Memphis 3.0 Transit Vision Choices Report

SEPTEMBER 25, 2017

For Innovate Memphis and the City of Memphis

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1 Introduction and Summary

Introduction and Summary

What is the purpose of this report?

This Choices Report is the first step in the Memphis 3.0 Transit Vision. This plan is an outgrowth of the Memphis 3.0 comprehensive planning process and is being led by the City of Memphis and Innovate Memphis in partnership with the Memphis Area Transit Authority (MATA). This plan will do the following:

- Assess the existing transit network and the geometry of today's city;
- Engage the public, stakeholders and elected officials in a conversation about the goals of transit in Memphis;
- Develop recommendations for changing the transit network; and
- Consider the cost and financing options for improving transit in Memphis.

The Choices Report helps guide the Transit Vision, by *laying out relevant facts about transit and development in Memphis*, and by drawing the reader's attention to major choices that these facts force us to weigh.

What is the purpose of transit?

Transit can serve many different goals. But different people and communities value these goals differently. It is not usually possible to serve all of them well all the time.

Understanding which goals matter most in Memphis is a key step in developing the Memphis 3.0 Transit Vision.

Possible goals for transit include:

- **Economic**: transit can give businesses access to more workers, and workers access to more jobs. Transit can also help attract certain industries, new residents, tourists, or other economic contributors.
- **Environmental**: increased transit use can reduce air pollution and greenhouse gas emissions. Transit can also support more compact development and help conserve land.
- **Social**: transit can help meet the needs of people who are in various situations of disadvantage, providing lifeline access to services and jobs.
- **Health**: transit can be a tool to support physical activity by walking. This is partly because most riders walk to their bus stop, but also because riders will tend to walk more in between their transit trips.
- **Personal Liberty**: By providing people the ability to reach more places than they otherwise would, a transit system can be a tool for personal liberty, empowering people to make choices and fulfill their individual goals.

Some of these goals are served by high transit ridership. For example, the environmental benefits of transit only arise from many people riding the bus rather than driving. Subsidy per rider is lower when ridership is maximized. We call such goals "ridership goals" because they are achieved in part through high ridership.

Other goals are served by the mere presence of transit. A bus route through a neighborhood provides residents insurance against isolation, even if the route is infrequent, not very useful, and few people ride it. A route may fulfill political or social obligations, for example by getting service close to every taxpayer or into every political district. We call these types of goals "coverage goals" because they are achieved in part by covering geographic areas with service, regardless of ridership.

High ridership is not the only goal

If Memphis wanted to maximize transit ridership, it would focus its service only on routes useful to many potential riders. The City and MATA would be thinking like a business, focusing on places where its service is competitive for a large number of people.

Businesses are under no obligation to operate where they would spend a lot of money to reach few customers.

For example, McDonalds is under no obligation to provide a restaurant within 1/2 mile of everyone in Tennessee. If it were, then the company would have to add hundreds of additional locations, some serving just a handful of homes, and most operating at a loss because of the few customers nearby.

People understand that rural areas will naturally have fewer McDonalds locations than urban areas. We don't describe this as McDonalds being *unfair* to rural or suburban areas; they are just acting like a private business. McDonalds has no obligation to cover all areas with its restaurants.

Transit agencies are not private businesses, and most transit agencies decide that they do have some obligation to cover their service area. The elected 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.

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

Figure 1: Is an empty bus failing? That depends entirely on why you are running it in the first place.

Ridership and Coverage Goals Conflict

Ridership and coverage goals are both laudable, but they lead us in opposite directions. Within a fixed budget, if a transit 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 right, the little dots indicate dwellings and commercial buildings and other land uses The lines indicate roads. Most of the activity in the town is concentrated around a few roads, as in most towns

A transit agency pursuing only a 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 into fewer routes, frequency is high and a bus is always coming soon. This would result in a network like the one at bottom-left.

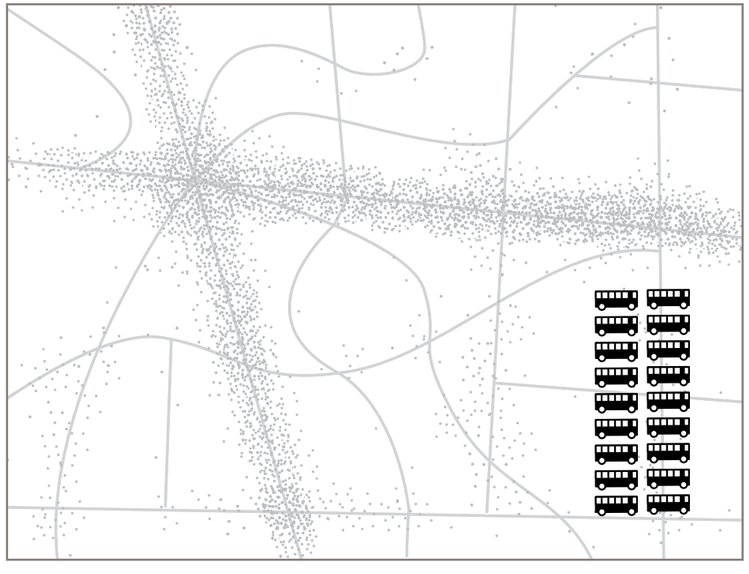
If the town were pursuing only a coverage goal, on the other hand, the transit agency would spread out services so that every street had a bus route, as in the network at bottom-right. As a result, all routes would be infrequent, even those on the main roads.

In these two scenarios, the town is using the same number of buses. These two networks cost the same amount to operate, but they deliver very different outcomes.

On a fixed budget, designing transit for both ridership and coverage is a zero-sum game. In the networks at right, each bus that the transit agency runs down a main road, to provide more frequent and competitive service in that market, is not running on the neighborhood streets, providing coverage. While an agency can pursue ridership and provide coverage within the same budget, it cannot 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. Networks offering high levels of coverage (like the MATA network in Memphis) are naturally more complex.

In this imaginary town, 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).



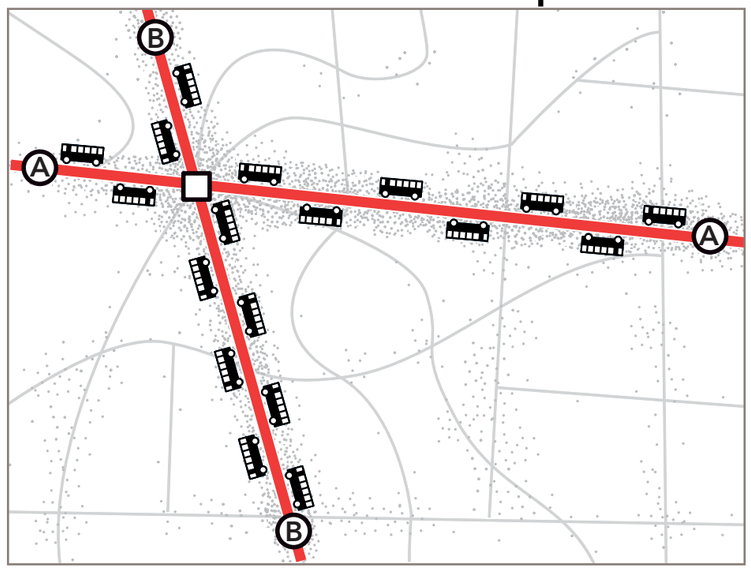
Imagine you are the transit planner for this fictional town.

The dots scattered around the map are people and jobs.

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

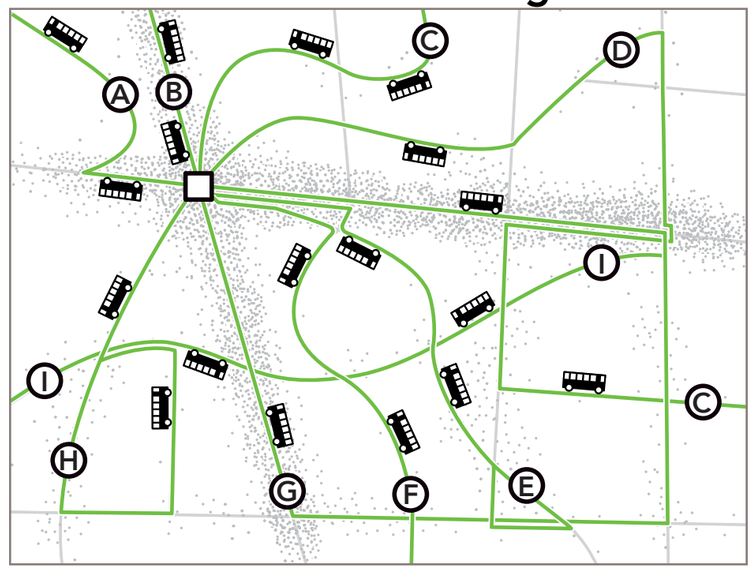
Before you can plan transit routes, you must first decide: What is the purpose of your transit system?

Maximum Ridership



All 18 buses are focused on the busiest areas. 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.

Maximum 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 2: Ridership and coverage goals, both laudable, are in direct conflict within a fixed budget.

A Cycle of Decline

Memphis is experiencing a slow-moving self-reinforcing decline in transit, which could be called a vicious cycle of declining ridership and service. The danger is that, if it is not halted, transit will ***decline into irrelevancy***. (Memphis is not the only city that has experienced this.)

We can see evidence of this cycle in the levels of ridership and service hours (Figure 3 at right). From 2005 to 2015, MATA cut service by 22% and ridership fell by 28%. The contributors to this process include:

- ***Residential and job growth.*** The region has grown slowly in population and jobs but more quickly in developed land area. Most new developments are far away from the transit network and from each other.
  - Triggered by population increases, Memphis crosses a threshold into a category of larger regions, and MATA starts receiving less federal funding.[1]
  - Meanwhile, new development areas are much more expensive to serve with transit, because they are lower density and far away.
  - Service is cut, frequencies are reduced so that routes can be lengthened, and ridership drops predictably.
- *Cost increases*. The costs to MATA of delivering each hour of transit service has increased. Federal, State and City contributions have, in most years, not kept up with inflation.
  - MATA is able to put less service on the street, and ridership drops predictably.
- *Federal funding cuts.* MATA's share of federal funding has been reduced because ridership has dropped so much.
  - Service is cut, and ridership drops again, predictably.
- *Development continues away from the existing network.* Because the transit network is useful to fewer and fewer people, there has been no incentive for developers and businesses to locate on it.
  - More growth happens in places that are hard to serve with useful transit.
- *And so on.*

1. After the 2010 Census the population of the Memphis Urbanized Area increased above 1 million people. Under the Federal Transit Administration funding formulas for its Section 5307 programs, all urban areas are split into two groups, those over and under 1 million for part of the funding formula. By crossing the threshold of 1 million people, Memphis is now rated in comparison to much larger regions for this program. The formula rewards areas with more transit investment, higher populations and higher densities. Therefore, Memphis is rated relatively low among its new competition in the higher category.

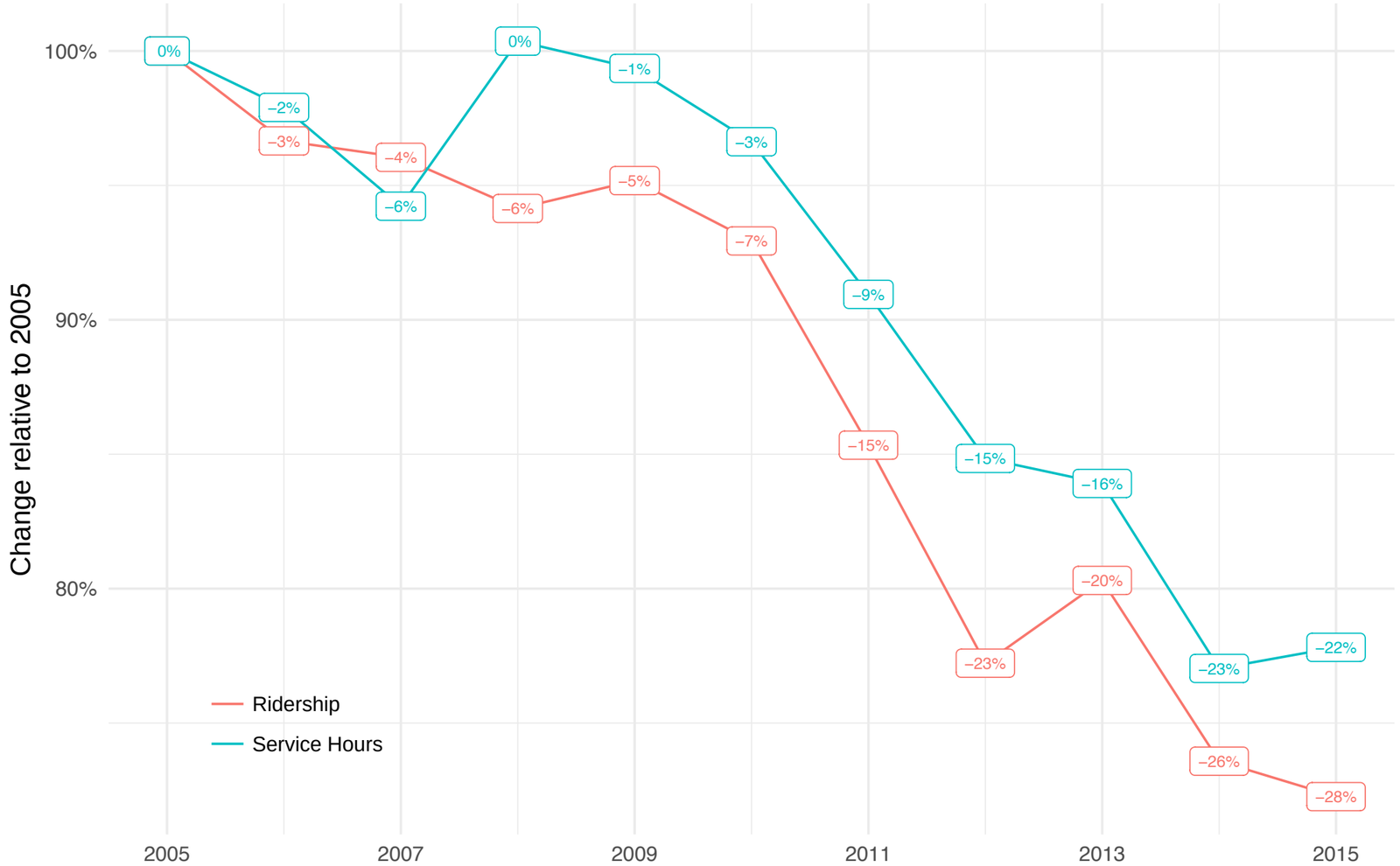


Figure 3: Changes in MATA's total service supply (service hours) and ridership between 2005 and 2015. Ridership fell nearly hand-in-hand as service was reduced over the years.

One purpose of this transit vision is to *arrest* this cycle of decline. This means breaking the cycle of disinvestment, loss of usefulness and loss of ridership that has been happening in Memphis in recent decades.

Frequency is Freedom

In transit conversations there is always a great focus on *where* transit is provided, but sometimes not enough attention paid to *when* it is provided.

The "when" of transit service can be described as "frequency" or "headway" (how many minutes between each bus) and "span" (how many hours per day, and days per week, it runs).

The map at right shows MATA's network, with every route color-coded based on its frequency during midday on a weekday.

Low frequencies and short spans are one of the main ways that transit fails to be useful, because it means service is simply not there when the customer needs to travel.

Frequent service:

- 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.
- Makes transferring (between two frequent services) fast and reliable.

The map at right reveals that only a few MATA routes offer 30-minute frequency; only one offers 20-minute frequency; and only the trolleys offer service every 15 minutes or better (which is the transit industry norm for calling something "frequent").

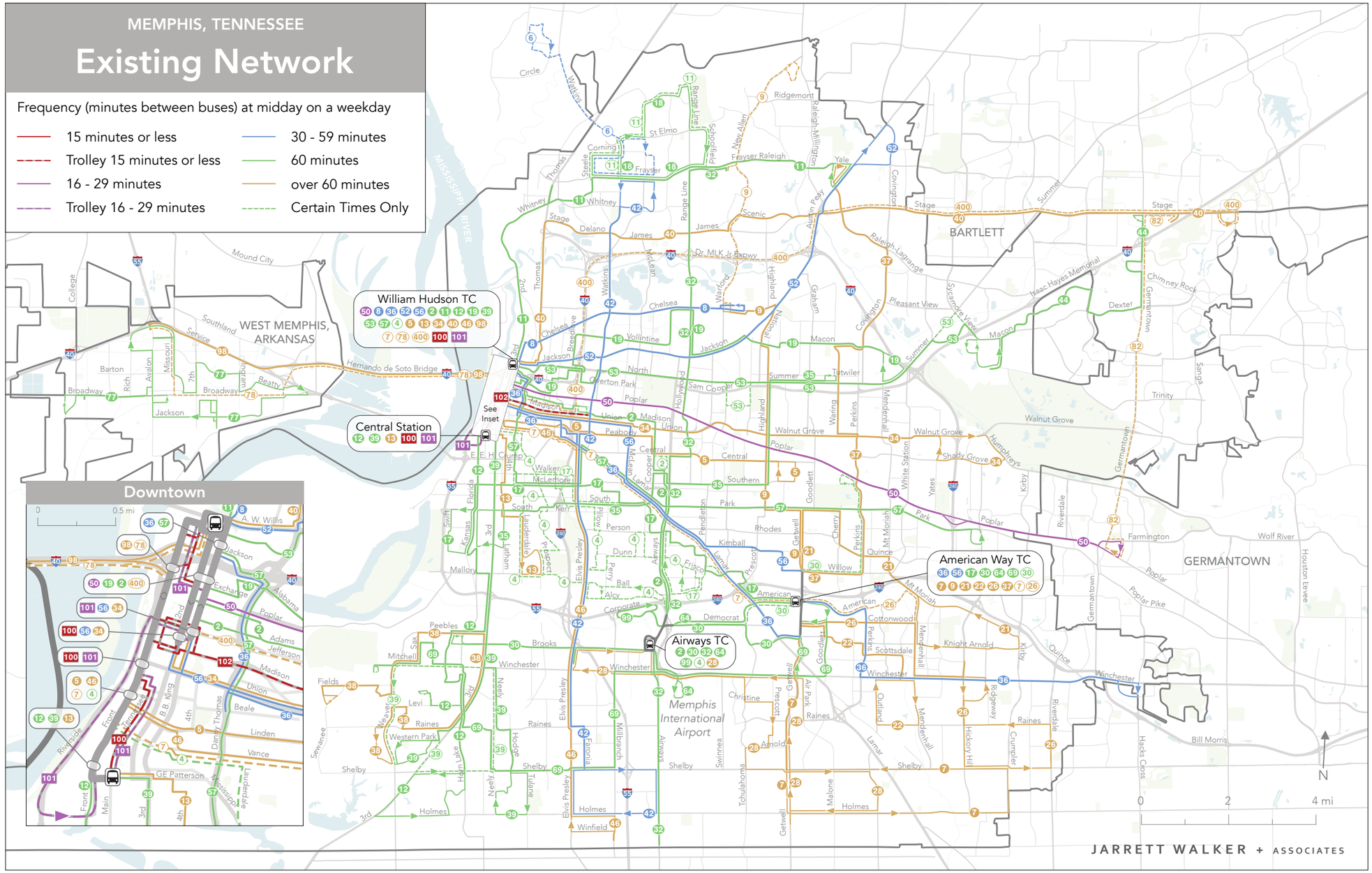


Figure 4: Map of the existing Memphis transit network. Routes get near most residents and many jobs, but nearly all routes are infrequent.

In order to think about whether any frequency is "frequent enough," imagine waiting one-half of the frequency, on average (since statistically, you will) and ask yourself whether you could tolerate waiting that long as part of an everyday trip.

Many people assume that today, with real-time transit arrival information (like *MATATraveler or TransLoc Rider)* and smart phones, nobody needs to wait for a bus anymore, and frequency therefore doesn't matter. If a bus only comes once an hour, that's fine, because your phone will tell you when it is a few minutes away and you should walk to the stop.

Despite all these new technologies, frequency still matters enormously, because:

- ***Waiting doesn't just happen at the start of your ride***, it also happens at the end. You may not need to leave the house long before your departure, but ***if your bus is infrequent, you have to choose between being very early or too late***. If you start work at 8:00 am but the hourly bus passes your workplace at 8:10 am, you can be 50 minutes early or 10 minutes late.

- ***Many of the places we go don't let us hang out until our bus's arrival is imminent***. We can easily do this when leaving home, but it is

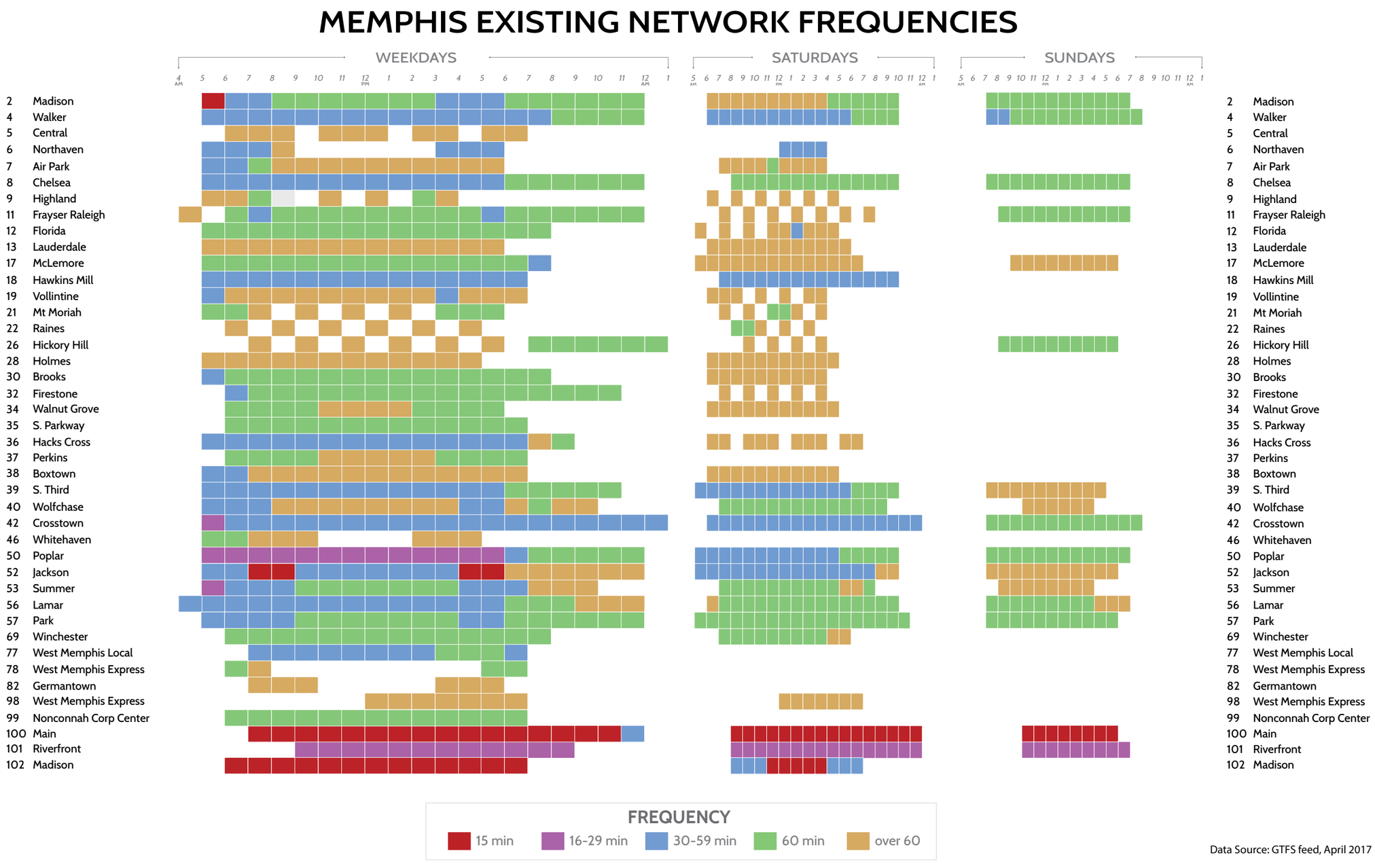


Figure 5: The frequencies and spans of service of each MATA route.

