protect public health and water quality.
- Wastewater Treatment:** Faculty and staff in the Soil Environment Technology Learning Lab have developed improved strategies for wastewater treatment and reuse of urban wastewater through irrigation to reduce discharge of pollutants to streams and lakes and protect public health.
- Biodigester Effluent:** Victor Ujor, Ohio State ATI, and Thaddeus Ezeji, Department of Animal Sciences, have worked to find more effective methods for reducing ammonia in anaerobic digestion wastewater.
- Urban Soil Remediation:** Basta is developing methods to remove lead and other contaminants from soils in Cleveland and Columbus.

## Collaboration and Extension

- Evaluating Stormwater Infrastructure Investments:** Martin, Jiyoun Lee, Jeremy Brooks, SENR, Brian Roe, AEDE, and Winston are collaborating with the city of Columbus to study the impacts of green stormwater infrastructure on water quality outcomes, public health, property values, and neighborhood resident well-being and environmental behavior.



- Well Owner Resources:** Anne Baird, SENR, Mancl and Peggy Kirk Hall, OSU Extension, collaborate with the Ohio Department of Health to maintain an online tool to help well owners understand water test results, and provide resources for well water testing and treatment.
- Food Safety Training:** OSU Extension’s ServSafe food safety program emphasizes the importance of water quality in training programs across the state for food service industry managers and personnel.

# AQUATIC ECOSYSTEM HEALTH AND RESTORATION

*Preventing losses of nutrients and contaminants from rural and urban areas is only part of the answer to solving water quality challenges. It is equally important to understand the factors that shape the overall health of aquatic ecosystems in wetlands, rivers, and lakes. CFAES faculty include some of the nation's premier environmental scientists studying aquatic ecosystem health and restoration.*



## Science

- **Aquatic Ecosystem Health:** Mažeika Sullivan, Lauren Pintor, and Suzanne Gray, all in SENR (Sullivan also serves as director of SENR's Wilma H. Shiermeier Olentangy River Wetland Research Park), have documented how major human stressors on aquatic ecosystems—such as invasive species, land-use change, nutrients, and sedimentation—impact biodiversity, fish, and other aquatic organisms, and aquatic ecosystem health and function in water bodies in Ohio and globally.

## Innovation

- **Highway Bridge Design:** Witter has developed innovative new designs for highway stream crossings to allow improved hydrologic and ecological function while reducing costly flooding impacts on infrastructure.
- **Peatland Restoration:** Matt Davies, SENR, is testing the effectiveness of alternative strategies to restore and recover Ohio's peatlands.

## Collaboration and Extension

- **Wetlands Outreach:** Faculty and staff at SENR's Wilma H. Shiermeier Olentangy River Wetland Research Park have trained thousands of people, including hundreds of K-12 teachers and students, about the importance of wetlands in maintaining good water quality and healthy aquatic ecosystems.
- **Environmental Education:** Baird works with other land-grant institutions in the Great Lakes region to research core competencies for watershed managers, and to design and deliver environmental professional development programs such as the Ohio Watershed Academy.
- **Pond Management:** Eugene Braig, OSU Extension and SENR, has developed important resources to help private landowners better manage small ponds for fishing and recreation.
- **Lake Erie Research and Education:** CFAES works closely with the Ohio State-based Ohio Sea Grant program to support research that addresses harmful algal blooms, invasive species, nutrient loading, coastal economic development, marine debris, fisheries management, and resilient coastal communities. Further, the Stone Lab island campus, which is part of CFAES, is a center for educational efforts on these topics, hosting field trips for fifth- through 12th-graders, Ohio State college courses, professional development workshops, and outreach events for local, state, and regional stakeholders.

## THE CORNERSTONE COLLEGE

The College of Food, Agricultural, and Environmental Sciences (CFAES) plays a critical role in carrying out the land-grant mission of The Ohio State University. For nearly 150 years, our faculty and staff have engaged in research, teaching, and Extension outreach to address real-world problems facing Ohio. We are an independent and objective source of scientific knowledge, and we turn scientific discoveries into practical applications that are made widely available to our state's residents.



**COMING SOON** In fall 2018, CFAES will launch an Ohio Water Quality Initiative to coordinate, support, and expand on the efforts described above. An eight-person task force is designing the initiative. The task force is using extensive input from faculty, staff, and diverse stakeholders to ensure the initiative has grassroots support, is strategic in investments of time and money, and increases the impact and relevance of our work for all Ohio residents.

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