MISSISSIPPI
WATER RESOURCES RESEARCH INSTITUTE

2015

ANNUAL REPORT

CONTENTS

DIRECTOR'S UPDATE

The Mississippi Water Resources Research Institute (MWRRI) had an eventful year in 2015. Early this year, Mississippi State University through MWRRI, the University of Alabama Water Policy and Law Institute, and the Auburn University Water Center signed a memorandum of agreement creating a new long-term partnership to advance interdisciplinary water science, policy and law research, economic development, ecosystem management, and capacity building. We are currently working on economic development concepts.

The annual Mississippi Water Resources Conference was held at the Jackson Hilton on April 7-8, 2015. More than 120 researchers and students from colleges and universities as well as water resources planners, managers, and regulators from state and federal agencies, industry, and other backgrounds described projects and outcomes from over 50 water resources research and watershed-based projects. The conference featured 14 topically-focused sessions covering all regions of Mississippi and the Gulf, three plenary sessions, a poster session for which an award-based student competition was reinstated, and a well-attended opening night reception.

MWRRI, in its role as a Center of Excellence for Watershed Management as designated through a Memorandum of Understanding with the Mississippi Department of Environmental Quality and U.S. Environmental Protection Agency, reached a milestone with the completion of the comprehensive Water Resources Management Plan for the Redbud-Catalpa Creek Watershed. The plan, developed by teams of over 40 university scientists and state/federal/local agency staff, will guide future restoration and protection of the ecosystem, water quality, and stream function of Catalpa Creek, which runs through and near MSU's campus. This effort will be leveraged into a new Watershed D.R.E.A.M.S. (Demonstration, Research, Education, Application, Management and Sustainability) Center at MSU which is in the conceptual development stage.

Working with our advisory board, this summer MWRRI updated our water resources research priorities. These priorities guide the development and selection process for our 104b Water Research Program as well as collaborative projects which we facilitate with state and federal agencies, nongovernmental organizations, Mississippi's institutions of higher learning, and other stakeholders. The 104b Program is supported by MWRRI and USGS.

The Institute also became involved in several regional activities including the Mississippi River/Gulf of Mexico Hypoxia Task Force and serving on the Gulf of Mexico Alliance's Water Resources Steering Team. The overall goal of these efforts is to restore and protect the water resources of the Gulf Coast. MWRRI serves to provide the expertise in researching water quality and quantity management issues and conducting outreach activities for Mississippi citizens and communities.

Thank you for your continuing support of MWRRI.

Cary W. "Bill" Herndon, Jr.

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; and
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;
8. Provides water planning and management organizations with tools to increase their efficiency and effectiveness.

WHO WE ARE

CONFERENCE

The annual Mississippi Water Resources Conference was held at the Jackson Hilton on April 7-8, 2015. More than 120 researchers and students from colleges and universities as well as water resources planners, managers, and regulators from state and federal agencies, industry, and other backgrounds described projects and outcomes from over 50 water resources research and watershed-based projects that addressed 14 session topics.

In addition, a poster session included exhibits of 14 research and watershed-based projects. A feature of the poster session included a student poster competition with awards for 1st, 2nd, and 3rd place.

Following the first day's activities, more than 60 conference attendees stayed after the technical sessions for a reception hosted by MWRRI to foster networking among Mississippi's water resources management and research communities.

Plenary speakers included Don Underwood, Mississippi Soil and Water Conservation Commission; George Ramseur, Mississippi Department of Marine Resources; Mike Freiman, Greg Jackson and Kim Caviness, Mississippi Department of Environmental Quality; and Laura Bowie, Gulf of Mexico Alliance.

Special recognition was given to retiring interim director Dr. Joe Street during the opening plenary session.

SESSIONS INCLUDED:

- Agricultural Water Management
- Groundwater
- Gulf of Mexico Coastal Issues
- Impacts of Reforestation and Agricultural and Forestry Management on Surface Water Quality in the Lower Mississippi River Basin
- Methodology
- Phosphorus Dynamics in the Mississippi Landscape
- Policy
- Spatial and Temporal Controls on Surface and Groundwater Hydrology in the Mississippi Delta
- Sustainable Agricultural Water Management Strategy, Technology and Practice
- Understanding the Impacts of Coastal Water Quality on Ecological and Human Health
- Water Quality of the Gulf of Mexico
- Water Resource Management in the Mississippi Delta
- Watershed Management
- Wetlands

EPA 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 new center will be housed at Mississippi State, where it will serve as a resource for universities throughout the state.

"Mississippi State University is extraordinarily pleased to partner with the EPA on this Center of Excellence," said David Shaw, MSU's vice president for research and economic development. "Research in water quality and quantity is one of the highest priority areas for our university, and the center will utilize the breadth of capacity from the entire campus to address these needs."

