BED31 TWO 977-14
Leveraging mobility data analytics to inform mobility hub development in Florida

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What are mobility hubs?

A platform where people can connect to multiple modes of transportation to make their trip safe, convenient and reliable.

A sketch of a mobility hub that integrates public transit and shared micromobility (Source: CoMoUK, 2021)

Example: A small mobility hub in Berlin (Source: Traif, 2021)

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Why need to site mobility hubs?

Serve multimodal travel needs

Enhance first-/last-mile connectivity and facilitate seamless transfers

Provide equitable accessibility for all

A mobility hub may include these features (Source: City of Boston)

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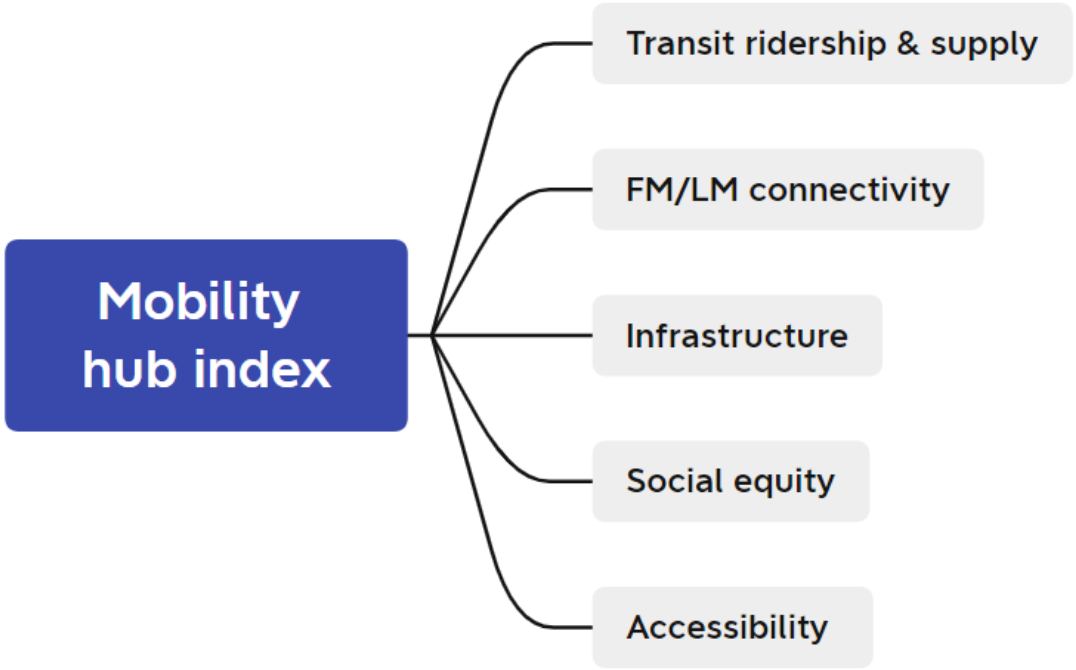
Project Objectives

To develop a GIS-based analytical framework for Florida agencies to decide the optimal locations of mobility hubs



Five criteria in deciding mobility hubs

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Novelty of our proposed approach

1. Unit of analysis: Previous research usually focuses on areal units (e.g., Block groups), we focus on transit stops;

2. The existing method does not distinguish hub typology (neighborhood, district, regional)

3. The emphasis on first-/last-mile connectivity and gaps

4. Use of (mostly) publicly and widely available datasets

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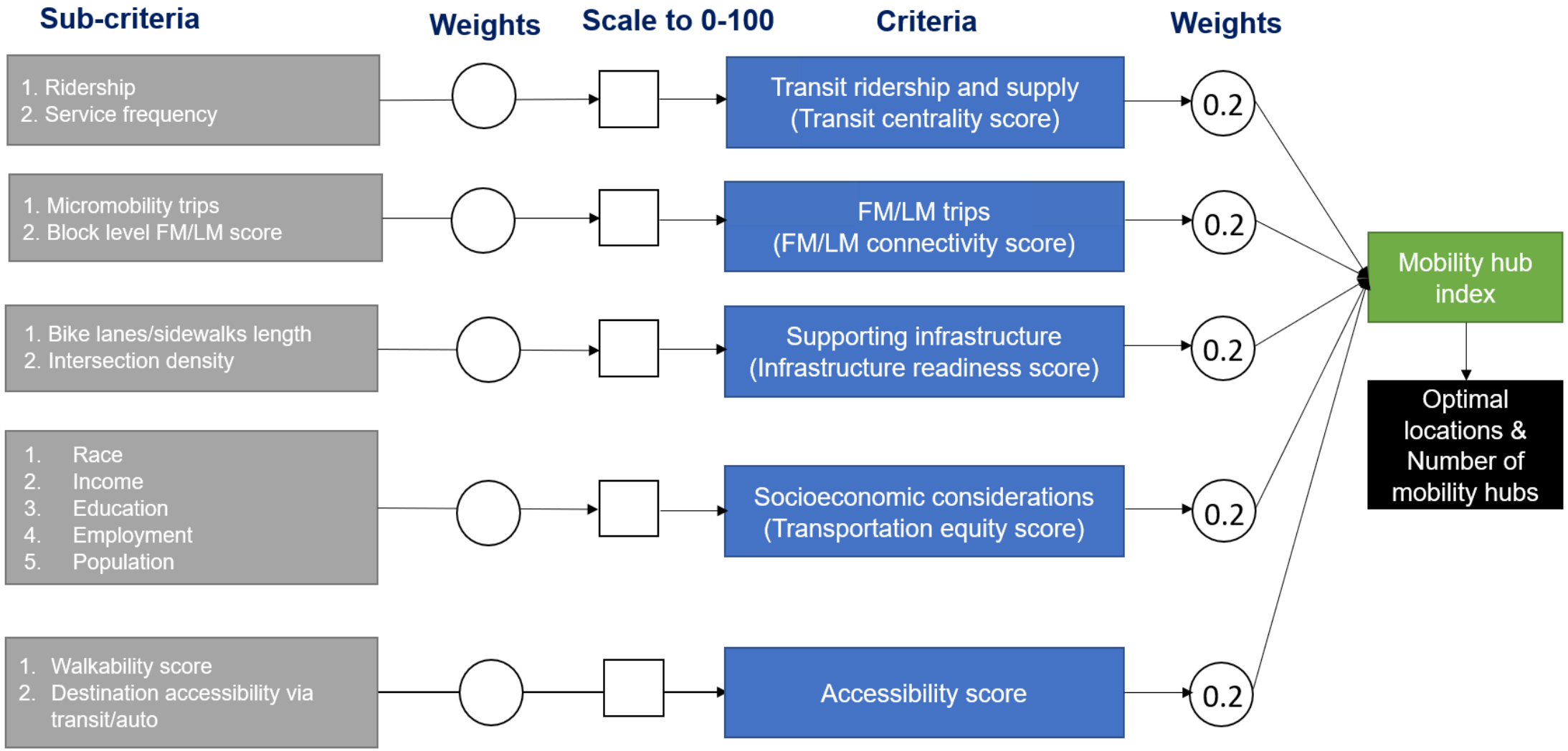
Methodology



