



2017 Request for Proposals

The Mississippi Water Resources Research Institute (MWRRI) invites proposals for water research from faculty and staff at any Mississippi research university. Key areas for this year's priority research have been identified below. Non-tenured faculty members are strongly encouraged to submit proposals. The MWRRI strongly encourages applicants to collaborate with local, state, and federal agencies.

Research Priority Areas

- ❖ **Climatic Water Research Topics**
 - Predictions of future water needs in various regions of the State under various climatic and/or pumping scenarios
 - Innovative water capture techniques and applications
- ❖ **Groundwater Research Topics**
 - Innovative approaches to estimate aquifer recharge
 - Development of water budgets
 - Determining aquifer transmissivities and characteristics
- ❖ **Surface Water Research Topics**
 - Evaluation of BMP Effectiveness, Site Placement, Reliability, and Maintenance
 - Research and Development to Support Water Quality and Ecosystem Health Assessment Applications
 - Identification of Appropriate Response Measures for Mississippi's Waters and Linkage between Nutrient Concentrations and the Identified Response Measures
 - Analysis of Nutrient Loading Trends
- ❖ **Coastal-specific Research Topics**
 - Harmful Algal Bloom and Early Pathogen Detection Research for Mississippi Coastal Waters
 - Various Topics (see Full Descriptions)
- ❖ **Water Use Efficiency and Water Reuse Research Topics**
 - Water Reclamation and Reuse
 - Water Use Efficiency
- ❖ **Drinking Water and Waste Water Research Topics**
 - Mitigation of Lead Corrosion in PWSs
 - Protection of Source Water Resources
 - Innovative and Affordable Waste Water Treatment for Small Communities
- ❖ **Modeling and Tool Development**
 - Development of models and tools
- ❖ **Social Sciences Research**
 - Development of social indicators
 - Development of social science applications to advance water resource management

❖ **Economics Research**

- Economic analysis of reducing nutrient loadings

❖ **Emerging and Innovative Technologies**

- Current and potential use of Unmanned Aerial Vehicles (UAVs)

The Water Resources Research Act of 1984 requires that federal funds (USGS) be matched by at least two non-federal dollars for each federal dollar. MWRRRI, using USGS funds, will provide approximately \$45,000-\$55,000. MWRRRI state appropriation funds, if available, will be provided as much as possible to help individual researchers to achieve their match requirement. Each research proposal must provide the remaining cost share match requirement not provided by MWRRRI. Instructions and other relevant information concerning proposals are attached to this memorandum. Please share the materials with others who may be interested in having a project considered for funding.

A more-detailed description of all ten (10) water priority areas can be found at the back of the proposal beginning on page 15.

Note: Proposal funding is contingent upon funds being made available by the USGS and the State of Mississippi.

Timeline

September 1, 2016	RFP released.
October 31, 2016	Proposals due in the MWRRRI Office (311 Bost) by 5:00 p.m.
November 18, 2016	MWRRRI Advisory Board completes evaluation/grading.
November 28, 2016	Applicants notified of results and any modifications needed.
December 5, 2016	Revised final proposals returned to Institute if requested.
January 13, 2017	Final MWRRRI program package submitted to USGS.
March 1, 2017	Projects begin (assuming the federal budget has been signed).
June 12, 2017	Recipients notified of the amount of state appropriations available for cost share for their project.
July 1, 2017	If available, state appropriations distributed for WRRRI cost share requirements.



MEMORANDUM

TO: Deans, Directors, and Department Heads
Principal Investigators and Other Researchers
Mississippi Water Resources Research Institute Advisory Council

FROM: Cary "Bill" W. Herndon, Jr., Interim Director

SUBJECT: RFP, 2016 Annual Competitive Grants Program

DATE: September 1, 2016

The Institute is issuing its request for proposals (RFP) for the research year beginning March 1, 2016. Please email one electronic proposal copy (a single file in WORD format) **that has been reviewed and approved by the Office of Sponsored Programs** to Jessie Schmidt at jessie.schmidt@msstate.edu to the Institute office to be received by **5:00 p.m. October 31, 2016**.

Note: Federal support for the selected proposals is dependent on availability of USGS funding.

Scope of Work, research, other activities; cooperation and coordination:

Proposals should be for applied research, information transfer, information management systems, education, or other work that fosters the research priorities shown on page 15 and also advances

- the entry of new research scientists, engineers, and technicians into the water resources field;
- the dissemination of research results to water managers and the public; and
- close cooperation with other colleges and universities in the State that have demonstrated capabilities for research, information dissemination, and graduate training in order to develop a statewide program designed to resolve State and regional water and related land problems.

Source: 42 USC Sec. 10303(b), Chapter 109 – Water Resources Research Act, amended 2006 (Public Law 109-471) and signed into law on January 11, 2007 by President Bush.