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.

"A watershed approach is one of the most effective frameworks to engage communities and address today's water resource challenges," said EPA Regional Administrator Gwen Keyes Fleming. "Ultimately, this designation will help fulfill our mutual goals to protect and restore water quality and improve the quality of life in our local communities."

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.

ADVISORY BOARD

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SPONSORED PROJECTS

RESPONSES OF WATER QUALITY AND WETLAND PLANT COMMUNITIES TO MULTI-SCALE WATERSHED ATTRIBUTES IN THE MISSISSIPPI DELTA

Dr. Gary N. Ervin
Mississippi State University

This project will provide an assessment of local and landscape factors affecting water quality and wetland function in restored wetlands within the Mississippi portion of the Mississippi Alluvial Valley (MAV). Restoration of marginal land to wetlands has been promoted through government programs for the past 20 years and is a goal of many private groups. Restorations have focused on restoring functions such as the improvement of water quality and establishment of former wetland vegetative communities. Current results are inconclusive as to the long-term success of these projects in restoring desired functions, but research often shows a sizable portion of wetlands not mirroring characteristics of natural wetlands.

This project seeks to understand the influence of local and landscape factors in shaping wetland functions within the MAV. An understanding of scale effects on function is both critical and timely for MAV wetlands. Recent efforts aimed at creations or restorations of marginal agricultural lands to wetlands have been sponsored through government and private wetland restoration projects. Unfortunately, the outcomes of these projects in terms of conservation goals are unknown. Moreover, with an annual increase of conservation easements as well as increased demand for agricultural land coupled with the expiration of existing conservation easements, policy decisions are being made without adequate scientific knowledge of the benefits and limitations of these systems. Additionally, with little to no long-term monitoring conducted on many sites, the ultimate outcome of restoration efforts is unknown. A better understanding of the influence of local and landscape factors on wetland functions will permit more effective targeting of limited resources toward restoration of sites having characteristics most conducive to successful achievement of the desired wetland services.

The data gathered in this project will provide information on the combined effects of local and landscape factors on wetland restoration success. This project will assess restored and natural reference wetlands in 12 different watersheds in the MAV. Restored wetlands will be selected through collaboration with landowners enrolled in the USDA's Wetland Reserve Program across a spectrum of land use and land cover attributes, and reference wetlands will be selected for their proximity to restored sites. Water quality and plant species composition will be measured as local wetland ecological responses to drivers at multiple spatial scales. Water quality entering, within, and leaving the wetlands will be measured during base flow and select storm events to assess wetland function. Wetland plant species will be measured for overall biodiversity and ecological quality twice during the growing season. Potential ecological drivers measured at the local scale will include factors such as wetland hydrology and hydroperiod, wetland size, management history, hydrogeomorphic classification, and wetland soil composition. At a watershed scale, the role of land cover, land use, and wetland isolation and hydrologic connectivity will be investigated. Factors examined at an meso-scale will include variables on the surrounding landscape, within approximately 150 meters of the wetland boundaries. These factors will include surrounding soil composition, land use, and land cover.

INFLUENCE OF WETLAND PLANT COMMUNITY TYPES ON WATER QUALITY IMPROVEMENT IN NATURAL AND RESTORED WETLANDS OF THE MISSISSIPPI DELTA

Dr. Gary N. Ervin
Mississippi State University

Restoration of former agricultural land to wetlands, funded largely by government mechanisms such as the Wetlands Reserve Program (WRP) and Conservation Reserve Program (CRP) typically has focused on restoring functions such as water quality improvement and the re-establishment of former wetland habitat for wildlife. Existing literature is inconclusive as to the long-term success of these projects, but research often shows a sizable fraction of restored wetlands to exhibit substantially lower ecological functionality than nearby natural wetlands.

This project seeks to understand interactions between wetland function and wetland vegetation within the Mississippi portion of the Mississippi Alluvial Valley (MAV). Increasing allocation of land and money to conservation easements, along with an ever-increasing demand for quality agricultural land, make optimization of effectiveness and efficiency in land management decisions more important than ever. Unfortunately, little to no long-term monitoring has been conducted on many wetland restoration sites, leaving the ultimate outcome of restoration efforts unknown. A better understanding of the influence of factors influencing critical wetland functions, such as nutrient and sediment abatement, will permit more effective targeting of limited resources toward restoration of sites having characteristics most conducive to restoring desired wetland function.

During the summer of 2014, we assessed vegetation, land use, soils, and water quality in and around 24 restored and six natural wetlands across a gradient of human land use in the MAV. Results from that work revealed differences in soils and surrounding land use of natural versus restored wetlands but showed few differences attributable solely to a deductive classification of wetlands based on agricultural land use in the surrounding watershed. We also found that there is a great deal of variation in plant species among our study sites, and that types of plant species present vary between natural and restored wetlands, as well as among wetlands surrounded by different levels of land use intensity.

