

APPLIED SCIENCE FOR NON- STRUCTURAL ADAPTATION PLANNING, A CASE STUDY IN MANDEVILLE, LA

**Using Travel-time to Essential Services to Identify
Vulnerable and Fragile Communities**

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School of Industrial Engineering

Agenda

- Background / Motivation
- Methods
- Results
- Conclusion
- Implications / Future work

Background / Motivation

- Transportation networks are critical element of flood risk resilience in terms of providing **timely access** to essential services.
- Changing climate will impact coastal communities, where residents could experience up to **643 min of commute time per year** in 2060 in current sea level rise (SLR) trajectories due to **reduced speeds** on inundated roads (Hauer et al., 2021)
- Existing transportation network in **Louisiana** has the **second highest risk** among all coastal communities in US in terms of both **isolation** and inundation in low sea level rise scenario (SLR) and third in middle and high SLR scenarios (Logan et al., 2023).
- People living in coastal communities across Louisiana mentioned the **increased drive time to essential services** as an important outcome of flood risk.



Figure 1. Aerial picture of Louisiana road inundation, Source: Houston Chronicle

Background / Motivation

- With changing climate population dynamics are changing in coastal communities:
 - Population ↓ → Services closing either because of the damage from the tropical cyclones or decreased business activity → Drive time ↑
 - Population ↑ → Strained capacity in existing facilities, and potential increased drive time for new residents of a region

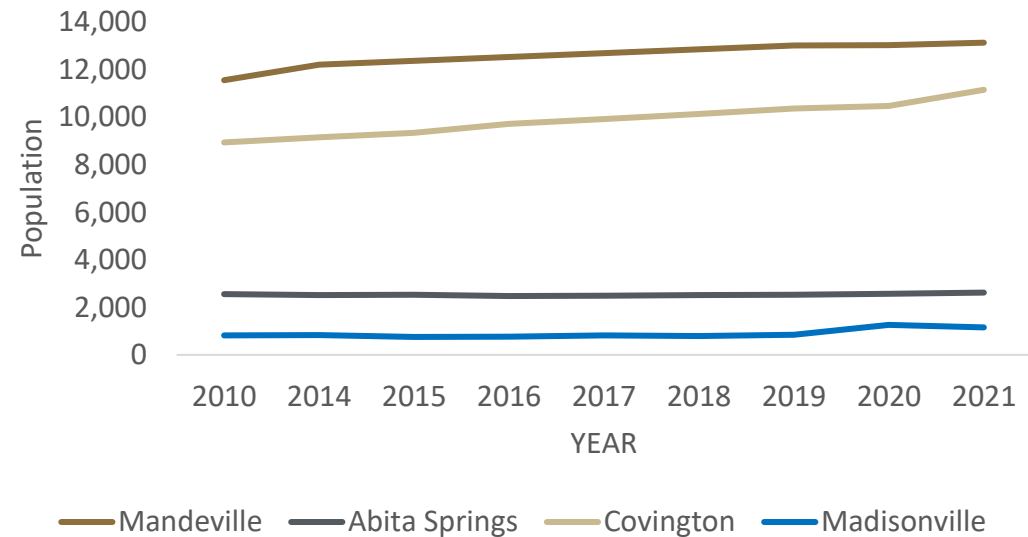
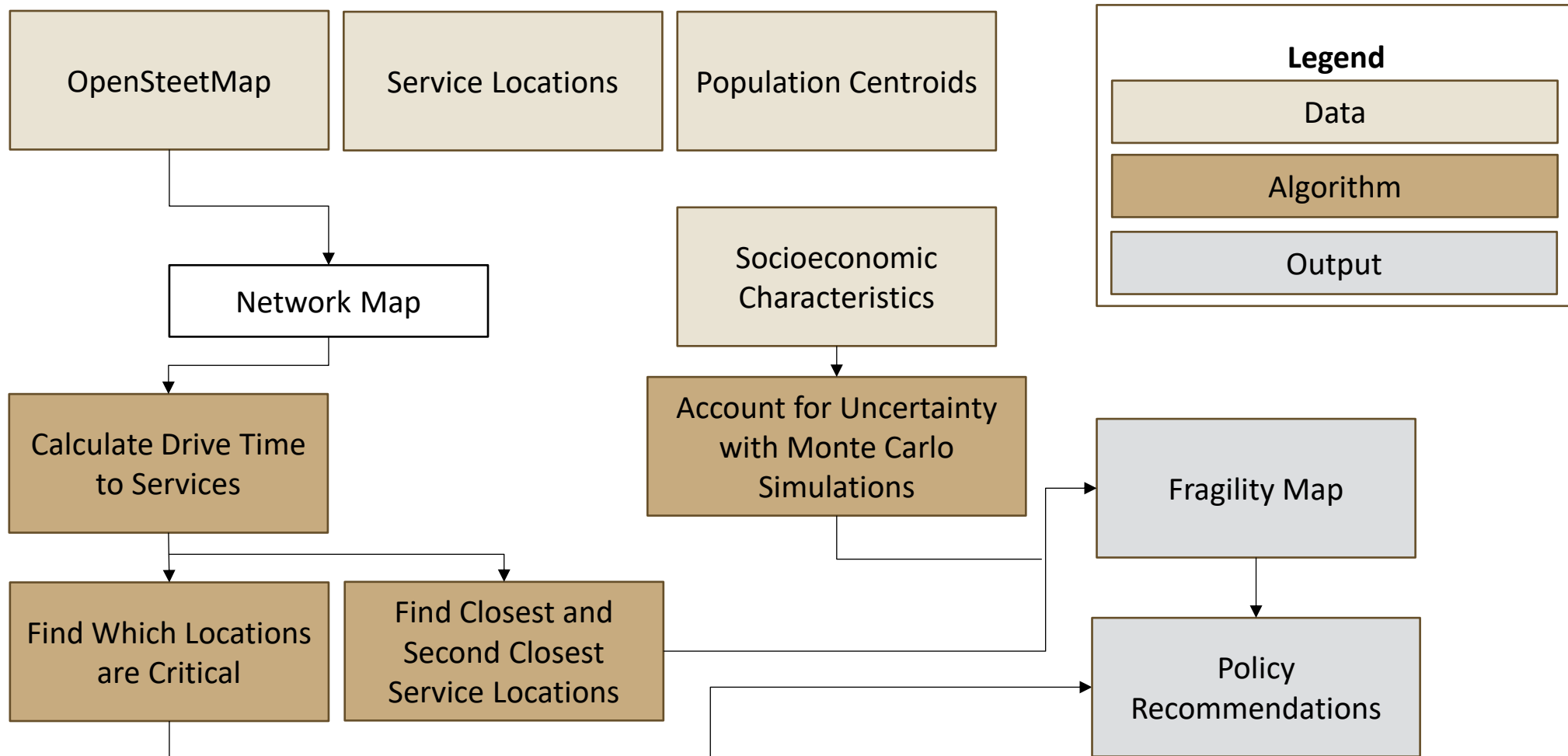


Figure 2. Population change over years

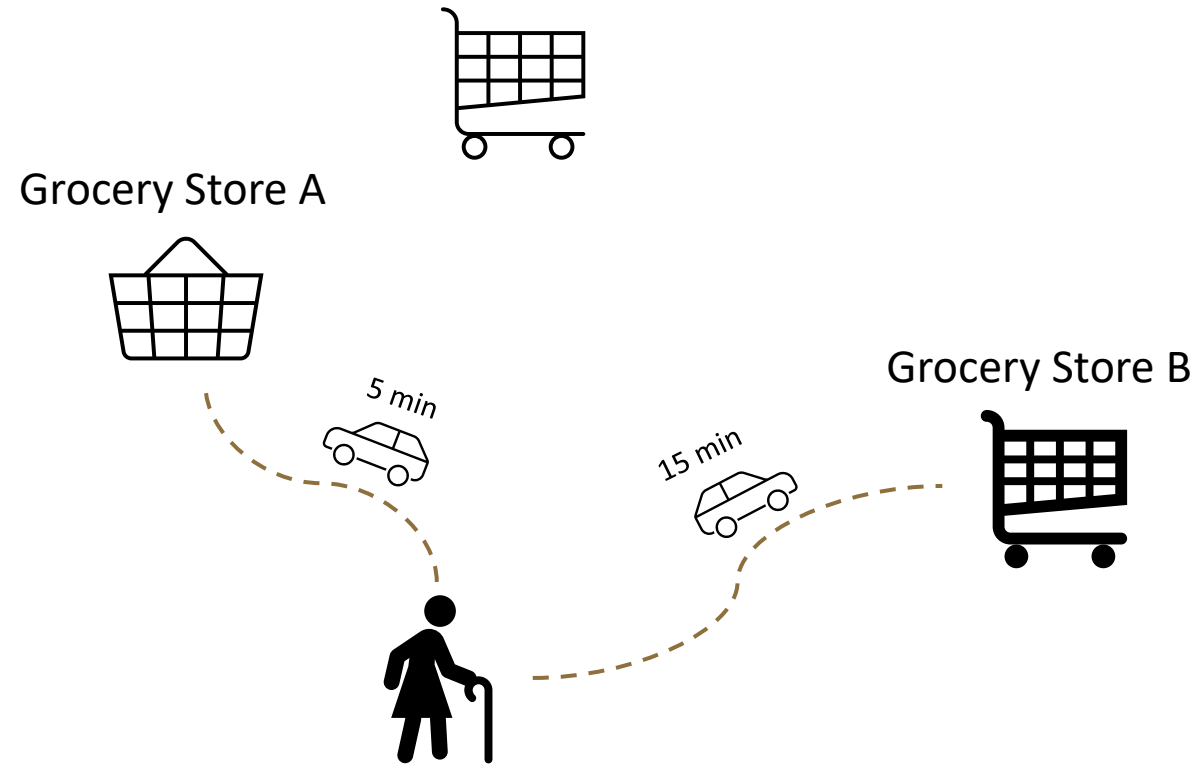
Research Questions

- How to quantify the fragility of the access to essential services using transportation networks as it relates to resilience?
- Which facilities are critical in terms of access?
- Are there any racial differences in terms of access to essential services?

