REPORT OF THE
COMMONWEALTH TRANSPORTATION BOARD

Interstate 95 Interim Corridor Improvement Plan (HJR 581, 2019)

TO THE GOVERNOR AND
THE GENERAL ASSEMBLY OF VIRGINIA

HOUSE DOCUMENT NO. 6

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Interstate 95

Interim Corridor Improvement Plan

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VDOT

Office of INTERMODAL Planning and Investment

DRPT Virginia Department of Rail and Public Transportation

INTERSTATE 95

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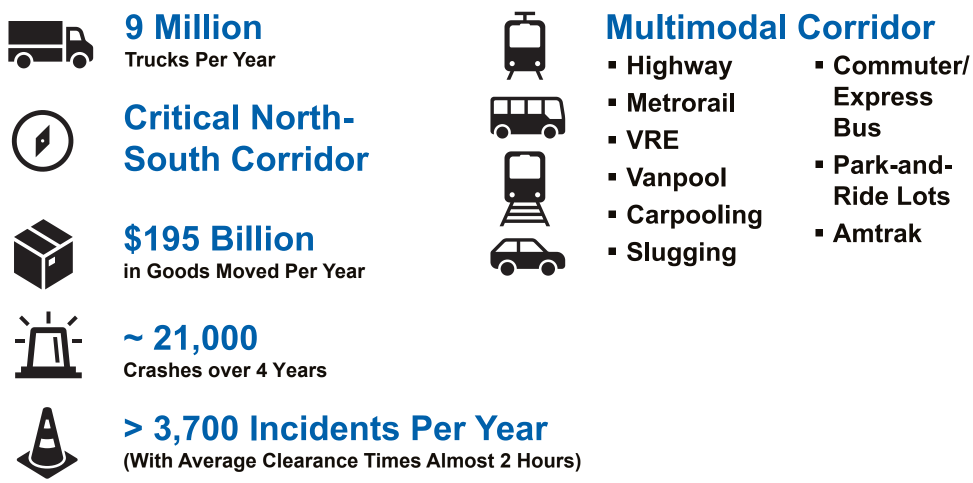
Introduction

I-95 is the primary interstate corridor on the East Coast of the U.S. with more than 1,900 miles between Maine and Florida. This corridor serves 38 percent of all US jobs, which represents the second largest economy in the world. According to the I-95 Corridor Coalition, by 2035, 100 percent of the urban segments will be heavily congested and 55 percent of the non-urban segments will see increased congestion. I-95 serves as a vital conduit for Virginia's urban crescent, connecting the Richmond, Fredericksburg, and Washington, DC, metropolitan regions—a population of almost 3.5 million. In Virginia, I-95 provides north-south movement of people, goods, and freight, with every mode of transportation represented, as shown by the breadth of travel options and amenities in **Figure 1**. Approximately nine million trucks and almost $200 billion in goods are moved through the corridor per year, second only to the I-81 corridor in Virginia.

FIGURE 1 SIGNIFICANCE OF THE I-95 CORRIDOR



Rail is an important travel mode in the I-95 corridor. CSX's north-south intermodal mainline in Virginia is part of CSX's multi-state National Gateway Initiative, generally paralleling I-95. This route provides service from Washington, DC, to Richmond and then farther south via Petersburg and Emporia. At Weldon, south of the Virginia/North Carolina border, this mainline has an eastward extension to the Port of Virginia facilities in Hampton Roads. The CSX National Gateway Initiative will improve the efficiency of container movements between the Mid-Atlantic and the Northeast/Midwest by clearing obstructions that currently limit double stack train operations in the I-95 corridor, as well as improving train operations to and from the Port of Virginia.

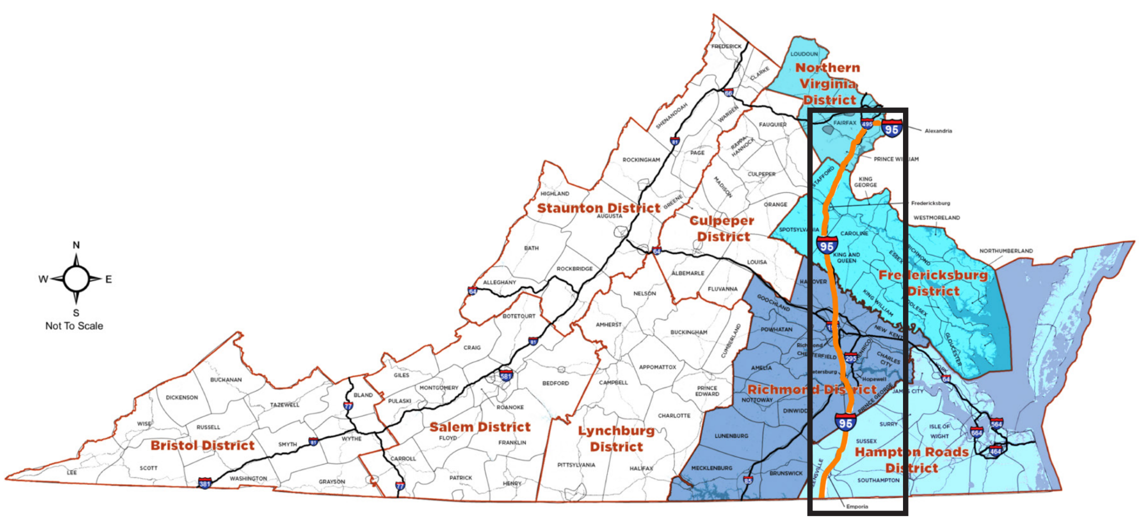
In addition to the National Gateway Initiative, Governor Northam announced a partnership with CSX on December 19, 2019. As part of the announcement, Virginia will make over $3 billion in capital improvements between Washington, DC, and Richmond, VA. The improvements include removing one of the largest rail bottlenecks on the East Coast, called Long Bridge. This new Virginia-led rail expansion program is expected to remove 5 million cars and one million trucks off of Virginia's highways each year, while propelling the Port of Virginia towards its goal of moving 40% of containers by rail.

Study Request

During the 2019 Virginia General Assembly Session, the Senate and House of Delegates approved similar resolutions (SJR 276 and HJR 581) requesting the Commonwealth Transportation Board (CTB) study the 52 miles of the I-95 corridor between Exit 118 (Thornburg) in Spotsylvania County and Exit 170 (I-495/I-395) in Fairfax County along with potential financing options for improvements to the corridor. The Office of Intermodal Planning and Investment (OIPI), the Virginia Department of Transportation (VDOT), and the Department of Rail and Public Transportation (DRPT) jointly conducted this study resulting in the I-95 Corridor Improvement Plan (Plan).

The Secretary of Transportation and the CTB requested that the study area for the Plan be expanded to include all 179 miles of I-95 in Virginia between the North Carolina state line in Greensville County and the Woodrow Wilson Bridge in Alexandria as shown in **Figure 2**. The corridor traverses twelve counties, six cities, and four VDOT construction districts: Northern Virginia, Fredericksburg, Richmond, and Hampton Roads. Also, this study includes the development of a corridor-wide operations plan and evaluation of two key parallel routes to I-95—U.S. 1 and U.S. 301—to identify strategies and improvements to more efficiently accommodate diversions of traffic, especially during major incidents on I-95.

FIGURE 2 STUDY AREA FOR CORRIDOR IMPROVEMENT PLAN



Study Purpose

The purpose of this project is to identify a package of targeted operational, multimodal, and capital improvements that are expected to deliver faster, safer, and more reliable travel on I-95 throughout Virginia.

According to SJR 276 and HJR 581, a 2017 nationwide study conducted by the Texas Transportation Institute ranked southbound I-95 at Exit 133A in Fredericksburg as having the worst traffic congestion in the nation. According to that study, this location is projected to cost drivers $2.3 billion from 2017 through 2026 in time lost, fuel wasted, and carbon emitted. Additionally, northbound I-95 between Exit 126 (US 1/Route 17) in Spotsylvania County and Exit 143 (Route 610) in Stafford County was ranked the seventh worst traffic hotspot in the nation with a projected cost to drivers of $1.1 billion. The Northern Virginia portion of the Washington, DC, metropolitan region is projected to grow by 20 percent in population and 25 percent in employment by 2040, placing additional strain on the I-95 corridor and the transportation system in general.

Multimodal Corridor Characteristics

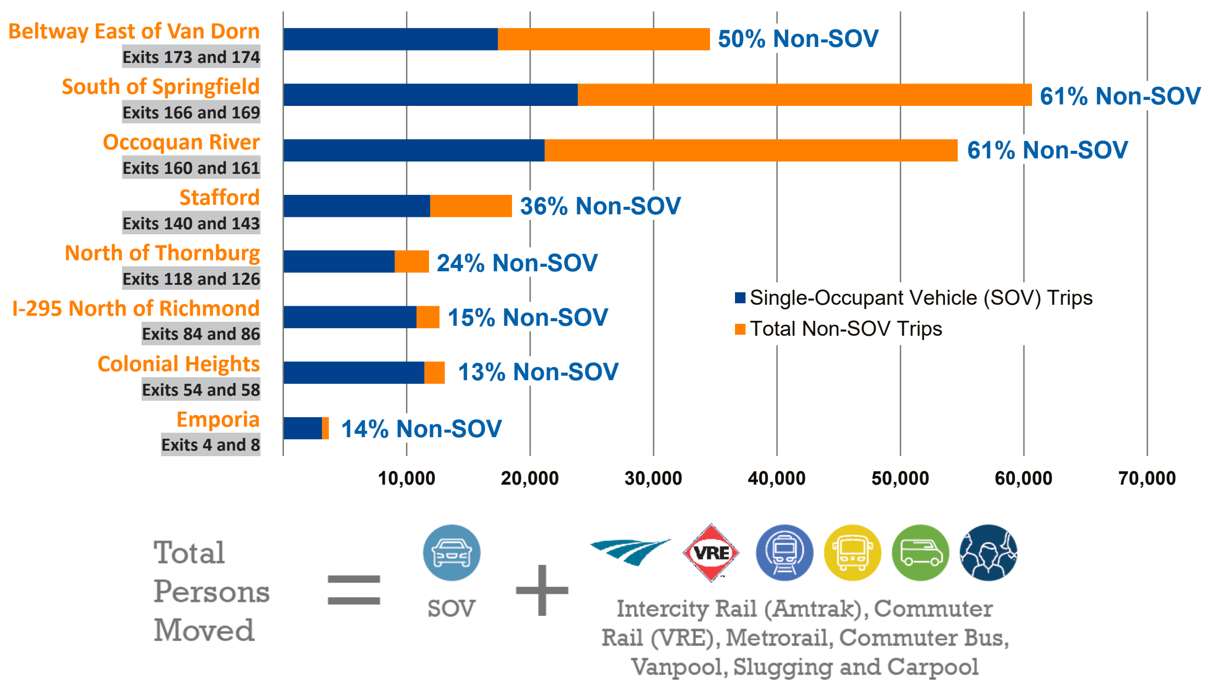
The I-95 corridor is one of the most multimodal interstate corridors within Virginia. Multimodal travel options such as bus, rail, carpool, and vanpool contribute greatly to moving people in the I-95 corridor, offering a wide array of alternatives to Single-Occupancy Vehicle (SOV) travel. Rail service along the corridor is provided by Virginia Railway Express (VRE) (commuter rail), Amtrak (intercity and long-distance passenger rail), and Washington Metropolitan Area Transportation Authority (WMATA) (Metrorail/heavy rail). Commuter bus service is a popular commuting choice along the northern section of the I-95 corridor, with several providers offering service to key employment hubs including Tysons, Mark Center, the Pentagon, Crystal City, Rosslyn, Ballston, and Washington, DC.

Park-and-ride lots also contribute positively to multimodal travel along the corridor. The availability of commuter parking not only enables even more people to make use of bus and rail systems when co-located with transit hubs, but also helps to enable a robust culture of carpooling and vanpooling, including slugging—ad hoc, informal carpools for purposes of commuting. Commuter assistance programs, such as Commuter Connections, Go Alex, Fairfax County Commuter Services, Potomac and Rappahannock Transportation Commission (PRTC) OmniMatch, GWRideConnect, and RideFinders, provide residents, employers, and workers along the I-95 corridor with travel options information, trip planning, guaranteed ride home, and multimodal ridematching services.

Additionally, the presence of the I-95 Express Lanes between the Fredericksburg region and the I-495 Beltway around Washington, DC, makes bus travel along the corridor more reliable and incentivizes carpooling and vanpooling as vehicles with three or more people do not pay a toll. Traffic and occupancy counts indicate that during peak periods, the Express Lanes on I-95 are carrying more people than the general purpose lanes.

Throughout the corridor, the availability of these multimodal travel options facilitates tens of thousands of commutes each weekday. To better understand and illustrate the levels of persons moved along the corridor on a typical weekday, the study team divided the corridor into eight representative segments, as shown in **Figure 3**. Multimodal travel is most prominent in the areas of Northern Virginia and Fredericksburg, which are characterized by higher densities of population, employment, and transit service. As an example, in the I-95 corridor between the Occoquan River and I-495, more than 60 percent of all weekday commute trips are made by a combination of rail, bus, vanpool, and carpool trips. The proportion of multimodal trips at the southern end of the corridor is consistent with the more limited amount of commute options available and generally lower density of development.

