

# Exploring County-wide and Regional Responsible Management Entities for Decentralized Wastewater Infrastructure Systems in the Rural Alabama Black Belt

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*The materials being presented represent authors' own opinions, and do NOT reflect the opinions of NOWRA.*

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# Alabama's Black Belt's Wastewater crisis

- What is Black Belt?
  - Named for its fertile **black soils**
  - Mostly **rural region** with small spread-out residential clusters and low population density
  - Home to many **underserved** communities
  - High **poverty** with average annual income of only \$28,873 (i.e., ~54% of national average)
  - Rich **clay soils** that shrink and swell with moisture, causing **low permeability**



# Wastewater problems in Alabama's Black Belt

- Impermeable soils:
  - Do not accept water
  - Typical onsite wastewater systems (septic tanks and drainfields) do not work
- 49% of residents in the Black Belt do not have access to municipal wastewater services<sup>1</sup>
- In Bibb county<sup>1</sup>
  - 35% of homes with septic tanks showed signs of system failure
  - 15% use straight pipes discharge



1: (White & Jones, 2007)

# Site visits: Straight pipes and drainfield failures



# Regulatory constraints exacerbating wastewater challenges

- Existing ADPH\* wastewater discharge option: **Subsurface infiltration** into ground → does not work with clay soils
- Discharge constraints by ADEM\*\*
  - No wastewater **discharge to surface** (treated or untreated)
  - National Pollutant Discharge Elimination System (NPDES) permit is needed
  - Permitting individual homes not doable by ADEM



Source: UXWing (2021)

*What do we do to meet Black Belt communities' wastewater needs?*

\* ADPH: Alabama Department of Public Health

\*\* ADEM: Alabama Department of Environmental Management

# Decentralized Wastewater

A potential solution

*Customized decentralized wastewater models, including individual and clustered systems*

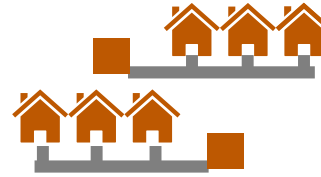
## Individual Systems



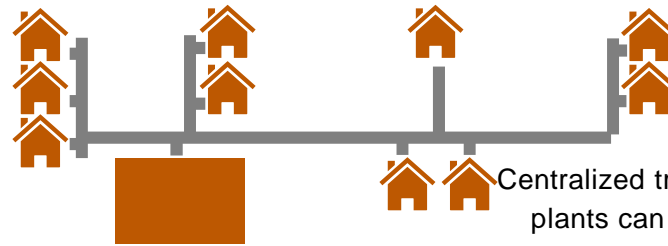
Individual decentralized wastewater treatment systems serve single homes

## Clustered Systems

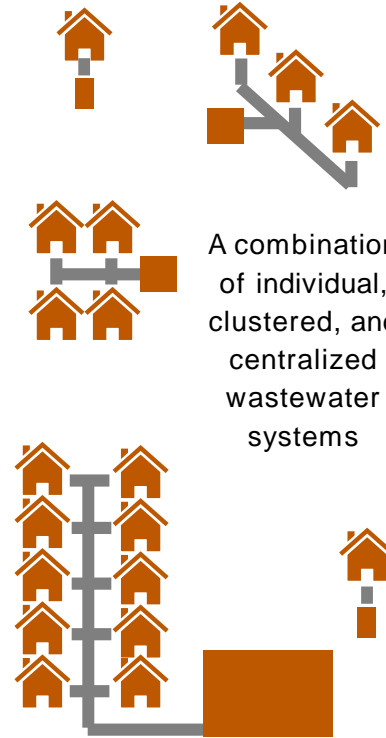
Decentralized wastewater clusters serve multiple households that share a treatment system



## Centralized Wastewater Treatment



Centralized treatment plants can serve entire large cities



A combination of individual, clustered, and centralized wastewater systems

# Operation and Maintenance (O&M) of decentralized systems

- Improper management of **decentralized clustered** systems<sup>1</sup>
  - Do not provide **treatment level** to protect public health and environment
  - Concerns regarding performance and **reliability**
- Need to identify long-term **responsible management entity (RME)**\* to provide O&M<sup>2</sup>
  - Entity characteristics (e.g., entity type, management scale)
  - Operational aspects (e.g., system size)



Source: EPA (2003)

\* RME: Legal organization with the technical, managerial, and financial capacity to provide O&M

1: (EPA, 2018)  
2: (EPA, 2003)

# Type and scale of RME

- Type<sup>1,2</sup>
  - **Public** service providers, such municipal utilities (e.g., water, wastewater, electric power, natural gas, solid waste management)
  - **Private** agencies (e.g., electric cooperatives, community development corporations)
  - **Non-profit** corporations
- Scale/jurisdiction<sup>1</sup>
  - **Community**-level management (e.g., a small group of homes)
  - **County**-level management (e.g., several clusters within a county)
  - **Regional**-level management (e.g., several clusters across multiple counties)
  - **State**-level management (e.g., several clusters within a state)



1: (EPA, 2005)  
2: (RMI, 2004)



# Scale of responsible management

- For effective operation of potential RMEs
  - Understand feasible scale options, aligning with communities' **social and institutional** settings
- Bridging knowledge gaps to identify whether any changes in **policy** is **proactively** needed
  - **Objective 1:** **Empirically** explore most feasible scale of management
  - **Objective 2:** Identify **challenges** and **opportunities** for adopting various scale solutions based on **stakeholders' perception**



