USING A CONFLICT MODEL TO DETERMINE OPTIMAL LOCATIONS FOR PARK AND RIDES IN ALACHUA COUNTY BASED ON CONNECTIVITY OF ROAD NETWORKS, POPULATIONS CHARACTERISTICS AND THE MIX OF LAND USE OF SURROUNDING PARCELS

By

JESSICA S. ALVAREZ

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To my parents

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of the University of Florida in Partial Fulfillment of the
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USING A CONFLICT MODEL TO DETERMINE OPTIMAL LOCATIONS FOR PARK-AND-RIDE LOTS IN ALACHUA COUNTY BASED ON CONNECTIVITY OF ROAD NETWORKS, POPULATIONS CHARACTERISTICS AND THE MIX OF LAND USE OF SURROUNDING PARCELS

By

Jessica S. Alvarez

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Chair: Paul Zwick
Co-chair: Ruth Steiner
Major: Urban and Regional Planning

The Florida Department of Transportation defines several different types of park-and-ride sites, Urban Corridor, Peripheral, Urban Fringe, and Remote (Gainesville Multimodal Corridor and Park and Ride Study, pg. 227). For this study in particular the author looks at: Urban Corridor, Peripheral, and Remote lots. Urban Corridor lots are characterized by being located along a major commuter corridor in an area, these types of sites are generally served by transit that is faster and more direct to the urban core. Peripheral lots are typically located at the fringe of an intensely developed, highly congested activity center. Finally remote lots are generally located outside the urban area in a rural or small town setting.

The main purpose of this paper is to determine optimal locations for any of the three types of lots throughout Alachua County. This was done by developing an opportunity model that consisted of three main elements: Connectivity, Population, and Land Use. Connectivity looks at the road network and public transit in an area. First it is determined how dense the road network is and next how frequent the bus service is to a

particular area. The population element identifies where higher densities of people can be found based on the total number of people in an area as well as the type of employment they have. Lastly the opportunity model addresses the land use of an area it concentrates on the variety and percentage mix of different types of land uses within a quarter mile of each parcel within the county.

These three elements are then integrated into an opportunity surface across Alachua County. The final results of the park-and-ride analysis show that the most suitable area for a park-and-ride lot is along the corridors to the City of Alachua and the City of Newberry as well as within the city limits of Gainesville. The final recommended park-and-ride locations included: Oaks Mall Regional Shopping Center, Butler Plaza, Williston Shopping Center, Waldo Road and Northwood Village Shopping Center.

CHAPTER 1
INTRODUCTION

Park-and-ride facilities have surfaced as a practical option for reducing traffic congestion on urban roadways and for increasing the use of mass transportation systems (Noel, 1988, pg. 9). The concept of a park-and-ride has been practiced for more than 50 years in the United States. Park-and-ride facilities permit commuters, traveling by private vehicle, to gather at a common site and transfer to higher-occupancy vehicles (Noel, 1988, pg. 2). According to Bullard and Christiansen, by the late 1960s the concept of fringe parking was well institutionalized and more than 36 cities in the United States had an ongoing involvement in some form of park-and-ride activity (Noel, 1988, pg. 2).

In 1968, the federal government became involved in a two-year study of park-and-ride facilities in accordance with the Federal Aid Highway Act of 1968. This involved the federal government paying 50 percent of the cost of right-of-way acquisition and the construction of park-and-ride facilities along the federal-aid highway system. In Woodbridge, New Jersey, a 12-acre site was the first facility funded under this act. This led to the authorization of a permanent provision for funding fringe parking by the Federal-Aid Highway Act of 1970 (Noel, 1988, pg. 3).

Interest among state and local governments in adopting a formal legislative process in regards to the planning, design, and implementation of park-and-ride facilities has risen from these federal provisions. Noel stated, “establishing the authority for the involvement of local government has been the key to the successful development of park-and-ride in many urban areas” (Noel, 1988, pg. 3).

This paper establishes a methodology to be used to determine the optimal location for a park-and-ride lot in Alachua County. The main goal of creating park-and-ride lots in a region is to lower the number of vehicles using the whole transportation system (Gainesville Multimodal and Park and Ride Study, pg. 227).

According to the Jacksonville Transportation Authority Park and Ride Study, some of the main benefits of park-and-ride lots include:

- User Cost Savings –The cost of using a free park-and-ride lot and purchasing a two-way transit trip is less than driving a personal automobile to work.
- Travel Time Savings –Using the park-and-ride lot vs. the personal automobile has higher time savings, mostly dependent on variables like origin, congestion, and availability of parking.
- Peak Period Traffic Reduction –Using the park-and-ride lot results in an increase in use of transit which results in a decrease in peak period traffic.
- Transit Ridership Increase – The transit agency and the user experience savings with an increase in transit ridership.
- Auto Emissions Reduction–The use of transit at park-and-rides results in a reduction of energy consumption and automobile-based emissions.
- Mobility Enhancement– The consumer is has more transit options if the park-and-ride lot is available.
- Transit System Improved Efficiency – Park-and-rides result in a higher ridership rate per mile because their demand increases with more expanded service such as express and BRT routes, which allows for faster and more direct service for people farther out from the urban core.

The following two sections will discuss the context, the City of Gainesville and Alachua County, in which this study will take place.

City of Gainesville

The City of Gainesville is approximately 62 square miles, with a 2008 population of 117,687 persons (U.S. Census Bureau, 2006-2008 American Community Survey). When compared with the 2007 population estimates of 113,942 persons (U.S. Census

Bureau, 2005-2007 American Community Survey) there was a growth of 3.3 percent in population within the City of Gainesville.

In the City of Gainesville Comprehensive Plan there are many objectives and policies that emphasize not only supplying transportation to those who need it but also capturing new markets and becoming competitive with other forms of transportation, which can be achieved with an adequate park-and-ride system. The Transportation Element within the City of Gainesville Comprehensive Plan states that one of its main purposes is to establish a transportation system that “provide(s) vehicular, public transit and non-motorized access to activity centers, community facilities, and neighborhood commercial areas” (Transportation Mobility Element, pg. B-1). This reinforces the fact that the City of Gainesville needs to ensure access to major activity centers, which is important in terms of types of land uses found near park-and-ride lots.

A major transportation entity within the City of Gainesville is the Regional Transit System (RTS). For the past 31 years RTS has provided the public transportation in the City of Gainesville and the adjacent areas of Alachua County. It has services an area of approximately 78 square miles and has an operating fleet more than 88 diesel buses (RTS Transit Development Plan FY2010 - FY2019, pg. 3-1). In the late 1990’s a partnership was formed between RTS and the University of Florida (UF), allowing unlimited access to the students. This has provided a significant positive impact on the ridership within the system as a whole. RTS had approximately 9 million riders during the 2009 fiscal year, with a majority of the routes surpassing more than 100,000 passengers (RTS Fiscal Year 2009 Ridership by Route). The surge in growth of the system over the last 10 years has forced RTS to consider new alternatives in order to satisfy the demands of its riders. In the year 2020 the expected transit service population within a ¼ mile from the fixed routes will be approximately 130,000 users (Transportation Mobility Element, pg. 52). Some of the main challenges that RTS faces are overcrowding on buses, on-time performance, maintenance and operational constraints, equity issues, system network design, and funding (RTS Transit Development Plan FY2007 - FY2011).

In 2002 the Transit Cooperative Research Program (TCRP) did an evaluation of ridership increases and found three key factors that positively influenced ridership at RTS. These include service expansion to meet overall student demand, an unlimited agreement for UF students, and a downtown area land use policy directing developer support for pedestrians and transit (TCRP Research Digest 69, pg. 10).

Two types of transit groups are defined by RTS. The first one is the traditional transportation disadvantaged group which is common for transit systems. This includes young people (< 18 years old), elderly people (>60 years old), disabled people, low-income households (<$10,000 annual incomes) and households with zero cars (RTS Transit Development Plan FY2007 - FY2011, pg. I-9). The City of Gainesville also has a unique transportation market that consists of university students (between 18-25 years old), environmentalist, proponents of livable and sustainable communities, and University of Florida employees (RTS Transit Development Plan FY2007 - FY2011, pg. I-9).

According to the RTS Transit Development Plan FY2010 - FY2019 in 2006, over 61 percent of the workers within the City of Gainesville did not live within the city itself. These workers were commuting from neighboring cities, with Jacksonville and Alachua having the largest portions of this percentage (See Table 1-1) (RTS Transit Development Plan FY2010 - FY2019, pg 2-18).

Table 1-1. Where Workers in the City of Gainesville Live, by City (2006)

City of Residence	2006 Count	2006 Share
Gainesville, FL	34,801	39.4%
Jacksonville, FL	2,619	3.0%
Alachua, FL	1,429	1.6%
Newberry, FL	639	0.7%
High Springs, FL	631	0.7%
Deltona, FL	367	0.4%
Lakeside, FL	312	0.4%
Archer, FL	306	0.3%
Palm Bay, FL	290	0.3%
Casselberry, FL	258	0.3%
All Other Locations*	46,631	52,8%

*All other locations include unincorporated areas
Source: US Census Bureau, LEHD Origin-Destination Database

Alachua County

Alachua County is approximately 969 square miles with a 2008 population of 239,046 persons (U.S. Census Bureau, 2006-2008 American Community Survey). This is a 1.2 percent increase from the 2007 population estimates of 236,308 persons (U.S. Census Bureau, 2005-2007 American Community Survey). A total of nine municipalities are located within the county, these include: Alachua, Archer, Gainesville, Hawthorne, High Springs, Lacrosse, Micanopy, Newberry, and Waldo (See Figure 1-1).

Alachua County has a lower unemployment rate than the state as a whole (RTS Transit Development Plan FY2010 - FY2019, pg. 2-4) (See Table 1-2). The major industries in Alachua County include education and healthcare and the major employment centers include UF and healthcare centers such as Shands, the Veterans Affairs Medical Center, and North Florida Regional Medical Center (RTS Transit Development Plan FY2010 - FY2019, pg. 2-19).

Table 1-2. Labor Force Statistics (2009)

Area	Civilian Labor Force	Number Employed	Number Unemployed	Unemployment Rate
Alachua County	131,599	123,979	7,620	7.4%
Florida	9,181,000	8,373,000	808,000	10.8%

Note: FloridaWorks as of June 2009

The 2006 Census Longitudinal Employer-Household Dynamics (LEHD) worker flow database indicates that 80.7 percent of the workers residing in Alachua County also work in Alachua County, with 62.3 percent working in the City of Gainesville (See Table 1-3) (RTS Transit Development Plan FY2010 - FY2019, pg. 2-13). Approximately 65.5 percent of the workers in Alachua County live outside of the City of Gainesville (See Table 1-4) (RTS Transit Development Plan FY2010 - FY2019, pg. 2-15).

Table 1-3. Where Alachua County Residents Work by City (2006)

City	Count	Share
Gainesville, FL	62,983	62.3%
Jacksonville, FL	3,503	3.5%
Alachua, FL	2,656	2.6%
Ocala, FL	1,370	1.4%
Newberry, FL	991	1.0%
Tallahassee, FL	801	0.8%
Tampa, FL	615	0.6%
High Springs, FL	554	0.5%
Lake City, FL	529	0.5%
Orlando, FL	389	0.4%
All Other Locations*	26,745	26.4%
All Total Jobs	101,136	100%

*All other locations include unincorporated areas
Note: US Census Bureau, LEHD Origin-Destination Database

The main focus of the transportation elements and policies within the Alachua County Comprehensive plan are, through specific site and design standards, to provide for interconnected, mixed-use developments that are designed with the densities and intensities needed to support transit service, reduce per capita greenhouse gas emissions and enable an individual to live, work, play and shop in a community without the need to rely on a motor vehicle for mobility. Alachua County has developed

Transportation Mobility Districts (See Figure 1-2) that provide an alternative to conventional transportation concurrency by encouraging future land use and transportation patterns that emphasize these principles.

Table 1-4. Where workers in Alachua County Live, by City (2006)

City	Count	Share
Gainesville, FL	42,111	34.5
Jacksonville, FL	4,146	3.4%
Alachua, FL	2,206	1.8%
High Springs, FL	1,089	0.9%
Newberry, FL	1,029	0.8%
Lakeside, FL	586	0.5%
Deltona, FL	545	0.4%
Palm Bay, FL	493	0.4%
Archer, FL	453	0.4%
Ocala, FL	435	0.4%
All Other Locations*	26,745	26.4%
All Total Jobs	101,136	100%

*All other locations include unincorporated areas
Note: US Census Bureau, LEHD Origin-Destination Database

The City of Gainesville and Alachua County have the potential to make use of a park-and-ride system as long as it is connected effectively with the transit system. The model described in this project determines the optimal locations for park-and-ride lots in Alachua County in conjunction with the current transportation system.

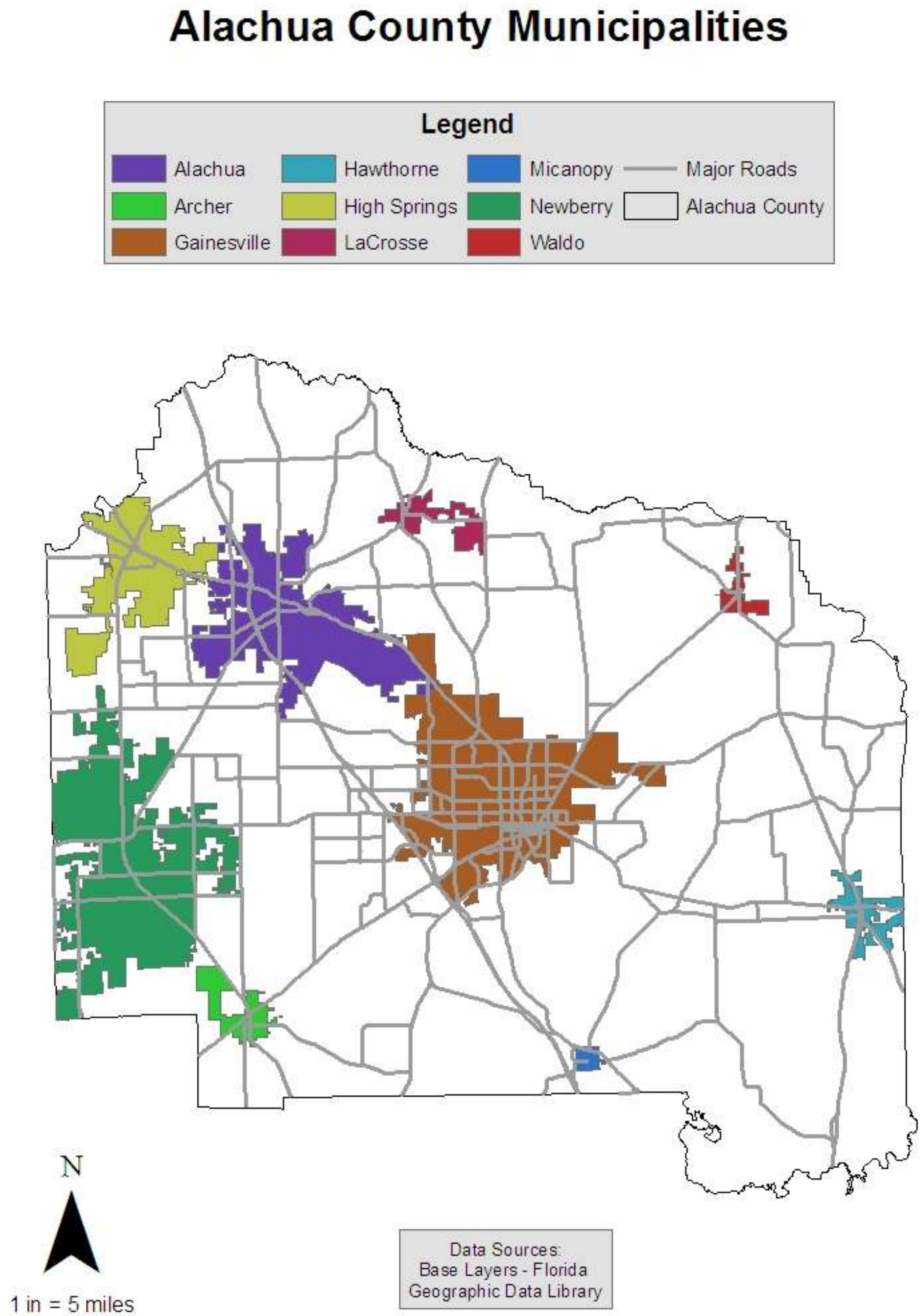

Figure 1-1. Alachua County Municipalities

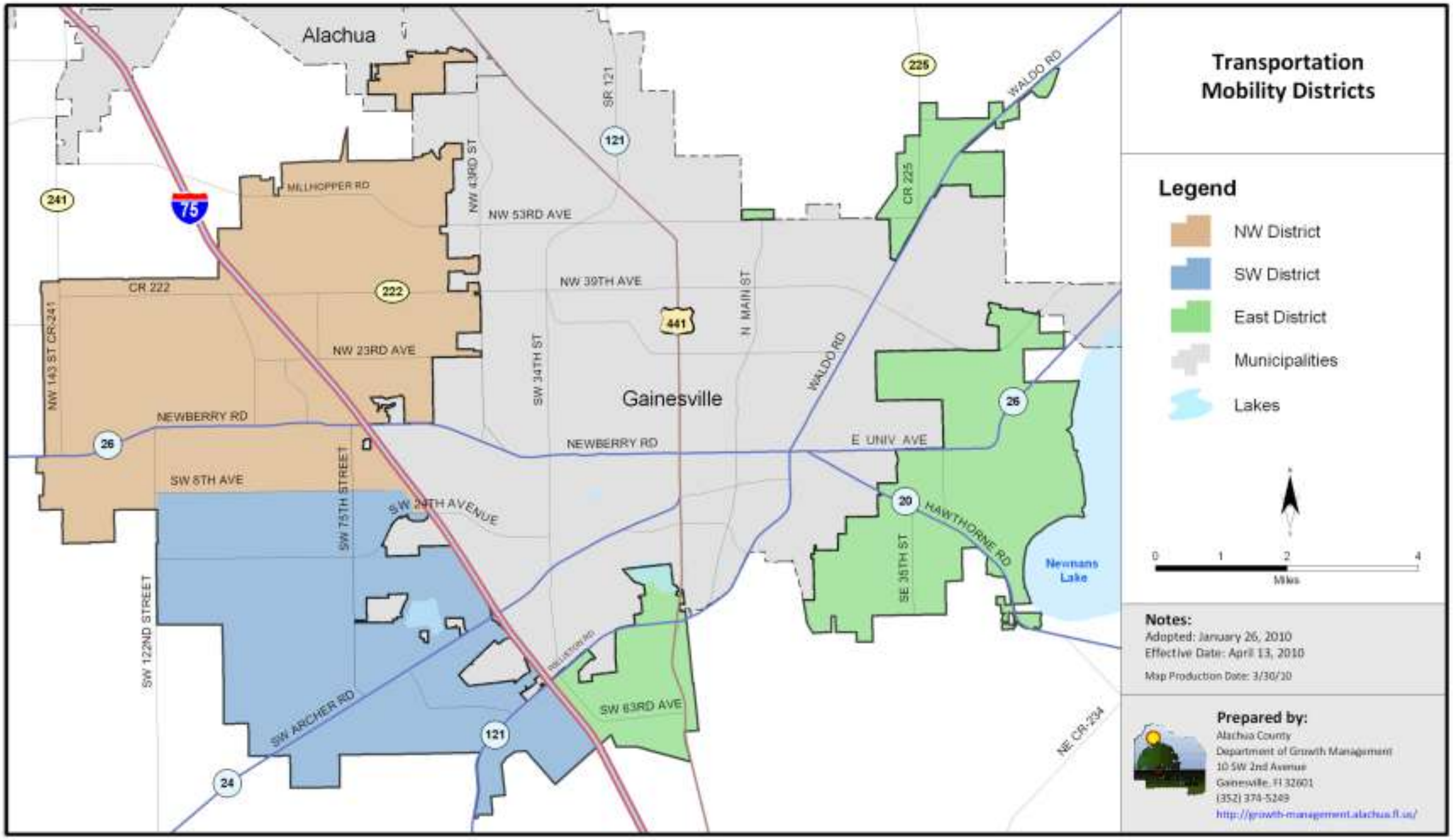

Figure 1-2. Alachua County Transportation Mobility Districts

CHAPTER 2
LITERATURE REVIEW

The following chapter will give a brief description of park-and-ride lots and their market sheds. It will also provide an overview of the three general variables, Roadway Connectivity, Population Density and Land Use, being discussed in this study.

Park-and-Ride Overview

According to the TCRP Report 95, "the majority of park and ride users typically come from within 5 miles and more than 80 percent travel less than 10 miles to their facility" (TCRP Report 95, pg. 3-8). Most surveys indicate that between 40 and 60 percent of users previously commuted by single-occupant vehicle. Studies of several park-and-ride facilities show that there is an average daily turnover rate of about 1.1 cars per parking space, with about 1.2 transit passengers per parked car, which translated to approximately 1.3 transit passengers per occupied parking space within a park-and-ride facility (TCRP Report 95, pg 3-9).

The FDOT Gainesville Multimodal Corridor and Park and Ride Study identifies four types of park-and-ride lots that could be found or expected within the State of Florida, these are as follows (Gainesville Multimodal and Park and Ride Study, pg. 227-228):

- Urban Corridor Lots – These lots are located along a major commuter corridor within an urban area; they are typically served by express bus, urban rail, or commuter rail services. The trip origin patterns tend to be dispersed along or concentrated at one end of the corridor. They are most appropriate on roads with a level of service (LOS) of E or worse (See Appendix A for the level of service definitions), more than 2,000 dwelling units within 2 miles, and more than 10 miles from employment centers.

- Peripheral Lots – Are located at the periphery or fringe of an intensely developed, highly congested activity center. The distances to the lot from activity centers is generally shorter than from other origins. Their standards include congested or restricted access to an activity center circulation, having a major access route to the activity center, and having insufficient parking facilities in the area.

- Urban Fringe Lots – Usually located at the fringe of urban development. The trips are more likely to originate outside of the urban area while destinations may be concentrated or dispersed within the urban area. The areas where fringe lots are found are generally not served by transit, having an arterial of 4 lanes or greater, an employee concentration of more than 10,000, and they need to be within the vicinity of an urban area boundary and less than ¾ of a mile from a commuter route.

- Remote Lots– Located outside of the urban area located near a rural or small town setting. Trip lengths for both home-to-lot and lot-to-work legs of the commute trip are much longer than lots of other types. They typically are 20-60 miles from the employment area, have more than 20,000 urban employees, and are centrally located in the service area and one mile from a commuter route.

TCRP Report 95 identifies three similar lots with slight variations in definitions; these are (TCRP Report 95, pg 3-3 - 3-4):

- Peripheral Lots – These lots are located on the edge of a downtown area or other major activity center. The main purpose of these facilities is to expand the amount of parking available in the central area and intercept automobiles before they enter the congested core. The end result is that users generally make the larger portion of their trip by automobile and then use transit or walk for the last shorter segment.

- Suburban Lots – These lots are located near the home origins of trips with the destinations being typically concentrated in a central employment area. A major draw is the presence of concentrated employment along the transit lines or major corridors serving this lot.

- Remote Lots – These lots are generally situated in rural or small town settings. The trip lengths between the home and the lots tend to be much longer.

The main goal of establishing park-and-ride lots in a region is to lower the number of vehicles using the whole transportation system (Gainesville Multimodal and Park and Ride Study, pg. 227). Some objectives of a park-and-ride lot as defined in the TCRP Report 95 are as follows (TCRP Report 95, pg. 3-2):

- To increase availability of alternatives to driving alone, by providing travelers with the opportunity to readily transfer from low- to high- occupancy travel modes and vice-versa.

- To concentrate transit rider demand to a level enabling transit service that could not otherwise be provided.
- To expand the reach of transit into low-density areas.
- To offer a convenient, safe meeting point and parking location for car poolers and van poolers, to facilitate pool formation, and to support ridesharing in locations where sufficient demand might not otherwise occur for ridesharing to a common destination.
- To reduce vehicle-miles of travel and possibly pollutant emissions.
- To shift parking away from the Central Business District and, to some extent, other dense activity centers.
- To relieve neighborhoods of uncontrolled informal parking caused by park-and-ride/pool activity occurring in the absence, or with insufficient capacity, of formal facilities.

Park-and-Ride Market Shed

Determining the market shed around a park-and-ride lot is important because it allows for the detailed description of the area around the facility and establishes how many users are drawn from the surrounding area to use the park-and-ride lot (TCRP Report 95, pg. 3-30). According to TCRP Report 95, “park and ride users tend to have higher incomes and are inherently choice riders capable of readily electing to forsake transit if the mode is made more difficult to use” (TCRP Report 95, pg. 17-69). In a 2001 study of Florida’s park-and-ride lot users it was found that approximately 50 percent of the users live within three miles of the lot and approximately 90 percent of the users live within 19 miles of the lot (TCRP Report 95, pg 3-31).

When evaluating the market shed for a park and ride lot a variety of factors should be considered. These factors are grouped into three categories: (1) to create a stronger demand for the park-and-ride facility; (2) to develop locations that simplify integration with the existing community; and (3) to minimize the overall cost (Faghri et al, 2002, pg.

20). This study will try to achieve these factors through focusing on three variables in particular: Connectivity, Population Density and Land Use.

