I-66 Transit/TDM Study
Final Report

December 31, 2009

Developed by
I-66 Transit/TDM Technical Advisory Committee

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ES.0 Executive Summary

The purpose of the I-66 Transit/Transportation Demand Management[1] (TDM) Study was to identify more transportation choices through transit service and TDM program enhancements to increase mobility in the corridor. The study set out to develop a recommended plan for short- and medium-term transit and TDM service improvements in the I-66 corridor between Haymarket and Washington, D.C. and to be positioned to provide input into the restart of the Virginia Department of Transportation (VDOT) I-66 Multimodal Transportation Environmental Study. The study was mindful to offer approaches that could lay the groundwork for rail extension in the long term.

The study was conducted by the I-66 Transit/TDM Technical Advisory Committee (TAC) consisting of members from state, regional, and local jurisdictions, transit agencies, and transportation demand management providers in cooperation with the Virginia Department of Rail and Public Transportation (DRPT). This multimodal transportation planning effort utilized the results of a market research survey, travel demand forecasting, and park-and-ride demand forecasting, as well as the expertise of the TAC to develop and consider alternative recommendations.

This Executive Summary provides a summary of the key messages emerging from the TAC's work as well as an overview of the study, including the major activities, findings, and recommendations. More detailed information is available on all of the topic areas within the body of the report.

ES.1 Key Messages

Key messages from the I-66 Transit/TDM Study include:

- Today there is robust transit service in the I-66 corridor, including many local and express bus routes with good service frequencies, in addition to trains traveling downtown every six minutes during the peak period on the Metrorail Orange Line. Additionally, complementary transit services operate nearby on U.S. 29, U.S. 50, and on the VRE Manassas Line. However, high quality service is limited during off-peak periods and in the reverse peak direction.
- The projections for the location of households and employment in 2030 for the I-66 corridor indicate that some future land uses in the corridor will be less conducive to being served by transit. Unless corridor-wide transit-oriented development strategies are implemented, sprawl and congestion will continue to grow with an expected 22 percent increase in commuter trips originating in locations within the corridor and an expected 40 percent increase in commuter trips destined to the corridor (due to employment growth exceeding residential growth). There would still be a large market for transit services and potentially some new markets; however, expected growth areas not easily served by transit should be reviewed for impacts on the transportation system.
- The recommended Priority Bus[2] transit improvements will greatly increase service frequency to important destinations from within the corridor by 2030 and, thus, attract more people to

[1] Transportation Demand Management is the application of strategies and programs to change travel behavior in order to reduce the demand on highways and to improve the performance of the transportation system (e.g., carpooling, vanpooling, park-and-ride facilities, guaranteed ride home programs, and shared-ride benefits and support programs).

[2] Priority Bus service includes BRT or elements of BRT that improve the quality and dependability of transit service, including frequent service, substantial stations, improved reliability, advanced technology and information systems, direct access to stations, modern vehicles, and distinct branding

live in the activity centers and ride transit, potentially reducing sprawl. For example, in Haymarket, interlined service frequency to major work destinations will increase from once every 60 minutes to once every 10 minutes (with new destinations served). At Centreville, interlined service frequency will increase from about one bus every six minutes to one bus every two minutes.

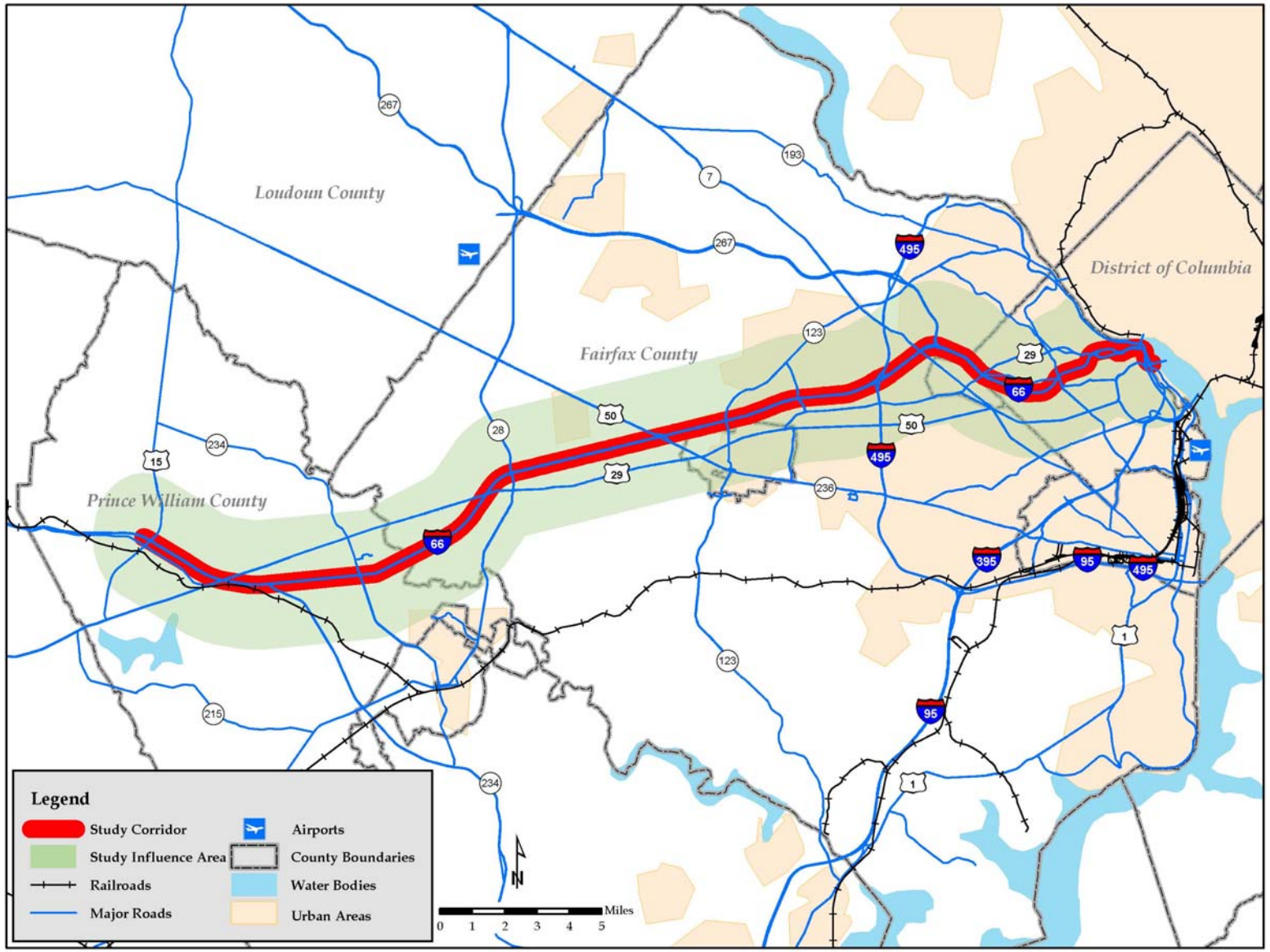
- The recommended Priority Bus transit improvements will also reduce the number of transfers required and create travel time savings to major markets in the I-66 corridor versus existing transit service, attracting more people to transit. For example, a 20 percent time savings is forecast for transit trips via services on U.S. 50 or U.S. 29. A 25 percent time savings is forecast from Haymarket to D.C. and a 10 percent time savings is forecast from Centreville to D.C.
- The full set of recommendations improves transit reliability and attractiveness, resulting in more people moving in the corridor by transit. Similar to the Dulles Corridor, Priority Bus improvements and facilities can be implemented in the short term and lay the groundwork for an extension of rail in the corridor in the long term. The limits of the short-term recommendations confirm that the long-term strategy for the corridor must continue to advance in order to provide the capacity required to meet forecasted demand.
- The recommended TDM programs provide benefits to all travelers in the corridor by reducing vehicle trips, providing a range of travel options, and raising awareness of transit services in the corridor; the corridor and its options are able to meet the needs of more people. As an added benefit, TDM programs have a generally lower cost than infrastructure improvements and can be implemented in the corridor quickly.
- The short-term recommendations require capital investment of $126.8 million and an annual operating cost of $11.8 million above the cost of existing service. The medium-term recommendations require additional investment beyond the short-term recommendations, including $163.7 million in additional capital investment (including replacement vehicles for improvements implemented in the short term). The annual operating cost for the medium-term recommendations is $14.7 million; $2.9 million more than the short-term recommendations. All of these figures are expressed in constant 2010 dollars and are net of projected farebox revenues.
- The study was conducted using the latest regionally adopted analysis tools and associated assumptions. These do not yet officially reflect significant ongoing activities, such as potential changes in land use for Tysons Corner and changes to HOV operations that could further increase the benefits of the strategies recommended in this study.

ES.2 Study Overview

The I-66 Transit/TDM Study represents a part of efforts by the Commonwealth of Virginia to review various multimodal solutions to manage existing congestion and expected growth in the I-66 corridor. This study is focused on identifying short- and medium-term transit and TDM improvements (infrastructure, services, and programs) for the corridor.

The study area comprises an area of approximately two miles on either side of the corridor defined by I-66 from U.S. 15 in Haymarket, Virginia, east to the District of Columbia. The study area included consideration of U.S. 29 and U.S. 50. Figure ES-1 shows the boundaries of the study area. Major destinations in the study area include the Washington D.C. core, Pentagon area, Rosslyn-Ballston corridor, Tysons Corner, Fair Lakes, Centreville, Gainesville, and Haymarket.

Figure ES-1. I-66 Transit/TDM Study Area



The project was executed as a series of closely associated tasks covering a spectrum of activities from data collection through analysis to development of recommendations. A public information program was an important activity throughout the project. The TAC, made up of agency and operator stakeholders, carefully guided the work. Ultimately, a set of multimodal recommendations were developed that encompassed transit service, transit stations, pedestrian and bicycle facilities, TDM strategies, and park-and-ride lots. Cost and revenue projections for these recommended elements were developed in the final stage of the study.

ES.3 Existing Conditions

The I-66 corridor features a wide range of transit services, including commuter rail operated by VRE, Metrorail service operated by WMATA, and various bus services, including express buses, operated by multiple agencies. Thousands of commuters use transit daily in the corridor. A variety of TDM programs and services also operate in and around the study corridor and support ridesharing and transit use as well as reduce overall travel demand. Park-and-ride lots in the corridor are generally heavily used, especially those associated with rail service.

The existing I-66 HOV lane is a critical element in the success of the existing transit services, providing the incentive of travel time savings to transit riders and carpoolers as compared to if the lane did not exist. However, pressure has been developing that is affecting the performance of the lane, and this has been exacerbated by recent construction work related to the Beltway HOT facility construction. Friction from the adjacent general purpose lane, in part due to a lack of physical separation, leads to degradation of the travel time savings available in the HOV lane and threatens the attractiveness of carpooling and transit in the corridor.

ES.4 General Travel Forecasts

Projected growth in population and employment in the corridor are expected to significantly increase in future years and additionally strain transit and highway capacity. This is particularly true in the I-66 corridor where growth and development is currently expected to occur. Areas forecast to experience the most substantial household growth include areas on the far western end of the corridor in Prince William County, west of the City of Fairfax and in Tysons Corner in Fairfax County, and in some parts of Arlington County. Several areas are forecast to experience major employment growth including the area near Dulles International Airport in both Loudoun and Fairfax Counties and the Tysons Corner area in Fairfax County.

In addition to existing traditional commuter patterns to the urban core, the marked increase in population, employment, and activity centers along the western half of the I-66 corridor suggests an increasing likelihood of a gain in prominence of reverse commuting patterns. However, this pattern of commuting is more challenging to serve with transit than are more traditional core commutes and thus the need to consider TDM programs, including ridesharing and telework, as part of the mix is clear. Of course, the form of the development in the corridor is a critical element to consider. Campus-type commercial developments and residential culs-de-sac are not transit friendly. To the extent that transit-oriented development (TOD) can be encouraged, then it may be possible to develop non-core-oriented transit services that are successful. Transit service works best for concentrated travel markets and requires supportive land use policies for optimum conditions.

The appeal of transit has grown in recent years and could signal a paradigm shift where commuters are more receptive to the idea of using transit. Coupled with enhancements in the quality and dependability of service, the potential for Priority Bus services to attract additional riders seems clear. As part of the I-66 Transit/TDM Study, exploration was made of the attractiveness of elements of improved transit service and a framework was developed for

potential expansion of implementation of Priority Bus infrastructure and services to the corridor. Implementation of Bus Rapid Transit or enhancement of the existing commuter bus and express bus services were among the alternatives considered as part of the study.

ES.5 Market Research Findings

As part of the outreach effort for this study, an extensive market research program was conducted. The market research was used to determine current travel patterns, attitudes, and preferences by mode in the study corridor and to explore expected changes in travel behavior as a result of introducing possible enhanced infrastructure, programs, and services. Postcard invitations were mailed to approximately 75,000 households, and direct e-mail lists with thousands of additional contacts were used to reach other potential participants. Nearly 3,000 completed interviews were obtained across the desired target segments to enable analysis with appropriate levels of statistical confidence.

The market research indicated:

- There is strong potential support in the corridor for new and/or improved transit services;
- Dependability is a critical attribute of successful bus services in the corridor;
- Time and cost are more important to commuters than whether the Priority Bus services offered are “BRT” or other forms of express bus;
- Employer and institutional TDM support is necessary to encourage use of modes other than single-occupant vehicles. For example, the availability of employer transit benefits and the presence of the guaranteed ride home program (GRH) are factors in mode choices being made in the corridor;
- Expanded telework programs could eliminate some commuter trips altogether; and
- There is a need for increased marketing of the availability of transit services and TDM programs to realize the full potential for ridership and usage.

The market research fed into the development of the analyzed alternatives, including the definition of potential Priority Bus services for the corridor. Ultimately, the formulation of the study recommendations was also informed by the market research.

ES.6 Public Information Program Findings

The information program for the study included extensive communication and outreach, including conducting stakeholder interviews and holding public meetings. For the stakeholder interview program, a selection of more than 40 stakeholders were interviewed, in consultation with the TAC, representing a broad and diverse cross-section of public interests including: elected and appointed officials; local transportation agency leaders; and representatives from home owners associations, civic associations, chambers of commerce, special interest groups for land use and alternative transportation modes, and industry associations. The interviews covered stakeholder knowledge of the study, preferences on mobility solutions in the corridor, and ideas on ways to communicate about the study. The interviews took the form of a dialog, guided by tailored interview protocols. The interviews provided valuable insights and guided the development of recommendations, including highlighting the criticality of the reliability of the I-66 HOV lane, the importance of providing fast and dependable transit service, and the wide support for transit and TDM improvements.

Six public information meetings were also performed as part of the public outreach program, in two rounds. Presentation boards, slides, handouts, and web site materials were developed for the purpose of informing interested citizens in the corridor about the study process and comment forms (paper and electronic) and question and answer sessions were used to solicit input for use in the study. The meetings were held in Arlington, Fairfax, and Prince William Counties and included both a formal presentation and an open house component. In addition, fact sheets were developed as the study progressed to share information about the progress of the study and its key findings. The input received from the public through this project confirmed the strong desire for transit service enhancements and improvement of the reliability of the underlying HOV lane and guided the development of recommendations.

ES.7 Analysis Findings

A set of three initial alternatives and a final refined alternative were among the improvement scenarios tested. In developing the alternatives, the focus was on short- and medium-term enhancements that could be made to transit infrastructure and services and TDM programs. The objectives that guided the definition and analysis of the transit alternatives and TDM strategies were as follows:

- Transit service improvements should be demand-driven and built from existing service levels to meet forecasts of increased transit demand in the planning horizon.
- Existing transit services already provide excellent coverage in areas with large numbers of transit trips and transit mode share in the corridor. Since it is anticipated that existing services will continue and that transit providers in the corridor have planned and approved service improvements, the alternatives were designed to enhance the coverage or the existing level of services and are defined by specific operator.
- Services should reflect that the basic market needs for transit in the corridor will still consist of long distance commuters whose trips end in downtown D.C., Tysons Corner and the Rosslyn-Ballston corridor in Arlington, though consideration should also be given to new markets.
- Transit service improvements would utilize existing HOV lanes as the travel lanes for any new transit service improvements in the corridor (i.e., no dedicated transit rights-of-way would be assumed) due to the objectives and time horizon of the study.
- Transit improvements would be designed so as to lay the groundwork for the extension of the Metrorail Orange Line.
- Any Priority Bus service framework proposed would be considered as part of an overall Northern Virginia Priority Bus system, including potential Priority Bus services along I-495 and I-95/I-395.
- Proposed Priority Bus services should interface effectively with the Metrorail system, particularly the new Silver Line to Loudoun County and Dulles International Airport.
- BRT would be among the Priority Bus implementation alternatives considered by the study for the I-66 corridor.

The process of developing the testing alternatives was iterative, with qualitative assessments performed with the help of TAC members. Travel forecasting was performed using the MWCOG/TPB regionally adopted model and a post-processor developed for WMATA for submode choice analysis to permit comparison among the testing alternatives. In addition, a number of sensitivity analyses and other checks were performed in reviewing and interpreting the forecasts and arriving at a refined alternative for further consideration.

The refined alternative was based on a broad set of inputs, not just the travel forecasting. The public, stakeholder, and TAC input; the market research; and information about current ridership patterns and recent growth were all important factors. The overall analysis showed that the significant existing transit service will continue to attract additional riders in the corridor over time. In addition, there are opportunities for introducing a Priority Bus framework to the corridor. This framework would include new or enhanced station and access infrastructure, new or expanded park-and-ride facilities, and new or enhanced bus services. In addition, supportive TDM programs were indicated to increase ridesharing, transit use, and telework in the corridor.

ES.8 Recommendations

The analysis work led to a set of infrastructure, program, and service recommendations for transit and TDM in the corridor. The recommendations have been developed to improve conditions in the I-66 corridor for travelers using all modes. Taken together, the recommendations strive to provide congestion relief in the corridor, improve the operations of the existing HOV lane, increase the reliability and speed of transit service in the corridor, increase the amount of park-and-ride spaces available, and provide a range of transportation options for residents and employees in the corridor.

The core recommended infrastructure improvements include the development of eight Priority Bus stations, new direct access ramps at several locations, several new and expanded park-and-ride facilities, and adjustments to improve the reliability of the existing HOV lane. Several complementary transit service recommendations are also made. In addition, a comprehensive supporting TDM strategy is recommended.

ES.8.1 Priority Bus Stations and Ramps

The eight Priority Bus stations recommended for the I-66 corridor include:

- Haymarket;
- VA 234 Bypass;
- Centreville;
- Stringfellow Road;
- Monument Drive/Fairfax Corner;
- East Falls Church;
- Ballston; and
- D.C. Core.

Each of these stations would be served by multiple transit routes, including new Priority Bus services in addition to feeder and realigned existing service. The study developed sketch plans for each of these stations, including desired direct or indirect ramp connections and potential parking facilities for 2015 and 2030 time horizons.

Among the proposed station infrastructure improvements, the study recommends development of a two-way direct access ramp from the eastbound I-66 HOV lane to the Vienna Metrorail station and vice versa. This ramp would make it faster for buses to access the station and provide an easy return in the opposite direction. Even this small amount of travel time savings could attract additional riders. In addition, by eliminating a weaving movement that would otherwise be necessary to access the station, the ramp would make an additional positive contribution to reducing congestion for general purpose traffic.

ES8.2 Runningway Improvements

The existing I-66 HOV lane is a critical element in maintaining dependable, high-quality transit services in the corridor. The travel forecasting, market research, and public input underlined the importance of addressing the reliability of the lane in the short and medium term. Signing and marking improvements are recommended by this study for the congested portion of the lane, particularly between approximately U.S. 50 and the Beltway to create a better defined buffer of two-to-four feet in width with appropriate enforcement. These improvements would define specific entry and exit points from the lane, using double white lines to mark areas where entry or exit was prohibited. In the long term it may be necessary to consider adjusting the hours of operation, occupancy requirements, clean fuel vehicle exemptions, or enforcement protocols of the HOV lane to maintain its reliability. Physical barrier separation of the lane does not seem feasible in the short or medium term. Where HOV facilities are not available, such as on U.S. 29, U.S. 50, or in the off-peak direction on I-66, bus-on-shoulder or queue jump operations may be useful to consider in some locations in order to provide bus services with a reliable runningway.

ES.8.3 Recommended Transit Services

A map depicting the recommended services, including Priority Bus services, is provided as Figure ES-2. The map also indicates the location of the recommended Priority Bus stations. The market focus for the recommended transit service is primarily traditional commute trips in the peak hours and peak directions, although some new reverse commute service is provided on the portion of I-66 east of VA 28. The Priority Bus routes provide service to the employment centers in Arlington by providing direct connections to Ballston. The connection at East Falls Church will also provide transfer opportunities to the Silver Line and the Tysons Corner area. Substantial feeder services are also recommended in addition to the Priority Bus services that provide connections to and from major destinations in the study area including Manassas, Fair Lakes, Centreville, Reston, and Herndon.

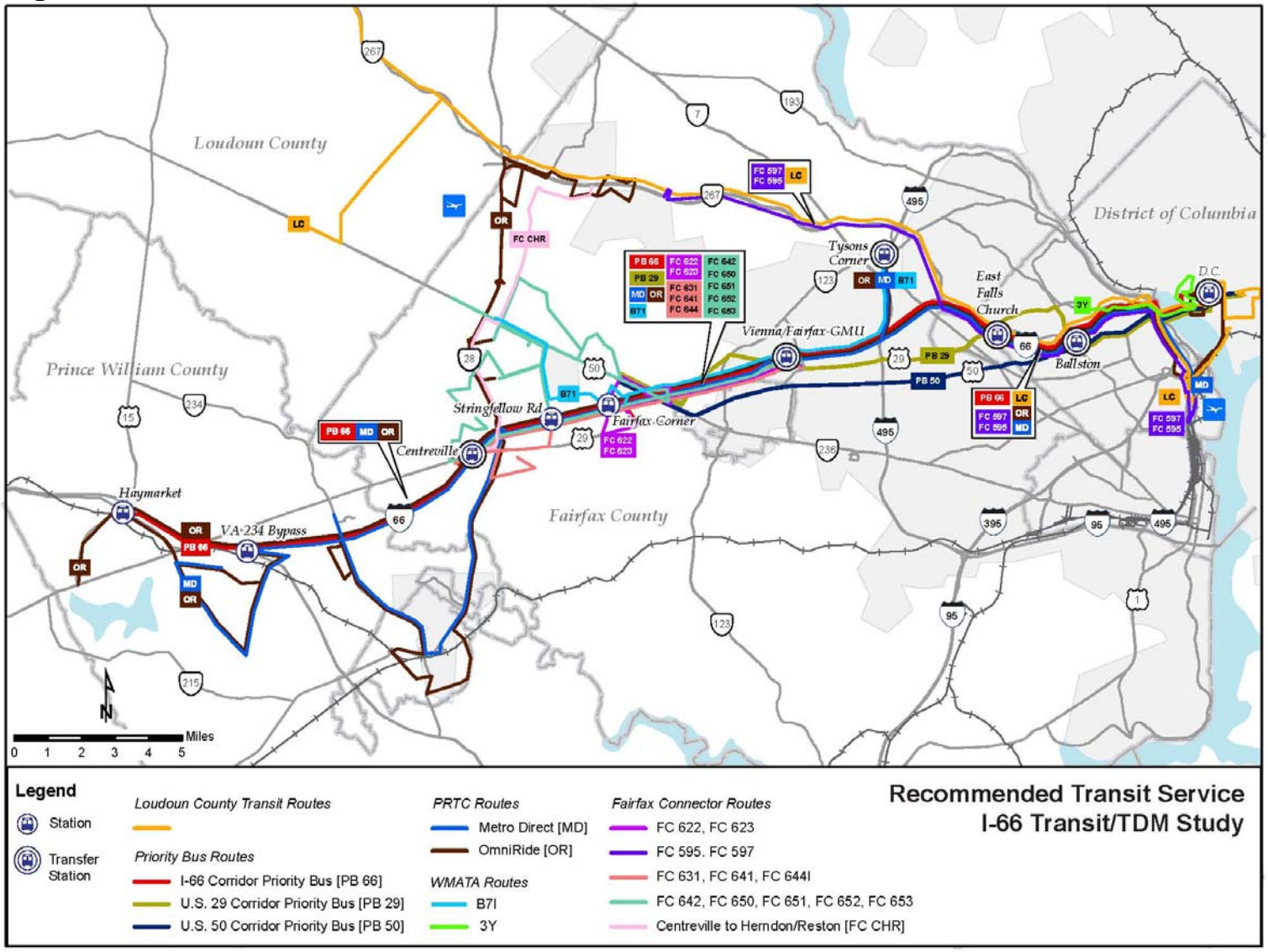
The recommended I-66 Priority Bus service includes many elements of BRT that will improve the quality and dependability of transit service provided in the corridor. Frequent service is supplemented by substantial stations, improved reliability, advanced technology and information systems, and direct access to selected stations. In addition, the market research indicated that the most compelling element of BRT was that it makes fewer stops than other transit alternatives. Each of the recommended new I-66 Priority Bus services has only five stops, providing a shorter a more direct trip to the major destinations in the corridor (e.g., the D.C. Core and the Rosslyn-Ballston corridor).

ES.8.4 Park-and-Ride Lots

Recommendations for expanded parking capacity were developed, in part, based on travel forecasts for the corridor with the other recommended improvements in place. The first priority in allocation of spaces was to provide parking for the proposed new facilities near Haymarket and Centreville. The second priority was to address areas with the largest difference between the forecast demand and capacity.

Where new lots are recommended, transit service is also recommended so as to provide a backbone for supplemental ridesharing activities. However, higher priority was given to expanding existing parking facilities over constructing new ones because travel behavior research has shown that there is usually inertia associated with the ridesharing and transit activities that occur at existing facilities and because the environmental and engineering processes are generally faster with lot expansion as compared with constructing an all new facility.

Figure ES-2. Recommended Transit Service



The recommendations include the addition of 2,650 spaces by 2015 and an additional 350 spaces by 2030 through capacity expansions at three existing lots and the construction of four new lots in the western end of the corridor. This represents a more than 25 percent increase in park-and-ride capacity in the corridor. Of the four new lots, three will be served by the recommended I-66 Priority Bus service.

Work should proceed on developing a system to provide real-time information about park-and-ride facility utilization to corridor travelers along the lines of the recommendations of a June 2009 Feasibility Study conducted by WMATA. The outlined system could include information directing patrons to open spaces as well as indicating space availability to help commuters plan their trips and reduce parking circulation related congestion and the associated time. Implementation of a pilot real-time parking information system at West Falls Church is recommended in the short term as the first step in such a corridor-wide project.

ES.8.5 TDM Strategies

Three tiers of TDM strategies representing varying levels of investment and market penetration were developed in the course of the study. TDM plays an important role in improving the quality of transportation in the I-66 corridor by providing a range of transportation options to residents and employees of the area. In addition, there are recommended TDM elements that focus on increasing awareness of transit services and providing programs that encourage transit use. Because of these potential benefits and the importance of high quality TDM programs illustrated by the market research survey, the highest tier of TDM services was recommended for the I-66 corridor.

TDM recommendations were developed for implementation by the horizon years of 2015 and 2030. Table ES-1 highlights all 15 program elements. Only elements “A” through “I” are indicated for implementation by horizon year 2015. By horizon year 2030, it is recommended that all 15 program elements be implemented. As envisioned, the TDM strategies would be implemented throughout the I-66 corridor study area, which would include areas adjacent to I-66 and residential areas that would be considered “feeders” to I-66 for commuting.

Table ES-1. Recommended TDM Strategies

ID	Program	Description
A	Enhanced Corridor Marketing	Adds targeted marketing (direct mail, newspaper advertisements) for TDM and transit along the corridor and in feeder markets
B	Vanpool Driver Incentive	Provides incentives to get new drivers and retain existing drivers for vanpools
C	Corridor-Specific Startup Carpool Incentives	Provides a three- to six-month startup carpool incentive for participating commuters in Northern Virginia
D	Rideshare Program Operational Support	Additional staff for commuter assistance programs in the corridor and feeder markets to promote TDM programs and transit and for additional employer outreach support
E	Carsharing at Priority Bus Activity Nodes	Expand the existing carshare program to include vehicles at Priority Bus activity nodes
F	Bike Hubs/Storage at Priority Bus Activity Nodes	Priority Bus nodes near employment or residential activity centers include “bike hubs” with bike maintenance, showers, personal lockers, and other services for bicyclists; additional lockers at other nodes

Table ES-1. Recommended TDM Strategies (continued)

ID	Program	Description
G	TDM Program Evaluation	Evaluation of travel and environmental impacts of TDM activities in Northern Virginia, with particular attention to impacts on I-66 corridor system operation
H	Enhanced Virginia Vanpool Insurance Pool	Provides affordable insurance coverage for vanpools
I	Enhanced Telework!VA	Adds new financial incentives for Virginia employers and/or extends the level of assistance available
J	Northern Virginia Ongoing Financial Incentive	Offers a small ongoing reward opportunity (e.g., prize drawings, etc.) to commuters traveling to or from Northern Virginia using a non-SOV mode
K	Van Priority Access	Allows vanpool vans to access bus-only infrastructure in the I-66 corridor
L	Capital Assistance for Vanpools	Provides financial assistance for purchase or lease of vanpool vans
M	Flexible Vanpool Network	Includes a network of overlapping vanpool routes which permits part-time ridership and flexibility for full-time riders to modify their vanpool schedule with a reservation
N	SmartBenefits Subsidy Public Share	Provides a public agency contribution to employer-provided SmartBenefit transit/vanpool subsidies and shares the cost of these subsidies with employers
O	Mobility Centers/Mobile Commuter Stores	Self-serve kiosks or staffed commuter stores at I-66 Priority Bus stations offering personalized trip advice, transit information, and fare media

ES.8.6 Related Recommendations

In addition to the core recommendations of the study, several related recommendations are also made to further the study objectives, including:

- Review of adequacy of pedestrian and bicycle facilities is recommended for existing transit hubs and stations and should be an essential planning element of new facility development.
- Transit-oriented development considerations are also recommended to be a part of new station planning as well as when considering redevelopment around existing transit hubs or activity centers in the corridor.
- As plans evolve for the proposed K Street Transitway, it is recommended that the needs of Priority Bus services traveling from outside D.C. be addressed in a manner that will maintain the attractiveness of these services. This includes exploration of bus priority lanes on facilities leading to and entering D.C., including the Roosevelt Bridge.
- The developments along the VA 28 corridor showed some promise as a potential transit market due to the large amount of employment growth anticipated. However, the land use form and scale and the types of roadway facilities involved indicated that a separate study should be conducted on how best transit ridership could be realized. Therefore, conducting such a study is among the related recommendations of this study. Indeed, a concept review of BRT lanes between U.S. 50 and the Dulles Toll Road is currently being considered as part of a study to develop 30 percent plans for widening VA 28.

- During the development of station sketch planning for the Haymarket area station it was realized that additional comprehensive multimodal planning in the area around and including the Town of Haymarket could be beneficial. Such a study would identify and select from among alternative locations the preferred location and form for a context-sensitive transportation hub and its associated parking facilities. Prince William County, the Town of Haymarket, the Potomac and Rappahannock Transportation Commission (PRTC), Virginia Railway Express, VDOT, and DRPT would be potential stakeholders in such a study.
- Planning for the longer-term extension of rail in the corridor should be progressed, including Metrorail Orange Line extension beyond Vienna and extension of the VRE Manassas Line. Station area plans for each proposed station should advance not only to inform rail planning but also to inform the synergistic development of appropriate Priority Bus infrastructure as a stepwise short- to medium-term improvement that lays the groundwork for rail (e.g., the site location and character of parking and station facilities).

ES.8.7 Program Costs

Table ES-2 summarizes the total capital and operating costs for this study's recommendations in 2010 constant dollars. The medium-term plan element costs are additive to the short-term plan element costs to arrive at the net difference between the medium-term plan elements and existing conditions. The plan elements shown include all recommended transit services, Priority Bus stations, TDM programs, the I-66 HOV lane buffer, and all park-and-ride lot recommendations. The majority of the costs are capital costs associated with park-and-ride lot expansions, construction of Priority Bus stations, and the purchase of vehicles. The total capital cost of the recommendations is estimated as $290.5 million. The annual operating cost for the full medium-term program, net of farebox revenue, is $14.7 million; about $2.9 million more per year than the short-term program.

Table ES-2. Summary Cost Projections for Recommendations

	Annual Operating Cost [2]		Capital Cost		
Plan Element	**Short Term**	**Medium Term [3]**	**Short Term**	**Medium Term [4]**	**Total**
Transit Services	$10.1	$11.1	$35.7	$47.5	$83.2
Priority Bus Stations	-	-	$57.3	$112.2	$169.5
Runningway Improvements	-	-	$2.0	-	$2.0
TDM Programs	$1.5	$3.6	$5.3	$0.5	$5.8
Park and Ride	$0.2	-	$26.5	$3.5	$30.0
Total	$11.8	$14.7	$126.8	$163.7	$290.5

Notes:
1. All costs are expressed in millions of 2010 constant dollars and represent costs beyond providing existing programs and services.
2. Annual operating costs are expressed net of farebox revenue.
3. Medium-term operating costs are inclusive of costs to operate plan elements included as short-term recommendations; they are not additive with the short-term operating costs.
4. Medium-term capital costs include new programs, services, and infrastructure beyond the short-term recommendations, plus cost for vehicle replacements for services initiated in the short term.

ES.9 Next Steps

The recommendations of the I-66 Transit/TDM Study are intended to be implementable in the short- or medium-term time frame. Although the horizon years for the analysis and planning were 2015 and 2030, the actual year of implementation could be earlier. Several of the recommendations represent actions that could be moved forward in the immediate future. These

include moving forward with design of the recommended HOV lane improvements, the preliminary engineering of the direct access ramp for the Vienna Station, park-and-ride capacity expansion at existing locations, and enhancement of many of the TDM programs, including enhanced corridor marketing. Development of cross-operator implementation plans for the Priority Bus framework should also progress in the immediate future.

In the short term, further planning for the additional recommended park-and-ride locations and implementation of new and enhanced transit services would proceed. The recommended VA 28 corridor transit study and Haymarket area transit hub/park-and-ride study could be completed. Additional planning for longer-term rail extensions should also continue. Engineering for two additional direct access ramps, at Stringfellow Road and at Monument Drive/Fairfax Corner could also proceed.

Working towards some of the medium-term recommendations will require additional planning work, including designing bus priority treatments on local streets, engineering for additional direct access ramps, considering additional HOV runningway improvements, and implementing the full range of recommended transit services and TDM programs.

Funding for the transportation infrastructure and service improvements will remain a challenge in the near term. Although the study explored and identified general potential funding sources, it will still be up to planners and policy makers to program funds for the recommended improvements to permit full implementation to be realized.

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1.0 Introduction

1.1 Background

The I-66 Transit/TDM Study represents a part of efforts by the Commonwealth of Virginia to review various multimodal solutions to manage existing congestion and expected growth in the I-66 corridor. The existing transportation infrastructure, both highway and transit, are heavily utilized and experience frequent congestion. Projected growth in population and employment are expected to significantly increase in future years and additionally strain the transit and highway capacity.

I-66 is the main east-west Interstate Highway in Northern Virginia. Segments of I-66 between Gainesville and Washington, D.C. are congested during morning and evening rush hours. The I-66 corridor serves the District of Columbia, Arlington County, Fairfax County (to include the Town of Vienna), Loudoun County, Prince William County (to include the Town of Haymarket), and the cities of Fairfax, Falls Church, Manassas, and Manassas Park.

The I-66 corridor includes a complex, comprehensive mix of transportation facilities and services, including highway (general purpose and high-occupancy vehicle (HOV)), commuter rail, heavy rail, and local and regional bus service:

- The highway lane configuration varies along the length of the corridor. There are two lanes in each direction from the Theodore Roosevelt Bridge to the Capital Beltway, although an additional lane for entry or exit is available through selected segments. There are three travel lanes in each direction from just west of the Beltway interchange to the I-66/U.S. 50 interchange at Fair Oaks. The right shoulder of I-66 between the Beltway and U.S. 50 is used as a travel lane in the peak direction during the rush hours to maintain three general travel lanes while providing the left lane as an HOV-2 lane. There are four lanes in each direction from the I-66/U.S. 50 interchange to the I-66/VA 234 Bypass interchange at Manassas. From this point west, there are two lanes in each direction. The Virginia Department of Transportation (VDOT) is widening two miles of I-66 between the I-66/VA 234 Bypass interchange and the I-66/U.S. 29 interchange in Gainesville. Two lanes are being added in each direction: one general purpose lane and one HOV lane. This widening project is scheduled to be completed in August 2010.
- Inside the Beltway, all eastbound lanes are reserved for HOV-2 and motorcycles from 6:30 a.m. to 9:00 a.m. and all westbound lanes from 4:00 p.m. to 6:30 p.m. Outside the Beltway, the left lane of I-66 east of Manassas is reserved for HOV-2 and motorcycles from 5:30 a.m. to 9:30 a.m. and 3:00 p.m. to 7:00 p.m.
- Metrorail's Orange Line operates on two tracks from the Vienna/Fairfax-GMU station through Washington, D.C. and into Maryland. The Metrorail trains operate aboveground in the I-66 median from the Vienna/Fairfax-GMU station to just west of George Mason Drive (at exit 71), where the trains enter a tunnel and continue underground to Ballston and into Washington, D.C.
- Virginia Railway Express (VRE) provides commuter rail service that operates parallel to the I-66 corridor originating at Broad Run, with stops in Manassas, Manassas Park, Fairfax, Alexandria, Arlington, and Washington D.C.
- Local and regional bus service is provided on I-66 and on adjacent facilities by the Washington Metropolitan Area Transit Authority (WMATA), the Potomac and Rappahannock Transportation Commission (PRTC), Fairfax County, Loudoun County, and the cities of Fairfax and Falls Church.

- Two bicycle/pedestrian trails, the Washington and Old Dominion (W&OD) and the Martha Custis Trail, roughly parallel nine miles of I-66 from the Capital Beltway east to Rosslyn, and in some areas, are located in the I-66 right-of-way.

1.2 Study Area

The study area comprises an area of approximately two miles on either side of the corridor defined by I-66 from U.S. 15 in Haymarket, Virginia, east to the District of Columbia. The study area was extended to include U.S. 50 and U.S. 29 throughout the length of the corridor. Figure 1-1 shows the boundaries of the study area. Major activity centers in the study area include the Washington D.C. core, Pentagon area, Rosslyn-Ballston corridor, Tysons Corner, Fair Lakes, Centreville, Gainesville, and Haymarket.

1.3 Study Process

The I-66 Transit/TDM Study was conducted under the direction of the Virginia Department of Rail and Public Transportation (DRPT), in cooperation with the I-66 Transit/TDM Technical Advisory Committee (TAC) consisting of representatives from local, regional, and state stakeholder organizations (see Section 1.4.1). The purpose of the study was to identify more transportation choices through transit service and TDM program enhancements to increase mobility in the corridor. The study set out to develop a recommended plan for short- and medium-term transit and TDM service improvements in the I-66 corridor between Haymarket and Washington, D.C. and to be positioned to provide input into the restart of the Virginia Department of Transportation (VDOT) I-66 Multimodal Transportation Environmental Study. The study was mindful to offer approaches that could lay the groundwork for rail extension in the long term.

The study delivery team was made up of DRPT and consultant resources. Michael Harris served as DRPT Project Manager under the direction of Corey Hill, DRPT Chief of Public Transportation. Other key DRPT staff in the effort included: Chris Arabia, Jennifer Pickett, and Courtney Ware. The consultant team was led by Cambridge Systematics (CS) in association with Jacobs Engineering Group (JEG); Southeastern Institute of Research (SIR); The Perspectives Group (TPG); KFH Group (KFH); MCV Associates (MCV); William G. Allen, Jr., P.E. (WGA); LDA Consulting (LDA); and Robert G. Stanley (RGS). John (Jay) Evans, P.E., AICP and Pramoda Gode of CS served as the consultant team Project Manager and Deputy Project Manager, respectively. Key project staff, team leaders, and report contributors included: Bill Allen (WGA), Lori Diggins (LDA), Joel Eisenfeld (KFH), Randy Farwell (JEG), David Feske (JEG), Dan Goldfarb (CS), Sue Knapp (KFH), Jim Lawson (TPG), Ken Leonard (CS), Dalia Leven (CS), Liang Long (CS), Laura McWethy (CS), Joe Mehra (MCV), Jennifer Moynihan (CS), Crystal Sarno (TPG), Doug Sarno (TPG), Karen Smith (SIR), and Bob Stanley (RGS).

The project was executed as a series of closely associated tasks for greater efficiency. While the tasks are listed separately, many tasks were interdependent and were developed using the findings from other tasks. The overall study process is shown schematically in Figure 1-2. The tasks involved in this project include:

- Task 1 – Detailed Work Program;
- Task 2 – Public/Agency Participation Program and Market Research;
- Task 3 – Data Collection;
- Task 4 – Technical Advisory Committee (TAC) Meetings;
- Task 5 – Regional Authority and Commission Meetings;
- Task 6 – Purpose and Need;
- Task 7 – Current and Baseline Conditions;

Figure 1-1. I-66 Transit/TDM Study Area

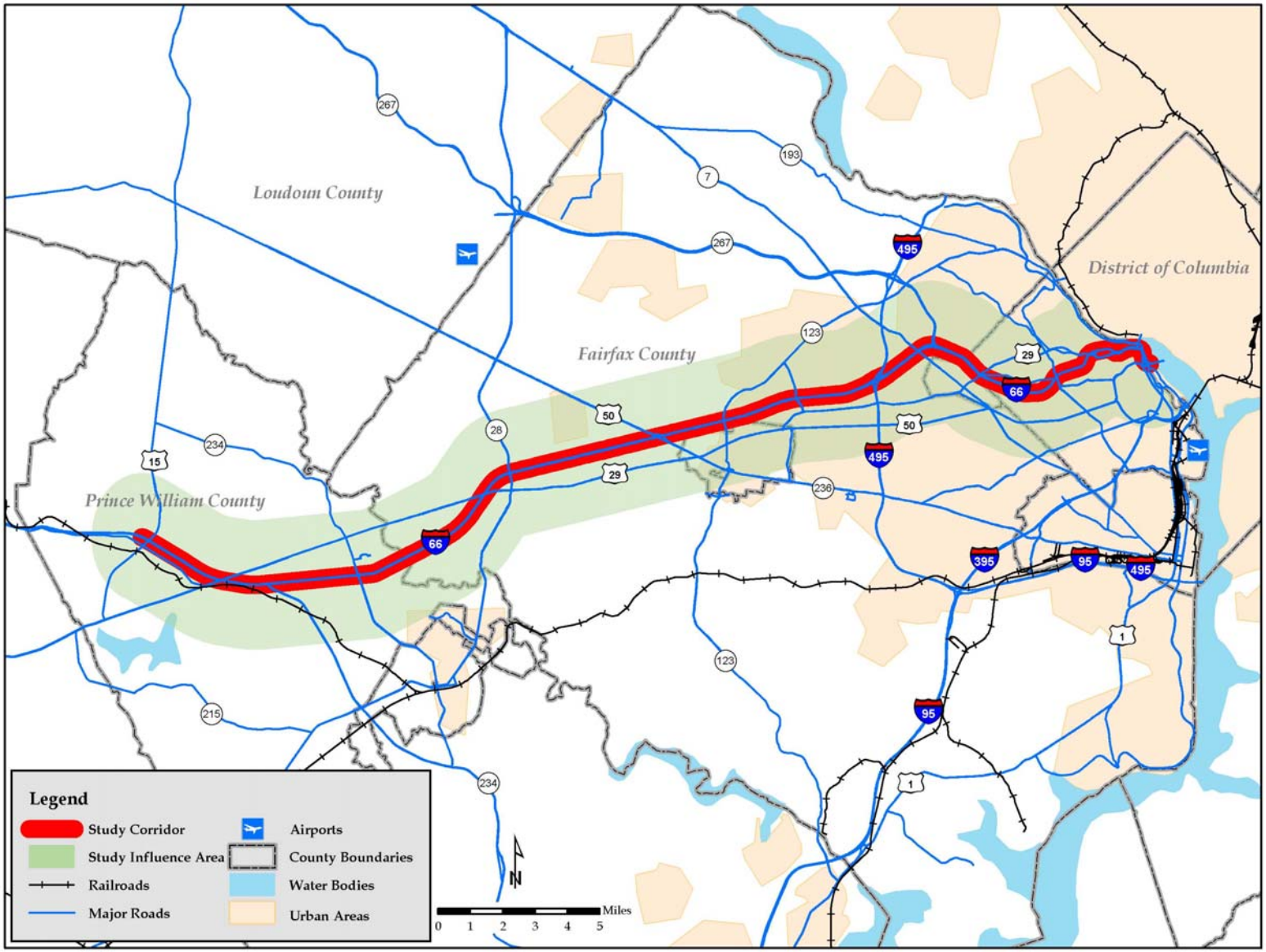
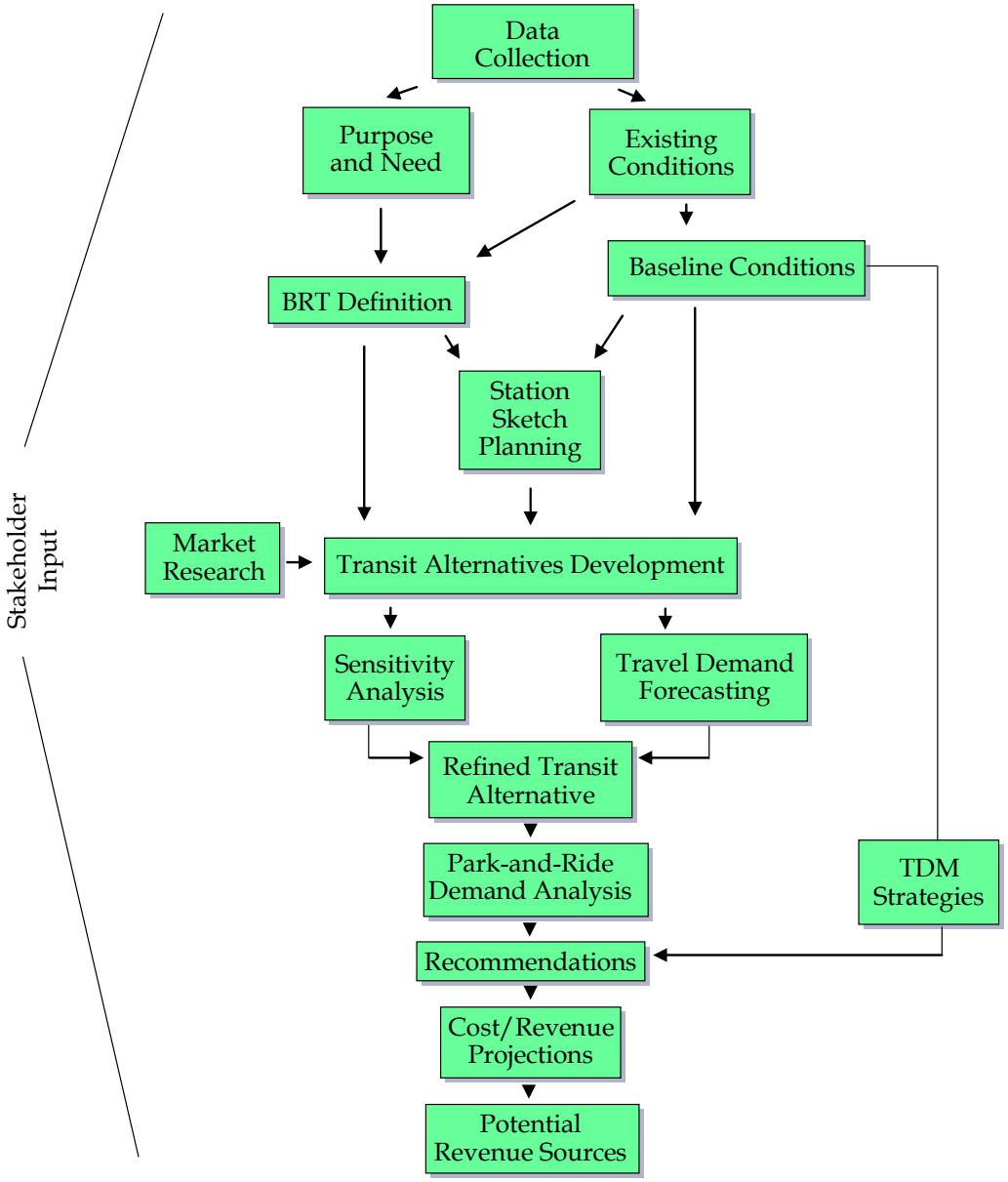


Figure 1-2. Study Process



- Task 8 – Market Demand Methodology and Forecasts;
- Task 9 – Bus Rapid Transit (BRT) Definition and Station Sketch Planning;
- Task 10 – Transit Alternatives Development;
- Task 11 – Sensitivity Analysis;
- Task 12 – TDM Strategies;
- Task 13 – Park-and-Ride Lots;
- Task 14 – Cost/Revenue/Subsidy Projections;
- Task 15 – Transit/TDM Recommendations;
- Task 16 – Potential Revenue Sources;
- Task 17 – Final Report; and
- Task 18 – Additional Project Support.

The public/agency participation program was a major activity throughout the study. Therefore, the study began with the development of the public involvement plan. The next step was to clearly define the purpose and need in the corridor so as to provide direction for the study. The study team also developed an on-line market research survey to help identify public opinion and attitudes. Concurrent with all other tasks, public outreach efforts continued, including public meetings, key stakeholder interviews, monthly TAC meetings, and advisory briefings for regional commissions. Next, the study identified existing conditions in the corridor and developed the baseline scenario for use in the study. Data were assembled and collected on current and planned transit service levels, use and costs, future travel markets, traffic levels, park-and-ride lot usage, and Transportation Demand Management (TDM) strategies. Baseline scenarios were defined based on planned changes for the horizon years 2015 and 2030.

Then, the study team set out to define Priority Bus (and BRT) in the context of Northern Virginia and the I-66 corridor. As part of this effort, planning level feasibility analysis was conducted for potential station sites in the study corridor. Next, three preliminary transit alternatives were developed for each horizon year. The alternatives were tested using the travel demand forecasting models and other sensitivity analyses were also performed. Based on these results, input from the TAC, public comment, and results of the market research survey, a single refined alternative was developed. Each of the alternatives included a selection of TDM strategies. A special model analysis was performed to analyze the future demand for park-and-ride lots throughout the corridor.

Following the evaluation of the alternatives, a set of multimodal recommendations were developed that encompassed transit service, transit stations, pedestrian and bicycle facilities, TDM strategies, and park-and-ride lots. Cost and revenue projections for these recommended elements were developed in the final stage of the study. The study also included consideration of potential funding sources for its recommendations.

1.4 Study Outreach and Information

This study involved an extensive communication and outreach program, which included professional cross-jurisdictional collaboration, providing information to the public, and receiving feedback from the public and various stakeholders. This section outlines the public outreach and informational elements included in this study. Full details and results can be found in the Public Information Report, located in Appendix A.

1.4.1 Technical Advisory Committee

A multi-jurisdictional TAC, which included representatives from local, regional, and state stakeholder organizations, helped develop the study by providing technical comments, feedback, and guidance to the study team throughout the study process. The TAC met approximately once per month for a total of eleven official meetings over the course of the study. In addition, several supplemental meetings and on-line seminars were conducted with TAC members to address issues of specific concern. The members of the TAC include:

- Arlington County – Dan Malouff and Lynn Rivers;
- City of Fairfax – Alex Verzosa and David Summers;
- Fairfax County – Randall White and Jaak Pedak;
- City of Falls Church – Wendy Block Sanford;
- Town of Haymarket – Gene Swearingen;
- Loudoun County – Nancy Gourley;
- City of Manassas – Mike Moon;
- Prince William County – Monica Backmon;
- District of Columbia – Tomika Hughey;
- Metropolitan Washington Council of Governments (MWCOG) – Ron Kirby and Gerald Miller;
- Potomac and Rappahannock Transportation Commission (PRTC) – Eric Marx and Al Harf;
- Northern Virginia Transportation Authority (NVTA) – Tom Biesiadny;
- Northern Virginia Transportation Commission (NVTC) – Greg McFarland;
- Virginia Department of Transportation (VDOT) – Valerie Pardo and Rahul Trivedi;
- Virginia Railway Express (VRE) – Christine Hoeffner; and
- Washington Metropolitan Area Transit Authority (WMATA) – Wendy Jia and John Magarelli.

1.4.2 Regional Commission Meetings

The study team met with NVTC and PRTC twice during the study period and once with NVTA to present the status of the project, including descriptions of major deliverables and recommendations. Slide presentations were available as handouts to attending members of the public and also posted to the affiliated organization web sites.

1.4.3 Public Information Meetings

An extensive public information program was conducted as an integral part of the study process. Presentation boards, slides, handouts, and web site materials were developed for the purpose of informing interested citizens in the corridor about the study process while comment forms were used to solicit input for use in the study. Public Information Meetings were held in each of the jurisdictions (Arlington, Fairfax, and Prince William Counties) and included an open house segment with staff on-hand to answer questions and a presentation given by DRPT. These meetings were conducted in two waves: the first wave in May 2009 focused primarily on the transit needs in the corridor and the BRT concept while the second wave in September 2009 focused on more specific station and service alternatives. More detailed summaries of these meetings and the input received can be found in Appendix A.

1.4.4 Market Research

The study included a formal market research component designed to allow commuters to share their opinions, state their needs, and express their preferences about transit and TDM development in the I-66 corridor in a structured and purposeful way. This survey profiles current travel patterns by mode in the study corridor and expected changes in travel behavior as a result of potential transit improvements. Nearly 3,000 surveys were completed from commuters traveling along I-66, U.S. 29, or U.S. 50 in the morning peak period at least three days per week. Respondents represent all major modes in the corridor, including single-occupancy vehicle (SOV), formal carpool, local bus, express bus, Metrorail, and VRE. A summary of the survey methodology and results can be found in Section 5 of this report.

The information obtained from this survey helps planners, engineers, decision-makers, and others charged with transit and TDM development to better understand the needs and preferences of commuters who travel this corridor regularly and better predict commuter response to potential new and improved products and services. A full reporting of the Market Research survey can be found in Appendix E.

1.4.5 Stakeholder Interviews

The study identified a group of key stakeholders with a broad and diverse cross-section of public interests including elected and appointed officials; local transportation agency leaders; and representatives from home owners associations, civic associations, chambers of commerce, special interest groups for land use and alternative transportation modes, and industry associations. Between March and May of 2009, approximately 40 stakeholders were individually interviewed about their knowledge of the study, preferences on mobility solutions in the corridor and ways to communicate about the study. The interviews took the form of a dialog, guided by tailored interview protocols. This element of the public outreach program helped raise awareness of the study in the corridor and provided valuable insights on potential improvements.

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2.0 Purpose and Need

This section presents the detailed Purpose and Need document called for in the scope of work for the I-66 Transit/TDM Study and guides the associated exploration of transit and Transportation Demand Management (TDM) improvements in the I-66 corridor. Section 2.1 describes the purpose of the overall study. Section 2.2 outlines the objectives of the study. Section 2.3 details the need for this study by presenting several illustrations of need in the corridor. The status of the project is described in Section 2.4.

2.1 Purpose

The purpose for the I-66 Transit/TDM Study is to identify additional transportation choices through transit and TDM enhancements that will increase mobility in the I-66 corridor in the short and medium timeframe. Recommendations for enhancements to transit services and facilities would improve service levels, capacity, and service quality without precluding the future extension of the Metrorail Orange Line.

2.2 Project Objectives

The Virginia Department of Rail and Public Transportation (DRPT) initiated the I-66 Transit/ TDM Study in the I-66 corridor (Haymarket to the District of Columbia including U.S. 50 and U.S. 29) to identify ways and means to increase mobility in the corridor by expanding or enhancing transit services and through transportation demand management efforts. Figure 2-1 presents a map of the study area. Project objectives for the study include:

- Examine and recommend transit operational concepts and capital investments that would increase mobility and connectivity in the corridor;
- Develop recommendations for enhancing TDM programs and program effectiveness to reduce single-occupant vehicular travel in the corridor; and
- Develop recommendations for actions in the short and medium timeframes.

2.3 Need

The existing and projected mobility and capacity deficiencies and constraints for the I-66 corridor are indicated by:

- Potential right-of-way constraints;
- The extensive use of special purpose lanes and high-occupancy vehicle (HOV)-only operations;
- Existing use of shoulders as general purpose lanes during peak periods;
- High ridership level on the Metrorail Orange Line service;
- High ridership levels on the Virginia Railway Express (VRE) commuter rail Manassas Line running parallel to I-66; and
- The overall congestion levels for all modes of travel in the corridor.

Key factors in establishing the need for the study are presented in the subsections which follow.

Figure 2-1. I-66 Corridor

2.3.1 System Linkage

The I-66 corridor is a complex mix of transportation facilities and services including highway (general purpose and HOV), commuter rail, heavy rail, and local and regional bus service. I-66 is the main east-west Interstate Highway in Northern Virginia. The I-66 corridor serves the District of Columbia, Arlington County, Fairfax County (including the Town of Vienna), Loudoun County, Prince William County (including the Town of Haymarket), and the cities of Fairfax, Falls Church, Manassas, and Manassas Park. The I-66 corridor also provides connections to other major facilities in the region, including the Capital Beltway (I-495). Current and projected travel demand in this corridor is heavily constrained.

2.3.2 Roadway Deficiencies and Constraints

I-66 Right-of-Way – The right-of-way along the I-66 corridor is constrained inside and outside the Beltway (I-495). The urbanized nature of the adjacent land uses and the existing transportation facilities consume most of the available right-of-way and limit right-of-way expansion opportunities. Capacity on I-66 from the Beltway to U.S. 50 was previously expanded by using the shoulders as travel lanes that open during specified hours. I-66 from U.S. 50 to U.S. 29 has been expanded to 8 lanes utilizing the existing right-of-way.

HOV Lanes – Inside the Beltway, traffic operations are restricted to HOV-2 only operations in the peak direction during peak periods (eastbound during 6:30 to 9:00 a.m. and westbound during 4:00 to 6:30 p.m.) from the Beltway east to North Lynn Street. East of North Lynn Street I-66 includes four to six general purpose lanes and a center reversible lane east of the George Washington Parkway on the Theodore Roosevelt Bridge.

Outside the Beltway, west to the VA 234 Bypass, I-66 has been expanded to eight lanes with six general purpose and two HOV lanes. The HOV lanes operate as HOV-2 in the peak direction between the hours of 5:30 to 9:30 a.m. and 3:00 to 7:00 p.m. on weekdays. This typical section is scheduled to be extended further west to U.S. 29 by 2010. A similar project was recently completed between VA 234 and VA 234 Bypass that expanded I-66 from four general purpose lanes to the eight-lane section. This doubling of the number of lanes confirms the high level of traffic occurring and projected for the corridor.

It should be noted that for the I-66 sections between the Beltway and U.S. 50, the outside shoulders are used as general purpose lanes in the peak periods. Where I-66 intersects the Capital Beltway (I-495) it will also connect to the High-Occupancy/Toll (HOT) lane system currently being constructed in Northern Virginia. HOT lanes are being constructed on the Capital Beltway from the Springfield Interchange to just shy of the Legion Bridge. There may also be HOT lanes along I-395 and south of the Capital Beltway along I-95 through Prince William County. The HOT lanes along I-95/I-395 would connect to the HOT lanes on the Capital Beltway.

2.3.3 Capacity

The existing transportation infrastructure in the corridor, both highway and transit, is heavily utilized and experiences frequent congestion. Projected growth in population and employment is expected to significantly increase in future years and additionally strain transit and highway capacity. Historical travel patterns reflect existing capacity constraints for all modes of travel. More than a dozen projects, programs, or initiatives are underway that either directly or indirectly relate to improving the I-66 corridor. Figure 2-2 shows the high levels of vehicle traffic currently traveling in the I-66 corridor.

Level of service (LOS) is an accepted standard quantitative measure of traffic volume to roadway design capacity and is used for describing operational conditions within a traffic stream, generally

in terms of such service measures as speed and travel time, freedom to maneuver, and traffic interruptions. LOS A is the highest and LOS F the lowest with LOS C/D generally considered acceptable for planning purposes.

Segments of I-66 between Gainesville and Washington, D.C. are congested during morning and evening rush hours. In the morning peak period, the greatest congestion (LOS E/F) is currently experienced eastbound as follows: between VA 234 Bypass and VA 28; between U.S. 50 and I-495; and between VA 110 and the George Washington Parkway, and westbound between North Fairfax Drive and Westmoreland Street. In the afternoon peak period, the greatest congestion (LOS E/F) is currently experienced westbound as follows: between Lee Highway (Spout Run) and N. Sycamore Street and between I-495 and U.S. 50 and between VA 234 and U.S. 29 and eastbound between U.S. 50 and I-495 and between VA 7 and N. Fairfax Drive. See Figures 2-3a and 2-3b for morning and evening peak conditions, respectively.

Of those traveling on I-66 near the interchange with I-495, 53 percent are bound for areas inside the Beltway including D.C., Arlington, Alexandria, and parts of Fairfax County. An additional 26 percent are bound for areas in Fairfax County outside of the Beltway including Tysons Corner and Springfield. The remaining 21 percent are bound for areas in Maryland.

Transit plays a major role in the transportation system of the I-66 corridor and assuring the continued availability and reliability of transit service is critical to the future viability of the corridor. The existing transit services in the I-66 corridor are well utilized, and approximately 60 percent of work trips from the corridor to the D.C. core in the morning peak period are made by transit. The Metrorail Orange Line experiences particularly heavy ridership and experiences major congestion during the peak periods due to passenger capacity constraints. This peak period congestion can be addressed by increasing the use of eight car trains which increases the passenger carrying capacity of the service. The addition of the Silver Line to the Metrorail system is also expected to mitigate some of the capacity constraints currently experienced on the Orange Line. However, the increased mobility that the Silver Line offers may also increase the demand for Metrorail use when the Silver Live service opens, offsetting some of the capacity increases. WMATA expects the Orange-Silver Line corridor to approach capacity by around 2025.

The Orange Line Metrorail station at Vienna/Fairfax-GMU experiences some additional congestion with the number of buses serving the station during the peak periods. In 2005, the station was served by dozens of different local, commuter, and shuttle bus routes, all of which must be accommodated at 15 bus bays at the station. Expansion of the number of bus bays available at the station may be necessary to accommodate increased bus service levels.

With a combined utilization of 85 percent, the park-and-ride lots in the corridor are also highly utilized. The park-and-ride lots at North Quincy Street, Stone Road-U.S. 29, Stringfellow Road, Four Mile Run, and the WMATA lots at Dunn Loring/Merrifield, East Falls Church, Vienna/Fairfax-GMU, and West Falls Church currently operate at capacity. The availability and congestion of park-and-ride facilities in the corridor plays a major role in the transportation decisions of commuters.

2.3.4 Modal Interrelationships

Metrorail Orange Line – Metrorail's Orange Line operates on two tracks from the Vienna/Fairfax-GMU Station through Washington, D.C. and into Maryland. The Metrorail trains operate above ground in the I-66 median from the Vienna/Fairfax-GMU Station to west of East Falls Church Station near George Mason Drive (Exit 71), where the trains enter a tunnel and continue underground to Ballston and into Washington, D.C. The Metrorail Orange Line is currently operating with high levels of passenger demand. Figure 2-1 shows the Silver Line extension from the East Falls Church Station on the existing Orange Line to Dulles International Airport along the

Dulles Toll Road through Tysons Corner. Figure 2-4 presents a map of the existing Metrorail system annotated with the Silver Line extension.

Virginia Railway Express (VRE) – VRE provides commuter rail service on the Manassas Line that operates parallel to the I-66 corridor originating at Broad Run, with stops in Manassas, Manassas Park, Fairfax, Alexandria, Arlington, and Washington D.C. (see Figure 2-5). Current ridership is robust and projected to continue to grow. Several improvement projects are ongoing or being programmed for the Manassas Line including platform upgrades, station parking expansion, rolling stock procurement, and infrastructure projects for track upgrades. Systemwide infrastructure projects are also underway that support expanded train capacity and reduced headways. A longer term project includes the evaluation of western extensions of the Manassas Line to Haymarket and Gainesville.

Local and Regional Bus Service – These services are provided on I-66 and on adjacent facilities by WMATA, the Potomac and Rappahannock Transportation Commission (PRTC), Fairfax County, Arlington County, and the cities of Fairfax and Falls Church. Loudoun County bus services utilize I-66 inside the Capital Beltway but do not stop in the study corridor. Existing bus routes are presented in Figures 2-6, 2-7 and 2-8. The WMATA bus map (available at <http://www.wmata.com/bus/maps/>) shows the bus services provided by WMATA, Fairfax Connector, Arlington County, and the cities of Fairfax and Falls Church. The PRTC system map is available at <http://www.prtctransit.org/system-map.php>.

Bicycle/Pedestrian – Two bicycle/pedestrian trails, the Washington and Old Dominion Trail (W&OD) and the Martha Custis Trail, roughly parallel nine miles of I-66 from the Capital Beltway east to Rosslyn, and in some cases, are located in the I-66 right-of-way.

2.3.5 Transportation Demand

Projected growth in population and employment are expected to significantly increase in future years and create transportation demand that will additionally strain transit and highway capacity. Figures 2-9 and 2-10 depict household (population) and employment growth between 2005 and 2030.

Figure 2-9 shows the areas expected to experience substantial household growth, specifically areas on the far western end of the corridor in Prince William County, west of the City of Fairfax and in Tysons Corner in Fairfax County, and in some parts of Arlington County.

Figure 2-10 shows areas estimated to experience major employment growth, especially areas near Dulles International Airport in both Loudoun and Fairfax Counties and the Tysons Corner area in Fairfax County.

Figure 2-11 depicts the activity centers in the I-66 corridor. In addition to existing traditional commuter patterns to the urban core, the marked increase in population, employment, and activity centers along the western half of the I-66 corridor illustrates the increasing demand as manifested in reverse commuting patterns. The existing transportation infrastructure, both highway and transit, are heavily utilized and experience frequent congestion.

2.3.6 Safety

Safety considerations are an essential element of any review of transportation conditions and the development of transportation improvements. A review of crash data provided by VDOT reflects that the rate of accidents and incidents are not excessive along the I-66 corridor despite the high

volume of traffic. Implementation of recommendations to improve mobility in the corridor should include considerations to improve safety.

2.3.7 Social Impacts and Economic Development

Transportation mobility, social impacts, and economic development factors are increasingly becoming interrelated as the urban area grows and intensifies. This is evident in the I-66 corridor and the adjacent and surrounding areas. The impact congestion has on location decisions related to housing and employment is well documented. The I-66 corridor has continued to see significant growth in population and employment despite increasing demand for mobility and resulting congestion levels. This continued intensification of development is reflective of the strong attraction of the Washington, D.C. metropolitan area for employment, educational, and residential uses.

2.4 Project Status

The I-66 Transit/TDM Study is a conceptual planning effort. The study was conducted by a Technical Advisory Committee (TAC) consisting of local, state, regional, and federal jurisdictional/agency staff in cooperation with DRPT, assessing and identifying feasible concepts to increase capacity along the I-66 corridor. In the future, specific concepts may be advanced through a formal Alternatives Analysis (AA), as part of a future phase of work such as the I-66 Multimodal Transportation and Environmental Study to complete an Environmental Impact Statement (EIS) for transportation improvements along the I-66 corridor. This study is consistent with other recent and current examinations of transportation improvements in Northern Virginia and is being coordinated with the current examination of transit and TDM improvements in the I-95/I-395 corridor.

Figure 2-2. Traffic Volume

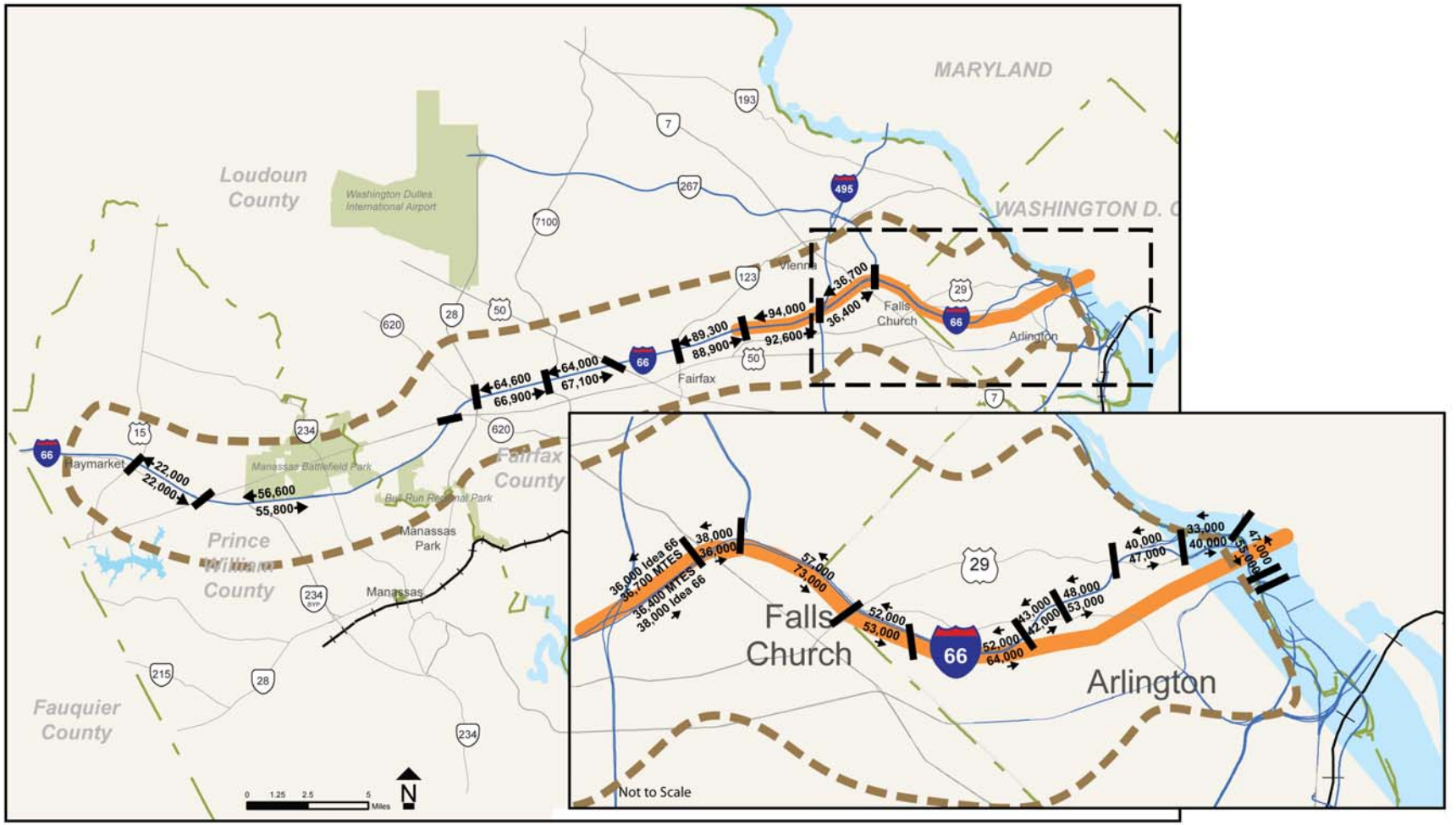


FIGURE 2-2
Traffic Volume
I-66 TRANSIT/TDM STUDY

Figure 2-3a. Levels of Service – Morning Peak Hour

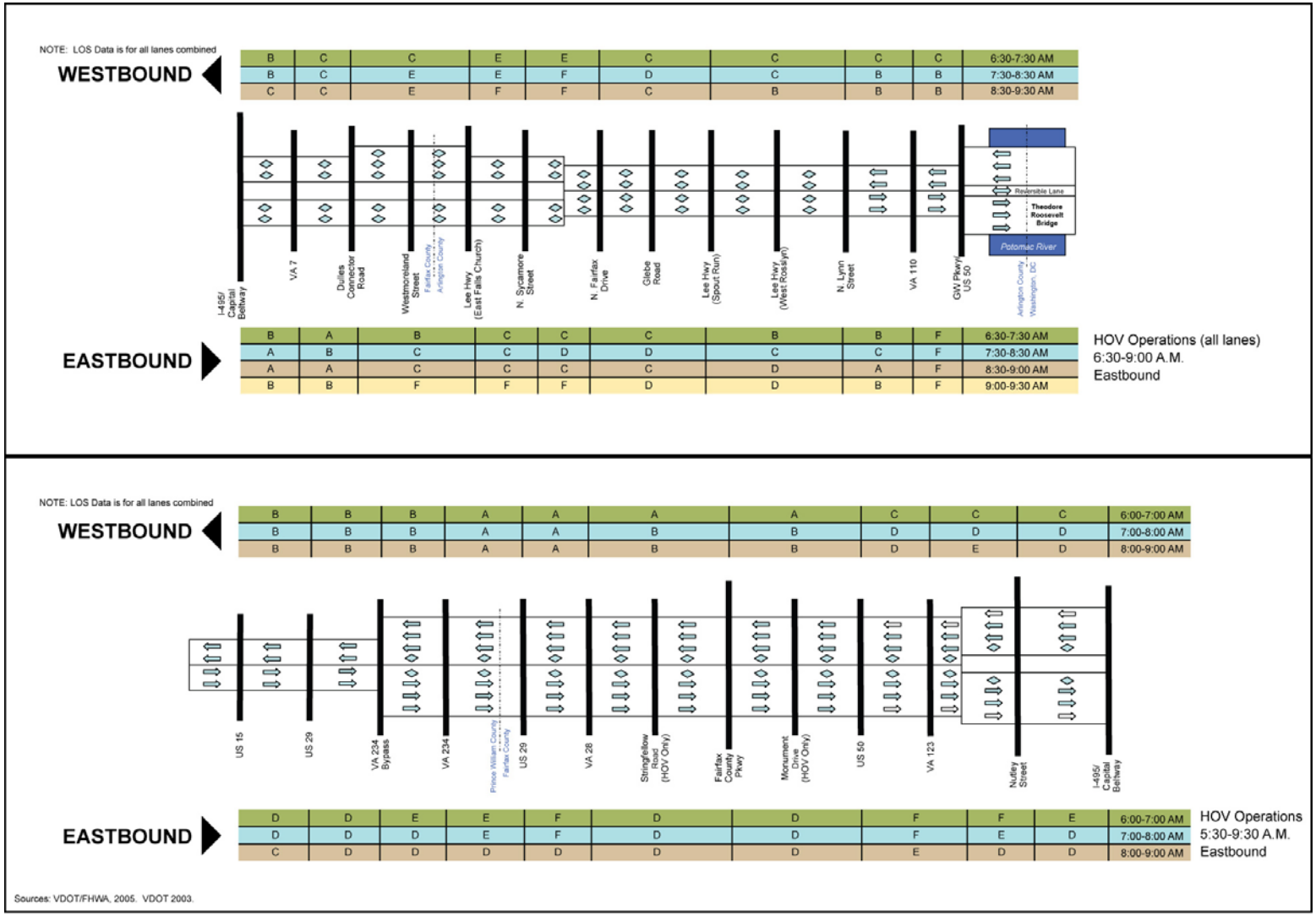


Figure 2-3b. Levels of Service – Evening Peak Hour

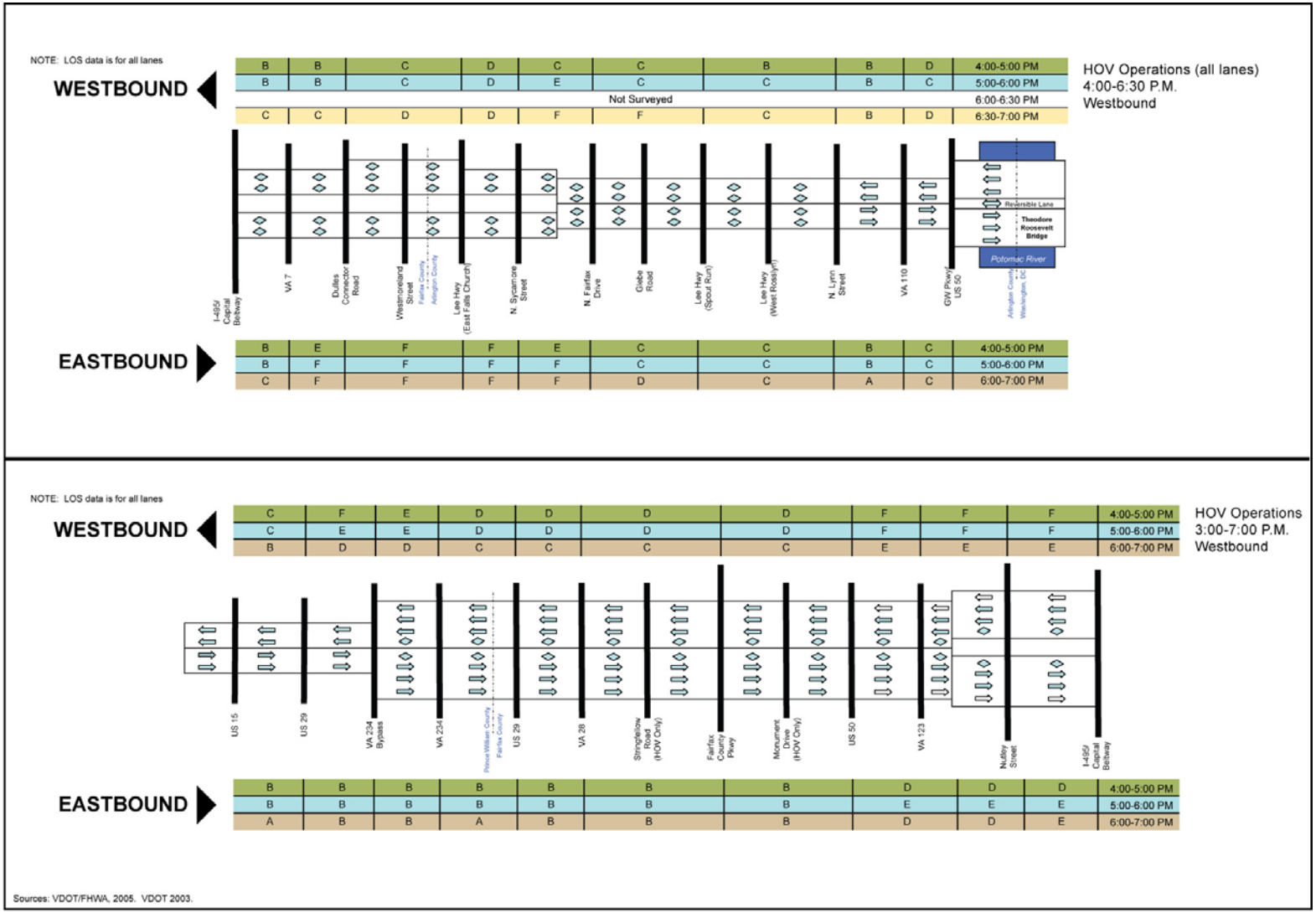
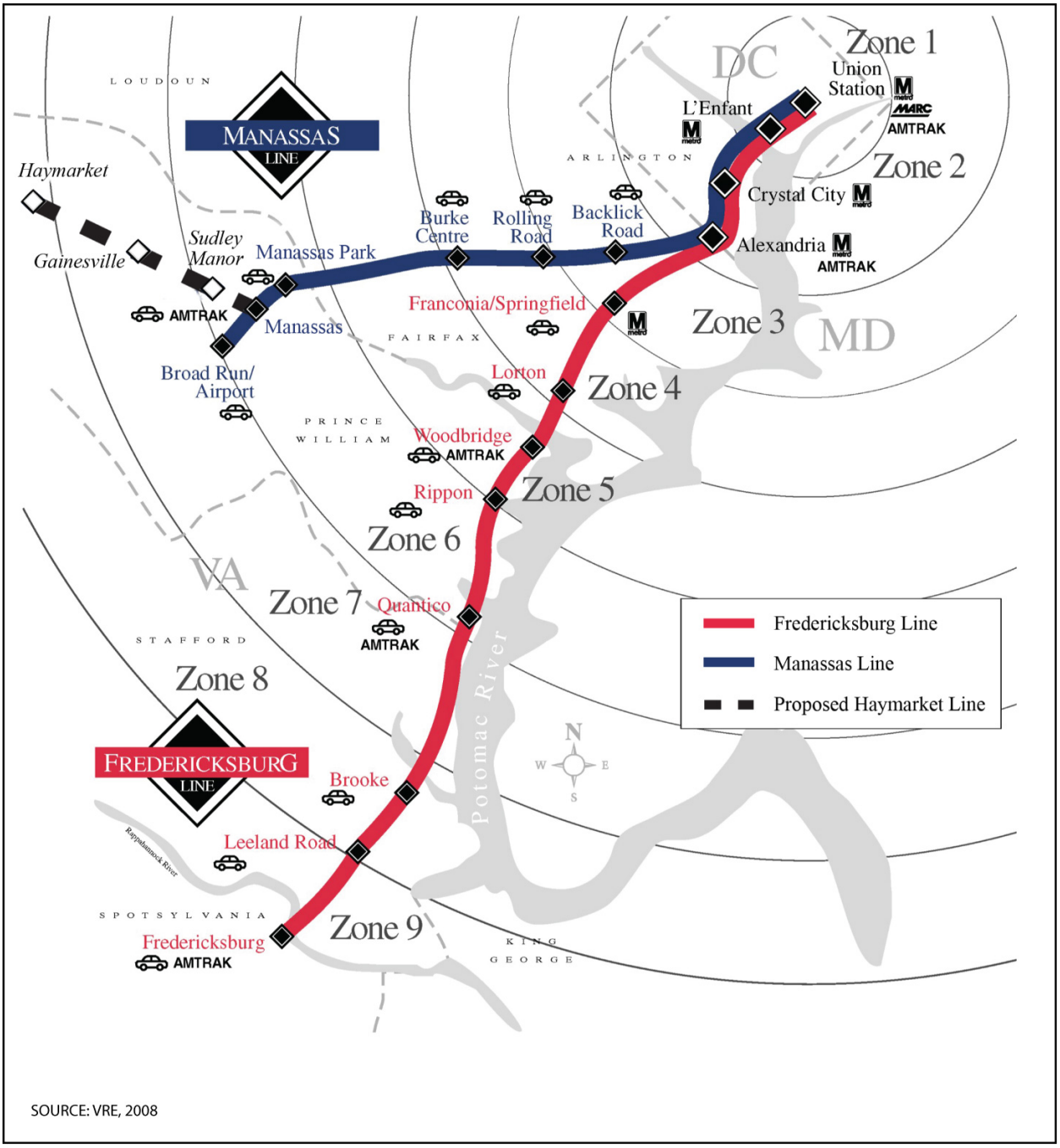


Figure 2-4. Metrorail System

Figure 2-5. VRE System Map



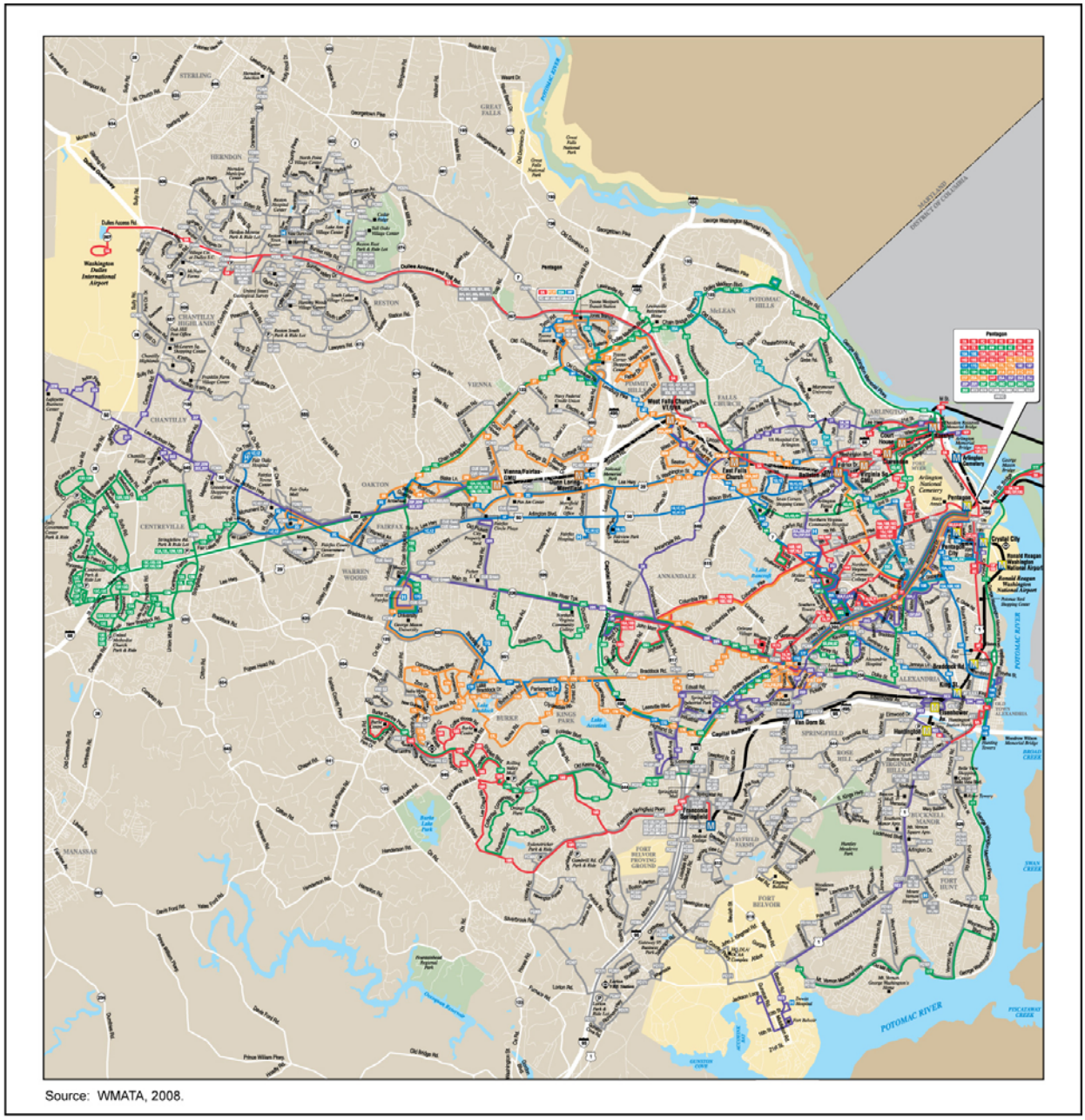
VRE System Map
I-66 TRANSIT/TDM STUDY

Figure 2-6. Arlington/Alexandria Corridor Bus Service

Source: WMATA, 2008.

