2

System Performance and Operations Analysis

2. System Performance and Operations Analysis

2.1 System and Service Data

Connector undergoes service changes multiple times a year so the number of routes can also change over time. For the purpose of the Transit Strategic Plan (TSP), the latest fiscal year (FY) data available at the time of analysis, or FY 2022, was considered as a baseline. All system and service data presented in this section is therefore reflective of FY 2022. The performance and operating and network efficiency evaluation in **Sections 2.3 and 2.4**, however, utilized calendar year (CY) 2019 data to account for seasonal fluctuations in transit use throughout the year and avoid the service and performance anomalies of years impacted by COVID-19.

With a service area of 407 square-miles, Fairfax Connector (Connector) provides fixed-route bus service to the majority of Fairfax County with an estimated population of 1,164,025 as of 2022[16] and population density of approximately 2,860 people per square mile. Fairfax County includes the three incorporated towns of Clifton, Herndon, and Vienna, as well as several notable census-designated places such as Huntington, Franconia, Reston, Springfield, and Tysons. Connector also operates service through the independent cities of Fairfax and Falls Church as well as neighboring jurisdictions such as Arlington County, the City of Alexandria, and the District of Columbia. A detailed analysis of current and future regional population density is included in **Section 2.2.1**.

During FY 2022, Connector's fixed-route bus service consisted of 100 routes. Since then, service adjustments have occurred, particularly in the Reston and Herndon area, and Fairfax Connector operated 94 fixed bus routes as of April 2023. Connector does not operate paratransit, but additional services are provided in the area by Fairfax County Neighborhood and Community Services (Fastran), Washington Metropolitan Area Transit Authority (WMATA), Virginia Railway Express (VRE), and Fairfax City-University Energysaver (CUE), as discussed in **Chapter 1**.

Connector had a total of 341 revenue vehicles compared to 284 vehicles operated in annual maximum service in FY 2022, as shown in **Table 2-1**.

TABLE 2-1: REVENUE FLEET AND PEAK VEHICLE NEED

Mode	Fleet Size	Peak Vehicle Need
Bus	341	284

Source: FY 2022 National Transit Database Report

2.1.1 Fixed-Route Bus Service

The following section summarizes information on Connector's fixed-route services, including level of service, operating costs, ridership, revenue hours, total hours, revenue miles, and directional route mileage from FY 2022. This is contrasted with the same information after the

[16] FY 2022 National Transit Database Report

Silver Line extension opened and the new Reston and Herndon area bus service began operating on November 16, 2022.

Connector operates fixed-route service seven days a week. In FY 2022, weekday service ran from 3:20 a.m. to 2:29 a.m. with morning and afternoon peak period headways as low as 10 minutes. The most common headway during the peak periods was 30 minutes, though the average headway was lower than that. The most common headway during the midday was 40 minutes. Weekend service was more limited but still operated between 4:25 a.m. and 3:26 a.m. (2:16 a.m. on Sundays). Weekend headways ranged from 20 minutes to 75 minutes. More details on route-level service are provided in **Section 2.4.1**.

Connector defines time periods when designing headways and span of service as follows:

- **AM Early:** 4:00-5:59 a.m.
- **AM Peak:** 6:00-8:59 a.m.
- **Midday:** 9:00 a.m.-2:59 p.m.
- **PM Peak:** 3:00-5:59 p.m.
- **Evening:** 6:00-8:59 p.m.
- **Late Night:** 9:00-11:59 p.m.
- **Other:** 12:00-3:59 a.m.

OPERATING STATISTICS

Fairfax Connector currently conducts all bus operations and maintenance activities from its three operating facilities, including repairing, cleaning, fueling, storing, and staging buses. All three facilities are open 24 hours a day. While one facility is open five days per week, the other two facilities are open seven days a week.

In FY 2022, Fairfax Connector reported operating just over 10.8 million revenue miles and nearly 841,000 revenue hours[17]. **Table 2-2** summarizes daily operational statistics for the October 2022 service schedule, which operated before the Silver Line extension opened and Reston and Herndon area bus route changes were made in November 2022. This information is also summarized in **Table 2-3** for service as of April 2023.

[17] *FY 2022 National Transit Database Report*

TABLE 2-2: OPERATING STATISTICS BY SUBAREA (FY 2022 – PRE-SILVER LINE EXTENSION)

Subarea	Weekday			Total Trips Per Day			Directional Route Mileage
	Total Hours	Revenue Hours[1]	Revenue Miles	Weekday	Saturday	Sunday	
Franconia-Springfield	969	874	11,537	911	297	210	562
Reston-Herndon	855	803	9,767	1,188	631	574	471
Chantilly-Centreville-Vienna-Tysons	787	689	9,869	1,113	393	269	797
Huntington	458	421	5,010	447	281	253	154
Strategic Vehicles	30	25	N/A	N/A	N/A	N/A	N/A
Total	**3,099**	**2,812**	**36,183**	**3,659**	**1,602**	**1,306**	**1,984**

[1]Defined by Fairfax County as the total revenue hours that it pays its contractor for service

Sources: Service Schedule for October 2022. Fairfax County DOT and Kimley-Horn, 2023.

TABLE 2-3: OPERATING STATISTICS BY SUBAREA (FY 2023 – POST-SILVER LINE EXTENSION)

Subarea	Weekday			Total Trips Per Day			Directional Route Mileage
	Total Hours	Revenue Hours[1]	Revenue Miles	Weekday	Saturday	Sunday	
Franconia-Springfield	969	875	11,588	911	297	210	566
Reston-Herndon	848	793	10,018	1,039	651	598	429
Chantilly-Centreville-Vienna-Tysons	858	754	11,426	1,199	393	269	808
Huntington	458	421	5,010	447	281	253	154
Strategic Vehicles	30	25	N/A	N/A	N/A	N/A	N/A
Total	**3,163**	**2,868**	**38,042**	**3,596**	**1,622**	**1,330**	**1,957**

[1]Defined by Fairfax County as the total revenue hours that it pays its contractor for service

Sources: Service Schedule for April 2023. Fairfax County DOT and Kimley-Horn, 2023.

Routes in the Franconia-Springfield area operated the greatest number of weekday total hours and revenue hours of the four subareas. While the longest one-way trip was Route 599 at 23.5 miles, the Chantilly-Centreville-Vienna-Tysons area had the longest overall average one-way trip length due to more long-distance express routes than the other subareas. Further route-level operational analysis is discussed in **Section 2.3.1**. In addition, annual data from historical and FY 2022 National Transit Database (NTD) reports is presented in **Section 2.3.2**.

OPERATING COSTS

An analysis of operating expenses and revenues can help evaluate the cost efficiency of Fairfax Connector operations. **In FY 2022, total operating expenses were approximately $106.2 million, with farebox revenue generating approximately $6.3 million, covering approximately 5.9 percent of the operational costs[18].**

ANNUAL RIDERSHIP

Fairfax Connector served an estimated 7.2 million trips in FY 2022[18]. Ridership in both FY 2018 and FY 2019 leading up to COVID-19 was approximately 8.3 million. Ridership by route is discussed in **Section 2.3.1**.

2.1.2 Route Design and Schedule Standards

Fairfax Connector uses service standards and guidelines as well as performance standards to provide an objective framework for designing and modifying service. The different standards and guidelines plus systemwide and route-level performance monitoring methodologies used by Fairfax Connector are discussed in **Sections 1.2.2** and **1.2.3**. Together, these result in the key performance benchmarks that are used to evaluate routes, as presented in **Table 1-8**. Performance evaluation according to these standards is included in **Section 2.3**.

2.1.3 Survey Results

During the past few years, Fairfax County conducted major survey efforts to understand the current and future community needs related to the Connector system. Two major surveys recently completed were the market survey and the on-board survey. Additional surveys and outreach efforts were conducted via the Bus Service Review studies for various subareas in the County. The 2021 TSP public survey gathered high-level feedback regarding Fairfax Connector services. Findings from the 2021 TSP survey helped validate the vision, goals, and objectives of the TSP. The following section provides an overview of the results and outcomes of each survey effort. Additional details of public outreach conducted to inform the TSP are included in **Appendix F**.

Market Survey and On-Board Survey

The market survey focused on gathering feedback from riders and non-riders regarding Connector service. This survey was conducted in the Fall of 2018 and resulted in 2,624 responses. The results from this survey were used to determine how to attract non-riders and reconnect with lapsed riders.

[18] *FY 2022 National Transit Database Report*

Results from the market survey identified the following quantitative results:

- 1 percent of the County residents see Connector as their primary mode of transportation
- 50 percent of respondents identified Connector as a means of connecting to other public transportation rather than as the sole mode of getting to a final destination
- 68 percent of current users view Connector as a smart way to commute, 53 percent believe it is at a good price, 52 percent view it as a clean mode, and 47 percent view it as reliable

The on-board survey focused on gathering more detailed information on rider use of the system. The County performed an on-board survey from March to May 2019 to understand the demographic of bus riders, determine the origin/destination of the rides, and gather information on service preferences. There were 3,672 respondents to this survey.

Results from the on-board survey identified the following quantitative results:

- 88 percent of the trips occur during the weekday
- 76 percent of riders live in the County
- 71 percent of the trips on a weekday are considered home-based work trips (home to/from work)
- 88 percent of riders walk to transit
- 49 percent of riders use only one Connector route to get to final destination, 36 percent transfer once, and 12 percent transfer twice
- 67 percent of riders identified as minorities (i.e., Black/African American, Hispanic or Latino, Asian, or other)
- 66 percent of riders make a household income of $60,000 or less and are considered low-income
- 59 percent of riders did not have access to a vehicle to make a trip on the day they were surveyed

Overall, the following findings were determined from these two surveys:

- There is a need to realign routes with travel patterns and key community locations
- There is a need to adjust routes to be more direct and reduce unneeded travel patterns
- There is a need to increase service hours on key routes to improve access and mobility
- There is a need to provide additional buses to key routes to increase frequency

Bus Service Review Studies

Additional recurring efforts are the Bus Service Review studies focusing on the Franconia-Springfield, Reston-Herndon, Centreville-Chantilly-Vienna-Tyson (CCVT), and Huntington subareas. Public surveys are an important element of these studies and are used to gather input on specific routes in the subarea to arrive at a preferred overall service plan. Surveys were conducted from 2018 through 2023 for these studies.

2021 TSP Survey

The 2021 TSP survey gathered feedback from January 1, 2021 to February 19, 2021. There was a total of 2,901 respondents. The survey was available online and allowed community members to ask further questions or provide comments via phone call, email, and mail. The survey was tailored to frequent, non-frequent, and non-riders in Fairfax County. It consisted of three major sections: travel patterns, opportunities for improvements, and optional demographic information. While the market and on-board surveys utilized statistical sampling, the TSP survey did not and was intended to solicit opinions and preferences from participants.

The travel patterns section of the survey identified how often the respondent currently uses Connector, will use Connector in the future, their origin/destination zip codes, and reasons why they may not ride Connector. Overall, the results showed:

- Roughly equal number of frequent, occasional, and non-riders responded to the survey
- Respondents expect to ride Fairfax Connector more in the future
- The top reasons occasional and non-rider respondents do not use Fairfax Connector were (1) the bus does not come frequently enough, (2) preference of other travel modes, (3) the bus does not travel when they want, and (4) service is not available where they start or end their trips
- The majority of frequent rider respondents (75 percent) were satisfied or very satisfied with Connector service

The opportunities for improvement section helped identify features of Connector service that would make Connector a more appealing travel option. Ideally, all forms of transit service would be available to everyone. However, the reality is that there are constraints with budget, operations, capacity, etc. Tradeoff questions were used to understand what the community would prioritize or prefer if a decision had to be made about providing certain transit services. Overall, the results showed:

- A slight preference for frequency over coverage especially among frequent riders (see **Figure 2-1)**
- A slight preference for walking over waiting especially among frequent riders (see **Figure 2-2**)
- A preference for all-day service over peak-only service especially for occasional riders (see **Figure 2-3**)
- A willingness to transfer buses if a shorter overall trip time can be achieved (see **Figure 2-4**)
- A moderate preference for local service over inter-jurisdictional service (see **Figure 2-5**)

FIGURE 2-1: PREFERENCE OF FREQUENCY OR COVERAGE

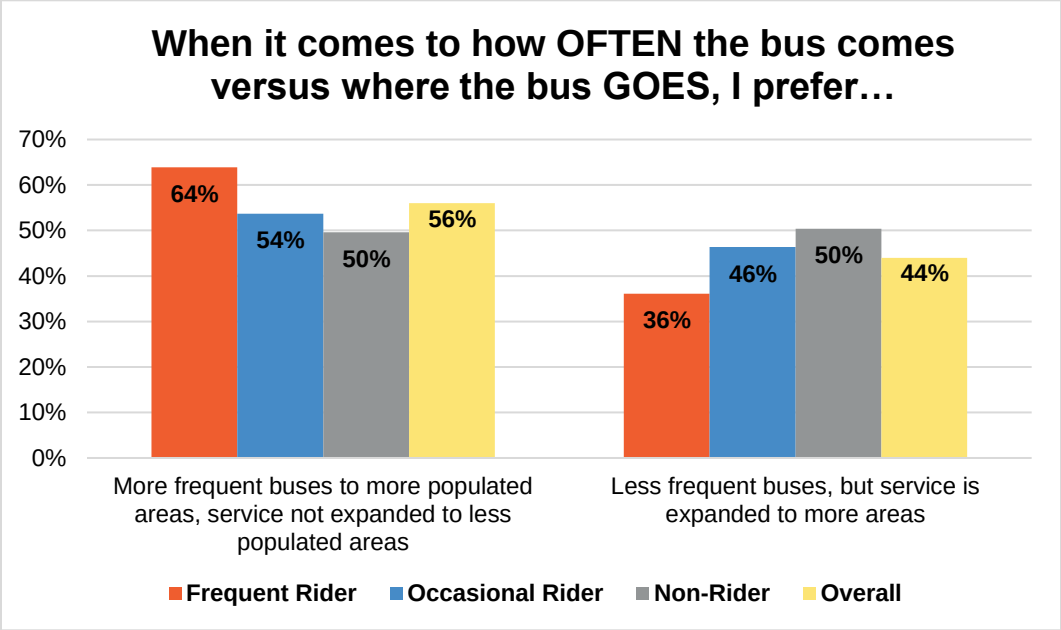


FIGURE 2-2: PREFERENCE OF WALKING TO THE BUS STOP OR WAITING FOR THE BUS

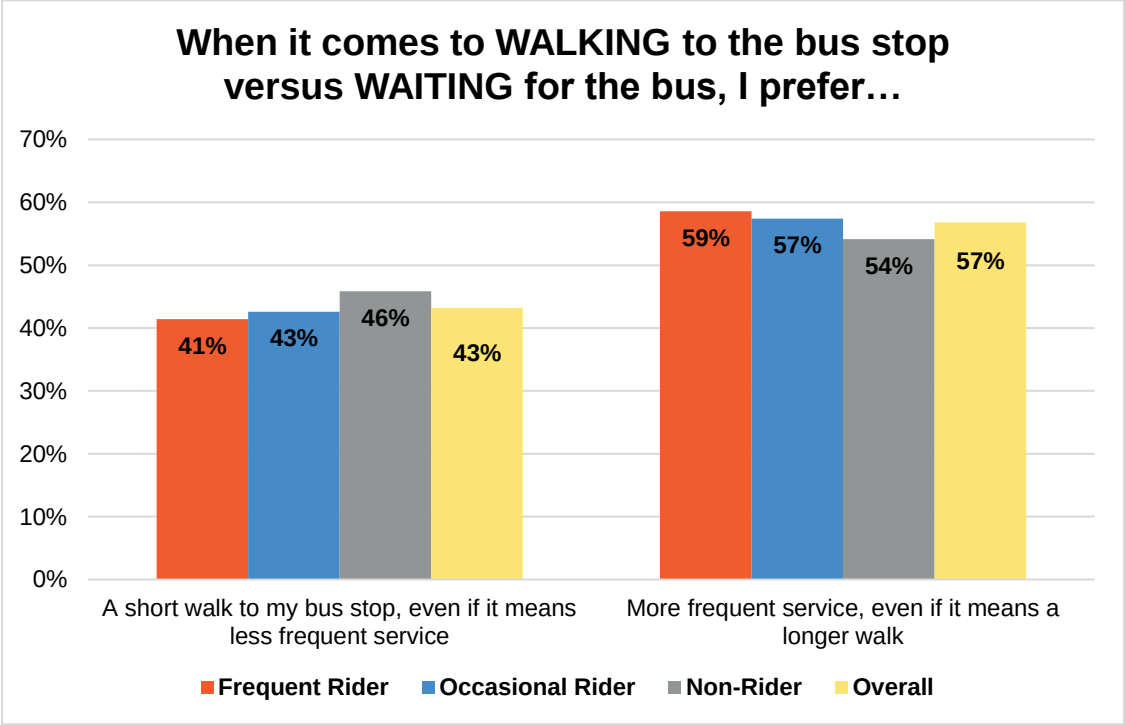


FIGURE 2-3: PREFERENCE OF PEAK OR ALL-DAY SERVICE

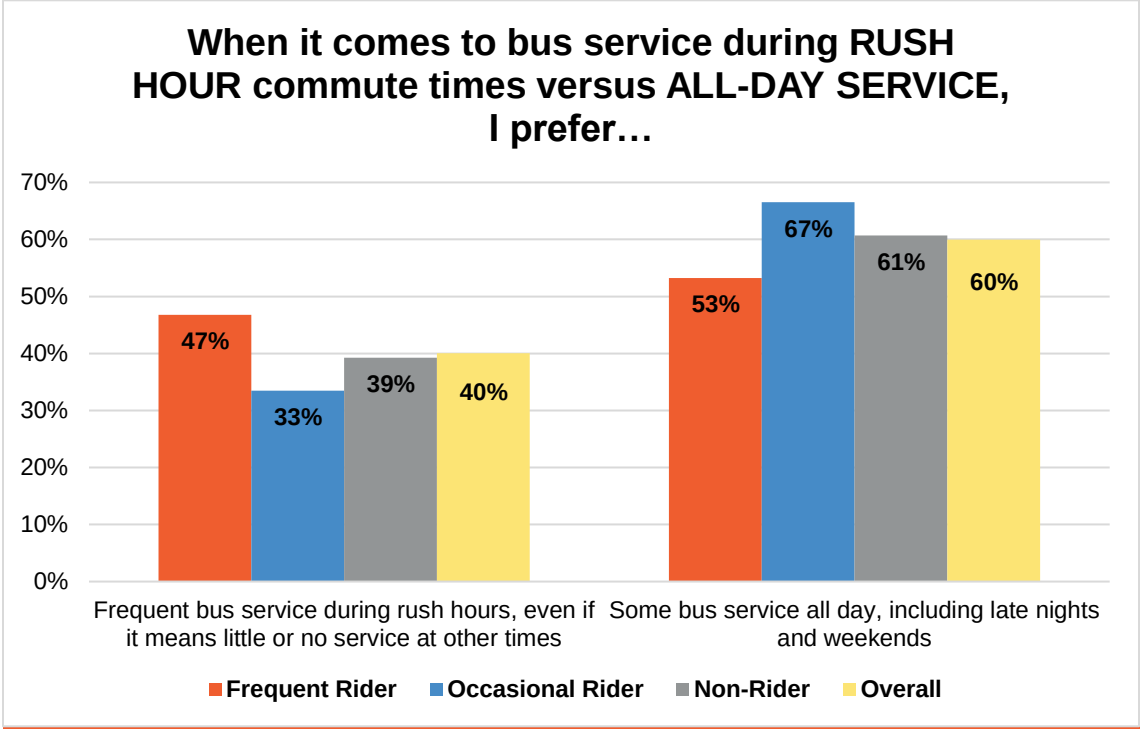


FIGURE 2-4: PREFERENCE OF TRANSFERRING BUSES OR A DIRECT RIDE

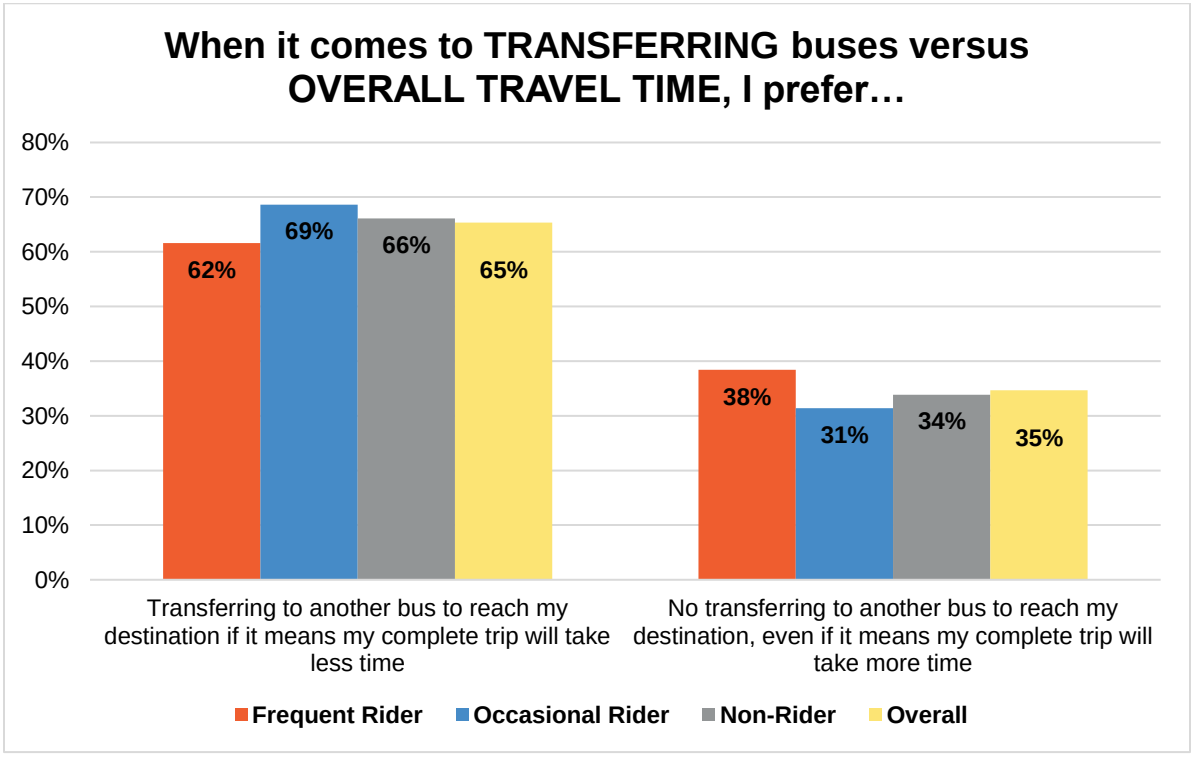
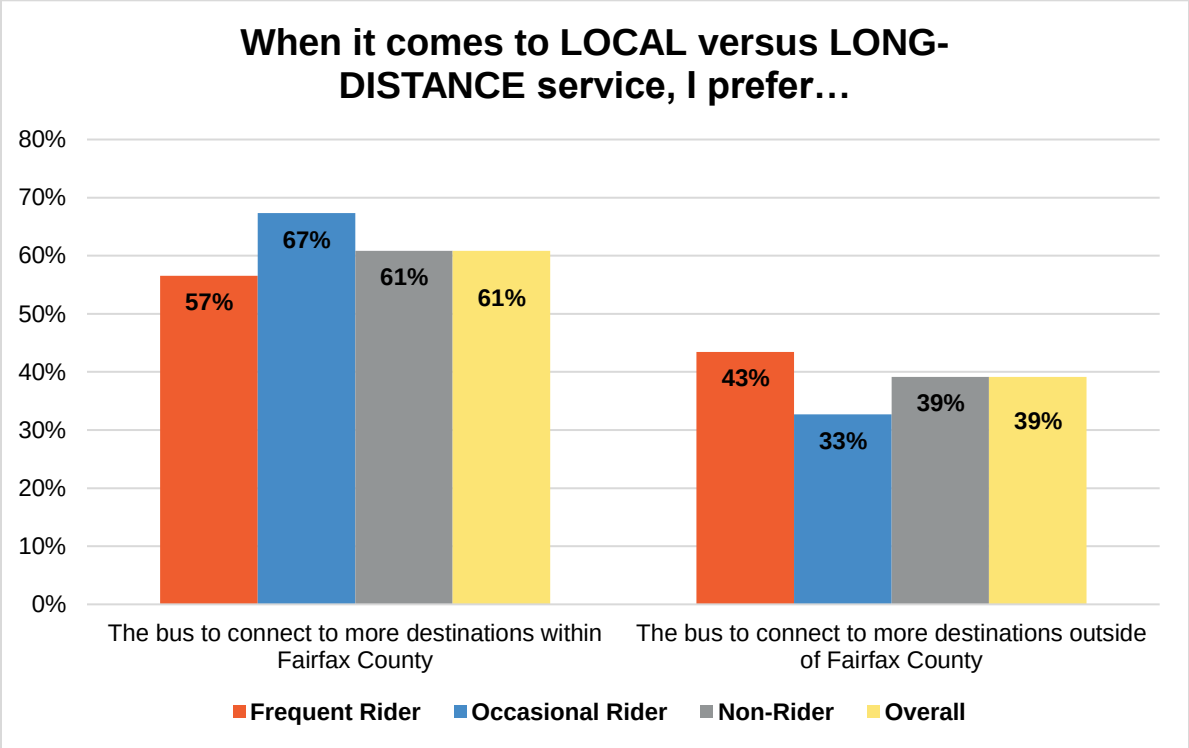


FIGURE 2-5: PREFERENCE OF LOCAL SERVICE OR INTER-JURISDICTIONAL SERVICE



2.1.4 Support for Transit

Within the region, there is strong support for transit overall and specifically for Fairfax Connector service. Localities within and surrounding the Fairfax Connector service area have transit-supportive land use policies or strategies in their comprehensive plans, reflecting a regional desire to link land use and transportation.

Current efforts to improve and transform transit service, including bus service, within the region are also reflected in several of the Fairfax Connector initiatives and regional initiatives mentioned in **Table 1-2** and **Table 1-3**. For example, the Autonomous Electric Shuttle Pilot Project was in partnership with Dominion Energy and other local and state entities and shows support for improving transit connections in the Fairfax Connector service area through innovative approaches. Furthermore, partnerships with other transit agencies in the area such as WMATA demonstrate regional support for comprehensive and well-connected transit service.

Fairfax Connector also has ongoing initiatives to gauge support for transit from key stakeholders and the public. As discussed in **Section 2.1.3**, Fairfax Connector has conducted major surveys, studies, and public outreach efforts over the past several years. Connector routinely engages with business and community stakeholder groups, as was done during the development of this TSP. The results of these efforts have helped shape Fairfax Connector's actions, including service changes. As part of this TSP, the involvement of over 3,000 individuals, companies and organizations during community engagement showed support for transit within the community.

2.2 Evaluation of Transit Market Demand and Underserved Areas

2.2.1 Transit Demand and Underserved Area Evaluation

The following market analysis maps the current and projected population and employment density of Fairfax County to determine demand for different types of transit services throughout Fairfax County. The market analysis includes:

- Population/Employment Trends
- Transit-Oriented Population Origins Propensity Index
- Commuter Origins Propensity Index
- Workplace Destinations Propensity Index
- Activity Destinations Propensity Index

This analysis was conducted for the TSP prior to the opening of the Silver Line extension and the associated Fairfax Connector service changes in the Reston and Herndon area that began on November 16, 2022.

TRANSIT DEMAND

This section provides an overview of how population and employment densities in Fairfax County will likely change over time. These metrics are not only a good indicator of where transit makes the most sense now, but also where a transit system could successfully grow in the future. Current land use designations (**Figure 2-6**) correlate with existing population and employment densities. Designated employment centers such as Tysons, Merrifield, and Reston-Herndon are where higher levels of employment density exist. The majority of the county is designated as low to medium-density residential, and this is reflected in the population densities being less than 15 people per acre within these areas.

2020 Population Density

Public transportation is most efficient when it connects population and employment centers where people can easily walk to and from bus stops. Transit accessibility is generally limited to within one-quarter mile to one-half mile of a bus stop, or a 10-minute walk. For this reason, the size of a transit travel market is directly related to an area's total population and population density. According to the Transit Cooperative Research Program (TCRP) *Transit Capacity and Quality of Service Manual, 2nd Edition*, densities of three households per acre (approximately six people per acre) or four jobs per acre can support hourly fixed-route transit service.

Figure 2-7 shows the population density at the Traffic Analysis Zone (TAZ) level of geography based on Metropolitan Washington Council of Governments (MWCOG) Cooperative Forecast Round 9.1 population and employment growth projections for the Washington, DC region.[19] Yellow areas indicate places where fixed-route service could be feasible; areas with darker colors have the potential to support more frequent service. Many areas with moderate density exist throughout Fairfax County. Pockets of higher density can be found in Tysons, Merrifield, and Belle Haven as well as along the county's border with Alexandria and Arlington, throughout

[19] *This data was prepared prior to COVID-19.*

the I-495 and I-66 corridors, and along Richmond Highway (US Route 1) between Belle Haven and Mount Vernon.

Regional rail service does not serve all high-density areas. Areas not served by regional rail include the east side of I-495 around Annandale, I-66 from Fair Oaks to Centreville, and along Richmond Highway.

2030 Population Density Growth

Figure 2-8 shows 2030 projected population density in Fairfax County. Areas projected to experience a 20 percent increase or decrease in population density from 2020 to 2030 are highlighted in red and blue, respectively. Over the next decade, the county's population is expected to grow by around 9 percent according to MWCOG's 2020 and 2030 population projections. No areas indicated significant population loss. Major population growth is projected in the Reston-Herndon area, along Route 28 in Chantilly, Tysons, Falls Church, Fair Oaks, Springfield, and along Richmond Highway from North Gateway to Beacon/Groveton, at Fort Belvoir, and in Lorton.

2020 Employment Density

The location and number of jobs in a region are strong indicators of transit demand, as traveling to and from work accounts for the largest single segment of transit trips in most markets. Transit that serves areas of high employment density also provides key connections to job opportunities. As mentioned earlier, the *Transit Capacity and Quality of Service Manual* suggests that an employment density of four jobs per acre or more can typically support base-level fixed-route service.

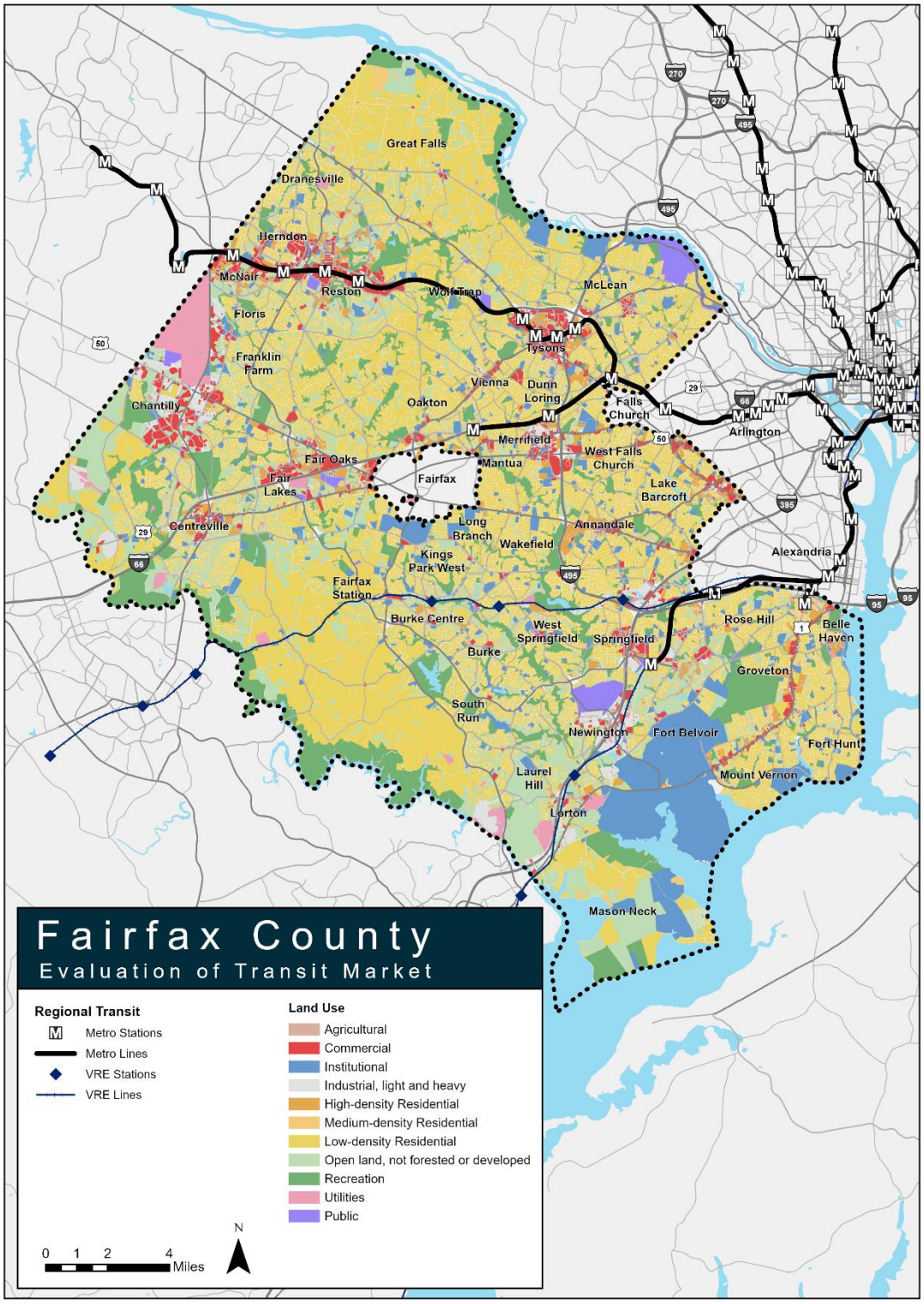
Figure 2-9 shows employment density at the TAZ level of geography based on MWCOG Cooperative Forecast Round 9.1 population and employment growth projections for the Washington, DC region. The county has three main employment centers: Reston-Herndon (along the Dulles Toll Road and within the Reston Town Center), Tysons (south of the Dulles Toll Road), and Merrifield along I-495. The Silver Line has improved transit access to employment centers along the Dulles Toll Road and transit connections between Reston-Herndon and Tysons, the county's largest employment centers.

