Choices & Concepts Report

GOBORO

SEPTEMBER 2023

Prepared for Greensboro Transit Agency

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1 Introduction

What Is GoBORO?

GoBORO is the Long-Range Transit Plan for Greensboro and will create a new vision for public transit service that supports the Community's goal to become a **car-optional city** by 2045[1].

This is a **collaborative planning effort** between the City of Greensboro, Greensboro Transit Agency (GTA), regional partners, transit stakeholders, and members of the Community to decide the goals and purposes for the City's investment in public transit. In the context of the goal of a car-optional city, this project will create a **framework for decisions** about:

- how and to what extent the City's level of investment in transit resources can match the Community's values and goals;
- how these resources are invested—where bus routes will go, what times they run, and how frequently they run;
- how to phase and prioritize changes to get Greensboro's transit network closer to its transit vision; and
- how to plan for future growth in and around Greensboro that can help support its car-optional vision.

Visioning the future of transit in Greensboro from a **blank-slate approach** is an opportunity to review existing and potential transit demand and need, and to design a network that meets those demands and needs most effectively in the long term.

Transit is expected to fulfill several different goals. Regardless of the level of resources available, many of these goals compete and present trade-offs. This process is a key opportunity to carefully **think through and weigh competing goals for transit service.**

Service and Infrastructure

Often, transit service is overlooked as a factor because infrastructure investments like large hubs are beautiful bus stops are more physically obvious. But these are not useful to a community if there isn't good transit service using them. Similarly, the benefits of a well-designed transit network with lots of service can be very diminished if there is no good infrastructure to support it.

The primary focus of GoBORO is transit service. However, investments in the infrastructure and land use that support transit are just as important as investment in transit service.

Greensboro still needs to invest in sidewalks, bike lanes, bus lanes, trails, safe crossings, bus shelters, transit hubs, and all the infrastructure that makes good transit service (and travel without a car) possible. The transit service plan that results from GoBORO can be used by Greensboro to encourage and prioritize investments in these elements.

What Is the Purpose of This Report?

This Choices & Concepts Report is the **first step** in GoBORO. It is meant to spark a conversation about transit needs and goals in Greensboro. This Report lays out relevant facts about transit and existing and potential development in Greensboro, and draws the reader's attention to major choices that these facts force us to weigh.

This purpose of this report is to assess the existing transit network, demographics, and geometry of Greensboro; and engage the public, stakeholders, and elected officials in a conversation about the goals of transit in the Greensboro Community. Reasonable people can disagree about the purpose of transit in their own community. Transit can deliver many different outcomes, but some of these outcomes trade-off against others.

Learning how the Community values different outcomes is an essential step in deciding where to run service, what kind of service to run, and how to define success.

This Choices & Concepts Report explains some of those trade-offs and helps the reader identify which choices are most consistent with their own values for transit. To do this, we present **two Conceptual Networks** in this report that demonstrate the outcomes of the choices that shape transit service.

This report represents the first step in a three-phase process of balancing goals and priorities for Greensboro's future transit network. It serves as a basis of information for public meetings, surveys, and outreach for what we call the "Choices Phase" of GoBORO. The public and stakeholders will be invited to respond to these key questions.

1 The car-optional goal is one of several community goals outlined in the GSO 2040 comprehensive plan. This plan and other plans that have informed GoBORO are summarized in Appendix B.

How We Got Here

As part of the process of leading up to this first phase of public and stakeholder engagement, the consultant team **began with a detailed analysis of the existing conditions** that are important to consider while planning transit service. This included examining GTA's service and ridership data; Greensboro's geography, demographic and job data; the resulting transit service outcomes; and the past and current plans relating to mobility and transit in Greensboro.

Following this, the project team, consisting of the consultant team and staff from GTA, the City of Greensboro, and PART, **designed two Network Concepts in charrette-style collaborative meeting** spanning multiple days. This critical component of the process brought together insights from the existing conditions analysis, our expertise in transit service planning, and most importantly, the GTA and City staff's extensive knowledge of the Greensboro Community. We then analyzed the outcomes of these networks in order to illustrate real potential impacts rather than abstract choices.

Figure 1: The Network Concepts presented in this report have been designed collaboratively with GTA and City of Greensboro staff at the table.

Timeline of GoBORO

The anticipated timeline for the GoBORO process is as follows:

- **March to September 2023:** Existing conditions analysis, past plans review, development of Conceptual alternatives for the long-term GTA network.
- **September to October 2023:** Public outreach, community review, and response to this report and Network Concepts.
- **November 2023 to January 2024:** Analysis of public input on network concepts, development of draft long-term GTA network.
- **February to March 2024:** Public outreach, community review, and response to draft long-term GTA network.
- **April to June 2024:** Finalize the long-term GTA network plan and implementation strategy.

At two key phases in this process, City staff and the consulting team will engage the public, elected officials, local and regional partners, and stakeholders in multiple ways:

- In-person outreach at transit stops and community events.
- Online and paper surveys.
- Consultation with a committee of key stakeholders.
- Public meetings with online and telephone call-in options.

More information about the process and details on the latest events will be posted at https://bit.ly/goboro_site.

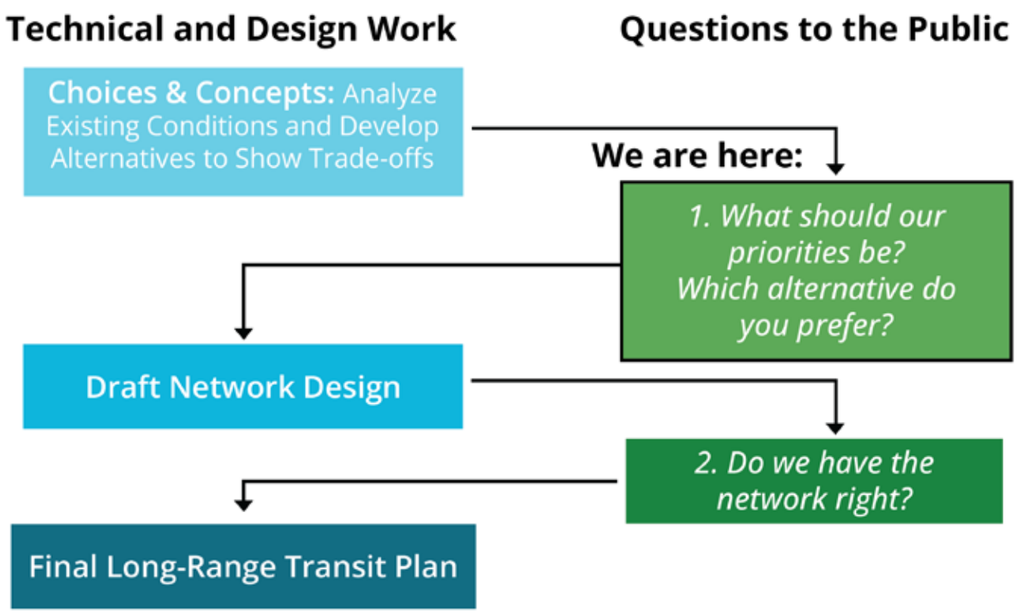


Figure 2: The process of Technical and Design Work and Public Engagement that will guide GoBORO.

What Does "Car-Optional" Mean for Transit?

When thinking about the long-term future of the transit network, it is important to understand what "car-optional" means for Greensboro. Does it mean that:

- **Most people** in Greensboro have a transit option that is **very useful** in reaching many places and destinations in a reasonable time? Or...
- **Everyone** in Greensboro has an option to use transit, even if for many people, transit **may not be very useful** in reaching many places and destinations in a reasonable time?

These two ways of thinking about the meaning of being car-optional with respect to the transit network lead to two very different, contrasting network designs and outcomes.

Transit's Many Goals

Beyond supporting a car-optional city, transit can also serve many other goals. Different people and communities value these goals differently. Understanding which goals matter most in Greensboro is a key step in designing future GTA service. Examples of other transit goals include:

Economic: Transit can give workers access to more jobs, businesses access to more people, and students access to education and training.

Social: Transit can meet the needs of people who are in situations of disadvantage, providing access to services and jobs. It can also promote equity and inclusion across a diverse society.

Congestion: Transit can allow for continued economic growth beyond what congestion would limit.

Environment: High transit use can reduce greenhouse gas emissions, and local impacts of air and noise pollution.

Some of these goals are only served if transit is very useful so that many people use transit. For example, transit can only mitigate congestion and pollution if many people choose the option of taking the bus rather than driving. The same is true for economic access. Transit is only effective at these goals if it is very useful to most people. We call these **ridership goals** because they are achieved by designing service to obtain high ridership.

Other goals are served by making simply some level of transit available in as many areas as possible. A route may serve a small number of people, but deliver a lot of benefit in their lives by giving them the option to take transit if they have no other way of traveling. In that way, it provides residents some choice, and insurance against isolation. It may also fulfill political or social obligations, for example by getting service close to every taxpayer or into every district. We call these types of goals **coverage goals** because they are achieved by covering geographic areas with service, regardless of ridership.

The purpose of transit and the goals it serves can vary depending on what you mean by "car-optional".

Figure 3: Is a mostly-empty bus failing? That depends entirely on why you are running it in the first place.

High Ridership Is Not Transit's Only Goal

If Greensboro wanted to maximize transit ridership, it would focus its network around the busiest places where the greatest numbers of people live and work. If GTA did this, it would be acting more like a business: delivering the best service in places with the most potential customers.

Businesses are under no obligation to spread their services around widely. In fact, they tend to avoid spending a lot of money to reach only a few customers.

For example, McDonald's is not obliged to provide a restaurant within half a mile of everyone in Greensboro. If it were, then the company would have to add several additional locations. Some locations would serve just a handful of homes, and most would operate at a loss because there are so few customers nearby.

Transit agencies are not private businesses. Most transit agencies decide that they do have some obligation to cover places with fewer people in them even when this would not be a "good business decision."

The officials who ultimately make public transit decisions hear their constituents say things like "We pay taxes too" and "If you cut this bus line, I will be stranded" and they decide that coverage, even in low-ridership places, is an important transit outcome. This is why transit agencies rarely act like private businesses.

Transit agencies are often accused of failing to maximize ridership, as if that were their only goal. In fact, most agencies are intentionally operating some coverage services that are not expected to generate high ridership.

Ridership and Coverage Goals Conflict.

All transit agencies must balance the competing goals of high ridership and extensive coverage. Within a limited budget, if an agency wants to do more of one, it must do less of the other.

Here is an illustration of how ridership and coverage goals conflict with one another due to geometry and geography. In the fictional town at the top of the image on the right, the little dots indicate dwellings, commercial buildings and other land uses. The lines indicate roads. Most of the activity in the neighborhood is concentrated around two roads, as in many towns.

A transit agency pursuing only a **high-ridership** goal would focus service on the streets where there are large numbers of people, where walking to transit stops is easy, and where the straight routes feel direct and fast to customers. Because service is concentrated onto fewer routes frequency is high and a bus is always coming through the neighborhood soon. This results in a network like the one at bottom-left.

If the transit agency were pursuing only a **high-coverage** goal, on the other hand, it would spread out services so that every street had a bus route, as in the network at bottom-right. As a result, all routes would be infrequent, requiring long waits, even in the busiest places.

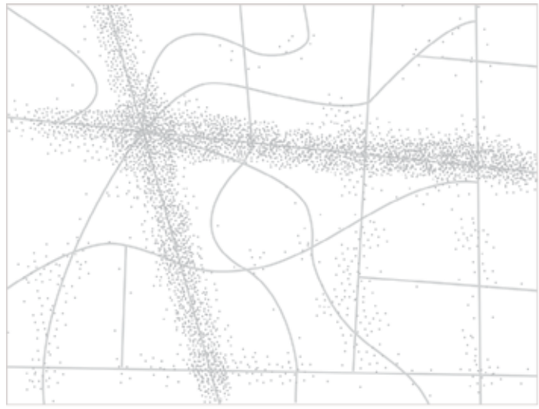
On a fixed budget, designing transit for both ridership and coverage is a zero-sum game. Each bus that the transit agency runs down a main road, to provide more frequent and useful service there, is not running on the neighborhood streets, providing coverage. An agency can pursue ridership and provide coverage within the same budget, but it can't do both with the same dollar. The more it does of one, the less it does of the other.

These illustrations also show a relationship between coverage and complexity. In this imaginary neighborhood, any person could keep the very simple "high frequency" network in their head, since it consists of just two routes running in straight lines. They would not even need to consult a schedule to catch a bus. The coverage network would be harder to memorize, requiring people to consult a map (to understand the routing) and a schedule (to catch these infrequent services).

These two scenarios require the same number of buses and cost the same amount to operate, but deliver very different outcomes.

The choice between pursuing ridership and coverage is not binary. It's a sliding scale. Every transit agency spends some portion of its budget on both types of goals.

A particularly clear way for transit agencies to set a policy balancing ridership and coverage is to decide what percentage of their service budget should be spent in pursuit of each. The "right" balance of ridership and coverage goals is different in every community.



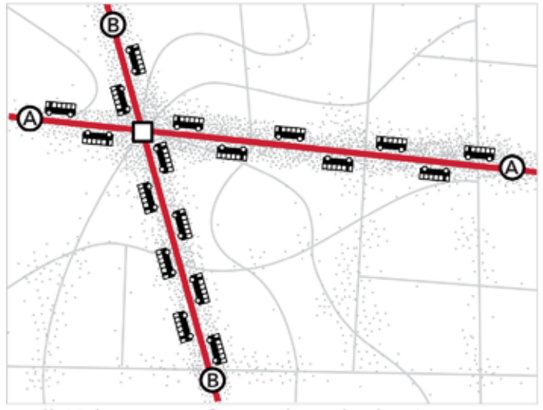
Imagine you are the transit planner for this fictional neighborhood. The dots scattered around the map are people and jobs.

The 18 buses above are the resources the town has to run transit.

Before you can plan transit routes, you must first decide:

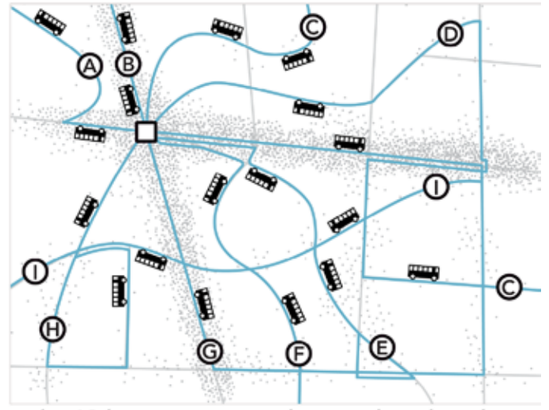
What is the purpose of your transit system?

If you maximize ridership...



...all 18 buses are focused on the busiest streets. Waits for service are short but walks to service are longer for people in less populated areas. Frequency and ridership are high but some places have no service.

If you maximize coverage...



...the 18 buses are spread around so that there is a route on every street. Everyone lives near a stop but every route is infrequent, so waits for service are long. Only a few people can bear to wait so long, so ridership is low.

Figure 4: Comparing an imaginary town, if transit were run with the goal of maximizing frequency and ridership, to the same town if transit is run with the goal of providing a little service near everyone.

Why Invest More in Transit Service?

The trade-off between transit's ridership and coverage goals is inevitable when there are limited resources. There simply aren't resources to provide high-frequency routes close to everyone. The most obvious way to expand the possibilities of what goals (even if they are ridership or coverage goals) a transit system can achieve is to increase the level of investment in the resources available to operate transit. **A growing resource pot protects the community from having to make painful trade-offs between competing, but closely-held, values.**

Current Transit Investment Is Low

A direct way to think about the level of investment in transit service is to look at the quantity of service an agency provides. This is often measured as "service hours" or "revenue hours". Each service hour or revenue hour is one vehicle and one operator out in the field, driving a route (or taking a necessary break) across one hour.

GTA has seen an overall decrease of 5% in service investment between 2012 and 2021. This can be seen in the chart on the left side of Figure 5. Between 2015 and 2017, there were slight increases in service, but these were not enough to offset sharper declines between 2012 and 2014, and from 2017 to 2019. The sharp dip and increase in 2020 and 2021 corresponds to the service changes during the COVID-19 pandemic.

Throughout this time, Greensboro's population has grown 10%. This means that on a per person basis, the investment in transit in Greensboro was 14% lower in 2021 than in 2012. This trend can be seen in the chart on the right side of Figure 5.

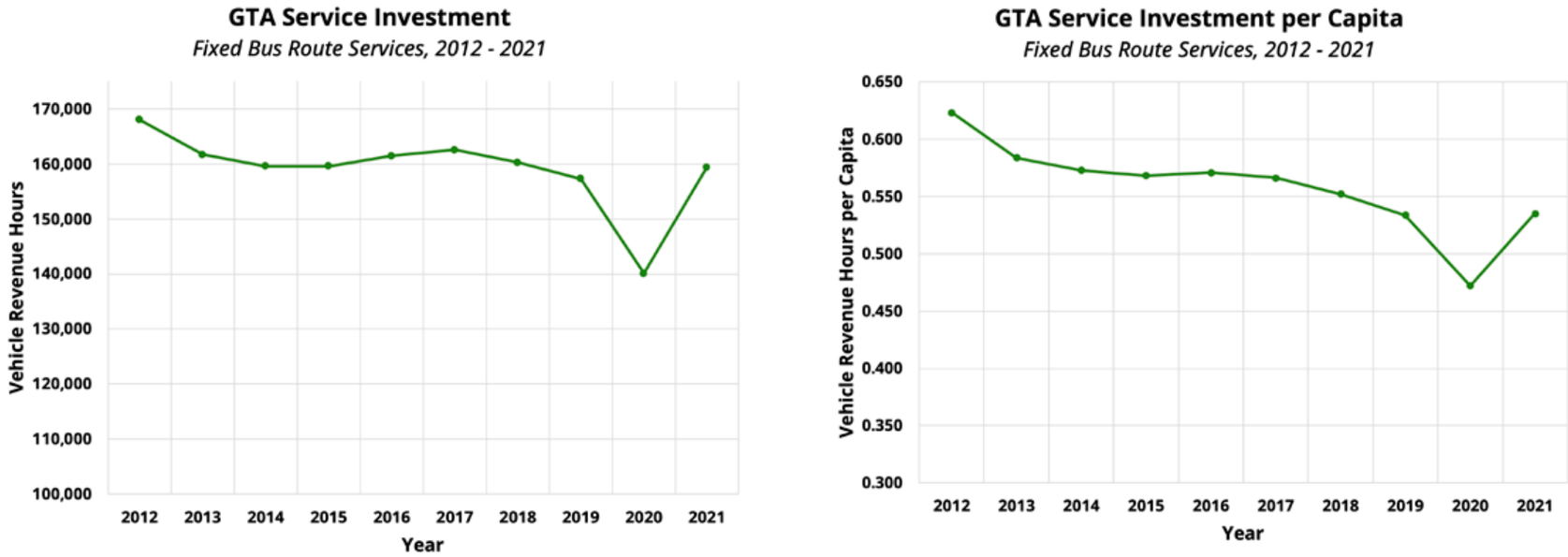


Figure 5: The total service that GTA provides is considerably lower than 2012 levels, with only small increases between 2015 and 2017, and in 2021 (which corresponds to COVID-19 pandemic recovery). Source: National Transit Database, 2021.

Outcomes of Transit Investment

Every transit agency is unique in terms of service area, political context, and funding mechanism. The outcomes of these factors can be compared among agencies by looking at how much service a transit agency invests in relative to the population of its service area.

The charts in Figure 6 compare service statistics for some of Greensboro's peer cities. These include similar mid-sized cities in North Carolina (Durham) and two neighboring states (Columbia, SC and Knoxville, TN), as well as other culturally and geographically different cities which are nonetheless economically similar (distinct mid-sized cities with large universities): Reno, NV; Lansing, MI; and Saskatoon in Saskatchewan, Canada.

Greensboro has quite a low level of service investment relative to its population. GTA's nearby peer **GoDurham operates 40% more service per capita than Greensboro**. Other peers also provide more service per capita than Greensboro does. Only Columbia, SC has a lower per-capita service investment than Greensboro.

The chart at the bottom of Figure 6 shows ridership relative to population for Greensboro and its peers. Generally, places that invest more in transit service relative to their population see a higher level of ridership relative to their population, in a "you get what you pay for" relationship.

Transit is more relevant as a travel option for more people if a community invests more in transit. In this way, **the level of investment in transit is related directly to Greensboro's "car-optional" vision.**

This can be visualized as two contrasting way to increase investment:

- Increased investment can make transit more frequent and available longer in the densest, most proximate parts of the City, making it useful for a large numbers of people, and will lead to a significant increase in ridership per capita.
- More resources can be invested in running more routes that cover a much larger area of Greensboro than today at frequencies and spans similar to today's. While this wouldn't lead to a large increase in ridership, it would expand transit as *an option* for many people, even if it isn't an *attractive option.*

The questions of how to balance frequency with coverage, and how much service to pay for, both relate to people's feelings that the transit network is valuable and relevant to their lives. If people do not understand what goals Greensboro's transit network is trying to achieve, then there will be some natural reluctance to increase investment in the transit system.

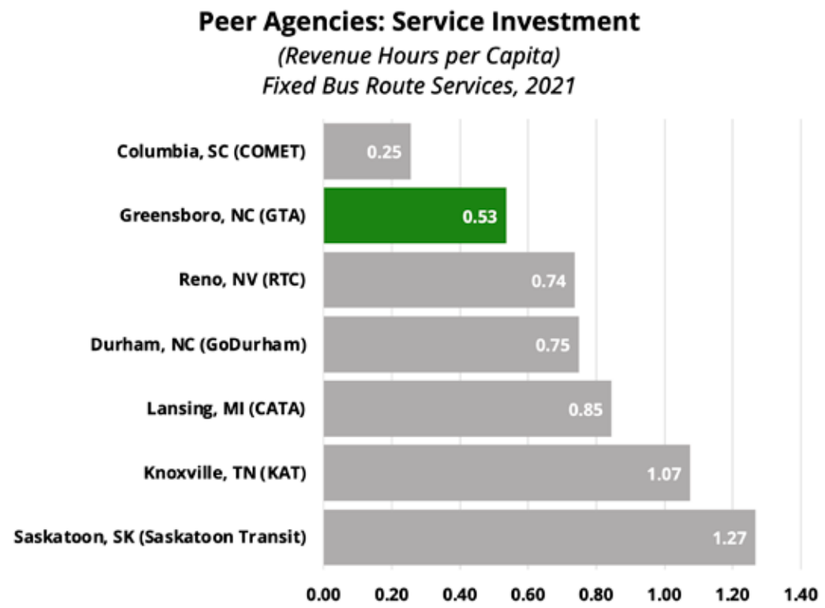


Figure 6: Revenue Hours per Capita (Investment) and Passenger Trips per Capita (Relevance) for Greensboro compared to peer cities. Source: National Transit Database, 2021.

Network Concepts

In order to spark a conversation about transit needs and goals in Greensboro, Chapter 6 of this report presents two different Conceptual Networks, which:

- Contrast each other to illustrate two opposite ways in which Greensboro could invest these increased resources in its transit network.
- Together illustrate the kind of transformative changes possible in the outcomes of transit service that people value, if Greensboro invested significantly more in its transit service.

The Ridership Concept concentrates frequent, useful service where there are more residents and jobs, and where transit can run in linear, direct paths. But there will be less resources to expand transit to new areas not served today.

The Coverage Concept expands transit service to many new areas in and around Greensboro, which means that many more people and jobs will be closer to transit than they are today. However, most routes will not be frequent, and transit may less useful to a lot of people.

Chapter 7 shows the differing outcomes of these Concepts, in terms of how many people and jobs will be covered by transit (proximity), and how many jobs can people reach from specific locations (isochrones) and from every location across the city (access).

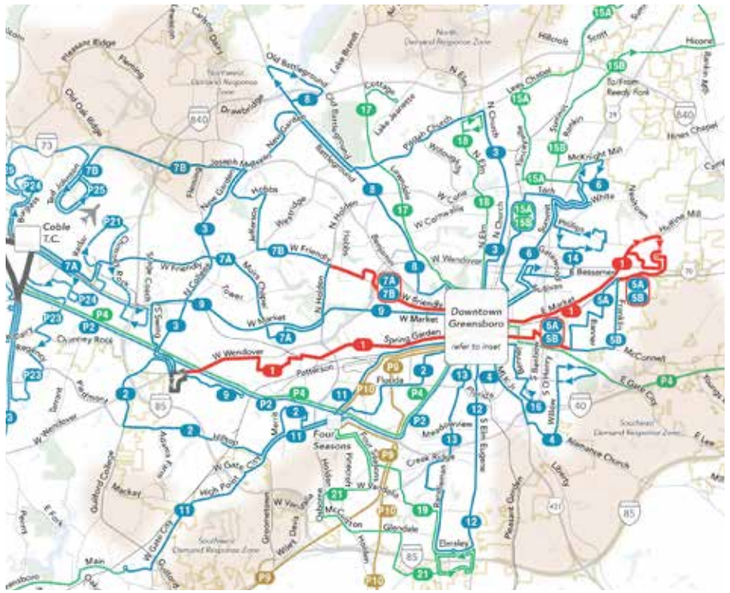
Higher Investment in Transit Service

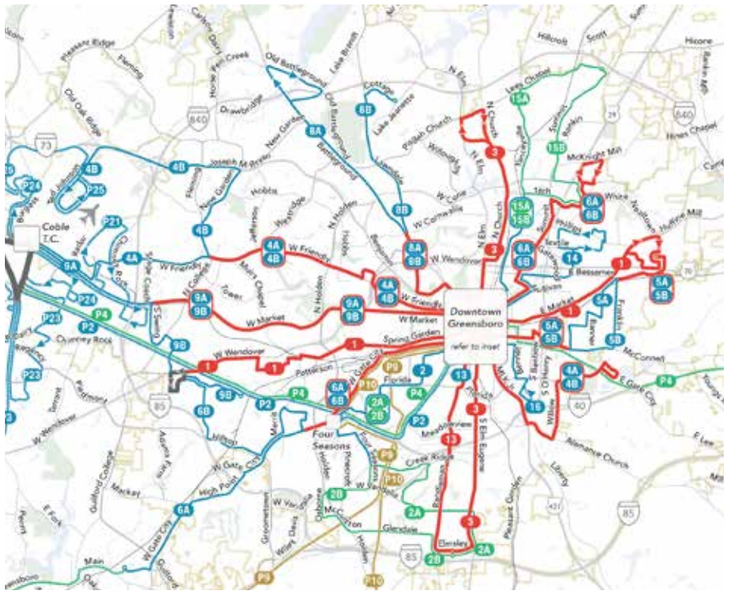
Both Conceptual Network show significant improvements in proximity and access outcomes compared to the Existing Network.

This is because both Concepts assume more than twice as many resources as today available to run transit. This is a deliberate choice on part of the project team, since as part of this project, we want to start a conversation about whether Greensboro should invest more in its transit network.

The project team has estimated that the increased resources in these Concepts could be funded by **a hypothetical ½-cent Sales Tax** across Guilford County. Such a tax would generate revenue to dramatically increase the operating resources for not just GTA, but also its partner agencies in the County: PART, High Point Transit, and Guilford County Transportation & Mobility Services. It could also fund several infrastructure projects to support transit, walking, and biking.

If such a hypothetical tax were in place in 2022, it would have cost households in Guilford County an average of $9 per month. For comparison, households in Guilford County spend an average of $840 per month on car-related expenses (which doesn't include the tax burden that funds highway and roadway projects).





What Else Is in This Report?

The Geometry of Useful Transit

In Chapter 2, we summarize the basic principles of transit geometry, how they affect the access and opportunities that transit can provide to residents, workers, and visitors. Access is what makes transit useful, and what makes people choose transit for their travel. It is important to understand how the underlying geometry forces every community to grapple with some key value trade-offs in the design of its transit system.

Markets and Needs for Transit

In Chapter 3, we assess the existing markets for transit in Greensboro, the potential for high ridership, and the areas where the need for transit is high.

By "market" we are referring specifically to demand for transit that results in high ridership relative to cost. This way of thinking about a transit market is similar to the way a private business thinks about its market for sales—how many potential customers there are, how useful they will find the product, and how well the product competes for their business.

The "need" for transit can be defined in many ways, but in most communities, people in need of transit usually includes those in poverty, people who are less likely to be able to drive, like seniors and youth, or households without cars.

Another important aspect while designing a transit network is not strictly related to demand or need, but rather to civil rights. The ramifications of historic segregation policies continue today, and it is important to understand where there are intersections between patterns of historic segregation and concentrations of high transit demand or need.

Existing Network

In Chapter 4, we analyze the fixed route transit network performance including the frequency of service, span of service, route productivity, and how the network performs on measures like access to jobs (how many jobs can someone reach by transit in a reasonable time) and proximity to transit (how many people and jobs are close to transit service). We also assess some key structural features of the GTA network which reflect the results of key choices in a constrained resource environment.

Key Choices

In Chapter 5, we summarize key value choices that only the Greensboro community and its leaders can make about how transit should serve the City. Key value questions include Ridership versus Coverage, Walking versus Waiting, and how much to invest in transit.

Next Steps

This report represents the first stage of planning for the long-term future of Greensboro's transit network. It serves as a basis of information for public meetings, surveys, and outreach for what we call the "Concepts Phase" of the GoBORO process.

Through Fall 2023, stakeholders, elected officials, bus riders, and members of the general public will be invited to respond to the key choices presented in this phase of outreach. We will gather their input through online and paper surveys, in-person outreach at transit stops and community events, consultation with a committee of key stakeholders, and public meetings.

This input will be crucial in informing the next phase of technical work, when we will design a single Draft Recommended Network based on the Community's preferences and choices.

For more information about the surveys and outreach event dates, please visit: https://bit.ly/goboro_site.

2 What Makes Transit Useful?

Transit Is Useful Because of the Access It Provides.

Wherever you are in your city, there are a limited number of places you can reach in a given amount of time. These places can be viewed on a map as a "blob" around your location, as in Figure 7. Beyond this area are things you can't reach because it simply takes too long to get there.

The technical term for the blob you can reach in a given time is an **isochrone**, and the destinations in that isochrone are the opportunities you can **access:** for work, school, shopping, or any other reason you might want to go somewhere.

It is also fair to think of **access as freedom,** in the physical sense. If you can use transit go to more places, you have the choice to not drive or hire a car, and you have more choice in the places you can go to, the jobs you can hold, the things you can do, and so on. In a sense, you are more free.

How Transit Expands Access

Transit provides value when it increases people's freedom. That happens by increasing the number of useful places people can access in a reasonable amount of time. The extent of your access is determined by:

- The **network,** including transit lines with their frequency, speed, and span. This determines how long it takes to get from any point on the network to any other point. So, if you can get further in the same amount of time, the "blob" around you is bigger, and you can access more opportunities.
- The **layout of the city.** This determines how many useful destinations can be located near transit stops. Where there are more people or useful destinations near a given stop, good access from that point is of value to more people. If there are more opportunities inside your blob, you can access more opportunities.
- Your **location.** This determines which routes are close and frequent enough to be useful to you, and changes how big or small your blob is.

Why Access Matters

On an individual level, access represents convenience and the ability to do the things you need to do, when you want to. It is not a prediction of what you will do. To that extent, **the level of access transit provides is part of what determines transit ridership.**

If you are deciding where to live based on whether you'll be able to get to your job, school, relatives, or medical care, you are asking a question about access. That access will influence your decision. If you want the **choice of not needing to drive a car**, you'd want to maximize access by walking, biking, and transit from your location.

Access is also something that many people see as **a worthy goal in itself**. For example:

- Access to jobs is a key concern for keeping people employed.
- Access to more people means that a business can have a larger pool of workers as well as customers.
- Access to many amenities from a particular location gives that location value. Real estate firms routinely outline where you can get to by car from a particular development parcel, and this is the same analysis for transit.

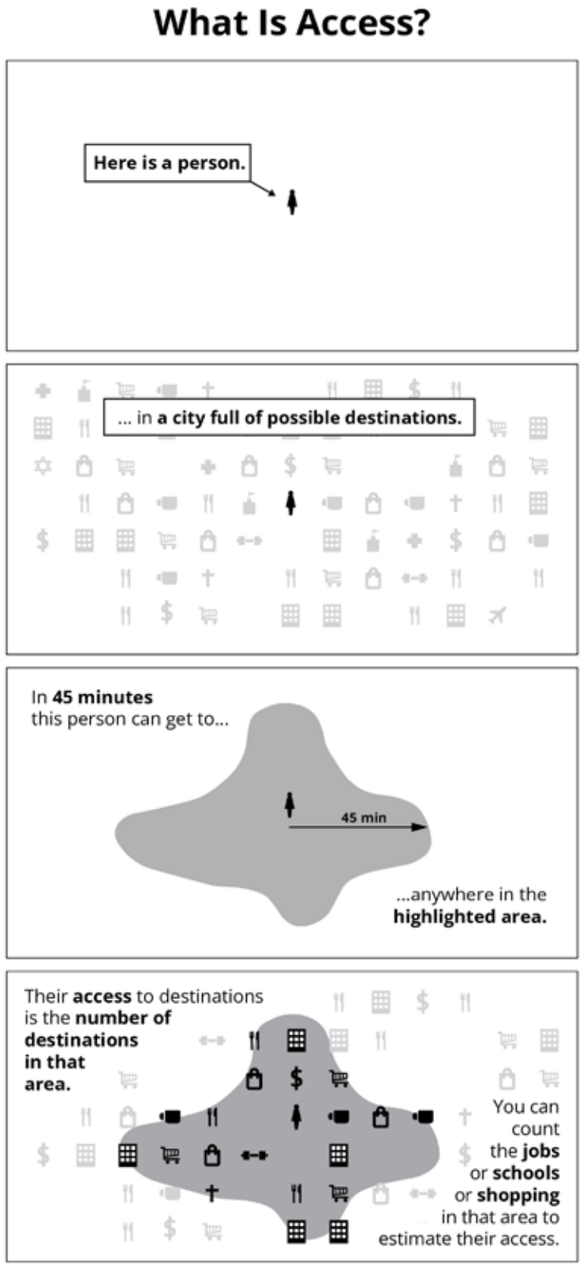
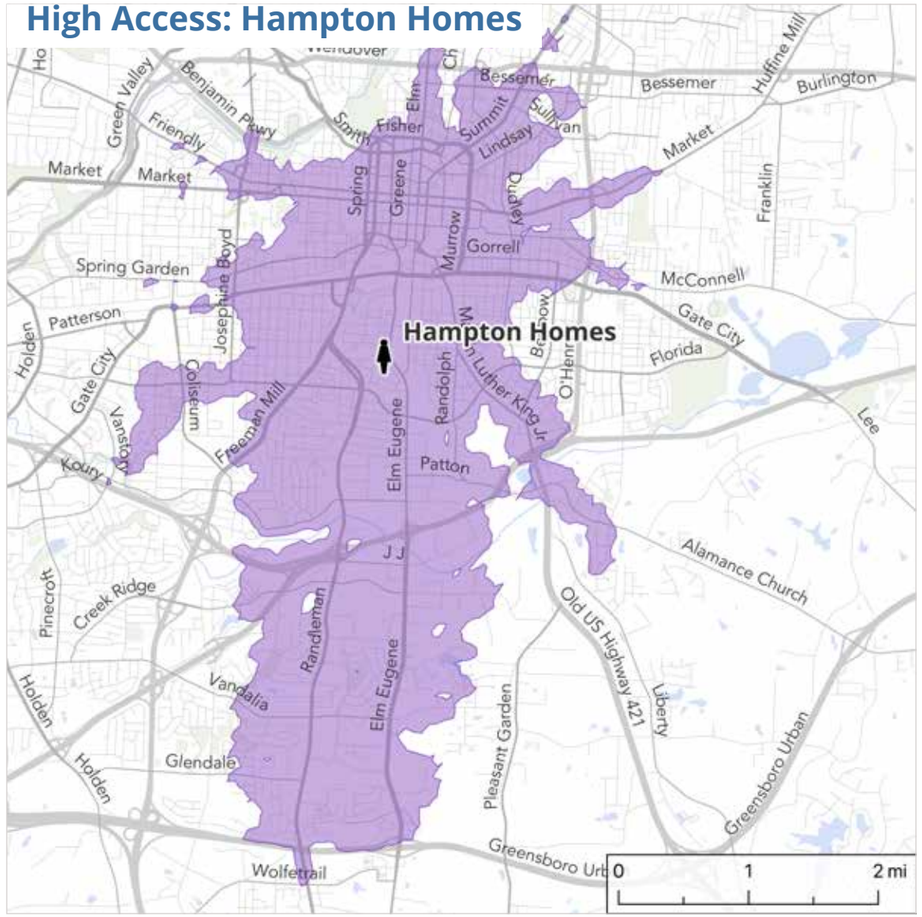


Figure 7: Visualizing Access as what you can reach in a given amount of time.

What Can I Get to in a Reasonable Amount of Time?

High Access: Hampton Homes



These maps show how far someone can reach by transit and walking in 45 minutes or less, starting from each of the locations.

The travel time includes:

1. Walking to the bus stop
2. Average waiting time for a bus
3. Time on the bus
4. Average waiting time and time on the bus for any transfers
5. Walking from the bus stop

Low Access: Willow Ridge Apartments

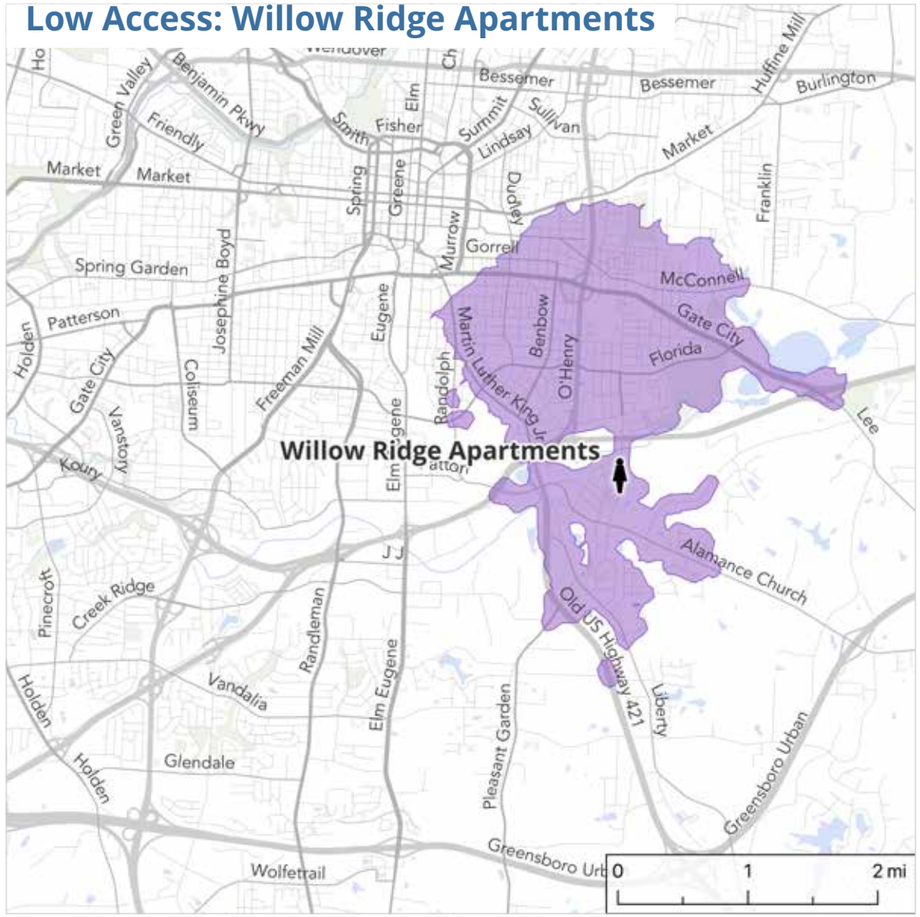


Figure 8: Examples of Isochrones From Two Locations in Greensboro: Hampton Homes and Willow Ridge Apartments. Source: US Census Longitudinal Employer Household Dynamics Program, 2020 and ACS 5-Year Summary File, 2021.

Hampton Homes is located quite close to Downtown Greensboro and also close to lots of jobs and opportunities in nearby places like UNCG, NCA&T, and the retail and business areas around Elmsley Drive. Although Routes 12 and 13, which are within a short walking distance, come only every 30 minutes, they are more direct than many other routes in Greensboro. A person can get to the Depot in a short time, transfer to many other routes with a short wait, and reach many places in the many "transit arms" branching out of Downtown, all within 45 minutes. This results in a relatively large isochrone. In total, someone in Hampton Homes can access **up to 42,700 jobs** in 45 minutes or less.

Willow Ridge Apartments are located further away from Downtown Greensboro and away from the many jobs and opportunities in the eastern and southern parts of Greensboro. It is on a large one-way loop at the outer ends of Route 4, which only comes every 30 minutes. The only major center of jobs you can quickly reach from here is the Joint School of Nanoscience and Nanoengineering/Gateway Research Park. To get to other job centers, a person has to ride the entire loop on Route 4 to get to the Depot. It is hard for someone to travel much further than the Depot within 45 minutes. This results in a relatively small isochrone. For all these reasons, someone in Willow Ridge Apartments can access only **up to 3,100 jobs** in 45 minutes or less.

Frequency Makes Transit Useful.

A transit network is a pattern of routes and services, where each line:

- follows a **path,**
- at certain days and times (its **span**),
- at a given average **speed**, and
- has buses coming once every certain number of minutes. This is the headway or **frequency**.

Frequency is invisible and easy to forget. Yet on transit it is one of the most important factors determining where you can get to in a given amount of time. This is because time spent waiting is a major component of travel, and waiting time is directly related to frequency.

Frequency Is Freedom

More frequent service dramatically improves access. High frequency reduces travel time by providing several related and compounding benefits:

- **Shorter Waits.** Unless you plan your life around a bus schedule, the average wait for transit is half the frequency. If a bus comes every 30 minutes, your average wait will be 15 minutes. But if it comes every 15 minutes, your average wait will be 7.5 minutes.
- **Faster Transfers.** To go further than the places on the bus route you happen to be on, you'll need to connect to another route. Better frequency makes this kind of connection easy, because the next bus is always coming soon.
- **Easier Recovery from Disruption.** Frequent service is more reliable, because if a bus breaks down you don't have to wait as long until the next one shows up.
- **Spontaneity and Freedom.** When transit comes every few minutes, there's no need to build your day around a bus schedule. You can turn up at the stop and go whenever you want.

Frequency and Ridership

One measure that can be used to assess transit routes is **productivity**, or how many riders use a route relative to the cost of operating that route. This measure speaks to what someone has in mind when talking about "efficiency". The total hours of service on a route (that is, the total time each bus and driver spend serving all the trips on a route) directly measure the cost of operating the route. Hence, productivity can be measured as ridership divided by service hours. This is explained in detail on page 41.

The plot in Figure 9 shows all the routes operated by transit agencies in 41 different U.S. cities, at various points in time within the last ten years. Each route is located on the plot based on its frequency and its productivity (boardings per service hour). More frequent routes are to the left, and more productive routes are higher up. The shade of each hexagon indicates the number of routes in that place on the graph.

The plot shows that higher productivity is correlated with higher frequency, even though higher frequencies require more service hours, and thus cost more. In other words, **ridership *relative to cost* appears to rise rapidly as frequency increases.** This is a two-way street: transit agencies rarely run high frequency service in places where they expect low ridership. But conversely, if frequency isn't very high, the amount of ridership transit can attract is fundamentally limited.

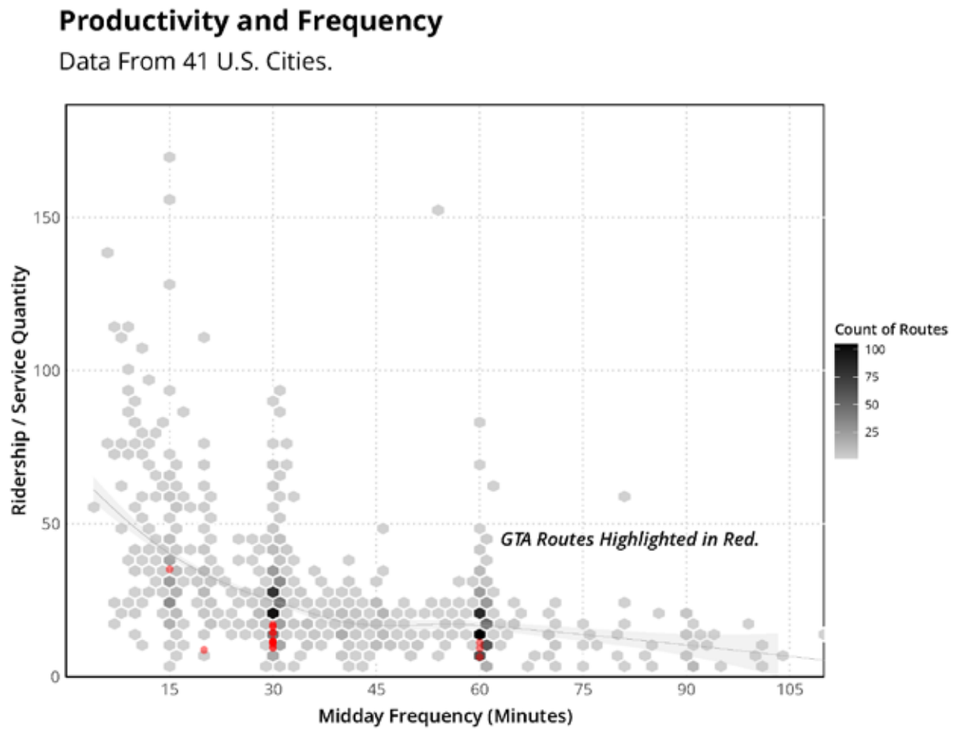


Figure 9: Transit Productivity and Frequency in 41 cities across the USA. More frequent routes tend to attract a higher number of riders per hour of service. Red dots show that most GTA routes have 30- or 60-minute frequency, and have relatively lower levels of productivity. (Source: Ridership and service data from multiple agencies)

Frequent service is strongly correlated with high ridership per unit cost.

What Is Frequent Enough?

Frequency is expensive, so it's important to think about just how frequent service needs to be. **A frequency of 15 minutes or better has a good chance of being useful** to someone whenever they need to travel, especially if that frequency extends over many hours of the day, every day. In the GTA system, 30-minute routes provide a much higher level of freedom than 60-minute routes.

Adequate frequency depends on trip length, because it doesn't make sense to wait long to go a short distance. Very short downtown or campus circulators, for example, don't make sense unless they can be run with frequencies well under 15 minutes. For many people, it wouldn't make sense to wait more than 10 minutes to go half a mile, because you could probably walk to your destination in that time. But it might make sense to wait that long to go several miles across town.

Radial Networks Allow Many Connections When Frequencies Are Low.

There are two basic network shapes that can be found in most transit systems, illustrated in Figure 10.

Radial networks have a central point, and nearly all routes go to that point—often downtown. A radial network design ensures that anyone looking to travel downtown can make their trip without the need to transfer. Anyone going to another outlying place can get there with a single transfer at the center. Radial networks arose naturally in pre-car cities because so much commerce and culture was centralized.

Grid networks also offer people a way to travel from anywhere to anywhere with a single transfer. But unlike in a radial network, the transfers in a grid network happen wherever two routes intersect.

Radial vs. Grid Networks

In many cities, there is a large concentration of people, jobs, and activities in the central downtown area. Radial networks make more sense in such contexts, as most people's travel can access the large concentration of opportunities in the center in a reasonable time with a direct ride, or can travel across the city to other destinations with a single transfer in the center.

In large urban areas with radial networks, some journeys from outlying areas near each other require such a long time to get into and out of downtown, that they become impractical by transit. This is when agencies start adding **orbital** or **cross-town** routes for more direct connections outside of downtown. However, if orbital routes are not frequent, the long waiting time can remove any time advantage over traveling to the center to transfer, making them less useful.

In large cities with many centers of activity or expansive areas of activity (such as Los Angeles, Chicago, or Houston) a large frequent grid requires much less out-of-direction travel than a radial network, with most routes converging in a single place would.

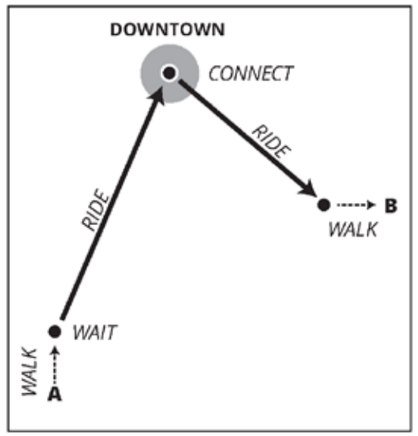
A frequent grid of intersecting routes offers the simplicity and reliability of a street network. The grid can be formed along two parallel sets of intersecting roads (a "lattice"), or a set of radial roads and intersecting orbital roads (like a spider web).

The key to a useful grid network is high frequency. When every route in grid network is frequent, then it is easy to transfer at any point where two routes cross. When routes are infrequent, grid networks become much less useful, because the waiting time for transfers become intolerable.

In a grid network, it is hard to coordinate route schedules such that transfers in all possible directions can be made with short waits at every possible place where routes cross. In such a case, radial networks can be more useful because many routes converge in one spot. It is then much easier to coordinate schedules such that transfers between many routes require only a small wait in the central location. This is a powerful network design feature, often called **pulsing.**

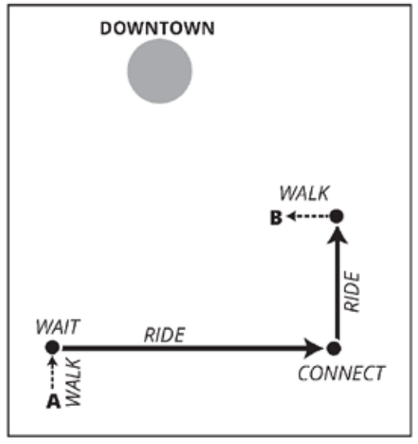
The existing GTA network is an example of a highly-radial, infrequent, pulsed network. The limited resources available to serve the relatively large area across Greensboro means that most routes are only every 30 or 60 minutes. Almost every route runs along one of the many arterial roads that radiate out of Downtown, meeting other routes at the Depot to offer timed connections.

Basic Transit Network Shapes



Radial
Most routes lead to and from the center. Anyone wishing to travel from one non-central location to another must pass through downtown and transfer there.

A radial structure makes sense when one part of a city (typically the downtown) is a dominant destination. In a radial network many routes can be scheduled to converge at a set time (called a "pulse") to reduce the waiting time needed to transfer.



