## MARTA BUS NETWORK REDESIGN

# Transit Choices Report

**March 2021**

TRANSFORMING TRANSIT

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HNTB

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**Anytime you see a symbol like A or B in this document, look for the same symbol on a nearby image.**

# Introduction

# What is the Bus Network Redesign?

MARTA's current bus network has gradually evolved over the past 60 years, as the region has changed and grown. With recent expansions of the system, changing travel patterns and declining transit ridership, it is time to reevaluate the goals and design of the MARTA bus network.

This Redesign is a collaboration among MARTA, its partners, stakeholders and riders, who will all have an opportunity to provide input on the new network.

This Redesign is part of the MARTA 2040 program, which supports faster and more reliable service, shorter travel times, connectivity and safety.

## Transit goals

Transit service can be designed towards different goals.

One of the goals for transit that gets a lot of attention is ridership, but that is not the only goal transit serves.

Transit agencies are often expected to serve areas where few people live or work, even if ridership is not high in those areas. This type of low-ridership service is pursuing a coverage goal, which has its own value.

***Do buses need to be full for transit to be "successful"? That depends on transit's purpose in the community.***

# Why Buses?

Urban areas are where people access all of the opportunities that arise from being close to other people. Every successful urban place hits physical limitations on how many people can get close to one another if they all move in small vehicles:

- **Severe road space limitations.** There is a limit to how much roads can be widened as travel demand increases, especially in urban places.
- **Parking limitations.** Places to store private cars and hired cars when they are not in use are costly, compared to the other ways that land could be used in a growing city.
- **Intensification of land use.** The MARTA service area is growing more dense, so these space limitations are only going to get more severe.

Hired cars and autonomous cars cannot change this basic geometric problem, as they take up nearly as much space as regular cars – plus they make driving so much easier and more attractive that they increase traffic. Carpools are helpful, but no car-based solution can get close to the space efficiency of people walking, cycling or riding transit, as illustrated by the photos below.

Trains are even more space-efficient than buses, but they are so incredibly expensive that they can only be justified on extremely high-ridership lines. In every global city with a high-ridership rail system, there is an even bigger high-ridership bus network.

**Wherever big cities need to be really efficient with public space, there is no replacement for high-ridership, big-vehicle transit.**

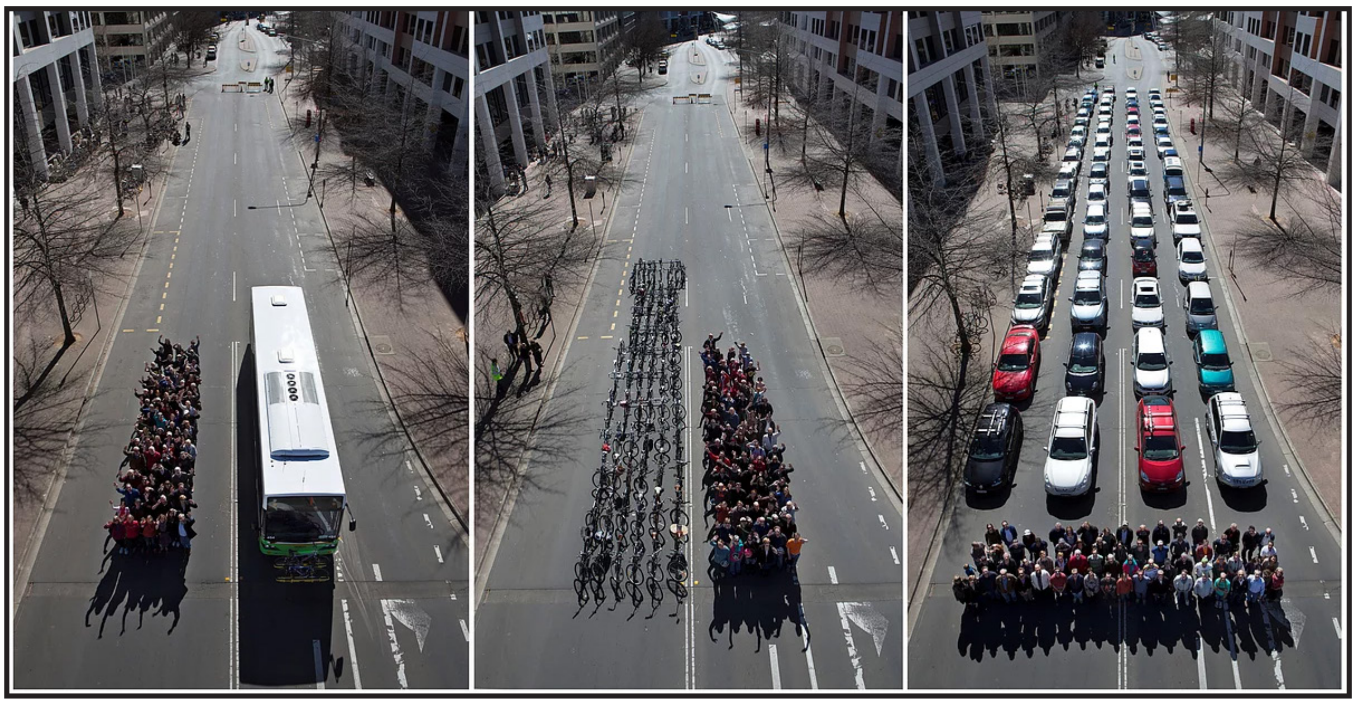


Photo credit: The Cycling Promotion Fund of Canberra, Australia

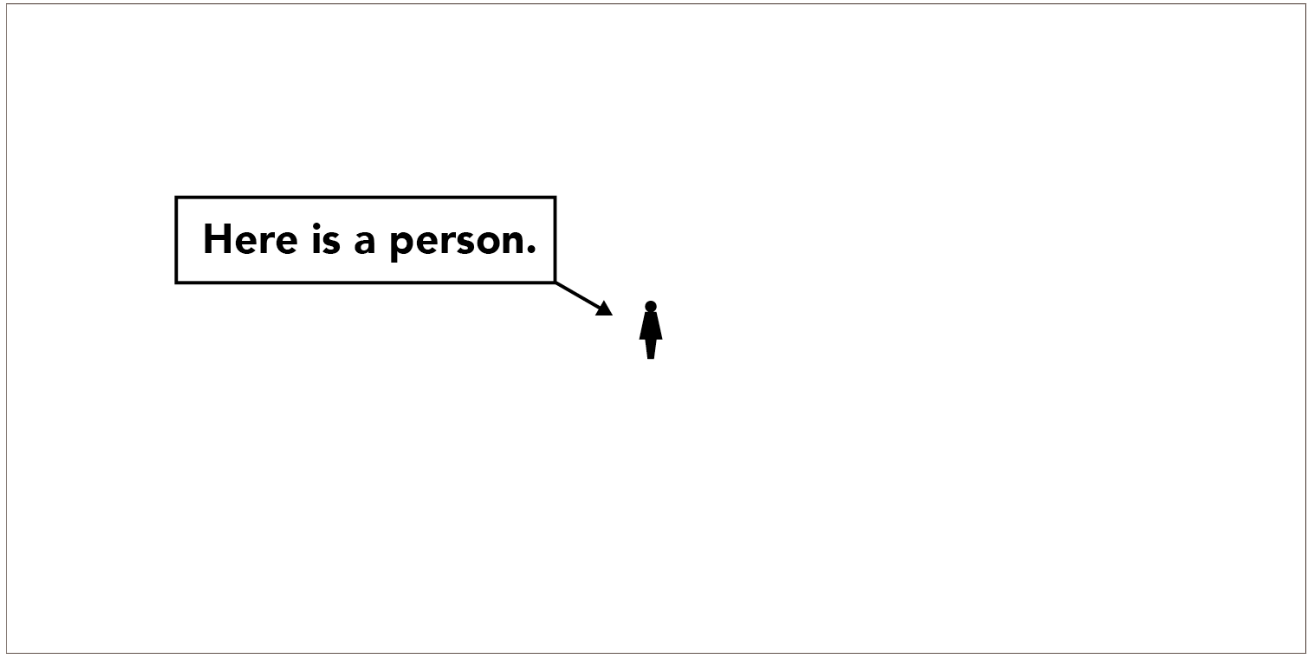
# Transit Access

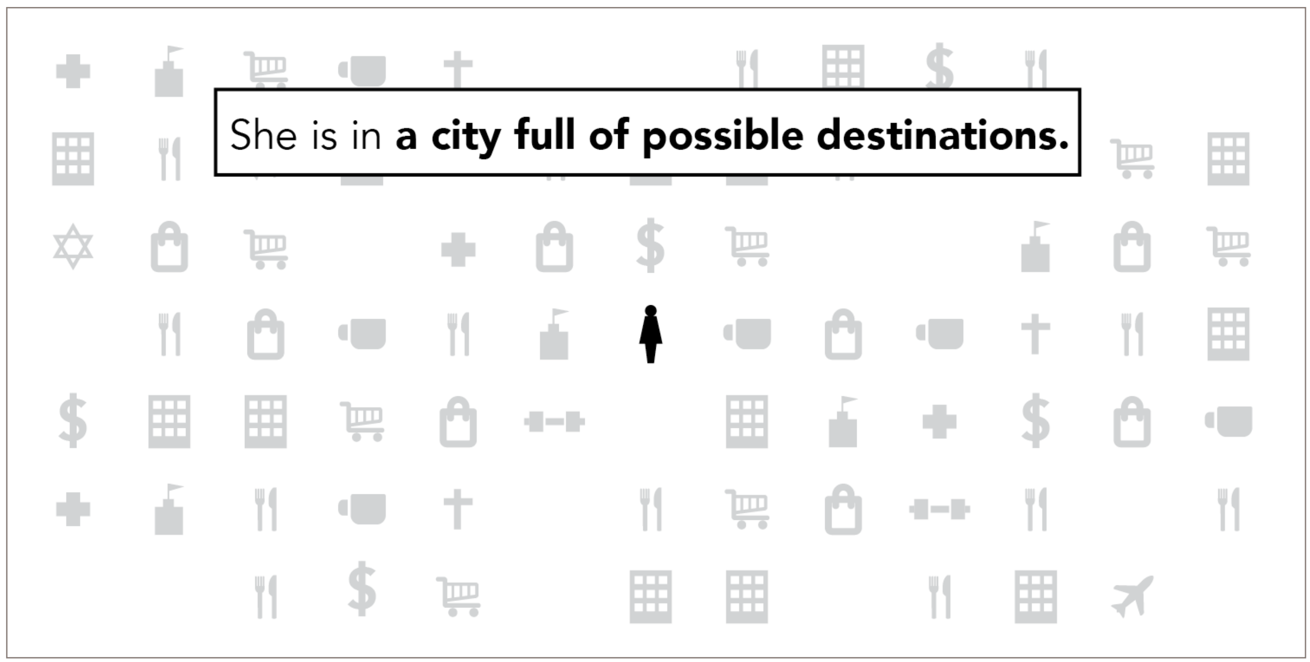
The word "access" means many things in different contexts.

In this report it has a very specific meaning: *the number of opportunities someone can reach through the transit network, in a given amount of time.*

Expanding access for as many people as possible:

- Makes service more useful for the trips people are already making, and for many new trips.
- Increases ridership potential, because more people find the service useful.
- Brings more opportunity within reach for more people
- Fights air and water pollution from roads and cars.
- Allows cities to grow without strangling on congestion.



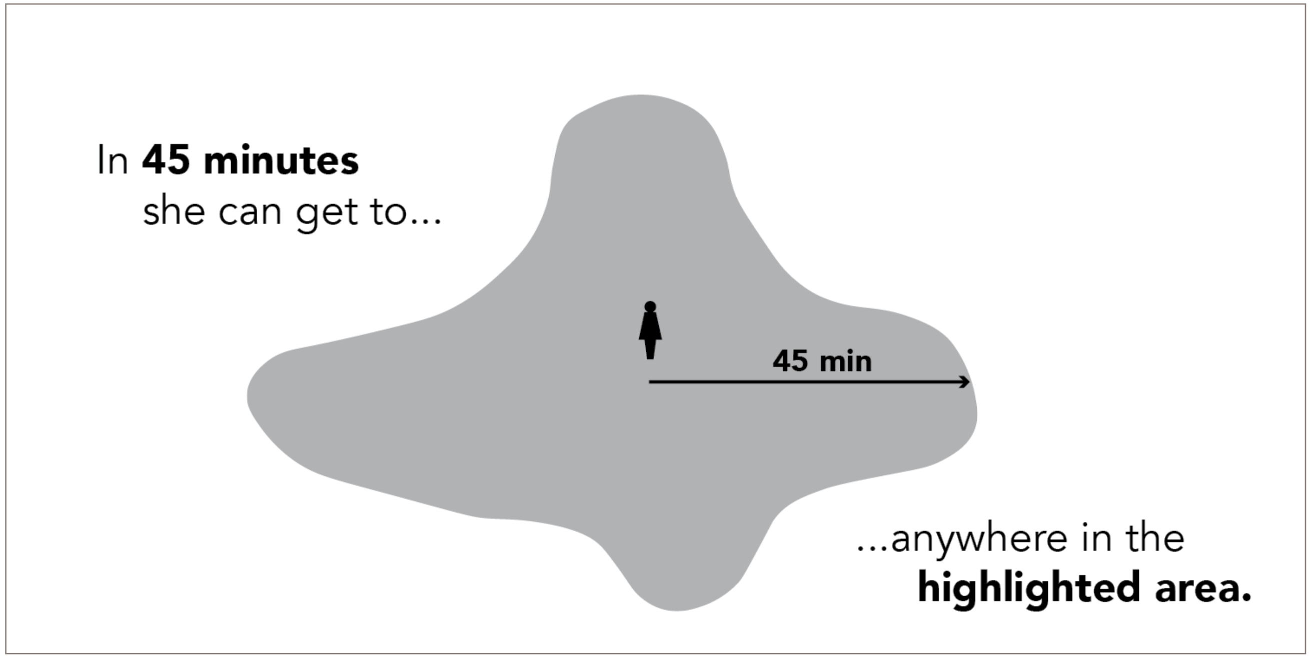



What factors affect a person's transit access?

- **How many destinations are near her**, and near transit.
- **How long she has to walk** to get to and from service.
- **How long she has to wait** for the service.
- **How far she has to ride** on the service.
- The **speed** of the service.
- **How long she has to wait for connections** between services.

Transit agencies have control over some of these factors: waiting time, connections, route directness, where service is provided.

They have less control or no control over other factors: transit speed, travel distances, where jobs and housing are located.




# How Transit Works

# What Leads to High Transit Ridership?

**Access**, described on the previous pages, is the way that transit network design can increase **ridership**.

There are many factors that affect ridership. Some of these are outside of MARTA's control, such as gas prices, the economy, the price of a hired-car ride and the price of buying or leasing a car.

In this report, we focus on the factors that MARTA, Counties and Cities ***CAN*** influence, and that contribute to high ridership:

- The **connections** among routes and rail, and the usefulness of the entire network
- **Frequency** and **hours of service**
- **Land use** and **development patterns**
- **Street design, distance** and **walkability**
- **Demographics**, and where people with particular needs or incentives are located

***If*** MARTA wishes to increase access and ridership, then the Authority will make certain decisions about what type of service to offer, when, and where. "If" is the most important word in that sentence, because high ridership is not transit's only goal, and may not be the most important goal of the MARTA network.

## Productivity: Riders Relative to Cost

Almost every time we use the word "ridership" in this report, we mean *ridership relative to cost.*

The technical word for this is "**productivity**." Non-technical people sometimes also say "**efficiency**" to mean the same thing.)

The productivity measure shows how much people are responding to a given level of MARTA investment. It can be an indicator of greater ridership potential, even if *total* ridership isn't high, for example if a route with poor frequency is highly productive nonetheless.

**Connections are key to high ridership. Individual transit lines must form a connected network so that people can reach many destinations without a long wait.**

# Frequency

One of the most powerful ways to increase access across a city is to shorten waits by improving frequency.

More frequent service:

- Reduces waiting time (and thus overall travel time).
- Lets you travel whenever you want.
- Improves reliability, because if you miss your bus or it breaks down, another one is coming soon.
- Makes transferring (between two frequent services) fast and reliable.

When frequency is improved in places with large numbers of people, jobs and other opportunities, that improves access.

Better frequency increases potential for high ridership, though it isn't enough to cause high ridership on its own.

## Most people are in a hurry

Sometimes frequency is proposed as a way to attract "choice" or "lifestyle" riders, the implication being that transit has to compete for ridership by more affluent people while less-affluent people are bound to use it regardless.

Pursuing higher-income people with high frequency service, or any other premium service, is rarely part of a high ridership strategy. The truth is that everyone's time is valuable.

Lower-income people who are juggling work, school, childcare and other obligations are particularly pressed for time. And they do have a "choice" in how they travel, which many of them have demonstrated by choosing to ride transit less and less over the past decade.

**Designing for high ridership means designing a network that is useful for the majority of people. And most people are in a hurry.**

## Frequency, Distance, Speed and Cost

Within a fixed budget, longer routes trade-off against higher frequencies, as illustrated below. Slower speeds have the same effect, increasing the cost to MARTA of providing frequent service over any distance.

This doesn't mean that a high-ridership network is all short routes – in fact, quite the opposite. But it means that the more people a route serves per mile, the more likely the agency can justify frequent service there.

**Longer distances and slower speeds make it harder for MARTA to provide frequent service.**

### Within a Fixed Budget, Distance Dictates Frequency

One bus can provide 30-minute frequency service over a short distance…

…but double the distance means half the frequency. Now the bus comes every 60 minutes.

As routes get longer, a transit agency must provide worse frequencies, or spend more budget to add buses and drivers to the route.

# Even With Real-Time Info, Frequency Still Matters

Real-time arrival information is an essential component of a modern transit system.

Many people assume that with good real-time info, we've eliminated waiting. This is not the case – only high frequencies can eliminate waits.

The reason is that waiting time doesn't just happen at the beginning of a trip, *it also happens at the end*. If you have to be at your job, an appointment or a movie at a certain time, the frequency of the transit line defines how long you'll spend waiting *somewhere*.

If your job starts at 4:00 p.m. and the hourly bus goes by at 4:10 p.m., you have to choose between being 10 minutes late to work or 50 minutes early.

**For a trip using multiple routes, it's the route with the *worst* frequency that defines how early you have to leave home.** For example, if your trip involves riding an infrequent bus and then riding frequent rail, the high-frequency of the rail saves you time when you transfer, but you still have to leave earlier than you might like because of the infrequent bus schedule.

This is why using infrequent transit means a long wait, even with good real-time information.


**Waiting time doesn't just happen at the beginning of a trip, it also happens at the end.**

**Infrequent service makes people get places much earlier than they want to.**

# The Ridership Recipe: Indicators of Potential

Transit planners and transit agencies can attract more riders by deploying service that more people find useful. However, land use and street design have a huge impact on the cost and usefulness of service, but are outside of the control of most transit agencies.

Five land use factors are especially suggestive of high ridership potential:

- Density
- Walkability
- Linearity,
- Continuity, and
- Mix of Uses.

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


## Density

A place with many residents, employees, shoppers, students, and customers has a high density of activities.

The graphic on the right shows two identical bus routes. The route on the top is traveling in an area that has twice as many houses as the route on the bottom.

All else being equal, the route on top will get more ridership because there are simply more people traveling to and from the area.

## Walkability

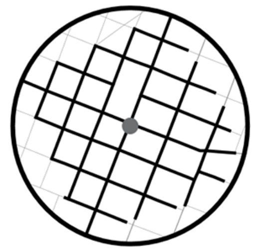
To use transit, people need to be able to get to the bus stop, and the vast majority of transit riders will start their trip by walking. The street network, sidewalks and crossings around a bus stop affect how many people are willing and able to walk to the stop.

A big challenge for high ridership transit in the MARTA service area is the uncrossability of roads, especially roads that have dense housing, commercial destinations or jobs nearby.

Some locations are so hazardous to pedestrians, both waiting and needing to cross the road, that MARTA cannot place bus stops there.

If a road is too dangerous to cross, people won't be able to ride transit in both directions. Or they might ask MARTA to drive the bus into their parking lot or down their street, so that riders don't have to walk across the main road. This makes the route longer and less useful to everyone else.

*Is it possible to walk between the stop and the activities around it?*

+ 

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!

In the MARTA service area, there are historic neighborhoods with walkable, connected street networks, but there are many more suburban and rural areas where walking is difficult or dangerous. There are also some suburban areas where walk distances are long, but sidewalks and crossings at least make walking safer.

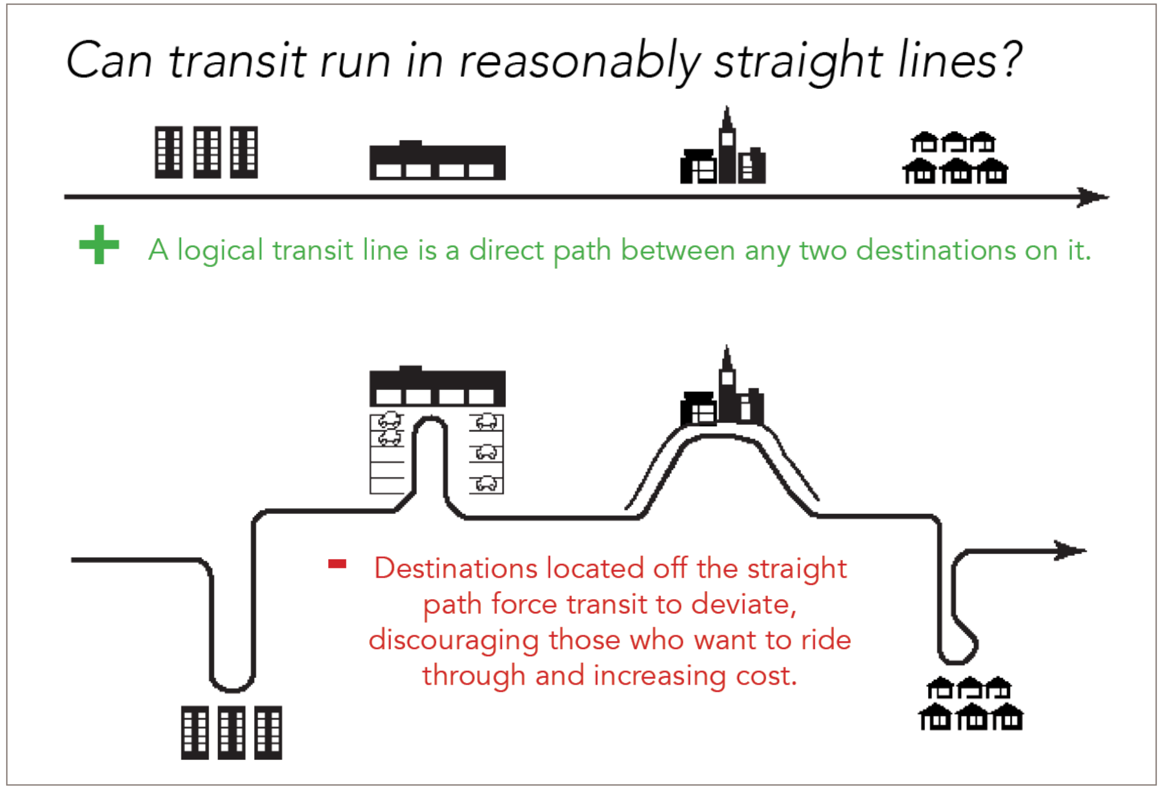
## Linearity

Exactly where development is allowed determines how *linear and direct* MARTA routes can be.

The graphic on the right shows four destinations aligned in different ways. In the town on the top, the destinations are right on the main road. Transit can serve all destinations with a straight line. If you are riding through this area, you're always traveling towards your destination, and never feel that you're being taken out of your way.

The town on the bottom has the same four destinations, but has permitted them to build far from the main road. To serve these places, a bus needs to drive away from the main road, get to the front door, and then drive back to the main road. If this is your destination, this is great for you...but if you are traveling between any other places, you are taken out of your way and your trip is longer.

These deviations can also happen if a road is too dangerous for people to walk across. The bus deviation becomes a costly sort of "crosswalk service."




Notice that the route at bottom is much longer than the route at top. For transit, a longer route typically means one of two things: higher operating cost, or worse frequency.

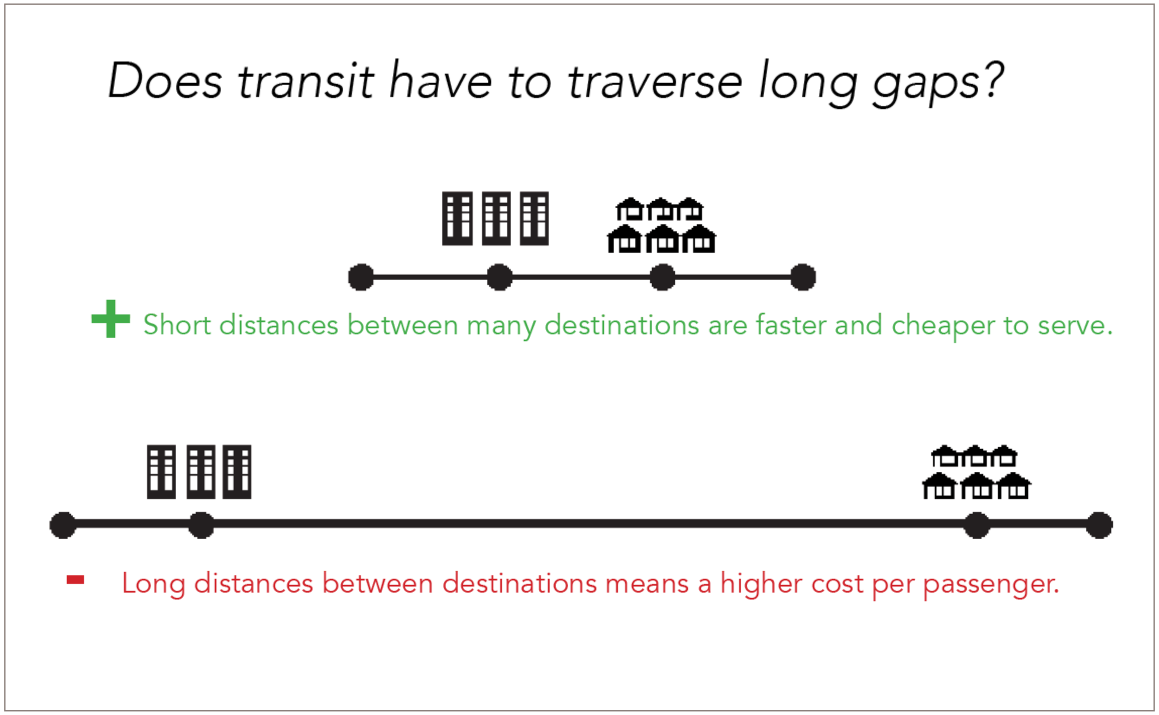
## Continuity

In transit, distance is a major contributor to the cost of service.

The longer distance MARTA has to drive a bus to serve 100 riders, the fewer riders it can serve within its limited budget. For this reason, places that have *continuous density and activities* along a road will generate higher ridership relative to costs.

Another way to describe this factor is *proximity*. Connecting places that are far away is more expensive than connecting places that are close by, and – as described on page 12 – longer routes require more spending or worse frequencies.

As MARTA's partner jurisdictions permit new developments, they will be much harder to serve well, or serve at all, if they are not part of a continuous development pattern.



## Mix of Uses

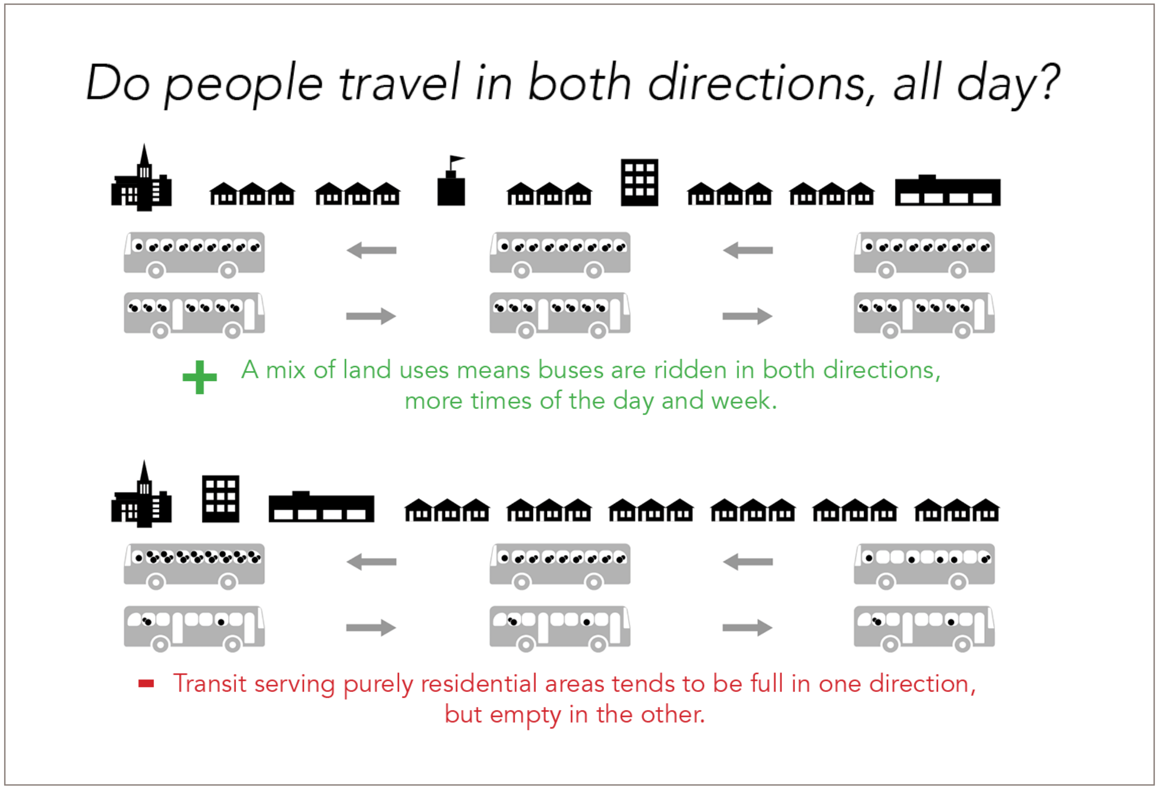
The mix of uses along a road affects how much ridership transit can achieve, relative to cost. A mix of uses tends to generate ridership *in both directions, at many times of day and week.*

Transit lines in purely residential areas tend to be used mostly in one direction – away from the residences, towards jobs – and mostly at rush hours.

There are three ways that **transit serving a mix of uses can attract more ridership relative to cost**:

- Transit vehicles can be full in both directions, rather than being empty half the time.
- If people board and alight all along the route, then the route is used for many short trips. Each seat on the vehicle is useful to multiple people.
- Vehicles can be full all day and all week, so the cost of buying and maintaining the vehicles is supporting more riders in total.

Most of MARTA's highest-ridership routes are used in these ways.



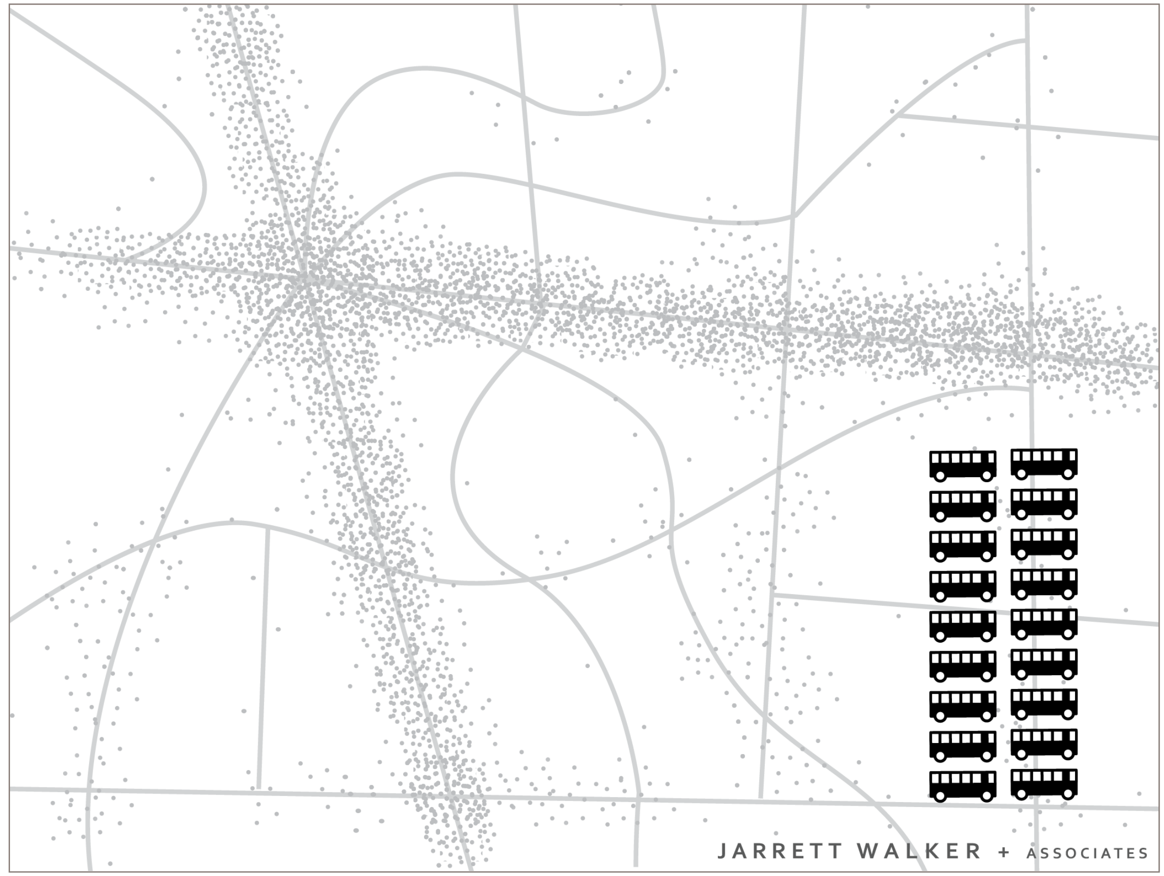

## Transit-Oriented Development

The relationship between development and transit service is two-way.

