



kat **REIMAGINED**

designing better transit together

Draft Network Report

JANUARY 2023

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1 Introduction & Executive Summary

What is KAT Reimagined?

KAT Reimagined is a chance for Knoxville to rethink and reconsider its entire bus network and consider how its transit system is meeting the City of Knoxville’s mobility needs. A bus network 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. This project is a collaboration between Knoxville Area Transit (KAT) & Knoxville Regional Transportation Planning Organization (TPO) and involves riders, the general public, and key stakeholders in conversations about how Knoxville’s bus network should serve its residents, businesses, and visitors.

Today, KAT’s network is the result of decades of cumulative small changes and adjustments. The resulting network may not be meeting the goals and priorities of today’s residents, employers, and institutions. Redesigning KAT’s bus network is an opportunity to review existing and potential transit demand and need, and to design a network that meets those demands and needs most effectively. It is also a key opportunity to carefully think through and weigh competing goals for transit.

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 Knoxville of today and tomorrow, not one based on the past.

What Is the Purpose of This Report?

The Draft Network is presented in this report for the consideration of the public, transit riders, community organizations, workers, businesses, and all other transit stakeholders in Knoxville. **From January 26th to February 28th**, the team is soliciting public input and comments on this Draft Network. Those comments will be considered before the preparation of the Final Network. The Final Network will be delivered to the KTA Board for approval. **The changes shown in the Final Network could start being implemented as early as January 2024.**

After the release of this report, KAT, TPO and City staff and the consulting team will engage the public, current transit riders, and community stakeholders in multiple ways:

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

The public health conditions mean that our study team may adjust our outreach events and processes depending on changes in guidelines and conditions. General information and details on the latest events are posted at

www.katreimagined.com

Technical and Design Work

Questions to the Public

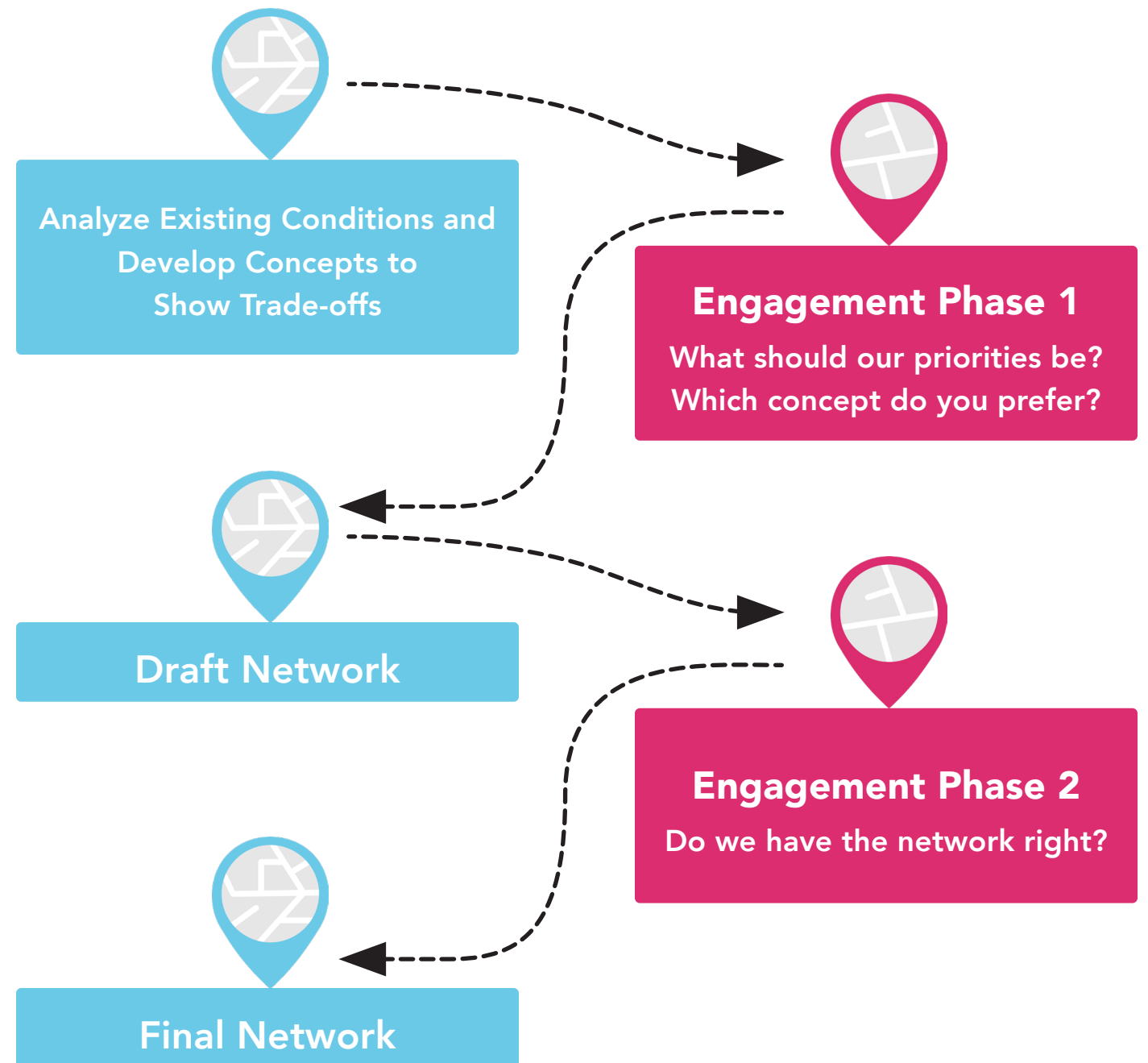


Figure 1: The process of technical work and public engagement for KAT Reimagined.

The Product of Transit: Access

Public transit can achieve many goals, but a commonly held goal for transit is to help people access opportunities: work, shopping, medical needs, education, and all the economic, social, cultural, and natural riches that a community has. Everyone has a limited amount of time in their day and, therefore, can only spend so much time traveling to meet their needs. Maximizing the people and places that people can reach in a limited amount of time is something we can calculate in assessing how well transit is meeting this goal. Figure 2 shows how we calculate this.

What Access Achieves

When we expand access for as many people as possible, we achieve many important things:

- We **make service more useful** for the trips people are already making and for many other trips that people might want to make by transit. When transit is more useful, more people use it.
- We **increase ridership potential**, as a result of service being more useful.
- We increase transit's potential to help with **pollution and congestion**. Ridership is the key to how transit achieves these things, and improving access is the path to ridership.
- We **expand access to opportunity** (jobs, education, shopping, services) for people who need transit for that purpose.
- We **increase the economic attractiveness** of the urban area. Connecting people with opportunities is the whole point of cities, so improving those connections makes any community more effective.

That's why the Draft Network looks as it does.

The Draft Network increases access to jobs and opportunities for most people and places in Knoxville. The average Knoxville resident could reach 2,400 more jobs, a 16% increase over today's network.

The network is also designed to achieve access equitably. Low-income people and people of color experience, on average, a 20% and a 24% increase in access, respectively.

WHAT IS ACCESS?

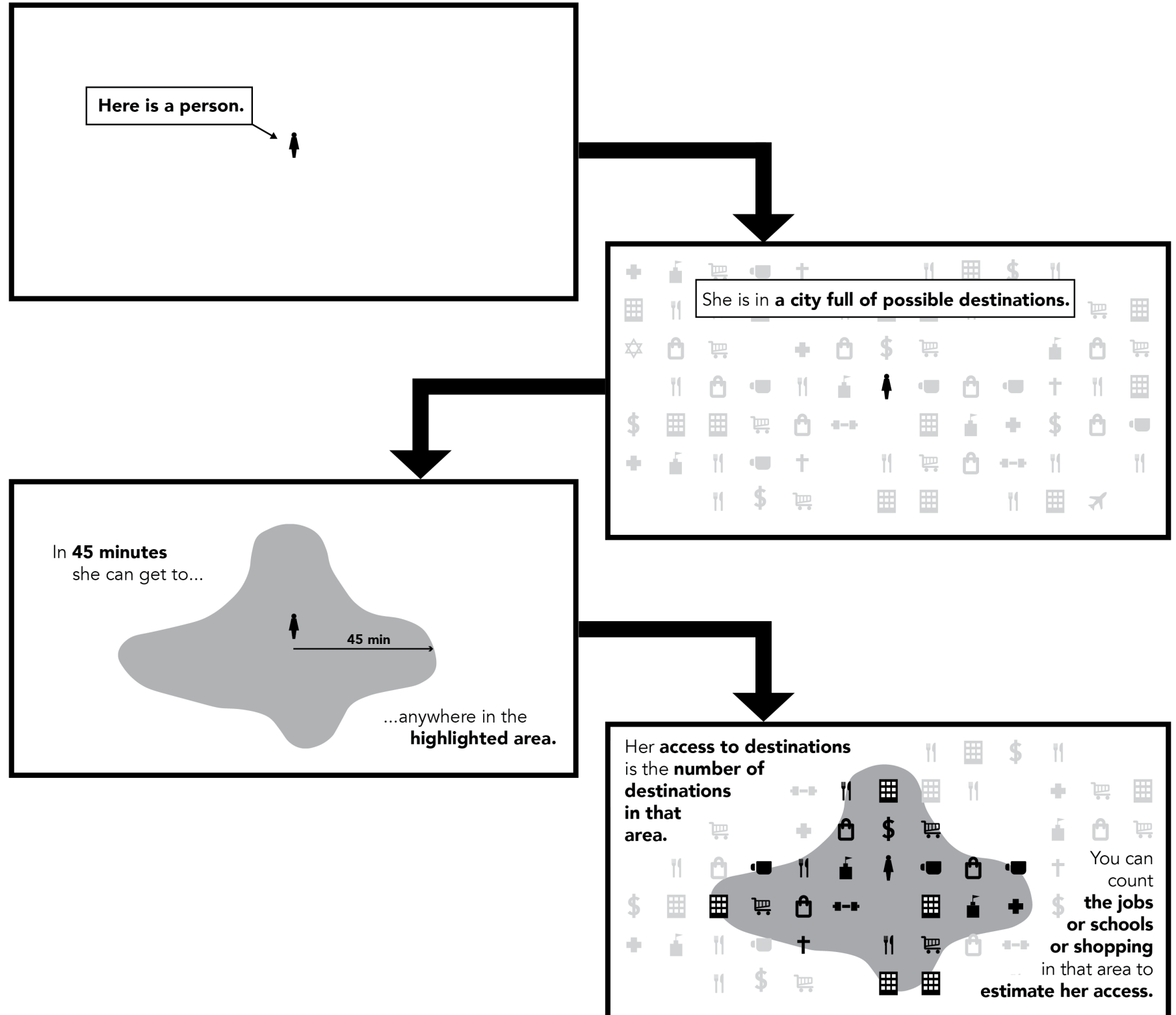


Figure 2: How transit service creates access to opportunity.

How the Plan Expands Access

Frequency is Freedom

Transit travel time has three elements: **walking**, **waiting**, and **riding**. If a trip requires changing buses, the steps may be repeated. When we talk about how far you can go in a particular amount of time, we are counting all parts of the trip, from the time you leave home to the time you reach a destination.

Waiting is often the most onerous part of a transit trip. Some people can wait for an infrequent bus at home or in a cafe, but for everyone, waiting is time spent not where you want to be. For some riders, waiting may involve being in a place where they don't feel safe, or exposed to severe weather.

The solution to the problem of waiting is frequency. Frequency—the amount of time between one bus and the next on a route—is a dominant factor in determining travel time, so it's a core focus of any plan that tries to expand where people can go in a reasonable time. Figure 3 shows the elements of transit travel time.

Frequency does three good things:

- **It reduces waiting**, the most onerous part of a transit trip.
- **It makes it easy to transfer**, from one route to another, so that you can go all over the network instead of just to other places on the route you live on.
- **It improves reliability**. (If a bus breaks down, the next will be along soon.)

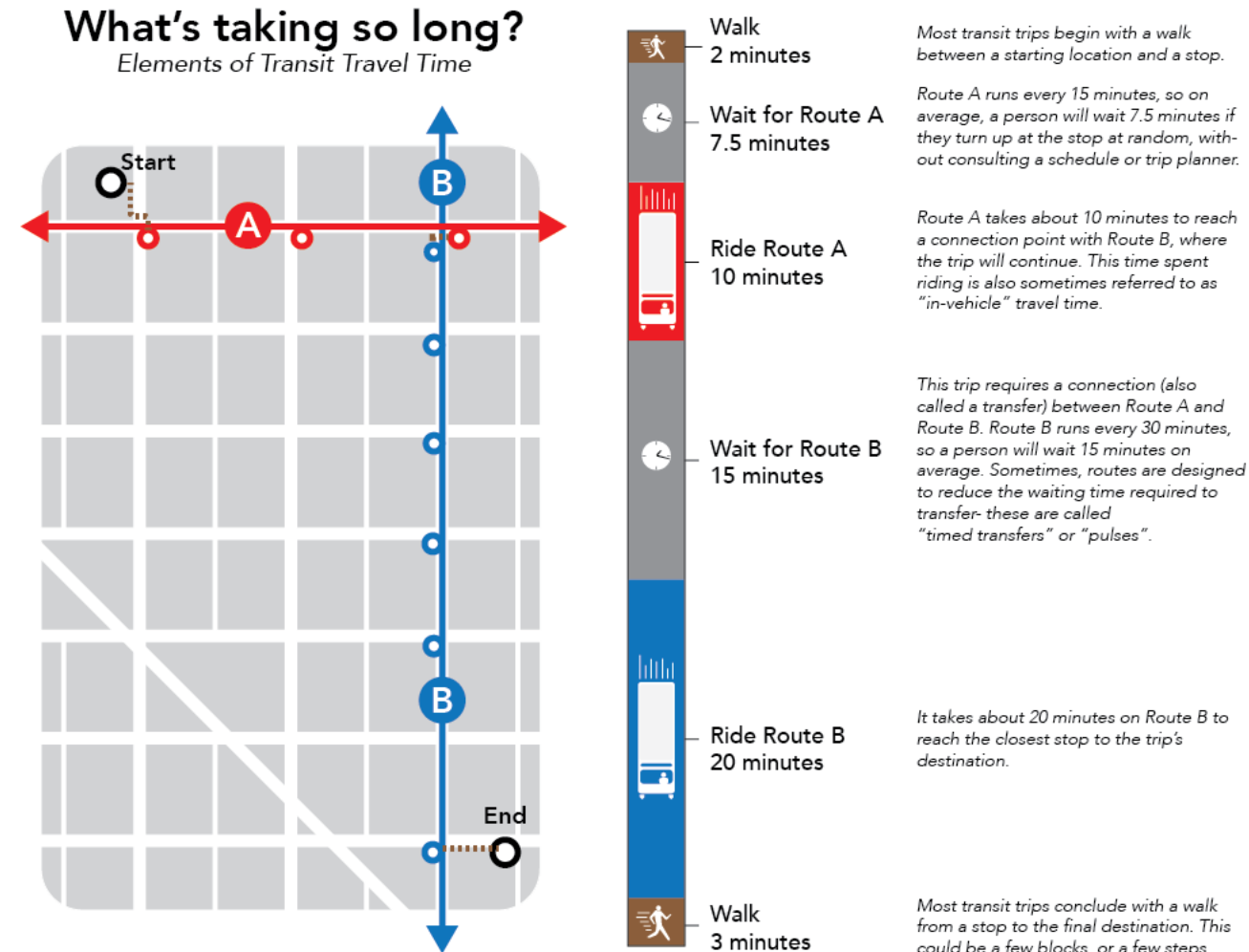


Figure 3: Waiting is an important part of a transit trip. A route that comes every 30 minutes requires, on average, a 15 minute wait. A route that comes every 15 minutes requires, on average, a 7.5 minute wait.

Draft Network

The map on the right (Figure 4) shows the Draft Network. Every route is color-coded based on its frequency during the midday on a weekday.

- **Dark red** lines every 12 minutes or better;
- **Light red** lines every 15 minutes;
- **Dark blue** lines every 30 minutes; and
- **Light blue** lines every 60 minutes;

Based on the KTA Board's resolution, the Draft Network has been designed to assign 70% of resources to goals that can achieve high ridership and 30% to provide coverage. This is done by consolidating duplicative resources and moving some resources from coverage service to ridership (or higher frequency) service. These changes are described in more detail starting on page 18.

For most people and places, the Draft Network improves access to jobs, people, and opportunities by transit. It does this by providing more frequent service along the busiest and densest corridors. Specifically, there would be frequent service on Cumberland/Sutherland, Western, and Magnolia.

To be able to provide these increases in frequency, some areas lose service. For example, no service is provided to areas along Washington Pike where Route 23 is today or along Merchant Drive and Cedar Lane where Route 90 operates today.

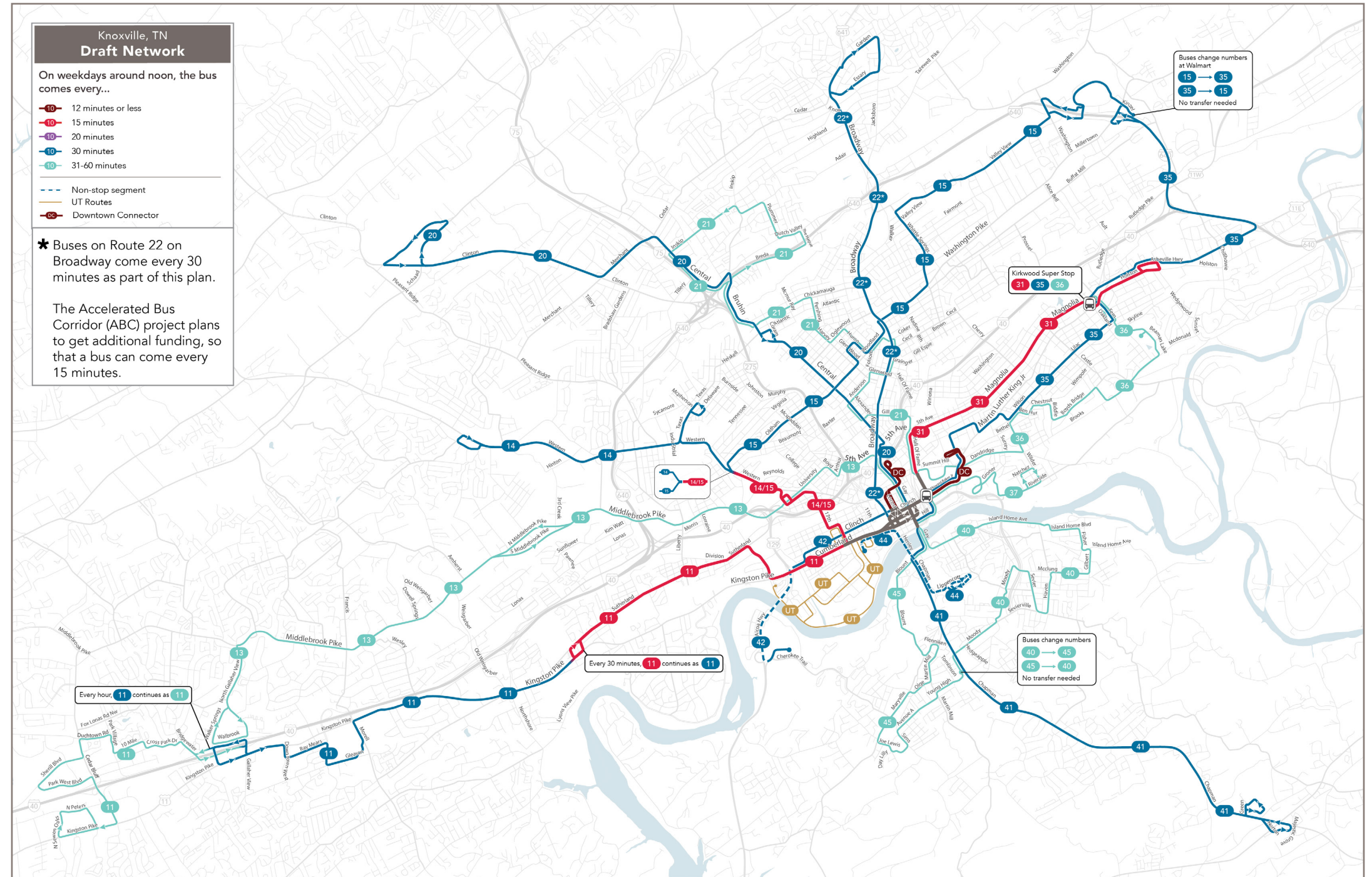


Figure 4: The Draft Network with routes color-coded by frequency.

