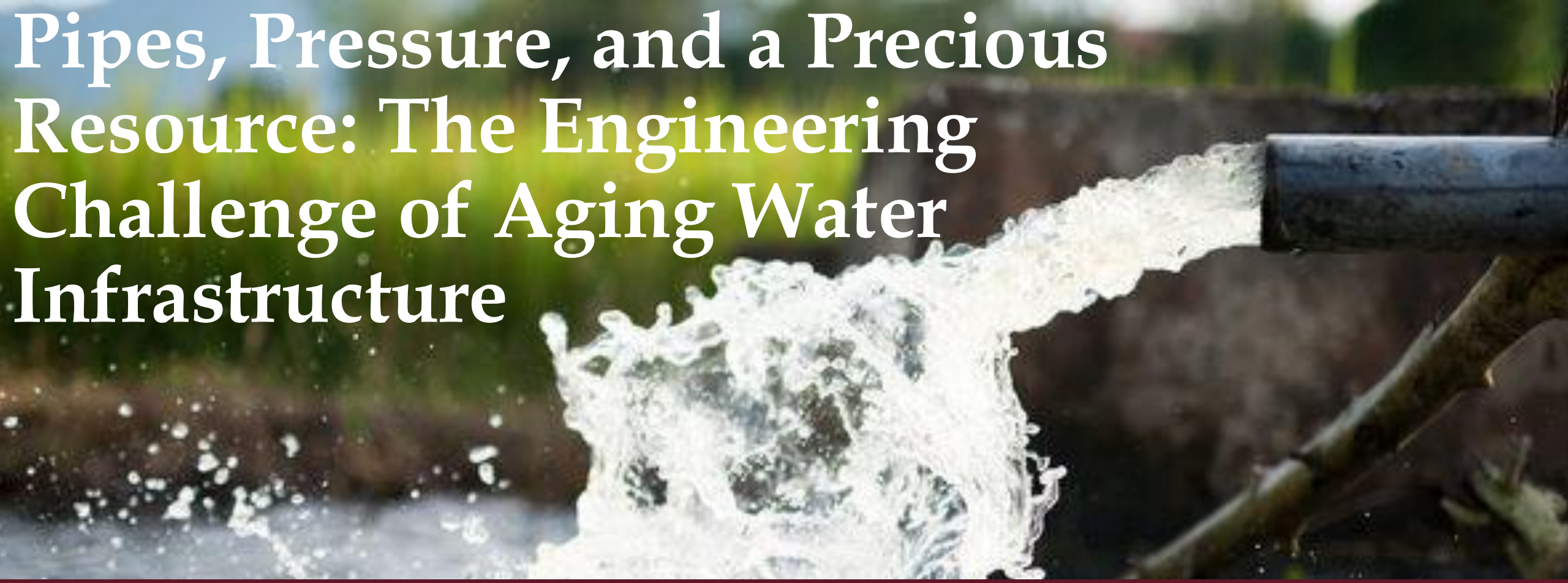
Pipes, Pressure, and a Precious Resource: The Engineering Challenge of Aging Water Infrastructure



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Eric Williams
Senior Project Manager

Eric.Williams@msstate.edu

www.wrri.msstate.edu

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MSU Water Resources Research Institute's Role

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- To provide a center of expertise in water and associated land-use problems and serve as a repository of knowledge for use in education, research, planning, and community service
- To serve public and private interests in the conservation, development, and use of water resources
- To provide training opportunities in higher education whereby skilled professionals become available to serve government and private sector alike
- To assist planning and regulatory bodies at the local, state, regional, and federal levels
- To communicate research findings to potential users in a form that encourages quick comprehension and direct application to a water-related problem
- To assist state agencies in the development and maintenance of a state water management plan

MSU Water Resources Research Institute Technical Services

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- Comprehensive System Evaluations
- Water Audits
- Financial Rate Analysis
- Cross Connection Control Program Assistance
- Treatment Optimization
- Compliance Consultation: GWR, RTCTR, LCR, etc…
- Asset Management Assistance
- Distribution System Optimization
- Chemical Feed Dosage Optimization

Presentation Overview

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- The State of Rural Water Systems and Municipalities in 2025
- Key Challenges Water Utilities Are Facing
- Exploring Viable and Economical Solutions
- The Role of Leadership
- Why Reinvestment Can’t Wait
- Asset Management and Education
- Path Forward