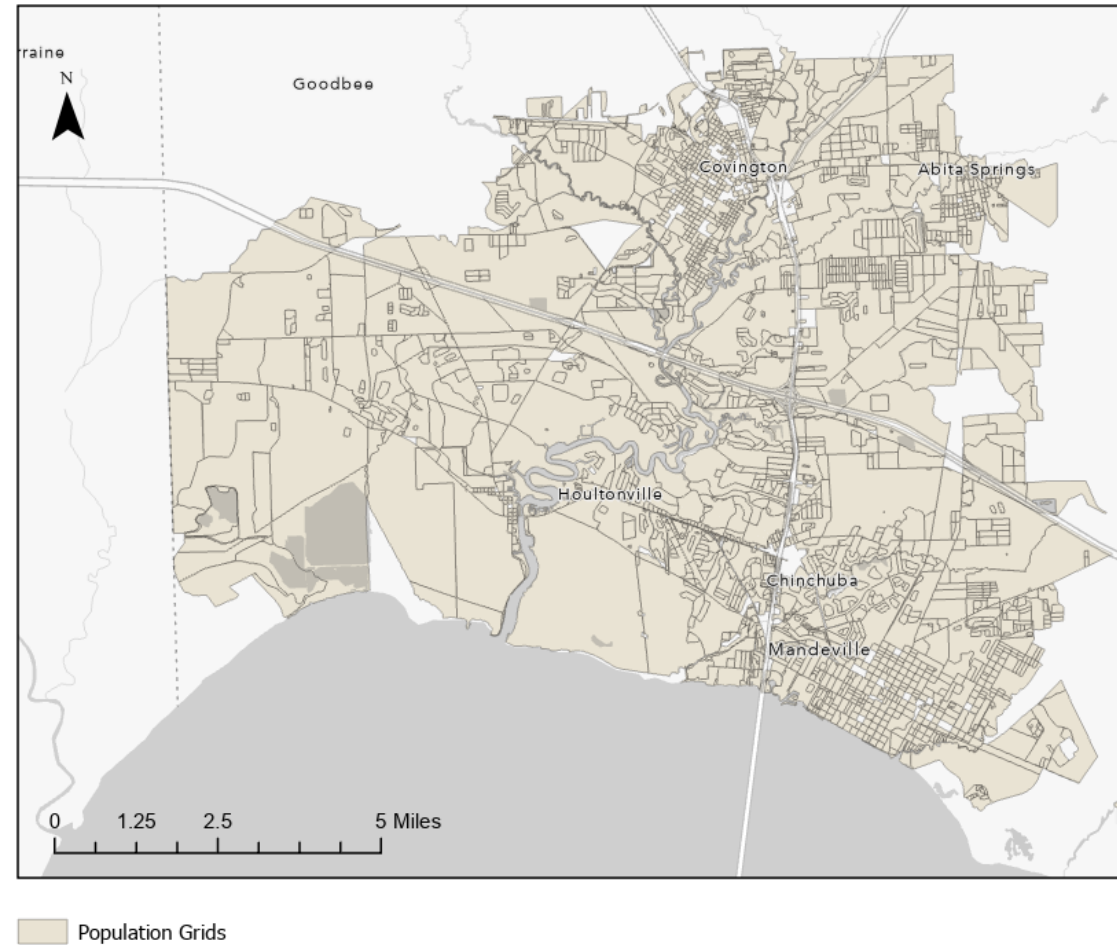
Methods



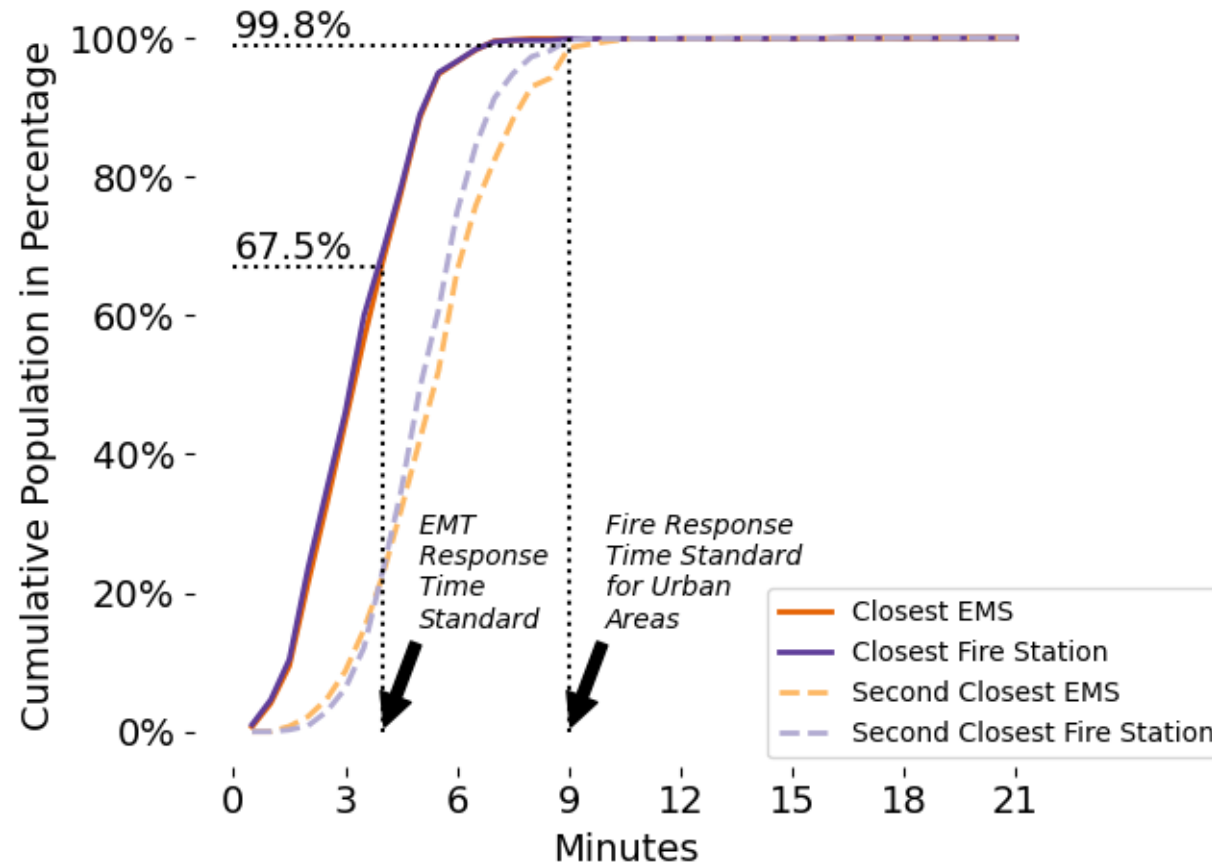
Methods



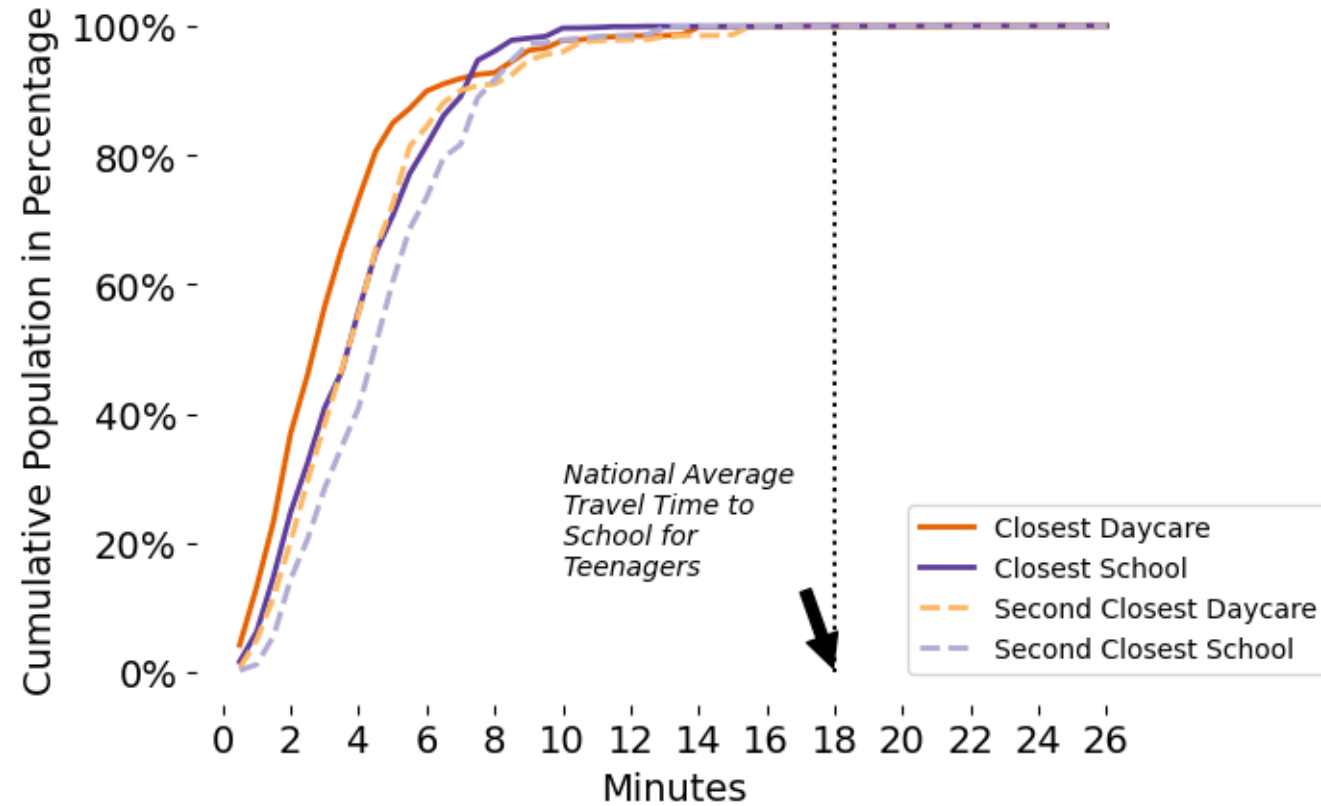
Study Area



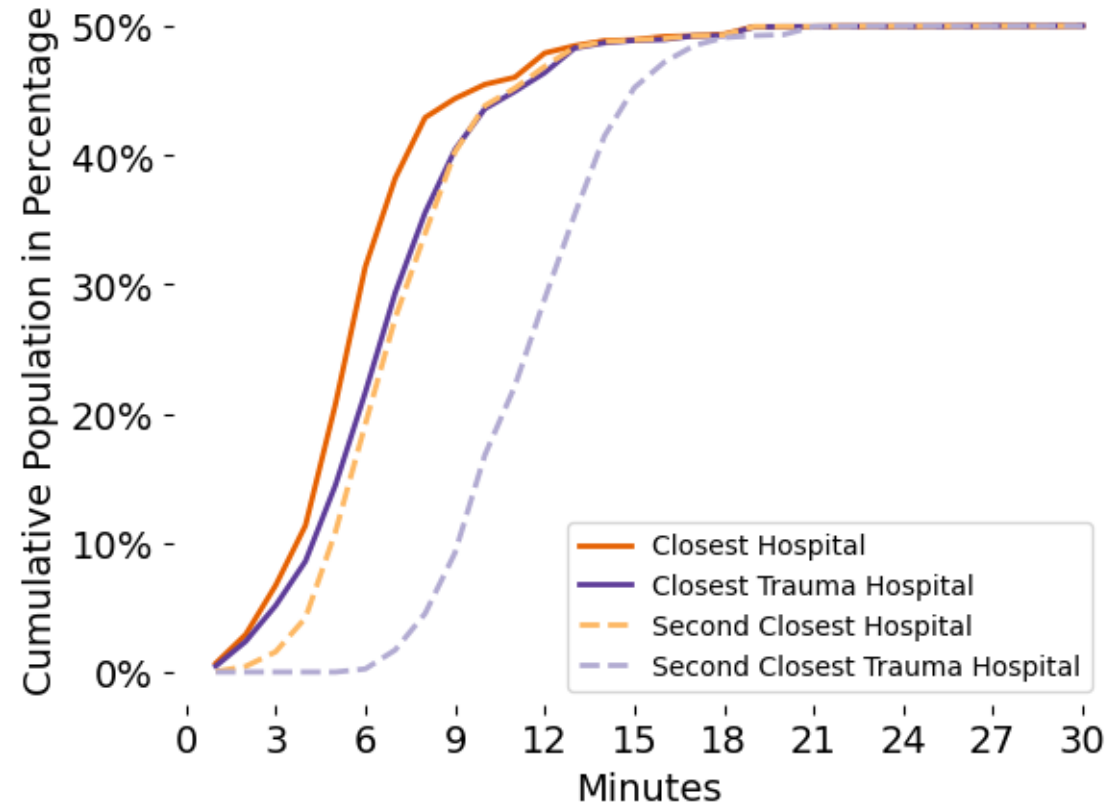
Emergency Services Access