Grid
Routes intersect all across the city, not only in a downtown, and people transfer in those places.

Grid networks are only effective when the intersecting routes offer high frequencies so that connections between routes do not require long, discouraging waits. A grid structure is most suited to a city with multiple activity centers and corridors, where people are traveling among many different destinations.

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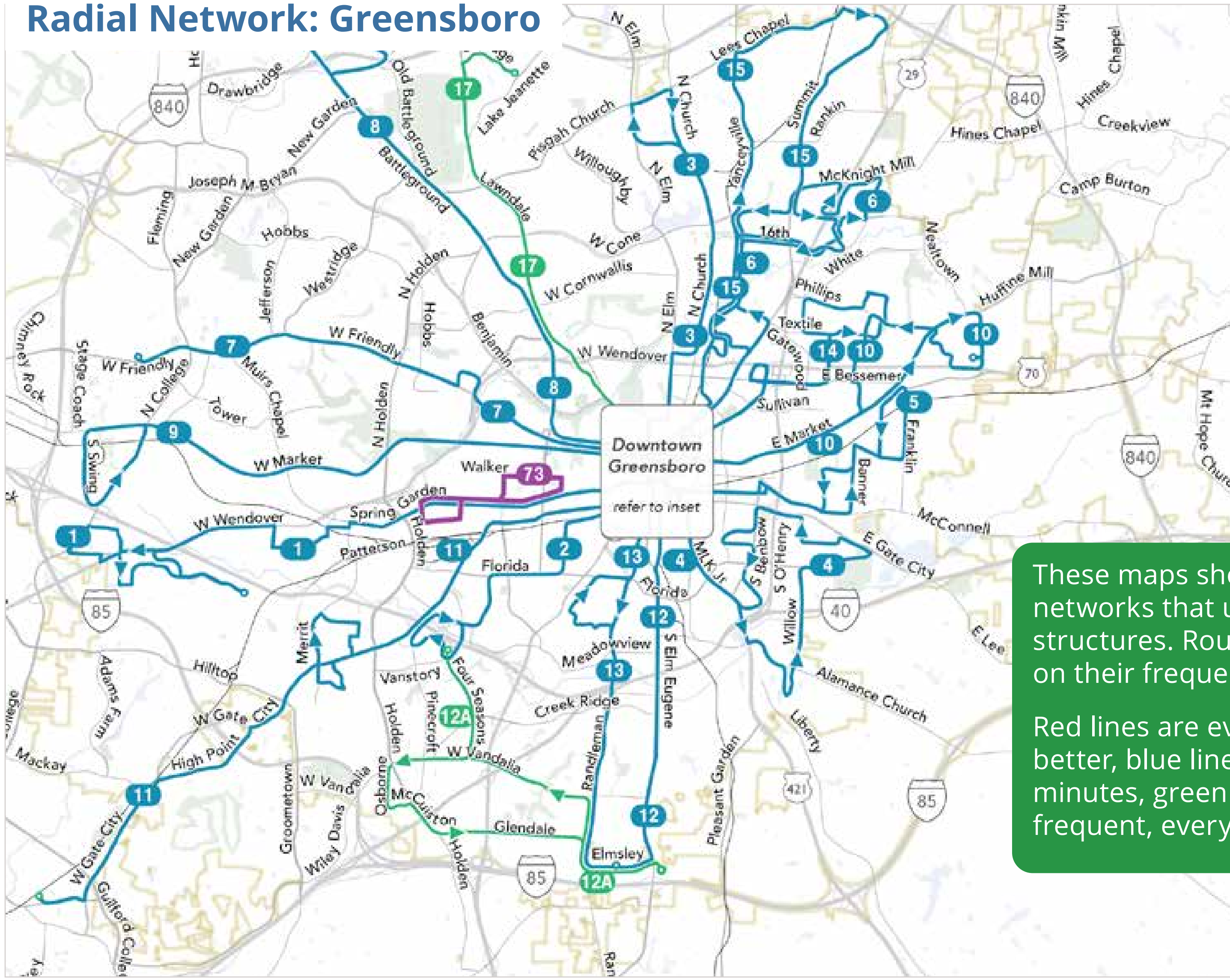
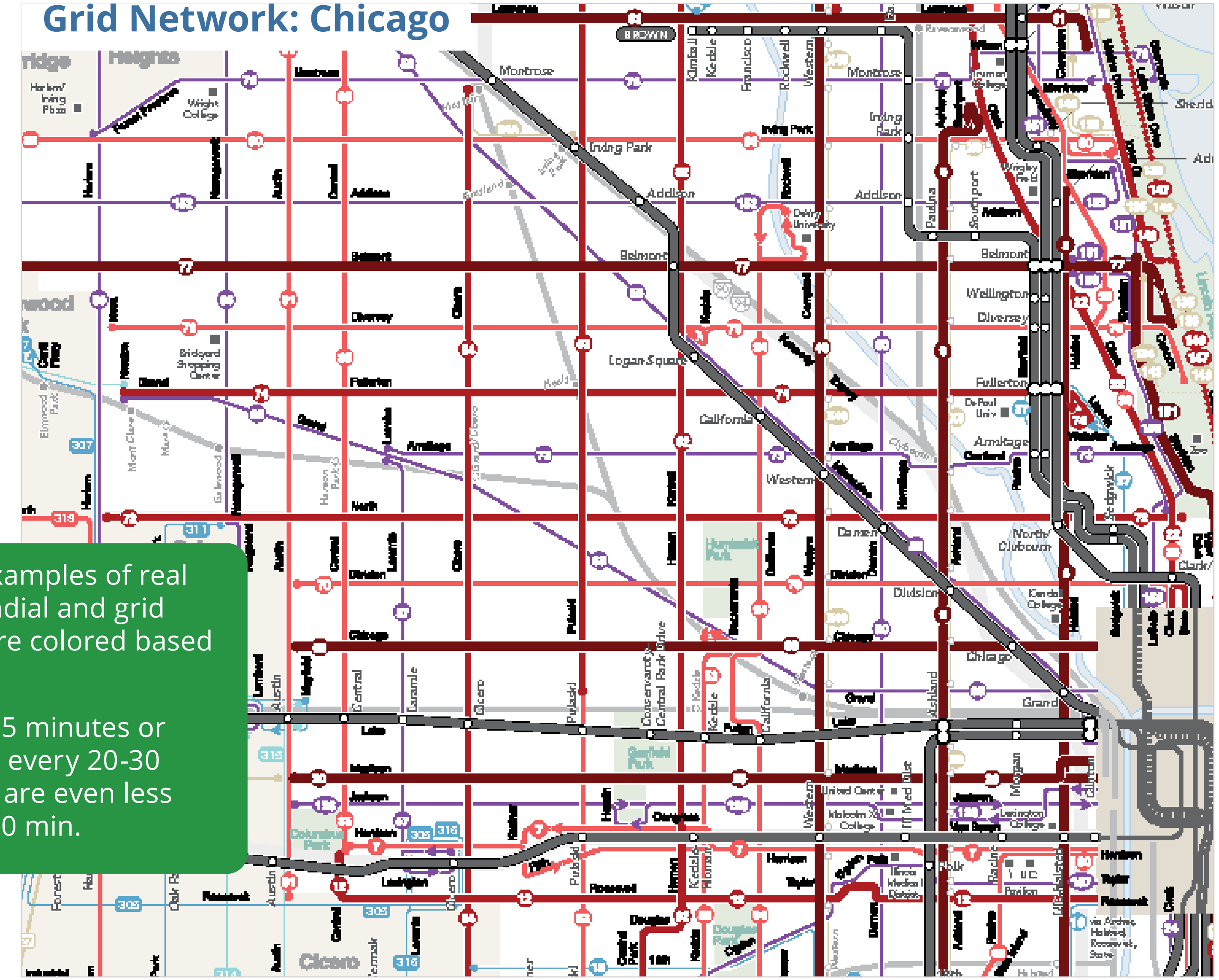
Figure 10: Radial transit networks vs. Grid networks.

Examples of Radial and Grid Networks

Radial Network: Greensboro



Grid Network: Chicago



These maps show examples of real networks that use radial and grid structures. Routes are colored based on their frequency.

Red lines are every 15 minutes or better, blue lines are every 20-30 minutes, green lines are even less frequent, every 40-60 min.

Figure 11: An example of the radial GTA Network at a glance and the grid network in Chicago, Illinois.

Greensboro has a big concentration of jobs, activities, and residents in and around Downtown, or located close to one of the many arterial roads that radiate outward from Downtown. Therefore, many of GTA's routes run radially along these arterials and meet at the Depot. Since most routes only have frequencies of every 30 or 60 minutes, route schedules are coordinated so that people don't have to wait very long at the Depot to transfer to another route.

Chicago is an example of a grid network. Above is a map of the CTA bus network in the western and northwestern parts of Chicago. Lots of residents are jobs are spread throughout this area, and most streets are arranged in a grid. A clear pattern emerges from the high-frequency North-South and East-West routes in the network. Anybody traveling in this area can transfer from one high-frequency route to another where they intersect, with a short wait, without needing to travel all the way into Downtown Chicago.

Access and Usefulness Also Depend on the Built Environment.

Creating a high-access transit network isn't just about faster or more frequent service. Many factors outside the control of GTA —such as land use, development, urban design, and street networks—affect transit's usefulness. This is why **land use and infrastructure decisions made by cities and other agencies are an essential part of transit's success.**

The built environment factors shown in Figure 12 are critical to facilitating a broadly useful transit network:

- **Density.** Where there are many residents, jobs and activities in an area, there are many places people might want to go.
- **Walkability.** An area only becomes accessible by transit if most people can safely and comfortably walk to and from the nearest transit stops.
- **Linearity.** Direct paths between many destinations are faster and cheaper for GTA to operate, relative to the number of places served. Linear routes are also easier to understand and more appealing to most potential riders.
- **Proximity.** The longer the distance between two places that GTA wants to serve, the more expensive it is to connect them. Areas with continuous development are more cost-effective to serve than areas where there are large, undeveloped gaps between destinations.
- **Mix of Uses.** When there is a mix of land-uses along a direct path, transit can provide direct access to a broad range of destinations. Mixed-use transit corridors also tend to be very productive, because people ride in both directions at many times of the day.

The variation of these built environment characteristics across Greensboro, and how that impacts the design for useful service, is explored in detail in Appendix C.

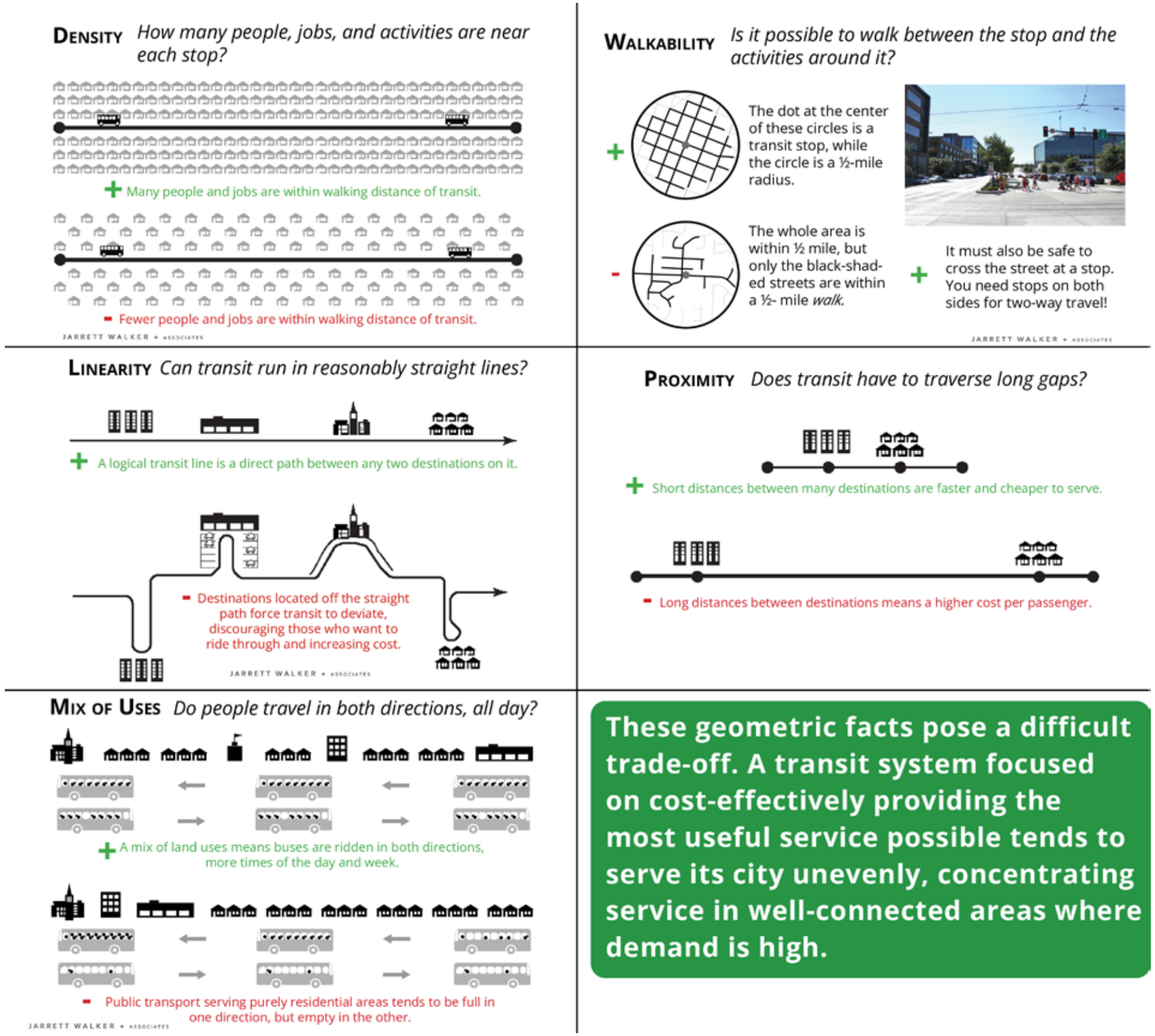


Figure 12: Five geographic indicators of high ridership potential in the built environment.

3 Transit Market and Needs

The Market and Need for Transit

In this chapter, we present and discuss data that inform two distinct types of considerations in transit planning:

- Where are the **strongest markets** for transit, with potential for high ridership and low operating costs per rider because of **demand**?
- Where are there **moderate or severe needs** for transit, where coverage services may be important even if they do not attract high ridership relative to cost?

Examining Demand and Need

The maps and diagrams on the following pages help visualize potential transit markets and needs based on the following considerations:

- **Residential** density
- **Job** density
- **Activity** density (combined residential and jobs)
- **Street connectivity** and **walkability** of an area
- **Zero-Vehicle households**
- **Poverty** density
- Density of **senior residents**
- Density of **residents under age 18** (youth)

For each category, this chapter typically includes a map of Greensboro and the surrounding areas, explaining the relevance of that category to transit planning, and key observations about the spatial variation in that category in Greensboro.

Using These Measures

No one measure tells us that a place has high ridership potential or high needs. Rather, we must consider them in combination.

Designing for Ridership

If you asked a transit planner to draw you a very high-ridership bus route, that planner would mostly look at densities of all residents and jobs, the walkability of streets and neighborhoods, and the cost of running a bus route long enough to reach them.

The potential demand for a strong transit market is mostly defined by *where* people are, and *how many* of them are there, rather than by *who* they are.

Only secondarily would that planner look into the income, age, or other attributes of those residents or workers. The "who" attribute that has the strongest influence on transit ridership potential is income. A lower-income person is often more likely to choose transit than someone with a higher income. This is especially true in outlying areas, where driving and parking cars is so easy, so transit tends to often be used by people who don't have the option to drive.

A detailed analysis of overlapping indicators of demand in various areas of Greensboro is provided in Appendix C. This specifically looks at potential service patterns where additional transit investment is likely to generate significant ridership compared to existing service.

Designing for Coverage

If you asked a transit planner to draw you a route that helped as many people with severe needs as possible, they would look at where low-income people, seniors and youth live, and where they need to go.

The densities at which these people live matters, because at higher densities a single bus stop can be useful to more people in need. However, the transit planner might also try getting the route closer to small numbers of people. In fact, the more distant and scattered people are, the more isolated they can be, and the more they might need access to transit.

Where there are *moderate or severe needs* for transit, coverage may be important even if it does not serve a large total number of people.

Civil Rights and Equity

Another important map in this chapter is not strictly related to demand or need but rather to civil rights. It shows where **People of Color** live.

Unequal treatment on the basis of race, ethnicity, or national origin is prohibited by the Civil Rights Act of 1964. Regulations by the Federal Transit Administration require that GTA consider the benefits and burdens that People of Color experience from transit service and consider this in the process of planning for transit projects.

While a person's race or ethnicity does not tell us directly if they need transit, or if they have a propensity to use transit, we know that there is a correlation between race/ethnicity and income and wealth.

The historic impacts of segregation and discrimination have had long-lasting effects on the patterns of housing, development, and investment across the region. The ramifications of these policies continues today. If you are a Person of Color in the United States you are more likely to have a lower income and less likely to own a car.

Therefore, knowing where People of Color live helps us see where there are intersections between patterns of historic segregation and concentrations of people in poverty today. Providing affordable transportation options for low-income communities and Communities of Color is an important strategy in addressing economic insecurity, and may be an important goal, more broadly, for addressing the racial and social equity goals of the Community.

It is also important to understand where large numbers of People of Color, people in poverty, and other historically marginalized populations live so that public outreach during this project can maximize opportunities for participation for those historically vulnerable communities that have not traditionally participated in the transportation planning process.

This requires being sensitive to language and cultural barriers to participation and offers an opportunity for historically vulnerable communities to share their perspective and voice in the contemplation of service changes and how those service changes have an impact on their community.

Indicators of Demand: Residential Density

Most people's daily travel begins or ends at home. Places with many households are also destinations for people not living there, be it for visiting friends, caring for family, or home-based trades. That is why understanding where many people live close together is key to assessing the strength of the market for transit.

Key Observations

The map on the right shows residential density in and around Greensboro.

The core of Greensboro has areas of high residential density close to Downtown, particularly on its east and west sides. These areas have a mix of apartments, student housing, affordable housing, and small-lot single-family residences. Many of these house students at NCA&T, UNCG, Greensboro College, and Bennett College, which are all located close to Downtown.

There are **many scattered pockets of high residential density outside the core**, which correspond to apartment and affordable housing communities. There are several apartment communities located near Friendly Avenue and Market Street in the west, West Gate City Boulevard in the southwest, Randleman Road and South Elm-Eugene Street in the south, and North Church Street, Yanceyville Street and Lees Chapel Road in the north. Many of these communities are surrounded by low-density single-family housing.

These residential complexes are quite dense inside, but they are often developed in a pattern that makes it hard to serve by transit: they are disconnected from other dense areas except on arterial roads, and have suburban-style street networks with lots of curved roads, loops, and cul-de-sacs. This means that either people have to walk a long distance to reach transit on a main arterial road, or buses have to deviate into each cul-de-sac to reach them, making transit less useful for everyone else.

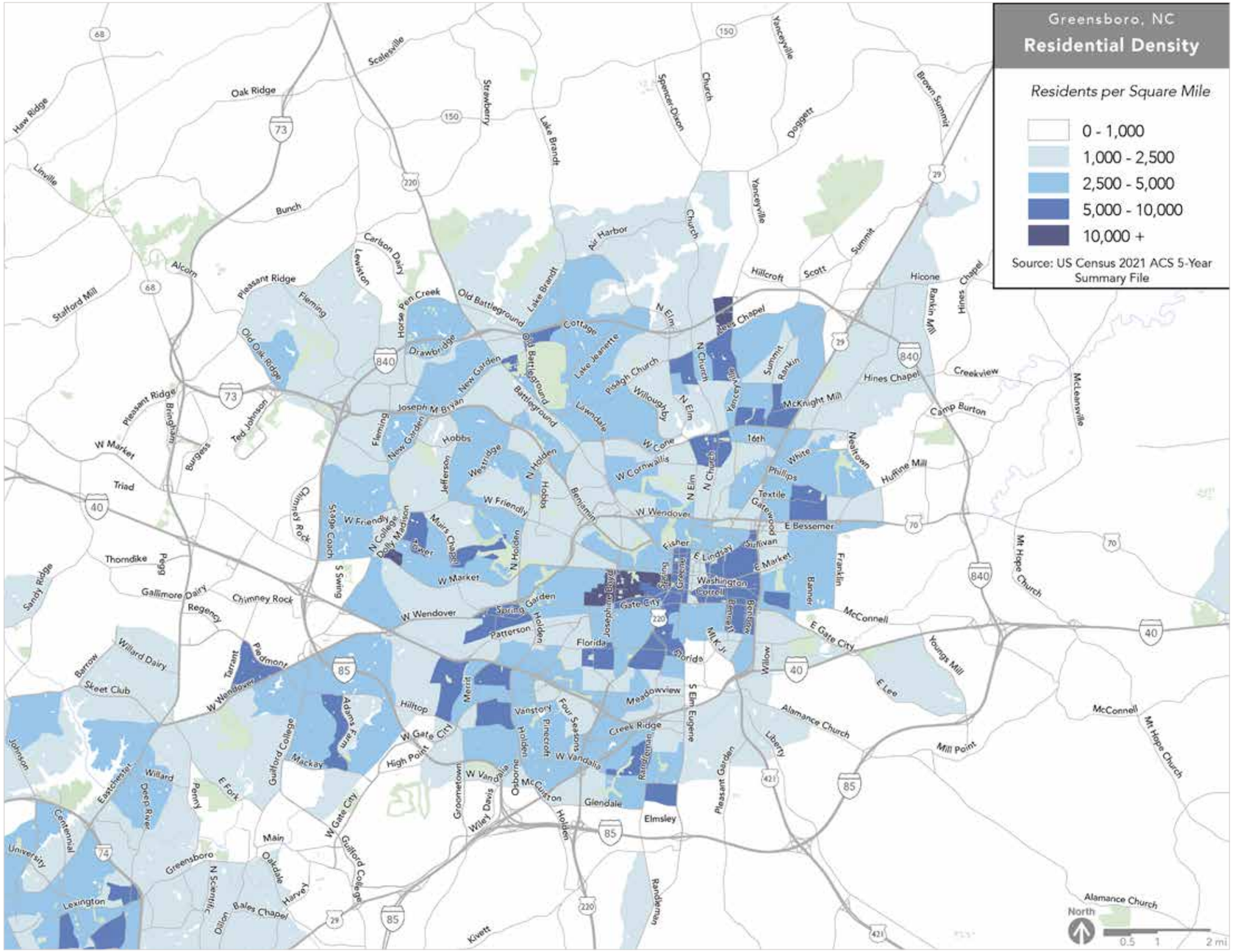


Figure 13: Residential Density in Greensboro.

Indicators of Demand: Job Density

Job density can tell us not just about where people go for work, but also about important destinations people travel to. **One person's workplace may be a destination for dozens or even hundreds of people throughout the day.**

College, universities, and hospitals have many jobs and also generate all-day travel demand as students, staff, patients, and visitors arrive and leave at different times throughout the day as classes start and end and medical appointments are scheduled. Retail and service jobs also attract numerous customers and visitors.

Office jobs can often generate demand from workers at peak times, but many office jobs are located in office parks, which are hard to serve with transit in a useful way. Industrial and logistics jobs, in contrast, attract few visitors beyond employees who arrive and leave at specific times of the day based on shifts, or suppliers—who arrive in trucks.

Key Observations

The map on the right shows the density of jobs in and around Greensboro. Many jobs are **concentrated in the Downtown core area**. Major institutions like UNCG, NCA&T, and Cone Health are situated quite close to Downtown and also have many jobs and visitors.

Throughout Greensboro, **Wendover Avenue** goes through several areas of moderate-to-high job density. However, large parts of Wendover are built like freeways and parkways, prioritizing through-running car traffic. The road provides a nice, direct route near many jobs, but accessing those jobs safely by transit requires the bus to take exits and drive in long loops. Since car traffic is prioritized, there are relatively few places where pedestrians can cross the avenue safely. So while it has relatively high job density, its built form makes direct, two-way transit along Wendover Avenue extremely hard to implement in a traditional form.

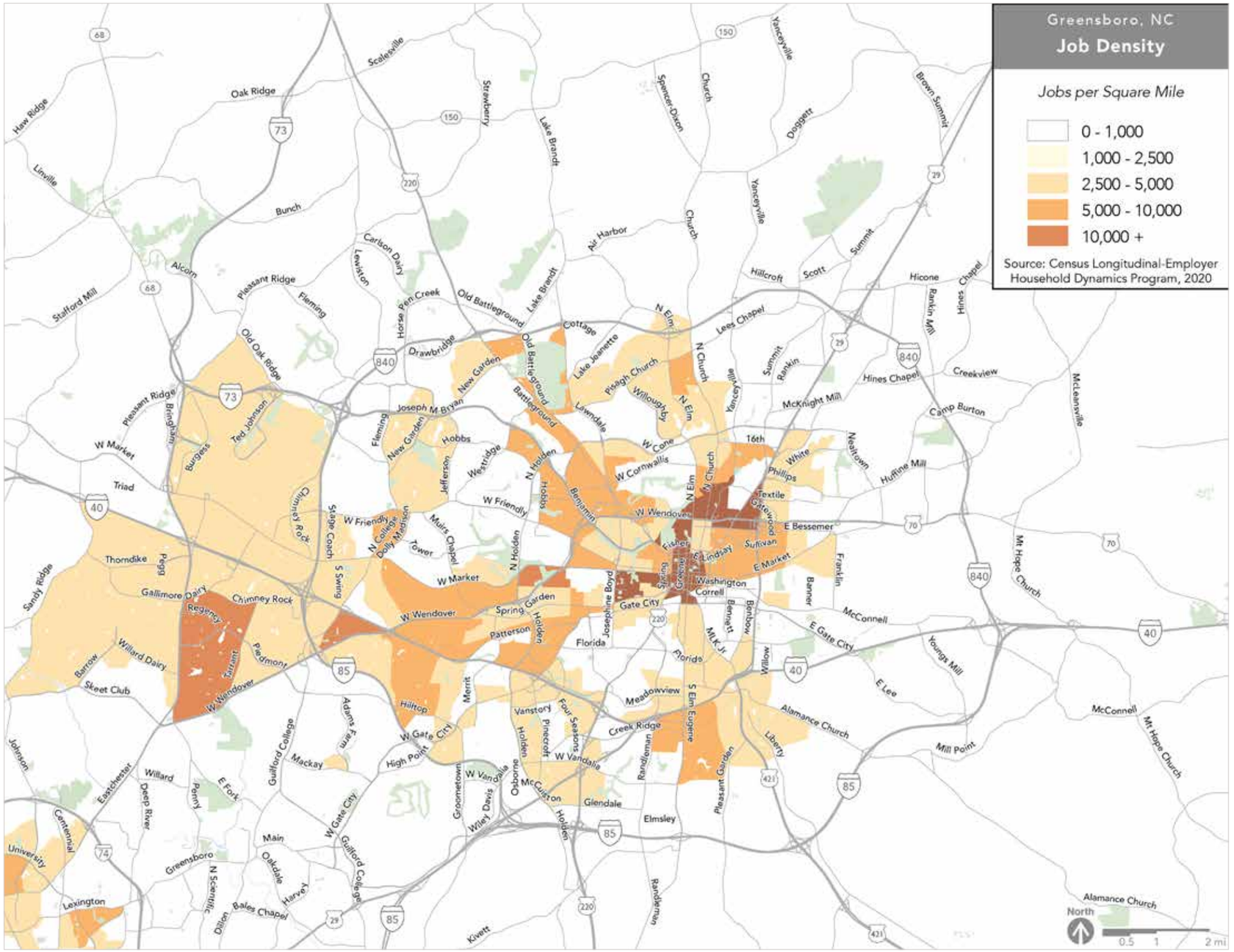


Figure 14: Job Density in Greensboro.

The segment of Wendover passing between Friendly Center and Wesley Long Hospital, shown on the right, is an example of this. There are no pedestrian connections to, sidewalks along, or crosswalks across this segment. It is not possible to safely walk to any potential bus stop on Wendover, and any hypothetical bus route along Wendover cannot serve both these major destinations directly, even though they are on opposite sides along the same segment. Such a hypothetical route could only reach one of these destinations at a time by taking exits at Benjamin Parkway. For someone travelling through this segment, that would be a long deviation, making the route less useful.

There are **moderate concentrations of jobs along other major arterial roads, particularly in the western and northwestern parts of Greensboro:** Church Street, Battleground Avenue, and West Gate City Boulevard. There are significantly fewer concentrations of jobs along arterial roads in the eastern and southern parts of Greensboro. Many of these jobs are in big-box retail stores and service establishments.

Despite having quite a few jobs, big-box stores only show up as areas of moderate employment density because they are located on large parcels with extensive parking areas that well exceed the already large building footprint of the retail space. In the example on the right, a big portion of the area in Friendly Center is dedicated to parking lots, compared to the store buildings.

Many jobs on the fringes of the city are located in large office parks and industrial areas, rather than along linear corridors. These include parts of Wendover Avenue near I-40, the areas around the Airport, South Elm-Eugene Street near I-40, and East Greensboro. Most of these areas are designed with buildings set behind large parking lots and wide streets, spaced far apart with little sidewalk and safe crosswalk infrastructure. Together, these design features limit potential ridership.

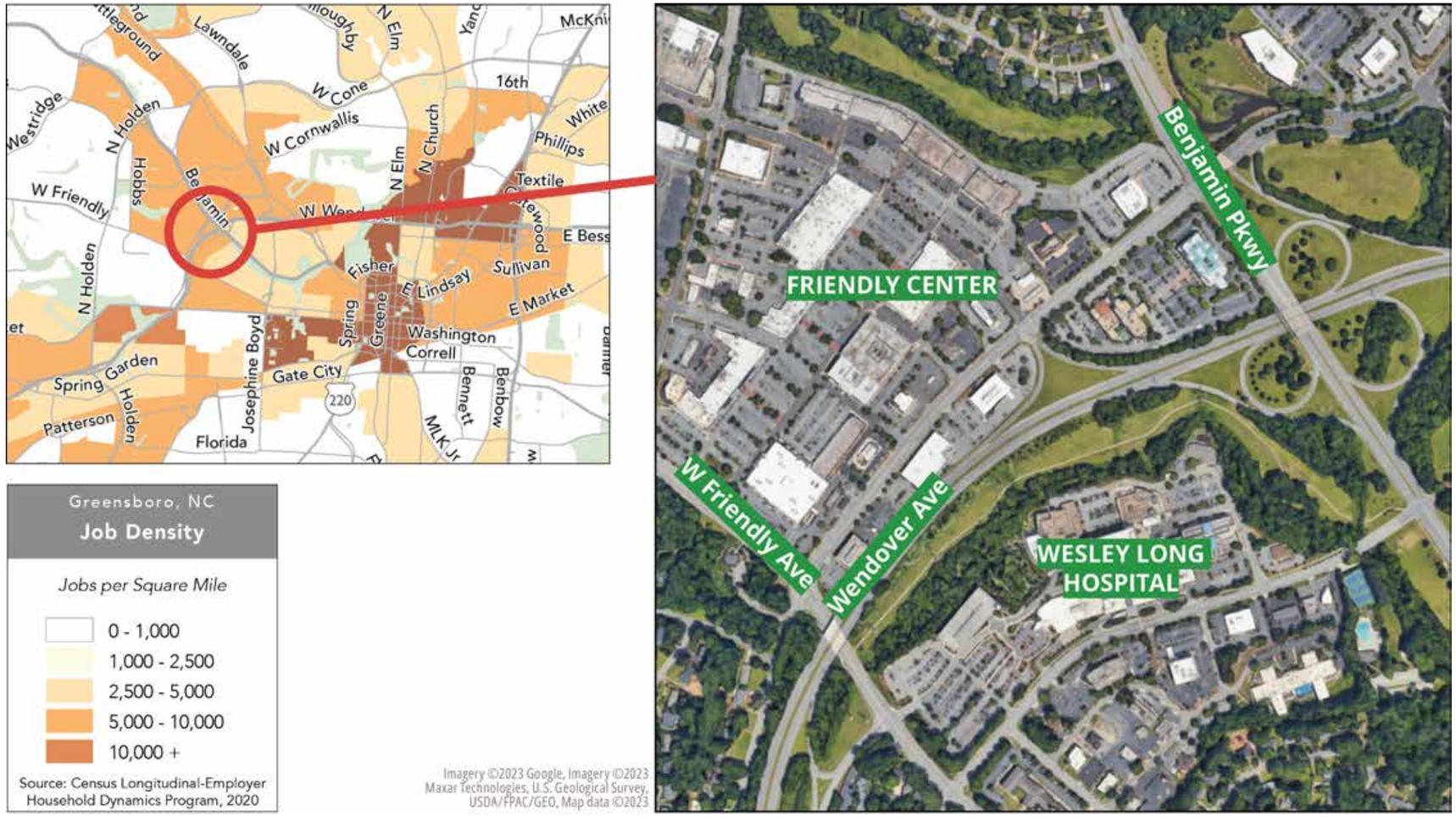


Figure 15: An example of a segment on Wendover Avenue with lots of nearby jobs, but with a street network and land use patterns that make it hard to serve by transit.

Indicators of Demand: Activity Density

Transit routes serving purely residential neighborhoods tend to be used mostly in only one direction each morning and evening rush hour. Where residential, commercial, and other uses are mixed, people are traveling in both directions so buses can be full in both directions. Corridors which straddle multiple purely residential and purely employment area see some of the benefits of mixed land-uses.

Activity density maps, like the one to the right, depict not only high density, but also the mix of activities in an area. In this map, places with more residential density are shown in deeper shades of blue, while places with more jobs are shown in increasing shades of yellow. Places with higher density and mix of uses show up as deeper red, purple, and orange shades.

Key Observations

The area in the center of Greensboro including Downtown, NCA&T, and UNCG has a high density of both jobs and residents. In the western part of Greensboro, areas near Spring Garden Street, Holden Road, and West Gate City Boulevard have a mix of moderate job and residential density. North Elm and Church Streets connect some areas with moderate density and a mix of uses: for example, the Spicewood neighborhood.

Major arterial roads like Battleground Road, Lawndale Drive, Wendover Avenue, Market Street, Martin Luther King Jr. Drive, and South Elm-Eugene Street connect places that have moderate density of either jobs or residents, but only a light mix of both jobs and residents.

One larger pattern that stands out in this map is the lopsided pattern of development. High to moderate density extends about 6-8 miles outward from downtown to the southwest, west, and northwest of the city. To the east and southeast, however, moderate to high density development ends only about 3 miles from downtown.

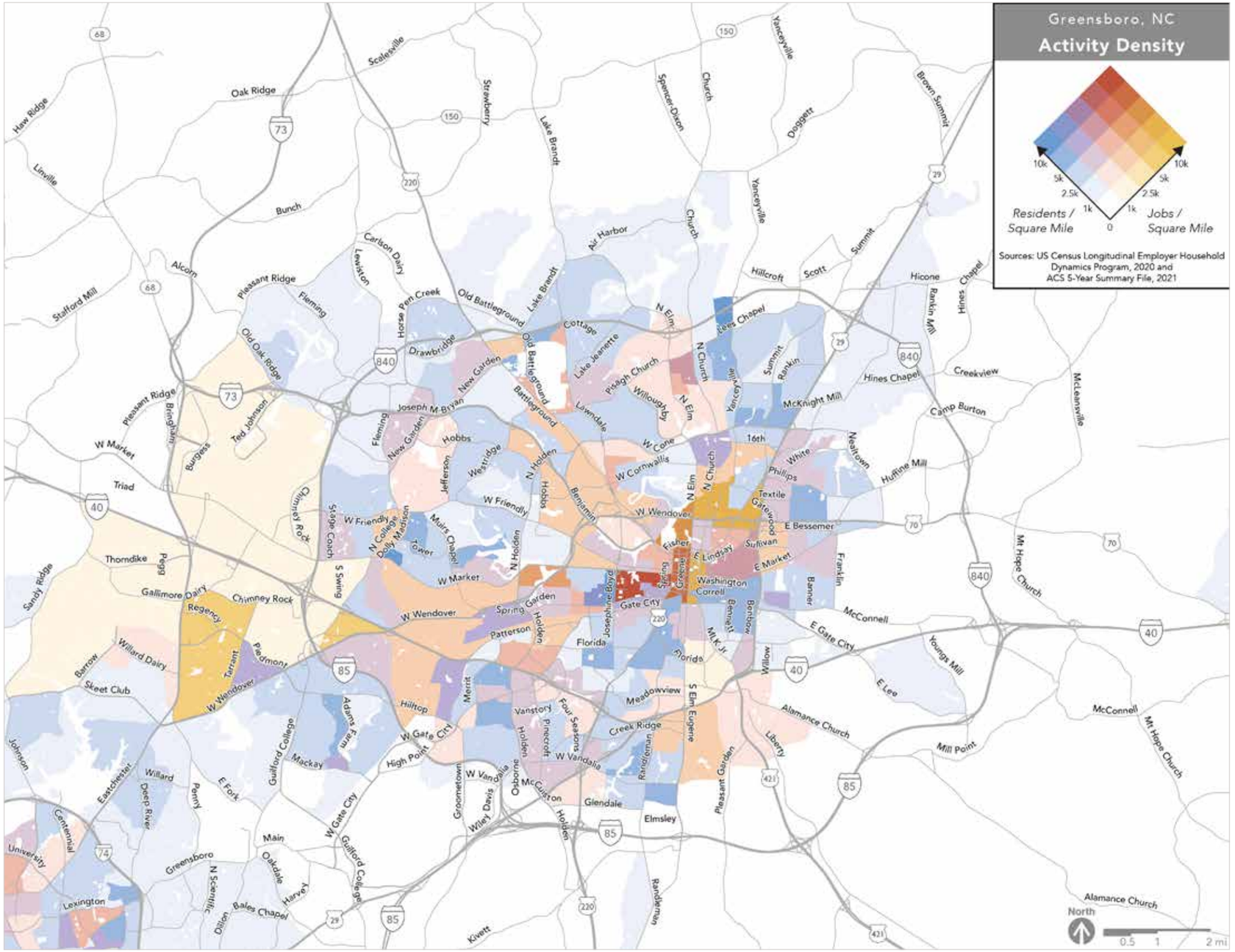


Figure 16: Activity Density in Greensboro.

Indicators of Demand: Street Connectivity and Walkability

In almost all cases, transit trips begin or end by walking. Therefore, the ability to walk to and from transit is very important. The more jobs and residents there are near a stop, the stronger the likely transit market. However, the size of the market is also limited by the street pattern, since that determines how much of the area around a stop is truly within a short walking distance.

Actual walking distances to and from bus stops can far exceed the direct, or "crow's fly", distances. Figure 17 shows how the street network's connectivity can be measured by comparing the area that can actually be reached on the street network to the direct distance area.

Areas with highly connected street patterns provide short and direct paths between any two locations. Areas with poorly connected street patterns, along cul-de-sacs, or close to freeways or other barriers, force long and circuitous paths between locations and discourage walking. The map on the right, in Figure 18, shows the street connectivity across Greensboro. Darker areas have higher street connectivity than lighter areas.

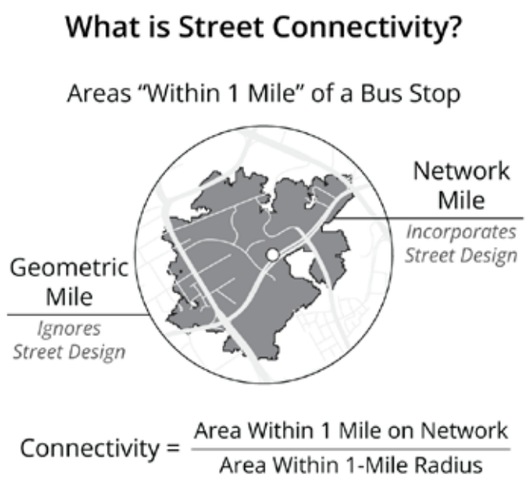


Figure 17: Calculation of Street Connectivity

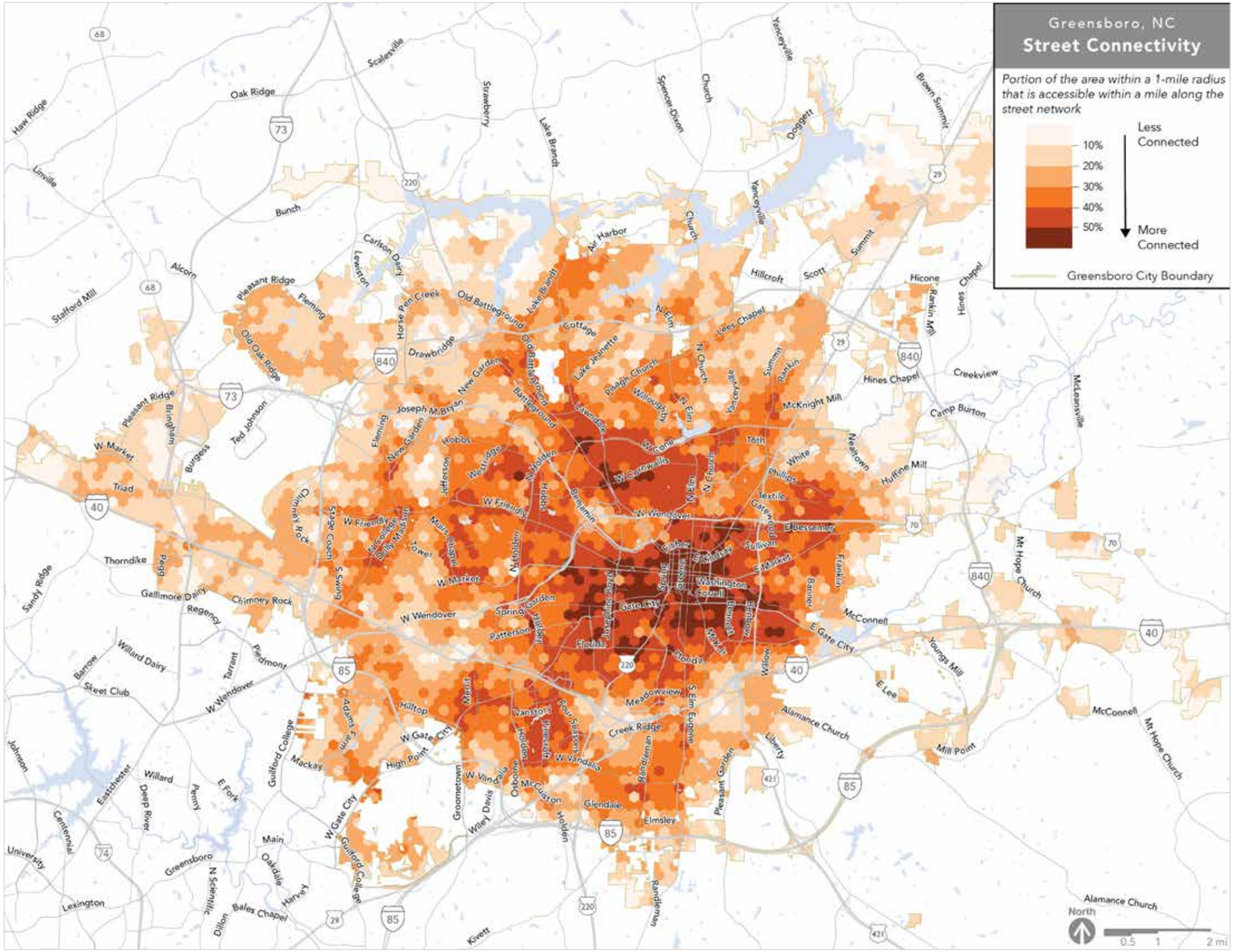


Figure 18: Street Connectivity in Greensboro.

Key Observations

The largest stretch of continuous, well-connected areas in Greensboro are in and around Downtown. Neighborhoods built before the 1950s tend to be more walkable, made of dense street grids with many intersections and consistent sidewalk networks that make it easier to walk to bus stops and neighborhood amenities. Many parts outside this core area also have moderately high street connectivity, but are segmented by parkways, freeways, and railway tracks. These obstructions can often be seen surrounded by lighter areas in the map.

Further out, street connectivity is much lower in suburban-style developments with disconnected street patterns and fragmented sidewalk networks. Many of these developments are designed to minimize car traffic past the most valuable real estate. This is done in part with intentionally poor street connectivity. If streets don't go through, only residents will drive down them, forcing others to use the nearest arterial road in an indirect path. Meanwhile, due to the cul-de-sacs and lack of connections to the main roads, walking routes to the nearest bus stop are long and circuitous.

Figure 19 shows how street design impacts connectivity, with examples of a low-connectivity area along West Friendly Avenue near I-840, and a high-connectivity area near Ray Warren Homes.

Both areas have moderate residential density with multi-family housing. In the first example, the apartments are all in isolated developments, with the main arterial roads being their only entrance. It is a long walk from deep inside many of these complexes to transit on West Friendly Avenue. In the second example, it is possible for someone in one of the buildings in the middle to walk to several potential streets to catch a bus, which makes it possible to more effectively serve this area by transit.

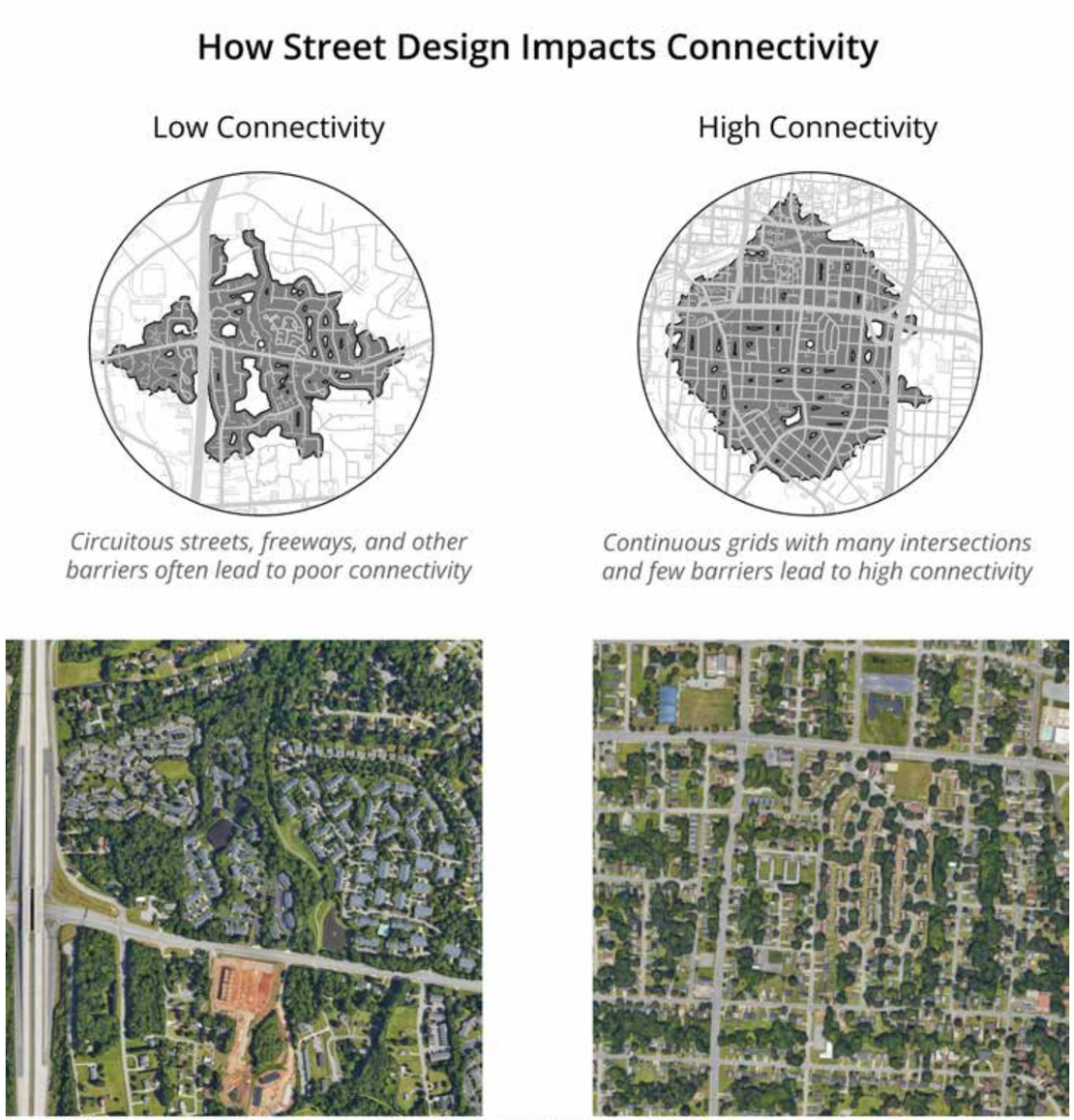


Figure 19: The impact of street design on connectivity, with examples of low-connectivity and high-connectivity areas in Greensboro.

Walkability

Street connectivity is essential for enabling easy walk access, but it does not take into account the presence of sidewalks, crosswalks, or the safety of intersections. All of which affect people's ability and willingness to walk to transit.

The map on the right shows the connectivity of the walk network, which only includes roads with sidewalks along with paths and trails. Many streets in Greensboro do not currently have sidewalks. That is why, compared to the street connectivity map on page 27, most areas show lower connectivity when only considering the walkable network.

The core of Greensboro in and around Downtown shows high walk connectivity because most streets there have sidewalks. Beyond this, segments along some arterial streets like Battleground Avenue, West Gate City Boulevard, South Elm-Eugene Street, Florida Street, and Randleman Road, show moderate walkability.

Greensboro's Bicycle, Pedestrian, Trail and Greenway (BiPed) plan prioritizes sidewalk construction along arterial streets and major roads. Major and arterial roads have high traffic and pedestrian volumes and vehicle speeds, and thus investments along these roads are critical.

The walk connectivity map does not take into account the ability to safely cross the street. If you take the bus to work and get off in front of your office, to go home, you normally need to cross the street to get the bus in the opposite direction. If you are forced to walk very far to reach a safe crossing to get to that other stop, you can't effectively use the route in both directions. Thus, safe crossings at regular intervals are critical for transit to be useful for riders.