Connectivity

Connectivity is an extremely important factor when determining the optimal placement of a park-and-ride lot, because if the time getting to the park-and-ride lot added to the time it takes to change to an alternate mode of transportation is longer than just traveling straight to the final destination, the park-and-ride lot will not be used as much (TCRP Report 95, pg. 3-33). In terms of developing a park-and-ride lot market shed the connectivity of a park-and-ride lot can contribute considerably to creating a stronger demand for the park-and-ride facility and minimizing the costs of a facility. Some of the connectivity variables that have been measured in previous studies include:

- Level of Service (LOS) of Corridors – It was found that corridors with severe traffic congestion, in particular those operating at a LOS E or worse, will have a higher potential for users than those lots found along free-flowing corridors (TCRP Report 95, pg. 3-33).
- Access of Lot – Park-and-ride lots that were difficult to access based on roadway connectivity were found to display reduced demand in comparison to facilities with quick and easy access (TCRP Report 95, pg. 3-34).
- Position Relative to Central Business District (CBD) – Park-and-ride lots should be no closer than 4 to 5 miles, and preferably 10 miles from the CBD or activity center (Faghri et al, 2002, pg. 20). This provision reduces the potential for park-and-ride facilities to add to the traffic problem by being placed in the center of congestion, and creates a manageable transit ride for commuters.
- Travel Characteristics – Sites might be more suitable if they are situated in a position easily accessible by inbound trips (Faghri et al, 2002, pg. 20). This is probably because the first leg becomes the most convenient encouraging more use.
- Transit Service – It is recommended that park-and-ride lots are within a quarter mile of existing or proposed transit lines. This is the typical distance a transit user will generally walk to use transit service. The optimal headway for any transit

service near a park-and-ride lot is 15 minutes (Faghri et al, 2002, pg. 21). According to TCRP Report 95, “park and ride lots with higher transit frequencies and more hours of service perform better than facilities with lower transit facilities and fewer hours of service” (TCRP Report 95, pg. 3-35).

- Multimodal Connections – By providing bicycle, pedestrian, and handicap access to a park-and-ride lot the site becomes accessible to a more diverse group of potential customers (Faghri et al, 2002, pg. 22).

In TCRP Report 95 “Land Use and Site Design” three non-density land use variables, accessibility, land use balance and land use integration were studied. It was found that accessibility, which measures the ease of access to activity sites at a traffic analysis zone local/regional scale, proved to be the most influential non-density land use variable with positive correlation with respect to the walk/bike mode choice and negative correlation in regards to the personal vehicle choice (TCRP Report 95, pg. 15-50). If we apply this principal to park-and-ride lots with increased ease of use we could find more people using these lots along with transit as their main mode choice.

According to Tresidder, a more connected road system provides a greater number of route options and decreases out-of-direction travel by providing more direct routes (Tresidder, 2005, pg.3). In order to measure connectivity, he suggests several different methods (Tresidder, 2005, pg. 6):

- Intersection Density (number of real nodes per unit area/area) = Number of intersections per unit of area; a higher number would indicate more intersections.
- Street Density (total street length per unit of area/area) = Number of linear miles of street per square mile of land.
- Connected Node Ratio (number of real nodes/number of total nodes) = Number of street intersections divided by the number of intersections plus cul-de-sacs.

Population Density

The measure of population density that is found to have the strongest relationship with mode choice in correlation and regression analyses is average gross population density at trip origins and destinations (Frank and Pivo, 1994, pg. 8). By increasing the density at the site surrounding the park-and-ride lot, the possibility for a larger market shed area population is amplified by developing a location that integrates with the existing community. However negative effects come with increased density, including less quick and convenient access to the park-and-ride site (TCRP Report 95, pg. 3-34).

In order to maximize service area population park-and-ride lots should be placed as close as possible to potential users. Fradd and Duff (1989) found that "50% of the demand for park-and-ride comes from population densities that are within a 5 mile radius…an extra 35% of the users are located within a parabola that extends 10 miles upstream from the lot with a long chord measuring 10–12 miles". Another study performed by Burns in 1979 found that approximately 90 percent of all park-and-ride users drive less than 16 miles to their park-and-ride lot (Faghri et al, 2002, pg. 21).

Land Use

Land use is important to the market shed because it creates a stronger demand for the park-and-ride lot and can minimize costs associated with the facility. Cervero quotes a report put out by Barton-Aschman Associates in 1983 that said "mixed-use projects create opportunities for shared-parking arrangements. The same parking used by office workers from 8 a.m. to 5 p.m. on Mondays ~ Fridays can serve restaurant and theatre-goers during the evening and on weekends" (Cervero, 1996, pg. 362). This is important to park-and-ride lots because it maximizes the efficiency of the lot and justifies its construction. He found that a 3 percent increase in transit and ride-sharing commutes could be found with a 10 percent increase in floor space devoted to retail commercial, and that buildings with mixed uses also averaged 3 percent more commutes by transit than buildings containing exclusively offices (Cervero, 1996, pg.

362). If a park-and-ride lot is placed along a corridor that provided access to such densities its use might be increased as well. It was also found that park-and-ride lot usage could be encouraged by locating them in areas with other businesses that supply the preferred services of the patrons (TCRP Report 95, pg. 3-34).

Major trip generators and attractors contain the vast majority of jobs, shopping, government offices and other essential services needed by city residents (Transportation Mobility Element, pg. 54). In a recent TCRP Report, it was found that concentrated, adjacent development and balanced land use provided opportunity for households to meet daily needs with shorter automobile trips or by walking, bicycling, or taking transit (TCRP Report 95, pg 15-3). Greater land use mixes concentrated in an area are found to affect both work trips and daily needs trip and could be used to promote the use of a park-and-ride lot.

According to Andy Johnson transit access is affected by close vertical mixed-use and retail plays an important role up to a quarter mile from transit service (Johnson, 2003, pg. 21). The results of his research suggests there are three ways in which to increase transit ridership, first he suggests in areas close to the transit corridors to increase residential density, second he says to concentrate (within an eighth mile of transit corridors) a mix-use development, and finally retail development should be at least within a quarter mile of transit lines (Johnson, 2003, pg. 35). In a TCRP study it was suggested that “clustering and intensification of residential and commercial development along transit lines and around transit facilities increases the number of opportunities that can conveniently be reached by transit, which in turn leads to higher levels of ridership, correspondingly increased service productivity and cost effectiveness, and potential for even higher transit service levels" (TCRP Report 95, pg 15- 3). It was also found that "insufficient park and ride parking at a TOD, without compensatory park and ride spaces elsewhere, can reduce transit ridership by limiting the auto access component" (TCRP Report 95, pg 17-66). According to the paper "Integrated Knowledge-Based Geographic Information System for Determining Optimal Location of Park-and-Ride Facilities" written by Ardeshir Faghri and his fellow authors, some site factors that should be considered when deciding the location include (Faghri et al, 2002, pg. 21-22):

- Relocation of existing structures: It is recommended to avoid existing shopping centers, residential neighborhoods, or other buildings when choosing a park-and-ride site.
- Location in areas with compatible land uses: Facilities in areas with similar uses, such as suburban business centers or industrial districts, or areas with the possibility of joint usage are optimal. (Riley and Maciasaac 1978) because construction costs can exceed $3,000 per parking space (Niblett and Palmer 1993).
- Site expansion potential: Expansion is much less expensive than building new lots, and reduces negative nearby lot competition and sites should be flexible enough to adapt to future park-and-ride and transit concepts (Riley and Maciasaac 1978).

Summary

Determining the market shed around a park-and-ride facility is important because it allows for the detailed description of the area around the facility and establishes how many users are drawn from the surrounding area to use the lot (TCRP Report 95, pg. 3-30). TCRP Report 95 states that "park and ride users tend to have higher incomes and are inherently choice riders capable of readily electing to forsake transit if the mode is made more difficult to use" (TCRP Report 95, pg. 17-69). In a 2001 study of Florida's park-and-ride lot users found that within three miles of the lot approximately 50 percent of the users lived and within 19 miles of the lot approximately 90 percent of the users can be found (TCRP Report 95, pg 3-31). As said by TCRP Report 95 the best locations for park-and-ride lots are areas no closer than 5 miles and preferably 10 miles or more from the activity center being served (TCRP Report 95, pg, 3-33).

Park-and-ride lots are largely used for commuting trips. As found in one study of 100 park-and-ride lots, the share of users at a specific lot making work, or work-related trips, was found to range from 83 to 100 percent (TCRP Report 95, pg. 3-46). In order to encourage more potential users at a park-and-ride facility the non-work trip needs to be attracted. There are several reasons that non-work trips aren't a greater influence on lot usage "first of all, park and ride is a travel mode most attractive for long trips destined to central areas, and non-work travel typically involves trips that are shorter and more dispersed. Many non-work trips occur outside peak travel periods, while many park and ride facilities are provided with transit service primarily designed to facilitate peak travel. Transit service tends to be less frequent during the midday, especially in the case of conventional express bus systems. Moreover, many park and ride facilities are full after the morning peak" (TCRP Report 95, pg. 3-48). If these issues are addressed in the siting of park-and-ride facilities the amount of potential users could be increased. Therefore throughout the following study variables attracting work trips and non-work trips will be taken into account.

CHAPTER 3
METHODOLOGY

The main focus of this project is to produce a suitability analysis of parcels deemed appropriate for use as a park-and-ride lot. A suitability analysis is “typically understood to be a measure of the relative usefulness of a land unit for some given purpose” (Carr and Zwick, 2007). The final product will be an opportunity model that will identify the areas that provide an appropriate prospect for the three different types of park-and-ride lots as defined by the Florida Department of Transportation (FDOT): Urban Corridors, Peripheral, and Remote (As defined in Chapter 2). This opportunity model consists of three elements: connectivity, population, and land use. These are essential to the model because they are crucial components in a working transportation system.

For the subsequent spatial analyses, ArcGIS 9.3.1 is used with the following default parameters:

- A raster cell size of 30m by 30m.
- A raster mask of Alachua County.
- A raster extent of Alachua County.
- A geometric interval classification is used for all suitability reclassifications.
- A reclassification from 1 to 9 is assumed, with 9 being the most suitable.

Element I: Connectivity

The first element of the opportunity model deals with the connectivity of the park-and-ride site. This is important because limited connectivity hinders the access of users to park-and-ride facilities and makes it more difficult and less cost effective to provide public transportation to the site. The main focus of the connectivity element is to identify sites that will be suitable for urban corridor lots. These lots are generally located along a major commuter corridor within an urban area. The trip origin patterns tend to be dispersed along or concentrated at one end of the corridor, and the typical standards include a level of service of E or worse along the roadways it is adjacent to.

The connectivity element consists of two categories: road network and public transit (See Figure 3-1). The data used to construct this surface is listed in Table 3-1.

Table 3-1. Data Layers Used in the Connectivity Element

Data Layer	Data Source
Bus Stops	City of Gainesville Regional Transit System (2009)
Multimodal and Park and Ride Corridors	FDOT - Gainesville Multimodal Corridor and Park and Ride Study
Routes	City of Gainesville Regional Transit System (2009)
Streets	Dynamap Data

The road network category will evaluate the distance from the defined Gainesville multimodal and park-and-ride corridors, the density of these defined corridors, the density of local roads and the distance to intersections within Alachua County. The Gainesville Multimodal Corridor and Park and Ride study identifies seven major corridors that connect the outlying centers of Alachua County with the City of Gainesville (See Figure 3-2). They accommodate both local and long distance trips, and five of the seven corridors were identified as not being able to accommodate future (2020) traffic conditions (Gainesville Multimodal Corridor and Park and Ride Study, pg. 3). The distance to these corridors are determined by performing a straight line distance spatial analysis, which is a straight-line distance measure from each raster cell center to cell center from the corridors. The density of the seven corridors will be determined by creating an attribute field that multiplies the number of lanes of the roadway to the linear distance in miles of the road, next a density spatial analysis will be performed on the layer. This calculates a magnitude per unit area from a feature using a kernel function to fit a smoothly tapered surface to each feature based on a population. In this case the corridors will be the feature and the new field will be the population. The density of the local roads will be determined by performing a density spatial analysis on the Alachua County roads layer using the length in miles as the population- as a note I-75 will be removed from this layer. Finally, the connectivity of intersections will be determined by performing a distance spatial analysis on all the intersections within Alachua County. To identify intersections network analyst will be used to derive intersection nodes from the road network. Then these nodes will be intersected back with the road network and the count of roads connected to the intersection can be obtained. Any intersection with a count of three or more roads connected to it will be used in the distance spatial analysis.

For the public transit category the distance to existing and proposed bus routes, and the density of frequency of a route at a bus stop will be used to measure connectivity. The routes and bus stop inventory used to perform the analysis was obtained from RTS and consists of their GIS data as of December 2009 (See Figure 3-3 and Figure 3-4). The existing routes used to perform the following analysis are made up of the city and campus RTS routes and the proposed routes consist of planned routes and express routes listed in RTS' adopted Transit Development Plan. A buffer of a quarter mile, which represents the area users are likely to walk from, and three quarter miles, which is the American Disabilities service area, is placed around the current route system. Anything within the quarter mile buffer is classified as a 9 which symbolizes very suitable. Anything between the quarter mile and three quarter miles buffer is classified as a 5 which symbolizes semi-suitable and everything else is classified as a 1, or unsuitable. This is repeated for the proposed bus routes analysis. To determine the density of the bus route frequency in an area, the number of trips at each bus stop is calculated. A trip can be defined as each one-way, inbound or outbound, trip a route completes. These bus stop points are then used to run a density spatial analysis with the frequency as the population.

Element II: Population

The second element focuses on the population of the study area. This is important because a park-and-ride needs to be placed close to a population that will support its use. The main focus of the population element is to identify remote lots. These lots are generally located outside of the urban area located in a rural area or small town. For this reason the City of Gainesville is also removed from the raster mask, which defines the study area, to exclude the areas within the city as suitable.

This element consists of three different categories. The first is the total population of the county, the second is the populations of the individual municipalities within the county, and the third is the employment population (See Figure 3-5). The data used to construct this surface is listed in Table 3-2.

Table 3-2. Data Layers Used in the Population Element

Data Layer	Data Source
Vehicle Ownership	United States Census Bureau (2000)
Traffic Analysis Zones	Metropolitan Transportation Planning Organization (2008)
City Limits	Florida Geographic Data Library
Employment Data	InfoUSA Data (2007)

The total population evaluates the population density of the county, the density of dwelling units per acre, and the density of car owners throughout the county. The population density of the county is determined by using Traffic Analysis Zones (TAZ) to establish the total population per acre (See Figure 3-6). This is done by removing water sources from the TAZs, than recalculating the areas and dividing the total population by the acreage. Then this layer is converted into raster form and reclassified to reflect higher densities with a higher suitability. This is repeated for the total number of dwelling units within a TAZ.

The number of car owners can be found in census blocks. To determine the density, the number of vehicles within a census block group are found and this is divided by the acreage of that particular census block group, giving the density of vehicles per acre. This is converted into a raster and reclassified to create a suitability surface.

The city population calculates the distance from city boundaries and the density of the municipality populations. The distance from city boundaries is determined by performing a distance spatial analysis on the boundaries of all the municipalities defined by Alachua County. The density of city populations is determined by placing a centroid within the municipal boundaries. Then this point is assigned the population value found through the US census (See Table 3-3) and an inverse distance weighted spatial analysis is performed on these points. This particular analysis determines cell values using a linearly weighted combination of a set of sample points, the city centroids, to interpolate a surface, and the weight in this case is population.

Table 3-3. Population Estimates for Cities within Alachua County

City	Population	Employees
Archer	1,229	408
Alachua	7,854	4,986
Gainesville	122,671	88807
Hawthorne	1,401	378
High Springs	4,739	1,619
LaCrosse	195	50
Micanopy	637	320
Newberry	4,787	1,671
Waldo	831	25

The employee population focuses on the concentration of employees throughout the county. It determines the density of total employees (which includes industrial and other non-transit supportive jobs), commercial employees and service employees. In order to determine this, InfoUSA 2007 data (See Figure 3-7) is used to determine specific points of employment. Then a density spatial analysis is run using separately the total, commercial, and service employees as the population field.

Element III: Land Use Element

The third element assesses an area's land use. This is important because the land use and land mix around a park-and-ride can encourage or discourage the use of a park-and-ride facility, as discussed in Chapter 2. The main focus of this element is to identify where it is appropriate to place peripheral lots. Peripheral lots are generally located at the periphery or fringe of activity center. The distances to the lot from the activity centers are generally shorter than from other origins. To begin the analysis a buffer is placed around Downtown Gainesville and UF of three quarters of a mile to exclude these activity centers from the analysis, this buffer was chosen because it excludes any areas taken into account for transit activity. This was done because Downtown Gainesville is a central business district and the University of Florida has its own parking policies in place.

The land use element focuses on three different categories: points of interest, mixed use areas, and employment locations (See Figure 3-8). The data used to construct this surface is listed in Table 3-4.

Table 3-4. Data Layers Used in the Land Use Element

Data Layer	Data Source
Major Trip Generators	Alachua County Comprehensive Plan
Parcel Data	Florida Department of Revenue (2009)

The major trip generator category is calculated by generating the distance to major trip generators as defined by Alachua County, the City of Gainesville and RTS (See Appendix B for a list of all generators), and distance to I-75 interchanges (See Figure 3-9). For the major trip generators a buffer of a quarter mile and three quarter miles is placed around each generator, which is consistent with the walking and ADA boundaries used in transit. Anything within a quarter mile is classified as very suitable, anything between the quarter mile and three quarter mile buffer is semi suitable and everything else is labeled as unsuitable. For the I-75 interchanges, a distance spatial analysis is run, determining the straight line distance from every interchange; the closer the cell is to the interchange the higher the suitability.

The mixed use category focuses on constructing a surface that identifies the highest diversity of land uses within an area. The entropy of land use calculates the percentage of a particular type of land use within a quarter mile of a parcel and takes into account its total acreage, even if it is outside the quarter mile. This is done by placing a centroid on each parcel and performing the Point to Feature function on every point, which determines the parcel number of every centroid within a quarter mile. Then this is related back to the acreage and it is possible to draw percentages of each type of land use (residential, commercial, retail, governmental and institutional) within a quarter mile of each parcel. This percentage is then used in the following entropy equation: $-(p_{residential}*\log(p_{residential}) + p_{commercial}*\log(p_{commercial}) + p_{retail}*\log(p_{retail}) + p_{institutional}*\log(p_{institutional}) + p_{government}*\log(p_{government}))$. After each parcel is assigned an entropy value, the output is converted into a raster and reclassified into a suitability surface. Next, the variety of land use within a quarter mile of each parcel is found. This is done by first placing a centroid on each parcel and then performing a neighborhood statistic on the point file looking at the variety found within a quarter mile from each parcel centroid. This identifies the amount of different types of land uses found in that area. This is converted into a raster to add weight to the parcels with the highest land use mix around them.

The final criterion, employment opportunities, evaluates the density and distance to retail and commercial parcels in Alachua County. The employment location describes where people are traveling to work. This suitability consists of a distance spatial analysis run to the commercial parcels and the retail parcels that are extracted from the Florida Department of Revenue parcels using the DOR codes to identify both the retail and commercial parcels (Figure 3-10). For retail parcels DOR codes 13, 14, 15, 16, 20, 21, 22, 23, 25, 26, 27, 30, 31, 32, 33, 34, 35, 36, 37, 38, and 39 are used. For commercial parcels DOR codes 11, 12, 17, 18, 19, 24, and 29 are used (See Appendix C for the list of DOR land use codes). Within the DOR data the square footage is extracted for each building type, which is then used to perform a density spatial analysis on both retail and commercial parcels.

Opportunity Model

The final step is to combine all of the suitability elements into an opportunity model. This is done by taking all the reclassifications previously made and combining them evenly weighted, first within their categories and then evenly weighted within their elements. Then each of these elements is reclassified from a scale of 1 to 3, with 3 being the most suitable. These three element's suitabilities are then combined using the equation: [connectivity] + 10*[land use] + 100*[population]. This produces an opportunity surface that can be used to determine the appropriate locations for urban corridor, peripheral, and remote lots. The results of this opportunity model will be discussed in the following sections.