Transit can be provided efficiently when development is organized to be walkable, linear, continuous and dense with a mix of uses. Where transit can be efficient, it's more likely to be frequent all-day and all-week, and that high level of service enables development without generating more car traffic.

# A Major Transit Trade-off

The previous pages described how transit providers can maximize the potential for ridership on their systems. ***But is ridership the most important goal for MARTA?***




High ridership trades off against other transit outcomes that people care about. Here's a demonstration using an imaginary system.

Imagine you are the transit planner for the fictional city shown at right. On this map, the lines are roads and the dots are people and jobs.

Places with more dots close together are dense with activity, and more people want to travel to and from those places. As in many towns, that dense activity is concentrated along the main roads.

The buses in the picture are the resources this little city has to run transit.

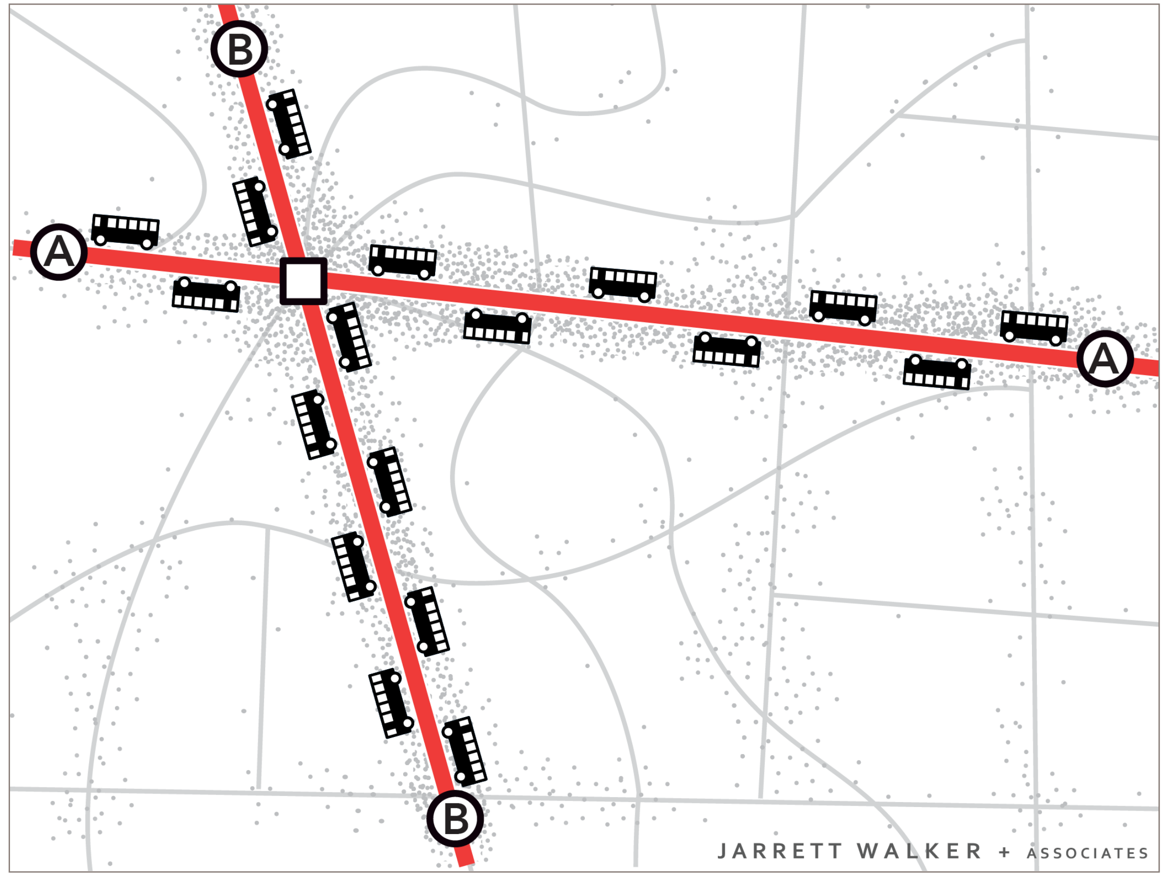
But before you can plan transit routes, you must first ask: *What is the city's goal for this transit system?*

### *If the goal is ridership...*

...then all eight buses should be focused on the busiest areas. Waits for service will be short. For large numbers of people, there's no need to even look at a schedule - they know a bus is coming soon.

Ridership will be high because direct, frequent service is available for the places most people are going.

*But this means some places have no service at all!*



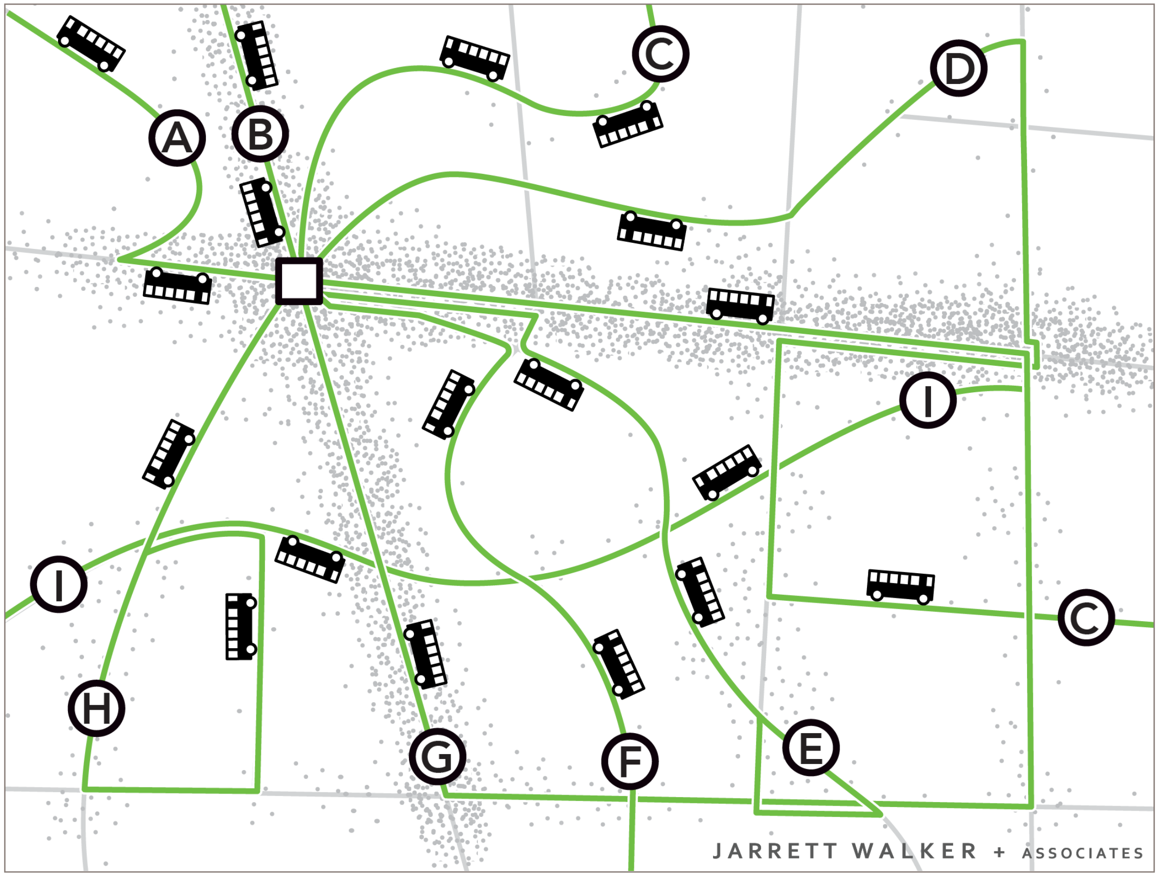
### *If the goal is coverage...*

...then all eight buses should be spread around so that each street has a route. Everyone lives near a stop, but routes are looping and circuitous in between major destinations, so rides are long.

Every route is infrequent, so waits for service are long, *even on the main roads.*

Fewer people can bear to wait or ride for so long, especially if they can find another way to make their trip, so ridership is low.

**Spreading transit out means spreading it *thin.***



The previous pages illustrate how two major, important transit goals trade-off against one another.

## High Ridership

If a transit agency wants to pursue **high ridership**, then it will run useful service in places where the Ridership Recipe is in effect – places that are continuously dense, walkable, linear and with a mix of uses – and where demographics suggest individual people are likely to ride.

But within a limited budget, if an agency wants to focus on making high-ridership routes as useful as possible, it can't afford to run service in a lot of other places.

**Reasons people care about high ridership include:**

- Using public resources efficiently.
- Serving more riders.
- Combatting congestion.
- Reducing vehicle emissions.
- Increasing fare revenue; reducing subsidy per ride.
- Supporting dense and walkable development.
- Improving job access for large numbers of workers.

## High Coverage

If a transit agency wants to provide **high coverage**, then it will spread service out so that there's some service everywhere. Or the agency might cover places that are of particular importance, for some of the reasons listed below.

But spreading service out means spreading it thin. With a huge area to cover and a limited budget, a high-coverage network offers poor frequency and sometimes short hours of service, too. This means fewer people find the service useful.

The people who do use coverage services really need them, and value them highly. Other people may value having service available "just in case", even though they don't use it most of the time.

**Reasons people care about high coverage include:**

- Promoting social and economic inclusion for all people, regardless of where they live.
- Serving people with a severe need for transit.
- Offering service near every voter, taxpayer, jurisdiction, etc.

# The Ridership-Coverage Spectrum

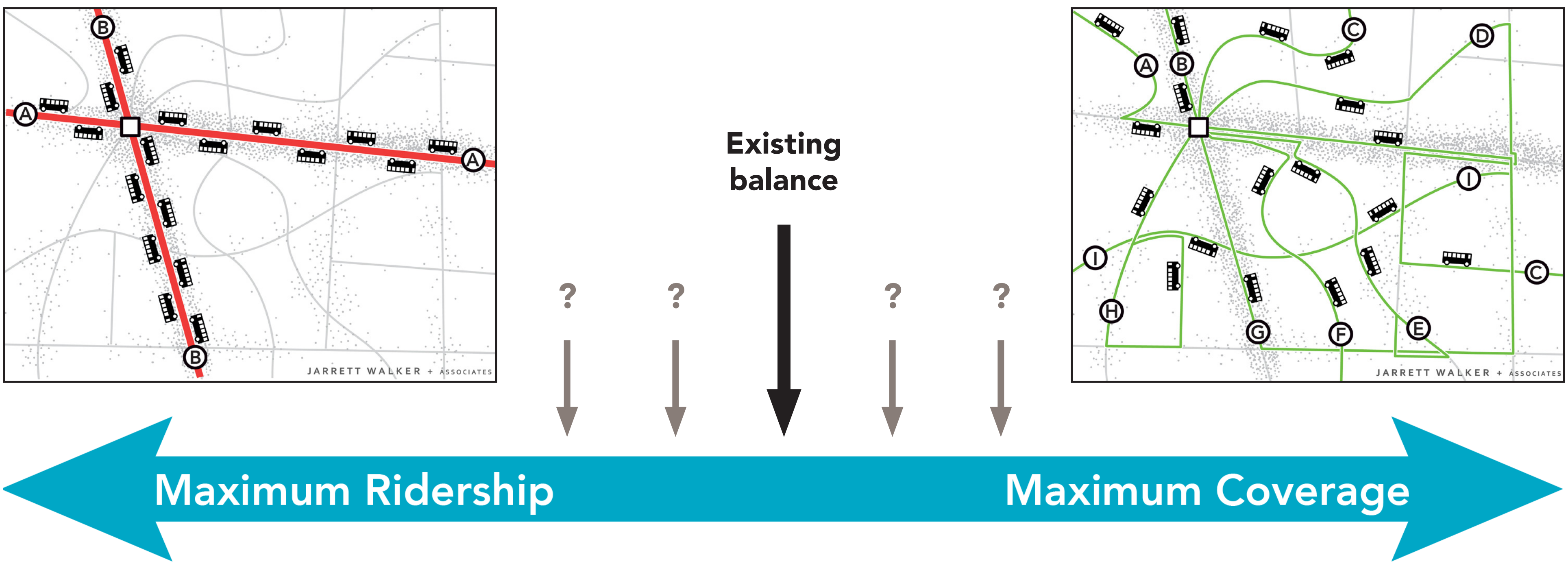
One of the most important, but difficult, decisions that has to be made in this Redesign is how MARTA should balance ridership and coverage goals within its limited budget.

People who have worked in or around public agencies will often say, *"If you want to know a place's values, look at its budget."* We recommend that MARTA explicitly balance its ridership and coverage goals by defining the portion of its bus operating budget to be spent towards each.

The fictional city networks shown on the previous pages were extremes. MARTA's actual choice lies on a spectrum between those extremes, as illustrated below.

MARTA spends about 60% of its bus operating budget on high ridership services, and 35% towards coverage. (About 5% is spent in duplicative ways, and a choice can also be made about whether that service should be repurposed.)

In this Redesign, a major question for the public, riders, advocates, partners and the MARTA Board will be: **Is the current balance of ridership and coverage goals right? Should it be shifted one way or the other?**



# The Existing Network

# Where and When is Service Available?

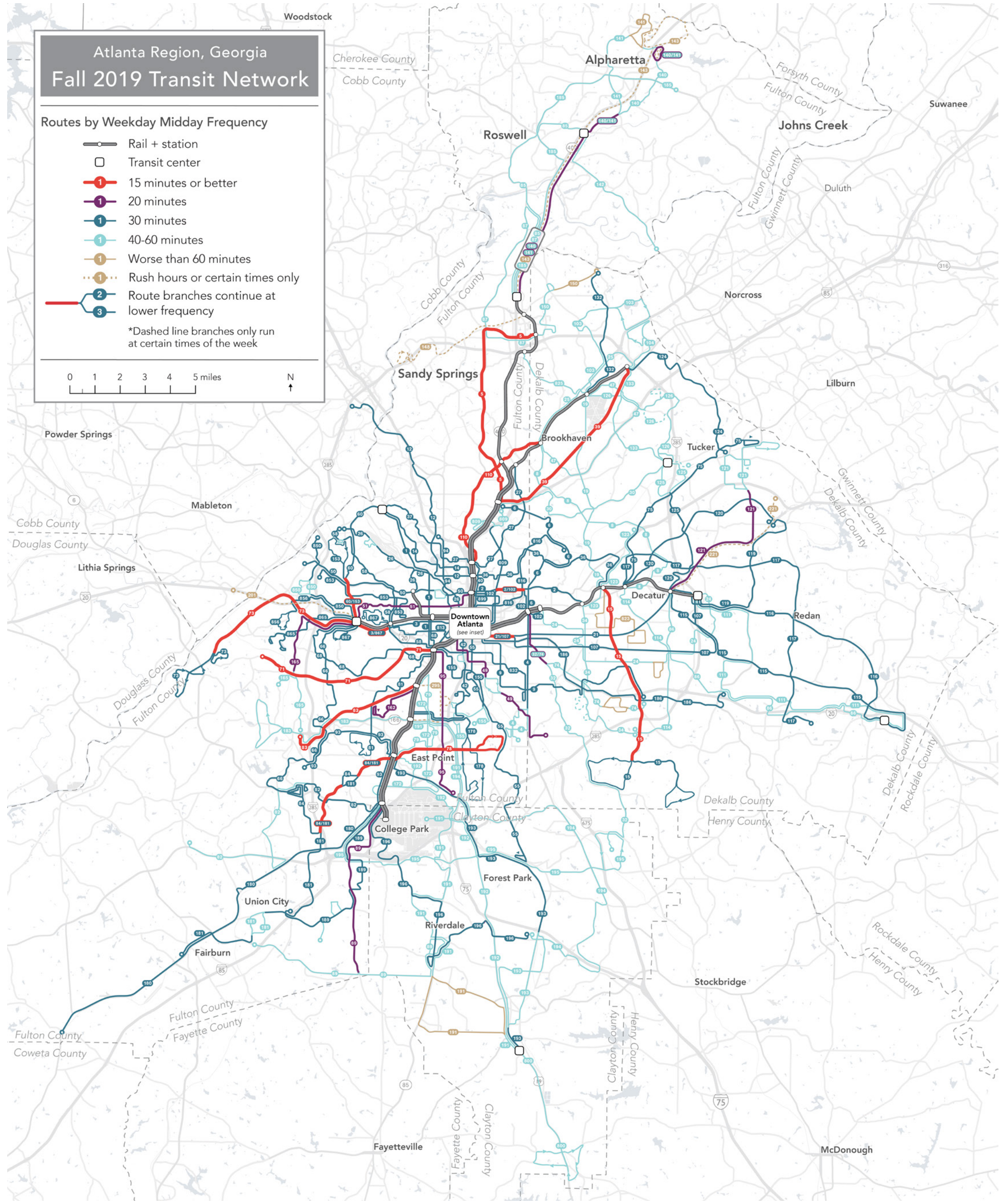
The maps on this and the following pages introduce a style used throughout this report, in which **route colors represent frequency**.

Red lines are frequent service, with a bus coming every 15 minutes or better, in the midday on weekdays.

Purple lines run every 20 minutes

Dark blue lines run every 30 minutes and light blue lines are the least frequent, with 40-60 minutes between buses.

Some bus routes offer better frequency than indicated on this map during rush hours, and some offer poorer frequency at night and on weekends.



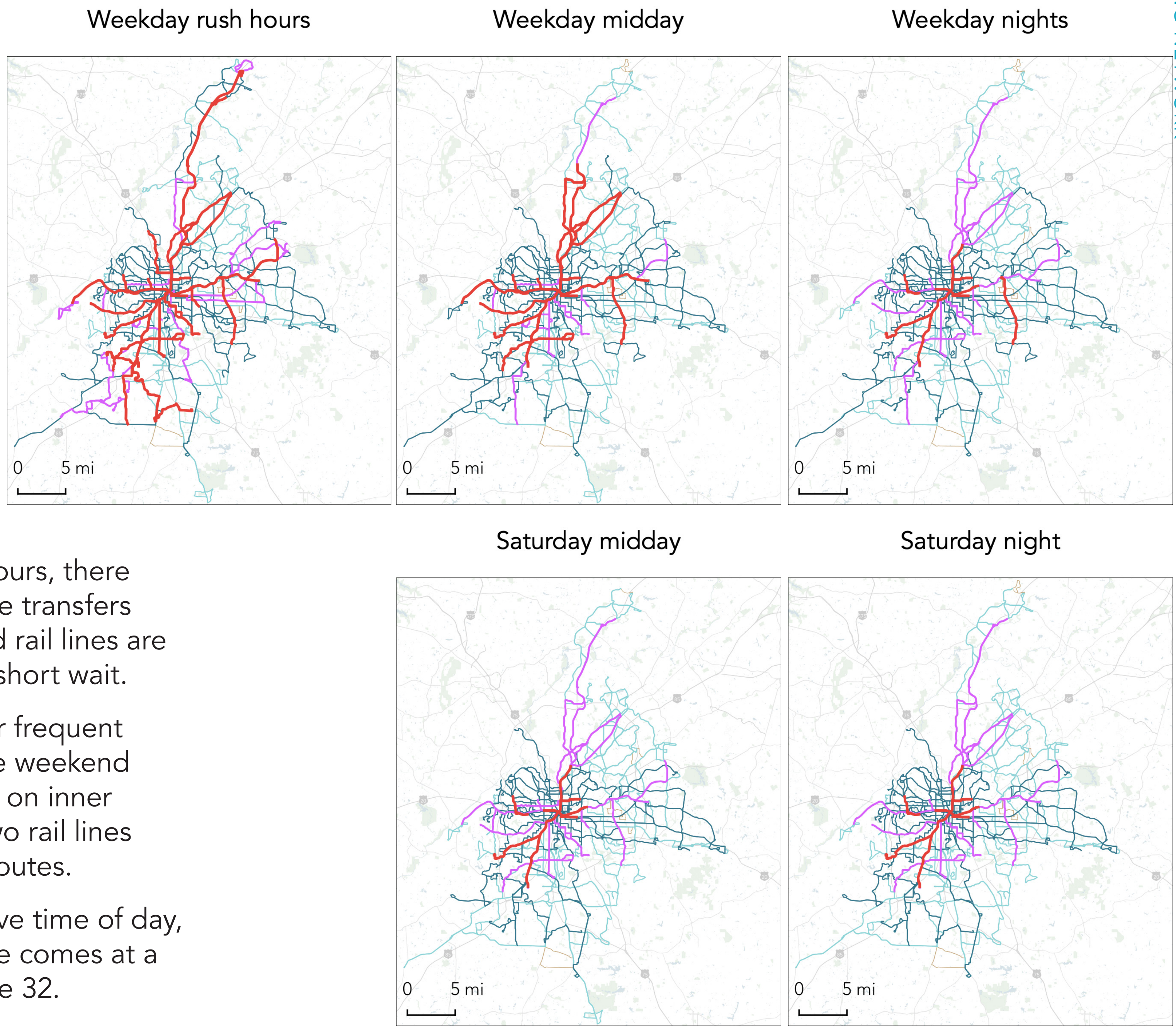
**In transit conversations, sometimes there is a great focus on *where* transit is provided but not enough focus on *when*.**

The mini-maps at right show how rail and bus frequencies change over the course of a weekday and the weekend in the MARTA network.

The highest frequencies (red lines) are offered during weekday rush-hours. During rush hours, there are dozens of places where transfers between frequent bus and rail lines are possible, involving only a short wait.

At midday, there are fewer frequent lines, and by night and the weekend the only high-frequency is on inner segments of rail (where two rail lines overlap) and a few other routes.

Rush hours are a productive time of day, but extra rush-hour service comes at a cost, as described on page 32.



# Proximity to Frequent Service and Any Service

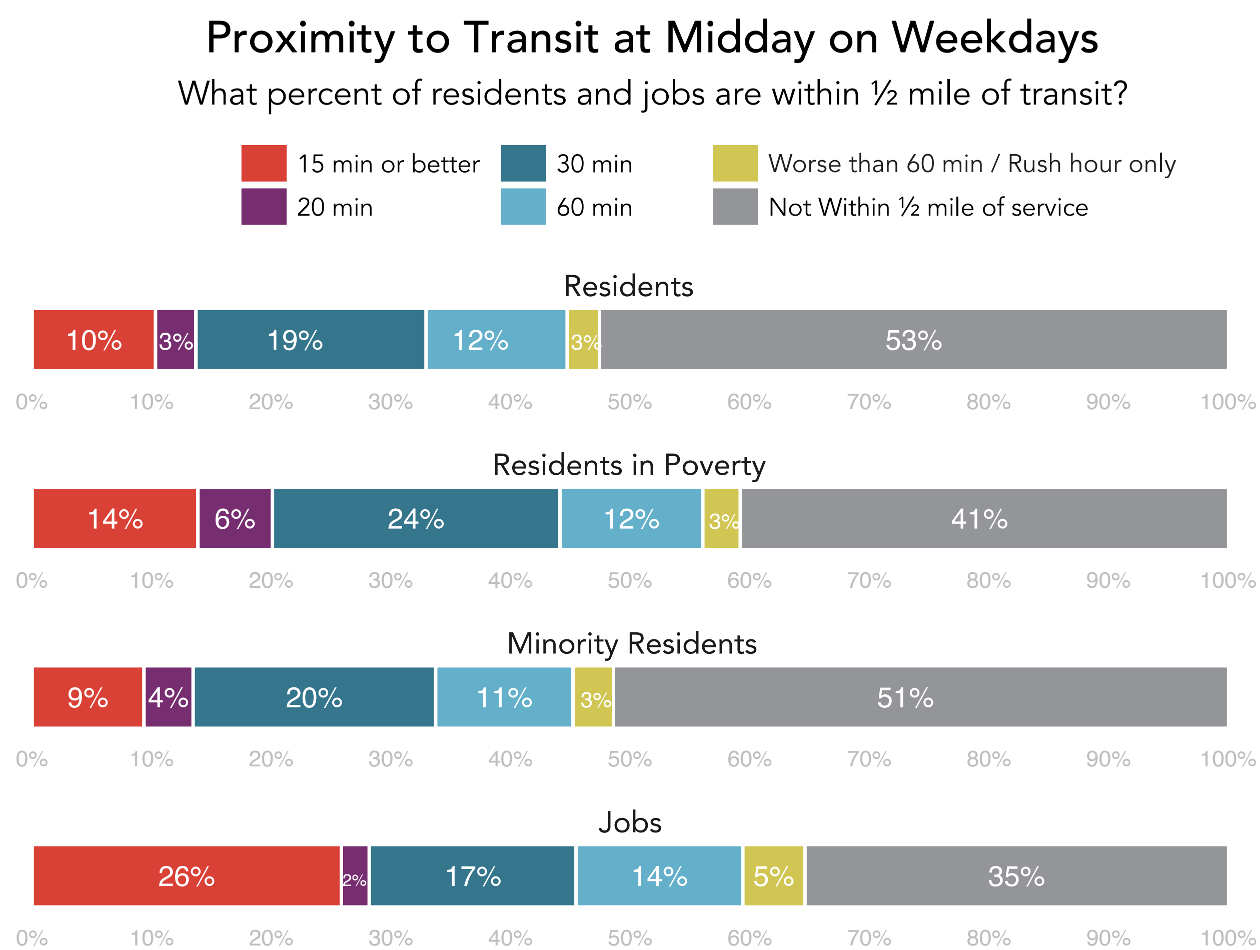
About **10% of MARTA-area residents live near all-day frequent transit** (bus or rail), and **47% live near service of any frequency**.

These percentages **increase when looking only at residents living in poverty**: 14% live near a frequent all-day service and 59% living near any kind of service.

Among **minority residents**, **9% live near frequent service, and 49% live near any service.** The next page gives a more detailed look at proximity to service by ethnicity.

**More jobs than residents are near frequent services.** 26% of jobs are located near a frequent service and 65% of jobs are near any level of service.

This is common in urban transit systems and relates to the dense concentration of jobs at the center of the rail network and near some rail stations.



**More White and Hispanic residents live close to frequent service** (12% and 14%) than do Black residents (9%).

**Hispanic and Black residents live closer to any service** (54% and 48%) than do White residents (45%).

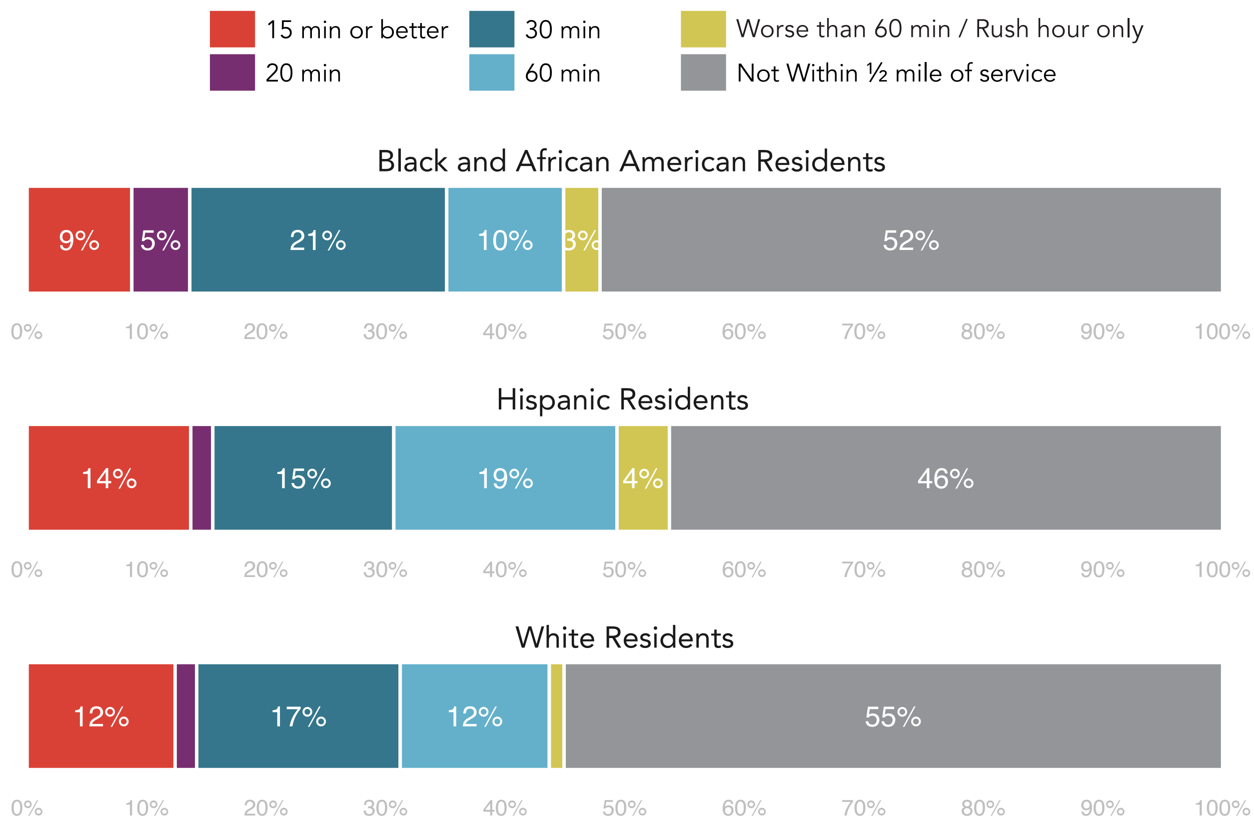
The graphs on this page and the previous page can be used to describe progress towards both coverage and ridership goals.

Increasing the percentage of residents (especially low-income or minority residents) near *any* service speaks to coverage goals.

Increasing the percentage of residents, especially residents in poverty, near *frequent* service shows potential for high ridership.

## Proximity to Transit at Midday on Weekdays

What percent of residents and jobs are within ½ mile of transit?



