

# MSWRI ANNUAL REPORT 2017



**MISSISSIPPI STATE UNIVERSITY™**  
WATER RESOURCES RESEARCH INSTITUTE

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# CONTENTS

## **3 DIRECTOR'S UPDATE**

## **4 WHO WE ARE**

Our Mission

EPA Center Of Excellence

Advisory Board

Staff

Permanent Director Announcement

Integrated Approach to Water Resources Research and Management

## **12 SPONSORED RESEARCH**

USGS/MWRRI 104b Water Research Program

Externally-Funded Research

## **18 WATERSHED MANAGEMENT ACTIVITIES**

Red Bud-Catalpa Creek Watershed Restoration and Protection  
Project—Phase 1

Watershed DREAMS Center

## **22 CONFERENCES & SYMPOSIA**

Regional Cover Crop Symposium

2017 Mississippi Water Resources Conference

SEC Water Conference—The Future of Water: Regional Collaboration  
on Shared Climate, Coastlines and Watersheds

## **30 OTHER ACTIVITIES**

Hypoxia Task Force/SERA-46 Committee

Gulf of Mexico Alliance Water Resources Steering Team

# DIRECTOR'S UPDATE

**Greetings from the Mississippi Water Resources Research Institute.** I am honored to serve as the new director of the Mississippi Water Resources Research Institute (MWRRRI) at Mississippi State University. I am looking forward to the opportunities as well as the challenges that will be faced in our efforts to position MWRRRI as one of the leading Water Resources Research Institutes in the nation.

Since my arrival, things have been moving at lighting speed. The MWRRRI staff have been evaluating new funding opportunities while also building the administrative infrastructure, support processes and tools needed to better compete for research funding. These activities are in addition to the routine duties that are a core function of the Institute which includes facilitating externally funded projects currently on the books. We have been working closely with our Advisory Board to solicit input as we determine research priorities and evaluate research proposals.

I hope this Annual Report will be helpful to you in understanding our mission, approach to research and management, research program and projects, watershed management efforts, and our support of several regional initiatives. One of our new initiatives in 2017 was co-hosting (with Delta F.A.R.M.) our first Regional Cover Crop Symposium held at the Delta Research and Extension Center in Stoneville.

We are always looking for opportunities to foster and support needed water research, and encourage you to contact us should you desire a collaborative partner.

Respectfully,



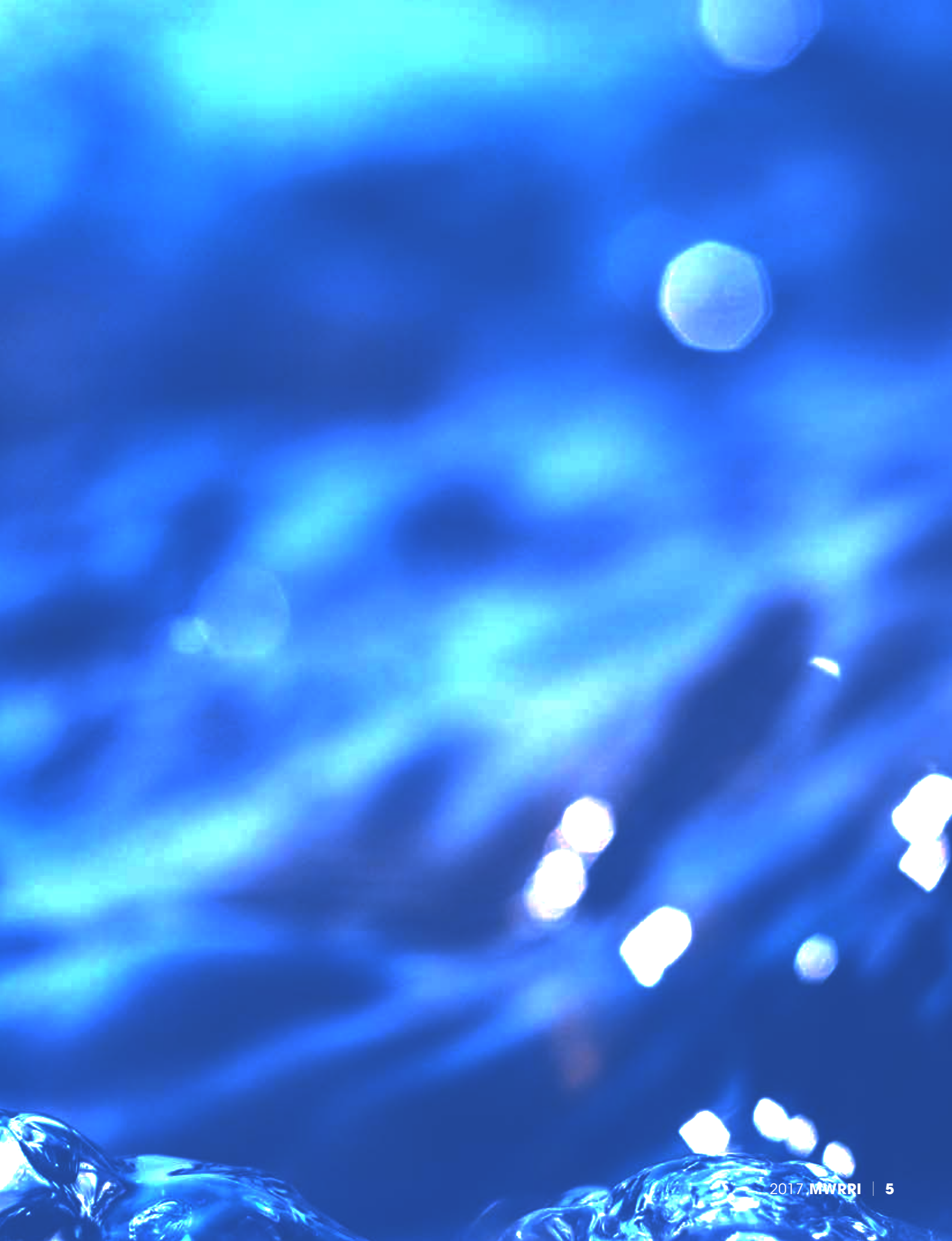
L. Jason Krutz, Ph.D.







# WHO WE ARE



# OUR MISSION

## **THE MISSISSIPPI WATER RESOURCES RESEARCH**

Institute (MWRRI) was authorized by Mississippi's Governor Paul B. Johnson in 1964 and is one of 54 institutes in the United States that form a network of coordinated research programs to solve water problems of state, regional, or national significance. In 1983, the Mississippi Legislature formally designated MWRRI as a state research institute. Federal legislation specifies that each institute consult with leading water officials of the state in developing a coordinated research technology transfer and training program that applies academic expertise to water and related land-use problems. These activities are funded in large part through an annual grant from the U.S. Geological Survey. MWRRI's state authorization charges it with carrying out the responsibilities listed to the right:

1. Assist state agencies in developing and maintaining a state water management plan;
2. Consult with state and local agencies, water management districts, water user associations, the Mississippi legislature, and other potential users to identify and establish water research, planning, policy, and management priorities.
3. Negotiate and administer contracts with local, regional, state, and federal agencies and other Mississippi universities to mitigate priority water and related problems;
4. Report to the appropriate state agencies each year on research projects' progress and findings;
5. Disseminate new information and facilitate transfer and application of new technologies as they are developed;
6. Be a liaison between Mississippi and funding agencies as an advocate for Mississippi water research, planning, policy, and management needs;
7. Facilitate and stimulate planning and management that:
  - Deals with water policy issues facing the state of Mississippi;
  - Supports state water agencies' missions with research on encountered and expected problems; and
  - Provides water planning and management organizations with tools to increase their efficiency and effectiveness.



# CENTER OF EXCELLENCE

**THE U.S. ENVIRONMENTAL PROTECTION AGENCY HAS** designated Mississippi State University as a Center of Excellence for Watershed Management, becoming the 10th such institution in the Southeast.