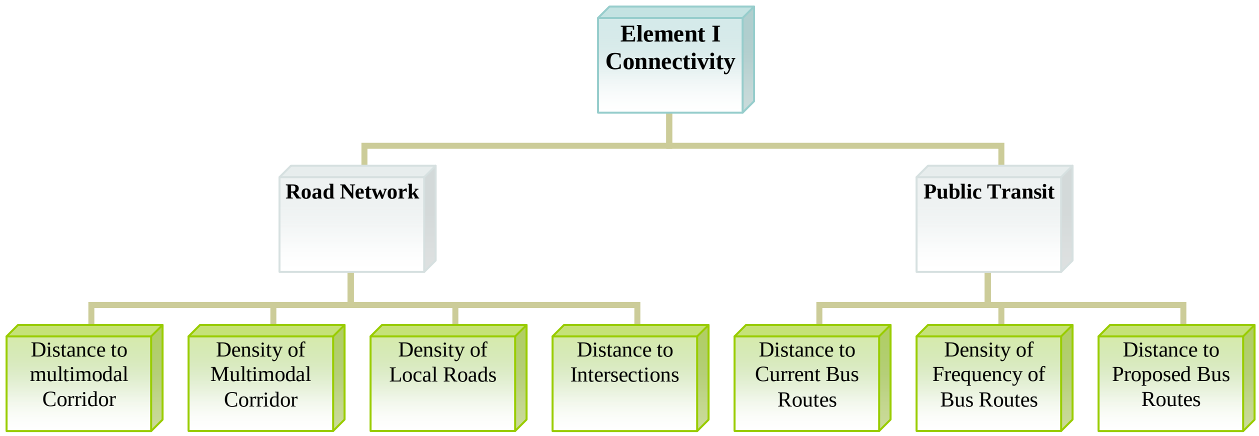

Figure 3-1. Element I - Connectivity

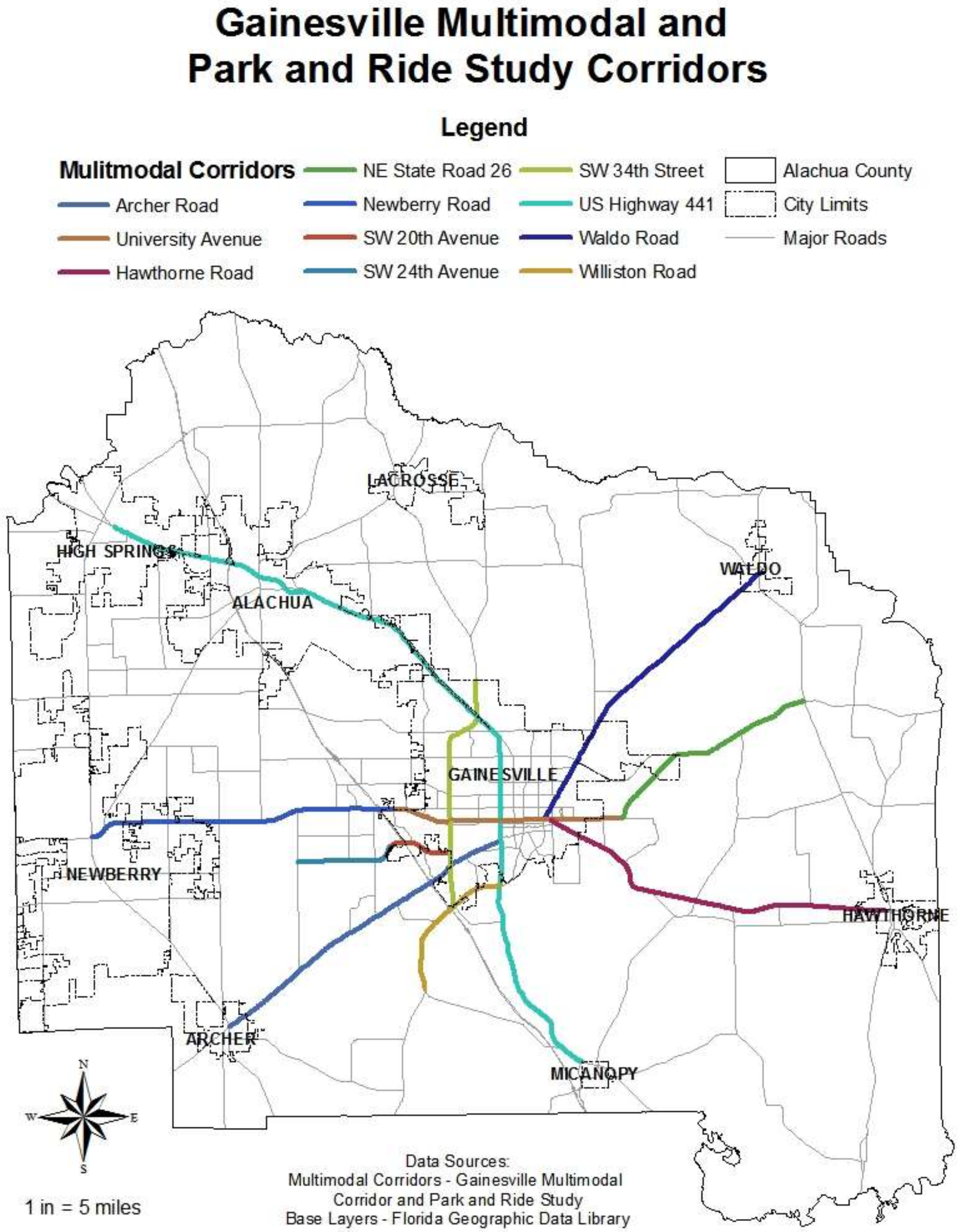

Figure 3-2. Gainesville Multimodal and Park and Ride Study Corridors

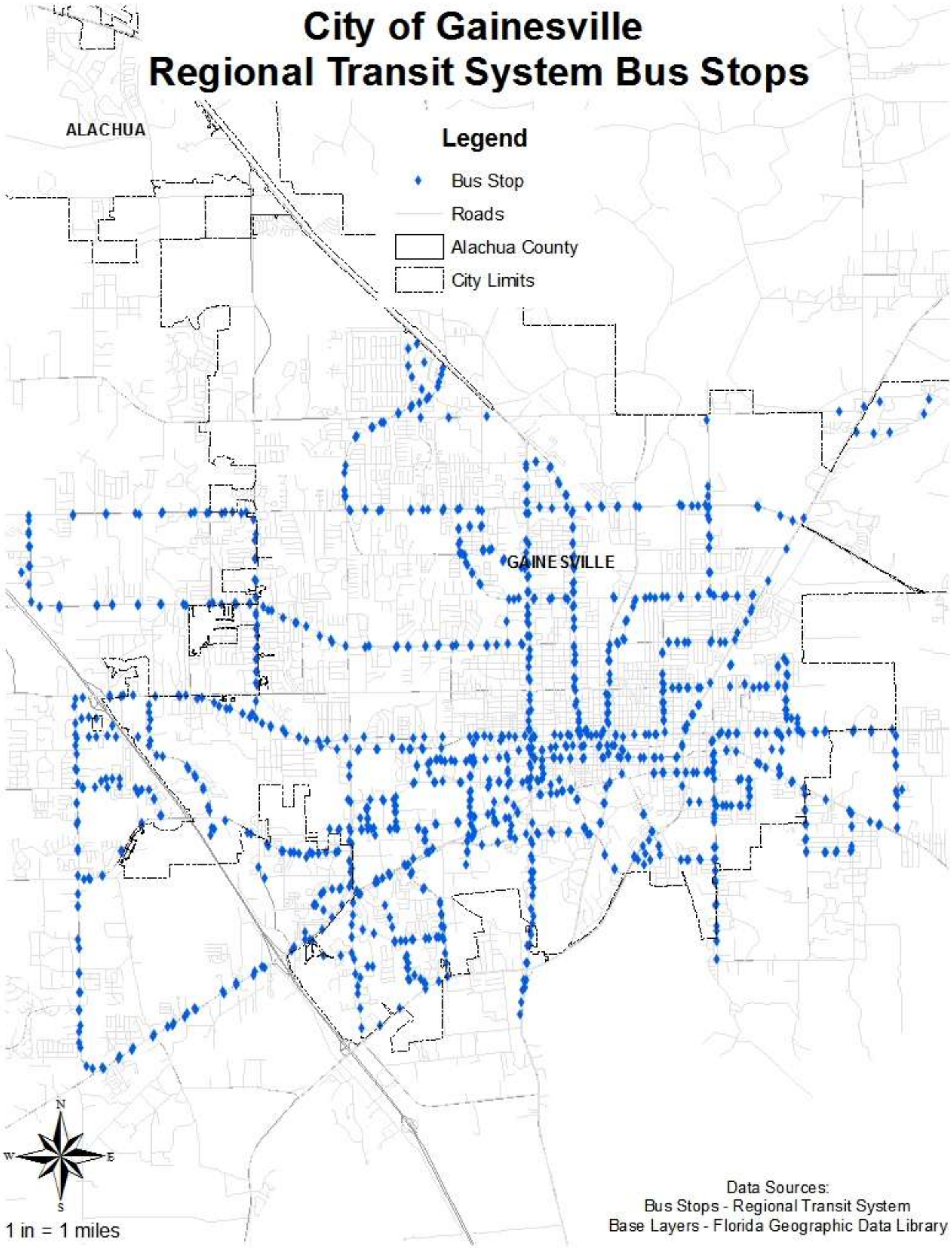

Figure 3-3. City of Gainesville Regional Transit System Bus Stops

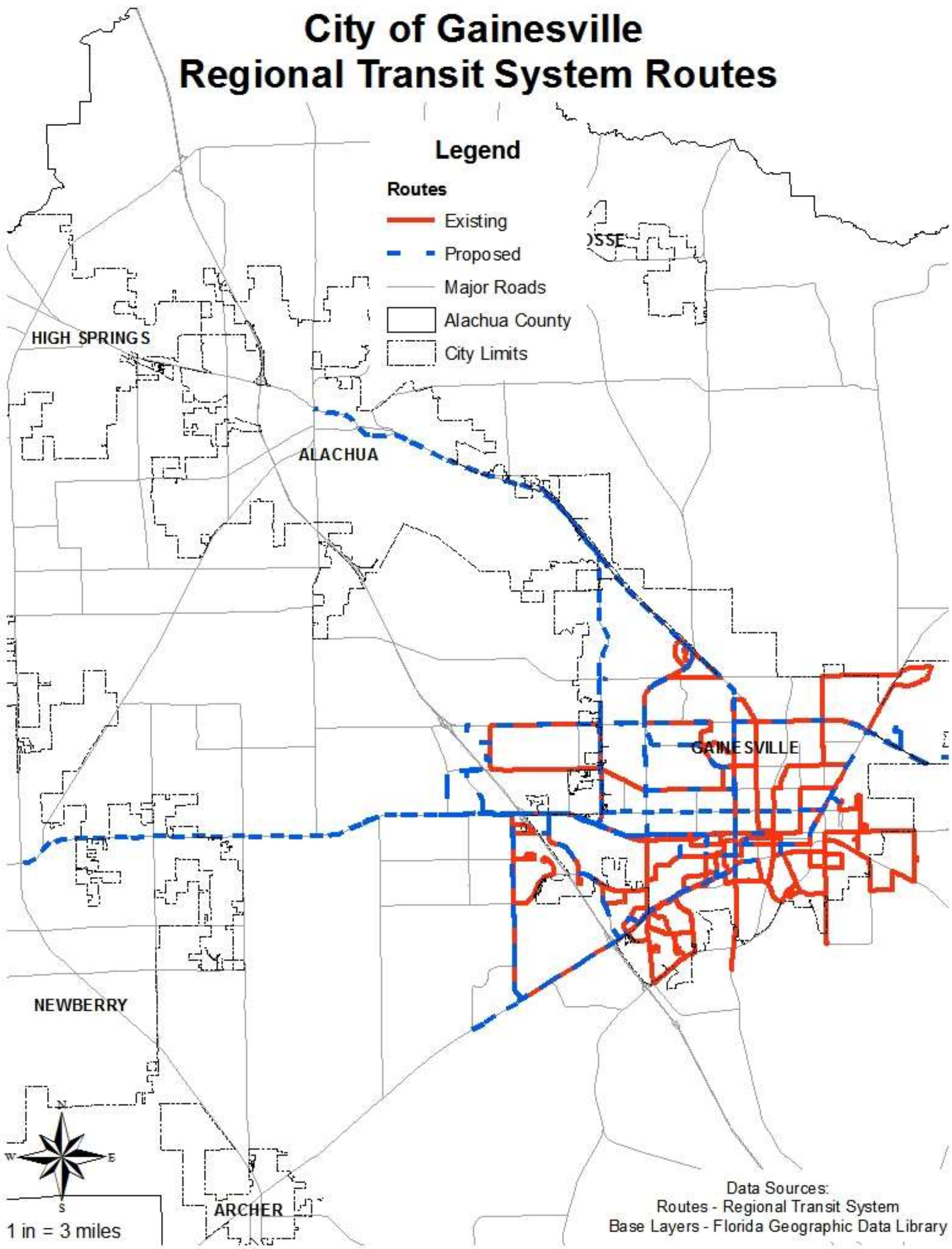

Figure 3-4. City of Gainesville Regional Transit System Routes

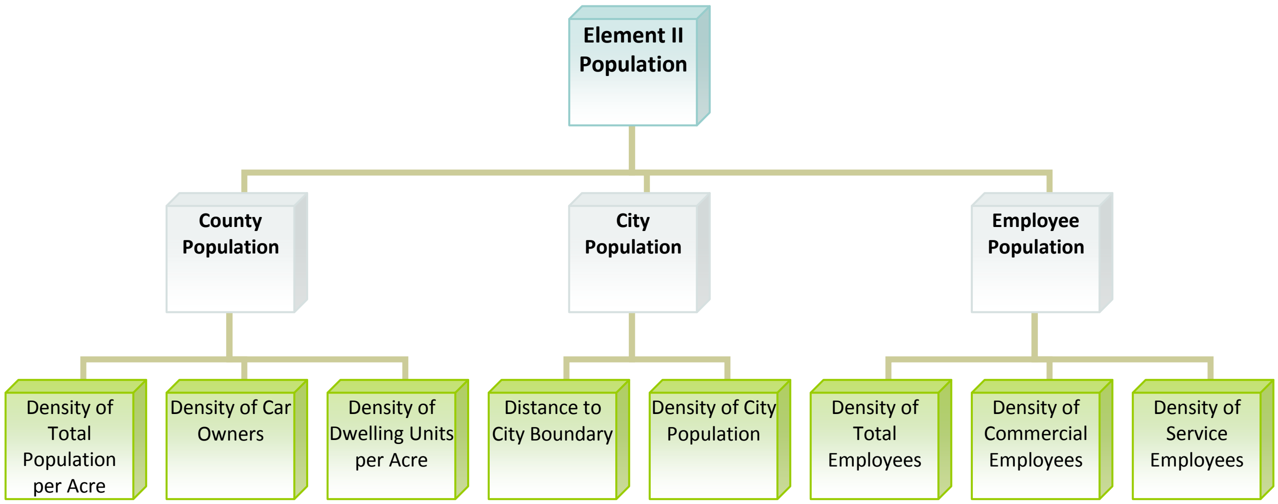

Figure 3-5. Element II - Population

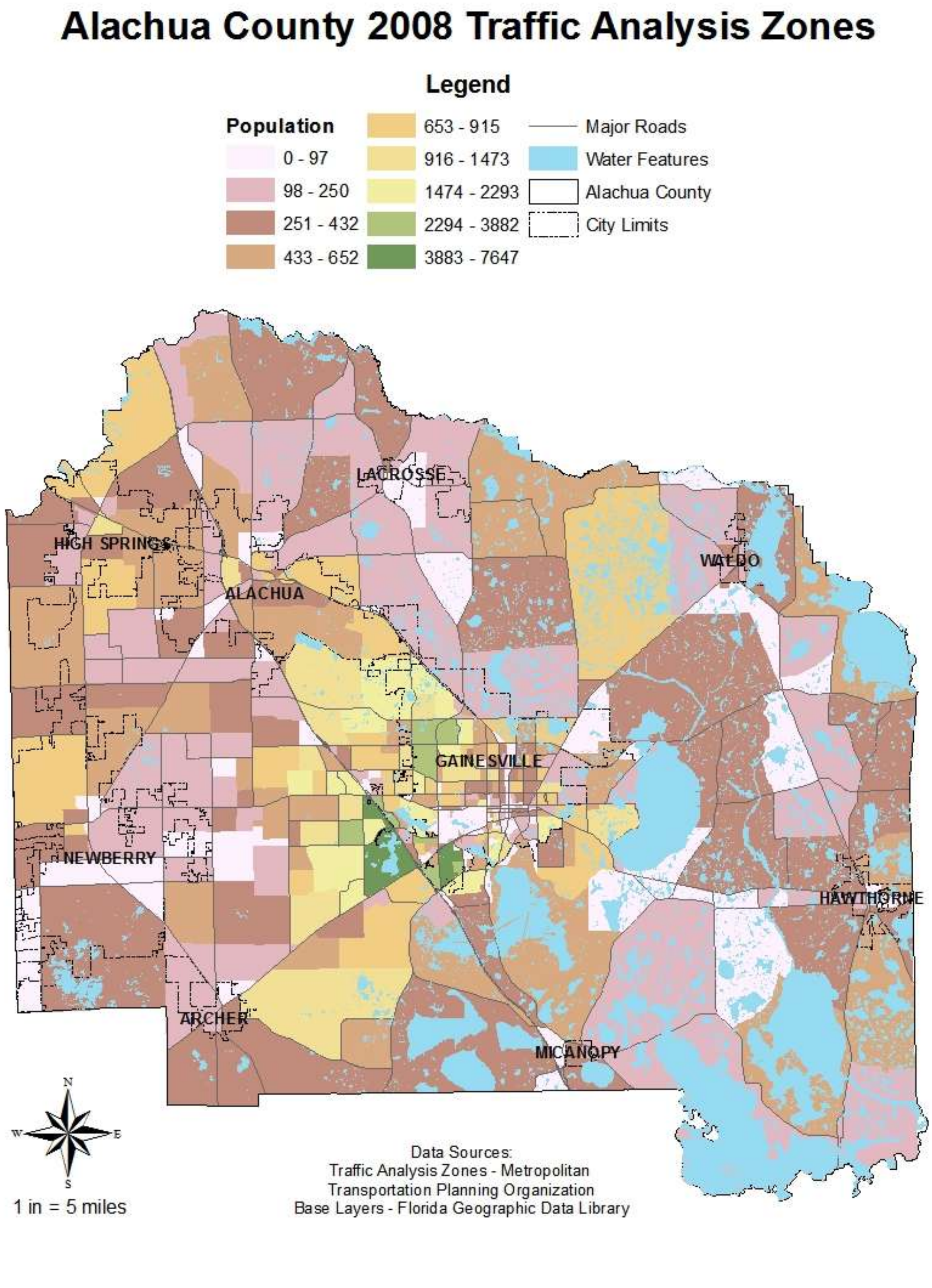

Figure 3-6. Alachua County 2008 Traffic Analysis Zones

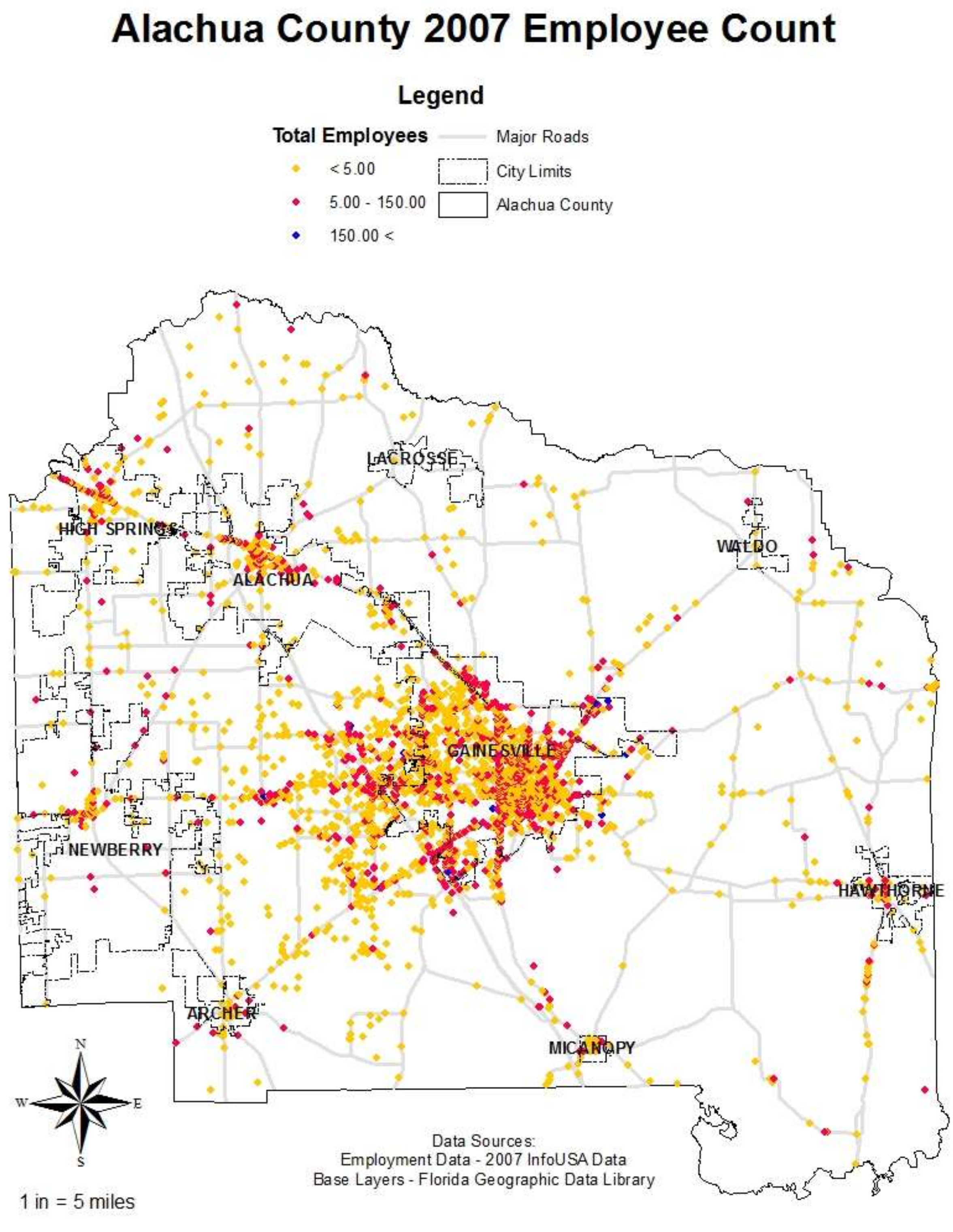

Figure 3-7. Alachua County 2007 Employee Count

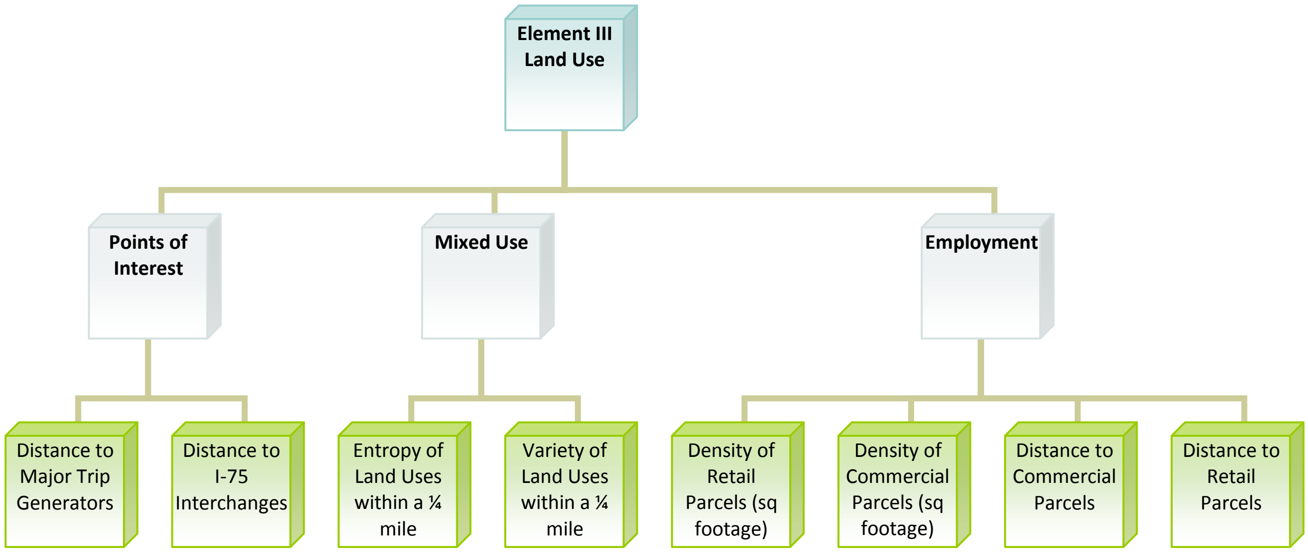

Figure 3-8. Element III – Land Use

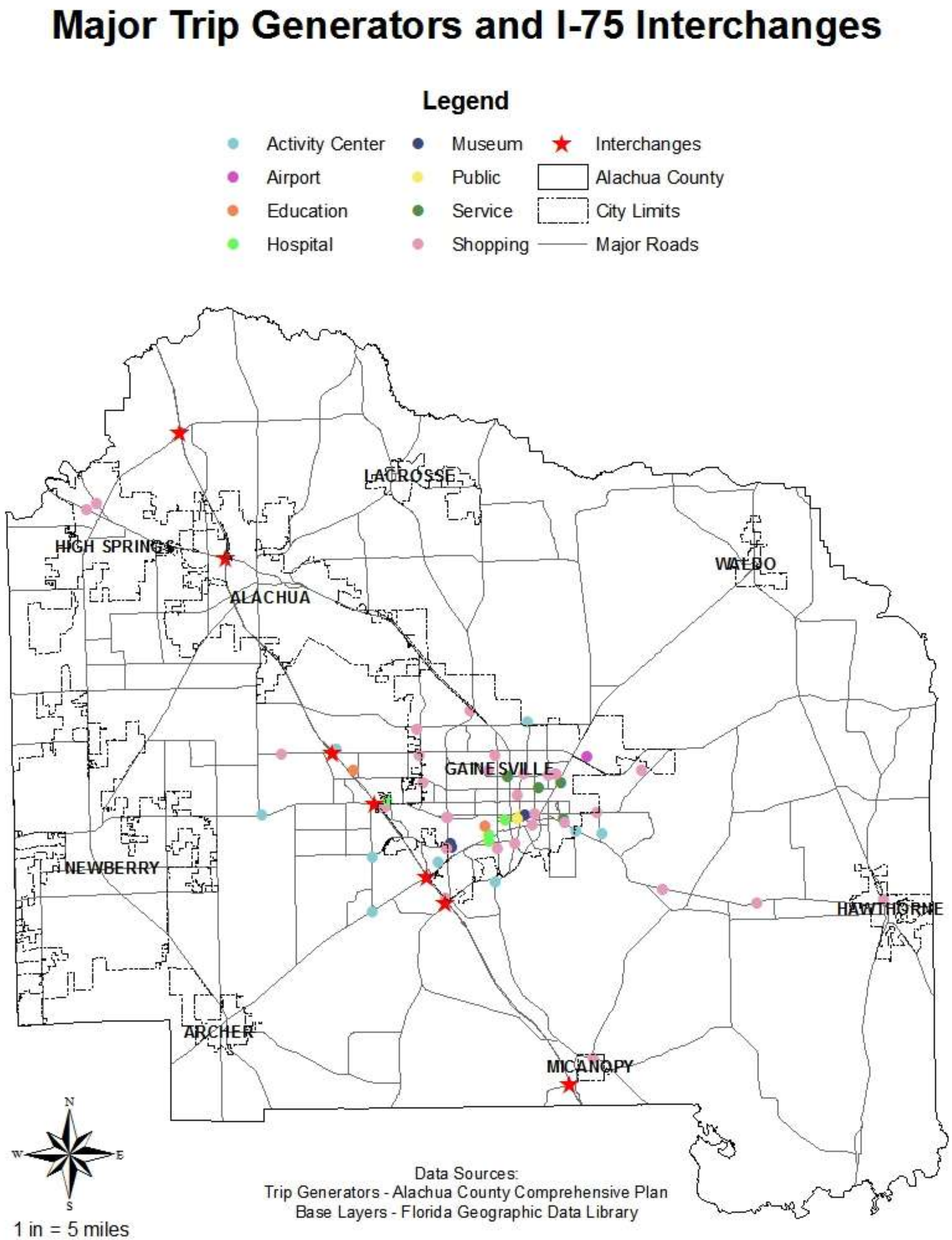

Figure 3-9. Major Trip Generators and I-75 Interchanges

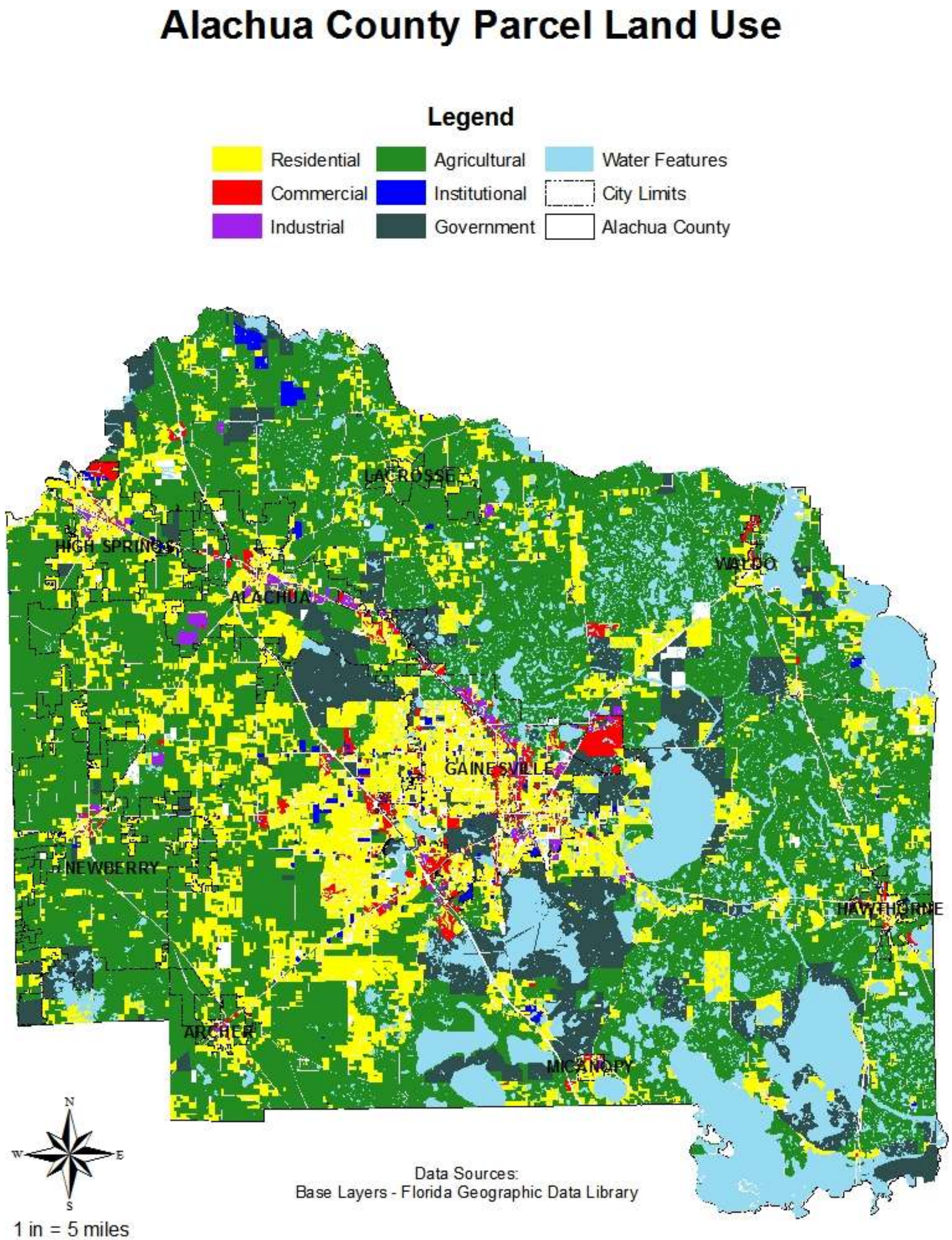

Figure 3-10. Alachua County Parcel Land Use

CHAPTER 4
RESULTS

This paper focuses on identifying areas within Alachua County that are appropriate for park-and-ride lots. The following section illustrates the results found through various suitability analysis performed on Alachua County. In total, there were 16 individual variables examined within eight different categories and three different elements (See Figure 4-1).

Element I: Connectivity

The connectivity element identifies areas that provide easy access to a park-and-ride site for users and public transportation. This element was composed of two categories and seven components, within each category the components were combined to construct a category surface and then all of the categories were combined to construct an element surface, reference Figure 4-2 for the equal weights used within each category.

