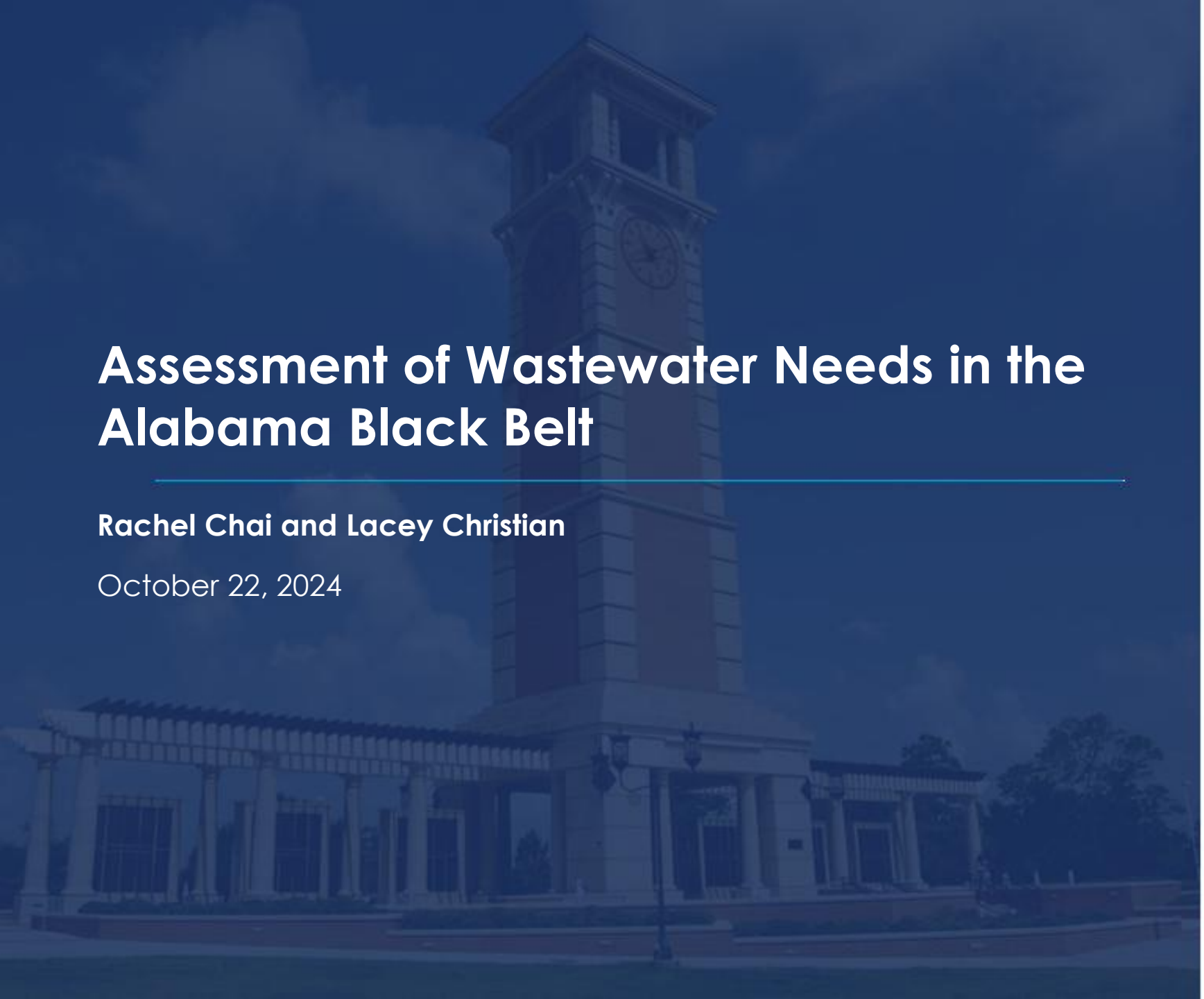
Assessment of Wastewater Needs in the Alabama Black Belt

Rachel Chai and Lacey Christian

October 22, 2024



UNIVERSITY OF SOUTH ALABAMA

Speaker Introduction

Rachel Chai

- Graduate Research Assistant
- MS & BS in Civil Engineering - University of South Alabama
- Working on a Phd in Systems Engineering

Lacey Christian

- Research Project Coordinator
- BS in Civil Engineering - University of South Alabama

The comments and opinions made on the presentation are those of the presenters and not of NOWRA or the Mega-Conference Sponsors.

Objectives

Introducing the Alabama Black Belt

What is the Alabama Black Belt and which regional circumstances warranted this study?