Outcomes

The charts on this page compare the Draft Plan to the Existing Network. For the purposes of this report, the Existing Network refers to the Network that KAT was running in 2019, before the COVID-19 pandemic.

Change in Access to Jobs

The Draft Plan allows the average person to reach 17,800 jobs within 45 minutes by walking and taking transit, **16% more jobs than are reachable within the existing network.**

For the average person in poverty, the number of jobs accessible by transit within 45 minutes would increase by 20%. For the average resident of color, jobs accessible would increase by 24%.

This analysis measures jobs, but it reflects a wide range of opportunities that a person can reach. This means a person can get to more shopping, education, recreational areas, social events, places of worship, and any other opportunities that the region can offer.

Proximity to 15-Minute Service

The Recommended Network provides 15-minute service near (within 1/2 mile of) 12,000 more residents and 8,200 more jobs—that’s 79% more residents and 23% more jobs than in the Existing Network.

With the Draft Network, residents near Knoxville Station can reach 8,200 more jobs in 45 minutes.

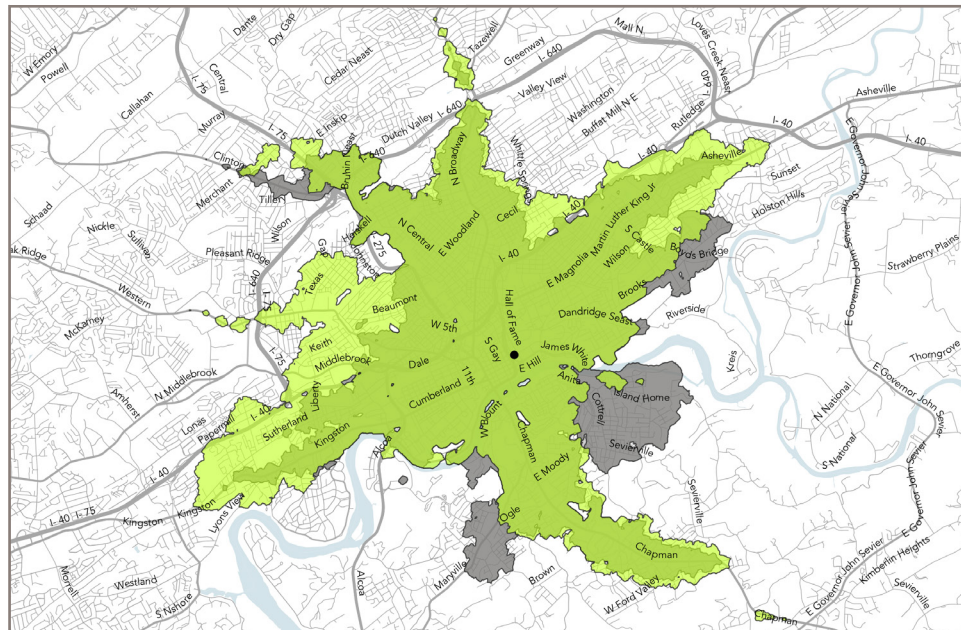


Figure 5: Example of change in places reachable in 45 minutes from Knoxville Station in the Draft Network, compared to the Existing Network

Change in Average 45-Minute Job Access

At midday on weekdays, the average number of jobs accessible by transit within 45 minutes by different groups

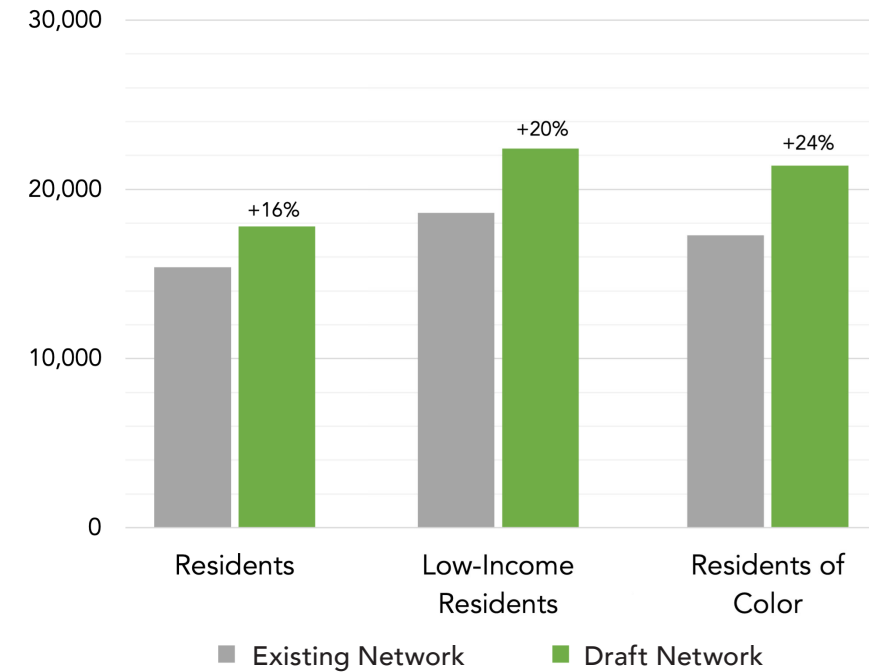


Figure 6: Jobs reachable for the average resident, the average low-income resident, and the average resident of color.

The Draft Network allows the average resident to reach 16% more jobs in 45 minutes.

What can I do?

How to use this Report?

This report shows the Draft Network in detail. To assess this Draft Network and how it fits your goals for transit, we suggest you:

- Look at the maps starting on page 18, find the places you care about and note the nearby routes and their frequencies (as indicated by the color). Route numbers in the Draft New Network may not match existing route numbers.
- Consider how all the routes connect various parts of the whole region. Remember that no bus network can provide direct service to and from every origin and destination, so look at how routes connect with each other.
- Frequencies (how often) and spans (how long) of every route in the Draft New Network can be found in the tables on page 22. This tells you when the route (or routes) you care about run and at what frequencies.
- For information about how the Draft New Network would affect access to jobs, look at the job access maps starting on page 25.
- If you care about proximity to transit, look at page 30, which describes how many people and jobs are near any transit service and near frequent service.

What is in the rest of this report?

How did we get here?

In Chapter 2, we describe the steps we have gone through to design the Draft Network. We explain how we analyzed the existing network, the key choices we considered, the conceptual networks we developed, and the first engagement phase.

Draft Network

In Chapter 3, we describe the Draft Network in detail. We go through the routing changes in the network but also the changes to the frequency along corridors and how long buses run on weekdays and weekends.

Comparing Outcomes

In Chapter 4, we analyze the Draft Network to the Existing Network by comparing the change in access to opportunities that residents throughout the city will experience. We also take a look at the change in residents near transit service.

Next Steps

In Chapter 5, we explain what happens next and how you can get involved throughout the engagement phase.

How to get involved

For more information and to stay involved in the project, go to www.katreimagined.com and:

Learn More

- Get more background on the project
- See scheduled events
- Sign up for project emails

Give Input

- Take the [online survey](#)
- Sign up for our online meeting
- Connect via social media

Share with Others

- Find videos, articles and reports to share
- Request a community presentation

2 How did we get here?

Steps to Design the Draft Plan

Designing the Draft Plan has been collaborative effort between KAT, TPO, the City of Knoxville, riders, the general public, and key stakeholders. These are the steps we have taken to reach this design.

Step 1. Analyze the Existing Network

We assessed the performance of existing routes and the network as a whole. By looking at ridership and land use patterns in Knoxville, we learned about how the network is used today and where there is potential for improvement.

Step 2. Consider Key Goals

There are different ways to design a transit network based on the community's goals and priorities. In particular, we can concentrate along dense corridors to provide frequent service and achieve high **ridership** or we can provide **coverage** to large areas to with low frequency service. We considered these goals to help understand what the network could look like.

Step 3. Develop Concepts

To illustrate the tradeoff between ridership and coverage, we developed two contrasting conceptual networks. These are the opposite ends of a spectrum for what the network could be.

Step 4. Engagement on Concepts

We had an extensive phase of engagement with riders, the general public, and key stakeholders about the key goals of transit. We asked their preference between the conceptual networks to understand what the public wants the future of KAT to be.



Step 1. Analyze the Existing Network

To understand how the network functions, our first step was to analyze the existing network. We looked at every route individually as well as the network as a whole. Ridership patterns told us when and where the network is being used today. Yet, we didn't just look at ridership numbers, we also compared them to the level of service provided to understand how productive each route is. The chart on Figure 8 shows the productivity of each route by their midday frequency. We generally saw that higher frequency routes are more productive.

Because existing ridership patterns only reflect how people can travel with the current layout of the network, we took a deep look at the land use patterns in Knoxville. We analyzed demographic data including residential density, job density, low-income resident density, and density of minorities. This gave us a better understanding of where activity is concentrated in the region. We learned where there is a strong market for transit and where there is a significant need for transit.

And finally, we analyzed how the current network uses its resources. A transit network can focus its resources on providing high frequency along dense corridors that can yield high ridership or spreading the service out to provide coverage. Our analysis indicated that the existing network uses 50% of its resources to achieve high ridership, 40% to provide coverage, and 10% of the network is duplication. The next step further explains this trade-off.

For more information about the analysis of the Existing Network, see the Transit Choices & Concepts Report. You can download it from katreimagined.com/library.

**The existing network uses:
50% of resources to achieve high ridership,
40% to provide coverage, and
10% of the network is duplication.**

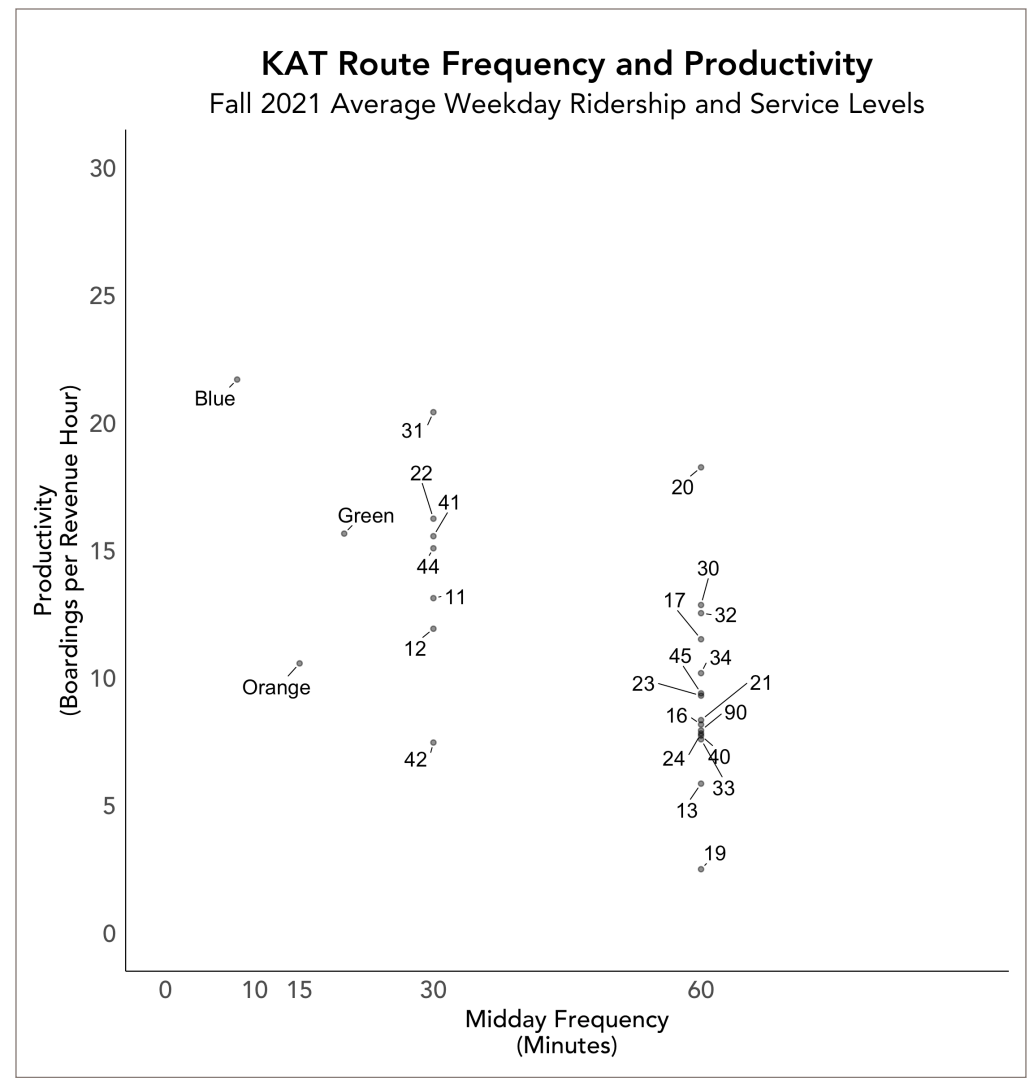


Figure 8: Productivity and midday frequency for all KAT Routes

Residential Density

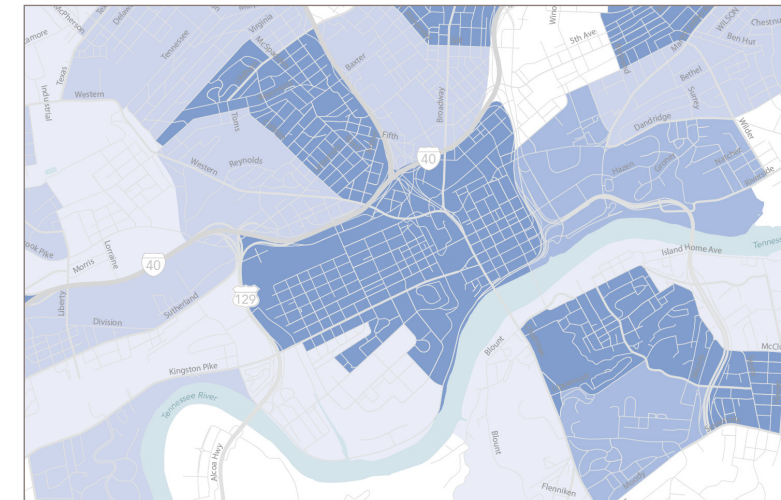


Figure 7: Demographic data, including residential density, was analyzed to determine where are the strongest markets for transit and where there is a significant need for transit.

Ridership

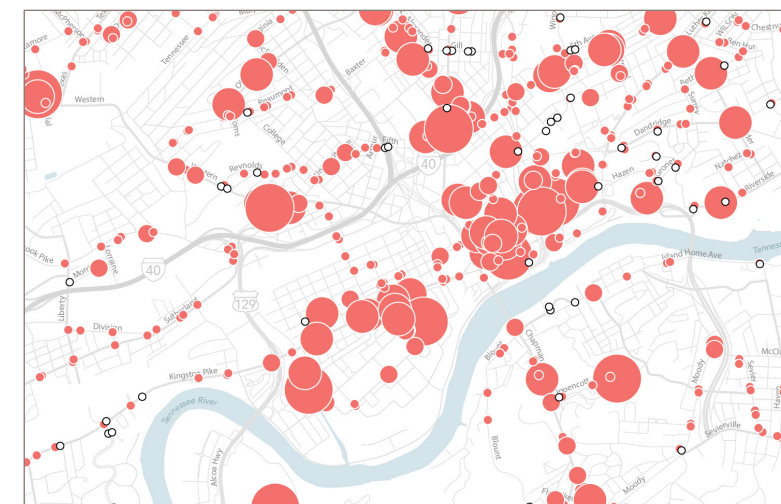


Figure 9: Ridership patterns were evaluated to understand how the network is used today.

Step 2. Consider Key Choices

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

Possible goals for transit include:

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

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

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

KAT receives many different comments requesting changes to the service in order to pursue these goals, but it has a limited budget, so doing more of one thing can mean doing less of another. That's why we need hear what your priorities are.

Transit's 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 town in Figure 10. The little dots indicate dwellings and commercial buildings and other land uses. The lines indicate roads. As in many towns, most activity is concentrated around a few roads.

A transit agency pursuing only ridership would run all its service on the main streets because 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 on the left.

