Greater RVA Transit Vision Plan: Near-Term Strategic Technical Analysis Appendixes B-D

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Prepared by:

Kimley»Horn

Richmond Regional Transportation Planning Organization
SUPPORTED BY PlanRVA

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Appendix B:
GRTC Passenger Survey

Priorities

In 2019, GRTC conducted a survey of passengers using fixed route services to better understand characteristics of the riders and their trips. A component of this survey asked respondents to prioritize changes to GRTC's service based on ten choices:[5]

- **Cost**: GRTC should keep fares low
- **Schedules at Bus Stops**: Your bus stops should have information about scheduled arrival times
- **Shelters**: Your bus stops should have shelters, benches, etc.
- **Frequency**: GRTC buses should run more frequently on weekdays
- **Weekends**: GRTC buses should run more frequently on weekends
- **Reliability**: GRTC buses should have better on-time performance
- **Comfort**: GRTC buses should have softer seats and look spotless
- **Destinations**: GRTC service should include bus routes to _____ (fill in location)
- **Security**: Regular security patrols should be done at transit centers
- **Website**: GRTC should have a more mobile-friendly website and text alerts

Each survey response included identification of specific GRTC route the survey respondent used, helping to identify which routes require specific changes.

According to the survey, besides cost, riders across all routes believed that GRTC's biggest priority should be adding and maintaining shelters at bus stops. Increasing the frequency of weekday service and service reliability were also high priorities for respondents on most routes. **Table B-1** shows the destinations identified as priorities for added service and the Near-Term Strategic Technical Analysis corridor that would increase service to that destination.

[5] GRTC 2019 Passenger Survey Report, December 20, 2019

Table B-1: Destinations to Prioritize Increased Service from GRTC Rider Survey

Destination	Near-Term Strategic Technical Analysis Route
Airport	F. Airport via Route 60
Brook Road	H. Route 1 to Ashland
Carytown	E. West End South
Chesterfield/Chesterfield Towne Center	D. Midlothian Turnpike
Downtown	A. Broad Street – Short Pump D. Midlothian Turnpike E. West End South F. Airport via Route 60 H. Route 1 to Ashland
West Broad Street	A. Broad Street – Short Pump
Super Walmart Brook Road	H. Route 1 to Ashland
Regency Square	E. West End South
West End areas	E. West End South

Appendix C:
Potential Funding Sources Details

Federal

REGIONAL SURFACE TRANSPORTATION BLOCK GRANT (RSTBG) PROGRAM

Applicable use of funds: Planning and Design, Construction of Pedestrian Improvements, Marketing, Transit Capital Improvements

Eligible funding recipients: Localities, DRPT

The RSTBG program is a federal-aid highway program administered by the Federal Highway Administration through the FAST Act of 2016. This program provides funding to localities and state agencies to advance a variety of projects to preserve and maintain the performance of surface transportation, including transit and bicycle and pedestrian projects. Given the multitude of projects eligible in this grant program, the RSTBG program could be used for bus stop improvements, as well as pedestrian facility projects to improve pedestrian safety and access to bus stops.

BETTER UTILIZING INVESTMENTS TO LEVERAGE DEVELOPMENT (BUILD) GRANTS

Applicable use of funds: Planning and Design, Construction of Pedestrian Improvements, Transit Capital Improvements

Eligible funding recipients: Localities, GRTC, PlanRVA, DRPT

BUILD grants are awarded on a competitive basis through the US Department of Transportation to localities, regional planning agencies, and state agencies to fund multi-jurisdictional projects that are more difficult to support through traditional DOT programs. Infrastructure projects funded through BUILD grants must have a significant local or regional impact. BUILD grants are awarded annually, with awards between $5 million and $25 million. A variety of projects are eligible for the program, including highway, public transit, rail, and port projects. Grants are awarded based on a project's impacts to safety, state of good repair, economic competitiveness, environmental sustainability, and quality of life. US DOT evaluates how a project incorporates innovative technologies and financing strategies, as well as a project's readiness for implementation. Given the multitude of projects eligible in this grant program, the BUILD grant program could be used for programmatic bus stop improvements, as well as pedestrian facility projects to improve pedestrian safety and access to bus stops.

TRANSPORTATION ALTERNATIVES SET-ASIDE

Applicable use of funds: Planning and Design, Construction of Pedestrian Improvements, Transit Capital Improvements

Eligible funding recipients: Localities, GRTC, PlanRVA, VDOT DRPT

This program is a component of the Surface Transportation Block Grant program under the FAST Act. The Transportation Alternatives (TA) Set-Aside component of the STBG program replaced the previous Transportation Alternatives Program. The TA Set-Aside program funds a variety of smaller-scale projects,

including pedestrian and bicycle amenities, landscaping, and stormwater mitigation. The acquisition of new buses, or design and construction of new fixed-guideway bus routes are not covered by the TA Set-Aside program, but minor improvements associated with new transit service and facilities are eligible to be funded. Funding is administered through VDOT and applications for the program are accepted annually.