The Water Resources Research Act of 1984, as amended, (42USC1031 et seq.) requires that federal funds be matched by at least two non-federal dollars for each federal dollar. The MWRRRI may provide a portion of the required cost share from funds appropriated to the Institute from the State of Mississippi. The extent of the Institute's contribution to cost share depends upon the amount of funds received from the state appropriation and the number of proposals funded. If MWRRRI experiences any reduction in its appropriated budget, then awarded project budgets will be reduced.

A written cooperator commitment to contribute non-federal funds is required if using third-party cost share. Two points of clarification: 1) you cannot use federal funds or federal in-kind services to match these federal funds, and, 2) **3rd party cash and in-kind contributions from state, regional or local businesses, agencies, and non-profit organizations can be used for cost share and will increase a proposal's ranking in the evaluation process.** The recipients will be required to fully and accurately document the cost share. Please contact us if you need assistance in identifying potential cooperators. Proposal format changes reflecting this new emphasis are bolded in the instruction.

Proposals must be complete and must have been reviewed by your sponsored programs or contracts and grants office when they are submitted. Proposals from any college or university in the state addressing Mississippi's water resource needs will be considered. Please remember that your proposal will be evaluated and scored by the Institute's Statewide Advisory Council and not a technical peer review panel. As such, in writing your proposal, please write to a general audience as Council members may not necessarily be experts in your particular field.

Multiple year proposals not exceeding two years will be considered, but it must be understood that **successful multiple year projects must reapply for funding annually.** The Institute is not required to give any preference to continued funding of multi-year projects. Instructions and other relevant information concerning proposals are attached to this memorandum. Please share the materials with others who may be interested in having a project considered for funding.

For your information, a copy of the Project Proposal Grade Standards (Evaluation Form) is attached. The Institute Advisory Committee, in their evaluation and ranking of the proposals, uses this form.

The MWRRRI strongly encourages applicants to seek third party cost share from outside local, regional and state agencies. In addition, to help leverage the MWRRRI's state appropriation, proposals which include some amount of cost-share from state, regional or local businesses, agencies, or non-profit organizations are given a priority in the evaluation process.

1. Is there a letter of support/cooperation from a state, regional or local agency?
2. Is there documentation of Contribution of Cost-Share from a state, regional or local agency?

**INSTRUCTIONS FOR THE PREPARATION OF PROPOSALS FOR THE
STATE WATER RESOURCES RESEARCH PROGRAM: FY 2017**

Proposal deadline is 5:00 PM, October 31, 2016

This year's RFP is being issued before we receive formal notification of funding from the U.S. Geological Survey (USGS) headquarters. While we do not anticipate any significant changes to the program's terms, conditions, deadlines or availability of funds, awards will be contingent upon available funding. You will be notified immediately of any significant changes. This provides guidance for preparing proposals for the Institute's annual U.S. Geological Survey research program. The 2017-2018 MWRRI Research Program's timetable is:

September 1, 2016	RFP Released
October 30, 2015	Proposals due in the MWRRI Office (311 Bost) by 5:00 p.m.
November 18, 2016	MWRRI Advisory Board completes evaluation/grading
November 28, 2016	Applicants notified of results and any modifications needed
December 5, 2016	Revised final proposals returned to Institute if requested
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Special Provisions

The following special provisions are issued by the USGS to guide the MWRRI in preparing the annual program package. They are included here for your information in developing your proposal and are subject to revisions by the USGS.

1. Performance Period: The period of performance of the project will be March 1, 2017 through February 28, 2018. Short **(1-2 pages)** quarterly reports are required, and PIs will submit draft copies of interim/completion reports which will be compiled and uploaded for required reports to USGS.
2. Participation Requirement
 - (a) Institutes may only consider project proposals from faculty members or affiliates at institutions of higher learning in the state.
 - (b) Institutes shall not submit proposals from any investigator who has not met reporting requirements for projects funded by a prior formula grant administered by the Department of the Interior.
3. Non-Federal Funds
 - (a) The non-federal portion must be \$2.00 for every \$1.00 federal.

NOTE: The Institute anticipates that some State appropriations will be available. In the event that State appropriations are not adequate to cover the non-federal share, other cost share contributions must be generated, thus the submitter's cognizant department/agency must be prepared to cover all cost share.

- (b) **If using third-party cost-share, one or more letters of commitment from state, regional or local business, agency, or non-profit organization are required.**
4. Charges Allowable to Federal Funds
- (a) Costs will be allowed in accordance with OMB Circular A-21, revised, "Cost Principles for Educational Institutions," on file in your university's contract office or available online at whitehouse.gov/omb/circulars.
- (b) The portion of benefits paid to individuals cannot exceed the proportion of their salaries paid from the grant.
- (c) **Indirect costs may not be charged on the federal funds provided by the Department of Interior; however, they are chargeable to the total direct costs and should be shown in the non-federal column.** The Geological Survey will accept indirect cost rates approved by the cognizant agency in accordance with OMB Circular A-88.
- Note: A copy of the approved rate agreement or other approving documentation must be attached to proposals from universities other than MSU.**
5. Program Funds Management: Funds available to the Institute (both Federal and State appropriations) will be applied to projects as available. **In the event that State appropriations are not adequate to cover the non-federal share, other cost share contributions must be generated, thus the submitter's cognizant department/agency must be prepared to cover all cost share.**

PROPOSAL APPLICATION FORMAT INSTRUCTIONS

The application shall be prepared in accordance with the following instructions.