# Frequency and Productivity Relate

**Productivity means ridership relative to cost.** A highly-productive route is attracting many riders relative to its level of service and its operating cost.[1]

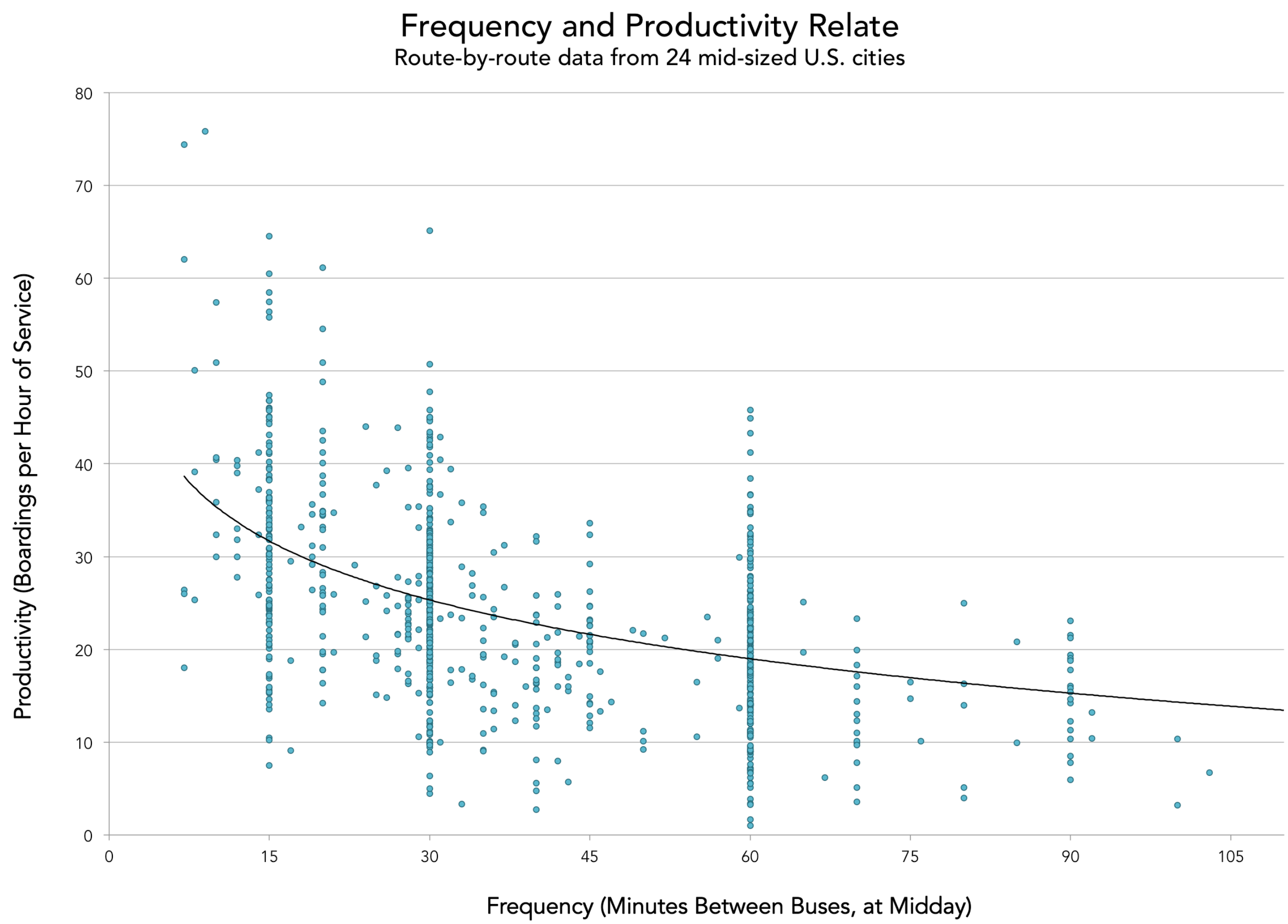
More frequent routes are likely to be more productive. Not only do they get more ridership, they get more ridership *relative to the higher cost of providing the better frequency.*

The scatterplot at right shows route-by-route data from 24 U.S. transit agencies. Each dot is a route. More frequent routes are plotted to the left, and more productive routes are higher.

As the upward-leftward curve shows, more frequent routes are, on average, more productive.

But we cannot increase the frequency of just *any* route and expect productivity to increase as well.

1 A common way to represent operating cost for transit is "vehicle hours" or "revenue hours," which are the hours a vehicle and its operator are on the road, available to riders.



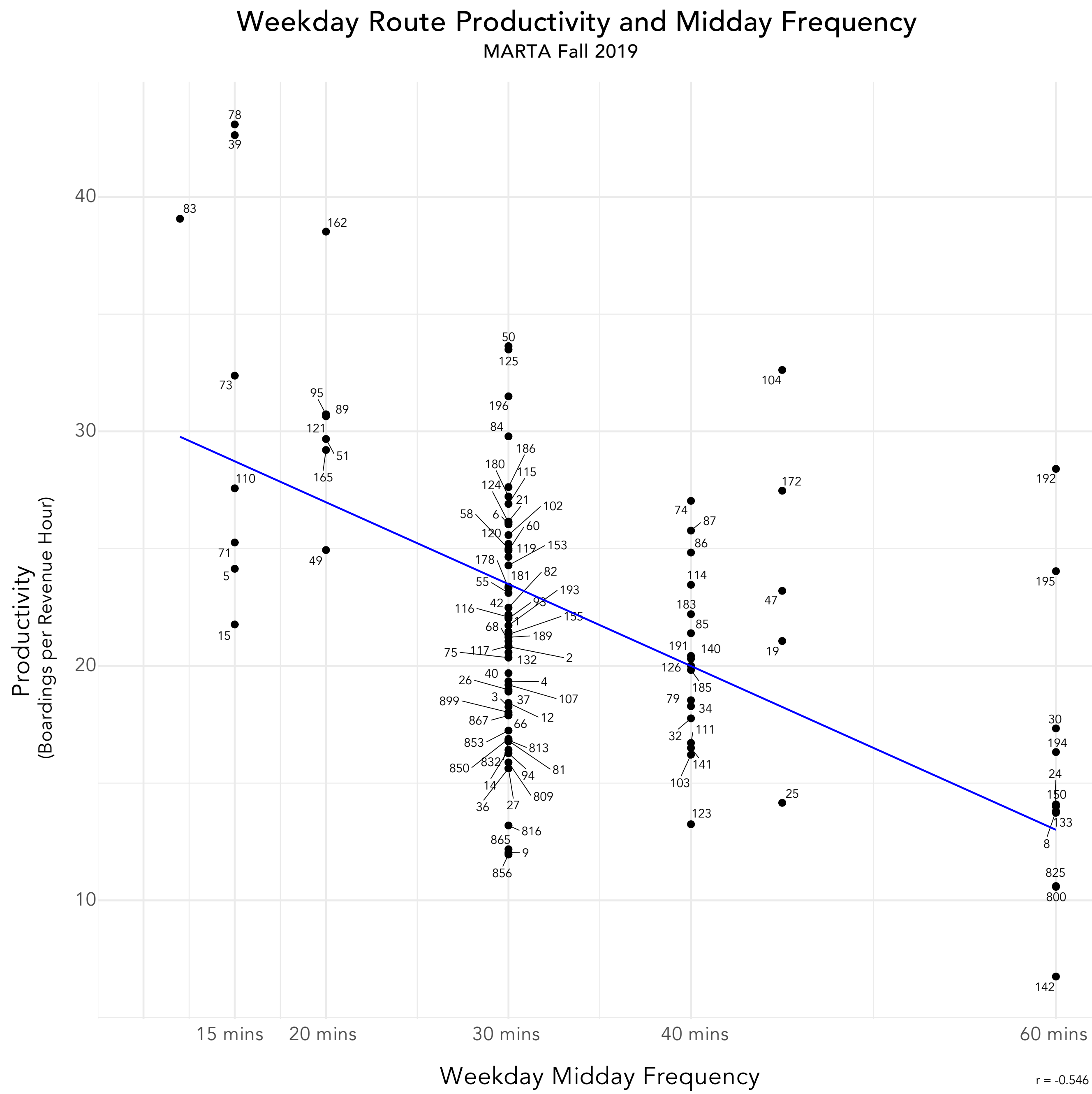

In pursuit of higher ridership, transit planners tend to increase frequency on routes that are already highly productive, or routes serving areas with high ridership potential. When they do, on average, the resulting ridership more than makes up for the increased cost of the frequency.

***Services that are designed for coverage goals will have low productivity.*** This does not mean that these services are failing. It means they may be serving non-ridership goals.

The scatterplot at right shows the productivity for each route in MARTA's 2019 network, plotted just as on the previous page. Again, more frequent routes are, on average, more productive.

This scatterplot is one input to the design of a high-ridership network. Transit planners can assess whether routes that are already very productive will be equally or more productive with greater frequency, longer hours of service, or other improvements – or whether the ridership return on investment is about as high as it can be.

Routes that are not very productive considering their high frequency can be evaluated for a decrease in frequency, in order to shift that service to places where it would serve more riders.

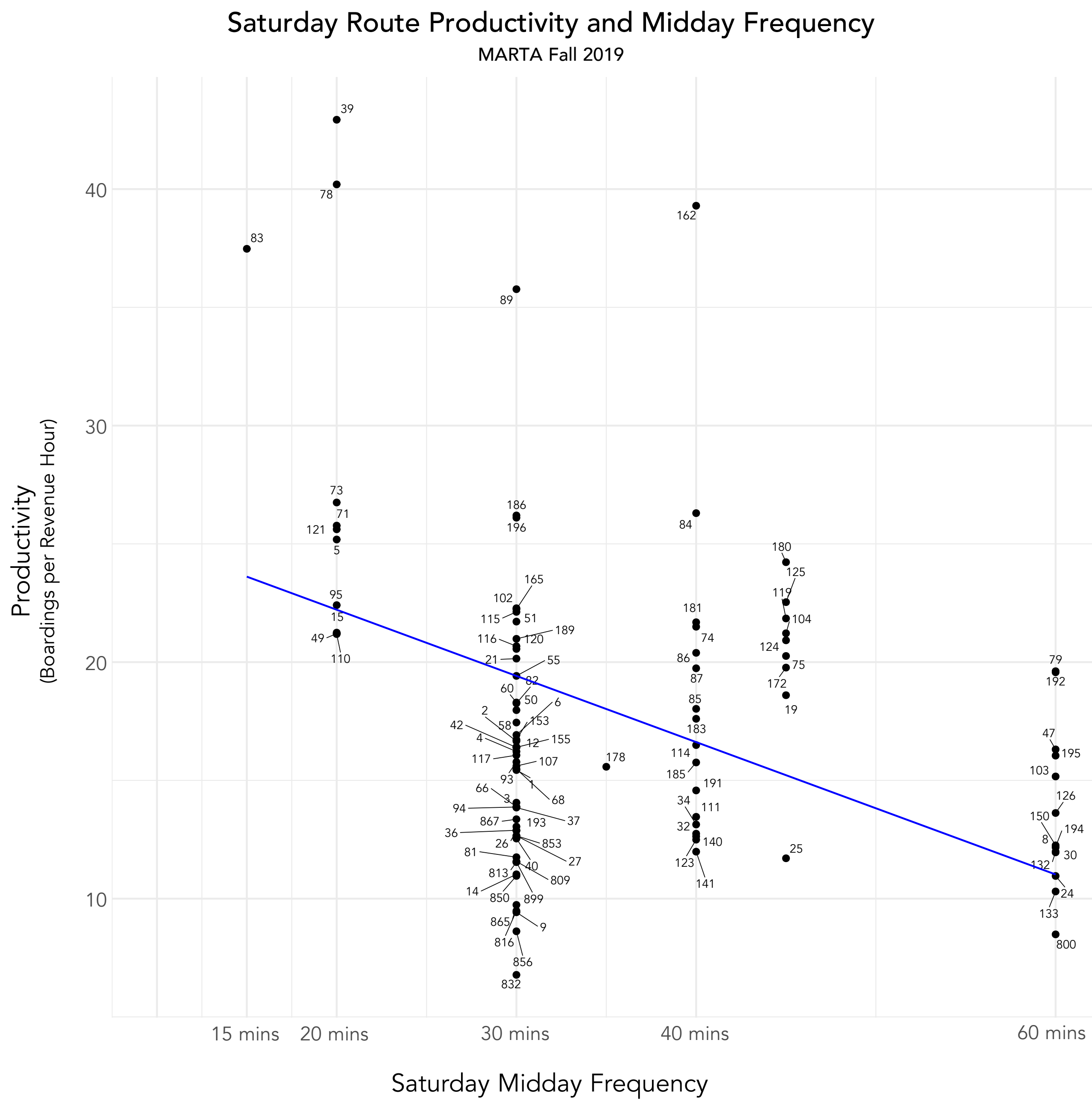


The scatterplot at right shows route productivity and frequency for Saturdays in 2019. (The same plot for Sundays looks very similar.)

Again, more frequent routes are, on average, more productive.

As in many other transit systems, some routes are surprisingly productive on weekends, despite their poor frequencies.

***Serving all-day, all-week demand is part of a high ridership strategy.*** Why? Transit agencies spend a lot to buy, maintain and store transit vehicles. When those vehicles can be used all day and all week to run productive routes, the fixed costs of buying and maintaining them goes farther.



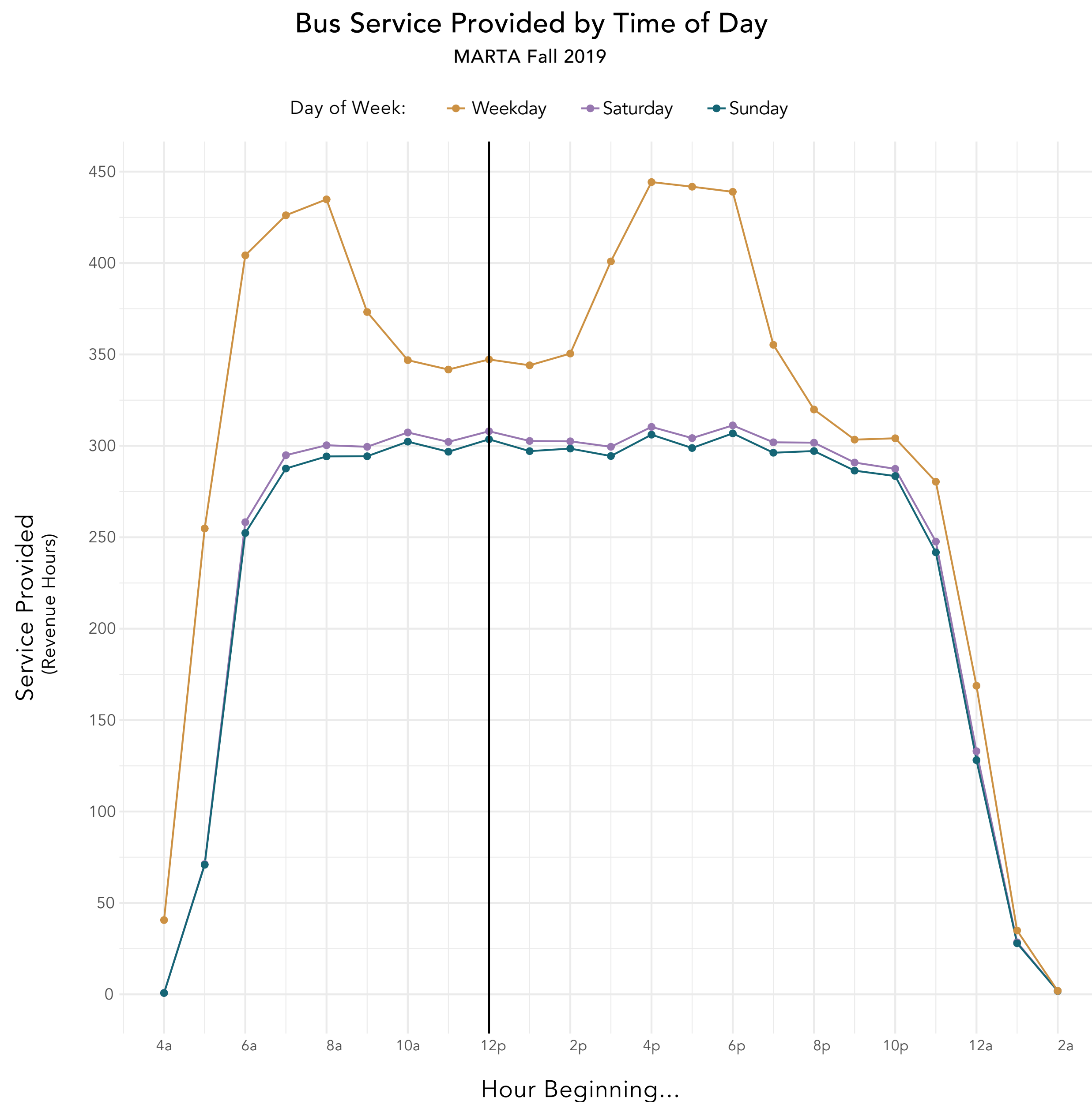
# The Cost of Peaking

MARTA provides higher frequencies during weekday rush hours (peaks), as well as a few peak-only routes. Rush hours are the most productive time of day for MARTA, so if we consider only the productivity measure this would seem like an obvious ridership-maximizing strategy.

However, there are costs that don't get captured in the productivity measure – such as the cost of extra vehicles that get used only for rush-hours.

**About 24% of MARTA's buses are only used for rush hours.** Some of those extra vehicles can't be avoided because slower rush-hour traffic requires adding buses, but most are used to increase frequencies at rush hours.

**Better rush-hour service requires more operators, more vehicles and more cost.**

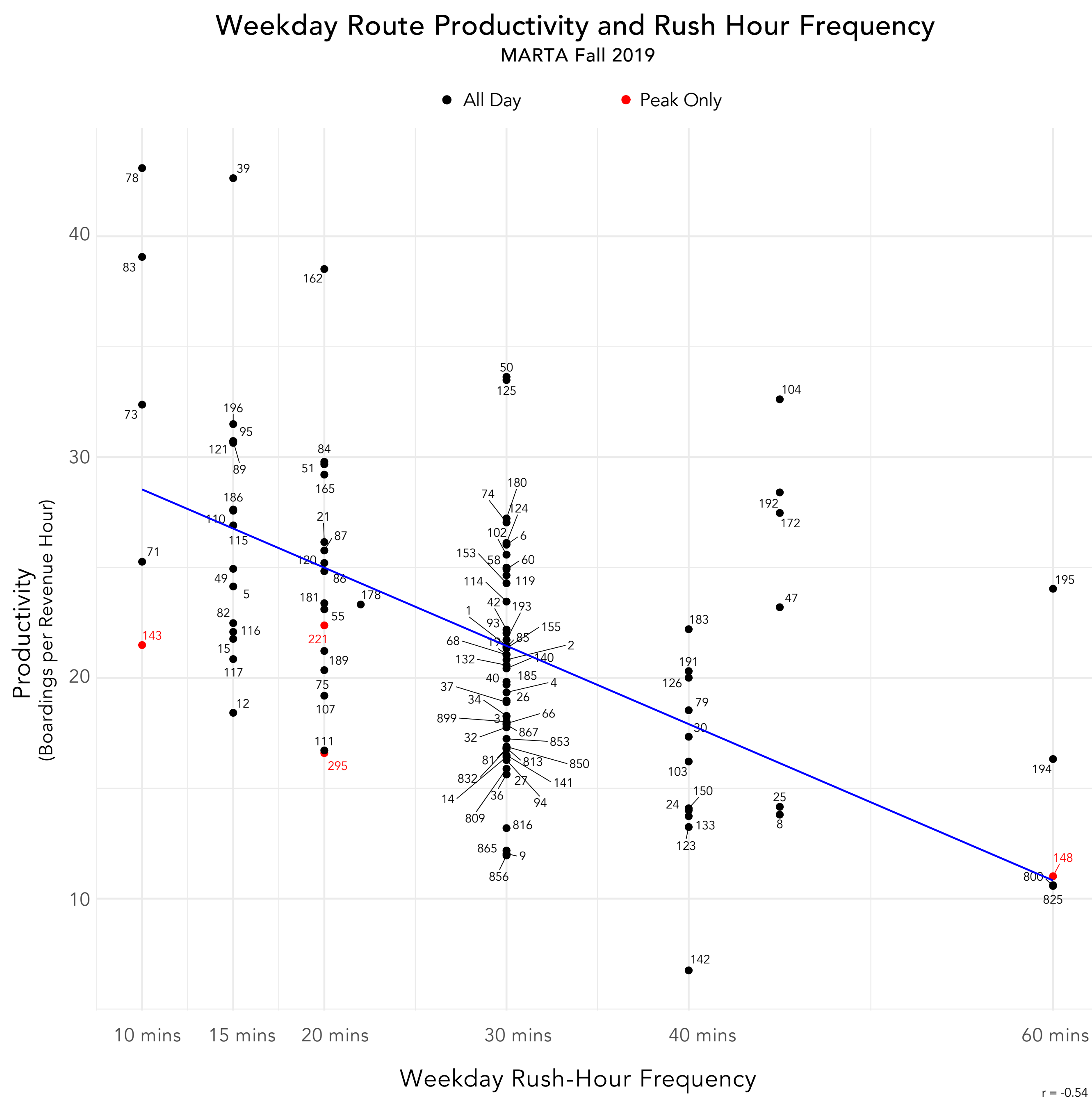


The scatterplot at right shows each route's weekday productivity, organized based on its rush-hour (peak) frequency. Keep in mind that productivity *does not capture* peaking's higher vehicle and labor cost

Even though the overall transit system is very productive during rush hours, MARTA's four peak-only routes are less productive, on average, than the all-day routes. This is typical for peak-only services.

Providing a service only at rush hours is rarely a high-ridership strategy, because so many people want to be free to travel all day long.

**If MARTA wants to maximize ridership, then peak services should be held to a very high standard of productivity.**



## Covid-19 Effects on Peaking

The Covid-19 pandemic sent most office workers home with their laptops, greatly reducing rush-hour travel by all modes, especially transit. Ridership on MARTA services at all hours decreased, and the traditional two-peak rush hour pattern of daily demand went away. Instead, for most of 2020, demand peaked in the afternoon, from about 3:00–6:00 pm.

Rush hour travel has been slowly coming back on the MARTA system. As of February 2021, the percentage of weekday boardings that occurred during rush hours was slightly lower than before the pandemic, and overall ridership at all hours was still down.

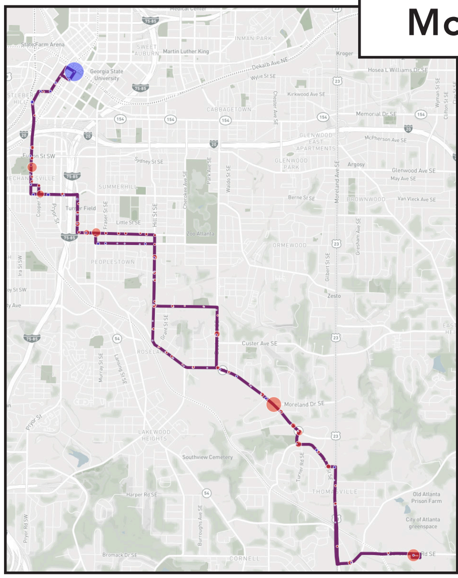
Reallocating some service away from rush hours might result in some crowding, which is difficult to imagine during the Covid pandemic. But avoiding major vehicle costs, and attracting all-day and all-week ridership, may be the higher-ridership strategy for the long term.

If some people with rush-hour commutes continue to work from home after the pandemic is over, then rush hours may no longer be as productive or important as they once were. Meanwhile, the commutes of the "essential workers" who hold service and industrial jobs, and go to and from work at all hours and all week long, may be considered by the community to be of greater importance than they once were.

This Network Redesign can be an opportunity for MARTA to make a considered decision about how much extra service to provide at rush hours, in light of the costs.

# Boardings and Activity Density

## Route 49: McDonough Boulevard



This route operates North/South from Five Points Station to Metro Transition Ctr. along McDonough Blvd. and Moreland Ave.

**Blue Dots = Outbound Boardings**

**Red Dots = Inbound Boardings**

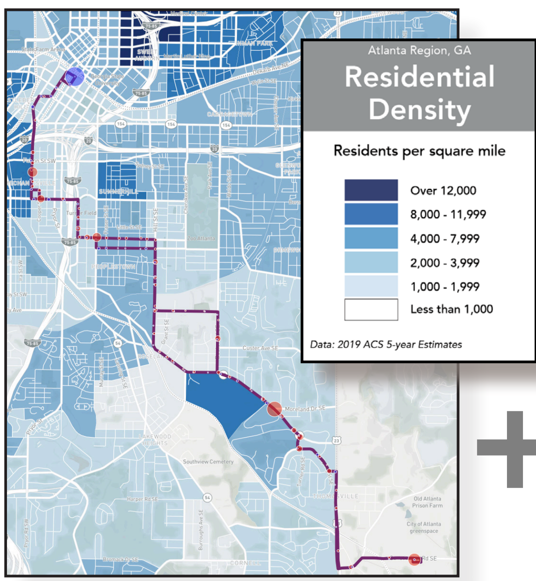
Boardings dots are scaled to show the average number of riders boarding at each stop during the week.

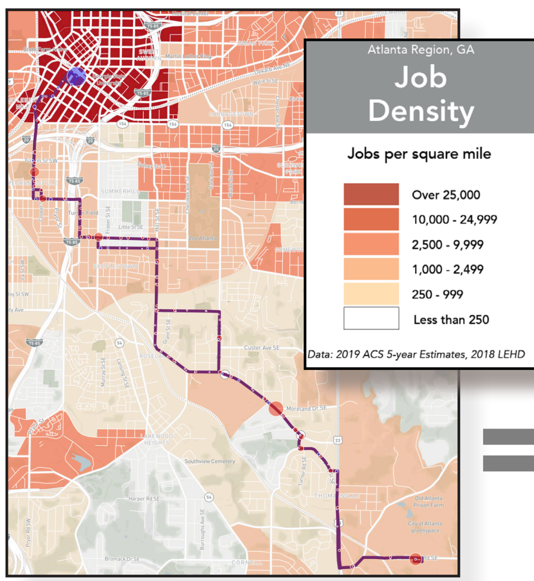
Blue dots show where people board in on direction, and red dots show where they board in the other direction.

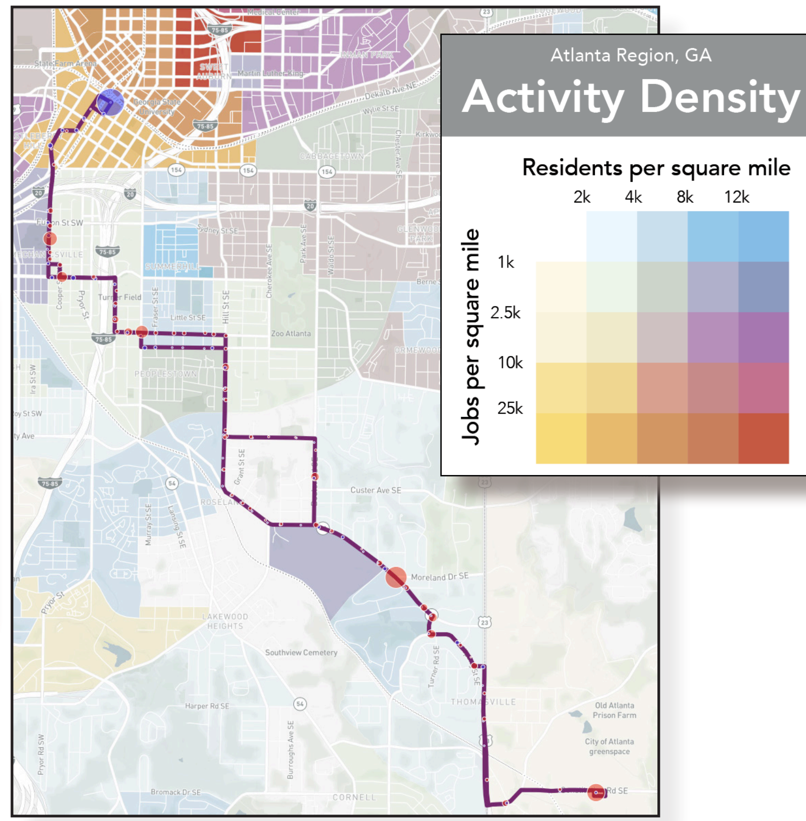
When redesigning the MARTA bus network, planners will look closely at transit boardings on Fall 2019 routes.

In addition, Census data can also reveal potential for high ridership, or areas with a need for coverage. We can map demographic densities for indicators like residents and jobs, as well as activity (people plus jobs).

The examples on the following pages show ridership patterns that arise where development patterns follow the Ridership Recipe (described starting on page 14). Density information from Census data is shown in the background of each route.



# High Density and Continuity: Local Examples

## Route 39–Buford Highway

At right, Route 39 is shown against a backdrop of residential density. Darker shades of blue represent more residents per square mile.

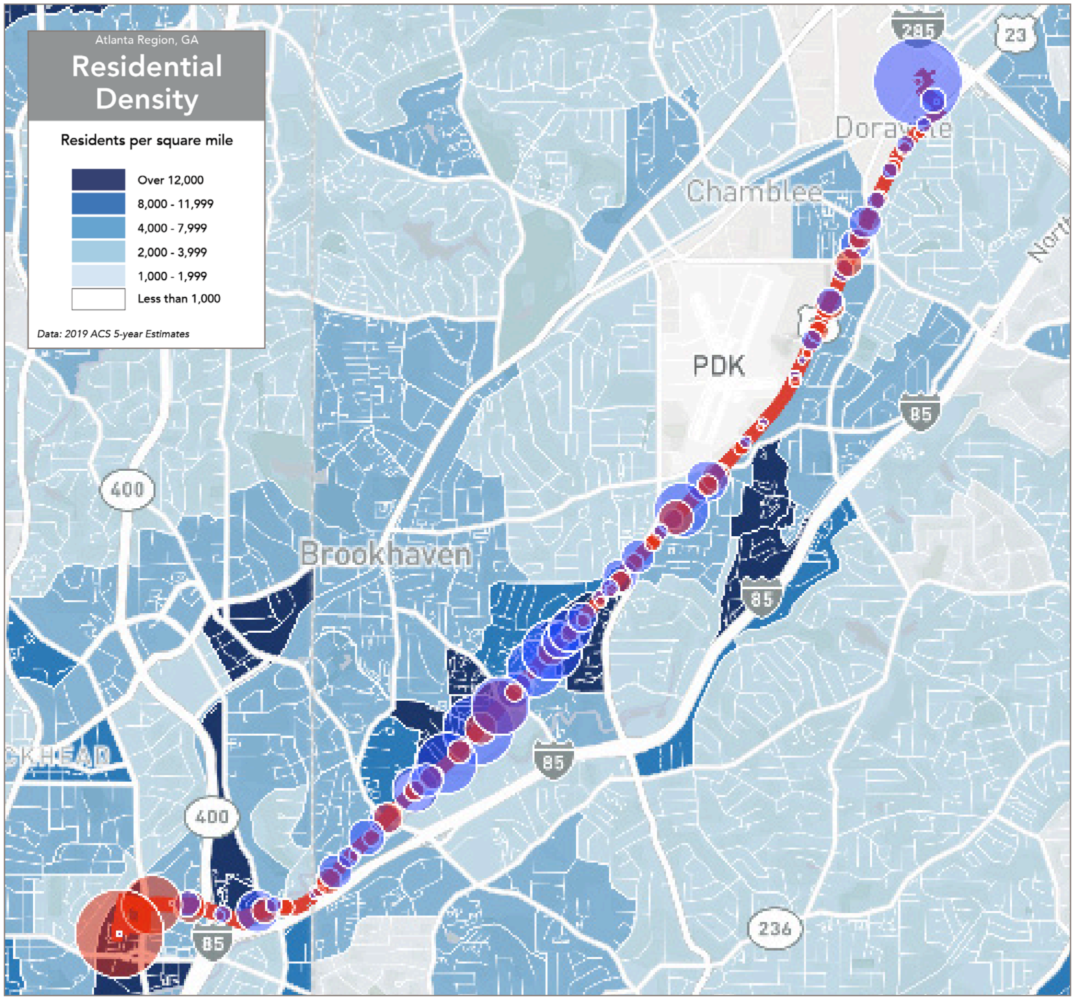
The dots on the route line represent boardings: blue dots are southbound boardings, red dots are northbound boardings.

**Route 39 is MARTA's most productive route.** The boardings dots are biggest where the density of residents is highest, and at the two ends where this route connects to the rest of the network.

**Other elements of the Ridership Recipe are in force** for this route:

- **15-minute frequency** on weekdays.
- Runs **all day and all week**, with 20-minute frequency on weekends.
- **Connects** with multiple other frequent lines.
- Serves neighborhoods with a high **density of lower-income residents**.
- Serves a **linear** and **continuously dense** corridor.
- Serves a **mix of land uses** (though only residential use is shown on the map at right).

**MARTA's most productive route moves an average of 42 people per bus, per hour, over the entire week, day and night.**



## Route 196–Upper Riverdale / Southlake

At right, Route 196 is shown against a backdrop of job density.