Arlington/Alexandria Corridor Bus Service
I-66 TRANSIT/TDM STUDY

Figure 2-7. Corridor Bus Service



Source: WMATA, 2008.

Corridor Bus Services
I-66 TRANSIT/TDM STUDY

Figure 2-8. PRTC Bus Service

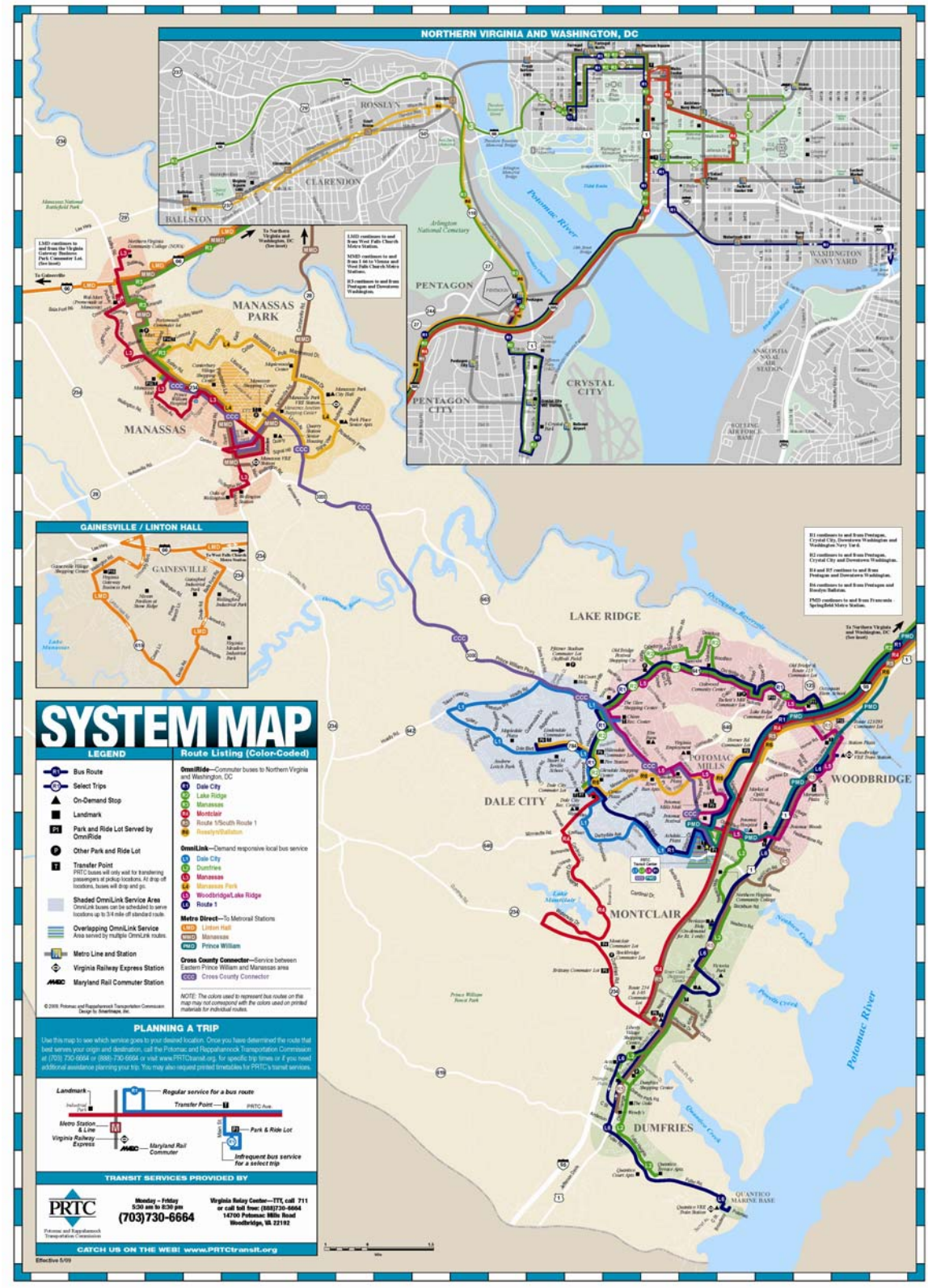


Figure 2-9. 2005-2030 Household Growth

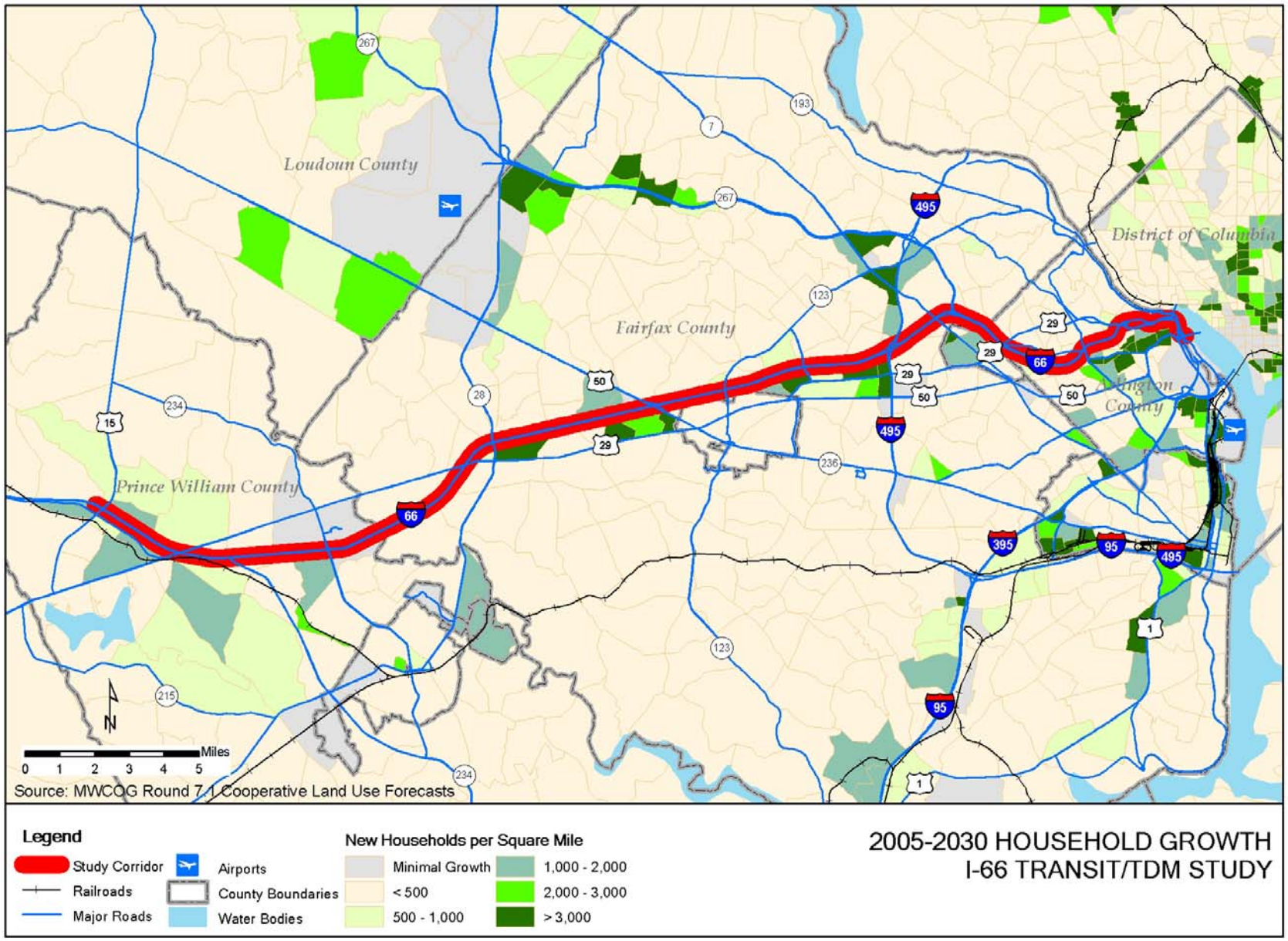


Figure 2-10. 2005-2030 Employment Growth

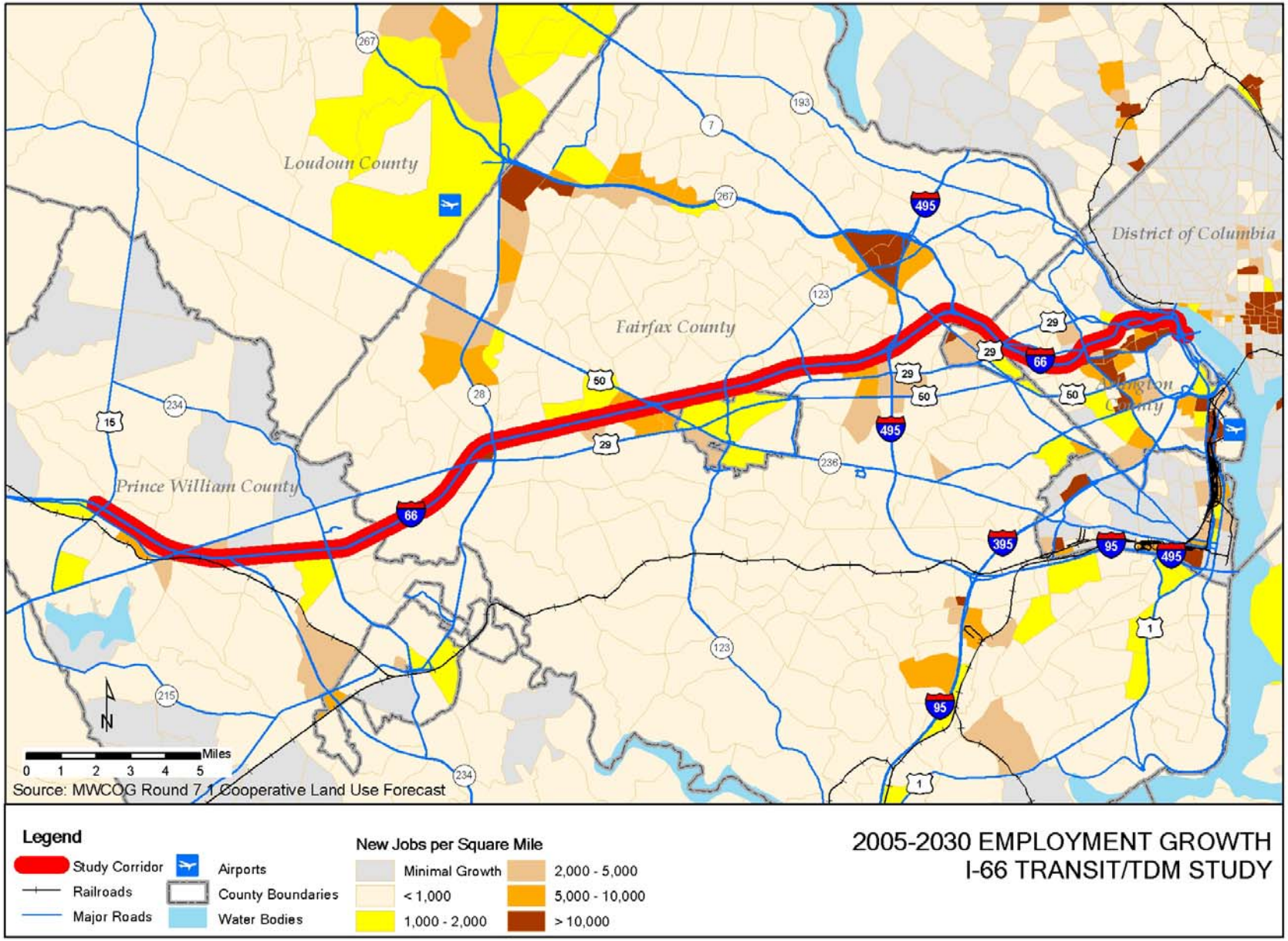
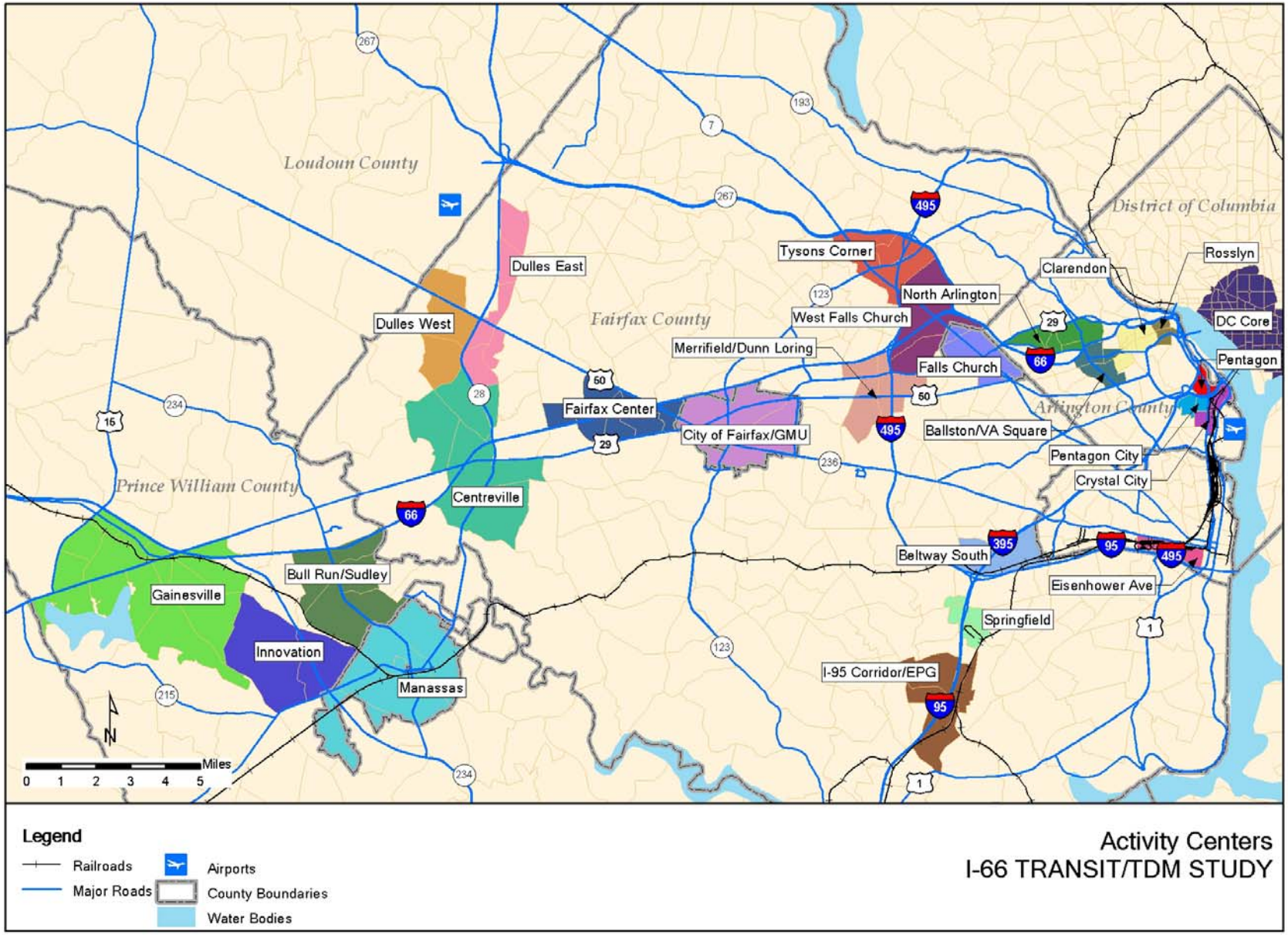


Figure 2-11. Activity Centers



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3.0 Existing Conditions

As an initial step in the study process, existing conditions were defined in detail for the transportation network, including roadway (general purpose and high-occupancy vehicle), transit, TDM, and bicycle/pedestrian elements. Existing services and facilities are defined in detail for the I-66 corridor, including U.S. 29 and U.S. 50 from the Potomac River to Haymarket. Existing conditions are defined as those services or facilities in place in the year 2005. This year was selected as the baseline because it is the most recent year for which data about all modes is easily and readily available. The existing conditions are used as a starting point upon which the baseline scenarios (see Section 6) and alternatives (see Section 8) are developed.

3.1 Existing Highway Network

The existing conditions for the 2005 highway network were established using the 2005 Conformity Network developed by MWCOG for the Washington, D.C. metropolitan region. This network includes all major roadways, highways, and HOV facilities in the region as of 2005. Figure 3.1 shows the existing 2005 roadway network in the study area.

3.2 Existing Transit Network

There are a wide range of transit modes and services in the project study area, including commuter rail operated by VRE, Metrorail service operated by WMATA, and various types of bus services operated by multiple agencies. During the morning peak period, the Metrorail Orange Line operates 10 trains per hour in each direction.[1] VRE operates two eastbound trains per hour and one morning westbound train along the Manassas Line during the morning peak period.[2] Additional service also is provided on the Fredericksburg VRE line which runs parallel to I-95.

Bus service in the I-66 corridor is operated by six different transit agencies, including Arlington Transit (ART), CUE, Fairfax Connector, Loudoun County Transit, OmniRide, and WMATA. The combination of these services result in the service pattern shown in Figure 3-2 which indicates bus frequencies ranging from 37 buses per hour in both directions in the eastern end of the corridor near Rosslyn to five buses per hour west of the Beltway. Bus frequencies along U.S. 50 range from five to 34 buses per hour while U.S. 29 accommodates an additional eight buses per hour in the study corridor. Table 3-1 details each bus route, by provider, that operates within the corridor.

[1] WMATA Trip Planner <http://www.wmata.com>.

[2] VRE Schedules <http://www.vre.org/service/schedule.htm#Manassas>.

Figure 3-1. 2005 Highway Network

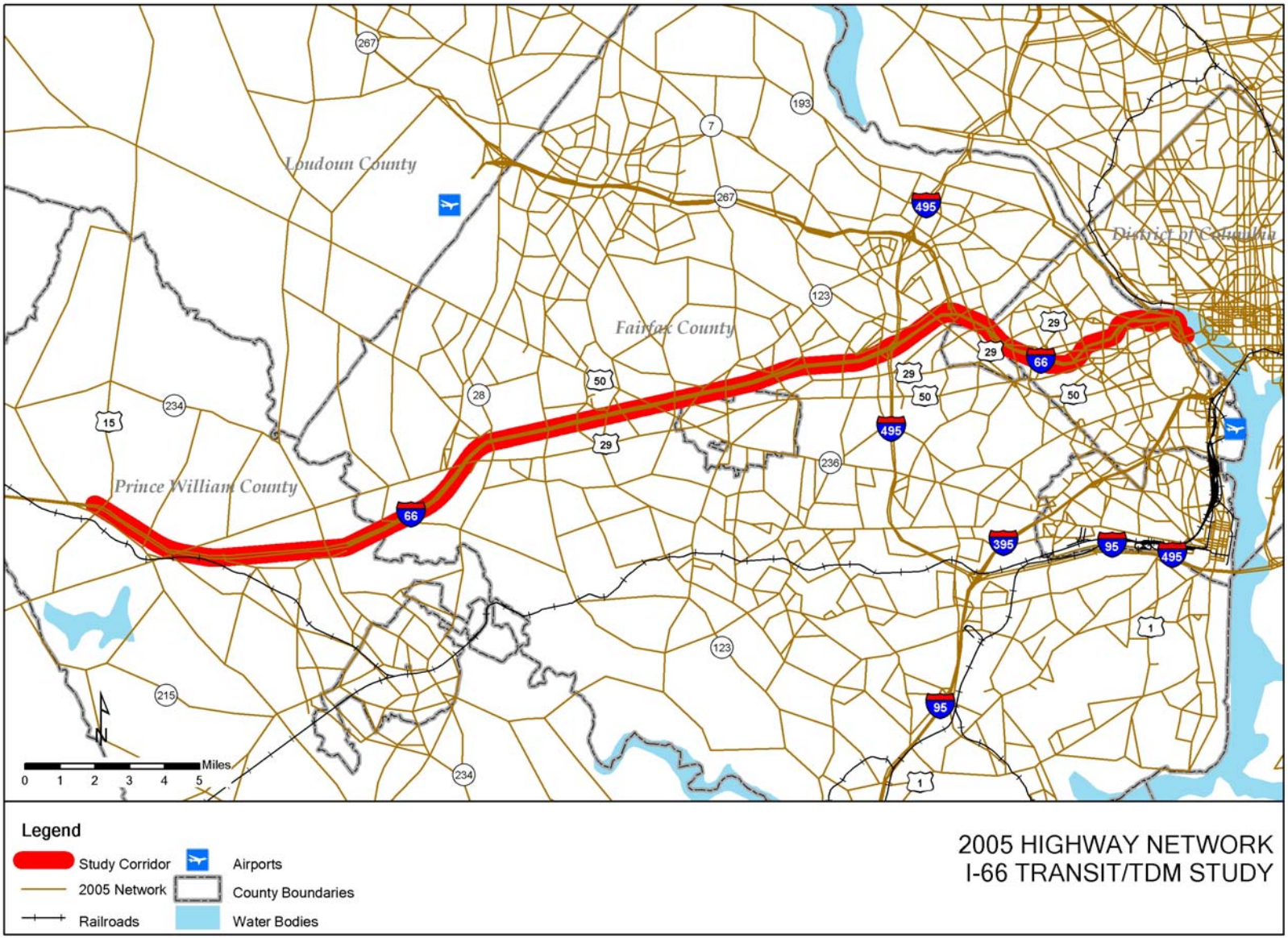


Figure 3-2. 2005 Morning Peak Bus Frequency

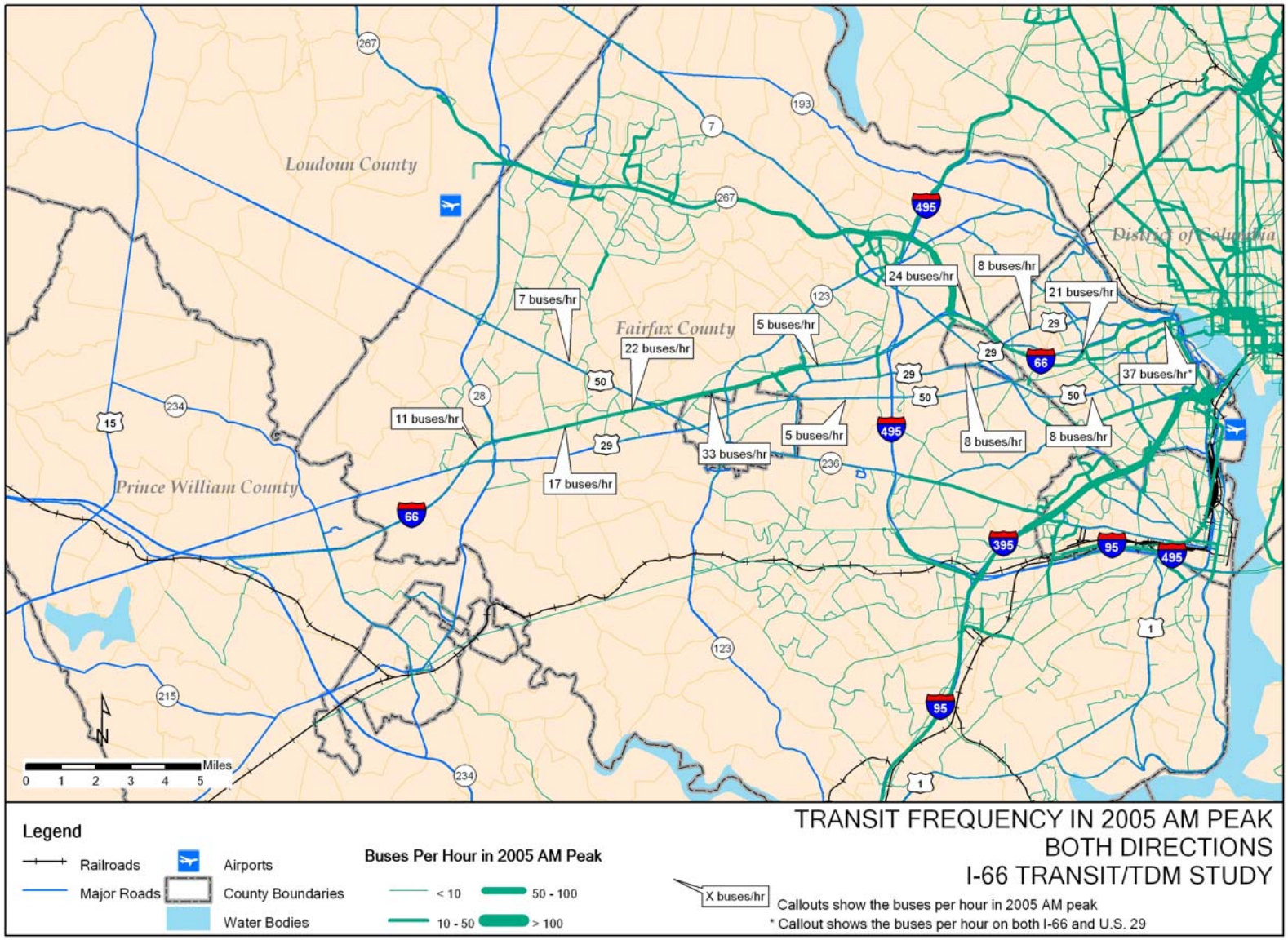


Table 3-1. Existing Corridor Bus Services by Provider

Bus Route	Type	Feeder Service?	Metro Stations Served	Corridor Roadway Used	Reverse Commute?
Arlington Transit					
Columbia Pike-Ballston-Court House	Local	Yes	Court House	No	Yes, service in both directions all day
Ballston-Virginia Hospital Center-East Falls Church	Local	Yes	Ballston-MU, East Falls Church	Parallel to U.S. 29	Yes, service in both directions all day
Ballston-Old Glebe-East Falls Church	Local	Yes	Ballston-MU, East Falls Church	No	Yes, service in both directions all day
Rosslyn-Court House Metro Shuttle	Local	Yes	Rosslyn, Court House	Parallel to U.S. 50	Yes, service in both directions (loop) during peak periods
Ballston Metro to Court House Metro	Local	Yes	Ballston-MU, Court House	Yes, segment parallel to I-66 but then would lose current stops	Yes, service in both directions during peak periods
Ballston Virginia Square Lunch Loop	Local	Yes	Ballston-MU, Virginia Square-GMU	No	Yes, service is continuous loop
Wakefield H.S.-Carlin Springs Road-Ballston	Local	Yes	Ballston-MU	No	Yes, service in both directions during peak periods
CUE					
Cue Gold	Local	Yes	Vienna/Fairfax-GMU	U.S 29 and U.S. 50	Yes, buses operate in a loop
Cue Green	Local	Yes	Vienna/Fairfax-GMU	U.S 29 and U.S. 50	Yes, buses operate in a loop
Fairfax Connector					
Backlick-Gallows Road Line	Local	Yes	Dunn Loring, Franconia-Springfield	No	Yes
Fairfax County Government Center Line	Local	Yes	Vienna/Fairfax-GMU	U.S. 50 and I-66 to Vienna Metro	Yes, buses operate in a loop
Herndon/Reston Town Center Line	Local	Yes	West Falls Church (WFC)	No	Yes, WFC Metro to Reston Town Center

Table 3-1. Existing Corridor Bus Services by Provider (continued)

Bus Route	Type	Feeder Service?	Metro Stations Served	Corridor Roadway Used	Reverse Commute?
Fairfax Connector (continued)					
North Reston Line	Local	Yes	West Falls Church	No	No
Reston South Express Line	Express	Yes	West Falls Church	No	No
Reston Town Center Line	Local	Yes	West Falls Church	No	Yes, WFC Metro to Reston Town Center
Reston/Herndon Reverse Commute Line	Commuter	Yes	West Falls Church	No	Yes, reverse commute only from WFC Metro to Reston/ Herndon
South Reston Line	Local	Yes	West Falls Church	No	Yes, WFC Metro to Reston/ Herndon
Tysons Corner/Reston Town Center Line	Local	No	No	No	Yes, Tysons Corner to Reston Town Center
Tysons West Park Transit Station/West Falls Church Metro	Local	Yes	West Falls Church	No	Yes, Tysons Corner to WFC Metro
Vienna-Merrifield-Dunn Loring Line	Local	Yes	Vienna/Fairfax-GMU, Dunn Loring-Merrifield	Runs just north of I-66	No
Loudoun County Transit					
Broad Run Farms-West Falls Church	Commuter	Yes	West Falls Church	No	No
Dulles North Transit Center-Rosslyn/Pentagon/ Washington, D.C.	Commuter	Yes	West Falls Church, Rosslyn, Pentagon, Farragut North, Farragut West, Smithsonian, Navy Yard, Union Station	I-66 from WFC Metro to Rosslyn	No
Dulles South-Rosslyn/ Pentagon/Washington, D.C.	Commuter	Yes	Rosslyn, Pentagon, Farragut North, Farragut West, Smithsonian, Navy Yard, Union Station	I-66 from Falls Church area to Rosslyn	No

Table 3-1. Existing Corridor Bus Services by Provider (continued)

Bus Route	Type	Feeder Service?	Metro Stations Served	Corridor Roadway Used	Reverse Commute?
Loudoun County Transit (continued)					
Hamilton-Rosslyn/Pentagon/ Washington, D.C.	No Longer in Service	N/A	N/A	N/A	N/A
Leesburg-Rosslyn/ Pentagon/Washington, D.C.	Commuter	Yes	West Falls Church, Rosslyn, Pentagon, Farragut North, Farragut West, Smithsonian, Navy Yard, Union Station	I-66 from West Falls Church Metro to Rosslyn	No
Purcellville/Rosslyn/ Pentagon/Washington, D.C.	Commuter	Yes	Rosslyn, Pentagon, Farragut North, Farragut West, Smithsonian, Navy Yard, Union Station	I-66 from Falls Church area to Rosslyn	No
West Falls Church to Dulles North	Commuter	Yes	West Falls Church	No	Yes
OmniRide					
Linton Hall Metro Direct	Commuter	Yes	West Falls Church	I-66 for about 22 miles	No
Manassas	Commuter	Yes	Pentagon, Smithsonian	I-66 for about 27 miles	No
Manassas Metro Direct	Commuter	Yes	Vienna/Fairfax-GMU, West Falls Church	I-66 for about 19 miles	Yes, from West Falls Church Metro to Manassas
WMATA-Metrobus					
28A, B Alexandria-Tysons Corner Line	Local	Yes	King Street, West Falls Church	No	Yes, service in both directions all day
38B Ballston-Farragut Square Line	Local	Yes	Ballston-MU, Clarendon, Court House, Rosslyn, Farragut North, Farragut West	No	Yes, service in both directions all day
24P Ballston-Pentagon Line	Local	Yes	Ballston-MU, Virginia Square (1 block), Clarendon, Pentagon City (1 block), Pentagon	No	Yes, service in both directions all day
15K, L Chain Bridge Road Line	Local	Yes	Rosslyn	No	Yes, service in both directions during peak periods

Table 3-1. Existing Corridor Bus Services by Provider (continued)

Bus Route	Type	Feeder Service?	Metro Stations Served	Corridor Roadway Used	Reverse Commute?
WMATA-Metrobus (continued)					
5A D.C.-Dulles Line	Express	Yes	L'Enfant Plaza, Rosslyn	I-66 for about six miles from Rosslyn to VA 267	Yes, service in both directions all day
1C Fair Oaks-Dunn Loring Line	Local	Yes	Dunn Loring-Merrifield	U.S. 50 and U.S. 29 for about seven miles	Yes, service in both directions all day
26A, E GEORGE, City of Falls Church Local Transit East Falls Church Line	Local	Yes	East Falls Church, West Falls Church	No	Yes, but service only runs both directions during midday; otherwise two loops, one to each metro, during peak periods
3Y Lee Highway-Farragut Square Line	Local	Yes	Rosslyn, Farragut West, Farragut North, McPherson Square	U.S. 29 for about two miles	No
3A, B, E Lee Highway Line	Local	Yes	West Falls Church, East Falls Church, Rosslyn	Route 3E and first part of 3A use U.S. 29, and 3B continues on VA 7	Yes, service in both directions all day
24T McLean Hamlet-East Falls Church Line	Local	Yes	East Falls Church	No	Yes, service in both directions during peak periods
23A, C McLean-Crystal City Line	Local	Yes	Crystal City, Ballston-MU	No	Yes, service in both directions all day
4A, B, E, H Pershing Drive-Arlington Boulevard Line	Local	Yes	Court House, Rosslyn	U.S. 50 for about five miles	Yes, service in both directions all day
3T Pimmit Hills Line	Local	Yes	West Falls Church	No	Yes, service in both directions all day
2T Tysons Corner-Dunn Loring Line	Local	Yes	Vienna/Fairfax-GMU, Dunn Loring-Merrifield	No	Yes, service in both directions all day
28T Tysons Corner-West Falls Church Line	Local	Yes	West Falls Church	No	Yes, service in both directions during peak periods

Table 3-1. Existing Corridor Bus Services by Provider (continued)

Bus Route	Type	Feeder Service?	Metro Stations Served	Corridor Roadway Used	Reverse Commute?
WMATA-Metrobus (continued)					
2A, B, C, G Washington Boulevard-Ballston-Vienna-Oakton Lines	Local	Yes	Vienna/Fairfax-GMU, Dunn Loring-Merrifield, East Falls Church, Ballston-MU	U.S. 29 and parallel streets for about nine miles	Yes, service in both directions all day
1A, B, E, F, Z Wilson Boulevard Line	Local	Yes	Vienna/Fairfax-GMU, Dunn Loring-Merrifield, Ballston-MU	U.S. 50 and parallel for about six miles	Yes, service in both directions all day
12A, E, F, G Centreville South[3]	Local	Yes	Vienna/Fairfax-GMU	I-66 for about nine miles	Yes, service in both directions during peak periods
12C, D Centreville North[3]	Local	Yes	Vienna/Fairfax-GMU	I-66 for about nine miles	Yes, service in both directions during peak periods
12L, M Little Rocky Run-Vienna[3]	Local	Yes	Vienna/Fairfax-GMU	I-66 for about seven miles	Yes, service in both directions during peak periods
12R, S Stringfellow Road-Vienna[3]	Local	Yes	Vienna/Fairfax-GMU	I-66 for about nine miles	Yes, service in both directions during peak periods
20F, W, X, Y Chantilly-Greenbriar[3]	Local	Yes	Vienna/Fairfax-GMU	U.S. 50 for five to seven miles and on I-66 for about four miles	Yes, service in both directions during peak periods

[3] These service operations have been transferred to Fairfax Connector as of June 29, 2009.

3.3 Existing TDM Services

A variety of TDM programs and services operate in and around the study corridor. These elements are considered to be part of the existing conditions for this study. This section provides details about each of the TDM strategies by provider jurisdiction, including:

- Park-and-ride lots;
- Carpool ridematching and incentives;
- Guaranteed Ride Home program;
- Vanpool ridematching and subsidies;
- Commuter stores;
- Telework programs;
- Carsharing services; and
- Commercial site plan review.

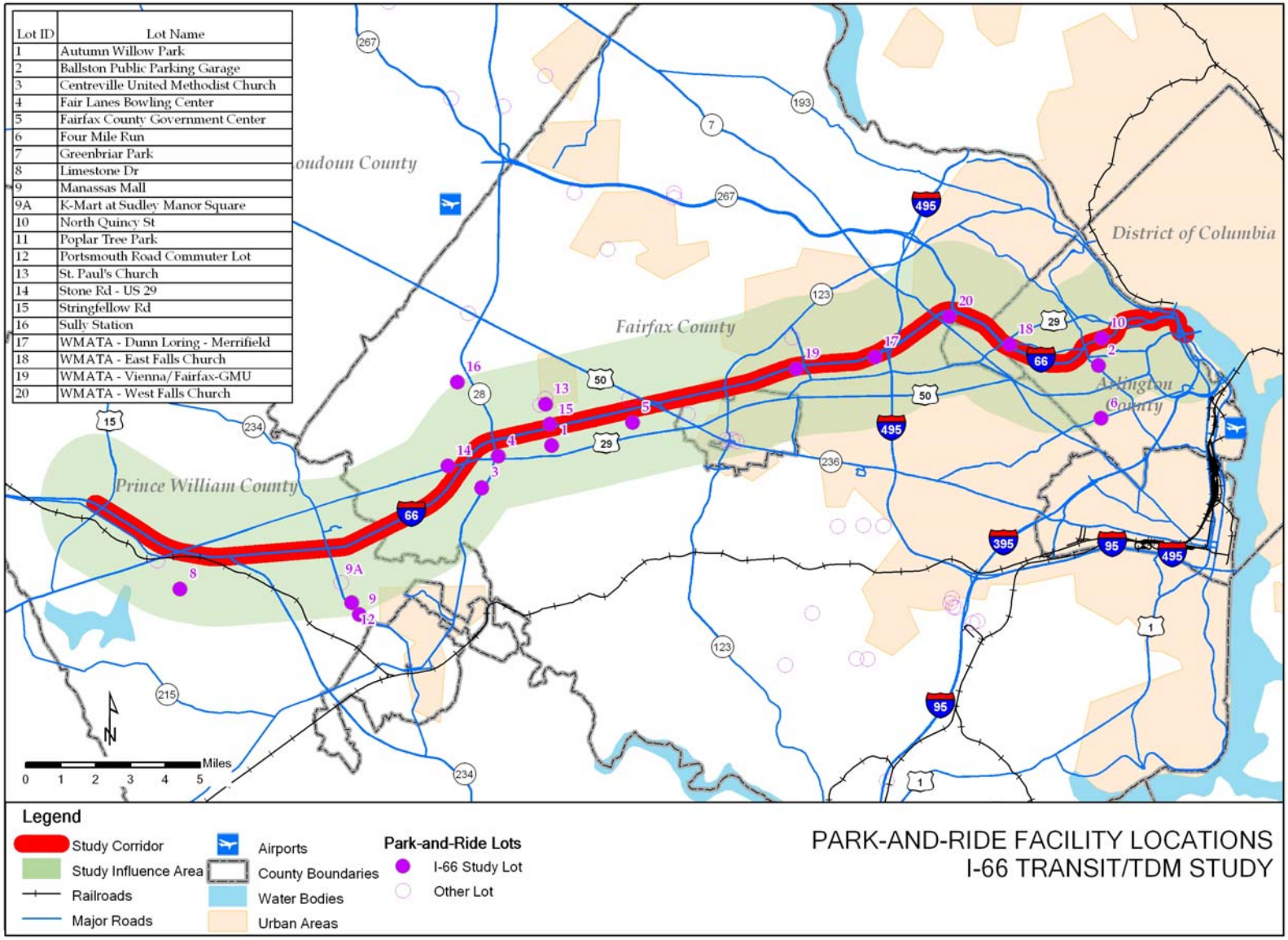
3.3.1 Park-and-Ride Lots

Eighteen park-and-ride lots have been identified within the project's study area: four in Arlington County; 11 in Fairfax County; and three in Prince William County. Of these facilities, four are located at Metrorail stations. The available park-and-ride facilities are shown in Figure 3-3.

The park-and-ride lots are served by a variety of bus services as well as provide convenient locations for the formation of carpools. The phenomenon of informal carpool formation (i.e., slugging) is largely absent from the I-66 corridor. This is thought to be chiefly due to the HOV occupancy requirement being two persons per vehicle in this corridor. It stands in contrast to the I-95 corridor where significant slugging activity is observed, but where the HOV occupancy requirement is three persons per vehicle.

Analysis of the park-and-ride facilities, including information on current usage, can be found in Section 10. The park-and-ride lots at Four Mile Run, North Quincy Street, Stone Road-U.S. 29, Stringfellow Road, and the WMATA lots at Dunn Loring/Merrifield, East Falls Church, Vienna/Fairfax-GMU, and West Falls Church are all currently fully utilized.

Figure 3-3. Study Area Park-and-Ride Facilities



3.3.2 Northern Virginia-Wide TDM Strategies

Table 3-2 details all of the regional TDM strategies that are in place as of 2005. Many of these programs are coordinated through the regional TDM network, Commuter Connections.

Table 3-2. Existing Northern Virginia-Wide TDM Strategies

Northern Virginia-Wide
Commuter Connections – A network of public and private transportation organizations – including state and local transportation agencies, regional/metropolitan planning organizations and transportation management associations that work together to achieve the mission of encouraging the use of alternatives to the single-occupant vehicle. Network members serving the I-66 corridor are: Arlington County, City of Alexandria, Fairfax County, Loudoun County, Metropolitan Washington Council of Governments (MWCOG), Northern Shenandoah Valley Regional Commission, Potomac Rappahannock Regional Commission (PRTC) and Rappahannock-Rapidian Regional Commission. The network promotes transit and high occupancy commute modes and provides carpool/vanpool matching, transit and commuter information to residents and workers. Network member MWCOG conducts region-wide television, radio, and print marketing for non-SOV modes.
Regional Ridematching – Regional Ridematching is the Commuter Connections ridematching service hosted by MWCOG. Commuters can apply by phone, on-line, through employers and the Commuter Connections network member for lists of potential carpool or vanpool partners. Commuters can access the regional ridematching site (commuterconnections.org) or through links from network member web sites.
Regional GRH – Commuter Connections Guaranteed Ride Home (GRH) service operated by MWCOG provides up to four free rides home per year to workers who use transit, carpool, vanpool, or bicycle to work, and work in the metropolitan Washington, D.C. region that includes the District of Columbia, Alexandria, Arlington County, Fairfax County, Loudoun County, and Prince William County.
Regional TDM Marketing – Regional TDM marketing is Commuter Connections' network marketing program. The program conducts regionwide marketing campaigns in the Spring and Fall. Marketing primarily focuses on Commuter Connections' GRH and ridematching programs. Marketing includes direct mail, radio advertisements, web banner advertisements, traffic sponsorships, and other promotions. Jurisdictional Commuter Connections network members also conduct local marketing and promotions using local newspapers, radio, and on-site promotions.
VanStart/VanSave – Virginia's Commuter Connections network members provide financial assistance to cover vacant seats to start a new vanpool and keep an existing vanpool in service until the vacant seats can be filled by regular riders.
NuRide Carpool Incentives – Provides financial incentives in the form of redeemable points at participating merchants. Points are earned each time a person carpools.
Employer Outreach – Commuter Connections network members provide outreach and assistance to employers to promote and implement new, or expand existing, employer-based TDM programs. See individual jurisdiction for details,
Telework!VA – Provides professional and technical assistance and financial incentives to employers in Virginia that start or expand telework programs.
Commuter Connections Telework Assistance (Maryland) – Provides professional and technical assistance to employers in Maryland that start or expand telework programs. Also open to Virginia residents employed in Maryland.
Regional Bike to Work Day – Annual one-day event in May to promote bicycle commuting.
HOV Lanes – I-66, Dulles Toll Road, and I-95/I-395.
Park-and-Ride Lots – Locations throughout the region, 18 within the corridor.

3.3.3 Details on Jurisdiction TDM Strategies

Tables 3-3 provides detailed information about TDM programs and services for each of the local jurisdictions in the study area in place as of 2005.

Table 3-3. Existing Regional TDM Strategies

City of Alexandria
Alexandria Local Motion TDM Program – Promotes transit, high-occupancy, and nonmotorized travel modes and provides carpool/vanpool matching and transit and commuter information to residents and workers. Provides outreach and assistance to employers to promote transit, high-occupancy, and nonmotorized commute modes. Encourages and assists employers with employee commute benefits and incentives.
Local Motion Web Site – Provides general commute information, commute cost calculator, local bike trail maps. Provides links to useful resources, including transit maps/schedules, Commuter Connections, vanpool leasing vendors, VDOT traffic cameras, Virginia 511, Virginia road alerts, Smart Tag/E-ZPass, NuRide, and HOV lane information.
Carshare Alexandria! – Vehicles available at eight locations. Membership program operated by Zipcar. The City offers reimbursement to residents for a first-time membership. Businesses receive partial reimbursement.
Old Town Transit Shop – Located across from the King Street Metrorail station. Offers transit schedules/ information and sells transit fare media for WMATA and other systems serving Alexandria.
Transit Services – DASH, Metrorail, Metrobus, VRE, King Street Trolley.
Arlington County
Arlington County Commute Services (ACCS) – Promotes transit and high-occupancy commute modes and provides carpool/vanpool matching and transit and commuter information to residents and workers.
ACCS Marketing Program – Provides marketing to Arlington residents for Arlington Transit (ART) and all TDM services via comprehensive direct mail, detailed transit schedules and maps at all ART stops and many Metrobus stops throughout the county, brochures, on-board and in-station transit advertising, and increasingly sophisticated Internet and electronic marketing.
Arlington Transportation Partners (ATP) – Works with employers to promote transit and high-occupancy commute modes. Encourages and assists employers with employee commute benefits, incentives, and telework programs.
Slug Lines – Morning drop-off at Pentagon, Crystal City, and Rosslyn. Afternoon pick-up at these locations and D.C. to destinations to the south.
Commuter Stores – Three stores (Ballston, Crystal City, and Rosslyn) and one mobile commuter store provide personal commuting assistance and ticket sales.
Arlington Carshare – Fifty vehicles available at 32 locations. Membership program (approximately 3,500 members) operated by Zipcar. Arlington County provides on-street parking spaces for visibility and access.
CommuterPage.com – Comprehensive transportation resource web site with general commute information. Provides extensive links to useful resources in Arlington, D.C., and other Northern Virginia and Maryland suburbs, including transit maps and schedules, Commuter Connections, vanpool leasing vendors, Washington Area Bicyclist Association (WABA), bike resources, VDOT traffic cameras, Virginia 511, Virginia road alerts, Smart Tag/Easy Pass, NuRide, HOV lane information, taxi companies, airport services, and most local/state/regional transportation organizations. Special section on resources for seniors and disabled populations. Can download many items from the web site to computer or personal data assistant (PDA) in addition to ordering schedules and brochures by mail.

Table 3-3. Existing Regional TDM Strategies (continued)

Arlington County (continued)

CommuterDirect.com – On-line ordering service for individuals to purchase transit fare media for all regional services; can place one-time order or "renewable" orders for regular (e.g., monthly) use.

Logistics and Distribution – Supports the dissemination of printed information via on-line ordering and high-volume distribution system to stock Commuter Stores, information displays, and employer and residential clients.

BikeArlington – Arlington County program to promote and support bicycling for commute and nonwork trips. Services include web site, bike advocacy, bike planning, group bike rides, and others. BikeArlington.com web site offers biking information, bike maps, safety information, and links to large number of bike resources.

WalkArlington – Arlington County program to promote and support walking for commute and nonwork trips. Services include web site, "walkabouts" group walking tours, pedestrian advocacy and planning activities, and others. WalkArlington.com web site offers walking information, local pedestrian maps, safety information, and links to large number of walking resources.

Commercial Site Plan TDM – TDM requirements for new commercial buildings where higher Floor Area Ration (FAR) is requested. TDM services can include information, bike racks/lockers, personal showers/ lockers, transit subsidies, and/or other site amenities that would encourage use of non-SOV modes.

Transit Services – ART, Metrorail, Metrobus, VRE.

Park-and-Ride Lots – Four locations include Ballston, Four Mile Run, North Quincy Street, and East Falls Church Metrorail station.

Culpeper Area

Rappahannock-Rapidan Commuter Services – Promotes transit and high-occupancy commute modes and provides carpool/vanpool matching and transit and commuter information to residents and workers.

Employer Services Program – Provides outreach and assistance to employers to promote transit and high-occupancy commute modes. Encourages and assists employers with employee commute benefits and incentives.

Rappahannock-Rapidan Regional Commission (RRRC) Commuter Services Web Site – Includes general commute information, a map of park-and-ride lots in the service area and links to other resources, including Commuter Connections (ridematch application, GRH), commuter bus services, regional/D.C. area services, and other Virginia rideshare programs: <http://www.rrcommute.org>.

Transit Services – Regional Commuter Bus service to Metrorail and D.C.

Park-and-Ride Lots – Two locations listed on Commuter Connections web site, although not within study area.

District of Columbia

District Department of Transportation (DDOT) – Promotes bicycle, walking, and transit for commute and nonwork travel.

On-Line Information Web Site – On DDOT's main web site under "Traveler Information." Extensive information on bicycling and pedestrian travel. Provides links to WMATA for transit information. Also maintains <http://www.goDCgo.com> as an on-line multimodal resource.

Carshare – Extensive program with vehicles available throughout the City. Membership program (estimate more than 15,000 members) operated by Zipcar. DDOT provides 86 on-street parking spaces for visibility and access.

Slug Lines – Morning pick-up in Virginia along I-95 for travel into D.C. Afternoon pick-up in D.C. for destinations to the south.

Special Events TDM – Works with special event organizers to incorporate TDM strategies into their event planning such as encouraging participants to use alternative transportation to get to event, providing valet bike parking, etc.

Transit Services – Metrorail, Metrobus, and D.C. Circulator in center city.

Table 3-3. Existing Regional TDM Strategies (continued)

Fairfax County
Fairfax County RideSources – Promotes transit and high-occupancy modes and provides carpool/vanpool matching and transit and commuter information to residents and workers.
RideSources Web Site – Provides general commute information and links to Commuter Connections for ridematching. Links to other commuter information (park-and-ride, transit, HOV) are available through the Employer Services page of the site.
Dulles Area Transportation Association (DATA) – This Transportation Management Association (TMA) promotes transit and ridesharing information to employers in the Dulles Corridor. Web site has links to other commute organizations in northern Virginia.
LINK – This TMA promotes transit and ridesharing to employers and commuters in the Reston area. Web site has links to other commute organizations in the D.C. region.
Transportation Association of Greater Springfield (TAGS) – This TMA works with transit service providers, including Fairfax Connector, WMATA, VRE, and OmniRide to identify needs, develop support, and assure the best possible transportation service in the Springfield area.
TYTRAN Commuter Program – This TMA is a voluntary program that provides opportunities for member employees to participate in a variety of ridesharing activities designed to increase employee awareness of transit and transportation options into and around the Tysons Corner area.
Fairfax County Employee Commuter Benefit Program – Provides a nontaxable commuter benefit or subsidy to encourage Fairfax County employees to use high-occupancy vehicles and public transportation for their daily commute.
Employer Services Program – Provides outreach and assistance to employers to promote transit and high-occupancy commute modes. Assists employers with employee commute benefits and incentives. Provides employers with customized maps of employee's origin points throughout the region.
Commuter Stores – Five stores, including Franconia/Springfield, Tysons West*Park, Reston East Park-and-Ride, Reston Town Center, and Herndon-Monroe Park-and-Ride.
Carshare – Vehicles at Metrorail stations. Membership program operated by Zipcar.
Transit Services – Fairfax Connector, Metrorail, Metrobus, VRE, CUE (Fairfax City), and George (City of Falls Church).
Slug Lines – Morning pick-ups at various locations along I-95. Afternoon pick-up in Arlington and D.C. to destinations to the south.
Park-and-Ride Lots – Approximately 45 lots located throughout the County, including 11 in the study area, including three Metrorail stations, Fairfax County Government Center, Autumn Willow Park, Stringfellow Road, St. Paul's Church, Fair Lanes Bowling Center, Centreville United Methodist Church, Stone Road – U.S. 29, and Sully Station.
Front Royal, Northern Shenandoah Area
Valley Commuter Assistance – Promotes transit and high-occupancy commute modes, and provides carpool/vanpool matching and transit and commuter information to residents and workers. Works with employers to promote transit and high-occupancy commute modes. Encourages and assists employers with employee commute benefits and incentives.
Valley Commuter Assistance Web Site – Provides general commute information with ridematch application and list of park-and-ride lots. Offers links to commuter bus services, GRH through Commuter Connections, vanpool lease vendors, Virginia transportation organizations, and Virginia 511.
Park-and-Ride Lots – Two locations listed on Commuter Connections web site, although none are within the study area.

Table 3-3. Existing Regional TDM Strategies (continued)

Loudoun County
Loudoun County Commuter Services – Promotes transit and high-occupancy commute modes and provides carpool/vanpool matching, and transit and commuter information to residents and workers. Works with employers to promote transit and high-occupancy commute modes. Encourages and assists employers with employee commute benefits and incentives.
On-Line Commute Information – Available through the County web site (www.loudoun.gov/commute). Site offers general commute options information and links to transit services, NuRide, Commuter Connections, vanpool lease vendors, and other County transportation services.
Transit Services – Loudoun County Transit (commuter bus), Virginia Regional Transit (fixed-route bus within Loudoun).
Park-and-Ride Lots – Twelve locations are listed on the Commuter Connections web site, although none within the study area.
Prince William County
PRTC OmniMatch – Promotes transit and high-occupancy commute modes, and provides carpool/vanpool matching and transit and commuter information to residents and workers.
Employer Outreach – Contracts yearly for employer outreach efforts in Prince William County and the cities of Manassas and Manassas Park. Works with employers of 100 or more employees to promote transit and high-occupancy commute modes and encourages and assists employers with employee commute benefits and incentives.
OmniMatch Web Site – Provides general commute information, ridematch application, and links to OmniRide transit service for schedules and downloadable maps. Other links include Commuter Connections for ridematching, park-and-ride maps (shows all transit serving lots), HOV information, slug line information, and on-line VanStart/VanSave applications.
SmartBenefits Voucher Redemption Center – Redeems SmartBenefits vouchers for vanpool operators.
Slug Lines – Morning pick-ups at various locations along I-95. Afternoon pick-up in Arlington and D.C. to destinations to the south.
Transit Services – OmniRide, VRE, feeder connections to Metrorail at West Falls Church, OmniRide Family Service.
Park-and-Ride Lots – Twenty-three locations listed on Commuter Connections web site, most served by OmniRide. Four in the study area include Limestone Drive, Manassas Mall, K-Mart at Sudley Manor Square, and Portsmouth Road Commuter Lot.

3.4 Existing Pedestrian and Bicycle Facilities

Facilities of many different types for pedestrians and bicyclists, including sidewalks, trails, bike storage facilities, and pedestrian-oriented safety measures are available throughout the study area. Many of these existing routes have regional significance as shown in the Northern Virginia Regional Bikeway and Trail Network Study conducted by VDOT in 2003. However, the quality and density of these facilities varies somewhat depending on the surrounding environment. Facilities for nonmotorized modes are a major part of the transportation infrastructure in the more urban areas of Arlington County, the City of Falls Church, the City of Fairfax, and Fairfax County within the study area. Although more suburban in nature, outer Fairfax County and Prince William County both accommodate bicyclists and pedestrians through a range of facilities and programs. Although not exhaustive, the following subsections provide an overview of the major programs and facilities offered in the study area.

3.4.1 Arlington County

The most urban of the counties in the study area, Arlington County has strong programs for both pedestrians and bicyclists. The I-66 corridor through Arlington County is especially friendly to bicyclists and pedestrians due to the presence of high-density developments along the Metrorail Orange Line. Sidewalks, crosswalks, and other pedestrian-friendly features are commonly found throughout this part of the study corridor. In addition, bicycle facilities, including trails and bike lanes, allow for safe cycling in many areas of the County. The Arlington County Bike Map includes all of these facilities and has been attached as Appendix B. Of particular note on this map are the Martha Custis Trail, a 4.3-mile-long trail running parallel and usually within the I-66 right-of-way that connects to D.C., and the Washington and Old Dominion Trail (W&OD). The W&OD trail is a 45-mile-long trail connecting the Shirlington area in Arlington County to Purcellville in Loudoun County and also runs along I-66 within Arlington County. In addition, these trails also connect to the Four Mile Run trail extending to the City of Alexandria border.

Arlington County supports a range of pedestrian and bicycle programs which are highlighted on a pair of web sites: <http://www.bikearlington.com> and <http://www.walkarlkington.com>. The County supports both a Pedestrian Advisory Committee and a Bicycle Advisory Committee that facilitate citizen input in the planning process and other nonmotorized needs. Bicycling programs in the County include the ART Bike on Bus program which provides a bike rack on each ART bus, Confident City Cycling Classes, and bike registration. Resources for pedestrians include guided tour information, safe walking routes to schools, walking for health information, an e-mail list for citizens to keep current on pedestrian information in Arlington County, trail maps, pedestrian safety tips, traffic calming information, a listing of all sidewalk closures, and a comprehensive database of current construction projects that involve pedestrians. New construction and land development projects in the county also are subject to review based on their effects on pedestrians and bicyclists. The Arlington County Bike and Trail Network map provided in Appendix B shows the existing and planned bicycle and pedestrian facilities in Arlington County.

3.4.2 City of Falls Church

The City of Falls Church has an urban character that incorporates pedestrian and bicycle facilities into transportation infrastructure. Pedestrian facilities, including sidewalks and crosswalks, can be found on most residential and commercial streets. The city has also recently completed a selection of pedestrian improvements to West Broad Street, the city's main east-west thoroughfare. The 2005 Comprehensive Plan supports the development of additional pedestrian infrastructure, especially on residential streets currently lacking sidewalks.

The city also supports the use of bicycles by providing a range of information, maps, and safety tips on the city web site. The major facility in the city is the W&OD trails, which continues between Arlington and Fairfax Counties. The trail travels for approximately 1.4 miles across the city. Falls Church also supports a network of local trails and bicycle routes that provide connections to regional facilities.

3.4.3 Fairfax County

The portions of Fairfax County within the study area are comprised of very urban communities and more suburban environments. However, Fairfax County has shown a commitment to accommodating pedestrians and bicyclists throughout the County. Of particular significance is the Fairfax County Parkway Trail that is over 25 miles long running north to south and intersecting the study corridor. In addition, the almost-completed Cross County Trail (CCT), extending from Great Falls to Occoquan, will also intersect the study corridor. In 2006, the Fairfax County Board of Supervisors approved the Comprehensive Bicycle Initiative, which facilitates making Fairfax County bicycle friendly. While the county already employed a pedestrian coordinator, a trails

coordinator, and maintains an extensive proposed county wide trail plan, this initiative included the establishment of a full-time staff position dedicated to bicycle facilities planning and coordination. This job description includes identifying roads and streets that may accommodate on-road bike lanes with minimal reconstruction, and establishing a pilot program for an interconnected bicycling network. Fairfax County has a Trails and Sidewalks Committee which evaluates existing facilities for the placement of trails, sidewalks, and bicycle routes, as well as assisting the county in planning new facilities. In addition the Fairfax County Board of Supervisors has established a Pedestrian Task Force, which includes citizens, appointed commission members, and county staff, who review pedestrian programs, make recommendations, develop education and outreach efforts, and prioritize funding for pedestrian projects.

The Fairfax County Bike Map, shown in Appendix C and developed in 2008, shows the range of existing trails and shared lanes available for bicyclists in the County. Major sidewalk projects have recently been completed along U.S. 1, U.S. 29, and VA 236. The County includes numerous pedestrian improvements in its four-year transportation plans. Other programs that have been implemented in Fairfax County to facilitate bicycle use include equipping all buses with front-mounted bike racks, installing bicycle lockers at the Reston East and the Herndon-Monroe park-and-ride lots, and establishing a dedicated phone line and e-mail mailbox for easier communication with the public. Standards for land development currently are being created by the County to address issues such as bicycle parking, rack, and locker specifications, provision of changing facilities, bicycle sharing and other programs, as well as developing a list of projects that will improve bicycle travel and securing funding for these projects.

3.4.4 City of Fairfax

The City of Fairfax incorporates urban and suburban features, including pedestrian and bicycling facilities. The City's center is more urban in nature than many of the surrounding areas and includes good pedestrian facilities including crosswalks and sidewalks. The City also supports a network of trails and pathways that is currently focused on recreational uses. However, the 2004 Comprehensive Plan[4] recommends the expansion and improvement of this system to accommodate and encourage daily use by providing better connections with other modes, including public transportation. Some residential neighborhoods within the City do not have pedestrian facilities. The City of Fairfax is currently sponsoring a program to construct concrete sidewalks on residential streets without them.

The City also supports bicycling with a network of multipurpose trails, paved trails, sidewalks, and shared roadway facilities. At the Vienna Metrorail station, the City's bicycle network is connected to the regional network at the W&OD trail. The City of Fairfax does support a Bikeways Review Committee that seeks to enhance bicycle facilities in the City. Information about bicycling locally and regionally, including maps, safety tips and other information is provided in the "Cycling in the City[5]" section of the City's web site.

3.4.5 Prince William County

Prince William County is the most suburban of the counties in the study corridor, and therefore has a lower density of pedestrian and bicycle facilities than the more urban portions of the

[4] City of Fairfax Comprehensive Plan. July 27, 2004. <http://www.fairfaxva.gov/CompPlan/CompPlan.asp>.

[5] Cycling in the City. Accessed November 23, 2009. <http://www.fairfaxva.gov/Transportation/BikingInCity.asp>.

corridor. Prince William County does maintain a strong commitment to the implementation of facilities and programs to accommodate and encourage pedestrian and bicycle travel through the development of a network of trails, sidewalks, bike lanes, and bike routes as outlined in the 2008 Comprehensive Plan.

Sidewalks and other pedestrian facilities are required by the County's Design and Construction Standards Manual, and are typically built by developers. Sidewalks also are built by the County and VDOT as part of road widening projects. Prince William County contains 75 miles of trails, including a trail along the Prince William Parkway. More trails are being planned throughout the County, especially in and around Manassas, where a new Bike Trail Master Plan recently has been completed.[6]

3.4.6 Transit Access

A total of nine Metrorail stations are located in the I-66 corridor located between Vienna/Fairfax-GMU and Rosslyn on the Orange Line. All Metro stations are equipped with some type of bicycle storage such as racks or lockers. The three westernmost stations are located in Fairfax County, while the remaining six stations are located in Arlington County. The five underground stations in Arlington County (Ballston-MU, Virginia Square-GMU, Clarendon, Court House, and Rosslyn) are located in dense urban areas and are well served by the many pedestrian and bicycle facilities located in the corridor. In addition, these stations are each within one-half mile of the Martha Custis bike trail.

While not quite as urban as eastern Arlington County, the area around the East Falls Church Metrorail station also is well served by dense network of sidewalks, crosswalks, and bike routes. The W&OD bike trail also is located directly adjacent to the East Falls Church station and also passes very close to the West Falls Church station. West Falls Church station also is connected to the surrounding neighborhoods through a network of sidewalks and pedestrian facilities.

The westernmost Metrorail stations in the corridor (Vienna/Fairfax-GMU and Dunn Loring-Merrifield) are located in more suburban areas and include large parking facilities. However, within the immediate station area, these stations also are well connected to pedestrian and bicycle facilities. Sidewalks, crosswalks, and bike routes are available to access both of these stations. In the areas closest to the station entrances, separated bike trails also are provided to provide access to the wider bicycle network in the County.

All six of the transit operators in the I-66 corridor have equipped all of their buses with bicycle racks. In addition, WMATA allows bicyclists on Metrorail vehicles during off-peak times. VRE also allows a limited number of bicyclists on midday trains and on certain peak trains. Bicycle lockers are also available for an annual fee at several VDOT park-and-ride lots under VDOT's Bicycle Locker Program.

[6] Miroff, Nick. "Manassas Gears up to Extend Bike Trails," *Washington Post*, June 22, 2006. <http://www.washingtonpost.com/wp-dyn/content/article/2006/06/21/AR2006062100067.html>.

4.0 Market Demand Methodology and Forecasts

This section presents findings from analyses conducted to help examine potential markets for transit and TDM services within the study corridor and the demand for these types of services. This analysis used existing and future MWCOG land use projections and Census data for the region, including household levels, employment levels, and other indicators of transit use for the three study years (2005, 2015, and 2030) to reveal geographic areas where transit and TDM programs may be successful in the future. Current travel patterns within the study corridor were reviewed to identify origin-destination pairs with high potential demand for transit and TDM services.

4.1 Land Use Forecasts

MWCOG land use projections provide detailed population and employment estimates for the Washington Metropolitan region for the horizon years of 2005, 2015 and 2030.[1] These estimates are used both to determine potential transit markets as discussed in this section and are also incorporated into the definitions of the existing and baseline conditions (Section 3 and Section 6, respectively.) A summary of the estimated population and employment levels in each of the three horizon years by jurisdiction is provided in Table 4-1.

Table 4-1. Land Use Summary by Jurisdiction

	Households (thousands)			Employment (thousands)		
	2005	**2015**	**2030**	**2005**	**2015**	**2030**
Washington, D.C.	253.6	283.1	325.7	745.3	818.8	881.4
Arlington County	92.2	108.8	117.8	194.9	217.6	258.4
City of Alexandria	66.3	74.5	87	105.7	119.3	141.5
Montgomery County	347	390	441.3	500	580	670
Prince George's County	307.3	346	377.8	347.9	389.1	518.4
Fairfax County	377.6	442.6	482.3	604	741.5	847.6
City of Fairfax	8.5	9.6	10.5	29.2	33.3	39.3
City of Falls Church	4.6	6.5	7.3	9.5	15.1	20.3
Loudoun County	87.5	125.9	165.9	130.3	203.8	290.7
Prince William County	122	158.5	193.1	111.6	143.7	186
City of Manassas	12.8	13.7	14.4	23.3	26.2	26.8
City of Manassas Park	4.2	5.3	5.4	3	4.6	4.9
Calvert County	28.3	32.7	36.2	29.4	33.7	35.6
Charles County	48.2	57.9	76.9	56.5	64.8	69.1
Frederick County	79.5	95.9	123.1	122.2	151.5	167.3
Stafford County	37.2	50.7	69.2	38.3	52.4	67.9
Total	**1,876.8**	**2,201.7**	**2,533.9**	**3,051.1**	**3,595.4**	**4,225.2**

Land use characteristics and demographic information, including employment and population densities and vehicle ownership levels can provide insight into which geographic areas within the

[1] MWCOG Round 7.1 Cooperative Land Use Forecasts.

study area are the best able to support successful transit and TDM services. High levels of concentrated employment or households provide more transit riders than low-density areas . Similarly, households with low levels of vehicle ownership are more likely to require transit services. This analysis used land use data (2005) and forecasts (2030) developed by MWCOG/TPB for the metropolitan region to determine areas within or near the study area that display these types of transit and TDM supportive characteristics. Data for 2015 was developed using straight-line interpolation; therefore, the 2015 data exhibits the same trends as those found in the 2030 data discussed in this section.

Figures 4-1 and 4-2 show the density of employment within the study corridor in 2005 and 2030, respectively. Major areas of employment growth are highlighted in Figure 4-3 and include Tysons Corner, the area surrounding Dulles Airport especially along VA 28, Gainesville, the area near the Pentagon, and the City of Fairfax. Northern Arlington along the Metrorail Orange Line, southern Arlington, the D.C. central business district, and the Reston/Herndon areas along the Dulles Toll Road are expected to maintain their high levels of employment density.

Figure 4-4 shows the 2005 household density in the region while Figure 4-5 shows regional household density in 2030. In both years, the highest residential densities can be found in D.C., Arlington, and Alexandria, all within the bounds of the Capital Beltway. Figure 4-6 highlights the areas with the highest amount of residential growth, most of which occurs in the western portion of the study area, including Haymarket, Gainesville, Dulles, Herndon, and Tysons Corner. Some additional residential growth also is expected in Arlington County south of the I-66 corridor.

The MWCOG/TPB forecast locations of zero-vehicle households are a good indicator of transit ridership, as residents in these areas may have limited alternatives. Figure 4-7 illustrates that zero-vehicle households are forecast to spread around the study area. Although the highest density of these households will be inside the Beltway in places like D.C. and Arlington, areas like Tysons Corner, Herndon, and Fairfax City are all projected to have relatively large increases in zero-vehicle households between 2005 and 2030.

Figure 4-1. 2005 Employment Density

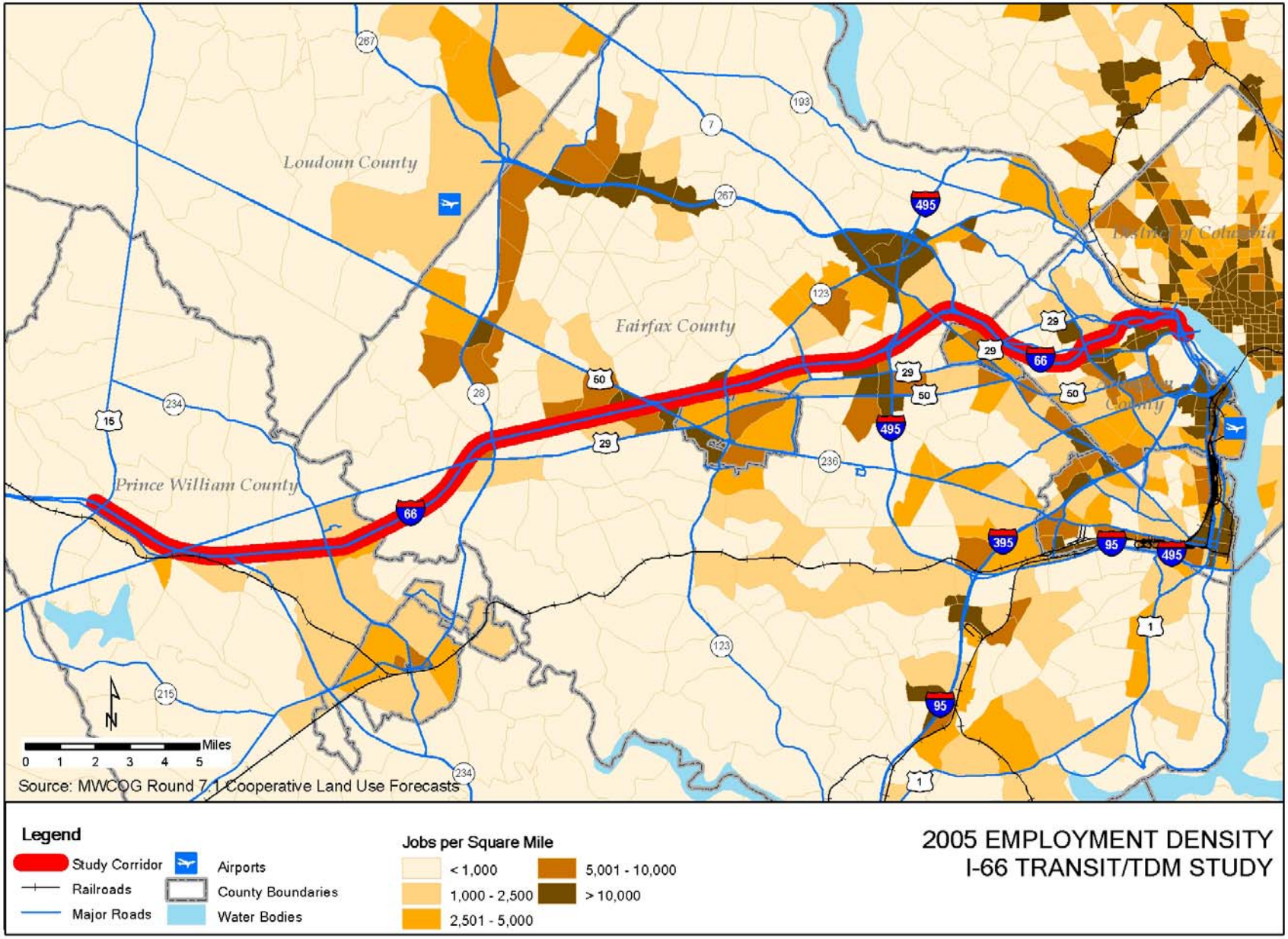


Figure 4-2. 2030 Employment Density

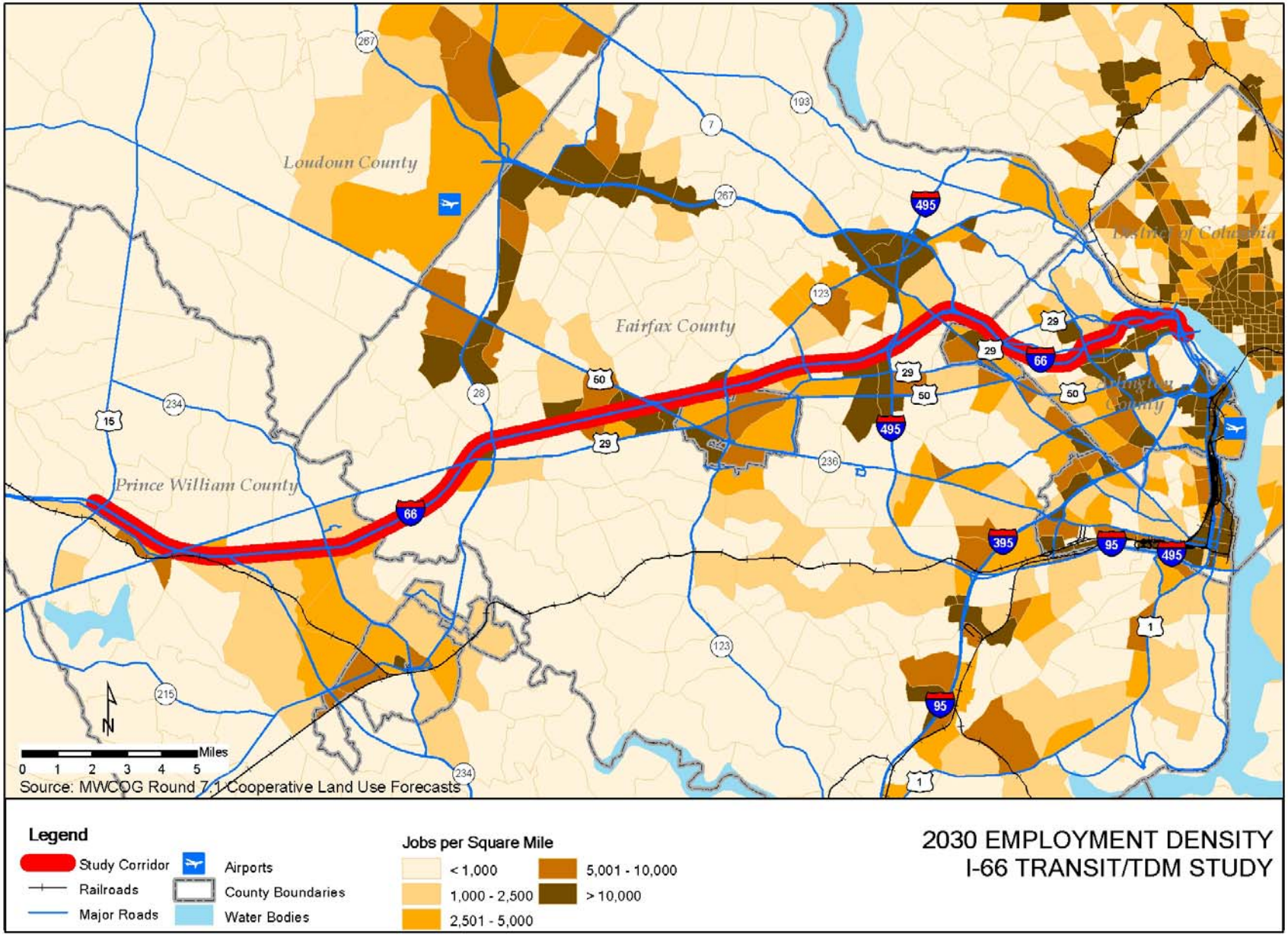


Figure 4-3. 2005 to 2030 Employment Density Growth

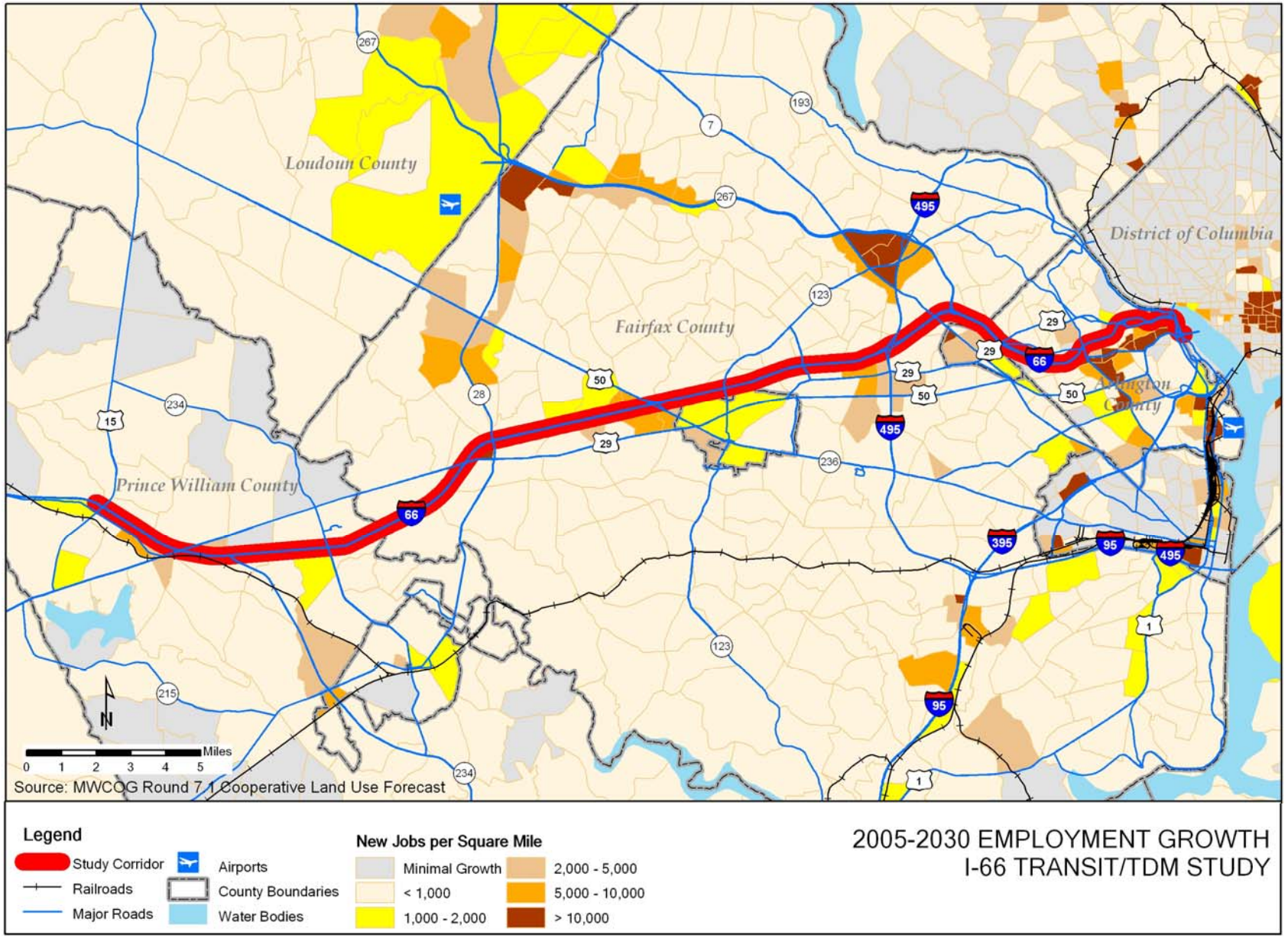


Figure 4-4. 2005 Household Density

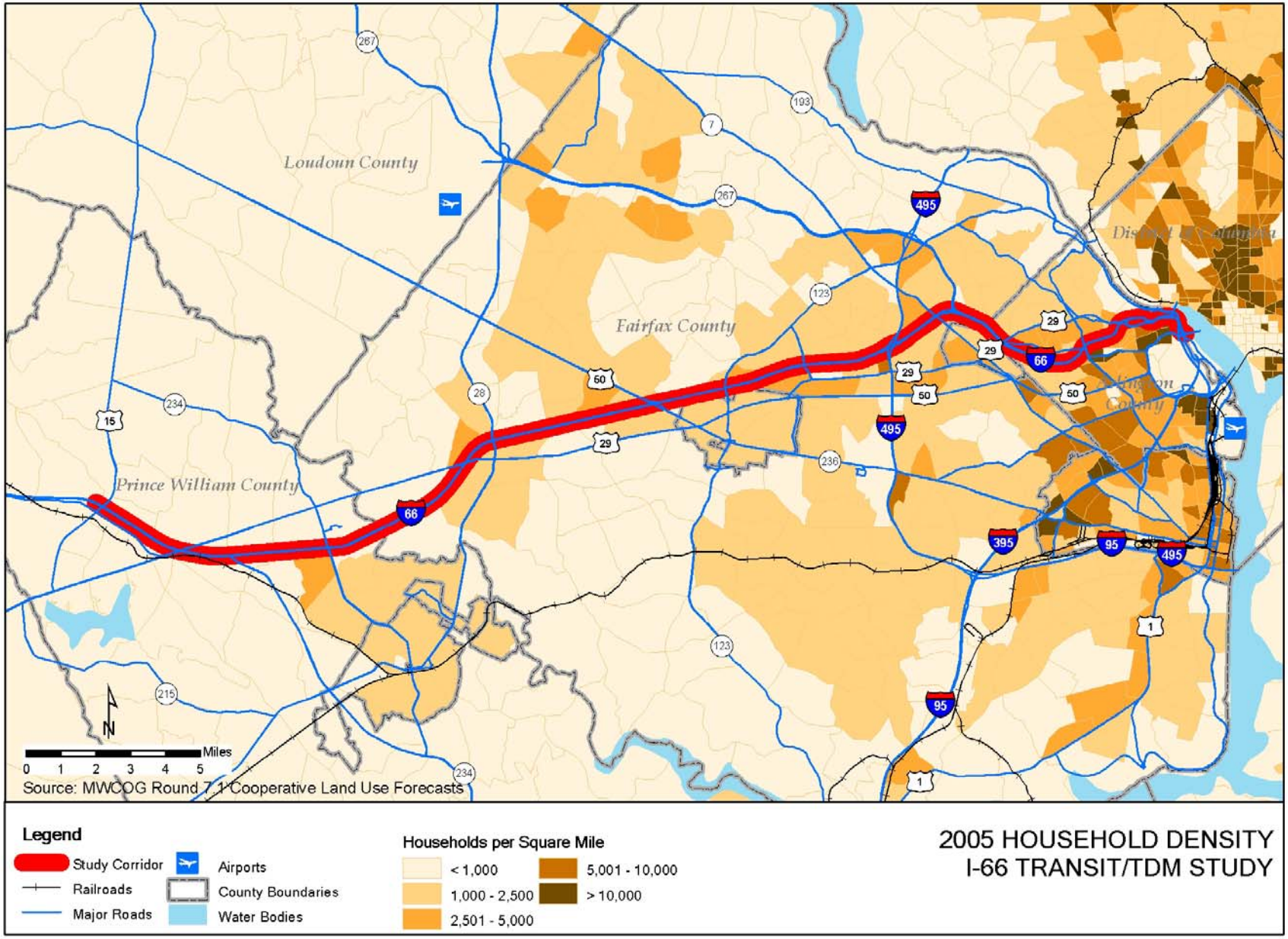


Figure 4-5. 2030 Household Density

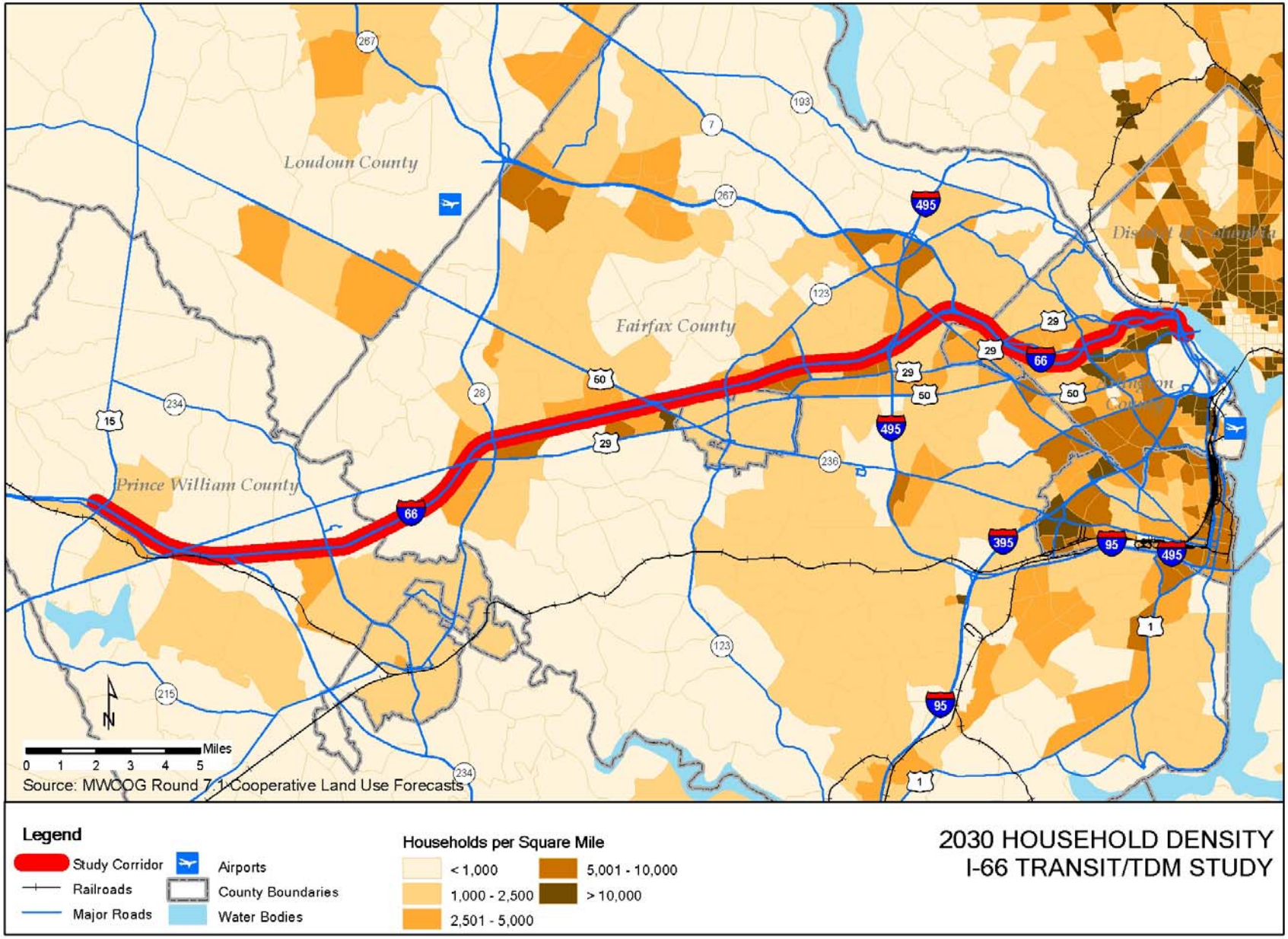


Figure 4-6. 2005 to 2030 Household Density Growth

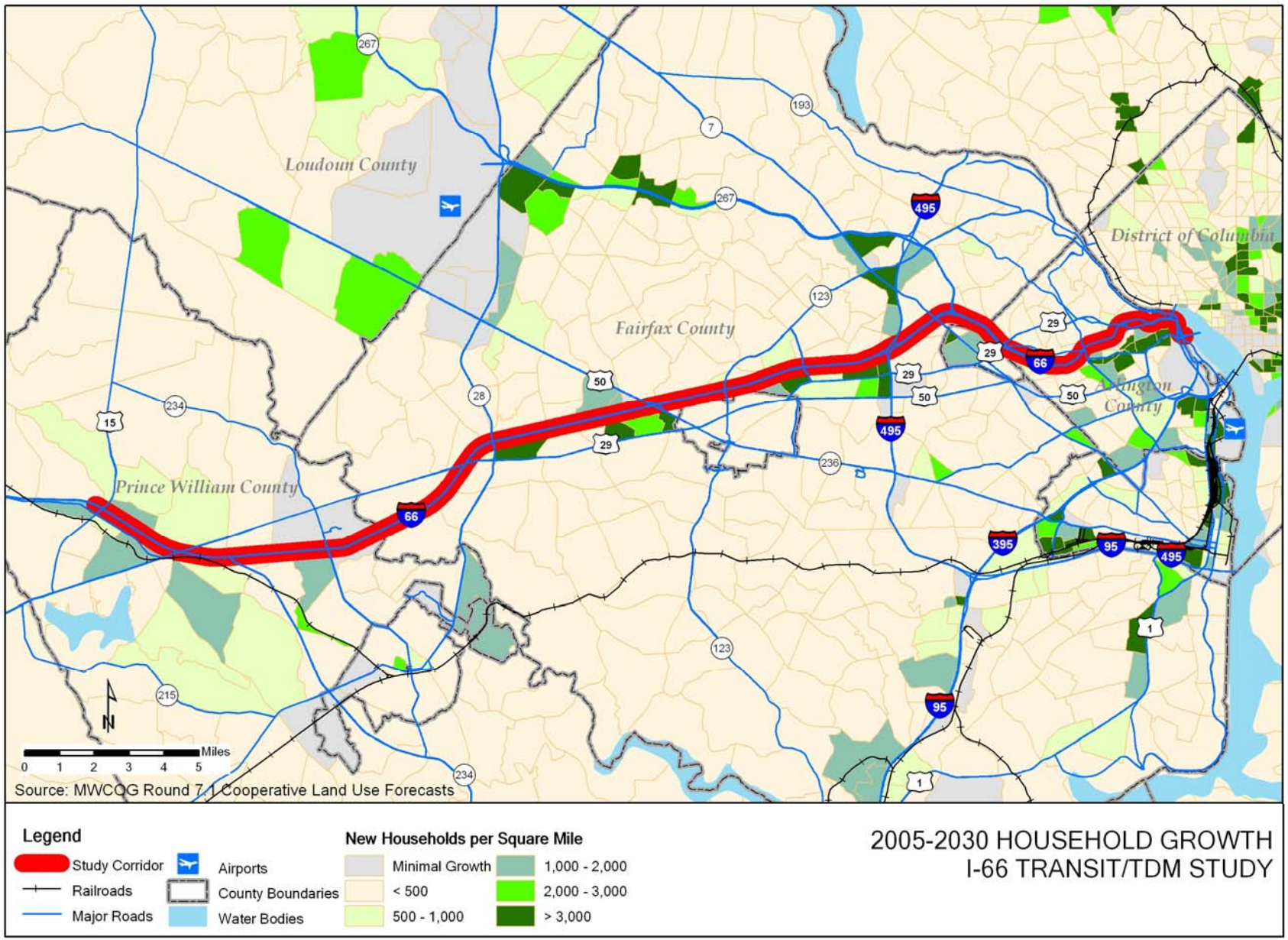
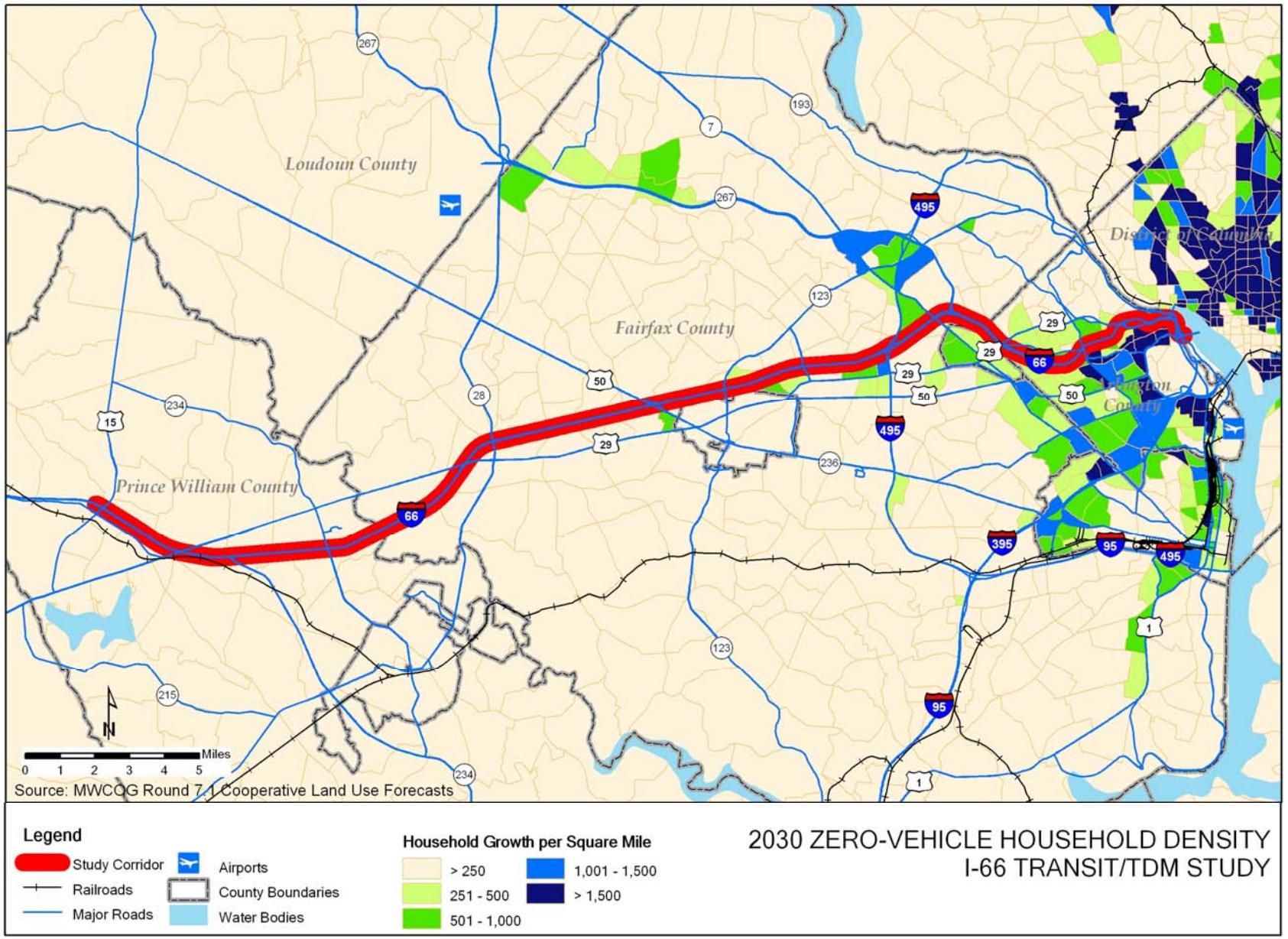


Figure 4-7. 2030 Zero-Vehicle Household Density



4.2 Potential Market Demand

The study identified a wide range of potential origins and destinations that may influence travel in the I-66 study corridor. The 25 locations shown in Figure 4-8 are based on major residential, commercial, or mixed-use activity centers in or near the study area.