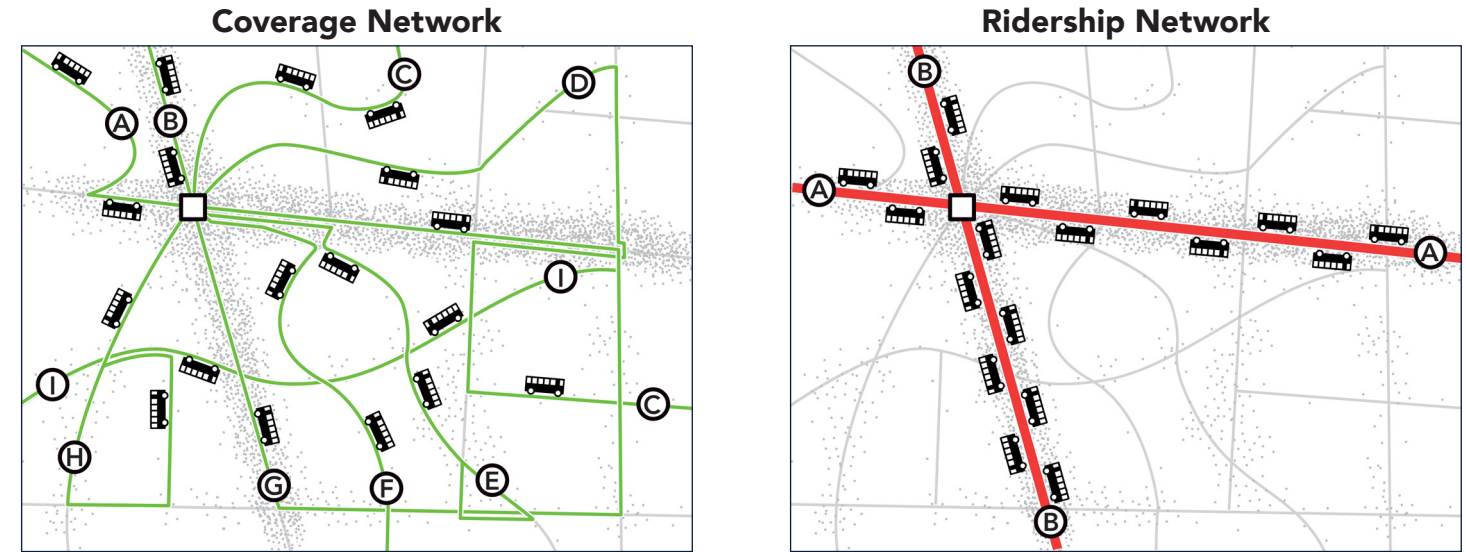


Figure 10: The network on the left is prioritizing coverage goals, while the network on the right is prioritizing ridership goals.

If the transit agency were pursuing only coverage, it would spread out so that every street had some service, as in the network on the right. 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.

Step 3. Develop Concepts

To clarify the trade-off between Ridership goals and Coverage goals in Knoxville, the consultant team and KAT staff worked together to create two conceptual transit networks. Sections of each network are shown in Figure 11.

The Coverage Concept

- slightly expanded the number of people that are close to transit service overall.
- used 50% of resources to achieve high ridership and 50% of resources to provide coverage.
- removed duplicative service and reinvested into covering new places where transit doesn't go today.
- only had routes with a frequency of 30 or 60 minutes.

The Ridership Concept

- provided much higher frequency along the City's most active and walkable corridors, but some people in lower density areas would lose bus service.
- invested 80% of resources into frequency that can yield high ridership and 20% into coverage.
- had five high frequency 15-minute routes that many people would find useful.
- removed service from many places to be able to provide this high frequency service.

For more information about the Concepts, see the Transit Choices & Concepts Report. You can download it from katreimagined.com/library.

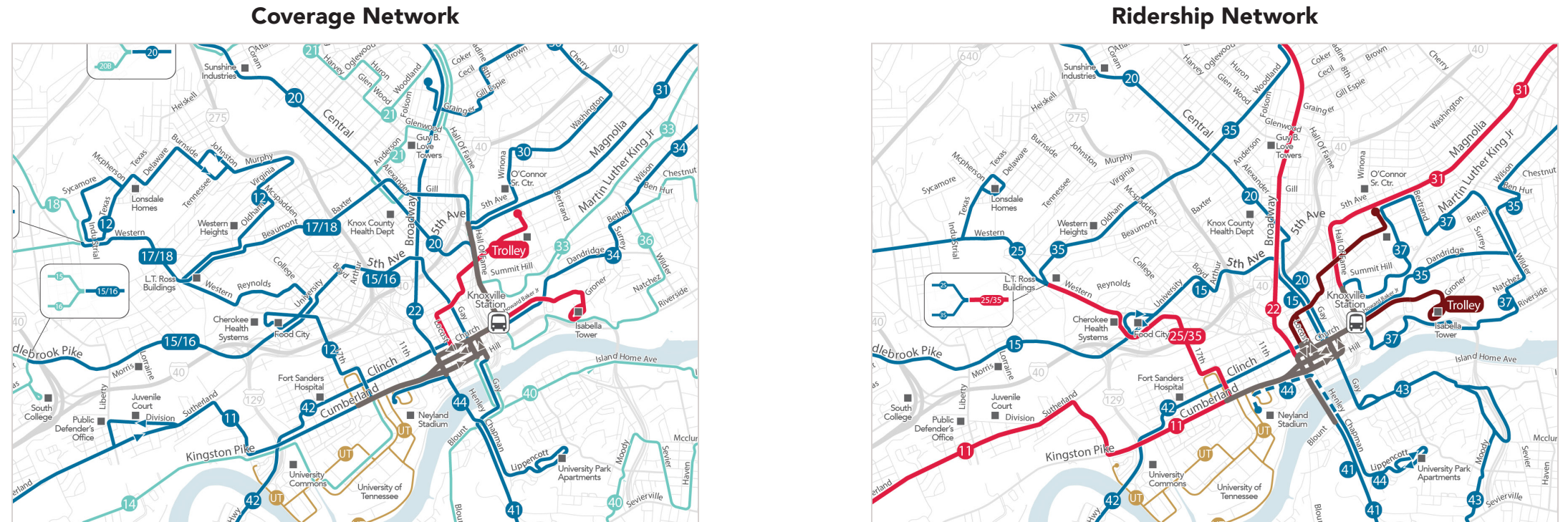


Figure 11: The Coverage and Ridership Conceptual Networks show different ways to use the same dollars to provide transit service in Knoxville.

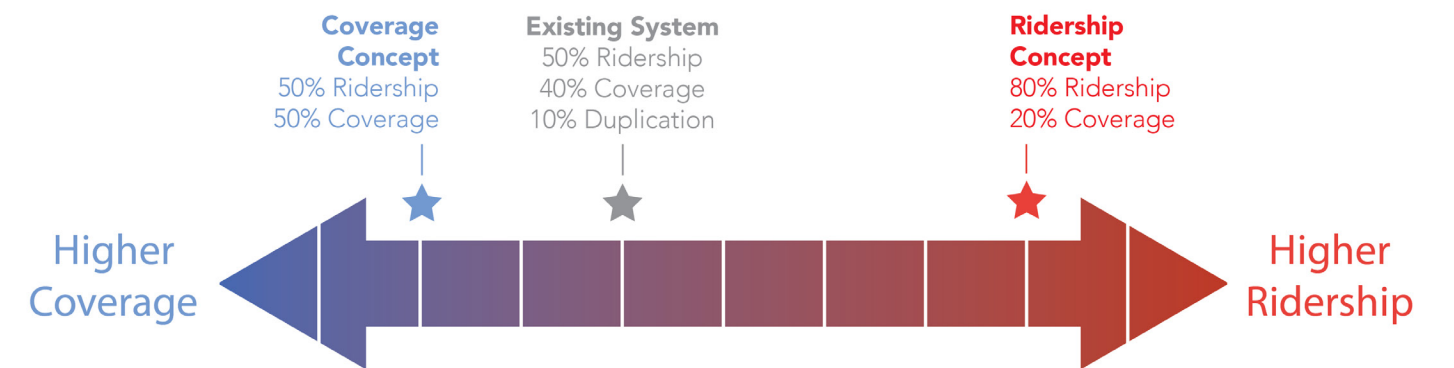


Figure 12: The conceptual networks are the opposite ends of a spectrum.

Step 4. Engagement on Concepts

By showing the public, stakeholders, and decision-makers the range of possibilities, we asked: **“Now that you see the outcomes of emphasizing one goal over another, how do you balance the Ridership and Coverage goals? In other words, if you want better service, what is your definition of better?”**

These conceptual networks developed were used to explain the trade-offs between ridership and coverage goals and ask the public which one they prefer.

We asked respondents which of the two network concepts they preferred. Of all who provided a response, 57% preferred or definitely-preferred the high-ridership scenario, while 43% preferred or strongly-preferred the high-coverage scenario. Between the two scenarios, most respondents tended to express more of a slight preference than a strong preference. Only 23% strongly preferred the Ridership Concept and only 19% strongly preferred the Coverage Concept. So, most respondents had a weak preference.

Another way to think about the trade-off is walking versus waiting. Transit services can be spread out on more streets, which means shorter walks to buses that come less often. Conversely, transit services could be more concentrated on a few streets, which means longer walks to buses that come more often. We asked respondents how they felt about this trade off in general. Of all who provided a response, 53% preferred or strongly preferred to shorter waits, while 46% preferred shorter walks.

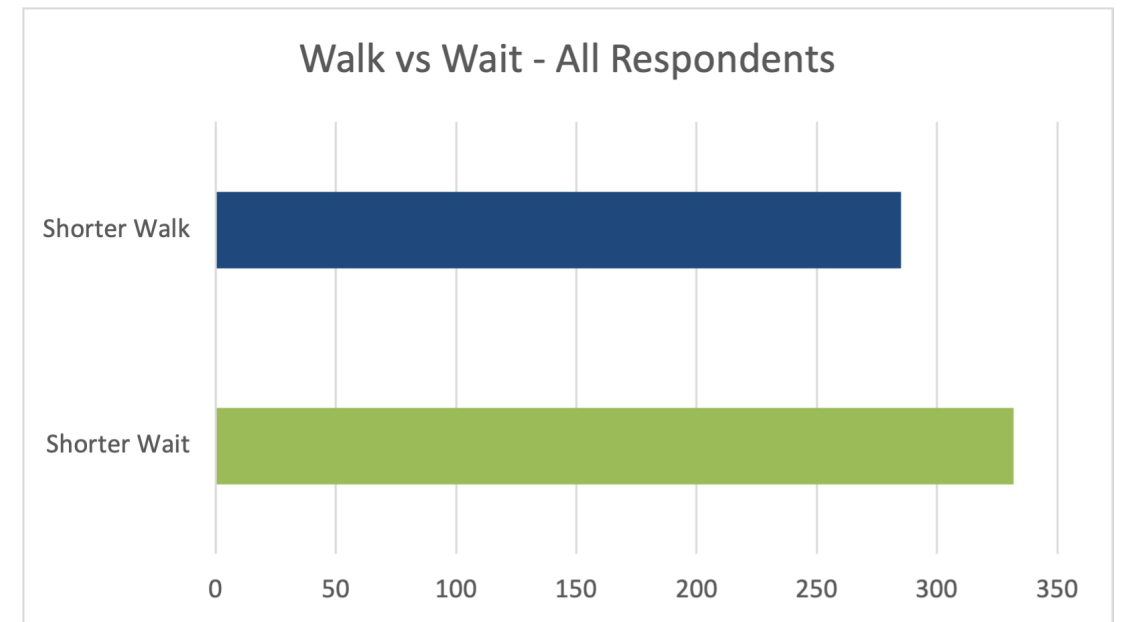
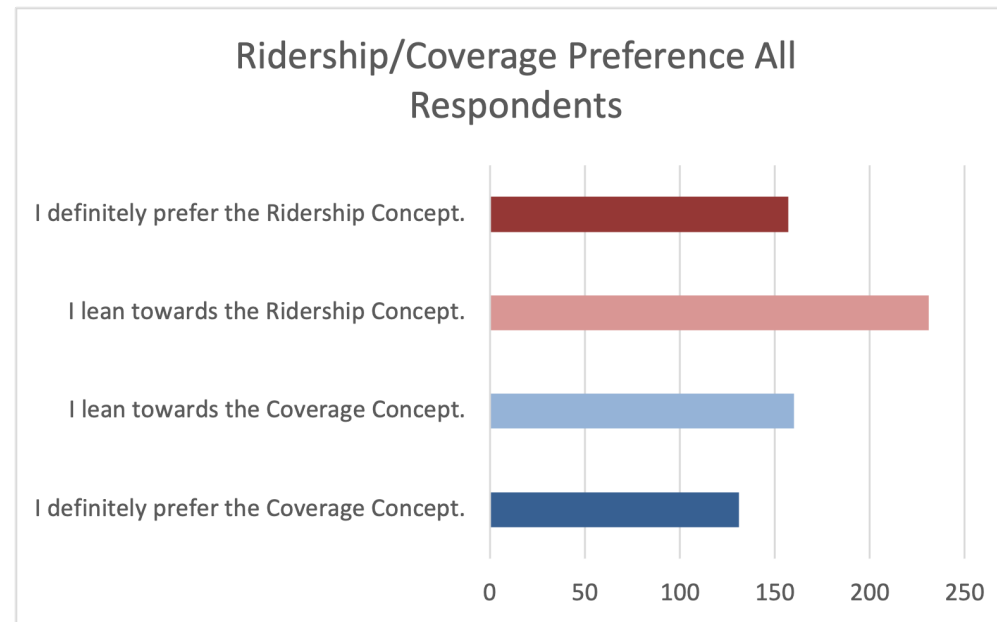


Figure 14: Survey respondents suggest a shift towards ridership from the Existing Network.

Policy Direction

The public survey responses were presented to the Knoxville Transportation Authority Board (KTA) to help them make a decision on how resource should be allocated between ridership and coverage. **On May 26, 2022 the KTA Board voted on a resolution to assign 70% of the transit operating budget to maximize ridership and 30% of the transit operating budget to maximize geographic coverage. This is a change that would mean shifting the budget from coverage to ridership.**

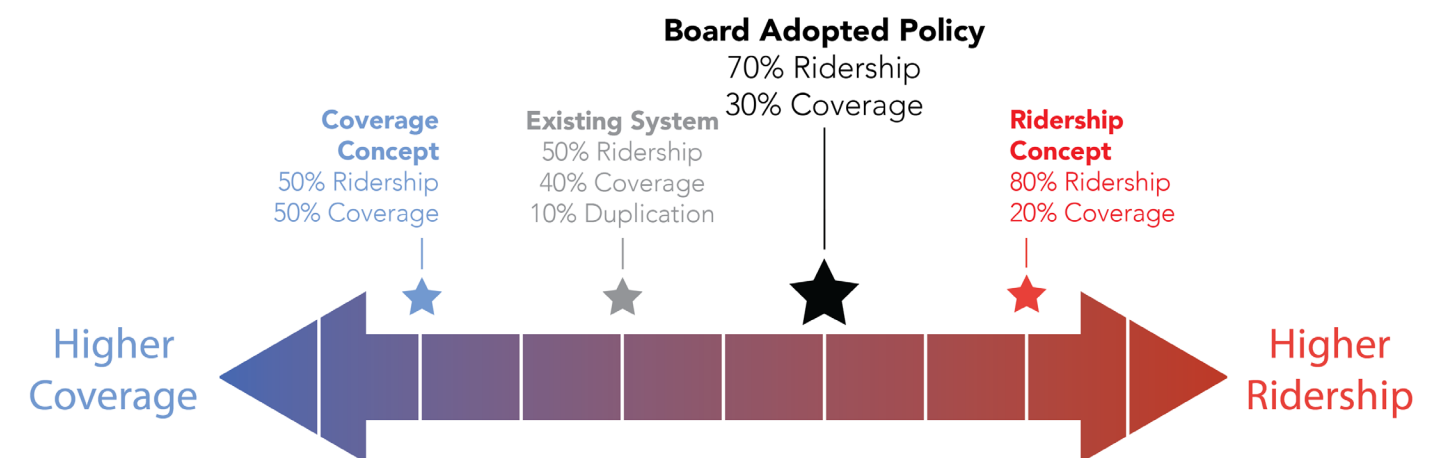


Figure 13: The board adopted policy is to design a new network that allocates 70% of resources towards achieving high ridership and 30% of resource to provide coverage.

3 Draft Network

Existing Network

The map on the right (Figure 15) shows KAT's existing bus network and the map on the following page shows the Draft Network.

In both maps, every route is color-coded based on its frequency during the midday on a weekday. In the network maps, colors make all the difference:

- **Dark red** lines every 12 minutes or better;
- **Light red** lines every 15 minutes;
- **Dark blue** lines every 30 minutes; and
- **Light blue** lines every 60 minutes;

Except for the trolleys, every bus route in KAT's network operates every 30 minutes or worse at midday.

The Existing Network uses 50% of resources towards service that can achieve high ridership, 40% is spent on coverage goals, and about 10% of the network provides duplicative service.

Route 44 is a specialized service with a separate funding source and any change to its service level is separate from this study.

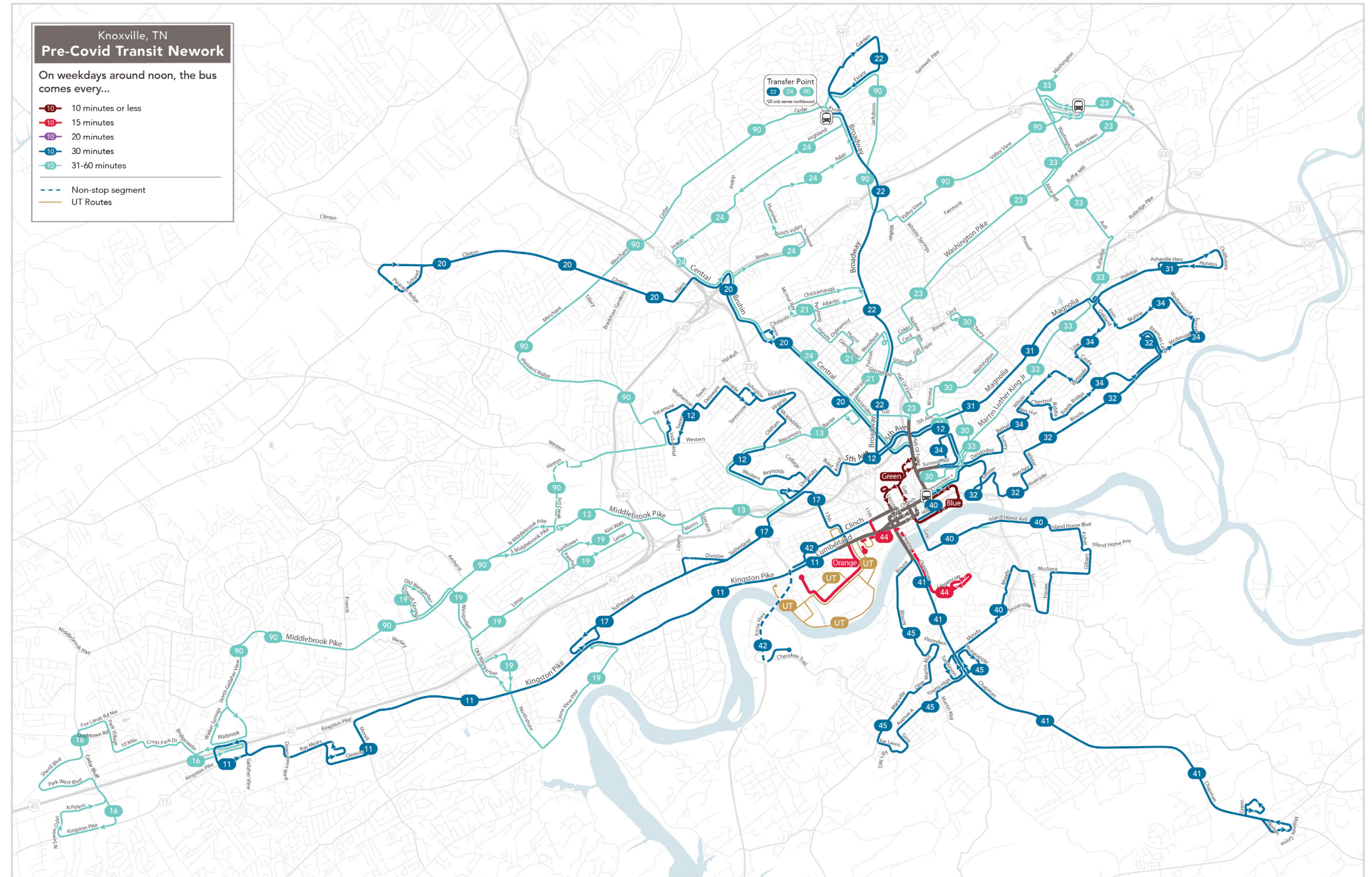


Figure 15: KAT's Existing Network with routes color-coded by frequency.

