Site Suitability Analysis of Mobility Hubs: Determining Suitable Locations for Transit Center Enhancement in Metro Atlanta

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Abstract

Mobility hubs are an efficient and effective transportation solution that promotes connectivity and last-mile modal options for commuters and residents that integrate multi-modal transportation infrastructure. They encourage place-making efforts and create a space for activity centers while providing many transportation options. Mobility hubs have helped to transform cities and regions with innovative approaches to seamless modal transitions and integrating smart technologies for wayfinding, safety, and accessibility.

This study identified three existing transit stations within Fulton, Clayton, and DeKalb counties in Georgia that can be turned into regional shared mobility hubs through analyzing origin-destination data of these stations, the surrounding land uses, and the population demographics of these areas. These three counties were selected as they make up the existing Metropolitan Atlanta Regional Transportation Authority (MARTA) passenger rail network.

Based on research on the benefits of mobility hubs, the factors of close distance, added connectivity, and proximity to activity centers are proven to improve because of implementing mobility hubs. Thus, the purpose of this study is to determine the potential for the tri-county area to implement mobility hubs at regional scales to expand the reach of alternative modes of transportation, and to address the issues of inaccessible transportation networks.

After analyzing the transit stations using demographic data of the study area and a multi-criteria analysis (MCA), three locations were found to be ideal sites for developing into mobility hubs: the Midtown, Decatur, and Dome/GWCC/Philips/CNN MARTA stations.

Introduction

In the tri-county study area, 57% of residents whose travel origins and destinations are within Georgia, use cars as their primary mode of transportation for commute, and 85% use cars as their primary mode in general, as of 2022. The percentage of residents relying on other modes of transportation comes to 43% for commute and 15% for general purposes. On face value, car usage appears as a more popular option for daily travel than riding transit, cycling, or walking, but there are a host of factors that influence this trend that have contributed to car dependency and a greater focus by governing authorities on car-oriented development. The socio-economic circumstances, economic goals, and political priorities of regions and neighborhoods within a state shape the direction of development for transportation systems. From their conception, cities have strived to expand their transportation system through inter-city passenger rail networks and highways to promote growth and ease of travel over long distances. The reliance on growth by expansion of the highway system has led to urban regions being built to accommodate highways. In the present day, there have been significant advancements made to alternative modes of transportation, from pedestrian facilities to bus rapid transit (BRT), and transportation systems all over the world have placed greater focus on expanding access and equitable practices in the implementation of these modes.

Cities have implemented and enhanced strategies over time to create accessible and equitable transportation solutions that are kept current with new technologies. Mobility hubs are one such strategy that has proven to provide connectivity between many different modes of transportation and encourage mobility in rural and urban areas. ‘Mobility Hub’ is a term that has grown to become familiar in urban and regional planning, but with such varied applications, a universal definition has yet to be identified. The reason is, in part, due to the difficulty in conceptualizing exactly what it means. Simply put, as described by the Bay Area’s Metropolitan Transportation Commission, “Mobility hubs are places in a community that bring together public transit, bike share, car share and other ways for people to get where they want to go

without a private vehicle." This idea provides last-mile connectivity and seamless transfers for people who use multiple modes of transportation daily.

Background

What is a Mobility Hub?

The concept of mobility hubs can be seen in many different forms; a large-scale example includes *The Oculus* in New York City which is an artistic landmark that incorporates retail and commercial spaces within the building that provides a connection to the subway and busses and is located conveniently by a financial district and tourist attractions which allows people to connect through walking and cycling as well. A smaller scale example is a park and ride or a train station that connects riders to buses and bike share.

Figure 1 Mobility hub rendering

It may also be of help to understand what it is not- Mobility hubs are not simply transit hubs as they incorporate additional modes of transportation such as walking, biking, driving, shared micro-mobility vehicles, and rideshare companies (TNCs). Mobility hubs should also be differentiated from transit-oriented development (TOD). Mobility hubs are centered on bringing together different modes of transportation in one place that is most accessible to residents of an area, and it is in its essence an easier way of getting around, but transit-oriented development puts greater focus on "maximizing the amount of residential, retail, and leisure space within walking distance of transit".[1] In essence, both are mutually significant to their respective success. Without adequate connected transportation systems, mobility hubs will not be able to provide the ease of access to transportation alternatives for residents, whereas poor locationality of residential, commercial, and leisure spaces will reduce accessibility for residents to these mobility hubs.

Components of a Mobility Hub

Locationality of mobility hubs can vary based on the demographics and economic objectives of a given area, and the scale may change according to usership and needs. Shared mobility hubs could be as simple as a bus stop, bike sharing station, or a park and ride if that meets the needs of the people it serves. Larger, regional scale mobility hubs could be located within city centers as highly accessible and central facilities that incorporate all major modes of transportation, as well as retail, commercial, and restaurant spaces that facilitate placemaking. A policy document by Metrolinx states "Anyone who has had to walk down a bleak and busy street to a cold and windy bus stop – with nowhere to find shelter or buy a paper or a cup of coffee – to wait anxiously, uncertain of when the next bus will arrive, while comfortable commuters whiz by in their cars knows what a mobility hub should be."[2]

[1] Wikipedia, Transit Oriented Development.
[2] Metrolinx, 2008.

As mobility hubs can vary by their scale and context, research was conducted to see what literature is available discussing mobility hub typology and their essential components on a regional scale, for the purposes of this study. In the Bay Area, hubs are categorized by their proximity to downtown or suburban areas. The regional downtown hub marks the major center of economic and social activities. These locations will observe the highest transit usage, frequency of bus services, and access to rideshare and shared micro mobility services.[3] Due to the higher urban density, all travelers can easily connect to their destination or transfer point, and most riders will opt for alternative modes of transportation since they are more convenient than cars. In North Hollywood, the Los Angeles Planning Commission included secured bike parking and a bus layover zone that has built-in amenities for riders to purchase food or use the restroom while waiting for their bus.[4] In Portland, priority access for pedestrians and cyclists was emphasized for all ages and abilities, as well as free Wi-Fi connection, to ensure the travel to mobility hub facilities was also accessible.[5] Any location would benefit from having all the amenities mentioned incorporated into their mobility hub, but they may not all be implemented if similar infrastructure already exists or funding is not available, for instance.

In this study, areas in Metro Atlanta, specifically Fulton, Clayton, and DeKalb Counties, with the potential for implementing regional scale mobility hubs will be identified through factors pertaining to the end-user of the facility. A research article whereby Koen Blad and peers from the Netherlands outlined a methodology for determining suitable locations for regional shared mobility hubs in Europe, is used as a guideline in this paper to identify criteria that should be considered.[6] In their research, a commonly adopted classification method for identifying neighborhood (residential), city, and regional level mobility hubs was identified as shown in **Table 1.**

[3] Bay Area MTC, 2021.
[4] Los Angeles Department of Transportation, 2016.
[5] Portland Bureau of Transportation, 2020.
[6] Blad, K, et al., 2022.

Table 1 Types of mobility hubs.

	Residential mobility hub	City mobility hub	Regional mobility hub
Urban context	>500 addresses/km^2	>2500 addresses/km^2	< 2500 addresses/km^2
Modes offered	Shared mobility	Shared mobility, transit	Shared mobility, transit, car parking
Transportation function	Provide an alternative to car	Improve city's accessibility	Improve reach to transit, provide alternative to car
Target groups	Residents	Residents, visitors, commuters	Residents, visitors, commuters

In this chart, regional mobility hubs include the greatest number of services from all three scales. In addition to this classification, there is another category that was added for this study, which is amenities. Spaces for shops and vendors is what transforms the transportation hub into an activity center that can serve as a third place for people passing through the area or waiting for their mode transfer. The idea of a third place is a location that is separate from one's home and office, where people can spend their free time. Some common examples of third place includes coffee shops, gyms, restaurants, or community centers where people frequent often for recreation or leisure purposes. Cities around the world have incorporated amenities from small coffee shops to luxury retail stores within mobility hubs to provide opportunity for people who use the hub facilities for their daily commute to have access to a convenient third place.

Small scale mobility hubs such as a bike share station or bus stop may not require amenities since the mode transfer is singular and is pinpointed to one small area. Medium to large scale hubs such as park and ride or union stations would greatly benefit from having amenities. There are many users travelling through the facility and there are multiple modes of transportation in concurrent operation so wait times may be longer or users may have to travel a distance to reach their transfer point at larger

facilities. A breakdown of amenity type for each classification of mobility hub is outlined in **Table 2**.

Table 2 Additional classification method created for this study.

	Residential mobility hub	City mobility hub	Regional mobility hub
Amenity type	News stand, post box	Coffee shop, convenience store, news stand, post box	Shopping center, restaurants, coffee shops, convenience stores, courier service

Including these amenities within mobility hubs will provide an incentive for people who typically drive to use alternative modes of transportation if their primary concern was convenience. Having the ability to grab a coffee and read a paper or drop off a package enroute to their destination will allow users to save time and reduce the number of trips they would take overall. This is an effective strategy for businesses to grow since they can rely on a consistent flow of customers given that the transit and shared micro-mobility stations are in operation.

This section has outlined the types of mobility hubs that exist in most contexts, and identified key components that should be included within each scale of mobility hubs. There are several components not mentioned, including digital wayfinding kiosks, self-serve transit ticket kiosks, seating, and real-time schedule information, to name a few. These serve as attributes of a mobility hub facility that should be considered on a case-by-case basis, and as a reminder that there are many variations of incorporating innovative technologies into mobility hubs that should be considered for project development. In this study, the focus is primarily on establishing core differences between mobility hubs at each scale that will be used in considering for identifying potential locations for mobility hubs in the tri-county area.

Identifying suitable locations for mobility hubs

There are several factors that can influence the location of a suitable mobility hub, from an end-user perspective, and many were introduced as part of a larger methodology for the research conducted by Koen Blad and peers. A select few were included as they relate to this study – distance, added connectivity, and proximity to activity centers.[7]

Distance from the user's home is a determining factor for if they are likely to use the facility, so the hub should be in an area that is centralized or provides direct connection to the hub from their homes. Cost plays a variable role in the location of a hub as different modes can vary in how much they charge for use. Since it is not a set number of vehicles available at every regional mobility hub and there is no guarantee on which types of shared mobility options will be available, cost per mode will not be included in the evaluation. *Added connectivity* is a factor that can sway the decision of users as more people will be likely to use the mobility hub if there are multiple ways to reach the hub facility. The last factor included in this study is *the variety of activity centers in proximity to transit stations,* which arguably may have the greatest influence on a user's ability and choice to use the facility. This factor works in tandem with distance as it is necessary to ensure location is central, but in addition to that, the proximity to a greater number of land uses will encourage more people to use it. Placing a mobility hub in a central location that is primarily industrial may not serve the greater need of people who wish to use the mobility hub as a connection to activity centers.

Specific strategies for measuring these factors will be further discussed in the methods chapter, which will serve as the basis for the analysis in narrowing down the suitable locations for mobility hubs.

[7] Blad, K, et al., 2022.

Data Overview

There are several demographic, land use, trip, and boundary datasets used as inputs for this study. The sources and descriptions are provided in **Table 3**, followed by a description of each dataset to address their usage in the following analysis.

Table 3 Datasets and sources used for analysis.

Dataset	Description	Source	Year
Census tracts	All census tracts within Fulton, Clayton, and DeKalb counties	US Census Bureau	2020
County boundary	Administrative boundary of Fulton, Clayton, and DeKalb counties	ARC Open Data Hub	2020
MARTA train route	All train routes of MARTA network	ARC Open Data Hub	2019
MARTA bus route	All bus routes of MARTA network	ARC Open Data Hub	2019
MARTA train stops	All stops along MARTA's train routes	ARC Open Data Hub	2021
Bikeways	Bike lane network	ARC Open Data Hub	2022
Demographics	Provides income, household ownership, car ownership, and ethnicity data at census tract level	US Census Bureau	2020
Land use	The land uses of origin and destination tracts.	Replica data hub	2022
Origin – destination tracts	The starting and ending census tracts of travelers	Replica data hub	2022

The data outlined above are specified to the extent of the tri-county area. The census tracts within each county are joined with origin and destination data to determine the most frequently visited stations that would indicate areas for greater investment in

amenities and shared mobility stations. The county boundaries define each county to assist in the analysis of differences between counties. The MARTA train, bus, and stop data are used to identify existing major transit centers across the three counties that have the potential to be enhanced as mobility hubs. Demographic data such as average household income, vehicle ownership, and race will show the population profile of riders at each location, as well as indicate which locations have more riders relying on alternative modes of transportation since they do not have access to a car. Land use data is critical in narrowing down the suitable locations because, as mentioned in the previous chapter, it will inform where key activity centers are located, and where there is the greatest diversity of land uses to serve the greatest number of people. The final dataset used is origin-destination data to identify how accessible the train stations are to the origin census tracts.