Wastewater Needs Assessment Methods

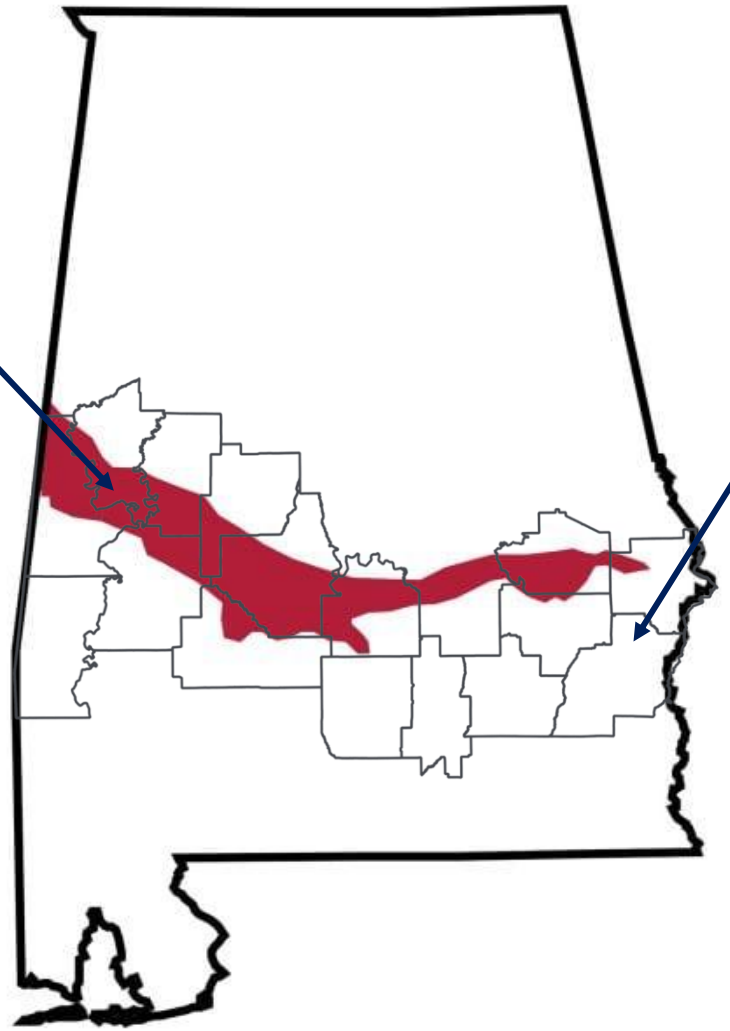
Step-by-step review of the framework and methodology of the wastewater needs assessments.

Wastewater Needs Assessment Results and Impacts

A rundown of the results of the study including recommendations and projected impacts.

Project Area: The Alabama Black Belt

Blackland Prairie Soil



16 counties:
Barbour, Bullock, Butler, Choctaw, Crenshaw, Dallas, Greene, Hale, Lowndes, Macon, Marengo, Perry, Pike, Russell, Sumter, and Wilcox

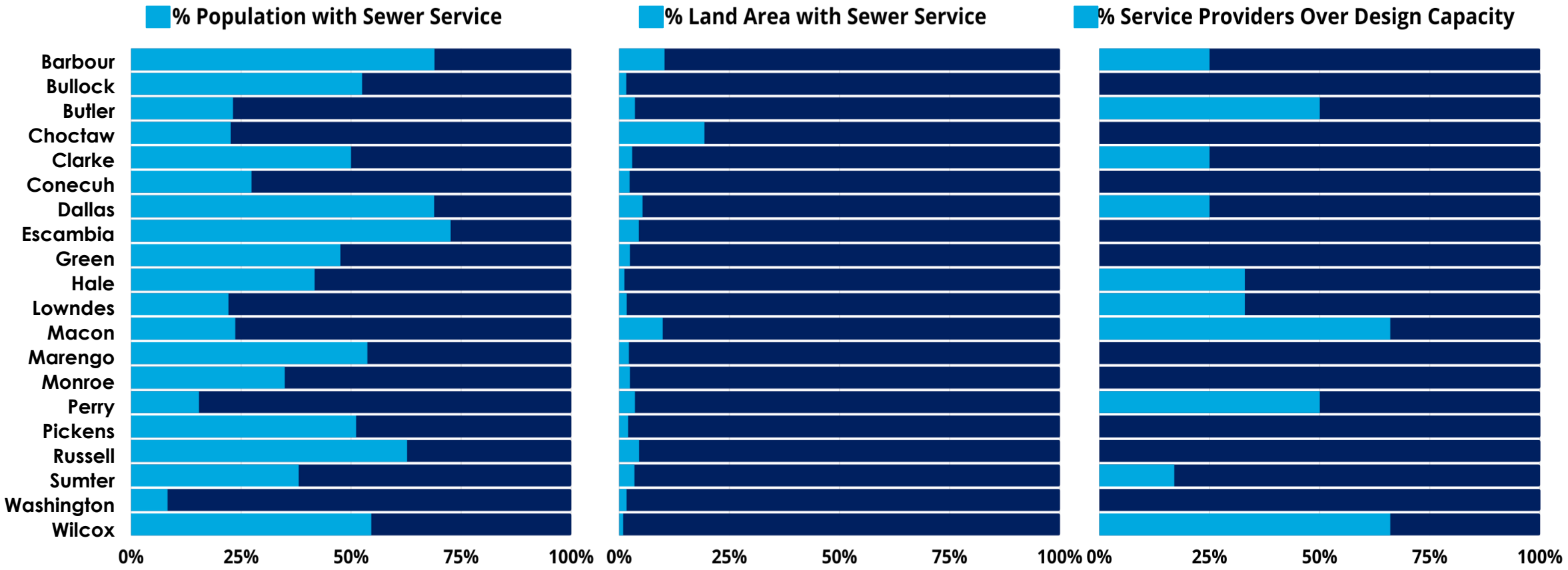
United Nations Special Rapporteur on extreme poverty and human rights said the region's sanitation issues were "very uncommon in the first world" and something that he had never seen before

Barriers to Equitable Sanitation in the Alabama Black Belt

Barriers:

- Geological - Impermeable soil conditions prevent the use of affordable onsite wastewater systems
- Economic
  - Low income and high poverty rates prevent residents from affording wastewater fees and onsite solutions
  - Low tax base limits local government funds for wastewater systems
- Population - Rural areas have low population density resulting in higher costs per home for infrastructure

Consequences of Regional Barriers - Limited Infrastructure



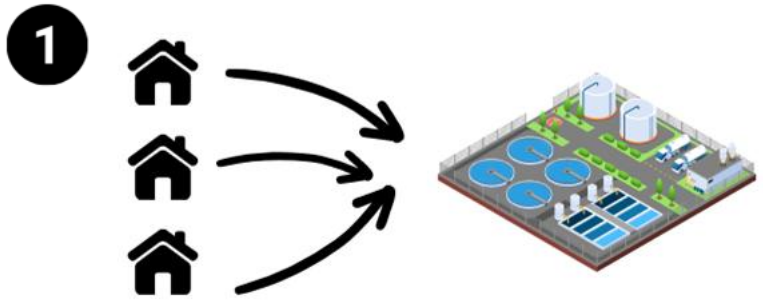
Results of Delta Regional Authority study - based on ADEM NPDES permit application data.