FIGURE 3 SINGLE AND HIGH OCCUPANCY VEHICLE USE ALONG I-95

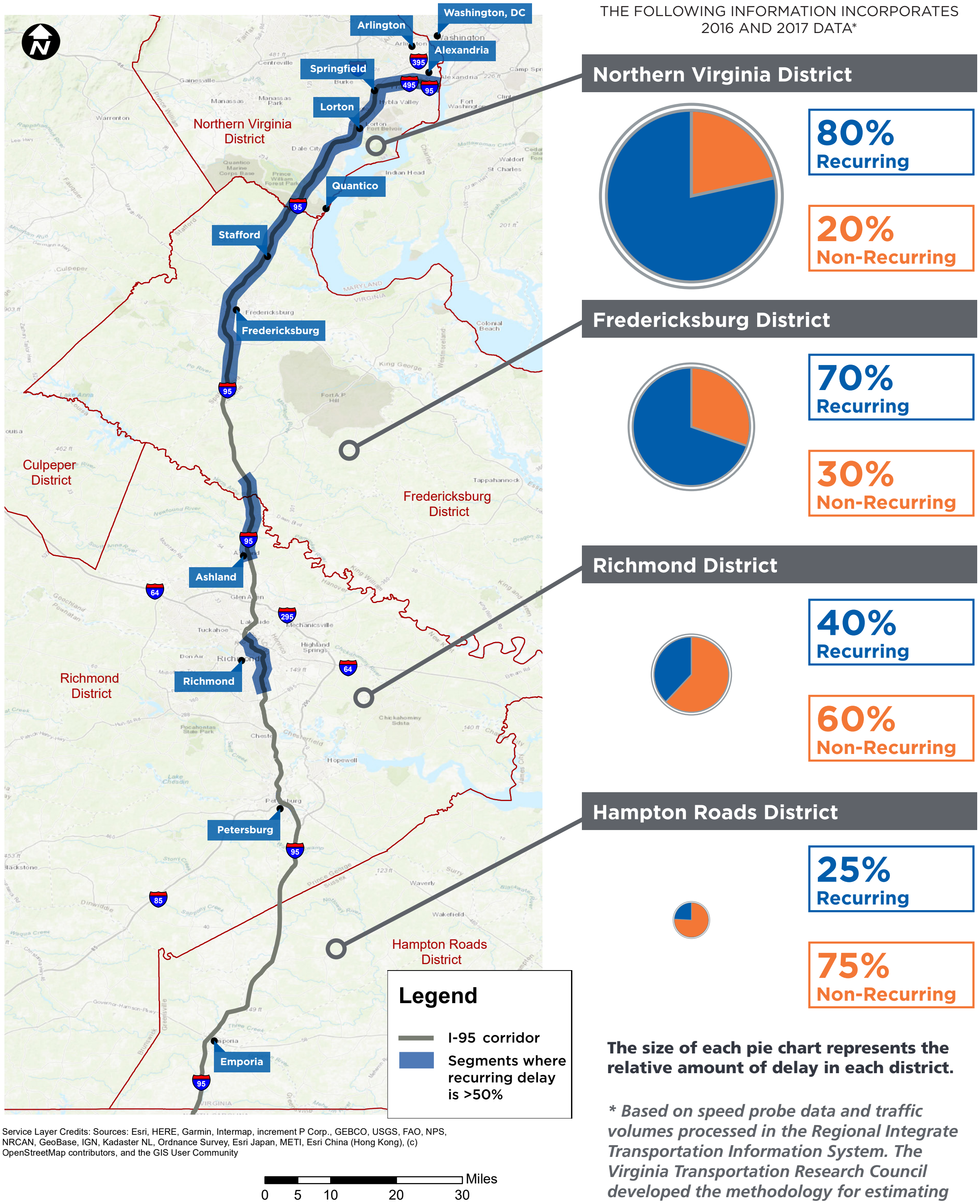


Challenges in the Corridor

While robust and overwhelmingly successful, the existing multimodal system needs improvement to address passenger travel demand along the I-95 corridor. Existing conditions include limited commuter bus service south of Dale City, a capacity-constrained Long Bridge across the Potomac River that lacks redundancy and is a major rail bottleneck limiting future passenger rail growth, and a lack of off-peak and weekend commuter train service. In addition, many park-and-ride lots with convenient access to I-95 are at or near capacity during weekdays.

Travel and reliability characteristics change drastically as motorists travel from south to north. Travel south of the Fredericksburg area (south of Exit 126) is typically much more reliable than the segments to the north. As shown in **Figure 4**, a greater number of overall and recurring delays (typically caused by congestion during peak periods) exist in the corridor to the north of the Fredericksburg District. The area between Fredericksburg and Richmond experiences reliability issues that are expected to worsen as development continues to expand into this area. There are a few areas in the Richmond District where recurring delay exists, specifically in the I-95/I-64 overlap, but the predominant type of delay is non-recurring delay, which is typically caused by incidents, crashes, weather, and/or special events.

FIGURE 4 RECURRING DELAY IN THE CORRIDOR



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

The size of each pie chart represents the relative amount of delay in each district.

** Based on speed probe data and traffic volumes processed in the Regional Integrate Transportation Information System. The Virginia Transportation Research Council developed the methodology for estimating causes of congestion.*

While the I-95 corridor has definitive segments that experience significant recurring peak hour weekday delays, several portions of the corridor experience weekend and seasonal delays. A key challenge on the I-95 corridor was to identify how travel changed by the time of the day, day of the week, and month of the year. Reliability issues that were prevalent on Sunday afternoons in the summer were not issues on Thursday afternoons in the summer. **Figure 5** shows how speeds fluctuate throughout the corridor on a typical weekday morning peak period (Tuesday through Thursday between 5 a.m. and 9 p.m.), while **Figure 6** shows speeds on a typical Saturday (between 9 a.m. and 5 p.m.).

FIGURE 5 AVERAGE SPEEDS ON NORTHBOUND I-95 ON A TYPICAL WEEKDAY MORNING

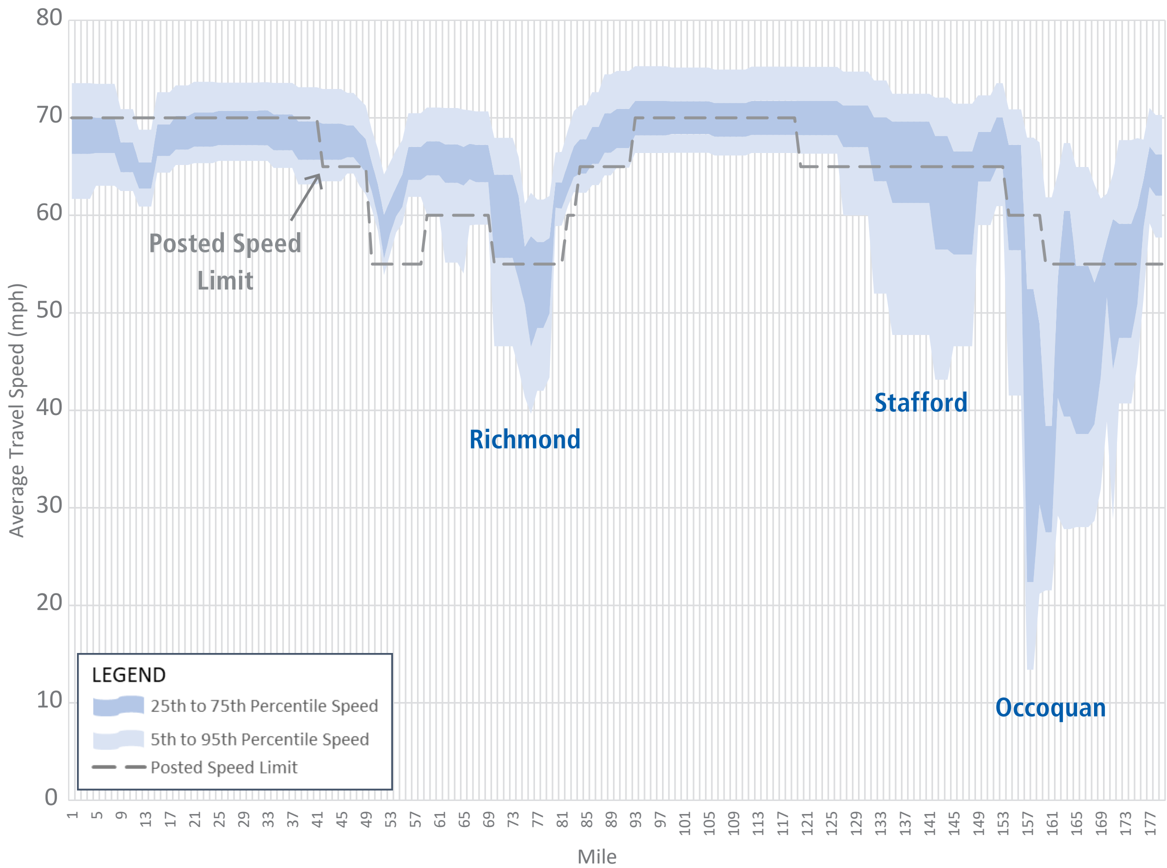
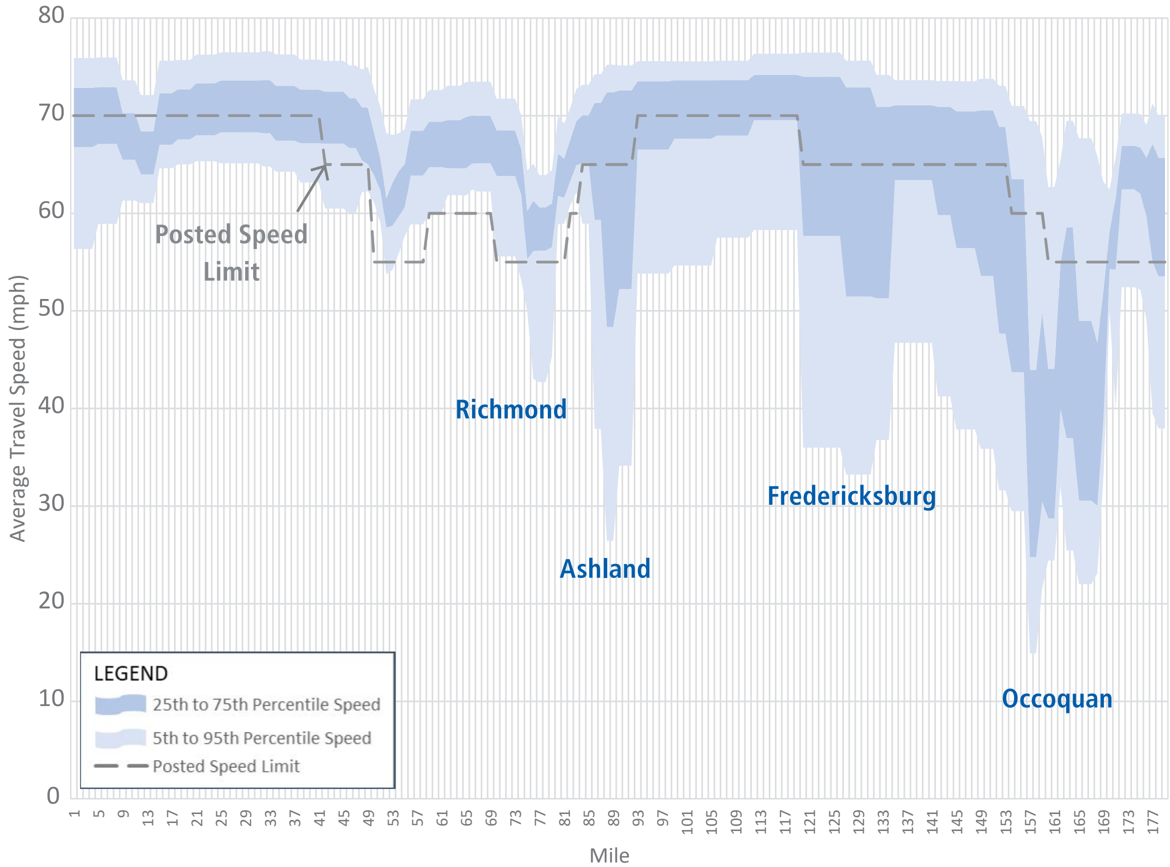


FIGURE 6 AVERAGE SPEEDS ON NORTHBOUND I-95 ON A TYPICAL SATURDAY

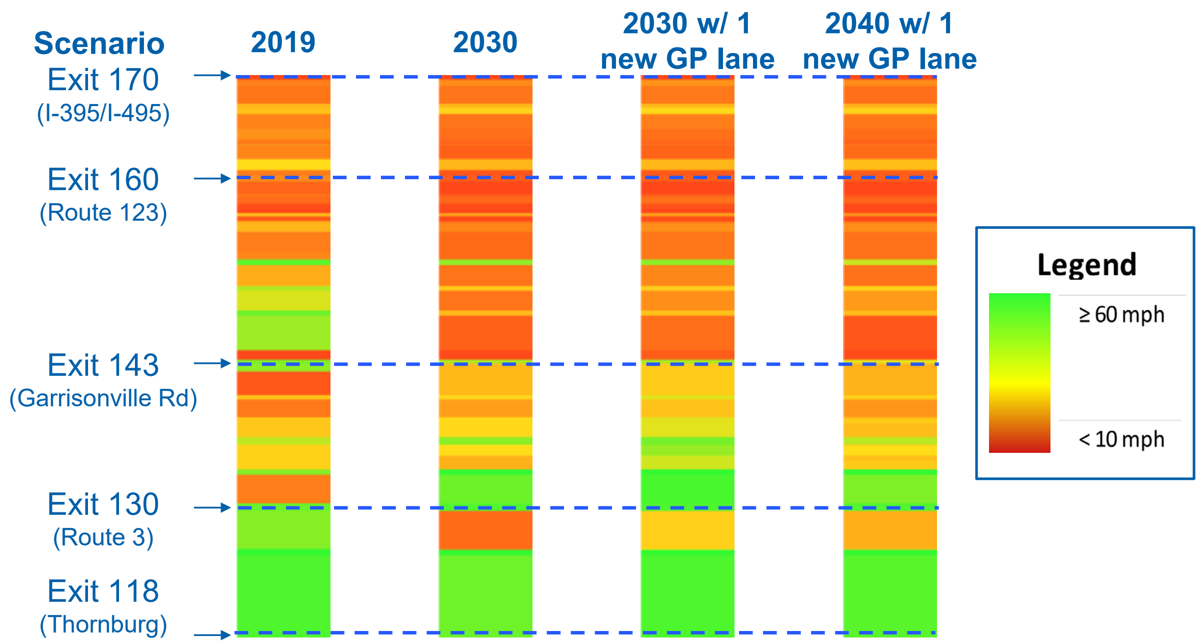


Another challenge was to identify improvements that could reduce congestion in the corridor to the north of the Fredericksburg area. Virginia is investing more than $1 billion over the next five years in the capital improvements shown in **Table 1**. These investments and their expected benefits were taken into consideration when identifying the top 25 percent of locations for congestion, safety, and reliability. As targeted capital improvement recommendations were identified in the areas of greatest need, the study team quickly determined that highway capital improvements alone are unlikely to make a significant enough impact to improve safety and increase speeds in the corridor. Using the travel demand model from the National Capital Region Transportation Planning Board, the study team conducted a hypothetical analysis that added one, two, and three additional general purpose lanes in each direction on I-95 between Exit 118 (Thornburg) and Exit 170 (Springfield Interchange: I-95/I-395/I-495). This analysis showed minor to no speed improvements in 2040 (as shown in **Figure 7**) at a planning level cost estimate of more than $12.5 billion for a single additional lane in each direction.

