

I-66 CORRIDOR TRANSIT & TRANSPORTATION DEMAND MANAGEMENT PLAN UPDATE



FINAL REPORT
February 2020

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- Appendix B - Transit/TDM Recommendations Technical Memorandum #2
- Appendix C - Transit/TDM Recommendations Testing, Refinements and Prioritization Technical Memorandum #3
- Appendix D - Transit/TDM Demand Forecasting Technical Memorandum #4

EXECUTIVE SUMMARY

INTRODUCTION

In 2016, the Virginia Department of Transportation (VDOT) and the Virginia Department of Rail and Public Transportation (DRPT) completed a study that developed multimodal improvement concepts to increase person throughput on I-66, the only east-west Interstate highway in Northern Virginia. The multimodal improvements included transit service and transportation demand management (TDM) strategies utilizing the I-66 Express Lanes (to be operational in 2022) extending from Gainesville to I-495.

The 2016 study concluded with a preferred alternative for the corridor, developed through a tiered National Environmental Policy Act (NEPA) process, with a horizon year of 2040. Stakeholder and public coordination, including public surveys, were vital to the creation of this preferred alternative. The preferred alternative proposed phased improvements, starting in the opening year of 2022, with progressively more robust services initiated in five-year increments between 2025 to 2040. The transit recommendations in the preferred alternative included 20 new or expanded commuter bus routes with service to six activity centers. Complimentary TDM strategies were also outlined in the study.

The recommendations of the 2016 study resulted in the establishment of annual transit payments to support implementation of identified multimodal improvements, available through the Transform 66: Outside the Beltway project. These annual transit payments have a net present value of \$800 million and have been amortized annually through FY2066, representing the entire span of the concession agreement.

DRPT intended to reevaluate the 2016 recommendations prior to the opening of the Express Lanes in 2022. This study represents that effort considering new data, assumptions, and reassessing the balance and mix of corridor transit services prior to the opening of the I-66 Express Lanes in 2022.

Public transportation is poised for an even greater role along I-66 in the future. The recommendations for bus and rail service in this plan, supported by strategies that promote transit usage and sharing rides, will preserve capacity for anticipated growth and maximize person throughput within the corridor.

NEW CONSIDERATIONS FOR THE UPDATE

Approach

The plan update pursued the following expanded goals as recommendations and were developed and revised from the 2016 study. The goals for adjusting the multimodal mix of projects are to:

- Increase mobility and maximize person throughput in the corridor.
- Coordinate projects that are currently funded by two funding mechanisms, I-66 Commuter Choice: Inside the Beltway program and Transform 66 Outside the Beltway.
- Evaluate the future mix of transit strategies to increase travel options and intermodal connectivity.

In order to fully coordinate funding approaches and service recommendations, for the purposes of this study update, the I-66 corridor was redefined to extend from Washington, D.C. (I-66 at the Potomac River) to Haymarket, Prince William County. Bus routes and rail lines that run on or across portions of I-66, as well as, services that run on parallel corridors are included in the study area.

Potential recommendations were evaluated based on person throughput to demonstrate the investment potential of higher capacity modes and the impact of those options on the I-66 corridor. Cutlines were established in the vicinity of Glebe Road, Nutley Street, and VA 28 with person throughput calculated as the number of people crossing a cutline by rail, bus, or auto in either direction daily. Preferred mobility options would demonstrate increased person throughput over baseline service and a change in mode share on I-66.

Assumptions

The timing of this update enables the incorporation of regional developments that have occurred since the completion of the 2016 plan, to specifically include consideration of the following:

- The commitment of funding from the Transform 66: Outside the Beltway concession agreement, which provides the basis for implementing transit and TDM improvements in the I-66 corridor west of I-495.
- Growing certainty in the feasibility and timeline for significant commuter rail service expansion not envisioned in the 2016 plan, as a result of the advancement of the Long Bridge project and efforts to Transform Rail in Virginia.
- Shift in focus from an extension of service to the Gainesville-Haymarket area of Prince William County to a capacity expansion along the existing Manassas Line, with operating and facility improvements for service originating at the existing VRE Broad Run station.

- The I-66 Transportation Management Plan (TMP) and Northern Virginia Transportation Commission (NVTC) Commuter Choice program have provided funding for multimodal transportation projects in the I-66 Corridor, with new bus routes and services operating since 2018. Therefore, the baseline of transit available before the Express Lanes opening day has changed from baseline services considered in the 2016 plan.

Adjusted Demographics

The corridor population and employment data¹ along the I-66 corridor provides insight into expected transit demand, representing the two most common origins and destinations for transit trips, namely home and work.

Population

By the year 2045, the total population within the I-66 corridor is forecast to grow to over 1.5 million people. This represents an increase of approximately 284,000 people, or a 22.6 percent increase from the 2020 population estimate. The annual population growth from 2020 to 2045 for the entire study area is 0.8 percent, with the fastest growing jurisdiction being Prince William County with a growth of 1.4 percent per year.

Employment

From 2020 to 2045, projected employment in the study area is expected to grow in areas that overlap with Metropolitan Washington Council of Governments (MWCOC) Activity Centers. By the year 2045, the total employment within the I-66 corridor is forecast to grow to over one million people. This represents an increase of almost 228,000 people, or a 27.7 percent increase from the 2020 population estimate. Additionally, as a major commuter destination, Washington, D.C. is expected to add 200,000 additional jobs from 2020 to 2045, a 23.5 percent increase.

KEY FINDINGS

Overview

Current transit service in the study area is a mix of feeder bus service to Metrorail and VRE stations, commuter service into parts of Arlington County and Washington, D.C., regional service along parallel arterials, and circulation in the communities along I-66.

¹ Round 9.1 Growth Trends to 2045, MWCOC, October 2018.

Figure E.1: Schematic of Existing I-66 Commuter Routes



Figure E.2: I-66 Corridor AM Peak Period Ridership by Bus Provider

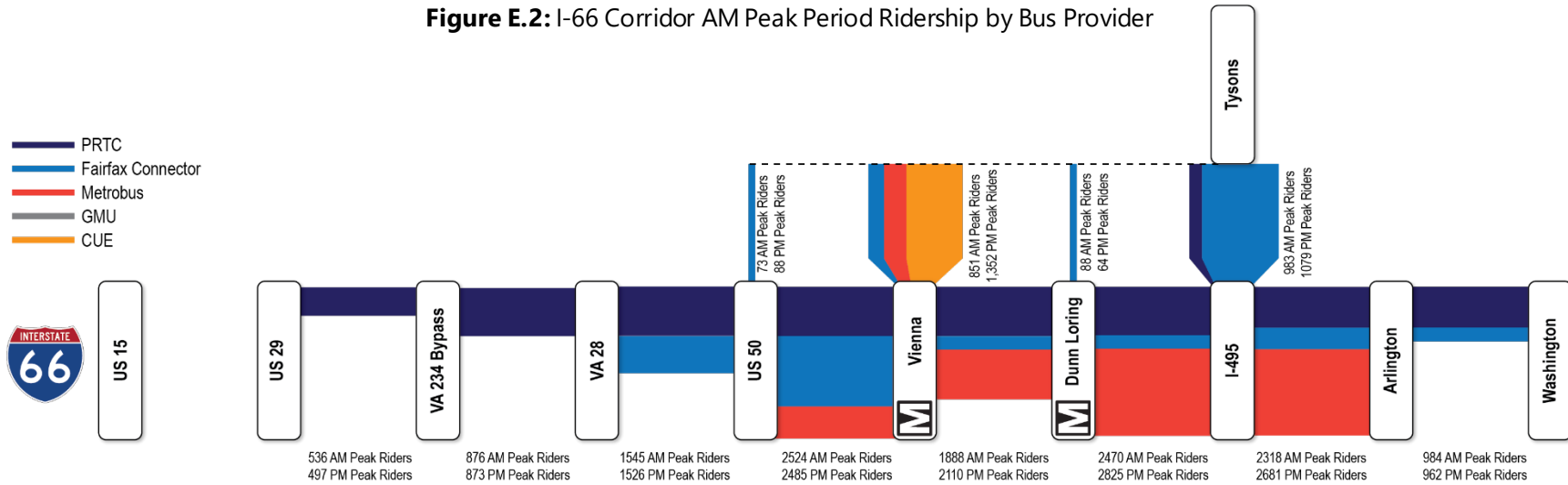
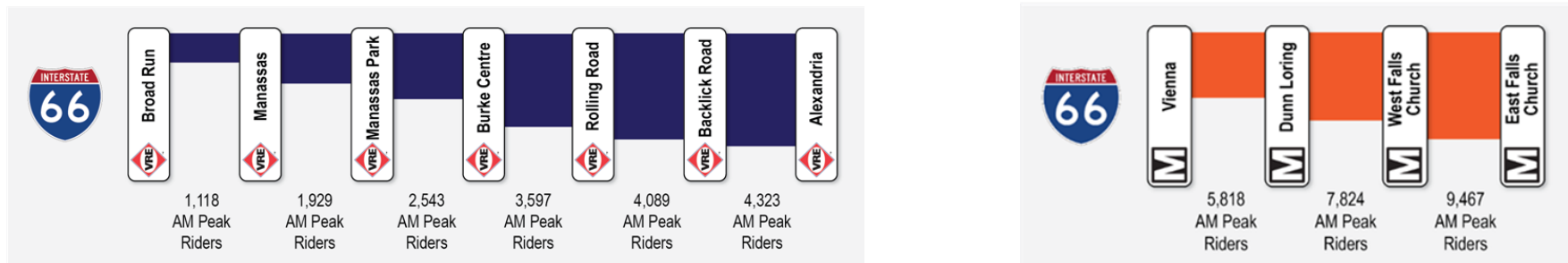


Figure E.3: I-66 VRE Manassas Line (left) and Metrorail Orange Line (right) AM Peak Period Ridership



The following summarizes key findings as initial recommendations were developed:

- The travel flow analysis pointed more towards heavy demand between Fairfax County and destinations in Arlington and Washington, D.C. Therefore, the initial recommendations included more service from Fairfax County to destinations along the corridor and to Arlington and Washington, D.C.
- Routes from Gainesville and Manassas to the Reston area along Route 28 showed lesser demand and lower benefits to the users of I-66, therefore the majority of these recommendations were removed from consideration.
- Analysis of the No-Build conditions indicated that commuter bus and VRE commuter rail markets had little overlap. Increases in commuter bus service had negligible effect on VRE ridership and conversely increases in VRE service frequency had negligible impact on the performance of commuter bus routes.

Commuter Bus Recommendations

A total of thirteen commuter bus routes are included in the updated recommendations. Five of these routes represent new service, while eight comprise enhancements to existing baseline service. Twelve routes are recommended for implementation on opening day of the Express Lanes (2022), with a frequency of service to match initial demand estimates. Subsequent frequency adjustments coincide with forecasted increases in demand from travel modeling conducted for 2030 and 2045. Overall, these recommendations reflect more concentrated service than previously considered.

An overview of destinations served by route is presented in Figure E.4. These routes account for 548 peak daily trips along the I-66 corridor in 2045. This represents a 40 percent increase in bus service from the 2016 study. Estimated 2045 bus ridership is estimated at approximately 4.2 million annually. Calculated person throughput for the recommended routes is graphically depicted in Figure E.5. The updated ridership estimates exceed the 2016 study's combined estimate of 3.4 million annual riders in 2040. Five routes generally aligned with the 2016 study's 20 routes from the preferred alternative. The most significant ridership gains are the result of additional service to Tysons Corner and the Pentagon.

Figure E.4: Bus Recommendations – Route Graphic

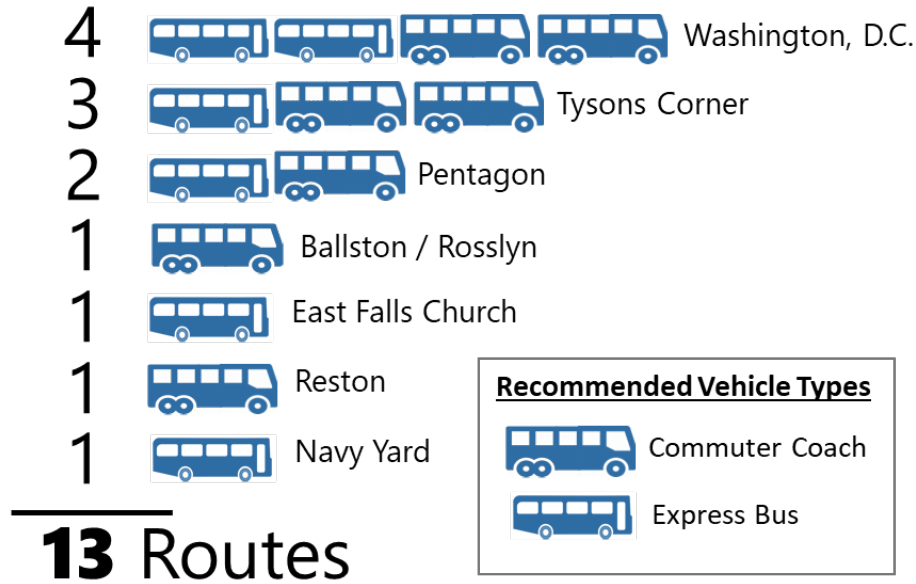
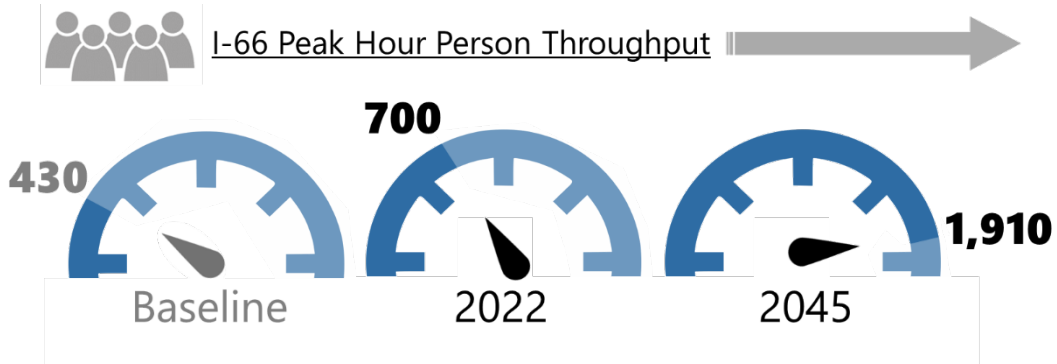


Figure E.5: Bus Recommendations – Person Throughput Graphic



Commuter Bus Route Prioritization

A route prioritization ranking was established in this update to guide implementation and the use of dedicated transit funding. This prioritization methodology mirrors the project selection process for the I-66 Commuter Choice Program. The ranking factors included:

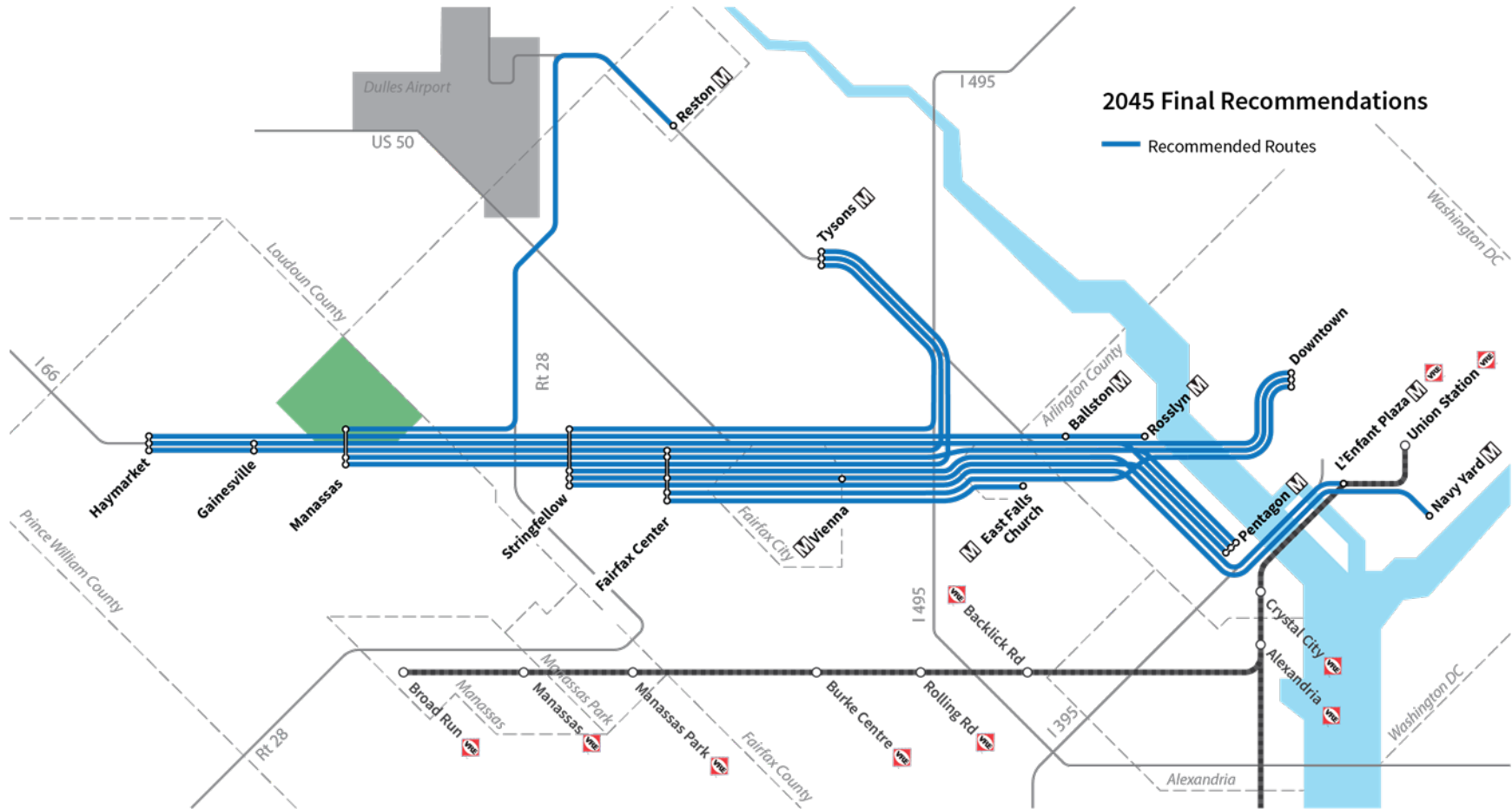
- Peak passenger throughput: Calculated on a route-basis at the maximum load point.
- Route distance on I-66: Round-trip portion of the route within the I-66 Express Lanes.
- Value ratio: Determined by contrasting service costs (operating and annualized capital) with anticipated ridership productivity.

All route service level details, including the priority rank for each recommendation year (2022, 2030, and 2045) are presented in Table E.1, with 2045 routes graphically depicted in Figure E.6.

Table E.1: Commuter Bus Recommendations Details and Phasing

Assumed Operator	Route (Origin/Destination)	New Route? (Y/N)	Commuter Choice Funding? (Year)	2022 Recommendations					2030 Recommendations					2045 Recommendations				
				Average Headway	Peak Trips	Peak Hours (# of hours)	Vehicles Needed (Total)	Priority Rank	Headway	Peak Trips	Peak Hours (# of hours)	Vehicles Needed (Total)	Priority Rank	Headway	Peak Trips	Peak Hours (# of hours)	Vehicles Needed (Total)	Priority Rank
OmniRide	Haymarket-Ballston/Rosslyn	No (H-100)	FY2020	40	8	4.0	4	6	40	8	4.0	4	10	40	10	5.3	4	12
OmniRide	Gainesville-Pentagon	No (G-200)	FY2017 FY2020	30	12	5.0	4	2	15	16	3.5	8	2	15	16	3.5	8	2
OmniRide	Gainesville-L'Enfant Plaza (Haymarket-Downtown DC in 2030)	No (Gainesville Express)	FY2020	35	14	8.4	4	8	15	38	8.7	11	3	20	26	8.0	8	8
OmniRide	Gainesville-Tysons (Haymarket in 2045)	No (LH-61)	FY2018	40	8	4.0	2	12	20	18	5.3	4	9	20	24	7.3	6	9
OmniRide	Manassas-L'Enfant Plaza (Downtown DC in 2030)	No (Manassas Express)		30	17	8.7	4	7	15	42	10.0	8	5	15	34	8.0	8	3
OmniRide	Manassas-Tysons	No (MT-60)		20	16	4.7	4	3	13	46	9.2	8	7	13	36	7.1	8	5
OmniRide	Manassas-Reston	Yes		20	20	6.0	8	10	16	34	8.5	10	12	16	30	7.5	10	11
Fairfax Connector	Stringfellow-Tysons	Yes		10	48	7.7	6	4	6	88	8.6	10	8	5	106	8.7	12	4
Fairfax Connector	Stringfellow-Pentagon	No (FC 698)	FY2018	10	54	9.0	12	1	5	106	8.7	24	1	5	116	9.5	24	1
Fairfax Connector	Stringfellow-L'Enfant Plaza	Yes	FY2020	16	34	9.1	5	5	8	60	7.7	10	4	10	52	8.3	8	6
Fairfax Connector	Fairfax Center-Downtown DC	No (FC 699)	FY2017 FY2020	20	25	8.2	4	9	8	62	8.0	10	6	10	56	9.0	8	7
Fairfax Connector	Fairfax Center-East Falls Church	Yes		20	16	4.7	4	11	16	18	4.3	5	11	20	16	4.7	4	13
Fairfax Connector	Stringfellow-Navy Yard	Yes												20	26	8.0	4	10

Figure E.6: Commuter Bus Recommendations – 2045 Route Schematic



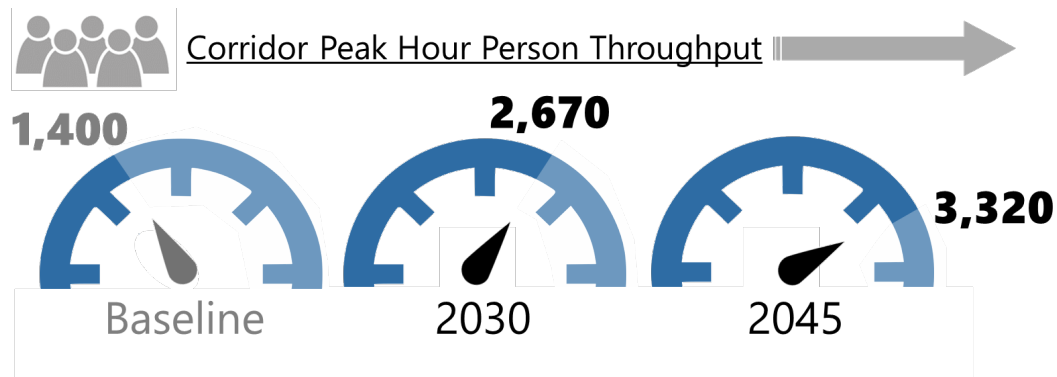
Commuter Rail Recommendations

The 2016 study did not include recommendations for improvements in commuter rail service on VRE’s Manassas line. With the potential for additional capacity in the corridor, the updated recommendations include one additional VRE Manassas Line train following completion of the Broad Run expansion project. The additional train enables VRE AM headways to decrease from 31 minutes to 27 minutes.

In anticipation of completion of the Long Bridge project, VRE could add additional peak period trains by 2030. A headway of 15 minutes between peak period trains was recommended for both 2030 and 2045. These recommendations only consider peak period commuting trips, however it should be noted that VRE is also considering the expansion of off-peak and/or bi-directional service as market conditions dictate.

As VRE service increases, the ridership specifically attributed to expansion recommendations grows to over 1.8 million annual riders, out of approximately four million total riders on Manassas Line service in 2030. While the headways are anticipated to remain the same in 2045, increasing demand and greater train utilization results in 2.3 million additional riders attributed to service expansion alone, out of a total of 5.1 million riders overall on the Manassas Line service. The anticipated person throughput for total Manassas Line ridership in 2030 and 2045 is illustrated in Figure E.7.

Figure E.7: VRE Commuter Rail Recommendations – Person Throughput Graphic



IMPACT OF UPDATED RECOMMENDATIONS

The overall ridership forecasts, including the commuter bus recommendations detailed in this report, existing VRE baseline growth and the VRE growth attributed to expansion service is presented in Table E.2.

Table E.2: Recommendations Ridership Summary

Transit Mode	2022 Service	2030 Service	2045 Service
Commuter Bus	1,568,100	3,766,000	4,194,000
VRE Manassas Line (Baseline)	1,963,500	2,233,800	2,789,700
VRE Manassas Line Recommendations	-*	1,856,400	2,295,000
TOTAL Bus & Rail	3,531,600	7,856,200	9,278,700

Source: Transit/TDM Study Update (2020)

Corridor-Wide Mode Split and Person Throughput Analysis

The combined impact of all recommendations results in noticeable shifts in I-66 commuting patterns with the implementation of the recommended services. The collective investments in Transit and TDM demonstrate an ability to accommodate growing travel demand throughout the I-66 corridor while contributing significantly to future non-SOV mode share. Overall, the recommendations accommodate growing travel demand throughout the I-66 corridor and maintain single occupant vehicle (SOV) travel near today’s levels, preserving the investment in I-66 well into the future.

Other highlights include:

- Person throughput generally increases at 1.4 percent to 2.2 percent per year in the corridor.
- The mode share for commuter bus increases from 4.8 percent in 2019 to 7.4 percent by 2045.
- The mode share for VRE increases from six percent in 2019 to over eleven percent in 2045.
- Mode shift from SOVs to higher occupancy modes is greatest at the Nutley Street cutline.

The effect on SOV travel at all three I-66 cutline locations, for 2030 and 2045 as contrasted against baseline conditions are presented in Figure E.8. Specific mode shifts from 2019 to 2045 are graphically presented in Figure E.9 for each of the corridor cutlines.

FigureE.8: I-66 Overall SOV and Non-SOV Shifts 2019, 2030, and 2045

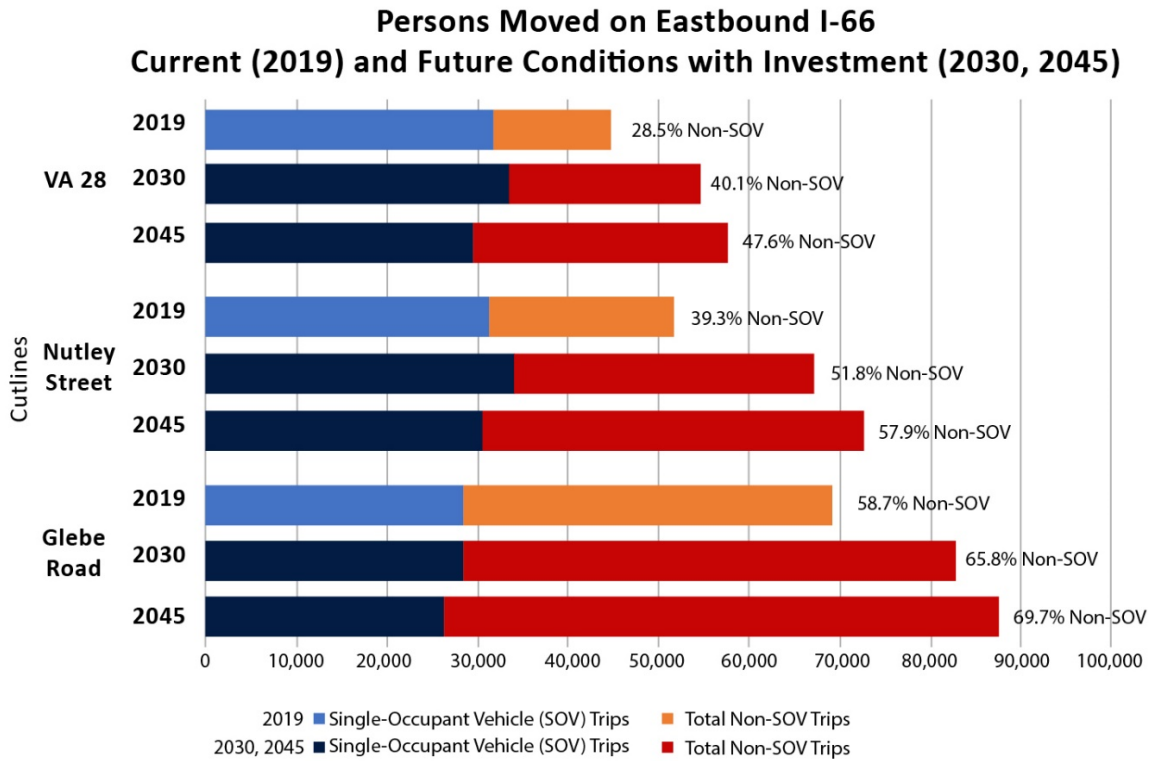
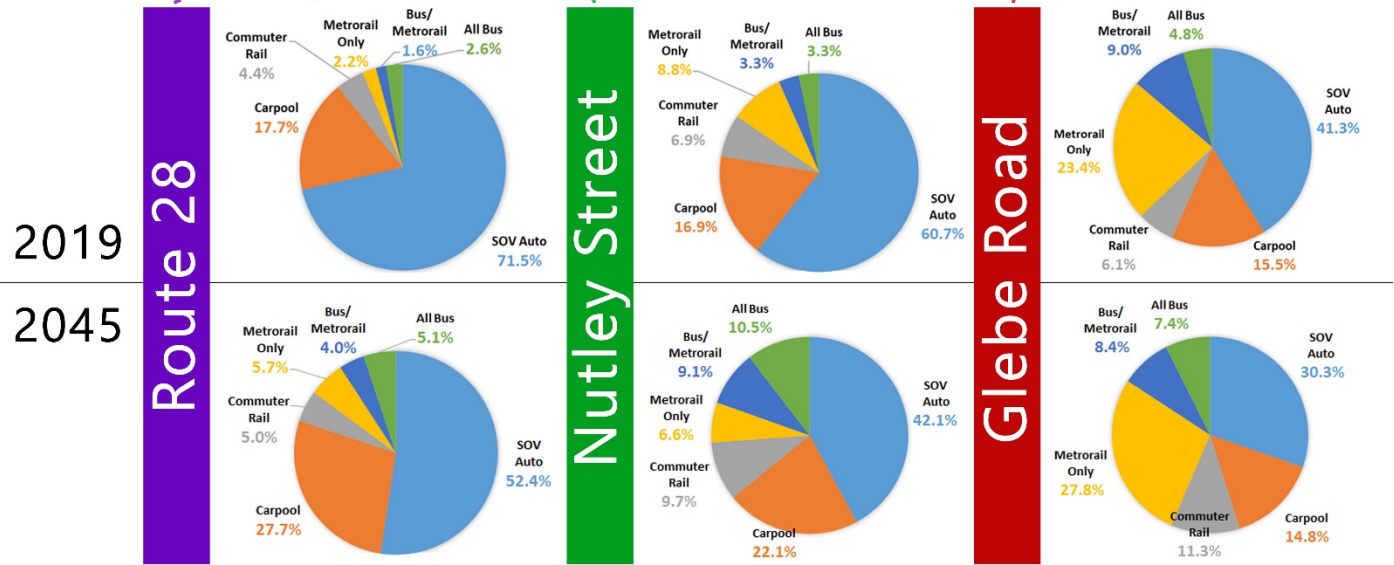
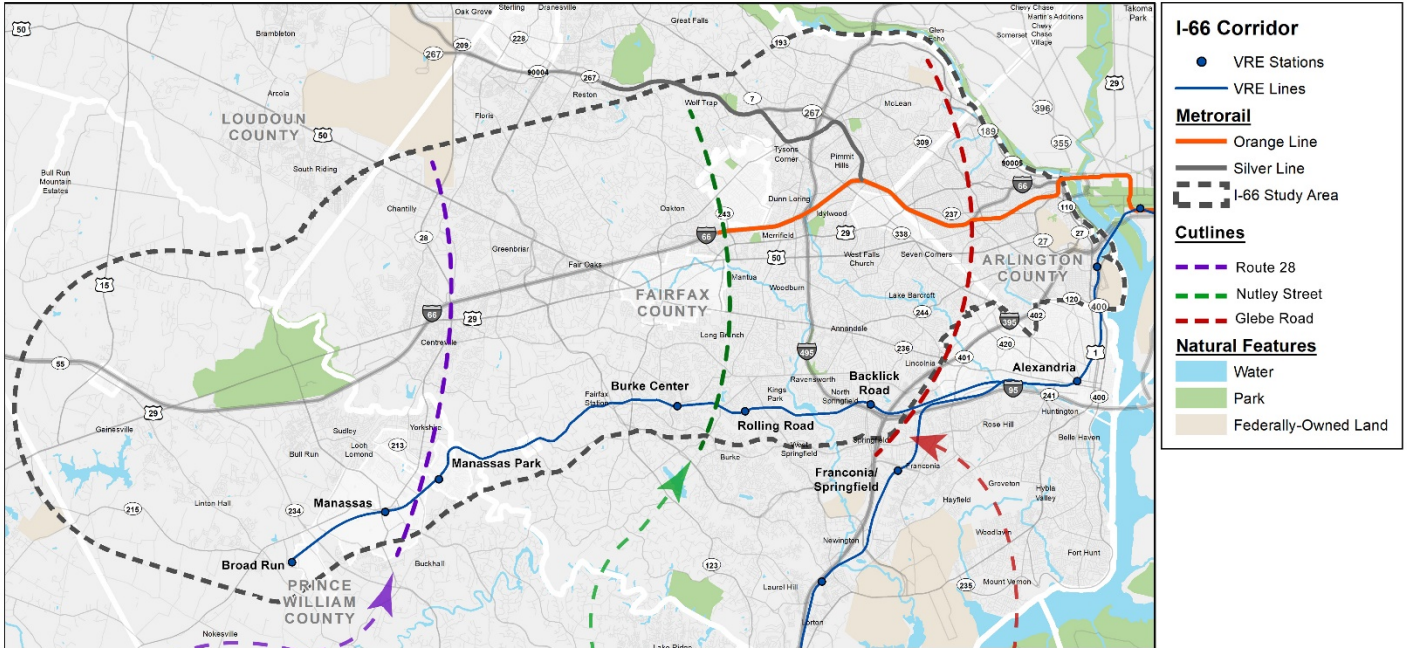


Figure E.9: I-66 Corridor Cutlines and Mode Split Results for 2019 and 2045



1 INTRODUCTION

1.1 2016 STUDY OVERVIEW

1.1.1 Background

In July 2014, the Virginia Department of Transportation (VDOT) and the Virginia Department of Rail and Public Transportation (DRPT) began a Tier 2 Environmental Assessment (EA) to study a combination of improvement concepts that collectively increase person throughput on I-66. This effort was a component of the overall I-66 Corridor Improvements Project, also referred to as “Transform 66 Outside the Beltway”. The process to consider improvements originated from the recommendations of the 2009 I-66 Transit/Travel Demand Management (TDM) Study that was conducted by DRPT. The needs and associated goals for this study are presented in Table 1.1.

Table 1.1: I-66 Corridor Improvement Needs and Goals

Needs	Goals
<ul style="list-style-type: none"> ▪ Corridor safety deficiencies. 	<ul style="list-style-type: none"> ▪ Enhance safety and travel predictability.
<ul style="list-style-type: none"> ▪ Corridor congestion. 	<ul style="list-style-type: none"> ▪ Reduce congestion.
<ul style="list-style-type: none"> ▪ Limited travel choices. 	<ul style="list-style-type: none"> ▪ Deliver innovative transportation solutions.
<ul style="list-style-type: none"> ▪ Travel reliability. 	<ul style="list-style-type: none"> ▪ Provide new, predictable travel choices.

Source: I-66 Corridor Improvements Project – Transit/TDM Technical Report (2016)

The development of the preferred alternative followed a tiered National Environmental Policy Act (NEPA) process, with a planning horizon year of 2040. Stakeholder and public coordination, including public surveys, were vital to the creation of the recommendations. The preferred alternative was packaged as a phased expansion of service following opening day, with its overall benefits confirmed against a No-Build condition. The study, concluded in 2016, noted that VDOT/DRPT would have the ability to monitor and measure performance of new services and adapt recommendations in the future with observed changes in travel patterns. DRPT always intended to reevaluate the recommendations prior to the opening of the Express Lanes in 2022.

Key components of the preferred alternative included:

- the addition of two managed toll lanes (Express Lanes) in each direction between I-495 and University Boulevard in Gainesville;
- new and expanded bus service along the corridor;
- enhanced TDM programs;

1.1.2 Outcomes

The development of the transit/TDM preferred alternative was collaborative, involving and engaging with the region's local government jurisdictions, transit operators, transportation organizations, and members of the community through a Transportation Technical Advisory Group (TTAG). Highlights from the 2016 study's multi-modal recommendations include (see also Figure 1.2):

New Transit Service

- Introduction by 2040 of 20 new/expanded commuter and local bus routes.
- Point-to-point commuter service between park-and-ride facilities and regional destinations.
- Services optimized to move more people along the corridor in expanded peak periods.
- Providing connections to existing Metrorail, VRE, and Metrobus services.
- The 2016 study did not directly address enhancements to rail services.

New and Expanded Park-and-Ride Facilities

- Introduction by 2040 of five new/expanded park-and-ride facilities.
- Amenities that support bus transit, carpool/vanpool, and kiss-and-ride.
- Direct access to the Express Lanes.
- Convenient connections to local roadway and trail networks.

