Chapter 11: Transit System Redesign

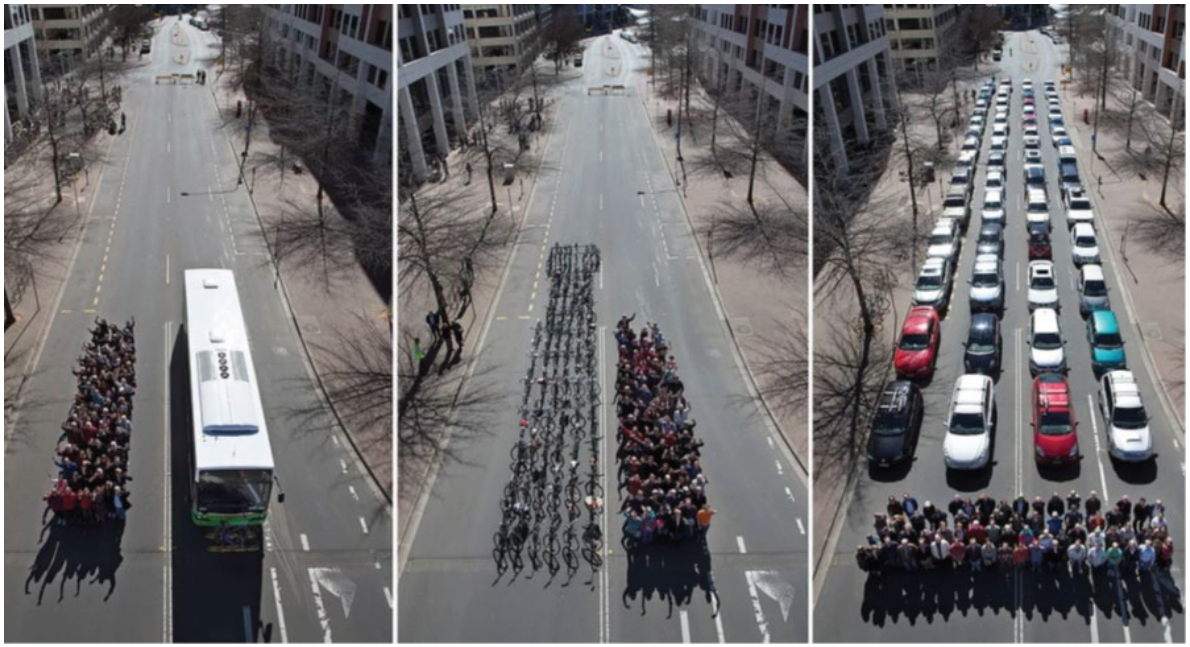
What is the Transit System Redesign?

As part of Multimodal Norfolk, the City has studied a full redesign of the public transit system to evaluate and recommend important policies related to transit funding, and most significantly, recommend how and where transit services should be provided in the city. As part of the redesign many types of transit services have been considered, including traditional fixed route services and on-demand options.

Norfolk is an old city, and overall, a moderately dense city. While not all of Norfolk is dense, large parts of it are, and like all places with high density, Norfolk has limited road space that regularly gets filled and is seeing an increase in the density and intensity of land uses.

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

In a growing city that is getting more dense, relying on bikes and transit as major modes of transportation is the only way to have room for everyone.



By providing more multimodal options for getting around, more people can move about in less space. Investing in transit service and facilities for walking and riding bicycles and scooters means Norfolk can continue to grow and thrive with a functional transportation system.

The only alternative to congestion is for a larger share of the population to rely on public transit and other modes that carry many people in few vehicles, or that take far less space per person than cars (i.e. bicycles).

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.

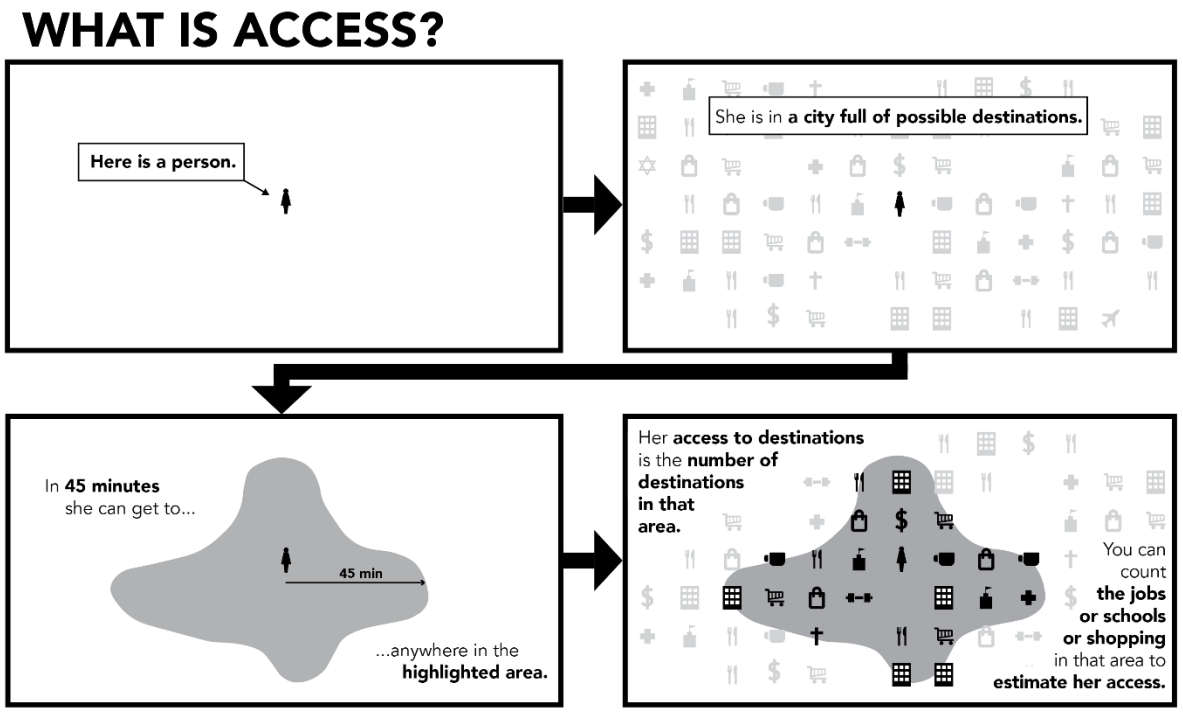
Access, or the Wall Around Your Life

What if we planned public transit with the goal of freedom? Access is your ability to go places so that you can do things. We calculate access, for anyone anywhere, like the diagram at the right.

Whoever you are, and wherever you are, there's an area you could get to in an amount of time that's available in your day. That limit defines ***a wall around your life***. Outside that wall are places you can't work, places you can't shop, schools you can't attend, clubs you can't belong to, people you can't hang out with, and a whole world of things you can't do.

We chose 45 minutes travel time for this example, but of course you can study many travel time budgets suitable for different kinds of trips. A 45 minute travel time one way might be right for commutes. For other kinds of trips, like quick errands or going out to lunch, the travel time budget is less. For a trip you make rarely it might be more.

But the key idea is that we have only so much time. There is a limit to how long we can spend doing anything, and that limit defines a wall. We can draw the map of that wall, and count up the opportunities inside it, and say: *This is what someone could do, if they lived here.*



Measuring access helps us see how much freedom a transit system is providing.

Access is a combined impact of land use planning and transport planning. We can expand your access by moving your wall outward (transport) or by putting more useful stuff inside your current wall (land use). On an individual level, access represents convenience and the ability to do the things you need. As such, the level of access transit provides is part of what determines ridership, but it is also something that many people will see as a worthy goal in itself.

Frequency is Freedom

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

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

Frequency is invisible and easy to forget, and yet on transit it is often the most important factor determining where you can get to in a given amount of time.