2030 Employment Density Growth

Figure 2-10 shows 2030 projected employment density in Fairfax County. Areas projected to experience a 20 percent increase or decrease in population density from 2020 to 2030 are highlighted in red and blue, respectively. Over the next decade, the county's employment is expected to grow by approximately 12 percent according to MWCOG's 2020 and 2030 projections.

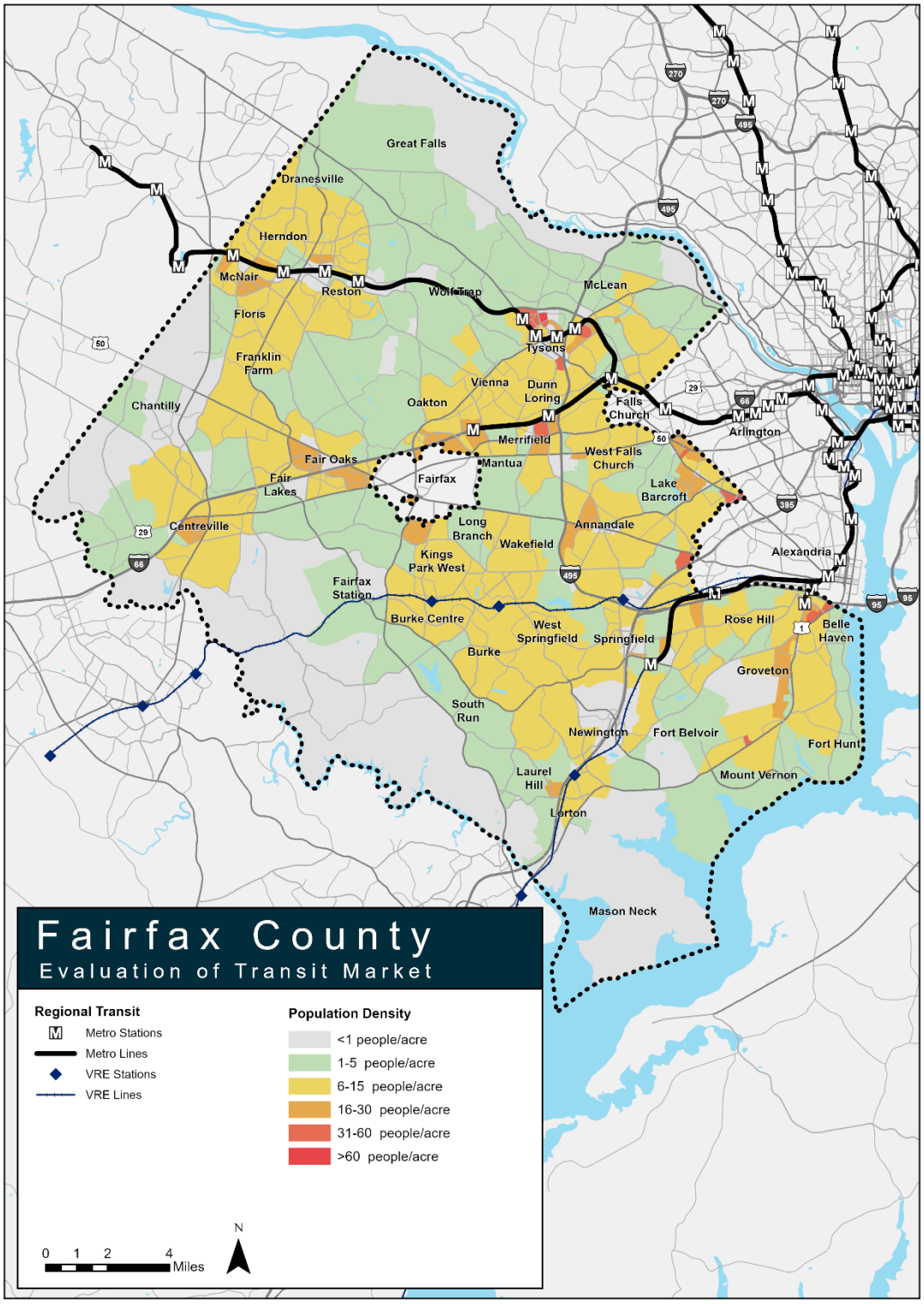
The only area of the county projected to lose a notable percentage of employment is a portion of Tysons, south of Maple Avenue, which is mostly residential. However, Tysons as a whole is projected to grow in employment. In addition to Tysons, major employment growth is projected in Reston-Herndon along the Dulles Toll Road. The employment growth projected in Chantilly, Merrifield, Springfield, and Newington will turn these areas into key employment centers.

FIGURE 2-6: CURRENT LAND USE IN FAIRFAX COUNTY



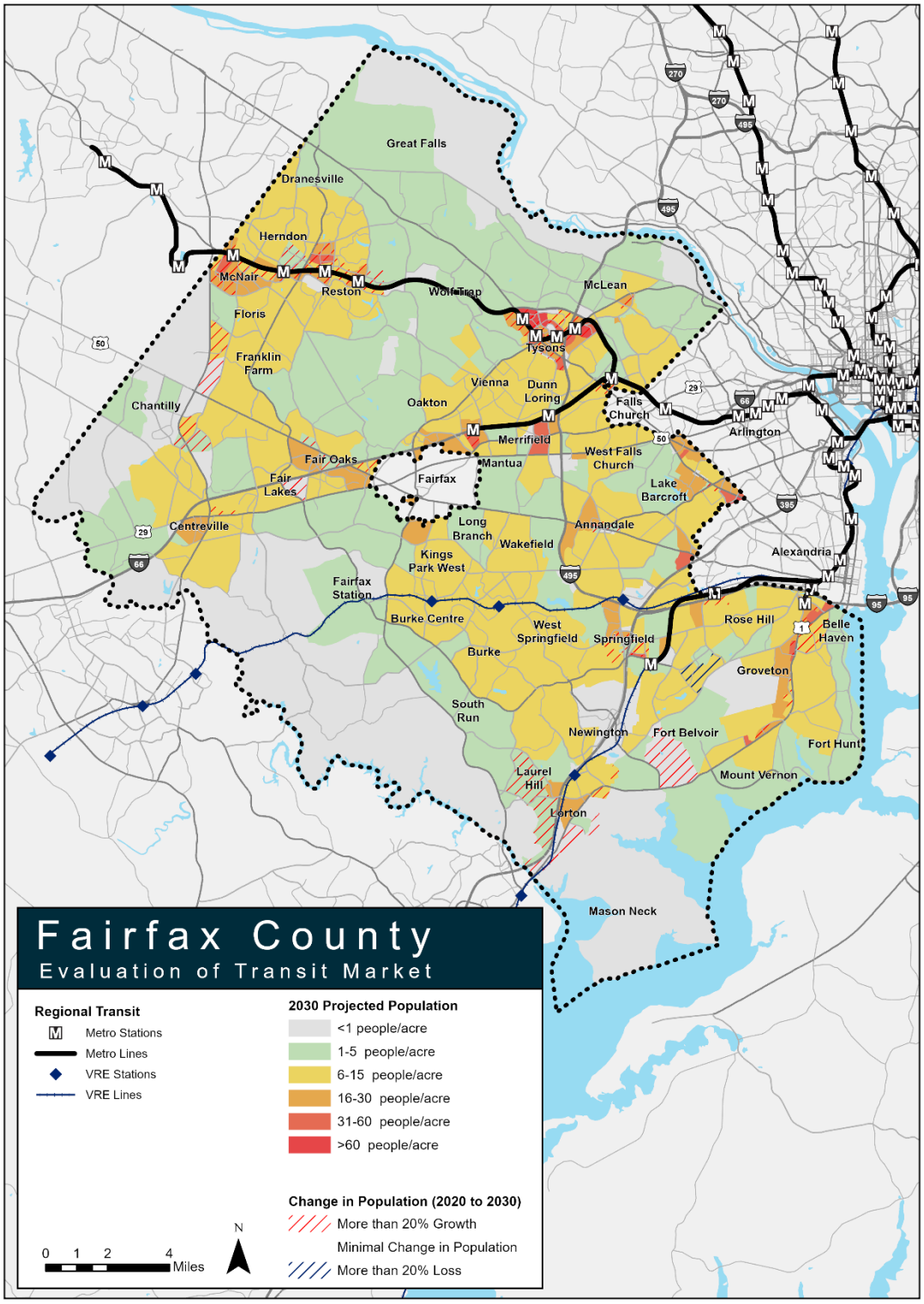
Source: Fairfax County. February 2021.

FIGURE 2-7: 2020 POPULATION DENSITY



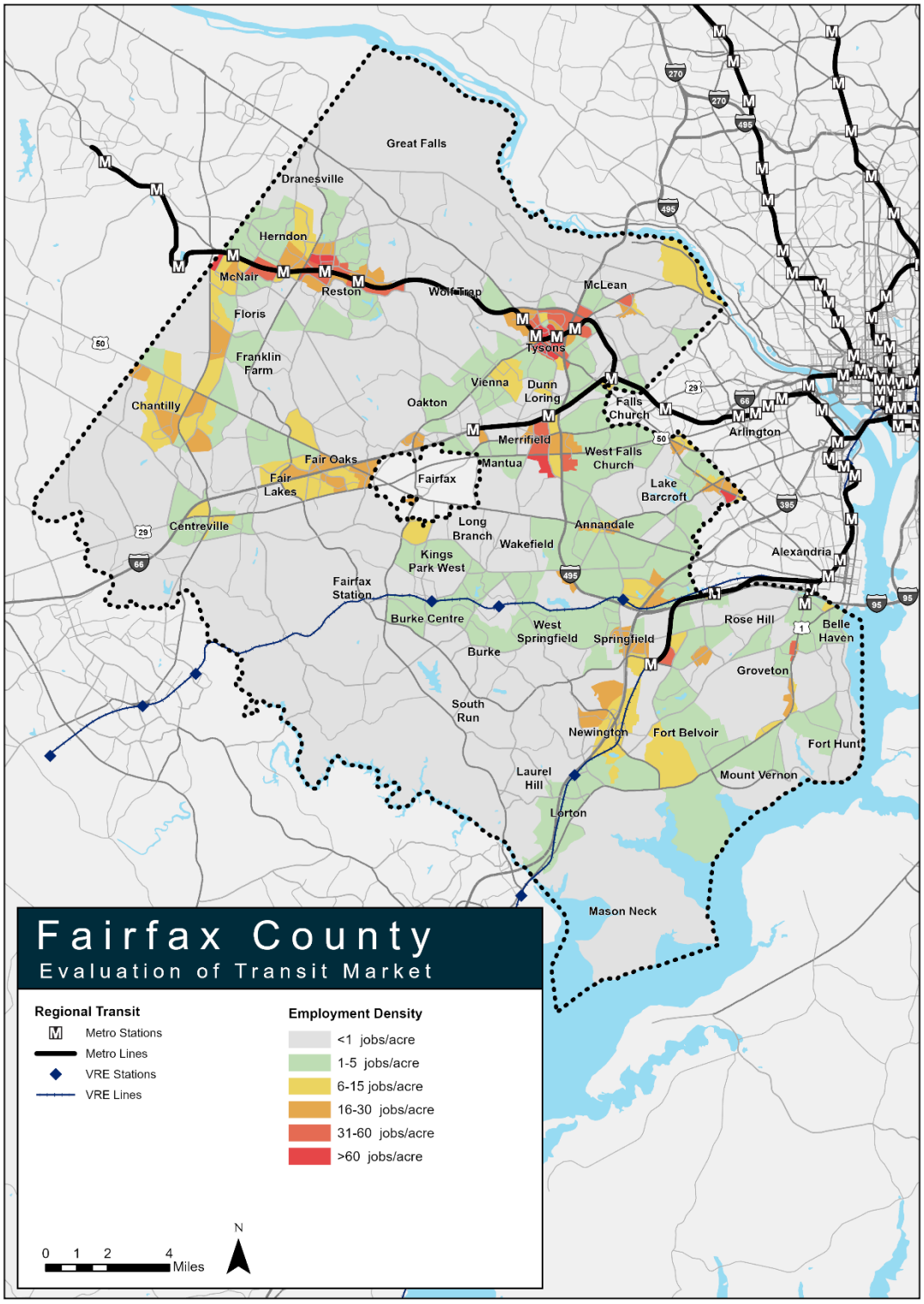
Source: Metropolitan Washington Council of Governments Round 9.1 Cooperative Forecasting. 2020.

FIGURE 2-8: 2030 POPULATION DENSITY PROJECTION



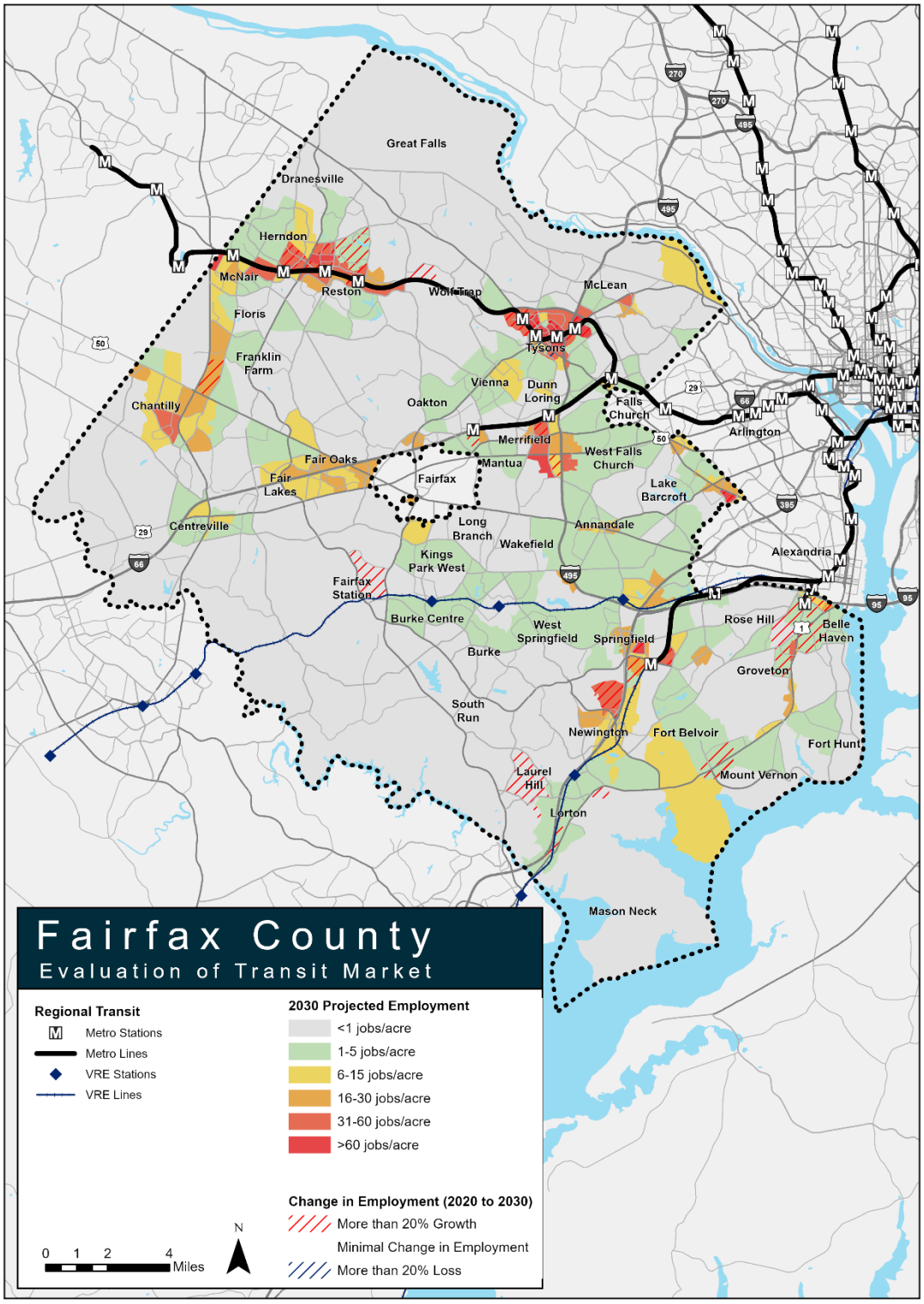
Source: Metropolitan Washington Council of Governments Round 9.1 Cooperative Forecasting. 2020.

FIGURE 2-9: 2020 EMPLOYMENT DENSITY



Source: Metropolitan Washington Council of Governments Round 9.1 Cooperative Forecasting. 2020.

FIGURE 2-10: 2030 EMPLOYMENT DENSITY PROJECTION



Source: Metropolitan Washington Council of Governments Round 9.1 Cooperative Forecasting. 2020.

TRANSIT POTENTIAL

In general, higher concentrations of residents and/or jobs tend to correlate with higher transit ridership. Transit potential combines the population and employment densities of each TAZ to indicate the viability of fixed-route transit service in an area. Although population and employment density are not the sole factors in selecting where to operate transit, typically, transit is most viable in areas with population densities of six people per acre and job densities of four jobs per acre. Simplified, the transit potential model assumes that regions where residents plus jobs total more than five per acre are transit supportive.

Concentrated employment centers and large areas with moderate population density provide much of Fairfax County with moderate transit potential. As shown in **Figure 2-11**, transit potential in Fairfax County is highest in the following locations:

- Along the Dulles Toll Road around the Reston Town Center and Herndon Metrorail stations
- In the Tysons area, especially around Metrorail stations
- South of Dunn-Loring Merrifield Metrorail station
- In the Fair Oaks region along the I-66 corridor
- Bailey's Crossroads adjacent to the county's border with Arlington
- Near Franconia-Springfield Metrorail station
- Huntington and Belle Haven along the Richmond Highway corridor

Correlating with density, transit potential decreases as one moves away from the county's urban centers. Areas showing moderate transit potential include:

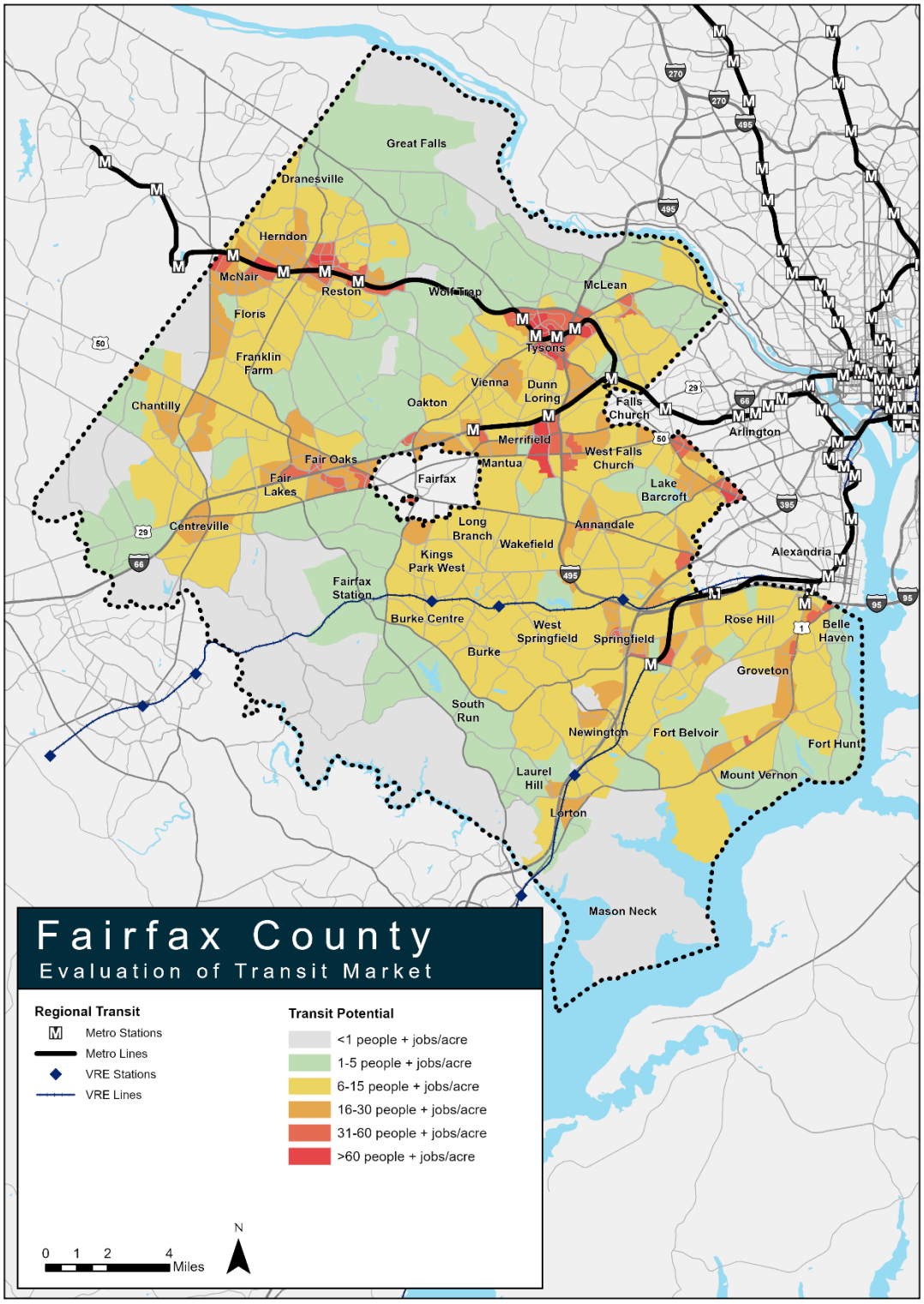
- Centreville around the intersection of US 29 and I-66;
- Chantilly south of US 50
- Newington east of I-95
- South of Lorton VRE Station
- Richmond Highway corridor north of Mount Vernon
- Eastern portion of McLean
- West Falls Church along the US 50 corridor

Outlying, low-density areas, including Mason Neck, South Run, Fairfax Station, and Great Falls, have relatively low transit potential.

TABLE 2-4: TRANSIT POTENTIAL THRESHOLDS

Category	People and Jobs per Acres
Low	1-5
Low-Moderate	6-15
Moderate	16-30
Moderate-High	31-60
High	>60

FIGURE 2-11: TRANSIT POTENTIAL



Source: Metropolitan Washington Council of Governments Round 9.1a Cooperative Forecasting. 2020.

TRANSIT PROPENSITY

Like transit potential, transit propensity indices use a series of demographic and employment statistics to identify geographic areas with high demand and need for fixed-route transit service. Index models assume that certain demographic subgroups may be more inclined to use transit. For example, a location with a high number of zero-car households will be more likely to have potential transit users than a location with relatively more multi-car households.

Each index is created using 2018 U.S. Census American Community Survey and 2017 Longitudinal Employer-Household Dynamics (LEHD)/LEHD Origin Destination Employment Statistics (LODES) data. Within each index model, block groups are ranked based on demographic or employment characteristics (such as total population or total jobs). Each block group is subsequently assigned a score for each characteristic based on its rank. Scores are then multiplied by weights and combined across the index to generate a propensity score for each block group index. Each index and its results are described in the sections that follow.

Transit-Oriented Population Origins Propensity Index

The transit-oriented population origins index runs on the assumption that areas with higher total population or household densities, as well as higher concentrations of seniors, youth, persons living in poverty, households with reduced vehicle access, and disabled persons, will have a greater propensity to use transit. The weights of each of the factors in the transit-oriented populations origin index model are listed in **Table 2-5**.

TABLE 2-5: TRANSIT-ORIENTED POPULATION ORIGINS INDEX INPUTS

Category	Weight
Total Population	30%
Youth Population	5%
Senior Population	5%
Low-Income Households[20]	20%
Zero-Car Households	20%
One-Car Households	10%
Persons with Disabilities Population	10%

Figure 2-12 illustrates the results of the transit-oriented population origins index.

[20] *Low-income was defined as having a household income less than or equal to 150 percent of the U.S. federal poverty guideline.*

Areas with a high propensity toward transit based on this index include:

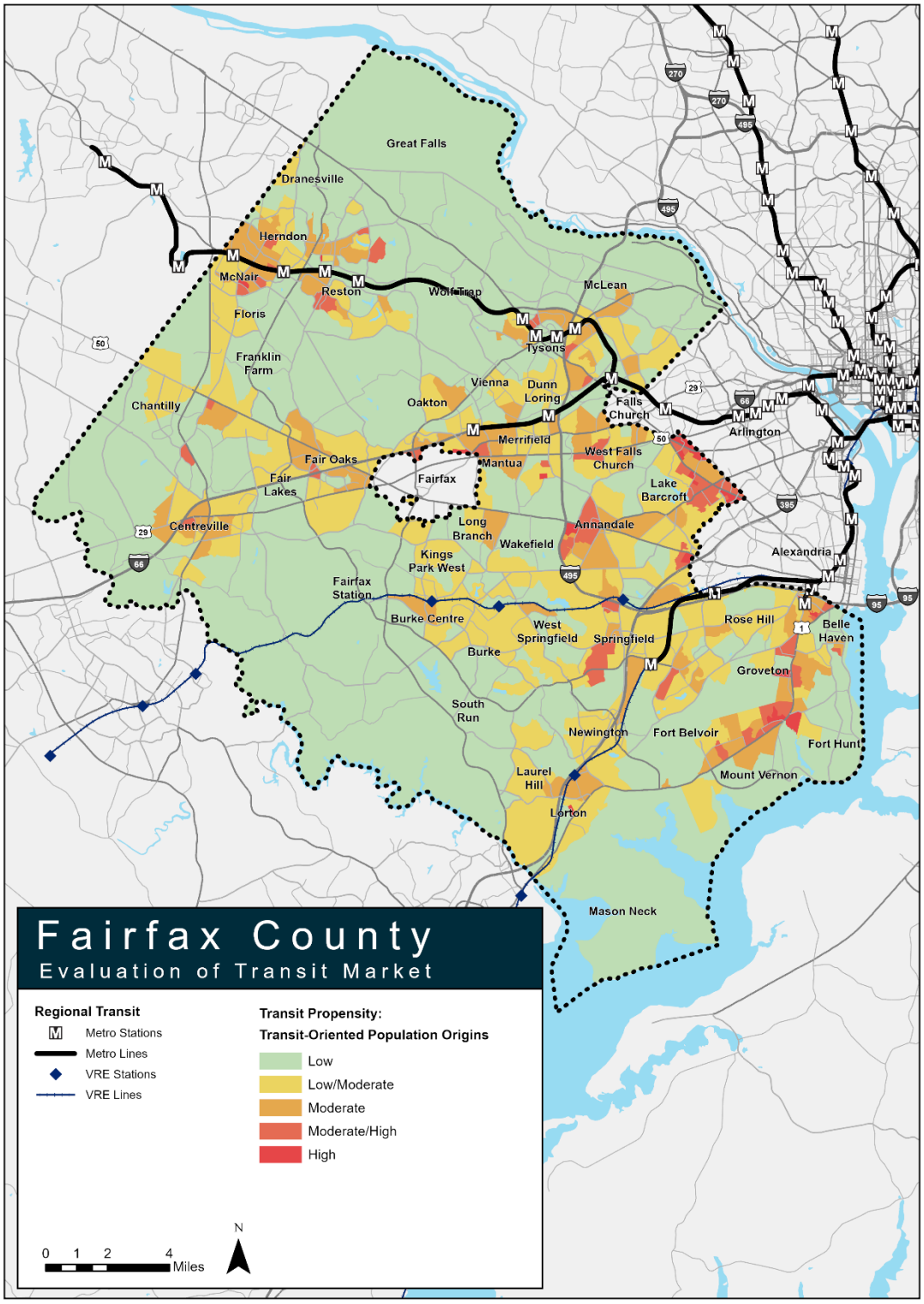
- Centreville around the intersection of US 29 and I-66
- The Dulles Toll Road corridor surrounding the Herndon and Reston Town Center Metrorail stations
- Areas surrounding Tysons area Metrorail stations
- Annandale along the Little River Turnpike corridor
- East of I-495
- West Falls Church along the US 50 corridor
- Springfield north of Franconia-Springfield Parkway
- Bailey's Crossroads adjacent to the county's border with Arlington
- Along the Richmond Highway corridor from Groveton to Mount Vernon

Transit propensity based on transit-oriented populations tends to decrease as one moves away from regional urban centers and major corridors. Areas with moderate transit propensity include:

- Kings Park West
- The vicinity of Burke Centre VRE Station
- The vicinity of Lorton VRE Station
- George Mason University

Transit propensity is lowest in lower-density areas such as South Run, Fairfax Station, northern McLean, Franklin Farm, Mason Neck, and Great Falls.

FIGURE 2-12: TRANSIT-ORIENTED POPULATION ORIGINS PROPENSITY INDEX



Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data

Commuter Origins Propensity Index

The commuter origins index consists of two categories: labor force population (weighted for 70 percent of the model) and population of non-single occupancy vehicle commuters (weighted for 30 percent of the model). Employed persons, commuters, and transit commuters all contribute to this index, which is indicative of where traditional peak-hour commuters live, and where those that currently use transit to commute live. Areas with a high commuter index tend to have both a higher employed population as well as a higher percentage of residents commuting by transit.

Pockets of high transit propensity based on the commuter origins index (**Figure 2-13**) largely overlap with high propensity areas based on the transit-oriented populations index. They include:

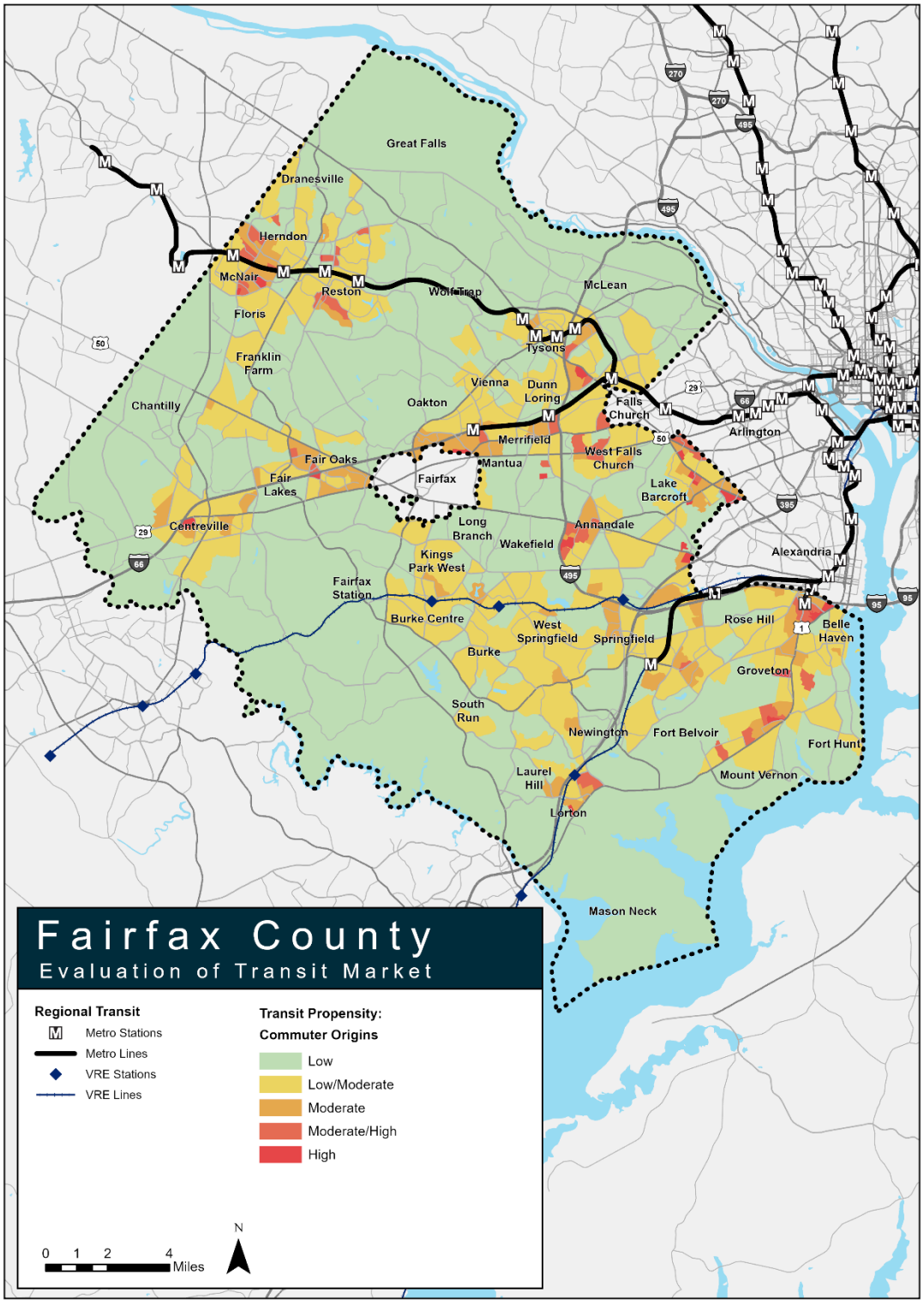
- Centreville around the intersection of US 29 and I-66
- Surrounding the Herndon and Reston Town Center Metrorail stations
- South Reston
- Fair Oaks along the US 50 corridor
- The area surrounding Dunn Loring-Merrifield Metrorail station
- Annandale along the Little River Turnpike corridor
- East of I-495
- West Falls Church along the US 50 corridor
- Around Lorton VRE Station
- Bailey's Crossroads adjacent to the county's border with Arlington
- Along the Richmond Highway corridor from Belle Haven to Mount Vernon

Low to moderate transit propensity based on this index is found:

- In the Springfield/West Springfield area
- Around Burke Centre VRE Station
- The Rose Hill area
- Vienna north of the Metrorail station

Like the transit-oriented populations index, transit propensity based on commuter origins is lowest in outlying areas of Fairfax County such as Great Falls, McLean, western Chantilly, Fairfax Station, Fort Belvoir, and Mason Neck.