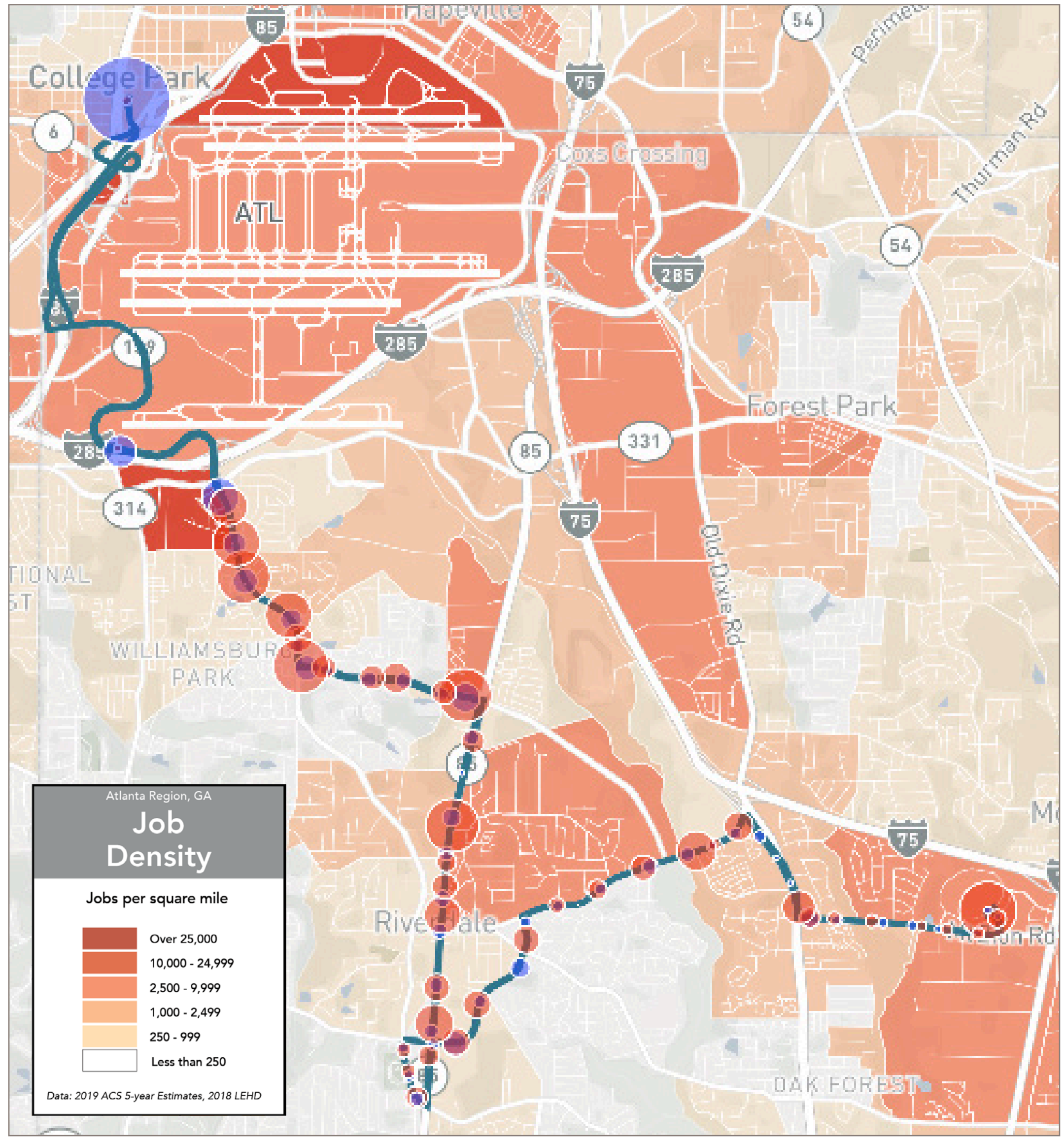
Darker shades of red indicate more jobs per square mile.

The dots on the route represent boardings, colored differently for the two directions.

**Route 196 is a productive route, moving an average of 31 people per bus per hour throughout the week.**

The route **exhibits some elements of the ridership recipe.** Job density on the south side of the service area is generally low. Developments are not arranged in linear patterns. The roads and street networks are not very walkable. But the 196 connects some of the densest commercial and industrial areas, as well as dense housing (which is not shown on this map) and places with large numbers of lower-income residents near each bus stop. While it is not linear overall, its western and eastern segments each connect many dense places.

Route 196 offers frequent service at rush hours (coming every 30 minutes the rest of the day), and has one connection to an all-day frequent service (the Red/Gold rail line).



# Low Density: Local Example

## Route 142–East Holcomb Bridge Rd.

In contrast with the previous two examples, Route 142 (shown at right) serves a very low-density area.

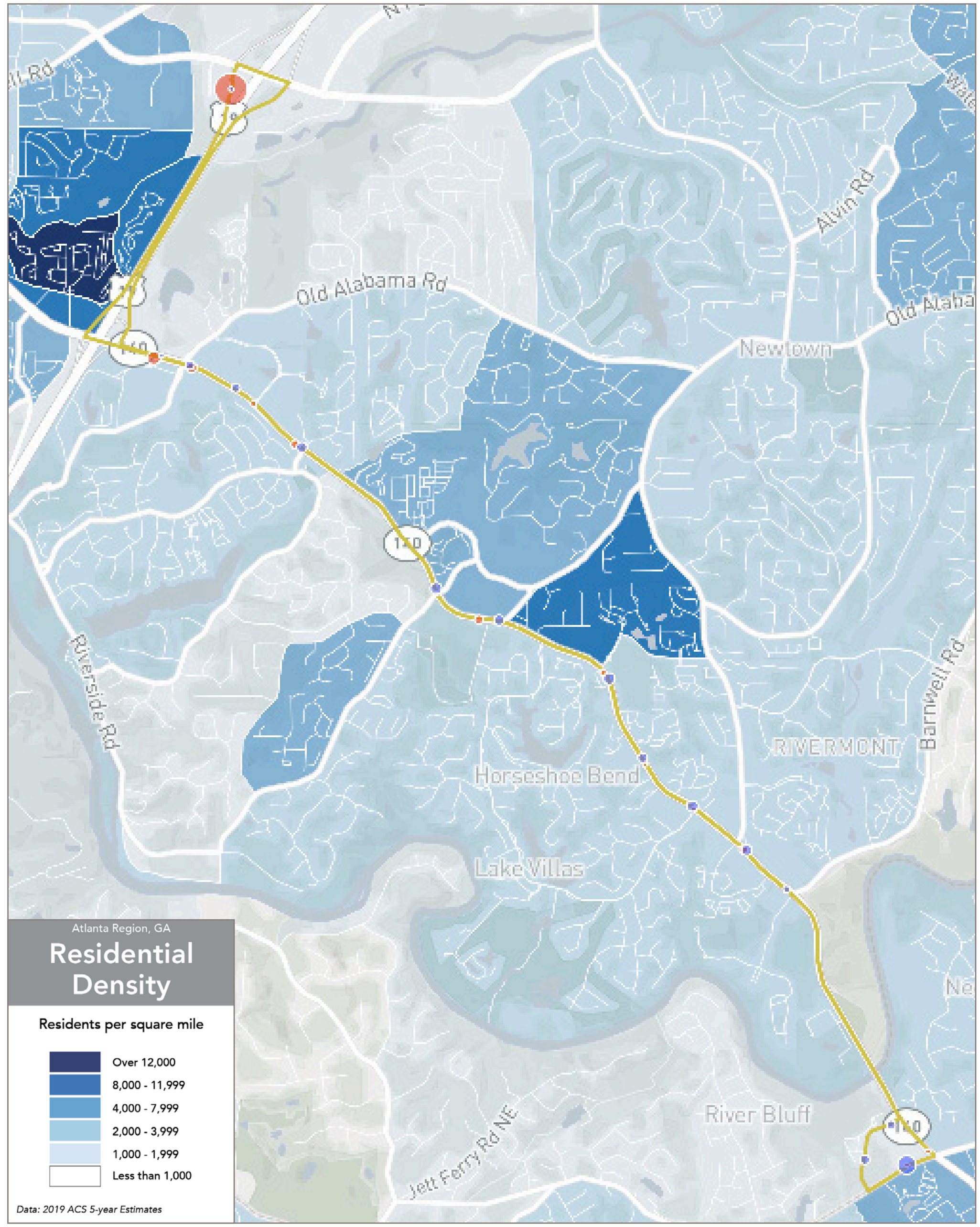
On this map, darker shades of blue signify greater residential density. Job density, which is not shown, is also low along this route.

**Route 142 is MARTA's least productive route, averaging 7 riders per bus, per hour, throughout the week.**

It **shows very little of the Ridership Recipe, except linearity.** It serves an area of low residential and job density, and a low density of residents in poverty. It offers poor frequency, short hours of service, and few useful connections to the rest of the network.

It also doesn't go into the nearest activity centers. On the left edge this map the route appears to get close to the dense residential and commercial area in Roswell, but it actually passes by on the freeway without stopping.

Route 142 is but one example of routes that simply have too few residents and jobs near each bus stop to attract much ridership, regardless of the frequency of service provided.



# Mix of Uses: Local Example

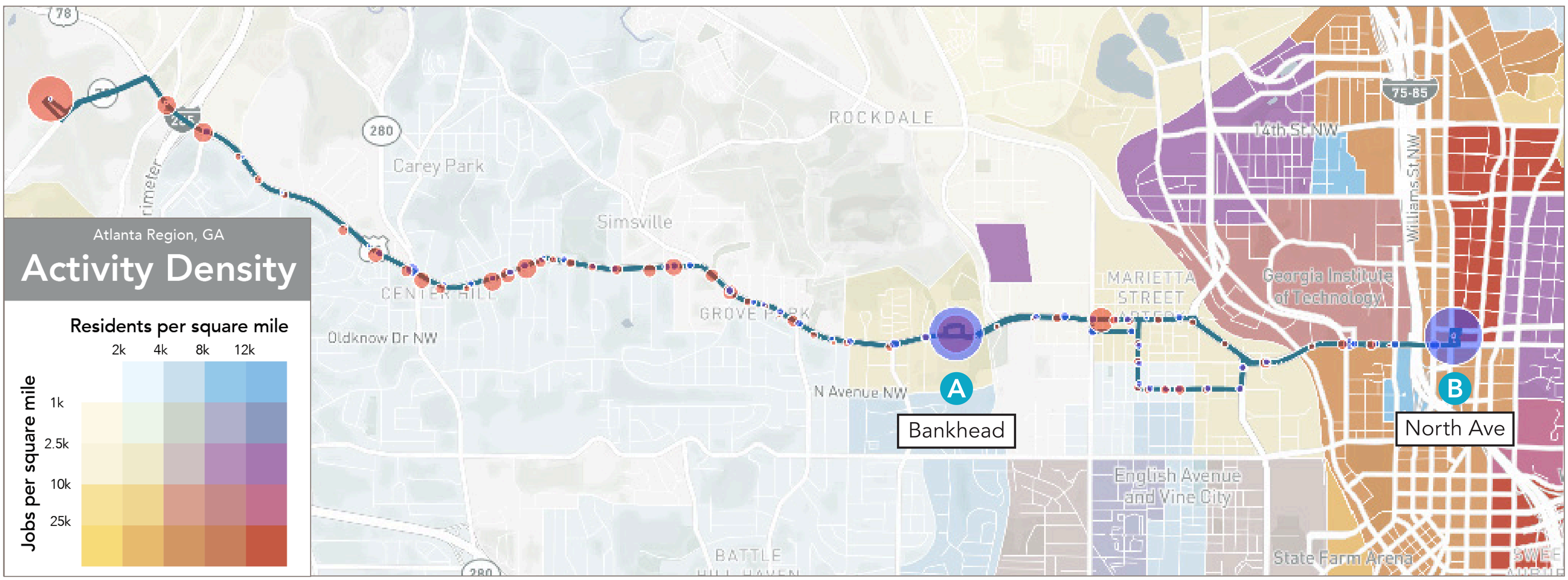
## Route 50–Hollowell Parkway

The map below shows Route 50 with both residential and job density in the background. (The color scheme for this combined Activity Density map is more muted than in the maps on prior pages.)

**Route 50 is the most productive route among those offering 30-minute all-day frequency.** It moves an average of 29 people per bus per hour. It serves moderate residential and commercial developments on the west side, and a major employment center (the UPS distribution facility) at its western end. It connects to Georgia Tech and the hugely dense, walkable, mixed-use Midtown area of Atlanta.

**Route 50 also demonstrates the value of connections:** it connects with both east-west rail (at Bankhead A) and north-south rail (at North Ave B). All day, people are riding the segment between those two stations *in both directions.*

***The more that MARTA buses can be full in both directions, all day, the more riders MARTA will serve with its limited budget.*** Mixed uses and a highly-connected network both support that outcome.



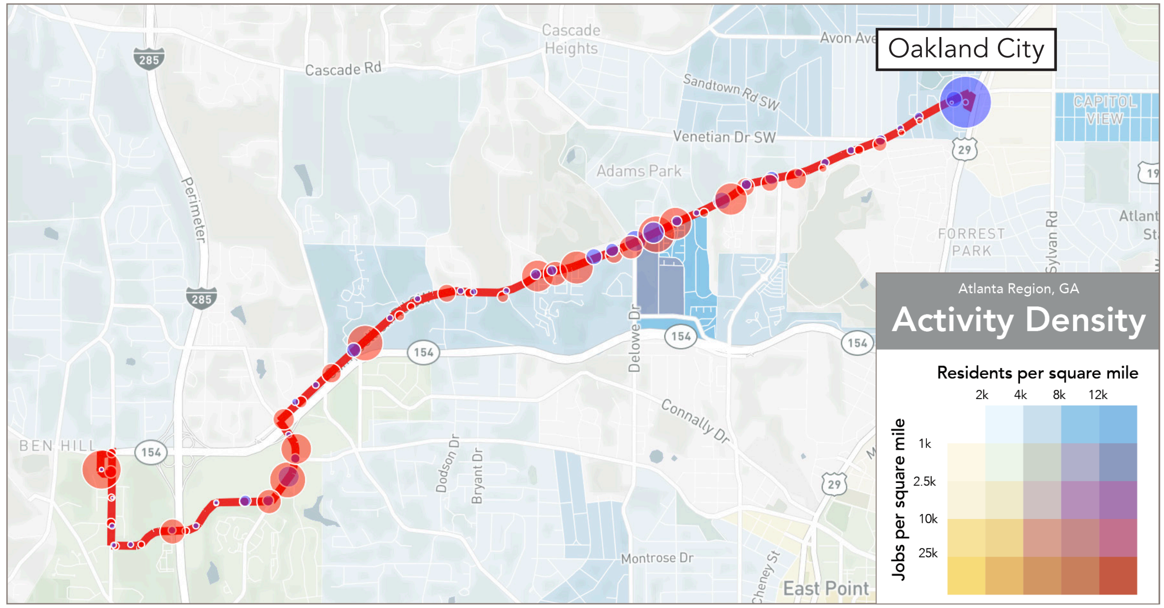
# High Walkability and Linearity: Local Example

## Route 83–Campbellton Road

Campbellton Road is a dense, somewhat-mixed use corridor with sidewalks, crosswalks and signals. **Route 83 is the third-most productive bus route, with 38 boardings per bus, per hour.**

In some places the road is narrow, and it is therefore relatively easy to cross. There are continuous sidewalks, regularly-spaced signals and marked crosswalks, such as in the image at right, below. In the older section of Campbellton there are also apartments and businesses built close to the street, and trees, which likely make it a more pleasant and interesting place to walk.

Even near the very car-oriented Greenbriar Mall, where the road is wide and fast, there are multiple signals that allow people to access transit from either side of the road.




# Poor Walkability: Local Example

## Route 15–Candler Road

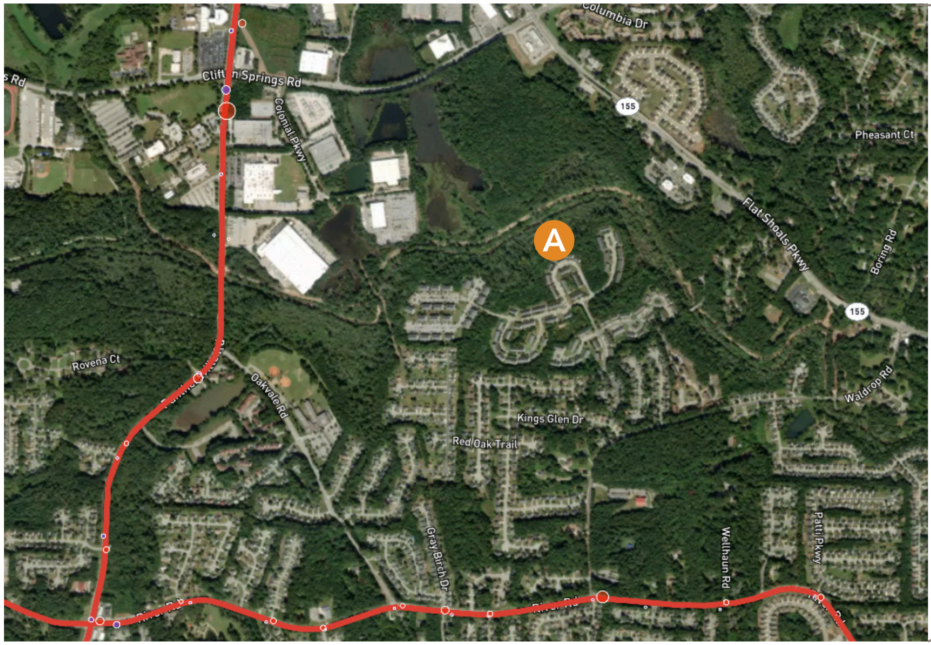
At right, the southern end of Route 15 is shown with residential density. Route 15 connects Panthersville to Decatur.

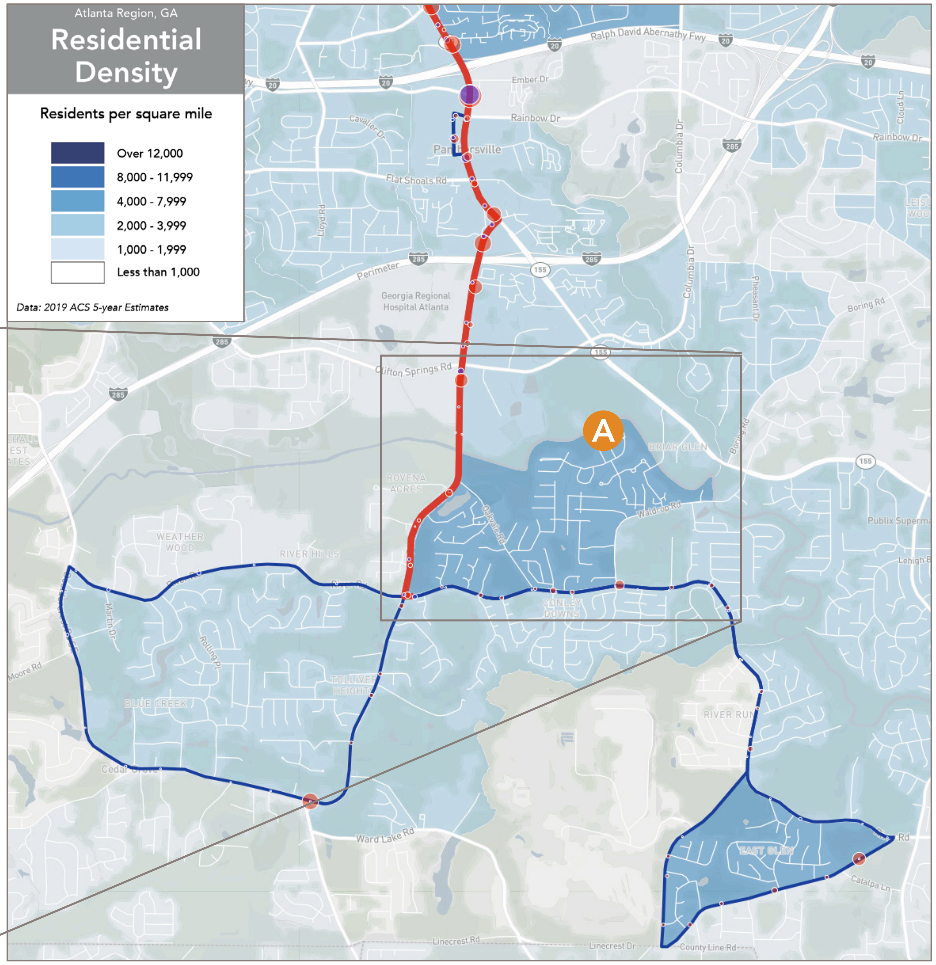
**Route 15 offers a useful demonstration of the limits of frequency in maximizing ridership.** It is an all-day frequent route, but it is the least productive of MARTA's frequent routes, averaging 21 riders per bus per hour.

There are some very large apartment complexes A near Route 15 *as the crow flies* but they are set so far back in labyrinthine street networks that the walk to a bus stop is very long. As a result, very few people catch the bus even when dense areas are seemingly nearby.

Poor walkability is a challenge in other suburban parts of the MARTA service area, not only around Route 15.

MARTA does not control street connections, but a severe lack of street connections – and the placement of dense housing far from main roads – reduces the potential for ridership.



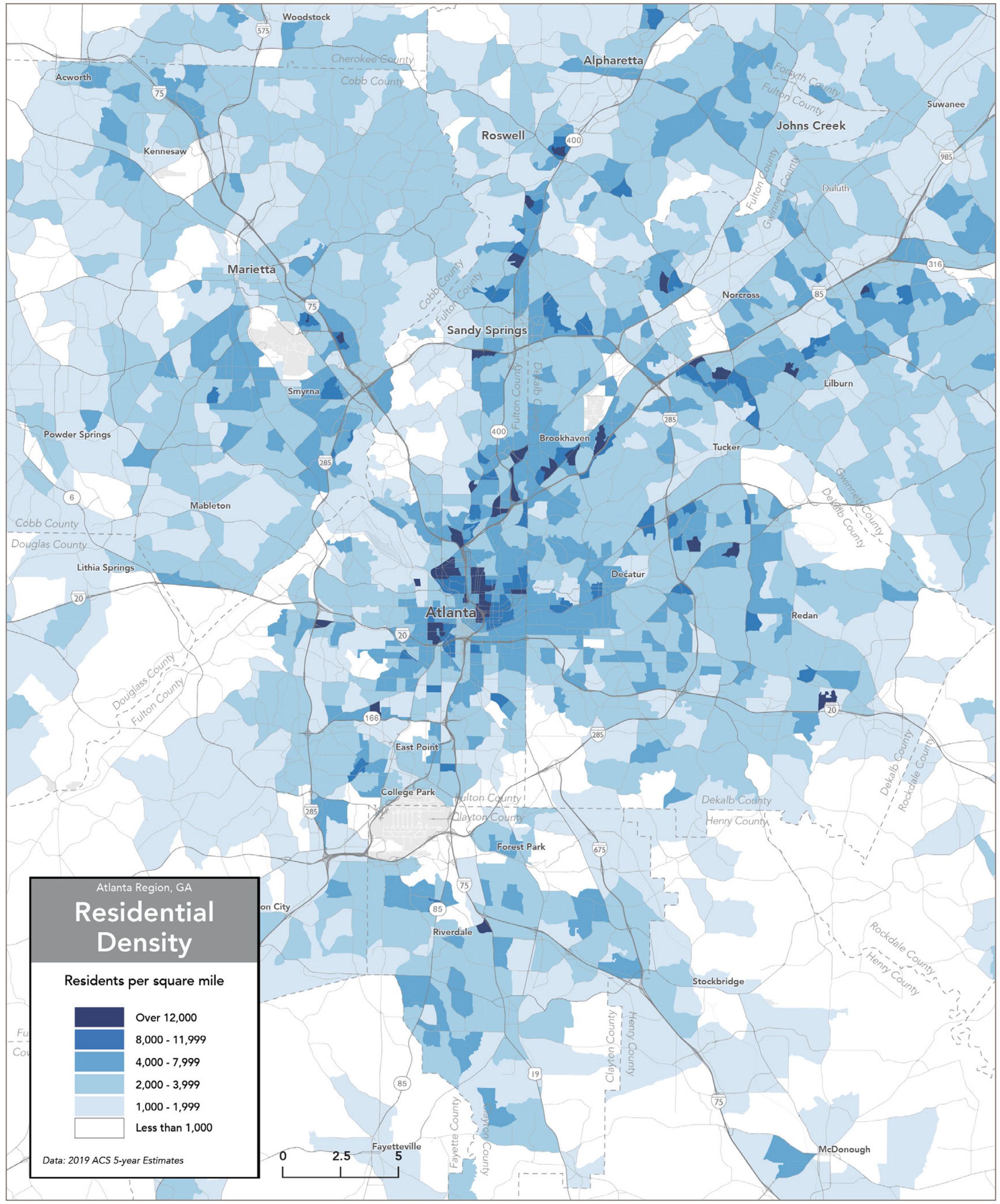



# Residential Density

The places with high residential density in the MARTA service area are shown in darker shades of blue, at right.

Residential density is not quite as strong a predictor of transit ridership as job density.

However, every kind of daily trip begins at peoples' home, so dense residential areas, arranged in linear and continuous patterns that transit can serve, are a key part of the Ridership Recipe.



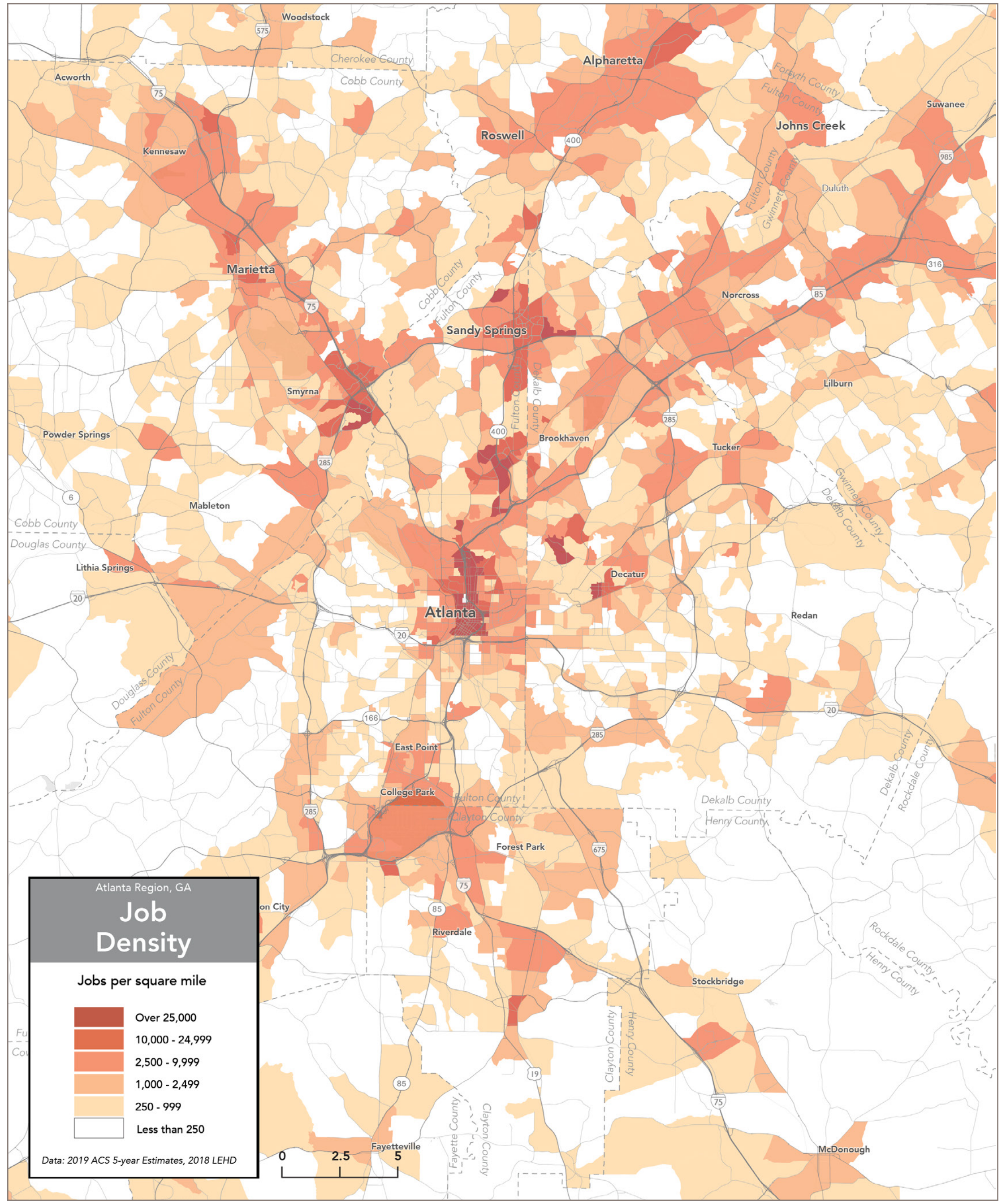
# Job Density

Places with high job density are shown in darker shades of green, at right.

The trip to work is of existential importance for most households, and that is why job density is an important factor in considering the design of a transit network.

Places with high job density are destinations for many other kinds of trips, not only work commutes.

Retail, restaurants, schools, medical services, and other activity centers are often visited by customers, students, and patients. Some of the job clusters shown in this map can also be thought of as activity clusters that people want to access for many reasons, at many times of day and week.



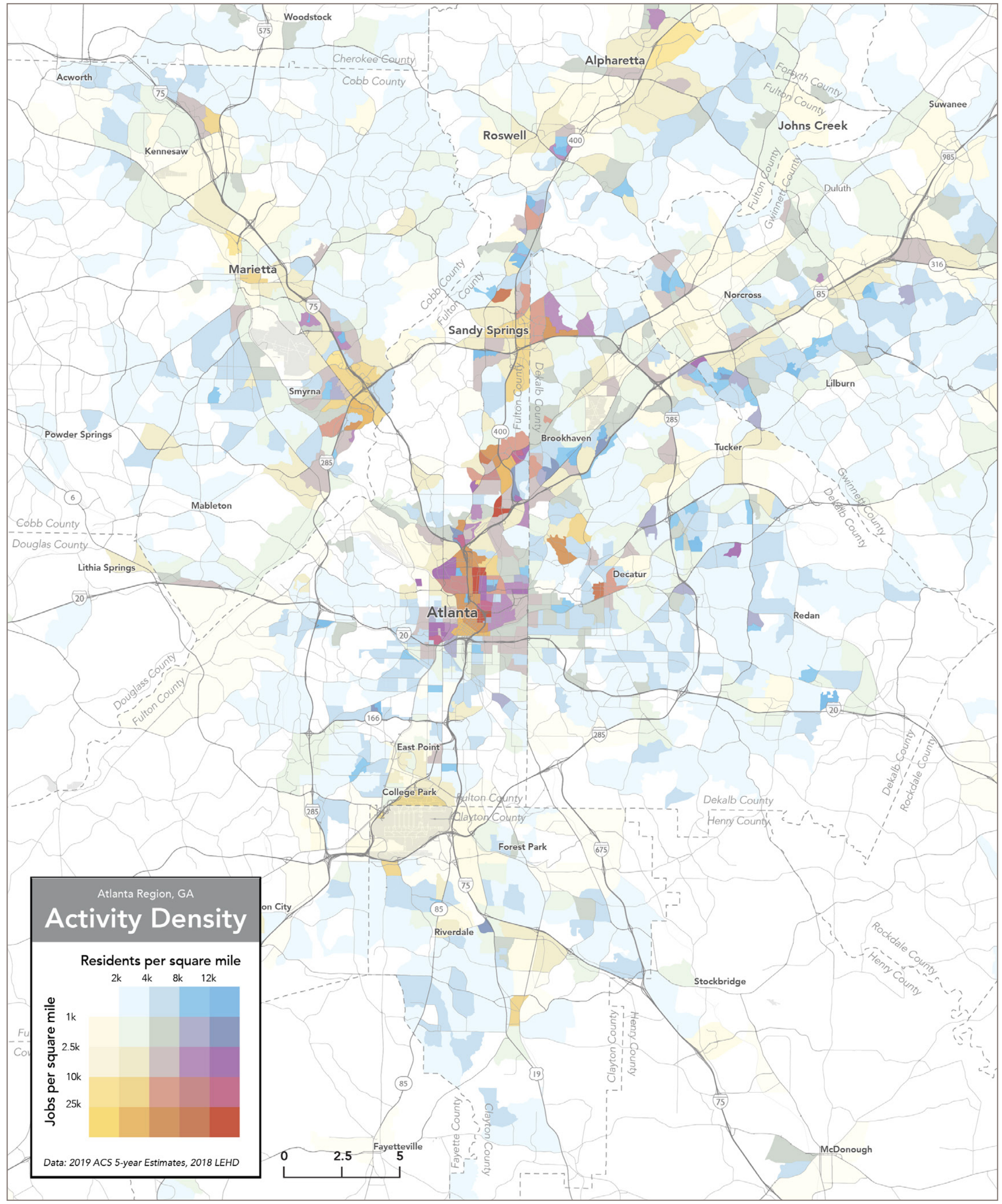
# Activity Density

If we combine residential density and job density, we get this map. Color indicates the land use: yellow is jobs, blue is residents, and red is mixed.

The MARTA service area has few "dense" corridors by U.S. standards. However, roads that pass by areas of moderate-density housing and jobs are present in most parts of the service area. Moderate densities show up as light blue or light yellow here.

This map reveals that the densest mixed-use corridors are north of downtown Atlanta, roughly around Peachtree Road, Buckhead and Sandy Springs.