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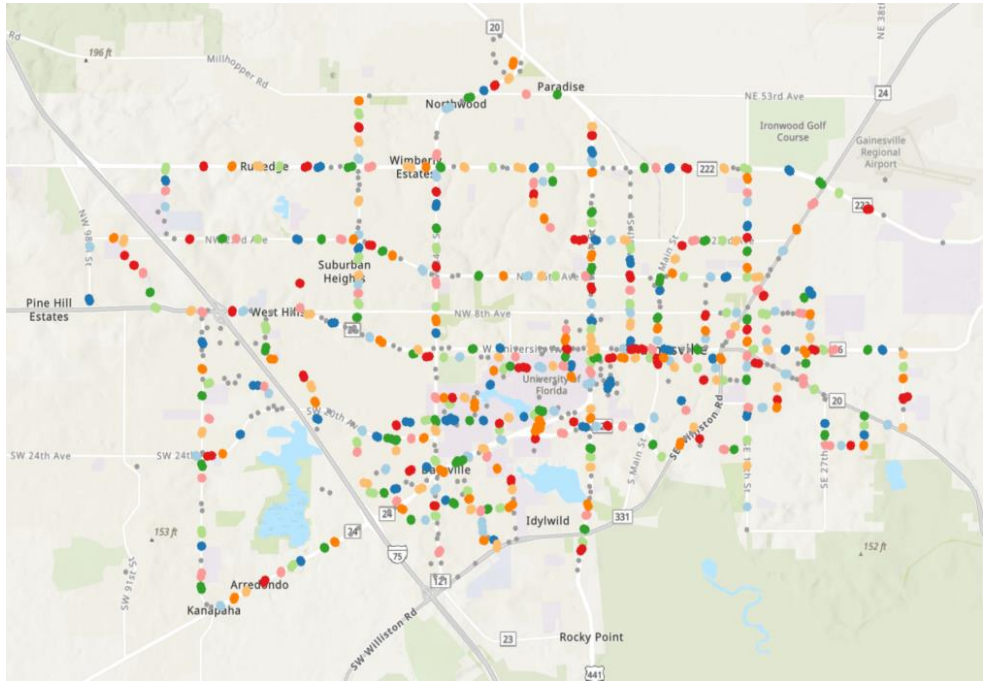
weights	Criteria	Sub-criteria	Variable	Source	weights
			passenger count		0.4
		Ridership	wheelchair		0.1
	Transit ridership and supply		number of unique bus routes		0.1
			bus stop number		0.1
0.2		Service frequency	number of bus total passing by the stop	RTS, city	0.3
		Bicycle trips	bicycle trips at stops		0.15
		Microtransit FMLM trips	number of trips within bus stop buffer		0.15
		escooter FMLM trips	number of trips within bus stop buffer	city	0.15
0.2	**FM/LM Connectivity**	FM/LM gap score	census block level FMLM gap score	ACS, LEHD	0.55
			Multi-Modal: 4-leg (D3bmm4)		0.16
		Intersection density	Pedestrian-Oriented: 4-leg (D3bpo4)	Smart location	0.16
			bike lane length/street segment length		0.16
		Bike lanes	bike lane length		0.16
			sidewalk lane length/street segment length		0.16
0.2	**Infrastructure**	Sidewalks	sidewalk lane length	OSM	0.16
		Hispanic population (%)			0.125
		Household without vehicle (%)			0.125
		Black population (%)			0.125
		Elderly (%)			0.125
		People living in rental units (%)			0.125
		Poverty (%)			0.125
		Non-English speaker (%)			0.125
0.2	**Socio-demorgraphic**	Disabilities (%)	Percentage	ACS	0.125
		Destination accessibility via auto	Jobs within 45 minutes auto travel time, time-decay weighted (D5ar)		0.25
		Destination accessibility via transit	Jobs within 45-minute transit commute, distance decay weighted (D5br)	Smart location	0.25
0.2	**Access to destinations**	walk score	0-100	Walkscore API	0.5

Methodology

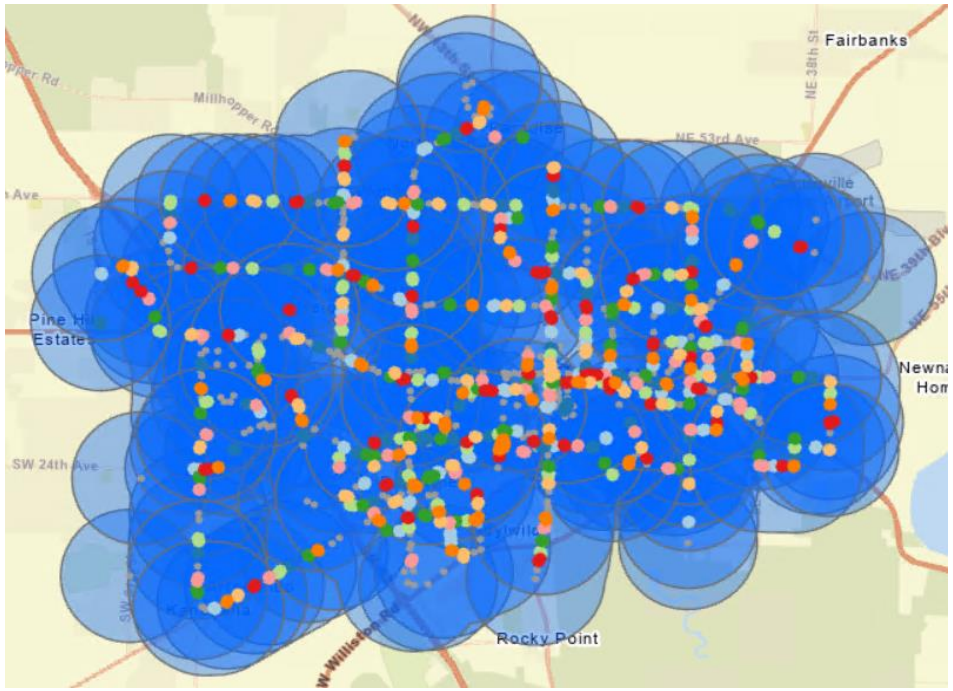
Step 1: define the spatial unit for locating mobility hubs

- Group adjacent transit stops



DBSCAN clustering algorithm: generate **628** clusters from **1081** stops

- Create buffers around transit-stop clusters



The buffer size indicates the service area of a mobility hub

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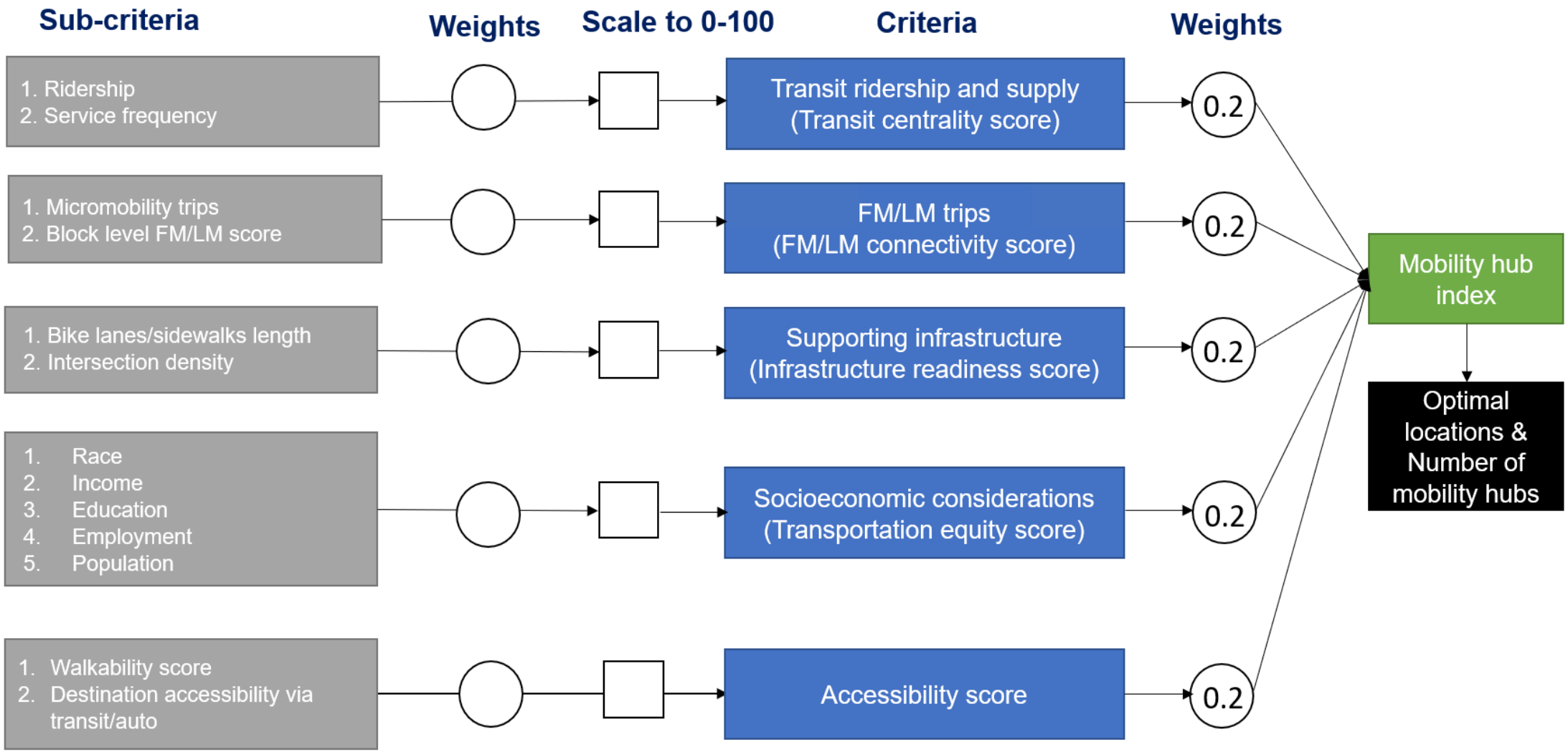
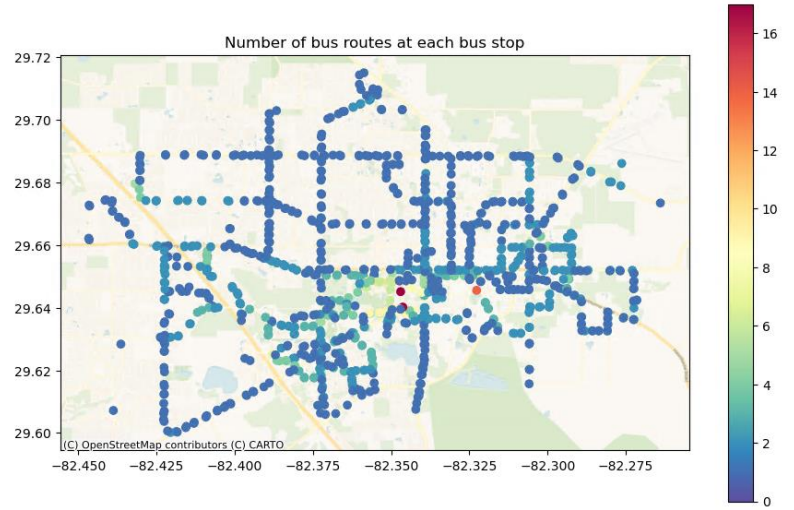
Methodology