More frequent service dramatically improves access.

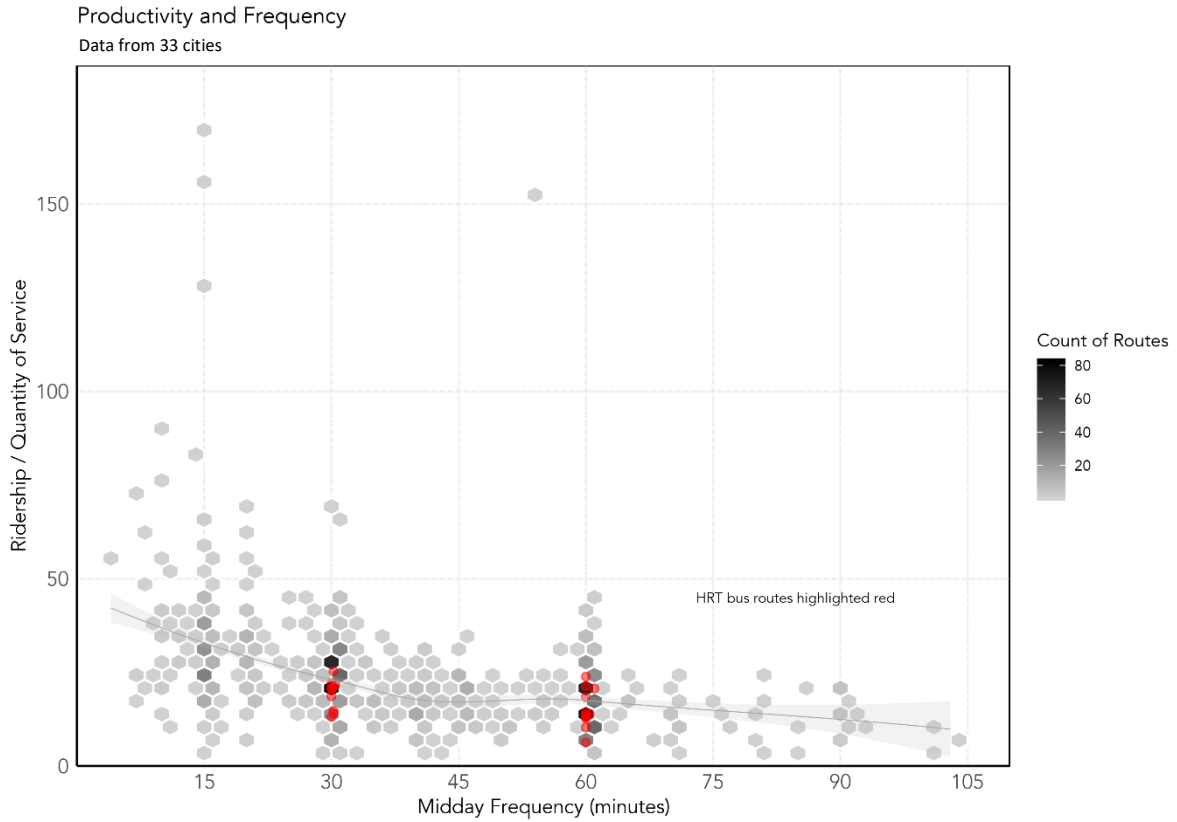
High frequency reduces travel time by providing several linked benefits:

- Shorter waits,
- Faster transfers,
- Easier recovery from disruption, and
- Spontaneity and freedom.

For these reasons, more frequent service is vastly more useful, and is often more highly used, resulting in higher ridership even relative to cost.

The plot to the right shows all the lines operated by 33 different U.S. transit agencies, at various points in the 2010s. Each line is located on the plot based on its frequency and its productivity (boardings per service hour). More frequent service is to the left, and more productive service is higher up. The shade of each hexagon indicates the number of lines in that place on the graph. The plot shows that higher productivity is correlated with higher frequency, even though higher frequencies require more service hours. In other words, ridership appears to rise exponentially as frequency increases.

This is a two-way street: transit agencies rarely run high frequency service in places where they expect low ridership. But conversely, if frequency isn't very high, the amount of ridership transit can attract is fundamentally limited.



More frequent service is often more productive service, as seen in this hex-plot diagram comparing frequency of service and productivity across hundreds of bus routes at 33 transit agencies in North America. HRT bus routes are highlighted in red.

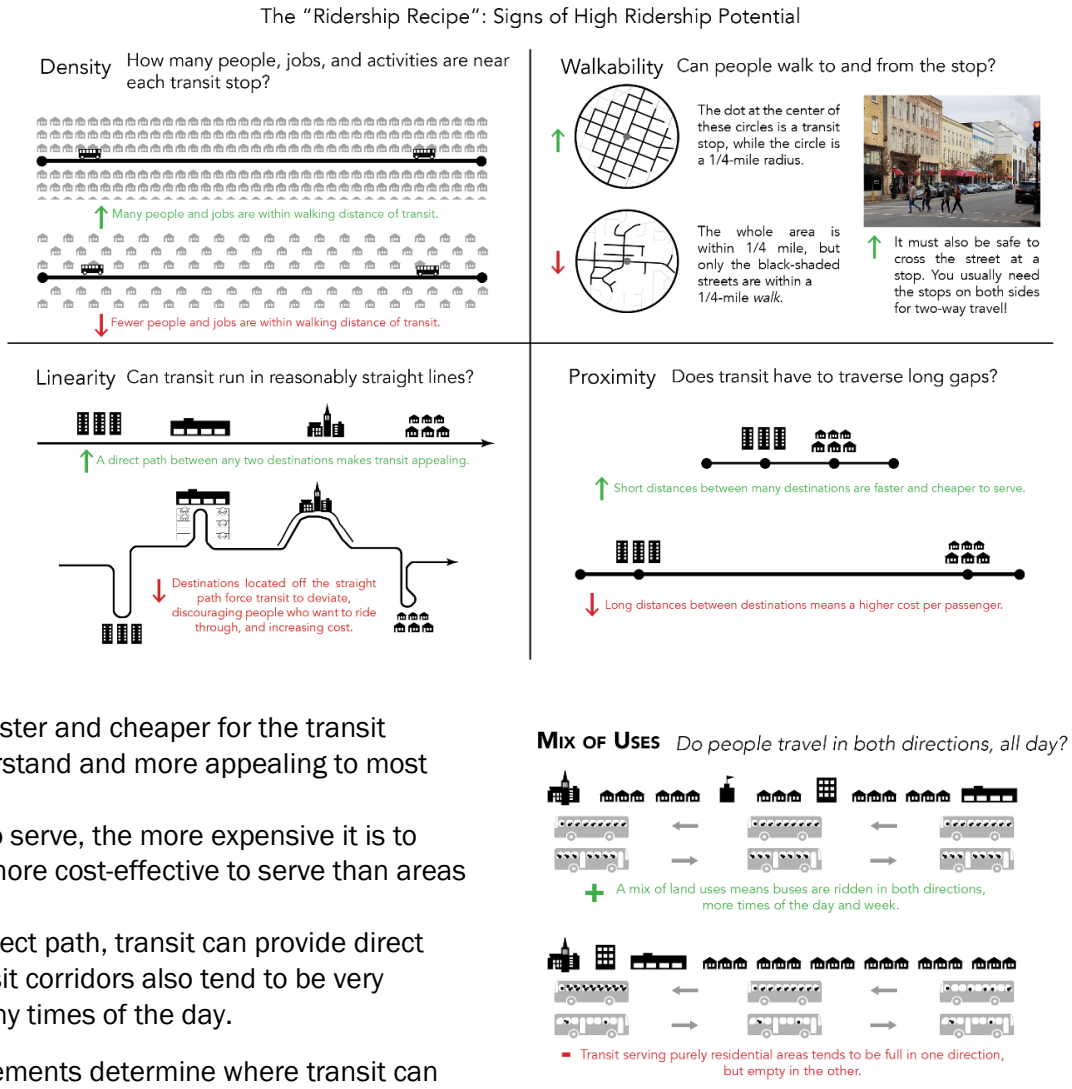
Transit Access Depends on the Built Environment

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

1. **Density.** Where there are many residents, jobs and activities in an area, there are many places people might want to go.
2. **Walkability.** An area only becomes accessible by transit if most people can safely and comfortably walk to and from the nearest transit stops, since most people reach transit by walking. Improved bike access can also expand the "market area" of transit stops, though only a small portion of riders use bikes to reach transit.
3. **Linearity.** Direct paths between many destinations are faster and cheaper for the transit agency to operate. Straight lines are also easier to understand and more appealing to most potential riders.
4. **Proximity.** The longer the distance between two places to serve, the more expensive it is to connect them. Areas with continuous development are more cost-effective to serve than areas with big gaps.
5. **Mix of Uses.** When there is a mix of land uses along a direct path, transit can provide direct access to a broad range of destinations. Mixed-use transit corridors also tend to be very productive because people ride in both directions at many times of the day.