The travel demand model results from running the November 2008 MWCOG/TPB Version 2.2 model on 2015 and 2030 CLRP networks were analyzed for each of these activity centers in order to determine origin-destination pairs with enough demand to support potential new transit service. Potential transit markets in the peak direction (eastbound) are shown in Table 4-2. Markets served by existing or planned Metrorail service are highlighted in the Metrorail column.

Table 4-2 highlights that Arlington County is a major destination in the corridor and includes several markets with medium potential for successful transit. However, the majority of trips in these markets in Arlington County are destined for the Ballston-Rosslyn corridor, instead of the Pentagon/Crystal City area.[2] This indicates that direct service from the I-66 corridor to the Pentagon area is not a market with high potential for successful transit service.

Table 4-2. Peak Direction Potential Transit Markets

Area		Horizon	
Originating	**Destination**	**2015**	**2030**
High Potential			
Inside the Beltway			
Rosslyn	D.C. Core	●	●
Clarendon/Court House	D.C. Core	●	●
Ballston/VA Square	D.C. Core	●	●
North Arlington	D.C. Core	●	●
Outside the Beltway			
Centreville	Fairfax Center	●	●
Centreville	Dulles West	●	●
Centreville	Dulles East		●
Medium Potential			
Inside the Beltway			
Falls Church	D.C. Core	●	●
West Falls Church	D.C. Core	●	●
Merrifield/Dunn Loring	D.C. Core	●	●
City of Fairfax	D.C. Core	●	●
Fairfax Center	D.C. Core	●	●
Centreville	D.C. Core	●	●
Manassas	D.C. Core	●	●
West Falls Church	Arlington County	●	●
Merrifield/Dunn Loring	Arlington County	●	●
Fairfax Center	Arlington County	●	●
City of Fairfax	Arlington County	●	●
Centreville	Arlington County	●	●
Manassas	Arlington County	●	●

[2] MWCOG/TPB Model results show that in 2030 more than 60 percent of home-based work trips in the morning peak from West Falls Church, Merrifield/Dunn Loring, Fairfax Center, City of Fairfax, Centreville, and Manassas bound for Arlington County are destined for the Rosslyn-Ballston corridor.

Table 4-2. Peak Direction Potential Transit Markets (continued)

Area		Horizon	
Originating	**Destination**	**2015**	**2030**
Medium Potential (continued)			
Outside the Beltway			
West Falls Church	Tysons Corner	●	●
Merrifield/Dunn Loring	Tysons Corner	●	●
Fairfax Center	Tysons Corner	●	●
Centreville	Tysons Corner	●	●
Fairfax Center	Merrifield/Dunn Loring	●	●
Centreville	Merrifield/Dunn Loring	●	●
Centreville	City of Fairfax	●	●
Manassas	Fairfax Center	●	●
Bull Run/Sudley	Fairfax Center		●
Bull Run/Sudley	Dulles East		●
Gainesville	Dulles East		●
Gainesville	Fairfax Center		●

Several reverse commute markets with high-transit potential were identified in the off-peak direction (westbound) as shown in Table 4-3. Markets served by existing or planned Metrorail service are highlighted in the Metrorail column.

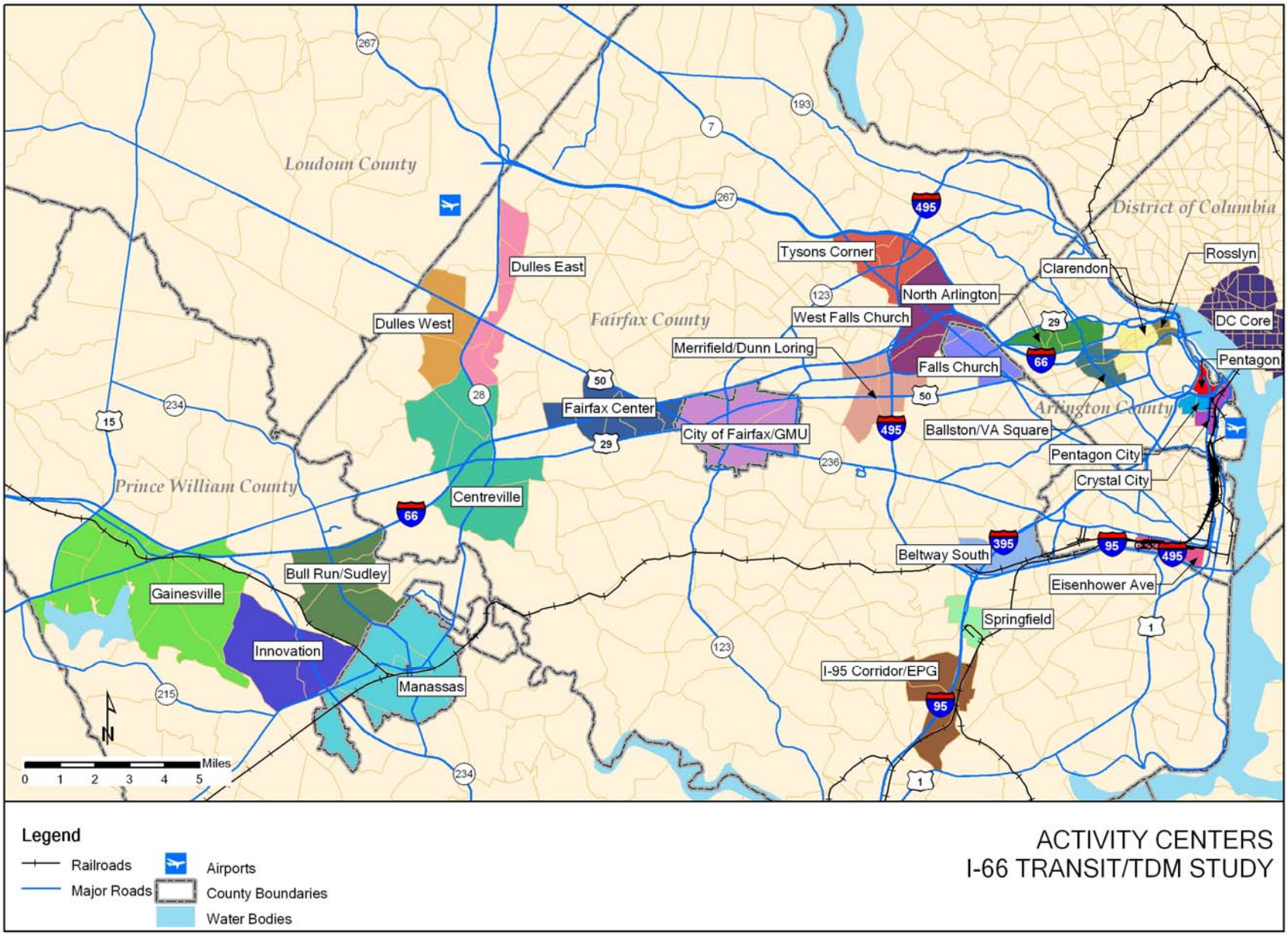
Table 4-3. Reverse Commute Potential Transit Markets

Area		Horizon	
Originating	**Destination**	**2015**	**2030**
High Potential			
Outside the Beltway			
Ballston/VA Square	Tysons Corner		●
Fairfax Center	Dulles East	●	●
Fairfax Center	Dulles West		●

As can be seen in Tables 4-2 and 4-3, most of the potentially viable transit markets traverse only portions of the I-66 study corridor; the longest viable market is between Manassas and the D.C. Core. Markets that traverse only a portion of the corridor include those terminating in Tysons Corner or the Dulles area activity centers or those destined for the D.C. Core and originating in activity centers inside the Beltway. Further, all of the high-potential markets inside the Beltway are already served by the Metrorail Orange Line.

These findings inform the development of the alternative transit and TDM concepts to serve these potential markets which are described in Section 8 of this report. In addition, the viability of these markets is further explored through travel demand modeling performed as part of the overall study.

Figure 4-8. I-66 Corridor Activity Centers



5.0 Market Research

In order for transit services and TDM programs to be successful, these services and programs must meet commuters' needs and preferences. Therefore, the I-66 Transit/TDM Study included a formal market research component designed to allow commuters to share their opinions, state their needs, and express their preferences about transit and TDM development in the I-66 corridor in a structured and purposeful way. The information obtained helps planners, engineers, decision-makers, and others charged with transit and TDM development to better understand the needs and preferences of commuters who travel this corridor regularly and to better predict commuter response to potential new and improved products and services. It facilitated the evaluation and formulation of recommendations within the context of the I-66 Transit/TDM Study. This section presents an overview of the market research program and its key highlights. A full reporting on the Market Research survey conducted as part of this study can be found in Appendix E.

5.1 Market Research Objectives

Clearly established objectives guided the market research component of the I-66 Transit/TDM Study. The research was designed to meet the following specific informational objectives:

- Profile current travel patterns and behaviors of commuters traveling in the I-66 corridor during peak travel times:
  - By current mode; and
  - By direction traveled during morning commute.
- Identify and understand the needs and factors guiding commute mode choices;
- Explore attitudes about commuting and preferences of commuters in the corridor;
- Identify the relative appeal of specific enhancements and programs (transit/TDM alternatives) needed to increase the likelihood of using non-SOV modes.

In addition, the research was designed to examine closely the potential appeal of various transit modes, including Bus Rapid Transit (BRT). As one form of Priority Bus[1] service that was considered in the study, it was important to understand the current level of awareness of and familiarity with BRT and its perceived benefits. Furthermore, the research sought to assess the likelihood of using BRT or other Priority Bus services under different conditions, and it sought to determine which attributes were most attractive.

5.2 Study Methodology

The market research study consisted of an on-line survey which was developed with input from the TAC and benefited from member expertise related to transit, TDM, and other commuter issues in Northern Virginia. Postcards were mailed to a random sample of households in the corridor inviting people to participate in the survey. Additional responses were solicited from users of targeted modes through special distribution methods, including email lists, agency newsletters, seat drops, and handouts. In order to qualify for the study, respondents had to commute along I-66, U.S. 29, or U.S. 50 at least three days each week during the morning peak

[1] Priority Bus service includes BRT or elements of BRT that improve the quality and dependability of transit service, including frequent service, substantial stations, improved reliability, advanced technology and information systems, direct access to stations, modern vehicles, and distinct branding.

travel period, in either direction. The total sample size was nearly 3,000 and the final sample distribution by mode[2] and direction is reported in Table 5-1. The target sample sizes were developed to ensure statistical validity of findings within an appropriate confidence level. Data collection for this study occurred during the spring of 2009. Respondents represented all major modes in the corridor, including SOV, formal carpool, local bus, express bus, Metrorail, and VRE.

Table 5-1. Research Sample by Primary Transportation Mode

Mode	Targeted Quota	Completed Interviews
Single Occupant Vehicle		
Gas Engine – Eastbound	500	949
Gas Engine – Westbound	400	219
Hybrid – Eastbound	-	109
Hybrid – Westbound	-	12
Formal Carpool – Eastbound	200	365
Formal Carpool – Westbound	200	11
Vanpool – Eastbound	100	27
Vanpool – Westbound	-	-
Local Bus – Eastbound	200	143
Local Bus – Westbound	200	9
Express Bus – Eastbound	100	328
Express Bus – Westbound	100	4
Metrorail – Eastbound	200	547
Metrorail – Westbound	200	29
VRE – Eastbound	200	210
Total	**2,600**	**2,962**

Commuters traveling in both directions in the I-66 corridor were included in this study; however the incidence of Westbound commuters is quite low in the morning peak. As fewer Westbound commuters are included in the research sample, this research summary focuses on Eastbound commuters. Nevertheless, responses of Westbound SOV users also are reported since they represent a unique opportunity for new alternate mode usage.

The questionnaire was designed to meet the specific objectives for this study. It was programmed for on-line completion and tested prior to fielding. It required between 20 and 25 minutes to complete.

[2] Respondents are classified based on the primary commute mode used for their morning commute. Some commuters ride a bus although it is not their primary commute mode. Thus, regardless of whether bus is their primary commute, all bus riders are classified as either “local” or “express” bus riders. They are also classified by their primary mode. Consequently, some of the mode classifications are not mutually exclusive.

5.3 Survey Results

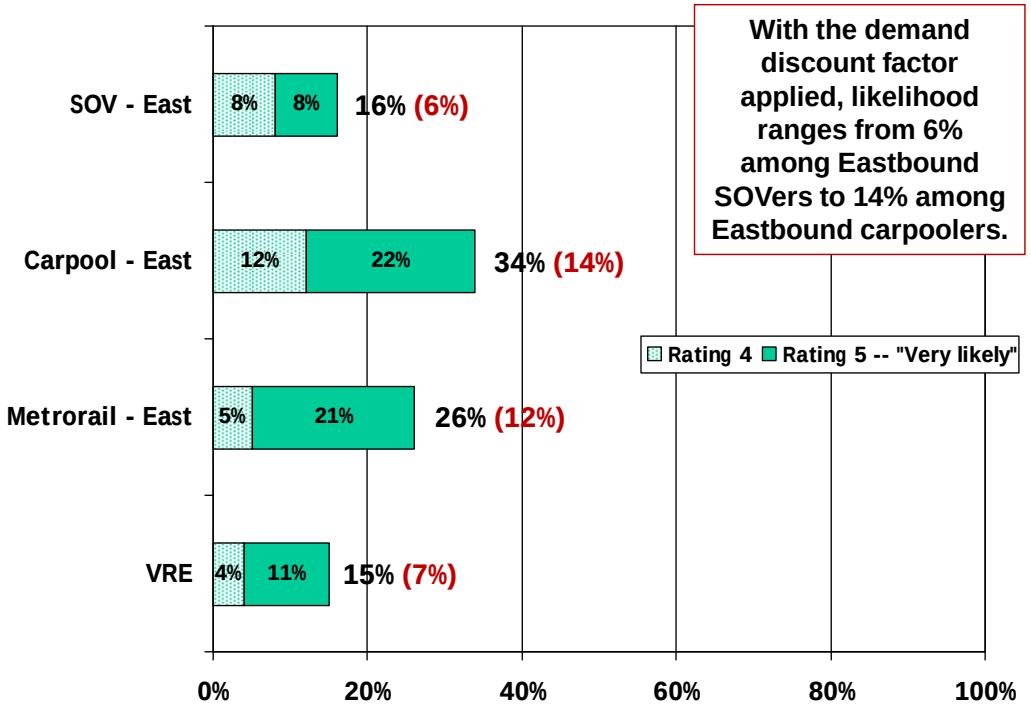
In the review of the market research reported in this section, potential responses to specific alternate modes, to new products and services, and to product and service enhancements are presented. The findings from this study indicate that commuters traveling regularly in the I-66 corridor have adopted and will continue to adopt alternate modes for their commutes. Not all commuters will change from their current mode, but those who are willing to change must have their needs and preferences met in order for alternate modes to be attractive.

Previous research has indicated that, in studies such as this, respondents tend to overestimate the likelihood that they will adopt a particular program or service. A demand discount factor has been developed that recalculates likelihood to a more realistic level. When appropriate, likelihood estimates reported for this study are recalculated using the demand discount factor. Both stated likelihood and the likelihood using the demand discount factor are reported in the graphs. Likelihood scores with the demand discount factor applied are always reported in a red color.

5.3.1 Appeal of Express Bus

With no new program services or features, stated interest in riding an express bus among those who have express bus available but do not ride it ranges from 15 percent (among current VRE riders) to 34 percent (among Eastbound carpoolers), as shown in Figure 5-1.

Figure 5-1. Likelihood of Using Express Bus Service



*Stated likelihood scores reported in **black**; likelihood scores with the demand discount factor reported in **red**.*

Question: Regardless of the mode of transportation you use today for your commute, how likely are you to take an express bus in the future? Question asked of those who have express bus available but do not use it or is not their primary mode.

Greater availability of park-and-ride lots could increase express bus ridership. Currently, more than half of SOV users reported that they do not have a park-and-ride lot available where they could catch an express bus or that the lot is always full, as reported in Table 5-2. If there were a lot with available spaces, a third of Eastbound SOV users say they would use it to catch an express bus. These results are the reported availability of park-and-ride facilities. It is possible that some SOV users do not know of an existing park-and-ride lot or they believe a lot to be full that is not.

Table 5-2. Availability of Park-and-Ride Lots for Express Bus

	SOV	
	Eastbound	**Westbound**
Yes	24%	6%
Yes, but Lot is Usually Full	13%	8%
No	37%	53%
Don't Know	26%	32%

Question: Is there a park-and-ride lot located along your commute where you could catch an express bus?

5.3.2 Interest in Bus Rapid Transit (BRT)

As a form of Priority Bus considered for application in the I-66 corridor by this study, it was important to examine current awareness about the BRT concept. Awareness of the BRT concept without prompting is low for all commuters in the corridor, although it is higher for transit users (18 percent) than for SOV commuters (13 percent).

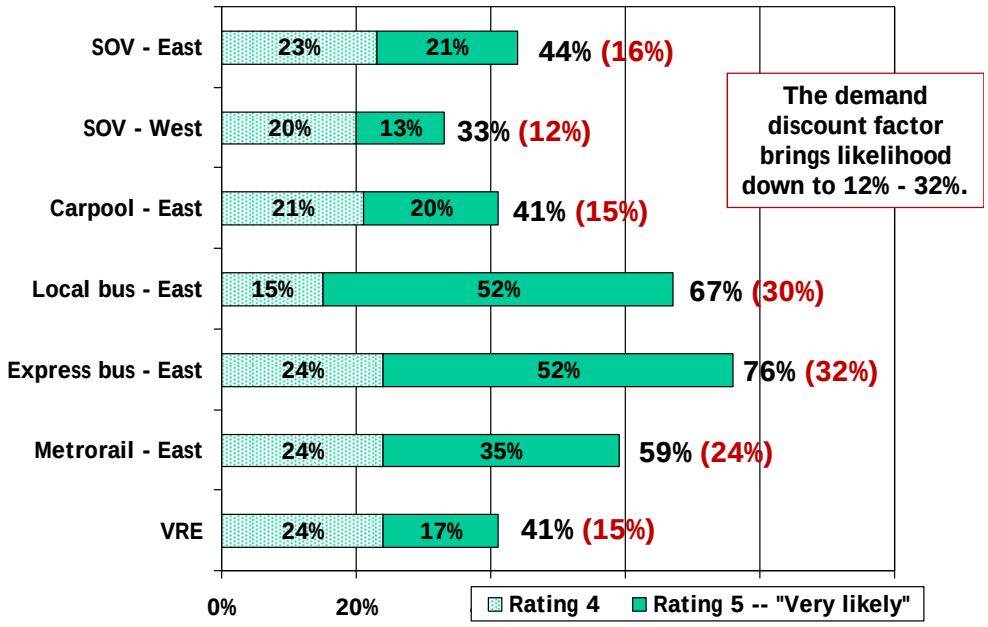
After this question was asked, a definition for the concept of BRT service was given to survey participants. Respondents were provided with the following description of BRT:

> "Bus Rapid Transit is an innovative, high capacity, public transit solution that can achieve many of the performance benefits of rail transportation modes. This system uses advanced modes or specialized vehicles on roadways or dedicated lanes to quickly and efficiently transport passengers to their destinations. BRT is like express bus, but design improvements, such as fewer stops that other buses; faster service; and specialized, efficient vehicles help make this an attractive option. Passengers board and exit BRT at stations, rather than at bus stops."

In response to this basic concept description of BRT, stated interest in using this mode ranges from 33 to 76 percent, as reported in Figure 5-2. The greatest interest is expressed by current transit users, including current local bus, express bus, and Metrorail riders.

Eleven features or attributes of BRT were tested in the research. Each of them enhances the appeal of BRT; however, making fewer stops than other buses is the single most compelling feature of BRT for users of all commute modes. The likelihood of riding BRT based on the idea that it has fewer stops than other buses is reported in Figure 5-3.

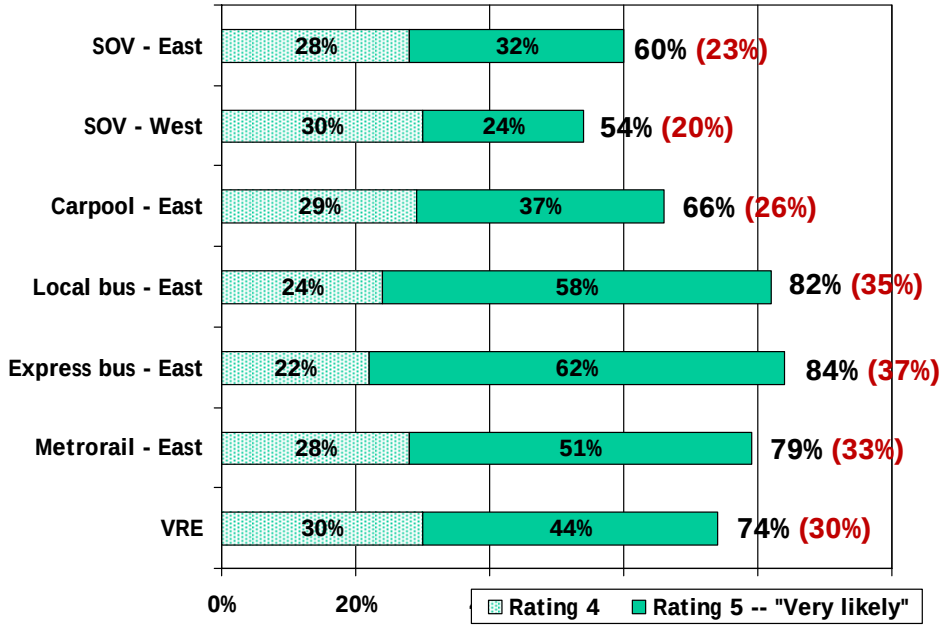
Figure 5-2. Likelihood of Riding BRT



*Stated likelihood scores reported in **black**; likelihood scores with the demand discount factor reported in **red**.*

Question: Suppose Bus Rapid Transit were conveniently accessible from the area where you live to your destination, that is the place where you work or attend school. How likely would you be to use BRT for your regular commute to work or school at least 2 days per week?

Figure 5-3. Likelihood of Riding BRT Because It has Limited Stops



*Stated likelihood scores reported in **black**; likelihood scores with the demand discount factor reported in **red**.*

Question: There are other features of Bus Rapid Transit that might influence the likelihood that you would use BRT if it were available in your area. How likely would you be to use BRT based on the following information? Has limited stops, getting you to your destination faster.

As the project analyses progressed, it became clear that a full BRT implementation would not be the most appropriate short- or medium-term recommendation. However, the market research survey was very useful in helping to identify the attractive elements of BRT that could define Priority Bus service for the corridor.

As reported in Table 5-3, many features of Priority Bus are attractive to commuters. Among the most attractive Priority Bus features for SOV users and carpoolers were 15-minute headways, transit hubs, real-time service information, and advanced technology features. In general, Westbound SOV users are slightly less attracted to most of the features of Priority Bus than are either Eastbound SOV users or Eastbound carpoolers. Percentages shown in Table 5-3 are "stated likelihood" prior to application of demand discount factor.

Table 5-3. Appeal of Priority Bus Features

	SOV		Carpool
	Eastbound	**Westbound**	**Eastbound**
Advanced Technology	48%	43%	55%
Runs Every 15 Minutes	53%	49%	57%
Cleaner for the Environment	41%	39%	47%
Stations are Transit Hubs	47%	39%	54%
Real-Time Service Information	47%	44%	52%
Stations are Activity Centers	35%	32%	42%
Off-Vehicle Ticketing	42%	36%	44%
Has Stations, Not Stops	39%	32%	40%
Front and Rear Loading	41%	35%	45%
Larger Vehicles than Other Bus Systems	41%	29%	51%

Question: There are other features of Bus Rapid Transit that might influence the likelihood that you would use BRT if it were available in your area. How likely would you be to use BRT based on the following information?

5.3.3 Priority Bus Scenario Testing

In order to assess more fully the appeal of various forms of Priority Bus to corridor commuters, this study used scenario testing with choice-based conjoint analysis. In this analysis, the appeal of BRT and the appeal of express bus are compared. In addition, the importance of time is compared to the importance of cost. Finally, the importance of time and the importance of cost are compared to the importance of a specific mode (BRT and express bus).

Conjoint analysis allows for the identification and prioritization of the factors important in commute mode choices. It is sometimes referred to as "tradeoff analysis" because respondents are asked to make trades that reflect what is and is not important to them. It is a multivariate technique that measures the relative importance of different variables, attributes, or product features.

In this study, respondents were asked which mode they would select, given scenarios that varied time savings and cost savings. In each scenario, the respondent was presented with a different combination of attributes and asked which combination they select. Attribute levels tested are reported in Table 5-4.

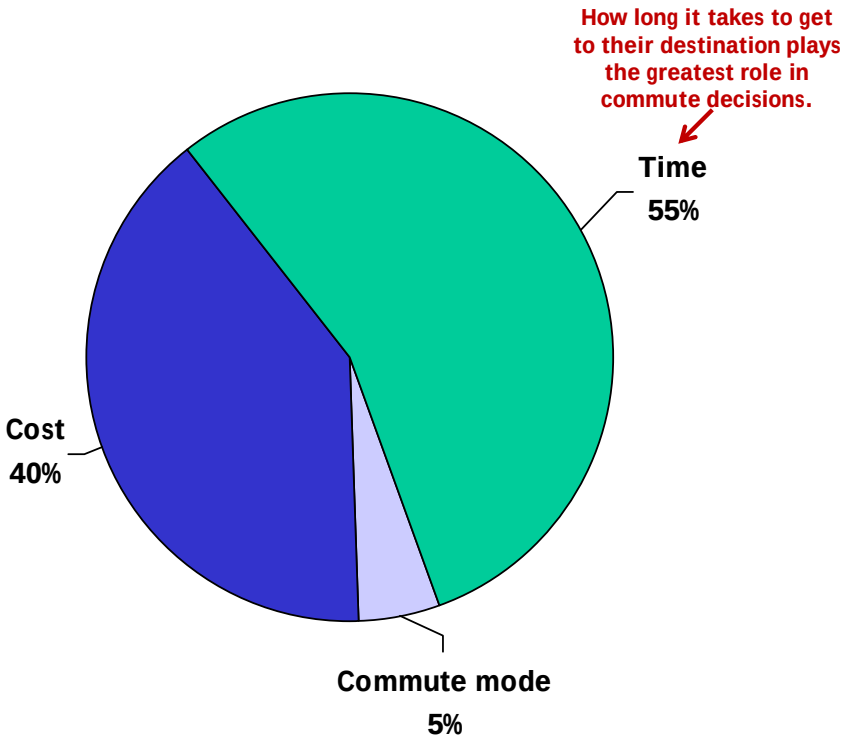
Table 5-4. Attribute Levels Used in Scenario Testing

Attribute	Levels
Commute Mode	"Express Bus" or "Bus Rapid Transit"
Time Savings/Penalty	-30% to +30%
Cost Savings/Penalty	-15% to +15%

As illustrated in Figure 5-4, the conjoint analysis indicated that time is the most important element in commute mode decisions; when deciding how they will commute to work, commuters in this corridor give greatest priority to saving time. Second priority is given to saving money. Finally, priority is given to mode preference – express bus or BRT. Based on this analysis, 55 percent of the decision reflects time, 40 percent reflects the importance given to saving money, and only five percent reflects the importance given to a preference for a specific mode. This indicates that commuters are most interested in a mode that will save them time on their commute. The strength of these preferences is related to the amount of time or cost saved; therefore, the more time or cost saved by a particular option, the greater the preference for that option.

When all attributes are held constant, commuters prefer BRT over express bus, 81 percent to 19 percent. However, when given the opportunity to save time, commuters will select express bus over BRT. Thus, while BRT is an attractive alternative, saving time takes precedence over any modal preference.

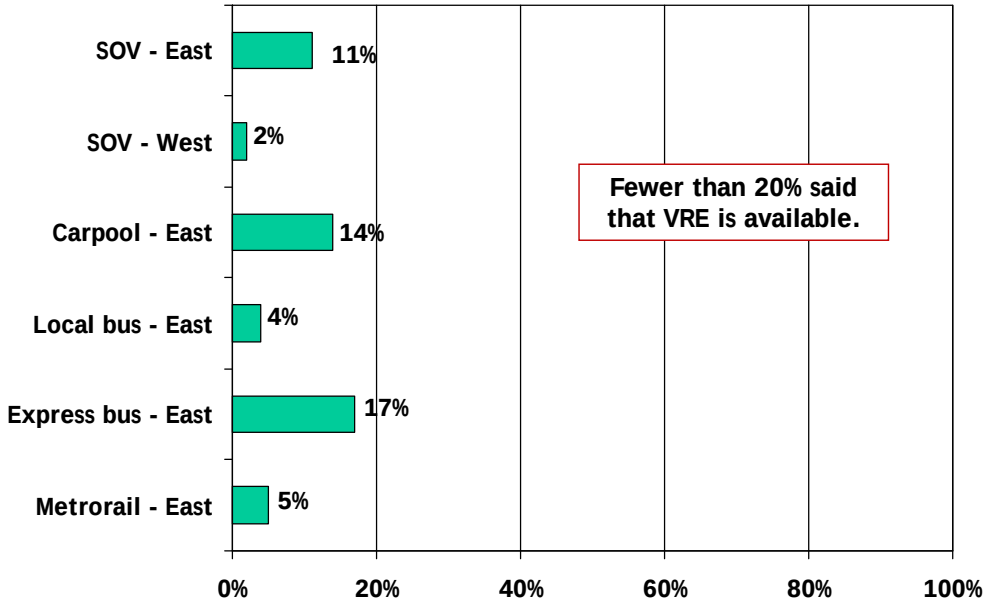
Figure 5-4. Relative Contribution of Factors in Determining Mode Choice



5.3.4 Attracting Riders to Virginia Railway Express (VRE)

As reported in Figure 5-5, VRE is available to only a small portion of commuters in this corridor, ranging from only two percent among Westbound SOV users to 17 percent among Eastbound express bus riders.

Figure 5-5. Availability of VRE



*Stated likelihood scores reported in **black**; likelihood scores with the demand discount factor reported in **red**.*

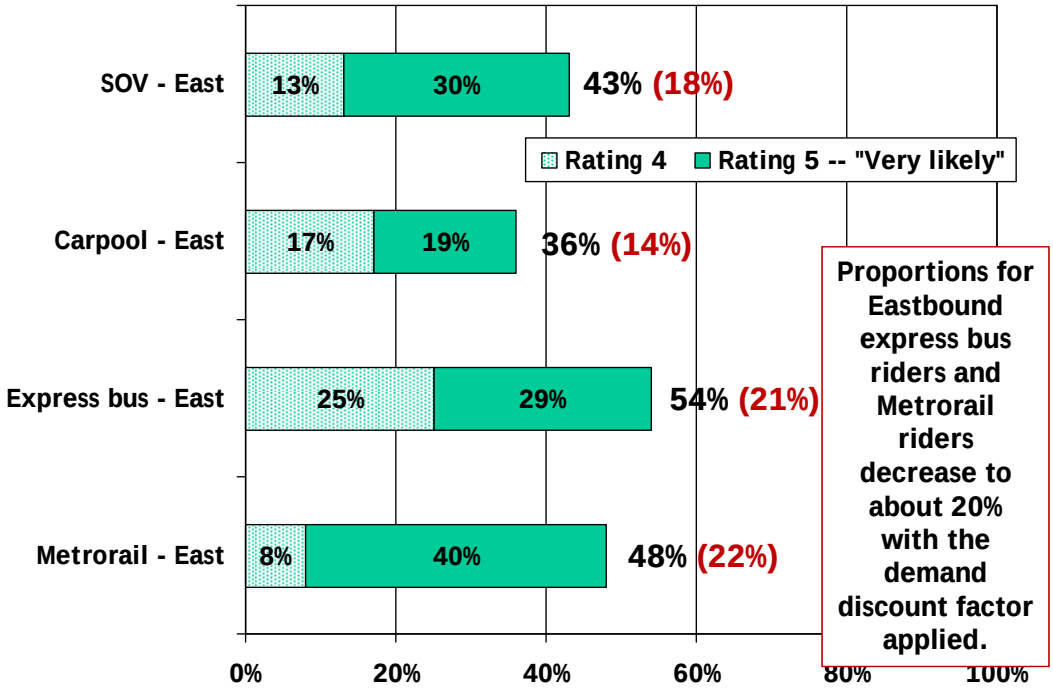
Question: Is Virginia Railway Express (VRE) conveniently available for at least a portion of your commute? Question asked of those who do not currently ride VRE.

Five VRE service and feature enhancements were tested. Based on the survey responses, the implementation of shuttle service and the addition of more trains appear to offer the greatest potential to attract commuters who have VRE available but currently do not ride it. The market research survey did not include specific questions regarding commuters' opinions on the proposed extension of the VRE service to the Gainesville-Haymarket area, only general questions regarding improvements such as adding trains, adding seats, and adding parking at stations were asked.

It is important to note that the shuttle service questions did not provide a description of every detail that might be relevant to the usage of a shuttle service and instead leave the respondent to mentally fill details in. For example, the wait time, travel time, and vehicle attributes are not indicated in the questions and this could lead the respondent to imagine the best possible shuttle service (or worst possible shuttle service) in considering their response. The responses to the shuttle service questions are therefore considered to speak more broadly to the perceived need for improved VRE access and distribution rather than an indication of actual riders that would be realized were various shuttle services introduced. The actual experience with past VRE shuttle services indicates that ridership would not be strong for such services. However, it is useful to review the responses to the hypothetical shuttle service as indication of a potential untapped market for VRE were it possible to address either the perception or the reality that it could be made easier to access VRE from home and/or easier to access jobs from VRE.

In the research, both neighborhood and work shuttles were tested. The neighborhood shuttles had slightly greater appeal. As shown in Figure 5-6, about half of commuters said they would ride VRE if a shuttle circulated in their neighborhood and went to the VRE station. Again, this service enhancement, while specifically testing shuttle service, indicates the strong appeal of generally improving VRE station access by any means.

Figure 5-6. Likelihood of Riding VRE if Neighborhood Shuttle

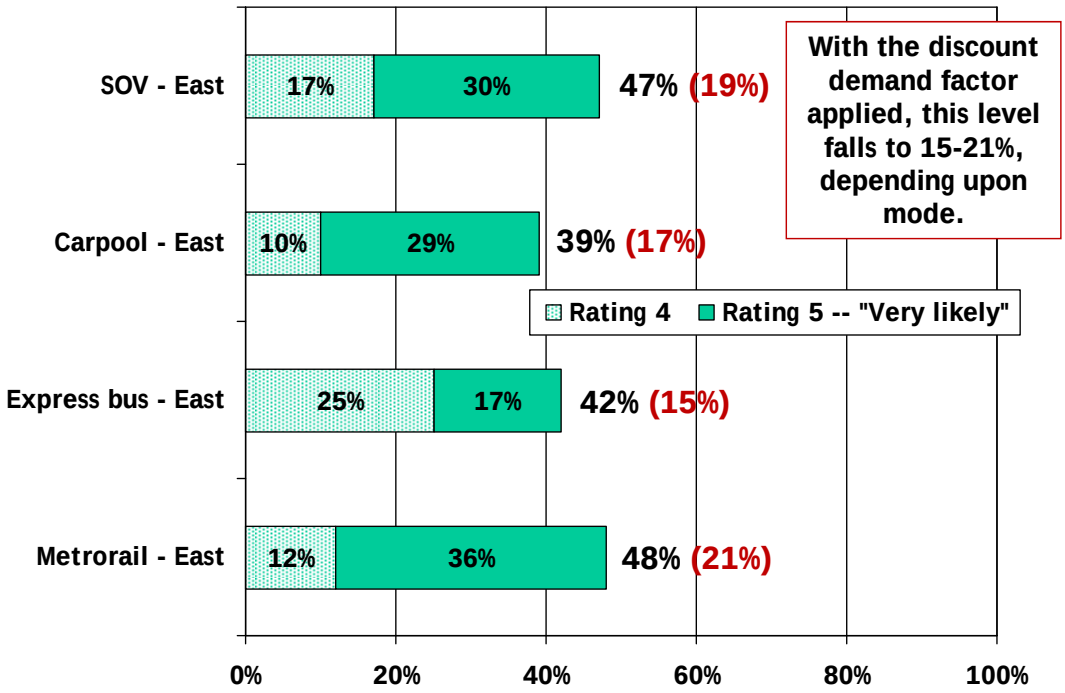


*Stated likelihood scores reported in **black**; likelihood scores with the demand discount factor reported in **red**.*

Question: Suppose that a shuttle bus could operate frequently enough in your neighborhood that would circulate and connect to the VRE station. How likely would you be to use this feeder bus and take VRE at least 1-2 days a week? Question asked of those with VRE available but do not ride it.

Adding more trains also is an effective method of attracting riders to VRE. As reported in Figure 5-7, about the same proportion of nonriders would be attracted to VRE under these conditions.

Figure 5-7. Likelihood of Riding VRE if Additional Trains



*Stated likelihood scores reported in **black**; likelihood scores with the demand discount factor reported in **red**.*

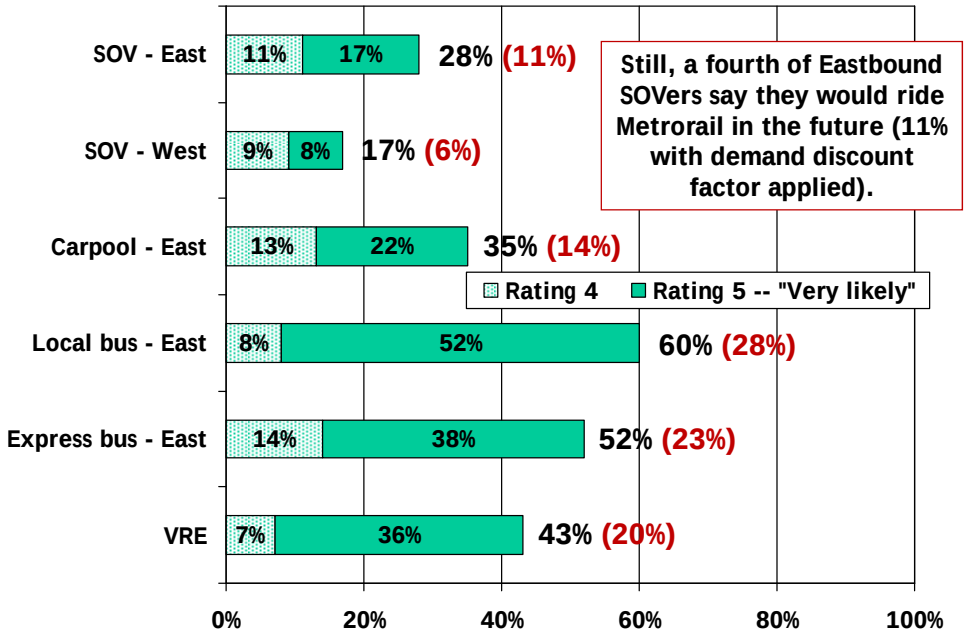
Question: If additional VRE trains were added so that they came more often, how likely would you be to use the Virginia Railway Express (VRE) for your commute at least 1-2 days a week? Question asked of those with VRE availability but do not ride it.

In summary, the appeal of shuttles and availability of trains suggests that convenience and access are important features for attracting new riders to VRE.

5.3.5 Appeal of Metrorail

Among those who have Metrorail available but currently do not use it, overall the greatest interest in using Metrorail for their commute is expressed by current transit users, including Eastbound local bus riders, Eastbound express bus riders, and VRE riders, as reported in Figure 5-8.

Figure 5-8. Likelihood of Riding Metrorail



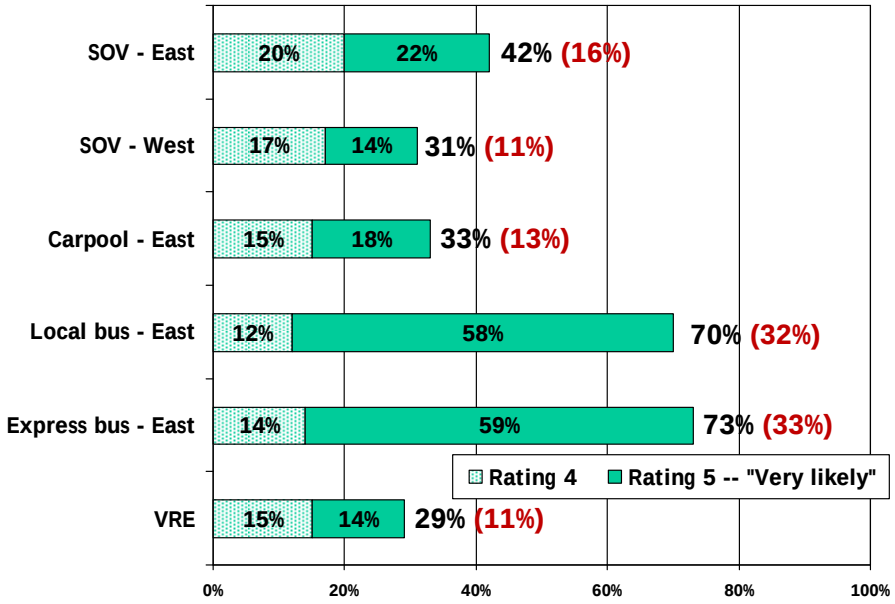
*Stated likelihood scores reported in **black**; likelihood scores with the demand discount factor reported in **red**.*

Question: Regardless of the mode of transportation you use today for your commute, how likely are you to use Metrorail for at least part of your commute at least 1-2 days a week in the future? Question asked of those with Metrorail available but do not ride it.

Seven program and service enhancements for Metrorail were examined in this study. Interestingly, respondents indicated that a neighborhood shuttle offered the greatest potential for attracting new riders to Metrorail. As discussed with the VRE findings, it is important to note that the shuttle service questions did not provide a description of every detail that might be relevant to the usage of a shuttle service and instead leave the respondent to mentally fill details in. In the case of the Metrorail neighborhood shuttle questions, two frequencies of service were explicitly tested to see if a difference in response would emerge. Neighborhood shuttles were tested with headways of 15 and six minutes. Interestingly, based on the survey results, there was little difference in the attractiveness of neighborhood shuttles whether a 15 minute or six minute frequency was indicated. As shown in Figures 5-9 and 5-10, 42 percent of Eastbound SOV users say they would ride Metrorail with a neighborhood shuttle with headways of 15 minutes, while this number increases to 48 percent with headways of six minutes – a slight increase in ridership with a major difference in services.

As with the VRE responses, the responses to the Metrorail neighborhood shuttle service questions are considered to speak more broadly to the perceived need for improved Metrorail accessibility rather than an indication of the number of actual riders that would be realized were the shuttle services introduced.

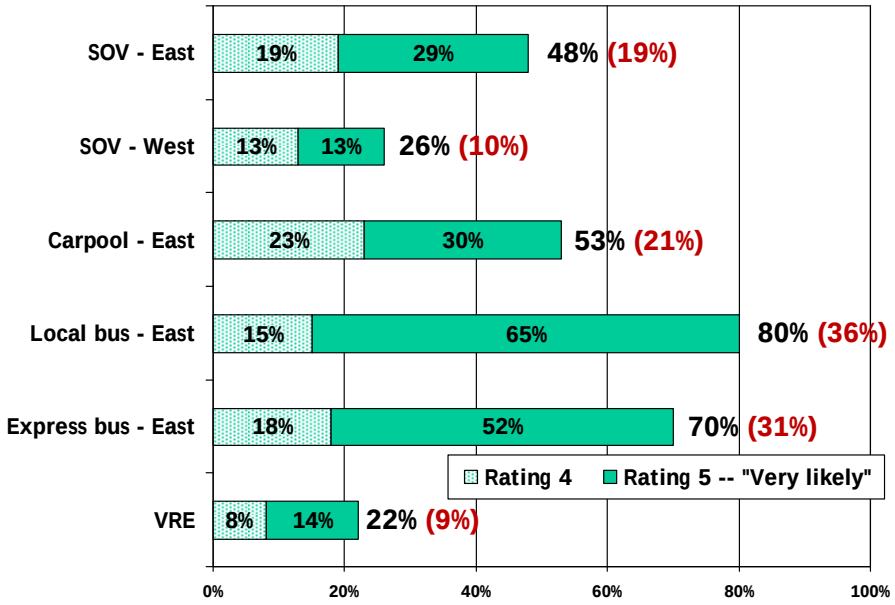
Figure 5-9. Likelihood of Riding Metrorail with Shuttle with 15-Minute Headway



*Stated likelihood scores reported in **black**; likelihood scores with the demand discount factor reported in **red**.*

Question: Suppose that a shuttle bus could operate every 15 minutes in your neighborhood that would circulate and connect to the Metrorail station. How likely would you be to ride the Metrorail at least 1-2 days a week if a feeder bus operated in your neighborhood? Question asked of those with Metrorail available but do not ride it. Half were asked about shuttle running every 15 minutes. Half were asked about shuttle running every six minutes.

Figure 5-10. Likelihood of Riding Metrorail with Shuttle with Six-Minute Headway



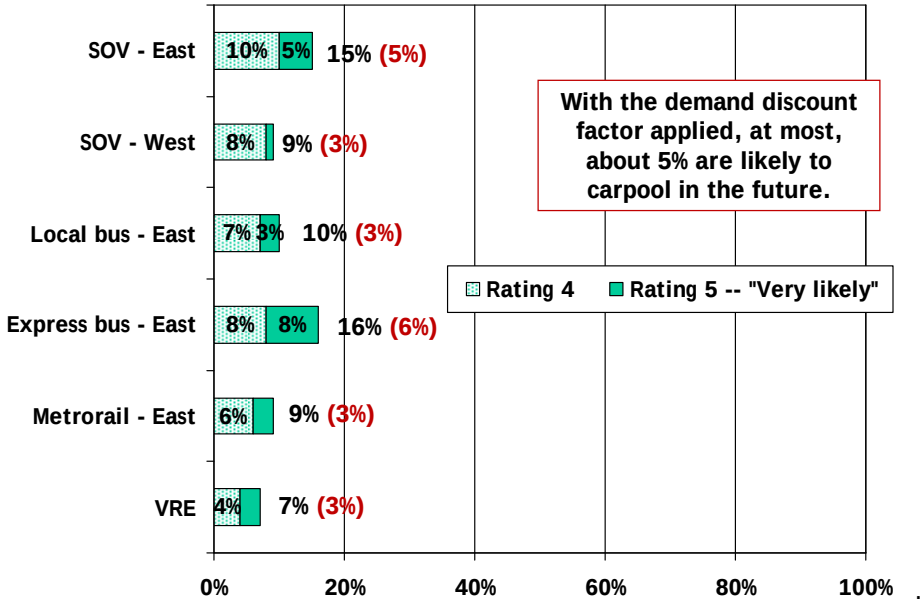
*Stated likelihood scores reported in **black**; likelihood scores with the demand discount factor reported in **red**.*

Question: Same as for Figure 5-9.

5.3.6 Propensity to Carpool or Vanpool

The appeal of carpooling and vanpooling appears somewhat lower in the I-66 corridor as compared with the I-95/I-395 corridor, possibly due to diminished time savings available due to commute lengths and the current performance of the HOV lane. Current SOV users are about as likely to say that they would carpool in the future as current transit users. As shown in Figure 5-11, stated likelihood of carpooling ranges from seven to 16 percent. As reported in Table 5-5, SOV users often cite perceived problems they associate with carpooling and vanpooling as reasons not to use these modes. For example, SOV users say they cannot carpool because their work hours vary, they have no one to carpool with, or they need their car for their job.

Figure 5-11. Likelihood of Carpooling



*Stated likelihood scores reported in **black**; likelihood scores with the demand discount factor reported in **red**.*

Question: Regardless of the mode of transportation you use today for your commute, how likely are you to carpool in the future? Question asked of those who do not currently carpool.

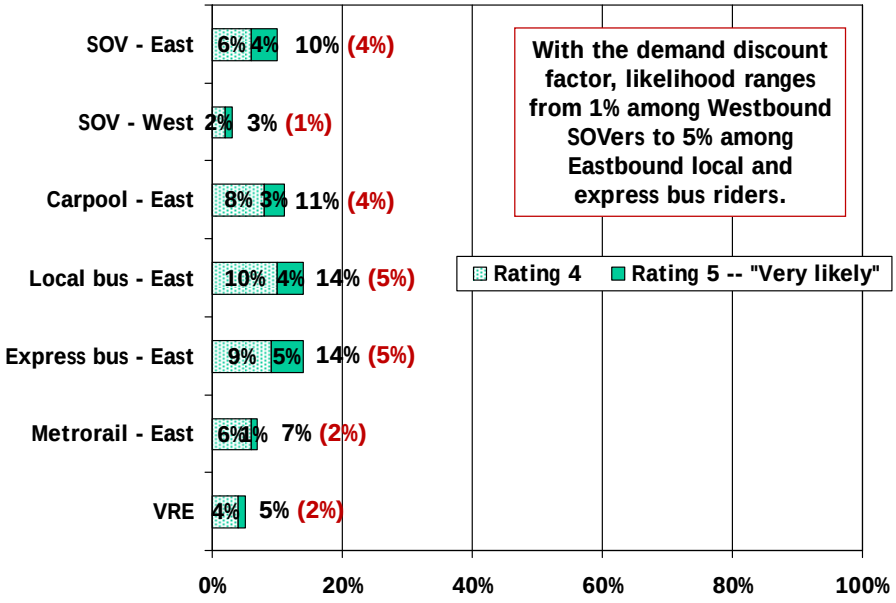
Table 5-5. Reasons for Not Carpooling

	SOV		Bus – Eastbound		Metrorail	
	Eastbound	Westbound	Local	Express	Eastbound	VRE
Prefer Current Mode	8%	8%	29%	27%	31%	39%
Work/School Hours Vary	19%	16%	18%	17%	18%	11%
No one to Carpool With	17%	20%	13%	12%	8%	9%
Need My Car for Job	14%	16%	0	0	1%	0
Would Not Save Time	3%	5%	5%	4%	6%	8%
Might Need to Leave Early	5%	4%	4%	3%	3%	1%
Would Not Save any Money	4%	5%	3%	5%	2%	2%

Question: You indicated that you do not currently commute in a carpool. What is the most important reason you do not commute in a carpool?

Figure 5-12 reports that stated interest in vanpooling ranges from three to 14 percent with Westbound SOV users being the least likely to say they would vanpool. As shown in Table 5-6, they would not vanpool because there are no vanpools in their area, their work hours vary, and they might need to stay late. In contrast, current transit users are not likely to switch to carpooling or vanpooling because they prefer their current mode.

Figure 5-12. Likelihood of Vanpooling



*Stated likelihood scores reported in **black**; likelihood scores with the demand discount factor reported in **red**.*

Question: Regardless of the mode of transportation you use today for your commute, how likely are you to vanpool in the future? Question asked of those who do not currently vanpool.

Table 5-6. Reasons for Not Vanpooling

	SOV		Eastbound				
	Eastbound	Westbound	Carpool	Local Bus	Express Bus	Metro Rail	VRE
Prefer Current Mode	14%	12%	26%	30%	34%	34%	41%
No Vanpools in My Area	22%	30%	19%	19%	20%	16%	13%
Work/School Hours Vary	19%	14%	9%	16%	13%	15%	9%
Might Need to Stay Late	11%	8%	3%	5%	5%	6%	5%
Would Not Save Time	4%	5%	10%	6%	5%	7%	9%
Might Need to Leave Early	8%	7%	4%	3%	2%	3%	2%
Would Not Save any Money	0	0	4%	4%	2%	2%	2%

Question: You indicated that you do not currently commute in a vanpool. What is the most important reason you do not commute in a vanpool?

5.3.7 Interest in On-Line Ride-Matching

On-line ride-matching enhances the appeal of carpooling and vanpooling. As shown in Table 5-7, between 29 percent (Westbound) and 37 percent (Eastbound) of SOV users say they are likely to use on-line ride-matching in order to commute by carpool or vanpool. Note that for some commuters, on-line ride-matching must be provided by their employer in order to make the option attractive. In Table 5-7, stated likelihood scores are reported in a black color and the likelihood scores with the demand discount factor applied are reported in a red color.

Table 5-7. Likelihood of Using On-Line Ride-Matching

	SOV		Bus – Eastbound		Metrorail	
	Eastbound	**Westbound**	**Local**	**Express**	**Eastbound**	**VRE**
Likelihood of Using On-Line Ride-Matching	28%	20%	35%	30%	24%	24%
Likelihood of Using On-Line Employer Ride-Matching	9%	9%	2%	6%	7%	7%
Total Likelihood	**37%**	**29%**	**37%**	**36%**	**31%**	**31%**
With Demand Discount	13%	10%	13%	13%	26%	11%

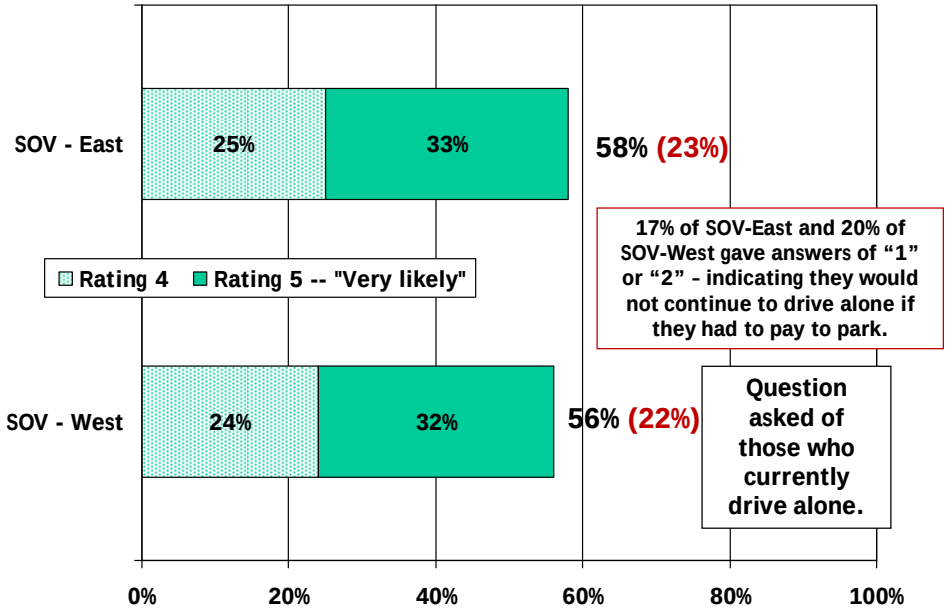
Question: Suppose that you could use a self-assisted, online ride-matching service to find a partner to carpool or vanpool. This service provides you with a list of commuters who live in your area, commute to the same area as you do, and are also looking for a vanpool or carpool partner. You register for this service online and receive the information online. How likely would you be to use this type of ride-matching service if you wanted to carpool or vanpool?

5.3.8 Employer Provided Programs

Employer provided and sponsored programs are related to mode usage. Employer transit fare subsidies, for example, lift transit usage. Use of local bus, express bus, and Metrorail among commuters who work for employers who provide a transit fare subsidy is twice that of commuters who work for employers who do not provide a transit fare subsidy. The rate of VRE usage is four times higher among commuters who work for employers who provide a transit subsidy than among those who work for employers who do not provide the subsidy. The higher rate of transit usage by commuters who work for employers who provide a transit fare subsidy may be related to the fact that employers in transit accessible areas are more likely to provide a transit benefit, but still indicates the appeal of transit benefits to commuters in the corridor.

Parking also plays a role in commute mode choices. Among employers who provide preferred parking for carpoolers, the rate of carpooling is twice that for employers who do not provide preferred parking for carpoolers. Similarly, parking is related to driving alone. Among employers who offer free or subsidized parking, the rate of SOV commuting is twice what it is for employers who do not provide free parking. Additionally, the prospect of having to pay to park could deter some current SOV users from driving alone in the future. As reported in Figure 5-13, only 58 percent of Eastbound SOV users and 56 percent of Westbound SOV users say they would drive alone in the future if they had to pay to park.

Figure 5-13. Likelihood of Driving Alone if No Free Parking



*Stated likelihood scores reported in **black**; likelihood scores with the demand discount factor reported in **red**.*

Question: Assume that there is ample parking at your worksite or school. Suppose that commuters who drive alone to work or school will be charged a fee to park their vehicles. How likely would you be to continue driving alone to work or school and pay to park your vehicle there? Question asked of those who currently drive alone.

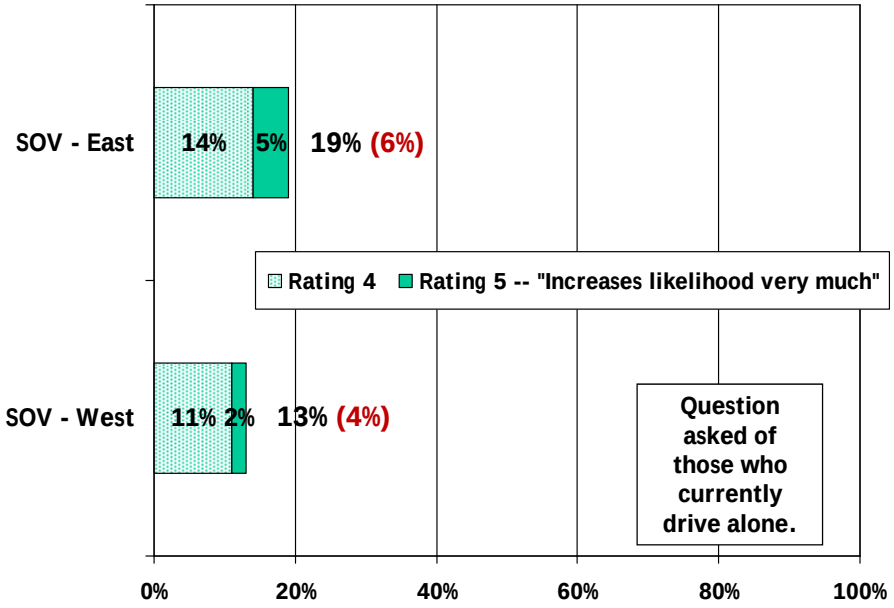
5.3.9 Potential of Guaranteed Ride Home Program

The survey revealed opportunity to grow awareness and usage of Guaranteed Ride Home (GRH). A program that provides flexibility to transit users who unexpectedly must return home at hours other than those at which their regular transit or carpool operates. Currently, 72 percent of Eastbound SOV users and 57 percent of Westbound SOV users have heard of GRH. More than 10 percent of SOV users (both Eastbound and Westbound) say that the GRH program increases the likelihood that they would carpool, vanpool, ride a bus, or ride a train (see Figure 5-14).

5.3.10 Potential of Rewards Incentive Program

Nearly a quarter of SOV users would share a ride to work if every time they share a ride they could earn points that could be redeemed towards rewards at various retailers (see Figure 5-15).

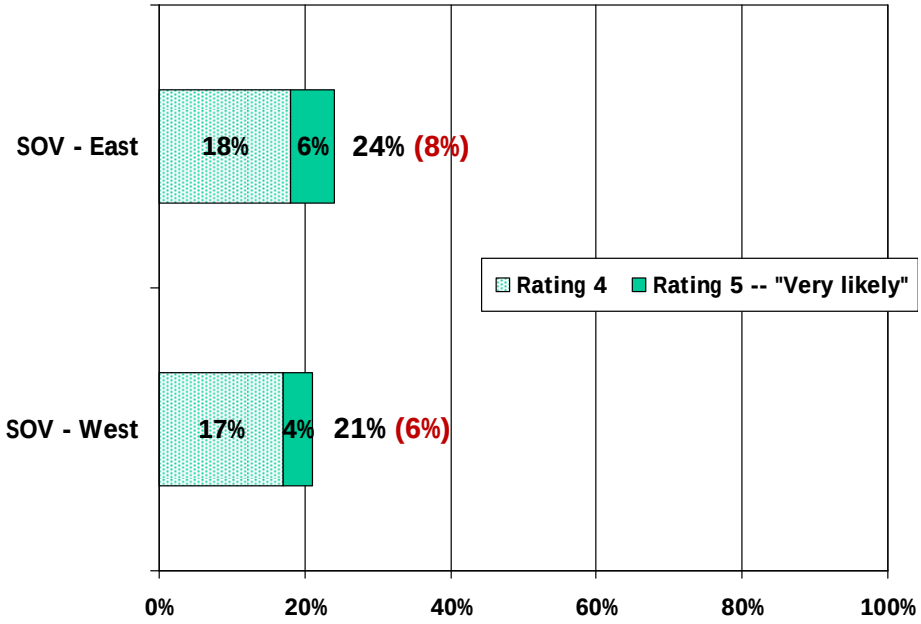
Figure 5-14. Likelihood of Ridesharing with Guaranteed Ride Home



*Stated likelihood scores reported in **black**; likelihood scores with the demand discount factor reported in **red**.*

Question: Commuters who travel in carpools, vanpools, buses, or trains can enroll in a Guaranteed Ride Home program. This program takes them home or to their car in case of an emergency or unscheduled overtime. This service can be used up to four times per year. How much does this program increase the likelihood that you would carpool, vanpool, or ride a bus or train? Question asked of those who currently drive alone.

Figure 5-15. Likelihood of Ridesharing if Had Rewards Incentive Program



*Stated likelihood scores reported in **black**; likelihood scores with the demand discount factor reported in **red**.*

Question: Assume that you could earn points that can be redeemed towards rewards at various retailers every time you share a ride to work. How likely would you be to share a ride if you could earn points that can be redeemed for rewards? Question asked of those who currently drive alone.

5.3.11 Attributes and Features that Drive Commute Decisions

From a list of approximately two dozen attributes and features, commuters are able to identify those that are most important to them when deciding how they will commute to work, as reported in Tables 5-8 and 5-9. Additionally, many of the same attributes and features drive different mode choices. Across all modes, time is important – especially the time it takes to get to their destination. Being in control of their commute and selecting a mode that is dependable also are important across all modes. But, among transit users, accessibility is especially important. Having transit available to their home and work – especially at the right time – is vital to being able to use transit successfully.

Table 5-8. Most Important Features for SOV Users and Carpoolers for Deciding How to Commute

SOV – Eastbound	SOV – Westbound	Carpool – Eastbound
Time it Takes	Availability of transportation if have to leave early/late	Time it takes
Being in Control	Time it takes	Dependability
Dependability	Being in control	Arriving on time
Time have to Leave in Morning	Dependability	Being in control

Question: Next, think about what factors are important to you when deciding how you will commute. How important to you are the following factors in choosing how you commute on your morning commute trip? For your answers, please use a scale of 1 to 5 where "1" means it is "not at all important" and "5" means "very important" in choosing your mode of transportation, How important is each of the following? .

Table 5-9. Most Important Features for Transit Users for Deciding How to Commute

Eastbound			
Local Bus	**Express Bus**	**Metrorail**	**VRE**
Availability of Bus at Right Time	Dependability	Dependability	Dependability
Availability of Transit near Home/Work	Availability of bus at right time	Availability of train at right time	Availability of train at right time
Dependability	Arriving on time	Time it takes	Reducing stress
Reducing Stress	Time it takes	Availability of transit near home/work	Arriving on time

Question: Next, think about what factors are important to you when deciding how you will commute. How important to you are the following factors in choosing how you commute on your morning commute trip? For your answers, please use a scale of 1 to 5 where "1" means it is "not at all important" and "5" means "very important" in choosing your mode of transportation, How important is each of the following? .

5.3.12 Perceived Benefits of Ridesharing

As reported in Table 5-10, regardless of whether commuters drive alone or use another form of transportation for their commute, they recognize the benefits of ridesharing that commuters who do rideshare can experience. Proportions in Table 5-10 show the percentages of people who recognize benefits of ridesharing.

Table 5-10. Perceived Personal Benefits of Ridesharing

	SOV		Carpoolers
	Eastbound	Westbound	Eastbound
Save Money	66%	69%	79%
Can Use Time Productively	54%	49%	61%
Have Company during Commute	43%	39%	54%

Question: Regardless of the mode of transportation you currently use for your commute, to what extent do you agree that each of the following is a benefit of ridesharing over driving alone?

Similarly, commuters recognize societal benefits of ridesharing – even if they do not commute in a ridesharing mode, as reported in Table 5-11. Proportions in Table 5-11 show the percentage of people who recognize benefits of ridesharing.

Table 5-11. Perceived Societal Benefits of Ridesharing

	SOV		Carpoolers
	Eastbound	Westbound	Eastbound
Saves Energy	84%	84%	87%%
Reduces Air Pollution	83%	83%	83%
Less Traffic Congestion	81%	82%	84%
Less Wear and Tear on Roads	74%	73%	76%

Question: Now, think about how society benefits from ridesharing. To what extent do you agree that society benefits in the following ways when commuters rideshare?

5.4 Sources of Uncertainty

The market research findings are based on an on-line survey. Survey data is very useful in obtaining patterns and indications of human behavior, but all survey data has uncertainty, as human subjects introduce variability through levels of understanding, personal agendas, etc. In addition, there is some self-selection bias in the sample in that survey respondents represented people in the population that chose to fill out the survey (a small gourmet coffee card incentive was provided to help obtain a higher response rate). Some potential confounding influences at work in the survey responses could be that the respondents chose “No Change” because they did not believe that their destination could be reached with the service, or they did not believe that they could achieve the time savings presented to them. While information was presented to the respondents prior to the questions, it is impossible to control what other information or misinformation the respondent had previously received, which also could impact their response. However, there is confidence that the findings from the survey work is highly informative to the study, in part due to the size of sample obtained and the manner in which the data have been used and summarized.

5.5 Conclusions

Overall, the results of the market research survey indicate strong potential support in the corridor for new and/or improved transit services. Key messages from the research included that dependability is a critical, addressable attribute of bus services in the corridor and that time and cost are more important to commuters than whether the Priority Bus services offered are BRT. The market research also showed the importance of employer and institutional TDM support to encourage use of modes other than single-occupant vehicles. These findings feed in to the development of the definition of Priority Bus services in Section 7, the development of the transit and TDM alternatives presented in Section 8, and the formulation of the study recommendations in Section 12. First, the baseline scenarios for the study are discussed in the next section.

6.0 Baseline Scenarios

Baseline scenarios were developed for the horizon years 2015 and 2030. These scenarios are used as a comparison against each of the proposed alternatives (presented in Section 8) and include roadway (general purpose and HOV), transit, TDM, and bike/pedestrian projects. Baseline conditions represent the conditions that are expected in the horizon years based on currently programmed plans and projects. The baseline scenarios and the travel demand forecasting analysis for the study used the adopted Fiscally Constrained Long Range Plan (CLRP).

The highway network developed for each of the baseline scenarios is described in Section 6.1 and is based on the MWCOG Constrained Long-Range Plan (CLRP) adopted in January 2008, which includes a range of highway, transit, and bicycle/pedestrian construction projects. The CLRP incorporated the then-current policy plan of converting all regional high-occupancy vehicle (HOV) facilities from requiring two or more persons per vehicle (HOV-2) to requiring three or more persons per vehicle (HOV-3). The baseline conditions assume that all facilities carry a peak-period HOV-3 restriction in both the 2015 and 2030 horizon years. The baseline transit networks also are based primarily on the CLRP list of planned and programmed transit projects and are detailed in Section 6.2. Section 6.3 details the baseline conditions for TDM services in the study corridor and were developed based on discussions with all TDM agencies in the corridor and the project TAC regarding planned program improvements. Section 6.4 outlines the plans for improved pedestrian and bicycle facilities in the corridor based on projects included in the CLRP. The land use data used in each of the baseline scenarios is discussed in Section 4.0 of this report.

6.1 Highway Networks

Both the 2015 and 2030 highway networks were constructed based on the 2030 CLRP network provided by MWCOG. This network was built based on the list of roadway construction projects found in the *FY 2008 Network Documentation: Highway and Transit Network Development, Appendix A* of the CLRP documentation. A comprehensive list of projects included in the 2030 highway network is included as Appendix D of this report. More than 575 regional highway projects were included in the 2030 network. Table 6-1 highlights some of the major projects in the I-66 corridor.

The CLRP lists an estimated year of completion for each project. This date was used to determine when projects would be operational and hence included in the 2015 and 2030 networks. Figures D-1 and D-2 in Appendix D show the 2015 and 2030 baseline highway networks respectively.

Table 6-1. Highway Network Projects in the Study Corridor

Agency	Project	From	To	Year Expected	2015 Baseline	2030 Baseline
VDOT	Widen I-66 HOV during peak	U.S. 15 (includes interchange reconstruction)	U.S. 29	2015	X	X
VDOT	Reconstruct I-66 interchange	At U.S. 29		2017		X
VDOT	Widen I-66 HOV during peak	VA 234	VA 234 Business	2006	X	X
VDOT	Widen I-66 HOV during peak	U.S. 29	VA 234	2010	X	X
VDOT	I-66 access interchange	At I-495		2013	X	X
VDOT	I-495 HOT lanes interchange	Provides SB to WB, WB to SB, EB to SB, NB to WB & EB to NB HOV to HOT	At I-66 HOV lanes	2013	X	X
VDOT	I-495 HOT lanes interchange	HOT movements to and from south only	At U.S. 29	2013	X	X
VDOT	Widen U.S. 15	U.S. 29	I-66	2020		X
VDOT	Widen U.S. 15	I-66	VA 234	2008	X	X
VDOT	Widen U.S. 29	Virginia Oaks Dr	I-66	2016		X
VDOT	Widen U.S. 29	I-66	Entrance to Conway Robinson MSF	2016		X
VDOT	Widen U.S. 29	U.S. 50	I-66	2010	X	X
VDOT	Widen U.S. 29	ECL City of Fairfax (Nutley St)	Espana Court	2020		X
VDOT	Widen U.S. 29	Espana Court	I-495	2015	X	X
VDOT	Widen U.S. 29	U.S. 50	Chain Bridge Rd	2011	X	X
VDOT	Widen U.S. 29	Chain Bridge Rd	Eaton Pl	2010	X	X
VDOT	U.S. 29 (parallel)	U.S. 29 near U.S. 15	Sommerset Crossing Dr	2025		X
VDOT	Widen U.S. 50	I-66	Waples Mill Rd	2020		X
VDOT	Widen U.S. 50	I-66	West city limit City of Fairfax	2020		X
VDOT	Widen U.S. 50	East city limit City of Fairfax	Arlington County line	2020		X
VDOT	Widen U.S. 50	Arlington County/Fairfax County line	Washington Blvd	2015	X	X
VDOT	Reconstruct U.S. 50	Pershing Dr	Ft. Meyer Dr	2015	X	X
VDOT	U.S. 50 interchange	At Jaguar Trail		2007	X	X
VDOT	U.S. 50 interchange	At VA 120		2010	X	X
VDOT	U.S. 50 interchange	At VA 27		2015	X	X
VDOT	U.S. 50 interchange	At Courthouse Road/10th St		2010	X	X
VDOT	U.S. 50 interchange	VA 110		2020		X
VDOT	VA 28 PPTA (Phase II)	I-66	VA 7	2010	X	X

Table 6-1. Highway Network Projects in the Study Corridor (continued)

Agency	Project	From	To	Year Expected	2015 Baseline	2030 Baseline
VDOT	Remove VA 28 SB ramp	At I-66		2008	X	X
VDOT	Remove VA 28 NB ramp	At I-66		2008	X	X
VDOT	VA 28 Bypass	VA 234 at Godwin Dr	I-66	2015	X	X
VDOT	VA 28 Bypass	I-66	VA 620 at VA 613	2020		X
VDOT	Widen VA 55	Gainesville UM Church	U.S. 29 at VA 619	2016		X
VDOT	VA 123	U.S. 50	I-66	2010	X	X
VDOT	Widen VA 234 (Manassas Bypass)	VA 234 S. of Manassas	I-66	2020		X
VDOT	Widen Ashton Ave	Coverstone Dr	Balls Ford Rd	2010	X	X
VDOT	Widen Balls Ford Rd	VA 234	Bethlehem Rd	2015	X	X
VDOT	Widen Balls Ford Rd	Bethlehem Rd	VA 234 Bypass	2015	X	X
VDOT	New Braddock Rd	VA 28	U.S. 29 at VA 662	2015	X	X
VDOT	Widen Catharpin Rd	VA 55	Heathcote Blvd	2020		X
VDOT	Widen Clifton Rd	Braddock Rd	U.S. 29	2007	X	X
VDOT	Widen Fairfax County Pkwy	Rugby Rd	U.S. 50	2015	X	X
VDOT	Widen Fairfax County Pkwy	U.S. 50	Fair Lakes Pkwy	2010	X	X
VDOT	Widen Fairfax County Pkwy	Fair Lakes Pkwy	I-66	2010	X	X
VDOT	Widen Fairfax County Pkwy	I-66	VA 123	2015	X	X
VDOT	Construct Fairfax County Pkwy interchange	Fair Lakes Pkwy	Monument Dr	2010	X	X
VDOT	Widen Fair Lakes Pkwy	Fairfax County Pkwy	Fair Lakes Circle	2010	X	X
VDOT	Widen Gallows Rd	Gatehouse Rd	Providence Forest Dr	2013	X	X
VDOT	Heathcote Blvd	Old Caroline Rd	U.S. 15	2010	X	X
VDOT	Heathcote Blvd	U.S. 29	Catharpin Rd	2007	X	X
VDOT	Widen Linton Hall Rd	U.S. 29	Glenkirk Rd	2007	X	X
VDOT	Widen N. Pershing Dr	George Mason Dr	VA 120	2012	X	X
VDOT	Widen N. Quincy St	Wilson Blvd	VA 237	2007	X	X
VDOT	North/South Rd at Innovation	VA 840	VA 674/VA 660	2010	X	X
VDOT	Widen Stringfellow Rd	Fair Lakes Blvd	U.S. 50	2013	X	X
VDOT	Sudley Manor Dr extension	Linton Hall Rd	VA 234 Bypass	2007	X	X
VDOT	Sudley Manor Dr extension	VA 234 Bypass	Chatsworth Dr	2007	X	X
VDOT	Tri-County Pkwy	I-66	Loudoun County line	2012	X	X

Table 6-1. Highway Network Projects in the Study Corridor (continued)

Agency	Project	From	To	Year Expected	2015 Baseline	2030 Baseline
VDOT	University Blvd	Hornbaker Rd	Wellington Rd	2025		X
VDOT	University Blvd	Wellington Rd	U.S. 29 at entrance to Conway Robinson MSF	2006	X	X
VDOT	Widen Washington Blvd	Wilson Blvd	Kirkwood	2015	X	X
VDOT	Widen Wellington Rd	Godwin Dr	VA 28	2010	X	X
VDOT	Widen Wellington Rd	Limestone Dr	Vicinity Cellar Door Dr	2006	X	X
VDOT	Williamson Blvd	Sudley Manor Dr	Portsmouth Rd	2020		X
VDOT	Wilson Blvd	N. Quincy	Washington Blvd	2010	X	X

6.2 Transit Networks

The 2015 and 2030 baseline transit networks were developed in a fashion similar to the baseline highway networks. Transit construction projects and new services were taken from the MWCOG 2008 CLRP multimodal network. A full list of these projects and their estimated completion dates is included as Appendix E of this report. More than 50 projects are listed and included in the 2015 baseline transit network. Those in the study corridor are highlighted in the Appendix and include:

- Seven Corners Transit Center;
- Park-and-Ride lot near VA 234 and I-66; and
- Dulles Corridor Metrorail to VA 772 (Silver Line Phase I and II).

The network documentation list of projects includes an estimated year of completion for each project. This date was used to determine when projects would be operational and hence included in the 2015 network and which should be included in the 2030 network. Major transit projects that were completed after 2015 and are therefore added to the 2030 baseline network and not the 2015 baseline network include:

- Corridor Cities Transitway from Metropolitan Grove to Clarksburg;
- Potomac Yard Metrorail station; and
- Beltway HOT lanes transit service.

Table 6-2 shows each of the bus routes that operate on the I-66 corridor that are included in the 2015 and 2030 baseline scenarios. The frequencies are shown for each of the horizon years (2015 and 2030) and for 2009 as a comparison. Transit service coverage in the 2030 baseline scenario in the study area is illustrated in Figure 6-1. This scenario has between 10 and 41 buses per hour on I-66, with the highest service levels occurring inside the Beltway and approaching the Vienna/Fairfax–GMU Metrorail station.

