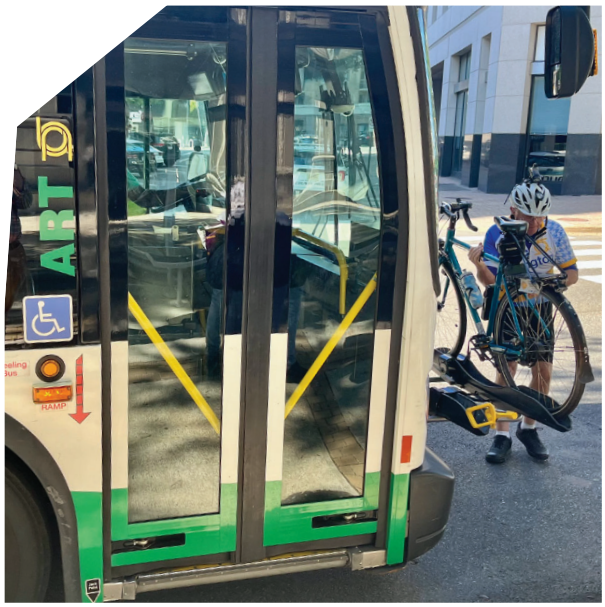
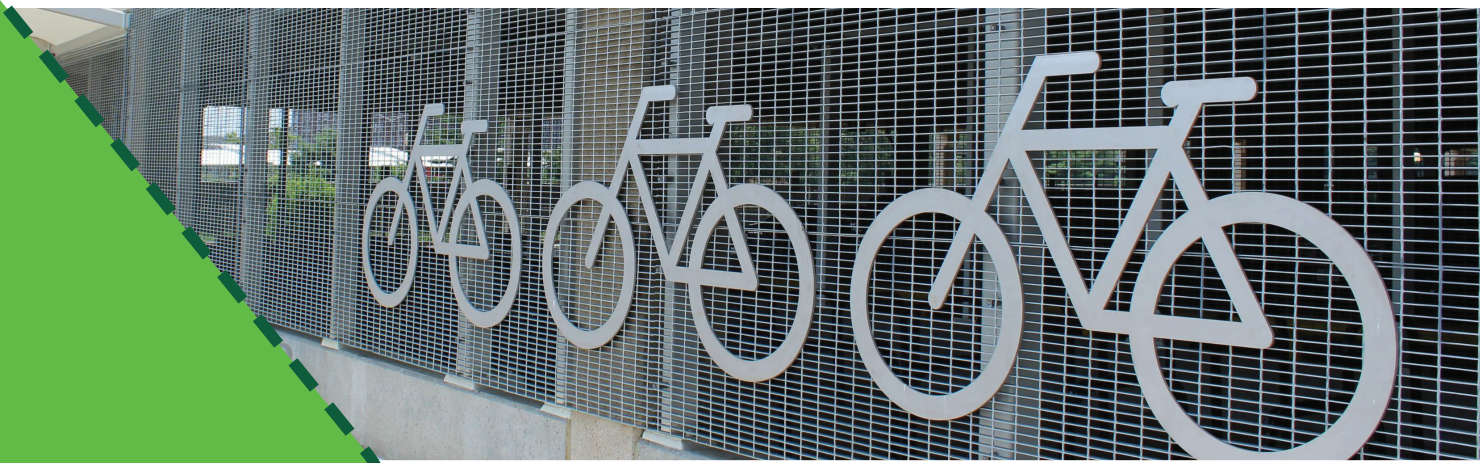
Integrating Transit, Bicycling and Micromobility in Northern Virginia

NVTC
NORTHERN VIRGINIA TRANSPORTATION COMMISSION





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Executive Summary

Integrating transit with bicycling and micromobility can benefit both transportation modes. Connecting these modes can result in benefits like increasing transit access, expanding transit's reach and the efficiency of its services, while also increasing the use of both bikeshare and dockless micromobility. This report studies the integration between these modes in Northern Virginia. This study specifically evaluates these connections using five dimensions:

1. Bicycle parking at transit stops and stations
2. Bike rental (e.g., bikeshare and scooter share) at transit stops
3. Bikes on transit vehicles
4. Safe routes to transit
5. Customer communication and education

These different aspects of transit, bicycling and micromobility integration are explored using existing plans and policies, spatial and statistical analysis of transit, bike, and micromobility data and case studies from across the US.

Key Findings

- ✓ Transit and bicycling integration is an important regional goal
- ✓ Bicycle infrastructure results in large increases in transit access
- ✓ Metrorail is associated with increases in both bikeshare and scooter use
- ✓ Northern Virginia does a good job but there are still opportunities to learn from others

Recommendations

The region can improve integration between transit and micromobility by focusing on the following:

1. Continue coordination with regional partners including between jurisdictions and transit agencies as well as with private property owners, major employers and major regional travel destinations
2. Increase transit and bicycling integration in suburban areas, especially near commuter transit services, including:
    a. Micromobility like CaBi and scooter share at transit stations
    b. Easier access for bicycles on commuter buses
    c. More bicycle and other micromobility parking at transit stops
    d. More bicycle facilities connecting bicyclists safely to and between transit stops
3. Package more transit and bicycle improvements together into larger funding requests and infrastructure projects
4. Enhance clarity in infrastructure policies when transit and bicycling intersect; specifically:
    a. Bicycle use in bus lanes
    b. Floating bus stops
5. Improve the collection and sharing of data focusing on transit-bicycling integration
    a. Bicycle and other micromobility parking at transit stops
    b. The number of people bringing bicycles on transit vehicles (buses and trains)
    c. The number of people using bicycles and other micromobility to access transit services

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Acknowledgements

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Glossary

Term	Definition
Bike Lane[1]	Bike lanes are areas of a roadway primarily designated for bicyclists. They are generally demarcated with pavement striping and/or green paint. VDOT standards require bike lanes to be at least 5 feet wide, 6 feet when there is greater bus or other heavy vehicle traffic.
Bikeshare	A program where bicycles are shared by members of the public at a low cost. They can be docked with a fixed station or dockless with no fixed location. See: *Micromobility*.
Bus Lane	A section of road that is typically reserved for transit buses only (though emergency vehicles are still permitted). Bus lanes can be exclusively for buses or also permit other vehicles like right-turn movements (e.g., Business Access Transit (BAT) lanes). These lanes are generally demarcated with signage, special traffic signals and sometimes with red paint on the pavement.
CaBi	Capital Bikeshare. The bikeshare system for the Washington, DC area. See: *Bikeshare*; *Micromobility*.
Docked or dockless	A term associated with *Micromobility*. Docked micromobility is a shared mobility device that is docked in a station (like *CaBi*). Dockless micromobility (or floating micromobility) are shared mobility devices that can begin or end a trip from anywhere.
First/last Mile	The distance between the trip origin and the transit stop at the beginning of a transit trip (*first mile*) or the distance between a transit stop at the end of a transit trip and the end-destination (*last mile*).
Floating Bus Stop	A situation where a bike lane is positioned behind the passenger waiting area of a transit stop.
General Purpose Travel Lane	A road lane that can be used by any road-legal vehicle including cars, buses, trucks and bicycles.
Micromobility	A broad term for smaller, lower-speed vehicles that can be electric or human-powered and shared or privately owned. Examples include bicycles, bikeshare and scooters.
Park and Ride Lot	A designated parking area for people to leave their car and use transit or carpool to travel to their final destination.
Shared Use Path[1]	Paths that are separated from roads by a buffer, barrier or other physical separator. Shared use paths can be used by pedestrians as well as cyclists and other forms of micromobility.
Shared Lane[1]	Shared lanes are roadways where motor vehicles and bicyclists may be expected to share the road. The basic requirements for shared roadways included paved shoulders (VDOT recommends a width of at least 4 feet) or wider outside lanes to allow more space for cyclists to use the road (VDOT recommends 14 feet in width). Shared lanes that are part of preferred bike routes will also have "May Use Full Lane" signs and sharrows if the roads are posted 35 mph or less.

[1] More information about Virginia state guidance can be found here: https://www.vdot.virginia.gov/media/vdotvirginiagov/doing-business/technical-guidance-and-support/technical-guidance-documents/location-and-design/migrated/rdm/Appenda1_acc10192023_PM.pdf

1. Introduction

Integrating transit with bicycling and micromobility are important for many reasons. They help increase transit ridership, help transit riders get to their final destinations (*first and last mile*), and can stretch transit investment by making transit more efficient and a higher quality service. **Table 1** summarizes some of the many benefits these connections can produce for both transit and bicycling/micromobility.

Table 1: Potential benefits of transit and bicycle/micromobility integration

Category	Benefits	Reference
Transit Benefits	Bicycle/micromobility and transit connections can increase transit ridership	(*1–3*)
	Increasing bikeshare use increases transit ridership	(*4*)
	Bicycle and transit connections can increase transit efficiency	(*1*)
	Bicycle/micromobility and transit connections can increase transit catchment areas	(*1*, *5–10*)
	Bicycle and transit connections can reduce personal travel costs	(*5*, *9*)
	Bicycle and transit connections can improve trip speed and access to destinations	(*11*, *12*)
	Promoting cycling can reduce transit crowding	(*13*)
Bicycling and Micromobility Benefits	Bicycle and transit connections can increase bikeshare and other micromobility use	(*14*, *15*)
	Bicycle and transit connections can increase access to bikeshare and other micromobility	(*4*, *5*, *15*)
	Higher transit use can increase bicycling	(*2*, *16*)

While there are many advantages to connecting transit to bicycling and micromobility, we need a better understanding of how this is done in Northern Virginia. NVTC has studied this topic before. In 2010, NVTC released a guide on transit and bicycling connections (*17*). This report discussed Federal Transit Administration (FTA) policies for bicycling around transit stops, bicycles as a mode to access transit, and a variety of ways bicycling and transit can be connected. However, a lot has changed

What is micromobility?
Micromobility is a broad term for smaller, lower-speed vehicles that can be electric or human-powered and shared or privately owned. Examples include bicycles, bikeshare and scooters.

when it comes to bicycling and micromobility in Northern Virginia since the release of this report. Capital Bikeshare (CaBi) began, dockless bikeshare and scooter share companies came into existence, and the region has invested heavily in new bicycle infrastructure[2]. Consequently, it is time to update NVTC's previous study and re-evaluate transit, cycling and micromobility connections in Northern Virginia.

The purpose of this report is to update the 2010 NVTC report and provide a better understanding of how transit, bicycling and micromobility connect through the region. This evaluation considers both regional policies (Are bicycles allowed on trains? Can bikes use dedicated bus lanes?) as well as infrastructure (Where do bike lanes and bus stops intersect? Where do CaBi and transit stops meet?). The report is intended to serve as a regional resource to underscore why transit and bicycling/micromobility are important, how they can be used to benefit each other, and how they already benefit each other.

Section 2 of the report provides a background of transit and cycling connections, focusing on previous studies and research that have been done to combine the two transportation modes. **Section 3** explores the integration between transit and cycling in Northern Virginia. This section evaluates these connections in different ways, including intersecting transit and cycling infrastructure, accessing transit using cycling and micromobility, and the impacts of transit on cycling and micromobility. **Section 4** summarizes case studies of innovative transit-cycling integration policy and practice from around the US. Finally, **Section 5** summarizes key findings and recommendations developed through the report.

2. Background

Transit and biking integration has been studied for many years with existing work on this topic providing a variety of guidelines and considerations for making decisions that better integrate the two transportation modes. The American Public Transportation Association (APTA) (*18*), summarizes these interactions in four different ways:

- **At transit**... bicycle parking and facilities at transit stops and other transit facilities
- **On transit**... the ability to take bicycles and scooters on buses and trains
- **To transit**... bicycle infrastructure that safely connects bike users to transit
- **With transit**...bicycle policies and infrastructure that are designed so transit and bicycling can be better used together

These different types of transit and cycling interactions can be achieved through different types of strategies that transit agencies and municipalities can implement to improve bicycle and transit connections. These strategies can be summarized into five main categories (*13*, *18*):

- Bicycle parking at stops and stations with different types of shelters and security
- Bicycle and other micromobility rental (e.g., bikeshare) near transit stops
- Bike racks and other bicycle storage on transit vehicles to allow for personal bicycles to be used at both ends of a transit trip
- Bike paths, bike lanes and other bike infrastructure that provide safe ways to connect to transit stops and stations

[2]The region is anticipated to spend another $750 million on projects that integrate bicycling and transit in the coming years (see **Appendix A**).

- Communication and education approaches that help transit riders understand how they can use cycling/micromobility as part of their transit journey

Table 2 summarizes how the different strategies are connected to the different ways bicycles and transit can be integrated.

Table 2: Summary of transit and bicycling integration

Integration Strategy	At Transit	On Transit	To Transit	With Transit
Bicycle parking at transit stops and stations	✓			✓
Bike share and scooter share at transit stops	✓			✓
Bikes on transit vehicles		✓		✓
Safe routes to transit			✓	✓
Customer communication and education	✓	✓	✓	✓

Previous work has shown that some integration strategies are more preferred than others. For example, many bicyclists prefer to bring their bicycles with them on board transit vehicles rather than leave them parked at transit stops and stations (*19*). This is because having personal bicycles available gives people more flexibility in their trip-making (*11*) but also reflects that some people have concerns about the safety of the bicycle when parked at a stop or station. Secure bike parking is becoming especially important given the rise of e-bikes in the US (*20*).

While bicycle and transit integration strategies require investment, combining the two modes creates a synergistic relationship where both modes benefit including increases in bicycling or micromobility use (*2*, *14–16*) as well as increases in transit effectiveness. For example, while transit agencies often have limited operational funds to extend their service, capital funding sources can be used to build supporting micromobility with infrastructure like bikeshare docks and parking (*15*), increasing access to transit and potential transit ridership (*1–3*). For example, the NVTC Commuter Choice program has previously funded CaBi projects near transit stations (see **Figure 1**).

While transit and bicycle connections can benefit urban mobility (*21*), there are also unique benefits for suburban areas. Bicycle access can be particularly important in suburban areas with moderate population densities and dispersed destinations (*8*, *10*). For example, good cycling infrastructure may allow for larger bus stop spacing, improving the access and efficiency of suburban transit systems (*5*). In addition, commuter bus and rail systems often have parking for cars in suburban areas to provide access to transit. However, providing parking for cars requires much more land and money compared to providing parking for bicycles (*22*). Consequently, providing bike parking can be a cost-effective way to allow more people to access transit in suburban areas.

While connecting bicycling and transit can reduce operational costs and increase efficiency in suburban areas, it's also a popular choice for those that might be more likely to use those two modes together. Previous research has found people who combine biking and transit are more likely to do so for longer trips and commutes (*23–25*). This may be because having a bicycle allows transit commuters to reduce personal costs (*5*) as well as avoid some transit transfers (*25*), which may lengthen an already long trip.

Overall, there are many potential regional benefits to the integration of transit, cycling and micromobility. **Table 2** provides a framework for evaluating these integration strategies further, providing an outline for **Section 3** of this report.