Draft Network

The Draft Network, shown on the right, concentrated more frequent service where there are more people, jobs, and opportunities. Based on the KTA Board's direction, this network was designed to allocate 70% of resources towards service that can achieve high ridership and 30% to provide coverage.

The Draft Network concentrates frequent 15-minute service on the most dense and active corridors, with frequent service on Cumberland/Sutherland, Western, and Magnolia.

The cost of these investments in frequency is that some areas lose service. No service is provided to areas along Washington Pike where Route 23 is today, along Merchant Drive and Cedar Lane where today's Route 90 is, or along Lonas Drive where Route 19 runs today.

In other places, routes are consolidated so people will have to walk farther to reach a bus stop, but, in general, buses are coming more frequently. This happens along Martin Luther King Jr Ave. Since people have to wait less for a bus, this results in great access meaning that, on average, most people can get to where they are going in less time.

Route 22, on Broadway, has buses coming every 30 minutes as part of this plan despite being a very dense corridor. However, The Accelerated Bus Corridor Project (ABC), includes the addition of service that will increase service on Route 22 with buses coming every 15 minutes. The project also includes improvement to Broadway that would increase bus speed and reliability.

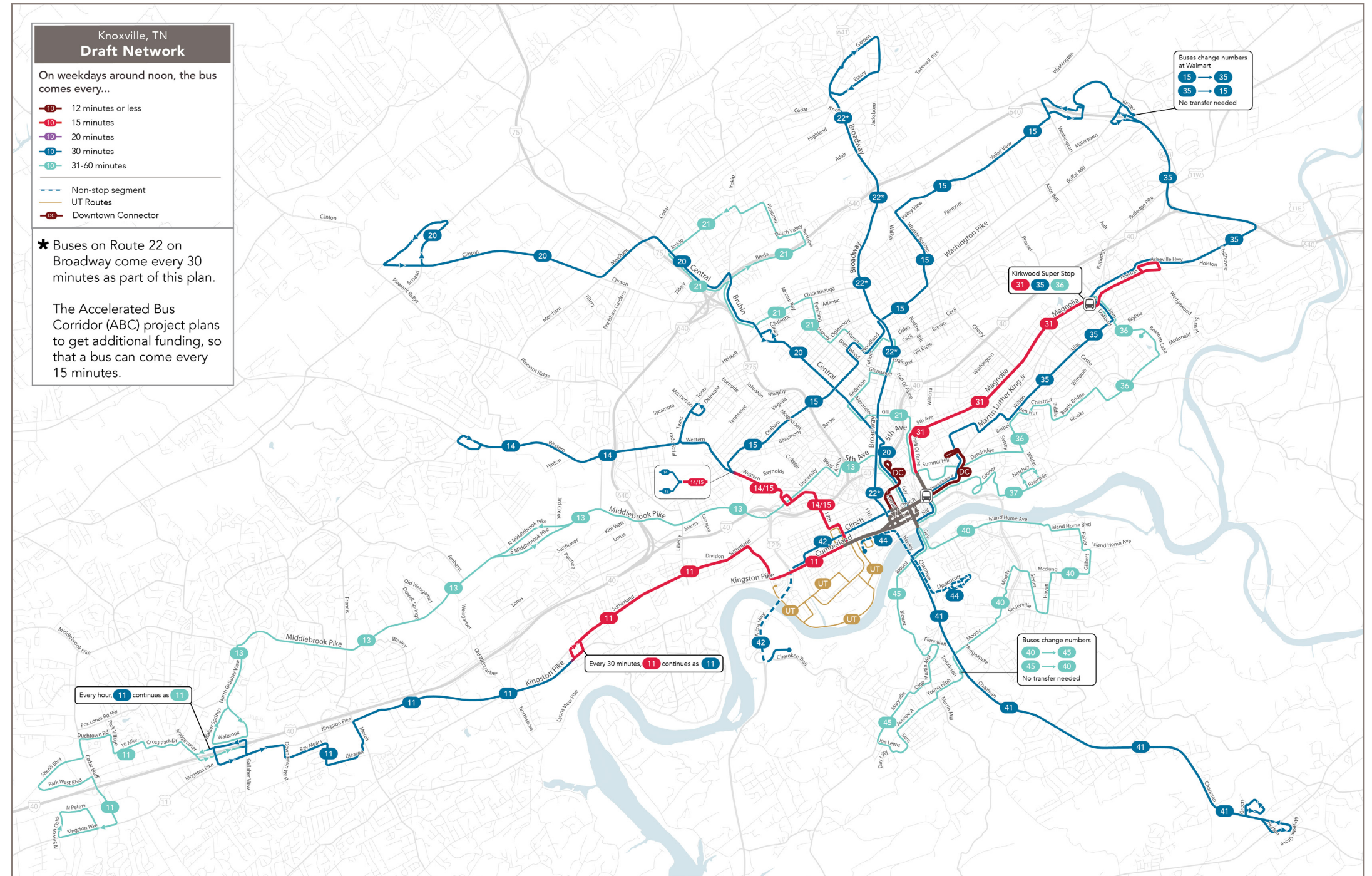


Figure 16: The Draft Network with routes color-coded by frequency.

Downtown: Existing Network

Downtown Knoxville has the strongest offering of transit service in region. This is due in part to the radial design of the system. Most routes come into Knoxville Station to provide an opportunity for customers to transfer from one route to another. KAT's three trolley routes also operate within the city's core. The Trolleys are short, relatively frequent routes which circulate passengers in and near Downtown Knoxville.

Downtown Trolleys

- **The Blue Line** is a large one-way circular route that provides 8 minute service passing through Downtown, the waterfront pathway, and Knoxville Station.
- **The Green Line** travels a short distance north to connect Downtown to Old City every 20 minutes.
- **The Orange Line** goes to the University of Tennessee every 15 minutes terminating at the Commons.
- **The Red Line** crossed the river every 8 minutes and came back. This was running before Covid, but has been eliminated.

Although the trolley routes do not directly overlap for their entire lengths with other routes in the KAT network, there is a good deal of overall duplication happening in the downtown area between regular KAT routes and the trolley routes. This creates competition between routes in the KAT system. The trolleys are designed and marketed primarily toward moving people just within the downtown areas. By separating out this service from the rest of the system, the market for transit downtown is being divided into smaller, potentially less productive segments. In transit, specialized services tend to dilute the market whereas generalized services tend to get the highest ridership across the entire system.

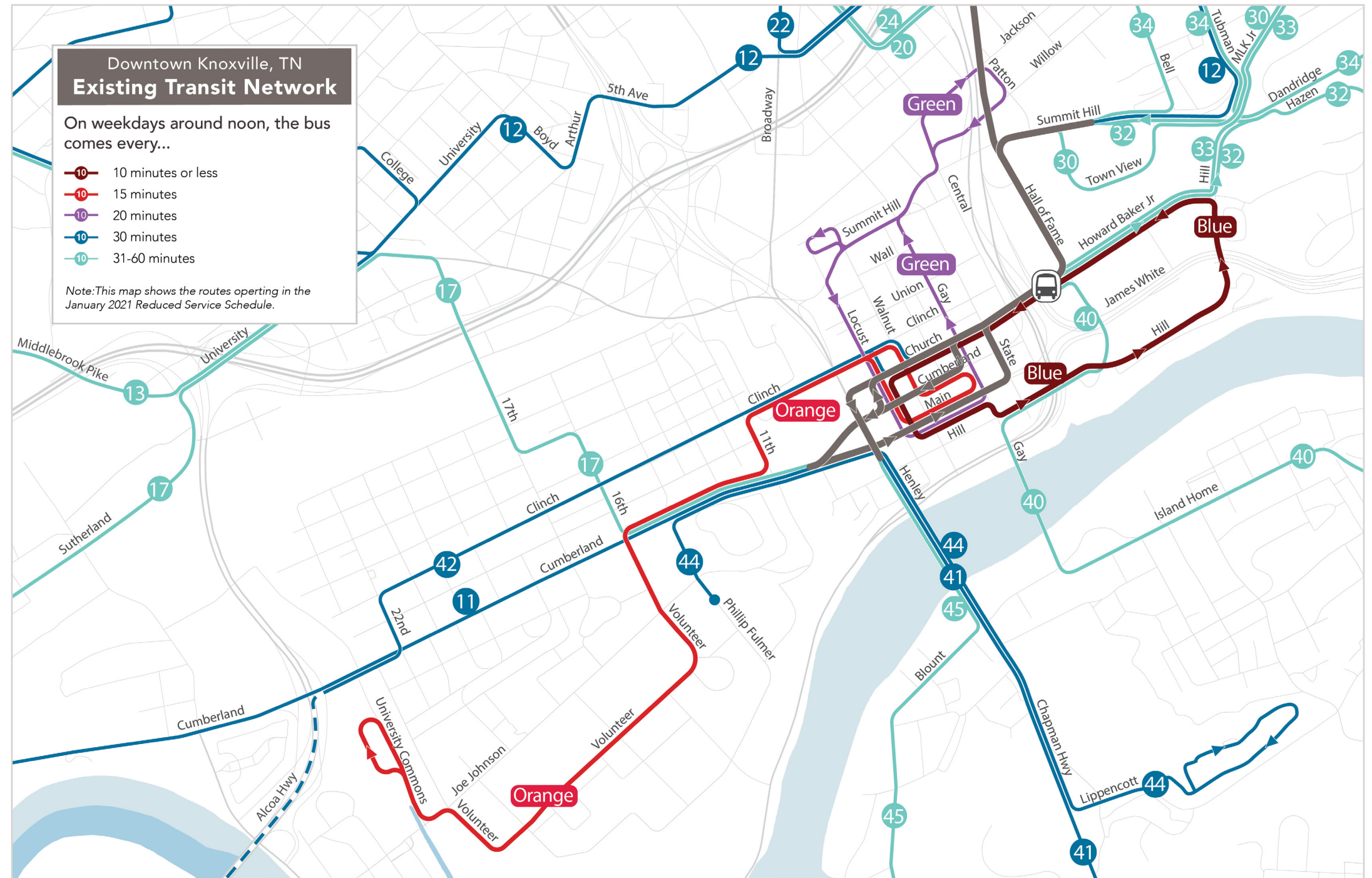


Figure 17: KAT's Existing Network in Downtown with routes color-coded by frequency.

Downtown: Draft Network

Downtown in the Draft Network would be served by four high-frequency routes and a much simpler network, making it easier for a rider to figure out how to get around Downtown. The existing trolley routes have been replaced with a new 12-minute Downtown Connector route that does something similar to what the Green and Blue are doing today.

Having so many corridors in Downtown with 15-minute routes means that many of the densest parts of Knoxville will have high frequency service and there would be multiple options for connecting across downtown and nearby destinations with relatively frequent service. For example, in this network, the combination of Routes 11, 14, and 15 would provide 8 buses per hour from downtown to the University of Tennessee. Therefore, many more people will find the transit useful.

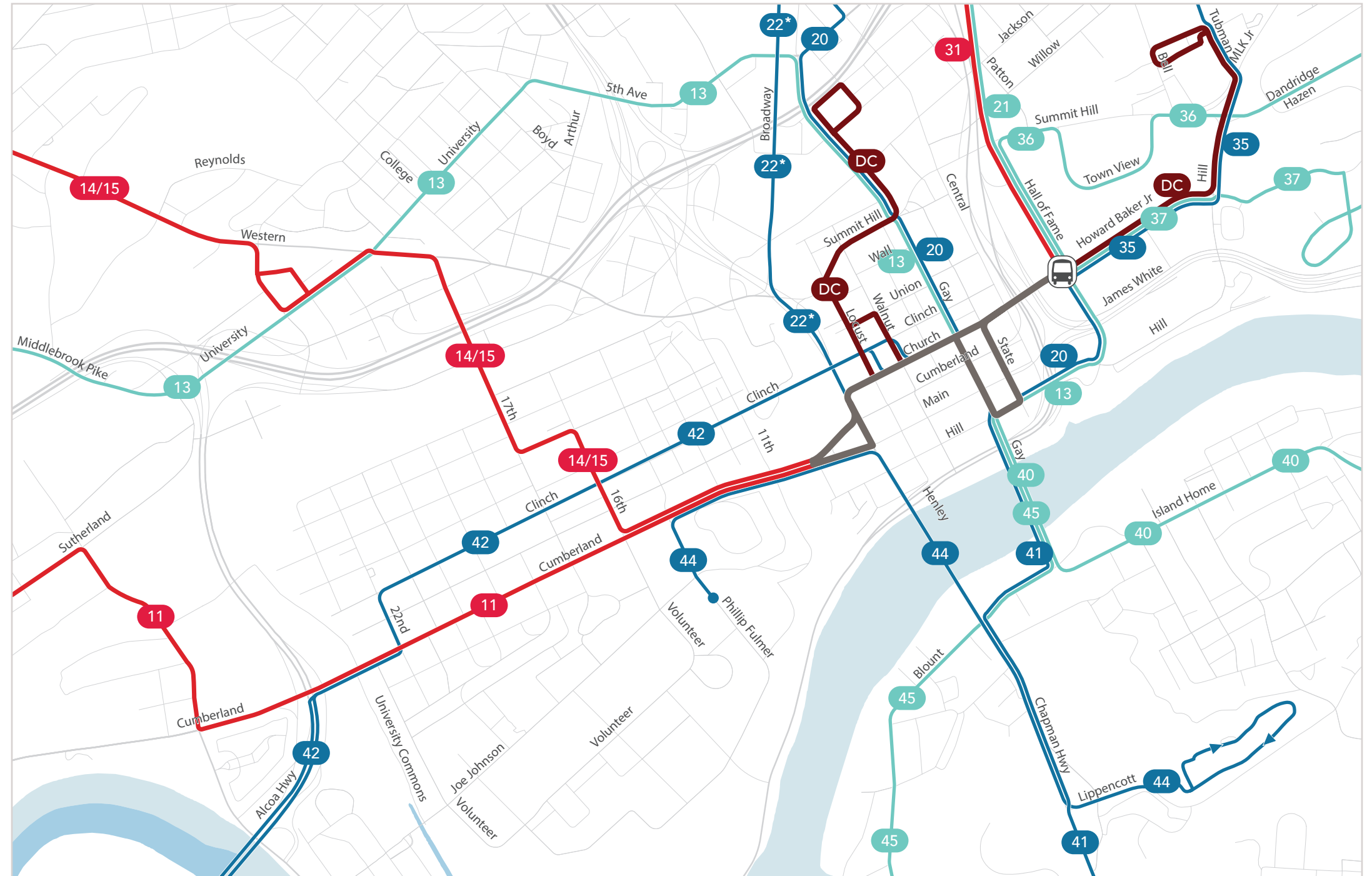


Figure 18: The Draft Network in Downtown with routes color-coded by frequency.

When is service available in the Existing Network?

The table on the right summarizes each route's **frequency** (how often a bus on the route comes) and **span** of service (what days and what durations the route operates). Each hour a route operates is shown by a single block, colored roughly according to the frequency offered in that period. From left to right, the columns of blocks show service for each route during weekdays, Saturdays, and Sundays, respectively.

Less Service on Weekends, Especially Sundays

Similar to the network maps earlier, the span-frequency chart on the right shows how KAT service consists of four frequent trolley routes, twelve 30-minute routes and the rest are 60-minute routes.

Remember that Route 44 is a specialized service with a separate funding source and changes to its service levels are not part of this study.

For most routes, the frequency is consistent throughout the day. Route 10 is the only peak-only service provided, and Routes 11, 22, and 31 have more service during the peaks.

On Saturdays, the frequency of several routes declines to 60 minutes, and Route 13 does not run at all. On Sundays, only eleven routes run, all with a frequency of 60 minutes. The trolleys run on Saturdays but not Sundays.

Most routes start around 6am, but in the evening, spans are inconsistent. This adds some complexity that might discourage some riders.