The proposal consists of the following 20 elements. The synopsis (first 11 elements) **cannot exceed 2 pages**. Begin a new page with element 12 (Nature, scope, and objectives of the research).

1. **Title.** Concise but descriptive.
2. **Project Type.** Choose from the following: Research, Information Transfer, Information Management System, Education, or Other (please specify).
3. **Focus Categories.** List a maximum of three focus categories, with the most relevant focus category first. A list of focus categories is provided on page 13. Enter the abbreviations in capital letters separated by commas.
4. **Research Category.** Choose from the following selections the one category that most closely applies: Social Sciences, Ground-water Flow and Transport, Water Quality, Biological Sciences, Engineering, or Climate and Hydrologic Processes.
5. **Keywords.** List descriptor words, separated by commas. Select words from the attached list of keywords (see page 13).
6. **Start Date.** Enter the actual beginning date for the project on or after March 1, 2017.
7. **End Date.** Enter the estimated end date for the project on or before February 28, 2018.
8. **Budget Breakdown.**

- **Federal** funds requested
- **Non-Federal** (matching) funds pledged and **cooperator contribution**.
- Please include a separate budget and justification along with the cooperator contribution letter at the end of the proposal submission. See pages 11 and 12 for an example of the budget format and include a budget justification for salaries (full-time and student), fringe benefits (full-time and student), tuition, travel, supplies (commodities), services (contractuals), equipment, and indirect costs.

Fiscal year 2017 Federal funds: _____

Non-Federal funds allocated: _____ (_____) (_____) (_____) _____
 (Total) Direct Indirect Cooperator
 Contribution

Project Total:

9. **Principal investigator(s).** Provide name, academic rank, university, email address and phone number of the principal investigators.
Cooperator (please attach an official letter of cooperation including a firm commitment to contribute non-federal funds or in-kind support for the project).

10. **Congressional District** of the university where the work is to be conducted.

11. **Abstract.** Provide a brief (one-page) description of the problem, methods, and objectives.

Note: Begin a new page with Item 12. Items 12-19 shall not exceed 10 single-spaced pages, 12 point font, exclusive of resumes.)

12. **Title.** Please use the same title as was entered in #1.

13. **Statement (2 paragraphs maximum) of regional or State critical water problem.** Include an explanation of the need for the project research, who wants it, and why. Specify the priorities addressed.

14. **Statement (2 paragraphs maximum) of the results, benefits, and/or information** expected to be gained during the performance period and by the end of the project, if of longer duration, and how they will be used. Discuss manner and amount parties will cooperate.

15. **Nature, scope, and objectives of the project, including a timeline of activities.**

16. **Methods, procedures, and facilities.** Provide enough information to permit evaluation of the technical adequacy of the approach to satisfy the objectives.

17. **Related Research. (research projects only)** Show by literature and communication citations the similarities and differences of the proposed project to completed or on-going work on the same topic.

18. **Training potential.** Estimate the number and class rank of graduate and undergraduate students, by degree, who are expected to receive training during the project.

19. **Investigator's qualifications.** Include resume(s) of the principal investigator(s). No resume shall exceed two pages or list more than 15 pertinent publications.

20. Attach Budget Breakdown (see example for budget preparation on page 11), Budget Justification, Cooperator letter(s), and Information Transfer Plan.

The Information Transfer Plan (up to two pages) should discuss plans for disseminating information on the results of the research and promoting their application. Each plan shall:

1. Define the subject matter and the problems to be addressed.
2. Identify the target audience.
3. Indicate the strategies to be employed; e.g. workshops, publications.
4. Identify the cooperators (e.g., Cooperative Extension service, external agencies).

Budget. Submit a detailed budget for each proposal, which includes the following line items. (Indicate the amount of cost sharing for each element):

Cost category - Allocate Federal and non-Federal costs.

I. Direct Costs.

- a. Direct costs are those costs which can be identified specifically with a particular research project, an instructional activity, or any other institutional activity, and which can be directly assigned to such activities relatively easily with a high degree of accuracy.
- b. Identifiable benefit to the research work rather than the nature of the goods and services involved are the determining factor in distinguishing direct from indirect costs of research agreements. Typical transactions chargeable to a research agreement as direct costs are the compensation of employees for performance of work under the research agreement, including related staff benefits and pension plan costs to the extent that such items are consistently treated by the educational institution as direct rather than indirect costs; the costs of materials consumed or expended in the performance of such work; and other items of expense incurred for the research agreement, including extraordinary utility consumption. The cost of materials supplied from stock or services rendered by specialized facilities or other institutional service operations may be included as direct costs of research agreements provided such items are consistently treated by the institution as direct rather than indirect costs and are charged under a recognized method of costing or pricing designed to recover only actual costs and conforming to generally accepted cost accounting practices consistently followed by the institution.