Consequences of Regional Barriers - Straight Pipes

- In a 2005-2006 field study of 2,000 homes in Bibb County:
  - 35% of households with septic tanks showed signs of system failure
  - 15% of households utilized straight pipes for direct discharge
  - 50% of households were observed to have untreated wastewater on the ground surface
- Similar results found in Wilcox and Hale counties in 2016-2017

Source: https://www.al.com/opinion/2022/03/guest-opinion-we-need-all-hands-on-deck-to-solve-americas-sanitation-problems.html

3-Part Plan



Connecting residents to existing municipal collection/treatment and upgrading systems if needed

Implement low O&M population cluster systems for residents who cannot tie to existing municipal sewer

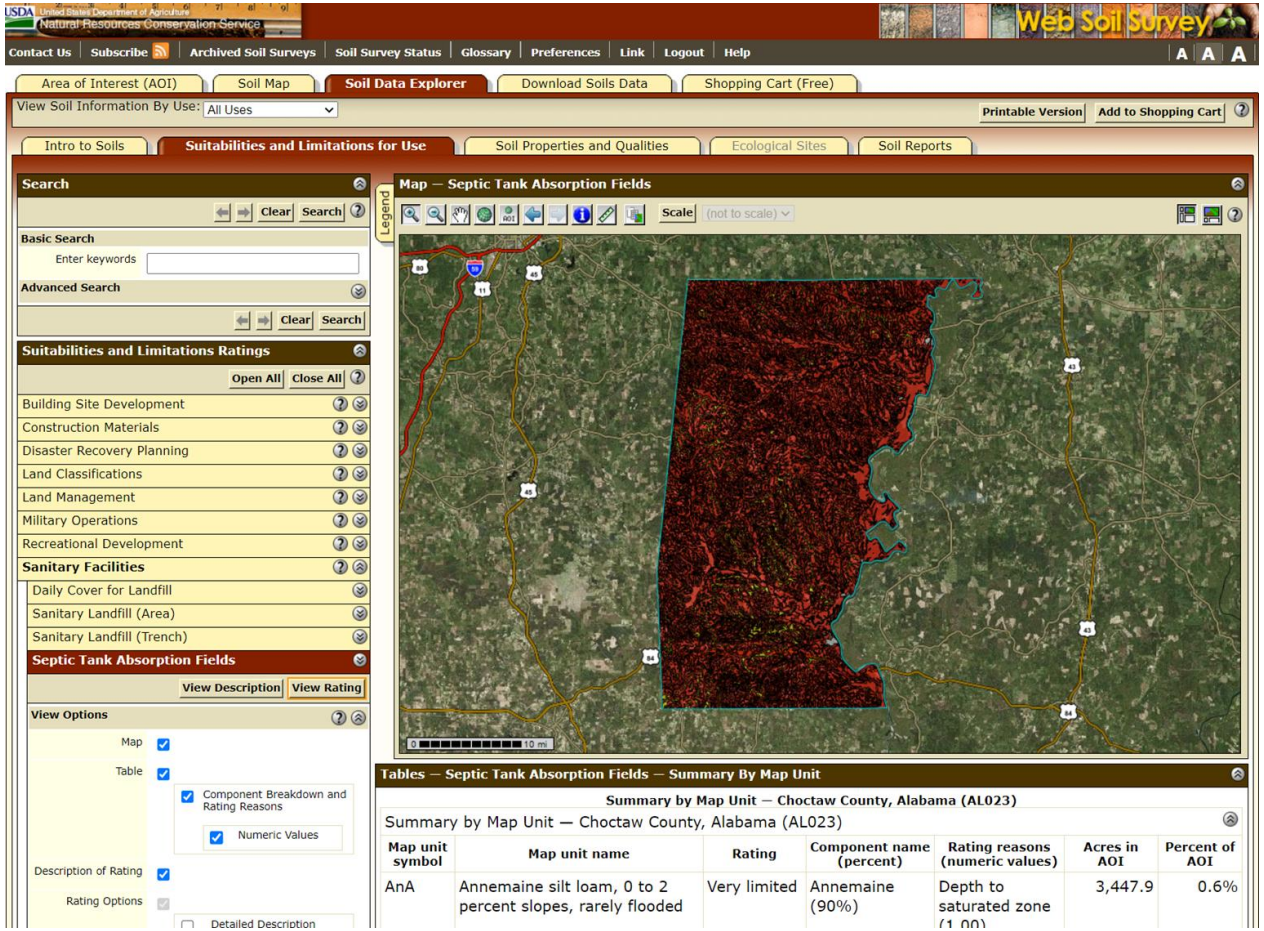
Connect the remaining residents to cost-effective individual onsite systems

Developing Solutions: Wastewater Needs Assessments

- Step 1: Soils mapping
- Step 2: Identifying existing municipal sewer systems
- Step 3: Identifying population clusters
- Step 4: Identifying best fit solutions
  - Building a wastewater collection system to tie-in to an existing municipal sewer system
  - Establishing a decentralized cluster wastewater collection and treatment system
  - Finding viable onsite solutions for homes outside of identified population clusters
- Step 5: Planning potential pipe networks
- Step 6: Developing cost estimates for population clusters