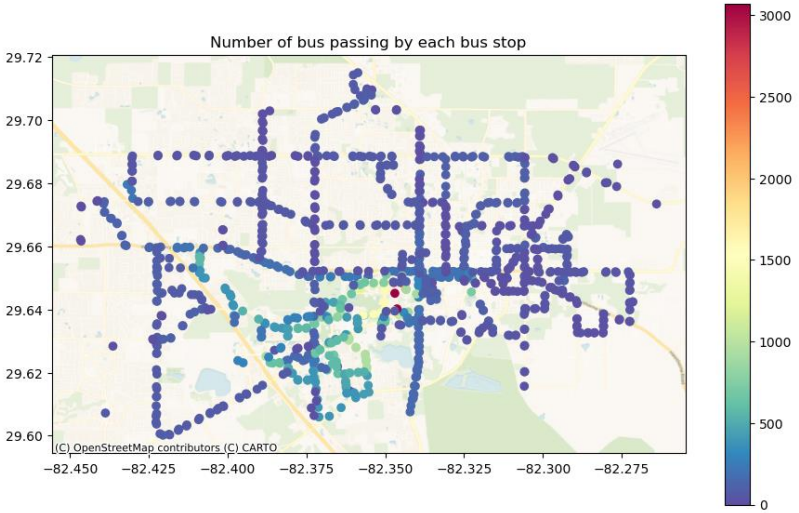


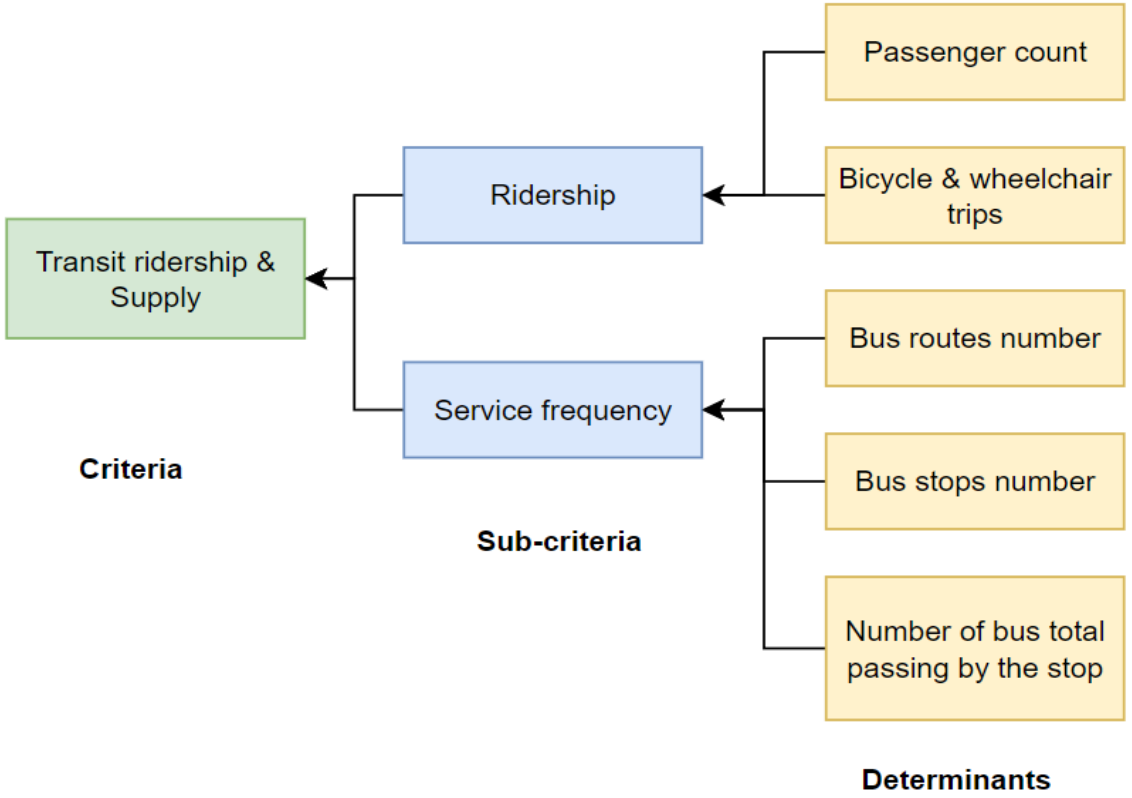
Step 2: Compute the four scores for each spatial unit

Step 3: Compute mobility hub index by weighing each of four score

Criteria #1. Transit Centrality Score



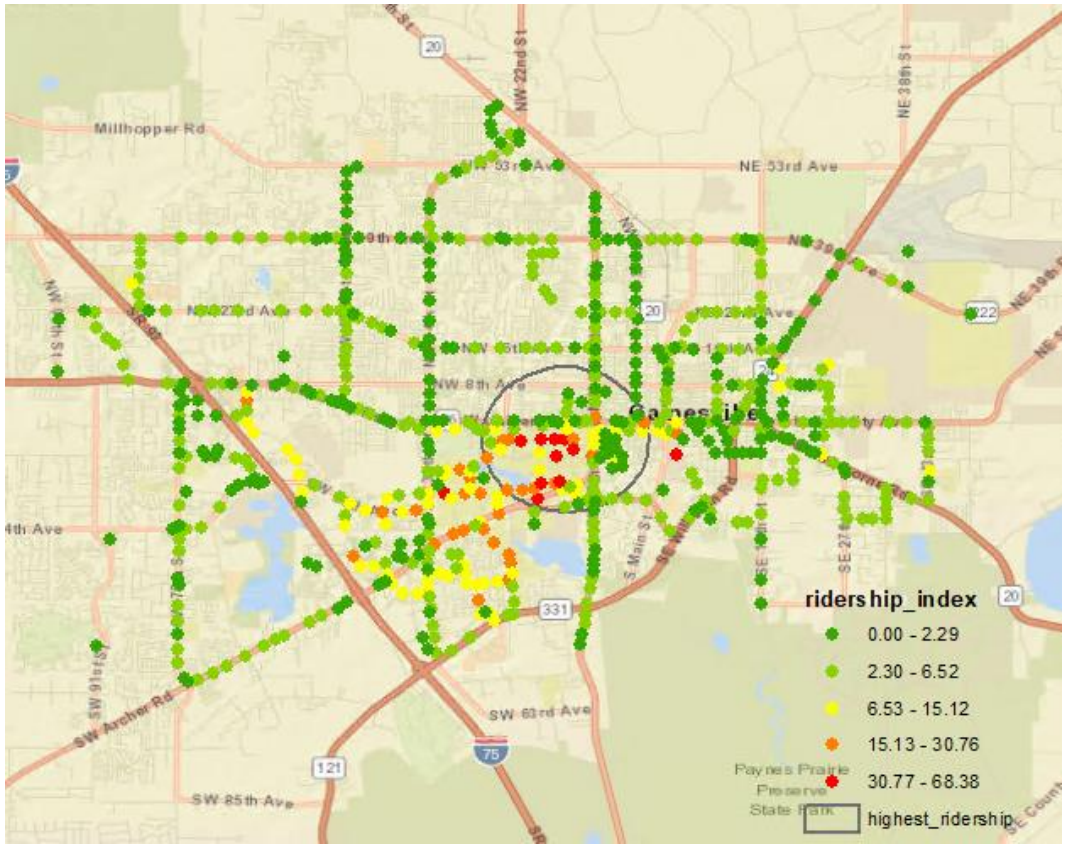




The stop-level determinants are aggregated to the spatial unit (i.e., bus stop clusters). (code)

Criteria #1. Transit Centrality Score

Criteria	Sub-criteria	Variable	Source	weights
Transit ridership and supply	Ridership	passenger count	RTS, city	0.4
		wheelchair		0.1
	Service frequency	number of unique bus routes		0.1
		bus stop number		0.1
		number of bus total passing by the stop		0.3