Table 6-2. Baseline Bus Along I-66 by Service Provider

Route	Alignment		Morning Peak Frequency (Minutes)		
	From	To	2009 Schedule	2015 Baseline	2030 Baseline
PRTC					
Linton Hall Metro-Direct	Linton Hall	West Falls Church Metro	50	60	60
Manassas Metro-Direct	Manassas	West Falls Church Metro	30-60	30[1]	30[1]
Manassas OmniRide	Manassas	Pentagon and D.C.	10-15	20[1]	20[1]
Loudoun Transit					
Purcellville to Rosslyn and D.C. Service	Purcellville, Leesburg	Rosslyn and D.C.	9 trips daily	20	20
Purcellville to D.C. Service	Purcellville, Leesburg	D.C.	4 trips daily	60	60
Dulles South to Pentagon and D.C. Service	Dulles South	Pentagon and D.C.	2 trips daily	30	30
Purcellville to Pentagon and D.C. Service	Purcellville, Leesburg	Pentagon and D.C.	n/a[2]	30	30
Dulles South to D.C. Service	Dulles South	D.C.	5 trips daily	60	60
Fairfax Connector					
622 - Fairfax Town Center (bi-directional)	Fairfax Town Center	Vienna/Fairfax-GMU Metro	30	30	30
623 - Fairfax County Government Center Line (bi-directional)	Fairfax County Government Center	Vienna/Fairfax-GMU Metro	30	30	30
595 - Pentagon Express	Reston	Pentagon	30	30	30
597 - Crystal City Express	Reston	Pentagon, Crystal City	30	30	30
631 - Little Rocky Run – Stringfellow Road P&R – Vienna Line	Centreville	Vienna/Fairfax-GMU Metro	These services began operations on June 29, 2009.	30	30
641 - Centreville South - Vienna Line	Centreville	Vienna/Fairfax-GMU Metro		30	30
644 - Centreville (Stone Road) P&R – Vienna Express	Centreville	Vienna/Fairfax-GMU Metro		30	30
651 - Chantilly - Sullyfield Circle - Vienna Line	Dulles South	Vienna/Fairfax-GMU Metro		30	30
652 - Chantilly - Franklin Farm - Vienna Line	Dulles East	Vienna/Fairfax-GMU Metro		30	30
642 - Centreville North - Vienna Line	Chantilly	Vienna/Fairfax-GMU Metro		30	30
653 – Chantilly to Vienna	Chantilly	Vienna/Fairfax-GMU Metro		30	30
Centreville to Reston/Herndon	Centreville	Herndon/Reston		30	30

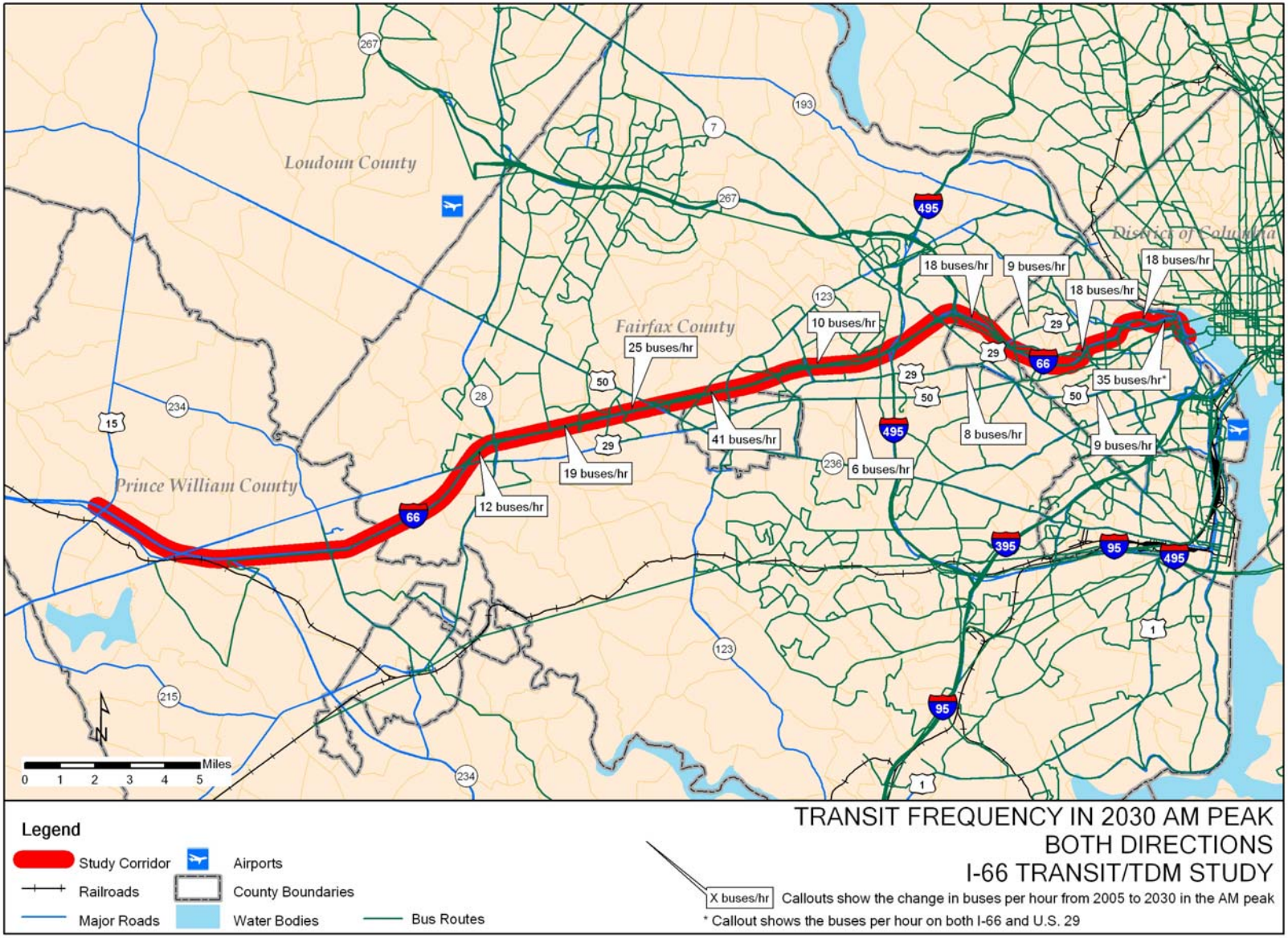
[1] These headways represent combined headways for routes with the same origin and destination but different stop patterns.
[2] Current Loudoun County services from Purcellville to the Pentagon and D.C. Core also stop in Rosslyn.

Table 6-2. Baseline Bus Along I-66 by Service Provider (continued)

Route	Alignment		Morning Peak Frequency (Minutes)		
	From	To	2009 Schedule	2015 Baseline	2030 Baseline
WMATA					
5A - D.C.-Dulles Line[3]	Dulles	D.C.	30	60	60
12 - Centreville South Line (bi-directional)	Centreville	Vienna/Fairfax-GMU Metro	10	These service operations have been transferred to Fairfax Connector as of June 29, 2009.	
12 - Centreville North Line	Centreville	Vienna/Fairfax-GMU Metro	15		
20 - Chantilly Greenbrier Line	Centreville	Vienna/Fairfax-GMU Metro	25		
3Y - Lee Highway – Farragut Square Line	Lee Heights	D.C.	30	30	30
Chantilly – Tysons Line	Dulles – Chantilly	Tysons Corner (via I-66)	n/a	n/a	15

[3] Although WMATA Route 5A currently appears in the CLRP, it is likely to ultimately be replaced by the Metrorail Silver Line.

Figure 6-1. 2030 Baseline Transit Frequency



6.3 TDM Strategies

The baseline scenarios for TDM were developed through discussions with each of the appropriate jurisdictional agencies. The baseline scenarios are cumulative and include all those programs included in previous years unless otherwise specified. Therefore, the 2015 baseline also includes all those elements listed as existing conditions (Section 3.3) while the 2030 baseline scenarios also includes the programs listed as 2015 baseline program elements.

6.3.1 2015 Baseline

The 2015 Baseline conditions include all projects and services that are planned, programmed, or committed to occur by 2015 as determined through interviews with each of the Northern Virginia jurisdictions. This baseline will be used as a comparison point for all potential alternatives to be analyzed. Table 6-3 details additions or changes to TDM services offered in 2015 when compared with the 2005 TDM existing conditions (see Section 3). Any program or service included in the 2005 scenario also is included in the 2015 baseline scenario unless otherwise noted.

Table 6-3. 2015 Baseline TDM Strategies

Northern Virginia-Wide
Regional On-Line Ridematching – On-line ridematching system hosted by Commuter Connections for commuters in the Washington metropolitan region. Started in 2008, it replaces other system in place for 20+ years. Local jurisdictions promote service and most offer links through local program web sites.
Other Informal Rideshare Services – Commercial on-line ride find bulletin boards (e.g., eRideshare.com, GoLoco, Craig's List, AlterNet.rides, carpoolconnect.com). Users post origin/destination and travel time information. The Commuter Connections web site also has an informal bulletin board that is widely used for carpool and vanpool postings.
Virginia Vanpool Insurance Pool – Provides affordable insurance coverage for vanpools.
On-Line Regional Telework Assistance – On-line collaborative resources for teleworkers and employers (FY 2009 launch).
Corridor-Specific Carpool Startup Incentive – Pilot program for corridor-specific three- to six-month duration carpool financial incentive. Initial implementation proposed for FY 2010 for commuters using two Virginia corridors (I-495 from Bethesda to Tysons and from D.C. onto I-395). Also offered to commuters using I-495 between Baltimore-Washington Parkway and I-270 in Maryland.
Special Transportation/Commute Events – One-day events to promote use of non-SOV modes for commuting and other travel. Events with regional scope include: Bike-to-Work Day; Earth Day promotions; and Carfree Day.
Live Near Your Work – Promotion of various national, regional, and local financial incentives (e.g., down-payment assistance, loans, grants, etc.) offered to commuters who purchase homes within specified distances of their work location.
City of Alexandria
Employer Incentives – Financial incentives for employers to provide transit, vanpool, and alternative commute benefits to employees.
Enhanced Local Marketing – Enhanced rideshare promotion and expanded employer services.

Table 6-3. 2015 Baseline TDM Strategies (continued)

Arlington County
ATP Residential/Visitor/Retail Programs – The residential component works with property managers of apartment/condo buildings to encourage/assist them in offering TDM services to residents. The visitor component provides travel information to all hotels in the County for employees and guests. The retail program provides travel information materials at point of purchase in local commercial locations.
Information Displays – Information display program puts TDM and transit information in lobbies of 150 buildings in the County.
Commuter Stores – One additional mobile commuter store (for a total of four permanent and two mobile) provide personal commuting assistance and ticket sales.
Arlington BikeShare – Membership system for bike rentals in Arlington; similar to carshare except for bicycles (2009 launch).
Fairfax County
Tysons Circulator Bus – Bus service will circulate around Tysons Corner area, with connections to new Tysons Metrorail stations. Will begin when Silver Line Metrorail route opens (planned 2013 first phase).
Slug Lines – Two locations in Centreville and Herndon for travel on I-66 to D.C.
New Transit/HOV Access Points – New access points onto HOV lane for buses at the Beltway and at the Vienna/Fairfax-GMU Metrorail station area.
Prince William County
SmartBenefits Centers – New program to sell/add money to SmarTrip cards. Eleven locations for SmarTrip card purchase; one location (transit center) also offers SmarTrip voucher redemption (expected 2009 or 2010 launch).
Slug Lines – One location in Manassas for travel on I-66 to D.C.
District of Columbia
D.C. BikeShare – Similar to carshare for bicycles. Membership system for bike rentals at multiple D.C. locations. Automated swipe-card system to pick-up bikes as needed and return at any location (2008 launch).

6.3.2 2030 Baseline

All of the TDM programs and services in place in the 2015 baseline are assumed to remain in operation for the 2030 baseline. No new TDM programs currently are programmed for the 2030 horizon year in any of the individual jurisdictions; however some Northern Virginia-wide improvements that are anticipated will be included in the 2030 baseline and are detailed in Table 6-4.

Table 6-4. 2030 Baseline TDM Strategies

Northern Virginia-Wide
Enhanced Corridor Marketing – Enhanced program adds targeted marketing of TDM/Transit along Corridor and in feeder markets.
Vanpool Driver Incentive – Provides incentives to get new drivers and retain existing drivers for vanpools.
Enhanced Virginia Vanpool Insurance Pool – Provides affordable insurance coverage for vanpools. Enhanced program would increase vanpool insurance premium pool buy-down for vanpools.
Enhanced Telework!VA – Expanded program adds new financial incentives for employers and or extend the level of assistance available.
Corridor-Specific Startup Carpool Incentives – Program offers three- to six-month carpool startup incentive to commuters using the I-66 corridor and other selected corridors in Virginia and Maryland (I-495 from Bethesda to Tysons; I-495 between Baltimore-Washington Parkway and I-270 in Maryland; and from D.C. onto I-395).
Rideshare Program Operational Support – Additional staff for Virginia commuter assistance programs in the corridor and feeder markets to promote TDM programs and transit and for additional employer outreach support.
Carsharing at Priority Bus Activity Nodes – Expand existing carshare program to include vehicles at Priority Bus activity nodes.
Bike Hubs/Storage at Priority Bus Activity Nodes – Bike lockers or other secure bike storage facilities at all Priority Bus activity nodes. Nodes near work or residential activity centers could include "bike hubs" that also offer bike maintenance, showers/personal lockers, and other services for bicyclists.
TDM Program Evaluation – Evaluation of travel and environmental impacts of TDM activities in Northern Virginia, with particular attention to impacts on I-66 corridor system operation. Evaluation process would include development of performance indicators, collection of survey and tracking data, analysis of impacts, and recommendations for strategy refinements.

6.4 Pedestrian and Bicycle Facilities

Pedestrian and bicycle projects for the baseline scenarios were developed based on the 2008 MWCOG CLRP. The Countywide Trails Plan adopted in 2002 and shown in Appendix C shows Fairfax County's planned trail system while details of the existing and planned bicycle and pedestrian facilities in Arlington County are shown in the Bike and Trail Network map in Appendix B. Figure 6-2 presents a map of all of the major pedestrian/bicycle projects included in the CLRP that will be completed by 2030.[1] Of the more than 50 projects included on this map, four are planned for construction within the study area, including:

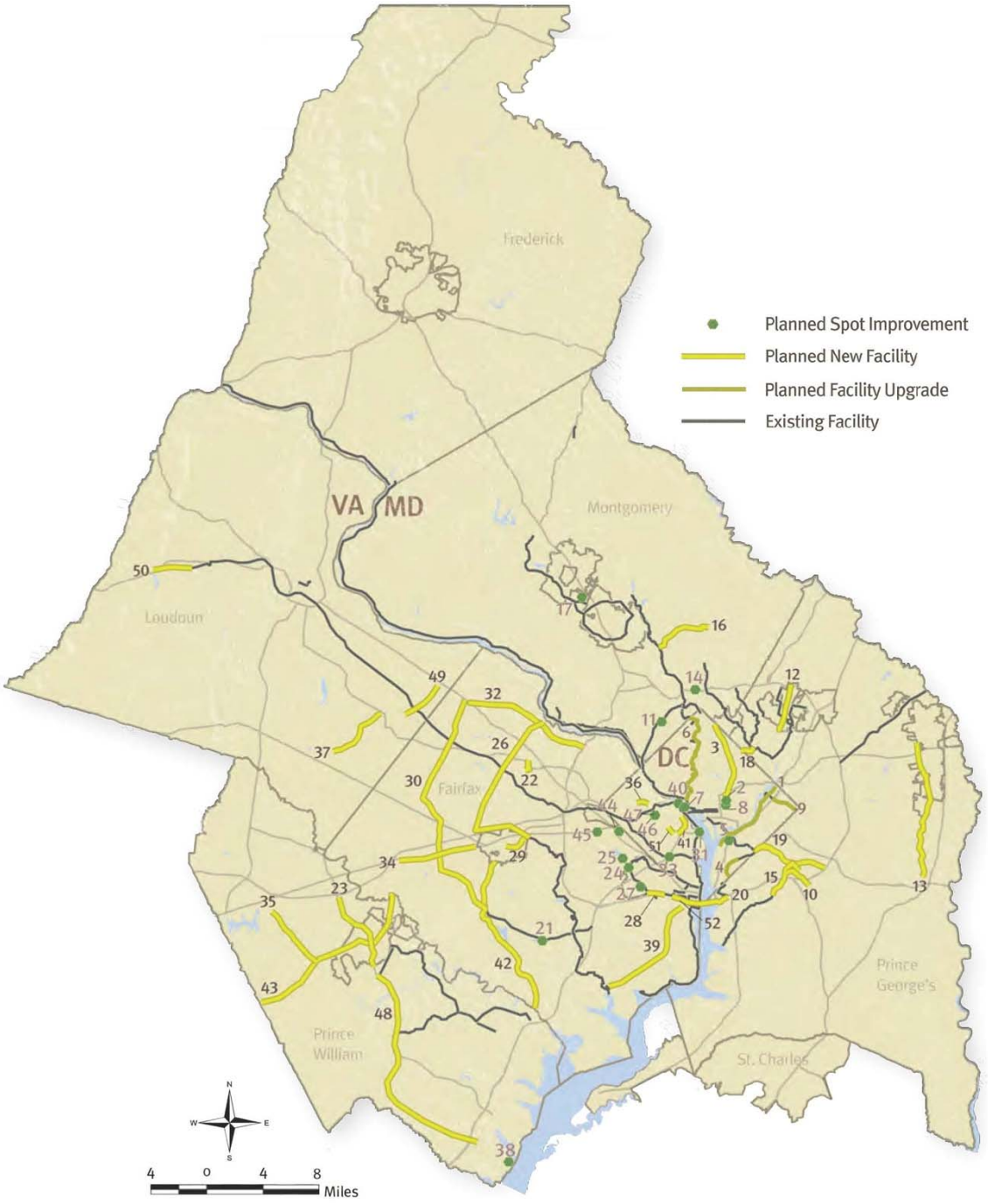
- Cross County Trail, construct shared use path, project 26;
- Lee Highway, construct shared use path, project 34;
- U.S. 50 Pedestrian Improvements, construct streetscape/pedestrian improvements, project 45; and
- VA 234 Business, add signalized crosswalks, construct streetscape/pedestrian improvements, project 23.

[1] The CLRP considers a project to be "major" if it is greater than three miles in length or $200,000 in cost.

In addition, two other trails will be constructed that connect to the I-66 corridor, allowing for nonmotorized access to the corridor, including:

- Fairfax County Parkway Extension Trail, construct eight-mile shared use path, project 30; and
- VA 234 Bike Trail, construct shared use path, project 48.

Figure 6-2. CLRP Pedestrian/Bicycle Projects



7.0 Priority Bus Definition

7.1 Background

The I-66 Transit/TDM Study uses the term "Priority Bus" to refer to a collection of premium bus infrastructure and services which incorporate elements of Bus Rapid Transit (BRT). Among the alternatives considered, the study explored the applicability of a full BRT implementation in the corridor. To provide a foundation for understanding the Priority Bus alternatives studied, and ultimately the recommended transit services, this section defines the functional and operational characteristics which distinguish Priority Bus modes in general, and provides consistent terminology and approaches for regional applications of Priority Bus elements or BRT in Northern Virginia. The section is organized around a series of questions which were used in the facilitation of discussion and refinement of the BRT and Priority Bus concepts.

7.1.1 What are Priority Bus and BRT?

In developing concepts for Priority Bus stations, runningway facilities, and operations, it is helpful to consider the definition of Bus Rapid Transit according to the U.S. Federal Transit Administration (FTA). The FTA identifies several key benefits from BRT, all of which are also applicable to Priority Bus:

- Reducing travel times yields benefits to all transit users;
- Faster service and better marketing will improve transit's image and increase ridership;
- Higher quality transit encourages transit-oriented development;
- BRT service can generally be developed at a lower capital cost than rail; and
- BRT offers greater flexibility in blending BRT and local transit service delivery to better respond to market demand.

The FTA defines BRT generally according to two key elements as follows: reduced travel-time and user-friendly service. In addition, to be eligible for funding through the FTA Small Starts Program, BRT systems must include at least three of the following elements:

- Substantial stations;
- Traffic signal priority or pre-emption;
- Level boarding;
- Branding of the service; and
- Operations 14 hours a day with a minimum of 10-minute peak-period service frequency and 15-minute off-peak period service frequency.

In the Washington, D.C., Metropolitan Area, the term "BRT" has remained reserved for future application only to rail-like bus services and is therefore currently not applied to any operating service since no such service currently exists in the region. Indeed, WMATA has avoided using the word "rapid" in its branding of skip-stop bus services, instead using "Metro Extra" and now

"Metrobus Express," to preserve the potential future branding power of the word when applied to a future BRT service. The term "Priority Bus" has been adopted regionally to describe a collection of services and infrastructure that support enhanced bus services with reduced travel time and user-friendly features, but which might not have all of the service attributes of BRT.

Further discussion is presented below to provide a clearer picture as to what attributes distinguish BRT and Priority Bus and address issues related to achieving reduced travel time and facilitating user-friendly service.

7.1.2 How Does Priority Bus Fit into the Public Transportation System in Northern Virginia?

Table 7-1 illustrates the public transportation modes most closely associated with Priority Bus although the specific vehicles depicted are only representative and not prescriptive (e.g., express bus service may be provided by transit vehicles or over-the-road coaches). The application of Priority Bus envisioned in Northern Virginia is expected to provide express service in primary travel corridors as well as facilitate improved or prioritized operating conditions for local, regional, and commuter bus operators accessing the Priority Bus infrastructure. The corridors targeted for Priority Bus encompass highways and major arterials with significant current and future traffic volumes. Priority Bus improvements in these corridors are intended to shift some of the traffic growth onto transit and more environmentally sustainable modes of travel.

7.1.3 What Are Examples of BRT and Priority Bus Service and Operating Plans?

BRT systems generally include rail transit features like all day service spans, greater spacing between stations, and high-frequency service. As compared with rail, the flexibility and lower cost of BRT allow it to potentially provide greater network coverage.

As compared with BRT, Priority Bus service may have a reduced span of service. Priority Bus may also only have high service frequency during peak periods, whereas most BRT systems offer service frequencies akin to rail transit all day. Priority Bus tends to share the attribute of greater spacing between stations.

BRT may be operated as a trunk service, where transfers are required from feeder or distributor services to provide full coverage of an area. BRT may alternatively be operated in a shared corridor fashion, where multiple routes offer one seat rides from different origins and destinations, but also provide service to the common corridor. Although Priority Bus can be designed with similar service options, shared corridor operations are the more common approach since a very high frequency of service is required for trunk service to work effectively.

Table 7-1. Public Transit Modes in Northern Virginia

	Mode		Description	Example
	Heavy Rail		High-speed, passenger cars on fixed rails in separate rights-of-way from which all other vehicular and foot traffic are excluded.	• Metrorail (WMATA)
	Commuter Rail		Long-haul rail passenger service operating between metropolitan and suburban areas, usually characterized by reduced fares for multiple rides. Typically peak hours and weekday only operations.	• Virginia Railway Express • MARC (Maryland MTA)
	Light Rail/ Streetcar		Passenger rail cars operating singly (or in short, usually two-car trains) on fixed rails in right-of-way that is not separated from other traffic for much of the way.	• New Carrolton to Bethesda Purple Line (Maryland MTA) • Columbia Pike Streetcar (WMATA, Arlington County/Fairfax County)
ENVISIONED FIT FOR PRIORITY BUS	**Commuter Bus**		Motor coach featuring comfortable all seated interior with interurban or suburban service to major employment centers. Typically peak hours and weekday only operations.	• Loudoun County Transit • OmniRide (PRTC)
ENVISIONED FIT FOR PRIORITY BUS	**Express Bus**		Buses operating on a faster schedule by not making as many stops as local bus services and often taking quicker routes, that other buses usually do not use, such as along freeways.	• Richmond Highway Express (WMATA) • Franconia-Springfield/ Pentagon Express –RT 380 (Fairfax Connector)
	Local Bus		Bus serving an area confined to a specific locale, such as a downtown area or suburban neighborhood with connections to major activity centers or traffic corridors.	• Arlington Transit • DASH • Fairfax Connector • PRTC • WMATA • Private Shuttles

7.1.4 How are Priority Bus or BRT Systems Distinguished from Other Bus Modes that Currently Exist in the Region?

Despite the challenge of finding one definitive description of a BRT or Priority Bus system, the following elements almost universally apply, namely that BRT and Priority Bus have:

- **Superior performance,** through technology and/or managed lanes, these services can offer travel-time savings compared to other transit modes and are designed to be competitive with the private automobile;

- **The ability to shape land use policy,** as high-frequency premium services tend to be oriented toward major activity centers which provide sufficient demand and support transit-oriented development; and

- **A strong identity,** through both stations and vehicles, branding means it is perceived as being distinct from the local bus system, uniquely identifying it as a premium service.

Priority Bus in Northern Virginia, however, also has some unique, and at times, corridor-specific properties which may impact the ability to distinguish services, namely that there exists:

- **Only one direction of service in some major corridors,** due to the availability of peak-commuter-direction only congestion-managed HOV/HOT runningways;

- **Established commuter, heavy rail, and other transit connections,** either requiring transfers or introducing parallel and comprehensive networks of transit service patterns; and

- **A variety of operators and fare structures** currently serving the coverage area.

7.1.5 What Could a Potential Regional Priority Bus System Look Like?

A regional Priority Bus system for the Northern Virginia area would provide additional connections to and from major activity centers along managed lane corridors. A Priority Bus system would complement existing transit services, including WMATA and VRE rail services. Individual BRT corridors could also be developed in the future within the Priority Bus system framework, if appropriate. Although this study focused on the I-66 corridor, there are other potential Priority Bus corridors in Northern Virginia, including the Beltway and the I-95/I-395 corridor.

7.1.6 How Can Priority Bus Be Branded with Multiple Modes of Bus Service Operating Along Parallel Routes in the Same Infrastructure (e.g., lanes, stations)?

Priority Bus infrastructure can be used to benefit other bus operations in the same corridor, thereby leveraging these infrastructure improvements for a variety of public transit users and enhancing the overall bus market and experience for riders. Priority Bus identity treatments can be applied to both dedicated and shared infrastructure, however it may be desirable to acknowledge that non-Priority services are different by having separate boarding areas for them as has been done on shared BRT/local corridors in other U.S. cities.

The Priority Bus system could be distinguished through the adoption of station design guidelines, vehicle specifications, and other passenger amenities which target the passenger experience of using Priority Bus. For example, a unifying Priority Bus co-brand, logo, color coding, or some other identifying feature could be applied to services operated by different agencies to create a recognizable Priority Bus service with a different set of service expectations that would operate

along with other services, but actually operated by multiple agencies. Regional quality of service guidelines could be adopted to help achieve similar levels of Priority Bus service across operators.

7.2 Components

7.2.1 What are the physical components and expected benefits of a Priority Bus or BRT system?

Figure 7-1 below depicts major elements of BRT and Priority Bus and their benefits. The graphic is fully applicable to either BRT or Priority Bus. The applicability of these elements only differs in degree between these concepts.

Figure 7-1. Major Elements of BRT or Priority Bus

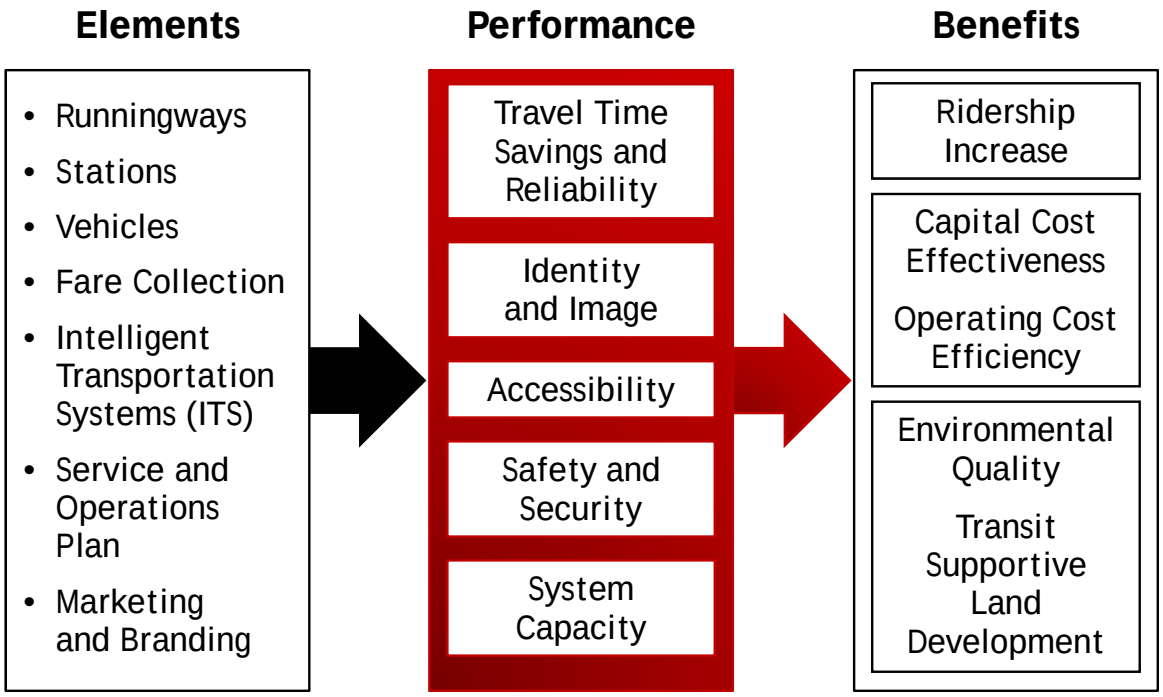
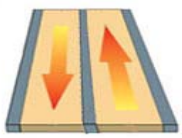


Table 7-2 introduces typical runningways within busways, limited access freeways, and along major arterial roads. The study alternatives were developed with these options in mind, but also considering the goals, objectives, constraints, and time frame of the study. Where there are existing or contemplated examples in the region, a location has been indicated.

Table 7-2. Examples of Runningways

Exclusive Access Guideway	Notes	Locations
Busway – Bus-Only 	This runningway represents dedicated and grade separated lanes which eliminate all interference from general traffic. It provides for the most "rail-like" operations, but requires new or expanded right-of-way and substantial capital investment.	

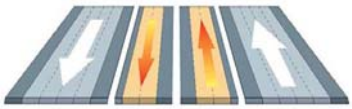
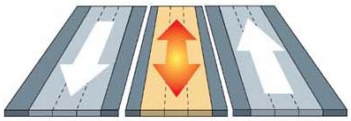
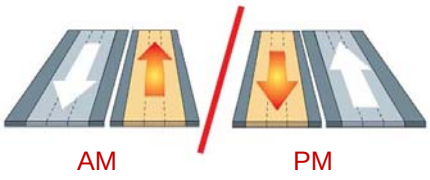
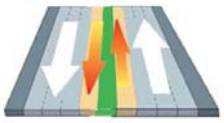
Limited Access Freeway	Notes	Locations
Central Lanes 	Can utilize access ramps directly into the managed lanes (preferred) or requires a weave into general purpose lanes to access on/off ramps.	Capital Beltway (I-495) future Dulles Airport Access Road
Reversible Lanes 	Ramps/facility design often not favorable to multiple on/off movements in peak direction, which may be required for transit station access. In-line stations not accessible from non-peak direction.	I-95/I-395
Peak Only Managed Lanes 	Conversion of general purpose lanes into managed lanes in peak direction during peak travel period only. At all other times, the freeway functions as a general purpose facility in both directions.	I-66 (Inside Capital Beltway)
Bus-Only Shoulder Lanes 	May not require a significant amount of right-of-way, and is applicable in constrained locations. However, conflicts will exist with general traffic at access points, impacting safety, operating speeds, and schedule reliability. This approach is not usually used on segments with HOV lanes.	Dulles Connector Road

Table 7-2. Examples of Runningways (continued)

Access Controlled Arterial	Notes	Locations
Median Lanes 	A central median location minimizes traffic interference and can preserve a parking lane. One platform can potentially serve both directions of travel; however specialized vehicles with left-side doors are required for median stations.	
Opposite Curbside Lanes 	Curbside lanes permit utilizing existing or improved bus stop locations, but traffic conflicts with vehicles parking, turning, and entering the arterial can impact schedule reliability and safety. A variation is to utilize shoulder lanes.	U.S. 29 future U.S. 50 future
Same Curbside Lanes 	Requires a major reconfiguration of existing and traditionally auto-oriented arterials and is most appropriate for corridors with mixed-use and pedestrian-friendly features in more urban settings.	

7.2.2 What is the Optimal Location for Stations Along The Transit Corridor?

The station location in a transit corridor can be determined by several factors, including:

- **Operations –** With point-to-point service (few, if any, intermediate stops) and where there is little demand for walk-up passengers, an indirect location within a large park-and-ride facility may be appropriate;

- **Major Activity Centers –** Locations particularly favorable to generating transit demand should be served directly where possible, with an emphasis on pedestrian connections and opportunities to serve a variety of activity types within the same station area (e.g., employment, retail, medical, etc.);

- **Land Use Plans –** Locations should be coordinated with local land use plans to be consistent with proposed developments and to provide the complementary interaction between the proposed transit investment and the adjacent uses to promote ridership;

- **Transit-Oriented Development (TOD)** – TOD proposals take maximum advantage of the benefits provided by station development. Uses are identified and located to maximize ridership, with such developments typically being smaller, higher-density, and featuring a mix of uses in a more environmentally sustainable design. TOD proposals are closely linked with the land use and specific development plans for the area and require coordination with local planning agencies;

- **Physical Constraints –** Ideal locations for freeway stations occur near highway overpasses, where passengers can, with a minimum of walking, transfer to/from local feeder bus services above or below the mainline. However, bridge pier locations, exit ramp configurations, and corridor width may preclude placement at these locations;

- **Access –** Vehicular, bicycle, and pedestrian – All modes of access should be considered in the location and layout of the stations. Pedestrian and bicycle access are important, particularly in the more developed areas, to minimize traffic congestion. The provision of parking also should be closely coordinated with the station ridership, the local area land use plans, and local roadway network. Parking is less important at urban intermodal stations than for stations located in suburban/exurban areas;

- **Existing Transit Facilities –** Where there is a pre-existing transit station for another mode, assuming a high demand for transfers or a location at a major activity center, service via a Priority Bus route should be weighed against the additional time required to reach the site;

- **Interconnectivity Points –** Station layout should facilitate efficient transit operations in station access/egress and direct connections to other transit services.

Table 7-3 presents three general station location sites, namely in-line or directly within the transit corridor, or off-line which requires vehicles to divert from travel lanes, either via direct access or indirect access to a station facility.

Table 7-3. Examples of Priority Bus Station Sites

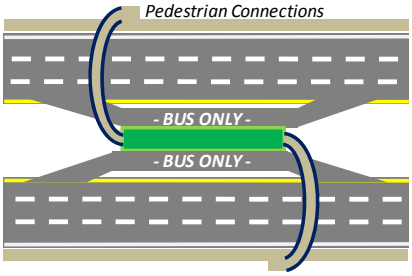
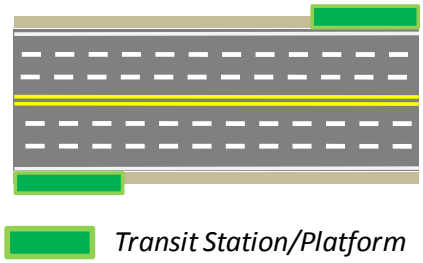
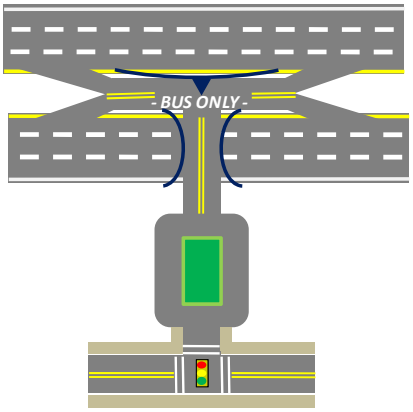
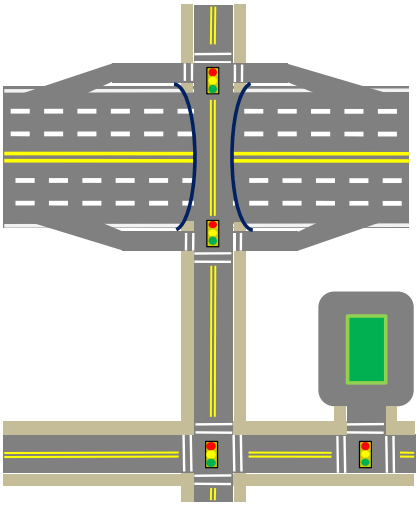
Station Type	Notes
In-Line (Freeway) 	Lowers in-vehicle travel time and improves reliability by avoiding need for the bus to divert from the transit corridor. Locations in median of freeway, however, will require longer walk distances to reach destinations on either side of the highway facility. Generally requires left-side doors; not compatible with existing commuter and express bus services.
In-Line (Curbside Arterial) 	Can be located at intersections, allowing for both easy vehicle and pedestrian access. Separate platforms required depending on direction of travel. May require additional ramps to permit transit vehicles to access stations without weaving through general purpose lanes.

Table 7-3. Examples of Priority Bus Station Sites (continued)

Station Type	Notes
Direct Access 	Achieved through HOV/bus ramps allowing access from the transit corridor to an adjacent station/intermodal center. Local services also can access the same bus bays and can enter the corridor at this location after collecting passengers on local streets. Travel time outside the corridor is minimized, walk times reduced, and land use integration improved.
Indirect Access 	Vehicles would travel through general purpose ramps and traffic signals to reach a transit facility located outside the corridor. This approach allows existing stations to be utilized by new transit services, however the impact to running times during the time spent outside the corridor degrades overall travel time. This station location challenges the tolerance of through passengers already onboard the vehicle to lose time in a deviation that could be spent reaching their desired station stop further down the line. Would require transit signal priority and other treatments to speed bus travel on local roadways.

7.2.3 How Can Stations Be Designed and Branded for BRT or Priority Bus?

The level of station design correlates strongly with the level of runningway segregation. BRT systems with designated lanes on arterials or segregated in-line stations require more-substantial station features. Station sites provide the permanent identity for the system and typically feature shelters, benches, lighting, ticket vending/validating machines, security features, and passenger information.

Many Priority Bus and BRT systems have adopted a “kit-of-parts” approach to develop modular station design concepts with a consistent appearance that can allow the infrastructure to be scaled based on the passenger demand requirements and also to be adapted to the character of

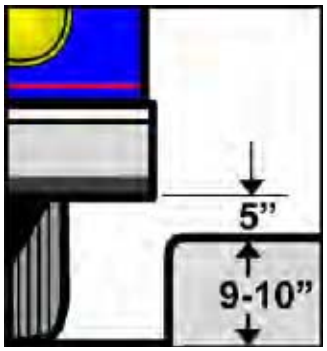
the unique areas in which they are located. Freeway located stations require lengthy pedestrian access ramps and bridges that should be made safe and inviting. Finally, public art may be incorporated.

Considerations for developing the station architectural scheme include:

- How will the various station types look distinctive for Priority Bus, yet vary based on location and level of service? (e.g., in line, indirect access, park-and-ride lot, etc.)
- How can existing stations be incorporated into a Priority Bus image/brand? (e.g., Franconia-Springfield, Pentagon, etc.)
- Which sets of amenities shall be in place based on passenger boardings, number of routes serving the station, and transit modes available?

Also important in station design is the fact that Priority Bus serves high-demand corridors, having only a limited number of stops, with passenger volume at each station being significantly higher than would be the case for a stop along a local bus line. With higher volumes, platform size and height can dictate vehicle dwell times. Figure 7-2 illustrates prototypical components.

Figure 7-2. Examples of Architectural Identity Elements



CURB HEIGHT – Higher than normal curb height is preferable to ease passenger loading/unloading and discourage passengers from walking into the bus bay.

SIGNAGE – Common signage at stations, however other transit provider signage should be co-located, indicating all services available at the station location.

7.2.4 What Sets Priority Bus Vehicles Apart as a Distinguishing Feature?

As envisioned for the I-66 corridor, Priority Bus services can take a few forms, utilizing several different vehicle types. For example, motorcoach-based services offer comfortable rides for longer-distance commuters while sleek, rail-inspired, low-floor vehicles with modern interior designs (known as "stylized buses") can be appropriate as well. It is believed that such vehicles can play a strong role in increasing the use of the services, particularly by choice riders. This supports the idea that vehicle design and branding is helpful to conveying a service that provides the amenities, capacity, speed, and reliability expectations.

In Northern Virginia, all envisioned stations would be shared by a variety of vehicles (from different operators), which would interact with the Priority Bus system. Table 7-4 highlights three Priority Bus vehicle types and their features in relation to the other transit vehicles operating within the same infrastructure. As a regional example, WMATA has added stylized buses to its fleet, but has used a different branding and color scheme for express (blue) versus local (red) service. It is envisioned that Priority Bus services could be provided by a number of vehicle types, including variations of the local bus vehicles. It is possible to purchase vehicles with multiple boarding doors for Priority Bus service, but the recommendations from this study considered vehicles with a single boarding door.

Table 7-4. Examples of Vehicle Types found along Northern Virginia Transit Corridors

Mode		Description	Example
Commuter Bus		Over the road coach with single door, holding all seated passengers. Favors comfort, not designed for frequent stops and high volumes of passenger on/off movements. Right-side doors.	OmniRide
Stylized Articulated		Larger vehicles to offer maximum seating on longer trips. Features left-side and/or right-side doors to accommodate center platform loading/ unloading.	WMATA
Stylized Standard Length		Stylized, standard length vehicles, better suited to more frequent service with standees. Preferably powered by clean (hybrid, CNG) propulsion. May include left-side and/or right-side doors. Some regional operators are currently purchasing stylized buses with right-side doors.	WMATA
Local Bus		Typically a 40-foot vehicle, designed for lower speed, frequent stop service; however many regional express routes are serviced using similar equipment. Right-side doors.	Arlington Transit DASH Fairfax Connector WMATA
Circulator/ Shuttle		May include small transit vehicles or cut-away vans used to transport workers and small groups to a specific destination.	Pentagon Shuttles

7.2.5 How Might Fare Collection Differ to Speed Boardings or Enhance the Passenger Experience?

Fare collection consists of both the media and the payment method. The Washington, D.C. region already uses Smart Card fare media (i.e., SmarTrip) and it would be anticipated that this media would continue to be used on Priority Bus services.

Several potential payment method options exist for Priority Bus services, in general. However, the lack of multiple-door boarding as a requirement among the recommended short- or medium-term services in the I-66 corridor was a key indicator that on-board payment would be sufficient during the study timeframe, and so no provisions were budgeted for changing this. The options considered for payment method are as follows:

- **On-Board Payment –** This system is what is used now on bus vehicles in the Washington area and is indeed typical of most bus systems. It involves a transaction adjacent to the drivers' position. It requires the passengers to board through a single door and pay as they enter (either with cash, tokens, transfer, pass, or machine readable fare media). This can result in longer dwell times as compared with the other options, particularly at high volume boarding and alighting points on the route. One advantage, however, is that there is negligible fare evasion as a result of each passenger passing the driver.

- **Barrier Enforced Payment –** This system requires the provision of turnstiles or ticket agents to allow access to a secure location whereby passengers can board a bus without having to pay either on entry or on-board the vehicle. Essentially the fare-control area operates similar to a subway platform; however, this is an expensive option and would generally require that all bus operations serving such a station to feature the same fare payment method. As such, it could reduce the operating flexibility of facilities shared by other bus modes and does not seem feasible in the short- or medium-term for the I-66 corridor.

- **Proof of Payment System –** This method requires the rider to carry a valid (usually by time and day) ticket or pass when on the vehicle. Riders are subject to a random check of tickets/ passes by roving inspectors. Ticket vending/validating machines can be conveniently located on the station platform. This is the typical payment system on newer light rail systems (e.g., Baltimore, Denver, and Portland). The primary advantage of such a system is that it supports the use of multiple door boardings and thus can speed the boarding process and reduce dwell times versus on-board payment. Additionally, it does not require separated facilities in the way that a barrier-enforced method does (i.e., Priority Bus and non-Priority Bus services can service the same station, but use different payment methods, if necessary). The proof of payment method generally experiences higher evasion rates than barrier-enforced or on-board payment methods, but the enforcement approach can be a determining factor.

7.2.6 What Is the Role of Intelligent Transportation Systems (ITS) and Highway Improvements for Schedule Reliability and Passenger Convenience?

Priority Bus incorporates ITS (intelligent transportation system) applications for faster and more convenient trips. ITS and highway modifications become especially important when vehicles are operating outside of managed lanes, where interaction with general traffic, pedestrian movements, and traffic signals can impact overall travel-time and schedule reliability. Key components for incorporation into a regional Priority Bus system where route segments operate outside managed lanes include:

- **Signal Priority –** Signal priority allows buses to maintain a swift service and to better adhere to their schedules. Since transit vehicles can hold many people, giving priority to transit also can potentially increase the person throughput of an intersection.

- **Queue Jumps –** These provide an additional travel lane on the approach to a signalized intersection. This lane is often restricted to transit vehicles only, with the intent of the lane to allow the higher-capacity vehicles to cut in front of waiting vehicles, reducing the delay caused by the signal and improving the operational efficiency of the transit system. An advanced signal can give the transit vehicle a "head start" over other queued vehicles and permit a merge into the regular travel lanes immediately beyond the signal.

- **Passenger Information –** This technology group includes various methods of providing real-time information to passengers so they can make the best use of their time. Information about the vehicle schedule can be provided via monitors at the station/stop and/or on the vehicle. Providing schedule information to travelers via personal data assistant (PDA), cell phone, or similar device and supporting trip planning are other functions that can be provided, if there is sufficient need by travelers. All the passenger information functions improve passenger satisfaction, help to reduce actual and perceived wait times, and can increase ridership.

- **Technology Amenities –** Buses and stations equipped with Wi-Fi service enable productive use of time by members of the riding public. This amenity is becoming more widely available on transit systems, especially on long-distance commuter services.

- **Advanced Transit Management Capabilities –** Use of an integrated system of global positioning system (GPS)-based automated vehicle location technology and computerized geographic information system (GIS)-based scheduling is an essential requirement for achieving increased operations management capabilities to improve service performance, on-time performance, service reliability, transfer connections, and to provide service status information to the public via the Internet, at stations/stops, and via PDAs, cell phones, and similar devices.

7.3 Priority Bus in the I-66 Corridor

The preceding sections have discussed possible elements of a Priority Bus network in Northern Virginia. This section addresses the elements of BRT that are most appropriate and useful for study in the I-66 corridor. In developing concepts for Priority Bus stations and operations, several key issues will need to be addressed including runningway, stations, operations, and connectivity with other regional services.

7.3.1 Runningway – How Should Priority Bus Work in the I-66 Corridor?

Several options for Priority Bus runningways in Northern Virginia were discussed in section 7.2.1, however not all of these are possibilities for the I-66 corridor in the short- to medium-term due to the configuration of the roadway. In the longer term, a widening of I-66 could permit additional transit runningway options. Possible runningway configurations for the I-66 corridor include:

- **New Bus-Only Lanes** – Long term, new lanes could be specifically designated as bus only lanes or shared bus/toll lanes. Construction of new lanes could be in the existing I-66 right-of-way or outside of it. This would require additional study and is beyond the scope of this short- to medium-term effort.
- **Priority Bus in HOV lanes** – This option has transit vehicles operating in the existing I-66 HOV lanes. The management and timing of the HOV lane restrictions could remain the same, could be changed, or the lanes could be converted to HOT lanes that could continue to be used at no charge by buses. Changes would likely require additional study, but might be

possible in the medium-term horizon. SR 167 in the Seattle area might provide an appropriate analog for a HOT lane without a physical barrier separation.

- **Bus on Shoulders** – Wherever available, buses could be operated in the shoulders of I-66. However, this option has generally been used in areas without HOV lanes. On freeway facilities, this option introduces conflicts at exit/entry points. The nearby U.S. 29 and U.S. 50 arterials could include locations where bus on shoulders could be effective.

7.3.2 Priority Bus Stations

Four general station types were described in Section 7.2.2, in addition to the considerations for selecting the optimal station type for any specific site. Due to the differing conditions along the length of the corridor, Priority Bus along I-66 would have several different types of station based on time horizon, location, operational considerations, and physical constraints at each station site. Different station possibilities include:

- Western terminal station – This location should include a park-and-ride lot that is easily accessible to drivers and provides easy access to I-66 for Priority Bus vehicles.
- Eastern terminal station – Located in the D.C. Core on the K Street busway, the eastern terminal station should be collocated with the terminal stations of many other commuter, express, and local bus services. Priority Bus is unlikely to have dedicated station space at this highly congested location.
- New stations – The physical constraints of the I-66 right-of-way make in-line stations extremely difficult and unlikely options, particularly for short or medium term implementation. In addition, in-line stations could be seen as interfering with potential long-term extension of rail service in the corridor. New stations west of existing Metrorail Orange Line service should have park-and-ride lots, which will necessitate good vehicular access. Stations could have direct or indirect access to I-66 for Priority Bus vehicles.
- Stations collocated with Metrorail stations – Priority Bus serving Metrorail stations should be one of many transit services at these locations; however some opportunities for specialized stations may still exist. No new park-and-lots should be constructed at Metrorail sites specific to the Priority Bus service. As these stations are likely to be major transfer points, pedestrian access between the Priority Bus and Metrorail services should be a focus of station planning efforts.

7.3.3 Priority Bus Operations

Operations of Priority Bus service in the I-66 corridor is a complex issue that raises many questions. These are among the questions explored by the study and addressed through the analysis and recommendation phases of the project. Some of these important issues include:

- Who will operate services? – Many agencies currently provide service along the I-66 corridor including WMATA, PRTC, LC Transit, and Fairfax Connector. In addition, I-66 passes through three counties, two cities and the District of Columbia. Any of these agencies could potentially operate Priority Bus services.

- Will the lanes and stations be exclusive to the Priority Bus service? – New Priority Bus lanes or other BRT facilities along I-66 (as discussed previously in Section 7.3.1) could be limited to use by branded Priority Bus service. This could help to promote the image and services of the Priority Bus line by providing clear benefits above traditional bus transit in the corridor. However, permitting the Priority Bus lanes and other facilities to be open to all transit services in the corridor would allow for improved transit speeds and reliability for all regional transit and would better leverage such investments.

- What kind of feeder bus system should be put in place? – As discussed in section 7.1.3, the operating plan is at least partially defined by the structure of the feeder system selected. Feeder bus systems in each of the communities along the I-66 corridor are likely to be necessary, although the western stations are likely to be fed primarily through park-and-ride.

- Should Priority Bus service serve all stops along I-66? – This issue determines the structure of Priority Bus service in the I-66 corridor as either long-haul service with stops only near the western end or a service that stops at stops spaced a few miles apart. While the former option provides time savings to riders, the latter serves more potential riders at more destinations in the corridor.

- Should Priority Bus service be provided outside of peak commuting times and directions? – Changing land use along the I-66 corridor is resulting in an increased number of jobs in suburban areas. In addition, I-66 is often congested at non-peak times and/or in the non-peak direction. However, long distance reverse commutes in this corridor are still not common and are hard to serve with transit due to the lack of concentrated destinations and because running all day service would be very expensive.

7.3.4 Regional Coordination

Priority Bus service in the I-66 corridor would require coordination with other transit services in the corridor and in the region as a whole on many issues, including:

- Connections and transfers with other transit services, including:
  - Metrorail, specifically the Orange Line and Silver Line,
  - Existing express and commuter bus services, and
  - Local bus service providers in each jurisdiction;
- Services beyond the WMATA Compact area;
- Fare policy and fare media;
- Marketing;
- Trip planning;
- Creation of feeder service networks; and
- Funding allocations and joint participation agreements.

7.4 Conclusions

Priority Bus infrastructure and services are already in existence in the I-66 corridor in the form of commuter and express bus services that make use of the existing HOV lane. However, as highlighted in this section, including additional elements of BRT may be possible to provide an enhanced level of service. The I-66 Transit/TDM Study includes consideration of a variety of such Priority Bus infrastructure and service enhancements. The next section discusses the specific transit alternatives and TDM strategies that were explored and later sections present the recommendations from the study.

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8.0 Transit Alternatives and TDM Strategies

The I-66 Transit/TDM Study included development of proposed alternative transit service and TDM program strategies for the study area. Alternative transit services were developed and tested for the horizon years of 2015 and 2030 and complementary TDM strategies were developed for a range of application levels. This section details each of the alternatives that were tested and describes the process used to develop them. Section 8.1 describes the three first-round testing alternatives and Section 8.2 discusses the development of the refined alternative. Section 8.3 details a range of potential TDM program recommendations considered for application in the Northern Virginia region to address conditions in the I-66 corridor.

8.1 Initial Testing Alternatives

Transit alternatives for the I-66 corridor were developed and tested for two horizon years: 2015 and 2030. A total of three initial testing alternatives were developed, as detailed in this section.

8.1.1 Development of Initial Testing Alternatives

Broadly speaking, the testing alternatives were developed by considering existing transit services in the I-66 corridor, reviewing and analyzing market conditions and projections, taking into account the broad range of planned transit service improvements in the I-66 corridor, and finally, by considering a wide range of stakeholder and public input. The development of alternatives for testing involved substantial coordination with and consensus among TAC members. Key assumptions that were established to guide the development of the transit alternatives include:

- Transit service improvements should be demand-driven and built from existing service levels to meet forecasts of increased transit demand in the planning horizon. Thus, the baseline scenario for 2015 and 2030 consisted of all service currently planned in the region's Constrained Long Range Transportation Plan (CLRP). Services included in the baseline are detailed in Section 6 of this report.

- Existing transit services already provide excellent coverage in areas with large numbers of transit trips and transit mode share in the corridor. Since it is anticipated that existing services will continue and that transit providers in the corridor have planned and approved service improvements, the alternatives were designed to enhance the coverage or the existing level of services and are defined by specific operator.

- Services should reflect that the basic market needs for transit in the corridor consists of long distance commuters whose trips end in downtown Washington, D.C., Tysons Corner, and the Rosslyn-Ballston corridor in Arlington. Section 4 of this report highlighted the process of identifying potential markets.

- Transit service improvements would utilize existing HOV lanes as the travel lanes for any new transit service improvements in the corridor (no dedicated transit rights-of-way would be assumed).

- Transit improvements would be designed so as not to preclude, and indeed lay the groundwork for, the extension of rail in the corridor in the long term.

- Any Priority Bus service framework proposed would be considered as part of an overall Northern Virginia Priority Bus system, including potential Priority Bus services along I-495 and I-95/I-395.

- Proposed Priority Bus services should interface effectively with the Metrorail system, particularly the new Silver Line to Loudoun County and Dulles International Airport.

- BRT would be among the Priority Bus implementation alternatives considered by the study for the I-66 corridor.

- Funding constraints or cost concerns were not to be considered when developing the testing alternatives.

8.1.2 Proposed Transit Service Elements

The transit service elements introduced in this section form the framework for the set of initial testing alternatives. The testing alternatives were built on the basis of the baseline scenario (described in Section 6). For convenience of reference, the services are presented in this section in the categories of "Baseline" and "New Priority Bus." Priority Bus in Northern Virginia and the I-66 corridor specifically are discussed in detail in Section 7 of this report.

Baseline – Baseline transit services were detailed for both horizon years in Section 6 of this report. This service package essential represents a continuation of the existing transit service in the corridor with a few changes including route consolidations, slight alterations of bus routings, and changes in operator. The changes from existing service are a part of the adopted CLRP for the Washington Metropolitan region and can be found in Table 6-2. The baseline routes, highlighted for 2015 and 2030 in Table 8-1, are included in each of the testing alternatives. All bus services included in this element would continue to use the available HOV facilities. The routes would continue to stop at their current terminus (Vienna/Fairfax-GMU, West Falls Church, or Washington, D.C.) and would additionally stop at the proposed Centreville Priority Bus station.

New Priority Bus – Some additions to the baseline transit services which were also tested as an element of the transit alternatives are commuter bus services already planned by PRTC to be included in a future version of the CLRP. These services would use the available HOV facilities in the corridor and could be implemented as Priority Bus services. These elements of the 2015 and 2030 testing alternatives are shown by route in Table 8-2.

In addition to these elements of the testing alternatives are new Priority Bus services that would be superimposed over the other services in the corridor. These Priority Bus services would include limited stops and operate in any available HOV facilities along the corridor in order to improve travel speeds.

Two of the routes tested in both 2015 and 2030 as part of this element were considered as Metrobus Express services, as follows:

- U.S. 29 Metrobus Express: Originating at Fair Oaks Mall, service along U.S. 29 to Washington, D.C. using the K Street busway with stops at Rosslyn, Farragut Square, 15th Street/Vermont Ave, and 9th Street. Stops would be limited to two or three per mile which would allow for an estimated 20 percent improvement in speed.

- U.S. 50 Metrobus Express: Originating at Fair Oaks Mall, service along U.S. 50 to Washington, D.C. using the K Street busway with stops at Rosslyn, Farragut Square, 15th Street/Vermont Ave, and 9th Street. Stops would be limited to two or three per mile which would allow for an estimated 20 percent improvement in speed.

Table 8-1. Baseline Transit Service Testing Alternatives Element

Route	Alignment		Morning Peak Frequency (Minutes)	
	From	To	2015	2030
PRTC				
Linton Hall Metro-Direct	Linton Hall	West Falls Church Metro	60	60
Manassas Metro-Direct	Manassas	West Falls Church Metro	30[1]	30[1]
Manassas OmniRide	Manassas	Pentagon and D.C.	20[1]	20[1]
Loudoun Transit				
Purcellville to Rosslyn/D.C. Service	Purcellville, Leesburg	Rosslyn and D.C.	20	20
Purcellville to D.C. Service	Purcellville, Leesburg	D.C.	60	60
Dulles South to Pentagon/ D.C. Service	Dulles South	Pentagon and D.C.	30	30
Purcellville to Pentagon/ D.C. Service	Purcellville, Leesburg	Pentagon and D.C.	30	30
Dulles South to D.C. Service	Dulles South	D.C.	60	60
Fairfax Connector				
622 - Fairfax Town Center (bi-directional)	Fairfax Town Center	Vienna/Fairfax-GMU Metro	30	30
623 - Fairfax County Government Center Line (bi-directional)	Fairfax County Government Center	Vienna/Fairfax-GMU Metro	30	30
595 - Pentagon Express	Reston	Pentagon	30	30
597 - Crystal City Express	Reston	Pentagon, Crystal City	30	30
631 - Little Rocky Run – Stringfellow Road P&R – Vienna Line	Centreville	Vienna/Fairfax-GMU Metro	30	30
641 - Centreville South – Vienna Line	Centreville	Vienna/Fairfax-GMU Metro	30	30
644 - Centreville (Stone Road) P&R – Vienna Express	Centreville	Vienna/Fairfax-GMU Metro	30	30
651 - Chantilly – Sullyfield Circle – Vienna Line	Dulles South	Vienna/Fairfax-GMU Metro	30	30
652 - Chantilly – Franklin Farm – Vienna Line	Dulles East	Vienna/Fairfax-GMU Metro	30	30
642 - Centreville North – Vienna Line	Chantilly	Vienna/Fairfax-GMU Metro	30	30
653 - Chantilly to Vienna	Chantilly	Vienna/Fairfax-GMU Metro	30	30
Centreville to Reston/Herndon	Centreville	Herndon/Reston	30	30
WMATA				
5A - D.C.-Dulles Line[2]	Dulles	D.C.	60	60
3Y - Lee Highway – Farragut Square Line	Ballston-MU Metro	D.C.	30	30
Chantilly – Tysons Line	Dulles – Chantilly	Tysons (via I-66)	n/a	15

[1] These headways represent combined headways for routes with the same origin and destination but different stop patterns.
[2] Although WMATA Route 5A currently appears in the CLRP, it is likely to be replaced by the Metrorail Silver Line.

Table 8-2. 2015 and 2030 Testing Alternatives – New PRTC Services

Route	2015 Headway	2030 Headway
Gainesville OmniRide route: route extension from current terminus at West Falls Church Metrorail station to D.C. Core and Navy Yard; to be implemented by 2015*	3 peak-period trips	3 peak-period trips
Haymarket/Gainesville – Metro-Direct route: New route which will in 2015 provide service from the U.S. 15/I-66 park-and-ride lot to Tysons Corner, peak direction only	4 peak-period trips	4 peak-period trips
Manassas – Dulles OmniRide route: Addition of new route by 2030 from Manassas to the VA 28 corridor and Dulles International Airport (four morning peak-period trips and four evening peak-period trips, peak direction only)		4 peak-period trips
Gainesville/Haymarket – Dulles OmniRide route: Addition of new route with service to the VA 28 corridor and Dulles International Airport, peak direction only		4 peak-period trips
West County – Reston/Herndon OmniRide route: Addition of new service by 2030 from western Prince William County to the Reston-Herndon area, peak direction only		4 peak-period trips
Manassas Metro-Direct route extension: By 2015, extension of route from current terminus at Vienna/Fairfax-GMU to Tysons Corner*	3 peak-period trips	3 peak-period trips

* Noted routes represent extensions to the baseline element presented in Table 8-1.

In addition, three BRT services were considered:

- Haymarket to D.C. service: Service between Haymarket and the D.C. Core along I-66. Service would operate all day, in both directions on seven minute headways.

- Haymarket to Dulles service: Service between Haymarket and Dulles Airport along I-66 and VA 28. Service would operate all day in both directions on 14 minute headways.

- Haymarket to Tysons Corner service: Service between Haymarket and Tysons Corner along I-66 and I-495. Service would operate all day in both directions on 14 minute headways.

Headways, stop patterns, and other characteristics for each of the Priority Bus services are the same for the 2015 and 2030 testing alternatives. However, the 2030 alternatives assume the addition of direct access facilities to many of the stations along I-66, as opposed to the indirect station access available in 2015. The specific opportunities for direct access to each individual station are discussed in detail in Section 11 of this report.

Direct access to stations in 2030 results in improved travel time for the services that operate on I-66 by minimizing the time lost as buses enter and exit the stations. Table 8-3 shows the difference in runtime achieved for each of the considered BRT services that would operate on I-66 in the testing alternatives. As can be seen in the table, no improvement in runtime is achieved on the Haymarket to Dulles Priority Bus service. This is because direct access to stations along this alignment was not deemed possible. Each of the other segments is able to realize significant time savings (up to 18 percent or 16 minutes) from the construction of direct station access infrastructure.

Table 8-3. BRT Service Runtimes: Direct and Indirect Station Access

Alternative	Priority Bus Services	Runtime (minutes) 2015	Runtime (minutes) 2030	Percent Change
Testing Alternative 1	Haymarket to D.C.	91	78	14%
	Haymarket to Dulles	60	60	None
Testing Alternative 2	Haymarket to D.C.	90	80	11%
	Haymarket to Dulles	60	60	None
Testing Alternative 3	Haymarket to D.C.	90	74	18%
	Haymarket to Tysons Corner	65	55	15%
	Haymarket to Dulles	60	60	None

8.1.3 Definition of Initial Testing Alternatives

Three initial testing alternatives were developed that comprise the elements described in the previous section. The three alternatives are similar in the elements that they include; the testing alternatives vary only in the Priority Bus services included and the stop patterns of those services (see Table 8-4). Further details about each alternative are provided below.

Table 8-4. Service Elements by Testing Alternative

Element	Testing Alternative 1	Testing Alternative 2	Testing Alternative 3
Baseline Services	√	√	√
PRTC Additions	√	√	√
Additional Priority Bus Services:			
U.S. 29 Metrobus Express	√	√	√
U.S. 50 Metrobus Express	√	√	√
Haymarket to D.C. BRT Service	√	√	√
Haymarket to Dulles BRT Service	√	√	√
Haymarket to Tysons Corner BRT Service			√

Testing Alternatives 1 and 2 differ only in I-66 Priority Bus stop configurations.

8.1.3.1 Testing Alternative 1

As shown in Table 8-4, the first testing alternative includes the baseline services detailed in Section 6, the PRTC service additions and four segments of new Priority Bus service: U.S. 29 Metrobus Express, U.S. 50 Metrobus Express, Haymarket to D.C. BRT service, and Haymarket to Dulles BRT service. Thirteen different stops on I-66 would be served by the two I-66 BRT services collectively, as shown in Table 8-5 and Figure 8-1. The figure shows potential stations on the I-95/I-395 corridor that were included as a part of this alternative (based on the best information available at the time of this analysis).

Table 8-5. I-66 BRT Service Stops – Testing Alternative 1

Haymarket to D.C.	Haymarket to Dulles
Haymarket	Haymarket
Gainesville	Gainesville
VA 234 Bypass	VA 234 Bypass
Bull Run	Bull Run
Centreville	Centreville
	Chantilly Crossing
	Dulles East
	Dulles International Airport
Stringfellow Road	
Monument Drive/Fairfax Corner	
Vienna/Fairfax – GMU	
East Falls Church	
D.C. Core	

This alternative would serve multiple geographic markets for home based work trips in the study area. Traditional commute trips into the D.C. Core would be served by the Haymarket to D.C. BRT service. As noted in Section 4, the level of employment in the western portion of the corridor, especially along VA 28 near Dulles International Airport is projected to increase dramatically. This market would be served by the Haymarket to Dulles BRT service. Reverse commute markets in these areas would also be served. In addition, this alternative would provide two connections to the Metrorail Orange Line, providing connecting service for commuters who work in Arlington. The connections at East Falls Church and Dulles International Airport will also provide transfer opportunities to the Silver Line and the Tysons Corner area.

8.1.3.2 Testing Alternative 2

As shown in Table 8-4, the second testing alternative includes all of the same elements as the first testing alternative: the baseline services detailed in Section 6 and the New Priority Bus services. However, as shown in Table 8-6 and Figure 8-2, the Haymarket to D.C. BRT service incorporates a different stop pattern, with a stop in Ballston instead of at Vienna/Fairfax-GMU. The figure shows potential stations on the I-95/I-395 corridor that were included as a part of this alternative (based on the best information available at the time of this analysis).

Table 8-6. I-66 BRT Service Stops – Testing Alternative 2

Haymarket to D.C.	Haymarket to Dulles
Haymarket	Haymarket
Gainesville	Gainesville
VA 234 Bypass	VA 234 Bypass
Bull Run	Bull Run
Centreville	Centreville
	Chantilly Crossing
	Dulles East
	Dulles International Airport
Stringfellow Road	
Monument Drive/Fairfax Corner	
East Falls Church	
Ballston	
D.C. Core	

This alternative serves many of the same markets as the first alternative including traditional commutes to Washington, D.C. and suburb-to-suburb commute trips to the growing VA 28 corridor. Reverse commute markets in these areas would also be served. This alternative also provides better service to the employment centers in Arlington by providing direct Priority Bus service to Ballston. The connections at East Falls Church and Dulles Airport also will provide transfer opportunities to the Silver Line and the Tysons Corner area.

8.1.3.3 Testing Alternative 3

As shown in Table 8-4, the third testing alternative includes all of the potential elements including the baseline services detailed in Section 6 and the New Priority Bus services, including the PRTC service additions and all five additional Priority Bus services. The major addition in the third alternative beyond that which is included in the first two testing alternatives is the addition of a fifth Priority Bus service from Haymarket to Tysons Corner without a stop at the Vienna/Fairfax-GMU Metrorail Station[1] as shown in Figure 8-3. Table 8-7 details the stop pattern for the three I-66 BRT services included in Testing Alternative 3. The figure shows potential stations on the I-95/I-395 corridor that were included as a part of this alternative (based on the best information available at the time of this analysis).

Table 8-7. I-66 BRT Service Stops – Testing Alternative 3

Haymarket to D.C.	Haymarket to Dulles	Haymarket to Tysons Corner
Haymarket	Haymarket	Haymarket
Gainesville	Gainesville	Gainesville
VA 234 Bypass	VA 234 Bypass	VA 234 Bypass
Bull Run	Bull Run	Bull Run
Centreville	Centreville	Centreville
	Chantilly Crossing	
	Dulles East	
	Dulles International Airport	
Stringfellow Road		Stringfellow Road
Monument Drive/Fairfax Corner		Monument Drive/Fairfax Corner
East Falls Church		
D.C. Core		
		Tysons Central 123

This testing alternative serves many of the same markets as the first two alternatives including traditional commutes to Washington, D.C. and suburb-to-suburb commute trips to the growing VA 28 corridor. In addition, this alternative serves the second largest employment center in the metropolitan region: Tysons Corner. The markets between I-66 corridor communities in Prince William and Fairfax Counties and Tysons Corner also are well served with direct connection in this alternative. Arlington destinations are served only indirectly with a connection to the Orange Line at East Falls Church. Reverse commute markets in these areas also would be well served.

[1] Note: The configuration of the roadways and exit/entrance ramps connecting I-66 and I-495 makes it difficult to reenter eastbound I-66 from the Vienna/Fairfax-GMU Metrorail Station and then exit to the northbound I-495 HOT lanes to serve Tysons Corner.

Figure 8-1. Priority Bus Service Element of Testing Alternative 1

Figure 8-2. Priority Bus Service Element of Testing Alternative 2

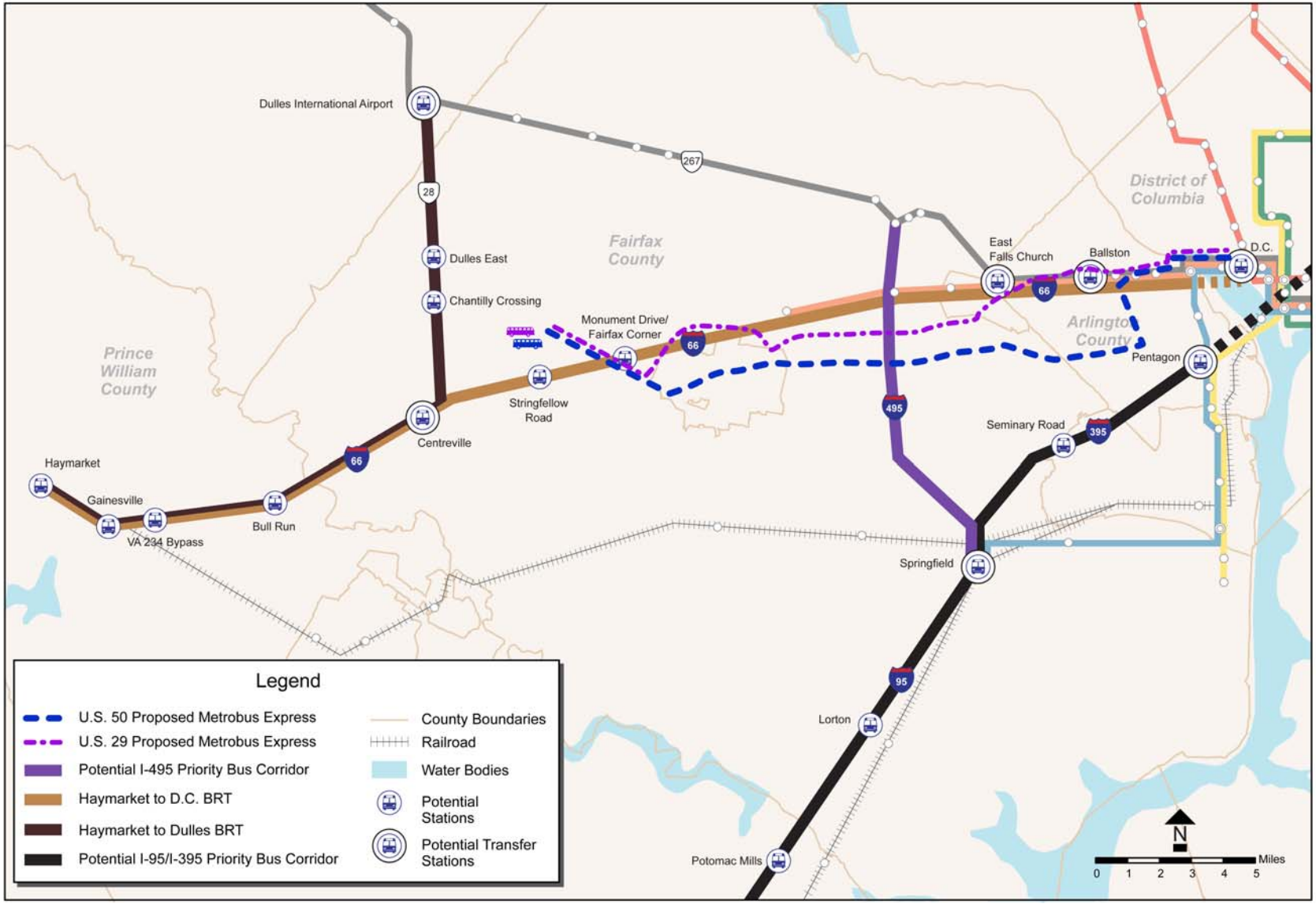


Figure 8-3. Priority Bus Service Element of Testing Alternative 3

8.2 Refined Alternative

Once defined, the initial testing alternatives were analyzed for 2015 and 2030 using the evaluation framework. Details of the modeling methodology and results can be found in Section 9 of this report. Based on this evaluation and TAC member feedback, a refined alternative was then developed. Some additional sensitivity analyses (described in detail in Section 9) were also used to develop the refined service proposal for this corridor. This process ensured that the refined transit alternative met the needs of the study stakeholders and provided a market-driven service that would be well-patronized and cost effective.

The Refined Alternative is comprised of elements similar to the testing alternatives; however some changes and additions were made to these elements to provide more appropriate services to the corridor. Again, for convenience, the services are presented in this section in the categories of "Baseline" and "New Priority Bus."

Baseline – The same baseline transit services are included in the Refined Alternative as detailed for both horizon years in Table 8-1. All bus services in this element would continue to use the available HOV facilities. The routes would continue to stop at their current terminus (Vienna/Fairfax-GMU, West Falls Church, or Washington, D.C.) and would additionally stop at the proposed Centreville Priority Bus station.

New Priority Bus – The same six PRTC route additions included in the Testing Alternatives are also included in the Refined Alternative. As shown in Table 8-8, some improvement in service levels is included in this element of the Refined Alternative (specifically the Linton Hall Route).

Table 8-8. 2015 and 2030 Refined Alternative – New PRTC Services

Route	2015 Headway	2030 Headway
Gainesville OmniRide route: route extension from current terminus at West Falls Church Metrorail station to D.C. Core and Potomac Yard; to be implemented by 2015. *The refined alternative increases frequency from 60 to 30 minutes.*	6 peak-period trips	6 peak-period trips
Haymarket/Gainesville – Metro-Direct route: New route which will in 2015 provide service from the U.S. 15/I-66 park-and-ride lot to Tysons Corner, peak direction only	4 peak-period trips	4 peak-period trips
Manassas – Dulles OmniRide route: Addition of new route by 2030 from Manassas to the VA 28 corridor and Dulles International Airport (four morning peak-period trips and four evening peak-period trips, peak direction only)		4 peak-period trips
Gainesville/Haymarket – Dulles OmniRide route: Addition of new route with service to the VA 28 corridor and Dulles International Airport, peak direction only		4 peak-period trips
West County – Reston/Herndon OmniRide route: Addition of new service by 2030 from western Prince William County to the Reston-Herndon area, peak direction only		4 peak-period trips
Manassas Metro-Direct route extension: By 2015, extension of route from current terminus at Vienna/Fairfax-GMU to Tysons Corner	3 peak-period trips	3 peak-period trips

In addition, in the Refined Alternative, four new Priority Bus services would be superimposed over the other services in the corridor. These Priority Bus services would include limited stops and operate in any available HOV facilities in order to improve travel speeds. The services tested as part of this element are illustrated in Figure 8-4 and include:

- U.S. 29 Metrobus Express: Originating at Fair Oaks Mall, service along U.S. 29 to Washington, D.C. using the K Street busway with stops at Rosslyn, Farragut Square, 15th Street/Vermont Ave, and 9th Street. The service would operate from 6 a.m. to 8 p.m. in both directions with 12 minute headways. Stops would be limited to two or three per mile which would allow for an estimated 20 percent improvement in speed.
- U.S. 50 Metrobus Express: Originating at Fair Oaks Mall, service along U.S. 50 to Washington, D.C. using the K Street busway with stops at Rosslyn, Farragut Square, 15th Street/Vermont Ave, and 9th Street. The service would operate from 6 a.m. to 8 p.m. in both directions with 12 minute headways. Stops would be limited to two or three per mile which would allow for an estimated 20 percent improvement in speed.
- Haymarket to D.C. Core Priority Bus – Proposed to be operated by PRTC serving five stops: Haymarket, VA 234 Bypass, Centreville, Ballston, and the D.C. Core. The service would operate only in the peak periods in the peak direction with 30 minutes headways.
- Centreville to D.C. Core Priority Bus – Proposed to be operated by WMATA serving five stops: Centreville, Stringfellow Road, Monument Drive/Fairfax Corner, East Falls Church, and the D.C. Core. The service would operate in both directions during peak periods at 30 minute headways.

The I-66 Priority Bus services both terminate in the D.C. Core and serve a total of eight stops in the corridor. The services would be scheduled to provide a combined service frequency of every 15 minutes at stops which they share. The service refinement represented in the Refined Alternative improves travel time for the services by reducing the number of stops served by each route as compared with the testing alternative while making use of the majority of the new stops which were proposed in the initial three testing alternatives.

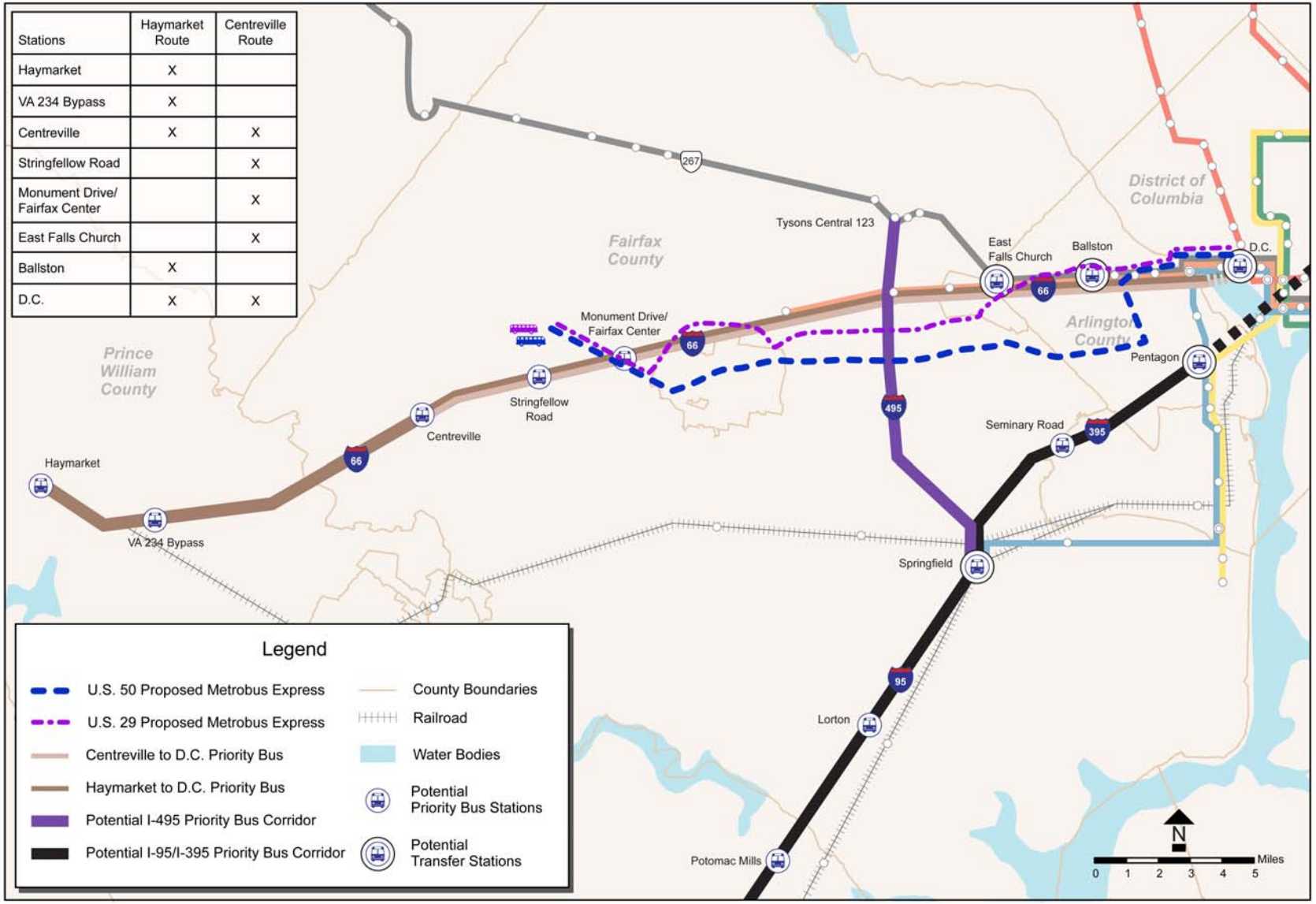
The market focus for the Refined Alternative is primarily traditional commute trips to the D.C. Core in the peak hours and peak direction, although some reverse commute service is tested on the portion of I-66 east of VA 28. The Refined Alternative does not include additional I-66 Priority Bus service to Tysons Corner or to Dulles, but does include significant enhancements to those markets indicated as new PRTC services. The I-66 Priority Bus services considered in the Refined Alternative are not dubbed “BRT” primarily due to the service frequency, service directionality, and hours of service contemplated.

As with the testing alternatives, the only difference in the Priority Bus service element between the horizon years of 2015 and 2030 is the addition of direct access to some of the I-66 stations by the 2030 horizon year, as detailed in Section 11 of this report. Table 8-9 shows the time savings that can be achieved by implementing these improvements for the Refined Alternative.

Table 8-9. Direct Access Runtime Improvements – Refined Alternative

	Runtime (minutes)		
Segments	**2015**	**2030**	**% Diff**
Haymarket to D.C.	70	60	14%
Centreville to D.C.	76	61	20%

Figure 8-4. Priority Bus Element of Refined Transit Alternative



8.3 TDM Strategies

Potential TDM strategies were developed and analyzed at three tiers – low, medium, and high – for two horizon years – 2015 and 2030. The tiers represent varying levels of investment and market penetration of TDM in the I-66 corridor and the Northern Virginia region as a whole. Higher-level packages added new and/or enhanced strategies to lower tiers. The TDM strategies were assumed to be implemented throughout the I-66 corridor study area, which would include areas adjacent to I-66 and residential areas that would be considered "feeders" to I-66 for commuting.

Based on the baseline TDM scenarios developed in Section 6.3 of this report, this section details the TDM strategies and their associated mobility benefits. Benefits for some strategies were estimated by assuming a total number of commuters who would participate in a program element or service and multiplying by an average trips reduced per participant. Benefits for other strategies were estimated by applying a trip reduction percentage to the morning peak-period trips using I-66.

In total, 15 strategies are included at varying levels of investment, market penetration, and depth. An overview of these program elements is found in Table 8-10. More detailed descriptions specific to each program tier can be found in the subsections that follow. The program description and benefits discussion is organized by horizon year and then by application tier.

Table 8-10. TDM Strategies

ID	Program	Description
A	Enhanced Corridor Marketing	Adds targeted marketing (direct mail, newspaper advertisements) for TDM and transit along the corridor and in feeder markets
B	Vanpool Driver Incentive	Provides incentives to get new drivers and retain existing drivers for vanpools
C	Corridor-Specific Startup Carpool Incentives	Provides a three- to six-month startup carpool incentive for participating commuters in Northern Virginia
D	Rideshare Program Operational Support	Supports additional staff for commuter assistance programs in the corridor and feeder markets to promote TDM programs and transit and for additional employer outreach support
E	Carsharing at Priority Bus Activity Nodes	Expands the existing carshare program to include vehicles at Priority Bus activity nodes
F	Bike Hubs/Storage at Priority Bus Activity Nodes	Priority Bus nodes near employment or residential activity centers include "bike hubs" with bike maintenance, showers, personal lockers, and other services for bicyclists; additional lockers at other nodes
G	TDM Program Evaluation	Evaluation of travel and environmental impacts of TDM activities in Northern Virginia, with particular attention to impacts on I-66 corridor system operation
H	Enhanced Virginia Vanpool Insurance Pool	Provides affordable insurance coverage for vanpools
I	Enhanced Telework!VA	Adds new financial incentives for Virginia employers and/or extends the level of assistance available
J	Northern Virginia Ongoing Financial Incentive	Offers a small ongoing reward opportunity (e.g., prize drawings, etc.) to commuters traveling to or from Northern Virginia using a non-SOV mode

Table 8-10. TDM Strategies (continued)

ID	Program	Description
K	Van Priority Access	Allows vanpool vans to access bus-only infrastructure in the I-66 corridor
L	Capital Assistance for Vanpools	Provides financial assistance for purchase or lease of vanpool vans
M	Flexible Vanpool Network	Includes a network of overlapping vanpool routes which permits part-time ridership and flexibility for full-time riders to modify their vanpool schedule with a reservation
N	SmartBenefits Subsidy Public Share	Provides a public agency contribution to employer-provided SmartBenefit transit/vanpool subsidies and shares the cost of these subsidies with employers
O	Mobility Centers/Mobile Commuter Stores	Self-serve kiosks or staffed commuter stores at I-66 Priority Bus stations offering personalized trip advice, transit information, and fare media

8.3.1 2015 Alternatives

Three program tiers of TDM strategies were developed for the 2015 horizon. Each tier is cumulative and includes the strategies in the tiers below it. For example, the medium-tier program includes all of the strategies in the low tier and the high tier includes all of the strategies in both the low and medium tiers. The subsections that follow describe the strategies in each of the program tiers for the 2015 horizon.

8.3.1.1 Low Tier

For 2015, the low-tier TDM program includes the following components:

A. Enhanced Corridor Marketing;

B. Vanpool Driver Incentive;

C. I-66 Corridor-Specific Startup Carpool Incentives;

D. Rideshare Program Operational Support;

E. Carsharing at Priority Bus Activity Nodes;

F. Bike Storage at Priority Bus Activity Nodes; and

G. TDM Program Evaluation.

A. Enhanced Corridor Marketing

This strategy adds targeted marketing (direct mail, newspaper advertisements) for TDM and transit along the corridor and in feeder markets. The strategy would increase awareness of transit options and supportive TDM program elements and encourage mode shift.