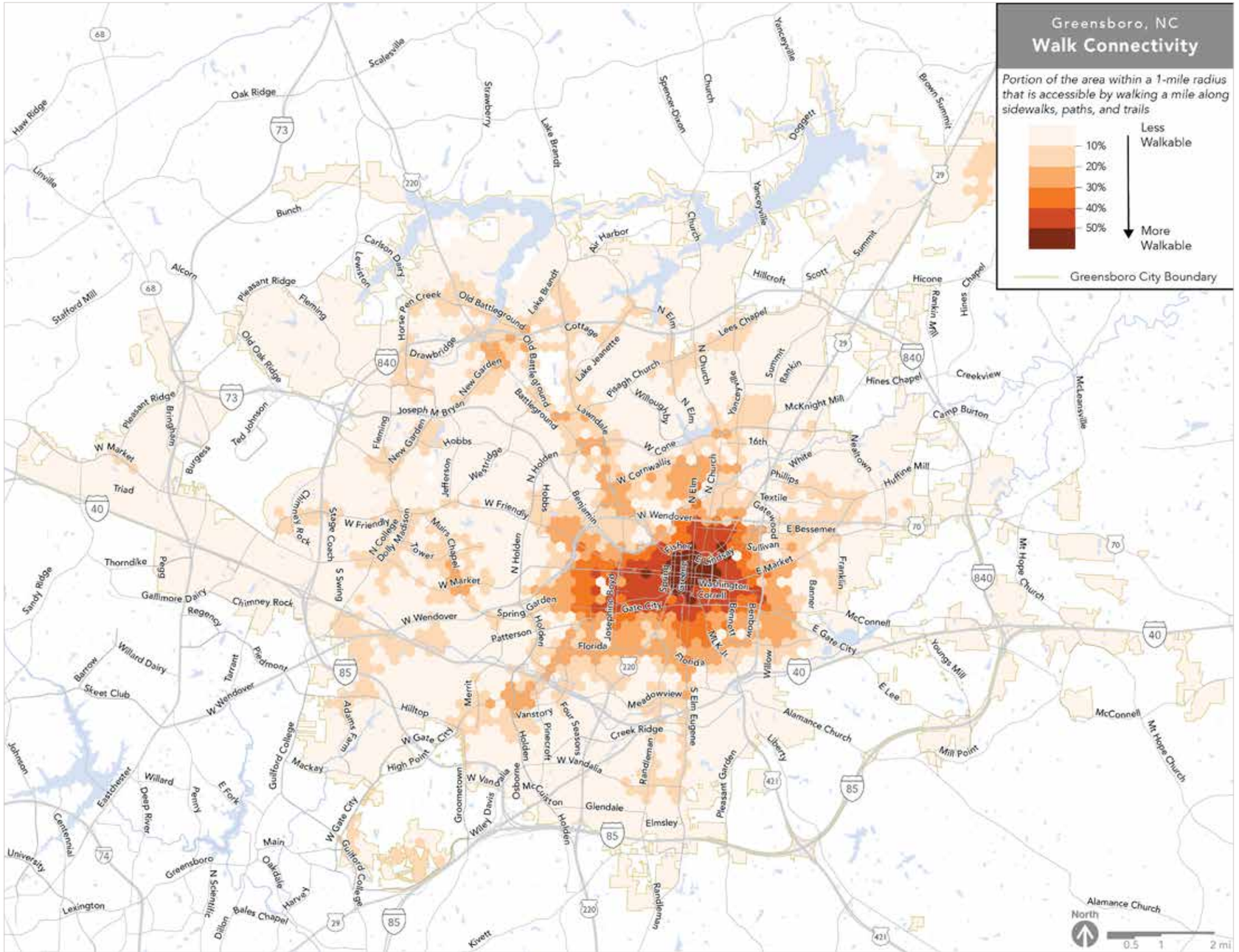


Figure 20: Walk Network Connectivity in Greensboro.

Indicators of Demand and Need: Zero-Vehicle Households

Another factor affecting transit's competitiveness and need in an area is the availability of personal cars. Generally, people without vehicles have fewer options than those who do have access to personal cars. However, **people without cars do not necessarily default to using transit.** If transit is useful—reasonably fast, reliable, available when needed—for people to use it to reach the places they need to go, it can be a compelling option.

If transit does not present a realistic travel option, then people without cars will find other ways to reach the places they need to go, by getting rides from friends or family members, cycling, using electric scooters, walking, or using taxis or TNCs like Uber. Alternatively, some people may not travel, thereby limiting their access to the economic, social, and other opportunities.

Key Observations

The map on the right shows the density of households with no vehicles. Areas of moderate zero-vehicle household density are found near Downtown, where many jobs and opportunities (including universities and colleges) are within walking and biking distance.

Outside of this core area, significant areas of moderate-to-high density of no-car households are found in northeastern, eastern, southern, and southwestern parts of Greensboro. Many of the densest spots of households without cars correspond to affordable housing communities and large apartment complexes close to retail areas.

There are also some areas of moderate zero-vehicle household density in the western parts of Greensboro, corresponding to the many apartment communities in that area. The number of households without cars is not that high compared to the overall density of this area, because of the disconnected, car-oriented development patterns that make it hard to provide useful transit service.

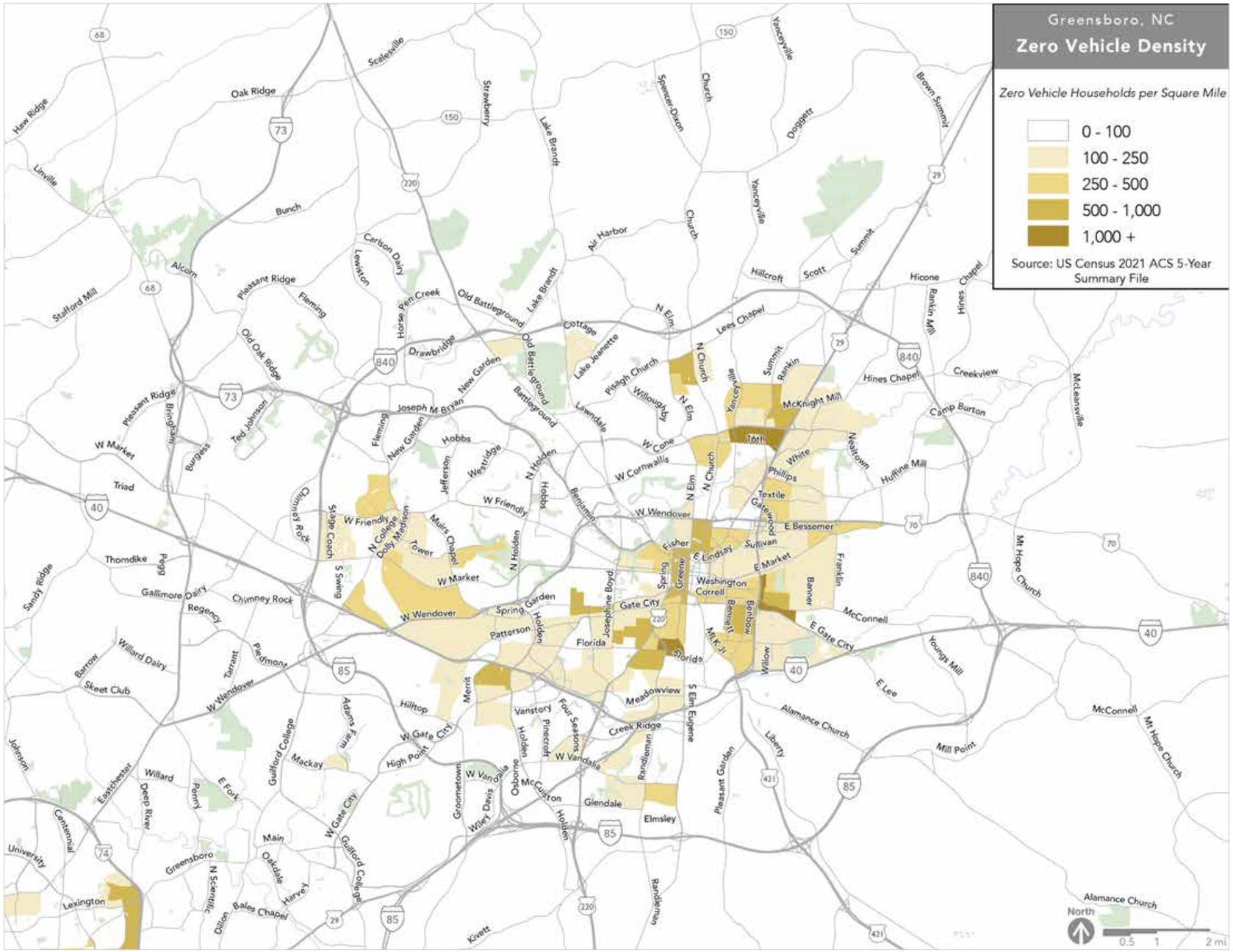


Figure 21: Density of Households Without Cars in Greensboro.

Indicators of Demand and Need: Low-Income Residents

A frequently-cited goal for transit service is to provide affordable transportation for lower-income people, who are less likely to own cars. Understanding where low-income populations are located is also a key civil rights requirement.

In some built-environments, serving people with low incomes can meet a ridership goal. Transit can be an attractive option due to its low price. In medium to high density areas with walkable street networks, this can produce high ridership.

However, if transit doesn't actually allow people to make the trips they need in a reasonable amount of time, even lower-income people will not use it. They will seek other options, such as buying a used car or getting a ride from a friend, even if it causes financial or social stress.

Key Observations

The map on the right shows the density of residents whose income is below 150% of the Federal Poverty Line level. The distribution of low-income residents in Greensboro follows a pattern similar to the zero-vehicle households in the map on the previous page.

Areas with moderate to high density of low-income people are located in the northeastern, eastern, southern, and southwestern parts of Greensboro, along with some areas in the West near Guilford Station and Hamilton Lakes. Correlation with the poverty map is expected, as income is one of the strongest determinants of whether a household can afford to buy a car.

Compared to the distribution of zero-vehicle households—which are concentrated in certain areas with affordable housing and apartment complexes, especially close to major retail centers—many more areas of the city have moderate or high densities of people with low incomes.

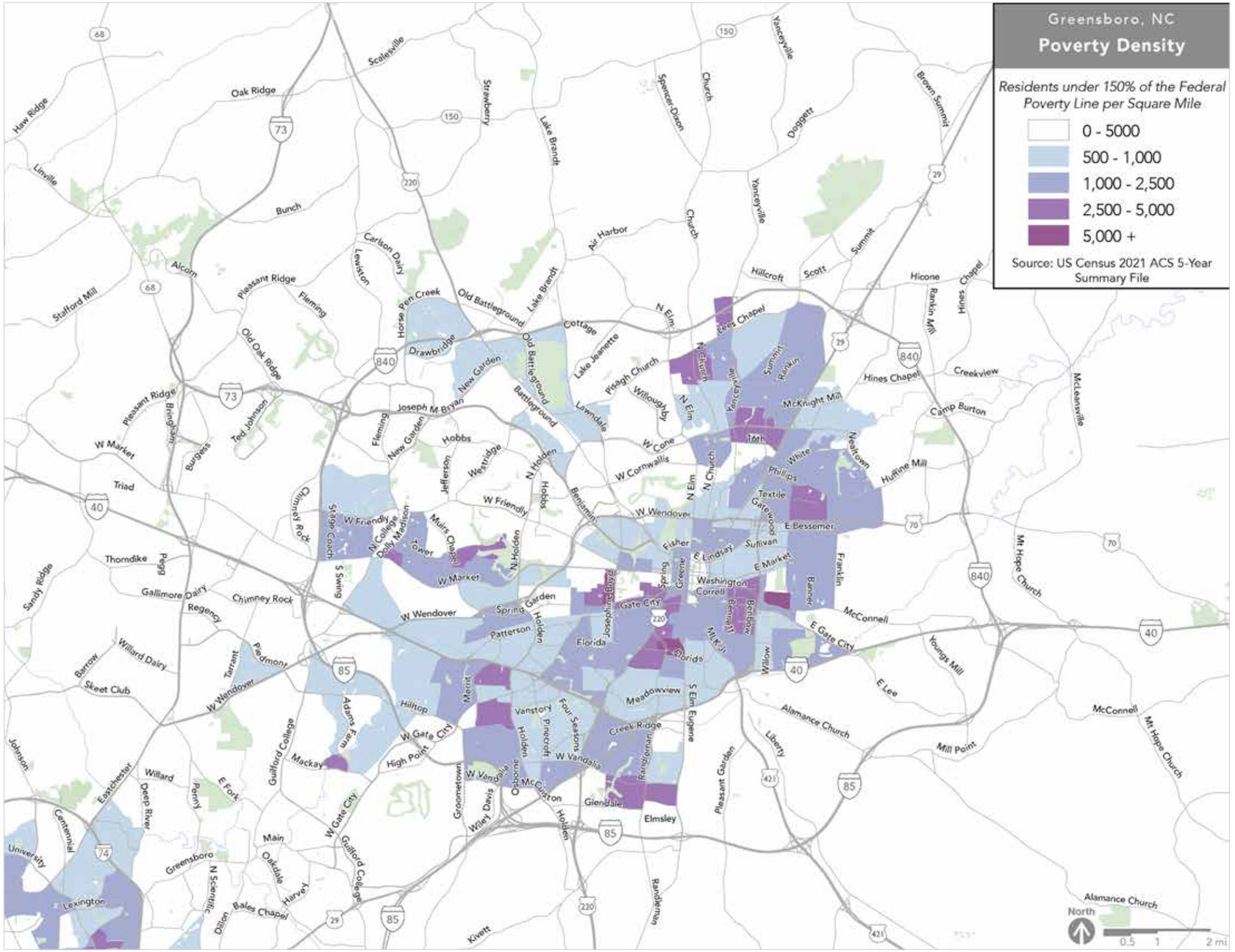


Figure 22: Density of Low-Income Residents in Greensboro.

Indicators of Need: Senior Residents

Some seniors cannot drive and may be more likely to use transit. And as a group, senior-headed households are also less likely to own cars than the general population.

Seniors tend to have different preferences for transit than younger people. Seniors are more likely to be sensitive to walking distance. On average, seniors also tend to be less sensitive to long waits and slow or indirect routes, because many are retired and have relatively flexible schedules. Most riders who are employed, in school, or caring for kids in school will find service with long waits and slow or indirect routes to be not as useful.

Due to these factors, transit service designed primarily to meet the needs of seniors rarely attracts high overall ridership relative to cost. Thus, the amount of focus that transit agencies place on meeting the needs of seniors should be carefully balanced with the needs and desires of the entire community.

Key Observations

The map on the right shows the density of senior residents (aged 65 and older) in Greensboro.

Across Greensboro, many apartment complexes, retirement communities, and nursing homes house seniors, which means there is moderate density of seniors spread throughout the city. Compared to the overall population density distribution, the distribution of density of senior residents is more prominent in the western and northwestern parts of Greensboro, and away from the core area near Downtown. Particularly in the West, areas with high density of seniors correspond to some areas with moderate density of zero-vehicle households. **There is no noticeable correlation between higher densities of seniors and high densities of poverty.**

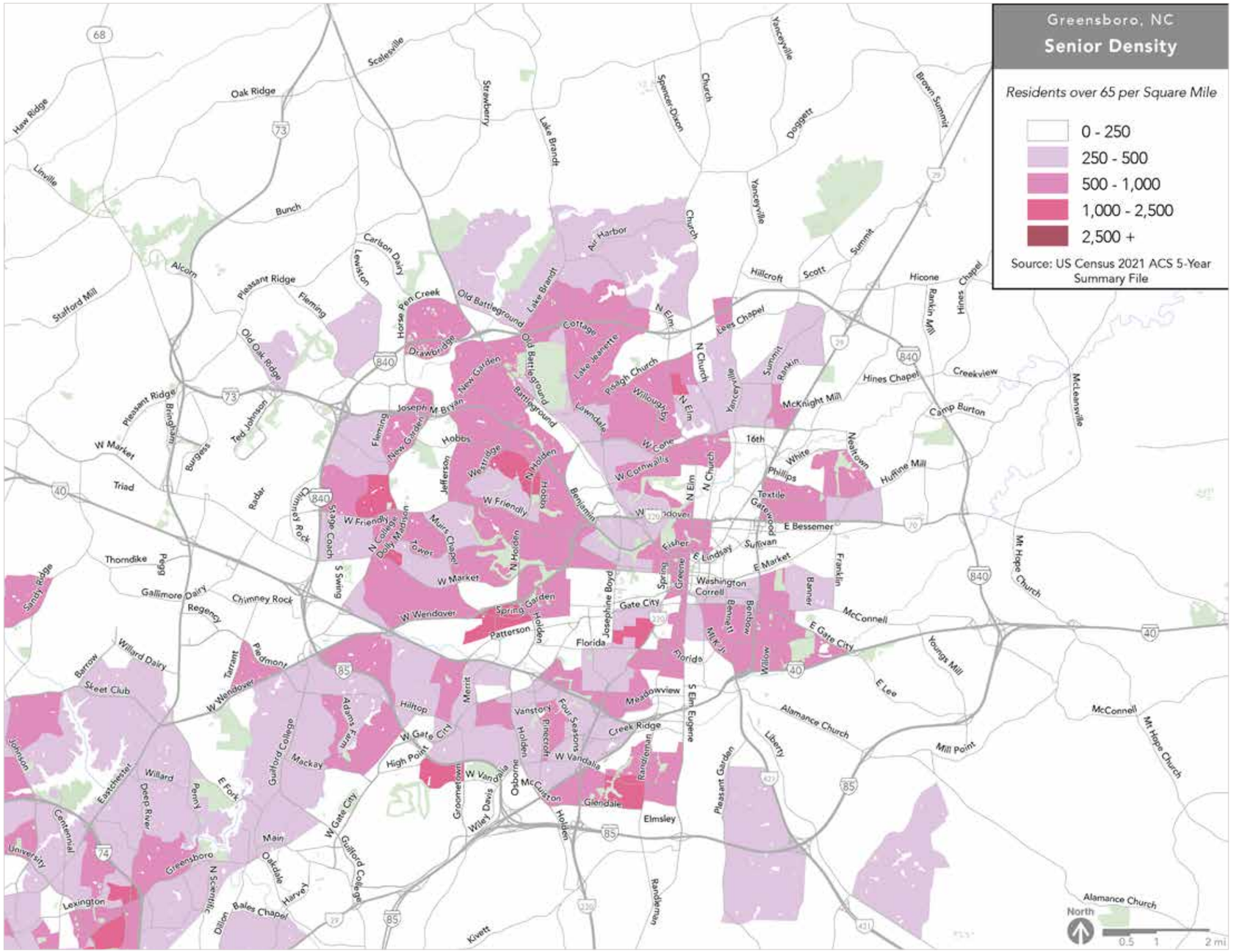


Figure 23: Density of Senior Residents in Greeensboro.

Indicators of Need: Young Residents

Just as transit coverage can meet the needs of seniors who cannot or choose not to drive, transit coverage can also meet the needs of children and teenagers who are too young to drive. Whatever effect an increase in price has on ridership among working age people, it will have an even stronger effect on ridership among young and old people. This is why most transit agencies, along with movie theaters and other for-profit businesses, offer a discounted price for seniors and children.

However, **young people and seniors are very different in their ability and willingness to walk to transit service**. Most young people can and will walk farther to reach transit service than seniors.

Key Observations

The map on the right shows the distribution of density of young residents (under 18). Overall, the density of young residents is higher across Greensboro than senior residents. Youth density generally tracks with the density of residents across the city, with the denser pockets of residents in multi-family apartment complexes and affordable housing communities also showing high youth density. The only exception is the areas near Downtown, NCA&T, and UNCG, which have very few youth compared to the population density. Residents in these areas are likely predominantly college and university students most likely in the 18-25 age group, with few residents aged under 18 living here.

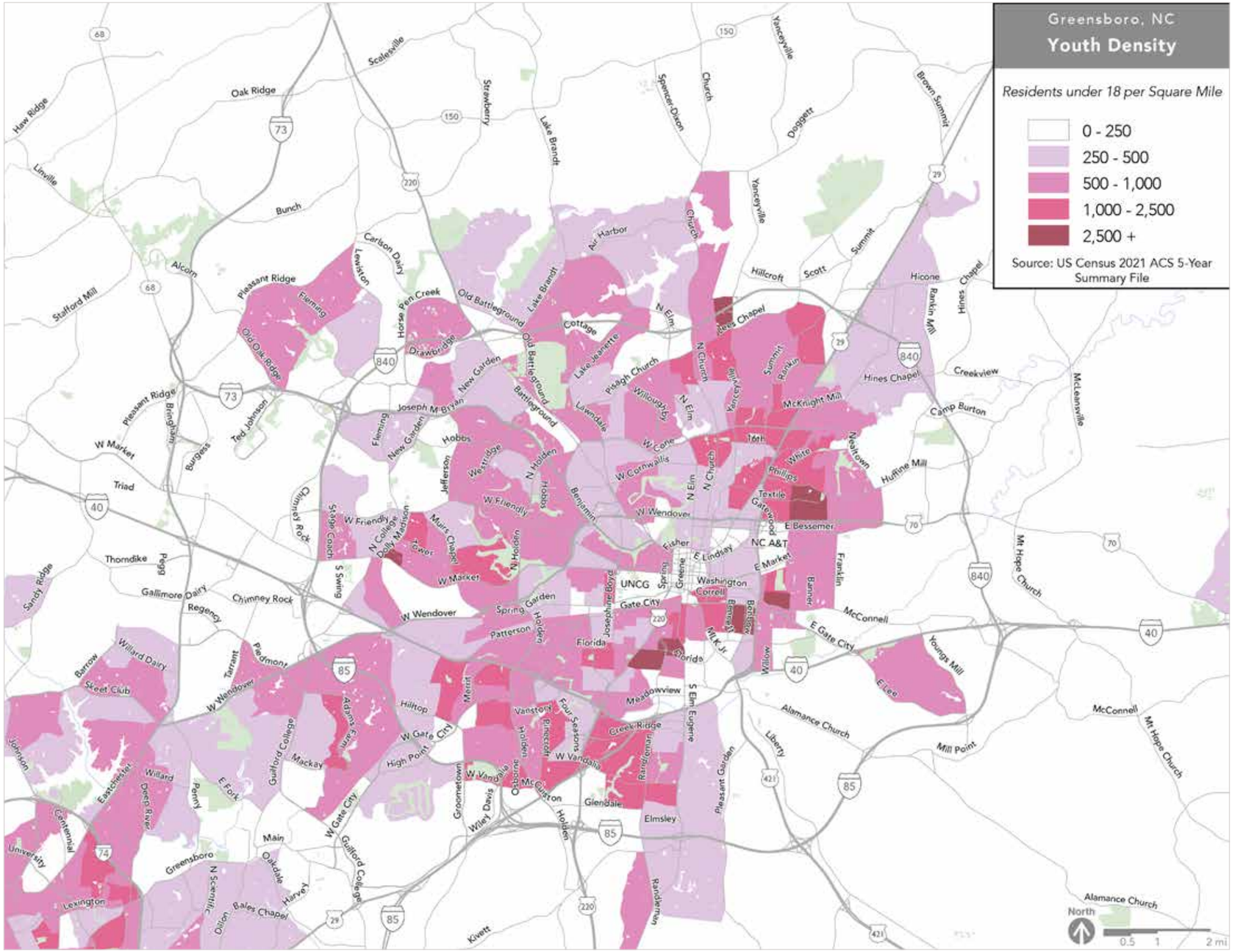


Figure 24: Density of Young Residents in Greeensboro.

Civil Rights: Race and Ethnicity

Understanding where People of Color live is critical to fulfilling the obligations of Title VI and other federal requirements to consider the benefits and burdens of transit service for historically-marginalized populations. Greensboro, like almost every U.S. city, has a history of discriminatory practices that have led to significant racial segregation to the present day. This means that when GTA makes decisions about where to provide service, down which streets and in which neighborhoods, those choices have a racial dimension.

Equity-based transit goals are often articulated in terms of improving mobility or transit access for people of color, particularly in places where the existing development patterns and transportation network contribute to disparities in access to jobs and other opportunities. **Intentional planning to address historic inequalities can be an important coverage goal** beyond just meeting federal requirements.

Where People of Color live **in relatively dense, linear, and proximate areas, transit can achieve high ridership relative to cost while also fulfilling coverage goals.** On the other hand, where People of Color live in neighborhoods that are not dense, and not linear, and not proximate, the challenge for transit is weighing the need to serve that neighborhood over others that might achieve higher ridership relative to cost.

Key Observations

The map on the right shows the distribution of people by race and ethnicity. Each dot corresponds to 25 residents who identify with that particular group. Like many U.S. cities, Greensboro is diverse overall, but has neighborhoods that are in effect segregated.

Residents in most areas in the northeastern. eastern, southeastern, and southern parts of Greensboro (which form a “crescent” shape)

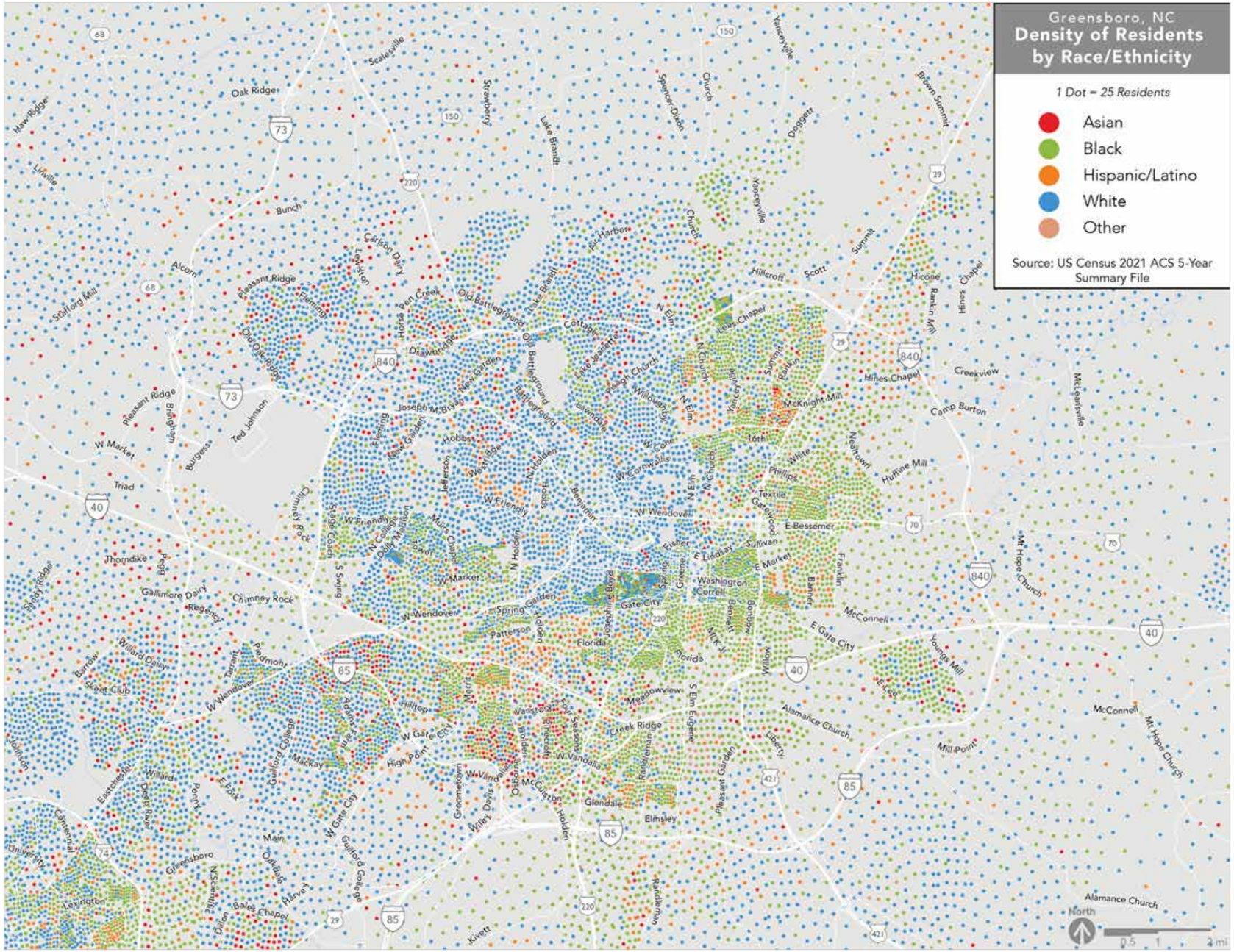


Figure 25: Distribution of Racial and Ethnic Groups in Greensboro. Each dot corresponds to 25 residents.

predominantly identify as Black or African American, and some residents there identify as Hispanic/Latino or Asian (particularly in the Rankin area). The northwestern quadrant of Greensboro has predominantly white residents, with some diverse areas near Country Park. The southwestern part of Greensboro and areas near the UNCG campus are considerably more diverse in terms of racial and ethnic identities of residents.

Historic Patterns of Segregation

The map on the right shows neighborhoods in Greensboro in 1937, color-coded based on assessments of their relative "security" for lending mortgages and home loans, produced by the Home Owners' Loan Corporation (HOLC). In general, neighborhoods with higher populations of People of Color (shown in yellow or red in this map) were rated at lower levels, meaning that it was harder to get loans to buy or renovate property in those neighborhoods. This was called **"redlining".**

Comparing this map to the map on the previous page shows that there is substantial correlation with the areas marked in red and yellow on this map and the areas where People of color live today, in the crescent-shaped area mentioned earlier. This redlining map is **just one example of a myriad of laws and regulations that encouraged and maintained segregation then, and still impact current patterns** of where people live in and the disparate levels of access to opportunity available to different people.

The implications of historical patterns of segregation on access to opportunity for People of Color are quite stark to the present day. The yellow and red areas in this map correspond closely with where People of Color live today, and the same areas shows high densities of poverty (page 31) and households without cars (page 30) today. Crucially, these areas are far from the many job opportunities that are more concentrated on the western side of the city.

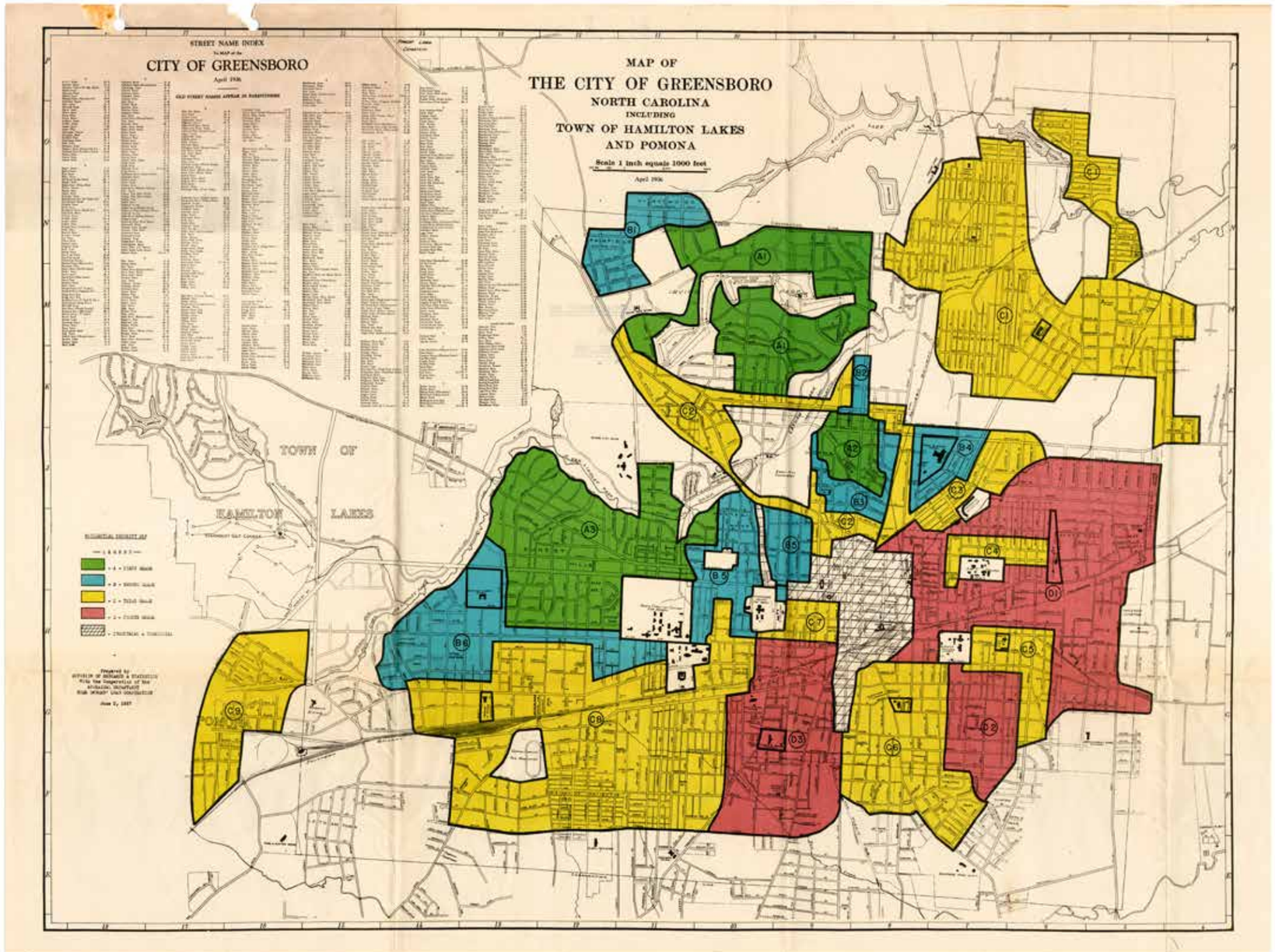


Figure 26: Historic map of "Residential Security" by HOLC that defined the relative "security" of investing in each neighborhood. The neighborhoods with higher rates of People of Color tended to get much lower ratings, which had severe subsequent economic repercussions. Source: University of Richmond Digital Scholarship Lab.

4 Existing Transit Network

The Transit Network in Greensboro

This chapter describes the existing transit network in Greensboro, its structure, context, limitations, and the available information about its performance.

Map of the Transit Network

A map of the transit service in Greensboro is shown at right, with service levels and route patterns as they were in Summer 2023. Fixed route service in Greensboro is mostly provided by Greensboro Transit Agency (GTA), while Piedmont Authority for Regional Transportation (PART) provides several regional routes (shown with the prefix "P" on the map). GTA Route 11 provides timed connections to High Point Transit System's Route 25 (shown as H25 in the map) at GTCC Jamestown Campus during daytimes on weekdays.

On every route map in this report, **the color of the line shows the frequency of that bus route** at midday on weekdays:

- **Red** means about every **15 minutes.**
- **Purple** means about every **20 minutes.**
- **Blue** means about every **30 minutes.**
- **Green** means about every **60 minutes.**
- **Tan** means the route operates only during peak hours or has infrequent or limited service.

In transit conversations there is always a great focus on **where** transit is provided. However, there are other important components of transit service that are essential to its usefulness:

- **Frequency** or headway: **How often** do buses come? How many minutes are there between each bus? How long of a wait is required to use a route?
- **Span** or duration: **When** and how many hours of the day and days of week is service running?

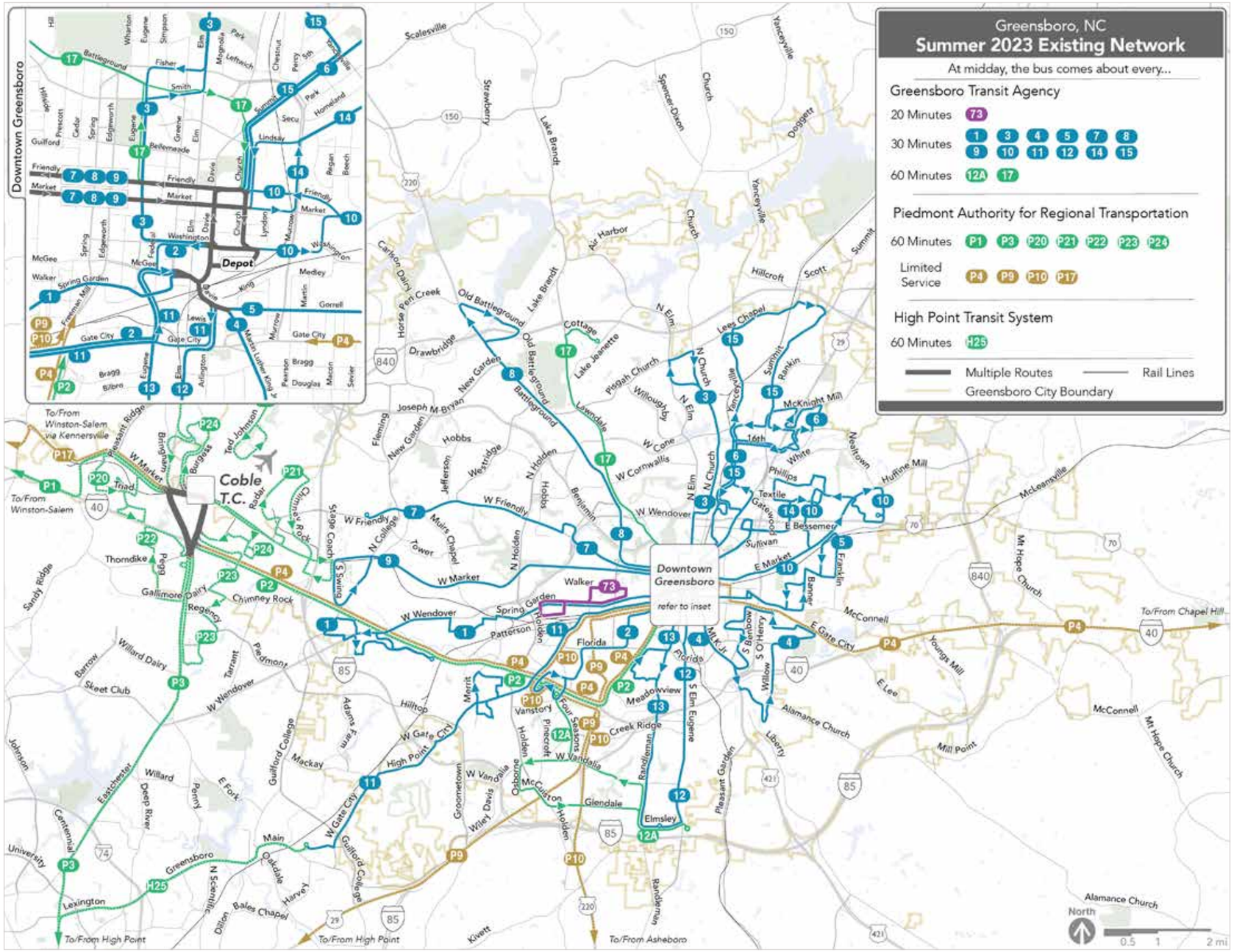


Figure 27: The existing transit network with routes color-coded by midday frequency.

Frequency is especially important for useful service because it:

- **reduces waiting** time (and thus overall travel time),
- **improves reliability** for the customer because if something happens to your bus another one is always coming soon,
- makes transit service **more legible** by reducing the need to consult a schedule, and
- makes **transferring** (between two frequent services) **fast and reliable**.

One of the most prominent features of the GTA network is that **there are no routes with a frequency of 15 minutes or better** in the system. Low frequencies and short spans are often major reasons that transit fails to be useful, as it means service is often not there when the customer needs to travel.

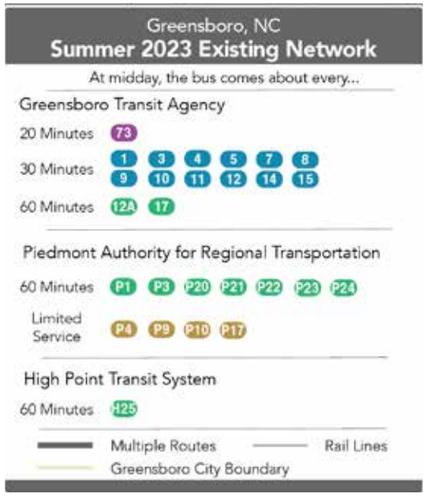
Downtown Greensboro

The map on the right shows the Downtown network in the same route color style as on the previous page. The central hub of the GTA network is the Depot. Many routes from all directions converge here, and riders can make transfers at this location to multiple routes connecting across the city. Amtrak, PART, and Greyhound also provide service to the Depot.

There is concentrated service on West Friendly Avenue and Market Streets, as Routes 7, 8, and 9 all use these streets to get to and from the Depot. From south of the railway tracks, there are fewer streets for buses to easily get to the Depot, so GTA service is focused on South Eugene and Davie Streets.

UNCG and NCA&T are located close to Downtown Greensboro. These institutions are major drivers of travel demand for students, staff and visitors. GTA's Higher Education Area Transit (HEAT) Route 73 acts as local circulator route for UNCG, in addition to the university's own shuttle service. Since Route 73 does not go to the Depot, travel between UNCG and much of the rest of Greensboro requires the use of the much less frequent Routes 1, 7, 8, and 9. Prior to its discontinuation, Route 75 was also a similar university circulator route for the NCA&T campus, which did not directly connect to many other GTA routes Downtown.

This map does not show the Downtown Trolley service that started operating in July 2023. The Trolley serves Elm Street, within the core of Downtown, at a frequency of every 7-8 minutes, but only from Thursday to Sunday, and only starts running at noon.



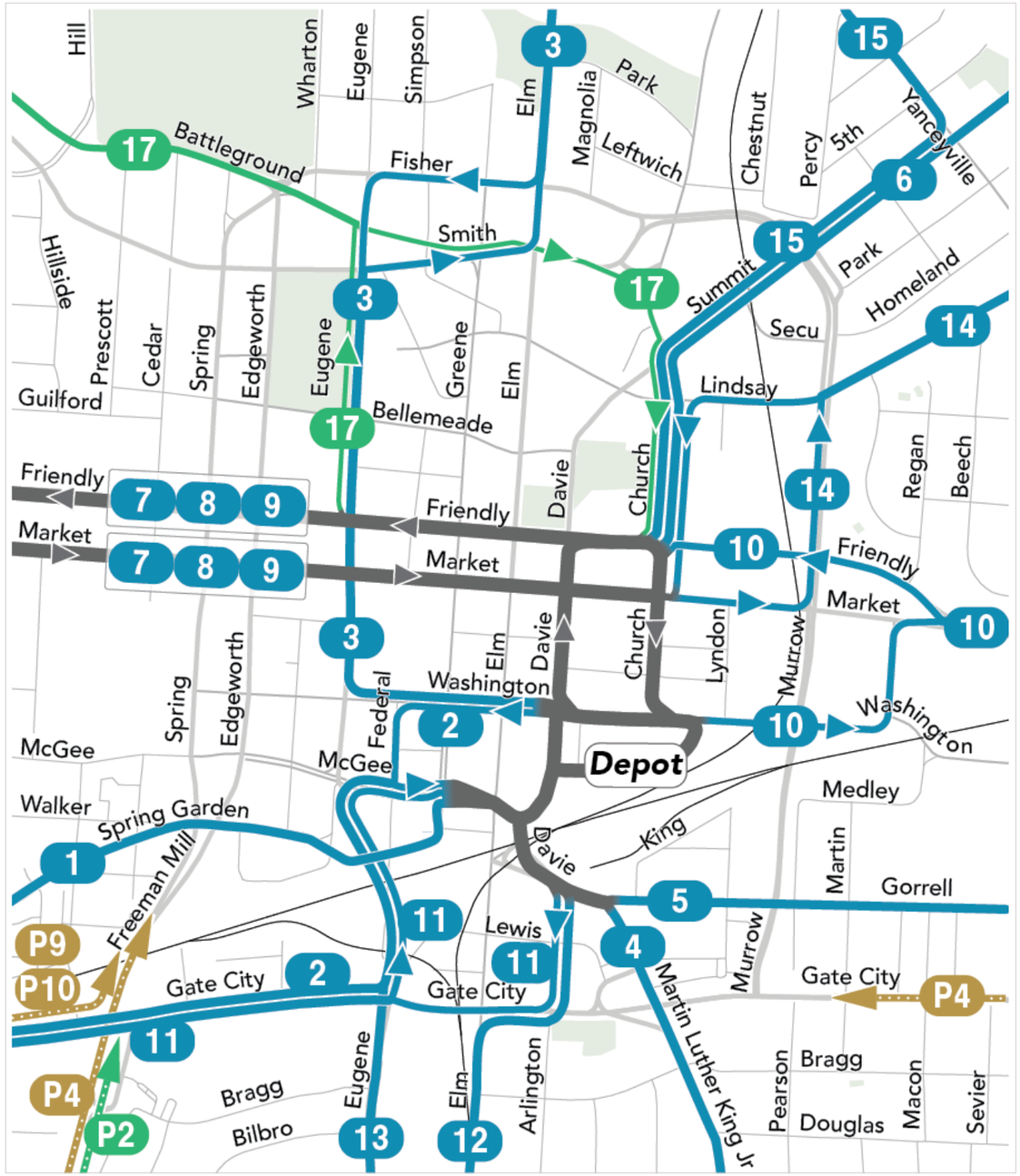


Figure 28: The existing downtown transit network with routes color-coded by midday frequency.

When Is Service Available?

The graphic to the right summarizes each GTA route's hours and days of service as of Summer 2023. The colors represent the **frequency** (how often a bus on the route comes) of service during each hour of each day. The graphic also describes the **span** of service (what days and what durations the route operates).

Less Evening and Weekend Service

On weekdays, GTA service typically starts between 5 and 6 AM, and ends around midnight. Weekend service typically starts around 6 AM and ends around 10 PM. Most routes that operate every 30 minutes drop back to every 60 minutes after 6 PM and on Saturdays. Reduced service and shorter spans on the weekends limits the usefulness of the transit network in several ways:

- **Few service workers commute during rush hours**. Many service workers change shifts in the early morning or late evening. If transit is less frequent in the evening, it makes trips for these workers much harder.
- **People working in retail or restaurant jobs often need to work on weekends.** A route that runs infrequently on the weekends is missing the peak time for people in these industries.
- **People value flexibility and spontaneity.** Having the flexibility to make a trip outside of specific hours is important to all people. Everyone wants the ability to get home outside of the traditional 8-to-5 workday.

Offering long spans of service throughout the day and week, in places where large numbers of people can use transit, is key to attracting high ridership over time. For many people, this can provide the **option to not drive or hire a car**, if transit is reliably available when they want to go, where they want to go.

Lower frequencies, short hours of service, and weekday-only schedules often help in achieving a coverage goal, as transit can be spread out over many routes, many neighborhoods and long distances, so that a little bit of service is close to many places and people. **Spreading transit out means spreading it thin.**

Yet, the resulting routes are often not very useful to most people because the schedules are so limited.

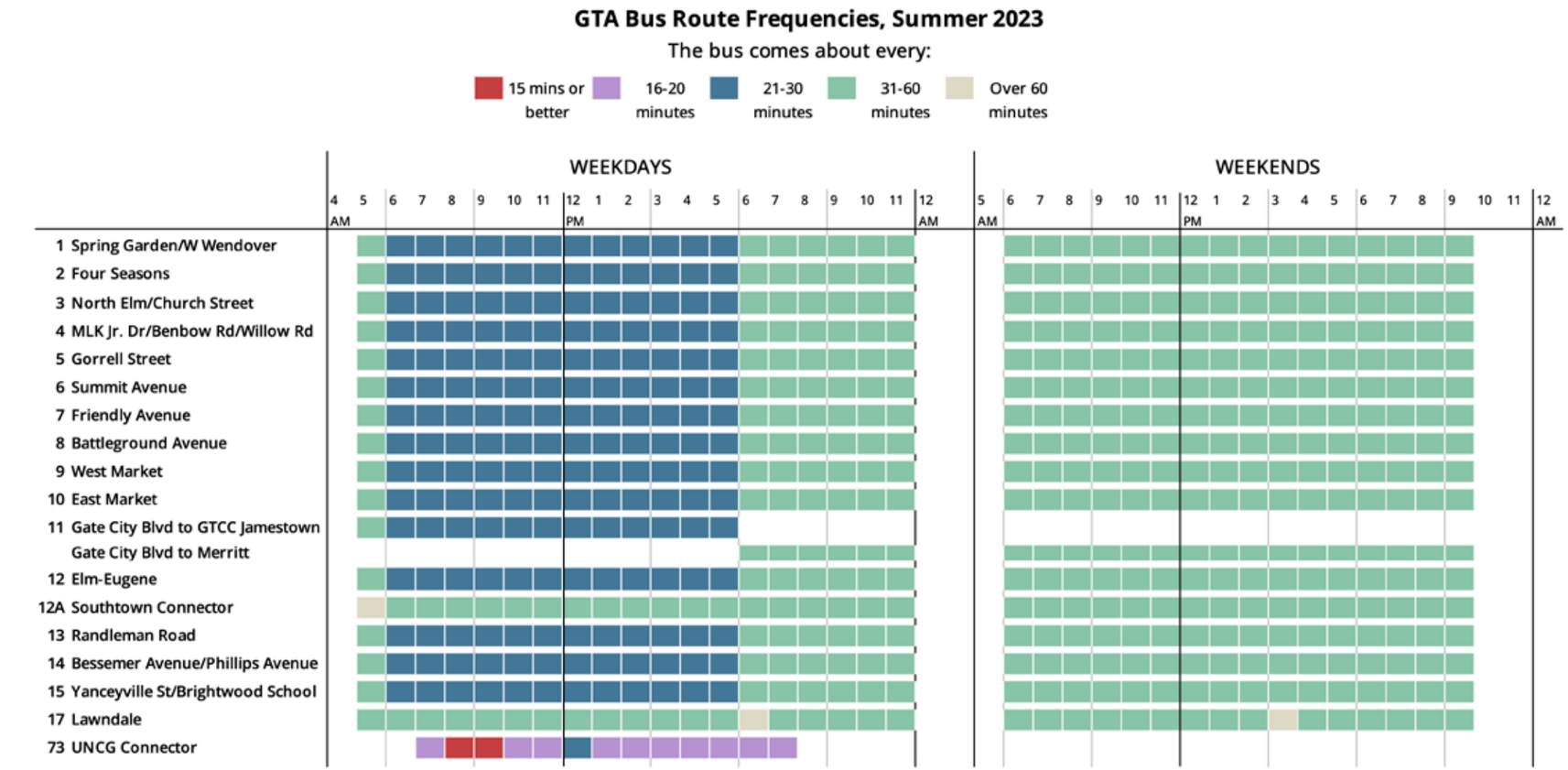


Figure 29: Span of service and frequency by hour for GTA routes on the weekdays and weekends during Summer 2023.