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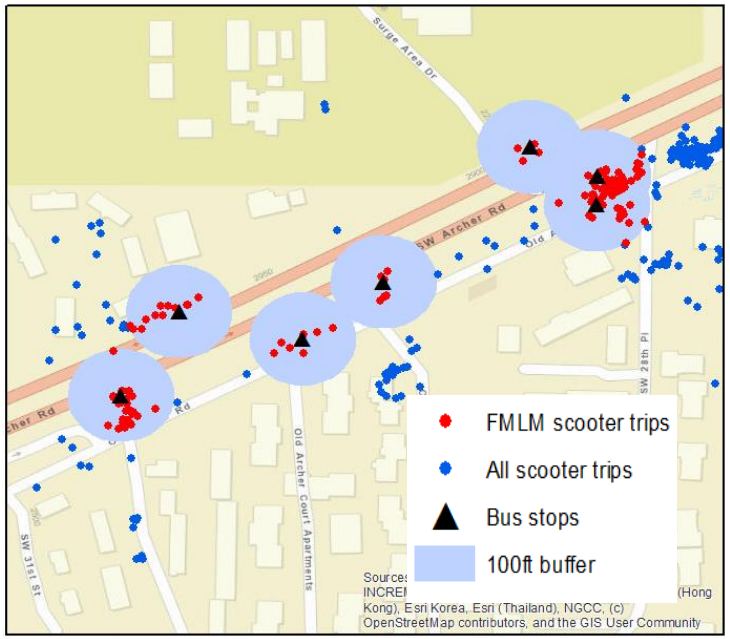
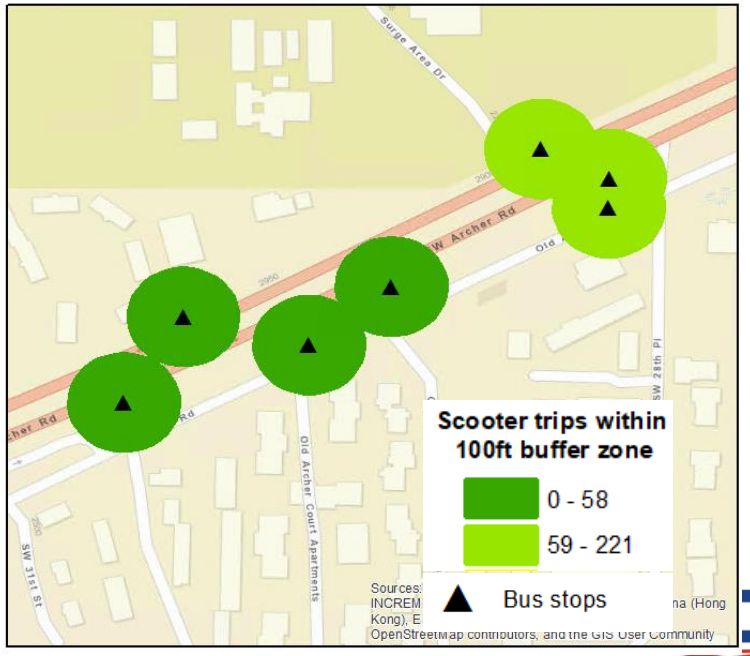
Criteria #2. First/last mile Connectivity Score

FM/LM connectivity score is measured by:

1. **micromobility trip origin/destination counts (scooter, microtransit, bicycle)** within 100ft buffer zone at the grouped bus stops.
2. Block level FMLM gap score





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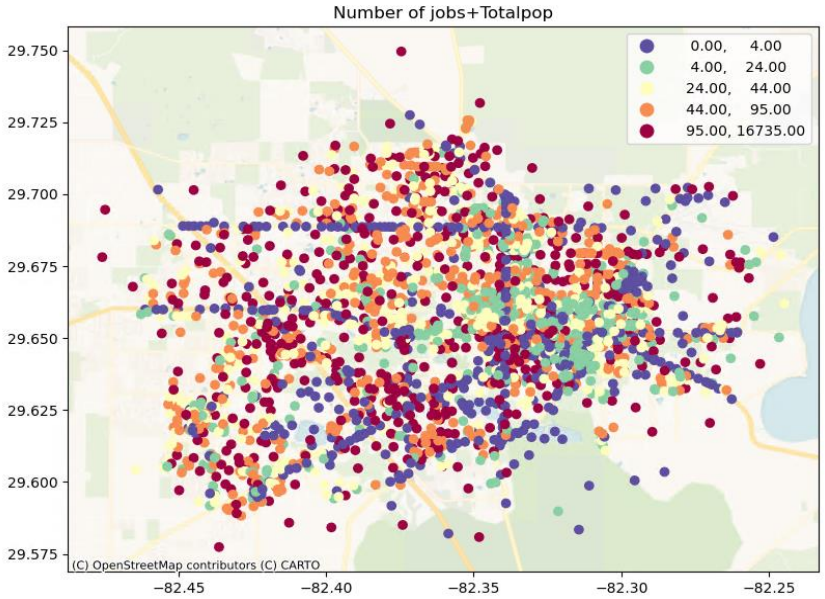
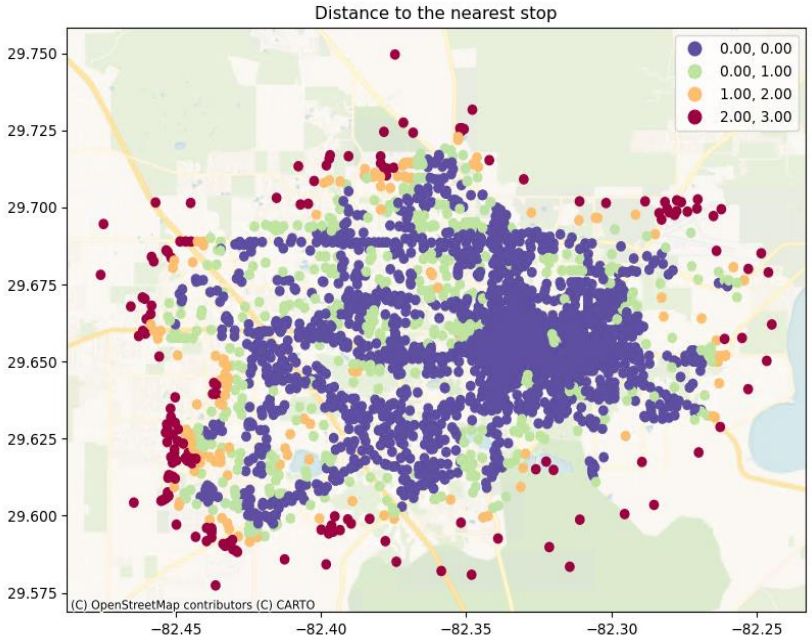
Block level FMLM gap score calculation

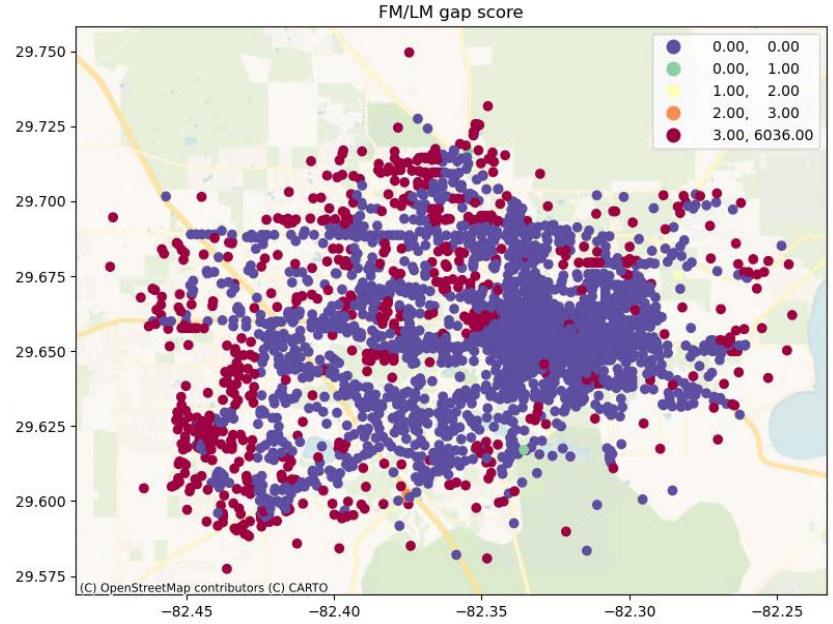


Step 1:
Calculate the number of jobs + total population of each block centroid

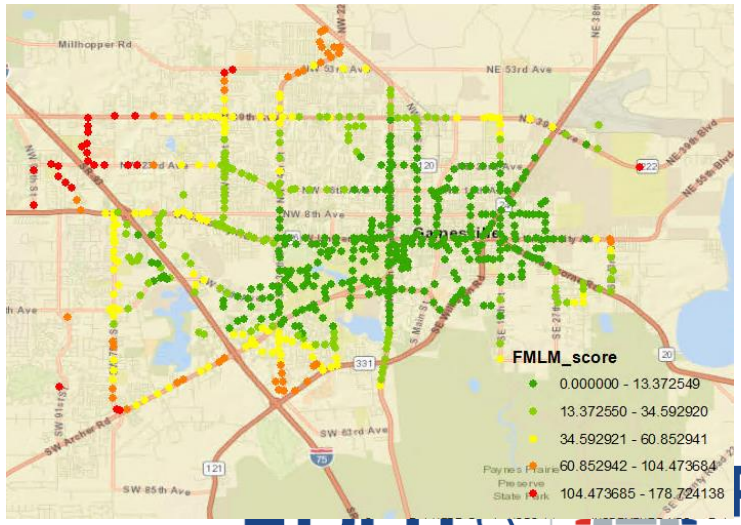


Step 2:
Find the distance to the nearest bus stop

Recode the distance
<0.25 mile: 0
0.25-0.5 mile: 1
0.5-0.75 mile: 2
0.75-1 mile: 3



