Better Bus Project

Transit Choices Report

For Miami-Dade County and Transit Alliance

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1 Introduction

Why this Choices Report?

What is the Better Bus Project?

The Better Bus Project is an advocacy-led and community-driven bus system redesign, led by Miami-Dade Department of Transportation & Public Works and Transit Alliance Miami. The county's fleet of over 750 buses, serve two out of every three transit trips in Miami. Buses are the most flexible component of a transit system and have the highest potential for immediate improvement.

A bus system redesign is a collaborative planning effort to decide where today's bus service should go, when it should run, and how frequently it should operate, starting from a clean slate. The Better Bus Project will focus on the Miami-Dade Transit (MDT) bus network, which carries most bus riders in the county, but will also look at improvements to trolley services in the cities of Miami, Miami Beach, and Coral Gables, which account for 70% of trolley ridership in the county.

Redesigning Miami-Dade's bus network is an opportunity to review existing and potential transit demand, and to design a network that meets those demands most efficiently. Redesign does not mean changing every bus route and stop. The key point is that thinking is not constrained by the existing network. Where the analysis suggests that existing service patterns make sense, those elements would be retained. Ultimately, the goal is a network designed for the city and region of today and tomorrow, not one based on the past.

What is a "Choices Report"?

This Choices Report is the first step in the Better Bus Project, through which Miami-Dade Transit and its partners will:

- Assess the existing network and the geometry of Miami-Dade today;
- Engage the public, stakeholders and elected officials in a conversation about the goals of transit in Miami-Dade County;
- Develop recommendations for changing the transit network in the future.

This Choices Report lays out relevant facts about transit and development in Miami-Dade, and draws the reader's attention to difficult choices that these facts force us to consider.

This is called a "Choices Report" to make clear that it contains no recommendations. The Better Bus Project will require difficult decisions about how to balance competing goals, and these decisions will be made by Miami-Dade based on input from stakeholders and the public.

What is the Purpose of Transit?

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

Understanding which goals matter most in Miami-Dade is a key step in updating the transit network.

Possible goals for transit include:

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

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

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

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

High Ridership is Not the Only Goal

If Miami-Dade Transit (MDT) wanted to maximize transit ridership, it would focus its service only on routes useful to many potential riders. MDT would be thinking like a business, focusing on places where its service is competitive for a large number of people.

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

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

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

Transit agencies are not private businesses, and most transit agencies decide that they do have some obligation to cover their service area. The elected officials who ultimately make public transit decisions hear their constituents say things like *"We pay taxes too"* and *"If you cut this bus line, I will be stranded"* and they decide that coverage, even in low-ridership places, is an important transit outcome.

Transit agencies are often accused of failing to maximize ridership, as if that were their only goal. In fact, they are intentionally operating "coverage services" that are not expected to generate high ridership. Agencies must balance the competing goals of high ridership and coverage. The balance they choose depends on the values of the agency and the region.

Limitations of Space

Public transit is essential to a place the size and density of Miami-Dade, because there is simply not enough room for everyone's car on the road, and ever larger parking garages are extremely expensive. Like most dense places, many parts of Miami-Dade presents features that make transit essential, and require that it be highly efficient:

- **Severe road space limitations.** Across much of the core of Miami-Dade, especially in the cities of Miami, Miami Beach, and Coral Gables, the road-width is fixed and will never be wider. Efforts at widening roads or creating double-decker highways in built-up areas are extremely costly, frequently destructive, and counterproductive. Curb space is also limited and cannot be readily expanded.
- **Intensification of land use.** In response to growing demands for housing and commercial space, both central and outlying areas are growing more dense. More and more people are living within the same limited area. Also, Miami-Dade is growing, and growing more dense, thus the space limitations are only going to get more severe.

These two factors combined mean that more and more people are competing for a fixed amount of road space. If they are all in cars, they simply do not fit in the space available. The result is congestion, which cuts people off from the freedom of opportunity and strangles economic growth.

Figure 2 shows that buses and bikes use exponentially less space than cars. Even autonomous cars will not change this basic geometric challenge, as they take up almost the same amount of space as today's cars and even carrying three to four persons per car, they cannot be anywhere near as space efficient as buses or bicycles.

The only alternative to congestion is for a larger share of the public to rely on public transit and other alternative modes that carry many people in few vehicles.
This requires services that most efficiently respond to the city's changing needs, as well as corridor improvements to give buses a level of priority over cars that reflect the vastly larger numbers of people on each bus.

Transit and bikes are two of the most space-efficient modes and are essential in dense places, where there is very little road space per person.

Figure 2: The road space required to move the same number of people using public transit, bicycles, and cars.

Photo copyright We Ride Australia

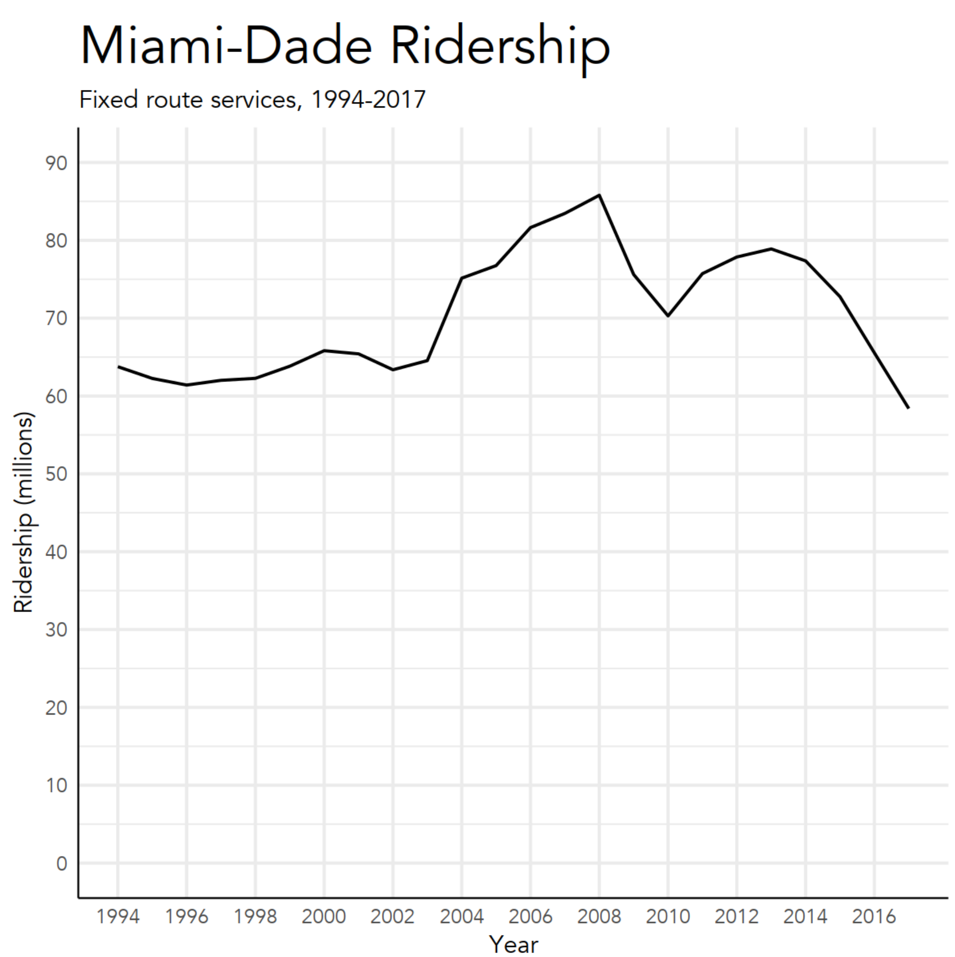
Ridership Has Declined on County Routes

Ridership and Service Trends

Over the last 25 years, ridership on Miami-Dade buses has risen and fallen, seeing large declines in the last four years. Figure 3 shows the trends in total annual ridership from 1994 to 2017. From 1996 to 2003, ridership rose slightly from about 62 million annual trips to about 65 million. Ridership rose dramatically from 2003 to 2008, in part because service increased dramatically, peaking at about 85 million annual riders. Ridership dropped dramatically from 2008 to 2010, again following to cuts to service, but bounced back a little through 2013. From 2013 to 2017, ridership declined from about 79 million annual riders to about 58 million in 2017.

Ridership can bounce up and down for a variety of reasons unrelated to what the transit agency does. But often, increasing or decreasing service can have a significant effect on ridership, and most of the dramatic swings in ridership from 2002 to 2013 can be explained by changes in total service hours. A service hour is one bus operating for one hour.

Figure 3: Ridership on Miami-Dade Transit Buses, 1994-2017



More service per person means more transit is available for people to ride. Because so much of transit's operating cost relates to human labor, and humans are generally compensated based on their time, the bulk of transit operating cost arises from hours of service (rather than distance, or the size of vehicles, or other factors).

Thus **service hours** describes the sheer quantity of transit service provided, without consideration for how much it costs the agency to deliver each hour of service. The service hours required to operate any given route will increase if:

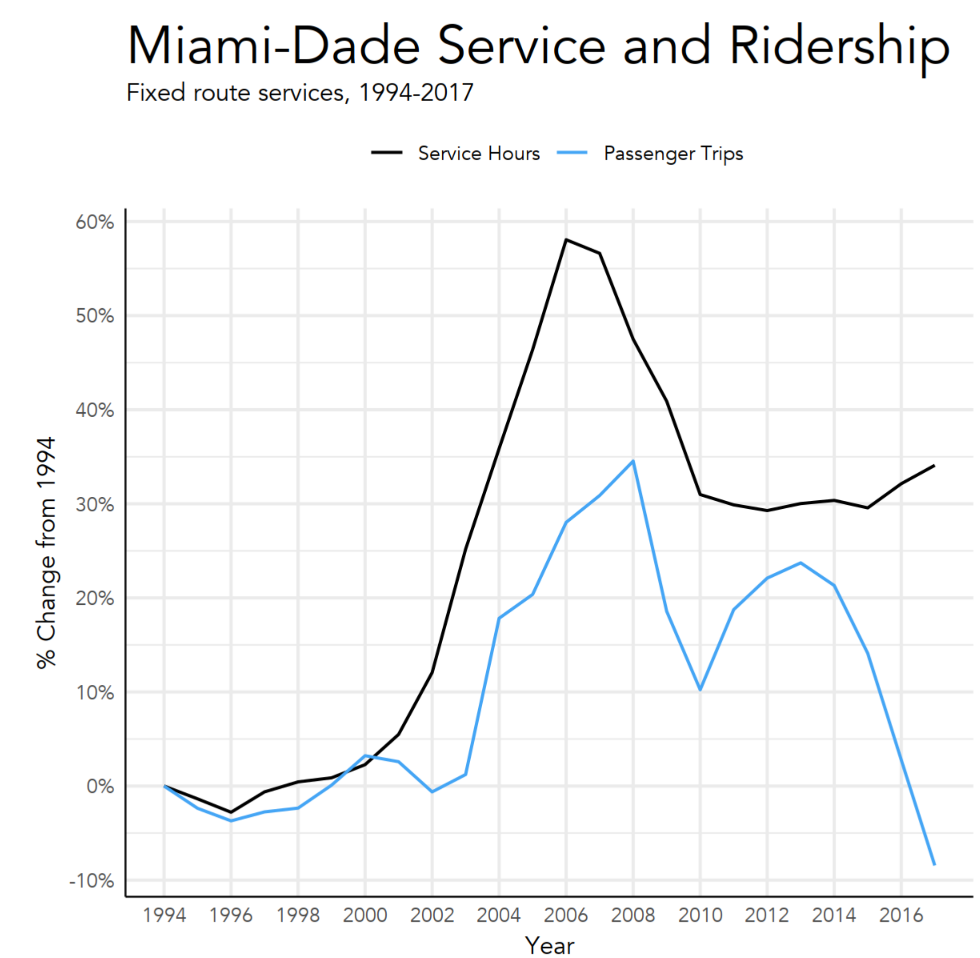
- The length of the route increases.
- The frequency of the route increases.
- The span (hours of operation) of the route increases.

Service cuts explain part of the decline in ridership since 2008. Yet since 2013, ridership has declined while the quantity of bus service has increased.

Figure 4 shows the percent change in ridership per person and service hours per person from 1994 to 2017. Ridership tracks closely with the big increases in service hours from 2001 to 2006, with ridership increases lagging a year or two behind service increases. Ridership drops dramatically when service is cut dramatically from 2006 to 2010. Since 2010, service hours have been flat or increasing, while ridership bounced back slightly and then declined dramatically.

The more recent declines in ridership suggest that the big expansions and contractions in service over the last 20 years may have left Miami-Dade Transit with a network that does not work well for the communities it serves. Or other recent changes may be causing Miami-Dade to have a less useful transit network, independent of the total amount of transit service.

Figure 4: Change in Ridership and Service Hours for Miami-Dade Transit, 1994-2017



Ridership Has Increased on Trolleys

National research suggests that transit ridership in many cities has been declining due to:

- The very low costs of purchasing and driving cars, from a combination of historically-low interest rates and low gas prices.
- Competition by Uber and Lyft for more affluent riders and for the most time-sensitive trips, especially at night and on weekends when some cities' transit networks become thin.
- The distances between jobs and housing continue to grow, as many regions (including Miami) continue to sprawl outward. Longer distances force transit agencies to offer less-frequent or more expensive services, which are less attractive to potential riders.
- Increasing desirability, property values and rents in pre-war inner city neighborhoods have forced lower income residents to move farther from the center of transit networks. Some of the people with the greatest incentive to try transit therefore live far from the most useful transit.

These trends were all in force in 2013 when the ridership of transit in Miami-Dade County began slipping despite increases in transit service.

Municipal Trolleys

Many of the dozens of municipalities in Miami-Dade operate their own transit services, usually in the form of city trolley routes. These services are funded mostly from a portion of the half-penny sales tax enacted in 2002. To operate trolley routes, each municipality must have an inter-local agreement and coordinate with MDT on route planning.

The relationship between county routes and trolley routes has sometimes developed in a complementary way. For example, on Coral Way, MDT runs a limited stop service on Route 24 where the City of Miami runs a trolley service, creating a more complementary service.

Yet, in many cases, trolley routes are highly duplicative of county routes. To develop a bus network that is most liberating and expands opportunity for more people would require changing trolley routes and county routes to reduce duplication and make the two services more complementary across more of the county.

The Cities of Miami, Miami Beach, and Coral Gables operate some of the highest ridership trolley routes in the county and have agreed to participate in the Better Bus Project to consider changes to their trolley networks in tandem with the county network changes. Other municipalities may decide to become more involved as the network planning process moves forward and the more that do, the greater the chances that the Better Bus Project can result in an overall network that expands liberty and opportunity for more people.

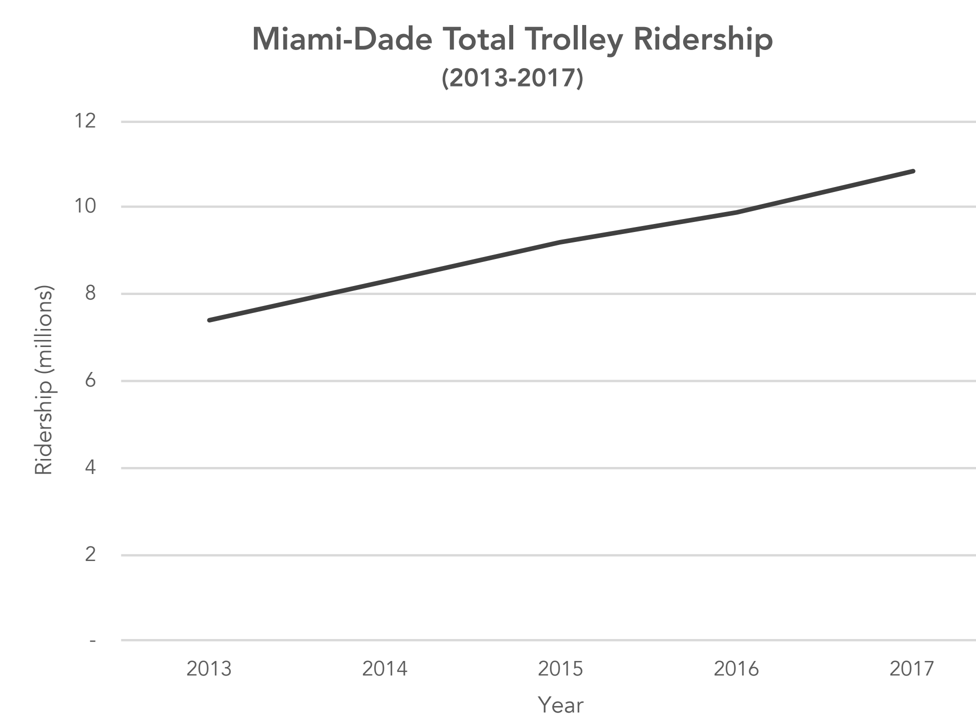
A key trend that is critical to understanding the decline in ridership on MDT routes in recent years is the expansion of municipal trolley service and ridership. Figure 5 shows the trends in trolley ridership on all municipal trolleys in Miami-Dade from 2013 to 2017. During this period, municipal trolley ridership rose from about 7.4 million rides to about 10.8 million rides, annually, an increase of about 3.5 million. During this same time, MDT routes lost about 21 million annual rides. So up to 15% of the decline in MDT ridership may be explained by the increase in trolley ridership from 2013 to 2017.

Yet, we do not know for sure that all trolley ridership is diverted from MDT routes. Some trolley ridership may not have happened without the existence of trolley routes. Given the level of duplication between trolley routes and MDT routes, as discussed on page 52, it is likely that a large portion of trolley ridership is diverted from MDT routes. Many riders may be willing to wait for a free trolley, instead of having to pay for an MDT service.

This report will describe some of the ways that municipal trolley services and MDT can coordinate to create a seamless network that maximizes the overall access and freedom of all potential transit riders. **This report will also describe how MDT, municipal trolleys, and any transit agency in any city, and in any situation, can increase the ridership they achieve within their fixed budgets.**

Ridership trends suggest that many riders have switched from county routes to free municipal trolleys.

Figure 5: Municipal Trolley Ridership in Miami-Dade, 2013-2017



The Network

Introducing the Network

The maps on this and the following pages introduce a style used throughout this report, in which **colors primarily represent frequency of service**. Red lines are frequent service, which means that they run every 15 minutes or better, in the midday and peak periods. Purple lines run about every 20 minutes. Dark blue lines run about every 30-40 minutes and light blue lines are the least frequent, 41-60 minutes.

We use this style because frequency is a critical element of service, and a network can only be fully understood if the patterns of frequency are apparent. We have categorized each route based on its midday frequency, which is the typical frequency of service between 10 am and 3 pm. The frequency of service on most routes is higher in the peak periods (generally 6 am to 9 am and 3 pm to 6 pm).

The Miami-Dade bus network covers nearly all developed parts of the county. During the midday there are only a few high frequency bus routes mostly serving Miami and Miami Beach. **Only five Miami-Dade routes or corridors are frequent (15-minutes or better) at midday.** Trolley routes operated by municipalities are shown with a dark outline. Only five trolley routes are frequent at midday.

The lack of frequent routes on most of the grid is remarkable when compared to other Sun Belt cities like Los Angeles, Houston, or Phoenix. In these cities, numerous frequent routes cover the dense parts of the core, creating a relatively easy grid of connecting lines. That grid of connecting lines means that travel across that core area by bus relatively easy. Miami-Dade, by contrast, only has one frequent north-south line on the mainland.

Also shown on the map is the Metrorail line in black, with stations marked with dots. The Orange and Green lines each run at 15 minute frequency during the day and combine for 7.5 minute frequency east and south of Earlington Heights station.

The map to the right is not meant to be readable in detail. Instead, it is meant to provide a high level view of the overall network within the county. The goal is to help the reader see the overall picture of frequent and infrequent service available across the county and the overall design of the network. The maps on the next few pages provide more detail on the exact location of routes on particular streets and in each part of the county.

The existing bus network in Miami-Dade mostly follows the grid pattern of major streets, but frequency is relatively low, making connections hard.

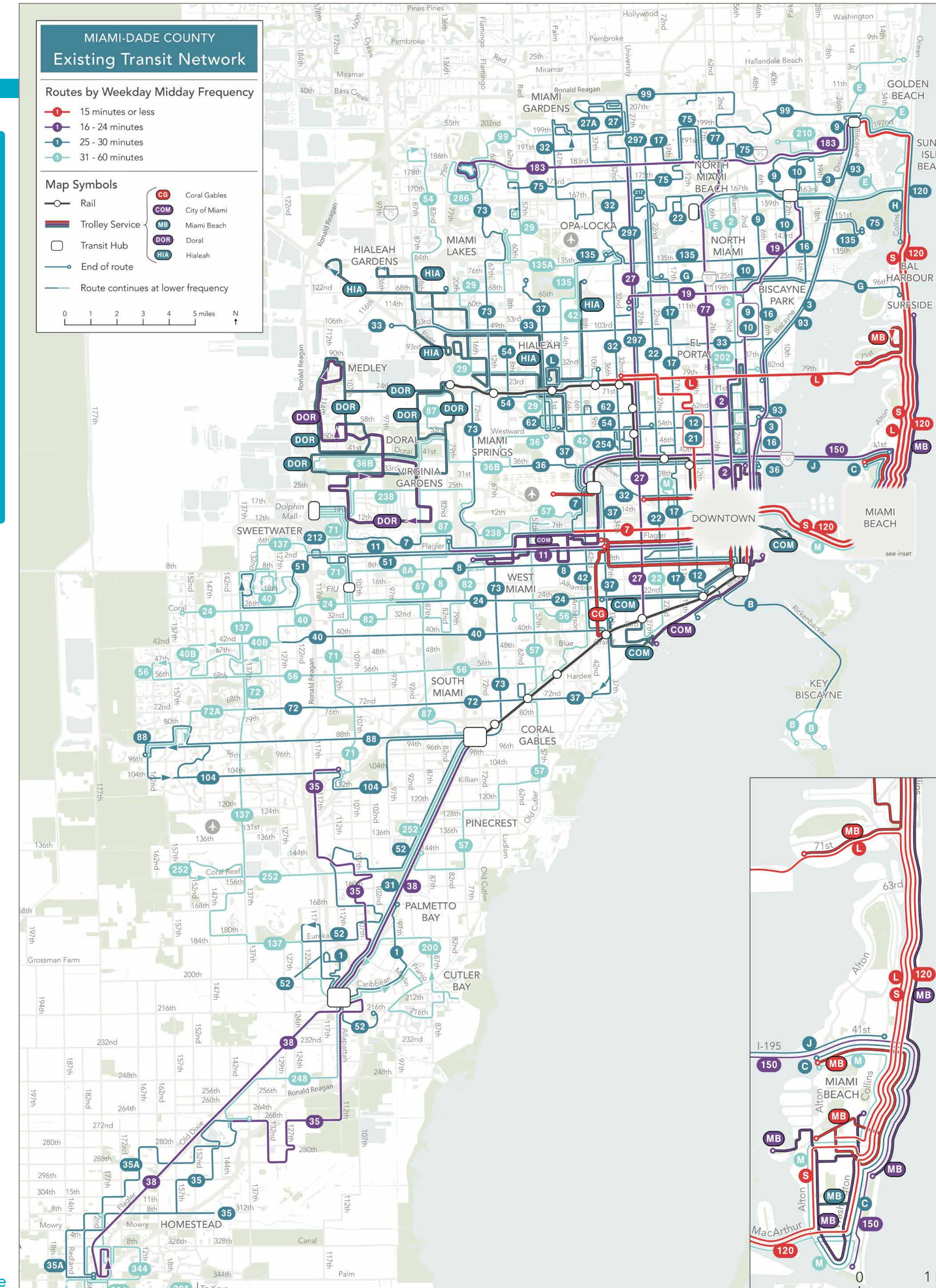


Figure 6: Existing Transit Network in Miami-Dade

Figure 7: Existing Transit Network in Miami, Miami Beach, Hialeah, and North Dade

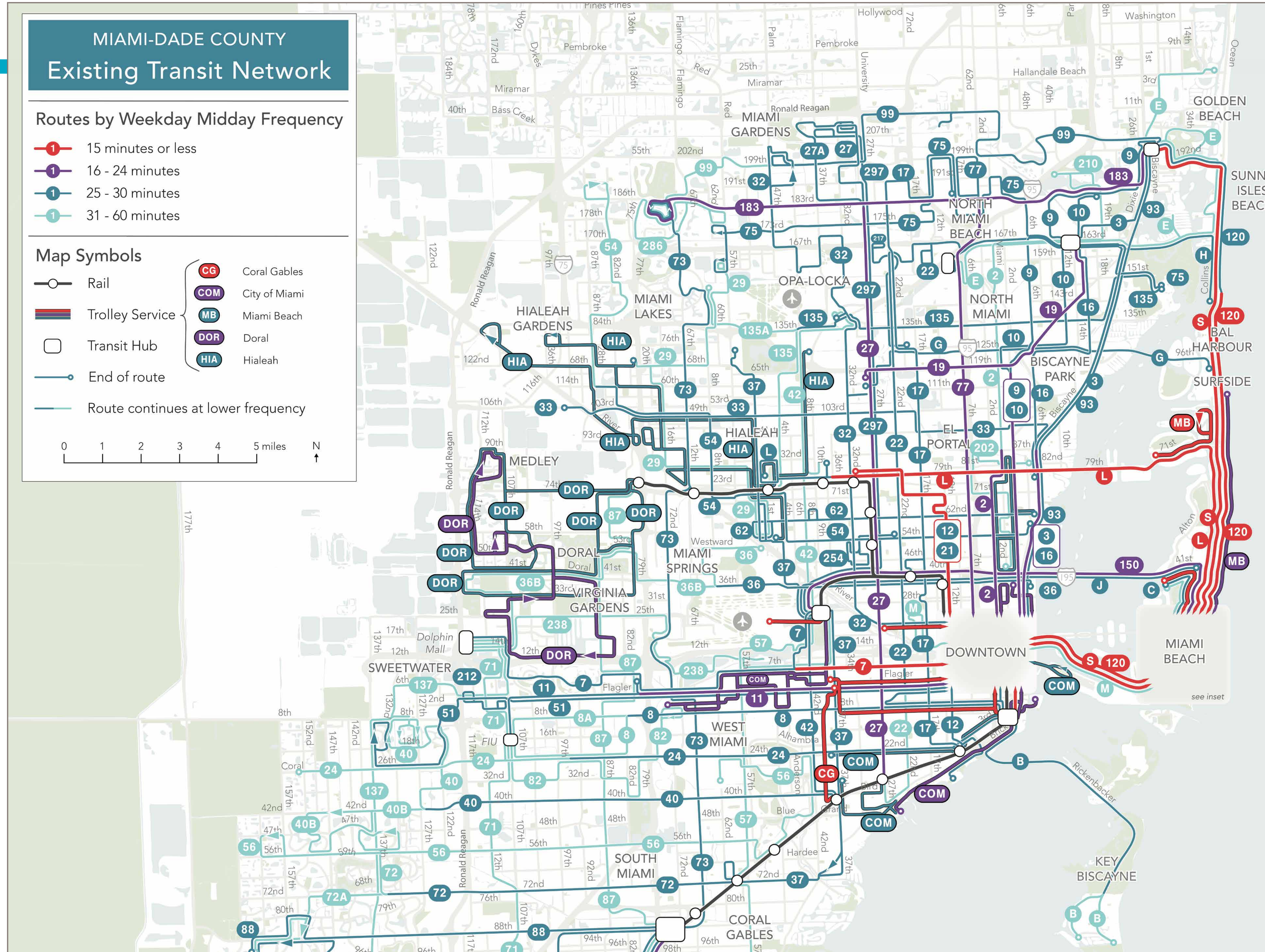
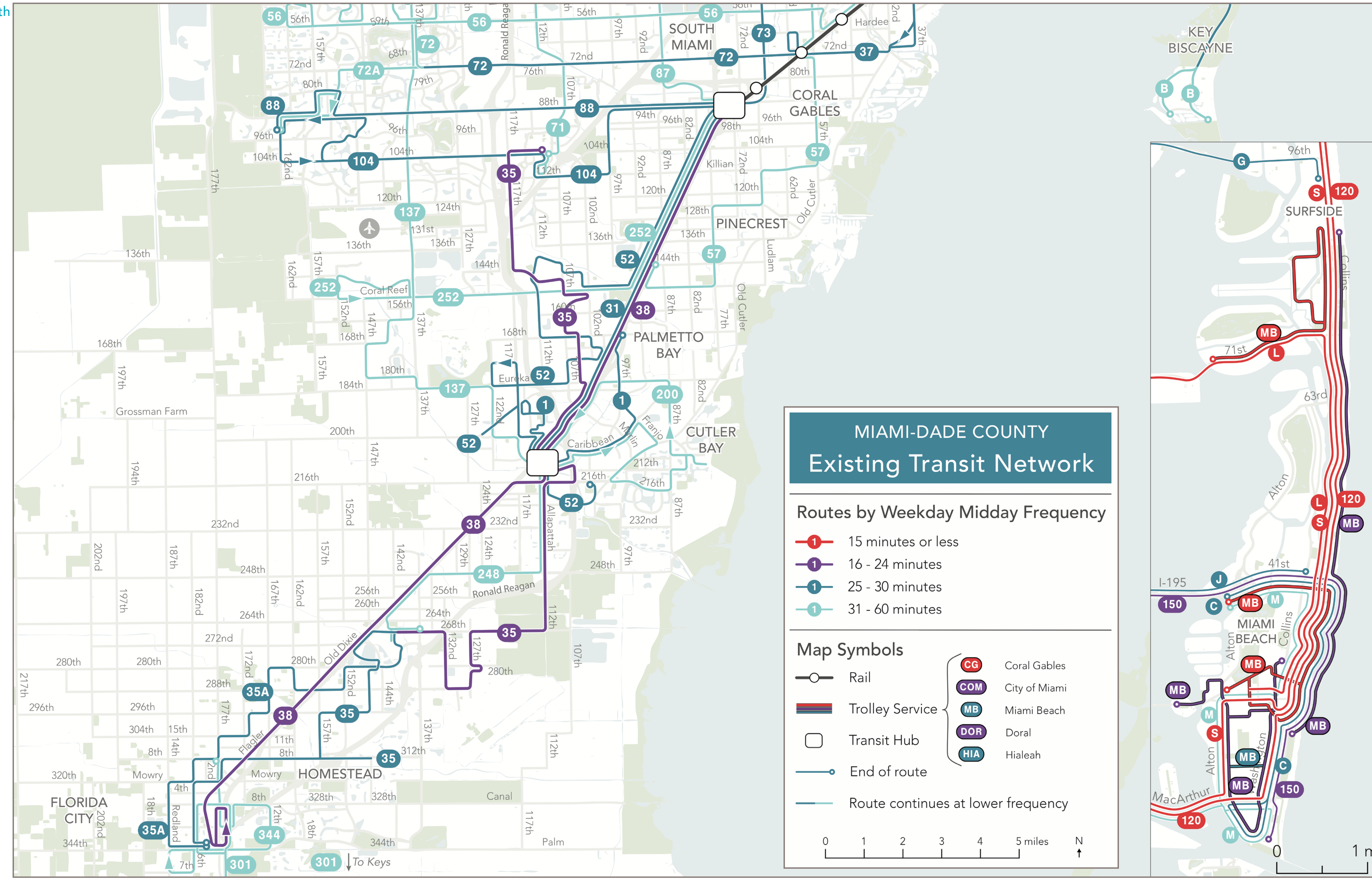


Figure 8: Existing Transit Network in South Dade and Miami Beach details



Why Focus on the Bus Network?

The Better Bus Project will focus on redesigning the bus and trolley network, though it will be considering the important role that Metrorail plays in the overall connectivity of the transit system.

Why focus on buses?

- Buses provide most of the transit service in Miami-Dade: about 85% of all service hours provided my Miami-Dade Transit are provided by buses.
- Buses serve most transit riders in Miami-Dade: more than 2/3 of all transit trips in Miami-Dade are taken on a bus.
- Finally, the bus network can be changed and improved *soon*. Implementing the Better Bus Project bus network redesign can be done within a year or two. Thus, buses are the only tool that can efficiently serve most of the county, soon.

Even in cities like New York, where a majority of the population is within a half-mile of a subway station, enormous numbers of people travel by bus. Bus service is much less expensive to operate than rail, bus vehicles are cheaper and easier to procure than rail vehicles, and bus service does not require lengthy and costly construction projects. **For moving large numbers of people across a large urban area at a reasonable cost, rail cannot compete with buses.**

Redesigning the Miami-Dade bus network does not mean every route or stop would change. It does mean, however, that everyone involved in this plan need not be constrained by the existing network. If there are routes and service patterns that are meeting the region's goals today, they are likely to be retained by the Better Bus Project. If there are routes and patterns that are artifacts of history and no longer make sense, they can be revised.[1]

Local Leadership is Critical

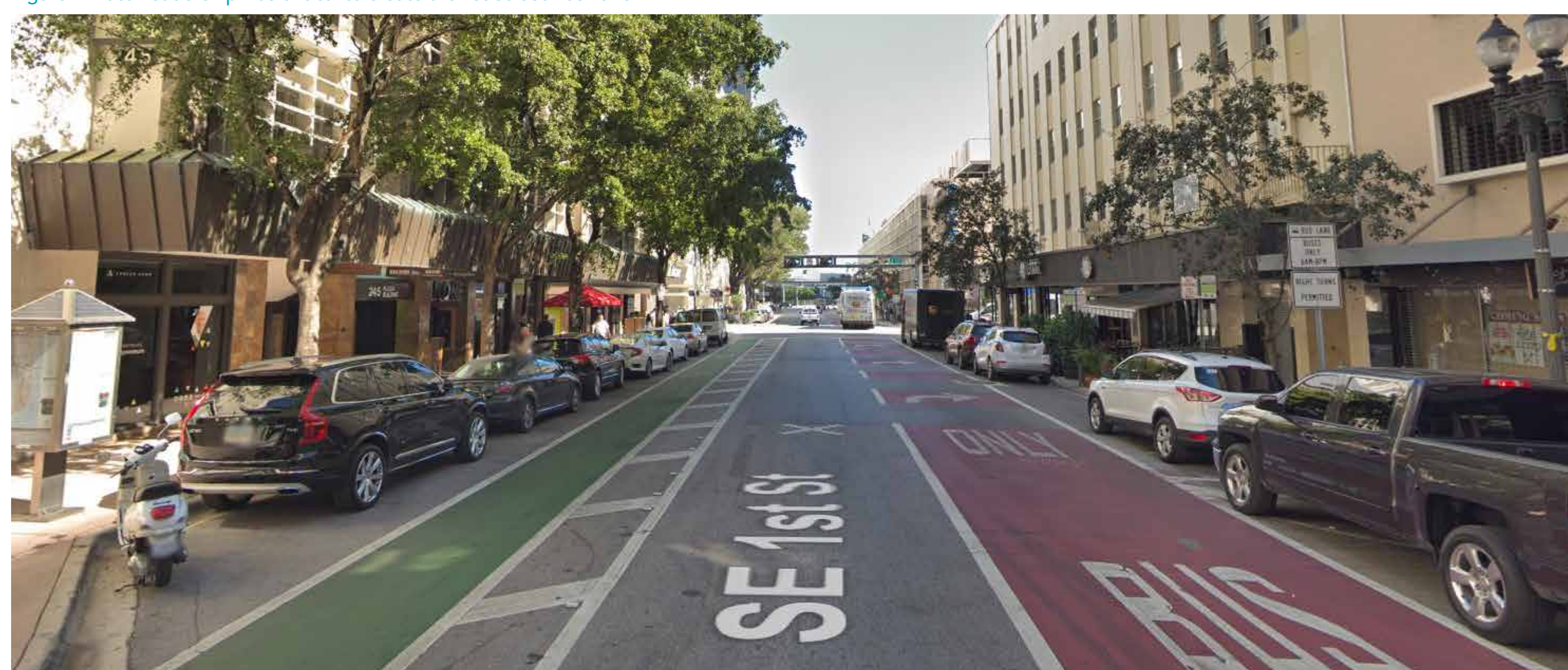
This process will focus on the design and operation of the bus network, which is largely under the control of Miami-Dade County. However, other authorities like municipalities, the State, and the Miami-Dade Transportation Planning Organization (TPO) control the success of the transit system as much as MDT, because of two enormous powers:

- Land use authority: Most of Miami-Dade county is within a municipal boundary. Cities, therefore, decide whether more people and jobs will locate in places where they can be served by transit that is both cost-effective and useful.
- Street Design: The state controls many of the busiest streets and highways on which buses operate. Most speed and reliability problems are related to delays caused by traffic. Other regions are addressing this problem through various kinds of transit priority, including signal improvements and bus lanes. The County manages some major streets and highways and has some control over this challenge, but must coordinate with the state, cities, and TPO to add transit priority lanes or transit priority signals.

Much can be learned from the success of the City of Seattle, which in 2004 became the first city to publish its own Transit Master Plan, even though it did not operate any transit itself. This was the first step of many, as Seattle has taken a leadership position on transit planning, transit-oriented development, and most recently in raising transit funding. The original Transit Master Plan (since updated), and the on-going municipal leadership, are probably the biggest reasons that Seattle is one of only two cities in the U.S. where transit ridership has grown, rather than fallen, in recent years.

Municipal transit plans for cities in Miami-Dade County can guide each city's actions in planning and expediting transit, and help city leaders align their land use, development and street design actions around their own goals for transit. And those plans can help inform regional choices by the TPO and state in deciding how to allocate funding and how to prioritize space on state highways.

Figure 9: Local leadership was critical to create the 1st Street Bus Lane



1 This is not to say that bus service patterns are *temporary*. Sometimes, in advocating for the use of rail vehicles, people argue that bus service is temporary, whereas rail is *permanent*. This is obviously not true, since for a few decades in the late 19th and early 20th centuries U.S. cities were full of trolleys and streetcars running on rails, nearly all of which were ripped out, proving their impermanence. Bus service isn't permanent either, in that sense.

What is very permanent, however, is a *high ridership transit market* and the *transit service patterns* that arise from it. The most frequent and high-ridership bus lines in the center of any U.S. city are likely to have been served by horse-drawn bus in the 1800's, streetcars in the early 1900's, and diesel or electric buses since then. For example, streetcars once operated to Miami Beach and along Coral Way, both productive and high ridership corridors today that are now operated by buses. Transit technologies come and go, but *a high-ridership transit market is permanent.*

What else is in this report?

In Chapter 2, we summarize the basic principles of transit geometry, how they affect the access and opportunities that transit can provide to residents, workers, and visitors, and how the underlying geometry forces every city or region to grapple with some key value trade-offs in the design of its transit system.

In Chapter 3, we assess the markets for transit in Miami-Dade, the potential for high ridership in the city, and the areas where the need for transit is high but the density of demand is not.

In Chapter 4, we review the existing network and describe its frequency and key outcomes, like how many people are near any service and how many jobs a rider can reach from different origins around the county.

In Chapter 5, we analyze the fixed route transit network performance including the productivity of service. We also assess some key challenges and opportunities for improving transit service in the county.

Key choices for the future of transit in Miami-Dade

In the final chapter of this report, we present some key choices that the public, stakeholders, and elected officials need to consider to guide the next steps in the Better Bus Project. These choices are suggested by the existing conditions and geometry of development in Miami-Dade, as well as how transit service is currently provided in the county. Most importantly, these choices are value questions that do not have technically correct answers and require the community to weigh important, but competing priorities.

Balancing ridership and coverage goals

In every transit system, a basic trade-off must be made between doing things that increase ridership (such as concentrating service into more frequent routes) and doing things that increase geographic coverage.

How should Miami-Dade balance ridership and coverage goals in its network?

Role of the municipal operators

Currently there are many places where county bus routes and municipal trolley routes duplicate each other. Also, the use of high floor vehicles with one door suggests that the trolleys will be limited to low-ridership areas where the operating challenges of such vehicles causes fewer delays.

A higher ridership network would involve separating out services, either onto different streets or into different operating patterns, so that each the county and each municipality maximized its productivity and the productivity of the entire network. It would also require that trolley operators reconsider their current vehicle types.

How should Miami-Dade balance the roles of county routes and the municipal operators?