Data Source: GTFS feed, April 2017

more awkward when leaving a restaurant or a workplace that is closing.

- *Real-time arrival information doesn't make the bus more reliable, but frequency does*. Your phone can tell you when your bus is arriving, but it cannot prevent your bus from having a problem and being severely delayed, or not showing up at all. Only frequency—which means that another bus is always coming soon—can offer this kind of reliability.

Short Spans Each Day and Each Week

The graphic on the previous page summarizes each MATA route's current frequency and span of service. It is striking, when looked at graphically, how little service exists on Saturdays and especially on Sundays.

MATA does run service into the night on weekdays (as shown in the map at right), but at extremely low frequencies. Only one bus route provides better than 60 minute service after 8 pm on weekdays.

The transportation profession has long been focused on the weekday peaks, because those are the times when our road capacity is most-used and congested. Yet people need to travel at all times of day and week.

Service workers tend to work from very early in the morning to midday, or from midday to late at night. Most people working in retail or restaurants are only given a job if they can commit to work on both weekend days. A route that doesn't exist on weekends is particularly useless to low-income service workers.

In addition, anyone taking an evening class, pursuing a hobby, going to worship, or staying late at work to finish a report needs a bus ride home outside of the traditional 8-to-5 workday.

Among MATA services, the trolleys offer the most sustained service at a consistent frequency for the most hours each day and each week. Yet the trolleys are necessarily short because their rail infrastructure is limited to primarily the downtown area. With only 12% of regional jobs in the downtown area (compared to a national average of 23%), the trolleys are limited in the access they can provide to jobs in such a decentralized city. While commuting is not the only reason to use transit, job locations (especially retail and medical job locations) are also places where people travel for other needs like medical appointments and shopping trips. Thus, the limited reach of the trolleys means that they can't help most people with the vast majority of their trips.

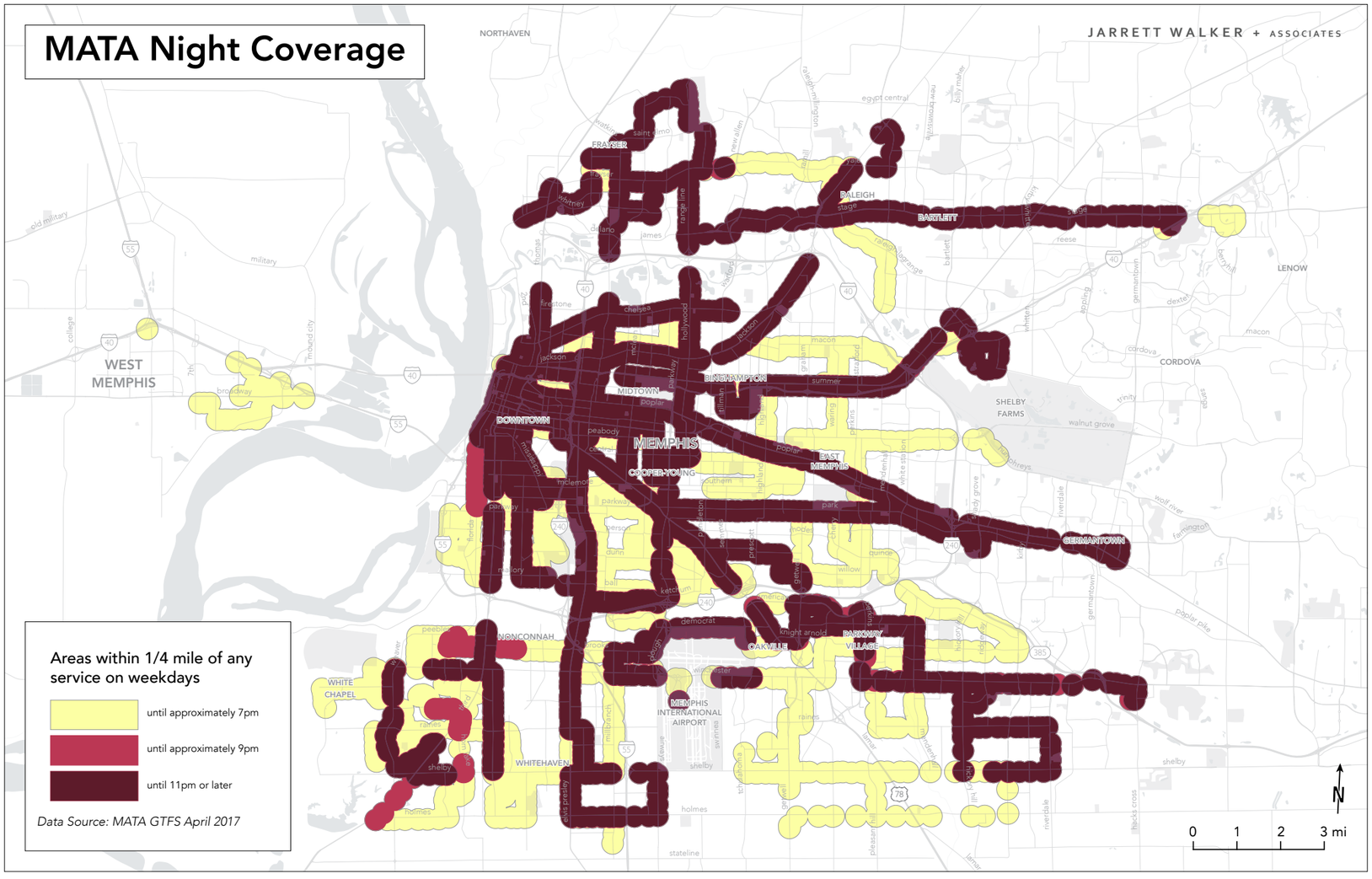


Figure 6: Comparison of areas covered by service as evening turns into night. Most of Memphis loses service after 7 pm.

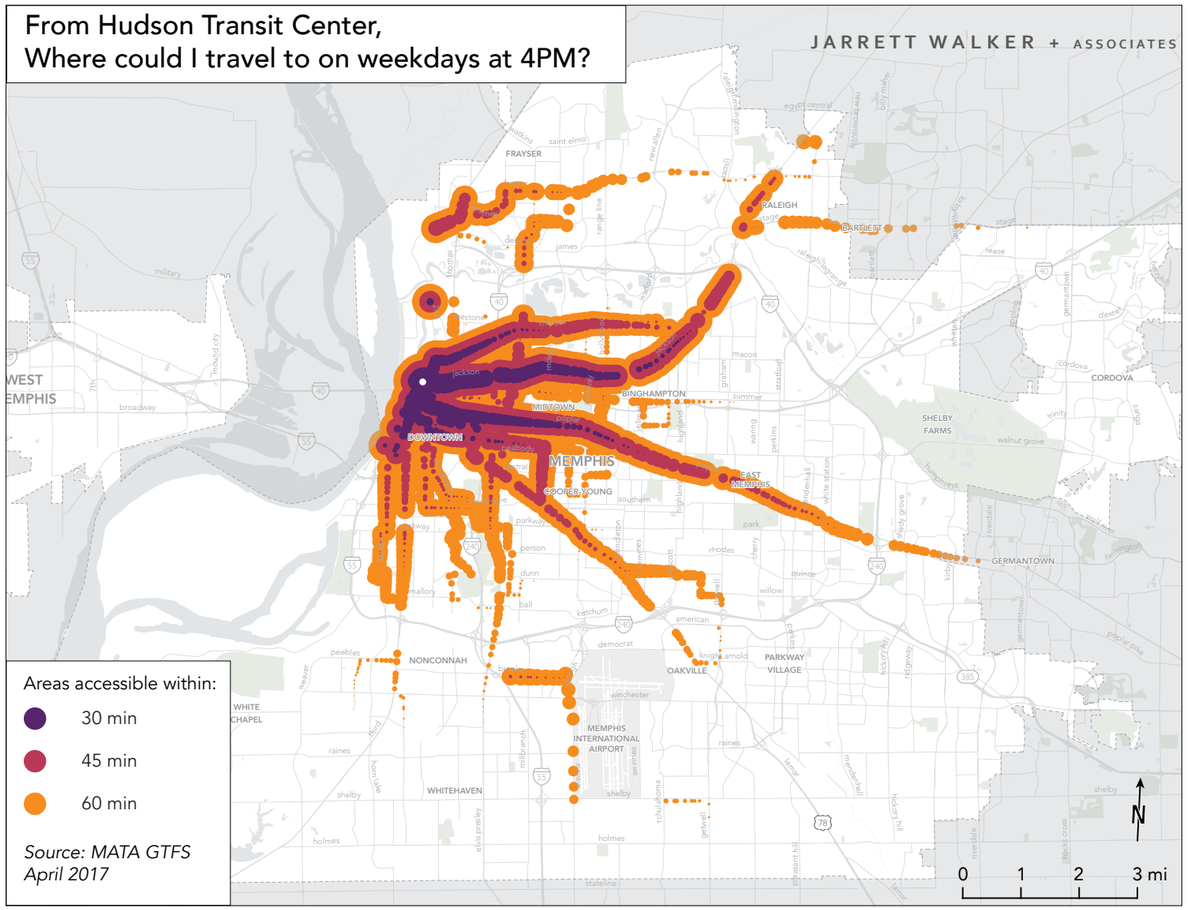
The Memphis Transit Network as an Instrument of Freedom

The map below shows where someone can go if they start out between 4 pm and 5 pm on a weekday. Areas they can reach in under 60 minutes are shown in orange.

We can think of the shape below as the walls around someone's life. A transit network can be liberating, giving people access to the opportunities of their city, the freedom to find work, go to school, worship, meet people, and do all of the other things that have drawn humans to cities for thousands of years.

The transit network can be an instrument of freedom for the current and future people of Memphis. The walls around their lives could be expanded. "High-freedom" networks tend to also be high ridership networks, if they are designed to provide the most freedom to the largest number of people.

This report presents a number of technical observations about why the transit network offers so little access to the city. This report also presents two key choices that will inform how much that access could grow in the future.



In addition to the (best-case-scenario) example below, similar maps show access to the city from three other places, starting on page 34.

Figure 8: Low freedom. Even riders starting at a transit center, on a weekday, during the day, can access little within an hour's time.

Access to Service Varies by Income, Though Not by Race

The chart below reports how much coverage is provided by the existing MATA network, to residents and jobs.

This chart measures access to any service as well as to frequent service. Unsurprisingly, a tiny fraction of residents and a small fraction of jobs have access to frequent service, since the downtown trolleys provide the only frequent service in the city. This reflects both the lack of frequent service in the MATA network and the low density of workplaces in the city's core.

Another observation we can make from this chart is that access to any service is roughly similar for non-white residents and for all residents. In contrast, access to any service is worse for residents in poverty than it is for all residents. This likely relates to the "suburbanization of poverty," in which low-income people increasingly reside in places that are hard to reach with transit, as we discuss further on page 25 and page 28.

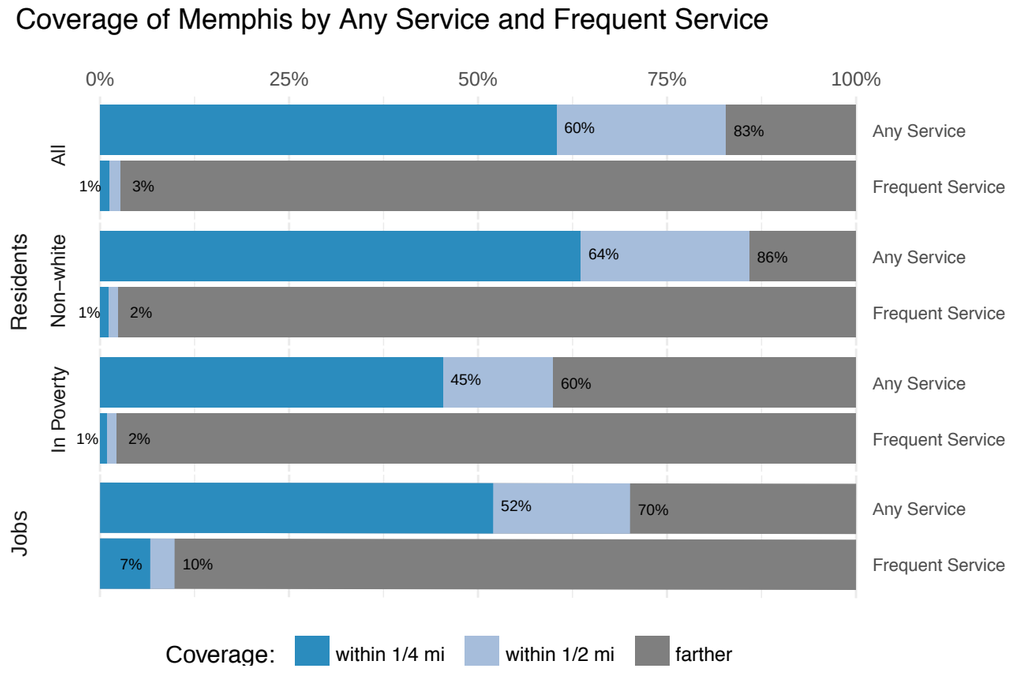


Figure 7: While a majority of Memphis is covered with some transit service, frequent service only covers the tiny handful of residents and jobs that are located downtown, near the trolleys.

Key Choices for the Transit Vision

At the end of this report, we present two key choices that the public, stakeholders and elected officials may want to make as part of a transit vision. These choices are suggested by the existing conditions of transit and land use in Memphis.

Memphis is facing a set of related choices for land use through the Memphis 3.0 process. This report contains information and maps demonstrating that land use, development and street design govern transit ridership and transit costs. The future success of the Memphis transit network depends a great deal on the land use decisions made in Memphis 3.0.

Balancing ridership and coverage goals

In every public transit system, a basic trade-off must be made between concentrating service into very useful routes that serve large numbers of people, and spreading service out to make sure that people everywhere have access to at least some service.

How should Memphis balance ridership and coverage goals in its network? Is the current balance (which derives from the historical tweaks and changes to the network over the years) the right one? Should Memphis shift the balance? Within a fixed budget, a shift towards higher frequencies and higher ridership would require reducing geographic coverage, and vice versa.

Level of service

Memphis provides less in transit service, relative to its population, than most peer regions (see Figure 36 on page 43). With such a low supply of service, the trade-off between offering wide coverage and high frequency will continue to be severe and painful. In addition, the scale of potential future success towards any transit goal will be limited by the total supply of service, no matter how Memphis decides to balance ridership and coverage goals.

Whether and when Memphis should increase the total supply of transit service is a separate choice that will be addressed in this transit vision.

Making the city more transit-supportive

In the context of the Memphis 3.0 Comprehensive Plan, this report can also inform the land use and street design policies that will be needed in the future, if higher-ridership and more useful transit is desired by the community.

Many factors outside the control of a transit agency—land use, development, urban design, street networks—affect transit's usefulness. This is why Memphis 3.0 comprehensive planning is such an essential part of a transit vision (and vice versa). In the long-term, land use planning can help to arrange development in places and in patterns that are cost-effective to serve with useful, high-ridership transit.

Should the City of Memphis , through its land use policies, encourage more development that encourages and reinforces the success of high ridership transit service?

Chapter Summaries

Chapter 2: Market and Need Assessment

Chapter 2 presents demographic and geographic data for Memphis, as part of an assessment of where there are large numbers of people and high-ridership transit is a possibility, and where there are people with severe needs for transit who could benefit from access to service.

Chapter 3: Network and Route Performance

Chapter 3 presents data relating to the performance of the existing network and individual routes (such as ridership and on-time performance). It also includes descriptions of some of the network and service design techniques that are currently used in the transit network, and others that could be considered in the future.

Chapter 4: Key Choices

The final chapter of this report lays out the key choices that Memphis can make as part of the Memphis 3.0 Transit Vision (described at left on this page). These choices will be the focus of public and stakeholder involvement over the next few months.

Appendix: Route Atlas

The Route Atlas contains maps of each route, showing the average number of people who board at each stop along the route each day.

2 Market and Need Assessments

Market and Need Assessments

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

- Where are the strongest ***markets*** for transit, where ridership is likely to be high relative to cost?
- Where are there moderate or severe ***needs*** for transit, regardless of potential ridership and cost?

These two types of considerations help us design transit networks that properly balance the competing goals of high ridership and wide coverage.

Market Assessment

The transit market is mostly defined by WHERE people are, and HOW MANY of them are there, rather than by WHO people are.

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

However, the "who" attribute that has the strongest influence on transit ridership potential is income. This is especially true in suburban areas like Memphis where driving and parking cars is so easy.

Low income people are, as individuals, more likely to choose transit. That said, the density of all people (including low-income people) around a transit stop will still be the overriding factor in predicting whether that stop gets high ridership. All else being equal, density trumps income (and age) if you are trying to predict where transit will get high ridership.

On the following pages, these maps and diagrams help us visualize the transit ***market***:

- Residential density map
- Job density map
- Activity density map
- Linearity example
- Walkability example

None of these data *alone* tell us that a place has high ridership potential and is therefore a strong transit market. Rather, we must consider them in combination.

This is not to say that *who people are* is not important. It is extremely important, especially when designing transit services to achieve a coverage goal.

Need Assessment

We learn about transit needs by examining WHO people are and what life situation they are in.

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

While the densities at which these people live would matter, because at higher densities a single bus stop can be useful to more people in need, the planner would still try to get the route close to even small numbers of people. In fact, the more distant and scattered people are, the more isolated they can be and the more badly they might need access to transit.

On the following pages, these maps help us visualize where transit needs are in Memphis:

- Density of seniors
- Density of youth
- Density of residents in poverty
- Density of zero-vehicle households

Most of these measures cannot by themselves tell us that a person has a severe need for transit. For example, many seniors are affluent and able to afford cars, or even taxis or drivers. The same is true of youth. People living in zero-vehicle households may be choosing to rely on transit, walking or cycling when they could theoretically afford a car. We must consider these measures in combination to understand where in Memphis people's needs for transit are likely to be severe.

One map included in the Need Assessment pages does not relate directly to people's need for transit, but does speak to a type of coverage goal, and that is the map of the race or ethnicity of Memphis residents. A person's race or ethnicity does not tell us if they need transit, or if they have a propensity to use transit. However, we know that race and ethnicity are correlated with income.

Understanding the race or ethnicity of Memphis residents is crucial to understanding whether transit service changes will affect people equitably. Unequal treatment on the basis of race or ethnicity is illegal under the Civil Rights Act of 1964. (Unequal treatment on the basis of other characteristics, including income and age, is also prohibited by law.) Thus an examination of where non-white people live in Memphis is less part of a "Need Assessment" than part of a civil rights assessment.

Future Opportunities

This section assesses the current state of the geometry and geography of Memphis and how transit supportive that geometry is. The focus of this analysis is how the current transit system relates to that geometry because the most urgent concerns are how to change or improve the network for today's city. But in the context of the long-range Memphis 3.0 Comprehensive Plan, this section is also a guide to what kind of land use and street design policy is needed to help Memphis become a more transit-supportive city in the future, if it wishes to do so.

Development Patterns Affect Ridership

Attracting riders requires more than clean, courteous, comfortable or even frequent service. Many factors outside the control of MATA—land use, development, urban design, street networks—strongly affect transit's usefulness. This is why Memphis 3.0 comprehensive planning is such an essential part of a transit vision (and vice versa).

If Memphis wants to achieve higher ridership on its transit system, then service must be focused on areas where high ridership is likely to result. Land use planning, in its turn, can help to arrange development in places and in patterns that are cost-effective to serve with useful, frequent transit.

The way that Memphis could attract higher ridership, within a fixed budget, is by targeting places where the "Ridership Recipe" is in effect:[1]

- **Density**: Demand for transportation increases as the number of people, jobs and activities in an area increases.
- **Walkability**: Service is only useful to people who can safely and comfortably walk to the bus stop.
- **Linearity**: Direct paths among destinations are faster, cheaper to operate, easier to understand and more appealing to customers.
- **Proximity**: Shorter distances between destinations attract more riders per hour and are cheaper to operate.

These are geometric facts of the city and its design. They are not a matter of opinion or personal values, unlike the Key Choices presented in this report. For example, some people react strongly to the term "density" and infer a value or judgment that must come with it. Yet ***density is a simple geometric fact: the number of people close to any given transit stop***.

All of these factors affect both the costs of providing transit in a particular place and how many people will find the service useful. ***Density and walkability tell us about the overall ridership potential***: *"Are there are a lot of people around, and can they get to the transit stop?"*

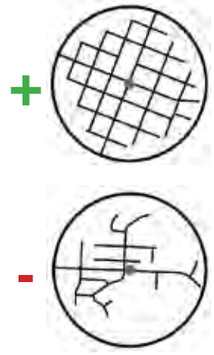
Linearity and proximity tell us about both ridership potential and cost: *"Are we going to be able to serve the market with fast, direct lines, or will we have to run indirect or long routes, which cost more to operate (and cost riders time)?"*

1. Research describing the relationships among transit ridership, transit cost, and land use and street design factors is abundant. For an introduction, see *Travel Demand and the 3Ds: Density, Diversity and Design*, by Cervero and Kockelman and *Travel and the Built Environment: A Synthesis,* by Ewing and Cervero.

Four Geographic Indicators of High Ridership Potential

Density *How many people, jobs, and activities are near each transit stop?*

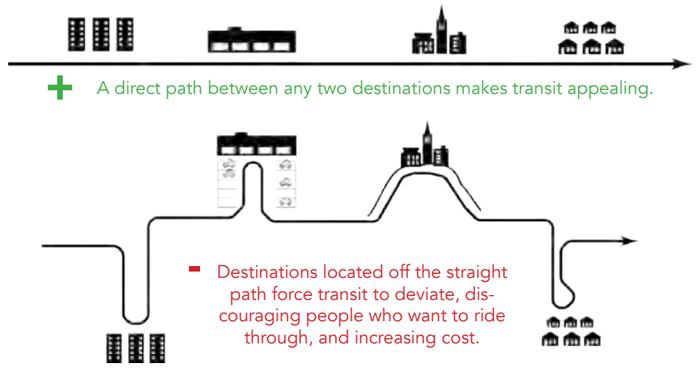
Walkability *Can people walk to and from the stop?*



The dot at the center of these circles is a transit stop, while the circle is a 1/4 mile radius. The whole area is within 1/4 mile, but only the black-shaded streets are within a 1/4 mile *walk*.

+ It must also be safe to cross the street at a stop. You usually need the stops on both sides for two-way travel!