FTA SECTION 5303 – METROPOLITAN PLANNING

Applicable uses of funds: Planning and Design

Eligible funding recipients: PlanRVA

FTA's Metropolitan Planning program provides funding and procedural requirements for multimodal transportation planning in metropolitan areas. The types of planning activities eligible for Metropolitan Planning funding include projects that:

- Support the economic growth of the metropolitan area;
- Increase the safety and security of the transportation system for motorized and nonmotorized users;
- Increase the accessibility and mobility of people using the transportation system;
- Protect and enhance environment, promote energy conservation, and improve the quality of life;
- Enhance the integration and connectivity of the transportation system, across and between modes; or
- Promote efficient transportation management and operation; and emphasize the preservation of the existing transportation system.[6]

CONGESTION MITIGATION AND AIR QUALITY (CMAQ) IMPROVEMENT PROGRAM

Applicable uses of funds: Planning and Design, Construction of Pedestrian Improvements, Marketing, Transit Capital Improvements, Operating and Maintenance Expenses

Eligible funding recipients: Localities, VDOT, DRPT

The CMAQ program is a flexible source of funding for state and local governments to implement transportation projects that help reduce congestion and/or improve air quality to meet the National Ambient Air Quality Standards (NAAQS). CMAQ funds are apportioned by the MPO (PlanRVA) to be administered to various projects based on local and regional priorities. CMAQ funds can be used for implementing a wide variety of improvements associated with high-frequency service, as well as operating and maintenance and marketing expenses.

State

SMART SCALE

Applicable use of funds: Planning and Design, Construction of Pedestrian Improvements, Transit Capital Improvements

[6] "Metropolitan & Statewide Planning and Non-Metropolitan Transportation Planning https://www.transit.dot.gov/funding/grants/metropolitan-statewide-planning-and-nonmetropolitan-transportation-planning-5303-5304

Eligible funding recipients: Localities, GRTC, PlanRVA

SMART SCALE is Virginia's method for prioritizing transportation improvements for the Commonwealth's Six Year Improvement Plan (SYIP), which is updated each fiscal year. Three rounds of SMART SCALE funding have completed since its inception 2015, and the fourth round of funding is currently underway at the beginning of 2020. Projects must meet needs identified in the Commonwealth's long-range transportation plan, VTrans2040, to be considered for prioritization. Each project is scored based on estimated costs and benefits related to congestion mitigation, economic development, accessibility, safety, environmental quality, and land use. Each factor is weighed differently based on the needs of the each MPO/PDC region as compared to other regions across the Commonwealth. Regions are classified into one of four weighting typologies. The Richmond Region is considered Category B, which has the following factor weights:

- Congestion Mitigation – **15%**
- Economic Development – **20%**
- Accessibility – **25%**
- Safety – **20%**
- Environmental Quality – **10%**
- Land Use – **10%**

SMART SCALE funding is divided into two pools: the District Grants Program, which prioritizes projects against each other within a VDOT Construction District, and the High-Priority Project Program, which prioritizes projects against others across the state. SMART SCALE funding includes funds that are not governed by other state programs, such as CMAQ, Revenue Sharing, TA, set-asides, regional-specific funding, and State of Good Repair.

DRPT CAPITAL ASSISTANCE

Applicable use of funds: Construction of Pedestrian Improvements, Transit Capital Improvements

Eligible funding recipients: Localities, GRTC, PlanRVA

The Capital Assistance program provides funding to capital projects that maintain, improve, or expand public transportation services. The Capital Assistance program is guided by a prioritization methodology called MERIT (Making Efficient and Responsible Investments in Transit). The MERIT scoring process classifies, scores, and prioritizes projects in the following categories:

- **State of good repair:** Projects or programs to rehabilitate an existing asset (State match up to 68%)
- **Minor enhancement:** Projects or programs to add capacity, new technology, or a customer facility with a cost less than $2 million or include a vehicle expansion of more than five vehicles of 5% of the existing fleet size (State match up to 68%)
- **Major expansion:** Projects or programs to add, expand, or improve service with a cost exceeding $2 million, or for expansion vehicles, an increase of greater than 4 vehicles or 5% of fleet size, whichever is greater (up to 50%)