Stop Spacing

In every transit system, a basic trade-off must be made between easier walk access to transit with closer stop spacing and faster bus speeds and quicker overall trips with wider stop spacing.

How should the Miami-Dade balance access and speed goals in its network through stop spacing standards?

Peak or All-day Service

Demand for transit service tends to be higher at peak periods during weekday mornings and evenings. These peak periods occur at similar times of day as peak traffic on major streets and highways. Yet, providing more service at the peaks comes with extra costs.

What is more important: fully serving higher demand at peak hours, or providing a useful level of transit service all day, everyday?

What's Next

This Choices Report will inform public and stakeholder outreach as part Better Bus Project. Transit Alliance will be conducting surveys and other outreach efforts during the summer of 2019. That outreach process will include the key choices highlighted here and responses from the public and stakeholders will guide the overall direction on the next steps of the redesign process.

With direction from the public and stakeholders, the study team will design two conceptual networks that can help everyone see more clearly what a more ridership or more coverage-oriented network would look like for Miami-Dade. Maps of those networks and measures like job access change, proximity to service, and speed of service will be summarized in a report for the public and stakeholder to review in the fall. The concepts will then be the center of another public conversation to determine the direction for the redesign of the Miami-Dade bus network.

Your voice matters! Contact the project team and take the Better Bus Project survey at www.betterbus.miami

PHASE 1	PHASE 2	PHASE 3
Evaluation	**Concepts**	**Final**
June – August	**September – November**	**December – January**
We are evaluating the current bus system and will release a report in early July.	We will release two different network concepts for discussion and debate.	The final network plan will be voted on by the Board of County Commissioners.
We are surveying riders across the bus system on the key choices that will help determine the design of the new bus network.	We will hold a series of workshops to determine how to shape the final network plan.	If the plan is approved, we will hold information sessions ahead of the plan being implemented in 2020.

Figure 10: This Choices Report is part of Phase 1 of the Better Bus Project

2 Geometry of Transit

Access and Freedom

Public transit can be described from many points of view, but there are some basic geometric facts about how transit works and how it interacts with the layout of a city. This chapter explains these key ideas, which provide important context for understanding the material that follows.

Public transit ridership arises from the combination of three things:

- Access (or Freedom). Where can you get to on public transit in a reasonable amount of time, compared to your alternatives?
- Pricing. What does transit cost given its alternatives?
- Preferences. These include everything else, all the subjective factors that govern decisions about how to travel, as well as reactions to other aspects of the transit experience.

Network design and planning mostly determine access, so let's look at that concept in more detail.

Access (or Freedom)

Wherever you are, there is a limited number of places you could reach in a given amount of time. These places can be viewed on a map as a blob around your location. Figure 11 shows an example of this type of visualization of transit access for Little Havana.

Think of this blob as "the wall around your life." Beyond this limit are jobs you can not hold, places you can not shop, and a whole range of things you can not do because it simply takes too long to get there. The technical term for this is accessibility, but it's also fair to call it freedom, in the physical sense of that word. The extent of this blob determines what your options are in life: for employment, school, shopping, or whatever places you want to reach. If you have a bigger blob, you have more choices, so in an important sense you are more free.

Access is a Matter of Geometry

The way these factors combine to determine the access from each point is purely a matter of geometry. That's because freedom is about what you could do, not what we predict you will do. Access is a basic part of what determines ridership, but it also represents something that many people will see as a worthy goal in itself. For example:

- **Access to jobs** is a key concern for keeping people employed.
- **Access from a particular location** is something that gives a location value. Real estate firms routinely study where you can get to by car from a particular parcel, and this is the same analysis for transit. In dense cities, transit access can be an important factor in land value.
- Access describes an outcome in terms that many people will care about. If you are deciding where to live based on whether you'll be able to get to your job, school, or relatives, you are asking a question about access.

From Access to Ridership

Ridership arises from the combination of access and human behavior. Human behavior is heavily impacted by pricing, and also by many other features that psychologists and social scientists study.

So while access is not, in itself, a prediction of ridership, it is a foundation of it. It is also the aspect of ridership that transportation planning mostly influences, and it can be described geometrically in a way that gives us a high degree of confidence. Finally, it's directly relevant to a range of other issues, such as unemployment and real estate value. This is why we recommend focusing on it as a useful measure of transit's outcomes.

How Transit Expands Access

On transit, the extent of access is determined by:

- **A network**, including transit lines with their frequency, speed, and duration. These features determine how long it takes to get from any point on the network to any other point.
- **The layout of the city**. For each transit stop on the network, this determines how many useful destinations are located there or within easy walking distance.[1] For example, if density is higher, that means there are more people or useful destinations at a given stop, which means that good access from that point is of more value to more people.

Building Access: The Network and Frequency

A transit network is a pattern of routes and services, in which each line has:

- a path;
- a duration, or span—what hours and days it runs;
- an average speed; and
- a frequency—how often a transit vehicle serves a stop, which determines how long a riders waits for a vehicle.

A high-access network consists of high frequency deployed in patterns that connect many residents to many jobs and activities.

1 There are other ways to get to transit other than walking, but walking is by far the most common, so we use it here for simplicity as we explain the basic concepts.

How far can I travel in 30, 45, and 60 minutes from

Little Havana - Flagler & 17th Ave

at noon on a weekday?

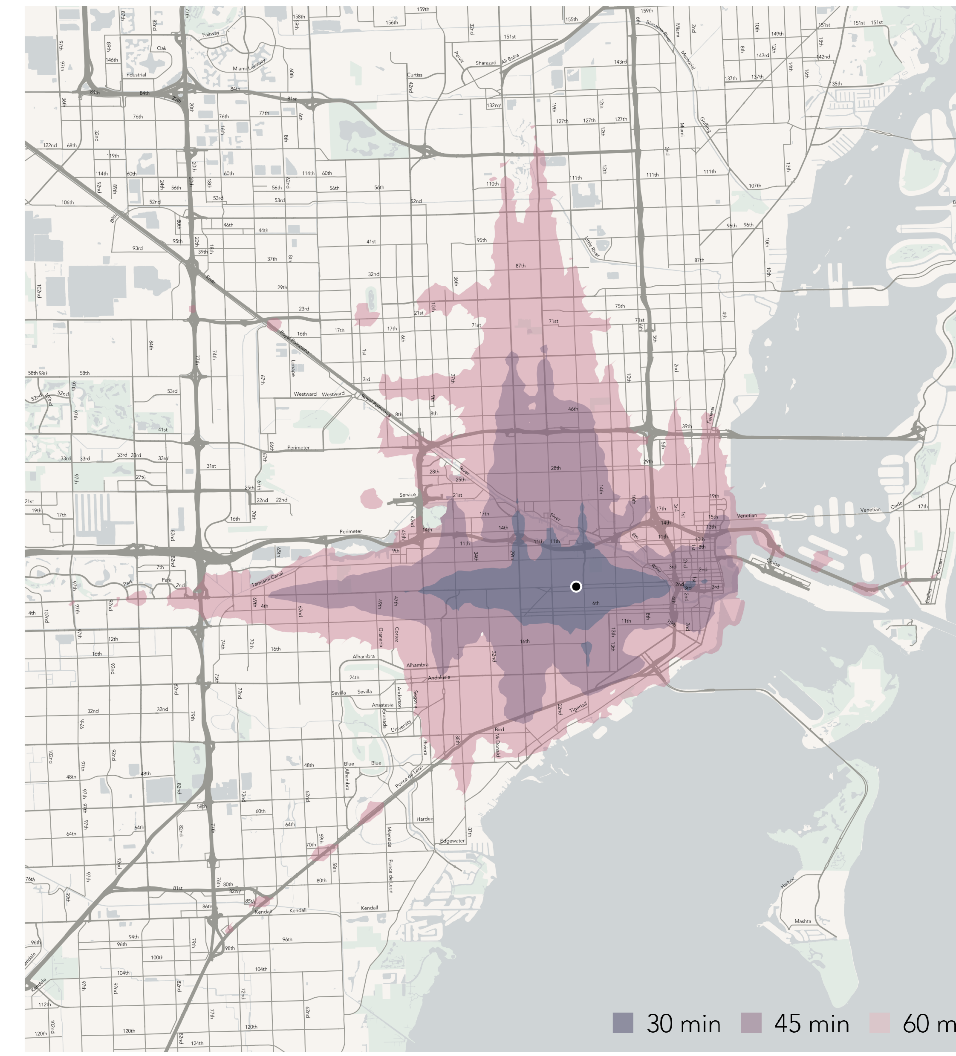


Figure 11: The blobs on this map effectively show the liberty and opportunity available to someone living in Little Havana if they rely on walking and transit.

The easy grid connections of the bus network in the core of Miami are visible in the tendrils of access that stretch in all directions from Little Havana.

Frequency is Critical to Access and Freedom

Frequency is the key factor for transit and the one that needs the most explanation. It is often invisible and easy to forget, and yet it is usually the dominant element of travel time, and hence of where you can go in a given amount of time.

Frequent service provides several linked benefits for customers:

- **Short Waits.** The average wait time for a 15 minute service is just 7.5 minutes.
- **Fast Connections.** The ability to change from one vehicle to another is the essence of how you get to many places that are not on the line you happen to be on. Connections are the glue that combines a pile of lines into a network. Frequency makes connections easy, because the next bus is always coming soon.
- **Easier Recovery** from disruption. Frequent service is more reliable because if a bus breaks down, the next bus is always coming soon.
- **Spontaneity.** Rather than building your life around a bus schedule, customers can turn up at the stop and go.

In total, these benefits mean that when high frequency transit is placed where it connects many residents with jobs and major destinations, more people can reach more jobs and opportunities. Therefore, more people have more access and freedom.

Because these benefits are independent of each other, it is not surprising that the payoffs of frequency are non-linear, with the highest ridership benefit usually being found in frequencies of 5 to 15 minutes. Figure 12 plots the frequency and productivity of each route operated by 24 transit agencies across North America. MDT routes are plotted with red dots. The x-axis is frequency (better frequency is a low number, so more frequent service is to the left). The y-axis is productivity—ridership divided by quantity of service provided. Each hexagon is shaded by the number of unique routes occupying that point on the graph.

Quantity of service is a close proxy for the cost of service and when frequency doubles, the denominator of the y-axis (cost) doubles. Thus if a transit agency doubled frequency and ridership doubled then productivity would remain the same. Figure 12 shows that ridership relative to cost rises with frequency even though the cost of frequency pulls the productivity ratio down.

How much frequency is enough? Two points should be noted:

- For most urban purposes, **a frequency of 15 minutes or better has a chance of being useful** for someone whenever they have to travel. At frequencies of this level, the nonlinear payoff begins to appear.

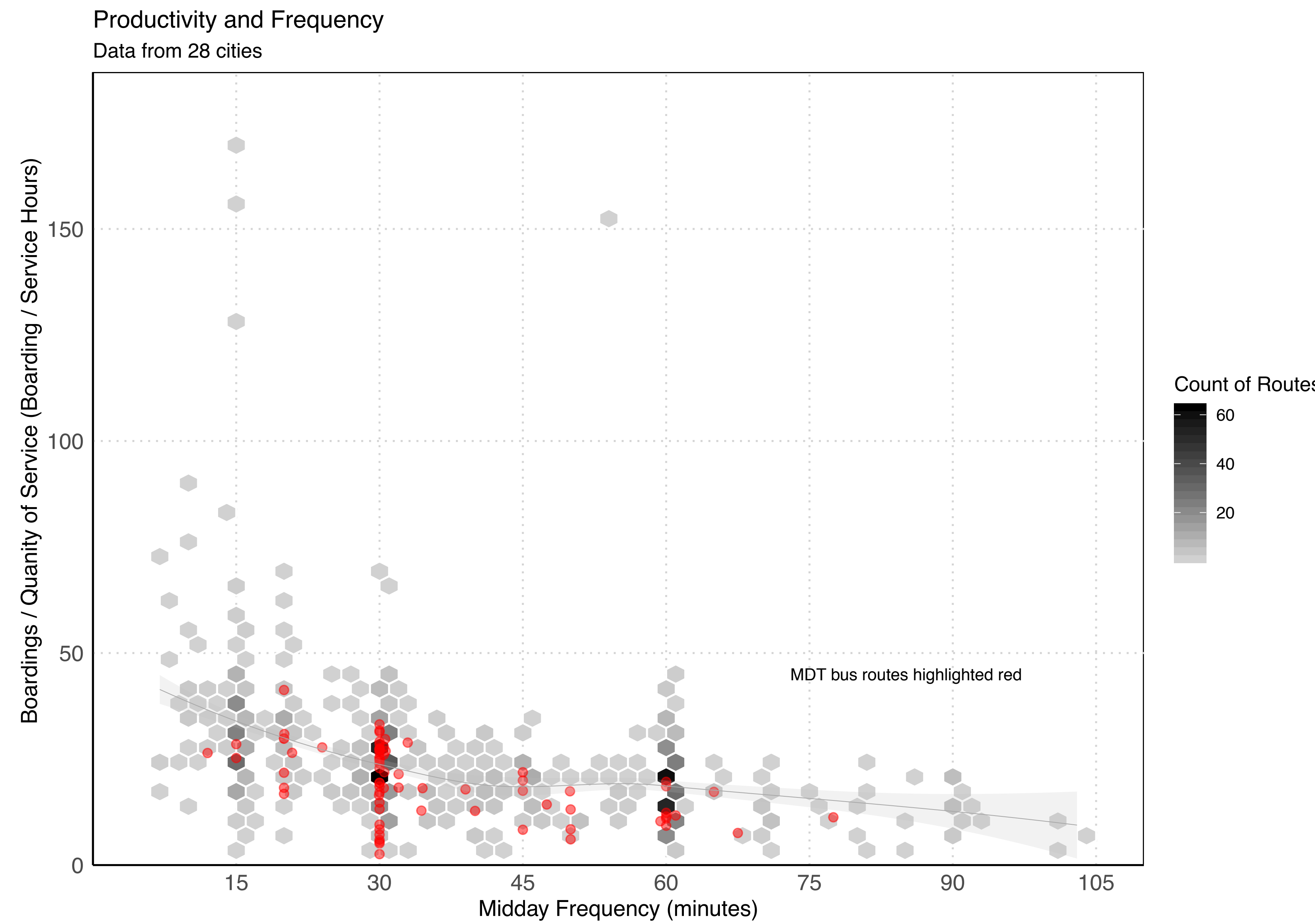


Figure 12: Transit Productivity and Frequency

- **Adequate frequency depends on average trip length**, because it doesn't make sense to wait long to go a short distance. Very short downtown circulators, for example, often don't make sense unless they can be run at frequencies well under 10 minutes. If the bus isn't coming very soon, it's probably quicker to walk the whole way.

Takeaway

High frequency service is strongly correlated with high ridership relative to cost.

Urban Form Governs Transit Outcomes

Because frequency is expensive, it can't be offered everywhere. The greatest access benefit arises from focusing frequency on the places where it will benefit the most people. It comes down to two questions:

- **How many residents or useful destinations can be easily reached from each transit stop?** The answer to that question is density and walkability. High density means more people will find a stop useful, and high walkability means that people over a larger area will be find the stop easy to walk to.
- **Are stops with high demand concentrated along a logical line?** The answer to that question is linearity (can the line be straight?) and proximity (does the line have to cross empty gaps with no demand?).

These geometric facts help us see why transit planning is always politically difficult, and why all transit plans make some people unhappy. Imagine that Mrs. Smith lives in an apartment downtown (dense, walkable, linear, proximate) while Mrs. Jones lives in a large house in a cul-de-sac on a peninsula on the edge of the city (not dense, not walkable, not linear, not proximate). The objective fact is that it would cost much more to serve Mrs. Jones than to serve Mrs. Smith. Is it fair to give them the same level of service regardless? Or is it fair to spend the same amount serving each of them, which would mean very little service for Mrs. Jones? It depends on transit's goals.

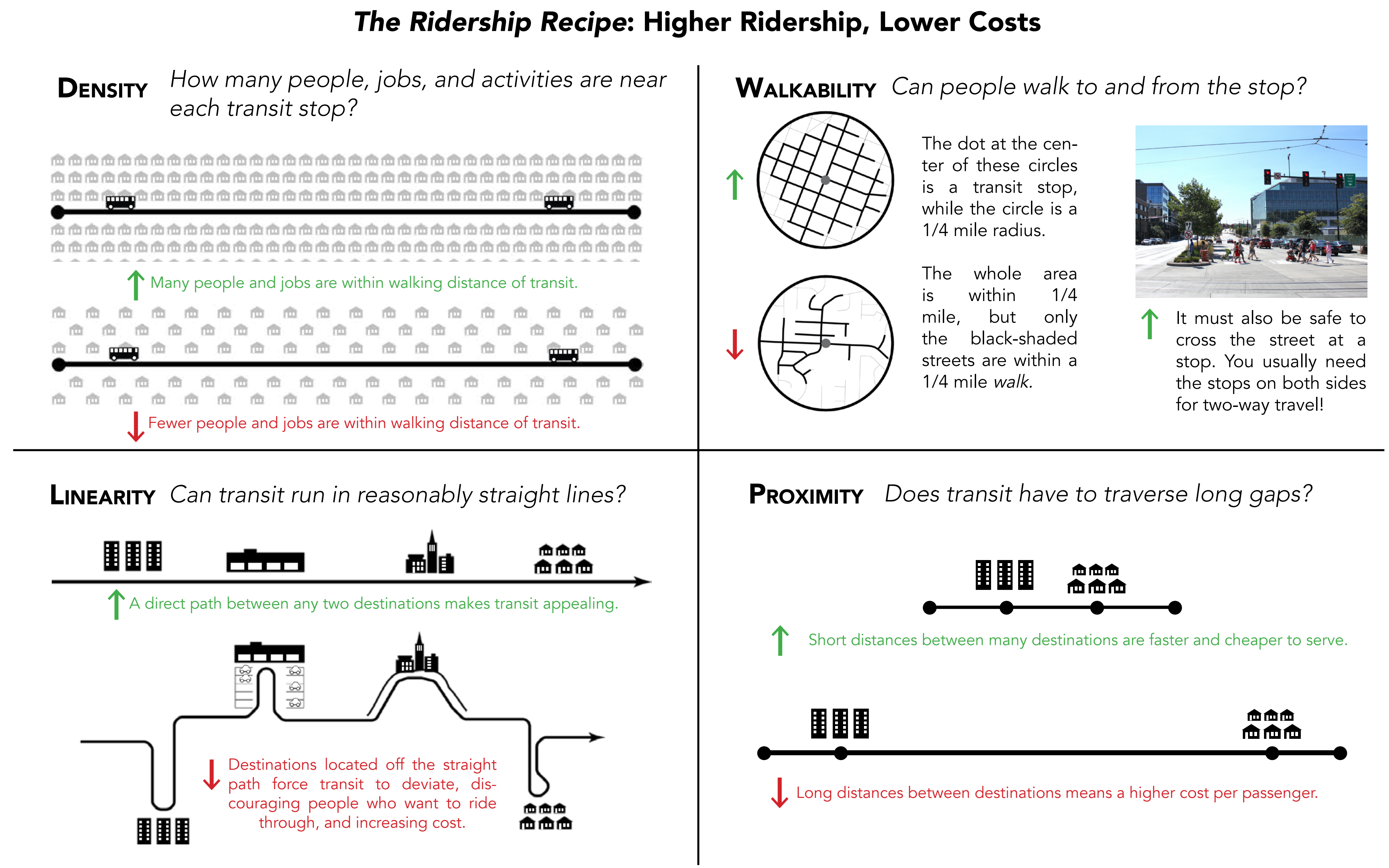


Figure 13: How Urban From Governs Ridership

Goals of Transit

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

Understanding which goals matter most in Miami-Dade is a key step in thinking about the role of transit in the county.

Possible goals for transit include:

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

Some of these purposes are served only when transit has high ridership. The environmental benefits of transit only arise from many people riding the bus rather than driving, taking a taxi, or otherwise getting a ride in a private vehicle. And subsidy per rider is lower when ridership is maximized. We call these **ridership goals**.

Other goals are served by the fact that transit is available in a given area. A bus stop in a neighborhood gives residents insurance against isolation, even if the service is infrequent, not very useful, and few people ride it each day. Or that same service helps fulfill political equality; the desire to provide some service to all political wards within a city or town. We call these **coverage goals**.

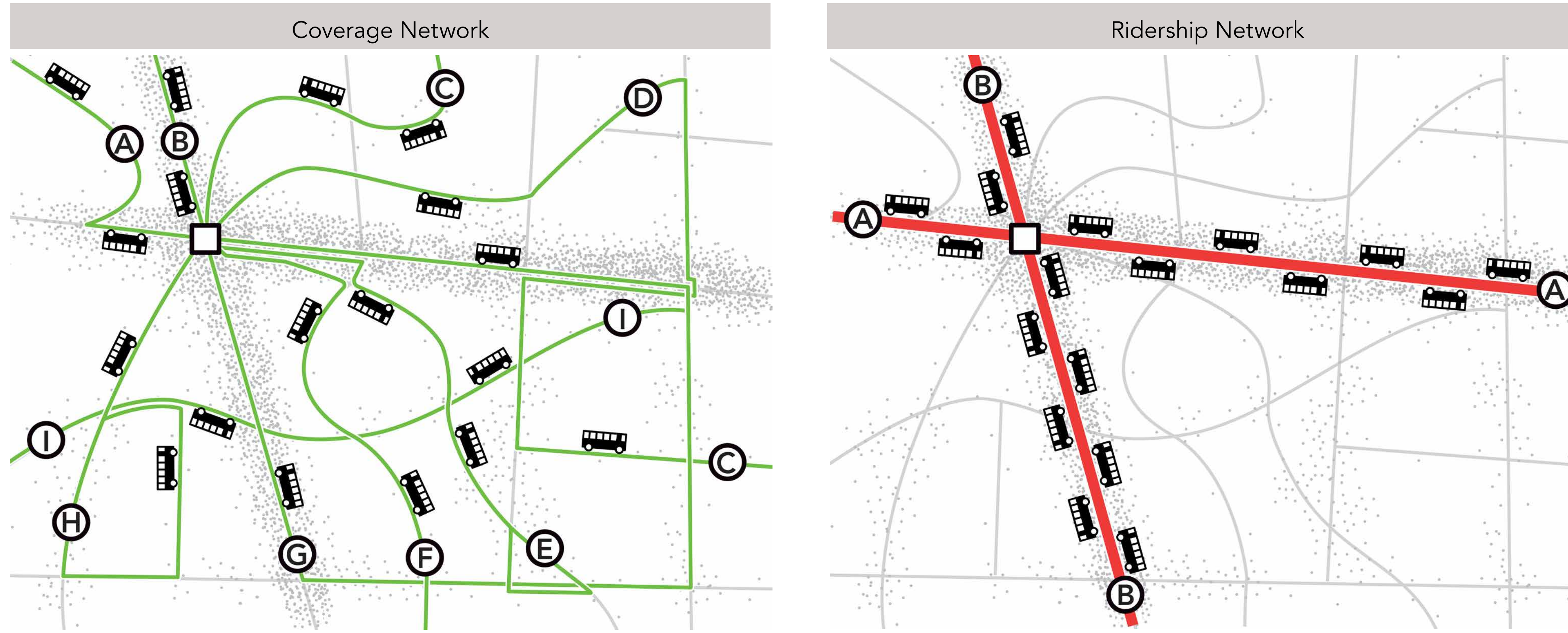


Figure 14: The Ridership / Coverage Trade-off

Ridership and Coverage Goals are in Conflict

Ridership and coverage goals conflict. **Within a fixed budget, if a transit agency wants to do more of one, it must do less of the other.**

Consider the fictional neighborhood in Figure 14. The little dots indicate dwellings, commercial buildings and other land uses. The lines indicate roads. As in many neighborhoods, most activity is concentrated around a few roads.

A transit agency pursuing only ridership would run all its service on the main streets, since many people are nearby, and buses can run direct routes. A high ridership network allocates frequent service to areas with favorable urban development patterns, forming a connected network. This would result in a network like the one at top-right.

If the transit agency were pursuing only coverage, it would spread out so that every street had some service, as in the network at top-left. All routes would then be infrequent, even on the main roads.

These two scenarios require the same number of buses and cost the same amount to operate, but deliver very different outcomes. To run buses at higher frequency on the main roads, neighborhood streets will receive less coverage, and vice versa.

An agency can pursue ridership and provide coverage within the same budget, but not with the same dollar. The more it does of one, the less it does of the other.

These illustrations also show a relationship between coverage and complexity. Networks offering high levels of coverage – a bus running down every street – are naturally more complex.

The choice between maximizing ridership and maximizing coverage is not binary. All transit agencies spend some portion of their budget pursuing each type of goal. A particularly clear way for cities and transit agencies to set a policy balancing ridership and coverage goals is to **decide what percentage of their service budget should be spent in pursuit of each.**

The "right" balance of ridership and coverage goals is different in every community. It can also change over time as the values and ambitions of a community change.

3 Market and Needs

Market: Residents

Residential Density

Most of people's daily travel behavior begins and ends at home, for this reason residential density is a key metric to assess the strength of transit markets. A transit system designed to achieve a ridership goal will seek to offer very useful services in places where most people live, thus high residential density areas. On the other hand, coverage services will seek to reach all or most of the inhabited residential area, offering a minimum service for all, even if the development pattern is such that few people live near any given stop.

Figure 12 shows the density of residents in Miami-Dade County by Census Block Groups. The median density in the county is around 9,000 people per square mile, however in some areas the densities can reach more than 100,000, particularly in the urban core around Downtown Miami, Brickell, and South Beach. Most of the high density is concentrated in the City of Miami and its surroundings, particularly the northern and eastern portions of the county such as Hialeah along Okeechobee Road (from Miami to Hialeah Gardens), Sweetwater, and North Miami Beach. The corridor along Flagler Street from downtown Miami to Sweetwater stands out as one of consistently high residential density in a linear pattern, suggesting it is a high ridership corridor for transit.

Most areas in South Dade have relatively lower densities compared to the rest of the region. For example Pinecrest, Palmetto Bay, and Princeton have much lower density levels. Pockets of higher residential density are found in South Dade, particularly in Kendall West, but these pockets tend to be long distances from other high density areas of the region, creating a problem of proximity.

The density of the city of Miami is the result of its urban footprint characterized by multi-story buildings, connected through a cohesive street pattern. On the other hand, the high residential density in Hialeah Gardens or Kendall West, is the product of clusters of single unit houses in areas with less connected streets.

Lower density neighborhoods are characterized by single family homes and large lots in places like Pinecrest, Palmetto Bay, and Miami Lakes. These neighborhoods have more greenspace and water features, and more circuitous local street networks, sometimes within private residential communities.

While density is a critical feature of high-ridership transit markets, the strongest markets are those where that density is located in walkable places that do not require circuitous walks to reach a bus stop and do not require onerous deviations by a bus route to reach lots of riders.

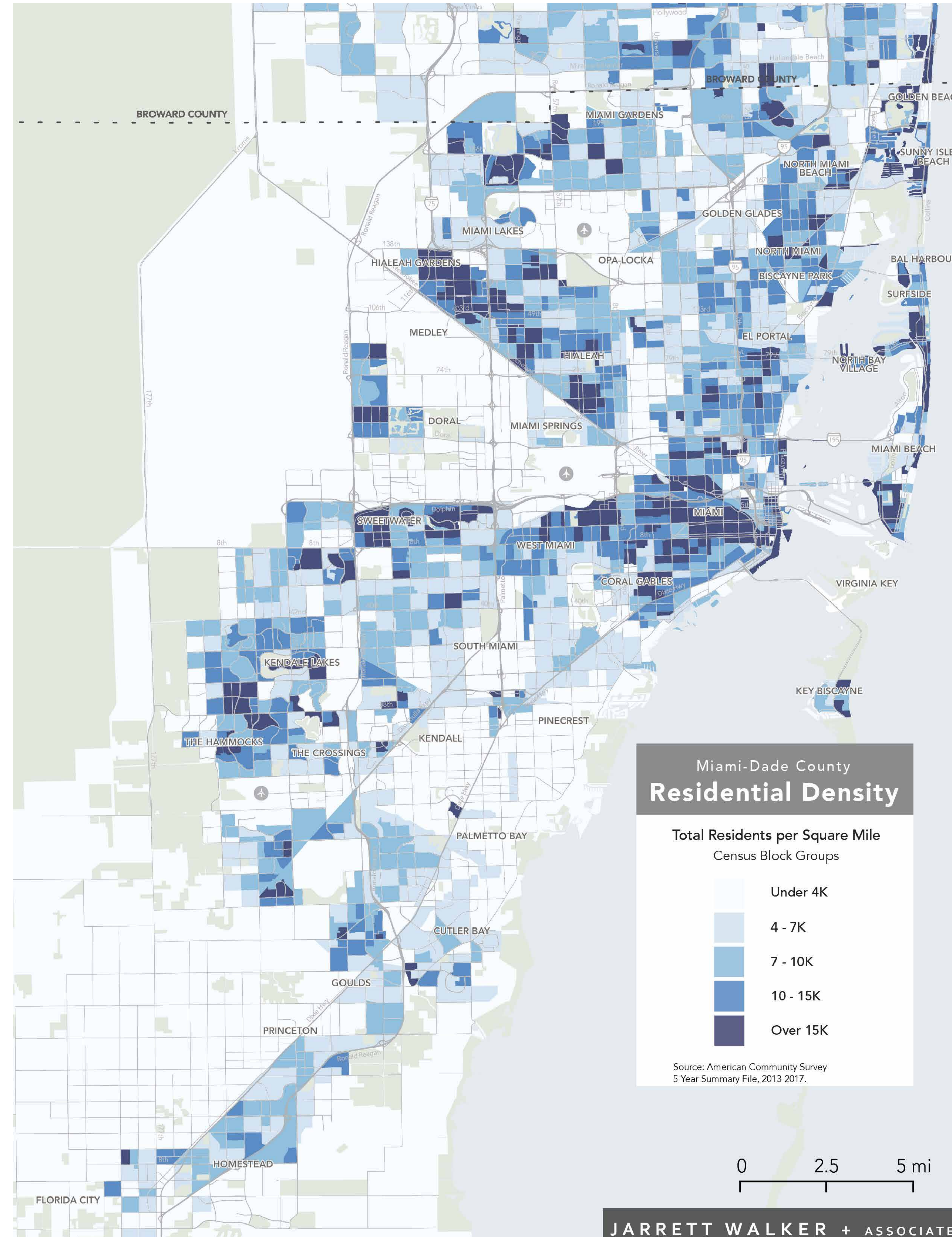


Figure 15: Miami-Dade Residential Density by Block Group

Market: Jobs

Employment Density

Employment density helps us understand important destinations people travel to. Employment doesn't just tell us about where people might be going to work. Particularly in the retail and service sectors, high employment density also indicates places that are likely to have a high density of customers or visitors.

This map shows that locations of employment are geographically dispersed across the region, with key labor centers in the core of the county. Half of the Census Blocks Groups hold less than 1,000 jobs; however the main key centers have more than 10,000 jobs. The densest employment areas in Miami-Dade are:

- Downtown Miami and its surrounding areas, feature major activity centers for local government, tourism, retail, and education. Multiple international and national major companies are headquartered in Miami due to its location, making it a major center of commerce and international business.
- Miami Beach, particularly South Beach, is a dense residential and employment hub in the region. It attracts a significant number of workers and customers every day. It features relatively continuous storefront commercial development, interspersed with larger activity centers. It accounts for more than half of tourism to Miami-Dade County, including more than 20,000 jobs in the tourism industry or related to it.
- In Doral, the cluster of jobs located between Ronald Reagan Turnpike and NW 42 Avenue hosts multiple businesses, industries, commercial malls, such as Dolphin Mall in addition to the Miami International Airport. This area features a challenging pedestrian environment due to its lack of sidewalks and wide intersections, which are mostly designed for fast vehicle movement. This area is bisected by the Dolphin Expressway and Ronald Reagan Turnpike, making it difficult for people to walk from the north and west side of this employment cluster.
- There is a long commercial strip along Dixie Highway from Miami to Coral Gables along the Metrorail line to Dadeland South. This corridor features commercial and retail thus attracting workers, shoppers, and visitors. Since this cluster of jobs developed in an auto-oriented way with development of Dixie Highway, walking here is challenging due to the lack of connectivity and pedestrian infrastructure.
- Smaller commercial nodes can be found near Miami Executive Airport, southwest of Kendall. There is a cluster of industries and commercial development between SW 136th and SW 120th Streets with more than 1,000 jobs.

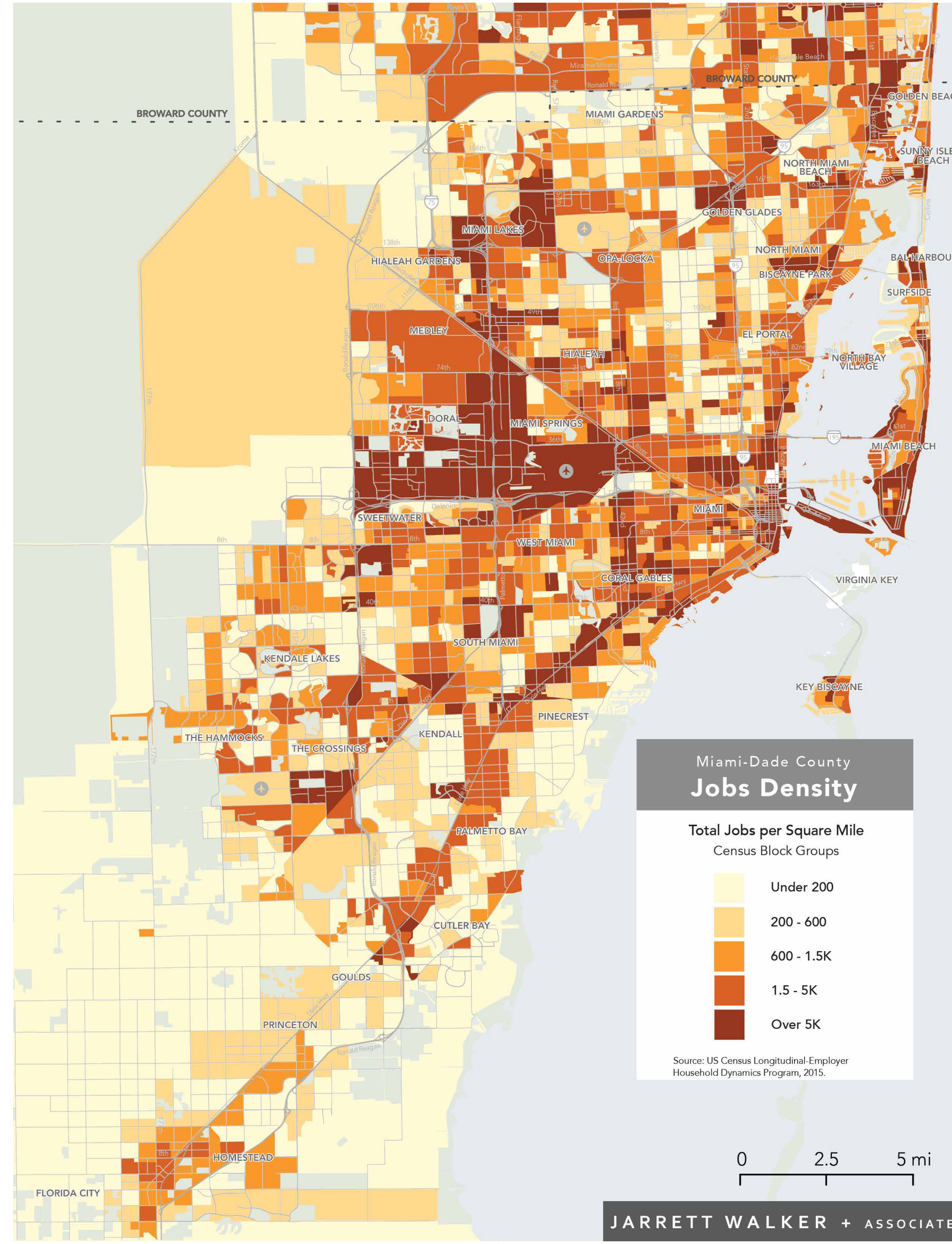


Figure 16: Miami-Dade Jobs Density by Block Group

Market: Mixed Uses

Activity Density

The last two maps showed residential and job density separately. This map combines them, to highlight places with both jobs and residents. As the legend shows, blue means residential and yellow means jobs, while red indicates a high density of both residents and jobs in the same place.

Places with high density of both residents and jobs tend to generate high ridership flowing both ways along a line, which means more people can be served with less crowding. By contrast, where jobs and residents are separate, buses often run full in one direction but empty in the other. Figure 14 visualizes the mixture of uses (jobs and people) in Miami-Dade, referred to here as activity density.

On this map, places that are predominately residential are shown in increasingly saturated shades of blue. Employment is shown in yellow. Orange, purple and red signify places with varying degrees of mixed residential and employment density levels.

Overall this map shows that most of the region consists of moderately mixed uses, especially in the urban cores. The City of Miami and Miami Beach are the densest and most mixed-use parts of the county, combining both very high-density residential development and a large number of offices, retail, and government jobs. There are three sizeable areas of mixed use and dense development outside the central core: Hialeah, with high density of retail and residential density, North Miami Beach, and Sweetwater.

Elsewhere in the city, densities are lower, but areas of mixed uses are widespread. Many areas along Dixie Highway have some mixture of use, due to the integration of the continuous commercial corridor with the moderately dense neighborhoods nearby.

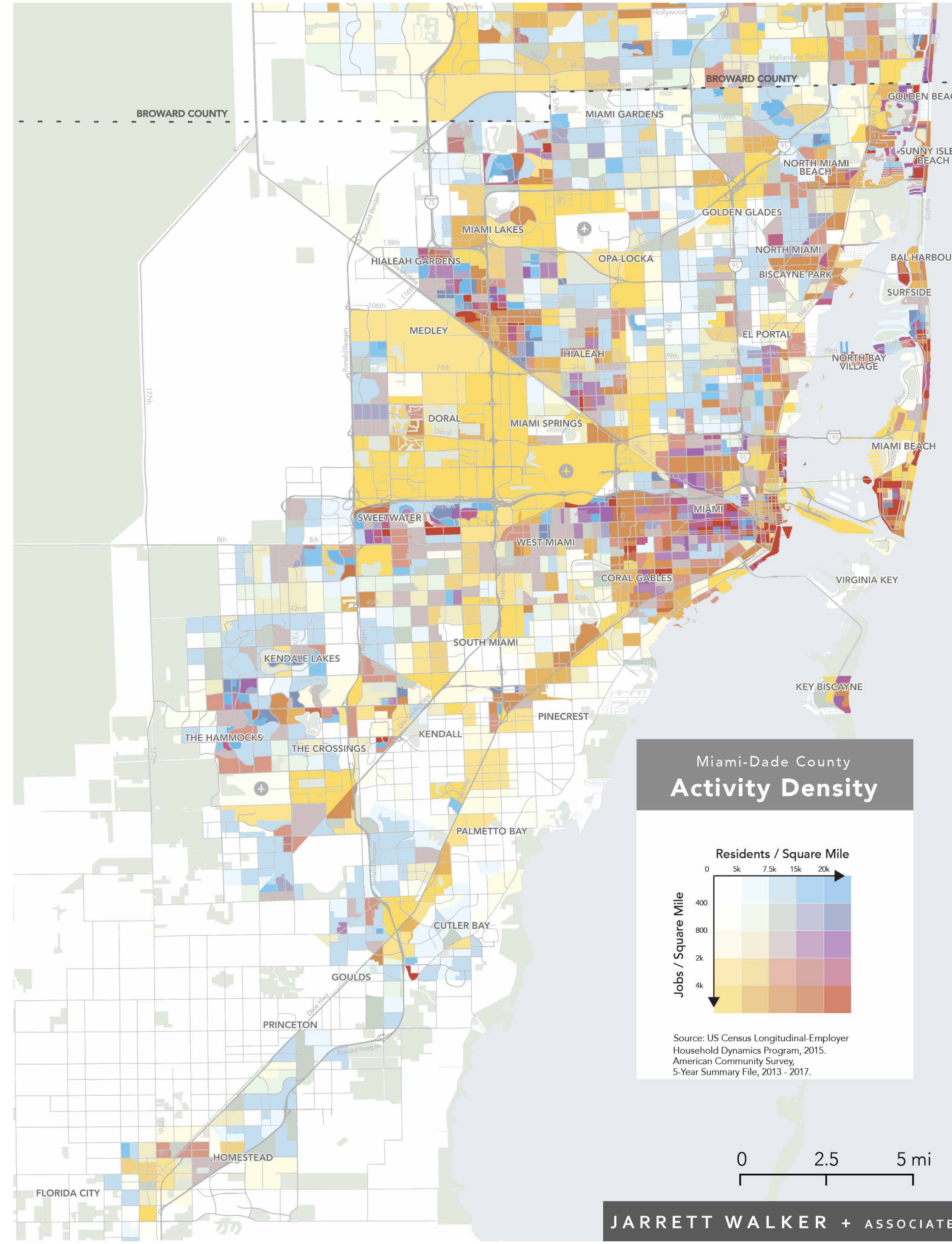


Figure 17: Miami-Dade Activity Density by Block Group

Market: Density and Ridership

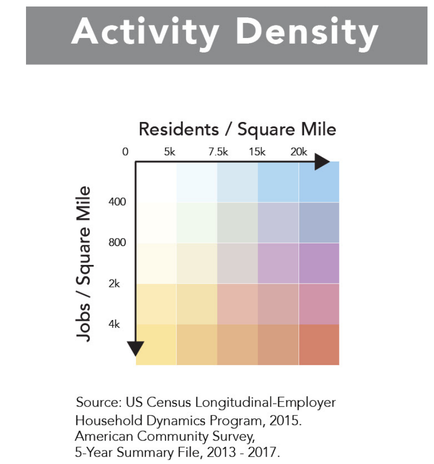
Density Drives Ridership

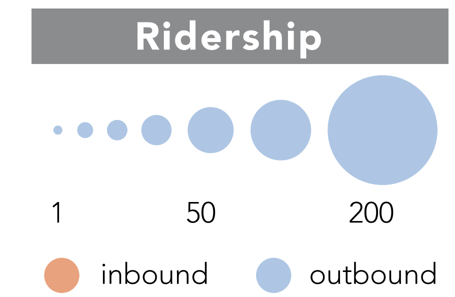
Route 24 presents an typical example of the relationship between density of activity and ridership potential. Figure 18 shows both the activity density (seen previously in Figure 17) and the number of weekday boardings at each stop on MDT Route 24 as it runs west from Vizcaya Metrorail station through Coral Way, Coral Gables, and Coral Terrace.