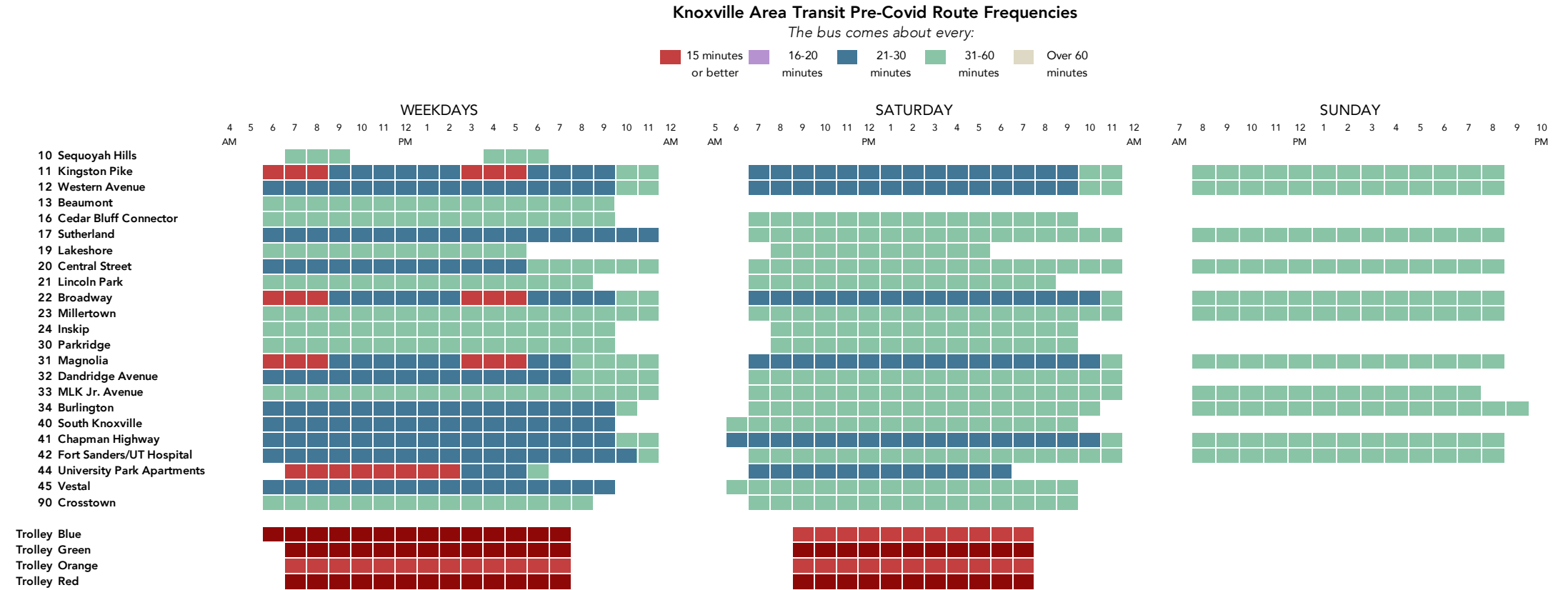


Figure 19: Spans and frequencies for all existing routes

When is service available in the Draft Network?

The chart on the right shows the frequency by time of day for the routes in the Draft Network. It generally has greater spans than the Existing Network. It also consolidates service into fewer routes and proposes higher frequencies on many routes.

The Draft Network would include 15-minute service or better throughout most of the day on routes 11, 14/15, 31, and the Downtown Connector. Routes 11 and 31 run every 30 minutes on weekends, but **all other routes would keep their weekday frequency on weekends (including Sundays), a significant improvement over weekend frequencies in the Existing Network.**

This increase in all-day and weekend frequencies reflects the fact that more and more jobs are on nontraditional schedules requiring shifts on weekends or that start in the midday and end later than 6pm. This trend is especially pronounced for lower-wage jobs in retail, healthcare, restaurants and personal services, so **improving weekend and evening service helps improve the lives of people with lower incomes.**

Many people may be reluctant to use transit because of its inconsistent availability. If someone buys a car to get home after evening or weekend work shifts when transit is unavailable, they may feel that they might as well drive on weekdays too. They are also much less likely to take transit at all, even if their bus comes every 15 minutes then.

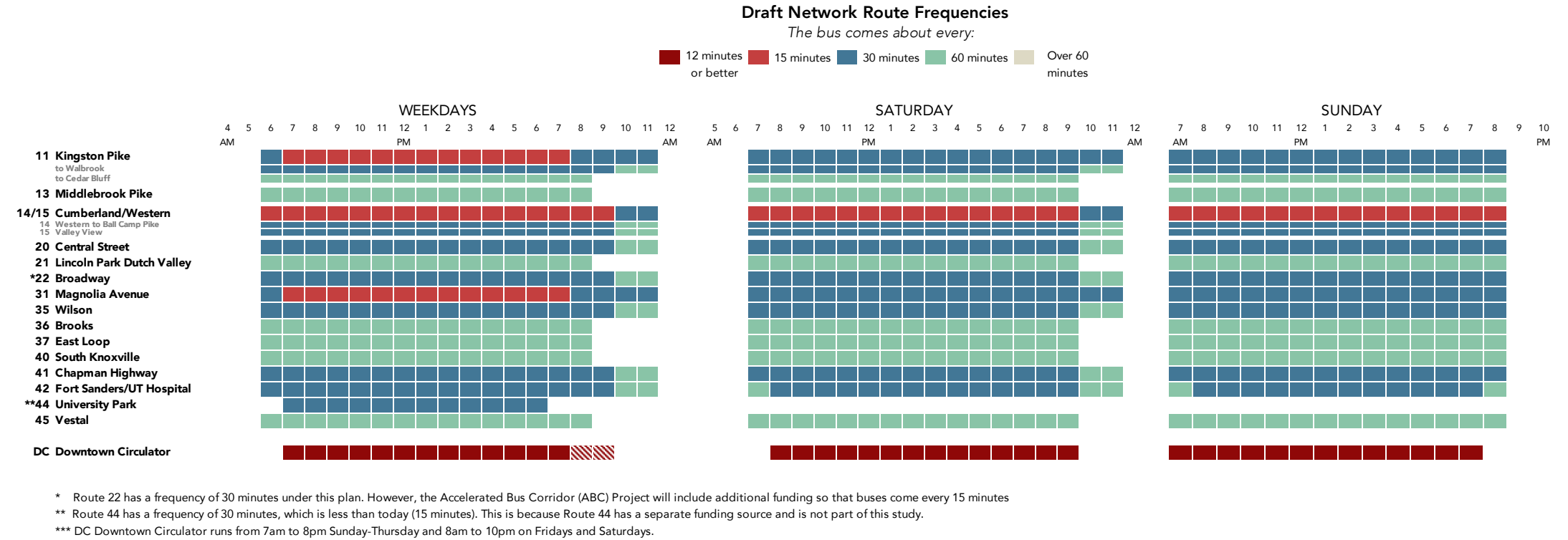


Figure 20: Spans and frequencies for all routes in the Draft Network.

The Draft Network has more consistent service 7-days a week, a key contributor to customer reliability and is likely to support higher ridership.

Weekend Service

The maps on the right show the network available during the weekends for the Existing and the Draft Network. The lines are color-coded by frequency like in the previous maps.

The Existing Network has several routes that run every 30 minutes during weekdays, but on Saturdays, they run every 60 minutes, and Route 13 does not run at all. This is shown on the map on the top-left.

Most 15-minute routes in the Draft Plan drop to 30 minutes on Saturdays, but everything else runs with the same frequency as weekdays. This is an improvement of the Existing Network. Central Street, one of the city's busiest corridors, has 30-minute service in the Draft Plan. Routes 15 and 35, that provide service to the Walmart, also run every 30 minutes on Saturdays. This is shown on the map on the bottom-left.

The Existing Network runs very little service on Sundays. Only eleven routes run, and they all run every 60 minutes. The trolleys don't run on Sundays. This is shown in the map on the top-right.

The Draft Plan provides the same service on Sundays as it does on Saturdays. This is a huge improvement of the Existing Network. This is shown on the map on the bottom-right.

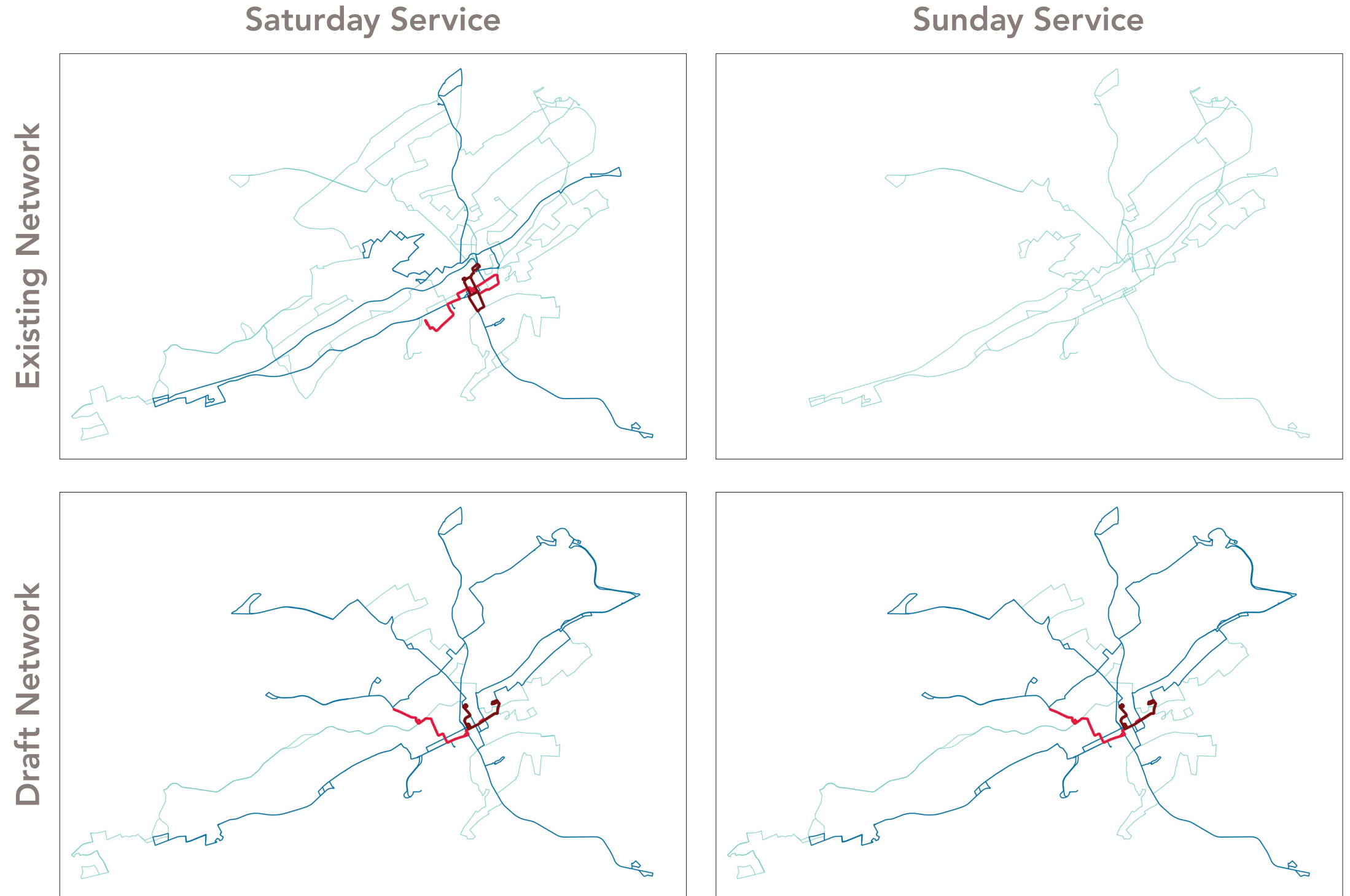


Figure 21: Weekend service in the Existing and Draft Networks color-coded by frequency

4 Comparing Outcomes

Freedom, Access, Usefulness

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 22 shows an example of this type of visualization of transit access for Knoxville Station, comparing the Draft Network to the Existing Network.

Think of this blob as “the wall around your life.” Beyond this limit are jobs you cannot hold, places you cannot shop, and a whole range of things you cannot 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

Freedom is about what you could do, not what we predict you will do. Access is how network design generates ridership, because it measures how likely it is that any particular trip will be viable on transit. Yet, 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** 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.

- The whole reason people live in urban areas is to have access to the opportunities that arise from being near other people. **So access is a fundamental measure of whether a city is functional.**

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;

1. 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.

- an average speed; and
- a frequency—how often a transit vehicle serves a stop, which determines how long a riders waits for a vehicle.

Of these, frequency is the one that is often invisible and easy to forget. Yet frequency is usually the dominant element of travel time, and therefore significantly affects access in a given amount of time.

To maximize liberty and opportunity for the greatest possible number of people requires a network of routes that optimizes (in order) Frequency, Span, Connections, Speed, Reliability, Capacity, and that follows favorable patterns in the built environment.

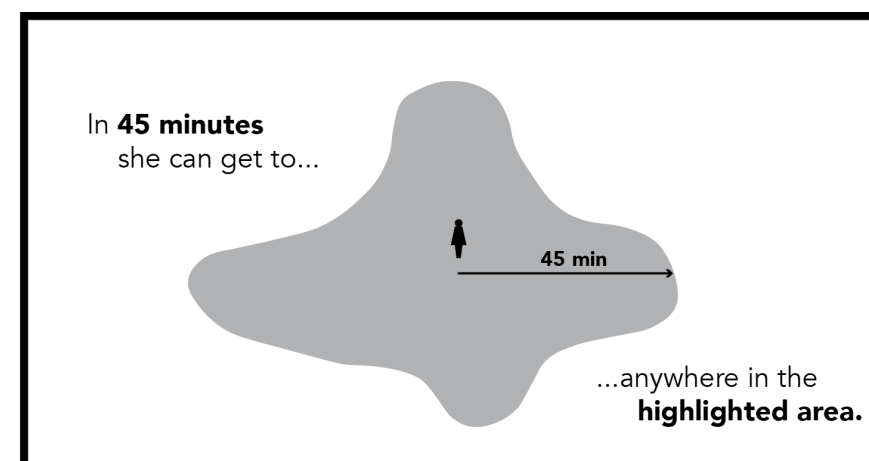


Figure 22: We can illustrate a person’s access to opportunity.

Measuring Access to Opportunities

Frequency Comes First

Ridership responds to many features of a service, including speed and reliability, but the dominant factor is frequency. Frequency is the elapsed time between consecutive buses on a line, which determines the maximum waiting time.

People who are accustomed to traveling by private vehicle often underestimate the importance of frequency, because there isn't an equivalent in their experience. A private vehicle is ready to go when you are, but public transit isn't available until it comes.

High frequency means public transit is coming soon, which means that it approximates the feeling of liberty you have with a private vehicle—namely that you can go anytime. Frequency has three independent benefits for the passenger.

- **Frequency reduces waiting**, which is everyone's least favorite part of a trip. Being able to go when you want to go is the essence of frequency. A smartphone can tell you when the bus is coming, but still does not reduce the wait or get you where you want to be.
- **Frequency makes connections easy**, which makes it possible for a cluster of transit lines to become a network. A transit line without good connections is useful for travelling only along that line. A network of frequent lines can make it easy to travel all over the city. This massively expands the usefulness of each line.
- **Frequency is a backup for problems of reliability.** If a vehicle breaks down or is late, frequency means another will be along soon.

Measuring Access and Freedom

To measure freedom and access outcomes, we measure the change in access to jobs. Since retail and services also account for jobs, access to jobs is a good indicator of the usefulness of transit for many other opportunities that the region offers. So we ask the question: **Could more people access more jobs (and other opportunities) by transit, in less time?**

To answer this question, we explore how a transit network changes people's freedom to travel and access more jobs and opportunities. We measure how far one could go in 45 minutes on transit (including walking, waiting, and riding) from anywhere in the region, and calculate how many jobs are located in the area that is reachable.

Not Just the Area – Also What is Inside the Area

The real measure of usefulness is not just how much geographic area we can reach, but how many useful destinations are in that area. Ridership arises from service being useful, for more people, to get to more busy places. That's why predictive models of ridership do this very same analysis behind-the-scenes.

The example in Figure 23 shows how access changes for Knoxville Station with the Draft Network compared to the Existing. Areas reachable with both networks in **dark green**, newly reachable areas in **light green**, and places no longer reachable are shown as **grey areas**. The table reports the change in jobs and people reachable. The technical term for this map is an isochrone, from Greek for "iso" meaning same and "chrone" meaning time.

The maps on page 27 show the same comparison of isochrones for three other example

locations around the region. Many more isochrone examples are in the Appendix, showing how different parts of the city are affected by the Draft Network.

When reviewing these maps remember that **waiting time counts, and in most cases, a longer walk to a high-frequency route can get people farther and faster**, than a shorter walk to an infrequent route. Also remember that some of the access shown in these maps isn't reached on a single route, but requires a transfer.

With the Draft Network residents near Knoxville Station could reach 8,200 more jobs than today.

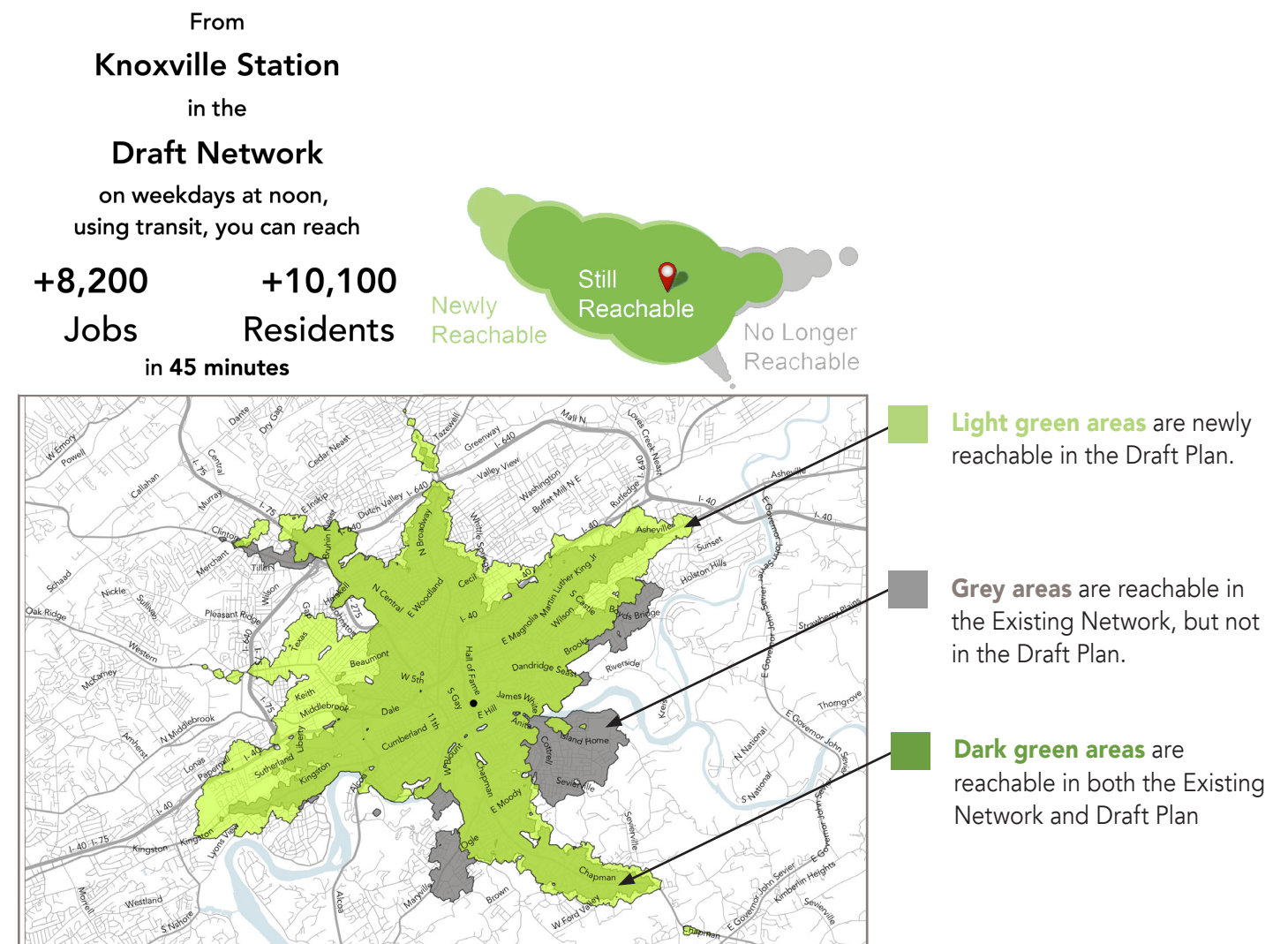


Figure 23: Example of change in places reachable in 45 minutes from Knoxville Station in the Draft Network, compared to the Existing Network

Isochrone Examples

Residents near Five Points could reach 4,000 more jobs in 45 minutes with the Draft Network.