Figure 1: CaBi station at Franconia-Springfield Metrorail station funded by the NVTC Commuter Choice program

2.1. Studies in the Region

The Washington, DC region has been featured in a variety of studies evaluating transit and micromobility connections. **Table 3** summarizes a sample of the different existing research from the area.

In the Washington, DC region, there is evidence that transit and bicycle integration benefits both modes. For example, research found that increasing CaBi use contributed to an increase Metrorail ridership (*4*) with most bikeshare and other micromobility trips also starting near Metrorail stations (*4*, *15*, *26*). Metrorail and bicycle infrastructure are especially important for transit, bicycling and micromobility integration. Most bikeshare stations are located near Metrorail stations (*13*, *27*) and building safe bicycle infrastructure to Metrorail, like bike trails, can increase the number of trips taken to transit (*14*). Overall, there is already some evidence that transit, bicycle and micromobility integration is an important and shared regional goal.

Table 3: Transit and bicycling integration in the Washington, DC area

Article Title	Year	Key Regional Findings	Source
Integrating Bicycling and Public Transport in North America	2008	• Bike parking is available at almost all Metrorail stations • 80% of bikeshare stations are located near Metrorail stops • Bikes are allowed on off-peak Metrorail trains, some VRE trains, and most regional buses • Bicyclists on Metrorail increased 60% between 2002 and 2007 • The Washington area needs to do better at coordinating bike routes with transit routes	(*13*)
Bicycle Sharing and Public Transit: Does Capital Bikeshare Affect Metrorail Ridership in Washington, D.C.?	2015	• Metrorail stations are important beginning and end points for CaBi trips • A 10% increase in annual CaBi ridership contributed to a 2.8% increase in average daily Metrorail ridership	(*4*)
Arlington County Shared Mobility Devices Pilot Evaluation Report	2019	• Most Arlington shared mobility trips occurred in areas of high transit supply with Ballston Metrorail station having the most trips nearby • 60% of shared mobility trip origins and 55% of trip destinations occurred in the Rosslyn-Ballston transit corridor • Getting to Metrorail was the primary purpose of 18% of e-scooter trips and 8% of dockless e-bike riders • Average scooter trips started 0.38 miles from transit and ended 0.48 miles away from transit with these distances both shorter for late night trips • After starting to use e-scooters, 11% of riders increased their use of bus and 10% increased their use of Metrorail	(*26*)
TCRP Research Report 230: Transit and Micromobility	2021	• 70% of scooter trips in Arlington started or ended with ¼ mile of a rail stop, 42% within 1/8 mile • In Arlington, 96% of scooter trips started or ended within 1 mile of a high-capacity transit stop	(*15*)
Docked Bikeshare Equity and Goal Conflict: An Evaluation Using Gini Coefficients and Lorenz Curves	2024	• Metrorail stations are associated with more bikeshare in Washington, DC	(*27*)
Bikeshare–Metrorail Integration in Washington, D.C.: What are the Characteristics of Neighborhoods that Encourage Capital Bikeshare Trips to and from the Metrorail?	2024	• Expanding bike trails was associated with increased trips between a neighborhood bikeshare station and a docking station near Metrorail • Bikeshare docking stations near national parks and areas with higher population density can increase trips near Metrorail stations	(*14*)

3. Evaluating Transit and Micromobility in Northern Virginia

As mentioned in **Section 2**, existing research has provided a framework for evaluating transit, bicycle and micromobility integration. This section follows this framework, evaluating transit and bicycling under five broad categories:

- Bicycle parking at transit stops and stations
- Bike share and scooter rental at transit stops and stations
- Bikes on transit vehicles
- Safe routes to transit
- Customer communication and education

Methodologies for all analyses used are described in more detail in **Appendix C**.

3.1. Bicycle Parking at Transit Stops and Stations

Providing bicycle parking at transit stops is one of the easiest ways to allow for better transit and bicycling integration. Bicycle parking at station stops doesn't impact transit operations. Bicycle parking can offer much greater capacity for transit bike integration than some other strategies (i.e., bike racks on buses), the costs for basic bike parking infrastructure can be low (*28*) and the costs can be borne by either transit agencies or local jurisdictions (unlike bike racks on transit vehicles, for example, which are a transit agency cost).

In recognizing the importance of bicycle parking at transit stops, some jurisdictions and regional entities have developed specific goals to help increase bicycle parking at transit stops and stations. For example, Arlington County has stated their goal is to provide covered bicycle parking spaces at all transit stations by 2030 (*29*). In addition, the Virginia Department of Transportation (VDOT) requires bike parking at medium to high density park and ride lots (*30*). VDOT specifically requires:

> *Bicycle parking at a rate of 1 space for every 10 to 20 vehicle spaces. Use racks with a 2-point locking capability such as "inverted U" and avoid "comb racks".*

However, as mentioned earlier, more secure bicycle parking facilities, like those shown in **Figure 2**, are an increasingly preferred option for people interested in integrating cycling with transit. While secure bike parking is more expensive than a basic bike rack, public-private partnerships are being developed in the US to help reduce financial barriers for jurisdictions and cyclists.[3]

Several regional policies and plans highlight the importance of bike parking near transit. Arlington County (*29*) emphasizes secure, sheltered bike parking should be available near all rail and bus stations. Fairfax County (*31*) recommends providing more and higher quality bike parking near transit, emphasizing bicycle parking with shelter, greater security, and more capacity for bikes. The City of Falls Church (*32*) wants to ensure "sufficient bike parking" by recommending bike racks be installed "close to bus stops whenever space and funding allow." Finally, the City of Fairfax (*28*) underscores that bike parking is important for facilitating first-mile and last-mile connections from transit.

[3] One example of this is *Oonee (*https://www.oonee.us/*)*, a bike locker company from Brooklyn, NY. This company partners with local governments to provide equitable access to secure bike parking. The organization is also working on potential expansions into the Washington, DC region:
https://www.threads.net/@shabazzstuart/post/DBRteedxdF2

Figure 2: Secure bicycle parking at a Metro station

Bike racks are also included in regional guidance for bus stop design. For example, Arlington (*29*) recommends that stops with more than 300 boardings a day should have a rack for bicycles and scooters. NVTC's 2023 study on bus stop amenities (*33*) also included bike racks in their evaluation of regional bus stop amenities. The study shows both CUE and Loudoun County Transit include bike racks at bus stops in their amenity polices. However, their type of guidance varies. CUE recommends bus stop amenities like bike racks at higher ridership stops while Loudoun County Transit just requires bike racks at their park and ride stops. While the study notes that bike racks are highly correlated with other accessibility features such as passenger boarding areas, curb ramps and adjacent sidewalks, less than 5% of the surveyed stops had bike racks. The study also showed the increase in bicycle racks at bus stops between 2014 and 2022 was the slowest across all bus stop amenity types included in the study.

Existing Bike Parking near Northern Virginia Transit

Although bike parking near transit is useful for transit and biking integration, it is not tracked by many of the jurisdictions and transit agencies in Northern Virginia. **Figure 3** shows where bike parking is available near transit in Northern Virginia. This figure likely undercounts bike parking due to the lack of data.

As **Figure 3** shows, bike parking data is particularly good for Metrorail. Bike parking is available at 20 Metro[4] stations in Northern Virginia, about 63% of all Virginia Metrorail stations. By comparison, 69% of Metro stations in the entire system are equipped with some type of bike parking amenity. Virginia Metro stations with bike parking are all in more urbanized areas of the region and almost all have direct connections to a bike path, lane or trail. Metro bike parking comes in three varieties: bike lockers, bike racks, and *Bike & Rides*. While bike racks are first-come, first-serve, bike lockers allow for a higher level of security as they can be reserved and rented by cyclists.

[4] Metro is currently undergoing an upgrade of their bike locker system with expected installations at the end of 2024 or early 2025. Because of this imminent update, this information is subject to change shortly after the publication of this report.

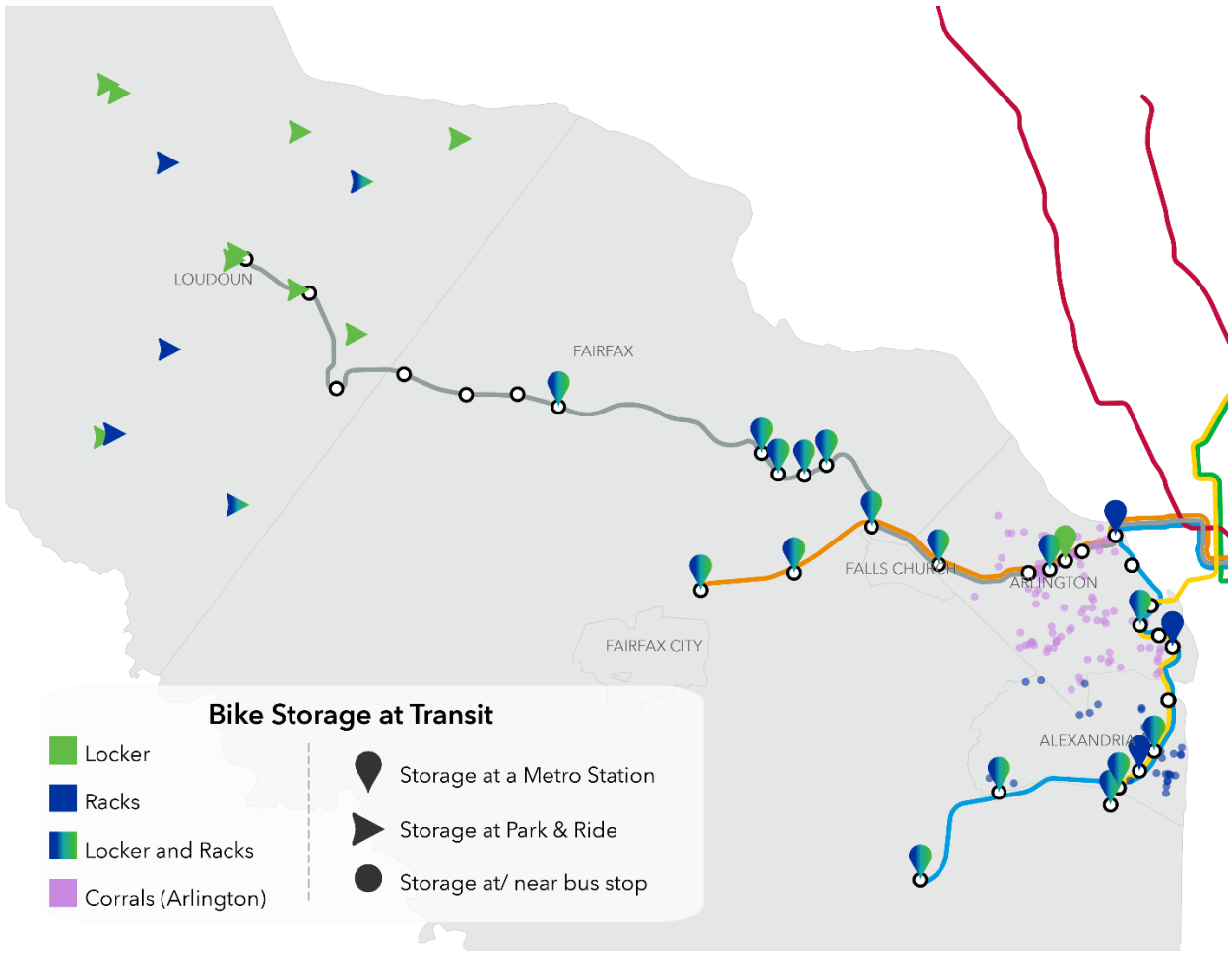

Figure 3: Bike parking at transit stops in Northern Virginia

Bike parking is also available at some bus stops in the region. According to City of Alexandria staff, about 5% of transit stops (44 of 836 bus stops) have bike parking in Alexandria, supporting both DASH and Metrobus stops. The number of transit stops with access to a bike rack increases to 19% when counting bike parking within 1/8 miles of a stop. Loudoun County currently provides both bike lockers and racks at 15 of their 20 park and ride locations.

Arlington County has installed more than 100 parking corrals[5] for micromobility devices in the county. A bike corral is an "on-street bicycle parking area that can accommodate many more bicycles than a typical sidewalk rack."[6] These corrals are commonly placed in on-street parking spaces or next to Capital Bikeshare stations. Arlington encourages users to also park shared mobility devices (like scooters and dockless e-bikes) in corrals to alleviate crowding on sidewalks and increase accessibility. While 95% of the corrals are within 1/8 of a mile of a transit stop, only 31% of Arlington transit stops have a corral within 1/8 of a mile.

[5] https://www.bikearlington.com/meetthecorrals/
[6] https://ladotlivablestreets.org/content-detail/Bicycle-Corrals/

3.2. Bike and Scooter Rental at Transit Stops and Stations

In 2009 when bike rental at transit stops was initially characterized as a form of transit-bike integration (*13*), short-term bike rentals, like bikeshare, were still in their infancy. In the Washington, DC area, SmartBike DC was the region's bicycle sharing system. However, this system only had 120 bikes and only operated in the central business district of Washington, DC (*34*). Consequently, the main focus in 2009 was longer term bike rental like the bikeshare station near Union Station.

Short-term bike rental changed in the region in 2010 when the District Department of Transportation (DDOT) partnered with Arlington County to develop a new, regional bikeshare system: Capital Bikeshare (*35*). Capital Bikeshare now has more than 700 bikeshare stations and 6,000 bikes across the Washington, DC region with connections to Metrorail an important part of the system's goals and development plans (*36*) (**Figure 4** shows an example of a Capital Bikeshare station near a Metrorail station). Even 14 years after its introduction to the region, Capital Bikeshare continues to break ridership records with almost 500,000 rides per month in 2024.[7]

Figure 4: Capital Bikeshare at Rosslyn Metro station in Arlington

While Capital Bikeshare is typically characterized by having stations where bikes are "docked," a dockless version of shared micromobility started emerging in the 2010s with e-bikes and then e-scooters in 2017 (*37*). Dockless micromobility first appeared in Washington, DC in 2017 (*38*) and has since spread across the region.

This section focuses on the integration between transit and both Capital Bikeshare as well as dockless micromobility like e-scooters in Northern Virginia.

[7] *Bikeshare Beat: For the fifth straight month, CaBi breaks ridership record*
https://ggwash.org/view/97337/bikeshare-beat-for-the-fifth-straight-month-cabi-breaks-ridership-record

Capital Bikeshare (CaBi)

CaBi[8] is available through most of Northern Virginia with stations in Arlington County, Fairfax County, the City of Alexandria, the City of Fairfax, and the City of Falls Church. Virginia jurisdictions see bikeshare having an important role in filling first mile/last mile travel gaps. For example, in their Bicycle Master Plan the City of Falls Church states that bikeshare members use these systems to connect to transit (*32*). Arlington County also recommends locating bikeshare stations near transit to both attract more bikeshare system users while also improving access to transit (*29*). Providing bikeshare at key bus stops was also popular among the public in a survey conducted by the City of Fairfax (*28*).