From Vizcaya Metrorail station to SW 42nd Ave, Route 24 traverses a relatively high density part of the City of Miami in the Coral Way neighborhood, as shown by the darker red and yellow areas on the map. Here the larger dots show that about 30-50 people board each weekday at each stop.

Around Granada Boulevard, in the western half of Coral Gables, the density drops dramatically, as shown by the much lighter colors in that part of the map. In this area average boardings at each stop are around 3-10 per weekday. Farther west, the density increases in Coral Terrace and average weekday boardings are about 10-30 per weekday at each stop.

The relatively high number of boardings at stops in the Coral Way neighborhood is also impressive given that the City of Miami runs a free trolley at about the same frequency as Route 24 from Ponce de Leon Boulevard into Downtown Miami. Thus ridership within Coral Way is even higher than what is shown in Figure 18, but it cannot be mapped since the City of Miami does not currently have complete data on ridership by stop.





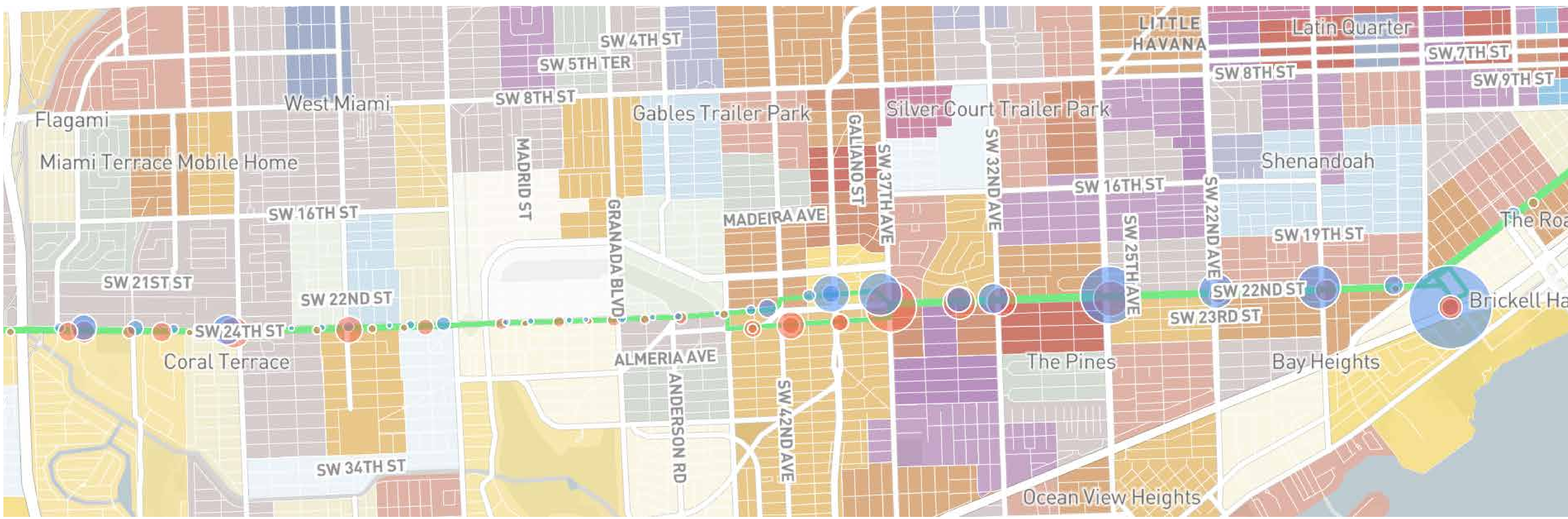


Figure 18: Route 24 through Coral Way, Coral Gables, and Coral Terrace with boardings by stop and activity density.

Market: Walking Access

Street Connectivity Is Essential to Walk Access

Density indicates how many people are in the fixed area around a transit stop, but walkability determines how many can actually walk to the stop. If you are near a stop but can't walk to it, often because of barriers such as roads that are unsafe or impossible to cross or disconnected streets, you might as well not have service at all. When the pedestrian environment is unsafe or walk paths are long and circuitous, transit is often required to make long deviations to reach the places where people are trying to travel, increasing the cost of operating the service and the length of trips for anyone riding through.

Walkability has several components:

- Connectivity of the street network;
- Availability of safe crossing points for major roadways, and signal timing of pedestrian crossings;
- Quality of pedestrian infrastructure and suitability for people with different levels of personal mobility.

The most straightforward of these to evaluate without conducting time-intensive data collection is the first: connectivity of the street network. The direct market of a transit stop is often described in terms of the half-mile radius around the stop. Yet not all places within a 1/2-mile radius circle of a bus stop can be accessed within a 1/2 mile distance along the street network. The design of the street network forces you to walk along the edge of blocks around buildings, around disconnected residential cul-de-sacs, or around large shopping centers. And thus you may only be able to reach 50% of the area of the circle within a 1/2-mile walk. We measure the actual area that you can reach within a 1/2-mile walk and call this measure the "effective walk radius" of a stop.

Figure 19 provides an illustration of this measure of walkability for a selection of locations in Miami-Dade. In locations with well-connected streets in a grid network, a characteristic diamond-shaped walkable area appears, for example from Government Center Metrorail station or from downtown Coral Gables. In these places, up to 70% of the area of the 1/2 mile circle is actually accessible within a 1/2-mile walk.

In other areas, where the street network is less connected, a much smaller portion of the 1/2-mile circle area is actually accessible within a 1/2-mile walk. For example, it is impossible to walk west of Biscayne Boulevard from Aventura Mall because the railroad corridor blocks access.

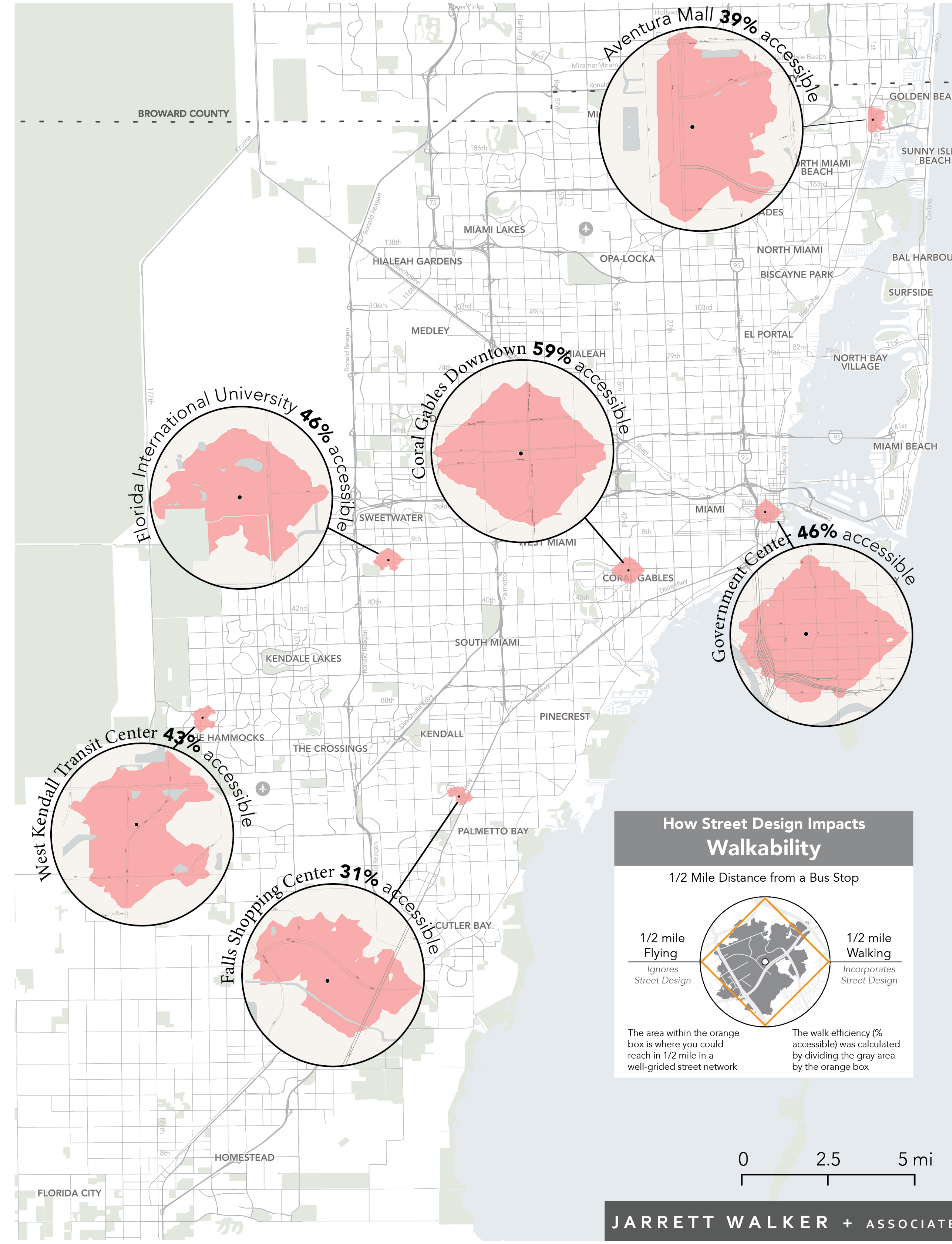


Figure 19: Walkability in Miami-Dade

Market: Walking Connectivity

Where is walk connectivity high or low?

While the map on the previous page illustrated transit access walksheds for a selection of locations around Miami-Dade, the map shown at right uses the same method to evaluate the connectivity of the street network for all areas in the county. From the center of each hexagon on the map shown in Figure 12, the effective 1/2-mile walk area was calculated. The hexagons are shaded by the portion of 1/2-mile radius covered by the resulting walkshed. On this map, the darker the hexagon is, the more the street connectivity makes walking distances shorter; the lighter, the more likely it is that walking distances are longer due to disconnected streets. This methodology does not capture other factors that may affect walkability, like safe crossings and the quality of the built environment.

Connectivity is highest and most continuous in the well-connected, grid street network in the City of Miami and adjacent cities and neighborhoods. The small block length and complete grid combine to produce the walk area that resemble the "diamond-shaped" images shown on the last page, where over 60% of the circular 1/2-mile radius can be reached along the street network.

Walkability is lower in outlying smaller cities and suburban neighborhoods, as a result of common features of suburban development, such as circuitous and disconnected streets. Many subdivisions are disconnected from neighboring development or are fragmented by highways, usually because there are simply no streets linking one area to the next one. Some of these areas are penetrable on foot, but the path used to traverse these places is more circuitous than in the better connected core areas of the county.

Three key areas stand out in comparing walkability and density: Kendall, Doral, and Miami Lakes. All three of these areas have relatively high density for outlying suburban areas. Yet each also have relatively low street connectivity. Therefore, while these areas have the density to support higher levels of transit, the lower level of walkability keeps transit from reaching its full ridership potential.

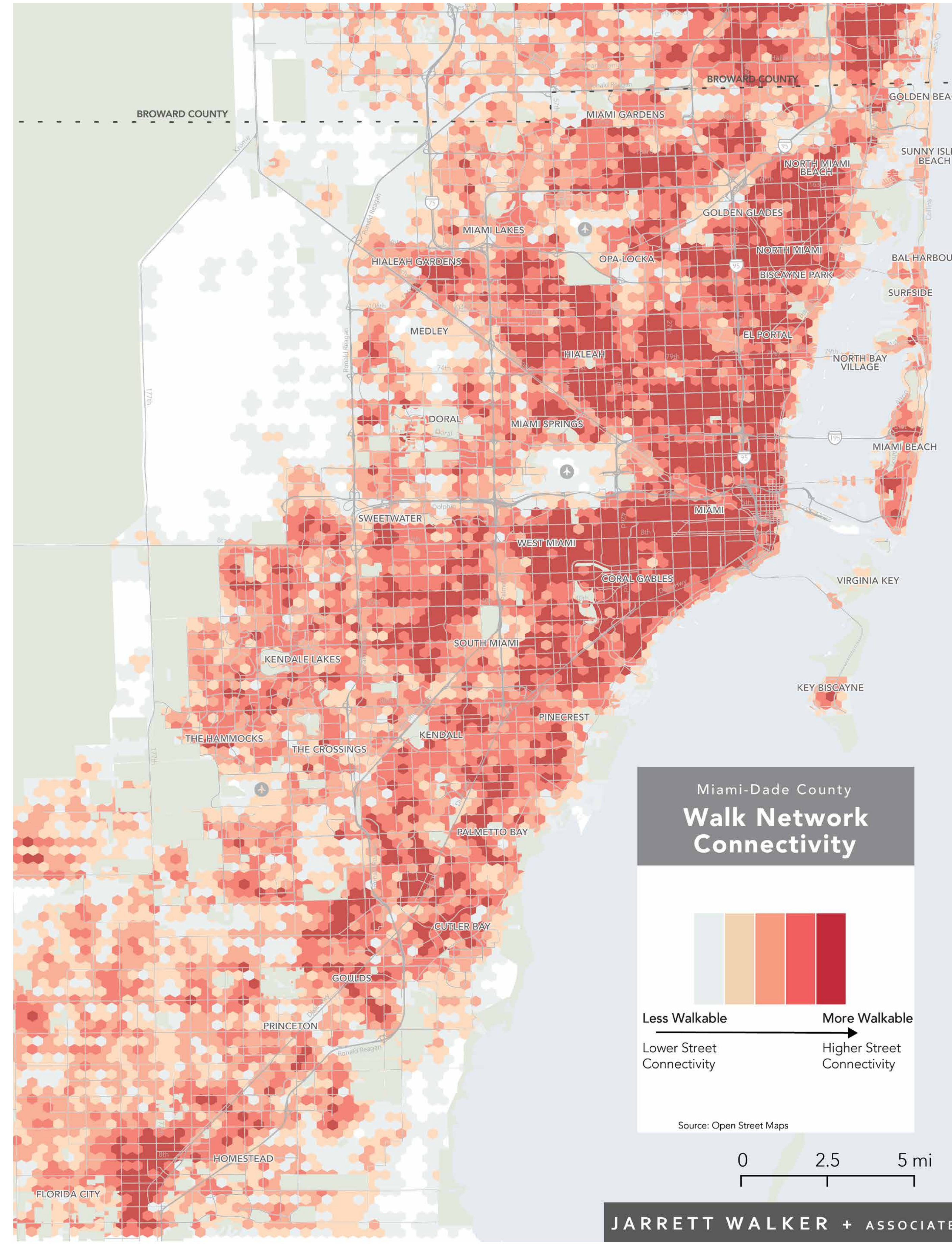


Figure 20: Miami-Dade Walk Network Connectivity

Need: People with Low Incomes

Poverty Density

Income is important to transit on both ridership and equity grounds, as well as for the goal of improving access to jobs. When people from a diverse range of incomes use transit it is a sign of a useful and healthy transit system. Yet, low income people are more likely to find transit a good option in the context of their choices, so it is logical to focus on their needs to a degree, purely in pursuit of ridership. Still, income matters less to ridership than the sheer quantity of people who are near service, which is measured by density and walkability.

In addition, access to low income people can be justified on the grounds of equity, in addition to the widely shared goal of improving access to jobs. Low income people are more likely to struggle to access the opportunities (jobs, education, quality food) that they need in order to prosper.

If transit isn't actually useful for the type of trips people need to make, in a reasonable amount of time, even lower-income people will not use it. If other viable options are available, even if those other options require personal or financial trade-offs, such as driving a worn-out vehicle that breaks down frequently, or relying on friends and family for rides, low-income people will choose those options rather than rely on transit that isn't useful or reliable.

Figure 18 shows the density of households under the 200% Federal poverty level in Miami-Dade. Overall the distribution of poverty is higher north of downtown Miami. This area of the city has a higher concentration of African-American communities living in medium or high density residential areas. Besides this area, the most extensive concentrations of households in poverty are found in Coral Way, Sweetwater, South Miami Heights and Homestead along the Dixie Highway. Most of these areas are served by infrequent routes (25 minutes or more), while affluent areas like Miami Beach are served by more frequent routes. Some areas of dense poverty, such as the areas around Florida International University, have high percentages of relative younger population and college students, who earn little income but may have other means of support.

It is important to notice that most of the areas with high levels of poverty are also areas where there is a high residential density. This represents a key opportunity to offer better transit to a significant number of people while improving the access to jobs and activities of those who need it the most.

In addition, understanding where low-income populations are located is key to adhering to the Federal Transit Administration's Guidance regarding the Executive Order on Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (1994), referred to as Environmental Justice (EJ). This Executive Order requires transit providers to incorporate environmental justice and non-discrimination principles into transportation planning and decision making processes as well as environmental review for specified initiatives.

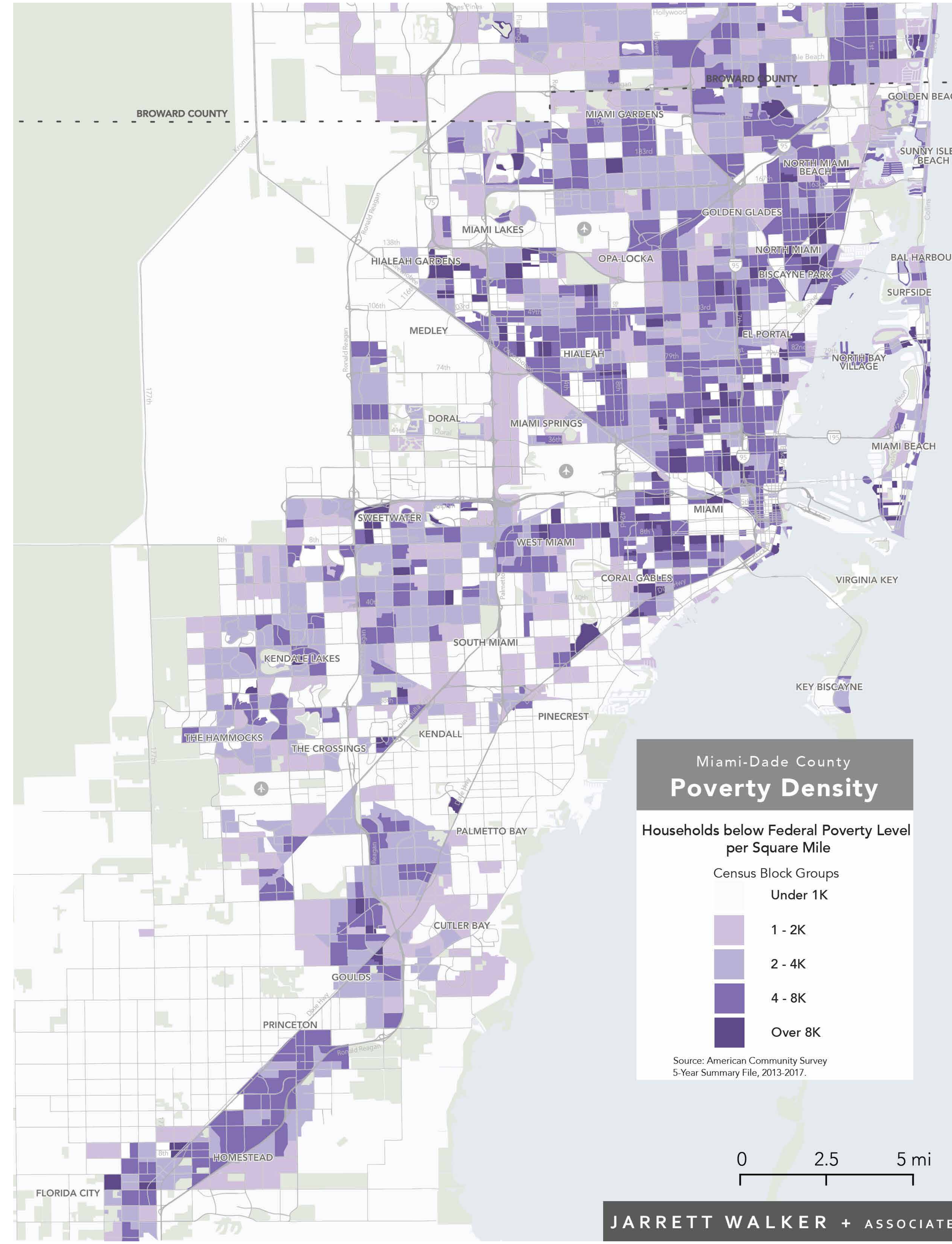


Figure 21: Miami-Dade Density of Households under 200% Federal Poverty Level

Need: People without Cars

Zero-vehicle Household Density

If you don't own a motor vehicle you are more likely to use a range of other options, including transit. This does not mean you are dependent on transit, or that transit agencies should take your ridership for granted. People without cars usually have a range of options for different kinds of trips, including cycling, walking, using ridesharing services, or arranging rides with family and friends. If transit doesn't meet their needs, many can also buy cars, which appears to have been happening in some US cities.

Still, because the pricing of car travel tends to make it cheap to drive once you own a car, people without cars are easier to attract to transit, so it makes sense to care about where these people are. Figure 22 shows where there are concentrations of households without a car. Overall, the concentration of households with zero vehicles is very similar to the concentration of households under the poverty level. Clusters of people with no car are north of downtown Miami, with other clusters in Sweetwater, and Homestead along Dixie Highway.

The cities of Miami and Miami Beach tend to have a high density of people living in a household with zero vehicles. These cities are served by frequent bus service (15 minutes or better), making it easier to live in those areas without needing to own a car. Downtown Miami, Brickell, and South Beach all have high density of households without cars.

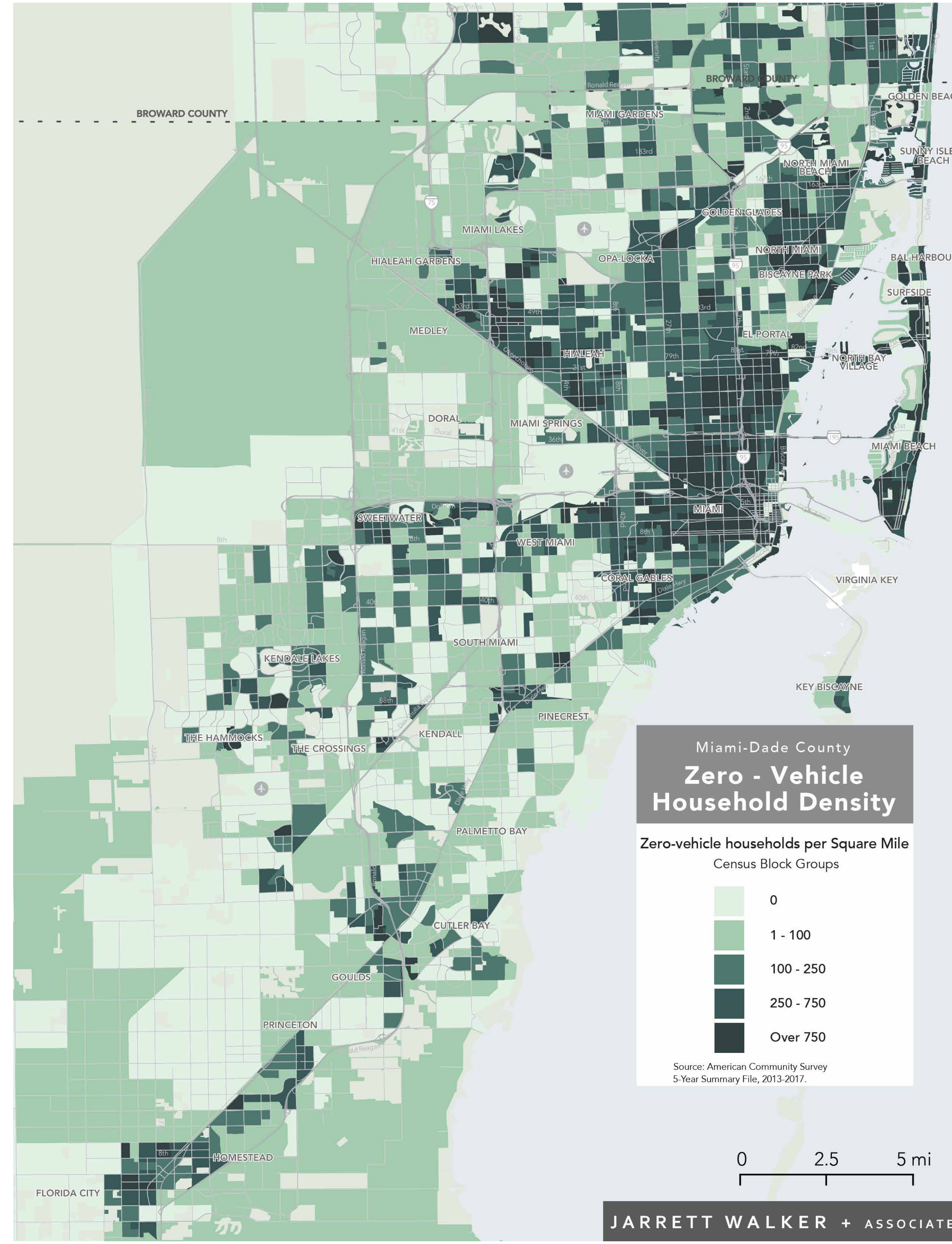


Figure 22: Miami-Dade Zero-Vehicle Household Density

Need: Race and Ethnicity

Racial and Ethnic Concentrations

While information about people's income tells us something about their potential interest in or need for transit, information about ethnicity or race do not alone tell us how likely someone is to use transit. However, avoiding placing disproportionate burdens on people of color, through transportation decisions, is essential to the transit planning process. Transit agencies are also required by Title VI of the Civil Rights Act of 1964 to ensure that services they provide do not discriminate on the basis of race, color or national origin.

Equity-based transit goals are often articulated in terms of improving mobility or transit access for people of color, particularly in places where the existing development patterns and transportation network contribute to disparities in access to jobs and other opportunities.

Miami-Dade shows a diverse distribution of races across the county. Figure 23 shows the distribution of people by race and ethnicity across Miami-Dade. Each dot represents 25 residents. Where many dots are very close together, the overall density of residents is higher. Where dots of a single color predominate, people of a particular race or ethnicity make up most of that area's residents.

The Hispanic population is shown as orange dots and the African-American population in green dots and make up the most significant racial or ethnic concentration throughout the region. 65% of the population identifies as Hispanic, 17% as Black (non-Hispanic) and a 15% as White (non-Hispanic). There is a clear spatial differentiation in the location of these groups: there is a sizeable cluster of African-American communities north of I-195 and east of NW 27th Avenue. The Hispanic population is concentrated in the City of Miami, west and south of downtown, and in Hialeah and Hialeah Gardens. High concentrations of Non-Hispanic White population are found in Miami Beach and the Brickell area of Miami.

2. American Public Transportation Association, "Who Rides Public Transportation", January 2017.

3. US Census American Community Survey, 5-Year Summary File 2017.

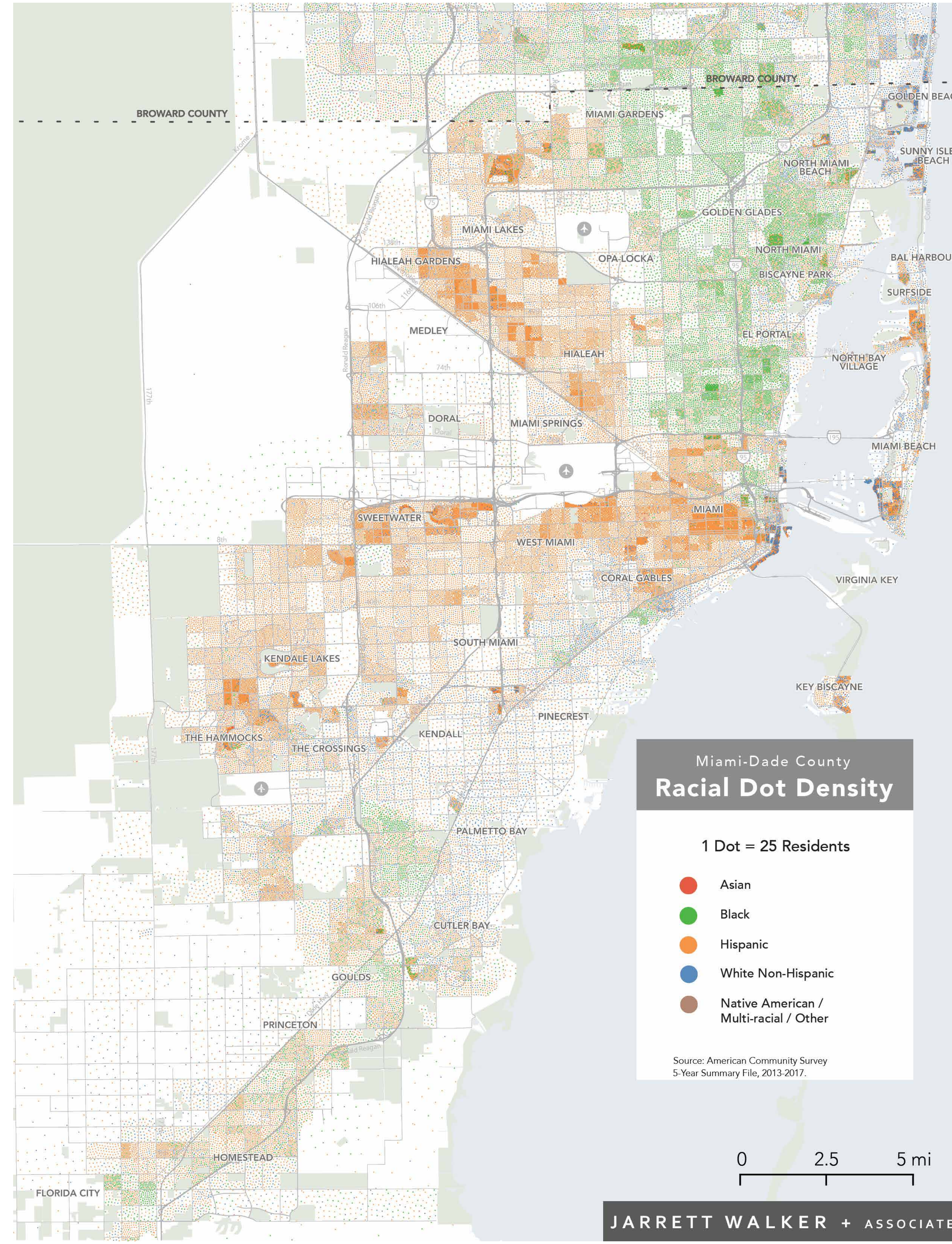


Figure 23: Miami-Dade Racial and Ethnic Dot Density

Need: Seniors

Density of Seniors

Seniors (persons age 65 and above) are an important constituency for transit. Overall, senior-headed households are less likely to own cars than the general population. Furthermore, people over the age of 65 are much more likely to have a disability than the general population, although many disabilities do not necessarily impact the ability to drive.

While seniors are an important constituency for transit, they often express demands that conflict with those of the broader population. The most efficient transit networks rely on customers to walk, and sometimes to change buses. On average, seniors tend to be more dissuaded by these things than other passengers, for understandable reasons.

Seniors constitute around 16% of the total population in Miami-Dade, 4% lower than the State of Florida. There is a high concentration of seniors along the Flagler and SW 8th Street corridors stretching west from downtown Miami. The heaviest concentrations of seniors in the county are located in the City of Miami and Hialeah.

Some of these high senior density areas, such as those along Flagler or SW 8th Street, are proximate to the urban core and along linear paths that are relatively easy to serve with transit. Other areas, like Kendall Lakes, are much farther from the core and difficult to penetrate with transit, due to poor walkability.

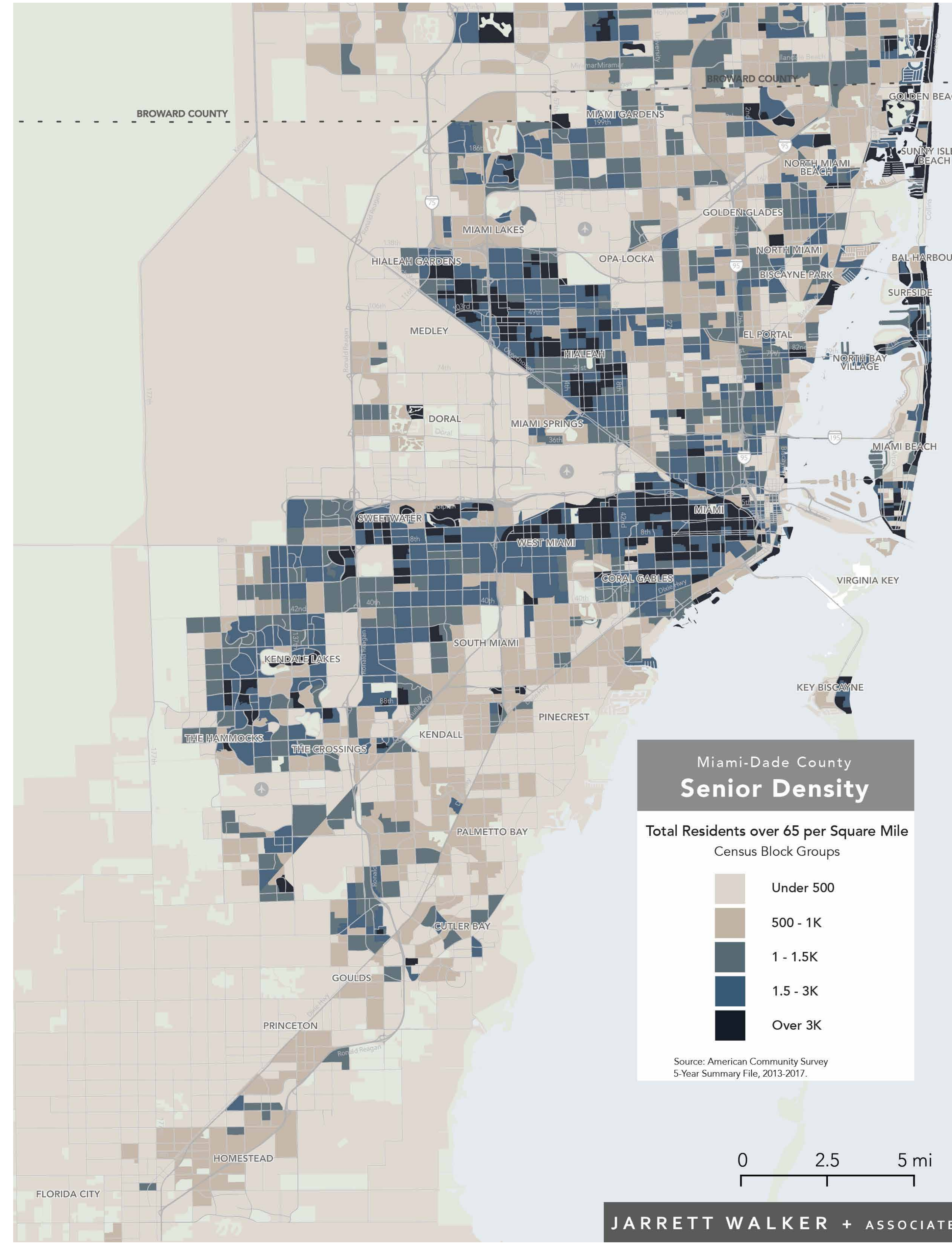


Figure 24: Miami-Dade Density of Residents 65 years or older

4 Existing Network and Outcomes

Existing Network

Figure 26 shows the existing bus network highlighting the frequency of service. Red lines are frequent routes, which means that they run every 15 minutes or better, in the midday and peak periods. Purple lines run about every 20 minutes, dark blue lines about every 30-40 minutes and light blue lines are the least frequent, 41-60 minutes.

We use this style because frequency is a critical element of service, and a network can only be fully understood if the patterns of frequency are apparent. We have categorized each route based on its midday frequency, which is the typical frequency of service between 10 am and 3 pm. The frequency of service on many routes is higher in the peak periods (generally 6 am to 9 am and 3 pm to 6 pm).

The Miami-Dade bus network covers nearly all developed parts of the county. During the midday there are only a few high frequency bus routes mostly serving Miami and Miami Beach. **Only five Miami-Dade routes or corridors are frequent (15 minutes or better) at midday.** Trolley routes operated by municipalities are shown with a dark outline. Only five trolley routes are frequent at midday.

On the mainland, much of the Miami-Dade bus network is designed in a grid pattern, with most bus routes following the major, section-line streets that are about every 1/2 mile. For example, in Little Havana, Routes 7, 11, and 8 each run east-west on while routes 12, 17, 22, and 27 each run north-south. Each of these streets is about 1/2 mile apart, and thus most people and jobs in this area are within 1/4 mile of a bus stop that could take them north-south or east-west.

If a rider wishes to go somewhere along this grid of routes, it *would* be easy to go from nearly any two points on the grid with one transfer, as show in Figure 25, **if the frequency of service were high enough to make these connections quickly and easily**. The grid of routes is not consistent across the whole county, however. West of 27th Avenue and south of SW 8th Street, not all section-line streets have a bus route, so route spacing may increase to every mile or more. Also, north of NE/NW 79th Street, the grid is not as consistent due to gaps in the street or bus network.

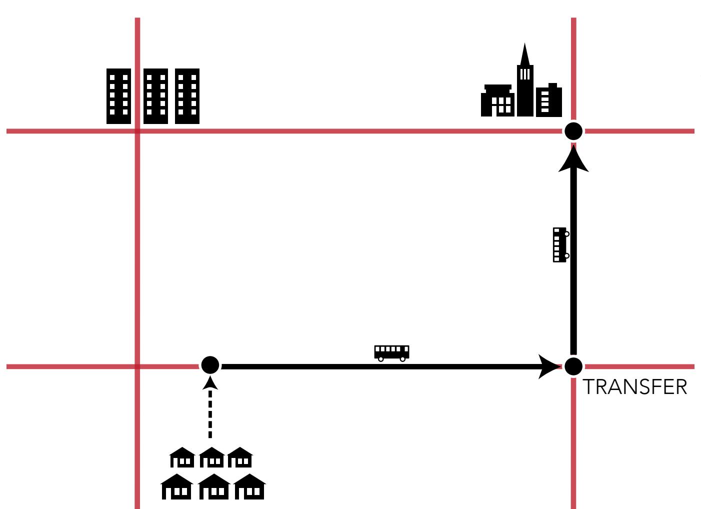


Figure 25: A grid network is a highly efficient way to connect any two destinations across a large area with a multitude origins and destinations.