TABLE 1 HIGHLIGHTS OF MAJOR PROGRAMMED CAPITAL IMPROVEMENTS IN CORRIDOR

Improvement	Jurisdiction(s)	Description	Planned Completion Date
Roadway Improvements			
Southbound Exit 160 to Exit 158 Auxiliary Lane	Prince William Co.	1.5-mile auxiliary lane on southbound I-95 between Route 123 and Prince William Parkway	2022
I-95 Express Lanes Fredericksburg Extension	Stafford Co.	Extend express lanes 10 miles to near Exit 133 (U.S. 17)	2022
I-95 Northbound Rappahannock River Crossing	Stafford Co. City of Fredericksburg Spotsylvania Co.	Add three collector-distributor lanes, construct new bridge over the Rappahannock River, and modify the U.S. 17 interchange	2024
I-95 Southbound Rappahannock River Crossing	Stafford Co. City of Fredericksburg Spotsylvania Co.	Add three collector-distributor lanes, construct new bridge over the Rappahannock River, and modify the U.S. 17 interchange	2022
Rail Improvements			
Franconia to Lorton 3rd Track	Fairfax County	3.5 miles between Newington Road and Lorton Interlocking	2024
Alexandria 4th Track	Arlington County / City of Alexandria	6 miles of fourth track between the RO and AF Interlockings	2026
Franconia-Springfield Bypass	Fairfax County	3 miles between north of Franconia-Springfield Station and Newington Road	2026
Potomac Creek 3rd Track	Stafford County	4 miles of third track between Potomac Creek and Dahlgren Junction	2026
Woodford to Milford 3rd Track	Caroline County	3 miles of third track between Woodslane Road and Paige Road	2026
Hanover 3rd Track	Hanover County	3 miles of third track between Vaughn Road/Henry Street and South Anna River bridge	2026
New Long Bridge for Passenger Rail	Washington, DC / Arlington County	1.8 miles of proposed improvements including eight rail bridges	2030
L'Enfant 4th Track and Station Improvements	Washington, DC	0.7 miles of fourth track through and around L'Enfant Station	2030
Neabsco Creek to Woodbridge 3rd Track	Prince William County	4 miles of third track between Woodbridge Station and VRE Rippon Station	2030
Aquia Creek 3rd Track	Spotsylvania Co.	3 miles of third track between Aquia Creek and Brooke Station	2030
Crossroads 3rd Track	Caroline County	4 miles of third track between Spotsylvania Station and Claiborne Crossing Road	2030

FIGURE 7 PEAK PERIOD SPEED RESULTS AFTER WIDENING

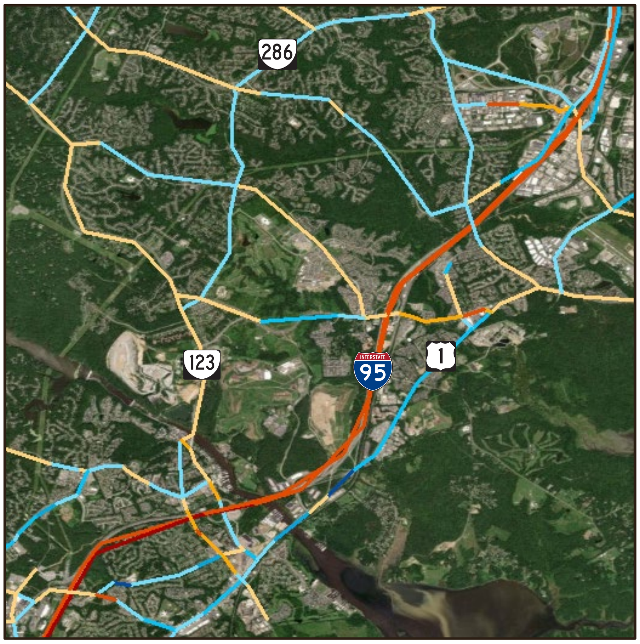


GP = general purpose

The travel demand modeling results can be explained based on two factors. First, the population and employment growth for the Northern Virginia and Fredericksburg regions is anticipated to be more than 24 percent during the next 20 years. This portion of the I-95 corridor falls within some of the fastest growing areas in Virginia. Second, whenever a higher-level facility (such as an interstate) that provides the fastest travel time is improved, it becomes more attractive for travel. In traffic-dense areas such as Northern Virginia and Fredericksburg, traffic using parallel facilities will likely be attracted to the new capacity on the interstate since it offers the highest travel speeds and the lowest travel times.

This phenomenon is known as latent demand; a sample reflecting the I-95 analysis is shown in **Figure 8**. The results are also consistent with recent roadway widening experience on I-95, using the I-95 fourth lane project between Exit 166 (Route 286/Fairfax County Parkway) and Exit 160 (Route 123/Gordon Boulevard) as an example. In 2011, an additional general purpose lane was added in both directions for these 6 miles. Despite the additional capacity provided by the project, average speeds in 2019 were 7.5 percent lower (22.3 mph versus 20.6 mph) than those in 2009.

FIGURE 8 LATENT DEMAND CHANGE IN DAILY VOLUME WITH ADDITIONAL LANE IN EACH DIRECTION



Legend

Decrease*

- 0-5%
- 5-10%
- 10-20%
- >20%

Increase*

- 0-5%
- 5-10%
- 10-20%
- >20%

*Percent change in daily volume from the 2030 No-Build scenario to the 2030 scenario with one additional lane on I-95

Based on the hypothetical widening analysis, the study team anticipates that multimodal recommendations and managed lane facilities that incentivize non-single-occupant travel will be key components of any solution development along the I-95 corridor in Northern Virginia and Fredericksburg.

To capture performance benefits for non-single-occupant travel, the study team adopted an approach that focused on person movement. Additional commuter bus and commuter train service during the peak hours were evaluated. Analyses showed that the number of people moved during those peak hours by bus and rail is projected to be equivalent or greater than the number of persons moved from adding one lane in each direction as described in more detail in the multimodal section of this summary. These types of multimodal solutions must also include the construction of new and/or expanded park-and-ride lots in strategic locations to allow commuters to safely and efficiently access the other modes of transportation.

Existing Conditions

To more thoroughly understand the current travel conditions in the corridor, the study team gathered data from a variety of sources. This data included travel speeds; numbers and types of crashes; numbers, types, and durations of incidents; origins and destinations of passenger cars and trucks; numbers and types of traffic; multimodal service; and location, number of spaces, and utilization rates at park-and-ride lots.

Depending on the time of day, the day of week, and the month of year, travel in the corridor varies greatly. These differences were important to understand as the study team developed potential improvements.

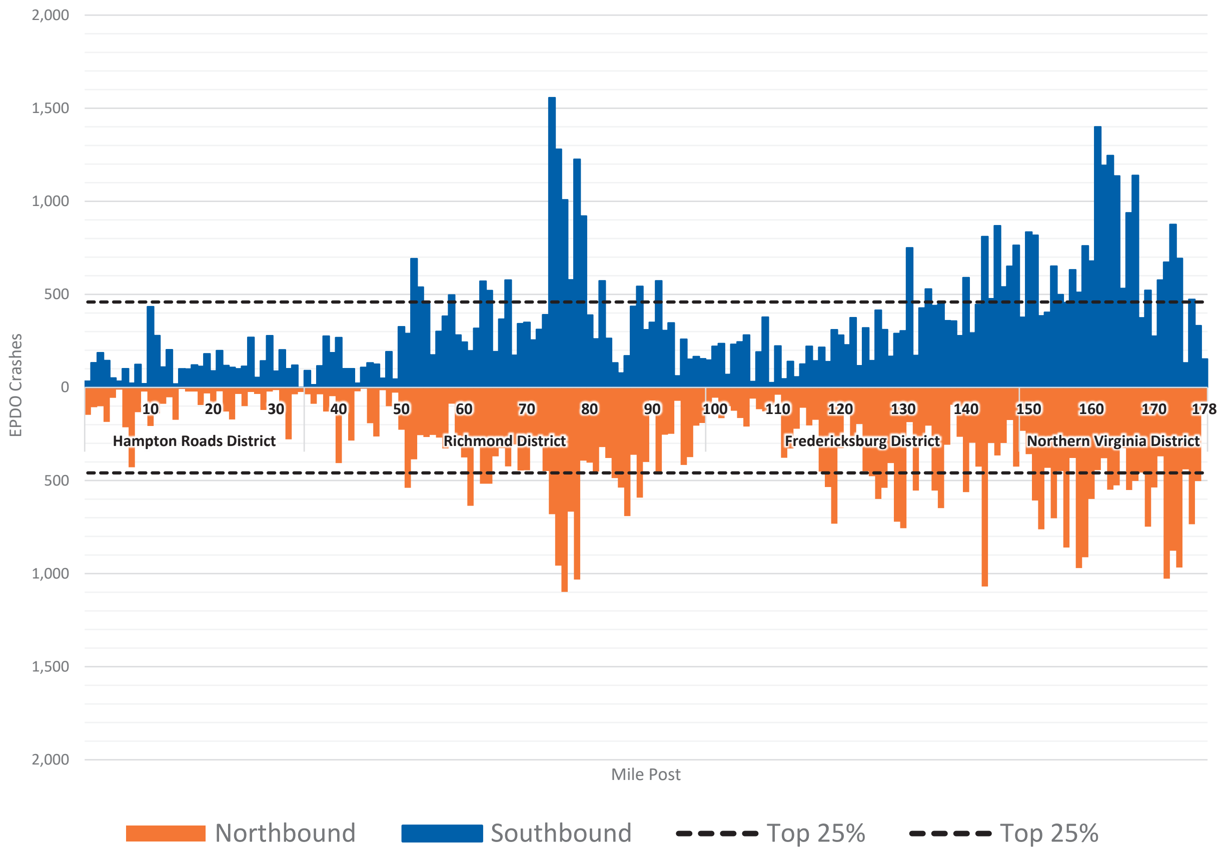
Performance Measures

Based on a review of the available data in corridor, the study team developed four performance measures to evaluate the existing operational and safety issues throughout the corridor. The team collected and summarized crash and delay data for 4 years, 2015 through 2018, in 1-mile segments. The study team then ranked the 1-mile segments and highlighted the top 25 percent of segments, regardless of direction, to be reviewed for potential improvements. The four performance measures included:

- **Crash frequency and severity:** the total number of crashes, weighted by severity using the equivalent property damage only (EPDO) scale. Source: Virginia Department of Transportation (VDOT) Roadway Network System
- **Crash severity rate:** the total rate of crashes, weighted by severity, per 100 million vehicle-miles traveled. Source: VDOT Roadway Network System and VDOT Traffic Monitoring System
- **Total delay:** the total person-hours of delay caused by the impacts of congestion, incidents, and weather events. Source: INRIX
- **Incident delay:** the total person-hours of delay caused by incidents (crashes and disabled vehicles) that lead to at least one lane of the interstate to be closed for an hour or more. Source: INRIX and VA Traffic

An example histogram detailing the EPDO crashes per 1-mile segments is shown in **Figure 9**.

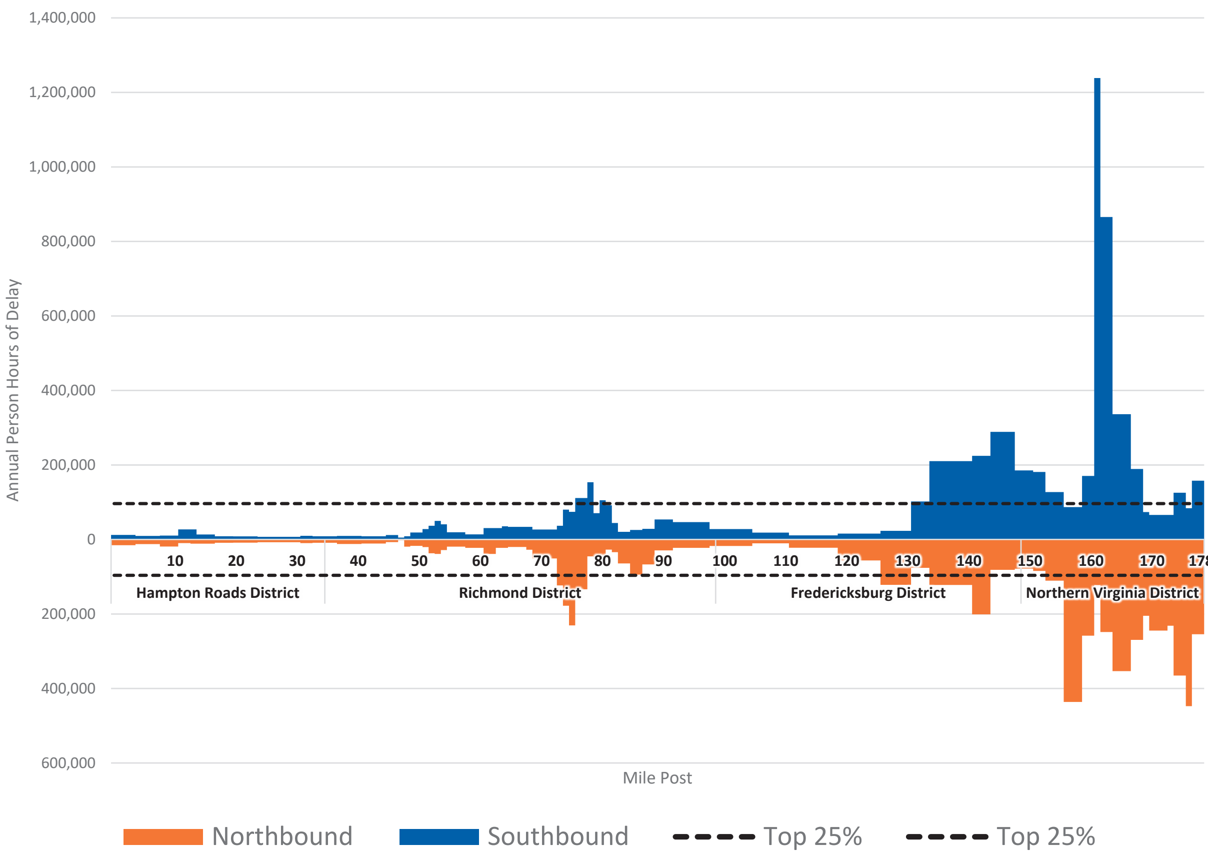
FIGURE 9 EQUIVALENT PROPERTY DAMAGE ONLY (EPDO) CRASHES



In addition to the crash data, person hours of delay data showed that I-95 southbound at the Occoquan River (Exit 160, Route 123) had the highest person hours of delay along the entire corridor: more than 1.2 million hours annually as shown in **Figure 10**.

The study team used this information to focus on improvements that would provide the greatest delay reduction for the stretch of I-95 between Exit 158 and Exit 177 in both directions.

FIGURE 10 ANNUAL PERSON-HOURS OF DELAY



Projects Completed by 2025

The study team reviewed projects already funded in the VDOT Six-Year Improvement Program (SYIP) to determine how those projects may resolve issues in the corridor relating to two performance measures: crash frequency and severity and total delay. The study team did not review 1-mile segments for additional improvements if the safety and delay benefits from the funded projects were projected to remove the segment from the top 25 percent of segments for all performance measures. The study team evaluated the potential benefits of the following 10 projects:

- Auxiliary Lanes between Route 288 and Route 10
- Interchange and Intersection Improvements at East Franklin Street
- Interchange Improvements at Belvidere Street
- Mudd Tavern Road Interchange Improvements
- Rappahannock River Crossing Northbound
- Rappahannock River Crossing Southbound
- I-95 Express Lanes Fredericksburg Extension (Fredex)
- Route 630 Interchange Improvements
- Express Lanes Access at Opitz Boulevard
- Southbound Auxiliary Lane between Route 123 and Prince William Parkway

Projected changes in peak period speed for three of these programmed improvements are shown in **Figure 11**.