Public Water Systems in 2025

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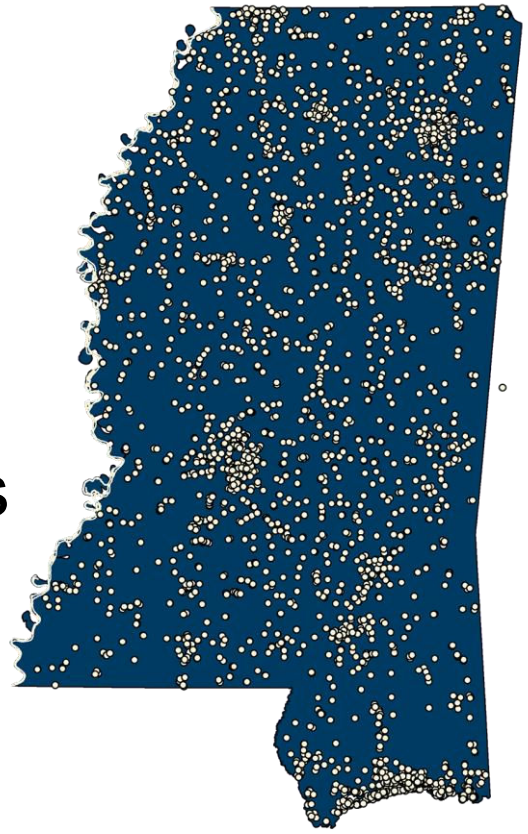
- 1,200 public systems in Mississippi
- Majority rely on **groundwater**
- Classified by EPA as **Small or Very Small** systems
- Many established in the **1970s** through FHA loan programs



Public Water Systems in 2025

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Water quality and quantity can vary greatly across the state.

Treatment techniques can be labor intensive and have high capital cost.

Upgrade process requires lengthy timeline:

- Planning
- Design and Engineering
- Regulatory Review
- Construction
- Operation

Aging Infrastructure: A Growing Concern

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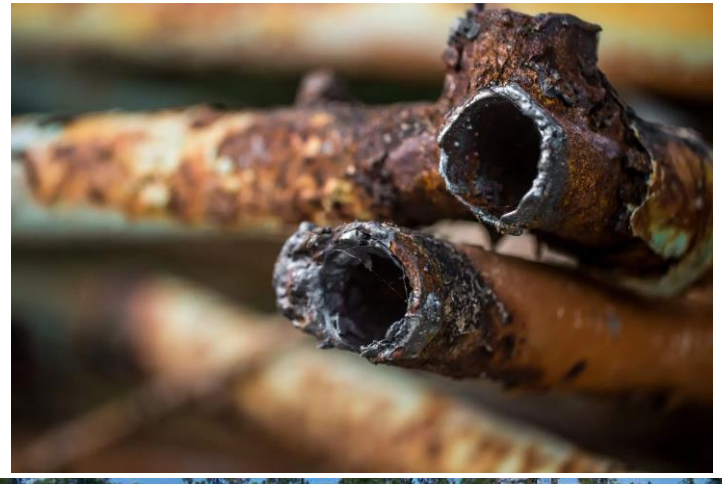
- Treatment plants and equipment far past design life.
- Water well yields decreasing
- Limited revenue restricts upgrades
- Struggling to meet modern regulatory and operational demands



Key Problems Associated with Aging Infrastructure

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- Aging Water Treatment Plants
- Aging Pumping Facilities
- Water Quality Degradation
- Distribution System Deficiencies
- Antiquated Electrical Components
- Sanitary Defects and Contamination Risks
- Operational and Customer Impacts

Aging Water Infrastructure: Technical Challenges and Solutions

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Many water systems are operating beyond their intended design life.

Aging infrastructure poses risks to **water quality, system reliability, compliance, and public trust**.

Lead service line inventory and replacement requirements are bringing renewed attention to the broader issue of aging infrastructure.

Infrastructure and Process Limitations

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Treatment facilities designed for:

- Past water quality conditions
- Lower regulatory standards
- Smaller system demands

Aging structures, basins, and equipment increase failure risk.

Water Quality and Compliance Risks

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Reduced treatment reliability can impact:

- Turbidity removal
- Fe/Mn Removal
- Disinfection effectiveness
- DBP control
- Optimization Control

Limited redundancy increases vulnerability during:

- Equipment failures
- Maintenance activities
- System outages
- Chemical process downtime

Operational Challenges

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Obsolete equipment and controls limit:

- Process optimization
- Water Quality Monitoring
- Data collection

Increased reliance on operator intervention increases operational risk. More room for errors.