Background Assumptions on Benefits – Metropolitan Washington Council of Governments' (MWCOG) 2008 Transportation Emission Reduction Measures (TERM) analysis estimated a reduction of approximately 0.1 percent of total vehicle trips and vehicle miles of travel (VMT) regionwide from mass marketing ad campaigns. For this analysis, an additional reduction of 0.05 percent of trips is assumed, to be applied along I-66.

Estimated Benefit – Reduces by 0.05 percent the daily morning peak-period vehicle trips along I-66 that originate west of Arlington County.

B. Vanpool Driver Incentive

This strategy provides incentives to attract new drivers and retain existing drivers for vanpools.

Background Assumptions on Benefits – Vanpool incentives have been successfully implemented in a number of cities including the San Francisco Bay area ($500 driver incentive after six months), Minneapolis/St. Paul area ($100 annual driver incentive and $50 annual backup driver incentive), and Atlanta ($150 one-time driver incentive and $75 one-time backup driver incentive). The subsidy assumed for this strategy in the I-66 corridor would be small. Since the vanpool rider would not receive this incentive, it is assumed to have a minimal trip reduction benefit separate from other vanpool strategies.

Estimated Benefit – No additional trip reduction benefits separately recognized over other vanpool strategies already in place (e.g., vanpool insurance pool), but would encourage new vanpools.

C. I-66 Corridor-Specific Startup Carpool Incentives

This strategy provides a three- to six-month startup carpool incentive for participating commuters along the I-66 corridor.

Background Assumptions on Benefits – Surveys conducted in Atlanta ("Cash for Commuter" program) and other regions have shown that startup incentives can generate new carpools with substantial retention – 65 percent continued carpool use after 12 months. This program level assumes that participation is capped at 500 new participants per year.

Estimated Benefit – Reduces 190 trips per day in the morning peak-period (500 participants divided by 2.2 persons per car multiplied by 85 percent previous drive alone). It is reasonable to assume 125 trips are still reduced one year after program ends.

D. Rideshare Program Operational Support

This strategy provides additional staff for commuter assistance programs in the corridor and feeder markets to promote the TDM program and transit service and for additional employer outreach support.

Background Assumptions on Benefits – The MWCOG 2008 TERM analysis estimated a reduction of approximately 0.2 percent of total vehicle trips and VMT regionwide from rideshare support (separate from other strategies). For this analysis, an additional reduction of 0.05 percent of trips is assumed, to be applied along I-66. Staff are assumed to be assigned to existing Fairfax County and Loudoun County programs.

Estimated Benefit – Reduces by 0.05 percent the daily morning peak-period vehicle trips along I-66 that originate west of Arlington County.

E. Carsharing at Priority Bus Activity Nodes

This strategy expands the existing carshare program to make vehicles available at Priority Bus activity nodes.

Background Assumptions on Benefits – A 2008 carshare survey conducted by MWCOG showed a very slight benefit on commute trips from carshare availability or use of

approximately 0.1 daily trips reduced per carshare member. Trip and VMT reductions were higher for non-work trips, but these occur primarily outside peak periods.

Estimated Benefit – Negligible peak-period trip reduction benefit, but would enhance mobility options.

F. Bike Storage at Priority Bus Activity Nodes

This strategy would provide bike lockers or other secure bike storage facilities at all Priority Bus activity nodes.

Background Assumptions on Benefits – A 2007 survey conducted in New Jersey of train station bike locker users estimated that about ten percent of locker users were previously driving alone and shifted to bike-train commuting. The remaining users were already using the train and were accessing the station by auto, bus, or drop-off. Locally, waiting lists are not uncommon for lockers at Metrorail stations. Assuming 20 lockers per Priority Bus node and six nodes, this would result in 12 fewer vehicle trips per day on I-66.

Estimated Benefit – Reduces 12 trips per day in the morning peak period (120 lockers multiplied by 10 percent previous drive alone).

G. TDM Program Evaluation

This strategy provides for evaluation of travel and environmental benefits of TDM activities in Northern Virginia, with particular attention to benefits of I-66 corridor efforts. The evaluation process would include development of performance indicators, collection of survey and tracking data, analysis of benefits, and recommendations for strategy refinements. Data collection would be phased over three year evaluation cycles.

Estimated Benefit – No direct trip reduction benefit, but would help refine and show the return on investment of the TDM program over time.

8.3.1.2 Medium Tier

The medium-tier TDM program includes all of the low-tier strategies discussed in the previous section and these additional components:

A. Enhanced Corridor Marketing (Expanded);

D. Rideshare Program Operational Support (Enhanced);

H. Enhanced Virginia Vanpool Insurance Pool; and

I. Enhanced Telework!VA.

A. Enhanced Corridor Marketing (Expanded)

This expanded strategy adds targeted marketing (direct mail, newspaper advertisements) for TDM and transit along the corridor and in feeder markets.

Background Assumptions on Benefits – The medium-tier application has the same assumptions as for the low tier, but with more funding applied. A trip reduction factor of 0.1 percent is assumed for the medium tier.

Estimated Benefit – Reduces by 0.1 percent the morning daily peak-period vehicle trips along I-66 that originate west of Arlington County.

D. Rideshare Program Operational Support (Enhanced)

In the medium tier, this strategy provides for additional staff for commuter assistance programs in the corridor and feeder markets to promote the TDM program and transit service and to provide additional employer outreach support.

Background Assumptions on Benefits – The medium-tier application has the same assumptions as for the low tier, but staff are also assumed to be assigned to feeder programs west of Loudoun County.

Estimated Benefit – Reduces by 0.1 percent the daily morning peak-period vehicle trips along I-66 that originate west of Arlington County.

H. Enhanced Virginia Vanpool Insurance Pool

This strategy provides affordable insurance coverage for vanpools. The enhancement would increase the vanpool insurance premium pool buy-down for vanpools.

Background Assumptions on Benefits – DRPT estimates the annual insurance cost per van at approximately $2,000 and estimates the $500,000 pool they currently have established for statewide vanpool support will enable a 10 to 15 percent savings. An additional investment of $1.5 million would create a pool of $2 million, enabling a 35 percent savings ($700 per year) per van.

MWCOG identified 860 registered vanpools with destinations in the MWCOG region. Assuming that only two-thirds of vans are registered, the total number of vans in the region is approximately 1,300. The MWCOG 2008 vanpool driver survey estimated that about 17 percent of vanpools currently use I-66; this results in an estimated 220 vans currently using I-66 (860 multiplied by 1.5 multiplied by 0.17). It is reasonable to assume 20 new vans are formed or saved per year though a combination of vanpool financial incentives (e.g., Van Start/Van Save, Vanpool Insurance Pool, etc.).

Estimated Benefit – Reduces 170 trips per day in the morning peak period (20 vans multiplied by 10 riders per van multiplied by 85 percent previous drive alone).

I. Enhanced Telework!VA

The enhanced strategy adds new financial incentives for Virginia employers and/or extends the level of assistance available.

Background Assumptions on Benefits – According to the 2007 State of the Commute (SOC) survey for the MWCOG region, about 21 percent of Northern Virginia workers telework today, an average of 1.6 days per week. The potential for additional telework (i.e., combination of telework-appropriate jobs and people expressing that they want to telework) appears to be about 27 percent of office-based commuters and 10 percent of non-office commuters. This figure assumes employers would allow all such employees to telework, but this is too aggressive. Instead, for 2015, an additional eight percent of office-based commuters and two percent of non-office commuters telework is assumed (weighted average of seven percent of all commuters). The “anticipated frequency” reported by these commuters is estimated to be about 0.9 days per week.

Estimated Benefit – Reduces by one percent the morning daily peak-period vehicle trips along I-66 that originate west of Arlington County (7.0 percent telework multiplied by 0.9 days per week divided by five days per week multiplied by 85 percent drive alone on non-telework days).

8.3.1.3 High Tier

The 2015 high-tier TDM program incorporates all of the elements of the low and medium tiers discussed in the previous sections. In addition, the high tier expands on the TDM program by including the following components:

C. I-66 Corridor-Specific Startup Carpool Incentives (Expanded);

F. Bike Hubs/Storage at Priority Bus Activity Nodes (Enhanced); and

G. TDM Program Evaluation (Expanded).

C. I-66 Corridor-Specific Startup Carpool Incentives (Expanded)

This strategy expands the low-tier corridor-specific carpool startup incentive to additional commuters with a participation capped at 1,500 instead of 500.

Background Assumptions on Benefits – The high-tier application has the same assumptions as for the low tier, but with an assumption of 1,000 new participants per year in addition to low-tier participants of 500, for a total of 1,500 participants.

Estimated Benefit – Reduces 385 trips per day in the morning peak period along I-66 (1,000 participants divided by 2.2 persons per car multiplied by 85 percent previous drive alone). It is reasonable to assume 250 trips are still reduced at the end of one year after program ends.

F. Bike Hubs/Storage at Priority Bus Activity Nodes (Enhanced)

The high-tier application assumes a higher level of bike support than is offered in the low tier. Priority Bus nodes near employment or residential activity centers include “bike hubs” with bike maintenance, showers, personal lockers, and other services for bicyclists. Additional lockers are provided at other nodes.

Background Assumptions on Benefits – The high-tier application has the same assumptions as for the low tier, but with greater investment and more lockers. The high-tier application would fund 50 lockers each at four Priority Bus nodes and bike hubs at two nodes, with storage for 100 bikes each. Due to the enhanced amenities, it is reasonable to assume a higher share of previous drive alone under this level of investment.

Estimated Benefit – Lockers/storage would reduce 80 trips per day in the morning peak period along I-66 (400 lockers multiplied by 20 percent previous drive alone).

G. TDM Program Evaluation (Expanded)

The high-tier application assumes similar activities as defined in low tier, but includes additional data collection and analysis.

Estimated Benefit – No direct trip reduction benefit, but would help refine and show the return on investment of the TDM programs over time.

8.3.2 2030 Alternatives

The three tiers of TDM program were also developed for the 2030 horizon. As with the 2015 program discussion, each tier is cumulative and includes the strategies in the tiers below. In addition, all 2030 TDM program tiers incorporate the 2015 high-tier program. The subsections that follow describe the TDM strategies in each of the program tiers for the 2030 horizon.

8.3.2.1 Low Tier

The low-tier TDM program for the 2030 horizon year includes all strategies indicated in the 2015 high-tier TDM program, plus the following components:

C. I-66 Corridor-Specific Startup Carpool Incentives (Expanded);

J. Northern Virginia Ongoing Financial Incentive;

K. Van Priority Access; and

L. Capital Assistance for Vanpools.

C. I-66 Corridor-Specific Startup Carpool Incentives (Expanded)

This strategy expands the market of the three- to six-month corridor-specific carpool startup program such that any commuter traveling to or from Northern Virginia for work is eligible to participate.

Background Assumptions on Benefits – The 2030 low-tier application has the same assumptions as the 2015 high-tier application, but allows 1,500 new participants per year to or from throughout Northern Virginia.

Estimated Benefit – Reduces 580 trips per day in the morning peak period (1,500 participants divided by 2.2 persons per car multiplied by 85 percent previous drive alone). It is reasonable to assume 375 trips are still reduced one year after program ends. Not all trip reductions would occur in I-66 corridor.

J. Northern Virginia Ongoing Financial Incentive

This strategy offers a small ongoing reward opportunity (e.g., prize drawings, etc.) to commuters traveling to or from Northern Virginia using a non-SOV mode. The system would use Internet-based reporting or logging of days using non-SOV modes. The reward would be tied to the frequency of non-SOV use (e.g., similar to NuRide, but offered beyond carpool riders).

Background Assumptions on Benefits – Surveys conducted in Atlanta estimated that about 60 percent of participants switched from drive alone to a non-SOV mode and reduced an average of 1.0 trips per day (0.5 trips morning and 0.5 trips evening) under the "Commuter Prizes" strategy. For every 1,000 participants, this would result in 300 morning trips reduced. It is reasonable to assume 2,000 participants at the end of three years.

Estimated Benefit – Reduces 600 trips per day in the morning peak period along I-66 (2,000 participants multiplied by 0.5 trips per morning peak multiplied by 60 percent previously drive alone).

K. Van Priority Access

This strategy allows vanpool vans to access bus-only infrastructure in the I-66 corridor.

Background Assumptions on Benefits – The benefit of this strategy would reflect the motivational value of a slight time savings for vanpools, similar to the value of an HOV lane. It is reasonable to assume that this benefit would generate enough new riders for five new vanpools in the I-66 corridor.

Estimated Benefit – Reduces 42 trips per day in the morning peak period along I-66 (five vans multiplied by 10 riders multiplied by 85 percent previously drive alone).

L. Capital Assistance for Vanpools

This strategy provides financial assistance for the purchase or lease of vanpool vans.

Background Assumptions on Benefits – MWCOG identified 860 registered vanpools with destinations in the MWCOG region. Assuming only two-thirds of vans are registered yields an estimate of 1,300 total vans in the region. The MWCOG 2008 vanpool driver survey estimated about 17 percent currently use I-66. This results in an estimate of 220 vans currently using I-66 (860 registered vanpools multiplied by 1.5 factor to arrive at registered and unregistered vanpools multiplied by 17 percent to arrive at users of I-66). It is reasonable to assume 25 new vans are generated by this program.

Estimated Benefit – Reduces 215 trips per day in the morning peak period along I-66 (25 vans multiplied by 10 riders multiplied by 85 percent previously drive alone).

8.3.2.2 Medium Tier

In addition to those elements listed in the low tier, the proposed 2030 medium-tier TDM program includes all of the programs indicated in the 2015 high tier, plus the following components:

C. I-66 Corridor-Specific Startup Carpool Incentives (Expanded);

L. Capital Assistance for Vanpools (Expanded);

M. Flexible Vanpool Network; and

N. SmartBenefits Subsidy Public Share.

C. I-66 Corridor-Specific Startup Carpool Incentives (Expanded)

This strategy expands the three- to six-month corridor-specific carpool startup program to be eligible for any commuter traveling to or from Northern Virginia for work.

Background Assumptions on Benefits – The medium-tier application has the same assumptions as for the low tier, but with 1,000 additional new participants per year throughout Northern Virginia (total of 2,500 participants for low and medium tiers).

Estimated Benefit – Reduces 385 trips per day in the morning peak period (1,000 participants divided by 2.2 persons per car multiplied by 85 percent previous drive alone). It is reasonable to assume 250 trips are still reduced one year after program ends. Not all of these trips occur in the I-66 corridor.

L. Capital Assistance for Vanpools (Expanded)

This strategy provides financial assistance for the purchase or lease of vans for vanpools.

Background Assumptions on Benefits – The medium-tier application assumes similar parameters as in the low tier, but with additional funding for subsidies. It assumes an additional 20 vans are generated, in addition to the 25 formed with low-tier funding levels.

Estimated Benefit – Reduces 170 trips per day in the morning peak period along I-66 (20 vans multiplied by 10 riders multiplied by 85 percent previously drive alone).

M. Flexible Vanpool Network

This strategy develops and markets a network of overlapping vanpool routes which permits part-time ridership and flexibility for full-time riders to modify their vanpool schedule with a one-day advance reservation.

Background Assumptions on Benefits – This strategy would provide the benefit of added convenience to vanpool users. However, it would not change the cost of vanpool fares and so would provide less motivational value than financial incentives. It is reasonable to assume that the strategy would generate enough riders for ten new vanpools in the I-66 corridor. Implementation of the service assumes it is applied throughout Northern Virginia, thus the operating or administrative costs to manage the network would be spread over a larger number of vanpools.

Estimated Benefit – Reduces 85 trips per day in the morning peak period along I-66 (10 vans multiplied by 10 riders multiplied by 85 percent previously drive alone).

N. SmartBenefits Subsidy Public Share

This strategy provides a public agency contribution to employer-provided SmartBenefit transit/vanpool subsidies and shares the cost of these subsidies with employers. It is assumed to be offered to employers in the I-66 study area.

Background Assumptions on Benefits – The benefit of this strategy would be to expand availability of transit subsidies by encouraging more employers to offer subsidies to their employees. Assuming the contribution would be offered only to employers that are not currently providing subsidies and employees who are not currently using transit (90 percent drive alone, ten percent carpool), all participating commuters would generate new trip reduction. The total benefit of the strategy would be driven by the amount of funding applied to it. The medium-tier estimate assumes program would be capped at 1,000 new transit riders.

Estimated Benefit – Reduces 720 trips per day in the morning peak period along I-66 (1,000 participants multiplied by 90 percent previously drive alone multiplied by four-out-of-five days per week transit ridership).

8.2.2.3 High Tier

The potential 2030 high-tier TDM program incorporates all of the elements of the 2030 low and medium tiers discussed in the previous sections, which in themselves incorporate the strategies articulated in the 2015 high-tier program. In addition, the following components are added:

J. Northern Virginia Ongoing Financial Incentive (Expanded);

N. SmartBenefits Subsidy Public Share (Expanded); and

O. Mobility Centers/Mobile Commuter Stores.

J. Northern Virginia Ongoing Financial Incentive (Expanded)

The high-tier application of this strategy which offers a small ongoing reward opportunity to any commuter traveling to or from Northern Virginia using a non-SOV mode would expand participation.

Background Assumptions on Benefits – The high-tier application has similar assumptions as the low tier, but with a higher participant level of 4,000 participants at the end of three years (2,000 more than in the low tier).

Estimated Benefit – Reduces 600 trips per day in the morning peak period along I-66 (2,000 participants multiplied by 0.5 trips per morning peak multiplied by 60 percent previous drive alone).

N. SmartBenefits Subsidy Public Share (Expanded)

This strategy provides a public agency contribution to employer-provided SmartBenefit transit/vanpool subsidies and shares the cost of these subsidies with employers. It is assumed to be offered to employers in the I-66 study area.

Background Assumptions on Benefits – The high-tier application has similar assumptions as the medium tier, but with a higher participant level of 2,000 participants (1,000 more than in the medium tier).

Estimated Benefit – Reduces 720 trips per day in the morning peak period along I-66 (1,000 participants multiplied by 90 percent previous drive alone multiplied by four-out-of-five days per week transit ridership).

O. Mobility Centers/Mobile Commuter Stores

This strategy consists of self-serve kiosks or staffed commuter stores at I-66 Priority Bus stations offering personalized trip advice, transit information, and fare media. Alternatively, on-site commute assistance and fare sales could be provided through mobile commuter stores that park at Priority Bus nodes one or more days per week, but rotate to various stations.

Background Assumptions on Benefits – Evaluation of Arlington County's Commuter Stores estimated a daily trip reduction of 1.5 daily trips for every 100 store customers, on a base of about 71,000 annual customers per store. It is reasonable to assume 35,000 annual customers for each of two Priority Bus stores after a two-year startup period.

Estimated Benefit – Reduces 525 trips per day in the morning peak period along I-66 (70,000 customers divided by 100 multiplied by 1.5 daily trips divided by 2.0 trips per day).

8.4 Conclusions

This section described the components that comprised the three initial testing transit alternatives, the refined transit alternative, and complementary proposed TDM programs. The initial testing alternatives focused on providing BRT service strategies within a Priority Bus framework for the I-66 corridor. The Refined Alternative provided an enhancement to the I-66 Priority Bus framework, but did not involve full BRT implementation. All of the alternatives were created to provide a spectrum of possibilities to inform the decision-making associated with developing recommendations for the corridor. The three program tiers of TDM strategies also provided a range of implementation intensities to consider as recommendations were developed. The next section describes the model evaluation of the initial testing alternatives, the refined alternative, and supplemental sensitivity analysis. Section 12 presents the ultimately recommended transit infrastructure and services and supportive TDM program.

9.0 Travel Demand Forecasts

This section presents the results of the travel demand forecasts for the I-66 Transit/TDM Study as well as a brief overview of the methodology. The travel demand forecasting effort for this analysis focuses on two horizon years: 2015 and 2030. The baseline scenario, as described in Section 6 of this report, was analyzed in addition to four alternatives for each horizon year. The three initial testing alternatives and the refined alternative were described in Section 8. In addition, five sensitivity analyses were conducted.

The travel demand forecasts estimated demand for usage of motorized modes, including single-occupancy vehicles (SOV), high-occupancy vehicles (HOV) with two or three occupants, and transit riders. The forecasts were used to analyze and refine a set of transit services for the I-66 corridor. Summaries of the model results are presented in this section, additional details can be found in Appendix F.

9.1 Forecasting Methodology

This subsection presents an overview of the travel demand forecasting methodology applied in this study. The methodology produced ridership and mode share results as well as highlighted shifts in modes from single-occupancy vehicles to shared rides and transit modes, including rail and bus. The results of the model are useful in analyzing and refining a set of comprehensive transit and TDM recommendations.

The core travel demand forecasting model applied for this project is the Metropolitan Washington Council of Governments (MWCOG)/National Capital Region Transportation Planning Board (TPB) regional travel demand forecasting model. Version 2.2 (November 2008) was used, the current model set adopted for conformity analysis at the commencement of the forecasting activities. This model covers the entire metropolitan region.

After running the model, the study applied an additional step, a post-processor mode choice model. This is a model developed for the Washington Metropolitan Area Transit Authority (WMATA) to be applied to the MWCOG model results. It has been used similarly on other studies in the region and a form of it will be incorporated into the next version of the MWCOG travel demand forecasting model. The benefit of the post-processor mode choice model is a more accurate result in terms of transit choice and access modes.

In addition to the WMATA post-processor, which was an integral part of the study's work with the regional forecasting tool, this study also utilized a park-and-ride lot demand forecasting tool. This tool utilized outputs from the regional forecasting tool as inputs, and was applied with feedback to the regional forecasting tool for purposes of interpreting results. Details of the park-and-ride demand forecasting methodology and results can be found in Section 10 of this report.

9.1.1 Regional Forecasting Tool Details

The MWCOG/TPB travel demand forecasting model uses a series of submodels or steps to produce potential travel demand given the future land use and transportation networks. The regional transportation options are represented in terms of a network. The network represents all of the transportation services and infrastructure. This network includes transit and highway facilities. The regional area is divided into transportation analysis zones (TAZs). For the Washington Metropolitan Area a total of 2,191 TAZs have been designated. A map showing the TAZs in the study corridor is provided in Appendix F. In the denser populated areas there are a greater number of TAZs and in less dense areas the TAZs are larger. At the boundaries of the

modeled areas, the TAZs are larger and the highway network is less detailed. In the primary jurisdictions of the modeled area, the highway network is more detailed and the corresponding number of TAZs is greater. The next four subsections describe the four basic model steps in this framework: trip generation, trip distribution, mode choice, and trip assignment.

Trip Generation

The MWCOG model is a four step model. Trip generation answers the questions of how much travel occurs and for what purpose(s). The trip generation model produces trips by purpose by TAZ. The output from the trip generation model is the number of production trips and attraction trips by purpose at the origin end or destination end, as appropriate. The trip generation step of the analysis uses as input the most recent MWCOG/TPB cooperative land use forecast at the start of the analysis phase of this study, Round 7.1. MWCOG's cooperative forecasting program provides regularly updated population, household, and employment forecasts from each jurisdiction in the region for use in areawide and local planning activities. These land use forecasts are the major input to this step of the modeling process and therefore greatly impact its results. In the MWCOG model process there are four primary trip purposes:

- Home-Based Work (HBW) – Trips originating at home and traveling to a place of work and back again;
- Home-Based Shop (HBS) – Trips originating at home and traveling to a place for shopping and return home again;
- Home-Based Other (HBO) – All other trips from a home not associated with work or shopping; and
- Non-Home Based (NHB) – Trips that do not originate or end at a home. These can include trips from the place of work which return to the place work.

Trip Distribution

The second step in the four-step process is trip distribution. Trip distribution answers the question of where do trips travel. The trip distribution model determines the origin and destination of the productions and attractions developed in the trip generation step. The trip distribution model looks at the distribution of trips based on travel time and applies that to match productions and attractions. As future congestion increases, the trip length tends to decrease, while the travel time distribution tends to remain constant.

Mode Choice

The third step in the four-step process is mode choice. This step answers the question of how travel will be done. The mode choice model produces the probability of a specific mode being used for a specific origin-destination pair. The model determines the probability based on elements such as in-vehicle travel time, out of vehicle wait time, the number of transfers, and other relevant choice criteria. The end product of the model choice model is a set of trip tables with origins and destinations by mode. The WMATA mode choice post-processor extends the information that is made available to include submode choice (e.g., bus versus rail) and mode of access (e.g., walk versus drive to transit).

Trip Assignment

The fourth step in the four-step process is trip assignment. This step answers the question of what route a trip will travel given an origin and destination. There are two assignments – a highway assignment and a transit assignment. The highway assignment captures vehicle trips on

the network, while the transit assignment captures person trips on transit modes through the network. The networks cover large geographic areas and therefore are less detailed representations of real world highway and transit facilities and services. Paths are determined based on weighted travel time cost. For highway assignment, an equilibrium concept is used to route vehicles between their origins and destinations. For transit assignment, typically the shortest path through the network (based on the perceived travel time cost which is a weighted combination of in-vehicle, out-of-vehicle time and cost elements) is taken.

9.1.2 Calibration

The model set is calibrated for a base year data set. The base year data set is linked to survey data which captures the travel characteristics of the modeled region. The MWCOG model set is calibrated to the 1994 home travel survey. A new household survey was completed in 2008 and will serve to update MWCOG's models in the future. Of special note here is that the mode choice post-processor model was calibrated and validated on more recent survey data collected around the year 2000.

9.1.3 Validation of the Tool for the Study

Version 2.2 (November 2008) of the MWCOG model has been validated on a regional basis to year 2000 travel data; however, this effort focused on validating the study corridor and the commute trips made to major work destinations such as: D.C. Core, Rosslyn-Ballston area, Pentagon/Crystal City area, and Tysons Corner. The validation was focused on trip distribution and mode choice results given the available data sources. The HBW trips represent the longer-distance trips and also the trips most likely to use the transit services being tested.

The model results for the year 2000 were compared against the 2000 Census Transportation Planning Package (CTPP) data. The CTPP data used for this validation process was further refined/factored by MWCOG based on other survey data from the year 2000. For the year 2000, the model predicts rail ridership of 12,364 in the morning peak period crossing the Capital Beltway, which can be compared to the observed ridership of 10,546. The bus ridership in the morning peak period crossing the Capital Beltway was predicted to be 1,119 which can be compared to the observed bus ridership of 1,075 in the year 2000. Traffic counts on radial transportation facilities crossing I-495 from the year 2001 were also used for the validation. Cutline results were reasonable based on state-of-practice for transit assignment.

The validation process highlighted that the MWCOG model may under-predict the number of HBW trips produced in the I-66 corridor west of Centreville. This study accounted for this under-representation when developing the study's final recommendations, outlined in Section 12 of this report.

9.2 Forecasting Results

The project and service elements of each of the initial testing and refined alternatives were represented in the inputs for the travel demand forecasting tools. The models were applied for horizon years of 2015 and 2030. The following sections provide an overview of these forecasts.

9.2.1 Baseline Forecasts

Trip Generation

The trip generation for each of the alternatives remains the same, as it is based on the land use inputs and not the transportation network. Each HBW trip can be broken into two pieces:

production at the home end and attraction at the work end. Because of this, the home end creates two productions (one each to and from work) and the work end makes two attractions (one each from and to work) for each day, creating two daily trips to work and from work.

For the entire MWCOG region, HBW trip productions increased by 580,000 between 2005 and 2015, an increase of 14 percent. Between 2015 and 2030 there is another 31 percent increase, or an additional 650,000 work trips, as shown in Figure 9-1. Because HBW trip productions are always at the home end, the increase shown in Figure 9-1 is indicative of continued population growth throughout the metropolitan region.

Figure 9-2 looks further at the growth in HBW trip productions by examining the mode split for each horizon year. In 2005 there were 650,000 HBW transit trip productions in the region, which decreases to 590,000 by 2015. There is an increase forecast again by the year 2030, with a total of 620,000 HBW transit trip productions in the MWCOG region. This pattern indicates that the model forecasts a regionwide decrease in the number of transit trips made in 2015. As discussed in Section 4 of this report, forecast changes in land use, specifically the growth of major employment centers in suburban centers not easily served by transit, may be responsible for this travel forecast. As services are made to adapt to these land use changes by 2030, the number of transit trips will increase again. As discussed later under the sensitivity analysis section, changed land use forecasts could also impact the forecasts for transit tripmaking.

Figure 9-3 shows the same HBW productions, however limited to productions within the study corridor. As shown, in 2015 there are forecast an additional 55,000 HBW productions (at the home end), which represents an 11 percent increase over the base year of 2005. By the year 2030, there are an additional 105,000 HBW productions forecast over the base year, which represents a 22 percent increase. This is slightly less than the regional increase, but still represents a large growth in HBW trips. This pattern is indicative of the population growth forecast for the I-66 corridor, as detailed in Section 4 of this report.

Figure 9-1. Regional Home-Based Work Trip Productions

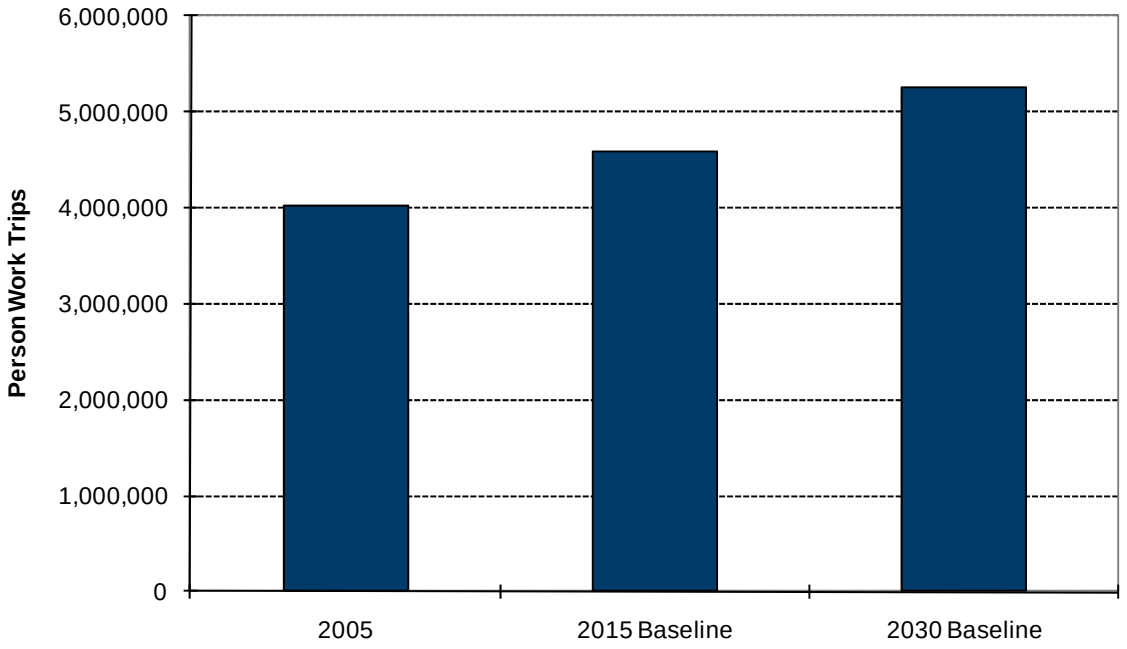


Figure 9-2. Regional Home-Based Work Trip Productions by Mode

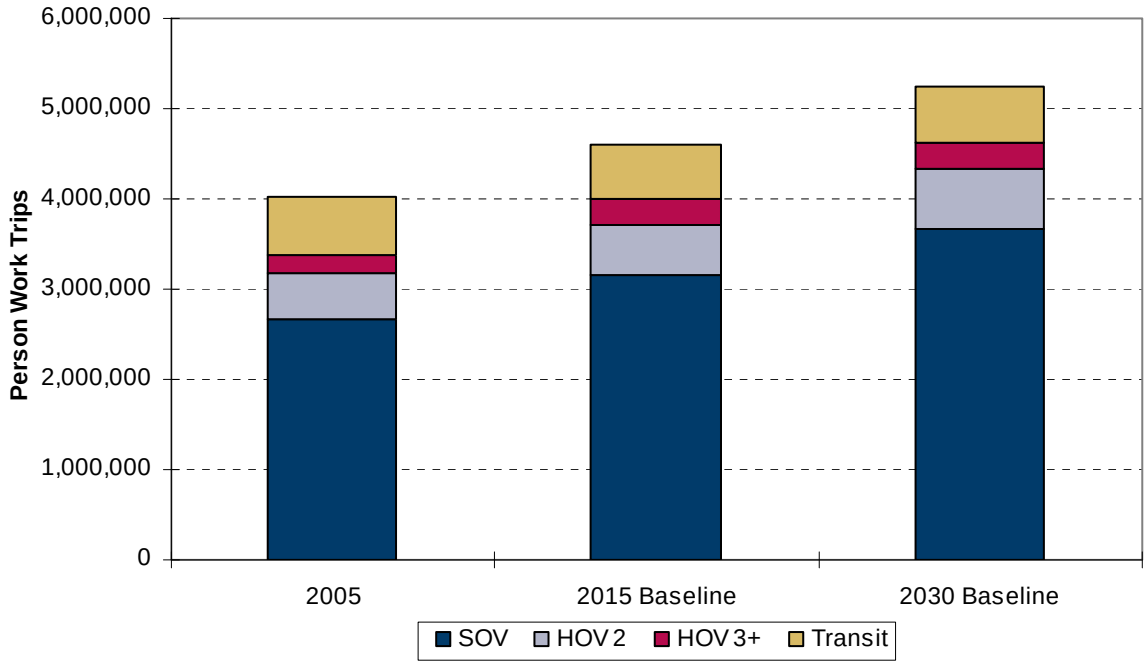
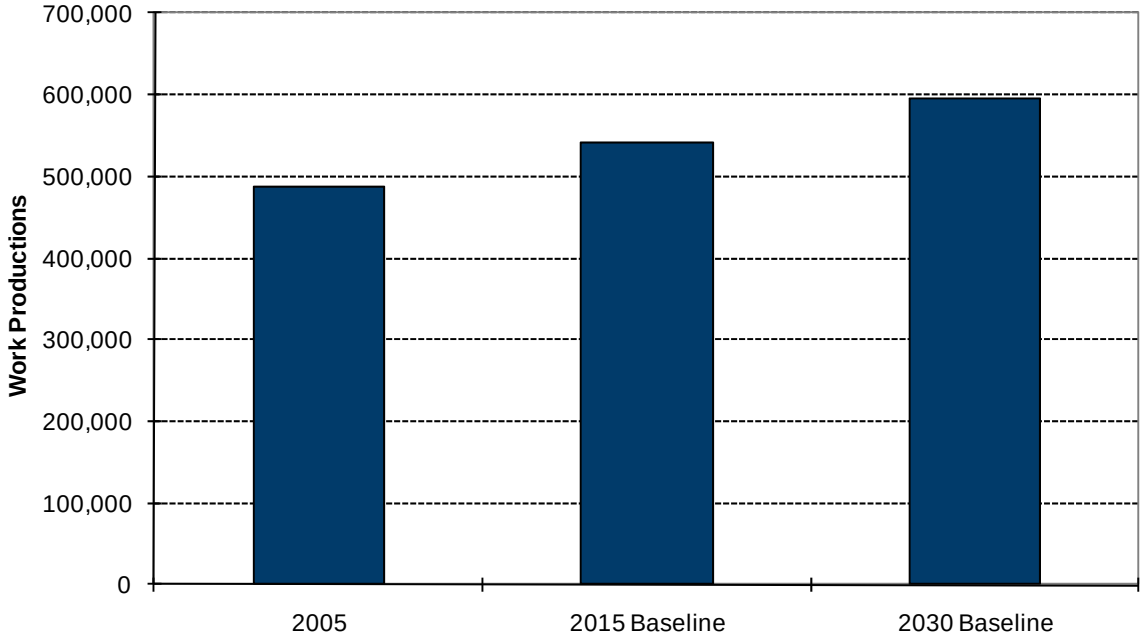


Figure 9-3. Corridor Home-Based Work Productions



The mode split of HBW productions in the I-66 corridor for each of the tested alternatives are provided in Appendix F. Figure 9-4 presents the mode shares for the baseline scenarios in the horizon years of 2015 and 2030. In the year 2005, there were 68,900 HBW transit productions (at the home end) in the corridor, which remains about the same in 2015, compared with a decrease in regionwide HBW transit productions over this same time period. There is an increase forecast again by the year 2030, with a total of 70,200 HBW transit trips produced in the corridor. It is important to note that the mode share trends in the I-66 corridor mirror those for the region as a whole, and that transit performs better in the corridor than elsewhere in the metropolitan area. This is illustrated in Figure 9-5.

A similar analysis can be completed for the attractions in the corridor, which take place at the work end of the trip. Figure 9-6 shows the growth in work attractions in the I-66 corridor. By 2015, there are an additional 98,000 HBW attractions, a 23 percent increase. By the year 2030, there are an additional 170,000 work attractions, which represents a 40 percent increase in the corridor over the base year of 2005. This growth mirrors the employment growth forecast for the corridor (detailed in Section 4) which indicate that many more people will be working in the I-66 corridor (especially the western portion) in 2030 than in 2005 or 2015.

Figure 9-4. Corridor Home-Based Work Productions by Mode

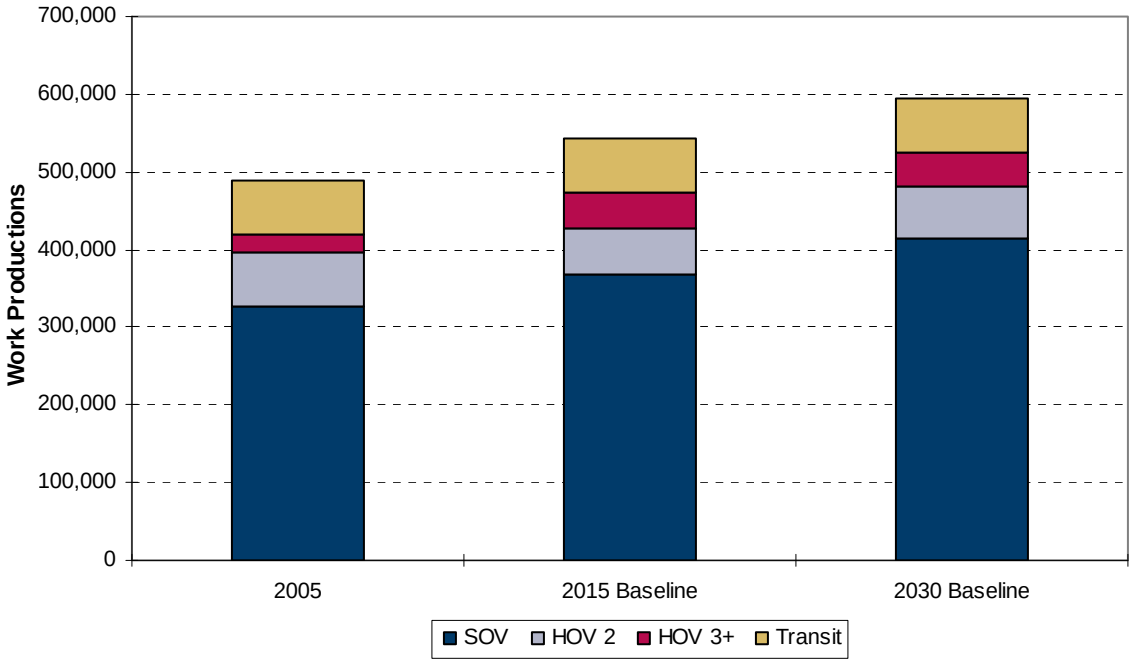


Figure 9-5. Home-Based Work Transit Productions

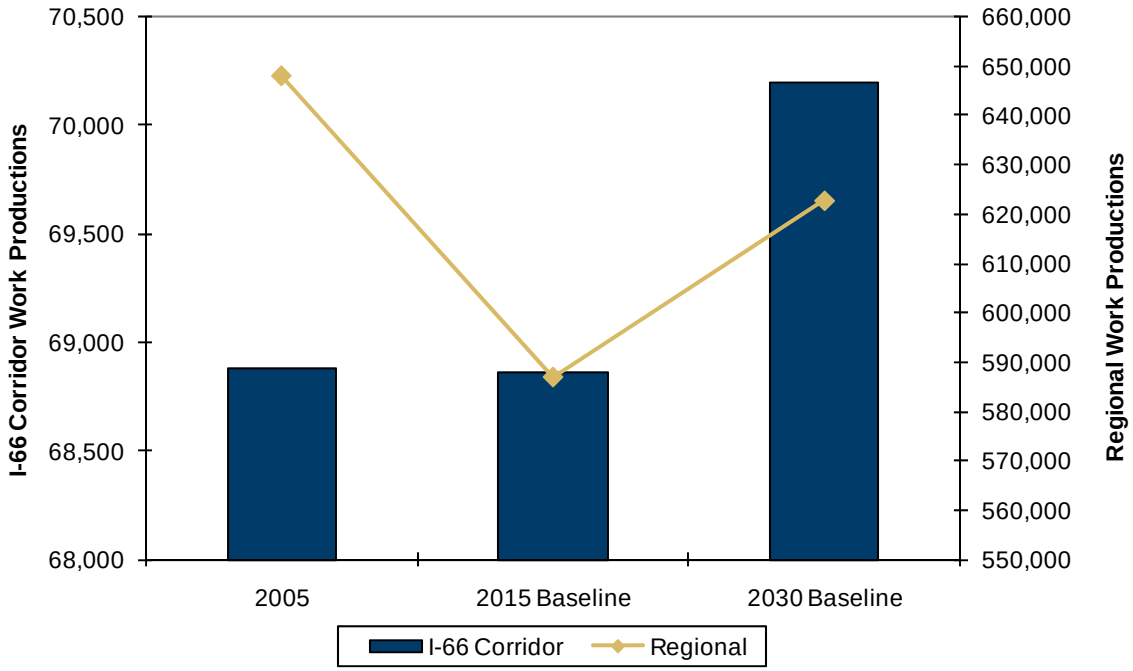


Figure 9-6. Corridor Home-Based Work Attractions

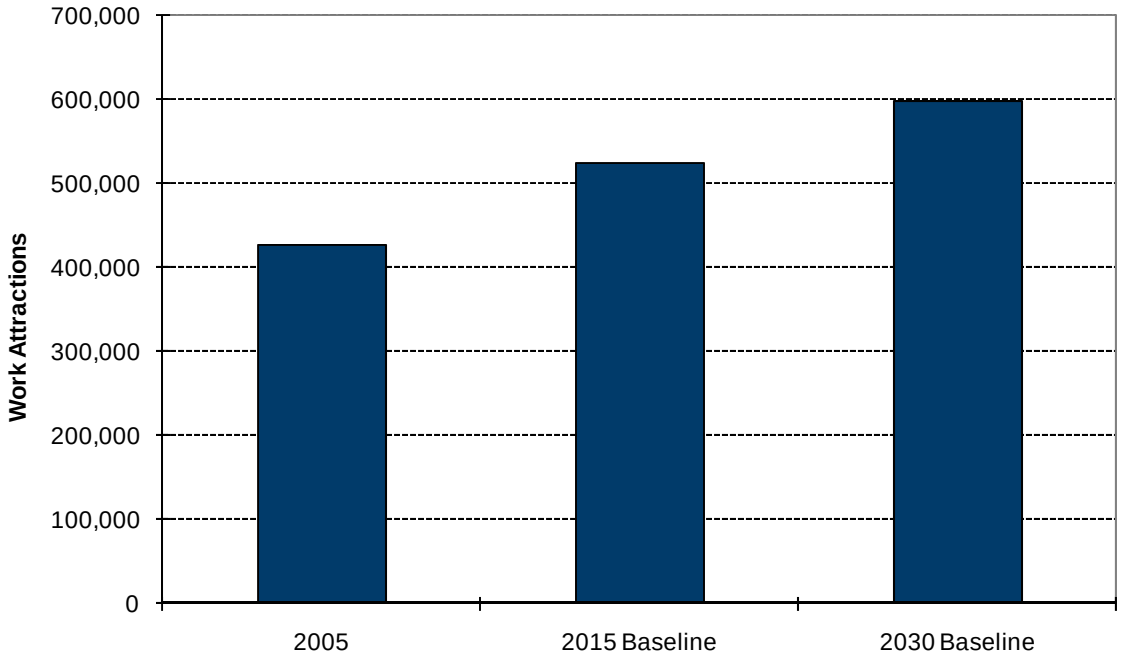
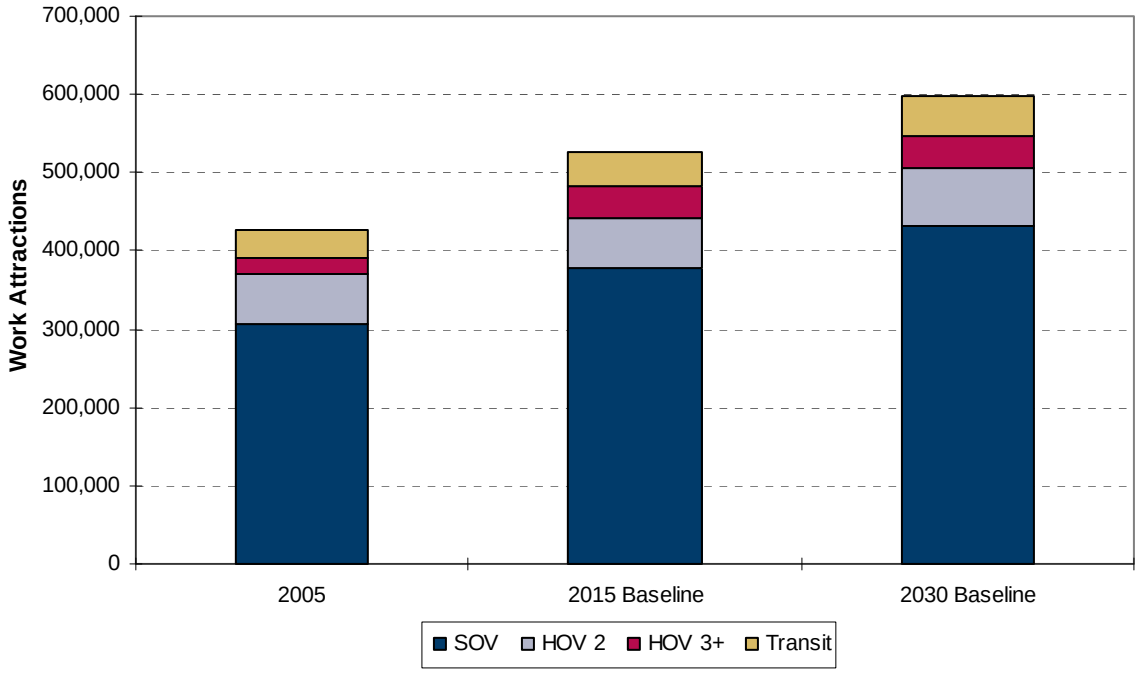


Figure 9-7 looks further at the growth in work attractions in the corridor by examining the mode split for each horizon year. In the year 2005, there were 37,600 transit work productions (at the home end) in the corridor, which increase to 43,000 by the year 2015. There is an increase again by the year 2030, with a total of 52,700 transit trips attracted to the corridor. Similar results for each of the tested alternatives can be found in Appendix F. The growth in HBW transit attractions follows the same pattern as the growth in total HBW attractions in the corridor.

Figure 9-7. Corridor Home-Based Work Attractions by Mode



Mode Share

Figure 9-8 looks at the mode share of the corridor's productions, rather than the absolute numbers of productions. In 2005, there was a 14 percent HBW transit mode share for productions. By 2015, this is forecast to decrease to 13 percent, with a further decrease to 12 percent forecast by the year 2030. This suggests that in the future, a smaller percentage of commuters living in the I-66 corridor will be using transit to get to work.

Figure 9-9 shows that the mode share for HBW attractions in the corridor for transit was nine percent in 2005 and is forecast to decrease to eight percent in 2015 and increase back to nine percent in 2030. This indicates that the mode share for employees in the study area will remain roughly static to 2030, despite the increase in jobs in the corridor. Most of the job growth is forecasted in locations not easily served by transit, such as the western end of the study corridor.

Figure 9-8. Corridor Home-Based Work Production Mode Share

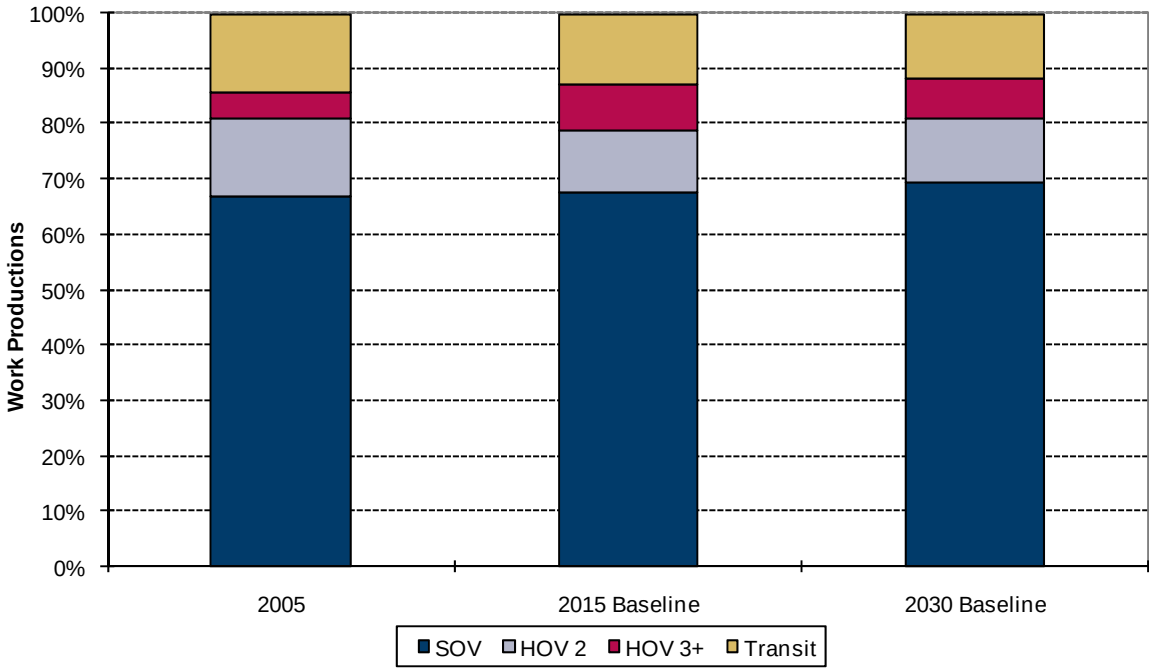
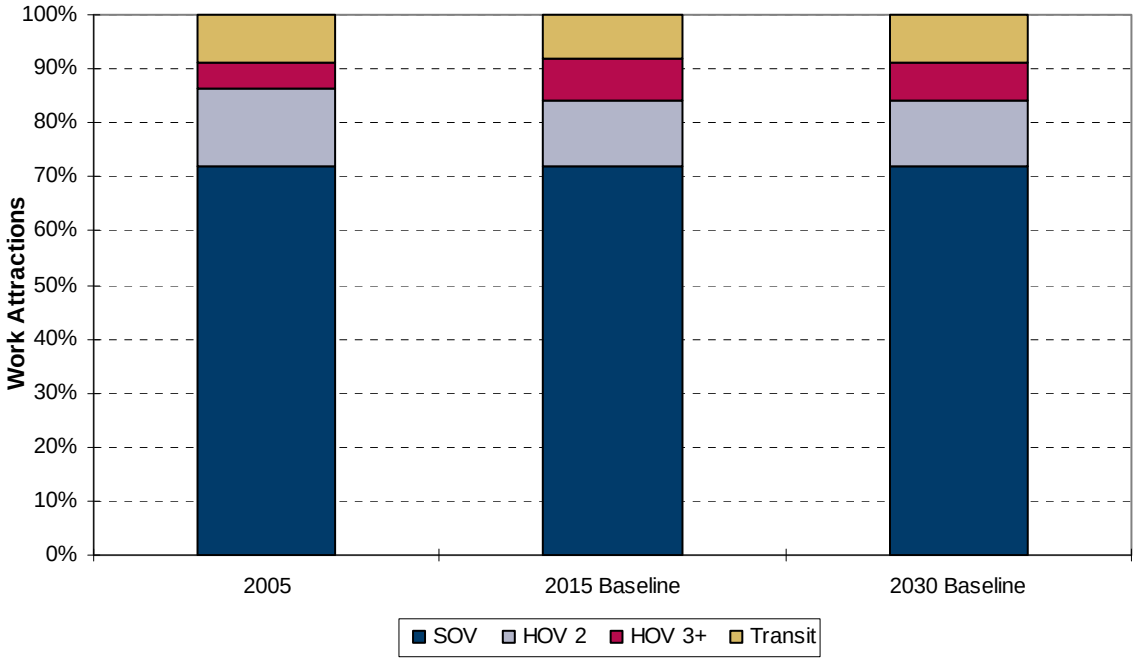


Figure 9-9. Corridor Home-Based Work Attraction Mode Share



A different view on the mode share for productions is the transit mode share to major work destinations such as D.C. Core, Rosslyn-Ballston corridor, and Tysons Corner, as shown in Figure 9-10 through Figure 9-12. Similar results for all of the tested alternatives can be found in Appendix F.

In 2005, there were 44,000 HBW transit trips to the D.C. Core with a mode share of 61 percent. The number of trips in 2015 is forecast to remain approximately constant with an increase in the mode share to 62 percent. For the year 2030, the number of HBW transit trips decreases by 2,900, with a mode share of 62 percent. This shows an increased number of people using transit to access the D.C. Core in 2030 over current conditions.

In 2005, there were 7,800 HBW transit trips to the Rosslyn-Ballston corridor from the I-66 corridor, with a mode share of 20 percent. The number of trips to this area increases to 8,400 trips by 2015, with an accompanying increase in mode share to 21 percent by 2015. An increase is again forecasted for 2030, with 10,300 HBW transit trips and a mode share of 22 percent. Some of this increase in transit usage in this market may be explained by the introduction of the Silver Line which provides a substantial increase in transit service to the area.

Tysons Corner was the final major work destination examined, with approximately 1,900 HBW transit trips in 2005 and a mode share of five percent. The 2015 forecast is for 5,200 HBW transit trips and a mode share of 13 percent. The 2030 forecast is for 6,400 HBW transit trips and a mode share of 14 percent. These increases seem generally related to the addition of the Silver Line Metrorail service by the 2015 horizon year and the associated forecasted land use changes over the longer term.

Figure 9-10. Home-Based Work Transit Mode Share to D.C. Core from the Corridor

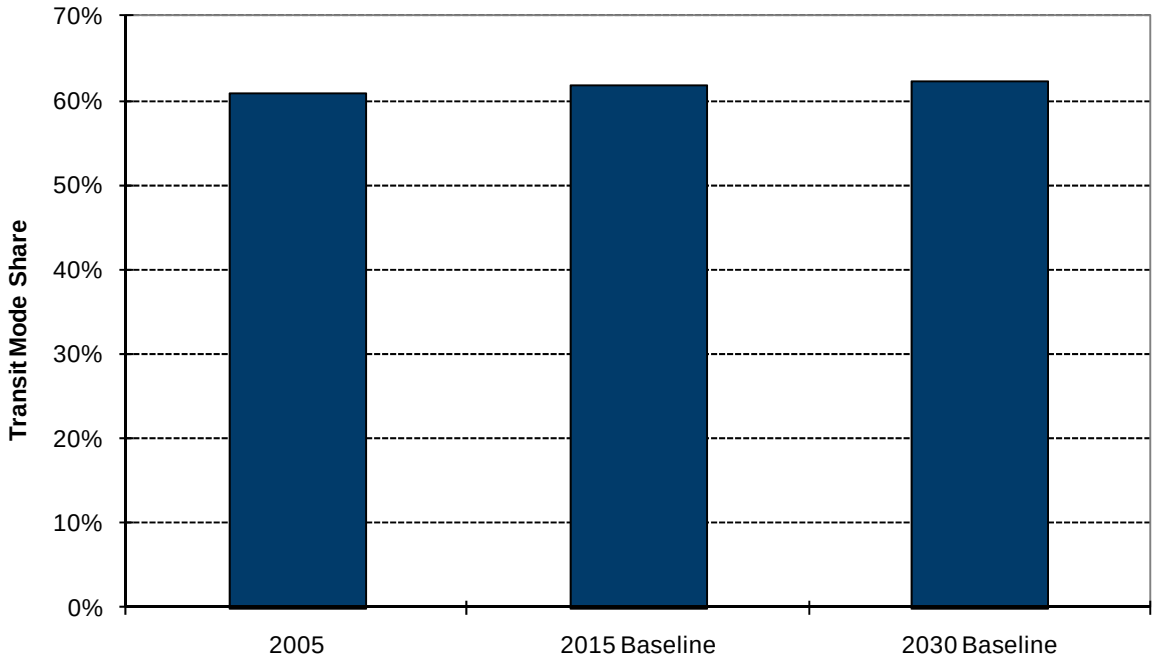


Figure 9-11. Home-Based Work Transit Mode Share to Rosslyn-Ballston from the Corridor

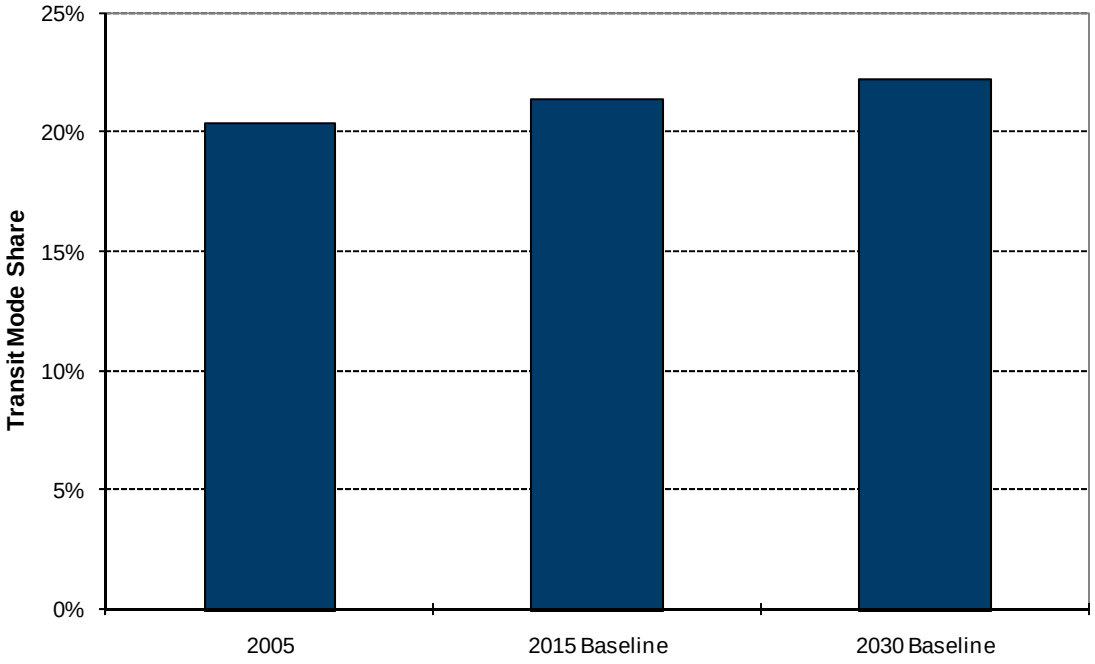


Figure 9-12. Home-Based Work Transit Mode Share to Tysons Corner from the Corridor

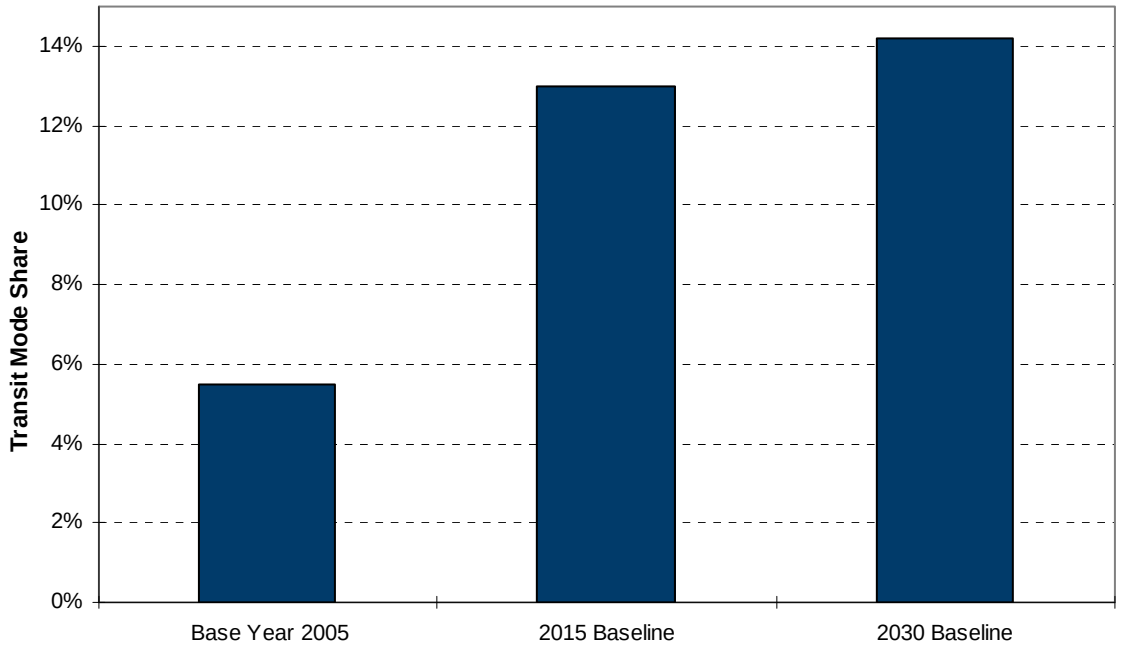


Table 9-1 shows comparison reference commute mode shares for other cities with rail transit service, including both low and high density areas. It can be seen that there is a large range for transit mode share.

Table 9-1. Reference Commute Mode Shares

	Drive Alone	Carpool	Transit
New York City	30%	9%	61%
Washington, D.C.*	35%	14%	51%
San Francisco	43%	16%	41%
Boston	50%	10%	40%
Pittsburgh	68%	13%	20%
Oakland	70%	15%	15%
Baltimore	72%	14%	14%
Atlanta	76%	14%	10%
Houston	80%	15%	5%
Pasadena	79%	16%	5%
Dallas	81%	15%	4%

Source: 2000 CTPP for work-trip destinations
*Includes only Downtown (greater area than MWCOG defined Core)

9.2.2 Initial Alternatives Testing Results

As described in Section 8 of this report, the three initial testing alternatives were similar in the elements they included, varying only in the BRT segments used, and the stop patterns of those BRT segments. The first two alternatives differ only in the BRT stop configurations. The first alternative includes a stop at Vienna/Fairfax-GMU, while the second alternative replaces that stop with a stop at Ballston. The third alternative does not stop at either Vienna/Fairfax-GMU or Ballston, but instead has an additional BRT segment which runs from Haymarket to the Tysons Central 123 Metrorail station. The BRT elements of these alternatives can be found in Figure 8-2 through Figure 8-4.

Among the key findings from the model analysis of the initial alternatives are:

- The separate all-stop BRT service along I-66 did not appreciably help existing express bus service and, because it had a slower overall travel time due to the absence of dedicated runningways, was not particularly attractive on its own. Coupling the inability of BRT vehicles to travel faster than other vehicles in the HOV lanes with the time lost to access indirect BRT stops/stations had a negative effect on potential ridership. This also led to the finding that overall mode share was not appreciably affected by the introduction of the service;

- Bus ridership increased from Centreville eastward, including to Tysons Corner. Ridership was carried across all of the services, including PRTC, Fairfax Connector, WMATA, and the all-stop BRT service.

- The BRT segment operating through the Ballston station attracted riders for whom there were travel time savings, suggesting a market for direct-to-D.C. service;

- The travel time savings offered by the Metrobus Express services on U.S. 29 and U.S. 50 was attractive to riders, but largely draws from the existing transit ridership base.

- The market is primarily for HBW trips, primarily in the peak hours and peak directions;

- There may be potential for developing a transit market along VA 28; however, destinations along VA 28 are hard to serve because of the campus-like nature of the employment locations. The new services proposed by PRTC appear to serve much of this market. In the forecasts, most of the riders on this BRT segment were not getting on/off the route along VA 28 but rather at the Dulles destination; and

- Trip ends in the VA 28 corridor proved difficult to serve with the BRT proposed in the testing alternatives. Further study of the special transit requirements of the VA 28 corridor is beyond the scope of this project, but is a recommendation as detailed in Section 12.4, especially given the continuing importance of the area as an employment center.

9.2.3 Refined Alternative

Based on the ridership projections from the model runs for the initial alternatives, TAC member feedback, and the market research results, the Refined Alternative was developed and tested. Figure 8-4 shows the Priority Bus network that is in place for the Refined Alternative. This alternative was developed based on the three initial testing alternatives as described in Section 8.2 of this report.

The objective in developing the Refined Alternative was to maintain the ridership and mode share levels from the tested alternatives while implementing only the level of additional service required in the market. The development of the Refined Alternative focused on identifying which elements of the tested BRT services were the most productive and beneficial to the region. Some additional sensitivity analyses (described in detail Section 9.3) also were used to develop the optimal service for this corridor. In addition, the raw model results were reviewed for areas in the network that under-predicted travel demand. These types of factors, which were tied to the validation exercise and balanced with the model results, were the basis for defining the Refined Alternative. This process ensured that the Refined Alternative met the needs of the stakeholders in the region, provided a market-driven service that would be well-patronized, and was cost effective.

Important adjustments between the initial testing alternatives and the Refined Alternative included:

- Move from all-stop BRT services along the entire corridor to creation of two Priority Bus lines – one serving stops west to Centreville and then operating non-stop into Ballston and D.C. and another starting in Centreville to serve stops eastward into D.C. This improved the travel time on both routes;

- Adjust service frequency for the new Priority Bus service;

- Confine service to peak hours and peak direction for areas east of Centreville; and

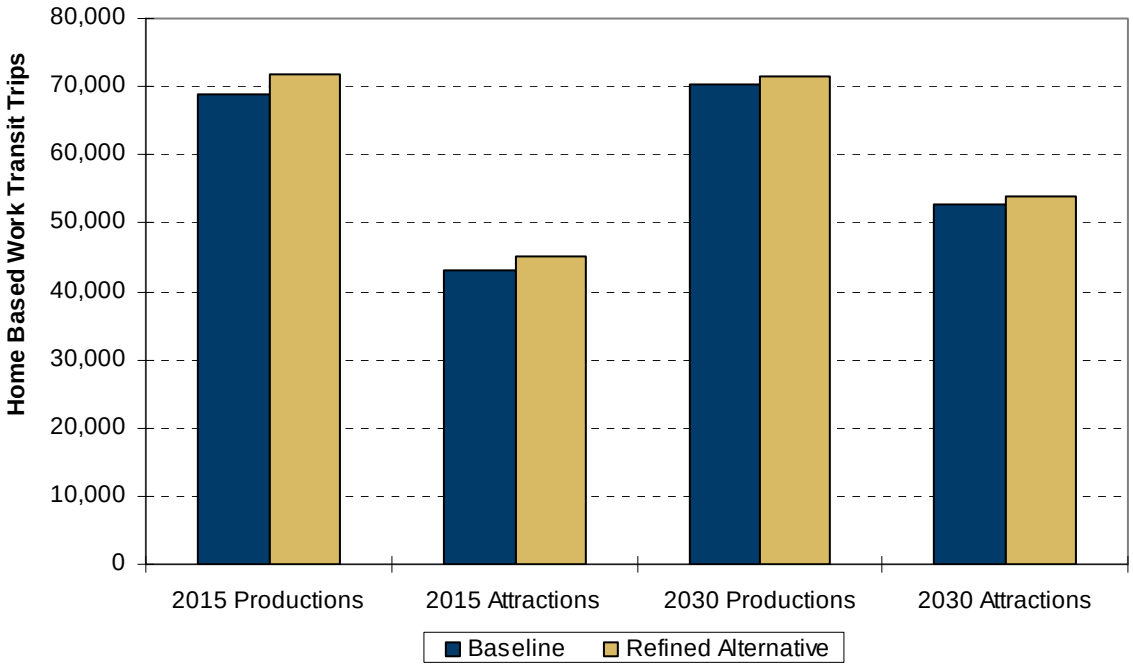
- No Priority Bus proposed as part of this project along the VA 28 corridor (pending further study of the VA 28 corridor) and Tysons Corner, although the recommended services include services to these areas planned/operated by PRTC.

Forecasting Results

Regionwide, the 2015 Refined Alternative produces about 2,200 more transit work trips than the 2015 Baseline. Similarly, the 2030 Refined Alternative produces about 1,000 more transit work trips than the 2030 Baseline.

In the I-66 corridor, the 2015 Refined Alternative produces 2,800 or four percent more transit work trips and attracts about 2,200 or five percent more transit work trips than the 2015 Baseline. Similarly, the 2030 Refined Alternative produces about 1,200 or two percent more transit work trips and attracts 1,400 or three percent more transit work trips than the 2030 Baseline. These increases in HBW transit trip productions and attractions in the corridor are shown in Figure 9-13.

Figure 9-13. Corridor Home-Based Work Transit Productions and Attractions – Refined Alternative versus Baseline



9.3 Sensitivity Analysis

Based on discussions with the TAC during the conduct of the study, several sensitivity analyses scenarios emerged that would represent incremental adjustments in the primary tested scenarios rather than wholesale scenarios. In addition, sensitivity analyses were conducted as part of the forecasting process to analyze the potential affects of various improvements or changes on future transit services. Details on each of these analyses are given in the following subsections.

9.3.1 VRE/PRTC Ridership/Forecasts

This study included consideration of competitive effects of PRTC and VRE services in and near the I-66 corridor. Consideration was given to the contrast between the transit travel demand forecasts for the western portion of the corridor and actual recent ridership counts. Since the focus of the study was not on performing a rail ridership forecast, the exploration was limited to the reflection of rail services in the existing adopted MWCOG model and the WMATA post-processor mode choice model. In the demand modeling, VRE service was retained on the existing VRE Manassas line service as called for in the CLRP. The demand modeling did not include analysis of a potential VRE service extension to the Gainesville-Haymarket area.

To support this analysis as well as to provide background information for framing the travel demand forecasts for the study in general, both PRTC and VRE supplied ridership count

information for the past several years and data from a recent origin-destination on-board survey. The count data were developed into figures showing growth in both services' ridership during the past several years. The on-board data were used to plot the geocoded locations of reported origins and destination of surveyed riders.

In addition, the travel demand forecasting model inputs and outputs were reviewed with an eye towards understanding the factors that lead to a choice between VRE and PRTC express bus service. This review included looking at the components of travel time in the input networks and the trip table matrices output at the submode level.

Recent Ridership

The recent ridership data showed system growth for both PRTC and VRE. PRTC experienced strong ridership growth over the past several years as shown in Figure 9-14. The Manassas service posted a nearly 15 percent compound annual growth in riders from FY05 to FY09.

Figure 9-15 illustrates the growth in VRE ridership over the same period. The ridership on the Manassas line itself was hurt in the period FY05 to FY07 by an extraordinary amount of track work being done (NS/CSX major tie replacement projects). These investment projects affected on-time performance and resulted in a drop in ridership. However, looking at the past two years, VRE has seen a 6 percent compound growth rate in ridership.

These recent ridership trends based on ridership counts stand in contrast with the forecasted ridership growth from the regional travel demand model. Although the economic growth forecasts implied by the cooperative land use forecasts would suggest that the observed growth rates would need to level off at some point over the forecast period, they do paint a scenario of strong transit ridership growth for the corridor. In contrast, the model forecasted compound average growth rates for transit ridership from Prince William County to the D.C. core are negative for both the 2005 to 2015 (-3.2 percent) and 2015 to 2030 periods (-0.6 percent).

These model results are thought to be driven by forecasted changes in land use over the period, with the model connecting a greater proportion of Prince William County residents with Prince William County jobs rather than continuing to link Prince William County residents with D.C. Core jobs. It is known through the validation work on this study, that the model generally under-predicts transit ridership from its outer reaches, including Prince William County. As a result, the I-66 Transit/TDM Study focused on relative changes in modeled ridership among alternatives (especially for services in the outer reaches of the model) during the testing phase rather than absolute transit productivity measures.

Figure 9-14. PRTC Recent Ridership Trends

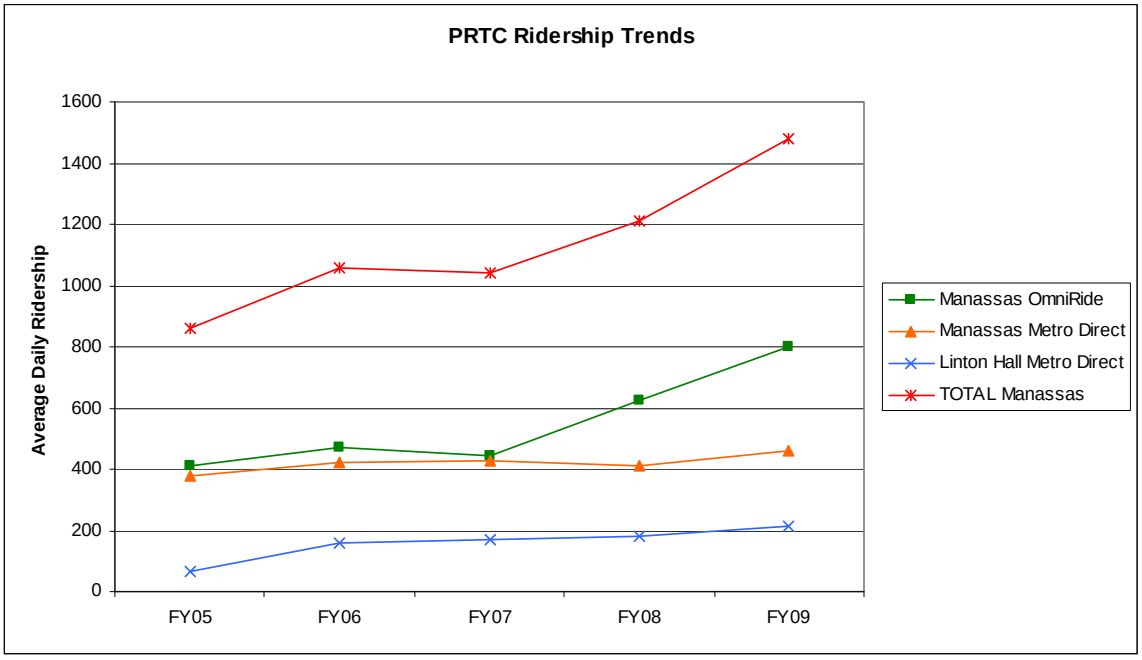
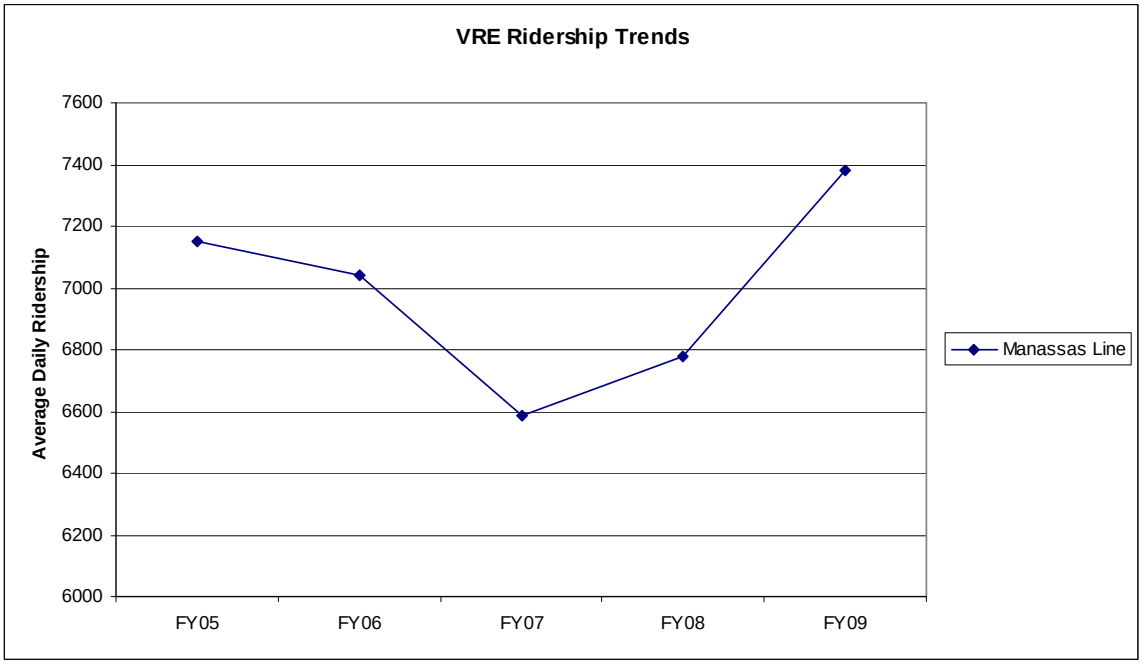


Figure 9-15. VRE Recent Ridership Trends



Travel Markets

A market analysis was conducted to explore the operations of proposed express bus services with the proposed VRE extension and existing VRE services coming from the western end of the corridor. From the perspective of the travel demand model, the VRE Manassas Line serves a select set of destinations particularly well, including the K Street vicinity and destinations near L'Enfant Plaza and Union Station in the D.C. Core. Additionally, VRE riders have the ability to transfer easily to Metrorail at all of these locations to extend the distribution shed of the service. The existing and proposed express bus services serve the western end of the D.C. core as well as some intermediate destinations more directly.

A review of the model networks, a major input to the mode choice model, reveals that the travel time to major Federal government work sites and Capitol Hill show an 18 percent faster time for VRE in 2015 and 2030 as compared with express bus services. The model outputs reflect this by forecasting that between 50 percent and 65 percent of transit riders destined for the D.C. Core will use VRE. Figure 9-16 and Figure 9-17 illustrate the weighted in-vehicle travel time and total travel time from the model for selected destinations from a sample origin in Manassas.

The market research performed for this study (detailed in Section 5) showed that in the I-66 corridor, dependability, time, and cost are important factors in determining mode choice. The model also can and does indirectly reflect amenity related aspects of the services through the use of constants in the formulation of the consumer utility assigned to each mode. These constants are developed during the model estimation process based on the observed transit mode choice given a set of travel time and cost parameters for each market segment used in the model (generally, demographic based). The I-66 Transit/TDM Study did not alter the constants already present within the WMATA post-processor mode choice model.

Figure 9-16. Manassas Transit In-Vehicle Travel Time

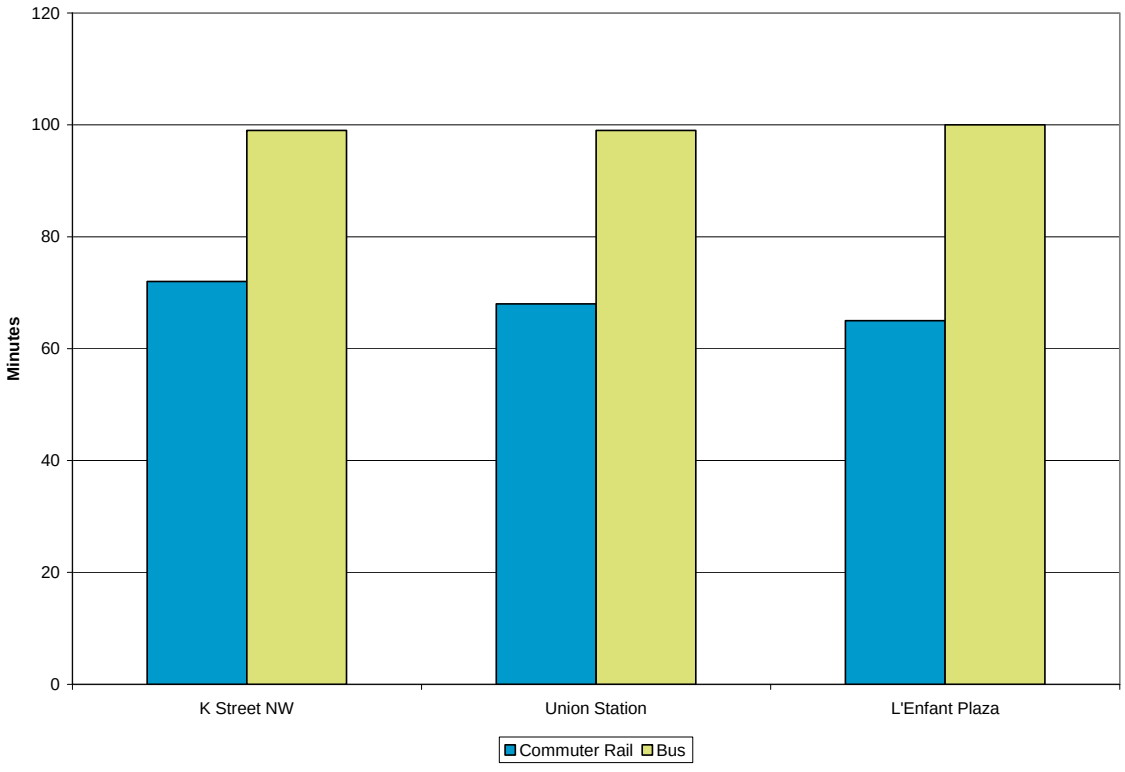
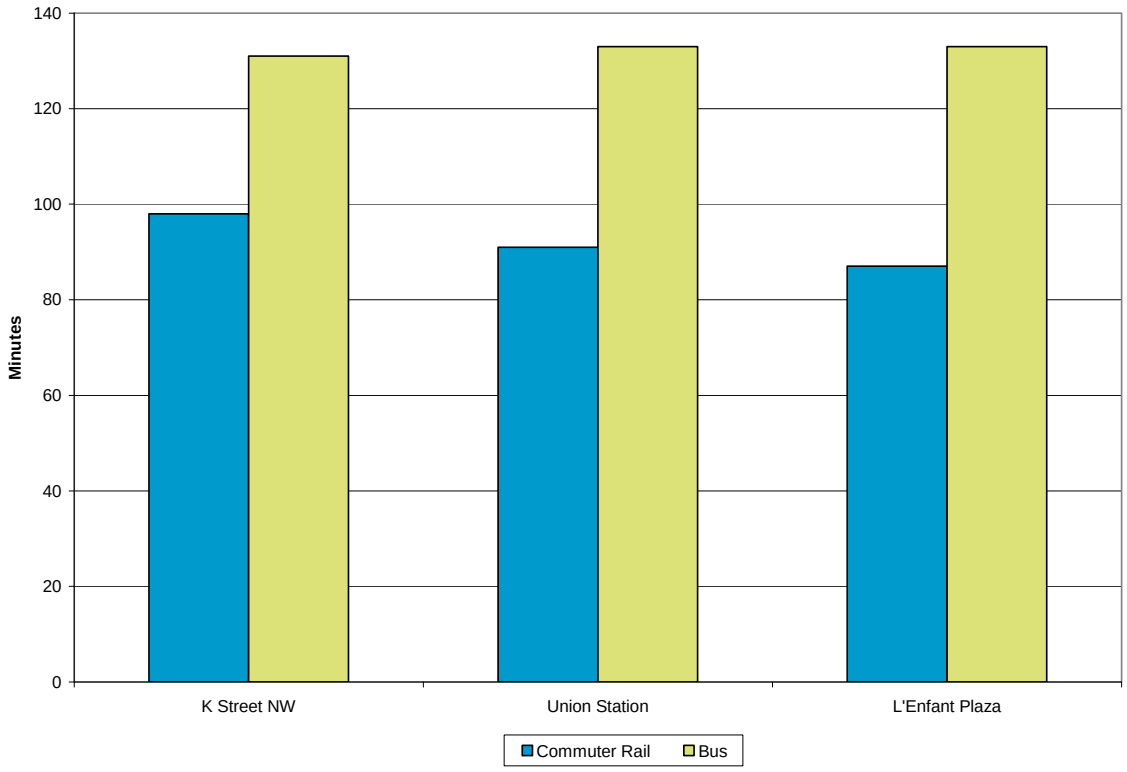


Figure 9-17. Manassas Total Transit Trip Travel Time (Unweighted)



On-Board Survey Analysis

The on-board survey data supplied by PRTC and VRE confirms several aspects of the ridership forecasts developed through the regional model application, including the size of the market sheds on both the origin and destination ends and some areas that do not overlap in terms of destinations. Figure 9-17 and Figure 9-18 show the systemwide origins and destinations of on-board survey respondents on PRTC and VRE, respectively. Figure 9-19 and Figure 9-20 limit the display to respondents originating on Manassas area services for PRTC and on the Manassas Line for VRE, respectively.

Figure 9-19 shows the clustering of origins in the PRTC service areas and the clustering of destinations in the Rosslyn-Ballston and D.C. core areas. Figure 9-20 shows the much-larger draw sheds for VRE service at each station as well as the different footprint of destinations. VRE stations at King Street, L'Enfant Plaza, and Union Station permit riders to transfer directly to all five lines of the Metrorail System. This seems reflected in the greater number of VRE passenger destinations along Red Line stations, for example. At the same time, there appear to be relatively fewer VRE passenger destinations along the Orange Line in the Rosslyn-Ballston corridor, consistent with travel time minimization that would be possible by transferring from a PRTC bus to the Orange Line at West Falls Church, for example, to reach that destination.

The origin-destination survey appears to generally support the theory of utility maximization among the transit users while also highlighting that there may be some differences in the scope of the appeal of each of the services. Both of these findings are consistent with research on travel behavior response to transportation system attributes.