Linearity *Can transit run in reasonably straight lines?*



Proximity *Does transit have to traverse long gaps?*

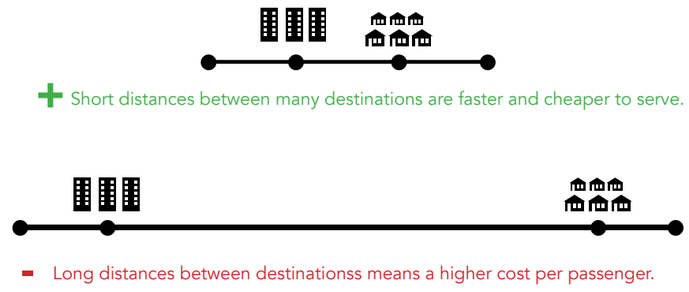


Figure 9: The Ridership Recipe

1960 to Present: Density and Proximity Collapse

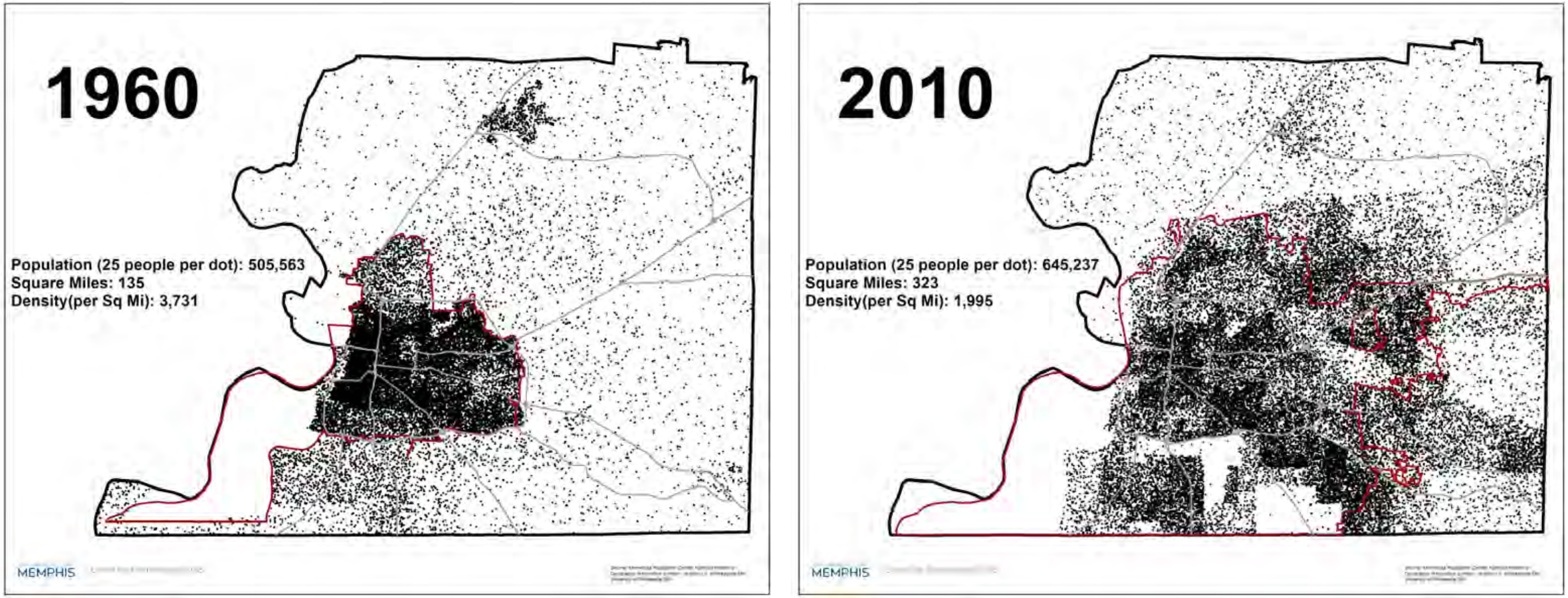


Figure 10: Population growth and distribution in Memphis between 1960 and 2010. Courtesy University of Memphis and Minnesota Population Center

Density and proximity are two ingredients in the Ridership Recipe, as described on the previous page.

Between 1960 and 2010 the population of Memphis grew more than 27%. During that time many residents and businesses moved out of the urban core and toward the fringes of the city. The developed part of the city sprawled out—growing by 239%—vastly decreasing density and increasing the distances between any two destinations in the city.

The massive shift from the urban core dramatically reduced density and proximity in Memphis. As a result of this change, the entire city's performance towards the Ridership Recipe collapsed. MATA is now faced with serving fewer people per bus stop, on roads that are barely walkable and crossable, across much longer distances and therefore at much higher cost than in the past.

Market Assessment: Residents

Residential density is the simplest measure of public transit's ridership potential. Nearly everybody makes at least one trip starting or ending at their place of residence every day.

The map to the right shows the estimated residential density for Memphis. The highest residential densities occur near downtown, Midtown and in a swath south of I240 and north of Winchester Road. Many small areas of high residential density are scattered around Memphis, removed from each-other.

A key challenge apparent from this map is that ***the highest density areas are scattered across the city,*** far from one another and from jobs and activities.

In addition, ***dense developments are not arranged in linear patterns*** which makes it difficult to draw bus routes that serve many people while feeling direct to through-riders. The most severe example is the Parkway Village area, where the densest housing is arranged around freeway exits (if anything) rather than along a direct road.

By comparing this map to the map of the existing network on page 7, we can see that at least some minimal transit service is provided close to the densest pockets of residential development, even if they are far from the rest of the city.

However, "close to" is a relative statement. In some developments the local street pattern puts most homes a long walk away from the nearest through-street, making it impossible for MATA to get close to very many homes. This walkability problem is illustrated on page 21.

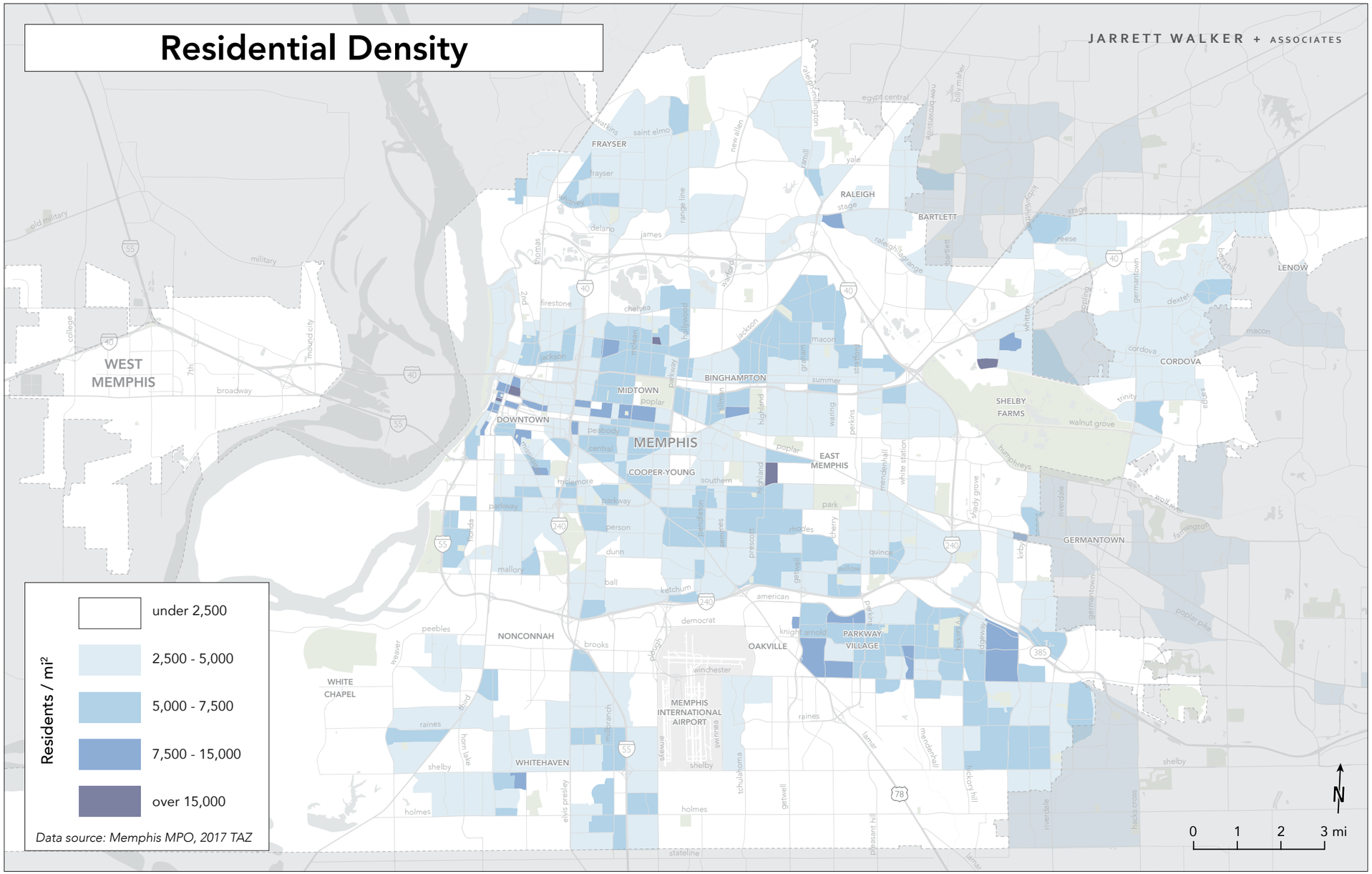


Figure 11: Residential Density Map

Market Assessment: Jobs

A map of job density shows us not only the places people travel for work, but also places people go for services, shopping, community, health care, and more. ***A person's workplace may be, throughout the day, a destination for dozens or even hundreds of people.***

The map to the right shows the existing job density across Memphis. Employment density is high in the traditional downtown core of Memphis and to the east of downtown, as well as near the Memphis airport (the hub of the region's logistics industry).

The pattern of high job density along Poplar all the way to Germantown is particularly *linear.* This means that MATA can run service close to the large number of jobs and activities on Poplar, in a pattern that riders will feel is direct.

Note that different types of employers trigger different levels of transit demand, and we cannot differentiate among them on this map. While retail and service job sites are also attractants for numerous customers and visitors, industrial and logistics job sites attract hardly anyone other than employees (often at only a few shift-change times a day) and suppliers (who generally arrive in a truck, with supplies).

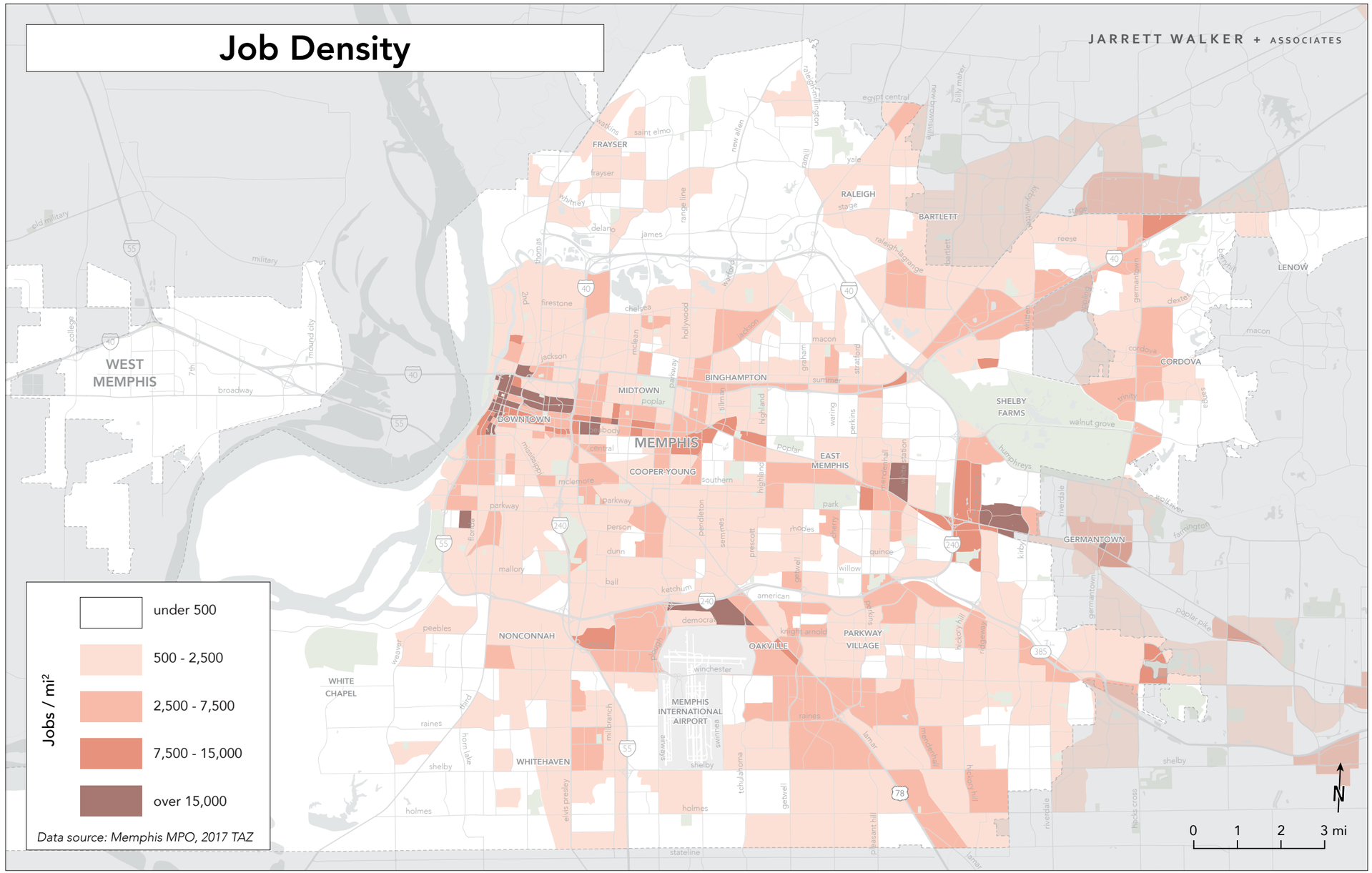


Figure 12: Job Density Map

Example: Low-Density Employment

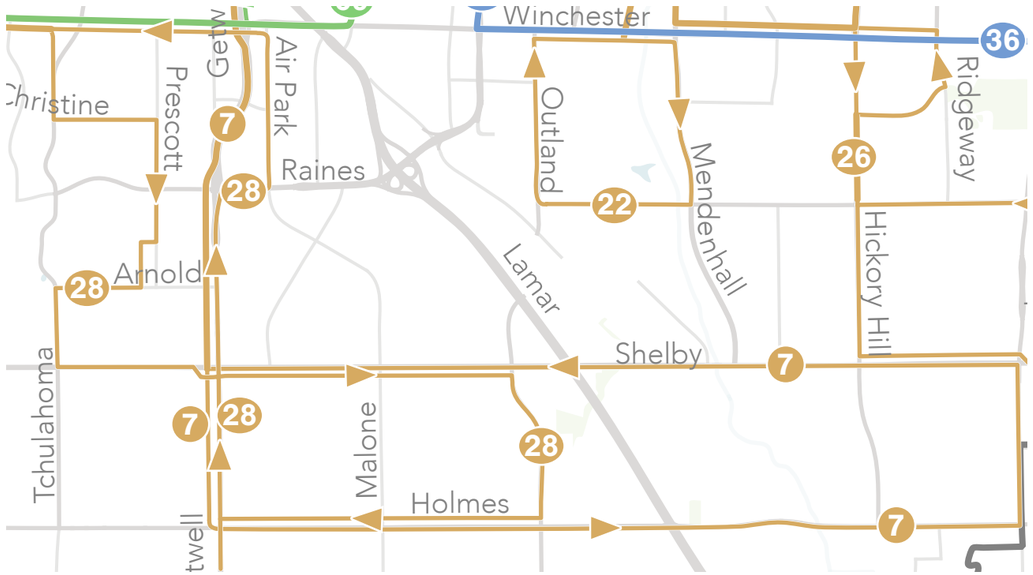
The transportation and logistics industry (including FedEx) is incredibly important to the Memphis economy. However, there are a few inherent attributes of transportation and logistics work that make it challenging to serve with useful transit.

Service must be justified on the basis of employee ridership alone, because there are few visitors or customers also riding transit to the employment area. In contrast, a hospital or grocery store generates ridership from both workers and customers, all day long.

Low density and low walkability are also a transit challenge, but are completely natural at logistics facilities. Logistics and transportation developments involve large parcels, big barriers (like railroads, runways and freeways), and streets are designed for truck access, not for human access.[1]

For a transit route to get high ridership, relative to cost, in such a low-density industrial area it would need to be designed like a company shuttle. Typically, a company shuttle matches the shift-change times of one or two employers. This requires a degree of coordination between employers and transit scheduler writers that is hard to achieve and maintain, especially in a larger city like Memphis where there are diverse demands on every bus route.

Figure 13: Aerial view of transportation and logistics industry near Memphis Airport (above). A large one-way loop of Route 7 (see below) serves the edge of this employment area every 120 minutes.



1. That said, one of the world's greatest freight and logistics industries is in Holland, also home to the world's highest standards for bicycling, walking and transit design.

Market Assessment: Activity

Residential and job densities are combined into Activity Density in the map at right. This map helps us understand the total level of activities in a place, the mix of uses on a corridor or in an area, and their proximity and linearity.

Downtown and Midtown are dense with a mix of activities. To a lesser degree, this pattern continues along Poplar to Germantown. The Oak Haven/Parkway Village/Hickory Hill area is also dense with a mix of uses, though they are not organized into a linear pattern or along transit-friendly streets.

Though it is not one of the four major factors named in the Ridership Recipe, ***the mix of uses along a corridor affects how much ridership transit can achieve, relative to cost.*** This is because a mix of uses tends to generate demand for transit ***in both directions, at many times of day.*** Transit lines serving purely residential neighborhoods tend to be used in mostly one direction and mostly during rush hours—away from the residential neighborhood, towards jobs and services. Buses serving a mix of uses can be full in both directions, all day and all week.

This Activity Density map gives us the best snapshot of Memphis's ***transit disoriented development*** pattern. Activity centers are dispersed, so MATA must run longer and more circuitous routes. These routes are long and therefore expensive and therefore less frequent. As a result, not very many people find them useful. A key goal of the Memphis 3.0 plan will be to re-orient Memphis development towards ***transit that can succeed.***

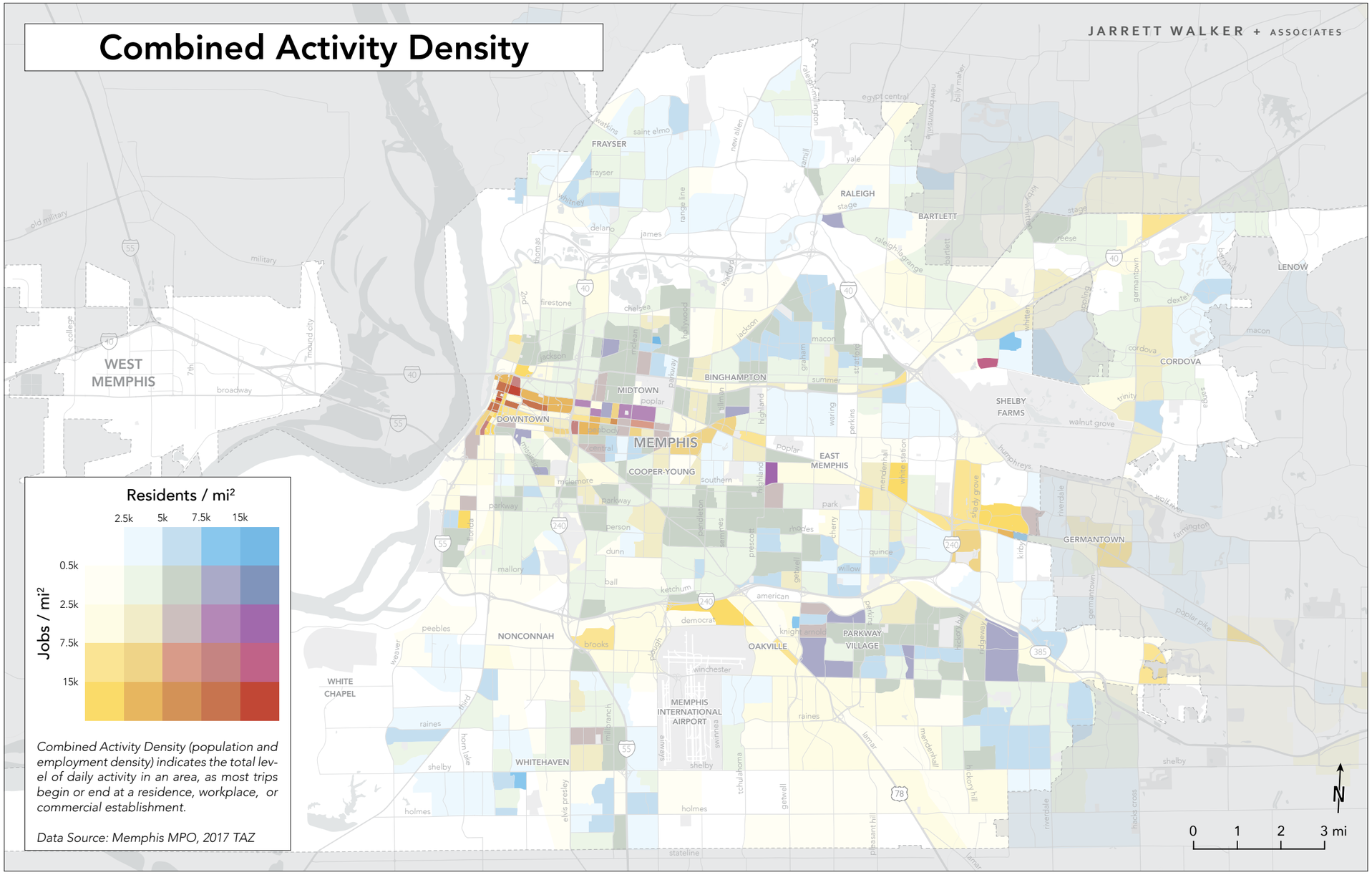


Figure 14: Activity Density Map

Examples: Density and Walkability

No ingredient of the Ridership Recipe is sufficient, by itself, to lead to high ridership relative to cost.

For example, there are places in Memphis that are dense with residents and jobs, but the street network and street design make nearby activities (and bus stops) nearly impossible to access by walking.

- *Hickory Hill: High residential density but low walkability*
  The area around Hickory Hill contains a number of high density multi-family developments. Very few streets go through, and most housing is located at the ends of cul-de-sacs. The streets that do go through are arterials with five or more lanes, which likely discourage all but the most healthy and daring of walkers from crossing the street to reach a bus stop.

Figure 15: High density and low walkability in the Hickory Hill neighborhood

- *Midtown: Moderate density and high walkability*
  In Midtown, a mix of uses exists at moderate densities. Because so many streets go through, people can pick short and direct walks to any destination, including a bus stop. Roads are smaller, and therefore easier to cross.