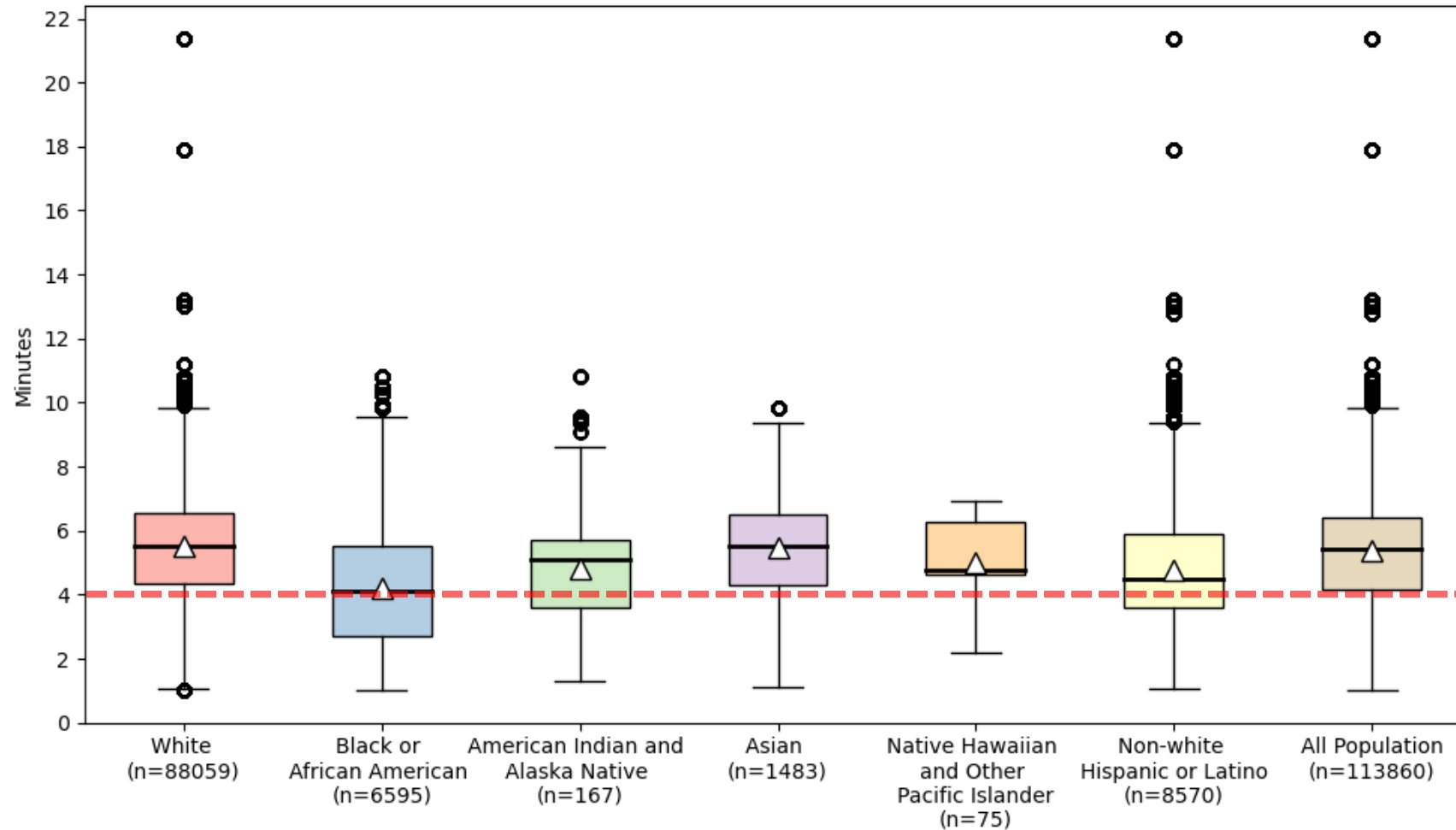


Education Access



Hospital Access

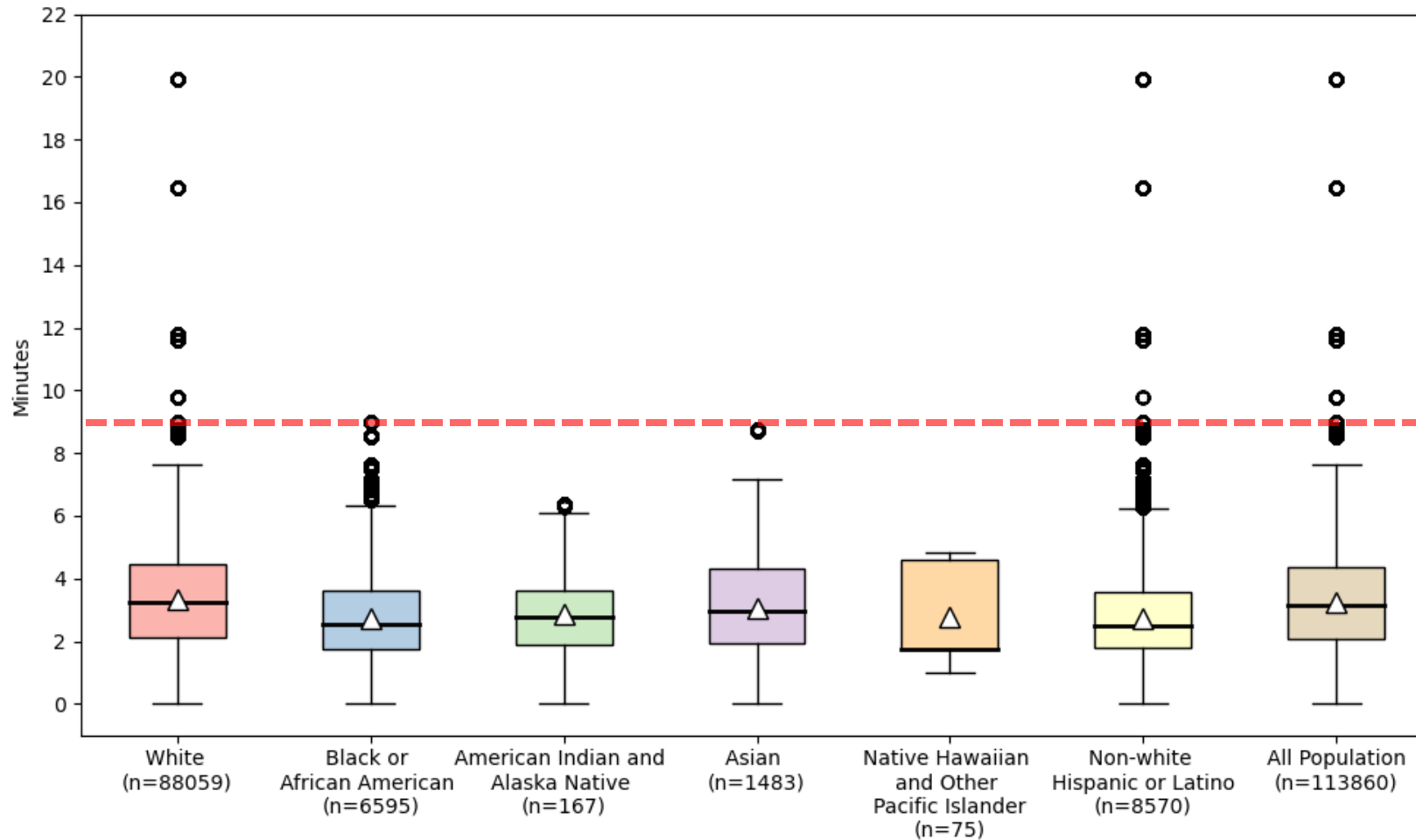




NFPA Standard
1710: EMT
Benchmark
Response Time
Goal (4 min
driving, 1 min
turnout time)