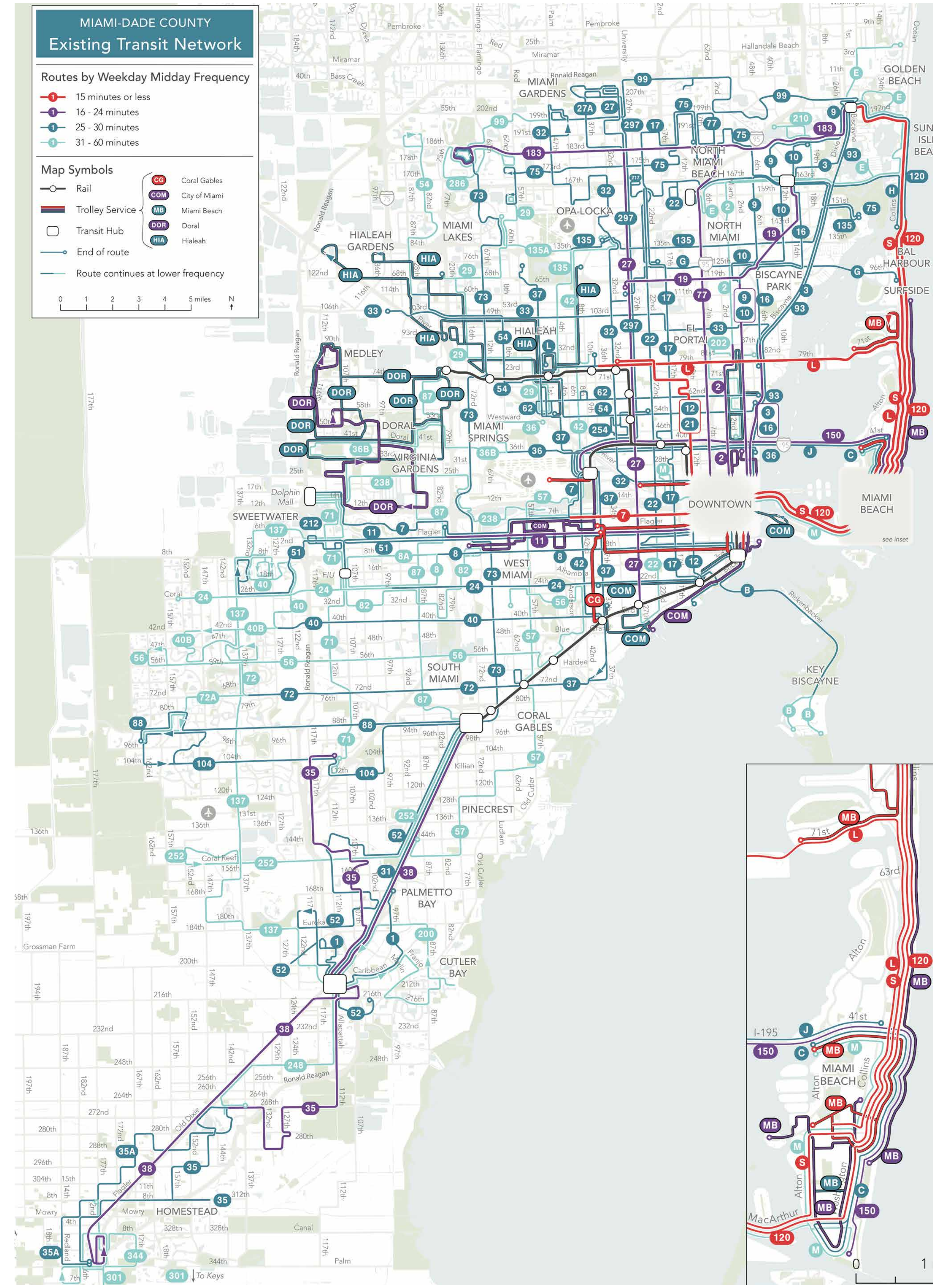
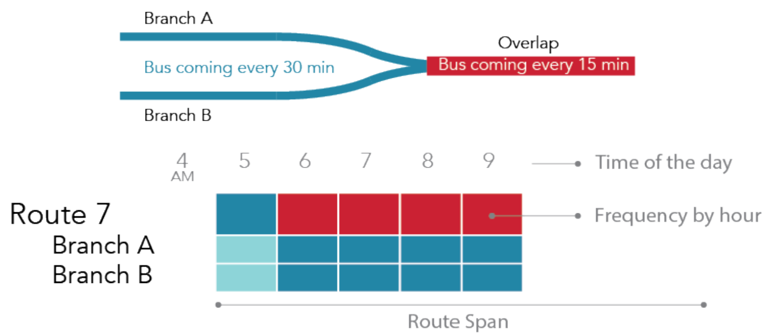


Figure 26: Existing Bus Network in Miami-Dade

Frequency and Span

Figure 27 shows the frequency by time of day for the most frequent routes in the Miami-Dade Transit network and the municipal trolleys. The example below shows how to use the network map and these charts to understand the span and frequency of service for every route.



The example shows a route with a bus every 15 minutes on the "Overlap" portion and a bus every 30 minutes on "Branch A" and "Branch B". The span chart shows how to read the frequency by time of day. In the example, Route 7 starts operating at 5am, with service every 30 minutes on the "Overlap"—the dark blue square under 5am. Each branch operates hourly during this time. At 6am the branches are every 30 minutes and the "Overlap" is every 15 minutes.

For the MDT routes in the high frequency groups on this page, service is provided late into the night, and often overnight, and seven days a week. Many municipal trolley services, however, do not run in the evenings or parts of the weekend.

- Miami's Little Havana and Allapattah trolleys are frequent, but do not run after 8pm on weekdays and the Allapattah trolley does not run Sundays.
- Miami's Biscayne and Brickell trolleys run every 20 minutes, but run weekends and evening hours. The Flagami, Health District, Stadium, and Wynwood trolleys have shorter hours and no Sunday service.
- The Coral Gables Trolley is frequent, and runs weekday evenings, but does not run on Saturday or Sunday.
- Miami Beach Trolleys are primarily every 15 or every 20 minutes and have evening and weekend service.

The lack of consistency in service levels into the evening and on weekends limits the ability of riders to rely on trolley services as dependable parts of the overall transit network.

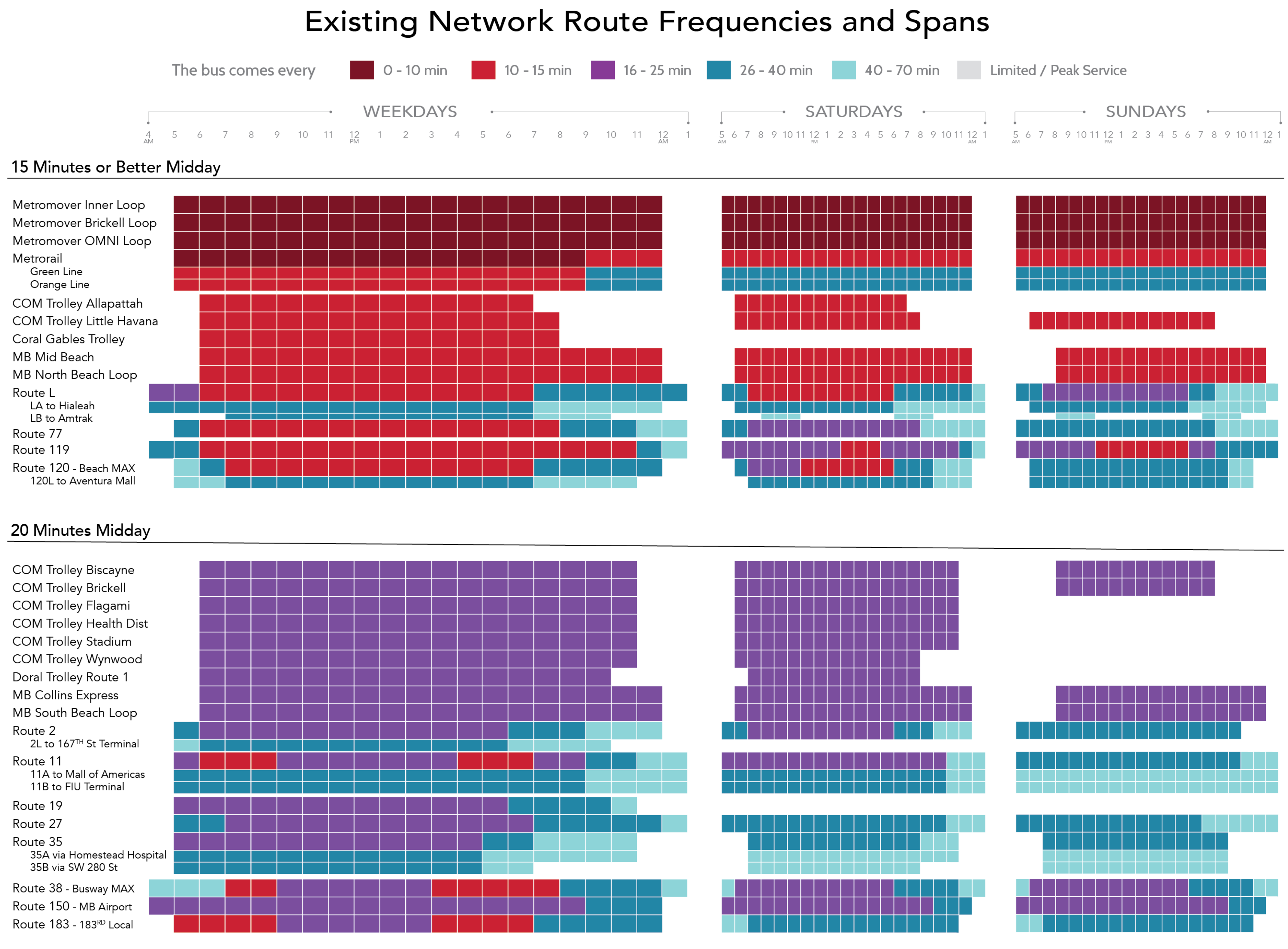


Figure 27: Frequency and Span of Routes with 20 Minute or Better Frequency at Midday

Figure 28 shows the frequency by time of day for routes that operate about every 30 minutes at midday in the Miami-Dade Transit network and the municipal trolleys. Of note is that many routes have higher frequency of service at peaks. As previously noted, this can cause inefficiencies in service delivery due to the extra costs of peak service. Also of note is how the frequency of service declines substantially in the evenings starting at 6pm or 7pm and many trolley routes disappear on weekends.

Evening and weekend service is relatively inexpensive to operate compared to peak period service, and it is also crucial to a large segment of transit riders. People who work in most retail and entertainment sectors have to work on weekends and often late into the evening. Having some transit then is important to making it possible for them to rely on transit at all.

Houston recently had great success with a network redesign that extended evening service and expanded Saturday and Sunday service to be the same level as weekday service, but without the peak period. In the first year of their new network, Saturday ridership increased 13 percent and Sunday ridership increased 34 percent.

We would like to recommend improved frequency in the evening and on weekends for Miami-Dade as part of the Better Bus Project network redesign, but without new resources it would require cutting the weekday network too deeply. Bringing evening and weekend service up to a similar standard to the examples noted above would increase annual costs by about 10–15 percent . Additional evening and weekend service should be a top priority for any new resources.

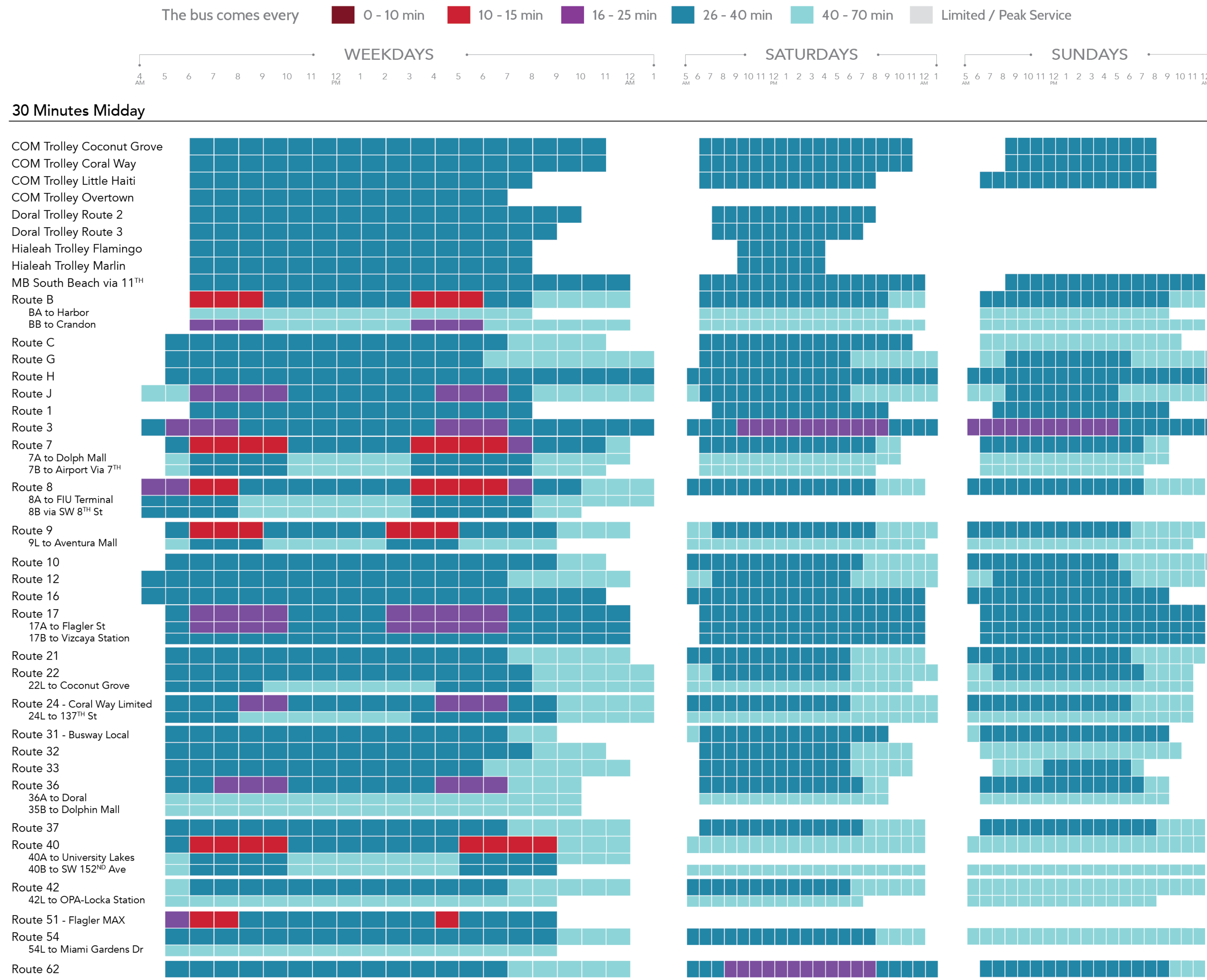


Figure 28: Frequency and Span of Routes with 30-40 Minute Frequency at Midday

Takeaway

Evening and weekend service is less costly than rush hour service and is a proven ridership generator in other cities.

Figure 29 shows the frequency by time of day for routes that operate about every 30 minutes or every 60 minutes at midday in the Miami-Dade Transit network and the municipal trolleys. Of note is that many of the circulator routes in the MDT network, such as routes 155 and 212, do not operate on weekends, making them less useful to many potential riders.

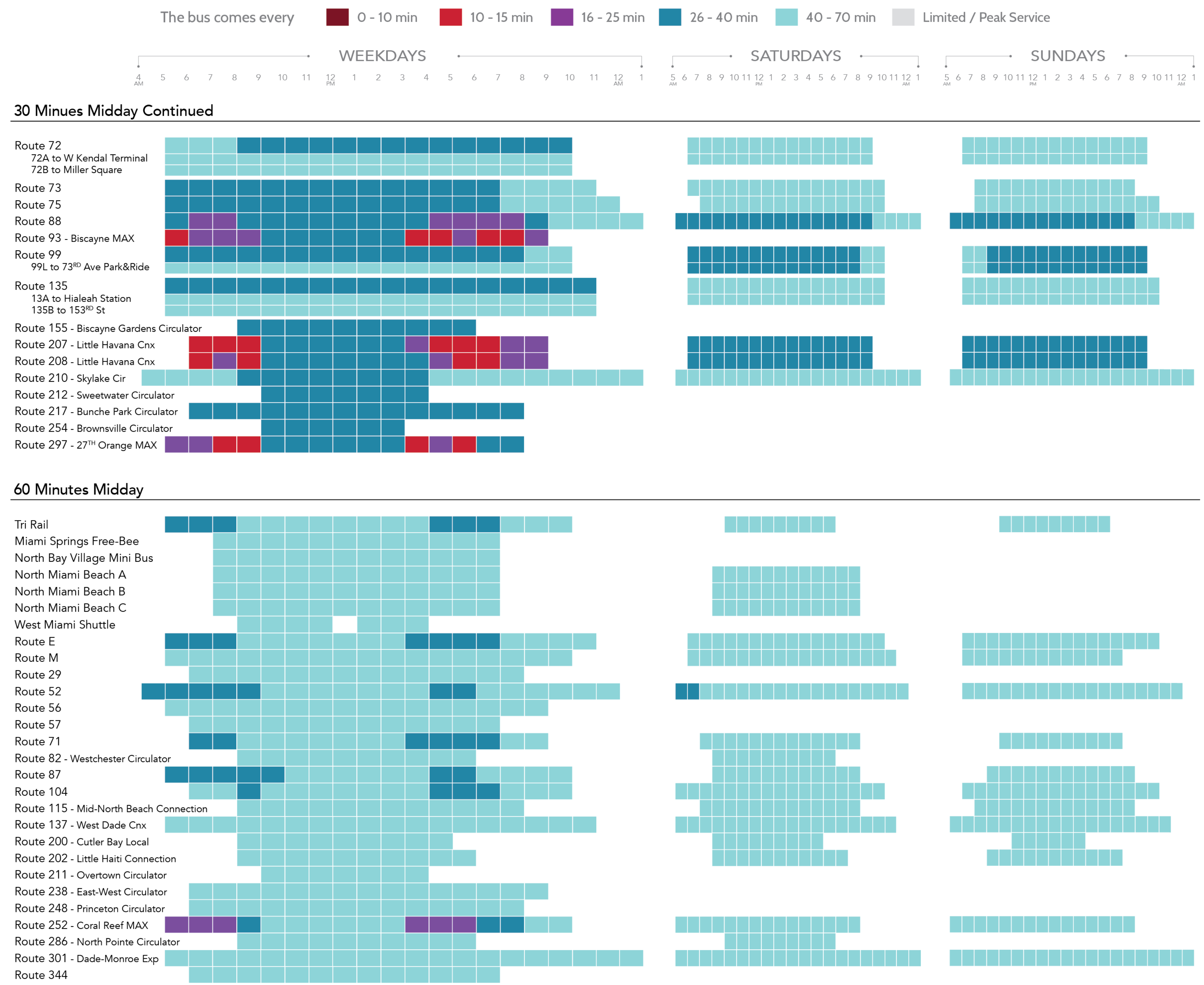


Figure 29: Frequency and Span of Routes with 30-60 Minute Frequency at Midday

Figure 30 shows the frequency by time of day for peak-only or limited trip routes in the Miami-Dade Transit network and the municipal trolleys. Note the many peak-only routes that operate at relatively high frequencies. This requires a lot of resources to be deployed in a relatively inefficient manner, as previously discussed.

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

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

In addition, anyone taking an evening class, pursuing a hobby, going to worship, or staying late at work to finish a report needs a bus ride home outside of the traditional 8-to-5 workday. Given the inefficiencies of peak-only service and the broader needs of non-traditional work shifts, it is worth questioning whether the costs of this substantial peak-only service are justified.

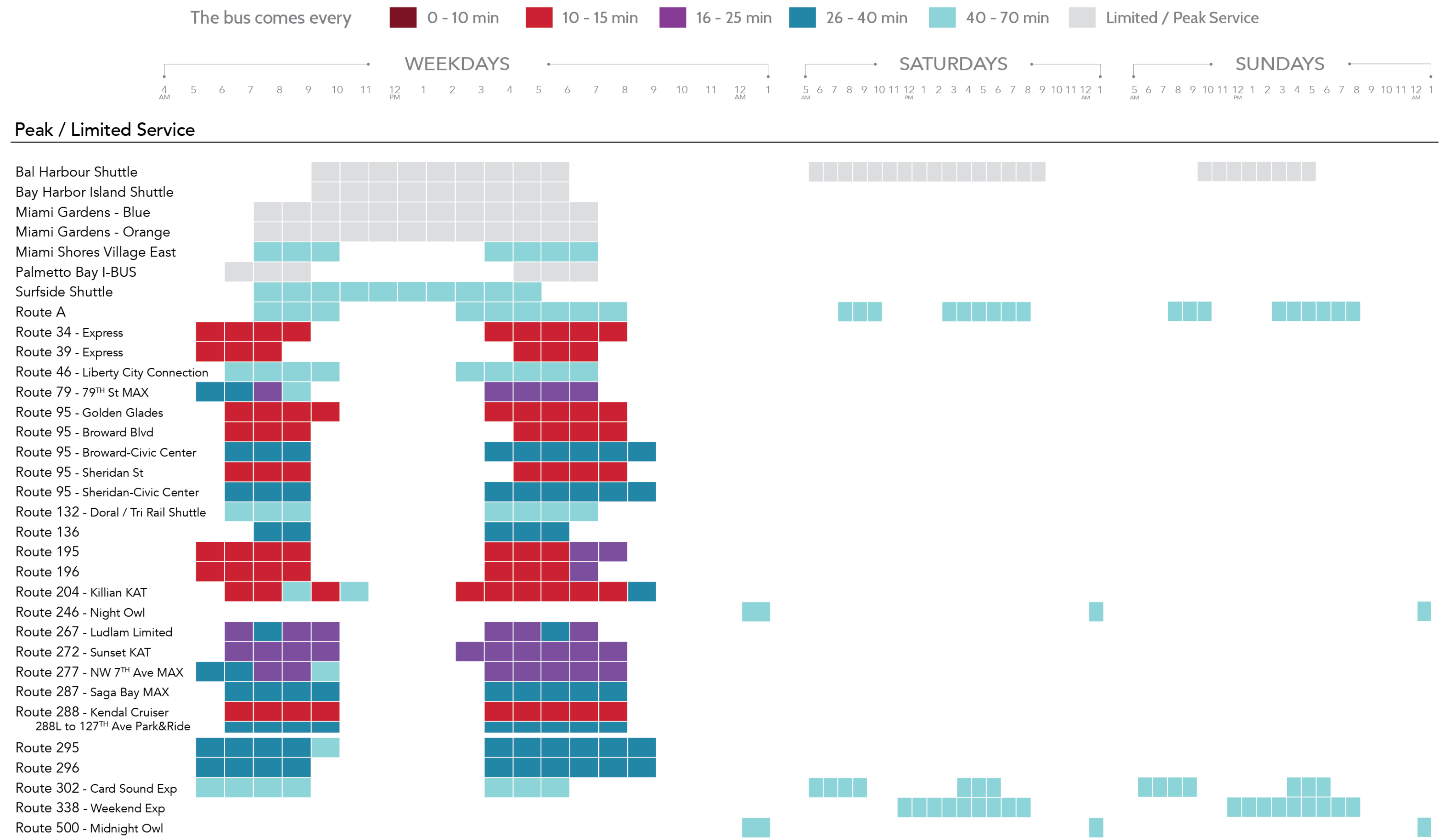


Figure 30: Frequency and Span of Peak-Only and Limited Trip Routes

On-Time Performance Systemwide

Given the low frequency of service in Miami-Dade, being on-time is critical to ensuring that the service that is available is useful. Unfortunately, **on weekdays four out of every ten buses are not on time**. On weekdays 31% of MDT buses are late and 12% are early.

The most common ways to measure bus service reliability is schedule adherence, measured by on-time performance. This measure counts the number of trips that meet the scheduled arrival at each stop within a given window of time, compared to all the trips on that route. MDT buses are considered on-time if the bus actually leaves no more than 1 minute before scheduled departure and no more than 5 minutes past the scheduled time of departure. By this standard, a bus that arrives at a time point 6 minutes late would be counted as late, but a bus that arrives 5 minutes late would be on time. Any bus that arrives early (MDT standard allows up to one minute early before counting an arrival as too early) is considered as not on-time and would count against this metric. This study is limited by the number of days included in the analysis (4 weekdays, 4 Saturdays and 4 Sundays), but helps to illustrate the governing pattern of the transit system reliability and to identify the main problems.

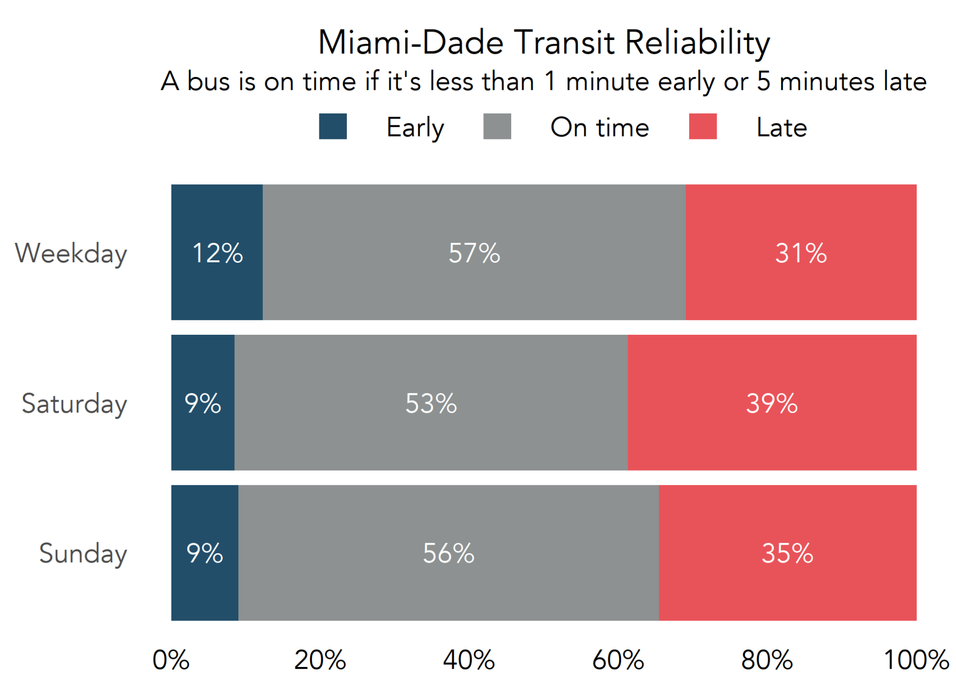


Figure 31: System wide On-time performance by day type

Figure 31 shows on on-time performance for the MDT bus system for weekdays, Saturdays, and Sundays for the period between mid-May and mid-June 2019. MDT performance standards call for buses to achieve a 75% on-time performance. As the figure shows, during a weekday, only 57% of the trips system wide were on time. Out of the 95 routes analyzed, only 2 were consistently on time.

Figure 32 shows performance standards by time of the day. Trips during peak hours tend to be less reliable than trips that run other times of the day. Buses operating during these periods experience variable travel times, resulting in unreliable service for people waiting at a stop.

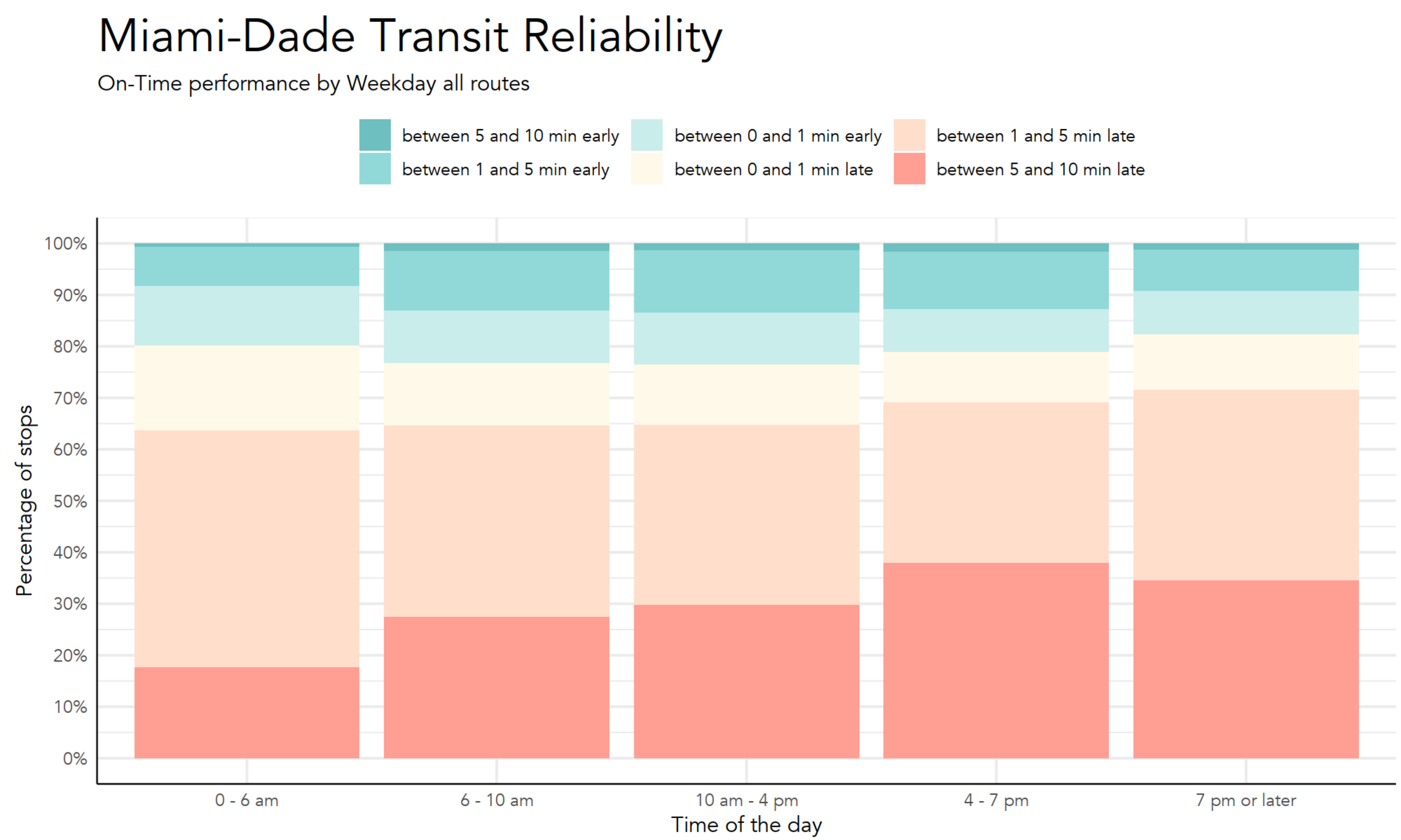


Figure 32: System wide On-time performance by time of the day (only weekday)

This raises a critical question in terms of frequent routes. For example, routes 11 and S achieve approximately 60% on-time performance. Yet the route is scheduled to operate at least every 15 minutes or better from 5 a.m. to 10 p.m. Earliness and lateness matter if somebody is really expecting a bus at a specific time, but on high-frequency services nobody has the need to rely on that. They just go out to wait for the next bus and trust that it will be along soon. The customer cares about waiting time, not earliness or lateness.

On-Time Performance by Route

Figure 33 attempts to measure the level reliability by each route. Overall, the vast majority of the routes don't meet the on-time MDT standards. More than half of the trips or Routes 132, 208, 248, 267, 277, and 297 were late by MDT standards. Most of the problems in these non frequent routes occurred during evening peak hours, when most of the people were traveling out of downtown Miami thus experiencing high levels of congestion. Imagine somebody trying to pickup his or her child after work. This many late pickups would make this person leave earlier so they can avoid missing the bus, adding wasted time to their day.

The routes with the best performance tend to be circulators, short routes and have fewer stops (e.g. 155, 211, 212, 286). On-time performance measures tend to be worse for routes with more stops (although no worse than routes running in peak hour). Long routes are more likely to encounter random delays from traffic, or multiple wheelchair pickups, or simply more passengers than expected. Closer stop spacing can cause delays by creating more opportunities for random delay from pulling in and out of traffic so often.

In a region as large and dense as Miami, the ability of transit to run quickly and reliably is most often the result of things outside the transit agency's control. The County, city, and state governments control multiple policies and enforcement priorities that can dramatically affect the speed and reliability of bus service. Streetscape design, signal timing, safe crossing locations, curb management practices, parking locations, parking enforcement, loading zone locations, and traffic enforcement all have enormous effects on reliable bus service. The County, cities, and the state also manage street priority by allocating lanes among competing uses. Overall, local and state government have as much control, if not more, over the success of transit than transit agencies, particularly in congested downtown places like Downtown Miami or South Beach.

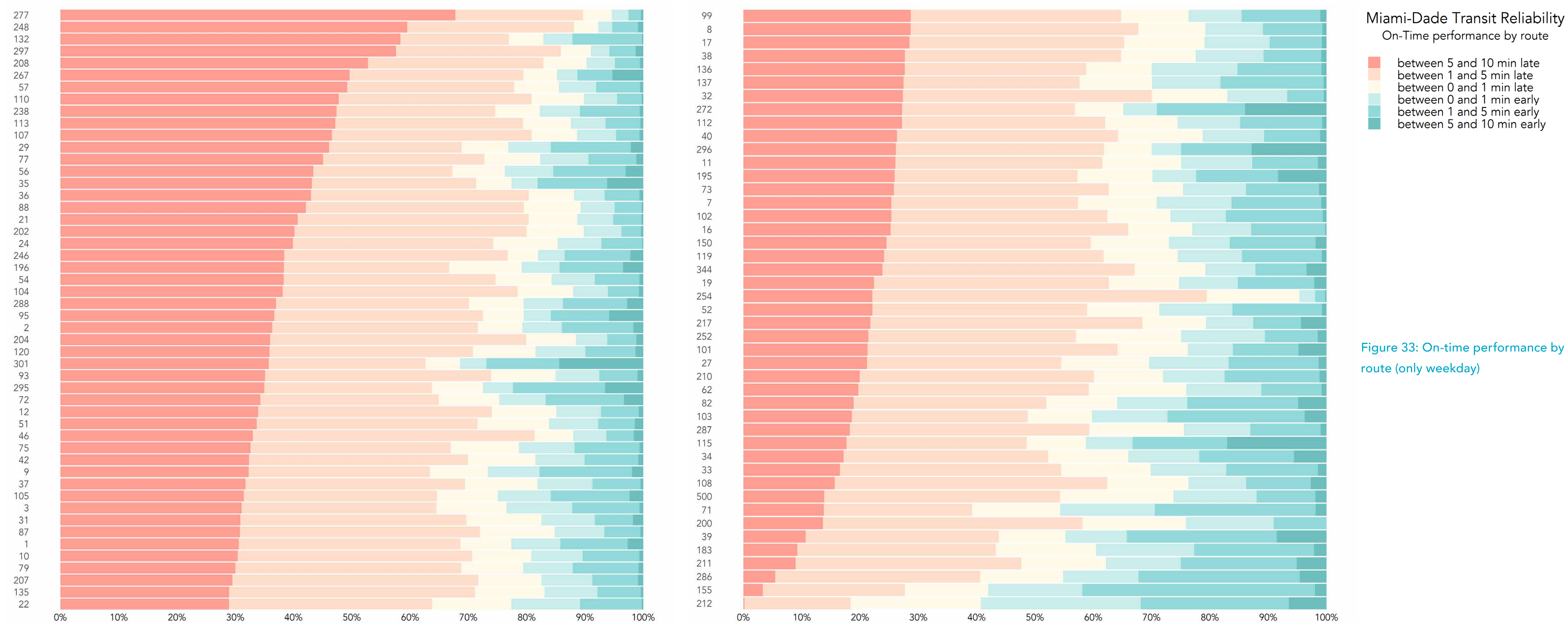


Figure 33: On-time performance by route (only weekday)

Proximity to Transit

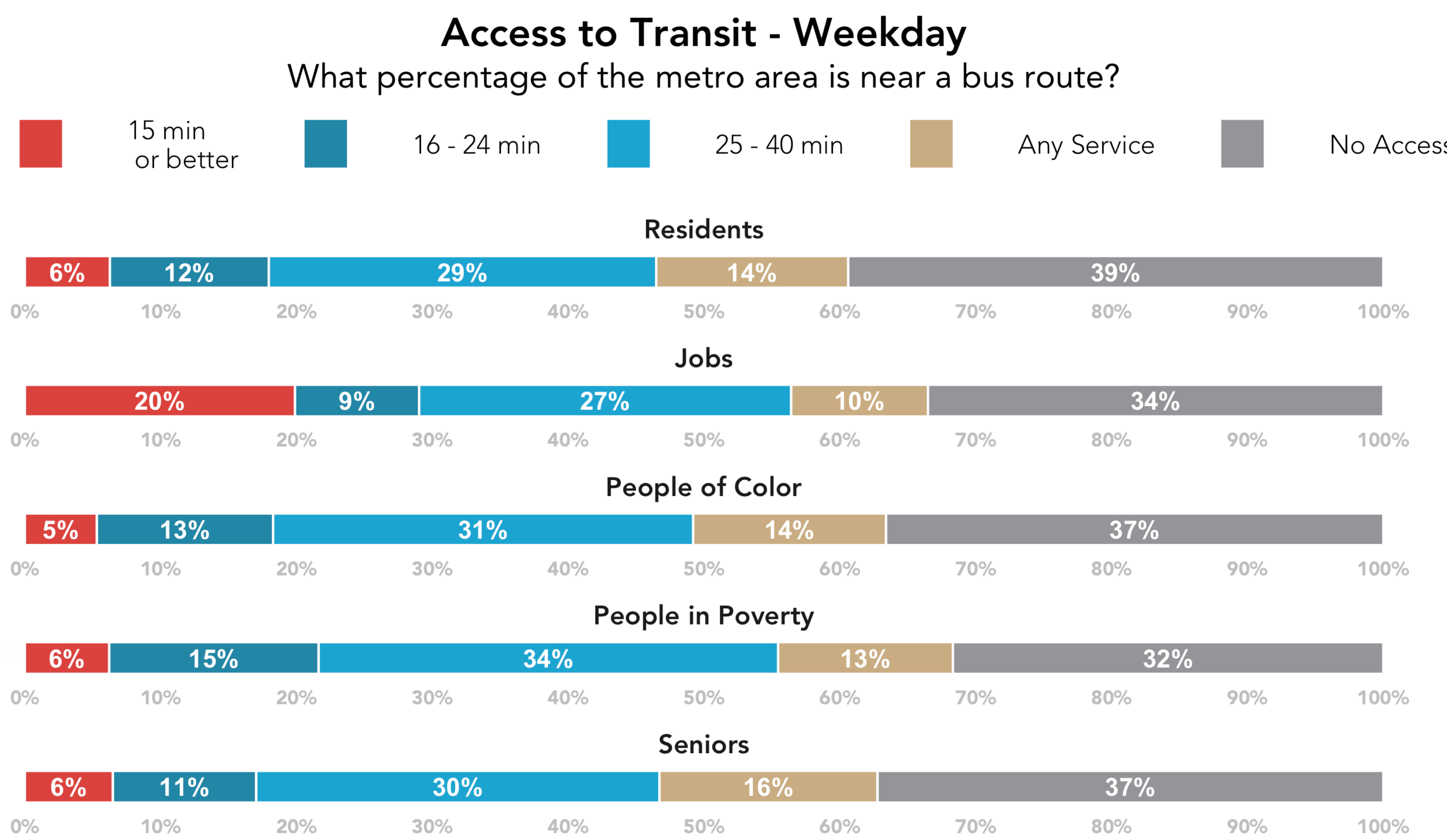
Overall the Miami-Dade transit network reaches most people and most jobs, with 60% of people and 68% of jobs within 1/4 mile of a transit stop. Yet because service is spread so thinly, into so many low frequency routes, only 6% of people are near a frequent route. Since jobs are more concentrated in the core, they are much more likely to be close to frequent service, with 20% of jobs near a frequent bus or train. Figure 35 shows the percentage of residents, people of color, people in poverty, and seniors near any service, and frequent service.