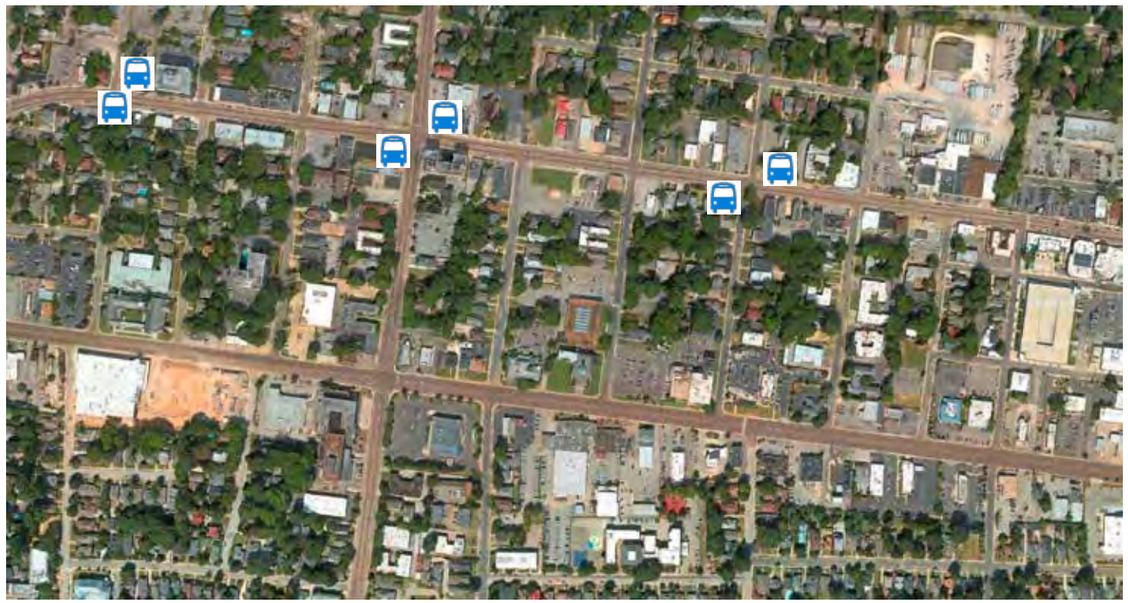


Figure 16: High density and high walkability in Midtown Memphis

People will walk farther to more useful transit, but everyone has a limit. The fewer streets go through and connect to one another, the longer walking distances become. In addition, without sidewalks or safe crossings of major streets, people may have to walk yet further to preserve their own safety.

For these reasons, walking distances to and from bus stops can far exceed "flying" distances.

- Areas with high street connectivity provide short and direct paths between any two locations.
- Low street connectivity, common in "walled garden" developments, forces long and circuitous paths between locations, discouraging walking.
- Low street connectivity tends to go along with wide, fast arterial streets, because what few streets do go through have to handle all of the neighborhood's car traffic.

The illustrations at right show the dramatic differences in walking paths between a housing unit and a hypothetical bus stop 1,200 feet away. Short and direct paths are available for almost any pair of locations in the Midtown neighborhood. In contrast, most location pairs in Hickory Hill require long and circuitous paths.

No matter how dense each neighborhood is, and how likely the individuals living there are to use transit, it will always be harder to get high ridership out of Hickory Hill because it is simply so much harder for people to access a bus stop.

Figure 17: Differences in walkability in two Memphis neighborhoods. Red lines show the longest-case walking paths for access to a bus stop that would be a short "flying distance" away.

Examples: Linearity and Proximity

People do not like to be taken out of direction when they are on their way somewhere. (They do, on the other hand, enjoy riding in circles when they are on vacation!) This is part of the reason that *linearity* is an ingredient in the Ridership Recipe. Routes that are circuitous or deviating can only feel direct to the people who are bound for the deviation itself—for everyone else, they feel like an infuriating waste of time.

The other reason linearity is part of the Ridership Recipe is that circuitous and deviating routes are simply *longer*, and therefore cost more for MATA to operate. (In the drawing at left, imagine stretching out the lines of the Circuitous and Deviating routes. They would be much longer, and therefore take more time to drive a bus down, than the Direct route.)

The longer a route is, the less frequent it can be for the same cost. The shorter a route is, the more can be spent on frequency.

The airport area: low linearity and proximity

The area around the Memphis International Airport contains a number of important employers. However, employers are spread across a wide area with large gaps between locations. Providing access to these jobs requires routes to wind through the area to get near each employer. One result is Route 28, shown in Figure 18 at right. This route gets close to many major job sites, but likely feels indirect and slow to all of its riders. If only those job sites were arranged in a linear pattern, Route 28 could be direct and shorter, and therefore more frequent. Arranging development in a more linear pattern in the future will be an important transit outcome of the Memphis 3.0 plan.

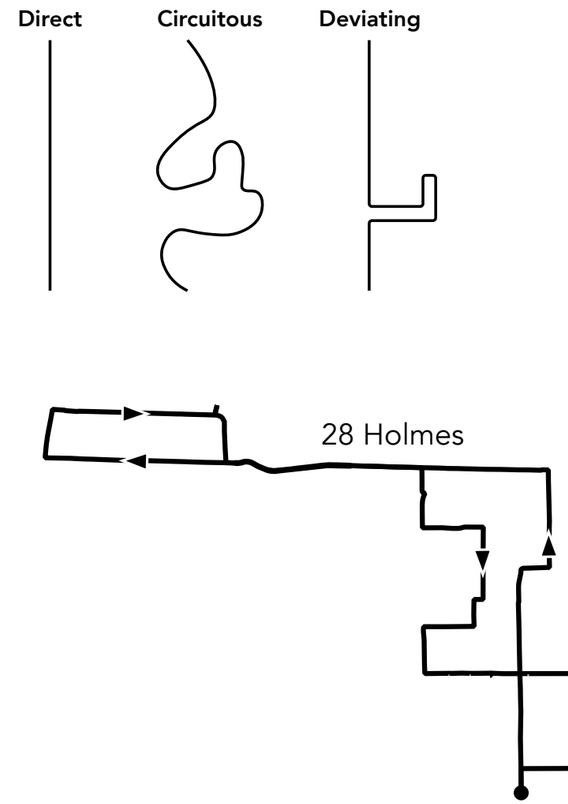


Figure 18: Low linearity and proximity in the area around the Memphis International Airport.

Poplar: high linearity and proximity

The close proximity of development in a line along Poplar allows MATA to run Route 50 along very appealing direct path from downtown, getting close to numerous residents and jobs along the way. It is not surprising that Route 50 is afforded the highest level of service of any bus route in the system.

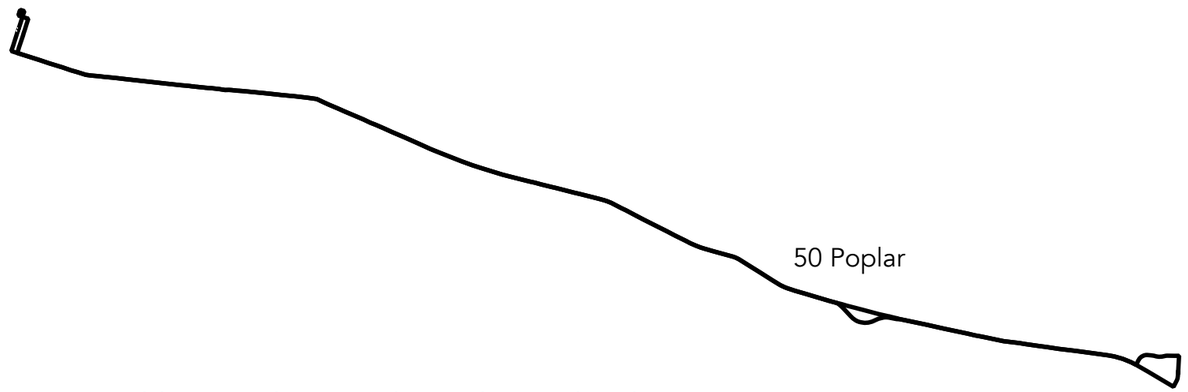


Figure 19: High linearity and proximity along Poplar over a long distance.

Need Assessment: Seniors

The maps on this page and the following pages show where large numbers of people with severe needs are living. Note that Census data is collected based on residential address, not based on workplace or shopping place or place of worship. This data thus shows us where people live, but not where they wish to go.

A major value of transit coverage is providing service for people who cannot drive, no matter where they live. This need can particularly acute among seniors. The map at right shows the density of senior residents in Memphis.

Seniors' needs and preferences are, on average, different from those of younger people. Seniors are more likely to be discouraged by long walks, because of limits on their physical ability, or concerns for their personal safety.

Seniors are less likely to be discouraged by long waits for transit, because they are less likely to be employed. For the same reason, seniors are, on average, less likely to be discouraged by slow or indirect routes that take them out of their way.

Because of these factors, ***transit service designed primarily to meet the needs of seniors rarely attracts high overall ridership.*** Most riders that place higher value on their time will find service with long waits to be intolerable. 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 general population.

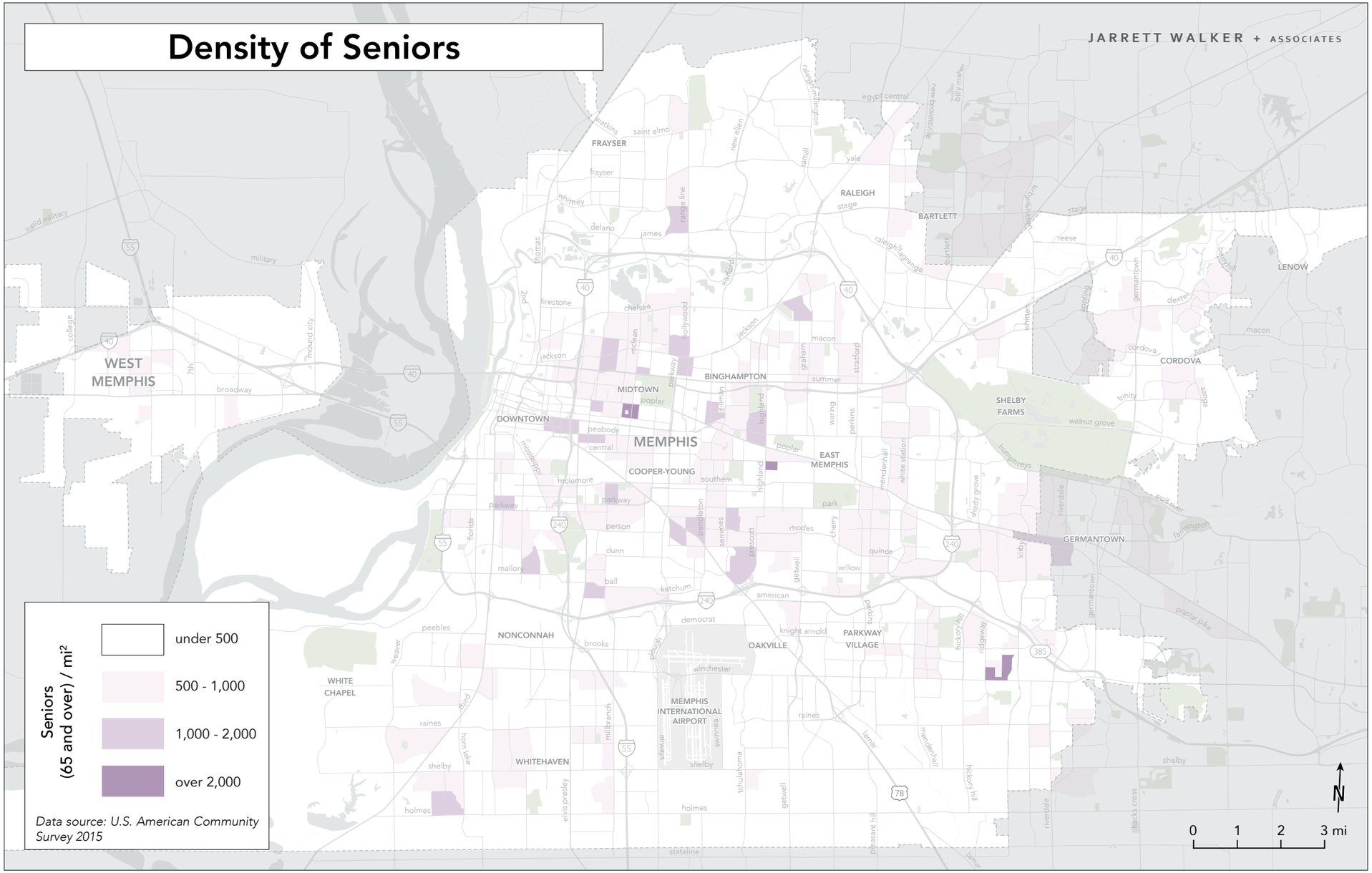


Figure 20: Density of Seniors Map

Need Assessment: Youth

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.

The map at right (Figure 21) shows the density of residents under the age of 18 in Memphis.

Youth are scattered all over the city, but there are clear concentrations north of Winchester Road.

Young people are like seniors in that they often live on a tighter budget than people of working age. For this reason, both are very sensitive to transit fares, and parents are sensitive to paying a fare for each child.

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 service than seniors.

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.)

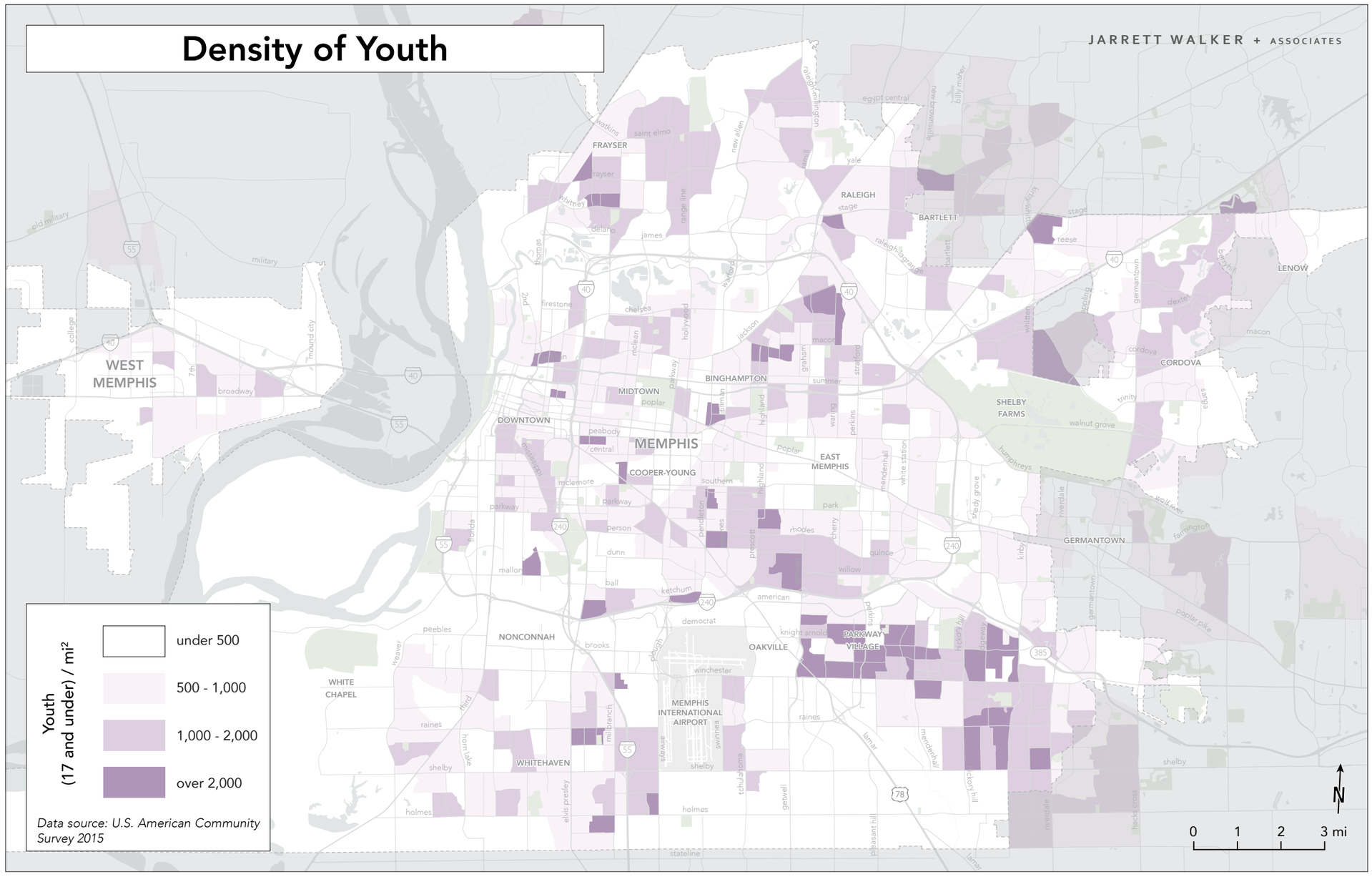


Figure 21: Youth Density Map

Need Assessment: Income

People who are living on limited incomes can represent either a strong market for transit or a need for coverage service (regardless of ridership), depending on the built environment around them.

A common misconception is that transit, especially all-day transit, is only useful to low-income people who cannot afford a car. People at all points on the income spectrum make choices about how to travel, based on their evaluation of cost, time, safety, comfort and other factors.

The more carefully a person must manage their money, the more attractive transit's value proposition may be. This doesn't mean that lower-income people will automatically choose transit because it's the cheapest option. ***Transit service must be useful and reliable for the kinds of trips they need to make.***

The map to the right shows the density of people in poverty in Memphis. ***As with jobs and residents, areas of dense poverty are scattered across the city.***

Density alone, as discussed earlier in this report, is not enough to support high transit ridership relative to cost. If a place is dense but is far away from other dense places, and is difficult to walk in, and requires transit routes to deviate or follow circuitous paths, then those factors will reduce its ridership potential.

This makes the "suburbanization of poverty" an enormous challenge for transit agencies. More and more people with severe needs for transit, living at fairly high densities, are nonetheless in a geographic situation that makes it very hard to reach them with cost-effective service.

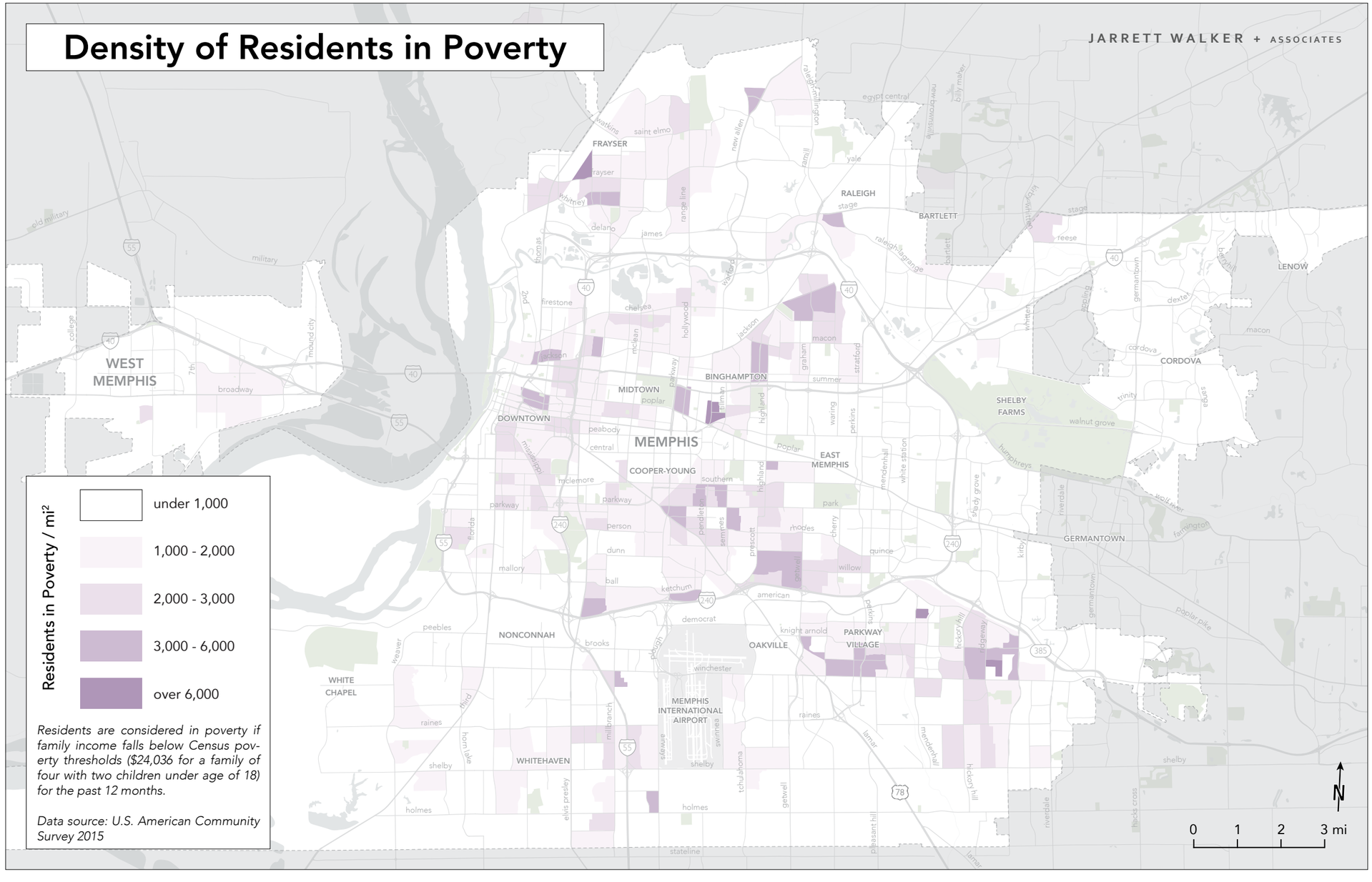


Figure 22: Residents in Poverty Map

Need Assessment: Vehicle Ownership

Not everybody has ready access to a personal automobile, and people who have less or no access will depend on other modes when they need to travel. This might include walking, cycling, getting a ride from a friend or family member, or, if it is reliable and available when they need to travel, transit.

The map at right shows the number of households without any vehicles available in Memphis. Darker areas have more households without vehicles.

Most households without vehicles are in or near downtown and Midtown. This pocket of high need and high demand is likely to be a high ridership location and is served well by the radial network centered on downtown Memphis. The concentration of useful transit near downtown and Midtown may have enabled people to forgo the expense of car ownership.

Several other ***pockets of dense households without vehicles are scattered throughout Memphis***. Comparing this map to the map of Seniors and low-income residents suggests many of the outlying concentrations of zero vehicle households are associated with senior housing or the lowest income households.