Representatives from the EPA's Region 4, the Mississippi Department of Environmental Quality, and the university signed a memorandum of understanding in 2013 to help communities identify watershed-based problems and develop and implement locally sustainable solutions.

The center is housed at Mississippi State, in the Mississippi Water Resources Research Institute, where it serves as a resource for universities throughout the state.

To become a recognized Center of Excellence, an institution must demonstrate technical expertise in identifying and addressing watershed needs; involvement of students, staff and faculty in watershed planning, protection, and restoration; capability to involve the full suite of disciplines needed for all aspects of watershed management; financial ability to become self-sustaining; ability to deliver and account for results; willingness to partner with other institutions; and support from the highest levels of the organization.

Located on the campus of Mississippi State, MWRRI administers and coordinates research programs dealing with water and related resources. It is one of the state institutes authorized by Section 104 of The Water Resources Research Act of 1984. Its activities are developed in close consultation and collaboration between the institute and leading water resources officials within the state.

Started in 2007, the EPA Region 4 Centers of Excellence for Watershed Management Program works with colleges and universities from across the Southeast to provide hands-on, practical products and services for communities to identify watershed problems and solve them.



# MSU NAMES JASON KRUTZ AS NEW MWRRI DIRECTOR

**AFTER A NATIONAL SEARCH, DR. L. JASON KRUTZ** was named MWRRI's new Director. Dr. Krutz, who assumed the position on July 1, 2017, has an extensive background in conjunctive water resources research and management, working primarily in agricultural landscapes. His most recent position was serving as Irrigation Specialist with MSU's Delta Research and Extension Center and as Executive Director of the H2O

Initiative. Prior to these positions, Dr. Krutz served as the Environmental CRIS Lead for USDA Agricultural Research Service's Crop Production Systems Research Unit in Stoneville, MS. In these and prior professional roles, he has conceived, designed, and directed research and/or extension programs that received regional, national, and/or international recognition. Dr. Krutz, an Arkansas native, received a B.S. and M.S. in Agronomy from the University of Arkansas and a Ph.D. in Agronomy from Texas A&M University.

Over the past five years, Dr. Krutz has successfully procured over \$6.5MM in extramural funding from state agencies, commodity boards, federal entities, and the private sector. He has also produced 186 scholarly works and 72 peer-reviewed manuscripts while directing research programs for five Ph.D. and five M.S. students and serving on 18 graduate committees. Additionally, Dr. Krutz conceived and directed the Row-crop Irrigation Science Extension and Research (RISER) Program which has increased the adoption of profitable irrigation BMPS for cotton, corn, soybeans, rice, and peanuts across Mississippi. During this time, he also formulated strategies to facilitate the adoption of RISER techniques throughout Arkansas, Louisiana, Missouri, and Tennessee for public and private stakeholders involved with the H2O Initiative.

MWRRI welcomes Dr. Krutz!





## ADVISORY BOARD

**Mr. Sam Britton**  
*Mississippi Public Service Commission*

**Mr. Tom Bryant**  
*Pickering Firm Incorporated*

**Dr. Pat Deliman**  
*Environmental Laboratory, U.S. Army Corps of Engineers*

**Mr. Mike Freiman**  
*Surface Water Division, Office of Pollution Control, Mississippi Department of Environmental Quality*

**Mr. W. Scott Gain**  
*U.S. Geological Survey*

**Mr. Mark Gilbert**  
*Mississippi Soil & Water Conservation Commission*

**Dr. Martin Locke**  
*Agricultural Research Service National Sedimentation Laboratory*

**Mr. Kirby Mayfield**  
*Mississippi Rural Water Association*

**Mr. George Ramseur**  
*Mississippi Department of Marine Resources*

**Mr. Chip Morgan**  
*Delta Council*

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**Dr. Don Christy**  
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**Mr. Andy Whittington**  
*Mississippi Farm Bureau Federation*

**Ms. Kay Whittington**  
*Mississippi Department of Environmental Quality*

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# INTEGRATED APPROACH TO WATER RESOURCES RESEARCH AND MANAGEMENT

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## INTEGRATED WATER RESOURCES RESEARCH

**EFFECTIVE ENVIRONMENTAL PLANNING** and water resources management must first be informed and supported by scientifically-accepted research, the development of which is MWRRRI's primary function. For over 30 years, MWRRRI through its member Institutions of Higher Learning has worked with agencies and organizations in Mississippi and beyond to support and advance water resources research. Today, more than ever, research is vitally needed in Mississippi to advance our understanding of the science and dynamics of multiple interconnected and interdependent water-related issues and to inform our water resources planners, managers, users, and stakeholders. Since its creation and as part of its statutory responsibility, MWRRRI has identified water resources research priorities through its Advisory Board and, supported by the U.S. Geological Survey through the 1984 Water Resources Research Act, has provided funding for selected research proposals that address these priorities.

Through its Advisory Board, three topical areas are pursued for MWRRRI research consideration: 1) common problems and challenges, 2) strategic research, and 3) transferring and applying knowledge. These are discussed briefly below:

**1. COMMON PROBLEMS AND CHALLENGES.** Today, significant research is needed across the water resources spectrum to address common problems and challenges

in Mississippi. These include developing a better understanding of the impacts of increasing population growth, changing land uses and demands on ground and surface water resources, and improving projections of water availability throughout the state. Research is needed to better understand groundwater recharge as well as the potential benefits and challenges of alternative surface and ground water supplies. More research is needed to better understand the water quality challenges identified by Total Maximum Daily Load studies; to document the impacts of innovative management practices and approaches designed to improve water quality; and to better understand the source, fate, and transport of nutrients at variable spatial and temporal scales across the state to inform decision-makers on what nutrient reductions are achievable and when. Additional research is needed on climate and its historic variability to better understand what the future may hold. Social science research is needed to develop a better understanding of stakeholder perceptions and beliefs for a variety of water resources issues across the state in order to develop effective outreach and education designed to change behaviors. These issues are only a subset of the type of research needed to address the common water resources problems and challenges facing Mississippi.

**2. STRATEGIC RESEARCH FOR INTEGRATED WATER RESOURCES MANAGEMENT.** Emphasis on stand-alone water resources research is diminishing due to recognition of the inter-relationships of multiple water resources issues, the expanding scale of research needs, and limitations on fiscal resources available for research.

While advancing research to address the common water resources problems and challenges in Mississippi, attention should be given to how this research can advance integrated water resources management in Mississippi. MWRRI's approach to strategic research for integrated water resources management seeks to explore the linkages among natural science, engineering, and the dynamics of social and economic systems that underpin water management decisions. Understanding the interconnected and interdependent relationships of diverse water resource issues while developing research project concepts will be vital to support the coordinated planning, development, protection, and management of water, land, and related resources.

**3. TRANSFERRING AND APPLYING KNOWLEDGE.** The research approach described in this document is designed to inform water resources planners and managers by providing them with the scientific information and understanding that they need. Also, the effective transfer of knowledge to water users and stakeholders is essential for a well-informed public in order to realize the overarching goal of sustainable water resources and ecosystems of good quality and ample quantity while sustaining a good economy and quality of life for current and future generations. Working with MWRRI's member Institutions of Higher Learning, MSU's Extension Service and REACH program are uniquely positioned to advance and sustain the transfer and application of knowledge gained through MWRRI's integrated water resources research approach.

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## INTEGRATED WATER RESOURCES MANAGEMENT

**THE CONCEPT** of integrated water resources management can be traced to early basin planning efforts in the United States in the 1920s. However, it was not until the late 1990's that acceptance of the concept began to become widespread. In Mississippi, the concept of integrated water resources management was identified in § 51-3-1 of the 1985 Water Law that stated: "... to the fullest extent possible, the ground and surface water resources within the state shall be integrated in their use, storage, allocation and management." This approach is emphasized by the Mississippi Department of Environmental Quality (MDEQ) which has jurisdiction over the water resources of the state.