II. Indirect costs (non-Federal share only). Indirect costs are those that have been incurred for common or joint objectives and therefore cannot be identified specifically with a particular research project, an instructional activity, or any other institutional activity. At educational institutions such costs normally are classified under the following functional categories:

- a. General administration and general expenses;
- b. Research administration expenses;
- c. Operation and maintenance expenses;
- d. Library expenses; and
- e. Departmental administration expenses.

Note: Indirect costs are allowed under the non-Federal cost category only.

1. **Salaries and Wages.** Identify the individuals and categories of salaries and wages, estimated hours or percentage of time, and the rate of compensation proposed for each individual or category. (Tuition remission and other forms of compensation paid as or in lieu of wages to students performing necessary work are allowable provided that the tuition or other payments are reasonable compensation for the work performed and are conditioned explicitly upon the performance of necessary work.) If the rate of pay shown is higher than the current rate of pay, include an explanation.
2. **Fringe Benefits.** Propose rates/amounts in conformance with normal accounting procedures. Explain the costs and the basis of the rate computations. Indicate whether the rates are used for application purposes or whether they are fixed or provisional rates for billing purposes.
3. **Supplies.** Indicate separately the amounts estimated for office, laboratory, computing, and field supplies. Provide detail on any specific item which represents a significant portion of the proposed amount. If fabrication of equipment is proposed, list parts and materials required for each, and show costs separately from the other items. (Follow Mississippi's rules and regulations (Asset Codes 710 through 799) for equipment purchases but show here if the amount is over \$500 but under \$5,000.)
4. **Equipment.** Identify nonexpendable personal property (Asset Codes 710 through 799) having a useful life of more than 2 years and an acquisition cost of more than \$5,000 per unit.
5. **Services of consultants.** Identify the specific project numbers for which these services would be used. List the contemplated consultants (including sub recipients), the estimated amount of time required, and the quoted rate per day or hour. State whether the consultant's rate is the same as s/he has received for similar services under other government awards.
6. **Travel.** All estimated costs should be itemized showing the number of trips required, type of trip (field, scientific meeting, or conference attendance), the destinations, the number of people traveling, the per diem and local reimbursement rates allowed by the applicant's organization, and any miscellaneous expenses for each trip.
7. **Other direct costs.** Itemize the costs not included elsewhere; e.g., shipping, telemetry, computing, equipment-use charges, age dating, or other services. Provide breakdowns showing how the cost was estimated; e.g. computer time should show the type of computer, the estimated time of use, and the established rates.
8. **Total direct costs.** Total (1) through (7).
9. **Indirect costs.** Specify the indirect costs in the non-Federal column only based on the applicant's approved rate agreement. An amount equivalent to what the indirect costs would have been under the federal portion may also be included as match under the indirect cost in the non-federal portion.
10. **Total estimated costs.** Total (1) through (8) for Federal and (1) through (9) Non-Federal

Sample Budget Form

Project Title:

Cost Category	Federal Contribution (up to \$25K)	State/WRRRI Contribution (up to \$25K)	Non- Federal Contribution (University)	Non- Federal Contribution (3rd Party)	Total
1. Salaries and Wages	\$	\$	\$	\$	\$
-					
-					
-					
-					
Total Salaries and Wages					
2. Fringe Benefits					
- full time employees					
- students					
- tuition					
3. Supplies*					
4. Equipment (> \$5,000)					
5. Services or Consultants					
6. Travel					
7. Other direct costs					
8. Total direct costs					
9a. Indirect costs on federal share					
9b. Indirect costs on non-federal share					
10. Total estimated costs					
Total Costs at Mississippi State on which the Institute or Center is located					
Total Costs at other University Campus Name of University	\$	\$	\$	\$	\$

*** Equipment costs greater than \$500 and less than \$5,000 are charged to supplies.**

Finally, a breakdown of the budgeted funds shown in elements 5 and 6 should be on a separate page.

At the present time, the bottom line (10) must show at least \$1.00 non-federal and \$1.00 State/WRRRI (total of \$2.00) for \$1.00 federal. The Institute hopes that some legislative appropriations will be available. In the event they are not, or they are inadequate to cover the required cost share, you must rely on department assistance.

If you are proposing a project of more than one-year duration, conclude with the statement:

Estimated Budget: Year 2 \$ _____

Negotiated indirect cost rate agreement. Attach a copy of the approved negotiated indirect cost rate agreement if you are not at Mississippi State University.