Some of these dense areas are organized around freeways like I-85 and GA-400, rather than around transit-operable roads. This makes them hard to serve with linear, cost-effective transit. But others are organized around arterial roads, such as Peachtree Road, that are transit-operable with decent sidewalks and pedestrian crossings.

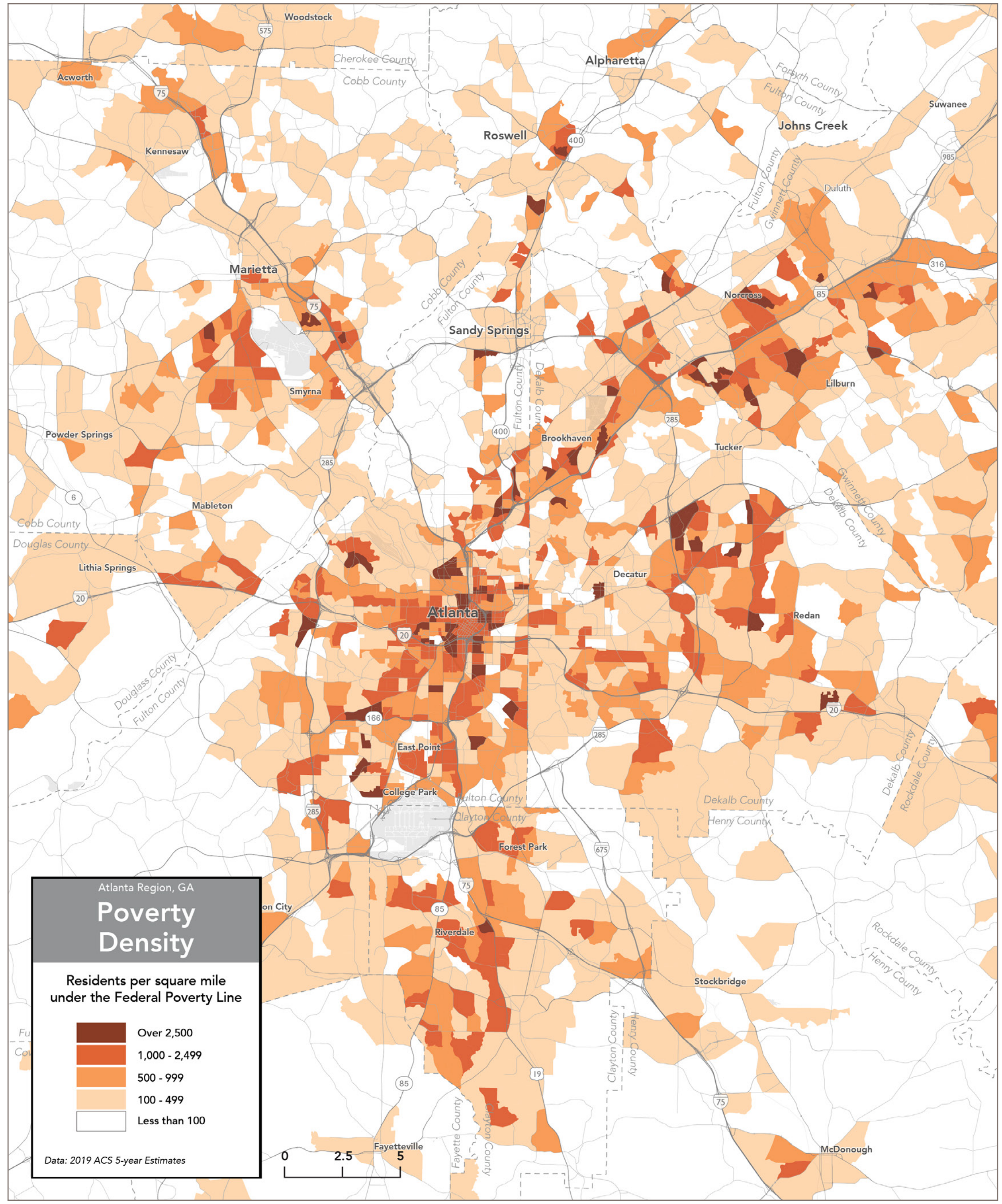


# Density of Low-Income Residents

The map at right shows where people living on low-incomes are most concentrated in the region.

This map can help us think about transit design to serve both ridership and coverage goals. Places that appear dense on this map are places where there are many residents near each bus stop, and many of them have a great incentive to choose transit.

One limitation of the Census data used to make this map, and to perform other analyses in this report, is that it does not tell us whether someone is only temporarily living in poverty. Atlanta is home to many colleges and universities. College students tend to show up in Census data as living in poverty, but their life situation is often not comparable to that of adults living in poverty.



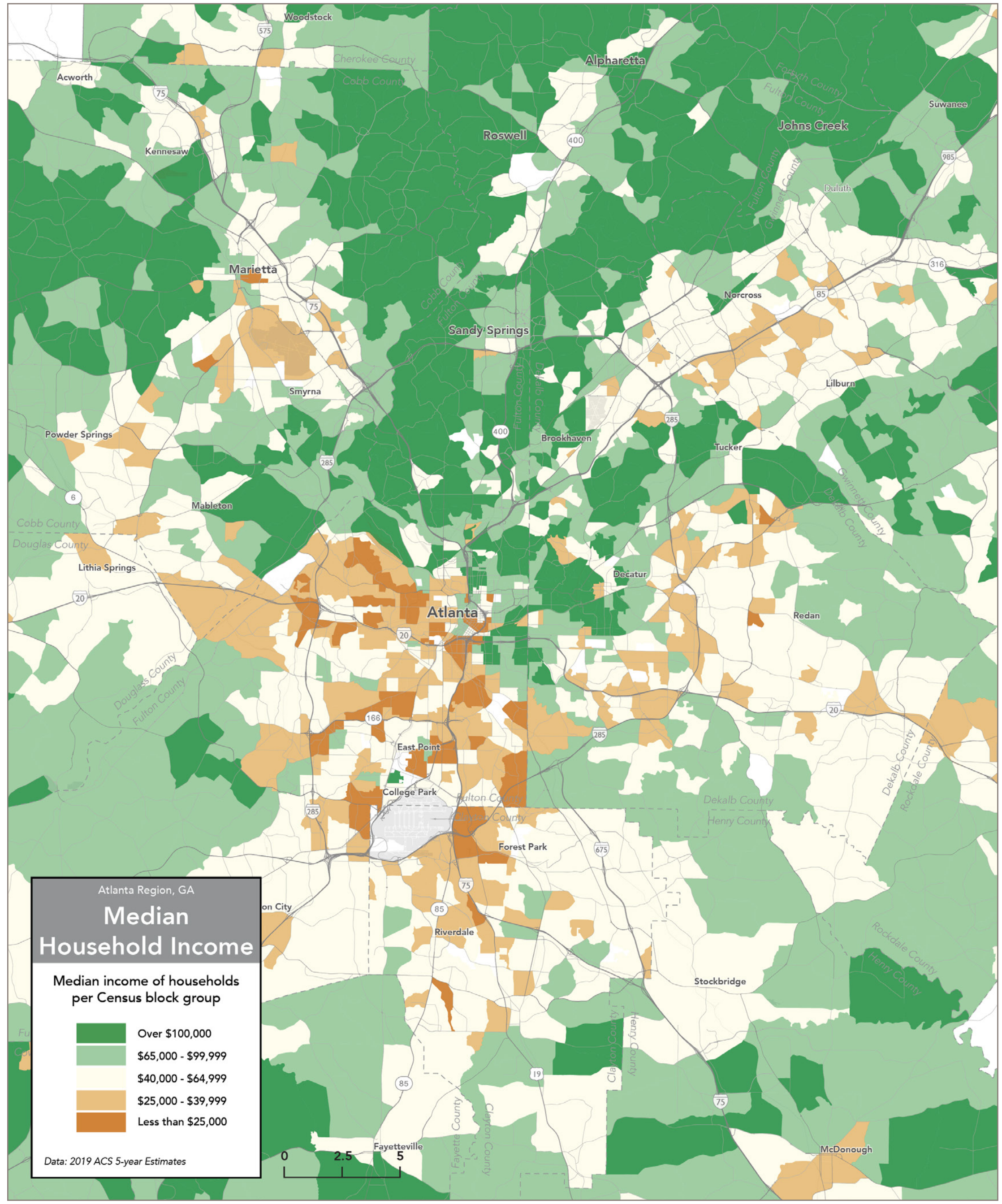
# Median Household Income

In the map at right, places where the median (typical) household income is low appear in orange, and places it is high appear green.

On this map, small numbers of people can show up intensely. A very dark color does not mean a large number of people – it can mean a small number of people whose income is high or low. To assess how many people live at the incomes shown on this map, compare this map to the density maps on the previous pages.

This map is helpful when designing coverage services whose goal is not to attract high ridership, but rather to reach people with severe needs, even if they are small in number.

By comparing this map to the maps of job and activity density on pages 43 and 44, we can see how much higher the incomes are for the typical households on the north side, in and around the commercial and mixed-use corridors between Atlanta and Sandy Springs.



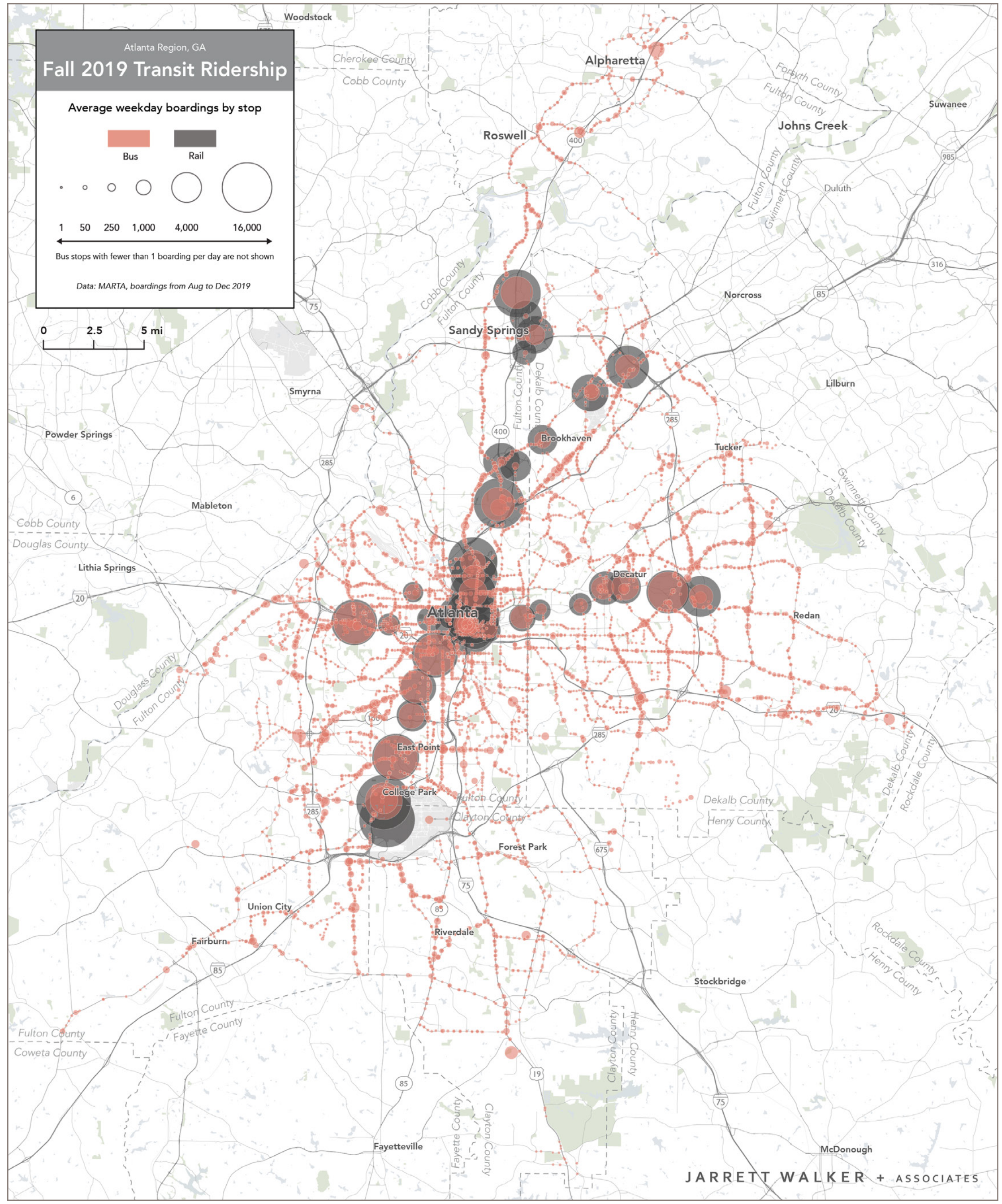
# 2019 Transit Boardings

The map at right shows boardings on MARTA bus and rail in Fall 2019.

This boardings data underlies the analysis of route productivity shown on other pages. It will also be carefully considered (at a much closer scale) during the Network Redesign.

There is a limit to what existing boardings tell us about underlying demand for transit. The existing (2019) MARTA network served certain trips well, certain trips alright, and certain trips not at all.

Boardings data will naturally reflect what the network and routes were doing well at the time, but won't tell us anything about what ridership *could* be like under different conditions. To make that type of judgment, the team will consult many other sources of information, including the density and demographic maps shown in this report, and the local expertise of MARTA, City and County staff.



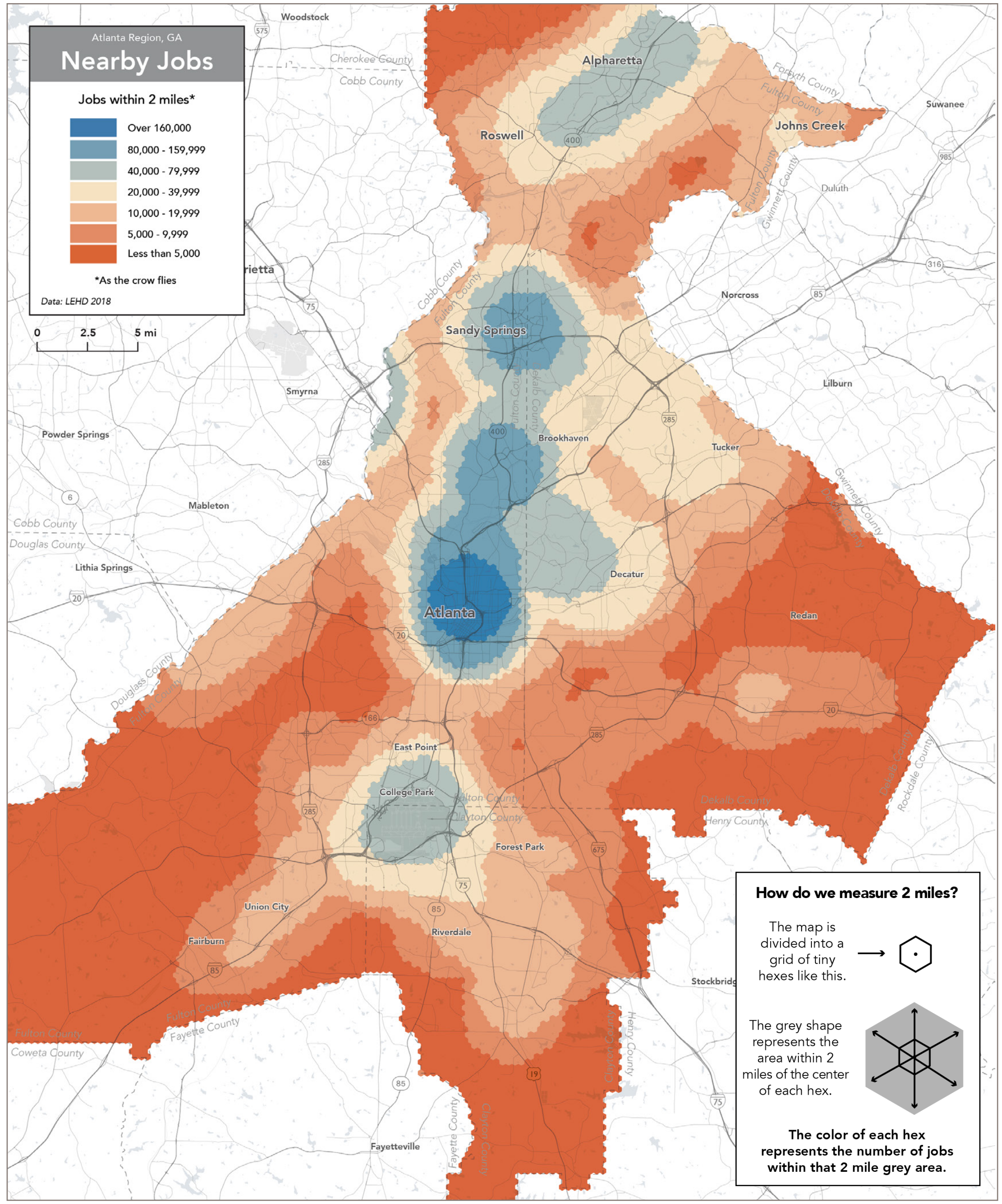
# Access to Opportunity

# Who Lives Near Jobs?

The map at right shows how many jobs are within 2 miles, for all parts of the MARTA service area. Areas in blue have many jobs nearby, and areas in red have few. Jobs that are close enough that someone might be able to walk or bike to them is reflected on this map.

**MARTA decides where transit goes, but it has little control over where jobs, housing and opportunities are located.** Housing and job locations are decided by cities, counties, state and federal authorities, banks and businesses.

This map shows (in red) where transit's job may be most important, because people need to travel far to reach opportunity. These places are also where transit's job is harder because of the longer distances between jobs and homes.



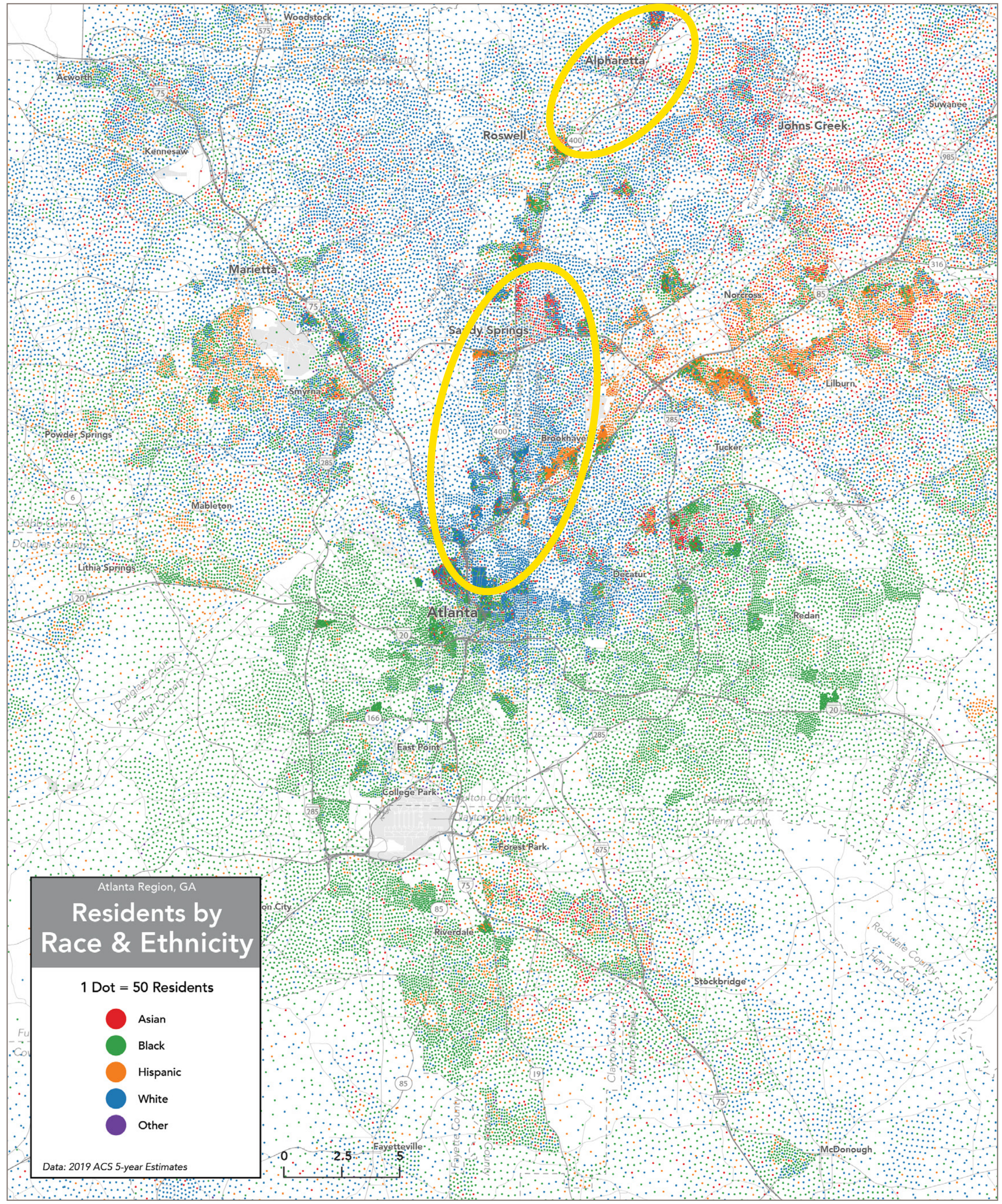
# Residents by Race/Ethnicity

In the Atlanta region, as in many other U.S. urban areas, decisions about where housing is located, and who can live in that housing, have created or perpetuated racial segregation as well as segregation by income. In some cases this segregation was intentional.

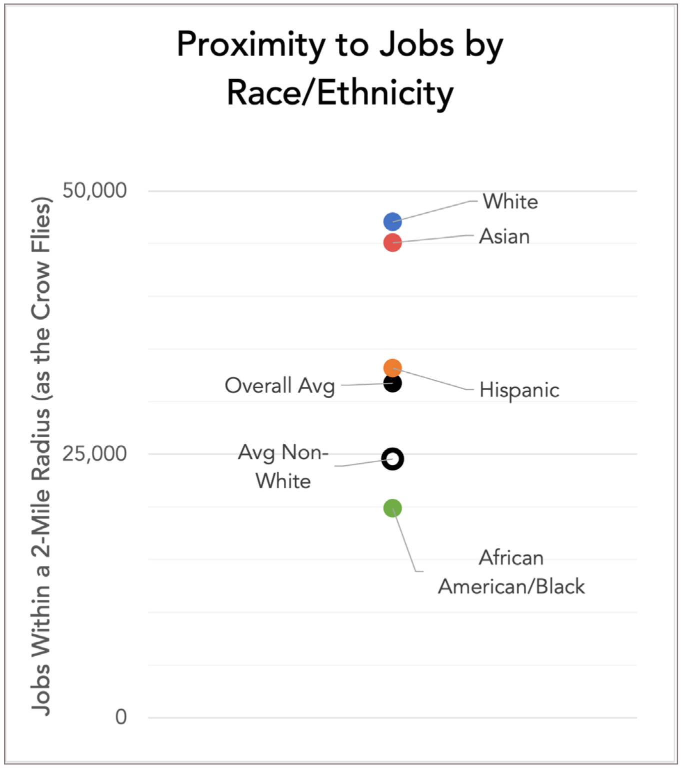
The cumulative effect is that **low income and minority people, especially Black people, tend to live further from jobs in the MARTA service area.**

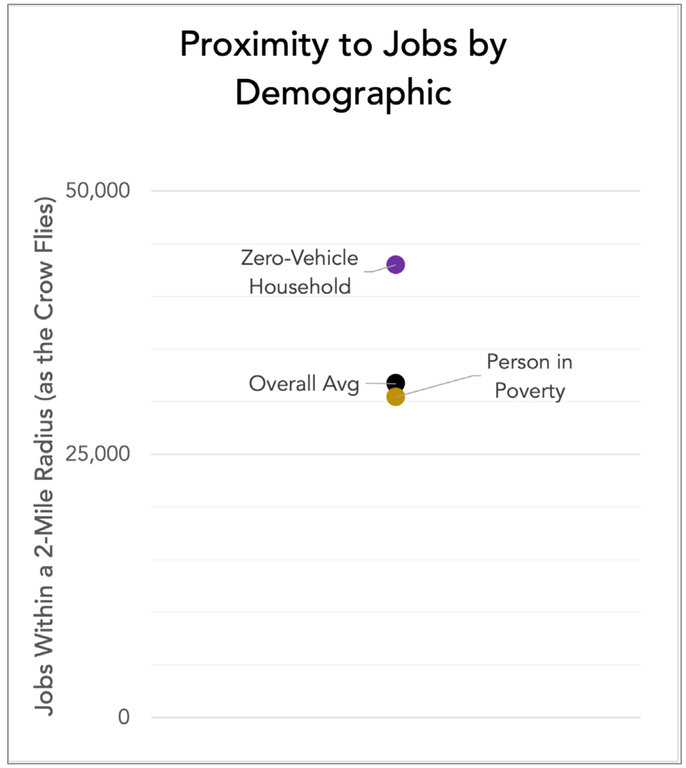
The map at right shows residential density by race. The yellow circles mark the areas where jobs are highly concentrated, between downtown Atlanta and as far north as Alpharetta. These jobs are fairly close to residences on either side of the circles, but farthest from the south, east and west sides of Atlanta.

As this map illustrates, the high concentration of jobs in the MARTA service area also opposite the part of the area that is predominantly Black.[1]




1 This pattern, known as the "favored quarter," in which high-rent commercial developments are built opposite the lower-income and often racial-minority neighborhoods, can be seen in other radial cities such as Washington, DC, and Paris.




**Compared to all residents, the average Black resident has 37% fewer jobs nearby. However, the difference is negligible when looking at residents' incomes.**

The charts on this page show the results of comparing the maps on the two previous pages.

The chart on the left shows that, on average, white and Asian residents live close to twice as many jobs as Black residents, and more jobs than Hispanic residents.

The chart on the right shows that, on average, lower income people live in neighborhoods with about the same proximity to jobs as the average resident.

The average person living without a car has more jobs nearby than the average resident.

Setting aside any additional access that might be provided by transit, Black residents simply have fewer jobs nearby, on average, than other residents.

# Who Has Transit Access to Jobs?

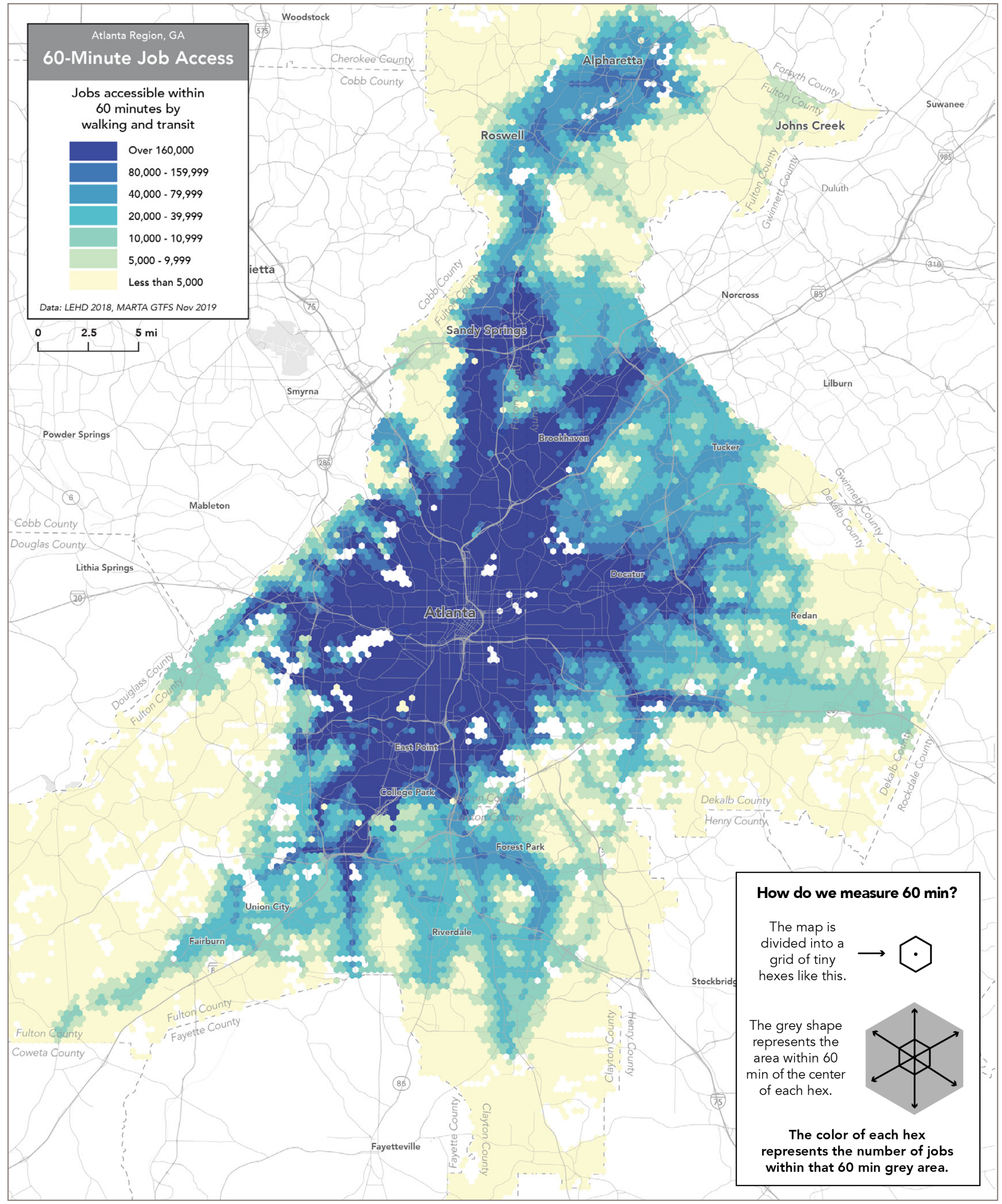
The map on page 49 showed how many jobs are *nearby* all locations in the MARTA service area.

The map at right shows how many jobs a person can reach within 60 minutes of all locations in the MARTA service area, by walking and transit.[1] Dark blue represents many jobs, while yellow represents much fewer jobs.

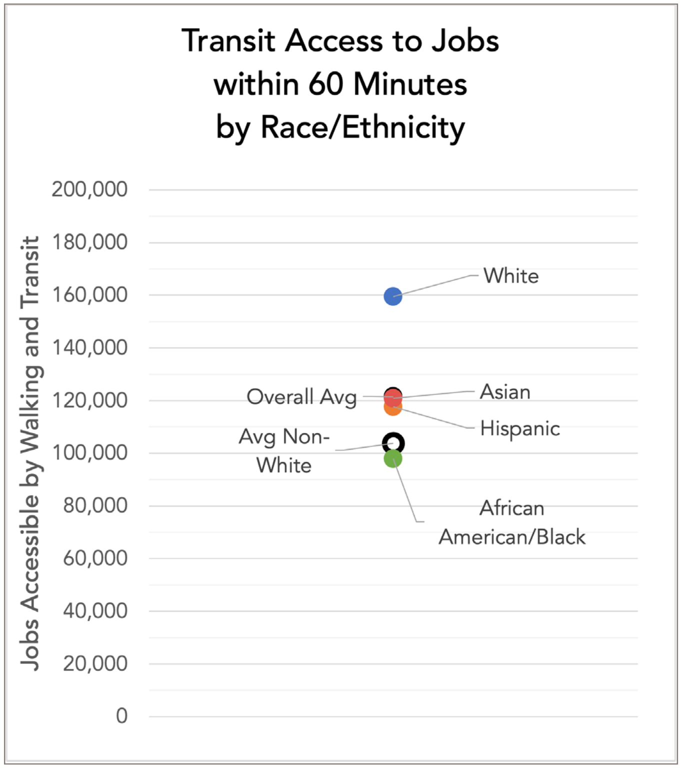
Most of the dark blue is within an hour of downtown Atlanta because there are so many jobs downtown and the transit network is optimized for travel to downtown Atlanta. Additionally, most of the dark blue areas are on the frequent bus and rail network.