It is encouraging to observe the lack of racial disparity in how the existing network covers Miami-Dade residents. Non-white residents are a little more likely than all residents to be close to some transit service, though they are slightly less likely to be close to frequent transit. Low-income residents are more likely to live close to some service and are just as likely as an resident to be close to frequent service. Seniors are just as likely as an average resident to be close to frequent service or an service.

These conditions are not static and may change in coming years as a result of a changing economy and a changing city. If increasing housing demand near transit and in urban areas is not matched by increases in the supply of housing, then people living on low incomes may move to seek lower rents and property prices. Whether or not this is a consequence of growth and the desirability of urban, walkable areas depends on land use planning, growth permitting and affordable housing policies at local jurisdictions.

Takeaway

About 60% of residents are near any transit service, while only 6% are near frequent service.



Note: Access is measured as being located within 1/4 mile of a bus stop.

Figure 35: Percent of people, jobs, and disadvantaged people near transit service

Freedom and Access

People ride transit if they find it useful. *High* transit ridership results when transit is useful to *large* numbers of people.

A helpful way to illustrate the usefulness of a network is to visualize where a person could go using public transit and walking, from a certain location, in a certain amount of time.

The map at right shows someone's access to and from downtown, near Government Center Metrorail station, at noon on a weekday. Areas they can reach in less than 60, 45 or 30 minutes are shown in pink, red and purple, respectively. The technical term for this illustration is *isochrone.*

A more useful transit network is one in which these isochrones are larger, so that each person is likely to find the network useful for more trips.

In drawing these isochrones, time is allocated for walking to and from bus stops.

Isochrones account for time spent waiting for a bus or train (either at the start of the trip or at the destination), and any time required to make a connection to another line. As described earlier in this report, if someone is transferring to a route that comes every 60 minutes, and the connection is not timed and therefore at random, they will wait on average one-half of the headway: 30 minutes. The average wait for a bus that comes every 20 minutes will be 10 minutes. Thus a great deal of Miami-Dade Transit customers' travel time is used up by waiting for their bus (or waiting at their destination, because the infrequent bus gets them there too early).

Government Center has the best transit access in the region, because it is at the center of the most *frequent* parts of the transit network, where many bus routes converge and along the center of the Metrorail Orange and Green lines.

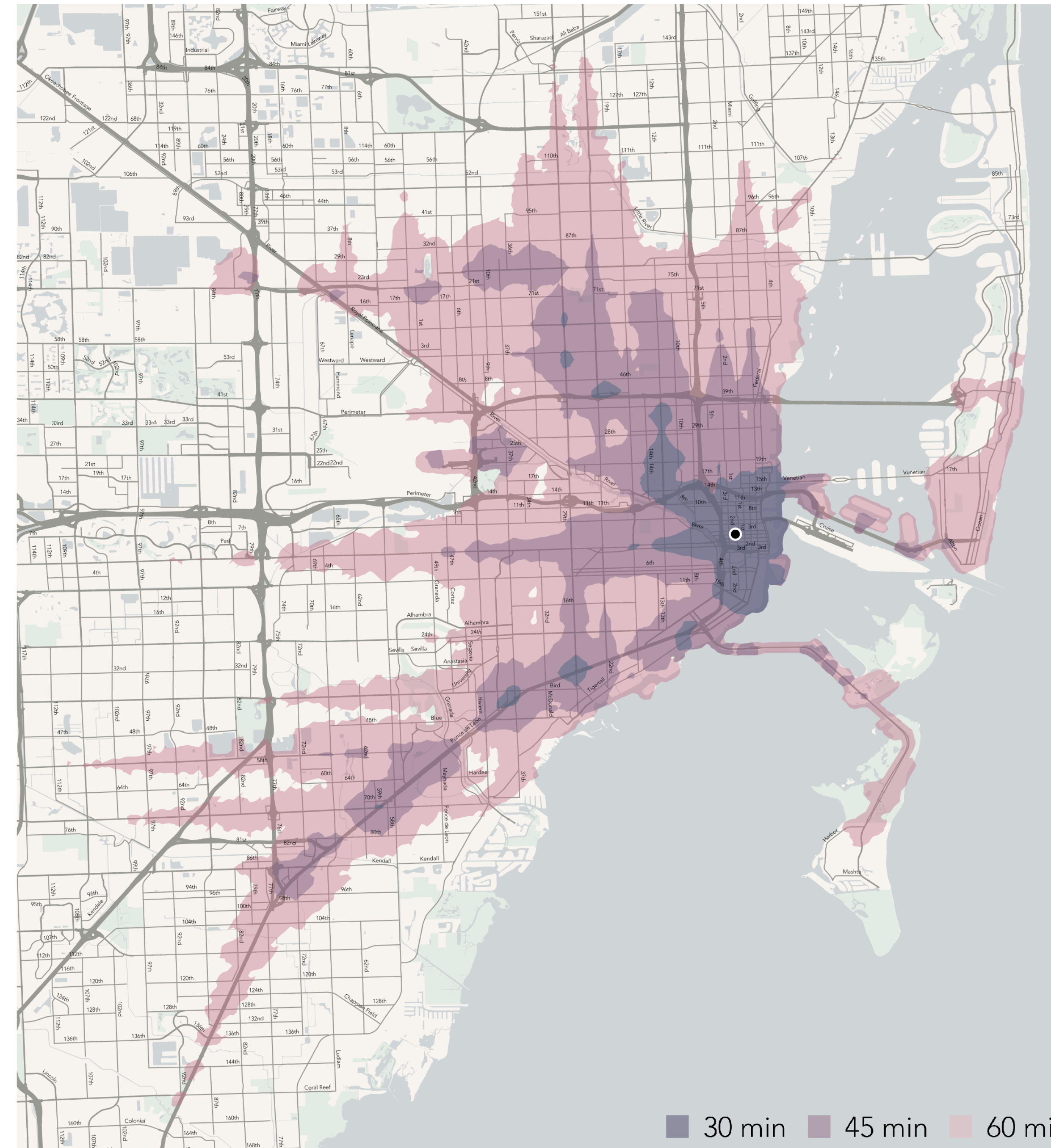
The power of Metrorail's frequency and speed can be seen in this isochrone. The Green Line to the northwest brings many neighborhoods within a 60 minute commute of downtown, with the far edge of the 60 minute area reaching Palmetto station. The same is true to the south, where Dadeland South Station is within 45 minutes.

Similarly, the power of frequent bus lines can be seen in this isochrone. The red "arm" extending down Flagler shows how far someone can get on Route 11, because they don't have to spend much time waiting. The pink blob extending up NW 27th Avenue is because the 20 minute frequency of Route 27 makes waits for a trip north towards Miami Gardens shorter.

How far can I travel in 30, 45, and 60 minutes from

Government Center

at noon on a weekday?



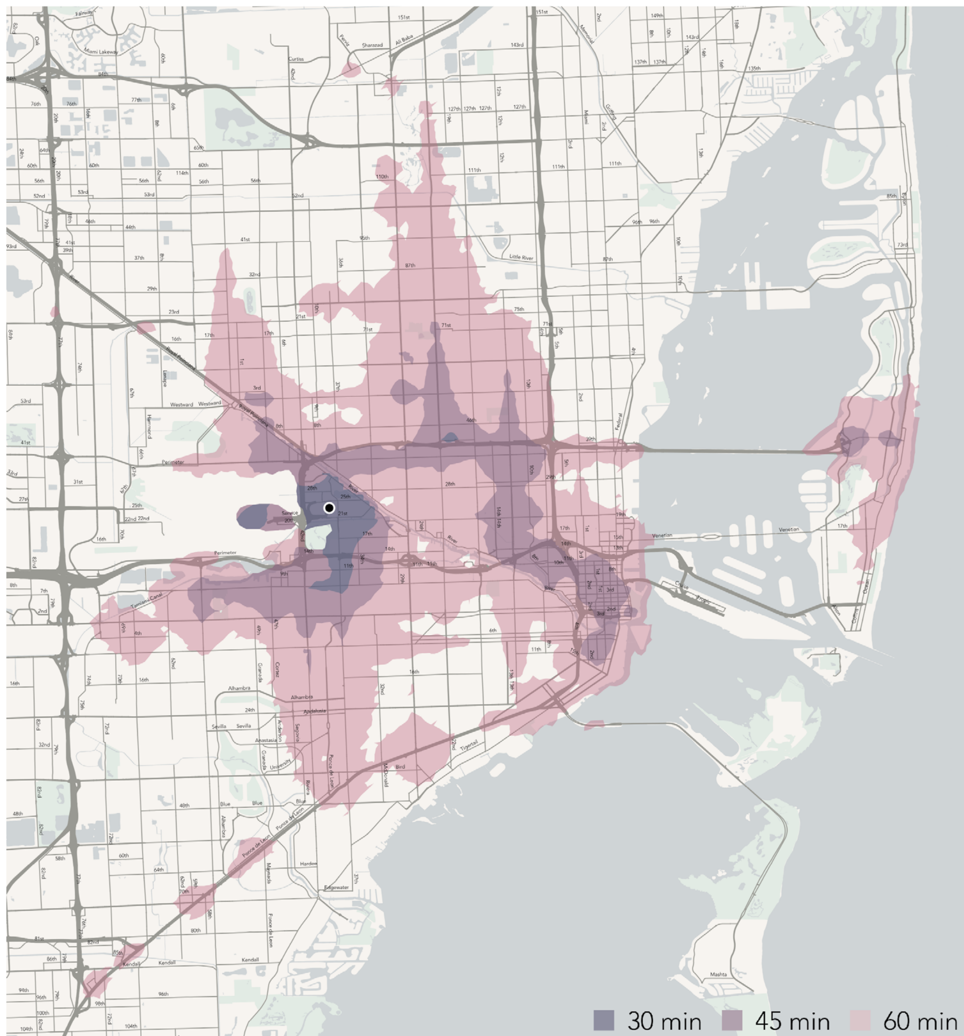
	30 minutes	45 minutes	60 minutes
Jobs Access	156,895	276,473	452,659
Resident Access	71,241	292,261	674,656

Figure 36: An isochrone shows how far someone can go, in a given amount of time, by walking and transit. Access to and from the Government Center within 30, 45 or 60 minutes of travel is illustrated here.

How far can I travel in 30, 45, and 60 minutes from

Miami Intermodal Center

at noon on a weekday?



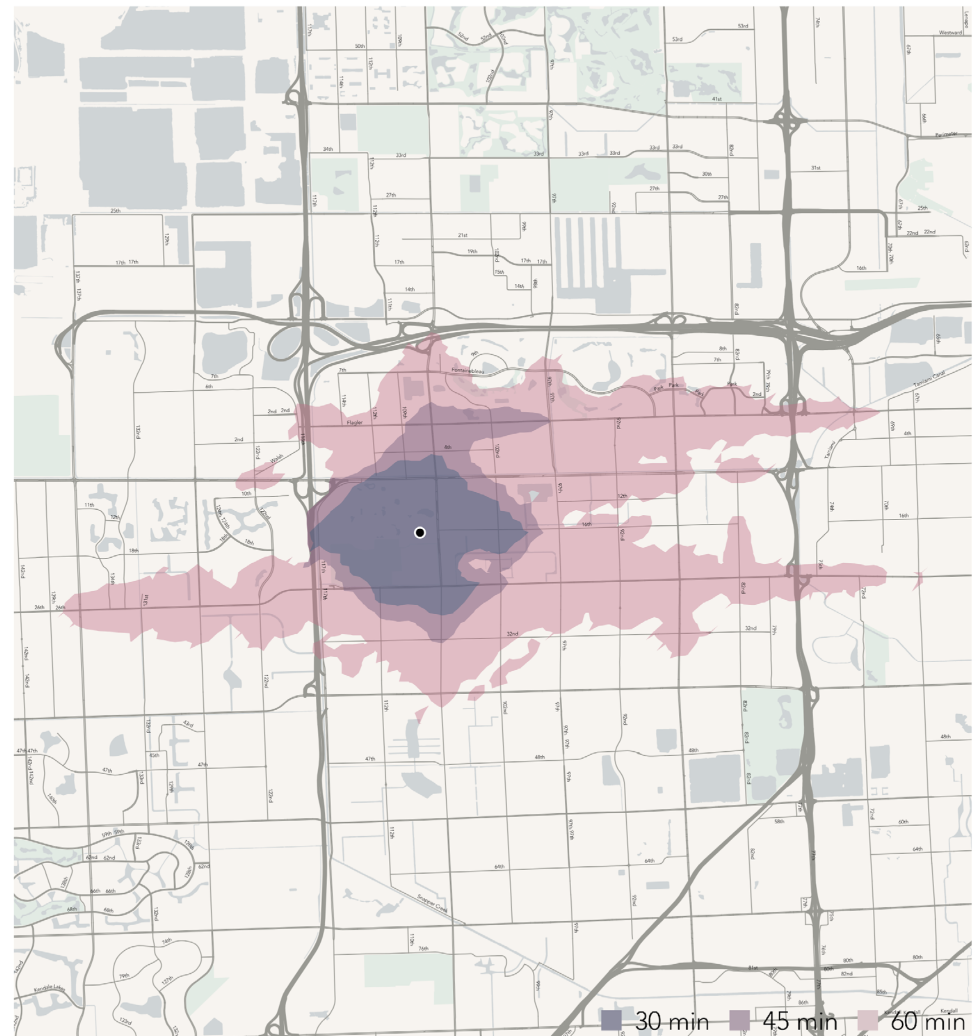
	30 minutes	45 minutes	60 minutes
Jobs Access	4,874	90,368	327,234
Resident Access	5,205	103,399	429,018

Figure 37: Access to and from the Miami Intermodal Center within 30, 45 or 60 minutes of travel.

How far can I travel in 30, 45, and 60 minutes from

Florida International University

at noon on a weekday?



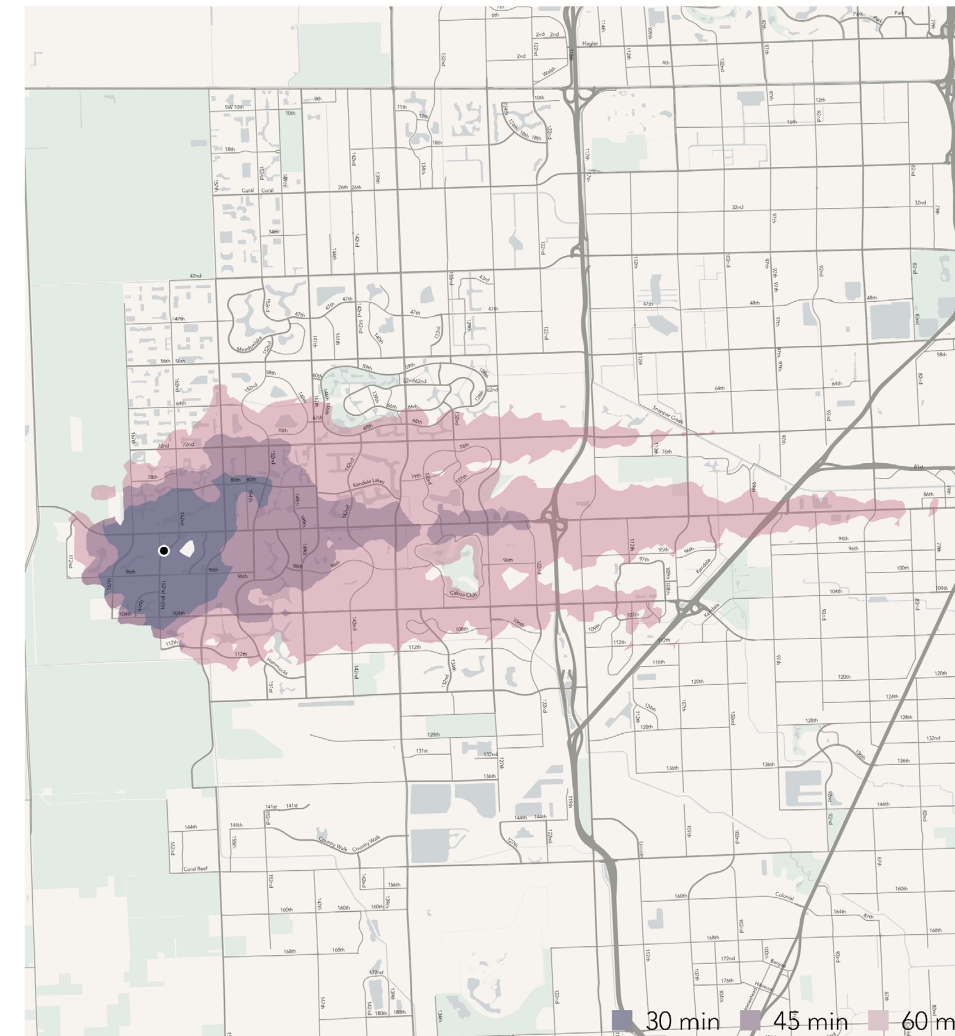
	30 minutes	45 minutes	60 minutes
Jobs Access	6,976	9,447	26,060
Resident Access	9,736	21,264	91,587

Figure 38: Access to and from Florida International University within 30, 45 or 60 minutes of travel.

How far can I travel in 30, 45, and 60 minutes from

West Kendall Transit Terminal

at noon on a weekday?



	30 minutes	45 minutes	60 minutes
Jobs Access	1,517	6,078	23,574
Resident Access	14,882	56,139	134,973

Figure 39: Access to and from Kendall Transit Terminal within 30, 45 or 60 minutes of travel.

Access to Jobs

Isochrones can show us the freedom and access for a given place. To see the total freedom a network provides across the entire county, it is possible to run the isochrone measure for nearly every place and display the results as a heatmap. Figure 41 shows such a result, specifically it shows the number of jobs that can be reached from each hexagon within Miami-Dade County. People who live in the darkest red areas can reach over 200,000 jobs in 45 minutes by walking and transit. In the lightest teal areas, residents can reach 1,000 jobs or fewer.

Much of the core areas of the City of Miami, Miami Beach, and Coral Gables are in the top three groups, where people can reach more than 50,000 jobs in 45 minutes. In South Dade, the power of the Busway can be seen in the relatively high accessibility of the Busway corridor as far south as Cutler Bay. Palmetto and Okeechobee Metrorail stations stand out with the dark red dots in a sea of orange and green. These stations provide high job accessibility to only the immediate area around them because the street connectivity is so poor and the frequency of connecting bus service is relatively low. Areas 1/2 to 1 mile away from these two stations get little to no job access benefit from being close to them.

Figure 40 shows the average jobs accessible for different sub-groups in Miami-Dade. The average resident in Miami-Dade can reach about 90,000 jobs by transit and walking in 60 minutes, as can the average person of color, and the average senior. The average person in poverty can reach about 110,000 jobs in 60 minutes, while the average person with no vehicle can reach about 180,00 jobs. Presumably, many people without vehicles are choosing to live near more frequent and useful transit to maximize their access to opportunities.

If Miami-Dade wishes to maximize its transit ridership, then a key goal would be to increase the number of jobs accessible to the average person, and it would do that by increasing the number of jobs accessible to the areas of the map on the right that have the most people in them.

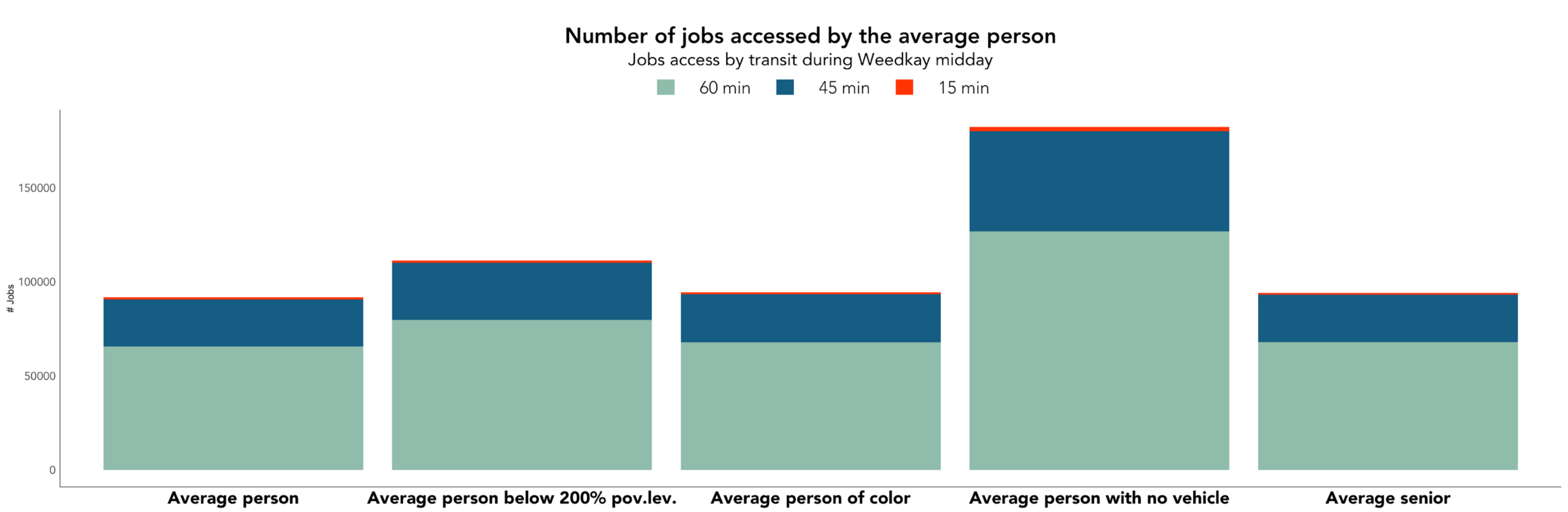


Figure 40: Jobs accessible in 15, 45, and 60 minutes by walking and transit for different groups in Miami-Dade

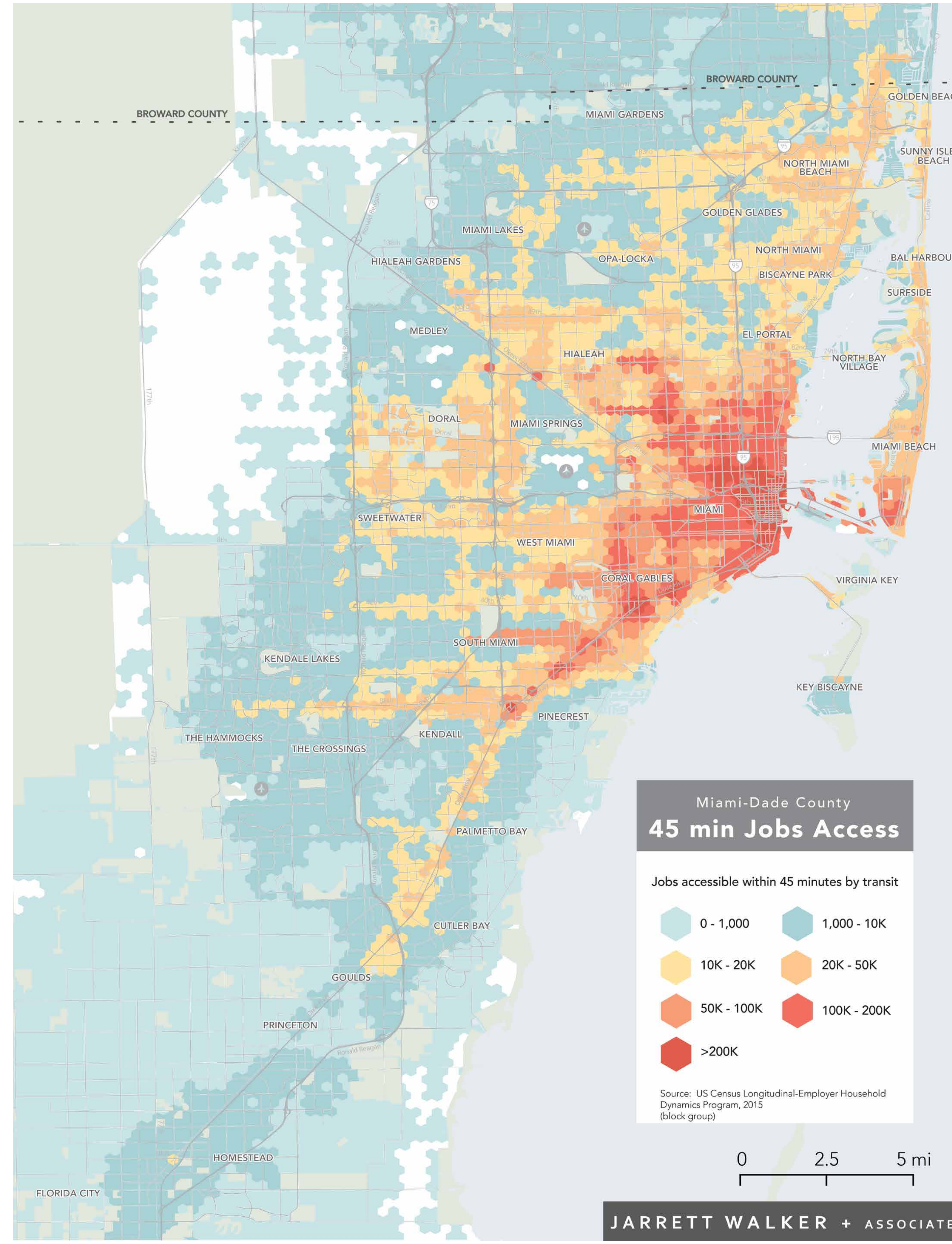


Figure 41: Map of Jobs accessible in 45 minutes by walking and transit for Miami-Dade

5 Transit Challenges and Opportunities

The Power of a Frequent Grid

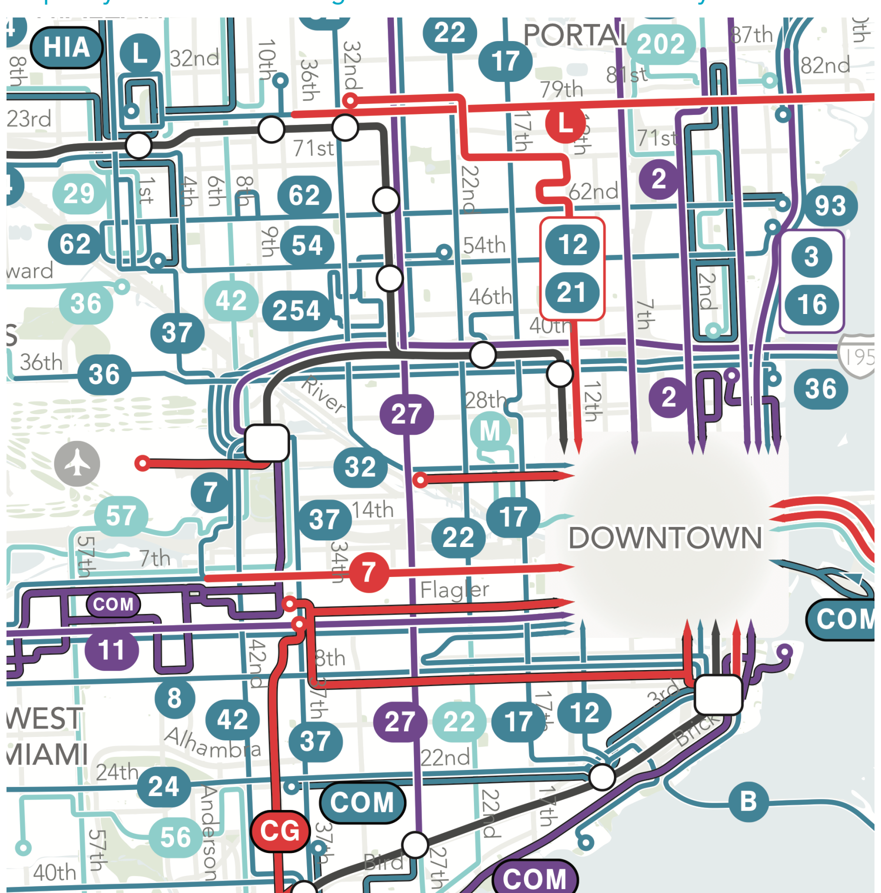
Frequent Grids Expand Access

While Miami-Dade has a network that is mostly designed as a grid, it lacks the frequency to create easy and reliable connections for most transfers between the grid routes. Thus, making connection between grid routes requires a long and uncertain transfers.

In cities with many centers (such as LA, Chicago or Houston) a frequent grid allows people to travel from-anywhere to-anywhere with a single fast transfer. A frequent grid offers the simplicity and reliability of a street network—you can use it just about anytime, without checking a schedule or making an advanced plan. However, they depend on high frequency, because they depend on transfers.

To maximize the usefulness of the grid in the core of the system, Miami-Dade would need to increase the frequency of service on most of these grid-oriented routes. In order to do that, MDT would have to either cut many routes outside the primary grid in the core, or raise additional revenue for additional service.

Figure 42: The core part of the Miami-Dade network is designed as a grid, but lacks the frequency of service to make grid connections reliable and easy for riders.



To understand the importance of frequency in determining the usefulness of a trip across a grid network, consider the examples from a fictional network of the same trip at 15 minute frequency versus 30 minute frequency shown in Figure 43. In the top example, the total trip takes 45 minutes, consisting of the following parts:

- **A 7.5 minute wait at the beginning of the trip** at 40th Street and 10th Avenue. Waiting time is on average half the frequency (or headway). For an every 15 minute route, if a rider walks out to a stop at a random time, their wait is in the range of 0 minutes (if they walk up as soon as the bus arrives) to 15 minutes (if they arrive just after the bus leaves). Thus, on average a rider will wait 7.5 minutes.
- Travel time on the first bus is **20 minutes** to go 40 blocks.
- **Waiting time to transfer is 7.5 minutes** at the intersection of 40th Street and 50th Avenue.
- Travel time on the second bus is **10 minutes** to go 20 blocks.
- Thus **total travel time is 45 minutes** and total waiting time is about one-third of the total trip time.

In the bottom example, the only difference is that each route operates every 30 minutes, instead of every 15 minutes. This change has an enormous effect on total travel time, as it doubles waiting time at both the beginning of the trip and at the transfer point.

- Waiting time at the origin and at the transfer point is now 15 minutes each, **increasing total wait time along the trip to 30 minutes**.
- Travel time on the bus is the same.
- Now **total travel time is 60 minutes** and total waiting time is half of the total trip time.

Since most routes in the grid-oriented part of the Miami-Dade bus network consists of 20, 30, 40, or 60 minute routes, wait times to transfer can be long, making travel times across the network much longer than they would be if the frequency of service were higher.

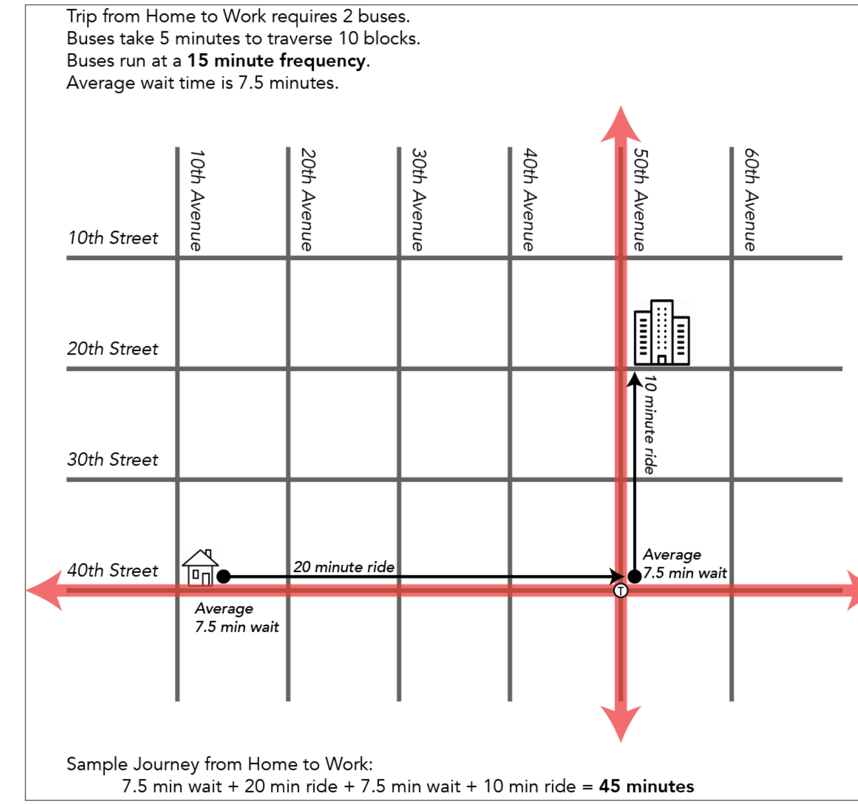
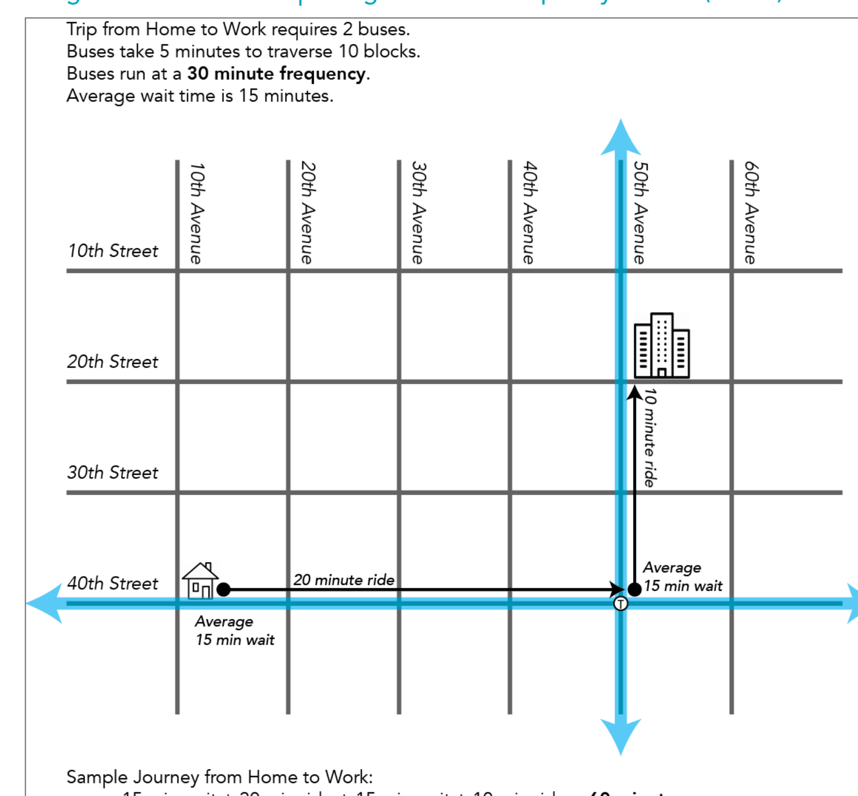


Figure 43: An example trip across a grid network at 30 minute frequency (below) takes 33% longer than the same trip using 15 minute frequency service (above).



Ridership Patterns

Figure 44 shows the number of boardings on an average weekday at every bus stop in the Miami-Dade Transit network. The busiest stops in the network see thousands of boardings per day while some stops see, on average, fewer than one boarding per day. Around the edge of the map, some higher ridership stops on the edge of the network are noted for orientation.

Generally, there are larger boarding dots where grid routes cross. This pattern shows that many people are using the grid to transfer from east-west to north-south routes and vice-versa to complete trips. Thus, despite the relatively low frequency of most of the grid-oriented routes in the Miami-Dade network, the pattern of ridership shows that many people use the grid network to connect across the county.

Another pattern visible here and in the network map is the different network design in South Dade compared to central and northern parts of the county. South of SW 88th Street, the grid pattern of the street network and the bus network begins to change. Because of the diagonal pattern of the shoreline and US 1, and the breakup of the consistent grid street pattern, the bus network changes to better fit the physical characteristics and density pattern of South Dade, such that higher frequency service. Also, in South Dade, the development pattern becomes less consistently dense and continuous, with large single-family residential areas in places like Pinecrest and Palmetto Bay. The activity density map (page 19) shows that density of people and jobs tends to be lower in South Dade, and therefore, higher frequency service is limited to just a few key corridors.

In the southern part of the county, the network transitions into a hybrid design that incorporates more radial network features. This more radial design relies on the South Dade Busway and the southern terminus of the Metrorail line at Dadeland South as central elements of the network. The South Dade Busway provides a much faster travel time for buses than mixed traffic operations on adjacent streets. Therefore, it is a powerful driver of bus ridership in South Dade, as evidenced by the large ridership dots along it all the way to Homestead and Florida City.

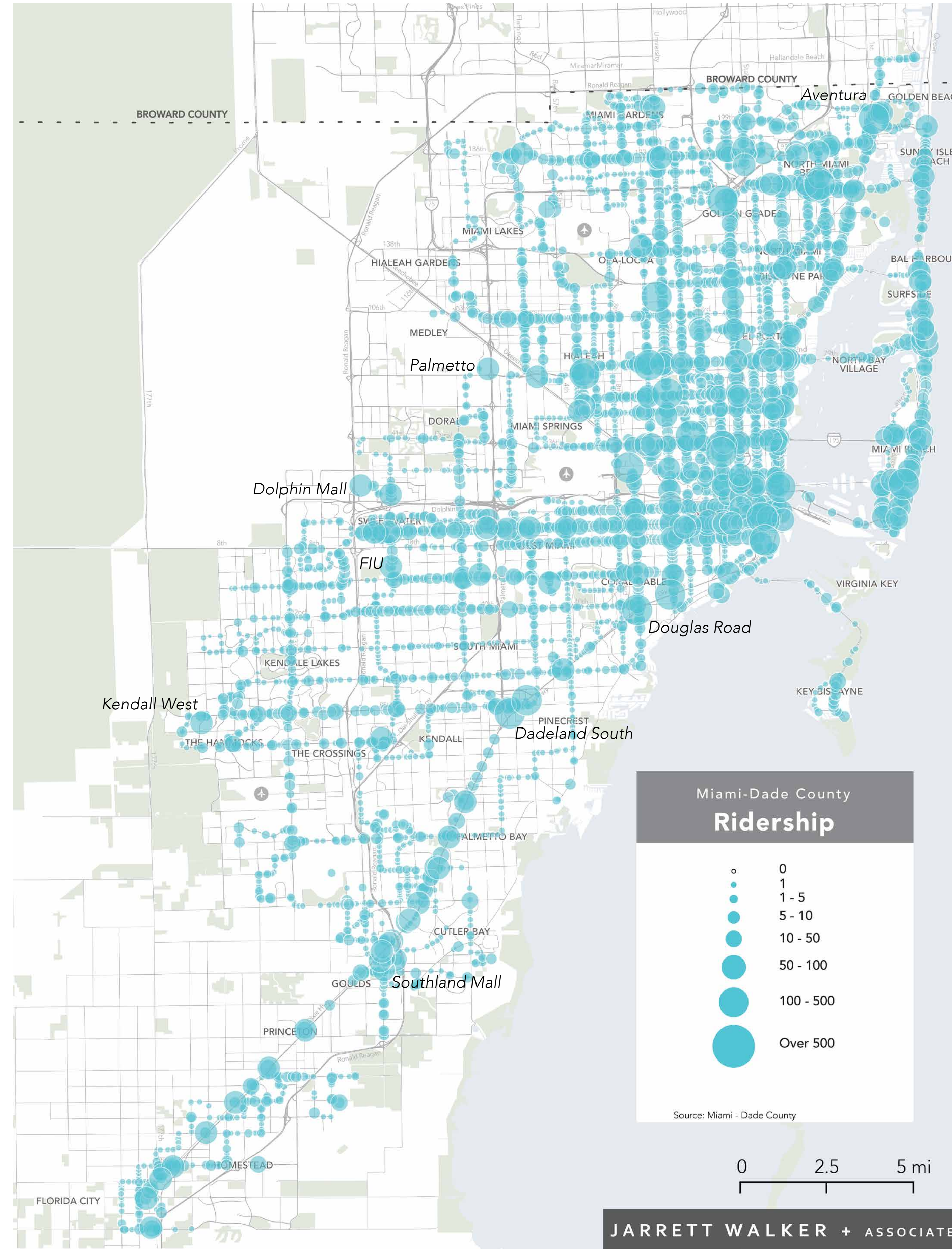


Figure 44: Boardings by stop at Miami-Dade Transit bus stops

Recent Trends Show Declining Productivity

Some transit agencies and cities have adopted a goal of "maximizing ridership." Implicit in this statement, however, is a constraint: there is a limit to how much funding is available to increase ridership. The transit agency cannot spend infinite amounts of money pursuing each additional rider in pursuit of "maximum" ridership.