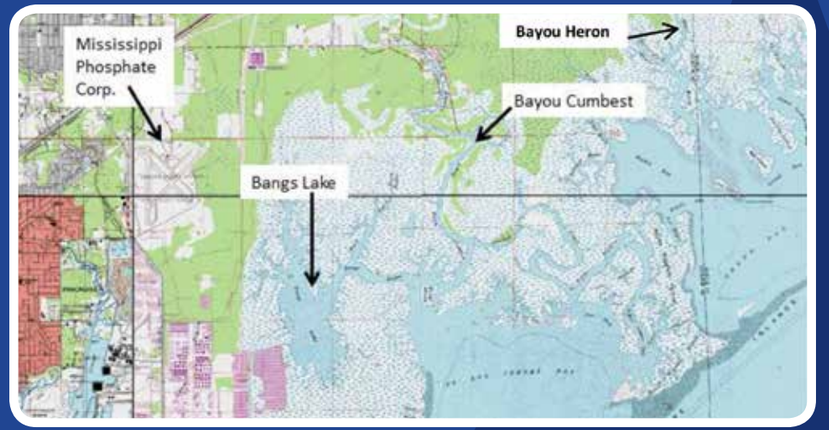
In an effort to quantify the specific linkages between wetland plants and water quality, we will assess vegetation and water quality improvement (nitrogen, phosphorus, and sediment reductions, in particular) in the same set of 30 wetlands. This research will examine interactions among water quality parameters and plant species to determine which plant species assemblages appear to most strongly influence nutrient and sediment abatement. The data gathered in the proposed project will improve our understanding of interrelationships between water quality improvement and particular plant species assemblages encountered in MAV wetlands. The expectation is that this information can be incorporated into the design of future restorations such that they can yield the greatest improvements in water quality while also providing other benefits, such as wildlife habitat, for the MAV.

WATER QUALITY IN BANGS LAKE: EFFECTS OF RECURRENT PHOSPHATE SPILLS TO A COASTAL ESTUARY: YEAR 2

Dr. Kevin Dillon
The University of Southern Mississippi

Two large phosphate spills have occurred from Mississippi Phosphate Corporation, a fertilizer production facility, to the Grand Bay National Estuarine Research Reserve's (GBNERR) Bangs Lake since 2005. Following these spills, phosphate concentrations in Bangs Lake surface waters rose from near zero to extremely high concentrations (as high as 7 mg L^{-1} or 225 μM) and pH dropped dramatically from an average of ~7.5 to near 3.7. Less dramatic changes in phosphate concentrations and pH were measured at other regularly sampled stations nearby, and large fish kills also occurred throughout the Reserve. Further, there is some evidence of potential continuous input of phosphate to Bangs Lake from smaller ongoing spills or dry deposition. These events and the obvious biological impacts to the waters of a protected national reserve warrant further investigation. The GBNERR has assembled a Phosphate Working Group (PWG) to investigate scientific questions related to these anthropogenic phosphate loadings. This working group includes members from the GBNERR, University of Southern Mississippi/Gulf Coast Research Lab, University of West Florida, Dauphin Island Sea Lab/University of South Alabama, and the Mississippi Department of Environmental Quality who are currently conducting MWRRI-funded research that assesses the water quality impacts of repeated phosphate spills on an otherwise relatively undisturbed estuarine ecosystem. With a second year of funding we will refine and build on our Year-1 research on the fate and effects of phosphorus loading to this estuary with additional targeted sampling and using multiple indicators of contamination.

This project will train six undergraduate students to collect and analyze water, sediment, and dry deposited particulates for phosphate concentrations in coastal ecosystems. These students will also measure chlorophyll *a* and determine the potential for sedimentary phosphate sequestration in the affected area. A graduate student from the University of West Florida with experience in nutrient analysis will be trained to coordinate and oversee much of the fieldwork conducted by the summer interns. In Year-2 we will refine and expand on our Year-1 research in three ways, including addition of: 1) an artificial tracer (fluorescein) study to directly visualize and track water movement in Bangs Lake to define likely areas of phosphate accumulation,



Map of the study sites, Bangs Lake and one reference site, Bayou Cumbest. The location of nearby gypsum stacks at Mississippi Phosphate Corporation are shown for reference.

2) Iron and trace element analyses to spatially and temporally trace phosphate spills through detection of the chemical signature of other contaminants in spill materials, and 3) continuation of work from Year-1 at new sampling stations chosen based on outcomes of the tracer study and results of Year-1 to better define locations of effects. Ongoing work continued from Year-1 will include sampling of sediment grain size, organic carbon and nitrogen content, phytoplankton and benthic microalgae concentrations, and porewater and water column nutrient analyses, which will be needed to support the newly proposed analyses and integrate the results of Year-2 with Year-1 data.