Regardless of the intricacies of local geography, these five elements determine where transit can be useful for many people, at a relatively low cost.

IF increasing access, freedom, and ridership were the primary goal of Norfolk's transit system, then the City would focus its transit resources on frequent service to those places where these five factors are the strongest. Yet, this is not the only goal that transit is asked to achieve.



These five factors are major predictors of where transit service can achieve high ridership relative to cost.

Goals of Transit

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

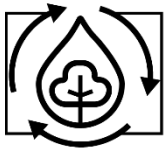
Possible goals for transit include:

Social Safety Net

Transit can help meeting the needs of people in situations of disadvantage, with access to essential services and jobs, or alliterative social isolation by providing a basic affordable transportation option.

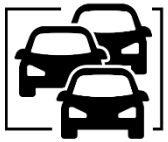
Economic Opportunity

Transit can give workers access to more jobs; businesses access to more workers; and students more access to education and training.



Climate & Environmental Benefits

By reducing car trips, transit use can reduce air pollution and greenhouse gas emissions. Frequent transit can also support compact development and help conserve land.



Congestion Mitigation

Buses carry more people than cars, transit use can mitigate traffic congestion by reducing Vehicle Miles Traveled (VMT). This is especially important in areas with high jobs-housing imbalances and a preponderance of long commutes.

Health

Transit can support physical activity. 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 higher transit access and 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, and they also align closely with higher access outcomes.*

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.*

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.

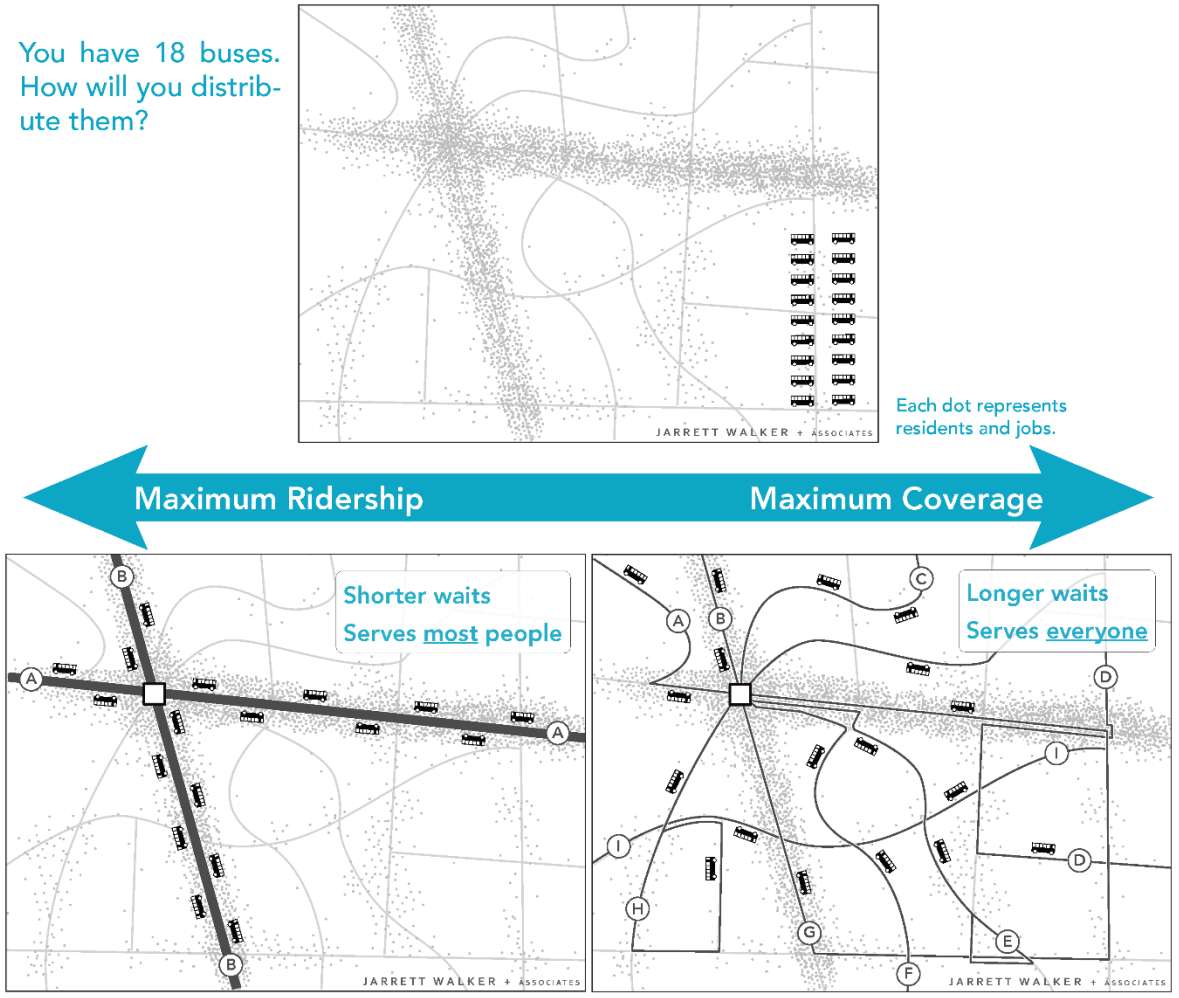
Consider the fictional town to the right. The little dots indicate dwellings and commercial buildings and other land uses. The lines indicate roads. As in many towns, most activity is concentrated around a few roads.

A transit agency that wants to maximize access for most people would run all its service on the main streets because many people are nearby and buses can run direct routes. A high access 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 bottom-left. This network also maximizes the potential ridership, so we could call it the Ridership Network.

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



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.