FIGURE 2-13: COMMUTER ORIGINS PROPENSITY INDEX



Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data

Workplace Destinations Propensity Index

The workplace destinations index identifies areas with high levels of employment activity; its only input is the total number of jobs. It is used as an indicator of employment density. **Figure 2-14** displays the results of this index.

Higher transit propensity areas based on total jobs tend to cluster in employment centers, including:

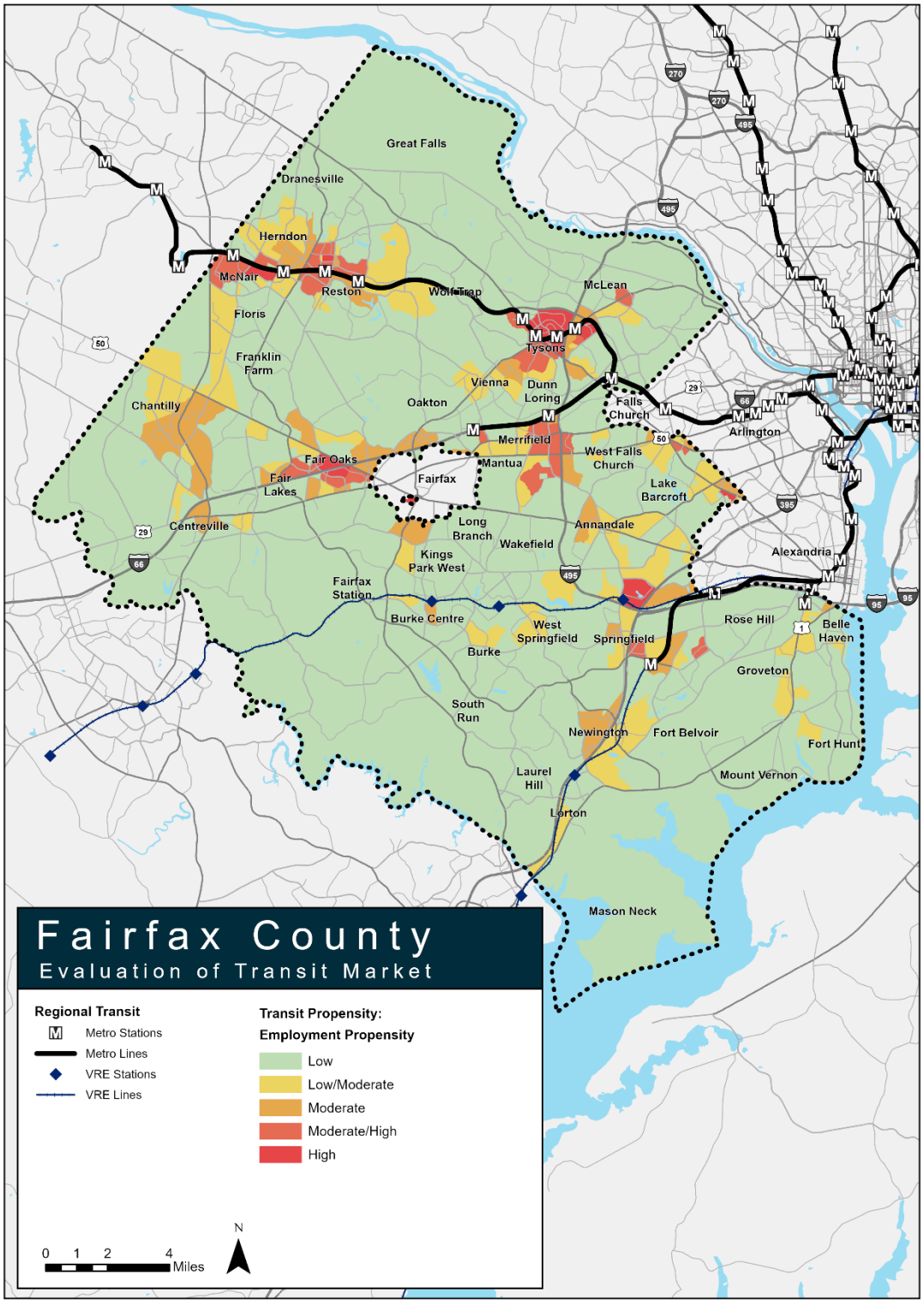
- Fair Oaks
- North Springfield
- Around the Dunn Loring-Merrifield Metrorail station
- Along the Dulles Toll Road corridor, especially in the vicinity of the Herndon and Reston Town Center Metrorail stations
- In the Tysons area
- Eastern portion of McLean

Areas with moderate transit propensity based on workplace destinations include:

- Chantilly
- Centreville around the intersection of US 29 and I-66
- Newington off the I-95 corridor
- Annandale along the Little River Turnpike corridor
- East of I-495
- Herndon north of the Metrorail station
- Springfield north of I-495

Given that jobs are fairly spread out in large swaths of Fairfax County, lower transit propensity areas fill a relatively high percentage of the region, including Great Falls, Dranesville, Franklin Farm, Oakton, Fairfax Station, Burke, Groveton, South Run, Mount Vernon, and Mason Neck.

FIGURE 2-14: WORKPLACE DESTINATIONS PROPENSITY INDEX



Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data

Activity Destinations Propensity Index

The non-work destination index uses the number of retail/restaurant, recreation, healthcare/social assistance, education, and government jobs as a proxy to evaluate transit propensity based on the density of "non-work" or activity-based destinations. The weights of each of the factors in the model are listed in **Table 2-6. Figure 2-15** summarizes the results of this index.

TABLE 2-6: ACTIVITY DESTINATIONS INDEX INPUTS

Category	Weight
Retail/Restaurant Jobs	30%
Education Jobs	20%
Healthcare/Social Assistance Jobs	30%
Entertainment/Recreation Jobs	10%
Public Sector Jobs	10%

Transit propensity based on activity destinations correlates closely with propensity based on workplace destinations. Higher propensity areas appear to cluster in job centers such as:

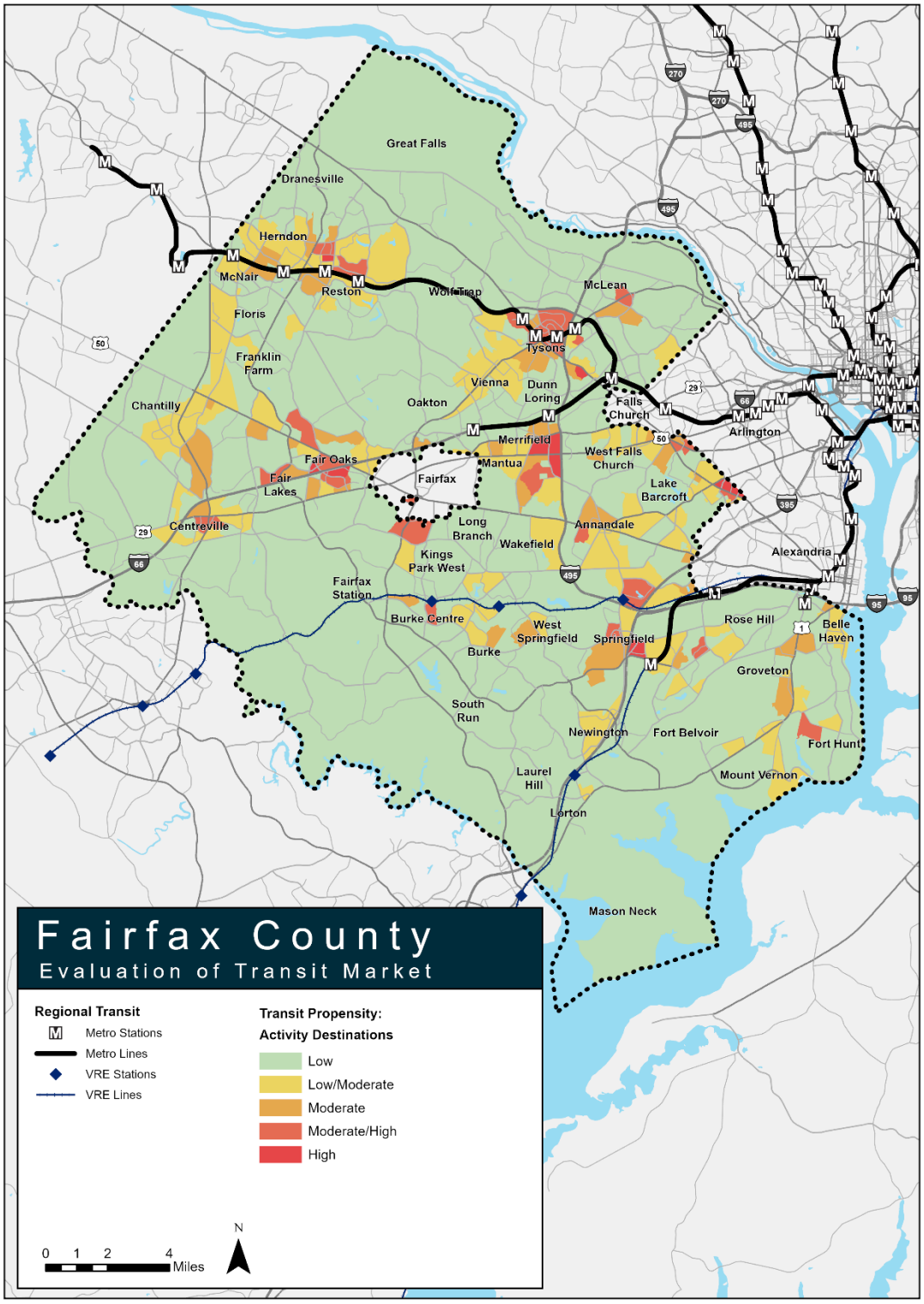
- Fair Oaks
- Fair Lakes
- Reston Town Center (especially north of the Metrorail station)
- Tysons
- Merrifield west of I-495
- Springfield along the I-95 corridor
- South of Burke Centre VRE Station
- Centreville along the US 29 corridor
- Bailey's Crossroads
- Western portion of Fort Hunt

Low to moderate transit propensity pockets based on this index can be found in regions such as:

- Chantilly along the US 50 corridor
- Newington along the I-95 corridor
- Mount Vernon southeast of Richmond Highway
- Along the Richmond Highway corridor from Groveton to Belle Haven

Low propensity areas based on this index cluster in regions with relatively low job density, such as Mason Neck, Lorton, Fort Belvoir, Laurel Hill, South Run, Fairfax Station, Oakton, Dranesville, and Great Falls.

FIGURE 2-15: ACTIVITY DESTINATIONS PROPENSITY INDEX



Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data

2.2.2 Transit Demand and Underserved Area Opportunities for Improvement

LEVEL OF SERVICE ANALYSIS

This analysis was conducted for the TSP prior to the opening of the Silver Line extension and the associated Fairfax Connector service changes in the Reston and Herndon area that began on November 16, 2022. Maps and details presented here represent a snapshot of service during the development of the TSP. In some cases, route alignments and route numbers have changed for Connector and Metrobus services since the time of analysis.

All-Day Propensity Service Index

The all-day transit propensity analysis identifies areas most suitable for all-day transit service. The all-day service index reflects where there are higher levels of transit-oriented populations and activity destinations as described in **Section 2.2.1**. **Figure 2-16** through **Figure 2-20** illustrate all-day transit propensity in each subarea of Fairfax County. For this level of service analysis, the Tysons and Centreville-Chantilly-Vienna subareas are shown separately. Gaps in service were indicated by areas with moderate to high propensities that were not served by transit midday, or areas with moderate/high and high propensities served by routes with more than 30-minute midday headways.

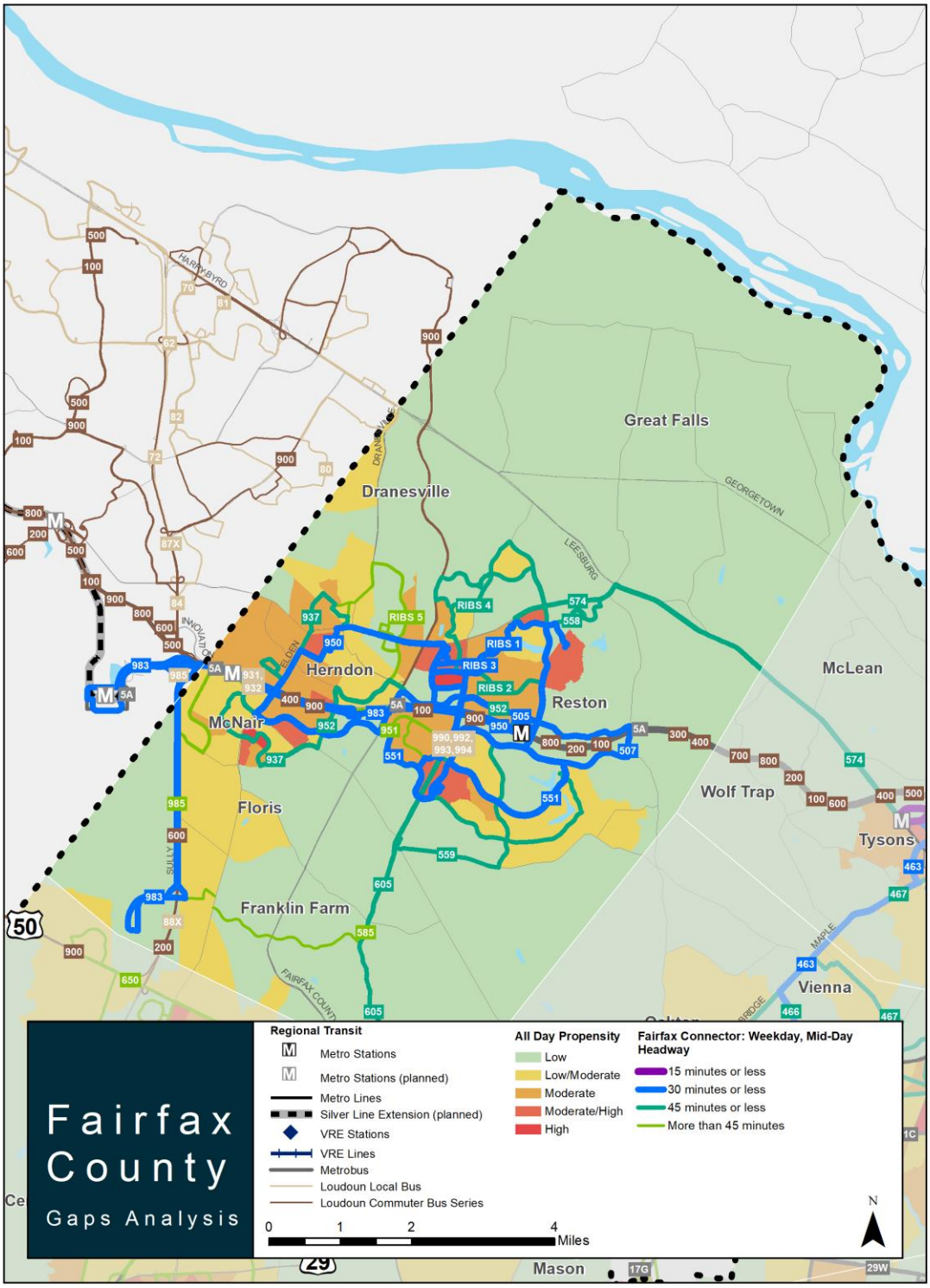
Gaps in services were identified for each subarea:

- The Reston-Herndon subarea's all-day service propensity is shown in **Figure 2-16.** Despite exhibiting moderate and moderate/high propensity, the area west of Elden Street and north of the Dulles Access Road, which is mostly residential, was not served during the midday by transit. This includes neighborhoods along the Herndon Parkway that were served during peak periods. A few areas of low/moderate propensity were also not covered by midday service including the southside of Route 608 (southeast of Floris) and the area to the west of Route 228 in Dranesville. All-day propensities in both areas can be attributed to residential developments.
- The Tysons subarea's all-day service propensity is shown in **Figure 2-17.** High propensity areas north of the Metrorail line were served frequently by Fairfax Connector routes. A few areas of moderate all-day propensity were not well-served by Fairfax Connector and Metrobus service including the area east of Great Falls Street and west of Westmoreland Street, and the area to the west of the Greensboro Metrorail station along Old Courthouse Road.
- The Centreville-Chantilly-Vienna subarea's all-day service propensity is shown in **Figure 2-18**. Moderate and moderate/high propensity areas in Centreville and Chantilly were not provided with frequent midday service. Headways in these areas were more than 45 minutes. High propensity scores in Centreville and Chantilly can be attributed to retail. Merrifield and Woodburn are one of the subarea's highest propensity regions and were well-served by transit. The propensity at this location can be attributed to the concentration of apartments and the Inova Hospital complex.
- The Franconia-Springfield subarea's all-day service propensity is shown in **Figure 2-19**. High and moderate/high propensity areas were well-served by Fairfax Connector and Metrobus. Many areas of low/moderate propensity exist throughout

the subarea. Areas of low/moderate propensity not served by transit included Newington Forest and south of Laurel Hill. Areas of moderate propensity not well-served by midday transit included Lincolnia Heights particularly along Lincolnia Road and the Old Colombia Pike. Propensity in Lincolnia Heights can be attributed to residential developments.

- The Huntington subarea's all-day service propensity is shown in **Figure 2-20**. The area east of the Inova Mount Vernon Hospital complex, along Collingswood Road, exhibited a moderate level of propensity for all-day transit service.

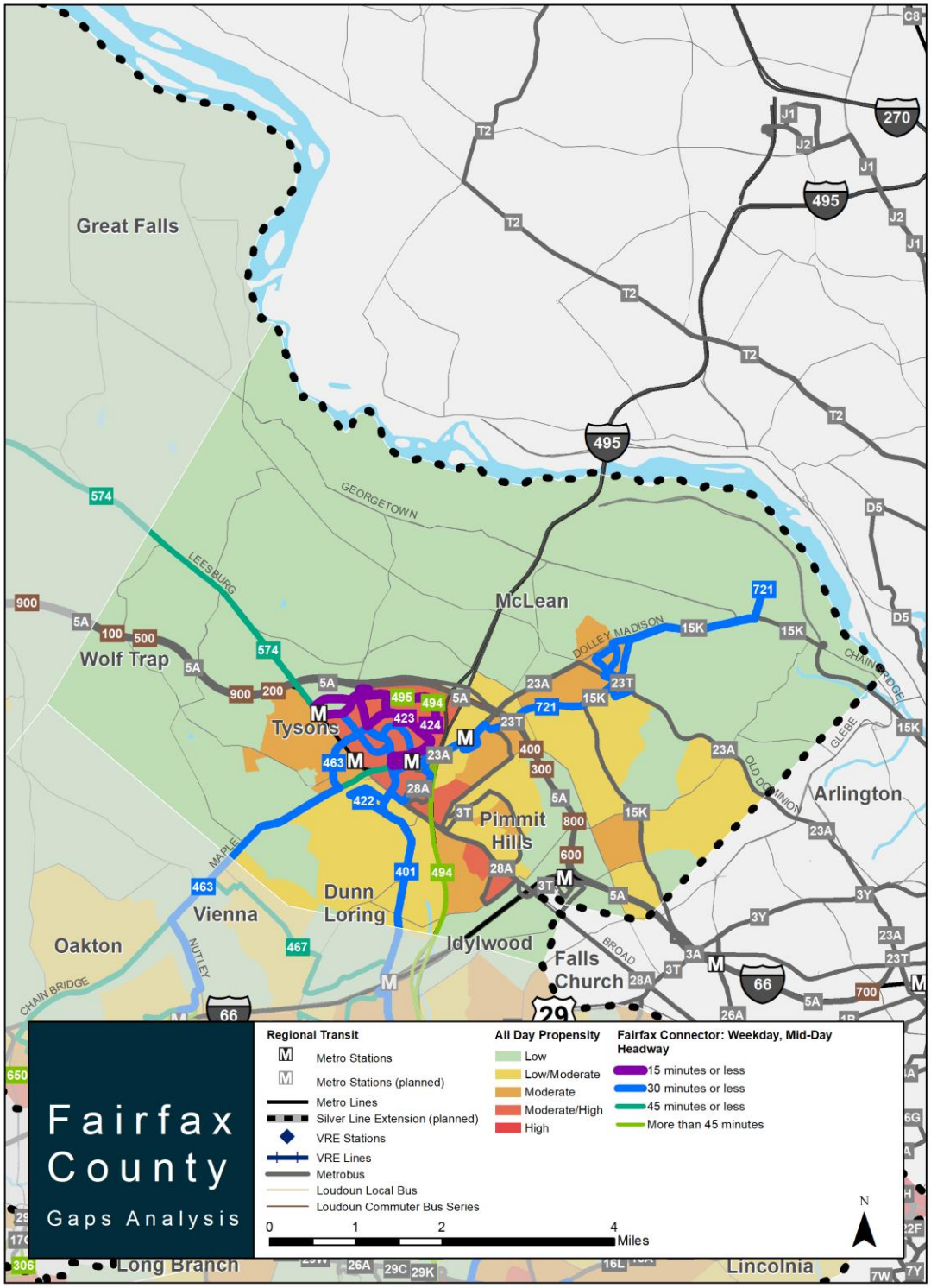
FIGURE 2-16: RESTON-HERNDON SUBAREA ALL-DAY PROPENSITY INDEX (PRE-SILVER LINE EXTENSION)



Note. Service changes have occurred for Fairfax Connector and Metrobus since the time of analysis.

Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data, August 2020 Fairfax Connector Service Schedule.

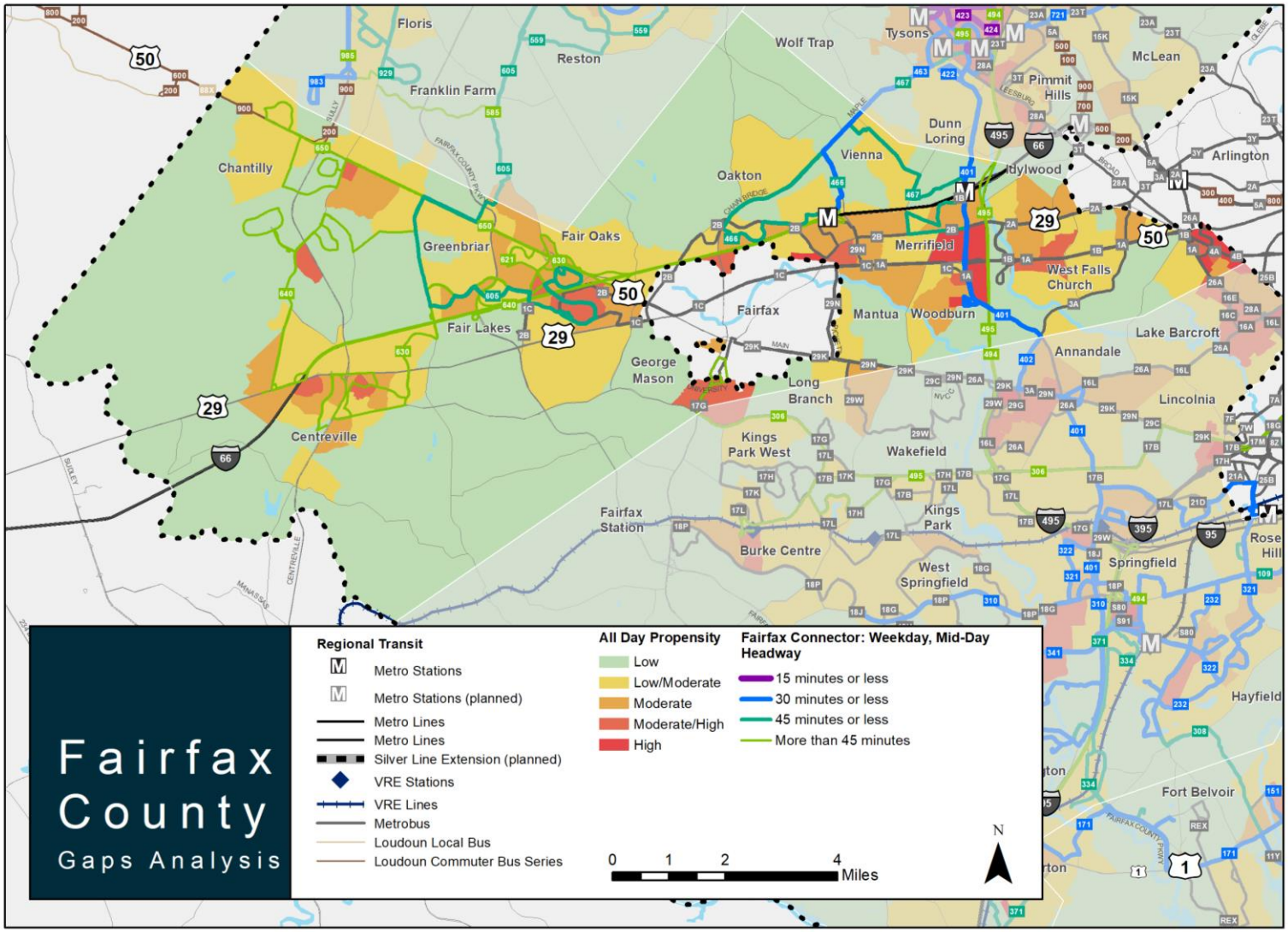
FIGURE 2-17: TYSONS SUBAREA ALL-DAY PROPENSITY INDEX (PRE-SILVER LINE EXTENSION)



Note. Service changes have occurred for Fairfax Connector and Metrobus since the time of analysis.

Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data, August 2020 Fairfax Connector Service Schedule.

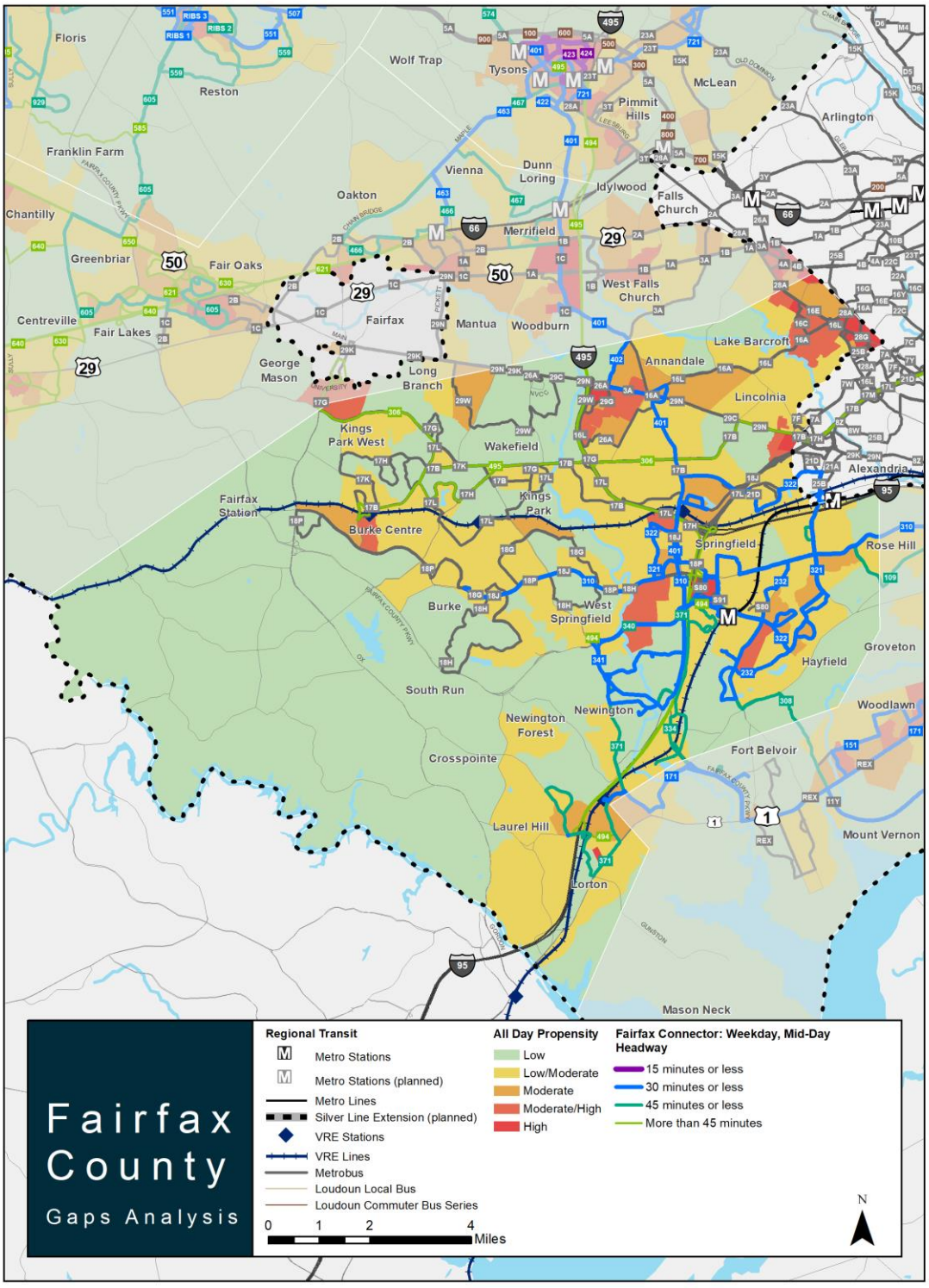
FIGURE 2-18: CENTREVILLE-CHANTILLY-VIENNA SUBAREA ALL-DAY PROPENSITY INDEX (PRE-SILVER LINE EXTENSION)



Note. Service changes have occurred for Fairfax Connector and Metrobus since the time of analysis.

Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data, August 2020 Fairfax Connector Service Schedule.