# Data: Quantitative and qualitative

## Survey questionnaire

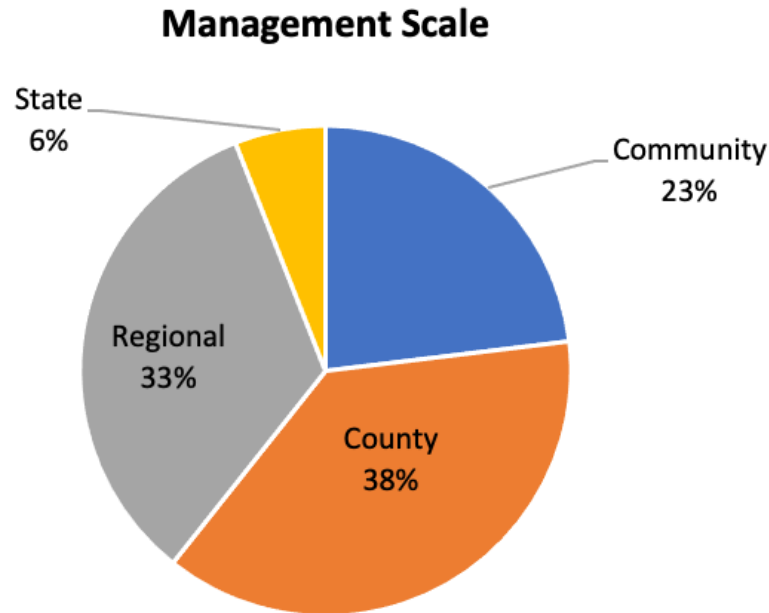
- Survey **questionnaire**
  - Participants' demographics
  - Entity type (e.g., public, private)
  - Service provided (e.g., water, wastewater)
  - Possible scale options
- Sampling: Random, convenient, snowball
- March 2022 – January 2023
- 117 complete responses from 27 states

## Semi-structured interviews

- Eight **interviews** with 11 stakeholders
- Sep 12, 2022 – Feb 8, 2023
- State gov. agencies, non-profit, for-profit, academic institutions
- Each more than 21 years of experience
- Ranging between 40 to 96 minutes
- Teleconferencing, transcription, QA/QC

# Mixed method: Descriptive statistics and qualitative analysis

- **Descriptive** statistics of survey data



# Mixed method: Descriptive statistics and qualitative analysis

- Hybrid **deductive-inductive** qualitative content analysis of interview data

Emergent Management Scale	Emergent Themes Within Management Scale	Total (Relative) Interviews Mentioned	Total (Relative) References <sup>a</sup>
<b>County-level</b> (3 interviews, 3 references)	Feasibility dependent on customer base and capacity of service provider	1 (33%)	1 (33%)
<b>Regional-level</b> (8 interviews, 46 references)	Opportunities of regionalization	5 (63%)	8 (17%)
	Challenges to regionalization	7 (88%)	14 (30%)
	Recommendations to promote effective regionalization	6 (75%)	13 (28%)

<sup>a</sup> Relative frequency based on total references within each emergent management scale.

# Political dynamics across communities

- Regionalization of responsible management → opportunity for sustainable O&M (e.g., economies of scale, sharing of information and operators)
- Need to consider communities' **preferences** and political dynamics
- Can be politically fraught and **risk opposition** from communities

*“Communities have to give up some **power** and, as such, putting it in a more regional authority sort of pulls it out at [the] local political level”*

*“[communities involved in regionalization] are going to squabble about who gets the money. So, if you've got multiple counties serviced by one regional manager, those counties are all going to want a **piece of the funding** coming from those systems and how you divide that up.”*

# Insufficient educational efforts

- Insufficient education about opportunities of regionalization with **all types of stakeholders** (e.g., regulators, elected officials, utilities, community residents)

*“I feel like they [communities’ stakeholders] probably haven’t really been presented with enough information about details about how it [regionalization] could work. ... I think they would be willing to consider [it ... if we are] able to show them an example of how it works on a **day-to-day** basis, what their **obligations** would really be, what the **fail safes** are, so that they could feel confident that they weren’t going to be too vulnerable.”*

- Need for additional **educational** efforts and **federal/state funding** to support these efforts

# Implications

- Empirical **understanding** to scale of management that may be adopted by RMEs to sustainably manage decentralized wastewater treatment solutions in the Black Belt
- Capturing key **stakeholders' insights** into challenges and opportunities to the adoption of various scale options in small, rural, underserved communities
- Highlighting **policy changes** for the adoption of suggested scale solutions in the Black Belt (and other rural communities) moving forward
- RMEs are better enabled to provide adequate O&M services to decentralized systems  
→ Long-term **sustainability** of systems

# Paths forward

- Incorporate additional stakeholders' insights
  - Conducted 32 semi-structured interviews (**diverse** stakeholders)
  - Comprehensive understanding to challenges and opportunities related to suggested scale
  - How to **operationalize** effective management scale
- Further investigate **(mis)alignment** between institutional players' **priorities** and Black Belt Communities' **preferences** as it relates to scale of responsible management



# Acknowledgement

- Funding is provided by Columbia World Projects: *Transforming Wastewater Infrastructure in the United States*

<https://worldprojects.columbia.edu/transforming-wastewater-infrastructure-united-states>



A screenshot of the Columbia World Projects website. The header features the Columbia World Projects logo on the left and the Columbia University logo on the right. Below the header is a navigation menu with five items: 'About', 'Social Impact Areas', 'Our Work', 'The Obama Foundation Scholars Program', and 'The Fourth Purpose', each with a downward arrow. The main content area has the word 'Projects' in a small font, followed by the project title 'Transforming Wastewater Infrastructure in the United States' in a large, bold, white font.

## For more information

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