In Figure 4-3, the suitability's that make up the road network category are shown. The first two maps show the density and distance to the multimodal and park-and-ride corridor. The main purpose of these corridor analyses was to designate areas closer to the corridors with more lanes and longer lengths, which contributes to finer connectivity and larger capacity, as a higher suitability. As we examine the density map we see that SW 13th/US 441 looks to have the highest suitability in regards to these requirements. The street density suitability shows there is a high concentration of suitable areas along I-75 and within the City of Gainesville and in the western part of the county, this is probably a result of the longer length of I-75 as well as the higher concentration of road networks in these regions which could be a result of the fact this is where we find the larger municipalities. As for intersection densities the City of Gainesville dominates the map as suitable, though we can see patches of higher suitability's along some of the wider/longer corridors throughout the whole county. The road network category combined suitability showed higher suitability's along the multimodal and park-and-ride corridors as well as concentrated within the City of Gainesville (See Figure 4-4), with outliers of semi-suitable areas at some of the other major intersections or on other major arterials.

The public transit suitability model components can be found in Figure 4-5. They show that the current concentration of public transit activity is in or very close to the City of Gainesville. The future bus route system expands public transportation to areas such as Newberry and Alachua, providing more service area and higher suitability's in these regions. This resulted in the public transit category combined suitability showing higher suitabilities within the City of Gainesville and semi-suitable areas in Newberry and Alachua, where express bus routes are proposed to run too (See Figure 4-6).
The final connectivity suitability model showed high suitability's within the City of Gainesville and along major arterials (See Figure 4-7). When this final suitability was converted into an opportunity raster what is found is that Urban Corridor Lots are more appropriate within the City of Gainesville and along the major arterials of Newberry Road/University Avenue, 13^{th} Street/US 441, Archer Road, and Waldo Road (See Figure 4-8).

Element II: Population

The population element's purpose was to identify areas outside of the City of Gainesville that have the appropriate population to support park-and-ride facilities. This element consists of three categories and eight components, reference Figure 4-9 for the equal weights used to combine them.

When examining the county population category components the population and dwelling unit densities show that the population within Alachua County is concentrated in the western part of the county, with spurts of higher densities within all the municipalities throughout the region (See Figure 4-10). For the vehicle ownership there is a similar pattern to the west with the exception of fewer municipalities to the east showing higher suitabilities. When combined the county population suitability has higher suitabilities within Alachua, Newberry, just outside of the City of Gainesville Boundaries, and out to the east we are seeing medium to high suitabilities in Hawthorne, basically within a majority of the urban clusters (See Figure 4-11).

The city population category suitability model components can be found in Figure 4-12. The city density suitability showed a pull towards higher populations in the western part of the county. This is where we find some of the larger municipalities, Newberry and Alachua.

The city distance suitability also had a greater pull towards the west because there is a high clustering of cities in that area, Alachua, High Springs, Newberry and Archer, most of which have a substantial sized municipality boundary. Excluding the City of Gainesville, when combined the city population suitability demonstrated that the City of Alachua had the highest suitability with regards to population and size in Alachua County (See Figure 4-13).

The employee population category suitability components models can be found in Figure 4-14. They show a higher concentration in the western part of the county as well, but what is interesting is that the higher densities flow along the major arterials leading to the cities of Alachua and Newberry, as well as being concentrated within the cities. It is also interesting to note the higher densities of commercial employment found in all of the outlying municipalities where as the service densities have higher concentrations within or in close proximity to the larger municipalities, Alachua and Gainesville. Once combined the employee population shows higher populations within the cities of Alachua and High Springs and along the peripheral of Gainesville (See Figure 4-15). The large amounts of semi-suitability around Newberry should also be taken into account.

The final population suitability shows the cities of Archer, Newberry, Alachua, and High Springs, as well as the periphery of Gainesville as having the highest suitability compared to the other areas in Alachua County (See Figure 4-16). Once converted into an opportunity model the areas just west of the City of Gainesville, and within the cities of Newberry, Alachua and High Springs were shown to be the most suitable for Remote park-and-ride lots (See Figure 4-17).

Element III: Land Use

The land use element‘s purpose was to identify areas with high differentiation in land use as well as activity centers that serve as major trip generators within Alachua County. The reason these attributes were chosen because areas such as these will encourage the use of the park-and-ride for uses other than just getting to and from work, it would allow them to be used throughout the day rather than just at peak hours. This element consists of three categories and eight components, reference Figure 4-18 for the weights used to combine them.

The points of interest suitability component models identified major trip generators and interchanges that would encourage the use of park-and-ride lots. The points of interest distance suitability classifies areas within a quarter mile of a generator as suitable, Figure 4-19 shows there is a higher concentration of these points of interest within the City of Gainesville. The I-75 interchanges distance suitability captures areas that people from outside the county or traveling between cities might use and could use a park-and-ride to exit the interstate and hop on public transportation. The combined model showed the majority of the high suitabilities along I-75 and just to the west of the City of Gainesville (See Figure 4-20).

The mix of land use suitability components were chosen to show where there was a high variety of land use. The variety of land use suitability showed where we could find different types of land uses clumped together. Areas within the City of Gainesville and along the major roadway corridors showed the greatest variety in land use (See Figure 4-21). This was also mirrored in the entropy of land use suitability conducted as well. The final mix of land use suitability showed the highest suitabilities within the cities of Gainesviile, Alachua and High Springs, along with patches along the 13th Street/US 441 and Newberry/University corridors (See Figure 4-22).

The employment locations suitability components pinpoint where retail and commercial activities are taking place. The distance to retail and commercial parcels identifies exactly where these types of business can be found. In this case we see more commercial and retail activity in the western part of the county particularly along the corridors to Newberry and Alachua. The density of retail and commercial gives an approximation of the impact each individual store is since it is based on the square footage of the buildings, typically buildings with higher square footage draw more customers and have more employees. In this case retail parcels tend to have higher square footage than commercial, and there seems to more of a pull towards higher square footage to the north along the 13th Street/US441 corridor to Alachua (See Figure 4-23). The combined employment location suitability showed higher suitabilities within Alachua and 13th Street/US 441 corridor leading to it, but it is also interesting to note that each of the municipalities centers shows high suitabilities with regards to employment locations (See Figure 4-24).

The final land use suitability had particularly high values in Alachua, Jonesville, Micanopy and on the outer limits of the city of Gainesville (See Figure 4-25). Once converted to an opportunity model the most appropriate areas for a Peripheral park-and-ride lot were in the City of Gainesville near the Oaks Mall and to the North near the Northwood Village Shopping Center and in the City of Alachua (See Figure 4-26).