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

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

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

Productivity = Ridership / Cost = Boardings / Service Hours

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

System-wide productivity

Looking at Figure 45, bus productivity for Miami-Dade Transit peaked in 2000, and has fallen since then. Despite steep reductions to service from 2006 to 2010, productivity was relatively flat during that period. It rose slightly from 2010 to 2013 as ridership increased and service hours remained flat. Other factors have likely contributed to the more recent decline in productivity: fare increases in 2008 and 2013 likely hurt ridership and the addition of some low-ridership services.

Two clues suggest that increases in low-ridership, coverage-oriented services have contributed to the decline in productivity since 2013. Figure 46 shows Route Density, or the number of route miles relative to the overall service area. If the transit agency adds new routes or extends existing routes, the value of this measure goes up. This measure is a rough measure of the change in coverage and duplication. Route density has been increasing consistently since 1994, suggesting that MDT has been consistently growing the coverage or duplication of its network.

Figure 47 shows Route Service, which is the total number of service hours divided by the total number or route miles. If a transit agency increases the frequency of an existing route it has more service hours, but the same number of route miles, and thus this measure would go up. This measure is a rough measure of changes in frequency or span of service. When MDT increased service from 2002 to 2006 it increased Route Service dramatically. Since 2006, Route Service has declined dramatically. Thus, it appears that even in recent years, when total service hours have been flat or slightly increasing, the network has been shifting away from frequency and toward coverage or duplication.

Figure 45: Productivity on Miami-Dade Transit Buses, 1994-2017

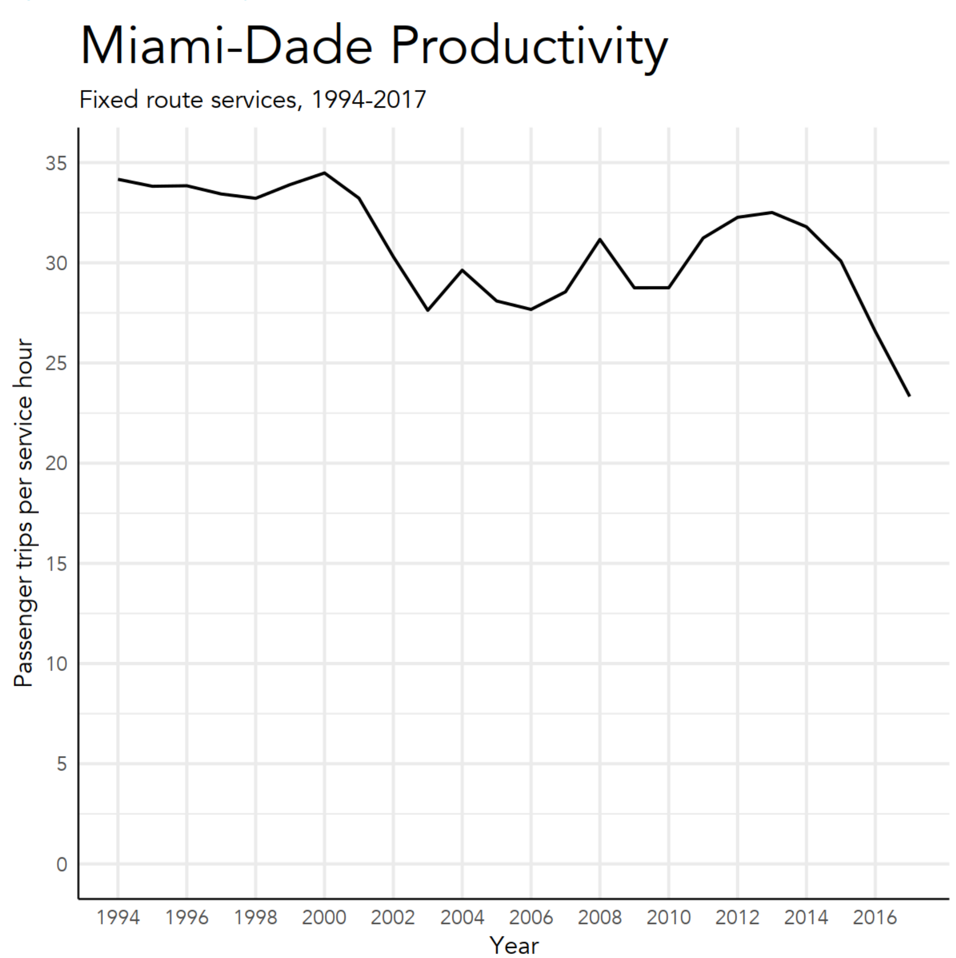


Figure 46: Route Density (route miles per square mile) in Miami-Dade, 1994-2017

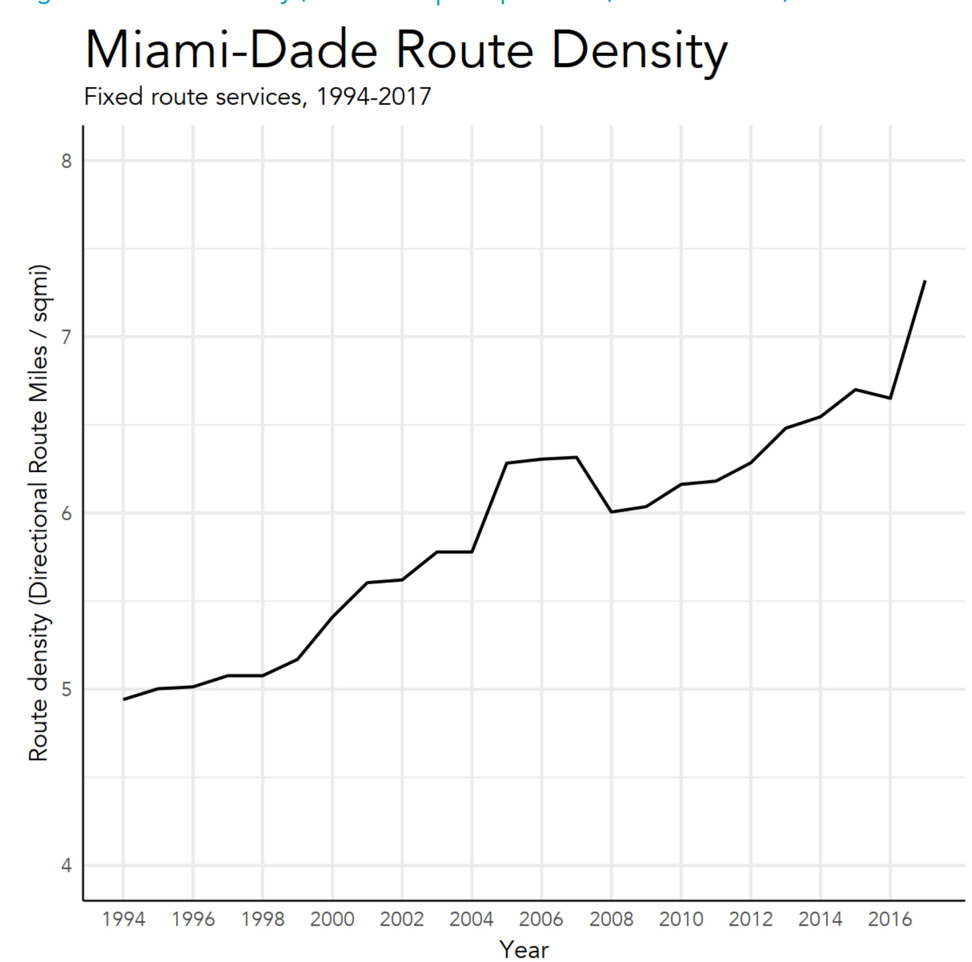
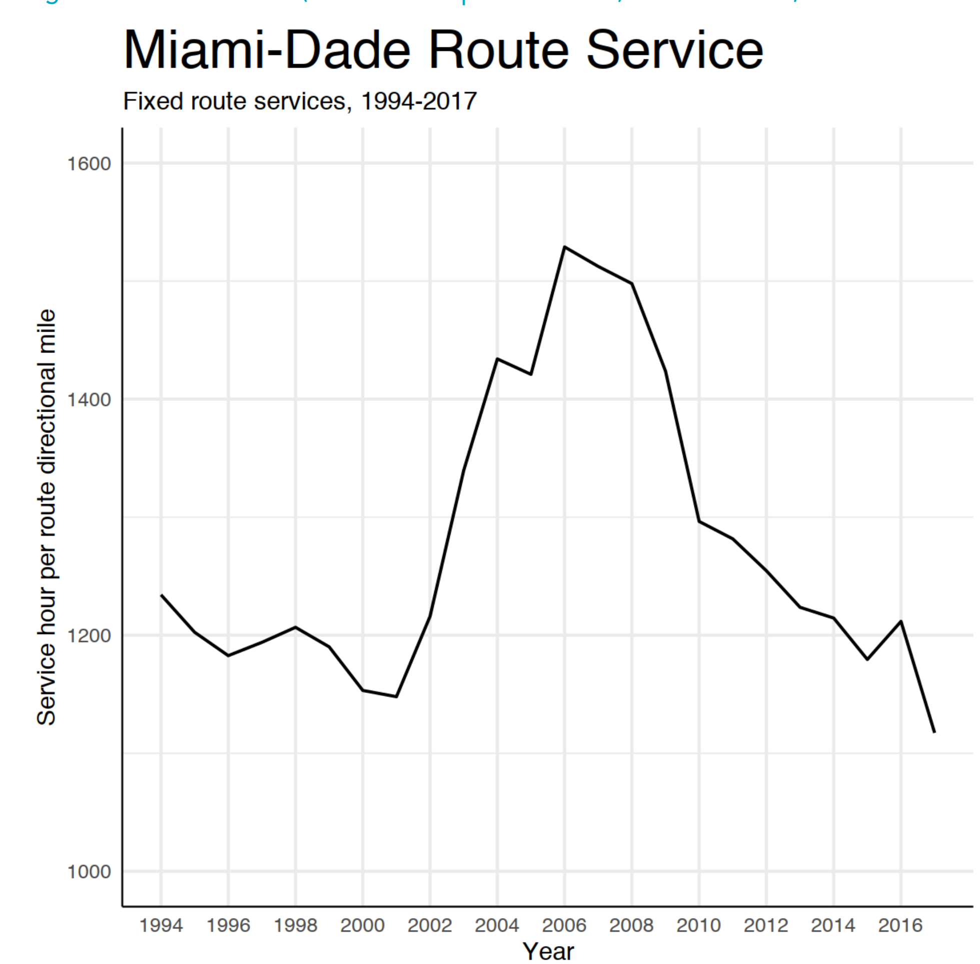


Figure 47: Route Service (service hours per route mile) in Miami-Dade, 1994-2017



More Frequent Routes Are More Productive

The quantity of service provided on any particular route is expressed as the total number of hours that buses operate on a route picking up and dropping off passengers, called **service hours** in transit terminology. The service hours provided by any route, and to any particular stop, will depend on a few factors:

- The length of the route.
- The operating speed of the bus, since a slower operating speed means that covering the same distance takes more time.
- The frequency of service along the route, since higher frequency is created by more buses and drivers working the route simultaneously.
- The span of service along the route each day and each week.

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

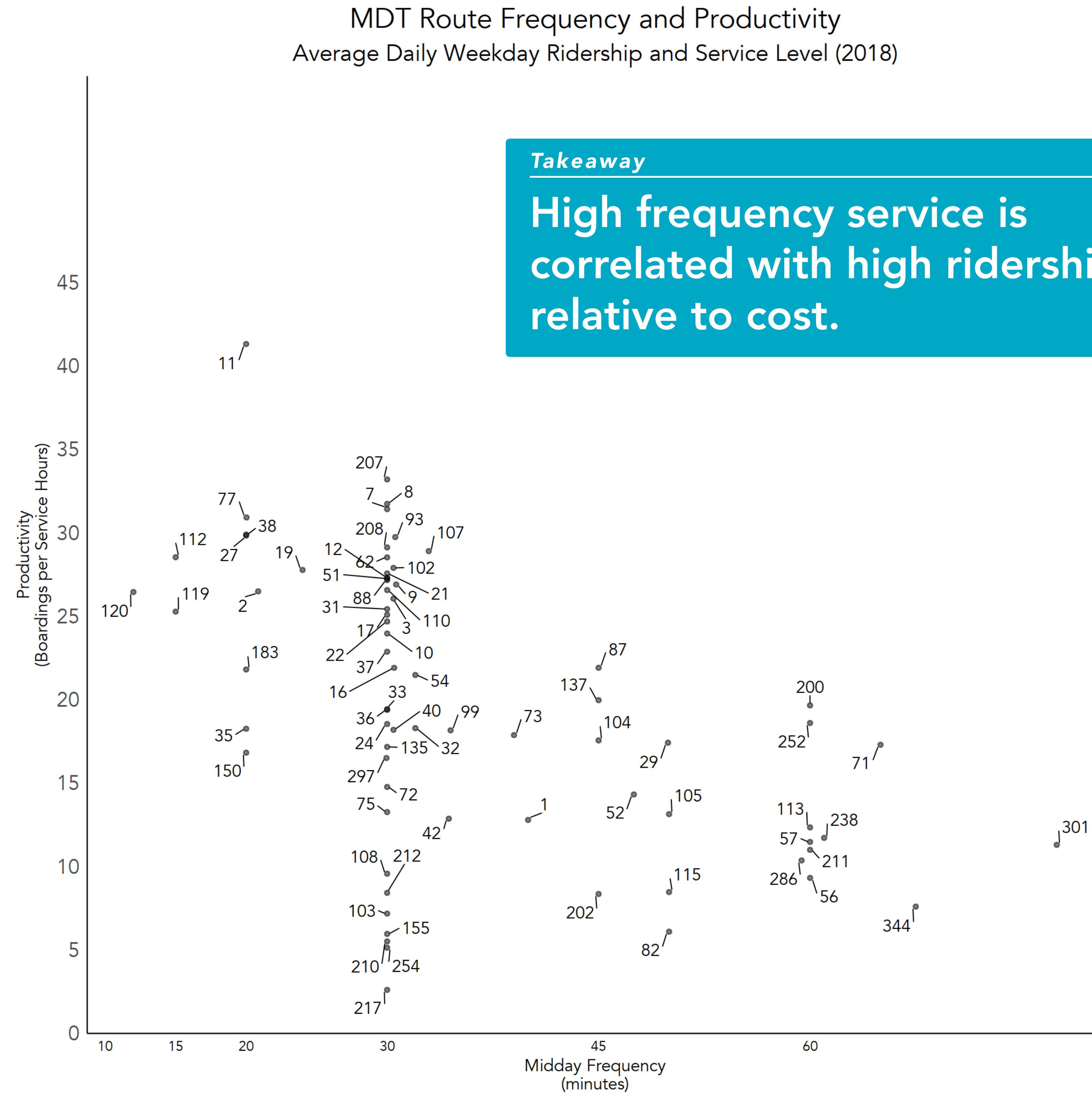
Figure 28, at right, shows the individual MDT bus routes, each plotted according to their frequency (horizontal axis) and their productivity (vertical axis). The data points form a diagonal cloud, up and to the left. More frequent services tend to have higher productivity (ridership per service hour), even though providing high frequency requires spending more service hours. This is true not only in Miami but also all over the world.

However, you can not simply increase the frequency of a route and expect productivity to increase as well. All of the other factors that predict ridership—good density, linearity, walkability and connections among activity centers—must be in place.

While most routes fall roughly in line with the trend, some are outliers.

- Route 11 connects Downtown to Florida International University (FIU) and the Mall of Americas along the dense, linear Flagler Street corridor. It has the highest productivity of any MDT route, averaging over 40 boardings per service hour.
- Routes 155, 210, 217, and 254 are all short "circulator" routes like the Skylake or Brownsville circulators. These routes are generally less than 5 miles long, one-way. They are circuitous and overlap longer and more useful MDT routes. These routes get very low productivity, less than 5 boardings per hour. Their primary function appears to be making connections within neighborhoods where short trips with a transfer between two 30 minute routes would take a long time.

Figure 48: Frequency and Productivity of Transit Service in Miami-Dade



Takeaway

High frequency service is correlated with high ridership relative to cost.

Linearity and Productivity

The principle of linearity from the Ridership Recipe (page 14) tells us that when you run in straight lines connecting multiple destinations, it makes transit more appealing to more potential riders. Destinations located off a straight path force transit to deviate, discouraging people who want to ride through, and increasing cost. **Data on productivity bears out the Ridership Recipe, as most long, straight routes in the Miami-Dade network achieve higher productivity than short, circuitous routes.**

Line drawings of some key example routes are shown below and to the right. The most productive routes, including Routes 11 and L in Figure 49, generally:

- Travel in fairly straight and direct lines with minimal deviations.
- Cover long distances, connecting major destinations that are many miles apart.
- Loop only at the ends, when the bus is likely to be empty. This means that few people have to travel out-of-direction.
- Run at higher frequencies (as shown in the scatterplot on the previous page).
- Operate at least until 11 pm on weekdays, and on both Saturdays and Sundays (as shown in the frequency table on page 29).
- Serve continuous areas of moderate or high density.

In contrast, less productive routes, like Routes 155 and 217 in Figure 50:

- Travel in circuitous paths.
- Deviate repeatedly from the most direct path between destinations.
- Cover very short distances.
- Operate on weekdays-only or have very limited hours on weekends (as shown in the frequency table on page 32).

An extreme example is Route 155. It is only 1 mile long and the crows-fly distance from Golden Pond Apartments to Golden Glades is only 1/4 mile. Route 155 is effectively a sidewalk replacement route for an area with poor street connectivity, unsafe crossings, and poor sidewalk conditions.

Short routes are not, on their own, a poor design choice, but as a route gets shorter, the value of frequency becomes even more important. If a route is only one mile long (one-way), and it only runs every 20 minutes, then if you just miss the bus, an average person could walk to the other end of the route before the next bus arrives at their origin.

Therefore for short routes, or short distances, frequency is the paramount factor in travel time by transit. The short circulator routes in the MDT system that run only every 30 to 60 minutes are not likely to garner high ridership relative to cost, because most people could walk to their destination faster than they could wait for the bus to arrive. Most of these circulator routes are near, or overlap with, longer, more frequent routes. Therefore these routes do not provide unique coverage. Some of these routes may serve very important needs or other coverage purposes, such as providing one-seat rides where a low frequency grid connection would require a long wait.

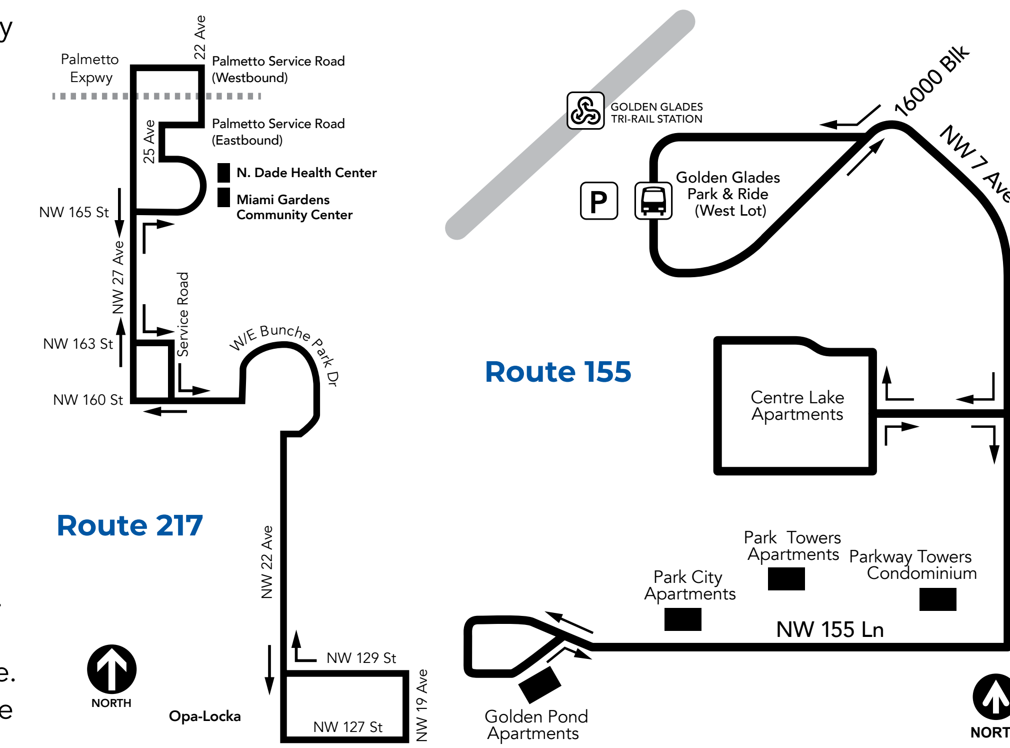
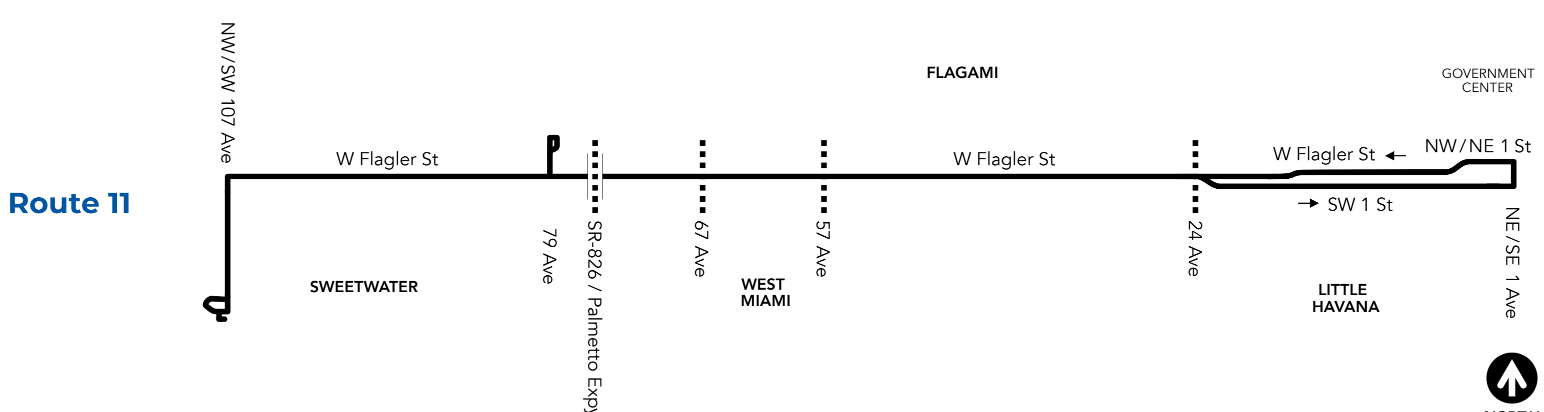
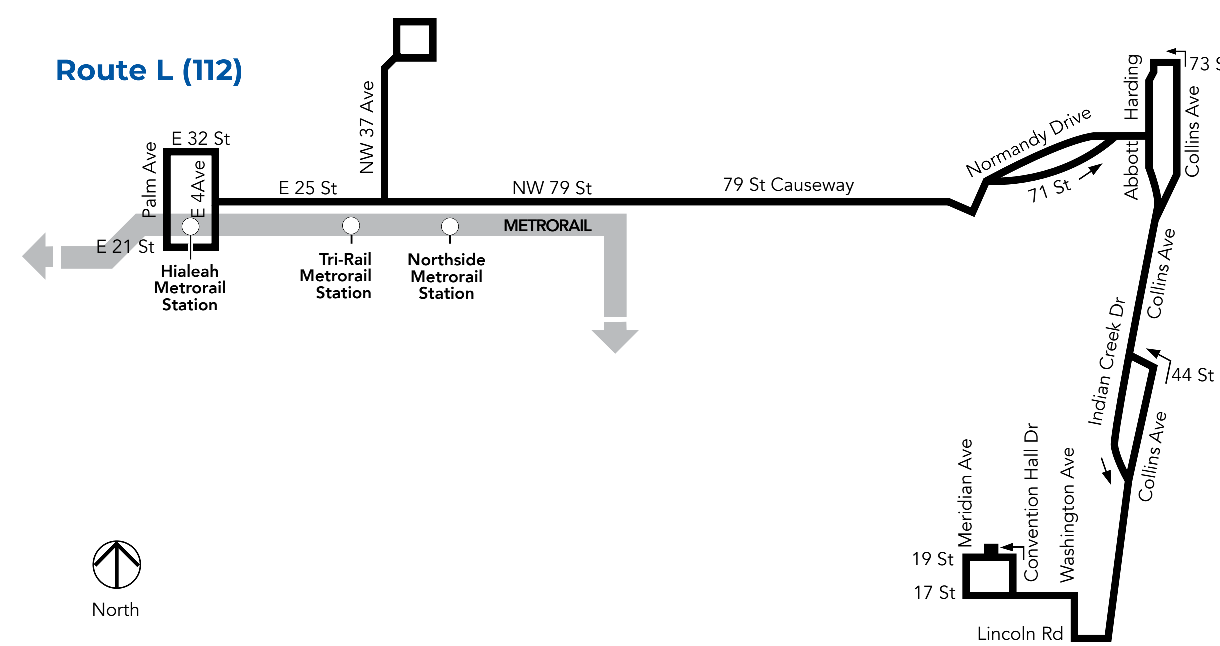


Figure 50: More circuitous routes, like 217 and 155, have lower productivity.

Figure 49: More linear routes, like 11 and L, have higher productivity.





Peak Service Is Less Productive Than Midday

During rush hours, the number of people traveling among certain places increases, and it's normal for service levels to increase in response. Some agencies offer a great deal of extra service during the peak, either in the form of unique rush-hour-only routes, or in the form of higher frequencies. Other agencies offer a largely all-day network, and supplement that network in small ways during rush-hours.

Miami-Dade Transit adds significantly more service during the weekday peaks. This service takes the form of commute express routes (such as the 95 Golden Glades or 34 and 39 South Dade Expresses), higher frequencies on many regular routes, and peak-only limited stop routes like the 277. (The pattern of frequencies through the weekday can be seen in the frequency charts on page 42).

Peaking has some high costs that are often invisible to the public, and some transit agencies even struggle to account for these costs in their internal decision-making:

- Peak services have higher labor cost than service at other hours, specifically for split shifts—where operators work in the morning and evening rush hours with a long break in between. Split shifts can be awful for operators and they can be expensive for a transit agency.[1]
- The agency must maintain a large fleet of buses for the peaks, a fleet that sits idle at all other times. For each extra bus that is run during peak times, the agency had to purchase the bus, find land to store it on, pay people to maintain it.
  - At midday MDT runs 347 vehicles, but at peak they need 584 on the road. Thus, about 40% of the fleet is maintained, stored, and ultimately replaced in order to provide many fewer hours and many fewer riders each week than the rest of the fleet.
- Short peak runs require drivers to go to and from the operating base with a bus twice a day. This time is called **deadhead**, and can cost an agency a great deal of time. The cost of this factor to MDT will be explored further on page 47.

The graph in Figure 51 compares how much bus service MDT puts on the road for each hour of the weekday, compared to how much ridership that service attracts. The productivity by hour is also shown. (All are reported in this graph as a percentage of the daily per-hour average).

The weekday peaks in service that are visible at the top of this graph are what drive MDT's fleet requirement, and cause the increased costs described in this section. For this reason, many agencies decide to ask their consumers to bear with some crowding out of respect for the extra costs of running extra peak service.

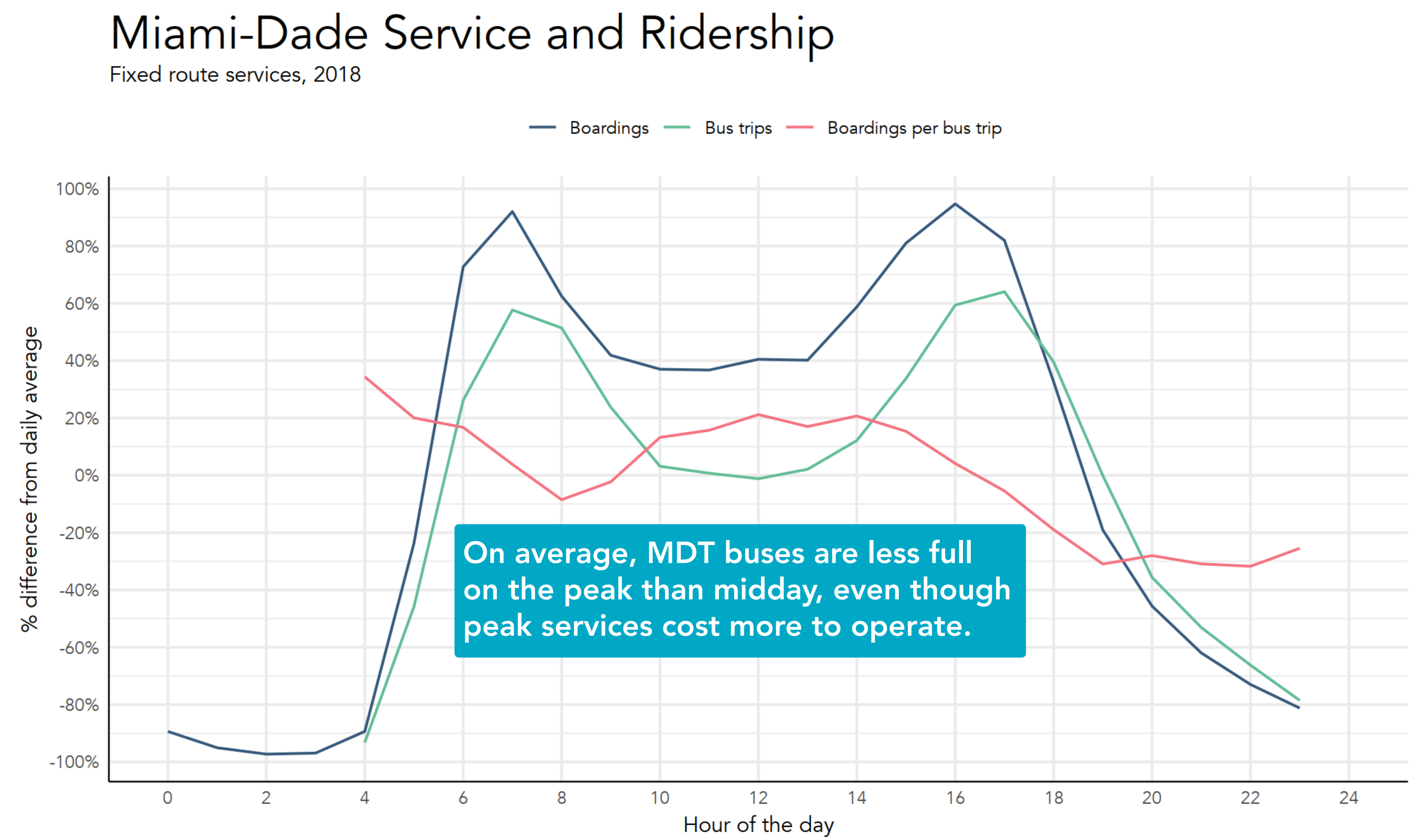


Figure 51: Boardings, Bus Trips, and Boardings per Trip by hour for an average weekday

In these charts, whenever the red line rises, buses are on average more crowded. Boardings and bus trips both go up significantly in the AM and PM peak periods, but productivity tends to decline. In the weekday in the middle of the day, buses are on average more crowded than they are during the AM or PM peak periods. In fact, **on average, rush hour is not a very productive time of day.** This suggests that shifting service hours from the peak to other times of the day would result in higher ridership relative to cost.

1 The MDT contract with its operators requires that overtime be paid for any shift with a total of 12 hours of spread—the time from showing up for work until being completely done with work for the day, including break time for a split shift.

Peak-Only Routes Have Low Productivity

People sometimes assume that targeting transit service at the peak of demand, in particular at rush-hours, will be most "efficient." Yet peak-only services have some limitations that leads to lower ridership relative to cost compared to all-day services:

- Peak services tend to be used in only one direction, toward downtown or a major destination, and run empty or nearly empty in the opposite direction. All-day services tend to be used more evenly in both directions.
- Peak services are less useful to low income workers, who tend to work in industries that have less traditional shift times. Thus one of the largest markets for transit is not served well by peak services.
- As noted previously, there are many hidden and obvious extra costs to peak services that reduce their ridership relative to cost.

Figure 52 shows the productivity of each route by frequency, but now with peak-only routes on the right half of the plot. In fact, all but three have lower productivity than the systemwide average of 23 boardings per hour.

The two most productive peak-only routes are Routes 34 and 39, which operate on the South Dade Busway, where buses have a significant speed advantage over private automobiles, where transfers to Metrorail at the north end are easy, and trip distances are relatively long. Therefore, these routes provide competitive trip times compared to the private automobile for a typical peak period commuter.

The next highest productivity peak-only route is the 95 Golden Glades. This route achieves a productivity of about 24 boardings per service hour, just above the systemwide average of 23. Route 277, which is a peak-only, limited stop MAX route that overlays Route 77 at peak times, achieves a productivity of 23 boardings per service hour. The remaining 18 peak-only routes achieve productivity levels lower than the systemwide average of 23 boardings per hour.

Takeaway

Most rush hour services are less productive than all-day routes.

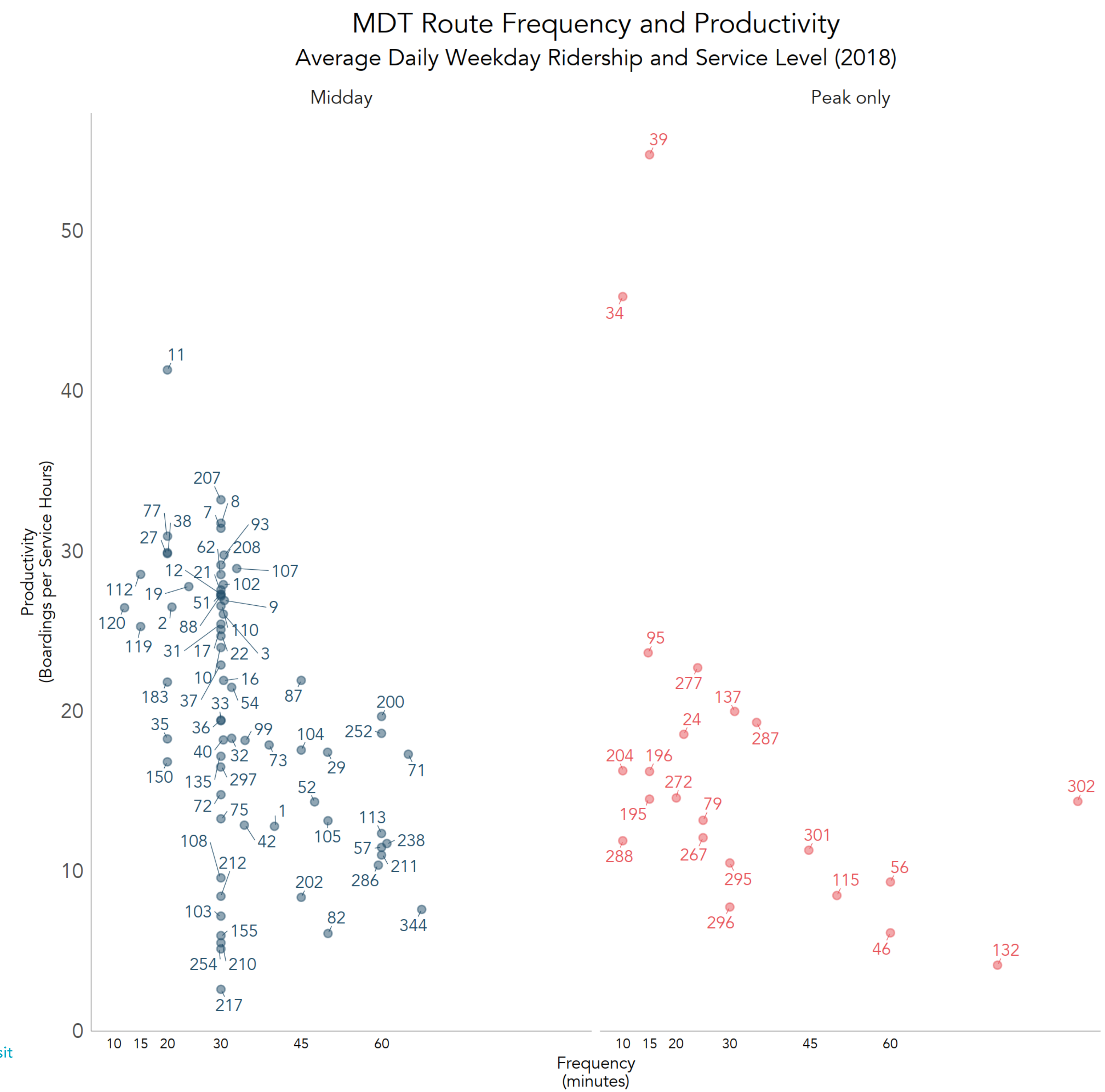


Figure 52: Frequency and Productivity of Transit Service in Miami-Dade with Peak Routes

Deadhead Is Costly for Peak-Only Routes

Deadhead is the time that a bus and driver spend getting from the operating base, or from another piece of work, to the start of a route, or returning from the end of a route to the operating base. The time a driver spends traveling for a lunch break is also considered deadhead.

While every route requires some deadhead, peak-only routes tend to be provided for longer distances, and in a single direction. (For example, nearly all 95 Golden Glades trips are one-way into downtown in the morning, and the reverse in the evening.) This peak-direction-only service can seem efficient to riders, who sit on a reasonably full bus each way. What riders often don't realize is that *the bus and driver have to drive back the other way, empty.* This deadhead time still costs the agency, but doesn't result in any ridership.

Deadhead is one factor that leads to overestimates of the productivity of peak-only routes. Peak-only routes have extra deadhead for two reasons:

- Many of the peak-only routes that MDT operates are peak-direction-only, and so have riderless deadhead time to return to their start.
- Even routes that run in both directions have extra deadhead, because buses and drivers are going to and from the garage at least twice a day, instead of once per day. For a peak-only shift, a driver leaves the garage for their AM shift, incurring deadhead to start their trips, then returns to the garage, incurring deadhead time, before lunch for a midday break. They then depart in the afternoon to begin their PM shift, again incurring deadhead time to start their PM trips, and once the driver finishes their afternoon trips they return to the garage again.

Figure 53 shows the percent of time spent on deadhead by route as a percent of the total service hours provided by route. The dashed line on the graph shows that the systemwide average is about 12%. This means that for every hour a bus is on the street providing service to riders, about 7 minutes is spent on deadhead time. Peak-only routes are highlighted in red and all but one has a higher deadhead percentage than the systemwide average, many much higher.

Some routes have substantially higher deadhead times. **Routes 34 and 95 have about 50% deadhead time relative to service hours. That means that for every hour those routes provide service, 28-30 minutes is spent on deadhead time.** By comparison, only four all-day routes have a deadhead rate of more than 20%, and none has a rate higher than 30%. Among all routes, the top seven in deadhead rates are peak-only routes. Route 95 shows up twice in the graph because different branches of that route are dispatched from different garages and those branches have different deadhead rates.