CaBi has 276 docking stations in Virginia, accounting for 35% of all stations. Docked bikeshare is very transit accessible in Virginia with almost 90% of CaBi stations close to a transit stop (within 1/8 of a mile). However, the level of access varies by mode. **Figure 5** shows the percentage of CaBi stations near different transit modes in Virginia. As the figure shows, most CaBi stations are near bus stops. However, as the access proximity increases, so does the access to other modes of transit. For example, increasing the radius from 1/8 of a mile to half a mile more than triples the number of CaBi stations with access to Metrorail. Metrorail access to CaBi is even better. Over 60% of the 32 Metrorail stations in Virginia are near (1/8mi) a CaBi docking station while almost 80% of Metrorail stations have a CaBi station within a quarter mile. Overall, while access varies by transit mode, CaBi is an accessible way to access and egress from transit.

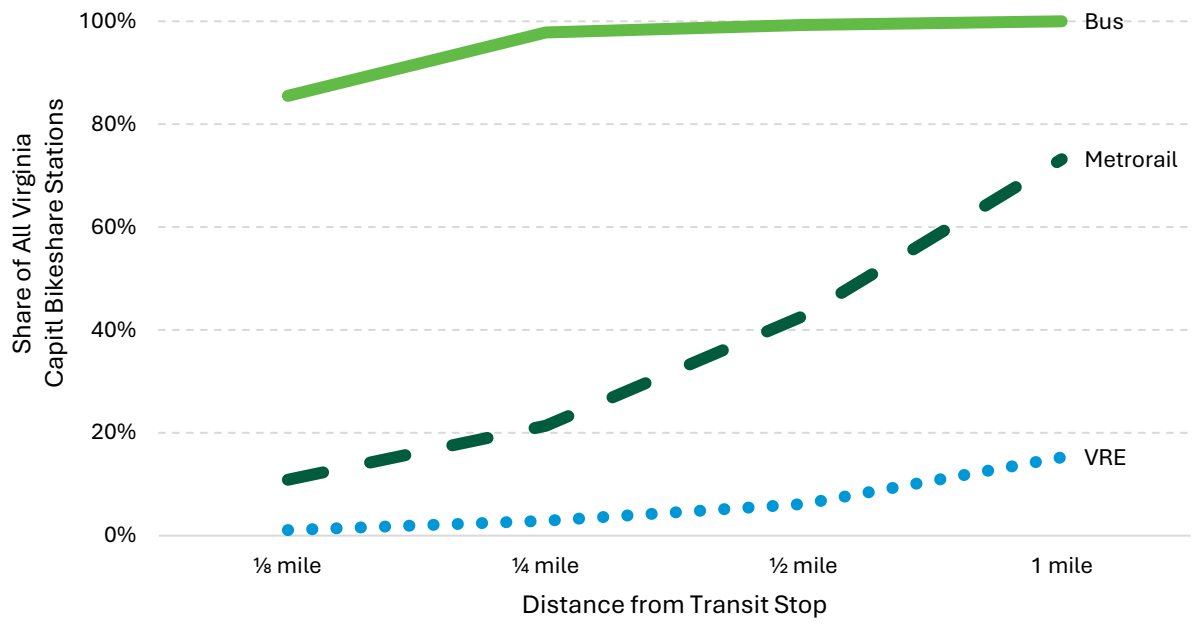

Figure 5: Percent of Capital Bikeshare near transit in Virginia

[8] More about CaBi planning and operations can be found in the Capital Bikeshare Development Plan Update https://ddot.dc.gov/sites/default/files/dc/sites/ddot/page_content/attachments/23397_Capital_Bikeshare_Plan_Update_v4_051220_WEB.pdf

Previous studies have suggested increased integration between transit and bikeshare may also help increase bikeshare use (*14*, *15*). **Figure 6** shows the CaBi trips at bikeshare stations within a quarter mile[9] of Metrorail compared to bikeshare stations farther away from Metrorail using recent trip data (May 2024). As the figure shows, bikeshare stations with more trips (indicated by larger circles) appear to be correlated with the location of Metrorail stations.

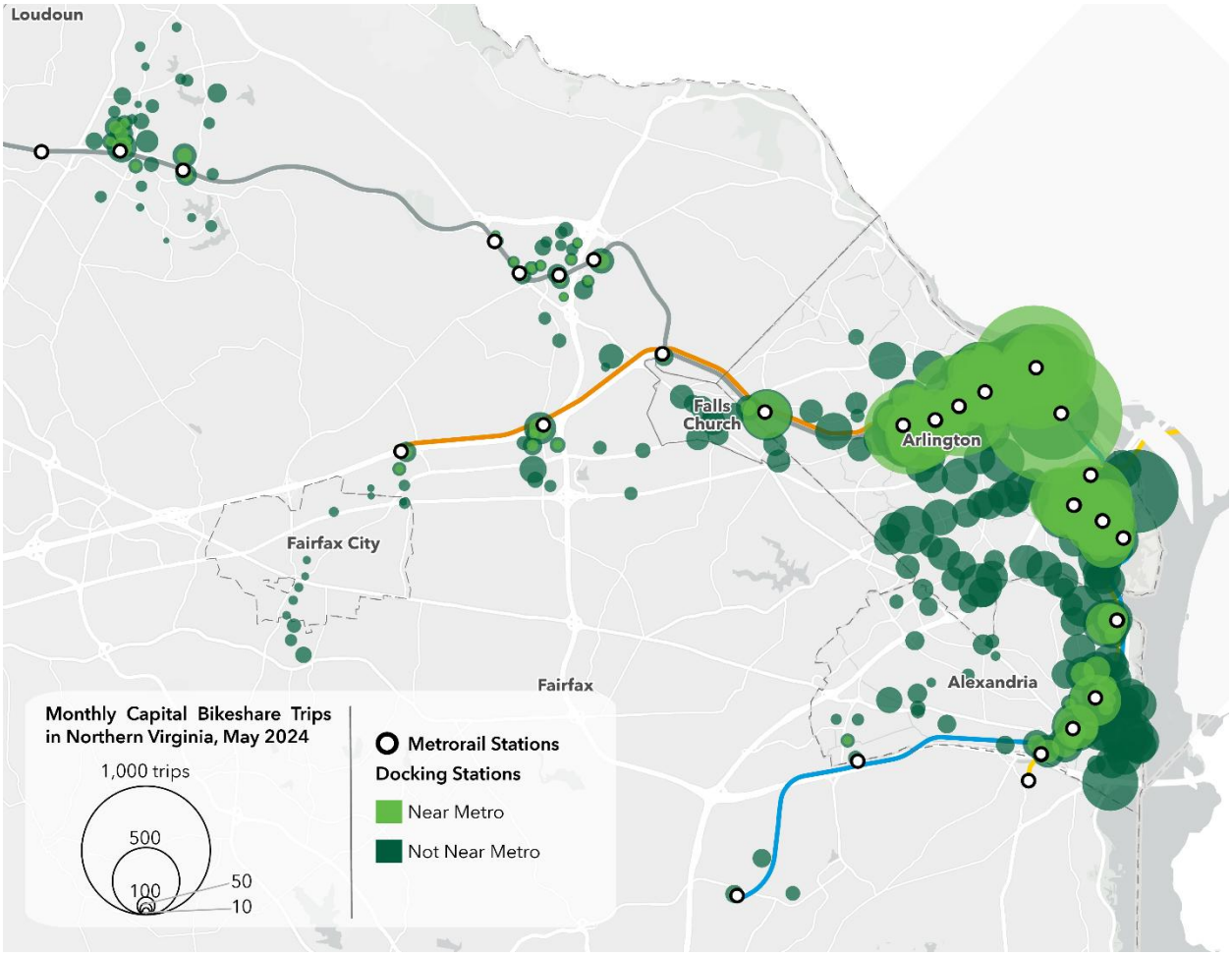

Figure 6: Capital Bikeshare trips and Metrorail proximity

Metrorail stations can often be associated with increased population density, jobs, more intensive land use and other factors that could also be contributors to higher numbers of CaBi trips. Consequently, statistical modeling was used to establish whether bikeshare trips near Metrorail are higher even after accounting for these other factors**. Appendix D** summarizes the results. The resulting models indicate higher bikeshare station trips are positively associated with Metrorail proximity, even after accounting for other factors. A CaBi station within quarter a mile of a Metrorail station has approximately an extra 55 trips a month[10] compared to a CaBi station more than a quarter mile away from a Metrorail station.

[9] Quarter mile is consistent with recently published research (*14*) looking at bikeshare and transit in the Washington, DC region.

[10] In May 2024, CaBi had an average of ~655 trips per bikeshare station.

Dockless Micromobility (Scooters and E-bikes)

Like docked bikeshare, dockless micromobility is available through much of the region. **Table 4** summarizes where different dockless mobility operators have scooters in Northern Virginia. As dockless micromobility operators are typically private companies, their inclusion or absence from a jurisdiction may be the consequence of a private company's decision rather than a public law or policy. For example, Loudoun has a Shared Mobility Devices Pilot Program and started accepting permit applications in 2020. However, the program web page[11] indicates the county has not received any permit applications from micromobility providers.

Table 4: Dockless micromobility availability in Northern Virginia

Jurisdiction	Bird	Lime	Spin
Arlington County	✓	✓	✓
Fairfax County	✓	✓	✓
Loudoun County	-	-	-
Alexandria City	✓	✓	✓
Fairfax City	✓	✓	✓
Falls Church City	-	-	-

**Bird, Lime and Spin were the only operators in Northern Virginia at the time this report was written.*

As dockless micromobility companies are private, data on their use is not available for all jurisdictions. Only Arlington County, the City of Alexandria, and the City of Fairfax have agreements to collect ridership information for dockless micromobility operators in their respective jurisdictions. In 2024, the three jurisdictions averaged almost 72,000 trips each month.[12] Arlington County consistently reported the highest number of trips; however, Alexandria has the higher ridership per square mile with more than 3,000 trips/mi^2 each month within the city limits.

Both Arlington County and the City of Alexandria trip data includes geographic information which can provide insight into how and where dockless micromobility is used in the region. **Figure 7** shows hot spots of dockless micromobility usage in these two jurisdictions. There are two key areas of dockless mobility use in the data. First, the Ballston-Rosslyn corridor has a concentration of both dockless mobility as well as Metrorail stations, suggesting a potential relationship. Second, there is a large concentration of dockless micromobility near Old Town in the City of Alexandria. Although there are no Metrorail stations right in Old Town, there are some heat spots near Metrorail stations traversing from Alexandria to Crystal City.

Like with CaBi, statistical modeling was also used to establish if the apparent association was between dockless micromobility and Metrorail or if it was a result of other factors like land use and population density. The results are shown in **Appendix D**. Due to some of the spatial differences seen in **Figure 7**, Arlington County and the City of Alexandria were modeled separately. The results show that, although some of the variable relationships are different to what was seen with CaBi, Metrorail proximity was still positively associated with greater dockless micromobility use in both Arlington County and the City of Alexandria.

[11] https://www.loudoun.gov/5292/Shared-Mobility-Devices

[12] Since 2019, monthly ridership totals for the three jurisdictions have remained relatively consistent, increasing approximately 4%.

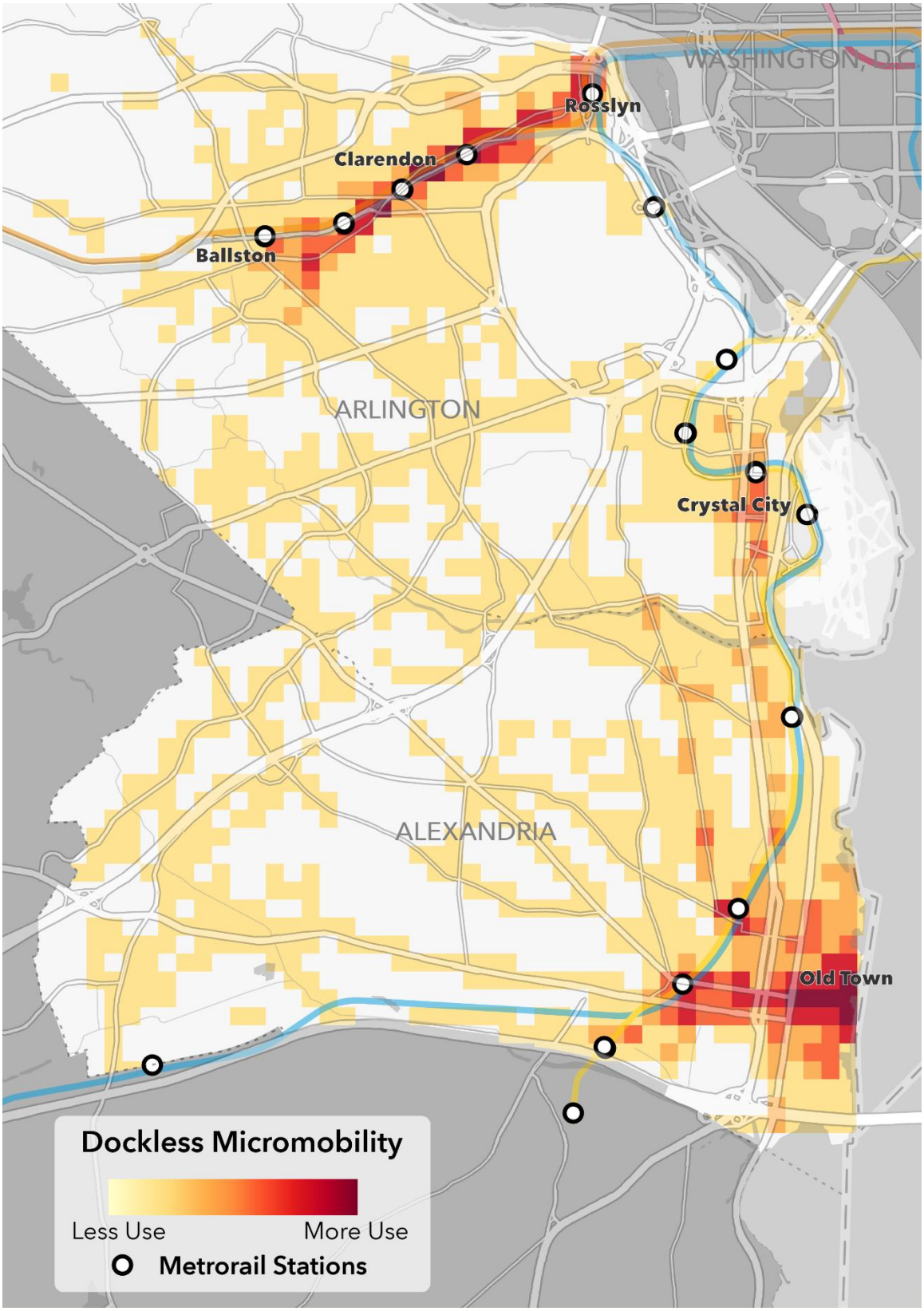

Figure 7: Dockless micromobility use in Arlington County and the City of Alexandria (January 2019 – June 2024)

3.3. Bikes on Transit Vehicles

As mentioned in **Section 2**, many bicyclists prefer to take their bikes on transit when they combine bicycling with transit. Allowing bicycles on transit vehicles, especially buses, has been an important transit-biking integration strategy for Northern Virginia for many years. Fairfax County, for example, has been equipping all Fairfax Connector buses with bike racks since 2007 (*31*). This section provides an overview of bikes on buses for the region.