TDM Strategies

- I-66 corridor marketing and outreach.
- Limited-time fare buy-downs for new transit users.
- Financial incentives and assistance for formation of carpools and vanpools.
- Support bicycle and pedestrian travel within the corridor.
- HOV-2 to HOV-3 conversion awareness.
- Expanded employer outreach.
- Innovative first/last mile solutions.

Key conclusions from the 2016 study included:

- There was an overwhelming desire from stakeholders and the public for expanded travel choices.
- The analysis provided more certainty that transit will continue to be a viable option for I-66 commuters well into the future.
- Service recommendations allowed local transit operators to continue to operate routes originating in their service areas.

Figure 1.2: 2016 Study Multimodal Project Elements

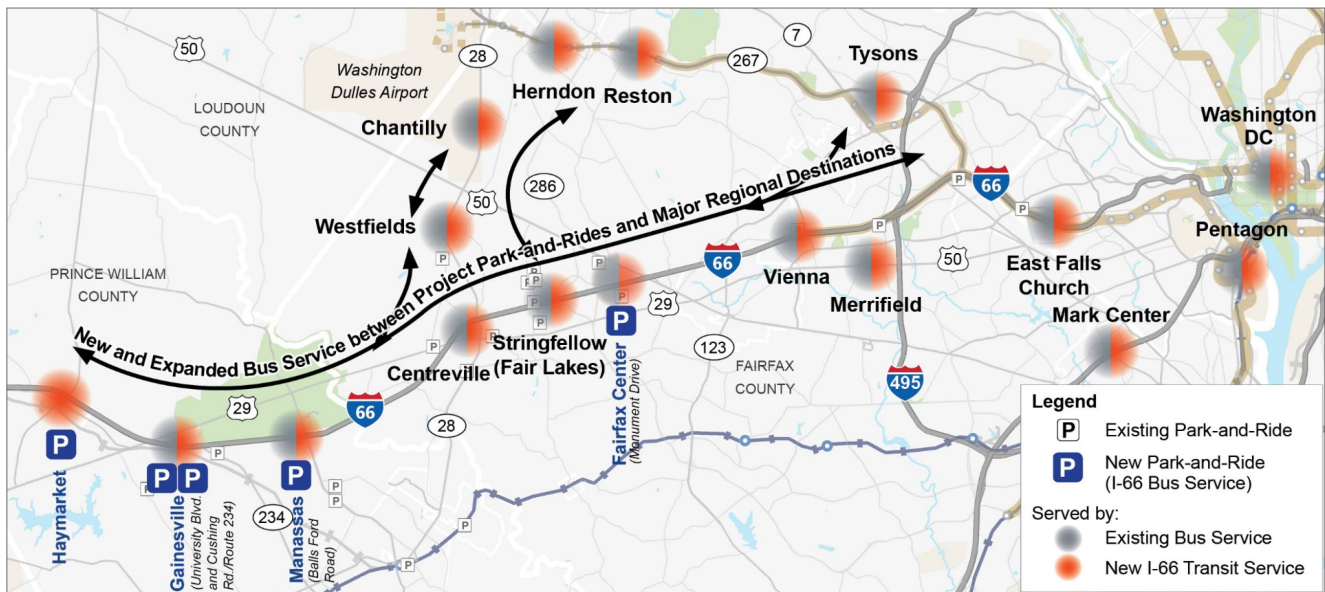


Table 1.2: 2016 Study Multimodal Project Benefits

Anticipated Project Benefits	
<ul style="list-style-type: none"> Increased number of one-seat bus rides to destinations in the greater Northern Virginia region. 	<ul style="list-style-type: none"> Expanded and new park-and-ride facilities with multimodal access and connections.
<ul style="list-style-type: none"> Reliable, predictable bus transit travel time due to the use of the Express Lanes. 	<ul style="list-style-type: none"> Support and incentives for non-single-occupant vehicle travel.
<ul style="list-style-type: none"> Transit service levels that increase incrementally as travel patterns change over time. 	<ul style="list-style-type: none"> Expanded transportation choices—transit and increased carpools and vanpools.

Source: I-66 Corridor Improvements Outside the Capital Beltway in Northern Virginia, USA, Kimley-Horn TRB Presentation (2016)

1.2 THE PLAN UPDATE PROCESS

This update adopts a holistic approach taking the entire I-66 corridor into account.

1.2.1 Rationale

As a strategic planning tool, revisiting previous conclusions is especially important when new data is available, assumed future external conditions become known, and actual performance of implemented services reshapes baselines and future forecasts. As noted, the 2016 study anticipated updates would occur to allow for adjustments in implementation. The timing of this initial update enables new considerations prior to opening day of the I-66 Express Lanes, alignment of evaluation and prioritization criteria across other regional corridor studies and overarching policy priorities. Subsequent updates will occur at regular intervals as travel patterns change and route performance is monitored.

1.2.2 New Considerations

This update revises the initially proposed program of Transit/TDM services. The timing of this revision enables the incorporation of new assumptions regarding regional developments that have occurred since the completion of the 2016 plan, to specifically include consideration of the following:

- The commitment of funding from the Transform 66: Outside the Beltway concession agreement, which provides the basis for implementing transit and TDM improvements in the I-66 corridor west of I-495.
- A growing certainty in the possibility and timeline for significant commuter rail service expansion not previously envisioned in the original plan, as a result of the advancement of the Long Bridge project and efforts to Transform Rail in Virginia.
- Shift in focus from an extension of service to the Gainesville-Haymarket area of Prince William County to a capacity expansion along the existing Manassas Line, with operating and facility improvements for service originating at the existing VRE Broad Run station.
- The I-66 Transportation Management Plan (TMP) and Northern Virginia Transportation Commission (NVTC) Commuter Choice program have provided funding for multimodal transportation projects in the I-66 Corridor, with new bus routes and services operating since 2018. Therefore, the baseline of transit available before the Express Lanes opening day has changed from baseline services considered in the 2016 plan.
- A Regional Multimodal Mobility Program (RM3P), was introduced in 2019 with the intent to use data-driven tools to encourage people to reduce single-occupancy vehicle travel. This effort will guide future TDM investments in the I-66 corridor, with a focus on real-time information sharing and Mobility as a Service (MaaS) to address first/last mile service gaps.

1.2.3 Goals for the Study Update

The plan update focused on the following goals as recommendations were developed and revised from the 2016 study. These goals align with the interests of various stakeholders and reflect their common vision of the I-66 corridor. The goals for adjusting the multimodal mix of projects are to:

- Increase mobility and maximize person throughput in the corridor through the identification of new transportation alternatives, including transit and TDM service improvements.
- Coordinate projects that are currently funded by two funding mechanisms, I-66 Commuter Choice: Inside the Beltway program and Transform 66 Outside the Beltway, to achieve efficiency and reliability of travel along the corridor.
- Evaluate the future mix of transit strategies to increase travel options and intermodal connectivity, as well as, reduce congestion in the corridor.

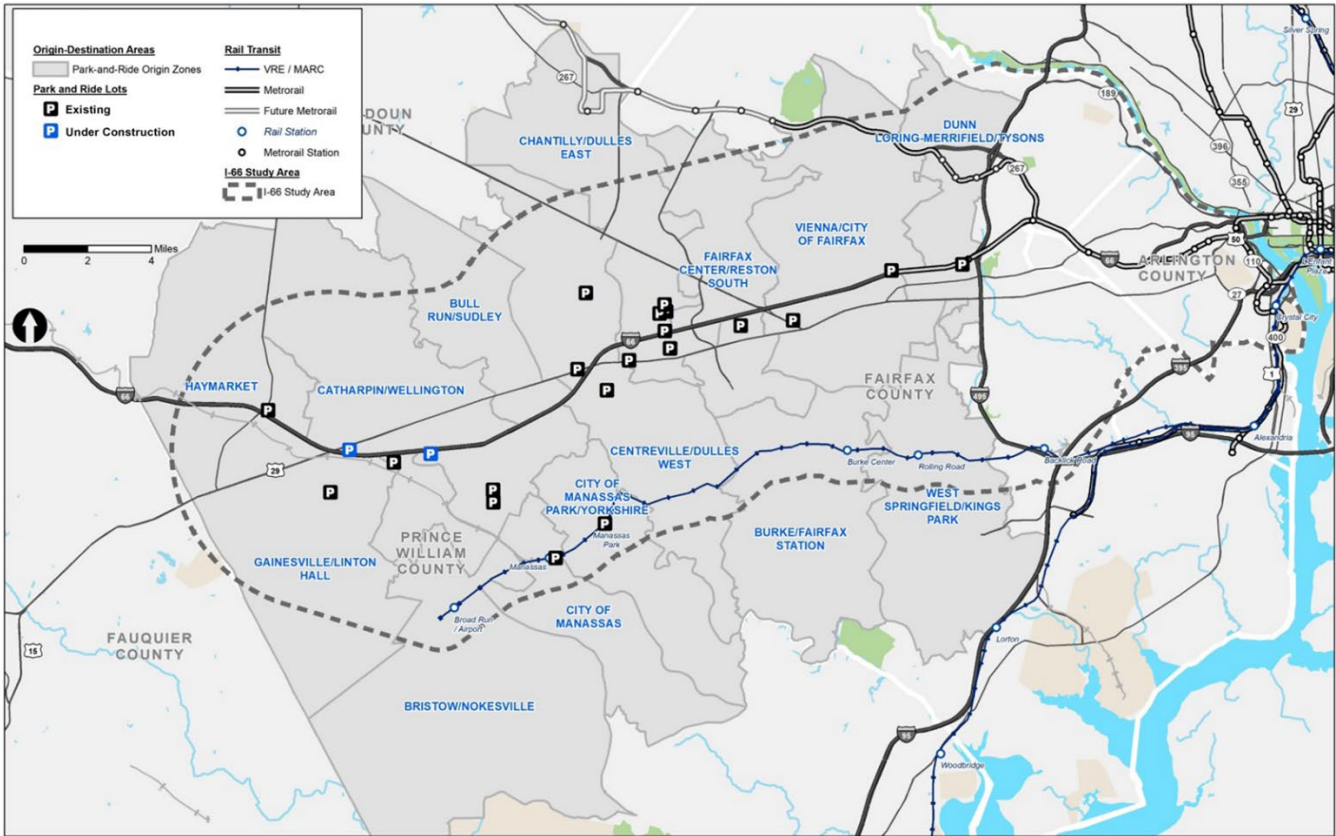
In order to fully coordinate funding approaches and service recommendations, for the purposes of this study update, the I-66 corridor limits were redefined to extend from Washington, D.C. (I-66 at the Potomac River) to Haymarket, Prince William County (see Figure 1.3). Highlights of key changes made and different inputs into this study update are listed in Table 1.3.

Table 1.3: 2016 Plan and Plan Update Key Differences

Plan Component	Previous Plan	Plan Update
Study extent along I-66 corridor	Haymarket to I-495 (25.5 miles)	Haymarket to Potomac River (35.5 miles)
VRE Manassas Line commuter rail service plans	Not included	Included
TPB travel demand model	Version 2.3.52	Version 2.3.75
Demographic data	Round 8.3	Round 9.1
Planning Horizon Year	2040	2045

Source: Transit/TDM Study Update (2020)

Figure 1.3: Study Update Corridor-Wide Map



1.3 I-66 CORRIDOR TOLLING AND FUNDING FRAMEWORK

The Transform 66: Outside the Beltway Project involves an interstate capacity expansion through construction of managed tolled lanes under a Public-Private Partnership 50-year concession arrangement entered into by VDOT. The concession agreement provides for an annual transit payment to the Commonwealth for multimodal improvements in the corridor.

Funding for multimodal improvements benefitting the segment of I-66 from I-495 to the Potomac River (Inside the Beltway) is provided through a separate agreement between the Commonwealth and NVTC with available funds generated by toll revenues collected by VDOT. In both cases, the overarching criteria for multimodal programs or projects selected for funding from either of these two funding

Commitment of toll revenues to transit payments and multimodal programs enables the Commonwealth to provide transportation options that otherwise may not have been possible.

mechanisms are that the improvements need to benefit the users of the I-66 Express Lanes.

Multimodal projects selected for funding must meet one or more of the following I-66 Program Goals:

- Maximize person throughput in the Corridor
- Implement multimodal improvements to:
 - improve mobility along the Corridor
 - support new, diverse travel choices
 - enhance transportation safety and travel reliability

Further details on the two funding agreements are provided in the following sections.

1.3.1 Transform 66 Outside the Beltway

As part of the Transform 66 Outside the Beltway Project Comprehensive Agreement (I-66 Concession Agreement), I-66 Express Mobility Partners (EMP) committed to an upfront payment of \$500 million (I-66 Concession Fee) to the Commonwealth for transportation improvements along the I-66 corridor prior to the opening of the I-66 Express Lanes. Fifteen transportation projects were recommended by the Northern Virginia Transportation Authority (NVTA) to utilize this funding and were subsequently approved by the Commonwealth Transportation Board (CTB). The ability to make these upgrades prior to the opening of the I-66 Express Lanes support the service levels recommended by this study. These projects are listed in Table 1.4.

The I-66 Concession Agreement also requires EMP to make annual transit payments to the Commonwealth for multimodal improvements until the end of the agreement in 2066. The annual transit payments have a net present value of \$800 million. These transit payments have been amortized annually through the entire span of the agreement (see Table 1.5). Funding can be used for capital, operating, and reserves for multimodal projects in the corridor. EMP has committed to making these payments after debt service, reserve accounts required by lenders, and other provisions in the loan documentation from the Federal government.

Table 1.4: I-66 Concession Fee Projects

Jurisdiction	Project	Funding (2018 millions)
Arlington County	East Falls Church Metrorail Station Bus Bay Expansion	\$4.8
Fairfax County	Jermantown Road Bridge over I-66: Widen to four lanes	\$11.0
	RT 50 and Waples Mill Road intersection improvements	\$2.0
	Monument Drive bridge pedestrian facility improvement	\$3.8
	Commuter parking structure at Government Center	\$38.5
	Lee Highway pedestrian improvements (Nutley St-Vaden Dr)	\$1.3
	Poplar Tree Road bridge construction to four lanes	\$6.0
	I-66 median widening for Metrorail accommodation (RT 29-RT 28)	\$40.0
	RT 29 Improvements (Pickwick Rd-Shirley Gate Rd)	\$26.7
Prince William County	RT 234 at Balls Ford Road interchange (including Balls Ford Rd)	\$145.0
	Balls Ford Road widening (Groveton Rd-Sudley Rd)	\$67.4
City of Fairfax	George Snyder Trail (Chain Bridge Rd-RT 50 at Draper Dr)	\$13.6
Town of Vienna	Nutley Street SW mixed-use trail (Marshall Rd SW-Tapawingo Rd SW)	\$0.3
PRTC	Western bus maintenance & storage facility	\$11.1
VRE	VRE Manassas Line capacity expansion and real-time information	\$128.5
TOTAL		\$500.0

Source: Commonwealth Transportation Board – Resolution 1/10/2018

Table 1.5: Annual Transit Funding Payments 2022-2066

Payment (year)	Amount (YOE millions)	Payment (year)	Amount (YOE millions)	Payment (year)	Amount (YOE millions)
2022	\$21.2	2037	\$25.0	2052	\$40.0
2023	\$21.2	2038	\$25.0	2053	\$41.5
2024	\$42.0	2039	\$25.0	2054	\$45.0
2025	\$11.0	2040	\$26.0	2055	\$47.0
2026	\$11.0	2041	\$28.5	2056	\$47.5
2027	\$11.5	2042	\$30.0	2057	\$49.0
2028	\$13.5	2043	\$30.0	2058	\$53.5
2029	\$16.5	2044	\$30.0	2059	\$57.5
2030	\$19.0	2045	\$30.0	2060	\$58.0
2031	\$22.5	2046	\$32.5	2061	\$58.0
2032	\$24.0	2047	\$35.0	2062	\$58.0
2033	\$23.0	2048	\$37.5	2063	\$59.0
2034	\$24.0	2049	\$40.0	2064	\$61.5
2035	\$25.0	2050	\$40.0	2065	\$65.0
2036	\$25.0	2051	\$40.0	2066	\$33.5
TOTAL	\$1559.0				

Source: VDOT Transform 66 P3 Comprehensive Agreement Amended Exhibit J (2018)

1.3.2 I-66 Commuter Choice

In 2017, the Commonwealth entered into a 40-year agreement with the Northern Virginia Transportation Commission (NVTC) to use revenues generated from tolling by VDOT on I-66 Inside the Beltway to fund multimodal transportation projects that benefit toll payers in that corridor. The most recent amended agreement between NVTC and the Commonwealth (2020) provides NVTC with a minimum of \$15 million per year (with a 2.5% escalation) beginning in FY2022.

NVTC established the I-66 Commuter Choice Program to plan and program eligible multimodal projects for funding. NVTC then, in consultation with DRPT, recommends a program of multimodal projects to the Commonwealth Transportation Board (CTB) for approval. Following CTB approval, NVTC issues funding agreements to successful applicants, coordinates with funding recipients to ensure efficient project delivery, and monitors the effectiveness of improvement projects. Further details on NVTC I-66 funded projects can be found at the following link:

<http://www.novatransit.org/programs/commuterchoice/i-66-commuter-choice/>

Eligible transit operations projects must represent new or enhanced services, and these projects may be subject to operating funding step-downs over time. For operations projects of any type (e.g., transit, bikeshare, transportation demand management), the program supports a maximum of 24 months of operations at a time. The program funds operating costs net of fares received.

NVTC issues a biannual Call for Projects that solicits proposals for the upcoming two fiscal years. The most recent call for I-66 projects (Round Four) received applications from November 15, 2019 through January 31, 2020 for FY2021 and FY2022 implementation.

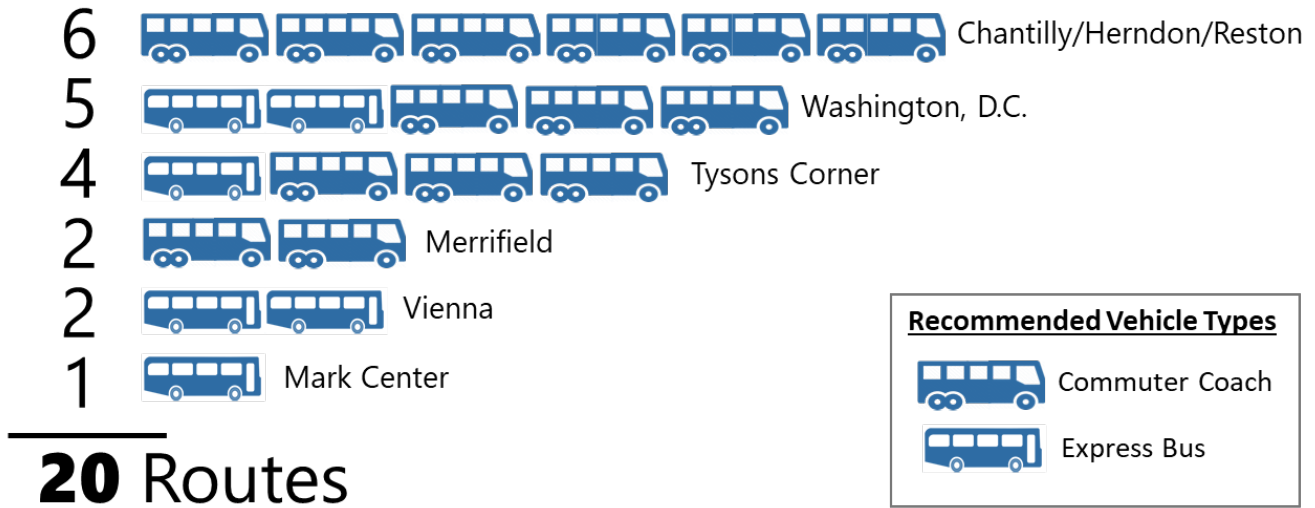
1.4 2016 STUDY RECOMMENDATIONS

The 2016 study provided information regarding a preferred alternative that featured investments in new transit services, park-and-ride facilities, and TDM elements of the I-66 Corridor Improvements Project (Transform 66) for the section of the corridor between the Town of Haymarket and I-495. Key recommendations related to the ability for transit/TDM investments to leverage the new Express Lanes and access improvements to move more people included:

- Expansion of existing commuter bus services (new routes, increased frequency).
- Development of new park-and-ride-facilities and expansion of existing facilities.
- Strengthening of existing TDM strategies to support other recommendations.

Specifically, the 2040 bus service recommendations from the 2016 study included 20 new/expanded commuter routes with service as indicated in Figure 1.4. These services will be updated, along with other recommendations, as documented in the remainder of this report.

Figure 1.4: 2016 Study - 2040 Recommended Commuter Bus Routes and Destinations



Full details on the 2016 study preferred alternative, phasing and service levels, and other recommendations that formed the basis for this update can be found in the [Final Tier 2 Environmental Assessment – Transit and Transportation Demand Management \(TDM\) Technical Report](#).

2 I-66 CORRIDOR EXISTING AND FUTURE CONDITIONS

2.1 DEMOGRAPHICS AND GROWTH

This study updates existing and projected future conditions along and adjacent to this corridor, typically within five miles of I-66 and within one mile from the VRE Manassas Line. Inclusion of the VRE Manassas Line and extension of the study area to the Potomac River resulted in an expanded study area and significant demographic shifts from the 2016 study.

The corridor population and employment data along the I-66 corridor provides insight into expected transit demand. These represent the two most common origins and destinations for transit trips, namely home and work. Due to the small geographic size of the Transportation Analysis Zones (TAZs) in the region, TAZs were aggregated to larger zones based on their geographic proximity to major park-and-ride locations along the corridor (see Figure 3.3). Since AM peak directional travel along the corridor is primarily west to east, the zones created were focused to the west of each park-and-ride or group of park-and-rides. This was done for population and employment growth analysis.

Low population and employment densities along I-66 outside the beltway provide opportunities for increased development and connectivity to future corridor mobility hubs that will enhance the performance of future transit recommendations.

2.1.1 Population

Current Population (2020)

Population data for all jurisdictions was obtained from the Metropolitan Washington Council of Governments (MWCOG) Round 9.1 Cooperative Forecasts. The total population attributed to the portion of jurisdictions within the I-66 corridor study area is expected to be approximately 1,256,000 people in 2020. Table 2.1 shows the study area population by jurisdiction, the percentage difference in these figures from the 2016 study, and the jurisdictional rank within the study area.

Table 2.1: 2020 Study Area Population

Jurisdiction	2020 Population	Percent Change from 2016 Study (2015)	Rank
Arlington County	238,295	834.5%	2
Fairfax County	742,892	34.0%	1
City of Fairfax	25,596	3.6%	5
City of Falls Church	14,211	8.5%	8
Fauquier County	9,354	246.4%	9
Loudon County	20,701	195.7%	6
City of Manassas	43,792	23.7%	4
City of Manassas Park	15,864	10.9%	7
Prince William County	145,310	1.9%	3
TOTAL	1,256,015	53.2%	

Source: MWCOG Draft Round 9.1 forecasts, I-66 Corridor Improvements Project – Transit/TDM Technical Report (2016)

Population Growth

By the year 2045, the total population within the I-66 corridor is forecast to grow to over 1.5 million people. This represents an increase of approximately 284,000 people, or a 22.6 percent increase from the 2020 population estimate. Table 2.2 shows annual population for 2020 and 2045 for the portions of the jurisdictions within the study area. The annual population growth from 2020 to 2045 for the entire study area is 0.8 percent, with the fastest growing jurisdiction being Prince William County with a growth of 1.4 percent per year.

Table 2.2: 2020 – 2045 Forecast Study Area Population Changes

Jurisdiction	2020 Population	2045 Forecast Population	2020-2045 Annual Growth Percentage
Arlington County	238,295	301,167	0.9%
Fairfax County	742,892	875,029	0.7%
City of Fairfax	25,596	35,166	1.3%
City of Falls Church	14,211	17,611	0.9%
Fauquier County	9,354	13,068	1.3%
Loudon County	20,701	24,988	0.8%
City of Manassas	43,792	52,133	0.7%
City of Manassas Park	15,864	17,609	0.4%
Prince William County	145,310	205,021	1.4%
TOTAL	1,256,015	1,541,792	0.8%

Source: MWCOG Draft Round 9.1 forecasts

From 2020 to 2045, projected population remains stable or grows in almost all TAZs throughout the study area. A handful of TAZs show population decreases, but, when the TAZs are aggregated into park-and-ride origin zones, all park-and-ride origin zones show population increases during this time period. The park-and-ride origin zone encompassing Tysons and Dunn Loring-Merrifield is projected to gain 50,000 people during this time period, and the park-and-ride origin zones for Gainesville/Linton Hall, Catharpin/Wellington, City of Manassas Park/Yorkshire, and Vienna/City of Fairfax each are projected to grow by more than 15,000 people.

2.1.2 Employment

Current Employment (2020)

Consistent with the 2016 study, in this update employment numbers reflect the number of jobs located along the I-66 corridor—not a measure of whether residents of the area are employed. Employment data for each jurisdiction was also obtained from the MWCOG forecasts. Compilation of this data reveals that approximately 820,000 people are expected to work within the study area in 2020. Table 2.3 shows 2020 employment estimates during this update, the percentage difference from the 2016 study, and the jurisdictional rankings.

Table 2.3: 2020 Study Area Employment

Jurisdiction	2020 Employment	Percent Change from 2016 Study (2015)	Rank
Arlington County	216,874	5189.6%	2
Fairfax County	453,125	29.2%	1
City of Fairfax	22,933	10.3%	5
City of Falls Church	14,300	19.2%	6
Fauquier County	3,745	167.5%	8
Loudon County	2,560	326.7%	9
City of Manassas	26,877	14.4%	4
City of Manassas Park	4,718	2.6%	7
Prince William County	75,534	44.1%	3
TOTAL	820,666	74.6%	

Source: MWCOG Draft Round 9.1 forecasts, I-66 Corridor Improvements Project – Transit/TDM Technical Report (2016)

Employment Growth

From 2020 to 2045, projected employment in the study area is expected to grow in areas that overlap with MWCOG Activity Centers. By the year 2045, the total employment within the I-66 corridor is forecast to grow to over one million people. This represents an increase of almost 228,000 people, or a 27.7 percent increase from the 2020 population estimate. Additionally, as a major commuter destination, Washington, D.C. is expected to add 200,000 additional jobs by 2045. Table 2.4 shows employment forecasts for 2020 and 2045 for the portions of the jurisdictions within the study area.

Although the number of jobs in some study area TAZs are expected to decrease, all MWCOG Activity Centers show an increase in the number of jobs (see Figure 2.2). In the study area, the MWCOG Activity Centers associated with Tysons, the proposed Silver Line Metrorail stations, and the Innovation area (northwest of City of Manassas) show the highest increases in number of jobs (See Figure 2.3).

Activity Centers are existing urban centers, traditional towns, transit hubs, as well as areas expecting future growth. From Haymarket to the Potomac River immediately adjacent to I-66 are twelve activity centers as defined by the TPB. Seven located along I-66 inside the beltway and five outside the beltway.

Table 2.4: 2020 – 2045 Forecast Study Area Employment Changes

Jurisdiction	2020 Employment	2045 Forecast Employment	2020-2045 Annual Growth Percentage
Arlington County	216,874	269,064	0.9%
Fairfax County	453,125	552,388	0.8%
City of Fairfax	22,933	23,429	0.1%
City of Falls Church	14,300	18,600	1.1%
Fauquier County	3,745	6,806	2.4%
Loudon County	2,560	4,082	1.9%
City of Manassas	26,877	31,032	0.6%
City of Manassas Park	4,718	5,205	0.4%
Prince William County	75,534	137,639	2.4%
TOTAL	820,666	1,048,245	1.0%

Source: MWCOG Draft Round 9.1 forecasts, I-66 Corridor Improvements Project – Transit/TDM Technical Report (2016)

Figure 2.1: Regional Population Growth by TAZ, 2020-2045

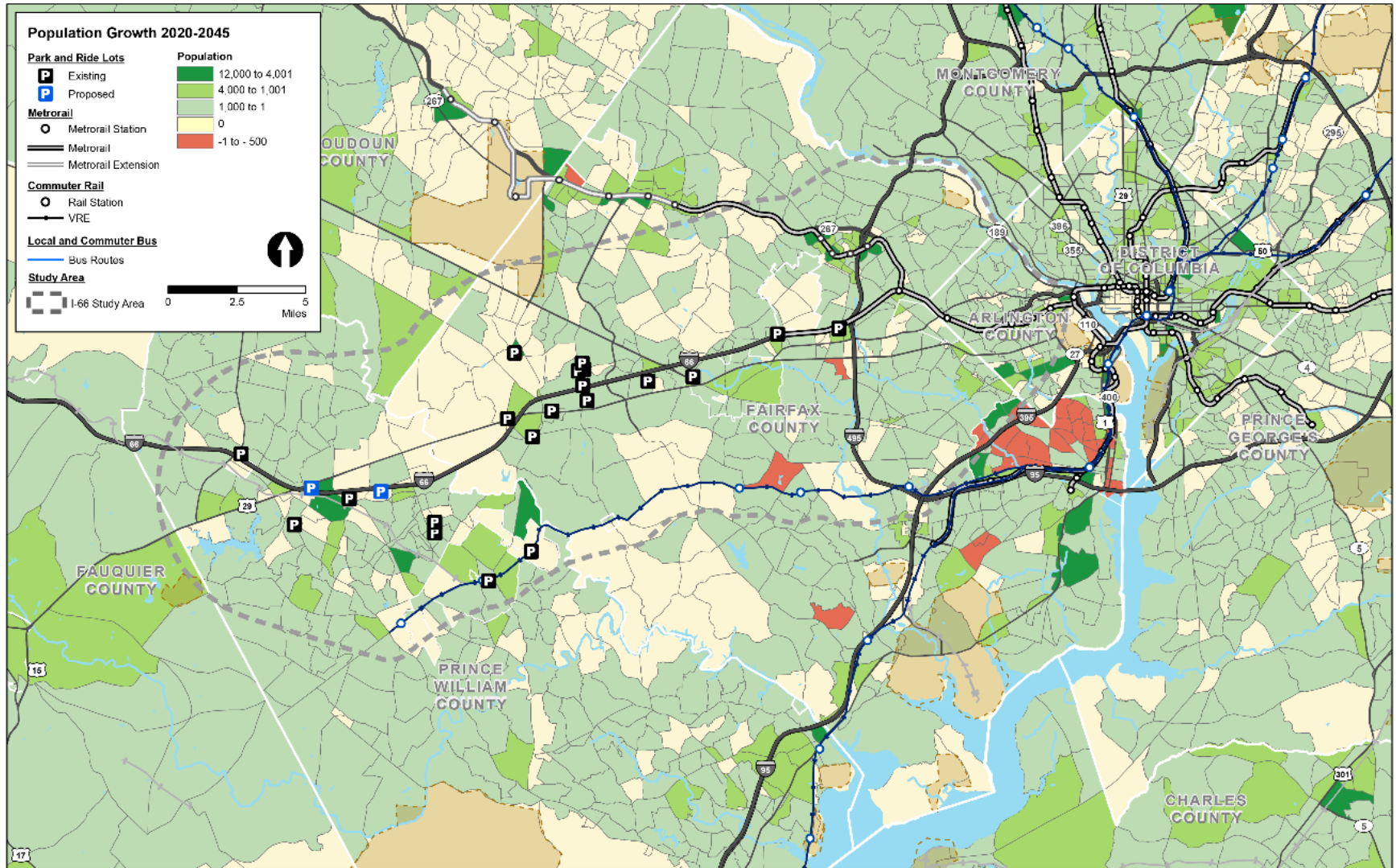


Figure 2.2: Regional Employment Growth by TAZ, 2020-2045

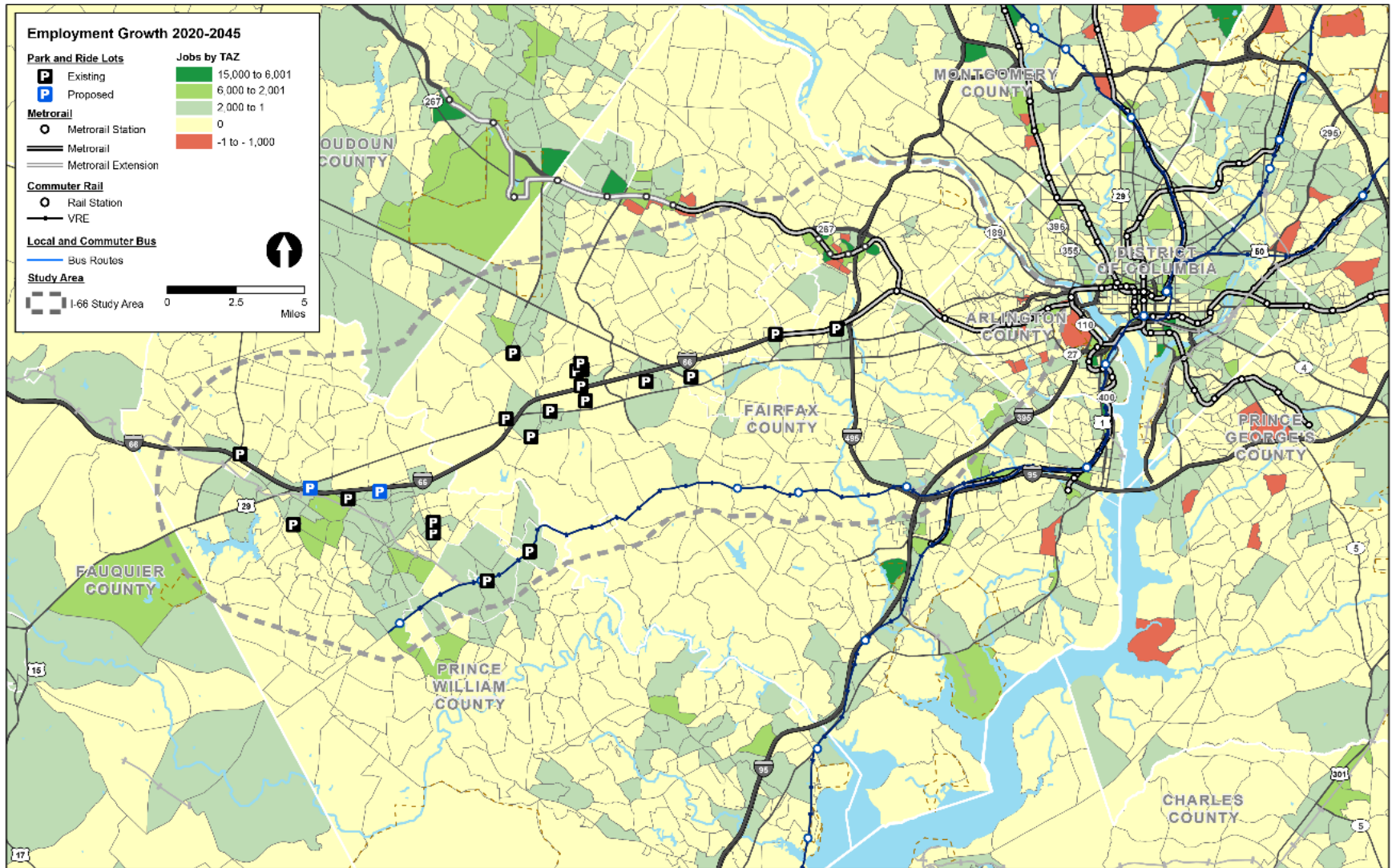
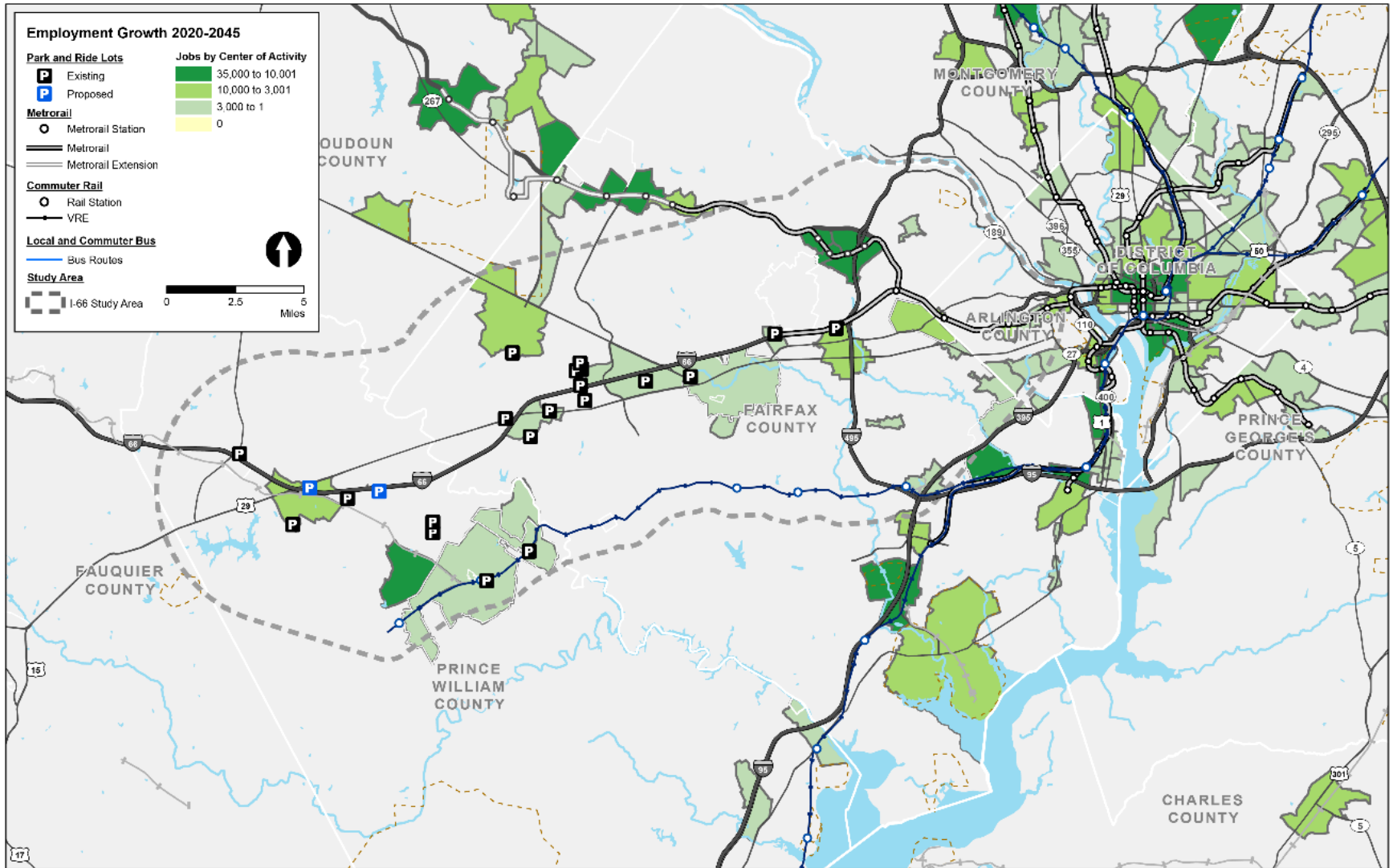


Figure 2.3: Activity Center Employment Growth, 2020-2045



2.2 TRANSIT MARKET ANALYSIS

Market analysis provides a high-level overview of transit needs and travel flows, based on current and projected demographics, to help determine the different types of transit service that would be the most successful along the I-66 corridor. The market analysis used four different transit indexes to determine where potential transit origins and destinations are located, and then considered a transit travel flow analysis to determine the connections needed between these locations. The indexes used included:

- **Commuters** - The commuter index combines employed persons, commuters, and transit commuters. Employed persons, commuters, non-single occupancy vehicle commuters, and zero and one-car households 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.
- **Employment** - The employment index includes total employment and employment density. This index is indicative of where people commute for work purposes.
- **Transit-Oriented Populations** - The transit-oriented population index consists of five categories: age, income, vehicle ownership, disabled population, and minority population. The data sets that contribute to these categories are all indicative of persons that are likely to be more reliant on transit. Therefore, this index is indicative of where transit-dependent populations live.
- **Service/Activity** - The Service/Activity index has five categories: retail/restaurant, recreation, healthcare/social assistance, education, and government. These categories are weighted based on the typical trip purpose proportions for transit users. Employment by sector data sets for these categories serve as proxies for how much travel demand that businesses that fall into these sectors would produce, and therefore, this index is indicative of where people make non-work trips.