WATER QUALITY IN BANGS LAKE: EFFECTS OF RECURRENT PHOSPHATE SPILLS TO A COASTAL ESTUARY: FINAL REPORT

Dr. Kevin Dillon
The University of Southern

Bangs Lake, an estuarine water body in the Grand Bay National Estuarine Research Reserve, has been the site of three industrial phosphate spills from a nearby fertilizer plant since 2005. Due to restricted tidal exchange in Bangs Lake, these events have had long lasting effects on water column phosphate concentrations which may stimulate biological activity and alter the biogeochemical cycling of essential elements within the water column and the sediments. To determine the fate of excess phosphate from the industrial spills, researchers measured soluble reactive phosphate concentrations in sediment pore water and total particulate phosphate concentrations from sediment cores (0-25 cm depth) from four locations: North Bangs Lake (closest to spill locations), Bangs Lake, and two low impact reference sites (Bayou Cumbest and Bayou Heron). Researchers also conducted phosphate adsorption experiments and measured benthic chlorophyll concentrations with sediments from these sites to determine if the excess PO_4 was fertilizing benthic microalgae to determine the fate of this excess PO_4. Pore water phosphate concentrations were highest (21 uM) from 10 to 20 cm depths in North Bangs Lake cores however pore water from the surface sections of these cores had much lower phosphate concentrations (<0.5 uM). Pore water from the Bangs Lake cores consistently had elevated phosphate concentrations (2 to 5 uM) throughout the core length while pore water phosphate concentrations from one reference site were much lower (<0.7 uM), likely reflecting background levels. Phosphate adsorption experiments show that surface sediments from North Bangs Lake and Bayou Cumbest rapidly stripped phosphate from solution to final concentrations of <3 uM while surface sediments from Bangs Lake had greatly reduced phosphate adsorption capacity with much higher final concentrations (24 to 32 uM) indicating these sediments are nearing saturation. Sediment chlorophyll a concentrations were higher in Bangs Lake compared to the reference site. Sediment chlorophyll *a* was significantly correlated with extractable phosphate concentration in sediments ($r = 0.88$). In addition, grow out experiments with amendments of phosphorus to water and sediment samples stimulated the growth of cyanobacteria capable of fixing nitrogen.

Grand Bay National Estuarine Research Reserve. West over Bayou Heron "alligator alley" showing pilings from old logging road bridge in center of photo by National Oceanic and Atmospheric Administration.

TOWARDS AN UNDERSTANDING OF SURFACE AND GROUNDWATER EXCHANGE WITHIN TAILWATER RECOVERY SYSTEMS

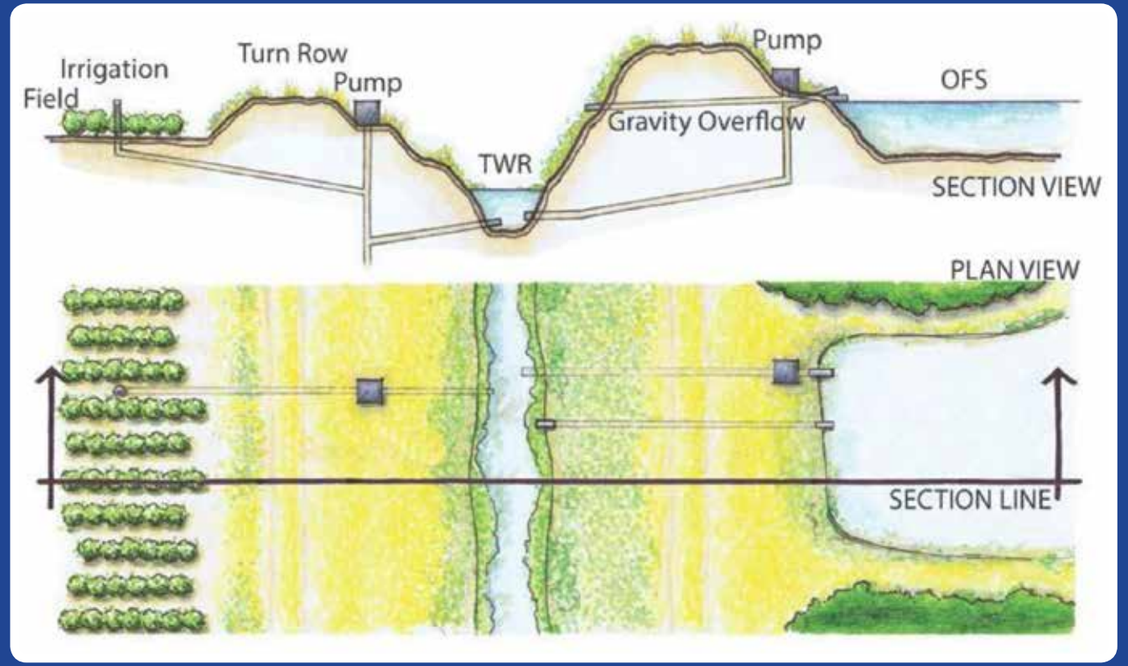
Dr. Joby Czarnecki
Mississippi State University