Methods

A suitability analysis is the primary method applied in this study for selecting potential locations for mobility hubs in the three counties. For this study, all 38 MARTA train stations will be used as a starting point for narrowing down which ones have the potential to be transformed into a regional mobility hub. In this section, the criteria selected for determining factors of the success of a mobility hub will be created and processes followed will be discussed.

The suitability analysis will be conducted in two steps: the first will review existing conditions of Fulton, DeKalb, and Clayton counties, and the second will be a multi-criteria analysis (MCA) that assigns a measure to the four factors identified through literature review in the *Background* chapter. The existing conditions review of the counties will include demographic information (household income and racial composition), and transportation information of residents (vehicle ownership and primary commute vehicle) at a census tract level. The multi-criteria analysis (**table 4**) will cover measurements for distance from home, added connectivity, and variety of

activity centers in proximity to transit stations. The results of both steps will be considered to finalize the potential locations for development.

The factors of household income, racial composition, vehicle ownership per household, and primary commute vehicle factors provide context to the types of users that utilize current transit centers. The determinants of income, race and vehicle ownership influence the decision of people use public transit and other alternative modes of transportation. The cost of owning and maintaining a car is much higher than the cost of taking transit, walking, or biking every day, so there is a greater chance that individuals with lower income will utilize alternative modes if given access. In the following chapter, we will explore the spatial distribution of the demographics to determine if there is overlap in the census tracts that have less vehicle ownership and low household income, as well as compare racial composition to understand which communities are most using shared mobility options.

The MCA follows a graduated screening model as shown in **Table 4** that indicates data ranges for each factor, provides a rating for each range, and analyses the data to determine how each MARTA station will test based on these criteria. It is necessary to assign a rating to the locations to ensure that each one is being evaluated by the same criteria, since the remaining locations that meet the criteria will be compared with the demographic data as well. With the rationale for each factor discussed in the previous chapter, the table will provide specific quantitative and qualitative measures to determine the potential of the station.

Table 4 Criteria for multi-criteria analysis of influential factors.

Factor	Data Range
Distance of transit station from home census tract centroid	0.00 – 0.25 mi
	0.25 – 0.50 mi
	0.50 – 0.75 mi
	0.75– 1.00 mi
	> 1.00 mi
Added connectivity to transit station	Access to cycle route, bus stop, and primary road from census tract
	Access to bus stop and primary road from census tract
	Access to primary road from census tract
Variety of activity centers in proximity to transit station	Retail, groceries, restaurants, attractions < 0.25 mi
	Retail, groceries, restaurants, attractions > 0.25 < 0.5 mi
	Retail, groceries, restaurants, attractions > 0.5 < 0.75 mi
	Retail, groceries, restaurants, attractions > 1 mi

Analysis

Part 1: Existing Conditions

In this section of the analysis, map outlines of MARTA's existing train network and population demographics are analyzed for the study area. As previously mentioned, the socioeconomic factors of an area will determine if an individual has the means to travel from their home to work and other services they may need. Understanding how far the MARTA train network extends and the demographics of the population living near the stations will clarify which locations would benefit the most from being redeveloped into mobility hubs that can serve more people who rely on alternative modes of transportation.

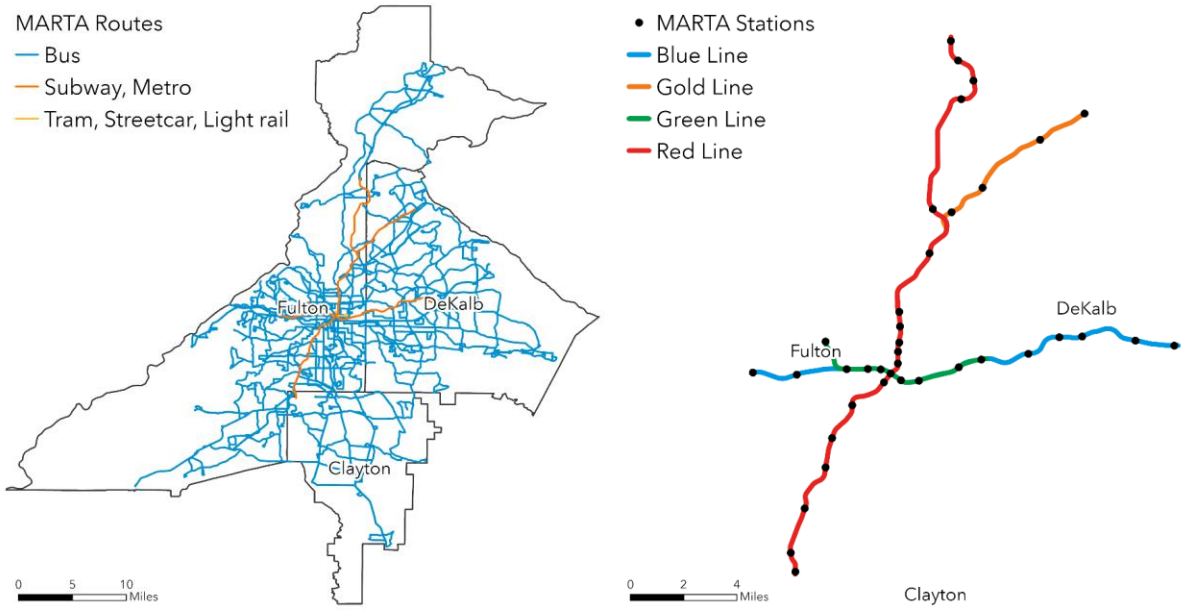


Figure 2 Complete MARTA train and bus network.

The MARTA network stretches to most corners of the study area (as seen in orange on the left); however, there are large areas in between that do not have passenger rail service that are primarily serviced by the MARTA bus network. Individuals living in the areas that are away from the four MARTA lines likely rely on a car or bus for their travel.

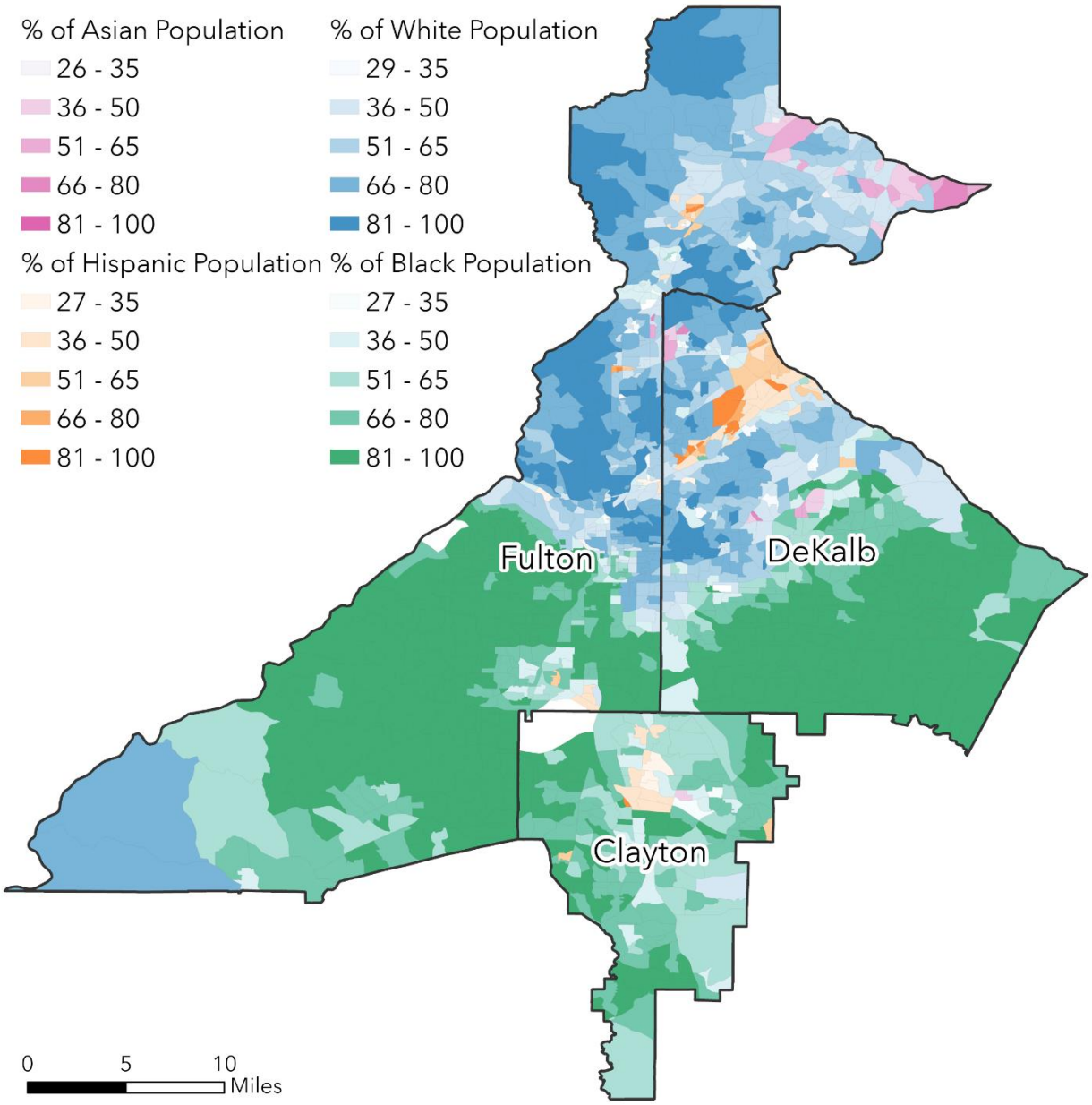


Figure 3 Demographic breakdown of population groups by race in Fulton, DeKalb, and Clayton counties.

The demographic distribution of people by race (**Figure 3**) shows a clear patter of clustering of neighborhoods that are predominantly black in the southern portion of the study area, and predominantly white in the northern half, with some tracts in the southwest as well. There are few areas with a high percentage of Hispanic and Asian populations. In relation to the MARTA maps shown in **Figure 2**, the southern section of the MARTA network will mostly serve African American or Black communities living in the College Park and South Atlanta area. The northern

stations will likely see a greater mix of racial backgrounds as census tracks are not as clearly defined. In terms of land use, from Atlanta towards the north and northeast, there are major financial and commercial districts that lend way to a diverse group of transit users as those stations see more office commuters and students.

Another finding from the demographic data is the visual correlation between annual household income and racial distribution. The household income map (**Figure 4**) illustrates a gradient of census tracts with an average low-income bracket in the south of the study area that gets darker as the income increases going north towards the cities of Sandy Springs, Alpharetta, and Johns Creek for instance. While this data is not sufficient to make an argument for a causational relationship, there is a pattern that follows closely to the racial distribution seen above. This leads to a question of whether household vehicle ownership rates are lower in areas of lower income and vice versa, or if it follows a different distribution pattern.

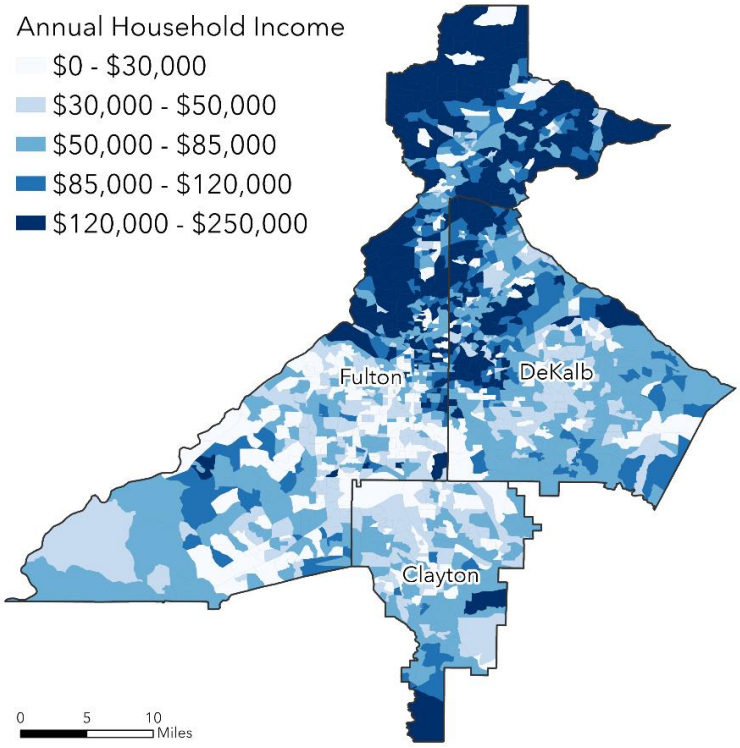


Figure 4 Distribution of annual household income by census tract.