Step 3:
(number of jobs + total population) * nearest distance to get the FMLM score at centroid level



Step 4:
Aggregated the average values to the spatial unit

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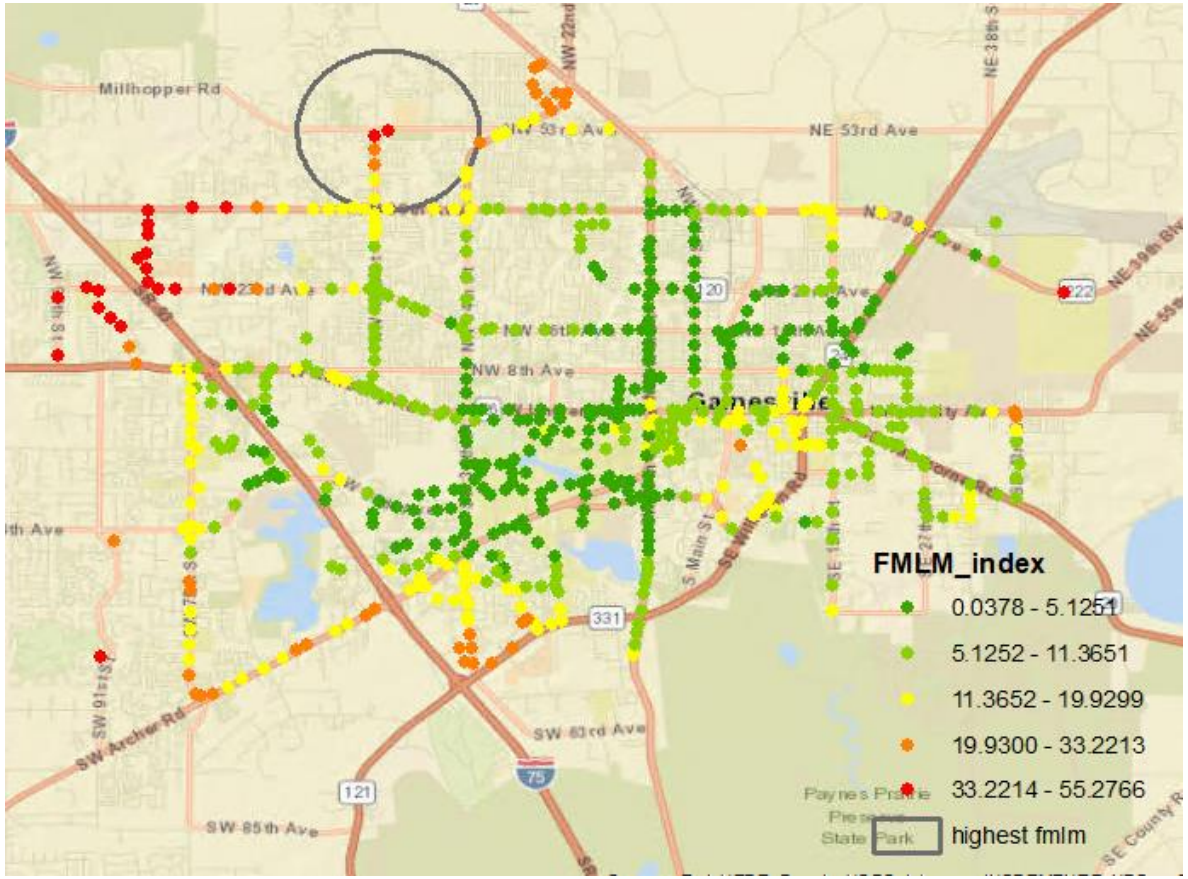
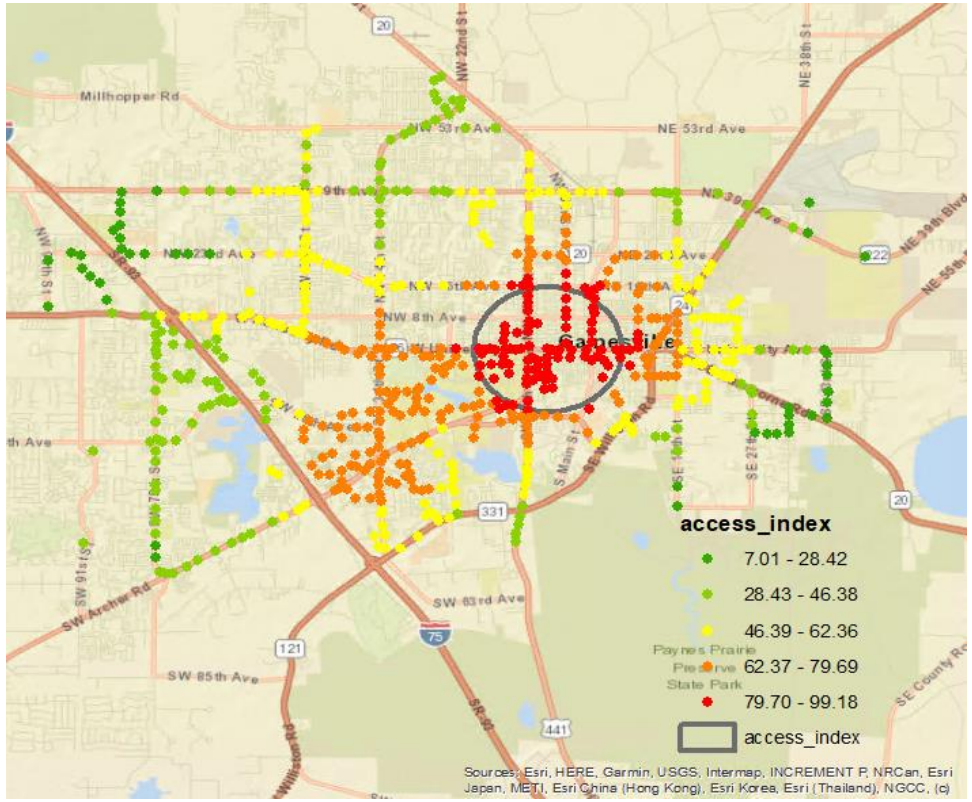
Criteria #2. First/last mile Connectivity Score

Criteria	Sub-criteria	Variable	Source	weights
	Bicycle trips	bicycle trips at stops		0.15
	Microtransit FMLM trips	number of trips within bus stop buffer		0.15
	escooter FMLM trips	number of trips within bus stop buffer	city	0.15
FM/LM Connectivity	FM/LM gap score	census block level FMLM gap score	ACS, LEHD	0.55



Criteria #3. Accessibility Score

Criteria	Sub-criteria	Variable	Source	weights
Access to destinations	Destination accessibility via auto	Jobs within 45 minutes auto travel time, time-decay weighted	Smart location	0.25
	Destination accessibility via transit	Jobs within 45-minute transit commute, distance decay weighted		0.25
	walk score	0-100	Walkscore API	0.5



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Criteria #4. Infrastructure Readiness Score

The infrastructure index score is measured by the following dimensions:

1. The sidewalk and bicycle lane length, the ratio between sidewalk/bicycle lane length and overall road network length within the spatial unit.