Mechanical and Electrical Deficiencies

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Pumps and motors operating beyond expected service life.

Increased likelihood of:

- Mechanical failures
- Seal and bearing issues
- Electrical and control system failures

Hydraulic and Pressure Impacts

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Inadequate pumping capacity or control can lead to:

- Pressure fluctuations
- Low-pressure events
- System-wide impacts during peak demand or outages

Overloading a system can lead to:

- Excessive friction loss
- Loss of consumer confidence

Hydraulic and Design Limitations

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Dead-end mains and unlooped lines lead to:

- Stagnation
- Poor water quality
- Increased flushing and maintenance costs

Aging pipes increase leakage and break frequency.

Water Quality and Contamination Risks

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Pressure losses increase the risk of:

- Contamination intrusion
- Backflow events

Aging pump stations may lack:

- Modern controls
- Backup power
- Alarm and monitoring capabilities

Water Quality Degradation

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Water Age Management Challenges

Increased water age contributes to:

Disinfection Byproducts (DBPs)	Loss of disinfectant residual	Free chlorine carrying deep into the distribution system

Aging tanks and poorly mixed storage facilities worsen water age issues.

Operational Control Limitations

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→ Insufficient valving limits the ability to isolate:

- Problem areas
- Repair zones
- Contamination events

Sanitary Defects and Contamination Risks

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- Sanitary defects and significant deficiencies
- Pathways for contamination through backflow events
- Vulnerabilities at treatment facilities and source water connections

Why Reinvestment Can't Wait

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Component	System Area	Life Expectancy
Water Wells	Source	25 years
Intake Structures	Source	35 years
Pumping Equipment	Source	10 years
Disinfection Equipment	Treatment	5 years
Tanks (Hydro/Concrete/Metal)	Storage	10 – 30 years
Piping & Valves	Distribution	35 years
Controls & Software	Electrical	5 – 20 years

* Source: EPA: "Taking Stock of Your Water System: A Simple Asset Inventory for Very Small Drinking Water Systems"

Operational and Customer Impacts

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- Boil water notices
- Emergency shutdowns
- Service disruptions
- Compliance-related violations
- Poor customer communication can erode public confidence during events.

Consequences of Inaction

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- Continued regulatory challenges and enforcement actions.
- Rising maintenance and emergency repair costs.
- Loss of institutional knowledge as experienced operators retire.
- Increased public health risks and customer dissatisfaction.

Solutions to Address Aging Infrastructure

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- Infrastructure Improvements
- Water Quality and Compliance Strategies
- Planning, Prioritization, and Funding
- Workforce and Knowledge Transfer
- Customer and Stakeholder Engagement

Treatment Plant Upgrades

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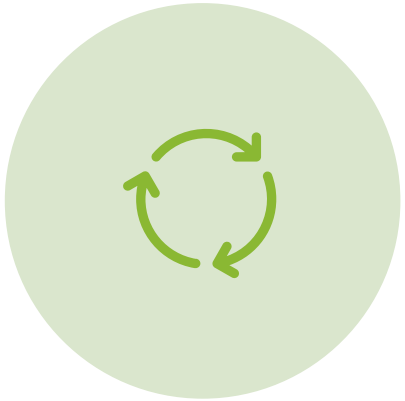
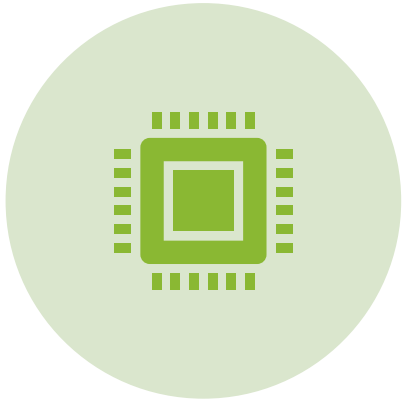


MODERNIZE TREATMENT PROCESSES TO MEET CURRENT AND FUTURE REGULATIONS.

ADD REDUNDANCY FOR CRITICAL TREATMENT COMPONENTS.



UPGRADE MONITORING, CONTROLS, AND AUTOMATION SYSTEMS.

Pumping Facility Improvements

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Replace aging pumps and motors with energy-efficient units.

Improve pressure management and system reliability.