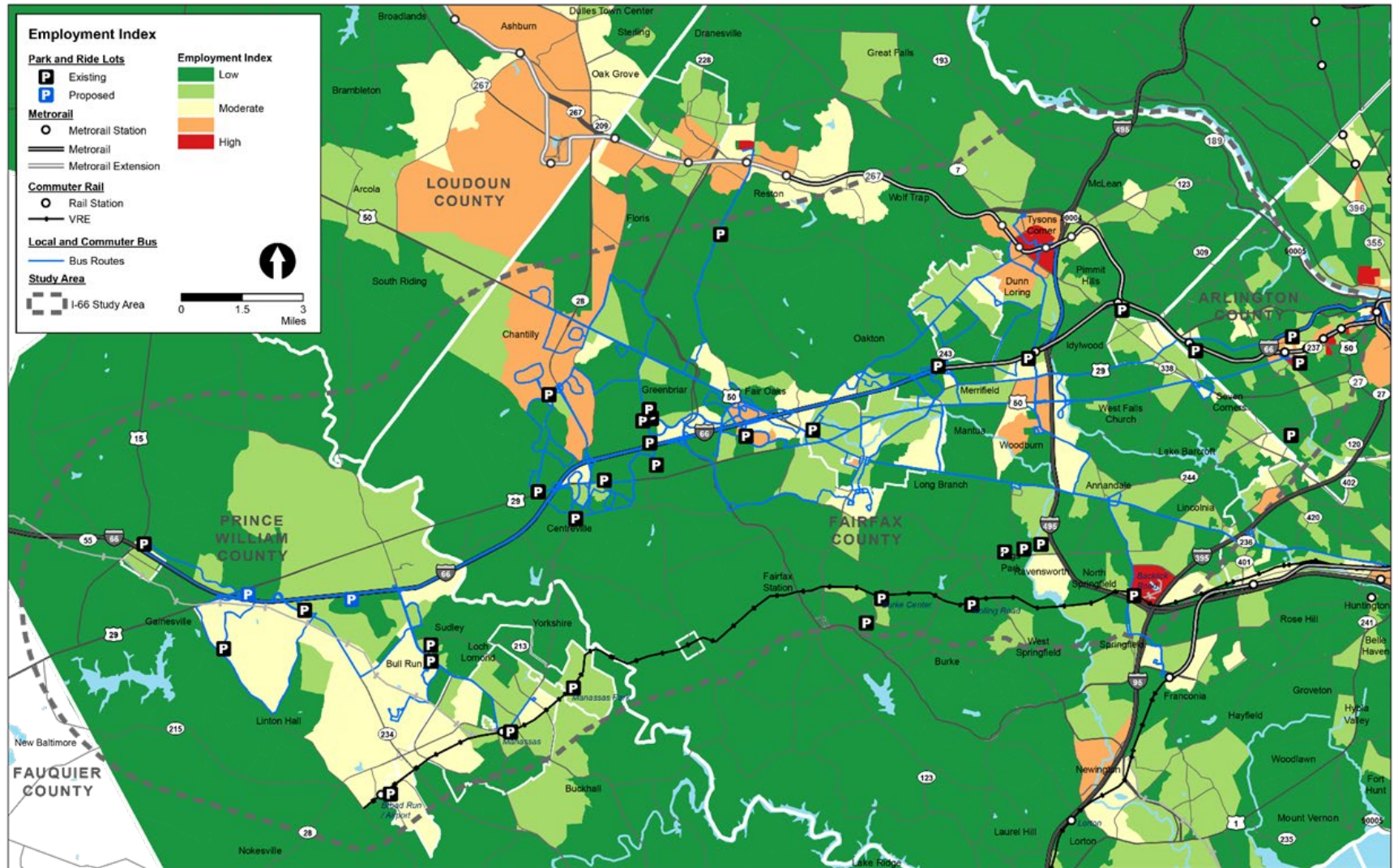
These four indexes combine to show two types of transit need: all-day service and peak service. Full details on the results of analyses for each index are found in the Appendix A of this report.

The commuter index is indicative of where traditional peak hour commuters live; the employment index is indicative of where people commute for work purposes. When combined, these two indexes show where commuter populations live and work. The current year commuter index results are depicted in Figure 2.4, showing higher values are concentrated in Arlington County, and along I-395. Moderate to moderate/high values are concentrated along I-66, the City of Fairfax, City of Manassas Park, and the area north of the City of Manassas (but south of I-66). The employment index results in Figure 2.5, showing high values are found in the region's major job centers including Tysons, Springfield, and the Rosslyn-Ballston corridor in Arlington. Moderate to high values are seen in Merrifield, Fair Oaks, Chantilly, the area around the Pentagon, and along the Silver Line expansion corridor.

Figure 2.4: Commuter Transit Index



Figure 2.5: Employment Index



2.2.1 Transit Travel Flows

This analysis determines which connections along the study corridor would have the highest potential for transit use. In many cases, these connections can be further aggregated to create new transit routes that serve multiple origins and destinations. Travel flows are depicted for the current baseline year (2019) and 2045. Two types of travel flows were considered, namely peak period flows and all-day flows. Peak period flows were scored using home-based work trips, the commuter index, and employment index scores. All-day flows were scored using all trips (from all purposes), the transit-oriented populations index, and the service/activity index. Additional analysis and a detailed methodology are presented in Appendix A.

Commuter Trips

In the study area, baseline flows are primarily between Fairfax County and activity centers in Washington, D.C. along the I-66 corridor. The highest scores represent potential demand for short trips within central Fairfax County and longer trips into Washington, D.C. (See Figure 2.6). Transit travel flows for 2045 are larger, and more evenly distributed between Washington, D.C., Tysons, and along the I-66 corridor. While 2045 flows show increasing potential demand to Reston, and across Prince William County, scores weaken slightly between southern Fairfax County and Washington, D.C. (See Figure 2.7). Overall, this analysis shows commuter transit trips tend to be focused toward Washington, D.C., and the I-66 corridor in Fairfax County. Trips to activity centers throughout Fairfax County grow between the baseline year and 2045.

All-Day Trips

Baseline transit travel flows are concentrated in shorter trips to and from activity centers in Fairfax County and Prince William County. High score flows are well-distributed throughout the study area, and trips to Washington, D.C. are overshadowed by localized all-day trips (see Figure 2.8). In 2045, transit travel flows continue to increase, with an emphasis on shorter trips. Compared to the baseline year, the greatest growth can be found in Gainesville and Tysons. Some longer trips to Ashburn, Dulles, and Fort Belvoir also emerge (see Figure 2.9). Overall, all-day potential transit travel flows favor shorter trips to nearby activity centers. Gainesville and Tysons show the most growth between the baseline year and 2045, and cross-county trips also show an increase.

Figure 2.6: Base Year Commuter Trip Flows (2019)

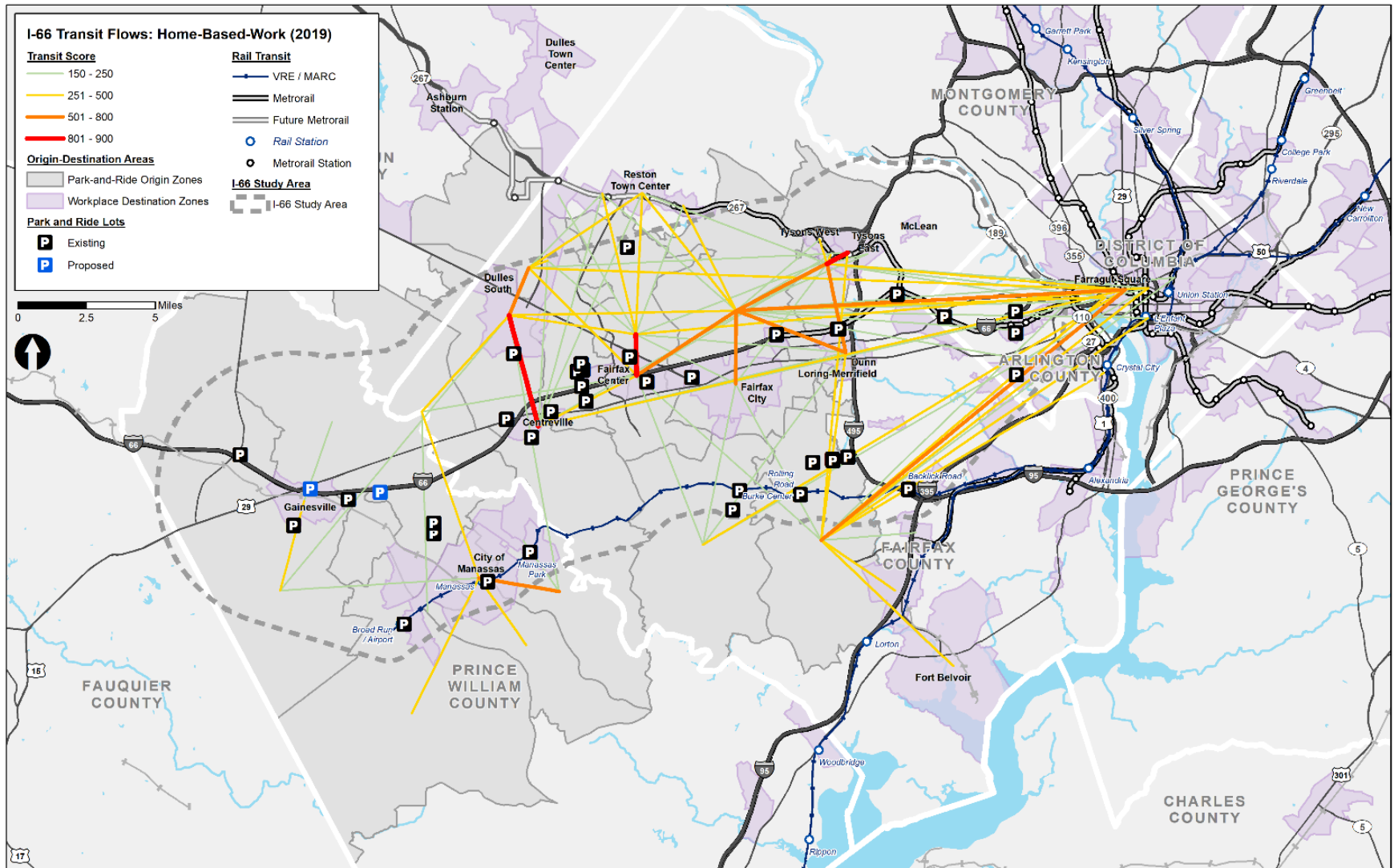


Figure 2.7: 2045 Commuter Trip Flows

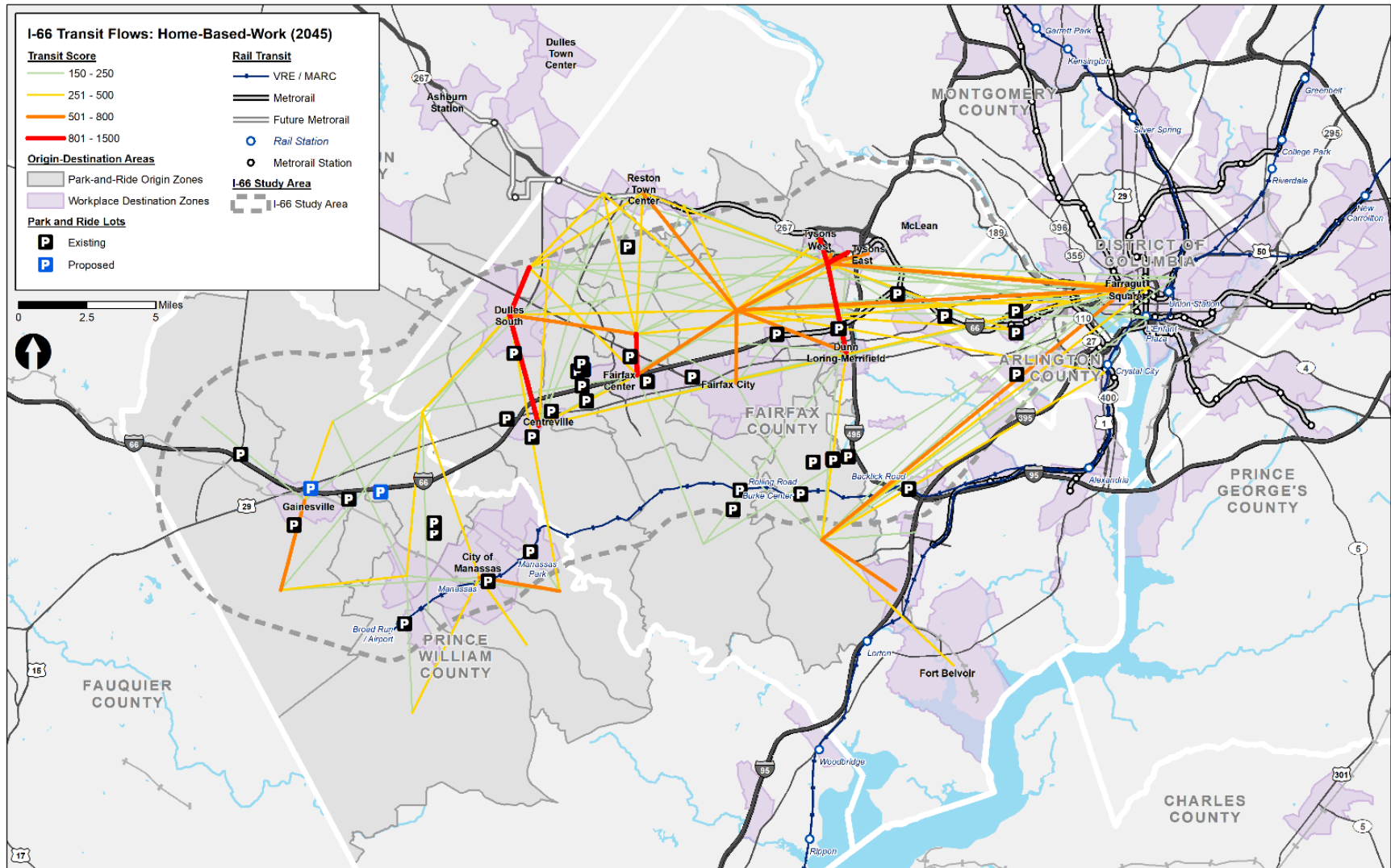


Figure 2.8: Base Year All-Day Trip Flows (2019)

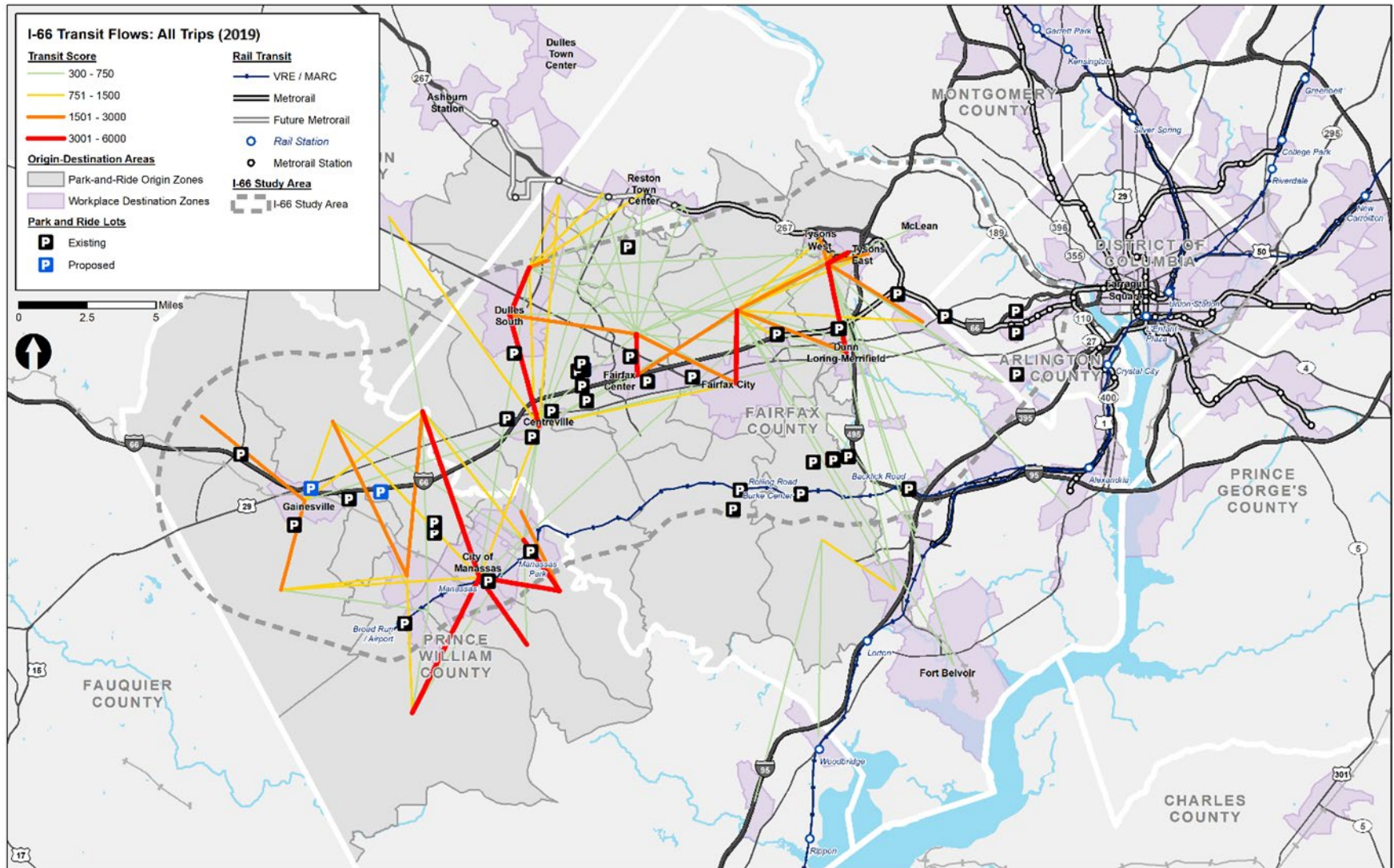
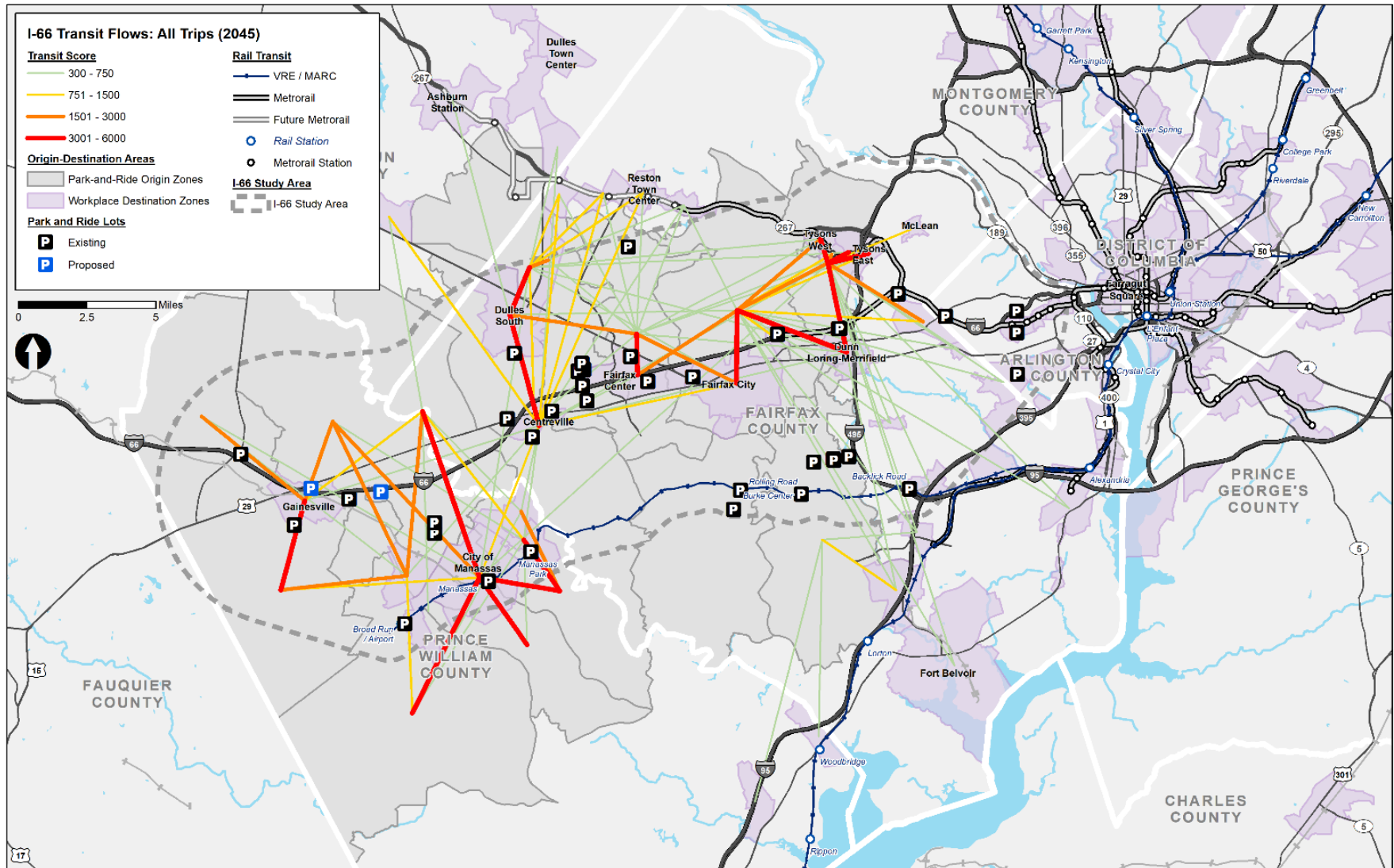


Figure 2.9: 2045 All-Day Trip Flows



2.2.2 Mode Share

Commute travel mode varies along the I-66 corridor. The difference in commute travel mode is likely due to the availability of alternate modes—modes of transportation other than single-occupancy vehicles—in proximity to commuters’ residences and workplaces. Commute mode shares were calculated for residents in zones created for the transit travel flow analysis that correspond to major park-and-rides or clusters of park-and-rides along I-66, as well as the Manassas Line VRE stations (see Figure 2.10).

“Regional transportation trends indicate single occupancy vehicle trips have been declining in favor of other modes.”

- MWCOG Visualize 2045 Long Range Transportation Plan

NVTC began tracking the overall transit mode and person throughput performance changes within the I-66 corridor following initiation of the I-66 NVTC Commuter Choice program. An initial performance report built upon the Transportation Planning Board’s (TPB) “2015 Mode Share Study: I-66 Corridor Inside the Beltway,” to provide a snapshot of how people move through the corridor². The study counted passengers in transit vehicles, carpools and automobiles, as well as those on bicycle or foot.

Table 2.5 summarizes the initial TPB analysis for the modal share of I-66 corridor AM peak person throughput. On a weekday during the AM peak period (6:30 a.m. - 9:30 a.m.), person throughput in the I-66 corridor measured at Glebe Road was 59,300 persons per hour. Fifty-nine percent of these commuters drove or carpooled, while 41 percent took public transportation, primarily Metrorail, VRE or commuter/local bus services.

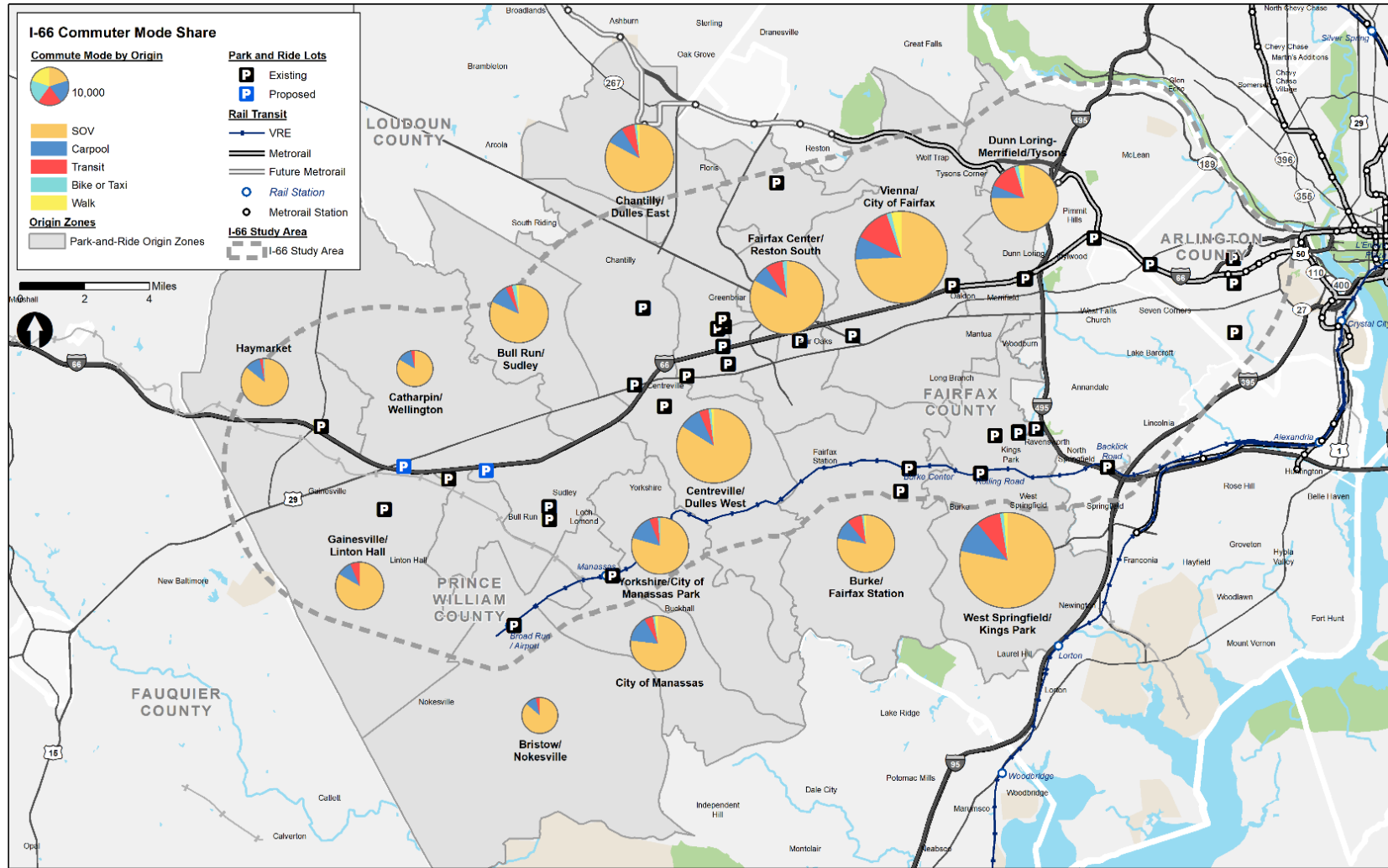
Table 2.5: I-66 Corridor AM Peak Person Throughput by Mode

Facility or Service	Drive Solo	Carpool	Person Throughput	Share by Mode
I-66	33%	67%	14,600	
U.S. 29	82%	18%	3,500	
VA 237	82%	18%	3,200	
U.S. 50	83%	17%	10,600	
Wilson Boulevard	80%	20%	3,000	
Driving				59%
Metrorail			17,800	
VRE			2,400	
Express Buses			2,300	
Local Buses			2,000	
Public Transportation				41%
TOTAL			59,300	

Source: Transit Performance Inside the Beltway Corridor, NVTC (2018)

² A draft 2019 performance report update was released as of publication of this document. The report can be found here: <http://www.novatransit.org/uploads/studiesarchive/2020%20CC%20Corridor%20Performance%20Report.pdf>

Figure 2.10: Commuter Mode Share by Park-and-ride Areas (2019)



2.3 CORRIDOR SERVICE AND FACILITIES

2.3.1 Overview of Transit Services

For the purposes of updating and analyzing existing and planned transit service in the corridor, this study considered bus routes and rail lines that run on or across portions of I-66 as well as services that run on parallel corridors. A summary of public bus transit service providers and rail operators within the corridor are presented in Table 2.6.

Table 2.6: Summary of I-66 Corridor Service

Provider	Service/ Brand	Routes/ Lines	Description
Fairfax County	Fairfax Connector	23 bus routes	Half of the routes operate during peak periods; most routes connect neighborhoods in Fairfax County to park-and-ride lots and Metrorail stations.
City of Fairfax	CUE	2 bus routes	Operates two circular routes seven days a week; provides connection between GMU, Old Town Fairfax, shopping areas, and Vienna Metrorail station.
GMU	GMU Shuttle	3 bus routes	Operates shuttles buses in the study area seven days a week; routes serve Fairfax and SciTech campuses, Sandy Creek Transit Center, and Vienna Metrorail station.
PRTC	OmniRide	5 commuter 2 Metro Direct	Operates commuter routes connecting Haymarket, Gainesville, and Manassas to Tysons Corner Metrorail station, the Pentagon, and downtown Washington, D.C.
WMATA	Metrobus Metrorail	6 bus routes Orange Line	Operates six bus routes and one Metrorail line in the study area; bus routes connect Metrorail stations and park-and-ride lots to destinations in Arlington County and Alexandria.
VRE	Commuter Rail	Manassas Line	Provides commuter rail service heavily concentrated in peak periods between the City of Manassas and Washington D.C. (via Alexandria and Arlington)
Amtrak	Passenger Rail	NE Regional	Limited service to Manassas and Burke Centre stations.

Source: Transit/TDM Study Update (2020)

In general, transit service in the study area is a mix of feeder bus service to Metrorail and VRE stations, commuter service into parts of Arlington County and Washington, D.C., regional service along parallel arterials, and circulation in the communities along I-66 (see Figure 2.11 and Figure 2.12).