FIGURE 11 PEAK PERIOD SPEED BENEFITS FROM PROGRAMMED IMPROVEMENTS

Legend
Increase 25-50% (time period)
Increase >50% (time period)

Project Description	Projected Change in Travel Speed	
	Northbound	Southbound
Rappahannock River Crossing Northbound	AM	N/A
Rappahannock River Crossing Southbound	N/A	PM
I-95 Express Lanes – Fredericksburg Extension (Fredex)	AM	PM

Supplementary Data

The study team collected and summarized additional data to supplement the four performance measures for the identification of problem areas and project identification. The supplementary data includes the following information:

- **Speed data:** INRIX data was collected in 15-minute intervals to summarize average speed patterns and variability in speeds throughout the corridor per time of day, day of week, and time of year for 2018.
- **Origin-destination data:** The study team collected StreetLight data and summarized origin-destination patterns on I-95 in 2018. The study team summarized the following by time of day and day of week:
  - Statewide interchange-to-interchange travel patterns as shown in **Figure 12**
  - The most popular origins and destinations by zip code for vehicles traveling across the Occoquan River in response to the exceedingly high person hours of delay occurring at that location during the peak periods as shown in **Figure 13**
  - Route choice for passenger cars and trucks traveling on I-95 when a parallel route is available. This included an evaluation of vehicles using I-295 for north-south through travel, I-295 for east-west through travel, and Route 207 and U.S. 301 for travel to and from Maryland.
- **Incident data:** The study team collected and summarized additional incident data from VA Traffic, including the number of total or lane-impacting incidents and the average time to clear a lane or scene.

This information was used to help identify specific countermeasures at various locations along the corridor. For example, the origin-destination analysis shown in **Figure 13** highlighted that a large percentage of vehicles traveling across the Occoquan River during the p.m. peak period were coming from Fort Belvoir. Given the large workforce at Fort Belvoir and the relatively short distance on I-95 from Fort Belvoir to the popular destinations, VDOT plans to coordinate with Fort Belvoir in the future to discuss multimodal solutions.

FIGURE 12 **STATEWIDE ORIGIN-DESTINATION PATTERNS BY INTERCHANGE**

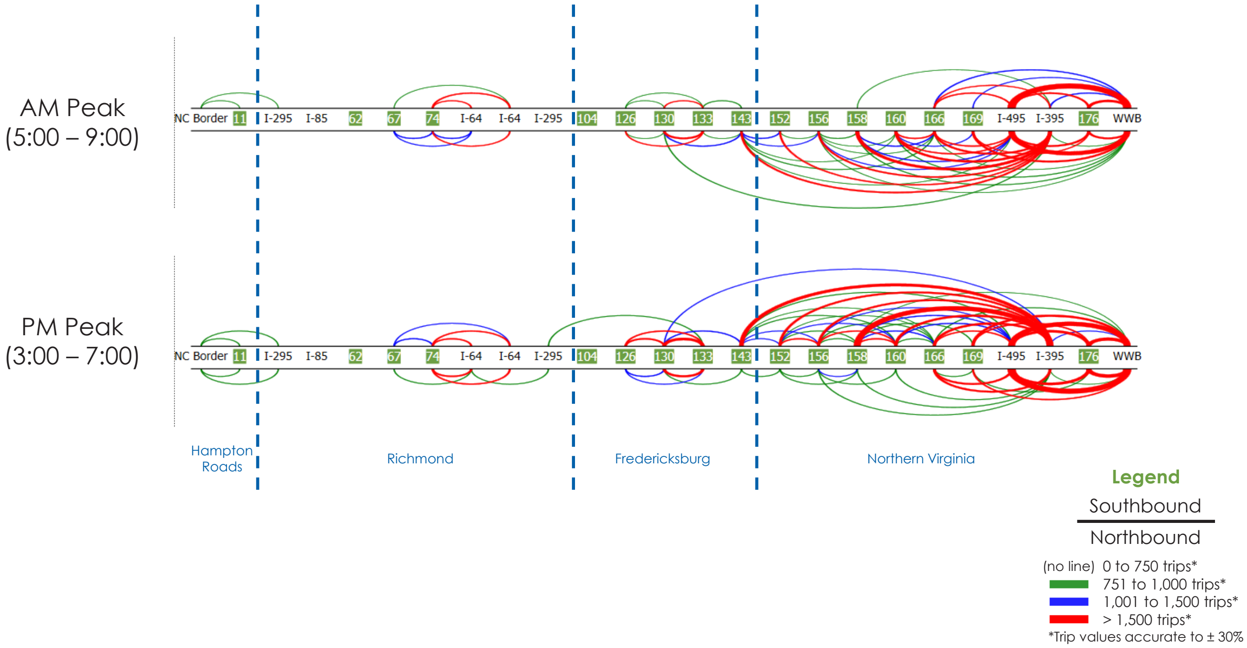
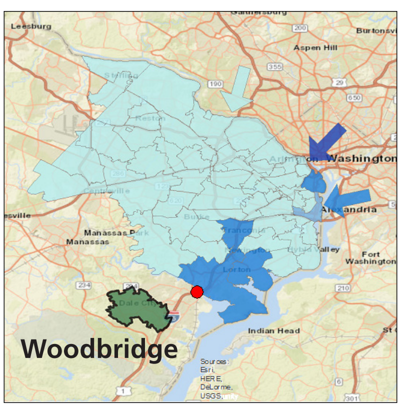


FIGURE 13 **ORIGIN-DESTINATION PATTERNS AT THE OCCOQUAN RIVER**

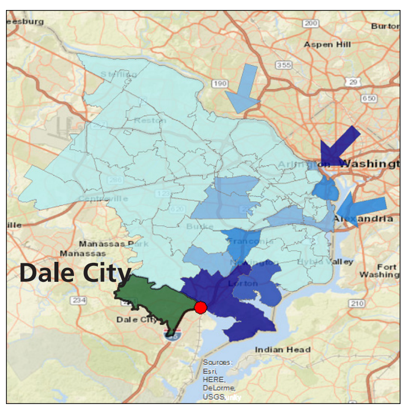
Legend

Occoquan River



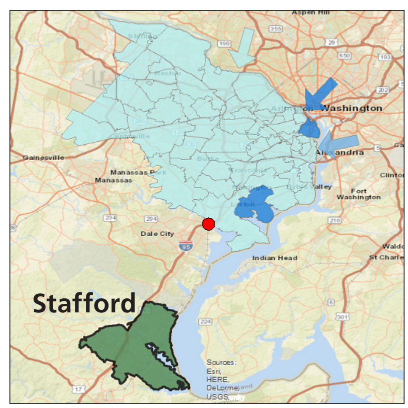
Top 3 Origins to WOODBRIDGE

1. Lorton
2. Southbound I-395 from DC
3. **Fort Belvoir**



Top 3 Origins to DALE CITY

1. Southbound 1-395 from DC
2. **Fort Belvoir**
3. Lorton

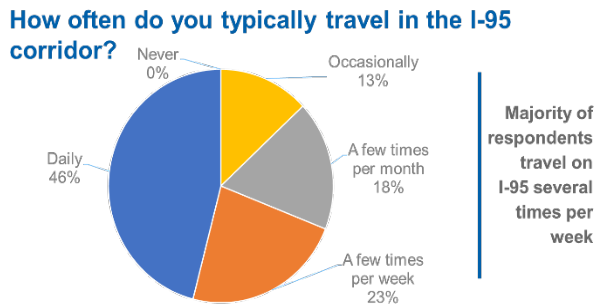


Top 3 Origins to STAFFORD

1. Arlington
2. Southbound I-395 from DC
3. **Fort Belvoir**

Public Meetings

Public involvement was encouraged throughout the development of the I-95 Corridor Improvement Plan (Plan) and served as a critical component of developing the Plan. The study team created a website, www.va95corridor.org, to provide information and to gather public input. In addition, an email address was established for receiving comments, and a public phone number was made available. The study team held nine public information meetings throughout the corridor. During the public meetings, attendees were able to view maps of the corridor in their respective area, listen to a presentation about the project and its progress, identify problem areas, ask questions, and submit comments and suggestions. The display boards and presentations also were made available on the project website.



Three sets of three public meetings were held in the corridor between July and January.

- **July:** summarized the existing issues along the corridor
- **October:** listed the potential solutions to be prioritized and identified solutions requiring additional study
- **January:** provided the results of the operational improvements

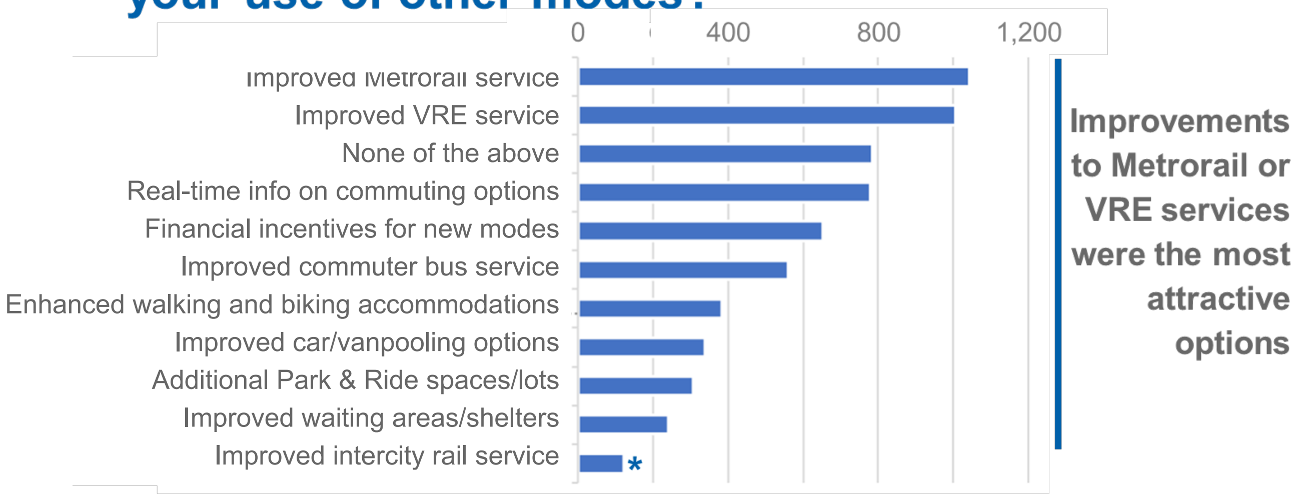
In addition to these public information meetings, the study team delivered presentations to several entities in the corridor, including metropolitan planning organizations, planning district commissions, other regional authorities, and cities. The Commonwealth Transportation Board (CTB) was also updated several times through the life of the project to track the progress of the study and ask questions of the study team.

Online Survey Results

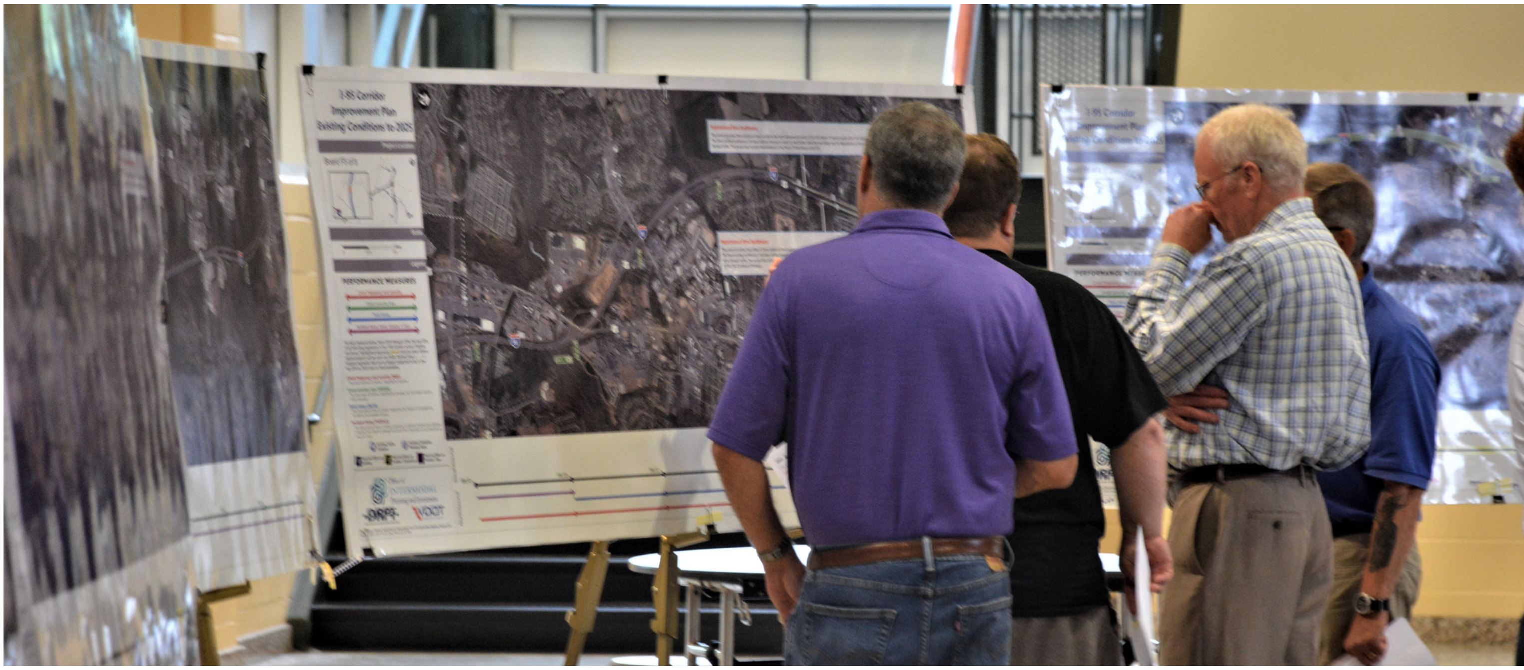
An online survey tool, MetroQuest, was used to obtain feedback from the public at the July and October meetings. The study team used comments documented using this tool to inform the identification and verification of problem areas in the corridor and develop proposed improvements for consideration. The public was also given the opportunity to identify how they currently use the corridor and document the types of improvements on which they would spend available resources.

More than 3,000 comments were received from the online survey for the first round of public meetings. The highest number of respondents were from the Fredericksburg area and north. The public added 11,700 comments on locations along I-95 with congestion, safety, technology, multimodal, and routing issues. At the second round of public meetings, respondents were asked to review potential solutions for the top 25 percent of problem areas and to identify their priority recommendations. Also presented was information on preliminary analyses showing that additional lanes in the northern portion of the I-95 corridor were unlikely to provide demonstrable benefit and would require significant investment. The highest percentage of respondents suggested that improved Metrorail and VRE service would enhance their uses of other modes in the corridor.

What potential improvements would enhance your use of other modes?