Dr. Beth Baker
Mississippi State University

Dr. Eric Dibble
Mississippi State University

Substantial withdrawals from the Mississippi Alluvial Aquifer for irrigation have resulted in a long-term trend of decreasing groundwater levels. Agricultural producers are adopting tailwater recovery systems, a best management practice for capturing surface water for re-use, but scientific data is lacking on the ability of these systems to mitigate aquifer depletion. One current area of interest is the potential for these systems to serve as a recharge mechanism. It is proposed that instrumenting tailwater recovery systems of varying age with piezometers, equipped with multiple loggers that measure temperature, atmospheric pressure, and depth, will provide data for a groundwater flow and heat transport model developed using VS2DH. Quantification of ground and surface water exchange could provide additional data for those tasked with estimating aquifer levels and assist policymakers in designing strategies and guidelines to appropriately manage this vital resource. An additional research question which will be pursued focuses on identifying any water quality impacts resulting from ground and surface water exchange.

Schematic of a tailwater recovery system and on-farm storage reservoir in section and plan view.



NON-LINEAR DOWNWARD FLUX OF WATER IN RESPONSE TO INCREASING WETLAND WATER DEPTH AND ITS INFLUENCE ON GROUNDWATER RECHARGE, SOIL CHEMISTRY, AND WETLAND TREE GROWTH

Dr. Gregg Davidson

University of Mississippi

Many oxbow lake-wetland systems in the Mississippi River floodplain are perched above the regional water table, resulting in a downward hydraulic gradient. Fine grained sediments that accumulate in these environments limit downward flow, but fallen tree trunks and limbs introduce heterogeneity and isolated pockets of higher hydraulic conductivity. Normally, flux is proportional to the gradient, but previous work suggested that the relationship between water depth and downward flow in these systems can be non-linear. Studies in Sky Lake, in the Delta region of Mississippi, have documented minimal vertical movement of water until a threshold water depth is reached. Above the threshold, abrupt changes in soil chemistry have been observed as water begins moving downward, which may in turn influence the growth of wetland trees. The role of oxbow lakes as points of groundwater recharge is also largely unknown. Though oxbow-lake bottom-sediments typically serve as barriers to flow, the heterogeneity that exists in the wetland perimeters may provide conduits for vertical flow that bypasses the surficial clay and silt deposits.

This project focused on the influence of changing water depth in Sky Lake, MS, in Humphreys County, where an elevated boardwalk into the heart of an old-growth bald-cypress wetland made it possible to mount equipment for long-term monitoring of a variety of environmental parameters. The study focused on both the identification of non-linear responses to changing water depth, and its potential impact on tree growth and groundwater recharge. Possible non-linear downward flux in response to increases in wetland water depth was investigated using a series of redox probes at two depths in the sediment to monitor changes in redox potential that might accompany changes in water depth. Significant downward flow of oxygenated surface water should result in a shift to higher redox potentials. The impact on bald-cypress tree growth was assessed using two sets of tree measurements: radial growth and sap flow rates. In order to link any changes in tree growth to water level, a series of additional variables were also measured that could also influence growth and mask a water-depth effect. These included temperature, relative humidity, and precipitation. Groundwater response was monitored by measuring the level of water in an abandoned irrigation well in the center of the oxbow meander loop.

Photos of the Boardwalk by Wildlife Mississippi

HYPOXIA TASK FORCE

Mississippi State University and 11 other land-grant universities recently joined a national effort to improve water quality in one of the nation's most significant watersheds. The Mississippi River/Gulf of Mexico Watershed Task Force partnered with nongovernmental agencies for the first time when it invited university scientists and Extension specialists to share their research findings and ideas for reducing water pollution.

"Mississippi State University and the other land-grant universities can provide substantive capacity in addressing nutrient management and environmental quality," said Wes Burger, associate director of the Mississippi Agricultural and Forestry Experiment Station and the Forest and Wildlife Research Center. "Through this new collaborative, the nutrient management practices and decision support tools developed through research conducted by our scientists will help to inform the recommendations of the Hypoxia Task Force."