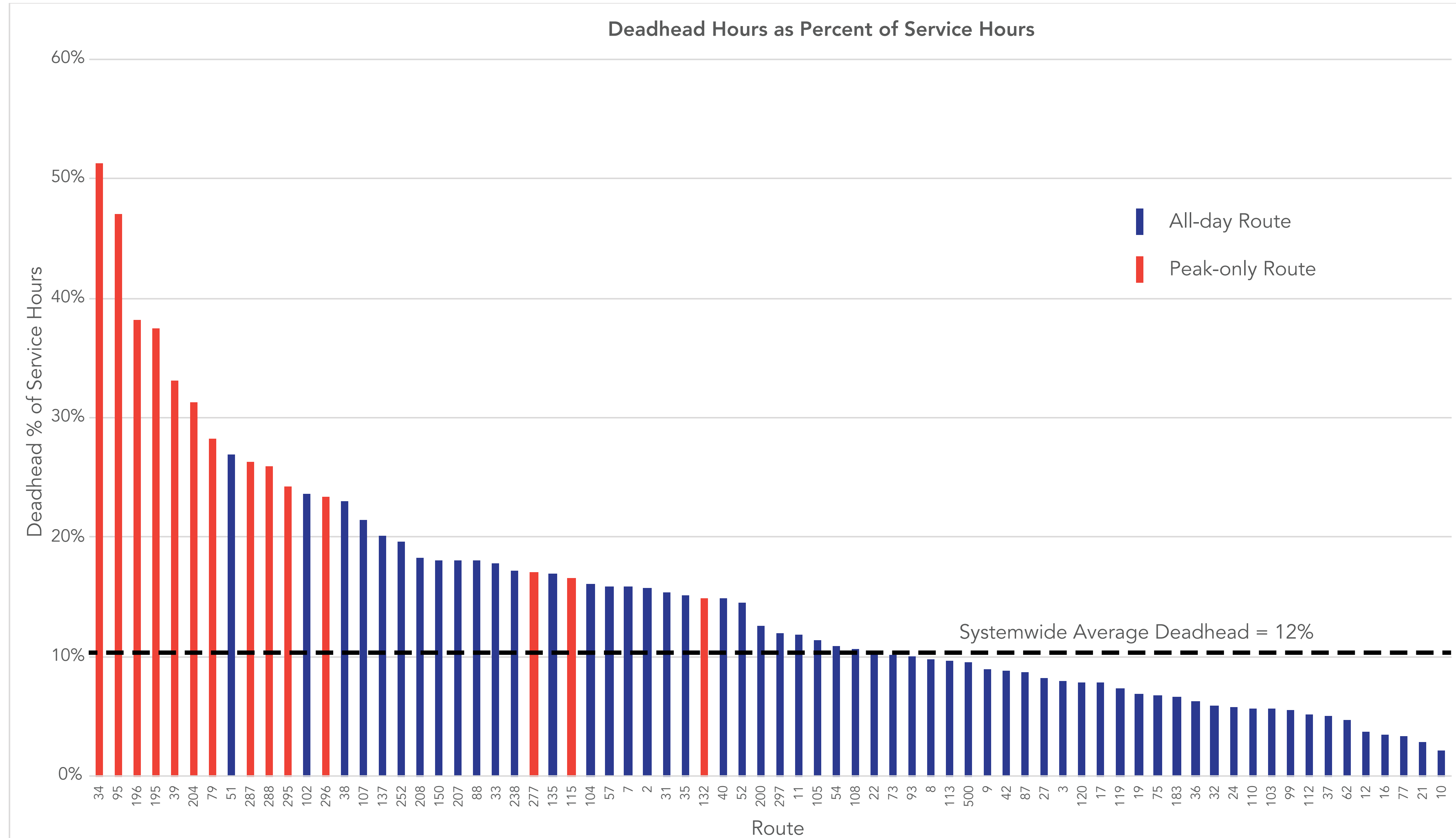


Figure 53: Percent of Time Spent on Deadhead Travel by Route for Miami-Dade Transit

The graph is also telling us that the productivity values for most peak-only routes shown on the previous page should be discounted by about 1/3 to account for the inefficiency of this extra deadhead time. Doing so would mean that all but two peak-only routes would have productivity levels below the systemwide average. If MDT chooses to continue running these peak-only routes, there is no way to avoid the higher costs of providing service over longer distances and the inefficiencies of extra deadhead. Thus, if Miami-Dade is interested in increasing ridership relative to cost, the community should consider reducing investment in peak-only service and extra peak frequency and invest in more productive service such as midday, evening, or weekend service.

Takeaway

Peak-only service is only about 2/3 as productive as it looks, once deadhead cost is accounted for.

MAX Routes Aren't Usually Worth the Wait

Miami-Dade Transit operates nine routes that make limited stops and are branded as MAX routes. Seven of these routes operate as supplemental to a local route that makes stops more often along the same corridor. Rarely is a MAX bus worth waiting for because the frequency of service is too low and the speed advantage is too little.

For example Route 3 is the Biscayne Local and Route 93 is the Biscayne MAX. Both routes start at Government Center and end at Aventura Mall in North Dade, though Route 3 makes a deviation to serve 163rd Street Mall. Route 3 stops about every 850 feet. Route 93 stops about every 1,500 feet, a 2:1 ratio of stop spacing. As a result of the wider stop spacing, Route 93 averages about 12 mph at midday, while Route 3 averages about 10 mph. Thus, for a relatively long trip from NE 123rd Street to Government Center, Route 93 will get there about 8-9 minutes faster.

At midday, both routes run every 30 minutes, so a rider at a stop served by both routes would be better off to catch a Route 3 bus if it arrived first. The long wait for the next Route 93 would likely outweigh the time made up in a faster in-vehicle travel time.

At peak times, Route 93 is every 15 minutes, while Route 3 is every 20 minutes. The higher frequency reduces the average travel time for a rider on Route 93 even more, due to shorter waits. Yet even at peak, if a rider is at a stop served by both routes south of 163rd Street, and a Route 3 bus arrives first, that rider would, on average, reach downtown only a few minutes after a Route 93 bus, given the wait for the next 93 bus.

This pattern holds true for many MAX routes since during middays most MAX routes run at the same or lower frequency than their corresponding local routes and their stop spacing patterns are similar. Even at peak times, some local routes run more frequently than their MAX counterparts. Figure 54 shows the productivity and peak frequency of MAX routes and their corresponding local routes. The following local routes achieve higher productivity results than their corresponding MAX routes: Routes 11, 77, 27, L (112). For these situations, it is worth asking whether adding frequency to the local would provide more useful service to riders than running a separate, limited-stop service.

MAX Routes 120, 93, and 38 have higher productivity than their corresponding local routes (S, 3, and 31). In these cases, the limited-stop may be providing more useful service. In other regions with rapid and local routes that overlay each other the stop spacing ratio is closer to 4:1, suggesting that one reason for the lackluster productivity on MAX routes is that they have too many stops.

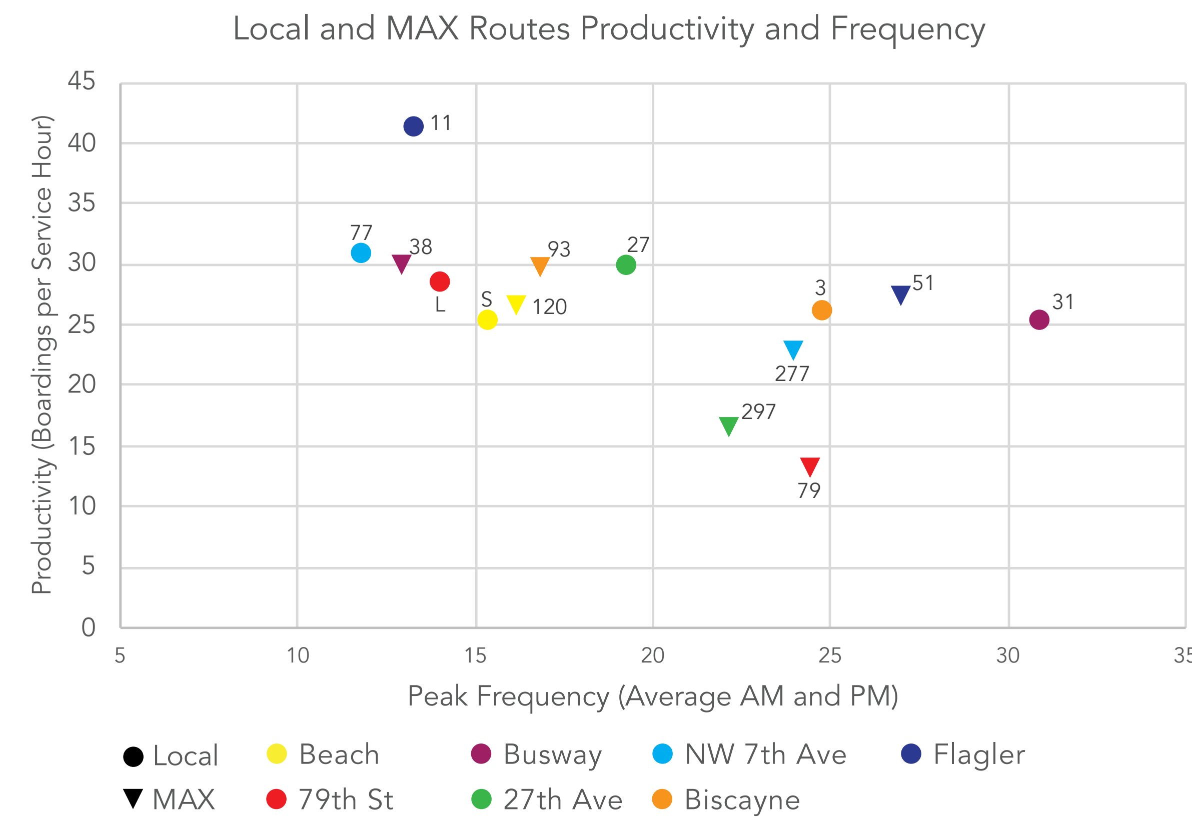
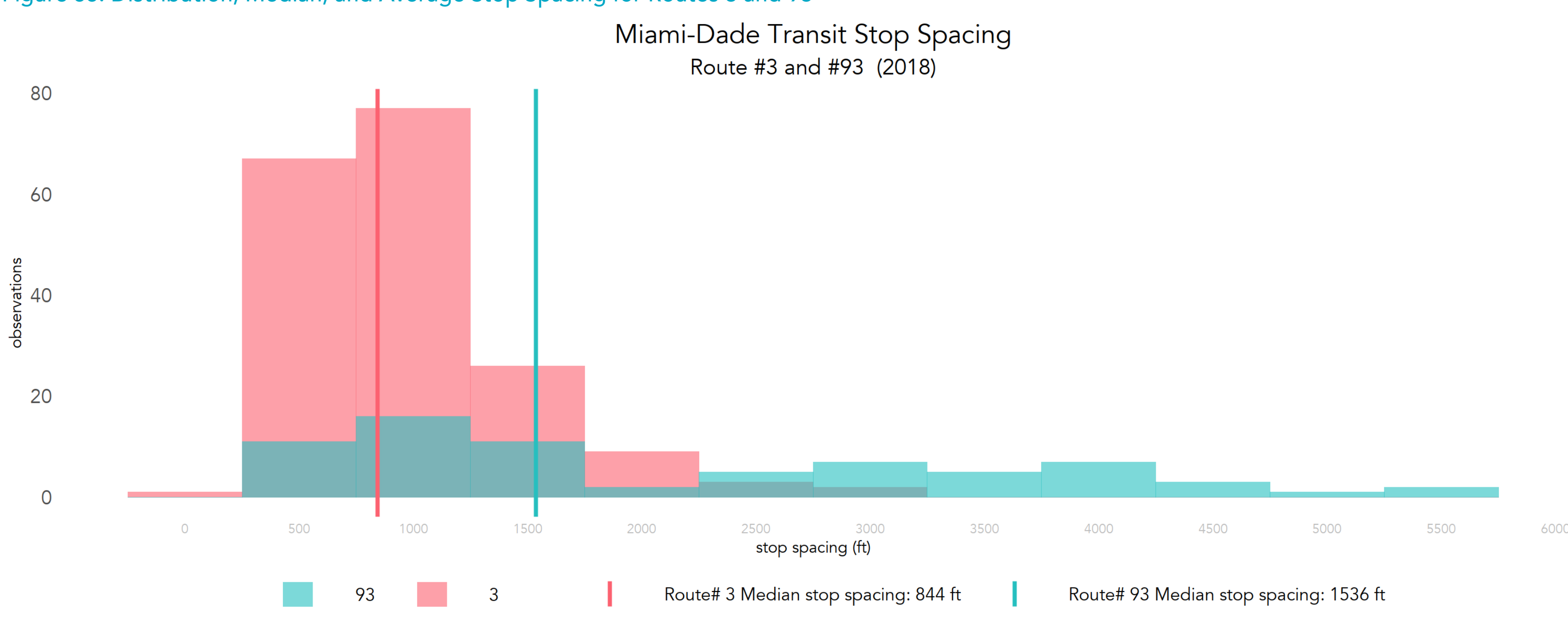


Figure 54: Productivity of Local and MAX Routes on the same Corridors

Figure 55: Distribution, Median, and Average Stop Spacing for Routes 3 and 93



Takeaway

The speed benefit of most MAX routes is canceled out by the long waiting time.

Stop Spacing and Speed

Across all routes in the Miami-Dade Transit system, the typical spacing between bus stops (the median stop spacing) is about every 850 feet. Figure 56 shows the distribution of the distance between stops. Express and MAX routes have much higher stop spacing, but most local routes, particularly in the dense, grid portion of the network have a stop about every 600 to 800 feet. In more suburban areas of the county stop spacing is farther apart, due to fewer safe road crossings and destinations that are farther apart.

The typical spacing of stops of every 600-800 feet in the dense core of the network comes about from relatively inconsistent spacing of stops across the grid of streets. Most streets and avenues in Miami are spaced about 660 feet apart, which is 1/8 of a mile. This reflects the subdivision of the county by section-line streets and avenues at every 1/2 mile, and the further subdivision into smaller equal sections. If there were stops at every street and avenue, then typical stop spacing would be every 660 feet. If there were stops at every other street or avenue, then typical stop spacing would be every 1,320 feet.

There is a geometric trade-off between closer stop spacing and faster bus speeds. Figure 57 shows the basic trade-off in conceptual terms. As stops are placed farther apart, buses can travel faster and cover more distance in the same time.

This is because most of the time required at a stop is not proportional to the number of passengers served. When there are many stops, passengers spread themselves out among them, so the bus stops more for the same number of people. When passengers gather at fewer stops, stopping time is used more efficiently, resulting in faster operations.

This increased speed has two benefits. First, riders can get farther faster and reach their destinations sooner. Also, as speeds increase across the entire transit system, more service can be provided for the same cost. Since the primary cost of transit service is the cost for labor which is paid based on time worked, the faster buses operate, the more service that can be provided for the same cost. So, higher frequency can be provided or routes can be extended to go farther for the same cost.

This is why standards for stop spacing in the US are generally in the range of 1,000 to 1,500 feet on high-frequency bus routes, or two typical Miami blocks. Many transit agencies are studying stop-spacing and developing consistent citywide policies, usually in that range.

A 1,300 foot or two block spacing would mean that:

- Buses run noticeably faster, because customers gather at fewer stops where they can board more quickly. Currently, MAX routes operate 10-30% faster than their local counterparts, but their stop spacing is closer to 2,600 feet. We estimate a 5% speed increase is likely possible on most local routes with wider stop spacing.
- Everyone is still within a short walk of one bus stop, but not necessarily two consecutive stops. Of course, riders only need to reach one stop, not two.
- Fewer parking spaces are removed to accommodate bus stops in dense areas with on-street parking, although those that remain will need stronger enforcement.

Stop spacing can be changed, but it requires a clear strategy and public conversation about whether faster operations are valuable. There are two major reasons people defend closely-spaced stops. First, some people have difficulty walking and will be inconvenienced by a longer walk. Seniors and people with disabilities are more likely to feel inconvenienced by this change. Second, as stops are spaced farther apart, transit becomes less useful for very short trips. This is because walking distances at each end of the trip increase to the point that very short trips would be faster by walking or biking. Some cities and agencies view this as a good thing, arguing that the point of transit is to provide an alternative to driving, not an alternative to walking.

As always, the key to a successful revision of stop spacing is for it to be a consistent policy applied in all comparable circumstances, and tied to a clear systemwide benefit in travel times. Many transit agencies have successfully widened stop spacing where these benefits were clear.

Takeaway

Wider stop spacing can increase bus speeds, making trips faster and freeing resources for more frequency or coverage.

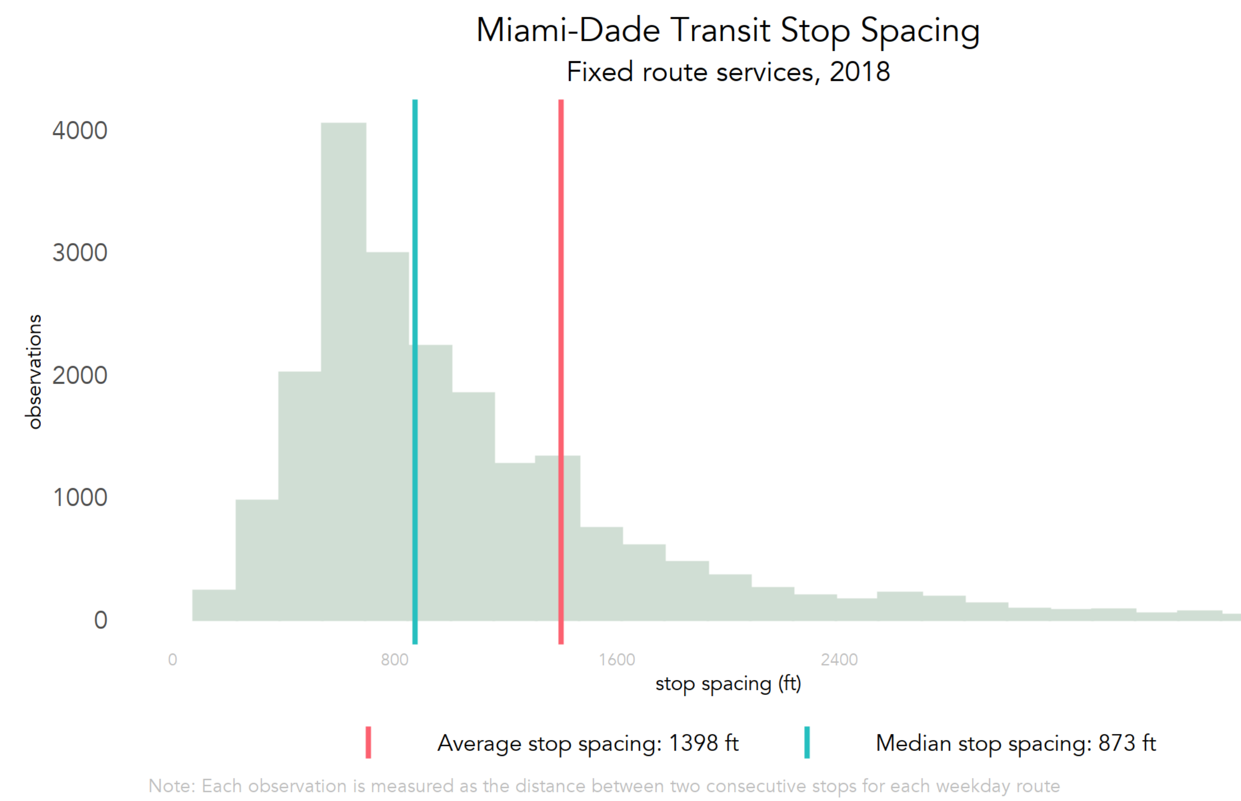
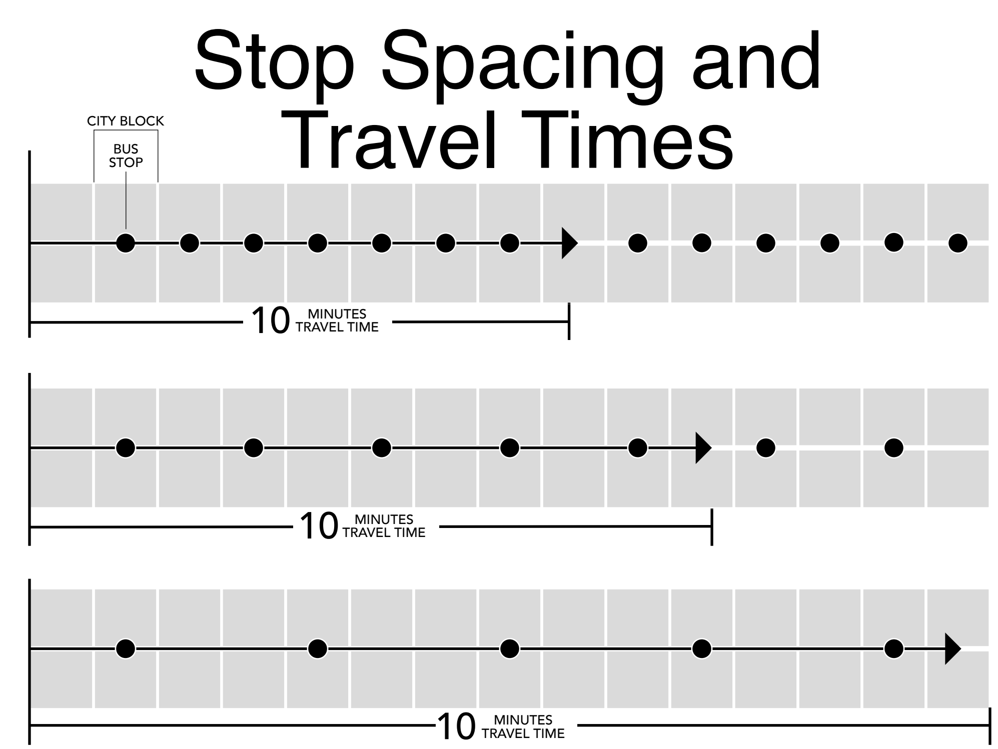


Figure 56: Distribution, Median, and Average Stop Spacing for all stops in Miami-Dade

Figure 57: Trade-off between stop spacing and travel time



Connections versus One-Seat Rides

Most of the Miami-Dade transit network is a grid that encourages riders to make connections to complete trips. Yet there is a natural desire from riders and key interests to ask for special exceptions to the grid to provide a one-seat ride across the grid. Yet, the more that MDT emphasizes one-seat rides, the more it would undermine the usefulness of the grid. In general, **a higher ridership network will consolidate routes to minimize waits and ask people to connect**. Most people will get where they are going faster, even with a transfer, because their wait time is much shorter. This tension is demonstrated in the design of Routes 12 and 21.

Routes 12 and 21 start at the Northside Metrorail Station and go east through Liberty City, eventually turning south and becoming the primary north-south grid route on NW 12th Avenue. Where the two routes run together, they provide a combined 15 minute frequency.

At 20th Street the routes branch and Route 21 goes east through Culmer and Overtown to Government Center in Downtown. Route 12 continues following 12th Avenue through Little Havana to Vizcaya Metrorail Station and then on to Mercy Hospital (see Figure 60). By splitting, each route only has service every 30 minutes at midday south of 20th Street and the combined 15 minute service is only available for trips that begin and end north of 20th Street.

For trips going downtown from points north of 40th Street, most riders would get there sooner by transferring to Metrorail at Allapattah station. The combined frequency of Routes 12 and 21 and the faster speed of service on Metrorail mean that trips between Liberty City and Downtown or Overtown are faster than waiting for the one-seat ride on Route 21. Only trips between Liberty City and the area around NW 3rd Avenue and NW 17th Street in Culmer are faster by the one-seat ride via Route 21 than any other combination of rail and bus.

One complicating factor is that Miami-Dade Transit charges 60¢ for transfers from Metrobus to Metrorail. While this is a small fee, it is still an impediment to the seamless use of the entire transit network as one unit for making trips. Riders will naturally respond by asking for long routes that avoid a Metrorail transfer, to minimize their own costs.

Figure 58: Routes 12 and 21 provide frequent service on NW 12th Avenue

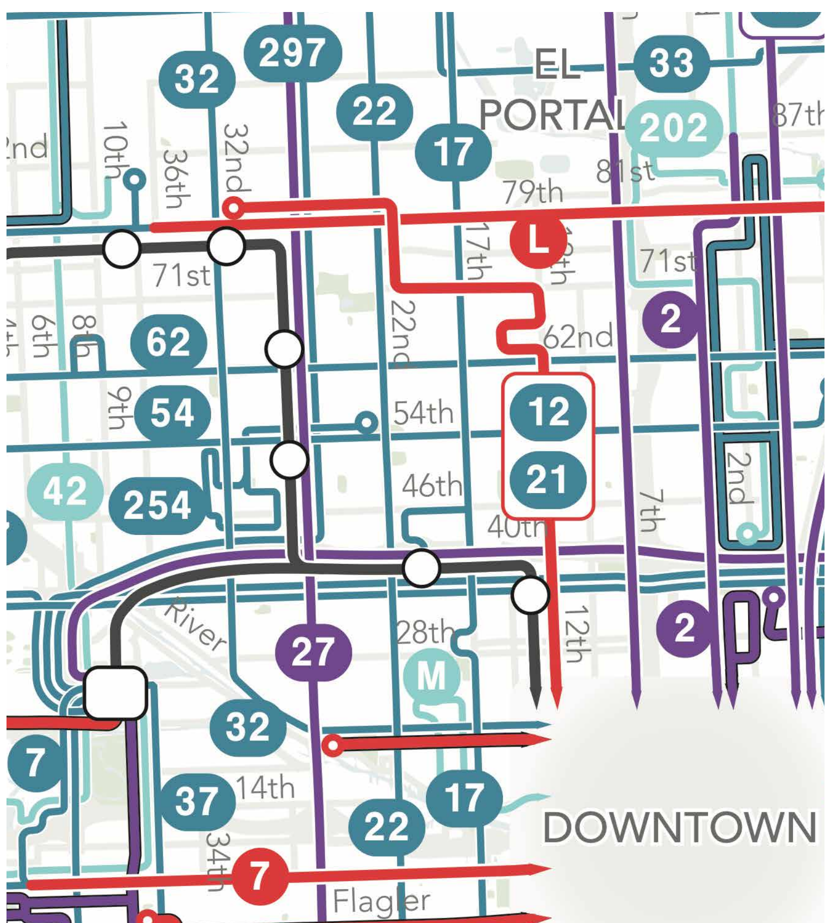


Figure 59: Direct routes lead to higher complexity and longer waits.

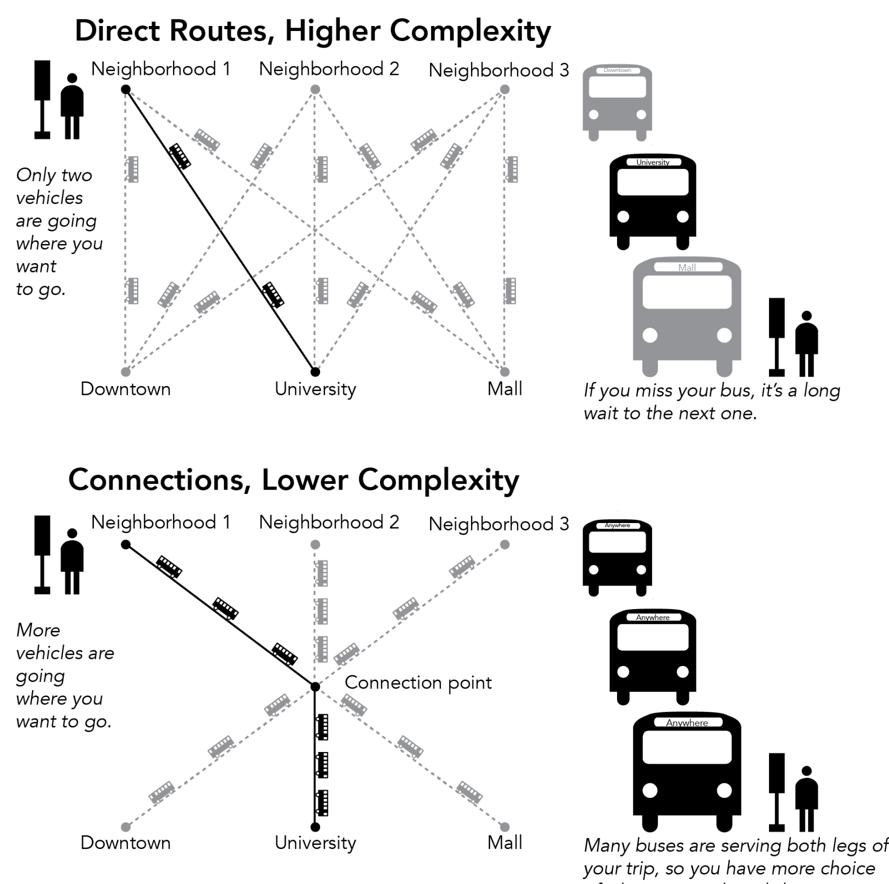
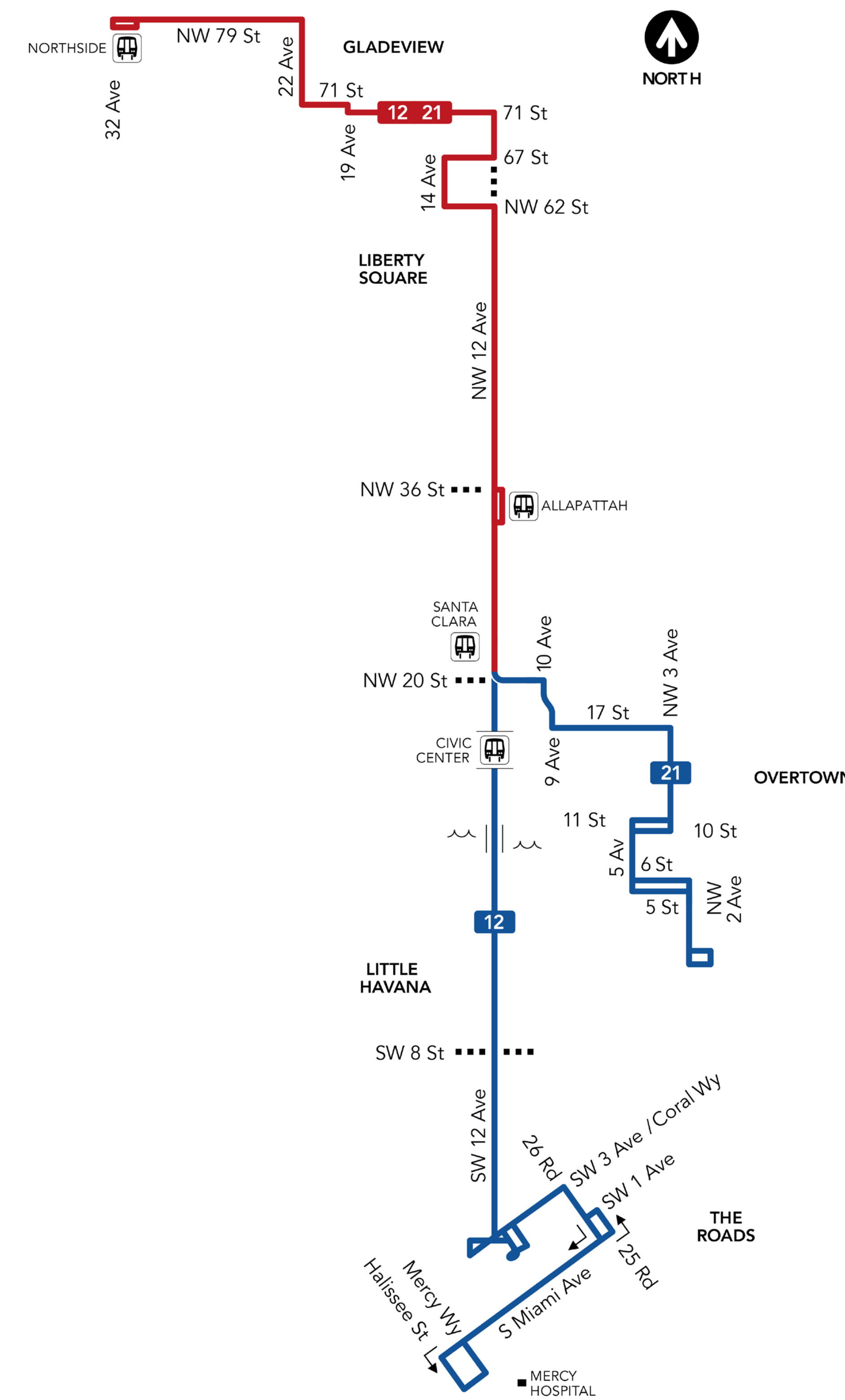


Figure 60: Routes 12 and 21 branch as they reach the Medical District, reducing the frequency of service south and east of the hospitals.



Downtown Missed Connections

Most MDT routes that come into Downtown Miami converge on Government Center station or traverse through downtown on SE/SW 2nd Street and NE/NW 1st Street. The connection of all of these routes in one location within downtown is important because it simplifies many trips by limiting the number of transfers required. Also, many of the north-south routes that run east of Miami Avenue would not touch Metrorail unless they come into downtown and reach Government Center. Metrorail is such as fast and frequent connection to so many activity centers around the region, so connecting to it is critical to maximizing access via transit for many trips

Figure 62, at right, shows the bus network within Downtown Miami and the Brickell Area. Figure 61, below, shows the Omni area bus network, just north of downtown. Looking closely, there are a couple of key connections that may be limiting the usefulness of the overall network. Routes 10 and 16, which come from the north along the NE 2nd Avenue and Biscayne corridors, respectively, terminate at Omni Bus Terminal. Therefore, these routes do not touch Metrorail directly, nor do they reach the multitude of other bus connections available near Government Center.

Similarly, from the south, Routes 8 and 24 terminate at Brickell Station, and therefore miss direct connections to key north-south routes, like Routes 2, 3, 9, and 93. Furthermore, to connect between Routes 10 or 16 and Routes 8 or 24, would require a four seat ride because Metromover does not connect Omni and Brickell directly. A rider must transfer within the Metromover downtown loop area.

Connecting buses across the Miami River does present some operating challenges. Unpredictable drawbridge openings can delay buses. And general downtown congestion is always a concern for transit operators. Bringing more buses into a highly congested area can seem to waste more time in traffic than it might save riders in connection time. The County, City of Miami and the State of Florida can help solve this problem by dedicating space on key streets for buses to move through downtown. Dedicated lanes already exist for eastbound travel on SE/SW 1st Street. Dedicating more lanes on key north-south streets would provide more reliable service and make it easier to provide all the important bus connections within downtown.

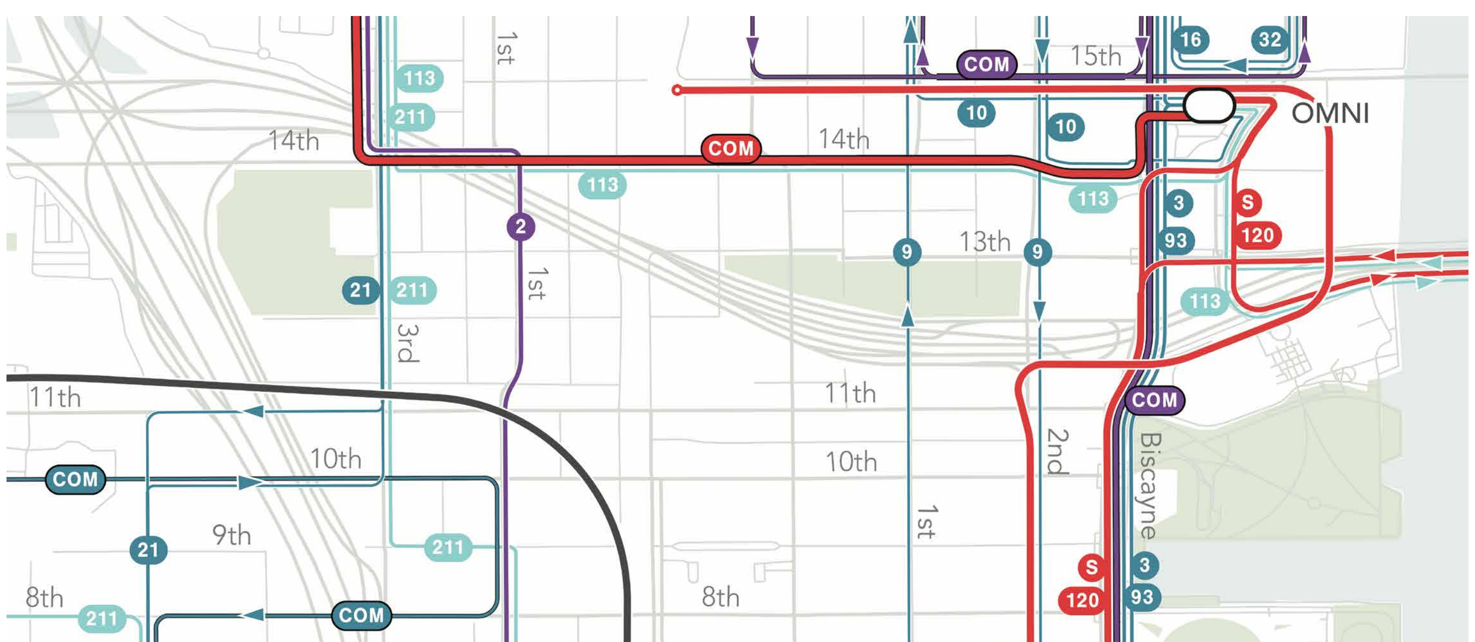


Figure 61: Omni Area Bus Network

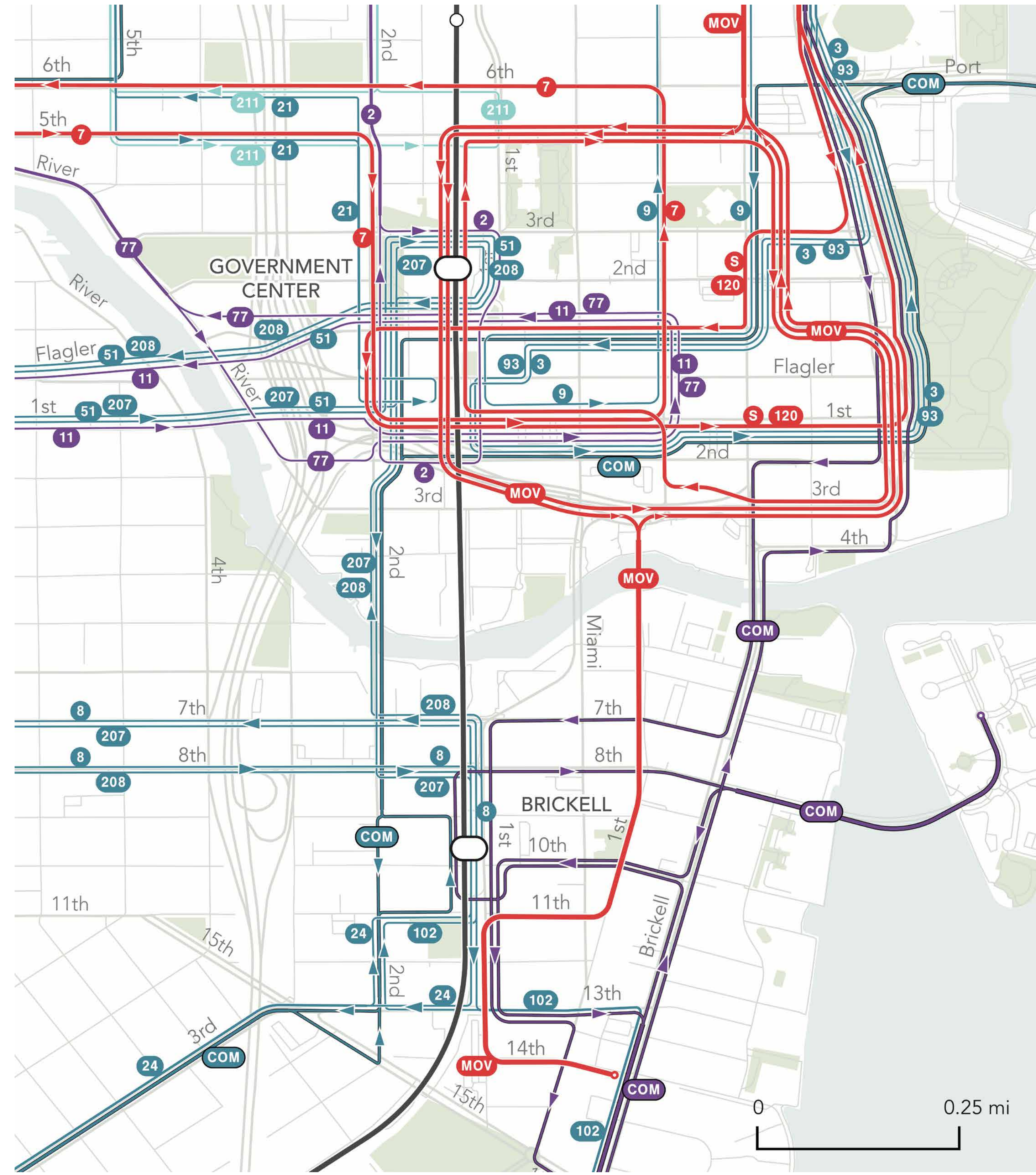


Figure 62: Downtown Miami and Brickell Area Bus Network

Municipal Trolleys Are Highly Duplicative

In 2002, Miami-Dade votes approved a half-penny sales tax levy to fund various transit improvements. The ordinance enacting that levy required that 20% of the tax proceeds go to municipalities to support local transportation improvements and many municipalities use that funding to support local transit services, usually with smaller trolley vehicles. Some municipalities supplement the half-penny funding they receive to expand transit even further than the half-penny funding allows. **Trolleys have generally been overlaid on MDT services, resulting in extensive duplication that may not be the best overall use of tax dollars.** Figure 63 shows a slice of the overall transit network where many City of Miami Trolleys overlap with MDT routes.