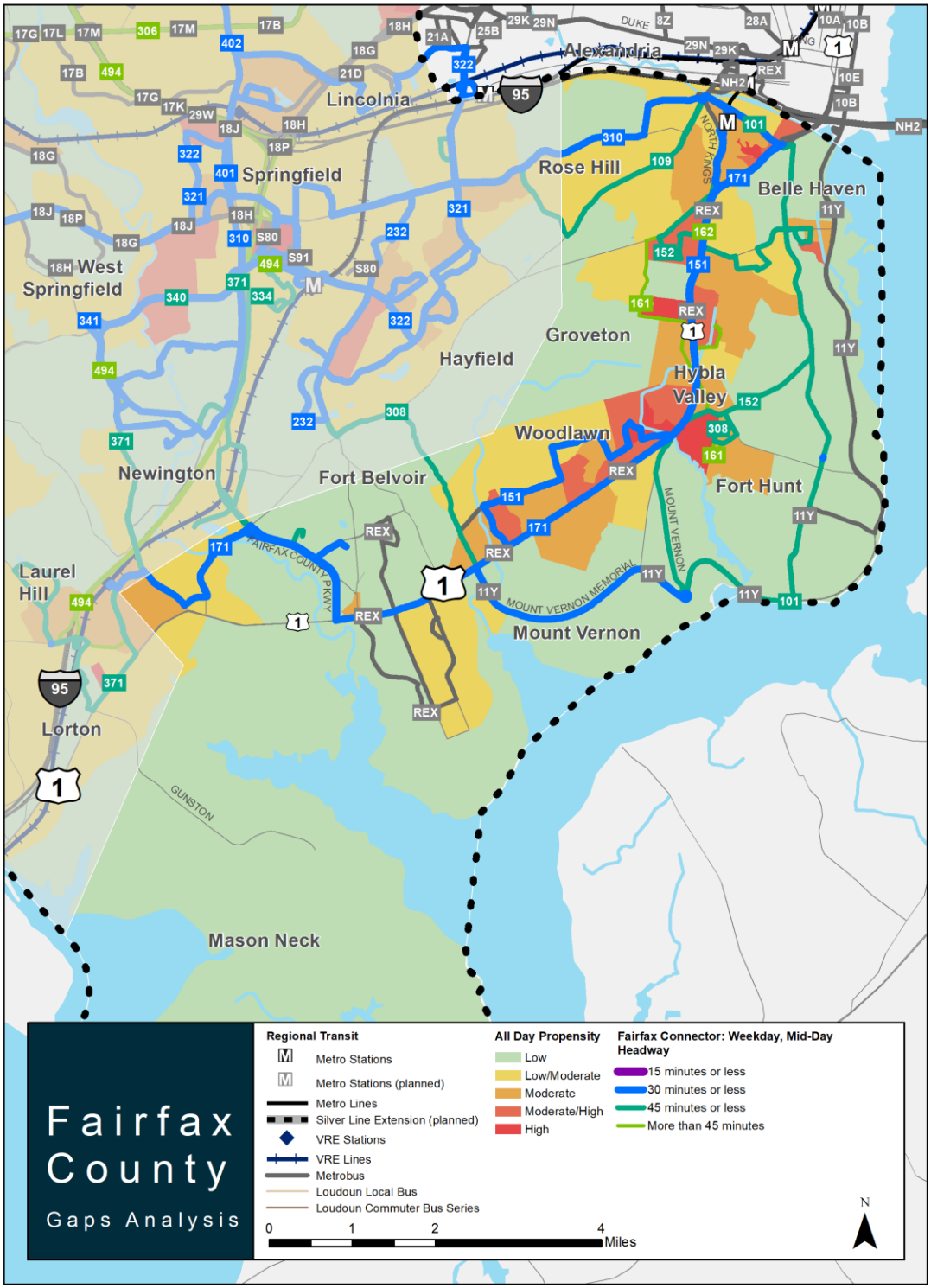
FIGURE 2-19: FRANCONIA-SPRINGFIELD SUBAREA ALL-DAY PROPENSITY INDEX (PRE-SILVER LINE EXTENSION)



Note. Service changes have occurred for Fairfax Connector and Metrobus since the time of analysis.

Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data, August 2020 Fairfax Connector Service Schedule.

FIGURE 2-20: HUNTINGTON SUBAREA ALL-DAY PROPENSITY INDEX (PRE-SILVER LINE EXTENSION)



Note. Service changes have occurred for Fairfax Connector and Metrobus since the time of analysis.

Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data, August 2020 Fairfax Connector Service Schedule.

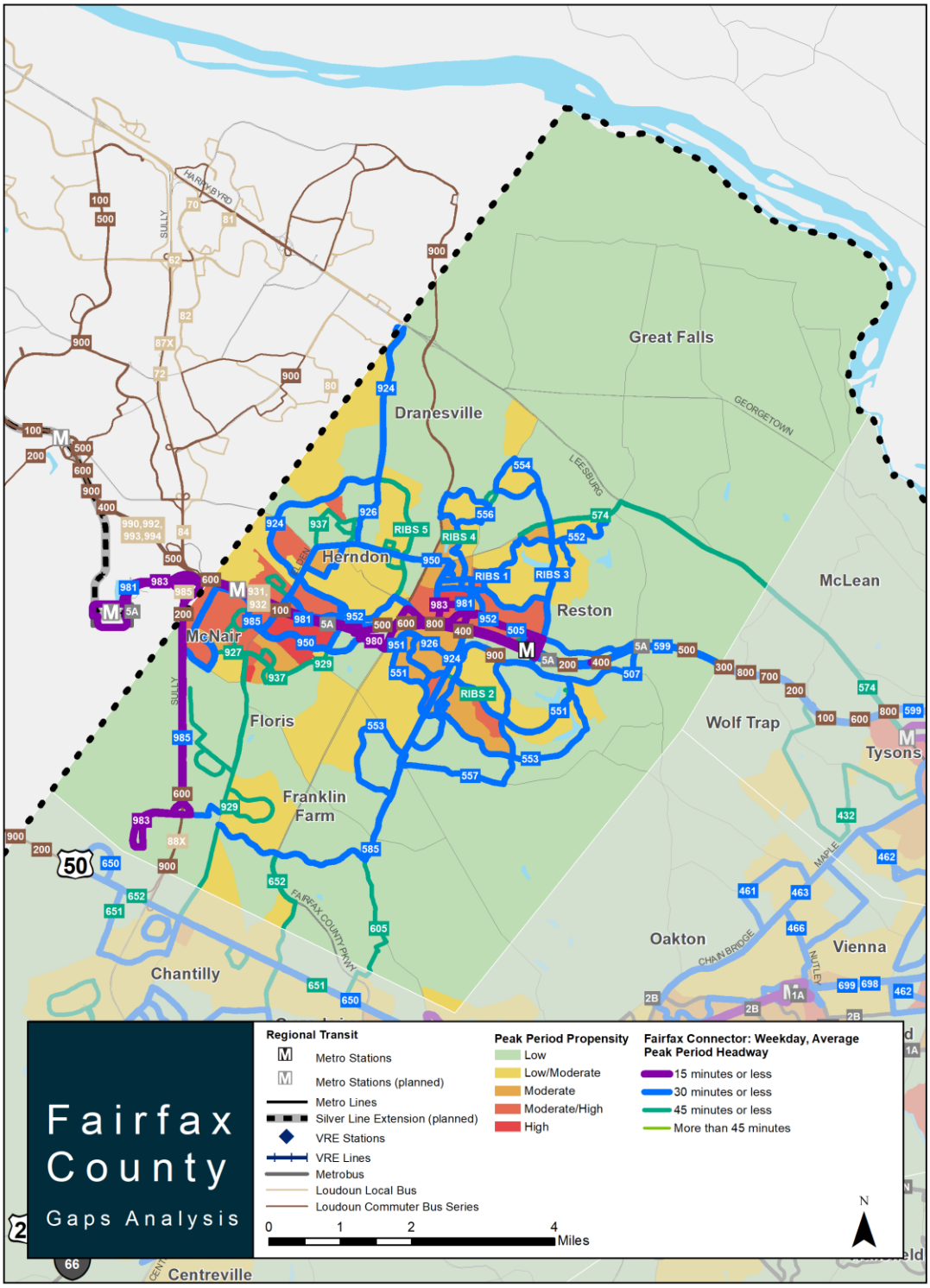
Peak Service Propensity Index

The peak service propensity analysis identifies areas most suitable for commuter-oriented service during peak periods or typical rush hour commuting periods. The peak service index reflects where there are higher levels of commuter origins and workplace destinations as described in **Section 2.2.1**. **Figure 2-21** through **Figure 2-25** illustrate peak period transit service and peak period propensity in each subarea of Fairfax County. Gaps in service were indicated by areas with moderate to high propensities that were not served by transit during peak periods, or areas with moderate/high and high propensities served by routes with more than 30-minute period headways.

Gaps in services were identified for each subarea:

- The Reston-Herndon subarea's peak service propensity is shown in **Figure 2-21**. High and moderate/high propensity areas were well-served by Fairfax Connector including along the Dulles Toll Road corridor. One area of moderate/high to high propensity served by routes with 30 minute or longer headways was the McNair Farms Community.
- The Tysons subarea's peak service propensity is shown in **Figure 2-22**. High and moderate/high propensity areas were well-served by Fairfax Connector and Metrobus. Many services were concentrated north of the Metrorail line.
- The Centreville-Chantilly-Vienna subarea's peak service propensity is shown in **Figure 2-23**. Woodburn is a high propensity area that was well-served by transit. High propensity at this location can be attributed to the concentration of apartments and Inova Hospitals. Given the lack of Metrorail or Metrobus service in Centreville, Fairfax Connector service is needed in this area. Areas of high, moderate, and low/moderate propensity existed in Centreville. Moderate propensity areas served by headways greater than 30 minutes included areas along Stone Road and Braddock Road.
- The Franconia-Springfield subarea's peak service propensity is shown in **Figure 2-24**. High and moderate/high propensity areas were well-served by Fairfax Connector and Metrobus. Springfield and Annandale had significant coverage and were served by routes with headways of 15 minutes or less. Many areas of low/moderate propensity in the subarea were not served by transit or only served in a limited capacity along the major corridors. One such area was Lincolnia Heights along Braddock Road and the Old Columbia Pike. Higher propensity at this location can be attributed to residential density.
- The Huntington subarea's peak service propensity is shown in **Figure 2-25**. The moderate, moderate/high, and high propensity areas in Huntington were served by 16-30 minute headways. The Richmond Highway/US 1 corridor had frequent service due to the presence of both Metrobus and Fairfax Connector routes. One area of Huntington with less frequent service included Rose Hill and Groveton. This region consisted of low and low/moderate propensity areas and was served by 31-45 minute headways.

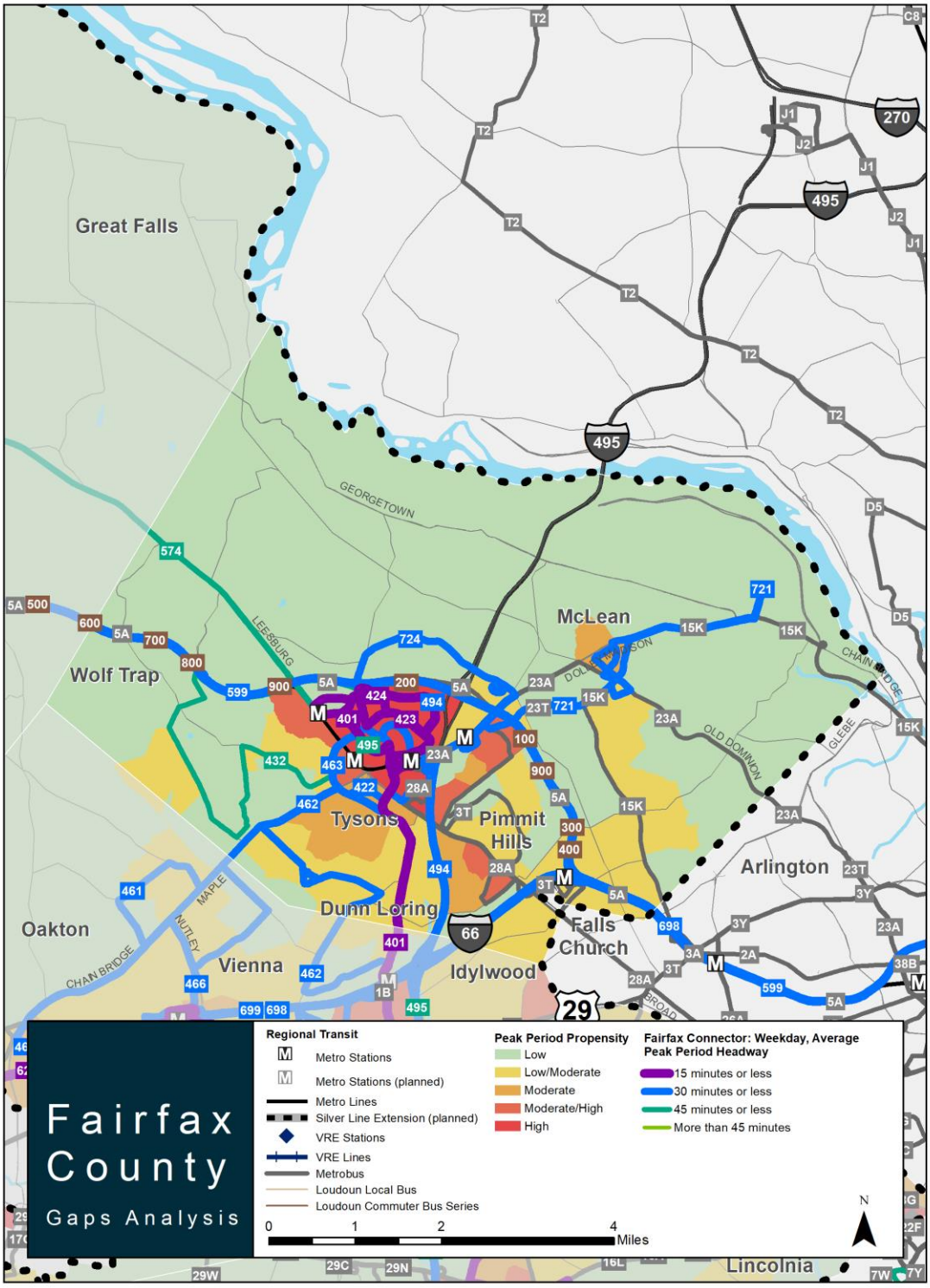
FIGURE 2-21: RESTON-HERNDON SUBAREA PEAK SERVICE PROPENSITY INDEX (PRE-SILVER LINE EXTENSION)



Note. Service changes have occurred for Fairfax Connector and Metrobus since the time of analysis.

Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data, August 2020 Fairfax Connector Service Schedule.

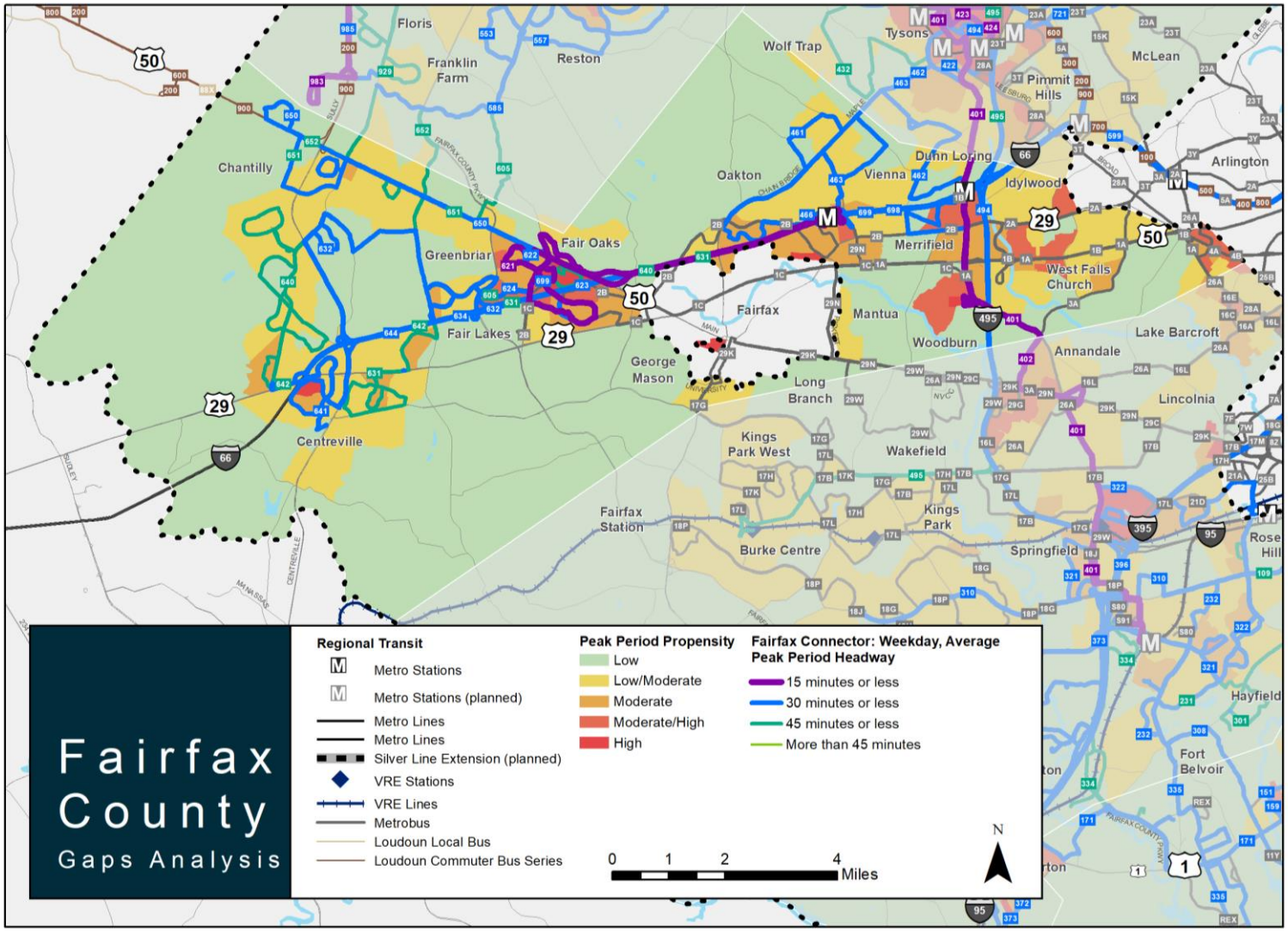
FIGURE 2-22: TYSONS SUBAREA PEAK SERVICE PROPENSITY INDEX (PRE-SILVER LINE EXTENSION)



Note. Service changes have occurred for Fairfax Connector and Metrobus since the time of analysis.

Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data, August 2020 Fairfax Connector Service Schedule.

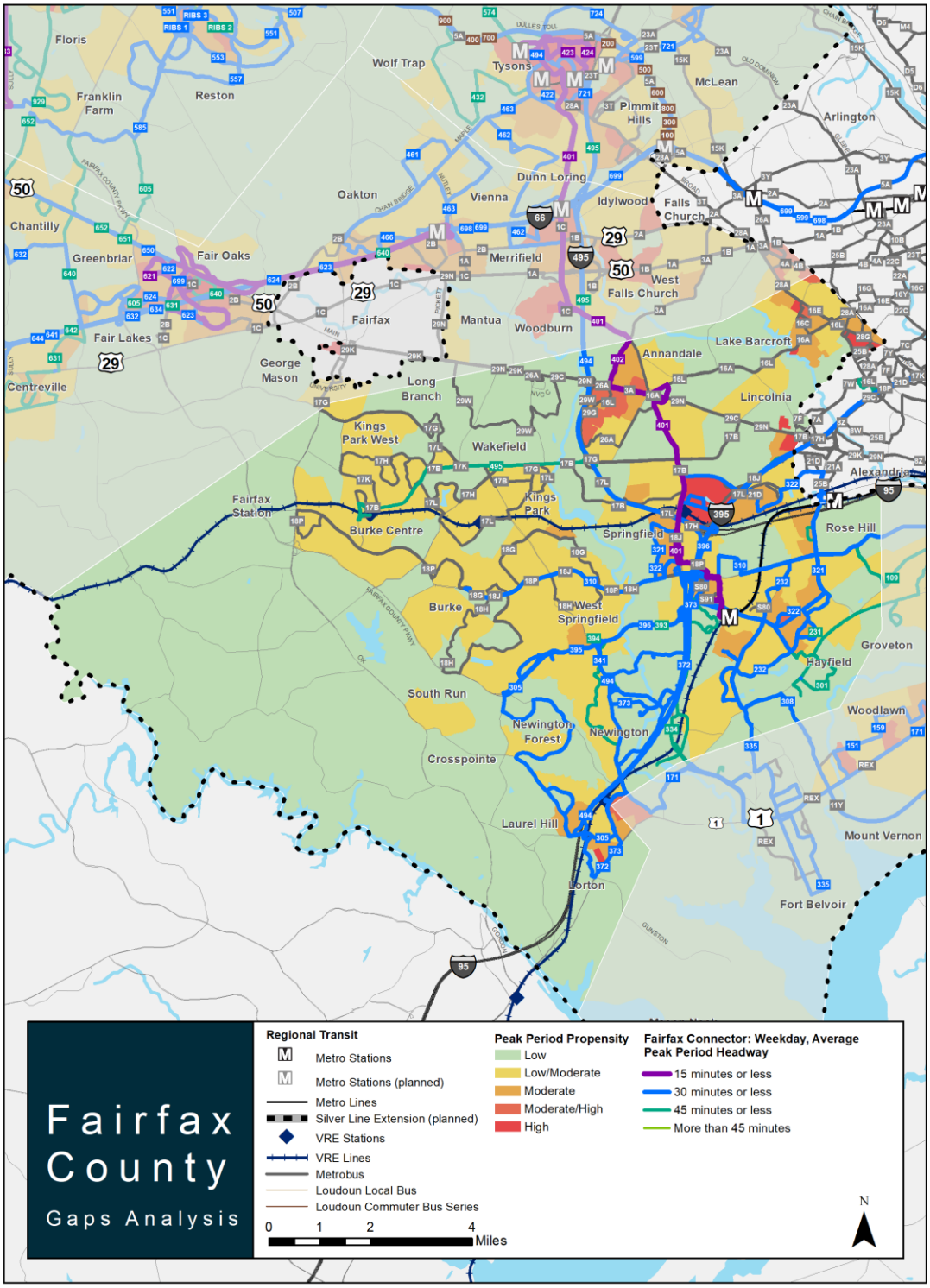
FIGURE 2-23: CENTREVILLE-CHANTILLY-VIENNA SUBAREA PEAK SERVICE PROPENSITY INDEX (PRE-SILVER LINE EXTENSION)



Note. Service changes have occurred for Fairfax Connector and Metrobus since the time of analysis.

Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data, August 2020 Fairfax Connector Service Schedule.

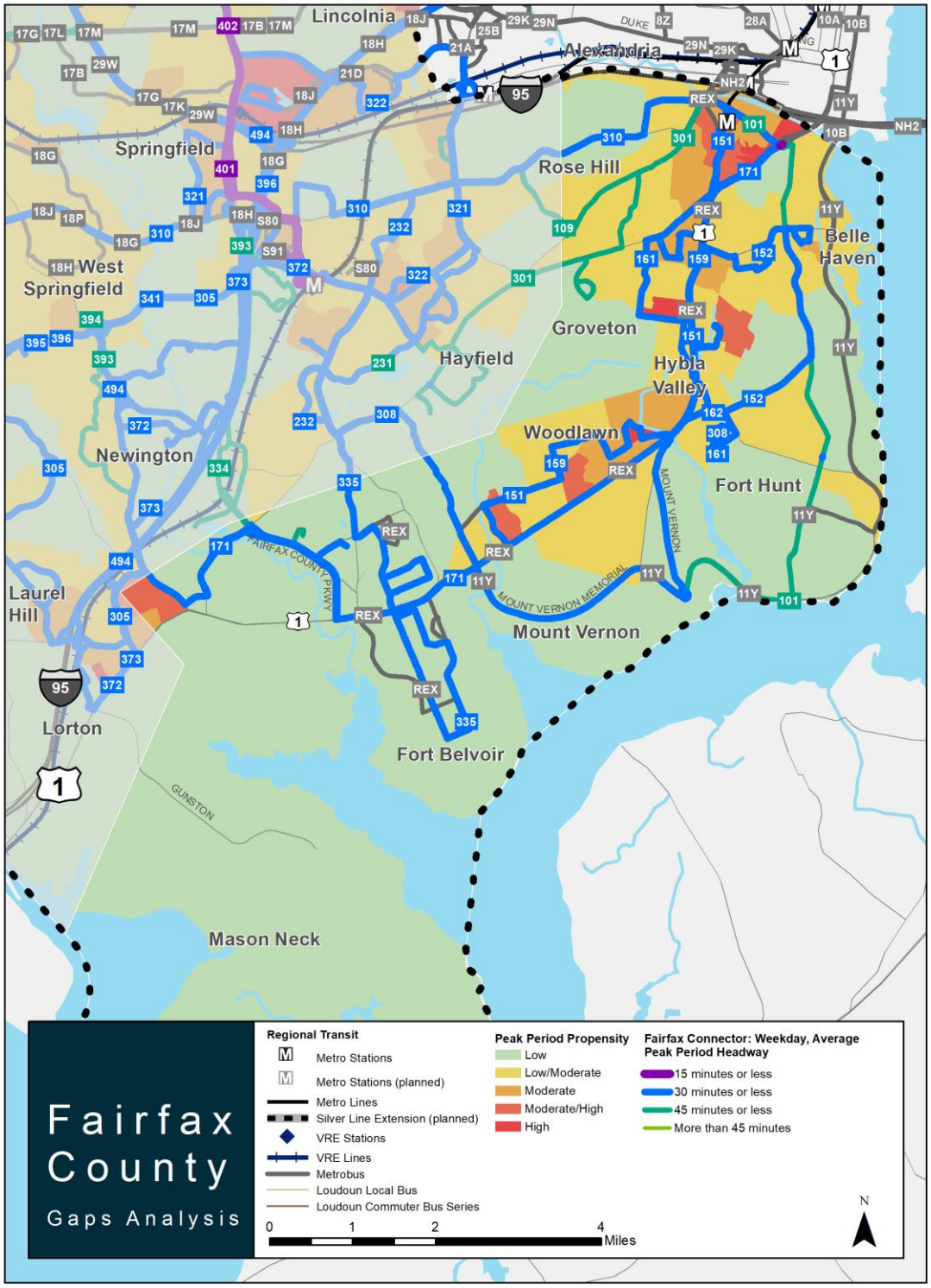
FIGURE 2-24: FRANCONIA-SPRINGFIELD SUBAREA PEAK SERVICE PROPENSITY INDEX (PRE-SILVER LINE EXTENSION)



Note. Service changes have occurred for Fairfax Connector and Metrobus since the time of analysis.

Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data, August 2020 Fairfax Connector Service Schedule.

FIGURE 2-25: HUNTINGTON SUBAREA PEAK SERVICE PROPENSITY INDEX (PRE-SILVER LINE EXTENSION)



Note. Service changes have occurred for Fairfax Connector and Metrobus since the time of analysis.

Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data, August 2020 Fairfax Connector Service Schedule.

Enhanced Propensity Service Index

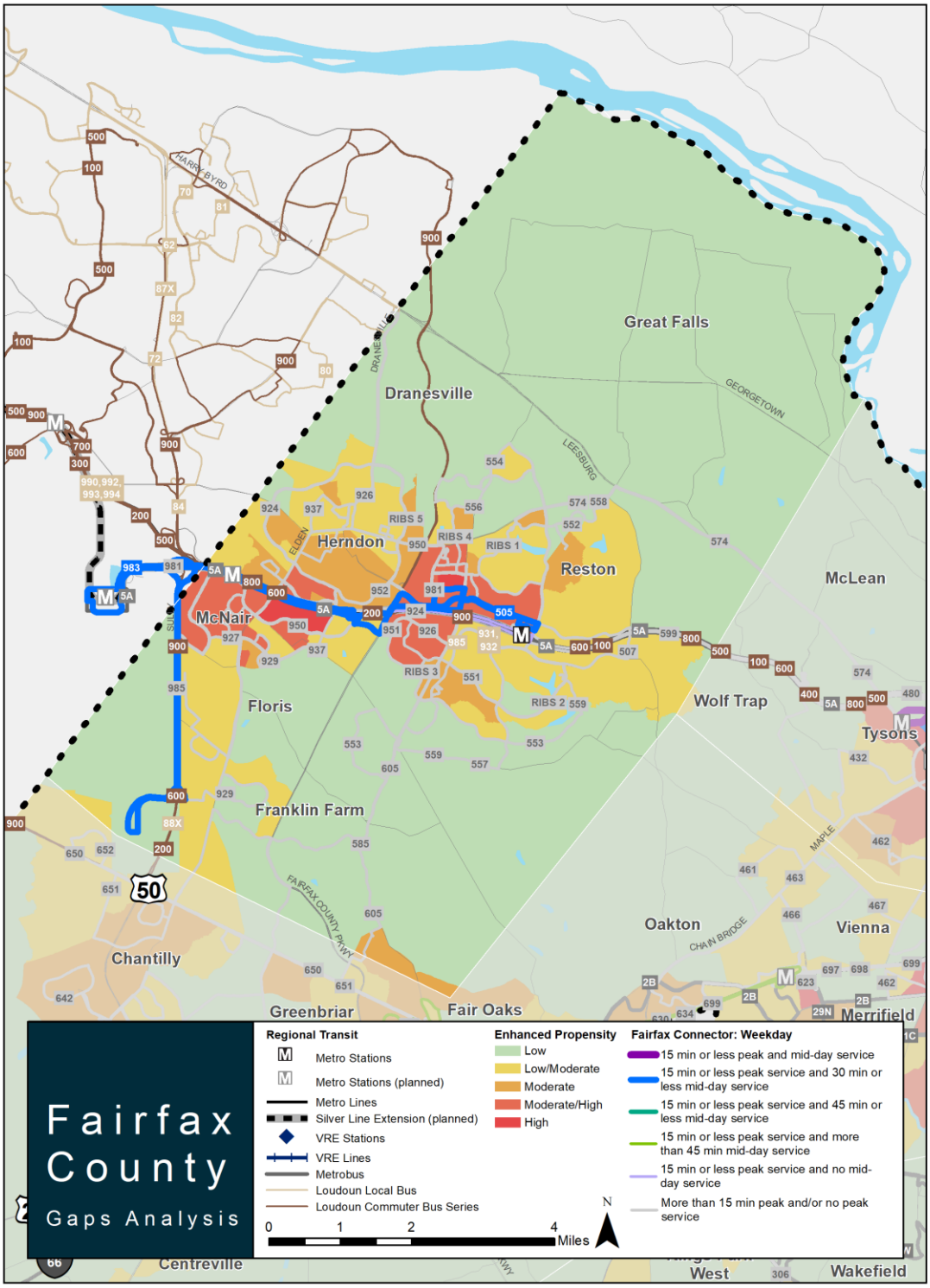
The enhanced transit propensity analysis identifies areas most suitable for frequent service, or service with a 15-minute or less headway. The enhanced service propensity index identifies areas with both high levels of transit-oriented population and commuter origins, as well as high levels of activity and employment destinations as presented in **Section 2.2.1**. **Figure 2-26** through **Figure 2-30** illustrate where higher frequency transit service, 15-minute or better service, make the most sense in each subarea of Fairfax County. In these figures, gaps in service were indicated by areas with moderate to high propensities with more than 15-minute peak service.

Gaps in services were identified for each subarea:

- The Reston-Herndon subarea's enhanced propensity is shown in **Figure 2-26**. High and moderate/high propensity areas were concentrated in Reston and McNair. These areas were served by three Connector routes that operated high-frequency service during peak periods: 983, 505, and 980. Route 980 operated during peak periods only. Route 983 served moderate/high, low/moderate, and low propensity areas and operated with 30-45 minute headways during mid-day periods. Both Reston and McNair had a significant density of Connector services but a limited number of high-frequency routes operating during peak periods. McNair could support additional high-frequency service along existing Connector routes 927 and 950.
- The Tysons subarea's enhanced propensity is shown in **Figure 2-27**. High and moderate/high propensity areas north of the Metrorail line were served by high-frequency services during peak and midday periods. Metrobus Lines 3T, and 28A served the high propensity area in Pimmit Hills. The area south of the Leesburg Pike and Chain Bridge Road was of moderate/high propensity and was not covered by frequent services. Routes 422, 462, and 463 operated in the areas but exhibited headways greater than 15 minutes during peak periods. The area of moderate/high propensity north of Old Dominion Drive, in McLean, was served by several Fairfax Connector and Metrobus routes but no high-frequency Connector services.
- The Centreville-Chantilly-Vienna subarea's enhanced propensity is shown in **Figure 2-28.** High and moderate/high propensity was concentrated in Centreville, Fair Oaks, George Mason, Merrifield, and Woodburn. High-frequency peak period service operated on Connector Route 401 through Merrifield and Woodburn, but propensity levels suggested the area could support all-day high-frequency service. High propensity in this area can be attributed to the concentration of apartments and Inova Hospitals. Fair Lakes north of I-66 was served by many Connector routes but none operated at high-frequency during peak periods and midday.

- The Franconia-Springfield subarea's enhanced propensity is shown in **Figure 2-29**. High and moderate/high propensity was concentrated in Burke Center, Annandale, and Springfield. Springfield and Annandale were served by routes with high-frequency peak period service and all-day 30-minute or less service. One area of moderate/high propensity in the subarea was attributed to Kingstowne Towne Center, which was served by multiple Connector routes but no high-frequency services.
- The Huntington subarea's enhanced propensity is shown in **Figure 2-30**. Moderate/high, and high propensity areas were located along Richmond Highway with concentrations in Huntington and Hybla Valley. This area of Richmond Highway was served by many Fairfax Connector routes and Metrobus Richmond Highway Express (REX) but was not served by any high-frequency Connector routes. Instead, several routes in the corridor combine to provide effective frequency of 15 minutes or less during peak periods and all-day. Existing services along the route provided the corridor with frequent service.