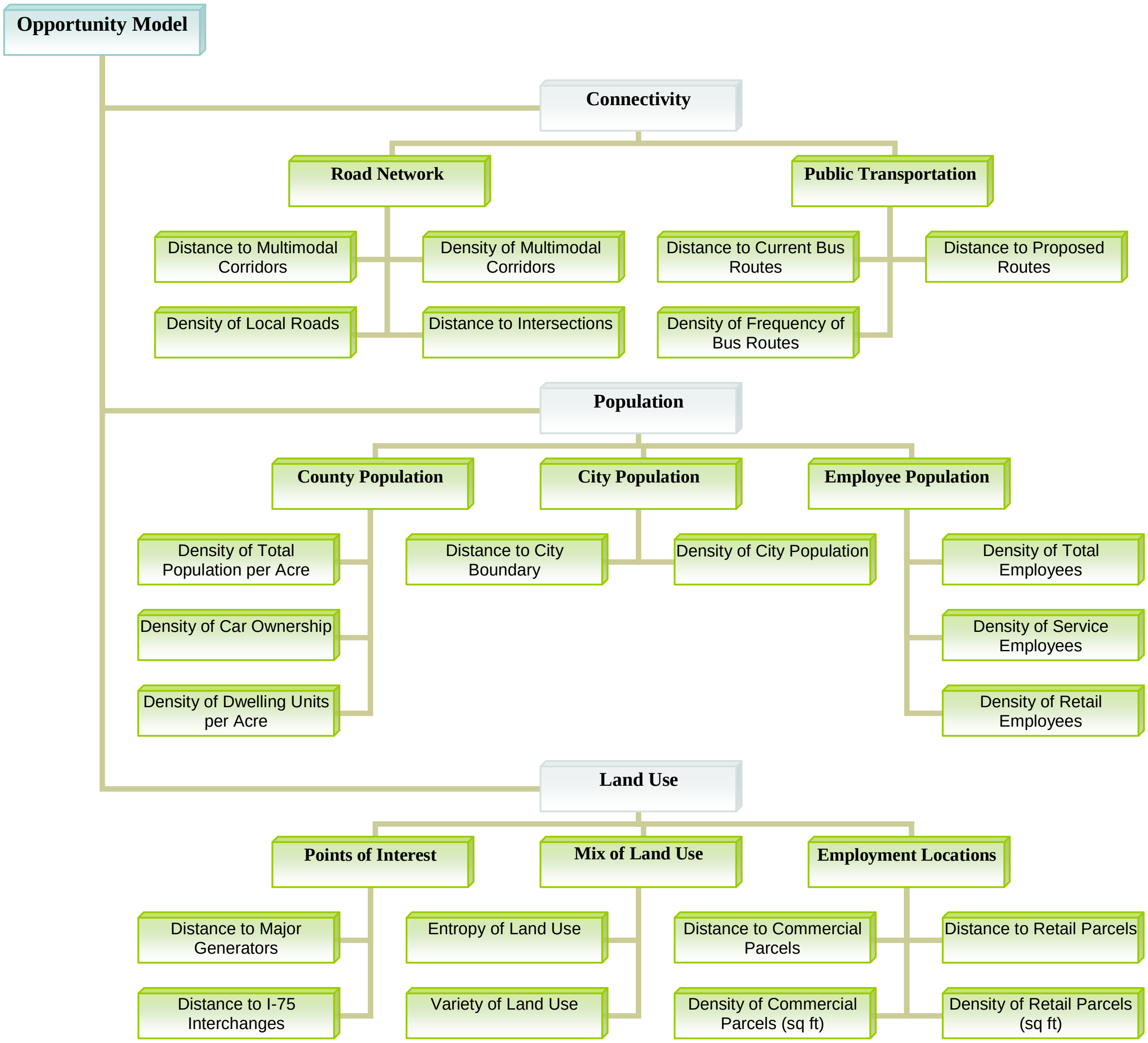

Figure 4-1. Opportunity Model

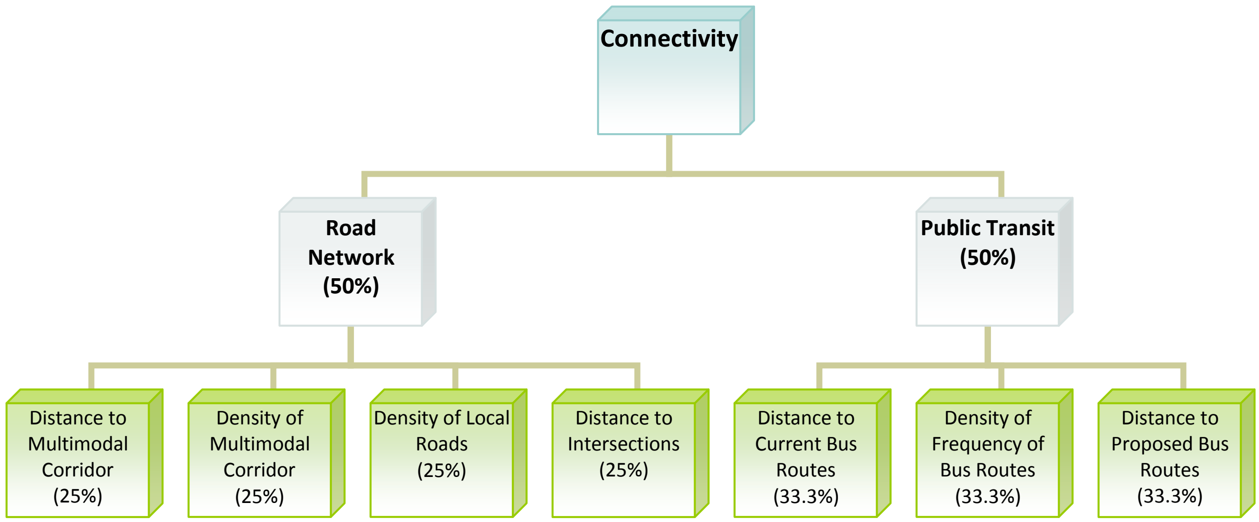

Figure 4-2. Connectivity Element Weights

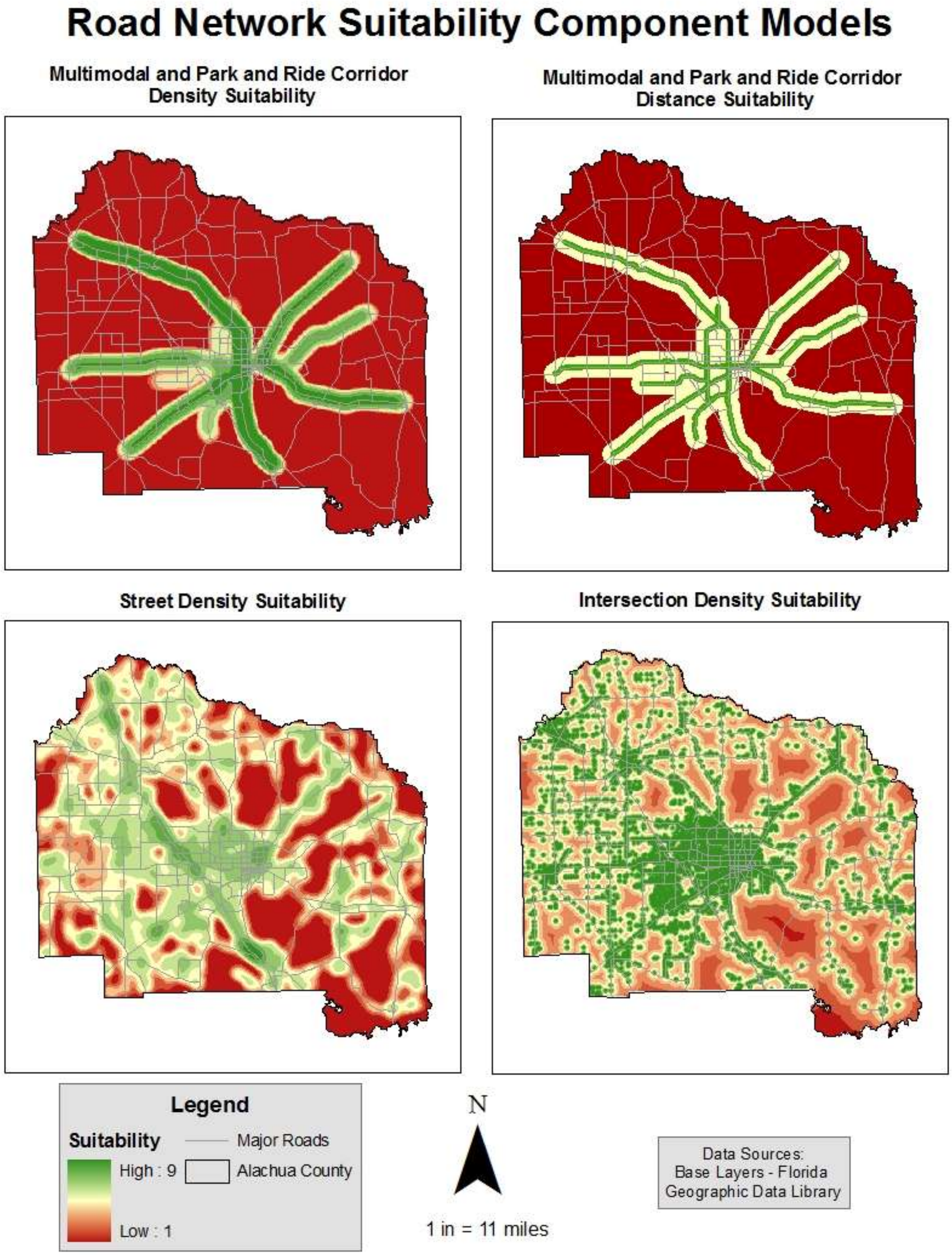

Figure 4-3. Road Network Suitability Component Models

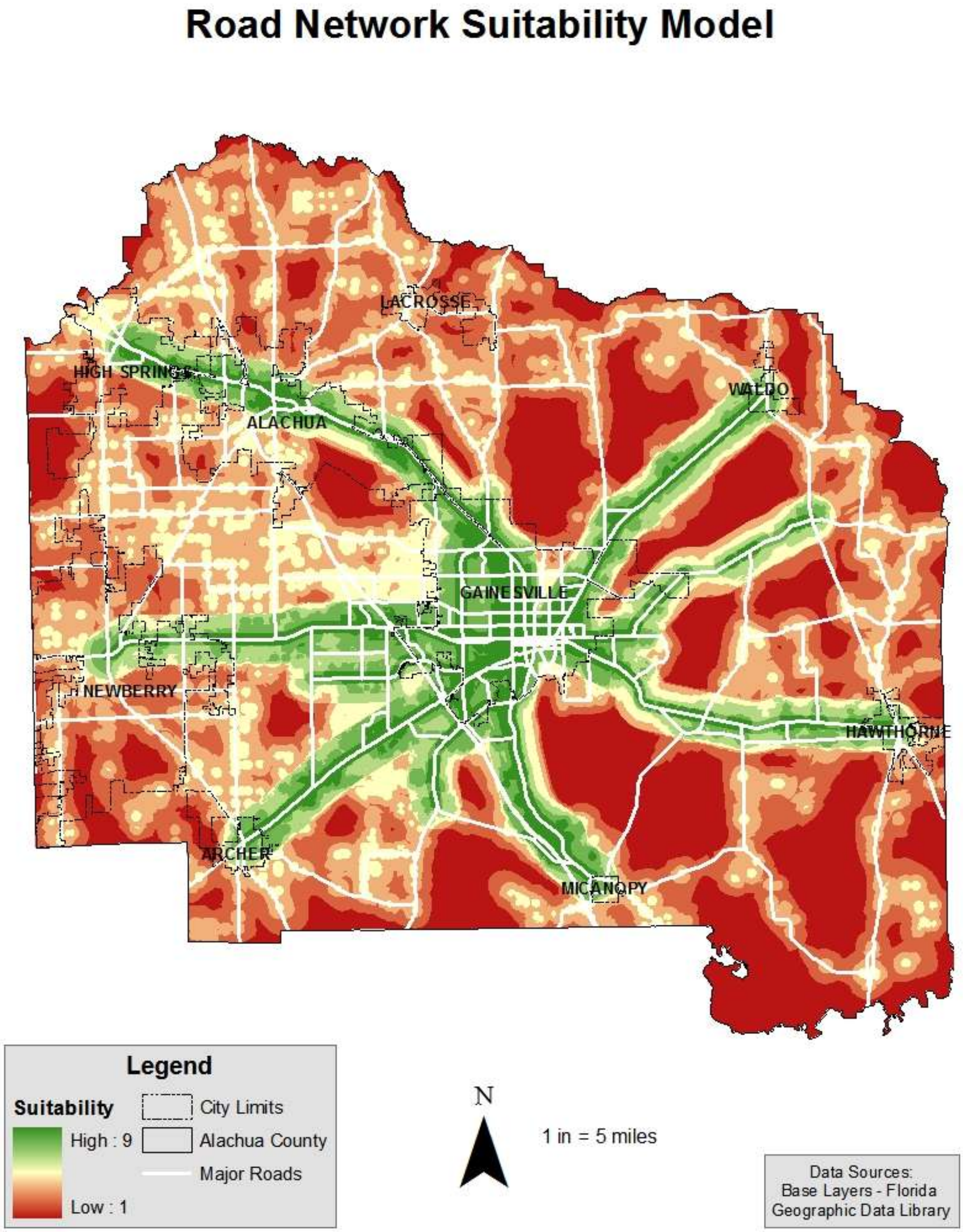

Figure 4-4. Road Network Suitability Model

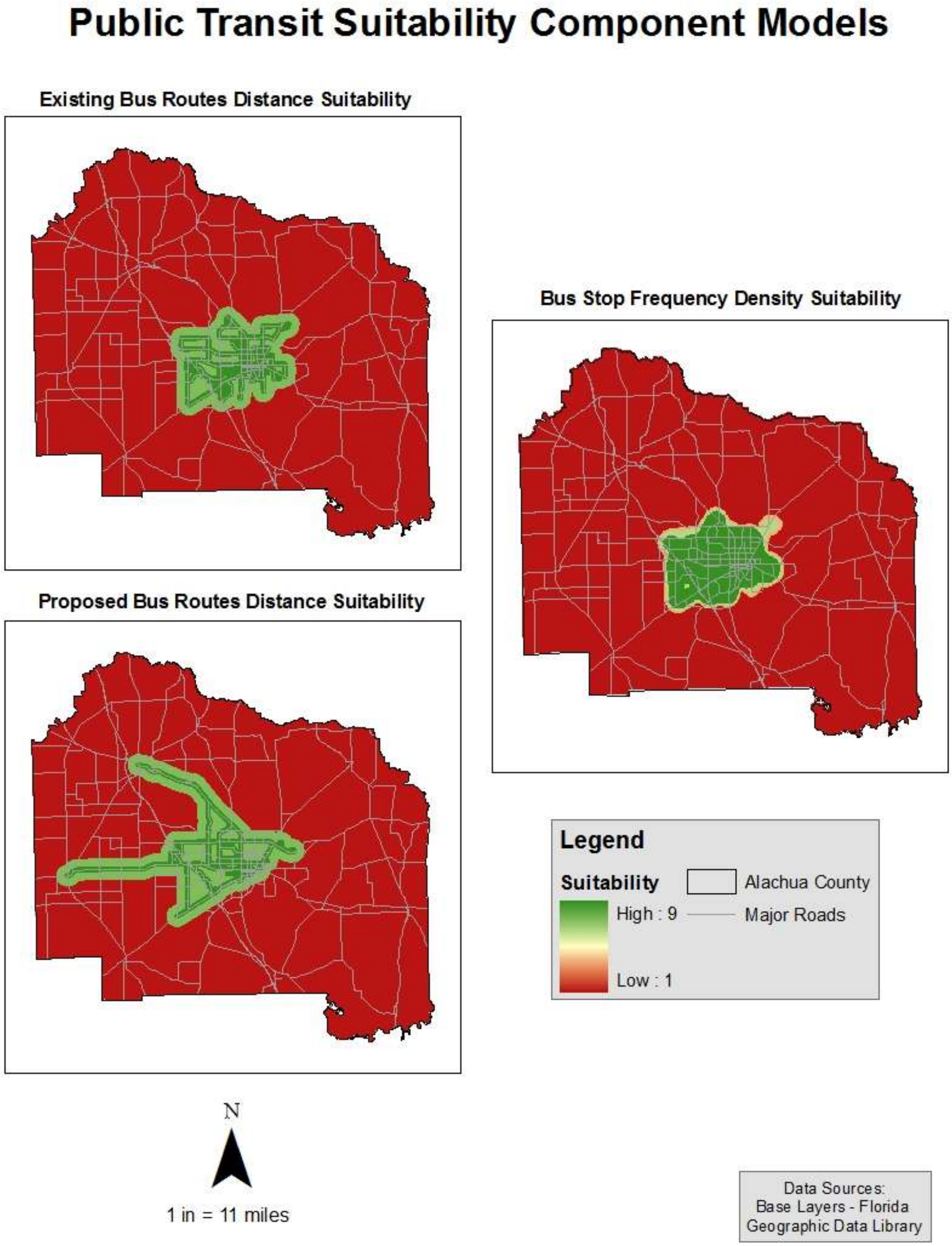

Figure 4-5. Public Transit Suitability Model Components

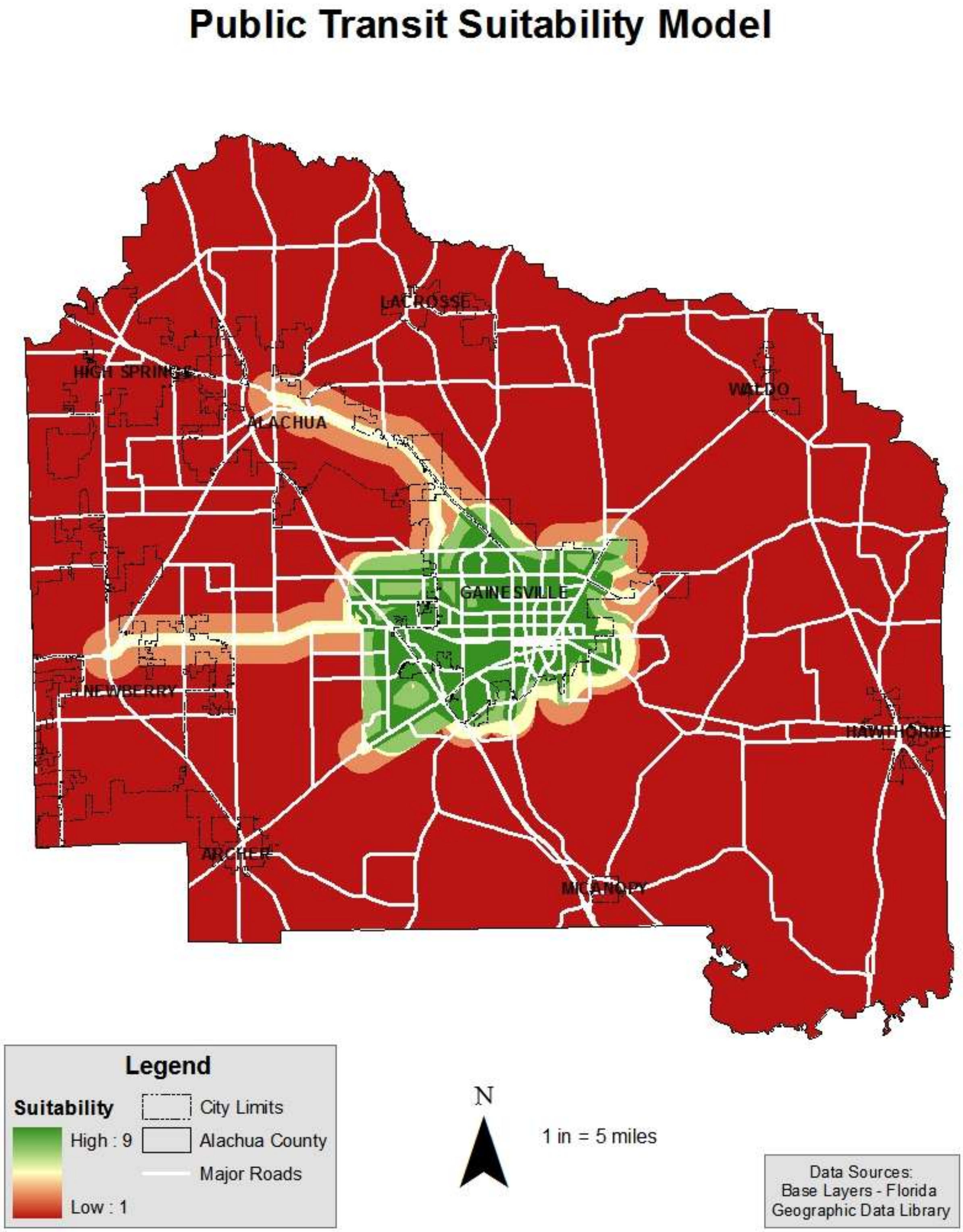

Figure 4-6. Public Transit Suitability Model

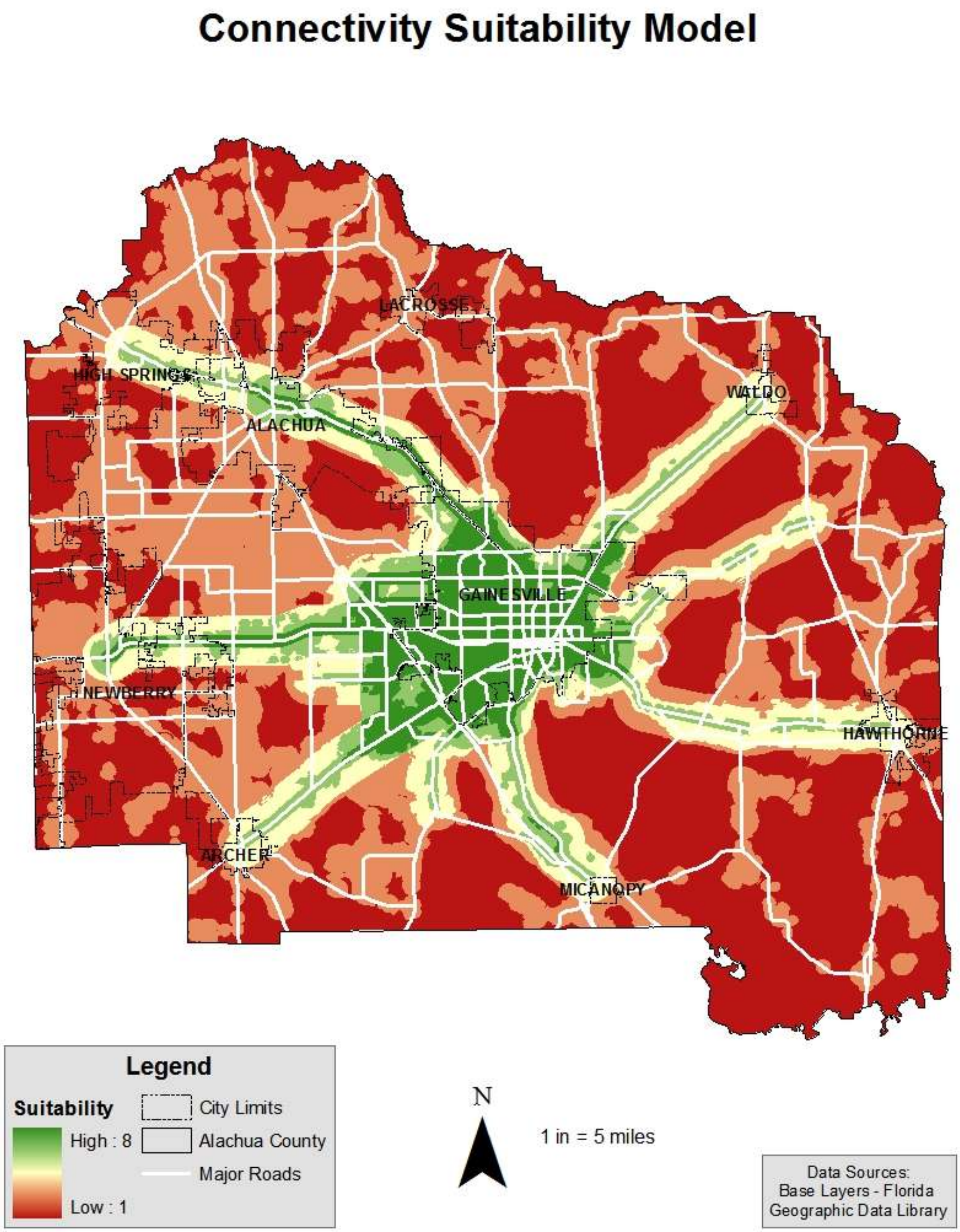

Figure 4-7. Connectivity Suitability Model

Urban Corridor Park and Ride Lots

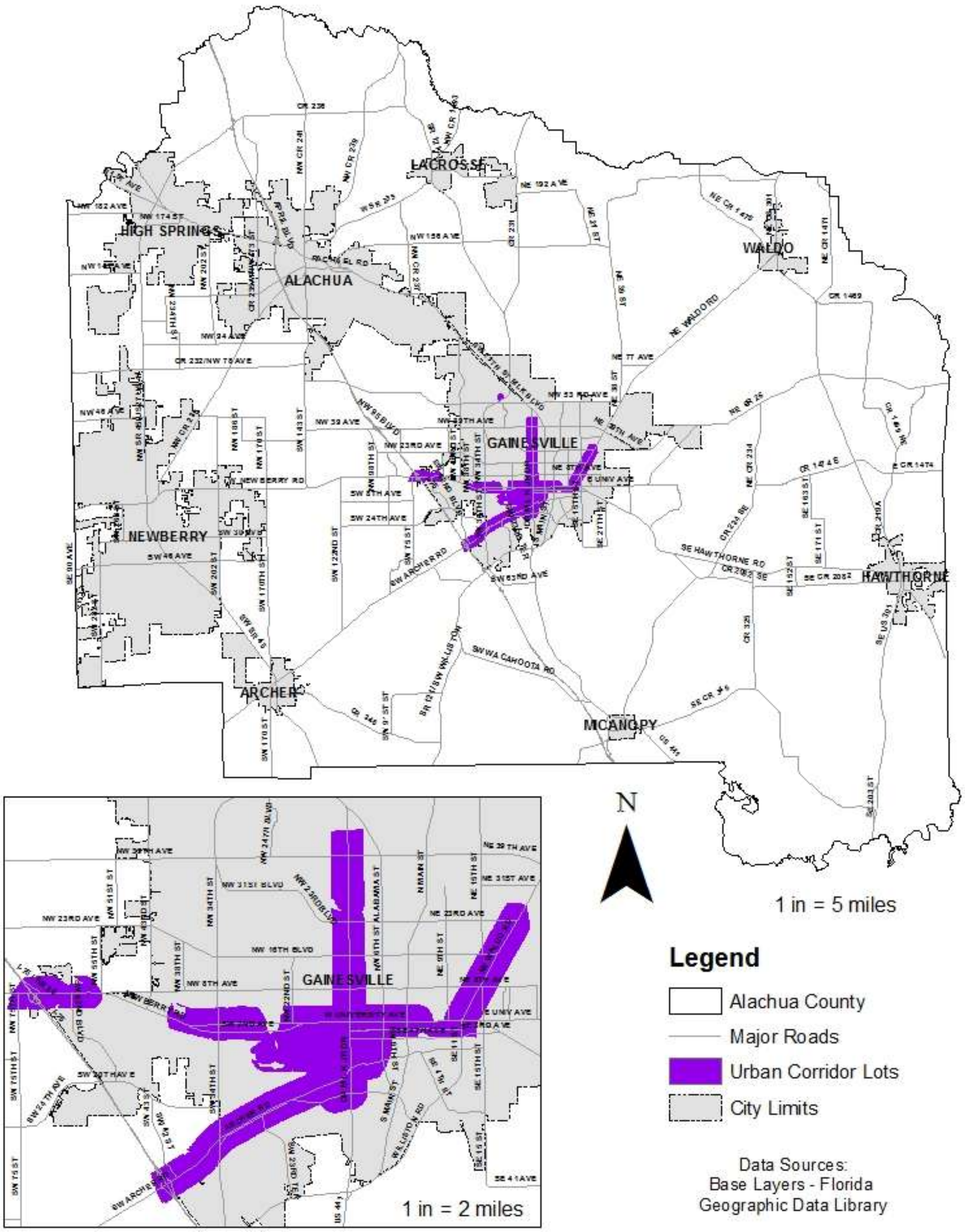

Figure 4-8. Urban Corridor Lots

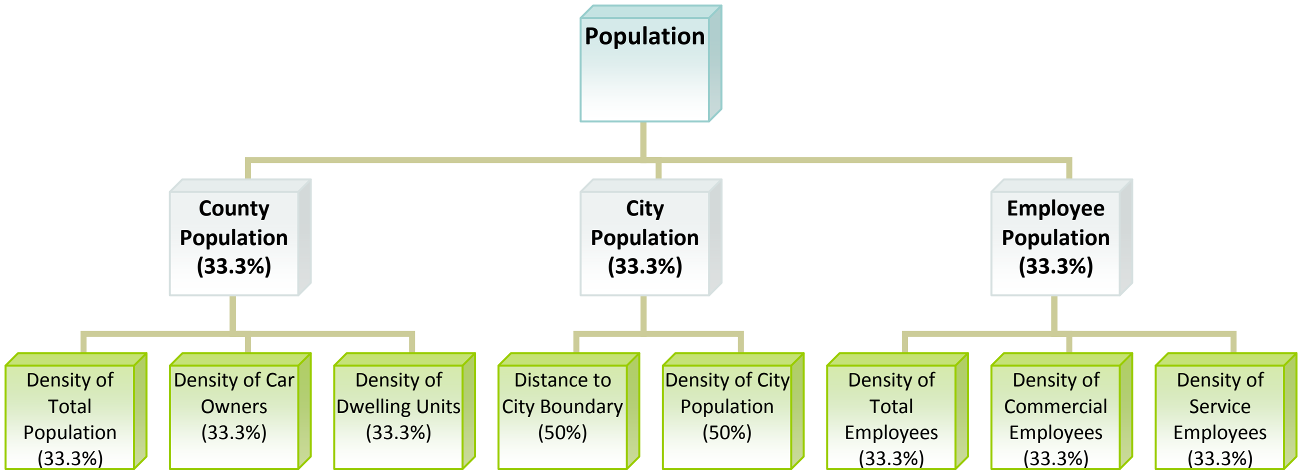

Figure 4-9. Population Element Weights

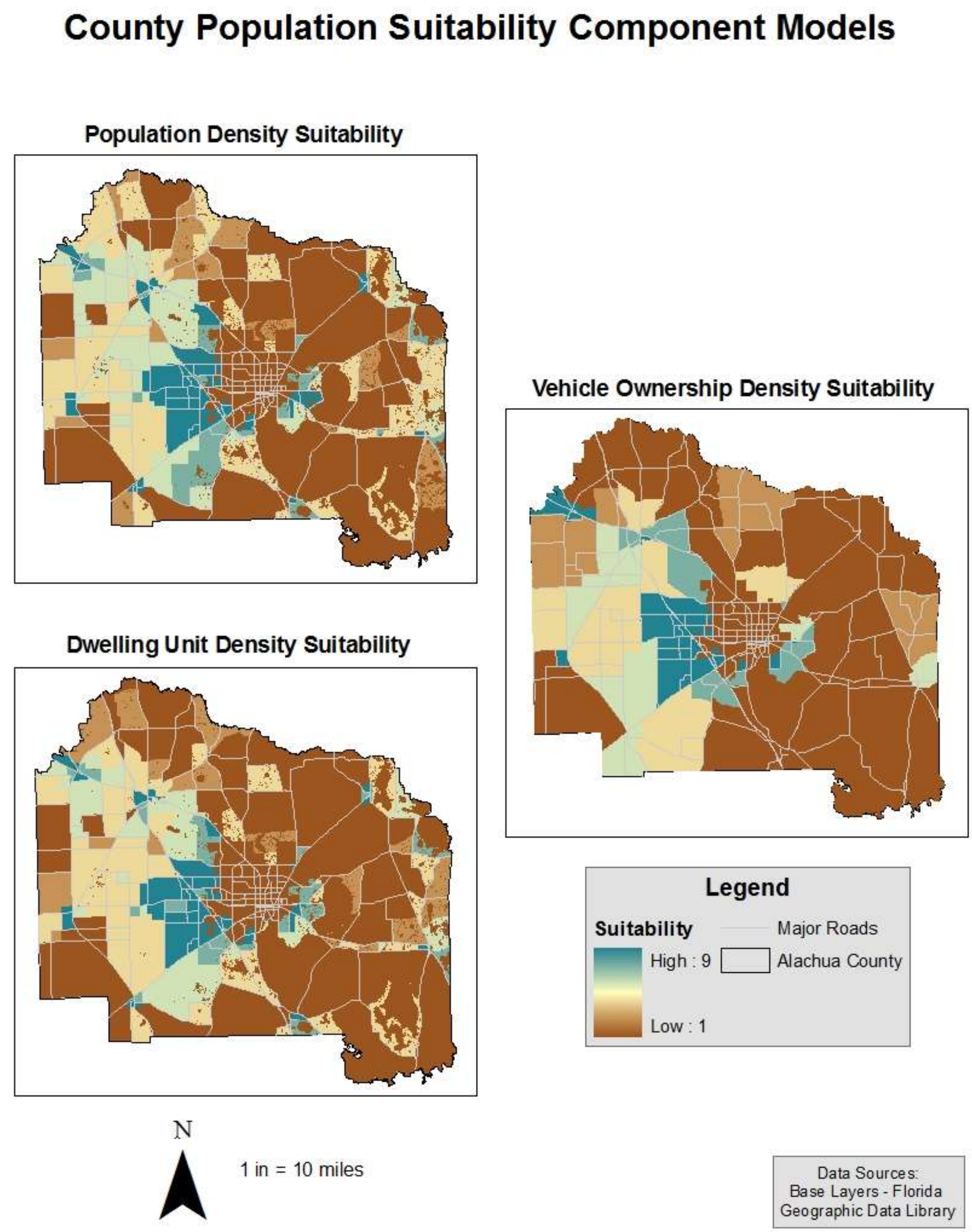

Figure 4-10. County Population Suitability Component Models

County Population Suitability Model

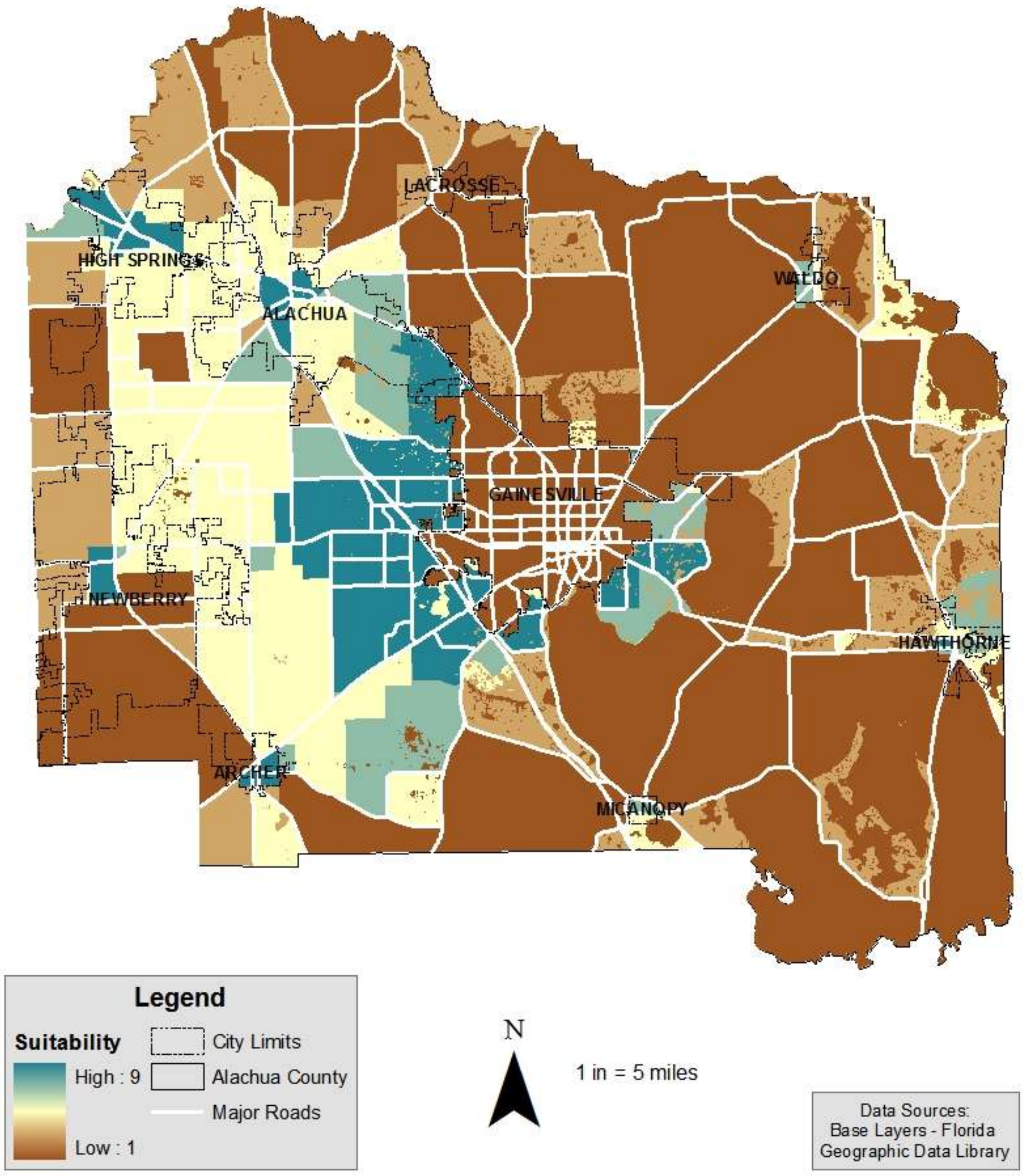

Figure 4-11. County Population Suitability Model

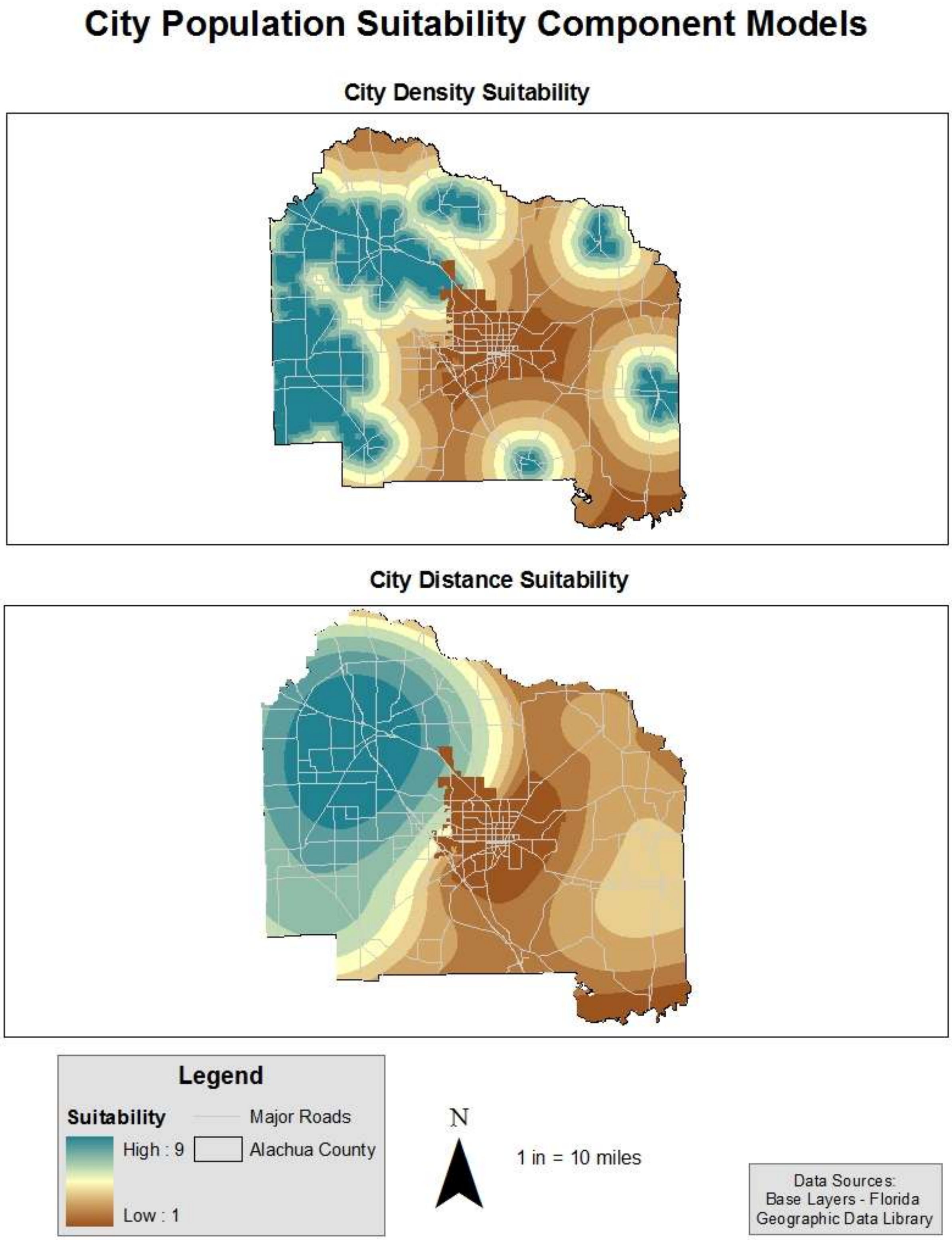

Figure 4-12. City Population Suitability Component Models

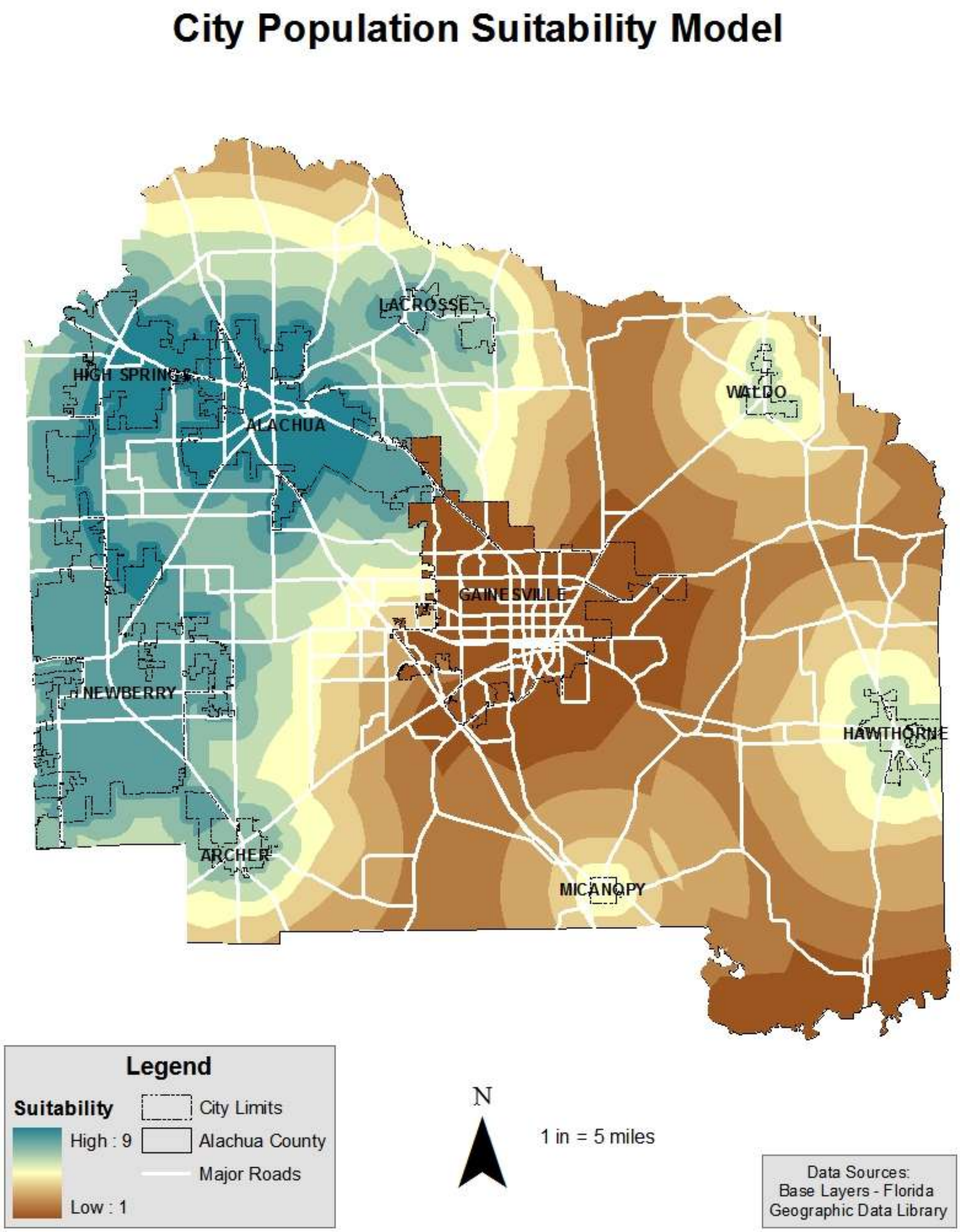

Figure 4-13. City Population Suitability Model

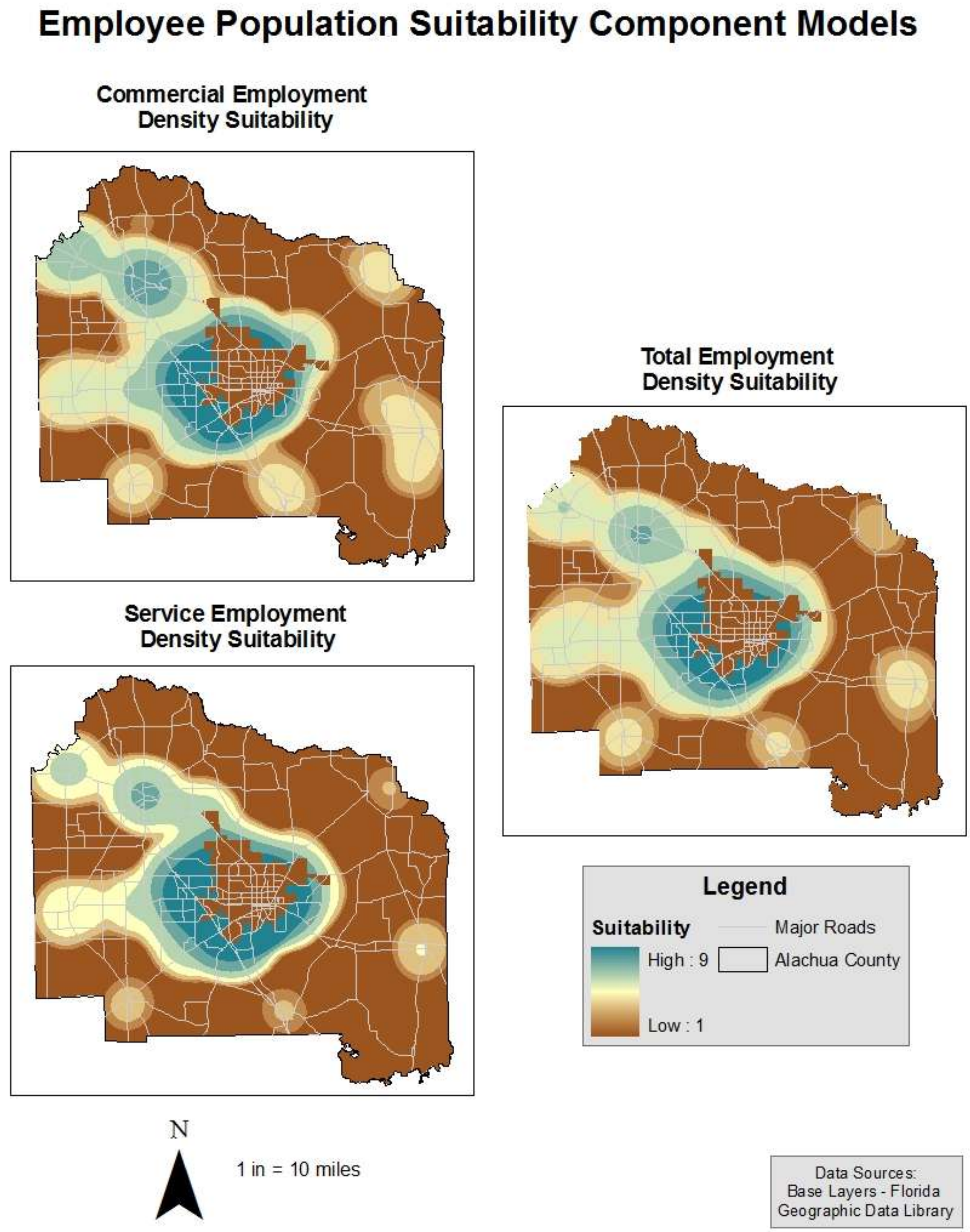

Figure 4-14. Employee Population Suitability Component Models

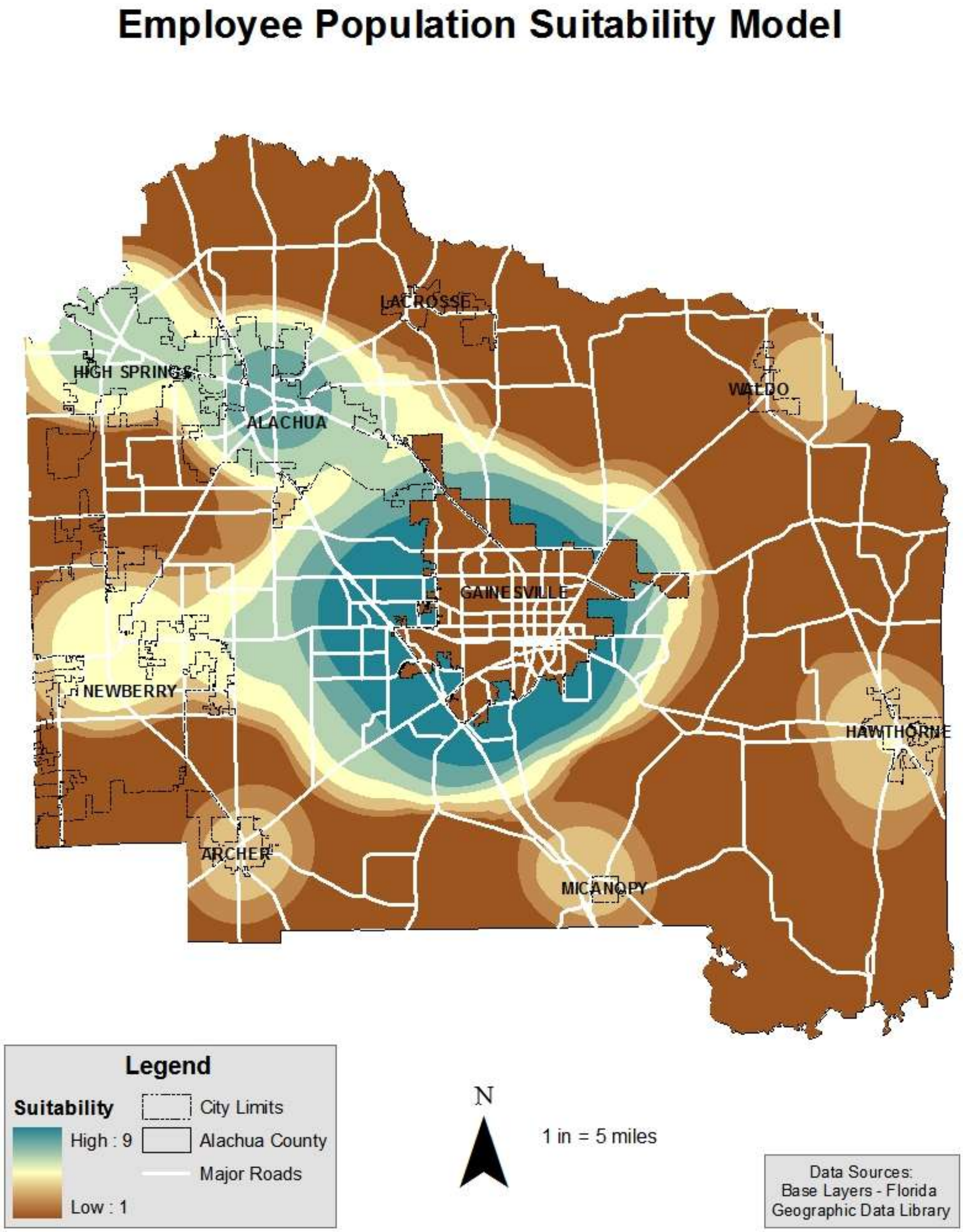

Figure 4-15. Employee Population Suitability Model

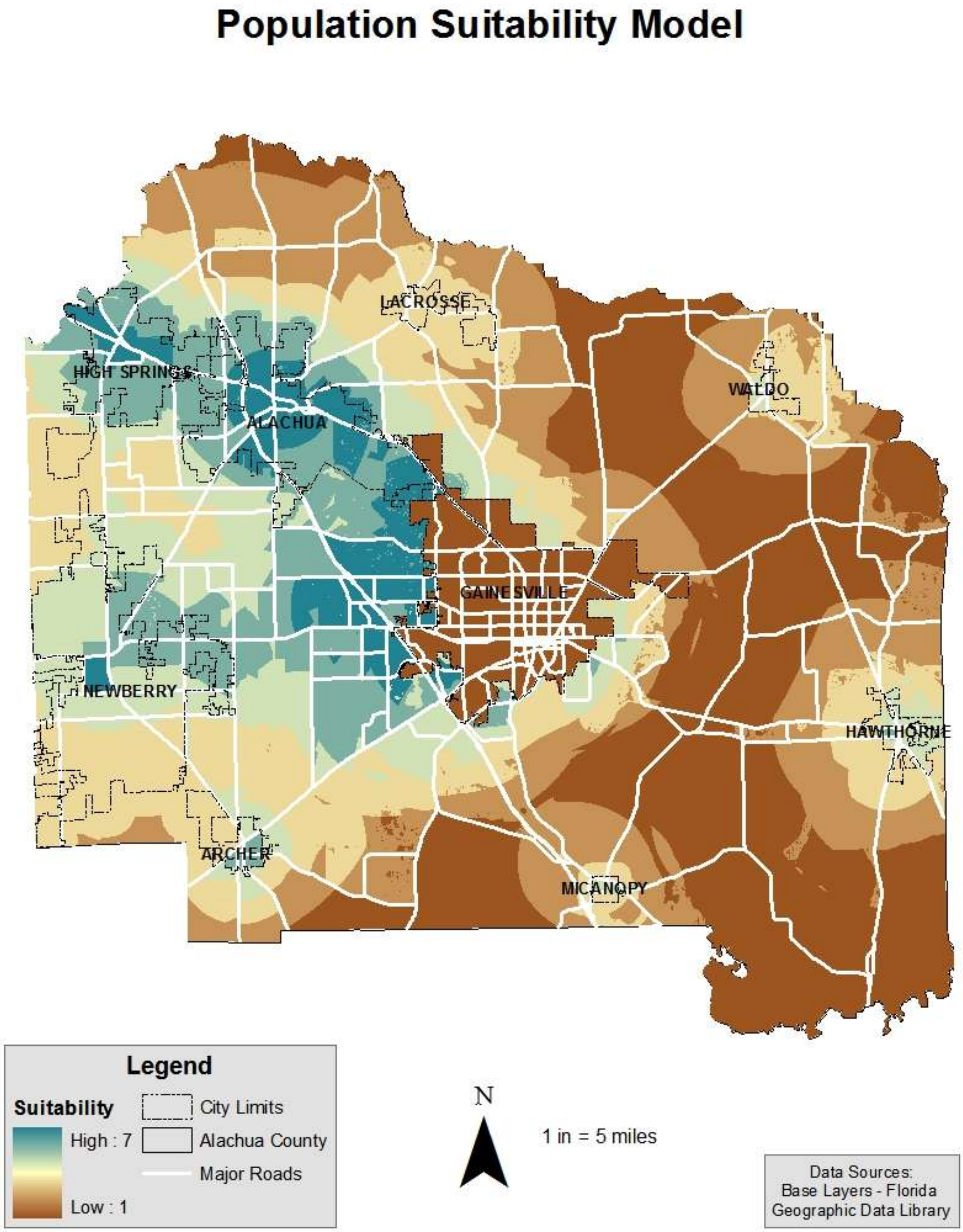

Figure 4-16. Population Suitability Model

Remote Park and Ride Lots

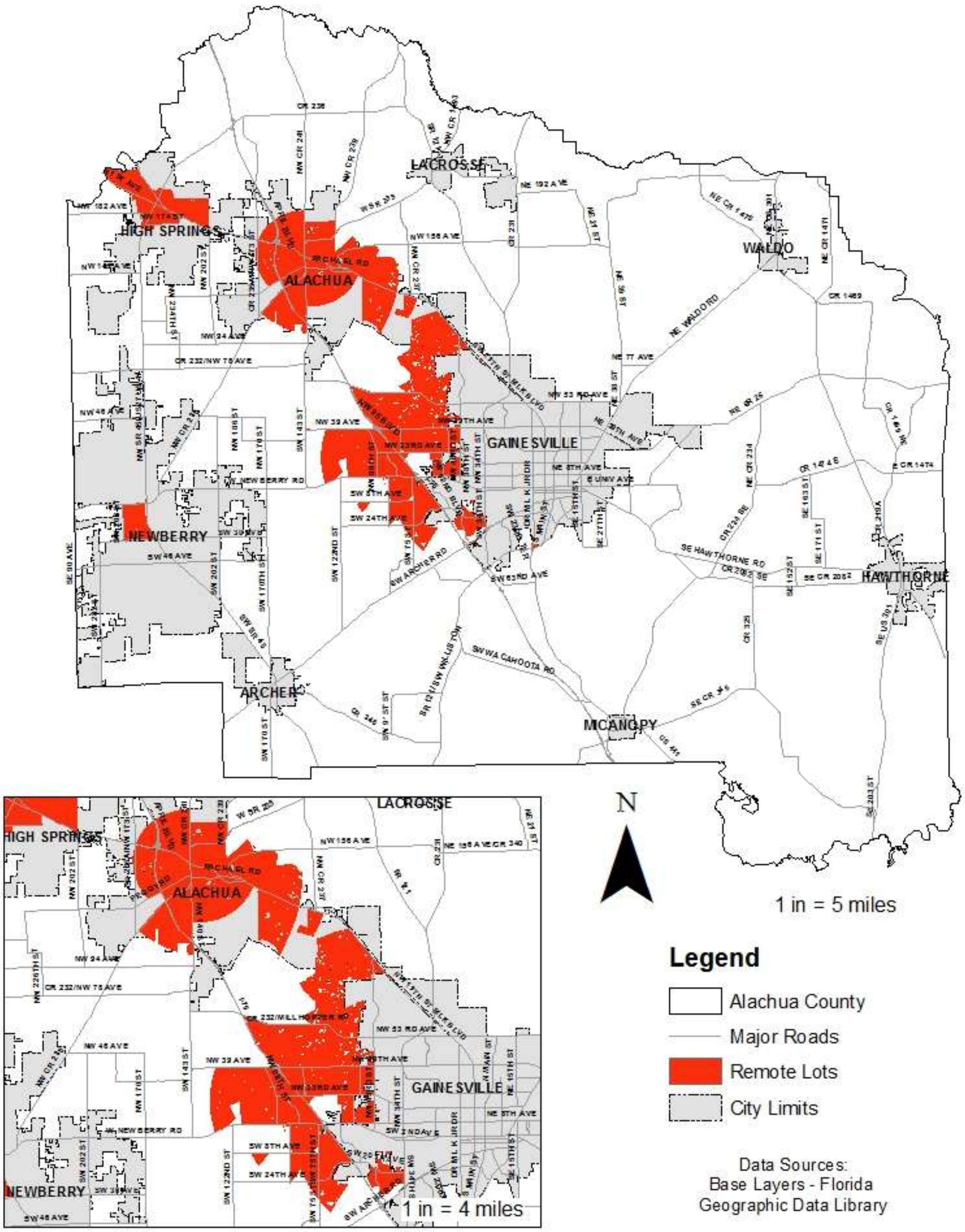

Figure 4-17. Remote Park-and-Ride Lots

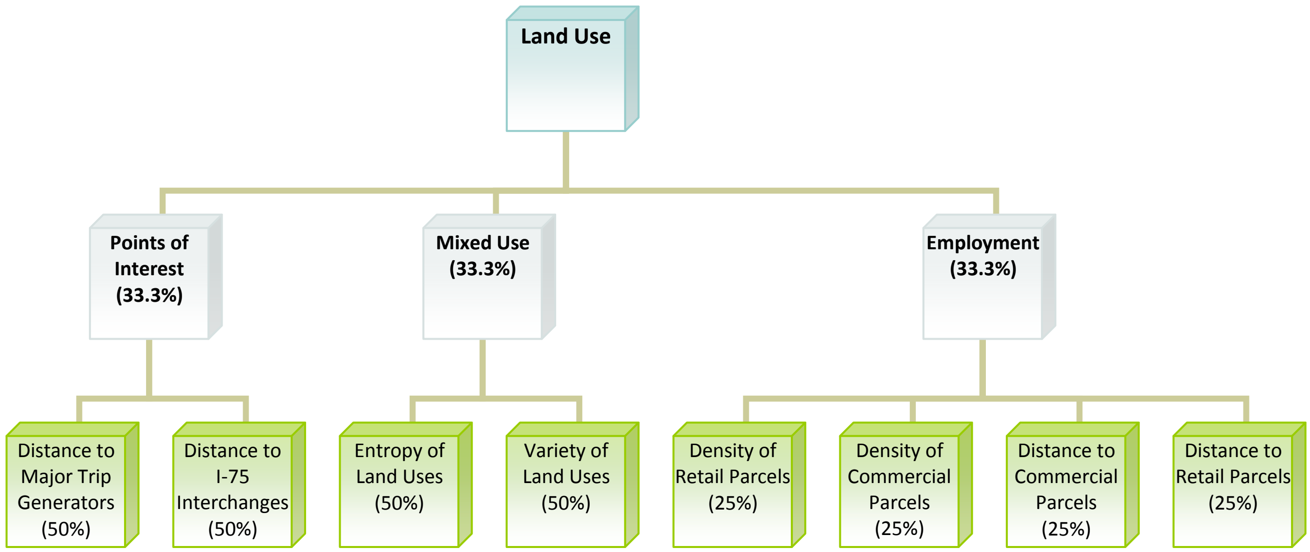

Figure 4-18. Population Element Weights

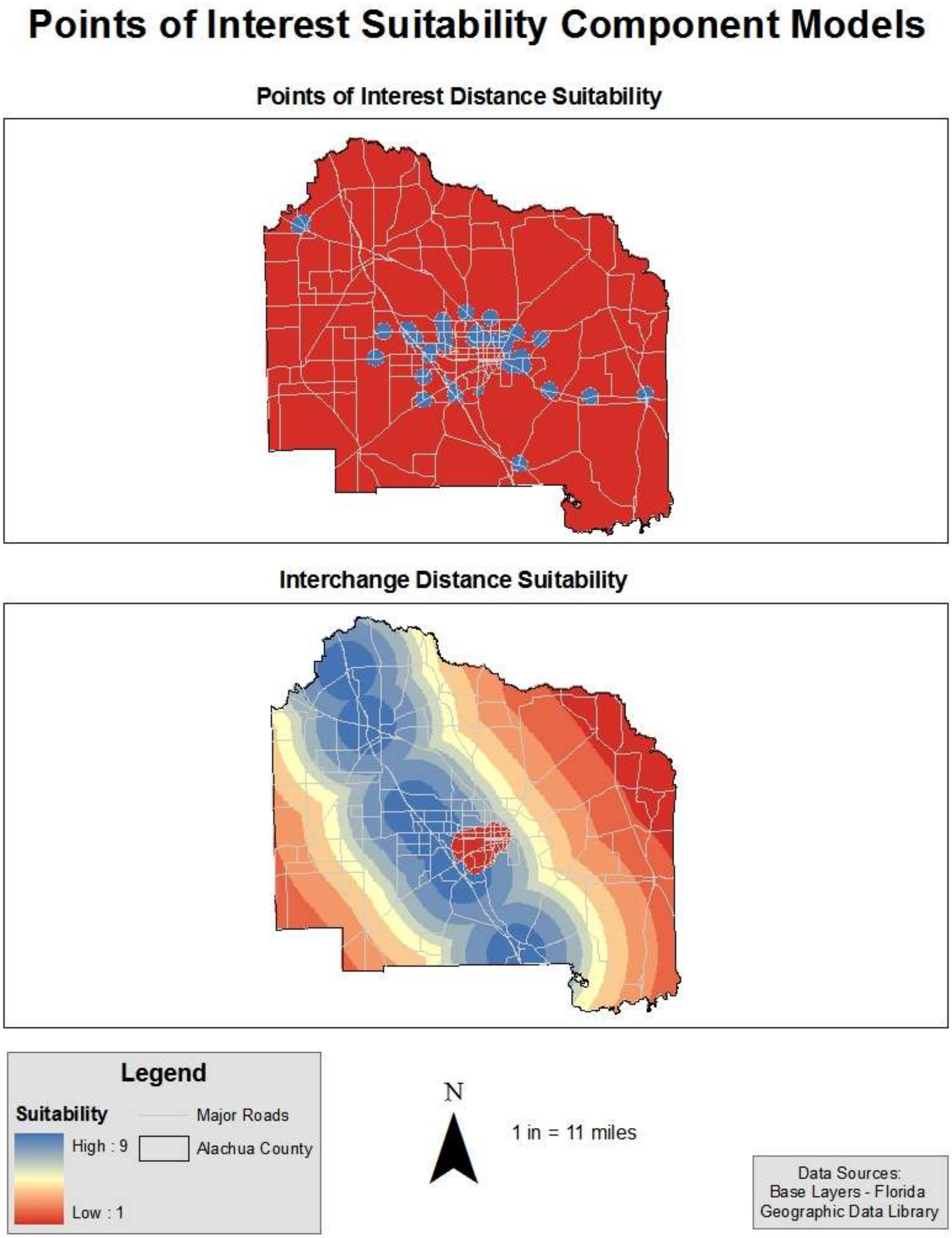

Figure 4-19. Points of Interest Suitability Component Models

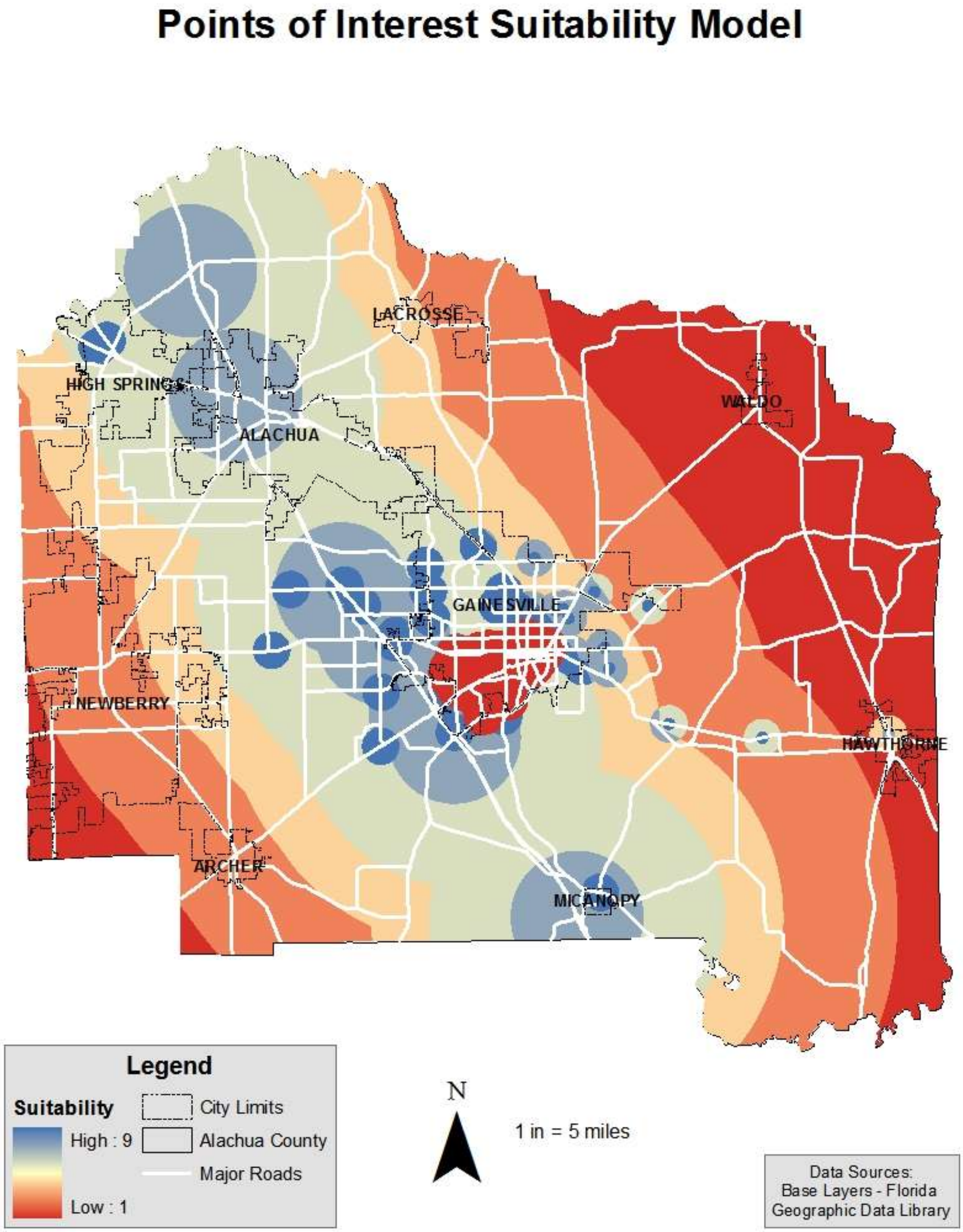

Figure 4-20. Points of Interest Suitability Model

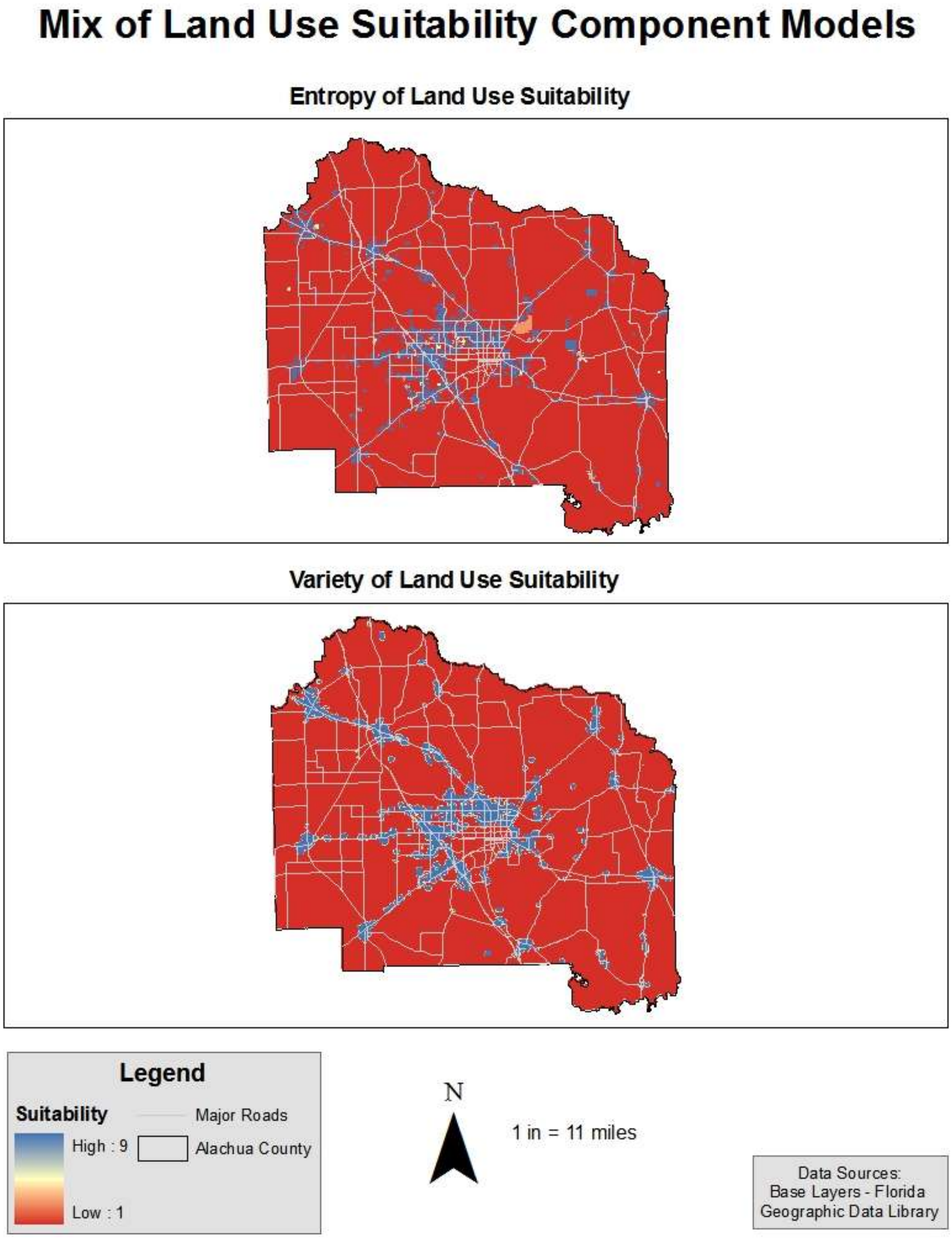

Figure 4-21. Mix of Land Use Suitability Component Models

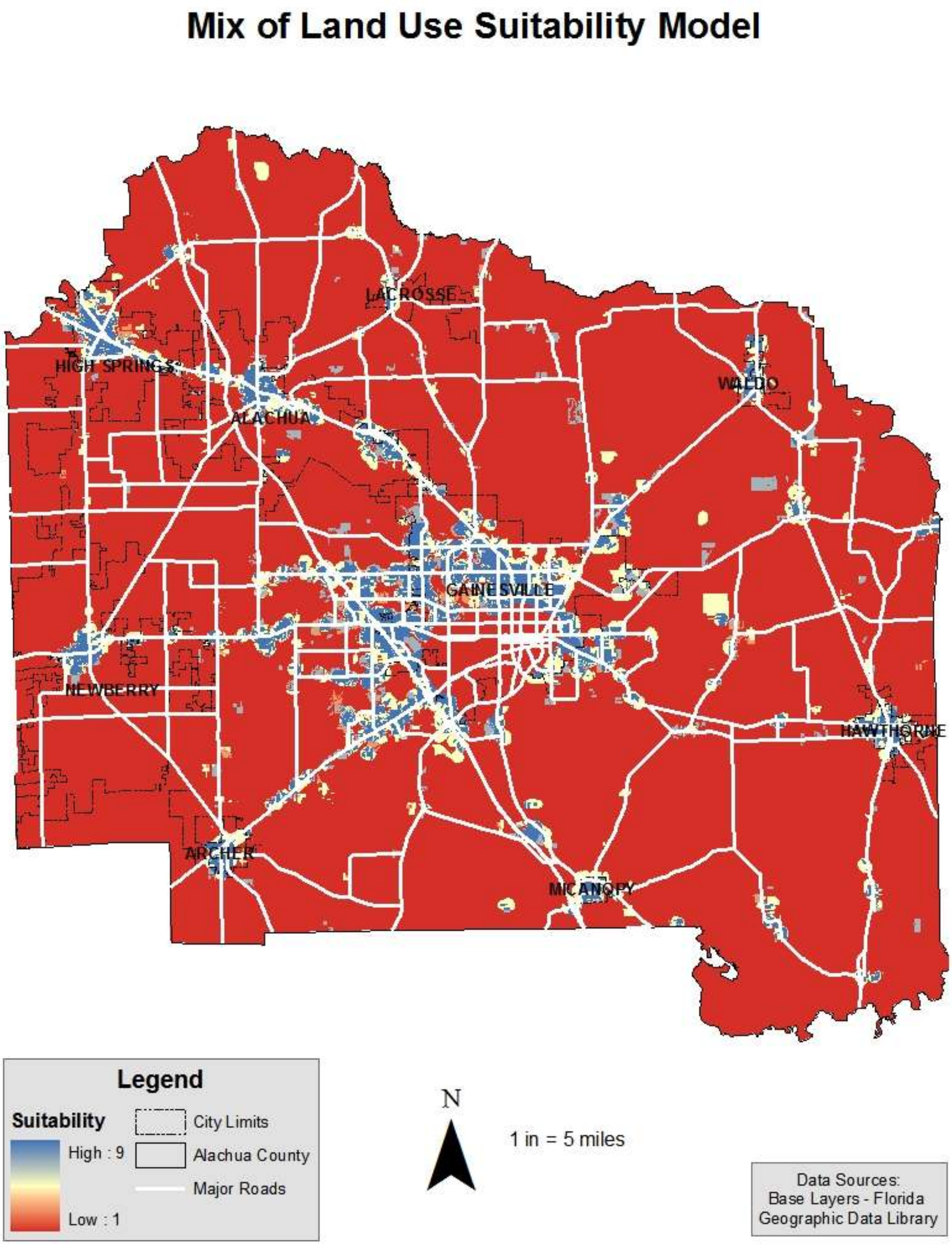

Figure 4-22. Mix of Land Use Suitability Model

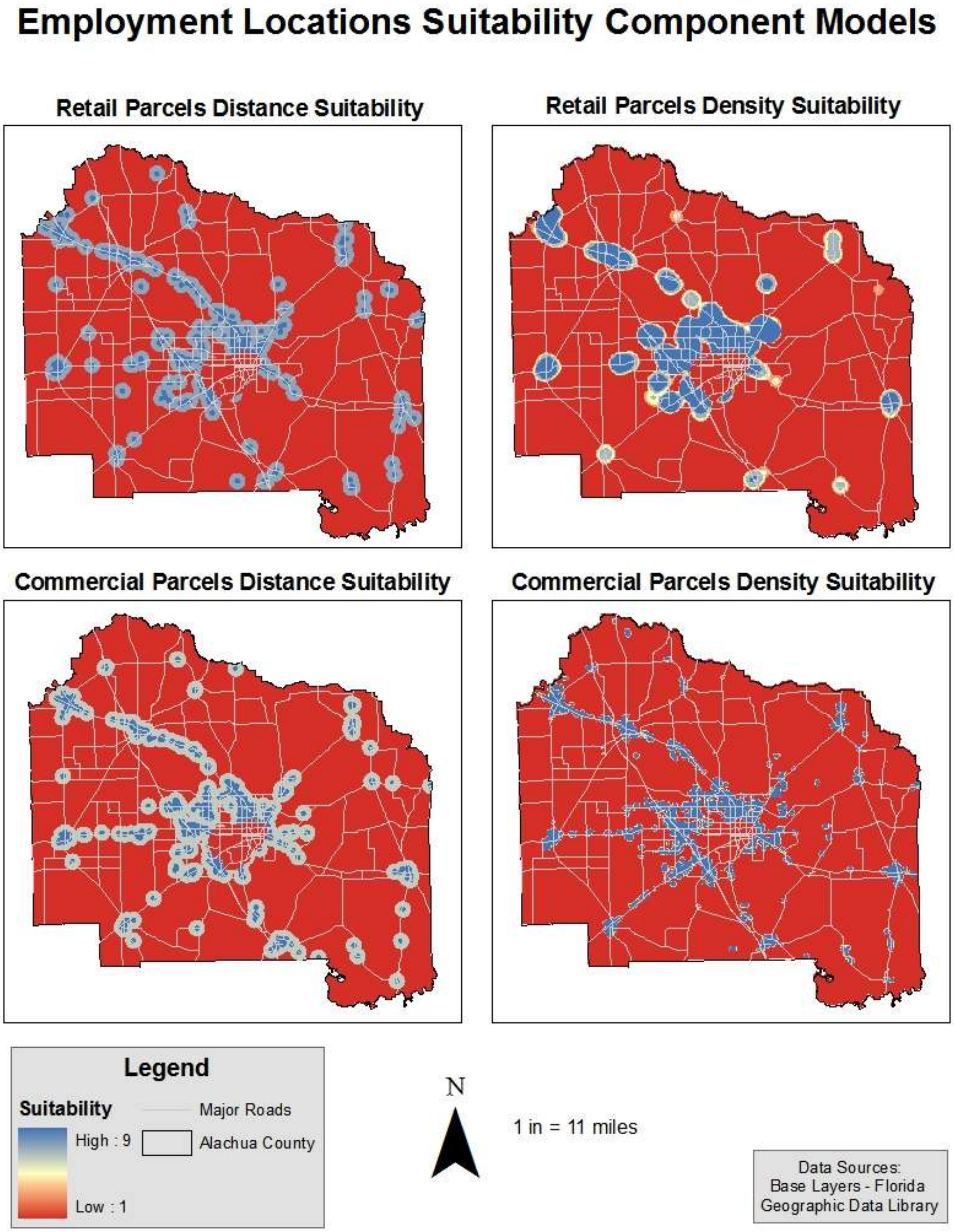

Figure 4-23. Employment Locations Suitability Component Models

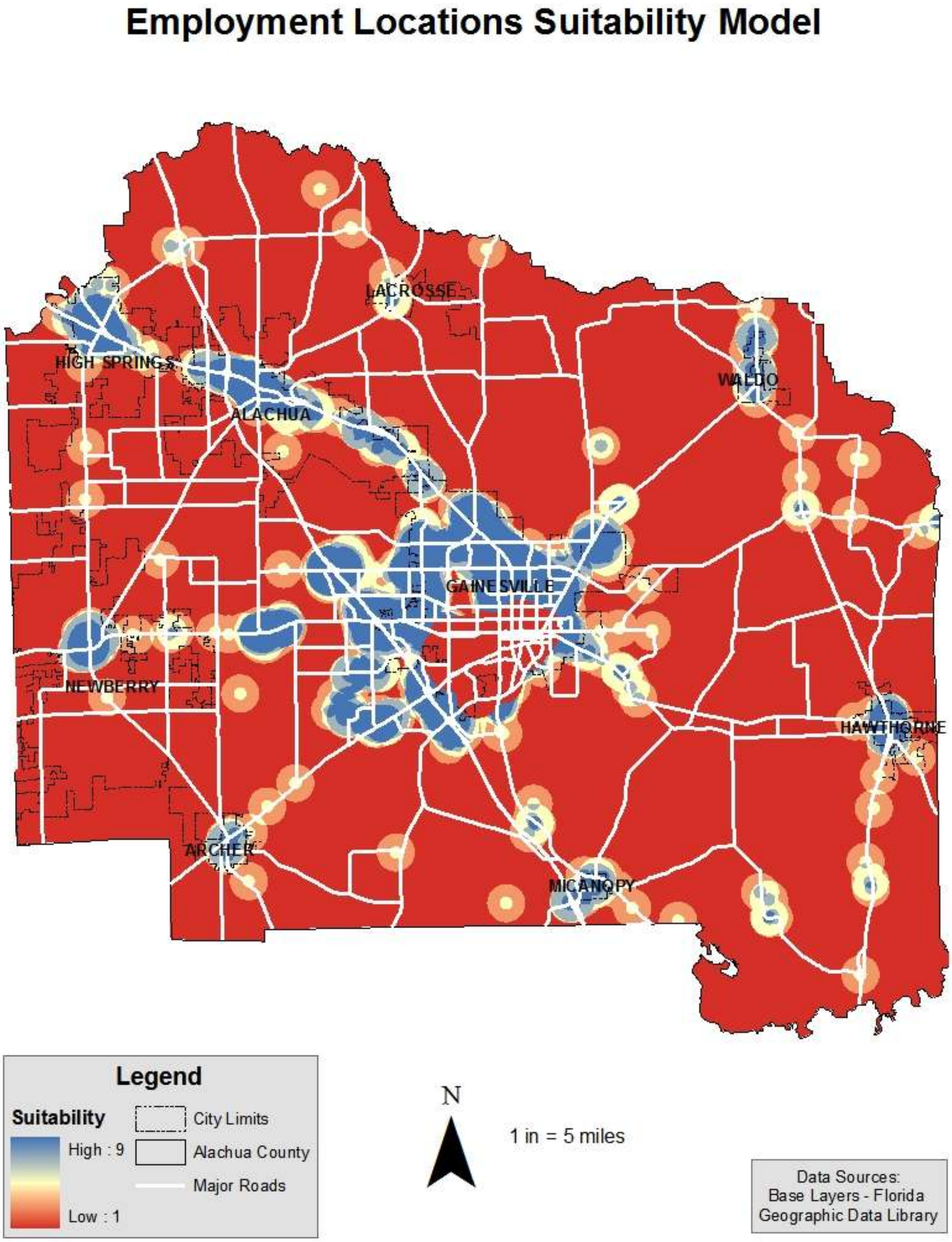

Figure 4-24. Employment Locations Suitability Model

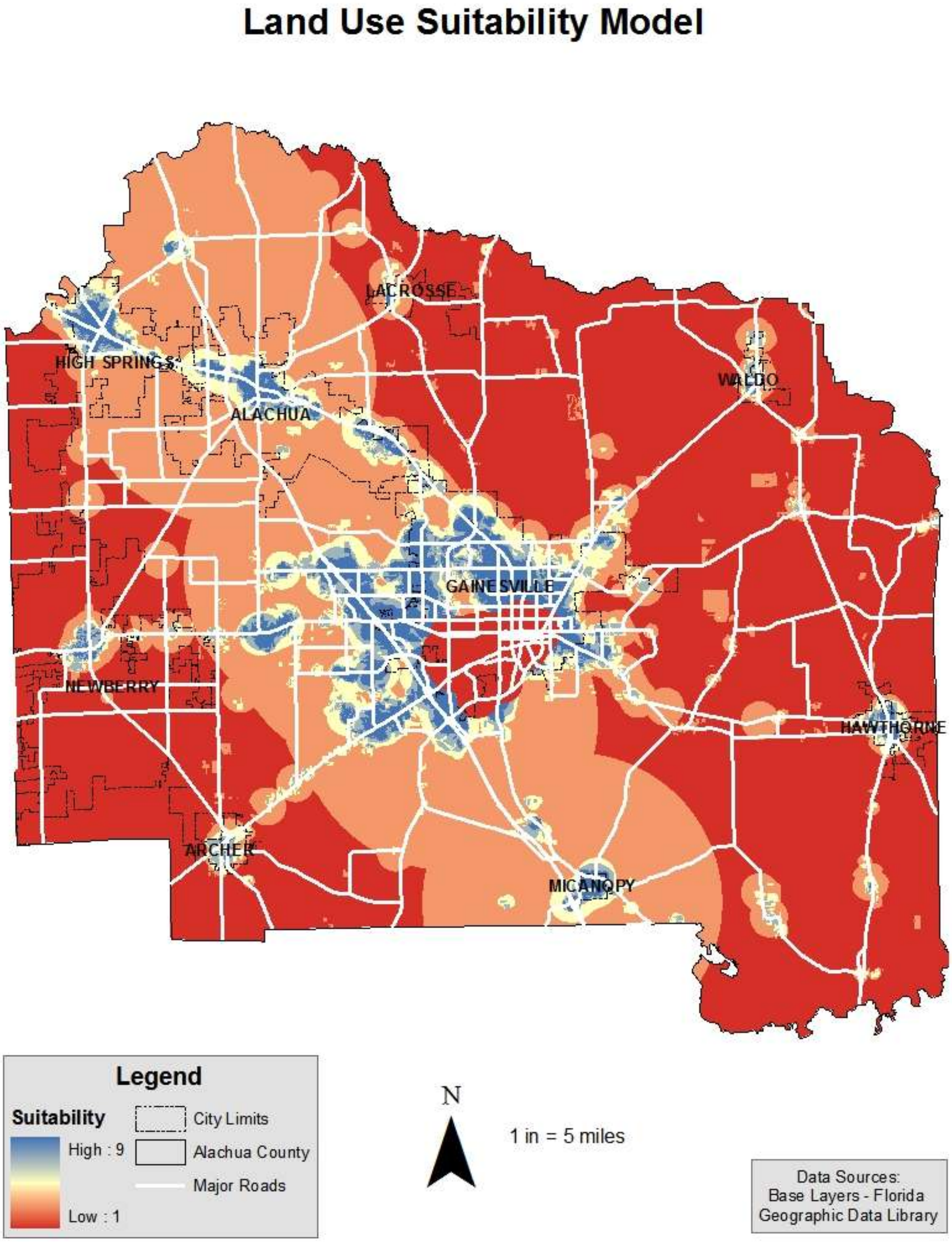

Figure 4-25. Land Use Suitability Model

Peripheral Park and Ride Lots

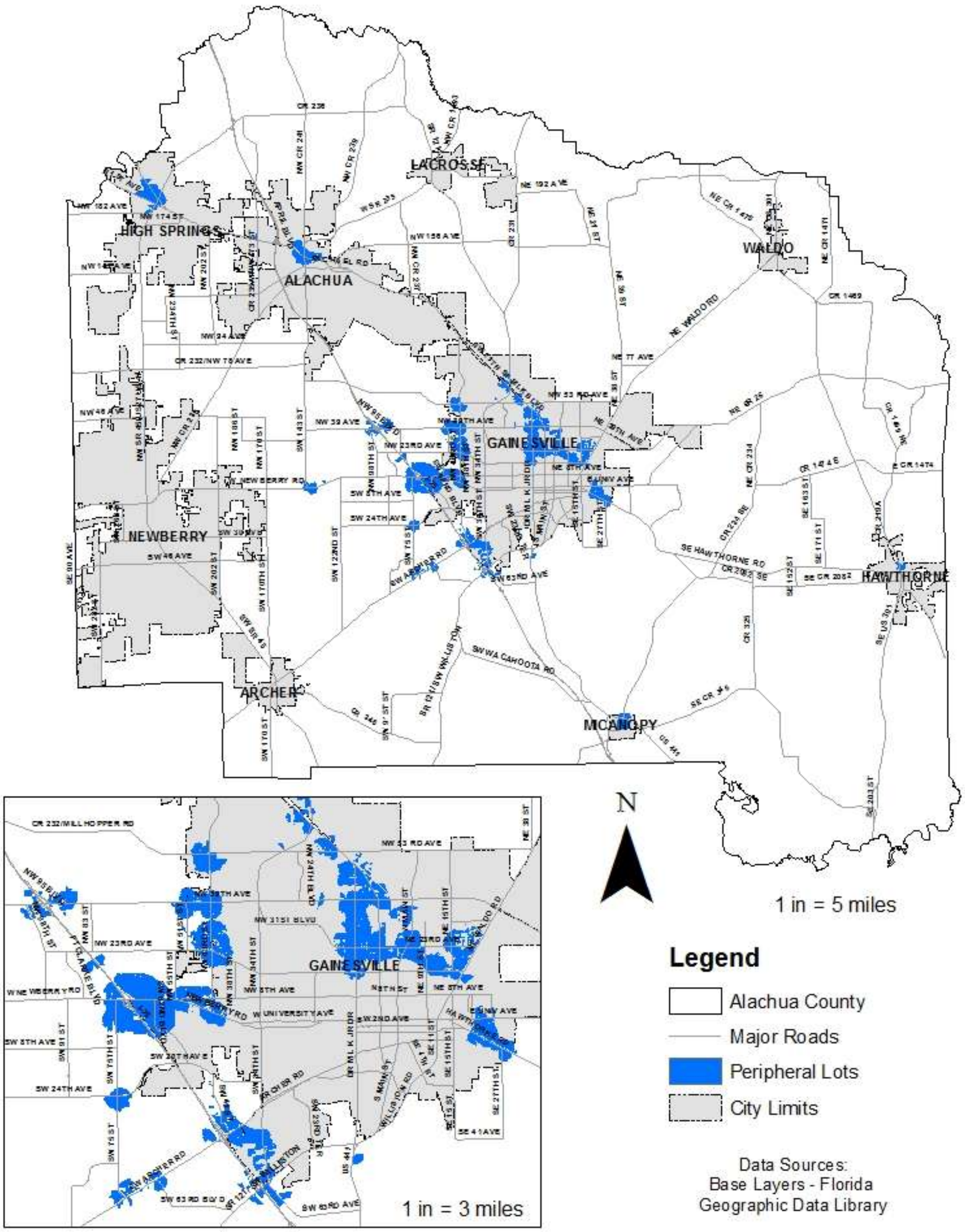

Figure 4-26. Peripheral Park-and-Ride Lots

CHAPTER 5
DISCUSSION

The opportunity model showed numerous locations that were appropriate for Park-and-ride lots throughout Alachua County. When compared with the potential park-and-ride locations identified by the City of Gainesville Regional Transit System and the Department of Transportation, similarities between the two recommendations were apparent.