Figure 9-18. PRTC Origins and Destinations

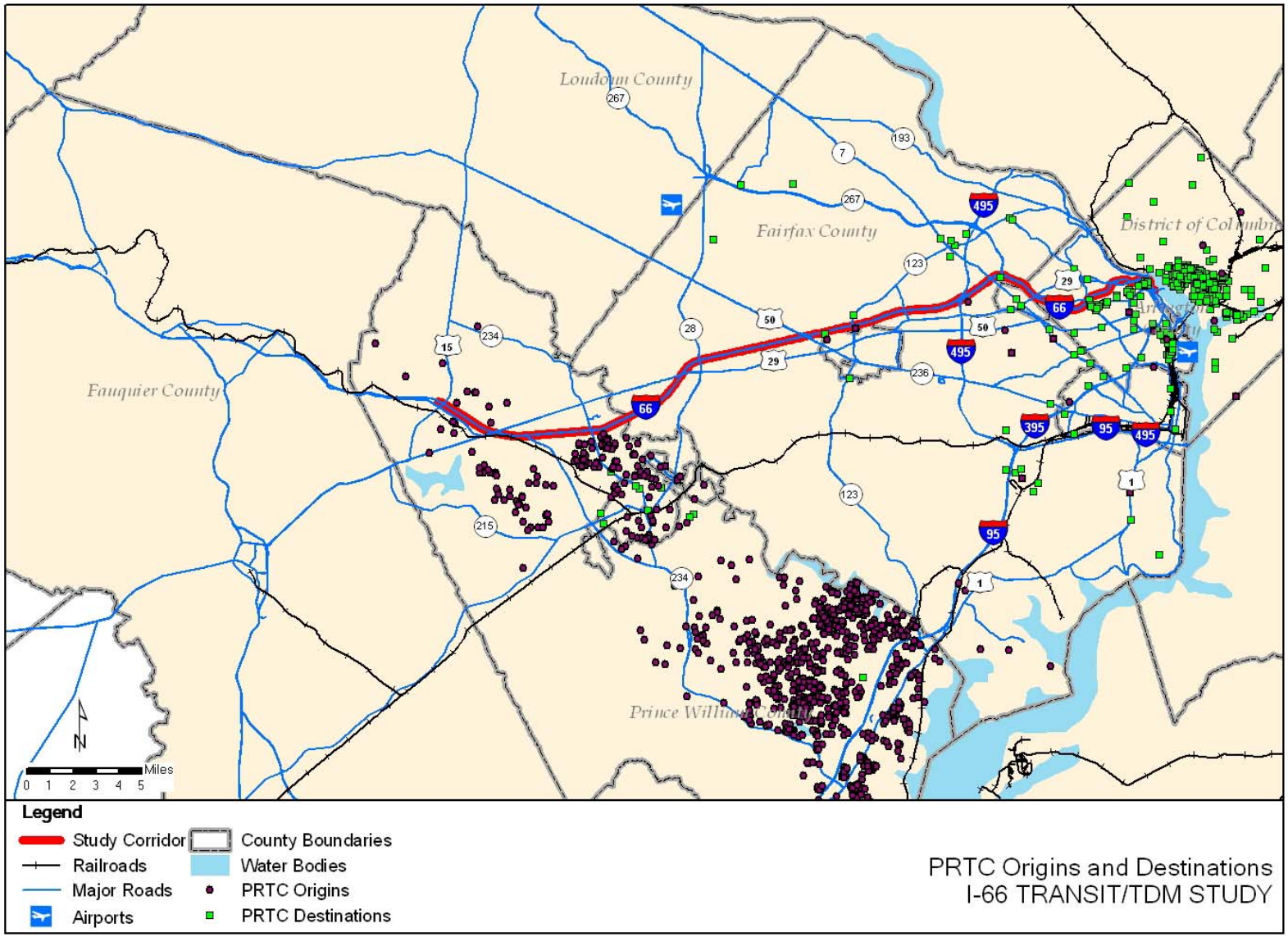


Figure 9-19. VRE Origins and Destinations

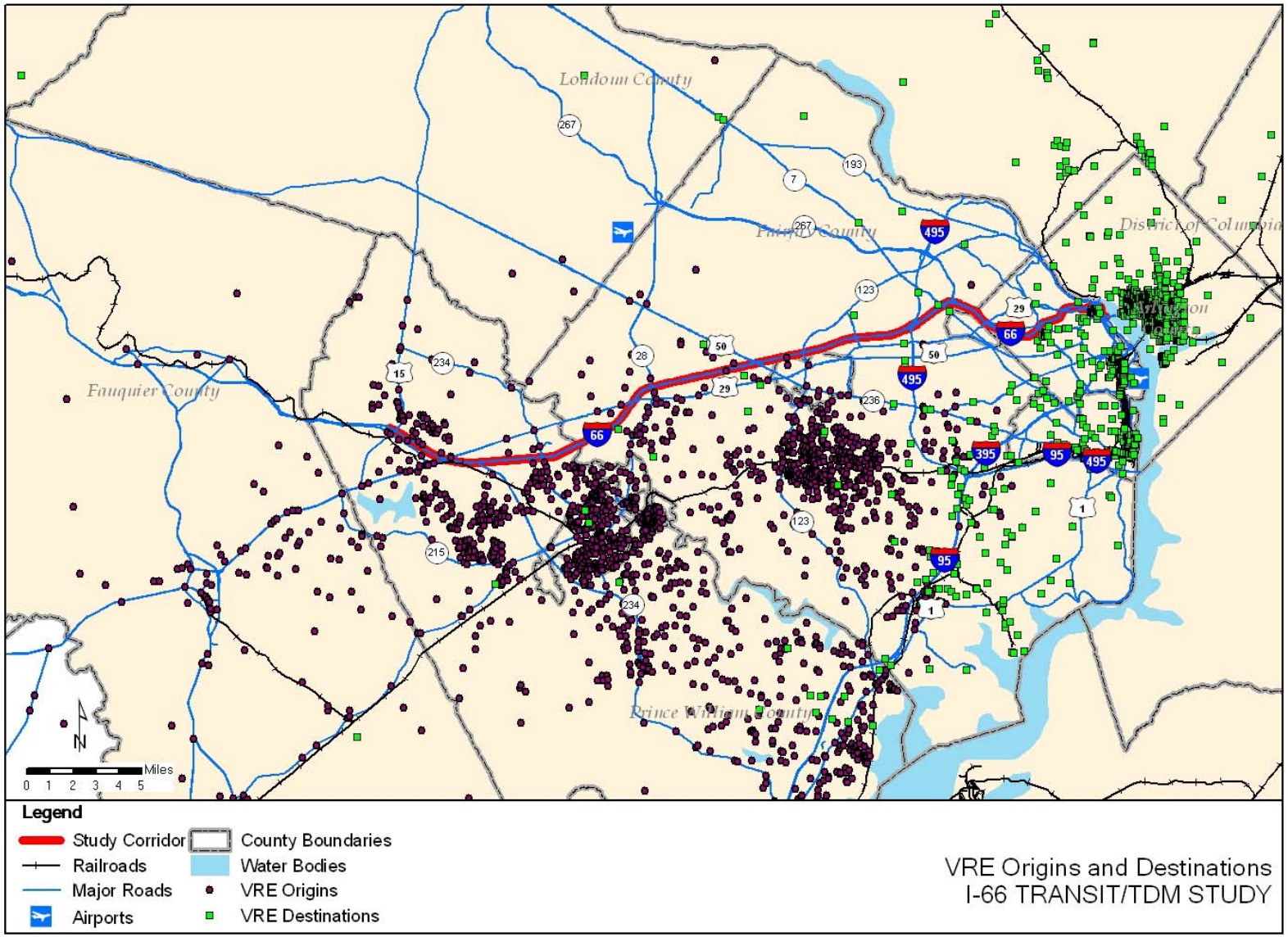


Figure 9-20. PRTC Manassas Service Origins and Destinations

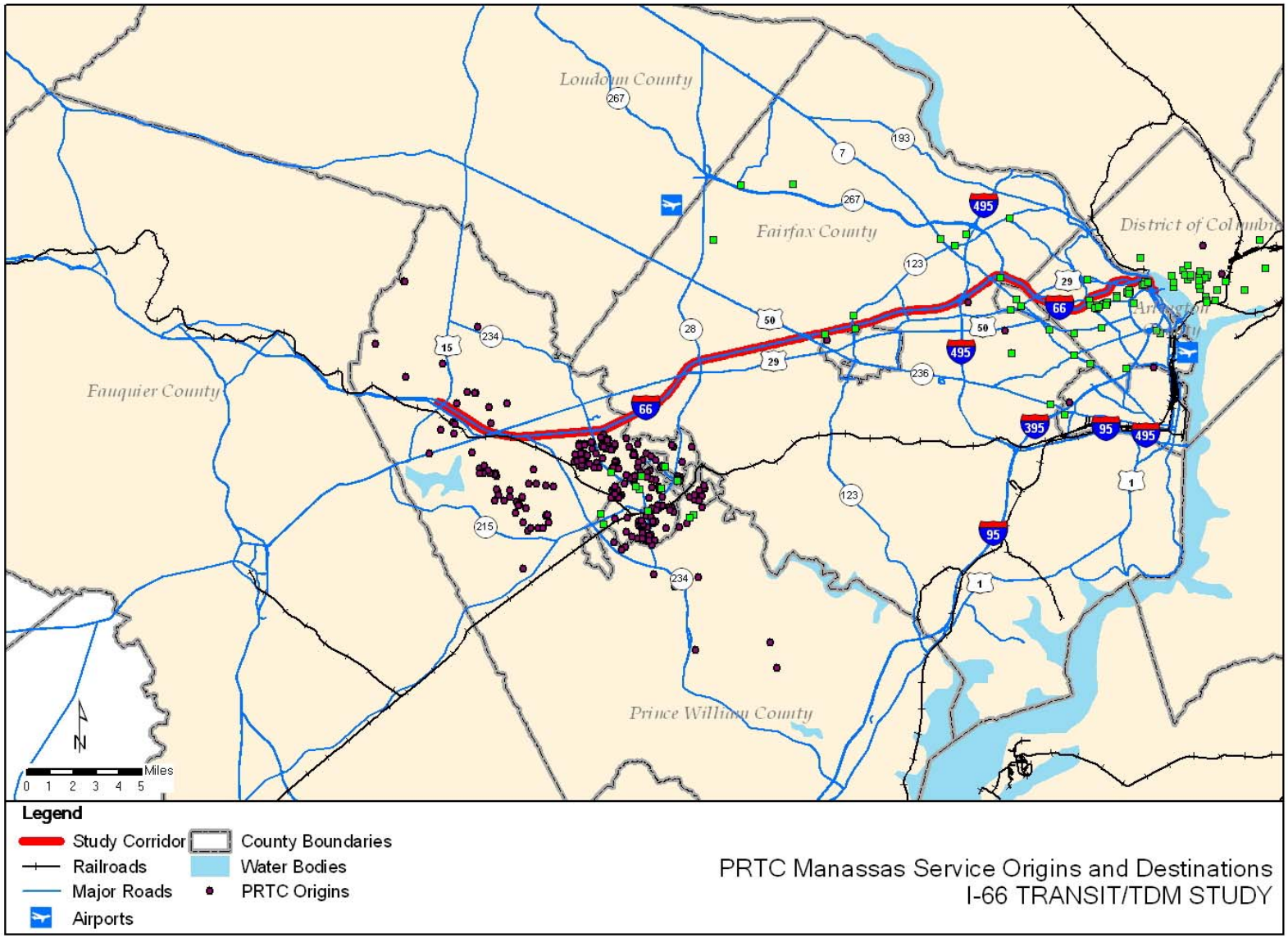
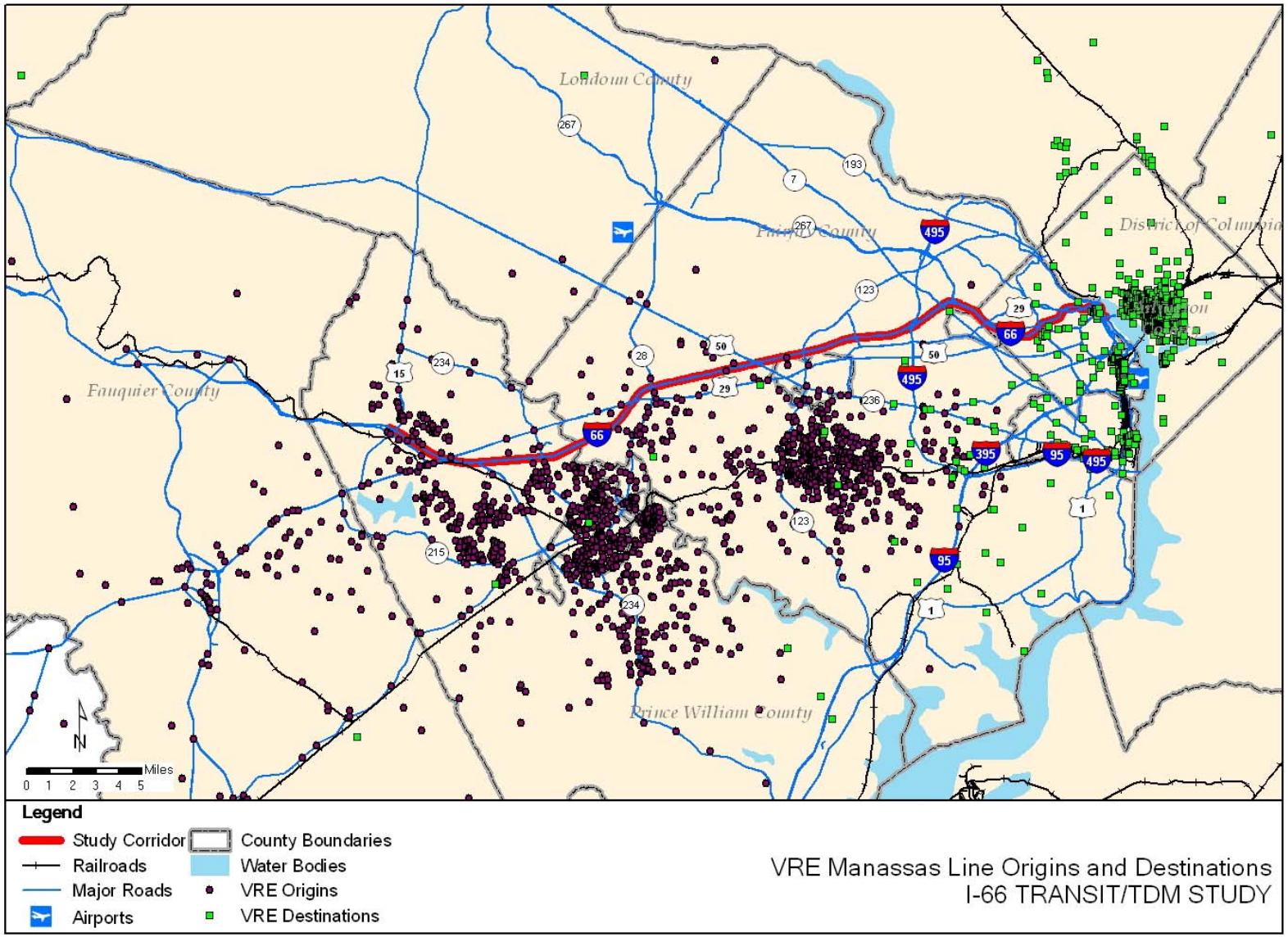


Figure 9-21. VRE Manassas Line Origins and Destinations



9.3.2 WMATA Ridership/Forecasts

WMATA performs station group forecasts and shared data from recent forecasting activity with the I-66 Transit/TDM Study team. The WMATA forecasts are generally based on the MWCOG Version 2.1 travel demand forecasting model (the previously adopted version) and the WMATA post-processor mode choice model. The WMATA forecasts are presented by rail station group. Two rail station groups were deemed relevant to the I-66 Transit/TDM Study; the "Western Group," which includes Vienna/Fairfax-GMU, Dunn Loring, and West Falls Church, and the "Eastern Group," which includes East Falls Church, Ballston, Virginia Square, Clarendon, and Court House. Table 9-2 presents the morning peak daily boardings supplied by WMATA.

Table 9-2. Morning Peak Daily WMATA Boardings

	2007	2010	2020	2030
Western Stations	19,756	21,643	21,158	20,422
Eastern Stations	14,981	16,427	22,713	24,162
Total	34,737	38,070	43,871	44,585

Table 9-3 provides the implied compound annual growth rates for this forecast.

Table 9-3. Forecast Compound Annual WMATA Growth Rates

	2007-2010	2010-2020	2020-2030	2007-2030
Western Stations	3.1%	-0.2%	-0.4%	0.1%
Eastern Stations	3.1%	3.3%	0.6%	2.1%
Total	3.1%	1.4%	0.2%	1.1%

Table 9-4 presents the comparable implied compound annual growth rates from the I-66 Transit/TDM Study model results for all transit trips produced during the morning peak period in two of the summary districts with similar geographic catchments as the applicable WMATA station groups.

Table 9-4. Study Forecast Compound Annual Transit Growth Rates

	2007-2010	2010-2020	2020-2030	2007-2030
West of Arlington	0.7%	0.5%	0.1%	0.3%
I-66 Arlington	-0.5%	-0.3%	0.2%	-0.1%
Total	-0.1%	0.0%	0.2%	0.1%

Although the model output is not exactly comparable with the WMATA supplied forecasts (different models used, different level of detail produced) it is useful to note where there are similarities and differences in the forecasts. Both forecasts are similar for the 2020 to 2030 time period overall and for the 2010-2020 time period for the Western Stations. For the Eastern Stations in the 2007 to 2020 time period, the WMATA forecasts show greater growth in boardings along the stations which have the added Silver Line service. The WMATA forecasts also show greater growth in the 2007 to 2010 time period.

With additional effort it would be possible to isolate the model forecasts for rail boardings at the same stations, but this was not the focus of the I-66 Transit/TDM Study forecasting effort due to the emphasis on non-rail transit options. In addition, it is important to understand that forecasts in the I-66 Transit/TDM Study were used to make relative comparisons against each other rather than for measurement of absolute transit service productivity. It is certainly useful to understand stakeholder expectations for growth in the Orange Line corridor in developing the study recommendations, and this exercise highlights the expected growth in demand, especially from the addition of Silver Line service.

9.3.3 MWCOG Land Use Forecasts

The analysis for the I-66 Transit/TDM Study made use of the Metropolitan Washington Council of Governments (MWCOG)/National Capital Region Transportation Planning Board (TPB) cooperative land use forecast that was adopted at the commencement of the analysis phase of the project, Round 7.1. During the course of the study, a new cooperative land use forecast, Round 7.2 was adopted and was obtained by the project team. The project team reviewed the Round 7.2 land use forecast as compared with the Round 7.1 land use forecast to assess the potential ways in which it might be beneficial to enhanced transit ridership forecasts. This review was conducted in part to address project stakeholder requests.

Table 9-5 presents a summary of the Round 7.2 household and employment forecasts at the jurisdiction level. Table 9-6 presents a summary of the Round 7.1 household and employment forecasts at the jurisdiction level.

Table 9-7 compares the absolute forecasts with one another by subtracting the Round 7.1 forecast from the Round 7.2 forecast for each horizon year and by jurisdiction.[1] At the MSA level, the Round 7.2 forecasts are slightly lower than the Round 7.1 projections throughout the 2010 to 2030 forecast period. For example, the Round 7.2 employment forecasts for 2030 are lower than Round 7.1 by approximately 5,500 fewer jobs, while the Round 7.2 2030 household forecasts are lower than Round 7.1 by approximately 26,000 fewer households. Since the Round 7.2 forecasts extend to 2040, in some cases the jurisdictions have slowed the growth through the now-intermediary year of 2030.

Table 9-8 summarizes the forecast growth in the Round 7.2 forecast. A further analysis (beyond what is depicted in Table 9-8) reveals that both the Round 7.1 and Round 7.2 forecast show a faster growth rate for households and employment between 2005 and 2015 as compared with between 2015 and 2030. However, Round 7.2 shows less of a contrast between the periods than does Round 7.1. That is, Round 7.2 grows more slowly between 2005 and 2015 and slightly faster between 2015 and 2030. Overall, Round 7.1 and Round 7.2 exhibit approximately the same compound annual growth rate for the comparable forecast period (1.2 percent per year for households and 1.3 percent per year for employment).

It should be noted that a Round 7.2a land use forecast is under development at this time. Round 7.2a is an update to Round 7.2 because of an amendment to the 2009 CLRP and FY2010-2015 TIP. This amendment includes the Purple Line Light Rail Project in Montgomery and Prince George's County and the I-395 Air Rights Project in the District of Columbia. The modifications in Round 7.2a affect the forecasts for just the District of Columbia, and Montgomery and Prince George's Counties in Maryland.

[1] The source documents from MWCOG/TPB contain differences in Year 2005 figures between Round 7.1 and Round 7.2.

Table 9-5. Round 7.2 Land Use Summary by Jurisdiction

	Households (thousands)			Employment (thousands)		
	2005	**2015**	**2030**	**2005**	**2015**	**2030**
Washington, D.C.	253.4	295.2	334.7	750.3	815.2	920.6
Arlington County	92.2	108.9	120.9	194.9	237.6	271.7
City of Alexandria	66.3	73.1	86.1	105.8	123.8	156.8
Montgomery County	347.0	386.0	440.0	500.0	547.0	670.0
Prince George's County	305.8	331.1	366.9	347.9	379.4	454.1
Fairfax County	375.8	409.5	462.9	602.0	714.5	819.7
City of Fairfax	8.4	8.8	9.7	26.1	28.7	34.0
City of Falls Church	4.6	6.2	6.7	9.5	14.0	16.9
Loudoun County	87.5	114.2	155.9	130.3	189.4	275.2
Prince William County	118.9	154.4	191.8	113.6	143.1	207.0
City of Manassas	12.8	14.8	17.1	23.3	27.3	31.8
City of Manassas Park	4.2	5.3	5.4	3.0	4.6	4.9
Calvert County	29.9	34.3	38.3	32.4	41.1	47.2
Charles County	47.4	57.5	75.9	58.6	68.4	77.5
Frederick County	79.5	95.9	123.1	122.2	151.5	167.3
Stafford County	30.7	52.1	72.7	36.9	48.6	65.0
Total	**1,864.4**	**2,147.3**	**2,508.1**	**3,056.8**	**3,534.2**	**4,219.7**

Table 9-6. Round 7.1 Land Use Summary by Jurisdiction

	Households (thousands)			Employment (thousands)		
	2005	**2015**	**2030**	**2005**	**2015**	**2030**
Washington, D.C.	253.6	283.1	325.7	745.3	818.8	881.4
Arlington County	92.2	108.8	117.8	194.9	217.6	258.4
City of Alexandria	66.3	74.5	87	105.7	119.3	141.5
Montgomery County	347	390	441.3	500	580	670
Prince George's County	307.3	346	377.8	347.9	389.1	518.4
Fairfax County	377.6	442.6	482.3	604	741.5	847.6
City of Fairfax	8.5	9.6	10.5	29.2	33.3	39.3
City of Falls Church	4.6	6.5	7.3	9.5	15.1	20.3
Loudoun County	87.5	125.9	165.9	130.3	203.8	290.7
Prince William County	122	158.5	193.1	111.6	143.7	186
City of Manassas	12.8	13.7	14.4	23.3	26.2	26.8
City of Manassas Park	4.2	5.3	5.4	3	4.6	4.9
Calvert County	28.3	32.7	36.2	29.4	33.7	35.6
Charles County	48.2	57.9	76.9	56.5	64.8	69.1
Frederick County	79.5	95.9	123.1	122.2	151.5	167.3
Stafford County	37.2	50.7	69.2	38.3	52.4	67.9
Total	**1,876.8**	**2,201.7**	**2,533.9**	**3,051.1**	**3,595.4**	**4,225.2**

Table 9-7. Round 7.2 Minus Round 7.1 by Jurisdiction by Year

	Households (thousands)		Employment (thousands)	
	2015	2030	2015	2030
Washington, D.C.	12.1	9.0	-3.6	39.2
Arlington County	0.1	3.1	20.0	13.3
City of Alexandria	-1.4	-0.9	4.5	15.3
Montgomery County	-4.0	-1.3	-33.0	0.0
Prince George's County	-14.9	-10.9	-9.7	-64.3
Fairfax County	-33.1	-19.4	-27.0	-27.9
City of Fairfax	-0.8	-0.8	-4.6	-5.3
City of Falls Church	-0.3	-0.6	-1.1	-3.4
Loudoun County	-11.7	-10.0	-14.4	-15.5
Prince William County	-4.1	-1.3	-0.6	21.0
City of Manassas	1.1	2.7	1.1	5.0
City of Manassas Park	0.0	0.0	0.0	0.0
Calvert County	1.6	2.1	7.4	11.6
Charles County	-0.4	-1.0	3.6	8.4
Frederick County	0.0	0.0	0.0	0.0
Stafford County	1.4	3.5	-3.8	-2.9
Total	**-54.4**	**-25.8**	**-61.2**	**-5.5**

Table 9-8. Round 7.2 Growth by Jurisdiction

	Households (thousands)			Employment (thousands)		
	2005-2015	2015-2030	CAGR	2005-2015	2015-2030	CAGR
Washington, D.C.	41.8	39.5	1.1%	64.9	105.4	0.8%
Arlington County	16.7	12	1.1%	42.7	34.1	1.3%
City of Alexandria	6.8	13	1.1%	18	33	1.6%
Montgomery County	39	54	1.0%	47	123	1.2%
Prince George's County	25.3	35.8	0.7%	31.5	74.7	1.1%
Fairfax County	33.7	53.4	0.8%	112.5	105.2	1.2%
City of Fairfax	0.4	0.9	0.6%	2.6	5.3	1.1%
City of Falls Church	1.6	0.5	1.5%	4.5	2.9	2.3%
Loudoun County	26.7	41.7	2.3%	59.1	85.8	3.0%
Prince William County	35.5	37.4	1.9%	29.5	63.9	2.4%
City of Manassas	2.0	2.3	1.2%	4.0	4.5	1.3%
City of Manassas Park	1.1	0.1	1.0%	1.6	0.3	2.0%
Calvert County	4.4	4	1.0%	8.7	6.1	1.5%
Charles County	10.1	18.4	1.9%	9.8	9.1	1.1%
Frederick County	16.4	27.2	1.8%	29.3	15.8	1.3%
Stafford County	21.4	20.6	3.5%	11.7	16.4	2.3%
Total	**282.9**	**360.8**	**1.2%**	**477.4**	**685.5**	**1.3%**

Note: CAGR is the compound annual growth rate over the period 2005 to 2030

To further illustrate differences between the Round 7.1 and Round 7.2 forecasts a series of four maps are presented in Figures 9-22 through 9-25 showing the projected household and employment growth within each of the forecasts in terms of density. That is, Round 7.2 household and employment growth per square mile are illustrated, followed by illustrations of Round 7.1 household and employment growth per square mile. These figures highlight differences in areas where growth was forecast in Round 7.1. Noted differences include:

- Clustered household growth around transit in the District of Columbia;
- Higher-intensity household growth in the Springfield, Centreville, and Reston/Herndon areas in Fairfax County;
- Generally slower growth in employment in Round 7.2 as compared with Round 7.1 in Fairfax County
- Lower and more-clustered household and employment growth in Loudoun County
- Somewhat-higher intensities of household and employment growth in Prince William County

Finally, Table 9-9 provides a summary of the potential ways in which the Round 7.2 forecast might and might not be beneficial to enhanced transit ridership forecasts based on the comparison of the two forecasts.

Table 9-9. Summary of Transit Ridership Impacts of Round 7.2

Difference in Forecast	Would tend to increase forecast transit ridership	Would tend to decrease forecast transit ridership
Higher growth in 2030 employment in D.C.	●●	
Higher employment growth in Arlington County	●	
Additional employment in western end of the corridor in 2030		●
Lower growth in Fairfax County		●
Lower growth in population and employment regionwide in 2015		●●[2]

[2] Also, would lead to a greater contrast between the 2030 and 2015 ridership forecasts.

Figure 9-22. Round 7.1 2005-2030 Household Growth

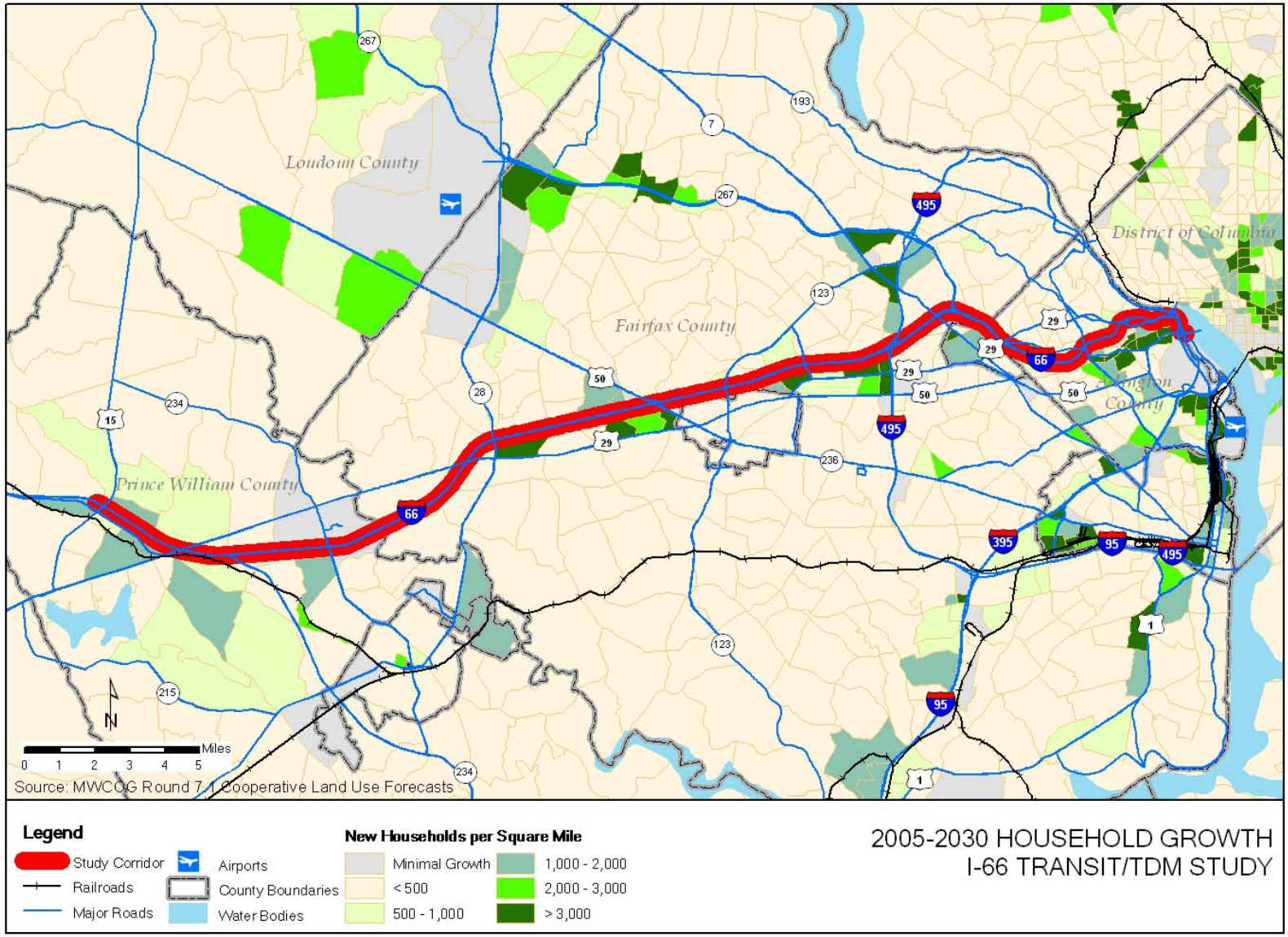


Figure 9-23. Round 7.1 2005-2030 Employment Growth

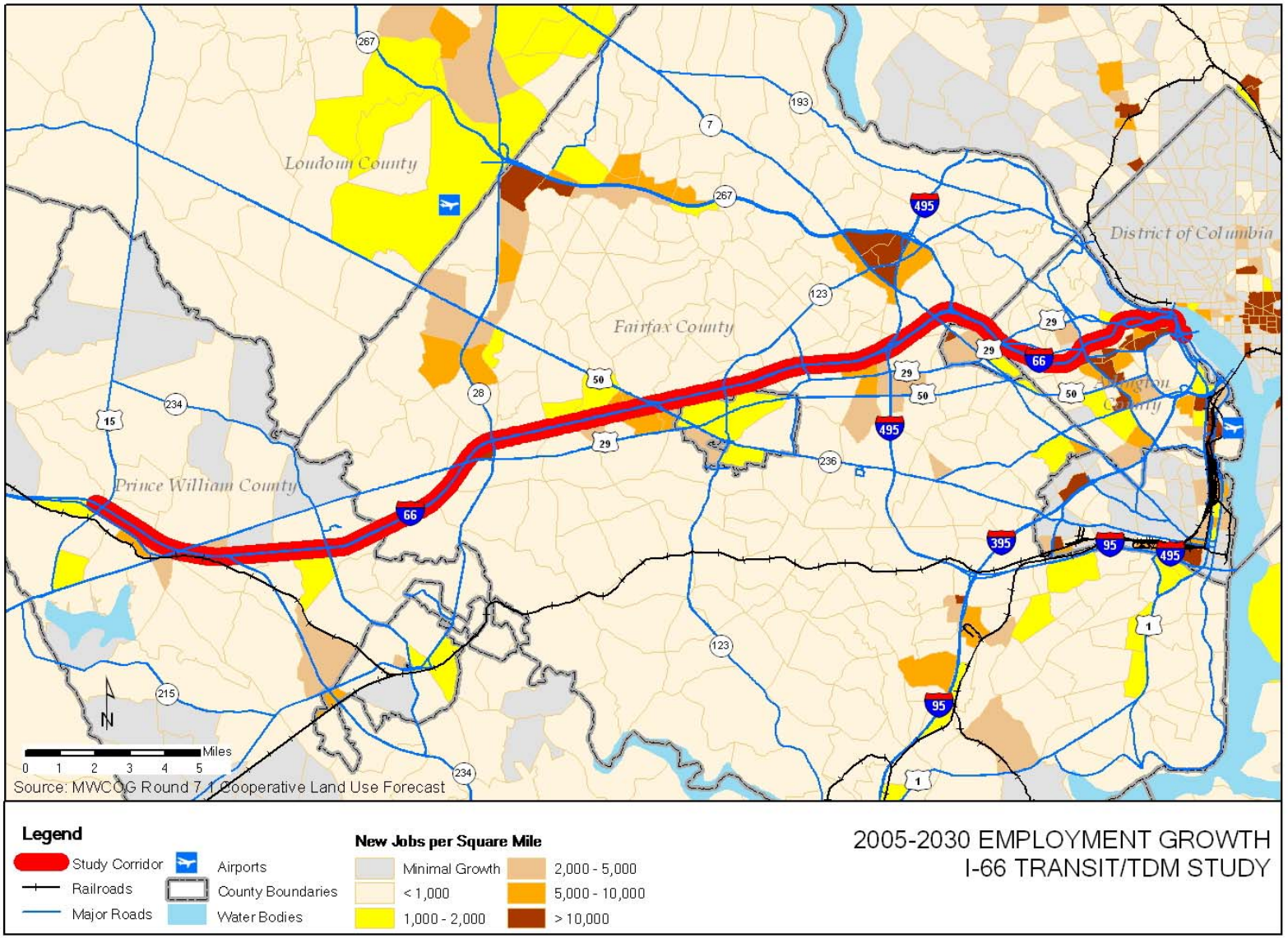


Figure 9-24. Round 7.2 2005-2030 Household Growth

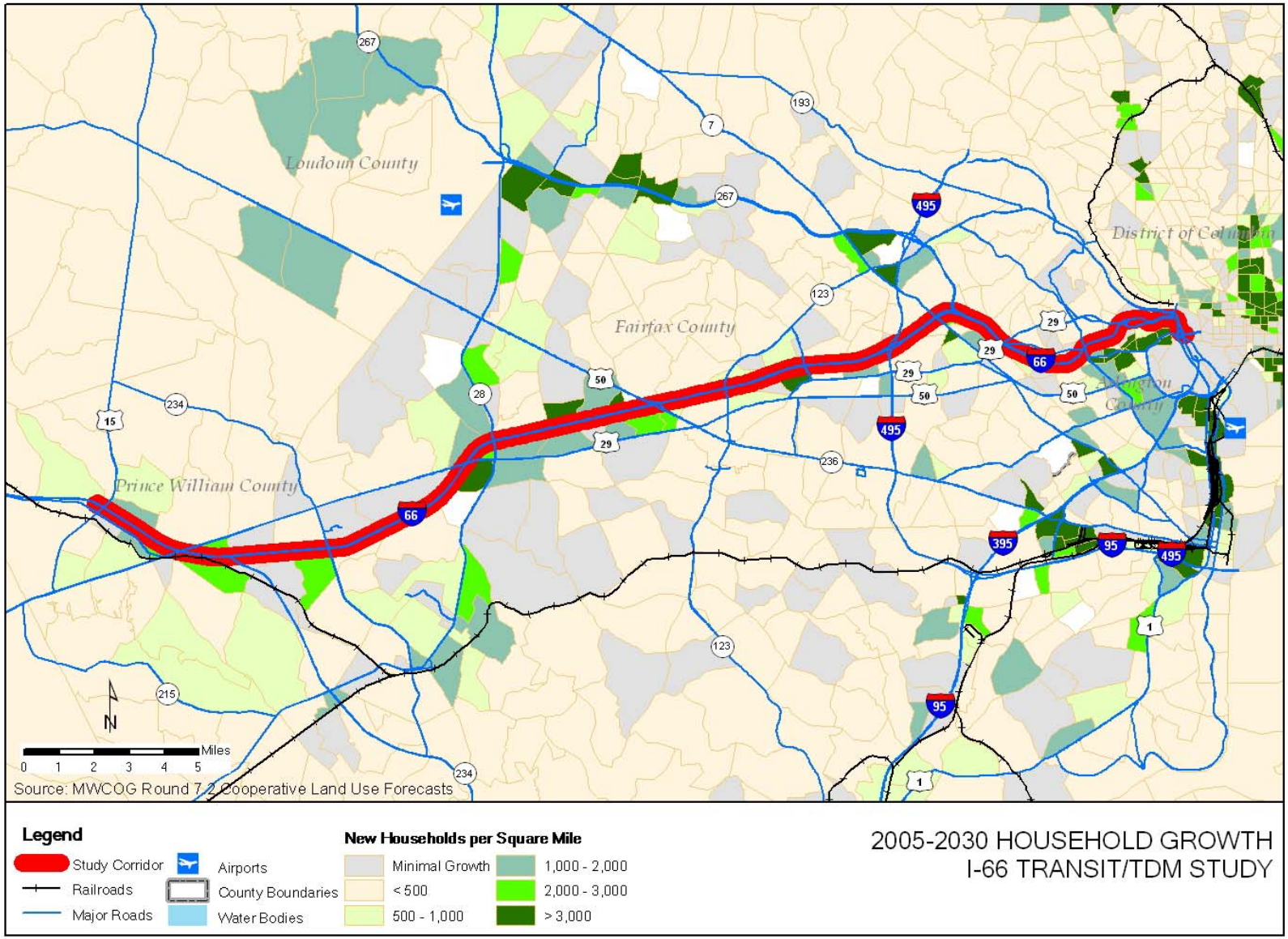
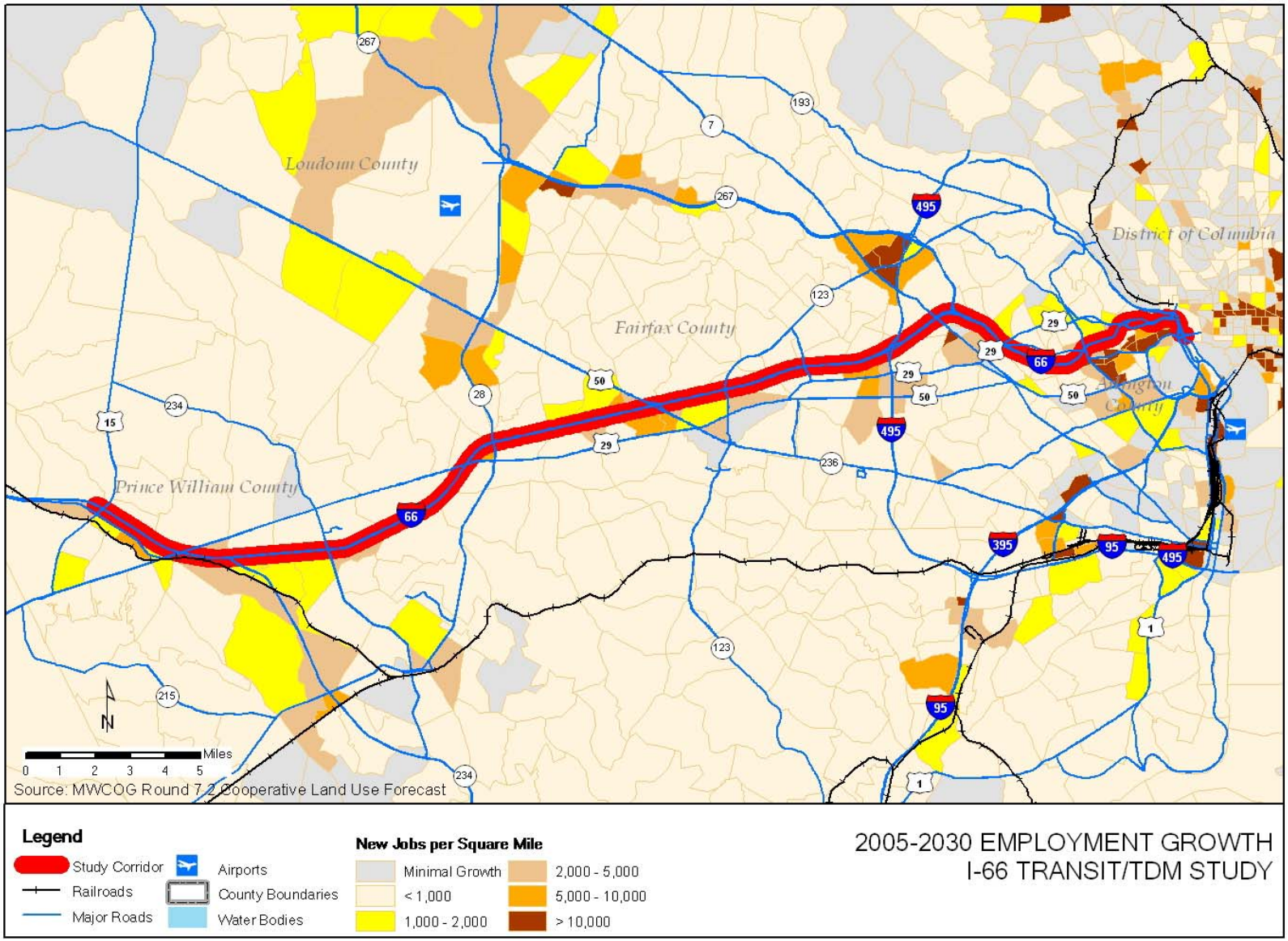


Figure 9-25. Round 7.2 2005-2030 Employment Growth



9.3.4 HOV-2 versus HOV-3 Policy

The travel demand forecasting analysis for the I-66 Transit/TDM Study accepted the adopted Financially Constrained Long Range Plan (CLRP) as of the beginning of 2009 and, therefore, incorporated the then-current policy plan of converting all regional high-occupancy vehicle (HOV) facilities from requiring two or more persons per vehicle (HOV-2) to requiring three or more persons per vehicle (HOV-3). That is, the forecasts for the I-66 Transit/TDM Study assume that all HOV facilities carry an HOV-3 restriction in both the 2015 and 2030 horizon years. However, since the start of the study, the National Capital Region Transportation Planning Board (TPB) has moved to delay the start of the all-HOV-3 policy from by 2010 to after 2010. Therefore, an off-model sensitivity analysis has been undertaken to explore the implication of such a delay in the policy change to the study findings.

As currently addressed by the TPB, the contemplated delay in policy change would only affect the 2015 forecasts for the I-66 Transit/TDM Study because the HOV-3 policy would still be in place by 2030. In simple terms, a delay in the increased HOV occupancy requirement would make continued formation of HOV-2 carpools an attractive alternative to HOV-3 or transit usage for whatever time savings are available through the dedicated HOV lane on I-66. Thus, a delay in the change in the requirement would be beneficial to HOV-2 usage, but potentially detrimental to both HOV-3 usage and transit usage in terms of the study's existing 2015 forecasts. Effects to study forecasts, if any, of a delay in the change in the requirement, would be expected both inside and outside the Beltway.

With the HOV-3 restriction in place (i.e., the study forecasts), the forecasted HOV-3 commuter mode share produced in the corridor, overall, was expected to be approximately eight percent by 2015 – a 70 percent increase in HOV-3 commuter share versus that observed in 2005 (approximately five percent). The number of HOV-3 daily commuter trips in the corridor was forecast to nearly double from 2005 levels to 2015 (from 26,000 to 51,000), in part due to the increase in occupancy requirements. At the same time, the HOV-2 commuter mode share was expected to be approximately 11 percent, a decline of over 20 percent as compared with 2005 (approximately 14percent). Transit usage between the two time periods was forecast to be steady, in part due to changing land use patterns (approximately 71,000 daily commuter trips). Were the HOV-3 restriction not in place in 2015, it would be reasonable to expect that HOV-3 commuter mode share would not grow by as much although the HOV-3 requirement on the Beltway HOT lanes would still encourage some mode shift.

One of the effects of the HOV-3 requirement is that fewer vehicles are required to move a similar number of people in the restricted lane(s), all things being equal. This might further result in improved travel times in the restricted lanes under an HOV-3 regime as compared with an HOV-2 regime assuming friction effects, clean fuel vehicle usage, and violator usage are not the controlling factors. Then, to the extent the restricted lane travel time is maintained or improved under an HOV-3 policy, a positive effect on usage would be expected for all users of the lane, including transit. The delay, then, in imposing an HOV-3 requirement on I-66 could thus potentially lead to longer travel times for users of carpools and transit versus what was modeled and, therefore, result in lower usage than what was modeled.

To the D.C. core, the largest transit and carpool market, HOV-3 commuter mode share in 2015 was forecast to be approximately 48 percent from west of Centreville; 21 percent from between the Beltway and east of Centreville; and approximately four percent inside the Beltway. The complementary transit mode share to the D.C. core was expected to be approximately 31 percent from west of Centreville; 51 percent from between the Beltway and east of Centreville; and approximately 76 percent inside the Beltway.

With an HOV-2 restriction in place instead, the HOV-3 mode share would be significantly lower, perhaps 50 percent lower than forecast given all of the factors described above. The resulting HOV-3 commuter mode share for 2015 for productions in the overall corridor might then be expected to be approximately 6.5 percent by 2015 – still, representing a 35 percent increase in HOV-3 commuter share versus that observed in 2005. The number of HOV-3 commuters in the corridor would still be expected to grow over 2005 levels to 2015 (to 40,000), due to the occupancy requirements to enjoy toll-free travel on the new Beltway HOT lanes. At the same time, the HOV-2 commuter mode share might instead be approximately 13 percent, a ten percent decline as compared with 2005. Transit usage between the two time periods might still remain steady.

Taking this what-if analysis a step further, it is clear that there would be no change to the overall I-66 Transit/TDM Study recommendations given a small delay in implementation of the HOV occupancy requirement policy change. That is, while the performance of the HOV lane remains critical to the success of transit and carpooling in the corridor, a delay in the implementation of an HOV-3 occupancy requirement would not appear to dramatically impact forecasted transit and overall carpool usage at 2015. The most important aspect of the HOV lane operation is its reliable performance and ability to generate travel time savings for its users. A parallel study effort commissioned by VDOT, the I-66 HOV Lane Operations Study, identified friction with the general purpose lanes as the primary problem afflicting the lanes and examined strategies for alleviating this primary issue with the lane outside the Beltway. The primary solution suggested by the consultant performing the study was to use new restrictions on merging and weaving and signing and pavement markings to create a two-foot buffer and designate permitted and prohibited merge and weave areas. Inside the Beltway, the HOV lanes work well during the hours that the HOV restriction is in place.

It should be noted that a difference in HOV policy for I-66 as compared with that for the Beltway HOT lanes could introduce new merging and weaving problems at the Beltway, as some HOV-2 vehicles would desire to exit onto the Beltway general purpose lanes rather than pay for travel in the Beltway HOT lanes to which the easier access is available. Traffic simulation models rather than travel demand models are more appropriate to use to explore this type of issue. Solutions to this type of operations problem might include additional advance signing and possibly a change in some of the specific lane restrictions in the vicinity of the Beltway interchange.

The restarted I-66 Multimodal Transportation and Environmental Study effort is anticipated to explore the policy and travel demand implications of different HOV occupancy requirements in more detail as part of its scope of work, using the travel demand forecasting model framework for that study for the portion of I-66 outside the Beltway. Some products from this study are expected in spring 2010.

9.3.5 Bus Priority Treatments

An exploration of bus priority treatments was among the sensitivity analyses performed as part of the study. Two types of treatments were considered in the analysis: barrier-separated bus lanes and bus-on-shoulder operations. Barrier-separated bus lanes were considered by modeling higher travel speeds of buses in the corridor than were otherwise used. The lanes were assumed to permit bi-directional use and to permit access/egress at all of the points otherwise available via the existing HOV lanes. This “what-if” analysis relaxed concerns about the potential difficulties of implementing such lanes and instead focused on what the potential ridership benefits might be as a hypothetical situation. The analysis was performed using the same travel demand forecasting tool used for evaluation of the refined alternative. The analysis suggested that a substantial number of additional daily person transit trips (approximately 1,200) could result from the associated 20 percent travel time savings and reliability improvement.

Elsewhere in the U.S., bus-only shoulder lanes have proven a solution for efficient movement of buses along selected congested highways and arterials without HOV lanes. For example, the U.S. Federal Highway Administration worked with Minnesota DOT to allow buses on shoulders along congested highways in the Minneapolis area that did not have HOV lanes. The buses started running along narrow shoulders with a speed limit of 25 miles per hour. Later, Minnesota DOT developed and implemented minimum design standards, including a 12 foot width and revised speed limit of 35 miles per hour.

Unlike congested corridors that do not have HOV lanes and permit bus operation on shoulders to provide a similar benefit, the I-66 corridor has dedicated peak-period HOV facilities which can be used by buses. The HOV facilities are important to overall mobility in the corridor (a single HOV lane is able to move more people than a single general purpose lane) and critical to the success of bus transit. Therefore, the protection of the reliable and uncongested operation of the existing I-66 HOV lanes should be the priority for the peak direction of travel.

Bus-on-shoulder operations were evaluated at a sketch planning level for I-66 both inside the Capital Beltway and Outside the Capital Beltway as well as for the proposed express skip-stop service for the U.S. 29 and U.S. 50 Metrobus routes. The primary concern with operating buses on shoulders is general safety, but a secondary important issue can be pavement design and damage potential. In many cases the shoulder pavement is not as strong as the actual lanes (e.g., this is generally true of the existing shoulders on I-66 inside the Beltway). As a result of these concerns, buses on shoulders are operated at a limited travel speed. For example, on the Dulles Connector Road, the buses operate at no more than 25 miles per hour when on the shoulder to access the West Falls Church Metrorail station.

In the off-peak direction, there are no operating HOV lanes on I-66, so bus use of shoulders might be justified in some spot locations or along longer highway segments. For example, in the westbound direction for the morning peak hour, level of service “F” congestion currently develops inside the Beltway on I-66 from Fairfax Drive to Sycamore Street. This location may represent the best current opportunity for a bus to save time by traveling on the shoulder. However, there are several challenges: 1) the entrance from Fairfax Drive is a two lane ramp, creating a challenging merge; 2) the number of revenue-service buses per hour that would use the bypass would be limited (i.e., most reverse-direction transit travel markets are served by Metrorail directly or indirectly); 3) the speed limit for such a bypass would likely be 25 miles per hour further minimizing time savings; and 4) the pavement would likely require reinforcement before use. In addition, there would also be safety concerns due to the potential presence of vehicles in the shoulder lane due to break downs or law enforcement activities.

Similarly, there is frequently congestion in the westbound direction in the evening peak hour where VA 267 merges with I-66. At this section, operations on the shoulder could lead to benefits for a limited area, but the same general concerns would exist and buses would need to weave across the two lanes of merging traffic from VA 267 to reach the right shoulder. Near Sycamore Street, the operating speeds on the shoulders would be similar to that of the mainline traffic and thus offer little additional benefit.

A third location for potential bus priority treatment on I-66 would be to consider providing queue jumping provisions on the metered ramps. Up until only recently, ramp metering on I-66 was limited to the peak-direction and was therefore only applicable to HOV traffic during the peak hour. However, now ramp meters are in operation in both directions and there may be benefit to consideration of providing queue jump capability for buses in the off-peak direction. As with the mainline bus on shoulder operations, there are limited revenue service vehicles that use the facility in this direction, but some benefit might be possible.

The parallel corridors of U.S. 29 and U.S. 50 have some spot locations which could be benefited through bus priority treatments such as queue jumps or bus usage of shoulders. There is limited availability of shoulders to use on these facilities though, particularly in the congested portions. In Arlington County, U.S. 29 has more limited shoulder availability than does U.S. 50, on which there are a few locations where this might be applicable. One potential location for queue jumps on U.S. 50 in Arlington would be at the intersection with Henderson Road. In Fairfax County, queue jumps on U.S. 29 at Nutley Street might be possible by restriping the intersection. Transit signal priority for buses on U.S. 29 at Gallows Road is also a potential opportunity. On U.S. 50, bus-on-shoulder operations may be possible in both directions from Wallace Drive to VA 649/Annandale Road and in the eastbound direction from Annandale Road to Seven Corners. Additionally, the access roads along U.S. 50 at Lohemann's plaza offer a queue-jump possibility. Further study into implementing queue jumping lanes or transit signal priority at key intersections could be useful to identify travel time improvements for the proposed Metrobus Express services.

9.4 Conclusions

The process of developing the alternatives was iterative, with qualitative and quantitative assessments performed with the help of TAC members to arrive at decisions on the direction in which to take the alternatives. In addition, public and stakeholder input, market research, current and forecasted travel demand in the study area, and park-and-ride needs analysis were used to develop and evaluate the alternatives. Travel forecasting involved use of the Transportation Planning Board's regionally adopted model as well as a post-processor developed for WMATA for submode choice analysis. In addition, a number of sensitivity analyses and other checks were performed in reviewing and interpreting the forecasts. In essence, the models permitted comparison of results with alternative strategies, but the results were carefully reviewed and considered for the information supporting decision making.

The travel forecasts showed that the significant existing transit service will continue to attract additional riders over time. In addition, there are opportunities for introducing a Priority Bus framework to the corridor. This framework would include new or enhanced station and access infrastructure and new or enhanced bus services. The service outlined in the refined alternative provides many of the benefits highlighted in the market research survey as important decision points for commuters including limited stops, high speeds, and good reliability. The forecast results reinforce these findings by showing the attractiveness of the proposed service as an increase in transit ridership on the tested alternatives.

The next section describes the park-and-ride demand analysis. Although the travel demand forecasts are used as inputs to the park-and-ride analysis, it should be noted that it also follows a process where model results are interpreted to lead to recommendations. Section 12, "Recommendations," features the final outcome resulting from the interpretation of the various model outputs, TAC guidance, and other information produced and reviewed as part of the study.

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10.0 Park-and-Ride Analysis

As part of the I-66 Transit/TDM Study, a comprehensive park-and-ride lot analysis was performed to determine the park-and-ride needs of the corridor. This analysis included both an on-site survey and a license plate survey providing origin locations for users of each of 17 park-and-ride lots in the corridor which are detailed in Section 10.1. Future park-and-ride demand forecasts were developed based on this data and growth rates in the corridor and are presented in Section 10.2. Findings of the park-and-ride analysis are provided in Section 10.3. Recommendations for expanded park-and-ride capacity in the I-66 corridor are found in Section 12.4 of this report.

10.1 Park-and-Ride Lot Survey

Seventeen park-and-ride lots in the corridor were surveyed for the I-66 Transit/TDM Study, as shown in Figure 10-1. The majority of these facilities (10 lots) are located in Fairfax County, four lots are located in Arlington County, and the remaining three lots are located in Prince William County. Of these lots, the four largest are located at Orange Line Metrorail stations. Surveys at the park-and-ride facilities encompassed multiple parking types including long-term parking lots, garages, kiss-and-ride facilities, and metered lots. On-site surveys were conducted at all 17 facilities between January 7, 2009 and March 19, 2009; the composition and condition of each lot along with photo documentation from these surveys is provided in Appendix G. In addition to the 17 lots surveyed, it has been noted that an additional 90-spaces of parking capacity are leased at the K-mart located in the Sudley Manor Square shopping center in Prince William County.

10.1.1 Lot Capacity and Utilization

The on-site surveys counted the number of available spaces at each facility and the number of occupied spaces during the middle of the day. These values and the resulting utilization rates for each park-and-ride lot are shown in Table 10-1. In general, the lots closest to I-66 have higher utilization than those that are located further away, and all four of the Metro stations have high utilization rates. Very low utilization rates were found at a few of the park-and-ride lots, notably, Sully Station and the Fair Lanes Bowling Center in Fairfax County.

It should also be noted that several of these facilities may serve multiple purposes beyond commuter park-and-ride. For example, the Ballston Public Parking Garage is also a major parking garage for the Ballston area, the Ballston Common Mall, and several office complexes located at or near the Mall. Likewise, the lot at the Fairfax Government Center and North Quincy Street may be used by people with business with Fairfax County or Arlington County government, respectively.

In total, the 17 park-and-ride lots in the corridor include 12,144 long-term spaces and an additional 450 short-term spaces (including metered spaces, kiss-and-ride spaces, and on-street parking spaces). During the surveys, over 10,300 vehicles were parked in the long-term spaces. The average utilization for all parking facilities at the 17 park-and-ride lots in the corridor was 85 percent.

Figure 10-1. Park-and-Ride Lot Locations and Utilization

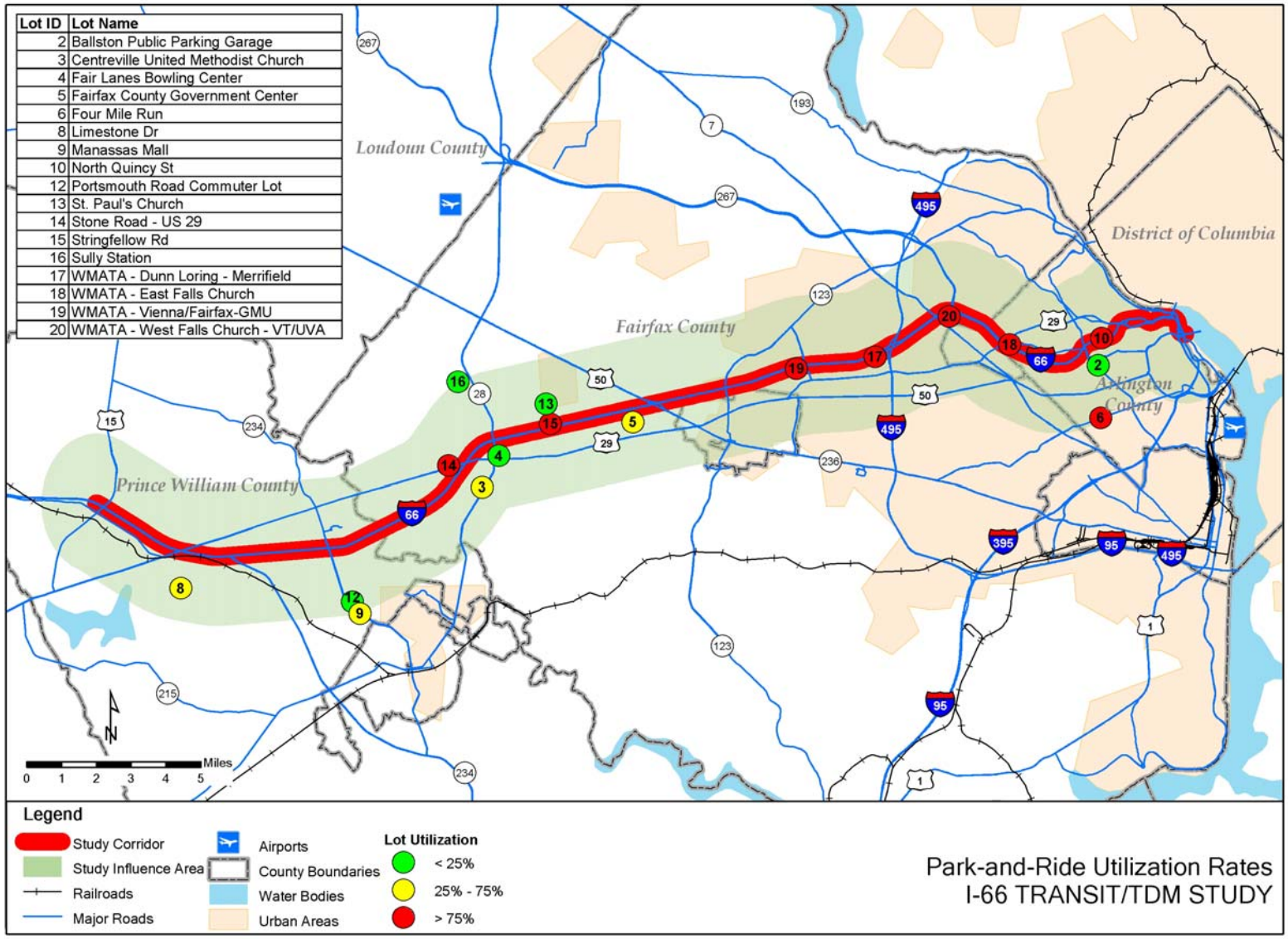


Table 10-1. Park-and-Ride Lot Capacity and Utilization

	Lot Name	Owner	2009 Capacity	2009 Utilization[1]
2	Ballston Public Parking Garage	County	804	20%
3	Centreville United Methodist Church	VDOT	147	40%
4	Fair Lanes Bowling Center	Private	32	10%
5	Fairfax County Government Center	County	170	30%
6	Four Mile Run	County	23	Full
8	Limestone Drive	Private[2]	211	40%
9	Manassas Mall	Private	217	60%
10	North Quincy Street	County	78	Full
12	Portsmouth Road Commuter Lot	VDOT	630	10%
13	St. Paul's Church	Private	112	10%
14	Stone Road – U.S. 29	County	372	Full
15	Stringfellow Road	VDOT	381	Full
16	Sully Station	VDOT	41	10%
17	WMATA – Dunn Loring-Merrifield[3]	WMATA	1,326	Full
18	WMATA – East Falls Church[3]	WMATA	422	Full
19	WMATA – Vienna/Fairfax-GMU[3]	WMATA	5,169	Full
20	WMATA – West Falls Church[3]	WMATA	2,009	Full
	TOTAL		**12,144**	**85%**

[1] Utilization rates of individual lots are rounded to the nearest 10 percent.
[2] Limestone Drive Lot is currently privately owned but is anticipated to be transferred to VDOT ownership.
[3] Indicated capacity and observed demand at WMATA lots is from May 2009 WMATA counts.

10.1.2 License Plate Survey

License plates were recorded for all vehicles parked in the 17 park-and-ride lots indicated in Table 10-1 during the survey period, for a total 9,358 plates. Of these, 8,695 had Commonwealth of Virginia tags and were sent to the Virginia Department of Motor Vehicles (DMV) to provide registration addresses for each of the vehicles; the DMV provided addresses for approximately 93 percent of the license plates. Through a combination of automated and manual processes 7,723 addresses were geocoded to be used for further analysis. Appendix G contains graphics showing the catchment areas for each of the surveyed park-and-ride lots.

10.2 Park-and-Ride Demand Forecasting

This section details the park-and-ride demand forecasting that was conducted as a part of this study. The methodology used is described in Section 10.2.1 and the results of the forecasting are presented in Section 10.2.2. Findings from this analysis are presented in Section 10.3. These findings are used to make recommendations about future additions or expansions to the park-and-ride infrastructure in the I-66 corridor in Section 12.4.

10.2.1 Forecasting Methodology

This section presents the methodology used to develop forecasts of park-and-ride trips for the I-66 Transit/TDM Study. Understanding the market shed for drive access to transit and shared ride modes and levels of travel demand are important for addressing transit route configurations, transit system sizing, parking lot sizing and location, and the need for additional parking spaces. The approach is straightforward both in concept and application and utilizes the collected existing park-and-ride lot survey data as well as the MWCOG regional model and land use forecast data. This approach was applied to the park-and-ride lots that serve shared rides and bus modes. Park-and-ride lot demand for the Priority Bus stations are also determined by reviewing the results of the mode choice model.

The data requirements of the park-and-ride lot forecasting methodology were:

- Parking lot utilization data;
- License plate survey data;
- Forecast year drive access to transit and high-occupancy vehicle (HOV) demand forecasts; and
- Base year drive access to transit access and HOV demand forecasts.

To obtain the first two items listed in the data requirements, a one-day usage count of existing lots was performed as detailed in Section 10.1. In addition, supplemental one-day usage data were provided by Fairfax County and WMATA for certain lots. The remaining two items in the data requirements list are results of the application of the MWCOG regional model in conjunction with the WMATA post-processor mode choice model.

This methodology applies a growth allocation approach based on the model results and the license plate survey data. The model calculates the forecast growth in drive access to transit and HOV trips between the base year and the forecast year from the post-processor mode choice model. This growth is then applied to the existing parking count data to produce forecasts of drive access to transit and HOV-oriented trips for each park-and-ride lot in the I-66 corridor. The process assumes that all HOV lanes carry an HOV-3 restriction in both the 2015 and 2030 horizon years. A flowchart depicting the process is provided in Appendix G.

For the parking demand forecasts, a series of districts (aggregations of transportation analysis zones) in the I-66 corridor were developed. The park-and-ride lot districts are configured to approximate the likely market or travel shed that the traveler will consider when driving to a park-and-ride lot in the corridor. The growth factors that are used to “grow” the existing parking lot counts are calculated at the district level to smooth the variances among zones over the two time periods. This is done to address the issue of small changes in trips over the base creating relatively large factors, thus inflating the forecasts. Each park-and-ride lot in the corridor is also assigned to a district for the application of the growth factors; however, lot-specific utilization forecasts are an output of the model.

To perform this assignment to districts, data from the park-and-ride lot license plate survey are used. The geocoded origin zone park-and-ride lot data from the survey were collected during the 2009 parking lot utilization survey described in the previous section to produce the baseline inputs to which the district-level growth factors are applied.

This forecasting methodology assumes that future drive access and HOV drivers will choose a park-and-ride lot in the same travel shed that they do today. For the future years, three new park-

and-ride lots were introduced: VA 234 Bypass/Cushing Road, Haymarket Priority Bus Lot, and Centreville Priority Bus Lot. With these additions, the access sheds were adjusted (split) using drive-distance information from the park-and-ride lot license plate survey. The park-and-ride lot forecasting process separates the demand at new lots into two markets, existing drive access to transit and shared ride access trips (which have moved to the new lot) and additional, new trips. This process also accounts for the change in utilization at lots from which existing drivers have switched.

10.2.2 Demand Forecasts

Forecasts were developed for each of 20 future park-and-ride lots in the I-66 corridor for the horizon years of 2015 and 2030 based on the refined transit alternative.[1] Unconstrained demand forecasts were developed assuming that demand at any of the lots could grow by any amount; Table 10-2 and Figure 10-2 present the unconstrained demand forecasting results compared with 2009 observed demand. The forecasts show a 27 percent increase in park-and-ride demand between the observed 2009 demand and 2015, and an additional 6.8 percent growth to 2030. Demand for the largest lot in the corridor at the Vienna/Fairfax-GMU Metrorail station is expected to grow by approximately ten percent, or more than 1,500 vehicles. Overall, the highest forecast growth rate is forecast for the Limestone Drive lot, which is forecast to more than double by 2030.

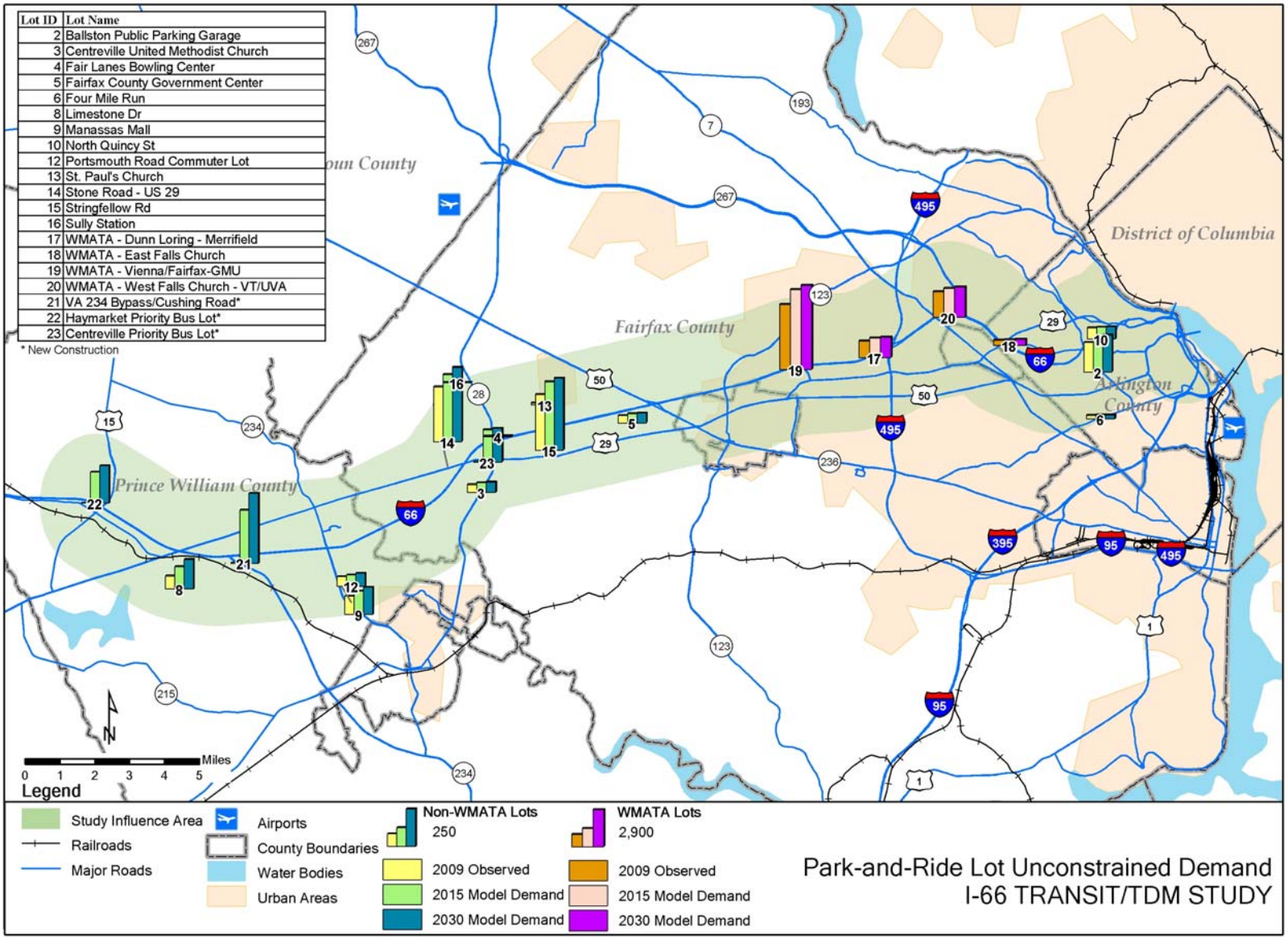
Table 10-2. Unconstrained Park-and-Ride Demand Forecasts

Lot	Name	2009 Observed Demand	2015 Model Demand	2030 Model Demand
2	Ballston Public Parking Garage	200	230	250
3	Centreville United Methodist Church	50	70	70
4	Fair Lanes Bowling Center	10	10	10
5	Fairfax County Government Center	50	60	70
6	Four Mile Run	20	30	30
8	Limestone Drive	90	150	200
9	Manassas Mall	120	150	180
10	North Quincy Street	78	80	80
12	Portsmouth Road Commuter Lot	60	80	90
13	St. Paul's Church	10	10	10
14	Stone Road – U.S. 29	370	450	500
15	Stringfellow Road	380	460	480
16	Sully Station	10	10	10
17	WMATA – Dunn Loring-Merrifield	1,326	1,540	1,610
18	WMATA – East Falls Church	422	460	480
19	WMATA – Vienna/Fairfax-GMU	5,169	6,330	6,690
20	WMATA – West Falls Church	2,009	2,290	2,390
21	VA 234 Bypass/Cushing Road	NA	350	470
22	Haymarket Priority Bus Lot	NA	210	250
23	Centreville Priority Bus Lot	NA	220	220
	TOTAL	**10,374**	**13,190**	**14,090**

Capacity and observed demand at WMATA lots is from May 2009 WMATA counts.

[1] Forecasts for the remaining testing alternatives were developed and found to remain fairly constant across alternatives, within one percent of the refined alternative values reported in Table 10-2.

Figure 10-2. Unconstrained Park-and-Ride Lot Demand Forecasts



It is recognized that at some park-and-ride locations physical and political obstacles may limit the possibility for expansion of the facility. This is especially true at the four WMATA facilities which are surrounded by land uses which may not permit easy expansion of existing parking capacity. The unconstrained forecasts detailed in Table 10-2 show a demand for more than 2,200 spaces across these four lots. Since this additional capacity was deemed unlikely to be provided in the short- to medium-term at these locations, constrained parking demand forecasts were developed that shift some of this demand to other lots in the study area.

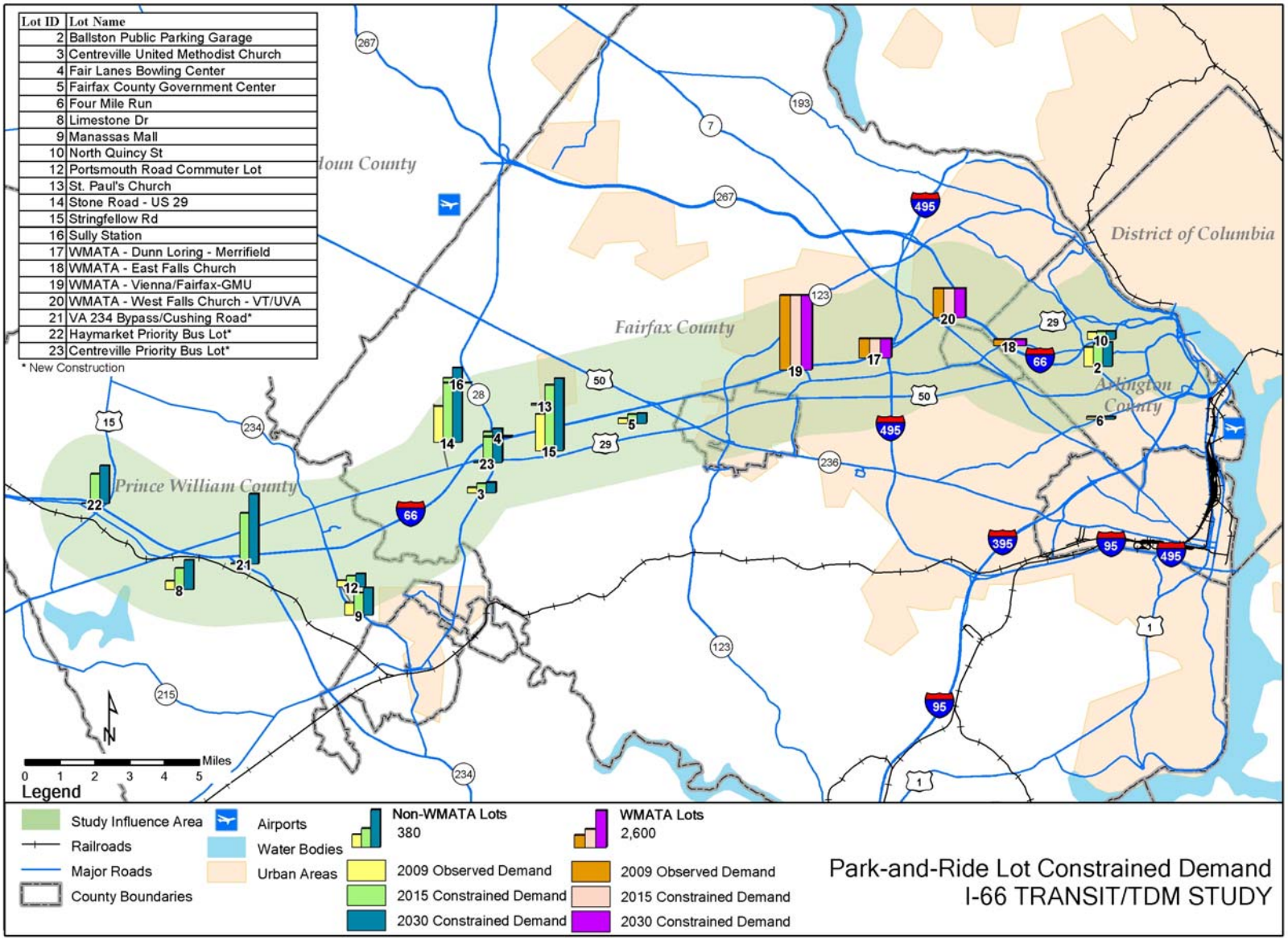
Under these constrained conditions, of the 2,200 space demand at the four WMATA lots, 60 percent or 1,350 spaces were assumed to shift to park-and-ride lots further west in the corridor. These spaces are divided among the 13 westernmost lots in proportion to their unconstrained forecasted 2030 demand. The remaining 40 percent are assumed to either shift away from transit or to shift to some other transit/access mode combination, including park-and-ride lots outside of our study corridor, Metrorail kiss-and-ride, or potentially VRE.

Table 10-3 and Figure 10-3 present the constrained demand forecast results when compared with 2009 observed demand. The forecasts show a 21 percent increase in park-and-ride demand between the observed 2009 demand and 2015, and an additional 5.3 percent growth to 2030. Overall, the constrained forecast represents six percent less park-and-ride demand in 2030 than the unconstrained forecasts. The constrained forecasts reallocate demand growth to the westernmost park-and-ride facilities in the corridor while maintaining the 2009 levels of demand at the four WMATA facilities. Under these assumptions, the largest increase in demand occurs at the VA 234 Bypass/Cushing Road and Stone Road – U.S. 29 park-and-ride lots.

Table 10-3. Constrained Park-and-Ride Demand Forecasts

Lot	Name	2009 Observed Demand	2015 Model Demand	2030 Model Demand
2	Ballston Public Parking Garage	200	230	250
3	Centreville United Methodist Church	50	100	110
4	Fair Lanes Bowling Center	10	10	10
5	Fairfax County Government Center	50	90	100
6	Four Mile Run	20	30	30
8	Limestone Drive	90	220	300
9	Manassas Mall	120	230	280
10	North Quincy Street	78	80	80
12	Portsmouth Road Commuter Lot	60	110	130
13	St. Paul's Church	10	20	20
14	Stone Road – U.S. 29	370	660	760
15	Stringfellow Road	380	670	740
16	Sully Station	10	10	0
17	WMATA – Dunn Loring-Merrifield	1,326	1,326	1,326
18	WMATA – East Falls Church	422	422	422
19	WMATA – Vienna/Fairfax-GMU	5,169	5,169	5,169
20	WMATA – West Falls Church	2,009	2,009	2,009
21	VA 234 Bypass/Cushing Road	NA	520	710
22	Haymarket Priority Bus Lot	NA	300	390
23	Centreville Priority Bus Lot	NA	310	350
	TOTAL	**10,374**	**12,516**	**13,186**

Figure 10-3. Constrained Park-and-Ride Lot Demand Forecasts



10.3 Park-and-Ride Findings

In determining the number of parking spaces required in the future, the constrained demand forecasts were used in order to account for some of the physical and political obstacles to park-and-lot expansion in the corridor. It was assumed that future capacity improvements should result in approximately 90 percent maximum utilization of each lot based on this constrained demand. Research shows the need to have some surplus at park-and-ride facilities to encourage use and provide some level of reliability. The analysis considered all lots and proposed increasing the number of spaces until there was a ten percent surplus at each lot.

In analyzing these findings for the expansion of park-and-ride lot capacity, the first priority in allocation of spaces was to provide parking for the proposed new facilities near Haymarket and Centreville. The second priority was to address areas with the largest difference between forecasted demand and current capacity.

Some adjustments were made in developing the recommendations to permit the acknowledgment of several factors. First, the forecasting model is known to embed a systematic under-prediction of transit and carpool usage in the western portion of the study corridor based on a review of Census Transportation Planning Package (CTPP) data as compared to the year 2000 validation model run. Second, some lots generate a unique synergy given their size and the level of transit service at the lot. Third, some lots at the western end of the corridor may also attract trips from outside the modeling region. The adjustments ultimately reflect knowledge of the historic travel patterns in the area and the locations in which premium transit service will be provided.

Given the travel behavior characteristics of HOV rideshare users, it was assumed that existing lots have some inherent inertia associated with the existing ridesharing and transit activities that occur there. Any newly constructed lot would lack this characteristic inertia. Therefore, wherever new lots are proposed, transit service is programmed in order to provide a backbone for any supplemental ridesharing activities. Table 10-4 provides a summary of the park-and-ride findings. Based on the constrained demand, the existing park-and-ride facilities would require an additional 2,800 spaces by 2030. This excess demand will need to be met at seven lots, including three new facilities.

Three sites for new park-and-ride lots in the western section of the study corridor that would be served by the proposed Priority Bus transit service in the corridor were analyzed as part of this study. The results indicate that 800 spaces will be needed by 2030 near at the VA 234 Bypass/Cushing Road facility; a smaller lot at this location is already in the planning phases in Prince William County. At the Haymarket Priority Bus station near U.S. 15, a 450-space park-and-ride lot is indicated. At the Centreville Priority Bus station near VA 28, a 400-space park-and-ride lots is indicated. Detailed site recommendations for each of these lots can be found in Section 11 of this report.

The analysis results also indicate that major expansions are also justified at other lots in Fairfax and Prince William Counties including expansion of the facility at Stringfellow Road by 400 spaces, expansion of Stone Road – U.S. 29 by 500 spaces, expansion of the Limestone Drive lot by 150 spaces, and expansion of the leased lot at Manassas Mall by 100 spaces.

Table 10-4. Park-and-Ride Analysis Findings

Lot	Name	2009 Capacity	Additional Spaces Needed by 2030
2	Ballston Public Parking Garage	804	
3	Centreville United Methodist Church	147	
4	Fair Lanes Bowling Center	32	
5	Fairfax County Government Center	170	
6	Four Mile Run	23	
8	Limestone Drive	211	150
9	Manassas Mall	217	100
10	North Quincy Street	78	
12	Portsmouth Road Commuter Lot	630	
13	St. Paul's Church	112	
14	Stone Road – U.S. 29	372	500
15	Stringfellow Road	381	400
16	Sully Station	41	
17	WMATA – Dunn Loring-Merrifield	1,326	
18	WMATA – East Falls Church	422	
19	WMATA – Vienna/Fairfax-GMU	5,169	
20	WMATA – West Falls Church	2,009	
21	VA 234 Bypass/Cushing Road[a]	0	800
22	Haymarket Priority Bus Lot[a]	0	450
23	Centreville Priority Bus Lot[a]	0	400

[a] New construction.

10.4 Additional Analysis Needed

The park-and-ride analysis presented in this section represents a planning findings rather than the actual programming of spaces and lots. Further study is needed to detail certain elements of the park-and-ride plan, including:

- Details on the specific locations and available land resources; and
- Preliminary engineering work to provide implementation cost estimates and to identify environmental impact or other concerns.

11.0 Station Sketch Planning

The development of alternative service concepts for the study led to the identification of potential station locations for Priority Bus service. Each potential station location required review on a sketch-planning basis to identify the basic footprint, type of stop/station, potential fatal flaws, general land requirements, and access opportunities. This section presents the planning assumptions, criteria used, station locations, and the product of the review.

The station sketch planning efforts included examinations of the existing comprehensive plans of Arlington, Fairfax and Prince William Counties as well as coordination with WMATA, PRTC, and VRE regarding planned transit improvements in the corridor. In cases where there exists specificity about planned improvements, this information is reflected on the enclosed station sketch plan maps. Where there is less certainty about planned improvements, these improvements are mentioned in the text but not on the maps. The intent is to acknowledge relevant planning work and need for continued coordination in the development of recommendations for the further transit improvements in the I-66 corridor.

While no detail assessments were done in terms of defining pedestrian and bicycle access at this level of analysis, the importance of facilitating bicycle and pedestrian access at each station is recognized. The current station sketch planning efforts assume that bicycle and pedestrian accommodations and access will be designed into the station plans at each location. Bicycle and pedestrian access and accommodations should provide safe, convenient access to the station from surrounding areas and fully comply with the Americans with Disabilities Act requirements. Bicycle and pedestrian access plans also should include clearly define wayfinding and well marked and signalized pedestrian crossings.

11.1 Transit/Priority Bus Running Assumptions

To facilitate the development of the station sketch planning, the following assumptions were developed in consultation with the TAC:

- Only Priority Bus runningways inside the I-66 corridor would be considered;
- The possibility for using commuter bus service vehicles with right door access needs to be preserved;
- Priority Bus station concepts further assume the following:
    - Service will use HOV lanes;
    - Service will use on/off ramps, which may require weaving through general purpose lanes to access;
    - Westbound exit/entrance median ramps for Priority Bus/HOV lanes will be considered in the 2015 timeframe only where such ramps already exist for eastbound traffic (e.g., Stringfellow Road, Monument Drive);
    - Indirect access to Priority Bus stations collocated with park-and-ride lots will be provided;
    - Accommodations for transfers from local buses to Priority Bus vehicles at Priority Bus stations will be provided;

- All 2030 Priority Bus Concepts:
    - Service will use HOV lanes; and
    - Direct access will be provided to stations between Fairfax Corner and Haymarket.