* Improved intercity rail service option added in the middle of the survey: about 25% selected this option



Operations Improvements Plan

Managing operations by efficiently responding to incidents and managing traffic congestion on the I-95 corridor is one of the fundamental responsibilities of VDOT. The Plan outlines critical foundational elements for enhancements to operations on the corridor and innovative strategies to improve safety, reduce delay, and enhance customer experience. The operational improvements were identified on both mainline I-95 and on parallel arterials, such as U.S. 1 and U.S. 301.

Using the performance measures for locations within the top 25 percent for incident-related delay on I-95, the study team initially identified more than $200 million in freeway operations and parallel facilities upgrades for the corridor. Using this list as a starting point, the team identified strategies with the greatest need using segment-specific traffic and crash data. This analysis resulted in a targeted operational upgrade plan totaling $60–68 million.

A description of the mainline operations improvements is followed by a description of the parallel arterial operations improvements.

Mainline Operations

Foundational Operations Strategies

Foundational operations strategies are used to address the impacts of non-recurring congestion, such as vehicle crashes and weather events, and respond to those incidents as quickly as possible. Foundational strategies are integral to the function of the freeway and are currently being used on I-95 and other roadways in Virginia. Foundational operations strategies include the following types of improvements:

- Closed-circuit television (CCTV) cameras
- Changeable Message Signs (CMS)
- Safety Service Patrol (SSP)
- Towing programs
- Miscellaneous low-cost operations improvements

CCTV Cameras

Cameras used to detect incidents and provide visual verification and situational awareness of incidents that facilitates improved emergency response

Foundational operations strategies are infrastructure improvements and/or incident response tools that require proper integration and coordination with traffic operations centers to be used most effectively. The study team used a combination of input from the VDOT District Regional Operations Directors (RODs), corridor characteristics, data analysis of traffic volumes and crashes, and coordination with other arterial and roadway improvements to determine proposed locations for the foundational strategies.

Based on stakeholder input and a nationwide standard, the study team determined that CCTV coverage should be expanded to cover 100 percent of the corridor in urban areas, all interchanges in rural areas, and locations with high incident rates in the rural areas. A detailed analysis of existing and proposed camera viewsheds resulted in a total of 89 proposed CCTV locations.

The Regions identified five new mainline CMS and three replacement CMS. The sign locations were identified to better communicate traffic conditions in the Central Region.

SSP is currently in use with varying levels of coverage along much of the corridor (120 miles), covering the area between mile marker 58 (near Exit 58 – Woods Edge Road [Route 620]/ Ruffin Mill Road [Route 746]) in the Richmond District and mile marker 178 (Woodrow Wilson Bridge) in the Northern Virginia District. There is 24/7 coverage for the 60 miles between mile marker 118 (Exit 118 – Thornburg [Route 606]) and the Woodrow Wilson Bridge. Three SSP routes operate for the 60 miles between mile marker 58 and mile marker 118 between 5 a.m. and 9 p.m. (16 hours) with a roving SSP route between 9 p.m. and 5 a.m. (8 hours).

The study team recommended that SSP coverage be improved on specific segments of the corridor experiencing more traffic and higher crash rates. The study team recommended that the current route that ends at mile marker 58 in Chesterfield County be extended 7 miles with the same coverage times to mile marker 51 (near Exit 51 – I-85/US 460) in the City of Petersburg. A new Richmond District SSP route on I-295 was recommended with the same coverage times as the I-95 route in the Richmond area for the 10 miles between mile marker 53 (Exit 53 – I-64) and mile marker 43 (Exit 43 – I-95). A new 24/7 SSP route was also recommended at the I-95/I-395/I-495 interchange at Exit 170 in the Northern Virginia District. It is also recommended that SSP vehicles be equipped with red flashing emergency lights for use when approaching incidents, which could reduce incident response time and overall incident duration.

Quick clearance towing is currently administered through several VDOT programs. The Towing and Recovery Incentive Program (TRIP), already in use in some locations along I-95, pays incentives to heavy duty recovery companies to clear collisions in less than 90 minutes. Expanding the TRIP program to include coverage in additional areas with high traffic volumes and crash rates is one of the recommendations of this study. The study team identified Greensville, Sussex, Caroline, Spotsylvania, and Stafford Counties as candidates for expanding TRIP. Instant towing is used to assist with lane clearance mainly in urban areas. The study team recommended that instant towing be expanded to the urban areas in the Richmond and Northern Virginia Districts (approximately 117 miles of new coverage) and contract towing be implemented in Fredericksburg and Northern Virginia, where hard shoulder running projects are recommended (approximately 27 miles of new coverage).

The study team identified additional low-cost improvements to facilitate the efficient and safe movement of vehicles on the corridor including Public Safety Answering Point (PSAP) integration, deployment of fiber optic cabling, traffic operations guidance documents, and an update to the current version of Active Traffic Management System (ATMS) software. In addition to these key improvements, other communications upgrades are required to support the implementation of the recommended innovative improvements.

Innovative Operations Strategies

While the foundational strategies mainly address non-recurring congestion, the innovative strategies address both recurring and non-recurring congestion resulting from travel demand exceeding the capacity of the corridor. The following list includes potential innovative operations strategies that could be implemented in the I-95 corridor.

- Ramp metering
- Variable speed limits (VSL)
- Geofenced emergency notifications
- Advanced technologies for work zone management
- Regional Multimodal Mobility Program (RM3P)

Ramp Metering

Ramp metering involves a signalized meter that regulates the flow of traffic entering a freeway according to current traffic conditions to ease traffic congestion. The study team identified the following 14 candidate on-ramp locations for ramp metering. Once these ramp metering improvements are implemented, it is recommended that they be operated together within an overall ATMS to be most effective.

1. Southbound Exit 143 (Route 610/Garrisonville Road)
2. Southbound Exit 148 (Quantico/Russell Road)
3. Northbound Exit 152 (Route 234/Dumfries Road)
4. Southbound Exit 152 (Route 234/Dumfries Road)
5. Northbound Exit 156 (Route 784/Dale Boulevard)
6. Southbound Exit 158 (Route 294/Prince William Parkway)
7. Northbound Exit 160 (Route 123/Gordon Boulevard)
8. Northbound Exit 161 (U.S. 1/Richmond Highway)
9. Southbound Exit 161 (U.S. 1/Richmond Highway)
10. Southbound Exit 163 (Route 642/Lorton Road)

11. Southbound Exit 166 (Route 286/Fairfax County Parkway)
12. Southbound Exit 167 (Route 617/Backlick Road)
13. Northbound Exit 176 (Route 611/Telegraph Road)
14. Northbound Exit 177 (U.S. 1/Richmond Highway)

Variable Speed Limits (VSL)

VSL is an ATMS that modifies the speed displayed on changeable speed limit signs based on road, traffic, and weather conditions. The VSL system uses CCTV cameras, traffic detectors, and algorithms to identify the ideal speed limit to improve traffic congestion and harmonize traffic flow. The study team recommends that VSL be deployed in both the northbound and southbound directions for the 62 miles from mile marker 68 (between Exit 67 [Chippenham Parkway] and Exit 69 [Bells Road]) in the Richmond District to mile marker 130 (near Exit 130 [Route 3]) in the Fredericksburg District.

Geofenced Emergency Notification System

The geofenced digital notification system is an ATMS tool that alerts drivers stuck in extended periods of congestion. When a large crash occurs and motorists become stranded, the geofenced digital notification system will send information to motorists' mobile phones directly through an alert system. Travelers can opt in to continued information by selecting a link included in the notification.

Advanced Technologies for Work Zone Management

Advanced technologies for work zone management provides the Traffic Operations Center (TOC) the ability to actively manage and inform the public of work zones while also managing work zones along the I-95 corridor. The tools for work zone management include additional technology such as the Work Zone Builder application, mobile work zone cameras, dedicated SSP, and mobile message signs.

SmartCone sensors alert VDOT in real time that an active work zone is in place. The Work Zone Builder application should be deployed to the contractor community to facilitate the generation and management of higher resolution work zone data. SmartVests are active vests worn by construction workers that actively communicate the locations of construction workers within a work zone. SmartCones, SmartVests, and the Work Zone Builder application are currently under research at the Virginia Transportation Research Council. As further research is completed, and new work zone management tools are identified and approved for further use, specifications mandating their use will need to be approved and implemented. Once these technologies are approved for implementation, the study team recommends that they be installed and integrated in work zones throughout the I-95 corridor.

Regional Multimodal Mobility Program (RM3P)

RM3P seeks to alleviate congestion by encouraging the use of alternate forms of transportation. RM3P consists of five interrelated initiatives designed to reduce corridor congestion and improve multimodal transportation. The study team recommended an area-wide deployment of the following strategies:

- Commuter parking information system
- Predictive Artificial Intelligence (AI)-Based Decision Support System (DSS)
- Corridor-based dynamic incentivization
- Mobility service gap dashboard
- Data lake and data store

Commuter Parking Information System

Park-and-ride lots provide commuters a place to park their vehicle when transferring to carpools, vanpools, buses, and transit. The system would provide real-time parking availability information to commuters. In contrast to current practice, which uses expensive technology to count each available parking space, the system will rely on infrastructure-right approach to identify and communicate real-time parking availability information. This data will be collected and stored in a format that can be disseminated to commuters by private service providers. VDOT and other partner agencies will use available infrastructure such as signs, 511, and social media to disseminate the information to customers.

Predictive AI-Based Decision Support System

The current state of the practice for coordinated responses to traffic operations and incidents between agencies is a manual process. A predictive AI-based DSS is driven by real-time data and machine learning technology to allow for generating multi-agency and multimodal responses to address transportation problems as they arise. There are two approaches to a DSS: 1) use a predefined response plan framework, or 2) analyze data in real-time to define an appropriate response.

Predictive AI-Based DSS

Existing incident, crash, and weather data leveraged with AI to pre-stage traffic management assets and coordinate responses throughout the region

As envisioned in the RM3P project narrative, the DSS will eventually have machine learning and predictive analytics capabilities to analyze real-time data to generate incident and congestion management responses to manage real-time conditions. To streamline the process to integrating the DSS, each agency will abide by agreed-upon standard operating procedures, which should allow for automated information sharing between agencies.

Corridor-Based Dynamic Incentivization

This project incentivizes customers to use alternative modes and timing of transportation in response to real-time traffic conditions. There are two overarching goals for this project: 1) to influence customers' transportation choices based on historic, real-time, and AI-predictive data to avoid work zones, crashes, and other predicted traffic congestion, and 2) to incentivize service providers to enable customers' choices. Examples of dynamic incentivization can include, but are not limited to:

- Incentivize route change when there is predicted delay
- Incentivize transit or ridesharing instead of driving alone
- Incentivize ride sharing to commuter lots when lots are predicted to be full

Corridor-Based Dynamic Incentivization

A data-driven incentive program that encourages commuters to choose alternate transportation modes or telework during times of congestion

Mobility Service Gap Dashboard

This project identifies "gaps" in the multi-modal transportation services and encourages transportation and mobility providers to fill those service gaps, thereby optimizing services to meet demand. The dashboard for the transportation and mobility providers uses a new set of objectively data-driven tools to optimize their infrastructure and services. This tool will assist the providers to plan for and respond to events to mitigate the level of congestion for planned and unplanned events.

Data Lake and Data Store

All RM3P projects require data and a technology-based transportation system to function effectively. This project would access and collect data from several sources and share with program partners. This cloud-based data store would be accessible to VDOT, partnering agencies, and third-party agencies to allow for streamlined use of the other RM3P elements.

The upfront capital expenditure for RM3P has been approved and funded in the Northern Virginia District. A separate Federal Highway Administration Advanced Transportation and Congestion Management Technologies Deployment grant application for expansion of RM3P in the Fredericksburg District has been submitted. This grant covers the initial capital costs. Therefore, since the O&M was not covered under the original grants for RM3P, it is proposed that under this I-95 plan, VDOT will fund the operations and maintenance for RM3P in the Northern Virginia and Fredericksburg Districts.

Other Strategies

Strategies such as ramp metering and variable speed limits are examples of the newer approaches to efficient freeway management and are focal points of the Federal Highway Administration (FHWA) Active Traffic Management (ATM) program. The methodologies outlined in the FHWA *Active Traffic Management Feasibility and Screening Guide* were used to identify segments of roadway to implement these strategies.

A full analysis was completed to specify applications of these strategies to areas along the corridor that are most in need. Expected benefits include:

- A reduction of 30 percent in crashes and an increase in vehicle throughput of 7 percent when VSL is in use
- A reduction of 25 percent in incident duration when SSP is on-site
- A reduction of up to 2 hours per incident for enhanced towing programs
- A reduction in travel times of 7 percent when ramp metering is in use

Other innovative strategies, such as geofenced emergency notifications and RM3P, are anticipated to enhance travel choice and enhance customer experience by using advanced technologies and techniques. As shown in **Table 2**, these strategies collectively comprise a program that is projected to make a significant difference to improve safety and vehicle throughput, reduce delays, and enhance travel experiences.

TABLE 2 BENEFITS OF RECOMMENDED FREEWAY OPERATIONS IMPROVEMENTS

Proposed Improvements	Move More People	Improve Safety	Reduce Non-Recurring Congestion	Reduce Recurring Congestion
CCTV Cameras		✔	✔	✔
Changeable Message Signs			✔	✔
Safety Service Patrols		✔	✔	
TRIP Towing Program		✔	✔	
Towing Program		✔	✔	
Miscellaneous Low-Cost Improvements	✔	✔	✔	✔
Ramp Metering	✔	✔	✔	✔
Variable Speed Limits	✔	✔	✔	✔
Geofenced Emergency Notifications			✔	✔
Regional Multimodal Mobility Project	✔			✔
Advanced Work Zone Technology		✔	✔	✔

Detour Routes and Improvements to Parallel Facilities

During traffic incidents or periods of congestion on the I-95 corridor, motorists choose to use the parallel facilities of U.S. 1 and U.S. 301 to avoid or minimize related delays. A major incident on the interstate can results in a road closure of the impacted interstate segments and result in temporary routing of traffic onto these parallel facilities. Because of this, the parallel facilities of U.S. 1 and U.S. 301 and routes connecting them to I-95 were evaluated for improvements that could enhance safety and improve operations during significant traffic incidents or periods of congestion. Highest priority was given to improvements that support the capabilities to directly influence or mitigate traffic during an incident and at locations where incident frequency is highest. Improvements identified ranged from $13–15 million.

The study team compiled available information, such as the existing geometric elements, asset data for traffic signal infrastructure, and the status of planned or programmed projects on the routes. The study team identified location-specific improvements targeted to address capacity constraints, geometric deficiencies, safety issues, and operational limitations of arterial facilities. More than 2,000 individual improvements at 300 locations were identified along U.S. 1 and U.S. 301. These improvements consisted of signing and marking plans, lane reconfigurations, turn-lane extensions, remote communication capabilities, and signal modifications. Systemic improvements, such as traffic signal timing optimization, traffic signal equipment upgrades, communications upgrades, and deployment of automated traffic signal performance measures (ATSPM), were also considering this data. In addition, locations were identified for the installation of CCTV cameras and CMS to provide improved monitoring and detection capabilities to support improvements to incident detection and response times and to be able to provide additional notifications to drivers. Planning level cost estimates were developed for each of the identified potential improvements. **Table 3** summarizes the number of parallel facility improvements in each district.