Each category of projects is scored separately using different criteria. State of good repair projects are scored based on asset condition and service impact criteria. Minor enhancement projects are scored solely on each project's service impact criteria. Major expansion projects are scored using the same six

factors and weighting typologies of the scoring SMART SCALE scoring methodology (see SMART SCALE). Each project's score is divided by the amount of State funding requested to calculate the cost-effectiveness score. More detailed information on the MERIT scoring process and methodology can be found on the DRPT website.[7]

DRPT OPERATING ASSISTANCE

Applicable use of funds: Operating and Maintenance Expenses

Eligible funding recipients: GRTC

The Operating Assistance program provides funding for operating expenses for all modes of public transportation services in the Commonwealth. DRPT uses a performance-based methodology to determine the allocation of operating assistance funds to each operating agency throughout the Commonwealth, capping funds to agencies at 30% of all operating expenses. The Operating Assistance methodology allocates funds to agencies based on an agencies' sizing and performance factors. Sizing factors are used to show the relative size of each agency relative to other agencies across the Commonwealth. Performance factors are used to show an agency's performance trends for a given metric relative to other agencies. To compute the operating allocation formula, each agency is required to provide the following metrics: operating cost for system sizing, operating cost for performance metric, ridership (unlinked passenger trips), revenue vehicle hours (RVH), revenue vehicle miles (RVM), and passenger miles traveled (PMT). The Operating Assistance program provides state funding up to 30% of a transit agency's operating budget. More information regarding the Operating Assistance methodology can be found on the DRPT website. [8]

DRPT DEMONSTRATION PROJECT ASSISTANCE

Applicable use of funds: Planning and Design, Construction of Pedestrian Improvements, Marketing, Transit Capital Improvements, Operating and Maintenance Expenses

Eligible funding recipients: Localities, GRTC PlanRVA

The Demonstration Project Assistance program is intended to assist with the development of local transit services and test innovative or non-traditional public transportation solutions. The program is designed to fill funding gaps for projects that may not be directedly suited or eligible for other State and Federal formula-based funding programs. Projects applying to the Demonstration Project Assistance program will be divided into two categories: new service projects (Type 1) and technology and innovations (Type 2) projects. The eligibility criteria for Type 1 and Type 2 projects varies, but both types of projects must provide evidence of the need for the service to be provided, support for long-term funding solutions, and a high level of readiness to move forward if the funding is awarded. The Demonstration Project Assistance program provides state funding up to 80% of the project's eligible expenses, with a 20% local match provided by the applicant. One eligible use of Demonstration Grant Project Assistance funding is to test the feasibility of a new proposed transit route.

DRPT TECHNICAL ASSISTANCE PROGRAM

Applicable use of funds: Planning and Design, Marketing

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[7] http://www.drpt.virginia.gov/transit/merit/operating-and-capital-assistance/
[8] http://www.drpt.virginia.gov/transit/merit/operating-and-capital-assistance/

Eligible funding recipients: Localities, PlanRVA, GRTC

The Technical Assistance program disburses funds to localities, Planning District Commission, and transit agencies to support studies, plans, research, data collection, and evaluation projects to improve, justify, and evaluate public transportation services. The program can be used for a variety of planning projects, including transit service feasibility studies, comprehensive operations analyses, and marketing and promotional plans. The Technical Assistance program provides state funding up to 50% of the total project cost, with the applicant providing the 50% match from non-state and federal funds. The Technical Assistance program could be used to study the feasibility of implementing a new high-frequency corridor.

Local

CENTRAL VIRGINIA TRANSPORTATION AUTHORITY

Applicable use of funds: Planning and Design, Construction of Pedestrian Improvements, Marketing, Transit Capital Improvements, Operating and Maintenance Expenses

Eligible funding recipients: Localities, GRTC, Central Virginia Transportation Authority

In 2020, the Commonwealth of Virginia established the Central Virginia Transportation Authority to oversee a special fund for transportation in the greater Richmond area. Revenues for the authority are received through additional wholesale fuels taxes and retail sales taxes in the City of Richmond and Henrico, Chesterfield, Hanover, Goochland, Powhatan, New Kent, and Charles City counties. A portion of these funds are designated for GRTC service, which could be applied to expenses associated with service improvements. Localities also will receive a portion of funds through the Central Virginia Transportation Authority, which can be used for construction of pedestrian and transit supportive infrastructure, as well as expansion of transit service.