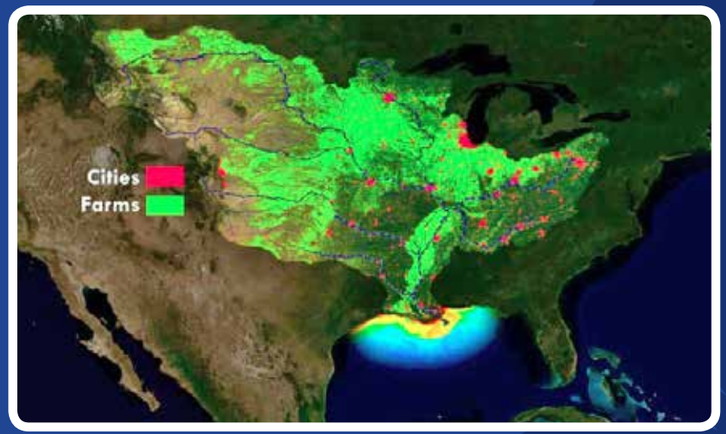
"These practices and strategies can then be delivered through educational programs by Extension Service specialists in support of state and regional nutrient-reduction goals," he said.

The task force was founded in 1997. It is a partnership of federal agencies, including the U.S. Environmental Protection Agency, U.S. Department of Agriculture, the U.S. Army Corps of Engineers, Native American tribes, and environmental quality, agricultural, and conservation agencies from the 12 basin states. Together, members of the task force work to address nutrient pollution and low oxygen levels, or aquatic hypoxia, in the Gulf of Mexico. Run-off from non-point sources, including agricultural land, is a primary contributor of excess nutrients that impair freshwater bodies and cause hypoxia in the northern Gulf of Mexico.

Each summer, a "dead zone" about the size of Massachusetts forms in the Gulf of Mexico, with oxygen levels so low the water cannot sustain most marine life. To reduce the size and severity of hypoxia in the northern Gulf of Mexico, the task force seeks to reduce nutrient inputs to the Gulf by 40 percent. Achieving this goal will require Mississippi River Basin-wide nutrient management.

MSU has existing research and outreach programs related to soil conservation and water quality, such as the Research and Education to Advance Conservation and Habitat (REACH) program. This program highlights the successful conservation practices agricultural producers have implemented around the state and connects producers with university experts who can help them preserve Mississippi's natural resources.

REACH is a collaboration of the MSU Extension Service, the Mississippi Agricultural and Forestry Experiment Station, and the Forest and Wildlife Research Center.



Depiction of Gulf of Mexico Hypoxia Zone by the National Oceanic and Atmospheric Administration

EPA RAINWORKS CHALLENGE

With a $20,000 U.S. Environmental Protection Agency grant, Mississippi State is creating a green infrastructure demonstration project. A collaborative effort between faculty and students in the university's landscape architecture, civil and environmental engineering, and art departments, the project involves construction of a 1,500 square-foot bioretention basin—rain garden—that will be the first of its kind on campus.

Cory Gallo said the rain garden is being located in the courtyard of the landscape architecture department where he is an associate professor.

The basin is being designed to treat at least 95 percent of the average, annual rainfall for the watershed it will manage. It also will be equipped with two educational kiosks to help visitors better appreciate the facility's function and benefit to water quality.

Green infrastructures reduce the volume of stormwater discharges by managing rainwater close to where it falls and removing many of the pollutants present in runoff, making it an effective strategy for addressing wet-weather pollution and improving water quality, according to EPA officials.