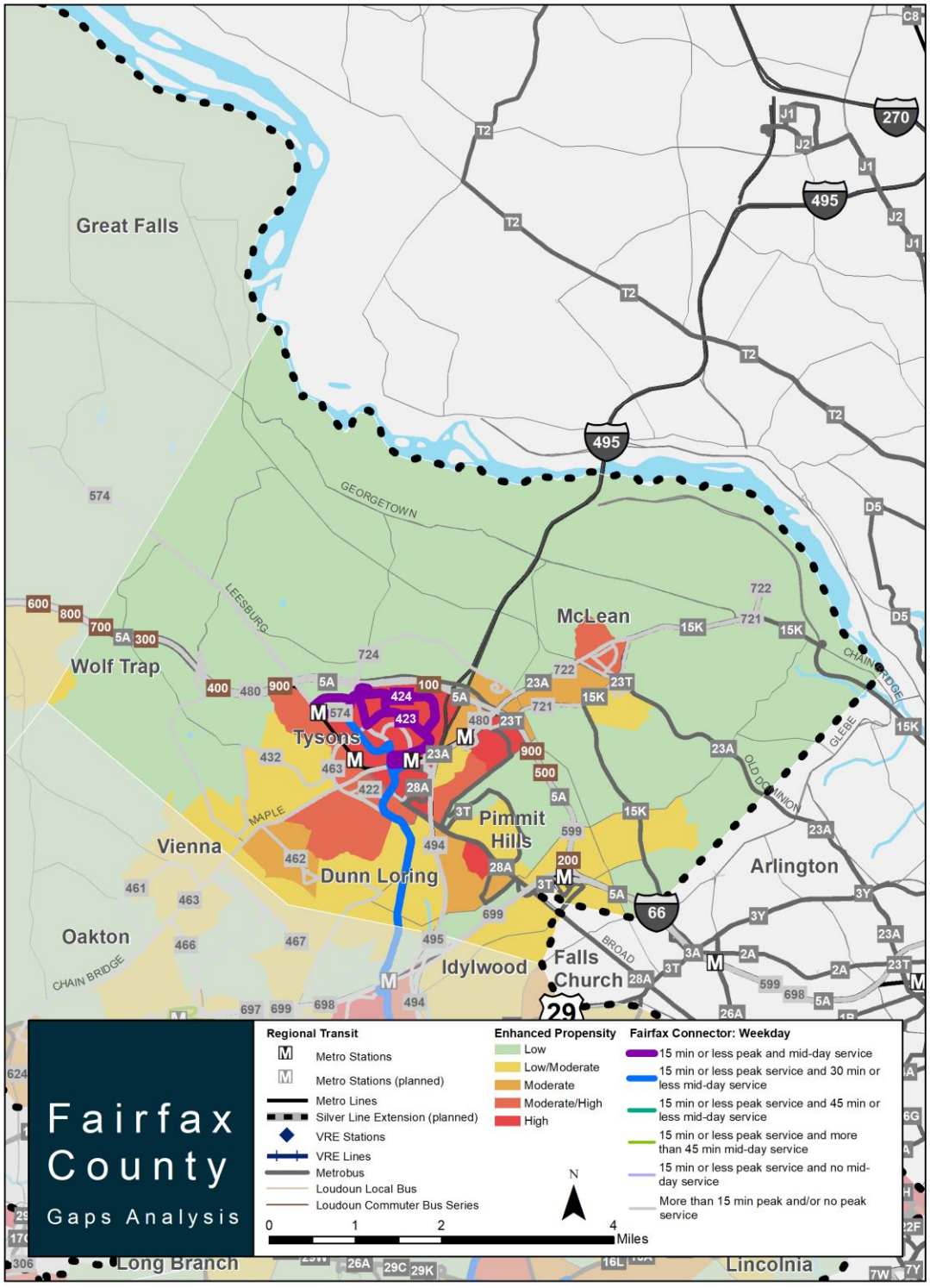
FIGURE 2-26: RESTON-HERNDON SUBAREA ENHANCED PROPENSITY INDEX (PRE-SILVER LINE EXTENSION)



Note. Service changes have occurred for Fairfax Connector and Metrobus since the time of analysis.

Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data, August 2020 Fairfax Connector Service Schedule.

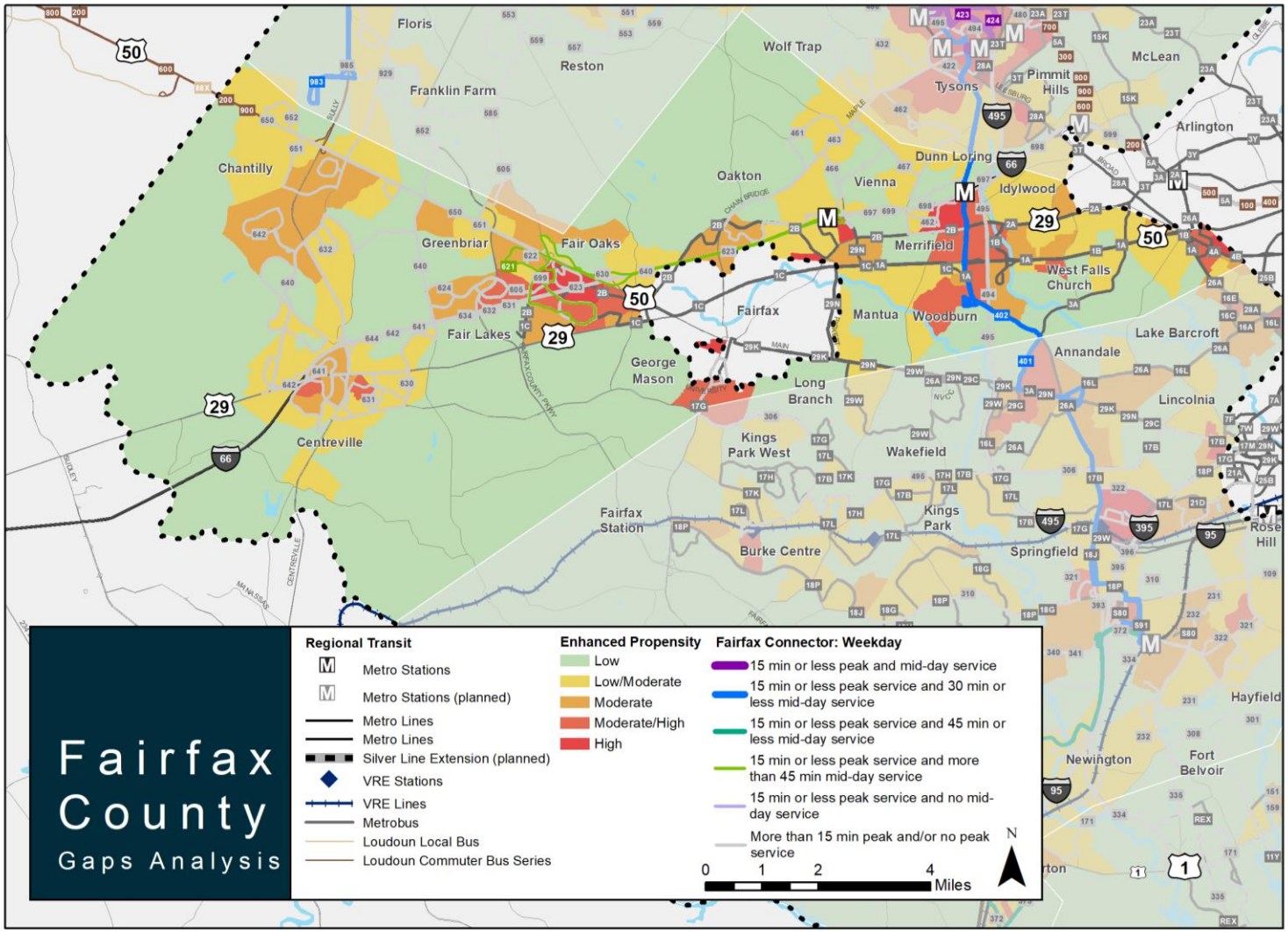
FIGURE 2-27: TYSONS SUBAREA ENHANCED PROPENSITY INDEX (PRE-SILVER LINE EXTENSION)



Note. Service changes have occurred for Fairfax Connector and Metrobus since the time of analysis.

Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data, August 2020 Fairfax Connector Service Schedule.

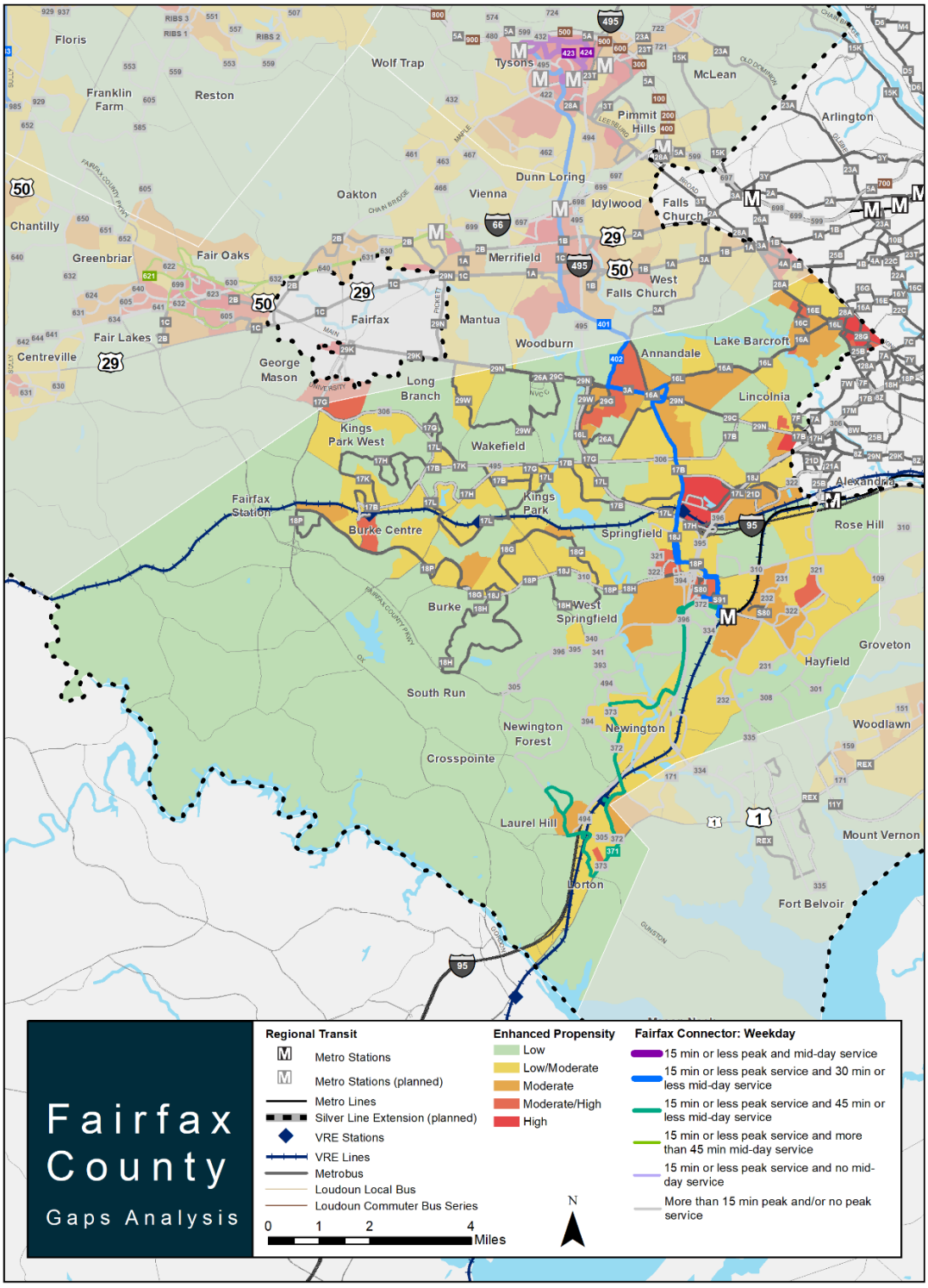
FIGURE 2-28: CENTREVILLE-CHANTILLY-VIENNA SUBAREA ENHANCED PROPENSITY INDEX (PRE-SILVER LINE EXTENSION)



Note. Service changes have occurred for Fairfax Connector and Metrobus since the time of analysis.

Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data, August 2020 Fairfax Connector Service Schedule.

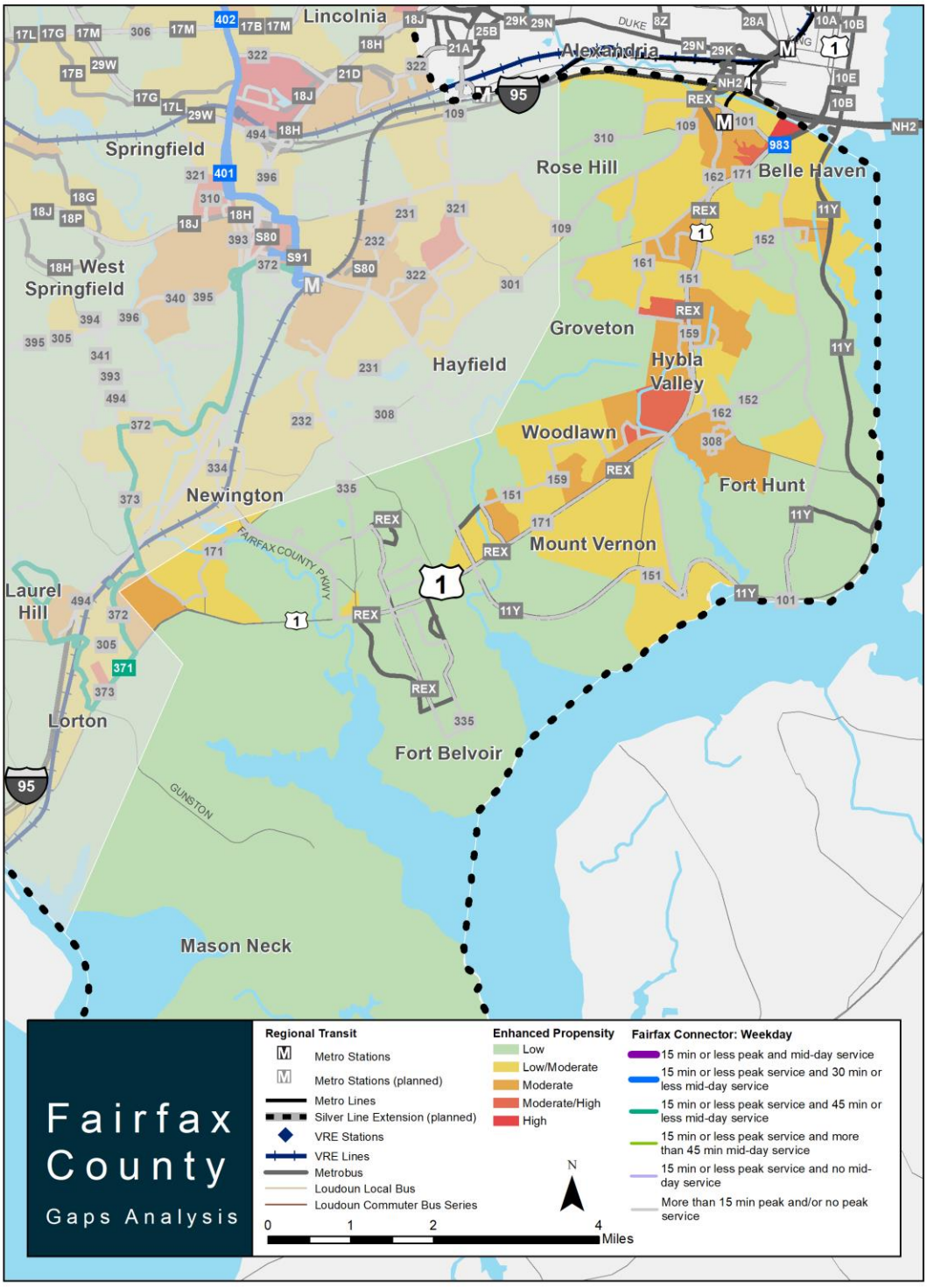
FIGURE 2-29: FRANCONIA-SPRINGFIELD SUBAREA ENHANCED PROPENSITY INDEX (PRE-SILVER LINE EXTENSION)



Note. Service changes have occurred for Fairfax Connector and Metrobus since the time of analysis.

Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data, August 2020 Fairfax Connector Service Schedule.

FIGURE 2-30: HUNTINGTON SUBAREA ENHANCED PROPENSITY INDEX (PRE-SILVER LINE EXTENSION)



Sources: U.S. Census Bureau 2018 American Community Survey, 2017 LEHD/LODES data, August 2020 Fairfax Connector Service Schedule.

Note. Service changes have occurred for Fairfax Connector and Metrobus since the time of analysis. Effective frequency of 15 minutes or less for peak and mid-day service is provided by multiple overlapping routes on segments of Richmond Highway.

SUMMARY OF GAPS

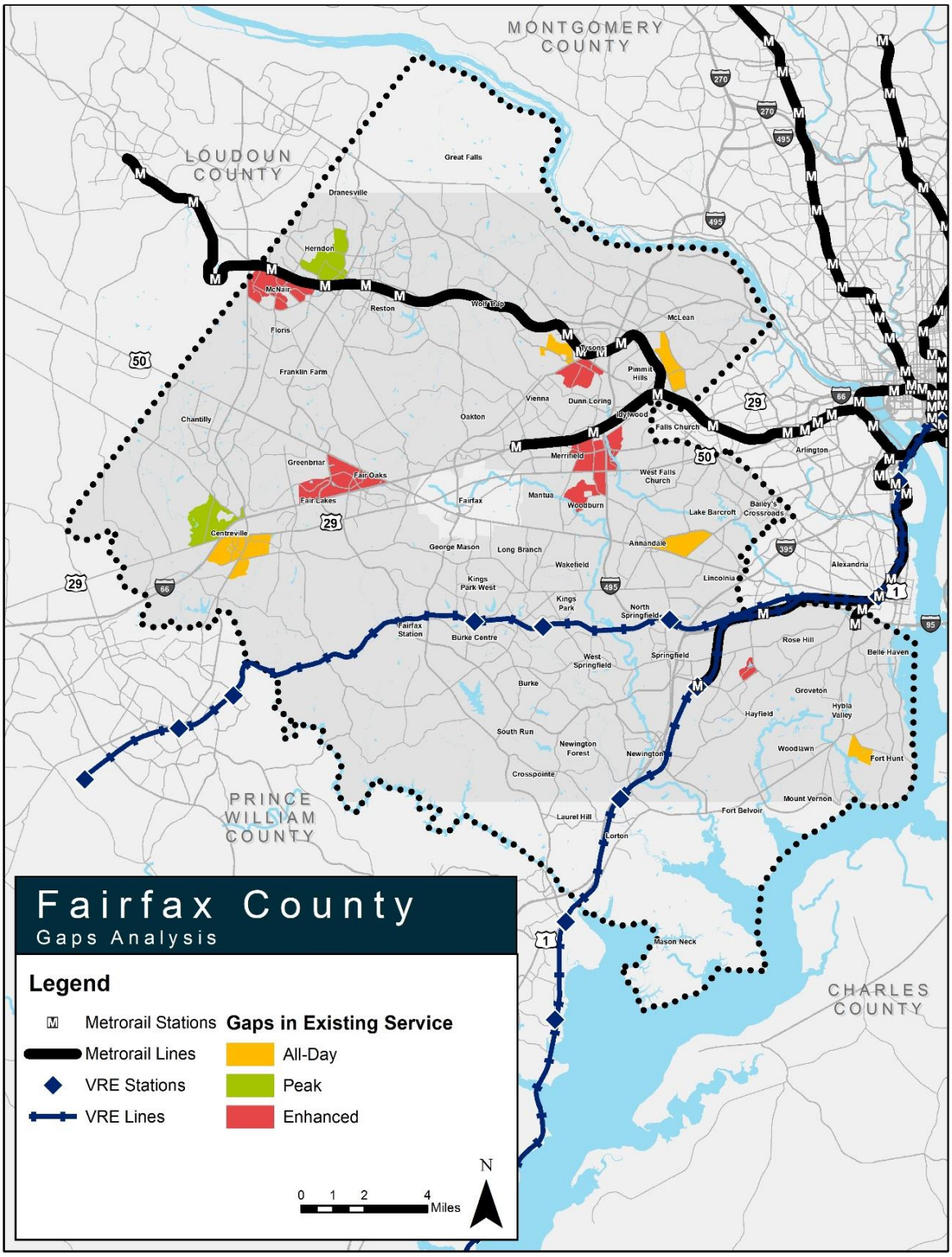
Table 2-7 and **Figure 2-31** provides a summary of the most significant transit service gaps that were identified in Fairfax County. More detail regarding each service type and subarea can be found in the preceding sections. Gaps in the Reston-Herndon subarea were addressed by the bus service changes that started on November 16, 2022.

TABLE 2-7: GAPS IN EXISTING SERVICE (PRE-SILVER LINE EXTENSION)

Subarea	All-Day Index *Areas that could support more midday service*	Peak Service Index *Areas that could support more peak period service*	Enhanced Service Index *Areas that could support more frequent service*
Reston-Herndon		Residential neighborhoods west of the Fairfax County Parkway.	McNair could support additional high-frequency service.
Tysons	East of Great Falls Street and west of Westmoreland Street West of the Greensboro Metrorail station along Old Courthouse Road		South of the Leesburg Pike and Chain Bridge Road.
Centreville-Chantilly-Vienna	Centreville between US 29 and New Braddock Road, and along Centreville Road	Centreville along Stone Road and Braddock Road, near US 29.	Merrifield and Woodburn could support all-day high-frequency service. Fair Lakes north of I-66
Franconia-Springfield	Lincolnia Heights particularly along Lincolnia Road and the Old Colombia Pike		Kingstowne Towne Center
Huntington	Between Fort Hunt and Hybla Valley		

Note. Service changes have occurred for Fairfax Connector and Metrobus since the time of analysis.

FIGURE 2-31: GAPS IN EXISTING SERVICE (PRE-SILVER LINE EXTENSION)



Note. Service changes have occurred for Fairfax Connector and Metrobus since the time of analysis.

2.3 Performance Evaluation

2.3.1 Performance Evaluation

This section evaluates performance in calendar year (CY) 2019 against the performance standards defined at the end of **Chapter 1** (see **Table 1-8**). CY 2019 data was used in the evaluation to account for seasonal fluctuations in transit use throughout the year and avoid the service and performance anomalies of years impacted by COVID-19. As a result, some of the routes referenced in this section no longer operate due to service changes that have occurred since 2019.

Performance was evaluated for the following aspects of service: system accessibility, ridership, reliability, cost efficiency, safety, and customer satisfaction. **Table 2-8** contains systemwide averages for the measures that were evaluated, and comparisons to the benchmarks set in **Chapter 1** are included in the following subsections. Performance-based opportunities for improvement are identified in **Section 2.3.3** based on this analysis.

TABLE 2-8: PERFORMANCE SUMMARY

Service Aspect	Key Performance Indicator	Route Classification	Measure (CY 2019)
System Accessibility	Fairfax County Population Within Service Area	Systemwide	54%
Ridership	Passengers per Revenue Hour (average weekday)	Local	11.6
		Express	14.5
		Systemwide	12.5
	Passengers per Revenue Mile (average weekday)	Local	1.0
		Express	1.0
		Systemwide	1.0
	Passengers per One-Way Trip (average weekday)	Local	9.6
		Express	12.2
		Systemwide	10.4
	Maximum Vehicle Load Factor (average weekday)	Local	0.26
		Express	0.41
		Systemwide	0.31
Reliability	On-Time Performance (average weekday)	Local	80%
		Express	77%
		Systemwide	79%
Cost Efficiency	Operating Cost per Passenger (average weekday)	Local	$9.58
		Express	$12.17
		Systemwide	$10.41
Safety	Bus Collisions	Systemwide	0.28 per 100,000 miles
	Customer Injuries	Systemwide	32
Customer Service	Customer Complaints	Systemwide	3.6 per 10,000 passenger trips

Note. Service changes have occurred for Fairfax Connector since the time of analysis.

Sources: Fairfax Connector's fleet Intelligent Transportation System, Service Schedules for 1/20/2019 to 1/24/2020, 2020 Fairfax County DOT Title VI Plan, FY 2019 National Transit Database Report. Fairfax County DOT and Kimley-Horn, 2021.

SYSTEM ACCESSIBILITY

Fairfax Connector seeks to maintain at least fifty percent of Fairfax County's population within a quarter-mile walking distance of a local route alignment or express route stop. According to the analysis conducted in the 2020 Fairfax County Title VI Program Update, **fifty-four percent of the population has access to Connector service**—exceeding the performance benchmark. About fifty-nine percent of the minority population and forty-nine percent of the non-minority population is within a quarter mile of the service, respectively.

RIDERSHIP

Fairfax Connector evaluates four key ridership metrics: passengers per revenue hour, passengers per revenue mile, passengers per one-way trip, and maximum vehicle load factor. These metrics are evaluated for local and express routes separately as the two types of service have different operating characteristics. As presented in **Chapter 1**, the benchmark for the first three metrics is one standard deviation below the systemwide average for local or express routes, as applicable. Routes that fall below this benchmark may be flagged as an opportunity to improve ridership performance; however, it is important to remember that low-performing routes may still be important components of the system for meeting Connector's goals of choice and access. FCDOT typically takes a deeper look at routes with performance outside of two standard deviations. The benchmark for maximum vehicle load factor is 1.25 for local routes and 1.0 for express routes. Routes that fall above this benchmark may be flagged as an opportunity to alleviate passenger crowding.

For this analysis, ridership metrics were evaluated using average weekday performance data from CY 2019, calculated based on the schedule periods for January 20, 2019, through January 24, 2020. There were no disruptions of service due to COVID-19 during this time period.

Passengers per Revenue Hour

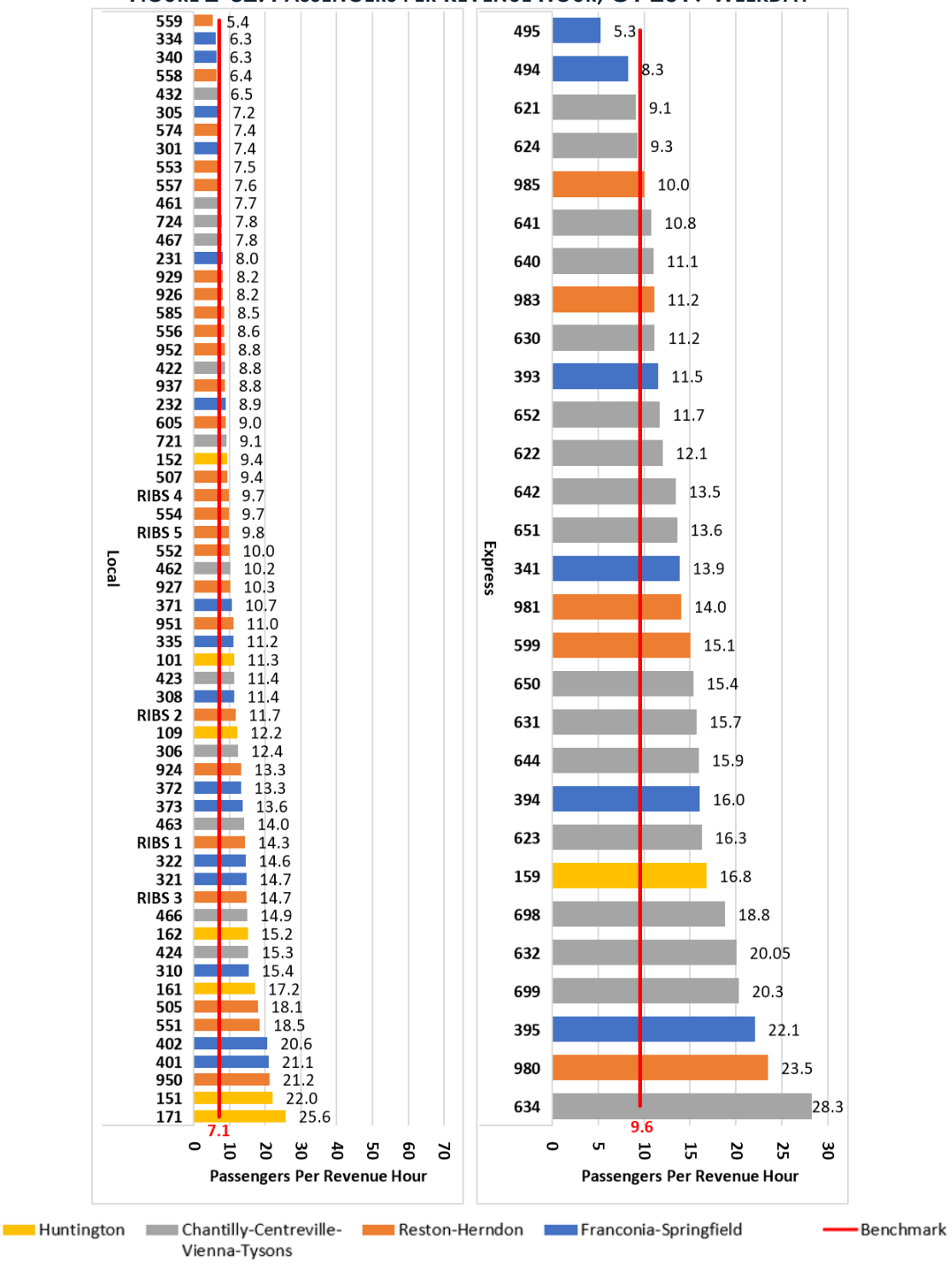
Passengers per revenue hour compares the total ridership on a route to the total number of revenue hours operated by the route. This is a measure of the productivity of a route's average passengers per revenue hour. **Figure 2-34** shows the route-level weekday passengers per revenue hour for CY 2019 as well as the benchmark level of one standard deviation below the systemwide average for either local or express routes.

Overall, express routes were more productive than local routes with an average of 14.5 passengers per revenue hour compared with a local route average and a combined systemwide average of 11.6 and 12.5 passengers per revenue hour, respectively. The most productive express route was Route 634 (Stringfellow Road – Fair Lakes), followed by Routes 980 (Herndon – Monroe), 395 (Gambrill Road – Pentagon), 699 (Government Center – Downtown D.C.) and 632 (Westfields – Vienna). The most productive local route was Route 171 (Richmond Highway), followed by Routes 151 (Engleside – Mt. Vernon), 950 (Herndon – Reston), 401 (Backlick – Gallows Northbound), and 402 (Backlick – Gallows Southbound). These routes each had an average of 20 or more passengers per revenue hour.

Huntington subarea routes were the most productive of the subareas, for both local and express routes, with a local route average of 16.1 passengers per revenue hour and an express route

average of 16.8 passengers per revenue hour. However, there were only seven local routes and one express route in this subarea. Franconia-Springfield local routes had an average of 11.9 passengers per revenue hour, while Reston-Herndon and Chantilly-Centreville-Vienna-Tysons had averages of 10.6 and 10.5 passengers per hour for local routes, respectively. For express routes, Chantilly-Centreville-Vienna-Tysons and Reston-Herndon each had 14.9 and 14.8 passengers per revenue hour, respectively, with Franconia-Springfield express routes having an average of 12.8 passengers per revenue hour.

FIGURE 2-32: PASSENGERS PER REVENUE HOUR, CY 2019 WEEKDAY



Note. Service changes have occurred for Fairfax Connector since the time of analysis.

Sources: Fairfax Connector's fleet Intelligent Transportation System, Service Schedules for 1/20/2019 to 1/24/2020. Fairfax County DOT and Kimley-Horn, 2021.

Excludes seasonal Route 480 (Wolf Trap Express) and existing routes that did not operate during CY 2019.