What is integrated water resources management? Integrated water resources management has been defined in numerous ways by numerous entities over time with a great deal of common language among the various definitions. In an effort to standardize a

definition, the American Water Resources Association in 2011 defined integrated water resources management as "the coordinated planning, development, protection, and management of water, land, and related resources in a manner that fosters sustainable economic activity, improves or sustains environmental quality, ensures public health and safety, and provides for the sustainability of communities and ecosystems." Numerous entities have accepted this definition since it was established. In this context, key considerations of integrated water resources management include:

**1. WATER RESOURCES ARE ALL CONNECTED** and recognizing the interconnected and interdependent relationships of climatic, ground and surface waters; water quality and quantity; freshwater and coastal waters; and rivers, streams, lakes and the land they share within a watershed or basin is foundational for effective integrated water resources management.

**2. WATER MUST BE MANAGED SUSTAINABLY** for current and future generations by balancing the multiple objectives of different interests with consideration for the environment, economic development, and social equity.

**3. COORDINATION IS REQUIRED FOR INTEGRATION** and coordinating water management activities (e.g., planning, management, research, et al) between and within levels of governmental and other organizations, with recognition of the respective roles of each, is vital for effective collaborative planning and leveraging of resources.

**4. PARTICIPATION MUST BE ACTIVELY ENCOURAGED** by continually engaging and involving the local public and stakeholders from all water use sectors.

In its application, integrated water resources management can be employed at virtually all watershed scales—from small watersheds to a broader basin. This concept directly supports the management approach called for in Mississippi's Water Law, embraces the Basin Management Approach established by MDEQ, and avails itself to the use of EPA's widely-accepted *9 Key Elements of Watershed Planning*. Indeed, integrated water resources management is the standard for Mississippi.

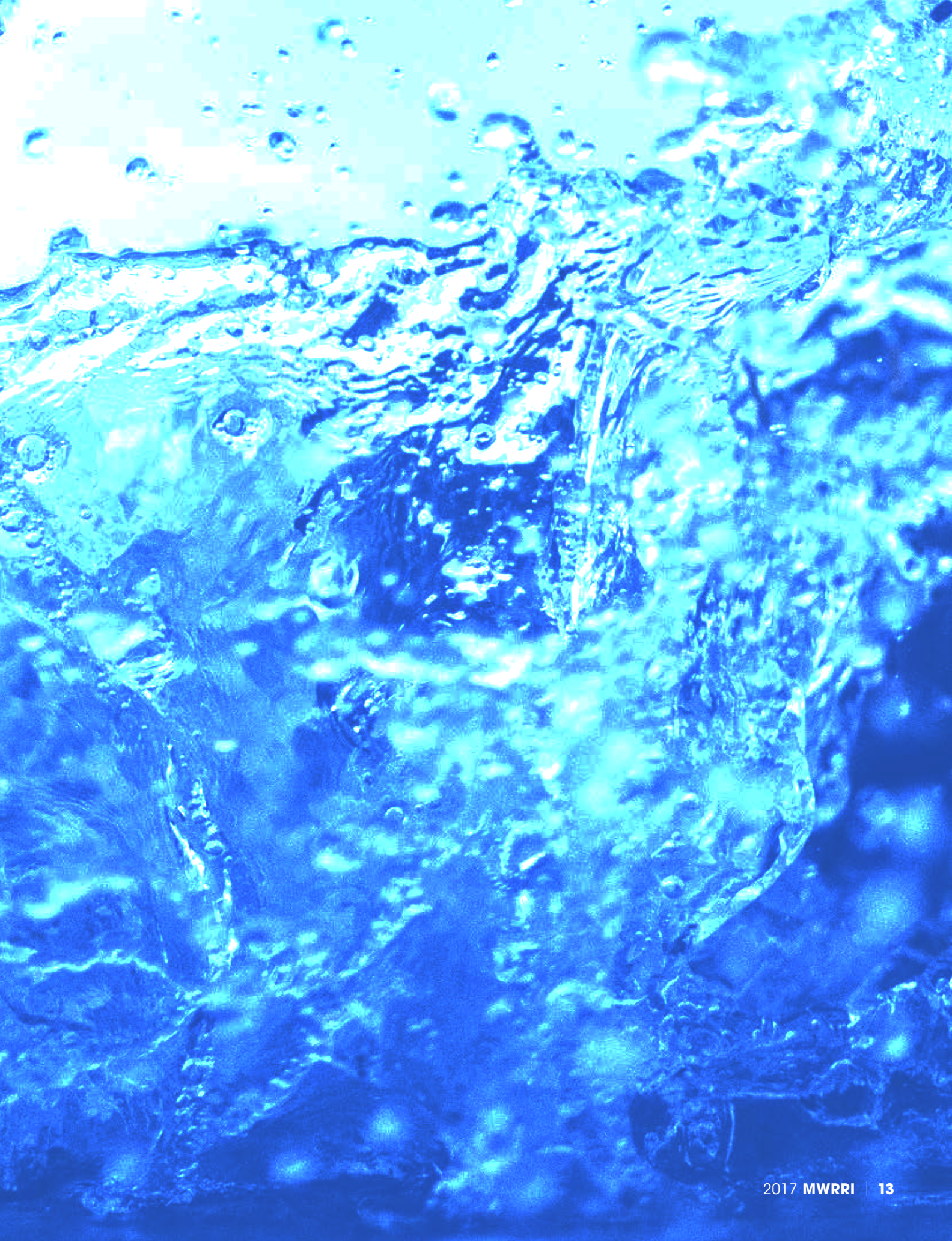
In support of this approach, MWRRI staff work diligently with departments and programs from Institutions of Higher Learning across Mississippi, state and federal agencies, and stakeholder organizations willing to participate in this collaborative approach in a team environment to develop research concepts and detailed project proposals to address Mississippi's water resources research and management priorities.





# SPONSORED RESEARCH







# MWRRI/USGS 104B WATER RESEARCH PROGRAM

**THE 104B WATER RESEARCH PROGRAM WAS ESTABLISHED** under the provisions of section 104 of the Water Resources Research Act of 1984 (Public Law 98-242), as amended by Public Laws 101-397, 104-147, 106-374, and 109-471. Section 104 of the Water Resources Research Act directs the Secretary of the Interior to administer program grants to Institutes and Centers established under the provisions of section 104(a) of the Act. Water Resources Institutes or Centers have been established in each of the 50 states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and Guam. Responsibility for administration of the State Water Resources Research Institute program has been delegated to the U.S. Geological Survey (USGS).

MWRRI's Advisory Board met on November 15, 2017 to discuss proposals received in response to MWRRI's 2018 RFP. Pursuant to recommendations made during this meeting, MWRRI has submitted the following projects for funding through USGS' 2018 104b Water Resources Research Program:

## MICROPLASTICS IN THE MISSISSIPPI RIVER AND MISSISSIPPI SOUND: CONCENTRATIONS, SOURCES, SIZES, TYPES, AND LOADINGS TO THE NORTHERN GULF OF MEXICO

*Dr. James Cizdziel, Associate Professor, Department of Chemistry and Biochemistry, University of Mississippi (Principal Investigator)*

**THERE IS GROWING EVIDENCE** that microplastics are harming marine organisms and finding their way into

the human diet. The majority of seafood consumed by humans comes from coastal areas where microplastic particles are ubiquitous. The Mississippi River drains approximately 41 percent of the contiguous U.S. into the northern Gulf of Mexico (GOM), making the Gulf Coast particularly vulnerable to microplastic pollution. Indeed, microplastic concentrations on the inner shelf of the northern GOM are among the highest levels reported globally. These particles are causing deleterious effects on filter feeders such as oysters, a vital industry for the Gulf Coast. Thus, Mississippi is the ideal place to study microplastic pollution and its impacts on aquatic ecosystems.