The frequency and span of service provided by these trolley routes varies dramatically across the different municipal providers and even within each provider. For example, the City of Miami runs twelve trolley routes (Figure 64) at a range of frequencies. Some City of Miami trolleys running every 15, 20, or 30 minutes. Some of these trolleys run late into the evening and night. Only six of the twelve trolley routes run on Sundays. Miami Beach runs trolleys that vary in frequency of service, but have relatively consistent span of service and operate late into the evening, and seven days a week. The Coral Gables Trolley runs only on weekdays. These three cities account for 70% of trolley ridership in the county and are therefore the primary focus of the Better Bus Project redesign effort.

These three municipalities contract out the operation of their trolley services to a private operator. Currently most trolley routes use high-floor vehicles, meaning there are stairs to enter and exit the vehicles. Miami Beach uses low-floor vehicles for the South Beach Loop and plans to purchase more low-floor vehicles to replace their current high-floor vehicles. The operating costs for each municipality is substantially lower than the per service hour costs that the county.

In some situations municipal operators and MDT have developed a complementary relationship. For example:

- In Miami Beach, the city has taken over operation of the South Beach Loop routes, which it can operate at a lower cost. The productivity of this route is below the MDT systemwide average, therefore having Miami Beach operate the route provides a more coverage-oriented service at a lower per rider cost.

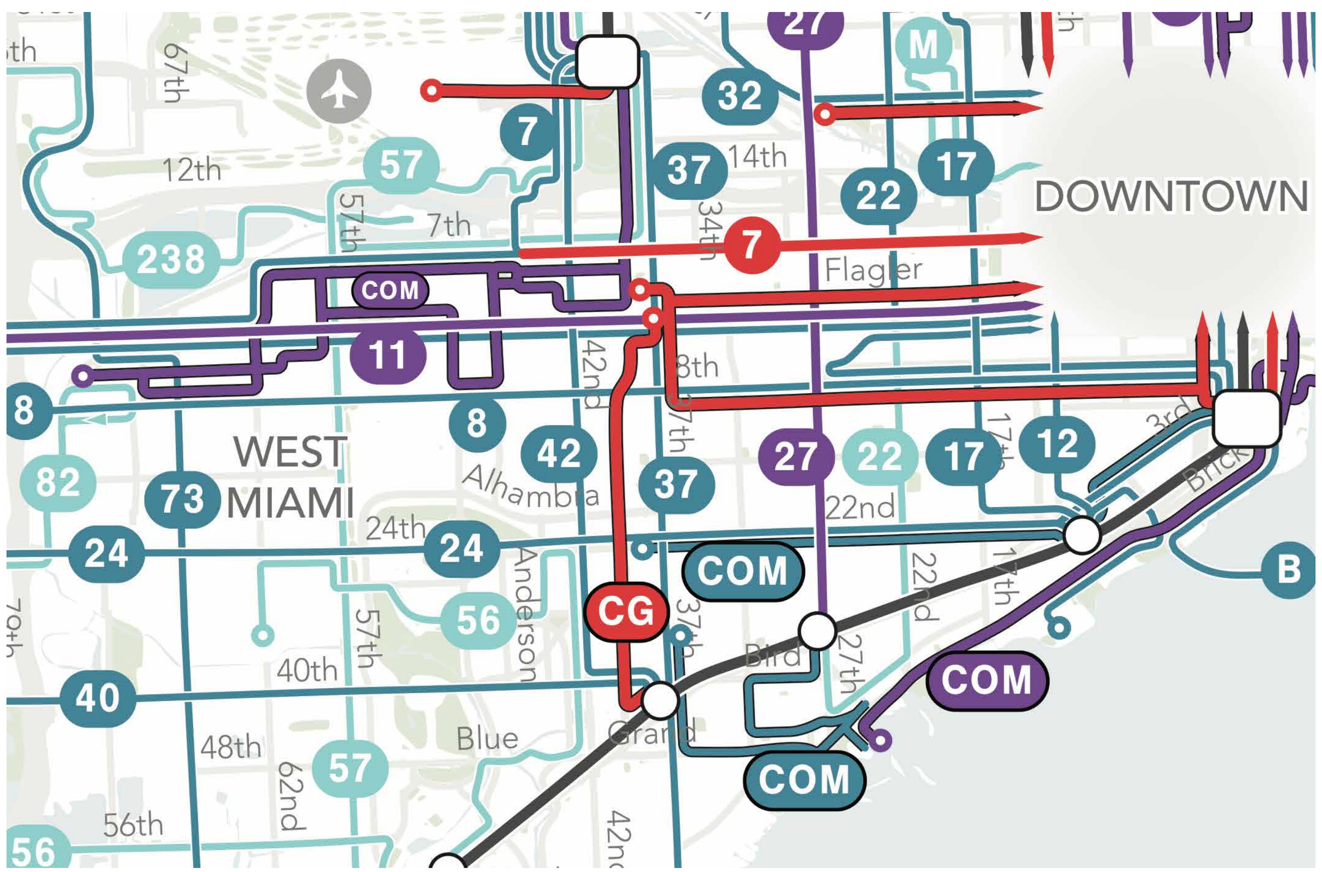


Figure 63: Most of the City of Miami Trolley Routes Overlay Existing MDT Routes

Figure 64: City of Miami Trolley Route Map

Complementary Trolleys Expand Access and Freedom

- In Miami, where the MDT's Route 24 overlaps with the City's Coral Way Trolley, the MDT route makes limited stops and the trolley makes local stops. This allows MDT to operate service slightly faster, saving riders going longer distances time and saving MDT some operating costs.

In other situations, municipal operator and MDT have ended up in less complementary conditions. For example:

- The City of Miami Little Havana Trolley largely duplicates the MDT Little Havana Circulator Routes 207 and 208.
- The Miami Beach Collins Express Route duplicates a significant stretch of MDT Routes S and 120.

A key question for municipal operators is whether they want to be a more coverage-oriented operator, running smaller vehicles on less productive routes and corridors. If so, then the practice of operating routes like the South Beach Loop and the City of Miami Overtown Trolley makes sense. And in response MDT should reduce similar, duplicative services that have low productivity.

If, however, municipal operators want to focus more on high ridership services, on longer corridors line Collins Avenue or Biscayne Boulevard, they will likely encounter some key challenges. First, high-floor vehicles will substantially reduce their productivity by making dwell times at stops much longer. It takes much longer for riders to board and alight a high-floor vehicle with one door. This fact creates less of a problem on low ridership, coverage-oriented routes. But high-floor vehicles increase delays substantially on higher ridership routes.

Second, municipal operators will face the inevitable challenge of overlapping with MDT routes. In situations like Coral Way, the municipal operator can do the local stop pattern and MDT operate in a limited stop pattern, to speed up service. This balance of roles is not always possible in every corridor, however. And this requires having a trolley route of sufficient length that MDT can skip enough stops to justify the substantial change in pattern for riders.

Ultimately, since municipal governments have primary control of their trolley services it is their decision on which direction they wish to go. **A key trade-off, however, is that less cooperation between municipal operators and the county would mean less freedom and access for all potential riders.**

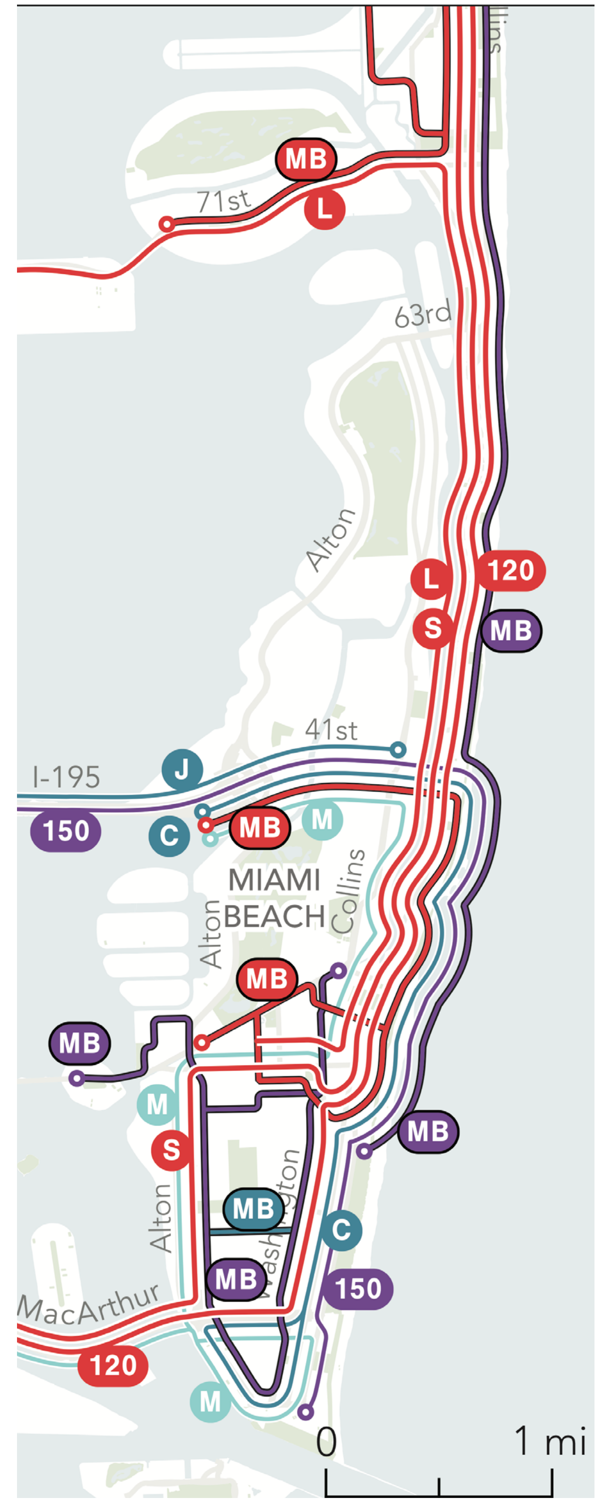


Figure 65: The Collins Express is the most duplicative trolley route in Miami Beach

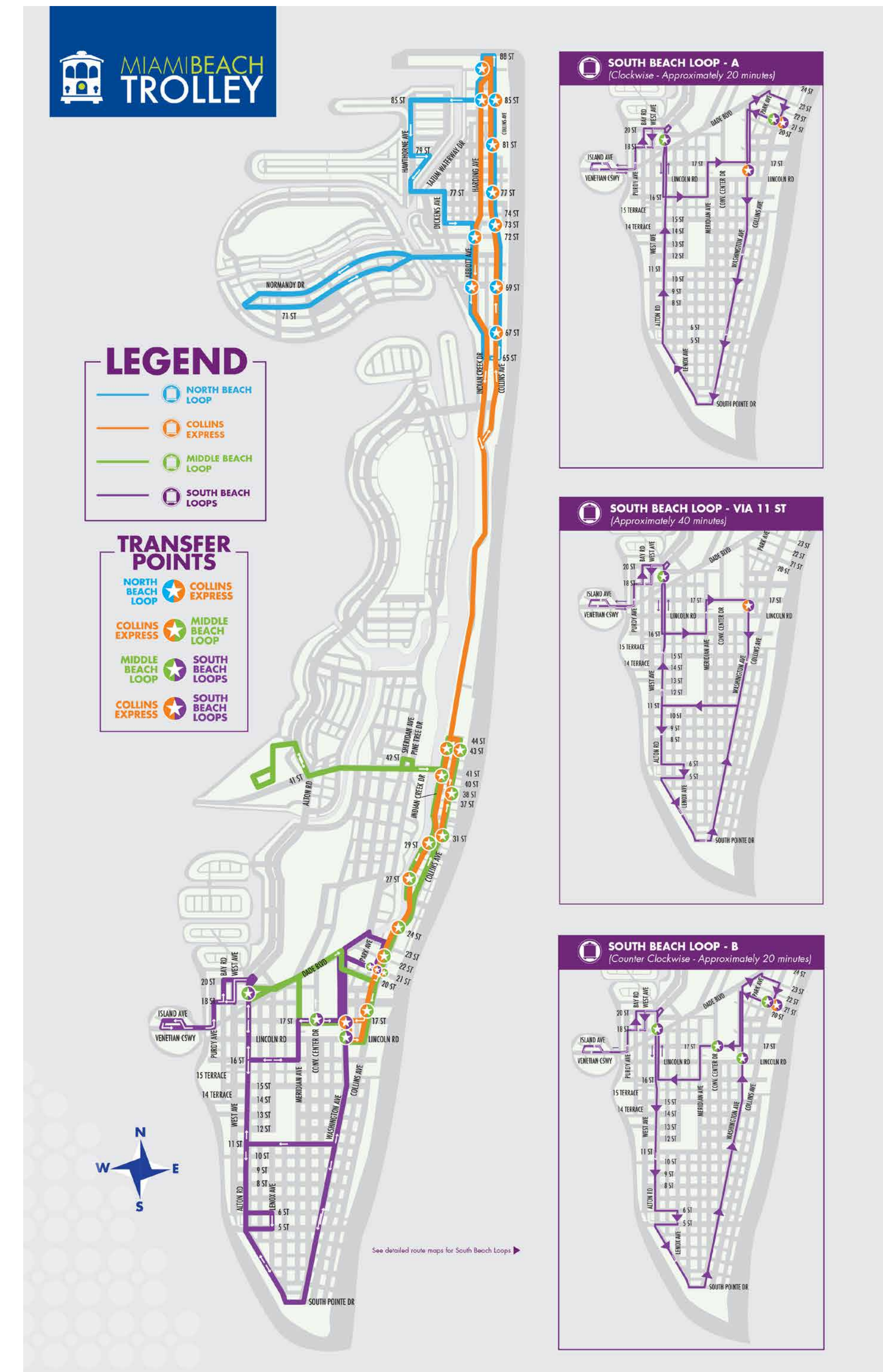


Figure 66: City of Miami Beach Trolley Route Map

6 Key Transit Choices

Key Choice: Ridership or Coverage

Ridership or Coverage?

The most important question governing the design of any transit network: should the service be designed to generate the most ridership (and in doing so, serve a range of other associated goals), or to reach more people?

Ridership-oriented networks serve several popular goals for transit, including:

- Reducing environmental impact through fewer Vehicle Miles Travelled.
- Achieving low public subsidy per rider, by serving more riders with the same resources, and by fares collected from more passengers.
- Allowing continued urban development, even at higher densities, without being constrained by traffic congestion.

On the other hand, coverage-oriented networks serve a different set of goals, including:

- Ensuring that everyone has access to some transit service, no matter where they live.
- Providing lifeline access for those who cannot drive.
- Providing access for people with severe needs.
- Providing a sense of political equity, by providing service to every municipality or electoral district.

Figure 67 provides an illustration of this concept, for a fictional neighborhood where density is shown with dots. Two networks are shown, each with 18 buses. In the Coverage Network on the left, lower-frequency services serve every part of the neighborhood and reach every dot. In the Ridership Network on the right, all the buses are allocated to the two main developed corridors in the neighborhood, providing very high frequency service. However, people living in low-density areas far from that high-frequency service must walk a greater distance to reach it.

Success is defined differently depending upon the goal. A network focused on coverage is not seeking to generate high ridership, so its success should not be evaluated based on its productivity; what matters is the degree to which service is available to the population. On the other hand, when ridership is the explicit goal, the key measure of success is return on investment (in terms of ridership) of every unit of service deployed.

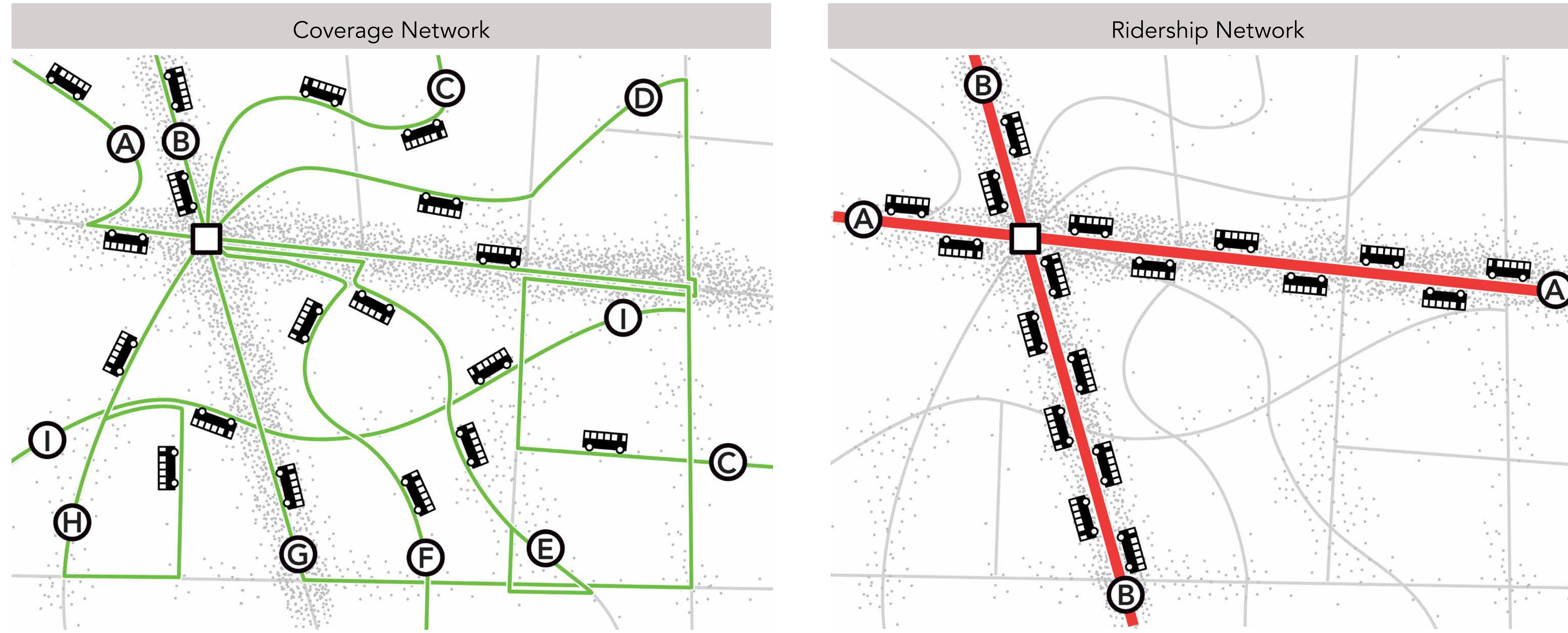


Figure 67: The Ridership / Coverage Trade-off

Ridership and coverage goals are both laudable, but they lead us in opposite directions. Within a fixed budget, if a transit agency wants to do more of one, it must do less of the other. Many agencies act as though these goals were not in conflict, promising that they will "increase ridership while ensuring that all residents have access," or "run efficiently" and "provide access for all." This generally leads to a feeling among the public, elected officials and even transit staff themselves that no matter what they do, they are failing to achieve their goals.

This is the natural result when major goals are in conflict. If a high-ridership bus line is crowded, a transit agency is criticized for not offering enough frequency; yet if they remove buses from a low-ridership line to reallocate them to the high-ridership line, they are criticized for cutting someone's lifeline transit access. Only by acknowledging the conflict between these goals, and explicitly deciding how much effort to use pursuing each, can a transit agency succeed at both.

It is often said about public and private organizations alike that if you want to know what really matters, look at their budgets. High-level policies are valuable, but when they are vague or in conflict, the real evidence of a community's values is in its budget. Thus we suggest that Miami-Dade think about this choice not as black-and-white, but as turnable dial that the community can help to set:

What percentage of the available budget for transit should be dedicated to generating as much ridership as possible, and what percentage should be spent providing transit where ridership is predictably low, but needs are high?

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

We estimate that for Miami-Dade Transit:

- About 70% of the existing transit network is designed as it would be if maximizing ridership were its only goal.
- The other 30% has predictably low-ridership, because of where or when it runs, or other factors that make it useful to predictably-small numbers of people. This suggests that it is being provided for non-ridership purposes.

A 70/30 balance between maximizing ridership and providing coverage may be the right balance for Miami-Dade in the future, or the community may wish for a shift in purpose. The direction of that shift – either towards higher or wider coverage – and how fast Miami-Dade should make such a shift are two questions that will be put to the public, stakeholders and elected officials in the Better Bus Project.

Key Choice: Role of County and Municipal Operators

Many of the dozens of municipalities in Miami-Dade operate their own transit services, usually in the form of city trolley routes. These services are funded mostly from a portion of the half-penny sales tax enacted in 2002. To operate trolley routes, each municipality must have an inter-local agreement and coordinate with MDT on route planning. Yet, the reality is that relatively little coordination has occurred in the past. Thus in most places and most corridors ***trolleys have generally been overlaid on MDT services, resulting in extensive duplication that may not be the best overall use of tax dollars.***

The relationship between county routes and trolley routes has sometimes developed in a complementary way. For example, on Coral Way, MDT runs a limited stop service on Route 24 where the City of Miami runs a trolley service, creating a more complementary service.

To develop a bus network that is most liberating and expands opportunity for more people would require changing trolley routes and county routes to reduce duplication and make the two services more complementary across more of the county.

The Cities of Miami, Miami Beach, and Coral Gables operate some of the highest ridership trolley routes in the county and have agreed to participate in the Better Bus Project to consider changes to their trolley networks in tandem with the county network changes. Other municipalities may decide to become more involved as the network planning process moves forward and the more that do, the greater the chances that the Better Bus Project can result in an overall network that expands liberty and opportunity for more people.

Also, the use of high floor vehicles with one door suggests that the trolleys will be limited to low-ridership areas where the operating challenges of such vehicles causes fewer delays. A higher ridership network would involve separating out services, either onto different streets or into different operating patterns, so that each the county and each municipality maximized its productivity and the productivity of the entire network. It would also require that trolley operators reconsider their current vehicle types.

How should Miami-Dade balance the roles of county routes and the municipal operators?

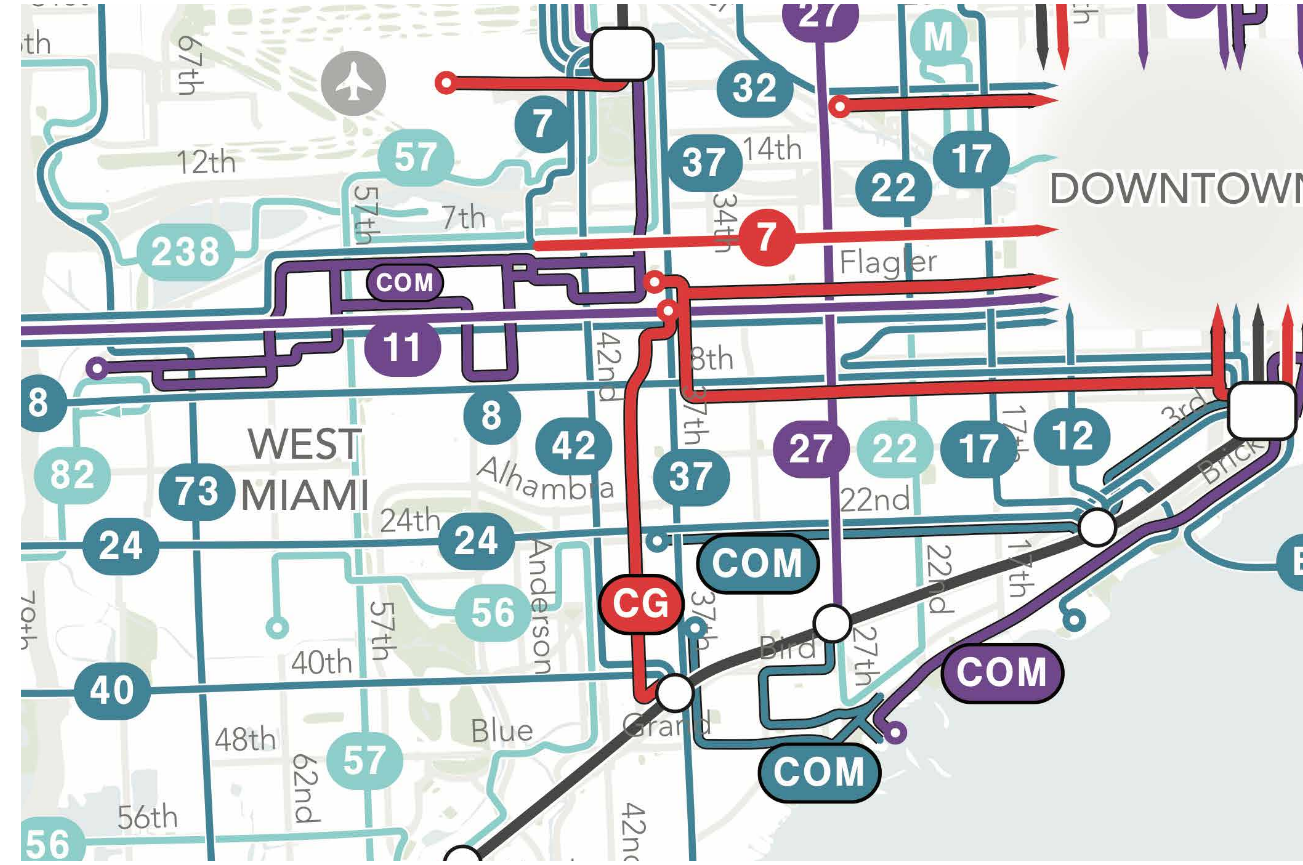


Figure 68: Most of the City of Miami Trolley Routes Overlay Existing MDT Routes

Figure 69: Most trolleys are high floor and low capacity, limiting their usefulness for high ridership service

Key Choice: Stop Spacing

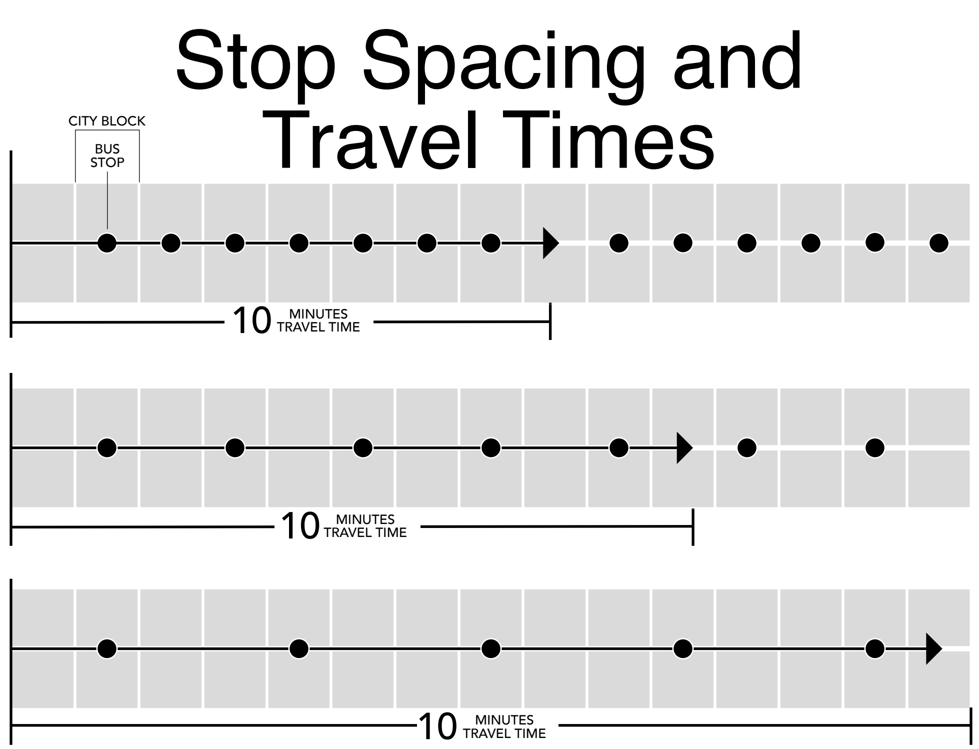
On most local routes in Miami-Dade, stops are about every 850 feet apart, which is about every 1.5 blocks. For most people, it is easy to walk to any of several stops on a route. But a customer does not need several stops; they need one stop. There is a geometric trade-off between closer stop spacing and faster bus speeds. Figure 70 shows the basic trade-off in conceptual terms. As stops are placed farther apart, buses can travel faster and cover more distance in the same time.

This is because most of the time required at a stop is not proportional to the number of passengers served. When there are many stops, passengers spread themselves out among them, so the bus stops more for the same number of people. When passengers gather at fewer stops, stopping time is used more efficiently, resulting in faster operations.

This increased speed has two benefits. First, riders can get farther faster and reach their destinations sooner. Also, as speeds increase across the entire transit system, more service can be provided for the same cost. Since the primary cost of transit service is the cost for labor which is paid based on time worked, the faster buses operate, the more service that can be provided for the same cost. So, higher frequency can be provided or routes can be extended to go farther for the same cost.

This is why standards for stop spacing in the US are generally in the range of 750 to 1,500 feet on high-frequency bus routes. Figure 71 shows the current stop spacing standards for MDT and four peer agencies. In general, MDT is close to its peers, but most peer agencies in the United States have relatively close stop spacing compared to European or Canadian systems.

Figure 70: Trade-off between stop spacing and travel time



There are two major downsides to widening stop spacing. First, some people have difficulty walking and will be inconvenienced by a longer walk. Seniors and people with disabilities are more likely to feel inconvenienced by this change. Second, as stops are spaced farther apart, transit becomes less useful for very short trips. This is because walking distances at each end of the trip increase to the point that very short trips would be faster by walking or biking. Some cities and agencies view this as a good thing, arguing that the point of transit is to provide an alternative to driving, not an alternative to walking.

Miami blocks are typically about 660 feet long. Widening stop spacing to every 2 blocks would result in stops about every 1,320 feet (1/4 mile). Every 4 blocks would result in spacing of about every 2,660 feet (1/2 mile)

One key to a successful revision of stop spacing is for it to be a consistent policy applied in all comparable circumstances across the city, and tied to a clear citywide benefit in travel times. Many transit agencies have successfully widened stop spacing where these benefits were clear.

Figure 71: Current stop spacing standards for MDT and peers

Stop Spacing Standards for MDT and Peers

City (Agency)	Downtown	Urban	Suburban
Miami (MDT)	5 per mile (≈1,000 ft)		3-4 per mile (≈1,500 ft)
New York (MTA Local Bus)	500–750 ft	600–1,200 ft	1,000–1,500 ft
San Francisco (MUNI)	800–1,360 ft		
Boston (MBTA)	1,000–1,300 ft	750–1,300 ft	1,000–1,300 ft
Portland (TriMet)	780 ft	1,000 ft	As needed

Most transit agencies, including Miami-Dade Transit, have networks that draw some compromise between maximizing the number of people who have short walks to a bus stop and maximizing the speed of service by having stops farther apart. It is worth asking the question:

What is more important:
Having very short walks to a stop, even if it means slower service and longer trips?
Or having longer walks to a stop and having faster bus trips and, potentially, more bus service?

Key Choice: Peak or All-Day

Demand for transit service tends to be higher at peak periods during weekday mornings and evenings. These peak periods occur at similar times of day as peak traffic on major streets and highways.

On a typical weekday in Miami-Dade, the number of transit boardings is highest between 6 and 8 AM, and between 2 and 5 PM. At the same time, there is always some demand for transit service outside peak hours and on the weekend.

There are distinct advantages to focusing a transit network on peak-hour services. For example:

- Peak-hour services have the most potential to produce full buses.
- Peak-hour services have the highest potential for traffic congestion relief on regional streets and highways.
- Peak-hour services have the highest potential to relieve individual riders of the stress of driving.

However, focusing on peak-hour services also has real disadvantages and costs, such as:

- Services focused on peak demand require transit agencies to maintain large fleets of buses that sit unused at most times. These buses must be purchased, maintained, stored and replaced on a regular basis.
- Peak-hour services tend to have a higher average labor cost than all-day services because MDT must pay drivers with split shifts a higher rate if their total workday exceeds 12 hours.
- Peak-hour service tends to focus on the commuting needs of full-time office workers. But there are many other reasons to ride transit and many other types of potential riders. If service is only (or mostly) available at peak hours, many potential transit riders may find that they are able to make a trip in one direction but not in another.

Most transit agencies, including Miami-Dade Transit, have networks that draw some compromise between meeting peak-hour demand and maintaining some level of service for the many transit rides that occur at other weekday times and on weekends. However, it is worth asking the question:

What is more important: fully serving higher demand at peak hours, or providing a useful level of transit service all day, everyday?

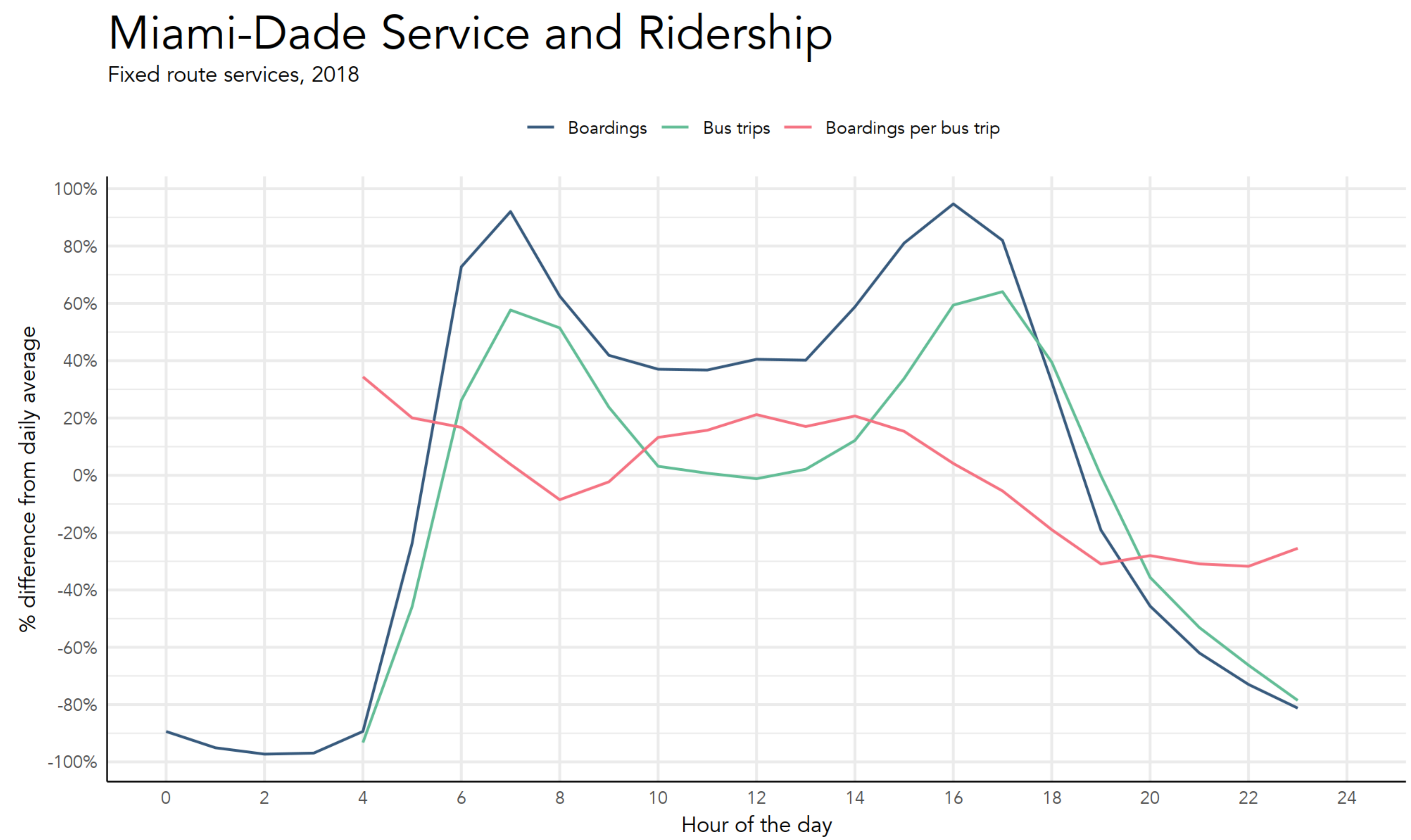


Figure 72: Boardings, Bus Trips, and Boardings per Trip by hour for an average weekday

Next Steps

What happens next?

This Choices Report will inform public and stakeholder outreach as part Better Bus Project. Transit Alliance will be conducting surveys and other outreach efforts during the summer of 2019. That outreach process will include the key choices highlighted here and responses from the public and stakeholders will guide the overall direction on the next steps of the redesign process.

With direction from the public and stakeholders, the study team will design two conceptual networks that can help everyone see more clearly what a more ridership or more coverage-oriented network would look like for Miami-Dade. Maps of those networks and measures like job access change, proximity to service, and speed of service will be summarized in a report for the public and stakeholder to review in the fall. The concepts will then be the center of another public conversation to determine the direction for the redesign of the Miami-Dade bus network.

The outreach process around conceptual networks is expected to start in September and a new survey will be available at that time to provide a new opportunity for additional input from the public. The draft recommended network is expected to be released in December and another survey and round of public meetings is planned to engage transit riders, residents, and stakeholders in the network redesign process.

For more information and to stay involved in the project, go to www.betterbus.miami to

- take the Phase 1 survey;
- sign up for the project newsletter;
- watch videos that summarize key choices and the network redesign process;
- request a phone call, community presentation, or just email and check in with the project team;
- sign up to volunteer or work with Transit Alliance to spread the word and support outreach efforts for the Better Bus Project; and
- generally stay up to date on the latest happenings with the network redesign process!

Better Bus Project

This Choices Report is part of Phase 1 of the Better Bus Project. Future Phases will have more opportunities for transit riders, residents, and stakeholders to participate in the process.

PHASE 1	PHASE 2	PHASE 3
Evaluation	**Concepts**	**Final**
June – August	**September – November**	**December – January**
We are evaluating the current bus system and will release a report in early July.	We will release two different network concepts for discussion and debate.	The final network plan will be voted on by the Board of County Commissioners.
We are surveying riders across the bus system on the key choices that will help determine the design of the new bus network.	We will hold a series of workshops to determine how to shape the final network plan.	If the plan is approved, we will hold information sessions ahead of the plan being implemented in 2020.

Your voice matters! Contact the project team and take the Better Bus Project survey at www.betterbus.miami