Figure 8: A bike on an ART bus

Regional Policies

Every transit agency operating in Northern Virginia allows bicycles on transit vehicles, including both buses and trains[13]. ART, CUE, DASH, Fairfax Connector and Metro allow bikes on all buses. While all local buses allow bicycles on board, there are some limitations with commuter buses. OmniRide doesn't allow bikes on commuter buses while Loudoun County Transit requires riders to get a "bike on bus permit card" for commuter buses. In the region, all buses with bike racks have capacity for up to two bicycles[14,15] while Loudoun County Transit commuter buses store bicycles in the bus luggage compartments. Both train operators (Metrorail and VRE) allow bicycles to be carried into the train car.

While bicycles are allowed on buses, several transit agencies specifically say that, for safety reasons, transit operators can't help and that installing bicycles on bus racks is the responsibility of the bicyclist. However, Fairfax Connector's transit strategic plan does emphasize that all bus operators are trained to use the racks and can assist bicyclists if needed (*31*).

Although all regional transit agencies encourage bikes on transit, there is some variation in the guidelines provided for transit riders. For example, while Fairfax Connector limits bikes up to 50

[13] When NVTC last studied this topic, DASH did not yet have bike racks for buses (*17*).
[14] Agencies state that if a bike rack already has two bicycle, a cyclist must wait for the next bus rather than be permitted to bring their bicycle onto the bus.
[15] TheBus in Prince Georg1e's County, MD, has installed triple bike racks on some buses. https://www.thebus.org/howtoride/How%20to%20Use%20the%20Bike%20Rack.pdf

pounds in weight, OmniRide allows bikes up to 75 pounds. Further, while almost all bus agencies require bicycles not to be too big or too small, DASH states smaller bikes, like bikes for small children, are allowed inside the vehicle, even though most agencies prohibit non-collapsable bikes inside buses.

Electric scooters and other micromobility devices are only mentioned by some agencies. Fairfax Connector, for example, has detailed guidelines about when micromobility devices are allowed on buses, stating they are not to use bike racks and must be folded if possible. Fairfax Connector also states shared or rented micromobility devices, bikes or scooters, are not allowed on buses. Metro states that folding electric scooters or bicycles are allowed on buses if they're folded and stored between the rider's legs. Electric scooters are also allowed on Metrorail.

Tracking Bikes on Transit Vehicles

Bike usage on transit isn't tracked by most Northern Virginian transit agencies with VRE being the primary exception. VRE began allowing bikes on board trains in January 2022. Since the inception of the program two years ago, bikes on board have increased approximately 123%.[16] In the first six months of 2024, an average of approximately 1,200 bikes were brought on board trains each month. The Fredericksburg Line has utilized this program more than the Manassas Line, with 43% more bikes on board morning Fredericksburg trains than Manassas. However, the share of VRE riders with bikes is still approximately 1% on both lines.

3.4. Safe Routes to Transit

Safety is part of the mission and goals of almost every transit agency operating in Northern Virginia while also being an important concern for many cyclists. Consequently, safety is an important part of transit and bicyclist integration. Although buses are a sustainable and efficient way of moving people through the region, their large size can pose a potential risk to bicyclists. Recognizing this, VDOT provides guidance on bicyclist safety around transit, stating cyclists should:[17]

> *Exercise great caution when riding in bus traffic. Watch out for buses pulling to and from curbs and passengers getting on and off buses.*

VDOT also tracks how often buses and bicyclists are involved in crashes with one another. **Figure 9** shows how many road crashes in Northern Virginia involve both a bicycle and a bus. Fortunately, as the figure shows, these types of crashes are relatively rare. However, while approximately 70% of crashes on Northern Virginia roads between 2016 and September 2024 did not result in an injury, every bus and bicycle crash did. Consequently, it is important to minimize bus and bicycle conflicts whenever possible.

This section of the report focuses on regional policies that emphasize the safe mixing of transit and bicyclist travelers, as well as infrastructure that improves safe connections between transit and bicycling.

[16] June 2022 to June 2024
[17] Bike Safety https://www.vdot.virginia.gov/travel-traffic/bike-ped/bike-safety/

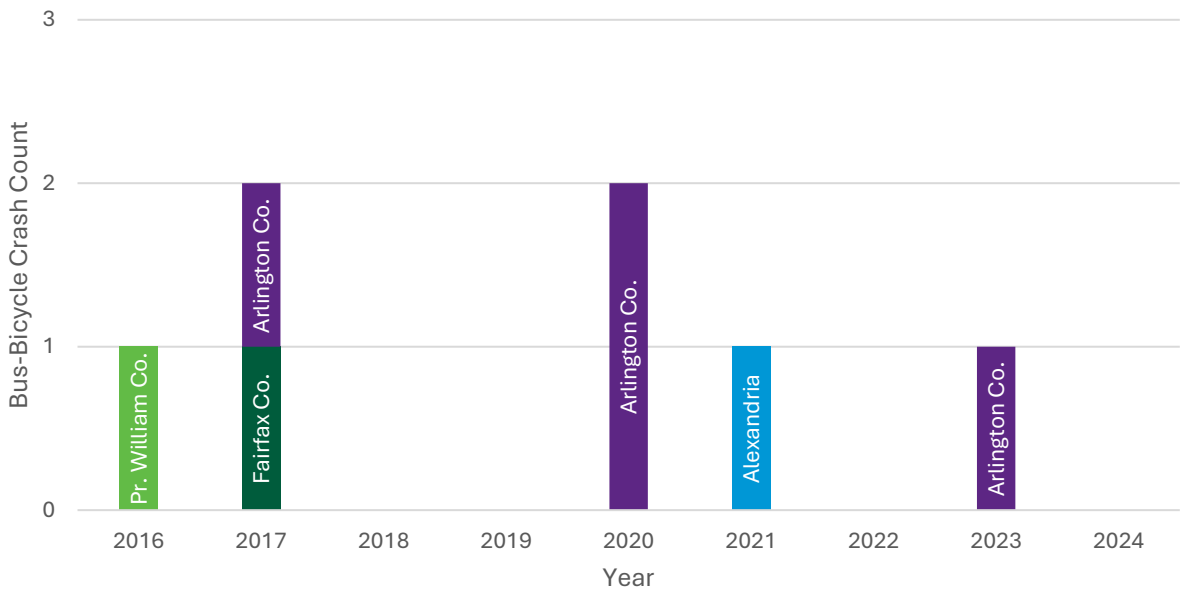

Figure 9: Bus-Bike Crashes in Northern Virginia (VDOT crash data 2016-2024)

Transit and Bicyclist Safety Policies

While safety is important to both transit agencies and bicyclists, there are few opportunities to use policy to address conflicts between bus transit and cyclists. This section focuses on two main types of potential bike and bus conflicts. The first is when cyclists encounter bus lanes while the second is when bike lanes intersect with bus stops.

Bikes and Bus lanes

With limited public right-of-way, it can often be difficult for jurisdictions to install both bike lanes and bus lanes on streets. **Figure 10** provides one of the few examples in the region where these two facility types can be found together. Consequently, in some parts of the region, there are bus lanes and general purpose travel lanes without any designated bicycle facilities. In these areas, a bicyclist may sometimes feel safer using a bus lane as bus lanes are typically used by fewer vehicles than general purpose travel lanes. Although cyclists may sometimes feel safer in bus facilities, there is an increased risk of bus-bicycle crashes. Only two jurisdictions in Northern Virginia directly address these potential conflicts in their policies and local laws.

Arlington County provides policies[18] that directly address the question of whether cyclists can use bus lanes. These policies provide three levels of guidance, depending on the street design and the location. Arlington policy guidance says cyclists are only allowed to use bus lanes where street signing and striping, including sharrows, explicitly permit cyclists. Cyclists are not permitted to use bus lanes where dedicated bike lanes exist (see **Figure 10** for an example) nor in the exclusive bus lanes in Potomac Yard. Arlington County Code[19] outlines enforcement for these policies. These local laws state “Unauthorized vehicles are prohibited from using the marked Transitway lanes” before listing all the streets where unauthorized vehicles are prohibited. The code continues to list authorized vehicles as “Metroway buses, Arlington Transit buses, and authorized police, fire and

[18] Understanding Transit Lanes https://www.arlingtonva.us/Government/Programs/Transportation/Transit-Lanes#section-5

[19] § 14.2-8.2. Fine for Use of Transitway Lanes https://www.arlingtonva.us/files/ae7dbb4a-cd32-4fcb-924f-7d1fd4af8c6b/Ch.%2014.2%20Motor%20Vehicles%20and%20Traffic.pdf

rescue vehicles." As bicycles are not listed as authorized vehicles, cyclists are prohibited from riding on the transitway lanes listed in the Arlington County Code and, like unauthorized personal cars and trucks, may be subject to a $200 fine.

Figure 10: A location in the Court House area of Arlington that has adjacent bus and bike lanes

The City of Alexandria's Code of Ordinances[20] also addresses the use of bicycles in bus lanes. These local laws specify that transitways are to be signed along the entire route and are to be used "for the exclusive use of designated buses and other transit vehicles … or by emergency vehicles." Like Arlington County, the City of Alexandria allows for fines for violating local laws, ranging from $200 to $1,000 depending on the number of violations.

While Arlington County and the City of Alexandria both have local laws addressing bikes in bus lanes, the two jurisdictions differ slightly in their approach. Arlington County explicitly lists every roadway that is included in their code while the City of Alexandria's code is based on a definition of transitways. The former requires an update to the code every time a new bus or transit lane is installed while the latter just needs to ensure all new bus or transit lanes are built in accordance with the definition in code.

Bus stops and bike lanes

Bus stop and bike lane conflicts result in potential conflicts for both bicyclists and bus riders. Cyclists must navigate buses pulling in and out of bus stops, which may mean crossing through bike lanes, while bus riders need to navigate bike paths when they get off their bus.

[20] Sec. 10-3-17 - Dedicated transitways
https://library.municode.com/va/alexandria/codes/code_of_ordinances?nodeId=PTIITHCOGEOR_TIT10MOVETR_CH3OPVE_ARTAGEPR_S10-3-17DETR

Floating bus stops are a proposed solution to bus stop and bicycle conflicts. Floating bus stops are defined by a bike lane providing a physical separation between the sidewalk and a transit passenger waiting area, creating an "island" to wait for the bus. The concept has been discussed in the US for about a decade.[21] There have also been ongoing discussions at the regional level about floating bus stop design and use. Metro has been evaluating these bus stop designs for several years and recently the Metropolitan Washington Council of Governments (MWCOG) Regional Public Transportation Subcommittee (RPTS) dedicated a significant part of one of their monthly meetings to the topic.[22] Montgomery County in Maryland has done arguably the most work[23] on floating bus stops in the greater Washington, DC region, with a particular focus on ensuring accessibility for all.

In Northern Virginia, guidance on floating bus stops is found in *Arlington's Bus Stop Guidelines & Standards Manual* (*39*) and described in Fairfax County's *Active Transportation Toolkit* (*40*). Arlington's guidance provides a more detailed description of this bus stop type as well as some design guidelines. **Figure 11** shows an example of a floating bus stop in Arlington that was installed in 2021.

Figure 11: A floating bus stop on Wilson Blvd in Arlington

[21] "Toward the Peaceful Coexistence of Buses and Bikes"
https://www.bloomberg.com/news/articles/2015-05-27/-floating-bus-stops-separate-transit-traffic-from-bike-lanes
[22] TPB Regional Public Transportation Subcommittee April 23, 2024, meeting agenda
https://www.mwcog.org/file.aspx?&A=Wl6fUlUMaWemgkLa1Jso8OXmgJ2yl%2b14WnyNpp8X4Ow%3d
[23] Transportation Research Board Webinar: Accessible Floating Bus Stops featuring Montgomery County, MD
https://onlinepubs.trb.org/onlinepubs/webinars/231128.pdf

Transit Stops, Bike Lanes and other Bike Infrastructure

Bike lanes and other types of bike facilities are an important part of safe routes to transit. This is because these facilities typically provide safer options for cyclists compared to riding in general purpose travel lanes on roads. Some of these facilities, like shared use paths, separate bicyclists from cars and other vehicles completely, providing the most safety for bicyclists and other micromobility users. In Northern Virginia, there are more than 4,500 transit stops in close proximity to a bike facility[24] (within 1/8 of a mile[25]), representing 60% of all transit stops in Northern Virginia. **Figure 12** shows the overlap between bicycle facility types and transit stops throughout the region while **Table 5** summarizes how many stops are accessible for each type of bike facility.