2. The intersection density at which multi-modal facilities or pedestrian-oriented facilities met.

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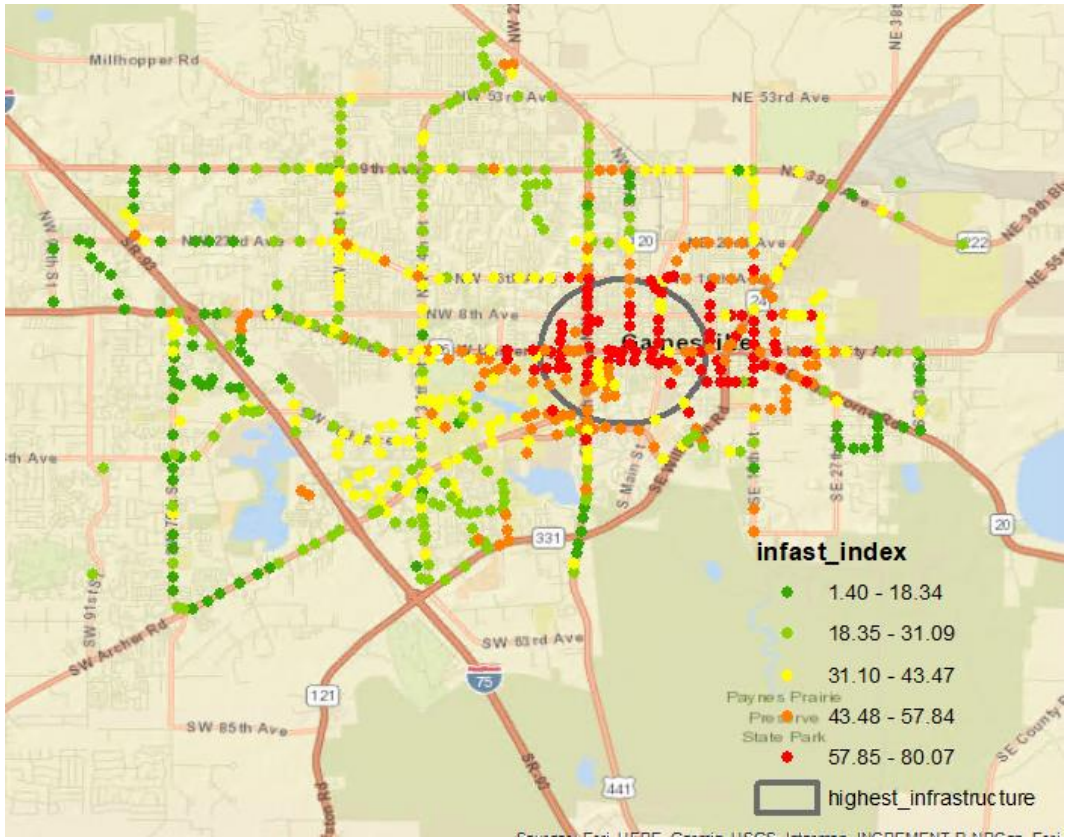
Criteria #4. Infrastructure Readiness Score

Criteria	Sub-criteria	Variable	Source	weights
		Multi-Modal: 4-leg		0.16
	Intersection density	Pedestrian-Oriented: 4-leg	Smart location	0.16
		bike lane length/street segment length		0.16
	Bike lanes	bike lane length		0.16
		sidewalk lane length/street segment length		0.16
Infrastructure	Sidewalks	sidewalk lane length	OSM	0.16



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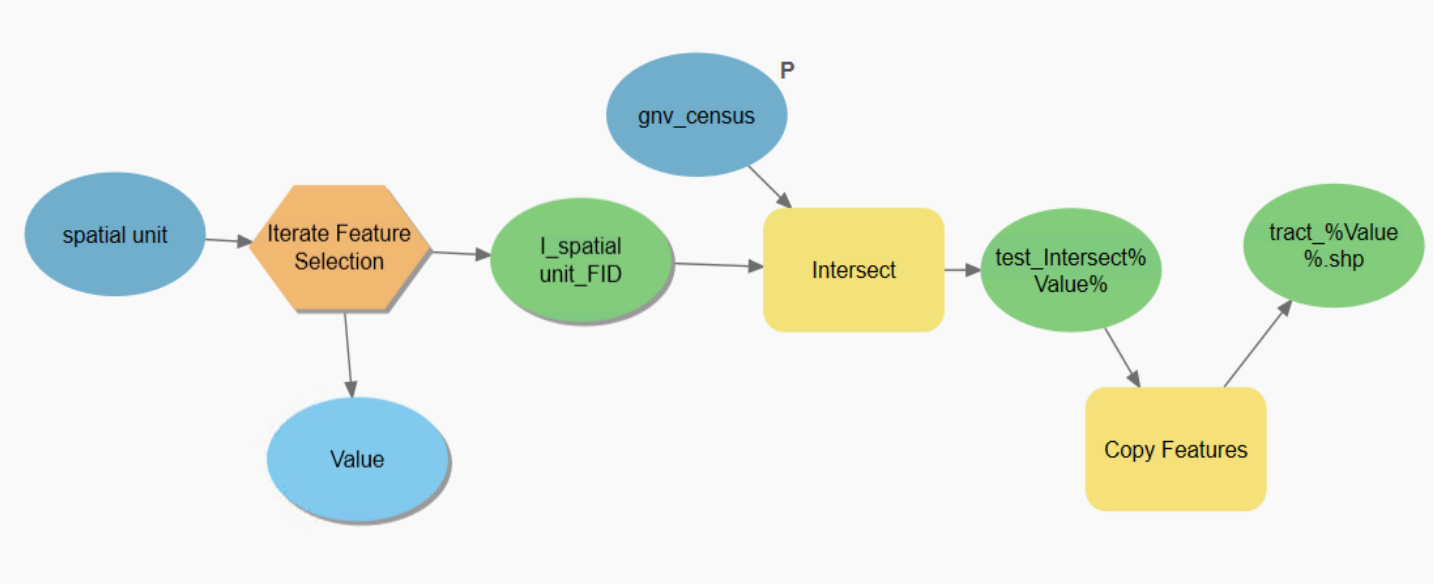
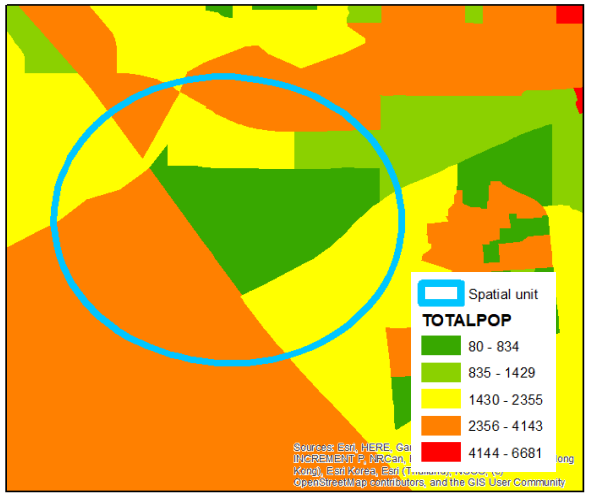
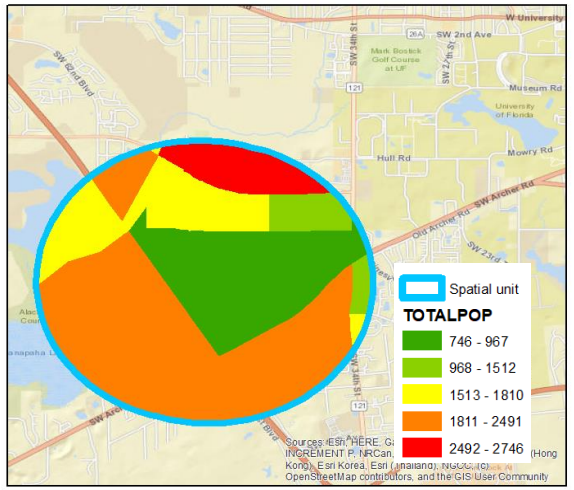
Criteria #5. Transportation equity score



The socioeconomic variables are collected at census block group level.

Module builder: intersect the census block group with each spatial unit to assign the sociodemographic information to the spatial unit