Low frequencies and short weekend and evening spans make transit less useful for most people, yet these features help achieve wide coverage by allowing more routes to cover more areas.

Where Are People Riding Today?

Each dot in the map to the right shows the average number of weekday boardings at each GTA bus stop during March 2023.

High ridership areas and corridors can appear in two different ways on this map: either as a few large dots, or as multiple medium-sized dots that are very close to each other. Looking for those patterns we can observe that the highest boardings occur:

- At transit nodes like the Depot in Downtown,
- At educational institutions like UNCG, NCA&T, Bennett College, and GTCC Jamestown Campus,
- Near hospitals and shopping centers, and
- Along parts of South Randleman Road, South Elm-Eugene Street, Spring Garden Street, and West Gate City Boulevard.

There are some medium-ridership areas that are more scattered or isolated. Most of them are attributable to specific generators like apartment buildings or social service providers.

Looking at this map, we must keep in mind that not every stop is offering the same level of service.

- A small dot on a low-frequency route may simply reflect the low level of service.
- A small dot on a more frequent route would suggest low demand for transit near that stop.
- A large dot on an infrequent route means that ridership is high despite a low level of service, which suggests that nearby transit demand may be high, and under-served.

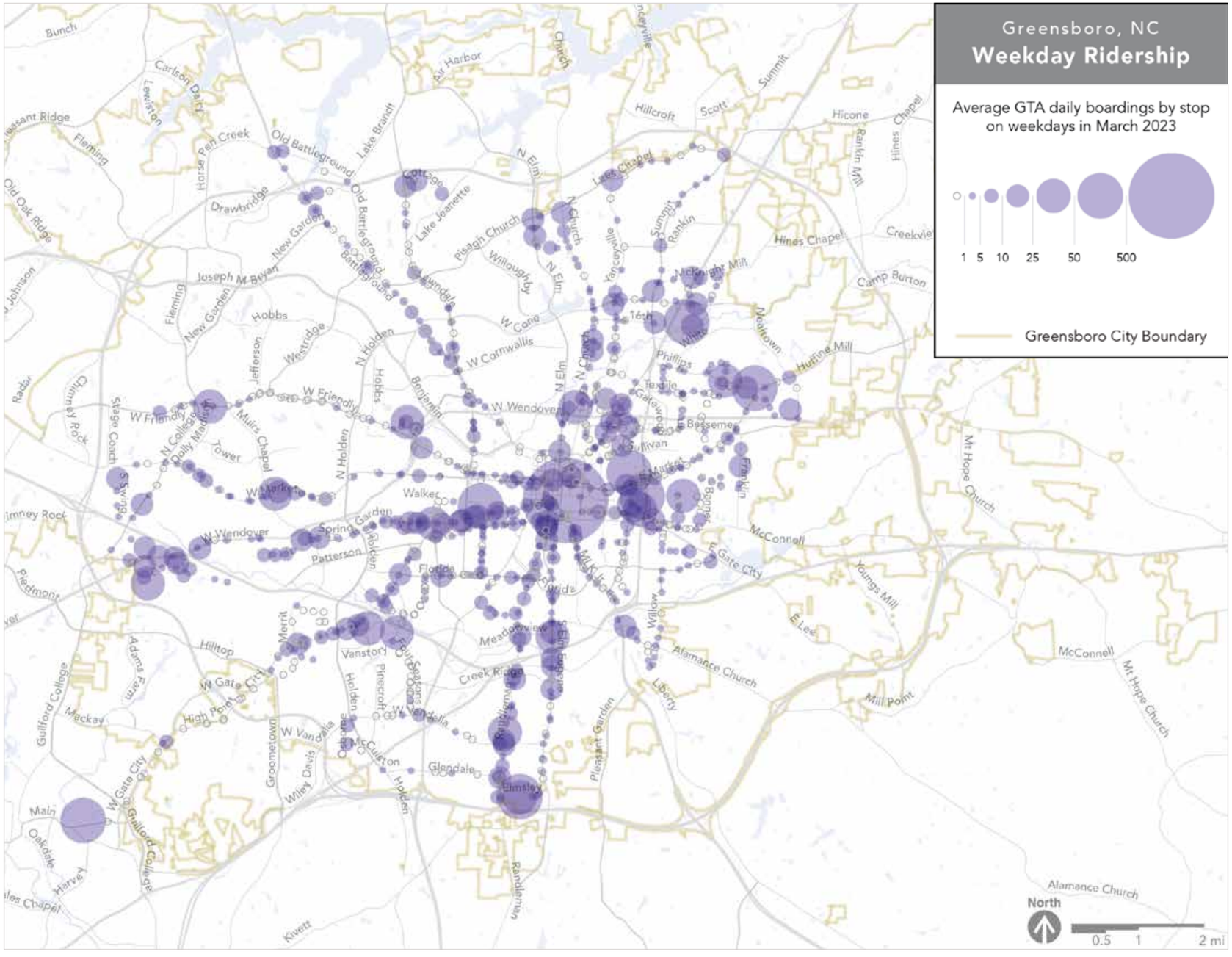


Figure 30: Average weekday boardings per stop (for all GTA routes) counted in March 2023.

Ridership Relative to Cost

Some communities adopt goals like "increasing transit usage" or "reducing car emissions". These are goals which depend on making transit useful to lots of people such that they can "maximize ridership". Implicit in this statement, however, is a constraint: there is a limit to how much funding is available to increase ridership. A transit agency cannot spend infinite amounts of money pursuing each additional rider in pursuit of "maximum" ridership.

The more specific way to state this goal, then, is to "maximize ridership within a fixed budget." Even if the budget grows, it is and will always be limited.

People who value the environmental, business, or development benefits of transit will talk about ridership as the key to meeting their goals. Since the transit agency is operating under a fixed budget, the measure they should be tracking is not sheer ridership but **ridership relative to cost**. They would not be satisfied simply by a large dot on the boardings map on the previous page, until they knew what it cost the transit agency to achieve that large dot.

Service Hours

The cost of a transit route relates primarily to the time spent by operators running the route, since most of the cost of transit is in the wages paid to everyone running the system day-to-day.

In the transit business, the measurement of time spent operating service is called "service hours" or sometimes "revenue hours". One bus operating on a route, picking up and dropping of passengers has spent one "service hour". Service hours are a direct measure of the quantity of service.

The service hours provided on any particular route, and to any particular stop, will depend on a few factors:

- The length of the route,
- The operating speed of the route (since a slower operating speed means that covering the same distance takes more time),
- The frequency of service along the route or to the stop (since higher frequency is supplied by more buses and operators out driving the route), and
- The span of service along the route each day and each week.

Ridership relative to cost is called **productivity.** In this report, productivity is measured as boardings per service hour:

$$\textit{Productivity} \quad \frac{\textit{Ridership}}{\textit{Cost}} = \frac{\textit{Boardings}}{\textit{Service Hours}}$$

Productivity is strictly a measure of achievement towards a ridership goal. Services that are designed for coverage goals will likely have low productivity. This does not mean that these services are failing or that the transit agency should cut them. It just means that their funding is not being spent to maximize ridership.

Where Is Productive Service Today?

The scatter plot on the right shows the individual routes from GTA, plotted according to their weekday midday frequency (horizontal axis) and their weekday productivity (vertical axis). More frequent services tend to have higher productivity (ridership per service hour), even though providing high frequency requires spending more service hours.

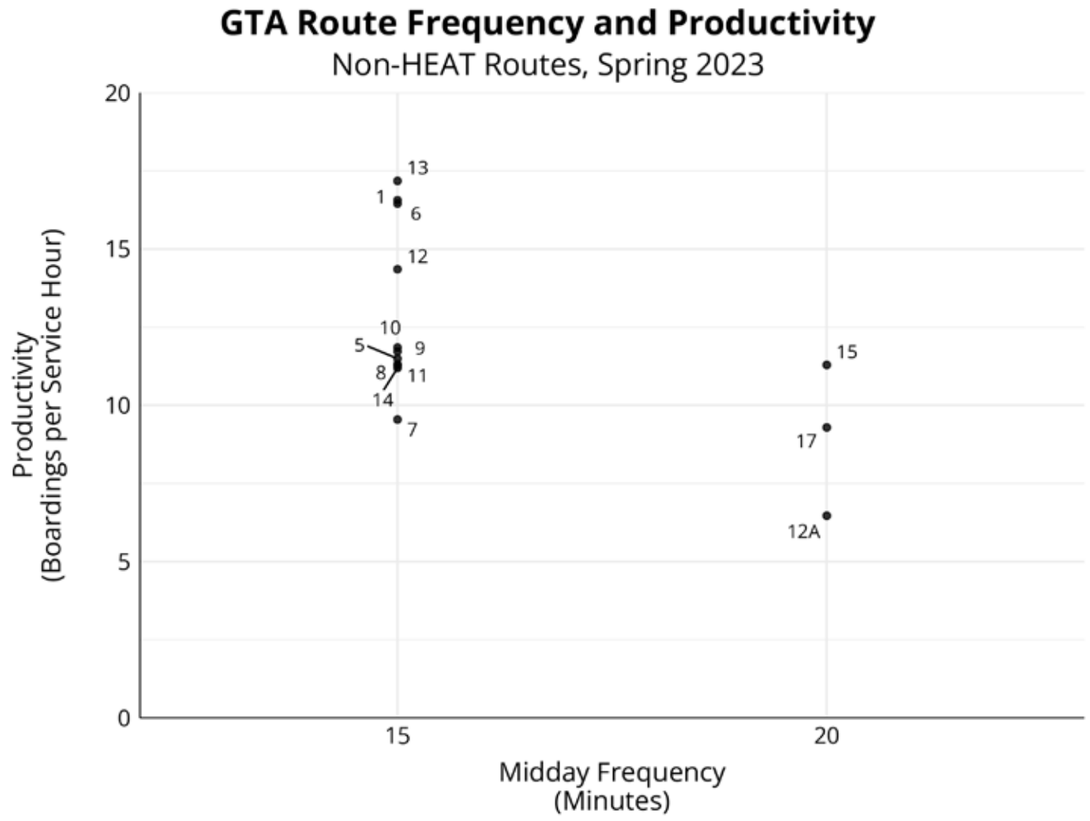


Figure 31: Productivity and Frequency by Route in Spring 2023.

This happens because frequent service is very useful and convenient for riders. Many transit agencies target this (more expensive) service towards their strongest ridership markets, often in suitably dense and walkable environments. High ridership is a common result of providing frequent service in such places.

Not only do such frequent routes tend to have higher ridership overall, but they often also have higher ridership *relative to their cost.* This relation between frequency and productivity holds across many cities, as seen on page 17.

Many GTA routes have a productivity of around 11 to 12 passengers per service hour. HEAT Routes 73 and 75 are not pictured in this chart. Route 75 ran every 15 minutes or better, and had an extremely high productivity of 35 boardings per service hour. Route 73 runs about every 20 minutes and has a productivity of about 9 boardings per service hour. Excluding HEAT Routes, Route 13, 6, and 12 are the highest productivity routes in the GTA network. Route 7 is the least productive route among those that operate every 30 minutes at midday, while route 12A is the least productive route among those that operate every 60 minutes.

Circuitous Routes Cover Many Areas, but Aren't Very Direct.

With limited resources available, a relatively large geographical area, and an apparent desire to cover most of that area, means GTA must spread its resources thinly. One strategy to cover many areas with few resources it to have very complex routes with deviations, loops, and splits—a coverage tool.

This type of route brings service close to a larger number of people and places. They reduce walking distances to bus stops. Circuitous and deviating routes are often very long, much longer than they seem on a map. This increases their operating cost, and makes it hard for transit agencies to provide high frequencies or long hours of service on them. In some cases, they discourage more ridership than they attract, but ridership is not the goal of a coverage service.

A few examples of circuitous routes are described below, and depicted in Figure 32 on the right:

- Route 4: Runs on M.L.K. Jr. Drive, Benbow Road, and Willow Road. The maps on the next page provide an example of a rider taking Route 4 to Kindred Hospital, and how the return trip can take much longer.
- Route 5: Runs on Gorrell Street, and has two loops, heading towards Franklin Boulevard.
- Route 6: Runs on Summit Avenue and serves shopping centers and other destinations on all on four sides of a large highway (US-29) interchange. This makes it difficult to run a linear service.
- Route 10: Runs on East Market Street and serves McGirt-Horton Library, GTCC Greensboro Campus, and NCA&T. Its outer end includes a large, "figure 8" loop.
- Route 12A: Runs on Four Seasons Road, Glendale Drive, Vandalia Road, and Holden Road. As described on the previous page, the route connects several shopping centers together, but include a very large split in the middle of the route.
- Route 15: Route 15 travels along Yanceyville Street and Brightwood School Road. This route serves the Greensboro Cultural Center, Greensboro Central Library, and the Department of Social Services. The far northern end of the route is a large, six-mile long loop.

Circuitous Routes Are Often Less Productive

Circuitous routes are used to provide coverage in many areas, but if they run infrequently, they can be difficult to use without consulting a schedule in advance. Many transit riders will walk a little further to reach more direct or more frequent routes, so agencies sometimes invest more service into nearby linear routes.

Long one-way loops are another factor that can make it difficult to use some feeder routes. These patterns exist so GTA can cover more area, but it presents significant challenges to riders who usually need to travel in both directions. One-way loops take passengers on circuitous paths, either from their trip to their destination, or on the return trip.

This is part of the reason that so many 30-minute routes like 4, 5, and 10 have modest productivity, and the productivity of a route like 12A is so low.

Routes with deviations and loops sometimes attract high ridership relative to their cost. The number of riders added due to a deviation is occasionally big enough to make up for the negative impacts on through-riders. This is the case in Route 6, which has relatively higher productivity. The deviations in these routes bring transit to social services and several shopping centers. The closely related hourly Route 15 is also the most productive route with that frequency.

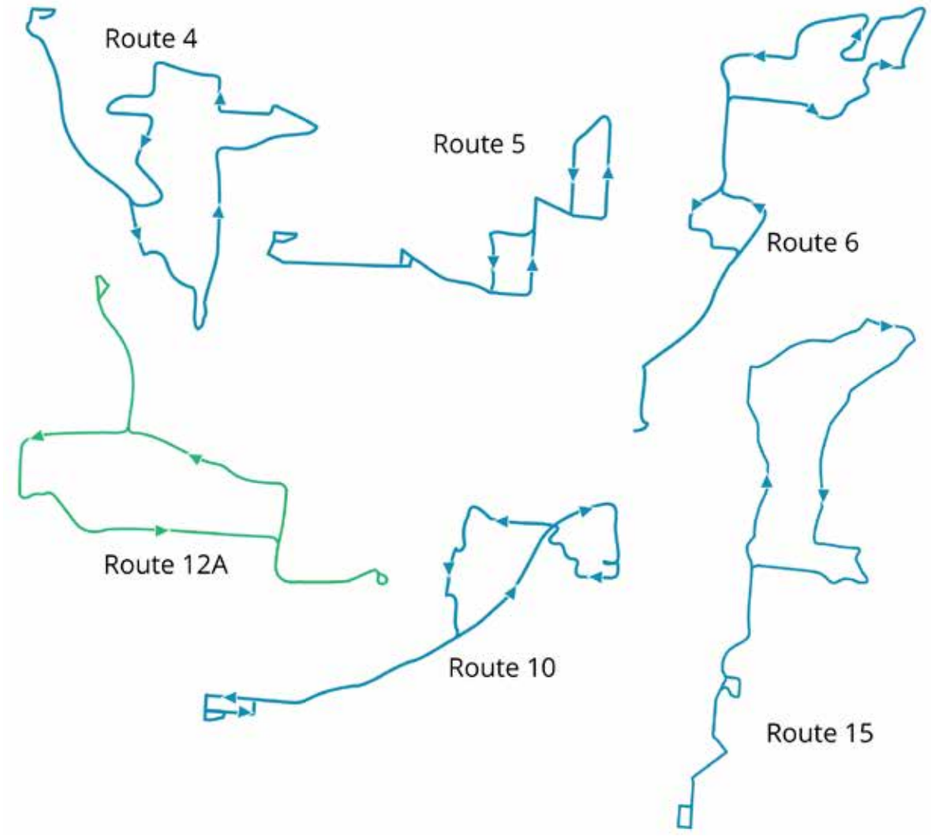


Figure 32: Examples of circuitous routes in Greensboro (routes not to scale).

Deviations and One-way Loops Add Significant Travel Time.

Routes with deviations and loops on them can only feel direct to the people who are bound to or from the deviation or a place along the loop—for most other riders, they often feel like a waste of time. People almost never want to be taken out of direction when they are on their way somewhere. This is part of the reason that linearity is one of the five geographic indicators of high ridership potential, as described on page 20.

The maps on the right show an example of a rider taking a trip to Kindred Hospital from Haven at Willow Oaks Apartments, located near McConnell Rd.

On the way to the hospital, an average trip takes 31 minutes. On the return trip home, a rider has two options: Take Route 4 back home, or take Route 4 to the Depot, and then take Route 5 back home. In either option, the trip back home takes about 20 minutes longer on average than the trip to the hospital.

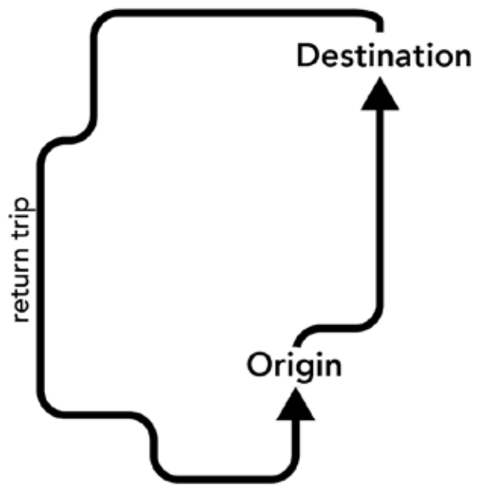


Figure 34: In a one-way loop, the more direct the service from A to B, the more circuitous it's likely to be on the return trip.

A trip from a residence near McConell Rd to Kindred Hospital:

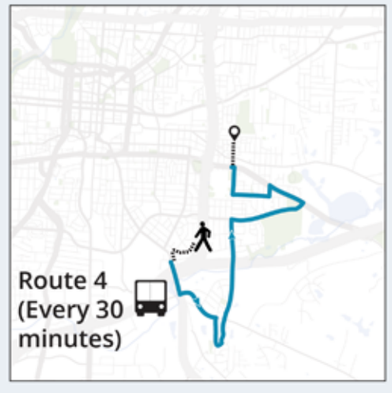
Total Travel Time: 31 minutes

- *6 minutes walking*
- *15 minutes average wait*
- *10 minutes riding*

There are two options to return home, both of which take longer than the trip to the hospital:

Total Travel Time: 47 minutes

- *3 minutes walking*
- *27 minutes waiting*
  Rt 4: 15 minutes average wait
  Rt 5: 12 minutes wait at Depot
- *17 minutes riding*
  Rt 4: 9 minutes riding
  Rt 5: 8 minutes riding



Total Travel Time: 48 minutes

- *13 minutes walking*
- *15 minutes average wait*
- *20 minutes riding*

Figure 33: Example of a trip using Route 4 to go from an apartment near McConnell Road to Kindred Hospital.

Predominantly Radial Network

As discussed in Chapter 2, there are two basic network shapes found in most transit systems. To summarize:

- **Radial** networks have a central point, and nearly all routes go to that point, often in downtown areas. Anyone looking to travel downtown can make their trip without the need to transfer. Anyone going to another outlying place can get there with a single transfer at the center.
- **Grid** networks also offer people a way to travel across an area with a single transfer. Unlike in a radial network, the transfers in a grid network happen wherever two routes intersect. Grid networks are only useful when frequencies are high, and waits to transfer are short.

A Radial Network Fits the Current Resources

Greensboro has a big concentration of jobs, activities, and residents in and around Downtown. The street network in Greensboro is mostly radial in orientation, and many residents and jobs are located close to one of the many arterial roads that radiate outward from Downtown. Therefore, a radial network fits naturally to the overall built form of the city. A majority of GTA's routes run radially along arterial roads and meet at the Depot.

As discussed on page 18, for a grid of routes to function well, they need to be highly frequent, every 15 minutes or better, so that wait times to transfer are minimal. However, frequency is expensive.

With the current level of resources and the decision to spread those resource thinly across most areas of the city means that GTA can only afford to operate most routes every 30 or 60 minutes.

With such limited frequency, it is critical to time connections between routes to minimize wait times when transferring. In Greensboro that central connection point is at the Depot. Such coordination is not easy to implement in the multiple possible transfer points of a grid network.

The radial, pulsed design results in two key outcomes:

- Many connections are possible through Downtown, and
- Very few trips are served more frequently than every 30 minutes. While many buses enter and leave downtown every half-hour, they all arrive at roughly the same time.

Another advantage of the radial structure is that at the Depot, most riders can very easily connect to a variety of other regional and national transit services like PART, Amtrak, and Greyhound buses.

Orbital Service in a Radial Network

Route 12A is the only route that is not a radial route. It is an **orbital** route, or a route that orbits around the core, and it links residents in the southwestern parts of Greensboro to retail on West Elmsley Drive and Four Seasons Town Centre, without entering Downtown.

When orbital routes are infrequent, and particularly when their schedules are not coordinated with other routes, waits can be extremely long. They are then not very useful for most people's travels.

Many features of Route 12A suggest that it is meeting coverage goals rather than ridership goals:

- Its frequency is only every 60 minutes.
- It has a large one-way split, where it serves different streets, far away from each other, in either direction, so that it can cover a larger area with minimal service.
- Route deviations along route 12A allow for service to Osborne Road at the expense of longer travel times for through-trips.
- Not every transfer to or from Routes 2, 12, or 13 is timed for a short wait[1].
- Any travel beyond those three connecting routes requires an additional transfer at the Depot.

Radial networks make the most efficient connections when frequencies are low. But for a useful network of radial and orbital routes, high frequency is essential.

Within radial networks, orbital routes can provide faster travel for many journeys and provide significant access to opportunities in the outer parts of a city **IF they are sufficiently frequent**.

1 Transferring from Route 12A to Route 2 at Four Seasons Town Center requires a wait of only 8 minutes, but transferring from Route 2 to 12A can require a 22- or 52-minute wait. At the Elmsley Walmart, transferring from Route 12 or 13 to Route 12A westbound requites a short 3-8 minute wait, but transferring from the eastbound Route 12A to Route 12 or 13 requires a 13-18 minute wait.

Figure 35: Within the highly radial network in Greensboro, Route 12A is an example of an orbital route.

Most Routes Are Designed to Pulse

Timed Connections at Transfer Centers

Connections allow people to travel in many directions but the amount of time a transfer takes depends largely on the frequency of the connecting routes.

For an untimed connection, transferring to a frequent route which comes every 15 minutes, would take on average just 7.5 minutes. However, transferring to a route that comes every 60 minutes could require a 30 minute wait, on average, and in the worst case a 59 minute wait! This is why **useful, untimed connections require high frequency**.

To make connections between low-frequency routes more tolerable, transit networks are often designed to offer **timed connections** at a few key locations. Buses on several routes arrive at the same place close to the same time, wait for a short duration so that passengers can transfer between routes, and depart soon after.

This pattern repeats regularly, once or multiple times in an hour, and is called a **pulse.** This can happen at any regular interval, though half-hourly and hourly pulses are common in most networks with a timed connections.

Most GTA routes come together at the Depot, offering a pulse every half hour. In such a way, they allow for relatively quick connections despite low frequencies. Pulsing only makes transfers short. Timed connections are available only as often as the least frequent route on your trip, so a transfer from a half-hourly route to an hourly route only happens once per hour.

Other places in and around Greensboro where pulsing occurs include Coble Transportation Center where many PART routes come together in an hourly pulse, and GTCC Jamestown Campus where GTA Route 11 and High Point Transit Route 25 have a timed connection.

Pulses Don't Always Work Perfectly

In theory, pulse timing at a transfer center means that every bus arrives a few minutes before the departure time, drivers take a quick break, and then every bus departs at roughly the same time, allowing for every transfer to be made with just a few minutes wait, perhaps 5-8 minutes.

In practice, schedules are rarely perfect. Designing routes to be a certain length so that buses can arrive at the hub at roughly the same time can be challenging.

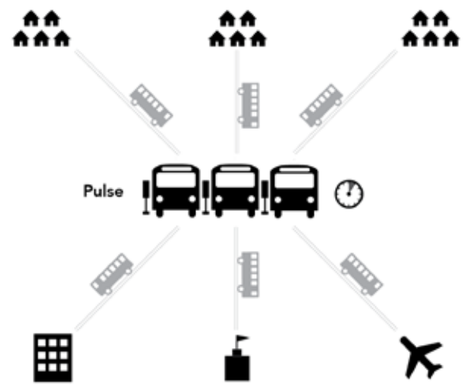


Figure 36: In a pulse, multiple low-frequency routes are scheduled to come together regularly, dwell for a few minutes so that passengers may transfer among them, and then depart again.

Loops and Pulses

Unless at a perfect length, a route that operates as a loop cannot be made to both depart from a Transfer Center on time, and return exactly five minutes before the next departure time without adding a layover somewhere along the route that makes it less useful for people riding through the loop.

GTA's Route 4 is an example of this. It departs at 0 and 30 minutes past the top of each hour from the Depot, travels out Martin Luther King Jr. Drive and Willow Road, completes a large one-way loop, and returns to the Depot 12 minutes before the next departure.

This means that many journeys which involve a transfer from Route 4 require a 12-minute wait at the Depot, instead of a short wait of around 5 minutes, which is more ideal. It could be possible for a driver to take a break somewhere on this outer loop to provide adequate layover. Yet, that break could mean that some riders cannot complete their journey without sitting through this layover, if they need to travel from one side of the break point to another along the loop.

Pulsing at Multiple Points

Similar to loops, unless a route is of the perfect length, timing it to pulse at multiple points can be quite challenging. For example, at Four Seasons Town Center, someone transferring from Route 12A to 2 will likely wait around 8-10 minutes, but someone wanting to transfer from Route 2 to 12A could have to wait as much as 50 minutes. Similarly, Route 12A reaches the Elmsley Walmart around 15 minutes before Route 12 and 13 buses get there.

Pulses Are Important But Fragile

There is a cost to pulsing. First, the routes must be designed so that they can make a round trip in the right amount of time to get back to the pulse with all of the other routes. This makes it hard to lengthen a route just a tiny bit in response to requests.

This inflexibility also means that any reduction in the speed of the bus can be threatening to the pulse, since that bus may not be able to do its round trip in the required amount of time.

The consequences of a bus arriving late to a pulse are more severe than that of an untimed connection. For an hourly route that arrives six minutes late and just misses a pulse, connecting passengers have to wait up to an extra 59 minutes for the next bus.

In a system with mostly infrequent routes, pulses are a very powerful tool in making transit more useful. **Transit agencies need to have the technology, expertise, staff, and political commitment to maintain functional pulses**.

Pulses are not just a network design tool. They are also an operating system, and an operating imperative.

Proximity: How Many People and Jobs Are Near Transit?

A commonly held goal for transit is to provide lifeline access for many people, and measuring how many people or jobs are served by transit tells us something about how well the transit network is meeting that coverage goal.

Coverage goals for transit are served when transit is available to people, whether or not they ride it in large numbers. Figure 37 shows the coverage provided by the existing transit services (including PART) to residents and jobs in Greensboro at midday on a weekday in Summer 2023. The overall coverage is divided into coverage by transit of particular frequencies at midday.

The are no red segments in the charts to reflect the portion of people or jobs in Greensboro within half a mile of stops on Route 75, because it is no longer in operation. This chart also does not include people and jobs near the Hopper Trolley, because it doesn't operate on every weekday.

Proximity to Transit

52% of Greensboro residents are within a half mile of some level of transit service. Of these, 43% are within a ½-mile distance of 30-minute service. An additional 4% of residents were covered by routes which provide 60-minute service. 64% of all jobs in Greensboro are within half a mile of transit service. 54% are near service that comes every 30 minutes.

60% of Residents of Color live near transit, compared to 52% of overall residents. 64% of Low-Income Residents live near some transit. 52% live near service that comes every 30 minutes. This stands in contrast with just 43% of the general population near 30-minute service.

72% of Greensboro's Households Without Cars are near transit, and two-thirds are near the 30-minute services. Since households without cars are likely to depend and use transit most, it makes sense that a larger portion of these households could try to locate close to transit. The proportions of young and senior citizens close to transit are similar to residents overall.

These conditions are not static and can change as a result of a changing economy and a changing city. Changes in the pattern of demand for housing or location of jobs can shift the patterns of who has access to what kind of transit, without any changes to the transit network.

Many cities have seen an increase in housing demand near transit and in walkable, urban areas. If this increasing demand is not matched by increases in the supply of housing, then people living on low incomes may have to move away from frequent transit (or any transit service) to seek lower housing costs.

Land use planning, growth permitting, and affordable housing policies at local jurisdictions affect the long-term access to useful transit as much as the transit service itself.

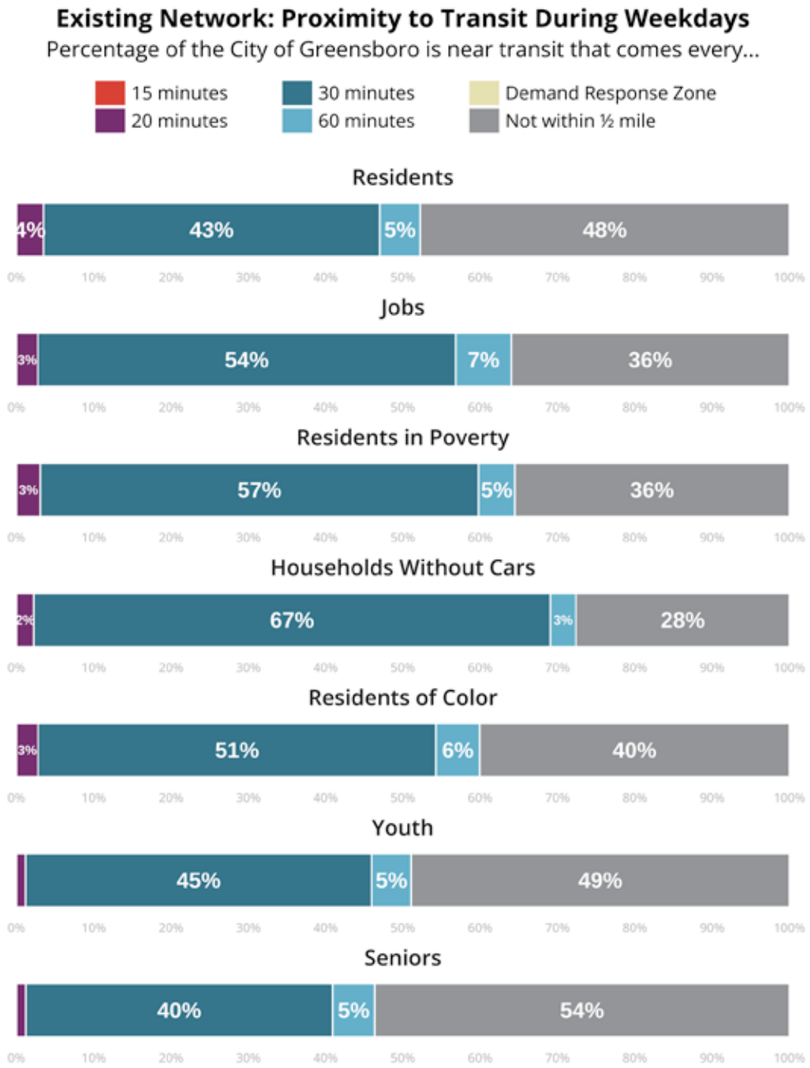


Figure 37: Proximity of Residents, Jobs, and Demographic sub-groups to transit. This chart shows percentages of people and jobs near service of different frequencies.

The map on the right depicts the availability of transit service of any quantity—whether frequent or infrequent.

Residents who are more than a ½-mile from a bus stop are shown in red. This map reveals that towards Greensboro's outskirts, very dense residential development has been placed far from existing transit service. This is especially true on the West, Southwest, and North sides, where nearly-solid red areas represent large numbers of people who can't easily reach to a bus stop.

It is worth noting that blue areas on this map may only be close to a bus stop with minimal service, which may not be very useful. Conversely, some small red areas may be just over half a mile away from 30-minute service.

Unfortunately, getting transit within reach of the red areas on this map is not as simple as just running bus routes there, for a few reasons:

- Running new routes to new areas requires new funding, or it requires cutting service elsewhere in order to reallocate it.
- Many dense residential developments are built in the form of gated communities with a disconnected street network, cul-de-sacs, and other barriers to safe and convenient walking.

In addition to the transit network itself, land use, development and street design choices all affect residents' proximity to transit.

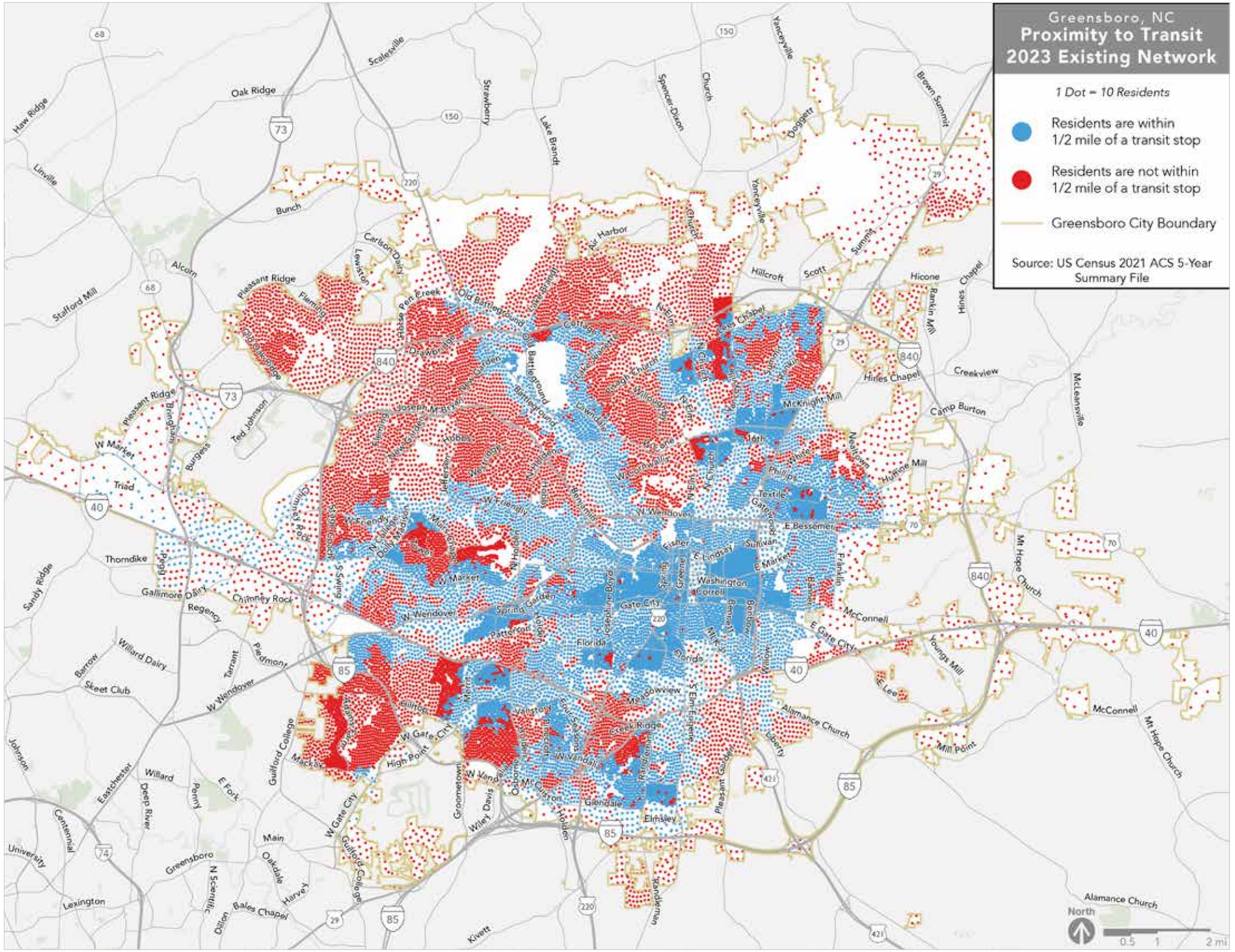


Figure 38: Residential proximity to transit. Red dots show where residents are over a half mile walk from transit service of any frequency.

Access: What Can You Reach in a Reasonable Amount of Time?

Wherever you are, there is a limited area you could reach within a reasonable amount of time. The extent of this area affects your options in life: for employment, school, shopping, health care or whatever other places you might want to reach.

The number of destinations you can reach within a set amount of time is called **access**, and we discuss this concept in more detail in Chapter 2 on page 15.

Transit is useful when it increases the number of useful places people can access in a reasonable amount of time.

We can make isochrones from many places across Greensboro as shown on page 16 and calculate how many jobs and other opportunities are inside each isochrone. The map on the right shows the number of jobs someone traveling from that point can access by transit or walking within 45 minutes. In places that have a deeper color, you can reach more jobs than in places with a lighter color.

Two major factors influence how many jobs you can access from a given location:

- **How many jobs are in and near that location.** This means that places close to lots of jobs, like near Downtown Greensboro, UNCG and NCA&T have large amounts of job access and appear darker.
- **How much transit expands your job access.** Areas near many of the linear 30-minute transit routes along arterial roads (for example, Battleground

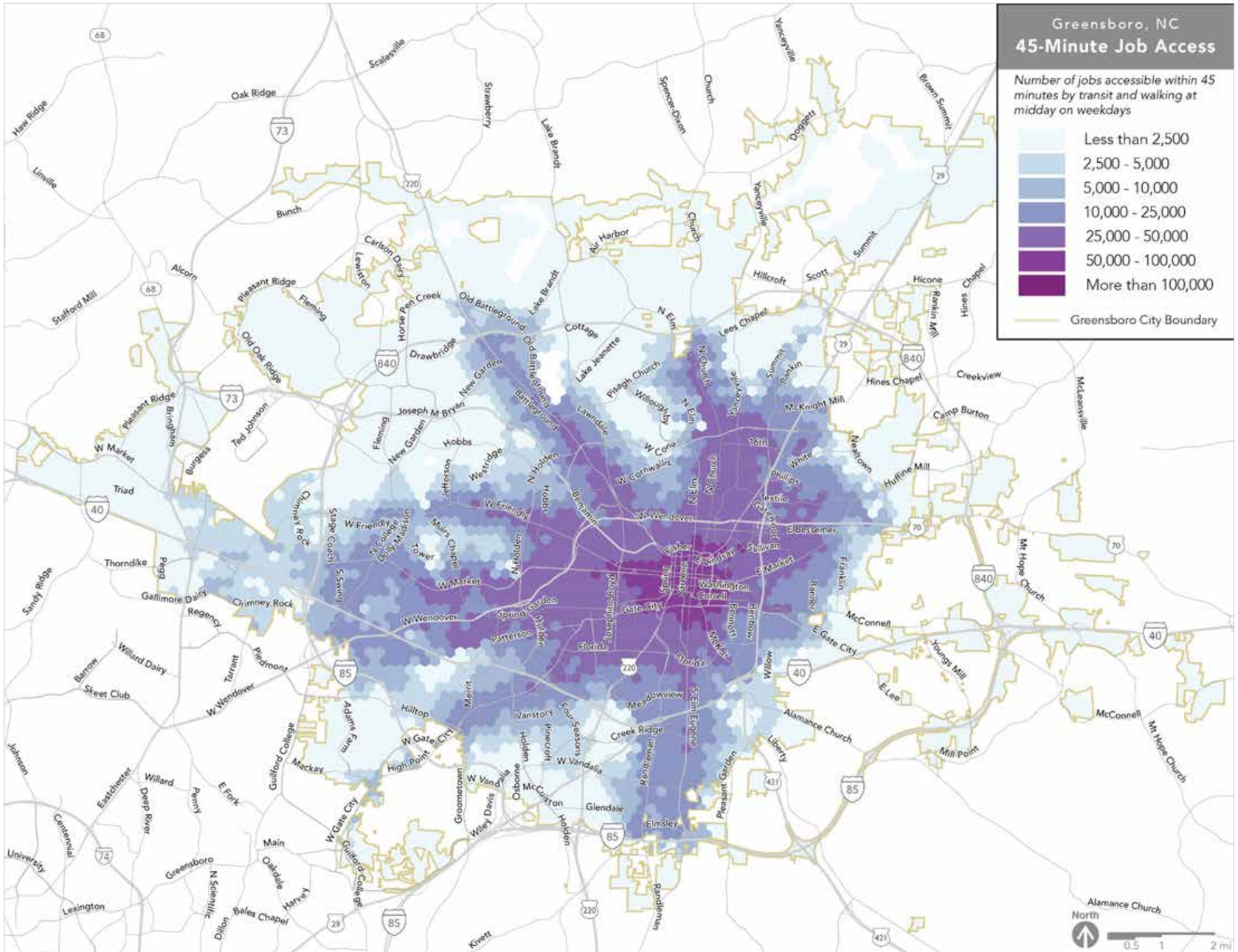


Figure 39: Map showing number of jobs accessible within 45 minutes by walking and transit using the existing network. Source: US Census Longitudinal Employer Household Dynamics Program, 2020.

Avenue, South Elm-Eugene Street, and North Church Street), show up as darker than areas with circuitous service (Northeastern Greensboro), 60-minute routes (Lawndale Drive) and areas that are too far from transit service.

Job Access By Sub-Groups

We can summarize the distribution of job access by transit in the map on the previous page based on how many people live across all the different parts of Greensboro. The chart on the right shows the number of jobs accessible by the typical resident of Greensboro and among various sub-groups.

For each group of people, we show the median access for a "typical", because that is a representation of the access that's in the middle of the range. 50% of people have better access than this, and 50% have lower access than this. A typical resident of Greensboro can reach around 6,500 jobs within 45 minutes of transit and walking, and 24,700 jobs within 60 minutes.

Low-Income residents and households without cars can access substantially more jobs than residents overall. This is because these groups are often more concentrated in denser places with more of a mix of uses, like near Downtown, universities, and in apartments close to large retail centers.

A typical Resident of Color in Greensboro only has modestly higher job access in 45 and 60 minutes than residents overall. Even though a larger portion of Residents of Color are near transit than residents overall, and often also closer to Downtown, UNCG, and NCA&T, many of them are very far away from many of the jobs in the western and southwestern parts of Greensboro.

Young residents and seniors have slightly less job access on average than residents overall. One of the reasons for this is the very low numbers of seniors and youth close to Downtown and the universities, as these areas are more university student-heavy.

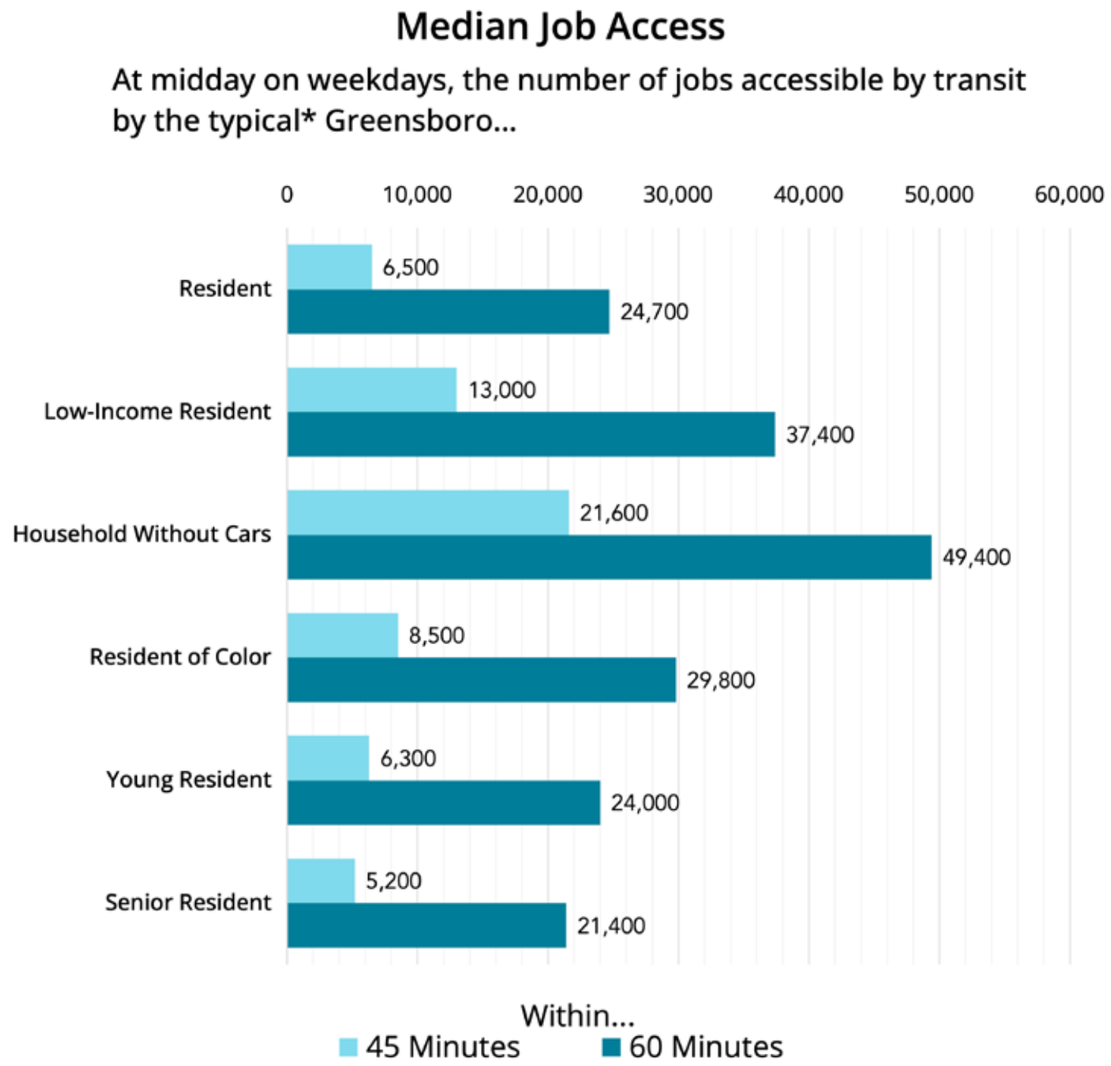


Figure 40: Median number of jobs accessible within 45 and 60 minutes by walking or transit by demographic group. We use median to show the "typical" result. Within each group, 50% of people have more access and 50% of people have lower access than this number.

Added Access by Transit

Transit can't provide equal access to everyone, because your access to destinations depends a lot on where you are located and how far you are from useful destinations, as well as the frequency and drive time of routes connecting a particular area. For example, when cities limit how much housing can be built, lower-income people are sometimes forced to live especially far from the things that they need, which can create an unequal access situation that is too big for transit to solve.

Figure 41 shows the access provided by transit within 45 minutes **relative to** what can be achieved just by walking up to 30 minutes. This shows where transit at its existing levels is most effectively adding access to what would be possible by walking.

Close to major centers of job density like Downtown and Cone Health, the added job access by transit is relatively modest, because there are already a large number of jobs nearby.

Many of the darkest-colored areas in the map are places which do not have many jobs nearby, but are within a distance of substantial job density where transit provides significant added access within 45 minutes.

The areas surrounding Lawndale Drive and Four Seasons Drive are only close to hourly transit service. However, because of the long waiting time, it isn't possible to travel very far within 45 minutes, which reduces how many more jobs and opportunities are accessible. That is why these areas appear lighter on the map than similar areas near 30-minute routes.

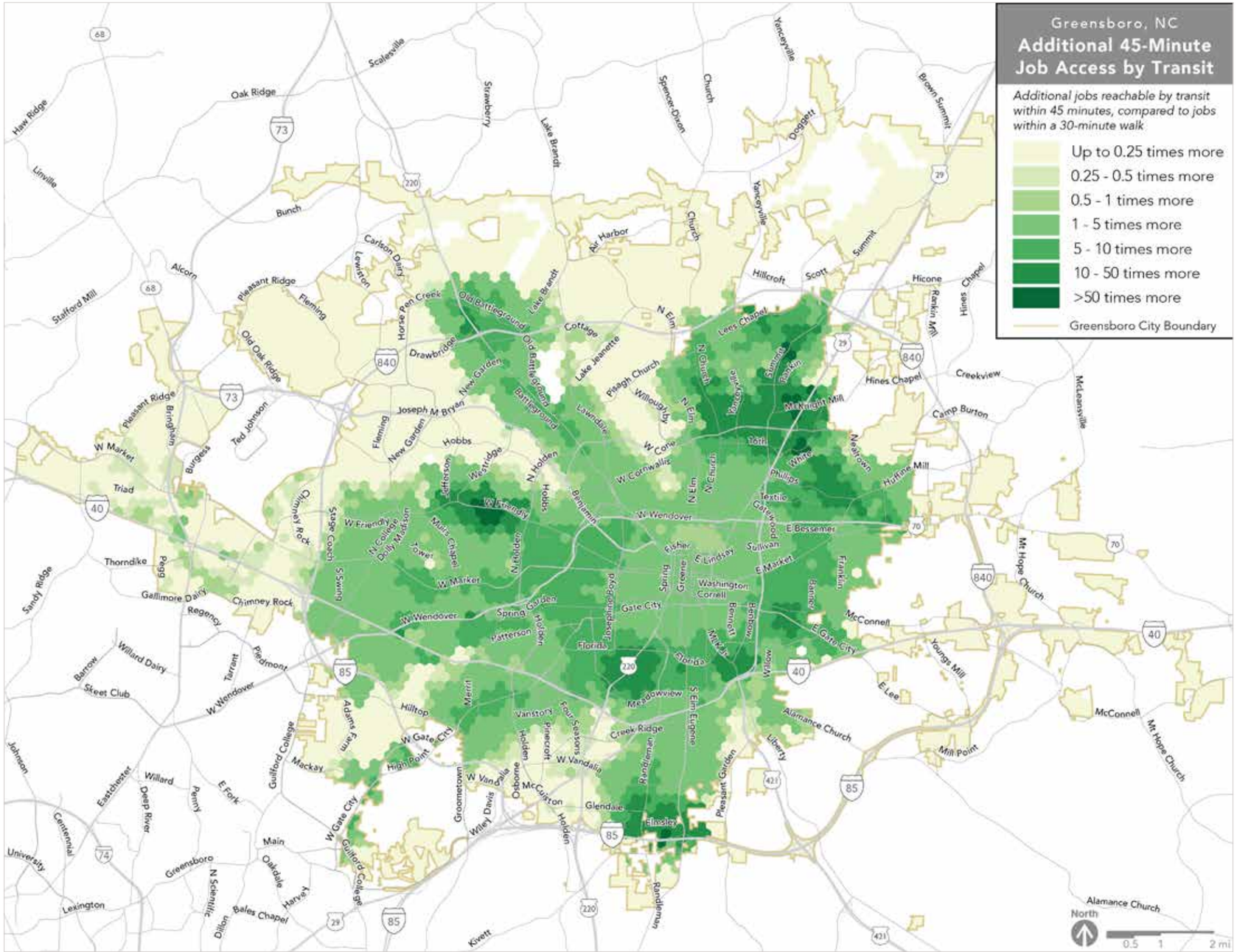


Figure 41: Map showing how many more jobs are accessible within 45 minutes by transit over those that are only reachable by walking up to 30 minutes.