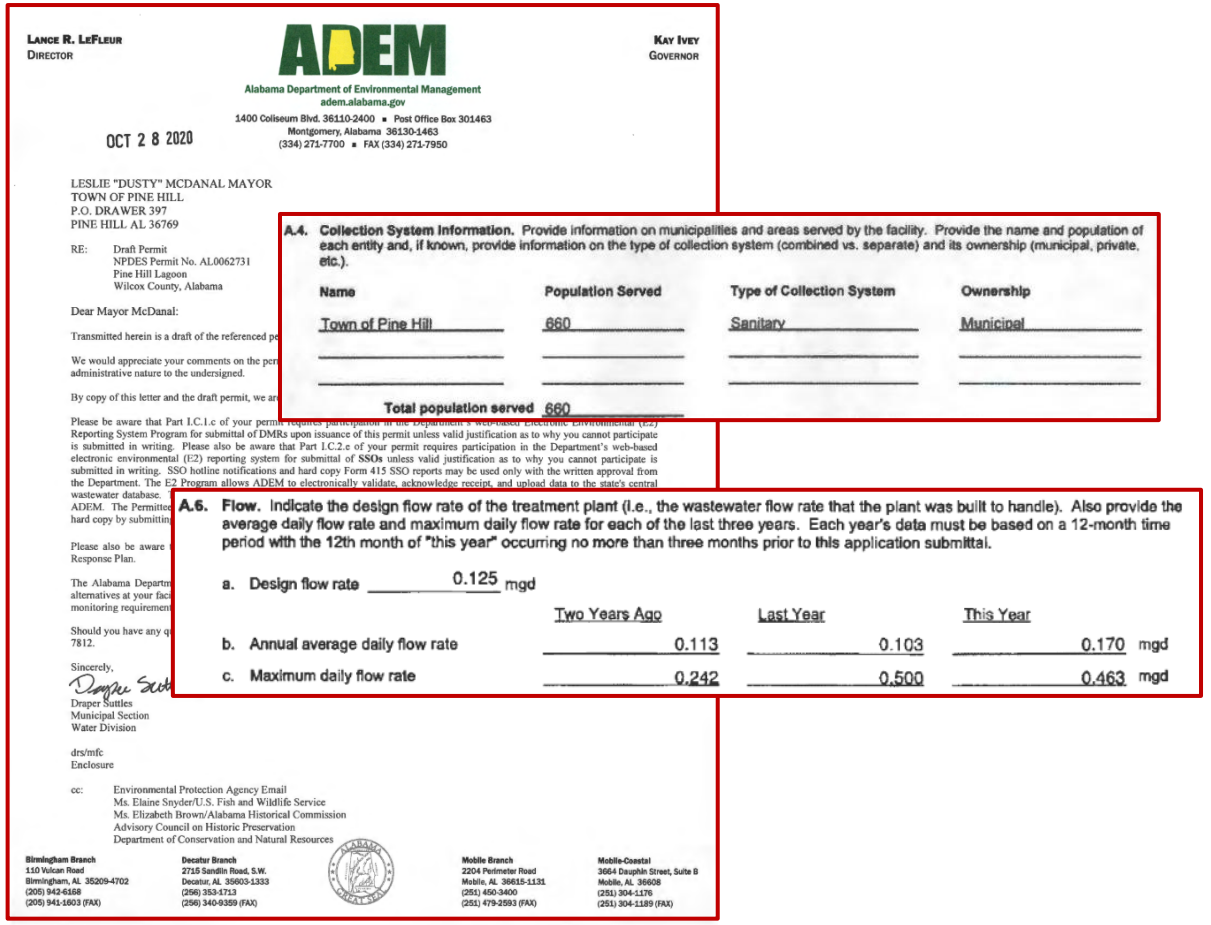
Step 1: Soils Mapping

- Utilized USDA Web Soil Survey - Septic tank absorption field rating
- Shapefiles in GIS software to create maps
- Allows identification of areas suitable for septic tanks and drainfields vs. advanced onsite treatment systems



Step 2: Identifying existing municipal sewer systems

- Service areas and flow rates pulled from ADEM outfalls map and NPDES permits
- Sewer service areas are estimated to city/town limits
- Design and average flow rates utilized to determine which systems have additional capacity or need upgrades



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DIRECTOR

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Montgomery, Alabama 36130-1463
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KAY IVEY
GOVERNOR

OCT 2 8 2020

LESLIE "DUSTY" MCDANAL MAYOR
TOWN OF PINE HILL
P.O. DRAWER 397
PINE HILL AL 36769

RE: Draft Permit
NPDES Permit No. AL0062731
Pine Hill Lagoon
Wilcox County, Alabama

Dear Mayor McDanal:

Transmitted herein is a draft of the referenced pe

We would appreciate your comments on the per
administrative nature to the undersigned.

By copy of this letter and the draft permit, we ar

Please be aware that Part I.C.1.c of your permit requires participation in the Department's web-based Electronic Environmental (E2) Reporting System Program for submittal of DMRs upon issuance of this permit unless valid justification as to why you cannot participate is submitted in writing. Please also be aware that Part I.C.2.e of your permit requires participation in the Department's web-based electronic environmental (E2) reporting system for submittal of **SSOs** unless valid justification as to why you cannot participate is submitted in writing. SSO hotline notifications and hard copy Form 415 SSO reports may be used only with the written approval from the Department. The E2 Program allows ADEM to electronically validate, acknowledge receipt, and upload data to the state's central wastewater database.
ADEM. The Permittee
hard copy by submittin

Please also be aware
Response Plan.

The Alabama Departm
alternatives at your fac
monitoring requirement

Should you have any q
7812.