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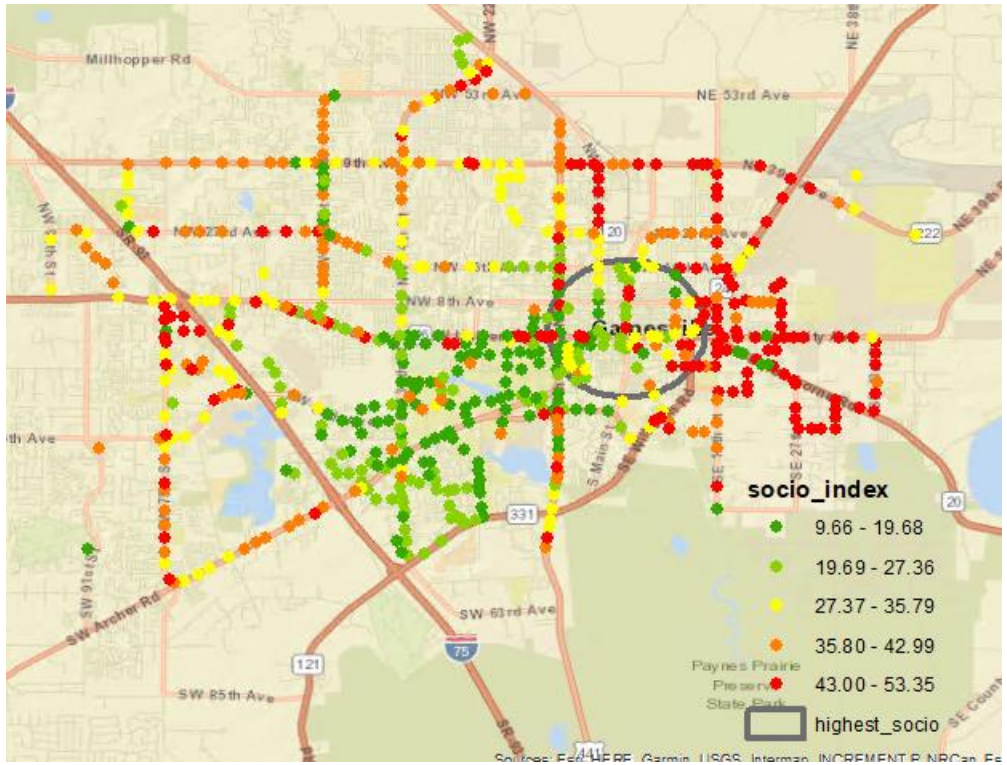
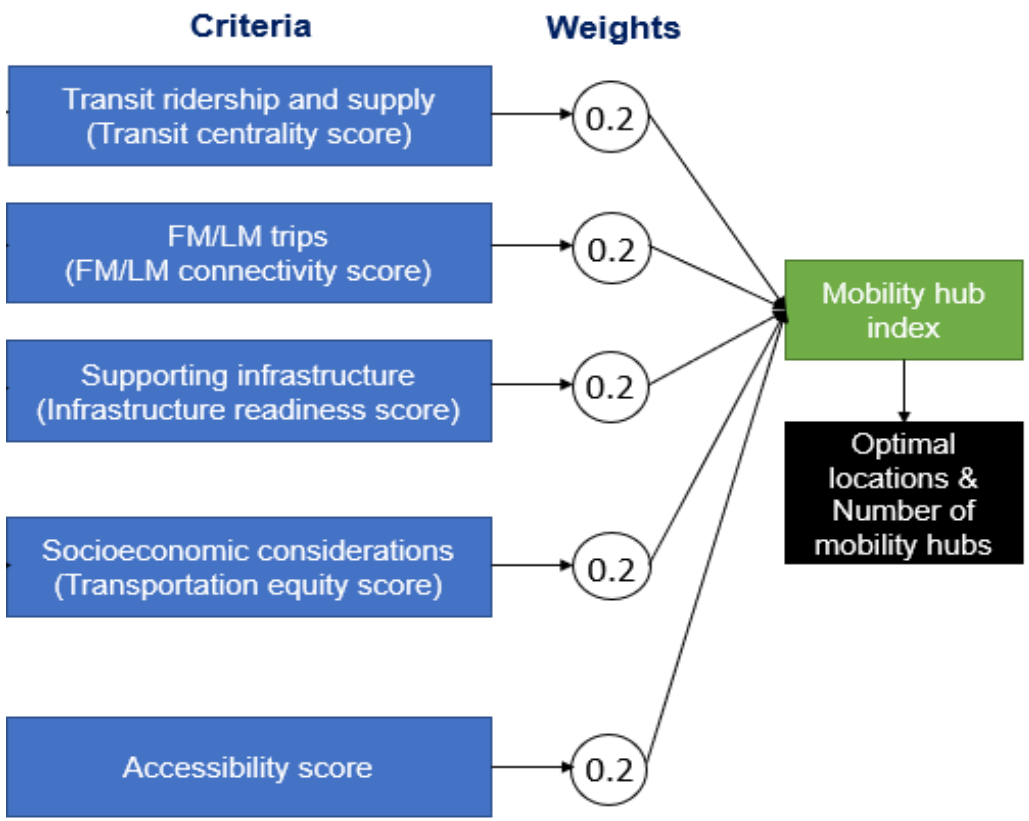
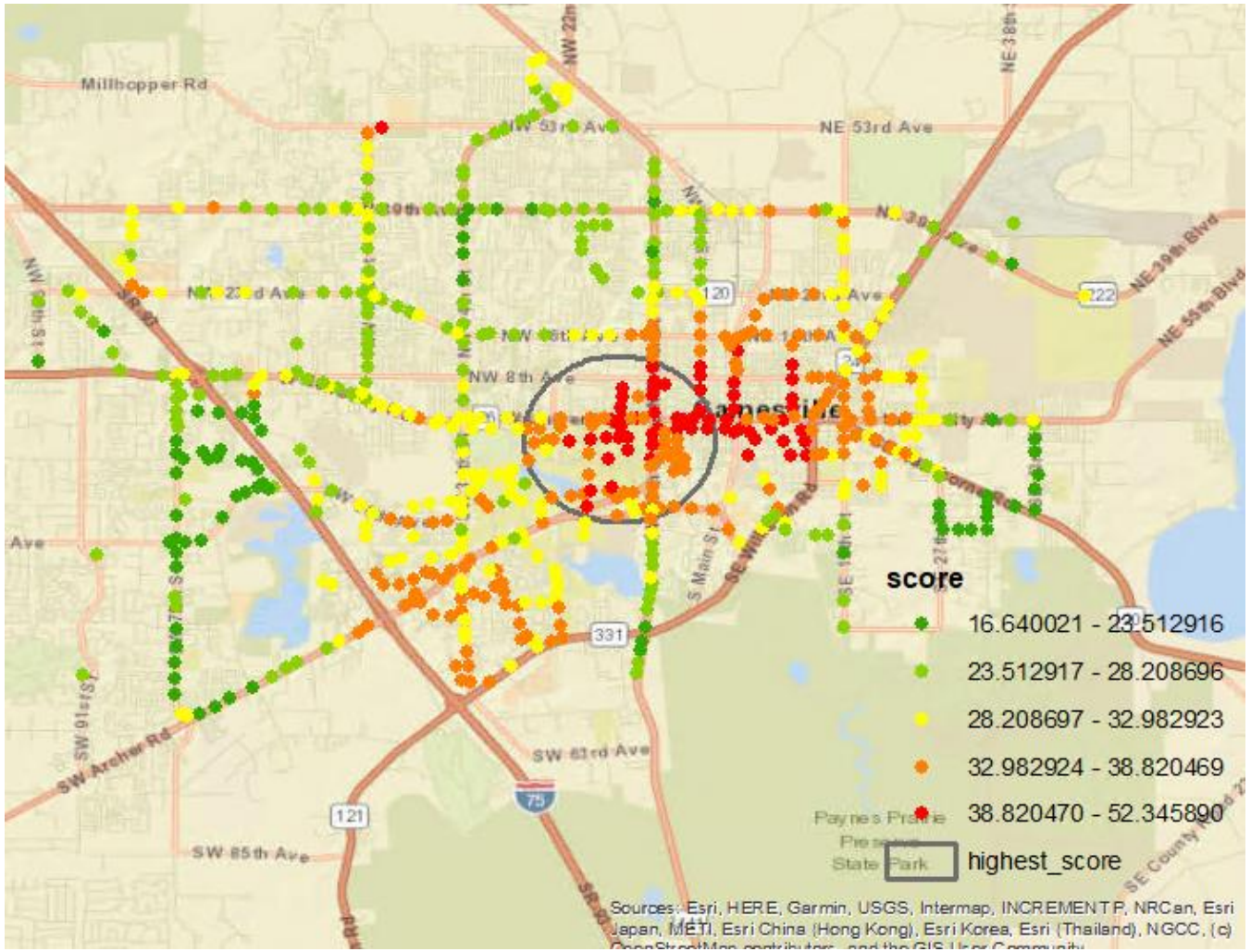
Criteria #5. Transportation equity score

Criteria	Sub-criteria	Variable	Source	weights
	Hispanic population (%)			0.125
	Household without vehicle (%)			0.125
	Black population (%)			0.125
	Elderly (%)			0.125
	People living in rental units (%)			0.125
	Poverty (%)			0.125
	Non-English speaker (%)			0.125
Socio-demorgraphic	Disabilities (%)	Percentage	ACS	0.125