Figure 2.11: Existing I-66 Study Area Routes

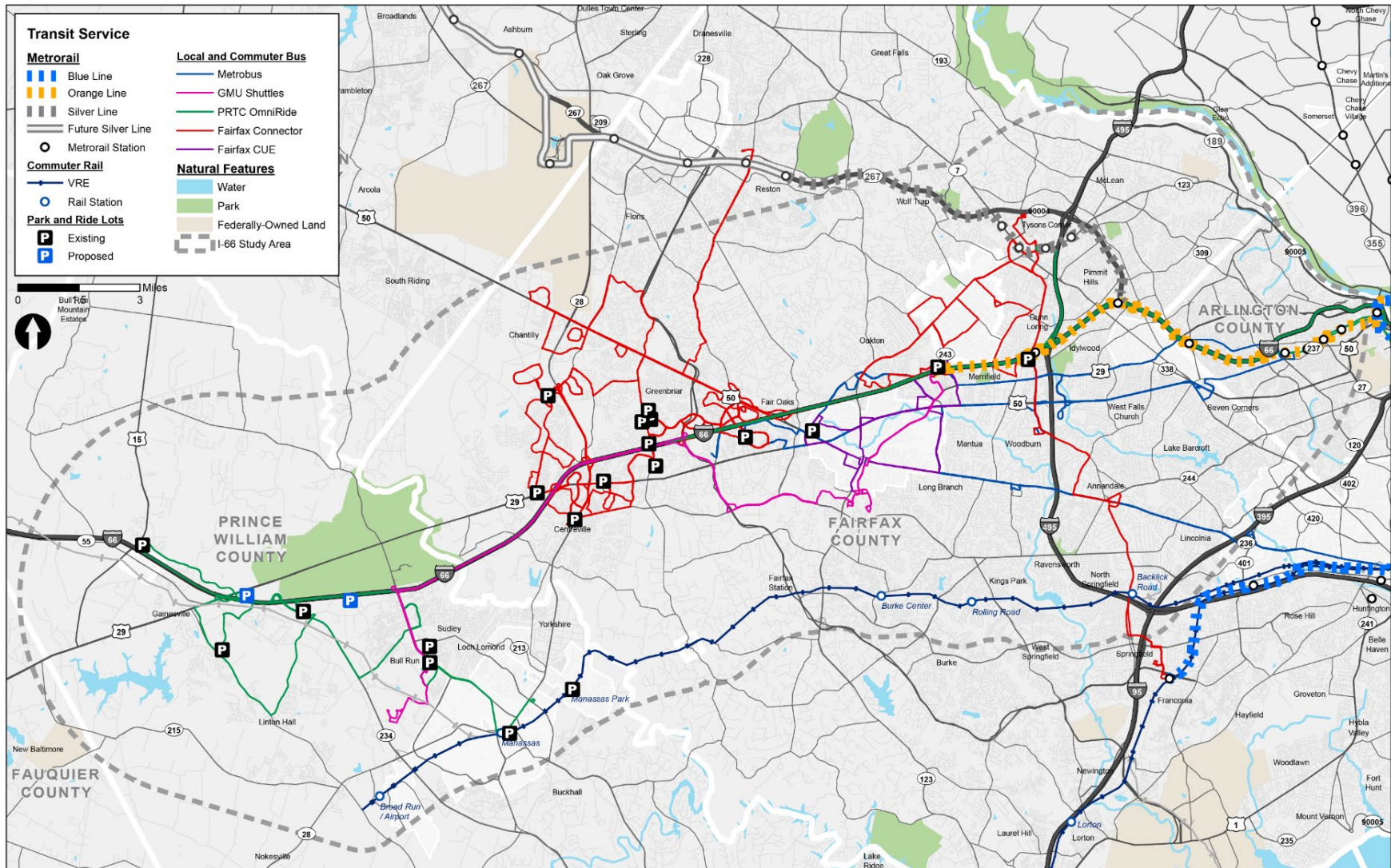
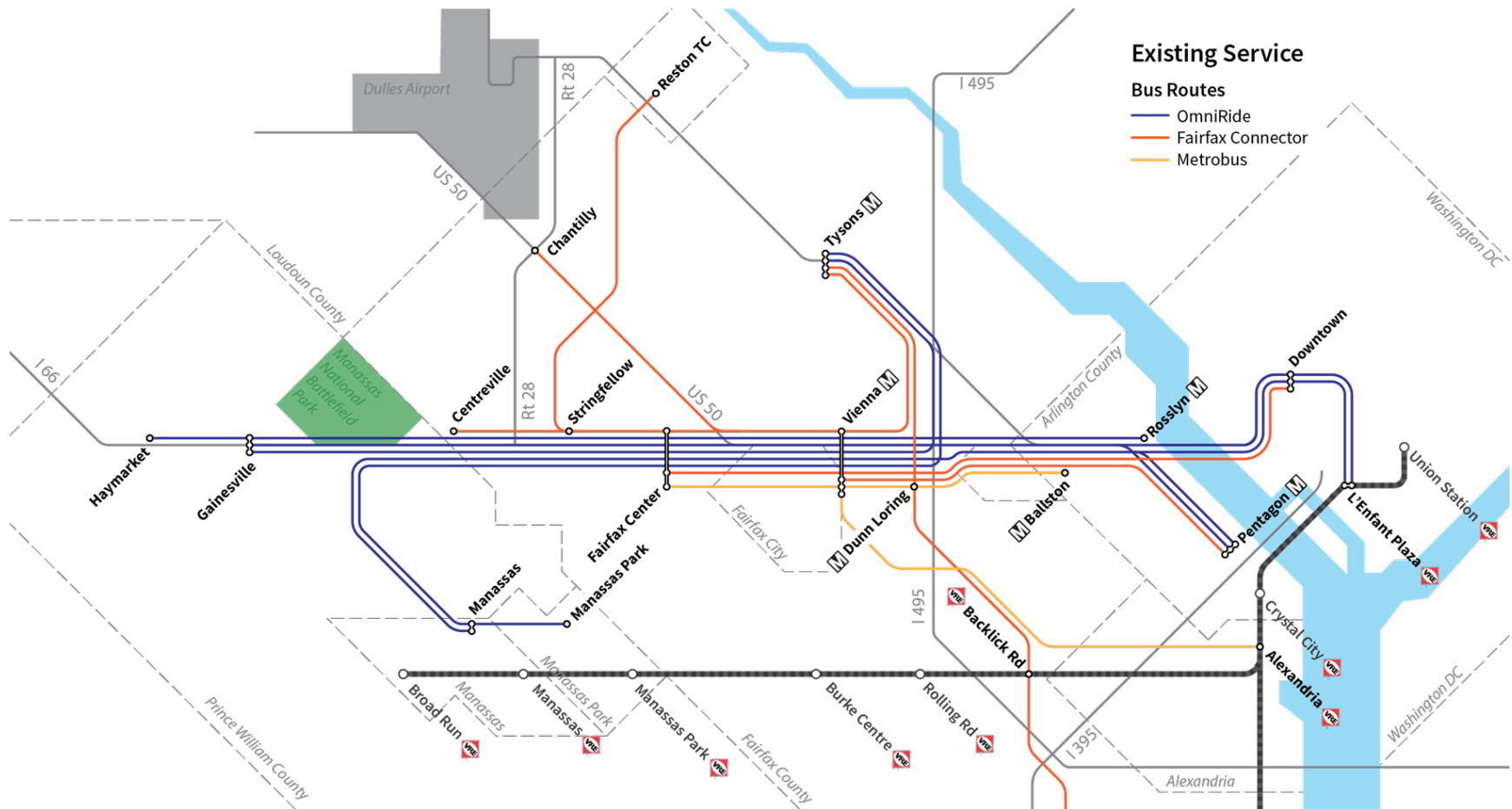


Figure 2.12: Schematic of Existing I-66 Commuter Routes



2.3.2 Transit Services - Bus

Fairfax Connector

Fairfax Connector operates 23 bus routes in the study area. Twelve of the 23 routes operate peak service only, seven routes operate seven days a week, and four routes operate weekdays all day. Most routes run along I-66 with many routes in the study area connecting neighborhoods to park-and-ride lots and Metrorail stations; Route 699, however, connects Fairfax County Government Center to downtown Washington, D.C.³

Other highlights:

- Fairfax County offers over 600 trips on a weekday, 60 percent during peak periods.
- Service on the corridor spans from 3:35 a.m. - 2:29 a.m. on weekdays, and from 4:25 a.m. - 2:16 a.m. on weekends.
- The number of trips and headways vary between time periods and routes.
- Routes 401 and 402 have the lowest headway among Fairfax County routes, 15 minutes during the morning peak. These routes also have the highest ridership among Fairfax Connector routes in the study area, connecting Franconia-Springfield and Tysons Corner Metrorail stations, also serving the Dunn Loring Metrorail station in the study area.

City of Fairfax CUE

City of Fairfax CUE operates two circular routes in the study area, seven days a week. Both routes run on clockwise and counterclockwise directions and provide connection between George Mason University, Old Town Fairfax, shopping areas, and the Vienna Metrorail station.

Other highlights:

- Weekday service spans from 5:15 a.m. - 11:10 p.m. with trips every 30 minutes during most of the day.
- Weekend service runs every hour from 8:00 a.m. - 8:52 p.m. on Saturdays, and from 9:33 a.m. to 6:28 p.m. on Sundays.
- Overall, both routes have similar levels of ridership, and peak ridership correspond to half of the total daily ridership.

George Mason University Shuttle (students and faculty only)

George Mason University provides several shuttle buses routes on the corridor, including three within the study area. Two routes operate seven days a week and one operates all day on weekdays. The routes serve Fairfax and SciTech campuses, Sandy Creek Transit Center, and Vienna Metrorail station. An Express

³ Enhanced service funded through the NVTC I-66 Commuter Choice FY2020 program.

Shuttle service also connects the campus to the Burke Rail Station (Amtrak/VRE Manassas Line). Transportation for students, faculty, staff, and contracted services employees is free of charge for with a valid Mason ID. All passengers must show a Mason ID to ride the shuttles buses from the following stops:

- Commerce Building
- Fairfax Circle
- Manassas Mall
- Rappahannock River Lane to Vienna Metro

Other highlights:

- Service is available from 5:55 a.m. - 12:45 a.m. on weekdays, 8:00 a.m.-12:45 a.m. on Saturdays, and 8:00 a.m. - 10:40 p.m. on Sundays.
- Average headways are:
 - Fairfax/SciTech: 30 minutes on weekdays, and 120 minutes on weekends.
 - Sandy Creek/Vienna Metro: 15 minutes on weekdays, and 30 minutes on weekends.
 - Global Center/Vienna Metro: 30 minutes on weekdays.

Potomac and Rappahannock Transportation Commission (PRTC) - OmniRide

Five OmniRide commuter bus routes operate during weekday morning and afternoon peaks, connecting Haymarket, Gainesville, and Manassas to the Pentagon and downtown Washington, D.C. OmniRide also includes two routes connecting Gainesville and Manassas to Tysons Corner Metrorail station, known as Metro Express routes.

- Two routes (M-100, G-100) terminate in Washington, D.C.
- Two routes (M-200, G-200) terminate at the Pentagon
- One route (H-100) terminates in the Rosslyn Ballston Corridor
- Two routes (Linton Hall [61], Manassas [60]) terminate at Tysons Corner Metrorail station

Other highlights:

- Of 89 trips along the corridor, 34 serve destinations in Washington D.C., 36 serve the Pentagon, 24 trips correspond to Metro Express service connecting locations along the corridor to Tyson's Corner Metrorail Station.
- Primarily commuter routes with peak direction service only.
- M-200 and Manassas (60) provide limited midday and evening service, but do not operate all day.
- The 100 series routes (G-100 and M-100), which provide service to downtown Washington, D.C., have higher ridership than the 200 series of the same routes providing service to the Pentagon.
- Gainesville routes carry nearly double the ridership of Manassas routes.

Washington Metropolitan Area Transit Authority (WMATA) – Metrobus

WMATA operates six bus routes on or near the I-66 corridor. Service extends on roads parallel to I-66 as far west as Fair Oaks Mall in Fairfax County. Five of the six bus routes operate seven days a week. All Metrobus routes in the study area connect to a Metrorail station and park-and-ride facilities to regional destinations, but none of the bus routes run on I-66 itself.

Other highlights:

- Metrobus 1B service is heavily concentrated toward peak period operation and only operates on weekdays.
- On weekdays, Metrobus service spans from 4:00 a.m. - 2:04 a.m.; on Saturdays, from 5:20 a.m. - 2:26 a.m.; on Sundays, from 5:45 a.m. - 12:58 a.m.
- Average weekday AM peak headways are:
 - 1A, 1B: 15 minutes
 - 1C: 30 minutes
 - 2A: 12 minutes
 - 2B: 40 minutes
 - 29N: 60 minutes
- Routes 1A and 2A carry almost double the ridership of all other routes.

Figure 2.13: I-66 Corridor AM and PM Peak Period Trips by Bus Provider

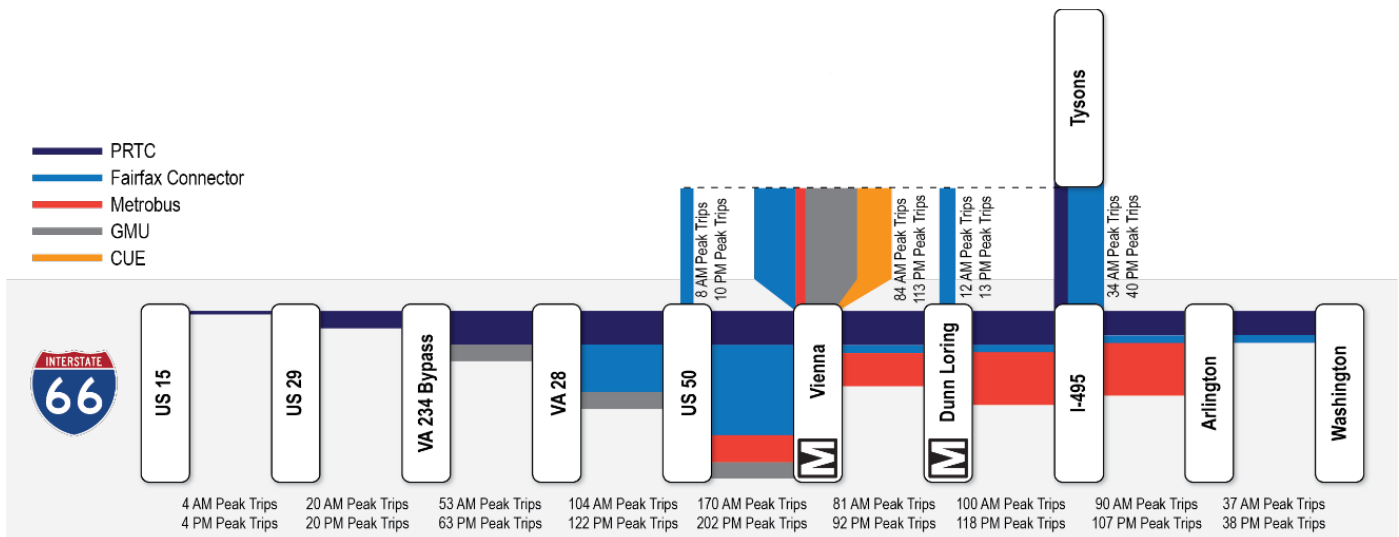


Figure 2.14: I-66 Corridor Midday Period Trips by Bus Provider

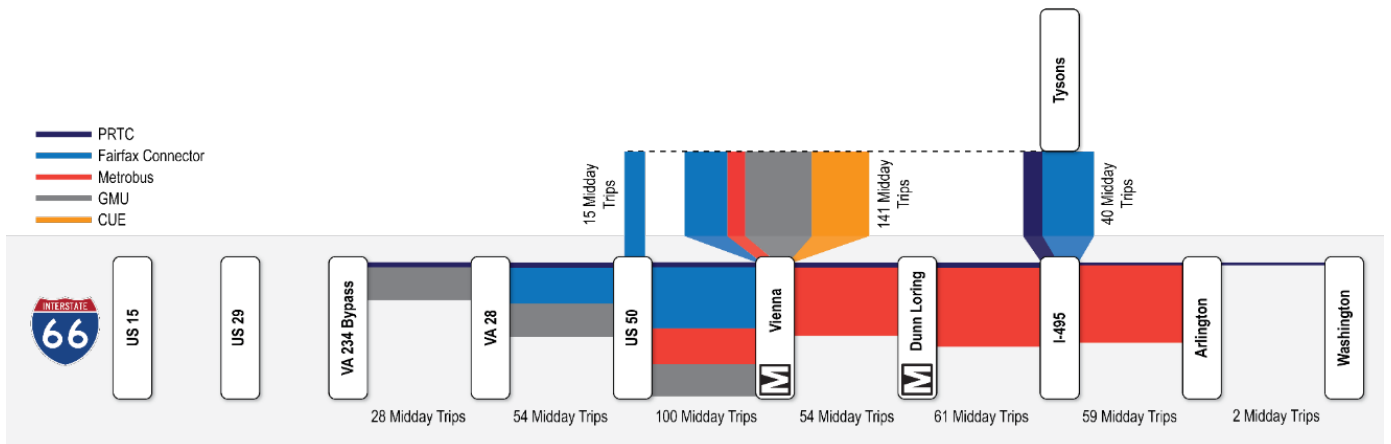
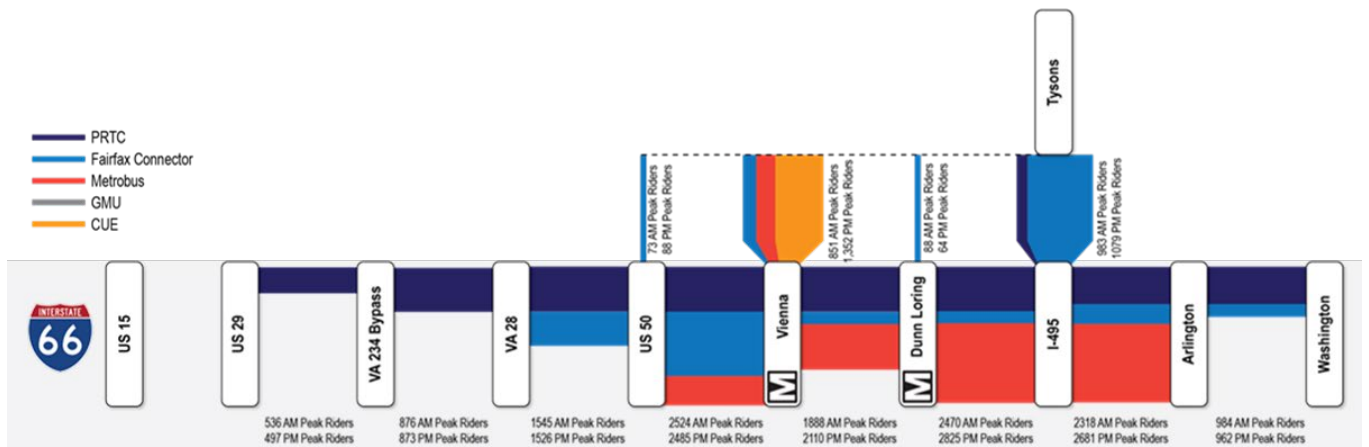


Figure 2.15: I-66 Corridor AM and PM Peak Period Ridership by Bus Provider



Currently funded bus service projects through the NVTC Commuter Choice program are identified in Table 2.7.

Table 2.7: NVTC Commuter Choice Funded Projects – Bus Services

Operator	Year of Award	Project Name	Project Description
Fairfax Connector	FY2020	Enhanced Bus Service from Government Center to D.C.	Enhances the service of the Fairfax Connector Route 699 bus, which runs from the Fairfax County Government Center to major employment areas in Washington, D.C. Adds three morning and three evening peak-direction trips to the existing 10 trips in each direction per day.

Operator	Year of Award	Project Name	Project Description
Fairfax Connector	FY2020	New Bus Service from Stringfellow to L'Enfant Plaza	Purchases six new buses and covers the operating costs for new express bus service from the Stringfellow park-and-ride to L'Enfant Plaza in Washington, D.C. The route will feature 10 morning and 10 evening peak-direction trips and provide access to major employment areas in Washington, D.C.
	FY2019	Express Bus Service Between Vienna/Fairfax-GMU and Pentagon Metrorail Stations	Links the Vienna/Fairfax-GMU Metrorail station to the Pentagon Transit Center via express bus service. Four new buses will provide eight inbound and eight outbound trips.
	FY2018	Express Service from Government Center to Foggy Bottom	Creation of a new weekday, peak-period Fairfax Connector Express bus service route between the Fairfax County Government Center park-and-ride facility and the State Department and the Foggy Bottom neighborhood in Washington D.C.
Omniride	FY2020	Enhanced Bus Service from Gainesville to D.C.	Purchases two new buses and adds two morning and two evening peak-direction buses between the Cushing Road Commuter Lot in Gainesville and major employment areas in Washington, D.C.
	FY2020	Enhanced Bus Service from Gainesville to Pentagon	The route enhances connectivity as riders can access multiple Metrorail lines, other regional bus providers and government shuttle routes at the Pentagon. Adds eight trips and covers the purchase of three new buses.
	FY2020	New Bus Service from Haymarket to Rosslyn	Adds new express bus service between the Haymarket park and ride lot and the Rosslyn-Ballston corridor.
	FY2019	OmniRide Linton Hall Metro Direct Bus Service Enhancement	Adds one morning and afternoon trip between Linton Hall and the Tysons Corner Metrorail station to serve more riders during I-66 construction and support transit and transportation demand management plans.
	FY2018	Gainesville to Pentagon Commuter Services	Includes the implementation of a new commuter bus transit service between Gainesville and the Pentagon, plus marketing and additional park-and-ride lease spaces.

Operator	Year of Award	Project Name	Project Description
WMATA - Metrobus	FY2020	Enhanced Bus Service on Metrobus 3Y: Lee Highway Farragut Square	Increases the peak-period frequency of Metrobus 3Y, a peak direction route that operates between the East Falls Church Metro and downtown Washington, D.C. via Lee Highway.
	FY2019	Metrobus Route 3T Extension and Service Expansion	Restores direct Metrobus service between West Falls Church-VT/UVA and East Falls Church Metrorail stations. The expanded 3T route will feature bi-directional, peak period service with 24-minute headways.
	FY2018	Metrobus Route 2A, Washington Boulevard-Dunn Loring	Peak Period Expansion to increase operating frequency from 15 minutes to every 10 minutes on parallel route to I-66.

Source: NVTC Commuter Choice Annual Report (FY 2018, FY2019, FY2020)

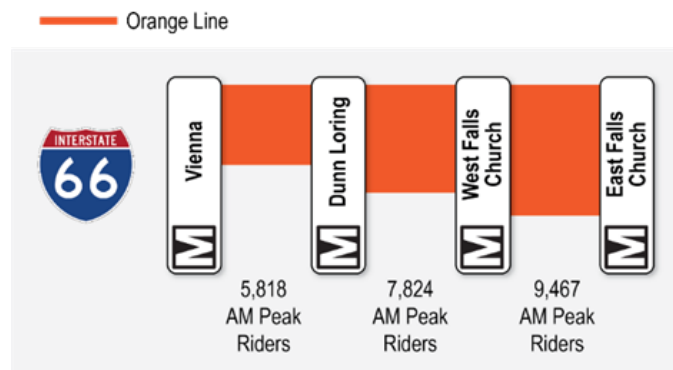
2.3.3 Transit Service – Metrorail and Commuter Rail

Washington Metropolitan Area Transit Authority (WMATA) – Metrorail

WMATA operates one Metrorail line within the I-66 corridor between Vienna and Washington D.C. The Metrorail line (the Orange Line) operates seven days a week. The Orange Line has two stations within the I-66 right-of-way, in relatively proximity to the Capital Beltway. The Orange Line connects Fairfax County to Arlington County and other destinations in the Washington Metropolitan Area. Heading inbound to Washington, D.C., the Orange Line combines with the Silver Line at the East Falls Church Metrorail station, effectively providing twice the frequency between trains between this point onward. Connections to Tysons and Reston are available via the Silver Line by transferring at the East Falls Church Metrorail station.

Other highlights:

- Almost 6,000 riders board at the Vienna Metrorail station during the weekday AM peak, and roughly a third of this number board at the Dunn Loring Metrorail Station (see Figure 2.16).
- Physical constraints on the Blue, Orange, and Silver lines limit Metrorail's service patterns. Combined sections of track are limited to 26 trains per hour. The highest achievable frequency on any line (Blue/Orange/Silver) is estimated to be every 8 minutes during the peak.
- By 2040, WMATA estimates there is not enough rush-hour train capacity to meet the future demand on this line.

Figure 2.16: I-66 Corridor Orange Line AM Peak Ridership**Virginia Railway Express (VRE)**

The study area is served by VRE's Manassas Line, which provides weekday commuter rail service heavily concentrated in peak periods between Manassas and Washington D.C. with stops in the City of Manassas, City of Manassas Park, Fairfax County, City of Alexandria, Arlington County, and Washington, D.C. VRE provides the following additional connections:

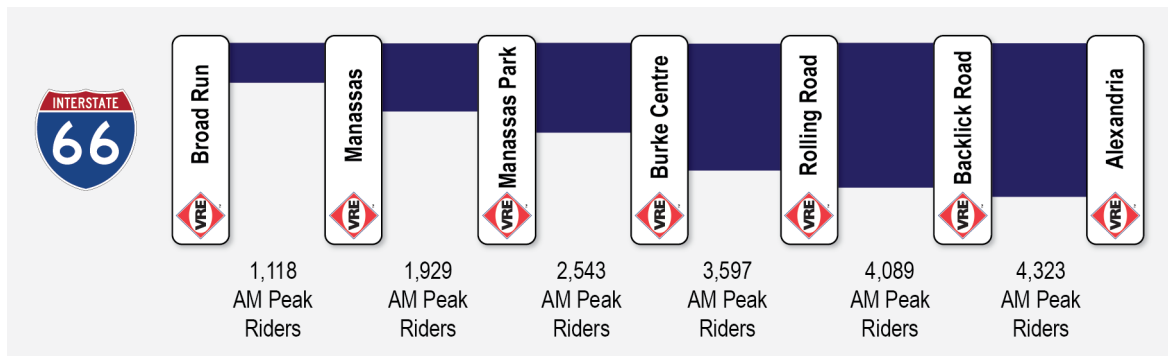
- To WMATA Metrorail lines at King Street (Blue and Yellow Lines); Crystal City (Blue and Yellow Lines); L'Enfant Plaza (Blue, Yellow, Orange, Silver, and Green Lines); and Union Station (Red Line);
- To Amtrak at Manassas, Burke Centre, Alexandria, L'Enfant Plaza, and Union Station;
- To the VRE Fredericksburg Line at Alexandria, Crystal City, L'Enfant Plaza, and Union Station; and
- To MARC commuter rail services at Union Station.

VRE also has a cross honor agreement with Amtrak that allows VRE multi-ride passengers the ability to purchase step up tickets for use on two specified Amtrak trains for commuter travel between Manassas and Washington, D.C.

Other highlights:

- In the northbound direction (Broad Run to Union Station), six trips serve the Manassas Line from 5:05 a.m. to 9:07 a.m.;
- In the southbound direction (Union Station to Broad Run), one trip serves the line during the midday period (serving Manassas train station at 2:24 p.m.) and six trips serve stations along the line during the afternoon from 3:45 p.m. to 8:09 p.m.
- Current VRE average headway on this line is 33 minutes (AM) and 37 minutes (PM).
- Broad Run and Burke Centre have the highest number of AM peak boardings (see Figure 2.17).
- Additional VRE service on both the Manassas and Fredericksburg Line will be made possible over the next decade incrementally as capacity constraints are alleviated through a landmark agreement with CSXT⁴.

Figure 2.17: VRE Manassas Line Inbound AM Ridership



2.3.4 Other Services

Vanpool

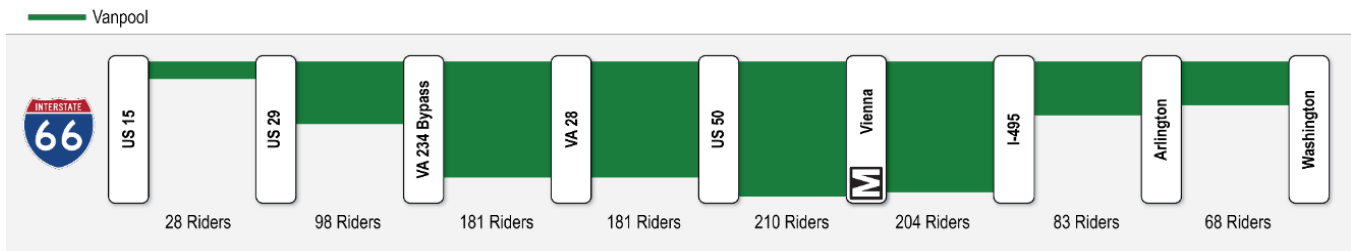
The Vanpool Alliance is a public-private partnership administered by PRTC, with partners that include the Northern Virginia Transportation Commission (NVTC), the George Washington Regional Commission (GWRC), and DRPT. In addition to offering an online “Vanpool Finder” for passengers, Vanpool Alliance provides marketing and financial support to over 50 vanpool operators, in part by coordinating vanpool data reporting to the National Transit Database.

Forty-seven Vanpool Alliance vanpools originate in ZIP codes within 2.5 miles of the I-66 corridor, between Haymarket and I-495. The vanpool destinations vary, but more than half terminate in Maryland,

⁴ <http://www.drpt.virginia.gov/rail/transforming-rail-in-virginia/>

either at Fort Meade or in Montgomery County. These vanpools typically leave the I-66 corridor when it intersects with I-495 (see Figure 2.18).

Figure 2.18: I-66 Corridor Vanpool Trips



2.3.5 Bus Maintenance Facilities

PRTC

PRTC currently operates all Omniride buses from its Transit Center in Woodbridge, which is at capacity and is a significant distance from the I-66 corridor. One of the Transform 66 concession fee projects (see Table 1.4) is the construction of a Western Bus Maintenance & Storage Facility in Manassas. The new facility, which is scheduled for completion in 2020, will have parking for 100 additional buses, as well as eight bays for bus maintenance. This facility will enable PRTC to more efficiently operate its current I-66 corridor services and to implement additional transit service in the corridor.

Fairfax Connector and Metrobus

Fairfax Connector and WMATA’s Metrobus operate I-66 corridor transit services from a shared bus maintenance facility site at West Ox Road in Fairfax County, which, after an expansion was completed in 2018, has capacity for approximately 310 buses.

2.3.6 Park-and-ride Facilities

Current Conditions

There are twenty-one park-and-ride facilities that serve the I-66 study corridor between U.S. 15 and I-495, including parking structures at two Metrorail stations. Data on the location, ownership, capacity, and occupancy of each park-and-ride facility was obtained from VDOT’s most recent Park-and-Ride Lot Inventory and Usage Study (2016) with details on key locations provided in Table 2.8. The park-and-ride facilities serving the corridor have various owners, including VDOT, WMATA, Fairfax and Prince William Counties, and private entities with a total capacity for over 12,000 vehicles. Over 8,800 of the park-and-ride spaces are located at Metrorail or VRE stations.

Utilization

The most recent VDOT Park-and-ride utilization counts are from 2016; and are detailed in Table 2.8 and illustrated in Figure 2.19. Compared to the previous VDOT park-and-ride utilization count from 2013, several of the larger park-and-ride locations along the corridor have seen a notable decrease in occupancy – especially those at the Dunn Loring-Metrorail station (98 percent in 2013 to 55 percent in 2016), the Vienna Metrorail station (99 percent in 2013 to 82 percent in 2016), and Stringfellow Road (98 percent in 2013 to 46 percent in 2016). Both Stringfellow Road park-and-ride and Dunn Loring Metrorail station have increased their parking capacity since 2013, but the decrease at the Vienna Metrorail station may be related to the 2014 opening of the Silver Line (Phase I), which provides Metrorail service to many riders of who may have previously used the parking facilities at the Vienna Metrorail station.

Future Conditions

Two new park-and-ride lots are to be constructed along the corridor, both in Prince William County, by VDOT as part of the Transform 66: Outside the Beltway project. The Gainesville park-and-ride, at U.S. 29 and University Boulevard opened in the fall of 2019 with 1,000 spaces, as well as carpooling support and bus service. This lot is planned to expand to over 2,000 spaces, with direct access from University Boulevard to the I-66 Express Lanes on opening day in 2022.

The Manassas park-and-ride, at the intersection of Balls Ford Road and Century Park Drive, will have a connection via the newly widened Balls Ford Road to the I-66 Express Lanes (see Figure 2.19). The new lot will have over 1,180 parking spaces when it opens and is slated to expand to over 1,500 spaces by 2040. Amenities will include real-time parking availability and covered bicycle racks. Construction is scheduled to begin in 2020.

2.3.7 Transportation Demand Management (TDM)

TDM services are generally aimed at increasing mobility and transportation choice throughout the greater Northern Virginia region and help to eliminate or shift single-occupant vehicle (SOV) trips to other modes or times of the day.

The I-66 study area is served by the following TDM agencies:

- **Fairfax County Commuter Services (FCCS).** A division of the Fairfax County Department of Transportation providing incentives, employee outreach, and tools to expand TDM offerings.
- **PRTC.** The OmniMatch program promotes ridesharing for Prince William County and OmniRide Employer Services assists employers in expanding commuter benefit programs. PRTC also oversees Northern Virginia's Vanpool Alliance Program.
- **Loudoun County Commuter Services.** Offers information and resources about a variety of commuting options, employer services, and incentives.
- **MWCOG.** Commuter Connections coordinates regional activities in their network, which includes Fairfax and Prince William Counties.

Table 2.8: I-66 Corridor Park-and-Ride Details

Lot Name	Owner	Capacity	Utilization	Bicycle Provisions	Transit Shelter	Bus Service	VDOT ID
Dunn Loring-Merrifield Station Metro	WMATA	2,150	55%	None	No	Fairfax Connector, Metrobus	112
Vienna-Fairfax-GMU Station Metro	WMATA	5,187	82%	Racks and Lockers	No	Fairfax Connector, Metrobus, CUE, GMU Shuttle	111
AMF Centreville Lane	Private	31	16%	None	No	Metrobus	110
Autumn Willow Park	Locality	105	0%	None	No	Metrobus	372
Fairfax Co. Gov. Center	Locality	110	46%	Racks	No	Fairfax Connector	28
Greenbriar Park	Locality	143	3%	None	No	Fairfax Connector, Metrobus	145
Poplar Tree Park	Locality	303	1%	None	No	Fairfax Connector, Metrobus	144
St. Paul Catholic Church	Private	109	1%	None	No	Fairfax Connector	129
Stringfellow Road	VDOT	713	46%	Racks	No	Fairfax Connector, Metrobus	314
Centreville - UMC	VDOT	146	26%	Racks	No	Fairfax Connector, Metrobus	36
Centreville - Stone Road	Locality	372	76%	Racks	No	Fairfax Connector, Metrobus	34
Sully Station	Locality	37	22%	Racks	No	Fairfax Connector	37
Kutner Park	Locality	36	6%	None	No	N/A	432
Manassas (VRE Lots)	Locality	873	71%	Racks	No	PRTC	244
Cushing Road	VDOT	433	84%	Racks	No	PRTC	423
Manassas Park (VRE)	VRE	596	99%	Racks	No	PRTC	245
Haymarket - Heathcote Blvd	VDOT	230	N/A	N/A	Yes	PRTC	443
Limestone Road	Private	145	55%	Racks	No	PRTC	402
Manassas Mall	Private	216	21%	None	No	PRTC	58
Portsmouth Road	VDOT	632	39%	Racks	No	PRTC	105
University Boulevard	VDOT	1,000	N/A	Yes	Yes	PRTC	465
Balls Ford Road*	VDOT	1,189	N/A	TBD	TBD	TBD	TBD

Source: VDOT

A summary of major TDM services available in the study area is presented in Table 2.9.

Table 2.9: Study Area TDM Services

Program	Description	FCCS	PRTC	LCCS	MWCOG
Commuter Incentives	Financial or other incentives for non-single-occupant vehicle travel.	○	○	○	○
Commuter Information	Provide info. in print / electronic format, including transit schedules and ride-matching.	○	○	○	○
Employer Outreach	Develop and coordinate transportation support for employers.	○	○	○	○
Guaranteed Ride Home	Provide a ride home for carpool, vanpool, bike, and transit commuters in unexpected situations.				○
Marketing / Promotion	Informational materials and/or ad campaigns promoting alternative travel choices.	○	○	○	○
Residential Support	Support for residential properties in providing travel information and facilities.	○	○		
Ridematching	Manage database of rideshare requests. Provide assistance in matching.	○	○	○	○
Vanpool Services	Support and / or provide incentives for starting new or maintaining existing vanpools.	○	○	○	○

Source: Transit/TDM Study Update (2020)

I-66 Outside the Beltway Transportation Management Plan

The I-66 Transportation Management Plan (TMP) contains a combination of strategies to mitigate traffic on I-66 and manage the flow of traffic on parallel routes during construction of the Express Lanes and other corridor improvements. The TMP’s transit and TDM strategies are designed to reduce single-occupancy vehicles on I-66 and encourage travelers to use alternative modes. Roll-out of the various strategies is ongoing, although many were implemented at the start of construction in 2018 to have the greatest impact.

Table 2.10 summarizes the strategies in the TMP, along with recent results of implemented programs and status of programs that have not yet been implemented. The primary transit and TDM strategies are subsidies and incentives for travelers to use bus services and form vanpools, carpools, and shuttle services. Employers are incentivized to implement telework programs for employees who commute in the corridor. VDOT and other agencies also plan to make capacity and multimodal access improvements to park-and-ride facilities and introduce free distribution of EZ-Pass tolling transponders for low-income travelers.

Table 2.10: I-66 TMP Strategies and Results

Strategy	Description	Results (Spring 2019)
Buses	50% fare subsidies on select PRTC and Fairfax Connector routes along the project corridor.	Fairfax Connector: Average 22 daily riders above baseline (131 before government shutdown) PRTC: Averages 66 daily riders above baseline (160 before government shutdown)
	Subsidy for new commuter bus from Front Royal to Arlington and D.C.	12 average daily round-trip riders; operator continued service with local funding after TMP subsidy ended in June 2019.
	Supplemental service on existing commuter bus routes	One morning trip has been added to PRTC's Gainesville-DC route.
Vanpools	Four-month subsidy for new vanpools on I-66, SmarTrip cards for riders, and gas card for vans with 10+ seats.	12 vanpools formed, providing 1,480 passenger trips per month.
Carpools	90-day subsidy of \$100 for new three-passenger carpools or two-passenger carpools which gain an additional rider.	Five new carpools formed
Telework Programs	\$10,000 incentive for employers to implement telework programs for I-66 commuters.	One employer implemented a new program and 13 were in process.
Transit/TDM Promotion	Trip Planning Tool: Smartphone or web-based trip planning application for multimodal travel in the corridor; the tool will integrate the existing CarFree A to Z planner with real travel time information from 511VA to provide active traffic management information.	VDOT 511 app includes travel speeds by mode, some transit layers, traffic speeds, and road conditions. Does not include Fairfax Connector or PRTC bus routes along I-66.
	Employer Outreach: Dedicated staff to promote TMP alternatives at employer outreach events.	27 events held, reaching over 500 employees.
	Ads: Advertisements in newspapers, on buses, on the radio, and online promote transit and TDM options.	Advertisements made over 877,000 impressions and generated 4,325 website click-throughs.

Strategy	Description	Results (Spring 2019)
Park-and-Ride Lots	Two new park-and-ride facilities in Gainesville and Haymarket.	Haymarket: The 230-space Haymarket Park-and-ride opened in December 2018 with a new PRTC commuter bus route from Haymarket to Rosslyn-Ballston, and infrastructure for VDOT's first electronic parking management, which provides commuters real-time information about parking capacity. Gainesville: The University Boulevard park-and-ride in Gainesville opened in Summer 2019.
Community Shuttles	Gainesville: The University Boulevard Park-and-ride in Gainesville opened in Summer 2019.	PRTC plans to link communities in the western part of the corridor with commuter lots.
Low-Income Transponder Subsidy	Six-month subsidy for new shuttle services from communities to park-and-ride lots.	The program will begin during outreach prior to conversion of the HOV lane from a 2 to 3-passenger requirement.
First Mile/ Last Mile Improvements	Free EZ-Pass Flex transponders for low-income families.	TBD; improvements are administered by VDOT and funded through the Local Network Operations Spot-Improvement strategy budget, separately from the transit and TDM strategies.

Source: Transit/TDM Study Update (2020)

Northern Virginia Regional Multi-Modal Mobility Program (RM3P)

The Northern Virginia Regional Multi-Modal Mobility Program (RM3P) will use data-driven tools to encourage people to reduce single-occupancy vehicle travel and build on earlier phases of other initiatives, including the I-95/395 and East-West Integrated Corridor Management (ICM) Deployment Plans. ICM takes a multi-modal, multi-agency approach to dynamically manage travel conditions and traveler behavior through a corridor, including:

- Route choice
- Mode choice
- Temporal choice

RM3P will use information and communications technologies to provide travelers, commuters, service providers and transportation system operators with tools that:

- Optimize system performance
- Improve travel time reliability
- Support on-demand multimodal trip options

The RM3P project is funded by the Commonwealth of Virginia’s Innovation and Technology Transportation Fund, with \$15 million in FY2020 and FY2021 funding to advance the following RM3P concepts:

- **Enhanced Commuter Parking Data.** Target/prioritize parking lots along multiple corridors, serving commuter bus, rail, and other high demand locations. Communicating parking availability in real time will facilitate carpooling, enhance access to transit, increase shared vehicle use, and reduce congestion;
- **Development of a Mobility as a Service (MaaS) Dynamic Service Gap Dashboard.** Targeted at transportation/mobility providers, this will encourage multi-modal travel by identifying service gaps, incentivizing MaaS activity, and facilitating first/last mile services;
- **Implementation of an Artificial Intelligence (AI)-Based Decision Support System with Prediction.** Use real time conditions and historic data to predict incidents and their impacts. This information will enable transportation system operators to better respond to incidents, reducing mobility impacts across the transportation system; and
- **Deployment of a Data-Driven Tool to Incentivize Customer Mode and Route Choice.** Customize existing tools providing customers a range of multi-modal transportation choices. Incentives will influence travel behaviors such as route, mode, and temporal choices, balancing travel demand during both recurrent and non-recurrent congestion.