Budget Form Example (For help in preparation only. Many other combinations are possible)

Project Title: **Example Project Using MSU Rates**

Cost Category	Federal Contribution (up to \$25K)	State/WRRI Contribution (up to \$25K)	Non- Federal Contribution (University)	Non- Federal Contribution (3rd Party)	Total
1. Salaries and Wages	\$	\$	\$	\$	\$
- Professor			9,800		
-					
- Grad Student Scholar	5,000				
- Undergrad Student		3,000			
Total Salaries and Wages	5,000	3,000	9,800		17,800
2. Fringe Benefits					
- full time employees 36.13%			3,540		3,540
- students .66% ** (insur- \$104)	330	20			350
- tuition \$863/mo (4 mo) **	3,868				3,868
3. Supplies*		2,800			2,800
4. Equipment (>\$5000)	10,000				10,000
5. XYZ Corporation Sponsor				10,000	10,000
6. Travel		4,000			4,000
7. Other direct costs					
8. Total direct costs	19,198	9,820	13,340	10,000	52,358
9a. Indirect costs on federal share @ 45.5% (less equipment + tuition)	XXXXXXX	2,425			2,425
9b. Indirect costs on state/WRRI share @ 45.5%	XXXXXXX	4,468			4,468
10. Total estimated costs	\$19,198	\$16,713	\$13,340	\$10,000	\$59,251
Total Costs at Mississippi State on which the Institute or Center is located	\$19,198	\$16,713	\$13,340	\$10,000	\$59,251
Total Costs at other University Campus Name of University	\$	\$	\$	\$	\$

* Equipment costs greater than \$500 and less than \$5,000 are charged to supplies.

** Fringe and tuition follow salary

Finally, a breakdown of the budgeted funds shown in elements 5 and 6 should be on a separate page.

At the present time, the bottom line (10) must show at least \$1.00 non-federal and \$1.00 State/WRRI (total of \$2.00) for \$1.00 federal. The Institute hopes that some legislative appropriations will be available. In the event they are not, or they are inadequate to cover the required cost share, you must rely on department assistance.

If you are proposing a project of more than one-year duration, conclude with the statement:

Estimated Budget: Year 2 \$ _____

Negotiated indirect cost rate agreement. Attach a copy of the approved negotiated indirect cost rate agreement if you are not at Mississippi State University.

Key Words

Climate – historic record of climatic conditions; comparison of past climate trends to variations in groundwater and surface water demands; projections of future climatic conditions.

Groundwater – innovative approaches to estimate aquifer recharge; spatial and depth variabilities of aquifer transmissivities and other characteristics.

Surface Water – performance and effectiveness of innovative and established nutrient, sediment, bacteria, and storm water management methodologies, and small community wastewater treatment technologies; linkages between N and P concentrations and ecosystem response variables; analysis of point source nutrient loading trends.

Water Reuse and Conservation – innovative wastewater treatment technologies and reuse applications; effective irrigation efficiency and conservation methods; innovative irrigation runoff reclamation and reuse methods.

Protection of Source Water – delineation of source water protection areas, identification of potential sources of contamination, assessment of threats, and contingency planning.

Social Science – stakeholder perceptions and beliefs at the individual, local and regional levels related to water resources issues; social indicators to identify the potential for and evaluate the success of watershed management projects and to build effective education and outreach.

Modeling and Tool Development – prediction of future impacts of climatologic change, water use changes, social drivers, and proposed infrastructure on water resources.

Focus Categories

Acid deposition	ACD
Agriculture	AG
Climatological processes	CP
Conservation	COV
Drought	DROU
Ecology	ECL
Economics	ECON
Education	EDU
Floods	FL
Geomorphological processes	GEOMOR
Geochemical processes	GEOCHE
Groundwater	GW
Hydrogeochemistry	HYDGEO
Hydrology	HYDROL
Invasive species	INV
Irrigation	IG
Law, institutions, and policy	LIP
Management and planning	M&P
Methods	MET
Models	MOD
Nitrate contamination	NC
Non point pollution	NPP
Nutrients	NU
Radioactive substances	RAD
Recreation	REC
Sediments	SED
Solute transport	ST
Surface water	SW
Toxic substances	TS
Treatment	TRT
Wastewater	WW
Water quality	WQL
Water quantity	WQN
Water supply	WS
Water use	WU
Wetlands	WL

Project Proposal Grade Standards

Reviewer Name: _____

NOTE: Conflict of Interest: Please do not review this proposal if you have an institutional or consulting affiliation with the submitting institution, applicants or collaborators, or will gain some benefit from the funding of the project, financial or otherwise. Please do not review this proposal if you have collaborated on a research project or been a co-author with the submitting applicants and collaborators within the past four years. We will ask you to leave the room when the review is conducted. This will ensure that we do not have any conflict of interest in the awarding of any submitted proposal.