A heretofore overlooked problem with microplastics is sorption of methylmercury (MeHg), a toxin that accumulates in organisms and concentrates in the food chain. Exposure to high levels of MeHg causes deleterious effects in both humans and wildlife. This is of particular concern along the Gulf Coast because, on average, residents there consume more seafood than other U.S. residents, and because GOM seafood tends to have higher levels of MeHg compared to other U.S. coastlines. Whereas there are significant health benefits from eating seafood, it is also the greatest source of MeHg exposure. As much as 30% of Gulf Coast residents may exceed the recommended



Sources of microplastics include fragments of debris and microbeads in commercial products (left) that are found in coastal sands, zooplankton



safe dose of MeHg. The GOM accounts for 41 percent of the U.S. marine recreational fish catch and approximately 16 percent of commercial fish landings. Given the importance of commercial and recreational fishing to the GOM economy, and the potential threat to the aquatic ecosystem, understanding the link between microplastics, MeHg, and impacts on the ecosystem is important to the long-term health and sustainability of the region. Examining microplastic pollutant load is the next step in advancing microplastics water research.

Microplastics concentrations on the inner shelf of the northern GOM are among the highest levels reported globally. Because their size range overlaps that of zooplankton, they are confused with prey and are accumulating in the food chain. The plastic particles are causing deleterious effects on aquatic organisms, particularly filter-feeders such as oysters. Moreover, plastics attract (sorb) certain contaminants, such as persistent organic pollutants and mercury, and thus their accumulation in biota may be an overlooked source of contaminants to ecosystems. This is a major concern to the state and region because seafood is a vital industry for Gulf Coast states, and because, on average, Gulf Coast residents consume more seafood than other U.S. residents. It is also a national problem because the majority of microplastics in the northern GOM originate from the Mississippi River, whose basin encompasses thirty-one states. Yet, surprisingly little is known about the concentrations, types, sizes, and loadings of microplastics in the river and its major tributaries, and along oyster reefs in the Mississippi Sound. This lack of data is hindering our understanding of the magnitude and sources of the problem. Our research will fill key knowledge gaps and improve people's education around microplastic pollution and its impacts.

## AQUATIC VEGETATION MANAGEMENT TO ENHANCE MULTIPLE-USER BENEFITS OF SOUTHEASTERN WETLANDS

*Dr. Gary Ervin, Professor, Department of Biological Sciences, Mississippi State University (Principal Investigator); Gray Turnage, Research Associate, Geosystems Research Institute, Mississippi State University (Co-Investigator)*

**ACROSS THE US**, it has been estimated that more than \$100 million per year is spent on control of aquatic weeds, and a recent estimate for the state of Florida alone places control costs for aquatic weeds on natural areas in the range of \$32 million per year. In Mississippi, two of the nine state noxious weed species listed by the

Bureau of Plant Industry (BPI) are aquatic weeds, and statewide surveys are often conducted to monitor the status of these and other aquatic weeds on Mississippi water bodies. Some of the reasons for concern over such plants include the plants' abilities to: restrict access to water bodies for recreational or other direct human uses, replace desirable plant species, reduce overall biological diversity, reduce utility of aquatic or wetland habitat for wildlife, increase mosquito breeding habitat and thus insect borne disease, and changes to ecosystem services, such as water quality improvement.

Biologists at the Sam D. Hamilton Noxubee National Wildlife Refuge (NNWR) have identified certain problematic aquatic plants, specifically American lotus (*Nelumbo lutea*), white/fragrant waterlily (*Nymphaea odorata*), and water shield (*Brasenia schreberi*), as key obstacles to achieving the multiple use needs of refuge lakes and associated wetlands. The biologists at NNWR further indicated that these issues are experienced by many other refuges, wildlife management areas, and private waterbodies in Mississippi and adjacent states. Few methods currently are known that allow the control of these regionally specific aquatic weeds, while simultaneously enhancing the diversity of desirable species and maintaining areas of open water that are needed for many species of wildlife and for human use of these facilities. This project aims to determine effective means of controlling these aquatic plant species and then cooperate with NNWR personnel in disseminating our findings among other refuges and similar land management areas. Accomplishing this work will address such water resource priorities as enhancing recreational water use, maintaining fish and wildlife habitat quality, and maintaining surface water quality.

The work we propose would explore a variety of chemical control measures (herbicides) to reduce the abundance of key nuisance plant species, while maintaining diversity of desirable species and also minimizing any negative impacts on key water quality parameters (dissolved oxygen, nitrogen, and phosphorus). Thus, this work would address numerous focus areas of the Mississippi Water Resources Research Institute, including natural resources conservation, wetland ecology, water quality, and management of problematic aquatic plant species. The ultimate objective of this work is to discover methods to control nuisance aquatic vegetation in wetland and aquatic habitats of areas like NNWR, while minimizing impacts on non-target vegetation and water quality. We will cooperate with NNWR staff in distributing our findings to land managers throughout the region who encounter similar habitat management challenges, in addition to distributing this information through more typical science outlets of peer-reviewed journals and conference proceedings.

# EXTERNALLY-FUNDED RESEARCH

## A SERA-46/HYPOXIA TASK FORCE/ GULF OF MEXICO ALLIANCE SUCCESS STORY: USING SOCIAL INDICATORS TO ADVANCE NUTRIENT REDUCTION EFFORTS IN THE MISSISSIPPI/ATCHAFALAYA RIVER BASIN – PHASE 1

**DURING THE FALL OF 2016**, EPA awarded a two-year grant to MWRRI in support of a consortium of land-grant universities established to provide technical services to the Mississippi River/Gulf of Mexico Watershed Nutrient (Hypoxia) Task Force in its efforts to reduce nutrient pollution within the Mississippi/Atchafalaya River Basin (MARB). Excessive nutrient loadings within the MARB are the leading cause of Gulf of Mexico hypoxia. This consortium, referred to by the Hypoxia Task Force as its Land Grant University Initiative and academically as the SERA-46 committee, consists of agricultural research and extension staff from the land grant universities in the twelve task force states. Through its Gulf Star Program, the Gulf of Mexico Alliance (GOMA) also awarded a two-year grant to expand the scale of the original grant to include all of the Gulf Coast states not covered in the EPA grant. The leveraging of these resources would ensure that all 15 states throughout the MARB and across the northern Gulf will work together to develop and implement consistent, correlatable measures to track progress in the human dimension of reducing excessive nutrient loadings.

Water quality problems that have accumulated over many decades often take decades to correct. This is the case when considering the complexity, scale, causes, and impacts of Gulf of Mexico hypoxia. The social dimension plays a key role. Every individual, community and culture have a set of beliefs and attitudes that guide decision-making and influence behavior. Because the success of nutrient reduction strategy implementation in state-designated priority watersheds

depends upon a large percentage of watershed stakeholders understanding both the water quality impacts of their land use activities and the importance of conservation, an important measure of progress should include confirming that awareness and attitudes are changing and behaviors are being adopted that serve to mitigate the problem. Social indicators provide consistent measures of social change and can be used by planners and managers at the national, state, and local levels to estimate the impacts of their efforts and resources even while a lag exists for monitored improvements in water and habitat quality. In addition, social indicators can inform planners and managers of changes needed to their nutrient reduction strategies to increase the effectiveness of their efforts.

The consortium established a Social Science Work Group that coordinates with a larger social science work group, the multi-state NC-1190 committee. The two-year grants provide resources for data discovery, assimilation, and analysis of published and unpublished social science projects and infrastructure within the MARB. Phase 1 of the project, “Refining and improving existing social indicators to guide, evaluate, and accelerate implementation of state-level nutrient reduction strategies through a regionally inclusive and consistent expansion of the use of the social indicators planning and evaluation system/social indicators data management and analysis (SIPES/SIDMA) tools throughout the MARB,” was completed in September 2017 with the release of the Phase 1 Synthesis Report: *Social Indicators to Accelerate Implementation of Nutrient Reduction Strategies*. The report’s final chapter, Recommendations, Next Steps, and Future Research, identified a set of activities needed to operationalize the expansion of social indicators throughout the MARB and Gulf Coast with a higher emphasis on nutrient reduction as well as modify the infrastructure and improve collaboration needed to support such an effort. These recommendations and next steps will be addressed as components of a new proposal which will be submitted to appropriate resource organizations for funding support.