“Connected travelers, continued advancements in transportation technologies, and private sector involvement present unprecedented opportunities for public transportation improvements. Concepts such as microtransit, mobility as a service (MaaS) and mobility on demand (MOD) have helped public agencies fill first and last mile gaps.”

- DRPT Statewide Integrated Mobility Initiative

Other Planned TDM Program Initiatives

Through funding applications and stakeholder feedback, jurisdictional highlights for future TDM offerings include the following:

Fairfax County

- TDM Marketing - Awareness campaign: including HOV-3 Express Lanes, Silver Line Phase 2 Metrorail stations, new bicycle and pedestrian infrastructure.
- Targeted Outreach for HOV-3 Transition (I-66 Express Lane Opening) - Provide targeted marketing to residents and employers in these corridors to support vanpool and carpool formation and to market the advantages of ridesharing.

PRTC

- New TDM Outreach - New program to target commuters traveling along the I-66 corridor.
- On-Demand Commuter Lot Shuttles in Prince William County - Free on-demand microtransit shuttles, operating between Gainesville/ Haymarket neighborhoods and nearby commuter lots.
- Flexible Vanpool Program - New platform for a flexible vanpool program that would give riders flexibility in modifying their commutes.
- I-66 Slug Line Campaign - Development of a marketing and communications plan to promote slug lines at four commuter park-and-ride lots.

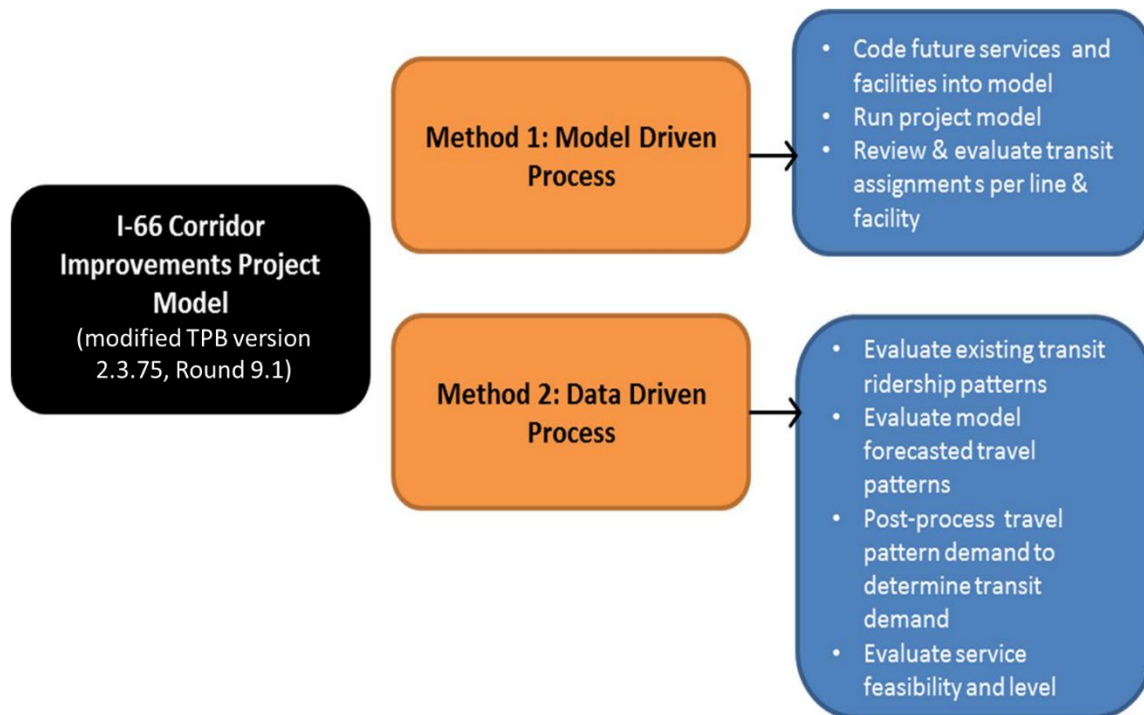
3 DEMAND FORECASTING AND ANALYSIS

3.1 APPROACH

To develop transit service recommendations, the travel patterns in the I-66 corridor and the greater Northern Virginia region were evaluated. Planned transit service is based on current and anticipated travel needs in the corridor and regionally. This chapter summarizes the methodology and assumptions for developing demand forecasts for future transit service and park-and-ride facility use for the I-66 Transit/TDM recommendations.

Development of transit demand forecasts utilized the TPB Version 2.3 Travel Model (the Travel Model) and a data-driven methodology. The Travel Model is appropriate for use at a regional level and is an input to the data-driven process that refined the bus ridership forecasts at a corridor level. The Travel Model also provided input into the development of commuter rail ridership forecasts. The process for evaluating transit demand and the development of transit and associated service recommendations is depicted in Figure 3.1.

Figure 3.1: Study Update Methods of Demand Assessment



Additional details about these methods:

- **Method 1:** Model Driven Process – required coding of potential future transit services and facilities into the model. This method provided important transit inputs into the development of traffic volume forecasts used for the project. It also provided insight in the planning process in identifying transit facility and service patterns that were of greater and lesser attractiveness.
- **Method 2:** Data Driven Process - extended from the regional travel demand model and focused on assessing mode estimated travel flows (between origins and destinations) associated with the I-66 corridor and identifying transit services and facilities to serve potential demand. This method provided specific data for the development of transit service and facility recommendations.

Travel demand forecasts provided are appropriate for use in determining the feasibility of modifying bus and commuter rail service specified in the original transit/TDM plan in the context of a periodic update. The data-driven post-processing featured in this study provided a means to refine the demand estimates in the I-66 Study Corridor.

3.1.1 Model Driven Process

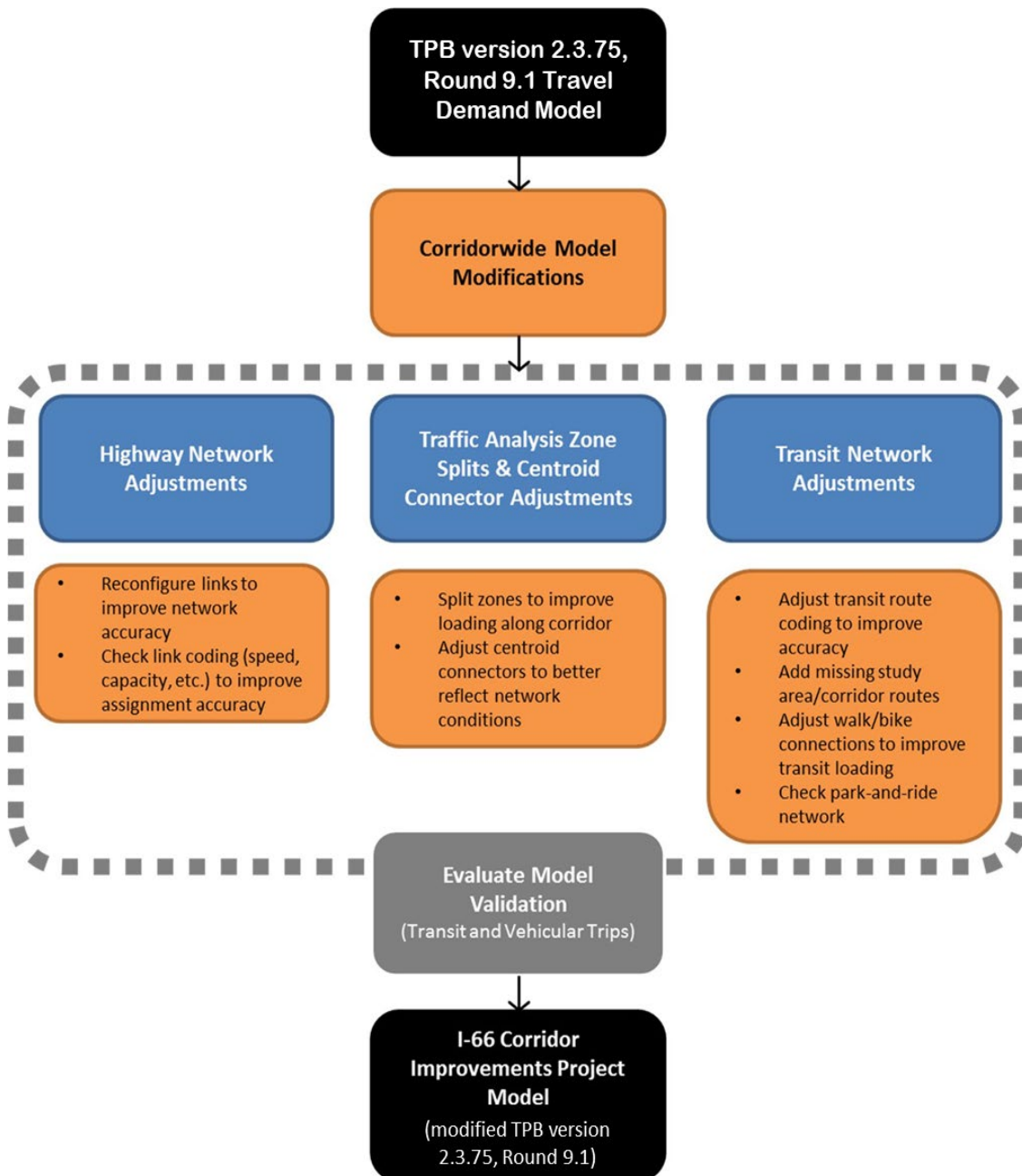
As part of the project, the MWCOG travel demand model was modified to increase the level of detail of its inputs and accuracy in development of forecasts for the project. Figure 3.2 summarizes the model update and modification process, which is an industry-standard practice for corridor studies of this nature. This project-specific model included adjustments to the highway network and TAZs as well as modifications to the transit network. For reference, TAZs are defined areas within a travel demand model that contain socioeconomic data such as numbers of residents and jobs and are usually defined based on geographic features such as major roads, parks, or bodies of water. TAZs from the project model were aggregated into origin zones to correspond with I-66 park-and-ride locations (see Figure 3.3).

Network modifications made during the model update process were important in enhancing model accuracy in producing transit forecasts for the I-66 corridor. Modifications included:

- Adjusting transit network characteristics (routes, headways, speeds).
- Adjusting walk/bike connections within the model network to improve transit loading.
- Review and modification of park-and-ride facilities/network.

The collective result of the modification process was a project-focused travel demand model for use in vehicular traffic and transit forecast development.

Figure 3.2: Travel Model Update and Modification Process

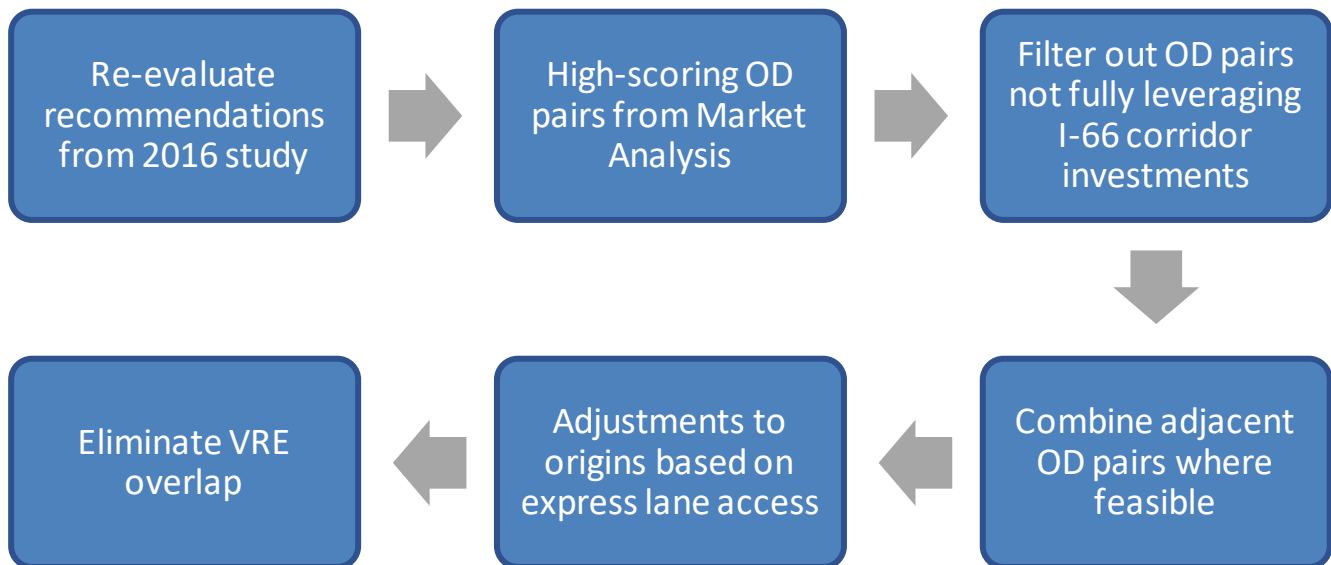


3.1.2 Data Driven Process

Prior to performing refinement to the model produced and corridor-specific results, the development of initial commuter bus recommendations followed a multi-step process outlined in Figure 3.4.

- The Market Analysis identified origin-destination (OD) pairs with a high potential for transit use based on travel flows from the regional travel demand model and transit propensity scores.
- The recommendations from the 2016 study were reviewed and compared to the transit demand of their corresponding OD pairs from this Market Analysis. Recommendations from the 2016 study that no longer showed high transit demand in comparison to other corridor routes were removed from further consideration.
- OD pairs with high potential transit use from the Market Analysis that did not parallel I-66 for a significant distance (limited to no usage of the I-66 Express Lane investments) or that could be better satisfied by the VRE Manassas Line were removed from further consideration.
- New routes were developed using OD pairs with high potential transit use.
 - Where feasible, adjacent origins and adjacent destinations were merged to create routes with the highest demand possible.
 - Where necessary, route starting points were shifted to park-and-ride lots in adjacent origin zones to be closer to Express Lane access points

Figure 3.4: Data Driven Commuter Bus Route Modification Process



Initial demand estimates were calculated OD pairs throughout the study area for the years 2022, 2030, and 2045. Origin zones were defined based on park-and-ride lot catchment areas and MWCOG Activity Centers were used as destination zones. The OD pairs with the highest demand were developed into recommended routes.

3.2 SCREENING METHODOLOGIES

3.2.1 Offered Capacity

Offered capacity represents the total number of people that could be carried on a particular route or service. For the purposes of screening recommendations, hourly offered capacity was calculated by calculating the capacity of each vehicle by the number of trips planned per hour. Vehicle capacities were 39 people or 57 people for routes that would be operated by Fairfax Connector and PRTC, respectively. These capacities represent the number of seats on the vehicles each agency currently uses, as express routes typically have load standards of 1.0 and do not allow standees.

With TMP and Commuter Choice services already initiated in the I-66 Corridor and serving as the baseline for this update, a review of offered capacity indicates that the difference between current (2019) service and the 2016 plan's opening day service (2022) is marginal. This comparison is depicted in Figure 3.5. The intent of recommendation screening is to prioritize services supported by demand. Other indicators noted in this comparison include:

- Overall the capacity from Manassas to Route 28 presents a slight increase in the opening year compared to the current service, because the increases in the service from Manassas to Tysons offset the service reduction to Washington D.C.
- Offered capacity between Route 28 and I-495 increases significantly.

3.2.2 Person Throughput

Person throughput was the primary metric to demonstrate the investment potential of higher capacity modes. The objective of the person throughput technical merit criteria is to assess the number of people and vehicles moved through the corridor. The approach this study utilized for measurement of this metric was to establish cutlines along the corridor in the vicinity of Glebe Road, Nutley Street, and VA 28 (see Figure 3.6). Person throughput would then be calculated as the number of people crossing a cutline by rail, bus, or auto in either direction daily. Preferred mobility options would demonstrate increased person throughput over baseline service.

Figure 3.5: Offered Capacity Comparison – Existing Service and 2016 Study Opening Day Service

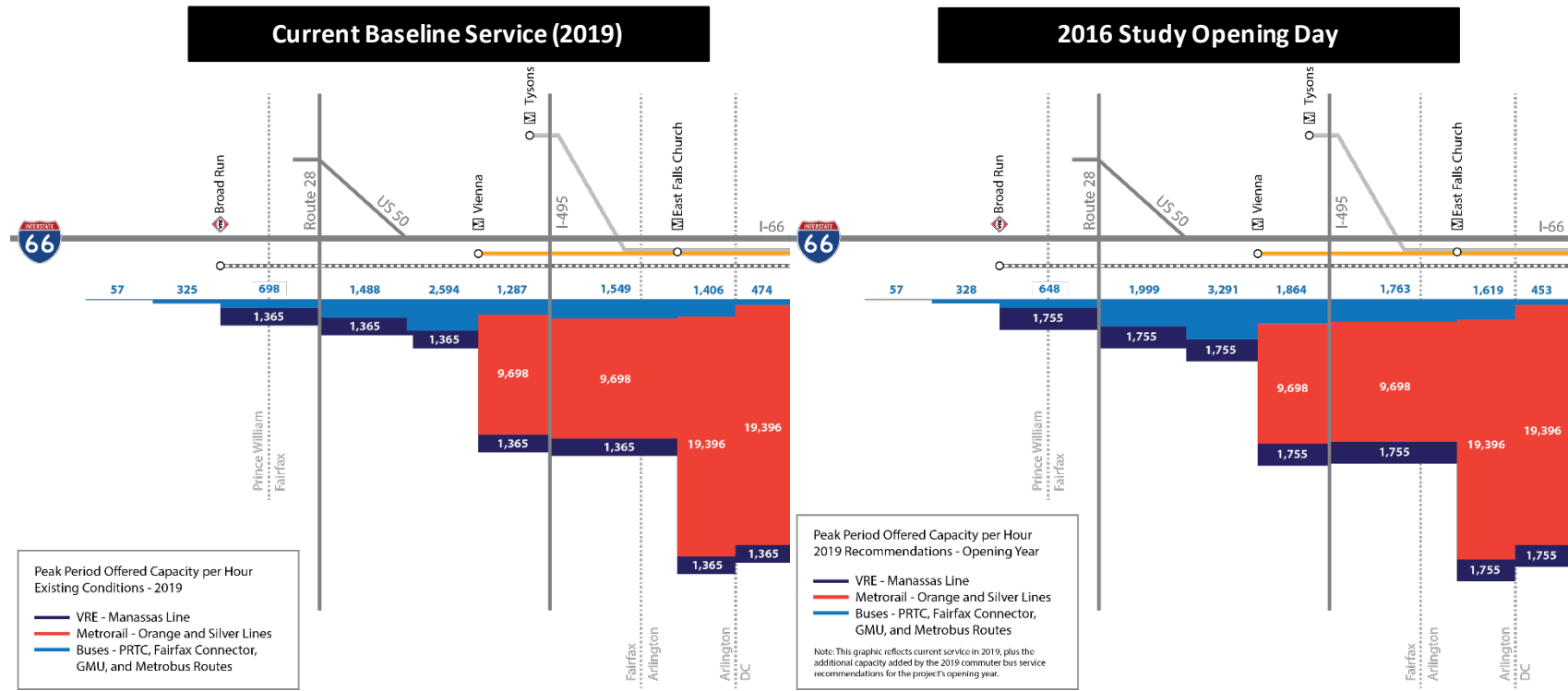


Table 3.1 shows the roadways parallel to I-66 included for each individual cutline.

Table 3.1: Parallel Roadways Considered with each I-66 Cutline

Cutline	Parallel Roadways
Glebe Road	▪ US 29
	▪ VA 237
	▪ Wilson Boulevard
	▪ US 50
Nutley Street	▪ VA 123
	▪ US 29
	▪ US 50
VA 28	▪ US 29
	▪ US 50
	▪ VA 620

Source: Transit/TDM Study Update (2020)

Public transportation is represented in each of the cutlines by the VRE Manassas Line, WMATA Metrorail Orange Line, and various express and local bus services. Rail passengers riding the Manassas Line were reported at the following locations for each cutline:

- Glebe Road – East of Backlick Road Station
- Nutley Street – East of Burke Centre Station
- VA 28 – East of Manassas Station

Persons commuting eastbound in the AM (home to work journey) using autos and public transportation were the basis for person throughput calculations. The tabulation for persons traveling on roadways and transit service crossing each of the cutlines were represented by the following modes of travel:

- **Drive-Alone Auto** – persons driving with no passengers in a private vehicle.
- **Carpool** – persons sharing a private auto.
- **Commuter Rail** – rail passengers.
- **Metrorail** – rail passengers.
- **Bus/Metrorail** – bus passengers that transfer to Metrorail to complete their trip.
- **All Bus** – bus passengers that ride only bus(es) for their entire trip.

Overall, the use of offered capacity and demonstrated person throughput as a screening and prioritization criteria aligned the evaluation of recommendations in this study update with a proven system already in place for project selection funded by the I-66 Commuter Choice program. Alignment of the approach to evaluating recommendations was deemed essential in treating recommendations uniformly across the entirety of the I-66 corridor.

3.3 POTENTIAL RIDERSHIP

Projected ridership on each commuter bus route was calculated using outputs from the regional travel demand model and existing ridership figures. Figure 3.7 summarizes this methodology which is explained in detail below.

Initial Demand Estimates

Initial demand estimates were calculated for OD pairs throughout the study area for the years 2022, 2030, and 2045. Origin zones were defined based on park-and-ride lot catchment areas and MWCOG Activity Centers were used for destination zones. The OD pairs with the highest demand were developed into recommended routes using the screening process outlined in Section 3.2.

Model Inputs

The number of bus trips on each route were developed based on the number necessary to accommodate the initial demand estimates for each year assuming each bus would be at 80% of its capacity. While all routes are peak period only, exact spans of service were varied across routes so that these trip numbers could be met. The routes, stops, and service levels (headways and span of service) were coded into the travel demand model for each year they would be in operation.

Model Outputs

Transit person trips and total person trips from the new model output trip tables were aggregated to the origin and destination zones and then filtered to the OD zone pairs associated with each route.

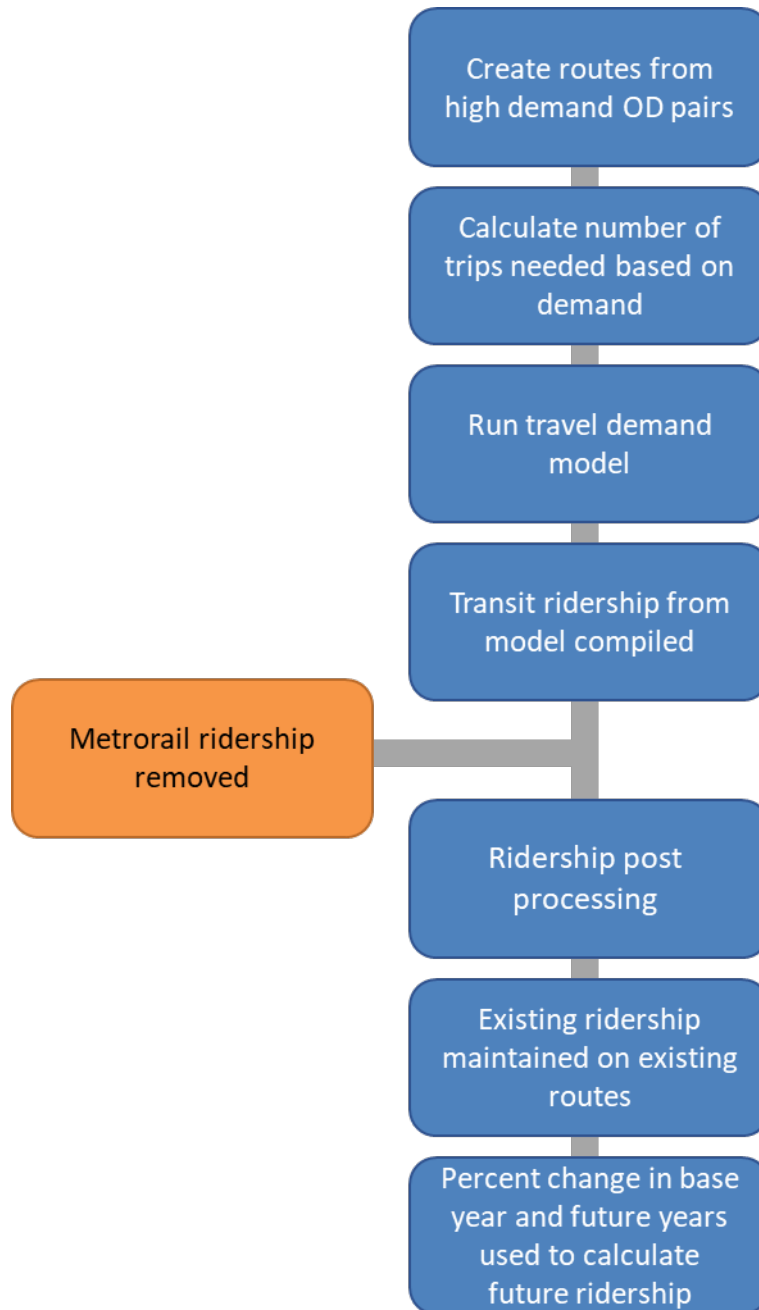
Final Ridership Calculations

The final ridership estimates for 2022 were calculated using a multi-step process:

- The transit person trip totals from the OD zone pairs associated with each route were converted into daily ridership figures for each route. Metrorail ridership was subtracted, given that the transit person trip totals included Metrorail.
- These daily ridership totals were reviewed in comparison to predicted travel flows from the transit propensity analysis initially performed. If modeled mode splits for the OD zone pairs significantly exceeded the propensity findings, the model results were adjusted downward as part of post processing.
- For routes that were based on existing routes, existing ridership was used.

For future years, 2022 ridership was adjusted according to the percent change in transit person trips in the model between 2022 and the future year.

Figure 3.7: Ridership Estimation Methodology Summary



4 DRAFT TRANSIT/TDM PLAN UPDATE

4.1 APPROACH

The first step in defining preliminary recommendations focused on assessing the 2016 study's proposed service plans as contrasted with recent corridor developments or changes in assumptions (see Appendix A). As the configuration of Express Lane access points are known, this enables refinement of route origin locations and viability of intermediate stops. Additionally, recommendations can be updated to reflect changing user preferences and behavior, new technology, and potential partnerships that have arisen since the 2016 study was completed.

Key goals informing the approach:

- Utilize a streamlined outreach approach to revisit and update corridor attitudes and perceptions from the 2016 study.
- Identify opportunities for refinement in the context of the latest travel flow estimates and in consultation with transit providers in the I-66 corridor (e.g. Fairfax Connector, PRTC OmniRide, VRE, WMATA, etc.) regarding their observations of travel patterns and service needs.

Key steps required in this process include:

- 1) Summarizing and reverifying past study key findings, stakeholder and public input utilized in recommendation development.
- 2) Reassessing the number of origin-destination pairs served by one-seat rides beyond opening day, especially in terms of recommendations that maximize I-66 corridor person throughput as compared with off corridor connections to Chantilly, Herndon, Reston, and Tysons Corner.
- 3) Incorporating and rebalancing service levels between both commuter bus and newly introduced VRE commuter rail service plans.

As recommendations will be developed for planning-level regional travel demand modeling, the approach also considers the data-driven post processing process to inform corridor-level decision-making. This data will consider updating capacity constraints, reflecting the latest input regarding park-and-ride lot utilization and capacity of existing bus bays at Metrorail station transfer points.

4.1.1 Affirming Baseline Bus Routes

All routes from the 2016 study’s preferred alternative, along with any newly adopted Commuter Choice or TMP initiated routes were assumed as the baseline commuter bus services for the I-66 corridor. The purpose of the approach to updating these recommendations for opening day (2022), 2030 and 2045 was guided by the following analytical questions:

- 1) Are the previously proposed routes or new route alignments supported by trip flow (or ridership) analysis and are the service levels scaled appropriately to the observed/anticipated demand?
- 2) Do the recommendations previously proposed or developed fully leverage the corridor investments by maximizing the route length (and therefore benefit) along the entirety of the I-66 corridor?
- 3) Do the recommendations as currently designed require any adjustments to better utilize the arrangement of direct access ramps to/from the I-66 Express Lanes?
- 4) Are current or future recommendations scaled appropriately to the capacity of the access roads and terminal facilities proposed for that route?

The preferred alternative recommendations from the 2016 study were the basis for a study team internal review and brainstorming session that considered initial updates. Trip flow analysis was the primary mechanism used to determine and test alternative origin and destination pairings. As modifications to recommendations were considered, a series of pros and cons were developed to validate the rationale for any adjustments. This initial screening approach is summarized in Table 4.1.

Table 4.1: Initial Route Screening Considerations

Pro	Con
Leverages Corridor Investment – Maximizes travel distance on the I-66 corridor.	Indirect Access – Overall route design requires lengthy travel outside the Express Lanes, thereby diminishing the time competitive advantage of the service.
Service Level Alignment – Intensity of service is commensurate with trip flow and initial demand estimation.	Service Duplication – Proposed recommendation or modifications would duplicate service already accommodated.
Established Route – Service envisioned is already in operation or soon to be implemented via Commuter Choice, the TMP program, or some other funding mechanism.	Capacity Constraints – The level of service for the route recommendation would exceed capacity of loading/unloading or other operational parameters.
Source: Transit/TDM Study Update (2020)	

4.1.2 Incorporating VRE Services

In developments since the 2016 study, VRE has concluded that expansion to the Gainesville-Haymarket area is infeasible. In reaching this decision, VRE's study also included an alternative option to expand service by relocating Broad Run station and expanding the yard in its current location was viable and those modifications were funded with the I-66 Concession Payment. VRE's Broad Run expansion alternative identified 2040 conditions with six additional VRE trains, resulting in a forecast reduction of at least 52,000 vehicle miles traveled (VMT). VRE concluded that expansion of service on the Manassas Line would divert commuters that would otherwise be using the I-66 highway corridor as their primary travel mode. VRE noted that this was substantiated in the 2016 VRE Passenger Survey which showed that over 40% of riders drove alone to work before they started using VRE, and 35% drive alone on days they choose not to use VRE.

Currently VRE operates 32 revenue commuter trains each weekday, with 16 trains on the Manassas Line and 16 trains on the Fredericksburg Line. To grow beyond these service levels, investments as outlined in the agency's System Plan 2040 are required. The System Plan 2040 outlines a vision for VRE system investments and recommended actions through 2040 to sustain and grow service to meet regional travel needs. In accordance with VRE service planning, as stated in the System Plan and Transit Development Plan (2019), modest service expansions were determined to be included in the package of I-66 recommendations prior to 2030. The completion of the Long Bridge Project was assumed following 2030, thereby removing significant capacity constraints on VRE and allowing for additional trains and a further increase in service frequency to approach a line maximum of 15 minutes between trains on both the Manassas and Fredericksburg Lines. This approach became the basis for developing the initial VRE service planning to be incorporated into the updated transit recommendations for the I-66 corridor.

4.2 SERVICE ASSUMPTIONS

This section describes the fundamental details of the types of transit service enhancements that were assumed for the initial draft of updated services. The service planning that resulted from these assumptions were refined throughout the planning process based on stakeholder feedback, modeling results, and operational considerations. Specific assumptions as outlined in Table 1.6 for commuter bus operations were maintained from the 2016 study. A summary of key assumptions is listed next:

Route Origins, Destinations and Alignments

- Proposed routes originate at park-and-ride facilities.
- Serve different areas of Washington, DC than those currently served by VRE (L'Enfant Plaza and Union Station).
- New service should follow existing commuter bus routing and operate in Express Lanes, where feasible.

Preservation of Existing Services

- Existing PRTC Omniride and Fairfax Connector routes operating in the I-66 corridor area will continue.
- Some proposed new service could use existing buses and service already in operation.

Service Hours

- Serve weekday and expanded peak-period, peak-direction demand along I-66 corridor.
- Expanded weekday peak period (8 hours total):
 - 6:00 a.m.–10:00am (VRE service more typically 5:00 a.m.–9:00 a.m.)
 - 3:00 p.m.–7:00 p.m.

Service Types

- Commuter Services: Services delivering peak period and peak direction one-seat rides along strategic routes to enhance connectivity to major destinations.
- New VRE trains will continue as all-stop service from Broad Run to Washington, D.C.

Phasing

- Recommendations phased at three intervals (2022, 2030, 2045).
- From opening day service, an increase in origins and destinations served by one-seat rides is anticipated as service ramps up.
- Over time, increase frequency of services, more trips.
- Adapt routes to new park-and-ride facilities.
- Adjust commuter bus Washington D.C. destinations to not duplicate increased Manassas Line service as it is introduced.

Operators

- Routes originating in Prince William County will be operated by PRTC Omniride.
- Routes originating in Fairfax County will be operated by Fairfax Connector.

Maintenance Facilities

- Prince William County: PRTC's proposed Western Bus Maintenance Facility.
- Fairfax County: West Ox Road Maintenance Facility.

Vehicle Types

- For PRTC routes – over the road commuter coach. Seating capacity of approximately 57.
- For Fairfax County routes – low floor transit bus. Seating capacity of approximately 39, with provisions for standees.
- VRE bi-level commuter coaches – average capacity of approximately 130 passengers. Maximum consist of 10 coaches per train.

The transit planning efforts of this study did not identify specific locations for bus stops within route destination areas but did estimate routing to and from the Express Lanes. Commuter services were planned to operate during the weekday peak periods. Generally, commuter services would operate in the eastbound direction in the morning peak and westbound in the afternoon peak. Commuter service would operate in Express Lanes on I-66. Run times for bus service reflects higher speed service than available in the general-purpose lanes. Potential routes deemed a lower priority would include services that would fail to utilize the Express Lanes at all or accrue minimal benefit of running in Express Lanes for the duration of their entire route.

4.3 INITIAL RECOMMENDATIONS

Initial service recommendations were identified solely using the data-driven methodology. These recommendations would be subsequently modified based upon stakeholder input, results from coding and running the travel demand model, and other modifications based on analysis and throughput performance within the corridor.

4.3.1 Commuter Bus

A total of 10 routes were developed initially with offered capacity estimates for baseline service already in place, opening day for the Express Lanes in 2022, and 2045 service levels (see Figure 4.1 and Figure 4.2). Route details are presented in Figure 4.3 through Figure 4.5. Key differences from the 2016 study are highlighted in Figure 4.6. Key aspects of the recommendations, in comparison to current baseline

operations, horizon year (2045) recommendations, and graphical route differences from the 2016 study are depicted in Figure 4.1 and Figure 4.2

Figure 4.1: Initial Bus Recommendations – Route Graphic

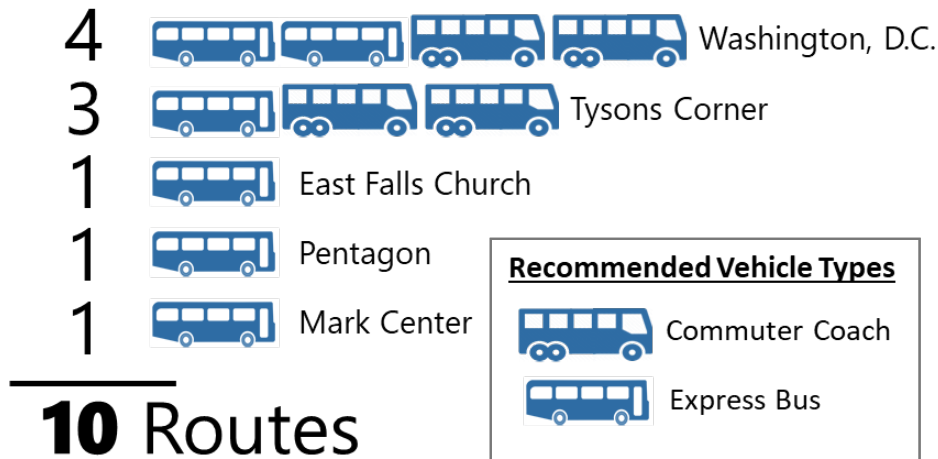
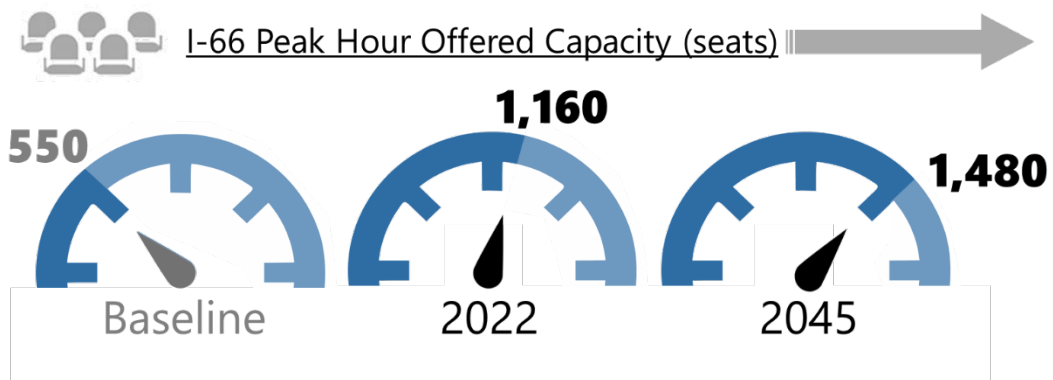


Figure 4.2: Initial Bus Recommendations – Offered Capacity Graphic



Key highlights of the initial draft recommendations included:

- Realignment of service levels with trip flow results and I-66 corridor travel preferences – elimination of off corridor Chantilly/Herndon/Reston services from the 2016 study.
- Peak period offered capacity increases almost 15 percent in opening year, almost five percent in 2030, and remains relatively stable through 2045 - reflecting increased VRE capacity.
- New reverse peak service provided on the Manassas/Tysons route.
- Increased service frequencies to the Pentagon.
- Mix of long-haul commuter services and peak period connections to major economic centers in Northern Virginia.
- Bus bay capacity deemed sufficient for increased services where specific destinations were identified.