Comparison with Bus Rapid Transit Park-and-Ride Lots

Comparing the opportunity model with the park-and-ride lots being proposed for Bus Rapid Transit (BRT) it was found that a majority of the BRT proposed park-and-ride lots lie within the regions being classified as suitable areas by the opportunity model (See Figure 5-1). Considering that a BRT system generally needs major arterials to operate on their designated bus only lanes, the best type of lot for that situation would most likely be an Urban Corridor Lot. Re-examining the BRT proposed lots three out of the six are located within close proximity or on top of areas designated as suitable for Urban Corridor Lots. Some areas that seem to be neglected in these proposed lots is the corridor along 13th street/US 441 as well as the corridor along E University Avenue just past Main Street. Recommendations for the BRT park-and-ride lots might include one in the vicinity of NW 13th Street at NW 23rd Boulevard or NW 13th Street at NW 39th Avenue, both are major intersections and would provide good connectivity and mixed use within the site for a transit hub.

Comparison with Department of Transportation Proposed Park-and-Ride Lots

Examining the Florida Department of Transportation (FDOT) proposed park-and-ride lots (See Figure 5-2) it was found that a bulk of these lots are located in outlying areas of the City of Gainesville within the surrounding municipalities. The majority of these park-and-ride lots come with a suggestion of express bus service running between them and the City of Gainesville. One of the FDOT's main reasons behind these suggestions is to improve the traffic flow on the major arterials into the City of Gainesville, which has reached a failing level of service in many areas. The lots that would be most appropriate in these situations would be the remote and peripheral lots. Comparing the opportunity model with the FDOT proposed park-and-ride lots, eight out of the ten lots can be found within or in close proximity to the areas suggested by the opportunity model as park-and-ride lots, in particular the remote and peripheral lot designations. The lots not included within the opportunity model were the ones located within the cities of Archer and Waldo. Two areas that seem to be neglected in the proposal that could be deemed appropriate are within the City of Micanopy along US 441, which has a high suitability for a peripheral lot, and near Jonesville along Newberry Road, which has a high suitability for both remote and peripheral lots.

Comparison with the RTS Transit Development Plan Proposed Lots