According to the distribution of vehicles per household shown in **Figure 5**, a clear pattern is not perceived that can be compared to the pattern seen in the racial demographic or household income maps. The number of vehicles per household varies drastically, and there is minimal clustering present. One pattern that may be insightful is the slightly higher clustering of 3 to 4 vehicles per household in the north and south of the study area. This could likely be due to urban sprawl as there are more suburban residential neighborhoods with greater distance from downtown Atlanta. This could indicate that individuals living near the city own fewer or no vehicles in their household, and they rely on alternative modes of transportation for their daily travel purposes.

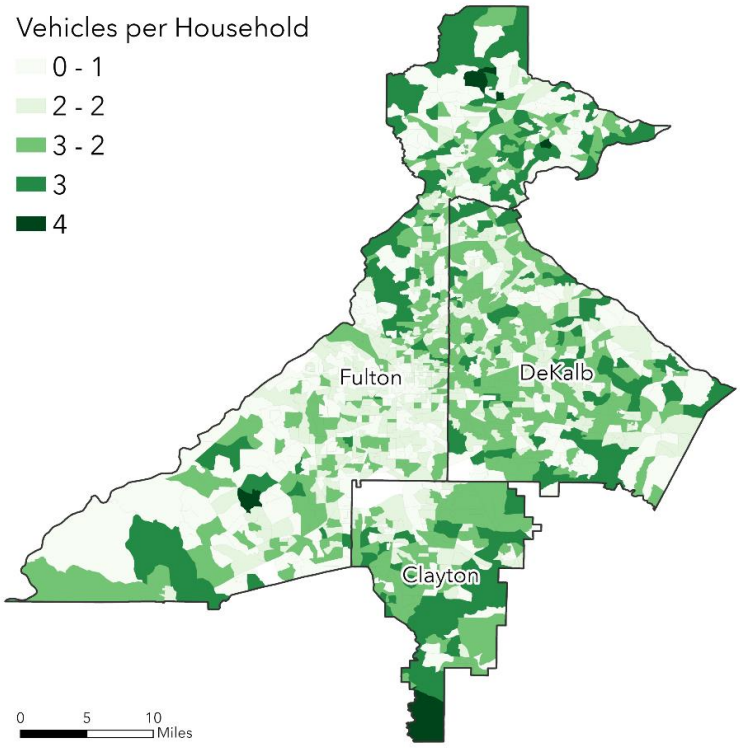


Figure 5 Vehicles per household in tri-county area by census tract.

The demographic breakdown in this section is an important precursor as it provides context for some patterns that arise during the multi-criteria analysis portion of the study.

Part 2: Multi-Criteria Analysis

The multi-criteria analysis method was used in this study as it was an effective way of ensuring that the goals and intended outcomes of creating mobility hubs in the city would be based on maximizing convenience, connectivity, and accessibility. The following maps outline the processes taken to reach the result of the study. This first map (**Figure 6**) shows the result of the first criteria in the MCA which is the distance of census tracts from the train station, at four increments. A multi-ring buffer was created around each MARTA station, and census tracts with centroids intersecting the buffer were extracted to see how many would be in proximity to the train stations.

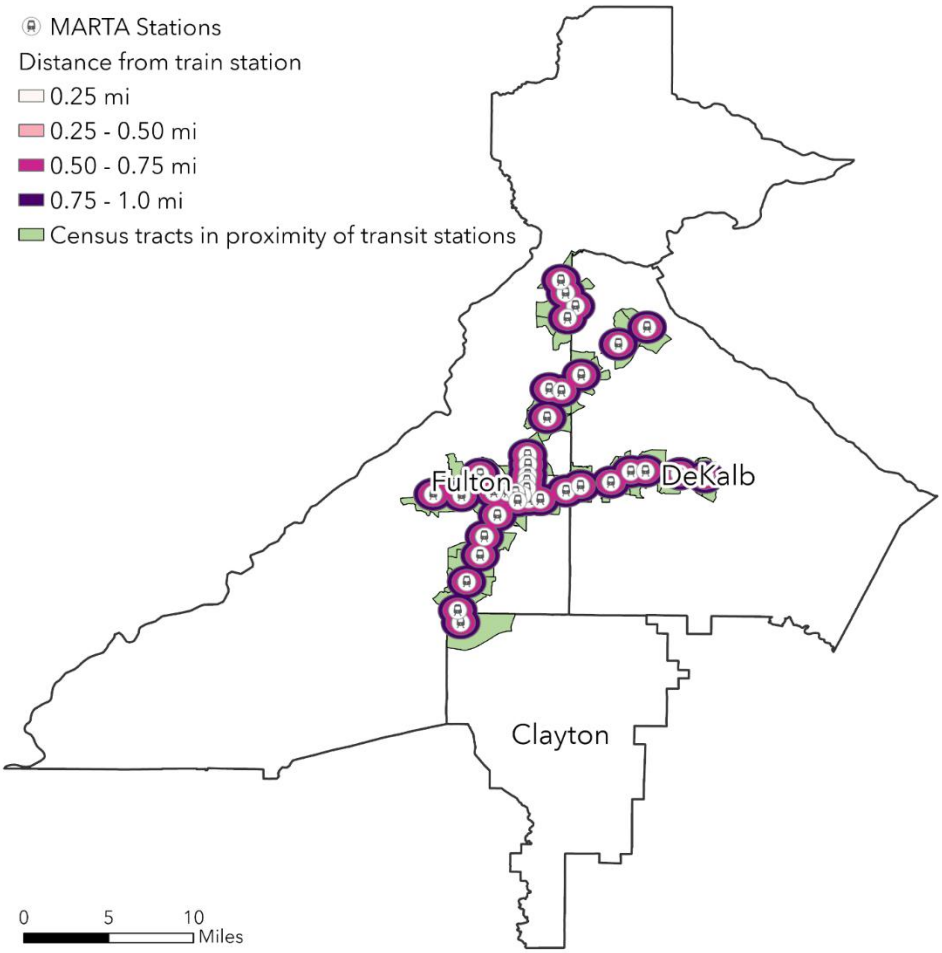


Figure 6 0.25, 0.5, 0.75, and 1 mile incremental distance buffer from train stations, intersecting with the centroids of census tracts that are in closest proximity to the stations.

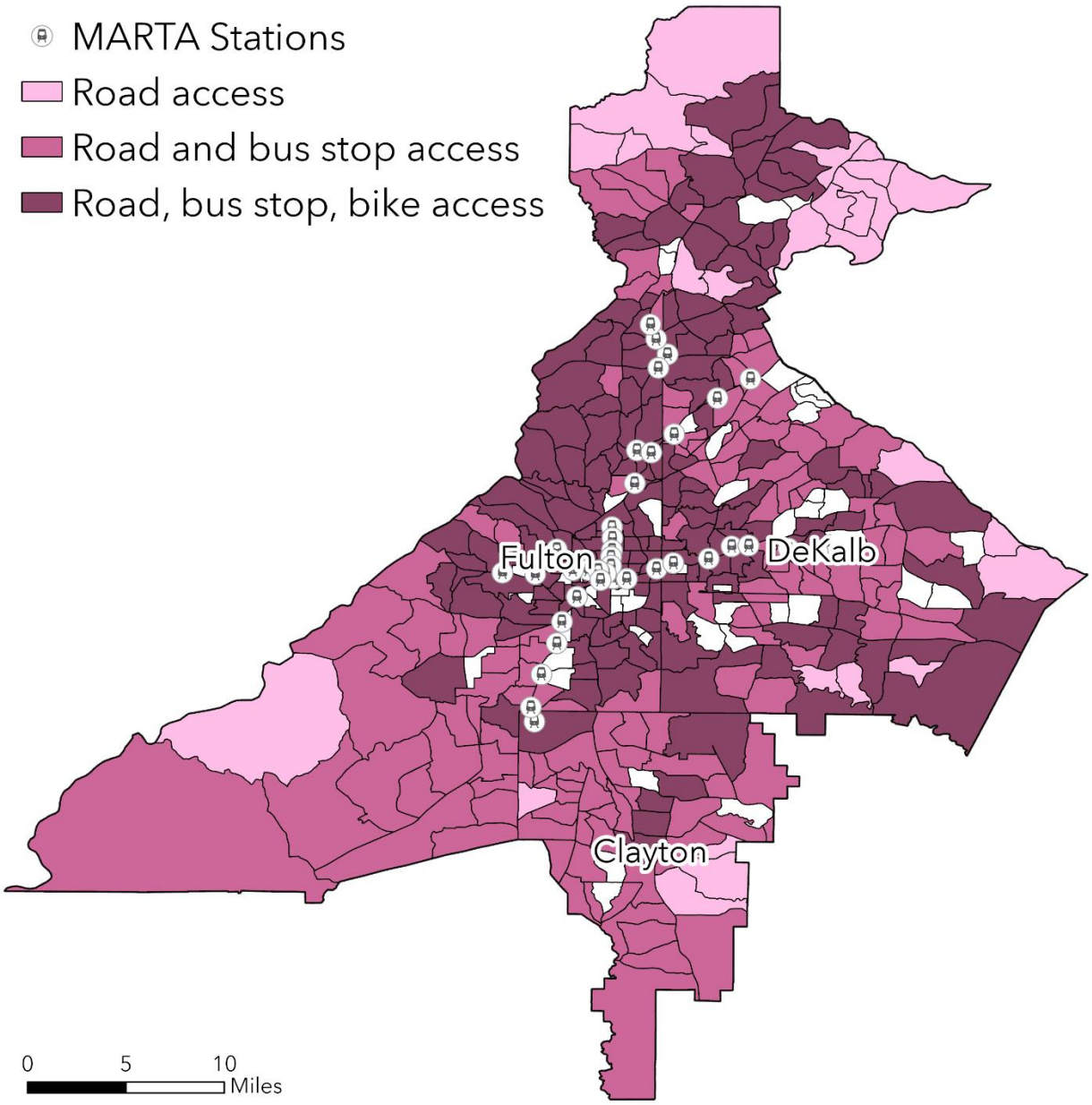


Figure 7 Area coverage of mode access level in all census tracts through the tri-county area.

The map shown in **Figure 7** illustrates the number of census tracts that provide access to all the transit stations through three modes of transportation – bus, car, and cycling. Areas closer to the CBD and activity centers have greater access to facilities that provide access to these modes.