## DEVELOPING CIVIC ENGAGEMENT MEASURES TO ASSESS AND ENCOURAGE NON-GOVERNMENT STEWARDSHIP OF STATE-LEVEL NUTRIENT REDUCTION STRATEGIES – PHASE 2

**PHASE 2 OF THIS PROPOSAL** focuses on the next generation of social indicators—the development of civic engagement measures and tools—and recognizes that, “we need to move the focus beyond initial adoption to include who will maintain practices over time.” In other words, to be successful over time, the intervention and policy emphasis must shift to long-term sustainability and engagement of civil society at the watershed level. This focus also expands original SIDMA/SIPES work and incorporates insights and research for measuring sustainable engagement, local leadership, and civic responsibility. Establishing sustainable citizen-based watershed protection groups is key to addressing the age-old problem of what happens after intervention funds run out.

This work emphasizes the importance of integrating interventions directed at environmental resources and social systems. Long term changes in land management associated with nutrient runoff must take into account the needs, interests and desires of stakeholders, landowners, users, interested parties and regulatory agencies who have interests in those locations. The interface between public and private management of resources has many concepts and names associated with it including; civic engagement, social capital, community capacity, community empowerment, citizen engagement, and finally community-based natural resource management (CBNRM). Fundamentally, they all measure similar concepts—to what degree are members of the community actively “engaged” and participating in their community? Communities composed of citizens who are actively engaged are more likely to assume ownership and on-going responsibility for

the protection and enhancement of their watershed.

Phase 2 of the EPA and GOMA awards employs a similar process as that used during Phase 1 for data discovery, assimilation, and analysis of published and unpublished reports describing various approaches and projects designed to encourage civic engagement in environmental restoration projects. Also included will be a review of incentives developed to encourage civic engagement. Phase 2 began in September 2017 and is scheduled for completion in August 2018.

MWRRRI received a grant award notice from EPA of \$194,100 for these phased projects. During 2017, grant monies were made available for Phase 2. These projects, developed in collaboration with MSU’s Social Science Research Center, also recently received a grant award from the Gulf of Mexico Alliance’s Gulf Star Program in the amount of \$13,500. This grant award will provide resources for Gulf States that are not members of the Hypoxia Task Force to participate in the effort to develop social indicators and civic engagement measures. This award will allow activities of the EPA award to be leveraged among all Hypoxia Task Force and Gulf of Mexico Alliance member states within the Mississippi River/Gulf of Mexico Watershed, facilitate the development of correlative metrics across the entire region, and advance cooperation between these two organizations.



The background of the entire page is a close-up, high-angle shot of blue water with gentle ripples and small waves, creating a textured, shimmering effect. The color is a vibrant, slightly cyan blue.

# **WATERSHED MANAGEMENT ACTIVITIES**





# RED BUD–CATALPA CREEK WATERSHED RESTORATION AND PROTECTION PROJECT: PHASE 1

## **DURING 2017, MWRRI RECEIVED NOTICE OF FUNDING**

support from the Mississippi Department of Environmental Quality and USEPA through the 319(h) Nonpoint Source Program (\$274,726 award with a match requirement of \$182,971), the Mississippi Agriculture and Forestry Experiment Station and its Strategic Research Initiative (\$17,980 in awards with a match total of \$33,300), and MWRRI/USGS's 104b Water Research Grant Program (\$36,916 in awards with a match total of \$74,578) to support implementation of the Implementation Plan for the Red Bud–Catalpa Creek Watershed Phase 1. The total investment to implement the Phase 1 plan is \$620,471 with all funding secured. The Phase 1 implementation plan, developed during 2016, builds upon the comprehensive Water Resources Management Plan for the Red Bud–Catalpa Creek Watershed developed collaboratively by 18 University units during 2015, and describes specific water quality and habitat restoration activities recommended for the headwaters of the Red Bud–Catalpa Creek Watershed in the proximity of the MAFES H.H. Leveck Animal Research Center (South Farm). The comprehensive plan calls for the installation of 24 best management practices (BMPs) in three delineated critical management areas, details an information and education program, describes a monitoring program to quantify the effectiveness of the installed BMPs, establishes an implementation schedule with measurable milestones and project outcomes, and contains a detailed budget. The plan also includes the coordination and leveraging of two complementary monitoring and modeling projects that received funding in 2017—*Assessing and Predicting Stream Processes in the Catalpa Creek Watershed (104b)* and *Applied Use of Unmanned Aerial Vehicles in Surface Water Quality Protection (MAFES/SRI)*.

The plan was developed by numerous contributors from Mississippi State University. These include the MSU Extension Service; Geosystems Research Institute; Mississippi Water Resources Research Institute; Bagley College of Engineering's Department of Civil and Environmental Engineering; and the Mississippi Agricultural and Forestry Experiment Station's Department of Animal and Dairy Sciences; Department of Wildlife, Fisheries and Aquaculture; Department of Landscape Architecture; and REACH (Research and Education to Advance Conservation and Habitat) Program. Staff from the Mississippi Department of Environmental Quality, Mississippi Soil & Water Conservation Commission, and USDA's Natural Resources Conservation Service also contributed. Implementation of the plan is scheduled for early 2018-2019. A comprehensive Phase 2 plan to address the entire watershed is currently in development and is scheduled for completion during the summer of 2018. The Phase 2 plan will serve as the basis for soliciting additional resources for BMPs, stream restoration, monitoring, and educational/experiential learning activities.



# WATERSHED DREAMS CENTER

**(DEMONSTRATION, RESEARCH, EDUCATION, APPLICATION, MANAGEMENT AND SUSTAINABILITY)**

**THE ESTABLISHMENT** of a Watershed Demonstration, Research, Education, Application, Management and Sustainability (DREAMS) Center on the MAFES H.H. Leveck Animal Research Center (South Farm) will serve as a showcase for watershed management throughout the state and southeast through the watershed-based restoration and protection activities affiliated with the Catalpa Creek Watershed Project. This center will be useful to state and federal agencies, water management districts, stakeholder and community service organizations, university departments and programs, secondary education teachers and students, local governments, and others. Beyond complementing the Catalpa Creek project, the center will focus generally on water resources, watersheds, and the ecosystem services they provide in a hands-on interactive way. It is envisioned that the Center will:

- Demonstrate the effectiveness of innovative and established sediment, nutrient, pathogen and other Best Management Practices (BMPs);
- Demonstrate innovative water management approaches;
- Advance innovative concepts and applications that address water resources and watershed management research needs;
- Provide for technology transfer of applications developed by MSU researchers to water resources planners, managers, water users, and other stakeholders;
- Educate water resources and watershed planners, managers, policy-makers, and other stakeholders about important watershed concepts; and
- Demonstrate MSU's capacity to effectively address a wide range of water resources and watershed issues occurring throughout the state and region.