Figure 4.4: Initial Bus Recommendations Phasing

I-66 Corridor Draft Bus Recommendations Peak Period Service Plan (2022-2045) Unconstrained																										
BASELINE						2022			2025			2030			2035			2040			2045					
From Prior Study?	Route Origin	Route Destination	Proposed Changes	Major Interim Stops	New Stops/Year	Peak Trips	Headway	Capacity	Peak Trips	Headway	Capacity	Peak Trips	Headway	Capacity	Peak Trips	Headway	Capacity	Peak Trips	Headway	Capacity	Peak Trips	Headway	Capacity			
Yes	Haymarket/Gainesville (University Blvd)	Downtown DC and L'Enfant Plaza	Remove L'Enfant Plaza service when VRE service increases in 2030	Dunn Loring	Haymarket / 2030 Dunn Loring / 2030	14	37	798	14	37	798	14	37	798	17	30	969	17	30	969	17	30	969	16	32	912
Yes	Haymarket/Gainesville (University Blvd)	Tysons Corner			Haymarket / 2045	8	69	456	8	69	456	8	69	456	8	69	456	7	80	399	7	80	399	8	69	456
Yes	Manassas Park and Ride	Downtown DC and L'Enfant Plaza	Truncate route at Ballston when VRE service increases in 2030 (upon review of updated ridership and trip flows)			12	44	684	6	96	342	6	96	342	7	80	399	7	80	399	7	80	399	6	96	342
Yes	Manassas Park (Balls Ford Road)	Tysons Corner	Add stop at Fairfax Center in 2022, start reverse peak service from Stringfellow to Manassas in 2022, increase service to Manassas Park in 2045	Fairfax Center (Monument Dr) Stringfellow	Fairfax Center / 2025 Stringfellow / 2025	16	32	912	16	32	912	16	32	912	21	24	1,197	21	24	1,197	21	24	1,197	24	21	1,368
Yes	Stringfellow	Downtown DC and L'Enfant Plaza	Remove L'Enfant Plaza service when VRE service increases in 2030			22	23	858	22	23	858	28	18	1,092	28	18	1,092	28	18	1,092	28	18	1,092	29	17	1,131
Yes	Stringfellow	Tysons Corner		Fairfax Center (Monument Dr)	Fairfax Center / 2022 Stringfellow / 2022	45	11	1,755	45	11	1,755	49	10	1,911	49	10	1,911	49	10	1,911	49	10	1,911	61	8	2,379
Yes	Stringfellow	Pentagon	Extension of Vienna Service	Fairfax Center (Monument Dr)	Fairfax Center / 2022	20	25	780	48	10	1,872	48	10	1,872	55	9	2,145	55	9	2,145	55	9	2,145	58	8	2,262
Yes	Fairfax Center (Monument Dr)	Downtown DC and L'Enfant Plaza	Remove L'Enfant Plaza service when VRE service increases in 2030			20	25	780	30	17	1,170	30	17	1,170	31	16	1,209	31	16	1,209	31	16	1,209	31	16	1,209
No	Fairfax Center (Monument Dr)	East Falls Church	Possibly using articulated buses	City of Fairfax	City of Fairfax / 2022	24	21	1,152	24	21	1,152	32	15	1,536	32	15	1,536	32	15	1,536	32	15	1,536	32	15	1,536
No	Fairfax Center (Monument Dr)	Mark Center		Franconia-Springfield	Franconia-Springfield / 2035										6	96	234	6	96	234	6	96	234	6	96	234
Peak Hour Person Throughput (New and Enhanced Bus Routes)						551			1,164			1,164			1,364			1,386			1,420			1,479		
Current Maximum Peak Hour Person Throughput (All Bus Routes)						4,148																				
Baseline Max. Throughput Excluding Recommended New and Enhanced Bus Routes						3,597																				
Max. Throughput with Recommended Bus Routes									4,761			4,761			4,961			4,983			5,017			5,075		
Percent Change									14.8%			0.0%		4.2%			0.4%			0.7%			1.2%			

- New Bus Service
- # Increase in trips
- # Decrease in trips
- ### Frequency change

Figure 4.5: Initial Bus Recommendations 2045 Schematic

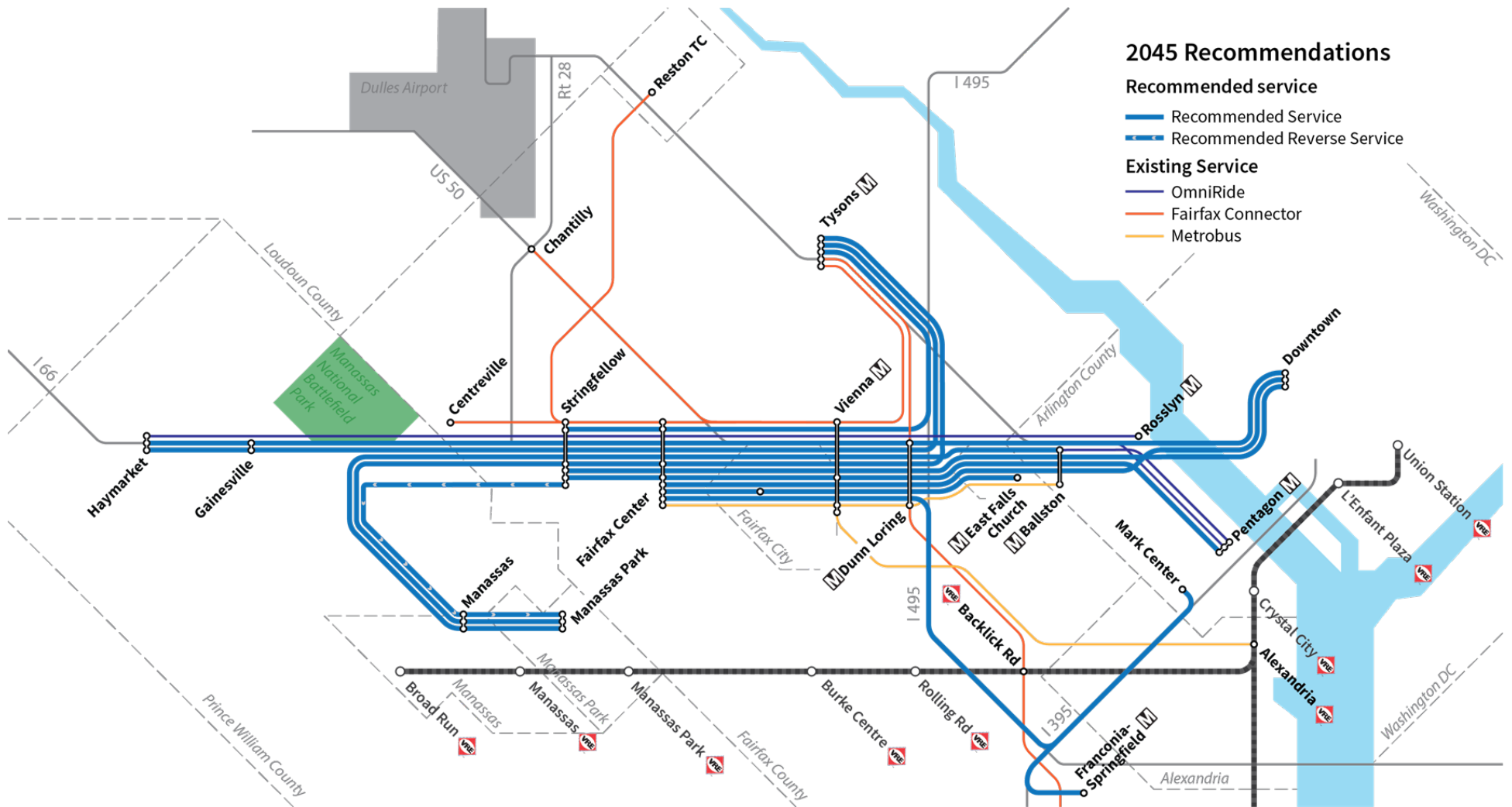
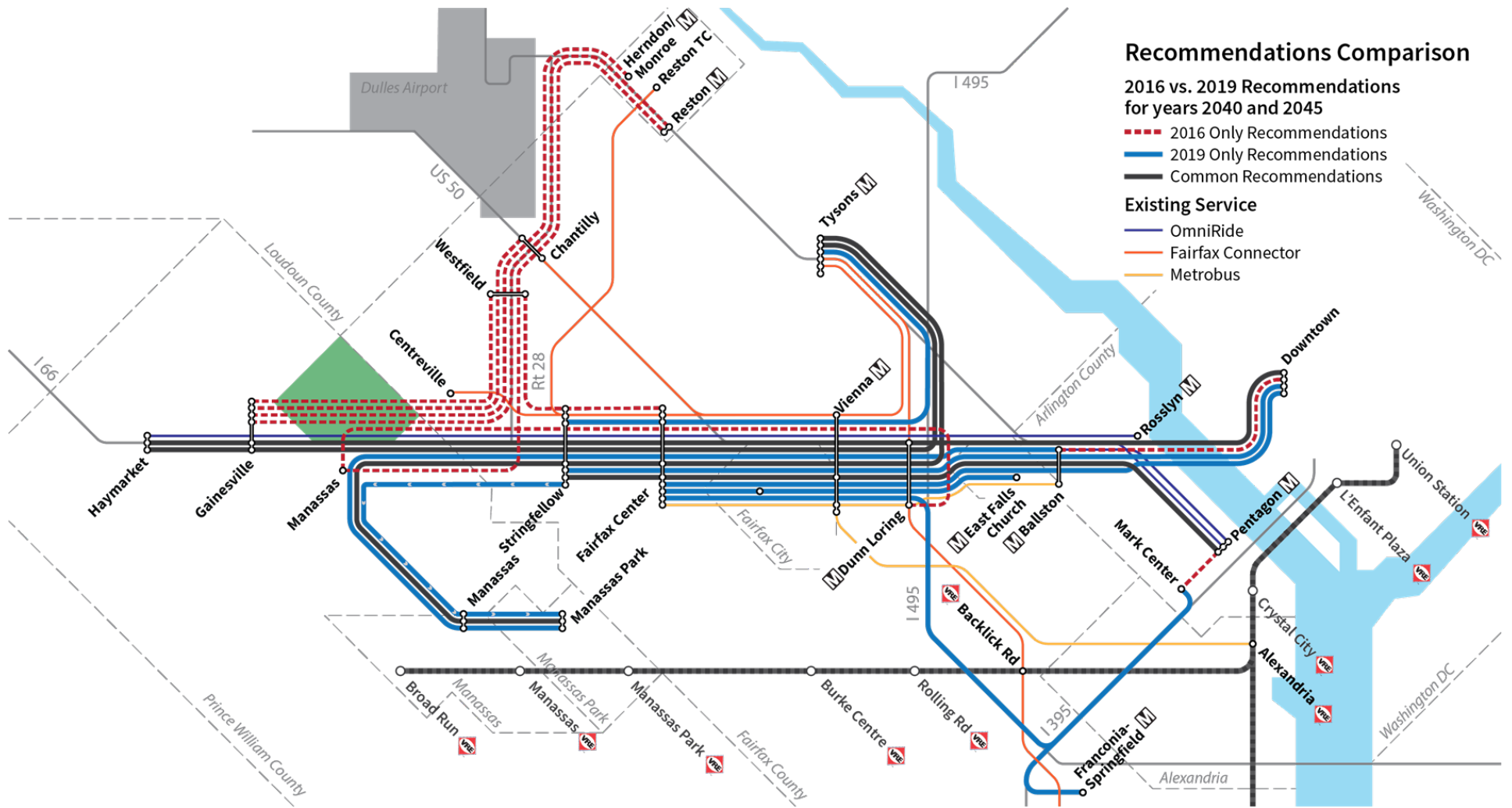


Figure 4.6: Initial Bus Recommendations 2045 Comparison Schematic with Previous Plan



The following summarizes key components of the development of the initial recommendations:

- Several routes recommended in the 2016 study were not included in this update, including all routes from Gainesville and Manassas to the Reston area along Route 28 and routes to Merrifield. The travel flow analysis (based on the updated MWCOG Travel Demand Model) in the Market Analysis no longer supported these connections. Additionally, routes between Gainesville and Reston/Herndon would not require the use of I-66 for a significant length and are better suited for other funding sources.
- The travel flow analysis in the Market Analysis instead pointed more towards heavy demand between Fairfax County and destinations in Arlington and Washington, D.C. Therefore, the initial recommendations included more service from Fairfax County to destinations along the corridor and to Arlington and Washington, D.C.
- Another difference between the recommendations from the 2016 study and this study update is that the update recommends all bus service to Washington, D.C. to terminate in the Downtown area instead of L'Enfant Plaza in 2030. This is because Manassas Line VRE service is planned to increase in 2030 and therefore satisfies much of this demand.
- The initial estimates for headways and number of trips needed on each route were calculated using trip flows from the MWCOG travel demand model and transit mode splits based on transit propensity scores from the Market Analysis. Each trip was assumed to be at 80 percent vehicle capacity.
- Park-and-ride lots with direct eastbound access to Express Lanes and westbound access from the Express Lanes were prioritized as route start and endpoints. Park-and-ride lots and other exits with direct eastbound access from Express Lanes and eastbound access from Express Lanes were prioritized as interim stops along routes.

4.3.2 VRE Commuter Rail

Initial recommendations reflected a combination of longer trains and gradual introduction of additional trains as capacity constraints are overcome. Currently estimated for completion in 2030, the expansion of the Long Bridge and other rail investments in the shared Manassas Line/Fredericksburg Line corridor (including 4th track and Franconia - Occoquan 3rd Track) will support 171 percent growth in overall VRE daily trains, and create a dedicated passenger corridor between Franconia to Union Station with better on-time performance. The service planning to leverage this new capacity included the following:

- Longer Manassas Line trains on opening day in 2022 (10 cars max.)
- Two new peak trips beginning in 2025
- Six additional peak trips from 2030 to 2045.

A total of four new peak period trains were envisioned by 2045 with offered capacity estimates for current service opening day for the Express Lanes in 2022, and 2045 service levels (see Figure 4.7 and Figure 4.8). Service plan details, including phasing and slotting of new trains and the resultant impact on headways is illustrated in Figure 4.9.

Figure 4.7: Initial VRE Commuter Rail Recommendations - Graphic

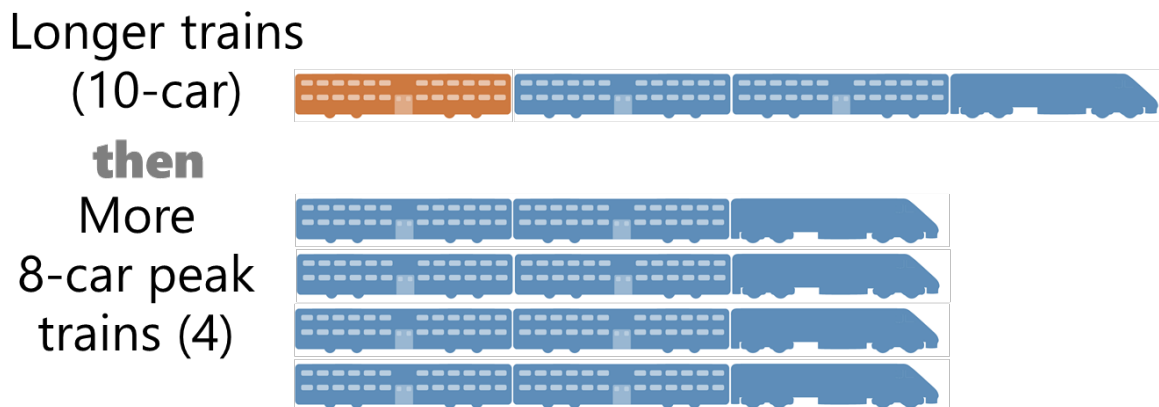


Figure 4.8: Initial VRE Commuter Rail Recommendations – Offered Capacity Graphic

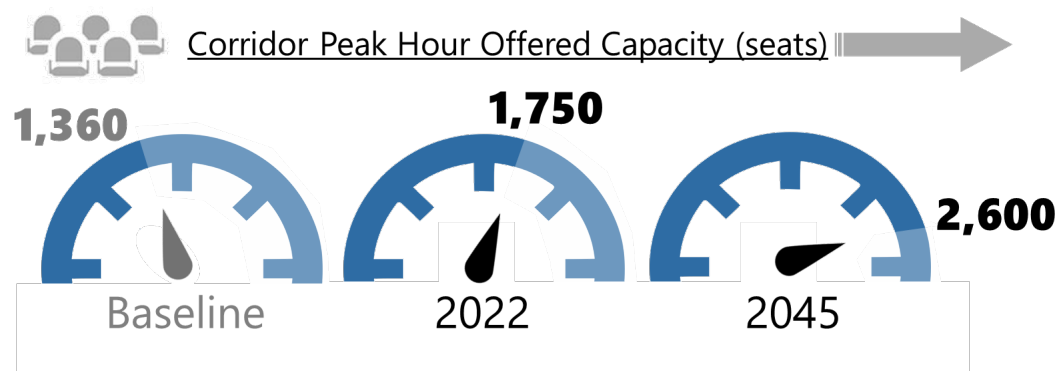


Figure 4.9: Initial VRE Commuter Rail Recommendations Details and Phasing

I-66 CORRIDOR VRE FUTURE SERVICE DRAFT RECOMMENDATIONS for inclusion in study update.

VRE Manassas Line Draft Recommendations
AM Peak Period Service Plan (2022-2045)
 Unconstrained

BASELINE		Long Bridge Corridor Opens													
		2022		2025		2030		2035		2040		2045			
TRAIN	Consist	Capacity	Consist	Capacity	Consist	Capacity	Consist	Capacity	Consist	Capacity	Consist	Capacity	Consist	Capacity	
322	6	780	8	1040	8	1040	8	1040	8	1040	8	1040	8	1040	
324	6	780	8	1040	8	1040	8	1040	8	1040	8	1040	8	1040	
NEW									8	1040	8	1040	8	1040	
326	8	1040	10	1300	10	1300	8	1040	8	1040	8	1040	8	1040	
NEW									8	1040	8	1040	8	1040	
328	8	1040	10	1300	10	1300	8	1040	8	1040	8	1040	8	1040	
NEW									8	1040	8	1040	8	1040	
330	8	1040	10	1300	8	1040	8	1040	8	1040	8	1040	8	1040	
NEW													8	1040	
332	6	780	8	1040	8	1040	8	1040	8	1040	8	1040	8	1040	
Peak Trips	6		6		7		8		9		9		10		
Total Coaches (+spares) ¹	39		50		57		61		70		70		79		
Total Locomotives (+spares) ¹	6		6		7		8		9		9		10		
Additional Coaches			11		7		4		9		0		9		
Additional Locomotives			0		1		1		1		0		1		
Offered Capacity (Seats) ²		5460		7020		7800		8320		9360		9360		10400	
Avg. AM Headway (min) ³		31		31		27		23		21		21		19	
Seats/Hr (4hr. Peak) ⁴		1365		1755		1950		2080		2340		2340		2600	
Change Amount (Seats) ²				1560		780		520		1040		0		1040	
Percent Change				28.6%		11.1%		6.7%		12.5%		0.0%		11.1%	

New Train Service
 # Increase in consist
 # Decrease in consist
 ## Frequency change

¹ Coach Spares = 10%, Locomotive Spares = 20%
² Assumes 130 seats/coach
³ Headway estimates based on 2019 VRE peak departure span
⁴ Previous I-66 Study defined AM peak as 6:00am-10:00am (4 hours)

4.3.3 TDM Strategies and Phasing

TDM strategies developed specifically for the I-66 corridor will supplement ongoing TDM efforts in the region, including those in Fairfax County and Prince William County. Strategies were focused on TDM policies that promote the use of new I-66 transit service and park-and-ride infrastructure; incentives are targeted toward new transit users and new vanpool/carpool users. These I-66 focused strategies would build on the strong TDM programs already in place in the region, with those programs helping to support I-66-specific strategies.

With the introduction of toll-free travel for HOV3+ in the Express Lanes of I-66, for the first time in the corridor, slugging is anticipated to become a viable, reliable option for commuting from places like Haymarket, Gainesville, and Manassas to Washington, D.C.

Based upon stakeholder interactions, some specific aspects of the TDM recommendations explored in this study update that will continue to inform future recommendations include:

- Insight into the state of practice regarding vanpools. Given the long-term future perspective of this study, research on any evidence that traditional vanpooling (employer-based, point-to-point) may be replaced by on-demand services like Uber Pool.
- Specific Intelligent Transportation System (ITS) applications in the I-66 corridor. Off-corridor service creates a significant ridership penalty, but possible transit prioritization treatments to adjacent destinations (i.e. City of Fairfax/GMU) could increase the attractiveness of these locations as interim stops or origin/destinations. ITS applications explored included message signs that inform drivers of parking availability at park-and-ride facilities or VRE stations.

Vanpools

As technology enables seamless flow of information from various modes service providers are moving towards providing mobility as a service (MaaS) where a single platform could provide users a single point for trip planning using various modes, fare payment and travel information. Transportation Network Companies (TNC) offering monthly passes which would include features like access to different modes (car rentals, scooters) and fixed pricing is an indication that the industry is moving toward consolidating different modes and travel options all on one platform, or becoming a one-stop shop for all mobility needs. A form of this can be seen in Helsinki where the Whim App is offering mobility options to users as a service for a monthly fee. The end goal would be that the user could pick any service for a given trip depending on the service time, cost and other preferences on a single platform in real-time, hence providing the best possible user experience.

ITS Applications – Real Time Messaging Signs

A central information database collecting information from parking management systems, road pricing system, transit system and ridesharing platforms could assist users in making travel decisions in real-time and help reduce SOV usage by making users aware of cheaper, faster and more environmentally friendly available modes. Availability of multimodal traveler information is shown to influence commuter choice of modes. Access to data would enable various service providers to include information about different modes and integrate it into their own platforms to offer the users the ability to plan a trip using different modes over a single platform. By analyzing user behavior, advanced systems would eventually plan journeys based on mode preferences. For example, a user commuting to work daily would automatically receive notifications on parking space availability near Metrorail and an option to book the space beforehand to reduce the time spent in finding a parking spot.

Key TDM elements identified for further development and implementation include:

- Single platform Mobility as a Service (Transit, Vanpool, Carpool, Transportation Network Company integration).
- ITS investment to accelerate on/off-corridor travel, specific to Route 123 – City of Fairfax.
- Real-time messaging on corridor (transit travel times/parking availability).
- Sweeper Bus – Later night return to VRE commuter rail stations.
- Slugging and other promotional initiatives.
- Commuter incentives programs.

5 PUBLIC AND STAKEHOLDER ENGAGEMENT PROCESS

Throughout the update process, there has been interaction and coordination with stakeholders from around the Northern Virginia region. Many of the same stakeholders were invited to participate in streamlined engagement that included individual kickoff presentations, a study update overview webinar, transit agency interviews and strategy sessions, an interactive story map, and two corridor workshops.

The stakeholder groups invited to participate are listed below:

- City of Fairfax
- City of Falls Church
- City of Manassas
- City of Manassas Park
- Town of Haymarket
- Arlington County
- Fairfax County
- Loudoun County
- Prince William County
- Potomac and Rappahannock Transportation Commission (PRTC)
- Northern Virginia Transportation Authority (NVTA)
- Northern Virginia Transportation Commission (NVTC)
- Virginia Department of Transportation (VDOT)
- Virginia Railway Express (VRE)
- Washington Metropolitan Area Transit Authority (WMATA)

5.1 MARKET SURVEY

The 2016 study conducted a survey via telephone and hard-copy surveys between July and August 2014. The survey received 1,321 responses from people, representative of all zip codes throughout the I-66 corridor. Especially relevant to the update process was to refresh this survey to understand the degree of continued support for the improvements envisioned in the 2016 study.

The 2016 study survey taker profile:

- Approximately half of the respondents live within 5 miles of I-66.
- Thirty-eight percent of respondents use the corridor at least 4 days a week.
- Slightly less than half of respondents primarily use I-66 for going to or from work.

- Fifty-seven percent primarily travel on I-66 as SOV travelers (31 percent either HOV-2 or HOV-3, and 12 percent Metrorail or bus).

While a large component of the 2016 survey was specific to the overall deployment of the Transform 66 Project, some information was beneficial to gauge perceptions toward transit and TDM recommendation development. The 2016 study noted that the attitudes and perceptions of those in the I-66 corridor should be reassessed at regular intervals. The original survey was telephone-based, whereas this study prepared a survey on the MetroQuest on-line community engagement platform. The survey was conducted from April 8th to May 20th, 2019 and received 690 responses containing 16,119 data points.

Highlights and contrasts with the 2016 survey are listed below. The access points onto and off I-66 are depicted in Figure 5.1. Full survey results and analysis is found in Appendix B.

- The majority of the survey participants are familiar with the VDOT and DRPT plans on the I-66 corridor and were not satisfied with the status quo.
- The participants are younger and a great majority of them have a higher average annual income.
- A significant portion of the participants already commute by transit.
- Inconsistent work schedules and varying school/work hours were the perceived barriers to more people carpooling or taking transit.
- Alongside teleworking, commuter bus service and Metrorail were the preferred modes after the tolls begin in 2022, and initiatives relevant to these modes received the strongest support.

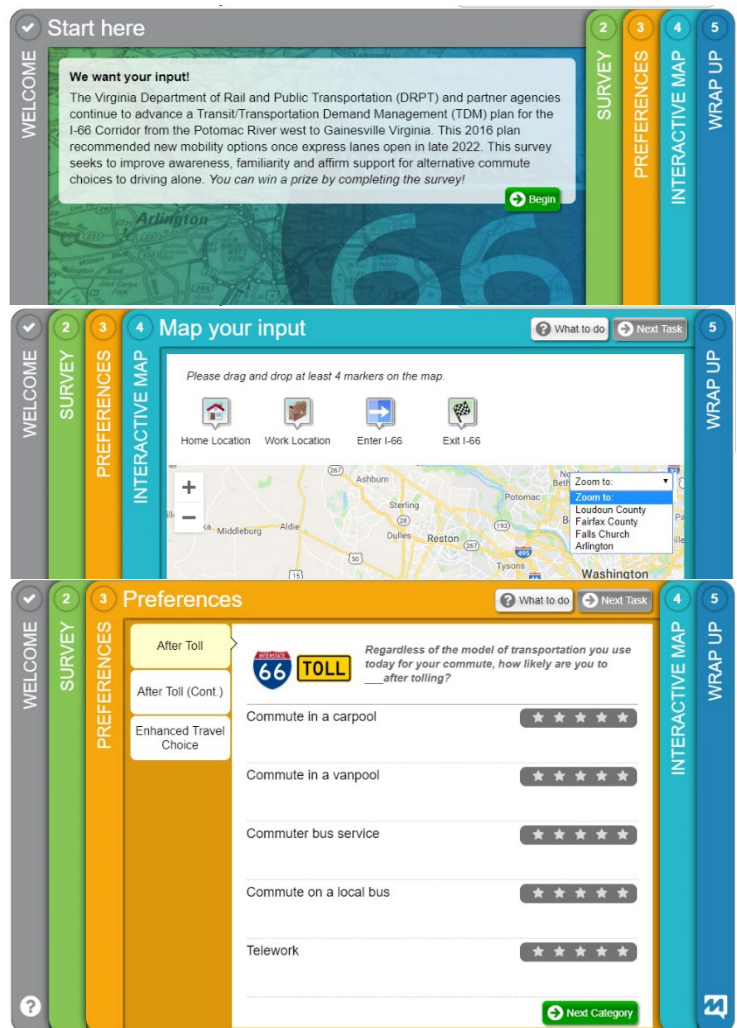
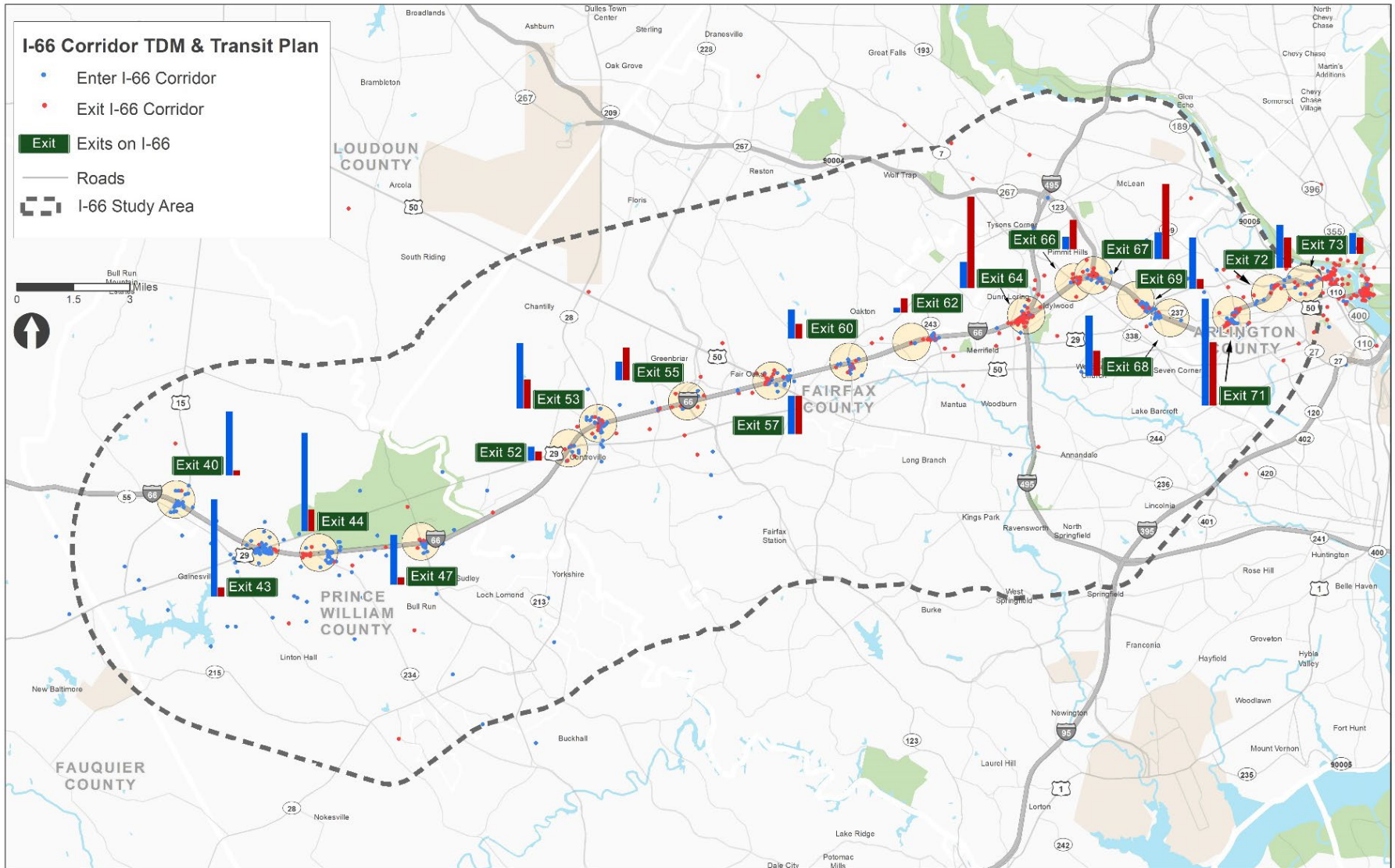


Figure 5.1: Survey Respondent Entry and Exit Points on I-66 During Commute



5.2 STAKEHOLDER FEEDBACK

During development of recommendations, interviews and meetings were scheduled with transit service providers to gather any additional input in general or in relation to specific plans, initiatives, or other long-term aspirations within the I-66 corridor. More formalized interviews were conducted via telephone from July 2 – July 11, 2019. Other one-on-one meetings and outreach was ongoing throughout the study as recommendations were developed and in response to received comments. The participating entities are identified below:

- Arlington County
- Fairfax County – Fairfax Connector
- NVTC
- Prince William County – PRTC
- VRE
- WMATA

These interviews, along with less formalized strategy sessions with VRE and NVTC were beneficial in establishing initial service recommendations, first/last mile considerations, and to gain a better understanding of corridor conditions and programmatic opportunities.

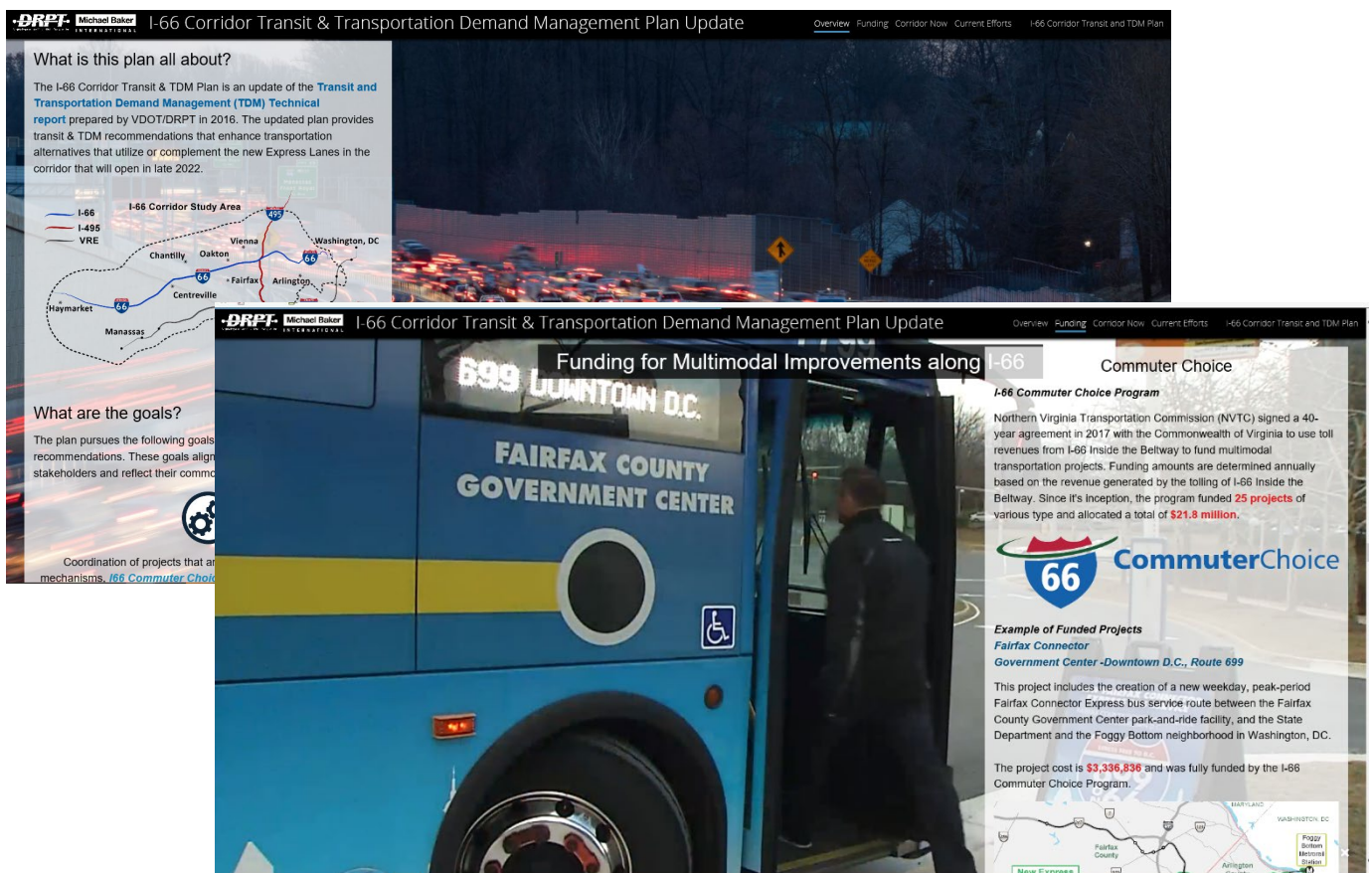
Key overall thematic comments gathered from various stakeholder feedback channels included:

- The Rapid Bus concept from the previous plan risks losing the travel time advantage with interim stops. The one-seat-ride on I-66 provides a well-known and well-used incentive. As soon as that bus must exit the highway, the result is lost ridership. The only exception might be with the introduction of in-line stations, perhaps at Government Center.
- Dynamic parking information - when lots are full, the goal is to redirect people to other lots. Eventually the goal would be to have dynamic information for drivers along I-66 so that they can make informed decisions about when they should keep driving.
- Important for this update to help with more integrated service planning.
- Making room for VRE growth is imperative to encourage higher-capacity rail.
- Would like to see more focus on the TDM aspects of study recommendations – especially on expanded employee outreach and telework initiatives.
- Strong support for bus service increases to East Falls Church and truncating Manassas to Washington D.C. at Ballston.
- Shared mobility devices (i.e. electric scooters) should be added as first mile/last mile TDM strategy.
- Bi-directional service from Tyson’s Corner (westbound in the AM) should be analyzed.
- Current carpool incentives did not receive the expected success.
- Slugging/Dynamic ride-shares could be an integral component of corridor TDM – consider facility improvements and marketing to promote a slug culture.
- Fairfax Connector has a lot of capacity, interested in better utilizing their buses.
- Interested in “game changing” improvements that increase corridor capacity.