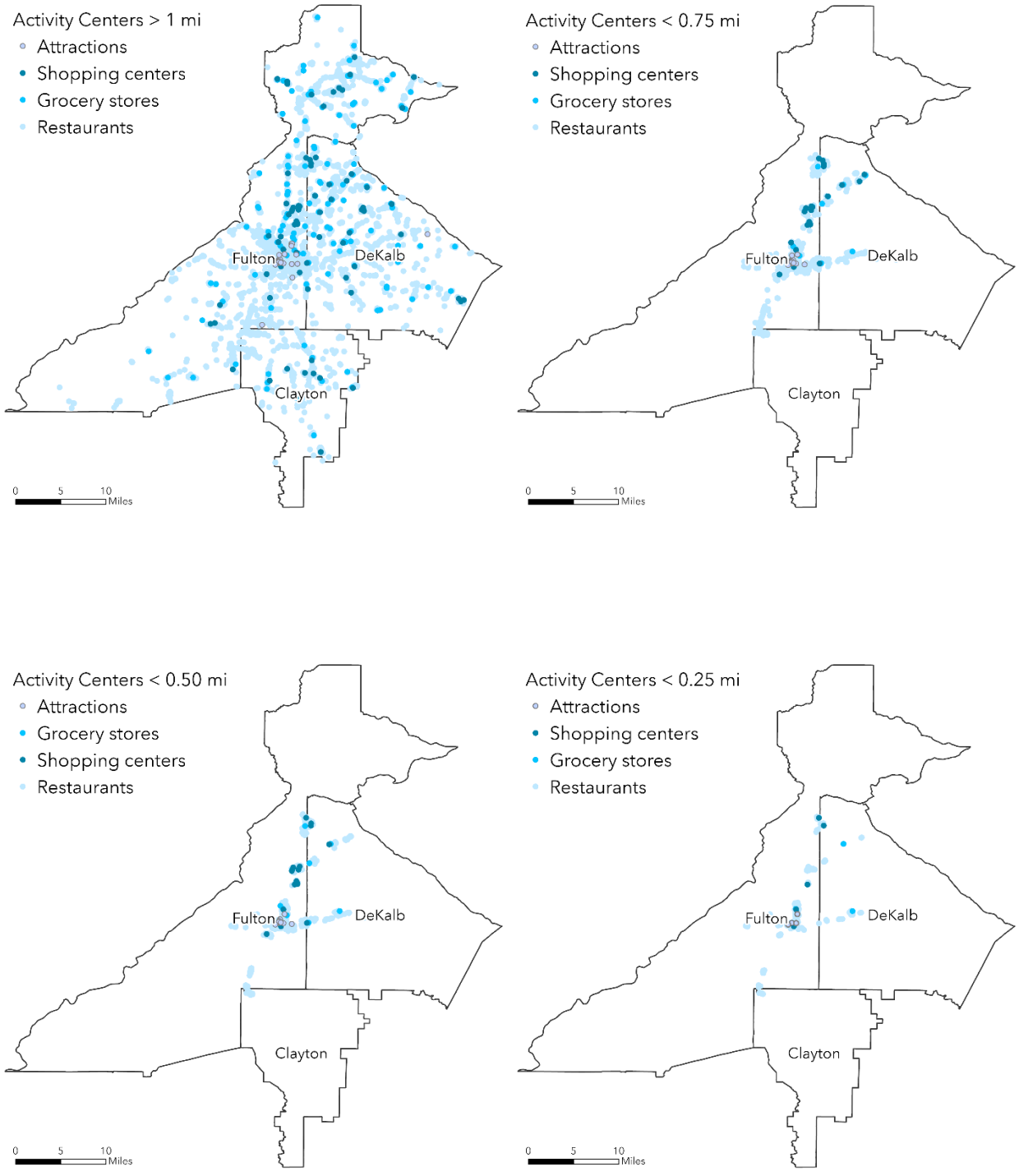


Figure 8 0.25, 0.5, 0.75, and 1 mile incremental distribution of activity centers showing proximity to transit stations.

Figure 8 shows how many types of amenities there are as distance grows closer to the transit stations. Within a 0.25 miles radius, there are much fewer activity centers

than a radius of 1 mile but for the purpose of this study, mobility hubs should provide easy access to these activity centers, which includes shared mobility and walking.

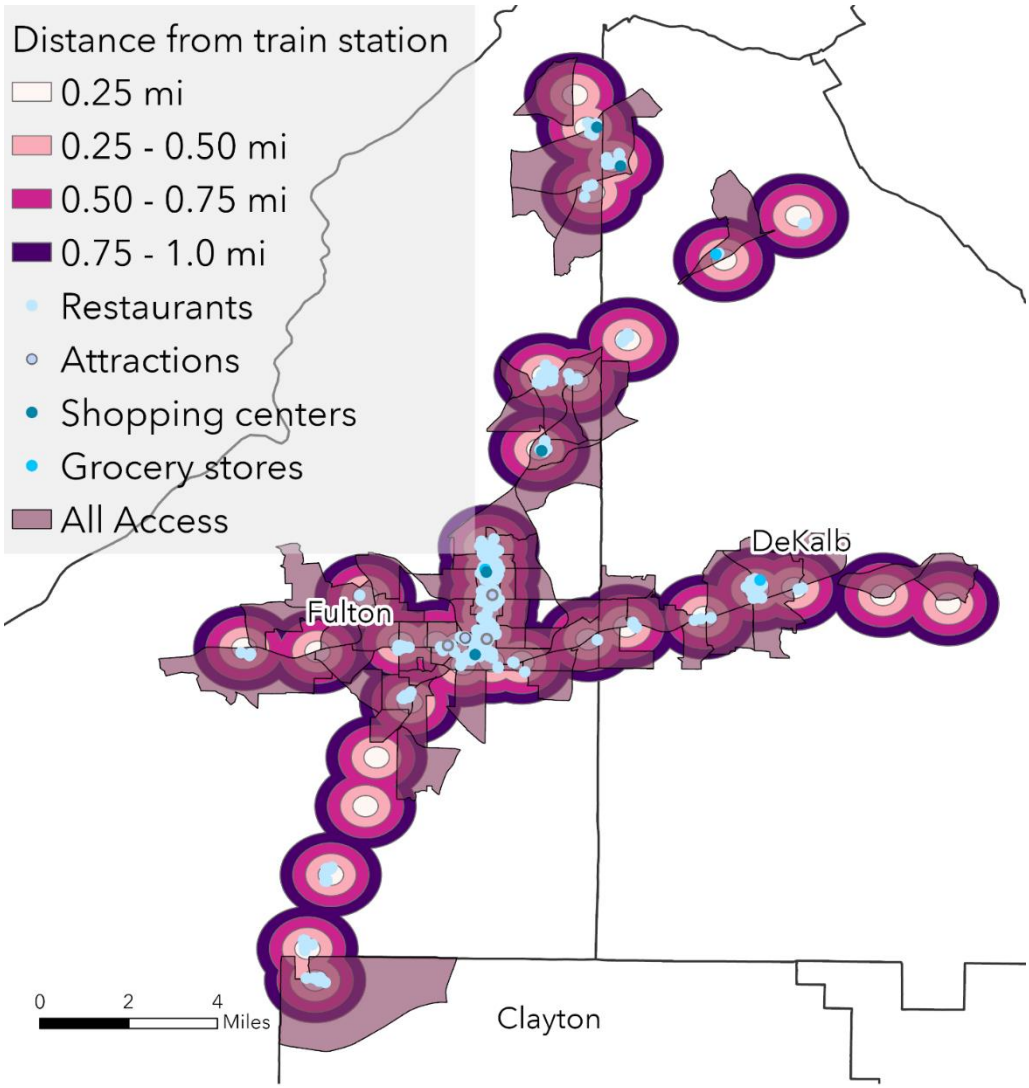
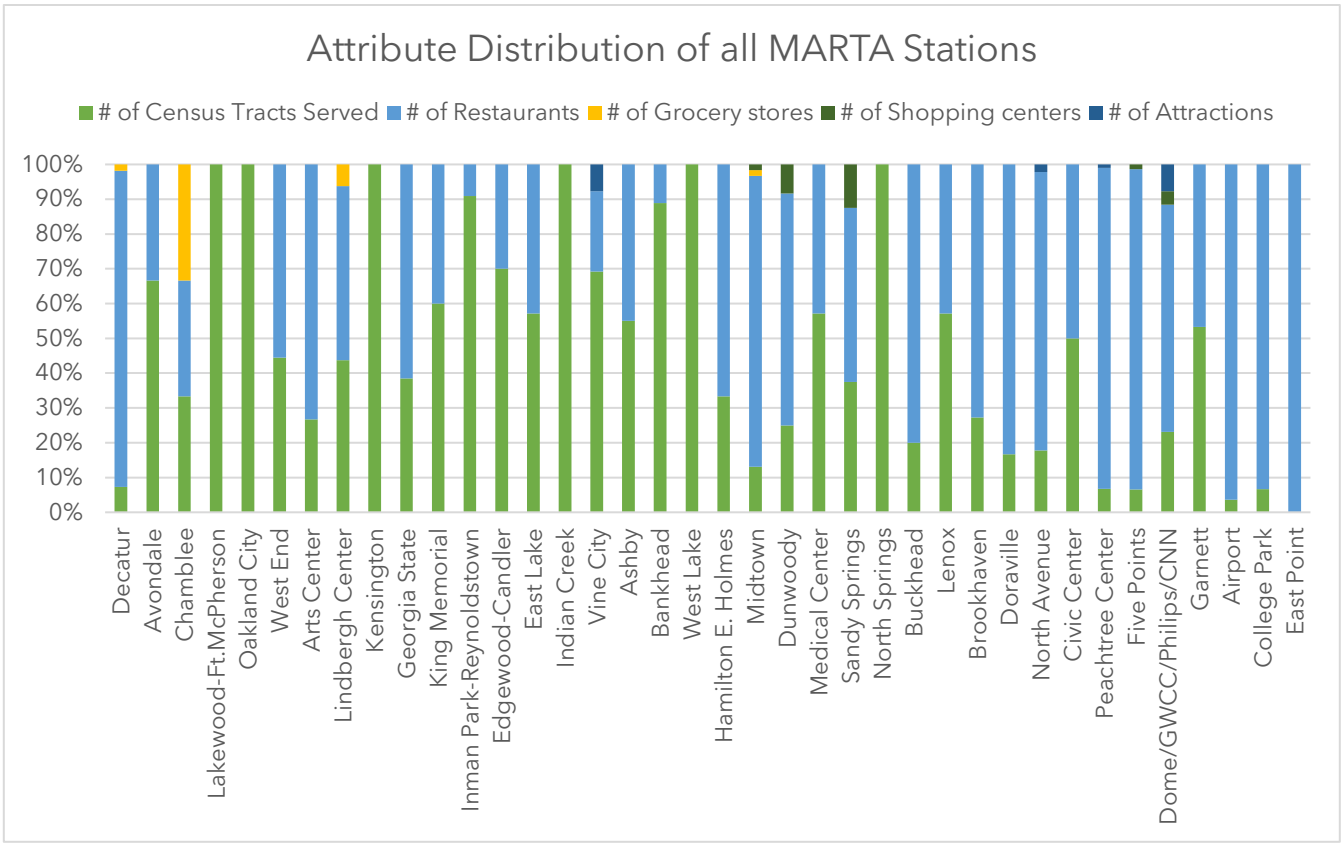


Figure 9 Preliminary analysis filtering for closest activity centers, and census tracts that are closest to transit stations that offer access through three modes.

The map shown in **Figure 9** is the result of filtering for activity centers within a maximum 1-mile radius from transit stations, and census tracts that are closest to the transit facility that also provide access to the facility through three modes of transportation. The final distribution of the different types of activities around the transit stations and the number of census tracts served are shown in the charts below (**Figure 10**).



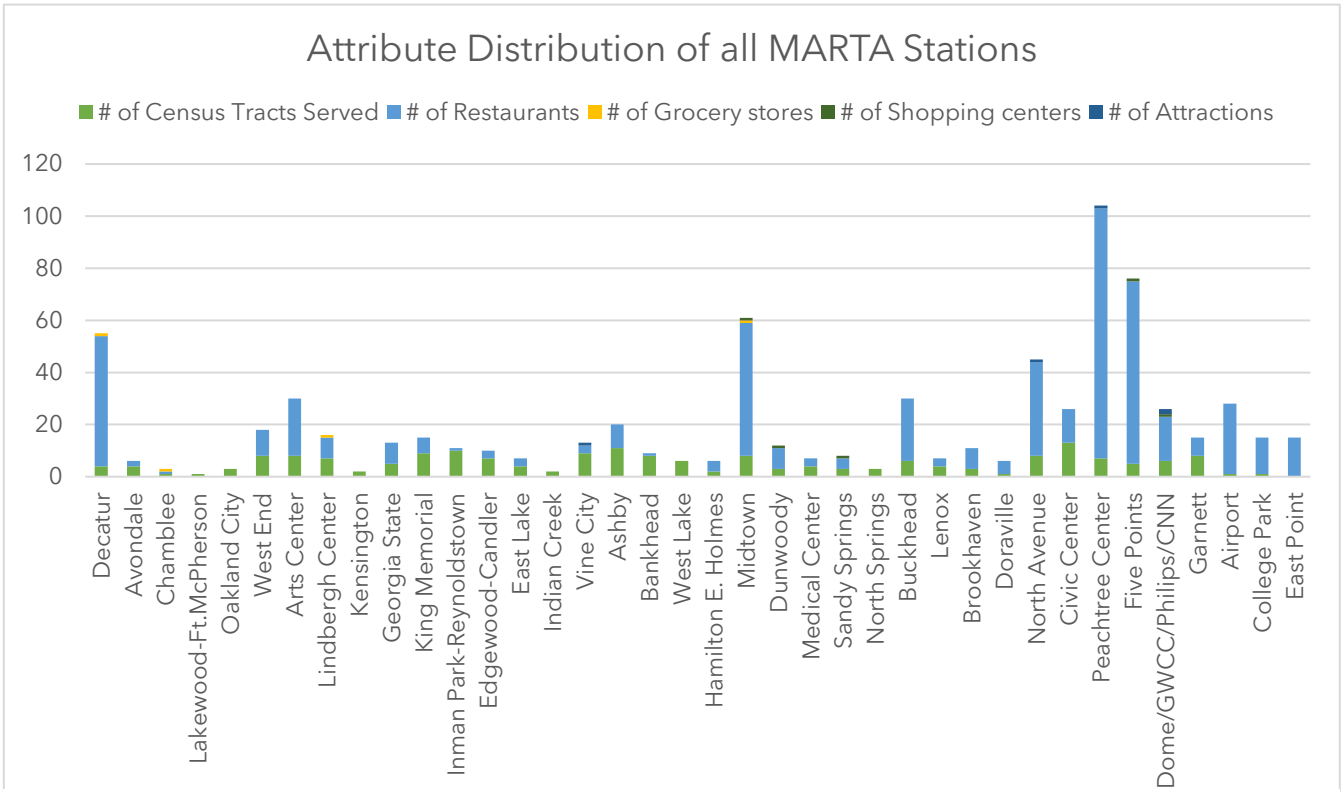


Figure 10 Number of census tracts served by each transit station, and the number of activity centers near each station, represented by stacked percentage of total attribution distribution (top) and number of attributes per station (bottom).