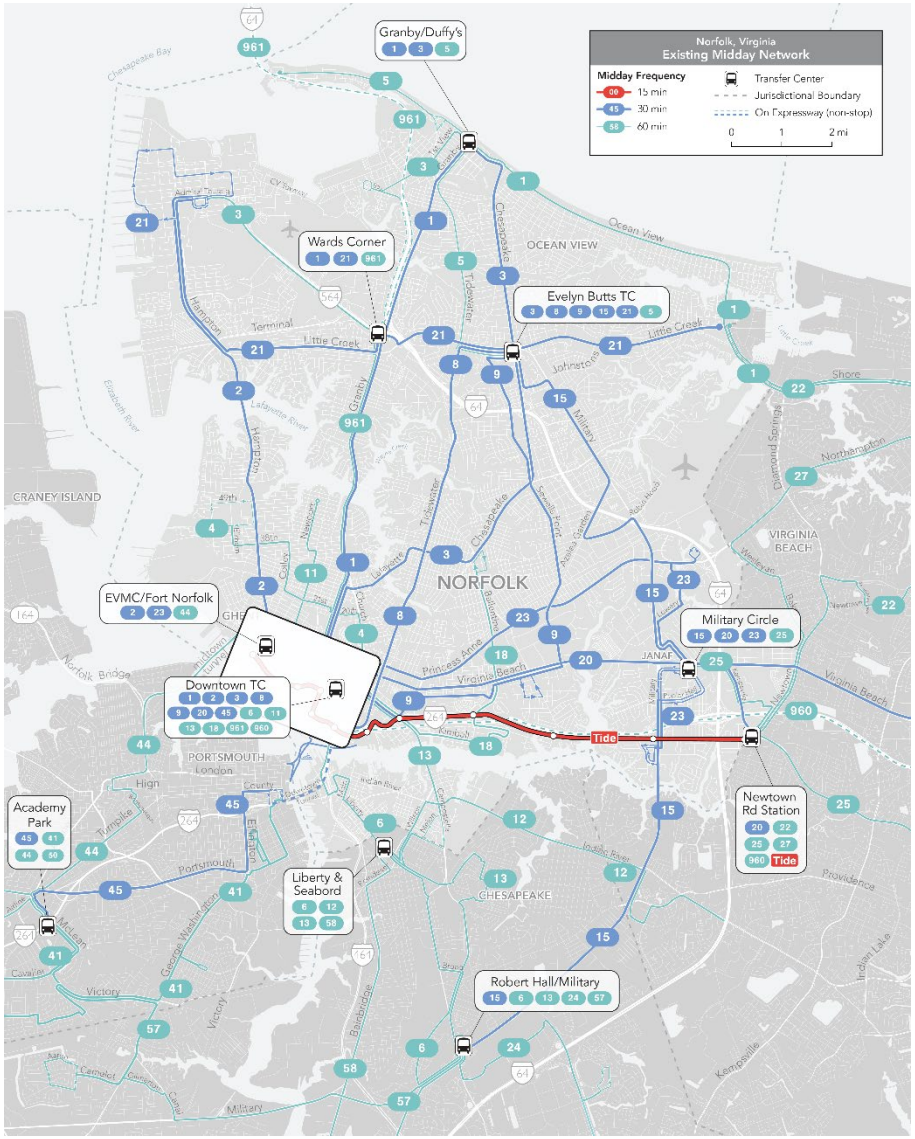
The "right" balance of ridership and coverage goals is different in every community. It can also change over time as the values and ambitions of a community change.

The Transit System Redesign planning process sought to help the City address how to balance these competing goals of Coverage and Ridership, and design a new bus network for the short-term that would better meet the goals, priorities, and needs of today's city.

This has been accomplished through three rounds of engagement with the public and stakeholders:

- In Round 1, we explored Key Choices such as Ridership versus Coverage and Walking versus Waiting.
- In Round 2, the City and the project team produced two contrasting Transit Network Concepts to highlight the difference between a network designed for Higher Ridership and Access versus a network designed for Higher Coverage.
- In Round 3, the City and the project team released the **Draft New Network** and asked the public, stakeholders, and transit riders for feedback about the new design. That feedback resulted in a **Revised New Network** presented in this plan.

Why consider changing the bus network in Norfolk? The map at the right shows the Existing[i] network color-coded by the frequency of service. In this map, the prominent red line is The Tide, the region's only service operating every 15 minutes or better throughout the rush hours and middle of the day. The network is dominated by blue lines, which run every 30 minutes and light blue lines, which run every 60.



The Existing Bus Network in Norfolk has mostly 30-minute or 60-minute routes serving most of the city at midday. A higher resolution image can be viewed in the Choices Report.

The network in Norfolk covers most major streets, so that most of the population and jobs are near some kind of transit service, but the low frequency of service means that most people are waiting a long time for a bus. For the residents, businesses, and leaders of Norfolk, there is a key question:

How much of the City of Norfolk's transit budget should be spent on the most useful, liberating service, in pursuit of higher ridership and better access for most?

How much should be spent providing coverage to ensure some service for nearly everyone?

Round 1 Key Choices

In Round 1 of public engagement, before any new networks for Norfolk were designed, the City and project team asked people to weigh-in on some of the tradeoffs that arise in every transit system and that are described in more detail in the Choices Report and on Key Choices section of the project website. For charts reporting the results of polls and surveys on these questions, please see the Concepts Report. Stakeholders were engaged in a half-day workshop and surveying process and the general public and riders were surveyed through a web and paper surveying process. In total, 255 people responded to the public survey in Round 1.

Stakeholders play a transit planning game to learn the basics of transit network design at the Transit Network Redesign Workshop 1 on February 8, 2020.

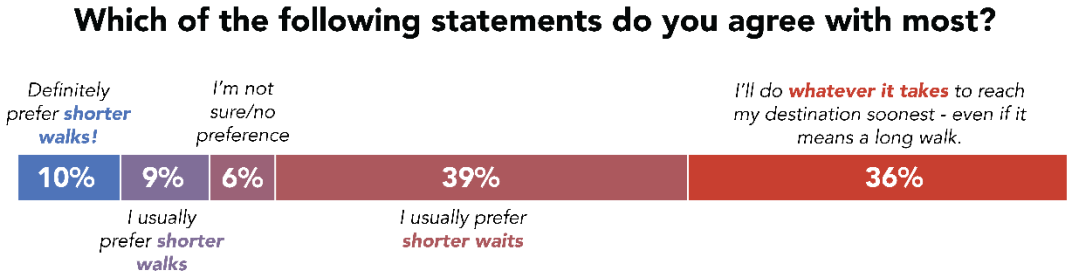
Walking vs. Waiting

In any transit network, there is a basic trade-off between walking farther to service, or waiting longer for service. A transit agency can concentrate its service into fewer, more frequent routes... but they will be spaced farther apart. Or it can spread its service out into more routes, that are closer together... but then they run infrequently. Within a fixed budget, the basic math of transit forces a trade-off between offering shorter waits and offering shorter walks.

When asked how they would like to see this trade-off made, Norfolk stakeholders and members of the general public tended to support longer walks in exchange for shorter waits. Among web survey respondents, there was a very strong preference for less waiting. And among public meeting attendees (whose sticker-votes are shown at right) there was also a strong preference for less waiting in exchange for more walking.

Stakeholder Feedback

Public Feedback

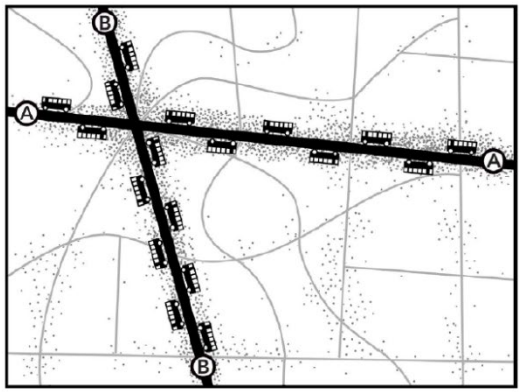


Ridership vs. Coverage

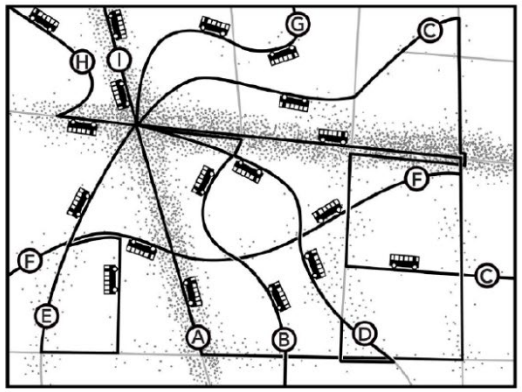
The trade-off between walking and waiting can also be described as a tradeoff between maximizing ridership and maximizing coverage. When transit agencies concentrate their service into fewer, but more frequent, routes, it nearly always leads to higher ridership. Yet, within a fixed budget, this means less service can be spread out to cover everyone.