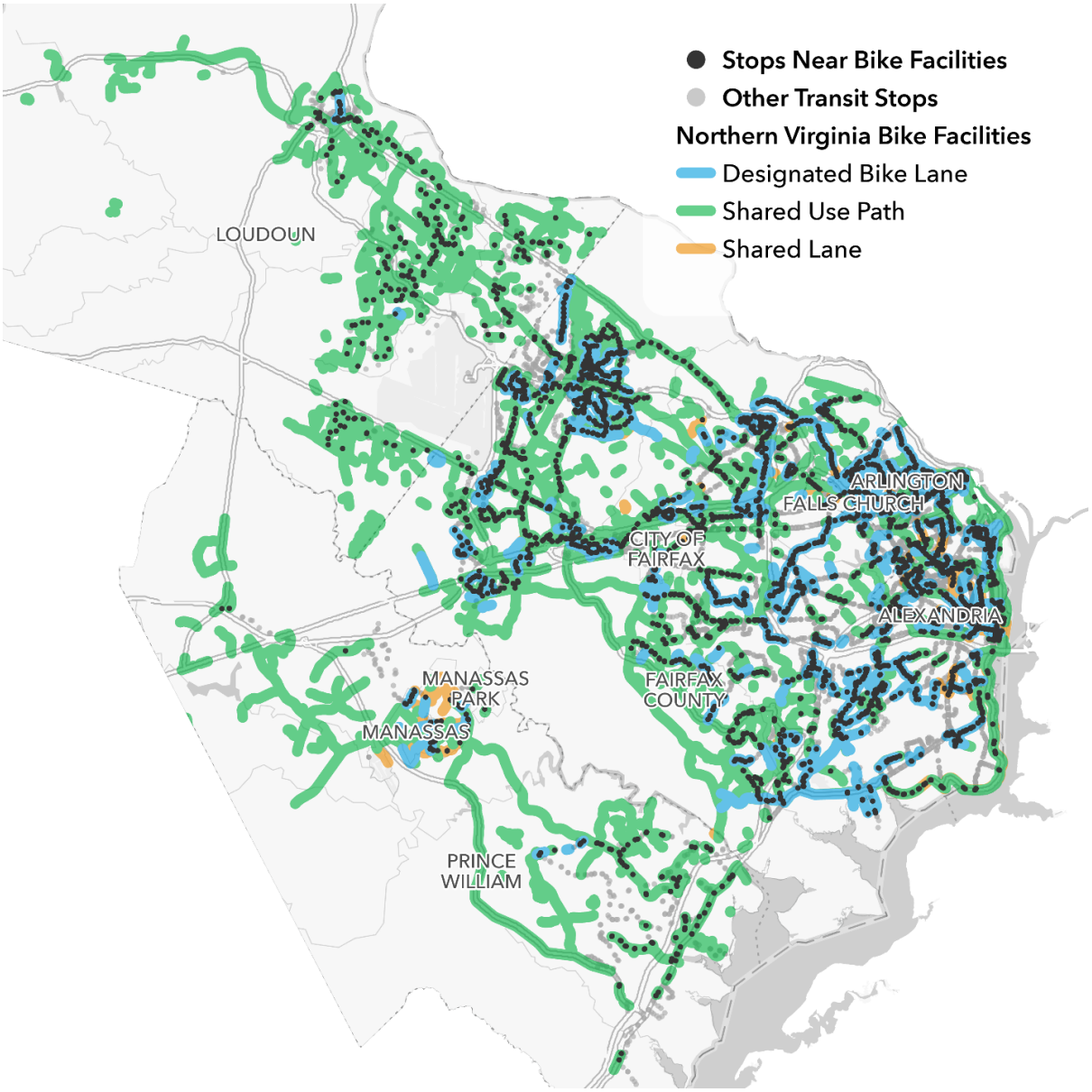

Figure 12: Transit stops near bicycle facilities

[24] This doesn't consider transit stops shared by multiple transit agencies, so this value is likely overcounted.
[25] This proximity threshold was also used by the *Alexandria Mobility Plan* (*49*).

Table 5: Transit stops near bicycle facilities

Type of bike facility	Stops 1/8 of a mile from bike facility	Share of all Northern Virginia transit stops (~7,500)
Designated Bike Lane	1,712	23%
Shared Use Path	2,253	30%
Shared Lane	521	7%
TOTAL	4,486	60%

As the table shows, nearly half of transit accessible bike facilities are shared use paths. However, the predominant bike facility and transit stop connections generally depend on the jurisdiction associated with the transit stop. Denser areas like Arlington County and the City of Alexandria tend to have more transit stops associated with designated bike lanes, while less dense, more suburban jurisdictions like Loudoun County and Fairfax County have a higher share of shared use paths near transit. For example, 70% of transit stops in Arlington County are near designated bike lanes while most transit stops in Loudoun County are near shared use paths. Metro, which inherently runs more cross-jurisdictional services, has a different type of breakdown in bike facilities near transit. For Metrobus, 42% of stops are near designated bike lanes and 39% of stops are near shared use paths. Further, 61% of Metrorail stations are near designated bike lanes and 39% are near shared use paths.

Bike's Role in Expanded Transit Access

The connections between bike facilities and transit stops can greatly improve safe access to transit stations. Northern Virginia jurisdictions and transit agencies have recognized this in their own plans and policies. For example, Arlington County, Fairfax County, the City of Fairfax and the City of Falls Church all have plans and policies that emphasize the use of bike infrastructure to increase transit access (*29*, *31*, *32*, *41*). The region also has plans to improve these connections. Over 90% of the $750 million in planned transit-bicycle projects include increasing bicycle and micromobility access to transit (see **Appendix A**).

The connection between bicycle facilities and transit stops was analyzed to determine how much access increases compared to walking.[26] The analysis considered bicycle facilities between one and three miles away from transit stops in accordance with previous work on this topic (*18*, *42*). The methodology is described in **Appendix C** while **Figure 13** summarizes the results.

As the figure shows, bike facilities greatly increase access to transit across all three transit modes. Considering bicycle facilities within one mile of a stop, there is a 10% increase in the number of residents with access to bus[27] and a 54% increase in access to Metrorail. Bike facilities within three miles increase residents with access to a transit stop even more with a 162% increase for Metrorail and an 111% increase for VRE. The change in access is particularly beneficial for historically marginalized demographic groups. For example, bicycle facilities provide lower-income households and people-of-color a much greater access to higher quality transit like Metrorail.

Access differences can also vary by jurisdiction. For example, Loudoun County specifically had a large increase in the total population with access to Metrorail with the addition of bike facilities. This is likely because of two reasons. First, there are only three Metrorail stations in Loudoun that are

[26] Transit access to walking information can be found in the NVTC Transit Data Dashboard (*50*).

[27] Bus is relatively low because a substantial part of the region can already access bus stops by walking.

relatively far apart. Second, there is an extensive network of shared use paths in Loudoun that help to expand access to these stations (especially at the three-mile buffer range).

Overall, the increased access demonstrates how bicycle facilities can extend the reach and efficiency of transit services. For example, fewer Metrorail stations must be built because bicycle facilities allow more people to access existing stations.

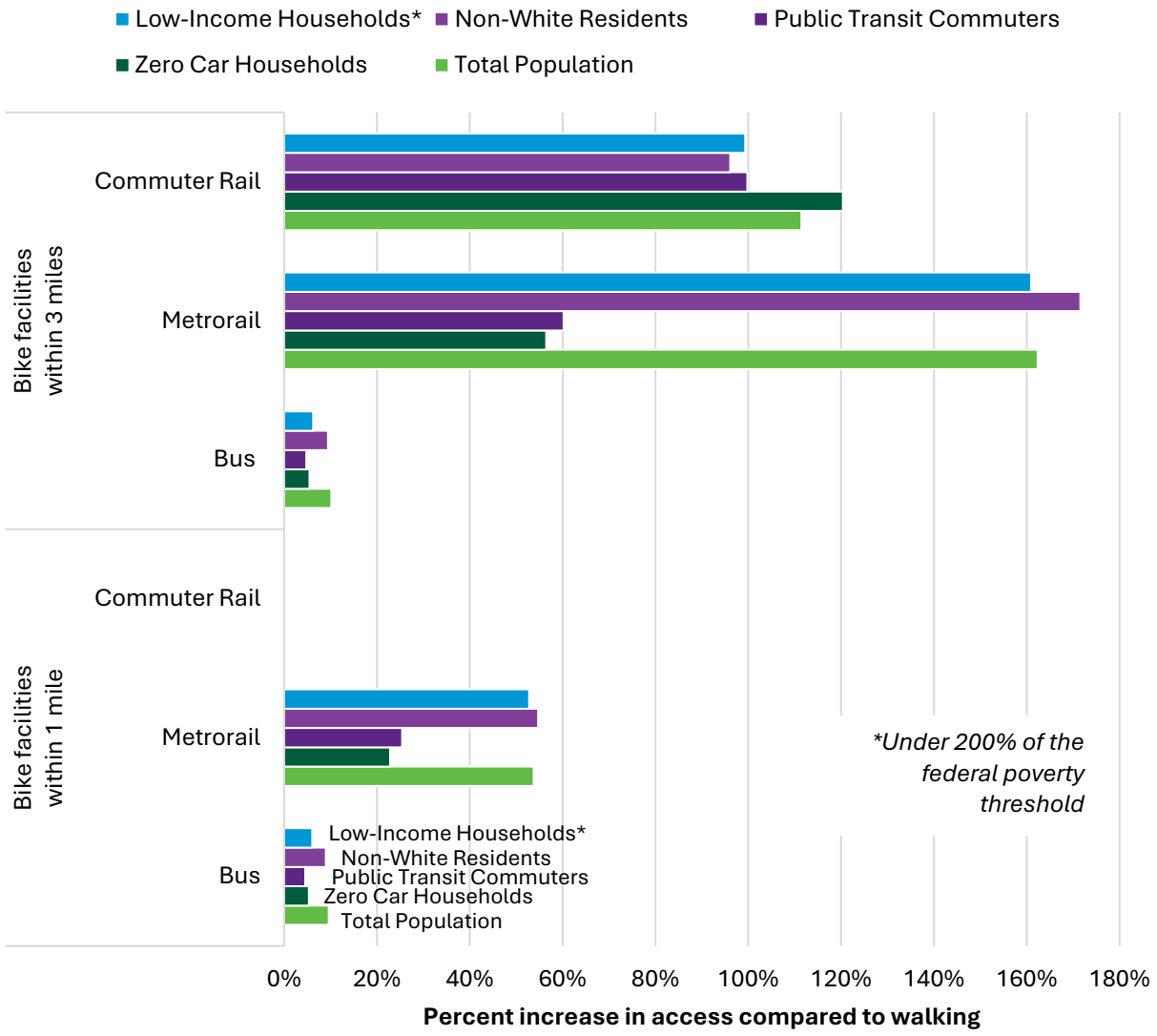

Figure 13: Change in transit access because of bicycle facilities

Although there is limited data that looks at the effects of increased access in Northern Virginia, there is evidence that trips that combine bicycling with transit are an important and growing part of the region's mobility. A report by Arlington's Mobility Lab (*26*) found "18% of e-scooter riders and 8% of dockless e-bike riders indicated connecting to/from Metrorail" as a primary trip purpose. The report also found that more than 10% of micromobility users increased their use of both bus and Metrorail after e-scooters became available in Arlington County. Another study by Mobility Lab found that about 1% of ART riders continue their trips with bicycles after getting off the bus (*43*).

Metro has also done some work on this topic, finding that almost 2% of Metrorail riders[28] use bicycling and other micromobility to connect to Metrorail stations[29] (*44*). The type of micromobility used for accessing Metrorail stations varies by station. **Figure 14** shows how different forms of micromobility are used to access Metrorail stations across Virginia (all categories are labeled by Metro).

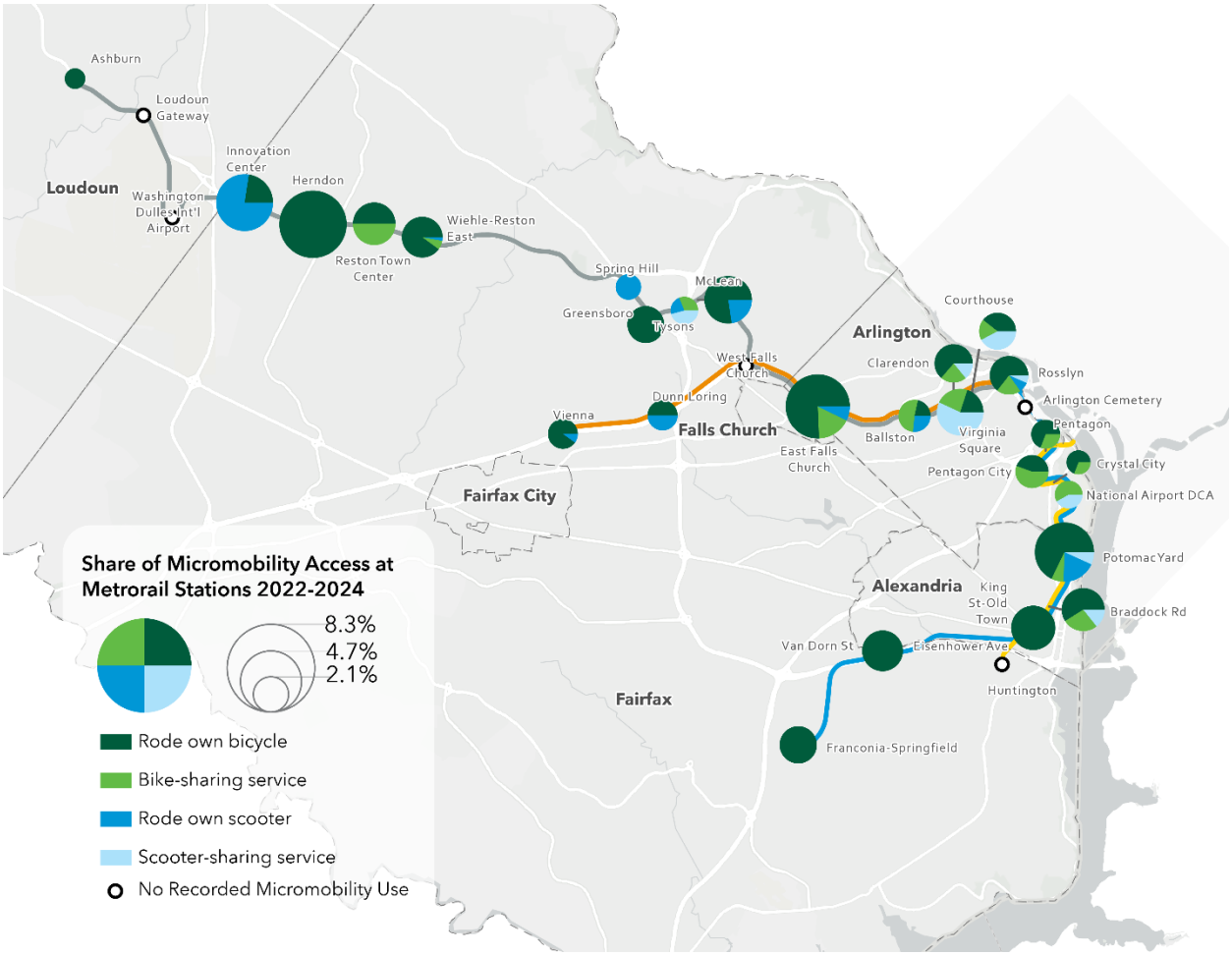

Figure 14: Micromobility access for Metrorail stations in Virginia

As the map shows, in the denser areas of Arlington County and the City of Alexandria, Metrorail riders typically use a mix of micromobility forms to access their station. However, in more suburban areas, especially Fairfax County, Metrorail riders tend to use their own bicycle. Also, while the denser areas have some of the higher ridership stations, some of the largest proportions of Metrorail riders using micromobility happen in more suburban areas like Herndon and East Falls Church. Although the use of micromobility for accessing Metrorail varies significantly across the region, **Figure 15** shows this mode of Metrorail access has been increasing over time. The average micromobility access for Metrorail stations in Virginia has grown from 1.1% to 1.7% between 2016 and 2022, an almost 60% increase.

[28] Metro staff have communicated this is likely an undercount given it can be more difficult to get bicycle commuters to complete surveys at stations.

[29] 2022 micromobility access was 2.66x greater than 2007, the latest data available when NVTC last studied this topic (*17*). Metro emphasizes their goal is to have 3.5% of Metrorail riders accessing stations by bicycle by 2030 (*44*).