NFPA: National Fire
Protection Association

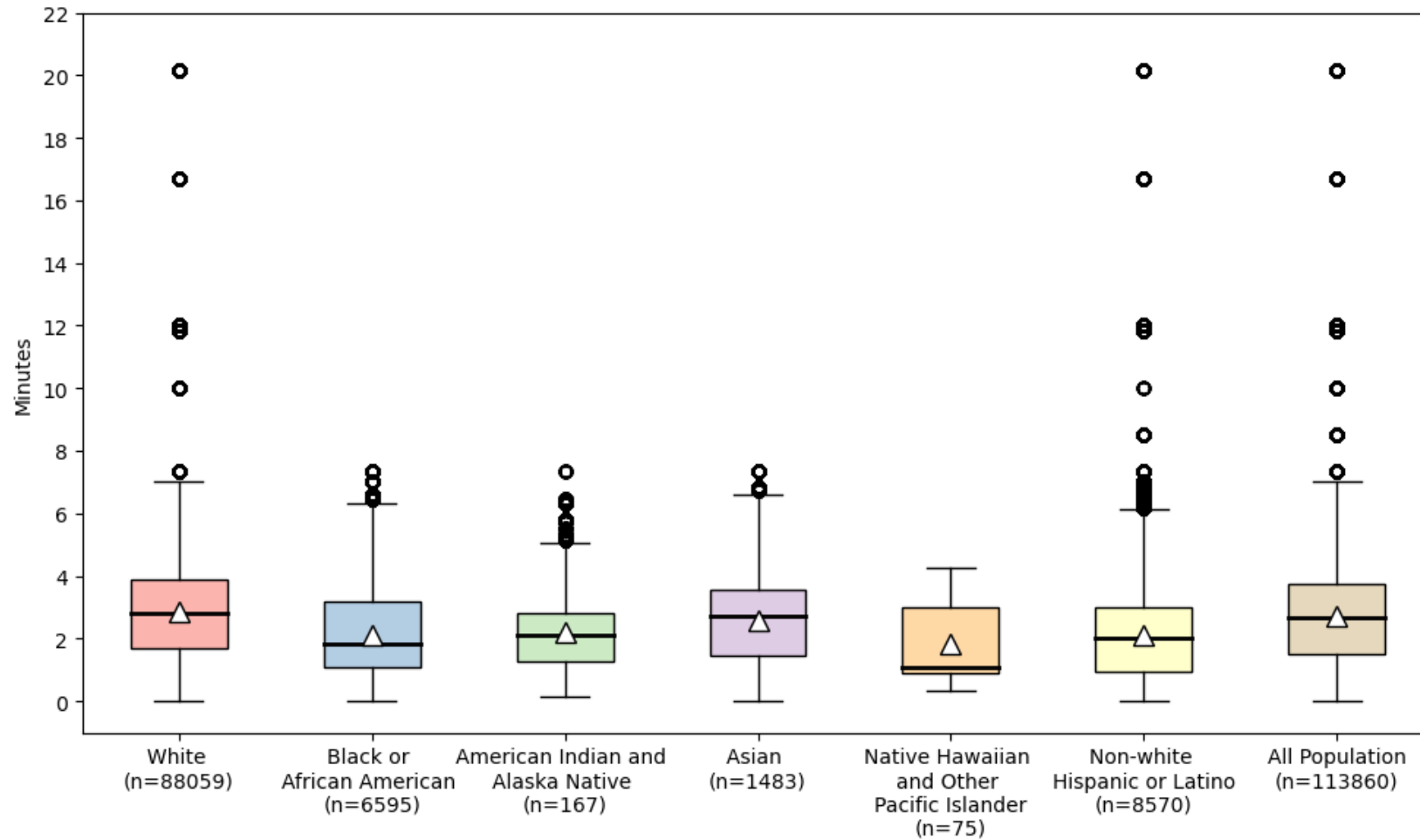
Fire Stations



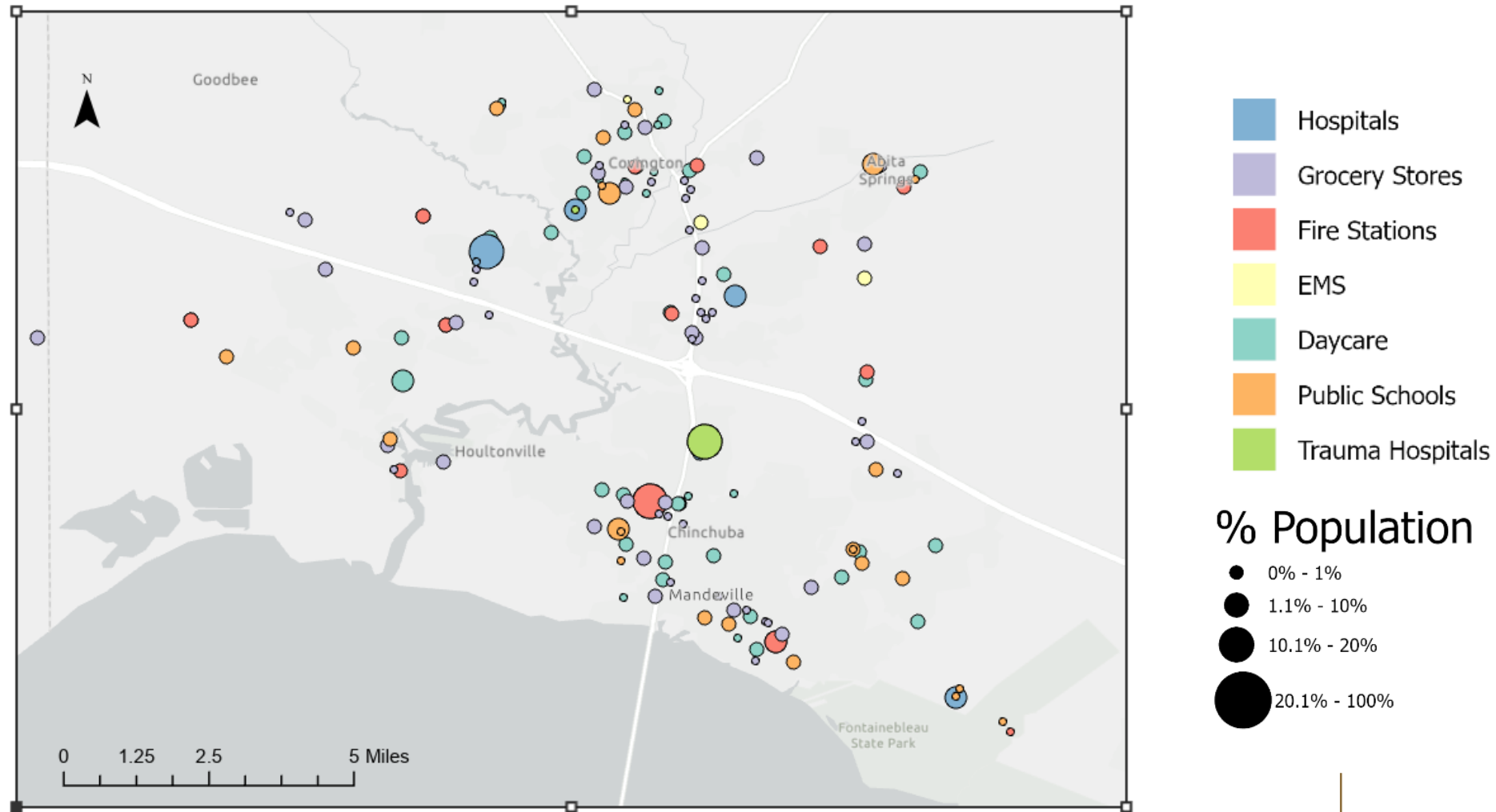
NFPA Standard
1720: Urban Area
Benchmark
Response Time
Goal for Fire
Response (9 min
after dispatch)

NFPA: National Fire
Protection Association

Grocery Stores



Criticality of Essential Services



Conclusion

- In terms of emergency response, **almost entire population** in the study areas has access to **fire response within benchmark time**. Approx. **70% of the population** also has **EMT response time within benchmark time**.
- There are **alternative** schools and daycares people can benefit from in the event of closures of the closest locations **without losing too much time** in access.
- Secondary trauma hospital for almost all the population is within 10-minute marginal time, and entire population has **access to hospitals within 30 minutes**.
- In terms of racial equity, there are **only minor differences** apart from a couple of communities that are predominantly **White or Non-White Hispanic/Latino** identified as outliers in all essential services.
- **No essential service location serves** as the primary location for at least 50% of the population (except trauma hospital which only has 2 locations) → Indicates **resilience** in terms of essential service locations

Implications

- Looking at the secondary, tertiary, etc. locations for essential service access could indicate fragility. Even though the study area does not suffer from this problem, other areas we looked at (such as Cameron Parish) shows high fragility for population decline induced business closures and lack of road access due to flooding.
- Identifying which locations are critical in providing access can help policymakers make decisions regarding protection of these locations before the hazard becomes a reality.