Add:

- Backup power
- SCADA and alarm systems
- Redundancy for critical pumping facilities

Storage and Distribution Improvements

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Loop distribution lines and eliminate dead ends.

Add strategically placed valves to:

- Improve isolation capabilities
- Reduce service interruptions

Upgrade storage tanks and install tank mixers to:

- Improve water quality
- Reduce water age

Coordinated Infrastructure Upgrades

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Coordinate water infrastructure upgrades with:

- Roads
- Sewer
- Broadband

Reduces costs, construction impacts, and public disruption.

“Dig Once” Policy

Water Quality and Compliance Strategies

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Implement proactive water age management programs.

Address DBP formation through:

System design improvements

Operational optimization

Prepare for and educate systems on upcoming regulatory requirements.

Other Paths Forward

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Invest in **efficient treatment technologies**

- Well Motor VFDs
- Smart Metering Technologies
- Continuous Chemical Monitoring

Upgrade **electrical components**

Distribution System Upgrades

- Line Looping
- Fire Flow
- Hydraulic Modeling

Implement **automated metering**

- Automated Master Meters
- Automated Residential and Commercial Meters

Planning, Prioritization, and Funding

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Help	• Assess treatment, pumping, storage, and distribution assets • Identify critical needs • Prioritize projects based on risk and consequence of failure
Explore	Explore partnerships and consolidation opportunities to: • Improve resiliency • Share resources • Reduce long-term costs
Increase	Increase outreach to identify and pursue funding opportunities, including: • Grants • Low-interest loans

Workforce and Knowledge Transfer

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Address the aging workforce by:

- Creating avenues for knowledge transfer from experienced staff
- Supporting training and mentorship for the next generation of operators

Standardize operating procedures and documentation.

Funding Opportunities

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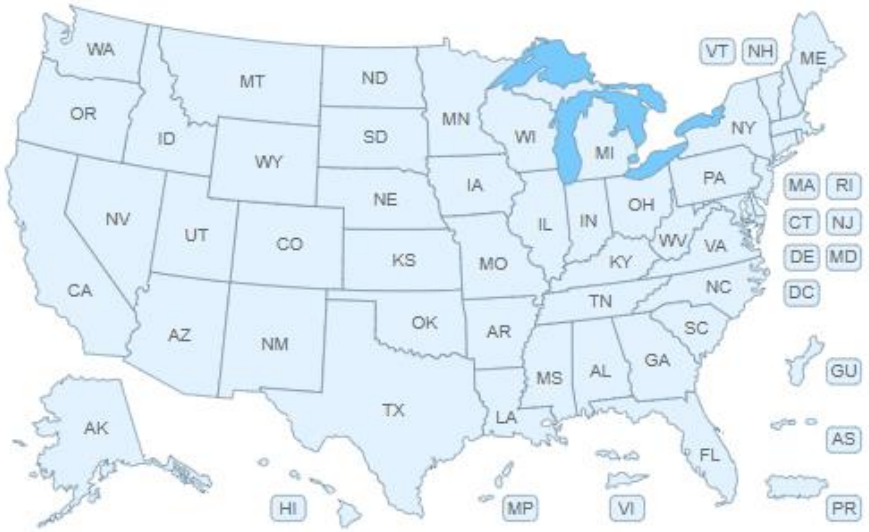
Funding Sources By State Or Territory

We work with state and federal agencies to make sure that current funding opportunities are consolidated in one place. Click the map below to find water and wastewater infrastructure funding sources for your state or territory.



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Funding Opportunities

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Mississippi Water and Wastewater Funding Sources Compiled by the Environmental Finance Center Network, Fall 2024