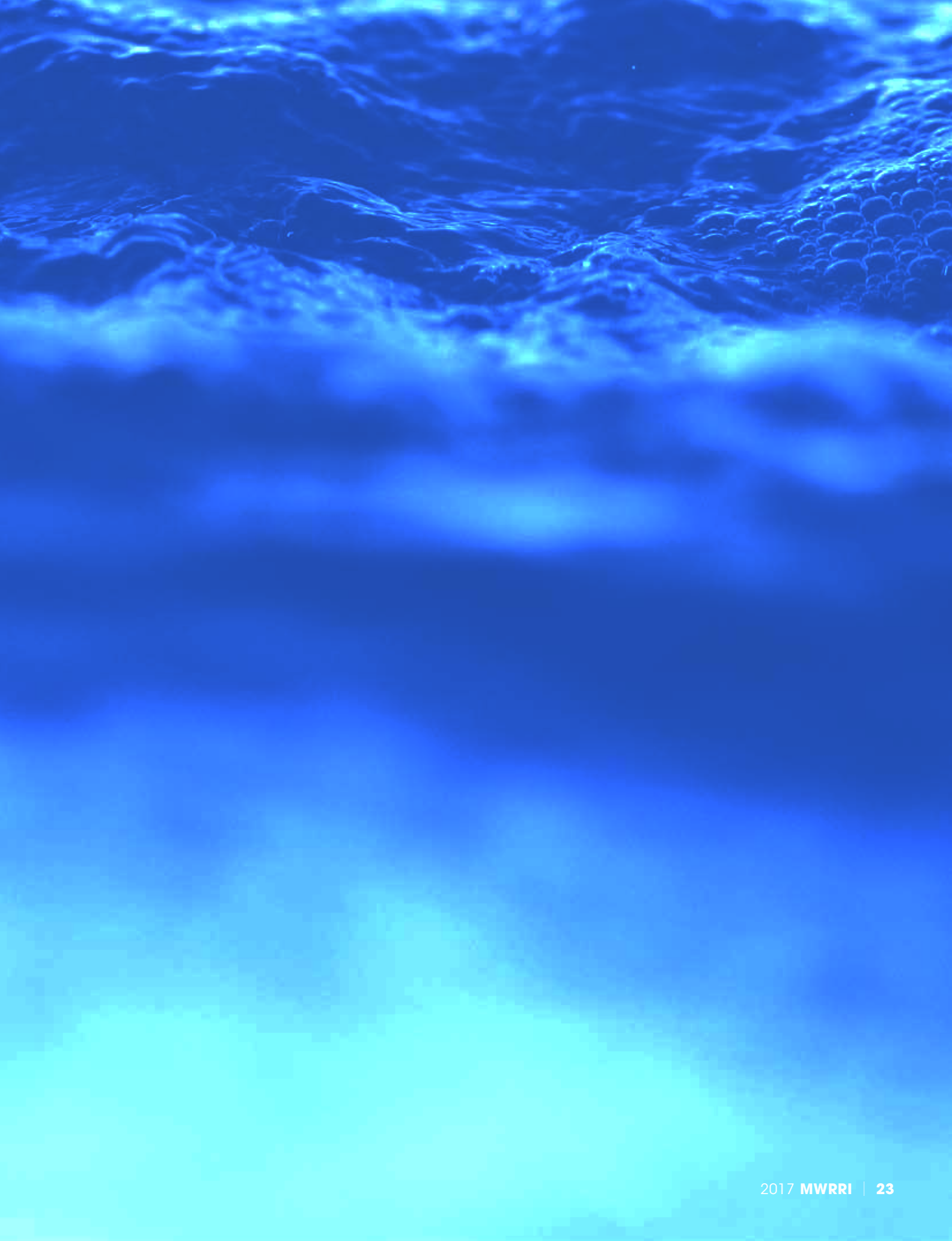


The MAFES H.H. Leveck Animal Research Center at Mississippi State University.

MSU's campus and the MAFES H.H. Leveck Animal Research Center (South Farm) are located in the headwaters of the Catalpa Creek Watershed which presents numerous opportunities for leveraging numerous MSU activities and assets. Of all the land grant universities in the United States, South Farm is one of the largest land reserves adjacent to a university campus. It encompasses about 1,600 acres used for cattle, equine and poultry management research. South Farm also hosts a NRCS Grazing Lands Conservation Initiative demonstration site, 18 acres of aquaculture ponds, and various water quality research projects. These projects include monitoring nutrient and sediment runoff under varying climatic conditions and cattle management scenarios, comparison of hydrologic modeling outcomes to evaluate pre- and post-BMP implementation related to dairy and poultry management, identification of potential environmental problem areas throughout South Farm that could impact Catalpa Creek, and development of baseline water quality information and a monitoring plan for Catalpa Creek.

The background of the page is a vibrant blue, depicting an underwater scene. At the top, there are numerous bubbles and light reflections, creating a sense of depth and movement. The color transitions from a darker blue at the top to a lighter, cyan-like blue at the bottom.

# CONFERENCES & SYMPOSIA





# 2017 MISSISSIPPI WATER RESOURCES CONFERENCE

**APRIL 11-12, 2017**

**THE ANNUAL MISSISSIPPI WATER RESOURCES CONFERENCE**, hosted by MWRRI, was held at the Jackson Hilton on April 11-12, 2017. There were more than 130 participants in the conference. Researchers and students from colleges and universities as well as water resources planners, managers, and policy-makers from state and federal agencies, industry, and other backgrounds presented 54 oral presentations and 14 posters on the following topics:

- Agricultural Water Storage and Reuse
- Climate and Agronomics
- Coastal Restoration Projects
- Delta Sustainable Water Resources: Irrigation Efficiency and Alternative Water Supplies
- Delta Sustainable Water Resources: Monitoring and Modeling
- Ecological Studies
- Innovative Studies and Applications I and II (2 sessions)
- Mississippi River Basin
- Modeling Applications
- Nutrient Reduction
- Statewide Management of Water Resources: Office of Land & Water Resources
- Surface Water—Groundwater Interaction
- Water Treatment and Management

The opening plenary session featured a panel from the Mississippi Department of Environmental Quality whose theme was “Water Management to Ensure Water of Sufficient Quantity and Quality for a Sustainable Environment and Economy in Mississippi.” Panelists

included Kay Whittington, Kim Caviness-Reardon, Valerie Alley, Adrien Perkins, and Natalie Segrest.

Tuesday’s luncheon speaker was Kurt Readus, USDA State Conservationist, speaking on the Natural Resource Conservation Service’s efforts to support sustainable water resources in the Mississippi Delta. Readus reminded everyone at the luncheon that while “service” is the last word in NRCS, it is the number one priority for the agency in assisting stakeholders with land and water issues.

Wednesday’s luncheon speaker was Brian Clark from U.S. Geological Survey. Clark spoke on the current USGS regional modeling initiatives.

Again, this year students had opportunities to be involved in both an oral and/or poster presentation competition. Through a Weyerhaeuser sponsorship and an anonymous gift, cash prizes of \$100 for 1st place, \$75 for 2nd place, and \$50 for 3rd place were awarded to the winners in both categories.

At the conclusion of Wednesday’s luncheon, Bill Herndon was presented with a plaque recognizing his service for the past two years as Interim Director of MWRRI. Herndon retired from MSU on June 30, 2017.

The Institute extends thanks to our sponsors and exhibitors: Collier Consulting, Inc. from Stephenville, TX; Visit Natchez/Natchez Convention Center, Natchez, MS; Pickering Firm, Inc., Hernando, MS; and Weyerhaeuser Company, Columbus, MS.

Special thanks go to the Mississippi Department of Environmental Quality and U.S. Geological Survey for their assistance with conference planning, and to all technical session facilitators/coordinators who identified and solicited speakers for sessions.

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## STUDENT POSTER COMPETITION WINNERS:

### 1ST PLACE

**MERCEDES SIEGLE-GAITHER**, College of Forest Resources graduate student at Mississippi State University. Siegle-Gaither's poster was titled, "Using Deuterium and Oxygen—18 Isotopes to Understand Stemflow Generation Mechanisms."

### 2ND PLACE

**ZEIMA KASSAHUN**, College of Forest Resources graduate student at Mississippi State University. Kassahun's poster was titled, "Species-Specific Environmental Factors that Influence Sap Flow Rates of Nine Bottomland Hardwood Species."

### 3RD PLACE

**HAZEL BUKA**, Agricultural & Biological Engineering graduate student at Mississippi State University. Buka's poster was titled, "Can One Hundred-year Precipitation Record Produce Patterns Allowing Seasonal Weather Prediction?"