Sincerely,

Draper Suttles
Municipal Section
Water Division

drs/mfc
Enclosure

cc: Environmental Protection Agency Email
Ms. Elaine Snyder/U.S. Fish and Wildlife Service
Ms. Elizabeth Brown/Alabama Historical Commission
Advisory Council on Historic Preservation
Department of Conservation and Natural Resources

A.4. Collection System Information. Provide information on municipalities and areas served by the facility. Provide the name and population of each entity and, if known, provide information on the type of collection system (combined vs. separate) and its ownership (municipal, private, etc.).

Name	Population Served	Type of Collection System	Ownership
Town of Pine Hill	660	Sanitary	Municipal

Total population served 660

A.6. Flow. Indicate the design flow rate of the treatment plant (i.e., the wastewater flow rate that the plant was built to handle). Also provide the average daily flow rate and maximum daily flow rate for each of the last three years. Each year's data must be based on a 12-month time period with the 12th month of "this year" occurring no more than three months prior to this application submittal.

a. Design flow rate 0.125 mgd

	Two Years Ago	Last Year	This Year	
b. Annual average daily flow rate	0.113	0.103	0.170	mgd
c. Maximum daily flow rate	0.242	0.500	0.463	mgd

Birmingham Branch
110 Vulcan Road
Birmingham, AL 35209-4702
(205) 942-6168
(205) 941-1603 (FAX)

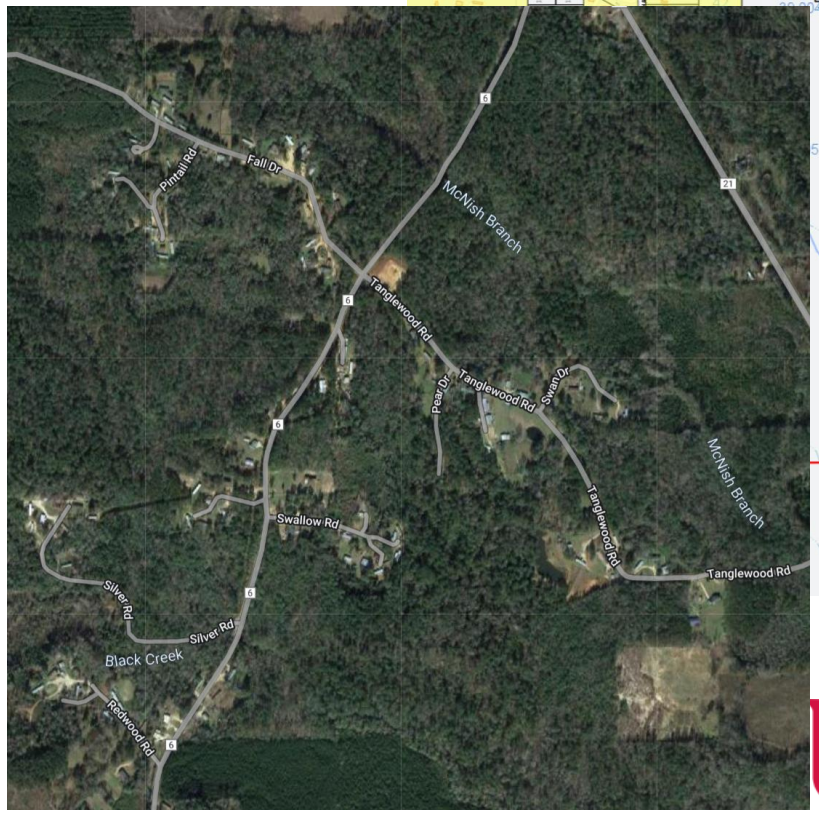
Decatur Branch
2715 Sandlin Road, S.W.
Decatur, AL 35603-1333
(256) 353-1713
(256) 340-9359 (FAX)

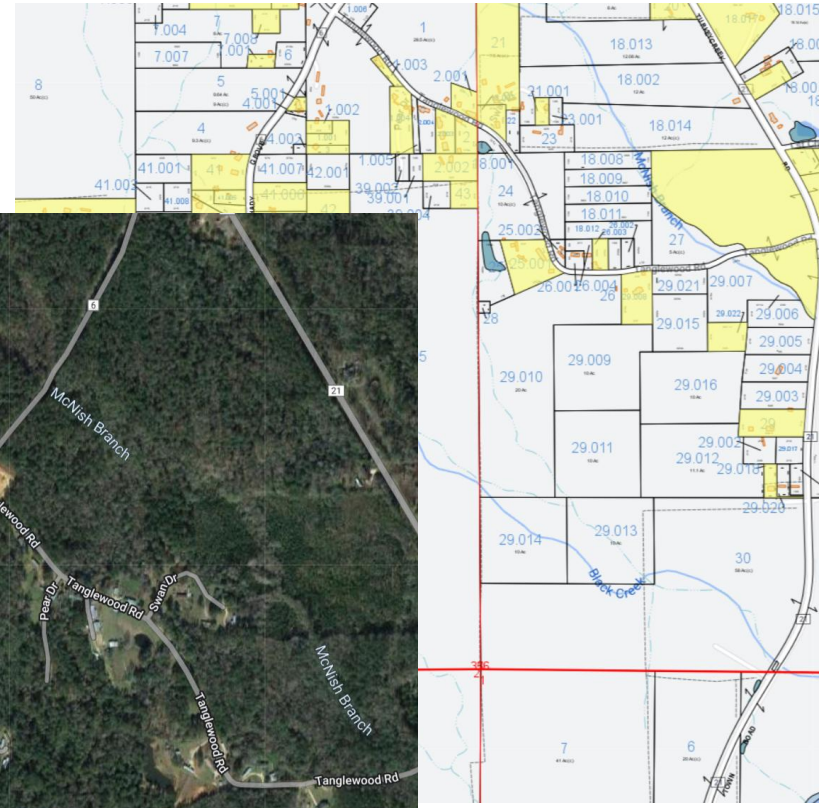
Mobile Branch
2204 Perimeter Road
Mobile, AL 36615-1131
(251) 450-3400
(251) 479-2593 (FAX)