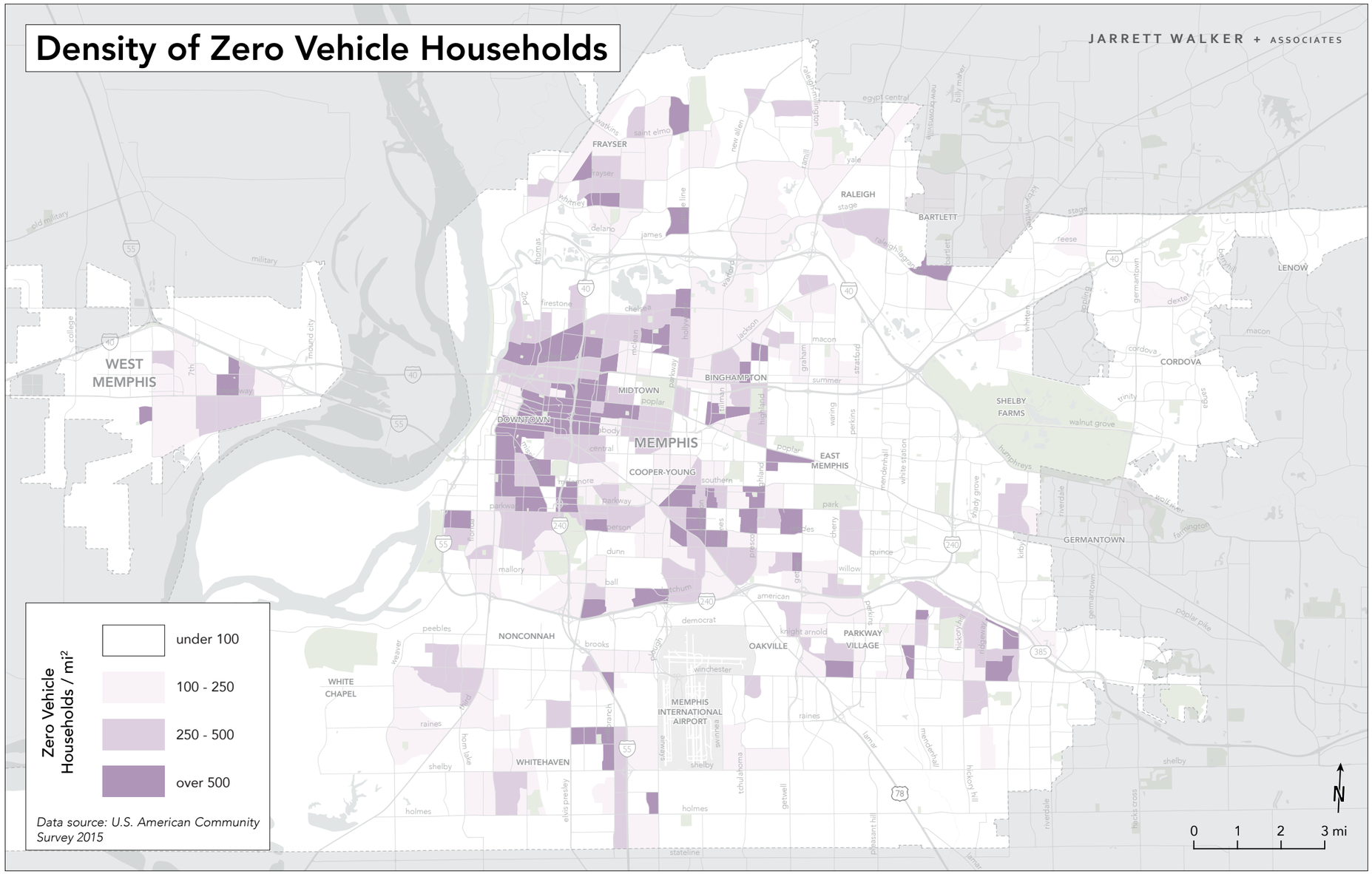


Figure 23: Households without Vehicles Map

Civil Rights Assessment: Race or Ethnicity

The map at right shows where white, black, Hispanic and people of other races and ethnicities live. Each dot represents 20 residents. Where many dots are very close together, the overall density of residents is higher. Where dots of a single color predominate, people of a particular race or ethnicity make up most of that area's residents.

While information about people's income tells us something about their potential interest in or need for transit, information about ethnicity or race do not alone tell us how likely someone is to use transit. However, avoiding placing disproportionate burdens on people of color, through transportation decisions, is essential to the transit planning process.

Transit agency policies that protect non-white people from negative impacts are one type of coverage goal. Such policies might state, for example, that service to high-density and high-minority neighborhoods should be prioritized even if such service would not maximize ridership.

In addition to local policies, federal civil rights law protects people from discrimination in the provision of transit service on the basis of their race or ethnicity. It is important to understand where large numbers of non-white people live, so that service changes can be evaluated in light of impacts to protected people.

Memphis's transportation and planning history, like that of many American and southern cities, has been fraught with outright racial discrimination by public and private actors. Particularly in the era before the Civil Rights Act of 1964, segregation and discrimination were major elements in transportation planning and government policy. Many decisions from that time have

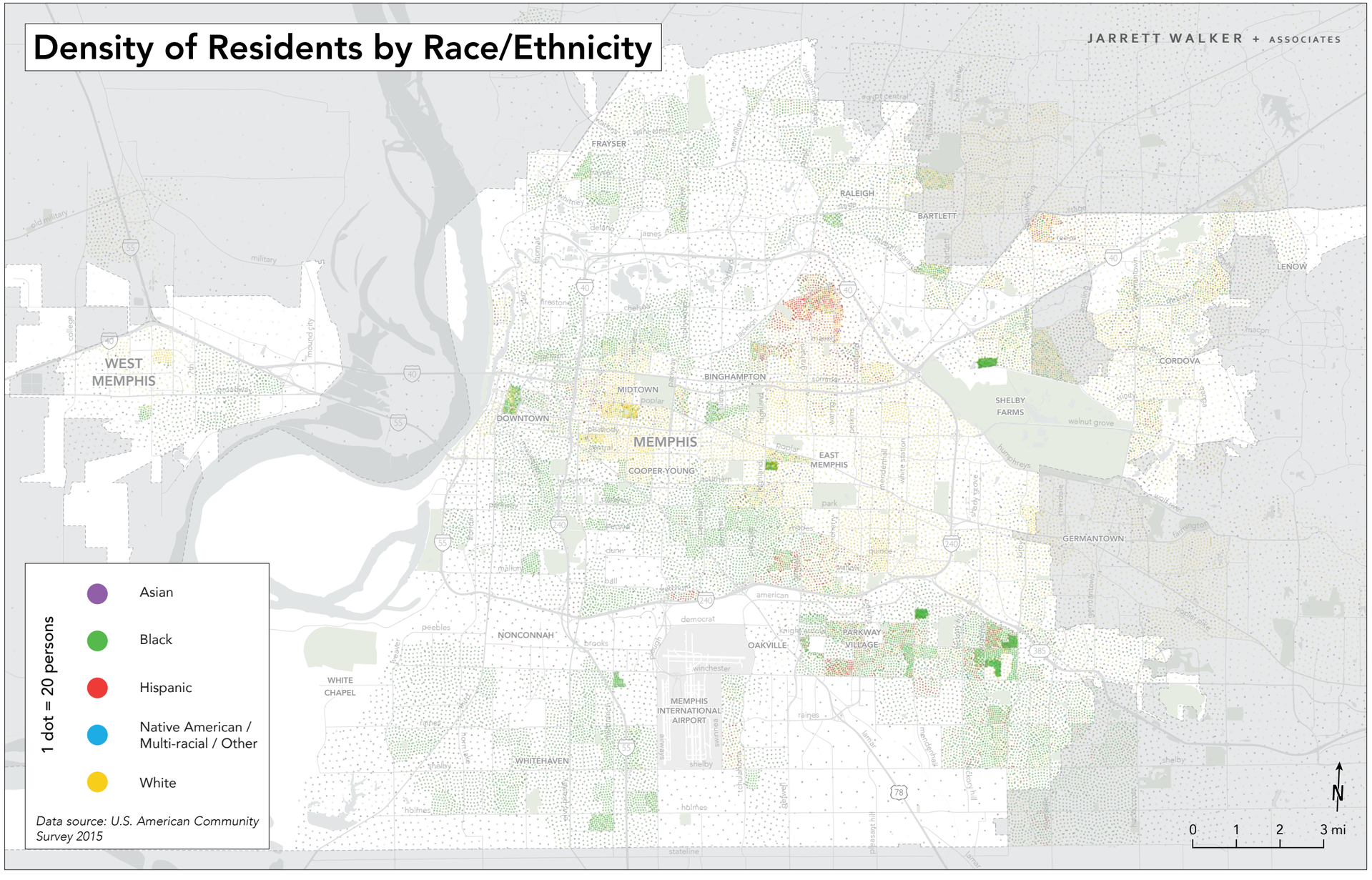


Figure 24: Map of Residents Showing their Race or Ethnicity

Civil Rights Assessment: Race or Ethnicity

left a trail of continuing problems for Memphis, like expressways cut through low income neighborhoods.

In addition to direct public actions, there have been many private discriminatory actions in the past, like red-lining, that have reinforced and use patterns that make useful transit service for low income and minority residents harder to provide. And through the latter half of the 20th Century the more subtle but awful effects of exclusionary zoning and "white flight" from the city have continued to make it difficult for minority residents in Memphis to use transit to access jobs and housing opportunities.

It is important in this process that we acknowledge the role that race and discrimination have played in past decisions, the harm those decisions has caused to black and low-income Memphis residents, and the way those decisions have undermined the usefulness of the Memphis transit network itself.

Given that history, it is somewhat encouraging to observe the lack of racial disparity present in the existing distribution of service in Memphis. Repeated from earlier in this report, the chart at right shows the percentage of residents and jobs that are near any service, and frequent service.

Non-white residents are just as likely as all residents to be close to some transit service. In contrast, low income residents are less likely to live close to some service.[1]

This may relate to a pattern of decentralization of poverty that has occurred in many regions for a variety of reasons. In some places, people in poverty have been pushed out of the core by gentrification. In Memphis, it appears more likely that the abundance of low cost housing being built in the suburbs has encouraged those in poverty to seek housing in the more suburban areas of the city. The housing may be cheap but the transit service is costly to provide. And the longer distances mean that transit trips are long and costly to each individual in their time wasted waiting for infrequent service and riding longer, more circuitous routes.

These conditions are not static and are likely to change in coming years as a result of a changing economy and a changing city. These conditions can also be affected by policy decisions about land use and zoning that the City can change, as it is considering in the Memphis 3.0 comprehensive planning process.

1. Meaningful differences in the usefulness of service—such as the difference between 20 and 50 minute frequency, and an all-week route vs. a weekday-only route—are not captured by this measure. Later in this visioning process, when we design alternative future networks for Memphis, we will use a more sophisticated measure that accounts for such differences.

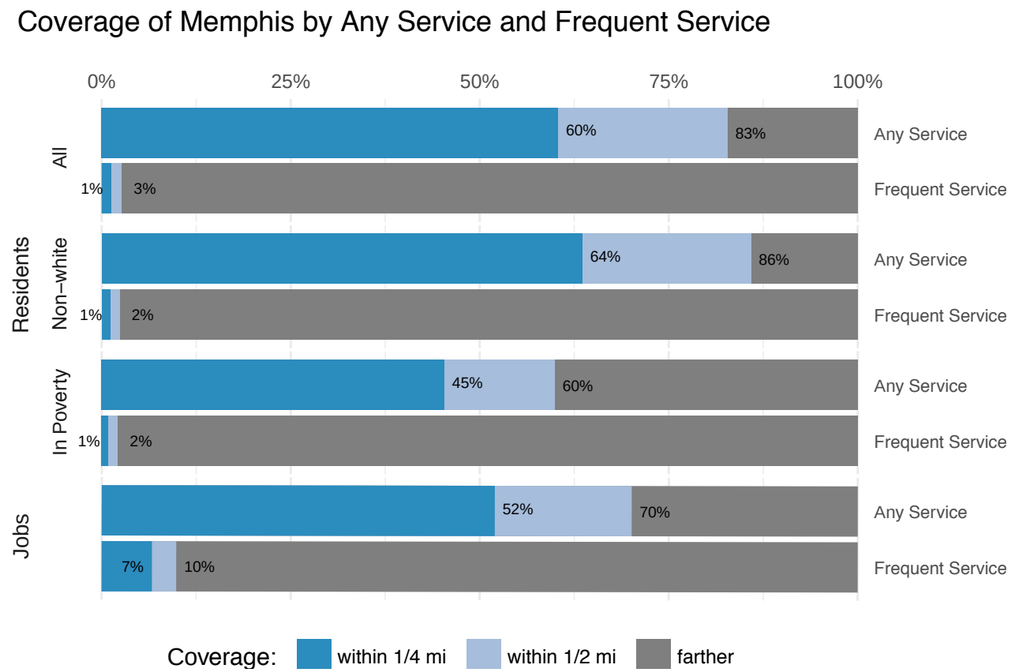


Figure 25: Access to transit does not vary much by residents' race or ethnicity, but does vary by income.

Paratransit

While the Memphis 3.0 Transit Vision Plan is concerned with the *fixed-route* transit network in Memphis, it is worth considering some of the ways in which changes to the fixed-route system can impact a transit agency's paratransit service obligations or practices.

MATA currently operates the Americans with Disability Act required demand-response transit service known as MATAplus. All transit systems in the United States are required to comply with the provisions of the ADA concerning transportation for qualifying people. MATA meets the minimum standard of demand-response service within 3/4 miles of a fixed route during the time when it is in operation.

Paratransit and Network Redesign Efforts

Major transit network redesigns can effect paratransit by changing the extent and hours of operation of service. Extending routes to new portions of the service area, or running service later into the evenings or during more of the weekends, can increase the period and area over which paratransit service must be provided.

On the other hand, reducing the coverage area of the fixed-route network has the potential to reduce the area an agency is obligated to provide complementary ADA service across. But, many agencies that remove an area from transit coverage where paratransit customers live will often provide continued eligibility for those customers for a set period of time. While it is not a central element of the choices for the transit network in Memphis, changes to the fixed route network may affect who is eligible for paratransit service and therefore any changes in that network must also consider the impacts to paratransit service.

It is important to note that in most places paratransit demand is increasing faster than general population growth or transit ridership growth. This is primarily due to general increases in the average age of the population. Thus, one should expect that even if no changes were made to the Memphis fixed route transit network in the next 5-10 years, the paratransit eligible population and ridership would likely rise.

3 Network and Route Performance

Ridership

One measure of transit performance is the amount of ridership it generates. This can be visualized by mapping boardings at transit stops, as shown at right.

From this map, we can observe that the highest boardings occur:

- At the Hudson, American Way and Airways TCs
- At intersections between long routes, e.g. the 42 and 50, the 30 and 39.
- Continuously along the most frequent routes, e.g. the 50 and 42.

Making a transfer between cross-town routes can easily double someone's total travel time. Yet the pattern of high boardings at route intersections shows that *some riders are diligently using the grid and bearing the long transfers necessary to get to their destinations*.

Looking at this map, however, we must keep in mind that not every stop is offering the same level of service. Some of these stops are served once every two hours. Some are served every 20 minutes. A small dot on a low-frequency route may simply reflect the low level of service. A small dot on a more frequent route, on the other hand, suggests other problems. Conversely, a large dot on an infrequent route means that ridership is high despite a low level of service, which suggests that underlying transit demand may be high.

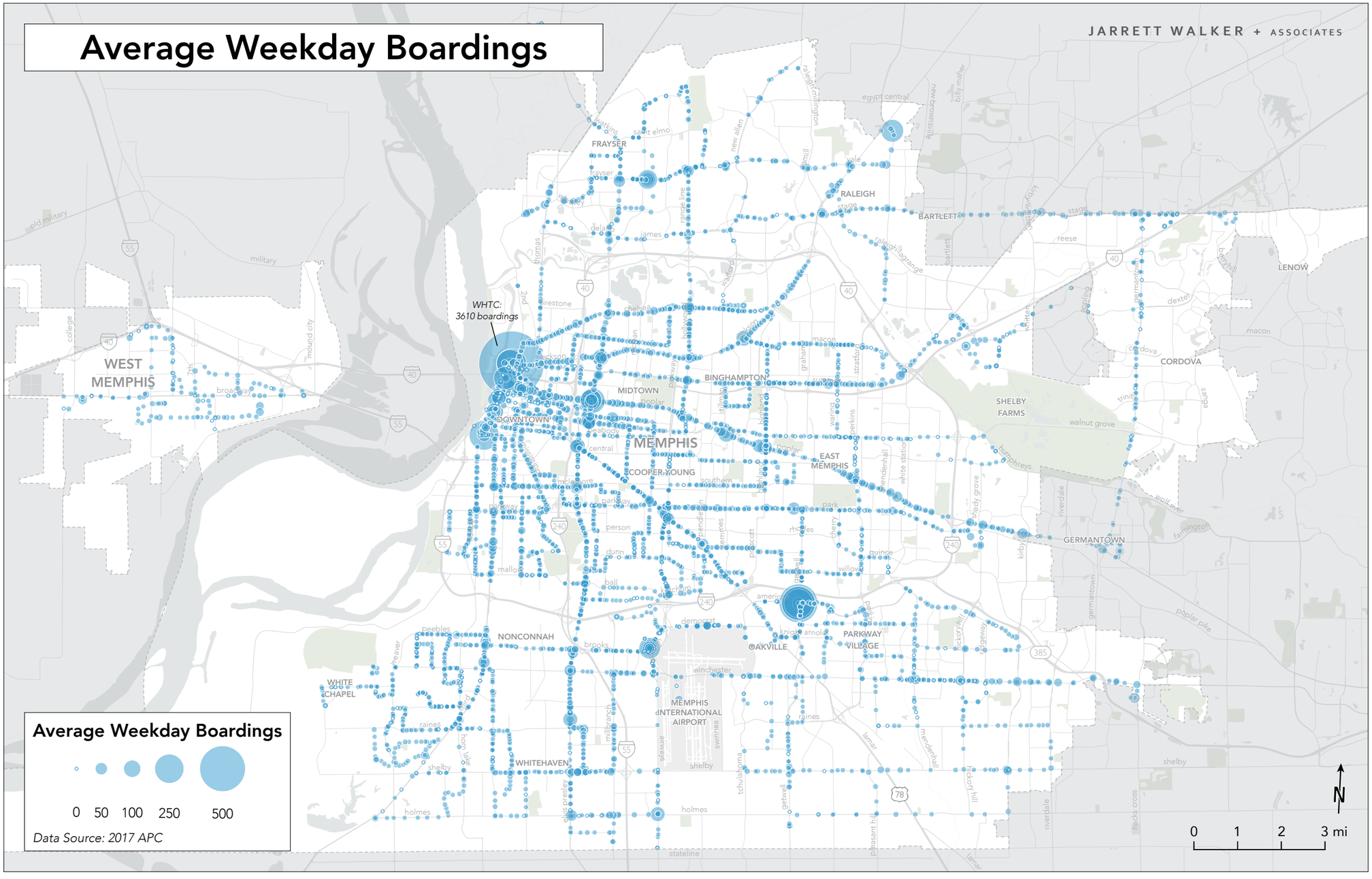


Figure 26: Average total weekday boardings at every MATA stop, from April 2 to July 27, 2017. When a stop is served by multiple routes, the boardings for all routes are summed for that stop.

System-Wide Productivity

Some transit agencies and cities have adopted a goal of "maximizing ridership." Implicit in this statement, however, is a constraint: there is a limit to how much funding is available to increase ridership. The 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 "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. However, because their 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.

Ridership relative to cost is called "productivity." In this report, productivity is measured as boardings per service hour.[1]

Productivity = Ridership / Cost = Boardings / Service hour

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.

System-wide productivity

Productivity in Memphis has remained fairly steady since 2005, as shown in the graph at right. This is striking, given that the supply of service declined over the same period of time (as shown in Figure 3 on page 6).

It is likely that MATA maintained high productivity by cutting service on its least-productive routes, and preserving service levels as much as possible on its most productive routes.

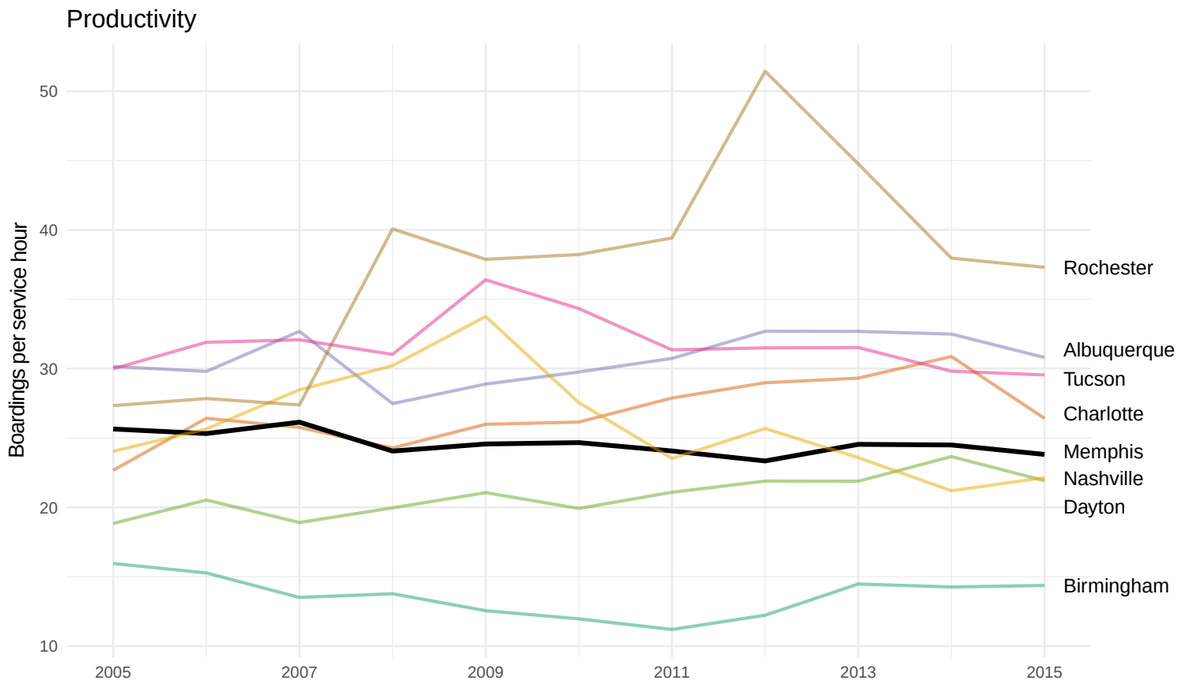


Figure 27: The productivity of MATA's bus network, among peer cities, from 2005-2015.

1. The technical term for a service hour is "revenue hour of service," which represents one hour of a bus and driver in operation, open to the public, accepting revenue. Revenue hours do not include the time drivers spend getting to the start of a route, which is known as deadhead. In this report we use the more intuitive term "service hour" instead of "revenue hour."

Route-by-Route Productivity

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 bus (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).
- The span of service along the route each day and each week.

Changing any of these factors for a transit route will affect the denominator of the productivity ratio. For example, doubling the frequency of service on a route will double the number of service hours being supplied. This means the denominator of the productivity ratio has been doubled. We might therefore expect that productivity of the route would be cut in half, unless the numerator of the productivity ratio—boardings—were to also increase.

The scatterplot at right shows the individual routes from MATA, each plotted according to their midday frequency (on the horizontal axis) and their productivity (on the vertical axis).

The data points form a curve, up and to the left. More frequent services tend to have higher productivity (ridership per service hour), even though providing high frequency requires spending more service hours. (This is true not only in Memphis but also all over the world.)

This happens because frequent service is the most useful and convenient service for riders; thus, transit agencies typically target this most expensive service towards their strongest markets. When frequent service is available to people in a suitably dense, walkable environment, high ridership is a common result.

As always, the "outliers" are the most interesting parts of this graph:

- Routes 38, 98 and 44 are relatively unproductive compared to "peer" routes at the same frequencies.
- Routes 42, 56, 57 and 7 are relatively productive compared to "peer" routes.
- Some of the least frequent routes, in the right-hand column, are just as productive as hourly routes.