5.3 STORY MAP

A story map was prepared to combine initial corridor mapping with narrative text, images, and multimedia content to create a compelling, user-friendly web-based application. The story map was developed to update stakeholders and other constituents on the study progress.

The I-66 Corridor story map presented the existing conditions of the I-66 corridor, the planning process to develop/refine previous recommendations, funding mechanisms, the plan’s timeline, parties involved, public outreach and other efforts taking place during the update process. The content also included static and interactive maps of the existing bus transit and commuter rail services, park-and-ride facilities, and initial service recommendations. The story map was shared by the participating jurisdictions and agencies on their official websites and social media accounts. A total of over 700 people viewed the story map as of December 2019.



5.4 STAKEHOLDER WORKSHOPS

Two stakeholder workshops were conducted in May and July of 2019 respectively. These workshops are organized to provide background information on the plan, to present the existing conditions and future trends of the I-66 Corridor, and to solicit feedback on future vision, service plan and changes to the corridor from the perspectives of stakeholders. Both workshops are held at the VDOT Northern Virginia District office in Fairfax County, Virginia.

Workshop #1

The first workshop was held on May 20, 2019. During the workshop, the stakeholders were provided an overview of the plan including the purpose, timeline, and necessary tasks. The existing conditions of the corridor such as available transit services, current and future demographics, travel flow analysis, and recommendations from the previous plan were presented. The online survey results and their implications, the survey respondents' impressions with the current corridor conditions and expectations from future services were also discussed.

In facilitated group working sessions, the stakeholders shared overall thoughts and visions of the corridor and discussed current challenges and opportunities, and future changes needed. The inputs from each working group were reported out and shared at the end of this session. A total of 26 individuals participated in this workshop.

Workshop #2

The second workshop was held on July 22, 2019. During this workshop, the progress of the project, findings from the initial modeling, stakeholder interview summaries, and approach to developing draft recommendations and relevant screening criteria were shared with the stakeholders.

The bus transit, VRE, and TDM service recommendations were presented and discussed in two workstations dedicated to each topic. Stakeholders were able to participate in both discussion groups, with comment forms available to capture any details beyond initial interactions. Comment sheets were either turned in at the end of the workshop or emailed afterwards. Stakeholders offered feedback on details of the recommendations, the phasing of implementation and additional points for consideration. A total of 24 individuals participated in this workshop.



6 UPDATED TRANSIT/TDM PLAN RECOMMENDATIONS

The following sections describe the main elements of the final recommendations, representing a refinement of the Preferred Alternative from the 2016 study. These sections further detail phasing, present the results of analysis on overall corridor performance in terms of person throughput, and bus route prioritizations to align implementation with funding availability across various resources.

6.1 SERVICE OVERVIEW

6.1.1 Commuter Bus

A combination of existing local and new or expanded corridor-focused transit services have been updated to serve weekday and expanded peak-period demand along the I-66 corridor. Existing commuter bus service will be expanded, and new routes will be implemented that will enhance existing services.

A total of thirteen commuter bus routes are included in the updated recommendations. Five of these routes represent new service, while eight comprise enhancements to existing baseline service. Twelve routes are recommended for implementation on opening day of the Express Lanes (2022), with a frequency of service to match initial demand estimates. Subsequent frequency adjustments coincide with forecasted increases in demand from travel modeling conducted for 2030 and 2045. Overall, these recommendations reflect more concentrated service than previously considered. In 2045, seven routes have recommended frequencies equal or less than 15 minutes.

The following AM origin locations are represented, primarily centered around park-and-ride facilities:

- Gainesville (University Boulevard)
- Gainesville (Cushing Road/Route 234 Bypass)
- Manassas (Balls Ford Road)
- Fairfax Center (Monument Drive)
- Haymarket

An overview of destinations served by route is presented in Figure 6.1. All routes combined account for 522 peak trips along the I-66 corridor in 2045. This represented a 40 percent increase from the 2016 study's 2040 levels. Total 2045 ridership for all routes is estimated at approximately 4.2 million annually. Calculated person throughput for only these recommendations is graphically depicted in Figure 6.2. The

most significant ridership gains now observed in these recommendations are the result of additional service to Tysons Corner and the Pentagon.

Figure 6.1: Bus Recommendations – Route Graphic

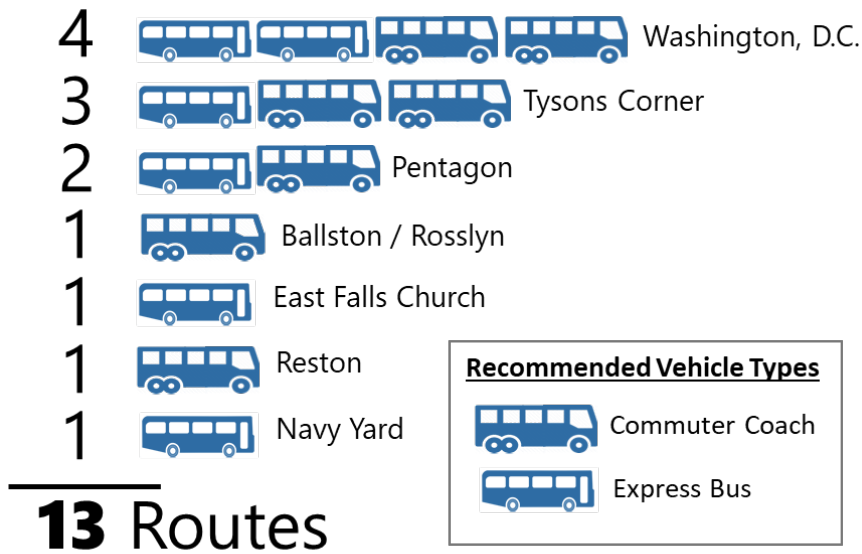
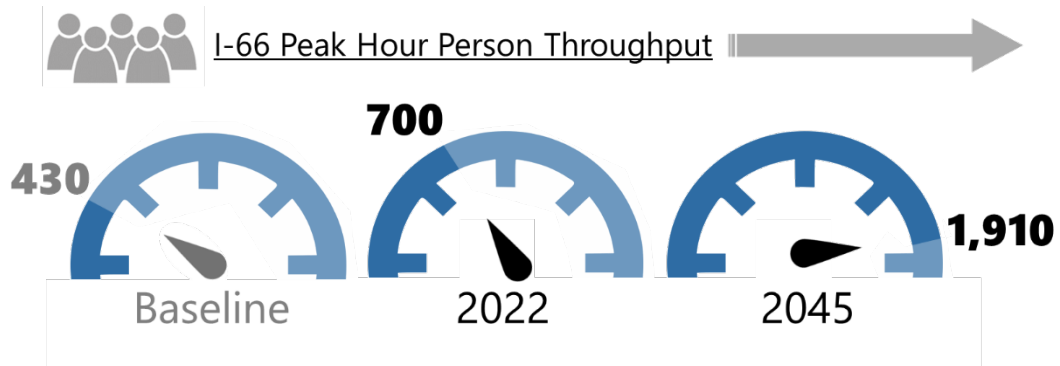


Figure 6.2: Bus Recommendations – Person Throughput Graphic



Not all the recommended routes perform equally, and prioritization of the best performing routes in 2022, 2030 and 2045 (see Section 6.4) enables any limitations in funding resources to be directed to services which are most impactful.

6.1.2 VRE Commuter Rail

The recommendations anticipate the removal of historic capacity constraints that have limited growth on the VRE Manassas Line. Capacity constraints have included insufficient yard and storage space at Broad Run and agreements with host railroads limiting train slots or movements due to conflicts with rail freight operations. The I-66 concession funding for the Broad Run expansion, estimated for

completion in 2022, will also accommodate an expanded fleet to support incremental service increases. Parking improvements at Broad Run and Manassas Park would add 1,200 new parking spaces, along with capacity available at Burke Centre (approximately 600 spaces) would support service expansion. Finally, the Long Bridge project to construct a second two-track rail crossing of the Potomac River enables expansion of VRE service for both the Manassas Line and Fredericksburg Line.

These recommendations assume one additional VRE Manassas Line train following completion of the Broad Run expansion project. The additional train is in lieu of longer trains (additional coaches per existing train) as outlined in the 2018 VRE Transit Development Plan. The additional train enables VRE AM headways to decrease from 31 minutes to 27 minutes. In anticipation of completion of the Long Bridge project, VRE could then add additional peak period trains by 2030. These recommendations only consider peak period commuting trips; however, it should be noted that service planning for the Manassas Line also includes the potential for off-peak and/or bi-directional service as market conditions dictate. For planning purposes, a VRE headway of 15 minutes between future trains was assumed for both 2030 and 2045 ridership forecasting. These service recommendations are conceptualized in Figure 6.3.

Initial ridership in 2022 shows no change as a result of the increased service. This is primarily due to trains currently operating over capacity, which would be absorbed by this expansion and initial market shifts with the I-66 Express Lanes. As VRE service increases, the ridership specifically attributed to this expansion grows to over 1.8 million annual riders, or approximately four million for total Manassas Line riders in 2030. Increasing demand and greater train utilization results in 2.3 million riders for the recommended service expansion, or a total of 5.1 million for total Manassas Line service in 2045. The anticipated person throughput for total Manassas Line ridership in 2030 and 2045 is illustrated in Figure 6.4.

VRE parking and station expansion projects along the Manassas Line, particularly at Broad Run and Manassas Park, and the excess parking capacity at Burke Centre are anticipated to accommodate initial ridership gains. However, the recommendations presented here are exclusive of any additional or expanded station-area infrastructure necessary to accommodate future year ridership and the associated expansion and replacement of VRE's fleet.

Figure 6.3: VRE Commuter Rail Recommendations – Graphic

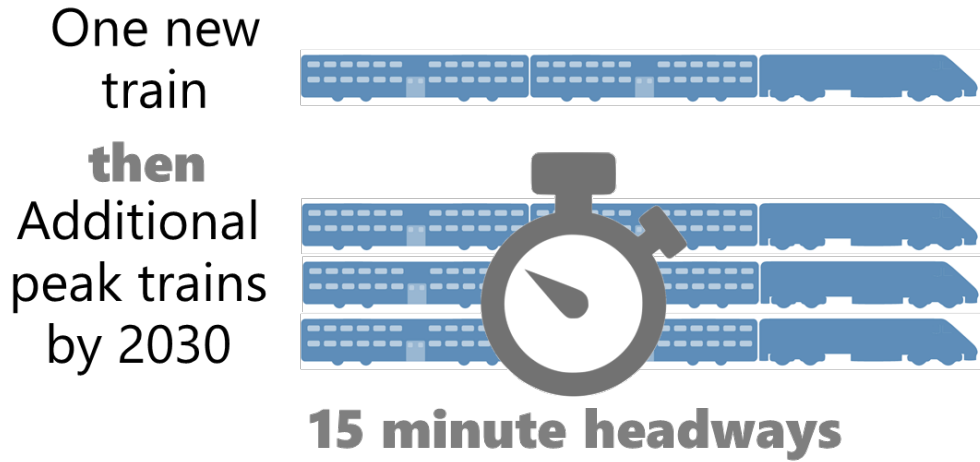
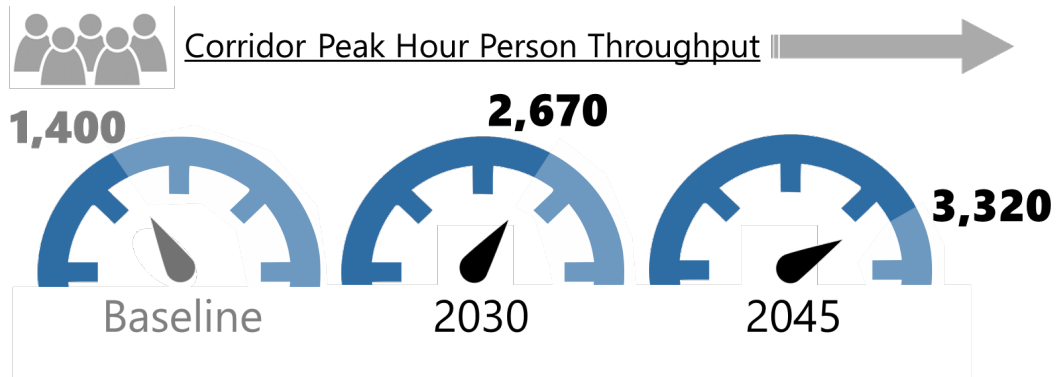


Figure 6.4: VRE Commuter Rail Recommendations – Person Throughput Graphic



6.1.3 Updated Ridership Forecasts

The section contrasts the ridership forecasts prepared for the updated recommendation with the similar analysis from the 2016 study. The results are presented in Table 6.1 and Table 6.2. This comparison notes the following:

- 1) The 2016 study's initial forecast year of 2025 and horizon year of 2040 are represented by 2022 and 2045 in this study update.
- 2) All routes from the 2016 study's recommendations and the study update recommendation are included in overall ridership estimations, irrespective of the fact that not all routes serve the same origin-destination pairs.
- 3) The 2016 study presented a ridership range for estimating purposes. The low range was used to compare with the updated recommendation ridership in 2022. The high range was used to compare with the updated recommendation ridership in 2045.
- 4) The 2016 study did not provide 2030 ridership estimates. An estimated 2030 amount was obtained by using the low range for newly initiated service or where service frequencies were reduced from 2030 to 2040. In all other cases, the high range was used for estimating purposes.
- 5) The 2016 study did not include VRE ridership nor feature any VRE commuter rail recommendations. No build analysis of VRE ridership conducted in this study update enables future year VRE ridership to be estimated absent any recommendations. In comparison with the 2016 study, the new VRE ridership associated with the specific service recommendations of this plan are used for 2022, 2030, and 2045. The baseline no-build VRE ridership is reported the same for both forecasts, with the 2022 and 2045 numbers used for the 2025 and 2040 reporting years in the 2016 study.

Table 6.1: Recommendations Ridership Summary

Transit Mode	2022 Service	2030 Service	2045 Service
Commuter Bus	1,568,100	3,766,000	4,194,000
VRE Manassas Line (Baseline)	1,963,500	2,233,800	2,789,700
VRE Manassas Line Recommendations	-*	1,856,400	2,295,000
TOTAL Bus & Rail	3,531,600	7,856,200	9,278,700

Source: Transit/TDM Study Update (2020)

Table 6.2: 2016 Study's Preferred Alternative Ridership Summary

Transit Mode	2025 Service	2030 Service	2040 Service
Commuter Bus	1,982,640	2,692,800	3,413,520
VRE Manassas Line (Baseline)	1,963,500	2,233,800	2,789,700
VRE Manassas Line Recommendations	-	-	-
TOTAL Bus & Rail	3,946,140	4,926,600	6,203,220

Source: Source: I-66 Corridor Improvements Project – Transit/TDM Technical Report (2016), Transit/TDM Study Update (2020)

6.2 FINAL RECOMMENDATIONS

6.2.1 Commuter Bus

The network of existing and proposed park-and-ride facilities are planned to serve demand along I-66—providing access to transit, ridesharing (carpool, vanpool, and slugging), and other travel services. Park-and-ride facilities serving as route origins will include dedicated space for transit operations, bus bays, and station/stop facilities. It is assumed that all routes originating in Prince William County will be operated by PRTC and all routes originating in Fairfax County will be operated by Fairfax Connector.

Table 6.3 identifies specific route details. A total of eight existing routes are identified for continued or enhanced operation through the horizon year of this study. While current ridership performance was considered in adjusting these route enhancements, it should be noted that without the significant time advantages afforded by the Express Lanes, the initial ridership response is not as indicative of future demand since current services operate in mixed traffic and along congested corridors.

Primary changes from 2022 to 2045 include an increase in service frequency on all but two of the twelve proposed routes. No route phasing is proposed, with all recommended services being initiated on opening day of the Express Lanes. Two routes feature interim stops:

- Stringfellow-Pentagon: Stops at Fairfax Center and Vienna Metrorail park-and-ride
- Fairfax Center-East Falls Church: Stopping within the City of Fairfax

Two routes originating at the Stringfellow Road park-and-ride lot with service to Tysons Corner and the Pentagon showed extensive demand, with the service levels established accordingly. Total combined ridership from these routes was 1.5 million annually, or 37 percent of the total combined ridership of all routes. Appendix B discusses these and other outliers, as well as steps taken to ensure sufficient capacity at origin and destination locations with anticipated high bus volumes.

Additionally, Metrorail station bus facilities at which additional transit service is proposed as part of the project face capacity concerns as well. Capacity at these stations, as well as in Washington, D.C., has been a concern raised by participating stakeholders. As part of the ongoing monitoring of service roll-out, continued coordination with WMATA and local jurisdictions will be required to ensure successful bus operations and to confirm routing.

Final Ridership Calculations

The final ridership estimates for 2022 were calculated using a multi-step process:

- The transit person trip totals from the OD zone pairs associated with each route were converted into daily ridership figures for each route. Metrorail ridership was subtracted, given that the transit person trip totals included Metrorail.
- These daily ridership totals were reviewed to see if the resulting transit mode splits for the OD zone pairs were reasonable. If they were too high or too low, adjustments were made to ensure a reasonable transit mode split.
- For routes that were based on existing routes, existing ridership was used.

For future years, 2022 ridership was adjusted according to the percent change in transit person trips in the model between 2022 and the future year.

Table 6.4 presents a comparative analysis between the updated recommendations and the 2016 study. All 20 of the 2016 study recommendations and all 12 of the update recommendations are presented. A total of five routes were deemed to align. Other routes, while along a route sharing portions of the same trip (i.e. Stringfellow-Vienna) had different operating parameters than did not support alignment across the two studies. This table illustrates the differences in ridership as a result of service frequency adjustments.

Table 6.3: Bus Recommendations Details and Phasing

Assumed Operator	Route (Origin/Destination)	New Route? (Y/N)	Commuter Choice Funding? (Year)	2022 Recommendations					2030 Recommendations					2045 Recommendations				
				Average Headway	Peak Trips	Peak Hours (# of hours)	Vehicles Needed (Total)	Annual Ridership	Headway	Peak Trips	Peak Hours (# of hours)	Vehicles Needed (Total)	Annual Ridership	Headway	Peak Trips	Peak Hours (# of hours)	Vehicles Needed (Total)	Annual Ridership
OmniRide	Haymarket-Ballston/Rosslyn	No (H-100)	FY2020	40	8	4.0	4	60,900	40	8	4.0	4	75,000	40	10	5.3	4	99,000
OmniRide	Gainesville-Pentagon	No (G-200)	FY2017 FY2020	30	12	5.0	4	90,000	15	16	3.5	8	141,000	15	16	3.5	8	171,000
OmniRide	Gainesville-L'Enfant Plaza (Haymarket-Downtown DC in 2030)	No (Gainesville Express)	FY2020	35	14	8.4	4	104,600	15	38	8.7	11	330,000	20	26	8.0	8	259,000
OmniRide	Gainesville-Tysons (Haymarket in 2045)	No (LH-61)	FY2018	40	8	4.0	2	51,200	20	18	5.3	4	163,000	20	24	7.3	6	237,000
OmniRide	Manassas-L'Enfant Plaza (Downtown DC in 2030)	No (Manassas Express)		30	17	8.7	4	125,900	15	42	10.0	8	373,000	15	34	8.0	8	350,000
OmniRide	Manassas-Tysons	No (MT-60)		20	16	4.7	4	112,400	13	46	9.2	8	394,000	13	36	7.1	8	367,000
OmniRide	Manassas-Reston	Yes		20	20	6.0	8	142,300	16	34	8.5	10	290,000	16	30	7.5	10	304,000
Fairfax Connector	Stringfellow-Tysons	Yes		10	48	7.7	6	242,600	6	88	8.6	10	530,000	5	106	8.7	12	741,000
Fairfax Connector	Stringfellow-Pentagon	No (FC 698)	FY2018	10	54	9.0	12	268,500	5	106	8.7	24	632,000	5	116	9.5	24	810,000
Fairfax Connector	Stringfellow-L'Enfant Plaza	Yes	FY2020	16	34	9.1	5	169,000	8	60	7.7	10	353,000	10	52	8.3	8	364,000
Fairfax Connector	Fairfax Center-Downtown DC	No (FC 699)	FY2017 FY2020	20	25	8.2	4	122,500	8	62	8.0	10	372,000	10	56	9.0	8	383,000
Fairfax Connector	Fairfax Center-East Falls Church	Yes		20	16	4.7	4	78,200	16	18	4.3	5	113,000	20	16	4.7	4	109,000
Fairfax Connector	Stringfellow-Navy Yard	Yes												20	26	8.0	4	181,000

Table 6.4: Bus Recommendations Contrasts with 2016 Study

Previous Study - Preferred Alternative	Study Update Recommendations	2016 Study - 2025 Transit Service					Study Update - 2022 Transit Service					2016 Study - 2040 Transit Service					Study Update - 2045 Transit Service				
		Peak Frequency (min.)	Daily Weekday Revenue Trips	Buses Required	Annual Ridership	Annual Billable Hours	Peak Frequency (min.)	Daily Weekday Revenue Trips	Buses Required	Annual Ridership	Annual Billable Hours	Peak Frequency (min.)	Daily Weekday Revenue Trips	Buses Required	Annual Ridership	Annual Billable Hours	Peak Frequency (min.)	Daily Weekday Revenue Trips	Buses Required	Annual Ridership	Annual Billable Hours
N/A	Haymarket-Ballston/Rosslyn						40	8	4	6	2,710						40	10	4	12	3,380
N/A	Gainesville-Pentagon						30	12	4	2	3,050						15	16	8	2	4,070
Gainesville-DC & Haymarket-DC (2 routes)	Gainesville-L'Enfant Plaza (Haymarket-Downtown DC in 2030)	24	40	15	372,240	14,580	35	14	4	8	4,890	23	44	16	512,160	16,000	20	26	8	8	8,820
Haymarket-Tysons & Gainseville-Tysons (2 routes)	Gainesville-Tysons (Haymarket in 2045)	20	24	6	242,880	5,240	40	8	2	12	2,040	23	44	10	425,040	8,630	20	24	6	9	6,110
Manassas-DC via Pentagon	Manassas-L'Enfant Plaza (Downtown DC in 2030)	20	24	10	198,000	9,930	30	17	4	7	4,420	15	32	14	298,320	13,240	15	34	8	3	8,670
Manassas-Tysons	Manassas-Tysons	30	16	3	145,200	2,950	20	16	4	3	3,400	25	20	4	240,240	3,690	13	36	8	5	7,650
Manassas-Reston	Manassas-Reston						20	20	8	10	6,790						16	30	10	11	10,180
N/A	Stringfellow-Tysons						10	48	6	4	6,120						5	106	12	4	13,510
N/A	Stringfellow-Pentagon						10	54	12	1	14,910						5	116	24	1	32,010
N/A	Stringfellow-L'Enfant Plaza						16	34	5	5	5,780						10	52	8	6	8,840
Fairfax Center-Downtown DC	Fairfax Center-Downtown DC	35	14	3	137,280	3,650	20	25	4	9	4,190	35	14	3	182,160	3,650	10	56	8	7	9,520
N/A	Fairfax Center-East Falls Church						20	16	4	11	2,720						20	16	4	13	2,720
N/A	Stringfellow-Navy Yard																20	26	8	4	4,500
Gainesville-Westfields	N/A	45	12	2	129,360	1,790						25	20	3	240,240	2,980					
Gainsville-Chantilly(US 50)	N/A											45	12	2	153,120	1,440					
Gainesville-Reston	N/A	25	20	4	179,520	3,390						25	20	4	242,880	3,390					
Gainesville-Herndon	N/A	45	12	3	129,360	2,390						25	20	4	216,480	3,980					
Gainesville-Chantilly/Herndon	N/A											45	12	2	163,680	1,440					
Gainesville-Merrifield	N/A	35	14	4	113,520	3,110						35	14	4	153,120	3,110					
Manassas-Merrifield	N/A	60	8	2	71,280	1,510						60	8	2	97,680	1,510					
Centerville-Tysons	N/A											45	12	2	126,720	2,230					
Centerville-Downtown DC	N/A	25	20	5	179,520	5,510						25	20	5	158,400	5,510					
Westfields-Vienna	N/A	60	8	2	84,480	1,740						60	8	2	97,680	1,740					
Stringfellow-Vienna	N/A											8	64	2	34,320	5,490					
Stringfellow-Mark Center	N/A											60	8	3	71,280	2,920					
TOTALS			212	59	1,982,640	55,790		272	61	78	61,020		372	82	3,413,520	80,950		548	116	85	119,980
		71 Buses + Spares					74 Buses + Spares					99 Buses + Spares					140 Buses + Spares				

Figure 6.5: Bus Recommendations – Opening Year Route Schematic

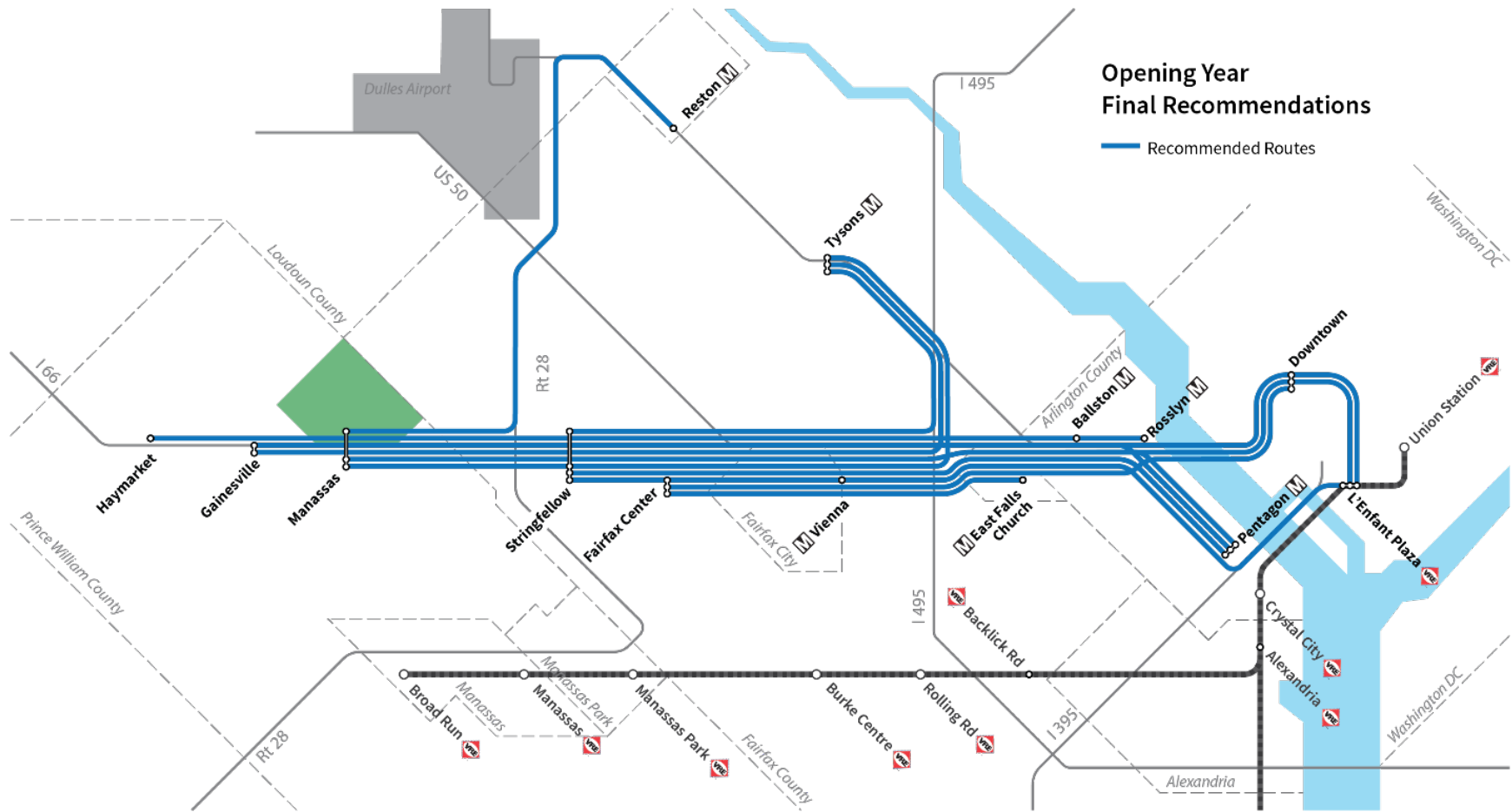


Figure 6.6: Bus Recommendations – 2030 Route Schematic

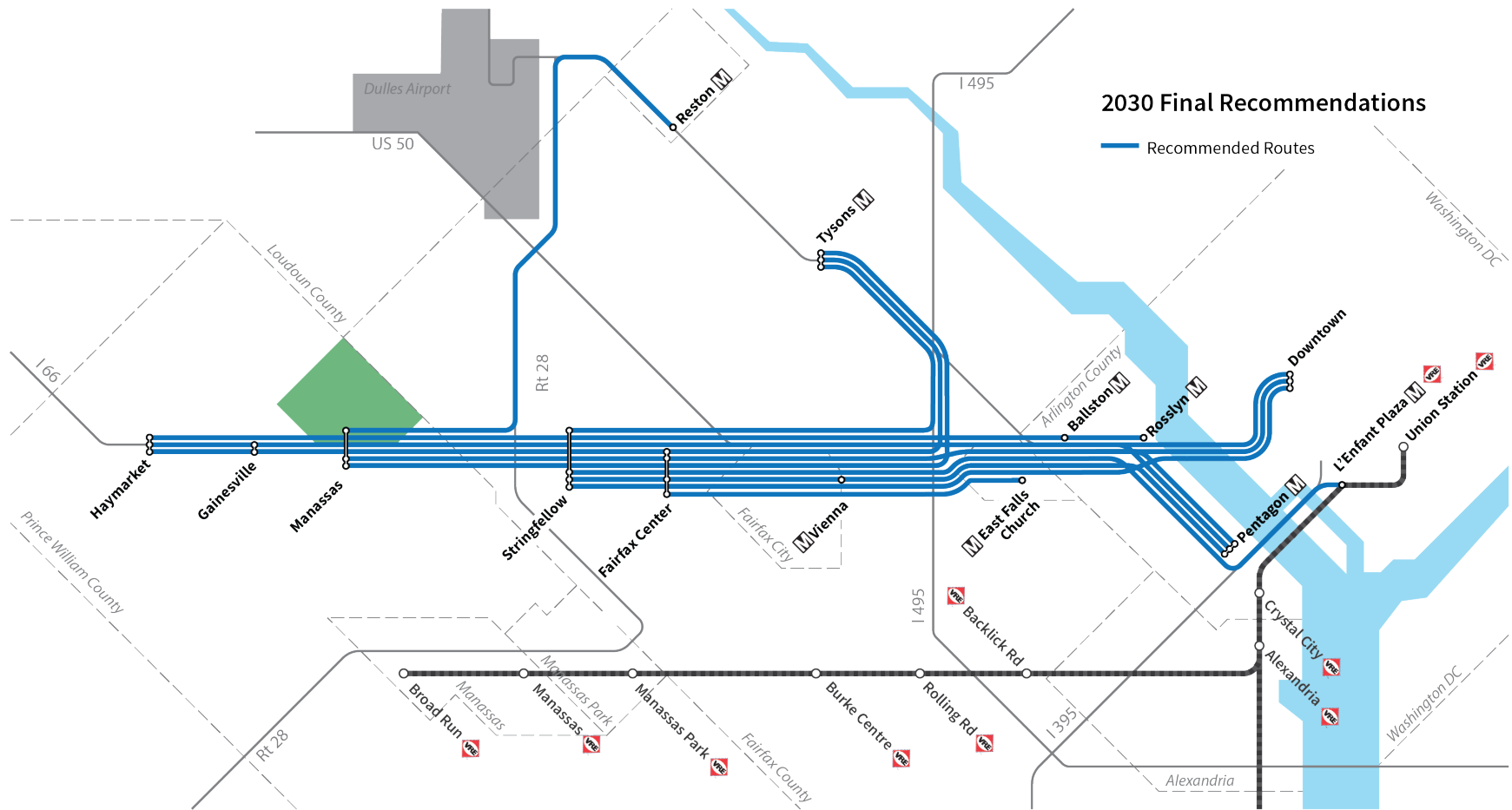
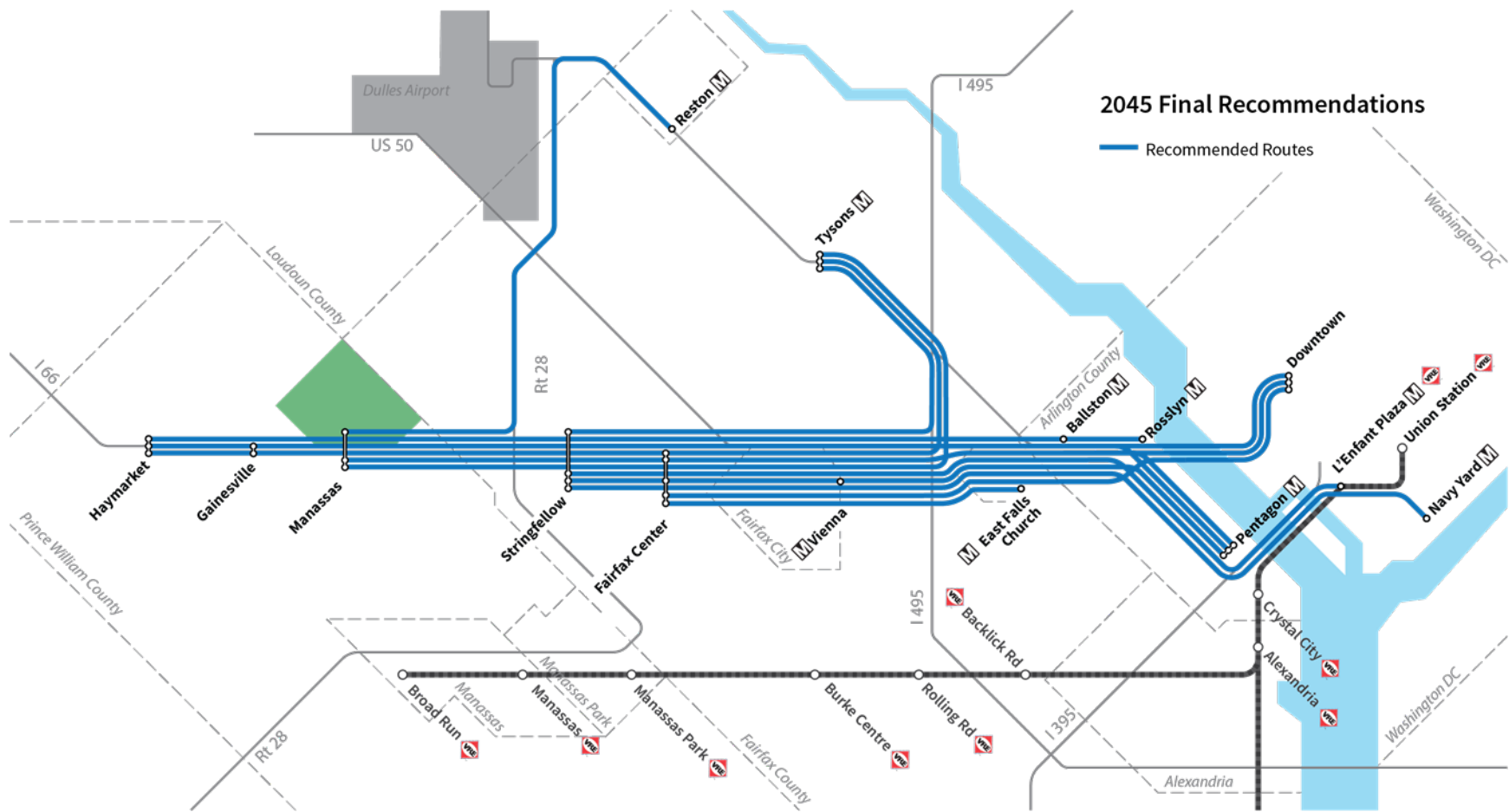


Figure 6.7: Bus Recommendations – 2045 Route Schematic

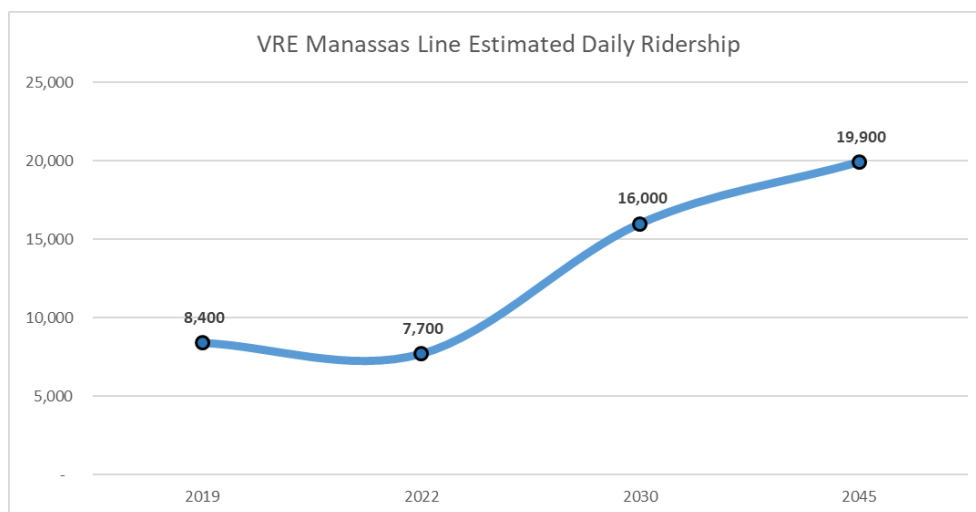


6.2.2 VRE Commuter Rail

Increased capacity offered through the I-66 Express Lanes impacts the initial effectiveness of transit recommendations. This was most apparent in analysis of VRE ridership performance. Analysis of the No-Build conditions indicated that commuter bus and VRE commuter rail markets had little overlap. Increases in commuter bus service had negligible effect on VRE ridership and conversely increases in VRE service frequency had negligible impact on the performance of commuter bus route.