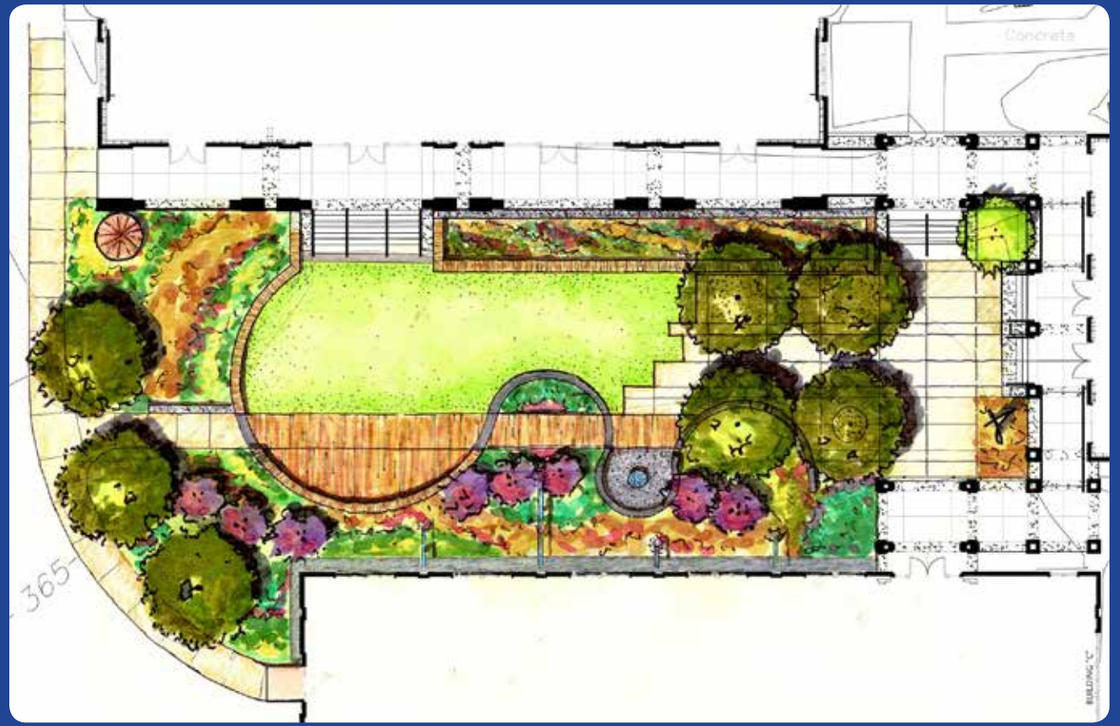
In addition to providing participating academic majors with valuable training and experience in the benefits of green infrastructure technologies, the project "hopefully will lead to the campus-wide adoption of green infrastructure technologies," Gallo said.

"By educating current and future practitioners on green infrastructure technologies and their applicability to the South, this effort also will be a regional resource for policymakers to learn about and promote green infrastructure in their communities," he emphasized.

The stormwater mitigation plan was conceived several years ago by a team of MSU landscape architecture, civil engineering and graphic design majors. Their efforts were recognized with a second-place award in the 2013 EPA Campus RainWorks Challenge. See water.epa.gov/infrastructure/greeninfrastructure/crw_challenge.cfm.

Throughout the current academic year, three original team members will continue working on the project, Gallo said. Student participation is essential since the rain garden primarily is being designed, built, maintained, and monitored through classroom activities, he explained.

Gallo worked with assistant professors Gnaneswar Gude of the civil and environmental engineering department and Suzanne Powney of the art department to prepare and submit the grant proposal through the MSU-based Mississippi Water Resources Research Institute.



A rendering of the campus demonstration project.

FUTURE PLANS

REDBUD-CATALPA CREEK WATERSHED PROJECT

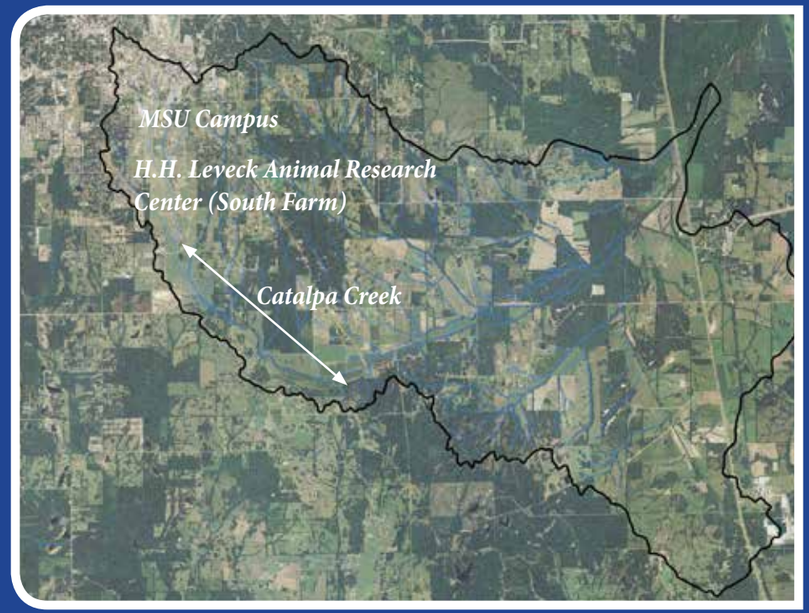
A significant portion of Mississippi State University's (MSU) campus and property resides within the Redbud-Catalpa Creek Watershed. This includes important MSU education and research facilities, such as the Mississippi Agricultural and Forestry Experiment Station's (MAFES) H.H. Leveck Animal Research Center, commonly called South Farm, which is used by numerous departments and programs. Unfortunately, some of MSU's land uses in this watershed may be contributing to the pollution of Catalpa Creek. Total Maximum Daily Load (TMDL) studies that apply to this watershed include those for sediment, nutrients, and pathogens. Each of these TMDLs recommend practices to reduce pollutant loadings to acceptable levels thereby providing improved habitat for the support of aquatic life and allowing for the attainment of applicable water quality standards.