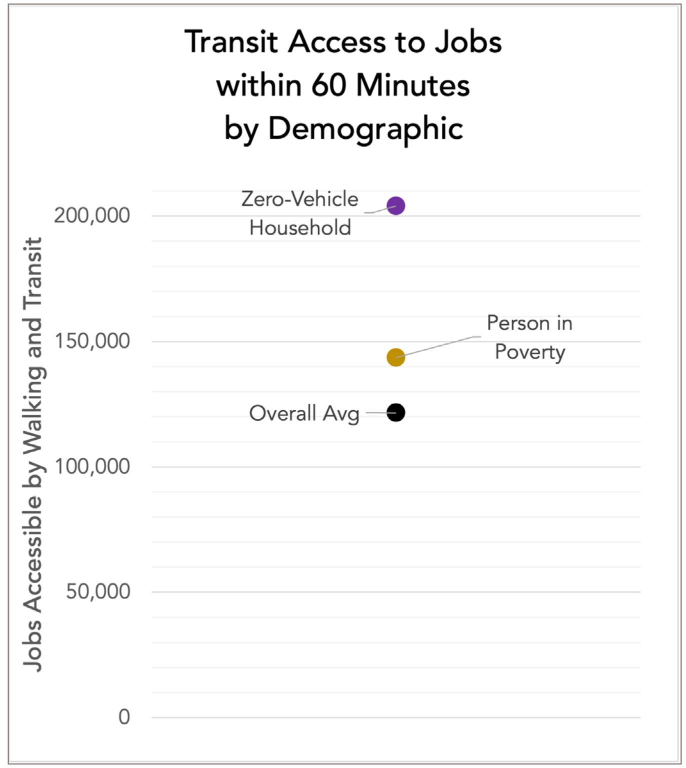
However, some of the dark blue areas offer a great deal of job access because, as shown on page 49, people living there could walk to nearly 100,000 jobs nearby! This is particularly the case in Buckhead and Sandy Springs.

Transit has a harder job to do outside of those job-rich, walkable, mixed-use areas.




1 This one hour travel budget includes time spent waiting for transit.




**Compared to all residents, the average Black resident can reach 20% fewer jobs in an hour by transit.**

The charts on this page show the transit access to jobs mapped on the previous page, split by race/ethnicity and other demographics.

The chart on the left shows that, on average, white residents have transit access to more jobs than Black, Hispanic or Asian residents.

The chart on the right shows that, on average, lower income people and people without cars in their households have transit access to more jobs than other residents.

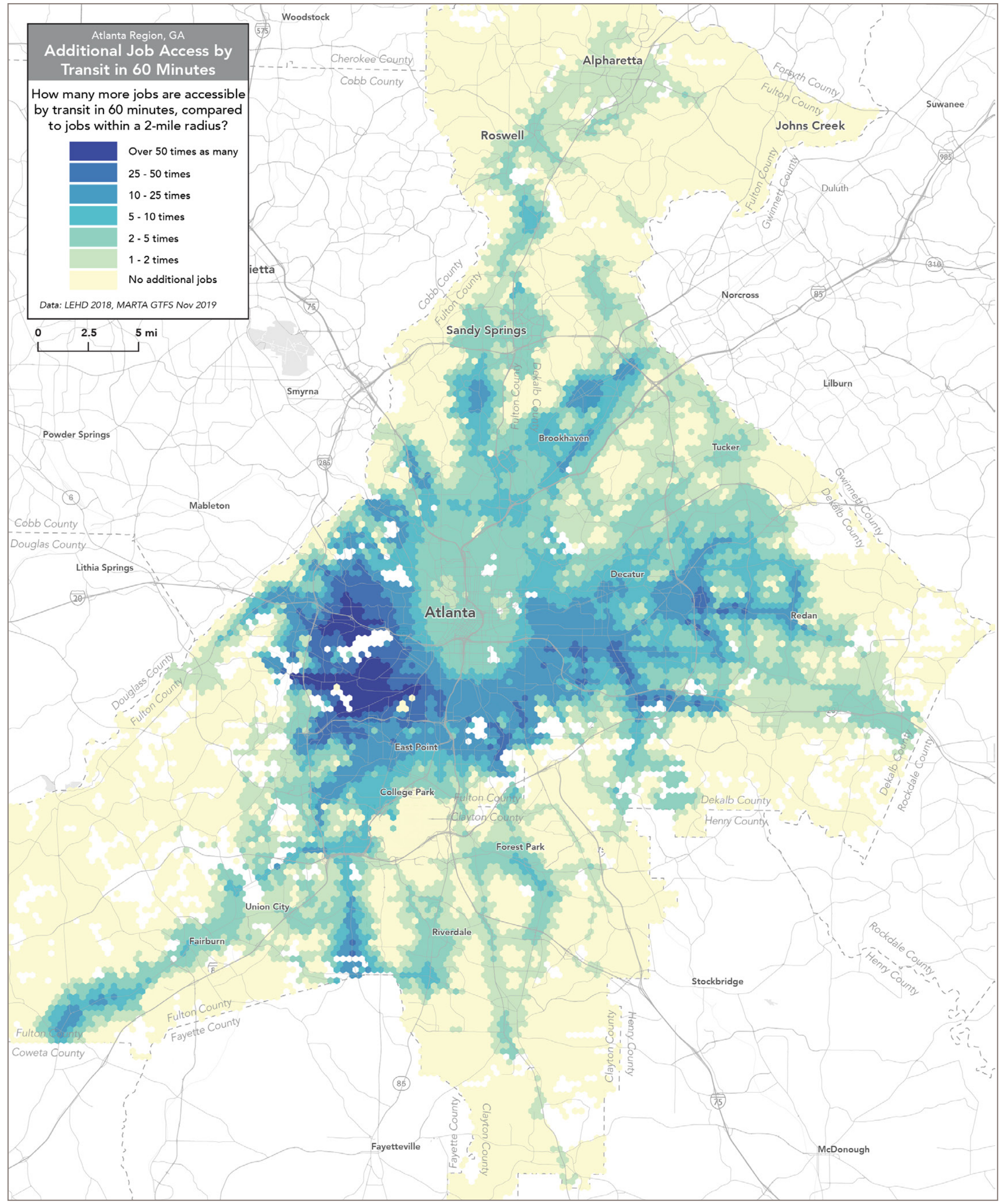
Some of the access to jobs shown in these charts is simply a result of people *living near* jobs, as shown in the charts on page 51.

## Transit-accessible Jobs vs. Nearby Jobs

This map shows the difference between the job access offered by transit and the jobs that are simply nearby.

Places that are dark on this map are places where MARTA is helping people overcome a lack of opportunity within their immediate neighborhoods.

But there is a problem with the map on this page and the previous page: they show job access from every area equally, regardless of how many people *live* there.



## Transit-accessible Jobs Beyond Your Neighborhood

In the map at right, each dot represents 25 residents. Dots are packed more closely where more people live.

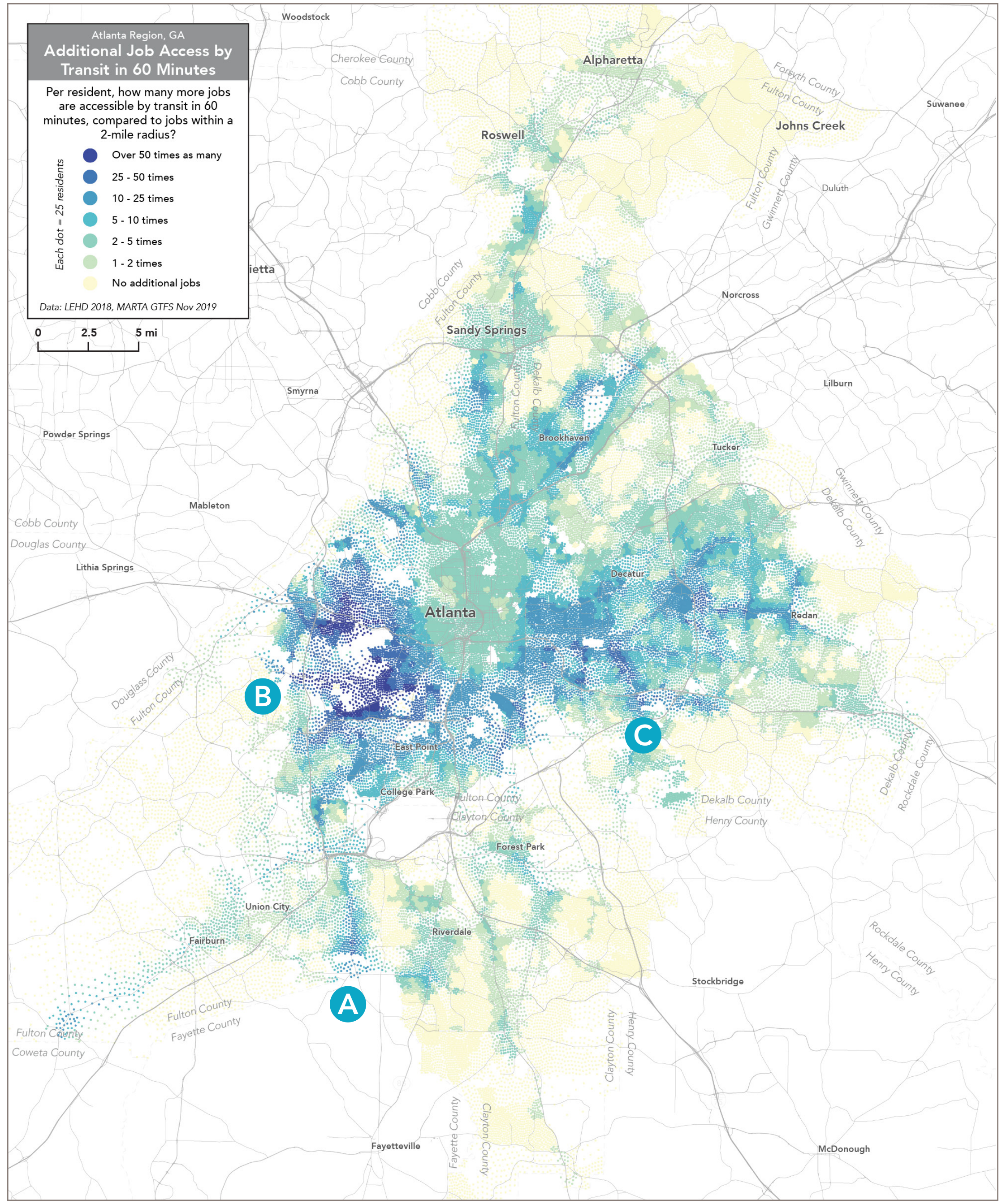
Areas that are dark blue on this map are mostly the areas near MARTA's frequent bus lines and rail stations – those are the places where transit is helping people reach jobs more than 2 miles away, and within an hour's transit commute.

For example:

A Route 89 on Old Nat'l Hwy stands out because it offers short waits in a moderately dense area, and goes straight north towards jobs around the airport.

B Frequent routes that connect to rail bring many downtown jobs within an hour's commuting time for southwest neighborhoods.

C The long frequent route on Candler Rd. can get people to the jobs in downtown Decatur within an hour.

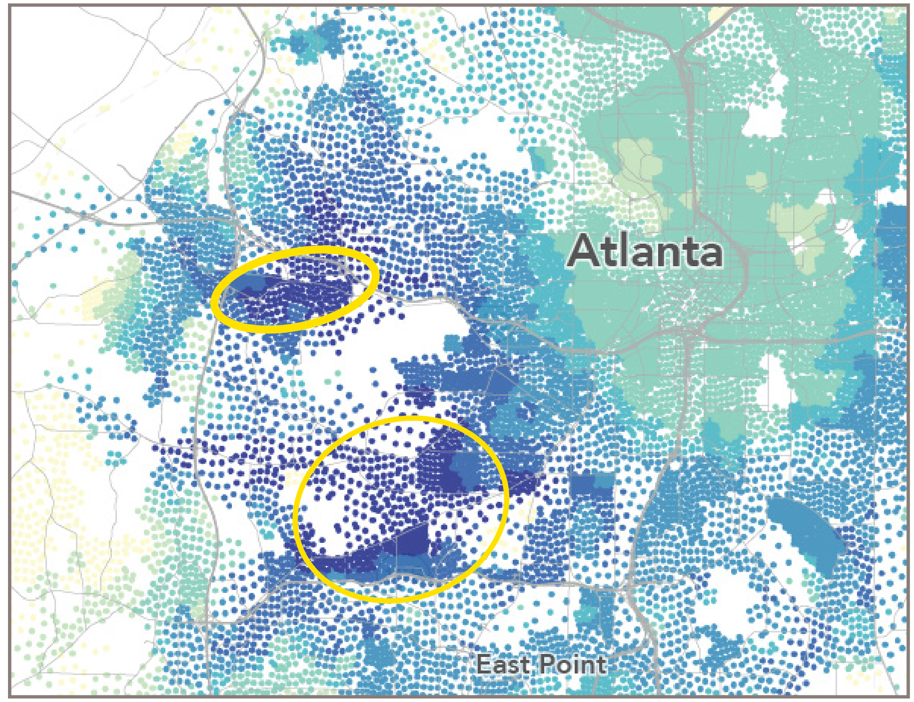


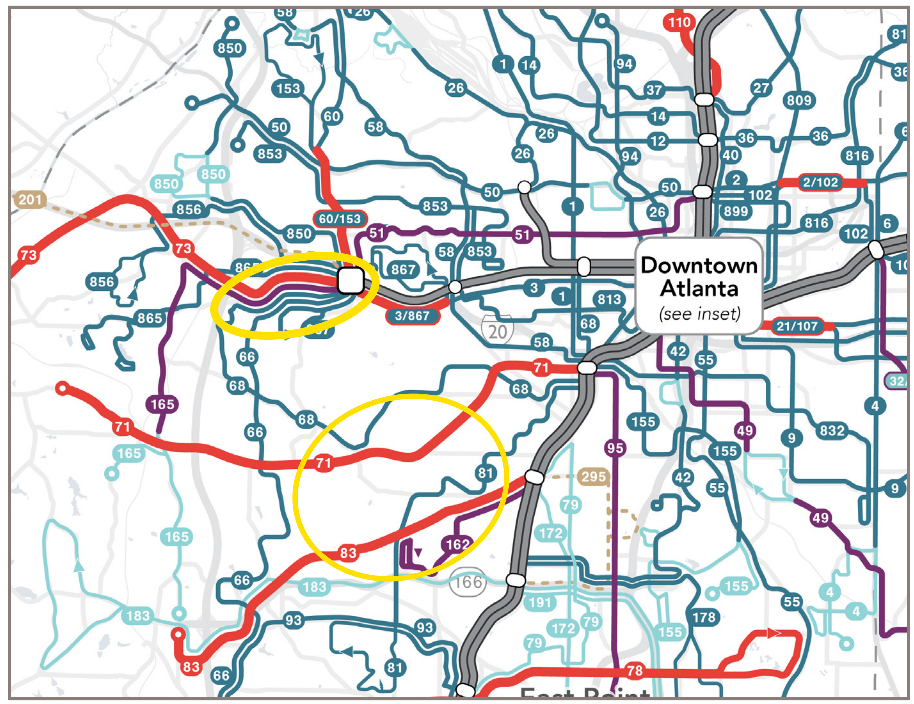
## Examples of Transit Increasing Job Access

On the two maps to the right, the circles highlight two examples of places where the MARTA network provides job access to residents many times over the jobs that are available nearby.

The dark blue dots in the top map correspond to all-day frequent bus routes (as seen in the bottom map) that connect with frequent rail.

- The bus and rail lines' high frequencies mean that residents spend little time waiting to start their trip or to transfer.
- The speed of rail means that they spend little time on the train.
- Because they are taken to the center of downtown and the center of the network (at Five Points) they can walk to numerous jobs nearby, or easily transfer to other buses and rail lines to reach jobs farther away.



# Access and Equity

If MARTA wants to increase ridership, then it should improve access to jobs (and other opportunities) in places where there is continuous development with numerous residents.

## Who needs better access?

However, this brings into question issues of equity and who is receiving improved access. Providing maximum access to the maximum number of people is a strategy for higher ridership, but MARTA could choose to de-prioritize high ridership and prioritize increasing access for specific populations of concern, accepting that it may not be the path to maximum ridership. For example, MARTA could choose to prioritize:

- **Increasing transit job access for Black residents** to close the gap in job access caused by uneven job development around the region and housing segregation.
- **Improving transit job access for low-income residents** more than for higher-income residents, in order to provide greater access to those who need it more. This is generally part of a high-ridership strategy, but it may be important in and of itself, regardless of ridership.
- **Covering areas where population is low, but where people have severe needs for transit,** for example due to age or disability.

## How can transit address inequity in the region?

On average, white residents live within two miles of 147% more jobs than Black residents – more than twice as many.

However, once we measure access to jobs *via transit*, the gap between white and Black residents becomes smaller. White residents have access to just 63% more jobs within an hour's commute than Black residents.

This means that MARTA's bus and rail lines are already helping to close the job-access gap that arises from unequal job development around the region, and unequal access to housing and opportunity.

# The Price of Distance

Jobs have been developed unequally around the MARTA service area. They are most concentrated and most oriented towards transit in the northern quadrant, where housing has been least accessible to Black people.

Rail is frequent and fast, and can help people traverse the region to reach jobs. But rail is extremely expensive and can therefore only be in a few places. Even in a future with fast bus service and more rail, ***someone has to pay the price of distance.***

The Atlanta region has apartments, low-wage jobs and essential services spread across enormous distances. Every time new developments are put far away from existing development and existing transit, the people of the region bear the cost of that distance:

- Transit riders spend hours on transit, and hours waiting, to cover that distance.
- MARTA spends more of its budget on distance, which means less can be spent on high frequencies or long hours of service. This undermines ridership potential.
- More people have to own and maintain cars, to access opportunities that in other regions are accessible by transit.

A long cascade of social, health, economic and environmental problems follow from those.

The grim news is that transit cannot solve this problem. At current transit funding levels MARTA can hardly make a dent. Distance must be crossed, which takes time and money that can't be spent towards other things people value.

This Network Redesign will examine ways that transit access can be increased, or valuable coverage can be added, despite the high cost of distance.

**Without major reform to the way development is planned and permitted, the problems caused by distance will grow worse, and transit will never be the savior.**

# Network Strategies and Choices

On the following page, we list out some strategies that could be used in the redesign of the MARTA network.

It is not possible to know which of these strategies are appropriate until we know how MARTA wishes to make two major trade-offs:

- Familiarity vs. change
- Ridership vs. coverage

## Degree of Change

MARTA riders used the pre-pandemic (2019) system because it worked for them. If it didn't work for them, they wouldn't use it. Many of them will want it to continue to serve the patterns they have built their habits and lives around. The value of a familiar network is that it continues serving existing riders in a familiar way.

A Network Redesign will disrupt some of the existing patterns, and therefore will disrupt some existing riders. **Network Redesigns are controversial in proportion to how much the network changes.**

How much change is desirable and tolerable given that change is disruptive?

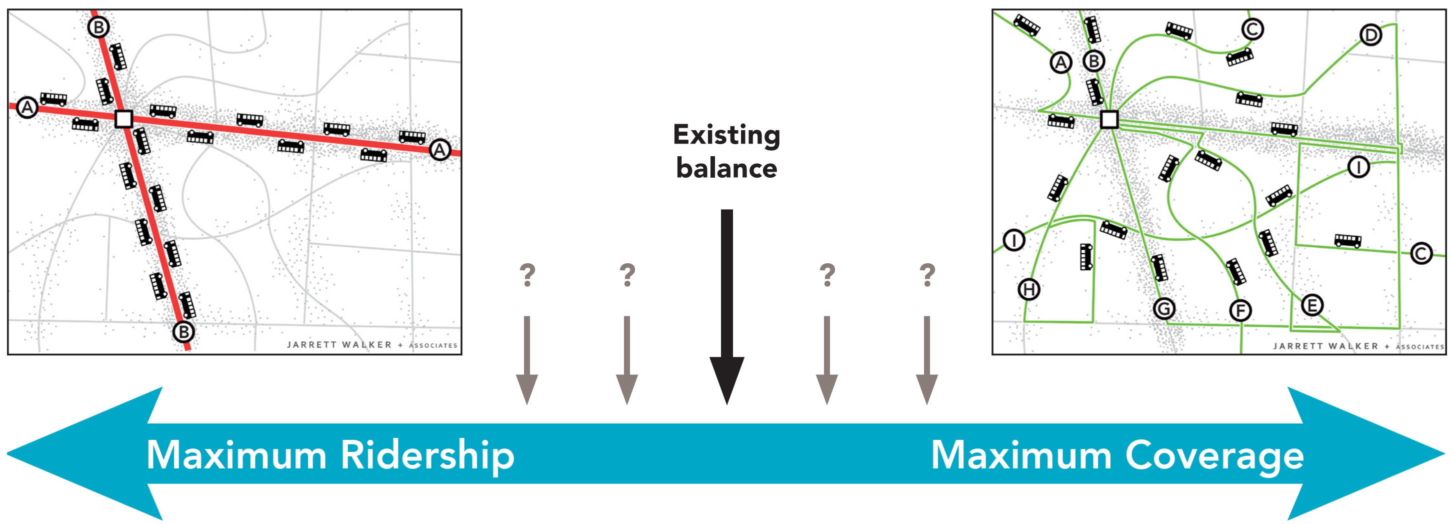
The degree of change MARTA wishes to see will tell us how many of the strategies that follow can be considered.

## Balancing Ridership and Coverage

As described earlier, about 60% of 2019 bus service was spent on high ridership services, and 35% on coverage.

Only 5% of service was spent in ways that are duplicative. There is very little "waste" or "inefficiency" in the existing bus network. MARTA could choose to eliminate this duplication, but it would not free up much service for improved frequencies or access. ***Shifting towards higher frequencies and higher ridership would require some loss of coverage.***

We cannot pick the strategies until we know the goals.



# Potential Design Strategies and Choices

LESS ↑ Controversy ↓ MORE

| # | Strategy or Choice | Goals Served | Benefits? | Difficulties? |
|---|---|---|---|---|
| 1 | Continue routes beyond rail stations. | Coverage or Ridership | Longer trips and greater access possible without a wait to transfer. | Changes the "feeder" tradition. May require adjustments by bus operators. |
| 2 | Focus infrequent routes on fewer stations. Time connections among them. | Coverage or Ridership | More trips possible within an area without a long wait to transfer. | Some existing travel patterns disrupted. Need more space at certain stations for all buses to be present at once. Sensitive to reliability problems. |
| 3 | Shift some peak service to serve all-day, all-week demand. | Coverage or Ridership | Lower cost to MARTA for extra peak-only vehicles. Freed-up budget for other service improvements. | Possible crowding during rush hours. Longer waits for some trips at rush hours. |
| 4 | Space stops more widely on frequent routes, in walkable places. | Ridership | Faster rides, better amenities at stops. Lower cost to MARTA to provide frequent service. | Some riders would have to walk one or more blocks further. |
| 5 | Standardize route spacing for walkable, dense places. Space routes farther apart to provide higher frequencies. | Ridership | Shorter waits for service. A simpler network. | Longer walks for some riders. |
| 6 | Eliminate deviations that serve few riders, to make routes faster and more direct. | Ridership | Faster rides. Freed-up service for MARTA to use on better frequencies or coverage of new areas. | Longer walks to a main road for some riders. |

# 1. Continue Routes Beyond Rail Stations

The existing network continues a tradition that bus routes are "feeders" to rail. Very few bus routes reach a rail station and keep going – just five routes in the whole system do so. This is a highly unusual network design.

There are places where routes can be designed to connect destinations that are on opposite sides of rail lines. This would eliminate transfers for many trips, saving 15 or 30 minutes of waiting time depending on the frequencies of the routes.

For example, four routes from the west serve the Arts Center, Midtown and North Ave. stations. Six routes from the east serve these stations. For someone to travel from Georgia Tech (A) to North Decatur (B), across the rail line, they must:

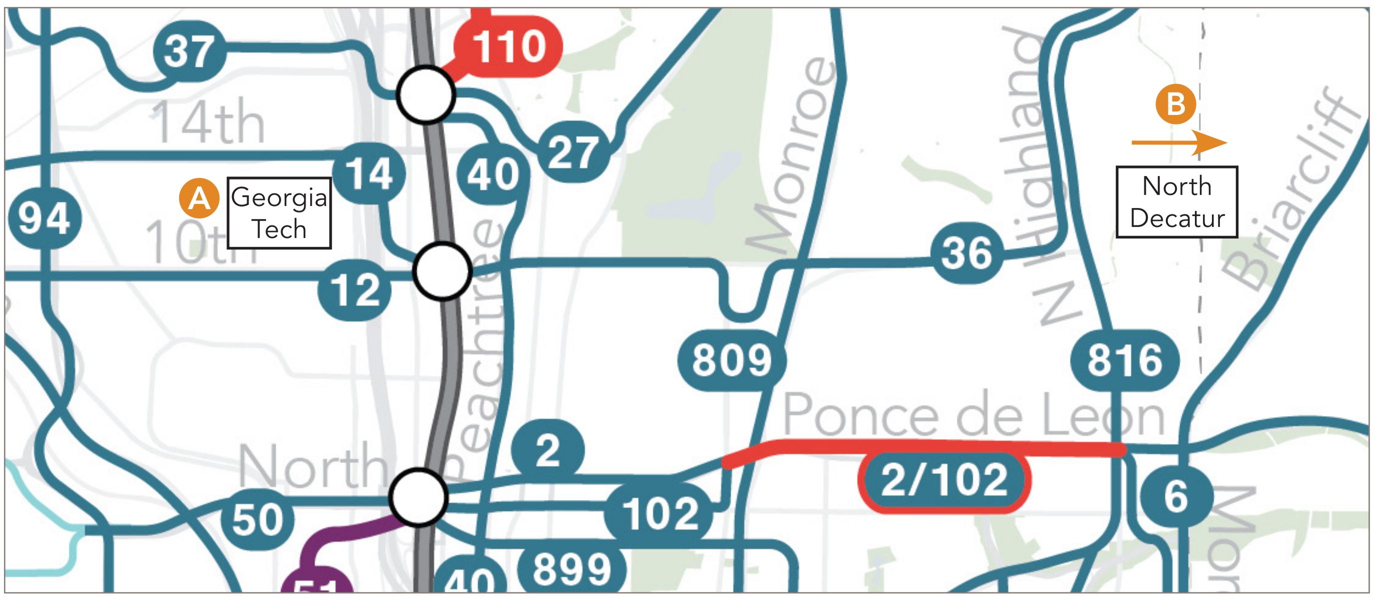
- Wait an average of 15 minutes for Route 14
- Take a short ride to the North Ave. station
- Wait another 15 minutes for Route 36
- Ride to North Decatur

Almost every transit trip across a rail line works like this, with two waits for infrequent bus routes. The result is that nearby areas are connected to downtown, but divided from one another by rail. Sometimes the two "feeding" routes aren't coming every 30 minutes, as in this example, but every 40 or 60 minutes, which means even longer waits.

In most parts of the service area, there are opportunities to improve connectivity by running more routes beyond rail stations.

**CHALLENGE: BUS PARKING AND RESTROOMS**

In order to run routes past rail stations, MARTA will need the help of local cities, counties and businesses to find places where operators can park their bus and take a break at the route's end.



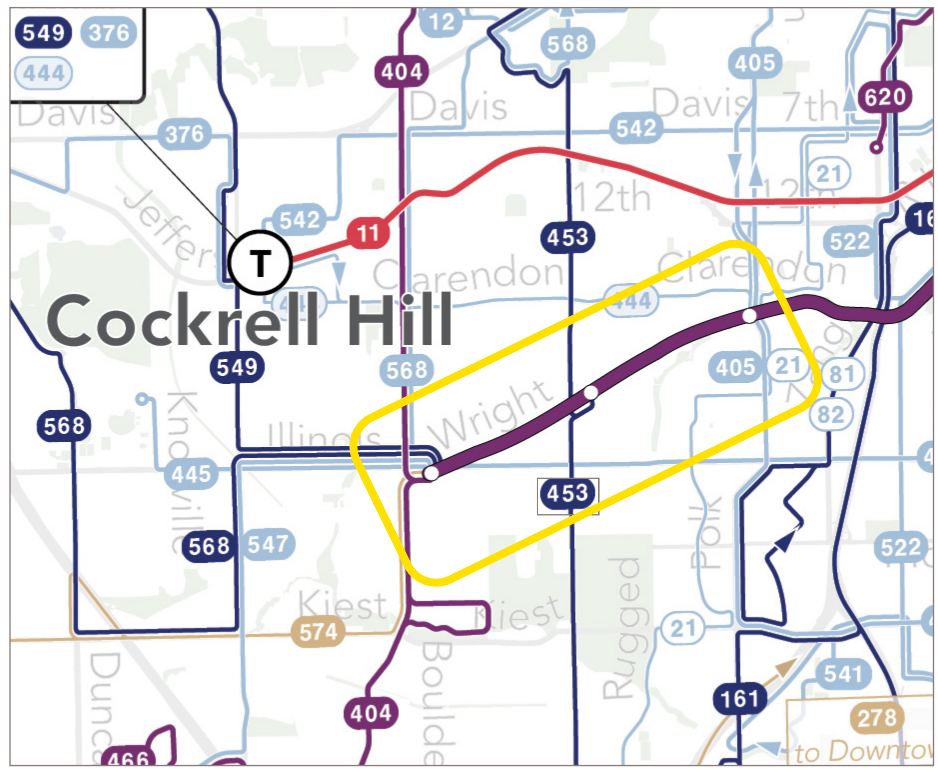
Bus network design around rail stations in Portland, Oregon, and Dallas, Texas, provides a counter-example to the MARTA system.

In both networks, the rail network is radial, emanating from downtown. Many routes go straight across rail lines.

In the Portland network, below at left, Routes 4, 44 and 75 all cross rail at the stations circled in yellow and keep going.

In the Dallas network, at right, Routes 404, 453 and 405 cross rail at the stations circled in yellow and keep going.

It is not generally feasible for *most* routes in a large region to have significant length on either side of rail lines, because of the natural limits on route length. But with only five MARTA routes doing this in the 2019 network, there is an opportunity to use this strategy more.

# 2. Time Connections Among Infrequent Routes

The inset map below shows the transit network around Decatur.

As described on the previous page, none of the routes from the south continue to the north, or vice versa. In addition, every station has its own mini-network of routes that terminate there. These routes are mostly infrequent, and so if anyone wants to connect among them, the waits will be long.

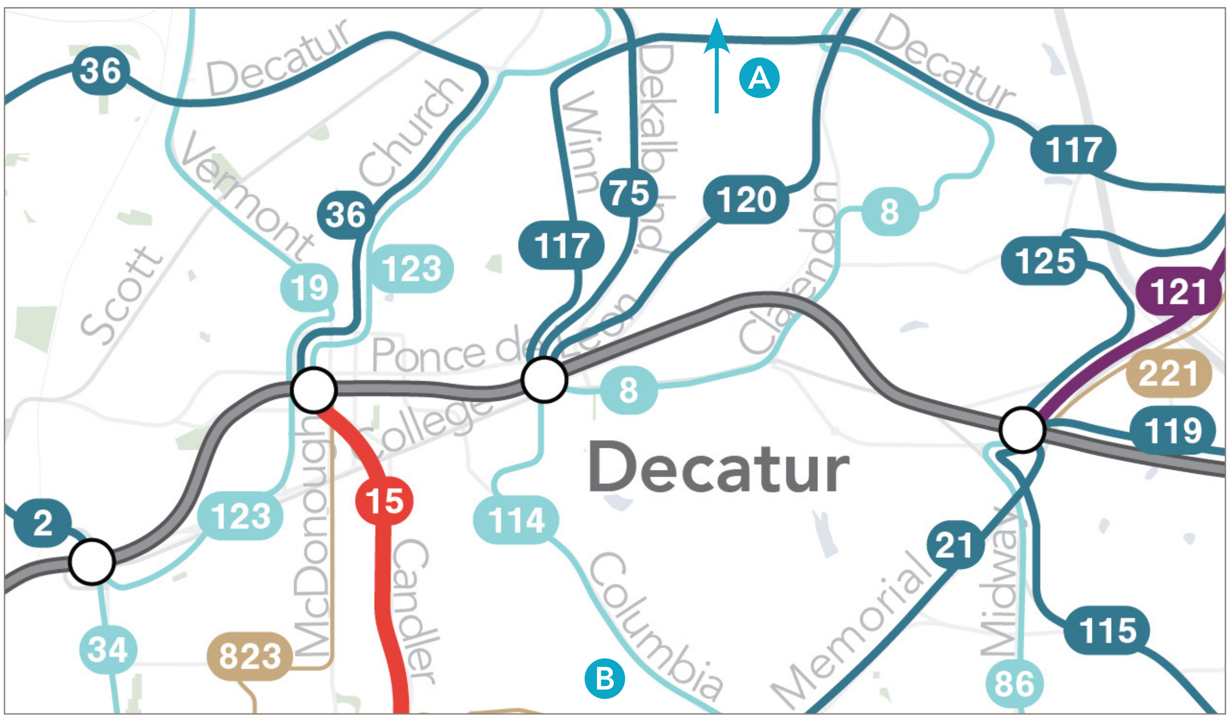
For example, someone riding home from Emory Decatur Hospital (A) to Columbia Drive (B) would:

- Wait 15 minutes for Route 75
- Ride south to Avondale Station
- Wait 20 minutes for Route 114
- Ride south on Columbia Drive.