Proposal Review Criteria: Please provide a concise summary of the merit of the proposed work, qualifications of the investigators, originality of approach, and probability of success. Please use the following rating scale (one point being the lowest, five points being the highest) in ranking the proposal in the following areas:

	1	2	3	4	5
Addresses defined priority topic	___	___	___	___	___
Clearly defines results or benefits	___	___	___	___	___
Scope and timeline of project are reasonable	___	___	___	___	___
Methods and procedures are clearly defined	___	___	___	___	___
Investigator(s) is/are qualified to conduct research	___	___	___	___	___
Has potential to result in other funded research	___	___	___	___	___
Significant collaboration with local, state, federal agencies	___	___	___	___	___
Graduate students are included on proposal	___	___	___	___	___

Total Points: ___

Comments:

2017 MWRRI Water Resources Research Topics (Full Descriptions)

Climatic Water Research

- Predictions of Future Water Needs in Various Regions of the State under Various Climatic and/or Pumping Scenarios
 - Changes have occurred in the amount of rainfall, variability, and recurrence in the past and will occur in the future. Comparison of past climate trends to variations in groundwater and surface water pumpage for all beneficial uses and projections of future climatic conditions can be used to help predict future water needs.
- Innovative Water Capture Techniques and Applications
 - Rain is the first form of water that we know in the hydrological cycle, hence it is a primary source of water for us. Rivers, lakes and groundwater are all secondary sources of water; however, today we depend almost entirely on these secondary sources. Water capture seeks first to understand the value of rain, and to make optimum use of the rainwater at the place where it falls. Mississippi's abundant rainfall presents numerous opportunities to achieve sustainability of our water resources through innovative water capture techniques and applications that include providing irrigation water; increasing groundwater recharge; reducing storm water discharges, urban flooding and overloading of sewage treatment plants; and reducing seawater ingress in coastal areas.

Groundwater Research

- Innovative Approaches to Estimate Aquifer Recharge
 - Groundwater is recharged naturally by rain and to a smaller extent by surface water (rivers and lakes). Rates of groundwater recharge are difficult to quantify, since other related processes, such as evapotranspiration and infiltration processes must first be measured or estimated to determine the balance. There is a need for innovative approaches to estimate recharge for all aquifers of the state as there are few scientifically defensible methods to determine recharge at this time. Having a more thorough knowledge of recharge would be invaluable in determining water budgets for the various aquifers in the state. Advances in our understanding of groundwater–surface water interaction is especially needed currently in the Delta and along streams in South Mississippi.
- Development of Water Budgets
 - A water budget is an accounting of inflows (recharge) to and outflows (pumpage/use) from a groundwater system. Ideally, under equilibrium conditions, when water levels are not changing, inflows should equal outflows. However, this is not the case in some areas of Mississippi where pumpage/use is exceeding

recharge. As Mississippi's population grows and shifts within the state and its economy expands, knowledge of water availability throughout the state is vital as is the understanding of past and prediction of future trends related to demographics, industrial and agricultural water use, infrastructure needs, etc., especially in areas of competing water use.

- **Determining Aquifer Transmissivities and Characteristics**
 - Transmissivity is defined as a measure of how much water can be transmitted horizontally, such as to a pumping well. Transmissivity of a confined aquifer is determined by pump tests. While many pump tests have been conducted throughout the state of Mississippi, the hydrogeology of an aquifer can vary significantly from place to place. Additional information (transmissivities or ranges of transmissivities and other aquifer properties) is needed to determining how much water can be pumped in a particular location.
 - Naturally occurring aquifer characteristics such as color, high iron content, and low pH, among others, can affect the taste, color, odor, and use of water from different aquifers. This information is very useful in determining where and how deep groundwater wells should be drilled and what type of treatment would be necessary.

Surface Water Research

- **Evaluation of BMP Effectiveness, Site Placement, Reliability, and Maintenance**
 - Reliable performance data for established and innovative best management practices (BMPs) in Mississippi is needed to develop effective responses to existing and evolving regulations and requirements regarding nutrients, fecal indicator bacteria, solids, metals, runoff volume and urban storm water. Public and private storm water dischargers will be spending substantial sums of money on these issues, primarily in the form of planning, designing, constructing, and maintaining structural and nonstructural BMPs. Research on BMP effectiveness, site placement, reliability, and maintenance (especially costs) continues to be a serious need. Specific applications of these BMPs include:
 - Implementing the load reductions identified by Total Maximum Daily Loads (TMDLs);
 - Implementing the requirements of numeric nutrient criteria;
 - Reducing nutrient loadings;
 - Reducing bacteria levels in water bodies used by the public for recreation; and
 - Reducing storm water runoff volume.
- **Research and Development to Support Water Quality and Ecosystem Health Assessment Applications**
 - Water quality and ecosystem health assessment applications are needed for more efficient management of Mississippi's water resources. Research and development needs to support these applications include:

- Investigation of the use of percent saturation of dissolved oxygen in waters as an indicator of aquatic life support;
- Investigation of the use of diurnal flux as an indicator of water quality degradation;
- Development of a simplified approach for ecosystem stressor identification;
- Development of a fisheries index for Mississippi waters;
- Study of algal community structure in Mississippi waters (especially within the Mississippi River Alluvial Plain);
- Further analysis of the potential use of DNA speciation of periphyton as a potential indicator of nutrient pollution; and
- Development of methods to measure and understand the impacts of pharmaceuticals, microplastics and other contaminants on aquatic ecosystems, agriculture and drinking water.
- Stream flow is an important habitat variable and research is needed to support water quality and ecosystem health assessment applications.
- Analysis and documentation of elements of hydrologic restoration (i.e., stream structure, sinuosity, etc.) and their effects on ecosystem health.
- Identification of Appropriate Response Measures for Mississippi's Waters and Linkage between Nutrient Concentrations and the Identified Response Measures
 - Nutrients, nitrogen (N) and phosphorus (P), are essential for plant growth, which then supports healthy aquatic ecosystems and provides habitat. In addition to natural sources, nutrients also come from anthropogenic sources related to agriculture, storm water discharges, wastewater discharges, etc. Excessive amounts of nitrogen and/or phosphorus (referred to as nutrient pollution) can lead to significant impacts on public health, aquatic ecosystems, and the economy. The link between nutrient concentrations and environmental impacts is well-supported by scientific literature; however, the ecosystem response to nutrient pollution can be variable due to the presence of confounding factors at a particular site, such as canopy cover, water column stratification, flow, turbidity, and others. These factors may inhibit a response at a particular site, but the effects of nutrient pollution may be observed where and when these factors subside. Existing research has shown that indicators (i.e., response parameters or assessment endpoints) that are most sensitive to nutrient pollution and most predictive of impacts to higher trophic levels were TN/TP concentrations, measures of primary production and algal assemblage, and, to a lesser extent, measures of ecosystem function (e.g., dissolved oxygen and pH). To develop appropriate and protective nutrient criteria for Mississippi, the following research is needed:
 - Identify the appropriate response measures for Mississippi's waters; and
 - Identification of linkage between nutrient concentrations and the identified response measures.
- Analysis of Nutrient Loading Trends

- For several years now, MDEQ has gathered nutrient data with respect to NPDES point dischargers. With the ongoing work related to the development of numeric nutrient criteria and ongoing work related to implementation of the State’s nutrient reduction strategies, a detailed analysis of nutrient loading trends from point sources would be of great value.

Coastal-specific Research

- Harmful Algal Bloom and Early Pathogen Detection Research for Mississippi Coastal Waters
 - Technological advancements associated with early detection and remediation efforts of Harmful Algal Blooms (HABs) and pathogens (such as *Vibrio vulnificus*) are critical for shellfish harvesting, fishing, swimming, and other industries that depend on clean coastal waters along Mississippi’s shoreline. This research priority will fund efforts to create and assess such technologies. This effort encourages leveraging and partnership opportunities such as with the Gulf of Mexico Alliance Water Resources Team, which included Human Health as one of its priorities for its Tier 2 research initiatives. Examples of types of research associated with this priority include, but are not limited to:
 - Assess information from existing water programs from other Gulf States regarding current monitoring for human health parameters to assess suitability for Mississippi Coastal waters
 - Identify and evaluate existing methods for detecting pathogens of concern (such as *Vibrio vulnificus*)
 - Identify technologies or sampling approaches to detect HABs and pathogens simultaneously and conduct pilot study
 - Smart Phone Apps, identify and evaluate existing and initiate discussions of new or expanded smart phone applications for early detection of HABs and/or pathogens
 - Implement plan to fill informational gaps to ensure Mississippi water resource managers have capability for assessing HAB toxicity in monitoring programs
- A variety of research is needed in our coastal areas that addresses both surface water and groundwater quality and quantity. Following is a list of specific research that is needed:
 - Submarine groundwater discharge;
 - Fresh water inputs and the relationship to oysters, microplastics, and constructed wetlands for nutrient reduction;
 - Research to inform oyster restoration siting; and
 - Impacts of ocean acidification on coastal waters, animals and industries.

Water Use Efficiency and Water Reuse Research

- Water Reclamation and Reuse
 - In an effort to help meet growing demands being placed on available water supplies, many communities throughout the U.S. are turning to water reclamation and reuse. Water reclamation and reuse offers an effective means of conserving

supplies while helping to meet the ever growing demands for water. The investment in treatment technologies required to meet restrictive discharge limits has led an increasing number of industries and communities to consider other uses for their treated waste water effluents. Further, as sources of water supplies have become limited, there has been greater use and acceptance of reclaimed waste water effluents as an alternative source of water for a wide variety of applications, including landscape and agricultural irrigation, industrial processing, power plant cooling, and wetland habitat creation, restoration and maintenance.

- **Water Use Efficiency**
 - Research aimed to utilize more practical, ecological, and economically feasible strategies in growing agricultural crops is a necessity. Research can include ways to identify best management practices aimed at preservation of water resources such as increases in efficiency of irrigation.
 - Both surface water and groundwater sources should be used efficiently for the purposes of addressing water quality and water quantity concerns. All sectors of water users would benefit from research and education promoting water use efficiency practices that save time and money as well as water.