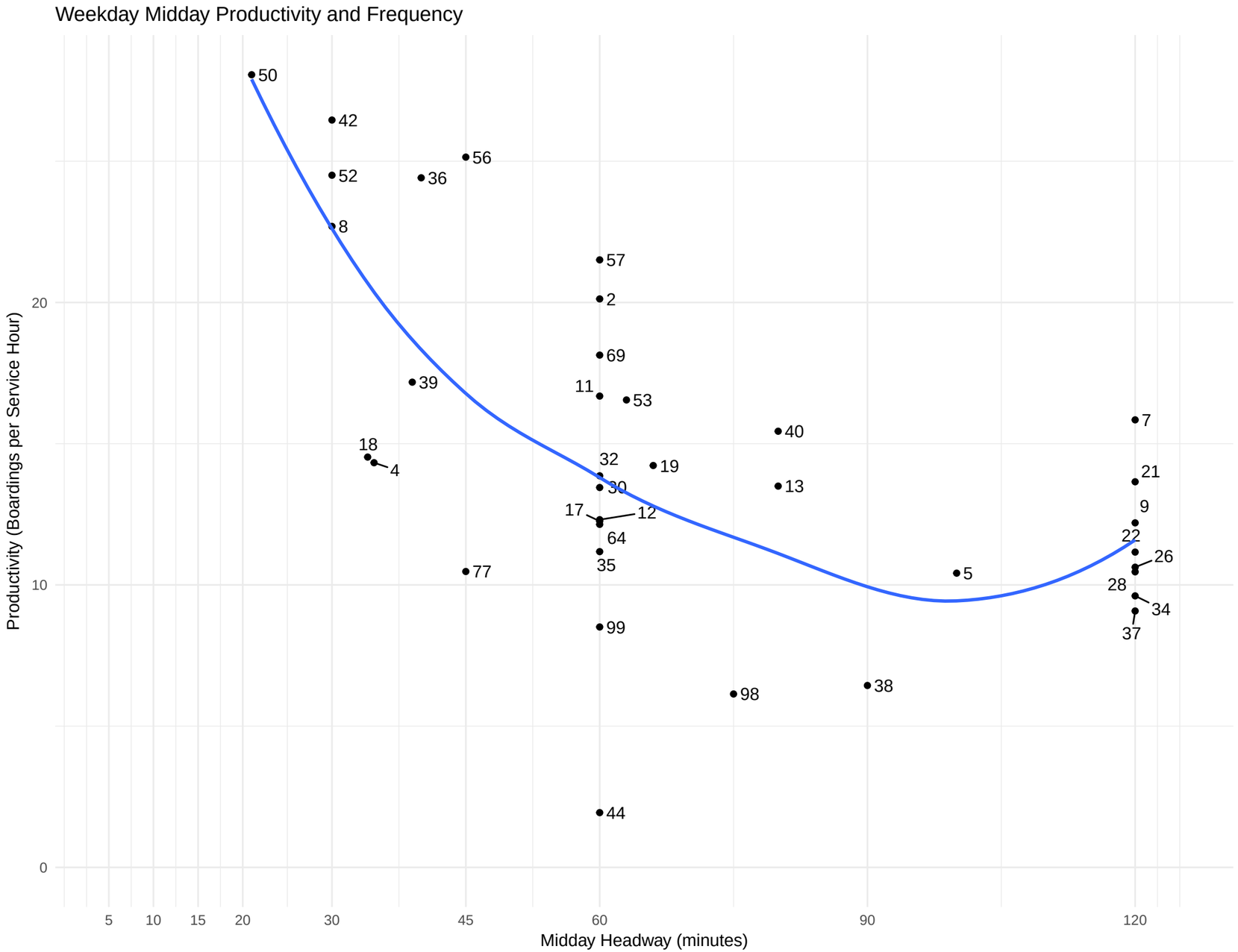


Figure 28: Boardings per service hour plotted against midday frequency. Higher frequency routes tend to be more productive, even though higher frequency increases their costs. Routes without midday service (6, 82) are excluded from the figure.

Route-by-Route Productivity

There is a striking difference between the shapes of the top four most productive routes and the bottom four least productive routes in the Memphis network..

Line drawings of these routes are shown at right. (West Memphis routes are not included in this demonstration, though they are shown in the scatterplot on the previous page.) The four most productive routes:

- Travel in fairly straight and direct lines without deviations. Even Route 56, while not a straight line, still follows a reasonably *direct* path across a grid of streets.
- Loop only at the ends, when the bus is likely to be empty. This means that few people have to travel out-of-direction.
- Run at higher frequencies (as shown in the scatterplot on the previous page).
- Operate at least until 11 pm on weekdays, and on both Saturdays and Sundays (as shown in the frequency table on page 8).
- Serve continuous areas of moderate or high density.

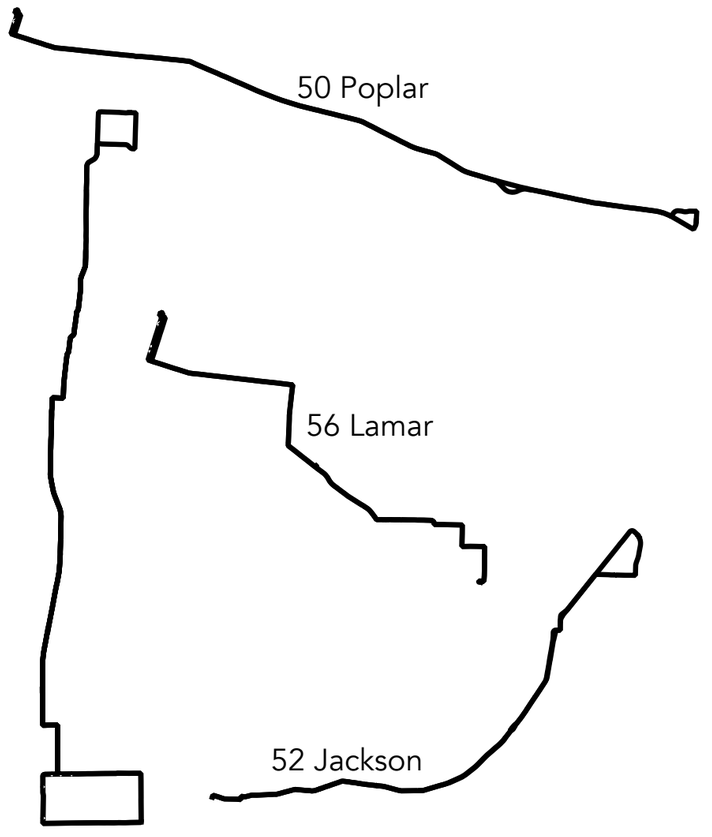
In contrast, three of the four least productive routes:

- Travel in circuitous paths (Routes 38 and 44).
- Deviate repeatedly from the most direct path between destinations.
- Run at very low frequencies (as shown in the scatterplot on page 32, in which they are all in the 90- or 120-minute column).
- Operate on weekdays-only or weekdays-and-Saturdays only (as shown in the frequency table on page 8).
- Serve areas with mostly low densities and long empty gaps between those pockets of density that are on the route.

Route 34 is unlike the other least-productive routes in that it is linear and serves downtown. Two factors likely contribute to the low productivity on Route 34. First, with the exception of Baptist Hospital at the terminal, the eastern half of Route 34 runs along Walnut Grove, through a relatively high-income, low-density residential neighborhood that generates predictably low ridership (as we can see on the boardings map in Figure 26 on page 30).

The second reason is that Route 34 is in competition with many other routes in downtown and Midtown. Transit routes in a network are of course not meant to compete with one another. Rather, they should be designed to provide the degrees of frequency and coverage desired,

Most Productive Routes



Least Productive Routes

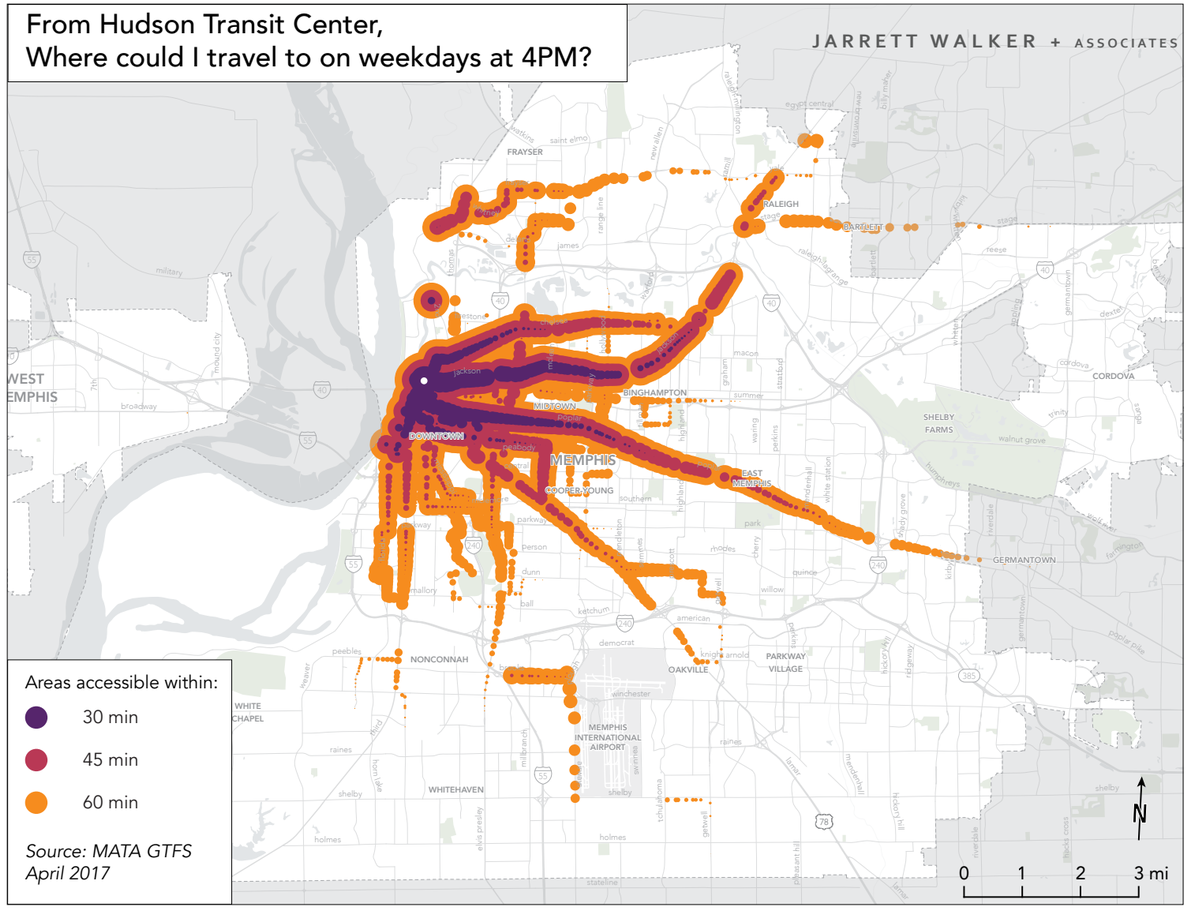
Figure 29: Route shapes for the most and least productive MATA routes (not drawn to scale). The most productive routes have in common a linear pattern, higher frequencies, and longer weekly spans of service, and they serve corridors in Memphis where density is high or moderate, and continuous along the corridor.

while minimizing duplication, so that the investment in each route is uniquely useful.

Later in this report, on page 38, we describe the redundant set of parallel routes that emerge from downtown and pass through Midtown. Route 34 is one of them. Downtown and Midtown present a very strong market for transit—with dense mixed use development, continuous over many miles, along linear yet walkable routes, with a connected local street network. Yet the potential ridership in downtown and Midtown is divided over numerous east-west routes, which are dividing potential riders among them, without offering the higher frequencies that would increase ridership. This is discussed at greater length on page 38.

All of the routes on this page can be examined more closely in the Route Atlas Appendix, starting on page 46. The Atlas contains maps of each route, with the average daily boardings at each stop.

Freedom and Access



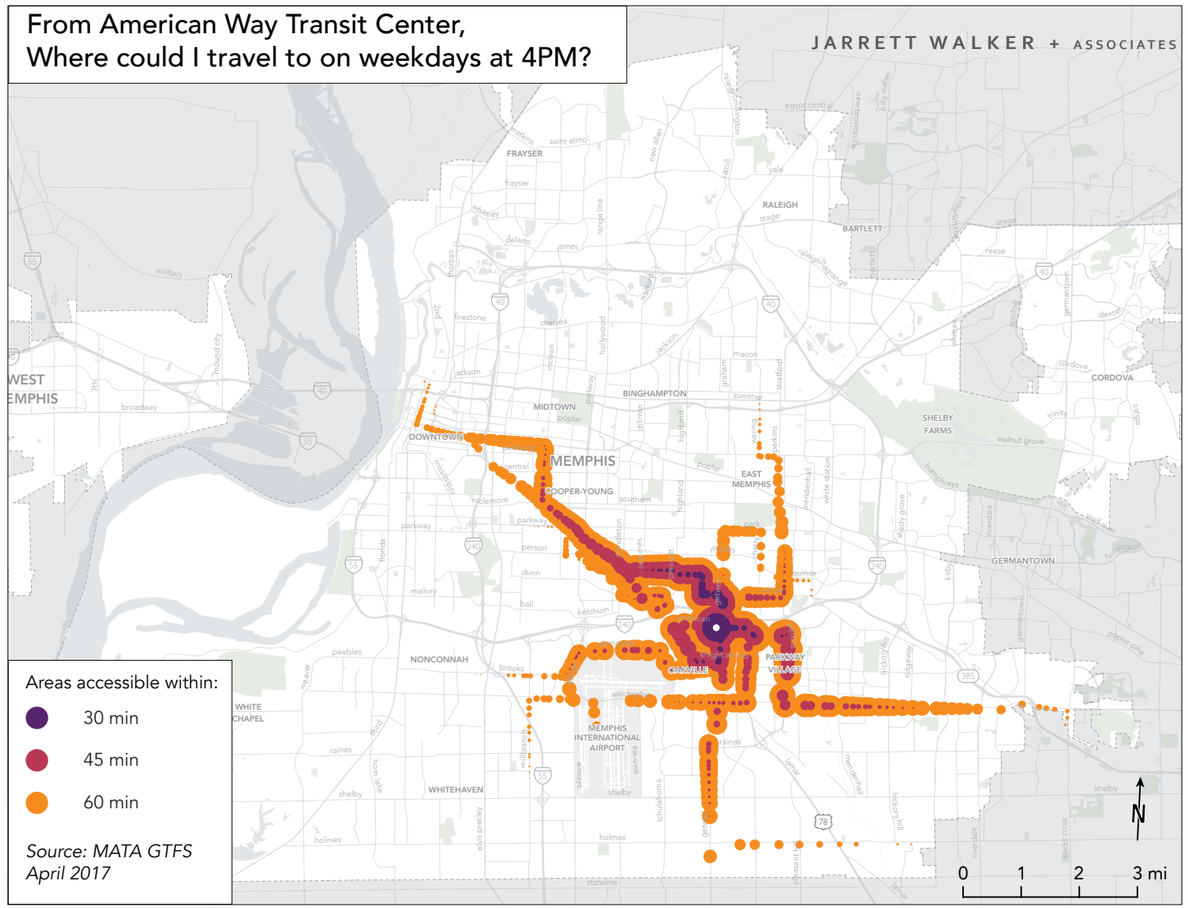


Figure 30: Low freedom. Even riders starting at the network's biggest transit center, on a weekday, during the day, can access little of the city within an hour's time.

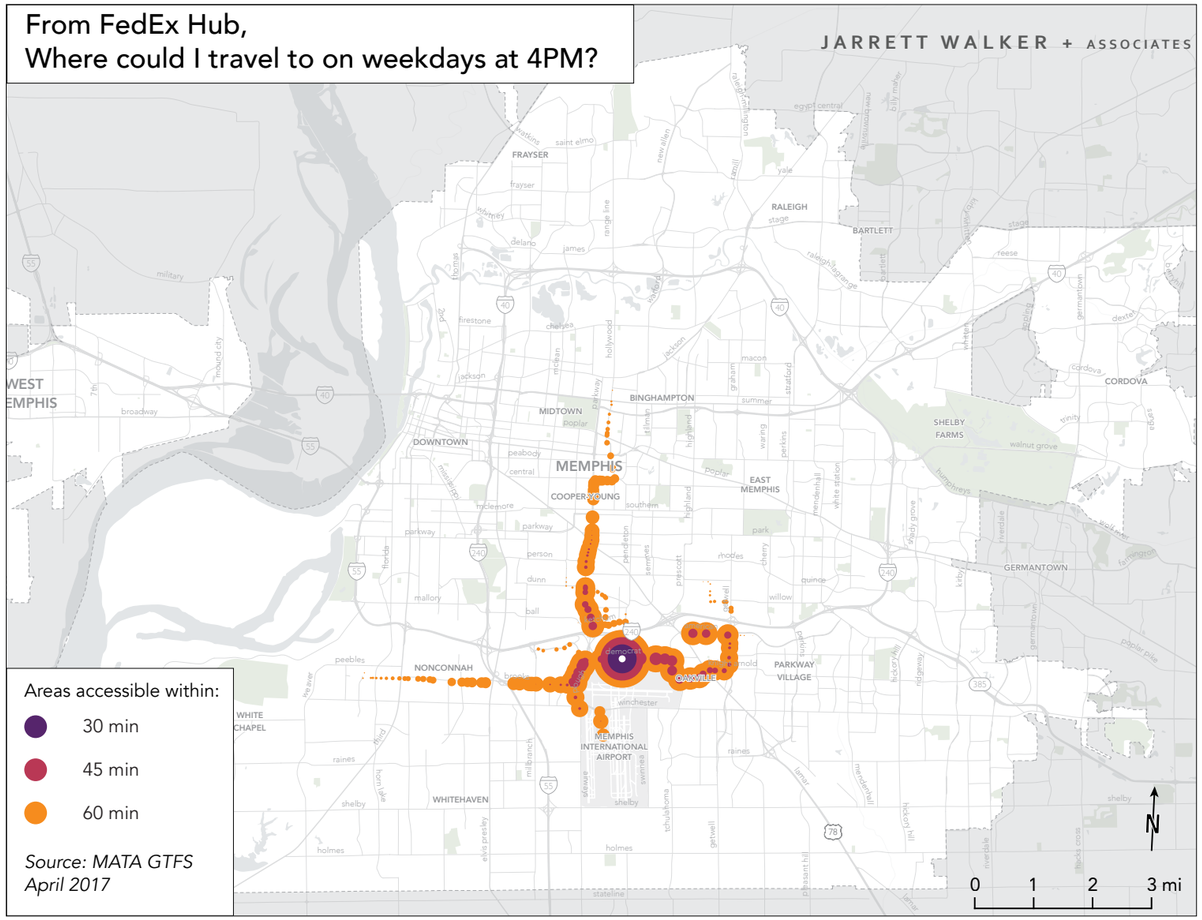
The maps on this page and the next show where someone can go if they start out between 4 pm and 5 pm on a weekday. Areas they can reach within 30 or 45 minutes are shown in purple and red. Areas they can reach in under 60 minutes are shown in orange. All other areas are not accessible within an hour.

In this travel time analysis, time is allocated for walking to and from bus stops. Time is also allocated for waiting for the bus, and waiting again to make a transfer. As described earlier in this report, if someone is transferring to a route that comes every 60 minutes, and the connection is untimed and therefore at random, they will wait on average one-half of the headway: 30 minutes. The average wait for a bus that comes every 20 minutes will be 10 minutes. Thus a great deal of Memphis transit customers' travel time is eaten up by waiting for their bus.

These two locations represent the "best case scenarios" for transit travel time measurement in Memphis. They are major hubs where numerous routes (including, at the Hudson TC downtown, MATA's most frequent routes) come together.

One thing we can observe from these two diagrams is that the Memphis transit network is barely performing as a *network*. We can see just two examples where a place is accessible using two routes within an hour. Someone could ride Routes 50 (Poplar) or 52 (Jackson) from the Hudson TC, and transfer to Route 32 to reach a short section of Hollywood St. (this access is visible as small orange dots at bus stops on Hollywood St.). Also starting from Route 50 or 52 someone could transfer to Route 42 to access Watkins St. to the North and Bellevue Blvd. to the South. Aside from that, an hour is only enough time to wait for and ride a single route.

Freedom and Access



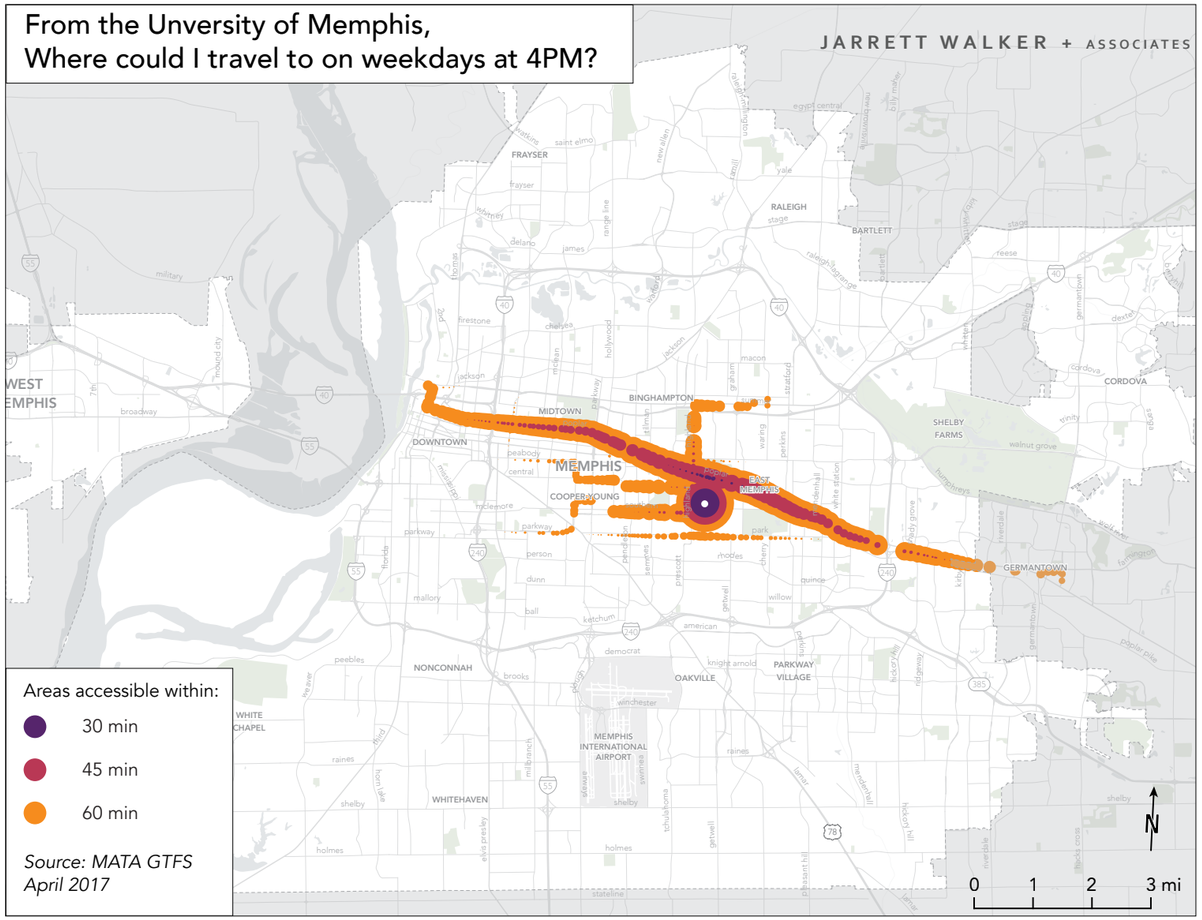


Figure 31: Low freedom. Two areas of potential high demand have limited transit reach.

The maps above repeat the analysis shown on the previous page, but for two places of major civic importance that are *not* transit centers: the FedEx Hub (at left) and the University of Memphis (at right).

Access from the city to these places is obviously much worse than in the previous two examples. While MATA has designed the network to deliver people to these locations, from more than one direction, only so much service can be concentrated at any one employer or college.

If a transit service is designed for a particular major employer, their shift-change times can sometimes be harmonized to the bus schedule. This reduces employees' waits for the bus and thereby gives them greater access to the rest of the transit network and the city. However, this only works if it is truly *one* major employer that generates the transit demand; otherwise, it is not possible for the transit agency to design the perfect transit schedule around multiple work-sites' shift-change times.