Comparing the opportunity model with park-and-ride lots proposed in the RTS TDP four out of five of the proposed park-and-ride lots were found in a suitable region (See Figure 5-3). The park-and-ride lot not considered suitable by the opportunity model was the one found on E University Avenue outside the City of Gainesville limits. When reviewed further against the opportunity model the location of this park-and-ride lot could be vastly improved by moving it west along E University Avenue closer to SE 43rd Street. This would provide the lot with more surrounding population which could enhance its use.

The other four lots suggested by the TDP seem appropriately placed since each is found in a suitable area for park-and-ride lots. Since the TDP looks at various variables to determine these optimal locations, including but not limited to: travel behavior, demographics population, land use and roadway consideration (RTS Transit Development Plan FY2010 - FY2019, pg. 105). It seems appropriate that the remaining four proposed park-and-ride lots should fall in areas that were deemed suitable for two different types of park-and-ride lots.

Opportunity Model Suggested Park-and-Ride Lots

Based on the opportunity model created five locations were identified that could serve as optimal park-and-ride locations (See Figure 5-4), though other locations should not be discounted based on these recommendations. The following sites were chosen based on their location within the model's designated suitable locations for park-and-ride lots. Tables 5-1 through 5-4 illustrate the average suitabilities found in the vicinity of the recommended areas.

Table 5-1. Recommended Location's Average Suitability by Variable

Location	Connectivity	Population	Land Use
Butler Plaza	7.65	5.11	5.934
Northwood Plaza	7.00	1.04	6.95
Oaks Mall	7.51	1.00	8.42
Waldo Road	8.00	1.00	7.80
Williston Plaza	6.28	1.00	6.62

Table 5-2. Recommended Location's Average Suitability by Connectivity Categories

Location	Public Transit	Roadway
Butler Plaza	7.78	7.622
Northwood Plaza	7.00	7.99
Oaks Mall	7.99	7.45
Waldo Road	8.00	8.00
Williston Plaza	5.69	7.50

Table 5-3. Recommended Location's Average Suitability by Population Categories

Location	County Population	City Population	Employee Population
Butler Plaza	6.707	1.000	8.98
Northwood Plaza	1.04	1.04	1.07
Oaks Mall	1.01	1.00	1.00
Waldo Road	1.00	1.00	1.00
Williston Plaza	1.03	1.00	1.00

Table 5-4. Recommended Location's Average Suitability by Land Use Categories

Location	Points of Interest	Mix of Land Use	Employment
Butler Plaza	5.952	5.878	6.776
Northwood Plaza	7.47	7.20	7.12
Oaks Mall	8.40	8.43	9.00
Waldo Road	7.00	8.60	8.00
Williston Plaza	9.00	4.47	8.00

The Northwood Village Shopping Center and the Butler Plaza park-and-ride lots were already suggested in previous plans. These locations were kept in the recommended park-and-ride sites because they have high densities of residential and commercial around the area which would allow them to be excellent peripheral lots, their locations also allow for good accessibility into the sites.