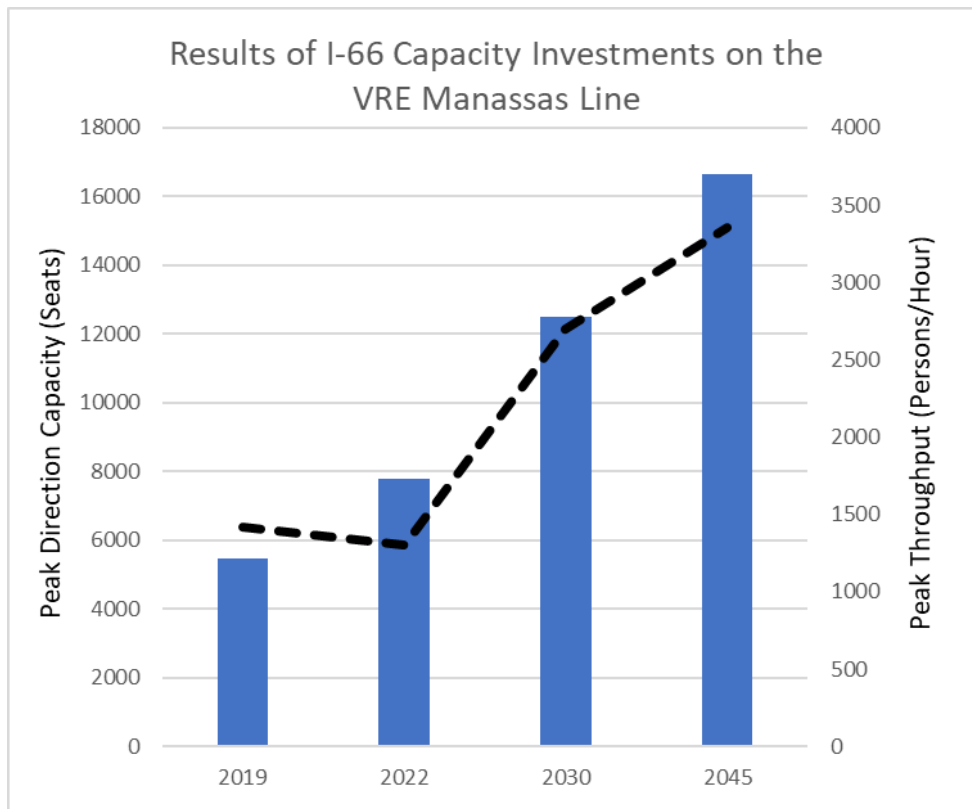
The most significant impact observed, however, was the effects of new mobility and capacity offered on I-66 through the Express Lanes and the subsequent impact on commuter rail ridership. Even with the proposed recommendations in 2022, VRE ridership remains relatively constant as depicted in Figure 6.8. Over time, VRE frequency increases attract significant market growth. Daily ridership is expected to climb from almost 8,000 to nearly 20,000 in the time period from 2022 to 2045.

Figure 6.8: VRE Commuter Rail 2019-2045 Estimated Daily Ridership



Another rationale for the VRE ridership response is the fact that currently several VRE Manassas Line trains exceed capacity. As new service is added, this capacity is absorbed, but doesn't initially grow the market further. The relationship between offered capacity and the demand response are illustrated in Figure 6.9. This analysis also illustrates that VRE productivity increases, which demonstrates growing efficiency in the investment of expanded service. The ridership projected can be accommodated by the offered capacity of the FY2045 VRE service plan assumed for this project, and train utilization increases with room for further growth.

Figure 6.9: VRE Commuter Rail 2019-2045 Performance Measures



6.2.3 Transportation Demand Management

TDM strategies developed specifically for the I-66 corridor will supplement ongoing TDM efforts in the region, including those in Fairfax County and Prince William County. Strategies include the promotion of new I-66 transit service and park-and-ride infrastructure and incentives targeted toward employers in the corridor and new transit/vanpool/carpool users. I-66-focused strategies will build on the strong TDM programs already in place in the region.

All the strategies recommended are designed to be flexible and adaptable to changes that take place in technologies and user needs in the coming years. They represent the types of strategies envisioned for the corridor; however, by necessity, finer details of the scope and design of each strategy will be developed nearer to implementation. Key elements of TDM envisioned to support these recommendations is presented in Table 6.5.

The most important aspect of the TDM initiatives will be for first mile/last mile support strategies to bridge the gap between where I-66 transit service and TDM options begin or end and the user’s origin or final destination points. Developing mobility hubs at park-and-ride origins, including enhanced bicycle connectivity and circulation networks will greatly enhance these locations in support of the high frequency transit service envisioned.

Table 6.5: I-66 Project TDM Strategies

Transit Mode	2022 Service	2030 Service
Marketing and Advertising Campaign	Marketing, Branding, Materials, and Ad Development	<ul style="list-style-type: none"> • Unified, recognizable brand for I-66 transit and TDM services. - Create promotional materials each time a new transit service is implemented. - Marketing consultant will be paid for development of marketing and advertising media at an industry rate of commissioned advertising revenue, using the I-95 Target Marketing campaign as a successful precedent. - Includes print, online, radio and social media. • Travel choice and incentives marketing. • HOV-2 to HOV-3 conversion marketing. - Extension of TMP strategy. - Utilize the same media as general marketing but with a specific focus on HOV-2 to HOV-3 conversion.
Employer Outreach	Employer Outreach	<ul style="list-style-type: none"> • Employer outreach opportunities that result in additional benefit above what existing TDM agencies currently provide in the I-66 corridor.
Commuter Incentives	Vanpool Incentive	<ul style="list-style-type: none"> • Vanpool rider fare buy-down: half fare for each new rider for a period of 3 months. • SmarTrip card with loaded value provided to each new member of a vanpool. • Extension of TMP strategy.
	Carpool Incentive	<ul style="list-style-type: none"> • Temporary cash incentive for carpoolers to encourage new carpool formation on the I-66 corridor. A method will be developed to allow those who slug to take advantage of this incentive.
First Mile / Last Mile Support	Partner with Private Providers	<ul style="list-style-type: none"> • Incorporate additional private providers and services (e.g., ride hailing, real-time ridesharing) into the Guaranteed Ride Home program, I-66 marketing materials, and trip planners. • Request that private providers include I-66 transit and TDM information on their platforms and materials.
	Microtransit	<ul style="list-style-type: none"> • 2025 onward: Provide funding flexibility for incentives for private microtransit solutions (emerging modern jitney services).
	Carsharing	<ul style="list-style-type: none"> • Vendor Incentives: Modeled after the 2005–2006 Arlington County pilot program. • User Incentives: Modeled after the City of Alexandria program.
	Flexible First Mile/Last Mile User Incentive	<ul style="list-style-type: none"> • Cash incentive that mirrors the Carpool Incentive but can be used for a variety of transportation solutions that meet first mile/last mile needs.

Source: I-66 Corridor Improvements Project– Transit/TDM Technical Report (2016), Transit/TDM Study Update (2020)

As trip planning is further integrated across providers seamlessly, for a total trip experience, existing private providers and services in the I-66 corridor—such as ride hailing and real-time ridesharing services—should incorporate I-66 transit and TDM information on their platforms and materials. In exchange, private providers can be incorporated into the Guaranteed Ride Home program and information on their services added to the I-66 marketing materials and trip planners.

6.3 MODE SPLIT AND PASSENGER THROUGHPUT ANALYSIS

In review of the combined impact of all recommendations, noticeable shifts in I-66 commuting patterns were observed. Overall, the recommendations are forecast to accommodate growing travel demand throughout the I-66 corridor. This helps to preserve the investment in I-66 capacity well into the future. Additionally, the SOV levels of travel Outside the Beltway, as forecast at I-66 and Nutley Street, by 2045 begin to resemble the current levels Inside the Beltway at Glebe Road, where managed lanes and high occupancy vehicle restrictions have built a favorable market for multimodal alternatives over the years. The collective investments in Transit and TDM demonstrate an ability to accommodate growing travel demand throughout the I-66 corridor while contributing significantly to future non-single occupant vehicle (SOV) mode share.

Other highlights of these findings include:

- Corridor person throughput generally increases at 1.4 percent to 2.2 percent per year.
- The mode split for commuter bus increases from 4.8 percent in 2019 to 7.4 percent by 2045.
- The mode split for VRE increases from 6 percent in 2019 to over 11 percent in 2045.
- Mode shift from SOVs to enhanced express bus service is greatest at the Nutley Street cutline for I-66 (most of the added express bus service traverses this location).
- SOV travel inside the beltway (as forecast for Glebe Road) remains at current levels until 2030 and then decreases as a share of person throughput.
- Transit share decreases moving away from the urban core.
- Generally, Metrorail is the predominant transit mode except for the VA 28 cutline where VRE is predominant.
- Metrorail mode share increases markedly; likely due to the opening of six (6) Silver Line Metrorail Stations.
- Bus mode share holds steady from FY2030-FY2045. The bulk of growth in the transit mode share during this period is attributed to the VRE growth.

Specific mode shifts from 2019 to 2045 are presented in Figure 6.10 through Figure 6.13. The overall investment in these recommendations reduced SOV mode share at Nutley Street while the non-SOV person throughput location grows by 100 percent during this time period. The effect on SOV travel at all three locations, for 2030 and 2045 as contrasted against baseline conditions is presented in Figure 6.14.

Figure 6.10: 2019 I-66 Corridor Cutlines and Mode Split Results

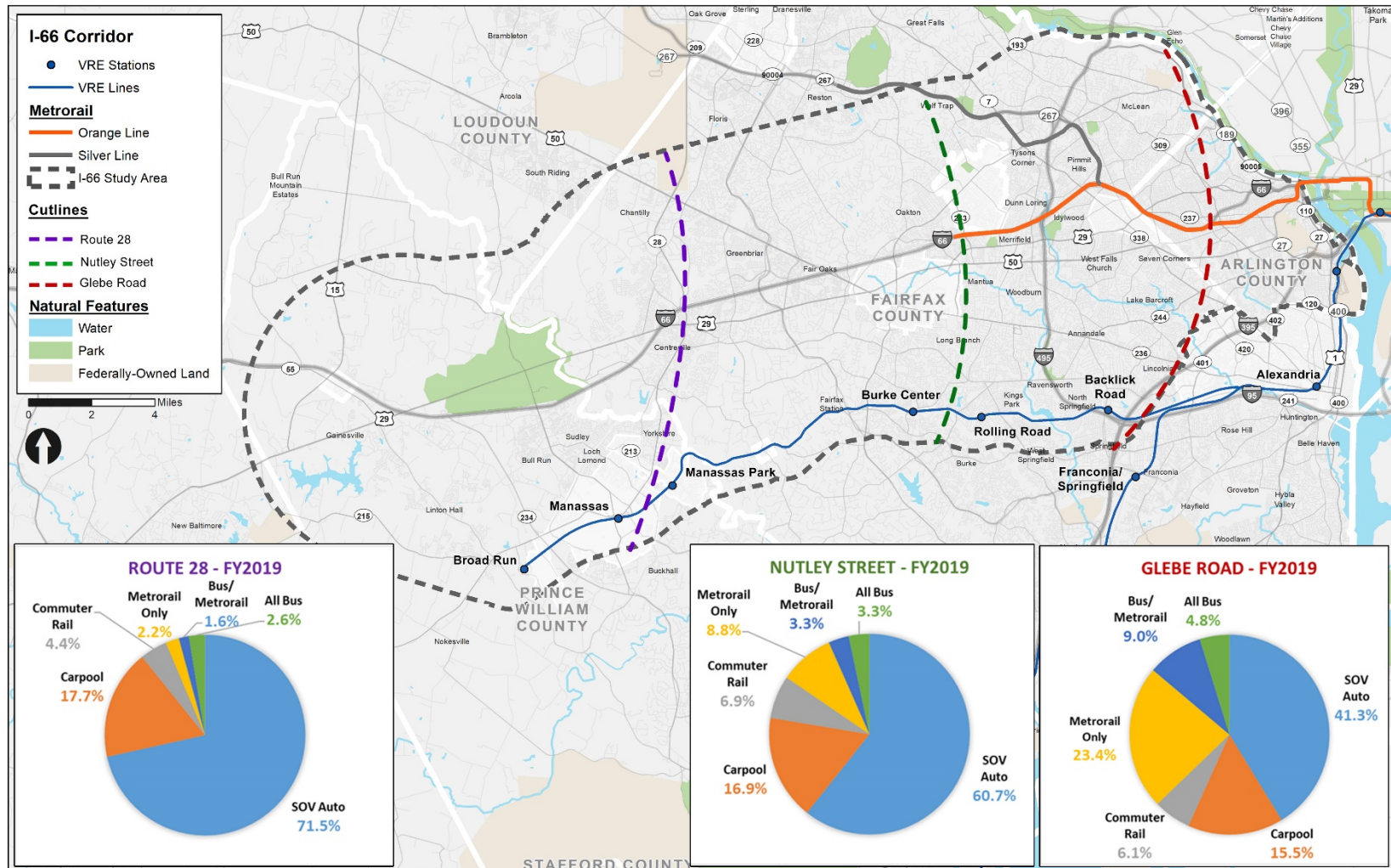


Figure 6.11: 2022 I-66 Corridor Cutlines and Mode Split Results

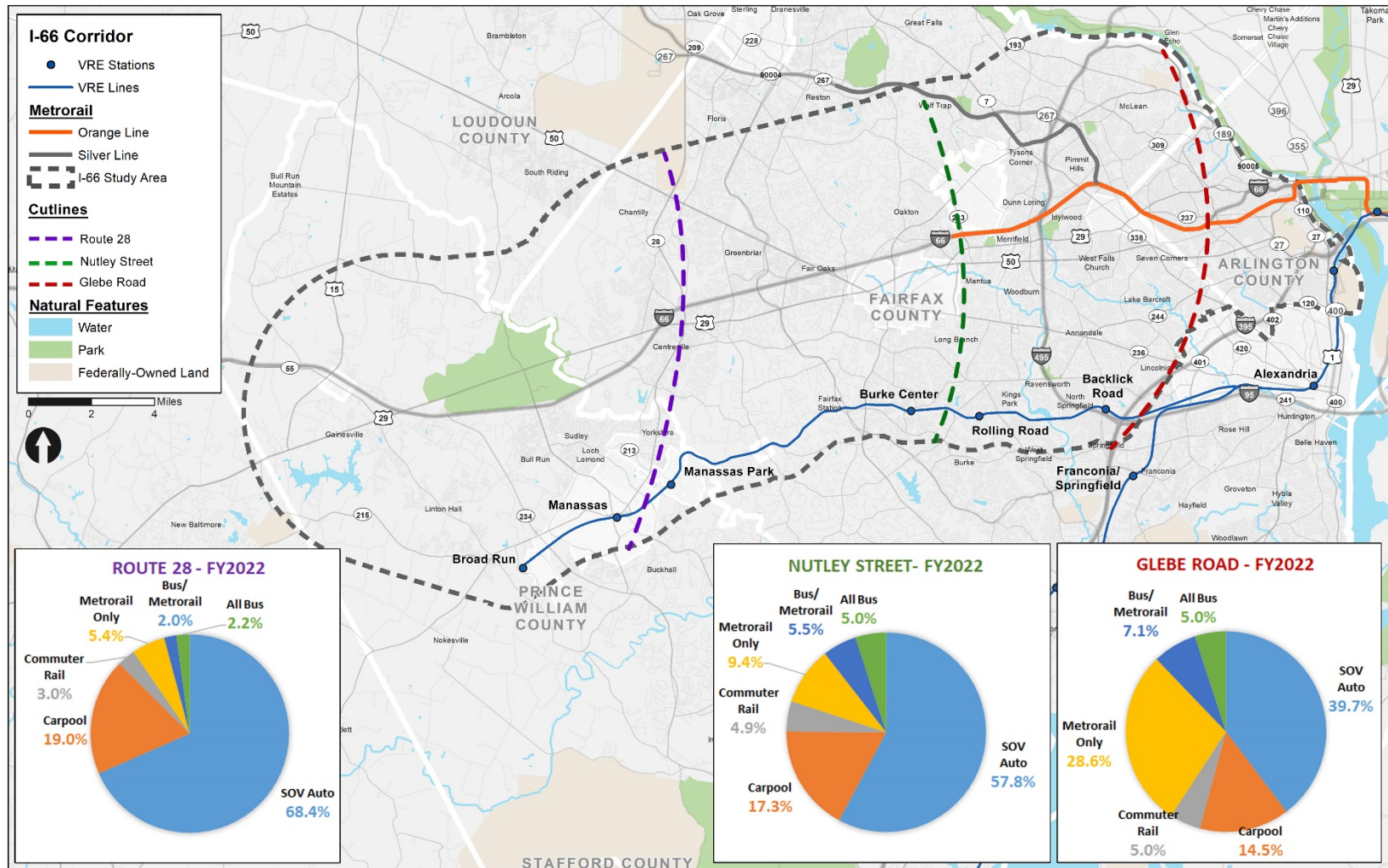


Figure 6.12: 2030 I-66 Corridor Cutlines and Mode Split Results

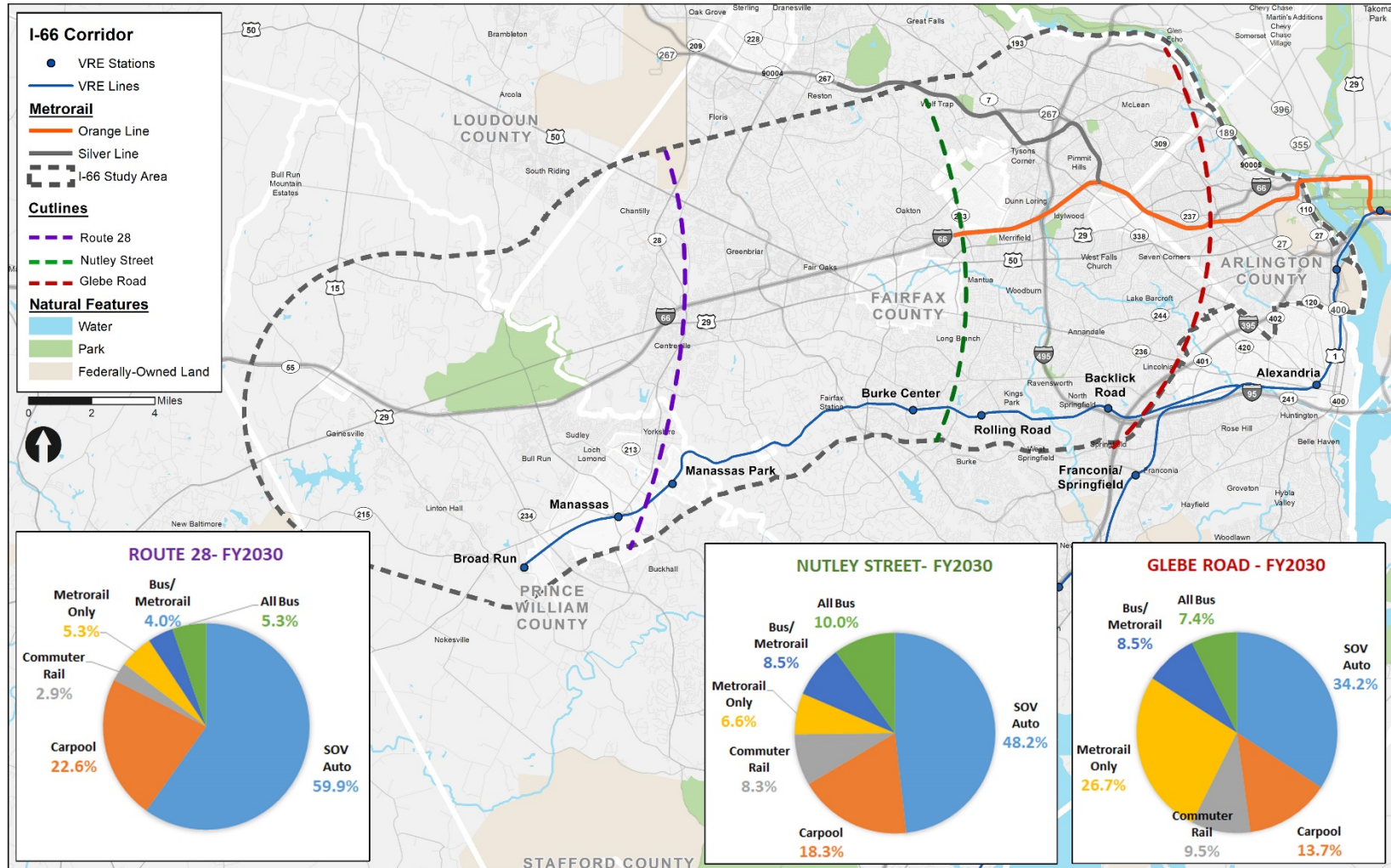


Figure 6.13: 2045 I-66 Corridor Cutlines and Mode Split Results

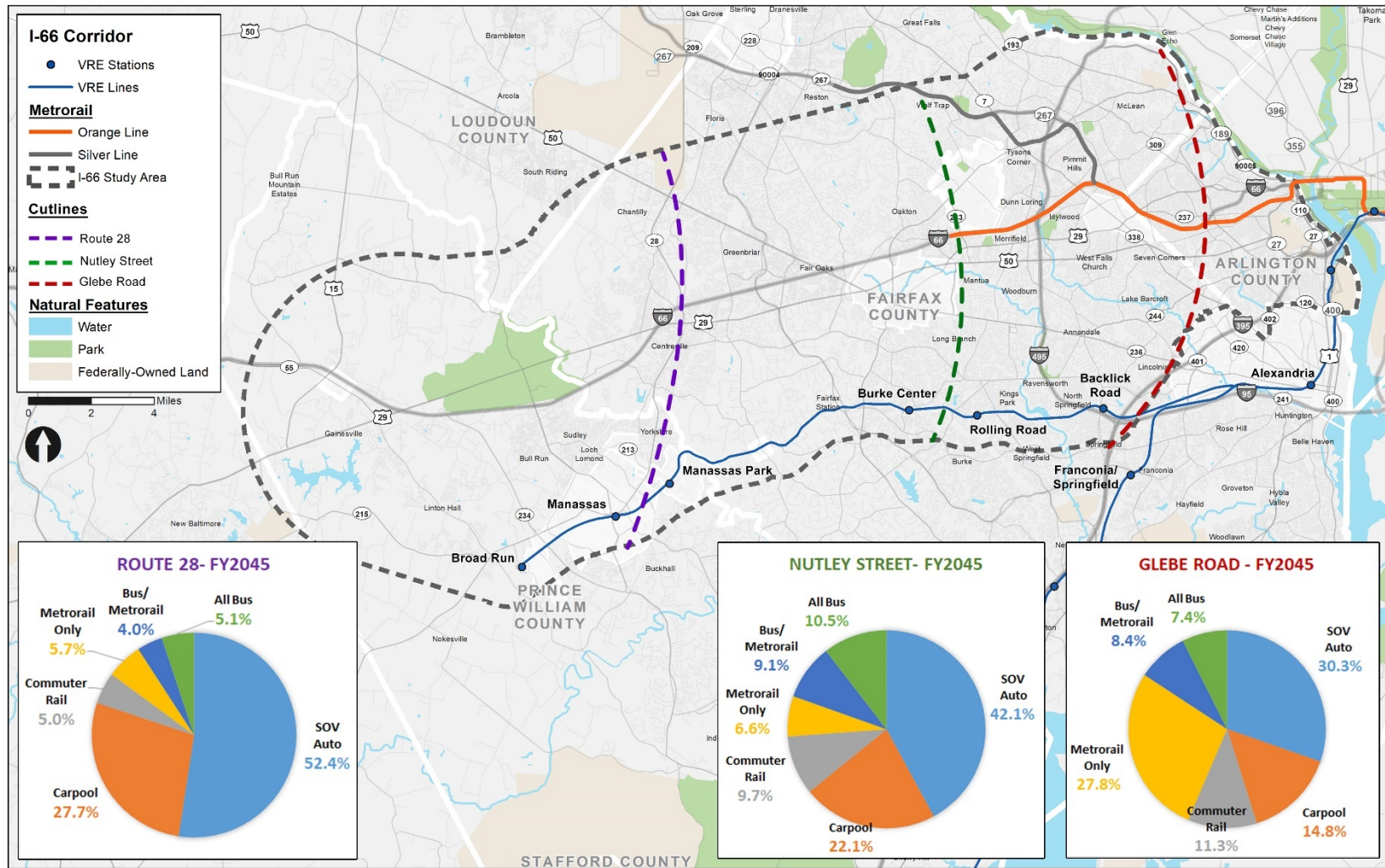
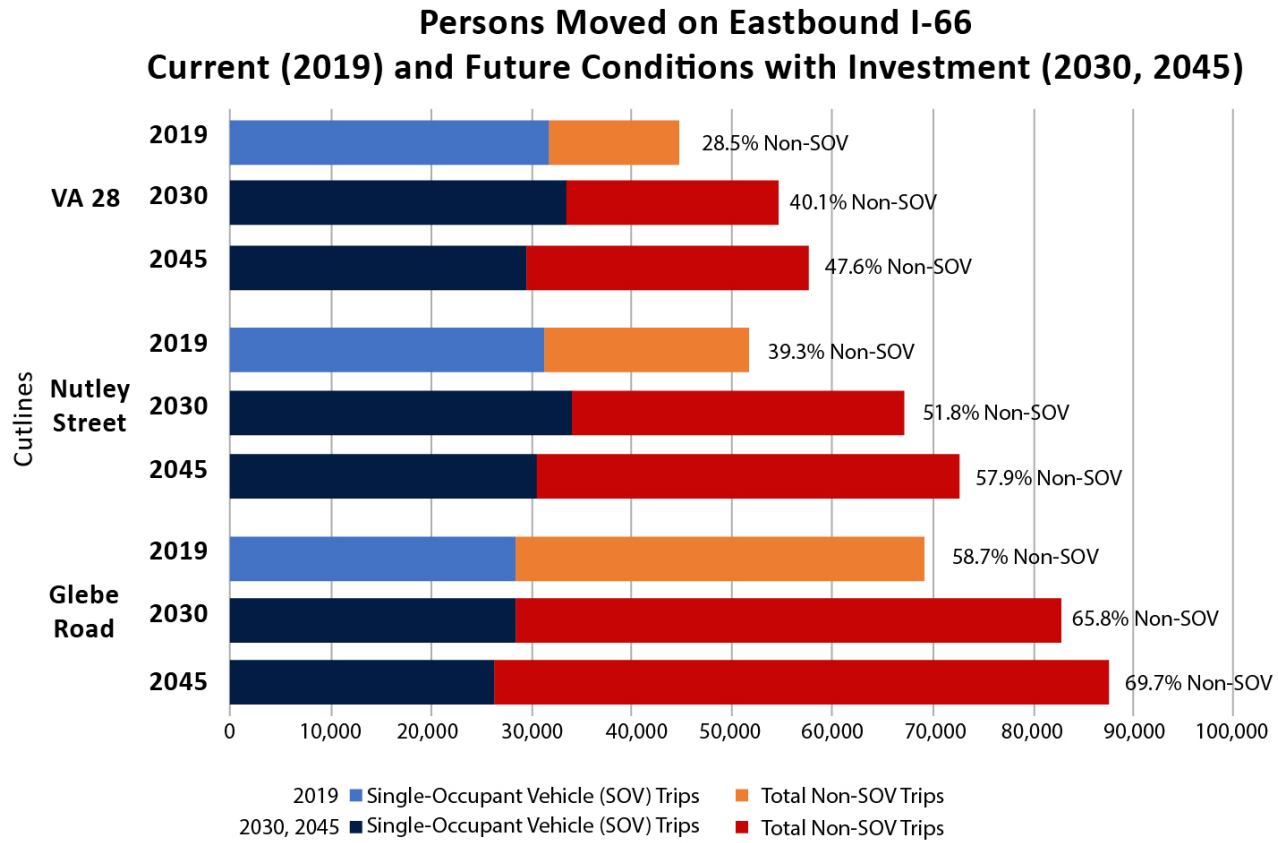


Figure 6.14: I-66 Overall SOV and Non-SOV Shifts 2019, 2030 and 2045



6.4 BUS ROUTE PRIORITIZATION

While all routes are shown as being implemented in the opening year, phasing considerations are provided based on route priority. The intent was to rank individual routes using high-level criteria and those with the highest ranking would be selected first for implementation. In the case of funding limitations, there would be a cut off at some point and any remaining and lower ranking routes would simply not be implemented. This mirrors the project selection process for the I-66 Commuter Choice Program. Lower priority routes do not mean that there is not a demonstrated need, but simply that in comparison to other investments they offer lower returns. These routes, especially those with low ranking for distance traveled within the corridor, could also be proposed for other funding programs. The ranking factors included:

- Route distance on I-66: Round-trip portion of the route within the I-66 Express Lanes
- Peak passenger throughput: Calculated on a route-basis at the maximum load point
- Value ratio: Determined by contrasting service costs (operating and annualized capital) with anticipated ridership productivity.

The results of the route prioritization are presented in Figure 6.15 – Figure 6.17. For 2030 and 2045, and changes in rank from the previous year for each route is highlighted.

In all years, the two routes with Pentagon destinations are the highest ranked. Tysons service ranks high initially, and then drops in comparison to other services in 2030 and rebound in 2045. Manassas to Downtown D.C. is a consistently well ranked longer-distance route in all years. Haymarket to Ballston/Rosslyn was initially ranked well but showed decline in subsequent years – possibly reflecting the limited ability for this route to grow in ridership as other routes expanded further. Both Manassas-Reston and Fairfax-Center-East Falls Church routes were consistently ranked lowest in priority order.

Figure 6.15: 2022 Bus Recommendations Route Prioritization Results

I-66 FY2022 Bus Route Service Recommendations								
Assumed Operator	Route (Origin/Destination)	Roundtrip Route Miles on I66	Average Headway	Peak Trips	Peak Hours (# of hours)	Annual Ridership Estimate	Peak Hour Person Throughput	Composite Rank
Fairfax Connector	Stringfellow-Pentagon	44.44	10	54	9.0	268,500	150	1
OmniRide	Gainesville-Pentagon	61.24	30	12	5.0	90,000	90	2
OmniRide	Manassas-Tysons	31.88	20	16	4.7	112,400	120	3
Fairfax Connector	Stringfellow-Tysons	15.18	10	48	7.7	242,600	160	4
Fairfax Connector	Stringfellow-L'Enfant Plaza	39.3	16	34	9.1	169,000	90	5
OmniRide	Haymarket-Ballston/Rosslyn	58.35	40	8	4.0	60,900	80	6
OmniRide	Manassas-L'Enfant Plaza (Downtown DC in 2030)	57.19	30	17	8.7	125,900	70	7
OmniRide	Gainesville-L'Enfant Plaza (Haymarket-Downtown DC in 2030)	61.65	35	14	8.4	104,600	60	8
Fairfax Connector	Fairfax Center-Downtown DC	35.97	20	25	8.2	122,500	70	9
OmniRide	Manassas-Reston	14.39	20	20	6.0	142,300	120	10
Fairfax Connector	Fairfax Center-East Falls Church	23.35	20	16	4.7	78,200	80	11
OmniRide	Gainesville-Tysons (Haymarket in 2045)	36.39	40	8	4.0	51,200	60	12

Composite Ranking Components: Distance on I-66
 Peak Throughput
 Value (Ridership vs. Cost)

Figure 6.16: 2030 Bus Recommendations Route Prioritization Results

I-66 FY2030 Bus Route Service Recommendations									
Assumed Operator	Route (Origin/Destination)	Roundtrip Route Miles on I66	Average Headway	Peak Trips	Peak Hours (# of hours)	Annual Ridership Estimate	Peak Hour Person Throughput	Composite Rank	Change in Rank (from 2022)
Fairfax Connector	Stringfellow-Pentagon	44.44	5	106	8.7	632,000	380	1	0
OmniRide	Gainesville-Pentagon	61.24	15	16	3.5	141,000	210	2	0
OmniRide	Gainesville-L'Enfant Plaza (Haymarket-Downtown DC in 2030)	61.65	15	38	8.7	330,000	200	3	+5
Fairfax Connector	Stringfellow-L'Enfant Plaza	39.3	8	60	7.7	353,000	240	4	+1
OmniRide	Manassas-L'Enfant Plaza (Downtown DC in 2030)	57.19	15	42	10.0	373,000	190	5	+2
Fairfax Connector	Fairfax Center-Downtown DC	35.97	8	62	8.0	372,000	240	6	+3
OmniRide	Manassas-Tysons	31.88	13	46	9.2	394,000	220	7	-4
Fairfax Connector	Stringfellow-Tysons	15.18	6	88	8.6	530,000	320	8	-4
OmniRide	Gainesville-Tysons (Haymarket in 2045)	36.39	20	18	5.3	163,000	160	9	+3
OmniRide	Haymarket-Ballston/Rosslyn	58.35	40	8	4.0	75,000	100	10	-4
Fairfax Connector	Fairfax Center-East Falls Church	23.35	16	18	4.3	113,000	140	11	0
OmniRide	Manassas-Reston	14.39	16	34	8.5	290,000	180	12	-2

Composite Ranking Components: Distance on I-66
 Peak Throughput
 Value (Ridership vs. Cost)

Figure 6.17: 2045 Bus Recommendations Route Prioritization Results

I-66 FY2045 Bus Route Service Recommendations									
Assumed Operator	Route (Origin/Destination)	Roundtrip Route Miles on I66	Average Headway	Peak Trips	Peak Hours (# of hours)	Annual Ridership Estimate	Peak Hour Person Throughput	Composite Rank	Change in Rank (from 2030)
Fairfax Connector	Stringfellow-Pentagon	44.44	5	116	9.5	810,000	450	1	0
OmniRide	Gainesville-Pentagon	61.24	15	16	3.5	171,000	250	2	0
OmniRide	Manassas-L'Enfant Plaza (Downtown DC in 2030)	57.19	15	34	8.0	350,000	230	3	+2
Fairfax Connector	Stringfellow-Tysons	15.18	5	106	8.7	741,000	450	4	+4
OmniRide	Manassas-Tysons	31.88	13	36	7.1	367,000	270	5	+2
Fairfax Connector	Stringfellow-L'Enfant Plaza	39.3	10	52	8.3	364,000	230	6	-2
Fairfax Connector	Fairfax Center-Downtown DC	35.97	10	56	9.0	383,000	220	7	-1
OmniRide	Gainesville-L'Enfant Plaza (Haymarket-Downtown DC in 2030)	61.65	20	26	8.0	259,000	170	8	-5
OmniRide	Gainesville-Tysons (Haymarket in 2045)	36.39	20	24	7.3	237,000	170	9	0
Fairfax Connector	Stringfellow-Navy Yard	39.8	20	26	8.0	181,000	120	10	N/A
OmniRide	Manassas-Reston	14.39	16	30	7.5	304,000	210	11	+1
OmniRide	Haymarket-Ballston/Rosslyn	58.35	40	10	5.3	99,000	90	12	-2
Fairfax Connector	Fairfax Center-East Falls Church	23.35	20	16	4.7	109,000	120	13	-2

Composite Ranking Components: Distance on I-66
 Peak Throughput
 Value (Ridership vs. Cost)