DEVELOPER NEGOTIATED SITE IMPROVEMENTS

Applicable use of funds: Construction of Pedestrian Improvements, Transit Capital Improvements, Operating and Maintenance Expenses

Eligible funding recipients: Localities

Local governments can negotiate conditions placed on new development undergoing the rezoning process as a means to mitigate the impacts of the development and justify the propriety of the rezoning. Developer-negotiated site improvements can take the form of proffered cash contributions, donations of land, or construction and dedication of planned public projects. In 2013, the Commission on Local Governments found that the largest share of proffered funds was spent on transportation improvements. Negotiated agreements related to transit projects could include proffered cash contributions to GRTC, construction of new bus stops and pedestrian facilities, and rehabilitation of existing transit infrastructure.

LOCAL GENERAL FUNDS

Applicable use of funds: Planning and Design, Construction of Pedestrian Improvements, Marketing, Transit Capital Improvements, Operating and Maintenance Expenses

Eligible funding recipients: Localities

General funds are revenue collected through local property, sales, and other taxes and fees, as well as revenue transfers from state and federal sources. General funds can be the most flexible form of funding given that they can be used for all types of projects, but general funds are reliant on local revenues and budget priorities. Most state and federal funding require a local funding match to receive funding, and local general funds typically account for the majority portion of this funding match.

Appendix D:
Transit Technology Memorandum

Introduction

The transportation industry has undergone significant change over the last decade. Transit technology discussions in the bus planning realm to date have largely been focused on elements specific to the bus and the passenger. Existing transit technology allows for accurate tracking of the bus's location (by agency or rider), fare payment, and optimizing transit vehicle flow by interacting with traffic signals. While these technologies continue to advance, emerging transportation technologies and concepts are changing the way travelers get from one place to another on a broader level. Shared mobility services such as car sharing, ridesourcing, bike sharing, microtransit, dock and dockless bike and scooter sharing, and autonomous vehicles are changing the way that agencies approach transportation planning at the local and regional levels. This has resulted in an expansion of the discussion on transit technology to include elements outside of the bus and exploring ways that technology can help provide a better overall mobility experience for the rider.

The purpose of this memorandum is to outline existing and emerging transportation technologies and identify potential opportunities for integration with the Greater Richmond region's transportation network to enhance transit operations and improve customer experience and satisfaction. The memorandum identifies two types of transportation technology: bus-specific transit-enhancing technology and transit-supportive advancements in other transportation realms. Finally, the memorandum summarizes the technologies and corresponding horizons of potential effects and impacts. Consistent with the scope of the Greater Richmond Transit Vision Plan: Near-term Strategic Technical Analysis plan, this memorandum focuses on improvements and programs that can be implemented within 5-10 years with consideration for longer-term policies to promote transit technology in GRTC's operations.

Transit-Enhancing Technology

This section describes technologies that GRTC uses today and may use in the future on their buses and in the transportation system to increase efficiency and provide a positive customer experience.

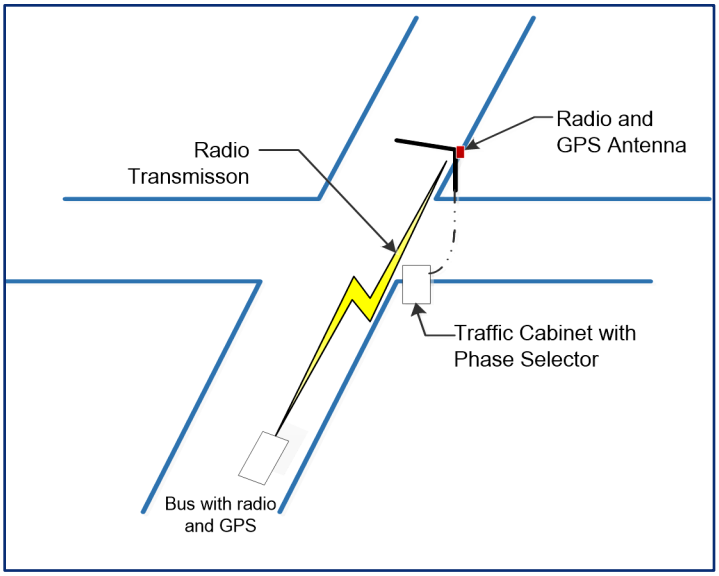
Transit Signal Priority

Transit Signal Priority (TSP) is the modification of traffic signal timing and/or phasing to give priority to transit vehicles at signalized intersections. There are two types of TSP systems: passive and active. A passive TSP strategy favors roads with significant transit use, moving traffic on transit-heavy corridors faster than roads with more vehicle traffic. Traffic signals which are coordinated in accordance with the average bus speed instead of the average vehicle speed can also make transit vehicles more efficient.