Mobile-Coastal
3664 Dauphin Street, Suite B
Mobile, AL 36608
(251) 304-1176
(251) 304-1189 (FAX)

Step 3: Identifying population clusters

- Identified using county GIS records and satellite images
- Population clusters fit the following criteria
  - 85+ homes per cluster
  - 25+ homes/mi^2
  - Maximum 5 mi diameter
- Criteria based on affordability and limiting need for lift stations





Solution 1: Tie-In Clusters

- Population clusters may connect to existing centralized sewer systems
  - Within 6 miles of existing service area
- Only building collection system reduces capital costs
- STEP systems recommended for collection
- Potential issues
  - Existing systems may not have capacity & need upgrades
  - Existing systems may be unwilling to accommodate
  - Communities may prefer an individual system

Image Source: https://www.epa.gov/septic/types-septic-systems

Solution 2: Decentralized Clusters

- Population clusters outside of range for tying into an existing system
- STEP systems recommended for collection
  - Small diameter pipes = reduced costs
- Modular decentralized technology recommended for treatment
  - Can be expanded as the community expands
  - No capital loss to overbuilding to meet potential future needs

Centralized Model:

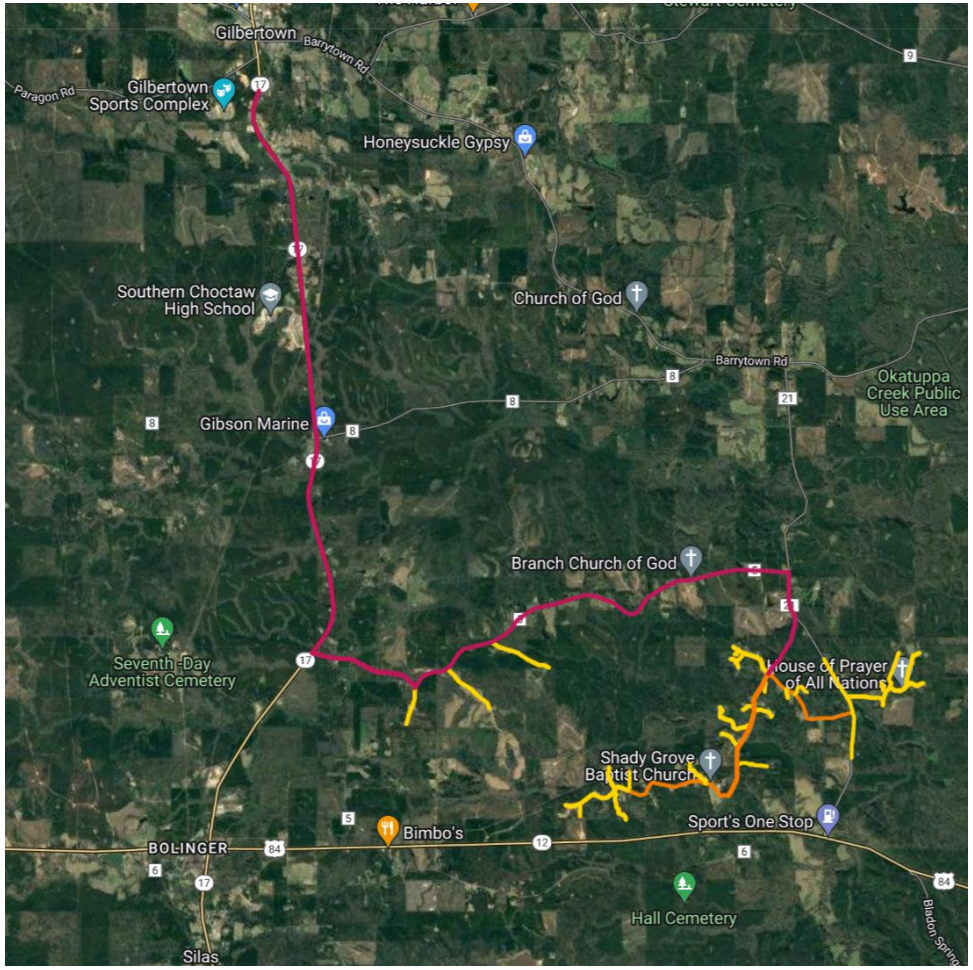
Decentralized Model:

Solution 3: Viable Onsite Treatment

- Any homes outside of an identified cluster need viable onsite wastewater treatment options
  - Homes with suitable soil condition can use septic tanks
  - Homes with unsuitable soil conditions require more advanced treatment
- Work is ongoing at USA and beyond
  - Developing affordable onsite solutions
  - Performing life-cycle cost analysis
  - Regulatory changes

Good		Better		Best	
Treatment Type	**Price**	**Treatment Type**	**Price**	**Treatment Type**	**Price**
Single-Pass Media Filter	$	Moving Bed Biofilm Reactor (MBBR)	$$$	Membrane Bioreactor (MBR)	$$$$
Extended Aeration Activated Sludge	$$	Fixed Bed Biofilm Reactor (FBBR)	$$	Recirculating Media Filter	$$$$
Constructed Wetlands	$	Sequencing Batch Reactor (SBR)	$$		