In response to questions about this tradeoff, most people said that they wanted Norfolk to spend somewhat more of its budget providing frequent, high-ridership service, and somewhat less of its budget on low-ridership coverage services. An interest in this direction of change, among a majority of respondents, was consistently heard from the different groups of people who took the web, or rider survey, or were on the Stakeholder Committee.

Main Goal: Maximize Ridership with a few high-frequency routes along direct corridors with lots of destinations



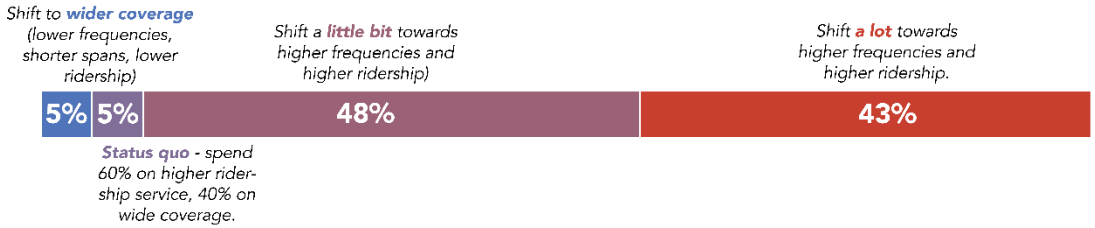
Main Goal: Maximize Coverage with many low-frequency routes on nearly all roads, even those with few destinations



In the Round 1 Public Survey, riders and the general public were asked which goal they preferred to focus on, Ridership or Coverage.

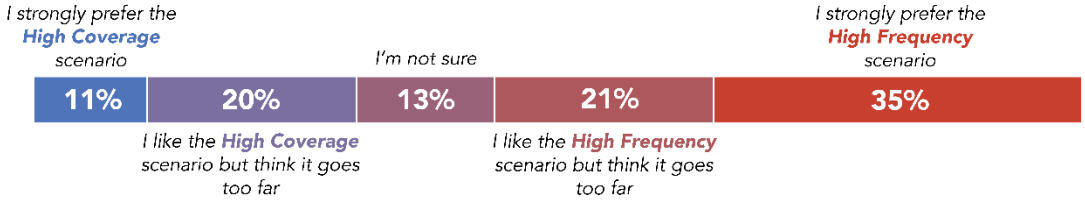
Stakeholder Feedback

Which of the following statements do you agree with most?



Public Feedback

Which Scenario comes closer to serving your values?



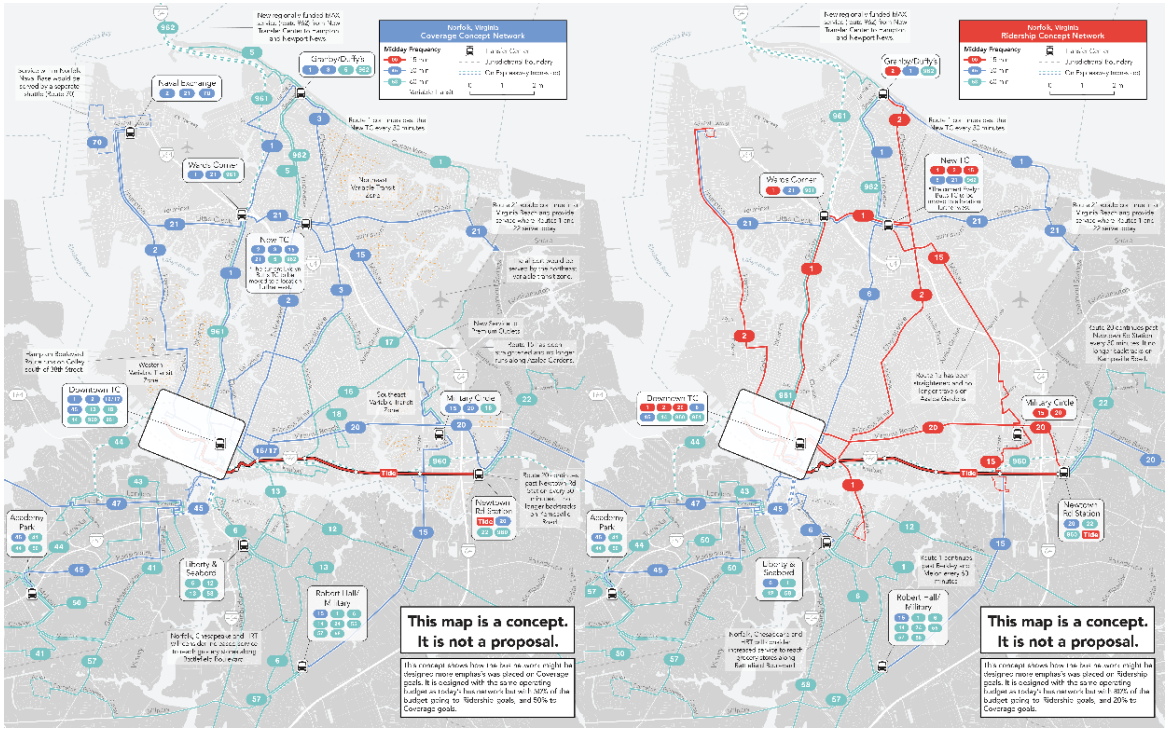
Round 2 Transit Concepts

To help people understand key trade-offs and develop confident opinions, the City and project team created two different "Network Concepts." The concepts differed in the degree to which they emphasize Ridership and Coverage goals.

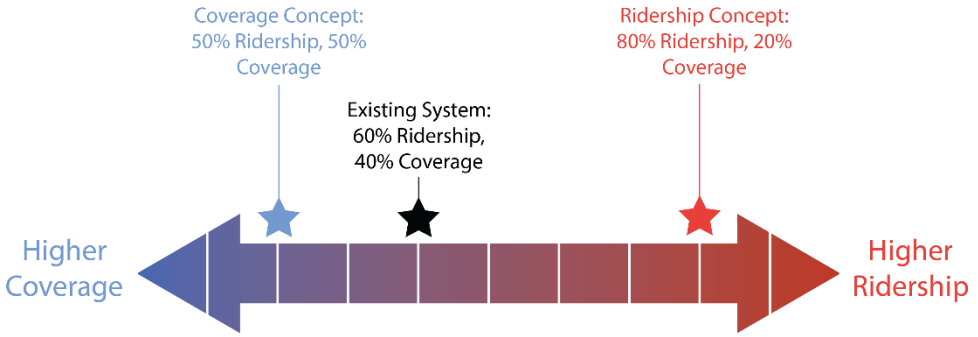
The existing system devotes about 60% of its resources toward Ridership goals and about 40% to Coverage goals and duplication. The Ridership Concept put about 80% of its resources toward Ridership goals and 20% toward Coverage goals. The Coverage Concept put 50% of its resources toward Ridership goals and 50% toward Coverage goals.

The "Coverage" and "Ridership" Concepts were blank slate redesigns of the transit network, completely re-thinking the shape of the transit network, to fit modern-day Norfolk. The Ridership Concept concentrated service into frequent lines, in places where ridership potential is highest. A much greater number of residents and jobs in the City would be close to frequent, direct service than are today.

The Coverage Concept, in contrast, spread service out to cover a large geographic area, but with low-frequency routes. Many fewer residents and jobs would be close to frequent service in the Coverage Concept. However, more residents and jobs would have access to some service, even if it



The Concepts showed a contrast in how to design a transit network for Norfolk across the spectrum between greater emphasis on Coverage goals and Ridership goals. Higher resolution images can be viewed in the Concepts Report.



comes infrequently and therefore isn't very useful.