11.2 Fatal Flaw Analysis Criteria

A fatal flaw analysis was performed for each potential station location to analyze the feasibility of each station sketch plan. Several criteria were used in this analysis. The results can be found in the "feasibility" column of Tables 11-3 through 11-12. Each criterion provided a qualitative level of impact scale (i.e., minor, moderate, major) and of costs (i.e., low, medium, high). The evaluation factors include:

- Roadways;
- Construction and maintenance of traffic (MOT) costs;
- Right-of-Way (ROW), and
- Other.

11.3 Station Review

This section presents a station-by-station treatment of the issues and opportunities at each potential station location and concept sketches for the applicable horizon years. The following potential station locations in the I-66 corridor were identified for some level of station sketch planning in this study due to their potential use as stops for proposed Priority Bus service:

- Haymarket at U.S. 15 (Prince William County);
- Gainesville at U.S. 29 (Prince William County);
- VA 234 Bypass at Cushing Road (Prince William County);
- Bull Run at VA 234/Sudley Road (Prince William County);
- Centreville at U.S. 29/Lee Highway (Fairfax County);
- Stringfellow Road (Fairfax County);
- Fairfax Corner at Monument Drive (Fairfax County);
- Vienna/Fairfax-GMU Metrorail station (Fairfax County);
- East Falls Church at Metrorail station (Arlington County); and
- Ballston at Metrorail station (Arlington County).

Figures 11-1 through Figure 11-19 present station sketches for each of the stations for the applicable horizon year(s). Station access is a major concern in this analysis, as improved access for transit vehicles can improve the performance of a transit service significantly. As indicated in Table 11-1, three stations have potential for direct access to and from I-66 to be addressed in the short- to medium-term, possibly by 2015. Additional stations could provide direct access by 2030.

Table 11-1. Stations With Potential for Direct I-66 Access

Station	2015 Direct Access	2030 Direct Access
Haymarket		
Gainesville		●
VA 234 Bypass/Cushing Rd		●
Bull Run		●
Centreville		●
Stringfellow Rd	●	●
Fairfax Corner/Monument Dr	●	●
Vienna/Fairfax-GMU	●	●
East Falls Church		
Ballston		

Another major issue in the station sketch planning is park-and-ride capacity. Each of the proposed station sites was analyzed to determine how many parking spaces could be built there. Table 11-2 shows a planning estimate as to the maximum number of spaces that could theoretically be built on the identified sites[1]; these are not recommended lot sizes, only maximums. Recommendations for the size of park-and-ride lots throughout the corridor can be found in Section 12.

Table 11-2. Maximum Park-and-Ride Lot Capacity by Station

Station	Spaces
Haymarket	2,235
Gainesville	2,150
VA 234 Bypass/Cushing Road	850
Bull Run	1,450
Centreville	1,450
Stringfellow Rd	1,200
Fairfax Corner/Monument Dr	100
Vienna/Fairfax-GMU	NA
East Falls Church	NA
Ballston	NA

[1] Assumes 50 spaces per acre in a surface lot including priority parking, vehicular circulation, landscaping, and storm water treatment.

Table 11-3. Haymarket Station at U.S. 15 Prince William County

Option	Option Feasibility Evaluation Factors and Results		
	Description	**Feasibility Evaluation**	**Result (FEASIBLE or NOT FEASIBLE)**
2015	Prince William County 2008 Comprehensive Plan reflects a park-and-ride lot near the I-66 and U.S. 15 interchange. VRE is considering a station in the vicinity. A park-and-ride lot is proposed by others near U.S. 15 and Graduation Drive. The sites proposed in this table are consistent with the Town of Haymarket land use plan.		
Option 1	Use existing ramps for Priority Bus access to HOV lanes on I-66 east of U.S. 15. Provide indirect access to Priority Bus Station and park-and-ride lot via U.S. 15 south to John Marshall Highway west; park-and-ride lot bounded by I-66 to the north and John Marshall Highway to the south. Access to site is also available via Antioch Road from north and south of I-66. Provide transit priority treatments on U.S. 15 and John Marshall Highway.	• Roadways – ***Minor*** addition of transit priority treatments on U.S. 15 and John Marshall highway from ramps to park-and-ride lot. • Construction Cost Range – ***Low.*** • ROW Requirements – ***Minor/ Moderate*** for park-and-ride lot. • Other – Out of direction travel: ***Minor***.	**FEASIBLE** Construction and MOT are minor. ROW also minor for park-and-ride lot. Out of direction travel not a significant factor for end-of-line station.
Option 2	Use existing ramps for Priority Bus access to HOV lanes on I-66 east of U.S. 15. Provide indirect access to Priority Bus Station and park-and-ride lot via U.S. 15 north to Heathcote Blvd. Access to site is also available via Antioch Road from north and south of I-66. Provide transit priority treatments on roadways between park-and-ride lot and I-66.	• Roadways – ***Minor*** addition of transit priority treatments on U.S. 15 and Heathcote Blvd. from ramps to park-and-ride lot. • Construction Cost Range – ***Low***. • ROW Requirements – ***Minor/Moderate*** for park-and-ride lot. • Other – Out of direction travel: ***Minor***.	**FEASIBLE** Construction and MOT are minor. ROW also minor for park-and-ride lot. Out of direction travel not a significant factor for end-of-line station.
2030			
	Same as 2015	Same as 2015	Same as 2015

Figure 11-1. Haymarket Station Map 2015 and 2030 – Option 1

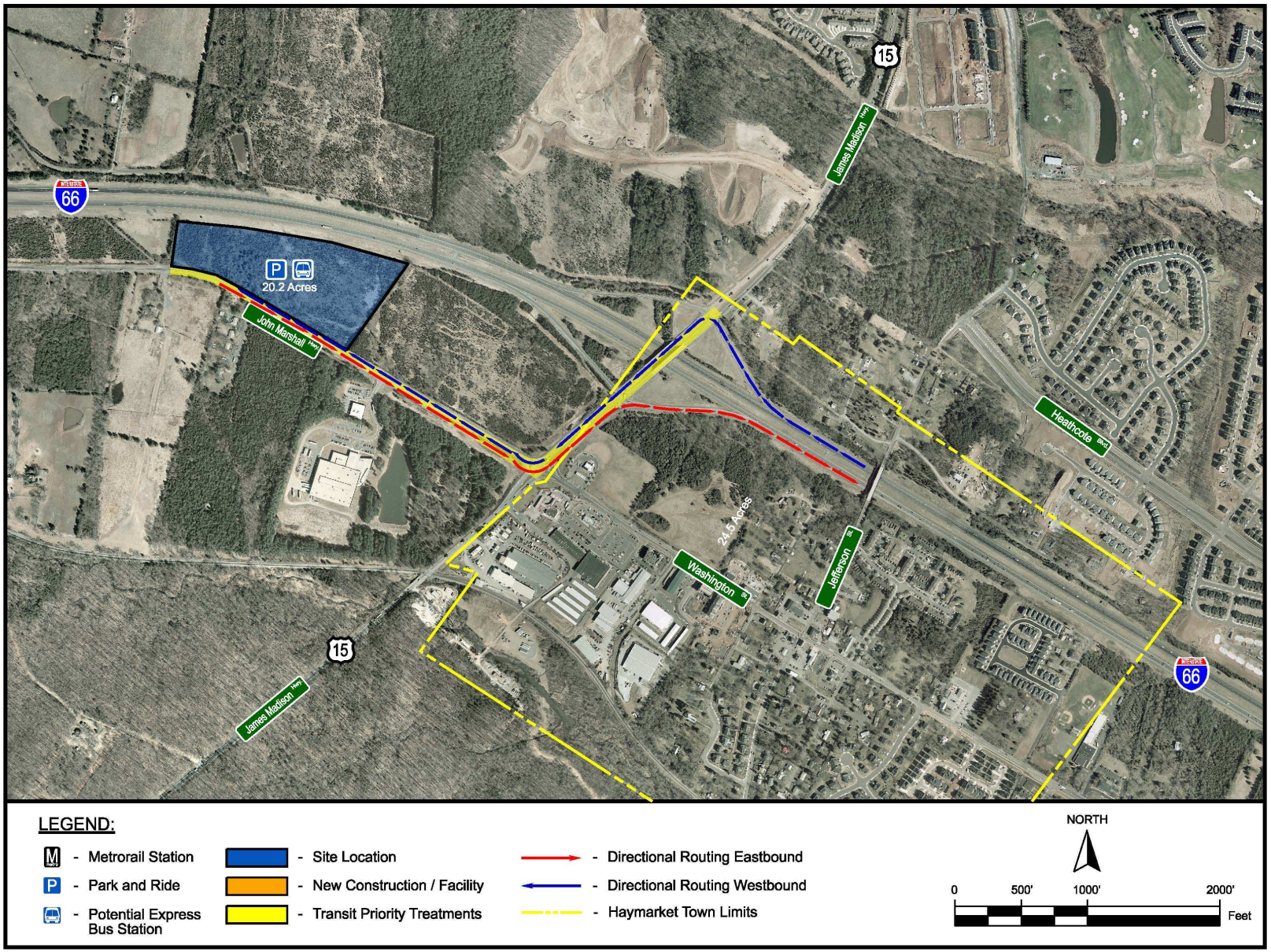


Figure 11-2. Haymarket Station Map 2015 and 2030 – Option 2

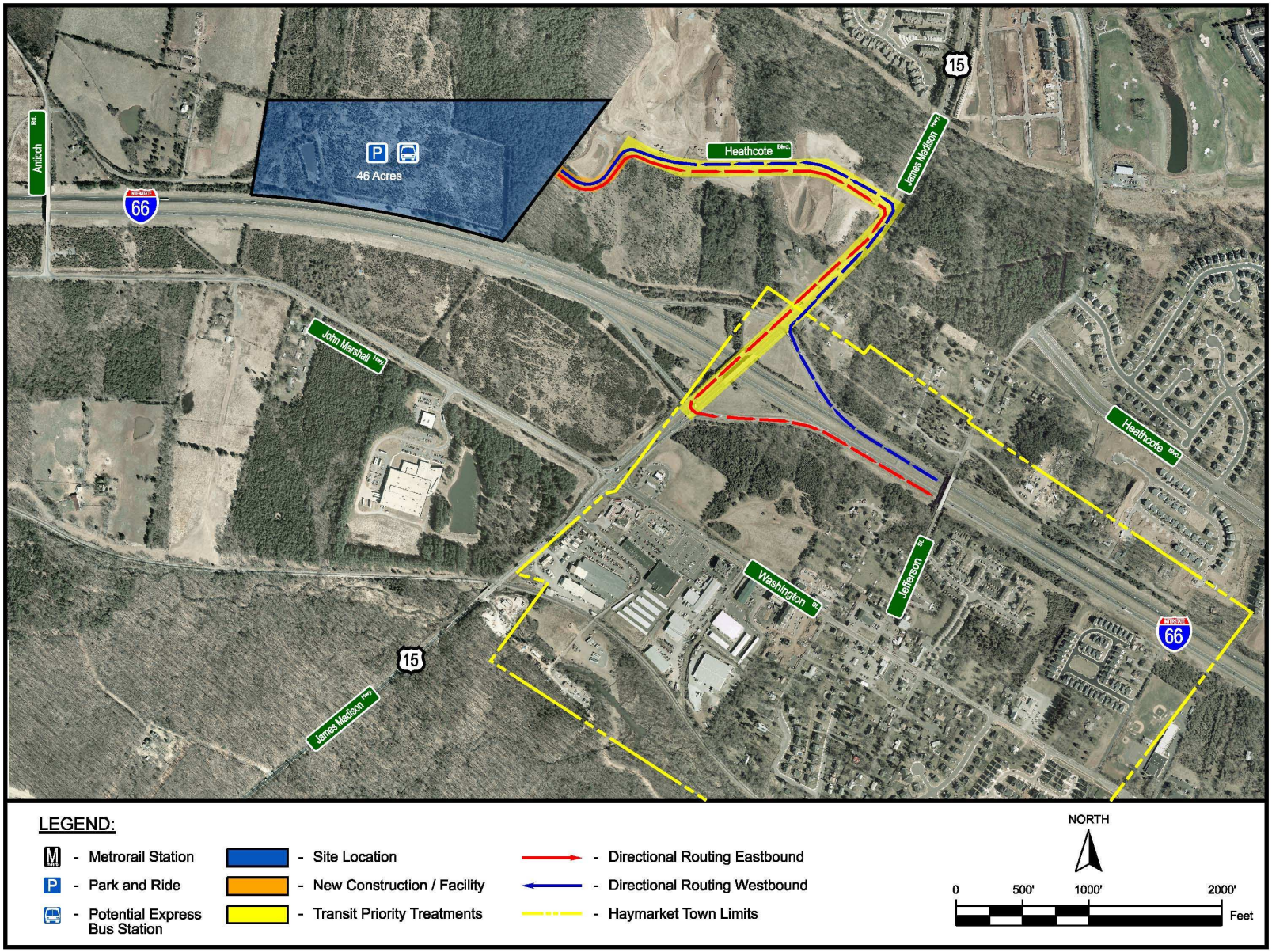


Table 11-4. Gainesville Station at U.S. 29 Prince William County

Option	Option Feasibility Evaluation Factors and Results		
	Description	**Feasibility Evaluation**	**Result (FEASIBLE or NOT FEASIBLE)**
2015	VRE is considering locations for a station in the vicinity of Gainesville.		
Option 1	Use existing ramps for Priority Bus access to existing lanes on I-66 east and west of U.S. 29. Provide indirect access to Priority Bus station and park-and-ride lot at Linton Hall Road and U.S. 29 per VDOT and 2008 Prince William County Comprehensive Plan 2008. Provide transit priority treatments on ramps and local roads.	• Roadways – ***Minor*** addition of entrances and transit priority treatments on U.S. 29 north of I-66. • Construction Cost Range – ***Low/ Medium***. • ROW Requirements – ***Moderate*** for park-and-ride lot on ***occupied*** land. • Other – ***Major*** travel time delay for indirect access.	**FEASIBLE** Construction and MOT are minor for transit priority treatments. ROW also moderate for lots on occupied land. Out of direction travel for buses is significant.
Option 2	Use existing ramps for Priority Bus access to existing lanes on I-66 east and west of U.S. 29. Provide indirect access to Priority Bus station and park-and-ride lot located north of I-66 and south of U.S. 29 at University Boulevard. Provide transit priority treatments on ramps and local roads.	• Roadways – ***Minor*** addition of entrances and transit priority treatments on U.S. 29 south of I-66. • Construction Cost Range – ***Low/ Medium.*** • ROW Requirements – ***Minor*** for park-and-ride lot on ***vacant*** land. • Other – ***Major*** travel time delay for indirect access significant.	**FEASIBLE** Construction and MOT are minor for transit priority treatments. ROW also minor for lots on vacant land. Out of direction travel for buses is significant.
2030			
	Add HOV/bus only ramps to/from I-66 east and west at University Boulevard to provide direct access to Priority Bus station and park-and-ride lot on north side of I-66 for priority bus access to HOV/Priority Bus lanes.	• Roadways – ***Moderate/Major*** for construction of new ramps. • Construction Cost Range – ***Medium/ High.*** • ROW Requirements – ***Minor*** for new ramps.	**FEASIBLE** Construction and MOT are moderate for ramps. ROW minor for lots on vacant land.

Figure 11-3. Gainesville Station Map 2015 – Option 1

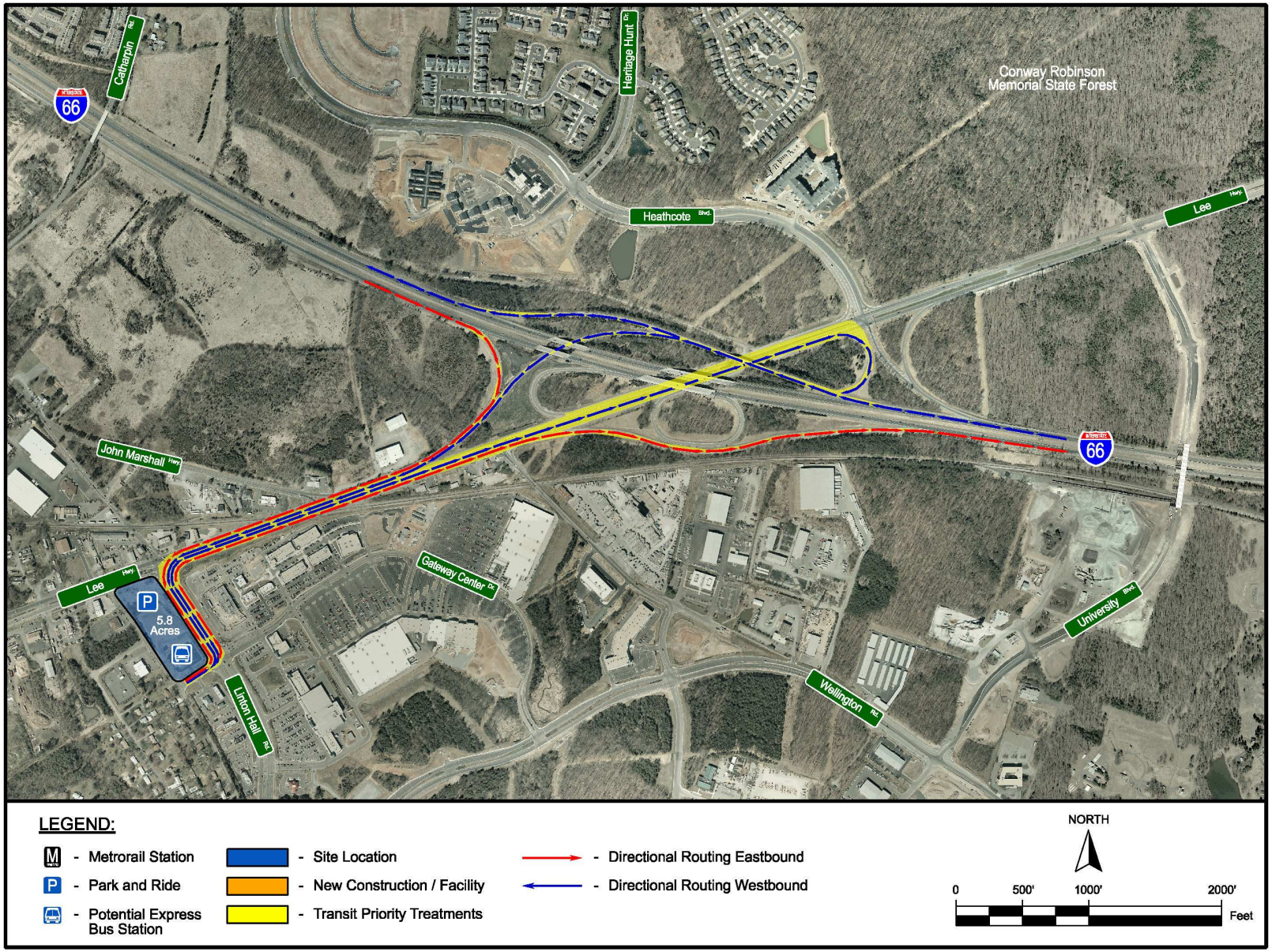


Figure 11-4. Gainesville Station Map 2015 – Option 2

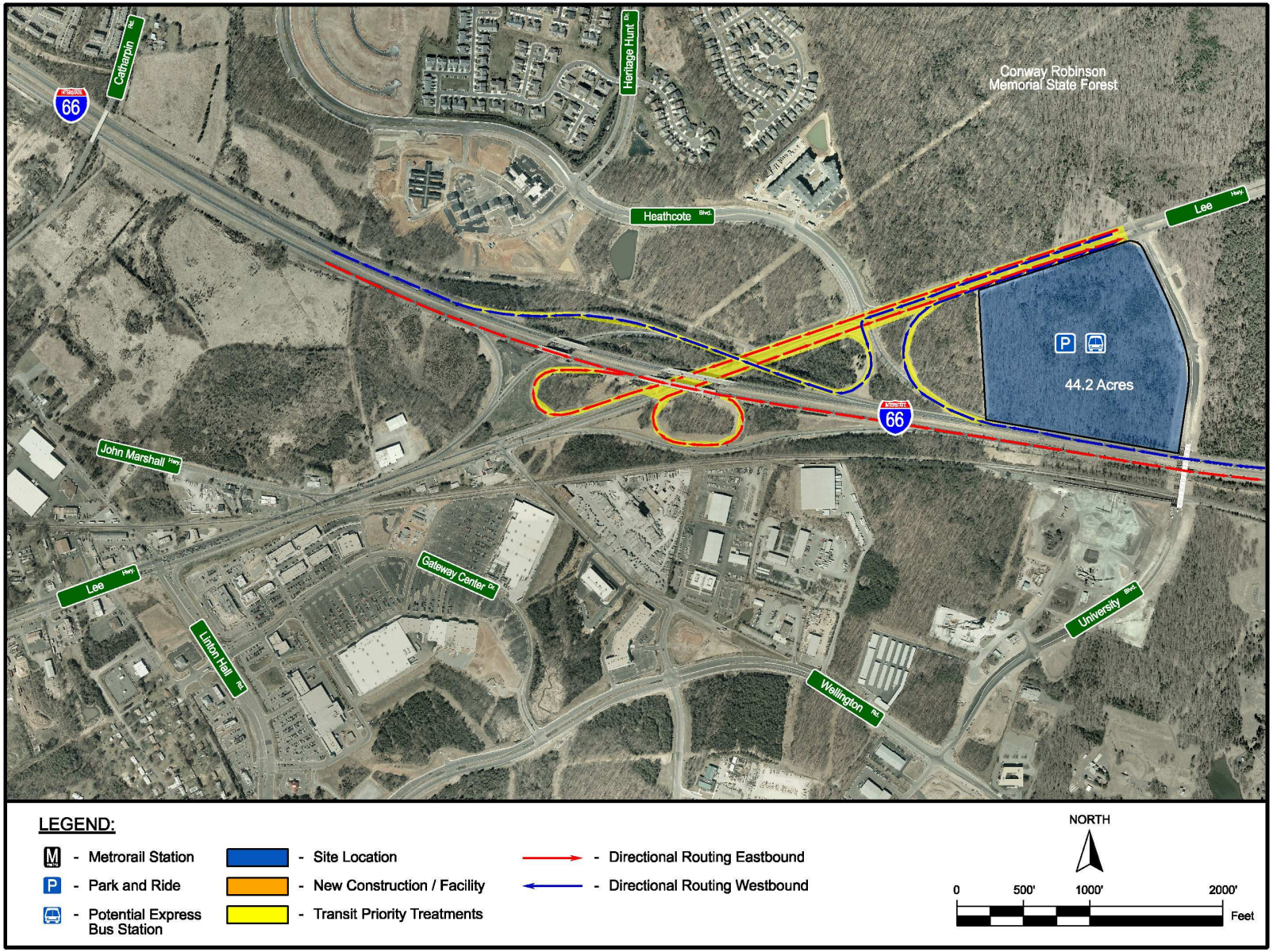


Figure 11-5. Gainesville Station Map 2030

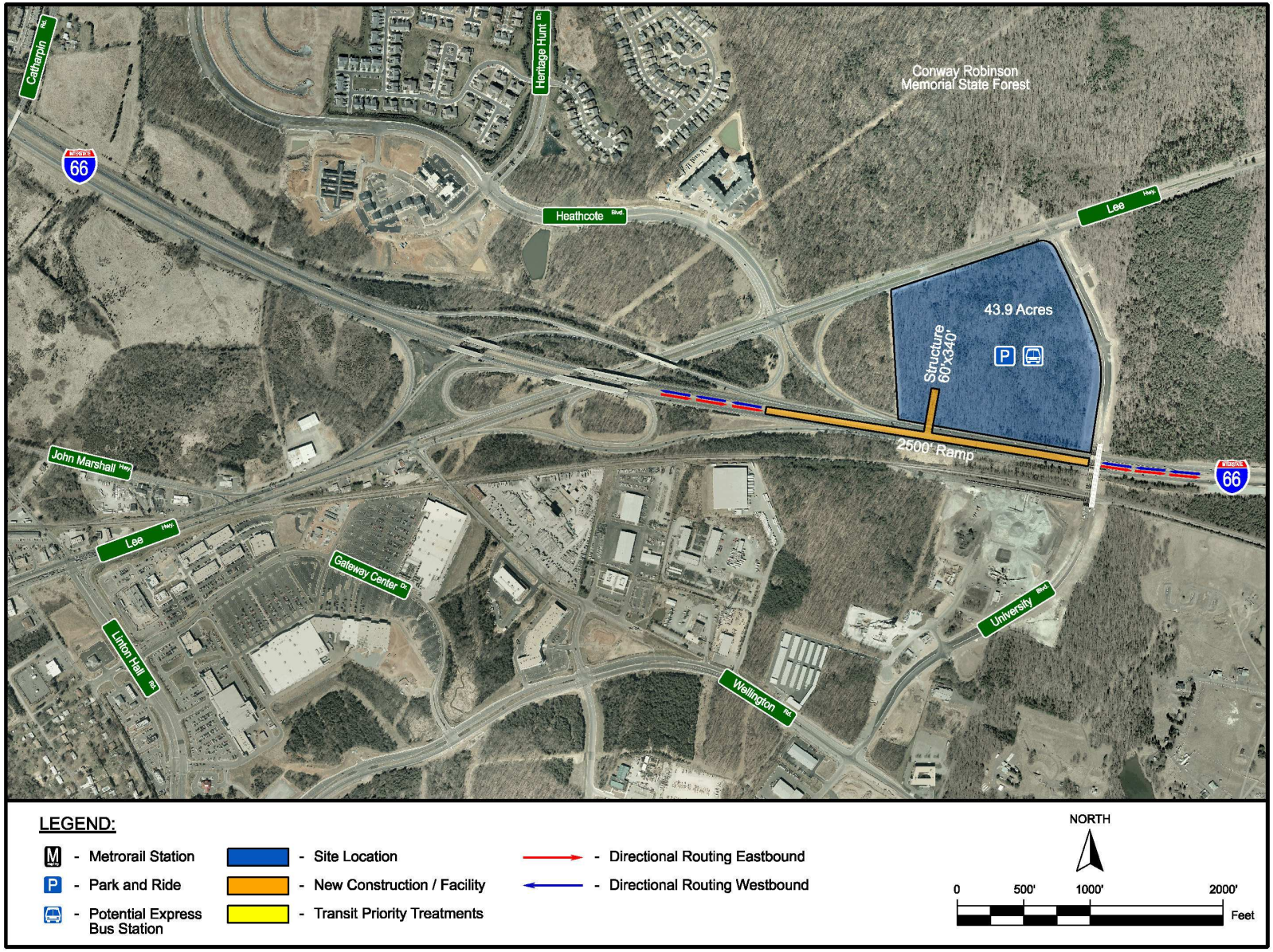


Table 11-5. VA 234 Bypass Station at Cushing Road Prince William County

Option	Option Feasibility Evaluation Factors and Results		
	Description	**Feasibility Evaluation**	**Result (FEASIBLE or NOT FEASIBLE)**
2015			
	Use existing ramps for Priority Bus access to existing HOV lanes on I-66 east and west of VA 234 Bypass. Provide indirect access to Priority Bus station and park-and-ride lot at Cushing Road including transit priority treatments on ramps and local roadways. Park-and-ride lot to be built by others. Phase 1 development on this site will include 450 parking spaces.	• Roadways – ***Minor*** addition of entrances and transit priority treatments. • Construction Cost Range – ***Low.*** • ROW Requirements – ***Minor*** for use proposed park-and-ride lot. • Other – ***Major*** travel time delay for indirect access.	**FEASIBLE** Construction and MOT are minor for transit priority treatments. ROW also minor. Out of direction travel for buses is significant.
2030			
	Add direct HOV/bus only ramps via bridge to/from I-66 HOV lanes east and west from VA 234 Bypass to additional lot adjacent to south side of I-66 and the Cushing Road lot. Provide direct access to station and expanded park-and-ride lot. 2008 Prince William County Comprehensive Plan, via amendment, references a potential future extension of Metrorail from Vienna with a stop in the vicinity of I-66 and Sudley Road. Phase 2 development on this site will include 140 parking spaces plus hotel and other uses.	• Roadways – ***Moderate*** improvements to HOV access to provide direct access to station from I-66 eastbound and westbound. • Cost Range – ***Medium.*** • ROW requirements – ***Minor*** for park-and-ride lot on ***vacant*** land and for I-66 median ramp and bridge.	**FEASIBLE** Construction and MOT are moderate for ramps. ROW minor for lots on vacant land.

Figure 11-6. VA 234 Bypass Station Map 2015

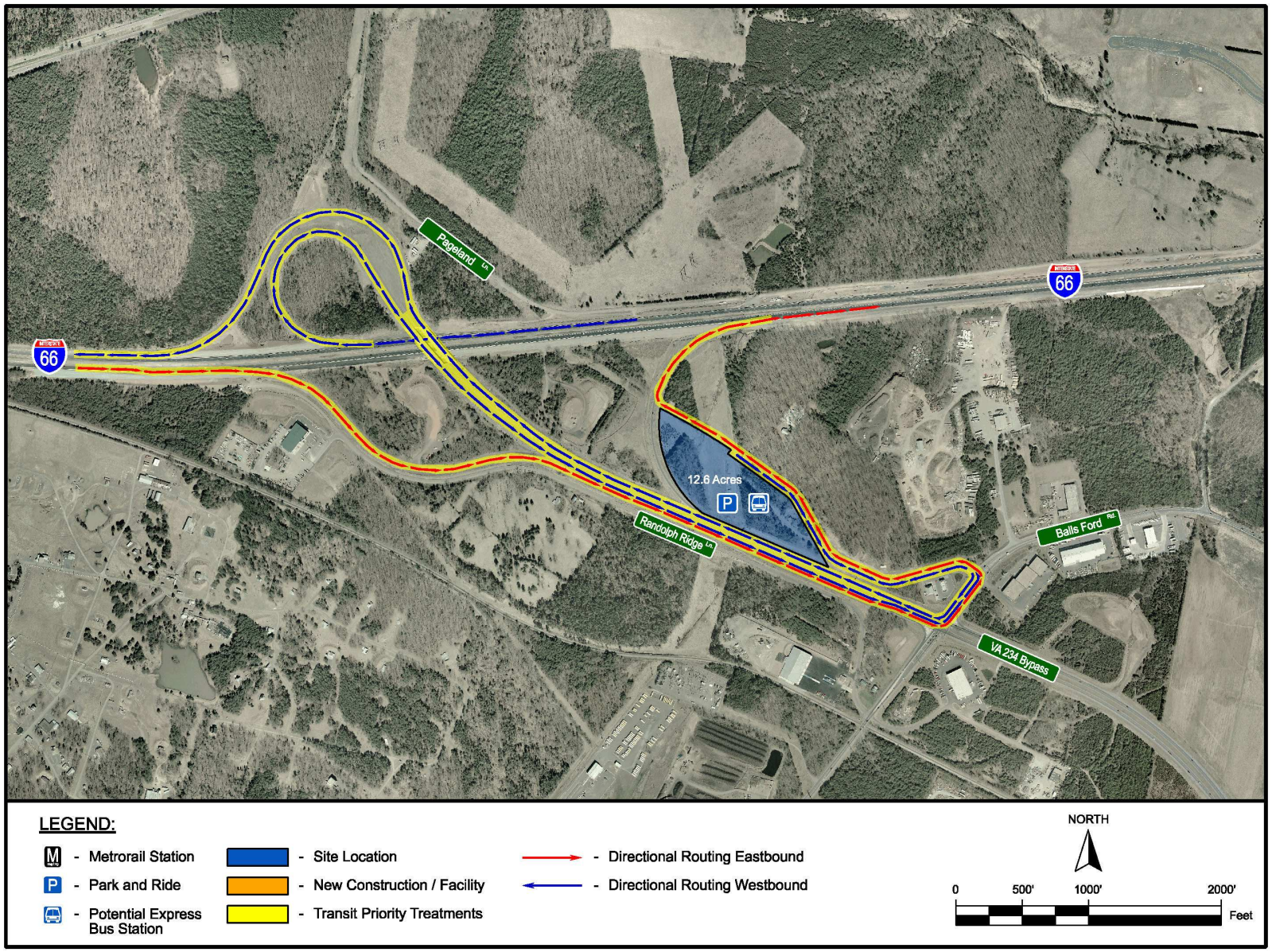


Figure 11-7. VA 234 Bypass Station Map 2030

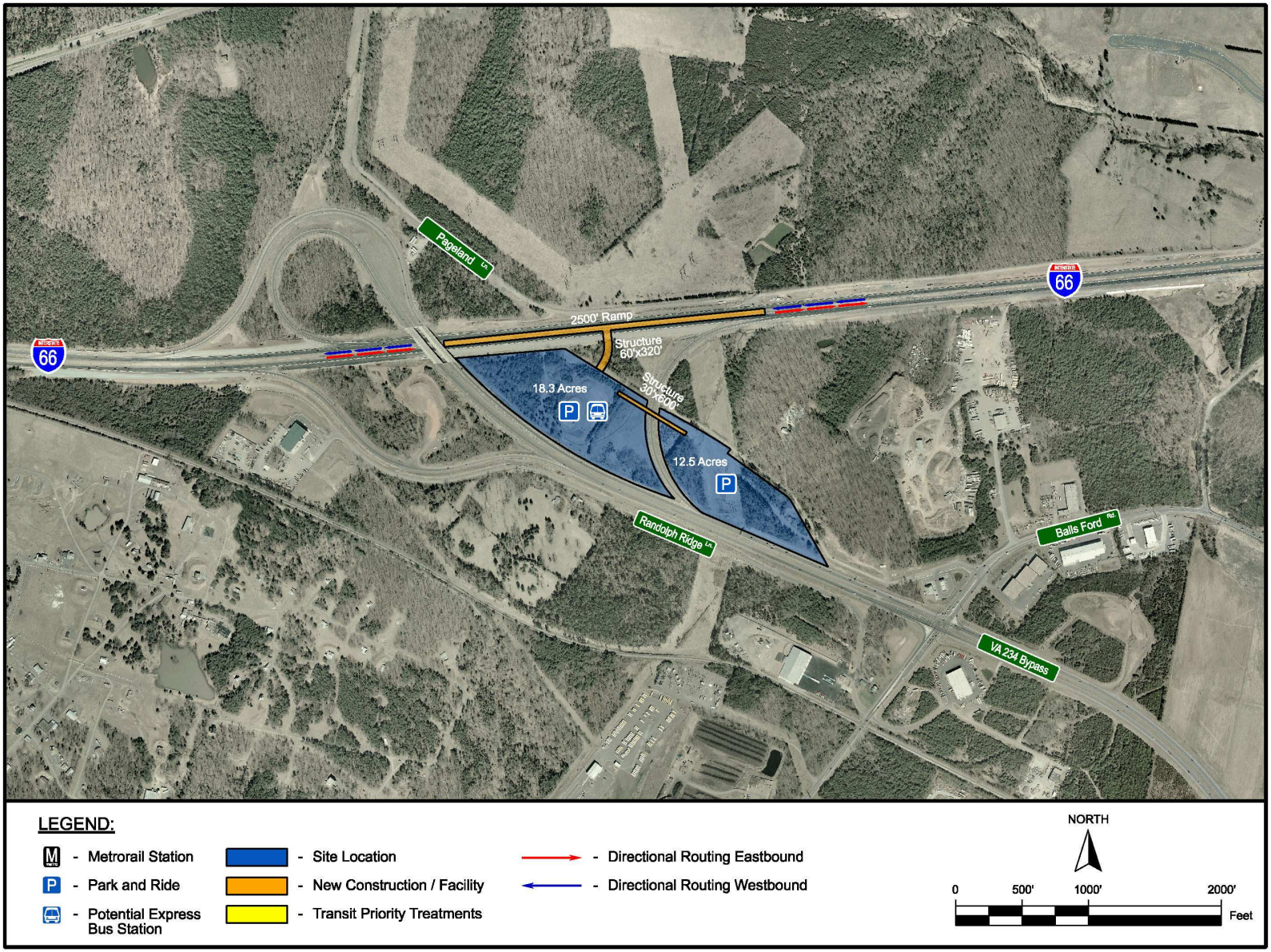


Table 11-6. Bull Run Station at VA 234/Sudley Road Prince William County

Option	Option Feasibility Evaluation Factors and Results		
	Description	**Feasibility Evaluation**	**Result (FEASIBLE or NOT FEASIBLE)**
2015			
	Use existing ramps for Priority Bus access to existing HOV lanes on I-66, east and west of VA 234/Sudley Road. Provide indirect access to Priority Bus station and park-and-ride lots along Balls Ford Road including transit priority treatments on ramps and local roadways.	• Roadways – ***Minor*** addition of entrances and transit priority treatments. • Construction Cost Range – ***Low.*** • ROW Requirements – ***Minor*** for park-and-ride lot on ***vacant*** land. • Other – ***Moderate*** travel time delay for indirect access.	**FEASIBLE** Construction and MOT are minor for transit priority treatments. ROW also minor. Out of direction travel for buses is significant.
2030			
	Add direct HOV/bus only ramps via bridge to/from eastbound and westbound I-66 HOV lanes to provide direct access to station and park-and-ride lot located between I-66 and Balls Ford Road. 2008 Prince William County Comprehensive Plan, via amendment, references a potential future extension of Metrorail from Vienna with a stop in the vicinity of I-66 and Sudley Road.	• Roadways –***Moderate*** improve HOV direct access to/from I-66 eastbound and westbound. • Construction Cost Range – ***Medium.*** • ROW requirements – ***Minor*** for median ramps/bridge on I-66.	**FEASIBLE** Construction and MOT are moderate for ramps. ROW minor for lots on vacant land.

Figure 11-8. Bull Run Station Map 2015

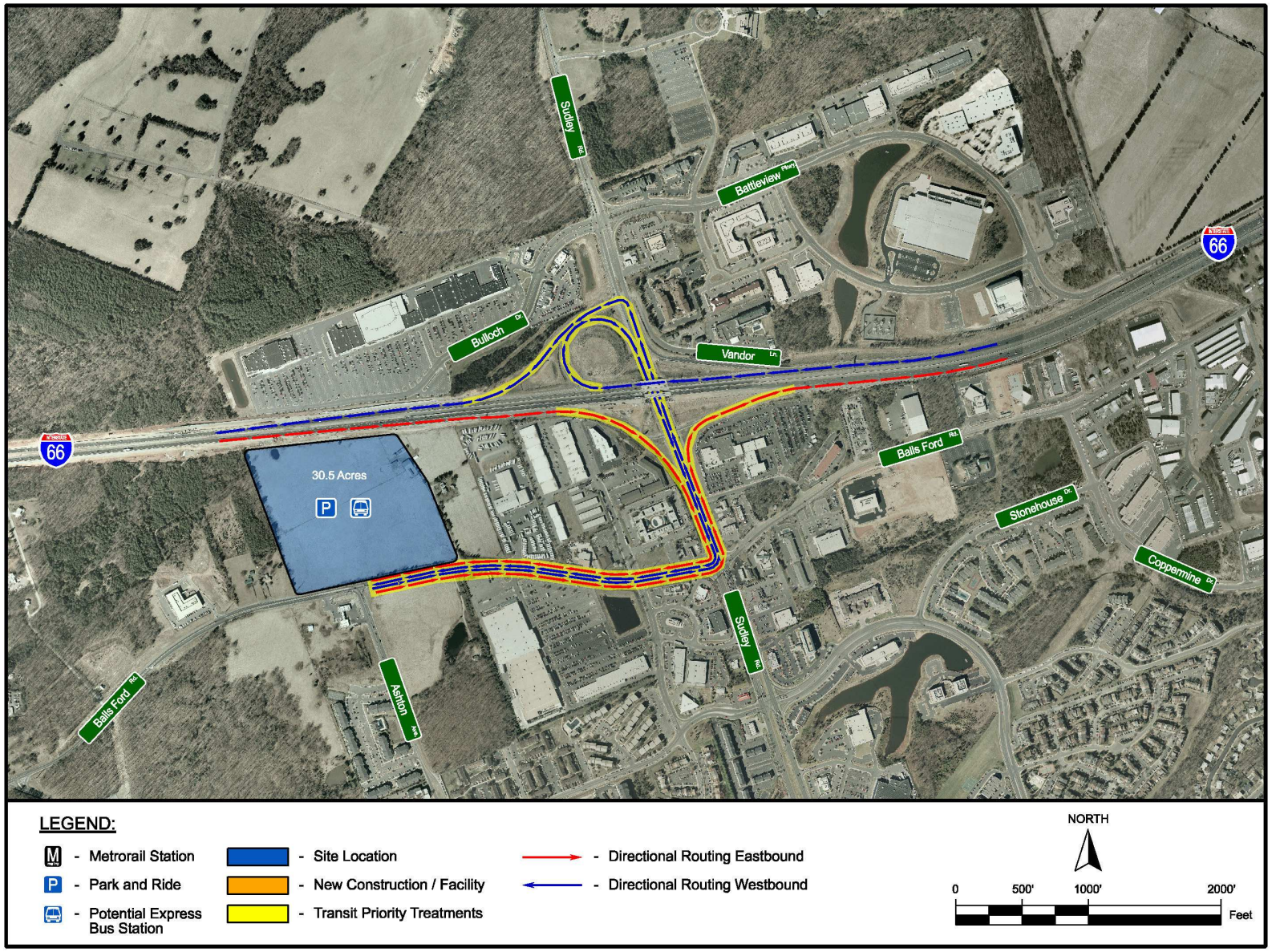


Figure 11-9. Bull Run Station Map 2030

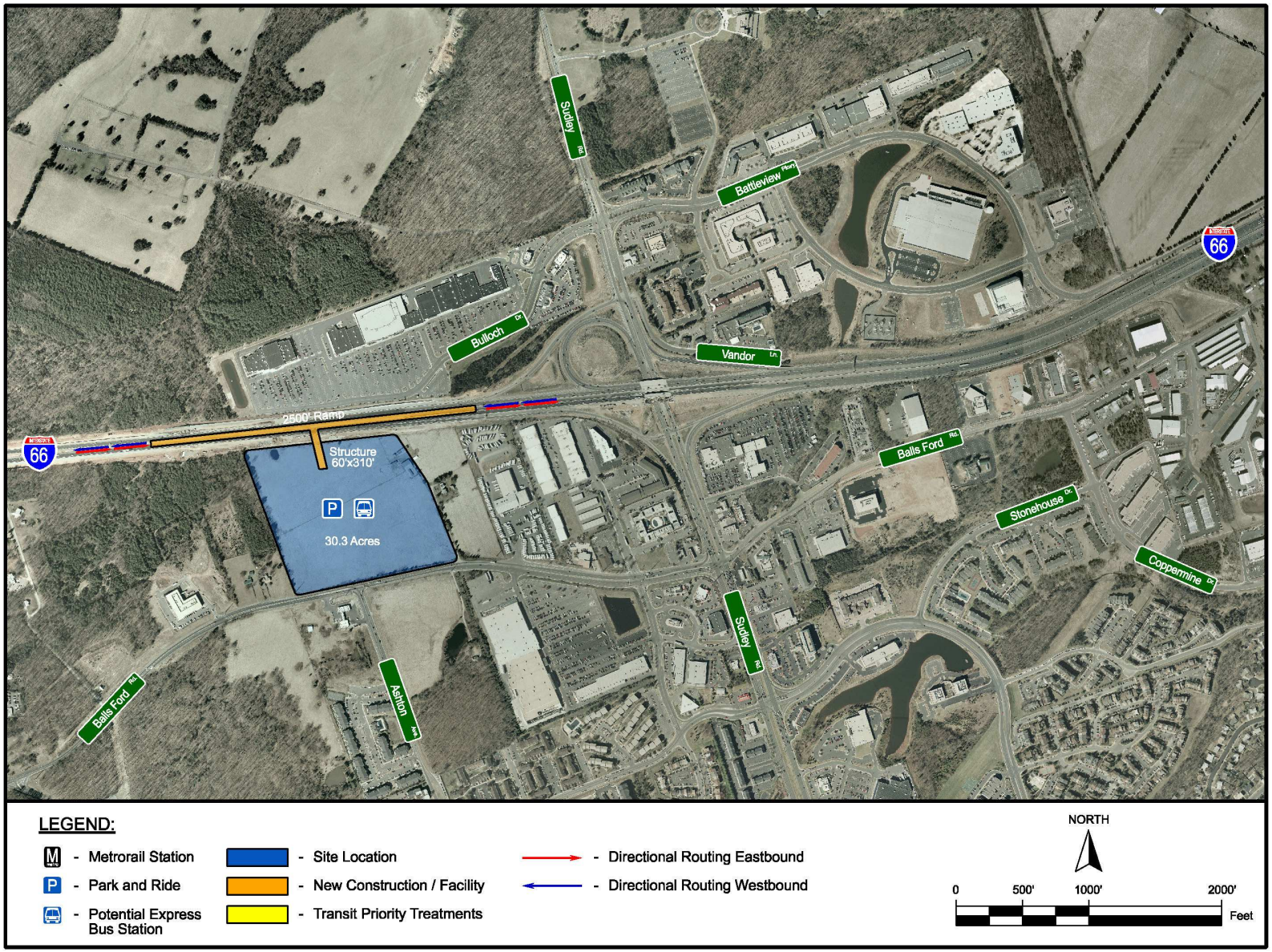


Table 11-7. Centreville Station at U.S. 29/Lee Highway Fairfax County

Option	Option Feasibility Evaluation Factors and Results		
	Description	**Feasibility Evaluation**	**Result (FEASIBLE or NOT FEASIBLE)**
2015	Fairfax County has identified a potential location for an alternative transit/park-and-ride improvement in the vicinity of Trinity Center.		
	Use existing ramps for Priority Bus access to existing HOV lanes on I-66 east and west of U.S. 29/Lee Highway to provide indirect access to Priority Bus Station and park-and-ride lot, including transit priority treatments on ramps and local roadways. The proposed extension of Braddock Road/Stone Road is referenced as future construction by others.	• Roadways – ***Minor*** addition of entrances and transit priority treatments on local roads. • Construction Cost Range – ***Low.*** • ROW Requirements – ***Moderate*** for park-and-ride lot on ***occupied*** land. • Other – Wetlands on nearly 50% of available land. Cost increase ***Moderate*** if impacted. Loss of available land for station and parking significant. • Other – ***Moderate*** travel time delay for significant indirect access.	**FEASIBLE** Construction and MOT are minor for transit priority treatments. ROW also moderate. Out of direction travel for buses is significant.
2030			
	Provide direct access to station and park-and-ride lot north of I-66, including transit priority treatments on ramps and local roadways. Improvements include new direct HOV ramps to/from the I-66 eastbound and westbound HOV/bus only lanes to the overpass at the proposed extension of Braddock Road/ Stone Road (construction by others). Fairfax County Comprehensive Plan refers to a Metrorail station at the referenced parcel between U.S. 29/Lee Highway and I-66.	• Roadways – ***Moderate*** add HOV access ramps via bridge on I-66. • Cost Range – ***Medium.*** • ROW requirements – ***Moderate*** for ***occupied*** land. • Other – Wetlands on nearly 50% of available land. Cost increase ***Moderate*** if impacted. Loss of available land for station and parking significant.	**FEASIBLE** Construction and MOT are moderate for ramps. Cost range medium. ROW moderate for lots on occupied land.

Figure 11-10. Centreville Station Map 2015

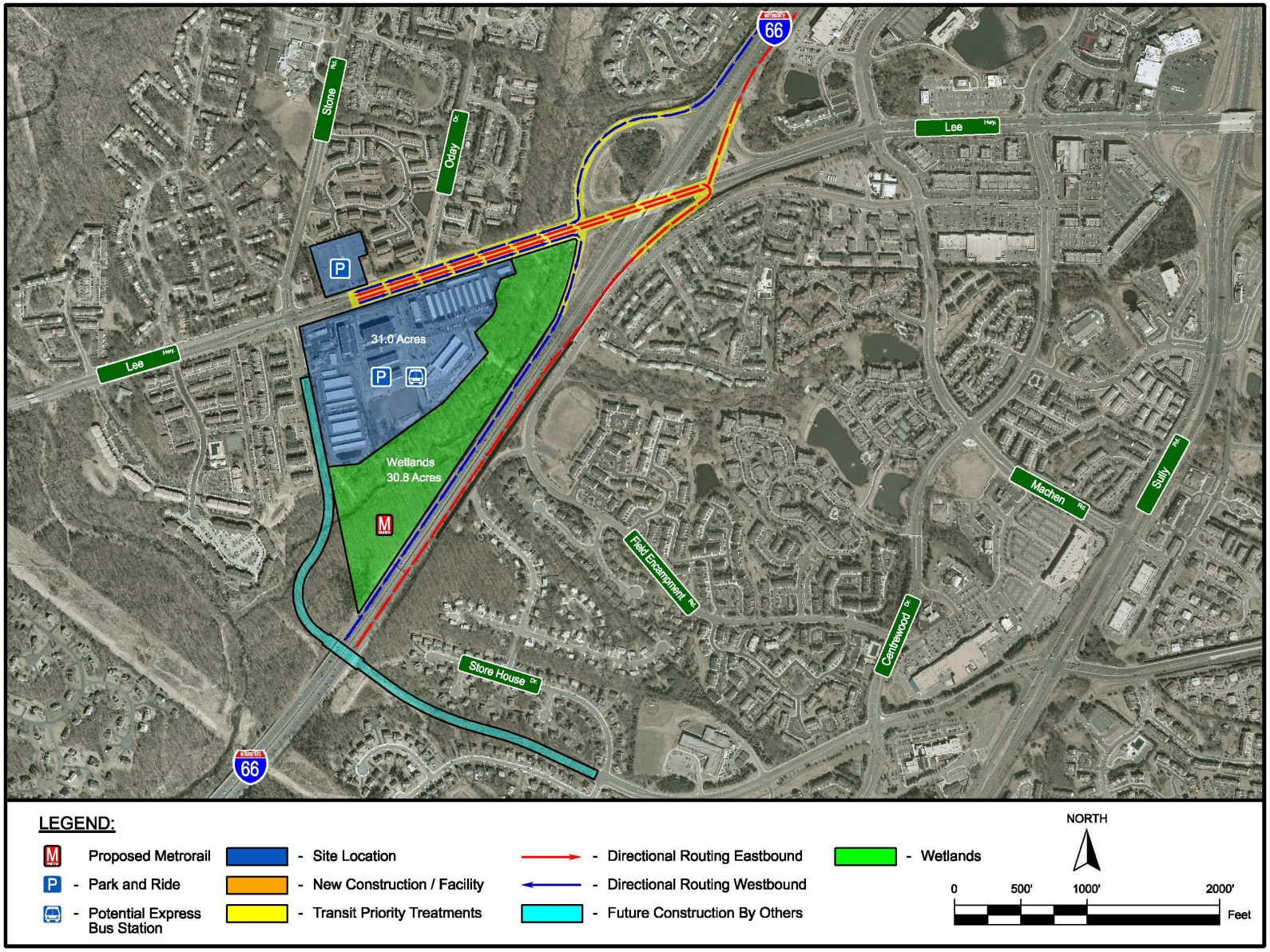


Figure 11-11. Centreville Station Map 2030

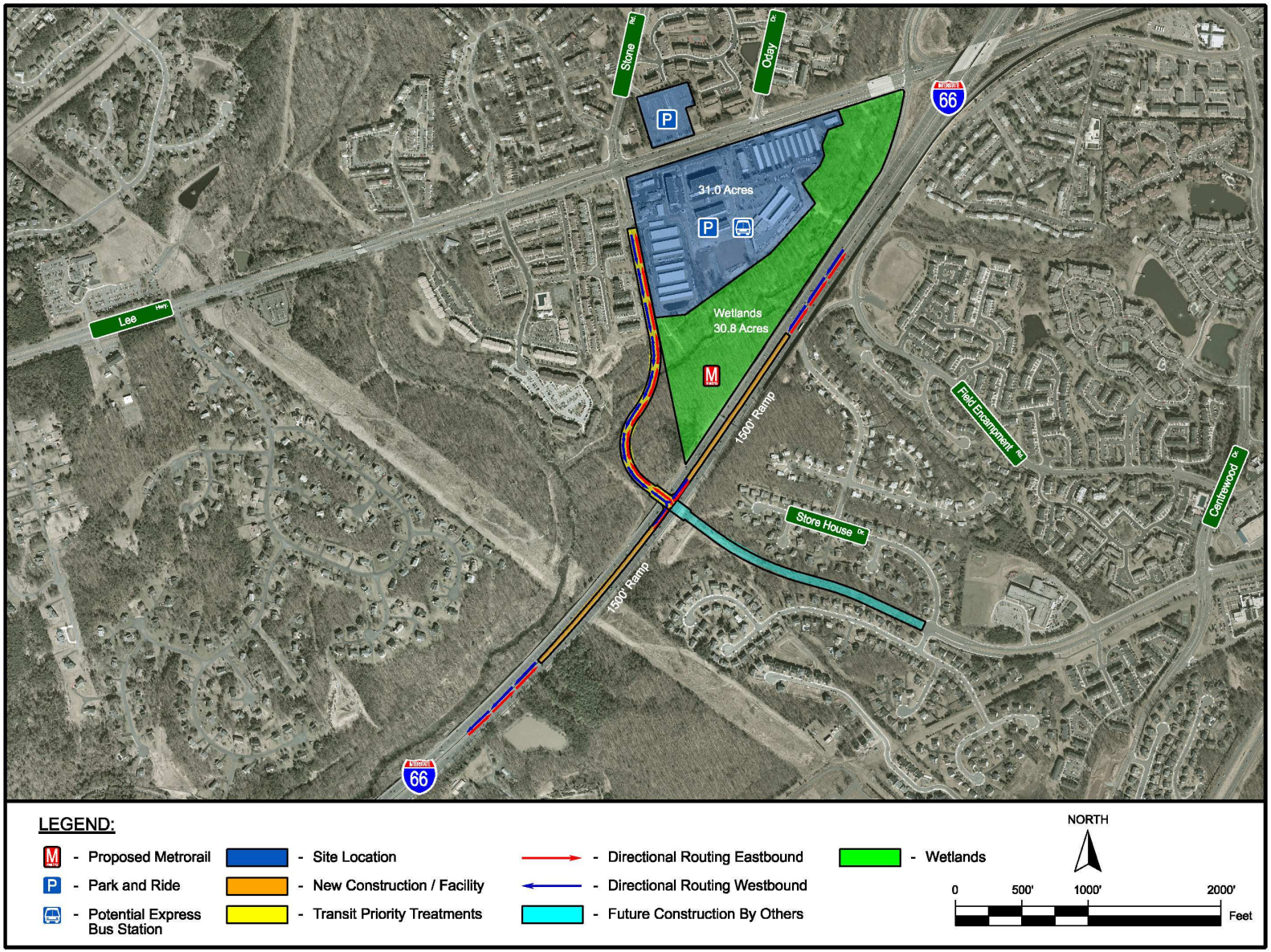


Table 11-8. Stringfellow Road Station Fairfax County

Option	Option Feasibility Evaluation Factors and Results		
	Description	**Feasibility Evaluation**	**Result (FEASIBLE or NOT FEASIBLE)**
2015			
	Add HOV ramps on I-66 west of Stringfellow Road opposite the existing HOV ramps. Provide indirect access to Priority Bus Station and expanded park-and-ride lot at Stringfellow Road. Provide transit priority treatments on roadways to/from station. The Fairfax County Comprehensive Plan refers to the Metrorail station and additional park-and-ride lot shown in the map.	• Roadways – ***Moderate*** addition of HOV ramps at Stringfellow Road and addition of transit priority treatments on Stringfellow Road. • Construction Cost Range – ***Medium.*** • ROW Requirements – ***Minor*** for park-and-ride lot on additional ***vacant*** land if needed.	**FEASIBLE** Construction and MOT are moderate for median HOV access lanes and minor for transit priority treatments.
2030			
	Add additional kiss-and-ride lot with bus staging south of I-66 with pedestrian bridge connecting north and south lots west of Stringfellow Road. Continue to provide indirect access to Priority Bus Station via Stringfellow Road with transit priority treatments. The Fairfax County Comprehensive Plan refers to the Metrorail station and additional park-and-ride lot shown in the map. Kiss-and-ride with bus staging assumes transit priority treatments for access by local buses. Foot traffic access via the connecting pedestrian bridge over I-66. Handicapped preferential parking located at main bus staging area north of I-66.	• Roadways – ***Moderate*** for addition of pedestrian bridge over I-66 connecting park-and-ride and kiss-and-ride lots. • Construction Cost Range – ***Low/ Medium.*** • ROW Requirements – ***Minor*** for added kiss-and-ride lot on ***vacant*** land.	**FEASIBLE** Construction and MOT are moderate for bridge. ROW for additional parking moderate.

Figure 11-12. Stringfellow Road Station Map 2015

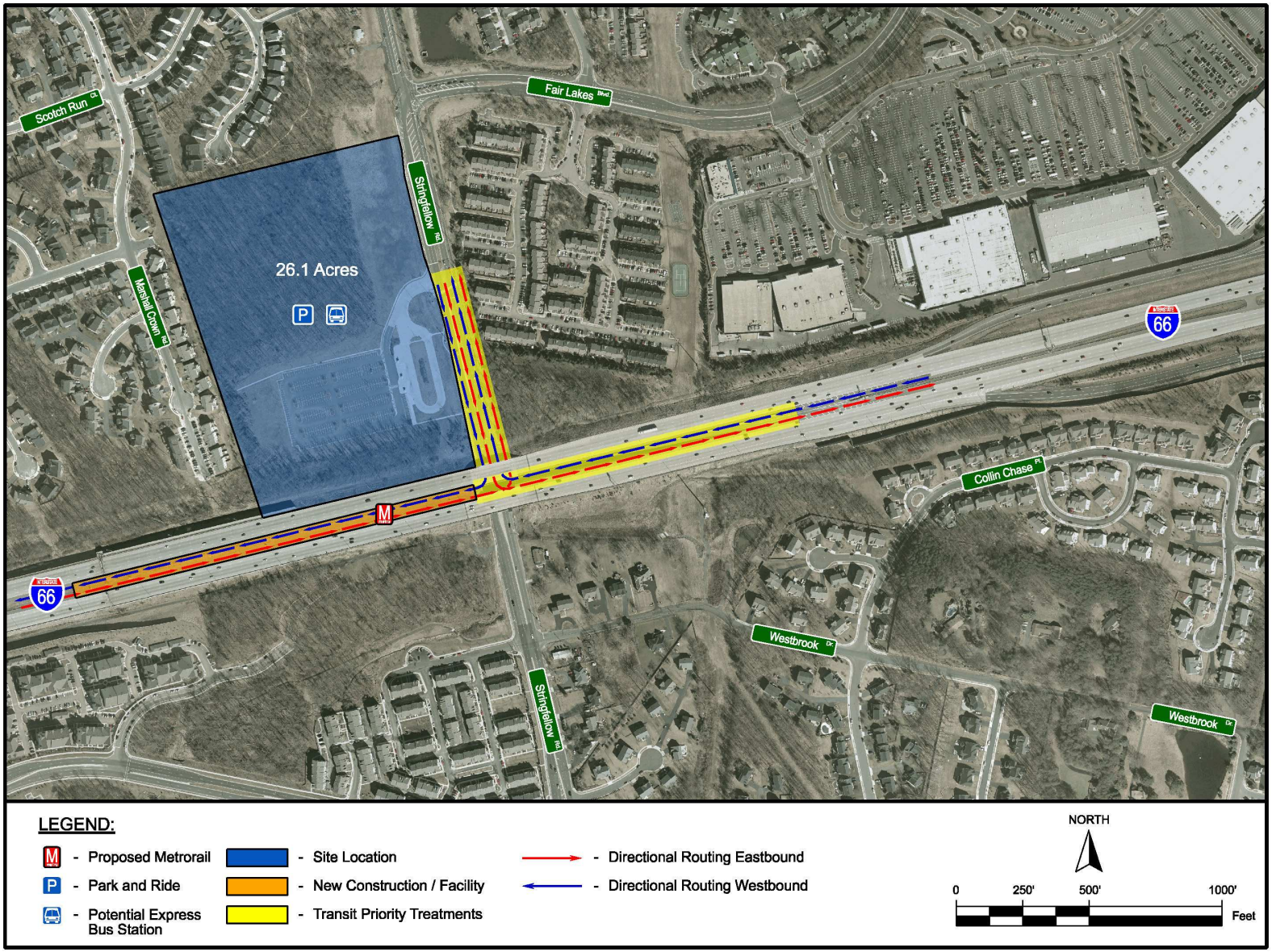


Figure 11-13. Stringfellow Road Station Map 2030

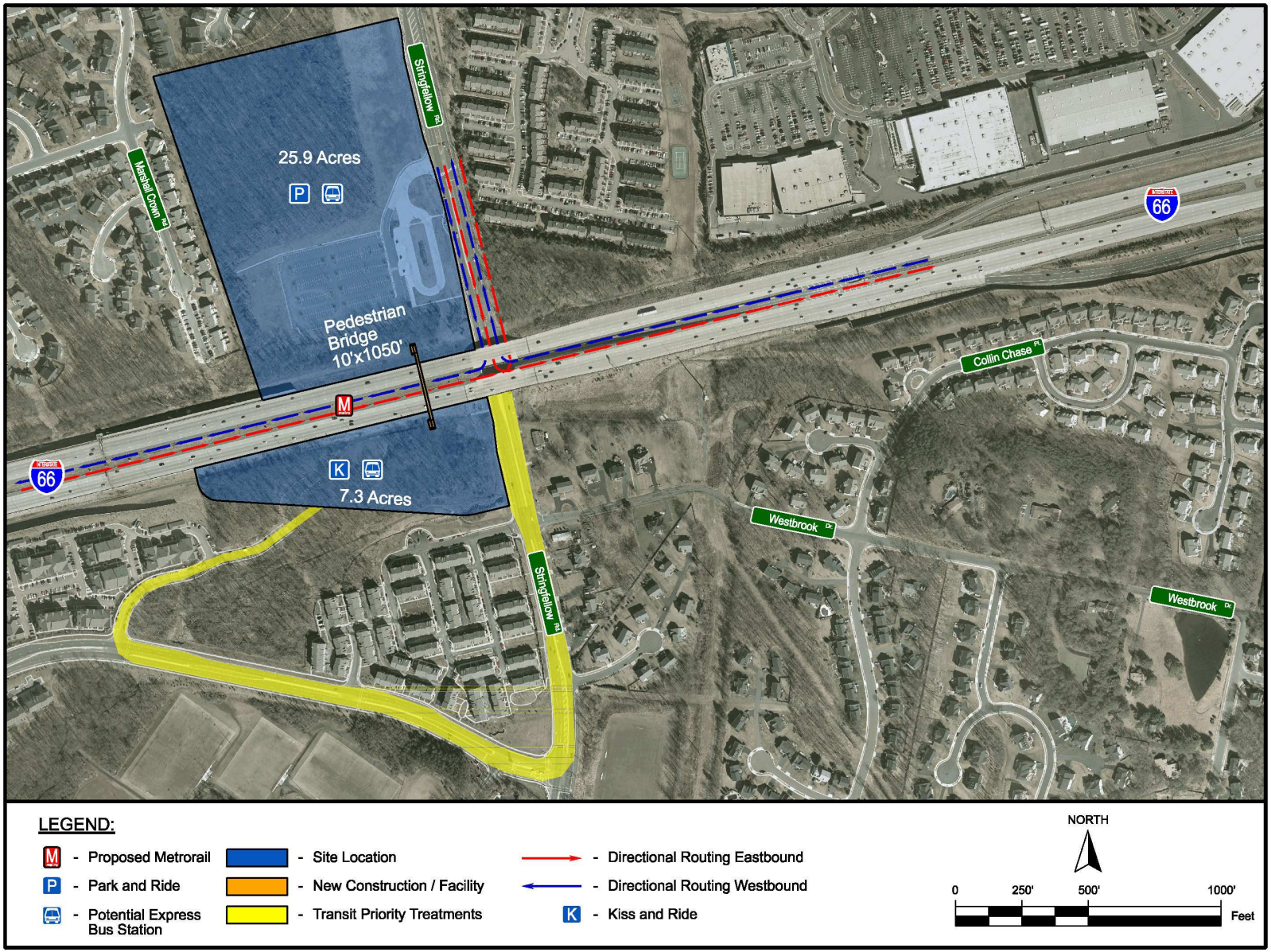


Table 11-9. Fairfax Corner Station at Monument Drive Fairfax County

Option	Option Feasibility Evaluation Factors and Results		
	Description	**Feasibility Evaluation**	**Result (FEASIBLE or NOT FEASIBLE)**
2015			
	Add HOV ramps to HOV lanes on I-66 to/from west of Monument Drive to match existing HOV ramps to/from the east. Provide indirect access to a new Priority Bus station and park-and-ride lot located at Monument Drive and Government Center Parkway and to the existing lot at the Government Center including transit priority treatments. Improvements reflected as per Fairfax County Comprehensive Plan.	• Roadways – ***Moderate*** addition of HOV ramps at Monument Drive and addition of transit priority treatments on ramps and local roadways. • Construction Cost Range – ***Medium.*** • ROW Requirements – ***Minor*** for park-and-ride lot on ***vacant*** and ***county owned*** land. • Other – ***Minor*** indirect travel to/from station and HOV access.	**FEASIBLE** Construction and MOT are moderate for median HOV access lanes and minor for transit priority treatments. Out of direction travel for buses is minor to moderate.
2030			
	Same as 2015	Same as 2015	Same as 2015

Figure 11-14. Fairfax Corner Station Map 2015 and 2030

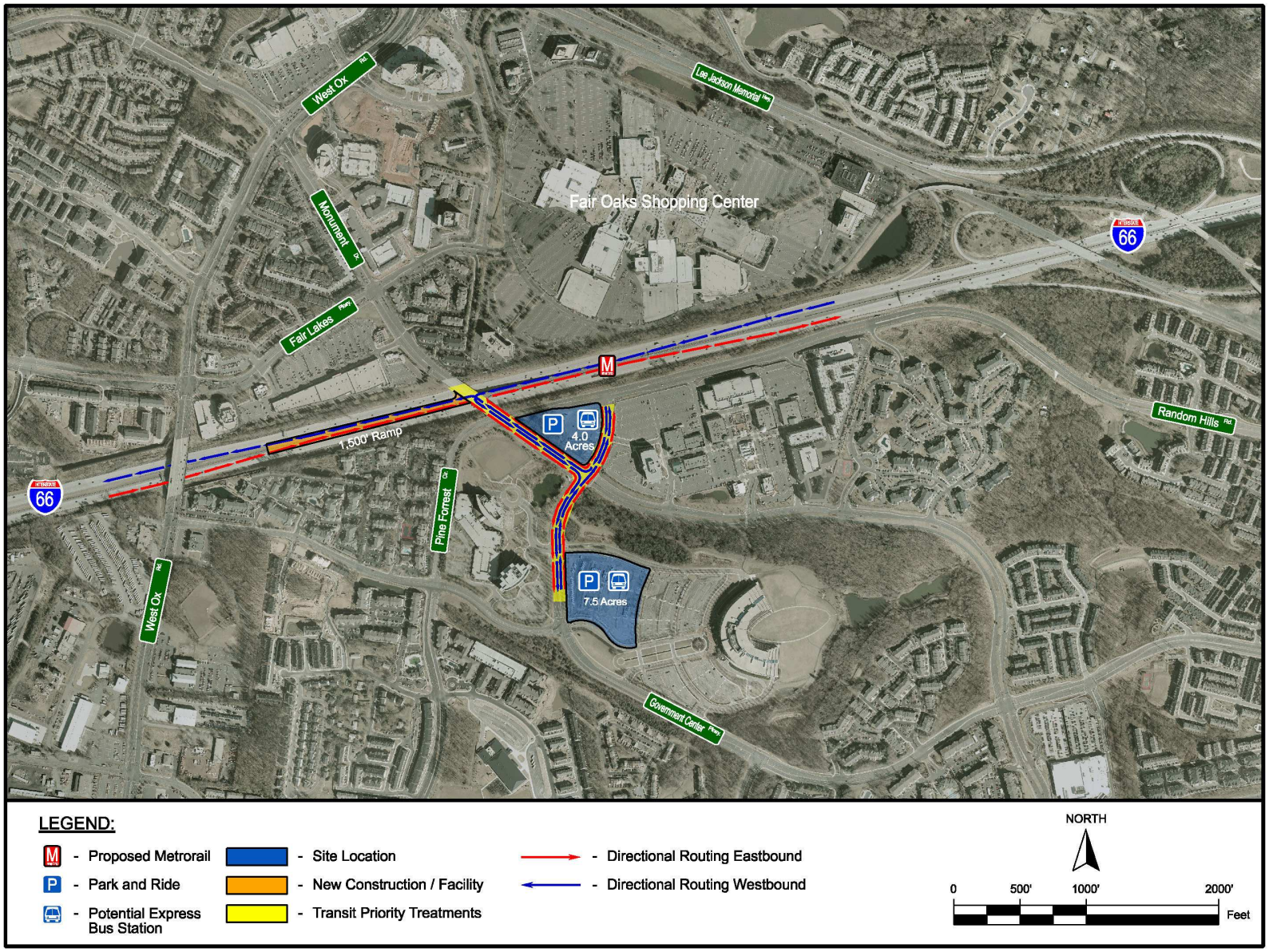


Table 11-10. Vienna/Fairfax-GMU Station at VA 243/Nutley Street Fairfax County

Option	Option Feasibility Evaluation Factors and Results		
	Description	**Feasibility Evaluation**	**Result (FEASIBLE or NOT FEASIBLE)**
2015			
	Access existing Vienna Metrorail station bus staging area from I-66 HOV lanes via new ramp proposed to be constructed by others at Vaden Drive, Saintsbury Drive, and existing ramps. Provide westbound station access via transition from HOV lanes through general purpose lanes to service roadway exit to Vaden Drive north of I-66 crossing over I-66 to station access via Saintsbury Drive. Provide transit priority treatments on ramps and roadways.	• Roadways – ***Major/Moderate*** for construction by others and transit priority treatments on local roads. • Construction Cost Range – ***High*** for construction by others. • ROW Requirements – ***N/A***. • Other – ***Moderate*** for westbound out of direction travel.	**FEASIBLE** Improvement by others. Significant out of direction travel including weave through general purpose lanes.
2030			
	Same as 2015	Same as 2015	Same as 2015

Figure 11-15. Vienna/Fairfax-GMU Station Map 2015 and 2030

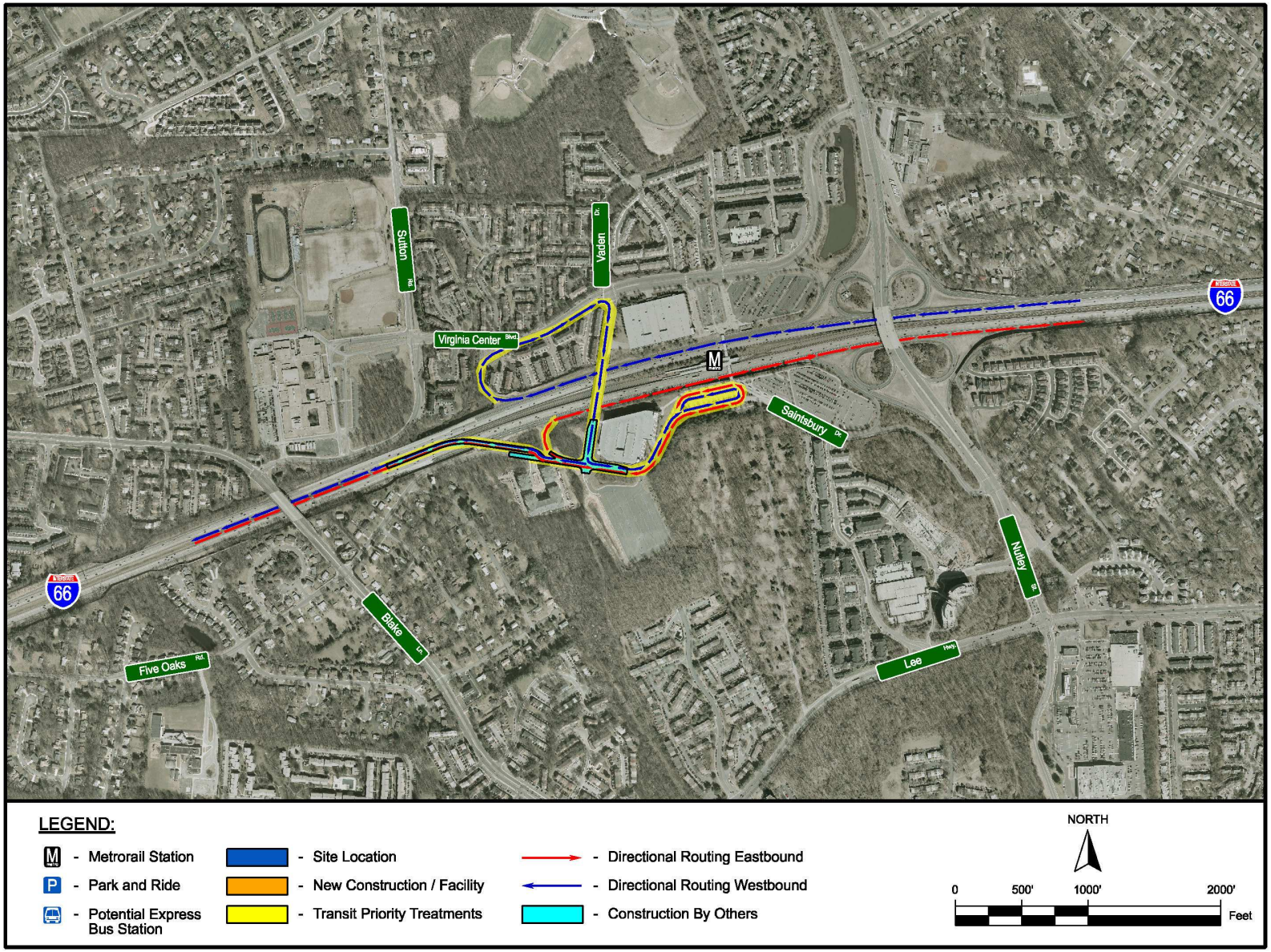


Table 11-11. East Falls Church Station at Washington Boulevard Arlington County

Option	Option Feasibility Evaluation Factors and Results		
	Description	**Feasibility Evaluation**	**Result (FEASIBLE or NOT FEASIBLE)**
2015			
	Use existing access ramps to Fairfax Drive/Washington Boulevard eastbound to existing Metrorail station bus staging area and use Washington Boulevard westbound to access I-66 westbound. Provide transit priority treatments to Fairfax Drive, Washington Boulevard, and North Sycamore Street.	• Roadway – ***Minor*** provide transit priority treatments on Fairfax Drive, Washington Boulevard, North Sycamore Street. • Cost Range – ***Low.*** • ROW Requirements – ***Minor*** little or no ROW required.	**FEASIBLE** Provides connection to Metrorail Orange Line and Silver Line and a bus turnaround facility for turn-back trips.
2030	Construction of a new access point is proposed to the East Falls Church Metrorail station on the Washington Boulevard bridge over the station. This access point could permit passenger drop off, bus bay(s), and direct pedestrian connection to the station.		
	Use new bus bay and Metrorail station access on Washington Boulevard via new construction for eastbound trips. Continue travel eastbound along Washington Boulevard to North Sycamore Street to I-66 eastbound ramp. Westbound trips exit I-66 onto North Sycamore Street and access existing bus staging area along North Sycamore Street then continue north on North Sycamore Street and west on Washington Boulevard to I-66 westbound. Buses will benefit from transit priority treatments provided via 2015 improvements. Capital cost estimates provided by WMATA.	• Roadway – ***Minor*** transit priority treatments on Lee Highway, Washington Blvd, North Sycamore Street – if any needed. • Cost Range – ***Moderate*** for improvements related to proposed new construction by others. • ROW Requirements – ***Minor*** if needed. • Other – Separate bus stop/Metro station access points for eastbound and westbound travel will require clear passenger wayfinding at the station and on board the vehicles (buses) serving this station - ***Moderate***	**FEASIBLE** Provides connection to Metrorail Orange Line and Silver Line and a bus turnaround facility for turn-back trips.

Figure 11-16. East Falls Church Station Map 2015

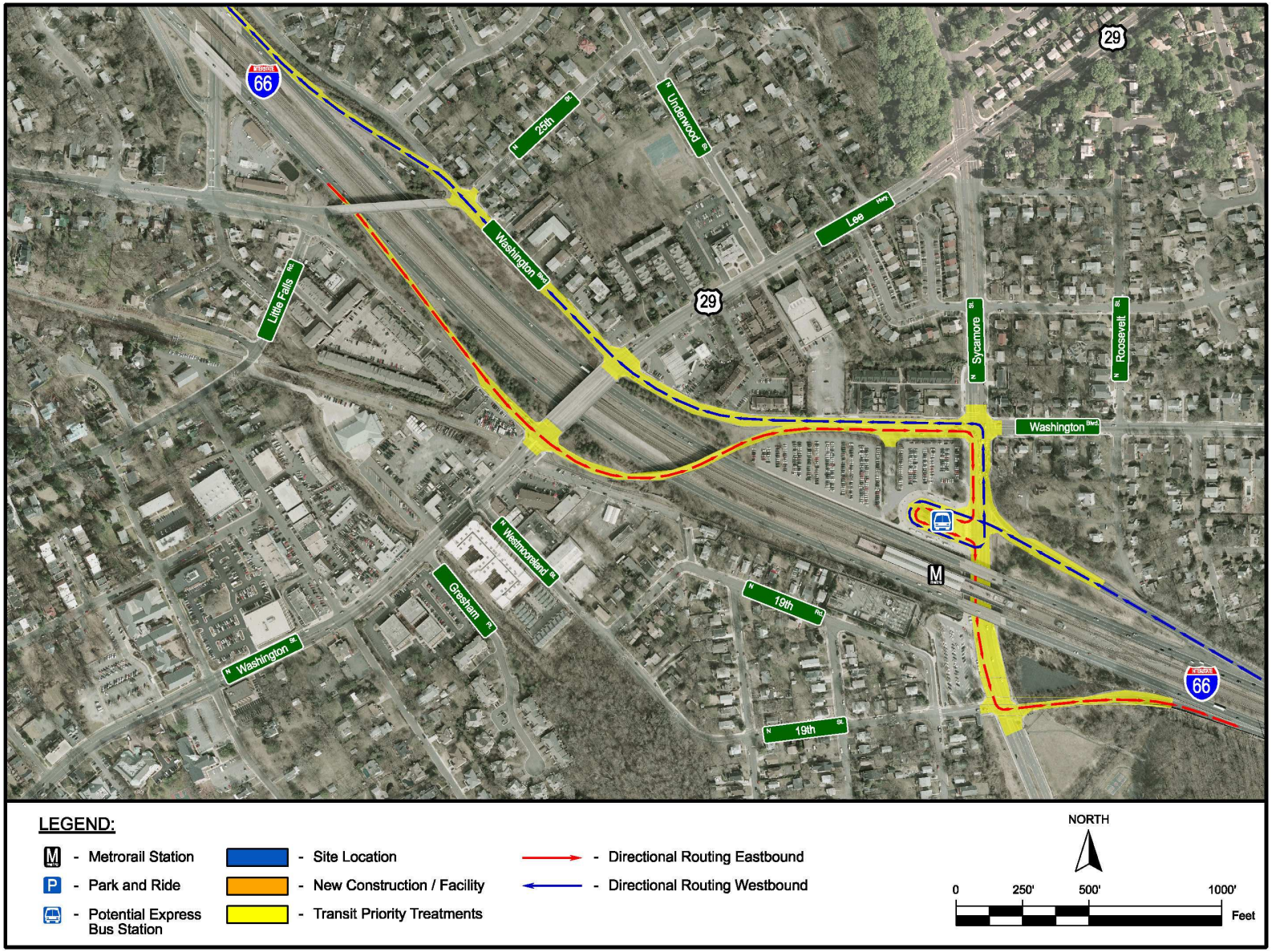


Figure 11-17. East Falls Church Station Map 2030

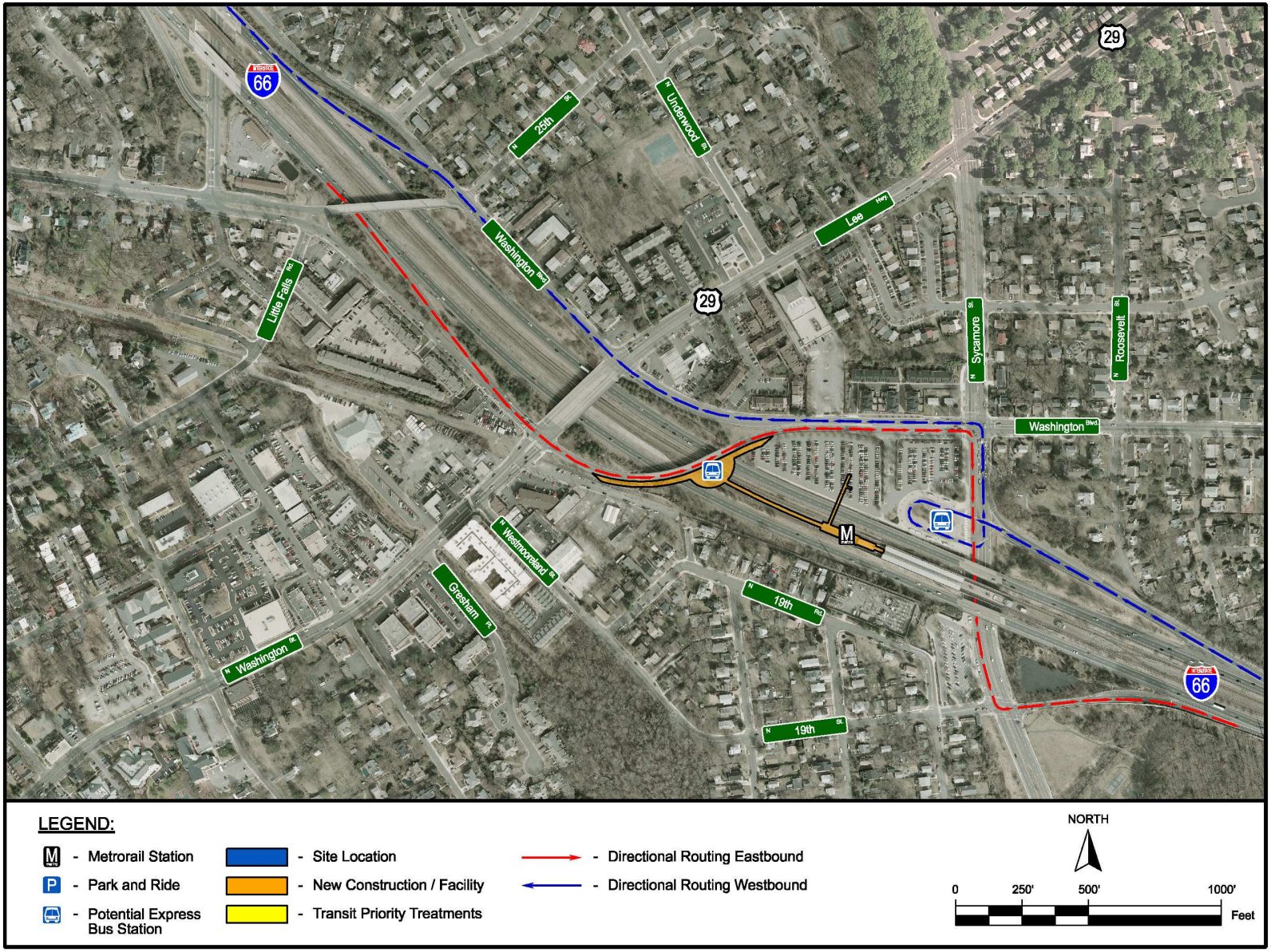


Table 11-12. Ballston Station Arlington County

Option	Option Feasibility Evaluation Factors and Results		
	Description	**Feasibility Evaluation**	**Result (FEASIBLE or NOT FEASIBLE)**
2015			
	Route Priority Bus vehicles from I-66 to Ballston Metrorail station. Eastbound buses run via Fairfax Drive, Glebe Road, Wilson Boulevard, and North Stuart Street and continue from the Metrorail station along Fairfax Drive and Glebe Road onto I-66. Westbound buses run from I-66 onto Glebe Road, Wilson Boulevard, and North Stuart Street and continue from the Metrorail station along Fairfax Drive to I-66. Provide transit priority treatments.	• Roadways – ***Minor*** for transit priority treatments. • Construction Cost Range – ***Minor*** for transit priority treatments. • ROW Requirements – ***Minor*** for transit priority treatments.	**FEASIBLE** Out of direction travel for buses is significant, may be prohibitive.
2030			
	New Metrorail access provided by others to be located at Glebe Road and Fairfax Drive. Provide for bus stop at intersection of Glebe Road and Fairfax Drive with appropriate signalized and marked pedestrian crossing to new station access. Eastbound buses run via Fairfax Drive, turn north on Glebe Road with stop serving the new Metro station access and continue on Glebe Road onto I-66 eastbound. Westbound buses run from I-66 onto Glebe Road south with stop serving the new Metro station access and turn west on Fairfax Drive to continue on I-66 westbound.	• Roadways – ***N/A***. • Construction Cost Range – ***N/A***. • ROW Requirements – ***N/A***.	**FEASIBLE** Improved out of direction travel impacts over 2015.