On unlucky days, they might wait even longer for one or both of these routes – 30 or 40 minutes if they just missed a departing bus. This is a lot of waiting to travel a short distance.

In addition to continuing routes past rail stations, another way to improve access for trips that don't involve rail is to time the connections of local routes.

This makes the wait time for a transfer shorter: once someone has planned their trip around one infrequent bus route, they don't have a long wait to connect to the other route.




However, this strategy likely requires some change to which routes go to which station. It also benefits from bringing routes together into larger networks at fewer rail stations.

The following pages describe how networks can be designed for high connectivity, including frequent network designs that are only possible if MARTA decides to shift its investment towards higher ridership.

A transit network, like other types of networks, should be greater than the sum of its parts. One line can take people only so many places – but if that line makes connections with many other lines, vastly more places become reachable.

There are a few basic shapes for transit networks, and the two that are most relevant to MARTA are the "radial" and "grid" networks, described at right.

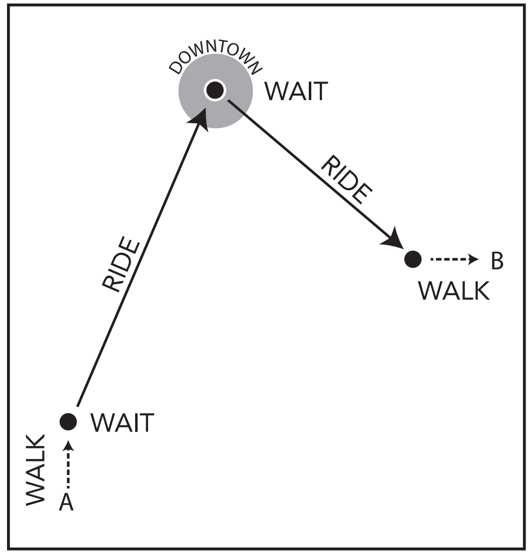
## Radial Networks

The MARTA rail network is highly radial, with all lines connecting at the center, and with the highest frequency in the center branching into lower frequencies in the north (Red and Gold) and the west (Blue and Green).

In a purely-radial network, every line connects with every other line at the center; only one transfer is needed to reach every point in the system. But as the system grows large, cross-town or orbital trips require such long trips through the center that they become impractical by transit.

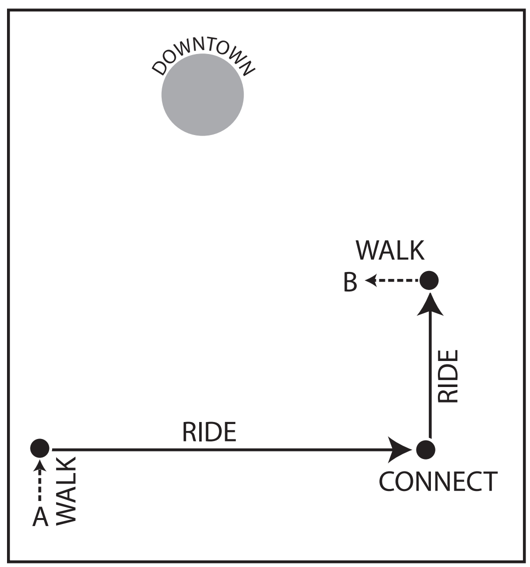
This is why purely-radial transit networks

### Basic Network Shapes




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

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




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

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

are mostly found in small towns. In big multi-centric regions, the radial network tends to be adapted over many years for more cross-town and orbital travel.

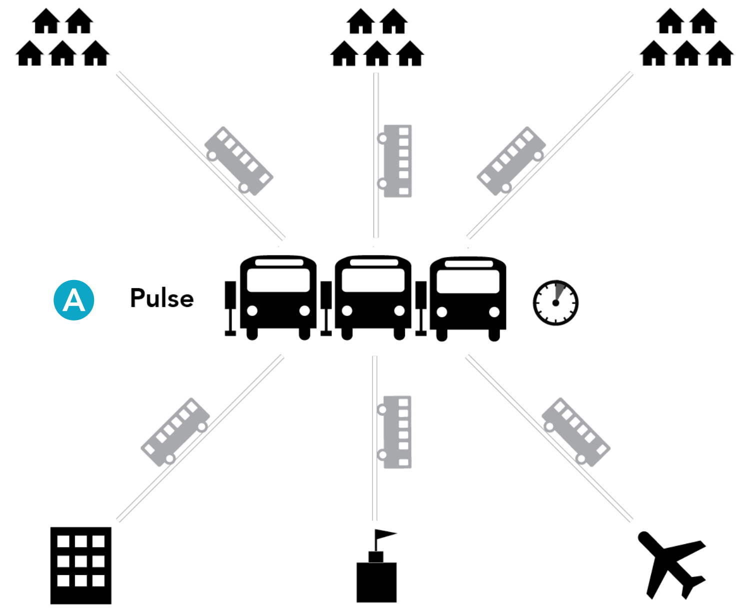
### Pulsing Infrequent Routes

Another powerful feature of radial networks is that the lines can be timed to "pulse" at the center of the network. (A) In a pulse, transit vehicles meet and dwell together for a few minutes. People can transfer among them with a reliably short wait.[1]

Pulses are a way that infrequent services can connect with one another, quickly and reliably. If two routes coming every 60-minutes cross, the untimed connection between them will require, on average, a 30-minute wait (one half of the frequency), and sometimes as bad as 59 minutes! But if two routes are designed to pulse, the connection can take just 5-10 minutes, every time.

The small "feeder" bus networks that radiate out from nearly every train station present an opportunity for pulsing. One way to increase the usefulness of the overall MARTA network would be to design these routes so that they pulse, giving riders shorter waits for cross-town trips. However, this does generally require that the local jurisdiction can provide enough curb space for multiple buses to stop at the same time.

1 Frequent air travelers might have noticed a pulse at an airport. Dozens of arriving flights make the terminal busy for about an hour, and then all flights depart and it becomes quiet again.




**The existing MARTA rail and bus network is optimized for travel to downtown Atlanta, or between rail stations.**

**Other network design strategies could make it easier to travel among more busy places.**

# 3. Shift Some Peak Service to All-Day, All-Week

MARTA deploys extra service at rush hours, mostly to increase frequencies on rail and bus lines, as described starting on page 32.

High peaks in service, especially for the two rush-hour peaks, come with hidden costs:

- MARTA routes are, on average, more productive during rush hours, so by that measure the peaking is a high ridership strategy...
- ...but there is a capital cost to so much peaking, which isn't captured in a route's productivity. **About 24% of MARTA's buses are only used during weekday rush hours.[1]**
- Buses have to be purchased, stored, maintained, and replaced about every 10 years, so a larger fleet imposes larger annual costs.
- Routes that *only* run during rush hours have not only a high vehicle cost but also a high "deadhead" cost. Deadhead is the time and mileage spent shuttling out-of-service vehicles to and from the start of a route.

Higher frequencies and extra routes during rush hours also affect labor costs, in ways that can be hard to see:

- Sometimes extra peaking is handled with "split shifts," in which drivers report for two short shifts a day, with a long break in between. These can be unpleasant and exhausting, and difficult for drivers who have other obligations besides work.
- Split shifts and other short shifts can be expensive (to the agency) if drivers are paid extra for them. They can be expensive (to drivers) if they pay the same but impose more personal costs.
- Peaking requires more complicated driver work schedules, which imposes an administrative cost.
- Peaking tends to require a larger crew of operators. Agencies around the country have recently struggled to attract and retain skilled bus operators.

There are a few small labor benefits to rush-hour peaking, such as the ability to do maintenance on buses that aren't being used during the midday (rather than at night).

MARTA may want to consider shifting some service to all-day, all-week patterns, especially if rush hour continues to be lower than it was before the pandemic. This would allow the Authority to deploy more service all-day and all-week.

1 At least some extra vehicles will always be needed at rush hours. Slower traffic at rush hours means that MARTA has to put out a few more vehicles to keep frequencies consistent. At rush hours some routes can become overcrowded, at which point adding more frequency can relieve crowding. In many big cities, agencies offer lower fares during off-peak, as a way to relieve crowding that is less costly than adding more vehicles.

# 4. Space Stops More Widely in Walkable Places

There may be opportunities to improve travel times and bus stop amenities for MARTA riders on certain routes, in walkable areas, where bus stops are very close together today. This is called "bus stop rebalancing."

But this would mean some people would have to walk a little farther to a stop. Why might it be worthwhile, despite that?

- **Fewer bus stops means a faster ride for passengers**, because the bus pulls over less.
- **The more bus stops MARTA has to improve and maintain, the less can be spent per stop.**
- Gathering **more riders per stop** can help **motivate local jurisdictions to invest** there, too.

### Local Challenge

**MARTA has more than 9,000 bus stops. About 1,600 are used by less than one person a day.** For any transit agency, dividing the limited bus stop budget across more stops will mean a lower level of amenity and maintenance at each stop.

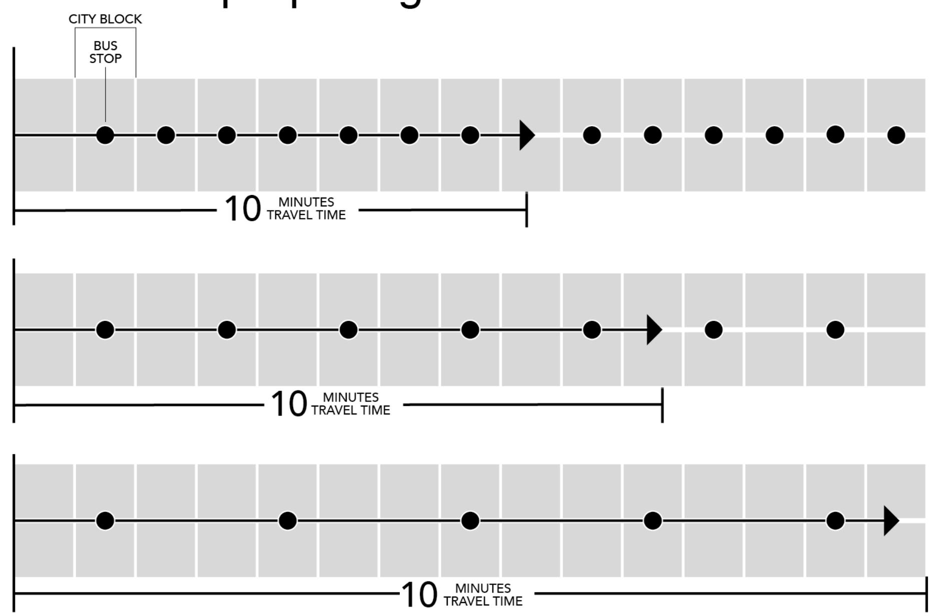
## Faster Travel Time

When agencies rebalance bus stops, they often find that it speeds up their service.

Every time a bus slows down, pulls over, then waits to merge back into traffic, and gets back up to speed, it slows down travel for everyone on board.

On high-ridership routes, where someone is likely to be waiting at every stop, this can make service incredibly slow. This means that stop spacing is more important to get right on high-ridership routes than low-ridership routes.

Stop Spacing and Travel Time



### Slightly Longer Walks for Some Riders

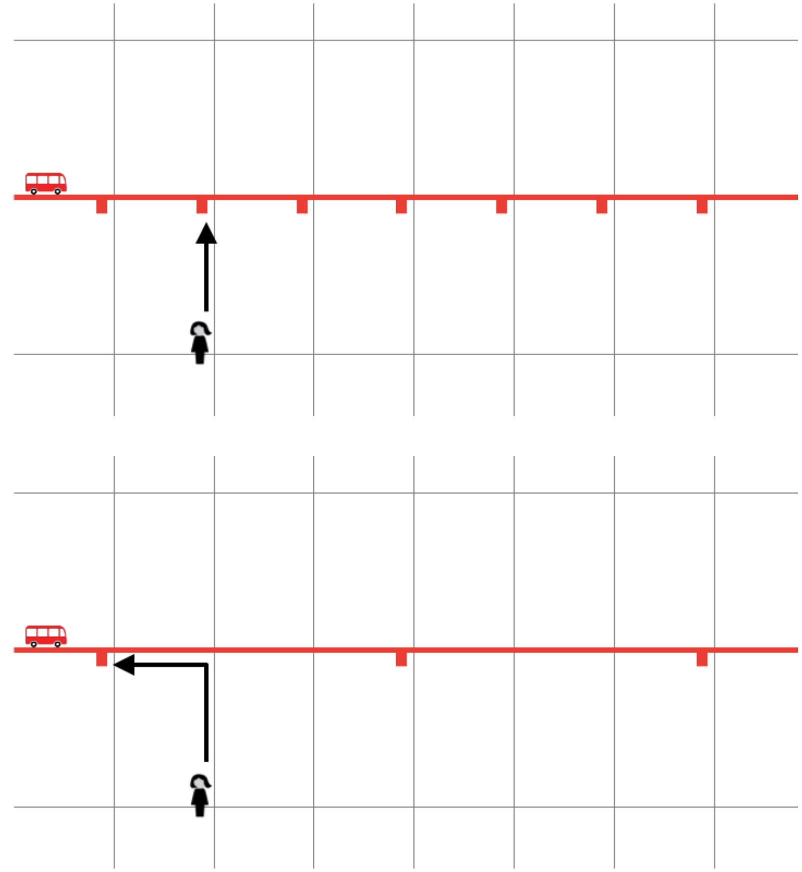
Rebalancing bus stops means that some riders have slightly longer walks to a stop. This is why agencies consider local walkability when they rebalance stops:

- In an area without sidewalks or streetlights, a longer walk on the main road can have a negative impact on riders.
- But in areas ***with*** sidewalks and lighting, and the other features that make walking safe, an extra block or two isn't a big impact on most people. (Consideration should be given to locations that serve people who might have difficulty with longer walks, such as medical centers or senior housing.)

The greatest potential to improve conditions for riders is therefore on **high-ridership routes** where **walking along the route is safe.**

The actual increase in walking distances for any rider would be very small. For example, if a route has stops at every corner, then **shifting to stops on every third corner would mean walking just one more block**, as shown at right. But this modest rebalancing could significantly reduce how many times the bus pulls over and slows down the route for everyone.

With one third as many stops on such a segment, MARTA could put more dollars into the quality of each stop, and more passengers would gather at stops with amenities, rather than stops that are just poles.



**On busy routes, wider stop spacing would mean faster rides, more improvement dollars per stop and better amenities for passengers.**

## Local Examples of Close Stop Spacing

The map below shows Georgia Avenue in the Summerhill neighborhood of Atlanta. The little orange dots are bus stops, with each dot sized based on how many people board the bus there per day.

Stops on this stretch of Georgia are spaced about 1-2 blocks apart. Most stops are just a pole in the ground.

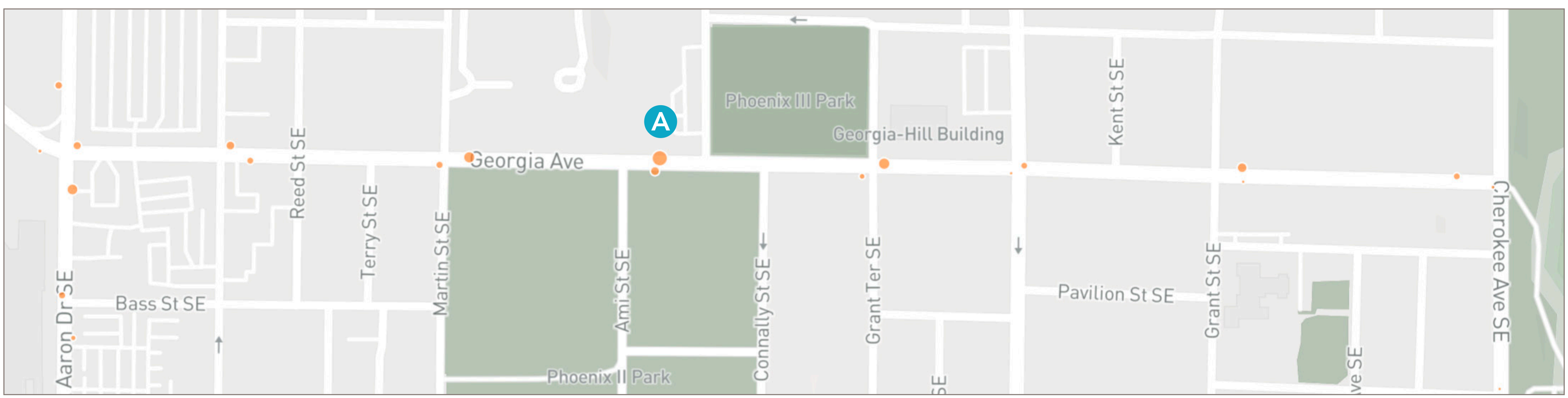
Because the riders who use transit on this street are spread out over so many stops, there aren't as many high ridership bus stops here. The busiest stop, at Ⓐ, averages 23 boardings per day, which means it is busier than about 87% of stops. But the other stops have many fewer users, some as low as one person per day.

It will be a long time, and perhaps never, before MARTA could justify adding and maintaining amenities at all of these very low-ridership stops.

Georgia Avenue is walkable, with sidewalks, lighting and even shade in places, so an extra block's walk would be less of an impact here than on other roads.

If MARTA were to rebalance stops here, would it be worth the hassle to existing riders, some of whom would have to walk an extra block? They, and people who ride through the neighborhood, might say "yes" because:

- It could make the route a little faster.
- It could allow MARTA to add amenities to stops, because more stops would have large numbers of people using them.
- It could help the City of Atlanta justify other investments as specific stops get used by larger numbers of people.

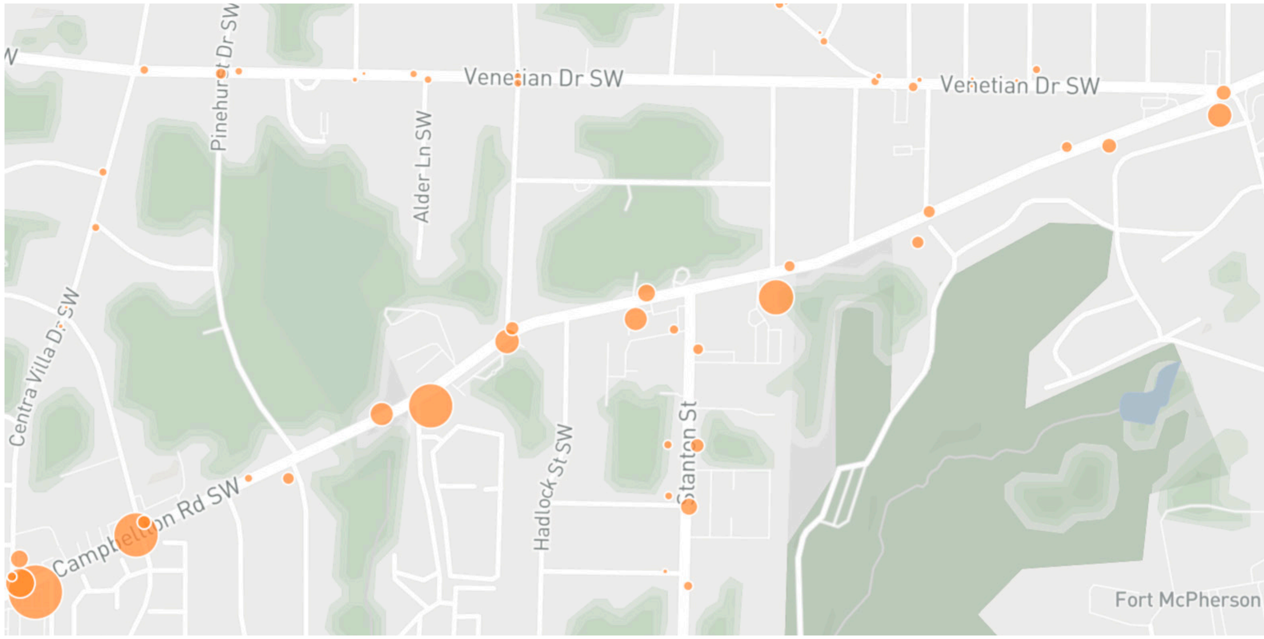


Georgia Avenue is but one example of a walkable street with very close stops. MARTA's typical bus stop spacing, across all local routes, is about 0.15 miles.[1]

Stops are close on some routes with higher ridership and higher frequencies, such as Campbellton Road, shown at right. ***The higher the ridership and the more walkable the road, the greater the benefits to riders of rebalancing stops.***

Bus stop rebalancing is a complicated undertaking. It involves looking at:

- Where people board and alight, in what numbers.
- In particular, where vulnerable people (like seniors and people with disabilities) board and alight.
- Local street conditions, like sidewalks, curb ramps, lighting and personal safety.
- How much stop removal would improve speed on a particular route.
- The types of amenities that could be installed.




The best bus-stop rebalancing programs involve advocates, bus operators, riders and city partners. Agencies that have done bus-stop rebalancing – some during a Network Redesign – report good results for existing riders:

- In Cincinnati, rebalancing stops sped up routes so much that reliability improved and trips got faster.
- In Providence, stress and complaints from bus operators and riders about bad on-time performance went down.
- In Richmond, VA, average bus speeds went from 11 mph to 12.5 mph.

The TransitCenter offers more information about successful bus stop rebalancing in other places.

1 This is closer than the typical spacing at Valley Transportation Authority in CA (0.23 miles), AC Transit in CA (0.18 miles). It is very similar to the spacing at DART in Dallas and METRO in Houston. These measurements do not include express routes and other special or non-local services.

# 5. Re-space Routes to Provide Shorter Waits

In walkable, dense places, MARTA could choose to space routes more widely in order to offer a shorter wait and a faster trip.

The illustration at right shows the trade off between walking and waiting in walkable neighborhoods.

***The design strategy that requires a longer walk, but a shorter wait, actually gets people where they are going sooner.***

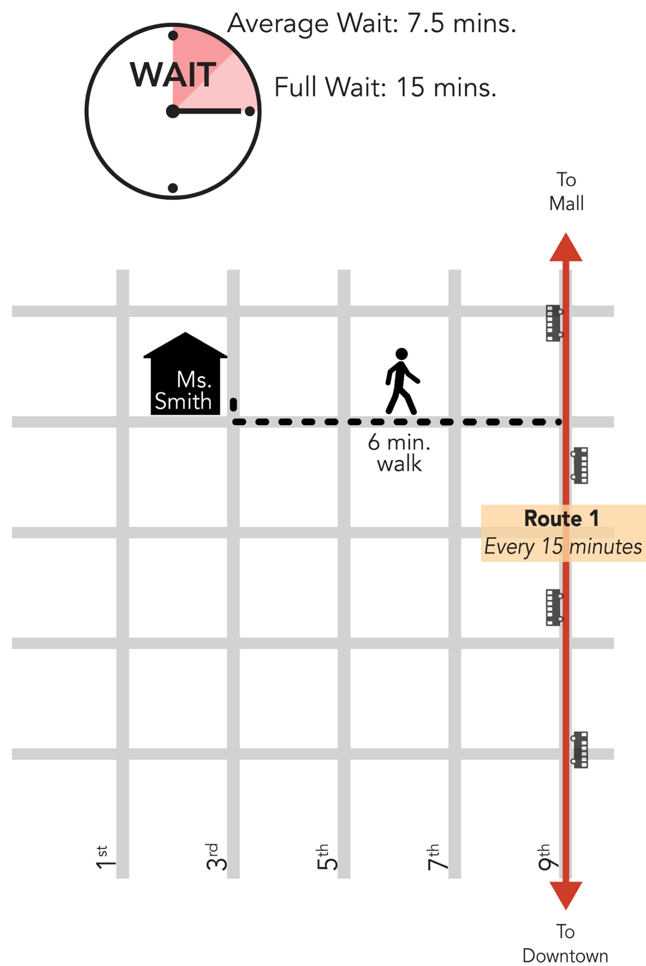
**In the example to the right, on average...**

*+ 4 MORE MINUTES WALKING*

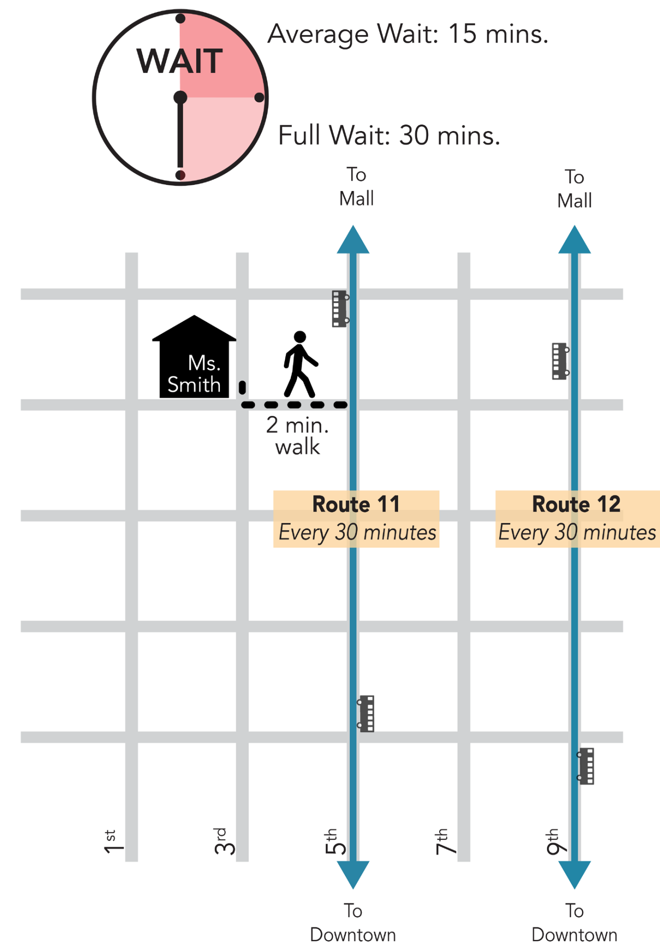
*– 7.5 FEWER MINUTES WAITING*

*= 3.5 MINUTES FASTER*

**Minimize Waiting**
with routes coming every 15 mins., more widely spaced.




**Minimize Walking**
with closely-spaced routes coming every 30 mins.




### Local Challenge

Respacing routes to increase frequency requires well-connected roads and good walking routes to main roads. Only a few parts of the MARTA service area have these conditions.

Walking and waiting both add time and inconvenience to any transit trip, and different people have a wide variety of preferences regarding each. But a network designed for shorter waits, rather than shorter walks, will increase access by shortening most peoples' total travel time.

One mathematical fact about transit is that the more you concentrate service into fewer lines, the more frequent those lines can be. More frequent lines mean shorter waits.

In dense, walkable areas, concentrating service into fewer lines doesn't have to mean people lose all access to service! There are places in the MARTA service area, especially in dense central Atlanta, where people are very short walks from routes heading the same direction, such as in the areas circled in yellow at right.

In these close-in neighborhoods, being walking distance from multiple routes that each come every 30 minutes, and go a very short distance, is not a way to attract high ridership.

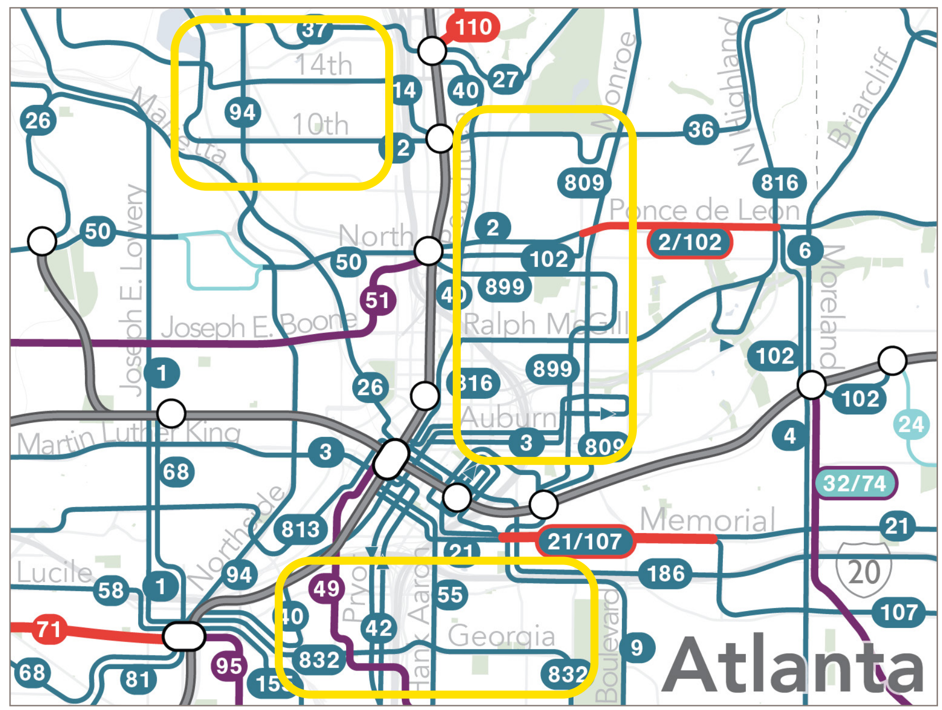
If someone can walk to downtown or a rail station in 25 minutes, or ride a bike in 10 minutes, or get a cheap Uber or Lyft in 5 minutes, they are unlikely to spend an average of 15 minutes waiting for transit.

For transit to be useful to large numbers of people for shorter trips, it must be *especially* frequent, otherwise peoples' other alternatives will be many times faster.

**With long waits for transit to travel short distances, it's predictable Atlanta routes aren't very productive.**

The way to maximize access and ridership potential in a dense, walkable area is to run frequent routes about ¼ to ½ mile apart. That way, riders have short waits and connections between routes are fast and reliable.

But choosing this strategy in Atlanta, would mean some people would walk further than they walk today.



## Frequent Grids

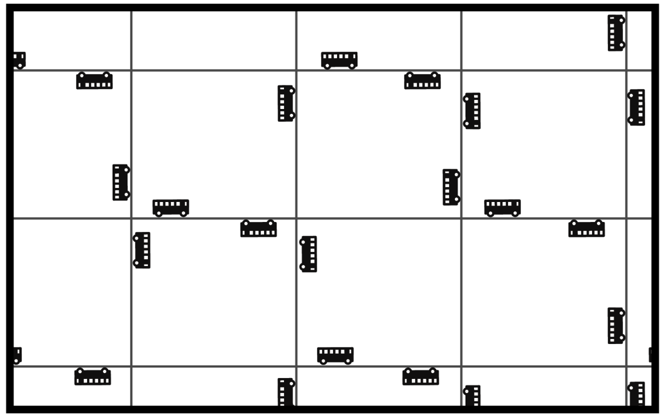
Frequent grids are another way that a network can be highly-connected and can maximize access.

But high frequency is expensive, and it trades off against coverage. Using frequency to improve the connectivity of the MARTA network is therefore a fairly controversial strategy and a major policy choice.

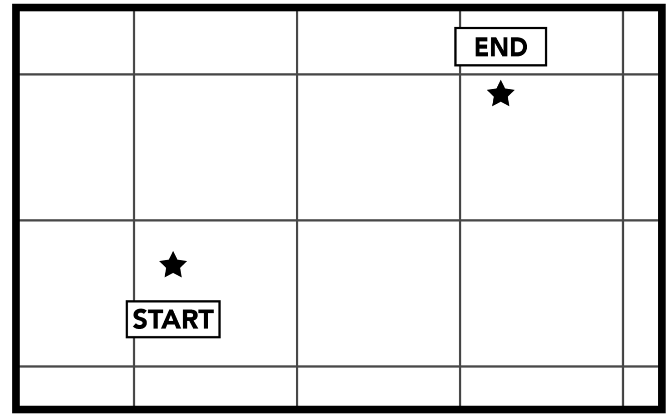
Additionally, frequent grids work best when a road network is well connected.