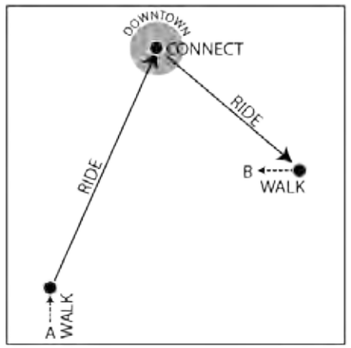
Network Design Choices

MATA's existing network uses three different basic shapes: it has radial elements, grid elements, and some outlying "feeder" networks. The diagram below (Figure 33) explains how grid and radial networks differ.

There is some awkwardness in the current design of the MATA network. Grids are wonderfully powerful shapes that can provide anywhere-to-anywhere freedom across a large area. However, they depend on high frequency, because they depend on transfers. MATA does not offer any frequent service, and so using the grid requires making long and uncertain transfers.

Similarly, feeder networks that connect at Transit Centers are an excellent tool for providing low-frequency coverage in outlying areas, but they depend on a "pulsed" connection with longer-distance routes if waits are to be short and reliable.

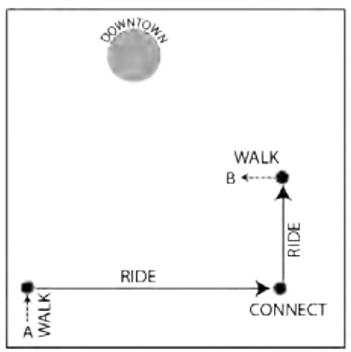
At the American Way and Airways Transit Centers, local feeders come together, and people can transfer from a feeder onto a downtown-bound route.



Radial Network

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

A radial structure makes sense when one part of a city (typically the downtown) is a dominant destination all day – for work, for play, and for commerce. Often, routes are scheduled to converge at a set time (called a "pulse") to reduce transfer times between routes.



Grid Network

Parallel east-west routes and parallel north-south routes intersect all across the city, not only downtown.

A grid structure is most suited to a city with multiple activity centers and corridors, where many people are traveling to many different destinations. Grid networks are only effective when intersecting routes operate at high frequencies, generally every 15 minutes or better, so that connections between routes do not require long, inconvenient waits.

Figure 33: How Radial and Grid networks work.

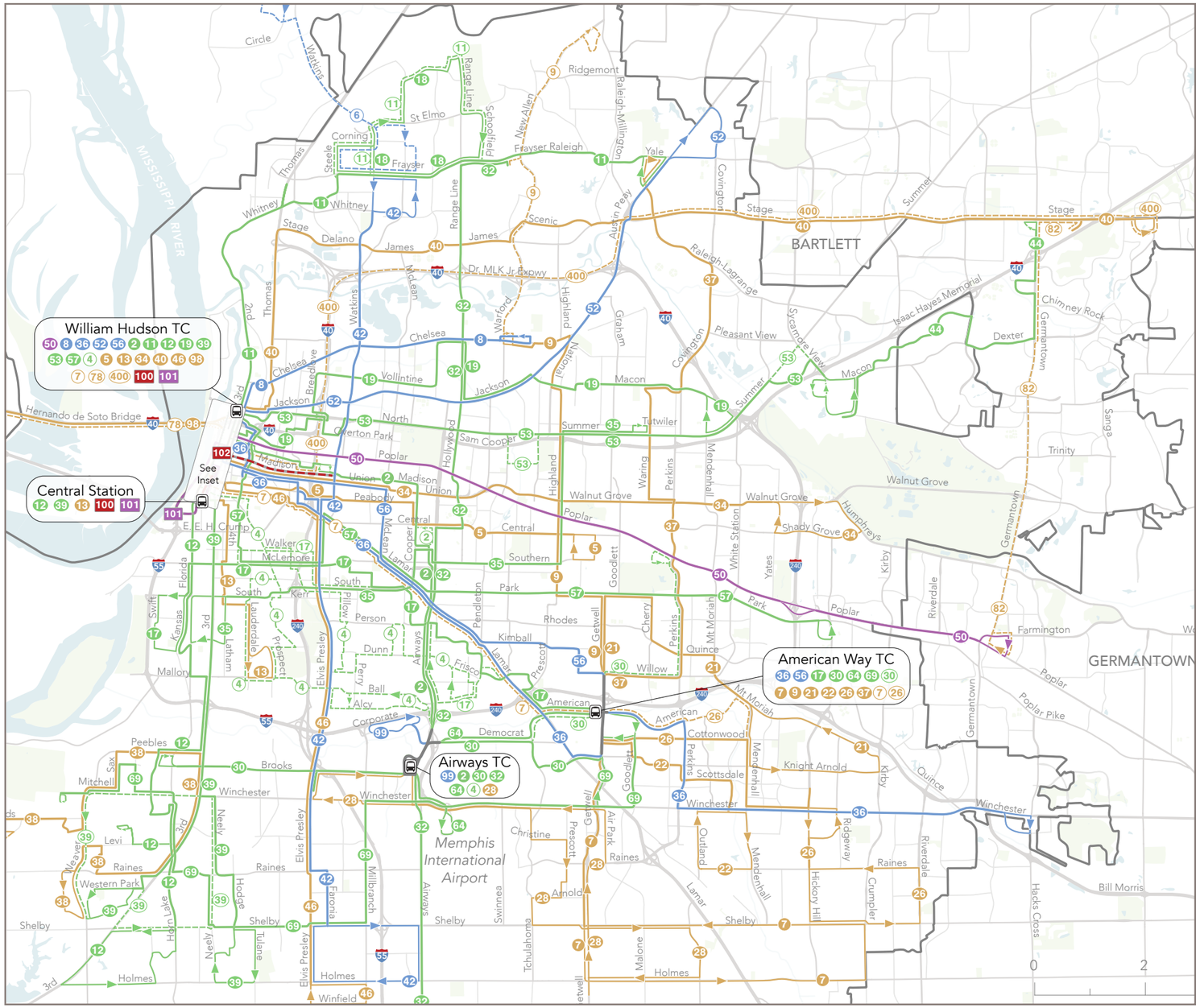


Figure 32: Network map excerpt. For the full map and legend, see page 7.

A radial network design ensures that anyone looking to travel downtown can make their trip without the need to transfer between routes. Radial networks arose naturally in pre-car cities because so much commerce and culture was centralized. In Memphis, the center was located where the railroads and the river intersect.

As a city grows larger, radial networks become less practical because the out-of-direction travel required to get between two non-downtown points gets so much longer. In addition, since the invention of the car and freeways, most U.S. cities have developed many more "centers." A radial system struggles to accommodate multiple centers or sprawling and scattered development. This is likely why the last Short Range Transit Plan for MATA so clearly recommended a shift to a grid-shaped network.

Memphis is not a highly centralized city and many people make work commutes far from downtown. The grid (crosstown) and feeder networks MATA has instituted are meant to facilitate those trips. The difficulty is that transfers are an integral part of these network shapes, and transfers among low-frequency routes are especially unappealing.

An untimed connection between two buses that come every 60 minutes could require a 30 minute wait, on average, and in the worst case a 59-minute wait! If one of the buses comes every 90 or 120 minutes, as some MATA routes do, the waits are even longer.

There are two ways to deliver a connected network that facilitates transfers without requiring long waits:

Frequent grids

In cities with many centers (such as LA, Chicago or Houston) a frequent grid allows people to travel from-anywhere to-anywhere with a single fast transfer. It requires much less out-of-direction travel than a radial network. A frequent grid offers the simplicity and reliability of a street network—you can use it just about anytime, without checking a schedule or making an advanced plan.

A necessary precursor to a successful frequent grid, however, is high frequency. MATA does not currently focus enough service into its crosstown routes to offer a frequent grid. In order to do so, MATA would have to either cut many routes, or raise additional revenue for additional service.

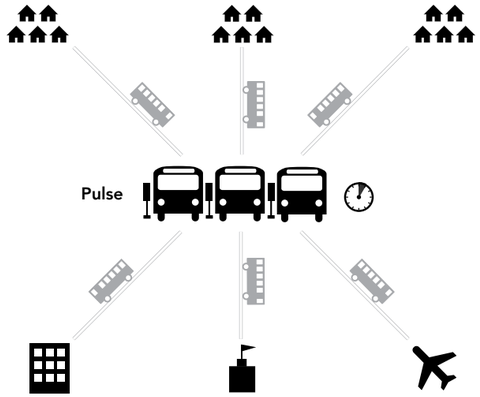


Figure 34: In a pulse, multiple low-frequency routes are scheduled to come together regularly, dwell for a few minutes so that passengers may transfer among them, and then depart again.

Feeder networks and pulses

A transfer between low-frequency routes can be appealing if the routes are designed to meet one another at the same time and the same place, in a recurring patter.

These timed-connections or pulses occur when multiple buses dwell at the same location, allow a few minutes for transfers among them, and then continue on. MATA currently schedules pulses at the Hudson and American Way Transit Centers.

Poor on-time performance can be devastating for pulsed connections. If buses run every 60 minutes and their connection is pulsed, but one bus is late, then transferring passengers must wait almost the full 60 minutes for the next bus. These are the situations in which transit riders are seen sprinting after a bus that is pulling away. Being an hour late to work can cost people their jobs.

Pulses are hard to see. A rider must use a trip-planner or decipher and reconcile multiple schedules to confirm that a transfer between two 60 minute routes won't require a long wait. In contrast, a frequent grid guarantees a low maximum wait time at the connection point, without the complexity of pulses.

Scheduling repeated timed-connections among infrequent routes requires recurring frequency patterns. For example, a pair of routes can connect repeatedly throughout the day if both have 60-minute frequencies. Or, if Route A comes every 60 minutes and Route B every 30 minutes, they can connect on every-other trip of Route B. As long as their frequencies repeat reliably, and divide into one another (as 30 does into 60), then the timed-connection can be scheduled to happen many times each day.

Timed-connections are less feasible when routes vary in shape and distance throughout the day, and when every route has a unique frequency, as some MATA routes do.

Clockface frequencies

Many transit agencies deliberately design routes, and write schedules, so that routes have "clockface frequencies." This means that the time between buses at any given stop is 15, 20, 30 or 60 minutes. This pattern in a schedule is far easier for most people to recognize than frequencies that don't relate to 60 minutes.

On an hourly route, for example, ***the schedule becomes vastly easier understand and remember if the bus leaves at the same time in each consecutive hour***. If you know that the bus leaves at :15 after each hour, and you know when service begins and ends each day, then with just these three facts you know the entire day's timetable.

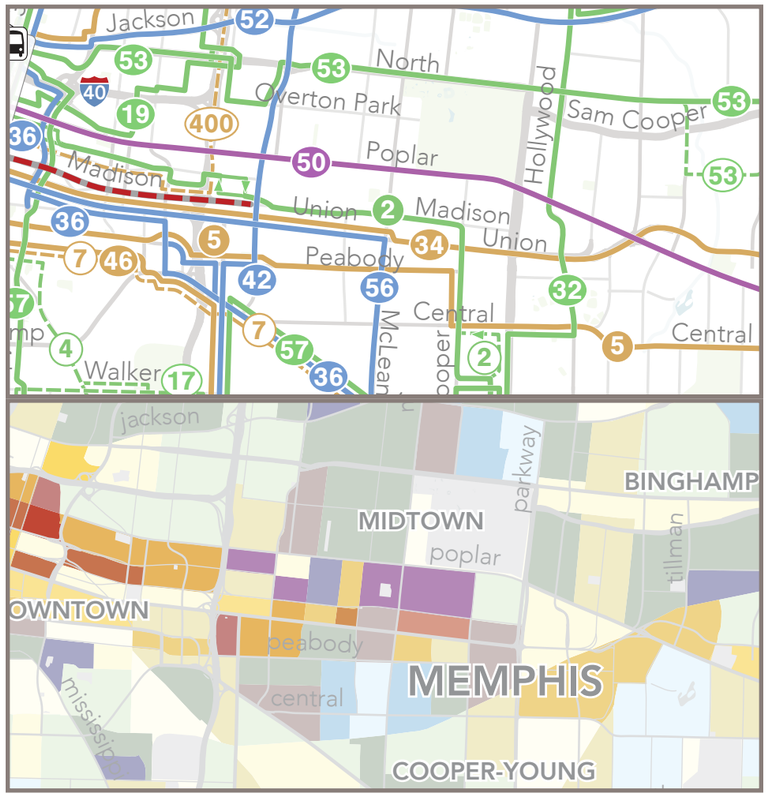
Clockface frequencies are especially important at low frequencies, such as hourly or half-hourly. At these frequencies, the trip must be planned around the limitations of the timetable, so ***a timetable that can be remembered makes it easier to plan those trips spontaneously***. For this reason, frequencies such as 21-, 37- or 66- minutes should be questioned. At these low service levels, the usefulness to the customer may actually be improved if the frequency is changed to a memorable 30 or 60-minute pattern, even if this is a technically worse frequency.

Ease of memorization directly contributes to the user's sensation of freedom. Low frequencies are not very liberating, but at least with clockface frequencies the user can remember the schedule. This makes it apparent what the options are at any time of day.

Duplication and competition

A natural, geometric consequence of the Memphis radial street network is that as streets near downtown they get closer to one another. The same is true of a radial transit network—as bus routes near downtown, they are either routed onto the same streets or they run on very nearby streets.

In Memphis, for the most part the transit network does the latter: as routes near downtown, they each run on a unique street, a very short distance from one another. This is most apparent downtown and in Midtown, where six to eleven routes run within walking distance of one another but on separate streets.



Downtown and Midtown present a very strong market for transit—with dense mixed use development, continuous over many miles, along linear yet walkable routes, with a connected local street network. It is reasonable for MATA to offer so much service there, given what a strong market for transit it is and how many people who need transit live there.

In the current arrangement, each of those parallel streets has one or more transit routes going down it. If someone wishes to travel to downtown and doesn't like to wait a long time, they must do a complicated survey of schedules (or use a transit planning app, if they have one) to figure out which street to walk to. Once underway, if they miss that bus, they have to start again, and walk to a different street. Nearby, infrequent, parallel routes make trip planning much more complicated for customers.

Dividing transit service among more streets inevitably leads to lower frequencies on each street, and therefore longer waits. If parallel routes can be consolidated onto a few main streets, service frequency to many destinations is better and waits are shorter. However, more walking is required. This is why walking distance and waiting time are inexorably linked in any transit network, and trade-off against one another.

These duplicative routes could in the future be designed and scheduled to have *additive frequencies*: if two routes on the same street come every 60 minutes, then they can be designed to arrive exactly 30 minutes apart, and someone traveling a short distance could wait at a single stop for either bus.

At present, however, these routes are less *additive* and more *duplicative* and *competitive* among one anther. Ridership is divided among them, yet they do not combine to offer the higher frequencies that would attract new riders and increase productivity.

Shapeshifting Routes

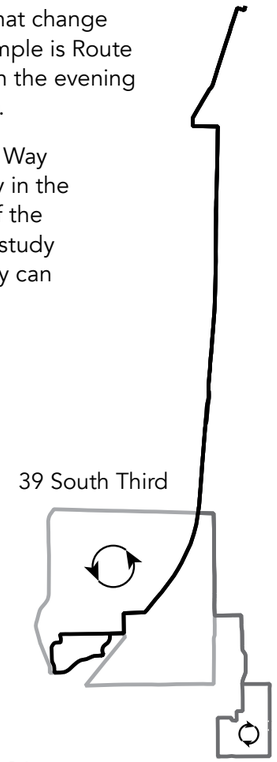
Transit agencies often design routes with branches. Branches effectively increase access to transit at the outer ends of a route while maintaining higher frequencies along the main corridor.

Several problems occur with route variations.

- One-way loops may change direction at different times of day.
- Coverage areas can change drastically.
- Transit may be useful only for reaching jobs in the morning peak and returning in the evening. Other uses like running errands during the day are effectively excluded.

These problems increase the difficulty of understanding the transit network. ***Riders cannot simply return to a stop across the street from where they departed the bus***. And riders have no guarantee they'll be able to return home on the same route.

MATA's network includes a number of routes that change shape and length throughout the day. On example is Route 39 (3rd Street) which radically changes shape in the evening by expanding its terminal loop (shown at right).



Similarly, Route 7 provides access to American Way Transit Center from Hudson Transit Center only in the early morning, with no return trip in any part of the day. This type of complexity requires riders to study and understand the service pattern before they can depend on it.

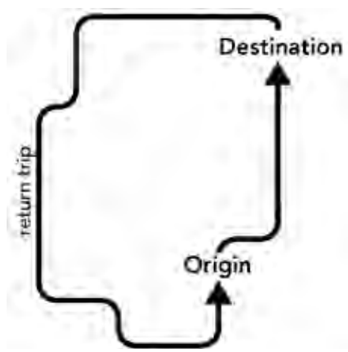
One-way Loops

One-way loops are sometimes put at the ends of long routes, because they are easy ways to turn-around a bus. At the end of a long route, buses tend to be empty, so very few people end up riding around the loop.

But sometimes one-way loops are used to provide coverage: access to service that doesn't result in much ridership. One-way loops sacrifice directness and travel time in order to cover a larger geographic area.

How does a passenger experience this sacrifice? It may be that on their way out, they can get on the bus and it goes in the direction they are traveling, so the trip feels fairly direct. But on their return trip (as illustrated below), they must ride around the loop the long way, out of direction, to get back to where they started.

Like hourly service, a one-way loop cannot attract a passenger whose time is scarce and valuable (and that person may be rich or poor) because ***the loop guarantees that in one direction or another, the trip will be long and circuitous***.



MATA's network includes large one-way loops on nearly every route, some with large one-way loops on both ends, covering large areas for a low cost.

Some one-way loops are narrow enough that people will walk to one stop for their outbound trip, and from

a different stop for their inbound trip, and thereby avoid riding around in a circle. For example, the eastern end of Route 8. However, the legibility of the network decreases whenever a rider gets dropped off in one place and has to walk to a very different place to get picked up again.

Managing complexity

Deviations, special trips, branches and loops are challenging for any transit agency to manage because the people discouraged by them tend to give up on transit and remain silent. On the other hand, the people and organizations who benefit from them tend to be vocal, obvious and organized.

Regular customers of the most complex transit systems may be experts at complex routes or schedules, and a few of them depend on elements of that complexity. Yet they are outnumbered by the people who tried the transit network once and found it too complicated and too unreliable, and then decided to not become regular customers.

Complexity arises from individual requests for transit access at certain times and certain places. In the long run, complexity is a barrier to transit access by large numbers of people across the city.

The sources of complexity we have described above arise, in part, when transit agencies need to provide coverage to many places, within a fixed budget. MATA's declining supply of service has likely generated more complexity, as staff do their best to continue meeting needs with less and less service.

If a community highly values the coverage-related outcomes of transit, the transit network that serves those values will tend to be more complex (though with sufficient funding, it needn't be as complex as the existing MATA network). If a community values ridership and productivity outcomes more highly, then the transit network will tend to be more frequent and simpler.

On-Time Performance

On-time performance is a measure of how reliably buses depart when customers expect them (and sometimes need them) to depart. MATA defines a bus as being "on-time" if it departs from a major bus stop from 1 minute earlier to 5 minutes later than scheduled.

Reliability is particularly important when a transit network is built of so many infrequent routes. Because another bus is *not* coming soon, the timeliness of each bus is extremely important.

This is even more true when low-frequency buses are meant to pulse so that passengers can make a quick transfer. If an arriving bus is late and misses the pulse by just a few minutes, that can cause passengers to be and hour or two late to their destinations. For many workers, this would be grounds for losing their job. It is also a small disaster for anyone who is going to pick up a child at day care, or going to school, or a medical appointment.

MATA's current target for on-time performance is that each route should be departing "on-time" (1 minute early to 5 minutes late) 60% of the time. This is a very low target, compared to targets at other agencies. Although 60% is the official MATA policy, the City of Memphis has set its own standard of 76% on-time performance for all fixed route service and MATA is reporting system wide on-time performance to the City on a monthly basis and is working toward achieving this goal

The chart on the following page (Figure 35 on page 40) shows the existing on-time performance of MATA routes, and the seven routes that are failing to meet the official MATA 60% target.

On-time Performance

Most routes are achieving the 60% target, as shown (in grey) in the chart at right. Most routes do not meet the City's target of 76%.

Seven routes are not achieving this target (shown in red). They include Routes 7, 26 and 56, which are meant to participate in pulses at the American Way Transit Center. This is cause for concern.

It is likely that the reason for such low on-time performance across MATA's network is that MATA is doing their best to squeeze the most frequency possible out of a small and declining supply of service. Routes may be scheduled based on "ambitious" cycle times (the cycle time is the amount of time it takes the bus to do a round-trip on the whole route). If anything goes wrong with traffic, with a rider, or if the route just gets more boardings than normal, that would be enough to lengthen the cycle time, and put the route behind schedule.

To guard against these regular delays, transit schedulers add a cushion to each cycle, called "recovery time." If the bus is running behind, when it gets to the end of the line it can skip its recovery time and thereby get back on schedule. (Another cushion of time is "layover," which is meant for driver breaks, and should not be skipped!)

Layover and recovery time are essential to maintaining reliable operations for a transit system. ***Without sufficient recovery time, a delay at the beginning of the day will cause greater and greater delays throughout the day.*** A single delay could affect passengers (and drivers) for hours after the original incident.

A typical planning standard is to keep 10-15% combined layover and recovery in the schedule, for driver breaks and to allow drivers to catch up in case they were delayed on any given trip. The exact needed recovery time can depend on the city, the route and the time of day.

Nearly 40% of MATA's routes have less than 10% of time set aside for recovery. ***These narrow recovery margins likely exacerbate poor on-time performance.*** Fixing them, however, would require reductions in the advertised frequencies of many routes.