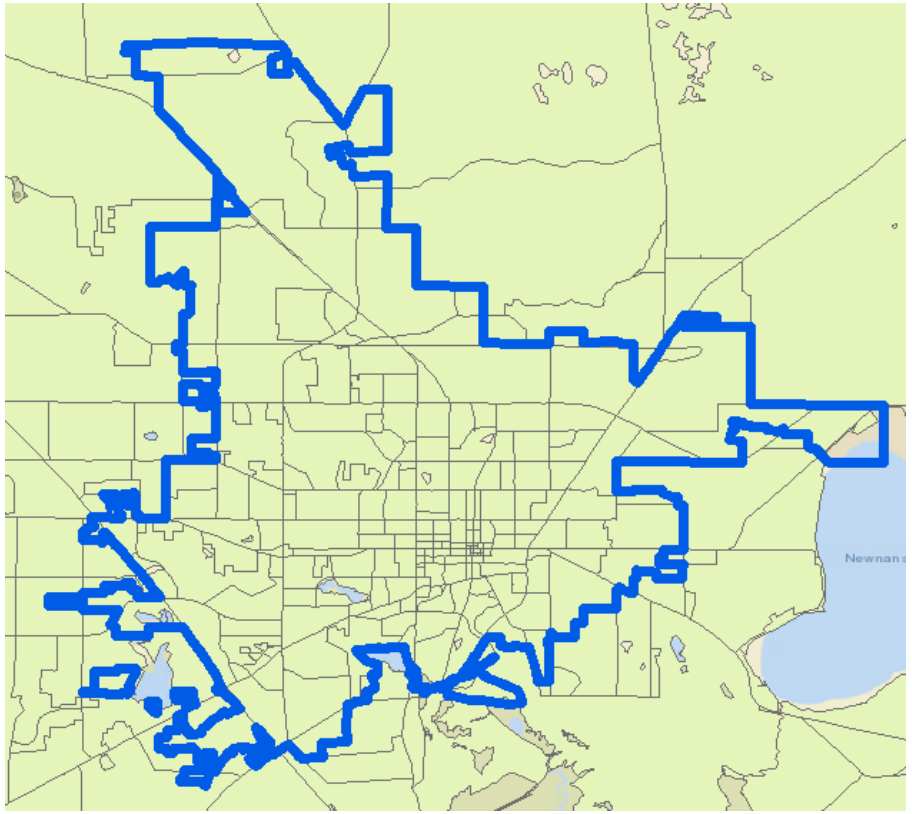


Mobility Hub index

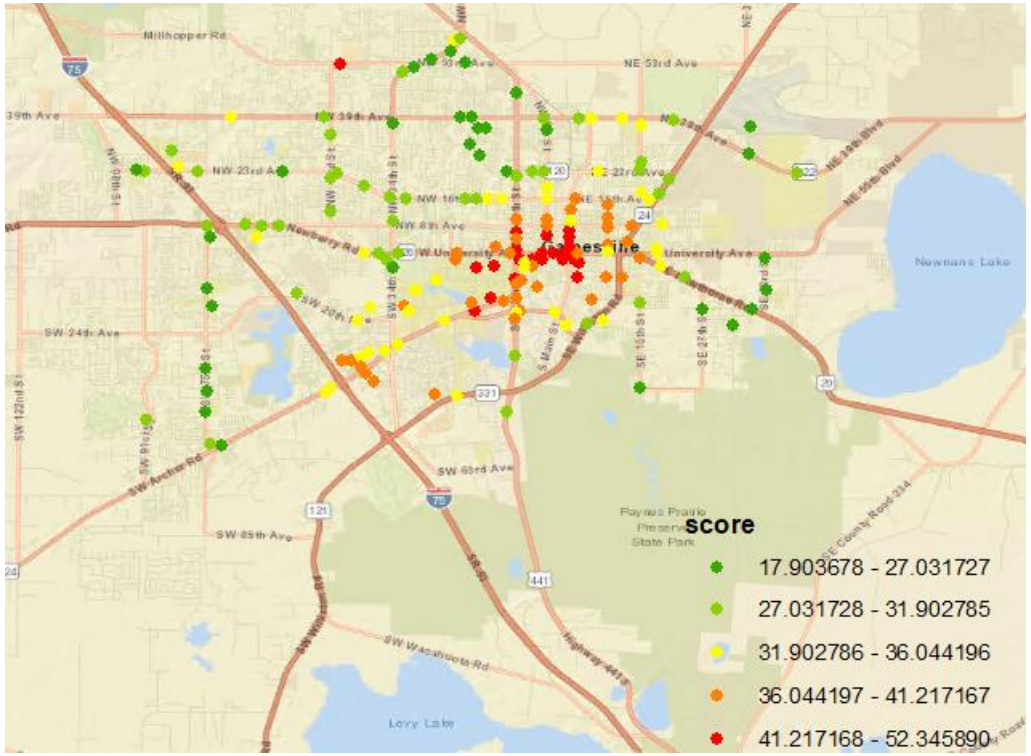




Site selection

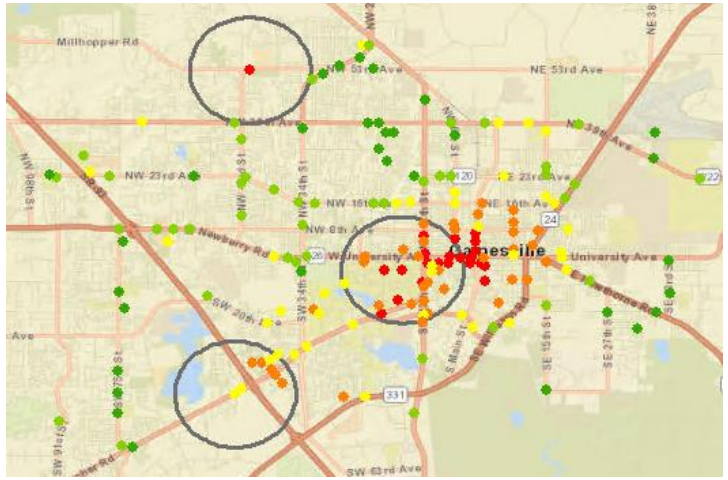


TAZ zones in Gainesville

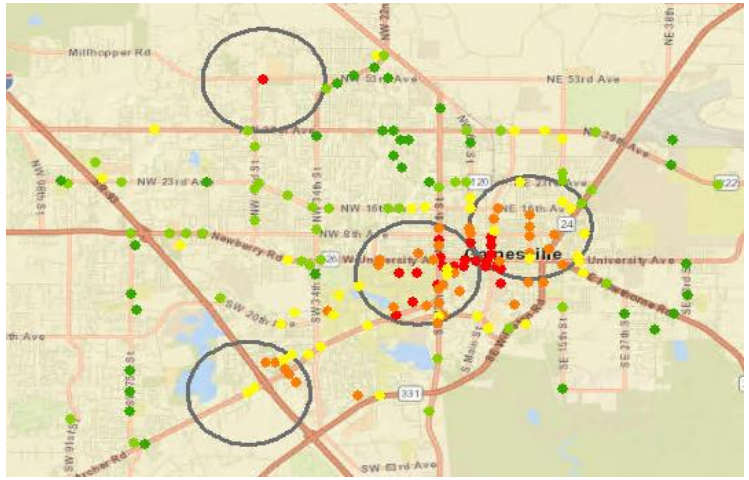


Choose the highest score from each TAZ

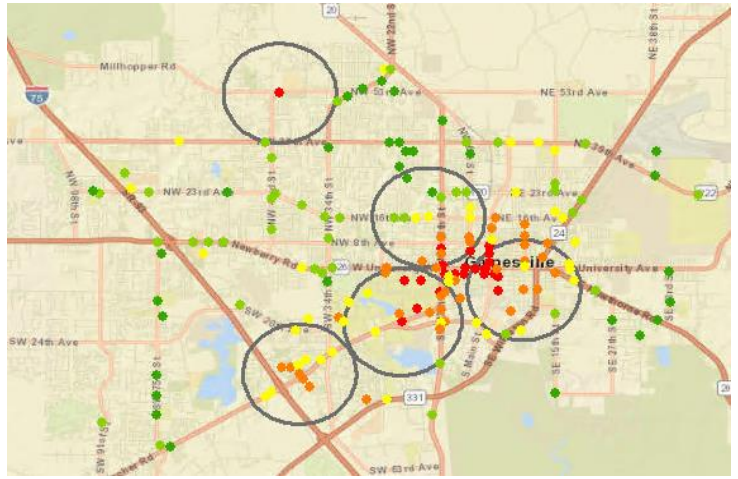
Site selection



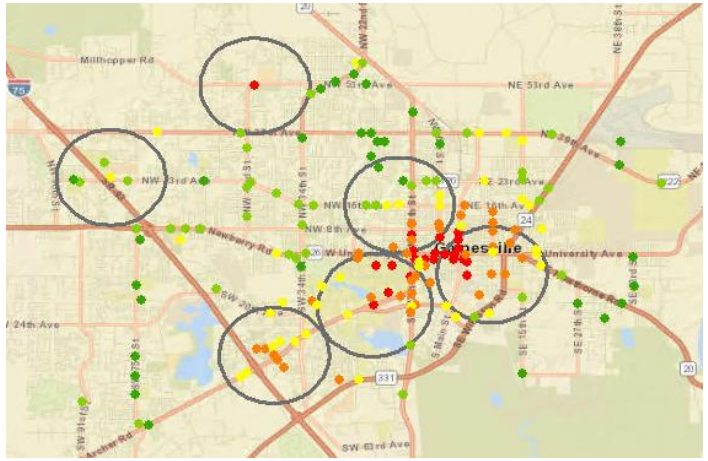
N=3, Total score = 130



N=4, Total score = 169



N=5, Total score = 199



N=6, Total score = 234

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Questions or Comments?

Thank you!

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