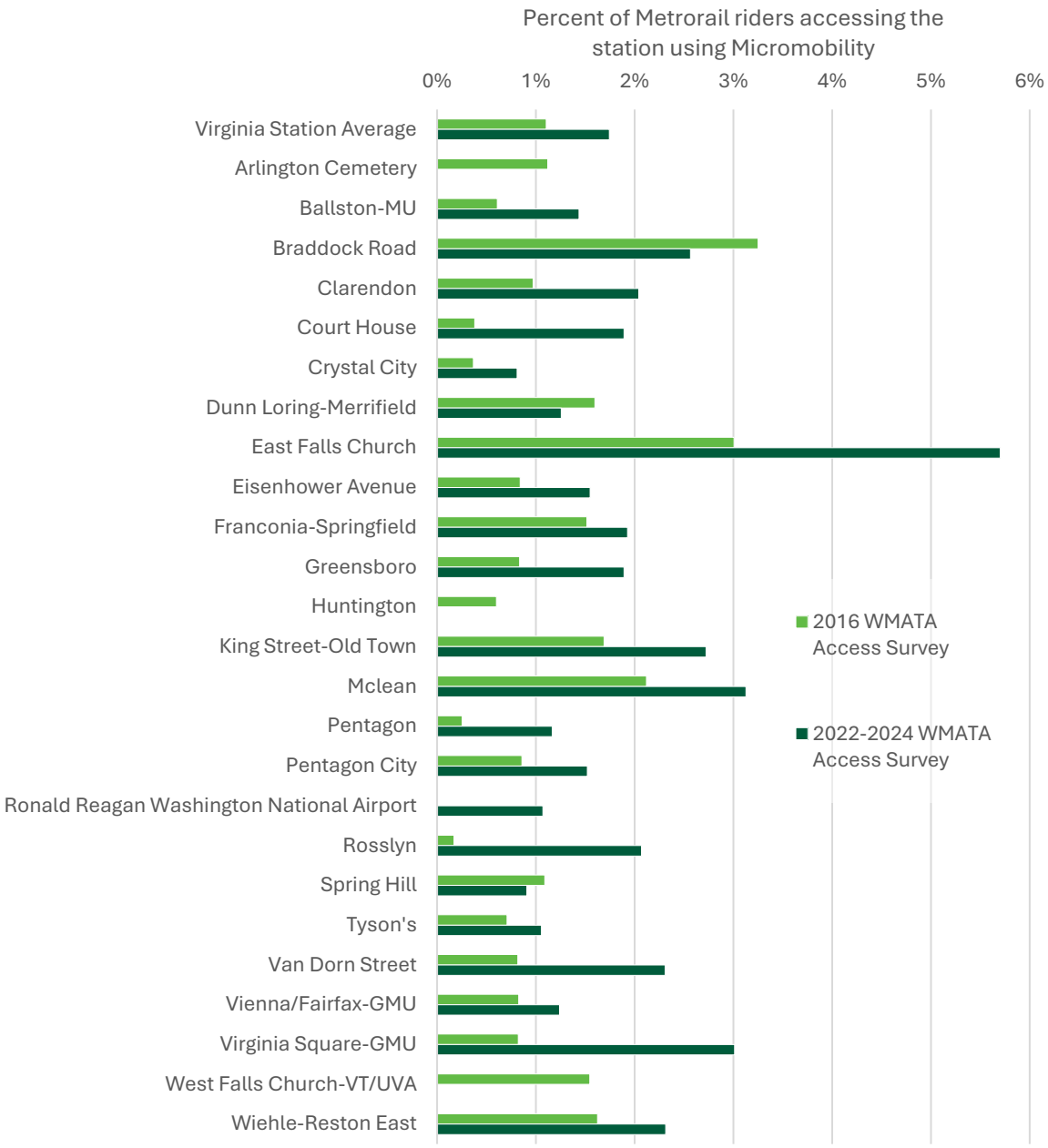

Figure 15: Changes in micromobility access for Metrorail stations in Virginia

***Note**: Only stations that existed in both 2016 and 2022 are included in **Figure 15**.*

3.5. Customer Communication and Education

There are many ways transit agencies and jurisdictions[30] may facilitate transit and bicycle connections through customer communication and education, as summarized below.

- **Educating riders on alternatives to cars for accessing transit**

As previously mentioned, cars can be a costly way to provide access to transit. There are also more environmentally friendly ways to traverse the first mile/last mile from a transit stop. Recognizing this, Arlington County makes it a priority to share information about bikeshare and bicycling to get to and from transit stops like Metrorail (*29*). Further, the County emphasizes promoting bikeshare as the preferred travel mode for first and last mile trips from transit services. City of Fairfax (*41*) and Fairfax County (*45*) provide websites that centralize both transit and cycling information and resources in one place, making it easier for people to find the information they need to make multimodal trips.

- **Demonstrating how to put bikes on buses**

Section 3.3 highlighted how prevalent bike on bus policies are in Northern Virginia. However, knowing how to put bikes on buses could be a barrier to people using personal bicycles as part of their transit trip. Consequently, some agencies, like ART and Metro, provide step-by-step guidance for putting bikes on buses while others, like DASH and Loudoun County Transit, provide videos to demonstrate how to install bicycles in bike racks. **Figure 16** shows a snapshot of a video DASH uses to educate transit riders on how to put bicycles on transit vehicles.

Figure 16: DASH video showing how to put a bike on a bus

[30] Private companies like Transit App and Google also provide tools and information that better enable people to combine bicycling and other micromobility with their transit trips.

- **Include bicycling and micromobility in real-time information**

Real-time information is important for transit riders to get information like vehicle arrival/departure times, service disruptions, and parking availability (*46*). In addition to these different types of information, the City of Fairfax recommends including information on shared bicycles (*41*). Knowing bikeshare is available at a destination, for example, could help transit users better plan multimodal trips.

- **Bicycle wayfinding at transit stations**

Wayfinding is about providing different ways to help people orient themselves and figure out how to get from where they are to where they are going. Good wayfinding can make transit-bicycle connections easier and more stress free for people who may choose to combine modes (*18*). Fairfax County recommends installing wayfinding for cyclists at transit stations (*31*). For example, providing distances and/or times from transit stations to nearby destinations for cyclists. Arlington County also recommends including directional signage to support bicycle access to transit stations (*29*). Finally, VDOT recommends bicycle route signage at park and ride facilities (*30*).

4. Case Studies Across the United States

Although transit agencies and municipalities in Northern Virginia have already implemented many strategies to integrate transit, bicycling and micromobility, there are still opportunities to learn from the policies, plans and actions of others. This section provides a selection of mini case studies from across the US that demonstrate novel or innovative ways to better integrate transit, bicycling and micromobility. Each case study briefly covers which agency/jurisdiction was involved, where the case study takes place, what the strategy was, and why this strategy can be useful for integrating transit, bicycling and micromobility. There are four mini case studies in total.

4.1. Including Bicycling in Capital Decision-Making

Bay Area Rapid Transit (BART) is a transit system that operates rail services in the San Francisco Bay Area in California. In FY 2022,[31] the agency provided almost 2.5 million hours of service carrying over 38 million passengers.

While capital spending is important to all transit, it is especially important in rail because rail systems must build and maintain train tracks in addition to vehicles, stops and buildings. In FY 2022,[2] BART spent over $700 million on capital projects. However, this focus on capital projects is also where BART has innovated when it comes to combining their transit services with bicycling. There are two particularly notable strategies to highlight.

First, the Bay Area is highly developed with land being notoriously expensive. Consequently, when investing in stations to connect more riders to the system, BART has had to be very strategic in its decision-making. As a result, BART developed a station access policy[32] that prioritizes station investment based on how people access their stations. Specifically, bicycling and walking, which take the least amount of space are prioritized over other forms of transportation. Recognizing operations extend from dense urban areas to more car-dependent suburbs, BART tailors the level of

[31] Federal Transit Administration (FTA) National Transit Database (NTD) data
[32] BART Station Access Policy https://www.bart.gov/sites/default/files/docs/BART%20Access%20Policy%20-%20Adopted%202016-06-09%20Final%20Adopted_0.pdf

prioritization based on where the station is located, as shown in **Figure 17**. While personal cars are explicitly not encouraged for some station types, bicycling is a primary or secondary level investment focus for all stations.

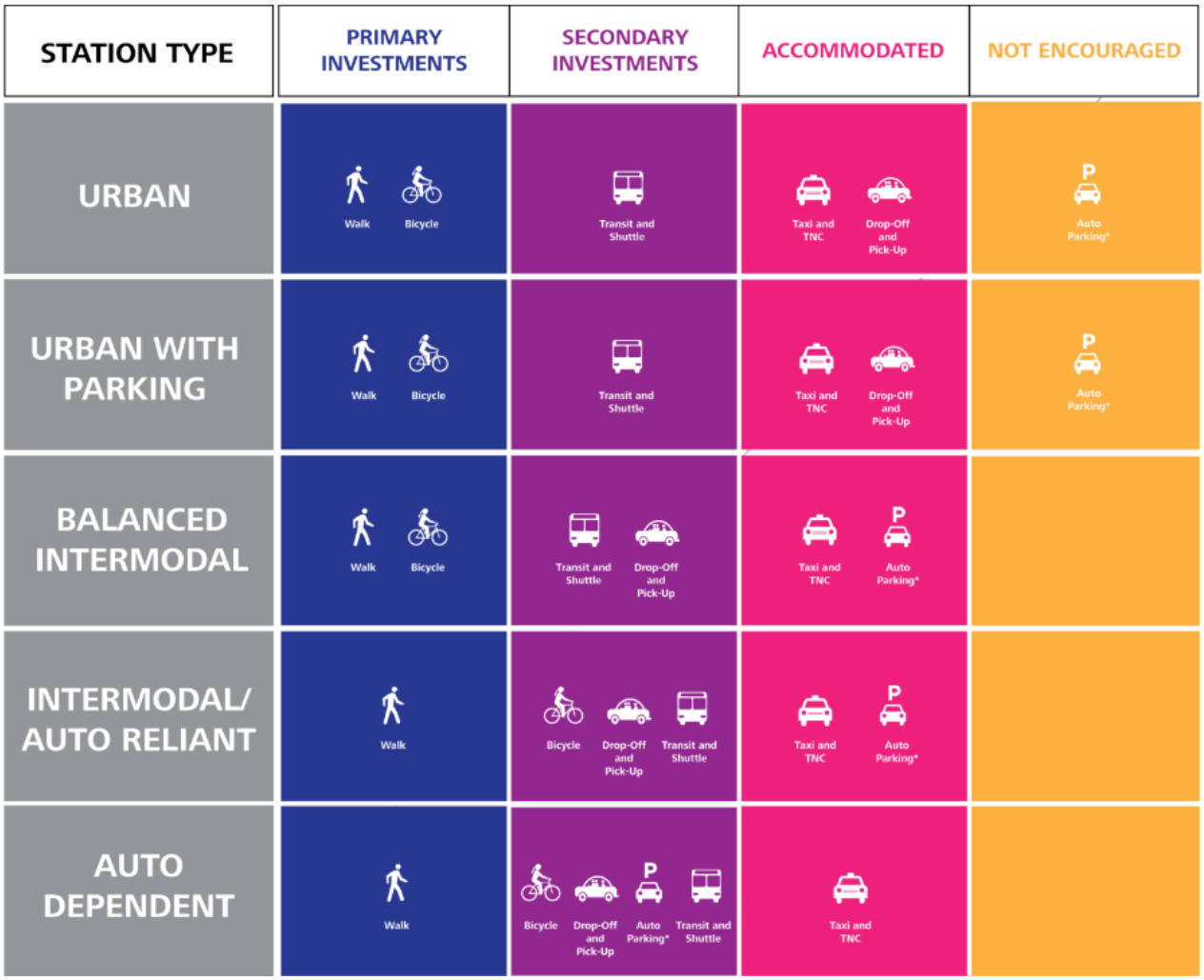

Figure 17: BART station access investment framework

The second strategy used by BART is the development of the BART Bicycle Program Capital Plan.[33] While the station access policy ensures bike access is prioritized for stations, the BART Bicycle Program Capital Plan has a broader purpose, explicitly focused on "capital improvements that encourage bicycle access to BART." This plan focuses on existing and recommended efforts for a variety of different infrastructure, including lockers to safely store bicycles, stairways with channels to make it easier to move bicycles up and down stairs and accessible fare gates that make it easier to take bicycles onto stations and trains. The document also summarizes data that support these capital decisions, including bicycle demand projections and an annual bicycle parking survey.

While these two planning documents are different, they both directly inform BART's capital decision-making. More impactfully, both documents demonstrate the explicit inclusion of bicycling into

[33] BART Bicycle Program Capital Plan
https://www.bart.gov/sites/default/files/docs/BART%20bicycle%20capital%20plan_FINAL_2017-05-31.pdf

capital decision-making. Rather than having bicycling as an afterthought, with an ad-hoc mix of retrofitted infrastructure to try and include bicycling, BART demonstrates that transit can be planned alongside bicycling. This result is a consistent experience for the cyclist-transit rider, a better anticipation of the needs for people who use both transit and cycling, as well as lower implementation costs as retrofitting is often more expensive than integrating bicycle-friendly infrastructure into new construction. The integration of bicycling and transit also helps BART achieve its other goals including increasing regional health and sustainability, more equitable services[34] and an overall better transit experience for riders and the community.

4.2. Bike Friendly Training and Culture

Metro Transit serves the Minneapolis–Saint Paul area in Minnesota with both bus and rail transit services. The agency served almost 39 million people with just under 2 million hours of revenue service in FY 2022.[25] Approximately two-thirds of riders and four-fifths of service were from bus with the remaining ridership and service from rail.

Metro Transit demonstrates how transit and bicycling integration should be more than a policy or infrastructure consideration. While policy and infrastructure are important, Metro Transit goes beyond them by integrating bicycling into the agency's training and culture. This case highlights different ways the agency does this.

Like all transit agencies in the US, Metro Transit prepares their bus operators for a variety of situations they might face while operating a transit vehicle. For Metro Transit, this training and preparation includes a focus on bicycles (*18*). New operators re-review local laws governing bicycles on the road, learn about the different experience levels and behaviors of cyclists using the road, and learn tips for operating a bus safely around cyclists. The agency also runs a bicyclist safety campaign every year (*18*). This campaign includes training and bulletins as well as a white bike[35] placed near the entrance of all bus garages, emphasizing bus operators should actively look for cyclists while driving.

Metro Transit bus operator's focus on cyclists is not just about safety. They also ensure operators are prepared to assist customers who want to use their bicycles as part of their bus journey. One way the agency does this is with their annual bus roadeo[36] (*18*). At Metro Transit, the bus roadeo includes loading and unloading bicycles to test their skills under the time constraints of the competition.

Finally, Metro Transit's bike friendly training and culture doesn't end with the organization's own employees. The transit agency also partners with other organizations in the local community. For example, Metro Transit partnered with Freewheel Midtown Bike Center, a local bike shop, to help others learn how to safely use bicycles with transit. Freewheel Midtown Bike Center provides showers, water, and bathrooms for cyclists who may commute with Metro Transit while the transit agency provides a fixed bus bike rack for cyclist education and training (*18*).

