Informing Wastewater Infrastructure Planning through Spatial Optimization

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Background

- One of the most publicized communities facing inadequate wastewater infrastructure is Lowndes County, Alabama, located in the Black Belt region, where there are ongoing efforts to improve infrastructure
- The wastewater infrastructure crisis has been exacerbated by low population density (limited sewer feasibility), sub-optimal geologic conditions (not suitable for traditional onsite wastewater treatment systems), and high poverty rates (necessitating affordable solutions)
- Identifying the optimal number, location, and type of wastewater treatment systems (WWTSs) (e.g., centralized, clustered, or onsite) remains a central challenge in developing cost-optimal solutions

Objective

Determine the cost-optimized layout of wastewater treatment infrastructure for Lowndes County, Alabama using a spatial optimization model—the sustainable infrastructure network planning model (SNIP)

Methods

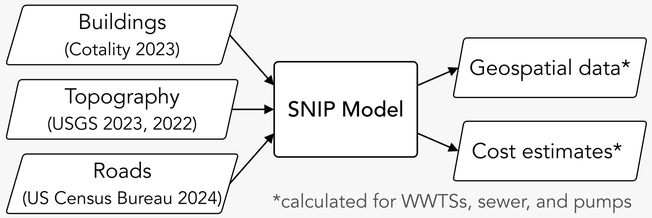

Figure 1. Workflow to find the cost-optimal wastewater infrastructure using the SNIP model. Note, SNIP does not account for current infrastructure.

SNIP Model Objective: minimize the total system costs (capital + operational costs) of wastewater systems (i.e., optimize costs), where the total system cost depends on the number of WWTS, the wastewater volume treated per WWTS, the sewer network length, the sewer diameters, the pumped volume, and the pump head at the duty point (Eggimann, Truffer, and Maurer 2015)

Key Results

At cost-optimal conditions, 39% of wastewater infrastructure should be centralized (currently 24% centralized)

Geospatial data outputs can guide parcel level guidance on the cost-optimal type of wastewater treatment infrastructure

The SNIP model can provide technical assistance quickly and at a low cost

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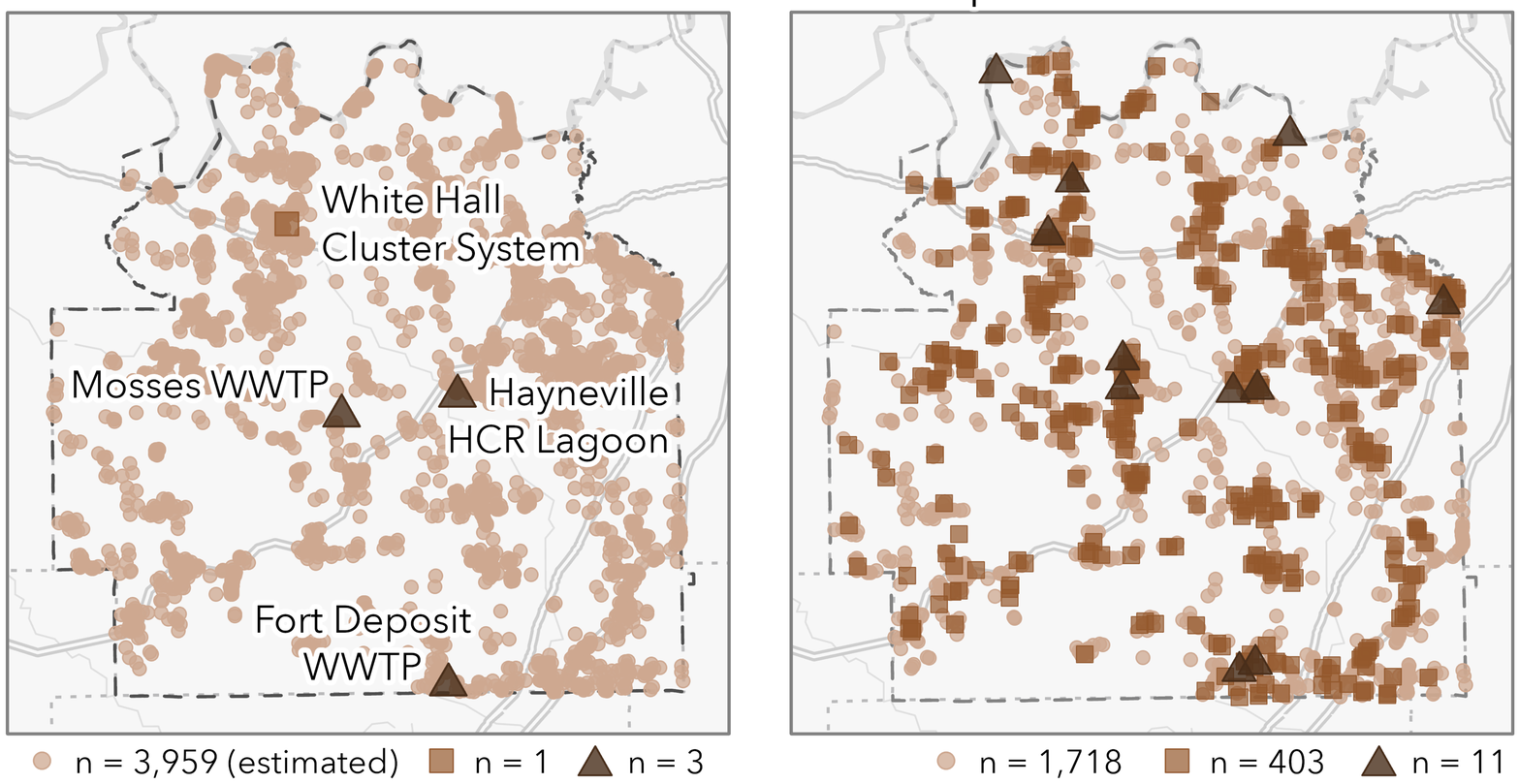
Spatial optimization model shows potential cost savings from more clustered and centralized wastewater treatment systems



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