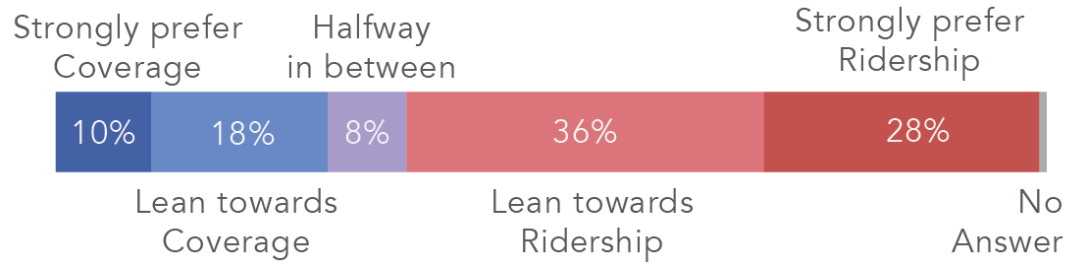
The number of people who would be covered by *any* service, or by *frequent* service and the changes in jobs reachable was summarized in the Concepts Report, available on the project website.

Using the Concepts on the previous page, the City and project team engaged stakeholders and the public in a conversation about which concept they preferred. Stakeholders were engaged in a half-day workshop and surveying process and the general public and riders were surveyed through a web and paper surveying process.

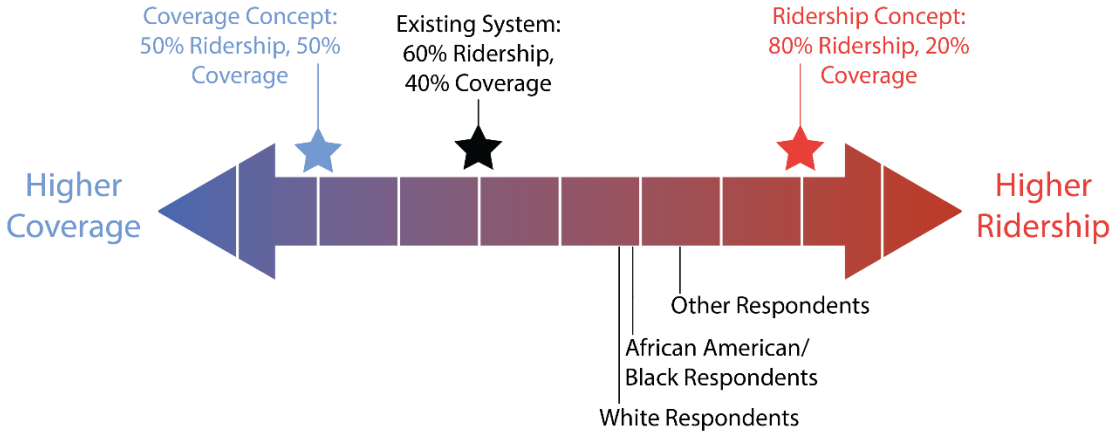
Through the online and paper surveying efforts, 1,085 survey responses were collected between June 25 and September 15, 2020. The largest share of responses (71%) were collected on paper. The remaining portion (29%) of responses were collected online.

Survey respondents were largely African-American/Black, mostly transit riders, largely of working age, mostly low-income, and almost entirely from Norfolk.

Nearly two-thirds (64%) of all respondents preferred the Ridership and about one-quarter (27%) preferred the Coverage Concept. Eight percent of respondents indicated that they were "halfway in between" both options and 1% of



Respondents to the Round 2 Public Survey largely preferred the Ridership Concept.



When mapped against the policy spectrum, the midpoint of public preference was about midpoint between the Existing System and the Ridership Concept.

respondents did not answer the question. Preference for the Ridership Concept was consistent across demographic groups.

Nearly two-thirds of survey respondents preferred the Ridership Concept.

When responses are mapped against the spectrum of possibility between the Coverage and Ridership Concepts, the graphic above shows that the average respondent across racial groups preferred that the Norfolk bus network be closer to the Ridership Concept. Based on this input, the City recommended a policy of designing the new network for Norfolk with 70% of resources focused on Ridership goals and 30% of resource focused on Coverage goals.

Round 3 Draft New Network

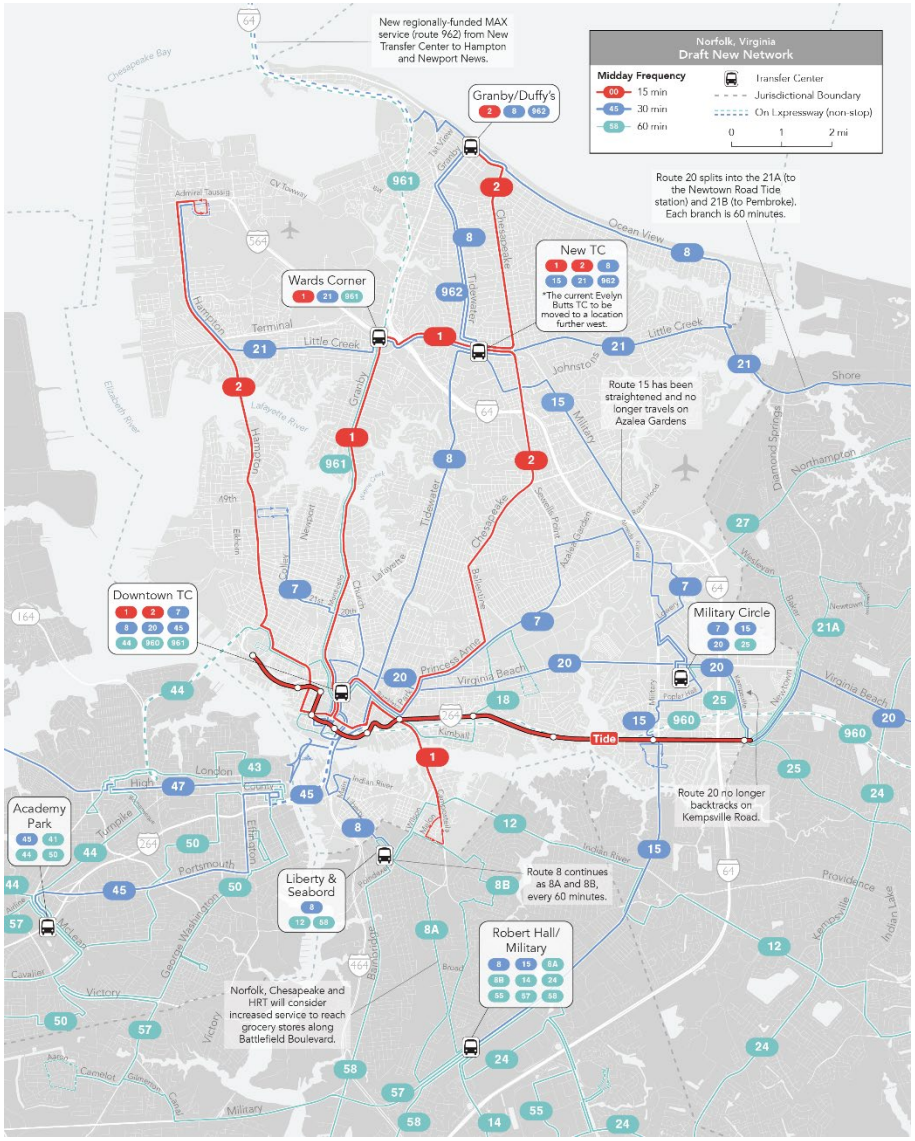
Based on public input collected in Rounds 1 and 2, the City and project team, together with HRT staff, designed a Draft New Network and that network was released for public review and comment in [the Draft New Network Report] in November 2020.