Step 5: Planning potential pipe networks



Street Name	Number of Connections	Standalone Pipe Estimates Length (ft)	Standalone Pipe Estimates Diameter (in)	Tie-In Pipe Estimates Length (ft)	Tie-In Pipe Estimates Diameter (in)
Shady Grove Rd	54	3,152 5,064	2 3	3,152 5,064	2 3
Topaz Rd	3	561	2	561	2
Oneal Rd					
Hartfield Ln					
Dan Rd					
Pine Tree Rd					
Tanglewood Rd					
Powe Ln					
Redwood Rd					
Silver Rd					
Swallow Rd					
Starling Dr					
Orchid Rd					
Fall Dr					
Pintail Rd					
Pebble Ln					
Pinto Ln					
Pear Dr					
Swan Dr					
Co Rd 21					
Sable Rd					
Pleasant Chapel Rd					
Mitchell Ln	7	2,281	2	2,281	2
Unnamed Road 1	5	423	2	423	2
Refugee Rd	3	280	2	280	2
Last Chapel Church Rd	5	1,673	2	1,673	2
Raintree Rd	15	5,861 2,862	3 4	5,861 2,862	3 4
Unnamed Road 2	7	2,619	2	2,619	2
Willow Rd	4	2,756	2	2,756	2
Branch Rd	59	1,679 18,797	2 4	1,679 18,797	2 4
Lindsey Rd	4	761	4	4,990	4
AL 17	0	-	-	25,189	4
Totals	351	39,124 15,719 24,379	2 3 4	39,124 15,719 53,797	2 3 4

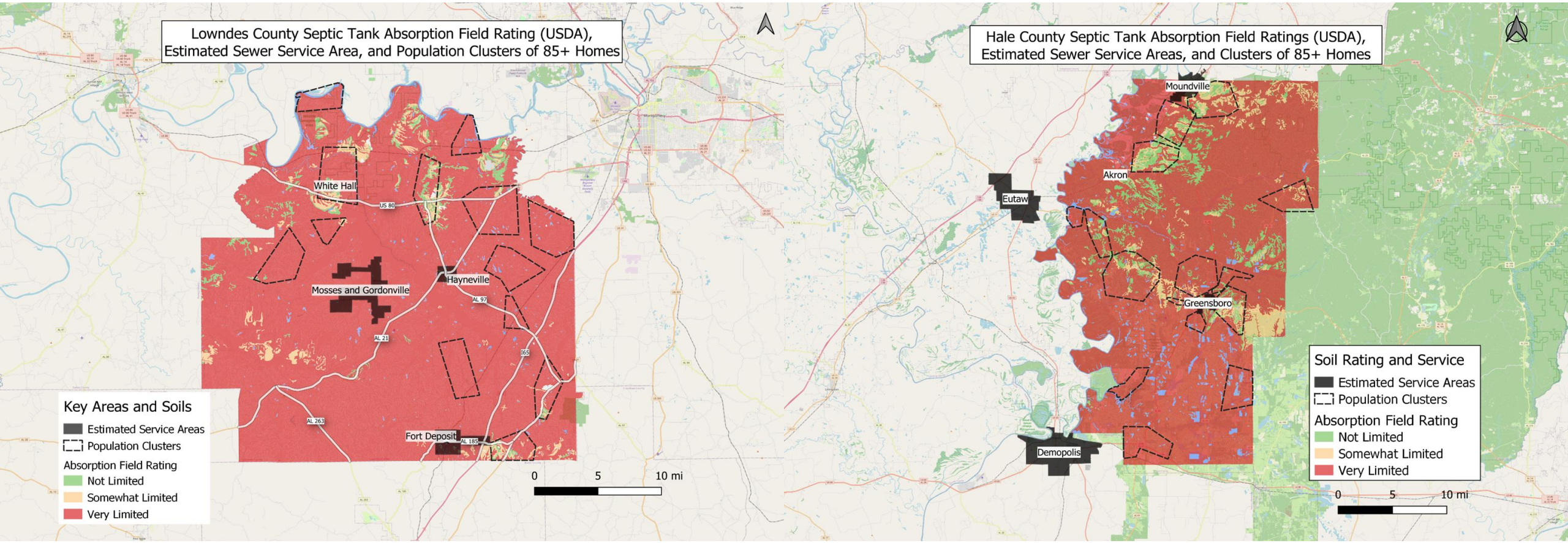
Assume 2.75 Capita per Connection

351 connections yields	966 Capita
Assume max 100 GPCD	**96,600 GPD**

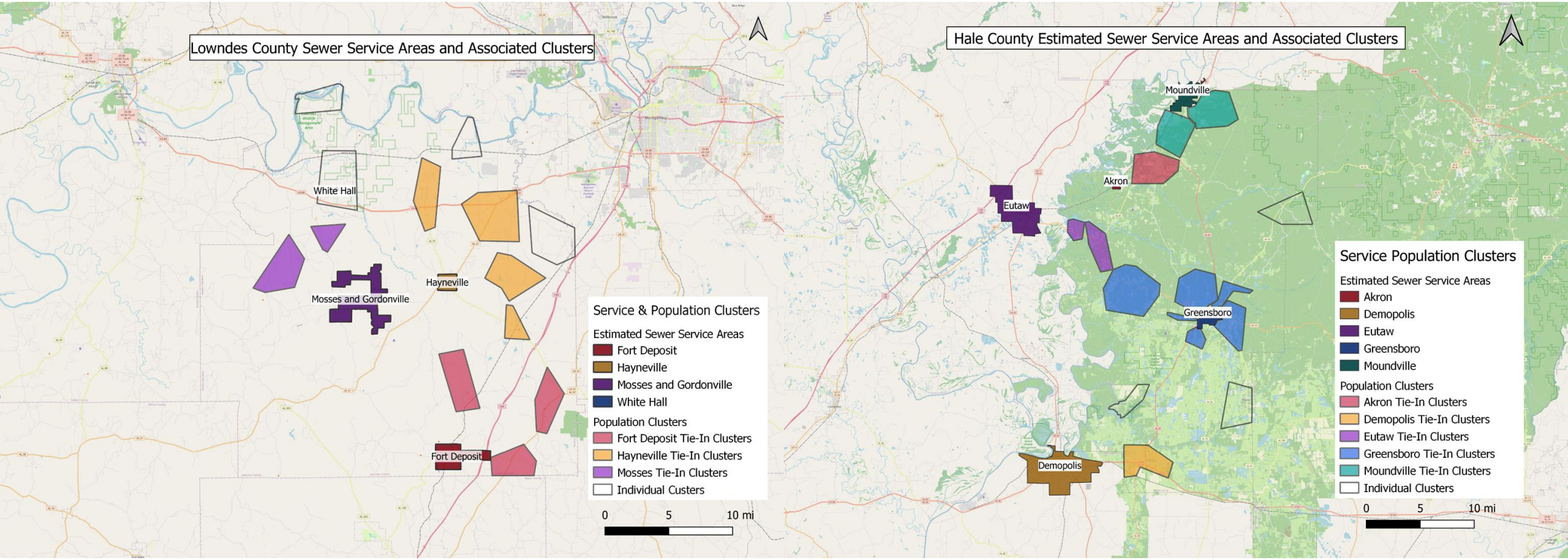
Step 6: Developing cost estimates for population clusters