[34] Sometimes a decision made to improve bicycle access to a station can also benefit others. For example, fare gates that make it easier to take bicycles onto stations and trains also make it easier for people with disabilities to access the station or people with strollers or luggage.
[35] A white bicycle, often referred to as a ghost bike, is used to remember a cyclist killed in a crash.
[36] A bus roadeo is a skill competition for bus operators. Bus operators demonstrate their skills by navigating a course with different obstacles and time constraints.

While each of these different examples may appear distinct, they overall demonstrate a culture focused on the inclusion and safety of cyclists. This culture helps ensure cyclists are safe in making bike-only trips as well as safe and included when using their bicycle as part of a transit-bike trip.

4.3. Bikeshare and Transit Fare Integration

Los Angeles (LA) County is the most populous county in the US. With about ten million people, it is almost twice as big as the next most populous county. The county has many mobility options to serve such a large population, including transit and bikeshare. There are many transit agencies in LA County, including LA Metro, one of the largest transit agencies in the country. In FY 2022,[25] LA Metro alone served more than 250 million passengers across six different transit modes.

In recognizing that with many transit systems fare payment can quickly get complicated, LA County provides a one-card fare payment system called TAP[37] (see **Figure 18** for a screenshot of the TAP website). Like SmarTrip in the Washington, DC area, TAP allows customers to pay fares for transit agencies across LA County, including LA Metro and 26 other agencies, making it easier to travel across the county using multiple transit systems. However, unlike SmarTrip, TAP can also be used for the local bikeshare system, Metro Bike Share, allowing people to pay for transit and bikeshare using the same payment method. TAP is also working on enabling the inclusion of other mobility programs like electric scooters.

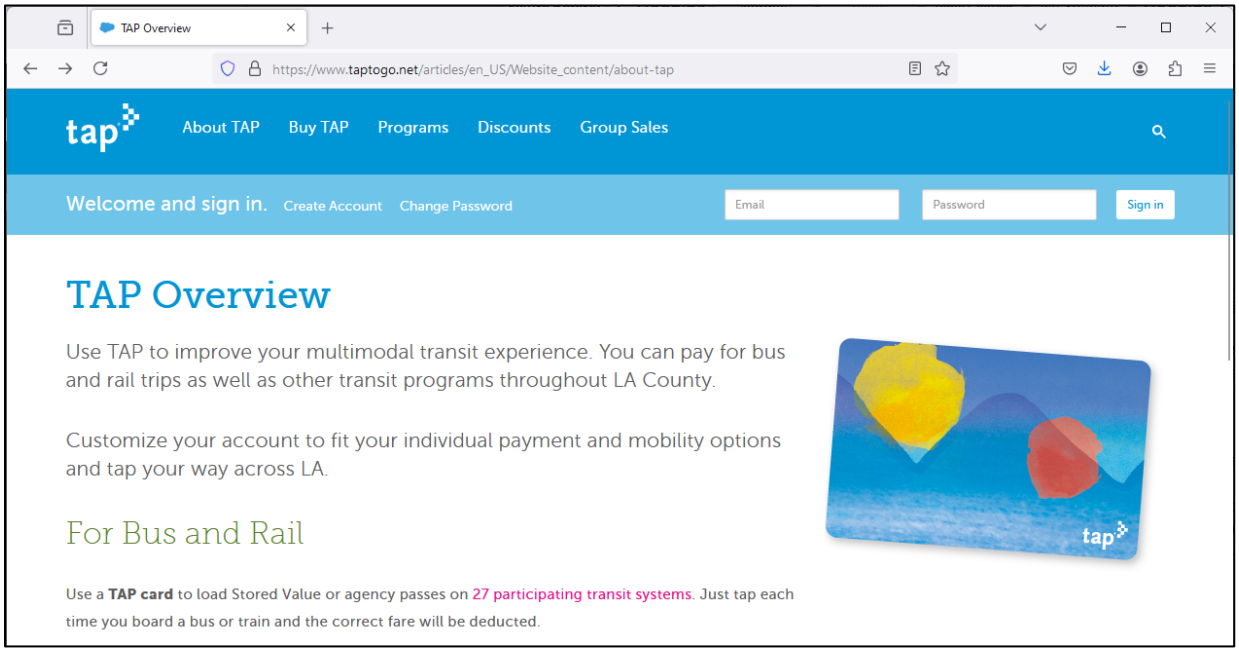

Figure 18: A screenshot from the TAP website

Fare integration programs like the one in LA County make it easier to use both bikeshare and transit together for multimodal trips. It's easier for customers to understand what is needed to use each system, customers only need one card to pay for both, and it makes it easier to choose combined bikeshare and transit trips more impulsively. This simplicity could potentially increase the use of both

[37] TAP Overview https://www.taptogo.net/articles/en_US/Website_content/about-tap

systems, especially considering understanding payment methods has been an issue in the acceptance of bikeshare use (*47*).

4.4. Tracking Bikes on Buses

Lane Transit District, located in Eugene, Oregon, is a much smaller transit agency compared to the other agencies featured in this section. In FY 2022,[25] Lane Transit District serviced just over 5 million passengers and just over 300,000 hours of revenue service. Approximately 94% of the ridership comes from bus service with the rest coming from demand response and vanpool services.

Like transit agencies in Northern Virginia, Lane Transit District encourages people to use bicycles as part of their transit trip. However, unlike most transit agencies, Lane Transit District tracks how often people board buses with bicycles. The bicycle count data is manually entered by bus operators. According to Lane Transit District staff,[38] "operators are supposed to count every bike they get on the rack (bike on), inside the bus (where applicable - Bike in), or if they turn down a bike either because the rack is full, or their rack is full and they are unable to take the bike onboard (bike no)."

The agency collects detailed information including the bus stops and routes people use when boarding with their bicycle as well as the time of day and day of week they board with their bicycle. Even more remarkably, Lane Transit District has been collecting these data for over a decade with data extending back to April 2014. The transit agency makes these data available in a public dashboard[39] that shows both how trends change over time as well as space. **Figure 19** shows a screenshot of Lane Transit District's bike on bus dashboard.

These data are useful for a variety of reasons. First, understanding when and where people prefer to board with bicycles can help the transit agency better allocate resources. For example, where does the agency need to provide more bike parking to help support bicycle passenger overflow? Second, these data can support transit planning that meets transit-bicycling integration goals. For example, where do cyclists as a passenger demographic need more services? Finally, the agency's dashboard serves as a communication tool for the public. It can be used to justify the investment in transit-bike integration strategies, demonstrate the agency is meeting its vision of "creating a more connected, sustainable, and equitable community" and help people who are interested in biking as part of their transit trip feel more comfortable getting started.

[38] Information received through email correspondence with Lane Transit District staff on January 3, 2025.
[39] Lane Transit District – Bikes on the Bus Dashboard https://www.ltd.org/bikes-dashboard/

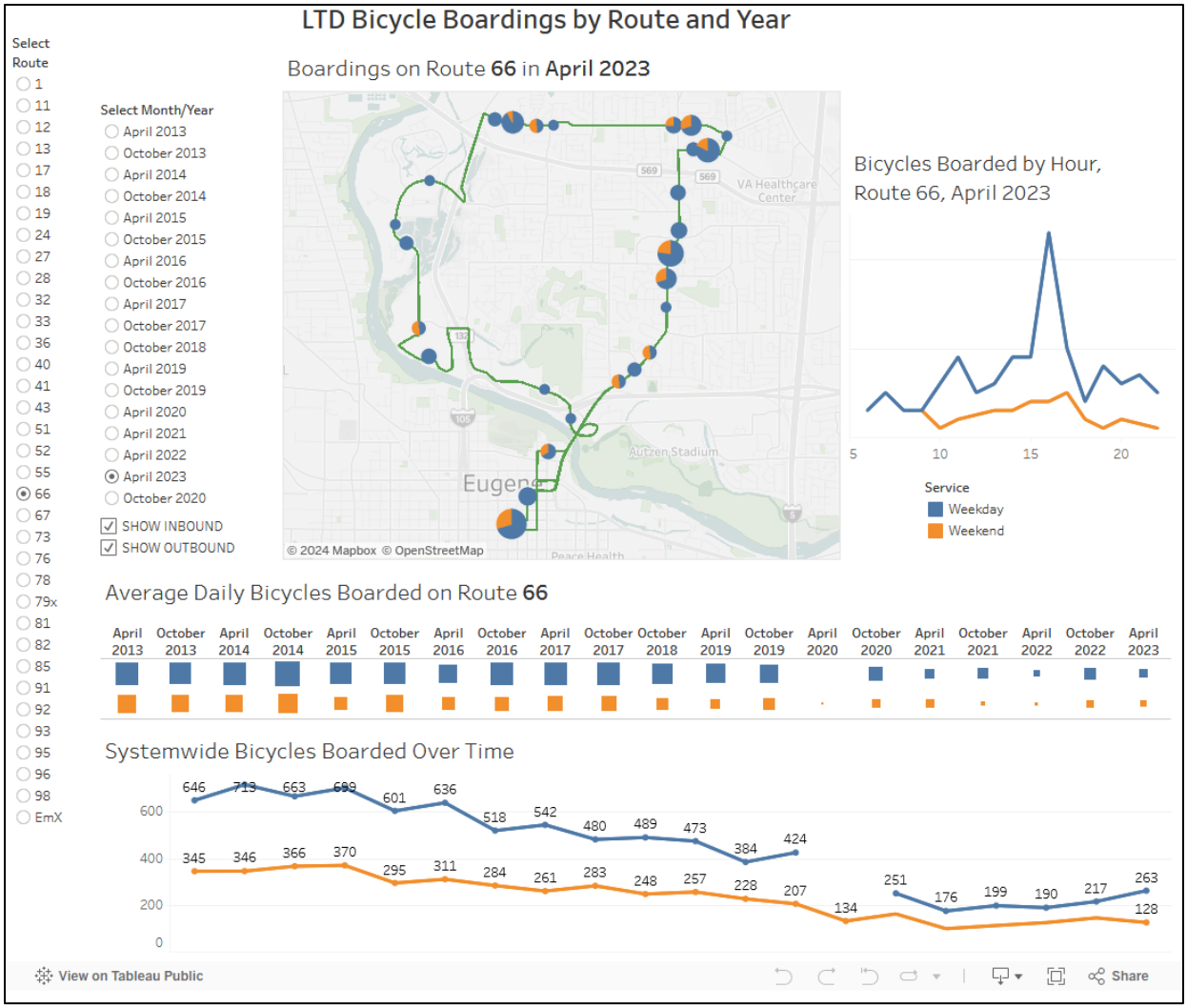

Figure 19: Lane Transit District bike on bus dashboard

5. Conclusions

Jurisdictions and transit agencies have been integrating transit with bicycling and micromobility for many years. This report has demonstrated some of the different ways this integration has been achieved, demonstrating benefits for both transit and micromobility. For example, transit has seen significant increases in access, expanding transit's reach and the efficiency of its services. This increased access also means more access to micromobility, increasing the use of both bikeshare and dockless micromobility.

Since NVTC last studied this topic in 2010 (*17*), the region has seen increases in these integrations. For example, all transit agencies now allow for bikes on buses, which was not the case in 2010, and the use of bikes and other micromobility to connect to Metrorail has seen a more than 150% increase between 2007 and 2022. There have also been significant changes to the micromobility landscape since 2010. CaBi bikeshare came into existence just months after the last report was finished with dockless micromobility appearing in the region a few years later. The success of these new micromobility options is partly due to their relationship with transit.

Although there are many findings in this report, there are four key conclusions from this study.

- **Transit and bicycling integration is an important regional goal**

This report demonstrates transit and bicycling integration is an important regional goal and has been for many years. There are bike storage facilities near transit stops in every jurisdiction, almost all jurisdictions have CaBi and dockless micromobility, all transit agencies allow for bikes on transit vehicles, and every jurisdiction has seen large increases in transit access because of the addition of bike facilities. Importantly, the region is committing to transit and micromobility connections into the future with $750 million in programmed projects to improve transit-bike integration (see **Appendix A**) from all six NVTC jurisdictions.

- **Bicycle infrastructure results in large increases in transit access**

Bike facilities within one mile of a transit stop give 10% more people access to bus services and 54% more people access to Metrorail services when compared to walking. These benefits are even greater when considering bike facilities within three miles with 162% more people having access to Metrorail and 111% more people having access to commuter rail.

- **Metrorail is associated with increases in both bikeshare and scooter use**

Capital Bikeshare and dockless micromobility (scooters and e-bikes) both have more trips and see more use in Virginia when they are near Metrorail stations. The association with Metrorail persists even when considering other factors like adjacent land use, demographics and job and population density.

- **Northern Virginia does a good job but there are still opportunities to learn from others**

Although this report demonstrates many of the ways transit and bicycling are integrated in Northern Virginia, the case studies in **Section 4** provide examples of other innovative ways transit agencies around the country are combining these two modes. These include explicitly integrating bike planning and facilities into capital planning, developing a bike-friendly culture within the organization, regional transit fare integration that includes bikeshare and better data collection and reporting processes. There are many opportunities to learn how others are trying to integrate transit and micromobility across the US.

5.1. Recommendations

The region has come a long way in integrating transit with bicycling and micromobility; however, there are still opportunities to continue advancing this goal. This section includes four recommendations that can help the region combine these two transportation modes.

- **Continue coordination with regional partners**

With a mix of cities, counties, and transit agencies in Northern Virginia, it is important to recognize that facilitating transit and bicycle connections is beyond the work of a single agency or jurisdiction. Consequently, coordination and regional partnerships continue to be an important regional strategy. Fairfax County, for example, has a policy that encourages coordination among neighboring jurisdictions to promote public transportation use and bicycle route connectivity (*31*). Arlington

County also recommends coordinating with Metro and private property owners to increase bicycle parking at Metrorail stations (*29*). Finally, the City of Fairfax also recommends coordinating with major employers and destinations to improve transit and cycling connections (*41*). As an example, the City of Fairfax coordinated with George Mason University to develop the *Mason to Metro Bicycle Route Project* (*48*), a study focusing on improving bicycle connections between the university and Vienna Metro station.

- **Increase connections between bicycling and commuter transit in suburban areas**

Transit, bicycling and micromobility integration is important across the region but there has so far been a focus on some of the more urban areas of the region. Consequently, there is an opportunity to improve transit and micromobility in suburban areas, including the following:

  - Micromobility like CaBi and scooter share at transit stations
  - Easier access for bicycles on commuter buses
  - More bicycle and other micromobility parking at transit stops
  - More bicycle facilities connecting to and between transit stops

As mentioned in **Section 2**, previous research has suggested these areas can be important for people who want to include bicycling as part of their transit trips (*8*, *10*). Arlington County has already highlighted the importance of integrating bicycling with commuter bus and rail services (*29*). Fairfax County has also emphasized bicycle infrastructure to improve access to the Silver Line (*31*). The County states these investments in bicycle infrastructure can increase station ridership while reducing the need for "costly automobile-oriented infrastructure" like parking garages and Kiss N' Ride lots. Finally, while VDOT requires bike parking at some of their denser Park & Ride locations, VDOT guidance still states bike parking is a preferred feature at low density lots, recommending at least 2-3 bike racks (*30*).