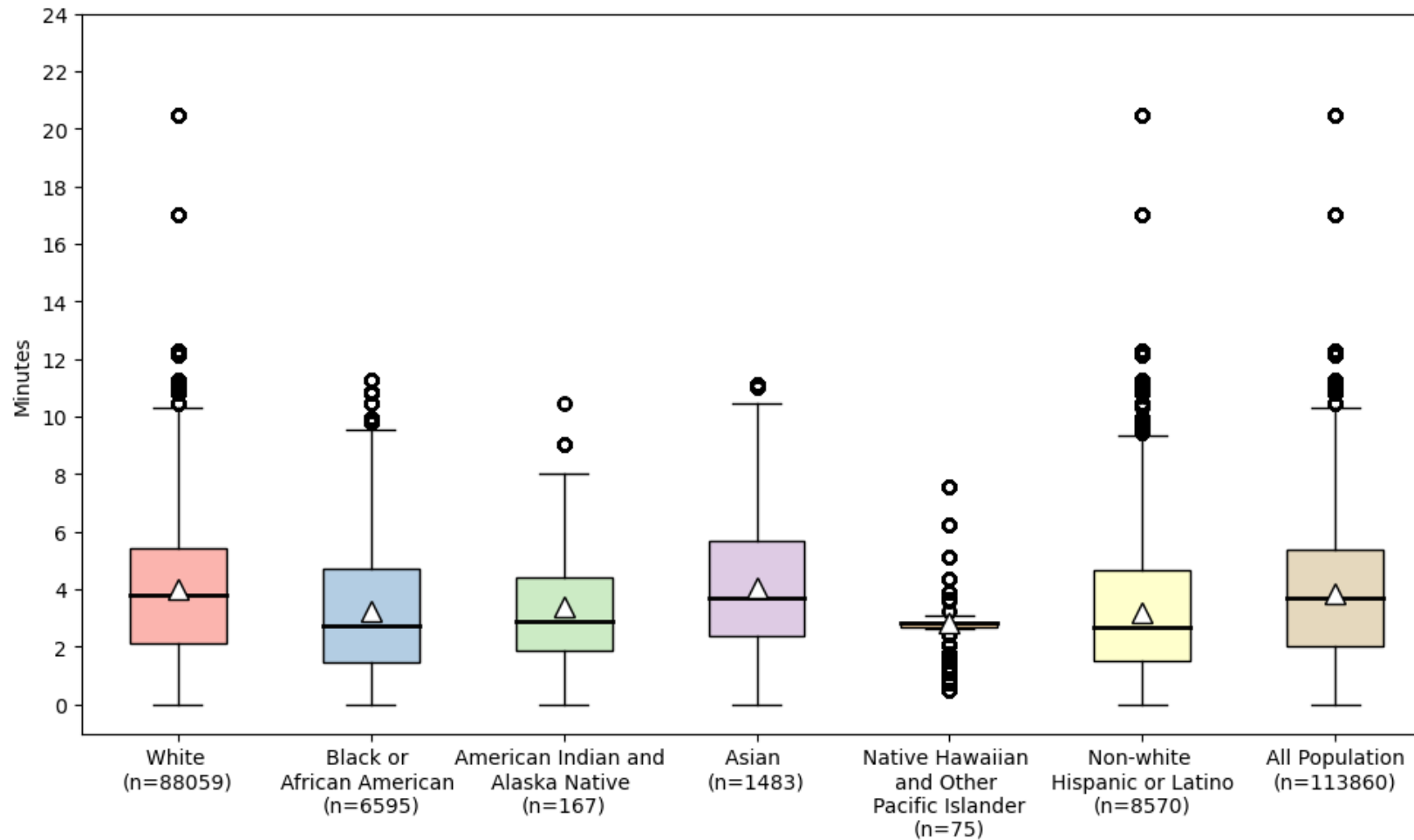
References

- Hauer, M., Mueller, V., & Sheriff, G. (2021). *US Commuting delays from tidal flooding worsen with sea level rise* [Preprint]. In Review.
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- NFPA, & National Volunteer Fire Council. (n.d.). *Understanding and Implementing Standards NFPA 1500, 1720, and 1851*. Retrieved April 2, 2023, from
https://www.nfpa.org/Assets/files/AboutTheCodes/1720/Standards_Guide_1500_1720_1851.pdf

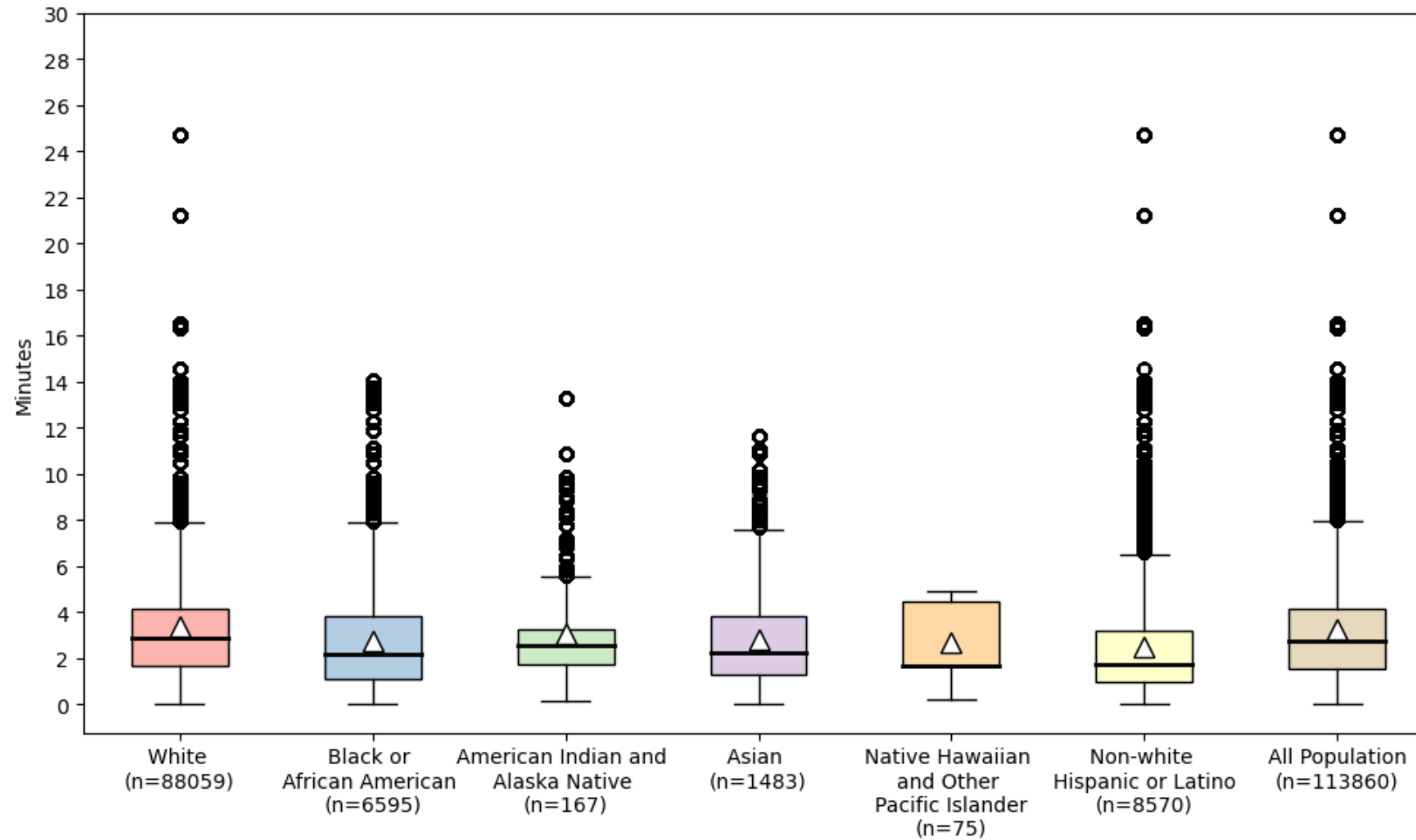
THANK YOU!

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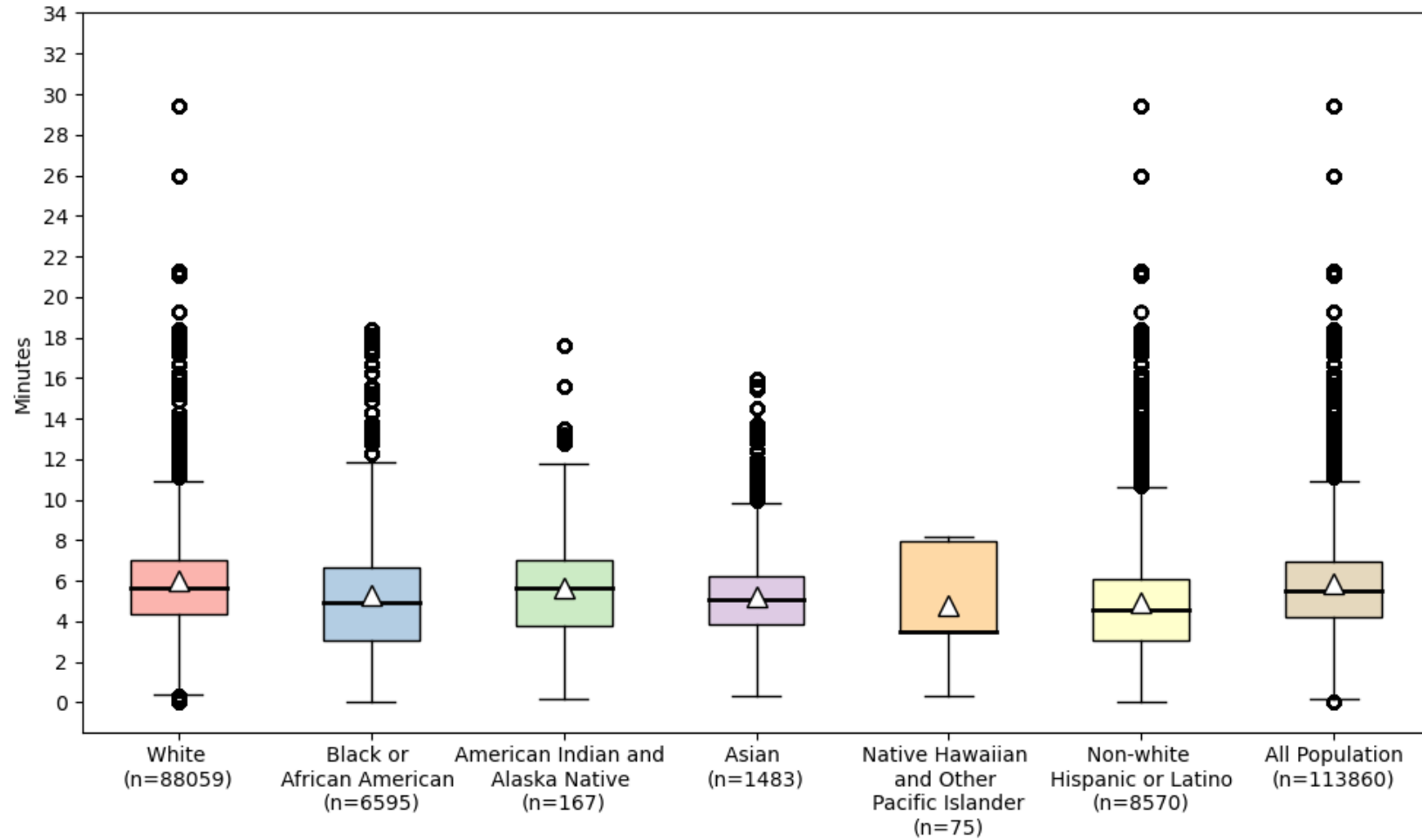
School