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## STUDENT ORAL PRESENTATION COMPETITION WINNERS:

### 1ST PLACE

**MARY ALEXANDRA FRATESI**, Chemistry undergraduate student at the University of Mississippi. Fratesi's presentation was titled "Community-Based Research Strategies to Analyze Risk of Lead Contamination in Public Water Supplies in the Mississippi Delta."

### 2ND PLACE

**BAILEY RAINEY**, Civil & Environmental Engineering graduate student at Mississippi State University. Bailey's presentation was titled, "Identification and Evaluation of Potential Impacts of Onsite Wastewater Treatment Systems in Decentralized Communities within the Jourdan River Watershed."

### 3RD PLACE

**MICHAEL GRATZER**, Geology & Geological Engineering graduate student at the University of Mississippi. Gratzner's presentation was titled, "Quantifying Recharge to the Mississippi River Valley Alluvial Aquifer from Oxbow-lake-Wetland Systems."

# ‘FUTURE OF WATER’ CONFERENCE AT MSU FOSTERS COLLABORATION ACROSS SE UNIVERSITIES

**MARCH 27-28, 2017**

**By: Allison Matthews, News Editor, Office of Public Affairs, MSU**

**A COLLABORATIVE CONVERSATION** on a simple topic—water—is yielding discussions that literally could change the world, and researchers are saying that change is critical for meeting increased water needs around the globe.

About 200 participants gathered March 27-28 for the 2017 SEC Academic Conference hosted by Mississippi State University. The conference focused on “The Future of Water: Regional Collaboration on Shared Climate, Coastlines and Watersheds.” With an emphasis on research collaboration, the conference highlighted how water, in its simplicity as the earth’s most life-giving resource, poses some of the world’s most complex scientific and social challenges.

In addition to researchers, academic leaders and students from all 14 SEC universities, governmental organizations including the National Oceanic and Atmospheric Administration, U.S. Department of Agriculture, U.S. Geological Survey, the Environmental Protection Agency and Mississippi’s Delta Council, among others, were represented.

MSU President Mark E. Keenum, who also is serving a term as president of the SEC, said research, technology and innovation are keys to making progress in water utilization issues.

“It won’t happen without a serious commitment to science, research and innovation. It will be through universities like Mississippi State and all of the universities represented here today,” Keenum said Monday [March 27]. “We have no choice as human kind. We have to be looking for ways to survive and do it in the most efficient and effective ways possible. That’s why this conference is so important.”

SEC Commissioner Greg Sankey also emphasized the significance of the water topic.

“This conversation is incredibly important. As we go forth, we bring you together not simply for 36

hours of conversation, but hopefully to facilitate collaboration across our 14 great universities,” Sankey said. “The service, research, education and, quite frankly, the leadership that we need on these and other important social issues comes from our campuses.”

Headlined by best-selling author John M. Barry, former National Geographic executive environment editor Dennis Dimick, and NASA Jet Propulsion Laboratory senior water scientist Jay Famiglietti, the event also included more than 60 speakers and panelists from throughout the SEC on a variety of water resource topics.

Torie Johnson, executive director for SECU, the academic initiative of the SEC, said the SEC Academic Conference represents an expanded slate of academic programming currently supported by the Southeastern Conference.

“Ideally, the conference is the beginning of a conversation that continues indefinitely involving these important topics,” Johnson said.

Throughout the presentations, the expert speakers repeatedly conveyed urgency, noting the rapid depletion of ground water, increased demand for water in conjunction with population growth, and concerns about climate variability issues.

“The shortage of water is no longer a scientific concern—it’s a societal concern,” said Venkat Lakshmi of the University of South Carolina during a talk on “Hydrological Extremes from Space.”

Presenters tackled a breadth of water-related issues, including regional policy, partnerships, coastal resiliency, sea level rise, restoration projects, contamination, water treatment processes, public perception, agriculture and economics. Additional sessions allowed students to network with professional contacts and Water Resource Research Institute representatives to discuss regional and multi-state management issues and opportunities.

Catie Dillion is an MSU master’s student in agricultural



and biological engineering interested in sediment transfer related to coastal change—an issue impacted by sea level rise. Dillon said the conference offers students a chance to step out of the traditional classroom setting to hear from additional experts who “drove home” the significant nature of problems she has been hearing about for some time.

“We’re all working toward the same goal, which is to make things better and make sure we’re doing the best we can so future generations don’t have to face an even worse situation,” Dillon said. “That’s what scientists do—they prepare for the future, and they give to the next generation.”

James Dobrowolski, national program leader for water for the USDA’s National Institute of Food and Agriculture, said attending an event like the SEC Academic Conference helps him gain a better understanding of regional water issues.

“In some cases, they’re quite local, and if you don’t get out and see some of those issues and understand them, then they’re really pretty academic,” he said, also explaining that he likes meeting project managers working with various USDA grants. He said the conference promotes education and recruitment of new scientists in agriculture and related fields.

“Plus, I’m an old professor, so I enjoy meeting the graduate and undergraduate students,” said Dobrowolski, who spent 16 years in academia before moving into government. Now, he manages

\$42 million in competitive grants for the Water for Agriculture Challenge Area launched by USDA in 2014.

As a Tuesday [March 28] speaker, Dobrowolski discussed how improvements to wastewater management are key to sustainable development. He said more than 80 percent of the world’s wastewater is released without treatment, but rapid technology developments over the last few years have made it possible to effectively treat

wastewater to safe, clean potable levels that exceed drinking water standards. He said several countries, particularly those in arid areas, are recycling water at high rates.

Around the world and in the U.S., raising public acceptance and social awareness of wastewater reuse is an issue, he explained.

MSU Associate Provost for Academic Affairs Peter Ryan said conference participants came at water issues from every possible angle.

“They are looking at all aspects of how the issues affect communities and the environment, including biological, ecological and economic perspectives,” Ryan said, noting that academic leaders must pursue solutions.

“We have to take a lead, and we have to be quite aggressive about it,” Ryan said.

SECU is the academic initiative of the SEC, serving as the primary mechanism through which the collaborative academic endeavors and achievements of SEC universities are supported and advanced. For more on SECU, visit [www.TheSECU.com](http://www.TheSECU.com).



Eban Bean of the University of Florida leads discussion during a SEC Academic Conference breakout panel on March 28 hosted at MSU. The conference focused on “The Future of Water” and included more than 60 speakers and panelists from throughout the SEC on a variety of water resource topics. (Photo by Megan Bean)

# SEC WATER CONFERENCE MWRRI-FACILITATED BREAKOUT WORKSHOPS: ESTABLISHING A SOUTHEAST REGIONAL WATER RESEARCH INSTITUTE FORUM TO ADDRESS MULTI-STATE AND REGIONAL WATER RESOURCES PRIORITIES

**WATER RESOURCES RESEARCH INSTITUTES** (WRRIs), established by the Federal Water Resources Research Act of 1984, operate in 54 states and territories of the United States. These Institutes are charged with arranging for research that addresses water problems or expands understanding of water and water-related phenomena, aiding the entry of new professionals into the water resources fields, helping to train future water scientists and engineers, and transmitting research results to water managers and the public. However, in this era of regional and multi-state water challenges only limited collaboration and coordination are occurring among the Institutes.

During the SEC Water Conference, “The Future of Water: Regional Collaboration on Shared Climate, Coastlines and Watersheds,” a series of four breakout workshops were facilitated by MWRRI. The workshops were structured to continue to advance the concept of establishing a southeast regional WRI forum to address multi-state and regional water resource priorities.