- **Package more transit and bicycle improvements together into larger funding requests and infrastructure projects**

Although more than $750 million is programmed for projects that connect transit and micromobility, more is needed to improve these multimodal connections (as the previous recommendation emphasizes). However, due to specific rules associated with different types of funding sources, as well as the relative size of some projects (e.g., bike racks), some of these projects may not be eligible or competitive for certain discretionary grant programs. Consequently, one way to help make these projects more competitive is to combine them together, increasing scope size and budget as well as overall project benefits. For example, while bike racks alone may be a small, uncompetitive improvement, including bike racks as part of a larger bus stop amenity improvement project may increase the chances of receiving funding.[40]

- **Provide clarity in infrastructure policies when transit and cycling intersect**

Section 3.4 highlighted that there are few policies that specifically target both transit and bicycling. The safety of bicyclists and transit riders is one area where there is a need for policy. However, **Section 3.4** also showed that few jurisdictions or transit agencies directly address these potential

[40] Bus stop amenities are eligible for multiple grant programs including the Virginia Department of Rail and Public Transportation (DRPT) Transit Ridership Incentive Program (TRIP) https://drpt.virginia.gov/our-grant-programs/trip/

transit-bicycling conflicts. Consequently, another recommendation is for jurisdictions and, where appropriate, transit agencies to take positions[41] on these transit-bicycle conflicts. Specifically, the following:

- Bicycle use in bus lanes
- Floating bus stops

These policy gaps will become increasingly important as more cross-jurisdictional bus routes are supported by bus rapid transit (BRT) and other bus priority infrastructure.[42] As an example, the proposed NVTC Envision Route 7 BRT project crosses through four jurisdictions. However, only two of these jurisdictions have local laws that address whether bicycles can use bus lanes, and these laws are approached in different ways.

- **Collect and share more data focusing on transit-bicycling integration**

Although this report has evaluated transit, bicycling and micromobility in Northern Virginia in many ways, there are data gaps that limit the analyses. Consequently, the final recommendation is to collect more data relating to transit-bicycling integration. Specifically, the following data needs to be better collected and shared across the region:

- Bicycle and other micromobility parking at transit stops
- The number of people bringing bicycles on transit vehicles (buses and trains)
- The number of people using bicycles and other micromobility to access transit services

These data are important for tracking changes over time, which could be useful for determining if transit-bicycling integration is improving. These data could also be useful for determining where there are gaps in existing transit-bicycling integration. Where is more bicycle parking is needed, for example. Finally, these data could help illuminate where people use transit with bicycling and other forms of micromobility. This information could be used to better understand why people do it in some places more than others, allowing data-driven policy and infrastructure decisions that can continue to improve transit-bicycling integration for the region.

[41] This report is not endorsing a specific policy solution; just emphasizing that a position should be taken. However, consistency between jurisdictions would be helpful for both transit riders and bicyclists.

[42] NVTC's *Northern Virginia Regional Bus Transit Analysis* (https://novatransit.org/uploads/studiesarchive/2024NVTC_RegBusTrtAnlys_FinalReport.pdf) and the NVTA *BRT Preliminary Deployment Plan* (https://thenovaauthority.org/brt/) are examples of regional efforts that are working towards this goal.

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Appendix A: Planned and Programmed Transit and Bicycling Projects

Table 6: Planned and Programmed Transit and Bicycling Projects

Project				Mode					Project Type		
Jurisdiction	Title	Project Cost ($M)	Est. Completion	Bus	Train	General Transit	Bicycle	Micromobility	Study	Connect to Transit	Bike Parking
Loudoun County	Loudoun County Metrorail Bicycle and Pedestrian Improvements	$32.70	2026		✓		✓			✓	
Loudoun County	Prentice Drive - Loudoun County Parkway to Shellhorn and Lockridge West	$163.07	2030		✓		✓			✓	
Loudoun County	Westwind Drive from Loudoun County Parkway to Old Ox Road	$122.20	2031		✓		✓			✓	
Fairfax County	Springfield Community Business Center Commuter Parking Garage	$63.81	2024	✓	✓		✓				✓
Fairfax County	Cinder Bed Road Bikeway	$14.75	2024		✓		✓			✓	
Fairfax County	Vienna Metro Station Bicycle and Pedestrian Improvements in Fairfax County	$10.50	2024	✓	✓		✓			✓	
Fairfax County	Wiehle Avenue at the W&OD Trail Pedestrian Improvement Project	$12.00	2024		✓		✓			✓	
Fairfax County	Herndon Metrorail Station Access Improvement Projects	*	*		✓		✓			✓	
Fairfax County	Innovation Station North Neighborhood Access	$6.60	*		✓		✓			✓	
Fairfax County	Reston Area Metrorail Station Access Improvement Projects	*	*		✓		✓			✓	
Fairfax County	Tysons Area Metrorail Station Access Improvement Projects	*	*		✓		✓			✓	
Fairfax County	I-66 Cross County Bikeway project	*	*	✓	✓					✓	
Arlington County	Route 1 Multimodal Improvements Study	$4.00	2024	✓	✓	✓	✓	✓	✓	✓	
Arlington County	Crystal City to Reagan National Airport Multimodal Connection	$57.20	2030		✓		✓	✓		✓	

Project				Mode					Project Type		
Jurisdiction	Title	Project Cost ($M)	Est. Completion	Bus	Train	General Transit	Bicycle	Micromobility	Study	Connect to Transit	Bike Parking
City of Falls Church	West Broad Street Multimodal Improvements	$5.72	2030	✓			✓			✓	
City of Falls Church	West Falls Church Multimodal Improvements	$15.70	2025	✓	✓		✓			✓	
City of Fairfax	Country Club Commons Connector Trail	$6.60	2029	✓	✓		✓			✓	
City of Fairfax	Blenheim Blvd (formerly Old Lee Hwy) Multimodal Improvements	$30.40	2026	✓			✓			✓	
City of Fairfax	Jermantown Road Corridor Improvements	$21.00	*	✓			✓			✓	
City of Alexandria	Bicycle Parking at Transit	*	*			✓	✓				✓
City of Alexandria	King-Callahan-Russell Intersection Improvement Project	*	2024		✓		✓			✓	
City of Alexandria	Duke Street In Motion	$87.00	2027	✓			✓			✓	
City of Alexandria	West End Transitway	$96.00	2027	✓			✓			✓	
	Total:	***$749.26***									

**Information not available*

Appendix B: Helpful Resources

Table 7: Helpful resources for transit and micromobility integration

Title	Author/ Organization	Year	About	Link(s)
Integrating Bike Share and Public Transport: Insights from the Netherlands	HUB Cycling	2025	A webinar on the Dutch approach to integrating bike share with public transportation	• https://www.youtube.com/watch?v=vci-TNDf6gs
Metrorail Station Pedshed and Bikeshed Atlas	Metro (WMATA)	2024	An analysis to help understand where there are barriers to bicycle access to transit and where there is potential for more bike-transit trips.	• https://www.wmata.com/initiatives/pedshed-and-bikeshed-atlas/upload/Metrorail_Pedshed_Bikeshed_Atlas_2-0.pdf
Bicycle and Transit Integration: A Practical Transit Agency Guide to Bicycle Integration and Equitable Mobility	American Public Transportation Association	2018	A national resource for understanding bike and transit connections with many case study examples.	• https://www.apta.com/wp-content/uploads/Bike_Transit_Integrartion_Booklet_APTA-SUDS-UD-RP-009-18.pdf • https://www.apta.com/wp-content/uploads/Standards_Documents/APTA-SUDS-UD-RP-009-18.pdf
Bike/Transit Integration	Victoria Transport Policy Institute	2018	Brief descriptions of ways bicycling and public transit travel can be combined.	• https://www.vtpi.org/tdm/tdm2.htm
Bike Plan	TriMet (Portland, OR)	2016	An example where a transit agency has developed its own bike plan.	• https://trimet.org/bikeplan/bikeplan-web.pdf
METRO Bike and Ride Access and Implementation Plan	Metro (Houston, TX)	2014	An example where a transit agency has evaluated how to improve transit and bicycling integration.	• https://www.h-gac.com/getmedia/de04079f-34d3-4826-970f-4eadad7f1dd7/METRO-bike-and-ride-plan.pdf
Integration of Bicycles and Transit	Transportation Research Board	2005	A synthesis of bicycle transit integration best practices.	• https://nap.nationalacademies.org/catalog/13554/integration-of-bicycles-and-transit

Appendix C: Methodologies

Capital Bikeshare Regression

1. Identify Virginian CaBi stations and make a ¼ mile buffer
2. Within ¼ mi buffer, use areal interpolation to determine population density, job density, median age, household income, male to female ratio, and shares of land use (source: 2022 ACS 5-year estimates (census tract level), MWCOG 2025 employment data, jurisdictional zoning data) as well as whether there is a Metrorail station nearby
3. Run regressions using May 2024[43] CaBi trip data as dependent variable (see **Appendix D**)

Bikes Facilities and Expanded Transit Access

1. Clip bike facilities (bike lanes, etc.) to within 1 and 3 miles of transit stops
2. Make bike buffer of 1/8 mi around bike facilities then dissolve into multiple polygons
3. Create walk-access buffers for each transit mode (bus, heavy rail (Metrorail), commuter rail)
    a. Select transit stops for specific mode
    b. Create buffer for mode: heavy rail ½ mi; bus, ¼ mile; commuter rail, 1 mile
4. Merge and dissolve transit buffer and the bike facilities buffer
5. Interpolate access based on this polygon using census tracts for Northern Virginia
6. Repeat steps 2-5 for 1-mile bike facilities clip and the 3-mile bike facilities clip
7. Compare walk access to transit with bike access to transit

Transit Stops and Bike Infrastructure

1. Spatial join transit stops to bike facilities within 1/8 mile

Dockless Micromobility Heat Map and Spatial Regression

Heat Map

1. Identify midpoint coordinate for each trip line
2. Create a fishnet polygon with 200 m (1/8 mi) cells
3. Sum trip count midpoints within each cell

Regression

1. Identify land use type at each scooter midpoint (or nearest land use)
2. Join block group census data (2022 ACS 5-year estimates) to each midpoint for population density, household income, male to female ratio, median age, and job density (from MWCOG employment data)
3. Identify midpoints within ¼ mile of a Metrorail station
4. Run regressions with micromobility usage as dependent variable (see **Appendix D**)

[43] May represents a typical month for Capital Bikeshare, just preceding the system's annual summer bump.

Appendix D: Regression Results

Table 8: CaBi Trips Regressions

	Dependent variable:		
	Monthly CaBi trips per station		
	(1)	(2)	(3)
Near Metrorail (within 0.25 miles)	55.140**	54.432**	92.137***
	(22.345)	(21.066)	(25.071)
Job Density (log)	16.411*	2.731	-
	(9.234)	(9.116)	
Population Density (log)	19.160	-	-
	(16.086)		
CaBi Members (%)	110.294**	83.306*	-
	(46.707)	(44.430)	
Commercial Land Use (%)	-149.847***	-75.185	-
	(54.637)	(52.216)	
Residential Land Use (%)	36.904	-17.911	-
	(42.916)	(41.072)	
Mixed Land Use (%)	312.802***	243.274***	-
	(69.809)	(66.097)	
Male-to-Female Ratio	1.004*	0.796	-
	(0.563)	(0.532)	
Median Age	0.127	-2.239	-
	(1.482)	(1.472)	
Median Household Income (log)	-	68.627***	-
		(14.638)	
Constant	-376.780**	-774.472***	93.892***
	(164.651)	(157.083)	(11.114)
Observations	173	173	173
R^2	0.474	0.533	0.073
Adjusted R^2	0.445	0.507	0.068
Residual Std. Error	101.098 (df = 163)	95.314 (df = 163)	131.037 (df = 171)
F Statistic	16.329*** (df = 9; 163)	20.637*** (df = 9; 163)	13.506*** (df = 1; 171)
Note:		*p<0.1; **p<0.05; ***p<0.01	

Median household income was strongly correlated with population density so they couldn't be included in a model together. Variance Inflation Factors (VIFs) were <4 for all models.

Table 9: Dockless Micromobility Regressions

	Dependent variable:		
	Dockless micromobility usage by roadway segment (2019-2024 data)		
	Arlington County	City of Alexandria	
	Negative Binomial	*Negative Binomial*	*Spatial Lag*
Near Metrorail (within 0.25 miles)	0.67***	0.24***	842.894***
	-0.08	-0.03	-186.875
Job Density (log)	0.23***	0.05***	227.626***
	-0.02	-0.01	-34.98
Population Density (log)	0.50***	0.04*	145.528
	-0.04	-0.02	-108.714
Commercial Land Use	0.12	0.28***	1,138.939***
	-0.09	-0.02	-155.615
Residential Land Use	-0.39***	0.05*	70.244
	-0.07	-0.02	-163.593
Mixed Land Use	0.38***	0.19***	843.071***
	-0.1	-0.04	-269.085
Male-to-Female Ratio (log)	-0.1	-0.04	-297.995
	-0.09	-0.03	-230.51
Median Age	-0.03***	0.01***	20.774**
	0	0	-8.308
Median Household Income (log)	0.1	0.12***	530.161***
	-0.06	-0.03	-178.336
Constant	0.32	6.24***	-5,360.098**
	-1.06	-0.38	-2,603.27
Observations	18,496	6,071	6,071
Log Likelihood	-97,515.06	-57,489.66	-60,022.51
Deviance	17,167.03	6,651.9	
$sigma^2$			21,980,495.00
Akaike Inf. Crit.	195,052.13	115,001.33	120,069.00
Wald Test			546.808*** (df = 1)
LR Test			489.578*** (df = 1)
Note:		*p<0.1; **p<0.05; ***p<0.01	

The available dockless micromobility data provided for trips that passed through different road segments in Arlington County and the City of Alexandria. Not all road segments had trips pass through them. This meant the dependent variable could be considered a form of overdispersed count data. Consequently, negative binomial regression was used. As dockless micromobility riders can move through multiple connected segments through a single trip, spatial autocorrelation was also considered. Moran's I was used to check for spatial autocorrelation. Arlington's scooter data had a Moran's I of 0.17 while Alexandria had a Moran's I of 0.38 (both had p-values of 0.001). The differences in spatial autocorrelation are not surprising given the spatial differences demonstrated in Figure 7. The presence of moderate spatial autocorrelation in the City of Alexandria suggests spatial relationships may affect the results. Consequently, spatial lag regression modeling was also used for dockless mobility usage in the City of Alexandria.