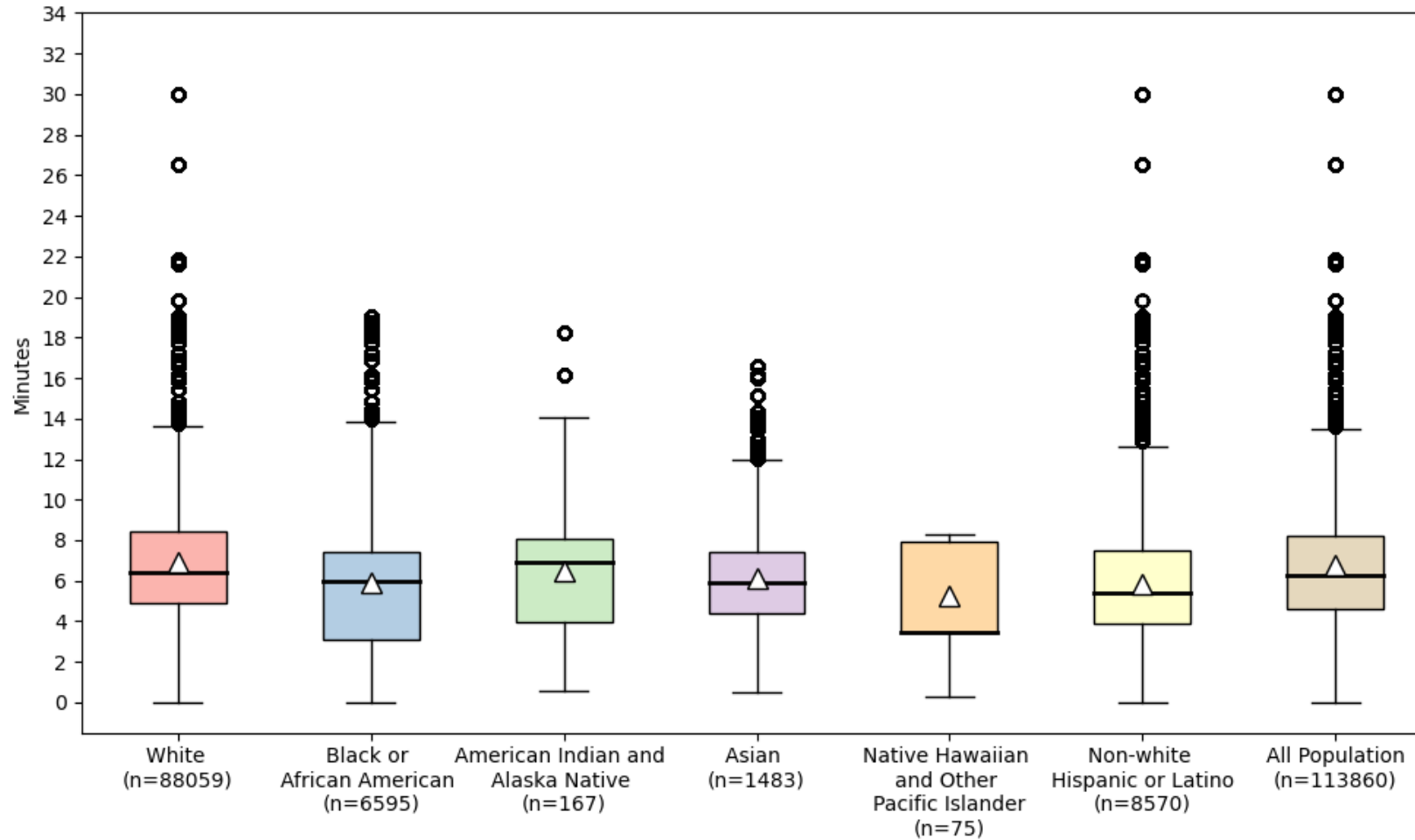
Daycare



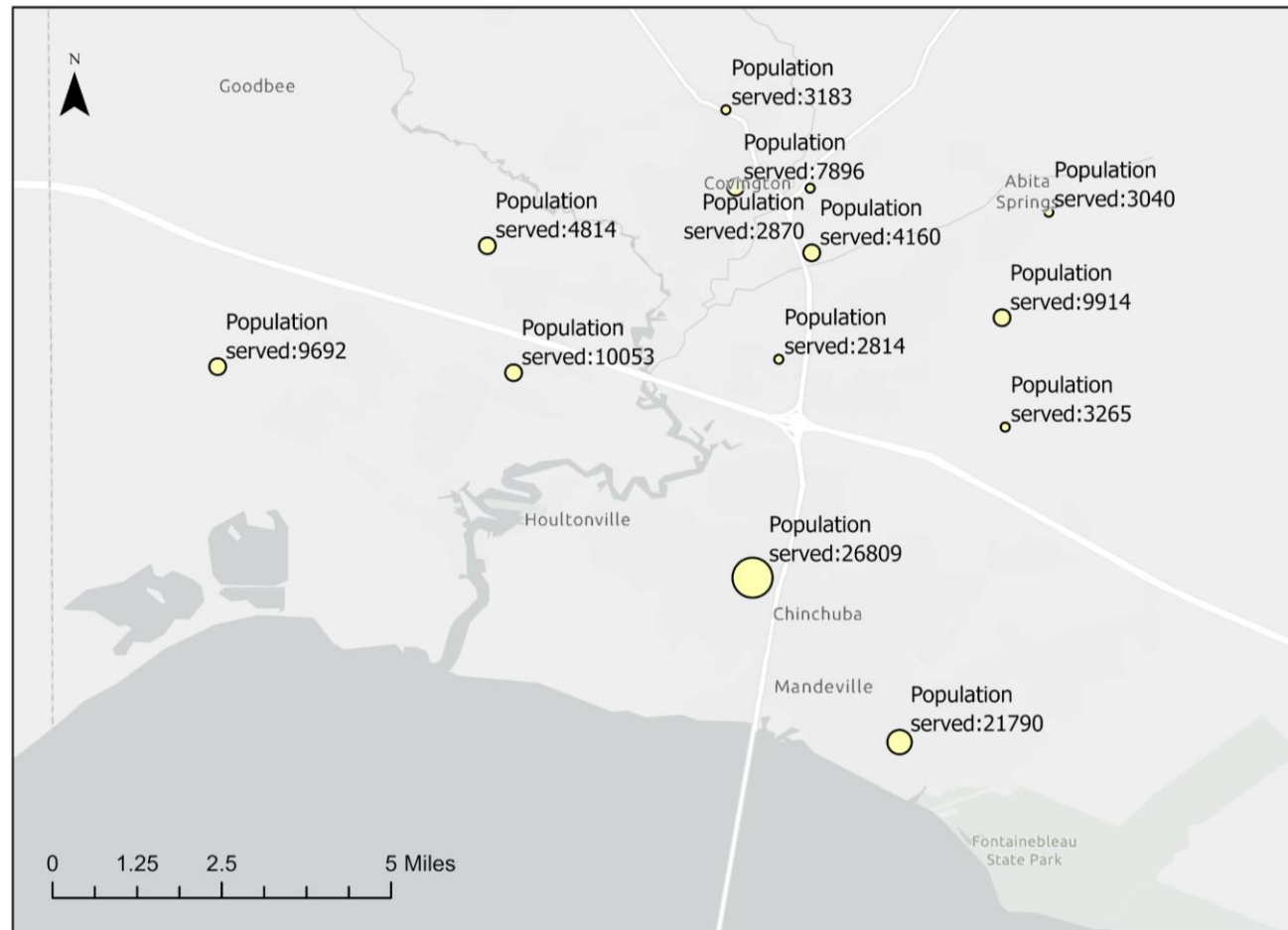
Hospital



Trauma Hospital



EMS

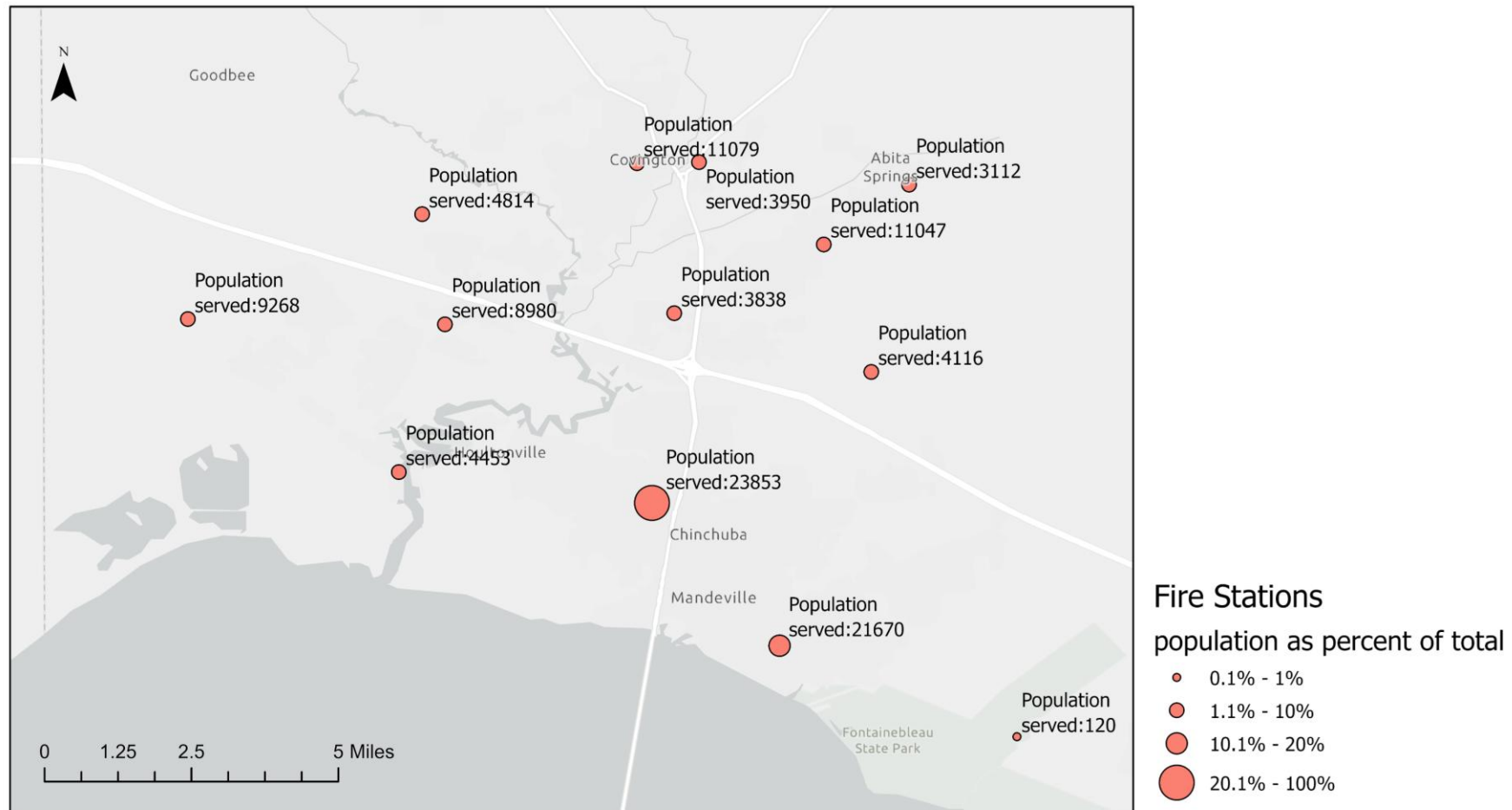


EMS

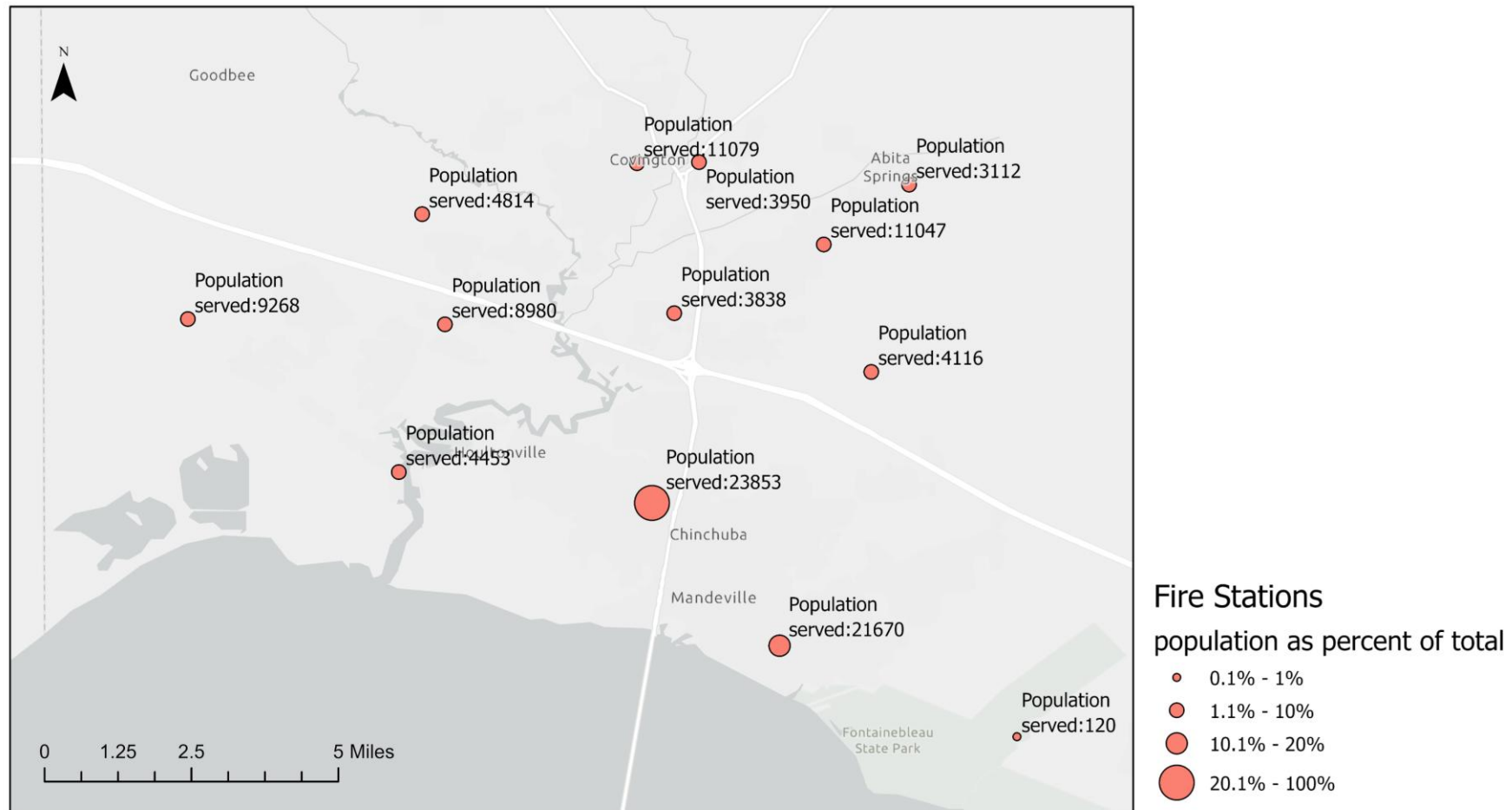
population as percent of total