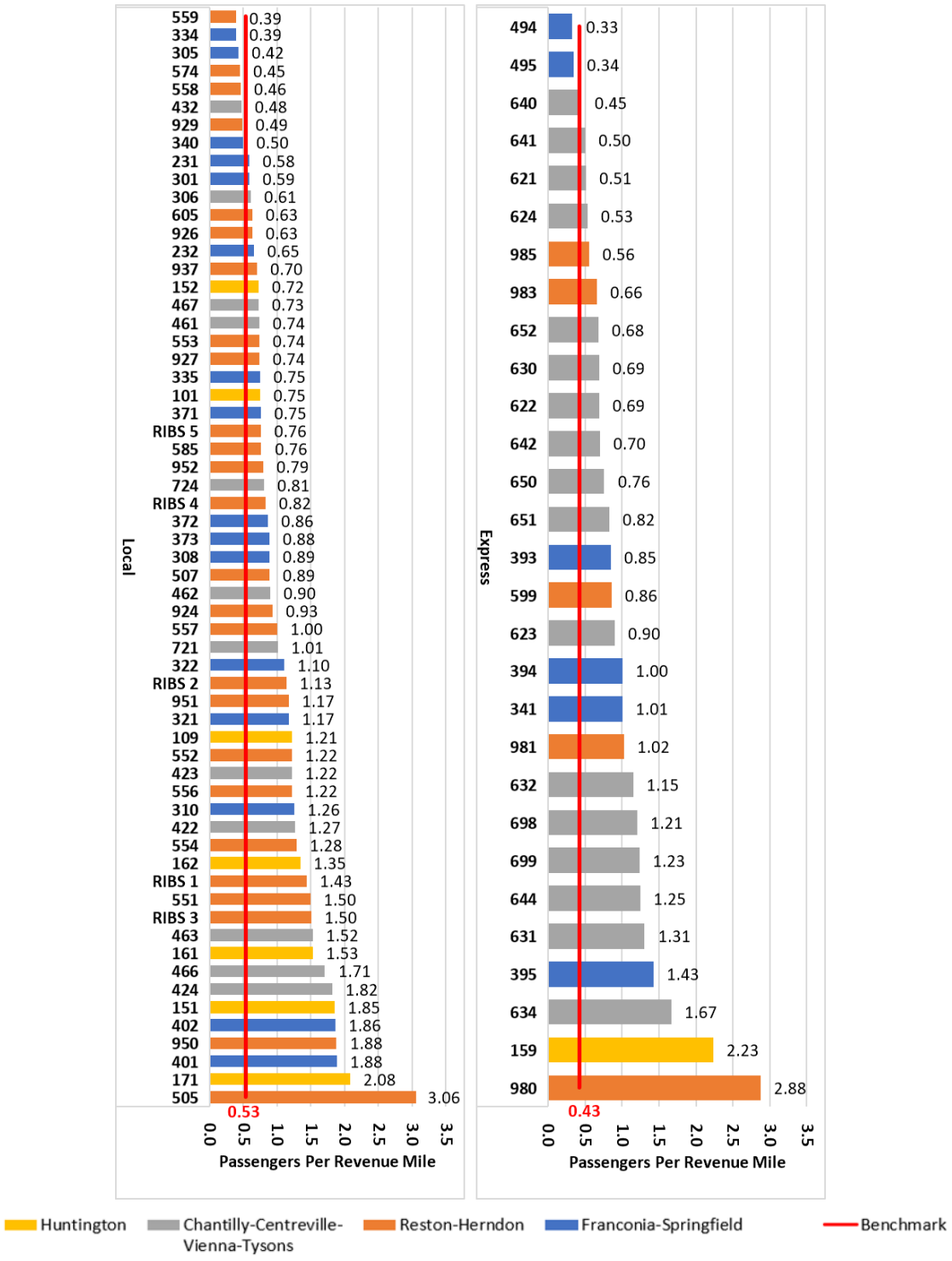
Passengers per Revenue Mile

Similar to passengers per revenue hour, passengers per revenue mile compares total ridership on a route to the total number of revenues miles operated by the route and is a measure of the productivity of a route's average revenue mile. **Figure 2-35** shows the route-level weekday passengers per revenue mile for CY 2019 as well as the benchmark level of one standard deviation below the systemwide average for either local or express routes.

The highest performing route was Route 505 (Reston Town Center), a local route with 3.1 passengers per revenue mile. The next two highest performing routes were both express routes—Route 980 (Herndon – Monroe) and Route 159 (Engleside Limited-Stop) at 2.9 and 2.2 passengers per revenue mile, respectively, followed by local Route 171 (Richmond Highway) at 2.1 passengers per revenue mile. **Overall, the systemwide averages for local routes, express routes, and all routes combined were 1.0 passengers per revenue mile**.

Again, Huntington was the highest-performing subarea with averages of 1.4 and 2.2 passengers per revenue mile for local and express routes, respectively. This was primarily driven by the high performance of Route 159 (Engleside Limited-Stop), which is the only express route in the subarea. The other three subareas all had average passengers per revenue mile between 0.8 and 1.2 for both local and express routes.

FIGURE 2-33: PASSENGERS PER REVENUE MILE, CY 2019 WEEKDAY



Note. Service changes have occurred for Fairfax Connector since the time of analysis.

Sources: Fairfax Connector's fleet Intelligent Transportation System, Service Schedules for 1/20/2019 to 1/24/2020. Fairfax County DOT and Kimley-Horn, 2021.

Excludes seasonal Route 480 (Wolf Trap Express) and existing routes that did not operate during CY 2019.

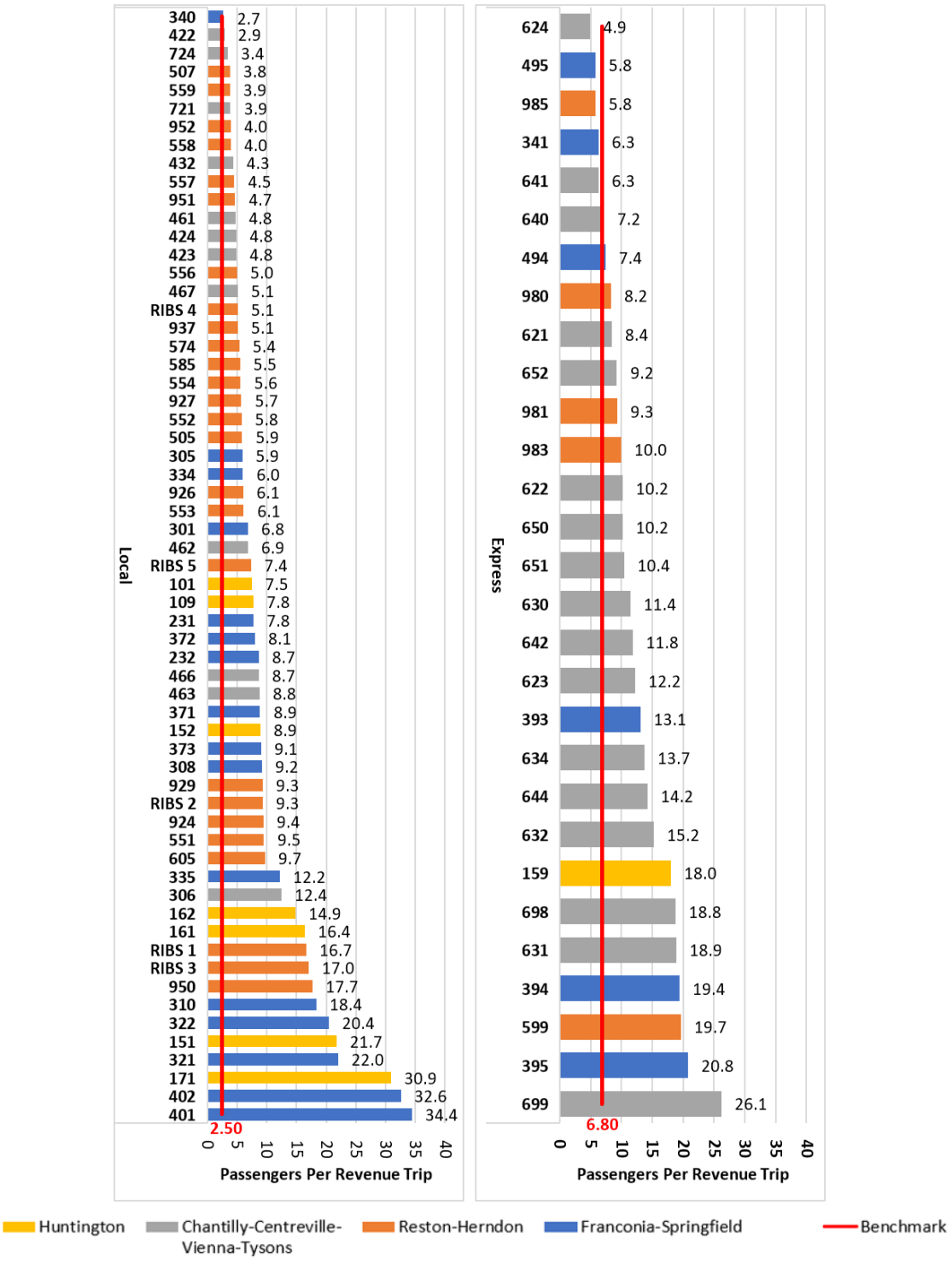
Passengers per One-Way Trip

Passengers per revenue trip or one-way trip is the third ridership metric and compares the total ridership on a route to the total number of vehicle trips on the route. **Figure 2-34** shows the route-level weekday passengers per one-way trip for CY 2019 as well as the benchmark level of one standard deviation below the systemwide average for either local or express routes.

The highest performing routes on a passengers per trip basis were Routes 401 and 402, which are the northbound and southbound Backlick – Gallows routes, with 34 and 33 passengers per trip, respectively. The next highest-performing route was Route 171 (Richmond Highway), also a local route, with 31 passengers per trip. The last route with more than 25 passengers per trip was express Route 699 (Government Center – Downtown D.C.) with 26 passengers per trip. Although these local routes were amongst the highest performing in the system, **overall local routes had an average of 9.6 passengers per trip compared to an average of 12.2 passengers per trip for express routes.**

Huntington was the highest-performing subarea for both local and express routes. After Huntington, the Franconia-Springfield subarea had the highest performing local routes with an average of 13.3 passengers per trip. The local route averages were much lower in the Reston-Herndon and Chantilly-Centreville-Vienna-Tysons subareas (7.4 and 5.9 passengers per revenue trip, respectively). However, for express routes, the Chantilly-Centreville-Vienna-Tysons subarea had the second-highest number of passengers per trip at 12.3, closely followed by the Franconia-Springfield area at 12.1 passengers per revenue trip.

FIGURE 2-34: PASSENGERS PER ONE-WAY TRIP, CY 2019 WEEKDAY



Note. Service changes have occurred for Fairfax Connector since the time of analysis.

Sources: Fairfax Connector's fleet Intelligent Transportation System, Service Schedules for 1/20/2019 to 1/24/2020. Fairfax County DOT and Kimley-Horn, 2021.

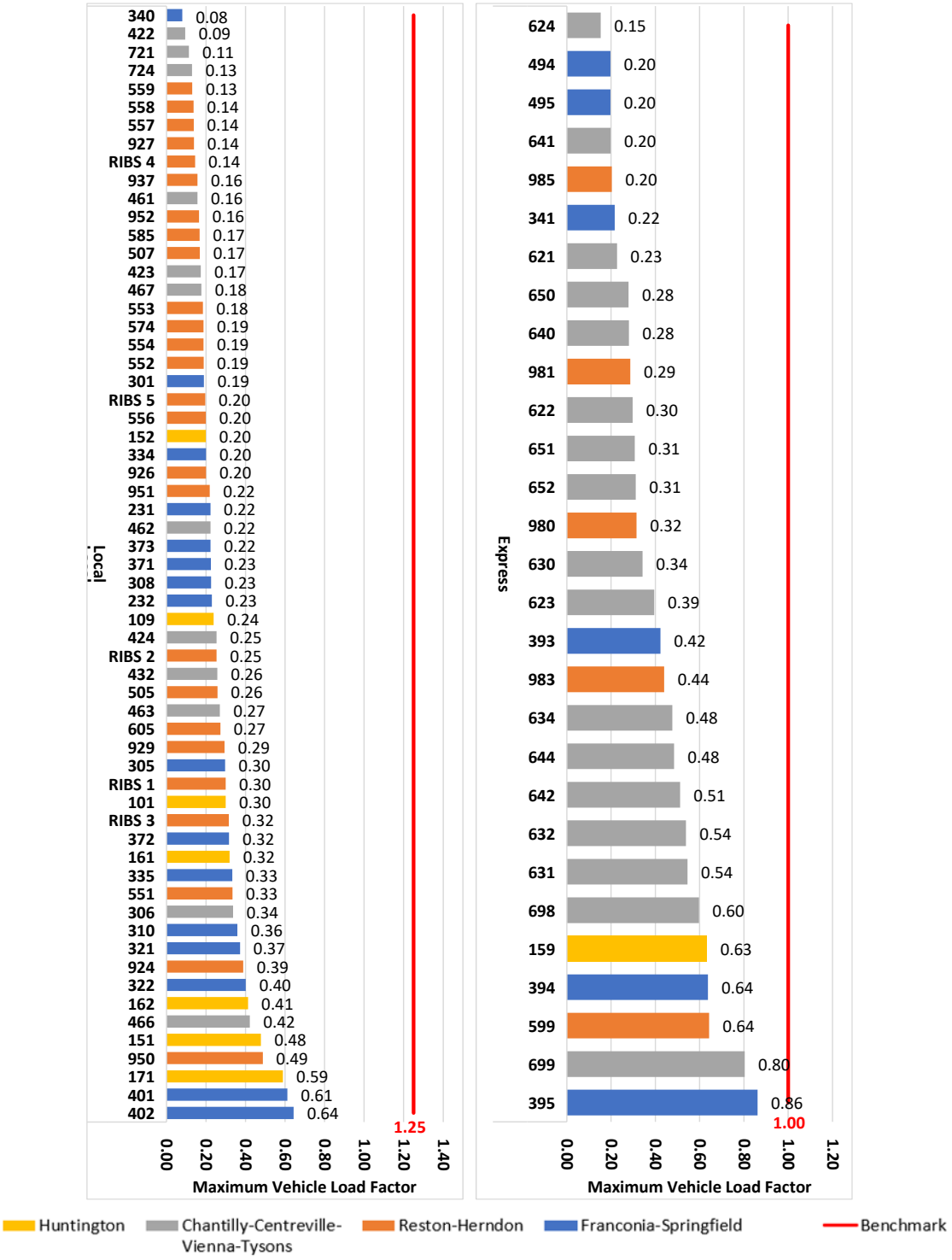
Excludes seasonal Route 480 (Wolf Trap Express) and existing routes that did not operate during CY 2019.

Maximum Vehicle Load Factor

Maximum vehicle load factor compares the maximum passenger load on a route to the average number of available seats in order to evaluate the level of passenger crowding. **Figure 2-35** shows the weekday maximum vehicle load factors for each route as well as the benchmark levels for both local and express routes. Overall, local routes had an average maximum load factor of 0.26 compared to an average of 0.41 for express routes.

None of the routes exceeded the benchmark values in CY 2019. Express Route 395 (Gambrill Road – Pentagon) had the highest load factor at 0.86, closely followed by another express route, Route 699 (Government Center – Downtown D.C.) at 0.80. The highest maximum load factor on a local route was 0.64 on Route 402 (Backlick – Gallows Southbound), closely followed by Route 401 (Backlick – Gallows Northbound) at 0.61. This means that all routes—both local and express—had a maximum load of less than one passenger per seat for weekday service. There were no routes that exceeded a maximum load factor of one passenger per seat for Saturday or Sunday service.

FIGURE 2-35: WEEKDAY MAXIMUM VEHICLE LOAD FACTOR, CY 2019 WEEKDAY



Note. Service changes have occurred for Fairfax Connector since the time of analysis.

Sources: Fairfax Connector's fleet Intelligent Transportation System, 2020 Fairfax County DOT Title VI Plan. Fairfax County DOT and Kimley-Horn, 2021.

Available seats for local RIBS routes were assumed to be 37 based on the average available seats for trips systemwide. Excludes seasonal Route 480 (Wolf Trap Express) and existing routes that did not operate during CY 2019.

RELIABILITY

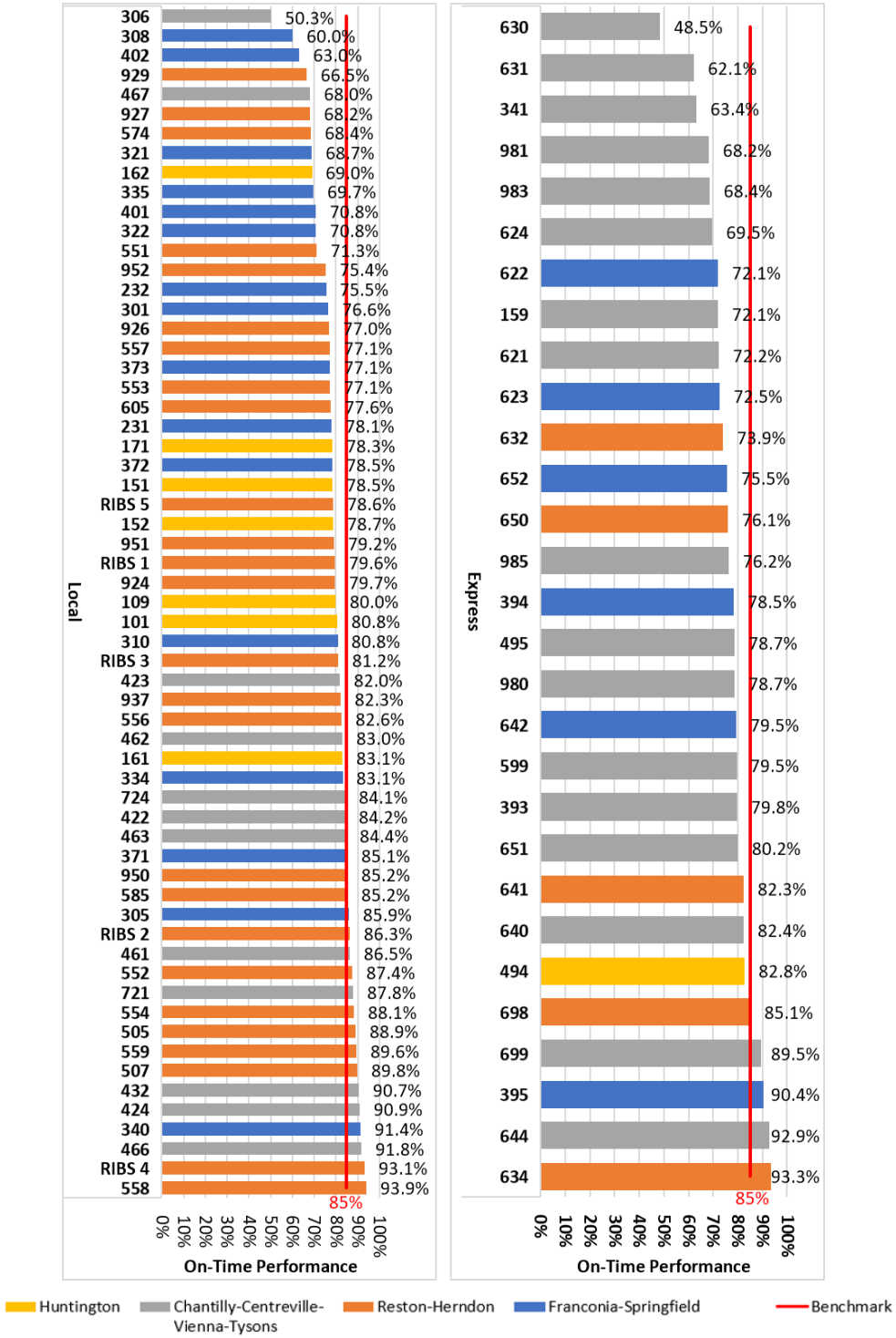
On-Time Performance

Fairfax Connector evaluates reliability in terms of on-time performance. Connector requires its operating contractor to maintain a minimum standard of at least 85 percent of trips for each route being "on-time," which is defined as being between one minute early and six minutes late at time points. **The average weekday on-time performance for all routes in CY 2019 was 79 percent**. Local routes were slightly better, with an average on-time performance of 80 percent compared to 77 percent for express routes. **Figure 2-36** shows the route-level weekday on-time performance for each route as well as the benchmark level of 85 percent. On-time performance has improved since the onset of the COVID-19 pandemic and has trended upward since the CY 2019 data.

There were 18 local routes and 5 express routes with on-time performance of 85 percent or more. The highest performing route was local Route 558 (Center Harbor – Lake Fairfax) with 94 percent on-time performance. This was followed by the highest performing express route, Route 634 (Stringfellow Road – Fair Lakes), and then local route RIBS 4 (North Point) and express Route 644 (Centreville [Stone Road] Park and Ride), all of which had on-time performance rates of 93 percent.

Overall, Reston-Herndon had the highest on-time performance of all of the subareas at 81 percent. Chantilly-Centreville-Vienna-Tysons had an average on-time performance of 74 percent for express routes, which was the lowest of all of the subareas. This was attributed to the unreliability of I-66 during congested peak periods for routes going to and from the Vienna Metrorail station. This reliability is expected to be improved with the construction of Express Lanes on I-66 that opened fully in November 2022. The Franconia-Springfield subarea had the lowest on-time performance for local routes at 76 percent compared to the other subareas.

FIGURE 2-36: ON-TIME PERFORMANCE, CY 2019 WEEKDAY



Note. Service changes have occurred for Fairfax Connector since the time of analysis.

Sources: Fairfax Connector's fleet Intelligent Transportation System. Fairfax County DOT and Kimley-Horn, 2021.

Excludes seasonal Route 480 (Wolf Trap Express) and existing routes that did not operate during CY 2019.

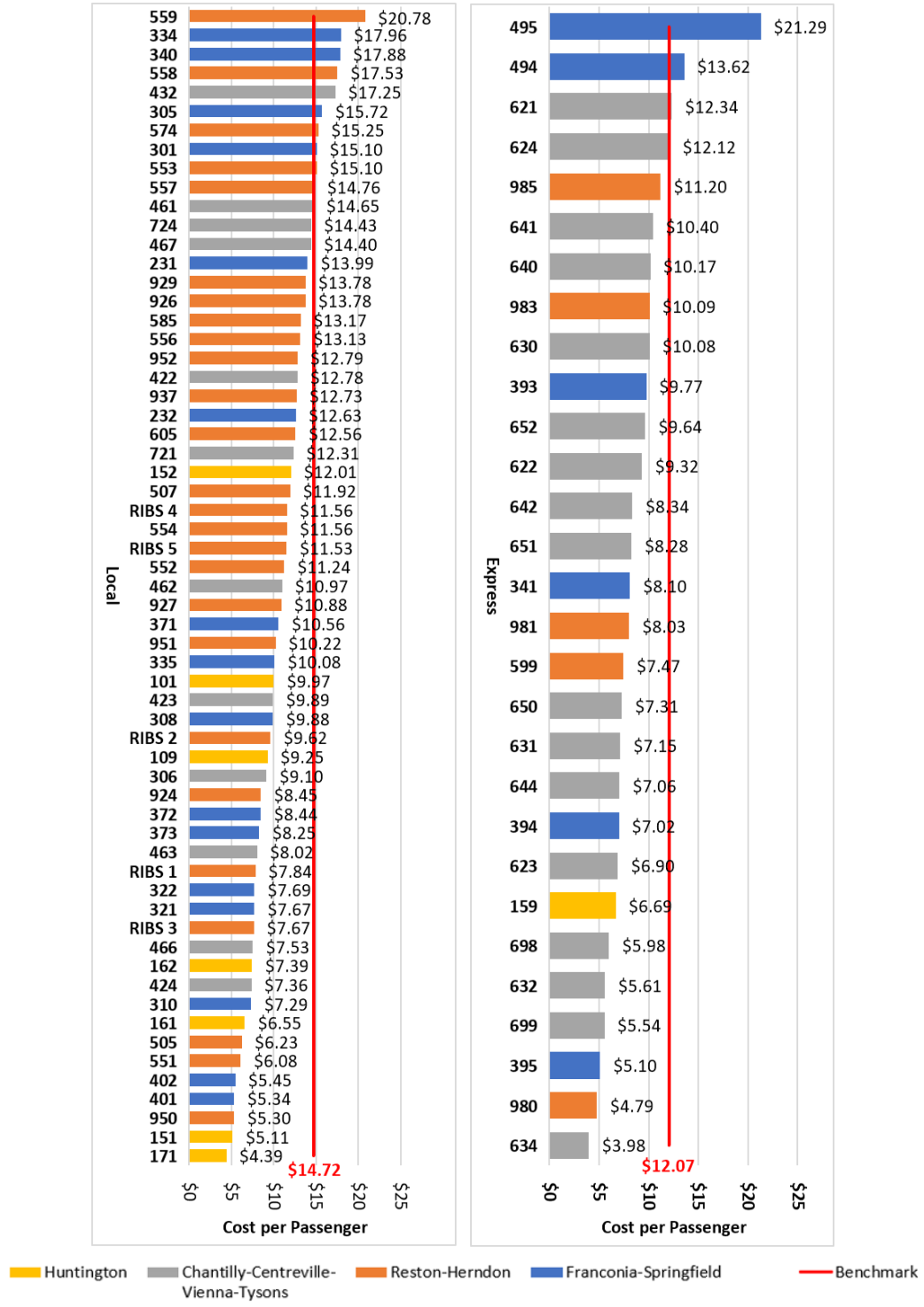
COST EFFICIENCY

Operating cost per passenger is a measure of the cost efficiency of service on a route that compares operating costs for a route to total ridership on the route. For this analysis, annual operating costs by route were estimated by first calculating Fairfax Connector's operating costs per revenue hour (based on total operating costs and vehicle revenue hours reported in the FY 2019 NTD Report) and applying this to the total CY 2019 annual revenue hours operated on each route estimated from service schedules. For the purpose of this calculation, the fully-allocated cost was used, as the resources invested in activities like administration and planning are all necessary to put service on the street. Unlike the previous ridership and reliability measures, for this cost efficiency measure, a *lower* number means better performance and routes should operate *below* the benchmark level. **Figure 2-37** shows the route-level operating cost per passenger for FY 2019 as well as the benchmark level of one standard deviation above the systemwide average for either local or express routes. Routes that have higher costs than this benchmark may be flagged as an opportunity to improve efficiency; however—like ridership—low-performing routes from a cost-efficiency standpoint may still be important components of the system for meeting Connector's goals of choice and access.

Express routes had a lower average operating cost per passenger at $8.74 per passenger compared to an average cost of $11.03 for local routes. The highest performing routes with operating costs less than $5.00 per passenger were express Routes 634 (Stringfellow Road – Fair Lakes) and 980 (Herndon – Monroe), with costs per passenger of $3.98 and $4.79, respectively, as well as local Route 171 (Richmond Highway) with a cost per passenger of $4.39. The highest operating cost per passenger in the system was for Route 495 (Burke Centre – Tysons). Three other express routes had costs per passenger greater than the express route benchmark of $12.07, including Routes 494 (Lorton – Springfield – Tysons), 621 (Fairfax County Government Center), and 624 (Stringfellow Road – Fair Lakes). There were 10 local routes with costs per passenger greater than the local route benchmark of $14.72, starting with Route 559 (Reston South – Glade – Soapstone), followed by Routes 334 (Newington Circulator), 340 (Patriot Ridge – Saratoga), 558 (Center Harbor – Lake Fairfax), 432 (Old Courthouse – Beulah), 305 (Newington Forest – Silverbrook Road), 574 (Reston – Tysons), 301 (Telegraph Road), 553 (Reston South – Viking – Pinecrest), and 557 (Reston South – Soapstone).

The Huntington subarea had the lowest operating costs per passenger of all the subareas, with a combined local and express route average cost per passenger of $7.67. For local routes, the subarea with the next lowest average operating cost per passenger was Franconia-Springfield at $10.87 per passenger, while the other subareas were over $11.50 per passenger. For express routes, Chantilly-Centreville-Vienna-Tysons and Reston-Herndon had similar costs per passenger at $8.25 and $8.32, respectively, while Franconia-Springfield had the highest average operating cost per passenger at $10.82 per passenger.

FIGURE 2-37: OPERATING COST PER PASSENGER, CY 2019



Note. Service changes have occurred for Fairfax Connector since the time of analysis.

Sources: Fairfax Connector's fleet Intelligent Transportation System. FY 2019 National Transit Database Report. Fairfax County DOT and Kimley-Horn, 2021.

Excludes seasonal Route 480 (Wolf Trap Express) and existing routes that did not operate during CY 2019.

SAFETY

There are several factors that can be considered when measuring safety. The two that are considered in this performance evaluation are bus collisions and customer injuries reported.

Bus Collisions

The bus collision safety measure identifies the number of bus collisions and incidents occurring in a year. In CY 2019, there were 36 bus collisions. Normalizing by vehicle mileage, there were **0.28 collisions per 100,000 miles in CY 2019**, which is well below the benchmark of 2.0 per 100,000 miles.

Customer Injuries

The customer injuries safety measure looks at the number of customer injuries identified, where injuries are defined as any damage or harm done to a person as a result of an event that requires immediate medical attention away from the scene. In CY 2019, there were **32 injuries identified**. This number was higher than the benchmark of zero injuries that Connector strives to achieve. Many of these injuries were a result of incidents that were non-preventable, such as another vehicle coming into contact with the bus.

CUSTOMER SERVICE

Customer complaints per 10,000 passenger trips is used as a measure of customer satisfaction. This metric uses passenger trips as a base for comparing across time periods with different ridership levels. In CY 2019, there were **3.6 customer complaints for every 10,000 passenger trips**. This measure was slightly higher than the benchmark of 2.5 customer complaints for every 10,000 passenger trips.

2.3.2 Trend Analysis

This trend analysis reports on and assesses Fairfax Connector's routes during a seven-year period spanning FY 2016 to FY 2022. Such an evaluation allows for an assessment of transit services over time and sheds light on how development and changing demographics have impacted transit performance and system growth. This analysis looks at performance metrics for service area characteristics, operational statistics, ridership, and revenue and cost. In accordance with DRPT's *Performance Based Operating Assistance Allocation Guidance*, this analysis includes the following performance metrics:

- Ridership
- Passengers per Vehicle Revenue Mile
- Passengers per Vehicle Revenue Hour
- Operating Cost
- Operating Cost per Vehicle Revenue Mile
- Operating Cost per Vehicle Revenue Hour
- Operating Cost per Passenger

SERVICE AREA CHARACTERISTICS

A review of service area characteristics allows an agency to assess how the scale of its operations and its constituency size have evolved along with the service provided. As shown in **Table 2-9**, there was an increase in service area population over the past seven years. Overall, from FY 2016 to FY 2022, there was a 3 percent increase in population. There was no change in the service area square mileage.

TABLE 2-9: TREND ANALYSIS SERVICE AREA STATISTICS

Service Area Statistics	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Square Miles	407	407	407	407	407	407	407
Population	1,131,886	1,138,652	1,125,385	1,152,873	1,152,873	1,150,856	1,164,025

Source: FY 2016 – FY 2022 National Transit Database Reports

OPERATIONAL STATISTICS

A review of operational statistics describes the level of service Fairfax Connector has provided from FY 2016 to FY 2022. **Table 2-10** presents the vehicles operated in maximum service as well as the revenue hours and revenue miles operated by Connector during the past seven years. As shown in **Table 2-11**, all three operational measures have increased since FY 2016 as a result of expanding Connector service, particularly in the years following the COVID-19 pandemic.

TABLE 2-10: TREND ANALYSIS OPERATIONAL STATISTICS

Operational Statistics	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Vehicles Operated in Maximum Service (VOMS)	226	235	245	264	237	276	284
Vehicle Revenue Miles (VRM)	9,191,836	9,574,848	9,865,555	10,047,341	9,519,621	9,989,631	10,863,043
Vehicle Revenue Hours (VRH)	721,190	735,918	749,786	759,778	783,021	777,466	840,571

Source: FY 2016 - 2022 National Transit Database Reports

TABLE 2-11: TREND ANALYSIS OPERATIONAL STATISTICS PERCENT CHANGE

Operational Statistics	FY2016 – FY2022
Vehicles Operated in Maximum Service (VOMS)	+26%
Vehicle Revenue Miles (VRM)	+18%
Vehicle Revenue Hours (VRH)	+17%

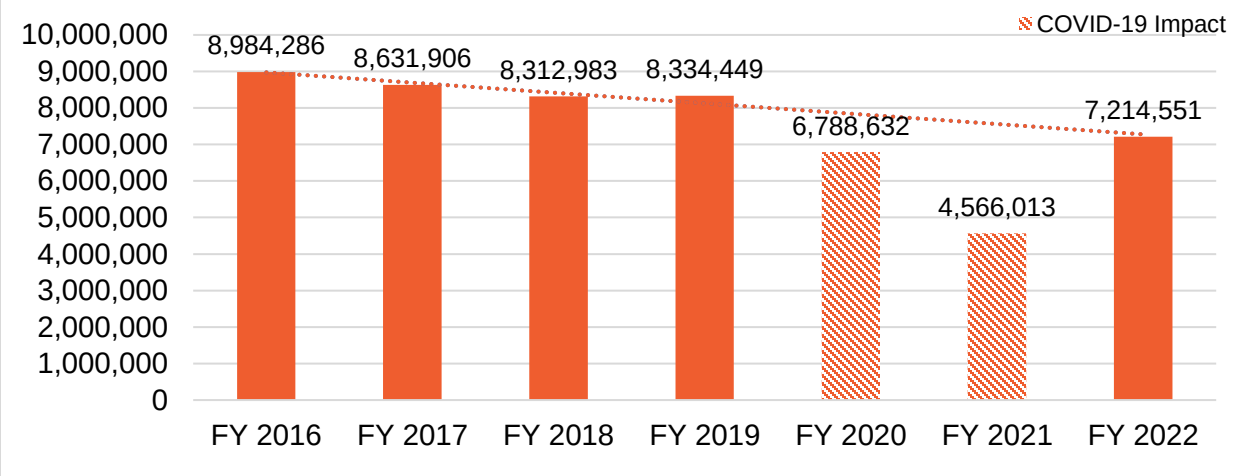
Source: FY 2016 - FY 2022 National Transit Database Reports. Kimley-Horn, 2023.