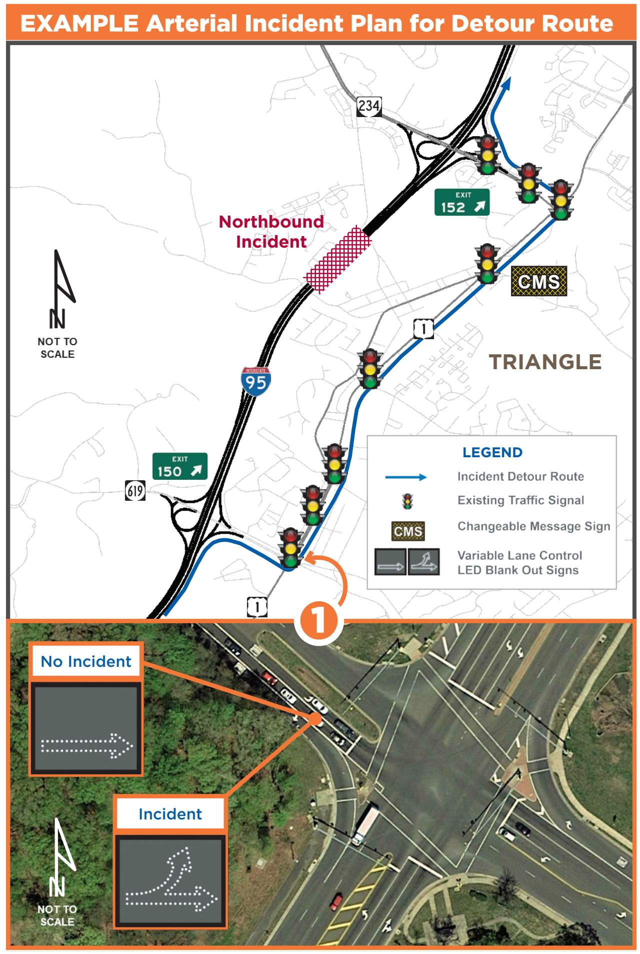
TABLE 3 PARALLEL FACILITY IMPROVEMENT IMPLEMENTATION SUMMARY

Jurisdiction	Number of Improvement Locations*				
	NOVA	Fredericksburg	Richmond	Hampton Roads	Total
VDOT	100	25	2	0	**127**
Locality	3	5	11	0	**19**
TOTAL	**103**	**30**	**13**	**0**	**146**

*Consists of improvements to enhance operations along incident detour routes, including ATSPM, communications, ATC controllers, CCTV cameras, and blank-out signs

Figure 14 provides an example of a detour route and potential improvements identified at the intersection of U.S. 1 and the intersecting arterial (Route 619, Joplin Rd) from Exit 150 on I-95. In this example, installing a dynamic LED blank-out sign is expected to allow for greater capacity to process turning vehicles along the detour route, reduce queue spillback toward I-95, and improve efficiency of signal operations. Additionally, localized widening along Route 234 could eliminate the need for lane changes for right-turning traffic from U.S. 1 as a result of a downstream lane drop, thereby enhancing safety and increasing the capacity for traffic approaching I-95.

FIGURE 14 EXAMPLE DETOUR ROUTE (I-95 BETWEEN EXIT 150 AND EXIT 152)



Example Arterial Strategies to Improve Incident Management

Automated Traffic Signal Performance Measures (ATSPM)

Install ATSPM technology along arterial routes to collect and analyze data and provide performance-based operations as well as implement traffic responsive operations along detour routes during a detour event.

Traffic Signal Operations

Modify signal phasing during a detour event, adjust left-turn signal phasing, implement right-turn overlaps, adjust signal displays and/or phasing, optimize signal timing, and install communications to provide remote signal control capabilities.

Return on Investment

ROI analyses were conducted for each of the operational improvement needs identified using safety, mobility, and environmental measures. Capital costs, as well as the 10-year operations and maintenance (O&M) costs, were calculated for each improvement and weighed against anticipated benefits.

The results of the analysis can be seen in the recommendations in Table 4 and Table 5. The implementation of operational upgrades to the I-95 corridor is in keeping with CTB desires to move forward with operational improvements that offer the highest ROI and fastest potential for implementation along interstate corridors in Virginia.

TABLE 4 FREEWAY OPERATIONS IMPROVEMENTS RETURN ON INVESTMENT

Proposed Operational Improvement	Implementation Cost	O&M Cost (10 Years)	Benefit (10 Years)	ROI (10 Years)
CCTV Cameras	$14.7M–$15.4M	$4.6M	$134.6M	7.0
Changeable Message Signs	$2.9M–$3.2M	$1.9M	$18.6M	3.9
Safety Service Patrols	$3.8M–$4.2M	$27.0M	$88.2M	2.9
TRIP Towing Program	$2.1M–$2.3M	$15.3M	$84.5M	4.9
Towing Program	$1.1M–$1.2M	$9.8M	$141.2M	12.9
Variable Speed Limits	$14.5M–$15.2M	$15.6M	$117.5M	3.9
Ramp Metering	$5.4M–$5.7M	$2.1M	$71.7M	9.7
Geofenced Emergency Notifications	$0.1M–$0.2M	$1.0M	$1.4M	1.3
Advanced Work Zone Technology	$0.9M–$1.0M	$4.1M	$19.2M	3.9
Regional Multimodal Mobility Project (RM3P)	N/A*	$9.6M	$28.2M	2.9
Misc. Low Cost Operations Improvements	$4.0M–$4.4M	$14.2M	$98.3M	5.4

* Innovation and Technology Transportation Funds (ITTF) are allocated to cover implementation costs

TABLE 5 ARTERIAL OPERATIONS IMPROVEMENTS RETURN ON INVESTMENT

Proposed Operational Improvement	Implementation Cost	O&M Cost (10 Years)	Benefit (10 Years)	ROI (10 Years)
CCTV Cameras - Arterials	$3.2M–$3.5M	$0.9M	$28.6M	7.0
ATSPM*	$10.2M–$11.2M	$2.5M	$65.1M	5.2
Blank-Out Signs	$0.3–$0.4M	$0.7M	$2.5M	8.1

* Includes communications and/or controller upgrades to support the deployment of ATSPM

Multimodal Improvements

I-95: A Multimodal Corridor—Development of Multimodal Improvements

Through a cooperative process involving VDOT, DRPT, and OIPI, rooted in existing planning efforts and public feedback, the study team defined and developed the specific multimodal improvements that will be included in the Plan. The process included the following steps to develop the final list of potential improvements:

1. Review existing plans and studies
2. Screen projects using subjective and objective evaluation factors
3. Conduct secondary screening based on project focus areas
4. Conduct modified SMART SCALE project scoring

Existing Plans and Studies

Based on the existing wealth of recent multimodal planning and the expedited time constraints of this study, the Secretary of Transportation directed the study team to focus on identifying improvements that have been previously documented in lieu of conducting new modeling or analysis. To identify multimodal and travel demand management improvements in the corridor, the study team looked to recently completed plans and studies that have targeted the I-95 corridor, including:

- I-95/I-395 Transit/TDM Study, Virginia DRPT, August 2017[1]
- I-95 Transit/TDM Study, Fredericksburg Area Metropolitan Planning Organization (FAMPO), December 2017[2]
- Visualize 2045, A Long-Range Transportation Plan for the National Capital Region, National Capital Region Transportation Planning Board, October 2018[3]
- Draft Richmond Regional Park-and-Ride Investment Strategy[4]
- Transit agency Transit Development Plans (TDPs)

1 http://www.drpt.virginia.gov/media/2628/final-report-i-95-i-395-transit-tdm-study-august-2017.pdf
2 https://www.fampo.gwregion.org/wp-content/uploads/FAMPO_95_Transit_Final_Document_with_Appendix-1.pdf
3 https://www.mwcog.org/visualize2045/
4 https://planrva.org/wp-content/uploads/RRTPO_Park_and_Ride_11-05-19.pdf

Additionally, rail-related improvements included in this study are informed by ongoing, long-term efforts throughout the Commonwealth, including:

- Ongoing Rail Partnership Agreement with CSX
- Washington, DC, to Richmond Intercity Passenger Rail Improvements (DC2RVA)[5]
- Long Bridge Project[6]
- Transforming Rail in Virginia Program[7]

Project Screening

The improvements that were compiled underwent several rounds of screening by the study team to evaluate their performance compared against the overall goal of the Plan: to provide faster, safer, and more reliable travel along the I-95 corridor.

Preliminary Screening

Following a review of existing plans, 130 potential recommendations were identified. The first preliminary round of screening occurred in August 2019 through which the team recommended a list of approximately 90 projects that had the potential to be carried forward based on the project goals as well as the objective and subjective evaluation factors listed below. The objective screening factors were assessed by data from existing studies and did not incorporate new analysis. Any projects that were duplicates or included in the baseline scenario (funded and to be complete by 2025) were not included.

5 http://dc2rvarail.com/

6 http://longbridgeproject.com/

7 http://www.drpt.virginia.gov/rail/transforming-rail-in-virginia/

Secondary Screening and Refinement

During September 2019, to further narrow down the list of potential recommendations, projects were compared using the criteria described above and the following direction from the Secretary of Transportation, especially for the most congested areas where adding additional capacity has limited feasibility:

- Focus on solutions for the top origin-destination pairs
- Prioritize commuter bus service that serves new origins and destinations
- Prioritize projects that help move more people across the Occoquan River, which was identified as a major bottleneck for delay along the corridor

This resulted in a list of 33 projects that could be advanced for the SMART SCALE evaluation described later in the "Prioritization of Improvements and Next Steps" section. Before the evaluation, the project list was refined based on the following:

- Allocation of I-395 Commuter Choice grant funding by the CTB
- Consideration of park-and-ride needs that have developed following the completion of the previous studies
- Decision that Transportation Demand Management (TDM) projects would be considered but not as individual projects
- Coordination with DRPT, VDOT, and OIPI to define specific rail projects that could be included to support the advancement of the Long Bridge and DC2RVA passenger rail initiatives

Multimodal Improvements

After the project screening process, a total of 26 multimodal projects have been proposed to be prioritized for funding for a total of $376 million. These 26 projects represent the priorities out of the 130 total multimodal projects initially identified for consideration in the three VDOT districts. The plan includes potential multimodal improvements as laid out in each of the areas below—commuter bus service, passenger rail service, park-and-ride lots, and transportation demand management. The multimodal improvements are part of the suite of proposed improvements along I-95 including operational improvements on I-95, improvements on parallel facilities (such as U.S. 1 and U.S. 301), and capital projects on I-95.

Type of Multimodal Improvement
Commuter Bus: improvements such as new express bus routes from Stafford and Prince William Counties to destinations north of the Occoquan River.
Passenger Rail: improvements such as enhanced station platforms, additional service, and longer trains on VRE lines.
Park-and-Ride: improvements such as expansion of existing lots and construction of new lots.
TDM: improvements such as enhanced multimodal ridematching, rewards for non-SOV travel, and strategic marketing and promotion of multimodal travel options and services, with emphasis on the most congested segments of I-95.

Commuter Bus

The provision of commuter bus service is an important part of the congestion solution along the I-95 corridor, especially in the Fredericksburg region. Today, commuter buses move about 3,000 people across the Occoquan River—a key corridor crossing—in the peak period. However, there is currently no public commuter bus service along the I-95 corridor south of Dale City. This is due to change with several new and improved commuter bus projects in the pipeline. The I-395 Commuter Choice program, for example, recommended funding commuter bus service between Stafford and Washington, DC, and Stafford and the Pentagon, both of which are now operational.

Previous studies conducted by DRPT and FAMPO have shown demand for and recommended commuter bus service originating in Spotsylvania and Stafford Counties to key destinations in Northern Virginia such as the Pentagon, Alexandria, and Rosslyn as well as Downtown Washington, DC.

Potential service improvements identified in this study include five new commuter routes that originate in Stafford County and four new commuter routes that originate in Spotsylvania County, connecting to key employment destinations including the Pentagon, Rosslyn, and Downtown Washington, DC. These recommendations include service that is expected to carry over 600 riders from Spotsylvania and Stafford to points north each morning. **Figure 15** shows the existing and proposed commuter bus service in the I-95 corridor. Compared to other mobility options, the provision of commuter bus is relatively inexpensive and nimbler to adjust based on changing travel patterns and needs.

FIGURE 15 EXISTING AND PROPOSED COMMUTER BUS IN THE I-95 CORRIDOR

ENHANCED COMMUTER BUS							
(North to South)	Direction						
Origin		Tysons (via I-495)	Mark Center	Old Town Alexandria (via I-95/I-495)	Pentagon/ Crystal City	Rosslyn/Ballston	Washington DC
Fairfax County	Springfield	○	○		○		○
Occoquan River							
Prince William County	Lake Ridge	○	○	●	○		○
	Dale City		○		○	○	○
	Montclair/Dumfries				○		○
Stafford County	Aquia Harbor		●		●		●
	Stafford		●		●		○ ●
Fredericksburg	Fredericksburg				●		●
Spotslyvania	Massaponax				●	●	●

Commuter Bus Key	
Existing (Baseline) Service	○
Proposed New Service	●
Proposed Additional Service	○ ●

Passenger Rail

During the development of the I-95 Corridor Improvement Plan, Governor Northam announced a landmark rail agreement between the commonwealth and CSX Corporation (CSX). The agreement between the Commonwealth and CSX outlines a separate investment that includes:

- Building a new Virginia-owned Long Bridge across the Potomac River, with tracks dedicated exclusively to passenger and commuter rail;
- Acquisition of more than 350 miles of railroad right-of-way and 225 miles of track; and
- 37 miles of new track improvements, including a Franconia-Springfield bypass.

In addition, over the next 10 years, the following improvements are planned:

- Doubling the number of Virginia Amtrak trains;
- Providing nearly hourly Amtrak service between Richmond and Washington, D.C.;
- Increasing Virginia Railway Express (VRE) service by 75 percent along the I-95 corridor, with 15-minute intervals during peak periods and adding weekend service;

- Increasing Amtrak service to Newport News and allowing for improved schedule of the third Amtrak train to Norfolk;
- Laying the foundation for Southeast High Speed Rail through the acquisition of the abandoned S-Line which runs from Petersburg into North Carolina; and
- Preserving an existing freight corridor between Doswell and Clifton Forge for future east-west passenger service.

With the agreement in place, the viability of the passenger rail recommendations developed as part of the I-95 Corridor Improvement Plan have greatly increased.