5 Key Choices

What Does "Car-Optional" Mean for Transit?

GoBORO is a unique opportunity for the Greensboro Community to think about the purpose of its transit network, and the role of transit service in achieving its long-term goal of a **car-optional city.**

When thinking about the long-term future of the transit network, it is important to understand what "car-optional" means for Greensboro. As a part of that, there are many choices that the Greensboro community will need to make that will bring its transit service closer to fulfilling this goal. These choices are important because they can result in very different transit networks that can have very different outcomes for the people, businesses, and institutions of Greensboro. These **key choices cannot be made by technical experts,** but must be based on the values of the Community.

Contrasting Visions

Often, these choices are trade-offs. The various goals that those choices help achieve are in conflict with each other, and there are not enough resources available to fulfill all of those goals simultaneously. Many of these trade-off choices can be related to two contrasting ways of envisioning what it means to be "car-optional".

Does being car-optional mean that:

- **Most people** in Greensboro have a transit option that is **very useful** in reaching many places and destinations in a reasonable time? Or...
- **Everyone** in Greensboro has an option to use transit, even if for many people, transit **may not be very useful** in reaching many places and destinations in a reasonable time?

These two ways of thinking about the meaning of being car-optional with respect to the transit service[1] lead to two very different, contrasting network designs and outcomes. However, they are not binary options, and no community focuses solely on one vision or another, but tries to find a balance between these contrasting visions.

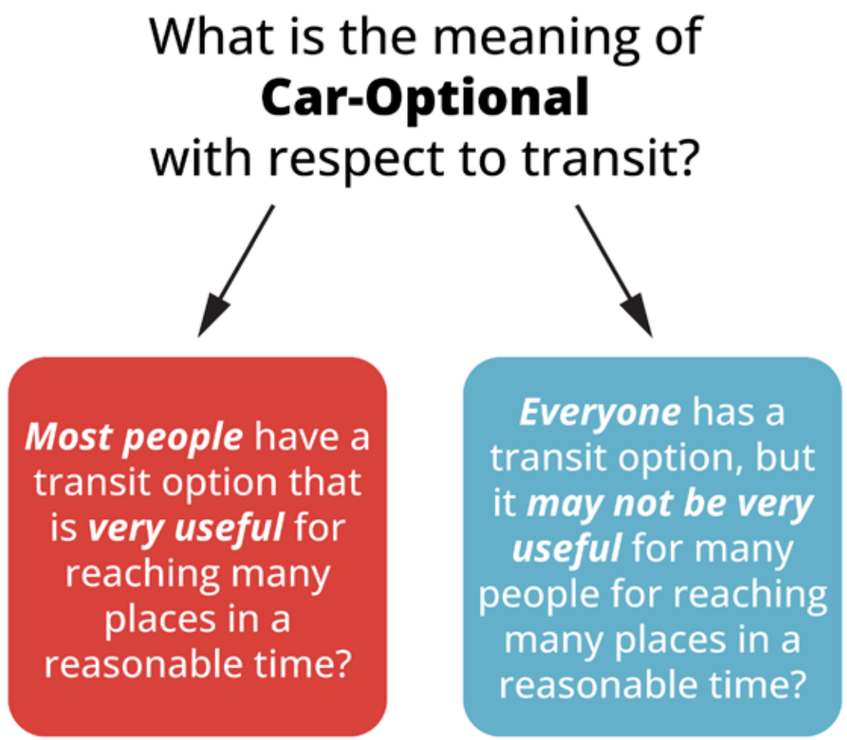


Figure 42: Two different and contrasting ways to think about what it means for transit to be an option to a car.

1 GoBORO's focus is transit service, but that is not the only component of a car-optional vision. Significant investment is needed in expanding the sidewalk and trail network, safe road crossings, better traffic signals, and safe bike and micromobility infrastructure, all of which are crucial components of a car-optional ecosystem. Good transit service and good walk-bike infrastructure complement to enhance each other's usefulness and success in a community. **Transit delivers people to their destinations as pedestrians (and bicyclists).**

Key Choice: Ridership or Coverage?

The most important and difficult choice for the Greensboro Community will be between providing useful service with high frequency and long spans that will attract **high ridership**, and providing **wide coverage** in as many parts of Greensboro as possible.

This choice is another way to phrase the contrasting visions for what it means to be a car-optional city from the previous page. A network designed to maximize ridership will be very useful to the most number of people, but not everyone will have service. A network designed to maximize coverage will have service close to as many people as possible, but there may not be very useful, frequent service close to many people.

A network designed for high ridership serves to fulfill several expected goals for transit, including:

- Getting more people to ride transit because transit is very useful for most people's journeys.
- Making more "efficient" use of tax dollars by reducing the cost to provide each ride by increasing the number of riders and collecting more fare revenue relative to cost of providing service.
- Improving emissions and air quality by replacing single-occupancy vehicle trips with shared transit trips.
- Supporting dense and walkable development and redevelopment.

On the other hand, many popular transit goals do not require high ridership in order to be achieved, and instead are achieved by providing transit coverage in many places. These include:

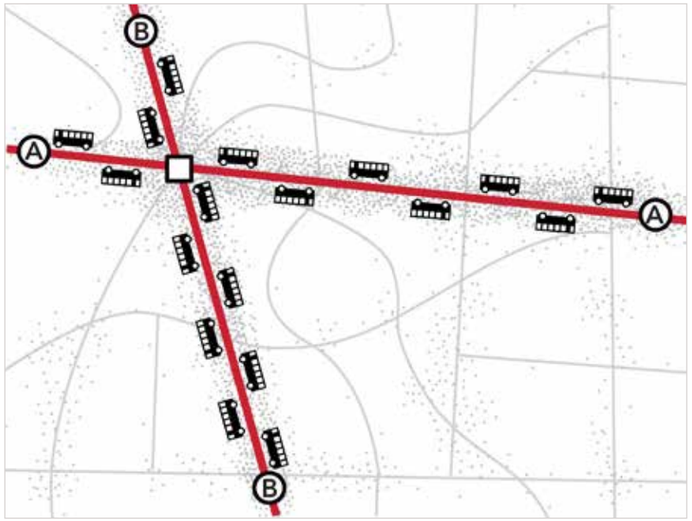
- Ensuring that everyone in the city or service area has access to some transit service, no matter where they live.
- Getting service close to as many neighborhoods within the area.
- Providing "lifeline" transit access as for people who cannot use personal vehicles.
- Serving newly developing places, even if they don't yet have the size or density to constitute a large transit market.

This choice is not binary. A community can pursue high ridership and extensive coverage at the same time, but the more it pursues one, the less it can provide of the other. Most cities have some direct, linear, frequent, long-span routes on which ridership and productivity are high, and other routes for specific coverage purposes, often with loops, deviations, low frequencies, and running during limited times.

Every dollar spent providing very high frequency along a dense mixed use corridor is a dollar that cannot be spent bringing transit closer to each person's home or reaching residential areas in the less dense parts of Greensboro, and vice versa. We suggest thinking about this choice not as a binary, "yes-or-no" decision, but as a point on a sliding scale that the community can help to set.

How much of Greensboro's transit resources should be spent on useful service in pursuit of high ridership? How much should be spent on providing coverage?

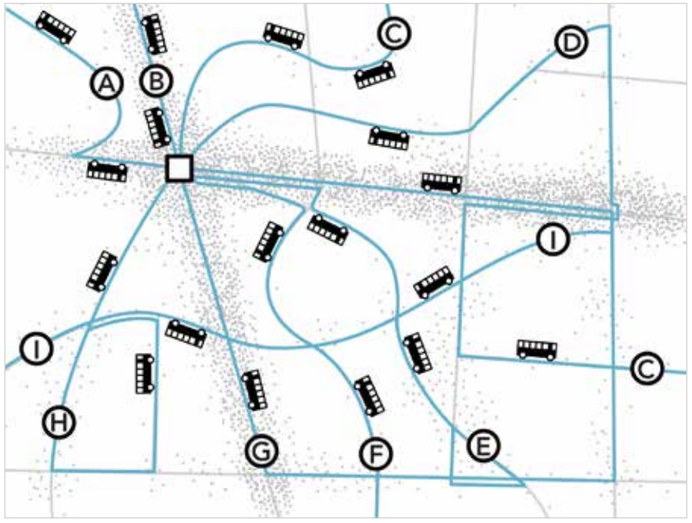
Ridership Network



Maximizing Ridership

A high-ridership network concentrates service where the most people and jobs are in close proximity. It has very frequent, direct, linear routes that operate longer in the day and across the week. Service is very useful for lots of people, so ridership is high.

Coverage Network



Maximizing Coverage

In a high-coverage network, service is spread thin to cover as many people and jobs as possible. Routes are less frequent, operate fewer hours, and have more deviations and large one-way loops and splits. Service is less useful to most people, so ridership is low.

Figure 43: A network designed solely to maximize ridership looks very different from a network designed solely to maximize coverage.

Walking or Waiting?

Another way to think about the question of ridership and coverage is to think specifically about how far a person should have to walk or bike to reach a bus stop, and how long they should have to wait, on average, before the next bus comes.

If Greensboro planned transit service around longer walks to service, more bus routes could operate more frequently on some corridors. Many riders would wait less and would get to their destination sooner, even with a slightly longer walk. Because it is more useful in getting people to their destinations sooner, frequent service tends to generate higher ridership, even when it requires longer walks.

Walking and waiting are important to consider on their own, because both of these activities add time and inconvenience to any transit trip, and different people have a wide variety of preferences regarding each. A young, able-bodied person who is in a hurry might have no problem walking half a mile to a bus stop if the bus is always coming soon. But longer walks can be challenging for many people, including seniors, disabled people, and those traveling with young children, groceries or a large bag.

Is it more important for service to be frequent with short waits, or for service to be available nearby within a shorter walk?

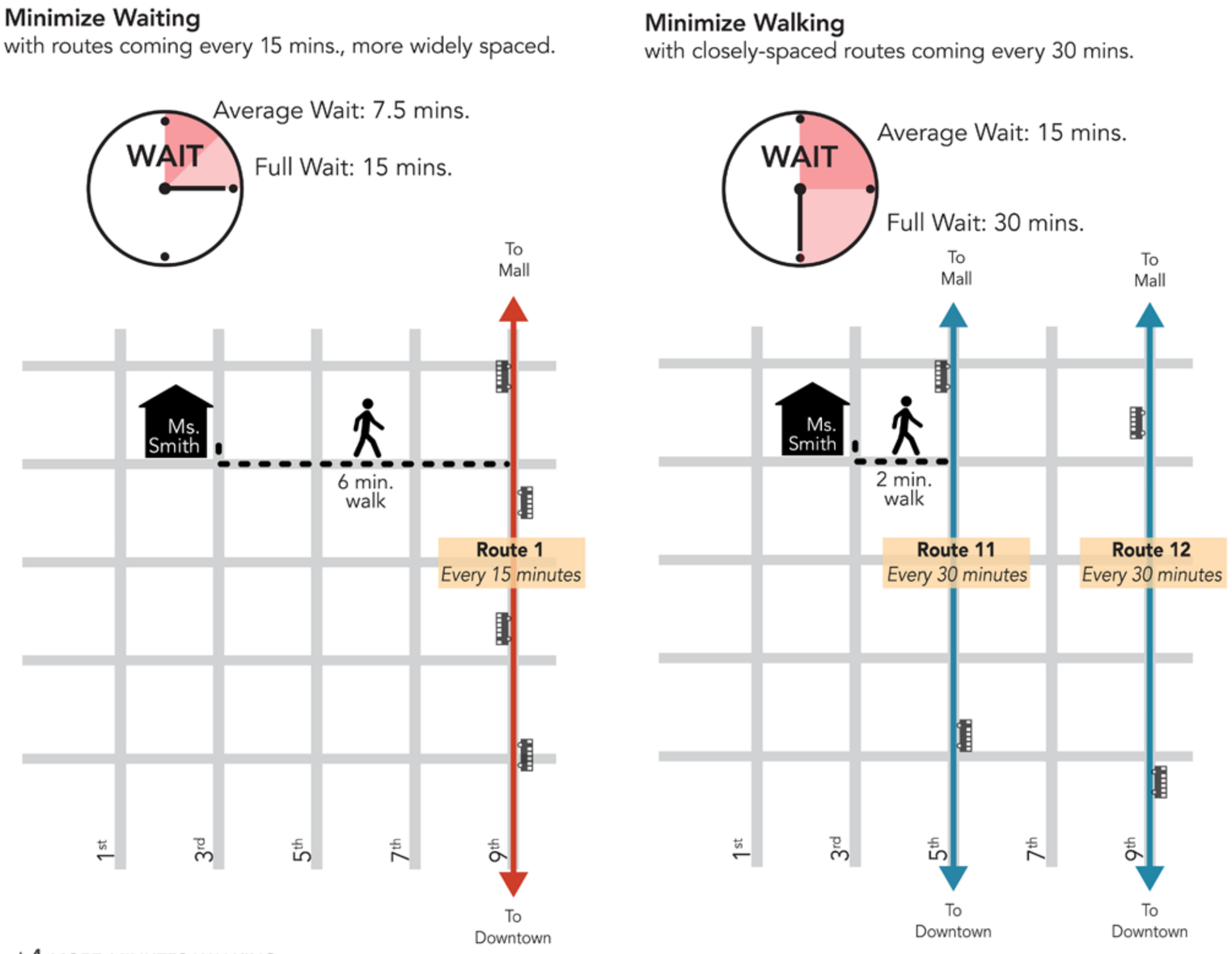


Figure 44: In many situations, consolidating service on many infrequent routes can make the average person's trip faster. However, people may value shorter walks over shorter waits.

Key Choice: What Level of Transit Resources Is Enough?

Wrestling with the first choice—how to balance ridership and coverage—and changing the transit network to meet clear goals that match the community values, may improve people's sense that the transit network is delivering on their goals and is worth further investment.

Today, the overall level of resources for operating transit in Greensboro is very limited. Compared to peer cities, Greensboro has the second-lowest investment in transit service relative to its population (measured as revenue hours per capita). It also has the second-lowest level of transit ridership relative to population. This "you get what you pay for" relationship between transit investment and its relevance to the community is shown in Figure 45.

In practice, this means that service is spread thin to get transit near as many people and jobs as possible, across a wide area. As a result, there are no frequent routes in the system, and many routes have large one-way loops and mid-route splits. Weekend and evening frequencies are even lower. Transit is not very useful for the journeys of large numbers of people, so ridership is low.

Despite the service being spread so thin, only about 52% of residents and 64% of jobs are near some level of transit service. **The current low level of transit resources makes it hard to achieve either many coverage goals or many ridership goals.**

What level of investment in transit is needed to meet Greensboro's "car-optional" goal?

Potential Funding Sources

If Greensboro wants more transit service, the City will need more funding from existing or new sources. **The primary cost of transit service is operating the service, a repeating annual commitment.** Potential funding sources include:

- General Fund: The City of Greensboro could choose to directly invest in improvements in GTA service through annual commitments from its General Fund and find ways to raise those funds through local taxes that it controls, like the real estate property tax.
- County-level Sales Tax: Guilford County could implement a dedicated ½-cent Sales Tax that is dedicated to public transportation. This dedicated tax source would provide a large and stable revenue stream that could fund large increases in GTA service. As a county-wide tax, portions of the revenue stream would also support PART, High Point Transit, and Guilford County Transportation services. It could also support transit-related infrastructure improvements.
- Other City, County, or State Sources: The City could work with partners at the County, MPO, or State to use other sources of funds like State Highway Trust Fund, Recordation Tax, or advertisements to provide funding to transit. The challenge with other sources is they may have limitations on their use. For example, some state funding programs are limited to capital expenses only. In addition, piecing together a large number of variable funding sources would be complex, and risk creating substantial funding uncertainty from year-to-year.

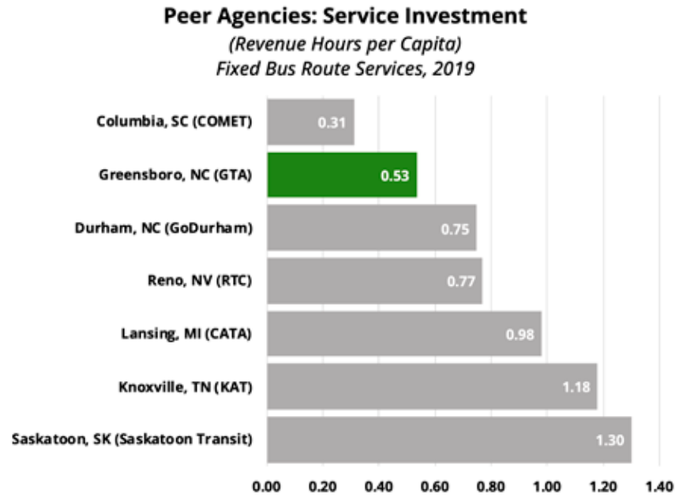


Figure 45: Revenue Hours per Capita (Investment) and Passenger Trips per Capita (Relevance) for Greensboro compared to peers shows the principle of "you get what you pay for" in terms of transit ridership compared to transit service provided. Source: National Transit Database, 2021.

Built Environment Choices to Support Transit

As discussed throughout this report, the built environment has a strong effect on transit's ability to succeed, especially in being useful and attracting ridership.

- **Density:** How many people, jobs and activities are near each bus stop?
- **Linearity:** Can transit reach large numbers of people by traveling straight, direct paths?
- **Proximity:** Can transit reach large numbers of people without crossing long, low-demand gaps?
- **Connectivity:** How many of the people near the bus stop can actually reach it?
- **Mix of Uses:** Is there a diversity of residents and activities that can support two-way demand?

Transit agencies are commonly placed in a very challenging position. They are expected to provide service everywhere but have very little influence in how a city chooses to develop. Establishing a clear goal and direction for transit service, including a desired balance of ridership and coverage services, and an agreement with the community on the level of service to provide, can allow a transit agency to more clearly communicate and work with partners in encouraging future development to be transit supportive.

With a clear direction on transit's goals, it becomes easier for city leaders to see how their policy or land-use decisions will encourage or discourage transit's ability to succeed in its goals. Business developers have a clear message on where and how best to build if they want the best access to transit, and the community has a clearer understanding about where and when their transit network is working its best, and meeting its values.

A vision of a future frequent network can be a very powerful tool for the transit agency and city to communicate to the public, businesses, developers, and other stakeholders about where transit is a priority and where people and business can locate if they wish to have the best transit access possible with the choice of driving a car.

Transit's Effectiveness in Car-Centric Developments

Many developments in outer neighborhoods of Greensboro are built in a way that makes them hard to serve with direct, linear transit routes.

Car-oriented built environment features like large parking lots, winding streets branching off of arterials roads, walled developments, and cul-de-sacs end up making walks to transit too long for many people. Pockets of developments spread across an area instead of being clustered in linear corridors make it harder to establish logical, linear patterns that can effectively connect people and jobs. To provide coverage in such areas, a route must deviate off of its linear path. Deviations bring transit closer to people in these areas, but make it less useful for anyone needing to ride through them.

Deviations make routes longer and more expensive to operate. This is true even if a community's goal is to increase coverage, rather than to increase ridership by concentrating service onto useful, linear routes. Every minute a bus and an operator need to serve a deviation is a minute not spent in providing useful service or valuable coverage somewhere else in the system. Even in a future with expanded bus service, someone has to pay the price of distance.

In the example in Figure 46, a bus on the outermost segment of Route 1 just beyond I-40 has to make many large deviations because it has to serve major destinations like government buildings, apartment complexes, and shopping centers. These add up to a substantially large mixture of jobs and residents, and drives significant transit ridership here.

However, because of how far apart and non-linearly arranged these destinations are, Route 1 is very long. As a result, it is expensive to operate, and its productivity (ridership relative to cost of providing service) is only modestly higher than most other routes in the system.

Figure 46: Disconnected, car-centric suburban development patterns like near West Wendover Avenue and Landmark Center Boulevard make it hard to provide useful transit, and spend resources effectively, regardless of whether a community's goal is high ridership or high coverage.

6 Network Concepts

What Are the Concepts?

This chapter presents two Concepts that illustrate the range of possibilities for the future of the transit network in and around Greensboro. **Specifically, they illustrate two ends of a spectrum, between prioritizing high ridership or wide coverage.**

The two Concepts are intentionally very different from one another, so that people can see clearly how a move in one direction or the other would affect bus services they care about, and the outcomes of prioritizing ridership or coverage.

Both Concepts differ from the existing transit network in a very major way: **they both assume a large increase in the resources available to operate transit,** compared to today. In order to highlight the ridership-coverage trade-off, we made a choice with respect to the increased resources. This increase is meant to demonstrate the outcomes of a dramatic shift in how much the Greensboro Community invests in its transit network.

Concepts, Not Proposals

At this stage, neither the City nor the consulting team are recommending either Concept. The purpose of these two Concepts is to help stakeholders and members of the public develop their own opinions, and have a conversation about:

- how Greensboro should balance ridership and coverage goals, and
- whether the Community should invest more in its transit network.

The results of this public conversation will guide development of an actual network proposal, in the next phase of planning.

No Preferred Concept

None of the staff from GTA, Greensboro City, nor the Consultant staff have a preference among the Concepts shown in this report.

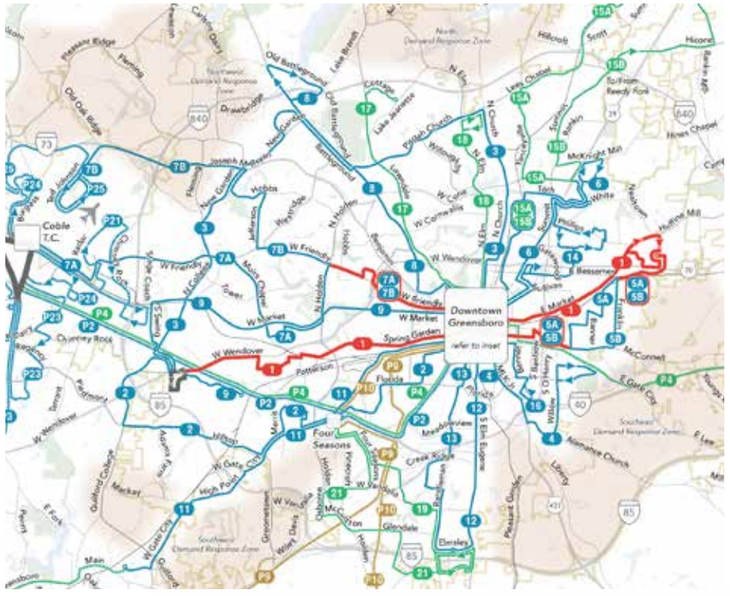
The most important word to remember is **"if".** The Ridership Concept shows what might happen **if** the Community chose to shift towards ridership goals as the primary goal. The Coverage Concept shows what might happen **if** the Community chose to invest in expanding transit coverage to more places.

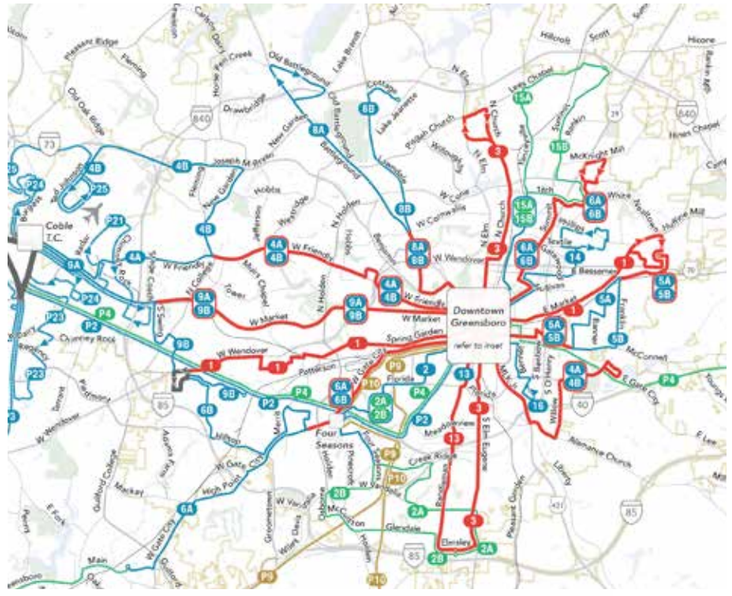
Focus on the Big Picture

These Concepts have not been refined to the point that they would be ready to implement, because their purpose is to illustrate conceptual visions at a high altitude. A later stage of planning will result in a proposed Draft Network Plan, and at that point more details will need to be decided.

In general, these Concepts are intended to describe the recurring pattern of services GTA could offer. Route schedules are described not down to the minute, but in terms of what frequencies are offered throughout different times of the day, across the week. The Concepts do not show all detail regarding:

- Changes in PART and High Point Transit service
- Local routing details such as turnarounds, especially near potential future transit hubs
- Minor deviations affecting small numbers of trips





Assumptions Behind the Concepts

Exploring the Concepts

Color Means Frequency

Color in the Concepts shows the frequency of that bus route during most of the day. **Red** means every **15 minutes, blue** means every **30 minutes, green** means every **60 minutes,** and **tan** means limited service or Demand Response Zones (which are explained in more detail in the Coverage Concept starting on page 63).

Branching Routes

In both Concepts, there are some routes which share a significant common segment, and are grouped together. It is possible to coordinate buses on these routes, so that these **branch routes** can provide a higher frequency on that **common trunk segment**. We show these trunk segments with the color of the combined frequency, and the branches at their lower frequencies. **The trunk segment is not a separate route, but a combination of the two branches.**

Route Numbering

In both Concepts, routes in some areas may have a different number than the routes that run in that area today, or have similar numbers as today. Branch routes in trunk-branch sets have the suffixes "A" and "B".

Figure 47: In the Concepts, "branch" routes combine to provide a higher frequency on their shared "trunk" segment. Such routes have the suffixes "A" and "B".

These Concepts include a few key assumptions regarding transit service in and around Greensboro.

County-Wide Sales Tax to Fund Investment in Transit

As mentioned in the previous page, both Concept networks are designed to demonstrate the outcomes of a large increase in transit service in and around Greensboro. Both networks have approximately 130% more service hours compared to the existing GTA network, so more than twice as much service as today.

We have built these concepts with the financial assumption of a Guilford County-wide ½-cent Sales Tax to fund this large increase in investment. The biggest advantage of a sales tax is that it is a large, broad-based, and relatively stable source of funding, as it is based on consumption of goods and services. Items like food, prescription medication, and cars are excluded from this tax.

The distribution of the County-wide sales tax to the various jurisdictions and agencies in Guilford County means that the County can fund not just a service increase for GTA, but also:

- Large increases in PART, High Point Transit, and Guilford County Transportation service levels;
- Local match for federal and state grants for new vehicles, transit hub infrastructure, and bus shelters; and
- Sidewalk improvements, traffic priority, and roadway improvements that can support transit service.

If the ½-cent Sales Tax were in place today, an average household in Guilford County would pay approximately $9 per month to fund investment in transit service and infrastructure across the various jurisdictions in the County. For reference, the average household spends around $840 per month on car purchase, maintenance, and fuel expenses[1].

The sales tax would produce approximately $42 million in revenue for transit annually across Guilford County. Of this, we assume 65%, that is $27 million, would be distributed to Greensboro for increased GTA service, paratransit operations, and infrastructure investment. In absence of the County-wide sales tax, the City of Greensboro could still operate the larger levels of GTA service in these Concepts by providing around $23 million in funding from local sources or taxation.

Service Increases in Other Guilford County Agencies

Since a large portion of PART's service operates in Greensboro, we have incorporated some assumptions about how PART's service could change with a large increase in funding for its service:

- Express Routes 1 (Winston-Salem Express), 2 (Greensboro Express), and 3 (High Point Express), and local routes 20, 21, 22, 23, 24, and 25 (out of Coble Transportation Center) will have a frequency of 30 minutes all day, all week.
- Route 4 will have a weekday midday frequency of every 60 minutes between Greensboro and Graham, and additional stops at Four Seasons Town Centre and Sedalia.

We have not included specific assumptions about service in High Point other than the increase in frequency on PART Route 3 when discussing the outcomes for the GTA Network. However, the ½-cent Sales Tax can fund a very large increase in transit service in High Point as well.

Investment in Evening and Weekend Service

The two Concepts both have very regular and consistent levels of service across most of the day, throughout the week. In both Concepts, every route has a consistent frequency from 6 AM and 10 PM. Almost every route also has service (but at a lower frequency) from 5 AM to 6 AM and from 10 PM through midnight until 1 AM.

For reference, all GTA routes today operate hourly frequency after 6 PM on weekdays (and all weekend), and only run until midnight on weekdays and 10 PM on weekends.

This is a major investment in service that is not visible on a map or in the outcomes calculated for weekday midday, but is nonetheless very important for many reasons, including travel for service workers, traveling for recreation, and providing the flexibility and spontaneity of being able to travel beyond traditional daytime hours.

1 These estimates are based on mean household expenditure values for the South Atlantic region in the 2022 Consumer Expenditure Surveys of the U.S. Bureau of Labor and Statistics. Guilford County's mean household income matches the South Atlantic region average very closely.

The Ridership Concept

The map on the right shows the predominant frequency on each route during most of the day in the Ridership Concept.

This Concept concentrates frequent, useful service where there are more residents and jobs, and where transit can run in linear, direct paths. More frequent service would reduce the amount of time people spend waiting for a bus, or to transfer, and increase the number of places they could reach within a reasonable amount of time. This would dramatically increase most residents' access to jobs and important destinations by transit, and make it a very attractive option to a car.

Frequent Crosstown Routes

In the Ridership Concept, **almost every major radial corridor out of Downtown is red,** which means these corridors have a frequency of every 15 minutes. Today, they have a frequency of only every 30 minutes.

Many of these corridors are "trunk" segments, consisting of two routes that combine to offer higher frequency. For example, Routes 4A from Coble Transportation Center and 4B from the Airport are both 30-minute routes, but East of Guilford College, they both arrive alternately, every 15 minutes, along West Friendly Avenue (and beyond).

A major difference between the Ridership Concept and the Existing Network is that many routes do not end in the Depot but run by it, and continue through Downtown, outwards along a corridor on the other side of Downtown. This creates **many more frequent crosstown one-seat rides:**

- Route 1 runs along East Market Street, then Washington Street close to the Depot, and continues West along Spring Garden Street and West Wendover Avenue.
- Route 3 from South Elm-Eugene Street runs beside the Depot on Davie Street and continues

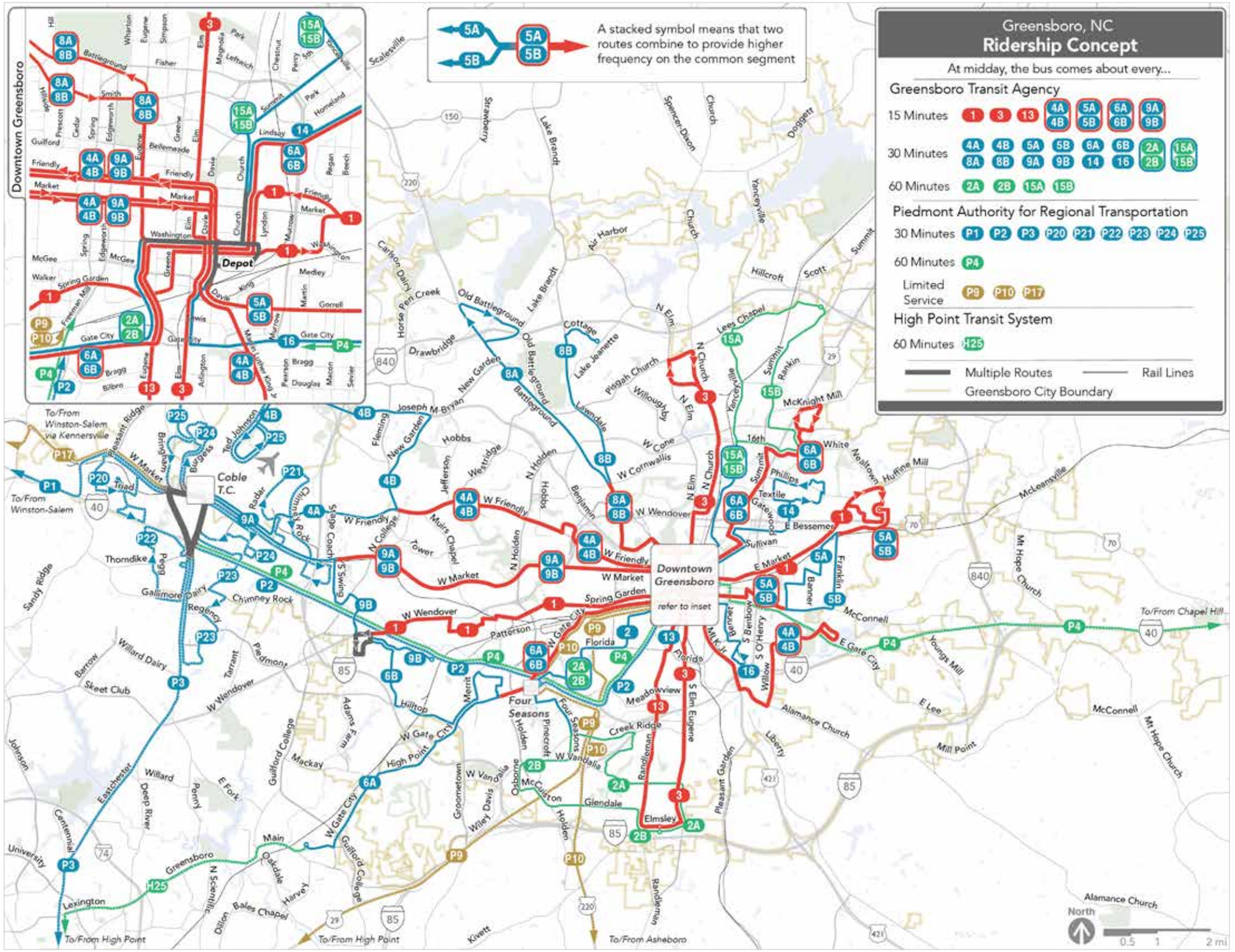


Figure 48: Map of the Ridership Concept with routes color-coded by midday frequency.

north along North Elm and North Church Streets.

- Routes 4A and 4B together provide 15-minute frequency along East Florida Street, Willow Road, and M.L.K. Jr. Drive, run close to the Depot on Davie Street, and continue along West Friendly Avenue, all the way to Guilford College. There they split, and provide 30-minute service to Coble Transportation Center, and the Airport, respectively.
- Similarly, Routes 6A and 6B provide 15-minute service from Pyramid Village along Summit Avenue and East Lindsay Street, touch the Depot at Washington Street, and continue along West Gate City Boulevard, separating slightly West of Four Seasons Town Centre.

Some New Coverage

Concentrating service into frequent routes in the densest and busiest areas means that fewer resources are available to provide transit in new areas away from the core of Greensboro not served by transit today. In the Ridership Concept, only some areas have new transit service. This is often because they include (or are on the way to) major activity centers, transit hubs, or residential development:

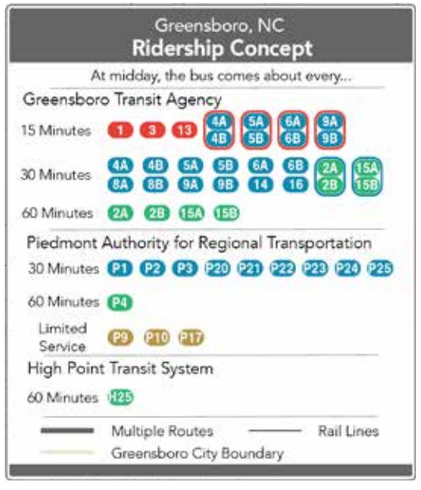
- Creek Ridge Road, Lynhaven Drive, and Greenhaven Drive (Route 2A)
- West Friendly Avenue and West Market Street to Coble Transportation Center (Route 4A)
- New Garden Road and Airport (Route 4B)
- Hilltop Road and Stanley Road (Route 6B)

Downtown Network

The map on the right shows the Downtown Network in the Ridership Concept. The service patterns are quite similar to the Existing Network, but most routes are every 15 minutes instead of every 30 minutes. A couple key differences include:

- Route 3 runs continuously along North and South Elm Streets except a short deviation to get close to the Depot.
- Routes 8A and 8B run two-way on North Eugene Street
- Routes 6A, 6B, and 14 run two-way on North Church Street and East Lindsay Street

As detailed previously, many routes do not end at the Depot, but continue through Downtown. Routes 2A, 2B, 8A, 8B, 9A, 9B, 13, 14, 15A, 15B, and 16 end at the Depot.



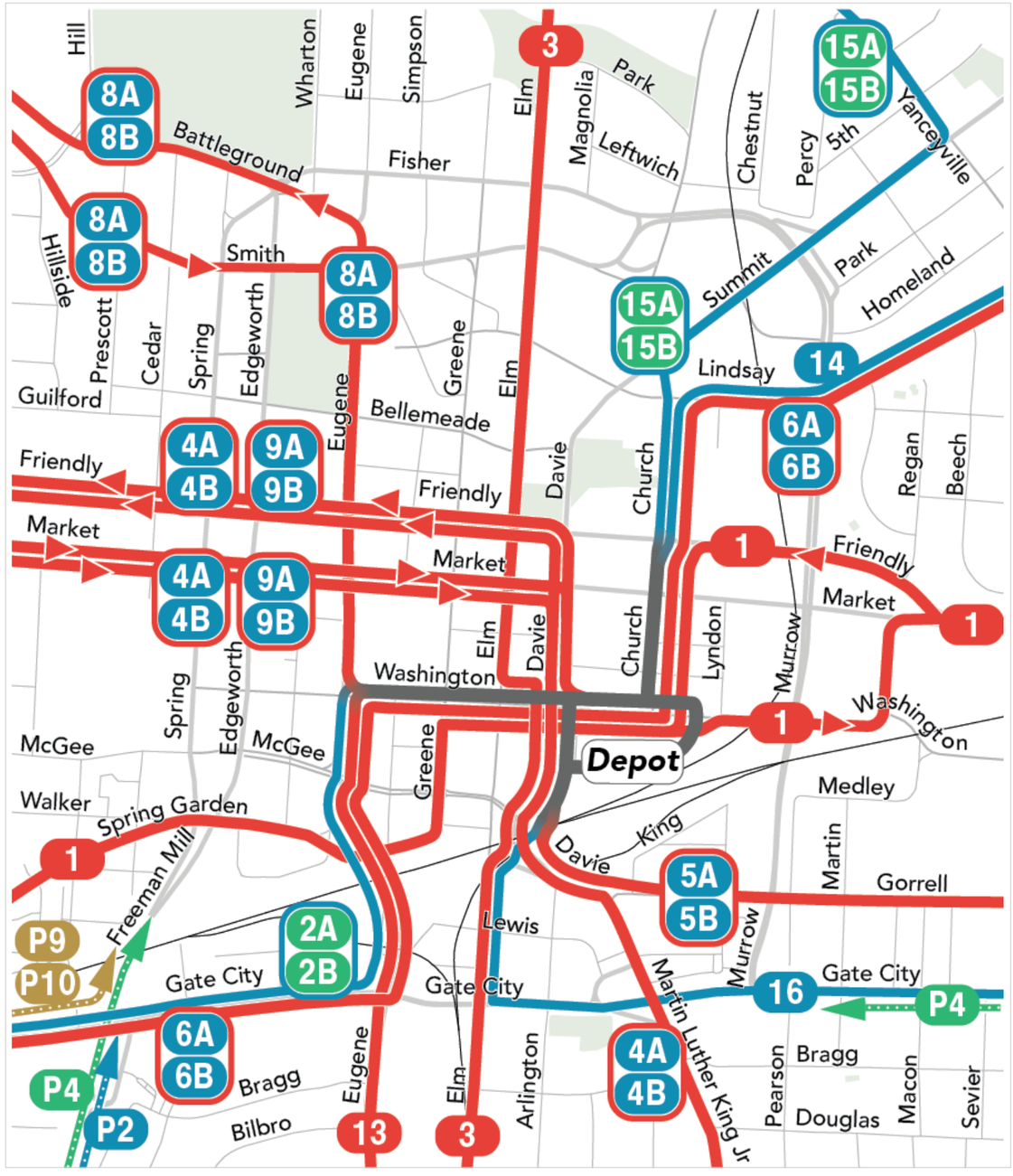


Figure 49: Map of the Ridership Concept in Downtown Greensboro.

Frequency and Span of Service

The chart on the right summarizes each route's frequency and span of service in the Ridership Concept. The chart also includes the effective frequency on the common trunk segments for branching routes.

Almost every route runs from 5 AM, through midnight, until 1 AM on the next day. Service is available during the same times on all seven days of the week.

Most routes operate their predominant daytime frequency from 6 AM to 10 PM. Between 5 AM and 6 AM, and 10 PM and 1 AM, routes run at a lower frequency. 15-minute routes run every 30 minutes, and 30-minute routes operate every 60 minutes. Routes 2B and 15B do not operate during these times.

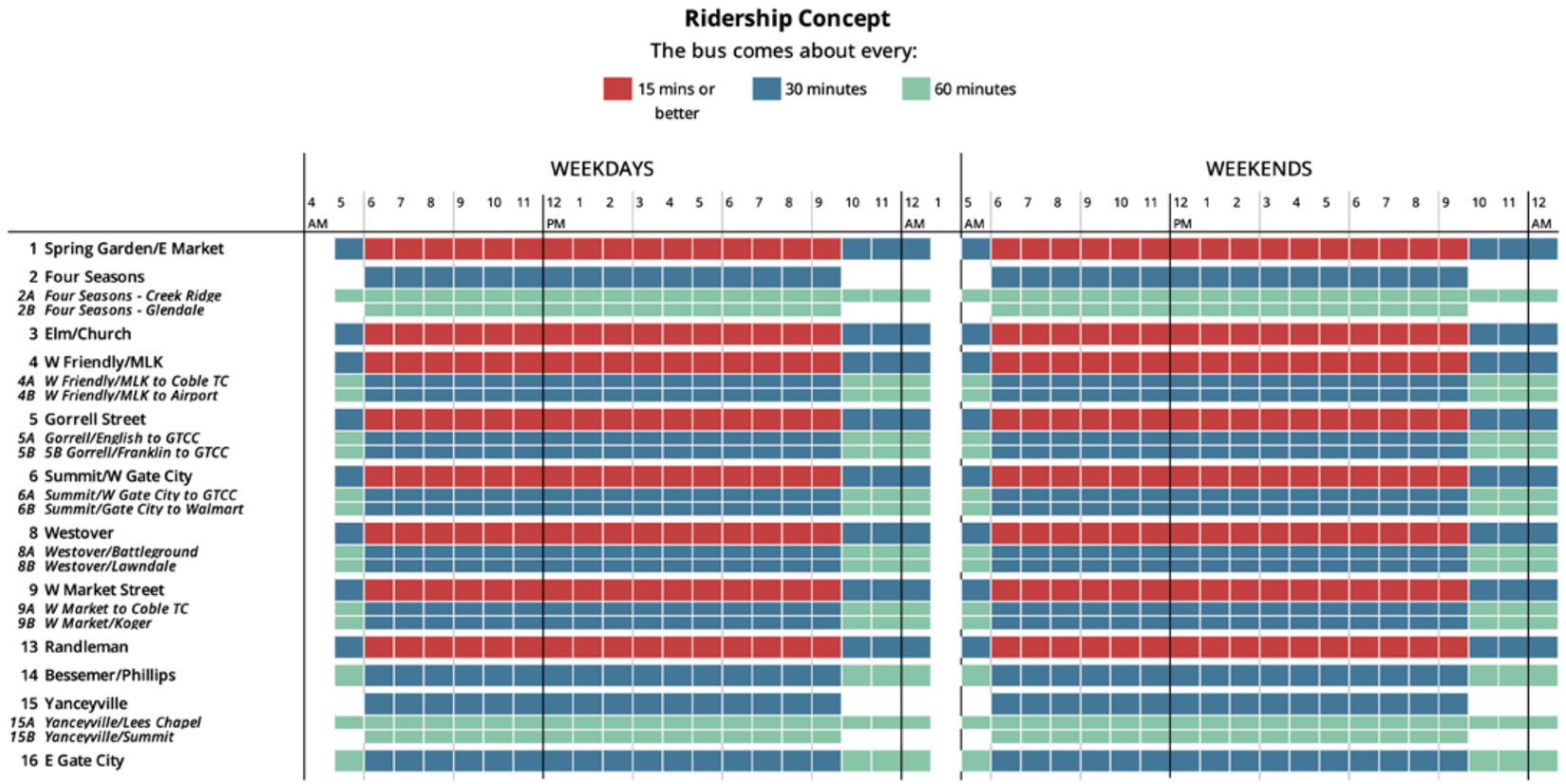


Figure 50: Span of service and frequency by hour on weekdays and weekends for routes in the Ridership Concept.

The Coverage Concept

The map on the right shows the predominant frequency on each route during most of the day in the Coverage Concept.

This Concept expands transit service to many new areas in and around Greensboro, which means that many more people and jobs will be closer to transit than they are today. However, because service has to be spread thinly, most routes have a frequency of only every 30 minutes, similar to today. In many places, large one-way loops have been replaced by two-way routes, and there are fewer deviations along routes. Only Route 1 provides a crosstown one-seat ride through Downtown. All other routes end at the Depot, where they would have a timed transfer similar to today.

Significant New Coverage

Many places which are not near transit service in the existing network have service in the Coverage Concept, notably on parts of:

- Hilltop Road and Guilford College Road (Route 2)
- Pisgah Church Road, New Garden Road, and College Road (Route 3)
- Pomona Drive, Muirs Chapel Road, and West Friendly Avenue to Coble Transportation Center (Route 7A)
- Jefferson Road (Route 7B)
- Northeast Greensboro beyond I-840 to Reedy Fork and Hicone Road (Routes 15A and 15B)
- Creek Ridge Road and Rehobeth Church Road (Route 19)
- North Elm Street (Route 18)
- Old Randleman Road (Route 21)

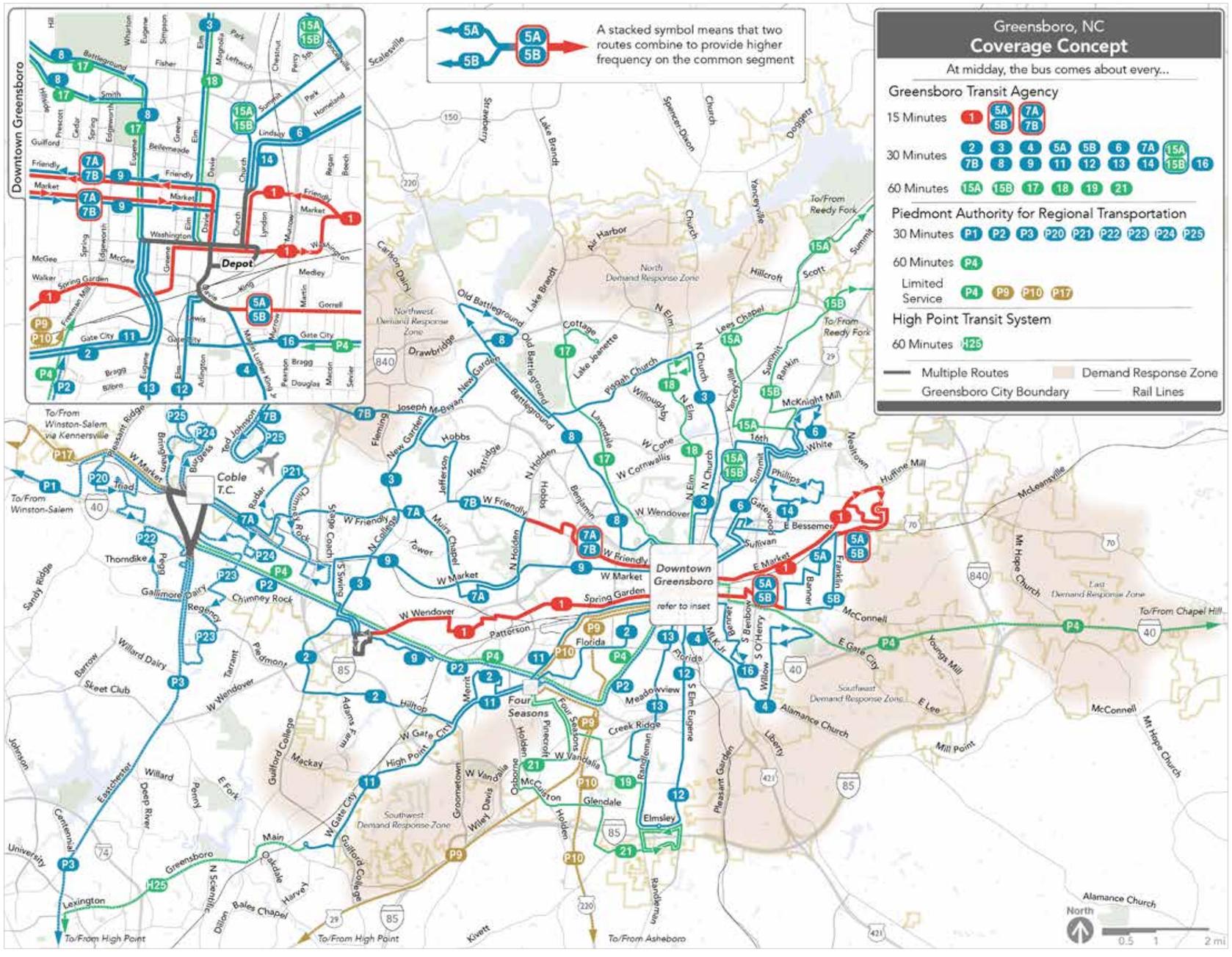


Figure 51: Map of the Coverage Concept with routes color-coded by midday frequency.