The Draft New Network concentrated service into few, more frequent routes, focused on the places with the most people and jobs. By doing so, the Draft New Network achieved better job access for most, but not all, residents of Norfolk. On job access measures, the Draft New Network:

- Increased the number of jobs that the average person could reach in 45 minutes by nearly 10,000, 31% more than with the existing network.
- Increased the number of jobs that the average person of color could reach in 45 minutes by 10,000, 32% more than with the existing network.
- Increased the number of jobs that the average person in poverty could reach in 45 minutes by 12,500, 39% more than with the existing network.

The increase in access in the Draft New Network is a result of more people and jobs near frequent service, with 140,900 more people and 95,100 more jobs near frequent transit. This increase comes with the cost of reduced coverage for some, as about 6,500 more residents and 13,800 more jobs would be more than ¼ mile from service.

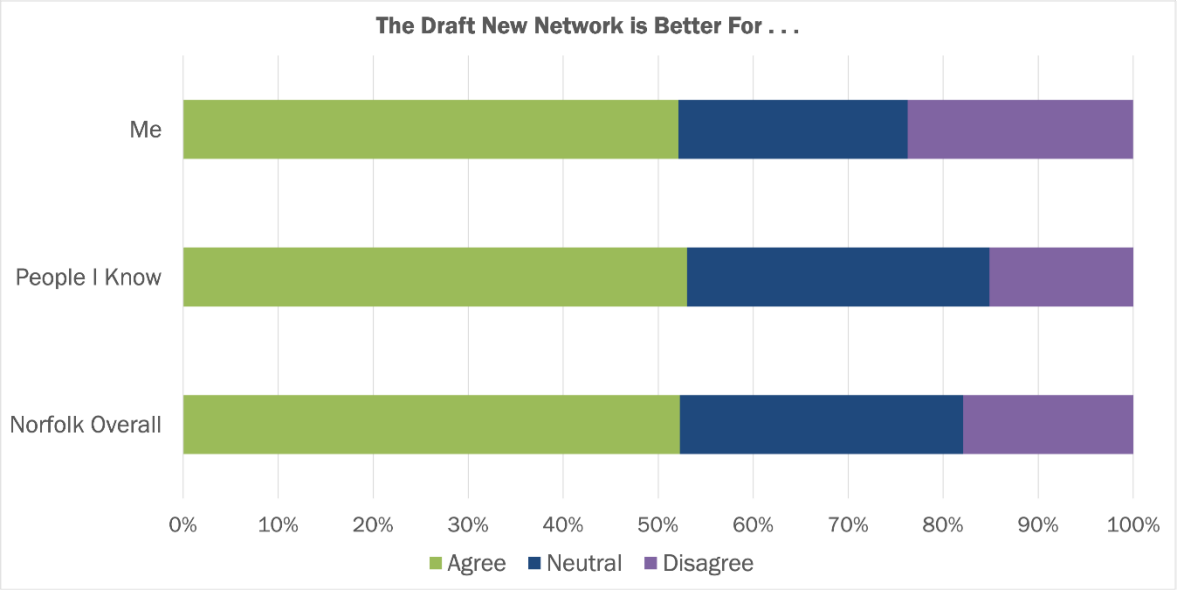
The City and project team engaged the public in two virtual meetings and surveyed bus riders and the public through a web and paper survey that was available from November 30, 2020 through January 8, 2021. Over 1,900 people responded to the survey, 76% were regular transit riders, 81% identified as African-American or Black, and 61% had an annual income below $25,000.



The Draft New Network was released for public review and comment in November 2020. A higher resolution image can be viewed in the Draft New Network Report.

Among these respondents more than three-quarters had a positive or neutral response to the Draft New Network.

The most commonly cited concerns were the walking distance to Sentara General Hospital for Route 2, the lack of service on Lafayette Boulevard west of Chesapeake Boulevard, and lack of service on Princess Anne east of Sewells Point Road.



Round 3 survey results on the Draft New Network

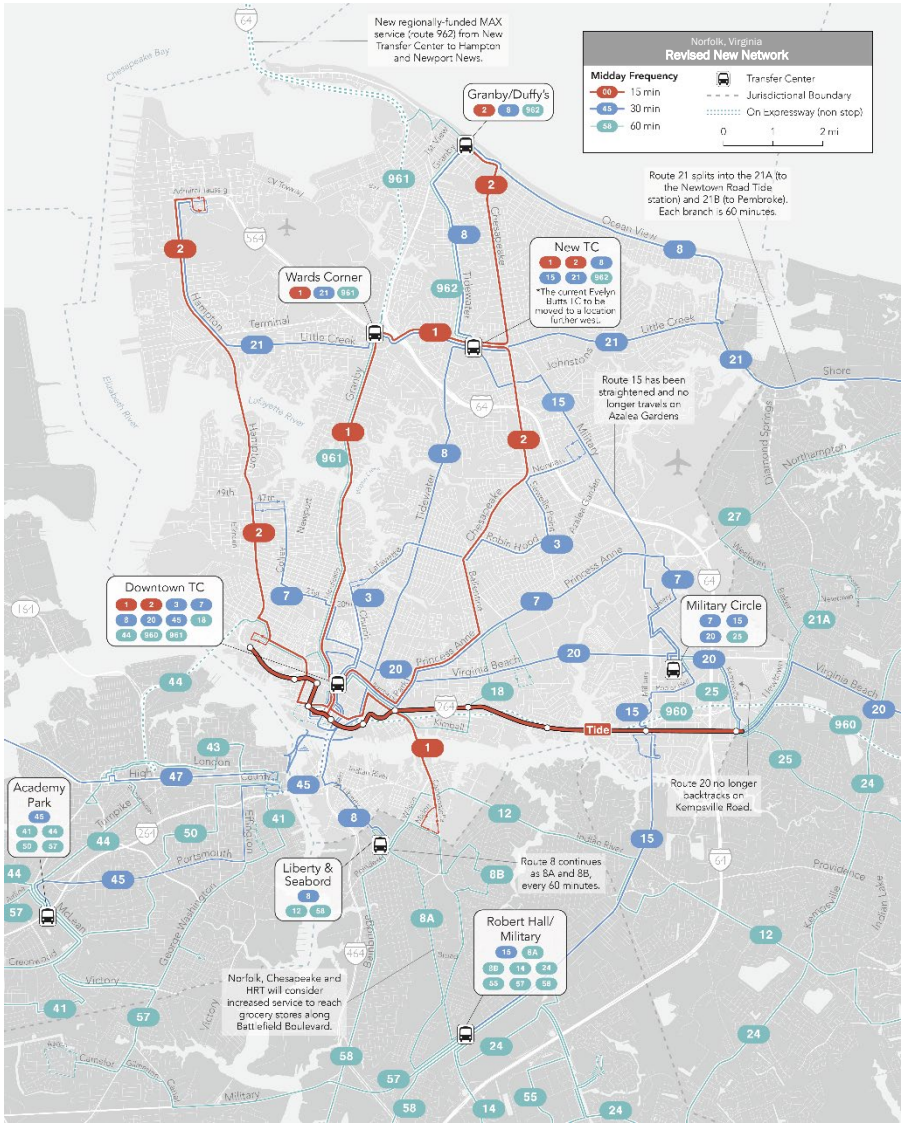
Revised New Network

Based on public input from Round 3 and additional input from HRT and City leaders, the project team revised the New Network and made the following changes:

- Added a new version of Route 3 that runs from DNTC via Church Street to 26th/27th Streets, Lafayette Boulevard, Chesapeake Boulevard, Robin Hood Road, Sewells Point Road, Norview Avenue, and terminating at Military Highway and International Boulevard. This new Route 3 would provide service along the eastern sections of the current Route 3, portions of existing Route 9, and provide a new radial connection from the Norview Avenue and Military Highway commercial areas to downtown.
- With the new Route 3 on potions on Sewells Point Road, Route 7 is shifted to serve Princess Anne Road from Sewells Point Road to Kempsville Road.
- Route 7 is also shifted to serve Princess Anne Road from Church Street to Monicello Avenue.
- The Route 2 loop through Sentara Norfolk General Hospital has been added back, though the loop may be shorter than the existing loop by using Children's Lane.