**A grid network requires high frequency. But high frequency is expensive, and trades off against coverage.**

A frequent grid consists of perpendicular lines all running **FREQUENTLY.**

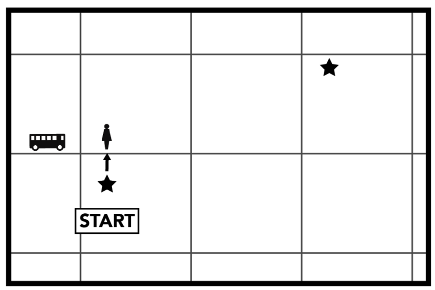


A grid serves trips from **ANYWHERE** to **ANYWHERE.** For example:

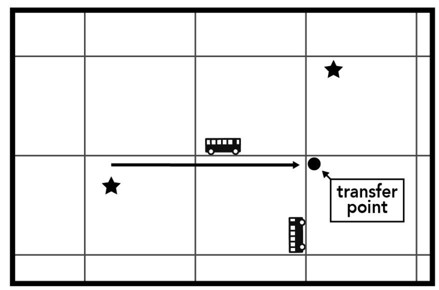



### For ANY trip...

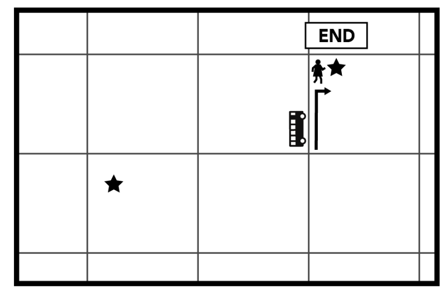
**1. WALK** and **WAIT*** for the first bus.
*The wait is **SHORT** because service is **FREQUENT.**




**2. RIDE** and **WAIT*** for the second bus.
*The wait is **SHORT** because service is **FREQUENT.**




**3. RIDE** and **WALK** to the destination.
You've arrived!




**THE HIGH FREQUENCY IS CRITICAL.**
It makes the **transfer fast**, so that the **whole travel time is reasonable**.

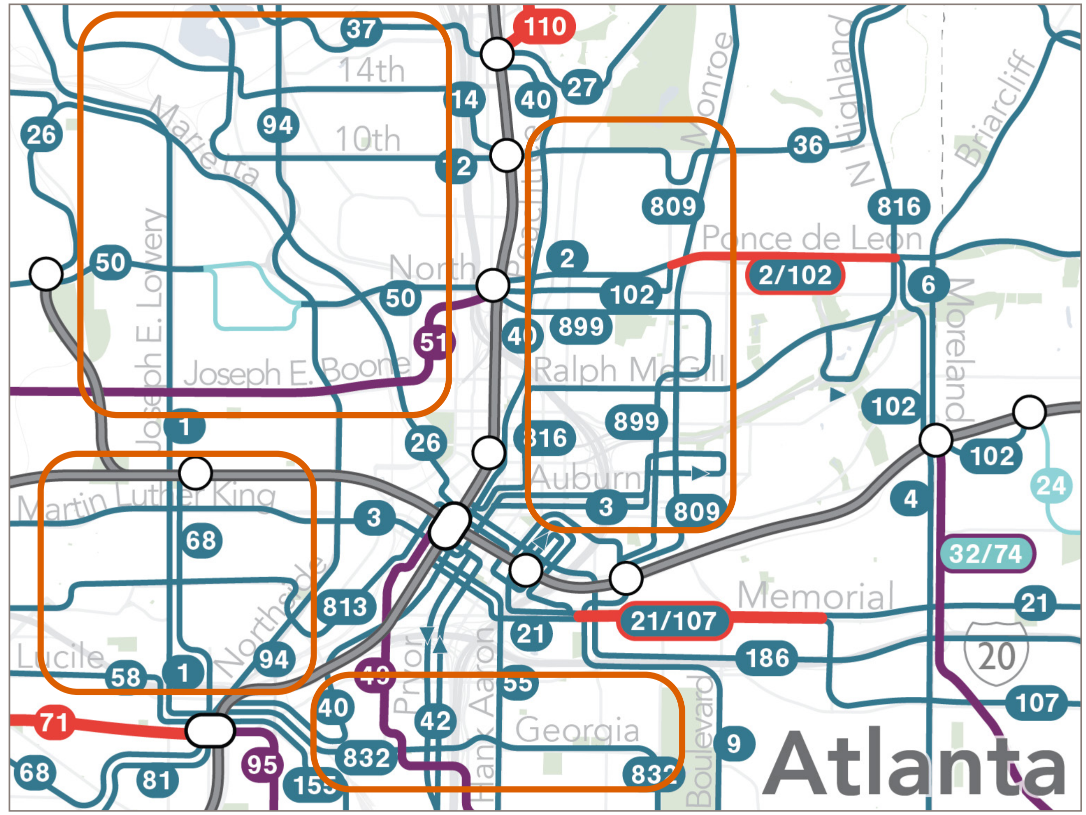
## Potential Frequent Grids in the MARTA Network

As the graphic on page 74 shows, frequent grid networks offer people freedom to move from anywhere to anywhere, with a single transfer.

In big cities with many centers (such as LA, Chicago or Houston) a frequent grid requires less out-of-direction travel than a radial network centered on downtown.

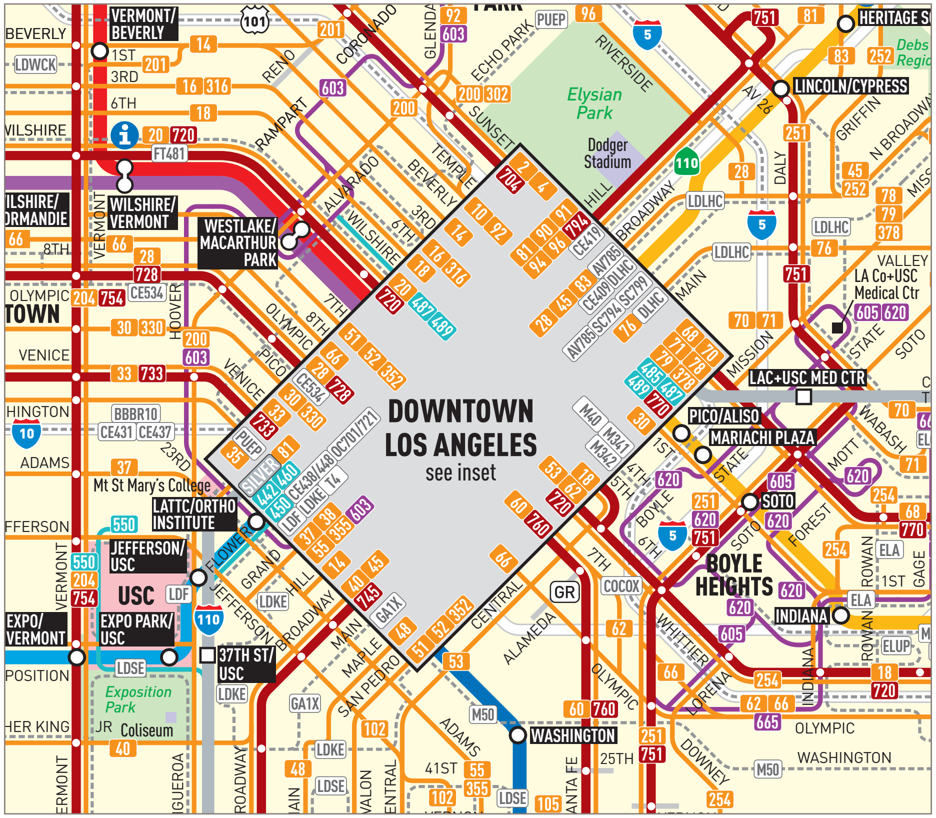
In the MARTA system, bus routes trace small grids in all four quadrants of dense central Atlanta (circled in **orange** at right), but without the high frequencies that make grid transfers easy. There aren't any frequent bus-rail connections downtown either.

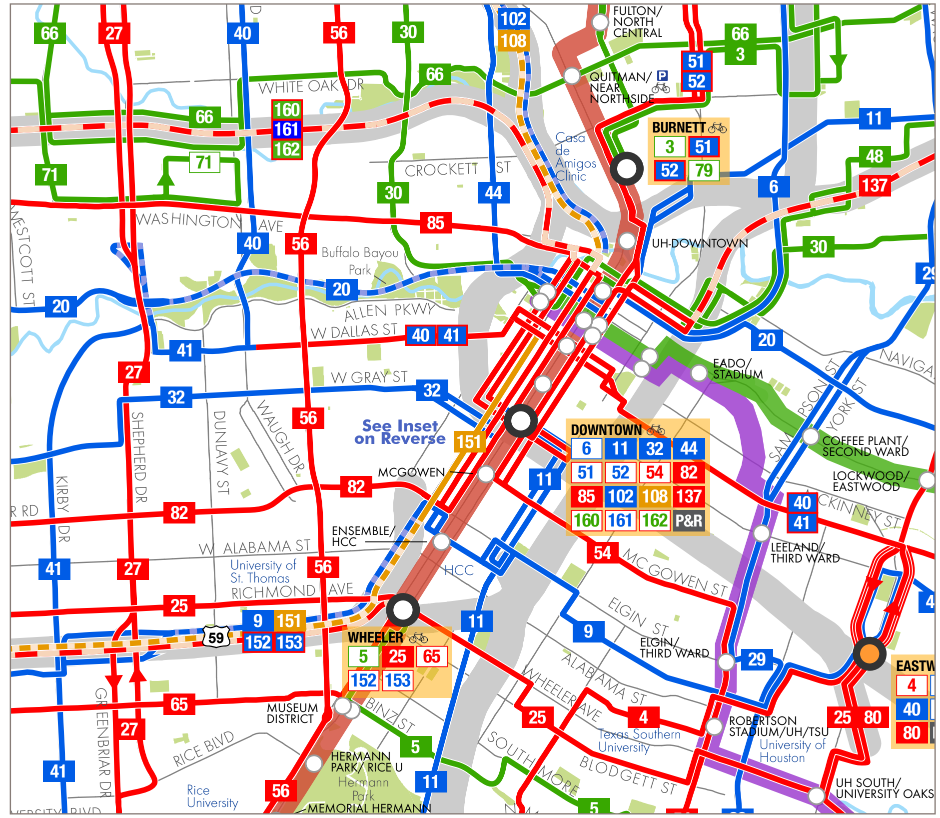
A frequent network connecting the densest parts of Fulton, DeKalb and Clayton Counties might also be productive. The difficulty in running such a large-scale frequent network is that crossing long distances is expensive, and routes in outlying areas tend to be long.




### Local Challenge

Frequent grids work best when there is a complete, well-connected network of main roads. The MARTA service area does not have many well-connected road networks outside of central Atlanta.




**It is unusual for a region as urban as MARTA's to have so few frequent routes**, and so few frequent connections. All-day frequent lines connect in only a handful of places around the service area.

It is especially unusual for dense, walkable areas like in central Atlanta, with income diversity and many universities and colleges, to have little frequent service.

Most other major US cities have frequent networks at least within their central cities. The maps on this page show the areas around downtown Los Angeles (left) and Houston (right). Red lines are frequent service. On the LA map most of the orange lines are frequent too.

Both LA and Houston are known to be sprawling, multi-centered and car-oriented, like the MARTA service area. In neither region is downtown as relatively important as downtown Atlanta.

In both of these places, the transit providers have adapted their networks to serve the dense center well, while also enhancing the connections that support anywhere-to-anywhere travel across their large urban areas.

# 6. Drop Little-Used Deviations to Speed Up Trips

Some MARTA routes include deviations. Most people tend to find deviating or circuitous routes less useful, because they take longer to travel between most places.

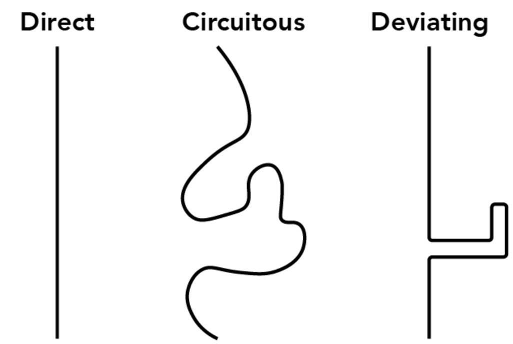
Deviations also take longer for MARTA buses to drive, and as a result they consume bus driving time that could instead be used to offer a better frequency. (See page 12 for more about length and frequency.)

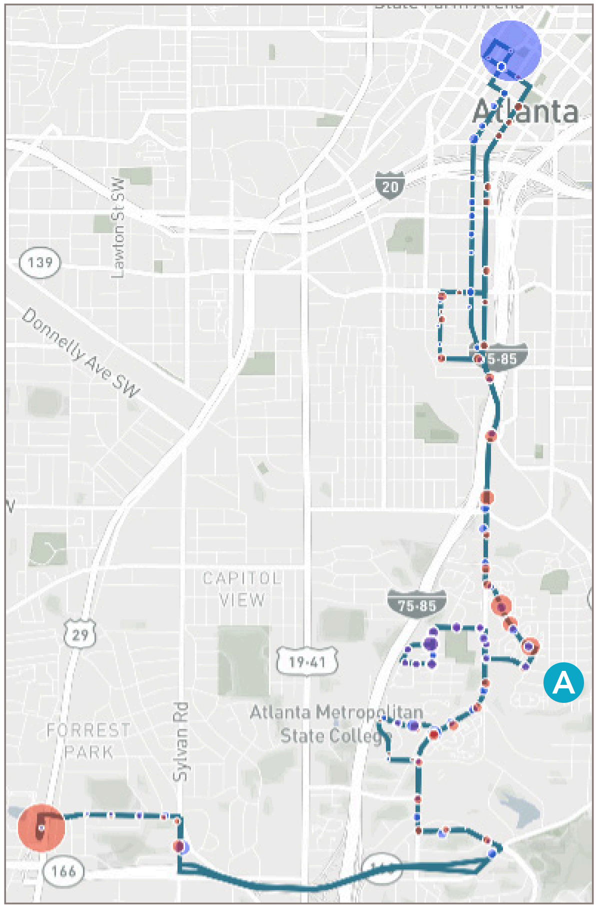
Deviations and circuitous patterns are helpful when the purpose of a route is coverage. They get service close to specific people or places, even if they make the service less useful to a larger group of people.

Route 42–Pryor Road, at bottom left, has four deviations from a direct path.

On three of the deviations, boardings aren't any higher than on the main road. On the fourth, at A, boardings are high, but the stops on the deviation are within a few minutes' walk of the main road, along good sidewalks.

Route 42 show us examples of deviations that serve a coverage goal. They get service very close to specific people, and provide very short walks, rather than attempt to be useful to large numbers of riders.



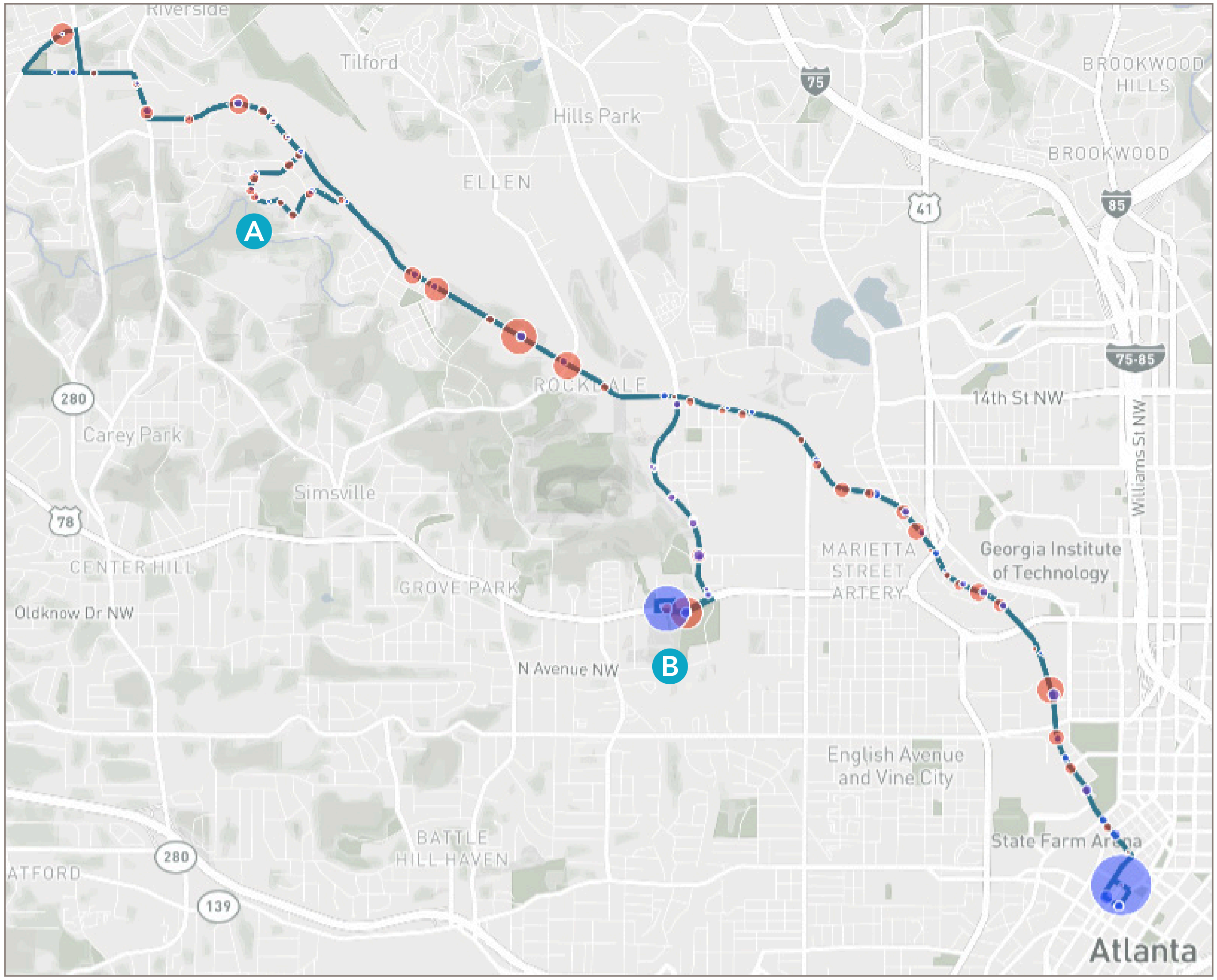



Route 26–Marietta, shown at right, has two deviations.

The small deviation at A is off of Perry Blvd. It is similar in size to the ones shown on the previous page. Ridership at stops on the deviation is low compared to the number of people riding through it and not getting on or off. The lack of sidewalks and hilly terrain helps to explain why the current route makes this deviation.

The other deviation goes to Bankhead Station at B, at the end of the Green Line. Numerous people get on and off at this station, heading in both directions at various times of day.

The deviation at B is the kind that might be kept in a high-ridership design. So many people use the deviation that they might be greater in number than the people who are discouraged from riding because of it.




If MARTA wishes to shift to a higher-ridership network, then making routes more direct and less deviating is one strategy to do so.

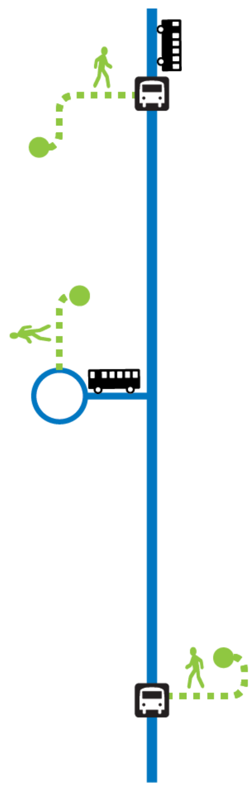
# Can On-Demand Service Help?

You may have heard about taxi-like services that pick you up when and where you request them, rather than running fixed routes at fixed times. This is often referred to as "dial-a-ride", "on-demand", "demand-response" or "microtransit" service.

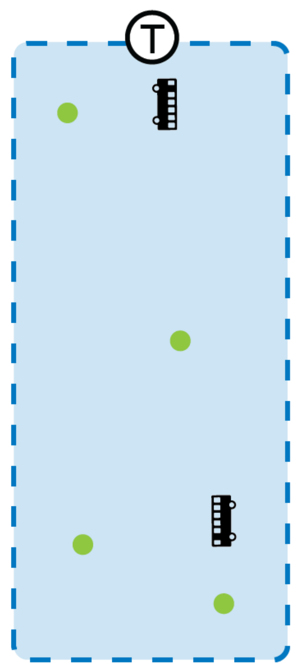
The graphics below show how on-demand transit differs from fixed route transit. For fixed routes, people walk to bus stops and buses arrive based on a predetermined schedule. On-demand service can pick up riders where and when they request it.

On-demand service can be very convenient for riders because it doesn’t ask them to walk to a bus stop. It may let them travel at the times they prefer, perhaps even with the short notice typical of calling a taxi or an Uber. But these features don’t come free.

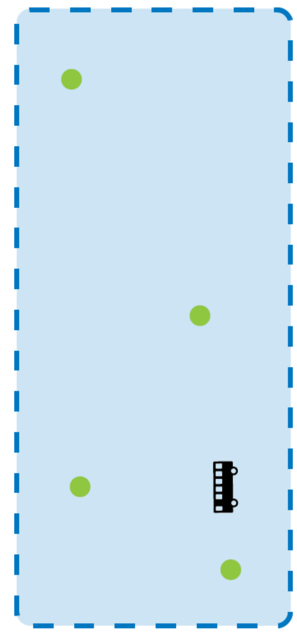
**Fixed Route**



**Fixed Route with deviations**



**On-demand service to a specific location**



**On-demand service to anywhere**

# Limitations

On-demand trips can be much more expensive to provide than fixed route trips. This is why transit agencies are careful and thoughtful about where they offer demand-response service and how they control its costs.

The cost of a fixed route is steady over time. It does not go up immediately when more people ride it. As a result, when more people ride, it becomes less expensive to provide each ride.

In contrast, the costs of demand-response service rise as more people request trips and more drivers and vehicles have to be added to serve them.

On-demand services hardly ever average more than 5 boardings per vehicle per hour. For comparison, MARTA's lowest-ridership fixed route averages 7 boardings per hour.

If you think about what the on-demand vehicle has to do – drive around to each person's requested pick-up, then their requested drop-off, at the time they choose, not necessarily at the most efficient times – then it's clear why it can only be done a few times in an hour.

**On-demand services rarely average more than five rides per hour. In comparison, MARTA's least-productive route averages seven rides per hour.**

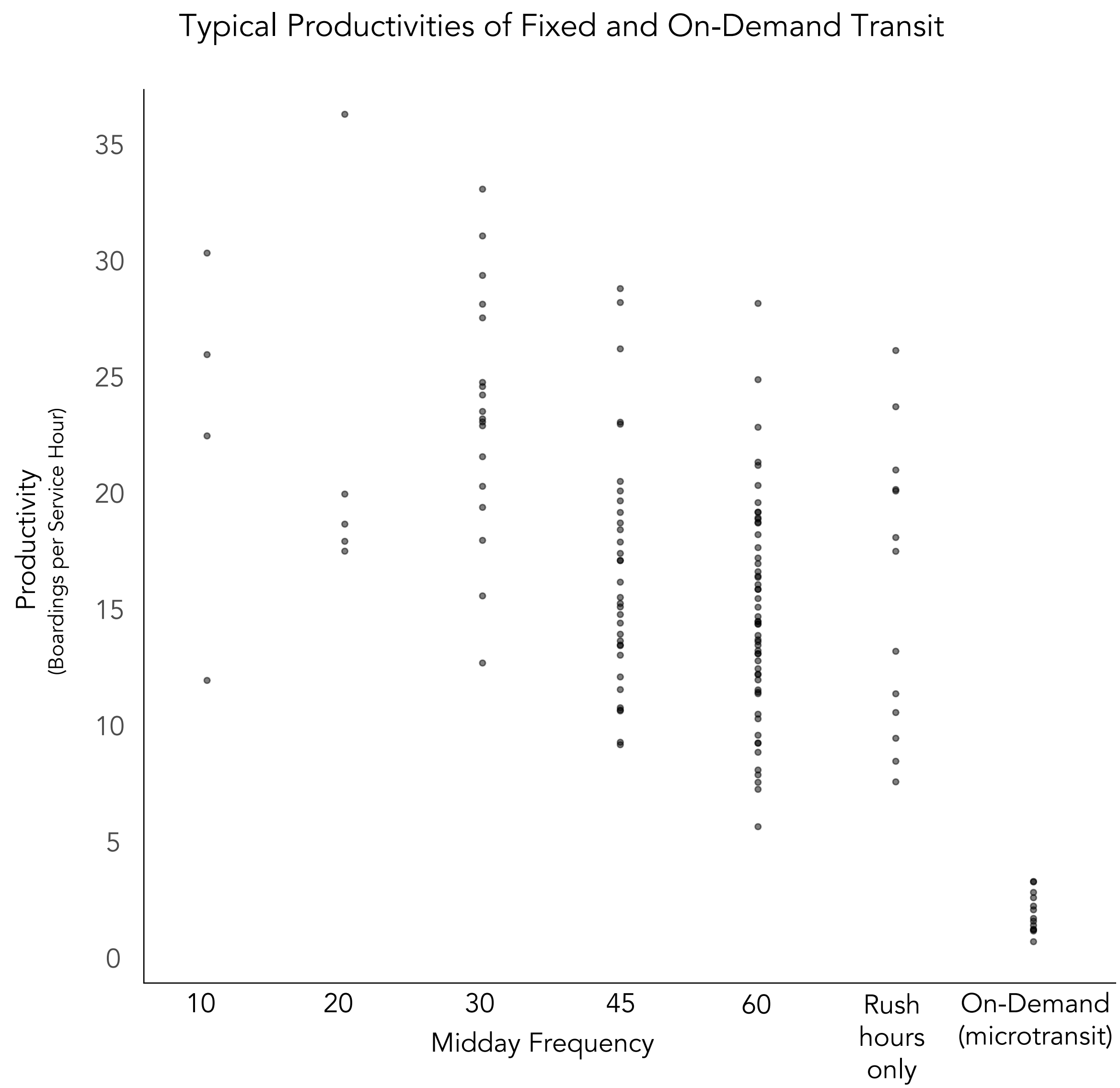
**The cost of on-demand service rises as more people request it, which makes it affordable only where demand is low.**

The scatterplot at right is from a real transit agency, with successful fixed and on-demand transit services. The data in the plot is typical of all such services.

Each dot is a single fixed route, or a single on-demand zone. The dot's height on the graph shows its average number of boardings per hour per vehicle. On-demand service (all the way to the right) handles fewer rides per hour than even the lowest-ridership fixed routes.

This difference in potential ridership per vehicle, when comparing fixed routes to demand-response, is quite typical, because of the basic math of how the two types of services work.

Just because an on-demand service can't handle as many rides as a fixed route doesn't mean the cost per ride of on-demand is higher, or that the subsidy per ride is higher. That depends on how much it costs the agency to deploy the on-demand service, and how high the fare is.



The scatterplot at right shows subsidies per boarding for different types of service. Subsidy per boarding comes from an equation that includes:

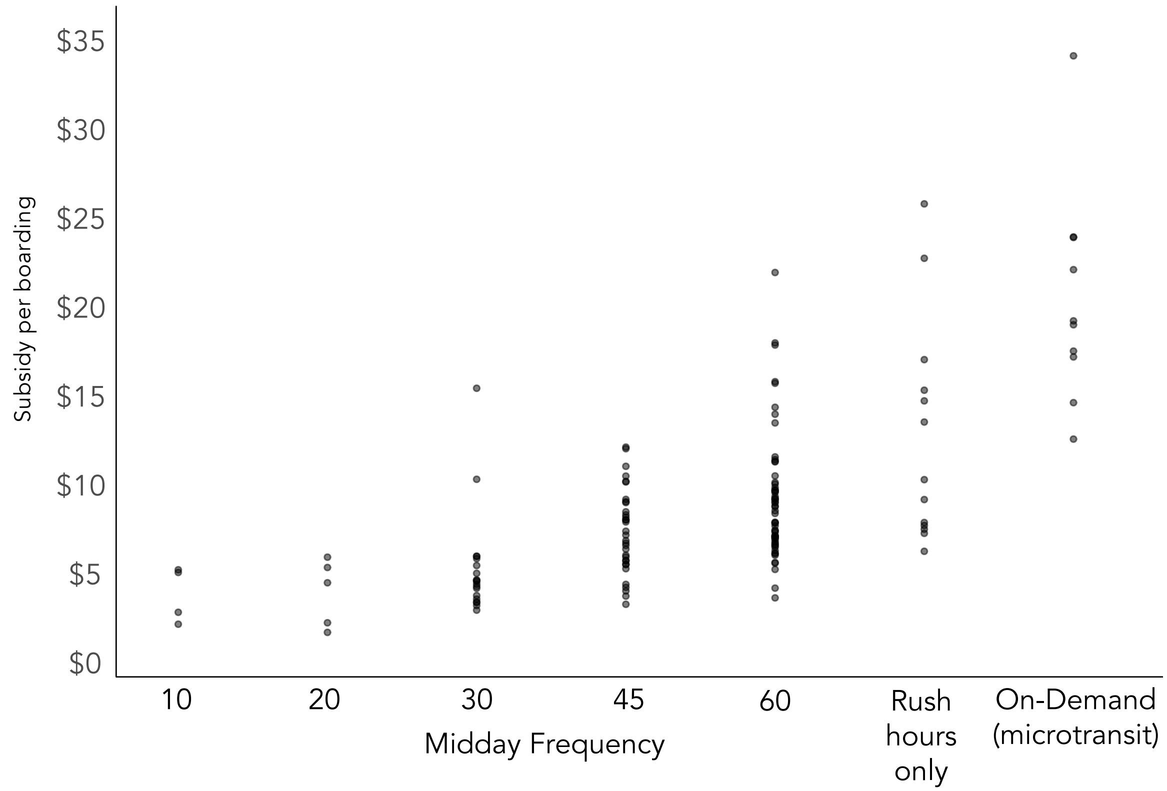
- Productivity,
- The operating cost of providing the service, and
- The fare charged to passengers.

This scatterplot demonstrates that on-demand service can in some situations achieve lower subsidies per boarding than fixed routes, despite moving so many fewer passengers per hour. But for this to come true:

- On-demand service must only be offered where demand will be *low.*
- The operating cost of providing on-demand service must be lower than the cost of fixed-route service, which generally means that the drivers are paid less.
- The fare for on-demand must be higher, or the range of places people can go with on-demand must be limited.

Agencies that have experimented with on-demand service without these types of controls have found the costs to grow beyond what they can justify.

Typical Subsidies per Boarding on Fixed and On-Demand Transit




**On-demand service can help with the ridership-coverage trade-off if it lowers the cost of providing coverage.**

# On-Demand Service is a Coverage Tool

The two scatterplots from the last two pages are repeated at right. Notice in the first scatterplot that on-demand isn't moving as many people per vehicle hour as even the least-productive fixed route. (A) There is a big gap between the fewest riders a transit agency can justify on a fixed route, and the most riders an on-demand vehicle can move.

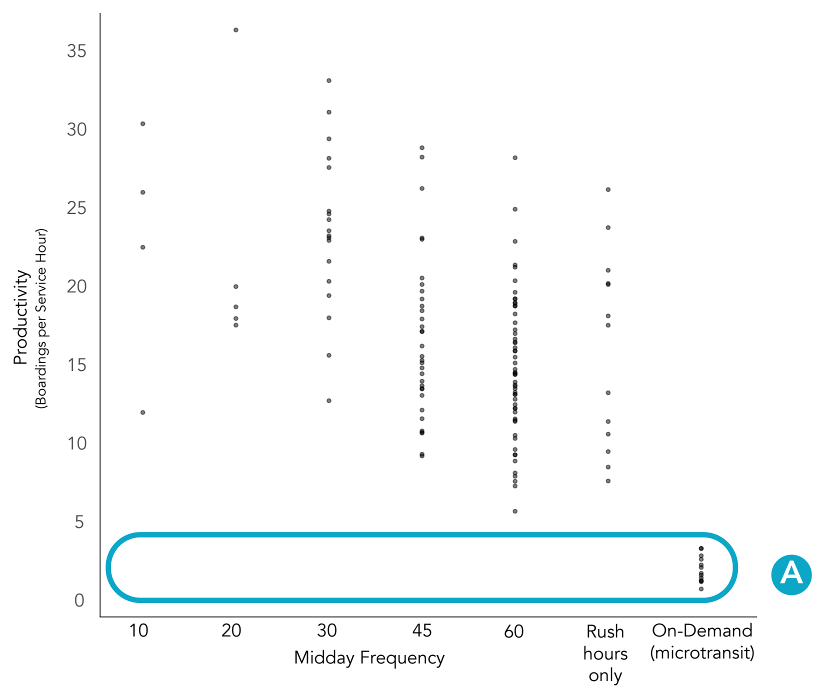
The subsidy per boarding for on-demand services is higher than the great majority of fixed routes. (B)

This is one way to demonstrate an important fact for the Network Redesign: On-demand service is not a high-ridership tool. It is a coverage tool.

**Even in its most efficient forms, on-demand service cannot move as many people per vehicle, or as many people per dollar, as a moderately productive fixed route.**

In addition, for it to be affordable (to MARTA) it can only be used where transit demand is low. This can lead to civil rights concerns if it results in a better customer experience in more affluent areas.

Typical Productivities of Fixed and On-Demand Transit




Typical Subsidies per Boarding on Fixed and On-Demand Transit