Given this backdrop, the Commonwealth continually seeks projects of benefit to both freight and passenger rail and works to identify those projects in partnership with host railroads. As part of this Plan, improvements to VRE are proposed to enhance and expand commuter rail service on the Fredericksburg Line between Spotsylvania and Washington, DC, and improve key rail stations in Northern Virginia that serve both the Fredericksburg Line and the Manassas Line. This does not factor in service or infrastructure improvements to the Manassas Line beyond projects identified in the baseline. As final improvements for inclusion in this plan are determined, the CSX and Virginia agreement will continue to be monitored.

Proposed Passenger Rail Improvements:

- Crystal City Station Improvements
- L'Enfant Station Improvements
- Additional Train Service*

*Specific service improvements to be coordinated with ongoing CSX and Virginia Agreement

Crystal City and L'Enfant Station Improvements

VRE's Crystal City station is among the busiest in the system, but its existing platform is not long enough for full-length trains and serves only one track. An improved Crystal City station with a longer platform—one serving two tracks—is projected to remove a prominent operational bottleneck, expand the station's capacity to accommodate full-length trains, and improve the overall safety and reliability of the railroad. Also, the project is expected to enhance local and regional connectivity by optimizing multi- and intermodal access, especially to Metrorail, the Crystal City-Potomac Yard Transitway, local buses and shuttles, and bicycle and pedestrian facilities.

Similarly, VRE's L'Enfant station platform is not long enough for full-length trains and serves only one track, representing an additional operational bottleneck that compromises service reliability. This project will create an island platform that allows for simultaneous boarding or alighting on two tracks and accommodates full-length trains.

Conceptual plans for both the Crystal City and L'Enfant station projects will be coordinated with a future fourth track currently under design by the Virginia Department of Rail and Public Transportation.

Additional Peak Period Trains

To efficiently meet current needs and progress toward the vision outlined in the VRE System Plan 2040, this plan also proposes additional VRE service on the Fredericksburg Line. Two service increase scenarios—one with two additional trains and one with four additional trains—for the morning and evening peak periods are included in this plan. Both scenarios address the need for additional seats by adding full-length eight-car trains to the Fredericksburg Line, increasing seating capacity consistent with projected ridership growth. Further efforts are recommended to understand the potential parking demand that adding these additional trains would generate. Alternative solutions, such as flexible shared shuttles and other transportation demand management strategies, are needed to get passengers to the rail stations.

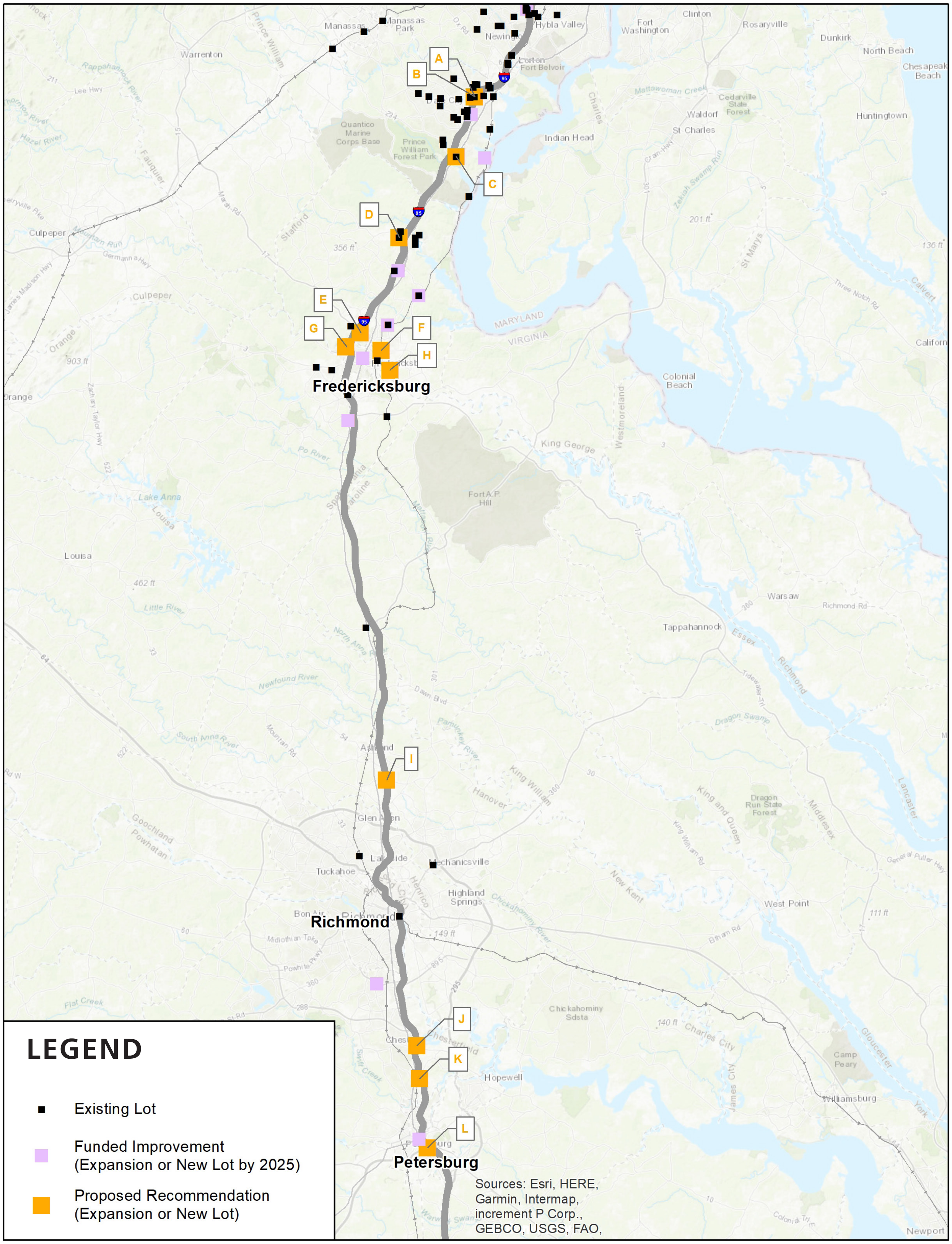
Park-and-Ride Lots

Park-and-ride lots are a common transportation feature along the I-95 corridor and include state-owned, privately-owned, and informal lots. Under the oversight of VDOT, these facilities allow commuters—particularly long-distance commuters—to park their vehicles at a convenient location and then finish their commute using alternative transportation modes including carpool, vanpool, bus, train, bike, or walking.

This plan recommends enhancement, expansion, or new construction of 12 park-and-ride lots at key points along the I-95 corridor as shown in **Figure 16**. When combined, these recommendations would contribute over 3,500 new parking spaces to the existing 18,000 spaces in the corridor, a 19 percent increase.[8] Many park-and-ride lots provide connections to existing and future commuter bus service, and all newly constructed lots will be designed to accommodate and optimize carpool, vanpool, and slugging operations.

8 Not inclusive of parking spaces at rail stations.

FIGURE 16 PROPOSED PARK-AND-RIDE IMPROVEMENTS



Transportation Demand Management Strategies

Building new and widening existing roads alone is not enough to meet Virginia's current and future transportation needs. Congestion was identified by the public survey as the most important issue to address. Modeling efforts completed as part of the study concluded that adding a general-purpose lane to I-95 in both directions between Exit 118 and Exit 170 would only temporarily relieve congestion issues and cost $12.5 billion. To effectively improve mobility, provide more travel options, move more people, and promote and sustain economic growth, there is a necessity to move more people with fewer vehicles by sharing rides and using high-capacity modes such as bus or rail. TDM strategies are part of the solution to ensure people know about and are supported in using non-SOV modes of travel. TDM programs provide transportation choices, make Virginia's transportation more efficient, and help improve air quality. This is accomplished by moving more people in fewer vehicles, reducing vehicle miles traveled, reducing vehicle trips, and moving peak period trips to off-peak times. Examples of how this is achieved are programs and services that:

- Promote transit, vanpools, carpools, telework, and biking
- Provide free ridematching and trip planning
- Increase the use of vanpools, carpools, transit, telework, and biking
- Work with employers to establish worksite programs for telework, carpool and vanpool formation, transit and vanpool employee benefits, biking to work, and alternative work schedules
- Help commuters realize the true cost of driving alone and the benefits of transit, vanpooling, carpooling, telework, and biking

Many statewide, regional, and local TDM initiatives are present today that cover the I-95 corridor. To advance and build upon these efforts, DRPT will continue to work with local and regional entities and further target the I-95 corridor with strategic marketing and promotion of travel options, including:

- Marketing that is targeted to corridor travelers with an emphasis on the most congested segments of I-95
- Coordinated marketing messaging with local commuter assistance programs
- Targeting of employers with a high concentration of employees that commute on I-95
- Commute!VA website and mobile app multimodal travel options and ridematching
- Carpool, vanpool, transit, rail, and telework options
- Commute!VA rewards for carpool, vanpool, transit, commuter rail, and telework
- Existing carpool and vanpool incentives and formation assistance
- Using the Express Lanes free with EZ-Pass Flex and a carpool/vanpool of 3+ (including driver)

Corridor Costs and Potential Benefits

Summary of Costs

The projects listed in the sections above are summarized in **Table 6**. In total, there are 26 multimodal projects that total $375.76 million.

TABLE 6 SUMMARY OF COSTS

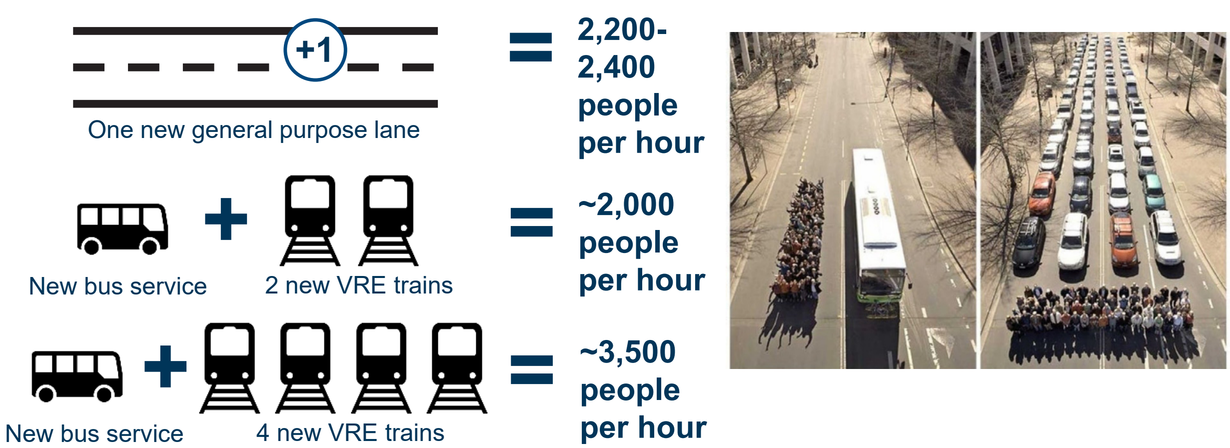
Type of Project	Number of Projects	Capital Costs
Commuter Bus	10	$58,500,000
Passenger Rail	4	$240,590,000
Park-and-Ride	12	$76,670,000
TOTAL	**26**	**$375,760,000**

Benefits

Today, over 60 percent of commuters between the Occoquan River and I-495 are moved by modes other than driving alone. Targeted improvements to transit, rail, and carpooling offer the greatest opportunities to not only improve performance on I-95 itself, but to provide fast and reliable trips along more parts of the corridor to more people.

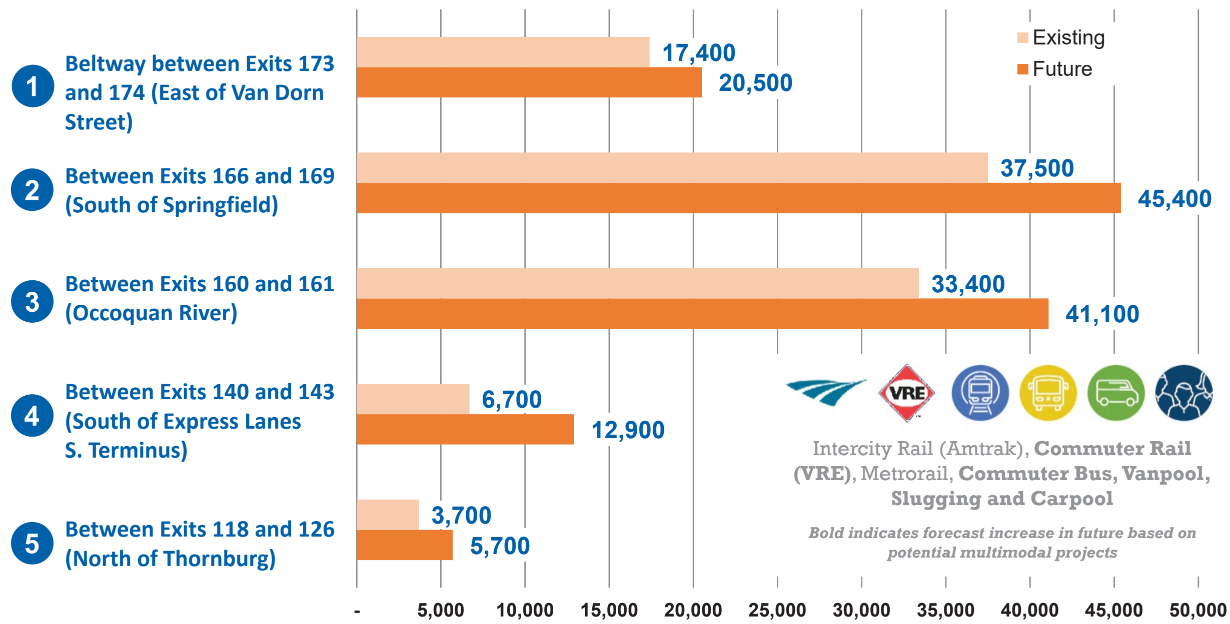
The suite of multimodal improvements included in this study offer unique opportunities to address peak period traffic conditions that can be implemented with far lower cost, a much greater ability to safely move people, and more flexibility to adapt to changing travel patterns and needs than that of a large-scale widening of I-95 as shown in **Figure 17**.

FIGURE 17 PEOPLE MOVING CAPACITY



The proposed multimodal improvements in the Northern Virginia and Fredericksburg Districts cost considerably less ($375 million) than building an additional lane of capacity ($12.5 billion), representing a significant cost savings in terms of potential performance benefits. As part of the previously-mentioned hypothetical analysis of adding a lane in each direction on I-95 between Exits 118 and 170, the proposed multimodal improvements were evaluated. The multimodal improvements are projected to increase the number of persons moved in the corridor by non-SOV modes. As a direct result of the projects, increases are projected in the number of people carpooling (including slugging), vanpooling, taking commuter rail, and taking commuter bus during the morning peak period (**Figure 18**) in the five northernmost portions of the corridor. Other increases in other modes may be possible but were not forecasted as part of this effort. The commuter rail total does not include any additional assumed improvements to the VRE Manassas Line. At the Occoquan River, a major bottleneck along the corridor, the study team projects an increase of approximately 7,700 multimodal persons moved during the morning peak period. Other increases throughout the corridor vary depending on location.