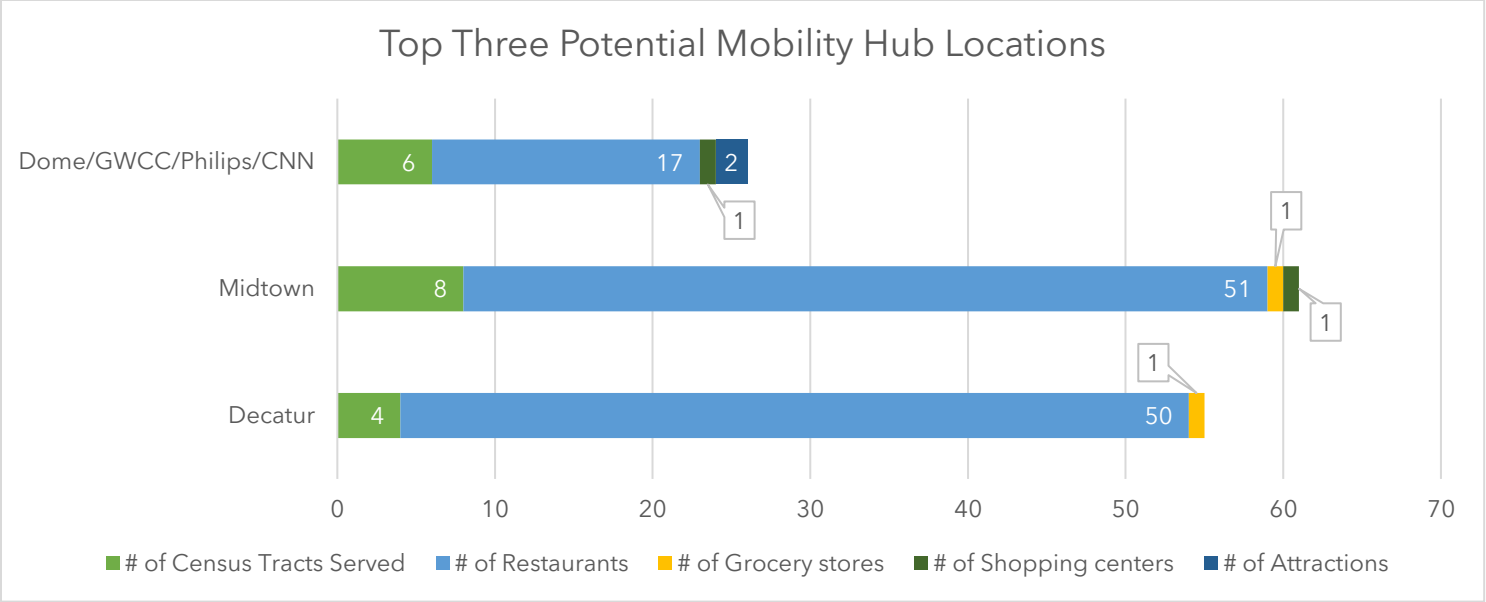


Figure 11 Final selection of top three potential mobility hub locations based on existing transit stations.

After analyzing the number of activities around the transit stations and the number of census tracts served, the three stations that provided the greatest variety of options for users and would be an ideal location for redevelopment as a mobility hub are Dome/GWCC/Philips/CNN station, Midtown station, and Decatur station.

Conclusion and Further Study

The analysis completed for this study provided insight into the potential for mobility hubs to be incorporated into the transportation system in Georgia in a way that utilizes the current infrastructure. Without disrupting the flow of movement and drastically impacting commute and travel patterns for people using alternative modes of transportation, mobility hubs provide a practical solution to efficient, accessible, and inclusive transportation options. In recent years, there have been conversations beginning to take place on the future of this type of transformation to the current transit network in Atlanta. In 2021, VHB, a planning consulting firm, wrote a brief post about the future of MARTA to improve rider mobility, and this would include consideration of infrastructure enhancements, place-making, seamless mode transfer facilitation, and other tools to enhance mobility and promote opportunities for

growth.[8] Another post regarding a potential transformation for Five Points Station in Downtown Atlanta was also released by Atlanta Downtown that referenced *The Oculus* in New York as a great example of re-organizing an existing space that has the space and potential for maximizing transit accessibility.[9] These examples indicate the direction that Atlanta can move towards if mobility hubs are viewed as an enhancement of the current system that is feasible to pursue in the near future.

[8] VHB, 2021.
[9] Atlanta Downtown, 2022.