		Standalone System Cost Estimates		Tie-In System Cost Estimates	
Item	**Unit Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**
Mobilization	$150,000	1	$150,000	1	$150,000
Clearing & Grubbing	$25,000	1	$25,000	1	$25,000
2” Class 200 PVC Force Main (LF)	$9	39,124	$352,116	39,124	$352,116
3” Class 200 PVC Force Main (LF)	$11	15,719	$188,628	15,719	$188,628
4” Class 200 PVC Force Main (LF)	$13	24379	$365,685	53797	$806,955
STEP Assembly	$9,500	351	$3,334,500	351	$3,334,500
Septic Tank Abandonment	$800	351	$280,800	351	$280,800
Seeding & Mulching	$35,000	1	$35,000	1	$35,000
Erosion Control	$20,000	1	$20,000	1	$20,000
Wastewater Treatment (per GAL)	$15	96,600	$1,449,000	0	$0
Subtotal Construction			$6,200,729		$5,192,999
5% Construction Contingency			$310,036		$259,650
Equipment			$225,000		$225,000
Boundary & Topographic Survey			$20,000		$20,000
ADEM Stormwater Permitting and Monitoring			$15,000		$15,000
ADEM NPDES/ADPH Permit Modification			$15,000		$15,000
Engineering Design (6.8%)			$421,650		$353,124
CEI (8%)			$496,058		$415,440
Total Project Cost			**$7,703,473**		**$6,496,213**
Cost Per Connection			**$21,947**		**$18,508**

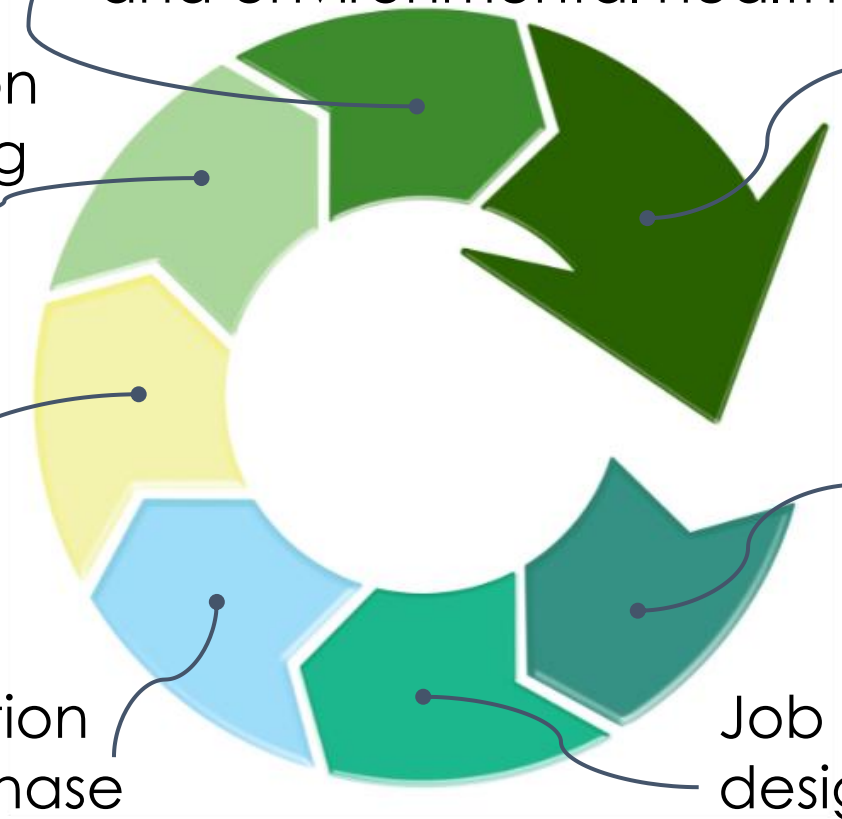
Soil Rating, Service Area, and Population Cluster Maps



Service Area and Associated Population Cluster Maps



Benefits of Implementing the 3-Part Plan



Conclusions

- The Alabama Black Belt is a rural, disadvantaged region with limited wastewater infrastructure and high rates of failed septic tanks and straight pipe usage
- The 3-part plan of wastewater solutions for the region includes upgrading and expanding centralized sewers, establishing decentralized cluster systems, and finding appropriate onsite wastewater solutions for areas with low population density
- Methods for performing wastewater needs assessments include soils mapping, identifying existing municipal sewer systems, identifying population clusters, identifying best fit solutions, planning potential pipe networks, and developing cost estimates for population clusters
- Implementing wastewater solutions can improve economic, environmental, and community health

For More Information

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Thank You!