RIDERSHIP

An assessment of ridership reveals how the usage of Fairfax Connector services has changed over the seven-year analysis period. This analysis looks at unlinked passenger trips, or the total number of boardings on vehicles, regardless of how many transfers were made during any single trip.

As shown in **Figure 2-38**, there has been a decrease in ridership since FY 2016. **Table 2-12** shows that between FY 2016 and FY 2018, there was a gradual decrease in ridership of about 4 percent per year, but ridership was leveling out and even increasing between 2018 and 2019 prior to the COVID-19 pandemic. This is similar to the national trend of a decline in bus ridership of 6.3 percent from 2015 to 2019 as reported by the American Public Transportation Association (APTA)[21]. FY 2020 brought a 19 percent decrease in ridership compared to FY 2019 due to impacts of the COVID-19 pandemic on transit usage. While ridership has rebounded significantly from the pandemic decline, FY 2022 ridership remained 13% below that of FY 2019. **Figure 2-39** shows all of Northern Virginia's transit ridership since FY 2016, which shows a similar trend.

FIGURE 2-38: TREND IN TOTAL RIDERSHIP



Source: FY 2016 - FY 2022 National Transit Database Reports

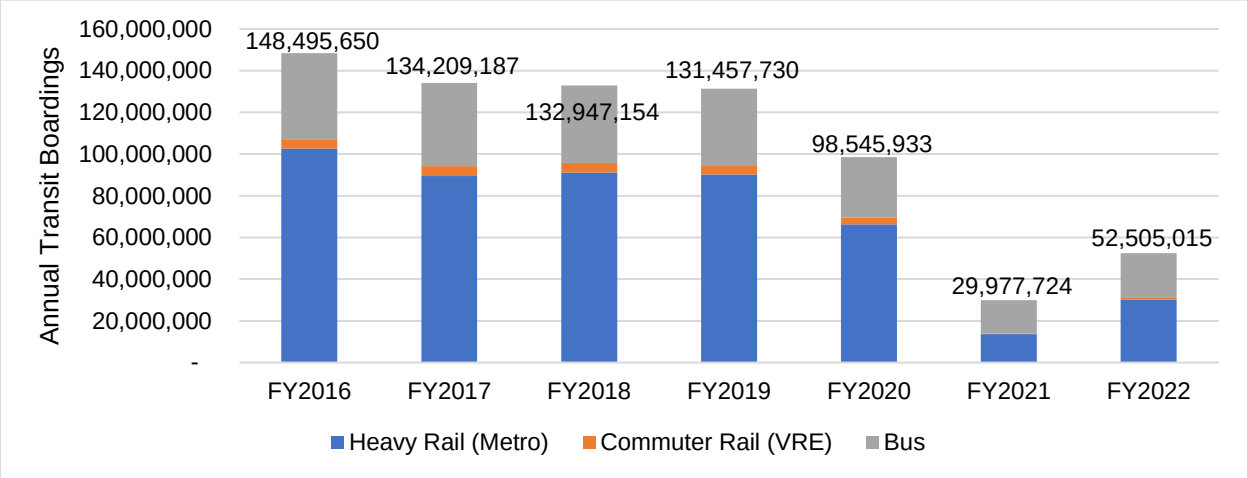
[21] https://www.apta.com/research-technical-resources/transit-statistics/ridership-report/

TABLE 2-12: TOTAL RIDERSHIP PERCENT CHANGE

Year Range	Percent Change
FY 16 – FY 22	-20%

Sources: FY 2016 – FY 2022 National Transit Database Reports. Kimley-Horn, 2023.

FIGURE 2-39: NORTHERN VIRGINIA ANNUAL TRANSIT BOARDINGS (ALL MODES), FY 2016 - FY 2022



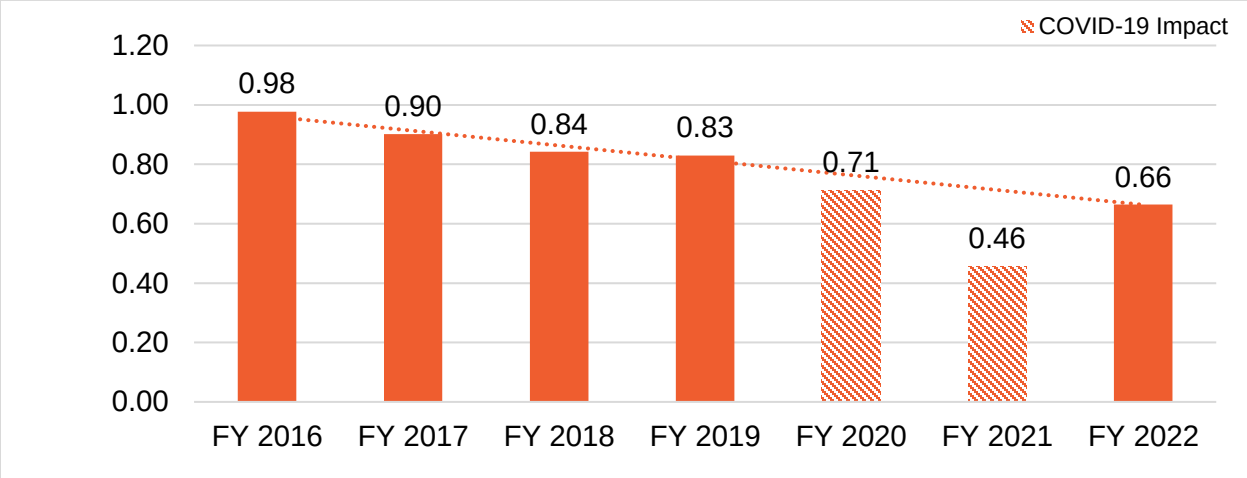
Source: Northern Virginia Transportation Commission[22]

[22] *https://novatransit.org/data-archive/*

Passengers per Revenue Mile

Passengers per revenue mile measures the productivity of Fairfax Connector in transporting its passengers. This measure is often, but not always, linked with trends in total ridership. Similar to the recent trend in total ridership, there was a decrease in passengers per revenue mile from FY 2016 to FY 2020, as shown in **Figure 2-40**, but the total decrease was more significant than the decrease in ridership, as shown in **Table 2-13**. This reflects the fact that while ridership decreased—especially between 2019 and 2020 due to the COVID-19 pandemic—revenue miles increased as new and enhanced services were introduced. Like ridership, this measure was leveling out between FY 2018 and FY 2019 prior to COVID-19 impacts. Similarly, passengers per revenue mile have recovered significantly from the pandemic decline and remained 20% below FY 2019 levels as of FY 2022.

FIGURE 2-40: TREND IN PASSENGERS PER REVENUE MILE



Source: FY 2016 – 2022 National Transit Database Reports

TABLE 2-13: PASSENGERS PER REVENUE MILE PERCENT CHANGE

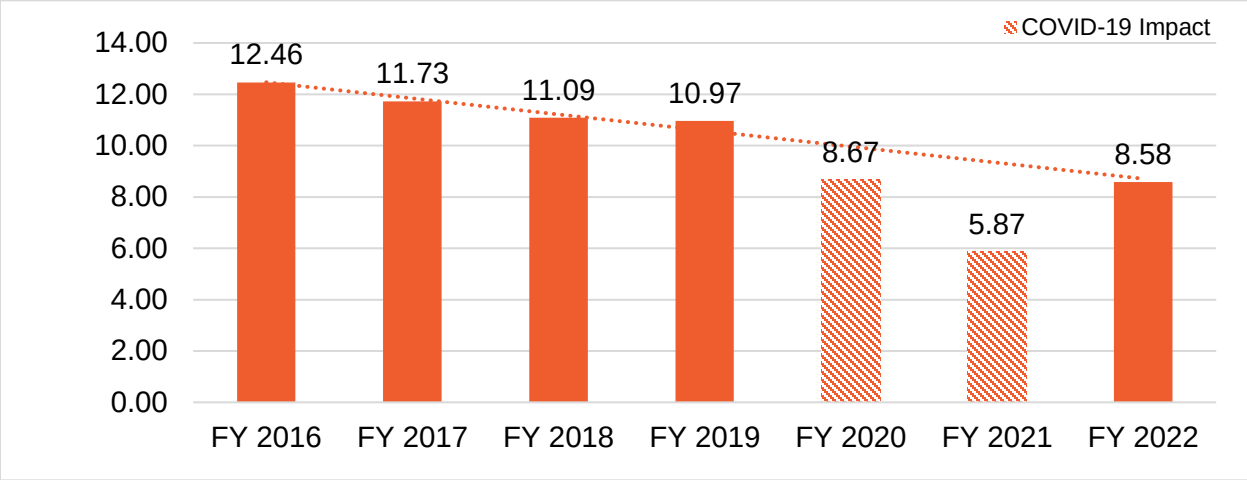
Year Range	Percent Change
FY 16 – FY 22	-32%

Sources: FY 2016 – FY 2022 National Transit Database Reports. Kimley-Horn, 2023.

Passengers per Revenue Hour

Passengers per revenue hour is another metric used to evaluate how productively Fairfax Connector vehicles spend their time (rather than distance) in service. As was the case with other ridership metrics covered in this section, passengers per revenue hour decreased from FY 2016 to FY 2019 with a steeper decrease in FY 2020 and FY 2021 attributed to the COVID-19 pandemic, as shown in **Figure 2-41** and **Table 2-14**. Between 2018 and 2019 passengers per revenue hour was leveling off compared to slight declines in prior years. Here too, passengers per revenue hour for FY 2022 showed a significant improvement over the declines induced by the pandemic and remained 22% lower than in FY 2019.

FIGURE 2-41: TREND IN PASSENGERS PER REVENUE HOUR



Source: FY 2016 – FY 2020 National Transit Database Reports

TABLE 2-14: PASSENGERS PER REVENUE HOUR PERCENT CHANGE

Year Range	Percent Change
FY 16 – FY 22	-31%

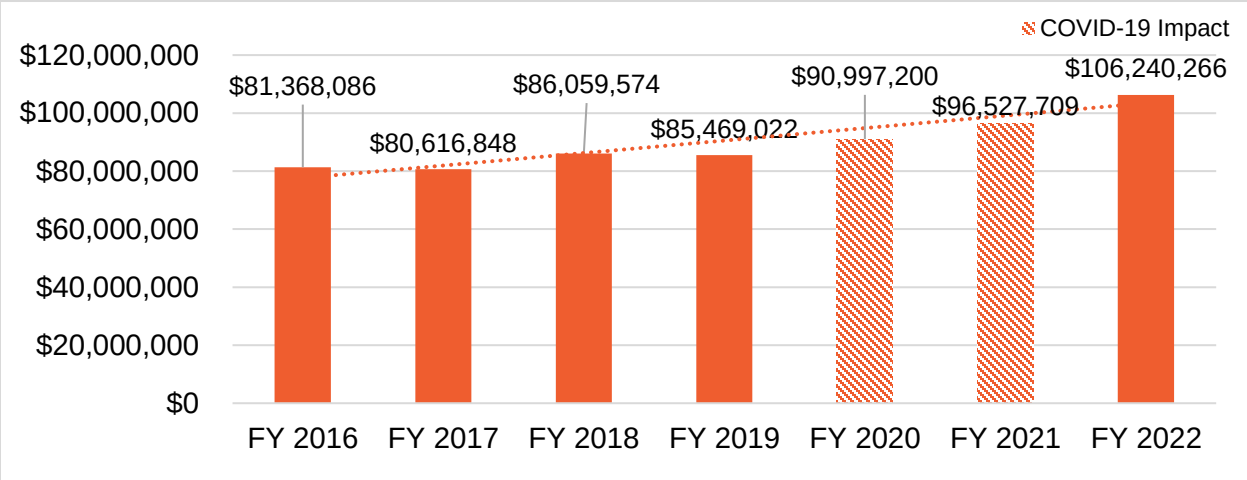
Sources: FY 2016 – FY 2022 National Transit Database Reports. Kimley-Horn, 2023.

REVENUE AND COST

An analysis of operating expenses over time can elicit an understanding of how much money Fairfax Connector expends to operate its services each fiscal year. This analysis looked at fully-allocated costs in order to incorporate all costs necessary to provide service, including costs such as administration and planning costs. Unlike ridership data, the percent change in operating expenses was neither consistently negative nor positive across the analysis time frame as **Figure 2-42** shows. Overall, there was a 5 percent increase in operating expenses from FY 2016 to FY 2019 and an additional 6 percent increase in operating expenses in from FY 2019 to FY 2020. There were several factors that contributed to increased expenses between FY 2019 and FY 2022 including a new service contract being initiated, which set new

hourly rates paid to the contractor for operating Connector service, and increased expenses due to COVID-19 (deep cleaning, masks, etc.). Since the pandemic started, operating expenses have continued to increase, with FY 2022 up 24% over FY 2019.

FIGURE 2-42: TREND IN OPERATING EXPENSES



Source: FY 2016 - 2022 National Transit Database Reports

TABLE 2-15: OPERATING EXPENSES PERCENT CHANGE

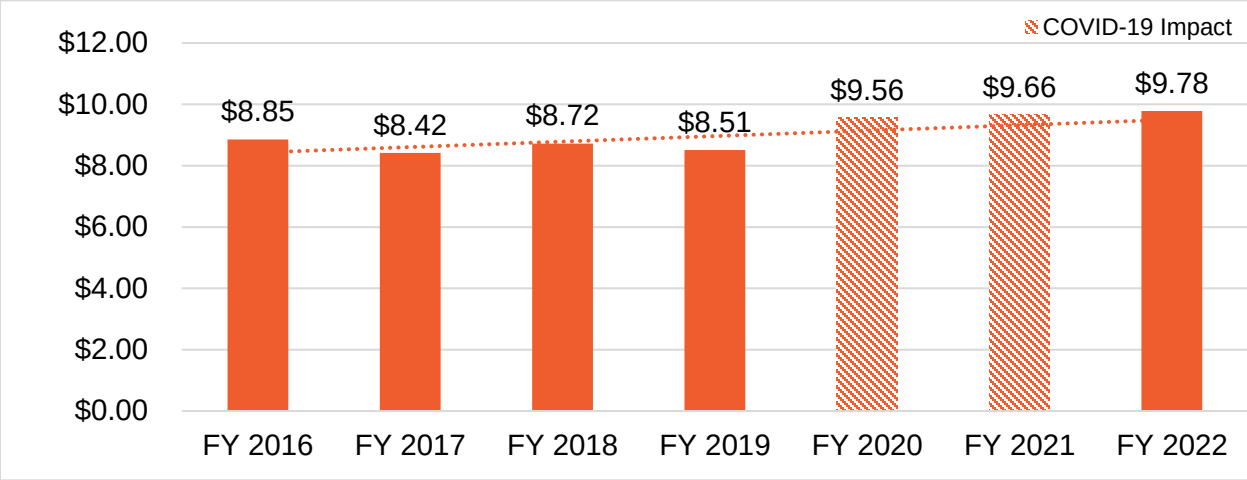
Year Range	Percent Change
FY 16 – FY 22	+31%

Sources: FY 2016 – FY 2022 National Transit Database Reports. Kimley-Horn, 2023.

Operating Expenses per Revenue Mile

Analyzing operating expenses per vehicle revenue mile allows for an evaluation of the efficiency of revenue miles operated by the service. While vehicle revenue miles increased each year from the prior year, with the exception of FY 2020 due to COVID-19, operating expenses did not consistently increase or decrease. As a result, operating expenses per revenue mile oscillated between FY 2016 and FY 2020, as seen in **Figure 2-43**. In total, operating expenses per vehicle revenue mile were down from FY 2016 to FY 2019, but the increase from FY 2019 to FY 2022 resulted in an overall increase over the period, as shown in **Table 2-16**. Operating expenses per revenue mile increased 12% in FY 2019 and have continued to slowly increase.

FIGURE 2-43: TREND IN OPERATING EXPENSES PER REVENUE MILE



Source: FY 2016 - 2020 National Transit Database Reports

TABLE 2-16: OPERATING EXPENSES PER REVENUE MILE PERCENT CHANGE

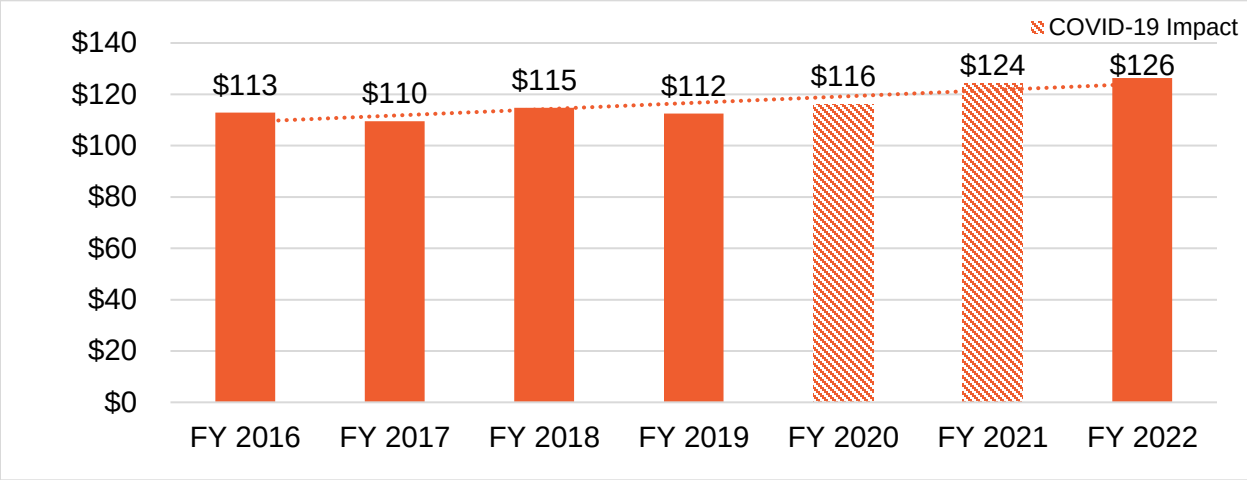
Year Range	Percent Change
FY 16 – FY 22	+10%

Sources: FY 2016 – FY 2022 National Transit Database Reports. Kimley-Horn, 2023.

Operating Expenses per Revenue Hour

Operating expenses per vehicle revenue hour is similar to operating expenses per vehicle revenue mile, but it looks at the efficiency of vehicle time rather than distances traveled. **Figure 2-44** shows that again this metric increased and decreased slightly over the past several years. **Table 2-17** shows that from FY 2016 to FY 2019 operating expenses per vehicle hour was ultimately flat despite the changes in the interim years, but operating expenses per vehicle hour increased in FY 2020 through FY 2022 relative to previous years due to the changes in operating expenses and revenue hours discussed above.

FIGURE 2-44: TREND IN OPERATING EXPENSES PER REVENUE HOUR



Source: FY 2016 - 2020 National Transit Database Reports

TABLE 2-17: OPERATING EXPENSES PER REVENUE HOUR PERCENT CHANGE

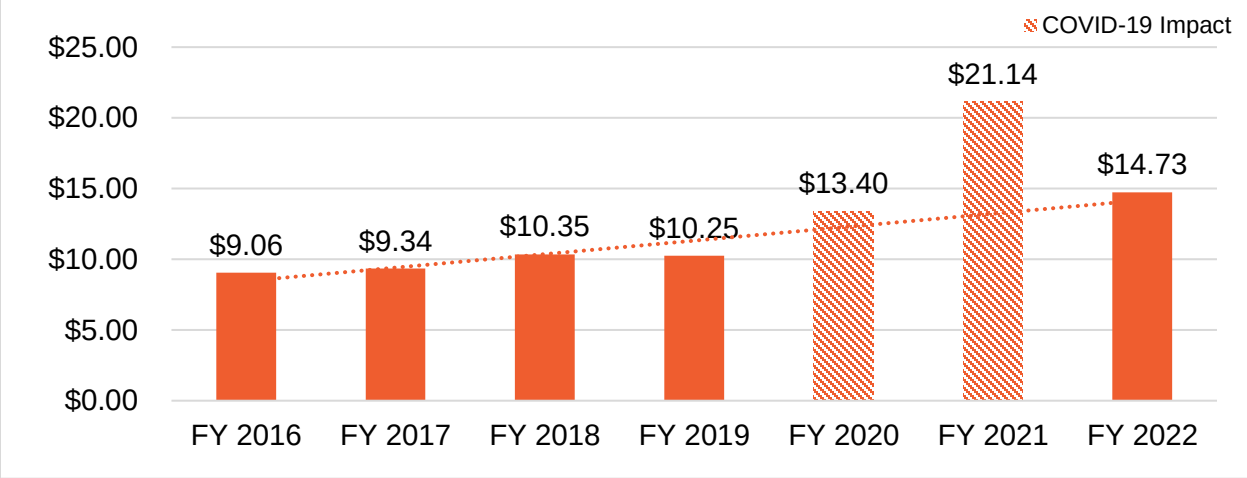
Year Range	Percent Change
FY 16 – FY 22	+12%

Sources: FY 2016 – FY 2022 National Transit Database Reports. Kimley-Horn, 2023.

Operating Expenses per Passenger

Operating expenses per passenger trip can provide insight into how efficiently an agency is utilizing its operating resources. This analysis can also shed light on whether a transit system's cost changes are correlated with ridership trends, in which case this measure would remain relatively flat year to year. **Figure 2-45** and **Table 2-18** show the change in operating expenses per passenger trip from FY 2016 to FY 2022. Between 2018 and 2019 operating expenses per passenger trip decreased compared to slight increases in prior years. In FY 2020, operating expenses increased 6 percent while ridership decreased 19 percent from FY 2019 due to reduced transit use during COVID-19. In response to the ridership impacts of the pandemic, operating expenses per passenger trip increased 58% in FY 2021 before declining 30% for FY 2022. In terms of recovery post-pandemic, FY 2022 figures remained 44% higher than in FY 2019.

FIGURE 2-45: TREND IN OPERATING EXPENSES PER PASSENGER TRIP



Source: FY 2016 - 2022 National Transit Database Reports

TABLE 2-18: OPERATING EXPENSES PER PASSENGER TRIP PERCENT CHANGE

Year Range	Percent Change
FY 16 – FY 22	+63%

Sources: FY 2016 – FY 2022 National Transit Database Reports. Kimley-Horn, 2023.

2.3.3 Performance Based Opportunities for Improvement

This section summarizes opportunities for improvement based on unmet performance benchmarks discussed in the previous section. CY 2019 data was used in the evaluation to account for seasonal fluctuations in transit use throughout the year and avoid the service and performance anomalies of years impacted by COVID-19. As a result, some of the routes referenced in this section no longer operate due to service changes that have occurred since 2019.

SYSTEM ACCESSIBILITY

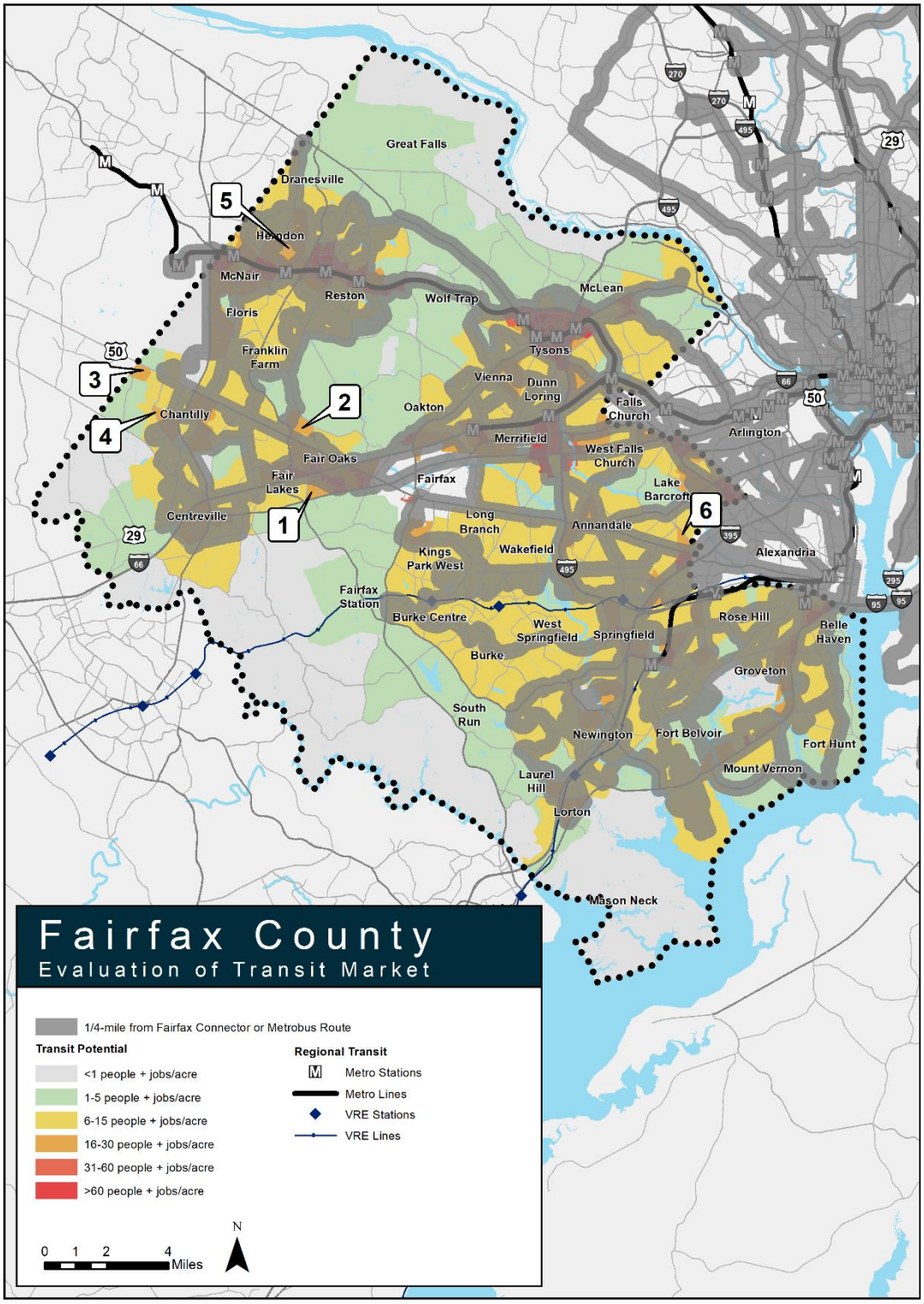
While Connector meets its benchmark of providing access to at least 50 percent of Fairfax County residents, there are opportunities to improve connections to fixed-route bus service in areas that have traditionally been unserved or difficult to service with bus service given the road networks and development patterns. Many of the areas outside of Connector's existing service area have low transit potential, as presented in **Section 2.2**. This includes areas such as Clifton, the Fairfax County Parkway corridor, South Run, and Great Falls. However, some areas have moderate transit potential, as shown in orange in **Figure 2-46**, that are adjacent to the service area represented as a ¼-mile buffer from existing routes. These areas include:

1. Along Legato Road north of US 29
2. Fair Oaks between Penderbrook Drive and Ox Trail
3. Lafayette Business Center at US 50 and Pleasant Valley Road
4. Chantilly along Stonecroft Boulevard near Westfield High School
5. Town of Herndon along Spring Street
6. Along Lincolnia Road in Lincolnia Heights

Additionally, areas of low-moderate transit potential, shown in yellow in the figure, are often lower density residential areas with road networks less conducive to fixed-route transit. However, these have transit supportive densities based on the transit potential model in **Section 2.2.1**.

In the future, Connector can consider innovative ways for expanding access to more locations that warrant connections through different types of service. This could include more flexible route or demand-response service types using smaller vehicles. Fairfax County completed a feasibility study on alternative transit services that could be operated either by Connector or through partnership with another mobility provider to connect customers from lower-density areas to fixed-route service.

FIGURE 2-46: OPPORTUNITIES TO EXPAND SYSTEM ACCESSIBILITY (PRE-SILVER LINE EXTENSION)



Note. Service changes have occurred for Fairfax Connector since the time of analysis.

RIDERSHIP

Routes that did not meet the benchmarks in CY 2019 in this category based on passengers per revenue hour were:

- **Local**: 334, 340, 432, 558, 559
- **Express**: 494, 495, 621, 624

Routes that did not meet the benchmarks in CY 2019 in this category based on passengers per revenue mile were:

- **Local**: 305, 334, 340, 432, 558, 574, 559, 929
- **Express**: 494, 495

Routes that did not meet the benchmarks in CY 2019 in this category based on passengers per one-way trip were:

- **Express:** 341, 495, 624, 641, 985

Connector can consider what strategies might be most effective for increasing ridership along these routes. Strategies for maximizing ridership include updating route alignments to streamline service and improve travel time, providing new connections to demand generators, and improving overall quality of service (for example, reliability). Additionally, increased awareness of service availability and customer convenience aspects of service such as easy-to-understand and reliable real-time information can support healthy ridership.

All routes met maximum load factor benchmarks in CY 2019 in this category.

RELIABILITY

There were many routes that did not meet the benchmark in this category in CY 2019. The routes with the worst on-time performance (70 percent or less) included:

- **Local**: 162, 306, 308, 321, 335, 402, 467, 574, 927, 929
- **Express**: 341, 494, 495, 624, 641, 985

Strategies that Connector can consider for improving on-time performance include adjusting schedules to add running time or recovery time or realigning routes.

COST EFFICIENCY

Routes that did not meet the benchmarks in CY 2019 in this category were:

- **Local**: 301, 305, 334, 340, 432, 553, 557, 558, 559, 574
- **Express**: 494, 495, 621, 624

Cost efficiency is correlated to ridership productivity, so strategies for improving cost efficiency are similar to those for ridership presented above. Connector should evaluate these strategies for all of the routes that did not meet the operating cost per passenger benchmark, even if they met all ridership benchmarks.

SAFETY

Connector met its safety benchmark for bus collisions in CY 2019. However, it exceeded its benchmark for customer injuries. In the past, many of the injuries were a result of incidents that were non-preventable, such as another vehicle coming into contact with the bus. Connector will continue to promote a safety culture, utilize best safety practices, and provide the best available safety and security training for all employees.

CUSTOMER SERVICE

Connector exceeded its benchmark for customer complaints in CY 2019. Strategies for improving customer service are related to many of the service aspects already presented on quality, reliability, and safety.

2.4 Operating and Network Efficiency Evaluation

2.4.1 Efficiency Evaluation

This section evaluates the operating efficiency of Connector service. When appropriate, measures were evaluated against the performance standards or guidelines as defined in **Chapter 1**. Efficiency was evaluated for the following aspects of service: frequency, span, ridership by time period, speed, and reliability. The analysis was conducted for CY 2019 using the schedule for the September 2019 service period and data for the January, March, May, and September 2019 service periods. CY 2019 data was used in the evaluation to account for seasonal fluctuations in transit use throughout the year and avoid the service and performance anomalies of years impacted by COVID-19. As a result, some of the routes referenced in this section no longer operate due to service changes that have occurred since 2019.

SERVICE DESIGN

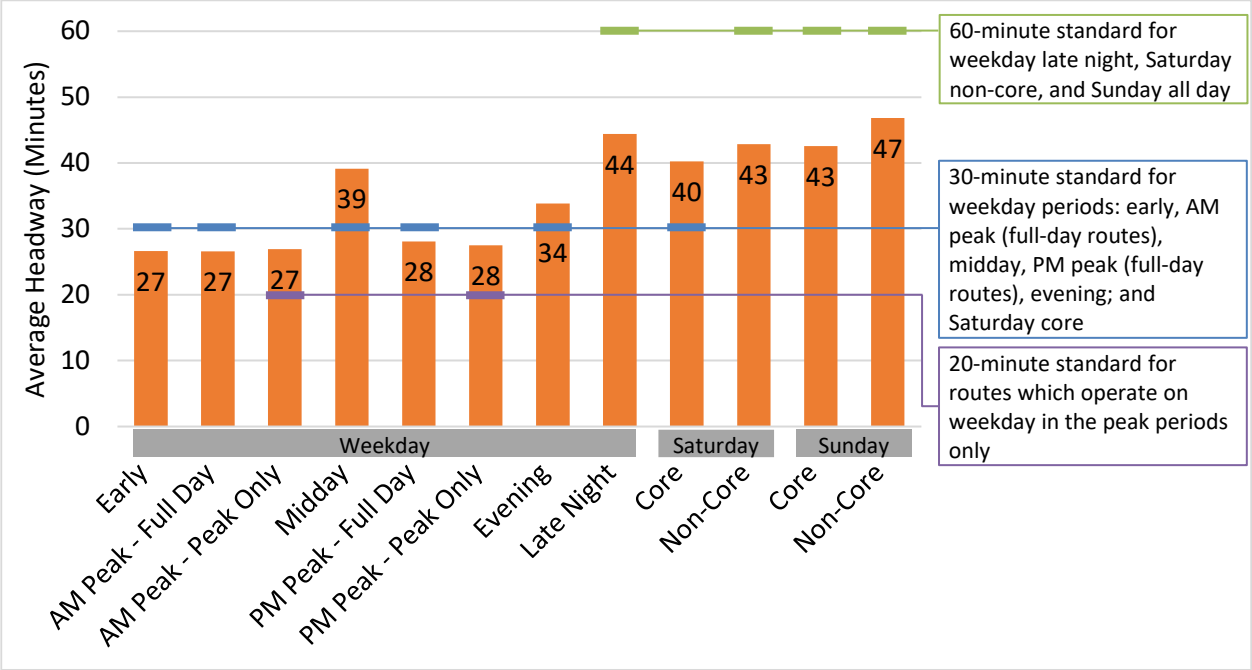
The service design measures evaluated in this section include frequency and span of service. These aspects of service design are important aspects of Connector's goal to provide high-quality transportation service and facilitate an efficient and cost-effective multi-modal transportation system. These design measures were evaluated the last service period of CY 2019 which operated from September 9, 2019, through January 24, 2020.