From
Five Points
 in the
Draft Network
 on weekdays at noon,
 using transit, you can reach

| | |
|---------------|------------------|
| +4,000 | +5,700 |
| Jobs | Residents |

in 45 minutes

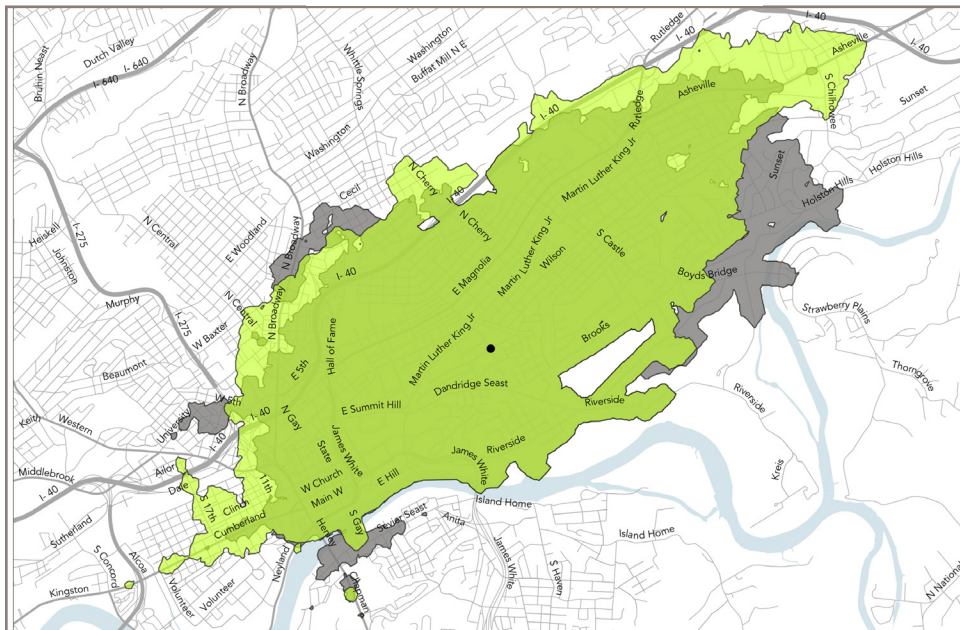


Figure 24: Places reachable in 45 minutes from Five Points in the Draft Network, compared to the Existing Network.



From
Western Heights
 in the
Draft Network
 on weekdays at noon,
 using transit, you can reach

| | |
|----------------|------------------|
| +24,400 | +17,700 |
| Jobs | Residents |

in 45 minutes

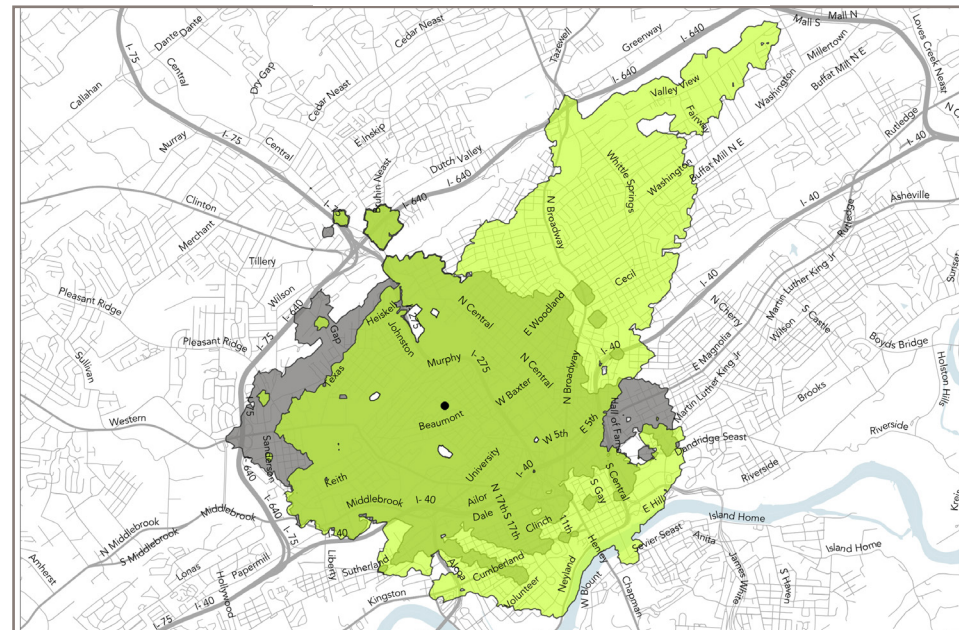


Figure 25: Places reachable in 45 minutes from Western Heights in the Draft Network, compared to the Existing Network.

With the Draft Network an additional 5,900 residents could reach the Tennessee College of Applied Tech.

From
TN College of Applied Tech
 in the
Draft Network
 on weekdays at noon,
 using transit, you can reach

| | |
|----------------|------------------|
| +23,400 | +5,900 |
| Jobs | Residents |

in 45 minutes

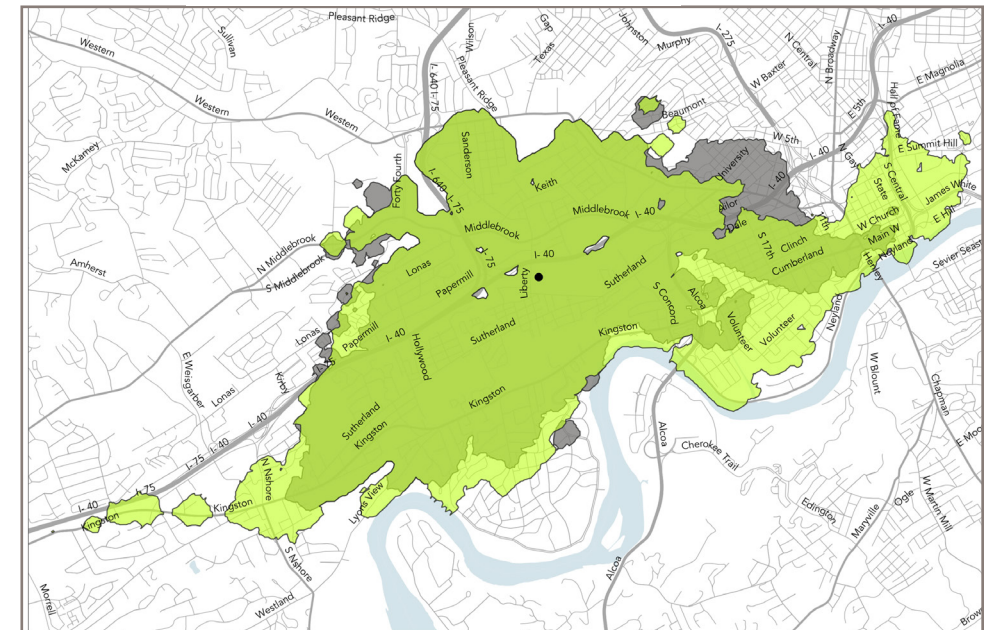


Figure 26: Places reachable in 45 minutes from the Tennessee College of Applied Tech in the Draft Network, compared to the Existing Network.

Change in Access to Opportunities

The previous maps show how the Draft Network changes where people could go in a given time, from certain places. We can run the same analysis on a grid of locations throughout the city to estimate the access impacts of the Draft Network on jobs access for different areas of the city.

The map on this page summarizes the change in jobs reachable for every part in the city. In this map, every dot represents 20 residents and the color indicates the jobs that can be reached in 45 minutes as compared to the Existing Network. Blue dots represent more jobs accessible and pink dots represent fewer jobs available. The darker the color, the greater the change in jobs accessible.

In general, the Draft Network significantly increases access to jobs for the most dense parts of the city, which is clear because places with many dots close together tend to be darker shades of blue. Also, more areas of the city are blue, indicating that more areas are benefiting from the increased frequency of service on major corridors.

Corridors like Cumberland/Sutherland, Western, and Magnolia would see large access benefits due increases in frequency. Even residents in other neighborhoods and corridors see job access benefits because of improved connections to other routes.

Not all parts of the city benefit as some areas see a decrease in frequency or a loss of service. The most substantial decrease in access would be experienced along parts of Brooks Avenue, Clinton Highway, Sequoyah Hills, and South Knoxville. The area along Kingston Pike, near Northshore Drive, also sees a decrease in access due to the changes to Route 11. This is because Route 11, in this area, has the same frequency as today and it is taking a longer route to Downtown via Sutherland. These losses are the trade-off of shifting service toward a higher ridership emphasis.

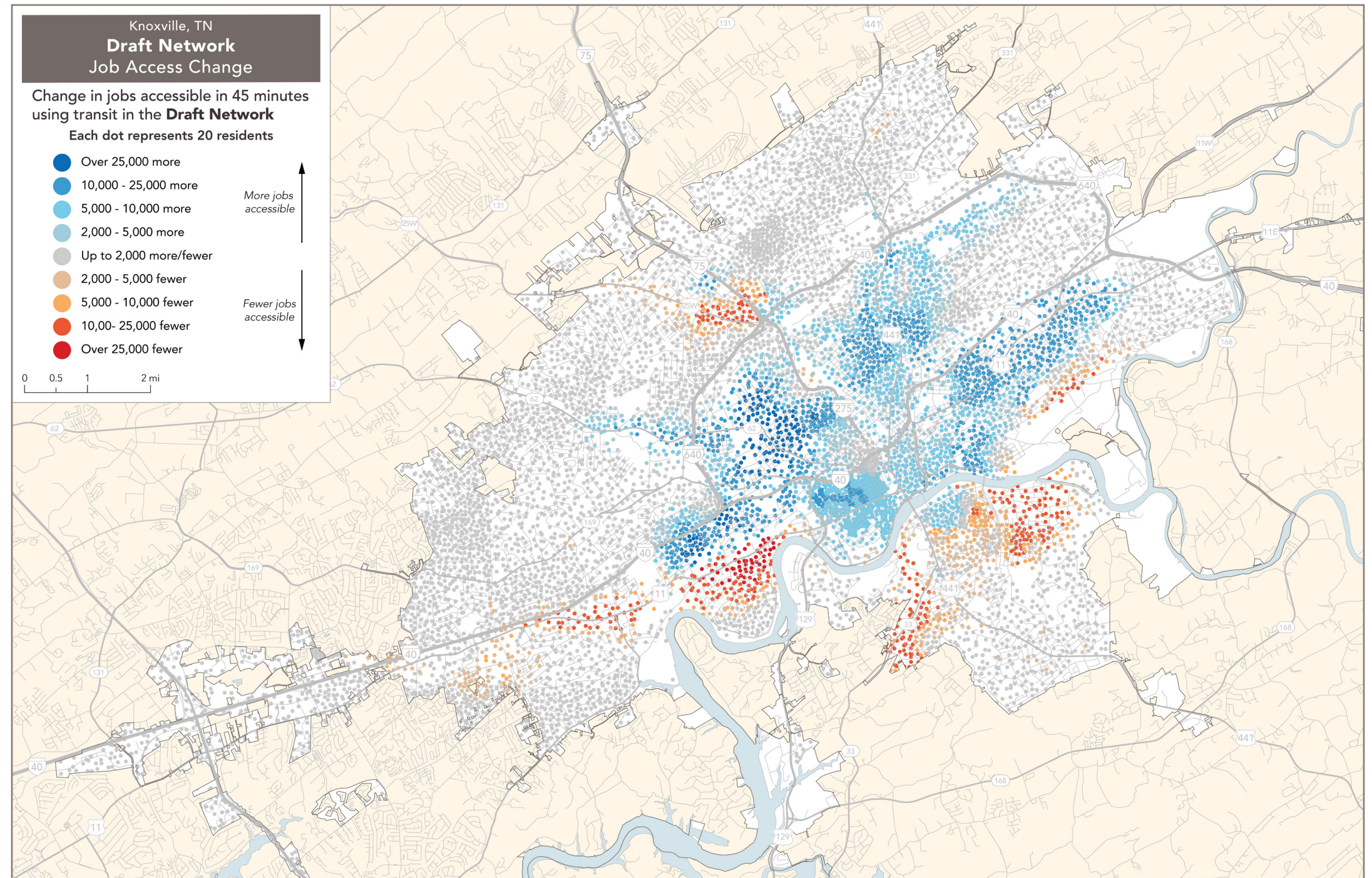


Figure 27: Change in jobs reachable in 45 minutes for the Draft Network compared to the Existing Network.

Change in Access Summarized

Using the data in the map on the previous page, we can estimate the change in access for the average person and for different subgroups as shown in Figure 28.

By multiplying the change in access in each dot by the population and then dividing by the total population, we can calculate that the Draft Network allows the average person to reach 17,800 jobs within 45 minutes by walking and taking transit—**16% more jobs than are reachable with the existing network.**

We can apply the same calculations to different population groups.

- The average low-income resident can reach 20% more jobs in 45 minutes.
- The average household without a car can reach 22% more jobs in 45 minutes.
- The average resident of color can reach 24% more jobs in 45 minutes.

This analysis measures jobs, but it reflects a wide range of opportunities that a person can reach. This means a person can get to more shopping, education, recreational areas, social events, places of worship, and any other opportunities that Knoxville can offer.

Change in Average 45-Minute Job Access

At midday on weekdays, the average number of jobs accessible by transit within 45 minutes by different groups

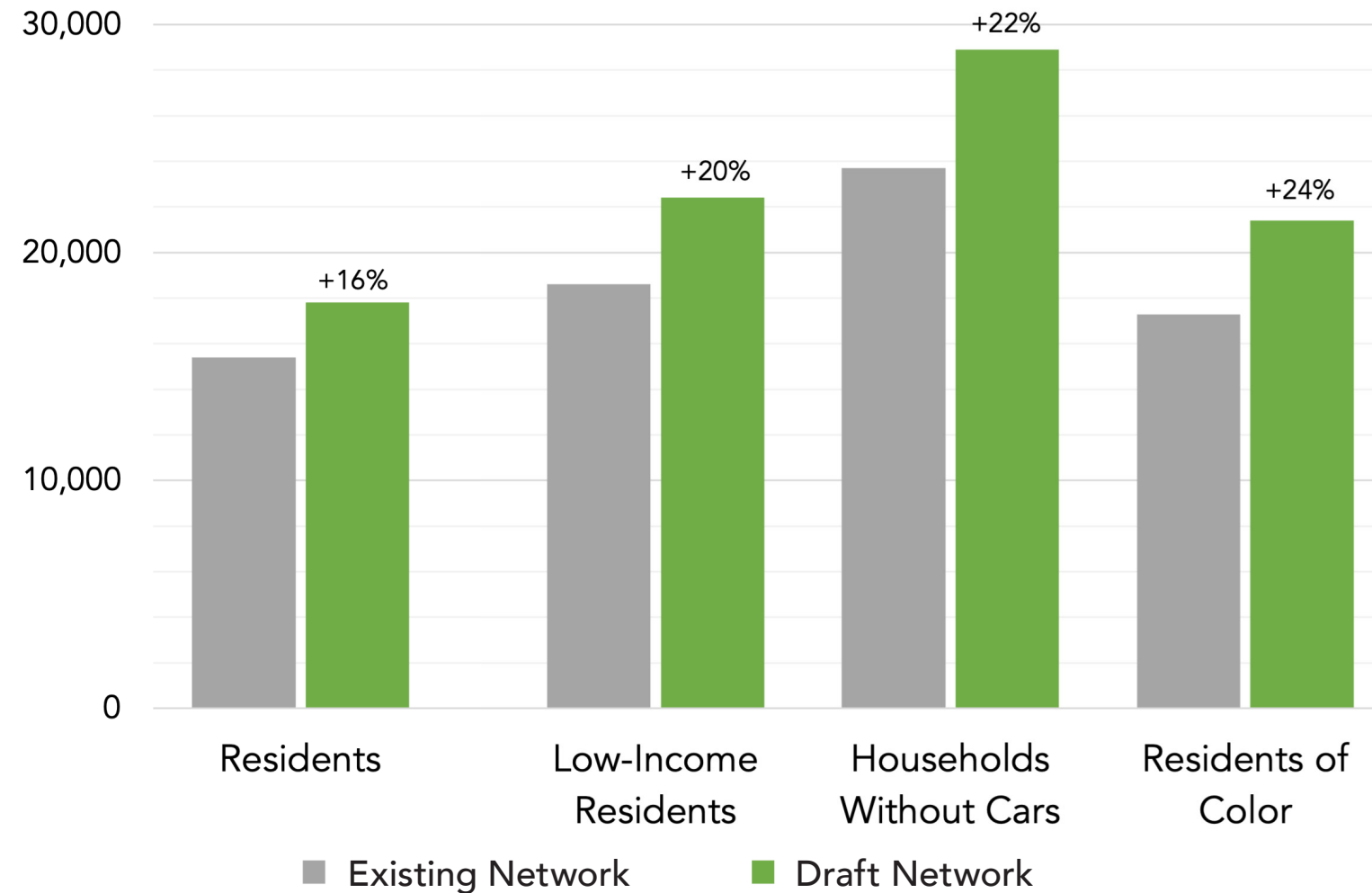


Figure 28: Jobs reachable by the average resident and the average resident in different groups.

Proximity to Transit

The number of people and jobs within a certain distance from transit is the simplest measure of transit outcomes. In this report, we call this measure “proximity to transit.”

Overall, the Existing Network reaches 109,800 people and 100,800 jobs, within 1/2 mile of a transit stop. Yet because service is spread so thinly, only 15,200 people and 35,000 jobs are near 15-minute service.

The Draft Network would increase the number of people and jobs near 15-minute service.