Demand Response Zones

In addition to bus routes, the map of the Coverage Concept has several **tan-colored areas.** These are "Demand Response Zones". This type of service is also sometimes referred to as "dial-a-ride", "on-demand", "flexible" or "microtransit" service. For fixed routes, people walk to bus stops and buses arrive based on a predetermined schedule. In contrast, Demand Response (DR) service can pick up riders where they request it, within some limits.

DR service can be very convenient for riders because it usually doesn't ask them to walk to a bus stop. Within the zones, passengers will have to request a pickup with a wait time of 30 to 45 minutes. They have timed arrivals and departures at nearby transit hubs, where people can connect to and from the fixed routes.

But DR services can only handle a few riders per hour, which means that growth in ridership causes its costs to increase rapidly. DR zones are included in the Coverage Concept because they cover a wide area without asking people to make very long walks to a bus stop. **DR service is not a high-ridership tool,** because it can only handle a few riders per hour, per bus. But the Coverage Concept is not designed to achieve high ridership, and **DR is a very useful tool for providing wide coverage in low-density, low-walkability areas.**

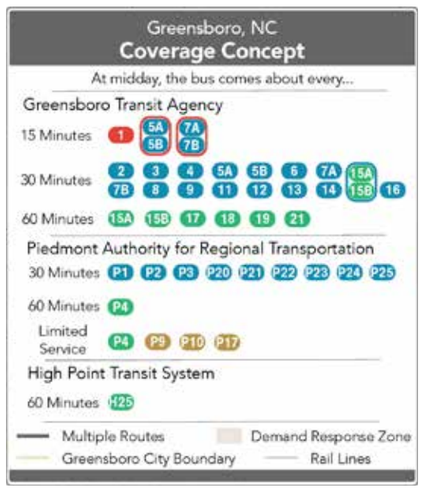
Some Frequent Corridors

Route 1 on Spring Garden Street and East Market Street is the same in the Coverage Concept as in the Ridership Concept. This has the potential to be one of the most useful service patterns, as it connects multiple university and college campuses, high density housing, Downtown, and large shopping centers in a direct, linear path. Routes 7A and 7B naturally converge on to the West Friendly-Market street pair, and their frequencies can be combined in their shared segment. Similarly, Routes 5A and 5B cover different areas in Eastern Greensboro, but closer to Downtown, their frequency can be combined.

Downtown Network

The map on the right shows the Downtown Network in the Coverage Concept. Similar to the Ridership Concept:

- Routes 3 and 18 run two-way on North Elm Street.
- Routes 8 and 17 run two-way on North Eugene Street.
- Routes 6 and 14 run two-way on North Church Street and East Lindsay Street.



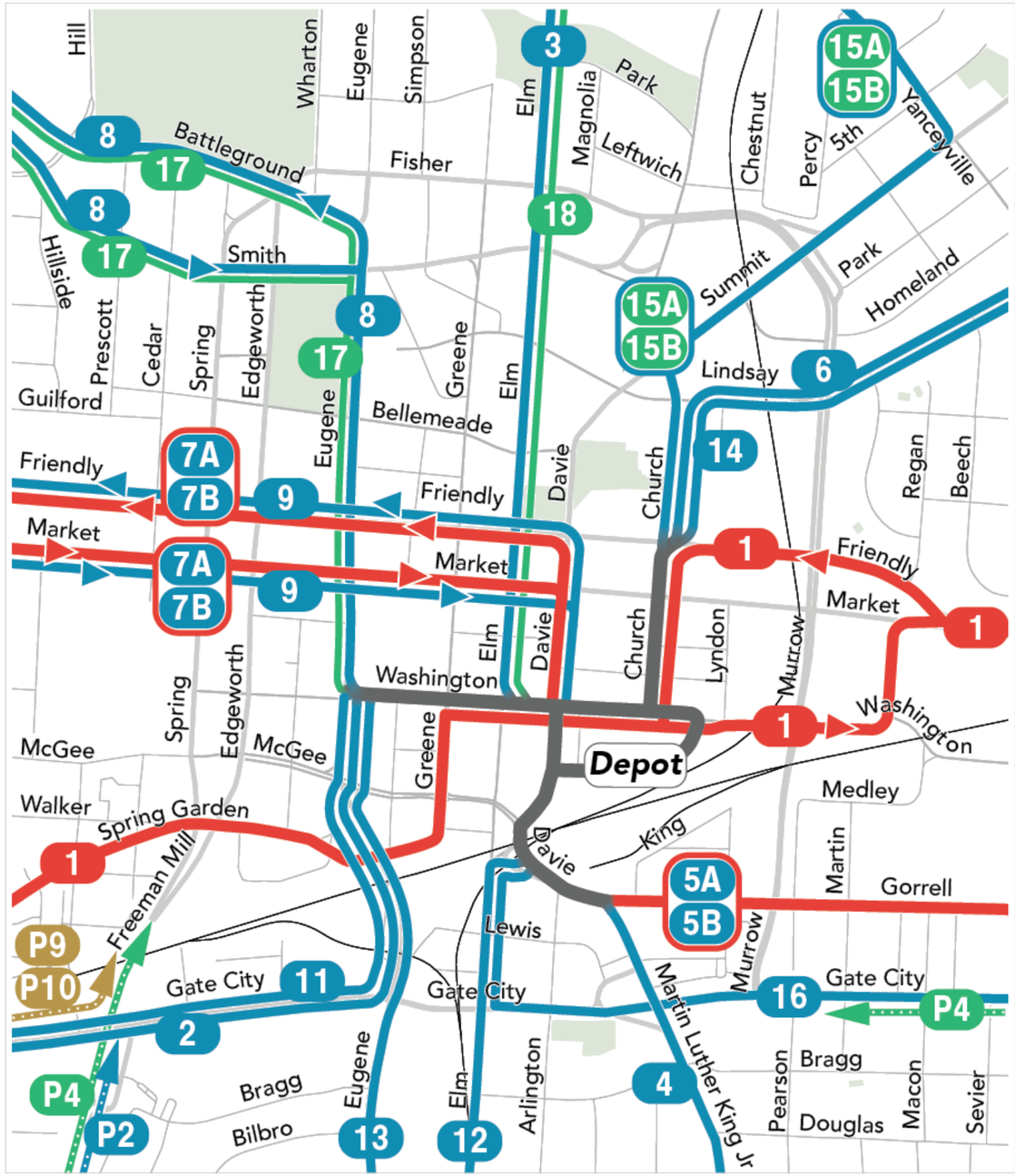


Figure 52: Map of the Coverage Concept in Downtown Greensboro.

Frequency and Span of Service

The chart on the right summarizes each route's frequency and span of service in the Coverage Concept. The chart also includes the effective frequency on the common trunk segments for branching routes, and shows the Demand Response Zones.

Similar to the Ridership Concept, almost every route runs from 5 AM, through mid-night, until 1 AM on the next day. The same timetable is operated all seven days of the week.

Most routes operate their predominant daytime frequency from 6 AM to 10 PM. Between 5 AM and 6 AM, and 10 PM and 1 AM, routes run at a lower frequency. 15-minute routes run every 30 minutes, and 30-minute routes operate every 60 minutes. Route 15B and the Demand Response Zones do not operate during these times.

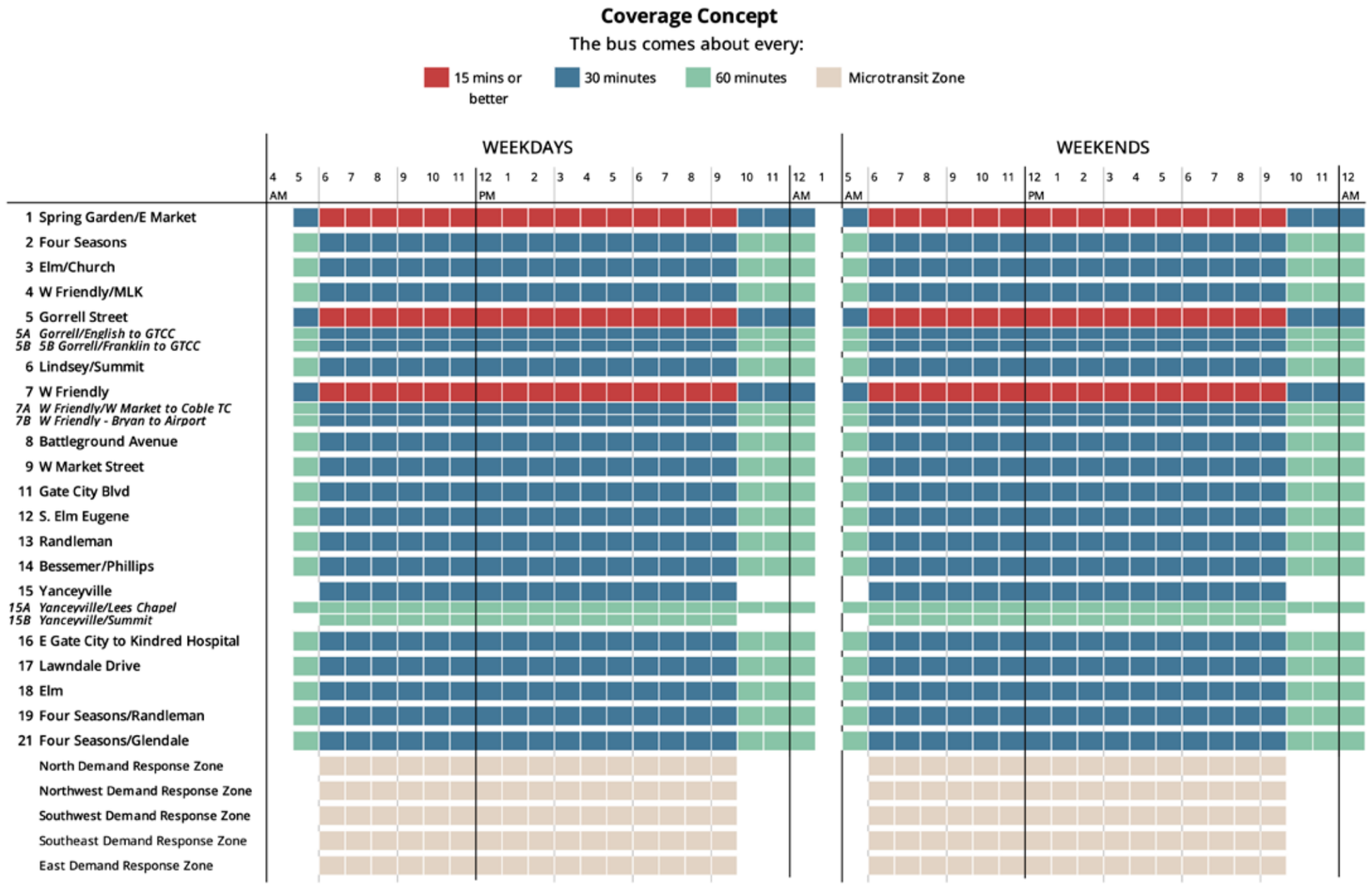


Figure 53: Span of service and frequency by hour on weekdays and weekends for routes in the Coverage Concept.

7 Outcomes of the Concepts

Comparing Outcomes

The design of the networks and when and where service operates are important to thinking about how service changes might affect individuals and their trips, but they tell us only so much about the overall effects of these networks.

In this chapter, we look at **three different ways of measuring potential outcomes** of the Concepts. These measurements are not forecasts. They do not need to make assumptions about how culture, technology, prices or other factors will change in the next few years.

These are simple arithmetic measures that combine existing distance, time, population, and job data to show the potential of each Concept and how they each differ from the Existing Network.

Proximity

The first measure reported, on the next page, is very simple: **How many residents and jobs are near transit?**

Proximity is a measure of the coverage a transit system provides. If resources are spread out to provide some service in lots of areas, more people and jobs will be near transit. A network that provides better proximity outcomes provides **an option of transit** to more people and workplaces.

However, proximity by itself does not tell us how useful it could be to people, only that it is nearby to them. We also report on proximity to transit by the frequency of service, to provide a little more information about how many people are near service that is more likely to be useful because of its frequency.

Isochrones

Another question a person could ask when thinking about these Concepts is: **Where could I get to with transit, in a reasonable amount of time, from where I am?**

Wherever you live, there is a certain area you can reach in a reasonable amount of time. You could draw a map of this area, and it would appear as a blob, with you at the center.

In this blob are things you can use transit to get to. These can be many things: work-places, schools, shopping, and anything else you might want to do. The more things are in this blob, the **more useful transit can be as an option** for travel.

The technical planning term for this blob is an **"isochrone".** Isochrones provide a visual explanation of how a transit network changes peoples' freedom to travel, on foot and by transit, to or from a place of interest. An isochrone helps visualize a person's access to jobs, schools, groceries, medical care, or any other opportunity.

Isochrones to Access

Isochrones show the access for a person from one particular place. By **adding up the access from isochrones across the entire city,** we can describe how access would change, on average, for all residents (or groups of residents) and to all jobs.

For comparing transit Concepts, an access analysis is better than a ridership forecast, because it describes the part of ridership forecasting that is basic math and geometry and therefore highly predictable.

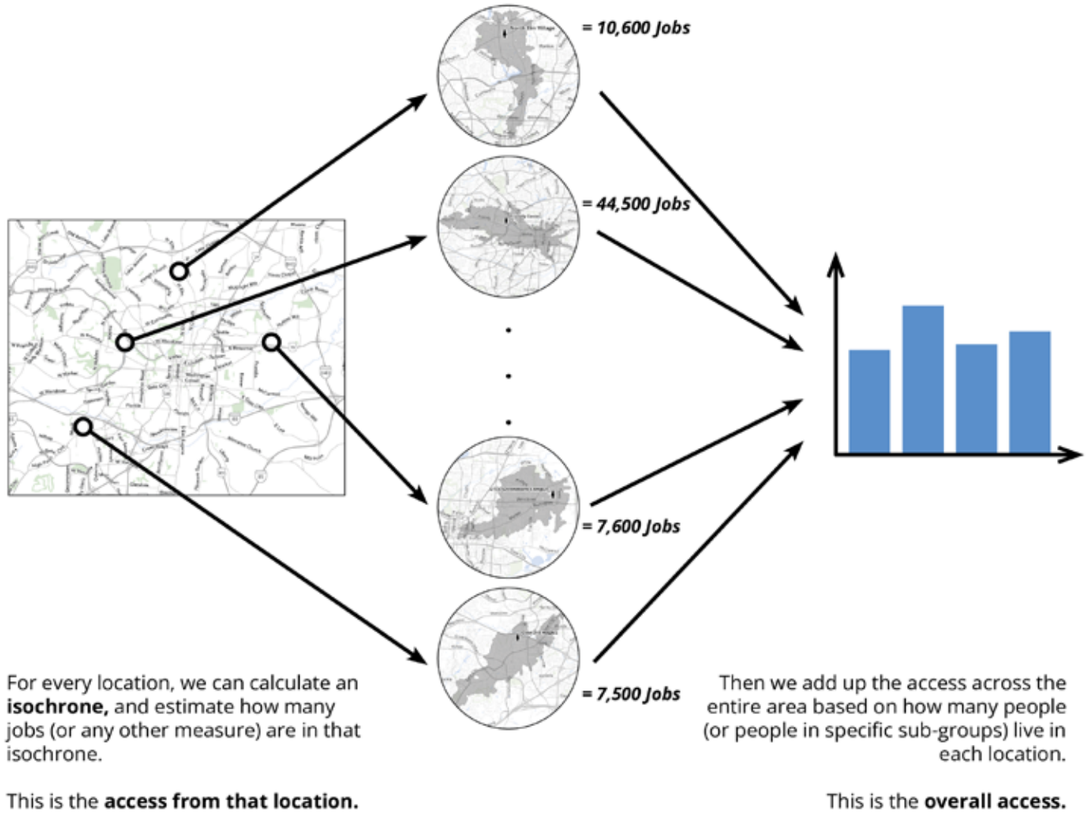


Figure 54: How you get from isochrones to access.

Proximity is a measure of the *coverage* transit provides, while access is a measure of the *usefulness* of transit.

Which measure is more important to you depends on your values and priorities.

Proximity to Transit

The number of people and jobs within a certain distance from transit is the simplest measure of transit outcomes. In this report we call this measure "proximity to transit", and define it as what portion of Greensboro's people and jobs are located within half a mile of a bus stop with service at a particular frequency, or inside a Demand Response Zone. The charts on the right show this proximity to transit in the Ridership and Coverage Concepts, respectively.

Overall Change

Today, only 52% of Greensboro's residents and 64% of jobs are close to transit. **The Ridership Concept only slightly improves overall proximity.** It brings transit close to 55% of Greensboro's residents, and 66% of Greensboro's jobs. **The Coverage Concept significantly improves overall proximity:** 76% of residents and jobs are close to transit. A large portion of this increase is achieved because of the Demand Response Zones (tan bars).

Proximity to Frequent Service

However, **the portion of people and jobs near frequent, useful service is much higher in the Ridership Concept** (red bars): 34% of residents and 48% of jobs in Greensboro will be close to frequent service during most of the day, compared to only 15% of residents and 24% of jobs in the Coverage Concept.

This difference reflects the basic geometric trade-off: the Ridership Concept focuses the highest frequency and most useful transit service to the best markets for transit with the goal of reaching the largest possible number of jobs and places most likely to generate high ridership relative to cost. The Coverage Concept, on the other hand, is trying to expand how many people and jobs are close to transit, even if it isn't frequent.

Proximity by Sub-Group

In both Concepts, compared to residents overall, similar but slightly larger proportions of Residents of Color and Residents in Poverty are closer to transit. Similar but slightly smaller portions of Youth and Seniors are closer to transit than residents overall. For all these groups, the Coverage Concept significantly expands proximity overall, while the Ridership Concept significantly expands proximity to frequent service.

The Ridership Concept brings a much larger portion of Households Without Cars close to frequent transit (51%) compared to residents overall (34%). The Coverage Concept only brings a modestly higher portion of Households Without Cars (20%) close to frequent transit compared to residents overall (15%). However, it brings 30-minute service close to a much larger portion of Households Without Cars (49%) than residents overall (35%).

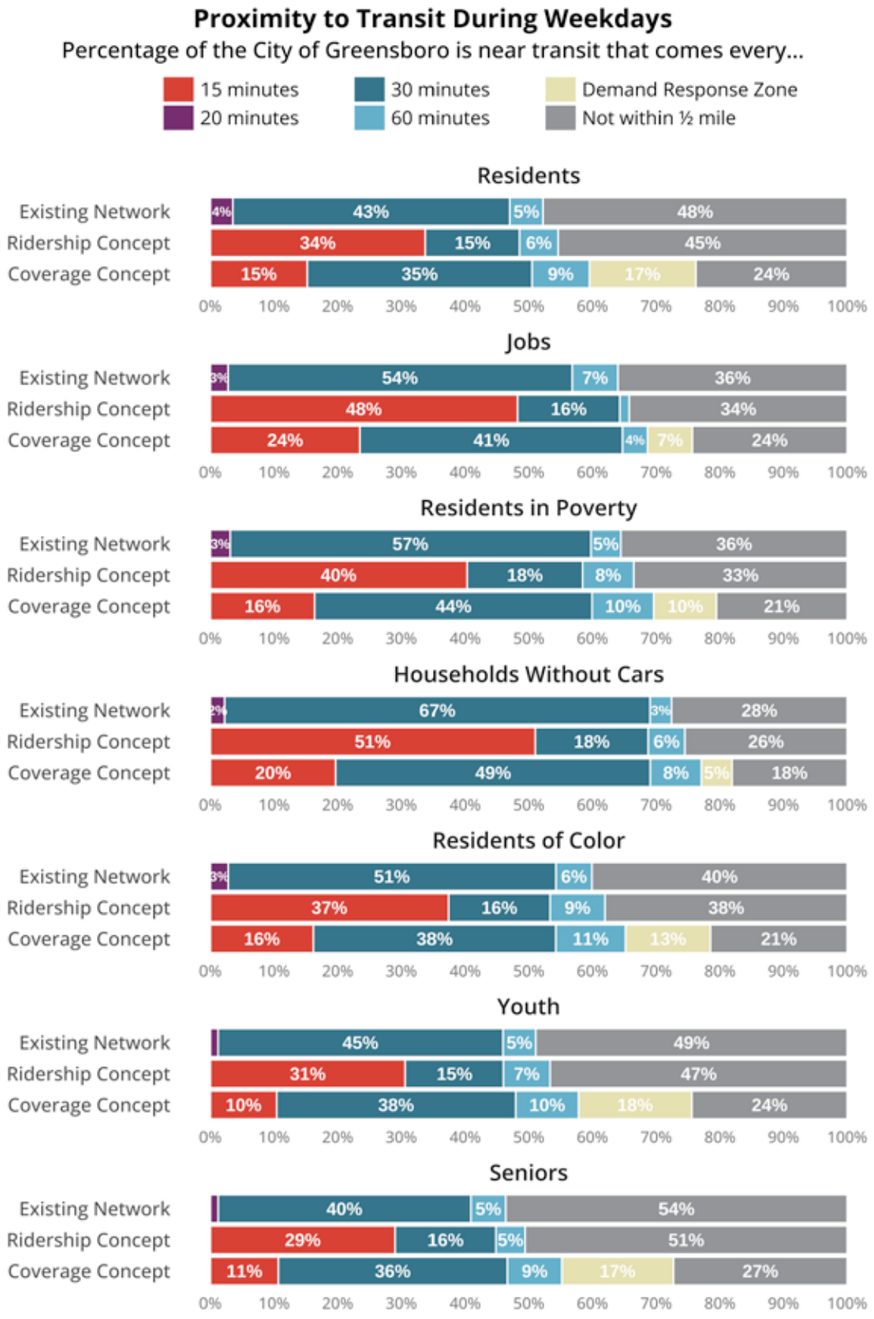


Figure 55: Comparison of Proximity to Transit in the Existing Network and the two Concepts.

Isochrones

People ride transit if they find it useful. A helpful way to illustrate the usefulness of a network is to visualize where a person could go by transit and walking, from a given location, in a given amount of time. The technical term for this illustration is "isochrone".

A more useful transit network is one in which these isochrones are larger and have more in them, so that people are likely to find the network useful for more trips.

The maps on the right show isochrones from the Downtown Depot in 45 minutes at midday on a Weekday in the Coverage and Ridership Concepts. Each Concept is compared to the Existing Network. The dark purple represents areas that are reachable today and remain reachable in the corresponding Concept. Areas that are newly reachable are shown in light purple, and areas that are longer reachable are shown in gray. More examples of isochrones are on the next page and in Appendix A.

These isochrones include all the different parts of a transit trip that take time:

- Average wait time to use a bus.
- Time riding in the bus.
- Any time needed to make a transfer.
- Time walking to the bus stop where you start your trip, and walking away from the stop where you get off.

While reviewing these maps, it is also important to note that **it is not just how large an isochrone is, but also what is inside the isochrone that matters.** This is the access from a particular location. The maps include an estimate of the additional number of jobs and residents you could reach in each Concept, compared to today.

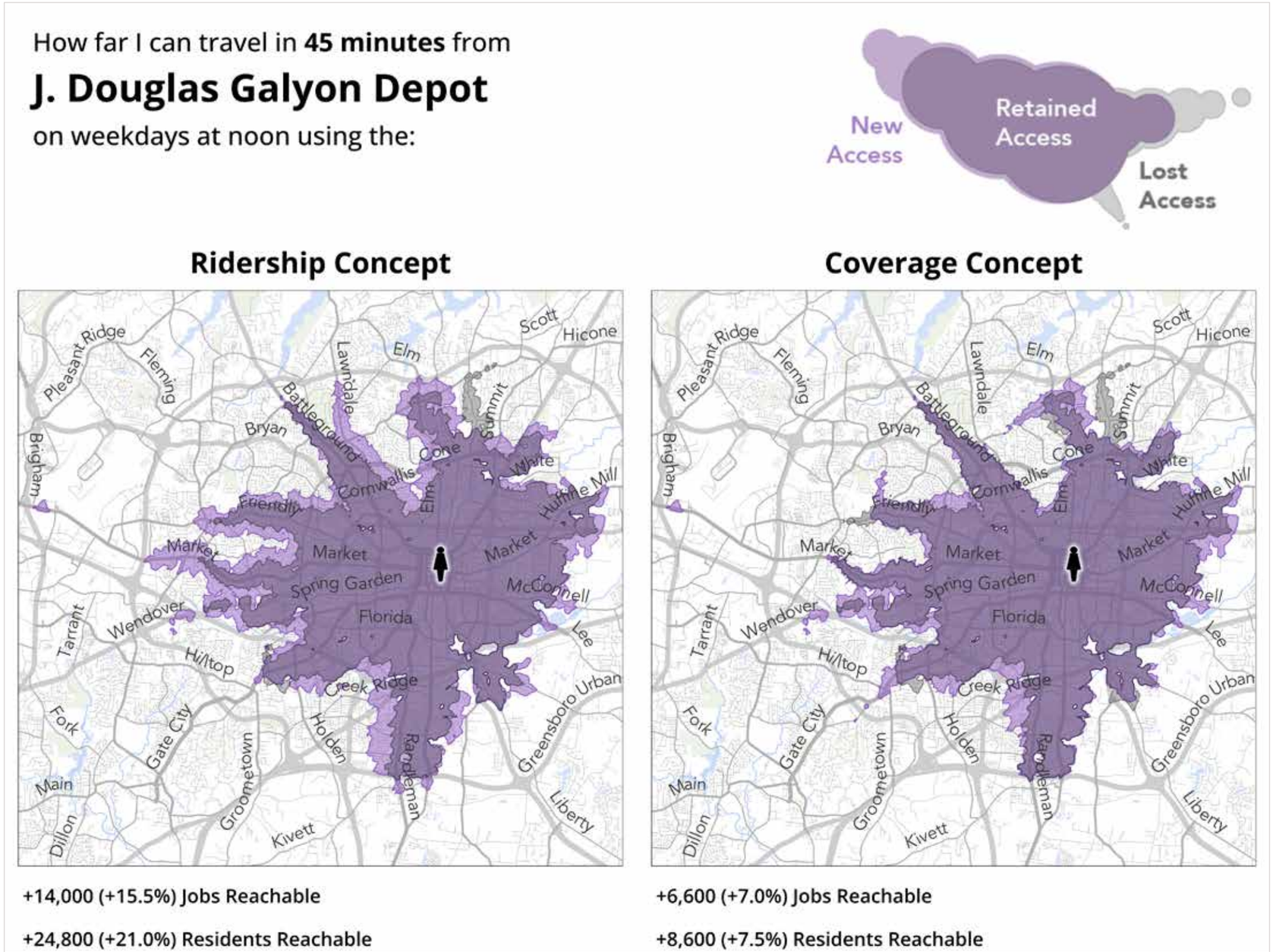
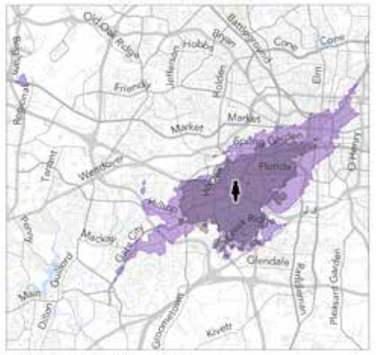


Figure 56: An isochrone shows how far someone can go, in a given amount of time, by walking and transit. These isochrone maps from the Downtown Depot show change in access to jobs and residents in 60 minutes in the Ridership and Coverage Concepts.

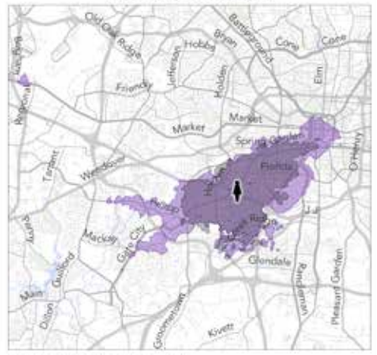
How far I can travel in **45 minutes** from
Four Seasons Town Center
on weekdays at noon using the:

Ridership Concept



+27,100 (+252.0%) Jobs Reachable
+25,700 (+102.0%) Residents Reachable

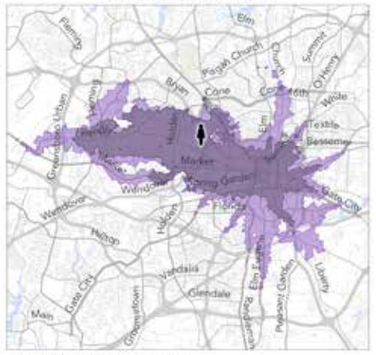
Coverage Concept



+19,300 (+180.0%) Jobs Reachable
+18,100 (+72.0%) Residents Reachable

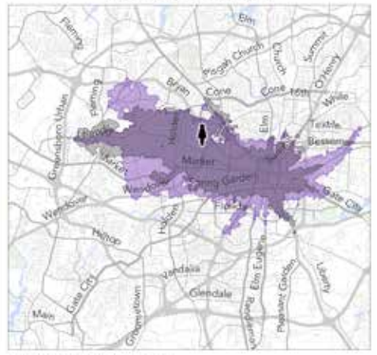
How far I can travel in **45 minutes** from
Friendly Center
on weekdays at noon using the:

Ridership Concept



+22,600 (+50.5%) Jobs Reachable
+31,400 (+65.0%) Residents Reachable

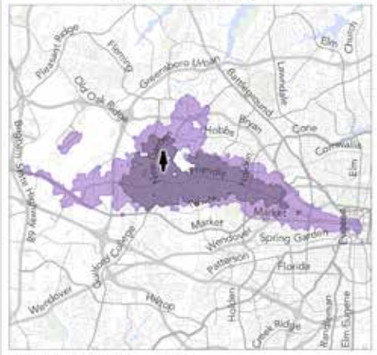
Coverage Concept



+8,200 (+18.5%) Jobs Reachable
+17,800 (+37.0%) Residents Reachable

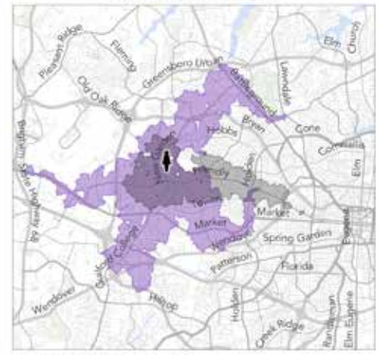
How far I can travel in **45 minutes** from
Guilford College Campus
on weekdays at noon using the:

Ridership Concept



+16,000 (+345.5%) Jobs Reachable
+16,000 (+123.5%) Residents Reachable

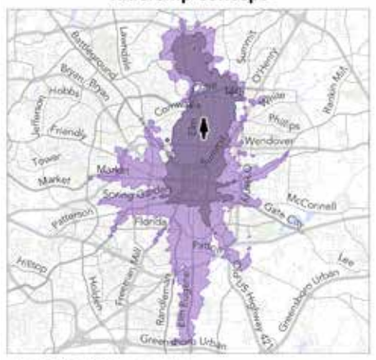
Coverage Concept



+16,000 (+344.5%) Jobs Reachable
+18,900 (+146.0%) Residents Reachable

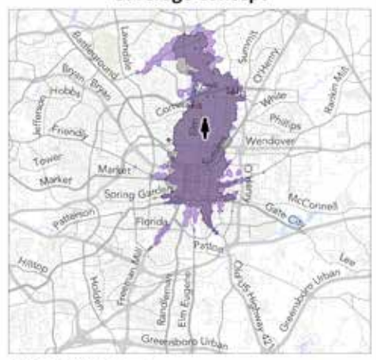
How far I can travel in **45 minutes** from
Moses H. Cone Memorial Hospital
on weekdays at noon using the:

Ridership Concept



+22,500 (+59.5%) Jobs Reachable
+35,300 (+142.0%) Residents Reachable

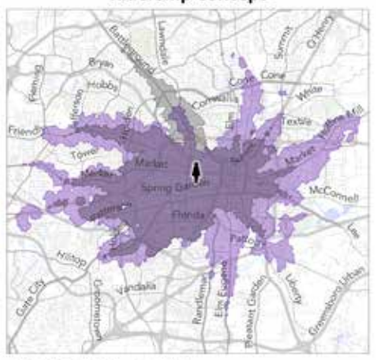
Coverage Concept



-100 (0.0%) Jobs Reachable
+4,000 (+16.0%) Residents Reachable

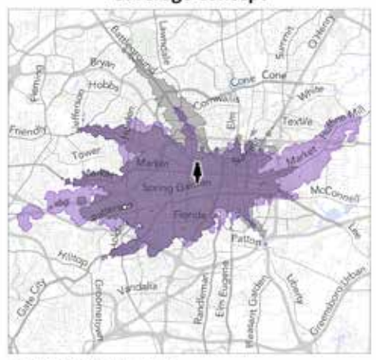
How far I can travel in **45 minutes** from
UNCG Campus
on weekdays at noon using the:

Ridership Concept



+25,700 (+49.0%) Jobs Reachable
+33,000 (+59.0%) Residents Reachable

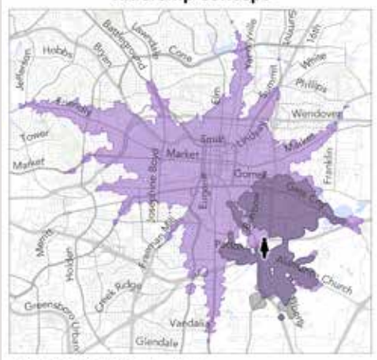
Coverage Concept



+3,600 (+7.0%) Jobs Reachable
+10,400 (+18.5%) Residents Reachable

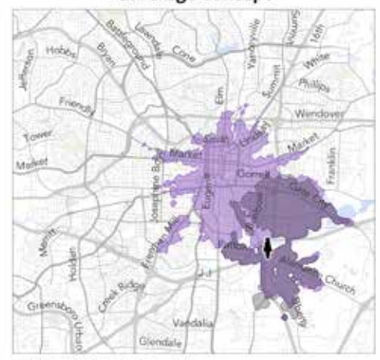
How far I can travel in **45 minutes** from
Walmart Alamance Church Road
on weekdays at noon using the:

Ridership Concept



+52,400 (+1 645.5%) Jobs Reachable
+47,600 (+473.5%) Residents Reachable

Coverage Concept



+27,100 (+849.5%) Jobs Reachable
+21,800 (+217.0%) Residents Reachable

Figure 57: Comparative Isochrones Showing How Far People Can Go in 45 Minutes Using Transit From Various Locations in Greensboro (See Appendix A for more locations)

Access Change

The previous maps show how the Concepts change where people could go in a given time, from certain places in Greensboro (access to other opportunities, like education and shopping would likely change in a similar way).

We can run the same analysis on locations throughout the City to estimate how each concept changes access to jobs and opportunities across all of Greensboro. The maps on the right and the next page illustrate this change for the Ridership Concept and the Coverage Concept, respectively.

In these maps, every hexagon represents the number of jobs that can be reached in 45 minutes as compared to the Existing network. Purple hexes represent more jobs accessible and orange hexes represent fewer jobs available. Where no hexes are shown, there is very little change (less than 1,000) in the number of jobs accessible within 45 minutes from that location in that Concept.

Ridership Concept

The Ridership Concept drastically increases access to jobs and opportunity throughout the densest and busiest parts of Greensboro close to Downtown, as seen in the deep purple shades that represent an increase of more than 20,000 jobs reachable within 45 minutes. Transit can be much more useful in these parts, because:

- There are many frequent routes, which require less waiting; and
- Many routes provide crosstown service, which eliminates the additional wait of a transfer.

Outside of the densest core of Greensboro, the Ridership Concept significantly improves job access close to many of the arterial corridors. Further out, the benefit of added frequency, crosstown service, and modest additions in coverage can be seen in dark purple spots along West Wendover Avenue, West Market Street, West Friendly Avenue, North

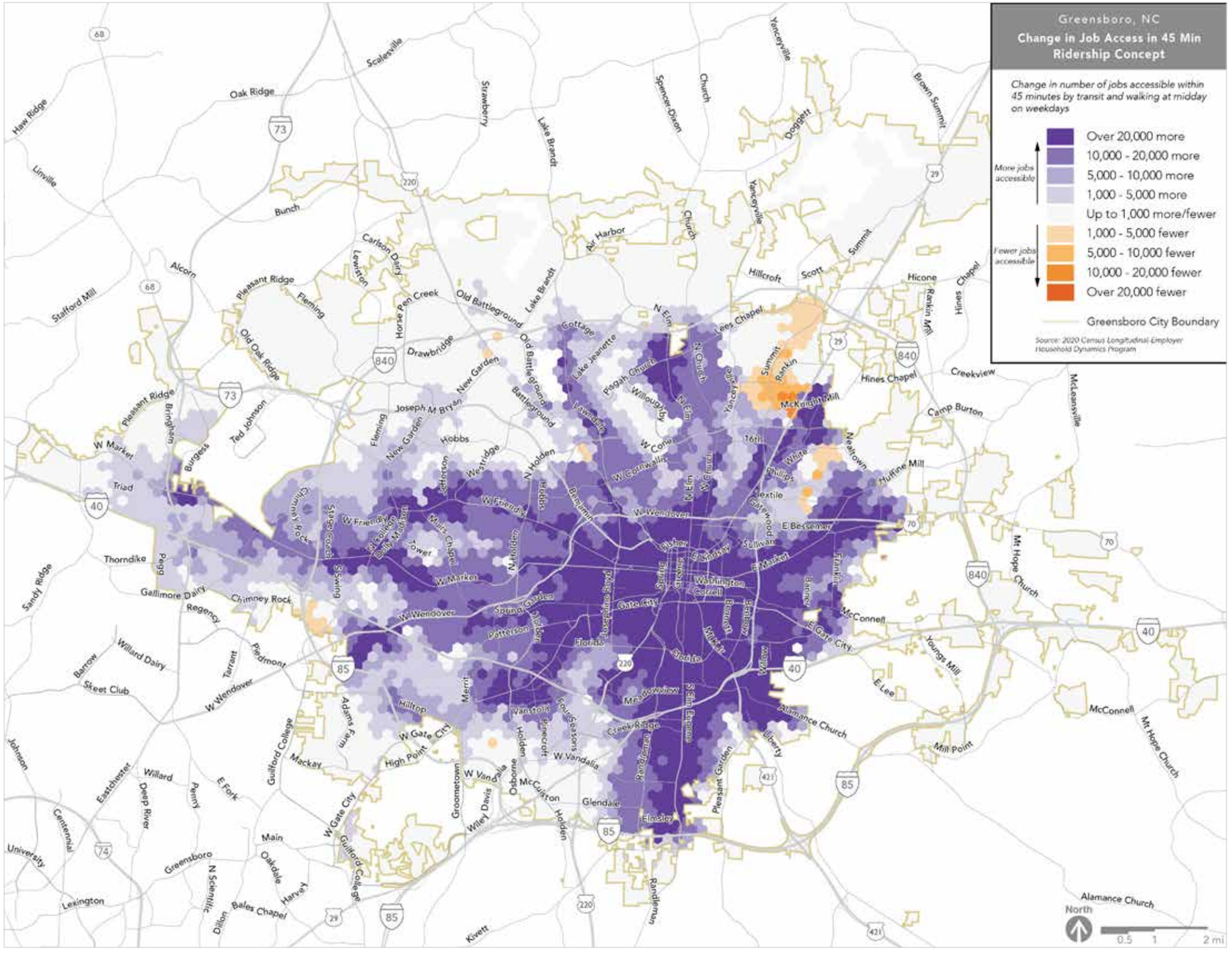


Figure 58: Map showing the change in the number of jobs accessible within 45 minutes in the Ridership Concept.

Church Street, and Summit Avenue and 16th Street.

The large orange area of access loss in the most Northeastern part of Summit Avenue is related to a lower frequency (but two way service along Route 15B) assumed there compared to today (where Route 15 runs in a large-one way loop, but at every 30 minutes).

The Ridership Concept requires people to walk longer distances to more frequent and direct routes, and for some areas, it means people can access fewer total jobs in 45 minutes. This is the reason behind other smaller areas of access loss.

Coverage Concept

The Coverage Concept shows access increases across most parts of Greensboro within 45 minutes. But these increases are more modest, especially in the densest and busiest core of Greensboro, compared to the Ridership Concept. This is because most routes have a similar frequency as they do today and almost all of them require a transfer at the Depot, like today.

Particularly around New Garden Road, Pisgah Church Road, Muirs Chapel Road, and Hilltop Road (all of which have new 30-minute service in the Coverage Concept, but not in the Ridership Concept), there are larger increases in job access. The benefit of the high-frequency crosstown Route 1 can also be seen along East Market Street and West Wendover Avenue, but these access gains are muted compared to the Ridership Concept because there are very few other frequent routes that someone can transfer to with short waits.

Despite the large additional investment in increasing coverage in the outermost parts of Greensboro, the access gains there are not significant. The waiting time for a 60-minute route is on average 30 minutes, and the wait for a Demand Response Zone pickup is assumed to be 45 minutes. These long waits (and longer travel time to reach jobs

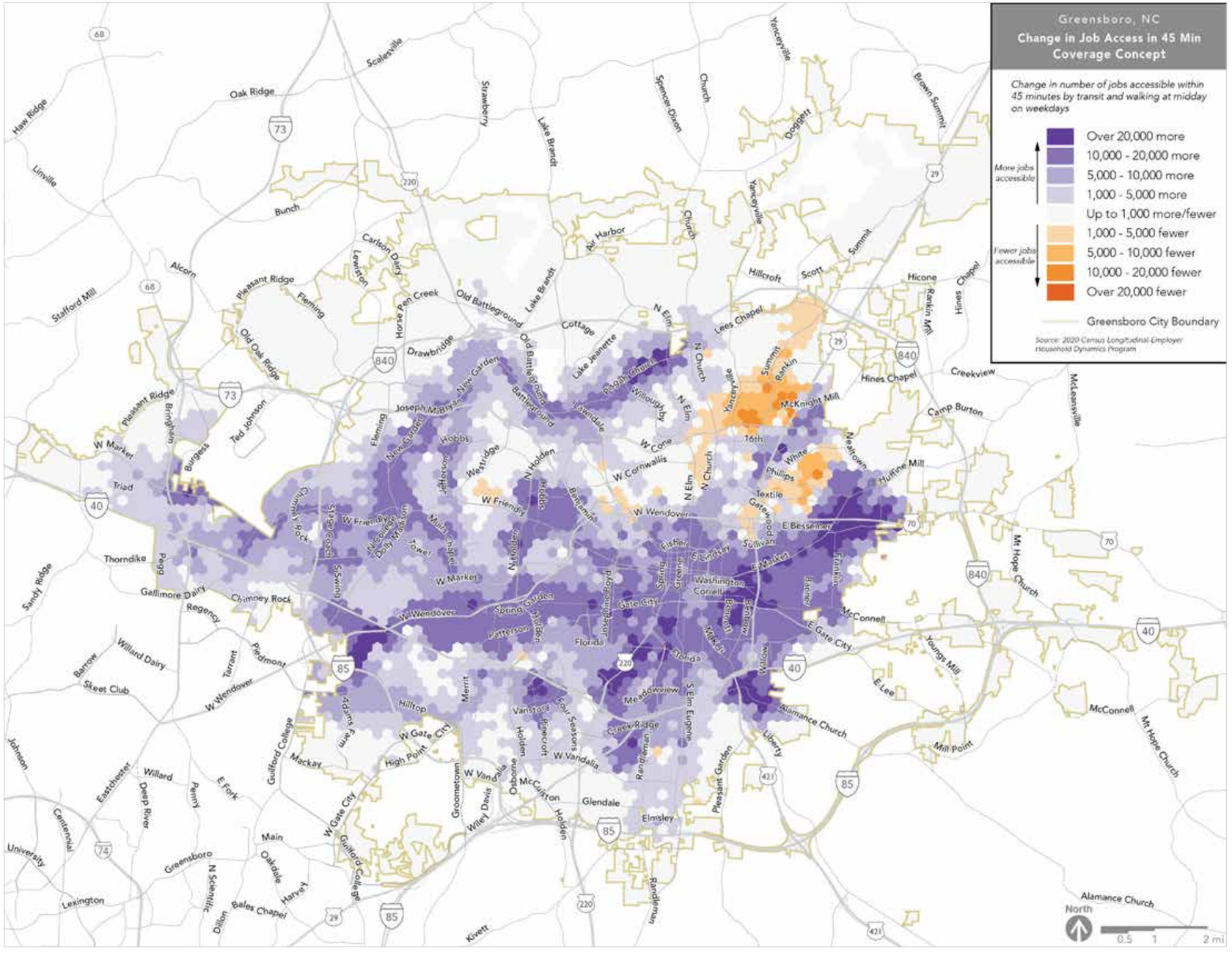


Figure 59: Map showing the change in the number of jobs accessible within 45 minutes in the Coverage Concept.

that are far away) mean that people in these areas cannot use transit to reach many more jobs in 45 minutes in the Coverage Concept than they can today, despite having new service. However, such an outcome can be expected, because the Coverage Concept is designed to maximize coverage, not to maximize access and usefulness for most people.

There are two relatively large areas with some access loss on either side of US-29 in the Northeast. On the West side, along Summit Avenue, the reason for access loss is the same as in the Ridership Concept: a one-way route at every 30 minutes is replaced by a 60-minute route with two-way service.

On the other side of US-29, Route 14 in the Coverage Concept is designed to travel to the Walmart at Pyramid Village (16th Street) *before* it goes Downtown. This gives residents here easy access to a large grocery store which also has some jobs. However, the trade-off is that it takes longer than it does today to reach Downtown Greensboro. Another consequence of this trade-off is that Route 14 in the Coverage Concept cannot make the timed transfer at the Depot. Both these factors lead to a job access loss for this area, but with the advantage of quick and easy access to Walmart.

Overall Access Change in the Concepts

The maps on the previous pages show how the two Concepts change access to jobs for different parts of Greensboro. By adding up all the increases and decreases across the City, we can estimate how each concept changes the access to jobs for the typical person in Greensboro.

The chart on the right shows the **median job access within 45 minutes** for Residents, Low-Income Residents, Households Without Cars, Residents of Color, Youth, and Seniors, in the Existing Network, Ridership Concept, and Coverage Concept.

We use the median of job access for people across Greensboro to show a value of how much job access each network provides for a "typical" person, or someone in the middle of the range. It is worth noting that 50% of people, in fact, have higher job access than that, and 50% of people have lower access.

With the Existing Network, the typical Greensboro resident can reach 6,500 jobs within 45 minutes. Both Concepts lead to large increases in job access. The Ridership Concept would increase the job access for a typical Greensboro resident by 140% to around 15,600 jobs. The Coverage Concept increases the typical job access by 86% to approximately 12,100 jobs.

If we consider access change for various groups of people, we still see large changes in typical job access in both Concepts, but a much larger change in the Ridership Concept than in the Coverage Concept:

- For Residents in Poverty, the Ridership Concept increases job access by 122% and the Coverage Concept increases job access by 51%
- For Households Without Cars, the Ridership Concept increases job access by 89% and the Coverage Concept increases job access by 45%
- For Residents of Color, the Ridership Concept increases job access by 174% and the Coverage Concept increases job access by 79%

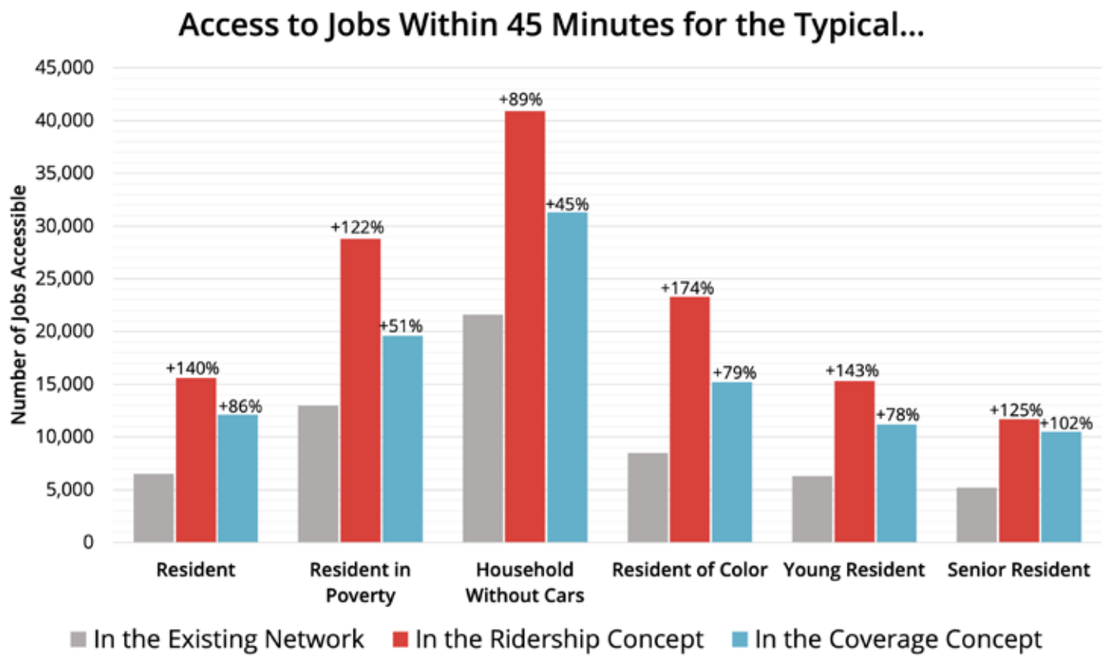


Figure 60: Median 45-minute job access for residents and various sub-groups of residents in the Existing Network and the two Concepts. We use median to illustrate access for a "typical" person in that group: 50% of the group will have a higher access and 50% will have a lower access than this.

- For Young Residents, the Ridership Concept increases job access by 143% and the Coverage Concept increases job access by 78%
- For Seniors, the Ridership Concept increases job access by 125% and the Coverage Concept increases job access by 102%

8 Next Steps

Next Steps

If you're interested enough to read this far, we'd love to have you more involved in this project!

This report is the first step in working with the Greensboro Community for GoBORO. It kicks off a round of public engagement for the Community's choices regarding whether it needs a larger investment in transit service, and in what direction such an increase in investment should go.

In September and October 2023, members of the project team, GTA and City staff, and others will be engaging the public through media outreach, social media engagement, and surveying at key locations, onboard buses, and online. The project team will also engage with a select group of local stakeholders.

Through this process, we need you to tell us what you think about these concepts and what priorities we should emphasize for the long-term future of the transit network.