The Mississippi Water Resources Research Institute, in its role as a Center of Excellence for Watershed Management, is advantageously positioned to bring resources together from various MSU departments and programs, nongovernmental organizations, and state and federal agencies to address the needs within the Redbud-Catalpa Creek Watershed. This project will not only put appropriate BMPs on the ground in strategic locations in the watershed to restore water quality and habitat, but also establish a venue for watershed-based demonstrations, research, education, application and management.

The vision of the Redbud-Catalpa Creek Watershed Project is to restore and protect the ecosystem health, ecosystem services and quality of life, and water resources of the watershed; develop an informed citizenry in the watershed and beyond; and create experiential learning activities for students and educators. The desired outcomes of this vision are identified below:

- Ecosystem Health – restoring and protecting the biological integrity and ecological functions of the watershed, and restoring stream hydrology and geomorphology;
- Water Resources – reducing pathogen, nutrients, and sediment loads in order to attain the applicable water quality standards and protect the watershed;
- Quality of Life – maintaining the quality of life for stakeholders in the Redbud-Catalpa Creek Watershed in the event of land use changes;
- Experiential Learning – creating and facilitating experiential learning opportunities for university students and faculty, secondary educators and students, and others through projects, workshops, and camps;
- Collaboration – fostering collaboration and leveraging among university departments and programs, state and federal agencies, stakeholder organizations, and watershed stakeholders; and
- Sustainability – advancing sustainable watershed management applications for the agricultural and urban environments.

Redbud-Catalpa Creek Watershed on the Mississippi State University campus.



D.R.E.A.M.S.

demonstration, research, education, application, management, sustainability

The establishment of a Watershed Demonstration, Research, Education, Application, Management, and Sustainability (D.R.E.A.M.S.) Center on Mississippi State University's H.H. Leveck Animal Research Center, commonly called South Farm, will serve as a showcase for watershed management in the state and southeast through the implemented watershed-based activities and best management practices in the Redbud-Catalpa Creek Watershed. This facility 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.

The center will:

- Demonstrate the effectiveness of innovative and established sediment, nutrient, pathogen, and other Best Management Practices (BMPs);
- Demonstrate innovative conjunctive 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.

QUANTIFYING THE BENEFITS AND COSTS OF NUTRIENT REDUCTION IN AGRICULTURAL PRODUCTION PRACTICES IN MISSISSIPPI USING LOCATION-BASED WHOLE FARM BUDGETS

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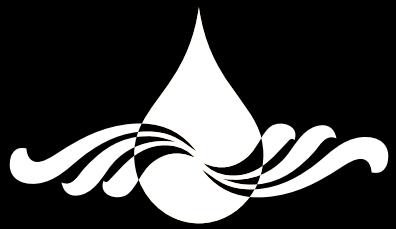
What are the actual benefits and costs of nutrient reduction in agricultural settings in Mississippi? This is potentially a multi-billion dollar question. Although predictive models have been built at various scales in attempts to answer this question, no project has been developed and implemented that provides real answers to the question. This proposal is designed to do exactly this through assimilating actual, documentable cost and financial information related to implementing state-level nutrient reduction strategies and management practices in Mississippi and providing analyses from various perspectives to better understand the relevance of the benefits from adopting best management practices (BMPs) as well as any costs, both fixed and variable. In this project, nutrient reduction goals (percent reduction) determine in part the benefits and costs of adopting BMP's to meet specific targeted nutrient reduction goals.

The products, information and analyses generated will be of significant interest and used to educate state and federal policy-makers, regulators, planners, managers and other stakeholders throughout Mississippi, across the Gulf of Mexico and throughout the Mississippi/Atchafalaya River Basin (MARB), including members of the Gulf of Mexico Alliance and Hypoxia Task Force. We propose the development of a set of whole farm budgeting tools that can be used to estimate the benefits and costs of reducing nutrients in agricultural settings in Mississippi. The budgets will be flexible and provide a wide range of available BMP options as well as documenting the associated benefits and costs of adopting BMP's per nutrient reduction goals. Depending on nutrient reduction goals, whole farm budgets will be developed for various agricultural production practices that adopt cost effective BMP's. The budget tool will be flexible to examine various agricultural production choices by producers as well as alternative time horizons for budgets including one, three, five and ten year planning budgets. The budgets can be used by policy-makers, regulators, planners, managers and other stakeholders across Mississippi to learn how adopting specific nutrient reduction goals can impact the benefits and costs of nutrient reduction across agricultural production practices statewide. One of the products proposed should be of special interest to producers as a smart phone application that will allow agricultural producers to access educational information about benefits and costs per acre when adopting strategies to reduce nutrients. By having this information, it is felt that adoption of nutrient BMP's will be modernized and perhaps more easily understood among agricultural producers.



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