FIGURE 18 FUTURE PERSONS MOVED (A.M. PEAK PERIOD)



Mainline Roadway Improvements Plan

The study team considered performance measures, supplementary data, existing roadway geometry, recently completed studies, and public input to develop potential capital improvements. The team also reviewed recently constructed projects and projects already funded in the Six-Year Improvement Plan (SYIP) to determine how those projects may resolve issues in the corridor relating to the performance measures.

The study team reviewed crash data for the 1-mile segments in the top 25 percent to determine the underlying causes of crashes and what solutions, if any, could mitigate the crashes. In several cases, capital improvements were not recommended to improve safety if there was no discernible crash pattern or if there were several crashes caused by miscellaneous factors that are not likely to be remedied by changes to the roadway. Miscellaneous factors include mechanical failure, medical issues, or behavioral issues, such as alcohol or distracted driving.

Table 7 describes the types of mainline roadway improvements considered and their associated benefits. The study team only recommended an interchange improvement if it was recommended in a previously completed study. **Table 8** displays the number of mainline roadway improvements per type that were initially proposed in each District. Appendix A contains a list of individual improvements identified by the study team that will advance to project prioritization.

TABLE 7 TYPES OF I-95 CAPITAL IMPROVEMENTS

Type of Improvement	Locations to Consider	Benefit
Auxiliary Lane: an extra lane constructed to connect on- and off-ramps between closely spaced interchanges to reduce the impacts of traffic entering and exiting the interstate	• Where spacing between an on-ramp and the subsequent off-ramp is less than 2 miles • Where there are many crashes between exits • Where there are large volumes between interchanges	• Reduces the potential for crashes caused by traffic entering and exiting the interstate • Gives entering and exiting traffic more space to maneuver
Widening by One Lane: an extra lane constructed for multiple miles to increase the capacity of the interstate	• Where there are high person-hours of delay and incidents/crashes with a lane closure • Where there are high traffic volumes • Where there are long distances that vehicles need to pass, merge, or travel through multiple interchanges	• Reduces the likelihood of congestion by providing additional roadway capacity • Reduces the potential for crashes by allowing more space for vehicles to maneuver
Acceleration or Deceleration Lane Extension: longer lengths to accelerate when entering the interstate and decelerate when exiting the interstate	• Where there are many crashes involving lane merges • Where acceleration or deceleration lane lengths are less than the VDOT standards	• Reduces the potential for crashes caused by slower moving traffic entering or exiting the interstate • Provides more time for entering vehicles to match the speed of the interstate traffic and exiting vehicles to slow down to safety exit the interstate
Shoulder Widening: widening the paved inside or outside shoulder	• Where there is high-crash frequency or severity with roadway departure crashes • Where the shoulder width is deficient	• Reduces the potential for roadway departure crashes by giving drivers a wider shoulder for recovery • Provides shoulder space to clear crashes
Hard Shoulder Running: operating a managed lane on the existing shoulder during one or more peak periods	• Where additional capacity is needed during the peak periods • Where there are high traffic volumes	• Reduces the likelihood of congestion by providing additional roadway capacity during the peak periods • Reduces the potential for crashes by allowing more space for vehicles to maneuver
Interchange Improvement: a variety of improvements that improve safety and reduce delay at interchanges by modifying the existing interchange configuration	• Where there are high person hours of delay or crashes caused by vehicles entering and exiting the interstate • Where short weaves exist on the interstate • Where congestion on the arterial affects the interstate	• Reduces the potential for crashes caused by traffic entering and exiting the interstate • Reduces person-hours of delay on the arterial and interstate

TABLE 8 PROPOSED MAINLINE ROADWAY IMPROVEMENTS BY TYPE BY DISTRICT

Improvement Type	Hampton Roads	Richmond	Fredericksburg	Northern Virginia	Total
Auxiliary Lane	0	0	1	1	2
Widening by One Lane	0	0	2	0	2
Acceleration or Deceleration Lane Extension	2	6	2	2	12
Shoulder Widening	0	2	0	5	7
Hard Shoulder Running*	0	0	0	2	2
Interchange Improvement	0	4	1	1	6
Total	**2**	**12**	**6**	**11**	**31**
Projected Cost (Millions)	$16–27	$365–563	$229–352	$571–748	$1,181–1,690

*The two hard shoulder running alternatives span parts of the Fredericksburg and Northern Virginia Districts but are included only in the Northern Virginia District numbers and cost projections.

Improvements and Locations Requiring Further Study

The study team also identified several improvements with the potential to resolve issues in the corridor relating to the performance measures that had not been recommended in a previously-completed study. These improvements would not be advanced to project prioritization because there is insufficient information to evaluate the projects. **Table 9** displays the number of mainline roadway and park-and-ride improvements and locations per type in each District that were recommended for further study. Appendix B contains a list of individual improvements and locations identified by the study team that were recommended for further study. The study team identified seven improvements and locations that are recommended priorities for advancing through concept development and study.

TABLE 9 PROPOSED IMPROVEMENTS FOR FURTHER STUDY BY TYPE BY DISTRICT

Improvement Type	Hampton Roads	Richmond	Fredericksburg	Northern Virginia	Total
Interchange	1	11	4	8	24
Express Lanes*	0	0	0	2	2
Park-and-Ride	1	1	5	3	10
Total	**2**	**12**	**9**	**13**	**36**

*One Express Lanes improvement spans parts of the Fredericksburg and Northern Virginia Districts but is included only in the Northern Virginia District numbers.

Prioritization of Improvements and Next Steps

House Joint Resolution 581 and Senate Joint Resolution 276 request a targeted set of improvements to be "evaluated using the statewide prioritization process pursuant to § 33.2-214.1 of the Code of Virginia." The study team intended to use a modified version of this process, commonly known as SMART SCALE, to prioritize mainline roadway and multimodal improvements for this Plan. The operational improvements were assumed to be a stand-alone fundamental element and, having gone through the return on investment (ROI) analysis, were intended to be excluded from prioritization.

However, upon development of planning level cost estimates, the study team determined that the needs identified far exceeded available revenues. The needs do not account for planning level cost estimates associated with "improvements and or locations identified for further study." **Table 10** outlines the estimated annual funding dedicated to interstates by Fiscal Year 2022 as a result of the creation of the *Interstate 81 Corridor Improvement Fund in Chapter 846 of the 2019 Acts of Assembly.*

TABLE 10 DEDICATED ANNUAL INTERSTATE FUNDING ESTIMATES FROM THE INTERSTATE 81 CORRIDOR IMPROVEMENT FUND

Description	Dedicated Funding Estimate (Millions)
I-95 south of Northern Virginia District	$40
I-64	$28
Any interstate at the discretion of the CTB	$44

The study team, following discussions with the Secretary and CTB, recommended that a study of the I-64 corridor be completed and that the proposed I-95 improvements be prioritized along with the proposed projects on I-64 so the CTB may make an informed decision on how to best allocate the discretionary funds. Prior to this prioritization process, the study team may advance projects from the list requiring further study to the proposed improvement list if sufficient study has been completed. Additionally, the Districts may seek alternative funding for projects identified in this Plan (e.g., SMART SCALE, revenue sharing).

APPENDIX A

Proposed Mainline Roadway Improvements

Table 1 displays the mainline roadway improvements identified by the study team that will advance to project prioritization.

TABLE 1 PROPOSED MAINLINE ROADWAY IMPROVEMENTS

District	Location	Direction	Description
Hampton Roads	Exit 11	SB	Extend deceleration lane
	Exit 13	SB	Extend acceleration lane
Richmond	Exit 41	SB	Extend acceleration lane
	Exit 50	SB	Improve interchange configuration. Relocate off-ramp from Graham Road to South Crater Road.
	Exit 51	NB	Construct flyover ramp from northbound I-95 to southbound I-85
	Exit 53	SB	Extend acceleration lane
	Exit 61	NB/SB	Improve interchange configuration. I-95 at Route 10 interchange improvements and Park-and-Ride lot – Phase 2
	Exit 62	NB	Extend acceleration lane
	MM 69 to MM 73	NB	Widen right shoulder or add emergency pull-offs
	Exit 73	NB	Extend deceleration lane
	Exit 78 to Exit 79	SB	Improve interchange configuration. Reduce southbound I-95 to two lanes prior to Exit 79 on-ramp and widen Exit 78 off-ramp to two lanes.
	Exit 79	SB	Extend acceleration lane for westbound I-64 onramp from southbound I-95
	Exit 81	NB	Extend deceleration lane
	MM 87 to MM 92	NB/SB	Widen left shoulder
Fredericksburg	Exit 126	NB	Improve interchange configuration. Widen US 1, widen northbound I-95 on-ramp to two lanes, and extend acceleration lanes.
	Exit 126B	NB	Extend deceleration lane
	MM 126 to MM 129	SB	Widen to four lanes
	Exit 126 to Exit 130	NB	Widen to four lanes
	Exit 133 to Exit 136	NB	Construct auxiliary lane from Exit 133 to Exit 136
	Exit 136	NB	Extend acceleration lane

District	Location	Direction	Description
Northern Virginia	Exit 133 to Exit 160	NB/SB	Construct a continuous managed lane (hard shoulder running) on the left shoulder. Open southbound in the AM and northbound in the PM.
	Exit 133 to Exit 160	NB/SB	Construct a continuous managed lane (hard shoulder running) on the right shoulder. Open southbound in the a.m. and northbound in the p.m.
	MM 151 to MM 152	NB	Widen left shoulder
	MM 151 to MM 152	SB	Widen left shoulder
	MM 155.8 to MM 156.1	NB	Widen left shoulder
	MM 155.8 to MM 156.1	SB	Widen left shoulder
	MM 157.5 to MM 159.5	SB	Widen left shoulder
	Exit 158 to Exit 160	NB	Construct auxiliary lane from Exit 158 to Exit 160
	Exit 163	SB	Extend acceleration lane
	Exit 163	NB	Extend acceleration lane
	Exit 163	NB	Improve interchange configuration. Construct flyover from northbound I-95 off-ramp to northbound Fairfax County Parkway (Route 286)

MM = mile marker; NB = northbound; SB = southbound

APPENDIX B

Improvements and Locations Requiring Further Study

Table 2, **Table 3**, and **Table 4** display the interchange, Express Lanes, and park-and-ride improvements and locations that were recommended for further study. Improvements and locations listed in bold should be advanced through concept development and study first.

TABLE 2 INTERCHANGE IMPROVEMENTS FOR FURTHER STUDY

District	Location	Description
Hampton Roads	Exit 11	Improve interchange configuration at U.S. 58 to remove weaving movements (further study underway)
Richmond	Exit 48	Improve interchange configuration at U.S. 460 (Wagner Road) to remove weaving movements
	Exit 53	Improve interchange configuration at Roslyn Road to address safety issues
	Exit 69	Improve interchange configuration at Commerce Road to address safety issues (further study underway)
	Exit 74 to Exit 75	**Improve interchange configuration at Broad Street and I-64 by consolidating access points and replacing with a northbound C-D road**
	Exit 75	Improve interchange configuration by providing additional access to and from 5th Street and 7th Street
	Exit 76	**Construct a single-point urban interchange (SPUI) at Belvidere Street and remove the northbound off-ramp to Chamberlayne Avenue**
	Exit 78	Remove the northbound on-ramp from Arthur Ashe Boulevard and construct a new on-ramp from Laburnum Avenue
	Exit 79	Improve interchange configuration with I-64 to improve the southbound I-95 to westbound I-64 ramp
	Exit 80	Remove Hermitage Road/Brooke Road interchange and construct new interchange at Dumbarton Road. Widen northbound I-95 on-ramp from eastbound I-64 to two lanes.
	Exit 83	Improve interchange configuration at Parham Road to remove weaving movements
	Exit 84	Improve interchange configuration with I-295 by adding a northbound C-D road
Fredericksburg	**Exit 126**	**Improve interchange configuration at U.S. 1 and U.S. 17 by constructing a northbound C-D road and a new on-ramp from U.S. 17**
	Exit 126	**Improve interchange configuration by adding direct access from southbound I-95 to eastbound U.S. 17**
	Exit 126	**Construct a diverging diamond interchange at U.S. 1 and U.S. 17**
	Exit 143	Improve interchange configuration at Route 610 (Garrisonville Road) to address safety and delay issues

District	Location	Description
Northern Virginia	Exit 150	Improve interchange configuration at Route 619 (Joplin Road) to address safety and delay issues
	Exit 152	Improve interchange configuration at Route 234 (Dumfries Road) by shortening the northbound deceleration lane to improve spacing from adjacent interchange(s)
	MM 155 to MM 157	Extend the existing southbound C-D road from Exit 156 to include the ramps for the cars only rest area. Construct auxiliary lane from the trucks only rest area to the C-D road.
	Exit 156	Improve interchange configuration at Dale Boulevard by constructing a spur to the northbound off-ramp to eastbound Dale Boulevard
	Exit 160	**Improve interchange configuration at Route 123 (Gordon Boulevard) to address safety and delay issues**
	Exit 166	Improve interchange configuration at Route 286 (Fairfax County Parkway) by improving the southbound I-95 off-ramp to southbound Route 286
	Exit 169	Improve interchange configuration at Route 289 (Franconia-Springfield Parkway) by adding access to general purpose lanes
	Exit 173	Improve interchange configuration at S Van Dorn Street to address safety and delay issues

MM = mile marker

TABLE 3 EXPRESS LANES IMPROVEMENTS FOR FURTHER STUDY

District	Location	Description
Fredericksburg/ Northern Virginia	Exit 130 to Exit 170	Convert existing Express Lanes to bi-directional operations
Northern Virginia	**Exit 170 to Maryland Border**	**Construct managed lanes from Exit 170 across the Woodrow Wilson Bridge into Maryland**

TABLE 4 PARK-AND-RIDE LOCATIONS FOR FURTHER STUDY

District	Location	Description
Hampton Roads	Exit 31	Expand parking at Stony Creek park-and-ride lot
Richmond	Exit 84	New park-and-ride lot near I-295 and Virginia Center Commons
Fredericksburg	Exit 110	New park-and-ride lot on Ladysmith Road near I-95
	Exit 130	Expand parking at Old Salem Church Road park-and-ride lot
	Exit 130	New VRE-structured park-and-ride lot near Frederick Street and Prince Edward Street
	Exit 136	Expand parking at Leeland Road VRE station
	Exit 136	New park-and-ride lot near U.S. 1 and Centreport Parkway
Northern Virginia	Exit 152	New park-and-ride lot near Route 234 (Dumfries Road)
	Exit 158	New park-and-ride lot near Prince William Parkway and Telegraph Road
	Exit 160	New park-and-ride lot near Route 123 and Old Bridge Road

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