Building on the input we get from you, our study team will develop a draft Long-Range Transit Plan. That will include maps of the new routes, and measures like job access change and proximity to service will be summarized in a report for the public and stakeholders to review in Spring 2024.

For more information about the surveys and outreach event dates, please visit https://bit.ly/goboro_site to:

- take the survey;
- contact the team to ask questions; and
- find out more about meetings and events where you engage in the GoBORO process!

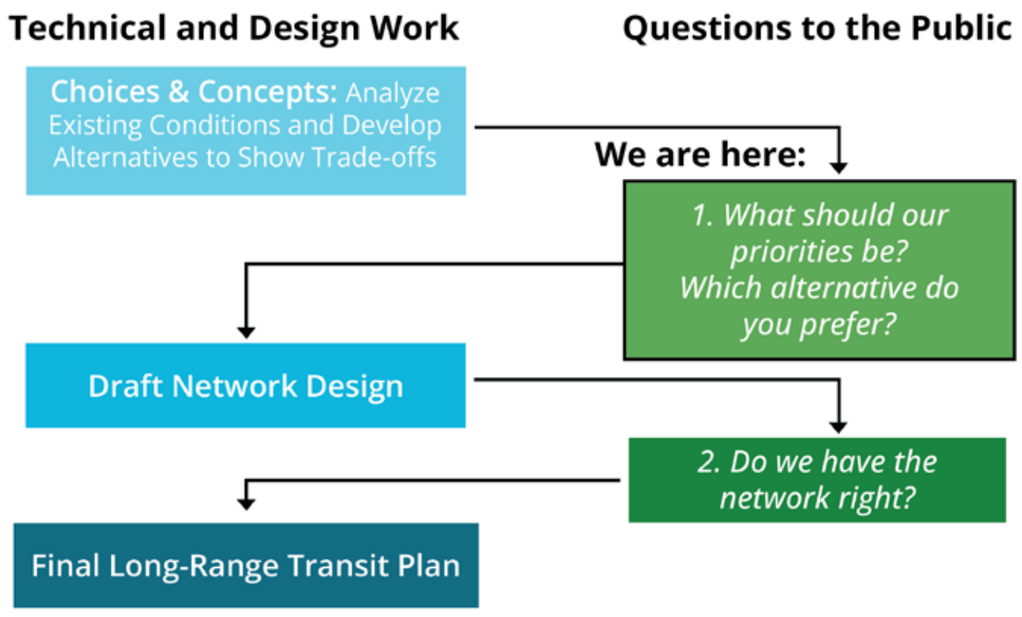


Figure 61: Process of Technical Work and Public Engagement That Will Guide GoBORO.

Appendix A: Concept Isochrones

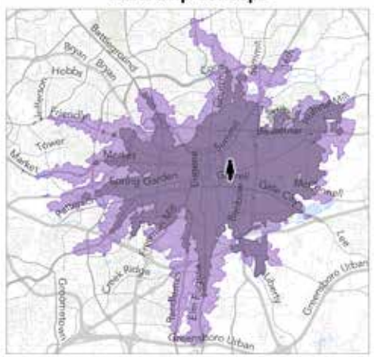
Summary Table of Access Change Within 45 Minutes

Location	Jobs Accessible in Existing Network	Jobs Accessible in Ridership Concept	Change in Jobs Accessible in Ridership Concept	Percent Change in Jobs Accessible in Ridership Concept	Jobs Accessible in Coverage Concept	Change in Jobs Accessible in Coverage Concept	Percent Change in Jobs Accessible in Coverage Concept	Residents Accessible in Existing Network	Residents Accessible in Ridership Concept	Change in Residents Accessible in Ridership Concept	Percent Change in Residents Accessible in Ridership Concept	Residents Accessible in Coverage Concept	Change in Residents Accessible in Coverage Concept	Percent Change in Residents Accessible in Coverage Concept
Bennett College	58,300	79,100	20,800	36%	63,600	5,300	9%	62,800	94,900	32,000	51%	73,700	10,900	17%
Claremont Courts	18,400	25,200	6,800	37%	14,400	-4,000	-22%	22,500	22,700	200	1%	22,900	400	2%
Coble Transportation Center	4,200	28,900	24,600	585%	25,600	21,400	508%	1,000	18,800	17,900	1856%	14,300	13,300	1384%
Gateway Research Park	5,000	22,600	17,600	351%	13,500	8,400	168%	16,700	24,800	8,100	48%	20,300	3,600	21%
Greensboro City Hall	79,300	104,400	25,100	32%	92,100	12,800	16%	91,500	138,800	47,300	52%	113,300	21,800	24%
Greensboro Coliseum	34,200	72,000	37,800	110%	44,800	10,500	31%	43,800	81,200	37,400	85%	54,200	10,400	24%
GTCC Greensboro Campus	7,600	35,400	27,800	366%	32,900	25,300	333%	16,200	44,500	28,300	175%	42,700	26,500	164%
GTCC Jamestown Campus	2,900	8,000	5,000	171%	3,000	0	0%	6,800	17,400	10,500	155%	6,800	0	0%
Guilford County Public Health Office	51,400	49,500	-2,000	-4%	48,200	-3,200	-6%	53,000	53,000	0	0%	51,000	-2,000	-4%
Guilford County Social Services Office	52,000	51,700	-300	-1%	44,900	-7,100	-14%	59,000	53,300	-5,700	-10%	41,100	-17,900	-30%
Hampton Homes	38,900	73,400	34,600	89%	45,300	6,400	16%	42,200	83,900	41,600	99%	50,200	8,000	19%
J. Douglas Galyon Depot	92,000	106,100	14,000	15%	98,700	6,600	7%	116,900	141,700	24,800	21%	125,500	8,600	7%
Jefferson Village Shopping Center	1,800	7,000	5,200	298%	16,400	14,600	830%	3,700	16,100	12,400	340%	32,100	28,400	776%
Kindred Hospital	38,800	48,000	9,200	24%	27,100	-11,700	-30%	36,600	49,200	12,600	34%	27,600	-9,000	-25%
Lawndale Crossing Shopping Center	28,700	39,300	10,600	37%	30,300	1,700	6%	25,200	37,300	12,100	48%	21,000	-4,200	-17%
NCA&T Campus	41,300	65,500	24,200	59%	53,700	12,400	30%	41,800	77,600	35,900	86%	63,600	21,800	52%
North Elm Village	10,600	36,600	26,000	245%	27,400	16,800	158%	11,300	27,200	15,900	141%	26,300	15,000	133%
Overland Heights	7,500	26,800	19,300	259%	15,300	7,800	104%	17,700	35,400	17,700	100%	33,800	16,100	91%
Ray Warren Homes	29,600	53,800	24,200	82%	40,100	10,500	35%	31,700	57,300	25,500	80%	47,300	15,500	49%
Revolution Mill	45,100	45,000	-100	0%	42,500	-2,600	-6%	44,300	35,400	-8,900	-20%	33,300	-11,100	-25%
Shoppes on Market	37,800	54,300	16,500	44%	46,900	9,000	24%	38,100	55,600	17,600	46%	50,300	12,200	32%
Smith Homes	34,000	55,200	21,300	63%	53,000	19,000	56%	39,000	61,100	22,100	57%	60,700	21,600	55%
Social Security Administration Office	15,100	35,900	20,700	137%	31,600	16,500	109%	14,500	47,100	32,600	226%	36,500	22,000	152%
W Florida St and S Josephine Boyd St	45,700	48,100	2,400	5%	45,300	-400	-1%	51,800	57,600	5,800	11%	60,100	8,300	16%
Walmart Cotswold Avenue	10,400	9,400	-1,000	-10%	13,500	3,200	30%	16,000	14,800	-1,200	-7%	22,400	6,400	40%
Walmart Elmsley Drive	12,200	34,300	22,100	181%	12,400	200	2%	18,800	29,200	10,400	55%	17,900	-900	-5%
Walmart Sixteenth Street	17,300	37,300	20,000	116%	26,700	9,500	55%	16,300	29,300	13,000	80%	25,800	9,500	58%
Walmart Wendover Avenue	12,400	27,500	15,000	121%	27,500	15,000	121%	11,200	36,900	25,700	230%	39,800	28,600	256%
Wesley Long Hospital	39,800	59,800	20,000	50%	44,700	4,900	12%	37,800	68,300	30,500	81%	48,000	10,200	27%
Westridge Square	17,700	24,500	6,800	39%	34,500	16,800	95%	21,200	20,700	-600	-3%	35,800	14,500	68%
Willow Oaks	29,200	55,400	26,200	90%	39,000	9,800	34%	32,600	60,200	27,700	85%	48,800	16,200	50%
Windsor Recreation Center	47,800	71,000	23,200	48%	55,300	7,500	16%	47,300	80,200	33,000	70%	63,300	16,100	34%

Isochrones by Location

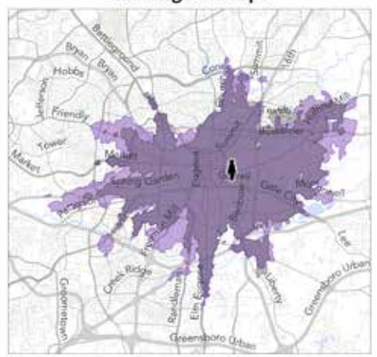
How far I can travel in **45 minutes** from
Bennett College
on weekdays at noon using the:

Ridership Concept



+20,800 (+35.5%) Jobs Reachable
+32,000 (+51.0%) Residents Reachable

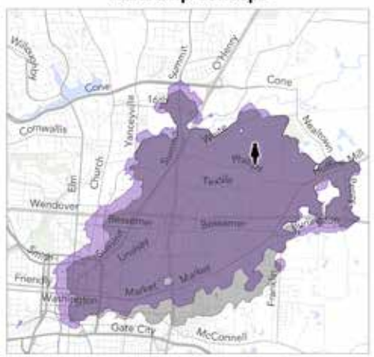
Coverage Concept



+5,300 (+9.0%) Jobs Reachable
+10,900 (+17.5%) Residents Reachable

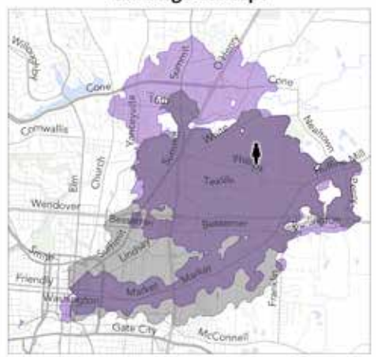
How far I can travel in **45 minutes** from
Claremont Courts
on weekdays at noon using the:

Ridership Concept



+6,800 (+37.0%) Jobs Reachable
+200 (+1.0%) Residents Reachable

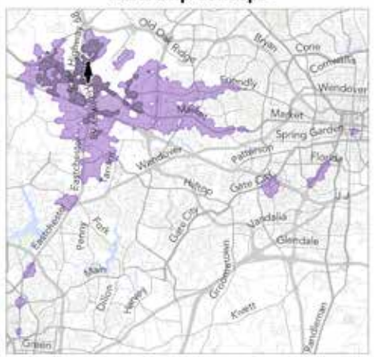
Coverage Concept



-4,000 (-21.5%) Jobs Reachable
+400 (+1.5%) Residents Reachable

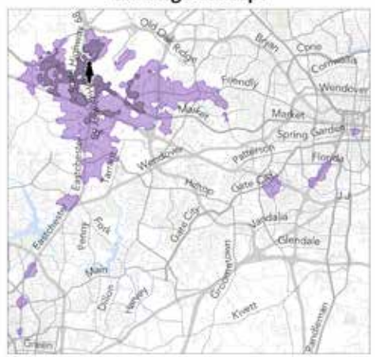
How far I can travel in **45 minutes** from
Coble Transportation Center
on weekdays at noon using the:

Ridership Concept



+24,600 (+585.0%) Jobs Reachable
+17,900 (+1 856.5%) Residents Reachable

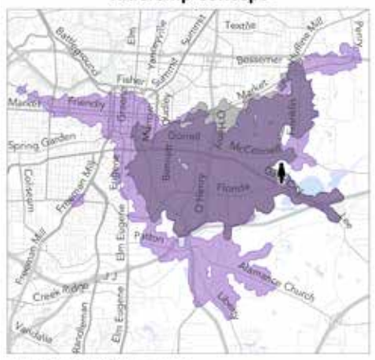
Coverage Concept



+21,400 (+507.5%) Jobs Reachable
+13,300 (+1 383.5%) Residents Reachable

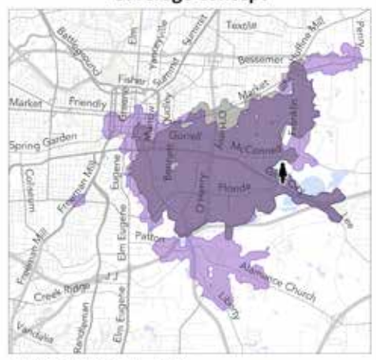
How far I can travel in **45 minutes** from
Gateway Research Park
on weekdays at noon using the:

Ridership Concept



+17,600 (+350.5%) Jobs Reachable
+8,100 (+48.5%) Residents Reachable

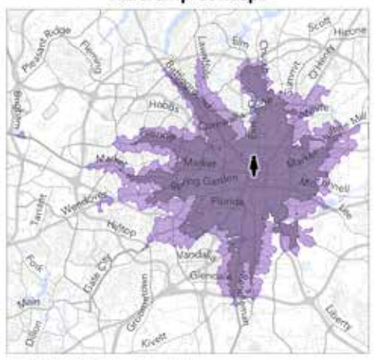
Coverage Concept



+8,400 (+168.5%) Jobs Reachable
+3,600 (+21.5%) Residents Reachable

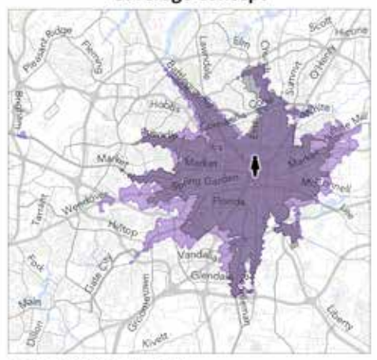
How far I can travel in **45 minutes** from
Greensboro City Hall
on weekdays at noon using the:

Ridership Concept



+25,100 (+31.5%) Jobs Reachable
+47,300 (+51.5%) Residents Reachable

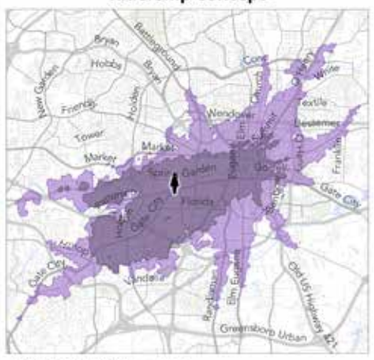
Coverage Concept



+12,800 (+16.0%) Jobs Reachable
+21,800 (+24.0%) Residents Reachable

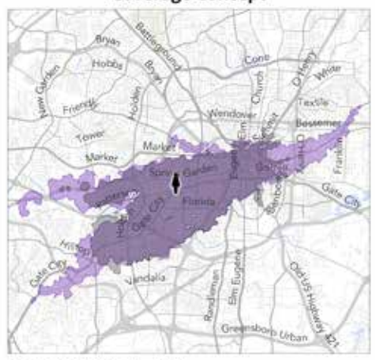
How far I can travel in **45 minutes** from
Greensboro Coliseum
on weekdays at noon using the:

Ridership Concept



+37,800 (+110.5%) Jobs Reachable
+37,400 (+85.5%) Residents Reachable

Coverage Concept



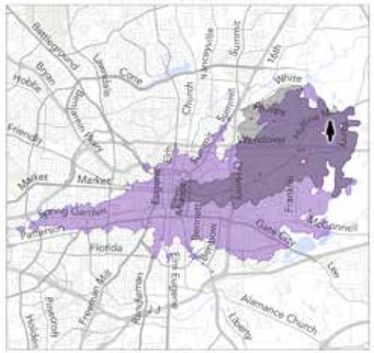
+10,500 (+30.5%) Jobs Reachable
+10,400 (+24.0%) Residents Reachable

How far I can travel in **45 minutes** from

GTCC Greensboro Campus

on weekdays at noon using the:

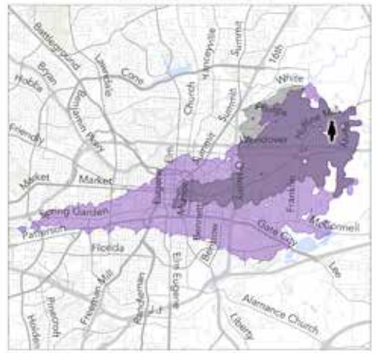
Ridership Concept



+27,800 (+366.0%) Jobs Reachable

+28,300 (+174.5%) Residents Reachable

Coverage Concept



+25,300 (+333.0%) Jobs Reachable

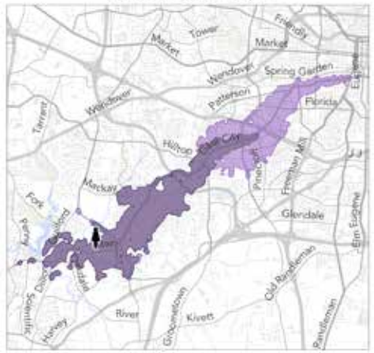
+26,500 (+164.0%) Residents Reachable

How far I can travel in **45 minutes** from

GTCC Jamestown Campus

on weekdays at noon using the:

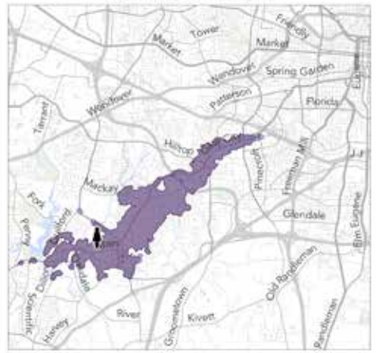
Ridership Concept



+5,000 (+170.5%) Jobs Reachable

+10,500 (+155.0%) Residents Reachable

Coverage Concept



+0 (0.0%) Jobs Reachable

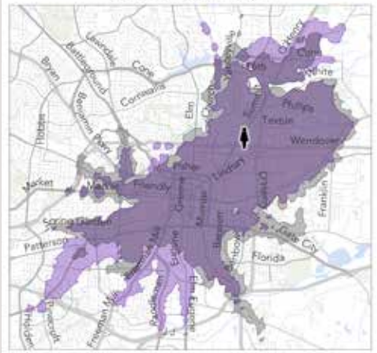
+0 (+0.5%) Residents Reachable

How far I can travel in **45 minutes** from

Guilford County Public Health Office

on weekdays at noon using the:

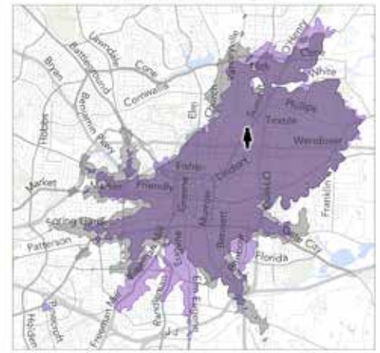
Ridership Concept



-2,000 (-4.0%) Jobs Reachable

+0 (0.0%) Residents Reachable

Coverage Concept



-3,200 (-6.0%) Jobs Reachable

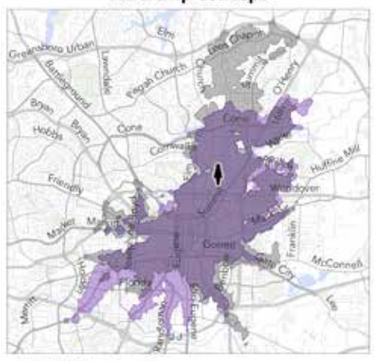
-2,000 (-4.0%) Residents Reachable

How far I can travel in **45 minutes** from

Guilford County Social Services Office

on weekdays at noon using the:

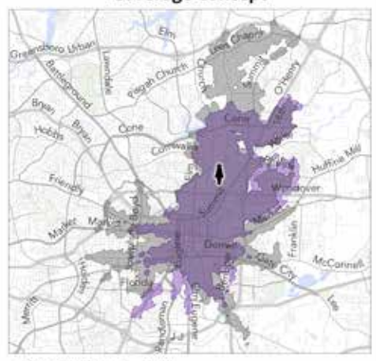
Ridership Concept



-300 (-0.5%) Jobs Reachable

-5,700 (-9.5%) Residents Reachable

Coverage Concept



-7,100 (-13.5%) Jobs Reachable

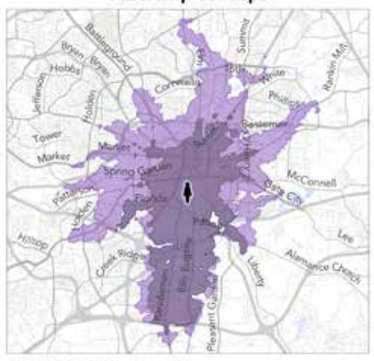
-17,900 (-30.5%) Residents Reachable

How far I can travel in **45 minutes** from

Hampton Homes

on weekdays at noon using the:

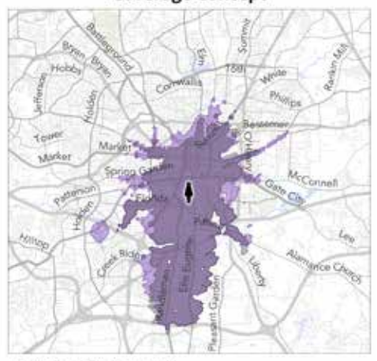
Ridership Concept



+34,600 (+89.0%) Jobs Reachable

+41,600 (+98.5%) Residents Reachable

Coverage Concept



+6,400 (+16.5%) Jobs Reachable

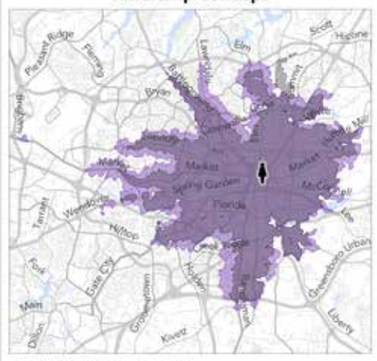
+8,000 (+19.0%) Residents Reachable

How far I can travel in **45 minutes** from

J. Douglas Galyon Depot

on weekdays at noon using the:

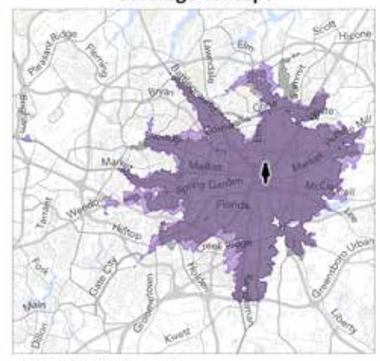
Ridership Concept



+14,000 (+15.5%) Jobs Reachable

+24,800 (+21.0%) Residents Reachable

Coverage Concept



+6,600 (+7.0%) Jobs Reachable

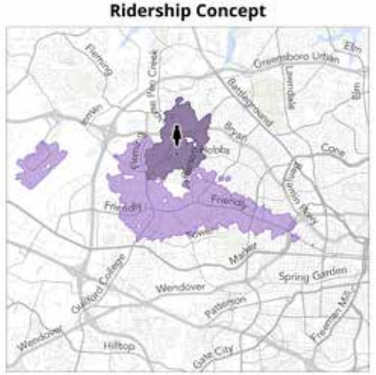
+8,600 (+7.5%) Residents Reachable

How far I can travel in **45 minutes** from

Jefferson Village Shopping Center

on weekdays at noon using the:

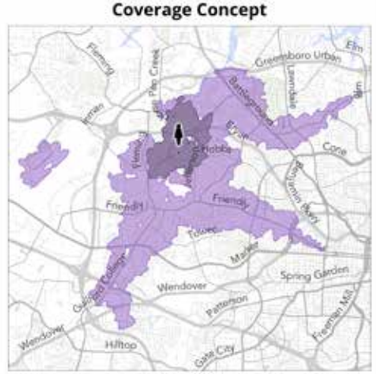
Ridership Concept



+5,200 (+298.0%) Jobs Reachable

+12,400 (+340.0%) Residents Reachable

Coverage Concept



+14,600 (+830.5%) Jobs Reachable

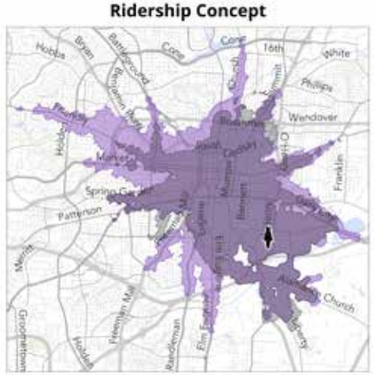
+28,400 (+776.0%) Residents Reachable

How far I can travel in **45 minutes** from

Kindred Hospital

on weekdays at noon using the:

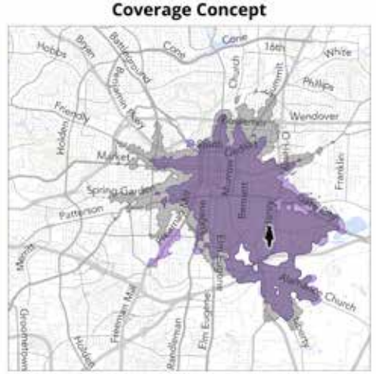
Ridership Concept



+9,200 (+23.5%) Jobs Reachable

+12,600 (+34.5%) Residents Reachable

Coverage Concept



-11,700 (-30.0%) Jobs Reachable

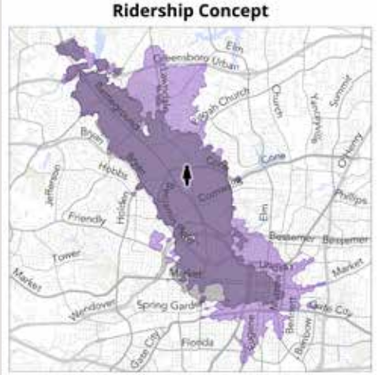
-9,000 (-24.5%) Residents Reachable

How far I can travel in **45 minutes** from

Lawndale Crossing Shopping Center

on weekdays at noon using the:

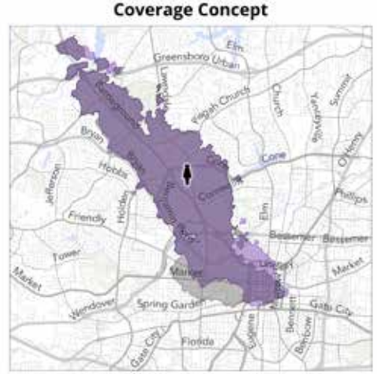
Ridership Concept



+10,600 (+37.0%) Jobs Reachable

+12,100 (+48.0%) Residents Reachable

Coverage Concept



+1,700 (+6.0%) Jobs Reachable

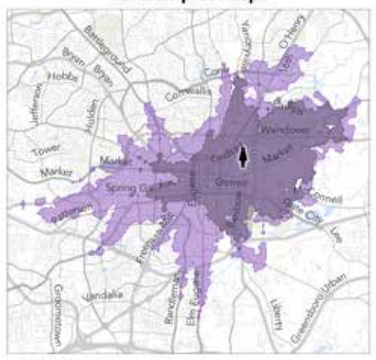
-4,200 (-16.5%) Residents Reachable

How far I can travel in **45 minutes** from

NCA&T Campus

on weekdays at noon using the:

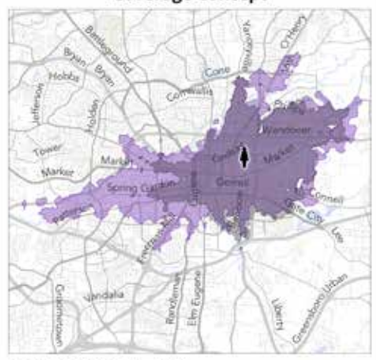
Ridership Concept



+24,200 (+58.5%) Jobs Reachable

+35,900 (+86.0%) Residents Reachable

Coverage Concept



+12,400 (+30.0%) Jobs Reachable

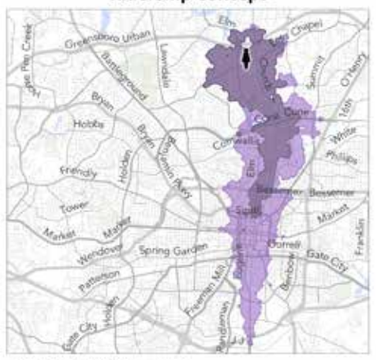
+21,800 (+52.0%) Residents Reachable

How far I can travel in **45 minutes** from

North Elm Village

on weekdays at noon using the:

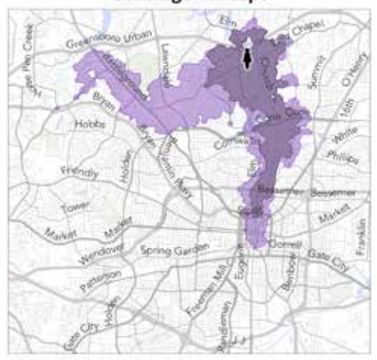
Ridership Concept



+26,000 (+244.5%) Jobs Reachable

+15,900 (+140.5%) Residents Reachable

Coverage Concept



+16,800 (+158.5%) Jobs Reachable

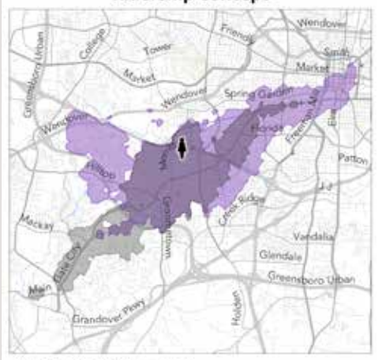
+15,000 (+133.0%) Residents Reachable

How far I can travel in **45 minutes** from

Overland Heights

on weekdays at noon using the:

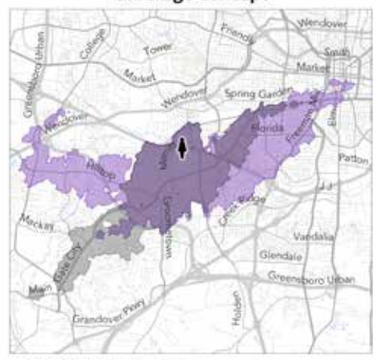
Ridership Concept



+19,300 (+259.0%) Jobs Reachable

+17,700 (+100.0%) Residents Reachable

Coverage Concept



+7,800 (+104.5%) Jobs Reachable

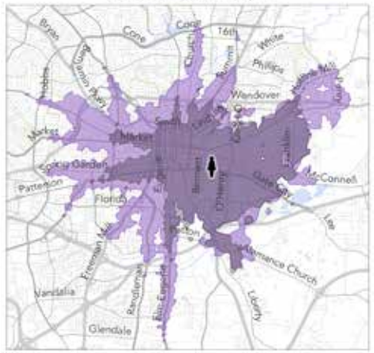
+16,100 (+91.0%) Residents Reachable

How far I can travel in **45 minutes** from

Ray Warren Homes

on weekdays at noon using the:

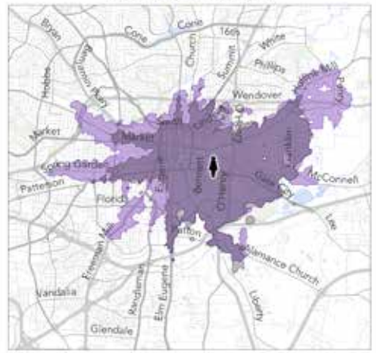
Ridership Concept



+24,200 (+81.5%) Jobs Reachable

+25,500 (+80.5%) Residents Reachable

Coverage Concept



+10,500 (+35.5%) Jobs Reachable

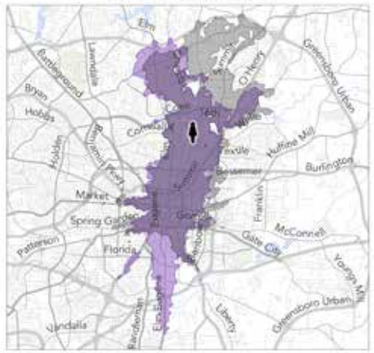
+15,500 (+49.0%) Residents Reachable

How far I can travel in **45 minutes** from

Revolution Mill

on weekdays at noon using the:

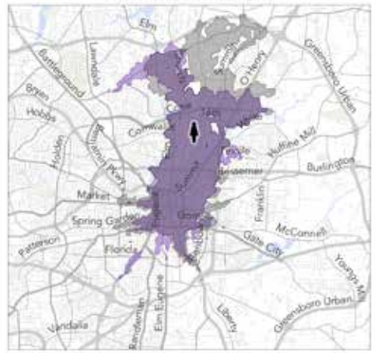
Ridership Concept



-100 (0.0%) Jobs Reachable

-8,900 (-20.0%) Residents Reachable

Coverage Concept



-2,600 (-6.0%) Jobs Reachable

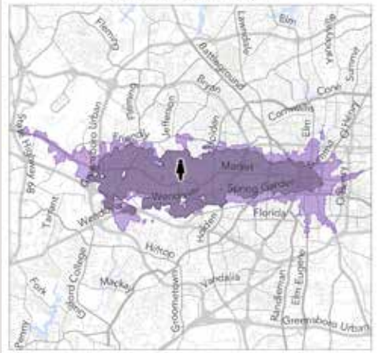
-11,100 (-25.0%) Residents Reachable

How far I can travel in **45 minutes** from

Shoppes on Market

on weekdays at noon using the:

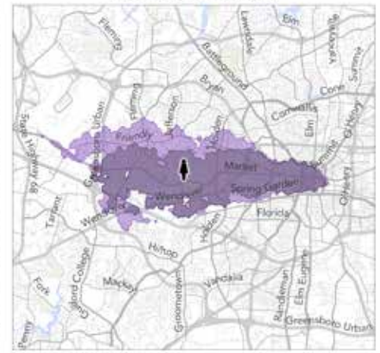
Ridership Concept



+16,500 (+43.5%) Jobs Reachable

+17,600 (+46.0%) Residents Reachable

Coverage Concept



+9,000 (+24.0%) Jobs Reachable

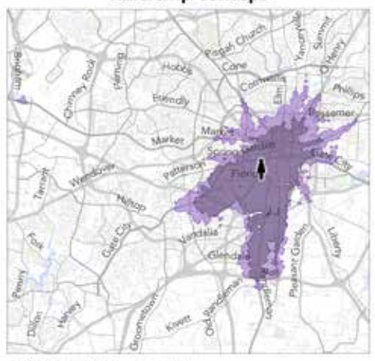
+12,200 (+32.0%) Residents Reachable

How far I can travel in **45 minutes** from

Smith Homes

on weekdays at noon using the:

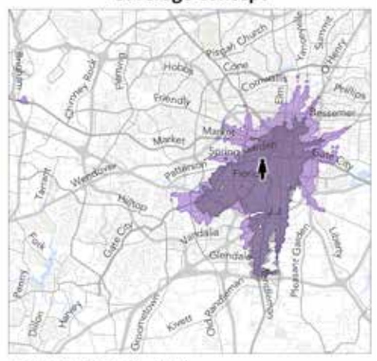
Ridership Concept



+21,300 (+62.5%) Jobs Reachable

+22,100 (+56.5%) Residents Reachable

Coverage Concept



+19,000 (+56.0%) Jobs Reachable

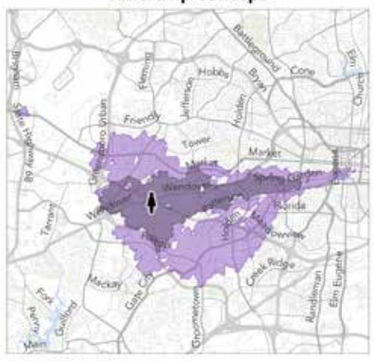
+21,600 (+55.5%) Residents Reachable

How far I can travel in **45 minutes** from

Social Security Administration Office

on weekdays at noon using the:

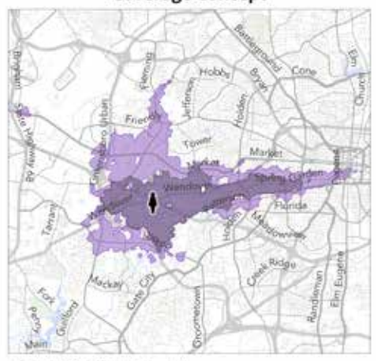
Ridership Concept



+20,700 (+137.0%) Jobs Reachable

+32,600 (+225.5%) Residents Reachable

Coverage Concept



+16,500 (+109.0%) Jobs Reachable

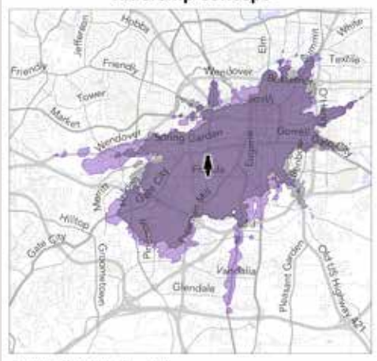
+22,000 (+152.0%) Residents Reachable

How far I can travel in **45 minutes** from

W Florida St and S Josephine Boyd St

on weekdays at noon using the:

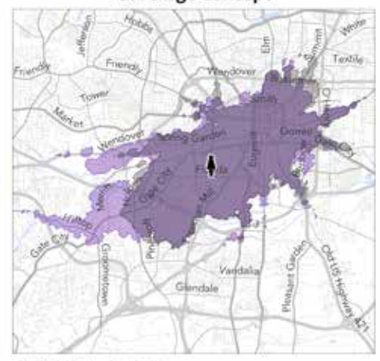
Ridership Concept



+2,400 (+5.5%) Jobs Reachable

+5,800 (+11.5%) Residents Reachable

Coverage Concept



-400 (-1.0%) Jobs Reachable

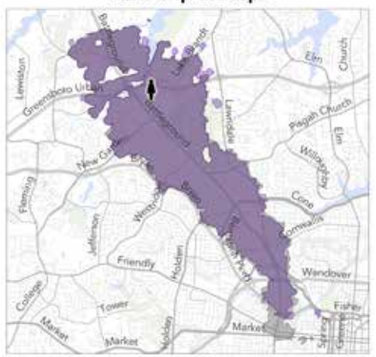
+8,300 (+16.0%) Residents Reachable

How far I can travel in **45 minutes** from

Walmart Cotswold Avenue

on weekdays at noon using the:

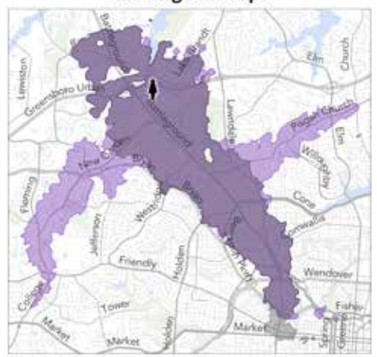
Ridership Concept



-1,000 (-10.0%) Jobs Reachable

-1,200 (-7.5%) Residents Reachable

Coverage Concept



+3,200 (+30.5%) Jobs Reachable

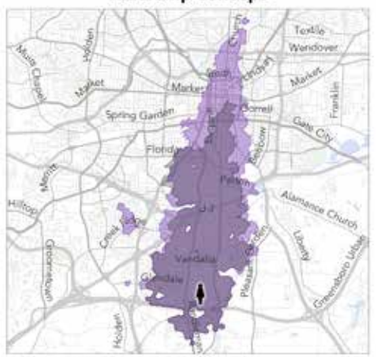
+6,400 (+39.5%) Residents Reachable

How far I can travel in **45 minutes** from

Walmart Elmsley Drive

on weekdays at noon using the:

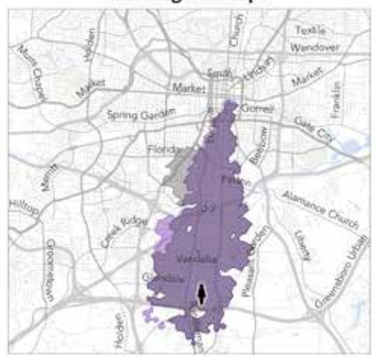
Ridership Concept



+22,100 (+180.5%) Jobs Reachable

+10,400 (+55.5%) Residents Reachable

Coverage Concept



+200 (+1.5%) Jobs Reachable

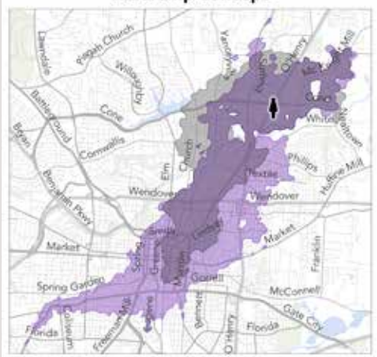
-900 (-4.5%) Residents Reachable

How far I can travel in **45 minutes** from

Walmart Sixteenth Street

on weekdays at noon using the:

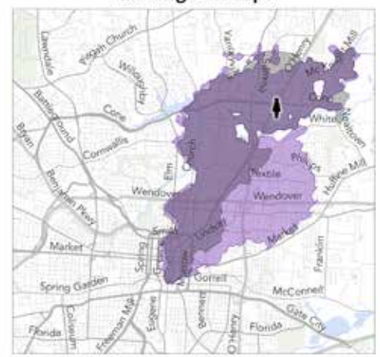
Ridership Concept



+20,000 (+116.0%) Jobs Reachable

+13,000 (+79.5%) Residents Reachable

Coverage Concept



+9,500 (+54.5%) Jobs Reachable

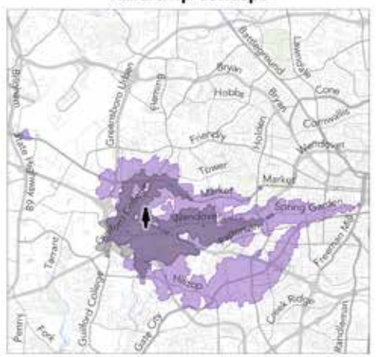
+9,500 (+58.5%) Residents Reachable

How far I can travel in **45 minutes** from

Walmart Wendover Avenue

on weekdays at noon using the:

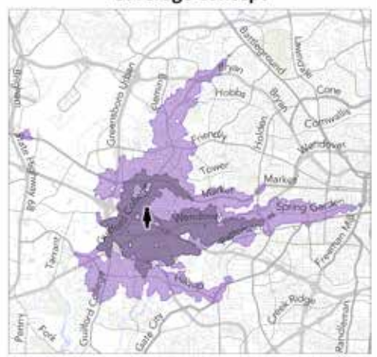
Ridership Concept



+15,000 (+120.5%) Jobs Reachable

+25,700 (+230.0%) Residents Reachable

Coverage Concept



+15,000 (+120.5%) Jobs Reachable

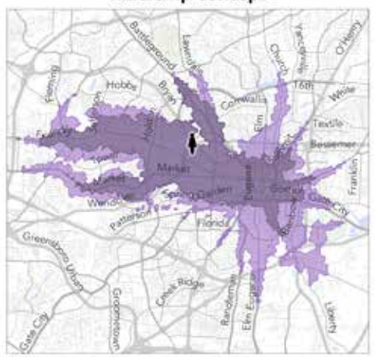
+28,600 (+256.0%) Residents Reachable

How far I can travel in **45 minutes** from

Wesley Long Hospital

on weekdays at noon using the:

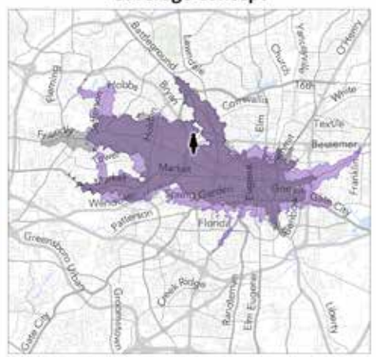
Ridership Concept



+20,000 (+50.5%) Jobs Reachable

+30,500 (+80.5%) Residents Reachable

Coverage Concept



+4,900 (+12.5%) Jobs Reachable

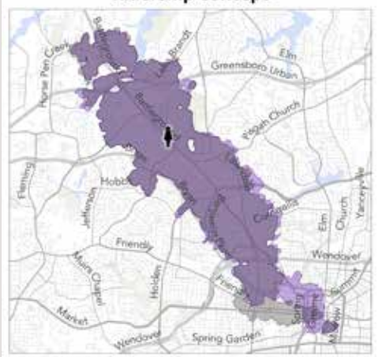
+10,200 (+27.0%) Residents Reachable

How far I can travel in **45 minutes** from

Westridge Square

on weekdays at noon using the:

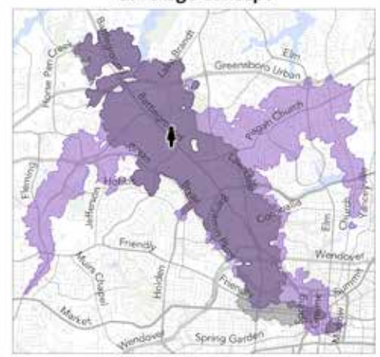
Ridership Concept



+6,800 (+38.5%) Jobs Reachable

-600 (-2.5%) Residents Reachable

Coverage Concept



+16,800 (+95.0%) Jobs Reachable

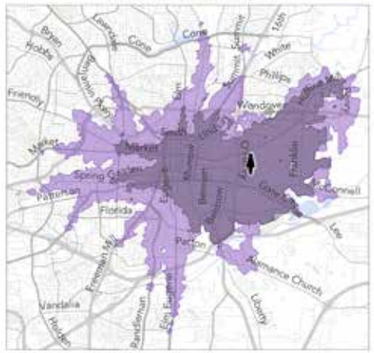
+14,500 (+68.5%) Residents Reachable

How far I can travel in **45 minutes** from

Willow Oaks

on weekdays at noon using the:

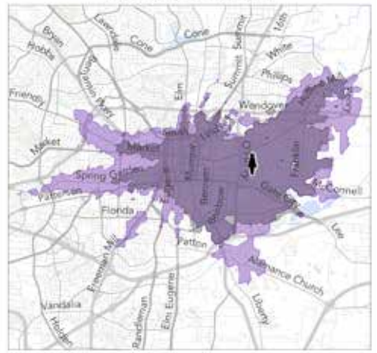
Ridership Concept



+26,200 (+90.0%) Jobs Reachable

+27,700 (+85.0%) Residents Reachable

Coverage Concept



+9,800 (+33.5%) Jobs Reachable

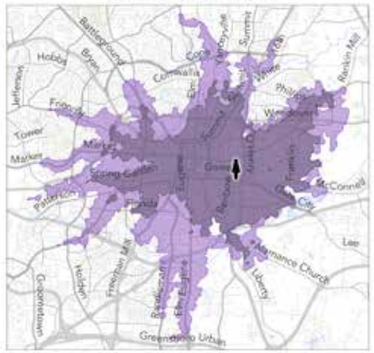
+16,200 (+50.0%) Residents Reachable

How far I can travel in **45 minutes** from

Windsor Recreation Center

on weekdays at noon using the:

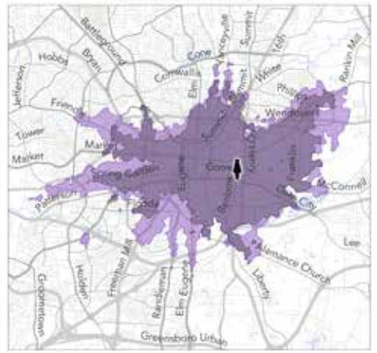
Ridership Concept



+23,200 (+48.5%) Jobs Reachable

+33,000 (+70.0%) Residents Reachable

Coverage Concept



+7,500 (+15.5%) Jobs Reachable

+16,100 (+34.0%) Residents Reachable

Appendix B: Summary of Past Plans

Summary of Past Plans

Understanding what has been planned for GTA and the current policies guiding network design is critical to planning for its future. As part of the analysis of existing conditions for GoBORO, we examined several past and current plans that relate to transit service, network design, and other related elements. Key takeaways from these plans are summarized here.

Mobility Greensboro 2040 (2018)

This plan provided short-term and long-term recommendations for the GTA network with the primary goals of increasing ridership and efficient use of resources. The plan includes two horizons: a short-term network with about 8% more resources and the long-term 2040 network with about 138% more resources.

GSO 2040 (2020)

This is a comprehensive long-range vision plan for the City of Greensboro, which includes land use, transportation, economic development, and capital improvement plans. The framework is organized along "Six Big Ideas", with associated goals and strategies for implementation. **Becoming Car Optional** is the idea most closely linked to the vision for GTA, and is the direct inspiration behind GoBORO. The idea **Filling in Our Framework** focuses on goals and strategies that build towards dense, walkable, mixed-use development to support car-optional travel by in-filling vacant or derelict properties.

2045 Metropolitan Transportation Plan (2020) and Congestion Management Process (2020)

The 2045 Metropolitan Transportation Plan (MTP) summarizes and complements several previous transportation plans (including both the plans above), with a broad vision and nine key goals. **Improving people's access and mobility** and **expanding non-car travel opportunities** are goals that specifically echo the previous two plans' goals. The MTP includes several transit performance measures that are laid out in the Congestion Management Process (CMP). These are organized into four objectives, one of which is to Increase Ridership, which echoes the goals of the MG 2040 plan. Building on the MG 2040 plan recommendations, the MTP includes three recommended plans for the GTA network: 2025, 2035, and 2045. These networks have about 34%, 126%, and 165% more operating resources, respectively.

Housing GSO (2020)

Housing GSO is a 10-year plan to guide the City of Greensboro's investment in affordable housing. The plan's goal of **Affordable Rental Homes** focuses on locating affordable housing in "Areas of Opportunity". The goal of **Reinvesting in Neighborhoods** recommends that the City focus its efforts and resources in specific neighborhoods, instead of spreading these efforts across the area. Both of these sets of recommendations affect priorities for transit network design.

GTA ADA Operational Analysis (2022)

This plan reviews GTA's ADA operations, and policies and outlines and prioritizes several recommendation action items along four focus areas: operations, eligibility, resources, and public involvement. It is important to note that **GoBORO is not a plan for ADA service, but for general public transit service.** The coverage of the general public service usually determines the *minimum* eligibility area for ADA service. We have not made specific ADA assumptions, but do assume some increase in funds to operate ADA service as part of this plan.

Bicycle, Pedestrian, Trails & Greenways Plan Updates (2015, 2018, 2023)

This plan includes chapters dedicated to cycling, pedestrian, and greenway infrastructure detail existing conditions, toolboxes of solutions, and recommendations for each component of the non-motorized network. The goals of the study are spread across five themes, one of which is Mobility. Pedestrian and bike infrastructure and their relation to transit, the street network, and land use, are all important considerations when thinking about multimodal connections and non-car travel options. **Transit delivers people to their destinations as pedestrians (and bicyclists).**

GTA Zero Emission Fleet Transition Plan (Draft, 2023)

This plan outlines a long-term fleet management plan for the electrification of GTA's bus and paratransit fleet. Because electric buses with their current technology cannot run as far as diesel buses and need a long time to charge, you need to send them back to charge after completing fewer trips, and they have to stay there for a long time. This means that you need more buses to make sure you can provide a certain service level. In this way, the electrification of buses has an indirect effect on transit service. The fleet transition plan is currently in development and will be informed by the two Concept Networks that are presented in this report.