The sites on Waldo Road and at the Williston Shopping Center are two new park-and-ride lot recommendations. The Williston Shopping Center was chosen because it has a high concentration of commercial land use in the area. It's location with respect to I-75 was also important because if placed correctly the site will be visible from I-75 which will encourage use. The Waldo Road site was chosen because of its location along the urban corridor preference, which would also increase use through visibility, and in connection with higher land use compatibilities (or peripheral lot suitabilities) being located in the area as well.

Finally the location at Oaks Mall has been previously suggested and is always highly encouraged, the recommended site would be recommended would be located just off of I-75 on the southside of Newberry Road, giving it high visibility and making it easily accessible to inbound trips. Based on the conflict model, this location was chosen because it is located in close proximity to all three types of lots, making it the closest for being suitable for any type of park-and-ride.

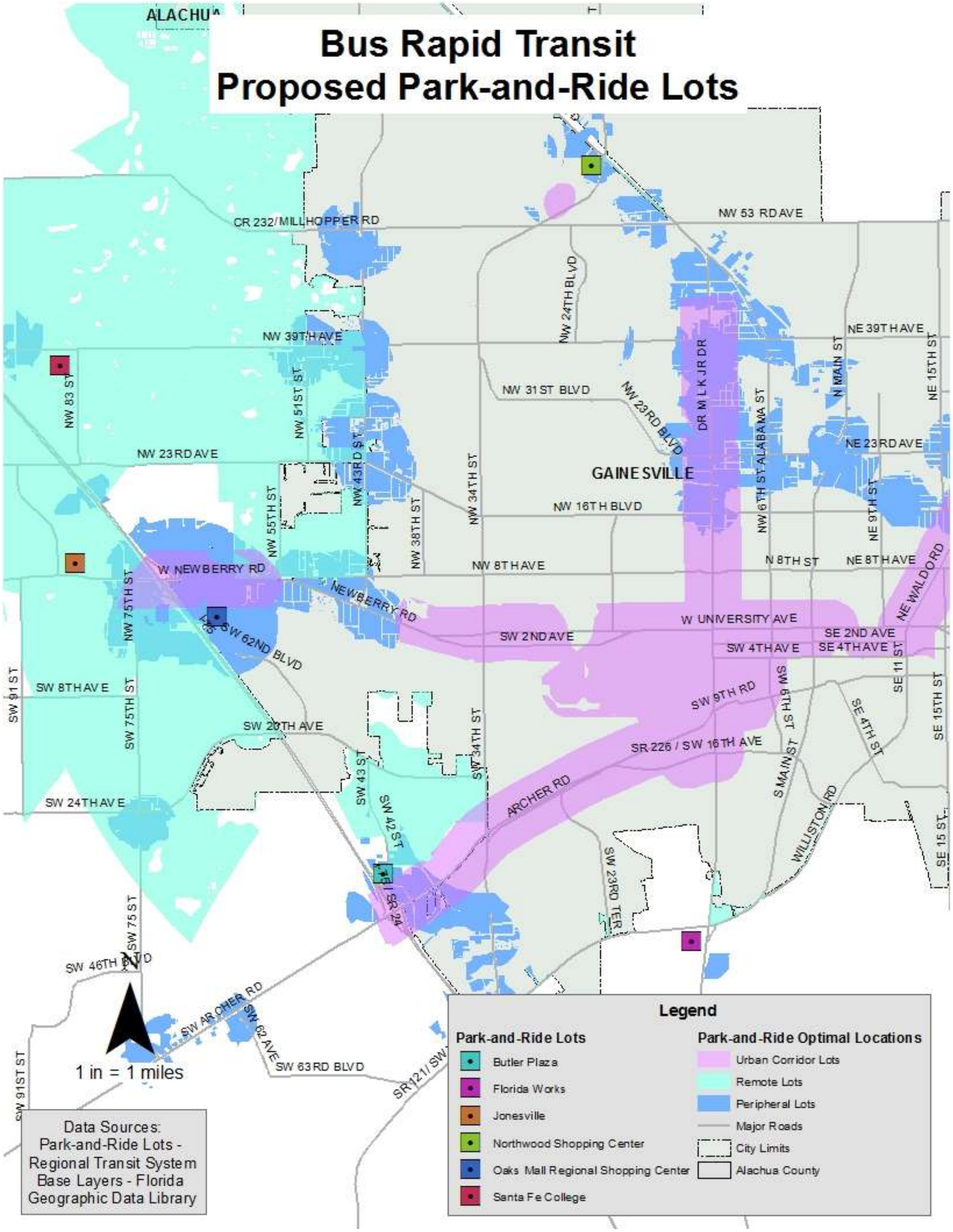

Figure 5-1. Bus Rapid Transit Feasibility Study Proposed Park-and-Ride Lots

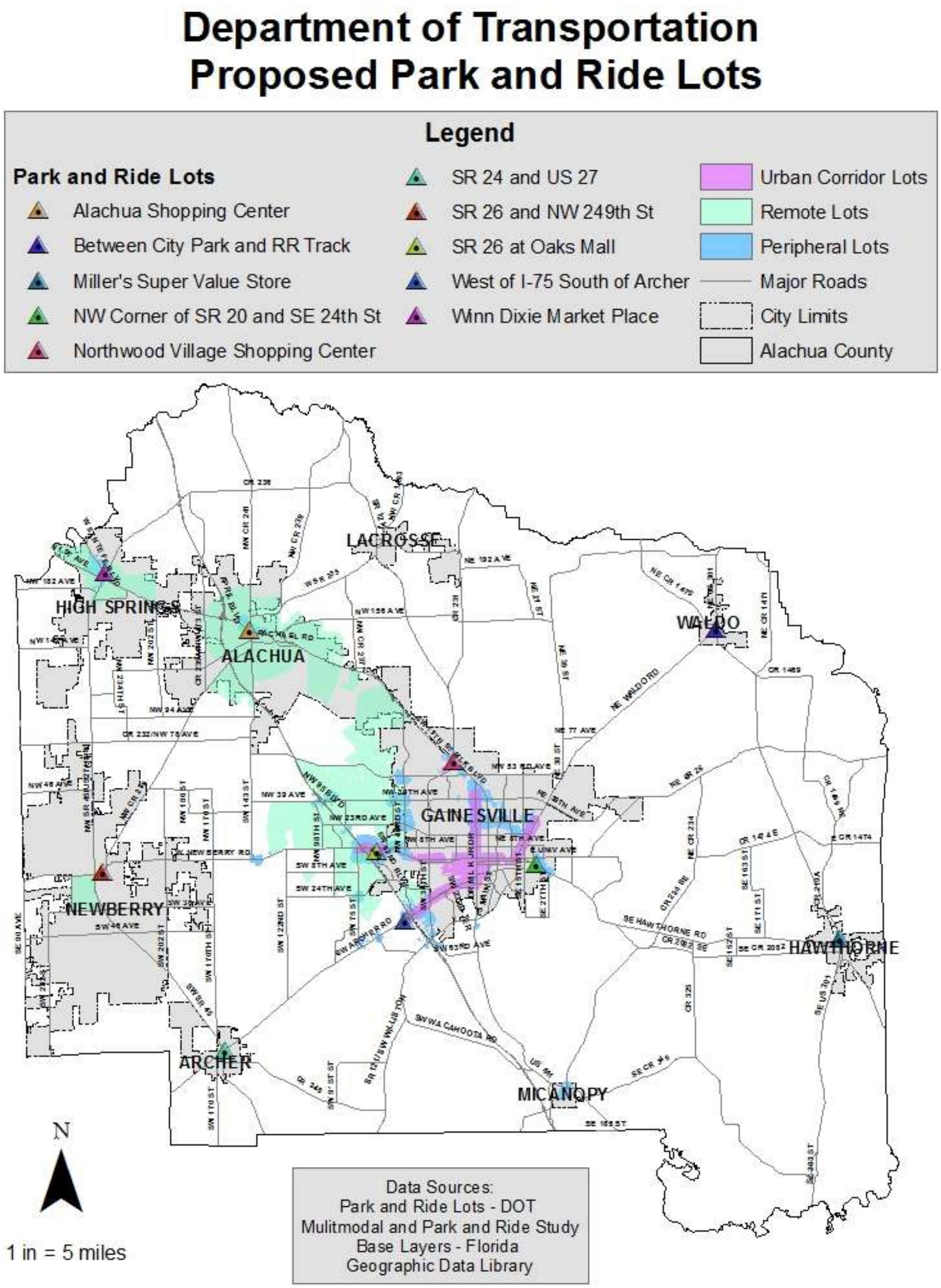

Figure 5-2. Department of Transportation Proposed Park-and-Ride Lots

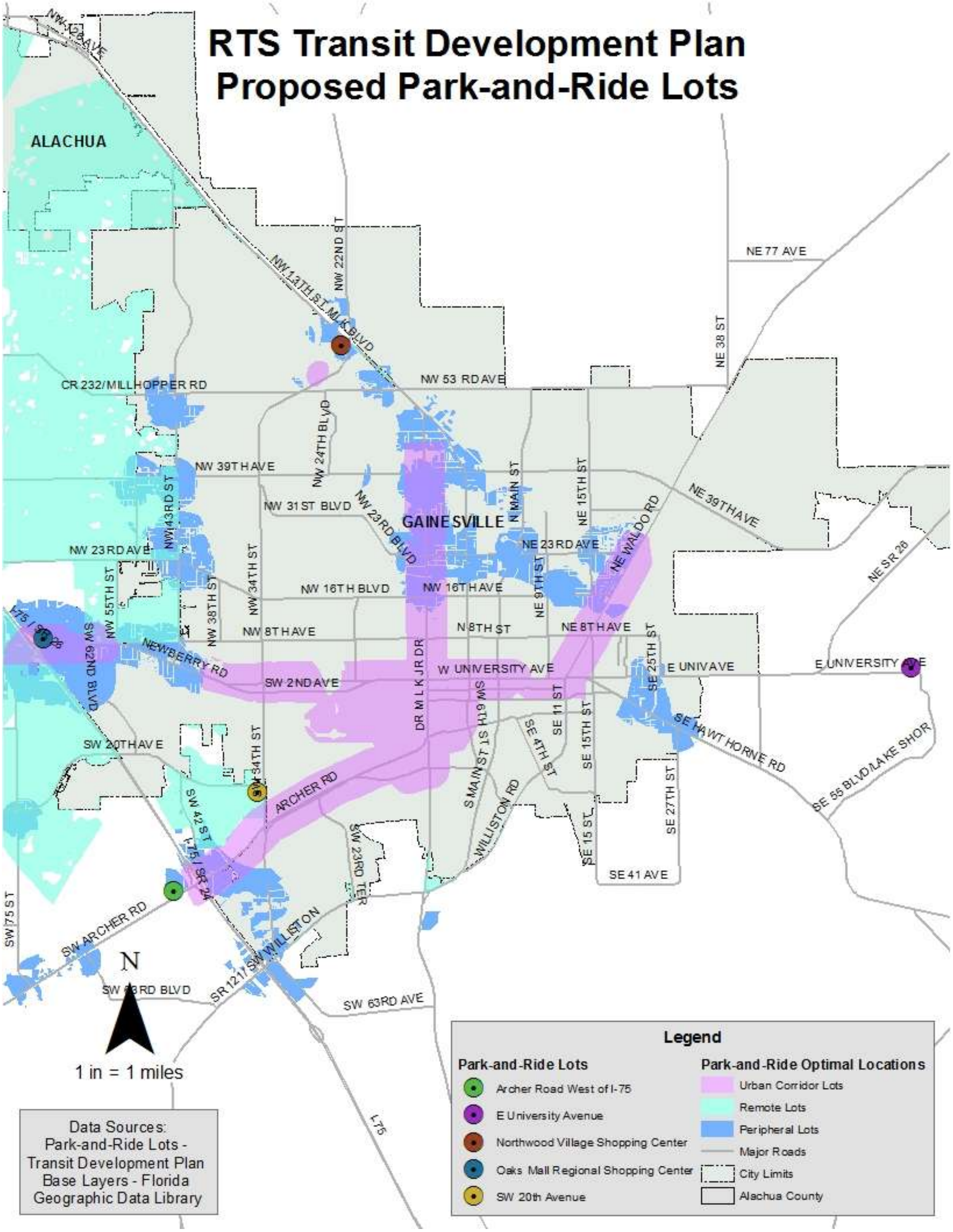

Figure 5-3. RTS Transit Development Plan Proposed Park-and-Ride Lots

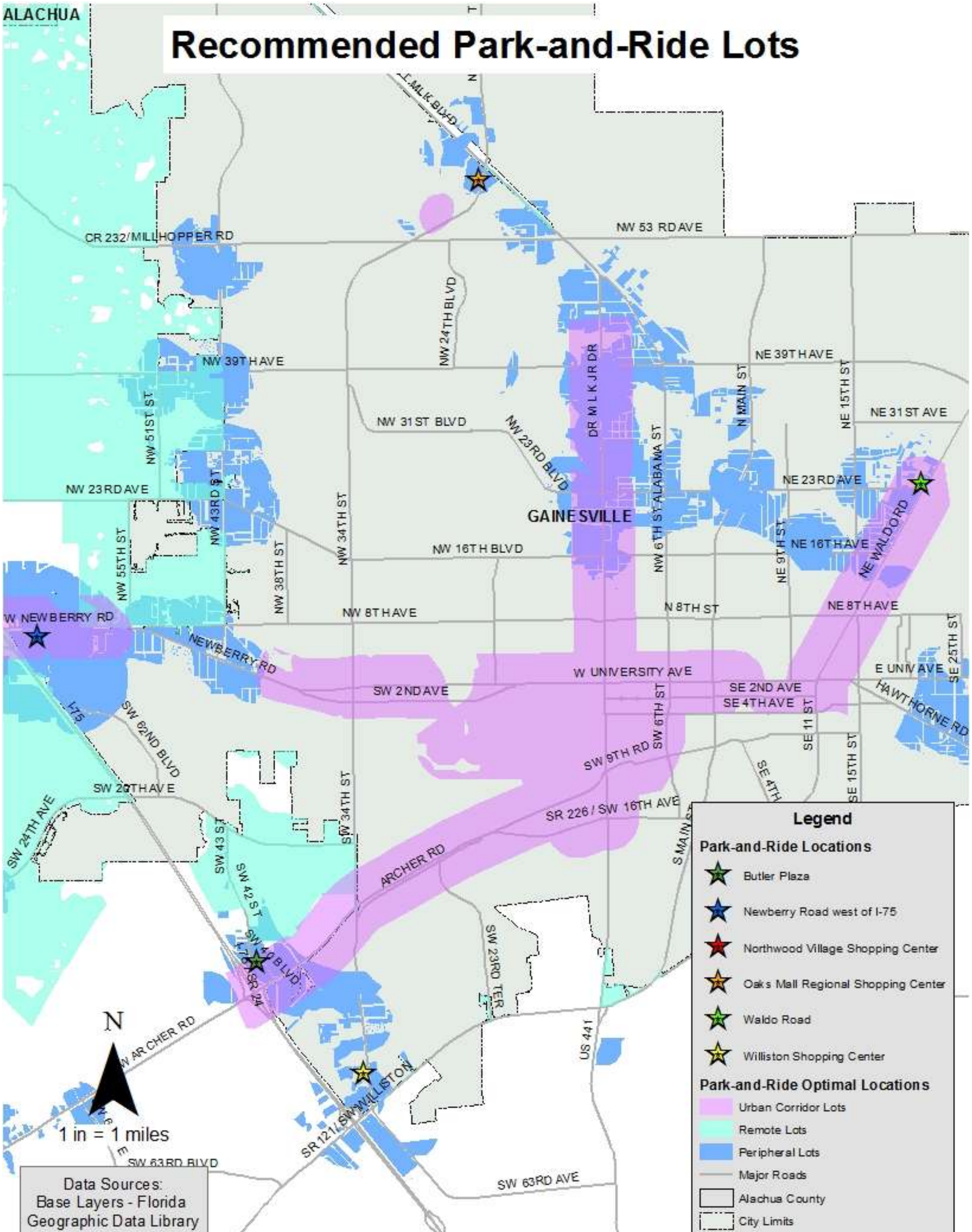

Figure 5-4. Recommended Park-and-Ride Lots

CHAPTER 6
CONCLUSION

This study set out to determine optimal locations for any of the three types of lots, Urban Corridor, Remote and Peripheral, throughout Alachua County. The final outcome rendered five potential park-and-ride lot locations: Northwood Village Shopping Center, Butler Plaza, Waldo Road, Williston Shopping Center and the Oaks Mall.

If the model was to be improved upon, some recommendations would be to use roadway level of service within the urban corridor analysis, to include access to bike routes and trails, to consider existing park-and-ride competition, and to use the capture rate as a parameter. The analysis could also be extended to include populations of unincorporated areas as well as take into account future roadway capacity projects. Some alterations that could be made would be to the buffers used to exclude the City of Gainesville, Downtown Gainesville and the University of Florida depending on the target audience these could be extended or shortened to accommodate.

Other factors that might be taken into consideration are to include site and economic characteristics. Site characteristics would include the impact on local community of the project, the number of parking spaces that would be needed, the expansion potential of the facility and even perhaps the parking security. Economic characteristics might include the cost, ease of acquisition, and the development costs of the land. As well as what might be some of the user cost and time travel saving associated with the site.

In conclusion, this opportunity model is successful because when compared with other proposed park-and-ride plans this model had 81% (or 17 out of 21) in common with them. This opportunity model is useful because it references multiple variables when trying to propose new park-and-ride lot locations. It also allows for more alternative locations of park-and-ride facilities with varying level of suitability making the process more subjective to the area and circumstances that might arise.

APPENDIX A
ROADWAY LEVEL OF SERVICE

Level of Service	Description
A	Free-flow conditions. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high. The general level of comfort and convenience provided to drivers is excellent.
B	Allows speeds at or near free-flow speeds, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected, but there is a slight decline in the freedom to maneuver within the traffic stream relative to LOS A.
C	Speeds at or near free-flow speeds, but the freedom to maneuver is noticeably restricted (lane changes require careful attention on the part of drivers). The general level of comfort and convenience declines significantly at this level. Disruptions in the traffic stream, such as an incident (for example, vehicular accident or disablement), can result in significant queue formation and vehicular delay. In contrast, the effect of incidents at LOS A or LOS B are minimal, and cause only minor delay in the immediate vicinity of the event.
D	Conditions where speeds begin to decline slightly with increasing flow. The freedom to maneuver becomes more restricted and drivers experience reductions in physical and psychological comfort. Incidents can generate lengthy queues because the higher density associated with this LOS provides little space to absorb disruption in the traffic flow.
E	Represents operating conditions at or near the roadway’s capacity. Even minor disruptions to the traffic stream, such as vehicles entering from a ramp or vehicles changing lanes, can cause delays as other vehicles give way to allow such maneuvers. In general, maneuverability is extremely limited and drivers experience considerable physical and psychological discomfort.
F	Describes a breakdown in vehicular flow. Queues form quickly behind points in the roadway where the arrival flow rate temporarily exceeds the departure rate, as determined by the roadway’s capacity. Vehicles typically operate at low speeds in these conditions and are often required to come to a complete stop, usually in a cyclic fashion. The cyclic formation and dissipation of queues is a key characterization of LOS F.

Source: The Highway Capacity Manual

APPENDIX B
POINTS OF INTEREST

Name	Type	Name	Type
Archer Road/34th Street	Activity Center	Oaks Mall Regional Shopping Center	Shopping
Archer Road/Tower Road	Activity Center	Gainesville Mall	Shopping
Eastgate	Activity Center	Westgate Plaza	Shopping
Eastside	Activity Center	Gainesville Shopping Center	Shopping
Jonesville	Activity Center	Hunter's Crossing	Shopping
North Main Street/53rd Avenue	Activity Center	Millhopper Shopping Center	Shopping
Springhills	Activity Center	Williston Plaza	Shopping
Tower Road/24th Avenue	Activity Center	Northwood Village Shopping Center	Shopping
Williston Road/13th Street	Activity Center	Food Lion	Shopping
Gainesville Regional Airport	Airport	Pearl of Micanopy	Shopping
Santa Fe College	Education	Grove Park Grocery	Shopping
University of Florida	Education	Millers Super Value Food Store	Shopping
Shands Hospital	Hospital	Tim’s Fast Nickel	Shopping
North Florida Regional Medical Center	Hospital	Fast Track Foods	Shopping
Veterans Administration Hospital	Hospital	Radha Indian Groceries	Shopping
Matheson Historical Center	Museum	Harvey's Market	Shopping
Harn Museum of Art	Museum	Publix Supermarkets	Shopping
Natural History Museum	Museum	Sun Store	Shopping
Civil Courthouse	Public	Winn Dixie	Shopping
Criminal Courthouse	Public	Golden Foods Incorporated	Shopping
Health Department	Service	Specialty Foods Unlimited	Shopping
Family Services	Service	Community Grocery Store	Shopping
Florida Department of Children and Families	Service	Safeway Property Insurance	Shopping
Tacachale Center	Service		

APPENDIX C
DOR CODES

Use Code		Category	Use Code		Category
Residential	0000	Vacant Residential	**Industrial**	4000	Vacant Industrial
	0100	Single Family		4100	Light manufacturing
	0200	Mobile Homes		4200	Heavy industrial
	0300	Multi-family >= 10 units		4300	Lumber yards, sawmills
	0400	Condominia		4400	Packing plants (fruit, vegetable and meat)
	0500	Cooperatives		4500	Canneries, bottlers and brewers distilleries, wineries
	0600	Retirement Homes		4600	Other food processing
	0700	Miscellaneous Residential		4700	Mineral processing, cement plants, refineries
	0800	Multi-family < 10 units		4800	Warehousing, terminals
	0900	Undefined Commercial		4900	Open storage
Commercial	1000	Vacant commercial	**Agricultural**	5000	Improved agricultural
	1100	Stores, one story		5100	Cropland soil capability
	1200	Mixed use		5200	Cropland soil capability
	1300	Department Stores		5300	Cropland soil capability
	1400	Supermarkets		5400	Timberland
	1500	Regional Shopping Centers		5500	Timberland
	1600	Community Shopping Centers		5600	Timberland
	1700	Office buildings, one story		5700	Timberland
	1800	Office buildings, multi-story		5800	Timberland
	1900	Professional service buildings		5900	Timberland
	2000	Airports		6000	Grazing land soil capability
	2100	Restaurants, cafeterias		6100	Grazing land soil capability
	2200	Drive-in Restaurants		6200	Grazing land soil capability
	2300	Financial institutions		6300	Grazing land soil capability
	2400	Insurance company offices		6400	Grazing land soil capability
	2500	Repair service shops		6500	Grazing land soil capability
	2600	Service stations		6600	Orchard Groves, Citrus, etc.
	2700	Auto sales, auto repair and storage		6700	Poultry, bees, tropical fish, rabbits, etc.
	2800	Parking lots, mobile home parks		6800	Dairies, feed lots
	2900	Wholesale outlets		6900	Miscellaneous agricultural Institutional
	3000	Florist, greenhouses			
	3100	Drive-in theaters, open stadiums			***Some definitions were truncated**
	3200	Enclosed auditoriums			
	3300	Nightclubs, cocktail lounges, bars			
	3400	Enclosed arenas			
	3500	Tourist attractions			
	3600	Camps			
	3700	Race tracks; horse, auto or dog			
	3800	Golf courses, driving ranges			
	3900	Hotels, motels Industrial			

	Use Code	Category		Use Code	Category
Institutional	7000	Vacant Institutional	Miscellaneous	9000	Leasehold interests (government owned property leased by a non-governmental lessee)
	7100	Churches		9100	Utility, gas and electricity, telephone and telegraph, locally assessed railroads, water and sewer service, pipelines, canals, radio/television communication
	7200	Private schools and colleges		9200	Mining lands, petroleum lands, or gas lands
	7300	Privately owned hospitals		9300	Subsurface rights
	7400	Homes for the aged		9400	Right-of-way, streets, roads, irrigation channel, ditch, etc.
	7500	Orphanages, other non-profit or charitable services		9500	Rivers and lakes, submerged lands
	7600	Mortuaries, cemeteries, crematoriums		9600	Sewage disposal, solid waste, borrow pits, drainage reservoirs, waste lands, marsh, sand dunes, swamps
	7700	Clubs, lodges, union halls		9700	Outdoor recreational or parkland, or high-water recharge subject to classified use assessment.
	7800	Sanitariums, convalescent and rest homes		9800	Centrally assessed
	7900	Cultural organizations, facilities Government		9900	Acreage not zoned agricultural
Government	8000	Undefined			***Some definitions were truncated**
	8100	Military			
	8200	Forest, parks, recreational areas			
	8300	Public county schools – include all property of Board of Public Instruction			
	8400	Colleges			
	8500	Hospitals			
	8600	Counties (other than public schools, colleges, hospitals) including non-municipal governments			
	8700	State, other than military, forests, parks, recreational areas, colleges, hospitals			
	8800	Federal, other than military, forests, parks, recreational areas, hospitals, colleges			
	8900	Municipal, other than parks, recreational areas, colleges, hospitals			

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BIOGRAPHICAL SKETCH

Jessica Alvarez is a Florida native that has been a resident of the City of Gainesville for seven years. Coursework for her bachelor degrees in anthropology and business introduced her to the cultural aspects related to the variables chosen for this study. Coursework for her first master's degree in civil engineering introduced her to the transportation technicalities related to park-and-ride lots. Throughout the author's graduate education, she worked as a teaching assistant within the Urban and Regional Planning Department for the Introductory Geographic Information System's class. The knowledge gained through this experience was applied to the methodology in this study. The author is currently working at the Regional Transit System (RTS) in Gainesville, FL. Specializing in transportation planning; this knowledge was also applied to this study. This park-and-ride study will be continued and expanded at RTS in order to produce a final document that can be incorporated into a product appropriate for use at RTS for the locating of park-and-ride lots.