An active TSP system is more advanced than a passive TSP system and requires advanced input data and detection technology to operate effectively but can yield much higher benefits for transit reliability than

a passive TSP system. Active TSP systems detect transit vehicles and, depending on the programming of the traffic signals and existing traffic conditions, give the transit vehicle special treatment. For instance, if the signal senses that a bus is approaching the intersection, the signal can hold a green signal that is already displaying. To do this, the active TSP system must be able to detect the bus, as well as predict its arrival time at the intersection, which can be influenced by existing traffic conditions and stops between the intersection and the bus's current location. Traffic signals can also be programmed to bus schedules and existing traffic conditions and give priority to buses that are running late. The same strategy can be used to slow down buses running ahead of schedule.

There are several factors to consider when implementing TSP, including transit facility type, traffic conditions and road capacity, signal spacing, and signal cycle length. An active TSP system is currently utilized to improve the efficiency and reliability and to maintain the headways of GRTC's Pulse BRT. The TSP system used with the GRTC Pulse BRT is a distributed system, meaning all decisions and requests to grant signal priority are made at the local intersection level. With a distributed system, the priority request is generated on the transit vehicle and is detected and served at the local traffic signal controller (inside the traffic signal cabinet). The signal controller software contains the priority logic and serves the request locally. In contrast, a centralized TSP system generates signal priority requests from a centralized location, such as the City of Richmond Traffic Operations Center or GRTC Transit Operations Center. Signal priority is then granted at the local controller level based on direction from the central location. Centralized TSP systems are advantageous for a local jurisdiction that has all its signals connected to a centralized location but could be problematic for transit corridors that run through multiple jurisdictions since each jurisdiction would need to coordinate traffic signal priority with the other to operate efficiently.



Distributed TSP system utilized with the GRTC Pulse BRT

The GRTC Pulse BRT also utilizes queue jumps when the bus transitions from travelling in a dedicated bus lane to a general traffic lane. Queue jumps give buses stopped at a signalized intersection in a dedicated bus lane a head start in front of the other traffic to allow the bus to get to the right most lane. Queue jumps reduce conflicts with other traffic.

Automated Passenger Counters

Automated passenger counters (APCs) are electronic devices installed on transit vehicles that count and record the number of boardings and alightings. APCs improve the accuracy of ridership data collection

over traditional methods such as through farebox revenue or designated ridership data collectors. APCs integrated well with GPS systems can enhance ridership data by linking boarding and alighting data with stop or station location. Data collected through APCs can be transmitted remotely and in real-time to a centralized location.

In 2016, GRTC began collecting ridership data on all fixed bus routes using APCs, ending years of reporting ridership using GFI or farebox data. APCs were also installed on each GRTC Pulse BRT bus when it began operation in June 2018. Collecting ridership data using an APC is especially important for the GRTC Pulse BRT since passengers purchase tickets beforehand and there is no farebox on-board. In addition to more accurate ridership counts, APCs can assist in calculating the amount of fare evasion taking place.

Mobile Fare Payment

In the theme of making transit easier and more convenient for customers, many agencies are exploring options for customers to pay via mobile devices. Mobile payment makes it more convenient for most passengers and also has the potential to increase data collection by providing location data of where a passenger boards or alights the bus, pending privacy settings of the application.

Currently, GRTC allows customers to purchase tickets via a mobile device, but the mobile ticketing application ("GRTC Mobile Pass") is separate from the main GRTC mobile application ("GRTC") that provides information on routes, stops, and alerts. A potential improvement for the customer experience is integrating fare payment into the main GRTC mobile application to allow customers to view routes and stops and pay for transit fares on a single platform.

Main GRTC mobile application (left) and GRTC Mobile Pass mobile application (right)

A future evolution of mobile fare payment could be to make it easier to pay without a specific application or integrate payment with other transportation modes. For example, Washington Metropolitan Area Transportation Authority (WMATA) has announced that users will be able to pay directly with an iPhone. Other cities are partnering with companies like Uber or Lyft or bikesharing companies to offer payment options across public and private transportation modes. Most recently in January 2019, the RTC of Southern Nevada in the Las Vegas region, partnered with Uber to provide bus information and payment options on the company's platform in addition to its ridesourcing options.[9] This concept is described further in the Mobility as a Service (MaaS) section below.

[9] "Uber, RTC announce partnership to change how people across Las Vegas ride the bus," KNSV News Las Vegas. https://news3lv.com/news/local/uber-rtc-announce-partnership-to-change-how-people-across-las-vegas-ride-the-bus

Real-Time Transit Information

Computer-Aided Dispatch (CAD) and Automatic Vehicle Location (AVL) are often paired together to discuss the process for which a transit agency can monitor the real-time location of their vehicles and adjust dispatching as necessary. The real-time information of vehicles provided through AVL is often the same information that is relayed to the public to convey when a bus is expected to arrive.