Appendix C: Latent Demand Analysis

Where is There Latent Demand?

Before designing the Network Concepts in this report, we examined specific parts of Greensboro and the potential of expanded or improved transit services in each of those parts, which could likely to generate relatively high ridership relative to cost.

Taking into account overlapping indicators of demand, we can see patterns in each area where additional transit investment is likely to generate significant ridership, compared to existing service.

To be clear, **these transit investments are not likely to pay for themselves through additional fare revenues.** There are almost no examples of transit services in mid-sized communities where transit fare revenues fully cover the cost of operations. Similarly there are very few examples of road expansions or extensions that pay for themselves.

The maps and images on each page help to understand the distribution of latent demand in that area. The satellite map illustrates two ingredients of the ridership recipe: linearity and walkability. The activity density map shows the other three ingredients: density, mix of uses, and proximity. The transit map shows the amount of service provided.

This analysis was just one part of a suite of tools that was used in designing the Ridership and Coverage Concepts. The process of designing these Concepts involved several hours of deliberation involving the staff members from the City of Greensboro and GTA in addition to the consulting team.

Focusing on Areas of High Demand

At the beginning of Chapter 2, we outlined how transit can serve many goals but that these goals conflict with each other.

Some of these goals are only served if many people use transit. For example, transit can only mitigate congestion and pollution if many people ride the bus rather than drive. We call such goals "ridership goals" because they are achieved through high ridership.

Other goals are served by the simple presence of transit. A bus route through a neighborhood provides residents insurance against isolation. A route may fulfill political or social obligations, for example by getting service close to every taxpayer or into every council district. We call these types of goals "coverage goals" because they are achieved in large part by covering geographic areas with service, rather than by high ridership.

We discussed on page 9 how all transit agencies must balance the competing goals of high ridership and extensive coverage. Within a limited budget, if an agency wants to do more of one, it must do less of the other.

This appendix is about where GTA may want to invest in additional service IF the goal is high ridership.

Is Existing Transit Service Enough?

Many of the areas we've identified as areas of latent demand already have some form of transit service but not all transit is equal in usefulness.

Some routes drive relatively direct paths, while other have many deviations or loops which reduce their usefulness to through-riders. Most lines currently run every 30 minutes, while some only run every 60. Frequency is invisible and easy to forget, but on transit it is often the most important factor determining where you can get to in a given amount of time.

In the areas highlighted in this appendix, it is likely that frequency improvements and route design changes have strong potential to attract higher ridership relative to cost.

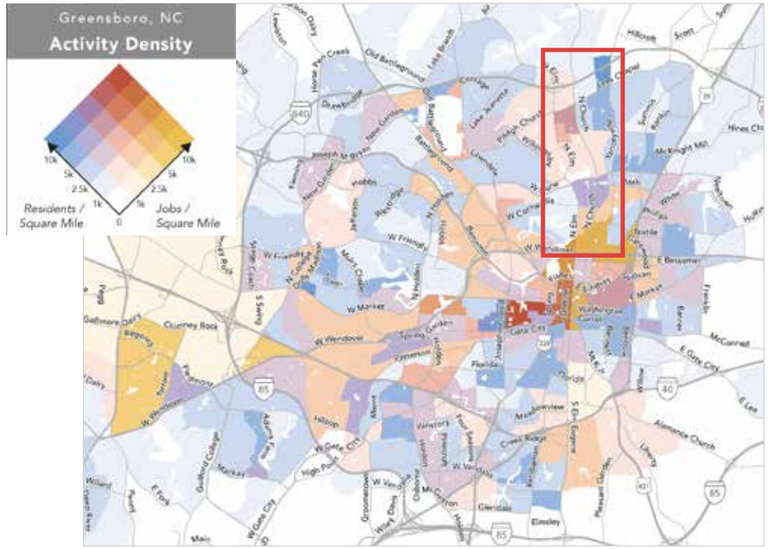
New Routes Where There Is Currently No Service

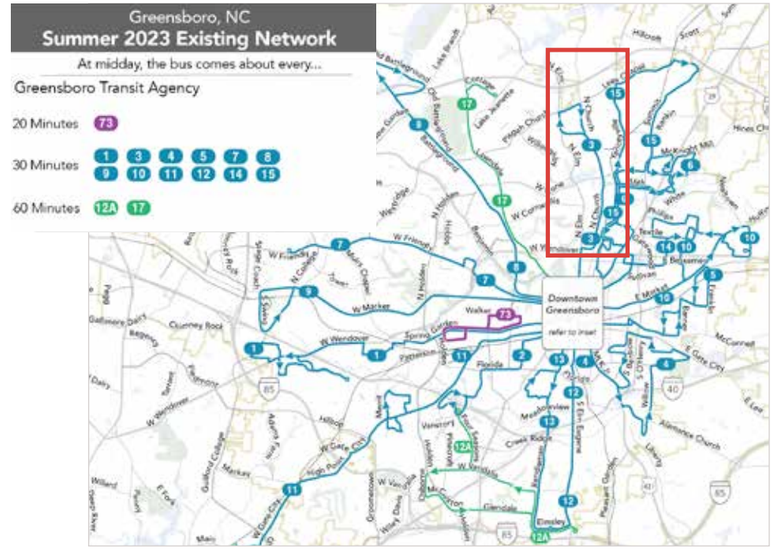
The existing transit network spreads service out throughout many parts of the city, and as a result, it spreads it thin. A service expansion strategy that focuses on areas with high latent demand would likely result in a lot more frequent service in areas currently already served by transit.

The region is growing, and some of that growth is horizontal, meaning it is stretching out into rural and undeveloped areas. Some new residents and jobs are being located farther from city centers, in areas that are beyond the reach of the existing transit network. In some of these cases, where there are many overlapping indicators of demand, we discuss how new service might attract high ridership relative to cost.

Latent Demand in Northern Greensboro

This is the area surrounding North Elm and Church Streets, and the outer parts of Yanceyville Street, and roughly enclosed by Wendover Avenue on the South, Amtrak/Norfolk Southern tracks on the East, and I-840 on the North.





Linearity: Medium to High

North Elm and Church Streets are major north-south arterial streets and provide logical linear patterns along each of them. However, they are spaced quite close: up to half a mile apart in many spots. This creates trade-offs while designing a single, linear bus route for this area, as both streets have considerable development. In the outer part, Pisgah Church Road, Lees Chapel Road, and Yanceyville Street make a relatively linear path for a transit route.

Connectivity: Medium

Along Elm and Church Streets, there are many cross streets forming a well-connected grid, with some developments having winding street patterns and cul-de-sacs. Connectivity is lower along Lees Chapel Road and Yanceyville street, with developments branching off of these arterial roads but no connections across them.

Imagery ©2023 Google, Imagery ©2023 Maxar Technologies, U.S. Geological Survey, USDA/FPAC/GEO, Map data ©2023

Density: Medium

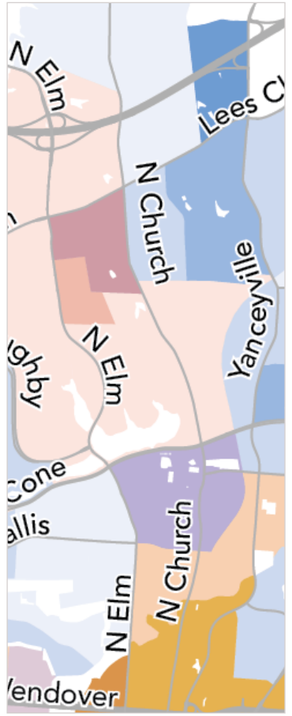
This area has a mix of single-family housing and apartment complexes. There are many jobs in the Moses H. Cone Hospital and in retail centers along Cornwallis Drive and Pisgah Church Road. Elm and Church Streets have some retail, commercial, and office buildings.

Mix of Uses: Medium to High

This area has a mixture of residential and commercial areas, with moderate density, signified by the purple and red areas in the activity density map at right, and is connected to employment areas in yellow.

Proximity: Medium to High

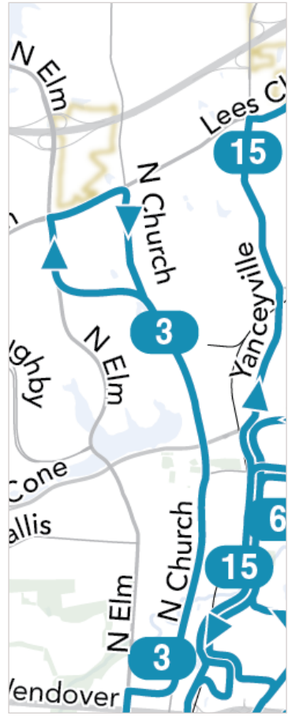
There are a few gaps between moderately dense areas. The southern end of this area is very close to Fisher Park and Downtown.



Potential Useful Service

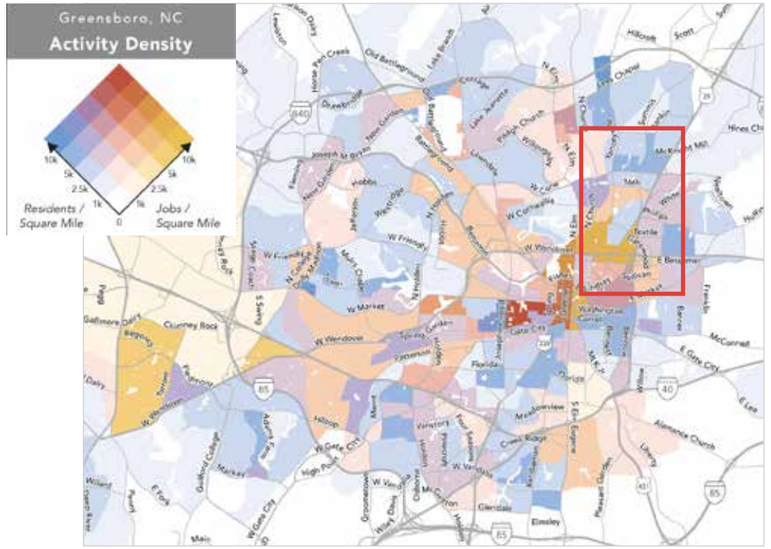
At present this area is served by Route 3, which mostly runs along Church Street. This is already a very useful, linear path. Extending a north-south route in this area along Lees Chapel Road up to Blackthorn or even Summit View Apartments could link those dense residential complexes to the many retail and office jobs in this area.

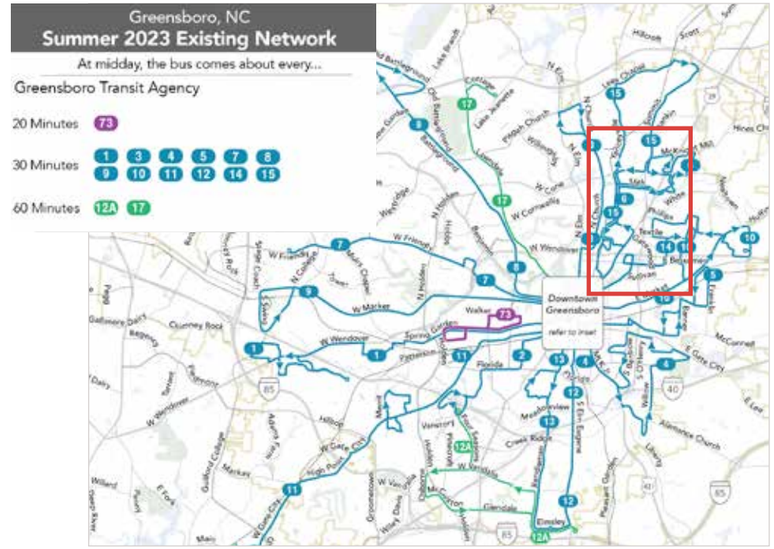
Increasing the frequency of such a route to every 15 minutes could make it significantly more useful to the people and jobs which are closer to Elm Street than to Church Street.



Latent Demand in Northeastern Greensboro

This is the area surrounding Yanceyville Street and Summit Avenue, as far north as Rankin Road, and roughly enclosed by Murrow Boulevard to the Southeast, Amtrak/Norfolk Southern tracks to the West, and Lindsay Street and US-29 to the East.





Linearity: Medium

Yanceyville Street and Summit Avenue are major north-south arterial streets and provide logical linear patterns along each of them. They have major destinations and activity, but those destinations are not consistently along one corridor. Major destinations are along Summit until Wendover Avenue, then Yanceyville up to Cone Boulevard, and then Summit again. This makes it hard to design a single linear bus route in this area.

Connectivity: Medium

There are many cross streets and a grid network as far north as Spry Street, with some obstructions like power lines and North Buffalo Creek. Revolution Mill, Printworks Mill, and the Sixteenth Street Walmart are major destinations with poor connectivity.

Density: Low to Medium

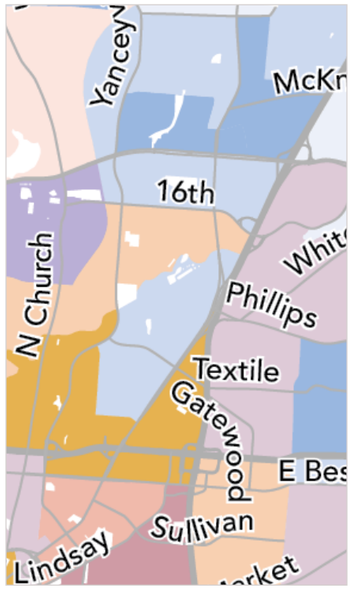
This area has some apartment complexes but a large proportion of single family housing relative to them. Other than the dense concentration of jobs in the south-western part of this area, there is not much job density beyond Revolution Mill.

Mix of Uses: Low to Medium

There are almost no dense red/purple/orange areas except south of Sullivan Street, and specific developments like Revolution Mill.

Proximity: Medium

Between Downtown/Murrow Boulevard and Revolution Mill, centers of activity are spaced quite close. Beyond that, there are large gaps between major destinations like shopping centers and apartment complexes.

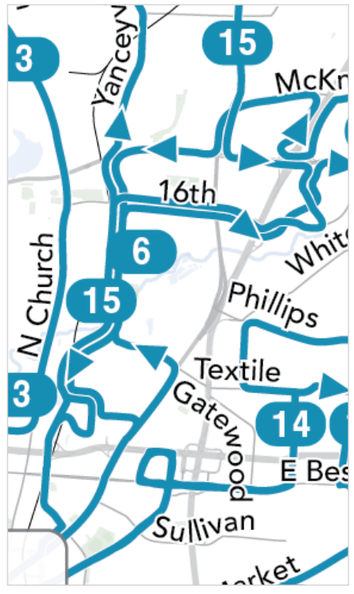


Potential Useful Service

Resources for this area are split between Routes 6 and to 15 serve this area. Route 6 is one of the more productive GTA routes. These routes overlap and have large one-way loops and mid-route splits.

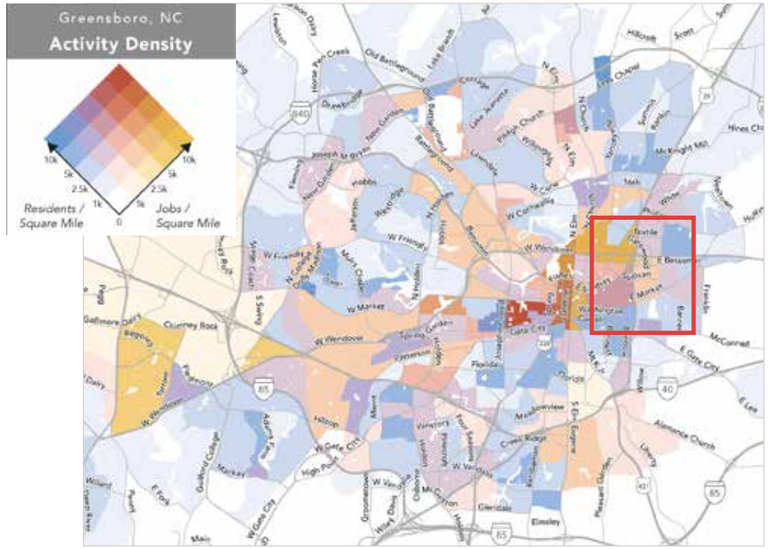
Compared to this structure, a frequent, relatively linear service in this area, at least as far north as Revolution Mill, could provide more useful service. It would require only modest additional resources compared to the existing route structure here.

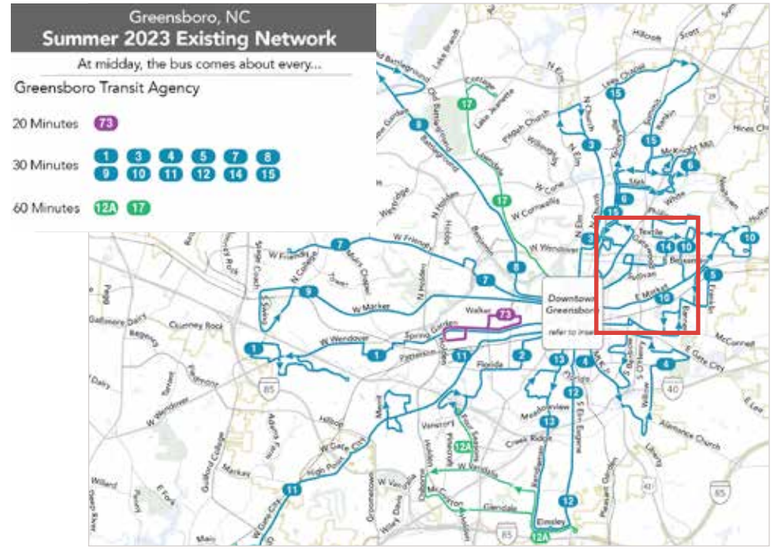
North of Cone Boulevard, the lack of proximity of key destinations like apartment complexes and shopping centers presents a significant challenge in providing a useful, linear route.



Latent Demand in Eastern Greensboro

This is the area East of Murrow Boulevard, and surrounded by Muddy Creek to the North and East Gate City Boulevard to the South.





Linearity: Low to Medium

There are many arterial streets crisscrossing this area which provide for potential direct, linear routes. However, development and major destinations in this area are scattered across the area, and not particularly connected in a linear manner. This makes it hard to concentrate service on fewer, more direct paths.

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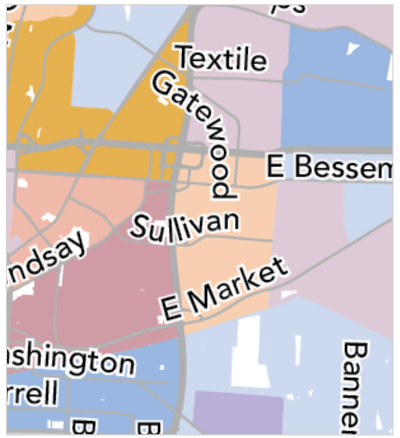
Connectivity: Medium to High

The street network in this area is generally well-connected. There are several cross-connecting streets and arterial roads, and few cul-de-sacs. Various creeks, US-29, Wendover Avenue, and the Amtrak/Norfolk Southern tracks have lower street connectivity around them.

Density: Medium to High

There are several apartment complexes and affordable housing communities in this area, which leads to a higher residential density, particularly of those with low incomes and not owning cars. NCA&T and Bennett College on the western side have a lot of jobs, with smaller concentrations of jobs along Bessemer Avenue and Burlington Road.



Mix of Uses: Medium

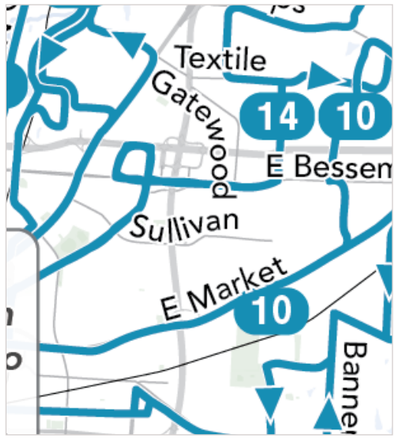
The area close to NCA&T is dense with jobs and residents, but other areas either have mostly housing, or mostly retail, or industry. They are also hard to connect in useful, linear patterns.

Proximity: Low

The centers of population and job density have significant gaps between them. This is especially the case in the outer parts, where places like GTCC Greensboro and Gateway Research Park are very distant from most other dense places in this area.

Potential Useful Service

The transit network in this area is complicated and tries to connect several centers of activity which are distributed in a non-linear pattern.

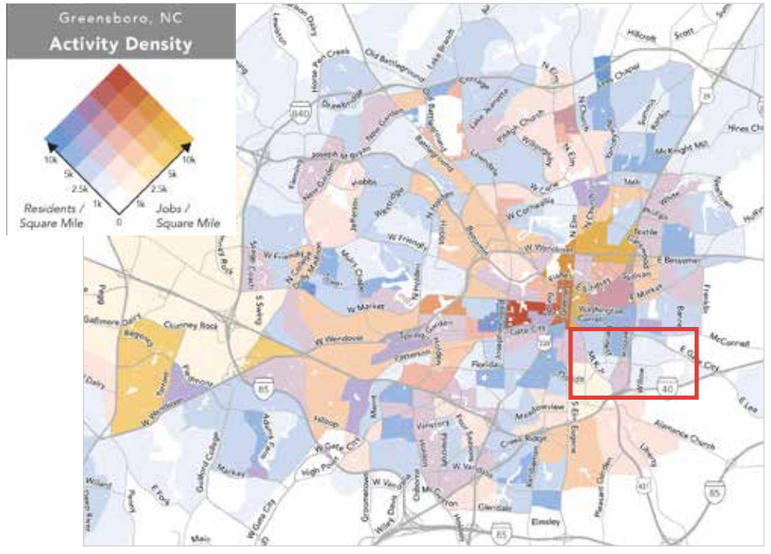


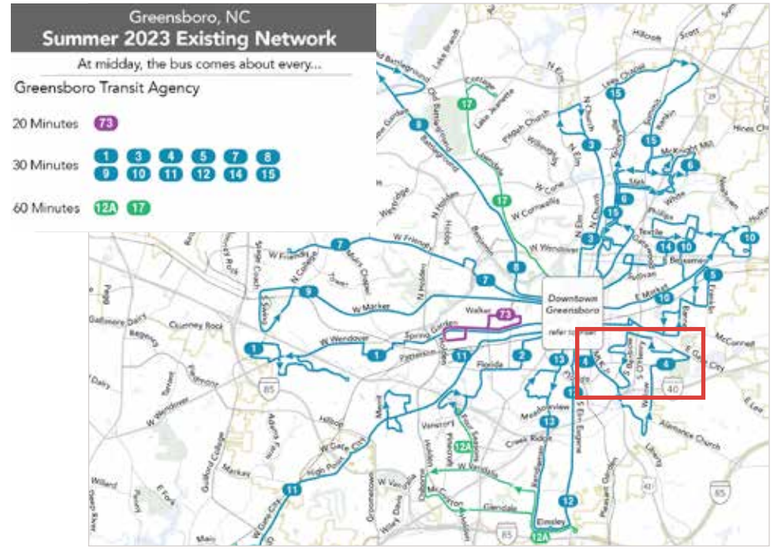
In a scenario with lots of resources for transit, many connections could be achieved by a network of frequent and linear intersecting routes: radial routes to and from downtown, and orbital routes running on the north-south streets like Benbow Road or English Street. Such a network of high-frequency radial and orbital routes with short waiting times for transfers can be extremely effective in providing useful connections without going into Downtown.

Orbital routes at low frequency are often used as a coverage tool, but in a low-frequency radial-orbital network, timed transfers are essential to provide some degree of useful service. These timed transfers can be extremely challenging to coordinate at every transfer point. That presents trade-offs for which transfers in a network are to be prioritized over others.

Latent Demand in Southeastern Greensboro

This is the area East of South Elm Street, and surrounded by East Gate City Boulevard to the North and South Buffalo Creek and I-40 to the South.





Linearity: Medium to High

There is not much density of development in this area, but activity centers like schools, apartments, and retail establishments are mostly located along linear arterial roads. The exception is Kindred Hospital, which is around a quarter mile away from Martin Luther King Jr. Drive.

Connectivity: High

The street network in this area is well-connected. There are several cross-connecting streets and arterial roads, and few cul-de-sacs. US-29 is the only major impediment to connectivity.

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Density: Low

Other that Ray Warren Homes and small apartments, this area mostly has single-family housing. There are also few job centers other than Kindred Hospital, and the Walmart across I-40.

Mix of Uses: Low

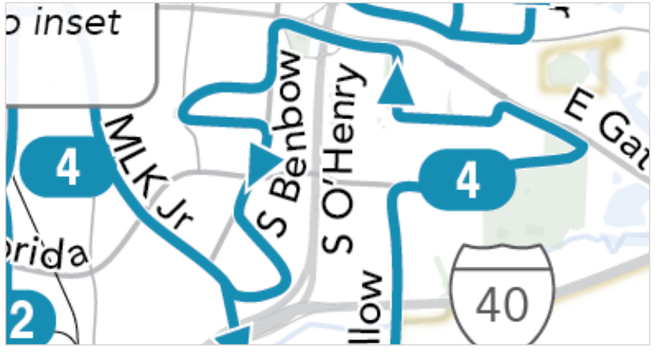
This area is predominantly residential.

Proximity: Low

The major centers of activity have large gaps between them. Jobs in Downtown and South Elm-Eugene Street are quite far from most places in this area.

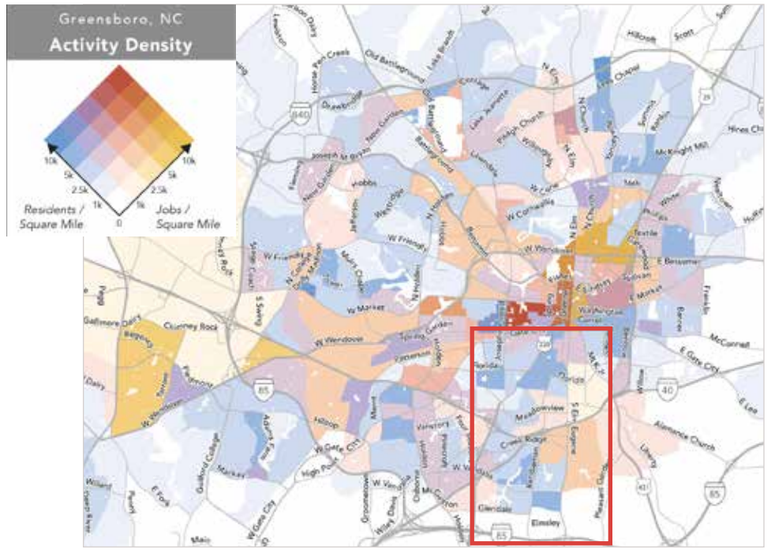
Potential Useful Service

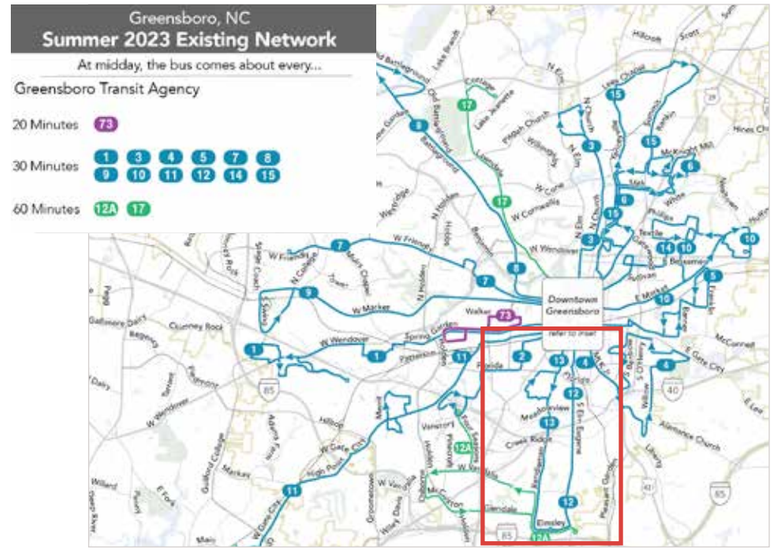
While this area has good linearity and connectivity, the low density and mix of uses means that, compared to other areas, transit investments here will serve fewer people or jobs, on average. The large one-way loop on Route 4 effectively makes it a local circulator and Downtown connector route. A revised design in this area would look at ways to provide more direct and less circuitous service to and from downtown. Additionally, a potentially useful orbital route from the eastern parts of Greensboro (described on the previous page) along Benbow Road could connect residents of this area to jobs to the north. This could also be linked to an orbital pattern along Florida Street to provide connections to the many jobs along West Gate City Boulevard.



Latent Demand in Southern Greensboro

This is the area South of Gate City Boulevard, and surrounded by Freeman Mil Road to the West and South Buffalo Creek and South Elm Street and the Amtrak/Norfolk Southern tracks to the East.





Linearity: Medium to High

South of Florida Street, South Elm-Eugene Street and Randleman Road are major north-south arterial streets. There is generally more intense development along Randleman Road compared to South Elm-Eugene Street, so it is likely a better candidate for a frequent, linear route.

Between Gate City Boulevard and Florida Street, Randleman Road is not suitable for transit. South Elm Street, South Eugene Street, and Ashe Street are spaced very close to each other.

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Connectivity: Low to Medium

There are many cross streets between the north-south arterials closer towards Downtown, but beyond that, many areas have large blocks with fewer intersections and winding, disconnected street patterns with many cul-de-sacs.

Density: Medium

This area has many dense housing developments with affordable housing and apartment complexes close to arterial roads, but also large areas of single-family housing. There are many industrial jobs close to I-40, but are spread out across a large area. The arterial roads also have significant concentrations of retail jobs.

Mix of Uses: Medium

There is a significant mix of residents and jobs along the arterial roads, although areas on a whole are predominantly residential or job-heavy.

Proximity: Medium to High

Along Randleman Road and South Elm and Eugene Streets, there is a pattern of continuous development with very few gaps. Many dense activity centers are within 1,000 feet of these roads.

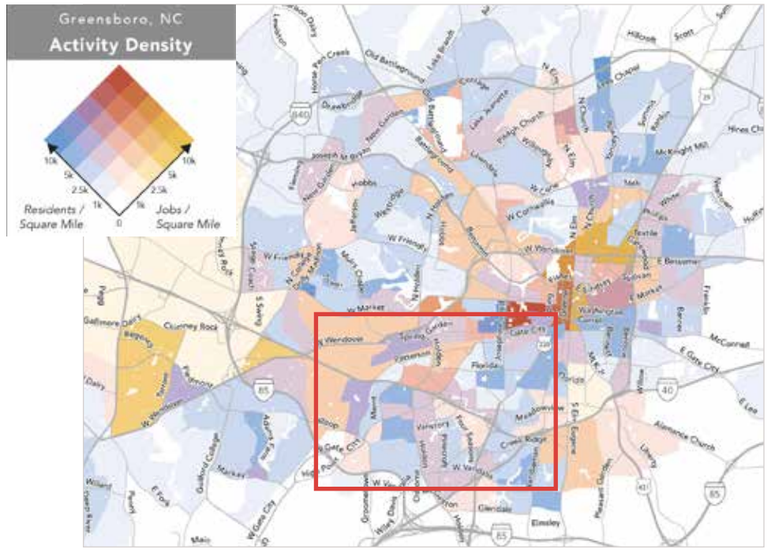
Potential Useful Service

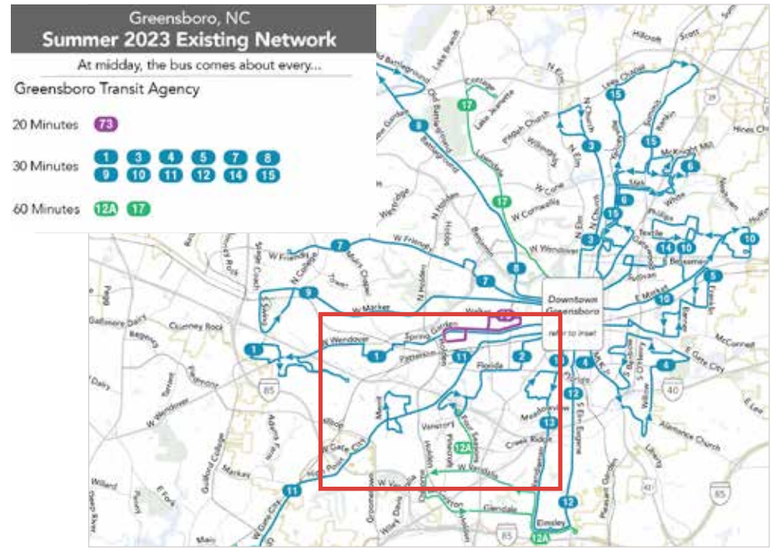
Routes 12 and 13 already provide substantially linear service in this area. Route 13 is the most productive GTA route, and has potential for even more useful service, and higher ridership, if it were more frequent.

The one-way split on Route 13 near Smith Homes reflects a coverage choice for getting service close to residents there. However, most parts of Smith Homes are at most a 10-minute walk from Randleman Road. With substantial frequency improvement along Randleman Road, this area can get direct, two-way service with reduced waiting with a slightly longer walk.

Latent Demand in Southwestern Greensboro

This is the area West of Freeman Mill Road, surrounded by Amtrak/Norfolk Southern tracks on the North and East.





Linearity: Low to Medium

West Gate City Boulevard is the primary linear arterial road and has significant jobs and residents surrounding it. However, many activity centers like apartment complexes, shopping centers, and government offices are quite far away from it, and require deviations to serve them. Fairfax Road has apartments and industrial jobs, but is not connected to other activity centers. Similarly, Patterson Street has industrial jobs, but is not connected to many residents. Other arterial roads like Holden Road and Florida Street have much less surrounding activity.

Connectivity: Low to Medium

There are many arterial roads across this area and that provide connectivity, but especially near and beyond I-40, the local street pattern is disconnected. Streets are better connected closer to Downtown.

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Density: Medium

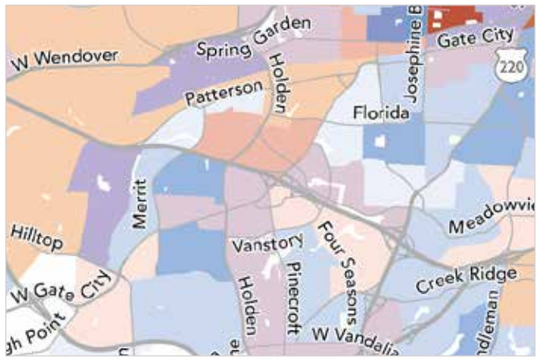
This area has many apartment complexes and job centers close to West Gate City Boulevard, but also has large swaths of single-family housing. There are many industrial jobs along Patterson Street which are spread out across a large area.

Mix of Uses: Medium

West Gate City Boulevard has a significantly dense mix of residents and jobs close to it. Fairfax Road also has residents on one side and industrial jobs on the other, but industrial job centers do not generate as much all-day two-way demand for transit. Other areas are predominantly residential or job-heavy, but are hard to connect in useful, linear patterns.

Proximity: Low to Medium

West Gate City Boulevard has almost continuous development up to I-73. Other activity centers, however, are quite distant. GTCC Jamestown is a major destination along West Gate City Boulevard for education and connections to High Point, but is very far from the densest developments in Greensboro.

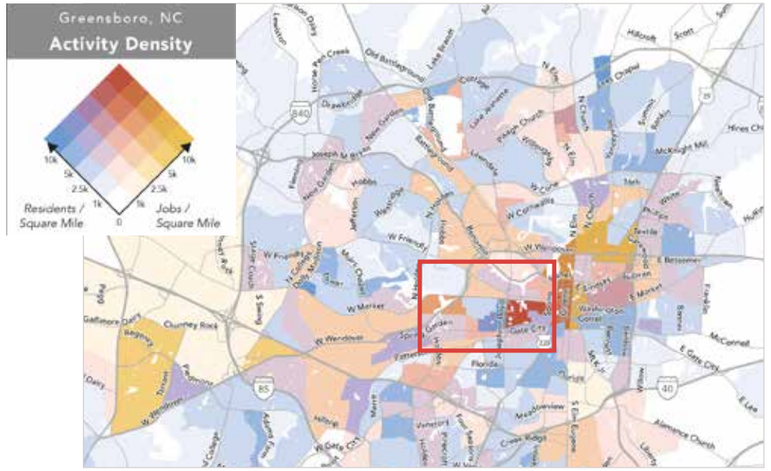


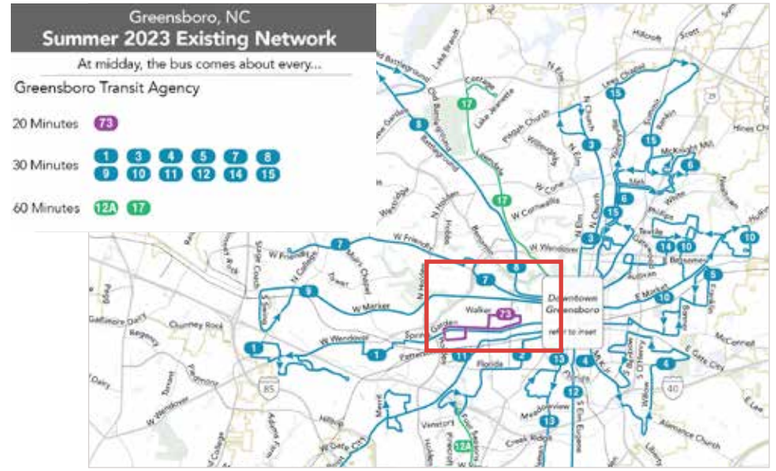
Potential Useful Service

Route 11 is the major linear route along West Gate City Boulevard with 30-minute frequency to GTCC during the day. A possibility of providing more useful service could be to alter the frequency so that the short segment between Merritt and Downtown is more frequent, and the long trips between GTCC and Downtown are hourly (but still timed to connect to High Point Transit Route 25 at GTCC). Route 2 is meant to provide coverage between West Gate City Boulevard and Florida Street. With more transit resources, a frequent orbital route centered along Florida Street could provide some useful connections across the southern parts of Greensboro.

Latent Demand in Inner Western Greensboro

This is the area West of Spring Street, and surrounded by North Buffalo Creek to the North and Northwest, Holden Road to the West, and Amtrak/Norfolk Southern tracks to the South. Friendly Center is a large retail center on the northwestern edge of this area.





Linearity: High

Spring Garden Street is a primary arterial road with a large concentration of development throughout its length in this area. West Friendly Avenue and Market Street are the other major linear corridors. Near Wendover Avenue, there are many jobs along West Friendly Avenue up to Josephine Boyd Street and then in the Friendly Center and the Wesley Long Hospital. Friendly Avenue and Market Street join at UNCG to form a one-way street couplet between UNCG and Downtown.

Connectivity: High

This area has an almost continuous street grid and high street connectivity. Closer to Wendover Avenue and North Buffalo Creek, there are larger blocks and some winding streets, but very few cul-de-sacs.

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Density: Medium to High

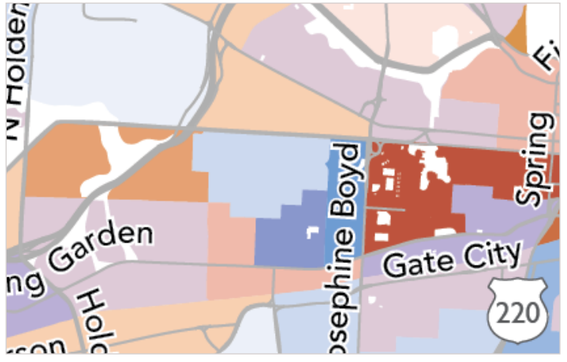
The area including and surrounding UNCG and Greensboro College has a very high density of residents as well as jobs. A lot of relatively dense development is focused along Spring Garden Street. Outside of these, housing is mostly single-family residences. Wesley Long Hospital is an important job center, but these jobs are spread out over a comparatively large area.

Mix of Uses: High

Close to UNCG and Greensboro College and along Spring Garden Street, there is a good mix of residents and jobs. Beyond these, the area is mostly residential with small retail centers.

Proximity: High

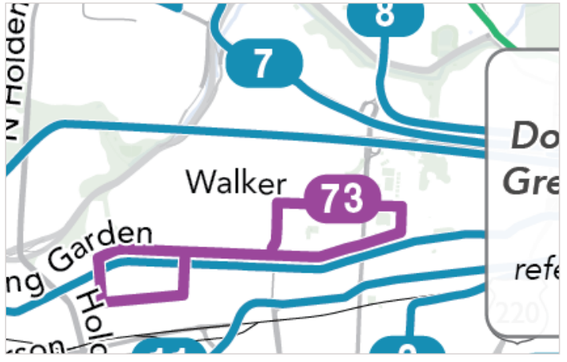
Spring Garden Street, the UNCG area, and Downtown have continuous density. West Friendly Avenue has a significant gap between Josephine Boyd Street and Wesley Long Hospital.



Potential Useful Service

This area already has very linear routes along Spring Garden Street, West Friendly Avenue and West Market Street. However, all these routes only have a frequency of every 30 minutes. This is one of Greensboro's densest and best-connected areas, and could be one of the best candidates for increased frequency for making service more useful.

The route along Spring Garden Street could have a frequency of at least every 15 minutes, between Downtown and Wendover Avenue. This would bring frequent transit to many residents and jobs as well as the two universities within a short walking distance of Spring Garden. On the western end, this route could potentially branch along the linear arterial roads, described on the next page.



Latent Demand in Outer Western Greensboro

This is the area surrounding the outer parts of West Friendly Avenue, Market Street, and Wendover Avenue which are beyond Holden Road, going as far West as the Greensboro Urban Loop.

Linearity: Low

West Friendly Avenue, Market Street, and Wendover Avenue are the primary East-West arterial streets. Market and Wendover have significant job centers along them, but many of these are big box stores, industries, and office parks, which require large deviations from the arterial roads to get close to. There are many people in apartment complexes which are also scattered throughout the area, often very far from these linear corridors.

Connectivity: Low to Medium

There are some cross-connecting streets between the network of arterial roads, but overall the street network in this area is quite disconnected. It consists of many winding roads and cul-de-sacs, especially in apartment complexes. There are many physical obstructions like freeways, railway tracks, and creeks which limit connectivity.

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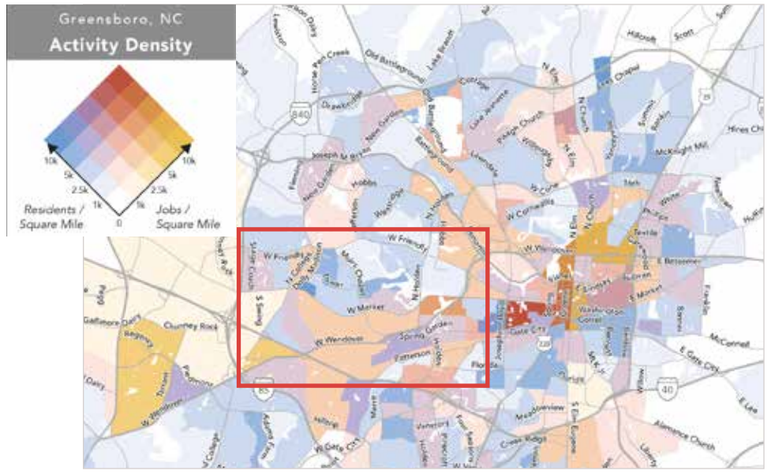


Density: Low to Medium

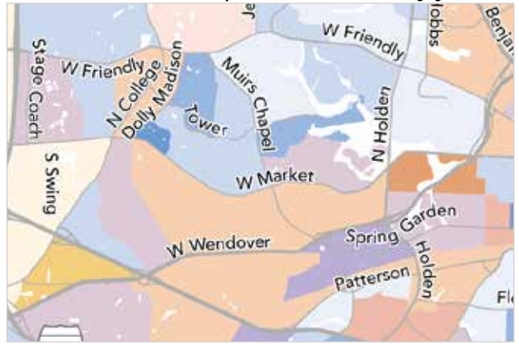
This area has a lot of jobs in retail centers, industries, and office parks, but they are almost entirely in car-oriented developments, which means these jobs are spread across a large area. Similarly, the many apartment complexes are quite expansive and scattered within large swaths of single-family housing.

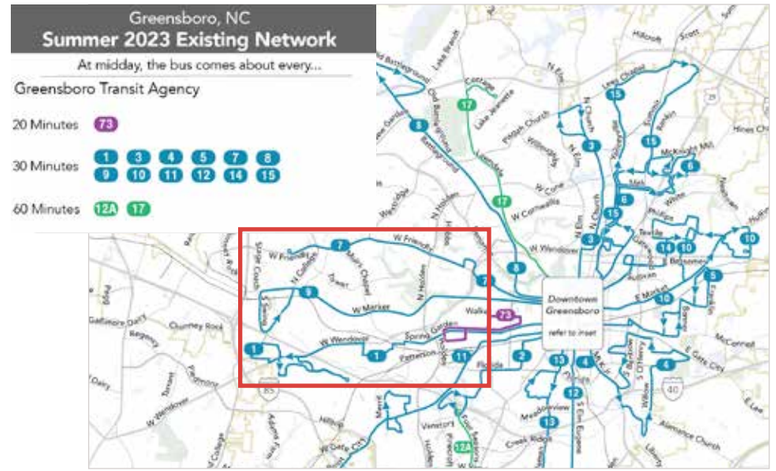
Mix of Uses: Medium

There are some places like the areas near Guilford College and Wendover Place Mall where many jobs and residents are located relatively close together. The arterial roads also connect predominantly residential areas to predominantly job-heavy areas.

Proximity: Low to Medium

West Wendover Avenue, and to a lesser extent, Market Street, have some degree of continuous development with many jobs and residents. Many of the apartments in this area are located very far from other development.





Potential Useful Service

At present, service is focused on the three radial corridors that connect to the core of Greensboro near Downtown.

There are many multi-family developments along Muirs Chapel road towards West Market Street. A more useful network design could have service on Muirs Chapel Road, connecting these apartments to the retail centers on Friendly and Market. Such a pattern could be a branch off of the frequent route along Spring Garden Street, discussed in the previous page.

The routes along Market and Wendover could also potentially be branches of a frequent route. This would connect the two universities directly to multiple apartments and retail destinations in the outer western side of Greensboro.

Latent Demand in Northwestern Greensboro

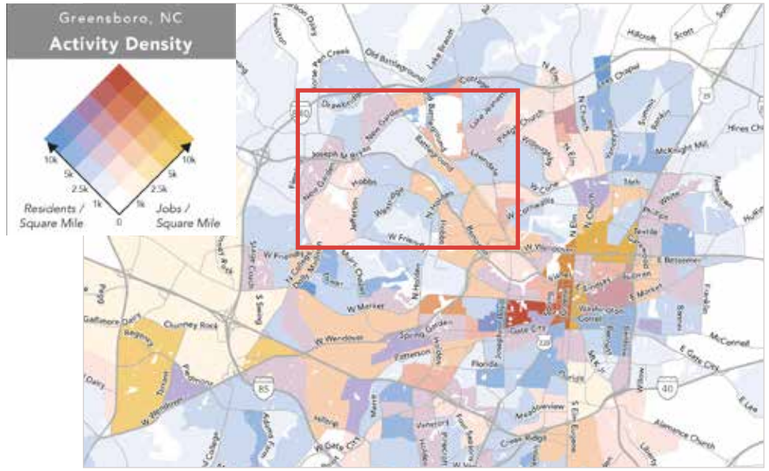
This is the area surrounding Hobbs Road, Joseph M. Bryan Boulevard, Battleground Avenue, and Lawndale Drive, about as far Northwest as the Greensboro Urban Loop and bounded on the Southwest by West Wendover Avenue.

Linearity: Medium

Battleground Avenue and Lawndale Drive are the two primary linear arterial roads with significant residents or jobs along them. Battleground has the comparatively higher intensity of development. Closer to Greensboro Urban Loop, there are many large apartment complexes and retail centers. Other than New Garden Road, these are often not connected in a linear manner.

Connectivity: Low to Medium

The street network in this area consists of many smaller areas with connected networks within them, but few connections outside to other areas. Connectivity across the area is mainly from the various larger and arterial roads. Closer to Downtown, there are more cross-connecting streets.



Density: Low

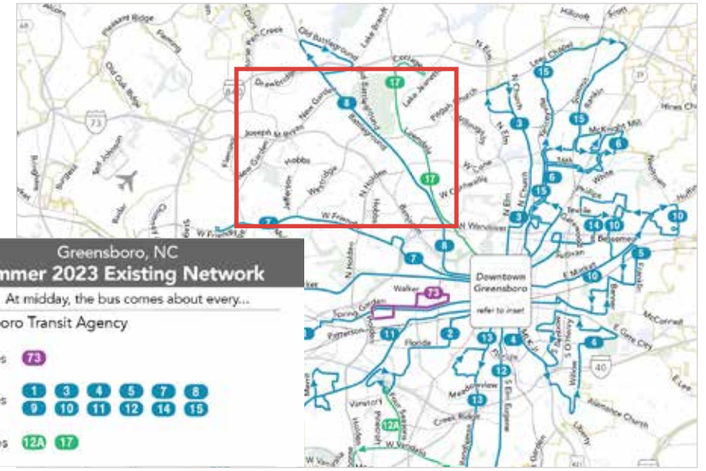
Beyond the apartment complexes and retail centers located closer in towards arterial roads, this area is mostly composed of low-density single-family housing.

Mix of Uses: Low to Medium

There are many retail jobs and some apartments close to Battleground Avenue, Lawndale Drive, and New Garden Road, but other than those corridors, most of this area is predominantly residential.

Proximity: Low to Medium

There are many gaps between pockets of higher density along all the arterial roads. Battleground Avenue, however, has a significantly large and continuous stretch of retail jobs.



Potential Useful Service

Routes 8 and 17 are both linear with service levels in line with the amount of development on them. In a scenario with significantly higher resources for transit, the frequency on Route 17 could be increased to at least every 30 minutes.

There is also potential for a local orbital service along New Garden Road, which could connect several retail centers, apartment complexes, and Guilford College. On the eastern side, this service could also connect to Pisgah Church/Lees Chapel Road, North Elm and Church Streets.