The net effect of these changes is to slightly increase the cost of the Revised New Network compared to the existing network, so that it is not strictly cost neutral, but is about 1% more costly than the Existing Network. In addition, these change shift the balance of Ridership and Coverage goals slightly toward Coverage.

The recommended changes in this network were the subject of significant public conversation, described above, and discussion with elected officials. Based on the thorough conversations and compromise around competing priorities, Norfolk City Council unanimously adopted a resolution supporting the implementation of this network on November 16, 2021.



The Revised New Network. A higher resolution image can be viewed on the www.MultimodalNorfolk.com website.

The revised new network shown on the previous page would have major benefits for most people in Norfolk. The **average resident could reach 7,400 additional jobs** by walking and transit in 45 minutes, a 23% increase over the Existing Network. The **average minority resident could reach 8,600 additional jobs** in 45 minutes, a 27% increase over the Existing Network. The **average resident in poverty could reach 10,700 more jobs** in 45 minutes, a 34% increase over the Existing Network.

Implementation of the New Network

Making such a significant change the bus network will require careful planning and coordination between the City and HRT to prepare for and implement the new network. In most communities that implement a major network, the actual changing of routes happens on a single day: one day the old routes are running and the next the new routes are running. A great deal of planning and effort goes into that seemingly overnight transition, however. Key steps in the implementation of the new network include

- Development of new schedules: HRT, with support from the City, will need to develop the final schedules for the new and redesigned routes. New public facing schedule booklets and related digital information will need to be produced so that riders can learn about the new routes.
- Designate new stop locations: The City and HRT will need to coordinate to define the exact locations for new stops in places where bus service does not run today, but will in the new network.
- Final Title VI Analysis: HRT, in coordination with the City, will need to conduct the necessary Title VI Service Equity Analysis on the final proposed changes and have the HRT Board review and approve the final changes.
- Update existing stations and stops with new route information: Many existing stops will need updated signage due to new route numbers or names. System maps and other bus route information at transit centers and Tide stations will need to be updated.
- Marketing and Communications: The City and HRT will need to coordinate to inform the public about the major changes through various media outlets, social media, on-bus announcements, and many other avenues so that riders are well-informed in the weeks and months before that a major change to bus routes will happen.

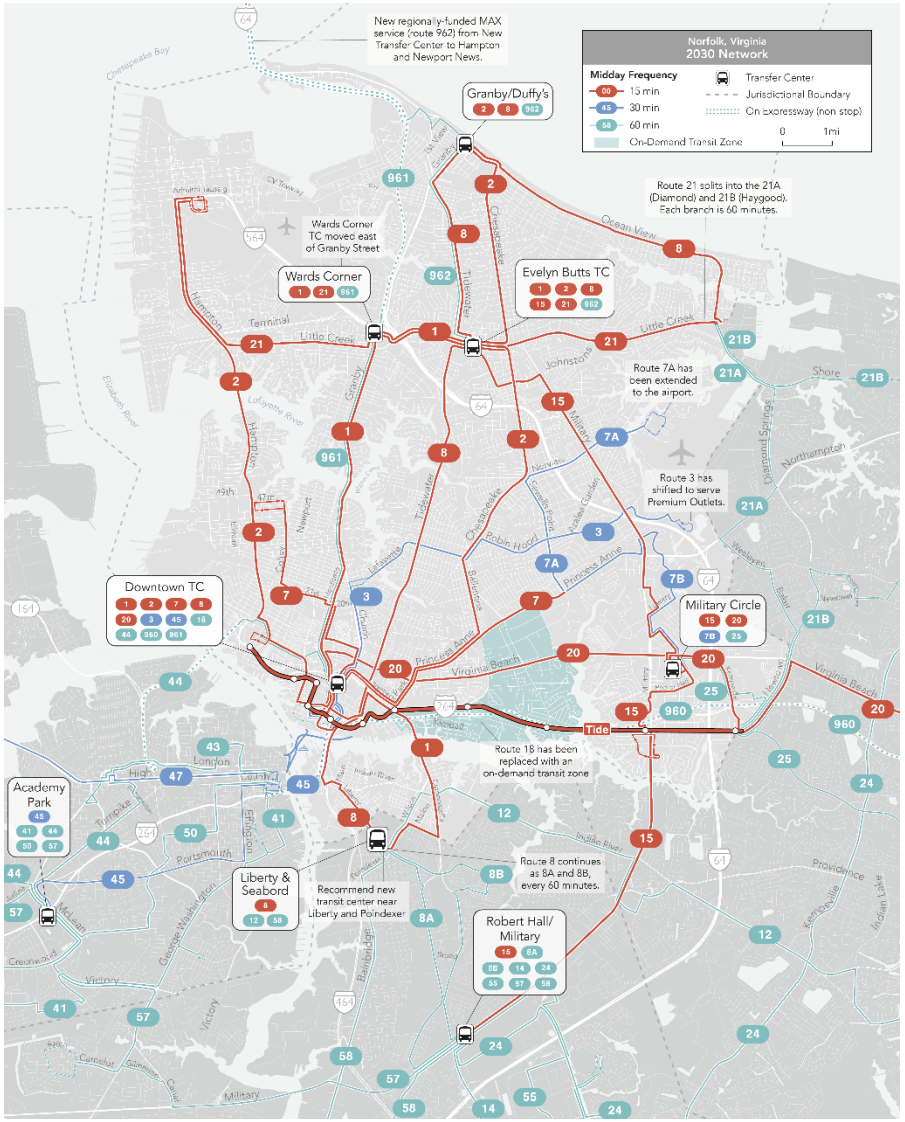
The new bus network is planned for implementation in 2023.

Long-Term Network

In 2020, the Virginia General Assembly passed legislation creating the new Hampton Roads Regional Transit Fund. This new funding source will allow Hampton Road Transit to invest in higher frequency service on its "Regional Backbone" routes which include existing Routes 1, 2, 3, 8, 15, 20, and 21. Under the Revised New Network, Routes 15, 20, and 21 are largely unchanged and the City expects that new or revised Routes 1, 2, and 8 would qualify as "Regional Backbone" routes and qualify for the regional funding to support more frequent service.

Building off the regional funding and continuing City investment, the bus network in Norfolk would drastically improve over the next 10 years, with a total increase in service levels of **nearly 40%**. The map at right shows how the extent of the frequent network could expand drastically by 2030 and shows the following improvements:

- Increased frequency for Route 8 on Tidewater Drive, E. Ocean View Avenue, and Liberty Street to every 15 minutes.
- Increased frequency for Route 20 along Virginia Beach Boulevard to every 15 minutes.
- Increased frequency for Route 15 along Military Highway to every 15 minutes.
- Increased frequency for Route 21 on Little Creek Road to every 15 minutes.
- Increased frequency for Route 7 from ODU to downtown to Princess Anne Road and Sewells Point Road to every 15 minutes.
    - East of Sewells Point Road, Route 7 would branch with each branch having service every 30 minutes. The new northern branch would serve the Airport.
- A revised Route 3 would extend to the Premium Outlets.
- Extend Route 1 from Campostella Road and Berkley Avenue to connect with Route 8 near Liberty Street and Seaboard Avenue.



The Long-Term Network. A higher resolution image can be viewed on the www.MultimodalNorfolk.com website.

This expanded and more frequent transit network would vastly expand access to opportunity for Norfolk residents and support a more vibrant economy for the city.

[i] In this plan, references to the Existing Bus Network refer to the state of the bus network in late 2019 and early 2020, before the Covid-19 pandemic forced major changes in the schedules of HRT services.