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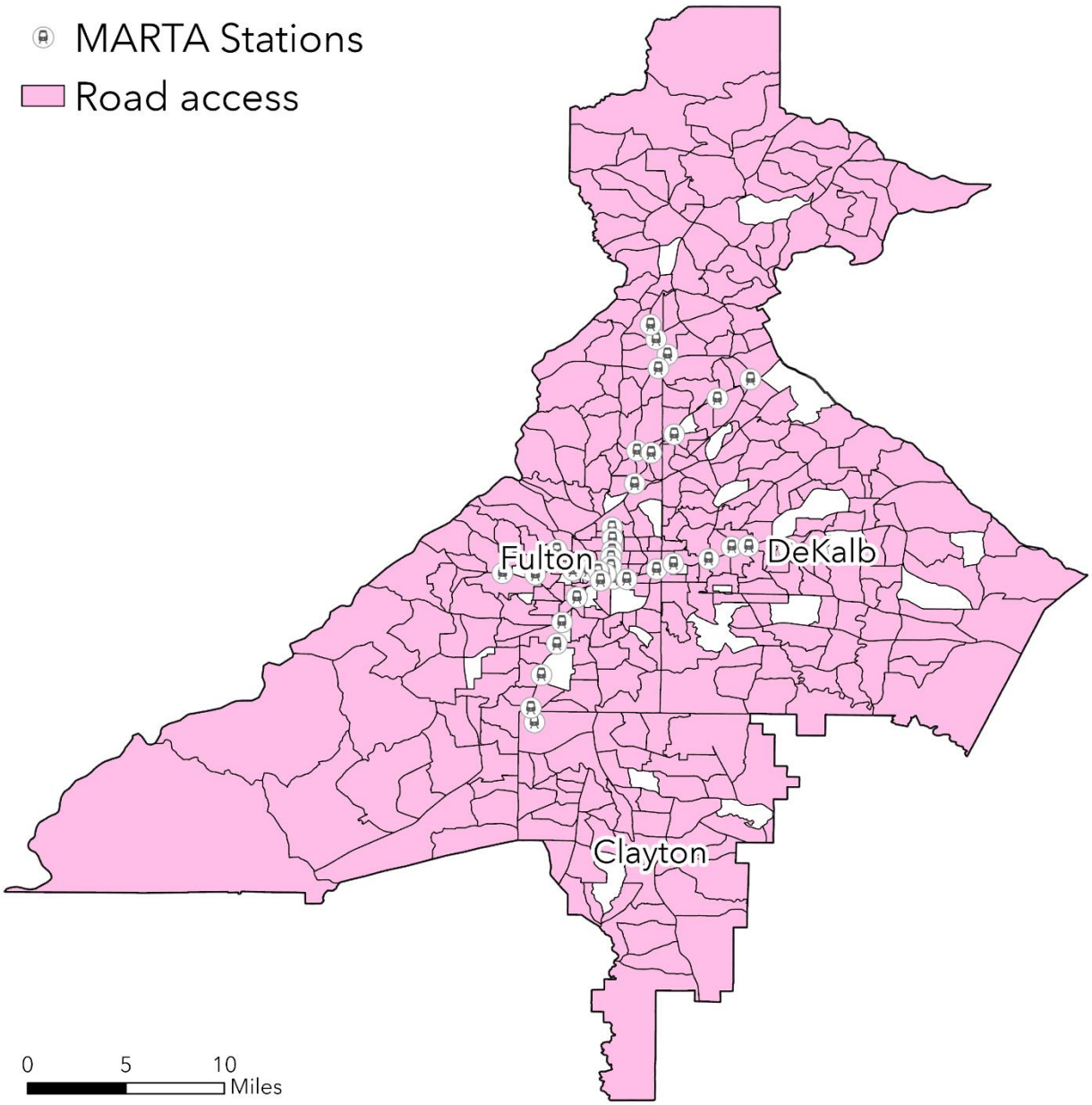
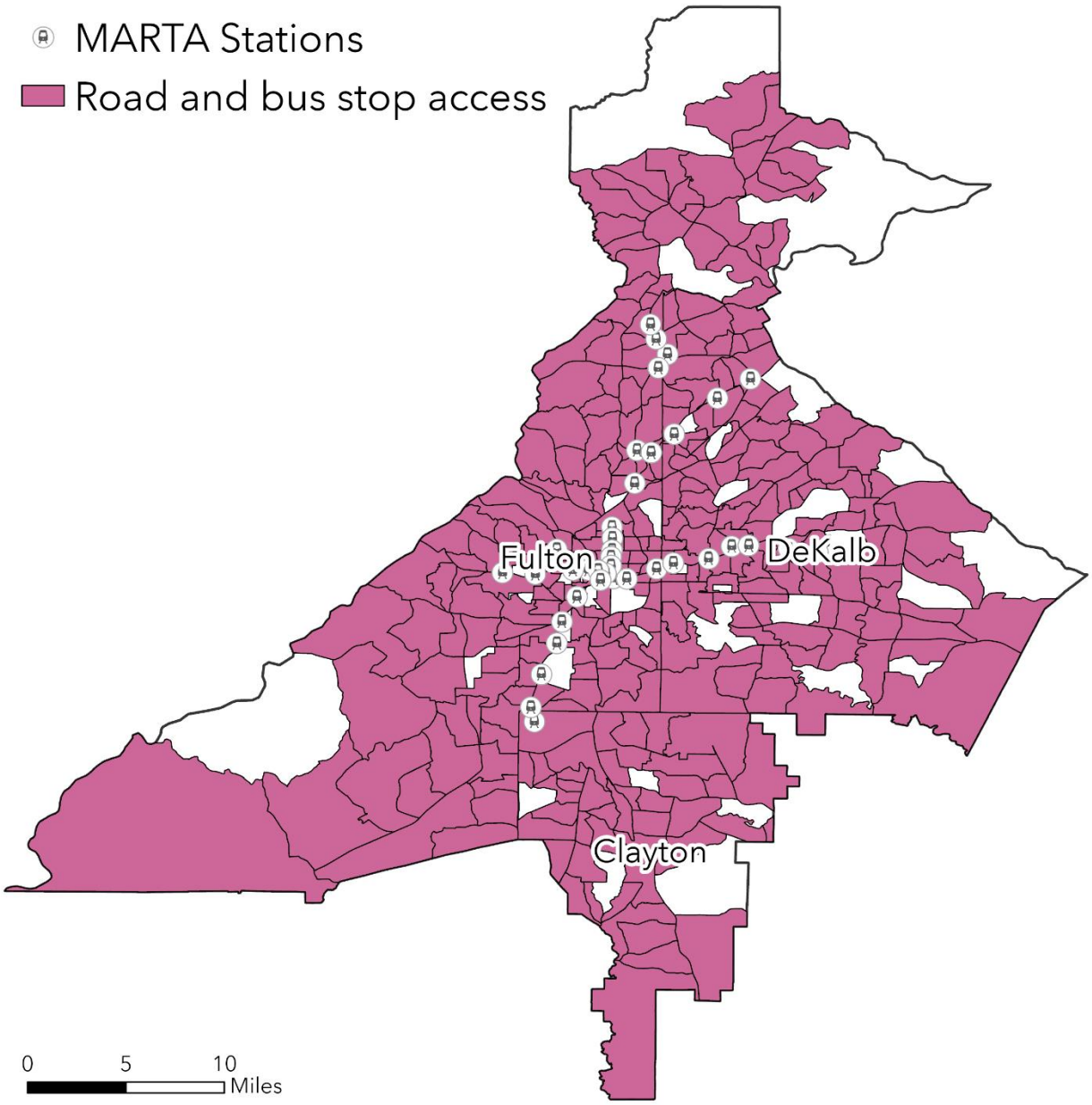
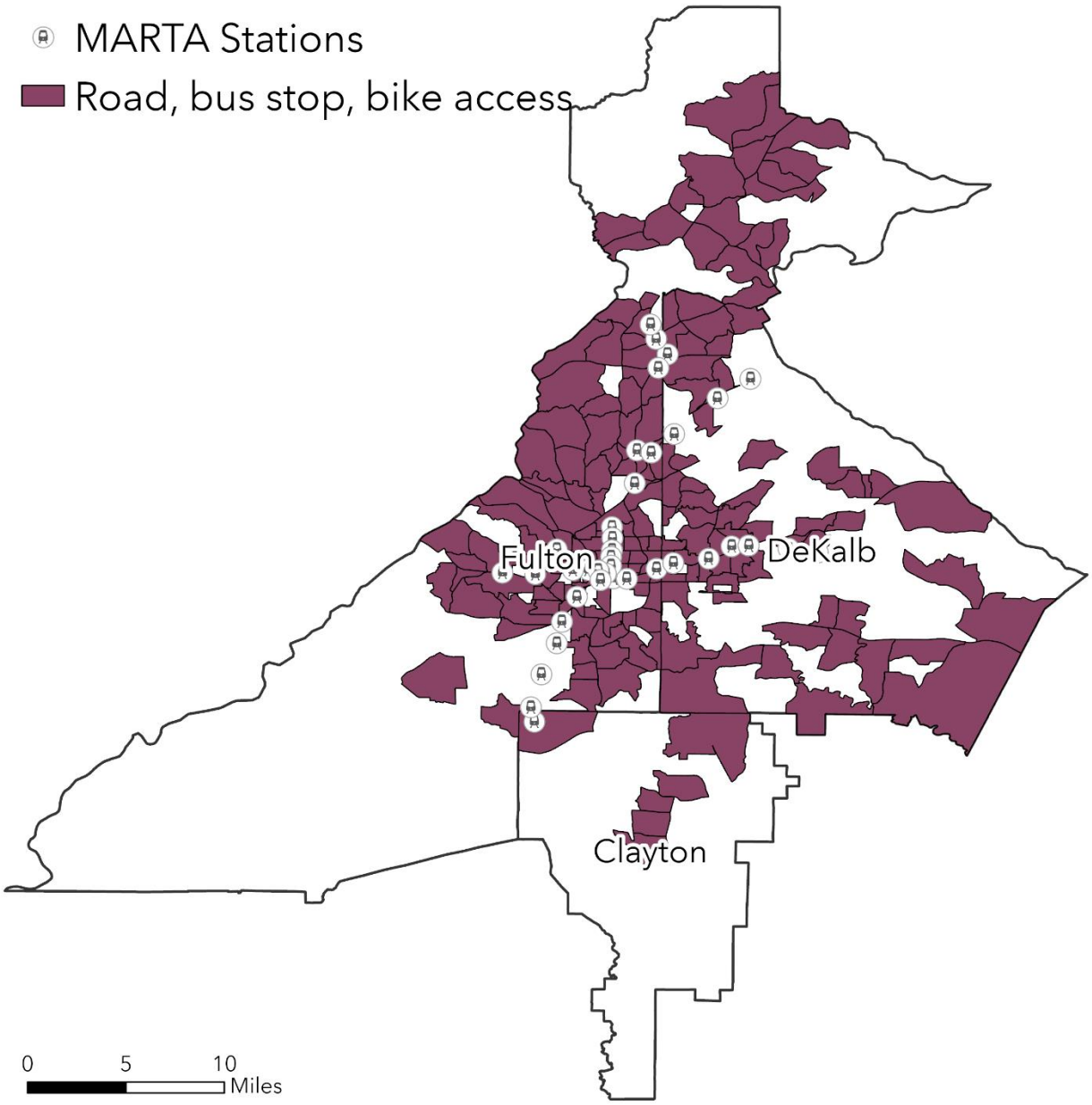
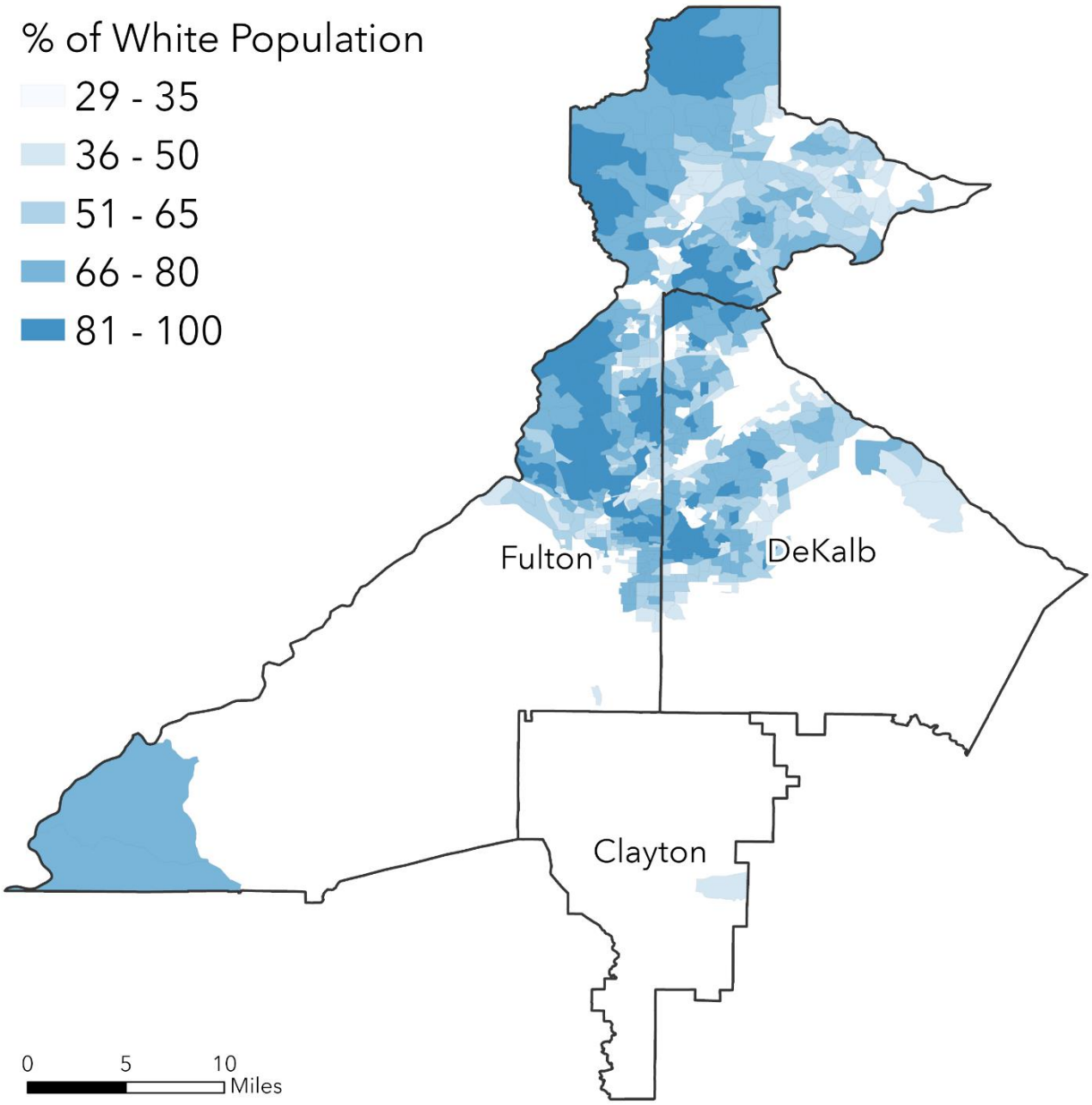
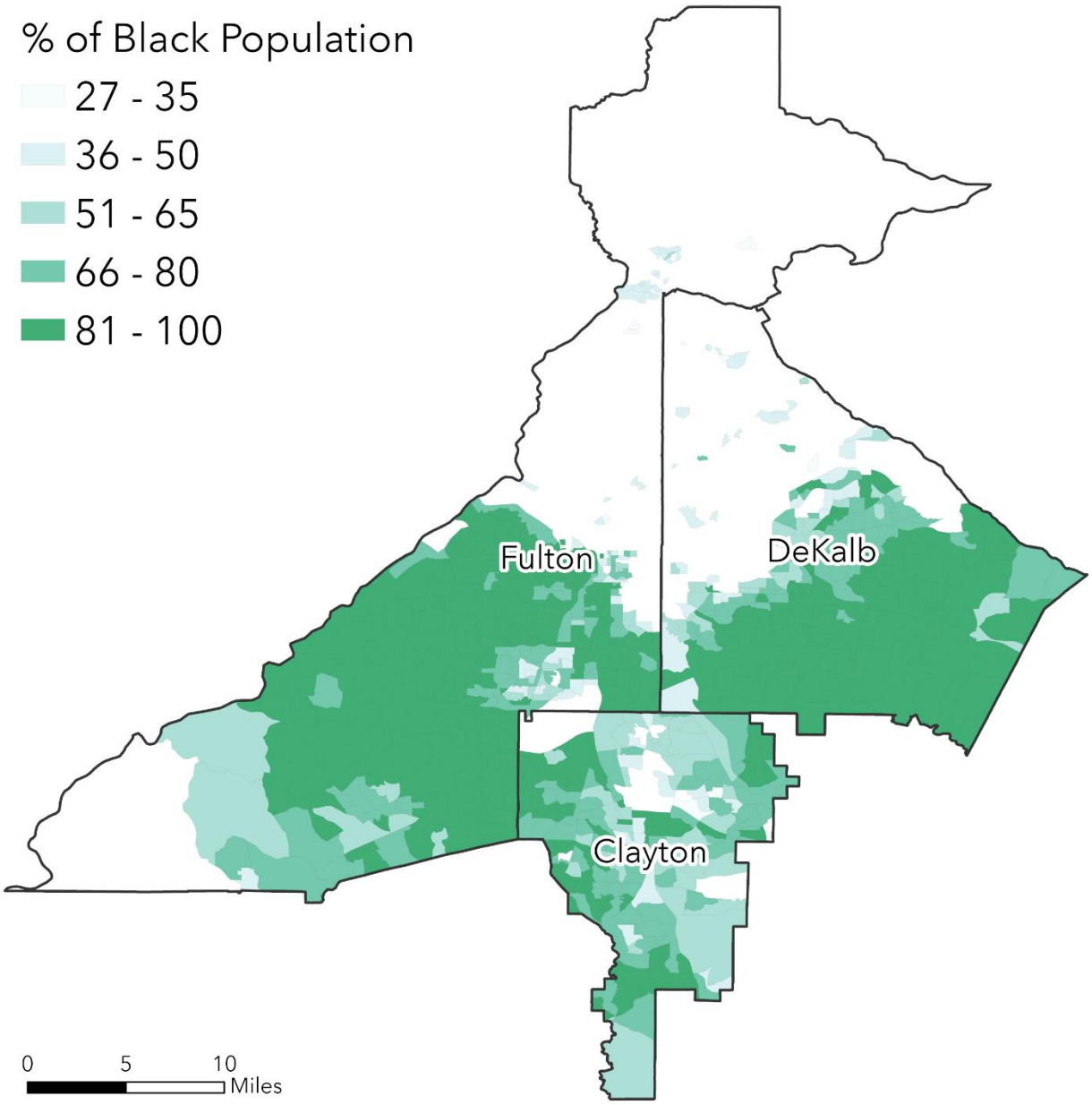
Appendix