Compared to Existing, the Draft Network would

- increase the number of residents near 15-minute service from 15,200 to 27,200, a **79% increase**.
- increase the number of jobs near 15-minute service from 35,000 to 43,200, a **23% increase**.
- reduce the number of residents who are within 1/2 mile of any transit service from 109,800 to 91,600, a 17% decrease in residents who are within 1/2 mile of service.
- reduce the number of jobs that are within a 1/2 mile of any transit from 100,800 to 87,000, a 14% decrease in jobs that are within 1/2 mile of service.

Proximity does not tell us how useful the service is to people—only that it is nearby. **Proximity to any service is measure of how well a network is achieving a coverage goal.** Since the policy direction provided by the KTA Board indicated a shift in emphasis away from coverage and toward ridership, the Draft Network reduces overall coverage.

Proximity to more frequent service is a key measure of ridership potential. Frequent service is more expensive relative to the area it covers, but it is more useful and therefore tends to attract higher ridership. Thus, the more people and jobs near frequent service, the more a network is achieving a ridership goal.

Figure 29 also shows how proximity to transit changes for different subgroups.

For low-income residents, the Draft Network would

- increase the number of low-income residents near 15-minute service from 7,100 to 15,800, a 123% increase.
- reduce the number of low-income residents who are within 1/2 mile of any transit service from 56,000 to 48,000, a 14% decrease in residents who are within 1/2 mile of service.

For households without cars, the Draft Network would

- increase the number of households near 15-minute service from 900 to 2,300, a 166% increase.
- reduce the number of households that are within a 1/2 mile of any transit from 6,300 to 5,800, a 9% decrease in households that are within 1/2 mile of service.

For people of color, the Draft Network would

- increase the number of residents of color near 15-minute service from 3,500 to 10,400, a 191% increase.
- reduce the number of residents of color who are within a 1/2 mile of any transit from 34,400 to 29,200, a 15% decrease in residents who are within 1/2 mile of service.

Proximity to Transit at Midday - Weekday

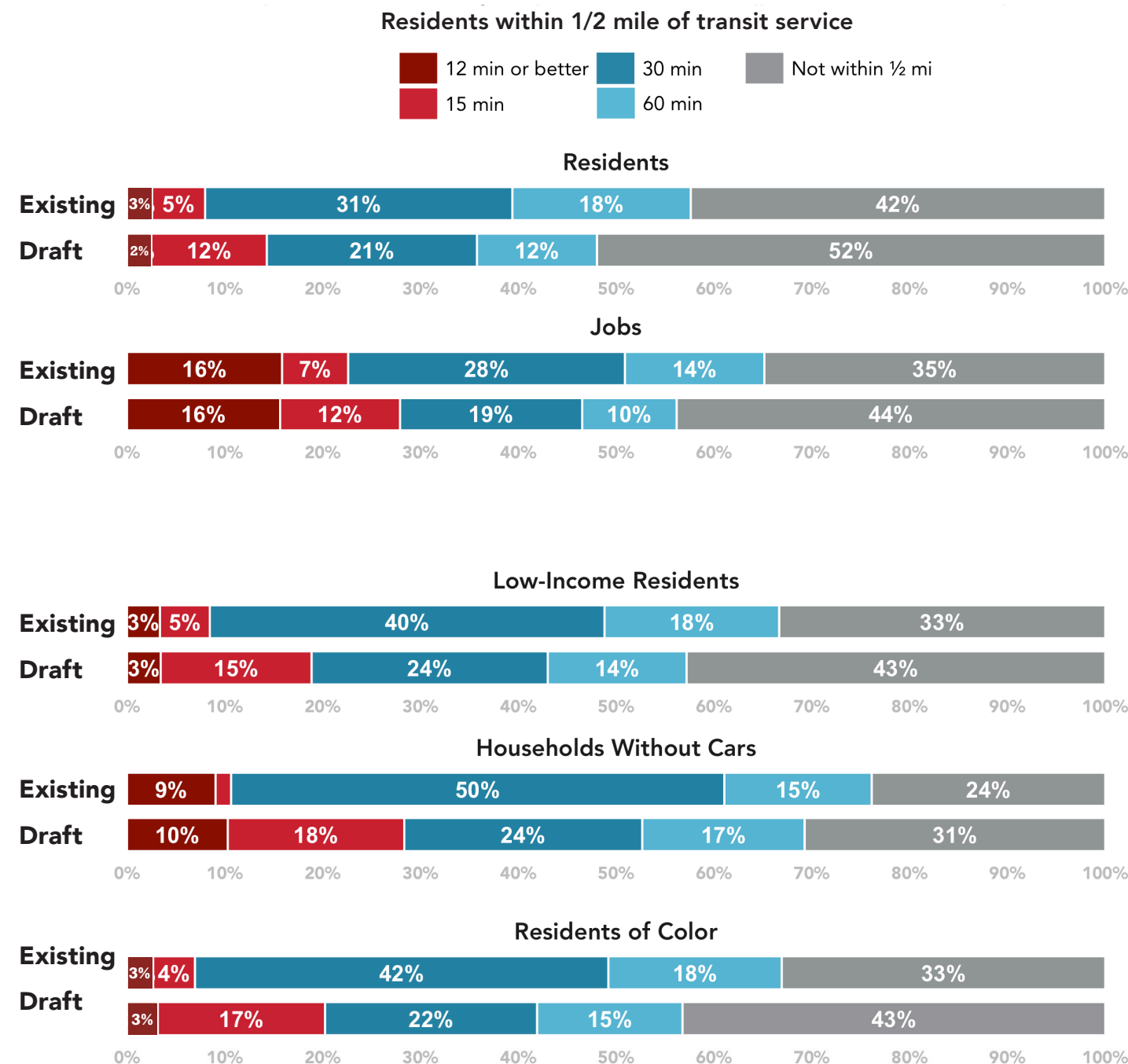


Figure 29: Proximity to transit for residents, jobs, and specific groups.

5 Next Steps

Next Steps

What happens next?

This Draft Network Report will inform public and stakeholder outreach as part of the Round 2 Engagement of the KAT Reimagined effort. The agency and consultant staff will be conducting surveys and other outreach efforts from January 26th to February 28th. That outreach process will include the key questions:

- Is the Draft Network better for you, your neighborhood or community, and for the City as a whole?
- If you don't like something, how would you change the network? Remember, this is a cost-neutral redesign. So if you want more service on your street, that must be paid for by cutting something else!

If you agree this would be an improvement for Knoxville, it's important to speak up. And if you don't like the plan, please let us know how it can be improved.

For more information and to stay involved in the project, go to katreimagined.com and:

- take the survey about this Draft Network;
- attend one of the public meetings as scheduled on the project website
- sign up for email updates about the project;
- generally stay up-to-date on the latest happenings with the network redesign process!

The KTA Board will review this Draft Network and ultimately decide if and when it will be implemented, and how it might be changed. **Your opinion matters in determining the final recommendations.**

How to get involved

For more information and to stay involved in the project, go to www.katreimagined.com and:

Learn More

- Get more background on the project
- See scheduled events
- Sign up for project emails

Give Input

- Take the [online survey](#)
- Sign up for our online meeting
- Connect via social media

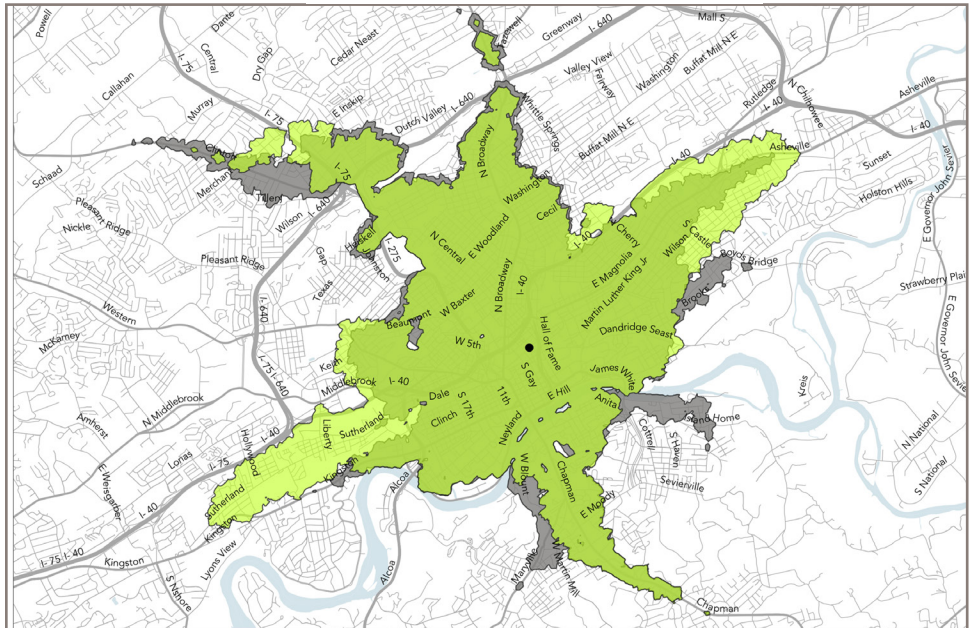
Share with Others

- Find videos, articles and reports to share
- Request a community presentation

Appendix

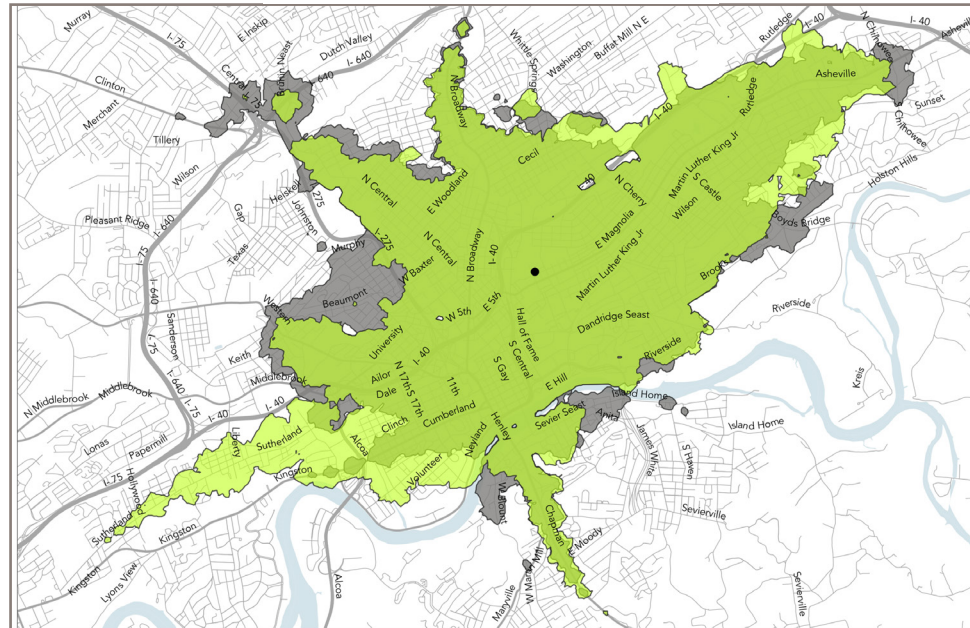
From
Old City
 in the
Draft Network
 on weekdays at noon,
 using transit, you can reach

+3,300 **+3,400**
Jobs **Residents**
 in 45 minutes



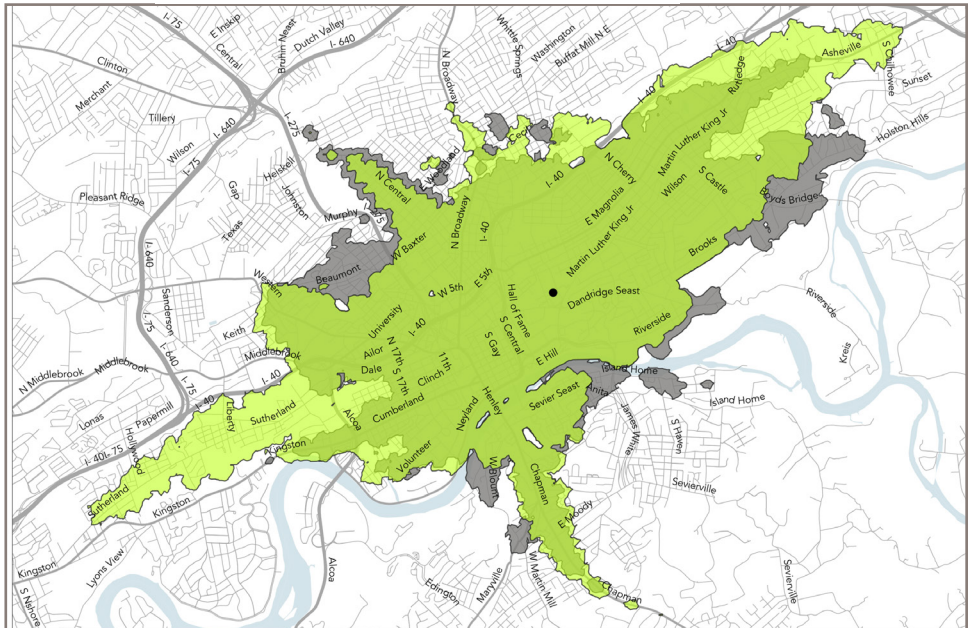
From
Cansler YMCA
 in the
Draft Network
 on weekdays at noon,
 using transit, you can reach

+7,300 **+1,100**
Jobs **Residents**
 in 45 minutes



From
First Creek at Austin
 in the
Draft Network
 on weekdays at noon,
 using transit, you can reach

+7,000 **+4,700**
Jobs **Residents**
 in 45 minutes



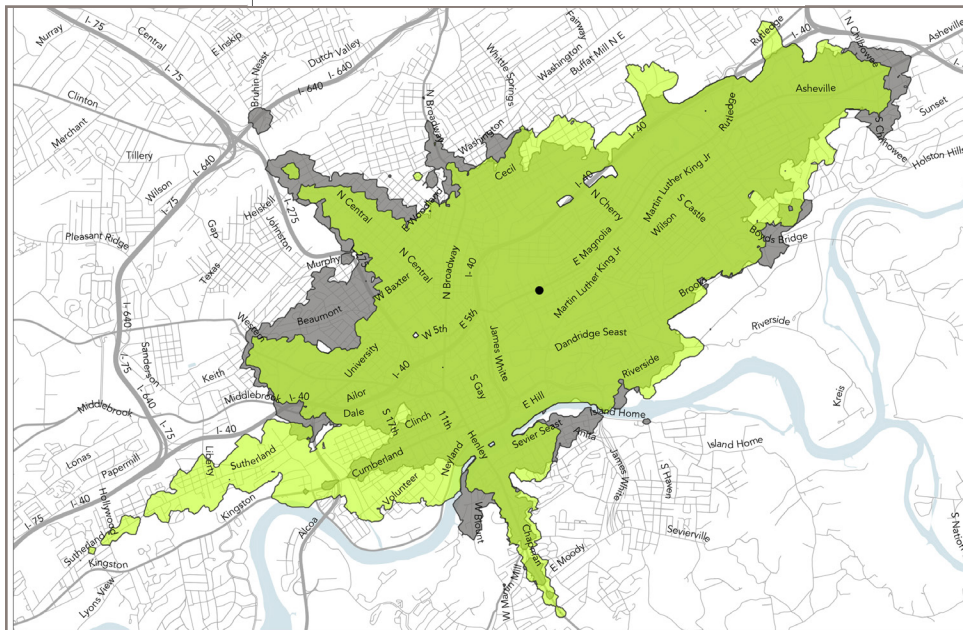
From
PSCC (Magnolia Ave Campus)