Organization	Program *(key words)*	Gov. Entity	Non-Profit	For-Profit	Purpose or Use of Funds	How to Apply	Website	Contact
Mississippi State Department of Health (MSDH)	State Drinking Water Revolving Loan Fund *(water)*	✓			The DWSRF assists public water systems to finance the costs of infrastructure needed to achieve or maintain compliance with Safe Drinking Water Act (SDWA) requirements and to protect public health objectives of the Act. A new emphasis is on preventing contamination problems through source water protection and enhanced water systems management.	Application forms and a detailed list of required items can be accessed on the MSDH website. Prior to submitting a Loan Application Form, projects will be ranked on the Intended Use Plan Priority List. Deadlines vary for each program.	https://msdh.ms.gov/msdhsite/_static/44,0,127.html	Jonathan Chaney jonathan.chaney@msdh.ms.gov -or- Drinking Water SRF Coordinator Division of Water Supply Mississippi State Department of Health P. O. Box 1700 Suite U-234 570 East Woodrow Wilson Boulevard Jackson, MS 39215-1700 (601) 576-7518 Telephone (601) 576-7800 FAX
	Emergency Loan Program *(water)*	✓			Provides emergency loans to counties, municipalities, districts, or other water organizations that are tax exempt, for the repair, replacement, or construction of drinking water projects. There is no set maximum loan limit for an emergency loan.	Application forms and a detailed list of required items can be accessed on the MSDH website. Prior to submitting a Loan Application Form, projects will be ranked on the Intended Use Plan Priority List. Deadlines vary for each program.	https://msdh.ms.gov/msdhsite/_static/44,0,127.html#Emergency	
	Water Infrastructure Improvements for The Nation Act - Small and Disadvantaged Communities Drinking Water Grant *(water)*	✓			Grants for small and/or disadvantaged public water system, with a 45% Cost Share Provided by Subgrantee, for plan and design, construction, expansion or repair, or the consolidation of water systems.	Application forms and a detailed list of required items can be accessed on the MSDH website. Prior to an Award, applications will be evaluated by program staff to assess the projects that serve the greatest need. Application deadline is April 30th of each calendar year that funding is available to the agency.	https://www.healthyms.com/msdhsite/_static/44%2c0%2c127.html	

Education: Building Capacity for the Future

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- Continuous training for staff and leadership
- Stay current with **regulations and technologies**
- Foster a **culture of professional development**

The Role of Leadership

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- Visionary boards drive success
- Manage as a business
- Need for **proactive planning** and **system evaluations**
- Growth forecasting
- Gradual upgrades
- Regular optimization reviews
- Rate adjustments tied to needs

Customer and Stakeholder Engagement

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Strengthen customer communication before, during, and after infrastructure projects.

Clearly explain:

- Why upgrades are needed
- How customers benefit
- What to expect during construction or service disruptions

The Role of Collaboration

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Partnerships are critical for:

- Project financing
- Technical assistance
- Regulatory navigation

Consolidation and regional cooperation can enhance:

- Operational efficiency
- Compliance stability
- Long-term system sustainability

Consolidation and Strategic Investment

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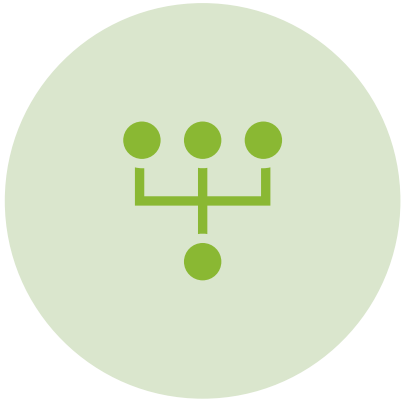
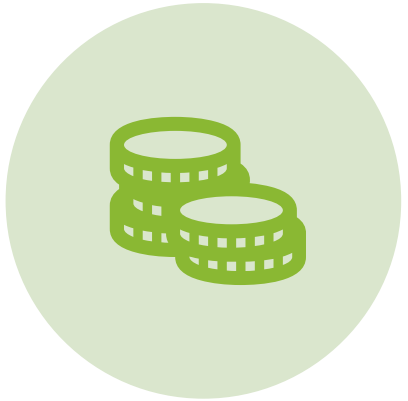


CONSOLIDATION: COMBINE SMALL SYSTEMS TO SHARE RESOURCES

EXPANDS CUSTOMER BASE AND REVENUE



LOWERS PER-UNIT COST OF OPERATIONS

Investing in the Future

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Reinvest now to ensure long-term viability

Combine smart planning + technology + leadership

Ensure **safe, reliable water** for future generations

Asset Management: The Foundation of Sustainability

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1

MAINTAIN INVENTORY OF ALL ASSETS

2

TRACK CONDITION, AGE, AND LIFE EXPECTANCY

3

PLAN FOR TIMELY REPLACEMENT

4

ENSURE EFFICIENT, RELIABLE OPERATION

Conclusion: Building Resilient Systems for the Future

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- Aging infrastructure is a challenge—but also an opportunity.
- Strategic investments in treatment, pumping, storage, and distribution systems:
  - Protect public health
  - Improve compliance
  - Reduce service disruptions
  - Build resilient water systems for future generations

Questions and Discussion

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