Understanding vehicle location greatly improves efficiency on the operations side but also allows for potential riders to know when their bus is coming and plan their trip accordingly. Especially for routes operating at a 30-minute or greater frequency, this allows the rider to better plan a trip and adjust to real-time circumstances if the buses are not operating according to schedule. Today, GRTC uses a CAD/AVL system to publish real-time information for its buses through its own mobile application and a feed which can be incorporated into other third-party mobile applications.

Connected and Autonomous Vehicles (CAV)

Connected and autonomous vehicles (CAV) have the potential to drastically alter the way in which people get from one place to another and change contemporary transportation planning practices as decision-makers reevaluate modern ways to accommodate this new technology. CAVs have the potential to greatly disrupt parking practices, roadway design, traffic signal timings, and transit operations.

Buses will likely be the first fully autonomous vehicle since buses operate on fixed-route corridors with a schedule. Autonomous and semi-autonomous buses and shuttles are being tested by a few transit agencies around the country, but the technology is still far from being ready for widespread implementation and integration into the transportation network. Most recently in November 2019, the Fairfax County Department of Transportation announced a partnership with Dominion Energy on an autonomous electric shuttle pilot project. This project is funded using a $250,000 grant from the Virginia Department of Rail and Public Transportation (DRPT), making it the first state-funded CAV project in Virginia.[10] The vehicle planned to be used in the pilot project can hold up to 12 passengers and features sensors that include Lidar, cameras, and GPS as well as a built-in automated electric wheel chair ramp. Implementation and integration of a connected and autonomous bus fleet that can replace or supplement GRTC's current fleet is still far into the future, but as more pilot studies are conducted and data is collected and analyzed, the AV technology will continue to improve and teach transit agencies about the ways in which AVs will affect transit operations.

METRO Houston's Autonomous Shuttle (Pilot Program)

[10] Autonomous Electric Shuttle Pilot Project, Fairfax County Department of Transportation https://www.fairfaxcounty.gov/transportation/autonomous-shuttle-pilot

An easy step to preparing for CAVs is the electrification of GRTC's bus fleet. Autonomous vehicles operate using state of the art technology and require adequate sources of electricity to operate. The CAVs of the future are likely going to be electric-powered. Consequently, converting GRTC's existing fossil-fuel powered bus fleet (Compressed Natural Gas (CNG) and diesel) with electric buses would be one step towards preparing for CAVs.

The Virginia Department of Environmental Quality (DEQ) administers over $93 million in the Volkswagen Environment Mitigation Trust to reduce air pollution in Virginia, of which $14 million has been set aside to replace older diesel public transit buses with all-electric buses. These funds are administrated through DRPT's annual MERIT public transportation capital grant program. Of the $14 million in funds, $9 million was awarded for the FY 2020 grant cycle and the remaining $5 million will be awarded for FY 2021's grant cycle.[11]

There are a few tradeoffs to replacing diesel buses with an entirely electric-powered fleet. First, the upfront capital costs would be substantial, although costs could be offset with the funds from the Volkswagen Environment Mitigation Trust. Second, GRTC would need to install charging and maintenance infrastructure to support the new electric fleet. Despite these up-front costs, GRTC is likely to save money on fuel in the long-run. Moreover, these electric vehicles will produce fewer emissions, making the Greater Richmond region a cleaner and healthier place to live.

Transit-Supportive Technology

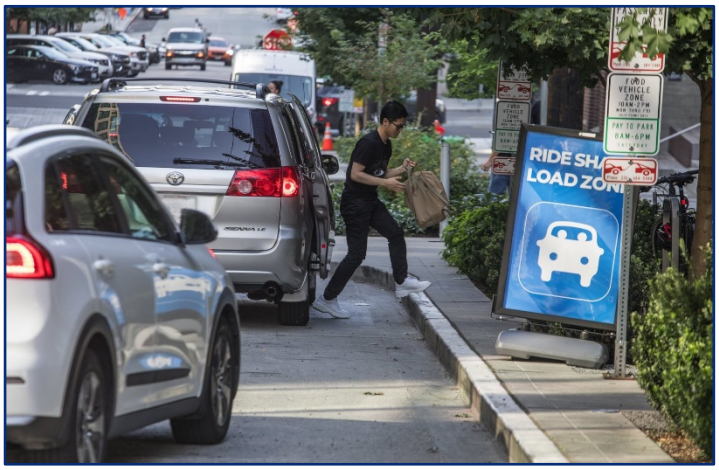
Shared mobility is defined as "transportation services and resources that are shared among users, either concurrently or one after another"[12]. This can include new emerging technologies but also more traditional modes such as carpooling, vanpooling, or even transit. These new services that are competing with, complementing, and collaborating with transit are described below.