in the

Draft Network

on weekdays at noon,
using transit, you can reach

+8,300 **+3,300**
Jobs **Residents**
in 45 minutes



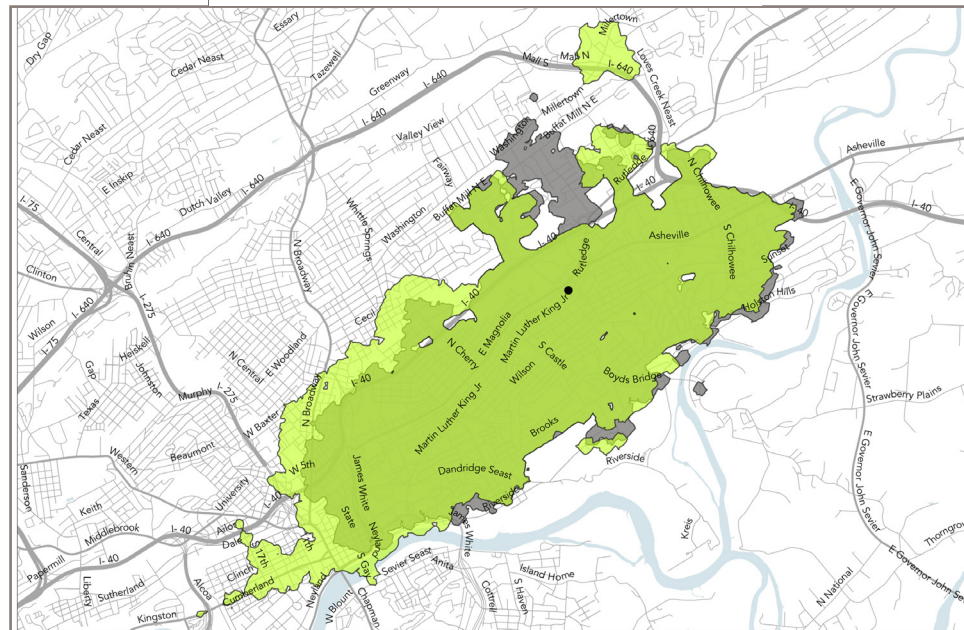
From
Kirkwood Transfer Point

in the

Draft Network

on weekdays at noon,
using transit, you can reach

+13,700 **+7,500**
Jobs **Residents**
in 45 minutes



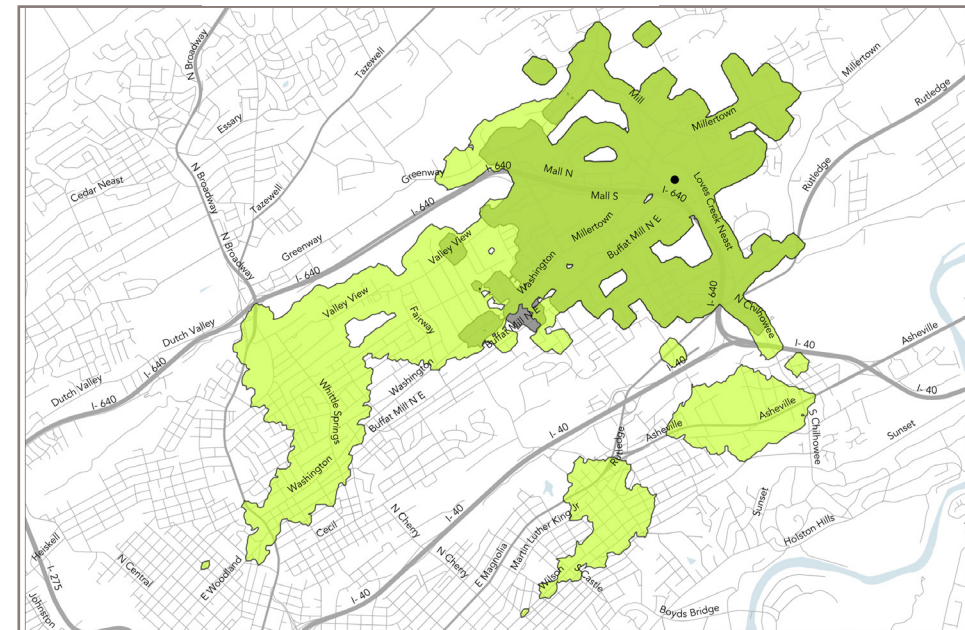
From
Walmart Millertown Pike

in the

Draft Network

on weekdays at noon,
using transit, you can reach

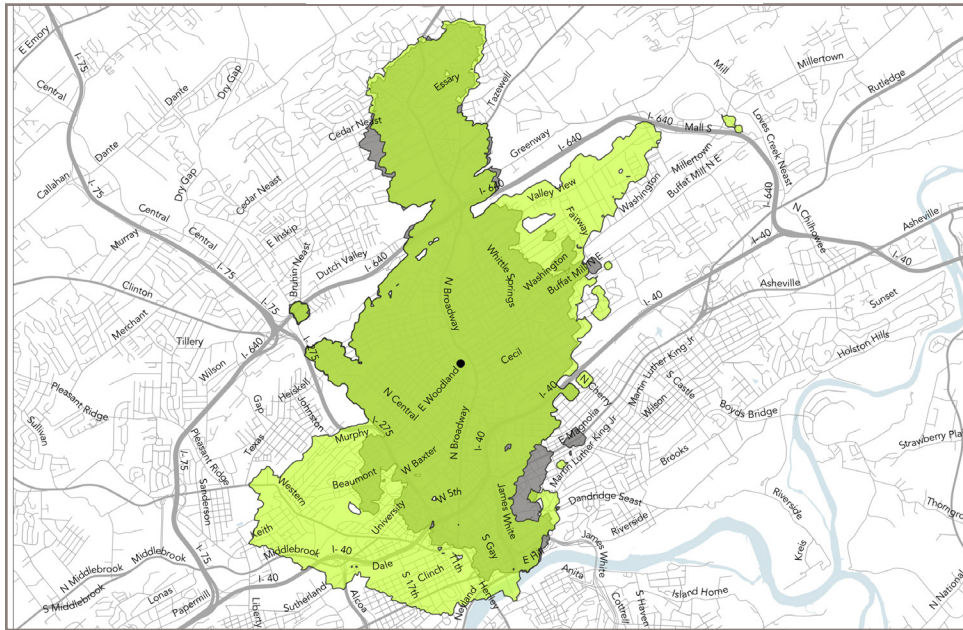
+2,300 **+8,500**
Jobs **Residents**
in 45 minutes



From
Fulton High School
 in the
Draft Network

on weekdays at noon,
 using transit, you can reach

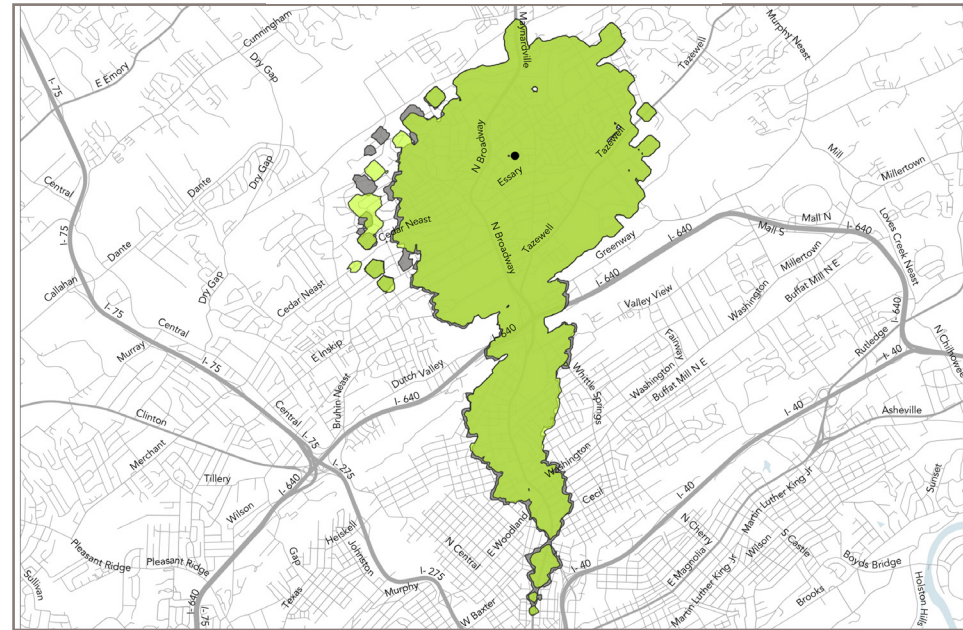
+12,000 **+15,500**
Jobs **Residents**
 in 45 minutes



From
Central High School
 in the
Draft Network

on weekdays at noon,
 using transit, you can reach

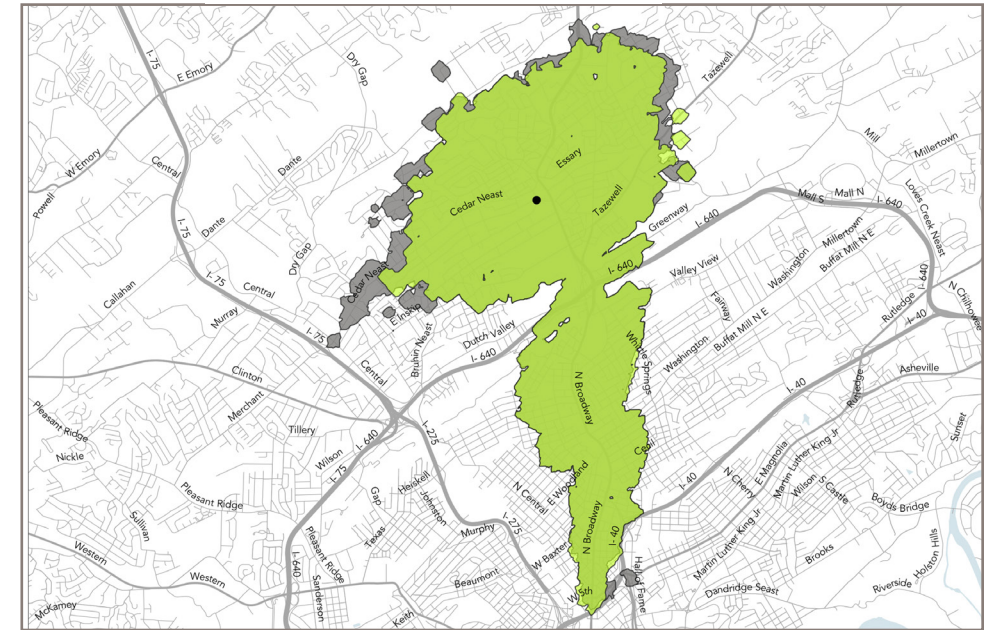
-200 **-400**
Jobs **Residents**
 in 45 minutes



From
Knox Road Transfer Point
 in the
Draft Network

on weekdays at noon,
 using transit, you can reach

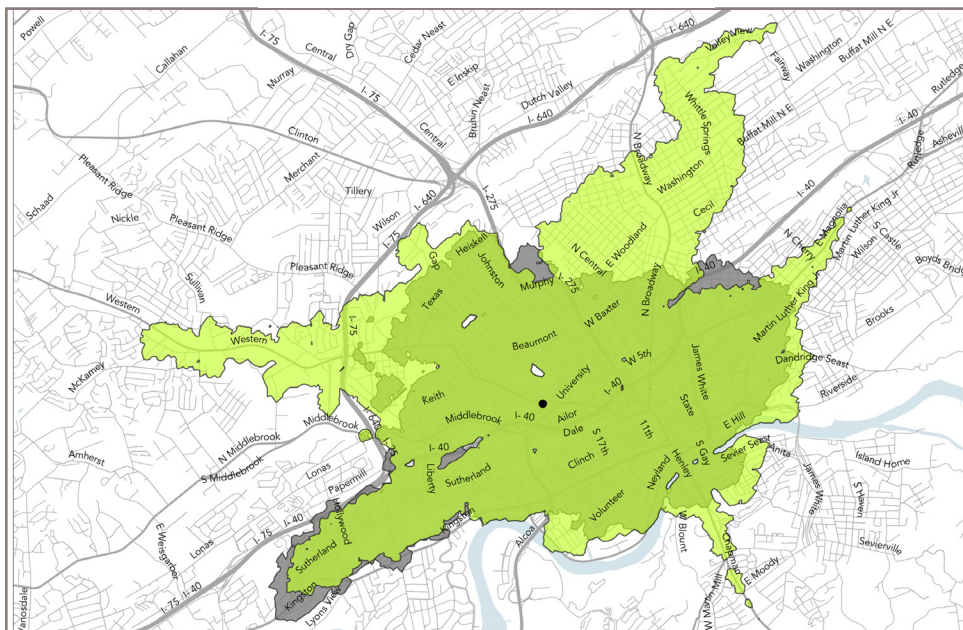
-100 **-1,900**
Jobs **Residents**
 in 45 minutes



From
Food City Western Avenue
 in the
Draft Network

on weekdays at noon,
 using transit, you can reach

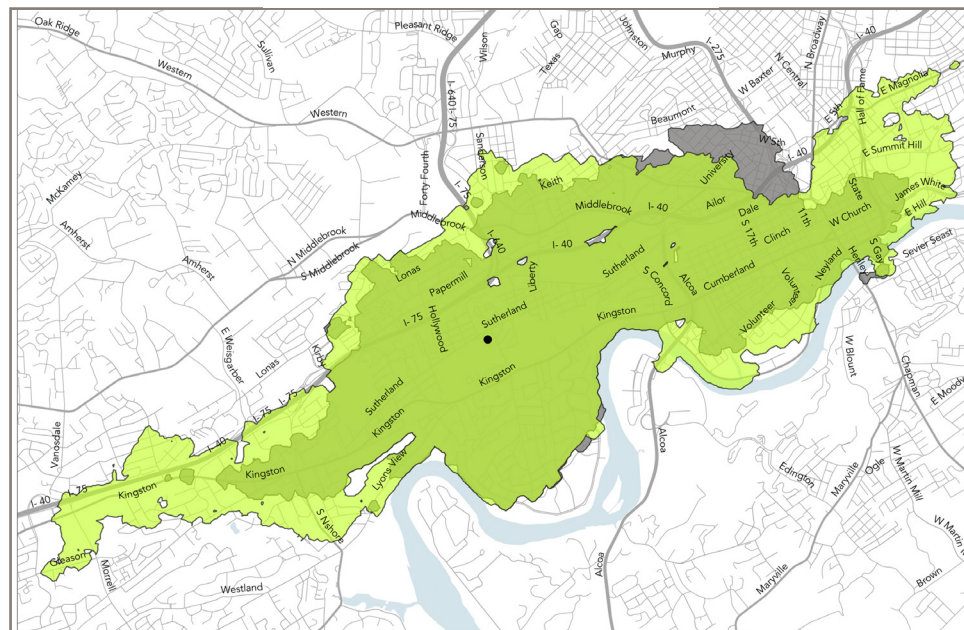
+8,700 **+15,900**
Jobs **Residents**
 in 45 minutes



From
West High School
 in the
Draft Network

on weekdays at noon,
 using transit, you can reach

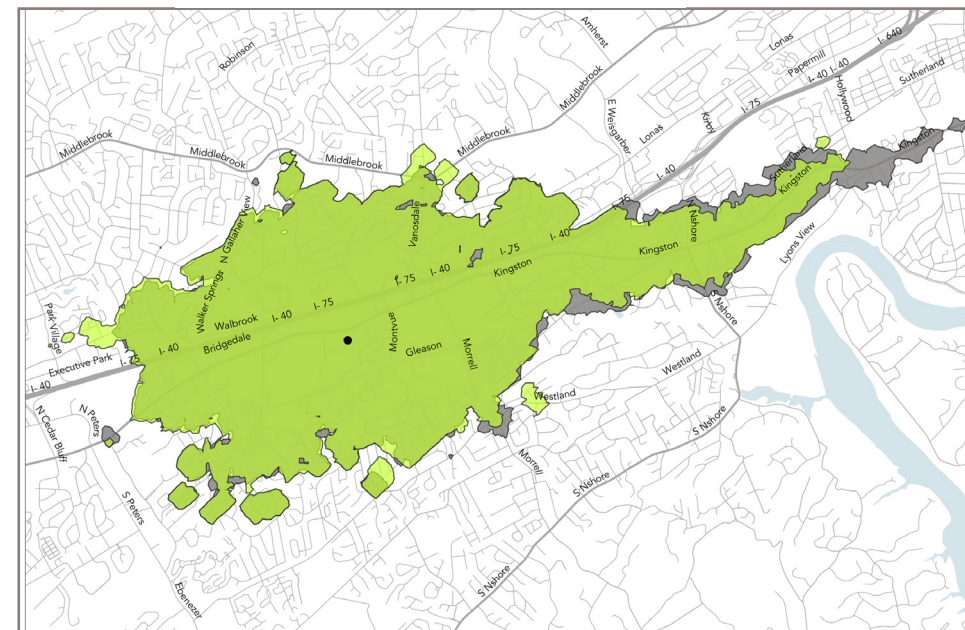
+22,100 **+5,600**
Jobs **Residents**
 in 45 minutes



From
Knoxville VA Medical Center
 in the
Draft Network

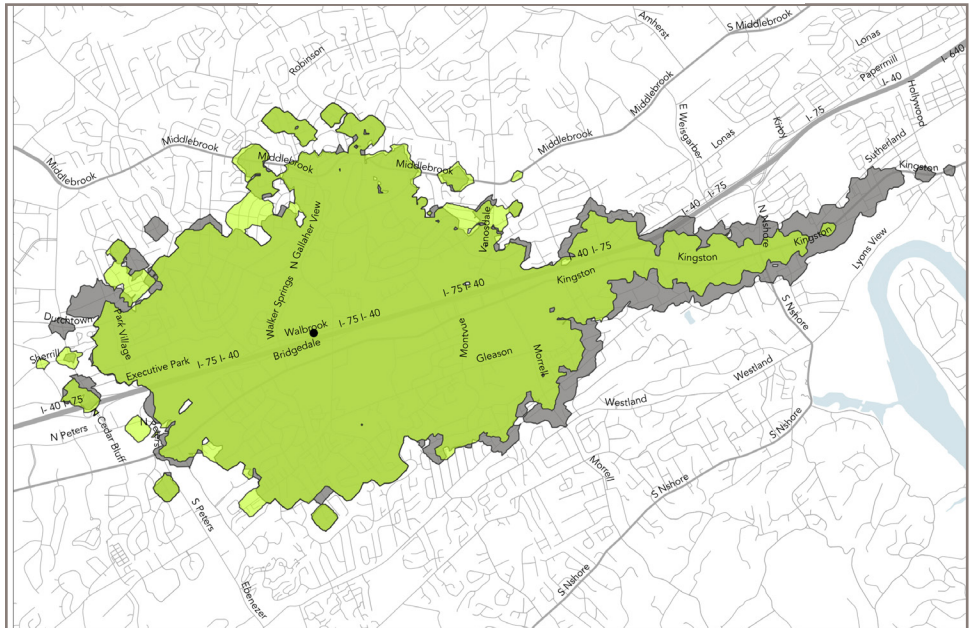
on weekdays at noon,
 using transit, you can reach

-400 **+200**
Jobs **Residents**
 in 45 minutes



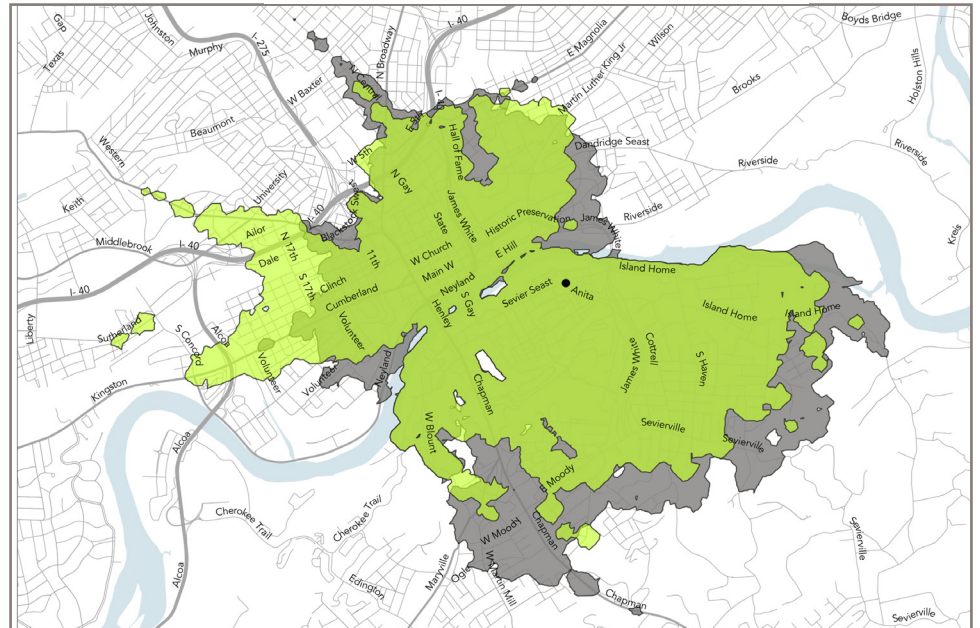
From
Walbrook at Walmart
 in the
Draft Network
 on weekdays at noon,
 using transit, you can reach

-3,300 **-1,200**
Jobs **Residents**
 in 45 minutes



From
Island Home Ave and Sevier Ave
 in the
Draft Network
 on weekdays at noon,
 using transit, you can reach

+4,000 **+1,200**
Jobs **Residents**
 in 45 minutes



From
Walmart Chapman Highway
 in the
Draft Network
 on weekdays at noon,
 using transit, you can reach

+1,600 **+400**
Jobs **Residents**
 in 45 minutes