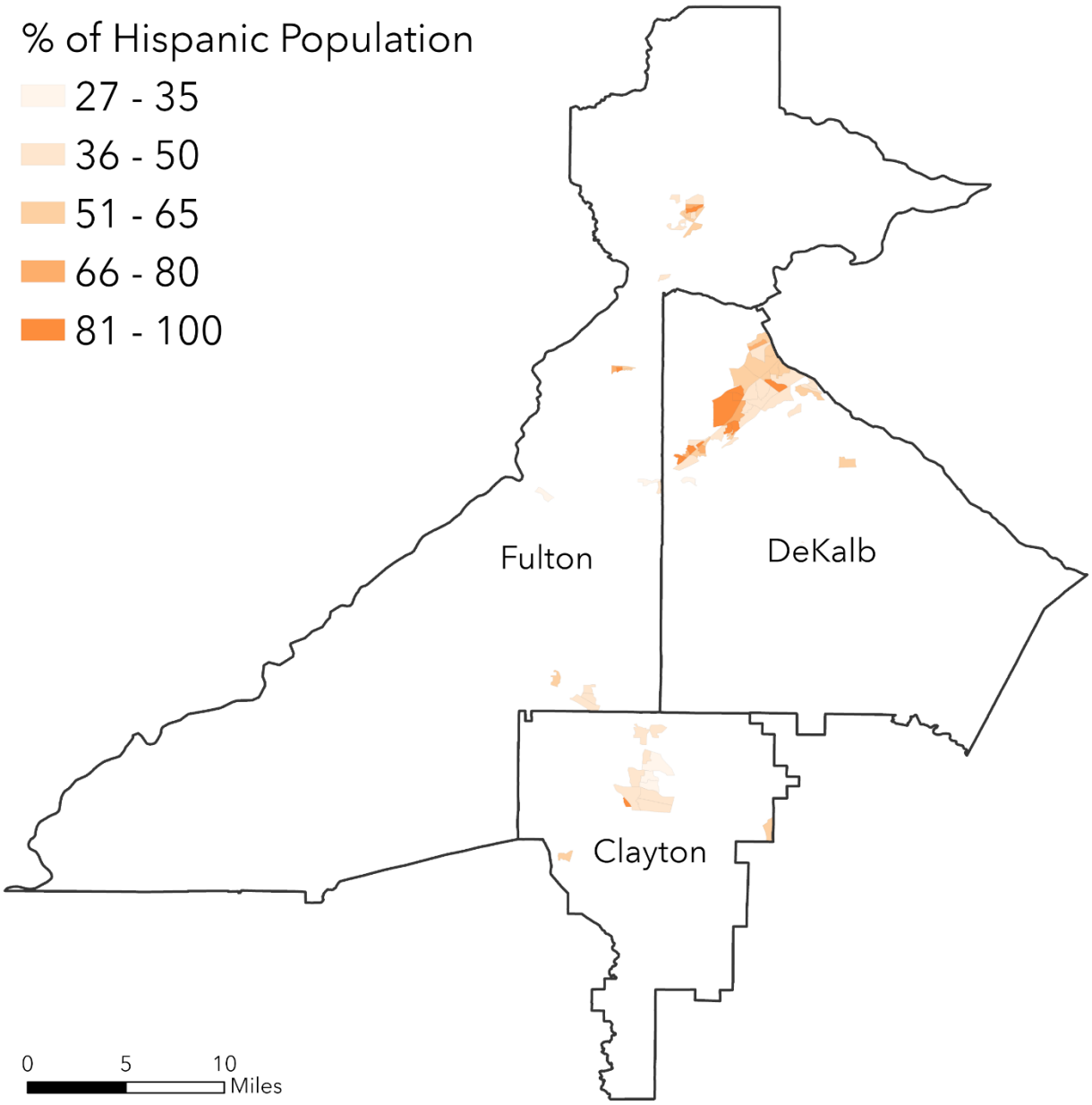


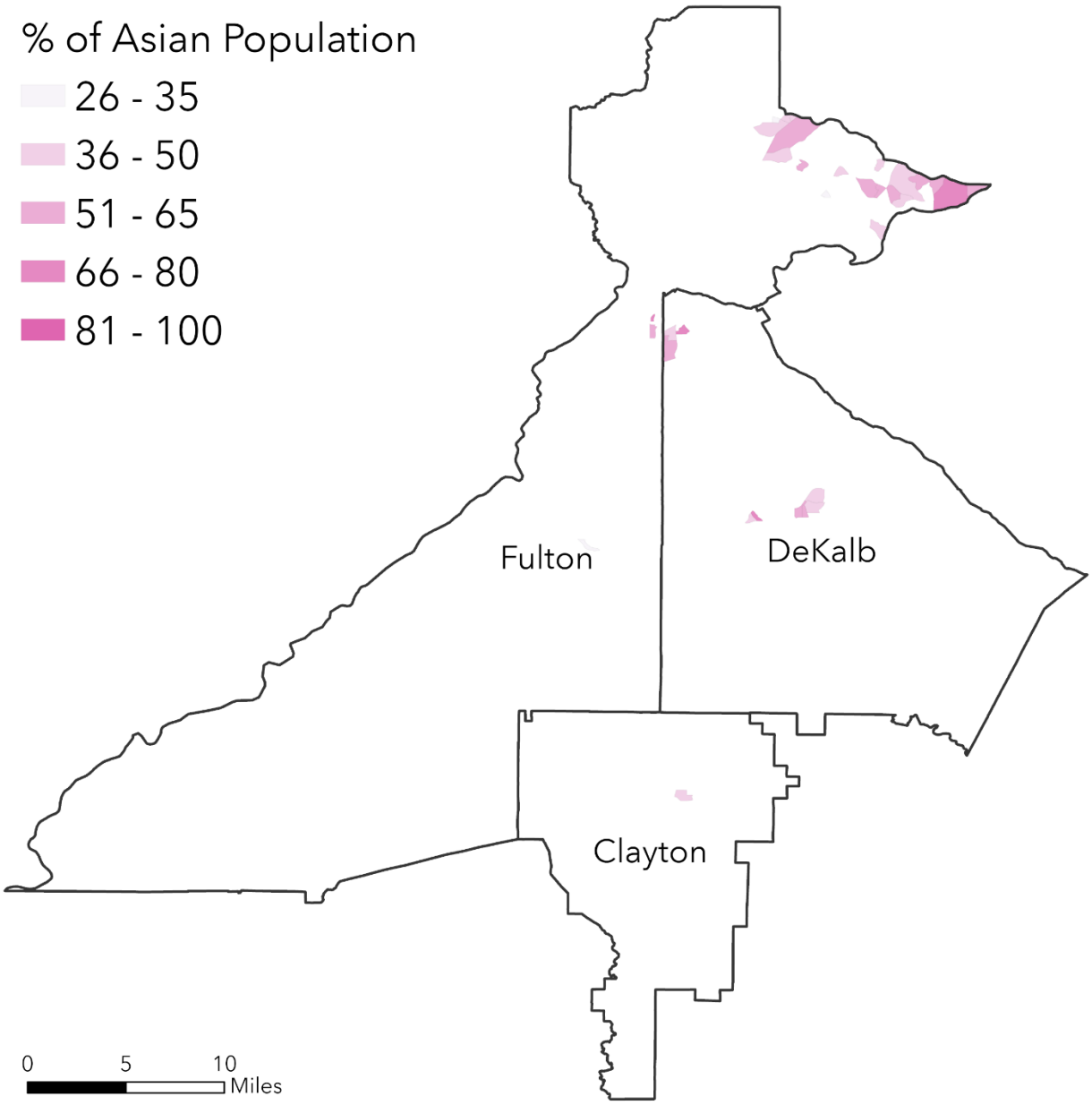

MARTA Stations
Road and bus stop access
Fulton
DeKalb
Clayton
0
5
10
Miles

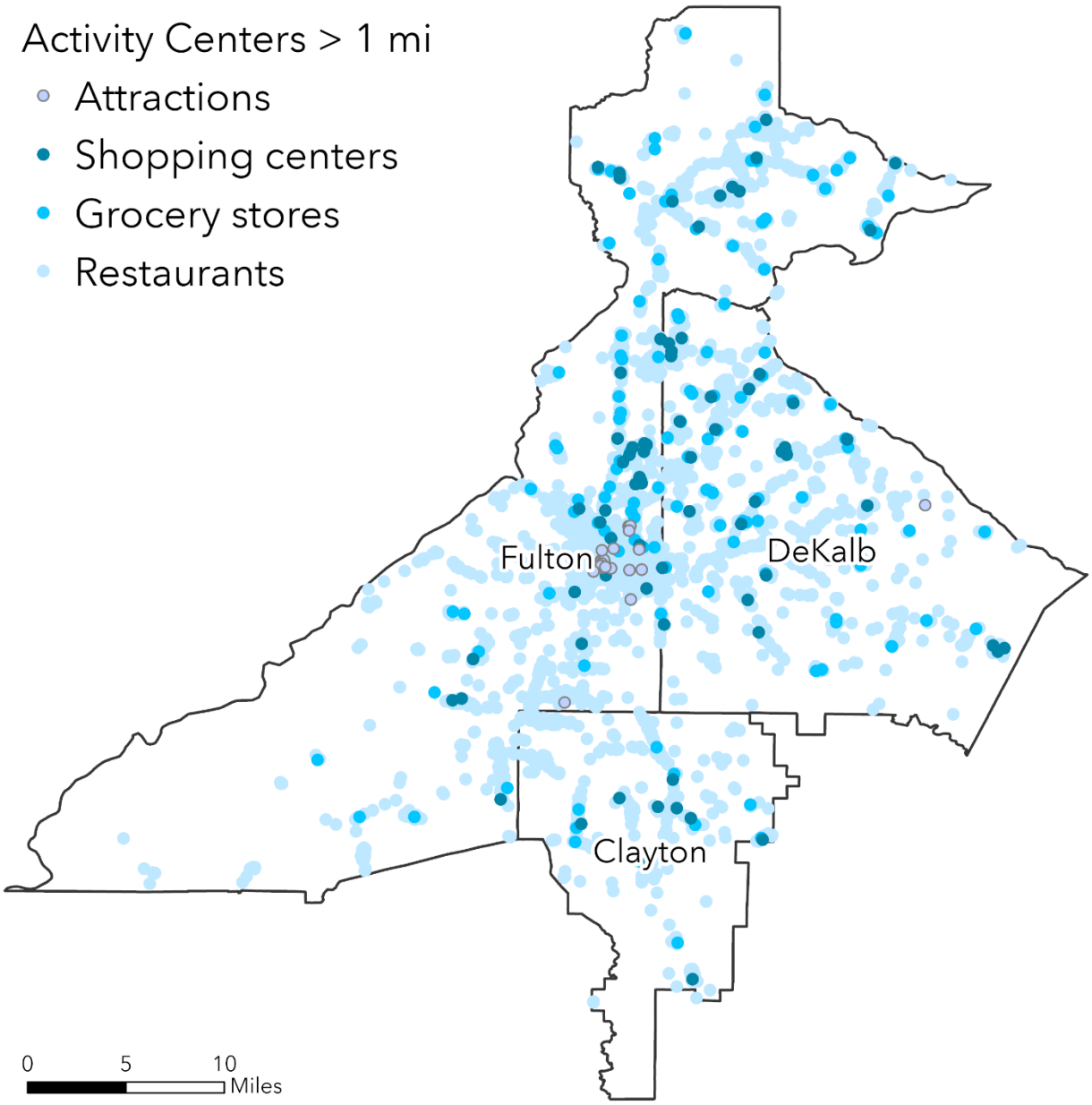

MARTA Stations
Road, bus stop, bike access
Fulton
DeKalb
Clayton
0
5
10
Miles

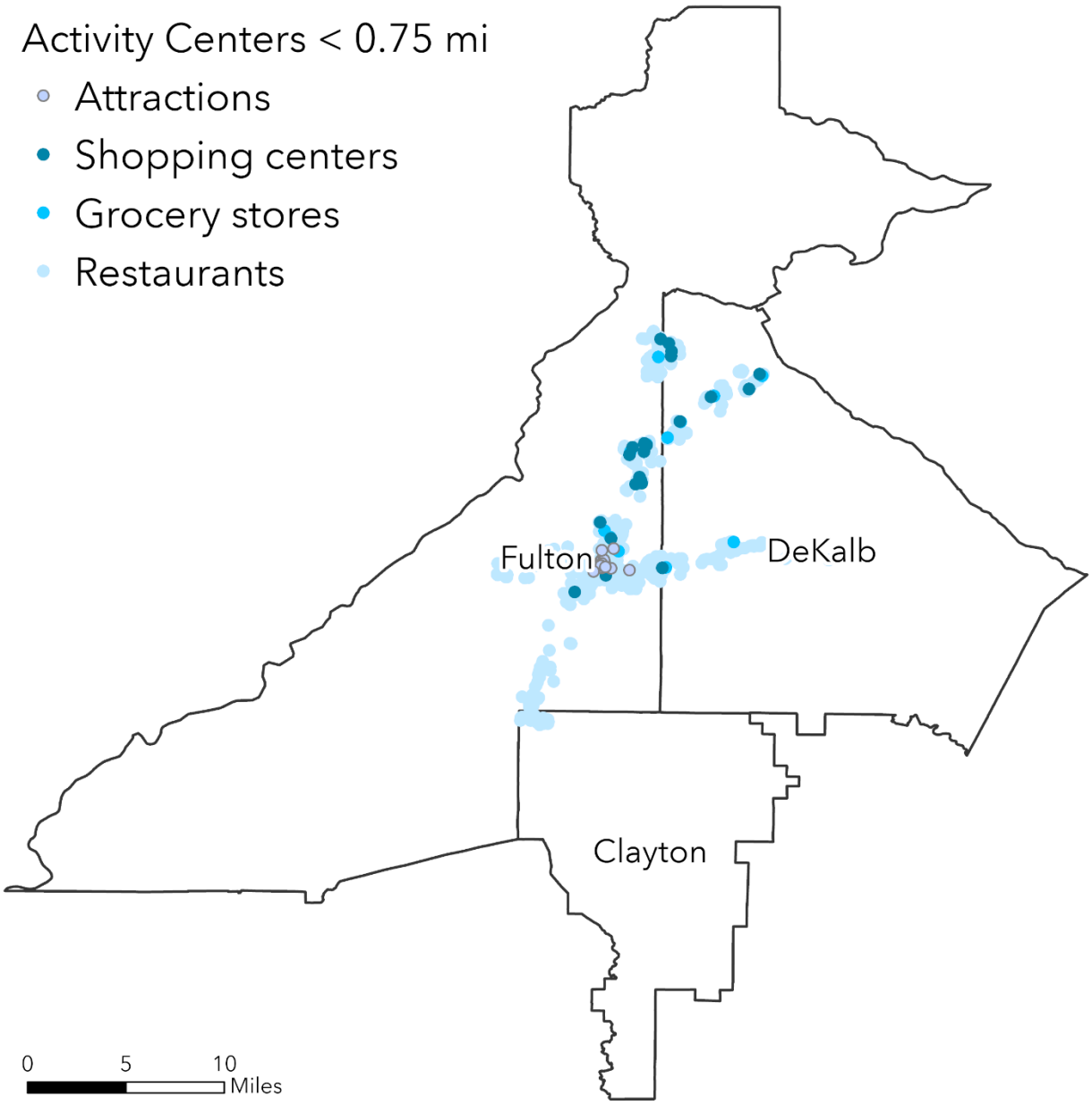

% of White Population
29 - 35
36 - 50
51 - 65
66 - 80
81 - 100
Fulton
DeKalb
Clayton
0
5
10
Miles

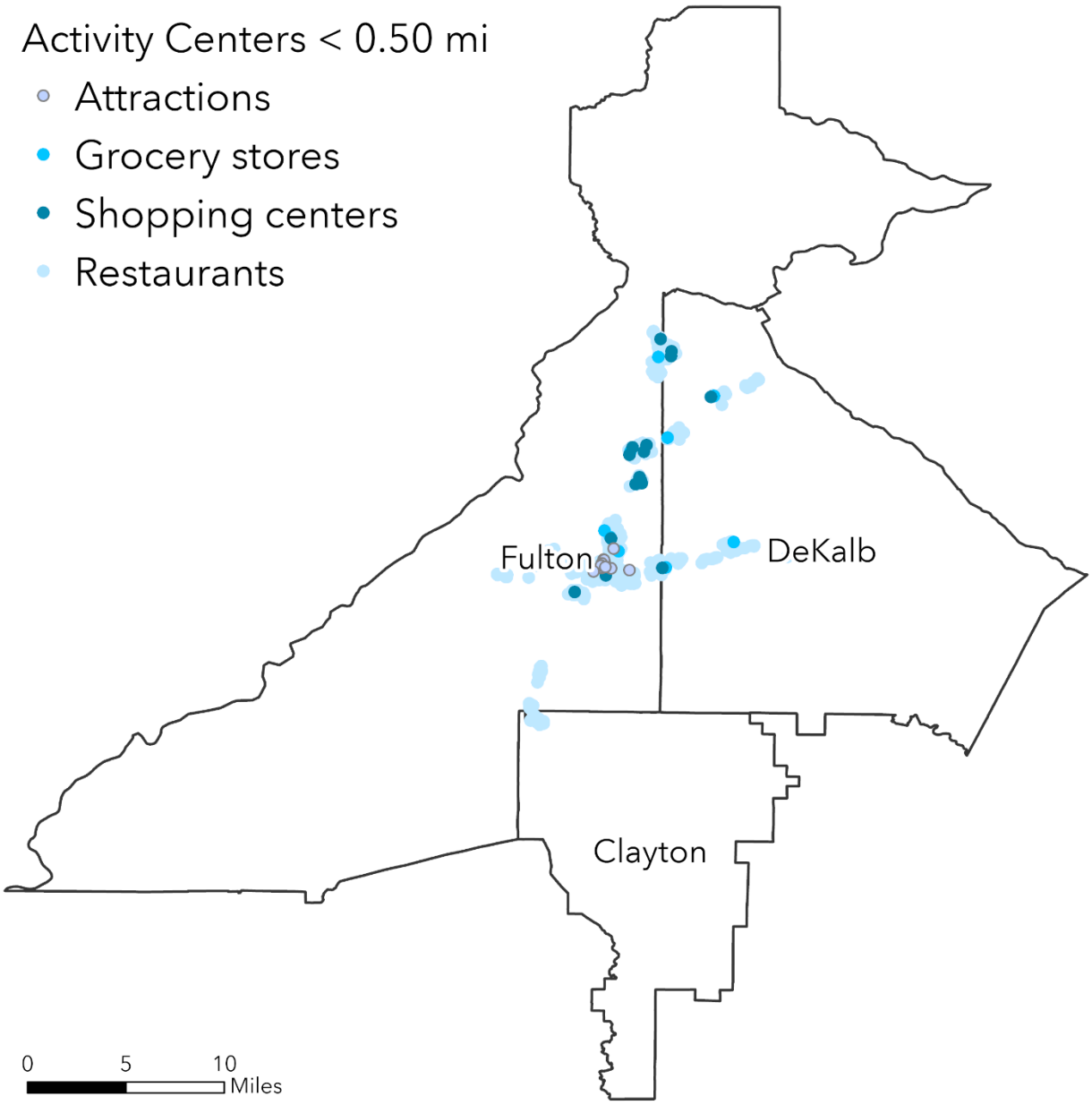

% of Black Population
27 - 35
36 - 50
51 - 65
66 - 80
81 - 100
Fulton
DeKalb
Clayton
0
5
10
Miles

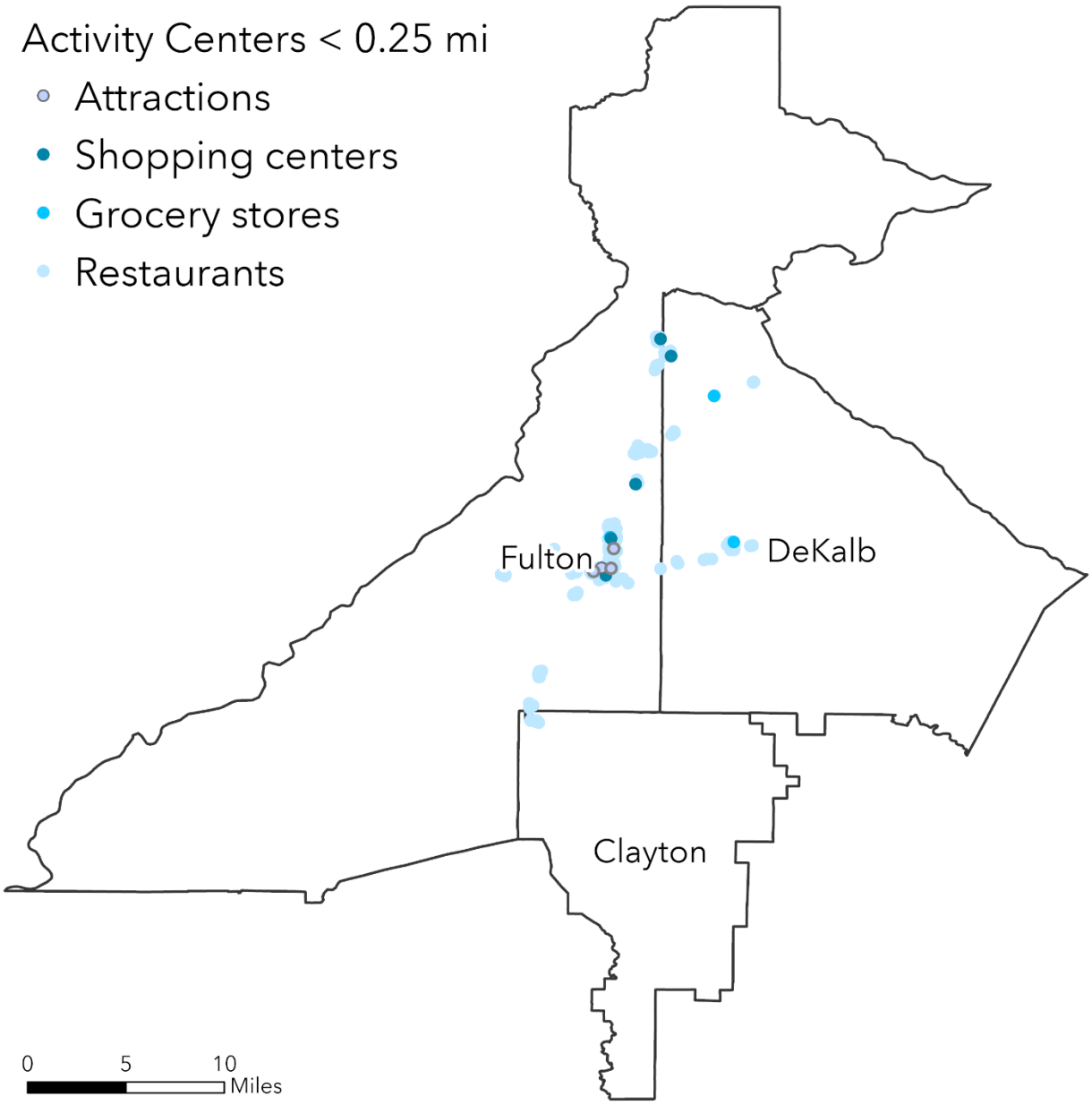

% of Hispanic Population
27 - 35
36 - 50
51 - 65
66 - 80
81 - 100
Fulton
DeKalb
Clayton
0
5
10
Miles


% of Asian Population
26 - 35
36 - 50
51 - 65
66 - 80
81 - 100
Fulton
DeKalb
Clayton
0
5
10
Miles


Activity Centers > 1 mi
Attractions
Shopping centers
Grocery stores
Restaurants
Fulton
DeKalb
Clayton
0
5
10
Miles


Activity Centers < 0.75 mi
Attractions
Shopping centers
Grocery stores
Restaurants
Fulton
DeKalb
Clayton
0
5
10
Miles


Activity Centers < 0.50 mi
Attractions
Grocery stores
Shopping centers
Restaurants
Fulton
DeKalb
Clayton
0
5
10
Miles


Activity Centers < 0.25 mi
Attractions
Shopping centers
Grocery stores
Restaurants
Fulton
DeKalb
Clayton
0
5
10
Miles