Ridesourcing Services

Ridesourcing services (also referred to as Transportation Network Companies or TNCs) use an online platform to connect passengers with drivers to book private or shared rides, often in personal vehicles. These platforms allow passengers to reserve and pay for rides in the same place, while also providing customer feedback on the driver and overall user experience. Uber and Lyft have emerged as the largest TNCs and have extensive driver and customer bases in the Greater Richmond area.

While ridesourcing could serve as an opportunity reduce the number of trips made by single-occupancy vehicles, ridesourcing services have the potential to increase vehicle congestion and idling in congested areas and entertainment venues as drivers look for their customers, which could negatively impact transit operations. In some cases, ridesourcing is competing with transit trips for those who can afford it due to faster trip times and convenience. In other cases, people are using ridesourcing as a first-last mile

[11] Volkswagen Settlement Information, Virginia Department of Environmental Quality https://www.deq.virginia.gov/programs/air/vwmitigation.aspx
[12] Shared Use Mobility Center



Designated pick-up/drop-off space in Seattle

solution to get to a higher-capacity transit mode, thereby eliminating the need for parking. Some transit agencies have explored pilot programs of providing subsidies for customers to use ridesourcing in place of fixed service, especially during late-night hours or for specialized user groups such as senior citizens. For example, GRTC offers an option for its CARE On-Demand paratransit service in which eligible users can call a booking center and be matched with a TNC for their trip to an authorized location[13]. Finally, in some busier locations, ridesourcing pick-ups and drop-offs are competing for curbspace with buses and other vehicles like shuttles at transit stops. Some jurisdictions have used dedicated pick-up and drop-off areas as a strategy to reduce competition for curb space, maintain traffic flow, and ensure that buses can easily access stops.

Bike Share

Short-term bike rentals serve as a potential first-last mile connection for transit users that would have otherwise driven a vehicle. RVA Bike Share operates numerous stations throughout the City of Richmond. The RVA Bike Share mobile application allows riders to check the availability of bikes at various locations and unlock bikes for usage. Coordinating bus stops with bike share locations adds another option for transit users to get to and from their final destination.

RVA Bike Share Station on Tredegar Street

[13] Care On-Demand. http://ridegrtc.com/services/specialized-transportation/care-on-demand

Dockless Bikes and Scooters

Dockless bikes and scooters are another mode of transportation that is becoming more common, generally in urban areas. Devices are located and trips booked through a mobile application. Dockless mobility is similar to bike share programs in that they could serve as a first-last mile connection for transit riders, however dockless bikes and scooters lack a hub or central location that users can expect to find or return the device. Therefore, it is hard to coordinate transit with dockless bike and scooter programs. Alternately, because they are dockless, users can travel further after using transit instead of walking or using ridesourcing to take the them to the destination. Transit agencies should be aware that dockless bikes and scooters are an emerging trend in the transportation industry that could be a powerful first mile/last mile mode choice for commuters that take transit. Some localities and private entities have encouraged and even incentivized parking of dockless vehicles in a safe, clustered area located near a transit stop.

In 2019, the City of Richmond passed an ordinance that charges companies $20,000 per year to put up to 100 scooters on Richmond's streets with options to pay $30,000 for 101-200 scooters and $45,000 for 201-500 scooters. Currently, the only dockless transportation provider in the city are Bird and Bolt.

Dockless scooters have gained the attention of Virginia policymakers as well. Beginning on January 1, 2020, if there is no local ordinance, the private companies that operate the devices may deploy their devices anywhere in Virginia.

Demand-Response Service (Microtransit)

Contemporary public transit mainly focuses on fixed-route service. Fixed-route service is intended to provide a level of predictability for riders while maintaining the service's efficiency. Some transit agencies are beginning to pilot technology-enabled demand-response service called microtransit. These demand-response services are typically booked using a mobile application that allows a user to request a ride at their location to a desired destination. Vehicles are typically multi-passenger vans or small buses and trips are often shared with other users travelling in a similar direction. These services are generally meant to replace fixed-route service in areas with low ridership or serve an area that feeds into a high-capacity transit service.

Microtransit is in its early stages of pilot testing and still a relatively unproven method of supplementing fixed-route transit. It can improve customer satisfaction due to a mobile application-based experience and lower wait-times, but many pilot programs have not shown increased efficiency as measured by

boardings per hour or relative costs as compared to fixed-route service. In the near-term, the Greater Richmond region should focus on improving existing GRTC services and opportunities for expansion of high-frequency transit routes to best serve the region. As more data becomes available and microtransit is deemed to be a useful alternative to fixed-route service in low ridership areas or to connect to high-capacity service, a pilot study may be considered.