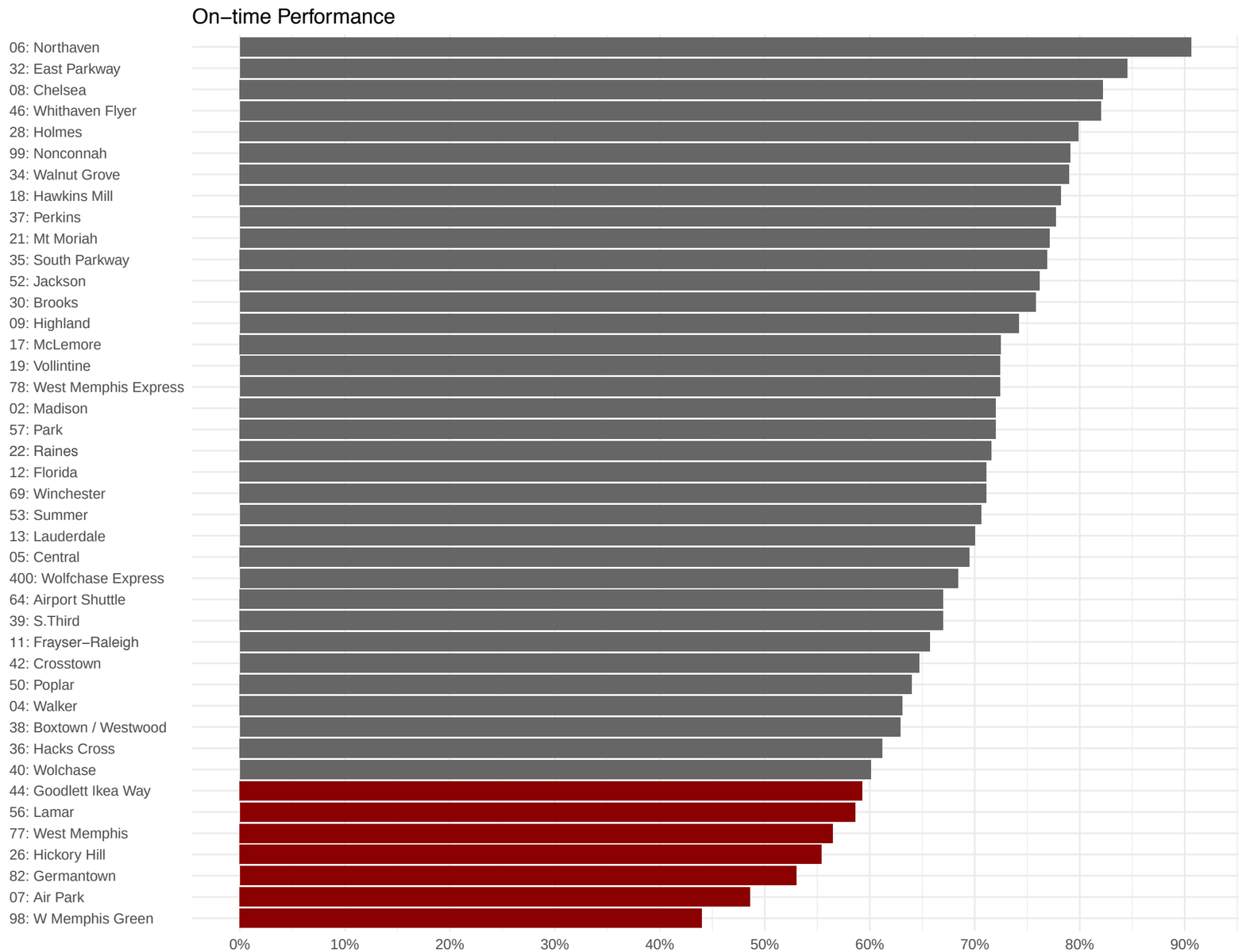


Figure 35: On-time performance for each MATA route. Routes are sorted from best to worst performing routes. Dark red bars indicate routes below MATA's 60% target.

4 Key Choices

Key Choices

How Should We Balance High Ridership with Wide Coverage?

The Memphis 3.0 Transit Vision presents a unique opportunity for the people of Memphis to rethink the basic purpose of their transit system. The current transit network is a legacy of past generations, and has accrued decades worth of history and complexity. Much of the existing network may be worth keeping as is, perhaps because it suits the city and its values, or perhaps because it is known and familiar to riders, which is a value in and of itself.

It is also possible that since this transit network was designed the city has changed and grown enough to justify a fresh start. Transit networks are intricate, interwoven, living things, and adapting them incrementally over time is very difficult. MATA has done a laudable job of making improvements, one route and one area at a time, over recent years. For numerous reasons, this moment in Memphis's history may be the right time to consider a clean-slate rethinking of the transit network:

- The supply of transit service has been steadily declining. While MATA has done a good job of "cutting the fat" and preserving high-ridership routes over the past ten years, there is little fat left to cut. Routes are running late, frequencies are extremely low, and ridership continues to fall. Halting this vicious cycle of decline requires either a major redefinition of the transit system's purpose, or an infusion of additional service—or, possibly, both.
- Memphis is rethinking all of its plans for future land use and growth. Transit can be an integral part of that future, but only if the transit network's own goals and purposes are clear.
- The city has grown and changed substantially since the "bones" of the existing network were put in place. Very few people remember why some routes do what they do. Meanwhile, large numbers of people in Memphis express desires and ambitions for transit that the existing network is failing to meet. Reconciling the network's history with the city's future requires big-picture thinking and some difficult choices.

The most difficult choices for Memphis will be between providing high frequency, long-span services, in order to attract high ridership; and providing wide geographic coverage.

Recall that high ridership serves several popular goals for transit, including:

- Reducing car costs, emissions and traffic.
- Achieving low public subsidy per rider.
- Allowing continued development, even at higher densities, without apocalyptic traffic congestion.
- Giving people more personal and economic freedom.

On the other hand, many popular transit goals do not require high ridership in order to be achieved. These include:

- Ensuring that everyone in Memphis has access to some transit service, no matter where they live.
- Providing lifeline access to critical services.
- Providing access for people with severe needs.

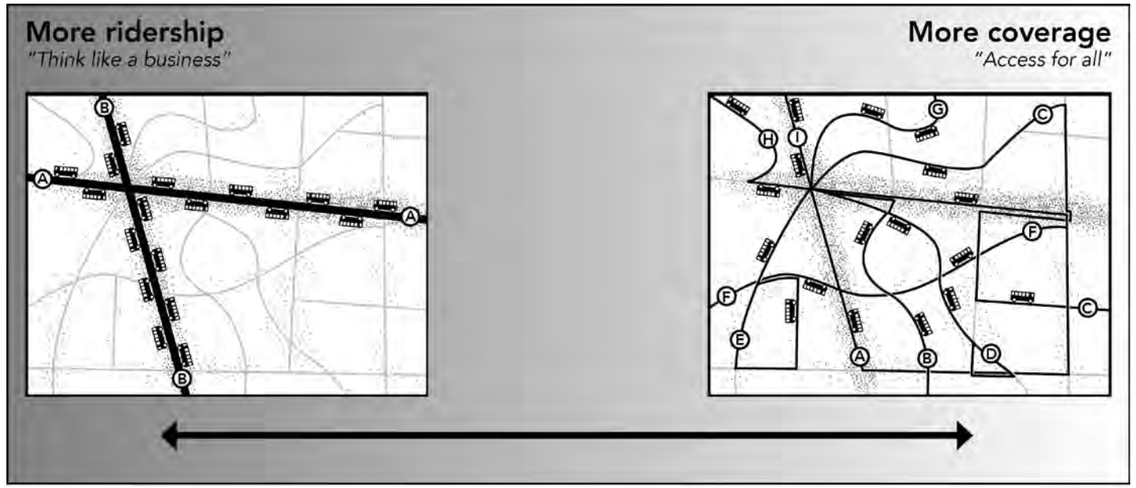
No transit agency focuses solely on either of these goals. Most transit agencies have some direct, frequent, long-span routes on which ridership and productivity are high, and others which run at lower frequencies and more limited times, for specific coverage purposes.

We suggest that Memphis think about this choice not as binary, "yes-or-no" decision, but as a sliding scale (as in the drawing above) that the community can help to set:

> How much of our budget should we spend on the most useful service, in pursuit of high ridership? How much should we spend providing coverage so that people with severe needs have access to some service?

This is not a technical question, but one that relates to the values and needs of a community.

We estimate that about 40% of the existing network is designed as it would be if maximizing ridership were its only goal. The other 60% has predictably low-ridership, suggesting that it is being provided for other purposes. This may be the right balance for Memphis in the future, or the community may value a shift in emphasis.



The direction of that shift—either towards higher ridership or towards wider coverage—and how fast Memphis should make such a shift are both questions for stakeholders to discuss in this planning process.

One way to manage the perennial conflict between ridership and coverage goals is to define the percentage of a fixed route budget that should be spent in pursuit of each one. Memphis could, as a result of this study, establish that it will continue to spend about 35% of its budget maximizing ridership, or it could decide to spend more or less towards that purpose.

Memphis could also decide to maintain the existing balance in the short term, but devote any new funding to either improving ridership or expanding coverage, and in that way shift the balance without cutting any existing riders' coverage or frequency.

Memphis's desired balance of ridership and coverage goals will determine how much of a role high-frequency routes play in its transit network. A high-ridership network would be made of fewer total routes, but with higher frequencies than any route has today.

The frequency of service on routes in the Memphis will affect some technical decisions about how the network is designed, such as whether there is a frequent grid, and whether there are "feeder" networks with pulsed connections. The usefulness of each of these techniques will depend on the frequency of the Memphis transit network. The frequency of the network, in turn, depends on how ridership and coverage goals are traded-off against one another in the future, and how much total service is available in the city.

How Much Transit Do We Want?

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

The three graphs on this page show how relevant transit was to the life of the community (relevance, Figure 36), how much service a transit agency supplied (investment, Figure 37)—both adjusted for population. Figure 38 shows the relationship between investment and relevance for Memphis and all peer cities for each year, with one dot per year from 2005 to 2015.

Among peers, only Birmingham provides less service relative to population than Memphis. In return ***Memphis sees the second lowest ridership relative to population*** among this group of peers[1].

Over the last ten years, while Memphis has consistently cut back service, Albuquerque and Nashville have increased the amount of service per capita each by more than 50%. As a result, both cities have seen consistent growth in the relevance of their transit systems.

While there are things a transit agency can do to get higher ridership within a *fixed* budget, the relationship between investment and relevance in Figure 38 demonstrates the principle of "you get what you pay for", more service generally leads to more ridership. People can't ride bus routes that don't exist.

Even more interesting is the trend line in Figure 38 suggests that for cities in similar situations as Memphis, doubling investment more than doubles relevance. This would suggest, that doubling the investment in transit would more than double the ridership per capita in Memphis.

The City and MATA could increase transit frequency and ridership without investing in more service. However, this would require cutting and reallocating low-ridership services. There is no way around this basic geometric fact.

There are only two paths forward, if Memphis wants to increase transit frequency, transit usefulness, and transit ridership:

- Cut low-ridership coverage services, or
- Supply more transit service.

When there is new revenue available for transit, ridership can be increased without cutting coverage. The growing resource pot protects the community from having to make painful trade-offs between competing, but closely-held, values.

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

Furthermore, if the community does not trust the City and MATA to properly manage their budgets, they will be unlikely to invest in the promise of additional service.

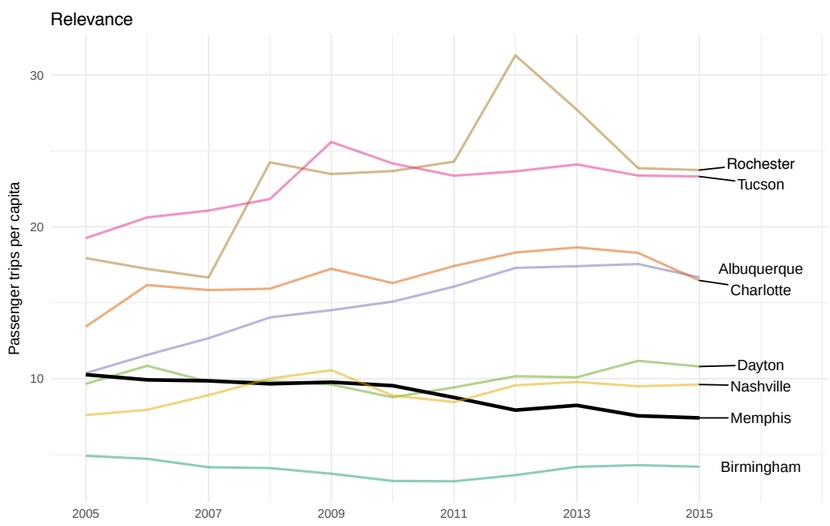


Figure 36: Annual total ridership, relative to population, among peer cities

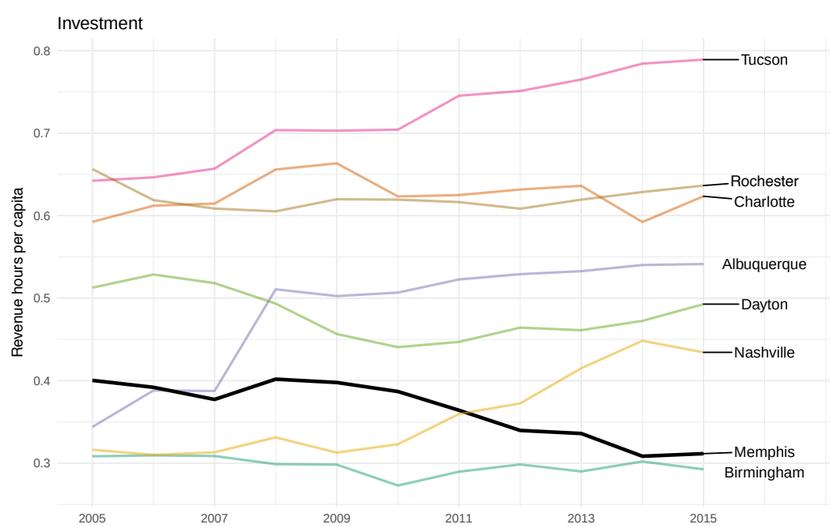


Figure 37: Annual total service, relative to population, among peer cities

Figure 38: Among peers more investment tends to yield higher relevance.

1. Peers selected from the 4 agencies most similar to MATA on the TCRP 141 likeness score and a list of commonly considered and aspirational peers.

Incremental Changes, or All-at-Once?

The answer to the question about the amount of service provided also has bearing on the question about how to change the transit network over time. Should changes be made incrementally, one route or one neighborhood at a time? Or should they be made all at once?

The short-range plan that MATA adopted in 2012 assumed that the agency would shift resources towards higher frequencies and higher ridership over multiple years. In early years, MATA would change routes and schedules. In later years, MATA would add service to increase frequencies and spans.

Within a fixed budget for transit, however, any increase in frequency or span on some routes requires cutting service on other routes. Meanwhile, the supply of service has actually decreased since the adoption of that 2012 plan. Service cuts have been necessary simply to keep MATA's budget in balance, making it even harder to contemplate service cuts for the sake of increasing frequencies or lengthening spans.

Any change to transit services is naturally disruptive to existing riders. Transit agencies can minimize the disruption by giving riders early warning of the change, by providing clear and detailed information about how service will be different in the future, and by making customer service staff available to help riders with individual trip-planning. Despite all of these efforts, even the best-executed and most-widely-supported transit network change will involve some grumbling and disruption, just like any road construction project.

One thing that can help to mitigate the disruption of a transit network change is if the overall supply of service is increasing, or the usefulness of the transit network is substantially improved. This can help riders and members of the public grit their teeth and bear the disruption, because they understand that it will yield a big payoff at the end.

An increase in the overall supply of transit service also allows a transit agency to increase frequencies, lengthen spans, or expand geographic coverage *without cutting anyone's existing service*.

Incremental Changes

Transit agencies sometimes implement network changes incrementally, working towards a new network vision over many years.

The advantages of evolving a network this way (as recommended in MATA's 2012 plan) include:

- The costs of implementation can be substantial: writing new schedules, updating real-time software feeds, training drivers on new routes, designing and printing materials, flagging and moving bus stops, advertising, providing extra customer service, and more. Spread out over multiple years, these costs are easier for a transit agency to absorb.
- The transit agency can manage most of the work of implementation with in-house permanent staff, instead of hiring temporary crews to make a big implementation push.
- The risk of city-wide disruption is low, since any problems will be limited to the area or routes being changed.

However, there are major downsides to making changes in just a part of the service area or just on certain routes:

- The major benefits of a transit network change arise from it working better *as a network*. This means that every part of it is connected to every other part, and changes in one part of town are actually beneficial to people *everywhere in the city.* If the big increase in freedom and access doesn't happen until the last year of a multi-year process, it is hard for people to see the benefits that make the early disruptions worthwhile.
- People will naturally feel as though they, their community or their neighborhood is being singled-out for disruption. The idea that everyone around the city will (eventually) be treated equally to disruption and benefit, over many years, is hard to convey. Changes on the other side of town that will benefit someone are still far in the future, and don't make them feel better about disruption that is coming to their neighborhood next month.
- The public and media may develop the vague sense, over multiple years, that transit service "keeps changing" and is confusing.
- Service changes benefit from marketing campaigns. Launching a large marketing campaign city-wide is more efficient than trying to build enthusiasm and knowledge within subsections of a city, over multiple years.
- Networks cannot actually be separated into distinct pieces. For example, low-frequency routes make timed-connections with one another; a change to one route will "break" the timed-connection with the others.

It is always easier for transit agencies to make incremental changes when there is a growing supply of transit service. That way, the pain and disruption caused by moving a bus route, or removing a bus stop, or changing transfer arrangements, can be offset by the benefits of having more service. Indianapolis raised new transit funding through an income tax in 2016, and is planning to "grow" into its transit vision through incremental changes.

MATA has worked hard since 2012 to fulfill the vision of its previous short-range transit plan. Given the decrease in the total supply of service and the challenges inherent in incremental service changes, the agency has gotten as close to full implementation of that vision as is reasonably possible.

All-at-Once Changes

Sometimes transit agencies decide to make changes to their networks all at once. (This could be described colloquially as the "rip the band-aid off" approach.) This is most common when the changes to the network are substantial, and are spread over many parts of town.

In a well-known example, Houston METRO overhauled their entire transit network at once in 2015. They changed routings, bus stops, frequencies, spans, transfer locations, and even route names and numbers. Houston decided the huge work effort and citywide impact to riders were worthwhile because:

- Everyone in the city could see that they were being treated equally.
- Huge increases in freedom and access were available to riders starting on Day 1.
- Public information and media coverage were more focused on the ultimate benefits of the change than they otherwise would have been.
- Nearly zero additional funding was available for service, so the only way to offer such benefits was to rethink the shape of the entire network.
- The benefits of the new network vision were obvious just weeks, rather than years, after the service change.

Agencies have been known to take the all-at-once approach when no new resources are available (as in Houston) or when new funding is available.

If new transit funding is *not* available for Memphis, then it will be very hard for MATA to implement any new transit vision without taking an "all-at-once" approach. If new funding *does* become available in the future, MATA may still decide that an "all-at-once" change will be more successful and less disruptive than an incremental approach.

Key Choices

Develop a More Transit Supportive City?

Parts of this report describe the current geography of Memphis, and how that geography affects the usefulness of transit service. The immediate concern of this transit vision is to improve the value of the transit network to Memphis in the near term.

However, in the context of the Memphis 3.0 Comprehensive Plan, this report can also inform the land use and street design policies that will be needed in the future, if higher-ridership and more useful transit is desired by the community.

Many factors outside the control of a transit agency—land use, development, urban design, street networks—affect transit's usefulness. This is why Memphis 3.0 comprehensive planning is such an essential part of a transit vision (and vice versa). In the long-term, land use planning can help to arrange development in places and in patterns that are cost-effective to serve with useful, high-ridership transit.

Through its land use policies, Memphis could encourage more development that reinforces the "Ridership Recipe":

- **Density**: Demand for transportation increases as the number of people, jobs and activities around a bus stop increase.
- **Walkability**: Service is only useful to people who can safely and comfortably walk to the bus stop.
- **Linearity**: Direct paths among destinations are faster, cheaper to operate, easier to understand and more appealing to customers.
- **Proximity**: Shorter distances between destinations attract more riders relative to cost, and are cheaper for MATA to operate.

All of these factors affect both the costs of providing transit in a particular place and how many people will find the service useful. In the context of the long-range Memphis 3.0 Comprehensive Plan, this is an opportunity to think more deeply about the land use and street design policy that is needed to help Memphis become a more transit-supportive city in the future, if it wishes to do so. So a key choice for the public is, how much should Memphis change its land use and streets policies to encourage more transit supportive development in the future.

Next Steps

This Choices Report is the first step in the Memphis 3.0 Transit Vision Plan. It has laid out certain key facts and choices about transit in Memphis and the opportunities and limitations for transit within

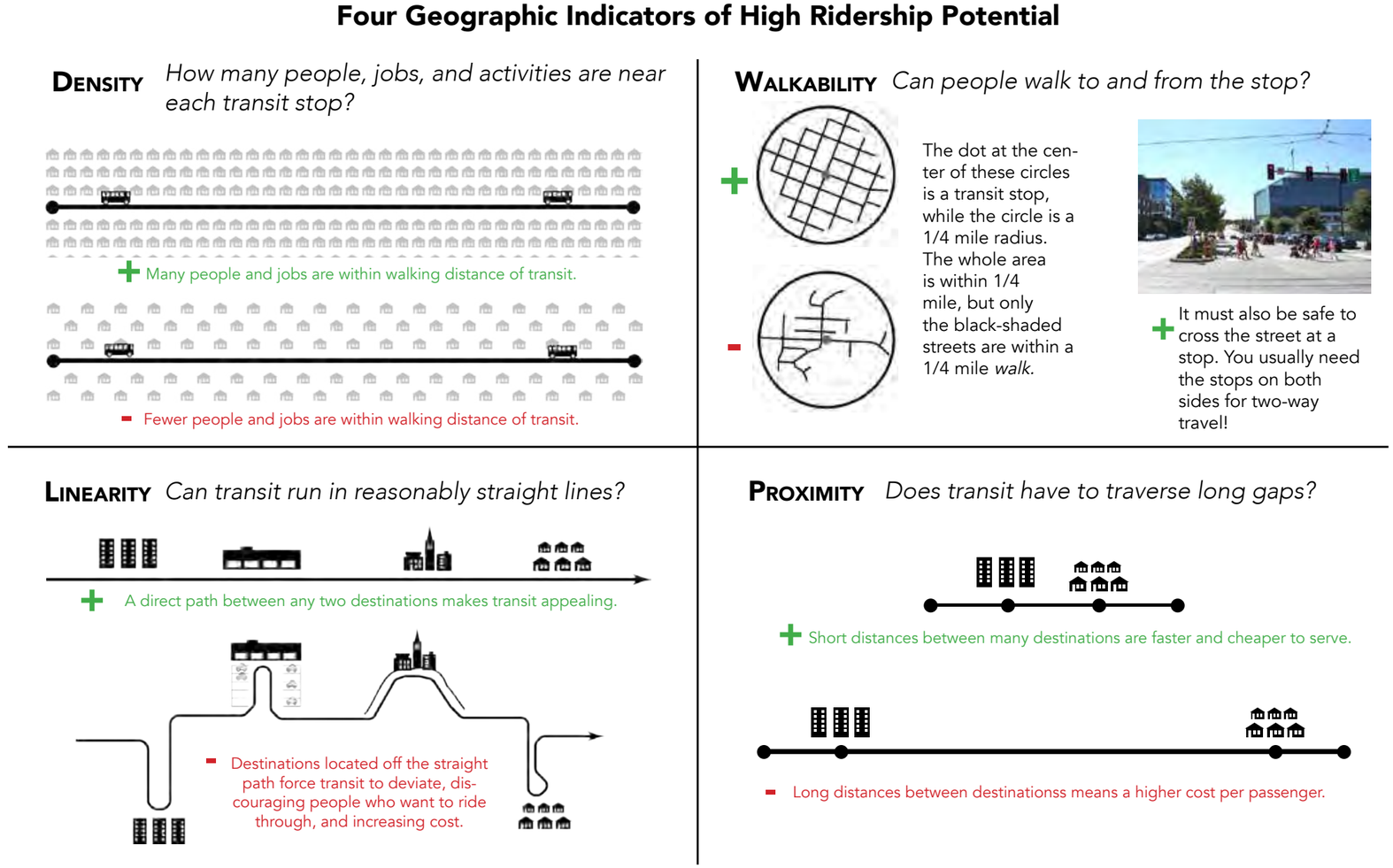


Figure 39: Density, walkability, linearity and proximity are four factors that have a major impact on transit's usefulness and efficiency. These factors are being addressed in the Memphis 3.0 Comprehensive Plan.

Memphis's existing geography and development pattern. The next step in this Transit Vision Plan will be for the public, stakeholders and officials to provide input on these key choices.

Later in the planning process, the study team will develop some illustrative future alternatives. These alternatives will help people see how pursuing different goals would require very different transit networks, and imagine how those different networks would affect them and the people they care about. The alternatives will represent a spectrum of choices, so that people can tell us where, in the range of potential futures, they think the Memphis transit network should be.

After receiving feedback on the key choices and the alternatives, the planning team will design a short-term recommended transit network and long-term recommendations. These will be presented to the public for consideration in the spring of 2018.