- 2.5% - 2.9%
- 3% - 10%
- 10.1% - 20%
- 20.1% - 100%

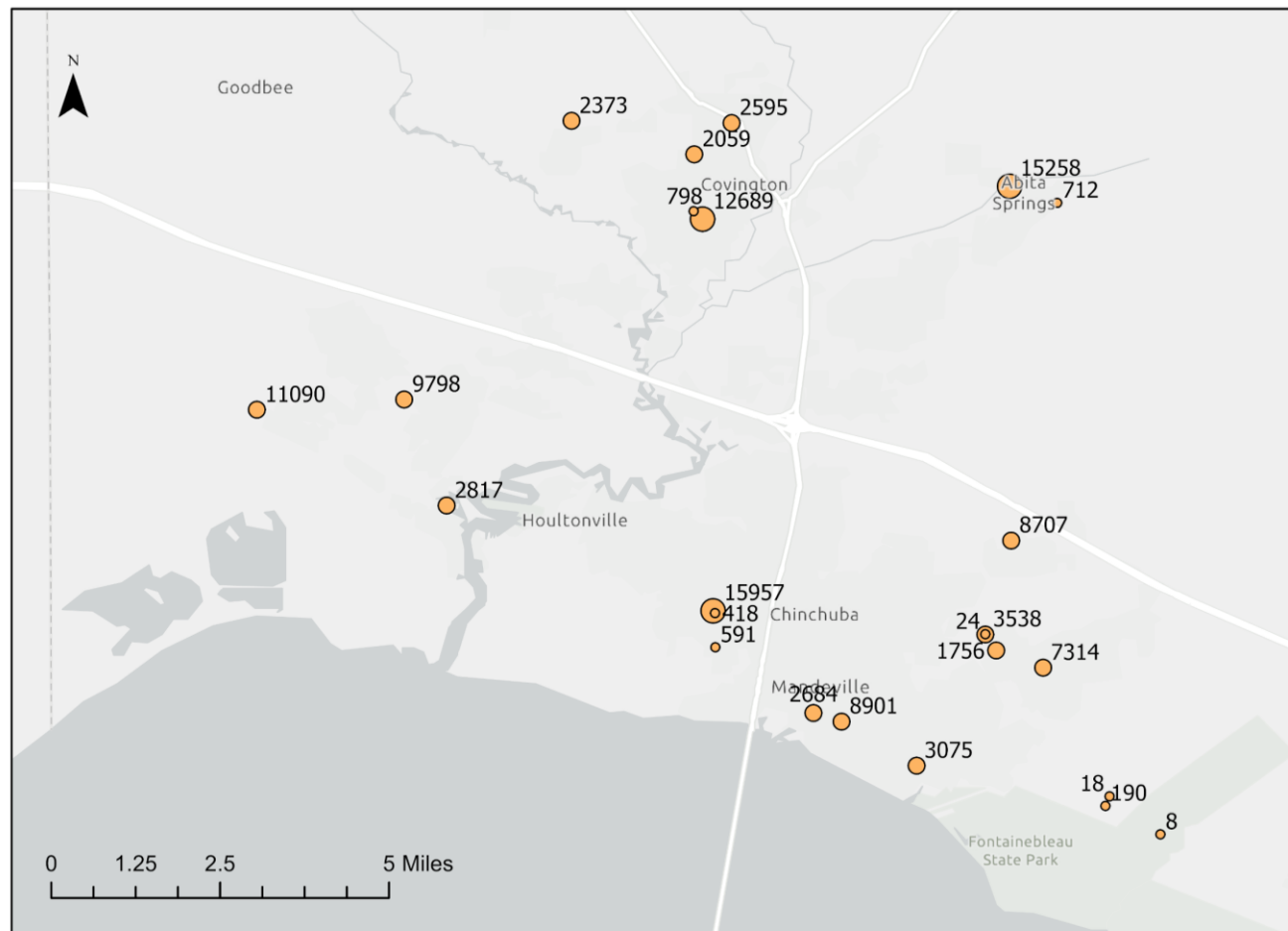
Fire Stations



Fire Stations



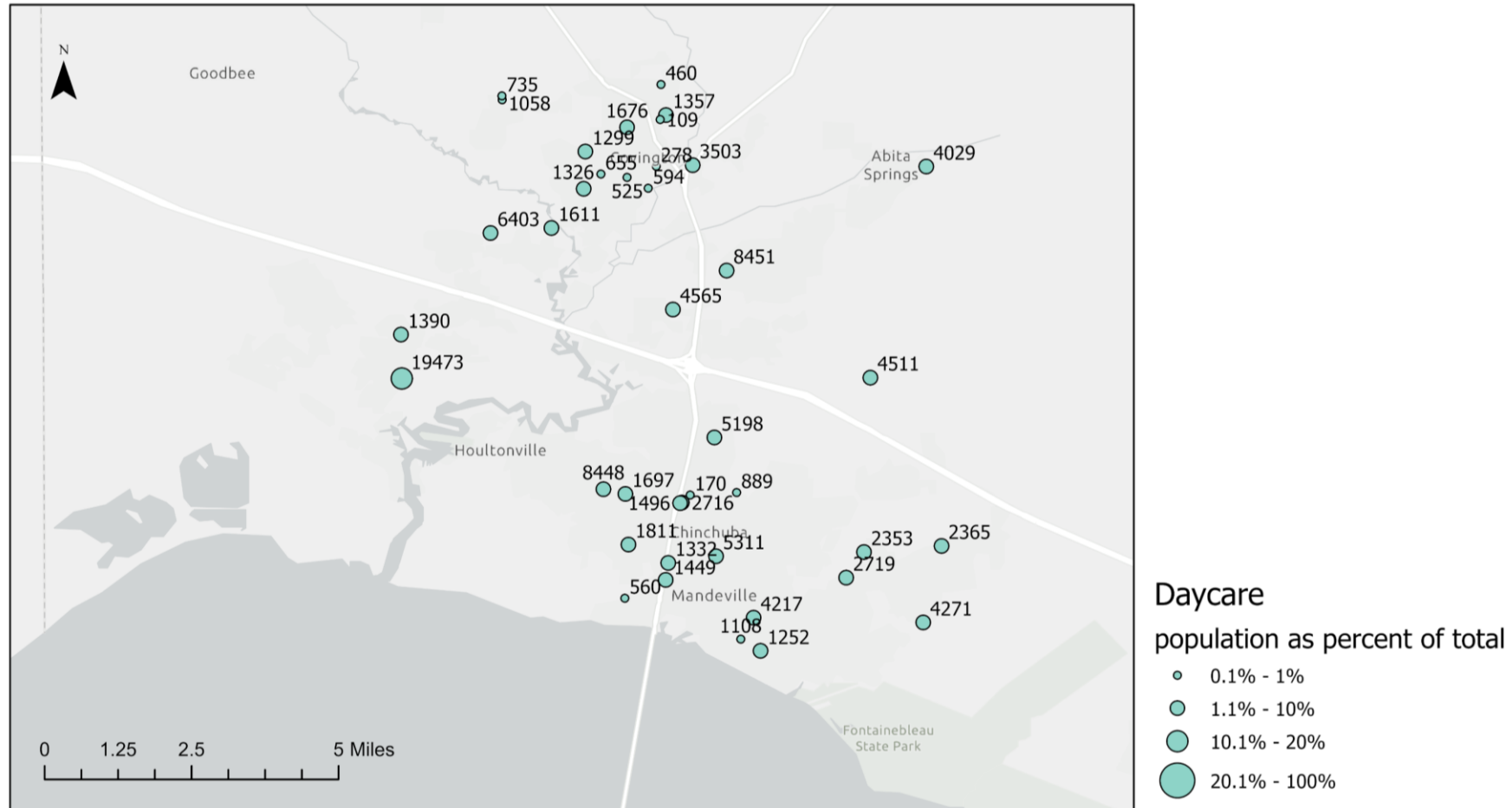
Schools



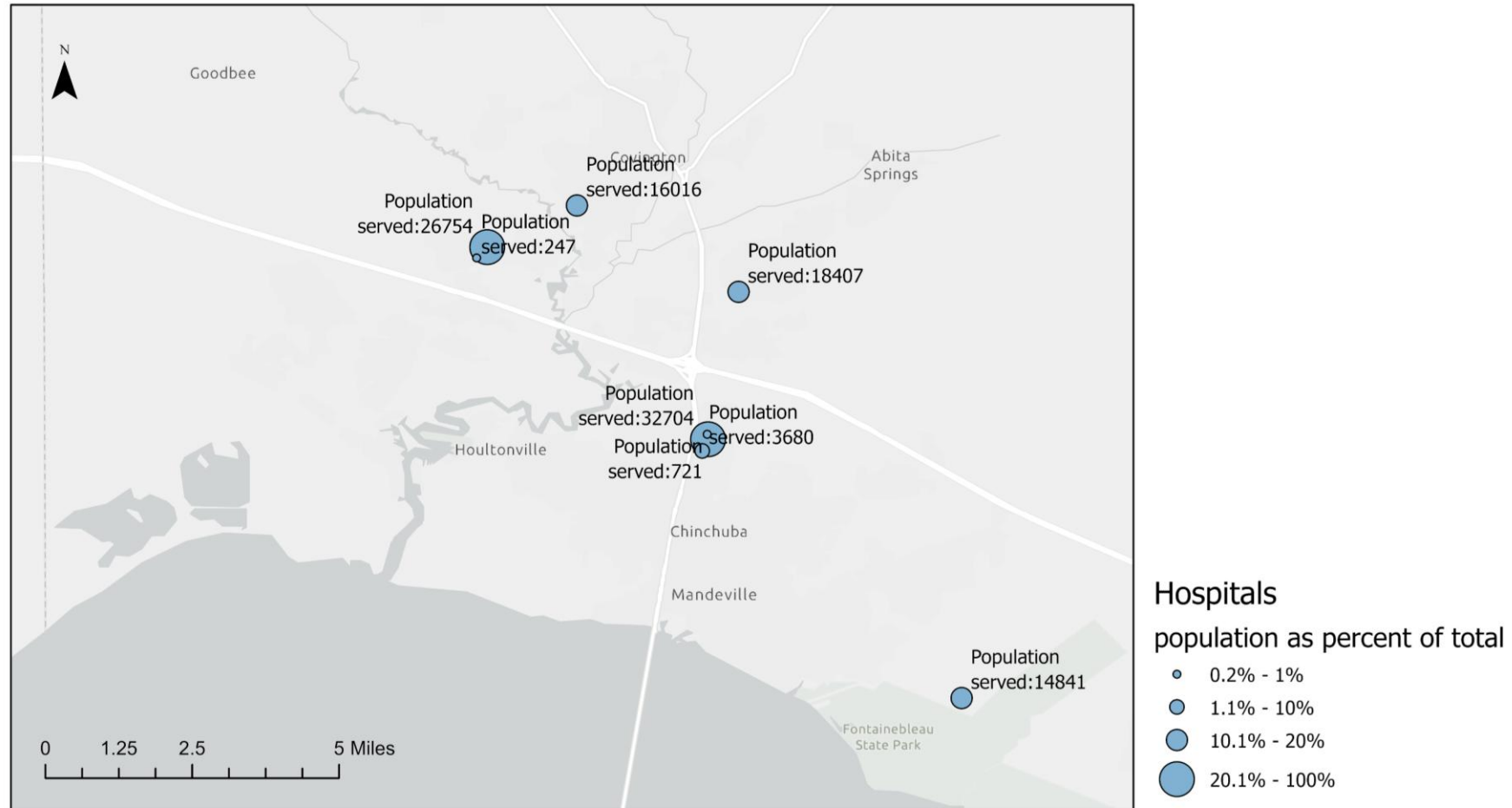
Public Schools
population as percent of total