Figure 11-18. Ballston Station Map 2015

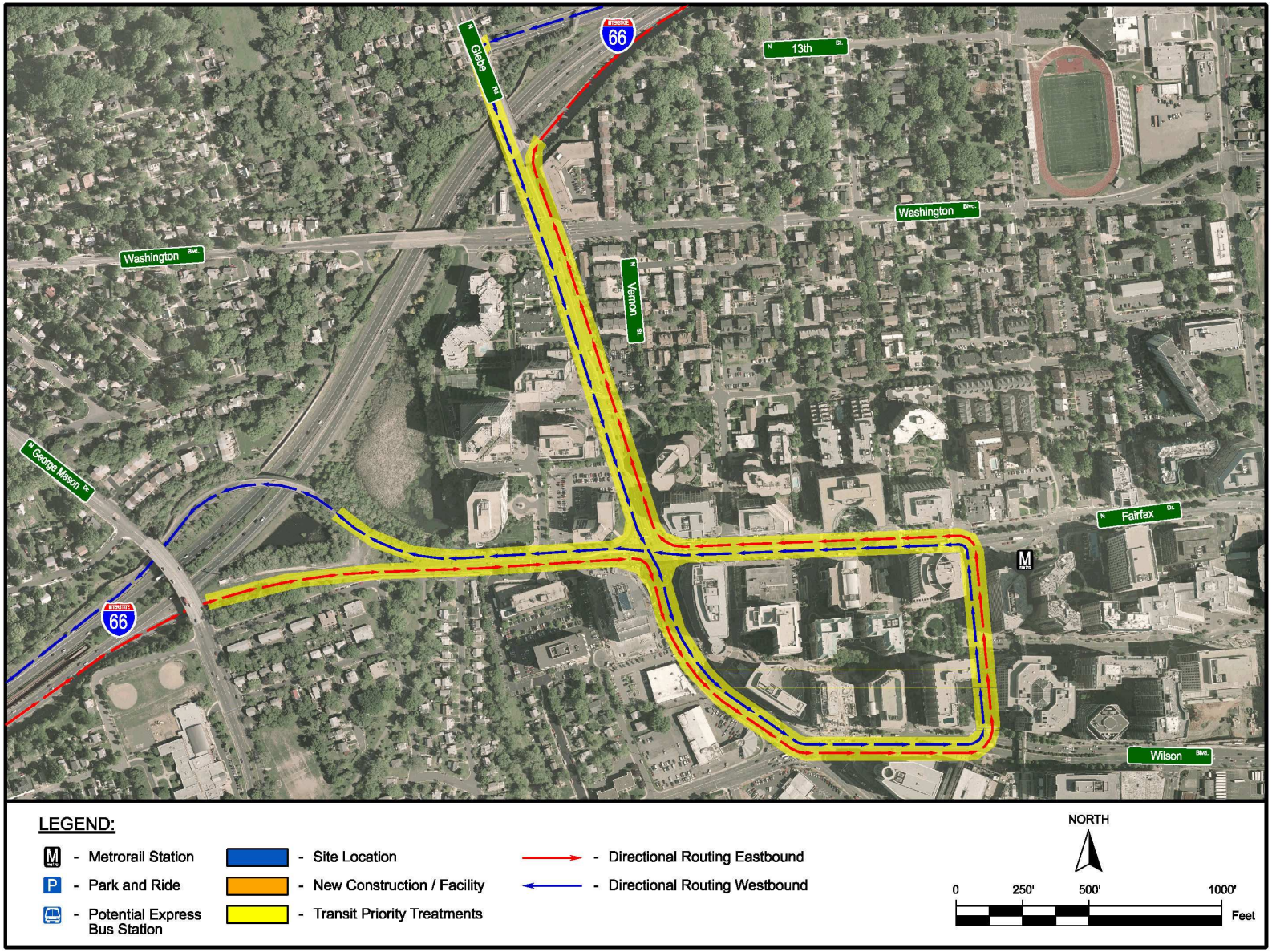
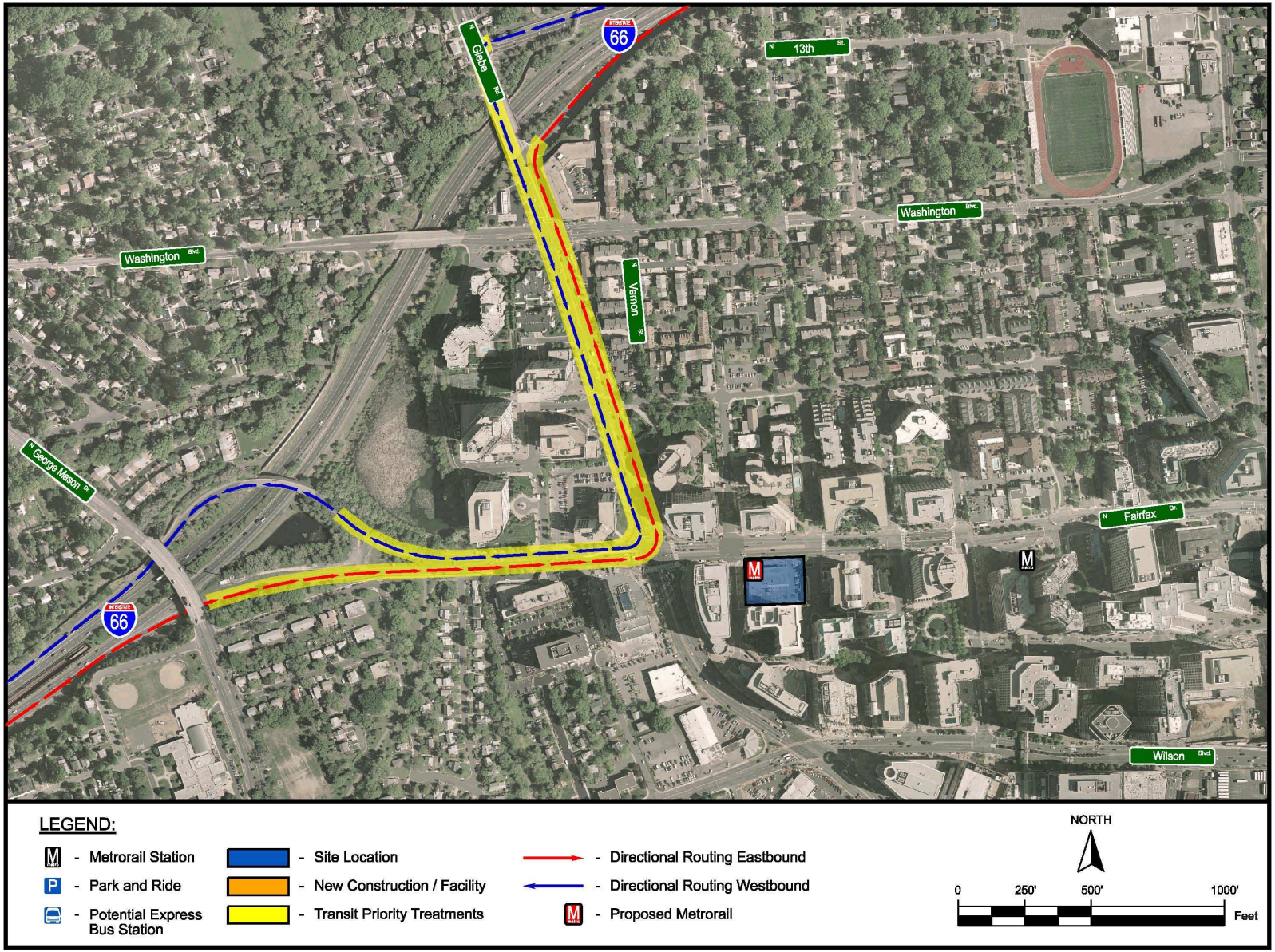


Figure 11-19. Ballston Station Map 2030



11.4 Capital Cost Estimates

Detailed cost assumptions for each of the station concepts are included in Appendix H. A summary of these costs and the assumptions used to develop them are provided in this section.

11.4.1 Capital Cost Assumptions

The capital costs assumptions employed in the development of the station sketch planning effort are documented include the following:

- **Transit Stations** – Each station includes: passenger waiting, four bus bays, bus circulation, pedestrian circulation, bike facilities, passenger information, shelters, bench, and trash receptacle. Area required is 1.25 acres[2]. Cost per unit: $1 million[3].

- **New Construction – Roadways** – Includes ramps and lanes added to provide access to/from HOV lanes and transit station. Assumes addition of 2 lanes (26'-30' paved) at a cost of $3.5 million per mile[4]. ROW and utility costs included at an additional factor of 75 percent of construction costs.

- **New Construction – Structures** – For structures exceeding 200 square feet, assumes structure cost of $170 per square foot.[4]

- **New Construction – Mechanically Stabilized Earth (MSE) Retaining Walls** - Assumes $88 per square foot based on current bid prices per local cost estimate. Cost includes all structural elements, including backfill.

- **Transit Priority Treatments** – Assumes $250,000 per intersection for replacement of signals, controllers, loops, and restriping for queue jump and bus bypass lanes. Planning costs based on recent projects and assumes a potential requirement for extending turn lanes and minor expansion of road section in intermittent locations. Engineering is required to identify precise requirements and costs.

- **Bicycle/Pedestrian Accommodations** – Assumes a planning-level estimate of $100,000 for each station. Engineering is required to identify precise requirements at each station when station site planning and designs are prepared. Estimate assumes ½ mile of 6-foot wide sidewalk plus bicycle lockers and signage.

- **Contingency** – Assumes 25 percent planning contingency on capital costs.

- **Inflation** – Assumes 8.41 percent cost increase from 2006 to 2010 based on the CPI for the DC-metropolitan area. Capital costs were adjusted for inflation from 2006 to yield 2010 costs for the costs that are based on the VDOT Region III urban construction Planning Cost Estimate guidelines (June 2006).

[2] Acreage and functional use based on *Accessing Transit: Design Handbook for Florida Bus Passenger Facilities, version II, 2008.*

[3] Cost estimate does not include supporting elements and ROW which are estimated separately.

[4] VDOT Region III urban construction Planning Cost Estimate guidelines (June 2006).

- **Right-of-Way** – All ROW costs at stations are assumed to be $250,000 per acre. This includes transit stations and surface parking lots. Roadway ROW costs are assumed to be 75 percent of construction costs, or $2.625 million per mile.

- **Parking Lots** – Parking costs at each station include only right-of-way acquisition at a cost of $250,000 per acre. The cost to construct a park-and-ride lot is not included in these total costs, and is detailed in Section 13.4 of this report.

11.4.2 Capital Cost Estimates – Summary

Table 11-13 presents the right-of-way and capital cost estimates by station for proposed 2015 and 2030 improvements. Costs for 2015 options are provided separately. 2030 costs reflect additional costs beyond costs incurred for the 2015 improvements (see notes below). Total costs by station represent the 2015 estimate plus 2030 improvements as noted below and in the detailed cost estimates found in Appendix H. The cost of parking is not included in these cost estimates; cost estimates for the recommended park-and-ride lots can be found in Section 13 of this report. Note that right-of-way costs reflect the cost for the parcels identified. All costs are in constant 2010 dollars.

Table 11-13. Station Sketch Plan Capital Cost Estimates by Station ($millions)

Station	2015 Cost Estimate			2030 Cost Estimate			Total Cost Estimate		
	Land Acquisition Cost	Construction Cost	Total	Land Acquisition Cost	Construction Cost	Total	Land Acquisition Cost	Construction Cost	Total
Haymarket*	$5.1-$12.4	$2.6-$3.2	$7.7-$15.6	-No Further Improvements-			$5.1-$12.4	$2.6-$3.2	$7.7-$15.6
Gainesville*	$1.5-$11.1	$2.0-$2.9	$4.4-$13.1	$1.3	$12.4	$13.8	$2.8-$12.4	$14.4-$15.4	$18.2-$26.8
VA 234 Bypass	$3.2	$2.6	$5.8	$5.9	$17.5	$23.5	$9.1	$20.2	$29.2
Bull Run	$7.6	$2.6	$10.3	$1.3	$12.0	$13.4	$9.0	$14.7	$23.6
Centreville	$7.8	$2.3	$10.1	$1.6	$9.9	$11.5	$9.4	$12.2	$21.6
Stringfellow Road	$7.3	$6.6	$14.0	$1.8	$7.2	$9.0	$9.2	$13.8	$23.0
Monument Dr./ Fairfax Corner	$0.0	$6.6	$6.6	-No Further Improvements-			$0.0	$6.6	$6.6
Vienna/Fairfax-GMU	$0.0	$32.0	$32.0	-No Further Improvements-			$0.0	$32.0	$32.0
East Falls Church	$0.0	$2.3	$2.3	$0.0	$68.2	$68.2	$0.0	$70.5	$70.5
Ballston	$0.0	$2.9	$2.9	-No Further Improvements-			$0.0	$2.9	$2.9

* Ranges are presented for stations with multiple feasible options.

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12.0 Recommendations

The I-66 Transit/TDM Study resulted in a set of infrastructure, program, and service recommendations for transit and TDM in the corridor. The recommendations were developed based on TAC member guidance, public and stakeholder input, the market research (described in Section 5), and the current and forecast travel demand work (described in Section 9). The recommendations were developed with the goal of improving mobility in the I-66 corridor for all travelers. Taken together, the recommendations strive to provide congestion relief in the corridor, improve the operations of the existing HOV lane, increase the reliability and speed of transit service in the corridor, increase the amount of park-and-ride spaces available, and provide a range of transportation options for all residents and employees in the corridor.

This section describes the recommendations and is organized into four subsections. Section 12.1 presents the transit infrastructure and service recommendations. Section 12.2 presents the TDM program recommendations. Section 12.3 presents the park-and-ride lot recommendations. Section 12.4 presents additional recommendations related to the study.

12.1 Transit Recommendations

The transit alternatives testing, sensitivity analysis, market research survey, public input, and TAC guidance that have been described in other sections of this report provided important insight into appropriate transit service for the I-66 corridor. The transit recommendations are based primarily on the Refined Alternative presented in Section 8. The transit recommendations are organized into three subsections, "Priority Bus Stations and Ramps," "Runningway Improvements," and "Services."

12.1.1 Priority Bus Stations and Ramps

Based on these service recommendations, eight Priority Bus stations are recommended for the I-66 corridor including:

- Haymarket;
- VA 234 Bypass;
- Centreville;
- Stringfellow Road;
- Monument Drive/Fairfax Corner;
- East Falls Church;
- Ballston; and
- D.C. Core.

Each of these stations would be served by multiple transit routes, including new Priority Bus services in addition to feeder and realigned existing service. Sketch plans for each of the recommended stations are provided at year 2015 and 2030 time horizons in Section 11 of this report. Additional study will be required to select the best Priority Bus station site for the Haymarket station; two options are proposed. Table 12-1 through Table 12-7 provide details about bus service availability in 2030 at each of the stations outside of the D.C. Core. The bus services listed include service developed as part of these recommendations and other feeder routes serving these station locations based on current services and planned services in the CLRP.

Table 12-1. 2030 Bus Service at Haymarket Station

Route	Destination	Serving	2030 Frequency (minutes)			Direction
			Morning Peak	Midday	Evening Peak	
PRTC						
PB66H	D.C. Core	VA 234 Bypass, Centreville, Ballston	15	--	15	Peak Only
LMD	D.C. Core	Gainesville, Centreville	30	--	30	Peak Only
-	Tysons Corner	Centreville, VA 234 Bypass	60	--	60	Peak Only
-	Dulles	Gainesville, Centreville, VA 234 Bypass, VA 28 Corridor	60	--	60	Peak Only
-	Manassas Mall	PRTC Transit Center	30	--	30	Both

Table 12-2. 2030 Bus Service at VA 234 Bypass Station

Route	Destination	Serving	2030 Frequency (minutes)			Direction
			Morning Peak	Midday	Evening Peak	
PRTC						
PB66H	D.C. Core	Haymarket, Centreville, Ballston	15	--	15	Peak Only
-	Tysons Corner	Gainesville, Centreville	30	--	30	Peak Only
-	D.C. Core	Manassas, Centreville, Pentagon	30	--	30	Peak Only
-	Tysons Corner	Haymarket, Centreville	60	--	60	Peak Only
-	Dulles	Gainesville, Haymarket, Centreville, VA 28 Corridor	60	--	60	Peak Only
-	Reston/Herndon	West Prince William County, Centreville	60	--	60	Peak Only

Table 12-3. 2030 Bus Service at Centreville Station

Route	Destination	Serving	2030 Frequency (minutes)			Direction
			Morning Peak	Midday	Evening Peak	
WMATA						
PB66C	D.C. Core	Stringfellow Rd, Monument Dr, East Falls Church	15	--	15	Both
Fairfax Connector						
630	Vienna/Fairfax-GMU Metro	Stringfellow Rd, Monument Drive	--	60	--	Both
631	Vienna/Fairfax-GMU Metro	Braddock Road	30	--	30	Peak Only
641	Vienna/Fairfax-GMU Metro	Centreville Methodist Church	30	--	30	Both
644	Vienna/Fairfax-GMU Metro	Centreville	30	--	30	Peak Only
642	Vienna/Fairfax-GMU Metro	Chantilly, Sully Government Center	30	--	30	Peak Only
CHR	Herndon-Monroe	VA 28 Corridor	30	--	30	Both
-	George Mason University	U.S. 29 Corridor	30	--	30	Both
PRTC						
PB66H	D.C. Core	Haymarket, VA234 Bypass, Ballston	15	--	15	Peak Only
LMD	D.C. Core	Gainesville, Haymarket	30	--	30	Peak Only
-	Tysons Corner	Gainesville, VA 234 Bypass	30	--	30	Peak Only
-	D.C. Core	Manassas, VA 234 Bypass, Pentagon	30	--	30	Peak Only
-	Tysons Corner	Haymarket, VA 234 Bypass	60	--	60	Peak Only
-	Dulles	Manassas, VA 28 Corridor	60	--	60	Peak Only
-	Dulles	Gainesville, Haymarket, VA 234 Bypass, VA 28 Corridor	60	--	60	Peak Only
-	Reston/Herndon	West Prince William County, VA 234 Bypass	60	--	60	Peak Only

Table 12-4. 2030 Bus Service at Stringfellow Road Station

Route	Destination	Serving	2030 Frequency (minutes)			Direction
			Morning Peak	Midday	Evening Peak	
WMATA						
PB66C	D.C. Core	Centreville, Stringfellow Rd, Monument Dr	15	--	15	Both
Fairfax Connector						
653	Vienna/Fairfax-GMU Metro	Chantilly	30	--	30	Both
631	Vienna/Fairfax-GMU Metro	Centreville, Little Rocky Run	30	--	30	Peak
605	Reston Town Center	Chantilly, Reston	60	60	60	Both
630	Vienna/Fairfax-GMU Metro	Centreville, Monument Drive	--	60	--	Both

Table 12-5. 2030 Bus Service at Monument Drive/Fairfax Corner Station

Route	Destination	Serving	2030 Frequency (minutes)			Direction
			Morning Peak	Midday	Evening Peak	
WMATA						
PB66C	D.C. Core	Centreville, Stringfellow Rd, Monument Dr	15	--	15	Both
B7I	Tysons Corner	Dulles, Chantilly	15	60	15	Peak Only
PB29	D.C. Core	Fair Lakes, U.S. 29 corridor	12	12	12	Both
PB50	D.C. Core	Fair Lakes, U.S. 50 corridor	12	12	12	Both
1C	Dunn Loring Metro	Arlington Blvd, Fair Oaks Mall	30	60	30	Both
1Z	Fair Oaks Hospital	Ballston Metro, Arlington Blvd	30	--	30	Peak Only
2B	Fair Oaks Mall	Washington Blvd, Vienna/Fairfax-GMU Metro	30	60	30	Peak Only
2G	Fair Oaks Mall	Washington Blvd, Vienna/Fairfax-GMU Metro, Arrowhead Dr	30	--	30	Off-Peak
B4	Landmark Shopping Center	Vienna Metro, Fair Oaks Mall	15	60	15	Peak Only
B5	Franconia-Springfield Metro	Fair Oaks Mall, Vienna Metro	15	60	15	Peak Only
Fairfax Connector						
622	Vienna/Fairfax-GMU Metro	Fairfax Town Center	30	--	30	Both
623	Vienna/Fairfax-GMU Metro	Fairfax County Government Center	30	--	30	Both
630	Vienna/Fairfax-GMU Metro	Centreville, Stringfellow Rd	--	60	--	Both
651	Vienna/Fairfax-GMU Metro	Dulles South	30	--	30	Both
652	Vienna/Fairfax-GMU Metro	Dulles East	30	--	30	Both
605	Reston Town Center	Chantilly, Reston	60	60	60	Both

Table 12-6. 2030 Bus Service at East Falls Church Station

Route	Destination	Serving	2030 Frequency (minutes)			Direction
			Morning Peak	Midday	Evening Peak	
WMATA						
26E	East Falls Church Metro	Roosevelt St, Wilson Blvd, Broad St	25	--	25	Circular
24T	Tysons-Westpark	Westmoreland St, Lewisville Rd	30-37	--	31-38	Both
2B	Fair Oaks Mall	Washington Blvd, Vienna/Fairfax-GMU Metro	30	60	30	Peak Only
2C	Tysons Corner	Washington Blvd, Dunn Loring-Merrifield Metro	30	60	30	Both
2G	Fair Oaks Mall	Washington Blvd, Vienna/Fairfax-GMU Metro, Arrowhead Dr	30	--	30	Off-Peak
3A	Annandale	Rosslyn, Annandale Rd	30	60	24-30	Both
3B	West Falls Church-VT/UVA Metro	W Broad St, Rosslyn	30	60	22-30	Both
PB66C	D.C. Core	Centreville, Stringfellow Rd, Monument Dr	15	--	15	Both
ART						
ART52	Ballston-MU Metro	Trinidad St, Yorktown Blvd, George Mason Dr	30	60	30	Both
ART53	Ballston-MU Metro	Williamsburg Blvd, Old Glebe Rd, Military Rd	30	60	30	Both

Table 12-7. 2030 Bus Service at Ballston Station

Route	Destination	Serving	2030 Frequency (minutes)			Direction
			Morning Peak	Midday	Evening Peak	
WMATA						
25A	Pentagon Metro	Carlin Springs Rd, NVCC, South Fairlington, Shirlington	35-55	60	25-40	Both
25B	Van Dorn Street Metro	Carlin Springs Rd, NVCC, Parkfairfax, Landmark	20-35	60	30-40	Both
38B	Farragut N & W Metro	Rosslyn Metro, Georgetown	12	20	15	Both
1A	Vienna/Fairfax-GMU Metro	Wilson Blvd, Seven Corners, Fairfax Hospital	30	30	--	Both
1B	Dunn Loring-Merrifield Metro	Wilson Blvd, Seven Corners, Fairfview Park	30-35	--	30-40	Both
1E	Seven Corners	Wilson Blvd, Dominion Hills	30-40	--	30-55	Peak Only
1Z	Vienna/Fairfax-GMU Metro	Wilson Blvd, Fairfax Hospital	20-48	--	30	Peak Only
23A	Tysons Corner-Westpark	Glebe Rd, Shirlington, Tysons Galleria, Crystal City	20-40	30	30	Both
23C	Langley	Glebe Rd, Shirlington, Crystal City	20-40	--	30	Both
2B	Fair Oaks Mall	Washington Blvd, Vienna/Fairfax-GMU Metro	30	60	30	Peak Only
2C	Tysons Corner	Washington Blvd, Dunn Loring-Merrifield Metro	30	60	30	Both
2G	Fair Oaks Mall	Washington Blvd, Vienna/Fairfax-GMU Metro, Arrowhead Dr	30	--	30	Off-Peak
10B	Hunting Towers	Shirlington, Braddock Road Metro	30	30	25-30	Both
22A	Pentagon Metro	George Mason Dr, Shirlington	20-23	40	21	Both
24P	Pentagon Metro	Wilson Blvd, Washington Blvd, Columbia Pike	20	60	20	Both
PB29	D.C. Core	Fair Lakes, U.S. 29 corridor	12	12	12	Both
PB50	D.C. Core	Fair Lakes, U.S. 50 corridor	12	12	12	Both
ART						
ART51	George Mason & Lee Hwy	N Glebe Rd, 16th St, George Mason Dr	30	30	30	Both
ART52	East Falls Church Metro	Washington Blvd, George Mason Dr, Yorktown Blvd	30	60	30	Both
ART53	East Falls Church Metro	Military Rd, Old Glebe Rd, Williamsburg Blvd	30	60	30	Both
ART62	Court House Metro	Lorcom Lane	30	--	30	Both
ART75	Wakefield HS	Wilson Blvd, Carlin Springs Rd, Frederick St	30	--	30	Both
PRTC						
PB66H	D.C. Core	Haymarket, VA234 Bypass, Centreville	15	--	15	Peak Only
R6	Pentagon/Rosslyn/Ballston	Dale City	60	--	50	Peak Only

In addition, the study recommends development of a two-way direct access ramp from the eastbound I-66 HOV lane to the Vienna Metrorail station and vice versa. This ramp would make it faster for buses to access the station and provide an easy return in the opposite direction. Even the small amount of travel time savings could attract additional riders. In addition, by eliminating a weaving movement that would otherwise be necessary to access the station, the ramp would make an additional positive contribution to reducing congestion for general purpose traffic.

12.1.2 Runningway Improvements

Concurrent with the I-66 Transit/TDM Study, VDOT commissioned the I-66 HOV Lane Operations Study as an analysis of the operational characteristics of the HOV lanes on I-66 from VA 234 outside of the Beltway to VA 7 inside the Beltway. The overall goal of the study was to identify potential solutions for improving operations and reducing congestion that VDOT can consider for implementation in the near term (i.e., one or two years) for a low cost (i.e., generally less than $2 million). Although the focus of the study was on low cost, near-term solutions, a broader set of mitigation measures, including both spot and general improvements, was presented in the draft report, including many that require more resources to study and potentially implement.

The draft I-66 HOV Lane Operations Study consultant report concluded that the HOV lanes on I-66 west of the Beltway currently operate in degraded conditions in both the morning and evening peak periods, as defined by the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). This result echoes the input received from the public during the course of the I-66 Transit/TDM Study which indicated that several issues related to the enforcement of the HOV restrictions have degraded the operations of the HOV lane outside the Beltway. In places, the speed of traffic in the HOV lane is reduced to nearly that of the adjacent general purpose lanes and the lane is therefore not providing the maximum level of time-savings benefit to carpoolers or transit users in the corridor.

The I-66 Transit/TDM Study recognizes that the existing I-66 HOV lane is a critical element in maintaining dependable, high-quality transit services in the corridor. The travel forecasting, market research, and public input underlined the importance of addressing the reliability of the lane in the short and medium term. Signing and marking improvements are recommended for the congested portion of the lane, particularly between approximately U.S. 50 and the Beltway, to better define a separation buffer between the HOV lane and the general purpose lanes outside of the Beltway. It is a recommendation of the I-66 Transit/TDM Study that a two-foot wide painted buffer using double white lines in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) is implemented in the short-term time horizon. This buffer would increase the visibility of the HOV lane and discourage the frequent lane changes that currently slow traffic in the HOV lane. As recommended, these improvements would define specific entry and exit points from the lane, using double white lines to mark areas where entry or exit was prohibited. In the longer term it may be necessary to consider adjusting the hours of operation, occupancy requirements, clean fuel vehicle exemptions, or enforcement protocols of the HOV lane to maintain its reliability. Physical barrier separation of the lane does not seem feasible in the short or medium term.

Highway congestion that hinders reliable bus operations remains a problem at other locations in the corridor, especially where buses do not have the advantage of operating in an HOV facility (e.g., on U.S. 29, U.S. 50, and in the off-peak direction on I-66). Bus priority treatments could be implemented where practical for use where and when conditions merit. The use of shoulder operations for bus service should be analyzed for each spot location based on the specific geometry of the roadway and congestion levels. Generally, long segments of bus-on-shoulder operations are not recommended for the corridor primarily due to safety concerns. Queue jumping provisions at ramp locations or at intersections in the corridor might also provide some travel time improvements for transit users at spot locations, as discussed in Section 9.

12.1.3 Services

Table 12-8 outlines all of the transit services recommended for 2015 and 2030 by operator. The baseline elements are shown in black, the additional commuter bus elements discussed in Section 8 are shown in red, and the new recommended Priority Bus services are shown in blue. A map depicting all of the recommended transit services can be found in Figure 12-1.

As shown, the market focus for the recommended transit service is primarily traditional commute trips in the peak hours and peak directions, although some new reverse commute service is provided on I-66. The Priority Bus routes provide service to the employment centers in Arlington by providing direct connections to Ballston. Those traveling to Ballston from Haymarket and Gainesville will experience time savings of approximately 13 and 19 percent respectively over the existing service configuration. The connection at East Falls Church will also provide transfer opportunities to the Silver Line and the Tysons Corner area. For example, those traveling between Centreville and Tysons Corner will experience a 17 percent time savings over the existing transit service offerings. Substantial feeder services are also recommended in addition to the Priority Bus services that provide connections to and from major destinations in the study area including Manassas, Fair Lakes, Centreville, Reston, and Herndon.

The recommended I-66 Priority Bus service includes many elements of BRT that will improve the quality of transit service provided in the corridor. Frequent service is supplemented by substantial stations, improved reliability, advanced technology and information systems, and direct access to selected stations. The market research survey (summarized in detail in Section 5 of this report) indicated that the most compelling Priority Bus attribute was to have fewer stops than other transit alternatives. Therefore, each of the recommended I-66 Priority Bus services makes only five stops, providing a shorter, more-direct trip to the major destinations in the corridor, the D.C. Core and the Rosslyn-Ballston corridor.

Also highlighted by the results of the market research survey, service reliability and time savings are major factors in the decision to use transit service for commuters in the I-66 corridor. Time savings and improved reliability are provided for the Priority Bus services and all the other recommended transit services in the corridor through the implementation of transit priority treatments on local streets, direct station access, and improved general operations of the I-66 HOV lanes. In addition to the aforementioned time savings, the recommended Priority Bus improvements are projected to provide a 25 percent time savings from Haymarket to D.C. and a 10 percent time savings from Centreville to D.C. Transit trips along U.S. 29 and U.S. 50 using the new proposed Metrobus Express services are projected to experience a 20 percent time savings as a result of the reduction in the number of bus stops.

The only difference between the Refined Alternative described in Section 8 and the transit service recommendations described in this Section is the increased service frequency on the two new line-haul I-66 Priority Bus services, from 30 minutes in 2015 to 15 minutes in 2030. This recommendation is made based on TAC and other stakeholder input. The decision to increase frequency of service in 2030 would be dependent on ridership and other factors contributing to the need at that time.

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Table 12-8. Recommended Transit Service

Route	Alignment		Morning Peak Frequency (Min.)		Stations Served							
	From	To	2015	2030	Haymarket	VA 234 Bypass	Centreville	Stringfellow Road	Monument Dr./ Fairfax Corner	East Falls Church	Ballston	D.C. Core
PRTC												
New I-66 Priority Bus	*Haymarket*	*D.C. Core*	30	15	●	●	●				●	●
Gainesville OmniRide	Linton Hall	D.C.	30	30	●		●					
Manassas Metro-Direct	Manassas	*Tysons Corner*[a]	30	30		●	●					
Manassas OmniRide	Manassas	D.C. and Pentagon	20	20		●	●					●
Haymarket/Gainesville Metro-Direct	*Haymarket/Gainesville*	*Tysons Corner*	60	60	●	●	●					
Manassas – Dulles OmniRide	*Manassas*	*Dulles (via Route 28)*	na	60			●					
Gainesville/Haymarket – Dulles OmniRide	*Haymarket/Gainesville*	*Dulles (via Route 28)*	na	60	●	●	●					
West County – Reston/Herndon OmniRide	*West Prince William County*	*Reston – Herndon*	na	60		●	●					
Loudoun Transit												
Purcellville to Rosslyn/D.C. Service	Purcellville, Leesburg	Rosslyn and D.C.	20	20								●
Purcellville to D.C. Service	Purcellville, Leesburg	D.C.	60	60								●
Dulles South to Pentagon/D.C. Service	Dulles South	Pentagon and D.C.	30	30								●
Purcellville to Pentagon/D.C. Service	Purcellville, Leesburg	Pentagon and D.C.	30	30								●
Dulles South to D.C. Service	Dulles South	D.C.	60	60								●
Fairfax Connector												
622 - Fairfax Town Center (bi-directional)	Fairfax Town Center	Vienna/Fairfax-GMU Metro	30	30					●			
623 - Fairfax County Government Center Line (bi-directional)	Fairfax County Government Ctr.	Vienna/Fairfax-GMU Metro	30	30					●			
595 - Pentagon Express	Reston	Pentagon	30	30								
597 - Crystal City Express	Reston	Pentagon, Crystal City	30	30								
631 - Little Rocky Run – Stringfellow Road Park-and-Ride – Vienna Line	Centreville	Vienna/Fairfax-GMU Metro	30	30			●	●				
641 – Centreville South – Vienna Line	Centreville	Vienna/Fairfax-GMU Metro	30	30			●					
644 – Centreville (Stone road) Park-and-Ride – Vienna Express	Centreville	Vienna/Fairfax-GMU Metro	30	30			●					
651 - Chantilly – Sullyfield Circle – Vienna Line	Dulles South	Vienna/Fairfax-GMU Metro	30	30					●			
652 - Chantilly – Franklin Farm – Vienna Line	Dulles East	Vienna/Fairfax-GMU Metro	30	30					●			
642 – Centreville North – Vienna Line	Chantilly	Vienna/Fairfax-GMU Metro	30	30			●					
653 - Chantilly to Vienna	Chantilly	Vienna/Fairfax-GMU Metro	30	30				●				
Centreville to Reston/Herndon	Centreville	Herndon/Reston	30	30			●					
WMATA												
New I-66 Priority Bus (bi-directional)	*Centreville*	*D.C. Core*	30	15			●	●	●	●		●
New U.S. 29 Metrobus Express (bi-directional)	*Fair Oaks*	*Ballston/D.C.*	12	12							●	●
New U.S. 50 Metrobus Express (bi-directional)	*Fair Oaks*	*Ballston/D.C.*	12	12							●	●
Lee Highway – Farragut Square Line	Lee Heights	D.C.	30	30								●
Chantilly - Tysons Line	Dulles – Chantilly	Tysons Corner (via I-66)	15	15					●			

[a] Extension of route to Tysons Corner at baseline frequencies is planned by PRTC

Color Code: Baseline elements are shown in **black**; the additional commuter bus elements discussed in Section 8 are shown in **red**; and the new recommended Priority Bus services are shown in **blue**.

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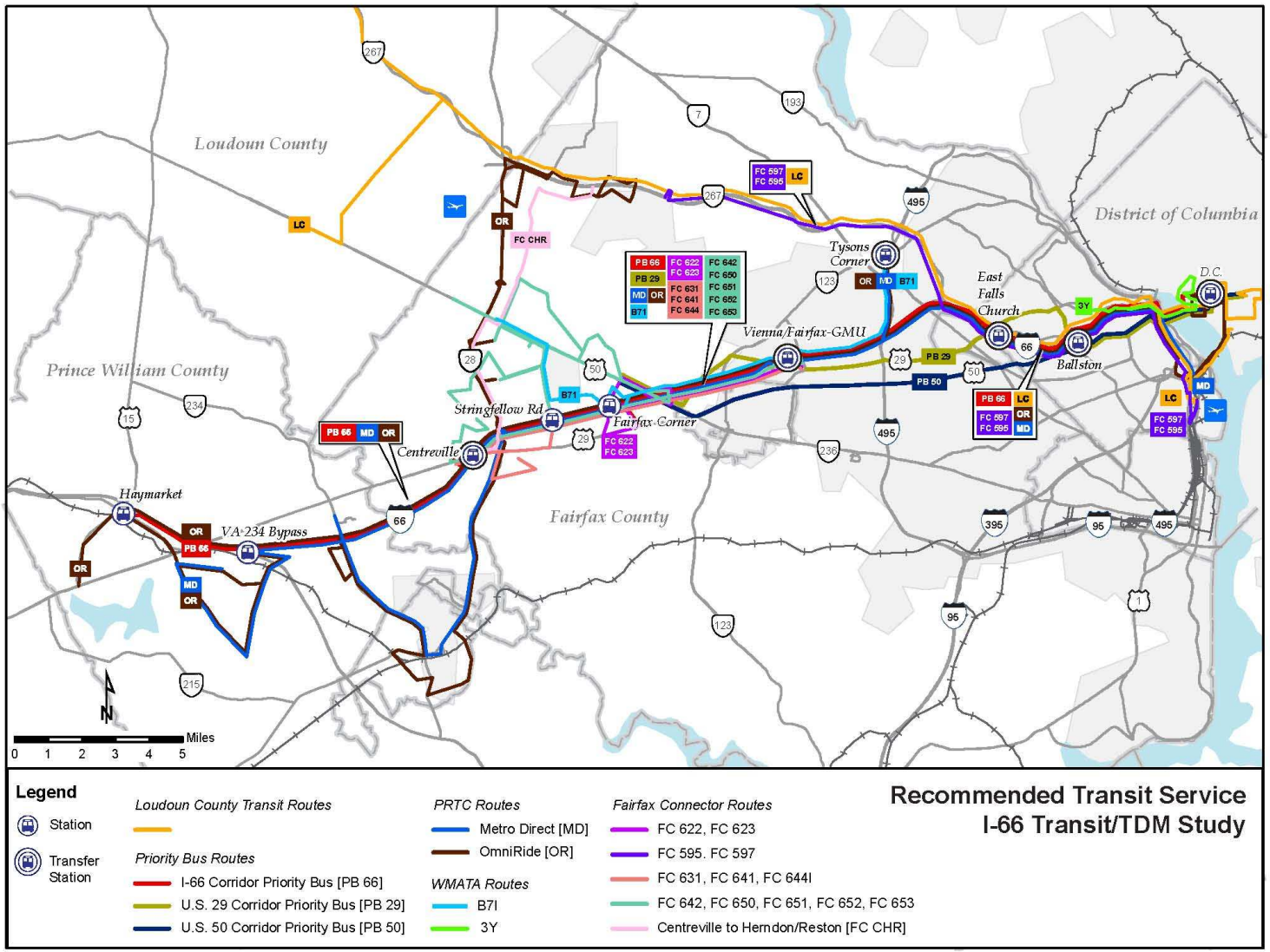
Figure 12-1. Recommended Transit Service



As shown in Table 12-1 through Table 12-7, all of the recommended Priority Bus stations are served by multiple routes and often multiple operators. This service structure provides feeder service to/from the surrounding neighborhoods and transfer opportunities to other transit services throughout the region.

12.2 TDM Recommendations

Three program tiers of TDM strategies representing varying levels of investment and market penetration were developed in the course of this study. TDM plays an important role in improving the quality of transportation in the I-66 corridor by providing a range of transportation options to residents and employees of the area. In addition, there are recommended TDM elements that focus on increasing awareness of and encouraging usage of transit services. Because of these potential benefits and the importance of high quality TDM programs illustrated by the market research survey, the highest tier of TDM services was recommended for implementation in the I-66 corridor.

The recommended TDM strategies are highlighted in this section for the horizon years of 2015 and 2030. Table 8-10 summarized the 15 strategies recommended for use in the corridor. These programs, their reference IDs (letters “A” through “O”), and their total estimated benefits are presented below. The TDM strategies were assumed to be implemented throughout the I-66 corridor study area, which would include areas adjacent to I-66 and residential areas that would be considered “feeders” to I-66 for commuting.

12.2.1 2015 Recommendations

This section summarizes the TDM program recommendations for implementation by the 2015 horizon year. This recommendation summary rolls up all three levels of implementation discussed in Section 8 into a single presentation. The nine programs collectively forming the program recommendation include:

A. Enhanced Corridor Marketing;

B. Vanpool Driver Incentive;

C. I-66 Corridor-Specific Startup Carpool Incentives;

D. Rideshare Program Operational Support;

E. Carsharing at Priority Bus Activity Nodes;

F. Bike Storage at Priority Bus Activity Nodes;

G. TDM Program Evaluation;

H. Enhanced Virginia Vanpool Insurance Pool; and

I. Enhanced Telework!VA.

A. Enhanced Corridor Marketing

This strategy adds targeted marketing (direct mail, newspaper advertisements) for TDM and transit along the corridor and in feeder markets. The strategy would increase awareness of transit options and supportive TDM program elements and encourage mode shift.

B. Vanpool Driver Incentive

This strategy provides incentives to attract new drivers and retain existing drivers for vanpools. The subsidy assumed for this strategy would be small, but it would still serve to encourage new vanpools, particularly in combination with other vanpool-supportive strategies. Since the vanpool rider would not receive this incentive, it is assumed to have a minimal trip reduction benefit separate from other vanpool strategies.

C. I-66 Corridor-Specific Startup Carpool Incentives

This strategy provides a three- to six-month carpool startup incentive for participating commuters along the I-66 corridor. Surveys conducted in Atlanta ("Cash for Commuter" program) and other regions have shown that startup incentives can generate new carpools with substantial retention – 65 percent continued carpool use after 12 months. It is assumed that participation is capped at 1,500 new participants per year.

D. Rideshare Program Operational Support

This strategy provides for additional staff for commuter assistance programs in the corridor and feeder markets to promote the TDM program and transit service and to provide additional employer outreach support. The staff are assumed to be primarily assigned to Fairfax County and Loudoun County programs.

E. Carsharing at Priority Bus Activity Nodes

This strategy expands the existing carshare program to include vehicles at Priority Bus activity nodes. Although not particularly useful for commute trips due to their daily costs and the round trip usage requirement, carsharing vehicles can provide flexibility to transit or carpool travelers and thus encourage transit use and ridesharing.

F. Bike Hubs/Storage at Priority Bus Activity Nodes

This strategy ensures that Priority Bus nodes near employment or residential activity centers include "bike hubs" with bike maintenance facilities, showers, personal lockers, and other services for bicyclists. Additional bicycle storage facilities (i.e., lockers) would be available at other nodes. A 2007 survey conducted in New Jersey of train station bike locker users estimated that about ten percent of locker users were previously driving alone and shifted to bike-train commuting. The remaining users were already using the train and had been previously accessing the station by auto, bus, or drop-off.

G. TDM Program Evaluation

This strategy provides for evaluation of travel and environmental benefits of TDM activities in Northern Virginia, with particular attention to benefits of I-66 corridor efforts. The evaluation process would include the development of performance indicators, collection of survey and tracking data, analysis of benefits, and recommendations for strategy refinements. Data collection would be phased over three year evaluation cycles.

H. Enhanced Virginia Vanpool Insurance Pool

This strategy provides affordable insurance coverage for vanpools by increasing the insurance premium buy-down for vanpools. By making insurance more affordable, an important financial incentive is provided to encourage vanpool formation.

I. Enhanced Telework!VA

The enhanced Telework!VA strategy adds new financial incentives for Virginia employers and/or extends the level of assistance currently available. According to the 2007 State of the Commute (SOC) survey for the MWCOG region, about 21 percent of Northern Virginia workers telework today, an average of 1.6 days per week. The potential for additional telework (consisting of people with telework-appropriate jobs who said that they want to telework) appears to be about 27 percent of office-based commuters and ten percent of non-office commuters, although the level of expected participation would be lower.

12.2.2 2030 Recommendations

The 2030 TDM programs and services recommended for 2030 are detailed in this section; these programs are in addition to those recommended for 2015. All fifteen programs are recommended for 2030 including:

A. Enhanced Corridor Marketing;

B. Vanpool Driver Incentive;

C. I-66 Corridor-Specific Startup Carpool Incentives (Expanded);

D. Rideshare Program Operational Support;

E. Carsharing at Priority Bus Activity Nodes;

F. Bike Hubs/Storage at Priority Bus Activity Nodes;

G. TDM Program Evaluation;

H. Enhanced Virginia Vanpool Insurance Pool;

I. Enhanced Telework!VA;

J. Northern Virginia Ongoing Financial Incentive;

K. Van Priority Access;

L. Capital Assistance for Vanpools;

M Flexible Vanpool Network;

N. SmartBenefits Subsidy Public Share;

O. Mobility Centers/Mobile Commuter Stores.

A. Enhanced Corridor Marketing

For 2030, this strategy is the same as detailed in the 2015 recommendations in Section 12.2.1.

B. Vanpool Driver Incentive

For 2030, this strategy is the same as detailed in the 2015 recommendations in Section 12.2.1.

C. I-66 Corridor-Specific Startup Carpool Incentives (Expanded)

For 2030, this strategy expands the market of the three- to six-month corridor-specific carpool startup incentives in the 2015 TDM program such that any commuter traveling to or from Northern Virginia for work is eligible to participate.

D. Rideshare Program Operational Support

For 2030, this strategy is the same as detailed in the 2015 recommendations in Section 12.2.1.

E. Carsharing at Priority Bus Activity Nodes

For 2030, this strategy is the same as detailed in the 2015 recommendations in Section 12.2.1.

F. Bike Hubs/Storage at Priority Bus Activity Nodes

For 2030, this strategy is the same as detailed in the 2015 recommendations in Section 12.2.1.

G. TDM Program Evaluation

For 2030, this strategy is the same as detailed in the 2015 recommendations in Section 12.2.1.

H. Enhanced Virginia Vanpool Insurance Pool

For 2030, this strategy is the same as detailed in the 2015 recommendations in Section 12.2.1.

I. Enhanced Telework!VA

For 2030, this strategy is the same as detailed in the 2015 recommendations in Section 12.2.1.

J. Northern Virginia Ongoing Financial Incentive

This strategy offers a small ongoing reward opportunity (e.g., prize drawings, etc.) as an incentive to commuters traveling to or from Northern Virginia using a non-SOV mode. The system would use Internet-based reporting/logging of days using non-SOV modes. The reward would be tied to the frequency of non-SOV use (e.g., similar to NuRide but offered to all non-SOV modes instead of just to carpoolers). Surveys conducted in Atlanta related to the “Commuter Prizes” program estimated that about 60 percent of participants switched from drive alone to a non-SOV mode.

K. Van Priority Access

This strategy allows vanpool vans to access bus-only infrastructure in the I-66 corridor.

L. Capital Assistance for Vanpools

This strategy provides financial assistance for the purchase or lease of vanpool vans.

M. Flexible Vanpool Network

This strategy develops and markets a network of overlapping vanpool routes which permit part-time ridership and flexibility for full-time riders to modify their vanpool schedule with a one-day advance reservation.

N. SmartBenefits Subsidy Public Share

This strategy provides a public agency contribution to employer-provided SmartBenefit transit/vanpool subsidies and shares the cost of these subsidies with employers. It is assumed to be offered to employers in the I-66 study area.

O. Mobility Centers/Mobile Commuter Stores

This strategy consists of self-serve kiosks or staffed commuter stores at I-66 Priority Bus stations offering personalized trip advice, transit information, and fare media. Alternatively, on-site commute assistance and fare sales could be provided through mobile commuter stores that park at Priority Bus nodes one or more days per week, but rotate to various stations.

12.3 Park-and-Ride Recommendations

12.3.1 Park-and-Ride Lot Capacity Expansions

Demand forecasting and analysis for park-and-ride lots in the I-66 corridor was detailed in Section 10 of this report. In developing recommendations for expanding parking capacity, the first priority in allocation of spaces was to provide parking for the proposed new facilities near Haymarket and Centreville. The second priority was to address areas with the largest difference between the forecasted demand and capacity.

Where new lots are recommended, transit service is also frequently recommended so as to provide a backbone for supplemental ridesharing activities. However, higher priority was given to expanding existing parking facilities over constructing new ones because travel behavior research has shown that there is usually inertia associated with the ridesharing and transit activities that occur at existing facilities and because the environmental and engineering processes are generally faster with lot expansion as compared with constructing an all new facility. The park-and-ride recommendations take into account the station sketch plans developed in Section 11 to help ensure that there is adequate space available for accommodating the recommended amount of parking at each station site.

Table 12-9 provides a summary of the 2015 and 2030 park-and-ride lot demand forecasts and the expansion recommendations. As detailed in Section 10, due to the physical and political obstacles of expanding parking facilities at the Metrorail stations in the corridor, the recommendations for park-and-ride expansion are based on the constrained demand forecasts, which assume no expansion at any of the WMATA owned lots. As was highlighted in Section 10, most of the growth in demand is forecast to occur by 2015. Because of this finding, and the desire to eliminate multiple phases of construction as much as possible, the majority of the lots are recommended for completion by 2015. Two lots in the corridor, Stringfellow Road and Monument Drive/Fairfax Corner, include recommendations for phased construction due to size restrictions of the recommended station plans provided in Section 11.

The recommendations include the addition of 2,650 spaces by 2015 and an additional 350 spaces by 2030 through capacity expansions at three existing lots and the construction of four new lots in the western end of the corridor. This represents a 25 percent increase in park-and-ride capacity in the corridor. Expansions are recommended at Limestone Drive, Stone Road – U.S. 29, and Stringfellow Road. Stringfellow Road, which will be served by the Priority Bus service, is recommended to include access and surface parking on both the north and south sides of I-66 as detailed in Section 11 of this report. To meet the forecast demand at this location, 300 spaces are recommended for construction on the northern site by 2015, with an additional 100 spaces on the southern site by 2030.

Of the four new lots, three will be served by the recommended I-66 Priority Bus service. The facility at VA 234 Bypass/Cushing Road, already in the advanced planning stage, is recommended for a 2030 build-out of 800 spaces. However, due to capacity constraints at the site, it will be necessary to construct 550 spaces on the initial site by 2015, and an additional 250 spaces on an adjoining site by 2030 (as shown in Figure 11-8). Prince William County is planning to construct a park-and-ride facility at Bull Run. The recommendation for 300 spaces at this location would accommodate the forecast demand at the Portsmouth Road Commuter Lot, the excess demand (above the current capacity) at the Manassas Mall lot, and the 90 spaces currently leased at the K-mart located very close to the proposed site. Figure 12-2 shows the geographic spread of the recommended 2030 park-and-ride capacity expansions.

Even though these recommendations do not include expansions of any of the WMATA parking facilities in the corridor, it should be noted that there exists substantial excess demand for parking at these locations. Should opportunities for expansion of the WMATA park-and-ride lots be presented, they should be seized and the parking facilities expanded in accordance with the unconstrained demand presented Section 10 of this report.

12.3.1 Real Time Parking Information

In June of 2009, WMATA completed the Feasibility Study of Real Time Parking Information at Metrorail Parking Facilities (Virginia Stations) to evaluate the feasibility of a real-time parking application for the Metrorail system, with the purpose of improving operations efficiency, reducing operating costs, encouraging more transit usage, and reducing congestion. The study presented best practices in the region and around the country and analyzed a comprehensive range of technological options for vehicle detection, data communication, and traveler information systems. The study recommends a hybrid system that includes both space and entry/exit detection as the most cost-efficient system for WMATA.

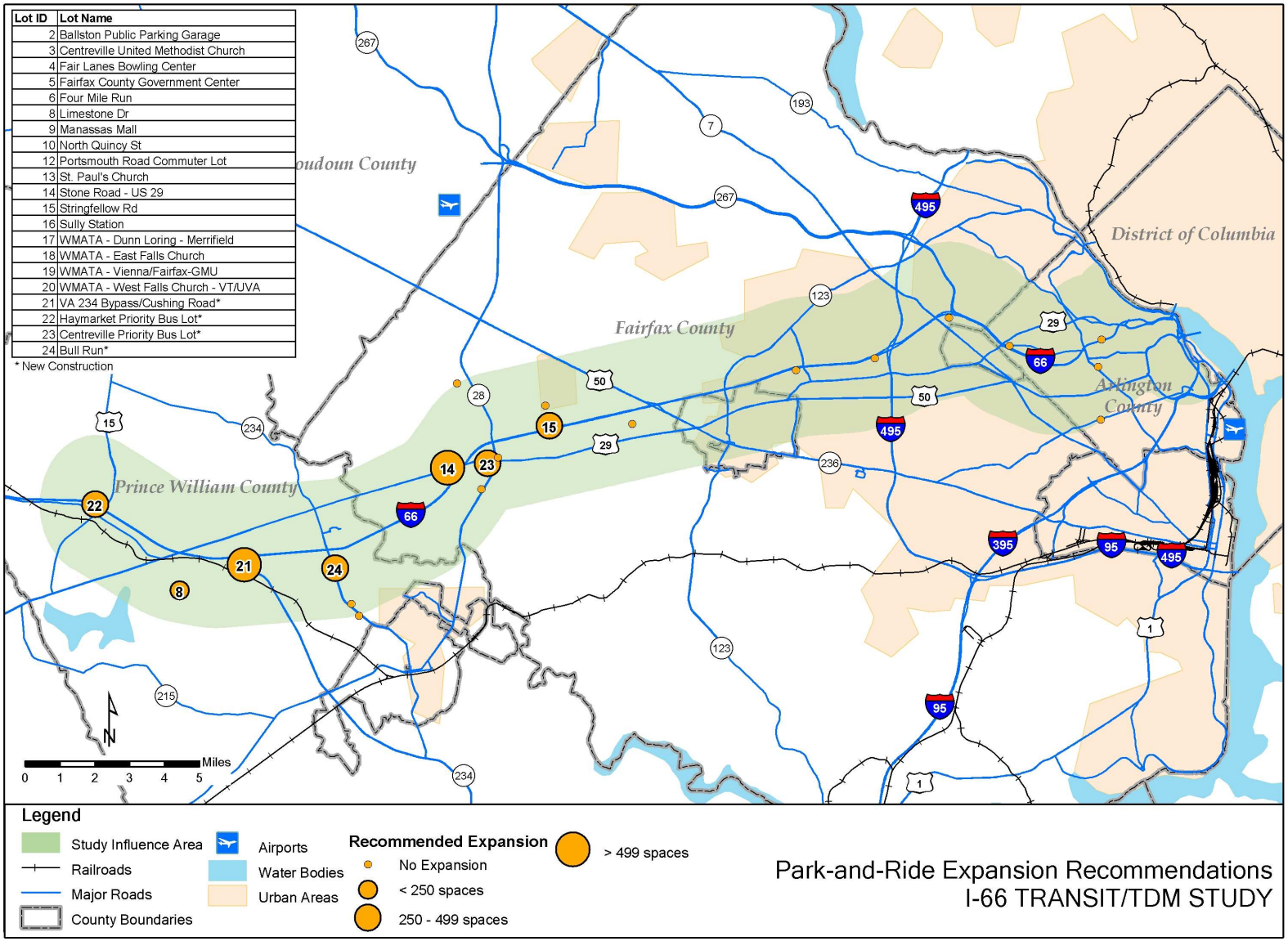
This type of system, if deployed at all of the Priority Bus stations and park-and-ride lots in the I-66 corridor, could have benefits for travelers throughout the study area. By providing real-time information about parking availability on the Internet, via portable devices, and on dynamic message signs en route to each park-and-ride facility, travelers will be better able to plan their morning commute and mode selection. The system could decrease congestion within the facilities by providing accurate information about parking availability. As detailed in the WMATA feasibility study, a pilot project of this real time parking information system is recommended for implementation at the West Falls Church Metrorail station.

Table 12-9. Park-and-Ride Lot Capacity Recommendations

Lot	Name	2009 Capacity	2009 Utilization	Constrained Model Demand		Recommended 2030 Capacity	Additional Spaces Needed	
				2015	2030		2015	2030
2	Ballston Public Parking Garage	804	20%	230	250	804		
3	Centreville United Methodist Church	147	40%	100	110	147		
4	Fair Lanes Bowling Center	32	10%	10	10	32		
5	Fairfax County Government Center	170	30%	90	100	170		
6	Four Mile Run	23	Full	30	30	23		
8	Limestone Dr	211	40%	220	300	350	150	
9	Manassas Mall	217	60%	230	280	217		
10	North Quincy St	78	Full	80	80	78		
12	Portsmouth Road Commuter Lot	630	10%	110	130	630		
13	St. Paul's Church	112	10%	20	20	112		
14	Stone Rd – U.S. 29	372	Full	660	760	850	500	
15	Stringfellow Rd	381	Full	670	740	800	300	100
16	Sully Station	41	10%	10	0	41		
17	Dunn Loring – Merrifield	1,326	Full	1,326	1,326	1,326		
18	East Falls Church	422	Full	422	422	422		
19	Vienna/Fairfax-GMU	5,169	Full	5,169	5,169	5,169		
20	West Falls Church	2,009	Full	2,009	2,009	2,009		
21	VA 234 Bypass/Cushing Road*	0	n/a	520	710	800	550	250
22	Haymarket Priority Bus Lot*	0	n/a	300	390	450	450	
23	Centreville Priority Bus Lot*	0	n/a	310	350	400	400	
24	Bull Run*	0	n/a	n/a	n/a	300	300	

* New construction

Figure 12-2. Recommended Park-and-Ride Capacity Expansions by 2030



12.4 Related Recommendations/Conclusions

The study resulted in additional recommendations and conclusions related to the major service and infrastructure improvements. The recommendations outlined in this section address non-motorized station access, transit-oriented development, integration with regional Priority Bus efforts, and items for further study.

12.4.1 Non-Motorized Station Access

As discussed in Section 3 of this report, each of the jurisdictions in the I-66 corridor maintains pedestrian and bicycle facilities that provide local and regional access for non-motorized transportation. Because access to transit stations is an important factor in travelers' decision to use transit (as highlighted in the Market Research presented in Section 5), these non-motorized networks should be connected to each of the eight Priority Bus stations recommended for the I-66 corridor.

The specific facilities recommended for each station depend on the individual context of the site and the surrounding neighborhoods, with some stations (e.g., Ballston) having facilities with a more urban character than other, more suburban stations (e.g., Haymarket). In addition to providing access to non-motorized travelers, the station area infrastructure should consider the safety of pedestrians and bicyclists; for example, at stations with large park-and-ride lots, accommodation will be necessary for pedestrians walking from their vehicles to the transit station through the parking lot. Detailed planning of station areas was not conducted as part of this study, but some of the facilities that are likely to be necessary include:

- Sidewalks;
- Crosswalks;
- Pedestrian crossing signage and signals;
- Trail connections;
- Bike lanes;
- Bike racks or other storage devices; and
- Pedestrian and bicycle wayfinding signage.

12.4.2 Transit-Oriented Development

Transit service works best for concentrated travel markets and requires supportive land use policies for optimum conditions. To the extent that transit-oriented development (TOD) can be encouraged, then it may be possible to develop transit services in markets that would not otherwise be successful. Transit-oriented development generally refers to development, with pedestrian priority, located within easy walking distance of a major public transit station or stop. TOD offers the potential to boost transit ridership, increase walking activity, mitigate sprawl, accommodate growth, and create interesting places. The I-66 Transit/TDM Study TAC expressed strong opinions that TOD considerations should be a part of new station planning as well as when considering redevelopment around existing transit hubs or activity centers in the corridor.

12.4.3 Priority Bus System Integration

Several of the recommended transit services include segments which travel into the District of Columbia. The TAC included representation from the District of Columbia Department of

Transportation and WMATA, and input from these members was considered in developing the service routing into D.C. which was tested in the evaluation phase of the study. Existing and improved direct bus service into the District of Columbia proved to be an attractive transit option. It is recommended that as plans evolve for the proposed K Street Transitway, the needs of Priority Bus services traveling from outside D.C. be addressed in a manner that will maintain the attractiveness of these services. Specifically, the potential for implementing bus priority lanes on corridor facilities leading to and entering D.C. should be explored, including on the Roosevelt Bridge and other runningway segments connecting to K Street.

12.4.4 Items for Further Study

A few items for further study emerged during the completion of this project which are beyond the present scope of work, but which warrant further consideration:

VA 28 Transit Service

The growth of population and employment in the Dulles corridor along VA 28 will continue to change travel patterns in the surrounding areas, and may ultimately impact travel along the I-66 corridor. As these changes occur, transit is likely to become both more desirable and more feasible as a commuting option in this area. However, the land use form and scale and the type of roadway facilities involved indicate that a separate study should be conducted as to how best transit ridership could be realized. Therefore, conducting such a study is among the related recommendations of this study. Indeed, a concept review of BRT lanes between U.S. 50 and the Dulles Toll Road is currently being considered as part of a study to develop 30 percent plans for widening VA 28.

Haymarket Transit Planning

As the recommended terminal station for the I-66 Priority Bus service, the location and composition of the Haymarket station are important issues. By working with members of the TAC, incorporating public input, and coordinating with the Town of Haymarket, two potential sites and sketch plans were developed as shown in Section 11 of this report. However, issues still remain to be addressed with this station site including future land development, station access, and park-and-ride development. Additional study is needed to determine which of the proposed station options would be preferred. Such a study could identify and select from among alternative locations the preferred location and form for a context-sensitive transportation hub and its associated parking facilities. Prince William County, the Town of Haymarket, the Potomac and Rappahannock Transportation Commission, Virginia Railway Express, VDOT, and DRPT would be potential stakeholders in such a study.

Corridor Rail Planning

As part of the long term future of the I-66 corridor, planning for extension of the regional rail system should be progressed, including the possibility for a Metrorail Orange Line extension beyond Vienna and/or an extension of the VRE Manassas Line. As planning and engineering for these potential rail extensions proceed, consideration should be given to opportunities for multi-modal stations in the I-66 corridor. Station area plans for any proposed stations should advance not only to inform rail planning but also to inform the synergistic development of appropriate Priority Bus infrastructure as a stepwise short- to medium-term improvement that lays the groundwork for rail (e.g., the site location and character of parking and station facilities).

12.5 Guide for Short Term Implementation

The recommended elements to be implemented in the short term can be staged in accord with how rapidly each can be implemented. The benefits from implementation of the recommendations can thus begin to accrue prior to 2015. In addition, identifying the elements which have short timeframes for implementation will enable the region to take advantage of any funding which may become available more quickly than other sources become available. This section is organized by recommendation area, as follows: transit recommendations, TDM recommendations, park-and-ride lot recommendations, related recommendations, and summary.

12.5.1 Transit Recommendations

Bus Acquisition and Bus Services – The recommendations of the plan provide for service implementation as of 2015. Lead times are generally about two years for acquisition of transit vehicles but will vary by service operator. Based on their own experiences with their vehicle vendors, PRTC and WMATA could start the procurement process as necessary to implement the services in the desired years. In addition, implementation of staged bus service improvements between 2010 and 2015 is possible and would provide for orderly development of corridor enhancements. PRTC and WMATA might identify staged bus service improvements between 2010 and 2015, depending on funding availability and demand. Given that each agency has many needs for new vehicles of these types, the timing of the needed 2015 vehicle purchases can occur earlier rather than later in the period from 2010 to 2014. In addition, the benefits of the new services can accrue immediately upon implementation of the services. Thus, if funding is available, bus investments and bus services can be pushed up prior to 2015.

Priority Bus Stations and Ramps – Eight priority bus stations and station access improvements are recommended by 2015. Based on the cost estimates, land acquisition costs are a slight majority of the costs of the stations, and since the development of the stations may have a long lead time in relation to other elements, short term funding for land acquisition and construction could proceed as rapidly as possible taking advantage of funding opportunities. Preliminary engineering work is already underway for the HOV ramps to and from the west to the Vienna Metrorail station area. HOV ramps recommended at two other Priority Bus stations – Stringfellow Road and Monument Drive/Fairfax Corner – would require preliminary engineering and design work in order to facilitate construction by 2015.

Runningway Improvements – This study recommends a two-foot wide painted buffer and appropriate signage to separate the general purpose lanes from the existing HOV lanes on I-66 outside the Capital Beltway to approximately U.S. 50 to improve reliability of this critical transit-supportive infrastructure. Engineering review and design in accordance with MUTCD standards can commence as soon as funding is available to enable the realization of the benefits at the earliest possible date.

12.5.2 TDM Recommendations

Nine different TDM programs are recommended for implementation by 2015. Incurring annual costs prior to 2015 would bring forward the benefits of the TDM actions. All of the 2015 TDM actions can be initiated and implemented immediately in the year 2010 or as soon as funding is available.

12.5.3 Park-and-Ride Lot Recommendations

New park-and-ride lot construction is preceded by consideration of potential environmental impacts and engineering work. For existing facilities, the environmental impact considerations

are reduced. The Stringfellow Road park-and-ride lot, an existing facility, might be expanded most immediately, particularly given the existing unmet demand and existence of land for expansion. Somewhat similarly, the engineering and planning work for the VA 234 Bypass/Cushing Road park-and-ride lot (550 spaces) is sufficiently advanced such that its development might be accelerated given funding. The remaining recommended new lots by 2015 on new locations – Haymarket (450 spaces), Bull Run (300 spaces), and Centreville (400 spaces) – can be expanded over the next five years after site identification, acquisition, and design. Implementation of real time parking information technology in the corridor could begin immediately given funding through implementation of the recommended pilot project at the West Falls Church Metrorail.

12.5.4 Related Recommendations

This study's additional recommendations include: non-motorized station access improvements, encouragement of transit-oriented development, integration of the I-66 Priority Bus system with planning for D.C. and the rest of Northern Virginia area, studying VA 28 transit service, Haymarket transit planning, and performing further rail planning in the corridor. To ensure the maximum benefits of the recommendations developed by this study, further planning studies are needed on these topics, and could proceed in the immediate term.

12.5.5 Summary

In summary, major opportunities exist to begin to accrue the benefits of the recommendations before 2015, and, should it be available, the required funding to implement the 2015 recommendations can usefully be applied in the time period from 2010 to 2014. Through the 2010 to 2014 period, such early-implementation elements include beneficial expenditures on the recommended elements of TDM operations, park-and-ride lots, initial vehicle acquisitions, and Priority Bus infrastructure (especially, runningway improvements).

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13.0 Cost and Revenue Projections

This section details both the capital and operating cost projections for all elements of the recommendations as detailed in Section 12, including transit service, transit stations, TDM strategies, runningway improvements, and park-and-ride lots. Revenues also are projected for the recommended transit service. Costs and revenues are estimated for both the 2015 and 2030 recommendations.

13.1 Transit Service Cost Projections

This section presents cost projections for the recommended transit service. The recommended transit service was presented in Section 12.1 and is largely based on the Refined Alternative developed in Section 8. Section 13.1 outlines important assumptions and data used to develop cost estimates along with summary estimates for the operation of transit service. Infrastructure cost estimates, including station and runningway improvements, are presented in Section 13.2. The TAC provided important input in developing the cost estimates for the recommended transit service. Both operating and vehicle cost data were obtained from the transit operators in the corridor.

Transit service costs are broken down into two major categories: service operation and vehicle acquisition. A summary of the estimates of costs and revenues for transit services is presented in Table 13-1. These estimates include all new recommended service planned for implementation in 2015 or later including planned PRTC and WMATA services and Priority Bus service. The many currently existing services or service changes planned for implementation by local jurisdictions before 2015 are not reflected in Table 13-1. Therefore, these costs represent an additional incremental cost incurred for new services in the corridor above what already exists or is planned for implementation before 2015.

The concept of present value guided the development of the cost estimates and all costs are expressed in current year (2010) dollars. For costs estimates obtained in 2008 dollars, a 3.0 percent annual escalation was used.[1] As shown, the transit service elements (including service operation and new vehicle acquisition) are projected to cost a total of more than $241 million between 2015 and 2030. These costs are in addition to the cost of the existing commuter bus and other transit services in the corridor that are currently operating or planned for implementation before 2015.

Table 13-1. Transit Service Cost Summary

Element	2015-2030 Total Cost (2010 dollars)
Operating Costs	$237,051,301
Operating Revenues	$78,886,740
Vehicle Costs	$83,200,000
Total Net Costs	**$241,364,561**

[1] Escalation rate is based on consumer price index (CPI) data

13.1.1 Operating Costs and Revenues

This section provides detailed operating cost and revenue estimates for each of the individual transit services recommended beyond the baseline scenario. In order to estimate costs and revenues through 2030, the following assumptions were applied:

- Table 12-1 outlined which services were included in only the 2030 recommendations and which were included in both the 2015 and 2030 recommendations. For the purpose of cost and revenue estimation, services included in the 2015 recommendations are assumed to begin in 2015. New services in the 2030 recommendations are assumed to begin in 2030.

- A straight cost per hour model was used for operating costs (rather than a multiple variable cost model). The level of accuracy using this methodology is sufficient given that the estimates are for a 15-year time horizon.

- Cost per vehicle hour figures were used. Vehicle hours were used rather than revenue hours since this allowed for more accurate inclusion of deadhead hours which vary among the services. In 2010 dollars, the incremental cost per vehicle hour figures applied were:
  - WMATA: $95.79
  - PRTC: $91.21

- Deadhead assumptions were developed for each recommended route based on the proposed operator and the route characteristics as follows:
  - PRTC services: 53.7424 percent based on data provided by PRTC;
  - WMATA bi-directional services: 20 percent based on WMATA service data; and
  - WMATA commuter (one-directional) services: 100 percent assuming a return to the garage mid-day.

- Operating revenues were assumed based on an assumed farebox recovery ratio appropriate for each operator and/or type of service, although the actual farebox revenue for each service will not be known until after the service has started. Farebox recovery ratios were determined based on local data provided by the operating agencies in the corridor as follows:
  - Commuter Service (PRTC and WMATA) – assumed 50 percent
  - Metrobus Express Services (WMATA) – assumed 25 percent

Table 13-2 details the estimated operating costs and revenues for each element of the recommended transit service. Annual operating costs (in 2010 dollars) in 2015 are estimated at $14.6 million with an increase to $17.4 million when all services are in place in 2030. Annual farebox revenues in 2015 are estimated at approximately $4.5 million for an overall farebox recovery ratio of 31 percent; in 2030, farebox revenues increase to approximately $6.2 million for a 36 percent overall farebox recovery ratio.

Table 13-2. Transit Service Cost and Revenue Estimates by Route

Operator	Description	Operating Cost per Vehicle Hour	2015 Costs			2030 Costs			Total Costs for 2015 through 2030			
			Annual Operating Cost	Vehicles Needed	Capital (Vehicle) Cost	Annual Operating Cost	Vehicles Needed	Capital (Vehicle) Cost	Total Operating Costs	Total Capital (Vehicle) Costs	Total Projected Farebox Revenue	Net Total Costs
PRTC	**Haymarket/Gainesville – Metro-Direct** - New route in 2015 which will provide service from the Haymarket and VA 234 Bypass park-and-ride lots to Tysons Corner, peak hours in peak direction only. No changes to 2030.	$91.21	$510,432	4	$2,080,000	$510,432	4	$2,080,000	$8,166,905	$4,160,000	$4,083,452	$8,243,452
PRTC	**Manassas Metro-Direct*** -In 2015, PRTC will be extending this route to Tysons Corner and discontinue service to West Falls Church Metro. No changes to 2030.	$91.21	$328,135	2	$1,040,000	$328,135	2	$1,040,000	$5,250,153	$2,080,000	$2,625,076	$4,705,076
PRTC	**Manassas – Dulles OmniRide** - In 2030, addition of new route from Manassas to the VA 28 corridor and Dulles International Airport (four a.m. peak period trips and four p.m. peak period trips, peak direction only)	$91.21	--	--	--	$320,843	4	$2,080,000	$320,843	$2,080,000	$160,421	$2,240,421
PRTC	**Gainesville/Haymarket – Dulles OmniRide -** In 2030, addition of new route with service to the VA 28 corridor and Dulles International Airport, peak direction only.	$91.21	--	--	--	$466,680	4	$2,080,000	$466,680	$2,080,000	$233,340	$2,313,340
PRTC	**West County – Reston/Herndon OmniRide -** In 2030, addition of new service from western Prince William County to the Reston-Herndon area, peak direction only.	$91.21	--	--	--	$466,680	4	$2,080,000	$466,680	$2,080,000	$233,340	$2,313,340
PRTC	**Gainesville OmniRide –** New route by 2015, follows existing Linton Hall Metro-Direct local routing with extension to D.C. with 30 minute headways. Peak hours in peak directions only. No changes to 2030.	$91.21	$1,166,701	8	$4,160,000	$1,166,701	8	$4,160,000	$18,667,210	$8,320,000	$9,333,605	$17,653,605
PRTC	**Haymarket to D.C. Priority Bus (PB66H) -** New line-haul service along I-66 corridor from Haymarket to D.C. with limited stops, peak hours and peak direction only. 30 minute headways in 2015, 15 minute headways in 2030.	$91.21	$666,686	5	$2,600,000	$1,333,372	10	$5,200,000	$11,333,663	$7,800,000	$5,666,832	$13,466,832
WMATA	**Centreville to D.C. Priority Bus (PB66C) -** New line-haul service along I-66 corridor from Centreville to D.C. with limited stops, peak hours and peak direction only. 30 minute headways in 2015, 15 minute headways in 2030.	$95.79	$828,852	5	$3,000,000	$1,625,825	10	$6,000,000	$14,058,600	$9,000,000	$7,029,300	$16,029,300
WMATA	**U.S. 29 Metrobus Express -** Fair Oaks Mall - Ballston - D.C. - Superimpose new Metrobus Express Service over existing WMATA service along U.S. 29 and extend into D.C. along K Street Busway with stops in Rosslyn, Farragut, 15th/Vermont, and 9th Street. Service 6 a.m. to 8 p.m. in both directions with 12 minute headways. No change to 2030.	$95.79	$4,844,756	15	$9,000,000	$4,844,756	15	$9,000,000	$77,516,091	$18,000,000	$19,379,023	$76,137,068
WMATA	**U.S. 50 Metrobus Express -** Fair Oaks Mall - Ballston - D.C. - Superimpose new Metrobus Express Service over existing WMATA service along U.S. 50 and extend into D.C. along K Street Busway with stops in Rosslyn, Farragut, 15th/Vermont, and 9th Street. Service 6 a.m. to 8 p.m. in both directions with 12 minute headways. No change to 2030.	$95.79	$5,064,972	15	$9,000,000	$5,064,972	15	$9,000,000	$81,039,550	$18,000,000	$20,259,887	$78,779,662
WMATA	**Dulles – Chantilly to Tysons Corner (B7I) -** In 2030, addition of new route between VA 28 corridor and Tysons Corner via I-66.	$95.79	$1,235,308	8	$4,800,000	$1,235,308	8	$4,800,000	$19,764,925	$9,600,000	$9,882,463	$19,482,463
	TOTAL		**$14,645,840**	**62**	**$35,680,000**	**$17,363,702**	**84**	**$47,520,000**	**$237,051,301**	**$83,200,000**	**$78,886,740**	**$241,364,561**

*Cost estimate is for the extension of the route, and does not include the cost to operate the existing portion of the route.
All costs are expressed in 2010 dollars.

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13.1.2 Vehicle Costs

The provision of additional transit service requires additional vehicles; the cost for vehicle acquisition for each element of the transit service recommendations is included in Table 13-2. Total vehicle costs between 2015 and 2030 are estimated at $83.2 million in 2010 dollars. These estimates are based on the following vehicle costs assumptions:

- The cost of vehicles was calculated as the actual dollars needed to be expended to purchase vehicles during the 15 year period instead of using a depreciated capital cost for vehicles.
- All vehicles are assumed to have a useful life of 12 years. Therefore, all vehicles purchased in 2015 will need to be replaced in 2027.
- The following schedule of vehicle costs was used in 2010 dollars:
  - PRTC: 45-foot Over the Road Standard Commuter Coach for a cost of $520,000;
  - WMATA: 43-foot Low Floor Hybrid Electric Bus for a cost $600,000.
- All services are assumed to maintain a 20 percent spare ratio.

13.2 Transit Station Cost Projections

The construction and improvement of Priority Bus stations represents the major infrastructure cost for the transit recommendations as presented in Section 12 of this report. The recommended Priority Bus element includes service to seven stations along the length of the corridor and a station in the D.C. core.

The Priority Bus station cost projections comprise many elements including station facilities, access roadways, pedestrian and bicycle facilities, transit priority treatments, and land acquisition. Land acquisition for right-of-way, station areas, access roadway facilities, and parking lots are included in these cost estimates, but the cost to construct the parking lot is not; park-and-ride lot cost estimates are provided separately in Section 13.4. Details about the assumptions used to develop the station estimates are provided in Section 11.4 of this report; detailed cost estimates for each of the stations studied can be found in Appendix H.

Table 13-3 shows the total projected costs for each of the seven stations to be constructed or improved. For the planned 2015 stations, the total projected cost is $57.3 million. For 2030, an additional $112.2 million in improvements are recommended, for a total projected cost of $169.5 million. Of these total costs, approximately 24 percent are related to the acquisition of land and right-of-way.

Table 13-3. Projected Priority Bus Station Costs (in millions)

	2015 Cost Estimate			2030 Cost Estimate			Total Cost Estimate		
Station	**Land Acquisition Cost**	**Construction Cost**	**Total**	**Land Acquisition Cost**	**Construction Cost**	**Total**	**Land Acquisition Cost**	**Construction Cost**	**Total**
Haymarket*	$12.4	$3.2	$15.6	-No Further Improvements-			$12.4	$3.2	$15.6
VA 234 Bypass	$3.2	$2.6	$5.8	$5.9	$17.5	$23.5	$9.1	$20.2	$29.2
Centreville	$7.8	$2.3	$10.1	$1.6	$9.9	$11.5	$9.4	$12.2	$21.6
Stringfellow	$7.3	$6.6	$14.0	$1.8	$7.2	$9.0	$9.2	$13.8	$23.0
Monument Drive/Fairfax Corner	$0.0	$6.6	$6.6	-No Further Improvements-			$0.0	$6.6	$6.6
East Falls Church	$0.0	$2.3	$2.3	$0.0	$68.2	$68.2	$0.0	$70.5	$70.5
Ballston	$0.0	$2.9	$2.9	-No Further Improvements-			$0.0	$2.9	$2.9
Total	**$30.6**	**$26.7**	**$57.3**	**$9.4**	**$102.9**	**$112.2**	**$39.9**	**$129.6**	**$169.5**

* Cost estimates for the Haymarket station assume the more expensive of the two options presented in Section 11, Option 2.

All cost are expressed in 2010 dollars

13.3 TDM Cost Projections

The recommended TDM programs are detailed in Section 12.2 of this report for the horizon years of both 2015 and 2030. Cost estimates for these recommendations are presented below.

13.3.1 TDM Cost Assumptions

The fifteen programs recommended for the I-66 corridor were first introduced along with their identifiers (letters "A" through "O") in Table 8-10. The assumptions used to develop cost estimates for each of the recommended TDM programs include:

- **Vanpool Driver Incentive (B) –** This program assumes a driver subsidy of $250 per driver per year.
- **Corridor-Specific Startup Carpool Incentive (C) –** Program assumes an incentive of $100 per person in 2015 and $125 per person in 2030. Additional administrative costs of $25,000 per year.
- **Carsharing at Priority Bus Activity Nodes (E) –** Costs are assumed to be borne by the carshare vendor. Some additional costs would be captured in the enhanced marketing program (A) costs. Some other costs may include foregone parking revenue for carshare spaces if they are provided to the vendor at no cost.
- **Bike Hubs/Storage at Priority Bus Activity Nodes (F) –** Capital costs assumed to be $250 per two-bike rack and $3,000 per two-bike locker unit. Bike locker fees are assumed to generate $100 per locker per year in revenues.
- **Enhanced Virginia Vanpool Insurance Pool (H) –** Assumes that the existing statewide vanpool insurance pool would be expanded by $1.5 million, and that ten percent of these funds will be provided by entities in the Northern Virginia region.
- **Capital Assistance for Vanpools (L) –** This program assumes a cost of approximately $1,500 per van per year.
- **Smart Benefits Subsidy Public Share (N) –** This program assumes that the public will cover 25 percent of a $100 monthly benefit, or $25 per month per participant.

13.3.2 Cost Projections

Table 13-4 details the projected costs by horizon year for both operating and capital expenses. The operating costs represent the annual projected cost for implementing a specific program at the high tier level for each horizon year; the 2030 annual cost projections include the cost of implementing the 2015 recommendations as well. As shown, implementation of the high tier recommendations is projected to cost approximately $1.5 million annually in 2015 and over $3.5 million annually by 2030. The table also includes the capital costs for each of the recommended TDM programs. The total costs for 2015 through 2030 include operating expenses for the 16-year period, in addition to all capital expenses. As shown, for this time period, the TDM recommendations will require $31.6 million in operating and capital funds. As with the transit improvements, programs and services listed in the 2030 recommendations are assumed to begin service in 2030.

Table 13-4. TDM Cost Projections

Program		2015 Costs		2030 Costs		Total Costs for 2015 through 2030		
		Annual Operating Cost	Capital Cost	Annual Operating Cost	Capital Cost	Total Operating Costs	Total Capital Costs	Total Net Costs
A	Enhanced Corridor Marketing	$350,000	$0	$350,000	$0	$5,600,000	$0	$5,600,000
B	Vanpool Driver Incentive	$5,000	$0	$5,000	$0	$80,000	$0	$80,000
C	Corridor-Specific Startup Carpool Incentives	$175,000	$0	$575,000	$0	$3,200,000	$0	$3,200,000
D	Rideshare Program Operational Support	$400,000	$0	$400,000	$0	$6,400,000	$0	$6,400,000
E	Carsharing at BRT Activity Nodes	$0	$0	$0	$0	$0	$0	$0
F	Bike Hubs/Storage at BRT Activity Nodes	$0	$5,195,000	$0	$0	$0	$5,195,000	$5,195,000
G	TDM Program Evaluation	$300,000	$0	$300,000	$0	$4,800,000	$0	$4,800,000
H	Enhanced Virginia Vanpool Insurance Pool	$0	$150,000	$0	$0	$0	$150,000	$150,000
I	Enhanced Telework!VA	$250,000	$0	$250,000	$0	$4,000,000	$0	$4,000,000
J	Northern Virginia Ongoing Financial Incentive	$0	$0	$275,000	$0	$275,000	$0	$275,000
K	Van Priority Access	$0	$0	$0	$0	$0	$0	$0
L	Capital Assistance for Vanpools	$0	$0	$100,000	$0	$100,000	$0	$100,000
M	Flexible Vanpool Network	$0	$0	$125,000	$0	$125,000	$0	$125,000
N	Smart Benefits Subsidy Public Share	$0	$0	$700,000	$0	$700,000	$0	$700,000
O	Mobility Centers/Mobile Commuter Stores	$0	$0	$500,000	$500,000	$500,000	$500,000	$1,000,000
Total		$1,480,000	$5,345,000	$3,580,000	$500,000	$25,780,000	$5,845,000	$31,625,000

All costs are expressed in 2010 dollars.

13.4 Park-and-Ride Cost Projections

Recommendations for the expansion of park-and-ride lots in the I-66 corridor are detailed in Section 12.3; cost projections based on these recommendations are provided in this section. These cost estimates assume that all lots will be constructed as surface lots at a cost of $10,000[2] per space. These estimates include only construction costs; right-of-way and land acquisition for any of these lots is included as an element of the station construction cost projections in Section 13.2. As shown in Table 13-5, the total projected cost to construct 3,000 new park-and-ride spaces is approximately $30 million.

Table 13-5. Park-and-Ride Lot Cost Projections

		2015		2030		Total Projected Cost
Lot	Name	Spaces Needed	Cost	Spaces Needed	Cost	
2	Ballston Public Parking Garage					
3	Centreville United Methodist Church					
4	Fair Lanes Bowling Center					
5	Fairfax County Government Center					
6	Four Mile Run					
8	Limestone Dr	150	$1,500,000			$1,500,000
9	Manassas Mall					
10	North Quincy St					
12	Portsmouth Road Commuter Lot					
13	St. Paul's Church					
14	Stone Rd – U.S. 29	500	$5,000,000			$5,000,000
15	Stringfellow Rd	300	$3,000,000	100	$1,000,000	$4,000,000
16	Sully Station					
21	VA 234 Bypass/Cushing Road*					
17	WMATA – Dunn Loring – Merrifield					
18	WMATA – East Falls Church					
19	WMATA – Vienna/Fairfax-GMU					
20	WMATA – West Falls Church	550	$5,500,000	250	$2,500,000	$8,000,000
22	Haymarket Priority Bus Lot*	450	$4,500,000			$4,500,000
23	Centreville Priority Bus Lot*	400	$4,000,000			$4,000,000
24	Bull Run*	300				
Total		**2,650**	**$26,500,000**	**350**	**$3,500,000**	**$30,000,000**

* Indicates not an expansion of an existing facility

All costs are expressed in 2010 dollars.

In addition to these capacity expansions, this study also recommends the implementation of a Real Time Parking Information System Pilot Project. This project, as detailed in WMATA's 2009 Feasibility Study, would be implemented at the West Falls Church Metrorail station for 18 months.

[2] Source: VDOT

The estimated costs for this pilot project include $955,000 in capital costs and $237,000 in operating and maintenance costs.

13.5 Additional Related Costs

In addition to the costs associated with each station, Section 12.4.4 recommends implementation of a two-foot painted buffer with designated entry and exit points between the HOV and general purpose lanes. The estimated cost for this project is $2 million.

13.6 Overall Cost and Revenue Projections

Table 13-6 summarizes the total capital and operating costs for all the elements of this study's recommendations. The costs shown in the summary table include all transit services, Priority Bus stations[3], TDM programs, the I-66 HOV lane buffer, and all park-and-ride lot improvements. As shown, the total cost between 2015 and 2030 for these recommendations is approximately $475 million, the majority of which is capital costs associated with park-and-ride lot expansions, construction of Priority Bus stations, and the purchase of vehicles.

Table 13-6. Summary Cost Projections (in millions)

	Annual Net Operating Costs*		Capital Costs		Total Costs for 2015 through 2030		
Plan Element	**2015**	**2030**	**2015**	**2030**	**Annual Operating Cost**	**Total Capital Cost**	**Total Net Cost**
Transit Services	$10.1	$11.1	$35.7	$47.5	$158.2	$83.2	$241.4
Priority Bus Stations	--	--	$57.3	$112.2	--	$169.5	$169.5
Runningway Improvements	--	--	$2.0	--	--	$2.0	$2.0
TDM Programs	$1.5	$3.6	$5.3	$0.5	$25.8	$5.8	$31.6
Park-and-Ride	$0.2	--	$26.5	$3.5	$0.2	$30.0	$30.2
Total	**$11.8**	**$14.7**	**$126.8**	**$163.7**	**$184.2**	**$290.5**	**$474.7**

*Operating costs are net of farebox revenues.

All costs are expressed in 2010 dollars.

[3] Priority Bus station costs assume the selection of the Haymarket-Option 2 station (north side of I-66). Lower costs are associated with Option 1.