Southeastern WRRIs identified the following desired outcomes resulting from the establishment of a regional forum:

1. Significantly increase collaboration and coordination among WRRIs in the Southeast on multi-state and/or regional water resources research and management proposals and projects;
2. Establish and coordinate regional communities of practice with an experiential learning component focused on building the next generation of water resources practitioners;
3. Increase funding to Southeastern WRRIs through traditional, non-traditional, and innovative approaches to address the multi-state and/or regional water resource priorities;
4. Access to innovative programs housed in individual WRRIs that could be shared with other WRRIs;
5. Strengthen relationships with appropriate regional offices of EPA, USGS, NOAA/Sea Grant, USACE, USDA (NRCS, NIFA), the National Water Center, and other water resources-focused agencies and organizations such

- as SERA-43, Landscape Conservation Cooperatives, the Gulf of Mexico Alliance, etc.; and
6. Regularly schedule conference calls/webinars and an annual meeting to support and advance the activities of the regional forum

During the breakout workshops four panels addressed the following foundational issues relevant to this initiative:

**SESSION 1:** What should be the objectives/desired outcomes and scope of the forum? What regional partnering opportunities should be explored? What benefits might accrue to individual WRRIs and the region?

**SESSION 2:** What do you see as existing/emerging regional and multi-state water resources research and management issues that impact the Southeastern U.S.? Which research and management issues for which regional/multi-state collaboration are needed should receive the highest focus?

**SESSION 3:** Presentations on recognized projects/programs implemented by Southeastern WRRIs that could be transferred to other states or across the region

**SESSION 4:** What organizational issues need to be considered for planning and implementation of this regional forum concept? What resource opportunities for WRRIs can be created through this concept? What do you see as next steps (activities and milestones)?

Significant input on these issues was generated and has been incorporated into a draft report that will serve as the basis for continuing to evolve the concept. MWRRI will actively work to build upon the progress made during these sessions and facilitate continuing efforts to advance the concept into an operational reality.

# REGIONAL COVER CROP SYMPOSIUM

**NOVEMBER 29, 2017**

**ON NOVEMBER 29, 2017, MWRRRI AND DELTA F.A.R.M.** (Farmers Advocating Resource Management) co-hosted a regional symposium where researchers from Alabama, Arkansas, Louisiana, Mississippi, and Tennessee presented recent research findings on the use and effectiveness of cover crops. The symposium, held at MSU's Delta Research and Extension Center, began and ended with panel discussions among producers from Arkansas and Mississippi. Thirteen presentations were also made during the symposium and included:

- Agronomic Benefits of Cover Crops—Jeremy Ross, University of Arkansas
- Impact of Improved Soil Health on Sustainability and Profitability of Cotton—Bill Robertson, University of Arkansas Cooperative Extension Service
- Cotton Yield and Soil Health Parameters in Cover Crop Systems—Darrin Dodds, Mississippi State University Extension Service and Mississippi Agricultural and Forestry Experiment Station
- Incorporating Cover Crops in Rice Production Systems—Trent Roberts, University of Arkansas
- Cover Crop Impacts on Sugar Cane Yield and Soil Health Parameters—Paul White, USDA Agricultural Research Service, Houma, LA
- Improving Soil Health and Crop Productivity in Mississippi Utilizing Cover Crops—Jack Varco, Mississippi State University, Mississippi Agricultural and Forestry Experiment Station
- Impact of Cover Crops on Early Season Insect Pests in Agronomic Crops—Jeff Gore, Mississippi State University Extension Service and Mississippi Agricultural and Forestry Experiment Station
- Weed Management in Conservation Systems—Andrew Price, USDA Agricultural Research Service National Soil Dynamics Laboratory, Auburn, AL
- Integrating Cover Crops and Herbicides for Weed Control—Larry Steckle, University of Tennessee Institute of Agriculture, Jackson, TN
- Results from the Arkansas Discovery Farm Program—Mike Daniels, University of Arkansas Cooperative Extension Service, Fayetteville, AR
- Cover Crop Effects on Soil and Water Resources—Martin Locke, USDA Agricultural Research Service National Sedimentation Laboratory, Oxford, MS
- Conservation Systems—Kip Balkcom, USDA Agricultural Research Service, Auburn, AL
- Cover Crop Effects on Erosion, N and P Transport, and Corn Grain Yield—Dave Spencer, Mississippi State University College of Agriculture and Life Sciences

CEUs were available for Nutrient Management, Integrated Pest Management, Soil & Water Management, and Crop Management. Sponsors included Local Seed Co., Pennington, USDA National Resources Conservation Service, Crop Production Services, and Southern Soil Solutions.



# OTHER ACTIVITIES



# HYPOXIA TASK FORCE/ SERA-46 COMMITTEE

## **THE MISSISSIPPI RIVER/GULF OF MEXICO WATERSHED**

Nutrient (Hypoxia) Task Force was established in the fall of 1997 to understand the causes and effects of eutrophication in the Gulf of Mexico; coordinate activities to reduce the size, severity, and duration; and ameliorate the effects of hypoxia. The Task Force includes five federal and twelve state agencies and the National Tribal Council. During 2014, the Hypoxia Task Force and its twelve state members formed a partnership with land grant universities in each of the member states through a non-funded cooperative agreement developed to support implementation of state-level strategies and actions to reduce nutrient loadings and mitigate Gulf hypoxia. These land grant universities organized through the establishment of a multi-state research coordinating committee and information exchange group referred to as SERA-46. MWRRI, the Mississippi Agricultural and Forestry Experiment Station, and the MSU Forest and Wildlife Research Center have representatives that serve on this committee. Three broad objectives were identified for the SERA-46 committee:

**OBJECTIVE 1:** Establish and strengthen relationships that can serve the missions of multiple organizations addressing nutrient movement and environmental quality.

**OBJECTIVE 2:** Expand the knowledge base through the discovery of new tools and practices as well as the continual validation of recommended practices.

**OBJECTIVE 3:** Improve the coordination and delivering of educational programming and increase the implementation effectiveness of nutrient management strategies that reduce nutrient movement for agricultural and non-agricultural audiences.

MWRRI actively participates in Hypoxia Task Force and SERA-46 committee meetings and activities, and serves as the lead for the EPA-funded project *Using Social and Civic Engagement Indicators to Advance Nutrient Reduction Efforts in the Mississippi/Atchafalaya River Basin* discussed previously in this report.



# GULF OF MEXICO ALLIANCE WATER RESOURCES STEERING TEAM

**THE GULF OF MEXICO ALLIANCE** (GOMA) was established in 2004 by the Gulf State governors in response to the President's Ocean Action Plan. Strongly supported by the White House's Council on Environmental Quality, 13 federal agencies led by EPA and NOAA, were identified to work with and support the effort. The mission of the Gulf of Mexico Alliance is to enhance the ecological and economic health of the Gulf of Mexico through increased regional collaboration.

The five U.S. Gulf States (Alabama, Florida, Louisiana, Mississippi, and Texas) face similar challenges and concerns regarding the Gulf Coast and its waters. Through the Alliance, the Gulf States collaborate to address the needs of the Gulf through a comprehensive, ecosystem approach. GOMA's structure allows a focus on the funding of priority projects to address these needs. Equally important, the Alliance also provides a forum to share knowledge and expertise as well as an opportunity to collaborate to reduce duplication of effort.

GOMA's Water Resources Team, and its steering team, have four goals:

- Protect human health, aquatic health, and economic health within the Gulf of Mexico by applying and advancing science and technology, improving education and overall environmental awareness, and enhancing partnerships.

- Identify, prioritize, and pursue additional data and research needed to better characterize, understand, and reduce potential threats to human health or aquatic life.
- Identify linkages between water quality, water quantity, water resource sustainability, human health, aquatic health, and economic health.
- Support ongoing local, regional, national, and international efforts related to protecting and/or improving water resources within the Gulf of Mexico.

The GOMA water resources team is led by the state of Mississippi, but has active participation from all five Gulf States and federal agencies working in the region, as well as academia, businesses, and non-profit organizations. MWRRRI actively participates on the Gulf of Mexico Alliance water resources steering team, and serves as the lead for the GOMA Gulf Star Program-funded project *Using Social Indicators and Civic Engagement to Advance Nutrient Reduction Initiatives throughout the Mississippi River/Gulf of Mexico Watershed* discussed previously in this report.



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