- 0% - 1%
- 1.1% - 10%
- 10.1% - 20%
- 20.1% - 100%

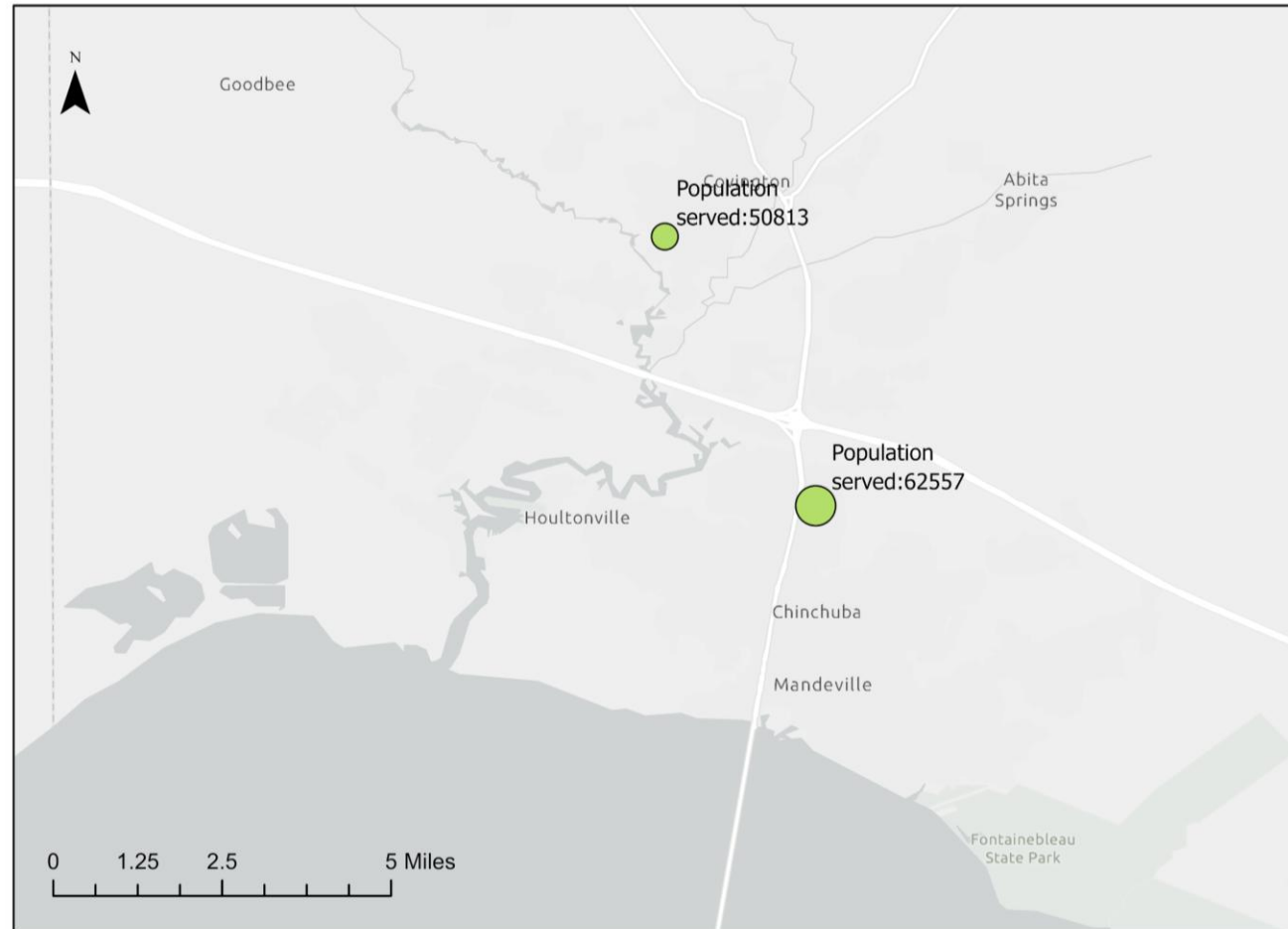
Daycares



Hospitals



Trauma Hospitals



Trauma Hospitals
population as percent of total

- 44.820499% - 50%
- 50.000001% - 100%

Grocery Stores