Headway

Vehicle headway, or frequency, is correlated with passenger wait times and therefore is an important service consideration. On the other hand, although shorter headways result in shorter customer wait times, they also result in higher costs due to greater demand for vehicles and operators as well as more revenue hours and miles. As a result, it is important to balance the tradeoff between shorter customer wait times and higher costs. The service standards for minimum vehicle headways are provided in **Table 1-5** in **Chapter 1**. There are different standards for full-day routes versus weekday peak-only routes and for peak and off-peak time periods.

Figure 2-47 shows the variation in average headways by day of week and time of day compared to the applicable standards. The standards that were not met based on these averages were morning and afternoon weekday peak-only routes, weekday midday, weekday evening, and Saturday Core. Average headways in these periods were 7 to 10 minutes longer than the standard. At current funding levels, attaining the headway standard for every route is cost-prohibitive, so Connector must prioritize its resources when setting route headways. Additionally for weekday peak-only routes, Connector uses a 20-minute headway standard for the peak of the peak only, so the average headway calculated over the overall peak period may exceed this. Multiple routes may also work together along a shared corridor to provide a combined effective headway that meets standards.

FIGURE 2-47: AVERAGE HEADWAYS COMPARED TO STANDARDS



Note. Service changes have occurred for Fairfax Connector since the time of analysis.

Source: 2020 Fairfax County Title VI Program Update

Span

Span of service is important to ensuring that service is available when passengers need it so that Connector can be a trusted transportation alternative. Connector's span of service guidelines are provided in **Table 1-4** in **Chapter 1**. For weekday service in CY 2020, there were 49 routes classified as full-day routes and the remaining 42 were considered weekday peak-only routes. Only full-day routes operate on weekends. This analysis excludes Route 480 (Wolf Trap Express).

While there was a lot of variability in span of service, this is often intentional as Connector has routes that supplement each other and therefore do not need to run simultaneously to achieve the span guideline. For example, full-day Route 371 (Lorton – Franconia-Springfield Metro) operated during the midday on weekdays and did not meet the full-day span of service guidelines, but during the morning and evening peak periods Routes 372 (Lorton – Alban Road) and 373 (Lorton – Fullerton Road) operated along a similar route in order to provide nearly uninterrupted service throughout the day.

The span of service for each full-day and weekday peak-only route as well as the start and end of the span of service guidelines are shown in **Figure 2-48**. For weekdays, the full-day route service guidelines are for service between 5:00 a.m. and 10:00 p.m. Of the 49 full-day routes included in the analysis, 32 of them started later than 5:00 a.m., but only 11 started after 6:00 a.m. Most of the remaining routes started at 8:30 a.m. or later, so they had limited to no morning peak service and were complemented by one or more peak-only routes. Only 12 of the 49 full-

day routes did not have service after 10:00 p.m., with four ending service between 9:00 p.m. and 10:00 p.m., and another three ending service between 8:00 p.m. and 9:00 p.m. Route 306 (GMU – Pentagon) only operated midday service from 8:50 a.m. to 3:53 p.m. and was the only full-day route that ended service before 7:30 p.m. This route, previously supplemented by Metrobus 17A until its suspension by WMATA, is now supplemented by Metrobus 17G which provides morning and afternoon peak service for the majority of the Route 306 alignment except for Braddock Road inside the Capital Beltway (I-495).

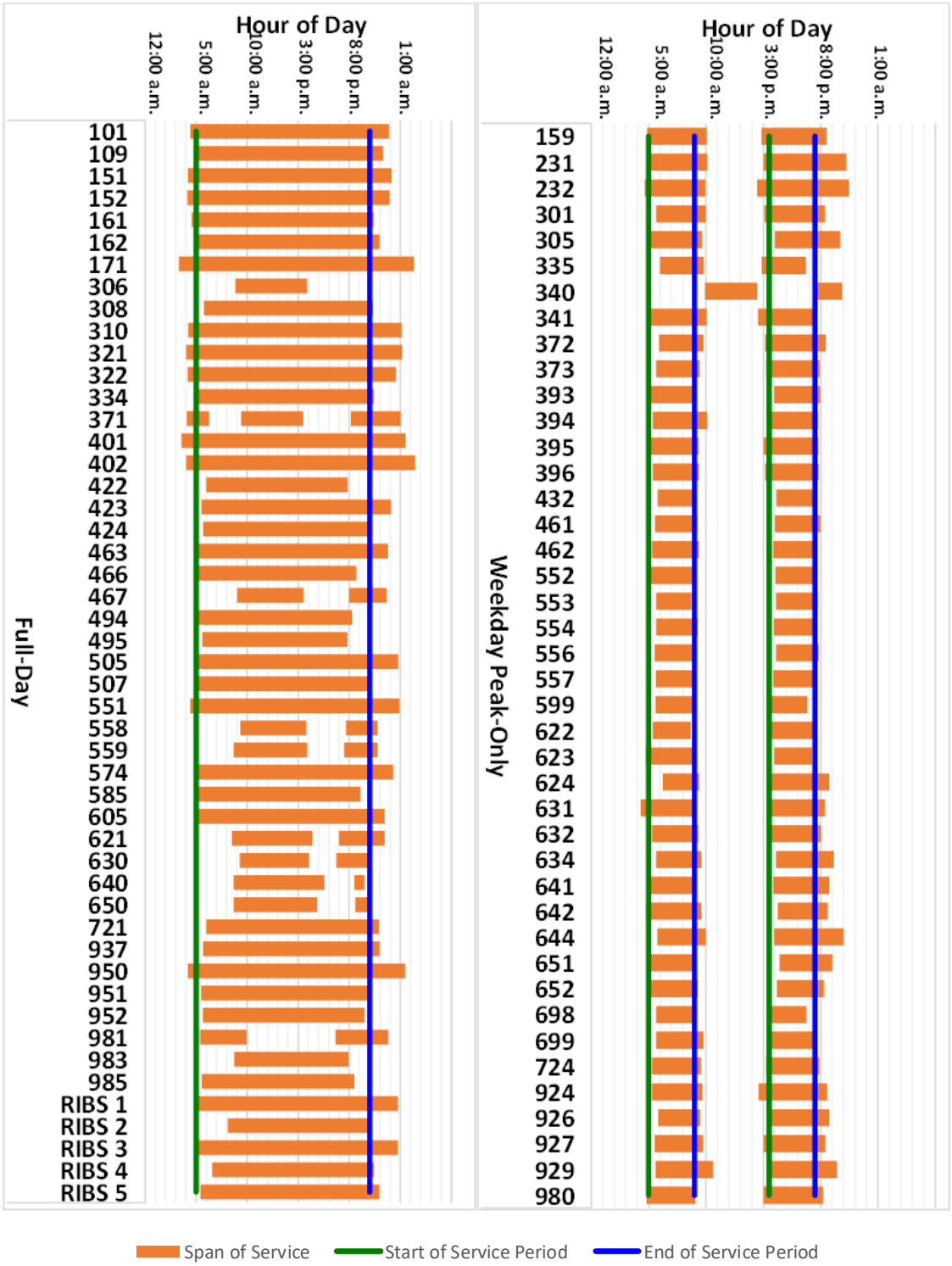
The span of service guidelines for weekday peak-only routes are 5:00 a.m. to 9:00 a.m. for the morning peak and 3:00 p.m. to 7:00 p.m. for the afternoon peak. However, the service guidelines recognize that for many routes service is tied to Metrorail service and therefore the ideal Connector span of service may be slightly different at certain Metrorail stations in order to maximize connectivity. Four routes met the guidelines in both the morning and afternoon periods: Routes 159 (Engleside Limited-Stop), 232 (Kingstowne Circulator), 341 (Patriot Ridge – Saratoga), and 980 (Herndon – Monroe).

In the morning peak, 11 routes met the service guideline and began service by 5:00 a.m. However, all but two routes (Routes 340 and 624) began service by 6:00 a.m. All but six routes operated through the end of the morning service period at 9:00 a.m., and the earliest a route ended was only 8:40 a.m., or just 20 minutes before the guideline time.

Again, in the afternoon peak most routes did not begin service until after the guideline start time, but most did operate after the guideline end time. Eight of the 42 peak-only routes began service by 3:00 p.m. Another 25 of the routes began service between 3:00 p.m. and 4:00 p.m. This left only nine routes that started after 4:00 p.m. This included Route 340 which was intended to operate midday and evening service while Route 341 provided peak service. Only three routes ended service before 7:00 p.m., and they all ended service less than 20 minutes before the guideline time (the earliest was Route 335 at 6:43 p.m.).

Only routes classified as full-day routes operate on weekends, and they can differ on Saturdays and Sundays. **Figure 2-49** shows the weekend spans of service and guideline start and end times. There were 37 routes in the analysis that operated on Saturdays, and 14 of those met the service guidelines (6:00 a.m. to 9:00 p.m.). None of the remaining 23 routes began service before 6:00 a.m., although 14 began service by 7:00 a.m. However, only six of the routes did not meet the Saturday end of service guideline. There are 34 routes that operated on Sundays, and 31 of them met the span of service guidelines (8:00 a.m. – 8:00 p.m.). Of the remaining three routes, Route 109 (Rose Hill) and Route 937 (Coppermine – Elden) ended service at 7:52 p.m. and 7:48 p.m., respectively, and Route 983 (Udvar-Hazy Center – Wiehle-Reston East) only operated 8:43 a.m. – 7:54 p.m. but had Route 981 serving most of the route during a longer span of service.

FIGURE 2-48: WEEKDAY SPAN OF SERVICE

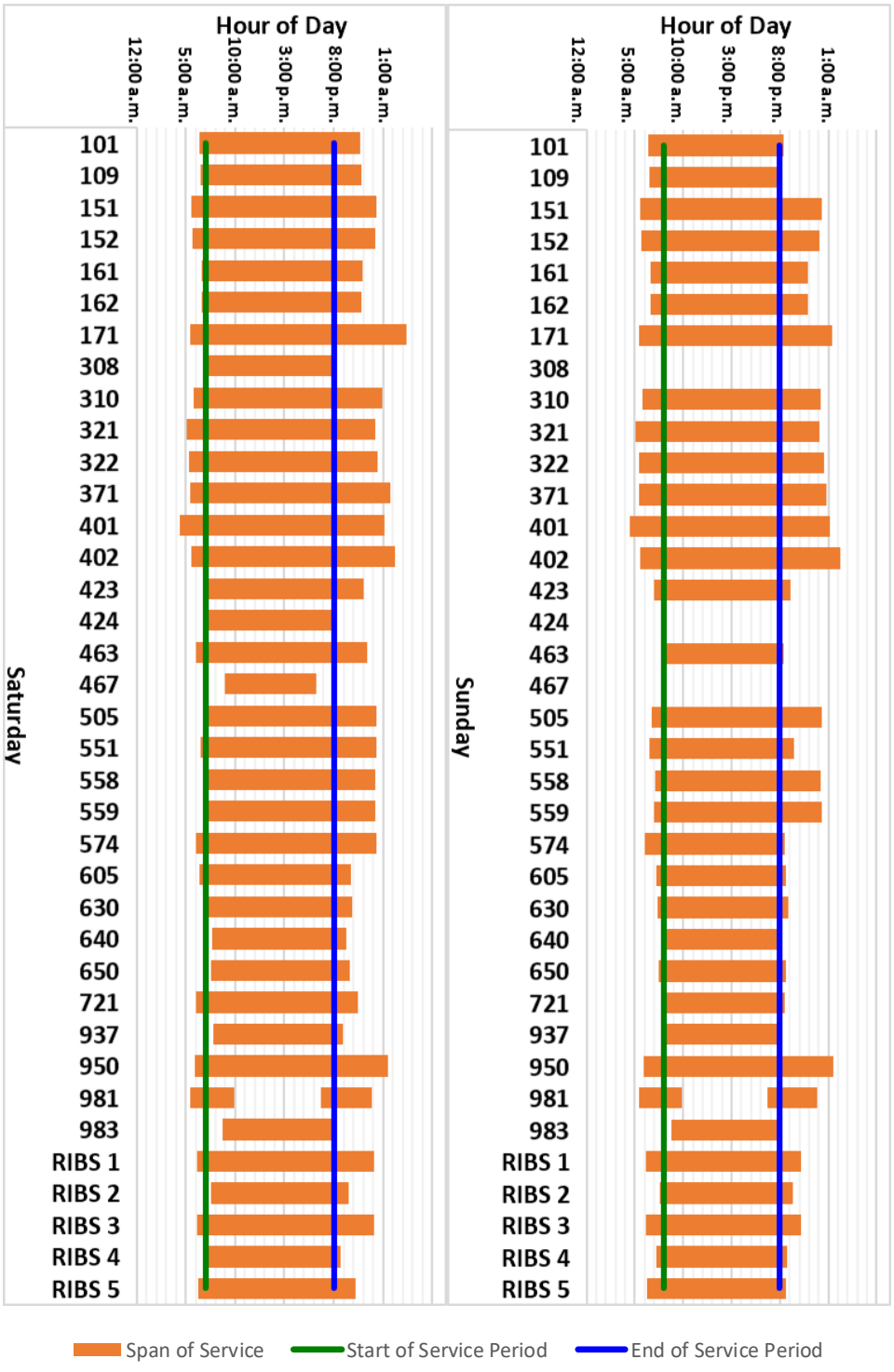


Note. Service changes have occurred for Fairfax Connector since the time of analysis.

Sources: General Transit Specification Feed (GTFS) for service week of 1/25/2020. Kimley-Horn, 2021.

Excludes Route 480 (Wolf Trap Express) and routes that did not operate in January 2020.

FIGURE 2-49: WEEKEND SPAN OF SERVICE



Note. Service changes have occurred for Fairfax Connector since the time of analysis.

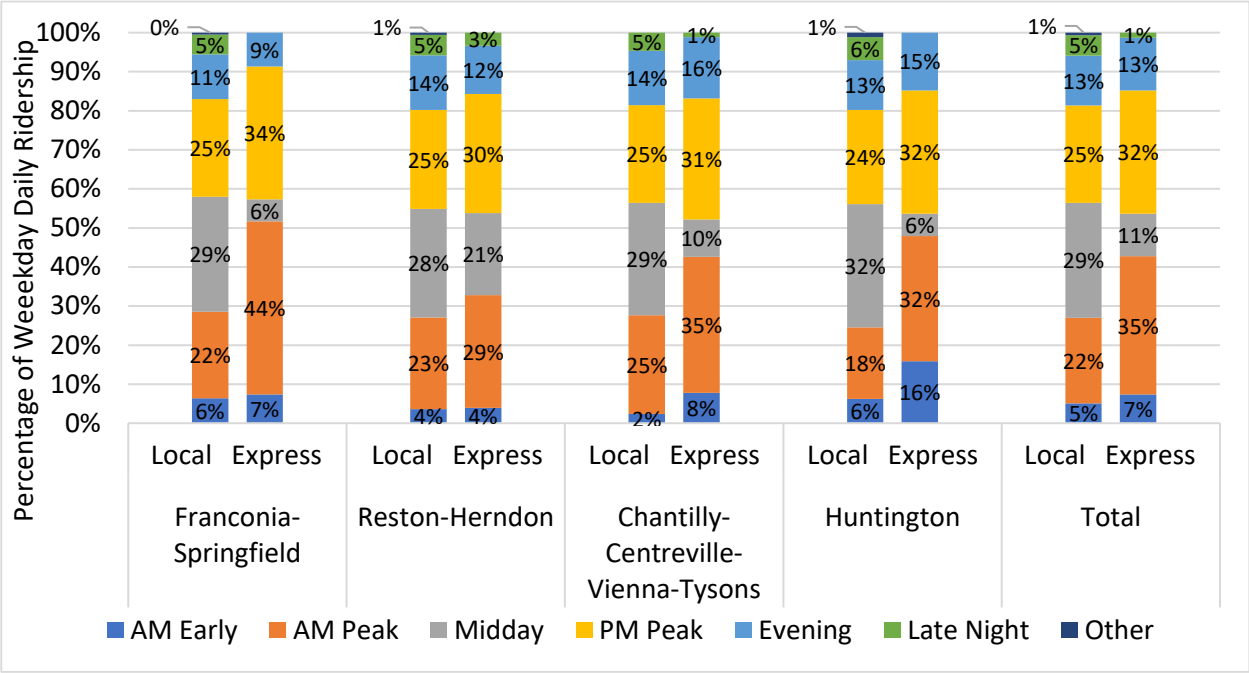
Sources: General Transit Specification Feed (GTFS) for service week of 1/25/2020. Kimley-Horn, 2021.

Includes only routes with Saturday or Sunday service and excludes routes that did not operate in January 2020.

RIDERSHIP BY TIME OF DAY

Understanding ridership by time of day is important for aligning service with demand. **Figure 2-50** shows the percent distribution of ridership across the different times of day for local and express routes in CY 2019. The ridership patterns were relatively consistent across the different subareas, but the patterns were different between local and express routes. For local routes, ridership was greatest during the midday period, closely followed by the morning peak and then the afternoon peak. Systemwide, 76 percent of ridership on local routes was during the midday and peak periods with an additional 13 percent of ridership occurring during the evening period. Express service was more heavily weighted towards ridership in the morning and afternoon peak periods. Early morning ridership was also generally greater on express routes than local routes.

FIGURE 2-50: PERCENT OF WEEKDAY AVERAGE DAILY RIDERSHIP BY TIME OF DAY



Note. Service changes have occurred for Fairfax Connector since the time of analysis.

Sources: Fairfax Connector's fleet Intelligent Transportation System for 1/20/2019 to 1/24/2020. Fairfax County DOT and Kimley-Horn, 2021.

Excludes seasonal Route 480 (Wolf Trap Express) and existing routes that did not operate during CY 2019.

SPEED

Average weekday speeds by time of day are presented in **Table 2-19**. **Figure 2-51** shows histograms of the percentage of routes that operated in each speed range during each time period. Express routes generally experienced faster average speeds (23 mph), regardless of the time of day, compared to local routes (15 mph). Speeds were also slightly lower during the peak periods when road congestion was greatest and higher in the early morning and late night. The

routes with the lowest overall average speeds were 423, 467, 505, and 556 which all ranged from 11 to 12 mph. These local routes operated in the Reston-Herndon or Tysons areas.

TABLE 2-19: SPEED BY TIME OF DAY (IN MPH)

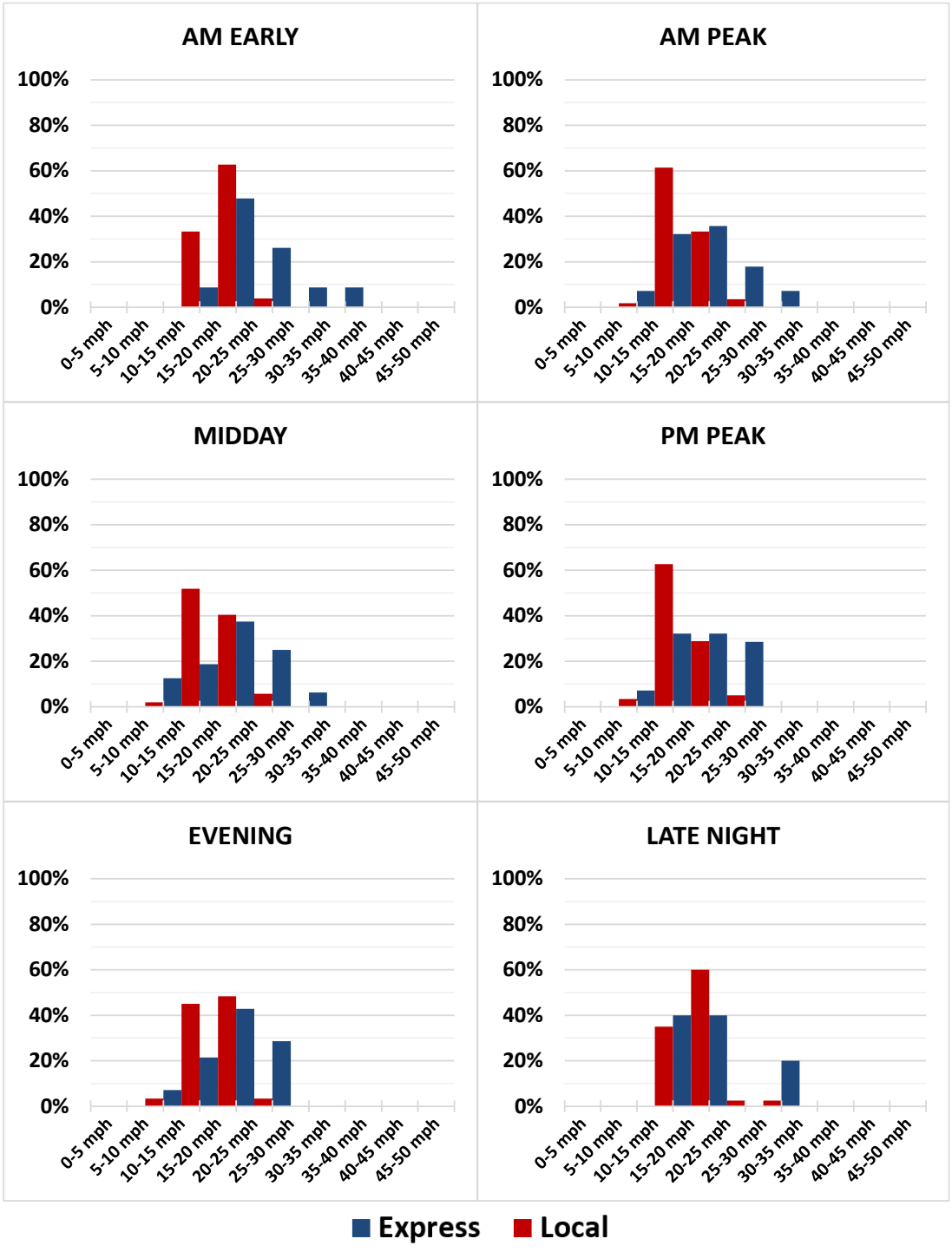
Time Period	Express Routes	Local Routes
AM Early	25	16
AM Peak	22	15
Midday	22	15
PM Peak	21	14
Evening	22	15
Late Night	20	16
Other	N/A	15
Overall	**23**	**15**

Note. Service changes have occurred for Fairfax Connector since the time of analysis.

Sources: Fairfax Connector's fleet Intelligent Transportation System for 1/20/2019 to 1/24/2020. Fairfax County DOT and Kimley-Horn, 2021.

Excludes seasonal Route 480 (Wolf Trap Express) and existing routes that did not operate during CY 2019.

FIGURE 2-51: SPEED BY TIME OF DAY



Note. Service changes have occurred for Fairfax Connector since the time of analysis.

Sources: Fairfax Connector's fleet Intelligent Transportation System for 1/20/2019 to 1/24/2020. Fairfax County DOT and Kimley-Horn, 2021.

Excludes seasonal Route 480 (Wolf Trap Express) and existing routes which did not operate during CY 2019.

RELIABILITY

On-time performance as a measure of reliability is discussed in **Section 2.3.1**.

2.4.2 Efficiency Based Opportunities for Improvement

This section summarizes opportunities for improvement based on routes that did not meet the standards or guidelines for efficiency-based measures as discussed in the previous section. CY 2019 data was used in the evaluation to account for seasonal fluctuations in transit use throughout the year and avoid the service and performance anomalies of years impacted by COVID-19. As a result, some of the routes referenced in this section no longer operate due to service changes that have occurred since 2019.

In order to better meet vehicle headway standards, Connector can consider increasing the frequency of the routes shown in **Table 2-20** in the future, if warranted by demand. These were routes for which average headways were more than 10 minutes greater than the standard for any given time period, with the specific time period highlighted in yellow.

TABLE 2-20: OPPORTUNITIES FOR IMPROVED HEADWAY (PRE-SILVER LINE EXTENSION)

Legend: Headway exceeds standard in this time period by more than 10 minutes

Route	Route Type	Early AM	Peak AM	Midday	Peak PM	Evening	Late	Saturday	Sunday
101	Full-Day								
109	Full-Day								
152	Full-Day								
161	Full-Day								
162	Full-Day								
301	Peak-Only								
306	Full-Day								
308	Full-Day								
321	Full-Day								
322	Full-Day								
334	Full-Day								
371	Full-Day								
393	Peak-Only								
394	Peak-Only								
432	Peak-Only								
463	Full-Day								
467	Full-Day								
494	Full-Day								
495	Full-Day								

Route	Route Type	Early AM	Peak AM	Midday	Peak PM	Evening	Late	Saturday	Sunday
559	Full-Day								
585	Full-Day								
605	Full-Day								
621	Full-Day								
630	Full-Day								
631	Peak-Only								
640	Full-Day								
642	Peak-Only								
650	Full-Day								
651	Peak-Only								
652	Peak-Only								
927	Peak-Only								
929	Peak-Only								
951	Full-Day								
985	Full-Day								
RIBS 2	Full-Day								
RIBS 4	Full-Day								
RIBS 5	Full-Day								

Note. Service changes have occurred for Fairfax Connector since the time of analysis.

Sources: General Transit Specification Feed (GTFS) for service week of 1/25/2020. Kimley-Horn, 2021.

In order to better meet the span of service guidelines, Connector can consider adding additional trips in the future for the following routes if warranted by demand and the route makes logical connections during earlier or later hours:

All-Day Routes

- Additional a.m. trip(s) to extend service earlier: **308, 423, 424, 495, 558, 721, 937, 985, RIBS 4**
- Additional p.m. trips(s) to extend services later: **466, 494, 495, 585, 985**

Peak-Only Route:

- Additional a.m. trip(s) to extend service earlier: **301, 335, 432, 461, 553, 554, 557, 599, 624, 634, 698, 699, 927, 929**
- Additional p.m. trip(s) to extend service later: **305**, **393, 432, 461, 624, 634, 642, 644, 652, 698, 699, 929**

Saturday Routes

- Additional a.m. trip(s) to extend service earlier: **109, 308, 423, 424, 467, 505, 551, 558, 559, 630, 640, 650, 937, RIBS 4**
- Additional p.m. trips(s) to extend services later: **308**

The lists above do not include routes that may not meet the span of service guidelines but that operated along shared corridors with other routes so that comprehensive service is provided along the majority of the route throughout the periods identified by the span of service guidelines.

Although there are no benchmarks for speed, Connector can continue to review route alignments in the Bus Review Studies for each subarea to identify opportunities for improving speeds. Other opportunities for improving reliability are included in **Section 2.3.3**.

2.5 Analysis of Opportunities to Collaborate with Other Providers

2.5.1 Collaboration Analysis

Fairfax Connector operates service alongside other transit providers in the greater Washington region. This includes WMATA Metrorail and Metrobus, VRE, CUE, Arlington Transit (ART), Alexandria DASH, OmniRide, and Loudoun County Transit. With the exception of VRE, all of these transit systems operate on the regional smartcard-based fare system, SmarTrip®, which allows customers to seamlessly travel throughout the regional transit system using a single fare media. Connector honors free bus-to-bus transfers and $2.00 discounts for bus-to-rail transfers. For passengers transferring from the VRE system to a Fairfax Connector bus, a free one-way transfer is allowed when the passenger displays valid VRE fare media (passes, tickets).

Connector provides service to and from all Metrorail and VRE stations in Fairfax County, with the exception of the VRE Rolling Road Station. When possible, Connector service is coordinated with these services—for example with Metrorail start and end times and VRE train schedules at connection points. Coordination is also required with WMATA for Metrobus service in Fairfax County, particularly when there are planned Metrobus service changes that impact travel opportunities for Fairfax County residents, workers and visitors.

The regional Bus Transformation Project also contained 26 recommendations[23]—many of which will require collaboration among transit operators in the region. The 26 recommendations all fell under four main recommendations:

1. Provide frequent and convenient bus service that connects communities and promotes housing affordability, regional equity, and economic growth.
2. Give buses priority on roadways to move people quickly and reliably.
3. Create an excellent customer experience to retain and increase ridership.
4. Empower a publicly appointed task force to transform bus and lead the implementation of a truly integrated regional system.

2.5.2 Collaboration Based Opportunities for Improvement

The following are opportunities for collaboration-based improvements which could benefit Fairfax Connector and other transit providers:

Coordination with WMATA on Metrobus routes: Fairfax Connector has a longstanding relationship with WMATA to operate fixed-route bus service in Fairfax County alongside Metrobus. Fairfax County is also collaborating through WMATA's Better Bus Network Redesign project. Over the years, operations for some routes that were historically operated as Metrobus have been transferred to Fairfax Connector. Recent examples of this include Routes 350, 351, 352, and 353 (formerly TAGS Routes S80 and S91, operated by WMATA) as well as Routes 703 (Metrobus 3T), Route 715 (Metrobus 15K), Route 803 (Metrobus 3A), 834 (Metrobus 29C) and 835 (Metrobus 29W). Additional route transfers are likely to continue in the future as Fairfax County has found it can achieve greater efficiency and control of service levels when routes are operated by Fairfax Connector than when they are operated by WMATA. Close collaboration

[23] https://bustransformationproject.com/resources/#strategy

with WMATA should continue as future reductions or eliminations of Metrobus service in Fairfax County are considered in order for Fairfax Connector to ensure that ongoing service continues to be provided to these areas.

Coordination with OmniRide and Loudoun County Transit on future transit services in the Route 28 and Route 7 corridors: Route 28 is a major north-south travel corridor that connects Manassas, Manassas Park, Centreville, Chantilly, Dulles, and Sterling. It crosses between Prince William, Fairfax, and Loudoun counties. Route 7 is a major east-west corridor connecting Ashburn, Sterling, Reston, Great Falls, Vienna and Tysons. Fairfax Connector should collaborate with neighboring transit provides on future connections along this corridor.

Coordination with OmniRide on future connections between Western Prince William County and Fairfax County: Connector service in the Centreville area stops less than five miles from the regional activity centers of Manassas, Manassas Park and Yorkshire. Although these activity centers are in a different county, daily transportation needs rarely conform to political boundaries. Many Fairfax County workers are residents of neighboring jurisdictions and vice versa. This is true of these activity centers, and many of their residents work in Fairfax County (approximately 30 to 40 percent according to 2018 U.S. Census Bureau data[24]). Fairfax County should collaborate with OmniRide on future transit connections in order to provide a robust transit network in the region.

Coordination with OmniRide on future connections between Eastern Prince William County and Fairfax County: Fairfax County should collaborate with OmniRide on future transit connections that span Prince William County and Fairfax County. Examples include connecting Prince William County to Fort Belvoir via the US Route 1 corridor, and Dale City/Woodbridge to George Mason University, Fairfax County Government Center, and Fair Oaks.

Coordination with regional partners on future transit service across the American Legion Bridge between Fairfax County and Maryland: The Virginia Department of Rail and Public Transportation (DRPT) and Maryland Department of Transportation (MDOT) embarked on a study in 2020 to find potential multimodal solutions to reduce congestion, improve trip reliability and regional connections, and enhance existing and planned multimodal mobility and connectivity across the American Legion Bridge. In the draft summary report, future potential transit connections were identified between locations in Fairfax County (Tysons, Reston, Dulles, Dunn Loring) and Maryland (Bethesda, Gaithersburg, Silver Spring, Germantown, Frederick). The most near-term potential service identified was bi-directional bus service between Bethesda and Tysons. The Fairfax County Board of Supervisors endorsed the draft report in January 2021. Fairfax Connector should collaborate with regional and state partners as they determine the necessary operator(s) and associated infrastructure required to support the new service.

Support the regional Bus Transformation Project Action Plan: Fairfax Connector should support or lead, as applicable, elements of the Action Steps of the Bus Transformation Project in collaboration with WMATA and other bus operating agencies. Details on recommendations and roles are contained in the Action Plan[25].

[24] *Longitudinal Employer-Household Dynamics (LEHD) program*
[25] https://bustransformationproject.com/wp-content/uploads/2019/12/Action-Plan-2019-12-06-SECURE.pdf