Mobility-as-a-Service

Mobility-as-a-Service, or MaaS, is a shift in contemporary transportation planning from personally-owned transportation modes to mobility options provided as a service. In the Greater Richmond region, the majority of travelers satisfy their own transportation needs through driving a vehicle since that is often the most efficient travel mode for completing work, shopping, and social trips. However, as the Greater Richmond region continues to develop and grow, single-occupancy vehicles will become less and less efficient for satisfying travel demand.

MaaS changes this paradigm by offering transportation solutions based on travelers' needs. This can be accomplished by consolidating transportation mode options from public and private providers into one mobile application on which users can view and pay for these services based on their own needs. This application provides users with transportation options they can choose based on cost, time, and convenience. For example, a user might be able to book a scooter trip that connects to a bus trip, all within the same mobile application and payment platform.

Because MaaS is an idea that changes the way localities plan transportation, MaaS could be a long-term transportation planning goal for the region. In the near-term, decision-makers in the Greater Richmond region should consider working with transportation and mobility service providers, both public and private, to learn more about the types of services provided in the region and where these services are offered. The next step is working with private partners to develop a mobile application that consolidates these mobility options in one place for users to view schedules, real-time location information, service alerts, and pay for transportation services. Services that should be included in this mobile application relevant to travelers in the Greater Richmond region are bikeshare organizations (RVA Bike Share), dockless scooter and bike providers (Bird, Bolt), ridesourcing and taxi services (Uber, Lyft, local taxis), ridesharing and carpooling services (RideFinders), local transit services (GRTC), and regional transit providers (Amtrak, VRE).

As mentioned previously, some transit agencies, notably RTD in the Denver Metro area and RTC in the Las Vegas Metro area, have partnered with Uber to provide transit information and the option to buy transit passes on the Uber platform. Another private platform, Transit, provides transit information for cities across the U.S. as well as the ability to reserve rides with Uber or Lyft, bikes with bikeshare operators, or vehicles with carshare companies. In other words, users can pay for multiple legs of one trip on the same mobile application. A platform that allows users to compare travel times and costs for several modes of transportation could potentially encourage more travelers to use transit. GRTC could partner with the Transit mobile application to provide payment options for transit service in addition to real-time transit information as an alternative approach to provide MaaS for travelers in the region.

Mobility Hubs

The idea of a mobility hub is a physical location where MaaS can materialize, fostering the integration of transportation modes. Mobility hubs are similar to existing multimodal centers but can be expanded to include accommodations for ridesourcing pick-up and drop-off, corrals for dockless bikes and scooters, and technology-driven travel or wayfinding information. These mobility hubs can take the form of large facilities built for this purpose or they can be implemented on a smaller scale, for example at a popular bus stop. Many of the GRTC Pulse BRT stations could be strong candidates for the development of a mobility hub.

Summary

The overarching goal of the Greater Richmond Transit Vision Plan: Near-Term Strategic Technical Analysis is to identify corridors that can support high-frequency transit service in the near term. The purpose of the Transit Technology Memorandum is to outline existing and emerging transportation technologies and identify potential opportunities for integration with the Greater Richmond region's transportation network to enhance transit operations and improve customer experience and satisfaction. This section summarizes the technologies described above and presents them in a general timeline format to help illustrate what is happening now and how technological advancements may continue to influence transportation into the future.

	Transit-Enhancing Technology	Transit-Supportive Technology
Existing Today	▪ TSP is improving bus travel through congested corridors ▪ APCs provide accurate ridership data ▪ Mobile fare payment allows users to purchase tickets before boarding the bus (GRTC Pulse BRT only) ▪ Real-time transit information is available to the agency and customer	▪ Ridesourcing companies are in operation and may be competing for some transit trips; GRTC has partnered to offer TNC trips as an option for its paratransit users ▪ Bike share and dockless scooters are becoming more prevalent in the Greater Richmond area
Near-Term (5-10 years)	▪ Electric buses may be explored as a more environmentally-friendly alternative ▪ Integration of GRTC mobile applications to combine real-time transit information with payment options ▪ Deployment of TSP on additional corridors to improve travel time and reliability	▪ Monitor microtransit trends to determine if and when a pilot is viable ▪ Development of MaaS platforms to integrate the selection and payment of public and private transportation modes ▪ Mobility hubs could be implemented to help foster the physical integration of public and private transportation modes
Long-Term	▪ Widespread deployment of autonomous vehicles and buses	▪ Full MaaS adoption