Drinking Water and Waste Water Research

- **Mitigation of Lead Corrosion in PWSs**
 - Within Mississippi and across the United States, numerous reports of exceedances of lead standards in public water supplies are making headlines. EPA's Lead and Copper Rule is not a health-based standard; it uses action levels. It doesn't indicate a health risk or exposure; it indicates where resources are needed (i.e., where local communities – elected officials and/or management boards – should invest their resources). As such, it addresses asset management. Small drinking water systems are being overwhelmed by the rule, as well as some larger systems. Research is critically needed in Mississippi to address the following questions:
 - Where are the locations of lead service lines?
 - Where are the detects and non-detects (violations and non-violations) of lead and copper in PWSs?
 - Identifying potential sampling sites and providing monitoring assistance to assess how pH is maintained throughout a system.
 - Analysis of school infrastructure
 - What are the options available for corrosion treatment?
 - How can the life of current pipes be extended?
- **Protection of Source Water Resources**
 - Drinking water in Mississippi comes from groundwater and surface water sources. Protecting these source waters from contaminants is a major national priority in protecting public health by providing safe drinking water to the public. Continued work is needed with some of our State's water systems to perform the following tasks:
 - Delineate the source water protection areas;

- Identify known and potential sources of contamination;
- Develop protection measures; and
- Address emergency contingency planning.
- Innovative and Affordable Waste Water Treatment for Small Communities
 - Approximately 180 communities in Mississippi are facing the challenges of having to upgrade or enhance waste water treatment in order to meet new or more stringent effluent limitations. It is estimated that the potential cost of waste water treatment upgrades necessary to come into compliance with new effluent standards in Mississippi alone could exceed one billion dollars. Grant funds dedicated to waste water improvements are becoming increasingly difficult to obtain. Many of Mississippi’s smaller communities have difficulty servicing debt on even low or no interest loans; therefore innovative and affordable technologies in waste water treatment and/or disposal for small communities are increasingly needed.

Modeling and Tool Development

- Development of Models and Tools
 - Models and tools are needed to predict future impacts of climatologic change (including extreme meteorological events), water use changes, social drivers, and proposed infrastructure on water resource availability and costs. The following applications have been identified as needs:
 - Options for simplified nutrient modeling;
 - WASP setup tools;
 - Methodologies, indicators, and decision support tools to inform decisions related to water quality and ecosystem health;
 - Predictive models to support beach actions (bacterial, algae, and storm water-related closures and advisories) as part of Mississippi’s Beach Monitoring Program;
 - Model and predict frequency and magnitude of freshwater input to coastal areas; and
 - Prediction of storm water flooding.

Social Sciences Research

- Development of Social Indicators
 - Most water quality impairments in Mississippi are anthropogenic. Because of this, the development and use of social indicators to assist in the prioritization, planning, implementation, and evaluation of the effectiveness of water resources projects and programs is important to track progress in the social aspects of water resources management.
- Development of Social Science Applications to Advance Water Resources Management

- Social science applications can inform the education and outreach processes, reveal water resources champions at various scales, and identify potential opportunities and incentives to engage the business community. To accomplish this, a better understanding of stakeholder behaviors, perceptions and beliefs is of great importance.
- Development of Civic Engagement Indicators
 - A significant research need related to sustainable water resources management focuses on civic engagement and support. Recognizing that federal funding support is tenuous in the long term, surveys are needed to reveal potential civic support, identify incentives that could be developed for non-governmental support, and identify leadership that could rally support for water resource restoration and protection projects at multiple scales.

Economics Research

- Economic Analysis of Reducing Nutrient Loadings
 - Decisions affecting the use of our water resources are driven by economics. An example of this can be found in the rapid increase in agricultural irrigation permit applications, especially in the Delta. Economic analyses conducted by MSU during 2010 and 2012 revealed an increase in yield of 68-70% of some irrigated crops over dryland farming. The following research need is identified in Mississippi's nutrient reduction strategies:
 - What are the costs of nutrient reduction? What are the benefits/values? The answers and analyses of these questions are vital to inform the state's adaptive management implementation process. Specifically, analyses of the costs and benefits of selected BMPs designed to reduce nutrient content and improve/enhance water quality are needed to estimate impacts of various BMPs on agricultural productivity, values and uses of land, and tax revenues generated at the local, regional and state levels.

Emerging and Innovative Technologies

- Current and Potential Use of Unmanned Aerial Vehicles (UAVs)
 - Interest in potential UAV applications is very high. Current research interest that has been identified is listed below:
 - Help with the identification of unpermitted/undocumented surface mining activities;
 - Potential for use in environmental emergency response;
 - As a tool to document existing or potential BMP locations;
 - As a tool to provide habitat mapping and data collection at remote locations;
 - Exploring potential opportunities and applications to collect environmental/water resource-related data and images.